4410 MA 0089 RV E3
10 Sept 2003

OPERATION AND MAINTENANCE MANUAL

FOR THE

ORE OFFSHORE MODEL 4410D-01

TRACKPOINT II *Plus* SYSTEM

(Includes 4410D-01, 4610B, 4211A & 4740A)

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Rev E2 - 4 April 2002 - DWF
Changed name to just ORE Offshore , updated contact info, warranty page, etc.

Rev E3 - Changed contact info - Changed Logo

Declaration of Conformity

We

ORE Offshore

Located at

4 Little Brook Road

West Wareham, MA. 02576 USA

declare under our sole responsibility that the product:

Trackpoint II Model 4410D-01 with

4740A VRU/Amplifier and 4211A Hydrophone,

and 4610B Hydrophone

to which this declaration relates is in conformity with the following standards or other normative documents:

Product Safety: EN61010-1:1993

EMC: EN55011:1991
EN50082-1:1992

Following the provisions of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC. (Reference Curtis Straus Report #970387)

Signature: David W. Fraser

Printed Name: David W. Fraser

Title: Eng Manager

Date: 17 Dec 03 Place: ORE Offshore

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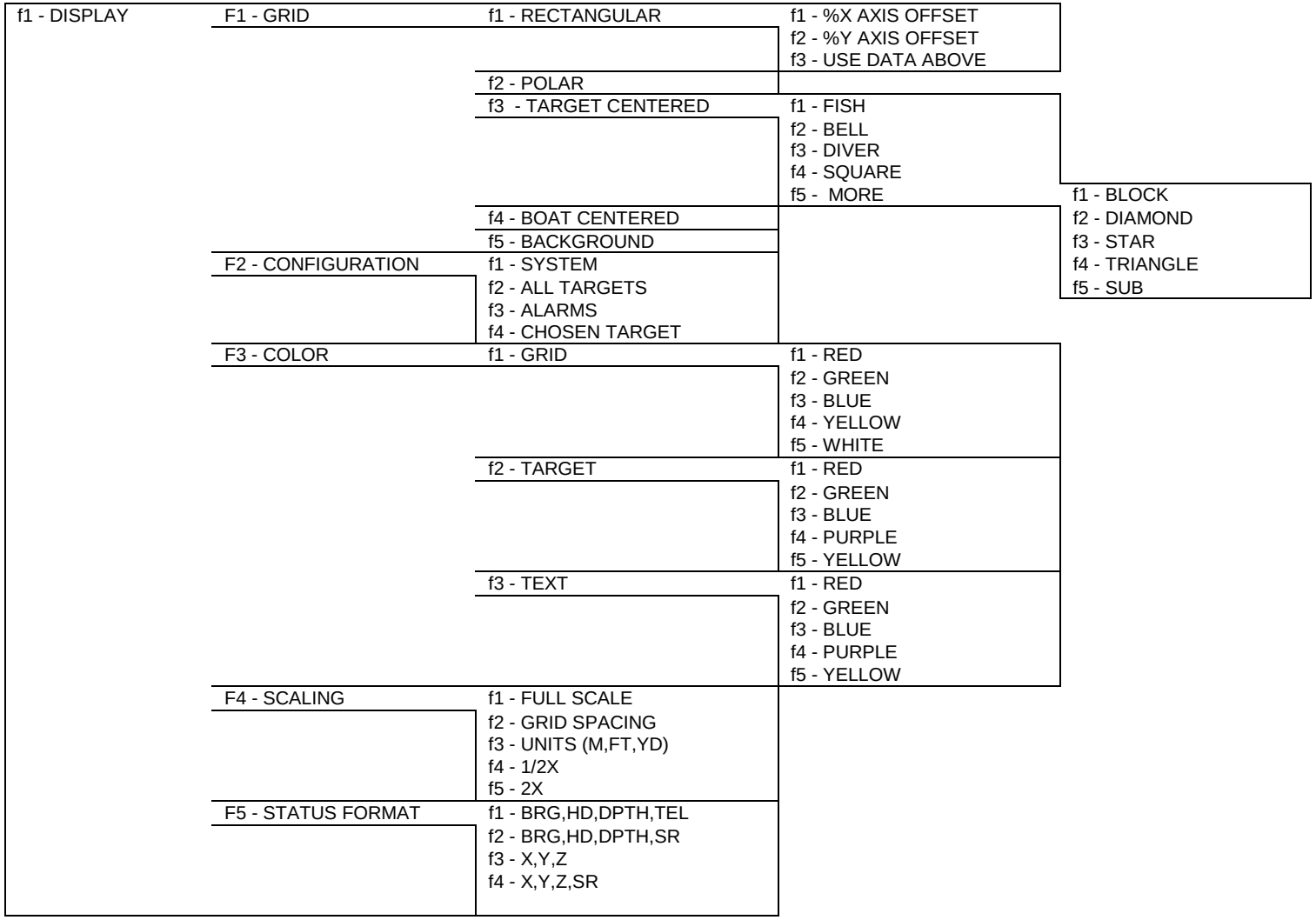
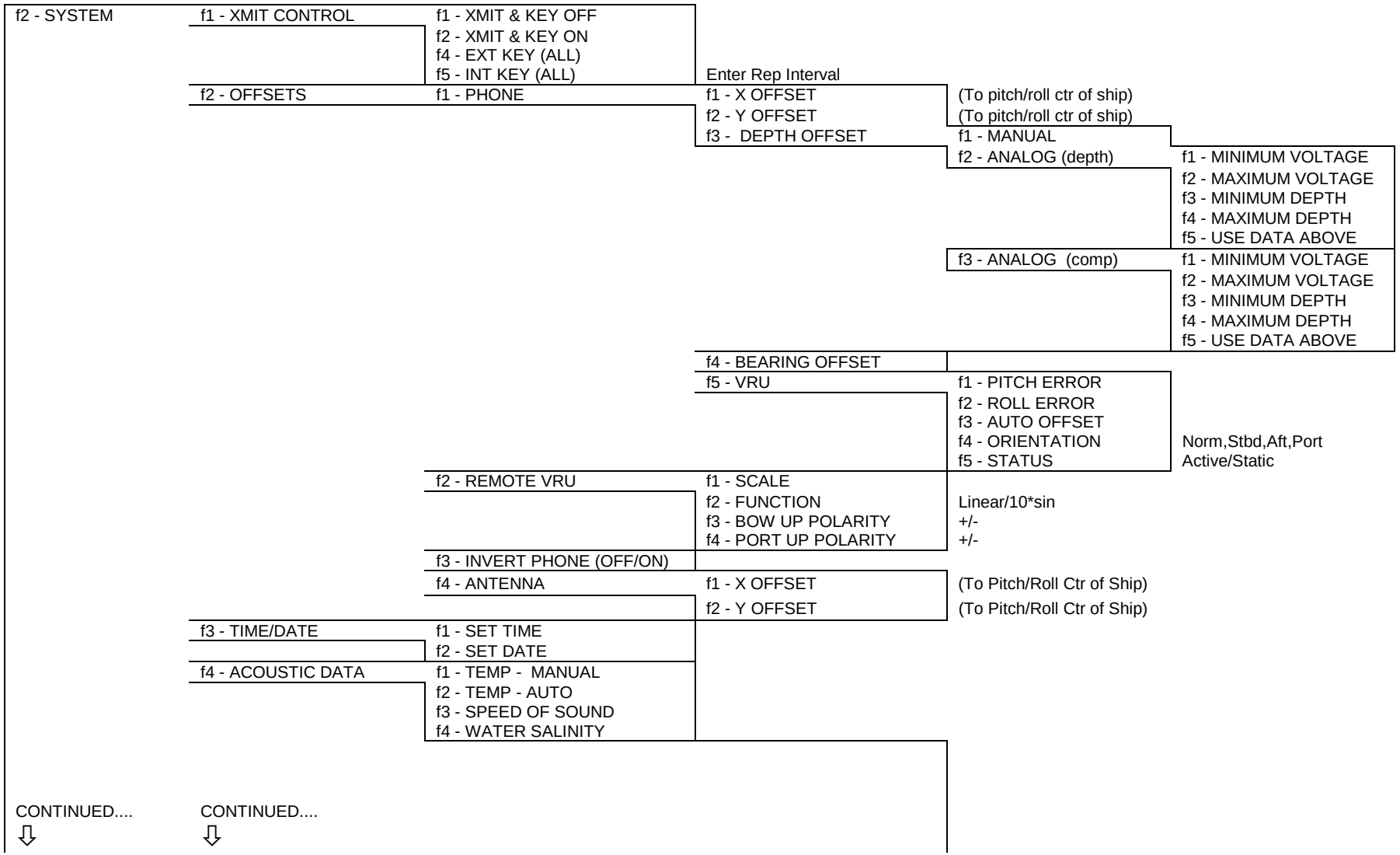
MENU FOR FIRMWARE REVISION 9.10

MAIN MENU SUB MENUS ⇨



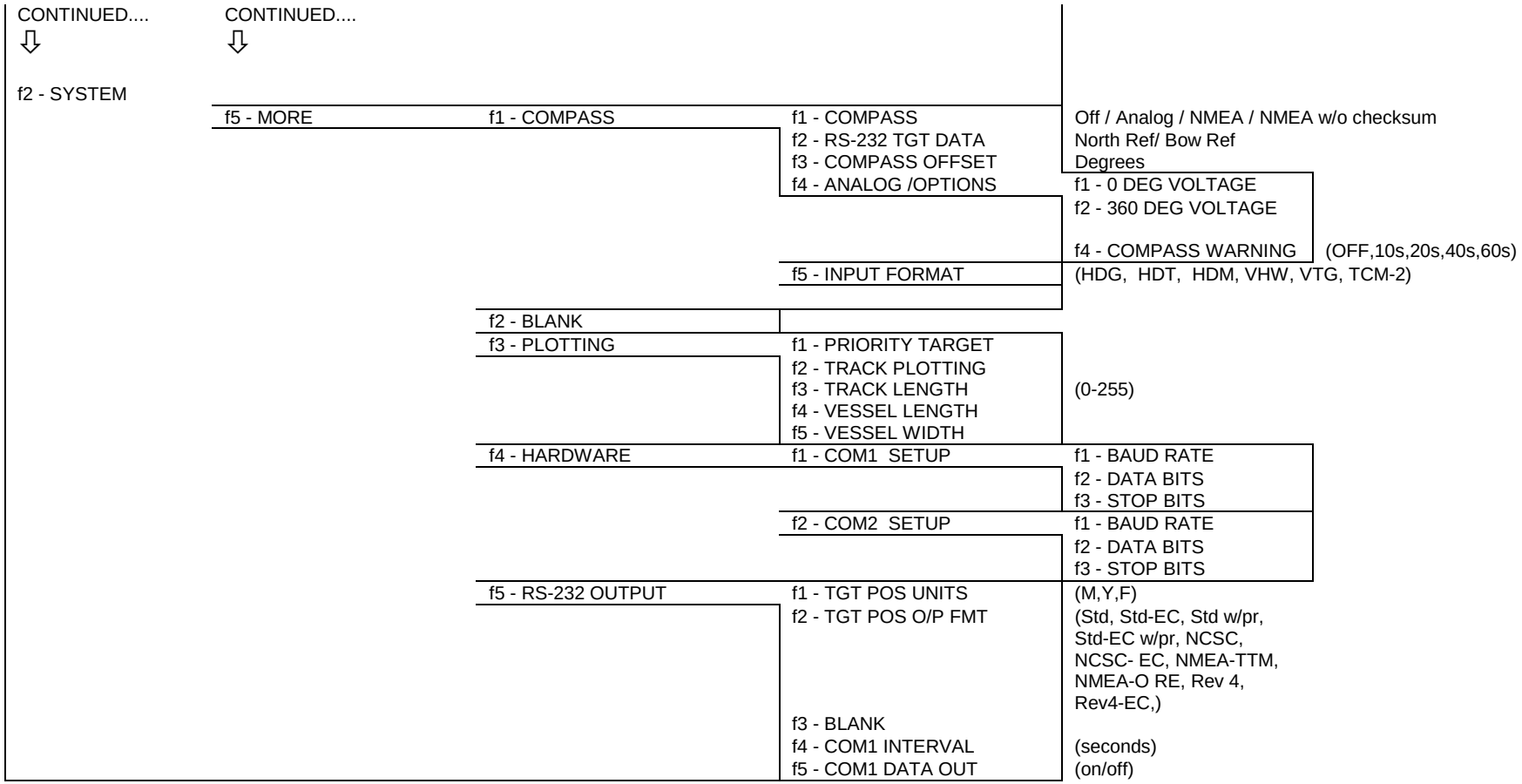
MENU FOR FIRMWARE REVISION 9.10

MAIN MENU SUB MENUS ⇨



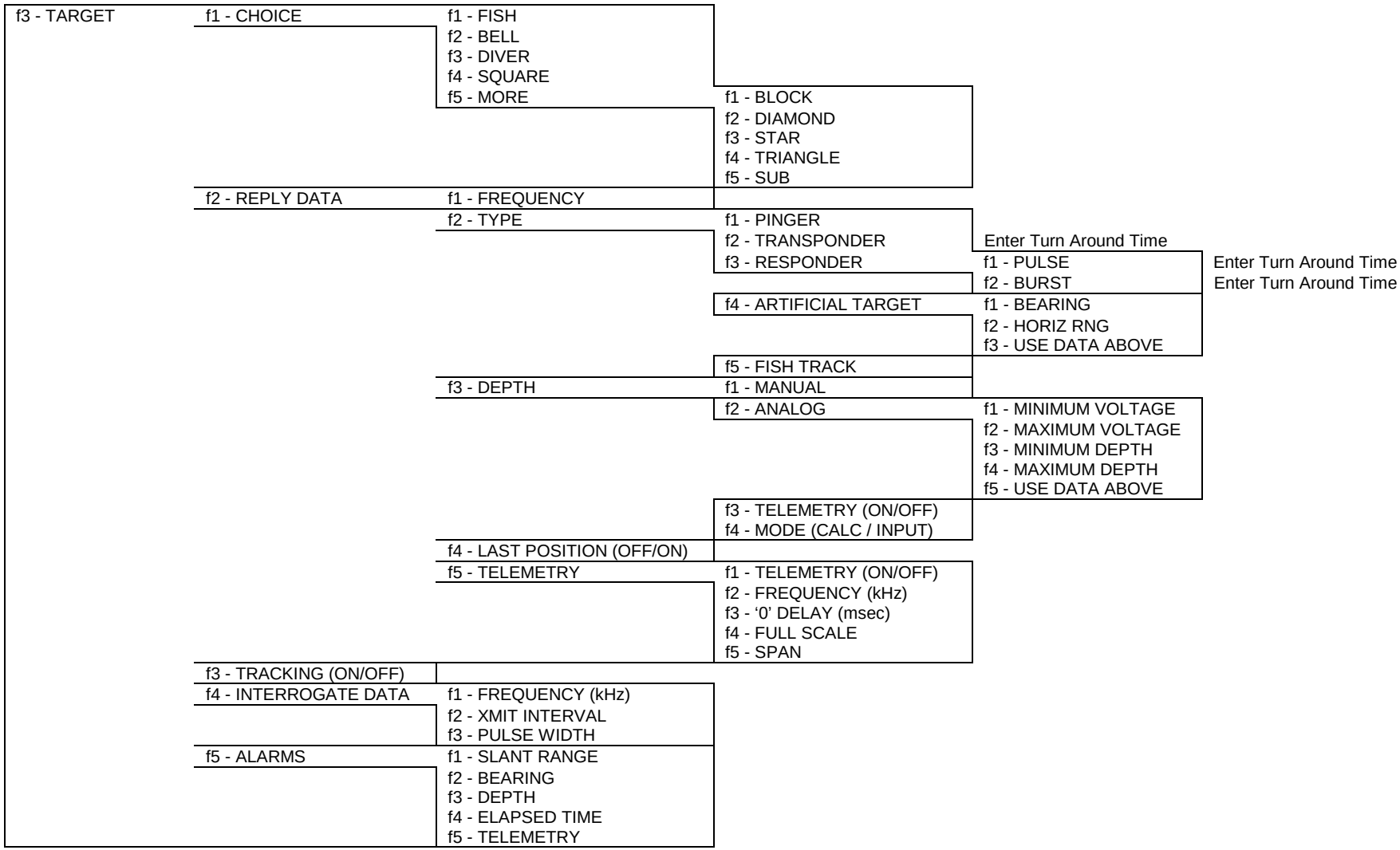
MENU FOR FIRMWARE REVISION 9.10

MAIN MENU SUB MENUS ⇨



MENU FOR FIRMWARE REVISION 9.10

MAIN MENU SUB MENUS ⇨



MAIN MENU SUB MENUS ⇨

f4 - FILTERING	f1 - SMOOTHING		All FILTERING settings are for the chosen target only.
	f2 - FILTER LEVEL		
	f3 - THRESHOLD		
	f4 - LIMITS	f1 - MIN XPNDER RNG f2 - MAX SLANT RNG f3 - BEARING LIMITS	
	f5 - QF FILTERING		

MAIN MENU SUB MENUS ⇨

f5 - SELF TEST	f1 - COMMAND UNIT		
	f2 - XMIT & REC/DET		
	f3 -	**(ENTER PASSWORD** to save parameters to the CUSTOM default settings in **FlashROM)**	See Section 5.9 of Manual 4410MA0089.
	f4 -		
	f5 -		

Y2K COMPATIBILITY

The Trackpoint System starting with firmware revision 9.06 is compatible with year 2000 requirements by having the ability to be setup prior to or after the year 2000 and provide accurate display, output and calculation of the year, month and day. This means that the year is entered in four digits from the menu, displayed in four digits on the CRT and sent out the RS-232 communications port in four digits. No anomalous conditions occur at the roll -over dates. It also recognizes that the year 2000 is a leap year so that February 29th is added to make a 366 day year. The system is compatible between the years 1951 to 2099. (A century year is a leap year if it is divisible by 400. The year 1900 was not a leap year but 2000 is.) (Refer to BSI standard, PD2000-1:1998, A Definition of Year 2000 Conformity Requirements)

Azimuth	Typically used when referencing a target position with respect to North or a compass heading. (Could also refer to a compass heading referenced to north.)
Beacon	Any underwater sound source. Sometimes abbreviated as "BCN".
Bearing	Typically used when referencing target position with respect tpo local coordinates, for example with respect to the hydrophone or vessel bow.
C/DM	Command / Display Module - The main processor of the Trackpoint II tracking system.
Depression Angle	The downward angle measured from the plane of the hydrophone receive elements to the target. (0 deg. to 90 deg.)
EPROM	Erasable Programmable Read-Only Memory. Nonvolatile memory in which data can be read from.
Horizontal Range	The distance from the hydrophone or offset point to the target on the X, Y plane. (plan view)
Hydrophone	An underwater listening device.
Interrogate	To cause a response from an underwater device such as a transponder.
Pinger	An underwater sound source which transmits at a fixed preset rate, asynchronously to a tracking device.
RS-232 Interface	A standard interface for serial communications.
Responder	An underwater sound source which responds to an electrical signal (interrogated via a hardwired link) and returns with an underwater acoustic reply. Sometimes abbreviated as "RSPDR".
Slant Range	The range from a target to the listening hydrophone. (Computed by the travel time from target to hydrophone multiplied by the speed of sound in water.)
Telemetering Beacon	Can either be a transponder or a responder. It outputs two replies in response to an interrogation. The first reply is the navigation pulse for the Trackpoint II and the second reply is the telemetry pulse. The time delay between the two replies is proportional to the sensor output on the telemetry beacon.

Trackpoint II *Plus*	ORE Offshore's Model 4410D-01 USBL Tracking System. A high accuracy survey quality acoustic navigation system.
Transponder	An underwater sound source which responds to an underwater signal (device is interrogated acoustically) and returns with an underwater acoustic reply. Sometimes abbreviated as "XPDR".
Turn Around Time	A preset time delay, built into a transponder or responder, between when a device is interrogated and when it replies. The delay is calibrated at the xponder to compensate for variations in receiver propagation delays.
USBL	Ultra Short BaseLine - A type of acoustic navigation system which utilizes an array of receiving elements spaced very close together (within inches). (As apposed to Long Baseline Systems)
VRU	Vertical Reference Unit - Used to compensate for pitch and roll motion of the ship.
X	The port (-) to starboard (+) direction which the target is referenced to (e.g., bow of vessel or north).
Y	The aft (-) to bow (+) direction which the target is referenced to. (e.g., bow of vessel or north)
Z	The targets depth. Referenced from the plane of the hydrophone elements or offset point to the target.

A "NOTE" message is used to emphasize a certain operation or condition.

NOTE: "_____."

A "CAUTION" message is noted where an operational hazard to the equipment could exist.

C A U T I O N

A "WARNING" is used where an injurious or life threatening condition to an operator, installer or troubleshooter could occur.

********** W A R N I N G **********

Routinely this system is a commercial target tracking system and should not be used as a life saving device with manned submersibles.

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SECTION ONE

GENERAL INFORMATION

1. GENERAL INFORMATION

The ORE Model 4410D-01 Trackpoint II is an integrated, ultrashort baseline acoustic tracking system designed to operate with up to six targets for a wide range of subsea navigation and relocation tasks. The target types consist of transponders, responders or free running pingers. The standard system is microprocessor-based, and consists of a hydrophone/VRU assembly, interconnecting deck cable(s) and Command/Display Module. Refer to section 1.1 for typical system components. Configurations for ROV tracking, vessel positioning, and subsea relocation are operator-controlled using a keypad entry system or via the RS-232 port. NOTE: The "-01" version is the latest revision which allows input of a dynamic motion sensing system. It is also known as the Trackpoint II *Plus* system.

Trackpoint II presents the user with a video display (VGA resolution) of the underwater position of the target or targets relative to a chosen reference point on the surface vessel.

In addition to the graphic display of target position, Trackpoint II displays digital values for azimuth and range to each target. Up to six targets may be tracked and displayed simultaneously.

A standard RS-232 connector is supplied which outputs position data for each target and allows input of most keypad control functions.

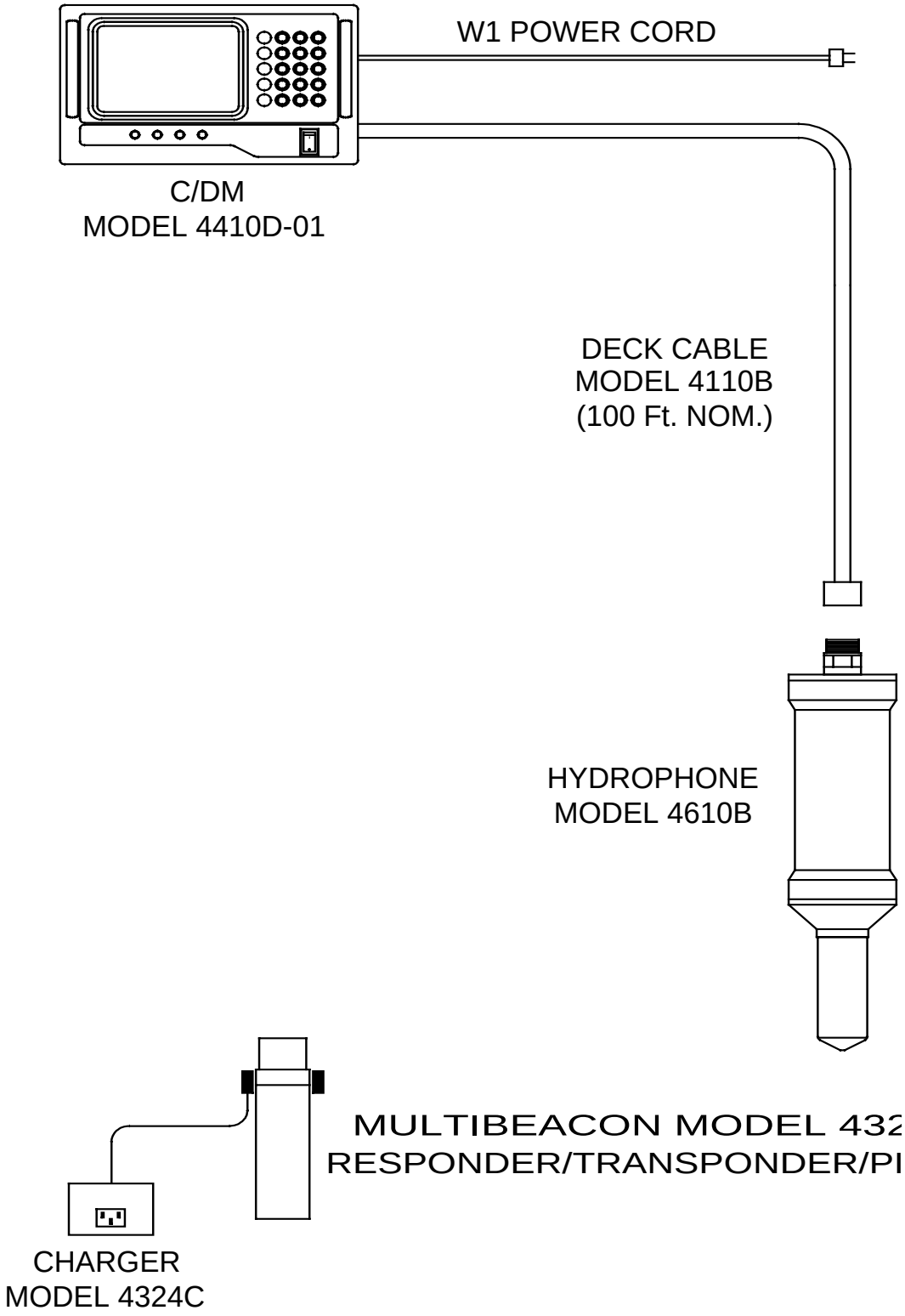
1.1 LIST OF TYPICAL TRACKPOINT EQUIPMENT

1.1.1 TYPICAL TRACKPOINT II SYSTEM

A typical Trackpoint II *Plus* system consists of the following equipment.

ITEM	PART NUMBER	DESCRIPTION	QTY
Shipboard:			
1.	4410D-01	MODEL 4410D-01 TRACKPOINT II *Plus* C/DM	1
2.	4610B	MODEL 4610B HYDROPHONE (22-30 kHz)	1
3.	4110B	MODEL 4110B DECK CABLE	1
4.	4410MA0089	MANUAL, TRACKPOINT II SYSTEM	1
5.	4414B	MODEL 4414B DYNAMIC MOTION SENS. SYS	1
Subsea:			
6.	4330B	MODEL 4330B MULTIBEACON	1
7.	4324C	MODEL 4324C CHARGER	1
8.	4330MN0003	MANUAL, MULTIBEACON SYSTEM	1

See Figure 1-1 for typical Trackpoint II *Plus* system.



SYSTEM INSTALLATION CONFIGURATION

Figure 1-1

1.1.2 SEPARATE HYDROPHONE AND VRU

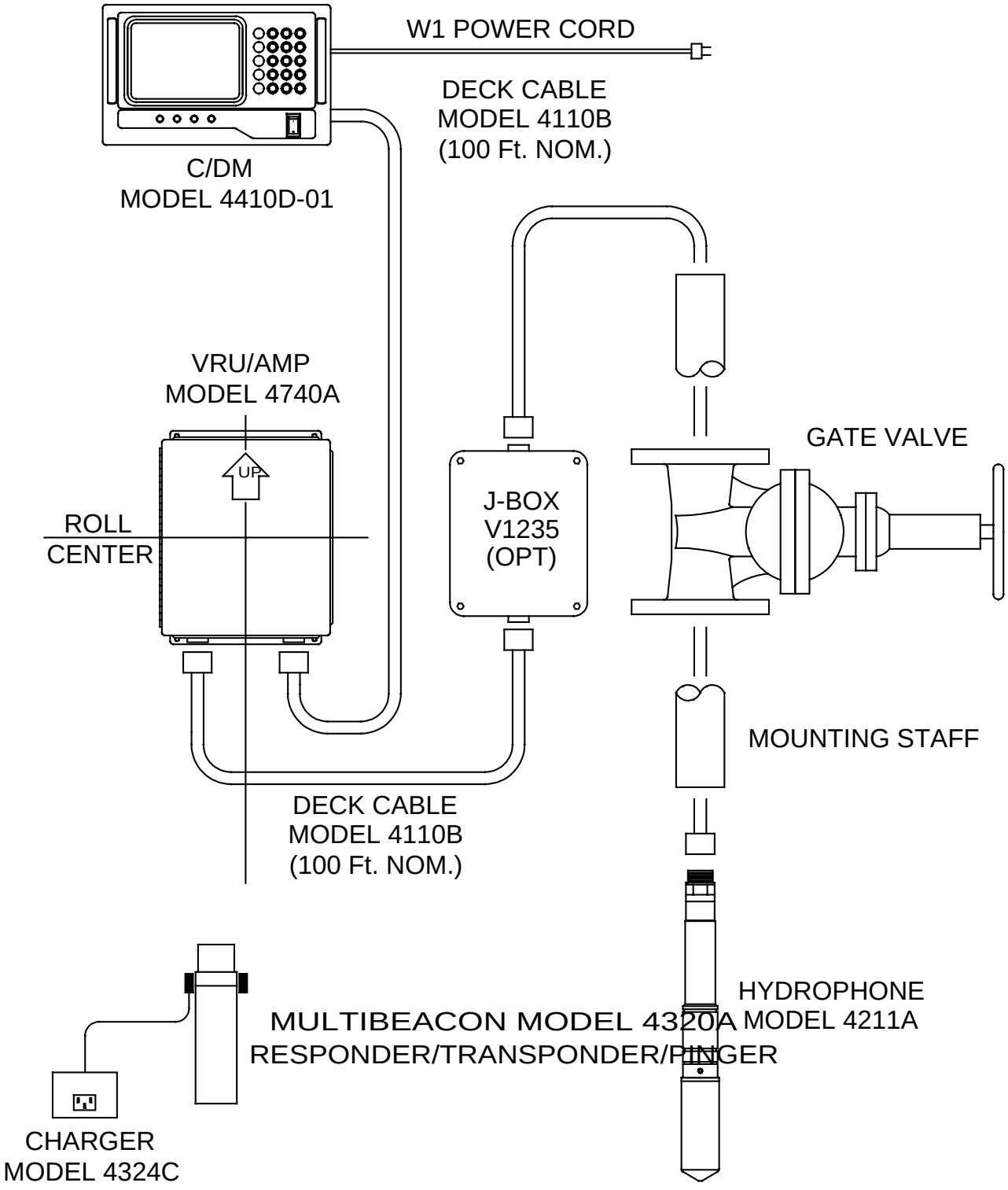
A typical Trackpoint II *Plus* system with separate hydrophone and VRU consists of the following equipment:

ITEM	PART NUMBER	DESCRIPTION	QTY
Shipboard:			
1.	4410D-01	MODEL 4410D-01 TRACKPOINT II *Plus* CD/M	1
2.	4211A-XXX-YY	MODEL 4211A 3" HYDROPHONE	1
3.	4740A-ZZ	MODEL 4740A REMOTE AMPLIFIER	1
4.	4110B	MODEL 4110B DECK CABLE	2
5.	4410MA0089	MANUAL, TRACKPOINT II SYSTEM	1
6.	4414B	MODEL 4414B DYNAMIC MOTION SENS. SYS	1
Subsea:			
7.	4330B	MODEL 4330B MULTIBEACON	1
8.	4324C	MODEL 4324C CHARGER	1
9.	4320MN0003	MANUAL, MULTIBEACON SYSTEM	1
Hull Mount:			
10.	4630D-XX	MODEL 4630D-XX THRU-HULL DEPLOYMENT SYSTEM	1
11.	4630MA0107-XX	MANUAL, , MODEL 4630D-XX	1

Note: All MODEL 4630D Thru-Hull Deployment Systems are custom designed for each installation.

"XXX" Denotes the hydrophone material, ASB or PVC and "YY" the receive frequency range of the hydrophone (LF = Low Frequency, MF = Medium Frequency & HF = High Frequency). "ZZ" denotes the frequency range of the VRU/Amplifiers.

See SYSTEM INSTALLATION CONFIGURATION Figure 1-1A for typical Trackpoint II *Plus* system with separate hydrophone and VRU.



SYSTEM INSTALLATION CONFIGURATION

Figure 1-1 A

1.2 COMMAND/DISPLAY MODULE

The Command/Display Module (C/DM) contains the system microprocessors, the transmitter and receivers, the display monitor, and the multi-function keypad for operator input and control. See Figure 1-2 for C/DM Block Diagram.

The microprocessors calculate relative bearing, depression angle and slant range to one or more submerged sound sources based on acoustic phase measurements and velocity of sound in water. Trackpoint II will work with most pingers, transponders or responders, provided they are frequency compatible.

FRONT PANEL

Figure 1-3 shows the location of the C/DM front panel controls and features.

Video Display

The full-color VGA video display is divided into four functional blocks. The **tracking window** gives a real-time representation of the position of the target(s) relative to the surface vessel, and may be configured as a rectangular (Cartesian coordinate) grid or a polar coordinate grid. A target-centered display can be chosen in either of the above configurations.

The **status block** updates bearing, horizontal distance, depth and error code data for the pinger targets every two seconds. The transponder or responder targets update when valid signals are received. The operator can choose to display slant range or X, Y, Z coordinates of the targets in the status block, as well.

The relative-position information displayed in the tracking window and status block of the video display updates as fast as the incoming data allows. When the system is used with a pinger, the rate is determined by the pulse repetition rate. The transit time of the sound signals from the ship to the transponder and back is the rate-limiting factor when a transponder is the acoustic source. Note that most transponders lock-out their receivers for typically two seconds, thereby producing a maximum update rate of two seconds. With a responder as the acoustic source, the limiting factor is the one-way travel time from the responder to the hydrophone, or the minimum one second rate as set by the transmitter rate parameter.

The Trackpoint II menu structure is a soft-key-driven, hierarchical set of command options. Command options display in the **menu block** with each option corresponding to the adjacent function key labeled f1 through f5. Each selection leads to a sub-menu of specific options or data input. As the operator progresses along a menu branch, a record of his choices is displayed in the **command line** at the bottom of the screen. Data input from the keypad is also displayed in the command line for immediate verification by the operator.

Most menu branches allow the operator to change multiple parameters within that menu before returning to the basic menu via the cancel key.

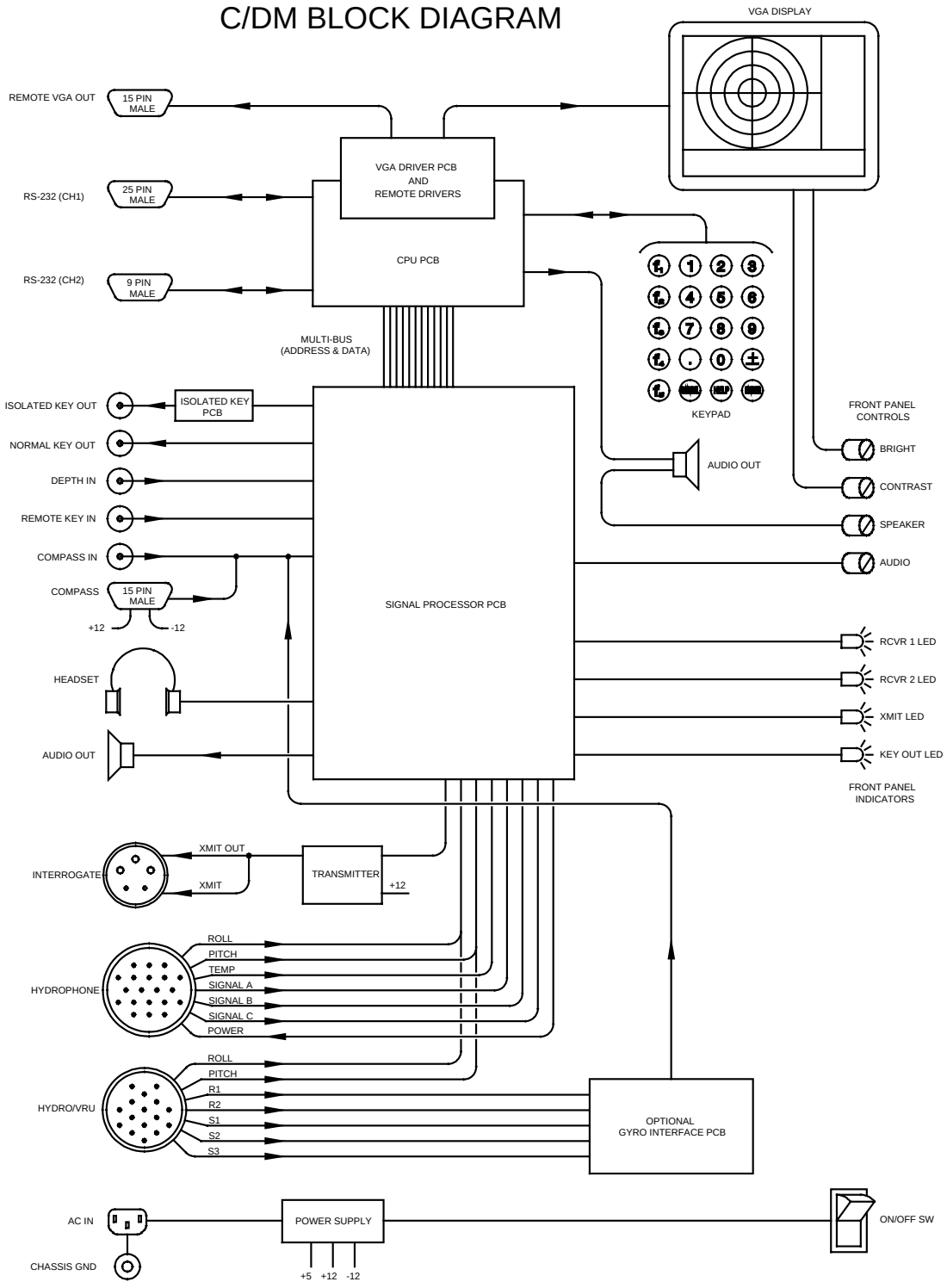
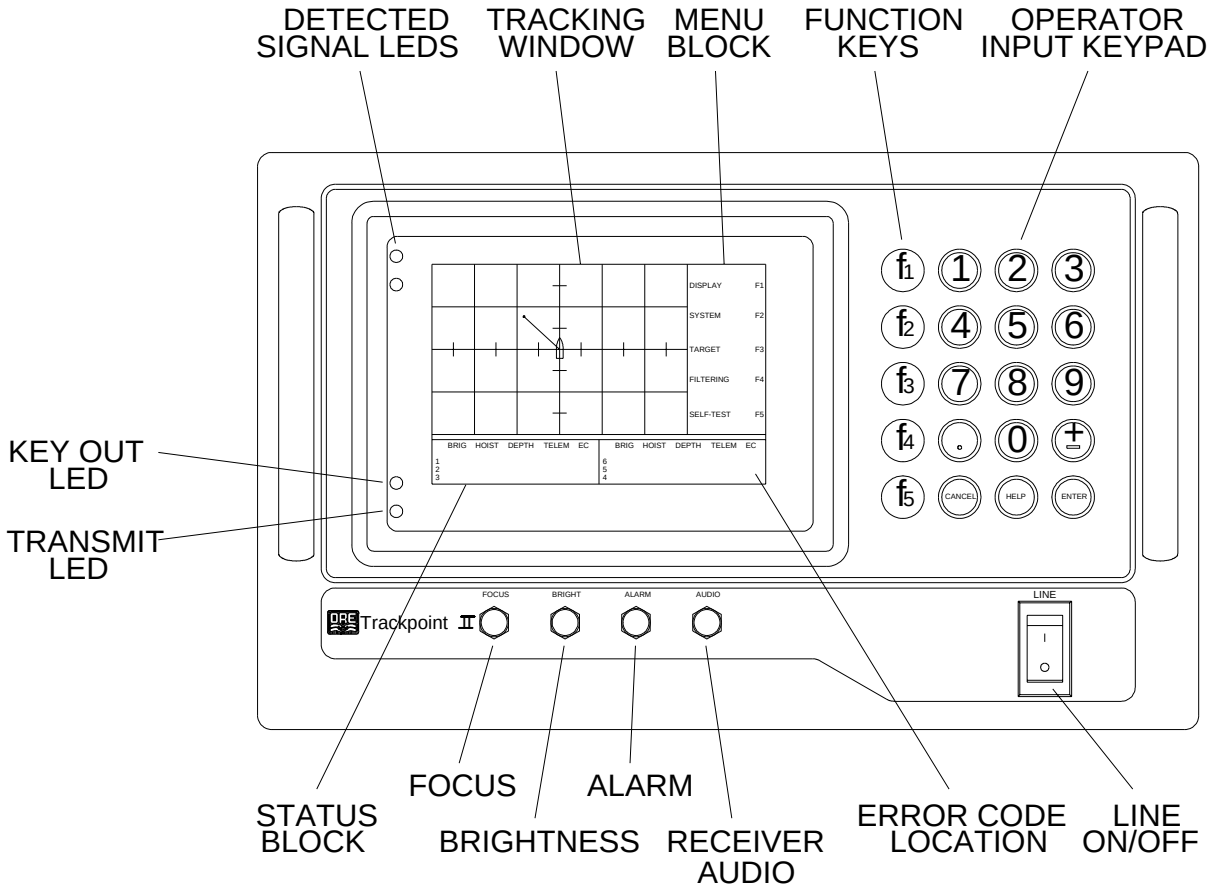

C/DM BLOCK DIAGRAM
VGA DISPLAY
REMOTE VGA OUT
15 PIN MALE
VGA DRIVER PCB AND REMOTE DRIVERS
RS-232 (CH1)
25 PIN MALE
CPU PCB
RS-232 (CH2)
9 PIN MALE
MULTI-BUS (ADDRESS & DATA)
KEYPAD
ISOLATED KEY OUT
ISOLATED KEY PCB
NORMAL KEY OUT
DEPTH IN
REMOTE KEY IN
COMPASS IN
COMPASS
15 PIN MALE
+12
-12
AUDIO OUT
FRONT PANEL CONTROLS
BRIGHT
CONTRAST
SPEAKER
AUDIO
SIGNAL PROCESSOR PCB
HEADSET
AUDIO OUT
RCVR 1 LED
RCVR 2 LED
XMIT LED
KEY OUT LED
FRONT PANEL INDICATORS
INTERROGATE
XMIT OUT
XMIT
TRANSMITTER
+12
HYDROPHONE
ROLL
PITCH
TEMP
SIGNAL A
SIGNAL B
SIGNAL C
POWER
HYDRO/VRU
ROLL
PITCH
R1
R2
S1
S2
S3
OPTIONAL GYRO INTERFACE PCB
AC IN
CHASSIS GND
POWER SUPPLY
+5 +12 -12
ON/OFF SW

Figure 1-2



COMMAND/DISPLAY MODULE

Figure 1-3

Function Keys/Input Keypad

The function keys and input keypad are located to the right of the video display. Their use is explained in detail in section 3.3.

LED's

In the upper left-hand corner of the display are two red LED's. The top LED corresponds to the transponder or responder reply received and the bottom LED corresponds to a pinger, if that target type is being tracked. Refer to section 3.13 for more detail. Each LED flashes once for each received signal from its corresponding beacon. This provides the operator with a quick verification that the beacon signals are being detected.

In the lower left-hand corner are two green LED's. The upper green transmit LED in the lower left-hand corner of the display flashes once for each outgoing transmitter pulse. The lower one flashes once for each output of the NORMal KEY OUT. This is useful when operating in the transponder or responder mode.

Control Knobs

Focus and brightness control are used together to achieve the most readable display for existing lighting conditions. The alarm control adjusts the volume of alarm signals and keyboard response. Audio control adjusts the volume of audible hydrophone receive signals.

Line Switch

The main power on/off switch is labeled LINE.

BACK PANEL

Figure 1-4 shows the location of the following back panel features:

The **HYDROPHONE** 20-pin connector connects the deck cable leading from the hydrophone.

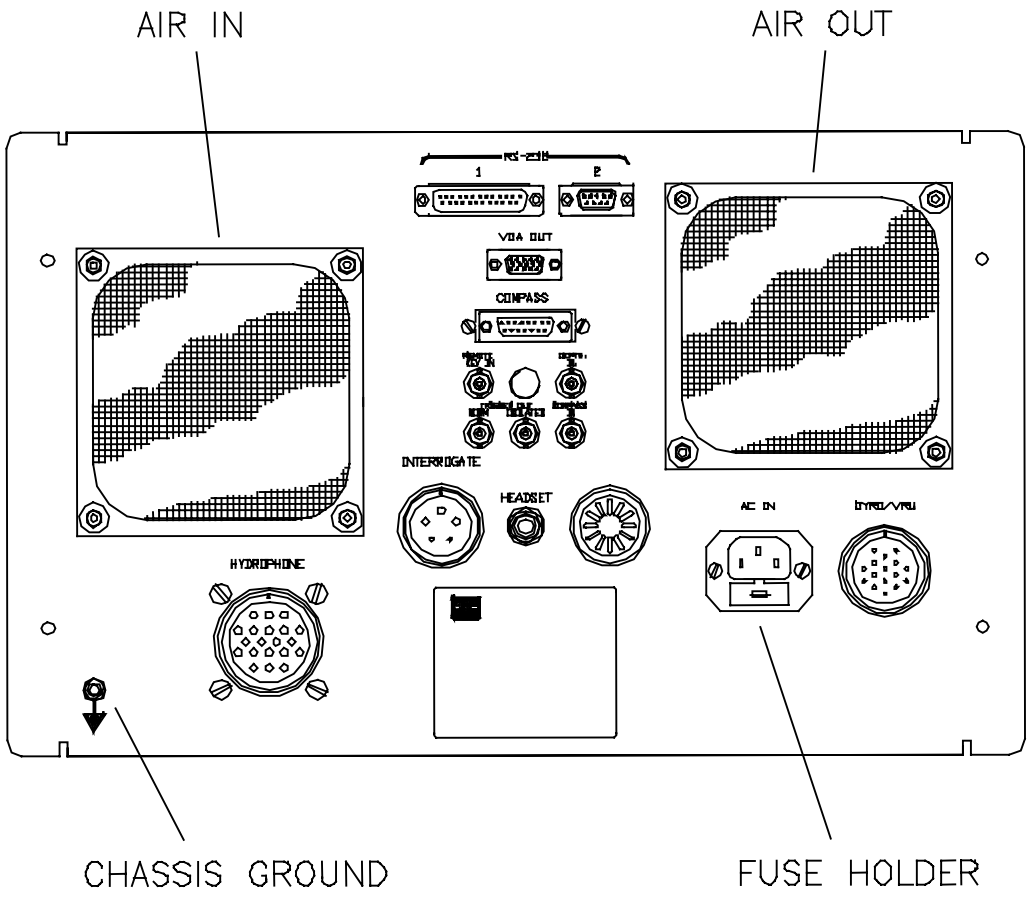
The **INTERROGATE** 5-pin connector connects a deck cable to a separate interrogate transducer. See section 2.2.7.

AC IN is a EURO Standard line input connector, which also contains the 5 x 20 mm line fuse.

The **VGA OUT** 15-pin high density female `D' connector outputs digital video signals (≈ 2 V p-p @ 75 ohms) to an external monitor. Refer to section 2.2.5 for pin assignments.

The **RS-232C #1** 25-pin female `D' connector outputs data with RS-232C standard levels. Accepts input data with RS-232C standard levels. Refer to section 3.12 for RS-232C pin assignments, format and protocol.

The **RS-232C #2** 9-pin male `D' connector accepts input data with RS-232C standard levels. Refer to section 3.12 for RS-232C pin assignments, format and protocol.



4410D-01
COMMAND/DISPLAY MODULE BACK PANEL

Figure 1-4

The **TRANSMIT REMOTE IN** BNC connector synchronizes the Trackpoint II transponder or responder cycle to external equipment. (The system transmit control parameters are outlined in section 3.4.2, SYSTEM. The repetition rate, frequency control and pulse width for each individual target is located in section 3.4.3, TARGET.) Accepts from TTL-level to +15 V positive-going pulses.

The **ISOLATED TRANSMIT TRIGGER OUT** BNC connector outputs an AC-coupled pulse that is either positive or negative, depending upon a slide switch located on the Isolated Key board. The polarity switch provides a positive pulse in the UP position and a negative pulse in the DOWN position. The pulse polarity is labeled next to the slide switch. The Trackpoint II is shipped with the polarity switch in the (-) or DOWN position, as ORE responders are normally configured for a negative key pulse. The Isolated Transmit trigger can drive up to a maximum pulse width of 2.0 milliseconds (1.0 millisecond into 100 ohms).

The **NORMAL TRANSMIT TRIGGER OUT** BNC connector outputs TTL-level, negative-going pulses, synchronized with the start of the Trackpoint II transponder or responder cycle.

The **AIR IN** filter allows air intake for cooling fan. Refer to section 5.0 for cleaning instructions.

The **GROUND** symbol indicates the chassis ground. On vessels with poor grounding systems, electrical noise may be reduced by connecting to a sea ground.

The **DEPTH** BNC allows the inputting of a 0-6VDC signal representing depth. Refer to section 3.4.3. NOTE: This input can also be configured for analog Hydrophone Depth Offset input.

The **HEADPHONE** jack allows the use of a standard headset to listen to the audio signal.

The **COMPASS** BNC is located just below the DEPTH BNC. The input signal is typically 0-6 V for 0-360 degrees. Refer to section 2.2.3 for installation, section 3.4.2 for configuration and Figure 3-11.
NOTE: This input can also be configured for analog Hydrophone Depth Offset input.

The **INTEGRATED COMPASS** 15-pin female D connector is used to connect to an ORE Model 4411B Flux gate Compass option. This connector provides power for the compass and accepts its analog signal output. Refer to section 2.2.4.

The **GYRO/VRU** interface connector is a 16-pin male Amphenol "MS" series connector. This connector provides an interface for both a dynamic motion sensing system (VRU-Vertical Reference Unit) and also a synchro-output type gyro compass. The VRU is used to compensate for the vessel's dynamic pitch and roll motion. The VRU interface receives the analog signals from ORE Model 4414A or equivalent dynamic motion sensing system. The analog signals are converted to digital signals for internal computations and RS232 output. The compass input is used to reference the tracked targets to North. (Trackpoint II normally references its tracked targets to the bow of the vessel in which it is installed.) The compass interface receives the synchro and reference signals from various gyros. The synchro signals are converted to analog (0-5VDC) and then to digital data. Refer to section 0 for specifications and section 2.2.12 for installation details.

NOTE: The VRU interface is standard in the Model 4410D-01 while the Gyro signal conversion board is an optional feature. Due to the variety of synchro voltages and frequencies available the Gyro Interface PCB board and wiring are installed at the factory. The various options are as follows.

NOTE: This converter is used with a synchro type gyro output NOT a stepper output as used in some gyros.

Opt 114: Synchro voltage 11.8 VAC, 400 Hz, ref. voltage 26 VAC +/-10% 400Hz +/-10%
Opt 904: Synchro voltage 90 VAC, 400 Hz, ref. voltage 115 VAC +/-10% 400 Hz +/-10%
Opt 906: Synchro voltage 90 VAC, 60 Hz, ref. voltage 115 VAC +/-10% 60 Hz +/-10%

1.3 HYDROPHONES AND VRU's

The housing for the Model 4610B Hydrophone is a stainless steel case. The Hydrophone includes an integral interrogate transducer for transponder operation, and an integral Vertical Reference Unit (VRU) to allow the Trackpoint II to measure vessel motion and correct tracking data for pitch and roll errors or when used with a Dynamic Motion Sensing System to measure the static offset of hydrophone with respect to the vertical axis. The hydrophone contains multiple receiving elements, required by Trackpoint II to measure the phase (time) differentials of incoming acoustic pulses between the elements. The microprocessors use this information to calculate both the azimuth and depression angle from which the acoustic pulse originated. The Model 4610B Hydrophone is available in three different frequency ranges, std 22-30 kHz, opt 8-14 kHz, and opt 35-45 kHz.

The Model 4211A is a smaller 3-inch diameter Hydrophone separate from the filters, amplifiers and VRU that are integral to the Model 4610B. The Model 4211A only contains the multiple receiving elements with pre-amplifiers and an interrogate transducer. The Model 4740A VRU/Amplifier contains the VRU, amplifiers and filters for each of the three listening channels. The Model 4211A and 4740A are calibrated as a set. The Model 4211A and 4740A are intended for installation through a hull mounted gate valve. The smaller diameter size of the 4211A hydrophone allows it to be towed faster through the water due to the decrease in drag and subsequent strumming. It is available in aluminum-silicon-bronze (ASB) or PVC material. The 4211A and 4740A are also available in three different frequency ranges, std 22-30 kHz, opt 8-14 kHz, and opt 35-45 kHz. A Model 4110B deck cable is required to connect the Model 4211A Hydrophone to the Model 4740A VRU/Amplifier.

1.4 DECK CABLE

The Model 4110B Deck Cable connects the Model 4610B hydrophone to the Command/Display Module, via the HYDROPHONE connector on the C/DM back panel (Figure 1-4). Refer to section 2.1.4 for proper connection of the Deck Cable to the Hydrophone. It is also used to connect the Model 4740A VRU/Amplifier to the Model 4211A Hydrophone and a second one is used to connect from the C/DM to the Model 4740A VRU/Amplifier.

1.5 ACOUSTIC SOURCES

The ORE Multibeacon series is recommended for Trackpoint II operation. The 4320 series Multibeacons are configurable for pinger, responder or transponder operation. The 4330 series Multibeacons are configured for responder and transponder operation. Some options include depth/data telemetry and remote head acoustic projectors.

Other sources can be used, providing they operate in the specified frequency ranges and have adequate acoustic power for the intended application. See Appendix A, Table of Data Ranges and Units.

Consult the nearest ORE Offshore Division, Accusonic Technologies, Inc. office (refer to directory in section 5.1) for the most suitable acoustic source for your requirement.

1.6 SPECIFICATIONS

Performance Specifications: (22-30 kHz/8-14 kHz/35-45 kHz)

PINGER

Horizontal Position

(Depression angle > 45° from horizontal)

Absolute Accuracy	±0.75 % RMS of Slant Range (22-30 kHz) ±0.75 % RMS of Slant Range (8-14 kHz) ±1.50 % RMS of Slant Range (35-45 kHz)

TRANSPONDER/RESPONDER

Horizontal Position (over entire hemisphere)

Absolute Accuracy	±0.5 % RMS of Slant Range (22-30 kHz) ±0.5 % RMS of Slant Range (8-14 kHz) ±1.0 % RMS of Slant Range (35-45 kHz)
Repeatability Accuracy	±0.3 % RMS of Slant Range (22-30 kHz) ±0.3 % RMS of Slant Range (8-14 kHz) ±0.6 % RMS of Slant Range (35-45 kHz)

Slant Range

Accuracy	±1 meter (assuming correct speed of sound input)
Resolution	0.3 meters

Vertical Reference Unit

Range		±45 deg. (linear range +/- 40°)
Accuracy	0° to 10°: 10° to 40°:	±0.1° ±1 % angle

Electrical Specifications:

Remote VRU Analog Input

Analog Voltage Input	Scaled for ±10 VDC
Analog Conversion Accuracy	0.27% of full scale (e.g., for a ±50° VRU range the accuracy is better than 0.135°)

Specifications subject to change without notice.

Zero Offset Error	±0.12% of full scale (e.g., for a ±50° VRU range the zero offset error is less than ±0.060°)
Linearity	±0.03% of full scale (e.g., for a ±50° VRU range the linearity error is less than ±0.015°)
Temperature (-10 to 55°C) Full Scale Calibration	±0.12% of full scale (e.g., for a ±50° VRU range the full scale calibration error over the temperature range of 0-70°C is less than ±0.060°)
Zero Offset	±0.06% of full scale (e.g., for a ±50° VRU range the zero offset error over the temperature range of 0-70°C is less than ±0.030°)
Resolution of A/D Converter	A/D converter = 3481.6 bits (e.g., ±50° = 100° total /3481.6 bits = 0.029° resolution)

NOTE: The displayed resolution on the SYSTEM-CONFIGURATION-DISPLAY is 0.01°, the RS232 "STD w/pr" string is 0.1° and the "NMEA ORE" string is 0.01°.)

Gyro Compass Synchro Input **(OPTIONAL)**

Options	OPTION 114:	11.8 VAC, 400Hz L-L, with ref. of 26 VAC ±10% 400Hz ±10%, ratio 1:1.
	OPTION 904:	90 VAC, 400 Hz L-L, with ref. of 115 VAC ±10% 400Hz ±10%, ratio 1:1.
	OPTION 906:	90 VAC, 60 Hz L-L, with ref. of 115 VAC ±10% 60Hz ±10%, ratio 1:1.
Synchro-Input Impedance		(option 114) 25k Ohm (option 904) 200k Ohm; (option 906) 150k Ohm. Minimum balanced Loading on gyro transmission signals S1, S2 & S3.
Reference-Input Impedance		(option 114) 5k Ohm; (option 90X) 40k Ohm
Output Signal		0.0 to +5.0 VDC where 0.0° = 0.00 VDC 359.9° = 5.00 VDC
S/D Conversion Accuracy		±0.55°
S/D Converter Resolution		0.12°
Temperature Coefficient		0.01° / °C

Specifications subject to change without notice.

Receive Signal Specifications

STANDARD:	
Frequency	22-30 kHz with 500 Hz increments
Pulse duration	1.33 ms minimum
Signal/noise ratio	> 40 dB at wideband filter
OPTIONAL:	
Frequency	08-14 kHz with 500 Hz increments 35-45 kHz with 500 Hz increments
Pulse duration	1.33 ms minimum
Signal/noise ratio	> 40 dB at wideband filter

Transmitter Output Specifications

Frequency	4.5-30 kHz in 500 Hz increments
Pulse Width	1 to 15 ms in 0.1 ms increments
Repetition Rate	1 to 20 seconds
Output Power	100 or 500 watts into 300 Ω, user selectable
Source Pressure Level (Hydrophone Interrogator in 4610B MF 22-30 kHz, HF 35-45 kHz or 4211A)	17 - 20 kHz, @ 500 W, nominal 193 dB re 1 µPa @ 1 m. (horizontal plane) (also refer to section 3.5.2)
(Hydrophone Interrogator in 4610B LF 8-14 kHz)	13 - 17 kHz, @ 500 W, nominal 193 dB re 1 µPa @ 1 m. (horizontal plane) (also refer to section 3.5.2)

Video

INTERNAL MONITOR Type:	Seven color VGA display
Size:	5 x 7 inch (127 x 178 mm)
Resolution:	640 x 480 pixels
REAR PANEL OUTPUTS	VGA output, buffered

Specifications subject to change without notice.

Remote In Trigger	Optically coupled, requires positive pulse, from TTL up to +15 V.
Norm Trigger Out	TTL negative pulse.
Isolated Trigger Out	Responder operation; transformer coupled, TTL level signal, (+) or (-) polarity.

Physical Specifications:

Model 4410D-01 Command/Display Module

Height	10.5 inches (26.7cm)
Width	17 inches (43 cm)
Depth	20 inches (51 cm)
Weight	55 lbs (25 kg)

Model 4610B Hydrophone Assembly

Length	25 inches (63 cm)
Diameter	6 inches (15 cm)
Weight	30 lbs (14 kg)

Model 4110B Deck Cable

Standard:

Length	100 feet (30.5 m)
Diameter	*0.8 inches (2.03 cm)
Weight	35 lbs (16 kg)

* Does not include connectors

Model 4211A Hydrophone; (3" dia) (LF/MF/HF) (ASB/PVC)

Length	22.75 in (57.8 cm)
Diameter	2.75 in (7 cm) maximum
Weight	10.5 lbs (4.8 kg) (ASB) 6 lbs (2.7 kg) (PVC)

Specifications subject to change without notice.

Model 4740A VRU/Amplifier (LF/MF/HF)

Width	13.375 in (34 cm)
Height	15.375 in (39 cm)
Depth	6.25 in (15.9 cm)
Weight	24 lbs (10.9 kg)

MF = Standard - Medium Frequency System, 22-30 kHz
LF = Low Frequency System, 8 - 14 kHz
HF = High Frequency System, 35 - 45 kHz

Environmental Specifications:

Command Display Module

Temperature	Operating: -10° to 55° C Storage: -40° to 70° C

Hydrophone; 4610B

Temperature	Operating: -4° to 40°C Storage: -40° to 70°C

Hydrophone & VRU/Amplifier; 4211A & 4740A

Temperature	Operating: -4° to 40°C Storage: -40° to 70°C

Power Requirements

Voltage	100-240 VAC (auto switching on voltage rise)
Frequency	50/60 Hz
Power	185 Watts

Specifications subject to change without notice.

SECTION TWO

INSTALLATION

2. INSTALLATION

This section includes instructions for designing and implementing a 4610B hydrophone mounting assembly, making proper attachment of the deck cable and back panel interconnects, and selecting an adequate location for the Command/Display Module. It also includes suggested mounting arrangements for the Model 4211A (3" Hydrophone) and Model 4740A VRU/Amplifier Assembly. The Model 4211A Hydrophone and Model 4740A VRU/Amplifier are calibrated as a set and perform the same function as the complete Model 4610B Hydrophone assembly. Both configurations have the same performance specifications.

Hydrophone bearing, X, Y, Z offsets and pitch/roll offsets are generally determined at the time of installation. This section includes sample procedures for determining those offsets.

2.1 HYDROPHONE INSTALLATION

The manner and location in which the hydrophone assembly is mounted on the vessel is the single most crucial element in the overall performance of the tracking system. In choosing a mounting location, the operator should keep in mind that the Trackpoint II is by nature an extremely sensitive acoustic system. The hydrophone assembly must be in a position to "hear" the acoustic pulses coming from the pinger, transponder, or responder in use. Mount the hydrophone as far as possible from noise sources, such as, thrusters, echo-sounder transducers, main engines, generators and other acoustic systems.

Ideally, the hydrophone should be mounted far enough from the nearest reflector to allow the direct arrival of a signal from the acoustic source before a reflected signal arrives. The minimum recommended distance between the hydrophone array and the nearest reflector (which is usually to the vessel's hull or keel) is one meter*. It is also important to keep the hydrophone below the level of the vessel's keel for 360-degree coverage.

System performance can be degraded by "multi-path," or underwater signal reflections and reverberation. To minimize the possible effects of multi-path, choose a hydrophone location that is as far away as possible from any surface that would make a good reflector of an acoustic pulse. Any hard plate or structure near the hydrophone has the potential to reflect pulses into the hydrophone. The air-water interface is also an extremely efficient acoustic reflector. Avoid any mounting locations that would place the hydrophone in the proximity of bubbles.

$$* \quad 1 \text{ meter} = \frac{1.33 \text{ milliseconds} \times 1500 \text{ meters/second}}{2 \text{ way travel time}}$$

Consult the nearest ORE representative for additional information on a specific installation.

2.1.1 4610B SUGGESTED HYDROPHONE MOUNTING ASSEMBLY

The main function of the mounting assembly is to support the hydrophone vertically in the water. Mount it at reasonable distance from the vessel's hull and below the level of the keel. The mounting should be rugged enough to withstand the expected forces during the planned operation, and easy to raise and lower. The type and size of the mounting recommended for the Trackpoint II hydrophone varies with the size of the surface vessel and the intended application.

The Model 4610B Hydrophone is supplied with a universal mounting bracket. The mounting bracket attaches to the end of a suitable length of pipe. Choose the size and material of the pipe according to

the application. With the system in operation and underway at several knots, a five or six-inch schedule 80 steel pipe with angle-iron fairings is recommended. On small vessels, the Trackpoint II has been used with the hydrophone mounted to a two-inch aluminum pipe. Figure 2-1 illustrates a suggested mounting arrangement typical for slow-speed operation. Refer to drawing 100909 for mounting flange dimensions.

In the suggested mounting illustrated in Figure 2-1, a length of pipe with an inner diameter slightly greater than 3 inches is permanently attached to the deck. A length of pipe with a 3-inch outer diameter, permanently attached to the mounting pole, is fitted into the larger pipe and secured with a locking pin. This secures the mounting pipe to the vessel for use, but allows the pipe to be removed if necessary.

A support plate near water level helps secure the pipe in a vertical position. The angle iron on the underwater portion of the pipe adds stiffness and reduces vibration.

The mounting bracket and hydrophone are attached to the lower end of the pipe with eye bolts. The pipe has forward and aft guys leading from the point of attachment and secured on deck to prevent bending or swaying.

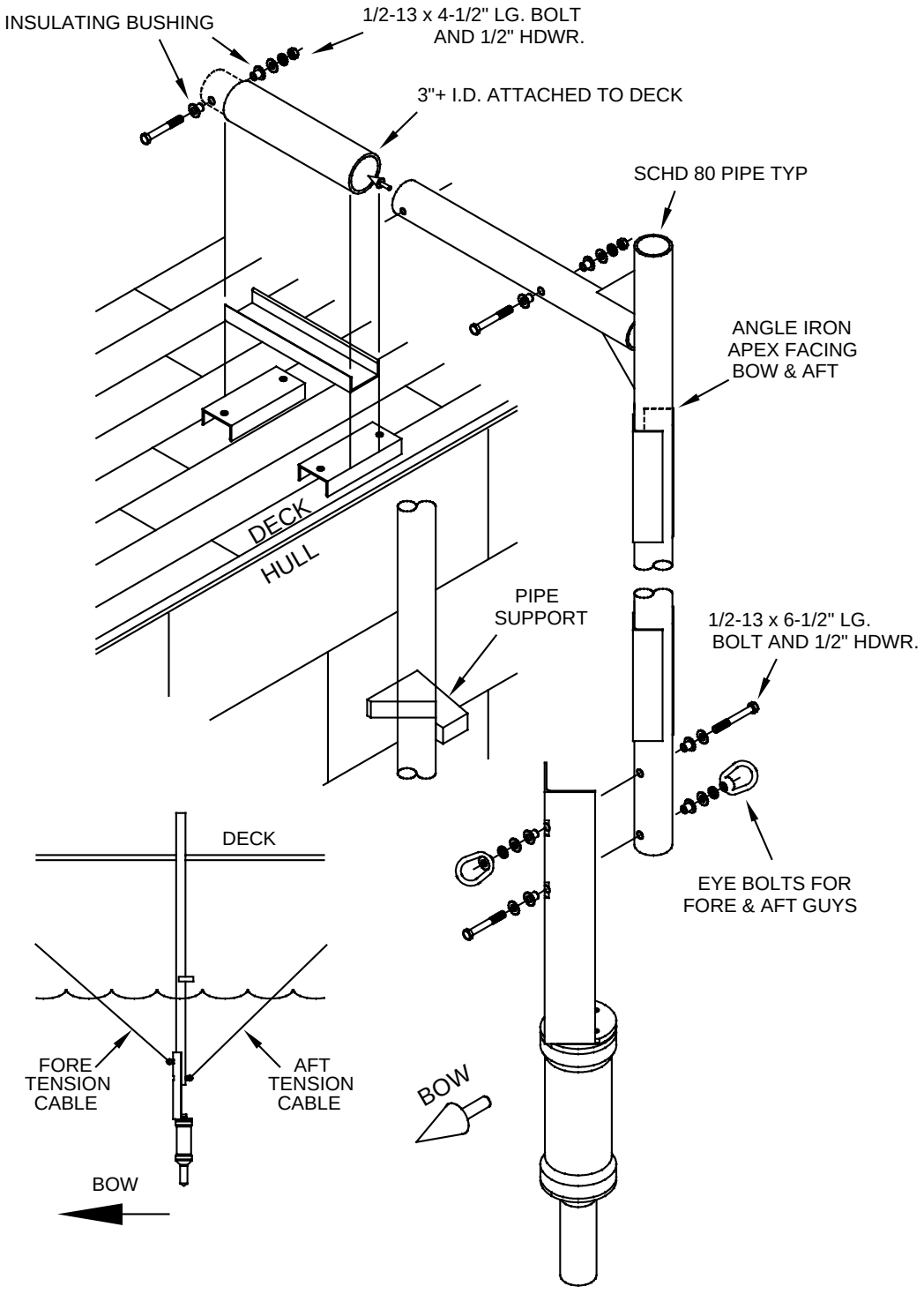

INSULATING BUSHING
1/2-13 x 4-1/2" LG. BOLT
AND 1/2" HDWR.
3"+ I.D. ATTACHED TO DECK
SCHD 80 PIPE TYP
ANGLE IRON
APEX FACING
BOW & AFT
DECK
HULL
PIPE
SUPPORT
1/2-13 x 6-1/2" LG.
BOLT AND 1/2" HDWR.
EYE BOLTS FOR
FORE & AFT GUYS
DECK
FORE
TENSION
CABLE
AFT
TENSION
CABLE
BOW
BOW

Figure 2-1

In general, consider the following when designing the hydrophone mounting.

1. The mounting pipe should be long enough to position the hydrophone below the vessel keel when in the vertical position.

2. The pipe used should be stiff enough to prevent vibration or strumming when the vessel is underway.

3. Attach the pipe to the side of the vessel so that the pipe and hydrophone assembly can be easily removed and set on board, if required, to tie the vessel up alongside other vessels or at dockside.

4. The entire assembly should be easy to raise and lower with available manpower or winches.

5. Hydrophone heading (appointed by the index mark) should align with vessel heading.

6. Forward and aft guys are used to hold the mounting pipe in vertical position.

7. A cradle or stop should be used to ensure that the hydrophone returns to the same position each time it is deployed.

2.1.1.1 ATTACHING MOUNTING BRACKET TO PIPE

The hydrophone mounting bracket typically attaches to the mounting pipe by drilling two 1/2-inch (13-mm) holes through the end of the pipe. Space the holes six inches (15.3 cm) apart, and align parallel to the centerline of the vessel. The fore and aft alignment is important in determining hydrophone offsets (section 2.3).

When drilling the lower hole, keep in mind that you need enough space between the end of the pipe and the connector on the top of the hydrophone itself to connect and disconnect the cable. For this reason, we recommend that the lower mounting hole be no more than two inches (5 cm) from the end of the pipe.

If you are using a mounting pipe with a sufficient inside diameter to allow the hydrophone cable to be fed through to the hydrophone, remember to run the cable through the pipe before placing the 1/2-inch (13-mm) bolts in the mounting holes, as the connector will not pass when the bolts are in place.

2.1.1.2 ATTACHING HYDROPHONE TO MOUNTING BRACKET

The index mark on the hydrophone assembly (see Figure 2-2) indicates the hydrophone heading. The "spine" of the mounting bracket should be aligned with the index mark on the hydrophone. The face of the mounting bracket fits over the hydrophone end cap and is bolted on as shown.

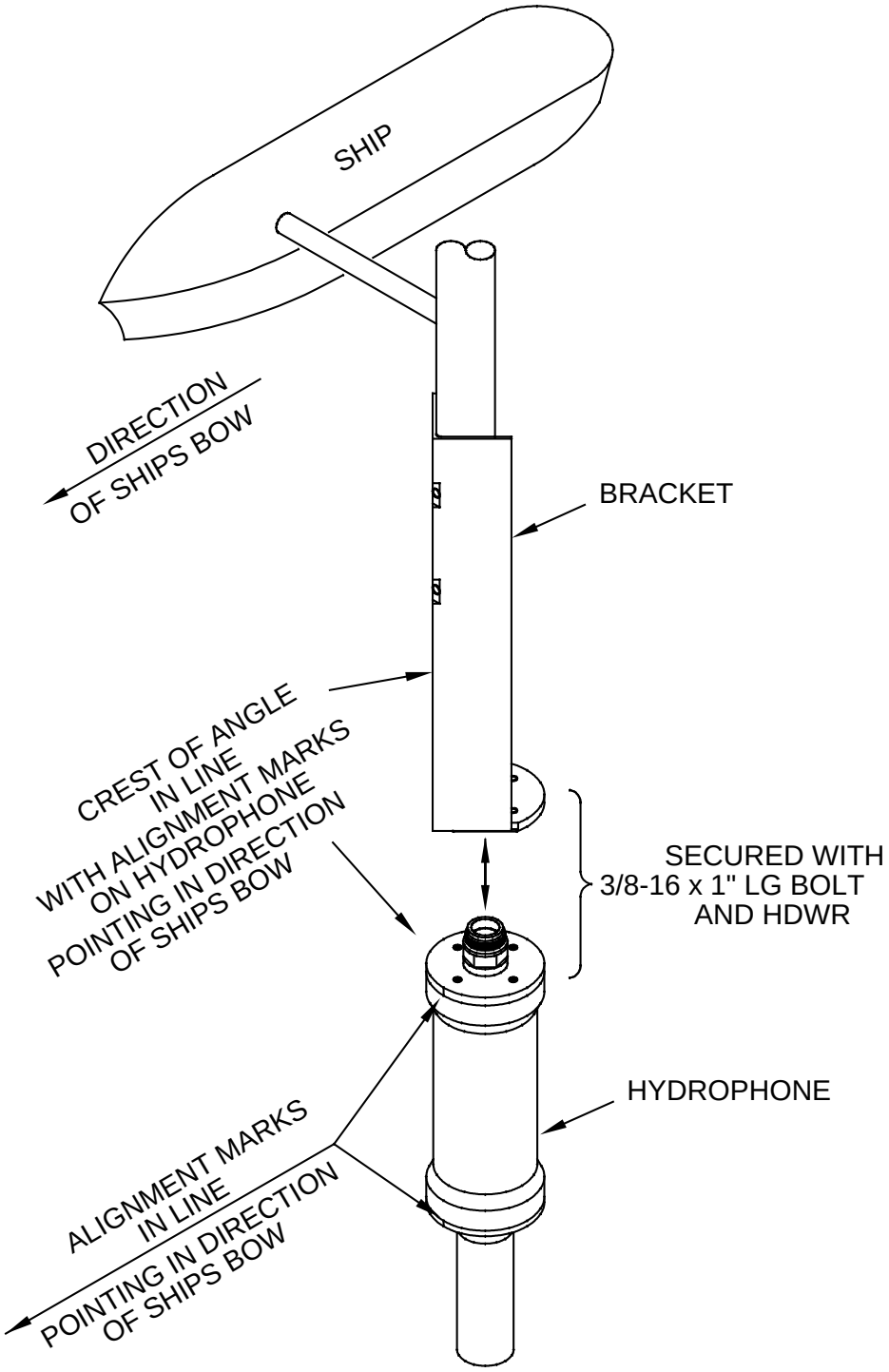

SHIP
DIRECTION
OF SHIPS BOW
BRACKET
CREST OF ANGLE
IN LINE
WITH ALIGNMENT MARKS
ON HYDROPHONE
POINTING IN DIRECTION
OF SHIPS BOW
SECURED WITH
3/8-16 x 1" LG BOLT
AND HDWR
HYDROPHONE
ALIGNMENT MARKS
IN LINE
POINTING IN DIRECTION
OF SHIPS BOW

Figure 2-2

2.1.2 4211A SUGGESTED MOUNTING INSTRUCTIONS

The model 4211A Hydrophone is intended for installation through a hull mounted gate valve. The hydrophone is first installed in a mounting staff and the mounting staff is projected through a gate valve. See Figure 1-1B. This allows for ease of deployment, recovery and maintenance of the hydrophone. An example of a gate valve type installation is shown in Figure 2-3. For information on the Model 4630D Motorized Gate Valve System contact ORE Offshore.

Figure 2-4 (4211AE0008) shows the suggested machining dimensions necessary for mounting the hydrophone to a staff.

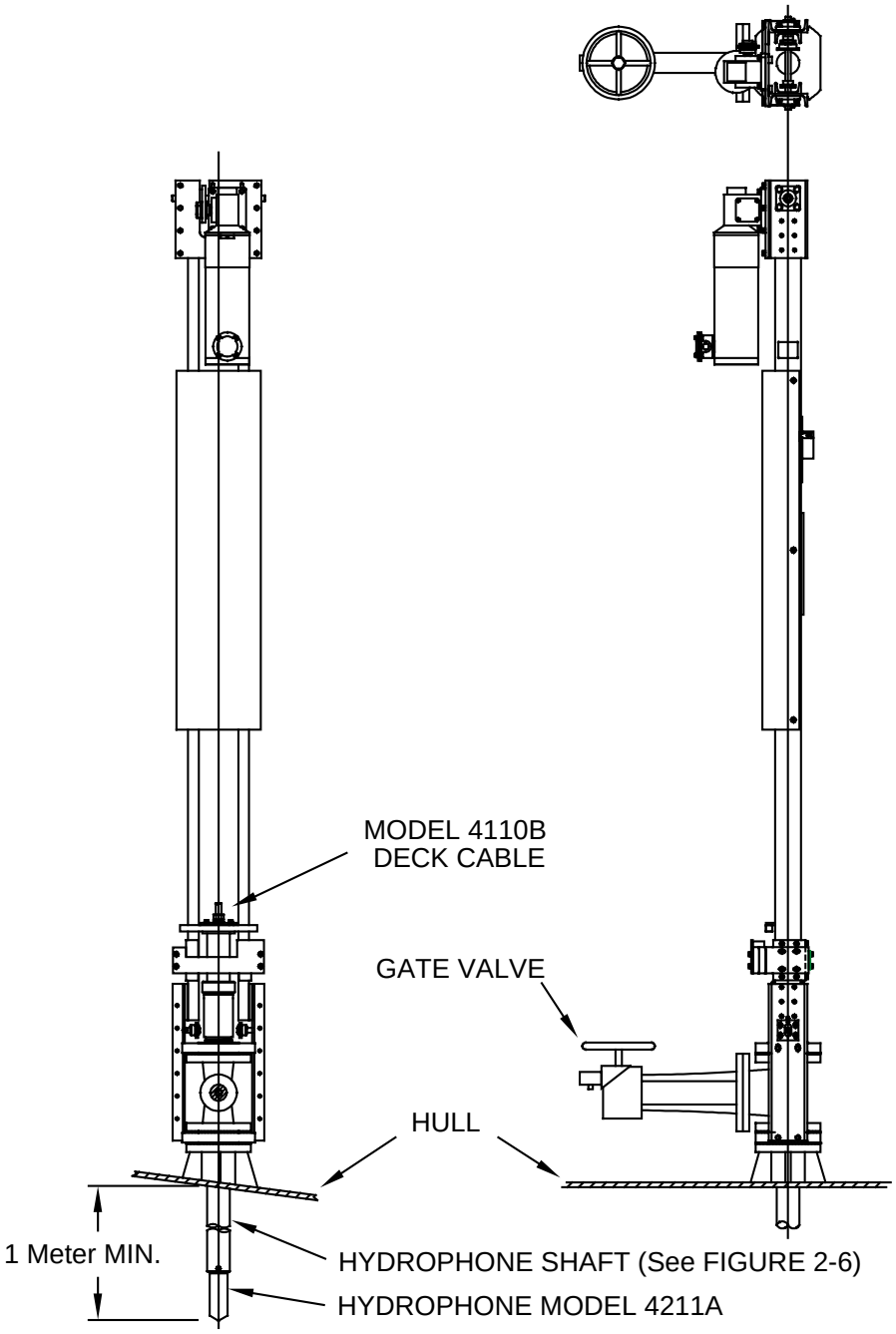
NOTE: The hole next to the alignment slot in the staff is the BOW reference point.

The hydrophone mounting staff must extend the hydrophone far enough from the nearest reflector, allowing the direct arrival of a signal from the acoustic source before a reflected signal arrives. This distance is a minimum of 1 meter. It is also important to keep the hydrophone below the level of the ship's keel for good 360 degree coverage.

When designing the hydrophone mount/deployment system keep in mind that the shaft be keyed to allow a repeatable bearing orientation. This ensures that the bow reference always returns to the same fixed position when the hydrophone is deployed.

The gate valve/mounting staff assembly should be installed in as close to a vertical position as possible.

The hydrophone mount can be installed offset from the centerline of the vessel. An X and Y offset can be input to the C/DM to correct for these offsets. Refer to section 2.3.



GATE VALVE TYPE INSTALLATION

Figure 2-3

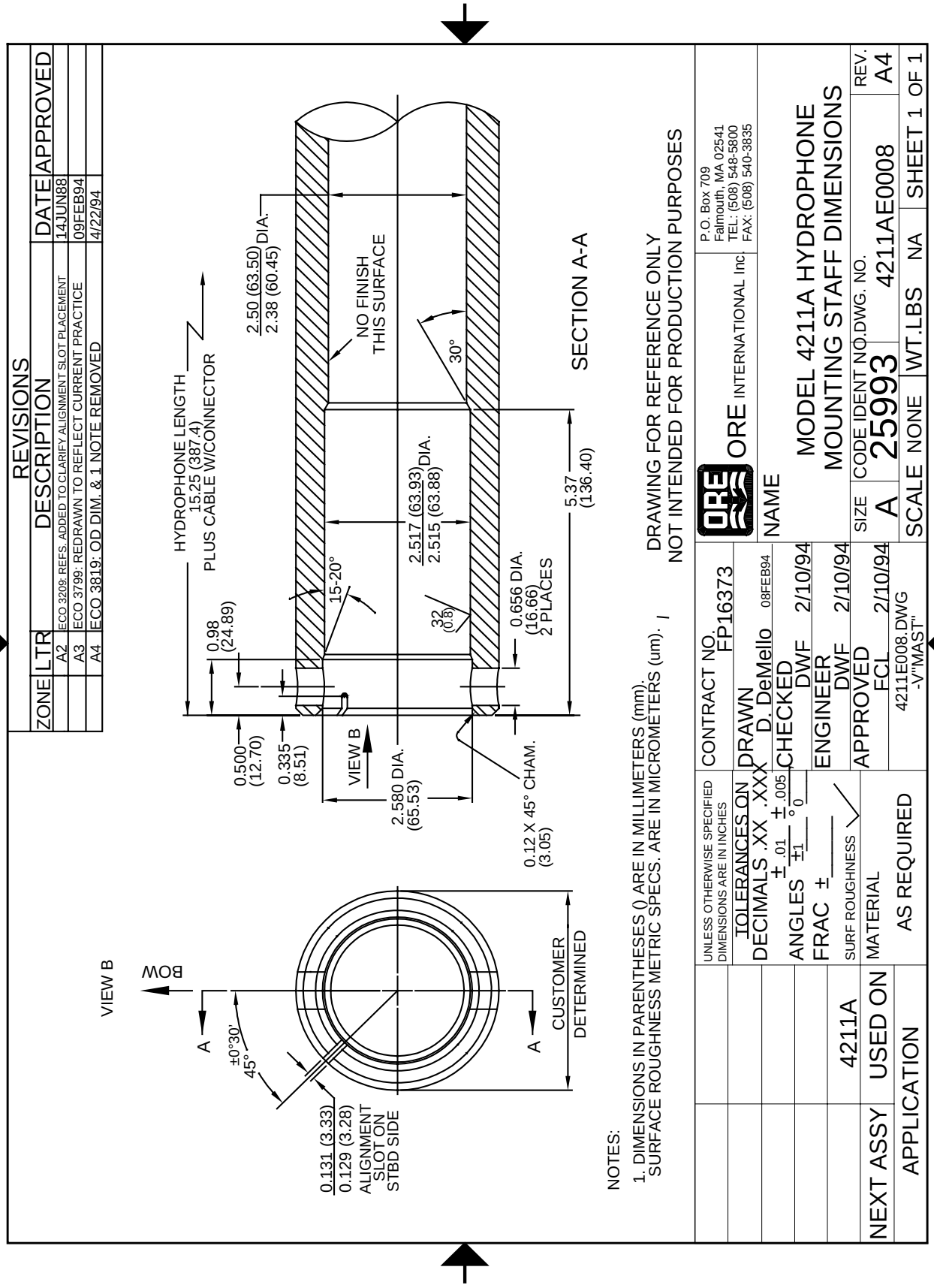


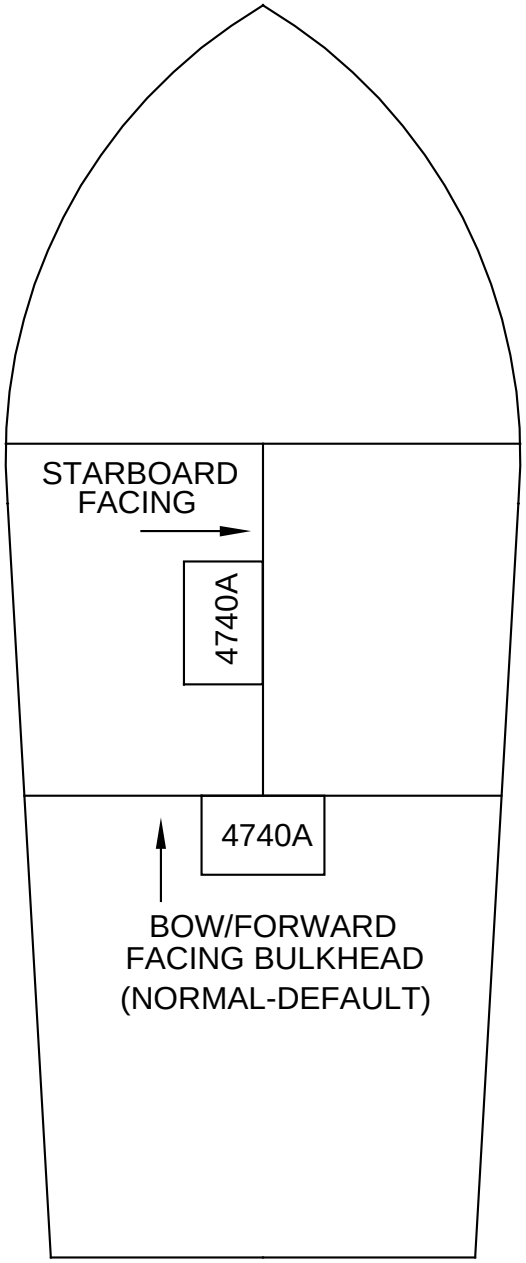
Figure 2-4 - Hydrophone Mount Machining Diagram

2.1.3 4740A VRU/AMPLIFIER SUGGESTED INSTALLATION

The Model 4740A VRU/Amplifier should be installed as close to the pitch and roll center of the vessel as possible. This reduces positional errors introduced by the VRU due to the horizontal acceleration the unit experiences. It is typically mounted to an interior bulkhead or other convenient vertical structure. The normal installation configuration is with the 4740A mounted on a bow (forward) facing bulkhead. Refer to 2-5. If the 4740A cannot be mounted in this configuration then it can be mounted 90°,180° or 270° offset from it. The menu parameter VRU/ORIENTATION compensates for this offset by switching between NORM (bow facing bulkhead mtg), STARBOARD, AFT or PORT. Refer to section 2.3.

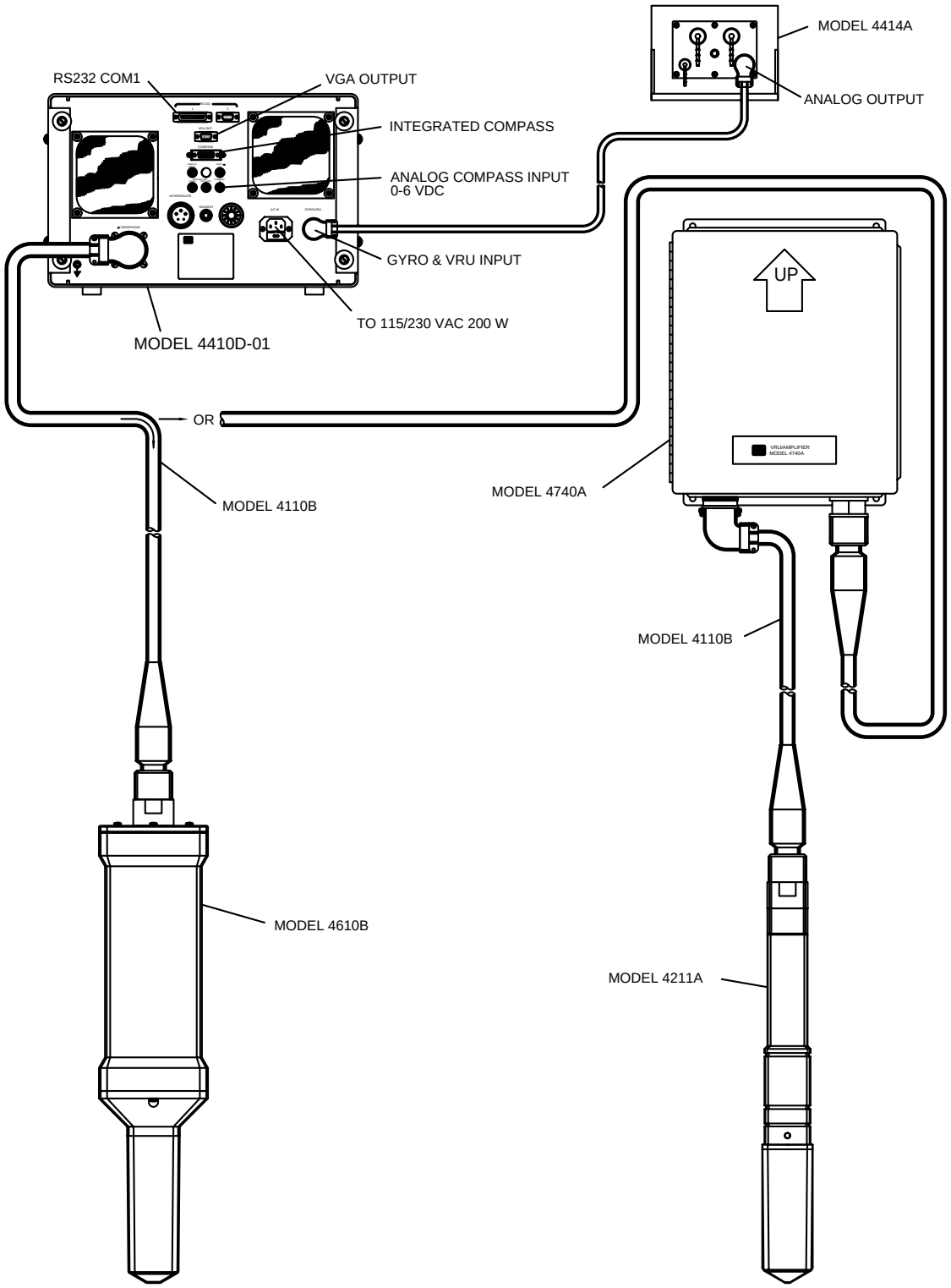
Keep in mind that the deck cable lengths are typically 100ft. This allows the C/DM to be mounted a maximum of 100ft from the VRU/Amplifier and the VRU/Amplifier mounted 100ft from the hydrophone. Refer to Figure 2-6, System Interconnection Diagram. If space permits, the VRU/Amplifier is sometimes mounted on the same staff as the hydrophone, 4211A. Using the latter method the AUTO-VRU-OFFSET calibration feature compensates the system for a non-vertical hydrophone installation or changes in vessel trim. Refer to section 3.4.2 for details on the offset menu parameters.

NOTE: The internal VRU within the 4610B or 4740A can either be used as a STATIC or an ACTIVE pitch and roll motion sensor (Refer to STATUS menu parameter under OFFSETS/HYDROPHONE. The STATUS command toggles between ACTIVE and STATIC mode.) In the STATIC mode the VRU's are used to compensate for the non-vertical installation of the system at dock-side only. An external or remote motion sensing system, such as the Model 4414B, would then be used in conjunction with the internal VRU's to provide pitch and roll compensation for the tracked target position under dynamic conditions. Refer to section 2.2.12 for installation of a external or remote VRU and section 2.3.3 for hydrophone VRU offsets.



MODEL 4740A INSTALLATION

Figure 2-5



SYSTEM INTERCONNECTION DIAGRAM

Figure 2-6

2.1.4 Connecting Deck Cable

Before connecting the deck cable to the hydrophone end cap, check that both the O-ring in the end cap and the O-ring in the connector are in place. Clean thoroughly both the end cap and the cable connection with a cotton swab or tissue, and lubricate the O-rings. Refer to Figure 2-7, Deck Cable Diagram.

A barium-based O-ring lubricant* is supplied for this purpose and is recommended over silicone-based lubricants. Exercise care to avoid contamination of the hydrophone by any type of grease or oil.

C A U T I O N

DO NOT use silicone grease to lubricate the O-rings. Should silicone come in contact with the hydrophone potting, proper sound transfer from water to hydrophone will be prevented. Attempting to remove silicone from the hydrophone can damage the potting material.

The cable connection fits into upper and lower guides in the end cap, tighten securely by hand.

NOTE: To ease Cable-to-Hydrophone connector mating, once guides line up, apply force with one hand on the Cable potted section while threading the stainless steel locking sleeve over the Hydrophone connector. This is to prevent overstressing the molded threads, thus stripping the connector or galling of the stainless threads (if applicable).

* Parker O-ring lubricant.
Parker Seal
P.O. Box 11751
Lexington, KY 40512

2.2 COMMAND/DISPLAY MODULE

The convenience and comfort of the operator are the primary considerations for installing the Command/Display Module. The unit is self-contained and requires only a suitable power source and free access for connecting the deck cable. If the C/DM is rack mounted, be sure to allow access to PCB's. Refer to drawing 100913.

Place the unit where it is most conveniently operated and protected from foul weather and sea spray. (The standard version of the C/DM is not intended to be splash resistant.) No special mounting or protective housing is required, beyond routine securing when the vessel is underway.

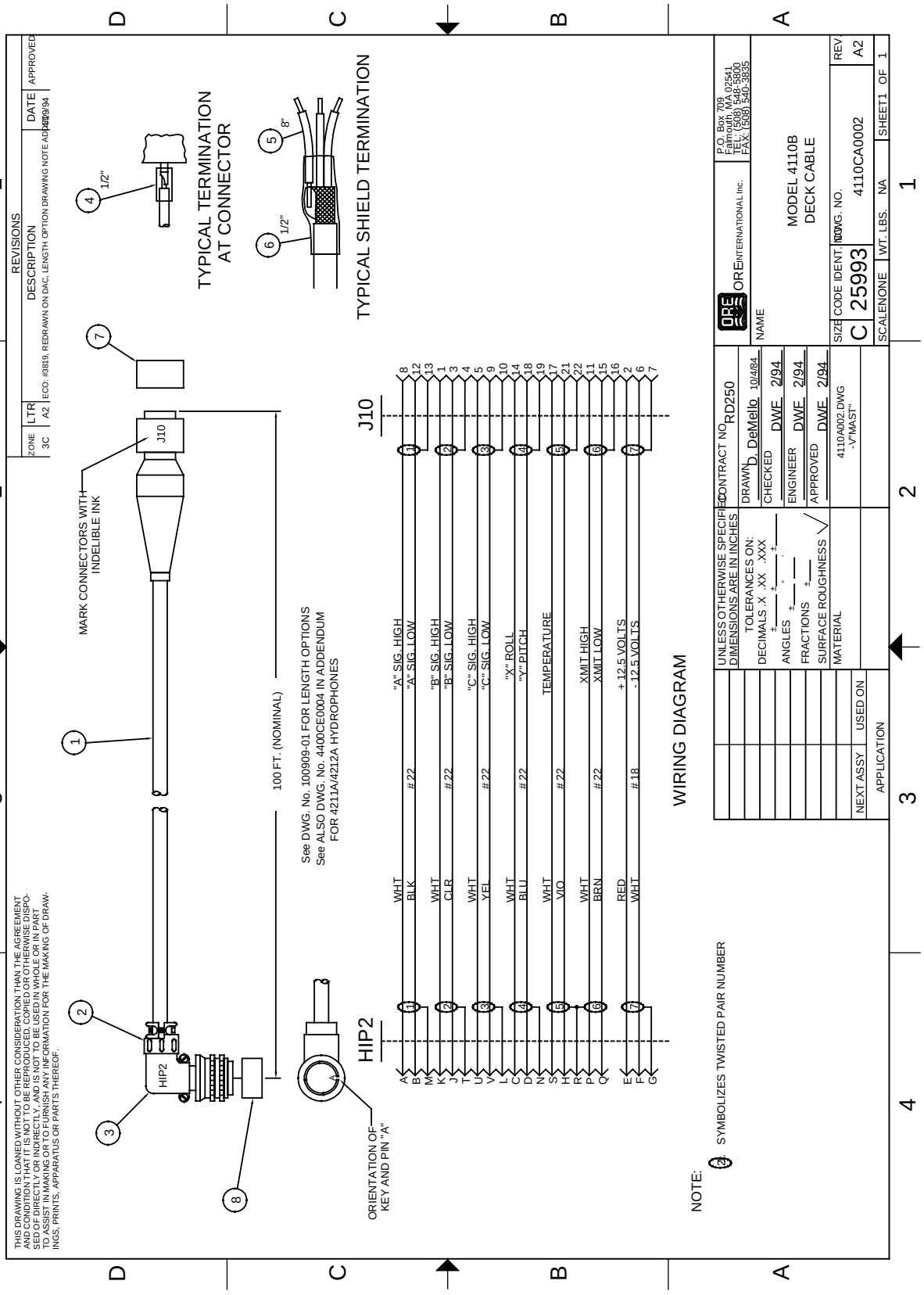


Figure 2-7

2.2.1 Line Voltage (IEC CONNECTOR)

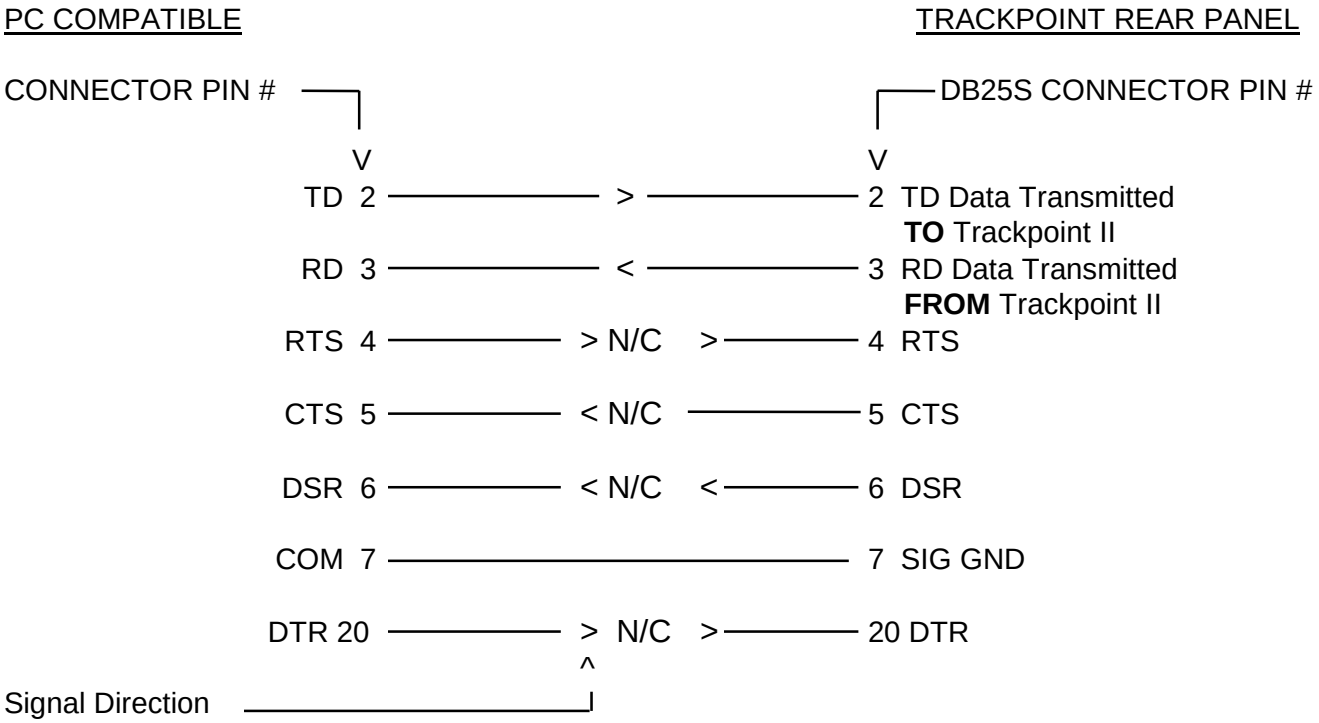
The Trackpoint II C/DM line voltage can be in the range of 98 to 132 or 170 to 264. The unit automatically switches to the higher range when the voltage is sensed. If the voltage goes below the high range minimum or 170, the unit does not automatically switch to the lower range, it must be turned off and on again.

2.2.2 RS-232 #1 Cable Wiring (25-PIN `D' CONNECTOR)

The Trackpoint RS-232 interface is designed to act as a "DCE" (Data Communication Equipment) device. Operating conditions are as follows:

(Refer to section 3.12 for complete interface information.)

RS-232 TYPICAL CABLE CONFIGURATION

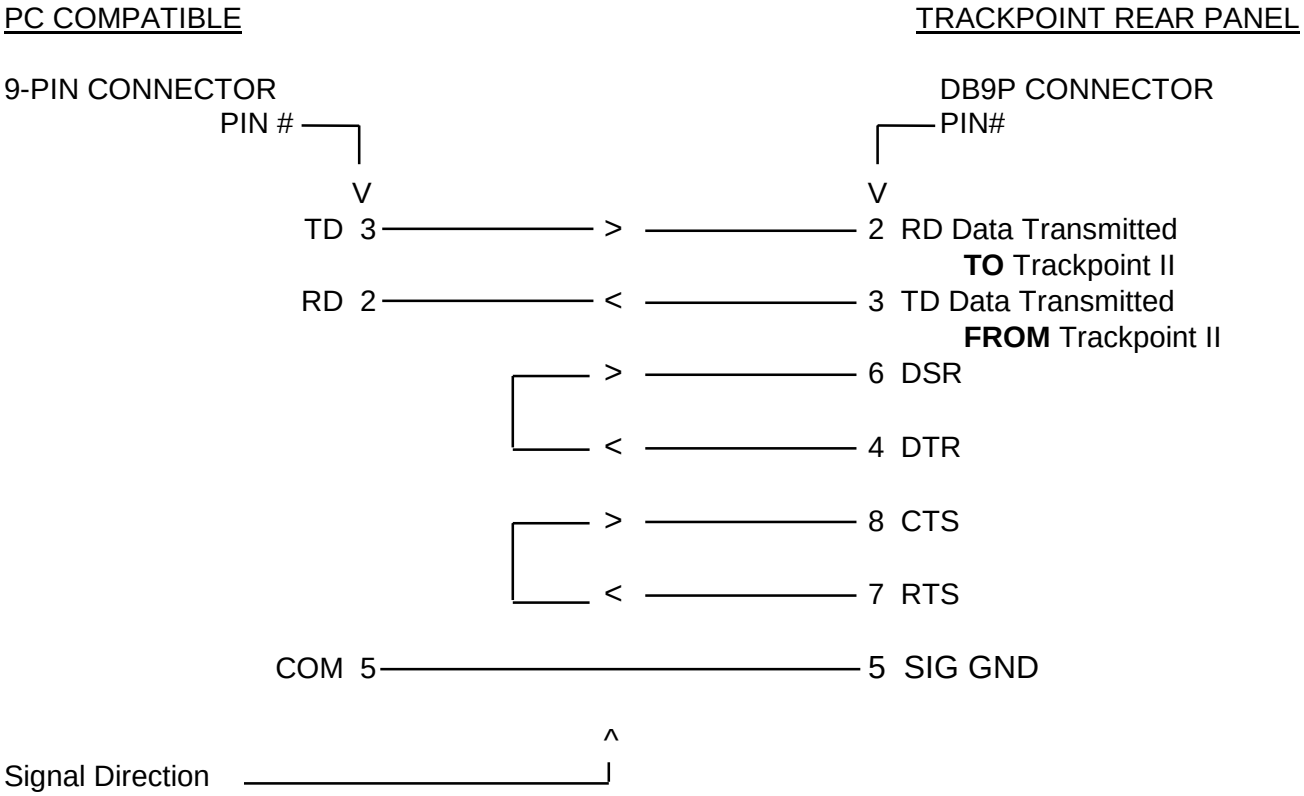


NOTE: Connect the RS-232 cables between each device before turning on the Trackpoint or the terminal. If the RS-232 cable is connected after C/DM is turned on, the unit may experience microprocessor malfunctions. Turn power off and then on again to reset unit. This cable shown above is when CTS & RTS are not used.

2.2.3 RS-232 #2 Cable Wiring (9-PIN `D' CONNECTOR)

The COM #2 I/O port is wired the same as a PC ("DTE", Data Terminal Equipment).

RS-232 TYPICAL CABLE CONFIGURATION



2.2.4 COMPASS Input (BNC)

The analog output voltage from a compass (0 - 6 VDC maximum) connects to the COMPASS input BNC located on the back panel. The Trackpoint converts this analog voltage to a vessel heading in degrees. (This input can be used alternatively as an automatic Hydrophone Depth Offset input also.)

2.2.5 DEPTH Input (BNC)

The analog output voltage from a depth sensor (typically located on a vehicle being tracked) connects to the DEPTH input BNC located on the back panel. The Trackpoint converts this analog voltage (0 - 6 VDC maximum) to a target depth. (This input can be used alternatively as an automatic Hydrophone Depth Offset input also.)

2.2.6 INTEGRATED COMPASS (15-pin D connector)

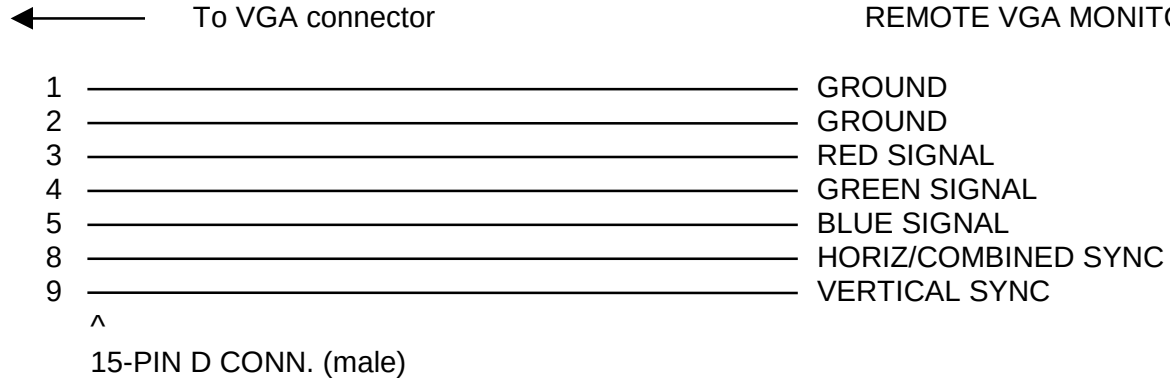
The optional Model 4411B Flux Gate Compass connects directly to the back panel 15-pin female D connector, labelled COMPASS. The Trackpoint provides the +/- 12 VDC to power the compass and the compass outputs 0.1 to 5.1 VDC (representing 0.1 - 359.9°) to the Trackpoint. The Model 4411B Compass comes complete with mating connector and cable. No extra cables are required. Refer to 4411B manual for further details.

2.2.7 Composite Video Output (OPTIONAL)

There is an optional NTSC Composite Video output module available that converts the external VGA signal to a composite signal. This signal can be used to drive a monochrome monitor or a video recorder. The unit requires connection to the rear panel VGA output and a 115 VAC source. It also has a pass-through VGA connector to connect to an external VGA monitor. Contact ORE Offshore Division, Accusonic Technologies, Inc. for details.

2.2.8 VGA Remote Monitor Output

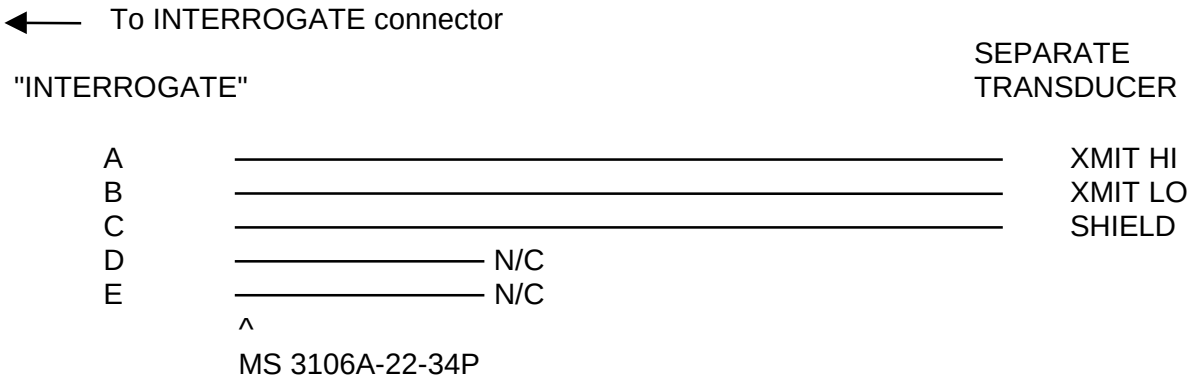
Connect a VGA monitor to the VGA OUT 15-pin female D type connector located on the back panel.



2.2.9 Interrogate Output Connector

The integral interrogate transducer in the Model 4610B MF or HF Hydrophone is designed for optimum acoustic output in the frequency range of 17 - 20 kHz. The 4610B - LF is designed for optimum output in the frequency range of 13 - 17 kHz. If the system is being used to interrogate outside of these frequency bands, it is advisable to connect a separate interrogation transducer to the back panel INTERROGATE connector. The C/DM transmitter drives both the INTERROGATE connector and the Hydrophone interrogation transducer simultaneously. Usually if the interrogation frequency is < 10kHz (MF or HF), the Hydrophone interrogation transducer is sufficiently detuned so as not to interfere or load the separate interrogation transducer. Consult factory or representative for specific applications.

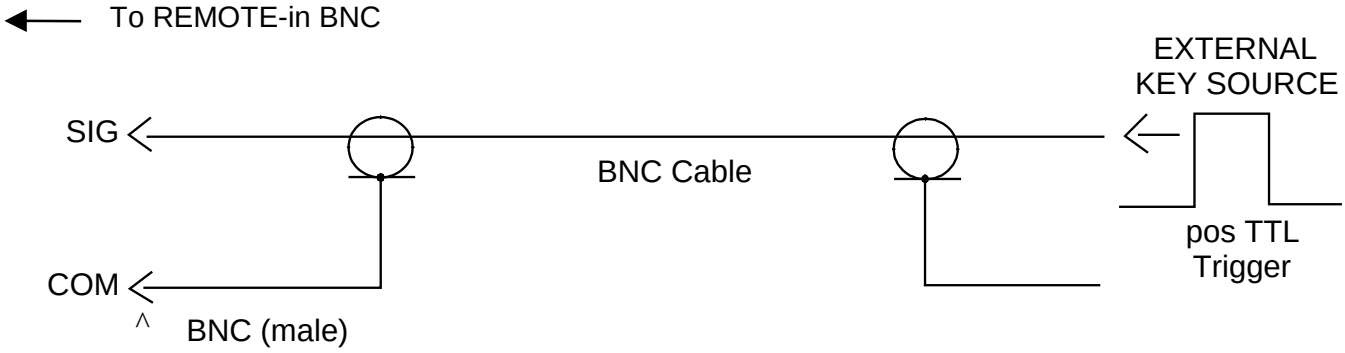
NOTE: The output power of the transmitter is 100 or 500 Watts (jumper selectable on the transmitter board) into a 300Ω load. Check the impedance of the separate transducer to be used before connecting to the Trackpoint.



2.2.10 REMOTE-In Trigger

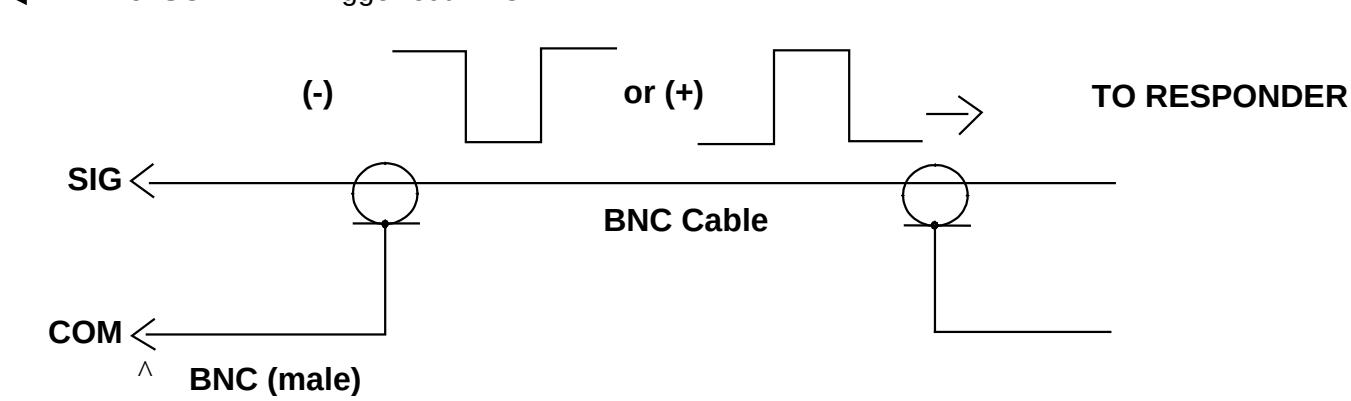
The Trackpoint can be externally triggered via the REMOTE-in BNC. A BNC cable can be connected between an external key source (trigger source can range from TTL to +15V) and the Trackpoint. Refer to section 3.4.2 for external key setup.

NOTE: The REMOTE-IN trigger is optically coupled.

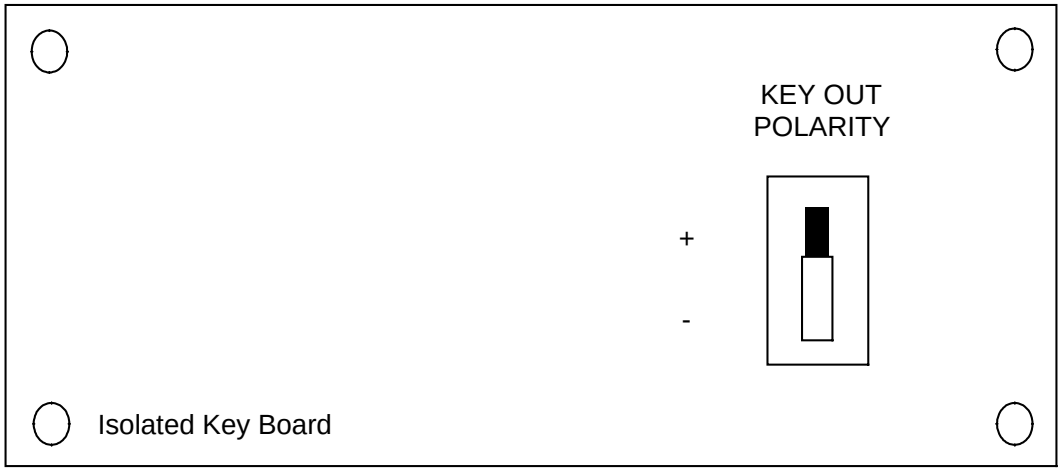


2.2.11 ISOLATED Trigger-Out

The Trackpoint outputs an ISOLATED key to trigger Responder-type sound sources. It is a transformer-coupled output which is TTL-compatible with a maximum pulse width of about 2 ms.

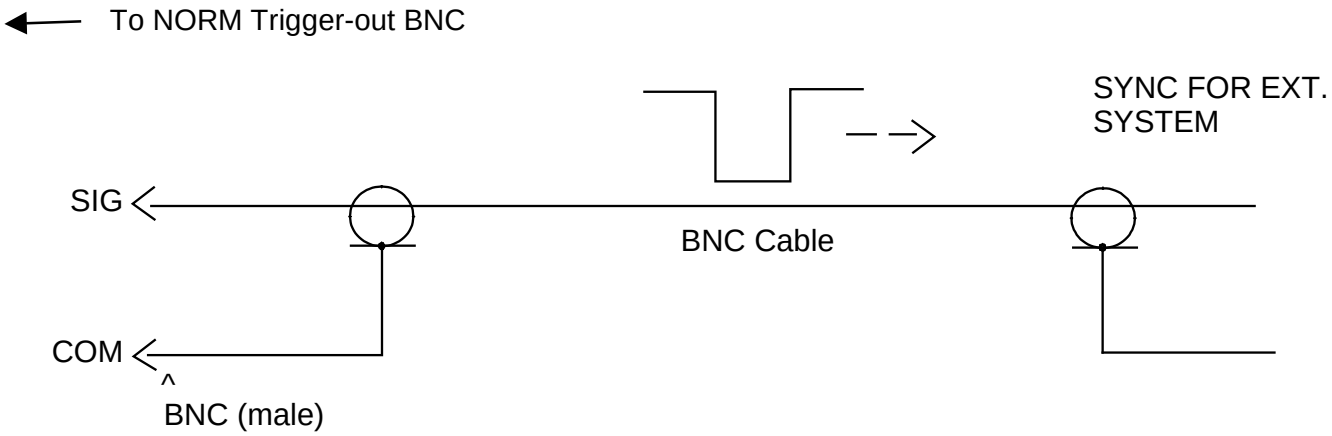


The polarity of the key pulse can either be positive or negative as set by the Isolated Key Board switch. The unit is shipped with the pulse set to negative to be compatible with the ORE Multibeacon Responder. To change the key polarity, remove top cover of C/DM, locate Isolated Key Board on the top rear left side panel, change Key Polarity switch setting as shown in diagram below.



2.2.12 NORM Trigger-Out (BNC)

The NORM trigger-out is a negative-going TTL-compatible pulse occurring at the time of interrogation for a transponder or a responder. This NORM trigger out pulse is present simultaneously with the leading edge of each interrogation pulse.



2.2.13 GYRO COMPASS AND VRU INTERFACE

The GYRO COMPASS and VRU input connector is a 16-pin MS/AN type, P/N MS3102A24-5P, and is labeled **"GYRO/VRU"**. This connector allows input of both the synchro and reference signals from an external gyro compass and also pitch and roll analog signals from an external dynamic motion sensing system, such as the ORE Model 4414A. The mating connector required is a MS3106B24-5S with AN3057-16 strain relief (not supplied). The connector pin designations are shown below.

GYRO/VRU Connector

Pin A = COMPASS reference R1
Pin B = COMPASS reference R2
Pin C = Power COM*
Pin D = +12 VDC out*
Pin E = -12 VDC out*
Pin F = COMPASS synchro S1
Pin G = COMPASS synchro S2
Pin H = COMPASS synchro S3
Pin J = Spare analog input
Pin K = N/C
Pin L = PITCH input
Pin M = Spare analog com
Pin N = N/C
Pin P = PITCH COM
Pin R = ROLL COM
Pin S = ROLL input

* The +/-12 VDC accessory output has limited current capabilities. If this supply is utilized maintain current drain at these pins below 0.250 Amperes each.

GYRO INTERFACE (OPTIONAL)

The gyro interface consists of a PC Board, P/N 4410-0049, mounted on the left side panel of the Trackpoint C/DM. This PC board converts the gyro's synchro signals to an analog voltage, 0 - 5VDC (zero volts represents a bearing of 0° and 5 volts represents a bearing of 359.9°). The analog voltage is input to the Signal Processor board where an A/D is sampled at the time of target signal detection. This ensures that the heading information coincides with the target's reply. Connections to the rear panel gyro compass interface are shown below.

NOTE: The analog signal from the synchro converter is connected in parallel with the existing rear panel compass heading BNC and the 15-pin compass interface connector. See the "CAUTION" note below.

C A U T I O N

DO NOT apply voltage to the rear panel COMPASS INPUT CONN. Or INTEGRATED COMPASS INPUT with the gyro modification on the Trackpoint II. This may damage the internal GYRO converter or the external compass.

NOTE: Make sure the gyro signals are compatible with the converter installed within the Trackpoint II C/DM. I.e., check that the synchro voltage and frequency matches the Trackpoint's installed option.

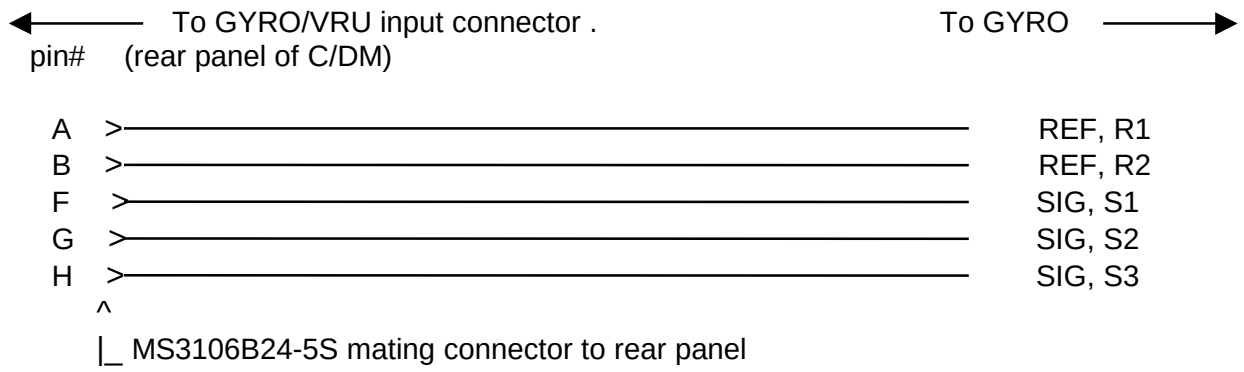
C A U T I O N

Before wiring gyro confirm that the REFERENCE voltage sent from the gyro to the C/DM is within tolerance of the S/AC specified, e.g., an option 114 S/AC requires the reference voltage be less than 28.6 VAC. This voltage can be measured with a DVM.

The gyro's synchro output and its reference voltage connect to the Trackpoint's rear panel GYRO/VRU connector. Refer to the gyro manufacturer's Technical/Installation Manual for connection to its synchro output and reference voltage. The type of cable used to connect the gyro to the converter is typically a five conductor #22 AWG with an overall shield (not supplied) (An example of a mil-spec shipboard cable for use with gyro signals up to 400 Hz is the 1XMSO-7 (MIL-C-24640/7), which has seven (7)-#22 gauge conductors with an overall shield). Connect the S1 terminal of the gyro to pin-F of the GYRO/VRU interface connector. Connect S2 and S3 to pin-G and pin-H respectively. Connect the reference voltage Rl and Rh to pin-A and pin-B.

************ W A R N I N G *************

MAKE CERTAIN ALL POWER TO THE GYRO/SYNCHRO IS TURNED OFF BEFORE MAKING CONNECTIONS TO THE TP-II. HIGH VOLTAGES ARE PRESENT AT THE SYNCHRO AND REFERENCE (LINE) TERMINALS.



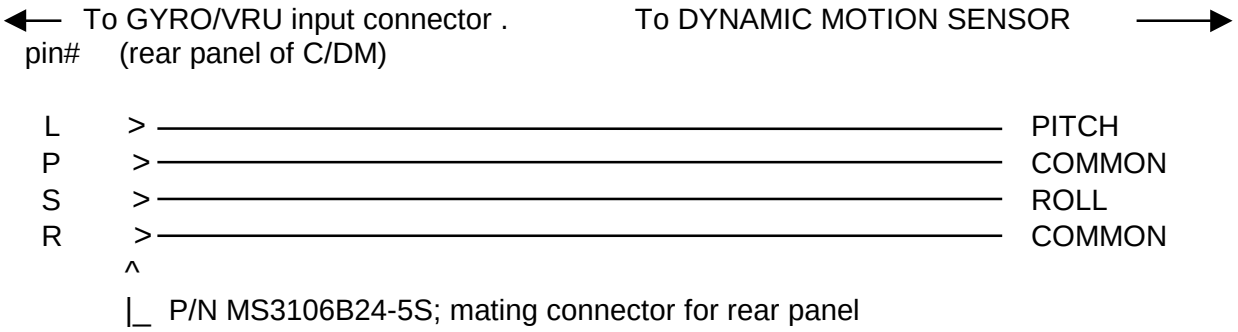
VRU INTERFACE

The VRU input of the GYRO/VRU connector accepts PITCH and ROLL analog signals from an external dynamic motion sensing system, such as the ORE Model 4414A. The pitch and roll signals compensate target position for vessel motion. The analog inputs can accept voltages up to +/-10 VDC. The normal vessel motion for a positive voltage pitch is BOW UP and the normal vessel motion for a positive voltage roll is PORT UP. The polarity of the analog input signals to the C/DM can be reversed and compensated for in the REMOTE VRU POLARITY menu. Normal polarity for pitching bow up is (+) and for rolling port side up is (+). The VRU scaling can also be modified under the REMOTE VRU SCALE menu. Normal scaling is 0.2 V/degree (+/- 10VDC = +/-50°).

NOTE: For a Remote VRU the normal voltage polarity for pitching BOW UP is [+]. The normal voltage polarity for rolling PORT UP is [+]. The system configuration display (DISPLAY/CONFIG./SYSTEM command) shows the roll and pitch polarity [+] when the vessel pitches BOW UP or rolls PORT UP. The RS232 Format STD W/PR (standard format with pitch and roll at end of data string) also outputs data with this same protocol. The RS232 Format NMEA ORE (NMEA 0183 type format string that is proprietary to ORE Offshore Division, Accusonic Technologies, Inc. and includes pitch and roll data at end of string) is different in that it outputs data in the same polarity as its incoming voltage. This allows pass-through of signals from remote VRU to integrated navigation system without modification of polarities.

Refer to section 3.4.2 for description of OFFSET menu parameters and section 3.6.1 for VRU STATIC CALIBRATION.

Wire the interface connector as shown below. Connect the pitch signal to pin-L and the roll signal to pin-S. Connect the analog commons to pin-P and/or pin-R.



2.3 HYDROPHONE OFFSETS

Trackpoint II computes range and bearing relative to the hydrophone, unless the system is instructed to add or subtract corrections (offsets) which relate range and bearing to some other reference point on the vessel. The hydrophone centerline, or zero bearing, is indicated by the index mark (see Figure 2-2), and is generally aligned so that it corresponds to the vessel heading.

It is difficult and time consuming to fabricate a mounting in which the hydrophone heading is aligned to within a degree of the vessel centerline, unless the vessel is in drydock. If you have the facilities to perform an exact mechanical alignment, or if the installation is to be permanent, consider fabricating a mount that will repeatedly return the hydrophone to the same physical location aligned to within 0.5 degrees of the vessel centerline.

Most operations requiring a portable tracking system will be on various vessels of opportunity, and require a quick and temporary mounting. In this case align the hydrophone with the vessel centerline as closely as possible. Use some variation of the following procedure to determine hydrophone offsets.

2.3.1 Bearing Offset

The bearing offset must be determined before X, Y and Z offsets can be measured.

1. Measure the distance (d) from the vessel centerline to the hydrophone location as shown in Figure 2-8.

NOTE: Almost all vessels have a centerline weld or plank that runs down the deck that can be used for alignment purposes. If your vessel has a seamless deck, you have to measure the vessel beam and determine the true centerline.

2. Weight a line to suspend the acoustic tracking source vertically in the water.

3. As far forward on the vessel as possible, hang the weighted acoustic beacon over the side at the same distance from the vessel centerline as the hydrophone. (position B1 in Figure 2-8.) It may be necessary to use a length of pipe or a boathook to extend the weighted line the required distance. The beacon should be slightly deeper than the hydrophone.

4. Turn the Trackpoint II system on and set it up to track the beacon in use. (Refer to sections 3.1 and 3.5.) If you have aligned the mounting bracket correctly, the system will track the beacon at or very near a 0.0-degree bearing.

5. If you have designed a mounting that can rotate while in the vertical position, you can rotate the hydrophone until you obtain the correct reading. If you cannot rotate the pipe it will be necessary to enter a bearing correction at the time of operation. The bearing value is the number of degrees that you need to add or subtract to the displayed target bearing to bring it to 0.0 degrees. Enter the bearing offset at the Command/Display Module as explained in section 3.6.

6. To check the bearing value determined in step 5, take the weighted beacon line to the stern of the vessel and again hang it straight down at the same distance from the vessel centerline as the hydrophone (position B2 in Figure 2-8).

   The target bearing should now be 180 degrees on the Trackpoint II display.

7. A further cross check can be performed by taking the weighted beacon to a position directly across the vessel from the hydrophone (position B3 in Figure 2-8). The target bearing display should now read either 090 or 270 degrees, depending on which side of the vessel the mounting is located.

DETERMINING HYDROPHONE BEARING OFFSET

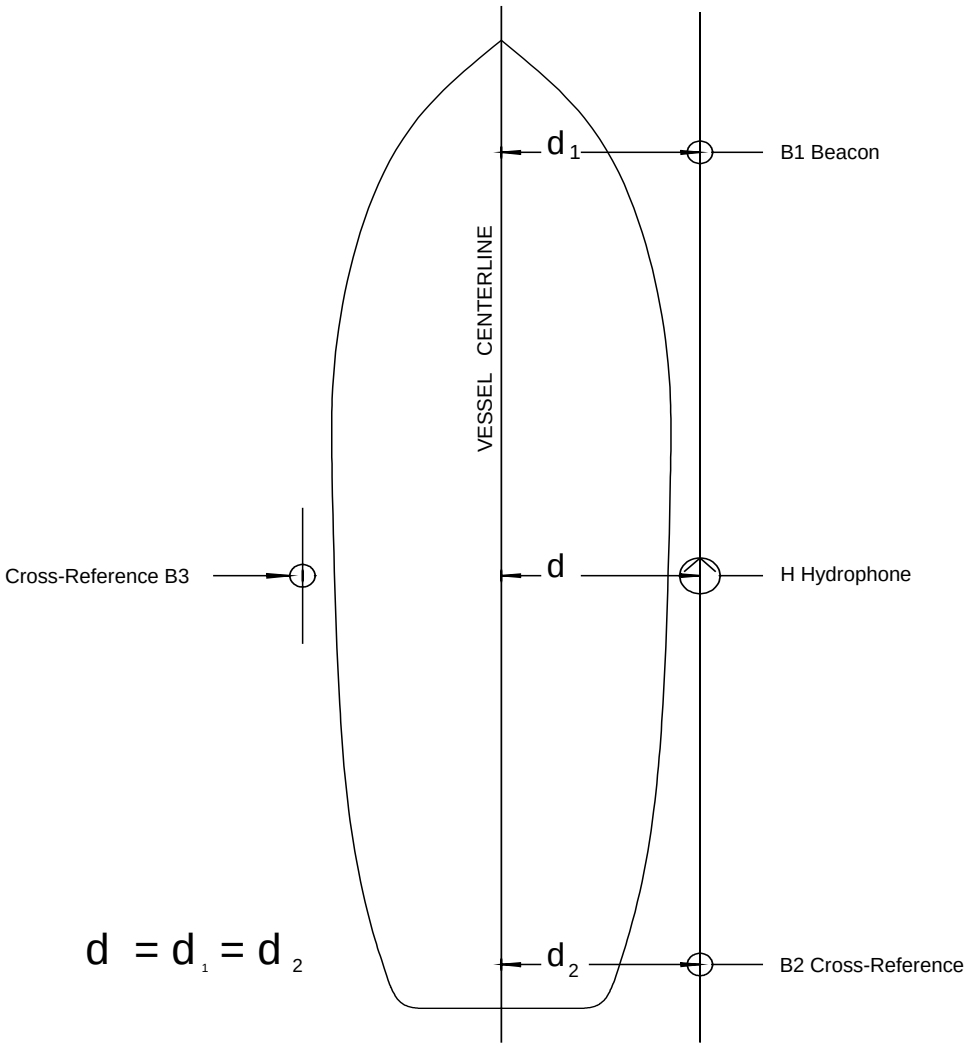


Figure 2-8

2.3.2 Hydrophone X and Y Offsets and Hydrophone Depth

Hydrophone Offsets are used to reference the target position to the pitch / roll center of the vessel and also to correct for the hydrophones dynamic motion. Hydrophone motion is due to the pitching and rolling of the vessel when it is not on the pitch or roll center of the vessel. (It is assumed the hydrophone is rigidly mounted to the vessel.) The hydrophone, when mounted offset from the vessel's pitch / roll center, swings in an arc about the pitch / roll center causing variations in the hydrophone depth, X and Y offsets as the vessel experiences dynamic motion. These variations cause the target to appear at a different depth, depression angle and bearing than it actually is. By entering in X, Y and Z offsets the system can correct for this dynamic motion if a survey grade Motion Sensing System is interfaced to the Trackpoint. See ORE Model 4414B Motion Sensing System.

Hydrophone X and Y offsets are entered with respect to the pitch / roll center of the vessel. (It is assumed that the vertical reference for the pitch / roll center is the water-line of the vessel or the entered "DEPTH OFFSET".) See SYSTEM / OFFSETS / PHONE / X-OFFSET, Y-OFFSET, DEPTH OFFSET in section 3.4.2. To reference the target position with respect to another point on the vessel refer to section 2.4 Antenna Offsets.

NOTE: The Trackpoint outputs the target position (X & Y) with respect to the pitch / roll center of the vessel graphically in the Display, numerically in the Status Block and also on the RS-232 serial communications port. If Antenna Offsets are entered, the target position remains relative to the pitch / roll center of the vessel when displayed on the Trackpoint **screen** but is repositioned relative to the antenna offset point when sent out the **RS-232 port**. In this case **Status Block data** and **RS-232 data** will **NOT** agree.

In Figure 2.9, horizontal distance and bearing (X & Y) for the beacon are determined relative to the pitch / roll center of the vessel (C). (Note that the slant range remains relative to the Hydrophone.) Determine the Hydrophone X and Y offsets as follows:

A. Measure the distance between the hydrophone (H) and the pitch / roll center of the vessel (C) in terms of X and Y coordinates on a horizontal plane at water level.

   The X coordinate is the distance perpendicular to the centerline (dx_H in Figure 2.9). The Y coordinate is the distance parallel to or along the centerline (dy_H in Figure 2.9).

   Distance along the X-axis from the centerline towards a starboard direction has a positive value. In this example, the X offset is 7 meters. Distance towards the port side of the vessel has a negative value.

   The hydrophone's distance along the Y-axis, forward of the pitch / roll center, is a positive value. In Figure 2.9, the hydrophone is aft of the pitch / roll center, and the Y offset is -10 meters.

B. Enter the offsets at the Command/Display Module (Section 3.6) and observe the display to verify that the hydrophone is being offset in the proper directions. Figure 2-10 illustrates the tracking window display as the X and Y offsets determined above are entered.

   The hydrophone is represented in the tracking window by a small H. Note that the H shifts to the right along the X-axis when the positive X offset (7 meters) is entered. The H moves down, parallel to the Y-axis, when the negative Y offset (-10 meters) is entered.

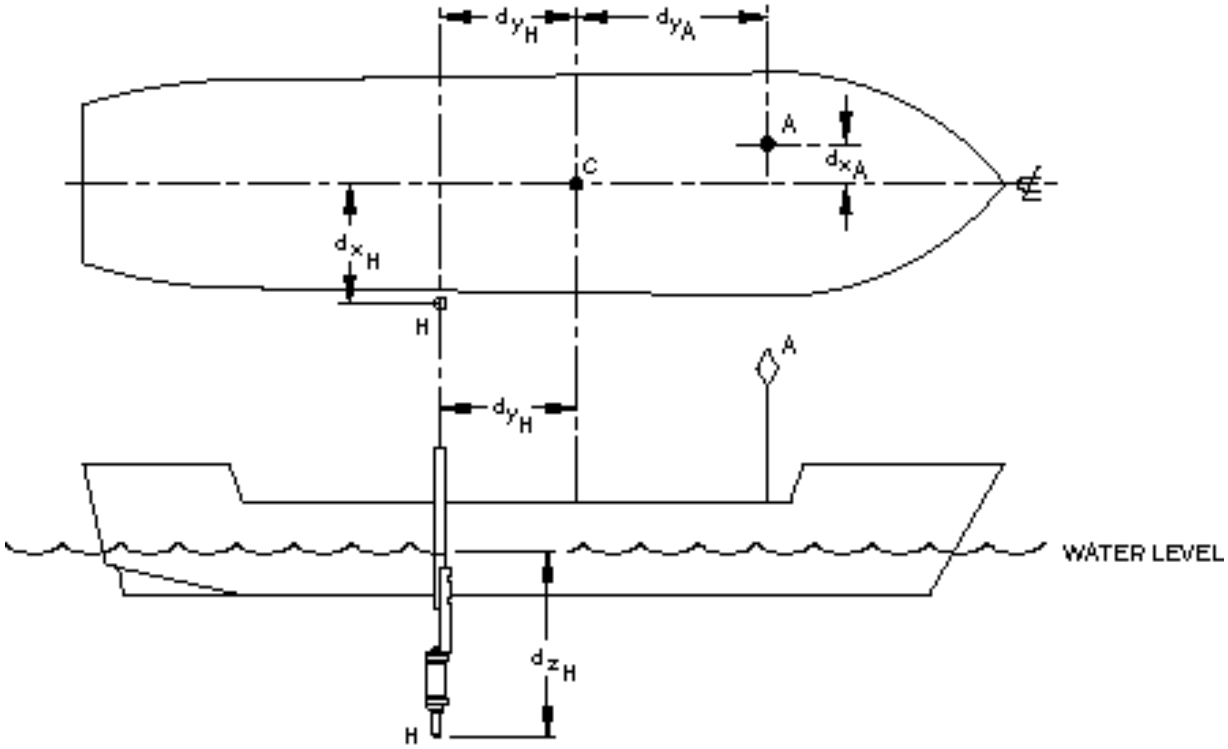
The target continues to be tracked and now displays X and Y data in relation to the pitch / roll center of the vessel.

C. Hydrophone Depth is the depth of the hydrophone below the surface of the water. (Refer to Figure 2.9.) Depth is entered as a positive value. Hydrophone depth can also be input automatically when the Trackpoint II system is used with a Model 4610B-V1399 Hydrophone. This Hydrophone contains a pressure sensor to measure the water depth. Refer to section 3.4.2 for hydrophone analog (compass input or target depth input) depth offset.

The Trackpoint II is ready for operation when the hydrophone is in position and the necessary offsets have been determined, and the acoustic sources to be tracked are active and in the water.

NOTE: If a pinger is at a depression angle of less than 20 degrees, the measured depression angle and, therefore, the horizontal range of the beacon are impossible to measure accurately. Consequently, the bearing of the source, relative to some offset position, is impossible to determine. If this combination of circumstances occurs (pinger; depression angle less than 20 degrees; and hydrophone offsets entered), Trackpoint ignores the entered X and Y offsets so that it can display a correct bearing relative to the hydrophone. Refer to section 3.15, error code 51.

DETERMINING X, Y & Z HYDROPHONE OFFSETS
AND ANTENNA X & Y OFFSETS



C = PITCH/ROLL CENTER OF VESSEL

A = ANTENNA REFERENCE POINT
dx_A = -3m = ANTENNA X OFFSET
dy_A = +15m = ANTENNA Y OFFSET

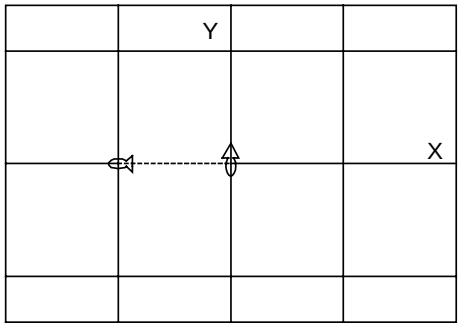
H = HYDROPHONE
dx_H = 7m = PHONE X OFFSET
dy_H = -10m = PHONE Y OFFSET
dz_H = 6m = PHONE Z OFFSET

Figure 2-9

Figure 2-9

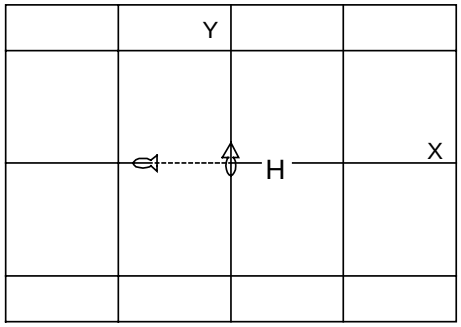
ENTERING X AND Y OFFSETS

TRACKING WINDOW
GRID SPACING 25yd



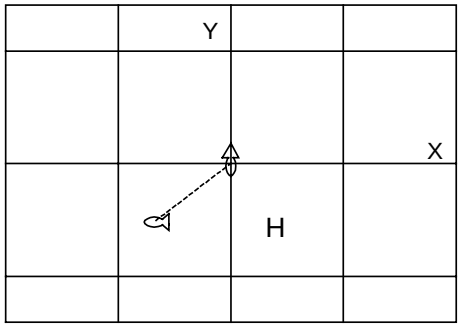
X OFFSET = 0yd
Y OFFSET = 0yd

STD. DISPLAY, NO OFFSETS



X OFFSET = 7yd
Y OFFSET = 0yd

X OFFSET ENTERED



X OFFSET = 7yd
Y OFFSET = -10yd

Figure 2-10

Y OFFSET ENTERED

⇧ = REFERENCE POINT
◅ = BEACON
H = HYDROPHONE

Figure 2-10

2.3.3 HYDROPHONE-VRU OFFSET

The VRU offset is the difference in angle between the installed hydrophone and vertical (static offset). Offsets can occur either due to a mis-aligned hydrophone or from changes in trim to the vessel. The system allows for either manual entry of attitude error corrections or auto correction via the hydrophone's internal VRU for offsetting the static tilt of the hydrophone/staff. The attitude (pitch/roll) offsets are error constants that subtract from the remote or external dynamic motion sensing system data to compensate for the non-vertical installation of the Hydrophone shaft.

ENTERED OFFSETS: For manual entry the operator must measure the angle of the shaft with respect to vertical and enter the data in the PITCH-ROLL ERROR menu. The vessel should be in a harbor or at dock to perform this measurement. Pitch and roll errors are entered in degrees. The system accepts and displays data with a precision of 0.01 degrees. If auto calibration is selected (see AUTO OFFSET below) the system displays the calculated errors in the space within the menu data-window normally reserved for display of the manually entered data. Refer to 3-12.

AUTO OFFSET: Auto Offset automatically calibrates the system, calculating the static offsets at dock-side. The system reads the pitch and roll data from the internal VRU (inside the 4610B or 4740A) and averages 100 readings. The spread of the error data is also calculated. It is the difference between the minimum and maximum value of the 100 readings of either the pitch or roll data (worse case). The averaged static errors are displayed in the pitch and roll menu data- windows. The offset errors correct for dynamic motion measured from either the internal VRU (active mode) or a remote VRU (static mode). It is possible to override the auto offset data by manually entering in new offsets. Refer to section 3.4.2 for AUTO OFFSET calibration.

VRU STATUS: If the internal VRU (4610B or 4740A) is to be used by itself then set the HYDROPHONE/VRU/STATUS to ACTIVE. If a remote VRU (dynamic motion sensing system) is to be used in conjunction with the internal VRU then set the STATUS to STATIC. In other words the internal VRU is only to be used to compensate for tilt and trim when the vessel is static or at dock-side.

ORIENTATION: Change the VRU ORIENTATION if the Model 4740A VRU/Amplifier is mounted on a surface other than bow facing. For example, if the arrow at the top of the unit is pointing towards starboard then change the ORIENTATION parameter to starboard.

2.3.4 ANTENNA OFFSETS

Normally, the Trackpoint II calculates and displays range and bearing (X and Y) information relative to the hydrophone or when hydrophone offsets are used the target is displayed and output relative to the pitch / roll center of the vessel. It is common, however, for the operator to require range and bearing information to be referenced to a particular point on the vessel such as a GPS navigation antenna. The operator can enter offsets at the Command/Display Module (refer to section 3.6) that enable the system to calculate the range and bearing or X, Y coordinates relative to any point on the vessel. These antenna offsets are subtracted from the Hydrophone Offsets for the RS-232 output but not the screen. The display continues to show the target with respect to the pitch / roll center of the vessel.

NOTE: The Trackpoint outputs the target with respect to the pitch / roll center of the vessel graphically in the Display, numerically in the Status Block and also on the RS-232 serial communications port. If Antenna Offsets are entered, the target position remains relative to the pitch / roll center of the vessel when displayed on the Trackpoint **screen** but is repositioned relative to the antenna offset point when sent out the **RS-232 port**. In this case **Status Block data** and **RS-232 data** will **NOT** agree.

In Figure 2.9, the Antenna Offsets are determined relative to the pitch / roll center of the vessel (C). Determine the antenna X and Y offsets as follows:

A. Measure the distance between the antenna (A) and the pitch / roll center of the vessel (C) in terms of X and Y coordinates on a horizontal plane at water level.

   The X coordinate is the distance perpendicular to the centerline (dx_A in Figure 2.9). The Y coordinate is the distance parallel to or along the centerline (dy_A in Figure 2.9).

   Distance along the X-axis from the centerline towards a starboard direction has a positive value. Distance towards the port side of the vessel has a negative value. In this example, the antenna X offset is -3 meters.

   The antenna's distance along the Y-axis, forward of the pitch / roll center, is a positive value. In Figure 2.9, the antenna is forward of the pitch / roll center, and the Y offset is +15 meters.

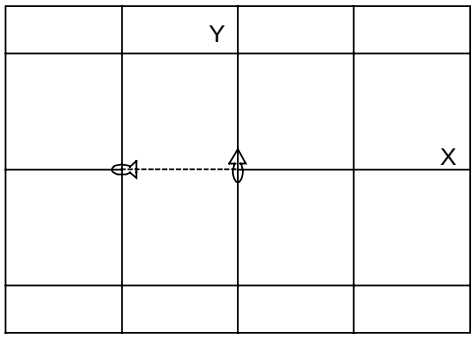
B. Enter the offsets at the Command/Display Module (Section 3.6) and observe the display to verify that the antenna is being offset in the proper directions. Figure 2-11 illustrates the tracking window display as the antenna X and Y offsets determined above are entered.

   The hydrophone is represented in the tracking window by a small A. Note that the A shifts to the left along the X-axis when the negative X offset (-3 meters) is entered. The A moves up, parallel to the Y-axis, when the positive Y offset (+15 meters) is entered.

The Trackpoint II is ready for operation when the hydrophone is in position and the necessary offsets have been determined, and the acoustic sources to be tracked are active and in the water.

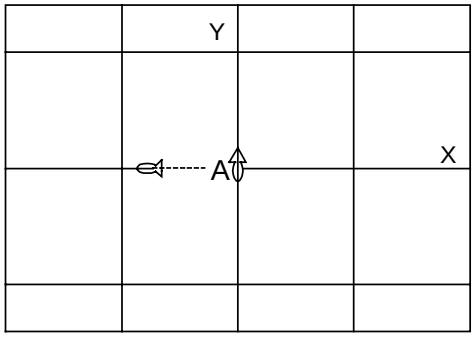
ENTERING X AND Y OFFSETS

TRACKING WINDOW
GRID SPACING 25m



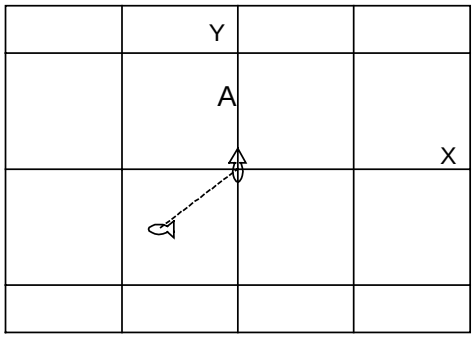
X OFFSET = 0m
Y OFFSET = 0m

STD. DISPLAY, NO OFFSETS



X OFFSET = -3m
Y OFFSET = 0m

X OFFSET ENTERED



X OFFSET = -3m
Y OFFSET = +15m

Y OFFSET ENTERED

Figure 2-11

⇧ = REFERENCE POINT
◅ = BEACON
A = ANTENNA

Figure 2-11

SECTION THREE

OPERATION

SECTION THREE

OPERATION

3.0 OPERATION

Throughout this section, specific system parameters are indicated by all capital letters.

3.1 POWER UP

Before turning on the Command/Display Module, insure that the Model 4610B hydrophone is connected via the cable to the C/DM back panel. If the system consists of a Model 4740A VRU and 4211A hydrophone check to make sure the hydrophone is connected to the VRU/Amplifier assembly and the VRU/Amplifier is connected to the C/DM.

NOTE 1: The Trackpoint II system as shipped is calibrated as one unit. System calibration will be affected if the C/DM does not have the EPROM corresponding to the hydrophone/VRU assembly in use installed in the CPU board. (Refer to section 5.3 for installation of EPROM.)

NOTE 2: If it is not possible to perform any of the steps below, try again, double-checking your actions. If it still will not perform correctly, see troubleshooting guide section 5.2.

Insure that the pinger(s), transponder(s) or responder(s), i.e., beacons, to be used is (are) in the correct frequency range for your hydrophone (either 8-14 kHz, 22-30 kHz or 35-45 kHz) with at least 1 kHz separation between beacon transmit frequencies, and transponder receive frequencies, unless operator has desired a common interrogate frequency, see section 3.5.

With the Command/Display Module connected to a suitable AC power source, turn the LINE switch on.

NOTE: For overside deployed systems, system integrity can be checked with a beacon (pinger or transponder) and hydrophone on deck, keeping in mind that the range and bearing information will be random and incorrect. Such a test insures that the pingers and hydrophone are operational before being put in the water.

NOTE: For installations using 4211A Hydrophone and 4740A VRU/Amplifier, (already installed in the ship), it is necessary to expose the hydrophone by raising the carrier tube to its maintenance position in order to perform an "air" test. Otherwise, it is necessary to deploy the hydrophone below the ship and hang a transponder or pinger or other target overside.

3.2 PREVIOUS SETUP/DEFAULT SETUP

The ORE Offshore Division logo and the revision of the firmware appears on the video screen during normal initialization (vs auto initialization). See Figure 3-1. The operator is presented with two options: PREVIOUS SETUP or DEFAULT SETUP. Function keys f1 and f5 correspond to the two options. If a selection of PREVIOUS or DEFAULT has not been made within 10 seconds the system automatically initializes using the PREVIOUS setup parameters. The previous parameters are stored in battery backed-up SRAM.

PREVIOUS SETUP initializes the system with all values and frequencies that were last in use. If you intend to use the same acoustic source(s) and installation as in use before power was turned off, PREVIOUS SETUP automatically resumes operation with those values and frequencies, providing the target(s) is (are) in the water. Press f1 for Previous Setup.

If DEFAULT is selected another screen is displayed explaining differences between PREVIOUS vs. DEFAULTS, allowing the operator to select either f1 for PREVIOUS, f2 for CUSTOM DEFAULTS or f3 for “ORE” DEFAULTS. See Figure 3-2A.

CUSTOM DEFAULT SETUP uses the customers saved parameters from the CPU board’s flashROM. These parameters are saved using a series of keystrokes from the SELF TEST menu. They are recalled by selecting f2 at this screen. See section 5.9 for saving of parameters to flashROM. If the data saved within the flashROM is corrupt or if no flashROM is installed the DEFAULT menu will only show f1 - PREVIOUS and f3 - DEFAULT, not allowing a choice for CUSTOM DEFAULT selection. See Figure 3-2B.

“ORE” DEFAULT SETUP initializes the system with a standard set of assigned frequencies and arbitrary setup values as preset at the factory (See Table of Data Ranges & Default values, Appendix A.) Any previous operator-input values and parameter settings will be erased. Generally, the “ORE” DEFAULT SETUP is selected during the initial setup of the system for a new mobilization.

AUTO INITIALIZATION: For the system to automatically initialize using either the CUSTOM DEFAULT parameters or the ORE DEFAULT parameters, a shorting jumper is inserted onto a set of pins on the Keybd “IN” connector located on the CPU board. If the jumper is set for CUSTOM DEFAULTS, the opening screen shows the ORE logo and a message stating that the system is “Loading Custom Defaults”. See Figure 3-3A. If the jumper is set for “ORE” DEFAULTS, the opening screen shows the ORE logo and a message stating that the system is “Loading ORE Defaults”. See section 5.9 for jumper configuration.

The system can either be setup from the front panel keypad or via the COM-1 RS232 serial I/O port. Refer to section 3.4 for the BASIC MENU structure and section 3.12.5 for RS232 COMMANDS.

A power-up self-test can be performed when the system is first turned on. A jumper is required on the Keybd “IN” header of the CPU board to initiate this self-test routine. See section 5.9.4 for jumper placement. After the selection of Previous or Default parameters, the system performs a single Command Unit Self-Test routine when this jumper is enabled.

The steps necessary to become operational from the DEFAULT SETUP are detailed in section 3.5 TRACKING PINGERS, TRANSPONDERS and RESPONDERS.

INITIAL TRACKPOINT II SCREEN

Figure 3-1

The normal Trackpoint II "boot-up" display shows the ORE logo and the firmware revision. The normal tracking screen is shown in Figure 3-4.

DEFAULT SELECTION SCREEN

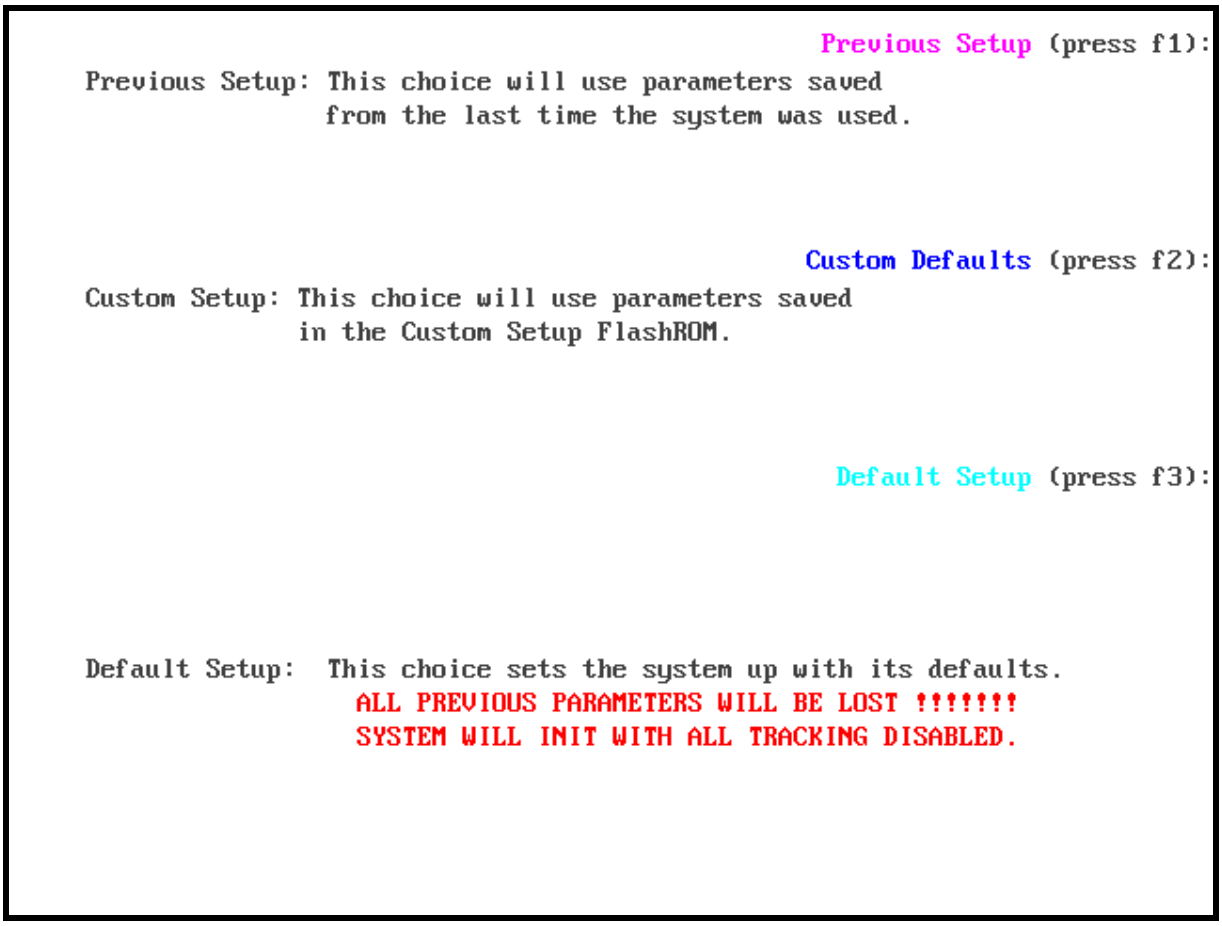


Figure 3-2A

If DEFAULT (f5) is pressed from boot-up screen then this message is displayed to confirm selection of DEFAULT parameters. Press f1 to use previously saved parameters or f3 to use DEFAULT parameters.

DEFAULT SELECTION SCREEN W/O FLASHROM

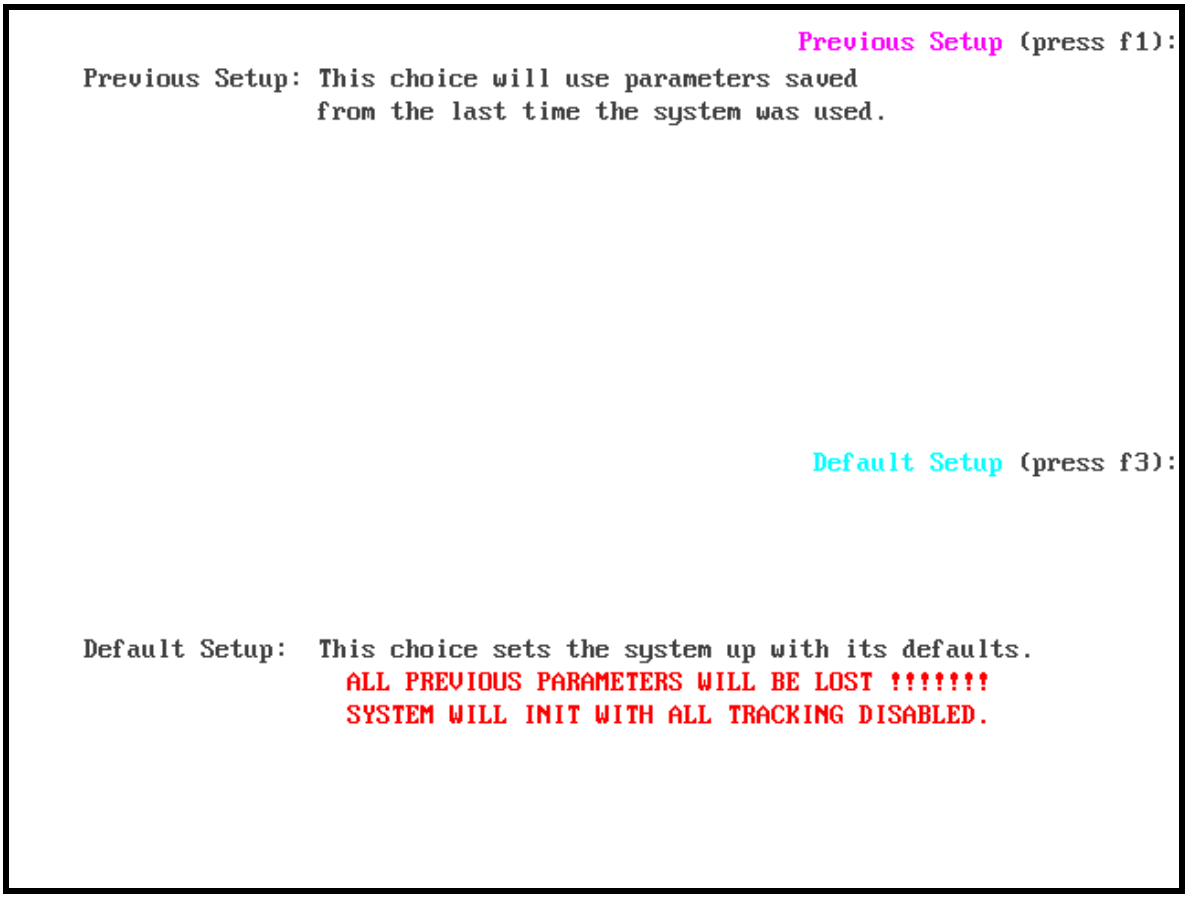


Figure 3-2B

LOADING CUSTOM DEFAULTS

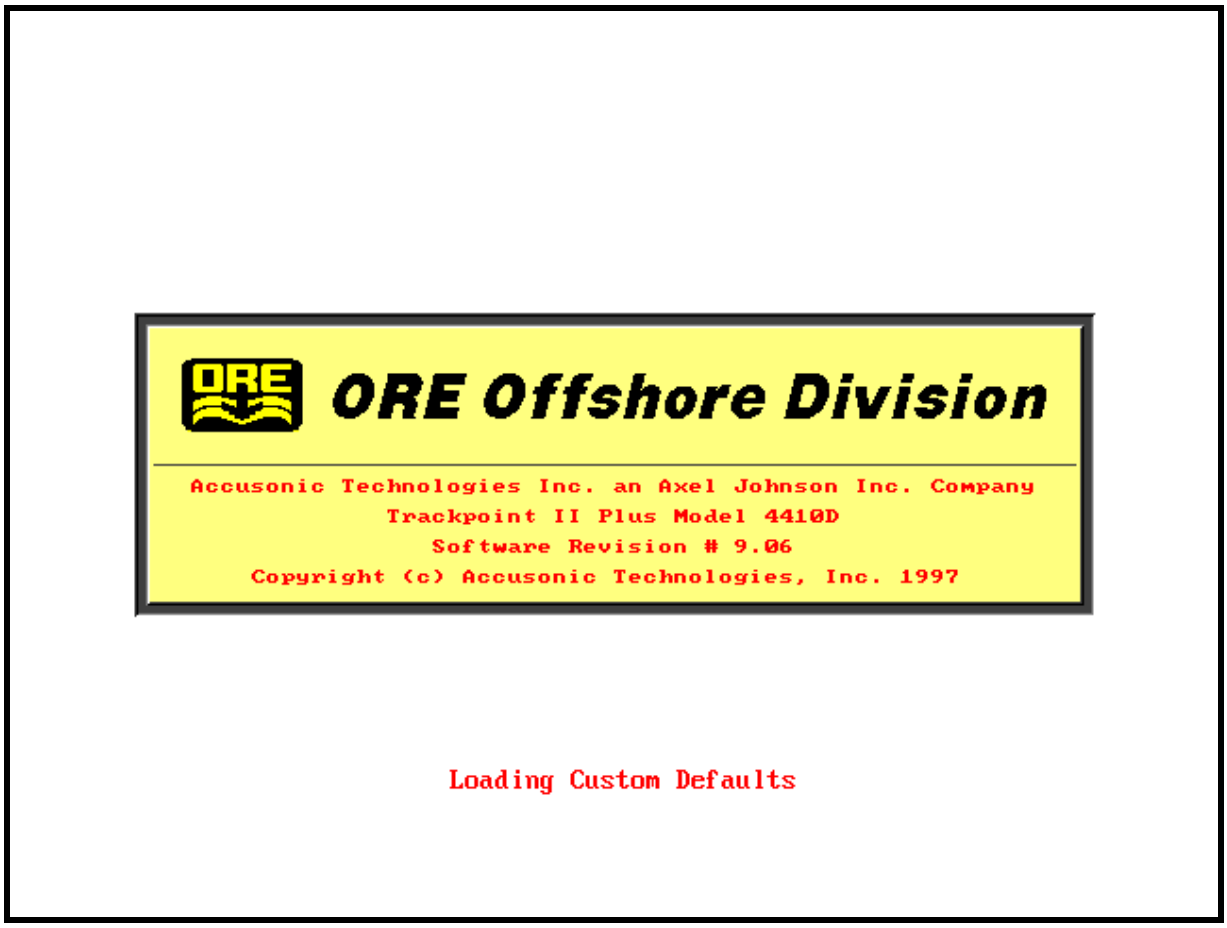


Figure 3-3A

If the boot-up configuration jumper on the CPU Board is set for CUSTOM DEFAULTS, the opening screen shows the ORE logo and a message stating that the system is “Loading Custom Defaults”. After 3 seconds the system initializes using the parameters saved in FlashROM. See section 5.9 for saving of parameters.

LOADING “ORE” DEFAULTS

Figure 3-3B

If the boot-up configuration jumper on the CPU Board is set for ORE DEFAULTS, the opening screen shows the ORE logo and a message stating that the system is “Loading ORE Defaults”. After 3 seconds the system initializes using the factory set parameters.

3.3 COMMUNICATION

The operator controls most system functions at the Command/Display Module keypad by making selections from the menu. In addition to extensive graphics formatting choices, the operator sets the transmitter functions, hydrophone offsets, sound velocity in water used for transponder and responder calculations, the format of the RS232C output, and all target parameters, including threshold and filtering levels. Target alarms can be set for range, bearing, depth, elapsed time and telemetry. The menu system is presented in detail in Section 3.4. Refer to Figure 3-4 for basic Trackpoint display.

Function Keys/Input Keypad

Communication with the Command/Display Module is accomplished by means of the five soft function-keys labeled f1 - f5 and the operator input keypad.

FUNCTION keys

The function keys correspond to the adjacent menu choices displayed in the menu block. The operator selects a menu option by pressing the appropriate function key.

KEYPAD

The keypad (0 -> 9 & ±) is used to input data. As it is keyed in, data is displayed on the command line for verification by the operator. Data is sent to the processor by pressing the ENTER key. (See alternate use of "±" key below.)

ENTER key

The ENTER key is also used as an event mark for the RS-232 data output. A data header is sent out the RS-232 port whenever the ENTER key is pressed and the operator is not being prompted to enter a value. See section 3.12 for RS-232 format.

NOTE: On some sub-menus which require many parameter changes on one page, the present page remains in the menu block until the CANCEL key is pressed, thus decreasing setup time.

HELP Key

The HELP key can be pressed at any time during operation to call up a brief explanation of the current options displayed in the menu block. The HELP display appears in the tracking window. (For convenience and safety, the target symbols being tracked remain on-screen.)

If an error code appears on a target status line, the HELP key can be pressed again to display a brief explanation of the error condition.

NOTE: If error code 50 is present, pressing the HELP key the second time displays the calculated depth VS the input depth to allow operator to update the depth input if required. The next pressing of HELP key displays an explanation of the error code condition.

TRACKPOINT DISPLAY

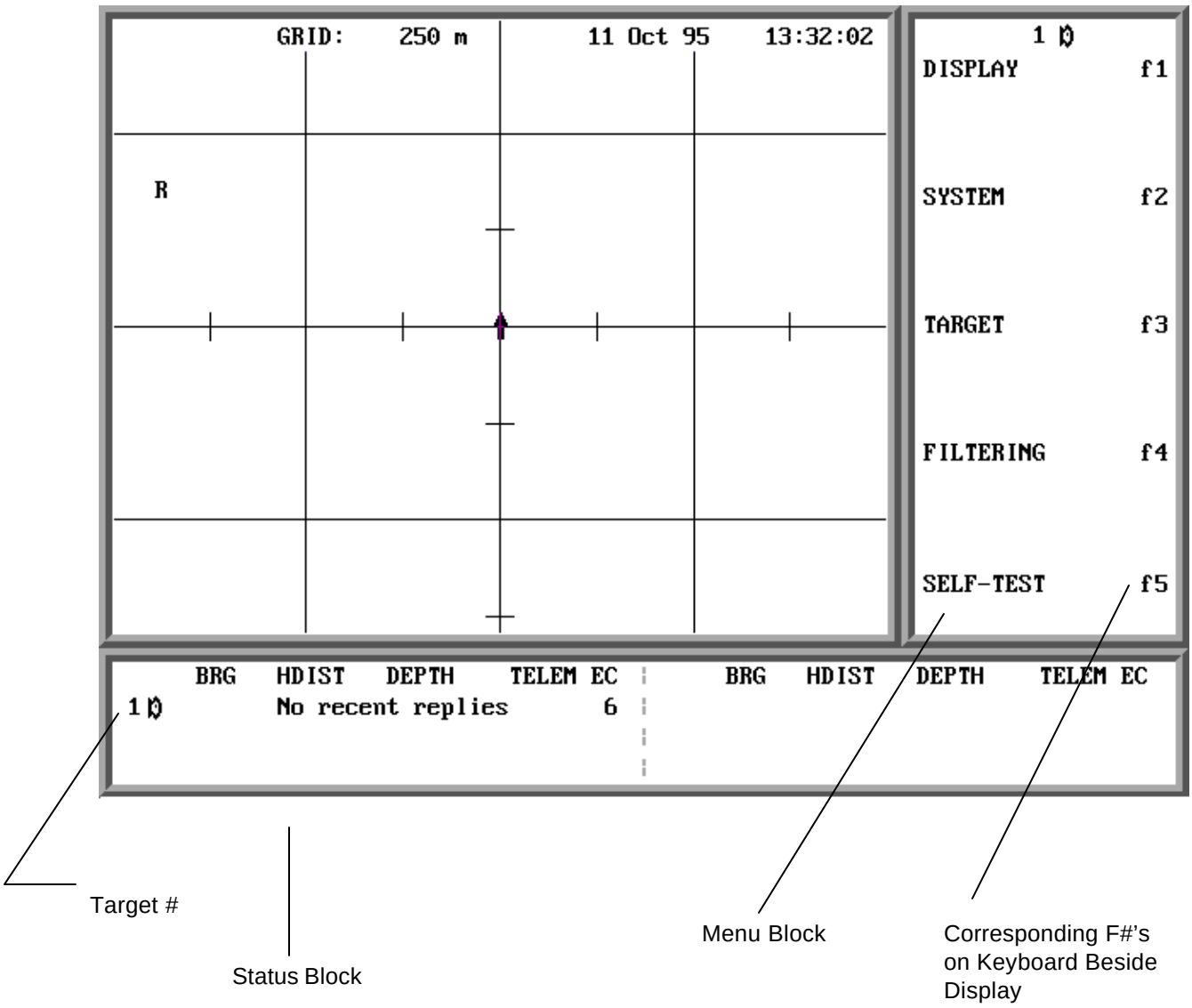


Figure 3-4

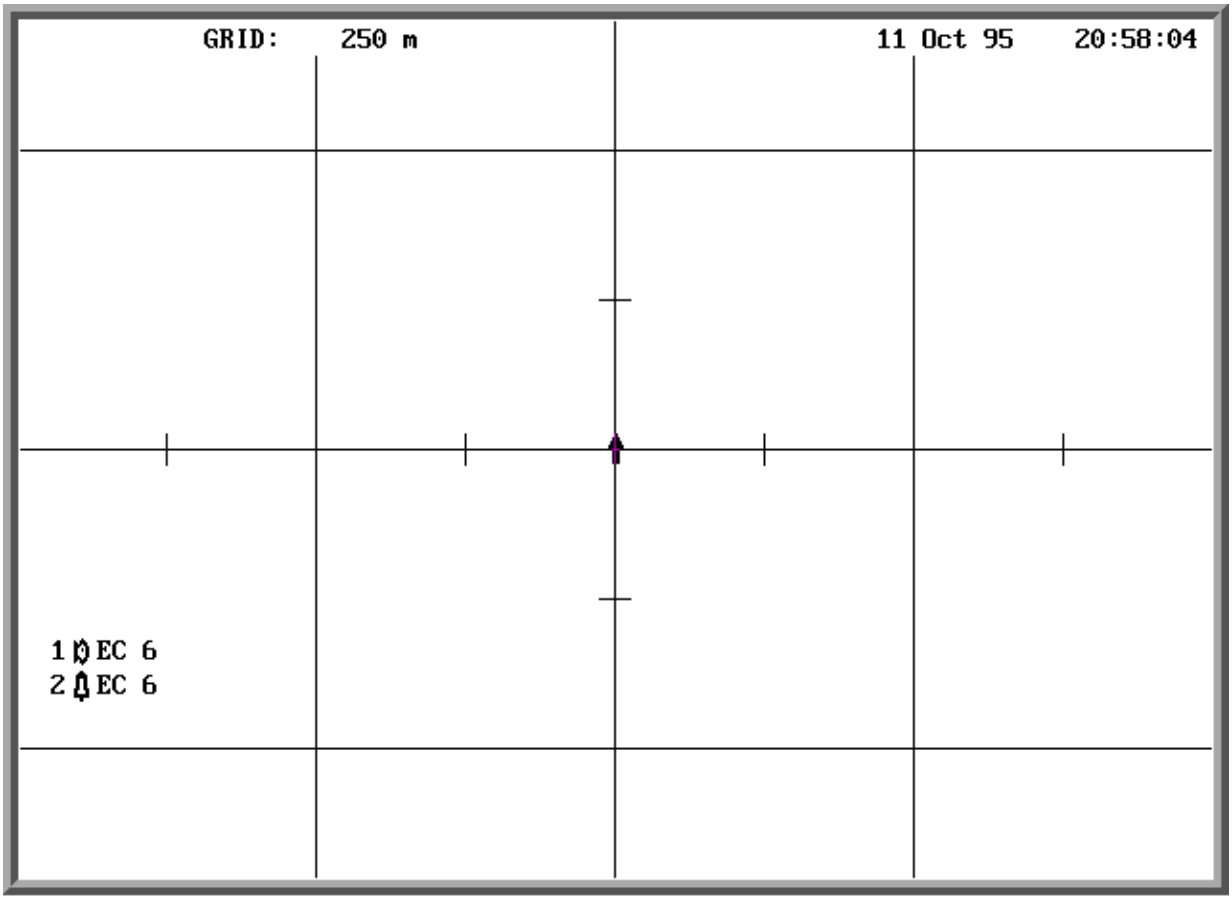
CANCEL key

The CANCEL key can be pressed at any time during operation to return to the basic menu display, to cancel keypad input, or to return to the tracking grid when a help or configuration screen has been called up in the tracking window. The CANCEL key allows the operator to "escape" from a particular menu branch without making a further selection. When inputting data from the keypad, the CANCEL key will discard keyed data, "erasing" it from the command line, before it has been sent to the processor by means of the ENTER key. Once data has been entered by pressing the ENTER key, it can only be altered by new data entry.

"±" key (TRACK VIEW MODE)

The Trackpoint tracking window can be expanded to the full screen size by pressing the " ± " key on the keypad while in the basic menu. This mode can be advantageous when a larger viewing area is desired. See Figure 3-5. The " ± " key acts as a toggle to enable and disable TRACK VIEW MODE. Enable expands the tracking window and disable returns to normal screen viewing. The tracking window expands to fill the entire screen and centers the grid in the middle of the screen. The status block that was located at the bottom of the screen is overwritten and the menu block on the right side of the screen is also overwritten. The grid size is displayed as usual at the top of the tracking window along with the date, time and also compass heading if compass is enabled. If there is an error code associated with any of the tracked targets it appears at the lower left corner of the screen, as shown on Figure 3-5. When the error condition no longer exists the error code is erased. The keypad remains functional and the basic menu reappears if the HELP key is pressed. The menu block overwrites a portion of the right side of the tracking window to allow full menu operation starting at the basic menu. If the HELP key is pressed again the tracking window erases and help information is displayed on the currently selected menu page. If the HELP key is pressed yet again the previous help information is replaced by target error code descriptions. Pressing the CANCEL key while any help information is displayed returns operator to the expanded tracking window. Pressing any of the " f " keys (DISPLAY, SYSTEM, TARGET, FILTERING, or SELF-TEST) while in the TRACK VIEW MODE provides direct access to that particular menu. I.e., if "f1" (DISPLAY) is pressed the menu block appears with the following options, as shown in Figure 3-6.

TRACK VIEW MODE



Note: Error codes only display when there are errors.

Figure 3-5

If power is removed from the unit the TRACK VIEW mode is not saved and upon power restoration the screen returns to the standard display mode (Figure 3-4). i.e., the screen contains the tracking window, the menu block and the status block.

TRACK VIEW MODE WITH MENU BLOCK

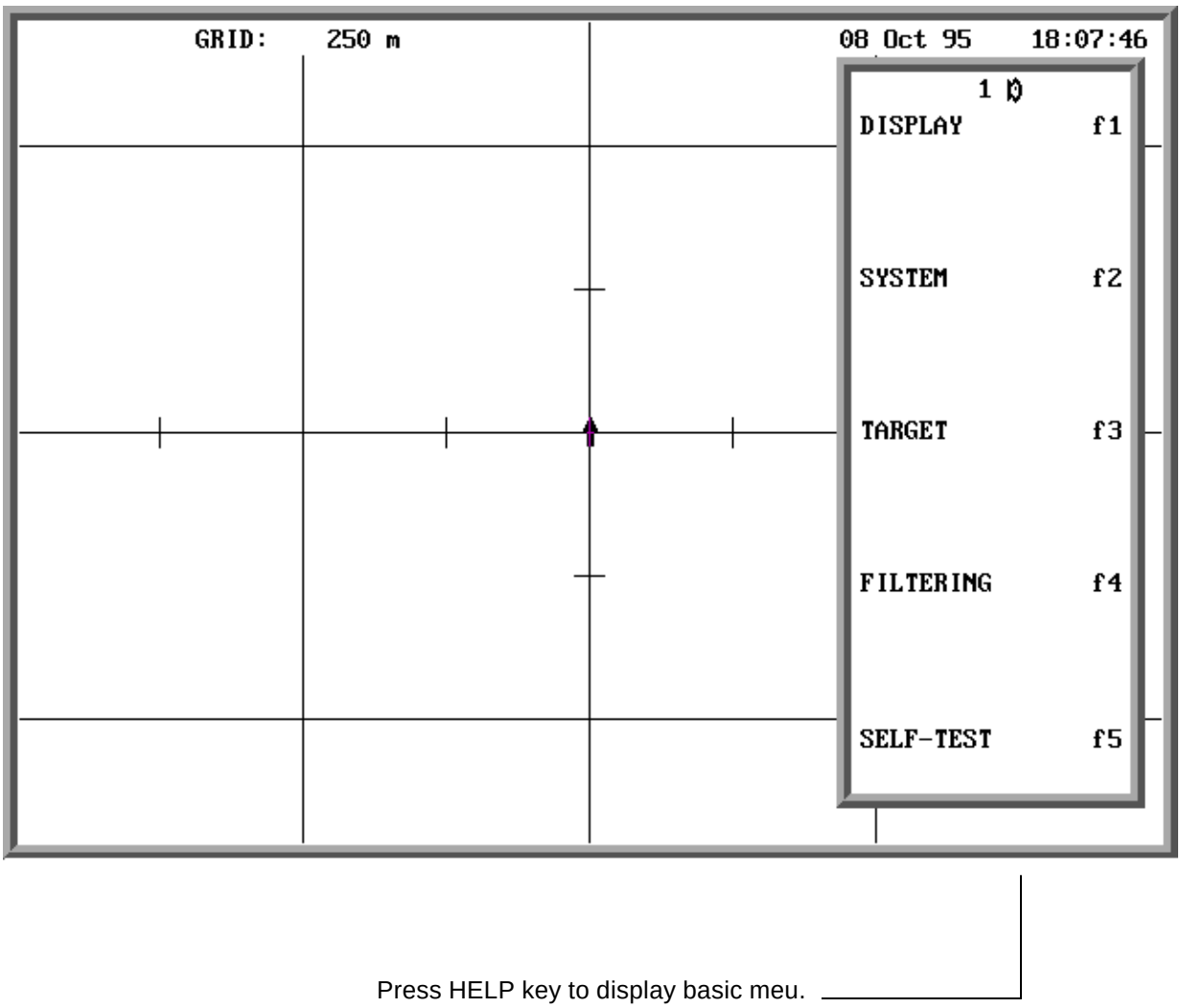


Figure 3-6

3.4 BASIC MENU

The Trackpoint II menu system is divided into five logical paths, each originating from the basic menu. The basic menu, represented below, provides the starting point for all communication with the system.

Menu Block	Corresponding Function Key
DISPLAY	f1
SYSTEM	f2
TARGET	f3
FILTERING	f4
SELF-TEST	f5

A selection from the basic menu brings up a sub-menu of further options within that path. This sub-menu pattern continues until a specific parameter is reached and acted on. If the sub-menu consists of other parameters that could also require setting, then the sub-menu remains in the menu block until a CANCEL key is pressed. At that point the basic menu automatically returns to the menu block, with the system ready for a new command. (Its easier than it sounds!)

The following sections outline the sub-menu sequence for each basic menu path. Refer to Appendix A for table of data ranges and units.

3.4.1 DISPLAY PATH (f1)

DISPLAY path options pertain to the video screen parameters. The function key corresponding to DISPLAY brings up a sub-menu of the following options:

GRID — The tracking window grid may be configured in any one of the following ways:

RECTANGULAR — a Cartesian coordinate grid.

- %X AXIS OFFSET — Enter signed percentage for offsetting the grid's X axis center.
- %Y AXIS OFFSET — Enter signed percentage for offsetting the grid's Y axis center.
- USE DATA ABOVE — Enables rectangular grid if % X and % Y offsets above do not require changing.

POLAR — a circular grid.

TARGET CENTERED — a rectangular or polar grid with a centered target, around which the vessel and other target(s) are plotted. When the TARGET CENTERED configuration is toggled on, a further sub-menu is called up, from which the operator selects the target to be centered.

BOAT CENTERED — a rectangular or polar grid with the boat as the centered target, around which the targets are plotted.

NOTE: The BOAT CENTERED and TARGET CENTERED functions are now independent of the polar or rectangular grid functions with Rev 8.0 and later firmware.

BACKGROUND

NORMAL — This mode displays the normal colors on a black background.

DAYLIGHT — This mode changes the background color of the grid to blue. This function usually enhances viewing under higher ambient light levels.

NIGHT — This mode changes the whole screen to dim red. This function enhances viewing under night or low ambient light conditions.

NOTE: When the DAYLIGHT mode is selected, the grid colors do not appear as selected. A RED grid color appears pink, GREEN appears cyan, BLUE shows no lines, YELLOW appears white. The Purple selection has been changed to WHITE (which actually appears WHITE). When turning BACKGROUND to DAYLIGHT mode the grid color is always defaulted to RED.

NOTE: If Text colors or Target colors are changed while the DAYLIGHT mode is selected, text and target symbols within the tracking window area remain white in color. The text or targets do not change color according to GRID, COLOR, TEXT/TARGET. Only the text and targets outside the tracking window change color.

CONFIGURATION

The tracking window can also be configured to display current parameters. (For convenience and safety, the target symbols being tracked remain on-screen when a DISPLAY CONFIGURATION is in effect.) The following four options are presented when CONFIGURATION is selected:

SYSTEM — displays the current settings of system parameters. See Figure 3-7.

ALL TARGETS — displays the current settings of all target parameters. See Figure 3-8.

ALARMS — displays the current alarm settings for each target. See Figure 3-9.

CHOSEN TARGET — displays a complete list of the parameters of the selected target. See Figure 3-10.

SYSTEM CONFIGURATION DISPLAY

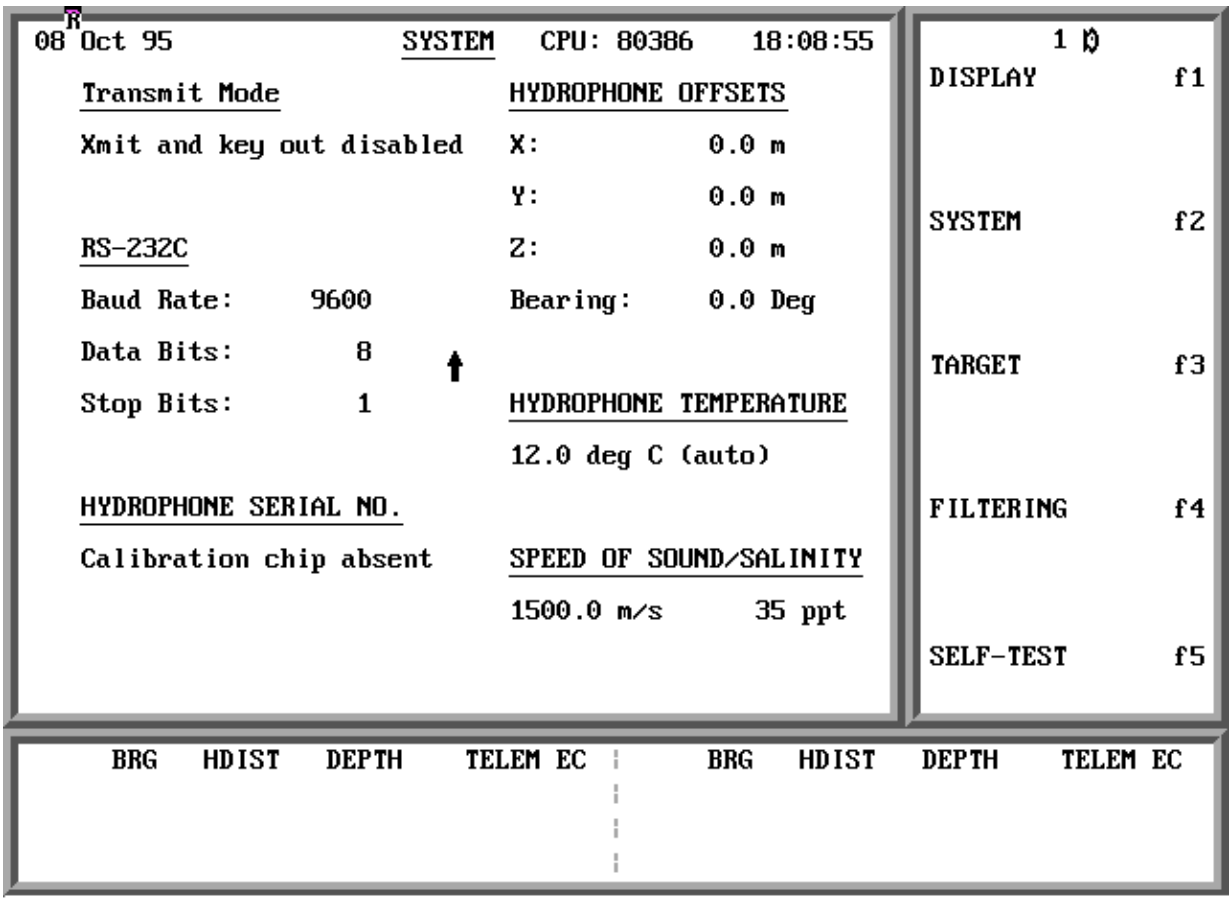


Figure 3-7

ALL TARGETS CONFIGURATION DISPLAY

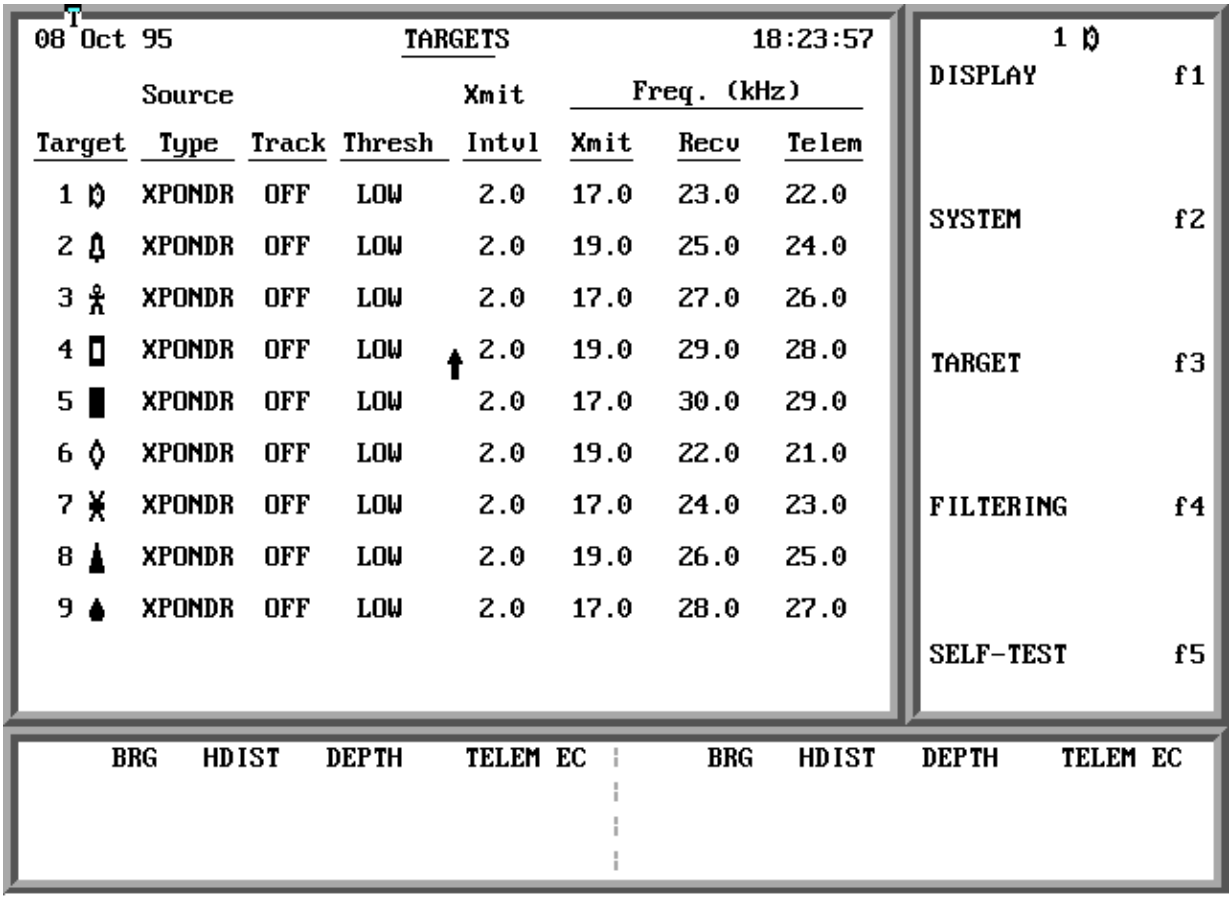


Figure 3-8

ALARMS CONFIGURATION DISPLAY

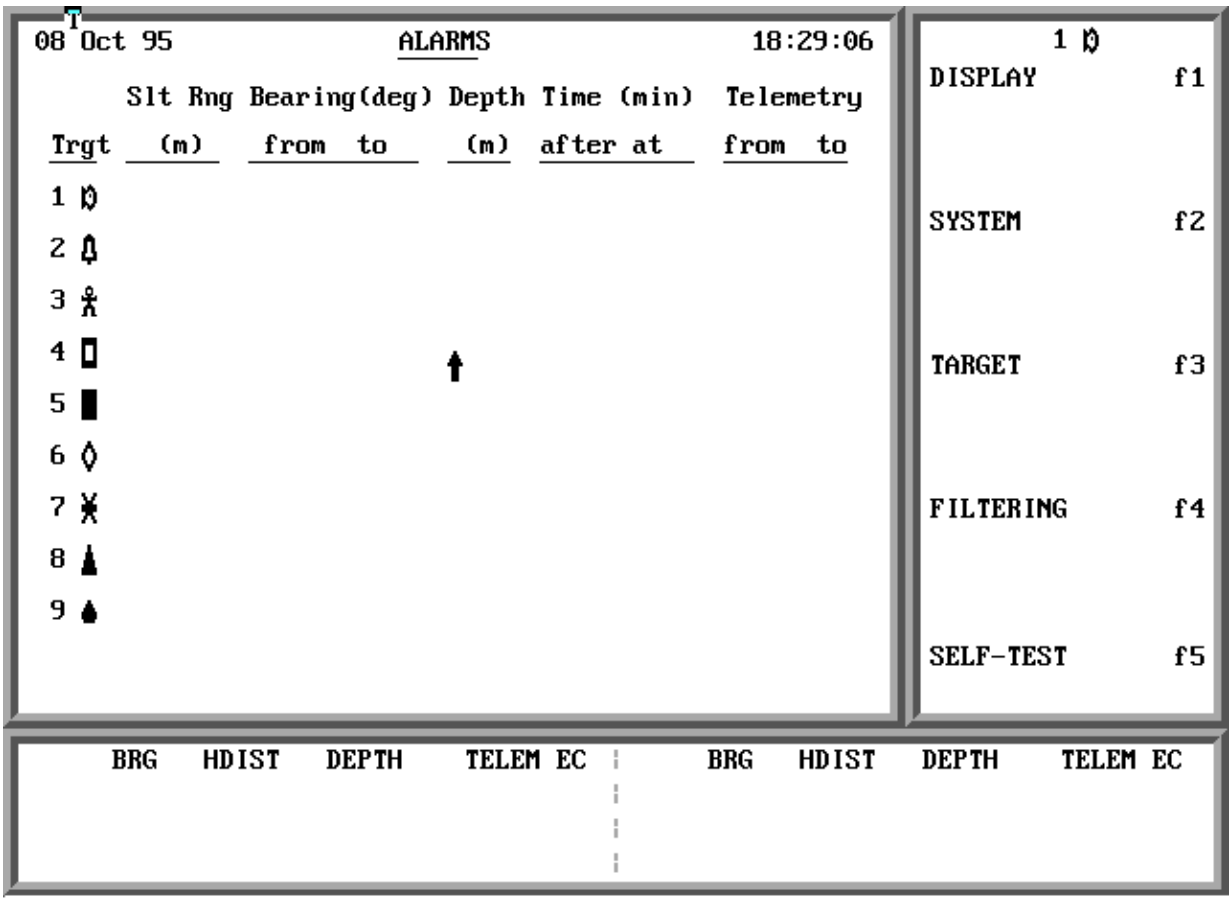


Figure 3-9

CHOSEN TARGETS CONFIGURATION DISPLAY

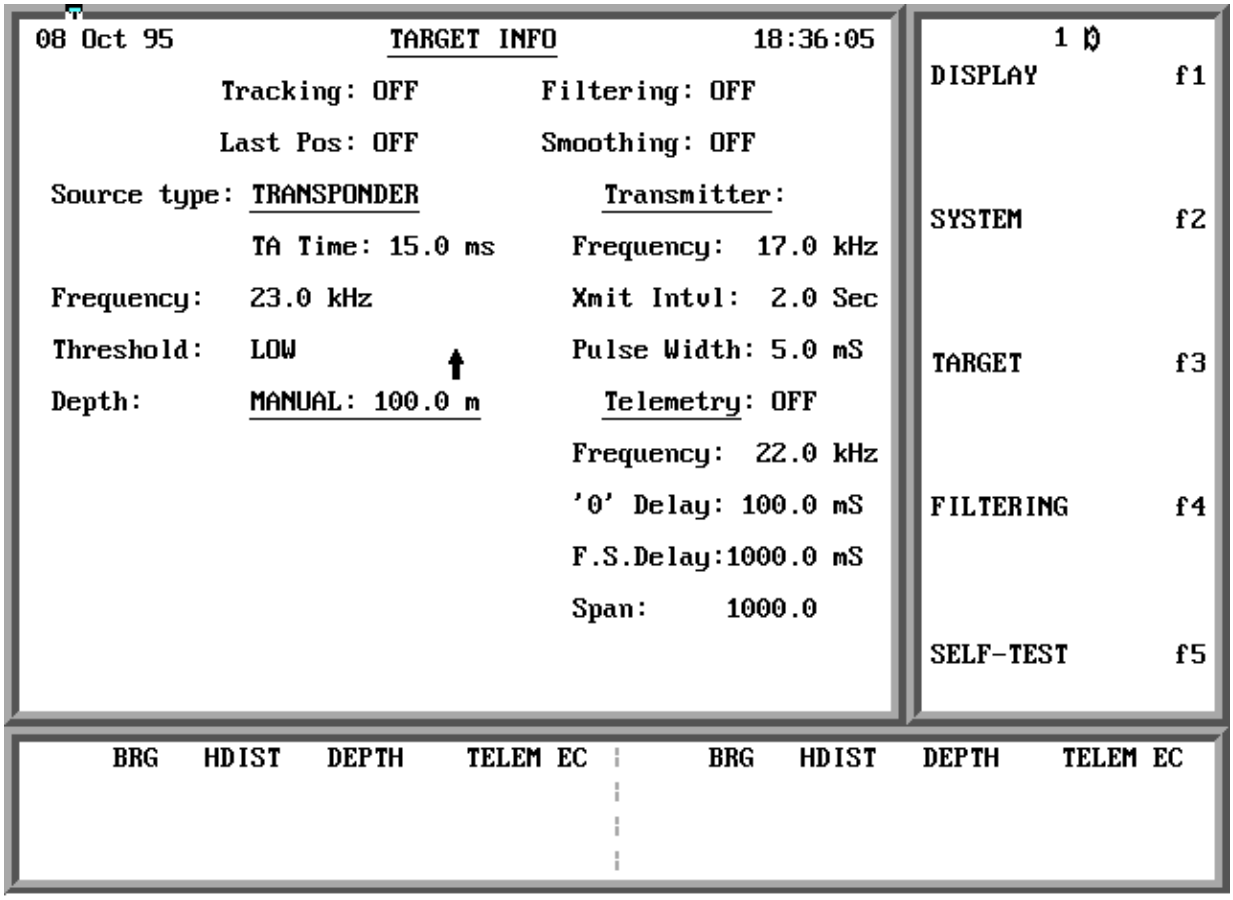


Figure 3-10

COLOR

A sub-menu is displayed in which the operator can specify the color of the grid, the targets and the text/data. The colors available are red, green, blue, purple, and yellow, except that for the grid color choices the purple is replaced by white.

SCALING

The SCALING function is used to determine the scale used in the tracking window grid:

FULL SCALE — When FULL SCALE is selected, the system prompts for the total distance along the X-axis. Enter the distance using the keypad and ENTER key.

GRID SPACING — prompts for the distance between grid lines. Enter the distance as above.

Any change in the FULL SCALE setting results in a GRID SPACING of 1/4 of the FULL SCALE setting. The GRID SPACING can then be changed appropriately.

UNITS — allows the operator to change the unit of measurement from meters (default setting) to feet or to yards. The current setting is displayed next to the UNITS option in the menu block. The corresponding function key acts as a "toggle" switch: if the current setting is meters, pressing the function key corresponding to UNITS changes the setting to feet, if in feet the UNITS change to yards, etc.

1/2 X — changes the grid scale and spacing to one-half the current values.

2X — changes the grid scale and spacing to twice the values.

STATUS FORMAT

Allows the operator to change the display in the Status Block as follows (See Figure 3-11, Figure 3-11A, Figure 3-11B):

DEFAULTS — The default setting displays the bearing, horizontal distance, depth and telemetry data of the target(s) being tracked.

SLANT RANGE — Replaces telemetry data with the Slant Range of the target(s) being tracked. The Slant Range for a transponder or responder is always an unfiltered/ unsmoothed value to give the operator the ability to know where the target is in relation to the hydrophone, even with offsets entered. It is also an indication of actual distance to the target vs. smoothed distance which may be lagging in some tracking situations.

X, Y, Z — displays the target X, Y, and Z coordinates, and the telemetry data.

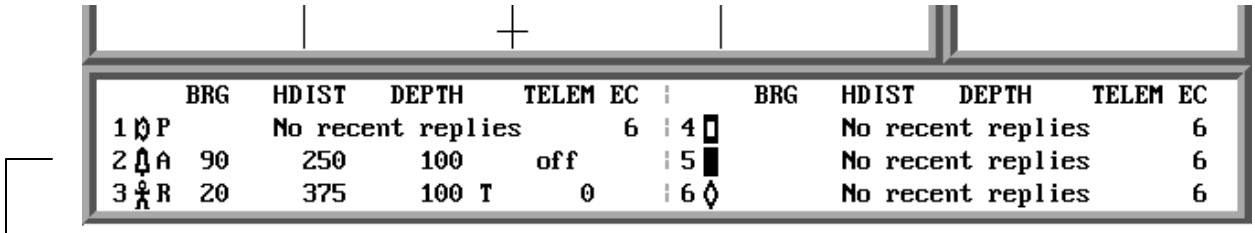
X,Y,Z,SR — displays the target X, Y, and Z coordinates, and the unfiltered/ unsmoothed slant range data.

STATUS LINE FORMATS

DEFAULT FORMAT

The default status format is shown below. It contains bearing, horizontal distance, depth and their telemetered data for all targets. The telemetered data can be depth or some other parameter, e.g. pitch or roll for beacons so equipped. If depth is selected as the telemetered data then a "T" appears next to the DEPTH or "Z" status line. If analog depth is selected for that target then an "A" appears next to the DEPTH or "Z status line. If the depth is being calculated by the system then a "C" appears next to the DEPTH or "Z status line.

When an ARTIFICIAL target is enabled an "A" is displayed next to its target symbol. No error code is associated with an ARTIFICIAL target. The ARTIFICIAL target's Slant Range is developed from the Entered Depth and Horizontal Range. The Entered Depth is an optional input if Slant Range calculations are required (depth is only input via keypad).



"C" next to depth data shows that depth is being calculated.
"T" next to depth data shows that depth is from the telemetry bcn.
"A" next to depth data shows that depth is input via the rear panel analog input BNC

"P" next to target symbol shows that the target is a pinger.
"T" is indicated when the transmit has just occurred for that particular responder or transponder.
"R" is indicated when the signal from that target has just been received.
"A" is indicated when an ARTIFICIAL target is enable, e.g. target #2.

Target number and target symbol

Figure 3-11

STATUS LINE FORMATS

SLANT RANGE FORMAT

If SLANT RANGE status format is selected, then the TELEMETRY is replaced by the SLANT RANGE in the display. The slant range for a transponder or responder is the measured slant range (not filtered, smoothed or offset).

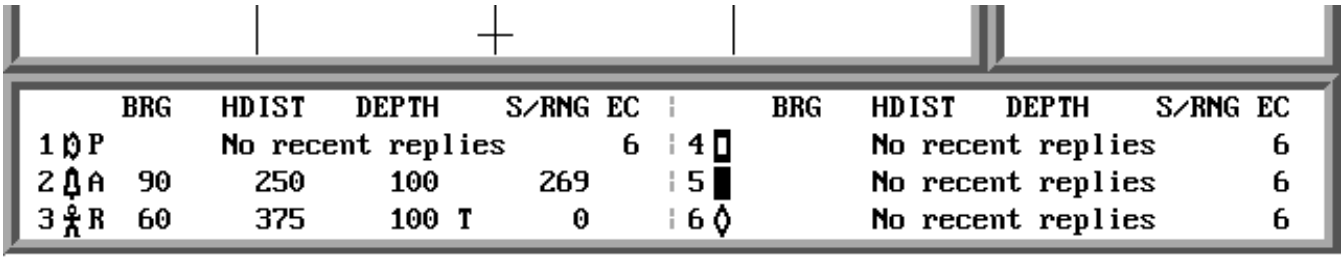


Figure 3-11 A

X, Y, Z FORMAT

The X, Y, Z, status format is shown below. It contains Target 1 -> 6's bearing, X position, Y position, & Z (depth) along with their respective telemetered data. In the X,Y,Z,SR format slant range replaces the telemetry field.

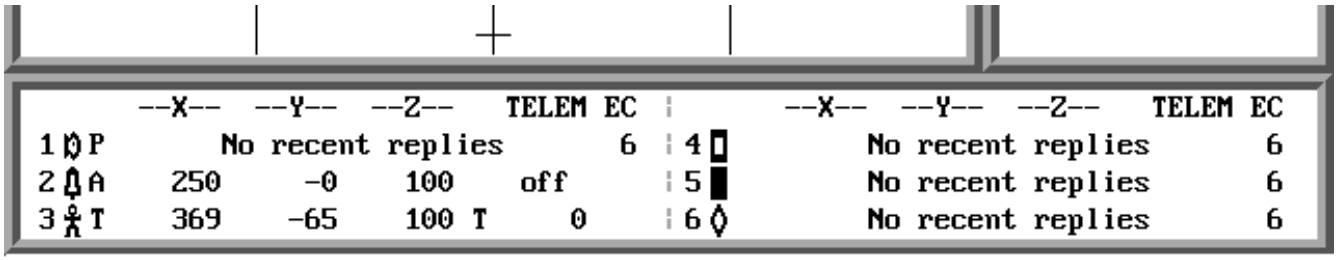


Figure 3-11 B

3.4.2 SYSTEM PATH (f2)

The SYSTEM path allows the operator to determine system parameters. The options that appear on the SYSTEM sub-menu are as follows:

XMIT CONTROL

The Model 4410D-01 independently controls the isolated key out, the normal key out and transmitter. If a transponder is activated, then both the normal key out and the transmitter are enabled for that target's cycle. If a responder is activated, then only the isolated key out and normal key out are enabled for that target's cycle. The bottom green LED in the lower left corner of the display should flash with each normal key out. The top green LED in the lower left corner of the display should flash with each transmit out. The following functions are global TRANSMITTER parameters which affect all targets:

NOTE: The key out signal from the NORM TRIGGER OUT connector on the rear panel BNC is negative-going TTL. The key out signal from the ISOLATED TRIGGER OUT connector is AC coupled and can be either positive or negative by selection of an internal switch. This switch is located on the Isolated Key board next to the transmitter (See Dwg 102297).

XMIT & KEY OUT OFF — to deactivate the transmitter and key out functions (isolated and normal). Overrides the transmitter and/or key that has been enabled by activation of a transponder or responder.

XMIT & KEY OUT ON — This is chosen to fully activate the transmitter after it has been turned off by XMIT & KEY OUT OFF.

EXTERNAL KEY — Used when the transmitter or responder sync pulse is to be externally keyed. If selecting EXT KEY, XMIT & KEY OUT is automatically turned on for proper operation.

NOTE: If only one target is being tracked and the tracking to that target is turned off, the External Key is automatically deselected and reverts to the Internal Key. If tracking is turned on again, External Key must be re-selected.

NOTE: The transmitter output power can be varied by changing the plug-in jumper on the transmitter board (full output 500W, reduced output 100W). Refer to drawings 4410BS0047 and 4410BA0047.

INTERNAL KEY — Internal repetition interval used. Prompts for a master repetition interval in seconds. When a repetition interval is entered it overrides all individual target (transponder or responder) preset repetition intervals.

NOTE: The Internal Repetition Interval is also individually selectable for each target. Refer to section 3.4.3, Target/Interrogation.

OFFSETS Presents the operator with a sub-menu for hydrophone offsets and remote VRU offsets.

PHONE The hydrophone offsets option allows the operator to enter the location of the hydrophone relative to the vessel's pitch and roll center and also the hydrophone depth below the water line. The automatic depth function ANALOG (DEPTH) or ANALOG (COMP) allows input of an analog voltage proportional to the hydrophone depth. Hydrophone offsets should be determined at the time of installation (see Section 2.3) and entered using the following submenu options:

X OFFSET prompts for horizontal distance (perpendicular to the vessel centerline) between the hydrophone and the vessel's pitch /roll center. Enter the value in meters (unless the unit of measurement has been previously set to feet or yards) using the keypad and ENTER key. (port side of centerline is negative)

Y OFFSET prompts for the horizontal distance (parallel to the vessel centerline) between the hydrophone and the vessel's pitch /roll center. Enter the value in meters (unless the unit of measurement has been previously set to feet or yards) using the keypad and ENTER key. (aft of centerline is negative)

DEPTH OFFSET This option allows selection of either a manually entered depth (Z) offset or an analog input depth offset through the rear panel DEPTH input BNC or the COMPASS input BNC. Refer to section 3.6.1.

MANUAL prompts for the depth of the hydrophone below the water line. Enter the value in meters (unless the unit of measurement has been previously set to feet or yards) using the keypad and ENTER key.

ANALOG (DEPTH) If ANALOG (DEPTH) Depth Offset is selected another menu pertaining to the analog voltage parameters is displayed (see below). The analog voltage that is proportional to the Hydrophone depth offset is input to the DEPTH input BNC on the rear of the Trackpoint. For greatest resolution, it is suggested 0-6V be used to represent the full operating range of the depth sensor. If the DEPTH INPUT is being used as a target depth you must turn off that targets analog depth before you can use it for the hydrophone analog depth input.

MINIMUM VOLTAGE Enter the minimum voltage applied to the rear panel depth BNC. This voltage represents the shallowest depth as entered under minimum depth. Typically the shallowest depth is zero and the minimum voltage is also set to zero, but it can also be offset as in the following example. If a re-scaled depth sensor is used and its operating range is from 10-40 meters and its proportional voltage is 1.0 VDC to 4.0 VDC, the minimum voltage would then be set to 1.0 VDC.

The minimum voltage can also be adjusted to calibrate the system at the surface to produce a zero depth.

MAXIMUM VOLTAGE Enter the maximum voltage applied to the rear panel BNC. This voltage represents the greatest depth as entered under MAXIMUM DEPTH. The maximum input voltage is +6 VDC.

MINIMUM DEPTH Enter the minimum depth which the minimum voltage represents, e.g., 0V = 0m depth.

MAXIMUM DEPTH Enter the maximum depth which the maximum voltage represents, e.g., 6V = 100m depth.

USE DATA ABOVE Upon entering the menu, if the analog parameters are already set correctly for the depth sensor; then press this function to initiate ANALOG DEPTH OFFSET. If a parameter "above" is changed, then the ANALOG (DEPTH) DEPTH OFFSET function is automatically enabled. To leave menu without using parameters press CANCEL.

ANALOG (COMP) If ANALOG (COMP) Depth Offset is selected another menu pertaining to the analog voltage parameters is displayed (see below). The analog voltage that is proportional to the Hydrophone depth offset is input to the COMPASS input BNC on the rear of the Trackpoint. For greatest resolution, it is suggested 0-6V be used to represent the full operating range of the depth sensor. If the COMPASS INPUT is being used for the compass you must turn off the analog compass function before you can use it for the hydrophone analog depth input.

MINIMUM VOLTAGE Enter the minimum voltage applied to the rear panel depth BNC. This voltage represents the shallowest depth as entered under minimum depth. Typically the shallowest depth is zero and the voltage is also zero, but a re-scaled depth sensor could be used where its operating range is from 10-40 meters and its proportional voltage is 1.0 VDC to 4.0 VDC; also, the minimum voltage could be adjusted to calibrate the system at the surface to produce a zero depth.

MAXIMUM VOLTAGE Enter the maximum voltage applied to the rear panel BNC. This voltage represents the greatest depth as entered under MAXIMUM DEPTH. The maximum input voltage is +6 VDC.

MINIMUM DEPTH Enter the minimum depth which the minimum voltage represents, e.g., 0V = 0m depth.

MAXIMUM DEPTH Enter the maximum depth which the maximum voltage represents, e.g., 6V = 100m depth.

USE DATA ABOVE — Upon entering the menu, if the analog parameters are already set correctly for the depth sensor; then press this function to initiate ANALOG (COMP) DEPTH OFFSET. If a parameter "above" is changed, then the ANALOG (COMP) DEPTH OFFSET function is automatically enabled. To leave menu without using parameters press CANCEL.

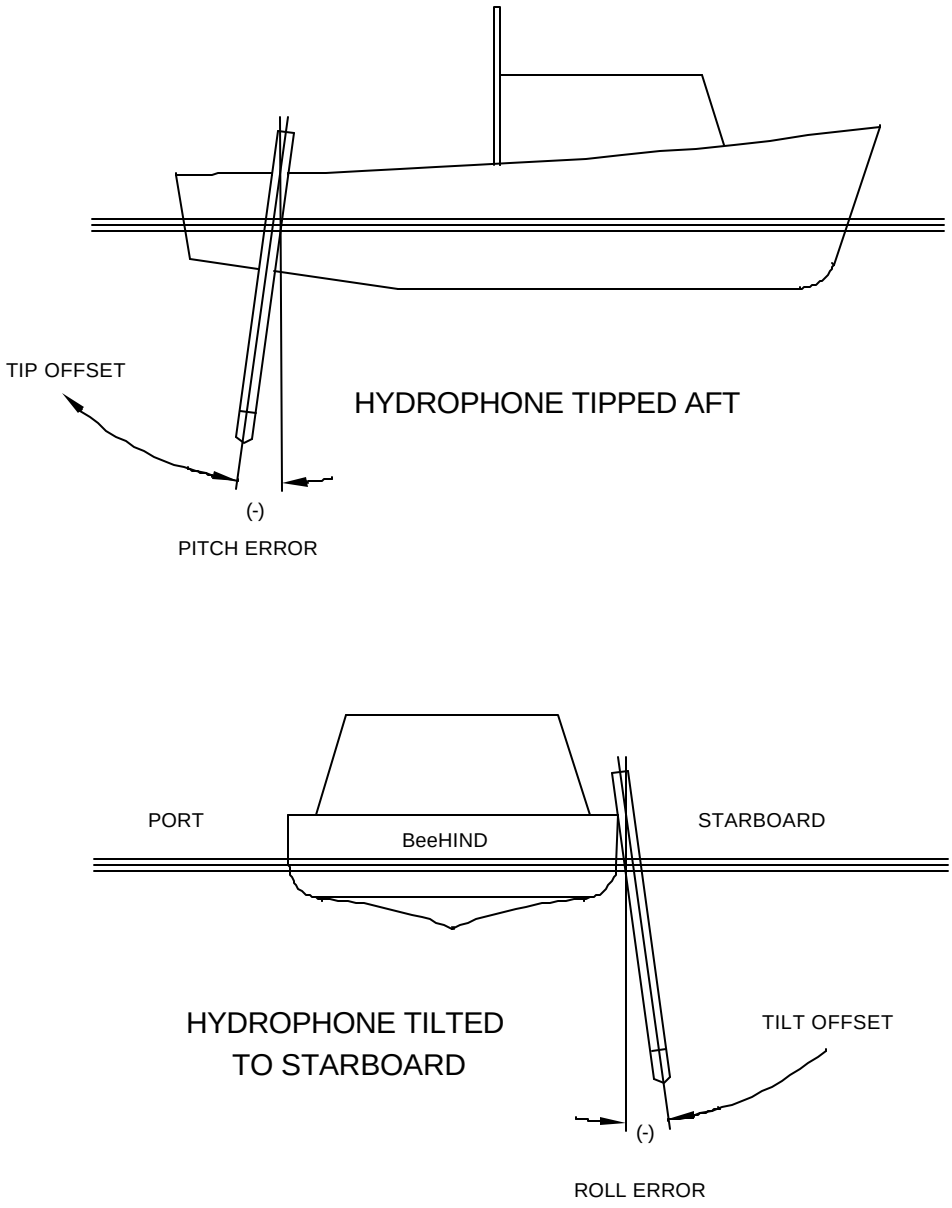
BEARING OFFSET — prompts for the value of the bearing offset determined at installation. Enter the value in degrees (refer to Figure 2-5).

VRU — The following menu parameters apply to the hydrophone (Model 4610B) or VRU/Amplifier (Model 4740A) and the VRU located inside these units. Refer to section 2.3.3 for setting of HYDROPHONE-VRU OFFSETS and also section 3.6.

PITCH ERROR & ROLL ERROR — prompts for manual entry of the hydrophone attitude error corrections in degrees. Used to offset the static attitude of the hydrophone/staff. The attitude (pitch/roll) offsets are error constants that compensate for the non-vertical installation of the hydrophone shaft and/or vessel trim. The operator must measure the angle of the shaft with respect to vertical and enter the data in this menu. Pitch and roll errors are entered in degrees. Maximum range is +/- 45°. The system accepts and displays data with a precision of 0.01°. The entered data appears in the menu block below the selected parameter. To use the internal VRU inside the Model 4610B Hydrophone to automatically calculate and store the pitch and roll offsets, select the AUTO OFFSET function as shown below. Refer to Figure 3-12.

The attitude (pitch/roll) offset errors follow the polarity convention of; vessel Bow up = [+], Port up = [+]. For example, if the combined hydrophone shaft and vessel trim causes the Hydrophone (Models 4610B or 4211A mounted on the end of the staff) to tilt towards the port side (has the same affect as tilting so that the port side of the vessel is up), the roll error is entered as a positive value. And, if the Hydrophone is tilted towards the aft of the vessel (vessel attitude = bow down) the pitch error is entered as a negative value.

Pitch and Roll have also been referred to as Tip (fore/aft) and Tilt (port/starboard).



HYDROPHONE TIP & TILT ERRORS

Figure 3-12

AUTO OFFSET

Auto Offset automatically calculates the attitude error corrections while the vessel is at dockside (static errors). The system reads the pitch and roll data from the internal VRU (4610B or 4740A) and averages 100 (mean) readings over a period of 100 seconds. The data is collected by forcing the system into a simulated BIT (Built-In-Test) mode. The two green key LED's flash once per second along with the two red reply LED's. All active targets are turned off and a simulated target #1 is displayed. An error code 62 is displayed on the RS-232 output signifying the data sentence is from a simulated target and that the pitch and roll data is from the internal VRU. The RS-232 output format also changes to the NMEA ORE format to show the pitch and roll data with a 0.01° precision.

Once the AUTO OFFSET function is initiated the tracking display changes to show the system configuration data. See Figure 3-7. The instantaneous pitch and roll data are displayed on the configuration screen along with the number of samples remaining and the spread of the data. The spread is the difference between the minimum and maximum value of the 100 readings of either the pitch or roll data (worse case). The averaged static offset errors are displayed in the space within the menu normally reserved for display of the pitch and roll-error manually entered data. The data is updated when the routine has completed the 100 samples or has been stopped by canceling the routine. The operator can stop the AUTO OFFSET routine at anytime by pressing the CANCEL key.

It is possible to override the auto offset data by manually entering in new offsets. Refer to PITCH and ROLL OFFSETS above.

To have the system perform an AUTO OFFSET calibration on a Model 4211A/4740A Hydrophone & VRU/Amplifier, the VRU/Amplifier must be installed at the same attitude as the hydrophone/staff. That is to say, measure the hydrophone shaft offset and shim the VRU/Amplifier box so that the pitch and roll outputs read the same angle. To view the pitch and roll data from the 4740A, change the screen to display the SYSTEM CONFIGURATION and then go into BIT (Built-In-Test) mode. The pitch and roll data updates on each reply of the simulated target. The pitch and roll data can also be viewed on the RS-232 port using either Formats; STD W/PR or NMEA ORE.

NOTE: The pitch and roll offset data are stored in CMOS battery backed RAM. If the PREVIOUS menu function is selected upon boot-up the system uses the stored parameters during initialization. If DEFAULT is selected then the offset data defaults to 0.00°.

NOTE: If the system uses an external or remote VRU, perform a pitch/roll zero calibration on this unit at the same time. This reduces errors induced by changes in vessel trim during mobilization. For external or remote VRU interface parameters refer to menu section SYSTEM/OFFSETS/REMOTE VRU.

NOTE: If the Signal Processor Board software or hardware is not compatible with this firmware revision then an error message states "This signal processor does not support AUTO CAL"

ORIENTATION — Steps the installation position of the 4740A VRU to either NORMAL (towards bow), STBD, AFT or PORT. Refer to sections 2.1.3 and 2.3.3 for VRU/Amplifier installation and offset entry. Default is BOW.

STATUS — The VRU-STATUS function informs the system whether the internal VRU is correcting for installation offsets (STATIC) only or if it is being used to compensate for pitch and roll motion under dynamic conditions also (ACTIVE). This function toggles between ACTIVE and STATIC modes. When ACTIVE the pitch/roll-relay within the C/DM remains set to the internal VRU. When STATIC the pitch/roll-relay switches to the remote dynamic motion sensing system and only switches back to the internal VRU for AUTO OFFSET corrections. Default is ACTIVE.

REMOTE VRU presents the following menus to allow the Trackpoint system to be interfaced to a remote VRU or dynamic motion sensing system, such as the ORE Model 4414B. The interface requires that the remote VRU output bi-polar analog voltages (typically ± 10VDC) for its pitch and roll data. To enable the REMOTE VRU make sure the internal VRU STATUS switch is set to STATIC.

SCALE — prompts for entry of the Remote VRU's full scale angular motion in volts per degree. Default is 0.20 volts per degree. System accepts and displays scaling with a precision of 0.01 volts/degree.

FUNCTION — toggles between a LINEAR or a 10 SIN θ input voltage function where θ is the pitch or roll angle in degrees. In the linear mode the pitch and roll analog voltages are scaled linearly based on the SCALE factor above by *X* degrees per 10V. In the 10 sin θ mode the voltage received is divided by 10 and then the inverse sin function performed to obtain actual degrees measured. This allows compatibility with various motion sensor configurations such as the ORE Model 4414B. Default is LINEAR.

The scale factor modifies the 10 SIN θ function to scale it to a range other than ± 90°. If the scale factor is 0.2 volts/degree the 10 SIN θ value is scaled to ± 50°. (± 10v/0.2v/deg = 50°) (for ± 90° enter a scale value or 0.1111 v/deg, (10v/90°))

BOW UP POLARITY — toggles between a VRU input polarity of [+] or [-] for the pitch data received from the remote VRU. If the remote VRU's output is a positive voltage for a bow up pitch then toggle switch setting to [+]. If the remote VRU's output is a negative voltage for a bow up pitch then toggle switch setting to [-]. Default is [+].

PRT UP POLARITY — toggles between a VRU input polarity of [+] or [-] for the roll data received from the remote VRU. If the remote VRU's output is a

positive voltage for a port up roll then toggle switch setting to [+]. If the remote VRU's output is a negative voltage for a port up roll then toggle switch setting to [-]. Default is [+].

Example: If a TSS Model 335B is set for bow up = [+] and port up = [-] then set POLARITY switches to ....
BOW UP POLARITY = [+] ; PRT UP POLARITY = [-]

NOTE: The POLARITY switches have no affect on the output of the RS-232 formats. The switch function is to modify the incoming data so that it agrees with the Trackpoint's BOW UP = [+] and PORT UP = [+] protocol. The display and RS-232 format STD W/PR also follow this protocol whether on INTERNAL VRU (ACTIVE) or REMOTE VRU (STATIC). The NMEA ORE RS-232 format follows the bow up/port up = [+] protocol when STATUS function is set to ACTIVE and follows the incoming voltage polarity when set to STATIC.

INVERT PHONE toggle function; turns the hydrophone inversion function either on or off. Normal hydrophone operation is with switch turned off. The inverted hydrophone function allows the operator to position a hydrophone on the seabed looking up towards the surface. This requires a hydrophone modified to V1390 specifications. When this function is turned on the system automatically compensates for the reversal in the X axis direction and also the pitch sensor polarity of the inverted hydrophone. Refer to section 3.6.3.

SHOWS HOW THE DISPLAY, RS-232 FORMAT STD W/PR & NMEA ORE ARE AFFECTED BY SELECTION OF INTERNAL VS REMOTE VRU'S & POLARITY

				RS-232 Format	
Internal VRU (ACTIVE)	Input Voltage Polarity	Polarity Switch	System Config. Display [1]	std w/pr [1]	NMEA ORE [2]
Pitch (Bow Up)	(-)	N/A	(+)	(+)	(+)
Roll (Port Up)	(+)	N/A	(+)	(+)	(+)
Remote VRU (STATIC)					
Pitch (Bow Up)	(+)	(+)	(+)	(+)	(+)
Roll (Port Up)	(+)	(+)	(+)	(+)	(+)
OR...					
Pitch (Bow Up)	(-)	(-)	(+)	(+)	(-)
Roll (Port Up)	(+)	(+)	(+)	(+)	(+)

NOTE 1: Follows the BOW UP/PORT UP = [+] protocol.
NOTE 2: Follows the incoming voltage polarity for remote sensors only.

TIME/DATA allows the operator to set the time and date.

SET TIME prompts for the current time. Enter time using the format hh.mm.ss.

SET DATE Set the current date using the format mm.dd.yyyy.

NOTE: If a date is entered, from the front panel keypad or the RS-232 communications port, that is equal to or less than XX50 then the system assumes it is 20XX. If the date is greater than XX50 then it assumes the date is 19XX. For example, entered date DD MM 1949 is converted to 2049 and shows up on the display and RS-232 as 2049. Entered date DD MM 2051 remains at 2051. Entered date DD MM 1995 remains at 1995.

ACOUSTIC FACTORS The following entries apply to the specific water conditions for a given application.

WATER TEMP - MANUAL When MANUAL mode is selected, the system prompts for the water temperature in degrees C.

WATER TEMP - AUTO In AUTOMATIC mode, temperature is read from the temperature sensor in the hydrophone.

NOTE: This parameter does not affect speed of sound calculations. It is used for phase correction.

NOTE: AUTO-TEMP only updates when valid acoustic signal is received.

SPEED OF SOUND prompts for the velocity of sound in the water column between the acoustic source and the hydrophone. Enter the value in meters per second, feet per second or yards per second, depending on the current unit of measure. The default value is 1500 m/sec. Refer to Appendix A.

WATER SALINITY prompts for the salinity in parts per thousand. The default value is 35 ppt (seawater). Refer to Appendix A.

MORE… Press for next series of menus.

COMPASS This function allows an external vessel compass, with an analog output, to be interfaced to the Trackpoint. This function key also selects the next page of menu options. They are as follows:

COMPASS toggle function; turns compass mode to off, analog input**,** NMEA or NMEA w/o cs input via COM2 serial port. The analog output voltage from a compass (typically 0-5 VDC) can be connected to the "Compass" input located on the rear panel BNC. The Trackpoint converts this analog voltage to a ship's heading in degrees (see Figure 3-13). When in analog compass mode the heading data is displayed at the top left of the screen and has a suffix “A” attached to indicate that the data is from the analog input. If the

HYDROPHONE DEPTH OFFSET is set to use the analog compass input then an error message appears stating that you will have to change the hydrophone depth offset to manual. At this point the system skips over the analog mode from the menu and jumps to the NMEA. mode. The NMEA mode allows input of various NMEA compass sentences. The NMEA wo/cs function reads the data string and accepts the compass data even if checksum is missing or invalid.

RS-232 TGT DATA — toggle function; switches between north referenced and bow referenced. When the compass is enabled (see COMPASS ON/OFF above) the RS-232 DATA is automatically switched to north referenced mode. This means that the target data (bearing, X, Y) output to the RS-232 port is referenced to North instead of the bow of the vessel. The operator can override this by toggling to bow ref.. This function is used in situations where the Trackpoint is interfaced to a navigation system and the navigation system already interfaces to a heading sensor such as a flux gate compass or gyro-compass. In this case, the Trackpoint's RS-232 data does not need to be corrected for North reference. However, the Trackpoint requires a compass input to compensate for vessel motion within its filtering algorithms. By toggling this function to "Bow Ref" (when the compass is enabled) the target data on the Trackpoint screen remains referenced to North while the RS-232 data is referenced to the bow of the vessel thus allowing both the Trackpoint II and the navigation system to function properly.

NOTE: When the COMPASS/RS-232 DATA function is set to Bow Referenced, the RS-232 data is averaged (when smoothing is enabled). However, the positional data on the **screen** of the Trackpoint is only smoothed or averaged **prior** to the target's compass correction resulting in positional changes directly related to the change in compass heading. When the RS-232 DATA function is set to North Referenced the target position is averaged after the compass has corrected the data for North Reference resulting in a more "smoothed" target position on the Trackpoint screen.

COMPASS OFFSET — Enter offset in degrees.

ANALOG/OPTIONS — displays sub-menu for the analog compass voltage ranges ranges and also some Compass related options..

ZERO-DEGREE VOLTAGE — Enter the minimum voltage that corresponds to zero degrees (Range 0-6V).

360-DEGREE VOLTAGE — Enter the maximum voltage that corresponds to 359.9 degrees (Range 0-6V).

COMPASS WARNING — Function toggles between OFF, 10sec, 20sec, 40sec, and 60sec. When the COMPASS WARNING function is set to OFF, the warning code "55" is not sent out the RS232 or displayed in the Status Block on the screen. The COMPASS data at the top left of the screen will not turn red either (signifying a warning 55). If the

COMPASS WARNING is set to 10sec then the system waits 10 seconds before enabling the warning. That is to say, the system checks the compass data continuously for 10 seconds. If any anytime during the 10second period the data changes by 0.1 degrees or more the internal warning code flag is reset. If there is no change then the warning code 55 is enabled, displayed on the screen and sent out the RS232. If COMPASS WARNING is set to 20 seconds then the system waits 20 seconds before enabling Warning Code 55, etc..

INPUT FORMAT toggle function; allows selection of either “HDG”, “HDT”, “HDM” “VHW” or “VTG” NMEA formats or the Precision Navigation TCM-2 format.

NOTE: If the TCM-2 format is selected the Trackpoint will read the pitch and roll data along with the compass data and correct the target’s position accordingly. In this mode the Trackpoint ignores the pitch and roll data from the Hydrophone or Remote VRU and only uses the TCM-2 data. If you do not want to use this pitch and roll data then setup the compass to output the NMEA “HDM” sentence and change the format as shown in the menu above.

PLOTTING Selects various functions concerning screen plotting. Selects a PRIORITY TARGET, TRACK PLOTTING (leaves a trail of dots) or display of a to-scale VESSEL SYMBOL.

PRIORITY TARGET This function is used when tracking multiple targets and one of the target positions is of greater concern than the others. (E.g., When in Target-Centered mode the centered target's position would have an impact on the position accuracy of the others.) In this case a position update at an increased rate would be beneficial. The Priority Target function makes the selected target a priority and changes the sequence of interrogation so that the target is interrogated on every other cycle no matter how many targets there are. The priority target is shown first in the status block, unless a pinger is enabled. (See Figure 3-14.) The target number has a white background around it to signify the priority target.

TRACK PLOTTING Toggles through the active targets to allow selection of one of them to leave a trail of its previous positions on the screen. The trail marks are cyan colored dots. The length of the trail can be varied by changing the parameter, TRACK LENGTH. The trail is not displayed while a target is off screen, i.e., target distance is greater than the full scale distance; thus the target is drawn at the edge of the screen and a dotted line is drawn to the target. To erase the dots press CANCEL while in the main menu.

TRACK LENGTH Used in conjunction with TRACK PLOTTING. The TRACK LENGTH can be varied from 1 to 255. The default setting is 255 points. Any other value entered will not be saved when the C/DM is powered down.

COMPASS DISPLAY FORMAT

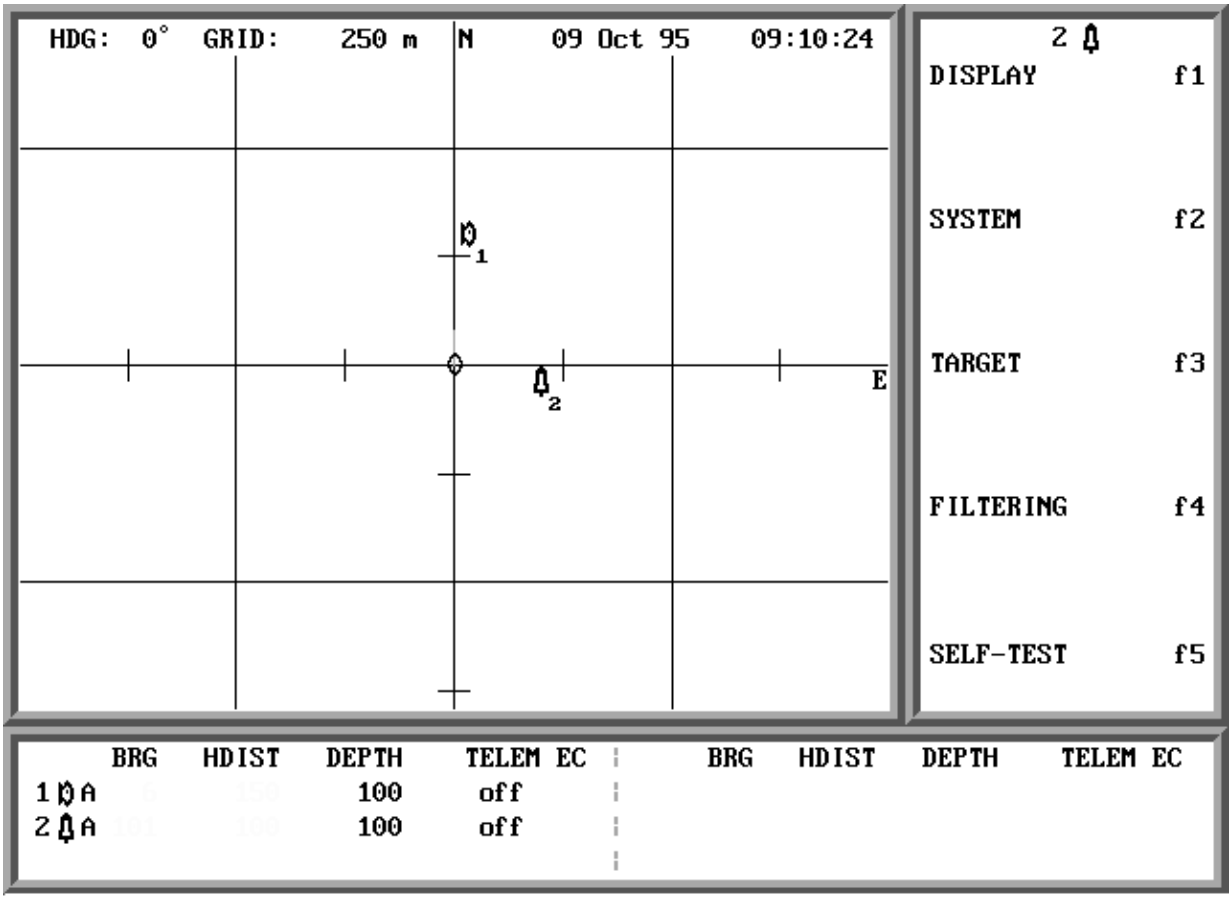


Figure 3-13

VESSEL LENGTH/WIDTH — These two functions allow a graphic representation of a vessel displayed on the screen proportional to the grid scale. This function is enabled when a value other than zero is entered as a vessel length and width. This function is only available when in boat-centered mode. If "0" is entered as either a vessel length or width the symbol is turned OFF, anything else = ON. The vessel rotates with respect to the compass input. If the vessel size that has been entered is too small to draw with respect to the grid size, an error message appears, "Boat Symbol Would Be Too Small To Draw," at which point it is possible to CANCEL from this menu selection and a minimum vessel size is drawn on the screen or the vessel size can be increased to appear proportional to the screen. Both the LENGTH and WIDTH must be within the proper limits to draw the symbol on the screen. If it is more important to show vessel size than the full scale dimensions, then the Grid Scale can be decreased until the vessel symbol appears on the screen. If the symbol is too large for the grid then an error message appears, "Boat Symbol Would Be Too Large For Grid," at which point a decrease in vessel size could be entered until the maximum vessel size could fit on the screen. The vessel is always centered on the grid. Hydrophone offsets can be entered to show the hydrophone with respect to the vessel. See Figure 3-14.

NOTE: The vessel is always drawn in the center of the grid. The target data shown in the Status Block is referenced to the pitch/roll center of the vessel. The target data on the RS-232 port is referenced to the antenna offset point.

HARDWARE — Selects next set of menus to allow changes in the HARDWARE setup such as the RS-232 communication ports.

COM1 SETUP — The following parameters are set for use with the communications port #1, RS-232 interface (rear panel 25-pin female D-connector):

- BAUD RATE — prompts for the bit-per-second rate of data transfer that the external receiving device requires. (300, 600, 1200, 2400, 4800, 9600 or 19200)
- DATA BITS — prompts for the number of bits per character. (7 or 8)
- STOP BITS — prompts for the number of timing bits appended to each character. (1 or 2)

COM2 SETUP — Set up COM2 to allow input of NMEA data sentences for compasses. This port is wired as a DTE and requires a null modem to interface to a PC. The following parameters are set for use with the communications port #2, RS-232 interface (rear panel 9-pin male D-connector):

- BAUD RATE — prompts for the bit-per-second rate of data transfer that the external receiving device requires. (300, 600, 1200, 2400, 4800, 9600 or 19200)
- DATA BITS — prompts for the number of bits per character. (7 or 8)
- STOP BITS — prompts for the number of timing bits appended to each character. (1 or 2)

NOTE: See section 3.12 for more details on use of the RS-232 interface.

PRIORITY TARGET / VESSEL LENGTH & WIDTH

Target number 3 is the priority target and is moved to the top of the status block.

The vessel symbol is shown above drawn to 350 meters in length and 100 meter in width. The Hydrophone symbol is shown with a "X" offset of 60 meters and a "Y" offset of -50 meters.

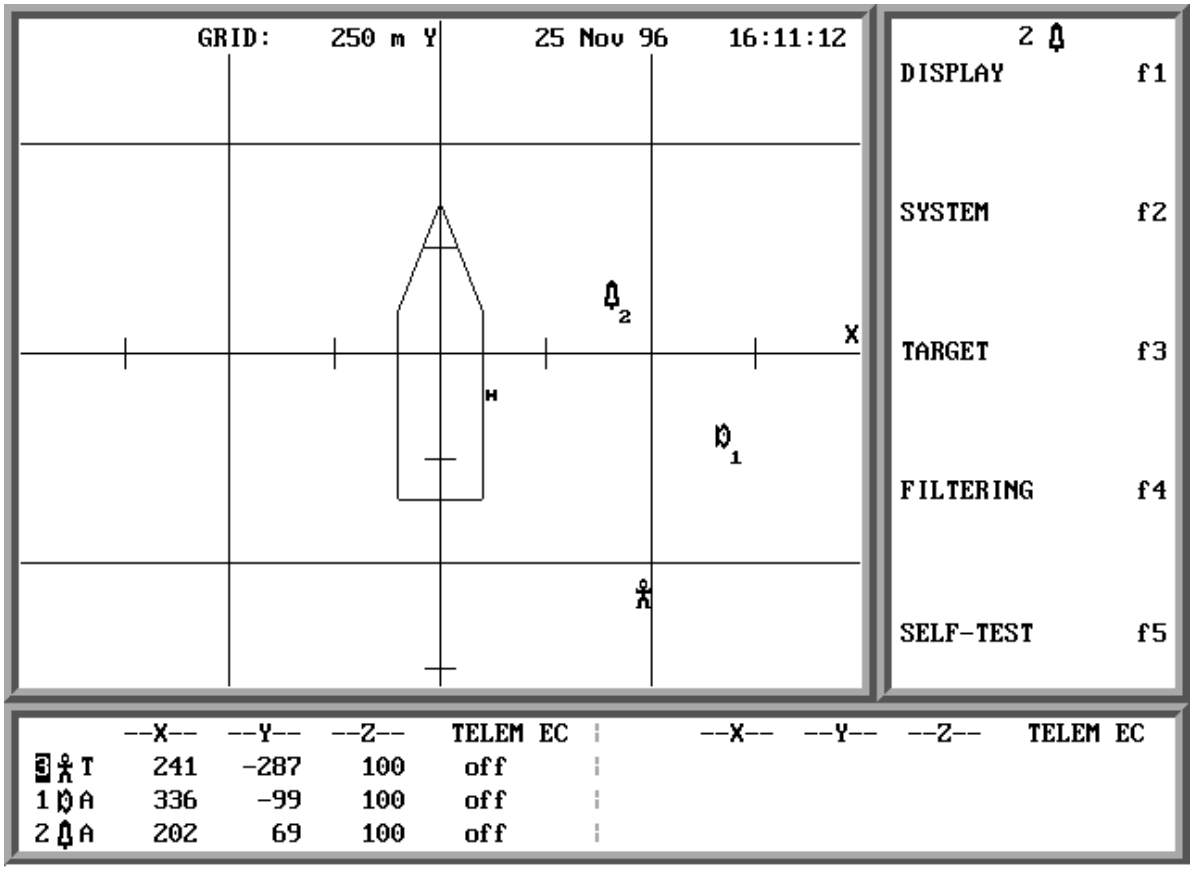


Figure 3-14

RS-232 OUTPUT Selects next set of menus to allow changes in COM#1's output parameters.

TGT POS UNITS Controls the COM#1 RS-232 data sentence units of measure. Toggles between meters, feet and yards. The data sentence header on the RS-232 is changed to reflect the selected unit of measure. (Press the ENTER key from the main menu or from a terminal connected to the COM#1 port type CTRL-E to output a header on the RS-232 port.) This unit of measure is separate from the "Displayed Units of Measure". Refer to section 3.4.1 DISPLAY/SCALING/UNITS.

NOTE: The feet, yards and meters UNITS of measure are saved when power is removed from the C/DM, and therefore the system reverts to the previously selected units when unit is powered up again.

TGT POS O/P FMT The various formats include; STANDARD, STANDARD-EC, STD W/PR, STD-EC W/PR, NCSC, NCSC-EC, NMEA TTM, NMEA ORE, REV 4 and REV 4-EC. Format STANDARD is the 66-character sentence length (not including <CR><LF>) containing only data that is valid, e.g., does not output data if in error or no data present. Only warning codes are sent out the RS-232 with this format. Format STANDARD is the normal format. Format STANDARD-EC is a 66-character sentence length also but outputs data even though it was determined to be invalid, under the premise that the interfacing equipment/software has been programmed to extract the good data from the sentence and ignore the data as flagged by the error code.

Format STD W/PR and STD-EC W/PR is the same as the Format STANDARD and STANDARD-EC, but has two more parameters added to the end of the sentence, Roll & Pitch, to create a 78-character line (not including <CR><LF>). Refer to section 3.12.3, RS-232 Data Output Formats.

Format REV 4 is a 40-character sentence length (not including <CR><LF>) containing only valid data, no warning or error codes. Format REV 4-EC is a 43-character sentence length (not including <CR><LF>) containing error codes as in format STANDARD-EC above. Refer to section 3.12.3, RS-232 Data Output Formats.

Formats NCSC and NCSC-EC are compatible with the NCSC format from the Trackpoint firmware revision 8.05. The NCSC format only outputs valid data while the NCSC-EC outputs the invalid data along with an error code. It is a 73-character long sentence, not including <CR><LF>. It also has a binary checksum within the sentence as opposed to the XOR NMEA type checksum. Refer to section 3.12.3, RS-232 Data Output Formats.

Format NMEA TTM follows the NMEA 0183 Version 2.1 Tracked Target Message format. It is a 51-character sentence length maximum, not including <CR><LF>. It is prefixed by the characters "SN" identifying it as an electronic positioning system. See example below. Refer to section 3.12.3, RS-232 Data Output Formats.

Format NMEA ORE is a proprietary NMEA 0183 sentence length of 78 characters maximum, not including <CR><LF>. It follows the sentence structure for a NMEA 0183 version 2.1 proprietary sentence. Refer to section 3.12.3, RS-232 Data Output Formats.

Both NMEA formats follow the NMEA 0183 sentence structure even though the hardware is not to EIA-RS-422 specifications. An adapter can be added to the Trackpoint's serial port to convert the RS-232 I/O to a RS-422 I/O if required. The NMEA standard uses the following parameters:

Baud Rate	4800	Data Bits	8
Parity	None	Stop Bits	One

These parameters can be changed within the C/DM under the SYSTEM/HARDWARE/COM1 SETUP menu. For further information on the NMEA standard contact the NMEA National Office, PO Box 3435, New Bern, NC 28564-3435 U.S.A.

NOTE: The selected Format is saved when the C/DM is powered down. The C/DM reverts to the previously selected Format when unit is powered up again.

Old Formats		New Formats
FORMAT 1	aka	Rev 4
FORMAT 1EC	aka	Rev 4-EC
FORMAT 2	aka	Standard
FORMAT 2EC	aka	Standard-EC
FORMAT 3	aka	Std w/pr
FORMAT 3EC	aka	Std-EC w/pr
	New	NCSC
	New	NCSC-EC
	New	NMEA TTM
	New	NMEA ORE

COM1 INTERVAL prompts for the repetition interval of RS-232 output in seconds for pinger operation or transponder operation if the error code #6, "No Valid Reply", occurs when "EC" Formats are selected.

COM1 DATA OUT toggles the RS-232 data output sentence on or off. No data is sent out the RS-232 when turned off but commands can be performed via the RS-232 port. The COM1 DATA OUT command performs the same function as the CTRL-T (disable data output) and CTRL-R (re-enable data output) from the RS-232 commands.

3.4.3 TARGET PATH (f3)

The TARGET path is used to set all parameters associated with the individual targets, and to turn tracking on or off. The sub-menu presents the following options:

CHOICE presents a two-page menu of target symbols. The symbol options are the FISH, BELL, DIVER, and SQUARE, which appear on the first page of the menu with a MORE....option. The BLOCK, DIAMOND, STAR, TRIANGLE and SUB appear on the second page.

REPLY DATA presents the following menu of target reply variables to be set for the chosen target:

FREQUENCY — prompts for the output frequency of the beacon assigned to the chosen target symbol.

TYPE — presents a sub-menu of the three types of beacons that can be used with the Trackpoint II:

PINGER, TRANSPONDER and RESPONDER. Select the appropriate function key to indicate which type of beacons the chosen target represents.

- PINGER — If PINGER is chosen, enter the appropriate repetition rate of the Pinger (from 4320A Multibeacon manual if applicable).
- TRANSPONDER — If TRANSPONDER is chosen, enter the turnaround time as shown on the label of the transponder. Refer to section 3.5.2.
- RESPONDER — presents a sub-menu for the type of responder using. The PULSE responder is the normal type where a key pulse is sent down an umbilical to trigger the unit utilizing the NORM or ISOLATED key out from the rear of the Trackpoint. The BURST or tone mode is for when triggering a responder using an acoustic tone from the Trackpoint's transmitter through an umbilical. Refer to section 3.5.3.
  - PULSE — If PULSE RESPONDER is chosen, enter the turn-around time as shown on the label of the responder.
  - BURST — If BURST RESPONDER is chosen, enter the turn-around time as shown on the label of the responder.
- ARTIFICIAL — Changes mode of selected target to allow positioning of target on screen via RS-232 or keypad entry. Refer to section 3.5.4.
  - BEARING — Manual entry of artificial target's bearing (relative to Trackpoint hydrophone).
  - HORZ RANGE — Manual entry of artificial target's horizontal range (relative to Trackpoint hydrophone).

USE DATA ABOVE — Enables artificial target mode if no settings require changing.

NOTE: If an artificial target is selected the target position is output the RS232 at the "RS232 OUT" rate.

FISH TRACK is an ON/OFF toggle type function. The “Fish Track” mode is an easy method for setting up a target for tracking a towfish. When “Fish Track” mode is enabled it automatically sets the SYSTEM parameters to the following; changes Grid to rectangular, moves the “Y” Axis Offset to +70%, displays small boat on the screen for the vessel symbol (offsets the center of the grid so that the vessel is at the top of the screen and the towfish at the bottom), sets the chosen target to the Priority Target and sets the display Status Format to X,Y,Z,SR. It also changes the chosen TARGET parameters to; Filter Level 6, Smoothing 5, Bearing Limit 135° to 225°, Minimum Xponder Range 1m, Maximum Slant Range 1000m and target Depth Mode to INPUT. A line is drawn from the vessel to the Fish Tracked target signifying a cable or umbilical when in Fish Track mode. This shows that the system is in Fish Track mode.

When one of the target‘s Fish Track mode is enabled all other targets are turned off. Target centered mode is not available in Fish Track mode. If the compass mode is enabled the displayed target remains relative to the vessel while a line emanating from the boat symbol represents North. The bearings shown in the Status Block are relative to vessel while the RS232 data remains relative to North, as it normally would with the Compass mode enabled. The polar grid is locked out. You cannot re-enable it. The rectangular grid % offset can be changed. The filtering parameters can be changed. Once another target has been enabled the priority function can be changed to this target.

When Fish Track mode is disabled, the Max Slant Rng is returned to 0, bearing limits are reset to 0 and the gird returns to polar if previously set. If any other targets were enabled prior to Fish Track being enabled they are not turned back on. To revert back to normal mode from fish track mode you can either reset and come back up in DEFAULTS or individually change the parameters that were forced into the Fish Track settings as shown above.

DEPTH presents a new menu page, with a choice of MANUAL, ANALOG or TELEMETRY. The depth MODE can also be selected. If DISPLAY/SCALING is set to meters, then the depth input under manual or analog are also assumed to be in meters; if in feet then depth is assumed to be in feet, etc. The TELEMETRY depth is always assumed to be input in meters. If the DISPLAY/SCALING is set to feet, the display status block will show the depth value reconverted to feet. The MODE function allows the operator to decide whether to use the INPUT depth (manual, analog or telemetry) or have the system CALCULATE the depth (depression angle from the horizontal > 45°). E.g., if a transponder has depth telemetry capability, select INPUT depth MODE for that target.

NOTE: When selecting analog or telemetry depth, the depth mode is set to INPUT. If in telemetry mode and the telemetry signal is lost or out of range, the system reverts to CALCULATED mode and uses the manually entered depth.

MANUAL In the MANUAL mode, depth is input via the keyboard. The value entered is the depth from the water surface to the sound source (Pinger, Transponder or Responder). The default depth mode for manual entry is CALCULATED. If INPUT MODE is necessary then toggle the MODE back to INPUT. It then remains in INPUT mode for the subsequent manual depth entries. A manually entered depth value is displayed in the status block in the same color as the TEXT.

NOTE: A manually inputted depth can also be from the RS232 port. (CTRL-D-*trgt #-depth*, refer to section 3.12.5.1)

ANALOG If ANALOG Depth is selected another menu pertaining to the analog voltage parameters is displayed (see below). The analog voltage that is proportional to the depth is input to a BNC on the rear of the Trackpoint. When the system is using the analog depth in its calculations for Horizontal Range an "A" is displayed next to the depth in the status block.

NOTE: This depth is averaged. For greatest resolution, it is suggested 0-6V be used to represent the full operating range of the depth sensor.

MINIMUM VOLTAGE Enter the minimum voltage applied to the rear panel depth BNC. This voltage represents the shallowest depth as entered under minimum depth. Typically the shallowest depth is zero and the voltage is also zero, but a re-scaled depth sensor could be used where its operating range is from 100-400 meters and its proportional voltage is 1.0 VDC to 4.0 VDC; also, the minimum voltage could be adjusted to calibrate the system at the surface to produce a zero depth.

MAXIMUM VOLTAGE Enter the maximum voltage applied to the rear panel BNC. This voltage represents the greatest depth as entered under MAXIMUM DEPTH. The maximum input voltage is +6 VDC.

MINIMUM DEPTH — Enter the minimum depth which the minimum voltage represents, e.g., 0V = 0m depth.

MAXIMUM DEPTH — Enter the maximum depth which the maximum voltage represents, e.g., 6V = 100m depth.

USE DATA ABOVE — Upon entering the menu, if the analog parameters are already set correctly for the depth sensor; then press this function to initiate ANALOG DEPTH. If a parameter "above" is changed, then ANALOG DEPTH function is automatically enabled.

TELEMETRY — In the TELEMETRY mode the depth is taken from a depth telemetering transponder. The transponder sends two replies to the Trackpoint II per interrogation. The first reply signal is used to determine slant range and bearing, while the second reply (whose delay from the first is proportional to depth) is used in the depth calculation. Given these three parameters a three-dimensional position fix is calculated.

Another menu is used in conjunction with DEPTH/TELEMETRY. Under each target's submenu of REPLY DATA, there is a function called TELEMETRY. It contains parameters to allow the operator to turn telemetry on or off, change the telemetry reply frequency, and also to change the zero delay, full-scale delay and span (see REPLY DATA/TELEMETRY below for further explanation).

When DEPTH/TELEMETRY is selected, the REPLY DATA/TELEMETRY function is automatically turned on. The operator only has to call up this menu if parameter changes are necessary. When DEPTH/TELEMETRY is selected a 'T' appears next to the depth value (value appears white) in the status block when the telemetered value is being used in the horizontal range calculations. (see Figure 3-11) If the system is using a calculated depth (mode set to CALC) then a `C' appears next to the depth value. If REPLY DATA/TELEMETRY is turned off while DEPTH/TELEMETRY is selected then the white numerals corresponding to telemetry depth change to the selected grid color, and the system reverts to the manually entered depth. Also if the depth telemetry replies are not received, then the target depth automatically defaults to the manually entered depth. If telemetry replies return, system reverts back to depth telemetry. If not using DEPTH/TELEMETRY then depth should be changed to Manual or Analog (refer to section 3.2 for default parameter settings and Appendix A for table of data ranges and units).

MODE — This option is valid for responders and transponders only. Toggles between INPUT depth MODE and CALCULATED depth MODE. (If a pinger is enabled then the MODE is automatically set to INPUT.) This function allows the operator the flexibility to have the system use the system CALCULATED depth or use the INPUT depth. For example, if the depth of the transponder is known either via an analog sensor, telemetered data or other source that could be

entered manually, then the INPUT depth MODE setting would be appropriate. The system then uses the input depth and the slant range to calculate the horizontal range; refer to section 4.0 for calculations.

MODE - INPUT

When using INPUT mode a relatively large horizontal distance error can occur when the depression angle from the horizontal approaches 90 degrees (target below boat) and there is a discrepancy between the slant range as determined by Trackpoint, and the INPUT depth. To remedy this potential error situation, the Trackpoint considers the transponder or responder as if it were a pinger when the depression angle is greater than 70 degrees; INPUT depth and measured depression angle (rather than slant range and measured depression angle) are used to calculate horizontal range. A warning code is displayed in the status block, and on the RS-232 data, if the INPUT depth and the calculated depth are not within 2% of each other when crossing the 70° depression angle boundary. (A hysteresis of three replies is necessary before system determines transponder has crossed boundary.) This is to warn the operator that a potential error in horizontal range could occur, either due to sensor inaccuracy or incorrectly inputted manual depth (See error code 50, section 3.15). Measured (not calculated) slant range is displayed in the status block and on the RS-232 data.

When INPUT mode is selected along with either ANALOG or TELEMETRY DEPTH, the system compares the measured depression angle against the calculated depression angle (using Slant Range and Depth) to determine horizontal range calculations. If the measured depression angle is greater than 70 degrees but the calculated depression angle (using slant range and depth) is less than 45 degrees then the system does not consider the transponder as a "pinger" (using depression angle and depth to calculate HR) but continues to use slant range and depth to calculate horizontal range. If this situation occurs then an error code 60 is displayed.

MODE - CALCULATED

If CALCULATED depth is selected, then the depth is calculated from the measured depression angle and slant range when the measured depression angle is greater than 45°. When the calculated depth is being used in the horizontal range calculations a ‘C' appears after the depth value in the status block. If the transponder's depression angle is less than 45° then the system reverts to the INPUT depth (manual, analog or telemetry) and a warning code 56 is displayed to indicate that the depth is no longer being calculated. A warning code is displayed in the status block, and on the RS-232 data, if the INPUT depth and the calculated depth are not within 10% of each other when crossing the 45° depression angle boundary. (A hysteresis of three replies is necessary before system determines transponder has crossed boundary.) This is to warn the operator that an error in horizontal range could occur, either due to sensor inaccuracy or incorrectly inputted manual depth (See error code 50, section 3.15).

LAST POSITION

The function key corresponding to LAST POSITION is another toggle function, which, when selected, shows the last tracked position of the target displayed at the top of the menu block. If the target has not yet been tracked, selecting LAST POSITION results in an error message stating this. Following an error code six, "NO VALID REPLIES," a target which has LAST POSITION enabled remains on the screen but has its target color changed to cyan.

TELEMETRY

With DATA/TELEMETRY turned on, but DEPTH/TELEMETRY turned off, the Trackpoint can be used to collect arbitrary data from a suitably equipped telemetering transponder. The delay time between the two replies of a telemetering transponder can be configured to be proportional to, for example, roll, pitch, heading (compass), altitude, etc. In this case transponder depth input must be either manual or analog, but not telemetered. DATA/TELEMETRY must be turned on and the related parameters set up for the device used. When TELEMETRY is selected the following page of sub-menus is called.

NOTE: Only transponders or responders can be telemetering devices. The telemetry data received is displayed in the status block (see Figure 3-13) and also sent out the RS-232 port.

NOTE: Up to six telemetry functions can be tracked at one time, e.g., six depth telemetry transponders or six telemetry specials such as pitch and roll, or any combination of these.

TELEMETRY ON/OFF	This key toggles the telemetry function ON or OFF for each target. When DEPTH TELEMETRY is selected this function is automatically set to ON and uses default or previously set parameters. If DATA TELEMETRY is turned OFF while the DEPTH-TELEMETRY is still ON, the status display shows the 'T' next to the depth, but the depth value changes color from white to the selected text color. This is a warning to let the operator know that the last depth value received is being used in the calculations. If not using DEPTH TELEMETRY, then DEPTH should be changed to MANUAL or ANALOG.
FREQUENCY	Input the telemetry frequency. Enter the frequency in kHz. Default is 1 kHz below navigation frequency.
ZERO DELAY	Input the delay that represents zero for the telemetry data. Enter time in milliseconds. Range adjustable from 50 ms to 500 ms.
FULL-SCALE DELAY	Input the full scale delay for the telemetry device (the delay is timed from the first reply not the Zero Delay). Enter time in milliseconds. The full scale delay can range from 500 ms to 1,500 ms.
SPAN	Span sets the range for which the delay is proportional to. The span can range from 1 to 5,000 units.

TRACKING This key acts as a toggle to turn tracking on or off for the target symbol displayed at the top of the menu block.

INTEROGATE DATA Select to set up target interrogation parameters. Used for transponders and responders.

FREQUENCY	prompts for the interrogation frequency of the transponder.
REP INTERVAL	prompts for the repetition interval (time in seconds between transmit pulses).
PULSE WIDTH	prompts for the length (in milliseconds) of the transmit pulse.

NOTE: The transmitter output power can be varied by changing the plug-in jumper on the transmitter board (full output 500W, reduced output 100W). Refer to drawings 4410BS0047 and 4410BA0047.

ALARMS

The following five alarms can be set for each target being tracked. (Refer to section 3.10 for a detailed explanation of alarm functions.)

SLANT RANGE	prompts for the distance (in meters, feet or yards) beyond which the alarm is to sound.
DEPTH	prompts for an alarm depth, as above.
BEARING	prompts for two bearings, which define an area (from the first to the second bearing in a clockwise direction) to sound the alarm. The ENTER key must be pressed between entry of the first and second bearing.
ELAPSED TIME	prompts for the time (in minutes) before the alarm sounds.
TELEMETRY	prompts for the telemetry data limit beyond which the alarm is to sound.

NOTE: When alarm has tripped all tracking ceases and the system awaits an operator input to either ACKNOWLEDGE alarm or CANCEL it.

3.4.4 FILTERING PATH (f4)

FILTERING path provides operator a choice of various combinations of smoothing, filtering, threshold settings and also limits on certain parameters. Filtering includes smoothing (averaging), target velocity checking, range gating, signal threshold, minimum xponder range, maximum xponder range, bearing limits and signal rejection via signal quality checking. The filtering parameters are individual per target that is to say each Target has its own smoothing, filter level, threshold, limits and QF filtering settings. The target symbol at the top of the menu block corresponds to which target the filter parameters are modifying. **Refer to section 3.7 and 3.8 for description of filtering function.**

SMOOTHING

The Smoothing parameter is variable from 1 to 10 along with a selection for OFF. It is independent of the Filter Level setting in that you can select the buffer size in which to smooth or average a number of replies over (1-10). This setting corresponds to the number of replies that are averaged along with the present reply. The Smoothing (averaging) routine is used in conjunction with the QF (Quality Factor) and the Filter Level. With a high quality factor the target position is weighted heavily both on the present reply and on the previous replies in the averaging buffer. If the present reply has a high QF and the previous reply had a low QF then the position with the high QF remains heavily weighted within the averaging buffer. As new replies are received the high QF positions maintain their heavier weight while the positions with lower QF's have very little weight. The weights of the target positions are reduced as the newer replies are received. Refer to section 3.7.

FILTER LEVEL

The Filter Level setting is variable from 1 to 10. The lower settings are for dynamic tracking situations while the higher settings are for stationary tracking (station keeping) scenarios. The parameter settings for the range gate and velocity filter "tighten up" as the Filter Level is increased with the premise that dynamic targets such as AUV's can change position quickly with respect to the vessel while static targets such as a tow fish or other moored targets do not. This function requires accurate input of the repetition rate if the beacon is a Pinger under the target menu. Refer to section 3.7. Also see error codes #2 and #5.

THRESHOLD The threshold key steps through four threshold settings for each target: LOW, MED-LOW, MED-HIGH and HIGH. This function only affects the CHOSEN target. As the threshold level is increased, only stronger signals are accepted, and weak signals, which could be caused by multi-path or extraneous noise in the water, are ignored. Refer to section 3.8.

NOTE: Use the lowest possible threshold setting that will prevent noise from falsely triggering the detector. LOW is the normal setting.

LIMITS presents the operator with a sub-menu of parameters to affect filtering. The LIMITS function is independent for each target.

MIN XPNDER RNG — The MIN XPNDER RNG (Minimum Transponder or Responder Range) function works in conjunction with the range gating system. This parameter sets a minimum value on the slant range to a target. It overrides the minimum range gate preventing early signal arrivals from being detected. The Minimum Xponder Range parameter can vary from 0 to 1000 meters. Setting the MIN XPNDER RNG parameter to zero (0) disables this function. Refer to section 3.7. Also, see error code #7.

MAX SLANT RNG — The MAX SLANT RNG (Maximum Slant Range) function compares the reply's slant range against this value. If the slant range is greater than the entered value the last good reply remains on the display. The Maximum Slant Range parameter can vary from 0 m which is OFF to a minimum value of 10 to a maximum of 8000 meters. Refer to section 3.7. Also, see error code #14.

BEARING LIMITS — The BEARING LIMIT function is enabled only in Fish Track mode, when the angle to the target is fairly well known. This function is a final check after the range gate and velocity filter are satisfied. The Fish Track mode automatically enables this function and sets these limits from 135° to 225°. These limits are always referenced to the vessel, whether compass mode is ON or OFF. The default values for the bearing limits are 0° to 0°, which disable the function. Refer to section 3.7. Also, see error code #15.

NOTE: If the system shows a continuous error code #15 press the HELP key to have the system update the target position on the screen. This allows the operator to see where the target really is and decide whether to reset the bearing limits accordingly or take other action with the target/vehicle.

QF FILTERING toggle function; turns QF Filtering on or off. For Filter Levels 1-5 the QF FILTERING function is automatically turned off. For Filter Levels 6-10 the QF Filtering function is turned on. This switch allows the operator to override this setting to suit the particular tracking application.

This function filters the data depending on the Quality Factor of the signal received. It is an individual function for each target. When "QF FILTERING" is "ON" and the Quality factor is less than the average of the last five QF's the data is not plotted. When "QF FILTERING" is "OFF" and the Quality factor is less than the average of the last five QF's the data is plotted on the screen and sent out the RS232 but the data is tagged with an error code #64 on both the display and RS232.

3.4.5 SELF-TEST (f5)

The SELF-TEST option of the basic menu pre-empts all other operation while the system cycles through a series of self-diagnostics. When SELF-TEST is selected, another menu is presented. This menu contains two choices of SELF-TEST: COMMAND UNIT and XMIT & RCV/DET. The COMMAND UNIT tests certain functions on the CPU/VGA and Signal Processor boards located in the C/DM. The XMIT & RCV/DET tests the data acquisition portion of the Signal Processor board.

NOTE: Self test does not test the Hydrophone or VRU/Amplifier or external cabling. These tests must be accomplished by either in-water or air testing using known good transponders, responders or pingers. See section 5.2 for details.

COMMAND UNIT A message appears on the command line instructing the user to press the ENTER key to begin diagnostics, or the CANCEL key to cancel the SELF-TEST selection (helpful if SELF-TEST is selected unintentionally). If the operator selects the ENTER key, the screen displays the tests performed in the SELF-TEST mode and indicates the test in progress. See Figure 3-15. To halt the SELF-TEST function, press ENTER. SELF-TEST stops when the test in progress is finished. Press ENTER again to resume testing, or CANCEL to exit the SELF-TEST mode.

NOTE: The CANCEL key does not interrupt a test in progress, which may take as long as 20 seconds to complete, although it does cause the system to exit the SELF-TEST mode when the current test is finished.

After exiting the COMMAND UNIT SELF-TEST mode, the system resets to the start-up menu of PREVIOUS SETUP and DEFAULT SETUP options. The system automatically reverts to the Previous Setup, 10 seconds after the start-up menu appears, if no key is pressed within that time.

COMMAND UNIT SELF-TEST DISPLAY

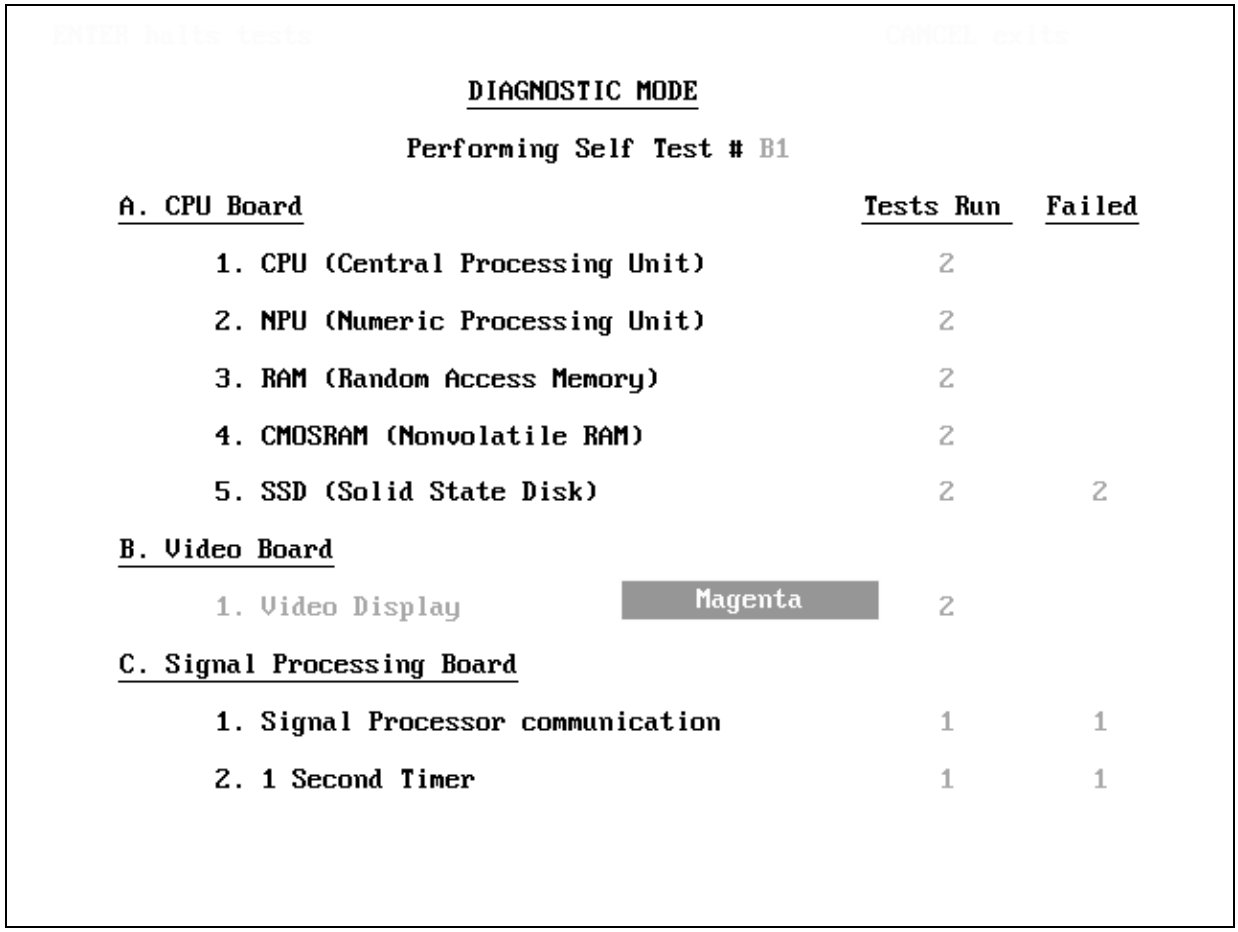


Figure 3-15

XMIT & RCV/DET

This test prompts for a frequency (in kHz) in which the Signal Processor functions are tested. Type in a frequency from 4.5 to 40 (kHz) and press ENTER.

The test begins by enabling target #1 (FISH) only, all others are turned off for this test. The green transmit and key LED's both flash at the transmitter repetition rate. The transmit and receive frequencies are set to the frequency entered when initiating the test. The red receiver LED's both flash a short time following the transmit signal, signifying proper receiver/detector operation for both receiver channels. This also confirms proper operation of the transmitter rate and output frequency.

The target is displayed in the center of the screen (X & Y or HDIST data ≈ 0.0) with a slant range of approximately 55 meters when a 15 ms turnaround delay is entered for that target. This confirms operation of slant range counter and phase counters. If the lamps indicate as above and the target position is steady in the center of the tracking display (X & Y or HDIST data ≈ 0.0), then the Signal Processor board PASSES the self-test.

NOTE: The calibration data is not used when in this mode. Also, if hydrophone offsets are used the target goes to the "H" symbol on the screen.

3.5 TRACKING PINGERS, TRANSPONDERS and RESPONDERS

The revision 9 Trackpoint II firmware has the capability to track up to 6 targets utilizing the two receiver detector channels. "Multiple Target Tracking" consists of a maximum of any of the following combinations of target types that can be enabled at one time (each transponder or responder can also include telemetry):

6 transponders
5 transponders and 1 responder
5 transponders and 1 pinger
4 transponders, 1 responder and 1 pinger
2 pingers

To track multiple targets the Trackpoint can sequence through the reply frequencies while interrogating on one frequency, or it can sequence through the interrogation frequencies and receive the same reply frequency, or a combination of the two. This capability provides the operator with the versatility to track various combinations of targets.

Example #1:
Transponder #1 - Interrogation Freq.: 16 kHz, Reply Freq.: 23 kHz
Transponder #2 - Interrogation Freq.: 16 kHz, Reply Freq.: 25 kHz
Transponder #3 - Interrogation Freq.: 16 kHz, Reply Freq.: 27 kHz
Transponder #4 - Interrogation Freq.: 16 kHz, Reply Freq.: 29 kHz
Pinger Reply Freq.: 22 kHz

In the example above, a potential problem exists if any transponders are very close to one another, i.e., less than 2 meters (at a normal pulse width of 1.3 msec). This would cause acoustic interference resulting in erroneous position data.

NOTE: If the repetition interval is set to 2 seconds, the Trackpoint updates each transponder position every 8 seconds.

Example #2:
Transponder #1 - Interrogation Freq.: 16 kHz, Reply Freq.: 25 kHz
Transponder #2 - Interrogation Freq.: 17 kHz, Reply Freq.: 25 kHz
Transponder #3 - Interrogation Freq.: 18 kHz, Reply Freq.: 25 kHz
Transponder #4 - Interrogation Freq.: 19 kHz, Reply Freq.: 25 kHz
Pinger Reply Freq.: 29 kHz

Example #3:
Transponder #1 - Interrogation Freq.: 16 kHz, Reply Freq.: 23 kHz
Transponder #2 - Interrogation Freq.: 17 kHz, Reply Freq.: 25 kHz
Transponder #3 - Interrogation Freq.: 18 kHz, Reply Freq.: 27 kHz
Transponder #4 - Interrogation Freq.: 19 kHz, Reply Freq.: 29 kHz
Pinger Reply Freq.: 30 kHz

NOTE: The Pinger reply frequency must never be the same as any of the transponder frequencies.

3.5.1 PINGER MODE

NOTE: Menu selections and data entry apply to the target displayed at the top of the menu block, and only to that target. Always be certain that the correct target symbol is displayed before entering target data.

Assign a Frequency and set target type.

In order for the system to track, the target must be assigned the correct frequency. From the basic (main) menu, select TARGET. From the sub-menu, select REPLY DATA. When FREQUENCY is selected from the sub-menu of specific parameter options, the system displays the current setting and prompts for input. If a new frequency is to be entered, key in the value using the keypad and ENTER key (see note below). If the current frequency setting is correct for the pinger in use press TYPE (f2) to display the target type menu. Press PINGER (f1) to select pinger mode. The display prompts the operator to input the repetition rate of the pinger in use in milliseconds. For example, for pinger with a 2-second rate, enter 2000.

NOTE: The maximum repetition rate for a pinger is 1 pulse per second. Press CANCEL to return to the basic menu.

NOTE: The new value keyed by the operator appears in the command line. If a wrong number is keyed, press CANCEL. When the correct value has been keyed, press the ENTER key. The new value is immediately put into effect. Should you attempt to enter an improper value, the system informs you of that fact and awaits a proper input. The keypad has a buffer associated with it. Keys can be pressed in succession without waiting for menu to actually change. If keys are pressed too rapidly the Trackpoint II System will not respond to it. (Refer to Appendix A for accepted parameter ranges.)

Turn Tracking On

To begin tracking your target, tracking must be turned on. Again, select TARGET at the basic (main) menu. The TARGET menu displays TRACKING as the f3 choice, with "off" as the current setting. Select the TRACKING function key to change the setting to "on."

At this point the system is tracking, and you should observe all of the following:

- Target position displayed on the tracking grid, represented by the chosen target symbol.
- The chosen target symbol appearing in the status block.
- Horizontal distance (range) and bearing information being updated for that symbol in the status block.
- The bottom red LED in the top left corner of the display flashing once for each received ping.
- Audio signal corresponding to flashing LED. (Adjust Audio dial on front panel if signal cannot be heard.)

Set Target Depth

If the Trackpoint II system is not hardwired to an external depth sensor, it is necessary to enter manually the target depth, so that the system can correctly compute the horizontal position (range) to the target.

Select TARGET/REPLY DATA to bring up the sub-menu DEPTH. When MANUAL is selected, the default setting is displayed and the system prompts for input. Enter the pinger's depth below the water surface, or press CANCEL if the default value is to be used.

NOTE: The default unit of measure is meters. If measurements are to be made in feet or yards, refer to section 3.11.3, Changing Unit of Measure, before entering values.

The status block should now be displaying accurate range and bearing readings for the target. If bearings appear erratic refer to section 3.7 FILTERING and section 3.8 THRESHOLD. If tracking problems still exist refer to section 3.14, ACOUSTIC PROBLEMS AFFECTING OPERATION.

When ANALOG is chosen, a new menu page is presented which allows the operator to set various parameters regarding the depth sensor being used (see section 3.4.3).

Tracking a Second Pinger

To establish simultaneous tracking of a second pinger, repeat the steps above. You must choose a different target symbol for the second pinger, and that second target symbol appears in the menu block while frequency and depth are assigned. Tracking must be turned on for the second target symbol as well.

When you have completed the setup procedure for the second pinger, you should observe both targets in the tracking window and both target symbols in the status block at the bottom of the display. Both symbols should have range and bearing information being continuously updated, both red LED's should be flashing in the top left corner of the display screen, and two separate audio signals should be heard, corresponding to each of the flashing LED's.

Display Configuration

During setup, it may be helpful to the operator to display a table of current settings and parameters for reference. This is accomplished by selecting DISPLAY from the basic menu, and CONFIGURATION from the sub-menu of display options. Current target parameters, system parameters or alarm settings may be displayed. The ALL TARGETS configuration produces a table of current target values in the tracking window, allowing the operator to verify at a glance the settings that have been input (see Figure 3-8). The CHOSEN TARGET configuration produces a more detailed table of only the chosen target parameters (see Figure 3-10). Notice that the target remains on the screen, and the status block continues updating. To return the tracking window to the original grid configuration, press the CANCEL key.

3.5.2 TRANSPONDER MODE

To establish tracking in the transponder mode, you must have the proper interrogation transducer and transponder(s) must be operational and in the water.

NOTE: The interrogation transducer inside the Model 4610B hydrophone has a frequency range of 17 to 20 kHz (see specification section 1.6). The earlier Model 4610A does not contain an interrogation transducer and requires a separate interrogation transducer. This separate interrogation transducer connects to the rear panel "INTERROGATE" connector (see Figure 1-2). The transmitter outputs 500W (HI PWR) into a 300Ω load. Make sure the interrogation transducer used is compatible with the transponders in use.

NOTE: When establishing tracking in the transponder mode, as in the following section, it may be helpful to display a configuration of SYSTEM parameters (see Figure 3-7). Select DISPLAY CONFIGURATION SYSTEM.

DESIGNATE TARGET

Select the target symbol that you want the target to be represented by. Pressing f3 TARGET then f1 CHOICE, presents a two-page menu of target symbols. The symbol options are the FISH, BELL, DIVER, and SQUARE, which appear on the first page of the menu with a MORE.... option. The BLOCK, DIAMOND, STAR, TRIANGLE and SUB appear on the second page.

NOTE: Menu selections and data entry apply to the target displayed at the top of the menu block, and only to that target. Always be certain that the correct target symbol is displayed before entering target data.

ASSIGN FREQUENCY AND SET TARGET TYPE / TURNAROUND TIME

In order for the system to track, the target must be assigned the correct frequency. From the basic (main) menu, select TARGET (f3). From the sub-menu, select REPLY DATA (f2). When FREQUENCY is selected from the sub-menu of specific parameter options, the system displays the current setting and prompts for input. If a new frequency is to be entered, key in the value using the keypad and ENTER key.

NOTE: The new value keyed by the operator appears in the command line. If a wrong number is keyed, press CANCEL. When the correct value has been keyed, press the ENTER key. The new value is immediately put into effect. Should you attempt to enter an improper value, the system informs you of that fact and awaits a proper input. The keypad has a buffer associated with it. Keys can be pressed in succession without waiting for menu to actually change. If keys are pressed too rapidly the Trackpoint II System will not respond to it. (Refer to Appendix A for accepted parameter ranges.)

If the current frequency setting is correct for the target in use press TYPE (f2) to display the target TYPE menu. TYPE calls up a menu of the three sound source options. Press TRANSPONDER (f2) to select transponder mode and enter the turnaround time of the transponder.

NOTE: TRANSPONDER is the default setting, and therefore changing target type is not necessary for operation in the transponder mode when the system is brought up with the DEFAULT settings.

SET UP TRANSMITTER

The transmitter must be set to transmit the interrogation frequencies of the transponders in use (refer to Figure 3-2 and Figure 3-3A for the default settings). When a transponder is selected, the transmitter output is automatically enabled. The parameters that require setting are frequency, repetition interval and pulse width. From the basic menu, select TARGET; from the sub-menu, select INTEROGATE DATA (yes, “interogate” is spelled wrong, it should be “interrogate”, but we were limited to 15 characters for the menu and felt it was a better representation of the parameter rather than try to abbreviate). The default FREQUENCY is present in the menu block. Press the FREQUENCY key to prompt for a new frequency. Use the keypad and ENTER key to input the transmitter frequency. Select XMIT INTERVAL and PULSE WIDTH to change data in the same manner. (XMIT INTVL for a transponder should not be less than 2 seconds; most transponders have a 1.5- to 1.75-second lock-out time built in to prevent interrogation echoes from retriggering the transponder. If interrogating two transponders at different frequencies then its possible to decrease the XMIT INTVL to less than two seconds as the XMIT INVTL for a single target will be the total of the intervals. E.g., interrogate #1 at 17kHz every 1.5 seconds and #2 at 19kHz every 1.5 seconds, the sequence interval for the two targets is 3.0s which is still greater than the lockout time of the transponders. Also keep in mind that when using telemetering transponders the second (telemetry) reply may come in up to one second later than the primary (navigation) reply. Increase interval accordingly.)

NOTE: With ORE Model 4320 and 4330 series of transponders, pulse widths of less than 5 msec may not properly interrogate the transponder. For Model 4350 transponders use a pulse width of 10 ms.

At a XMIT INTERVAL of 2 seconds, a transponder turnaround time of 15 ms and a speed of sound input of 1500 meters/second the maximum range the system could track the transponder would be about 1400 meters. [(1500m/s * (2s - .015s)) / 2 = 1489 m] If a telemetry transponder were used at its maximum range (telemetry delay of 1 second from primary reply) then the maximum range would be reduced further to about 700 meters. [(1500m/s * (2s - 1s - .015s)) / 2 = 738.75m]

INPUT SPEED OF SOUND

The correct speed of sound in the water column between the transponder and the hydrophone must be entered for accurate tracking in the transponder mode. From the basic menu, select SYSTEM; from the sub-menu, select ACOUSTIC FACTORS. When SPEED OF SOUND is selected, the system prompts for input of the sound speed in meters per second or feet per second or yards per second, depending on the current unit of measure.

The speed of sound in the water column is used to determine the transponder range. The average water column temperature is usually different than near-surface temperature (the temperature measured by the hydrophone), and therefore, this speed of sound generally differs from that computed by the operator from a reading of the hydrophone temperature. (The hydrophone temperature is used only to determine the target depression angle correction.) Refer to Appendix A for range of parameters and velocity of sound vs. temperature and salinity charts.

ENTER TARGET DEPTH

The target depth parameter can either be manually entered, telemetered or input via analog-in Depth BNC. From the main menu select TARGET, REPLY DATA, DEPTH. Choose the method used to update the depth parameter. Refer to section 3.4.3 for descriptions of depth input and mode.

TURN TRACKING ON

To begin tracking your target, tracking must be turned on. Again, select TARGET at the basic (main) menu. The TARGET menu displays TRACKING as the f3 choice, with "off" as the (default) current setting. Select the TRACKING function key to toggle the setting to "on."

The system is now tracking in the transponder mode, and you should observe the following:

- Target position displayed in the tracking window, represented by the target designated as the transponder.
- The chosen target symbol shown in the status block with position data agreeing with the target position on the grid.
- Range and bearing information being updated for that target in the status block.
- The two green LED's flashing for each interrogate signal transmitted, and the red LED flashing for each signal received.
- An audio signal corresponding to the red RCV LED.
- With a transponder at close range the Quality Factors should typically be 9's or 10's.

If problems in tracking occur, then refer to section 3.14.
Also Refer to Filtering Sections 3.4.4 and 3.7.

3.5.3 RESPONDER MODE (Pulse/Burst)

PULSE RESPONDER MODE
To establish tracking in the responder mode, the proper cable connection must be made from the Command/Display Module. Use the NORM TRIGGER OUT connection for systems incorporating a responder operating only on battery power and if no other targets are enabled. The Trackpoint II C/DM has a separate isolated trigger line that outputs a signal only when a responder-type target is being interrogated. If a transponder is enabled along with the responder then it is recommended to use the ISOLATED trigger out so that the responder is not triggered during the transponder's interrogation. The same applies if a responder has a common connection to an electrical system other than the Trackpoint II's, it is recommended that the ISOLATED TRIGGER OUTput connection be used. The maximum ISOLATED TRIGGER OUTput pulse width is 2 milliseconds. Use of this isolated output helps avoid problems associated with the responder triggering on power noise similar to that which may be encountered with an ROV system.
The responder itself must be operational and in the water. Refer to the instruction manual for the particular responder in use. Follow the steps outlined in the TRANSPONDER section, 3.5.2, to choose a target, set the frequency, turn tracking on for that target and enter depth. The target TYPE must be designated as a responder, turnaround time must be entered. Refer to Filtering section 3.7 for setting of FILTERING and LIMITS parameters.

It is not necessary to set a transmitter frequency for a Pulse Mode responder under the TARGET / INTEROGATE DATA menu. The XMIT INTERVAL must be set for the maximum range encountered to the responder. E.g., @ 1500 meters/second velocity of sound and a repetition interval of 2 seconds, the maximum range is about 3000 meters. The PULSE WIDTH must be set to be compatible with the responder in use, keeping in mind that the maximum pulse width output by the isolated trigger is 2 milliseconds.

NOTE: The ISOLATED TRIGGER OUTput only provides an effective key pulse width of 2.0 milliseconds. If the pulse width setting is longer than 2 milliseconds the signal amplitude will be diminished.

The ISOLATED TRIGGER OUT pulse is generated from an AC-coupled (~5 V pk) pulse that is either inverted, or non-inverted, as selected by a slide switch on the Isolated Trigger board. The board is located next to the Transmitter on the side panel (See dwg 102297). The pulse is a positive pulse with the switch in the UP (+) position, and a negative pulse with the switch in the DOWN (-) position. Refer to section 2.2.9.

The NORMAL TRIGGER OUT pulse is a TTL-compatible negative pulse and is NOT ISOLATED. It occurs on both the transponder (transmit) and responder (isolated key) cycles.

BURST RESPONDER MODE
The Burst mode Responder feature is used where a burst or tone from the transmitter triggers a transponder via an umbilical. A remote transmit output is available on the rear panel of the Trackpoint. This high level transmit burst (output = 800Vp-p on high) can be attenuated and impressed on an umbilical to trigger a hardwired transponder. This is useful in situations where there are not enough conductors available to trigger with the normal responder key out pulse or there is excess noise causing false triggers. This function can be selected via f3 - TARGET /f2 - REPLY DATA/f3 - TYPE/f3 - RESPONDER/f2 - BURST. When a target is set up as a Burst mode responder, the transmitter is enabled and the slant range is compensated for the one way acoustic travel time. Set the Target Interrogation Frequency to the correct value for the responders receiver.

NOTE: When using this function remember that the beacon is actually a transponder, that is being triggered similar to a responder, and the turn around time entered is from the transponder mode of the beacon.

NOTE: The transponder lock-out time can be reduced in these circumstances to allow for a faster interrogation rate than the normal 2 seconds.

NOTE: The turnaround time (tat) for the transponder and burst responder is the same variable. If you change it in one place it will also be changed in the other. E.g., if transponder tat is set to 15 ms, then once the responder menu is activated, the burst mode tat would also be set to 15 ms.

3.5.4 ARTIFICIAL TARGET

Designate a target to be artificial. From the basic menu select TARGET (f3). From the sub-menu select REPLY DATA (f2). From that sub-menu select TYPE (f2) then ARTIFICIAL (f4). The ARTIFICIAL target type brings up a sub-menu to allow entry from the keypad the target's bearing and horizontal range. If entering the data from the RS-232 port press USE DATA ABOVE (f3) to enable the artificial mode. To enable the ARTIFICIAL target from the RS-232 port type, SEL(n) n=target # and then ART (see section 3.12). If entering data via the keypad then select BEARING (f1) and enter a value between 0° and 359°, select HORZ RANGE (f2) and enter a value between 1 and 10000 meters (this value depends on the DISPLAY/SCALE /UNITS selected, i.e. meters, feet or yards). See section 3.4.3 TARGET PATH.

The total number of targets allowed is six, therefore if two targets are actively being tracked then up to four Artificial targets can be enabled. A horizontal range and bearing to a target (with respect to the hydrophone) is sent to the RS-232 port or entered from the keypad. The position information obtained for an artificial target could be from a sonar or radar system which detects a target (underwater or surface) and determines the range and bearing to it. The range and bearing information has to be corrected for the differences in position between the Trackpoint hydrophone and the sonar/radar transducer (E.g., an

offset must be applied so that the data is relative to the Trackpoint hydrophone). This corrected data is then sent to the Trackpoint via the RS-232 port or manually updated from the keypad.

The target has its symbol shown in the tracking window at the coordinates corresponding to the range and bearing as input via the RS-232. The target symbol has its color set to cyan and is labeled with the target number, as if it were in Last Position target mode. If the target is off-screen for the scale selected, a dotted line indicates the bearing to the artificial target (horizontal range still indicates in the Status Block). Only one artificial target is plotted (or sent out the RS232 port) every two seconds. For example, if three artificial targets were enabled and the three targets position data was sent consecutively to the Trackpoint via the RS-232 port, the Trackpoint would plot one target, in order of target number, every two seconds for a total target plotting rate of six seconds.

NOTE: The ARTIFICIAL target mode is not saved in battery backed up RAM. If Trackpoint II unit is turned off and power is re-applied the target defaults to normal tracking operation (pinger, transponder, etc.).

The artificial target can also be selected as a centered target. The vessel and other targets are then referenced to it.

If the Trackpoint has an external compass input, the artificial target data is corrected for NORTH. For example, if the vessel heading is 30° and the bearing of the artificial target, relative to the bow of the vessel is 90°, then the artificial target is compass cor

NOTE: The compass heading is only updated if a xponder or pinger is being tracked otherwise the last compass heading received is displayed.

The artificial target data is shown in the Status Block at the bottom of the screen and also sent out the RS-232 port just as if it were a tracked target. See Figure 3-11, A & B and section 3.12 for further information.

Refer to section 3.4.3 TARGET PATH (above) for keypad entry of position data and to section 3.12 for RS-232 INTERFACE (below) for updating the positional information via the RS-232 port.

The following sections are further explanations of parameter settings for pinger, transponder or responder modes.

3.6 INSTALLATION SET UP PARAMETERS

3.6.1 HYDROPHONE BRG, X, Y and DEPTH OFFSETS

Hydrophone Offsets are used to reference the target position to the pitch / roll center of the vessel. The system uses the hydrophone offsets to reposition the target with respect to the pitch/roll center of the vessel and also to correct for the hydrophone's dynamic motion. Hydrophone motion is due to the pitching and rolling of the vessel when it is not on the pitch or roll center of the vessel. (The system assumes the hydrophone is rigidly mounted to the vessel.) The hydrophone, when mounted offset from the vessel's pitch / roll center, swings in an arc about the pitch / roll center causing variations in the hydrophone depth, X and Y offsets as the vessel experiences dynamic motion. These variations cause the target to appear to be at a different depth, depression angle and bearing than it actually is. By entering in X, Y and Z offsets the system can correct for this dynamic motion if a survey grade Motion Sensing System is interfaced to the Trackpoint. See ORE Model 4414A Motion Sensing System.

At the time of installation, the hydrophone should have been oriented as nearly as possible in parallel with the centerline of the ship, and any remaining bearing offset determined (Refer to section 2.3).

Determine X and Y offsets for the hydrophone in relation to the pitch / roll center as explained in section 2.3.2. The following sections explain how to enter offset values into the system at the Command/Display Module. The operator may find it helpful to change the status block from range and bearing mode to show "X, Y, Z" coordinates while setting hydrophone offsets. This is accomplished by selecting DISPLAY at the basic menu, and STATUS FORMAT from the sub-menu. The X, Y, Z option replaces bearing and range values in the status block with X, Y, Z coordinates, and labels the X-axis and Y-axis in the tracking window.

X & Y OFFSETS

To enter hydrophone offsets, select SYSTEM from the basic menu, and OFFSETS and PHONE from the sub-menus. A sub-menu of options consisting of X, Y, DEPTH and BEARING offsets along with VRU is displayed. The BEARING OFFSET must be input before X and Y hydrophone offsets are entered.

To enter the BEARING OFFSET, select the function key corresponding to this option. The system prompts for input, see section 3.4.2. This sub-menu remains on screen until cleared by the CANCEL key to allow setting of other hydrophone offset parameters. The default unit of measurement is meters. If offsets are to be entered in feet or yards, refer to section 3.11.3, Changing Unit of Measure, before attempting to enter values.

Hydrophone X and Y offsets are entered with respect to the pitch / roll center of the vessel. It is assumed that the vertical reference for the pitch / roll center is the water-line of the vessel or the entered "DEPTH OFFSET". When X OFFSET is selected, the system prompts for the hydrophone offset along the X-axis. A small "H" symbol appears in the tracking window and moves in relation to the X and Y offsets that are input. Input the Y offset by repeating the steps above. To confirm offsets, change the full scale to a smaller number to see the "H" in the display. This "H" symbol represents the actual position of the hydrophone. The ships reference point remains in the center of the tracking display.

NOTE: The Trackpoint outputs the target position with respect to the pitch / roll center of the vessel graphically in the Display, numerically in the Status Block and also on the RS-232 serial communications port. If Antenna Offsets are entered, the target position remains relative to the pitch / roll center of the vessel when displayed on the Trackpoint **screen** but is repositioned relative to the antenna offset point when sent out the **RS-232 port**. In this case **Status Block data** and **RS-232 data** will **NOT** agree.

DEPTH (Z) OFFSET; Manual or Analog Input
The depth Offset can be either entered manually or automatically through the Analog Depth or Compass Input BNC. For a manually entered depth press the manual selection and enter in the Depth of the hydrophone from the water surface to the tip of the hydrophone. The automatic (analog-input) Depth Offset function is only available with the ORE Model 4610B-V1399 Hydrophone when coupled with the Model 4110B-V1399 Deck Cable. This hydrophone contains a pressure sensor which outputs an analog voltage proportional to the water depth of the unit. This analog voltage is sent up the deck cable to the rear panel DEPTH BNC on the Trackpoint II C/DM. The Hydrophone Depth Offset (analog input) menu allows the user to configure the analog input for the depth sensor's zero and span. By selecting either ANALOG (DEPTH) or ANALOG (COMP) the system presents the operator with a sub-menu listing the scaling parameters for the analog input. When this function is selected the DEPTH or COMPASS input can no longer be used for the TARGET Depth or COMPASS input. For example, if ANALOG (DEPTH) is selected and an attempt is made to enable Analog Depth within a TARGET menu an error message appears. The same applies when the Depth Offset is set to manual and a TARGET Depth is set to Analog Input; a message appears if an attempt is made to enable the Analog Depth Offset for the Hydrophone.

3.6.2 HYDROPHONE VRU (4610B or 4740A) and REMOTE VRU

Install HYDROPHONE/VRU as per section 2. Interface REMOTE VRU (if applicable) as per section 2 also.

ORIENTATION
The revision 8.02 and greater Trackpoint II firmware has the capability to allow for different mounting configurations of the Model 4740A VRU/Amplifier Assembly. In some instances, when attempting to mount the VRU assembly as close to the pitch and roll center of the vessel as possible, a convenient (bow facing) mounting surface is not always available. Refer to Figure 3-7. This revision firmware compensates for four different mounting arrangements. The VRU ORIENTATION function allows the VRU assemblies to be mounted in the NORMAL position with the assembly's directional arrow facing towards the bow, or mounted to STARBOARD, AFT or PORT. Refer to Figure 2.

Under the SYSTEM/OFFSETS sub-menu select VRU then ORIENTATION. The VRU orientation can also be configured from the RS-232 port, see section 3.12 for RS-232 commands.

STATUS
If the internal VRU (4610B or 4740A) is to be used by itself then set the HYDROPHONE / VRU / STATUS to ACTIVE. If a remote VRU (dynamic motion sensing system) is to be used in conjunction with the internal VRU then set the STATUS to STATIC. In other words the internal VRU is only to be used to compensate for tilt and trim when the vessel is static or at dock-side.

STATIC CALIBRATION
Run AUTO OFFSET, record average offset and spread. Repeat a few more times. Take the data with the lowest spread and enter in manually in the PITCH and ROLL OFFSET menu.

NOTE: If the system uses an external or remote VRU, perform a pitch/roll zero calibration on this unit at the same time. This reduces errors induced by changes in vessel trim during mobilization.

Following the static offset calibration the Trackpoint's hydrophone should be compensated for the center of gravity by the AUTO OFFSET function. The remote VRU (if used) should also be zeroed using its own calibration method. The pitch and roll data shown on the System Configuration Display is the difference between the static offset data and the present remote VRU data.

REMOTE VRU (Dynamic Motion Monitoring System)
Set up the parameters to comply with the requirements for the REMOTE VRU's interface. Set up the SCALE, FUNCTION (linear or 10 x sin θ) and POLARITY of the incoming pitch and roll voltages referenced to BOW UP and PORT UP. Perform a pitch/roll zero calibration on the dynamic motion monitoring system at the same time as the static offsets are being measured. This reduces errors induced by changes in vessel trim during mobilization.

3.6.3 INVERT PHONE

The inverted hydrophone function allows the operator to position a hydrophone on the seabed looking up towards the surface. For proper operation the pitch and roll sensors inside the 4610B Hydrophone must also be inverted (Variation #V1390 modifies the hydrophone for this configuration). In this configuration the BOW reference mark on the hydrophone remains referenced to zero degrees. The display shows targets moving in a clockwise direction with an increase in bearing angle. When this function is turned on the system automatically compensates for the reversal in the X axis direction and also the pitch sensor polarity. It also changes the Status Block's DEPTH heading to read DEPTH/ALT, which indicates hydrophone inversion and also that the value under this heading could either represent a depth, if the value is **input** (analog, telemetry or manual entry), or an altitude if the depth value is **calculated** by the system.

Once the hydrophone has been setup on the seabed a static offset calibration can be performed. From the main menu select f2 OFFSETS/f2 PHONE/f5 VRU. From the VRU menu set the STATUS to "static" and perform an AUTO OFFSET by pressing f3. The system then reads the pitch and roll sensor offsets and enters them into the pitch and roll offset fields. Therefore, if the hydrophone was mounted at a tilt the system compensates for this tilt and references the targets to the plane of the water surface.

For the system to operate correctly it must convert the target's input depth (analog, telemetry or manual entry) into an altitude as referenced from the top of the hydrophone to the target. To perform this conversion it must have the Hydrophone (Phone) Depth Offset entered as the depth of the hydrophone (Depth Offset represents the distance from the water surface to the end of the hydrophone). The system subtracts the Hydrophone Depth Offset from the input depth to obtain the height or distance from the top of the hydrophone to the target. It then calculates horizontal distance based on the slant range and this height.

The bearing, X & Y data on the display and the RS232 are relative to the water surface. If the target depth is **input** (analog, telemetry or manual entry), the entered Target Depth (Z) value is also relative to the water surface. If the system **calculates** the depth (user selectable when target is within a 90° cone above the hydrophone), the Target's "Z" or depth value is shown as the height of the target above the hydrophone, i.e. altitude, and is **not** relative to the water surface.

NOTE: Inverted operation is limited to the depth rating of the hydrophone.

3.6.4 GYRO SET UP

The GYRO option requires a PC board which is mounted on the left inside panel of the C/DM. The Gyro Interface Board, P/N 4410-0049, converts the synchro signals to an analog voltage for the Signal Processor Board. See section 2.2.12 for installation details, notes, warnings and cautions. The COMPASS menu parameters must be set to agree with the analog output from the Gyro Interface Board. Under the COMPASS menu set the 0 DEGREE VOLTAGE to zero and the 360 DEGREE VOLTAGE to 5.0. Activate compass mode by toggling the COMPASS ON/OFF switch under the same menu.

OPERATION AND CHECK OUT

Turn the gyro on. Wait for gyro to "warm-up". Connect a DVM to the COMPASS out BNC. Compare gyro heading against the DC voltage measured on DVM using the table below as a guide. The DC voltage measured should compare to the gyro's heading. Check the Trackpoint's heading reading against the gyro's bearing. With a signal being detected, the "HDG: " display on the Trackpoint should be showing the same bearing as the gyro compass bearing. (Set Trackpoint into self test mode to provide continuous detection for compass update.

NOTE: The "**HDG:XXX**" output at the top of the left corner of the Trackpoint screen will not update until....

1. a valid signal has been received from a sound source via the Hydrophone or…
2. the Trackpoint is in BIT mode (press F1-SELF TEST then f2 - XMIT & REC/DET) or...
3. a Hydrophone Simulator Model 4910 is used to generate simulated targets.

REFERENCE CHART FOR GYRO HEADING VS 4410 ANALOG OUTPUT

BEARING	OUTPUT VOLTAGE	BEARING	OUTPUT VOLTAGE
0°	0.000	180°	2.500
10°	0.139	190°	2.639
20°	0.278	200°	2.778
30°	0.417	210°	2.917
40°	0.556	220°	3.056
50°	0.694	230°	3.194
60°	0.833	240°	3.333
70°	0.972	250°	3.472
80°	1.111	260°	3.611
90°	1.250	270°	3.750
100°	1.389	280°	3.889
110°	1.528	290°	4.028
120°	1.667	300°	4.167
130°	1.806	310°	4.306
140°	1.944	320°	4.444
150°	2.083	330°	4.583
160°	2.222	340°	4.722
170°	2.361	350°	4.861

3.6.5 COMPASS SET UP FOR RS232 INPUT

The Trackpoint receives the NMEA or other data sentence on the COM port #2 only. Set up COM port #2 under the menu SYSTEM / MORE / HARDWARE / COM2 SETUP. Configure BAUD RATE, DATA BITS and STOP BITS. Refer to section 2.2.3 for COM#2 cable wiring for the 9-pin "D" connector located on the rear panel of the C/DM. For further information on the NMEA standard contact the NMEA National Office, PO Box 3435, New Bern, NC 28564-3435 U.S.A. For further information on the TCM-2 format contact Precision Navigation, Inc., 5550 Skylane Blvd, Suite E, Santa Rosa, CA 95403.

The following describes the format of each of the NMEA and the TCM-2 compass sentences. If the sentence structure only contains magnetic heading information then the Trackpoint displays an "M" after the heading data at the top left corner of the display. If it contains true heading information or enough information to calculate the true heading then the Trackpoint displays a "T" after the heading data. If the Compass function is set to "NMEA", and the checksums do not agree, the data is ignored. If the Compass function is set to "NMEA wo/cs" then the data is accepted even if the checksum does not agree or is missing from the string. (The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," delimiters, between both, but not including, the "$" and the "*" delimiters.) On the RS-232 target output data sentence there is no compass heading identifier to distinguish between True or Magnetic heading information except on the NMEA ORE format.

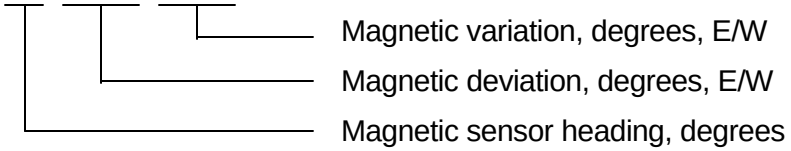
The Heading data is continuously received from ComPort #2, but only updates on the screen at a two-second rate. If the compass heading has not changed by at least 0.1° in 10 seconds then an error code 55 is displayed and the heading data in the top left corner of the display turns red. The maximum rate that the Trackpoint can receive the heading data is 8Hz at 4800 baud or 16Hz at 9600 baud.

If the RS232 output format (COM port #1 parameter) is set either to STD-EC or STD-EC W/P-R, and an error code #6 is encountered, the heading data from the NMEA device is sent out the ComPort #1. The Trackpoint waits approximately 16 seconds, after loss of replies, before generating an error code #6. The rate at which the RS232 is output is set by the COM1 Interval (minimum of two-second interval). If the NMEA sentence received on COM port#2 is from a Precision Navigation TCM-2 Compass Module and the sentence format is set to the standard TCM-2 format then the Trackpoint outputs the pitch and roll data also. This is only valid with the ComPort #1 output format, STD-EC W/P-R. The Trackpoint outputs the data as it is read from the sentence. That is to say, the remote VRU polarity switches have no affect on the RS232 data.

The various formats the system can receive are shown below;

HDG - Heading, Deviation and Variation

$--HDG,x.x,x.x,a,x.x,a*CS<CR><LF>



The Trackpoint calculates magnetic heading by adding Easterly deviation to, or subtracting Westerly deviation from, the magnetic sensor reading. It calculates true heading by adding Easterly variation to, or subtracting Westerly variation from, the magnetic heading. If the sentence structure only contains magnetic heading information then the Trackpoint displays an "M" after the heading data at the top left corner of the display screen. If the sentence contains variation information it calculates the true heading and the Trackpoint displays a "T" after the heading data indicating True heading.

HDT - Heading, True

$--HDT,x.x,T*CS<CR><LF>

Heading, degrees True

The Trackpoint displays the heading data in the top left corner of the screen and adds a suffix ”T” to indicate heading is True.

HDM - Heading, Magnetic

$--HDM,x.x,M*CS<CR><LF>

Heading, degrees Magnetic

The Trackpoint displays the heading data in the top left corner of the screen and adds a suffix ”M” to indicate heading is Magnetic.

VHW - Water Speed and Heading

$--VHW,x.x,T,x.x,M,x.x,N,x.x,K*CS<CR><LF>

Speed, km/hr

Speed, knots

Heading, degrees Magnetic

Heading, degrees True

If the True Heading data is available it takes precedence over the Magnetic Heading data. If only Magnetic Heading information is available then the Trackpoint uses that data as the heading reference. The Trackpoint displays an “M” after the heading data, located at the top left corner of the display, to indicate Magnetic heading or a “T” to indicate True heading.

VTG - Course over Ground and Ground Speed

$--VTG,x.x,T,x.x,M,x.x,N,x.x,K*CS<CR><LF>

Speed Over Ground (SOG), km/hr

Speed, knots

Course Over Ground (COG), degrees Magnetic

Course Over Ground (COG), degrees True

A “VTG” sentence is usually sent from a GPS receiver. For this sentence the Trackpoint only looks at the True Heading. The magnetic heading information is not used. The Trackpoint displays an “T” after the heading data to indicate True heading.

TCM-2 is a proprietary sentence from Precision Navigation. Sentence consists of the following parameters;

$C <COMPASS> P <PITCH> R <ROLL> X <BX> Y <BY> Z <BZ> T <TEMP> E <ERROR CODE> * CHECKSUM <CR> <LF>

Example: $C328.3P28.4R-12.4X55.11Y12.33Z-18.43T22.3E001*CHECKSUM<CR><LF>

The Trackpoint reads the compass, pitch and roll data from the sentence. All other data is ignored.

NOTE: Any parameters not enabled in the TCM-2 Compass module are not included in the output word. For example, setup the unit to only output compass, pitch & roll. See following;

$C328.3P28.4R-12.4*CHECKSUM<CR><LF>

The pitch and roll received from this string can be used for either dynamic or static offsets depending on the Hydrophone - Offset - Status Command within the Trackpoint.

3.7 FILTERING

Filtering consists of smoothing (averaging), target velocity checking, range gating (xponders), time gating (pingers) minimum xponder (transponder or responder) range, maximum xponder range, bearing limits and QF (Quality Factor) Filtering. The system use a combination of these functions to establish target position. The filtering parameters are individual per target, that is to say each target has its own independent filter settings (in previous revisions of firmware the filtering parameters were a global function for all targets).

The FILTER LEVEL setting is variable from 1 to 10. The lower settings are for dynamic tracking situations (targets moving constantly with respect to hydrophone) while the higher settings are for stationary type tracking scenarios such as station keeping. The parameter settings for the range gate and velocity filter “tighten up” as the Filter Level is increased with the premise that dynamic targets such as AUV’s can change position quickly with respect to the hydrophone while static targets such as a tow fish or other targets in moored scenarios do not. The SMOOTHING parameter is also variable from 1 to 10 along with a selection for OFF. It is independent of the Filter Level setting in that you can select the buffer size in which to smooth or average a number of replies over (1-10). This setting corresponds to the number of replies that are averaged along with the present reply. The Smoothing (averaging) routine is used in conjunction with the QF and the FILTER LEVEL to weight the position of the target depending on the Quality Factor of the reply received and also the filter level.

This approach biases the target position towards the better QF and also towards the most recent reply providing a better representation of target position than by using a mean or average of the target positions. At the higher filter levels the averaging is almost linear across all replies while at the lower filter levels the weight is higher on the most recent reply.
Also associated with filtering is the THRESHOLD setting. THRESHOLD is also a separate setting for each individual target enabled. Refer to section 3.8 for THRESHOLD settings. To access the filtering menu, select FILTERING.

FILTER LEVEL
A Filter Level setting of 1-5 is recommended for most dynamic applications (e.g., ROV tracking). The higher settings of 6-10 are appropriate for static applications such as station keeping. Filter settings 6-10 cause the analog or telemetry depth to average the last three readings. Filter settings 1-5 do not average the input depth. The measurement repetition rate must also be considered when filtering level is chosen. For example, with a transponder target being interrogated every five seconds, a high filtering level would not be appropriate in most applications, because of the extremely slow response of the "smoothed" target.

The table below shows the relationship between the range gate, velocity filter and smoothing weight Vs the Filter Level setting.

TARGET FILTERING FUNCTION			
Filter Level	**Range Gate (meters)** (based on 1500m/s speed of sound)	**Velocity Filtering** (4.5 m/s = 10 knots; 2.3 m/s = 5 knots)	**Weighting** Ratio of the weight of the previous reply to the 10th reply Vs Filter Level [3]
1	± 25 meters (± 16 ms) x Time factor [1]	OFF	4.0:1
2	± 20 meters x Time factor [1]	OFF	3.3:1
3	± 15 meters x Time factor [1]	OFF	2.8:1
4	± 10 meters x Time factor [1]	4.5 m/s + X % SR [2]	2.5:1
5	± 5 meters x Time factor [1]	4.5 m/s + X % SR [2]	2.3:1
6	± 25 meters fixed [4]	4.5 m/s + X % SR [2]	2.1:1
7	± 20 meters fixed [4]	2.3 m/s + X % SR [2]	2.0:1
8	± 15 meters fixed [4]	2.3 m/s + X % SR [2]	1.9:1
9	± 10 meters fixed [4]	2.3 m/s + X % SR [2]	1.8:1
10	± 5 meters (± 3.3 ms) fixed [4]	2.3 m/s + X % SR [2]	1.8:1

NOTE 1: For Range Gate description see Transponders and Responder below. Pingers utilize a Time Gating system, see Pingers below.

NOTE 2: Total velocity = Target Velocity plus 5% (X) of the Slant Range if external compass is used; Plus 10% of Slant Range if not used. Used for both Xponders and Pingers.

NOTE 3: At the higher filter levels the averaging is almost linear across all replies (up to 1.8:1 depending on number of replies smoothed) while at the lower filter levels the weight is higher on the most recent reply (up to 4.0:1 depending on number of replies smoothed). The QF also contributes to the weight in the smoothing buffer. See chart and also QF FILTERING below.

NOTE 4: Settings 6-10 affects the auto-depth readings (analog or telemetry) by averaging the last three readings. Settings 1-5 do not affect these depth inputs.

	Weight on the Target's Position Vs the Quality Factor as used in the smoothing									
QF	1	2	3	4	5	6	7	8	9	10
Weight	0	0	.04	.08	.12	.16	.2	.4	.6	1

VELOCITY FILTER

Velocity filtering is a technique of rejecting any target position changes that are unlikely due to an assumed maximum target velocity and elapsed time since last update. It is based on the difference between the previous X and Y position (averaged, if smoothing is enabled) and the present targets X and Y position. If the present calculated position passes the velocity filter test it is then sent to the smoothing function. If after a certain period of time there is no reply within the expected area then an error code #5 is flagged and the system opens up to find the reply.

NOTE: A fast-turning ship can cause the target to appear to be traveling at excessive speeds and be rejected by the velocity filter, when the compass option is not in use.

SMOOTHING

Smoothing is averaging some number of the most recent target positions so as to produce data with reduced jitter. It results in a less responsive display along with less jitter. The SMOOTHING parameter is variable from 1 to 10 along with a selection for OFF. It is independent of the Filter Level setting in that you can select the buffer size in which to smooth or average a number of replies over (1-10). The size of the averaging buffer is equal to the Smoothing Level plus one. This setting corresponds to the number of replies that are averaged along with the present reply. The Smoothing (averaging) routine is used in conjunction with the QF and the FILTER LEVEL to Weight the position of the target depending on the Quality Factor of the reply received and also the filter level. With a high quality factor the target position is weighted heavily both on the present reply and on the previous replies in the averaging buffer. If the present reply has a high QF and the previous reply had a low QF then the position with the high QF remains heavily weighted within the averaging buffer. As new replies are received the high QF positions maintain their heavier weight while the positions with lower QF's have very little weight. The weights of the previous target positions are reduced as the newer replies are received.

Smoothing occurs on the target's position only (X, Y or HD, BRG), not on the displayed slant range. The slant range displayed in the status block and sent out the RS-232 is the actual value. Because of this there may be an apparent discrepancy between the displayed position and slant range.

RANGE GATE (Transponders & Responders Only)
For Filtering Levels 1-5 the range gate window is dynamic in that it changes with respect to the time between interrogations, that is to say the range gate distance changes in meters per second depending on the sequence interval. For example, if target #1 has an interrogation interval of 2.5 second and target #2 has an interrogation interval of 3 seconds the total sequence interval is 5.5 seconds. The "Time Factor" is then the total sequence interval truncated to a whole number or 5 seconds. The time factor is limited to a maximum number of 10. If target #1's Filter Level is set to 2 and target #2's Filter Level is set to 4 then the range gate window for target #1 is ±100 meters (±20 meters x 5 seconds) and the range gate window for target #2 is ±50 meters (±10 meters x 5 seconds). For Filter Levels 6-10 the range gate window is a fixed value. The range gate operates on the targets raw Slant Range only. If after a certain period of time a reply is not received an error #2 is flagged and the window opens up to find the reply.

Range Gate and Telemetry (Transponders & Responders Only)
When telemetry is enabled the system also range gates on the telemetry reply. On the primary or navigation reply the Trackpoint accepts only the first signal arriving at the hydrophone following the opening of the range gate and ignores signals for ≈ 80 milliseconds following it. When the telemetry gate opens the Trackpoint accepts the first signal at the telemetry frequency and all other signals are ignored until after the next interrogation. This is advantageous when operating in a high multi-path environment, insuring that the system locks on to the correct reply.

TIME GATE (Pingers Only)
For pingers the system uses a Time Gating system based on the targets entered repetition interval instead of the slant range as used in the range gating. Time gating eliminates any unwanted signal detections that occur at a time when no response is expected. Since the pinger repetition rate is entered and the reply interval is known, Trackpoint II can determine, within some short time interval, when the next signal is expected and only allows signals which fall within their time window to be accepted for further processing. It depends upon accurate entry of repetition rates in the TARGET sub-menu for proper tracking. The time gate is a function that compares the time between replies against the entered repetition value. It accepts the first reply that arrives in a window 50 ms prior to the expected arrival of the signal (beginning of time window) and up to 50 ms after the expected arrival. It then ignores replies later than 50 ms after the calculated time gate window. If no replies are detected within a certain period, an error code #2 is flagged and the window opens up to find the reply.

QF FILTERING

The Quality Factor (QF) is a value (1-10) determined by the system on each reply that is detected. The system uses the phase or time counts from each of the hydrophone elements to determine the quality of the signal. If the phase counts are consistent through the reply burst the quality factor is very high. If the phase counts have jitter or are inconsistent then the quality factor is low. The QF FILTERING function filters the data depending on the Quality Factor of the signal received. It is an individual function for each target which compares the Quality Factor of the signal received to its previous five (5) average Quality Factors. The QF FILTERING function toggles Quality Factor checking on or off. For FILTER LEVELS 1-5 the QF FILTERING function is automatically turned off. For FILTER LEVELS 6-10 the QF Filtering function is turned on. The QF FILTERING switch allows the operator to override this setting to suit the particular tracking application.

When “QF FILTERING” is “ON” and the Quality factor is less than the average of the last five QF’s the data is not plotted and causes an error code #4 to be displayed. In this case the error is considered a “fatal” error (similar to all other error codes under 20) and the reply is not added to the smoothing buffer. The target position is not updated on the screen and the positional data is not sent out the RS232 port unless the “EC” formats are chosen. If “EC” formats are chosen then a post processing navigation system could be used to determine if the reply was good or bad by searching for a 4 at the EC location within the data string. When “QF FILTERING” is “OFF” and the Quality factor is less than the average of the last five QF’s the data is plotted on the screen and sent out the RS232. The data is tagged with an error code #64 on both the display and RS232. In this case the error is considered a “warning” error (similar to all other error codes greater than 50). The data is still smoothed but its “weight” within the averaging buffer is decreased. Again, a post processing navigation system could then be used to determine if the reply was good or bad by searching for a 64 at the EC location within the data string.

MIN XPNDER RNG

The MIN XPNDER RNG (Minimum Transponder or Responder Range) function works in conjunction with the range gating system based on the target slant range. The range gate is a hardware lockout that “opens up” and allows signals to be detected from the hydrophone. The time that the range gate opens (start -gate) is based on the Filter Level and the time the last reply was received. If a condition occurs where the range gate’s start-gate is less than the MIN XPNDER RNG parameter then the MIN XPNDER RNG value overrides the range gate’s start-gate. This in effect locks-out all signals from the hydrophone prior to the MIN XPNDER RNG. If the system loses tracking due to the MIN XPNDER RNG being greater than the actual slant range from the target the system shows an error code #7 (SR < Min Range). After 5 interrogations without a reply the system opens up the range gate and accepts the reply on the sixth (6th) interrogation (EC #6 may appear briefly prior to reception of signal). If the Slant Range is less than the MIN XPNDER RGE then the error code #6 is changed to #7. The Minimum Xponder Range parameter can vary from 0 to 1000 meters. Setting the MIN XPNDER RNG parameter to zero (0) disables this function.

NOTE: If you are operating with a known minimum range, for example with an ROV near the bottom in 500 meters of water, then the MIN XPONDER RANGE could be set for 450 meters. This would provide an effective "range gate" without the attendant target acquisition and re-acquisition time of the normal range gate. Of course, as you recover the ROV you will have to reset the MIN XPONDER RANGE parameter to track the ROV to the surface.

MAX SLANT RNG

The MAX SLANT RNG (Maximum Slant Range) function compares the reply’s slant range against this value. If the slant range is greater than the entered value the last good reply remains on the display (target position on the screen doesn’t change) and the status block shows an error code #14. If the RS232 Format is set to an “EC” format it also outputs the last good position and tags it with an error code #14. The Maximum Slant Range parameter can vary from 0 m which is OFF to 10 to 8000

meters. The Maximum Slant Range parameter can be changed from the RS232 port by entering “MXR” nn, where nn is a value from 0 to 8000 meters.

BEARING LIMITS
The BEARING LIMIT function is enabled only in Fish Track mode, when the angle to the target is fairly well known. This function is a final check after the range gate and velocity filter are satisfied. The system checks to see whether the target is within the parameters as set by the bearing limits. This function is only applicable to targets with a depression angle of less than 45°. If a target is outside the set limits then the system displays an error code #15, "BEARING LIMIT EXCEEDED". The system does not update the target on the screen but the data is sent out the RS232 (when an “EC” format is selected) with the fatal error #15 attached to the string. The Fish Track mode automatically enables this function and sets these limits from 135° to 225°. These limits are always referenced to the vessel, whether compass mode is ON or OFF. The default values for the bearing limits are 0° to 0°, which disable the function.

NOTE: If the system shows a continuous error code #15 press the HELP key to have the system update the target position on the screen. This allows the operator to see where the target really is and decide whether to reset the bearing limits accordingly or take other action with the target/vehicle.

3.8 THRESHOLD

Four levels of threshold are available for each of the active targets, accessed by selecting FILTERING/THRESHOLD. The lowest threshold setting increases the sensitivity of detection by recognizing smaller signals. In a high-noise environment this can lead to erratic readings. In a high-multi-path environment, lower settings result in earlier detection, reducing the inclusion of multi-path signals with the original signal. Higher threshold settings decreases the possibility of detecting on noise, but can lead to occasional missed valid signals and also late detections causing erratic bearings. A LOW threshold setting is usually the best choice, but trial will lead to the optimum threshold setting for a given application.

3.9 WATER TEMP

The default setting for WATER TEMP is AUTOMATIC. In this mode, water temperature is automatically read from the temperature sensor in the hydrophone. The operator also has the option of entering the water temperature manually. Select SYSTEM ACOUSTIC FACTORS to access the appropriate sub-menu. Select the WATER TEMP MANUAL option, and the system prompts for the water temperature in degrees C. The system continues to use this temperature reading until a different temperature is entered, or until the operator selects WATER TEMP AUTO. (If the system is reset to the default settings, the AUTOMATIC mode will again be in effect.) Refer to Appendix A, Table of Data Ranges and Units for the accepted temperature range.

NOTE: When in WATER TEMP-AUTO mode the system only updates water temperature upon receipt of a valid acoustic signal.

NOTE: The WATER TEMPERATURE parameter does not affect speed of sound calculations. It is used for phase correction (depression angle) at the water / hydrophone interface.

3.10 ALARMS

The Trackpoint II tracking system can be configured to notify the user of specific conditions by setting alarms for each of the targets being tracked. Alarms can be set to alert the operator that a target has reached a certain SLANT RANGE, BEARING, DEPTH or if the TELEMETERED DATA has reached a limit. The ELAPSED TIME alarm sounds after a set period of time.

SLANT RANGE and DEPTH are each defined by a single value, entered in meters, feet or yards (depending on the current unit of measure). The BEARING alarm is set for an area defined by two bearings read in a clockwise direction. The ELAPSED TIME alarm is set in minutes.

To enter alarm values, select TARGET from the basic menu and ALARMS from the sub-menu. A menu of the specific alarm options is displayed. Selecting the function key corresponding to a particular alarm causes the system to prompt for the value for that alarm.

NOTE: To view a tracking window configuration of the current alarm settings, select DISPLAY CONFIGURATION ALARMS.

When 90 percent of a set alarm value is reached, a warning signal sounds a continuous buzz, the associated target blinks on and off in white, and a message is displayed in the menu block, stating which alarm is in effect. At this point the menu block displays the options ACKNOWLEDGE ALARM and CANCEL ALARM.

If the ACKNOWLEDGE ALARM function key is pressed, the warning signal is discontinued, but the alarm setting is still in effect. If the full alarm value is subsequently reached, or if the alarm value goes below the 90 percent mark and then reaches it again, the warning signal goes off again, as before.

If the CANCEL ALARM function key is chosen, the warning signal is discontinued, and the alarm setting erased. The ELAPSED TIME alarm is automatically canceled after its full time period has been reached.

NOTE: When an alarm has been triggered, tracking ceases until ACKNOWLEDGE ALARM or CANCEL ALARM is pressed.

3.11 ADJUSTING DISPLAY

The Trackpoint tracking window can be modified for various modes of operation, including scale size, units of measure, color and types of symbols.

3.11.1 CHANGING DISPLAY GRIDS

When the system is brought up in the DEFAULT SETUP mode, the RECTANGULAR (Cartesian coordinate) grid is displayed in the tracking window. Select DISPLAY GRID to bring up a menu of grid options, see section 3.4.1.

The POLAR grid, like the RECTANGULAR grid, tracks the target around a centered reference point. The POLAR grid replaces the Cartesian coordinate grid with a configuration of concentric circles.

The TARGET CENTERED grid is a rectangular or polar grid in which the reference point and the other targets, if in use, move in relation to a stationary centered target. When the TARGET CENTERED grid is selected, a menu of target choices is displayed, and the operator must indicate which target is to be centered (see Figure 3-16 and Figure 3-17). When TARGET CENTERED is selected, the boat-centered display is disabled.

The BOAT CENTERED grid is a rectangular or polar grid in which the targets move in relation to the stationary boat. When BOAT CENTERED is selected TARGET CENTERED is disabled.

3.11.2 CHANGING SCALING

The size of the area in which the target(s) are being tracked determines the scale of the grid display. The default scaling is a full scale value of 1000 meters (total distance along the X-axis), with a grid spacing of 250 meters. To change scaling select DISPLAY SCALING, see section 3.4.1.

Entering a new FULL SCALE value automatically changes the GRID SPACING to 1/4 of the new FULL SCALE value. The GRID SPACING can then be changed appropriately.

For convenience, the current scale values can be reduced by half or doubled, by selecting either the 1/2 X or 2X options. This provides a quick, single-step method for adjusting the scale to reflect the overall requirements for a specific operation.
If a target is off scale, a dotted line is displayed from the center of the screen to that target.

3.11.3 CHANGING UNIT OF MEASURE

The default unit of measure is meters. If values are to be entered in feet or yards, the unit of measure must be changed. Select DISPLAY SCALING to access the appropriate sub-menu, see section 3.4.1. The current unit of measure is displayed next to the UNITS option. The function key corresponding to UNITS acts as a toggle switch. If the setting is meters, pressing the function key changes the setting to feet. All values in use throughout the system are automatically changed.

3.11.4 CHANGING DISPLAY COLORS

The operator may wish to change the color of the target(s), grid or text, to suit lighting conditions or personal preference. Select DISPLAY COLOR to access the sub-menu of TARGET, GRID and TEXT options. Selecting any one of the corresponding function keys produces a menu of the color choices available: RED, GREEN, BLUE, PURPLE, and YELLOW. In the GRID color selection, the PURPLE has been replaced by WHITE. The GRID BACKGROUND color can be changed by accessing the DISPLAY GRID menu. The Background color option is blue. See section 3.4.1.

TARGET CENTERED DISPLAY

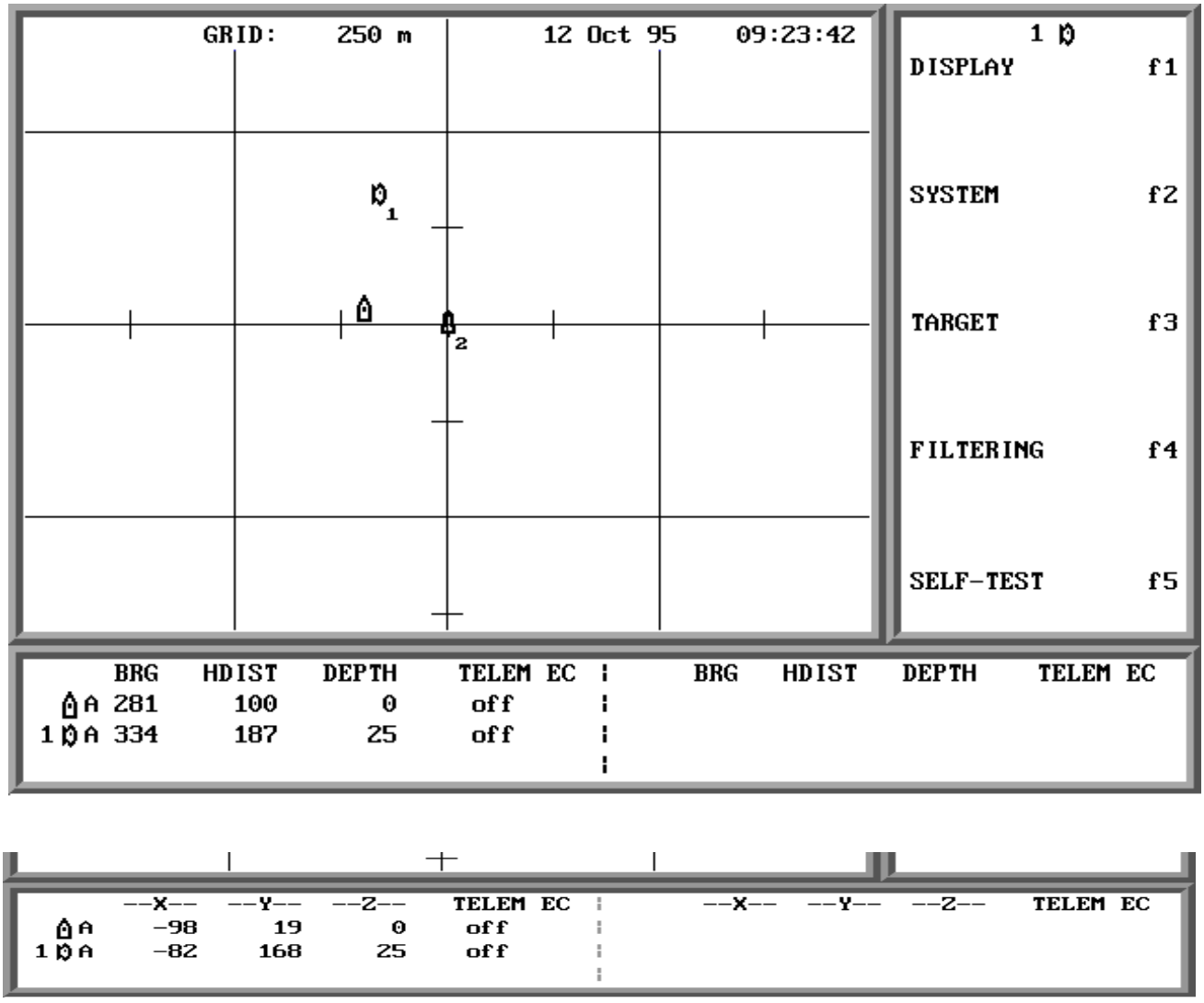


Figure 3-16

In Target-Centered mode the vessel symbol changes from an arrow to a boat. The vessel's target position is shown in the status block with the depth equal to zero. The target's RS-232 data does not change and its position remains with respect to the vessel. ONLY THE DISPLAY CHANGES TO SHOW VESSEL (and other target) POSITION WITH RESPECT TO A CENTERED TARGET.

Example of RS-232C output:

#	TOD	HDG	BRG	S.R.	X	Y	Z	TEL	ERR
2	23:59:58	101.1	111.8	98.2	-19.1	50.0	0.0		
1	23:59:59	6.0	152.1	15.7	149.2	25.0	0.0		

TARGET CENTERED MODE WITH COMPASS INPUT

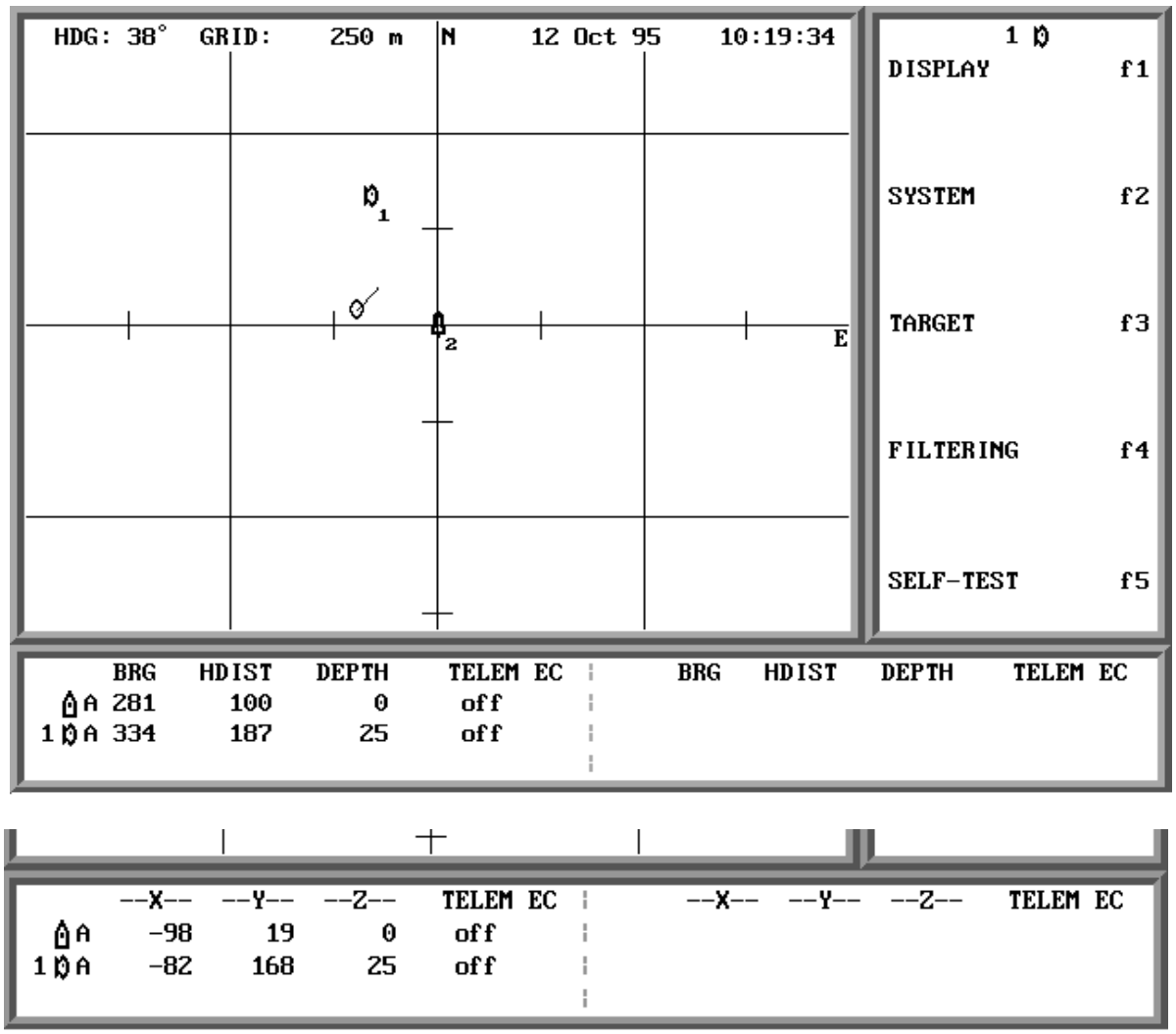


Figure 3-17

In Target-Centered mode with the compass turned on, the vessel symbol changes to a circle, with a line indicating vessel heading. The compass heading is displayed at the top left corner of the display. The bearings of the tracked targets in the status block are a bearing relative to the centered target (2). The RS-232 target position data is with respect to the vessel but relative to north. If a TARGET is off scale, a dotted line is displayed from the center of the screen to that target. If the VESSEL is off scale, a dotted line is displayed but the compass direction indicator will not be shown.

Example of RS232C output:

#	TOD	HDG	BRG	S.R.	X	Y	Z	TEL	ERR
2	23:59:58	38	101.1	111.8	98.2	-19.1	50.0	0.0	
1	23:59:59	38	6.0	152.1	15.7	149.2	25.0	0.0	

3.11.5 VESSEL SYMBOL

The vessel length and width can be input to allow a graphic representation of the vessel displayed on the screen proportional to the grid scale. See section 3.4.2. For chart of vessel symbols vs. modes of operation see Figure 3-18.

VESSEL HEADING SYMBOLS VS MODES OF OPERATION

		VESSEL SYMBOL = OFF		VESSEL SYMBOL = ON	
		BOAT CENTERED	TARGET CENTERED	BOAT CENTERED	TARGET CENTERED
COMPASS OFF		FIG 18A	FIG 18C (W/O LINE)	FIG 18D	FIG 18C (W/O LINE)
	But if boat is off-screen		FIG 18C		FIG 18C
	But if vessel too large or small to draw			FIG 18B	
COMPASS ON		FIG 18E	FIG 18F	FIG 18B	FIG 18G
	But if vessel is off screen		FIG 18G		FIG 18G
	But if vessel too large or small to draw			FIG 18I	

Figure 3-18

The vessel symbol changes depending on the various modes of operation. For example, with the Compass function turned off and the Vessel Symbol turned off, the vessel is represented by a stationary arrow pointing upwards in the center of the screen. If Target Centered mode is then activated, the vessel symbol changes to an outline of a small vessel (pointing upwards) and is displayed on the screen in relation to the centered target.

If the Compass function is activated, then the vessel symbol is represented by a circle with a line emanating from it to show compass heading, etc.

If the vessel symbol dimensions requested are too large or too small to draw proportional to the grid, then the symbol size defaults to a small vessel symbol.

VESSEL HEADING SYMBOLS VS MODES OF OPERATION

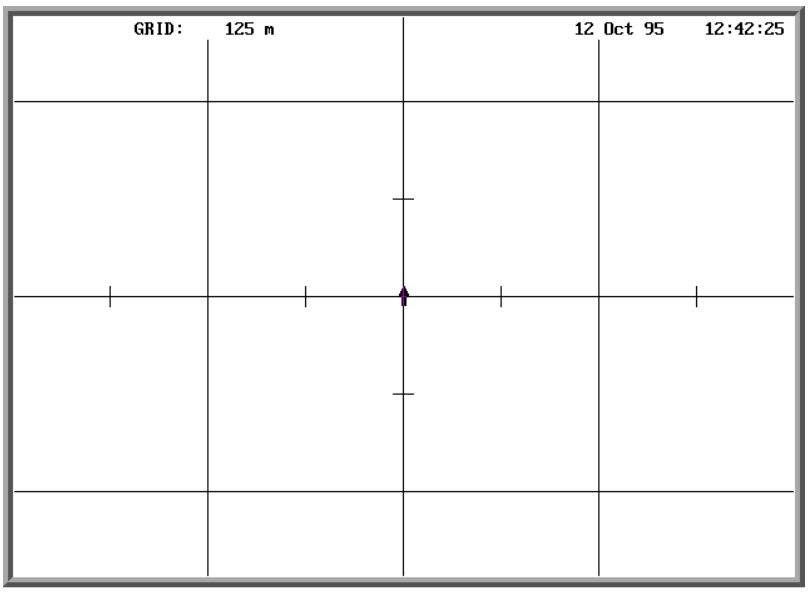


Figure 3-18 A

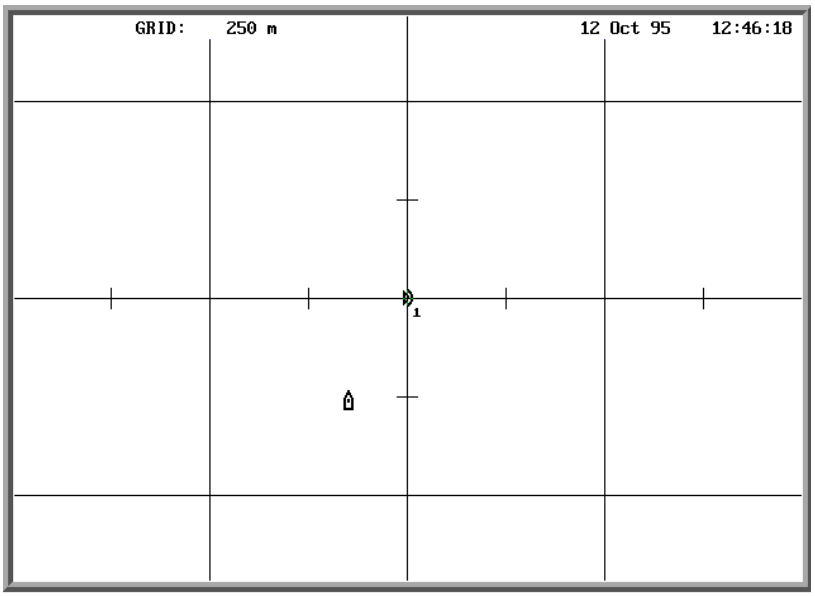


Figure 3-18 B

VESSEL HEADING SYMBOLS VS MODES OF OPERATION

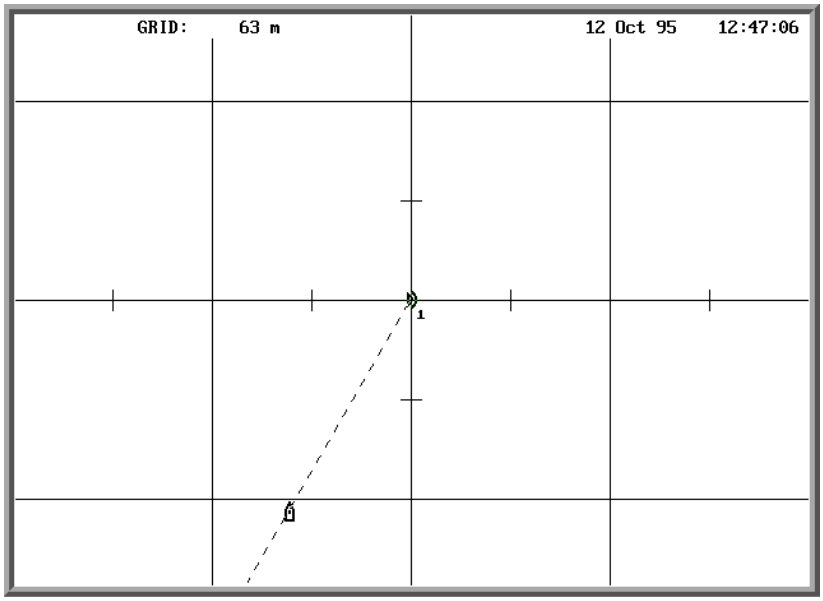


Figure 3-18 C

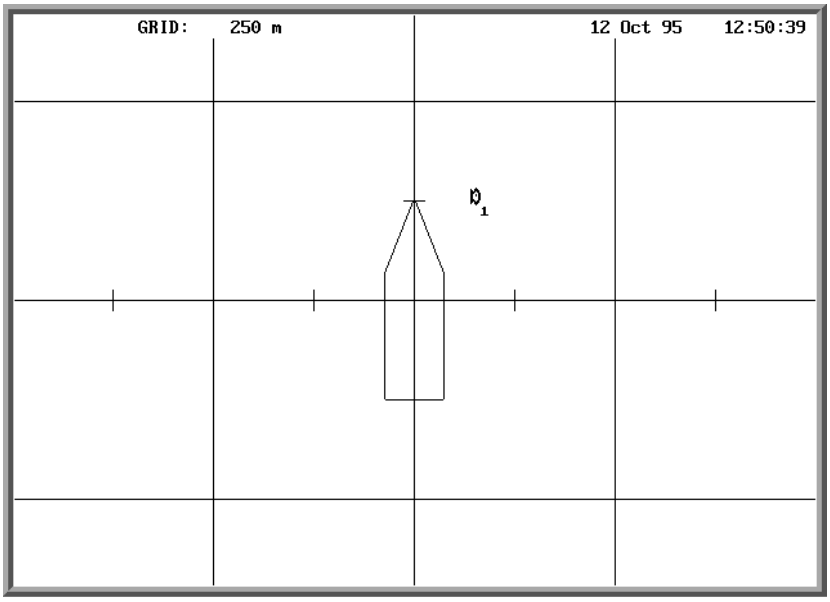


Figure 3-18 D

VESSEL HEADING SYMBOLS VS MODES OF OPERATION

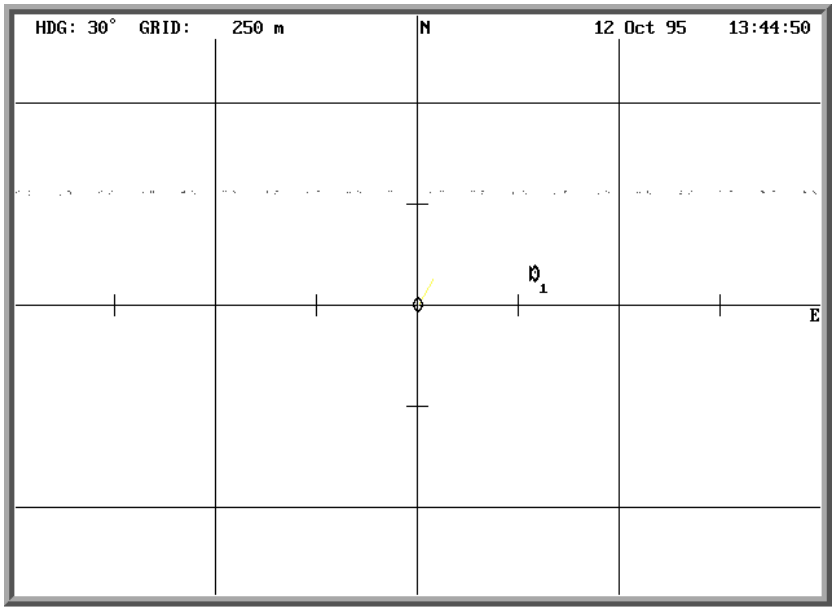


Figure 3-18 E

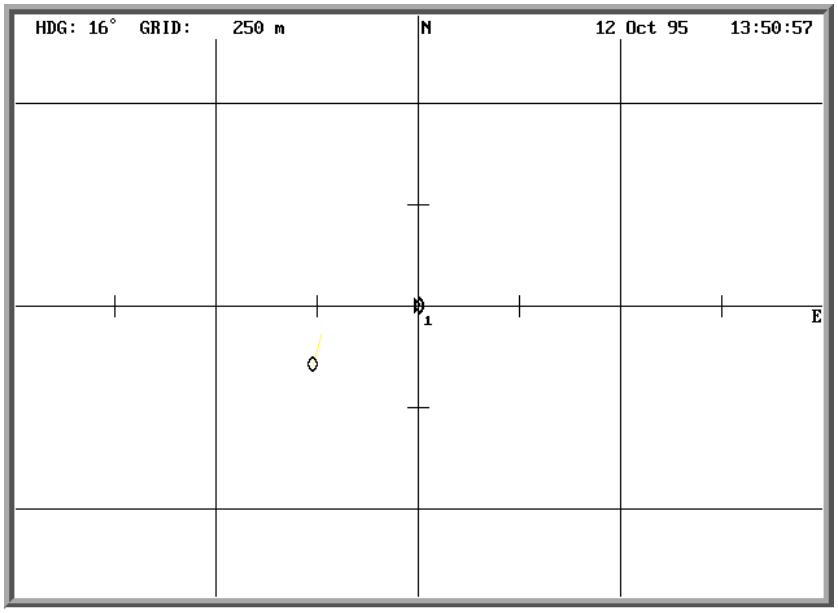


Figure 3-18 F

VESSEL HEADING SYMBOLS VS MODES OF OPERATION

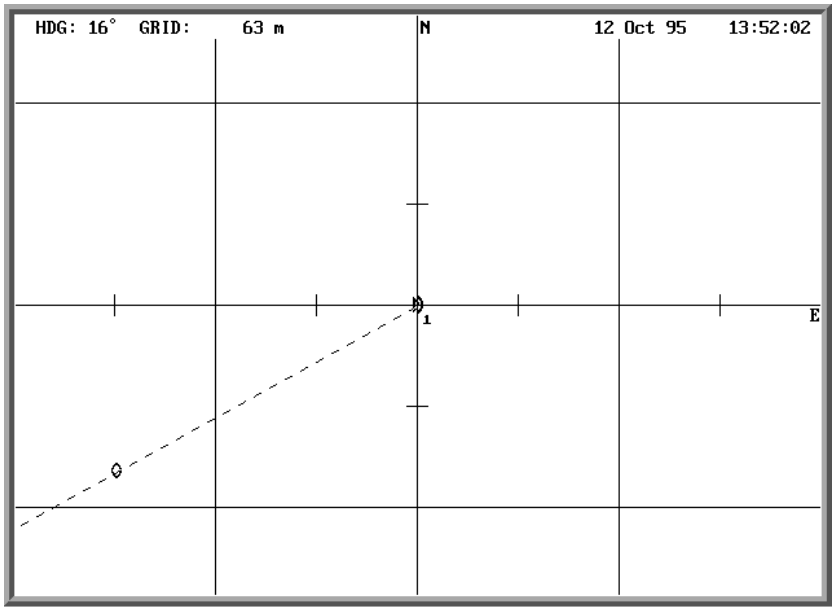


Figure 3-18 G

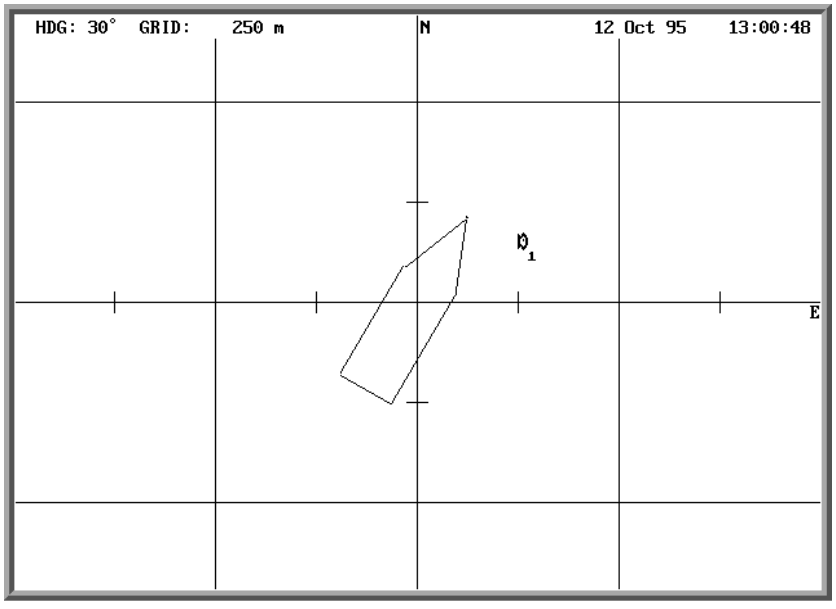


Figure 3-18 H

VESSEL HEADING SYMBOLS VS MODES OF OPERATION

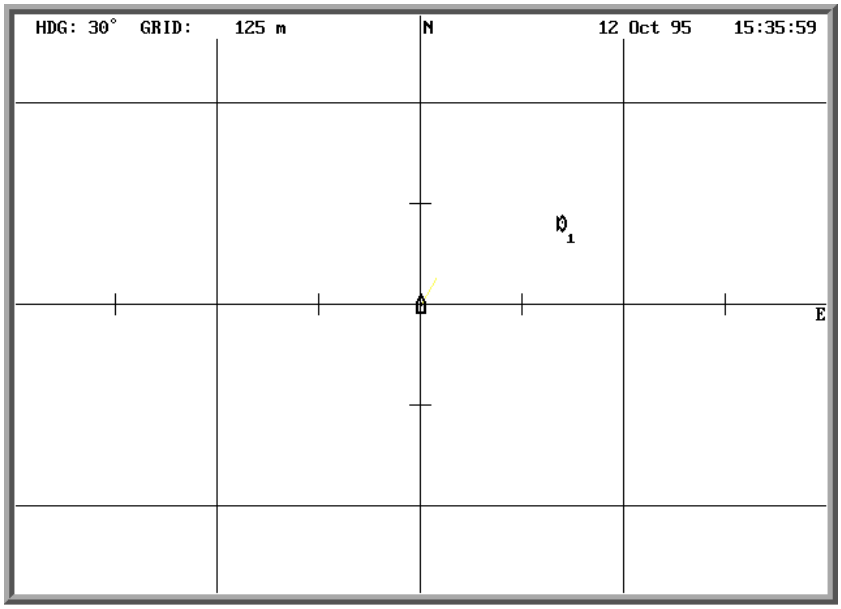


Figure 3-18 I

3.11.6 X AND Y DISPLAY AXIS OFFSETS

This function enhances display viewing by offsetting the center axis of the Grid to allow a larger grid display of a specific area/quadrant. For example, if the navigation operation requires tracking of a tow-fish behind the vessel the center of the grid can be offset towards the top of the screen to view only the area astern of the vessel. Conversely, if the navigation operation requires tracking of a Remotely Operated Vehicle (ROV) ahead of the vessel the grid can be offset towards the bottom of the screen to view only the area ahead of the vessel.

To enter an X DISPLAY AXIS OFFSET into the Trackpoint; select from the basic menu, DISPLAY (f1), GRID (f1), RECTANGULAR (f1), % AXIS OFFSET (f1), (see Figure 3-19 below). Enter the signed percent offset. To move the grid left of center, enter a number between -1 and -90 (no sign is assumed to be (+), a minus sign (-) is a negative value). This moves the center of the grid that percentage of the full window size to the left of the screen. To move the center of the grid to the bottom of the screen select % Y AXIS OFFSET and enter a number between -1 and -70.

X AND Y DISPLAY AXIS OFFSETS

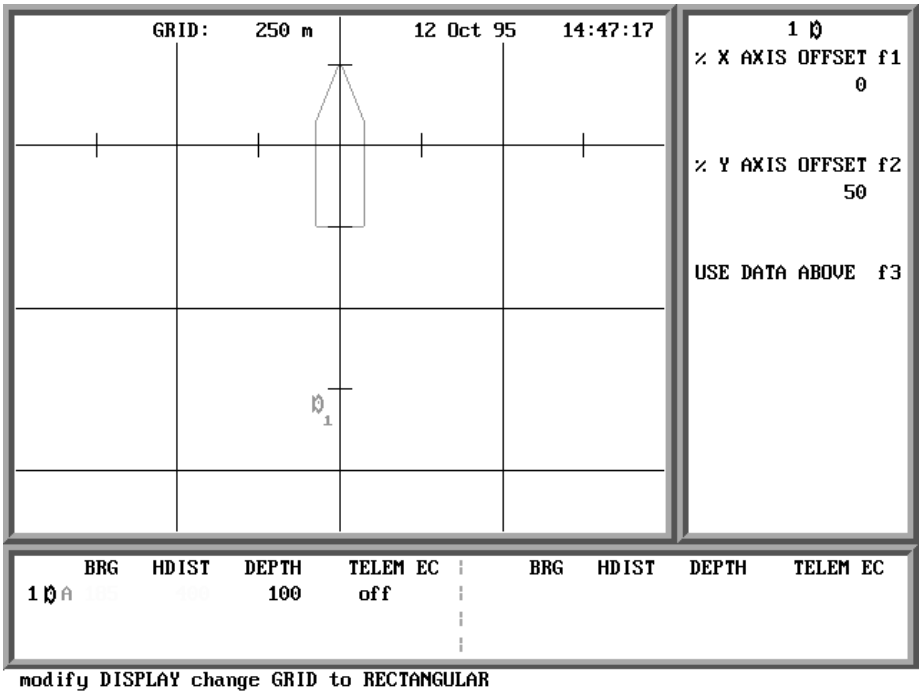


Figure 3-19

3.12 RS-232C INTERFACE

3.12.1 GENERAL

COM#1

Trackpoint II uses the standard EIA RS-232C serial communications interface to output data to an external device. This can be configured from the menu by setting the BAUD RATE, the number of DATA BITS required and the number of STOP BITS. With firmware revision 8.0 and greater the Trackpoint has the capability of changing most tracking functions via the RS-232 port. (Refer to the RS-232 COMMANDS section 3.12.5.)

The interface requires no parity and operates with an XON/XOFF protocol in the following manner. Data is sent over the RS-232C lines until an XOFF character is received from the external device or terminal. The XON/XOFF characters are also called DC1 and DC3, respectively, and are represented by Control Q and Control S on a standard terminal. (Their hexadecimal ASCII values are 11 and 13, respectively.) Data output resumes when an XON character is received by the Trackpoint. The Trackpoint does not transmit XON or XOFF characters to the Terminal. The system architecture is multi-tasking with a high priority on the communications interface. It is therefore unlikely that the Terminal device will send more setup commands than the Trackpoint can handle. If the Terminal device is fast enough so that it can receive the Trackpoint data without buffer overflow then the XON/XOFF protocol may not be required and the system can operate without this software handshake. (Refer to Figure 3-21 through 3-29 for the format of the data output.)

In Pinger mode the current data is output once per two seconds (default value) if the baud rate is greater than or equal to 1200 bps (e.g., 1200/2400/4800/9600). If the baud rate is 600 bps the data is output every four seconds, if 300 bps the data is output every eight seconds unless the rate is changed by the operator to be slower than the above rates (e.g., 6 or 10 seconds). In transponder or responder mode the data is output when the acoustical reply is received.

Do not plug or unplug the RS-232 connector from the Trackpoint while it is operating. This may halt the unit, thus causing loss of tracking. (If this does occur, look at the clock at the top right of the screen; if clock has stopped, reset the unit.)

NOTE: If the processor is busy performing screen changes from a keypad request, for example, a DISPLAY/ CONFIGURATION /SYSTEM or a HELP screen, the processor will not output RS-232 data at the received time or preset time. The data is stored in the RS-232 buffer until the RS-232 output can be serviced. The data buffer is 24 x 80 characters long. If keypad requests hold off the RS-232 port longer than the buffer can store the data, then some data may be lost and only the most recent data is output. The data output resumes at the next rate interval or received signal after this higher priority task is completed.

The RS-232C Typical Cable Configuration Table, 3-20A, illustrates the RS-232C data lines used by Trackpoint II.

COM#2

The NMEA mode allows input of various NMEA compass sentences, **with or without checksum verification,** “HDG”, “HDT”, “HDM” “VHW” or “VTG” NMEA formats. Set up COM port #2 under the menu SYSTEM / MORE / HARDWARE / COM2 SETUP. This allows the operator to configure the port’s Baud Rate, Data Bits and Stop Bits. Refer to section 3.6.5, NMEA COMPASS SET UP, for compass/gyro interface.

3.12.2 HARDWARE

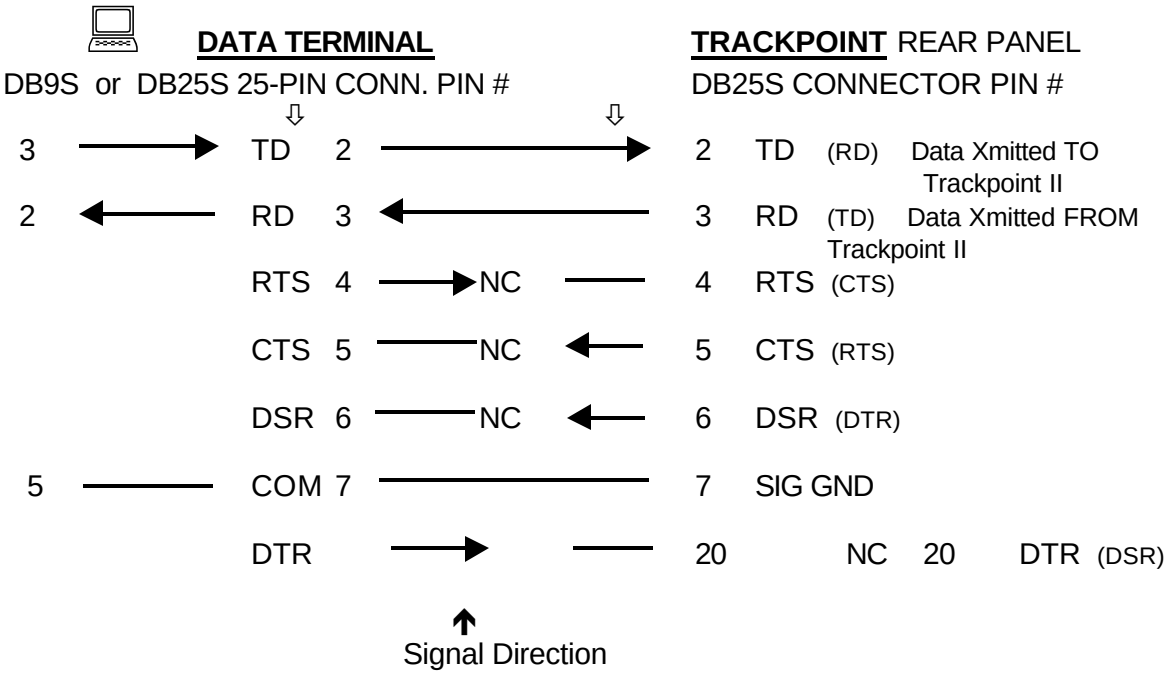
COM#1

The Trackpoint COM#1 interface is designed to act as a “DCE” (Data Communication Equipment) device. This means that it will interface directly to “DTE” (Data Terminal Equipment) device (Data terminal or PC), with the Trackpoint acting as if it were a modem. That is to say, a Null modem is NOT required between the PC and the Trackpoint.

With the increase in both processor speed and also the data rate (typically 9600 baud) a hardware handshake becomes less of a requirement. With this in mind and the favorable tests ORE has performed, the 4410 ”D” Trackpoint C/DM does not have hardware handshaking capability.

The Trackpoint COM#1 interface disables the hardware handshake lines (DSR & CTS) and only uses the XOFF & XON protocol. The DSR & CTS lines are set high on initialization of unit and remain in that state. I.e., the Trackpoint is always signaling the Data Terminal Equipment (i.e., PC) that it is OK to send it data.

RS-232 TYPICAL CABLE CONFIGURATION (COM#1)



NOTE: Connect the RS-232 cables between each device before turning on the Trackpoint or the terminal. If the RS-232 cable is connected after C/DM is turned on, the unit may halt. Turn power off and then on again to reset unit.

Figure 3-20A

COM#2

The COM#2 port is used typically for a compass input. Refer to section 3.6.5. No data is transmitted from this port. The hardware is setup for bi-directional communications but the Trackpoint does not utilize its transmit capabilities.

The Trackpoint's COM#2 interface is designed to act as a "DTE" (Data Terminal Equipment) device (Data terminal or PC). This means that the interface is the same as a "PC" and requires a null modem if connecting to a device whose output is compatible with one.

The COM#2 port does not have hardware or software flow control capability. The hardware handshake lines (RTS & DTR) are disabled and do not use the XOFF & XON protocol. The RTS & DTR lines are set high on initialization of unit and remain in that state. I.e., the Trackpoint is always signaling the connected device that it is OK to send it data. If an overrun in data occurs the data is lost and only the most recent is accepted. (In the case of a gyro or compass input you would not want the old data but rather accept only the most recent.)

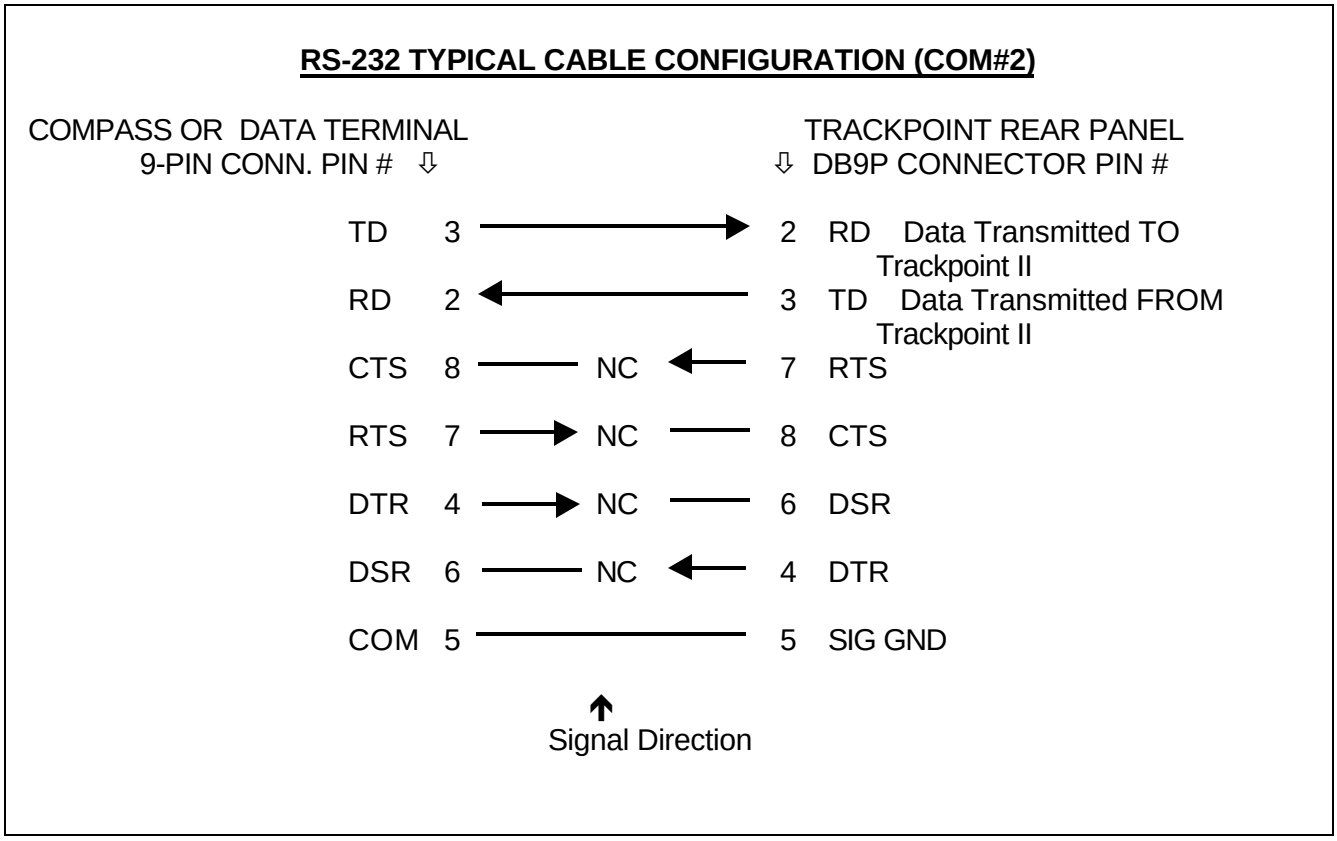


Figure 3-20B

3.12.3 RS-232 DATA OUTPUT FORMATS

There are ten types of string formats that the RS-232 can output, Rev 4 (formerly Format 1), Rev 4-EC (formerly Format 1EC), Standard (formerly Format 2), Standard-EC (formerly Format 2EC), Std w/pr (formerly Format 3), Std-EC w/pr (formerly Format 3EC), NCSC (rev 8.05), NCSC-EC (rev 8.05 w/EC), NMEA TTM and NMEA ORE.

The REV 4 (formerly Format 1) and REV 4-EC formats are minimal output strings containing only depression angle, bearing and X, Y, Z. Format REV 4 contains only valid data, no warning or error codes. Format REV 4-EC contains error codes as in format STANDARD-EC. Format REV 4 maintains the same character length by truncating the data for Slant Range, X, Y & Z when their values exceed 999.9. E.g., When values exceed 999.9 the values are truncated to 1000, or if values exceed -999.9 they are truncated to -1000.

The STANDARD Format (formerly Format 2) contains information such as vessel heading and telemetry data. The STANDARD and STANDARD-EC formats are compatible with older Trackpoint II firmware revisions 5.0 on up. The STD W/PR (formerly Format 3) and STD-EC W/PR contains the same data as the STANDARD and STANDARD-EC but has two more parameters added to the end of the string, Roll and Pitch (from rev 5.08).

Formats STANDARD, STD W/PR and NCSC contain only data that is valid. That is to say, when in these formats data is not output if in error or no data present. Only warning codes are sent out the RS-232 with these formats. Formats STANDARD-**EC,** STD-**EC** W/PR and NCSC-**EC** output data even though it was determined to be invalid, under the premise that the interfacing equipment/software has been programmed to extract the good data from the string and ignore the data flagged by the error code.

NOTE: If compass mode is enabled and RS-232 format STANDARD, STD-EC, STD W/PR, STD-EC W/PR, NCSC, NCSC-EC or NMEA ORE is selected, the heading data is available along with the target bearing and X & Y coordinates at the RS-232 COM port#1. If RS-232 format REV 4, REV 4-EC or NMEA TTM is selected, then no heading information is sent out the RS-232, but the target positioning data (BRG, X & Y) remain referenced to north.

Format NCSC is a new output string added to the RS-232 FORMAT menu selection since revision 9.04. This format is compatible with the NCSC format from the Trackpoint firmware revision 8.05.

Sample is shown below:

```
  TG  TIME     HDG  BRG    SR         X         Y         Z         TEL     EC
CS
☺ 1 10:28:31      210.7 00009.5 -00004.6 -00007.8 00002.0 000000.0 56 CS
```

The ASCII Start Of Text Character, "☺", is equal to 2 decimal or 02 hexadecimal. If a numeric field has more bytes than required to represent the ASCII number then leading zeroes are inserted in the data string. If the heading is not enabled the data field is filled with spaces. The Checksum includes all bytes in the message except the checksum bytes.

Format NMEA TTM follows the NMEA 0183 Version 2.1 Tracked Target Message format. It is a 51-character string length (not including <CR><LF>). It is prefixed by the characters "SN", identifying it as an electronic positioning system.

$SNTTM,##,HZRNG,BEAR,R,,,,,K,TPII,T,,HHMMSS,A*CS

$SNTTM,01,0.0002,080.5,R,,,,,K,TPII,T,,072432,A*4A

In the NMEA TTM message, if the compass is north referenced the heading identifier is “T” for true and if the compass is bow referenced the heading identifier is “R” for relative. (The data is only true if the operator selects a True heading data sentence via the NMEA input (e.g., HDT, VHW or VTG) or if the analog compass input has been offset to obtain a True heading.)

Format NMEA ORE is a proprietary NMEA 0183 string length of 70 characters not including <CR><LF>. It follows the sentence structure for a NMEA 0183 version 2.1 proprietary sentence. It is the only string that outputs the Quality Factor for the reply. The system automatically switches to this format when the AUTO OFFSET function is initiated. This allows greater resolution for reading of pitch and roll data. The system reverts back to the previous format once AUTO OFFSET has been completed.

$PORE,##,HHMMSS,, BRG ,ID, X (m) , Y (m) , Z (m) , ROLL , PTCH ,WC,QF*CS

$PORE,01,072450,,300.8,M ,-00001.0,000000.6,00505.4,000.00,000.00,00,10*18

A heading identifier has been added to the NMEA ORE sentence to indicate whether the heading information is True, Magnetic or derived from an Analog source. See Figure 3-29. Both NMEA formats follow the NMEA 0183 sentence structure even though the hardware is not to EIA-RS-422 specifications. An adapter can be added to the Trackpoint's serial port to convert the RS232 I/O to a RS422 I/O if required. The NMEA standard uses the following parameters:

Baud Rate	4800
Data Bits	8 (D7 = 0)
Parity	none
Stop Bits	One

NOTE: The NMEA standard also uses a checksum at the end of the string to verify data integrity. The checksum field follows the "*" delimiter character. The checksum is the 8-bit exclusive OR (not including start or stop bits) of all characters in the sentence including the field delimiter "," character and the checksum delimiter "*" character. (Does not include <CR> or <LF>.) The hexadecimal value of the four (4) most significant bits is converted to an ACSII character (0-9, A-F) and is transmitted first. The same conversion is performed on the four (4) least significant bits and it is transmitted next.

These parameters can be changed within the C/DM under the SYSTEM / HARDWARE / RS232 INTERFACE menu. For further information on the NMEA standard contact the NMEA National Office, PO Box 3435, New Bern, NC 28564-3435 U.S.A.

NOTE: To select the various Formats refer to SYSTEM path, section 3.4.2.

See Figure 3-21 through Figure 3-29 for output specifications on the various formats.

TRACKING DATA MESSAGE FOR FORMAT **"REV 4"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	TARGET NUMBER	ASCII	1-9	N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3	1	SPACE	ASCII SPACE CHARACTER		N/A
4-8	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
9	1	SPACE	ASCII SPACE CHARACTER		N/A
10-13	4	DEPRESSION ANGLE	ASCII	0.3-90.0	DEGREES
14	1	SPACE	ASCII SPACE CHARACTER		N/A
15-19	5	SLANT RANGE	ASCII	0.0-09500	METERS
20	1	SPACE	ASCII SPACE CHARACTER		N/A
21-26	6	X	ASCII	+/- 0.0-10000	METERS
27	1	SPACE	ASCII SPACE CHARACTER		N/A
28-33	6	Y	ASCII	+/- 0.0-10000	METERS
34	1	SPACE	ASCII SPACE CHARACTER		N/A
35-40	6	Z	ASCII	0.0-010000	METERS
41	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
42	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

NOTE: Format REV 4 only outputs data in meters. Leading zeroes following the ones digit are suppressed and replaced by spaces.

Example of Format REV 4 RS232 output is shown below:

```
O.R.E. TRACKPOINT II  REV # 9.05 15 Oct 97 15:32:21
#          BRG      DEPA     S/R        X     Y      Z

1          356.3    30.3     196.1  -11.1  168.9  100.0
```

Figure 3-21

TRACKING DATA MESSAGE FOR FORMAT **"REV 4-EC"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	TARGET NUMBER	ASCII	1-9	N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3	1	SPACE	ASCII SPACE CHARACTER		N/A
4-8	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
9	1	SPACE	ASCII SPACE CHARACTER		N/A
10-13	4	DEPRESSION ANGLE	ASCII	0.3-90.0	DEGREES
14	1	SPACE	ASCII SPACE CHARACTER		N/A
15-19	5	SLANT RANGE	ASCII	0.0-09500	METERS
20	1	SPACE	ASCII SPACE CHARACTER		N/A
21-26	6	X	ASCII	+/- 0.0-10000	METERS
27	1	SPACE	ASCII SPACE CHARACTER		N/A
28-33	6	Y	ASCII	+/- 0.0-10000	METERS
34	1	SPACE	ASCII SPACE CHARACTER		N/A
35-40	6	Z	ASCII	0.0-010000	METERS
41	1	SPACE	ASCII SPACE CHARACTER		N/A
42-43	2	ERROR CODE	ASCII	0-99	N/A
44	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
45	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

NOTE: Format REV 4-EC only outputs data in meters. Leading zeroes following the ones digit are suppressed and replaced by spaces.

Example of Format REV 4-EC RS232 output is shown below:

```
O.R.E. TRACKPOINT II  REV # 9.05 15 Oct 97 15:32:33
#        BRG      DEPA   S/R    X      Y      Z    ERR

1        356.3    30.3       196.3  -11.0  169.1  100.0  50
```

Figure 3-22

TRACKING DATA MESSAGE FOR FORMAT **"STANDARD"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	TARGET NUMBER	ASCII	1-9	N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-4	2	HOURS	ASCII	00-23	HOURS
5	1	COLON	ASCII COLON CHARACTER		N/A
6-7	2	MINUTES	ASCII	00-59	MINUTES
8	1	COLON	ASCII COLON CHARACTER		N/A
9-10	2	SECONDS	ASCII	00-59	SECONDS
11	1	SPACE	ASCII SPACE CHARACTER		N/A
12-14	3	COMPASS HEADING	ASCII	0-359	DEGREES
15	1	SPACE	ASCII SPACE CHARACTER		N/A
16-20	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
21	1	SPACE	ASCII SPACE CHARACTER		N/A
22-28	7	SLANT RANGE	ASCII	0.0-10000.0	METERS*
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-37	8	X	ASCII	+/- 10000.0	METERS*
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-46	8	Y	ASCII	+/- 10000.0	METERS*
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-54	7	Z	ASCII	0.0-10000.0	METERS*
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-63	8	TELEMETRY	ASCII	+/- 99999.9	UNITS
64	1	SPACE	ASCII SPACE CHARACTER		N/A
65-66	2	WARNING CODE	ASCII	Null, 20-99**	N/A
67	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
68	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

* The Slant Range X,Y & Z data can either be in meters, yards or feet. See SYSTEM/RS232 UNITS. Leading zeroes following the ones digit are suppressed and replaced by spaces (except for the time).
** Error Code 0 = Null Character

Example:
O.R.E. TRACKPOINT II Model 4410 Rev # 9.05 15 Oct 97 15:32:38
TOD HDG BRG S.R.(m) X (m) Y (m) Z (m) TEL WARN

1 15:32:40 359 356.3 196.3 -11.1 169.1 100.0 0.0 50

Figure 3-23

TRACKING DATA MESSAGE FOR FORMAT **"STANDARD-EC"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	TARGET NUMBER	ASCII	1-9	N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-4	2	HOURS	ASCII	00-23	HOURS
5	1	COLON	ASCII COLON CHARACTER		N/A
6-7	2	MINUTES	ASCII	00-59	MINUTES
8	1	COLON	ASCII COLON CHARACTER		N/A
9-10	2	SECONDS	ASCII	00-59	SECONDS
11	1	SPACE	ASCII SPACE CHARACTER		N/A
12-14	3	COMPASS HEADING	ASCII	0-359	DEGREES
15	1	SPACE	ASCII SPACE CHARACTER		N/A
16-20	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
21	1	SPACE	ASCII SPACE CHARACTER		N/A
22-28	7	SLANT RANGE	ASCII	0.0-10000.0	METERS*
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-37	8	X	ASCII	+/- 10000.0	METERS*
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-46	8	Y	ASCII	+/- 10000.0	METERS*
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-54	7	Z	ASCII	0.0-10000.0	METERS*
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-63	8	TELEMETRY	ASCII	+/- 99999.9	UNITS
64	1	SPACE	ASCII SPACE CHARACTER		N/A
65-66	2	WARNING AND ERROR CODE	ASCII	Null-99**	N/A
67	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
68	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

* The Slant Range X,Y & Z data can either be in meters, yards or feet. See SYSTEM/RS232 UNITS. Leading zeroes following the ones digit are suppressed and replaced by spaces (except for the time).
** Error Code 0 = Null Character

Example:
O.R.E. TRACKPOINT II Model 4410 Rev # 9.05 15 Oct 97 15:32:51
TOD HDG BRG S.R.(m) X (m) Y (m) Z (m) TEL ERR

1 15:32:53 359 356.1 196.6 -11.5 169.4 100.0 0.0 50

Figure 3-24

TRACKING DATA MESSAGE FOR FORMAT **"STANDARD-EC"** WITH EC#6

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	TARGET NUMBER	ASCII	1-9	N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-4	2	HOURS	ASCII	00-23	HOURS
5	1	COLON	ASCII COLON CHARACTER		N/A
6-7	2	MINUTES	ASCII	00-59	MINUTES
8	1	COLON	ASCII COLON CHARACTER		N/A
9-10	2	SECONDS	ASCII	00-59	SECONDS
11	1	SPACE	ASCII SPACE CHARACTER		N/A
12-14	3	COMPASS HEADING	ASCII	0-359	DEGREES
15	1	SPACE	ASCII SPACE CHARACTER		N/A
16-17	2	TARGET BEARING	ASCII SPACE CHARACTER		N/A
18	1	TARGET BEARING	ASCII MINUS CHARACTER (2D h)	-	N/A
19	1	TARGET BEARING	ASCII PERIOD CHARACTER (2E h)	.	N/A
20	1	TARGET BEARING	ASCII MINUS CHARACTER (2D h)	-	N/A
21	1	SPACE	ASCII SPACE CHARACTER		N/A
22-25	4	SLANT RANGE	ASCII SPACE CHARACTER		N/A
26	1	SLANT RANGE	ASCII MINUS CHARACTER (2D h)	-	N/A
27	1	SLANT RANGE	ASCII PERIOD CHARACTER (2E h)	.	N/A
28	1	SLANT RANGE	ASCII MINUS CHARACTER (2D h)	-	N/A
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-34	5	X	ASCII SPACE CHARACTER		N/A
35	1	X	ASCII MINUS CHARACTER (2D h)	-	N/A
36	1	X	ASCII PERIOD CHARACTER (2E h)	.	N/A
37	1	X	ASCII MINUS CHARACTER (2D h)	-	N/A
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-43	5	Y	ASCII SPACE CHARACTER		N/A
44	1	Y	ASCII MINUS CHARACTER (2D h)	-	N/A
45	1	Y	ASCII PERIOD CHARACTER (2E h)	.	N/A
46	1	Y	ASCII MINUS CHARACTER (2D h)	-	N/A
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-51	4	Z	ASCII SPACE CHARACTER		N/A
52	1	Z	ASCII MINUS CHARACTER (2D h)	-	N/A
53	1	Z	ASCII PERIOD CHARACTER (2E h)	.	N/A
54	1	Z	ASCII MINUS CHARACTER (2D h)	-	N/A
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-60	5	TELEMETRY	ASCII SPACE CHARACTER		N/A
61	1	TELEMETRY	ASCII MINUS CHARACTER (2D h)	-	N/A
62	1	TELEMETRY	ASCII PERIOD CHARACTER (2E h)	.	N/A
63	1	TELEMETRY	ASCII MINUS CHARACTER (2D h)	-	N/A
64	1	SPACE	ASCII SPACE CHARACTER		N/A
65-66	2	ERROR CODE	ASCII	06	N/A
67	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
68	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

When an error code #6 is detected the unit displays only the known data while replacing unknown data with "-.-".

Figure 3-24A

TRACKING DATA MESSAGE FOR FORMAT **"STD W/PR"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	TARGET NUMBER	ASCII	1-9	N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-4	2	HOURS	ASCII	00-23	HOURS
5	1	COLON	ASCII COLON CHARACTER		N/A
6-7	2	MINUTES	ASCII	00-59	MINUTES
8	1	COLON	ASCII COLON CHARACTER		N/A
9-10	2	SECONDS	ASCII	00-59	SECONDS
11	1	SPACE	ASCII SPACE CHARACTER		N/A
12-14	3	COMPASS HEADING	ASCII	0-359	DEGREES
15	1	SPACE	ASCII SPACE CHARACTER		N/A
16-20	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
21	1	SPACE	ASCII SPACE CHARACTER		N/A
22-28	7	SLANT RANGE	ASCII	0.0-10000.0	METERS*
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-37	8	X	ASCII	+/- 10000.0	METERS*
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-46	8	Y	ASCII	+/- 10000.0	METERS*
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-54	7	Z	ASCII	0.0-10000.0	METERS*
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-63	8	TELEMETRY	ASCII	+/- 99999.9	UNITS
64	1	SPACE	ASCII SPACE CHARACTER		N/A
65-66	2	WARNING CODE	ASCII	Null, 20-99**	N/A
67	1	SPACE	ASCII SPACE CHARACTER		N/A
68-72	5	ROLL	ASCII	+/- 0.0-45.0	DEGREES
73	1	SPACE	ASCII SPACE CHARACTER		N/A
74-78	5	PITCH	ASCII	+/- 0.0-45.0	DEGREES
79	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
80	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

* The Slant Range X,Y & Z data can either be in meters, yards or feet. See SYSTEM/RS232 UNITS. Leading zeroes following the ones digit are suppressed and replaced by spaces (except for the time).
** Error Code 0 = Null Character

Example:
O.R.E. TRACKPOINT II Model 4410 Rev # 9.05 15 Oct 97 15:32:57
TOD HDG BRG S.R.(m) X (m) Y (m) Z (m) TEL WARN RL PT

1 15:32:59 359 356.3 196.0 -11.0 168.7 100.0 0.0 50 0.0 -0.0

Figure 3-25

TRACKING DATA MESSAGE FOR FORMAT **"STD-EC W/PR"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	TARGET NUMBER	ASCII	1-9	N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-4	2	HOURS	ASCII	00-23	HOURS
5	1	COLON	ASCII COLON CHARACTER		N/A
6-7	2	MINUTES	ASCII	00-59	MINUTES
8	1	COLON	ASCII COLON CHARACTER		N/A
9-10	2	SECONDS	ASCII	00-59	SECONDS
11	1	SPACE	ASCII SPACE CHARACTER		N/A
12-14	3	COMPASS HEADING	ASCII	0-359	DEGREES
15	1	SPACE	ASCII SPACE CHARACTER		N/A
16-20	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
21	1	SPACE	ASCII SPACE CHARACTER		N/A
22-28	7	SLANT RANGE	ASCII	0.0-10000.0	METERS*
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-37	8	X	ASCII	+/- 10000.0	METERS*
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-46	8	Y	ASCII	+/- 10000.0	METERS*
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-54	7	Z	ASCII	0.0-10000.0	METERS*
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-63	8	TELEMETRY	ASCII	+/- 99999.9	UNITS
64	1	SPACE	ASCII SPACE CHARACTER		N/A
65-66	2	WARNING AND ERROR CODE	ASCII	Null-99**	N/A
67	1	SPACE	ASCII SPACE CHARACTER		N/A
68-72	5	ROLL	ASCII	+/- 0.0-45.0	DEGREES
73	1	SPACE	ASCII SPACE CHARACTER		N/A
74-78	5	PITCH	ASCII	+/- 0.0-45.0	DEGREES
79	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
80	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

* The Slant Range X,Y & Z data can either be in meters, yards or feet. See SYSTEM/RS232 UNITS. Leading zeroes following the ones digit are suppressed and replaced by spaces (except for the time).
** Error Code 0 = Null Character

Example:

```
O.R.E. TRACKPOINT II Model 4410 Rev # 9.05 15 Oct 97 15:32:57
#  TOD      HDG  BRG    S.R.(m)  X (m)   Y (m)   Z (m)    TEL   ERR   RL   PT

1 15:32:59  359  356.3   196.0   -11.0   168.7   100.0     0.0    50   0.0 -0.0
```

Figure 3-26

TRACKING DATA MESSAGE FOR FORMAT **"STD-EC W/PR"** WITH EC#6

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	TARGET NUMBER	ASCII	1-9	N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-4	2	HOURS	ASCII	00-23	HOURS
5	1	COLON	ASCII COLON CHARACTER		N/A
6-7	2	MINUTES	ASCII	00-59	MINUTES
8	1	COLON	ASCII COLON CHARACTER		N/A
9-10	2	SECONDS	ASCII	00-59	SECONDS
11	1	SPACE	ASCII SPACE CHARACTER		N/A
12-14	3	COMPASS HEADING	ASCII	0-359	DEGREES
15	1	SPACE	ASCII SPACE CHARACTER		N/A
16-17	2	TARGET BEARING	ASCII SPACE CHARACTER		N/A
18	1	TARGET BEARING	ASCII MINUS CHARACTER (2D h)	-	N/A
19	1	TARGET BEARING	ASCII PERIOD CHARACTER (2E h)	.	N/A
20	1	TARGET BEARING	ASCII MINUS CHARACTER (2D h)	-	N/A
21	1	SPACE	ASCII SPACE CHARACTER		N/A
22-25	4	SLANT RANGE	ASCII SPACE CHARACTER		N/A
26	1	SLANT RANGE	ASCII MINUS CHARACTER (2D h)	-	N/A
27	1	SLANT RANGE	ASCII PERIOD CHARACTER (2E h)	.	N/A
28	1	SLANT RANGE	ASCII MINUS CHARACTER (2D h)	-	N/A
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-34	5	X	ASCII SPACE CHARACTER		N/A
35	1	X	ASCII MINUS CHARACTER (2D h)	-	N/A
36	1	X	ASCII PERIOD CHARACTER (2E h)	.	N/A
37	1	X	ASCII MINUS CHARACTER (2D h)	-	N/A
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-43	5	Y	ASCII SPACE CHARACTER		N/A
44	1	Y	ASCII MINUS CHARACTER (2D h)	-	N/A
45	1	Y	ASCII PERIOD CHARACTER (2E h)	.	N/A
46	1	Y	ASCII MINUS CHARACTER (2D h)	-	N/A
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-51	4	Z	ASCII SPACE CHARACTER		N/A
52	1	Z	ASCII MINUS CHARACTER (2D h)	-	N/A
53	1	Z	ASCII PERIOD CHARACTER (2E h)	.	N/A
54	1	Z	ASCII MINUS CHARACTER (2D h)	-	N/A
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-60	5	TELEMETRY	ASCII SPACE CHARACTER		N/A
61	1	TELEMETRY	ASCII MINUS CHARACTER (2D h)	-	N/A
62	1	TELEMETRY	ASCII PERIOD CHARACTER (2E h)	.	N/A
63	1	TELEMETRY	ASCII MINUS CHARACTER (2D h)	-	N/A
64	1	SPACE	ASCII SPACE CHARACTER		N/A
65-66	2	ERROR CODE	ASCII	06	N/A
67	1	SPACE	ASCII SPACE CHARACTER		N/A
68-69	2	ROLL	ASCII SPACE CHARACTER		N/A
70	1	ROLL	ASCII MINUS CHARACTER (2D h)	-	N/A
71	1	ROLL	ASCII PERIOD CHARACTER (2E h)	.	N/A
72	1	ROLL	ASCII MINUS CHARACTER (2D h)	-	N/A
73	1	SPACE	ASCII SPACE CHARACTER		N/A
74-75	2	PITCH	ASCII SPACE CHARACTER		N/A
76	1	PITCH	ASCII MINUS CHARACTER (2D h)	-	N/A
77	1	PITCH	ASCII PERIOD CHARACTER (2E h)	.	N/A
78	1	PITCH	ASCII MINUS CHARACTER (2D h)	-	N/A
79	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
80	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

When an error code #6 is detected the unit displays only the known data while replacing unknown data with "-.-".

Figure 3-26A

TRACKING DATA MESSAGE FOR FORMAT **"NCSC"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	START OF TEXT	ASCII START OF TEXT CHARACTER, 02h		N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3	1	TARGET NUMBER	ASCII	1-9	N/A
4	1	SPACE	ASCII SPACE CHARACTER		N/A
5-6	2	HOURS	ASCII	00-23	HOURS
7	1	COLON	ASCII COLON CHARACTER		N/A
8-9	2	MINUTES	ASCII	00-59	MINUTES
10	1	COLON	ASCII COLON CHARACTER		N/A
11-12	2	SECONDS	ASCII	00-59	SECONDS
13	1	SPACE	ASCII SPACE CHARACTER		N/A
14-18	5	COMPASS HEADING	ASCII	0.0-359.0	DEGREES
19	1	SPACE	ASCII SPACE CHARACTER		N/A
20-24	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
25	1	SPACE	ASCII SPACE CHARACTER		N/A
26-32	7	SLANT RANGE	ASCII	0.0-10000.0	METERS*
23	1	SPACE	ASCII SPACE CHARACTER		N/A
34-41	8	X	ASCII	+/- 10000.0	METERS*
42	1	SPACE	ASCII SPACE CHARACTER		N/A
43-50	8	Y	ASCII	+/- 10000.0	METERS*
52	1	SPACE	ASCII SPACE CHARACTER		N/A
53-59	7	Z	ASCII	0.0-10000.0	METERS*
60	1	SPACE	ASCII SPACE CHARACTER		N/A
60-67	8	TELEMETRY	ASCII	+/- 99999.9	UNITS
68	1	SPACE	ASCII SPACE CHARACTER		N/A
69-70	2	WARNING AND ERROR CODE	ASCII	Null-99**	N/A
71	1	SPACE	ASCII SPACE CHARACTER		N/A
72-73	2	CHECKSUM	16-BIT BINARY SUM OF BYTES	00-FF	N/A
74	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
75	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

* The Slant Range X, Y & Z data can either be in meters, yards or feet. See SYSTEM/RS232 UNITS. Leading zeroes following the ones digit are output, maintaining a fixed field length.
** Error code 0 = null character

Example:

```
 TG  TIME     HDG  BRG     SR         X          Y          Z         TEL      EC   CS
☺1 10:28:31        210.7   00009.5   -00004.6   -00007.8   00002.0   000000.0  56   CS
```

The ASCII Start Of Text Character, "☺", is equal to 2 decimal or 02 hexadecimal. If a numeric field has more bytes than required to represent the ASCII number then leading zeroes are inserted in the data string. If the heading is not enabled the data field is filled with spaces.

Figure 3-27

TRACKING DATA MESSAGE FOR FORMAT **"NMEA TTM"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	$	ASCII "$" CHARACTER	NA	NA
2	1	S	ASCII "S" CHARACTER	NA	NA
3	1	N	ASCII "N" CHARACTER	NA	NA
4	1	T	ASCII "T" CHARACTER	NA	NA
5	1	T	ASCII "T" CHARACTER	NA	NA
6	1	M	ASCII "M" CHARACTER	NA	NA
7	1	COMMA	ASCII "," CHARACTER	NA	NA
8-9	2	TARGET NUMBER	ASCII	01-09	N/A
10	1	COMMA	ASCII "," CHARACTER	NA	NA
11-16	6	HORIZONTAL RANGE	ASCII	0.0000-9.9999	KILOMETERS
17	1	COMMA	ASCII "," CHARACTER	NA	NA
18-22	5	TARGET BEARING	ASCII	000.0-359.9	DEGREES
23	1	COMMA	ASCII "," CHARACTER	NA	NA
24	1	R	ASCII "R" CHARACTER	NA	NA
25-30	6	COMMA	ASCII "," CHARACTER	NA	NA
31	1	K	ASCII "K" CHARACTER	NA	NA
32	1	COMMA	ASCII "," CHARACTER	NA	NA
33	1	T	ASCII "T" CHARACTER	NA	NA
34	1	P	ASCII "P" CHARACTER	NA	NA
35	1	I	ASCII "I" CHARACTER	NA	NA
36	1	I	ASCII "I" CHARACTER	NA	NA
37	1	COMMA	ASCII "," CHARACTER	NA	NA
38	1	T	ASCII "T" CHARACTER	NA	NA
39	1	COMMA	ASCII "," CHARACTER	NA	NA
40	1	COMMA	ASCII "," CHARACTER	NA	NA
41-42	2	HOURS	ASCII	00-23	HOURS
43-44	2	MINUTES	ASCII	00-59	MINUTES
45-46	2	SECONDS	ASCII	00-59	SECONDS
47	1	COMMA	ASCII "," CHARACTER	NA	NA
48	1	A	ASCII "A" CHARACTER	NA	NA
49	1	*	ASCII "*" CHARACTER	NA	NA
50-51	2	CHECK SUM	ASCII	00-FF	NA
52	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
53	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

Example:

$SNTTM, ##, _HZRNG, _BEAR, R , , , , , , K, TPII , T , , HHMMSS , A*CS

$SNTTM , 01 , 0.0002 , 080.5 , R , , , , , , K , TPII , T , , 072432 , A*4A

Figure 3-28

TRACKING DATA MESSAGE FOR FORMAT **"NMEA ORE"**

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	$	ASCII "$" CHARACTER	NA	NA
2	1	P	ASCII "P" CHARACTER	NA	NA
3	1	O	ASCII "O" CHARACTER	NA	NA
4	1	R	ASCII "R" CHARACTER	NA	NA
5	1	E	ASCII "E" CHARACTER	NA	NA
6	1	COMMA	ASCII "," CHARACTER	NA	NA
7-8	2	TARGET NUMBER	ASCII	01-09	NA
9	1	COMMA	ASCII "," CHARACTER	NA	NA
10-11	2	HOURS	ASCII	00-23	HOURS
12-13	2	MINUTES	ASCII	00-59	MINUTES
14-15	2	SECONDS	ASCII	00-59	SECONDS
16	1	COMMA	ASCII "," CHARACTER	NA	NA
	(WITH HEADING ENABLED)				
	(17-21) 5	HEADING	ASCII	000.0-359.9	DEGREES
17	(22) 1	COMMA	ASCII "," CHARACTER	NA	NA
	(23) 1	HEADING IDENTIFIER	ASCII CHARACTER	T, M, A **SEE NOTE 1**	NA
18	(24) 1	COMMA	ASCII "," CHARACTER	NA	NA
19-23	(25-29) 5	TARGET BEARING	ASCII	000.0-359.9	DEGREES
24	(30) 1	COMMA	ASCII "," CHARACTER	NA	NA
25-32	(31-38) 8	HORIZ RGE X	ASCII	-00000.0-009999.9	METERS **SEE NOTE 2**
33	(39) 1	COMMA	ASCII "," CHARACTER	NA	NA
34-41	(40-47) 8	HORIZ RGE Y	ASCII	-00000.0-009999.9	METERS **SEE NOTE 2**
42	(48) 1	COMMA	ASCII "," CHARACTER	NA	NA
43-49	(49-55) 7	DEPTH Z	ASCII	00000.0-09999.9	METERS **SEE NOTE 2**
50	(56) 1	COMMA	ASCII "," CHARACTER	NA	NA
51-56	(57-62) 6	ROLL	ASCII	-50.0-050.0	DEGREES
57	(63) 1	COMMA	ASCII "," CHARACTER	NA	NA
58-63	(64-69) 6	PITCH	ASCII	-50.0-050.0	DEGREES
64	(70) 1	COMMA	ASCII "," CHARACTER	NA	NA
65-66	(71-72) 2	WARNING CODE	ASCII	Null-99 **SEE NOTE 3**	NA
67	(73) 1	COMMA	ASCII "," CHARACTER	NA	NA
68-69	(74-75) 2	QUALITY FACTOR	ASCII	01-10	NA
70	(76) 1	EOS CHARACTER	ASCII "*" CHARACTER	NA	NA
71-72	(77-78) 2	CHECK SUM	ASCII	00-FF	NA
73	(79) 1	CARRIAGE RETURN	ASCII CRG RET CHAR.		NA
74	(80) 1	LINEFEED	ASCII LINEFEED CHAR.		NA

NOTE 1: T = True heading, M = Magnetic heading, A = heading via Analog input
NOTE 2: The X,Y & Z data can either be in meters, yards or feet. See SYSTEM/RS-232 UNITS.
NOTE 3: Error Code 0 = Null Character

Example of Format: NMEA ORE

```
$PORE,##,HHMMSS,,, BRG,  X(m),  Y(m),  Z(m), ROLL, PTCH,WC,QF*CS

$PORE,01,072450,,,300.8,-00001.0,000000.6,00505.4,000.00,000.00,00,10*18
```

...with compass heading enabled

```
$PORE,##,HHMMSS,HDG,ID, BRG,  X(m),  Y(m),  Z(m), ROLL, PTCH,WC,QF*CS

$PORE,01,072537,125.8,M,125.5,000000.2,-00000.2,00505.4,-00.03,-00.02,00,10*16
```

Figure 3-29

3.12.4 RS-232 PARAMETER DESCRIPTION

When the C/DM is first turned on, the RS232 Format defaults to Format STANDARD. The Trackpoint, once initialized, outputs a CARRIAGE RETURN, LINEFEED followed by an acknowledge message.

If the RS232 Format is changed to STANDARD-EC, STD W/PR, STD-EC W/PR, NCSC, NMEA TTM, NMEA ORE, REV4 or REV 4-EC, a header/event marker can be sent out the RS232 which states the CPU Board Firmware revision, date, time and the data parameters. The ENTER key on the front panel of the Trackpoint, or a CTRL-E sent via the RS-232, can be used as an event marker. When the ENTER key is pressed and the Trackpoint is at a menu that does not require entering a parameter, or whenever a CTRL-E is received, the ORE header block is sent out the RS-232.

The **TARGET NUMBER** (#) represents the various target symbols and can range from 0 to 9. The zero is output when in the self-test mode to indicate that the RS-232 data is simulated.

The **TIME** (TOD) is output at the beginning of each target's data. It is synchronous with the 24-hour time on the screen of the Trackpoint. It is equal to the time that the Trackpoint received the acoustic reply. The accuracy of the time as output is within 1 second of the actual time of reply.

The **HEADING** (HDG) is only displayed when a compass interface is used. The HEADING can either be the Magnetic heading of the vessel or the True heading, if the NMEA heading data has been determined to be corrected for True North. The NMEA ORE output sentence shows an identifier in the string to show whether data is Magnetic (M), True (T) or from an Analog source (A). The heading is also displayed on the upper left corner of the Trackpoint's screen.

The **BEARING** (BRG) output in degrees is a relative bearing from the ship to the target. When the compass interface is in use, and the SYSTEM / COMPASS / RS232 TGT DATA is set to North Ref., the target bearing is referenced to North. The target bearing is corrected for the entered hydrophone offsets (target is referenced to the pitch roll center of the vessel) or if Antenna Offsets are entered it is corrected again to the Antenna offset point. The SYSTEM / COMPASS / RS232 TGT DATA switch can be set to either NORTH REF or BOW REF. See section 3.4.2.

The **SLANT RANGE** (S.R.) is the measured travel time between the hydrophone and the transponder. It is output in meters, feet or yards, depending on RS-232 UNITS selection. The Slant Range is the actual measured slant range to the transponder or responder. In transponder or responder mode no hydrophone offsets are applied to the data. If in Pinger mode it is a calculated value with offsets applied if applicable. (See NOTE below.)

The **X** and **Y** position are the coordinates from the ship to the target. They are output in meters, feet or yards if STANDARD, STANDARD-EC, STD W/PR, STD-EC W/PR, NCSC or NMEA ORE is selected, or just meters if Format REV 4 or REV 4-EC is selected. If NMEA TTM is selected then the X and Y ranges are in kilometers.

NOTE: Smoothing occurs on the target position only (X, Y or Horizontal Distance, Brg), NOT the slant range. For non-pinger targets the slant range is displayed in the status block and sent out the RS-232 as the actual value. For pinger targets the slant range is calculated and smoothed.

The **Z** (depth) can be either a manually entered value, a telemetered value, an analog input value or a calculated value. Z is in meters, feet or yards if Format STANDARD or STANDARD-EC STD W/PR, STD-EC W/PR, NCSC or NMEA ORE is selected, or just meters if Format REV 4 or REV 4-EC is selected. If NMEA TTM is selected then Z range is in kilometers.

NOTE: The telemetered depth value is an average of the previous three values.

The **TELEMETRY** (TELEM) data is independent of the position data. Its value is dependent upon the parameters set under each target's menu. It is an instantaneous value. If telemetered DEPTH is selected for that target instead of telemetered DATA, the TELEM number is the instantaneous depth value, while Z is the averaged depth value used for positioning calculations.

The **ERROR CODE** (ERR) or **WARNING CODE** (WARN) is a one- or two- digit error code indicating that the data received could not be used for a valid position fix, or it can represent a warning to let an operator know that the position accuracy could be compromised (see ERROR and WARNING CODES, section 3.15).

PITCH and **ROLL** is either from the PITCH and ROLL from the hydrophone VRU (Models 4610B Hydrophone or 4740A VRU/Amplifier) or a remote VRU (Dynamic motion monitoring sensor, such as the ORE Model 4414A). The units are in degrees. When the SYSTEM / OFFSETS / HYDROPHONE / VRU / STATUS function is set to ACTIVE a positive PITCH is output the RS232 when the BOW of the vessel is UP and a positive ROLL is when the vessel rolls to starboard or PORT side UP. If the internal VRU STATUS function is set to STATIC, configured for remote VRU sensing, the NMEA ORE format changes to follow the incoming voltage polarity instead of the BOW UP/PORT UP protocol.

The **QUALITY FACTOR** is a value (1-10) determined by the system on each reply that is detected. The system uses the phase or time counts from each of the hydrophone elements to determine the quality of the signal. If the phase counts are consistent on all three channels through-out the reply burst the quality factor is very high. If the phase counts have jitter or are inconsistent then the quality factor is low.

3.12.5 RS-232 COMMANDS

The Trackpoint has the capability of changing most tracking functions via the bi-directional RS-232 port. A computer (with communications software) or terminal is connected to the rear panel RS-232 connector (DB-25S). The Trackpoint sends out data as described in Section 3.12 and receives commands from a terminal as described below. There are two types of command structures, one is the ORE and the other is the NCSC. The ORE command structure is a simple three letter mnemonic used to modify certain parameters. The NCSC is a packetized structure that modifies many parameters at the same time.

3.12.5.1 ORE COMMANDS

Typical commands are three-letter mnemonics with optional parameter values following. At any time a HELP menu can be requested to view the mnemonics for certain parameters. There are four types of HELP menus: "HLP" OR "?" sends GENERAL help, "HLP1" sends help for TARGET parameters, "HLP2" sends help on SYSTEM parameters, "HLP3" sends help on CONTROL CODE functions, "HLP4" sends help on the ERROR CODE descriptions. Other master commands include "ALL" and "TST." The "ALL" command sends a brief listing of the selected target parameters and system parameters. The "TST" command can perform either a command unit self-test or a signal processing test consisting of the transmitter and receiver/detector.

An RS-232 command takes precedence over a keypad command. A message appears at the bottom of the Trackpoint screen, "Sorry to cut you off," if an RS-232 command overrides a front panel keystroke. When a mnemonic command is initiated from the RS-232, a message appears at the bottom of the Trackpoint screen, "Processing RS-232 Command," to warn operator not to invoke any commands from the keypad.

At boot-up the system sends a message to terminal stating....

```
        Welcome to Trackpoint II

For Previous Setup , Press ‘P’
For Default Setup, Press ‘D’
```

If ‘P’ is pressed, the system initializes with the saved parameters from the battery backed-up SRAM. (The same as if the f1 key was pressed from the front panel of the Trackpoint at the opening screen.) If ‘D’ is pressed, another message is output the RS-232 stating....

```
ARE YOU SURE???? press ‘Y’ if Yes (or ‘C’ for Custom)
**  WARNING: may effect rs-232 parameters!  **
```

By pressing the ‘Y’ key at the RS-232 terminal the system initializes using the ORE Defaults. If a ‘C’ is sent to the Trackpoint then the system initializes using the operator saved parameters in the FlashROM located on the CPU board. See section 5.9 for saving parameters to FlashROM. By sending a ‘Y’ or ‘C’ command to the Trackpoint the system may initialize using RS-232 parameters that are not the same as what is setup at this moment. For example, baud rate, number of start bits, etc. .

To save the present setup parameters to FlashROM from COM port#1 instead of the keypad, send the following command.

DWF 7 0 9 [enter] See section 5.9 for Keypad setup of FlashROM.
This will save the current setup to FlashROM.

```
DWF 709    VALID
INVALID KEY
NOTE: Current setup saved to FlashROM
DONE
```

To view general help, type, "HLP".

TYPE "HLP" FOR HELP ON HLP.

```
HLP

'n' denotes selection entry
(Use the DEL or RUB key to erase the command being entered)

HLP n        * display HeLP info. n: 1=TARGET, 2=SYSTEM, 3=CTRL, 4=ERROR
ALL          * view ALL settings (for selected target and for system)
TIM          * enter TIMe (hh.mm.ss)
DAT          * enter DATe (mm.dd.yyyy)
TST n (nn)   * select self TeST to be run, n = test number
```

General Help Parameter Example:

To set the time from the RS-232 port, type "TIM 10.35.29", the internal 24-hour clock is now set to 10:35:29. To set the date, type "DAT 10.07.1998." The date is set to October 7, 1998.

To view Target Help information, type "HLP1." The following screen is displayed.

TYPE "HLP1" FOR TARGET MNEMONIC LISTING.

HLP1

'n' denotes selection entry, 'nn' numeric entry, '()' optional entry
(Use the DEL or RUB key to erase the command being entered)

SEL n	* SELect target to be modified,	n = target number
TRK	* toggle TRacKing ON/OFF	
PNG (nn)	* select PiNGer mode,	nn = rep rate
TSP (nn)	* select TranSPonder mode,	nn = Turn Around Time
RSP (nn)	* select ReSPonder mode,	nn = Turn Around Time
ART	* select ARTificial mode	
MNR nn	* MiNimum slant Range for transponder/responder	
MXR (nn)	* MaXimum slant Range for transponder/responder	
RCV nn	* enter ReCeiVe Freq.	
THR	* THReshold selection.	
SMO	* SMOothing level selection	
FIL	* FILtering level selection.	
DEM	* toggle DEpth Mode INPUT/CALC'D	
DEP (nn)	* select (enter) manual DEPth,	nn = new depth
DEA n (nn)	* Analog Depth	n:1 = VOLTMIN, 2 = VMAX, 3 = DEPTHMIN, 4 = DMAX
TDP	* select Telemetered DePth	
TEL n (nn)	* TELemetry.	n: 1=ON/OFF, 2=FREQ, 3=LO, 4=HI, 5=SPAN
XMT n nn	* XMiT data.	n: 1=FREQ, 2=INTERVAL, 3=PLS WIDTH

This HeLP screen shows how to change various target parameters. To SELect target number two (2), type "SEL 2". (Typing SEL2 also works.) Any of the three-letter mnemonics concerning targets only affect target number two (2). To toggle tracking of target #2 to ON or OFF, type "TRK".

Target Parameter Examples:

- PNG 1000* Pinger enabled, with a rep rate of 1000 ms.
- PNG Pinger enabled, with previous rep rate.
- TSP 15 Transponder enabled, with 15 ms TAT.
- RSP 1 Responder enabled, with 1 ms TAT.
- ART Artificial target mode enabled.
- MNR 75 Changes min xpndr range to 75 m .

*NOTE: If the 1000 is not added to the command, the system uses the previously entered or default parameter. The same holds true for all the optional data entry.

Target Parameter Examples: (continued)

- MXR 1000* — Maximum slant range is set to 1000 units (m, ft or yd).
- RCV 23 — Receiver frequency of 23 kHz.
- THR — Steps to the next threshold setting. E.g., if threshold is set to LOW the threshold changes to MED-LO. If threshold is HI then it returns to LOW.
- SMO — Increments/steps the smoothing (averaging) value from OFF, to 1 to 10.
- FIL — Increments/steps the filter level from 1 to 10.
- DEM — Toggles depth mode to INPUT or CALCULATED.
- DEP — Selects manual depth. If no value is entered the last entered depth is used.
- DEP 100 — Changes manual depth to 100 meters.
- DEA 1 1.0 — The Target's analog depth parameter, Minimum Voltage, is set to 1VDC.
- TDP — Selects telemetered depth when using a depth Telemetry MultiBeacon. To revert back to manual depth, type "DEP". To change the telemetry data parameters see TEL below.
- TEL 1 — ON/OFF toggle of telemetry.
- TEL 2 22 — Changes frequency of telemetry signal to 22 kHz.
- TEL 3 100 — Changes the time relating to zero or minimum units of the telemetry data to 100 milliseconds.
- TEL 4 1000 — Changes the time relating to full scale or maximum units of the telemetry data to 1000 milliseconds.
- TEL 5 300 — Changes the span of the telemetry data to 300 units.
- XMT 1 17 — Changes transmitter frequency to 17 kHz.
- XMT 2 3 — Changes transmitter rep. rate to 3 seconds.
- XMT 3 10 — Changes transmitter pulse width to 10 milliseconds.

The following shows typical feedback from the Trackpoint after typing a command. Monitor or computer displays the new value or new setting of most parameters.

```
TSP 15    VALID  New Value =  15
RCV 24    VALID  New Value =  24
THR    VALID  New Value =  MED-LO
DEP 1000    VALID  New Value =  1000
DEM    VALID  New Value =  CALCULATED
TDP    VALID
TEL 1    VALID  New Value =  OFF
TEL 2 23    VALID  New Value =  23
XMT 1 16    VALID  New Value =  16
etc.
```

To get a brief check on system parameters, type "ALL". The following screen is then shown.

TYPE "ALL" FOR THE SELECTED TARGET'S INFO. AND ALSO SYSTEM INFO.

```
ALL    VALID

 TARGET #1          * Tracking: ON       Type: XPOND       Depth mode: INPUT
                    * Threshold: LOW     Filtering: 1      Smoothing: 5
 RECEIVER           * Freq = 23.0 kHz    TAT   = 15.0 mS
 XMITTER            * Freq = 17.0 kHz    Pulse =  5.0 mS    Interval =  2.0 Sec

                    * Xmit and Key Out ON

 HYDROPHONE         * Amp/Ser Num = 0366/0672 (3D), Element Spacing  0.900
                    * Temperature = 12.0 deg C (auto)  Speed of Sound = 1500.0 m/s
 OFFSETS            * X =   0.0 m  Y =   0.0 m  Z =   0.0 m  Bearing =   0.0 Deg
                    * Pitch Error =   0.00  Roll Error =   0.00
 SYSTEM VRU         * Orientation = NORM    Status = ACTIVE
 ANTENNA OFF        * X =   0.0 m  Y =   0.0 m

 COMPASS            * OFF * Lo Volt = 0.00  Hi Volt = 5.00  Offset =   0.0 Deg

 RS-232 COM1        * Baud Rate =  9600  Data Bits = 8  Stop Bits = 1
 RS-232 COM2        * Baud Rate =  4800  Data Bits = 8  Stop Bits = 1

 DONE
```

After the ALL command is entered the Trackpoint echoes back that the command is valid. The ALL command shows what target is selected, if the tracking is turned on or off, and receiver / transmitter parameters concerning the target. It also shows some system information concerning hydrophone offsets and RS-232 parameters. For the range of data entry see Appendix A of this addendum, TABLE of DATA RANGES AND UNITS. The commands entered via the RS-232 are identical to the commands as entered from the Trackpoint C/DM keyboard. For a more complete description of each function refer to section 3 of this manual. These RS-232 commands shown below are only a different way of invoking the same keyboard command.

To access help on SYSTEM information, type "HLP2." The screen displays the following.

TYPE "HLP2" FOR SYSTEM MNEMONIC LISTING.

```
HLP2

'n' denotes selection entry, 'nn' numeric entry, '()' optional entry
(Use the DEL or RUB key to erase the command being entered)

TOF          * Transmit and key OFf
TON          * Transmit and key ON
EXK          * EXternally Key transmitter
INK (nn)     * INternally Key transmitter, nn = master xmit interval
PRI          * PRIority target selection
FSH          * Toggle FiSH track on/off
VOS nn       * Velocity Of Sound
SAL nn       * SALinity level
HYD n (nn)   * HYDrophone offset. n: 1=X, 2=Y, 4=BEARING,
HYM nn       * HYdrophone Manual Depth   nn = DEPTH
HYA n (nn)   * HYd Analog depth   n:1 = VOLTMIN, 2 = VMAX, 3 = DEPTHMIN, 4 = DMAX
HYC n (nn)   * HYd Compass depth  n:1 = VOLTMIN, 2 = VMAX, 3 = DEPTHMIN, 4 = DMAX
ANT n (nn)   * ANTenna offsets    n:1 = X, 2 = Y
CMP n (nn)   * CoMPass n: 1=OFF/ON/NMEA/NMEAwoCS, 2=NRTH/BOW, 3=OFFSET, 5=FRMT
CMA n (nn)   * CoMpass Analog    n:1 = VOLTMIN, 2 = VOLTMAX
RSO nn       * RS232 Output rate, nn = rate in Seconds.
RSU          * RS232 Data Units selection
RSF          * RS232 data Format selection
RS2 n (nn)   * RS2 (COM2) n:1=BAUD, 2=DATA, 3=STOP BITS
HPE nn       * Hydrophone Pitch Error, nn = degrees +/-
HRE nn       * Hydrophone Roll Error, nn = degrees +/-
HAO          * Hydrophone Auto Offset calibration
HVO          * Hydrophone Internal VRU orientation
HVS          * Hydrophone VRU Status
VSC nn       * Remote VRU scale factor, nn = volts/degree
VRF          * Remote VRU Function
VBU          * Remote VRU Bow Up Polarity
VPU          * Remote VRU Port Up Polarity
```

System Parameter Examples:

- TOF — Toggles transmitter and key out to OFF.
- TON — Toggles transmitter and key out to ON.
- EXK — Selects the external key for transmitter.
- INK — Selects internal key at the previous or default parameter for its rep. rate.
- INK 4 — Selects internal key at repetition rate of 4 seconds for all targets. (For individual target rep. rates, see XMT under HLP1.)
- PRI — Toggles to the next active target for the priority target. E.g., if targets 1, 3 & 5 are active and no target has priority, then target #1 becomes the priority target. If target #1 is already the priority target, then target #3 becomes the priority target.
- FSH — Toggles fish track ON or OFF
- VOS 1463 — Changes velocity of sound parameter to 1463 meters per second.
- SAL 37 — Changes salinity parameter to 37 ppt.
- HYD 1-10 — Changes hydrophone X offset to –10 units (m, ft, yd).
- HYD 2 25 — Changes hydrophone Y offset to 25 units (m, ft, yd).

- HYD 4 315 Changes hydrophone bearing offset to 315°.
- HYM 8.7 Sets Hydrophone's manual depth value to 8.7 units (m, ft or yd)
- HYA 4 100 Sets the Hydrophone Depth's Analog Depth input, "maximum depth" value to 100 units (m, ft or yd)
- HYC 3 0 Sets the Hydrophone Depth's Analog Compass input, "minimum depth" value to 0 units (m, ft or yd)
- ANT 1 -13.7 Sets the Antenna X value to -13.7 units (m, ft or yd).
- CMP 1 Toggles compass function ON or OFF.
- CMP 2 0 Changes compass zero degree ref. Point to 0 volts.
- CMP 3 5 Changes compass 360 degree ref. Point to 5 volts.
- CMP 4 12 Changes compass bearing offset to 12°.
- CMA 2 5.0 Sets the Analog Compass' maximum voltage to 5.0VDC.
- RSO 2 Changes RS-232 pinger data output rate to 2 seconds.
- RSU Toggles RS-232 units between meters, feet and yards.

NOTE: NMEA TTM format is always in kilometers, designated by the "K" in the sentence.

- RSF Toggles RS-232 output Format between STD, STD-EC, STD W/PR, STD-EC W/PR, NCSC, NCSC-EC, NMEA TTM, NMEA ORE, REV 4 & REV 4-EC.
- RS2 1 9600 Sets COM port#2's baud rate to 9600 bps.
- HPE –2.15 Sets Hydrophone Pitch Error to -2.15°.
- HRE 1.62 Sets Hydrophone Roll Error to 1.62°.
- HAO Initiates Hydrophone Auto Offset calibration

NOTE: When the HAO command is initiated the RS232 Format automatically changes to Format NMEA ORE. See example below.

```
VRU auto calibration enabled, hit any key to exit...

$PORE,##,HHMMSS,, BRG ,  X (m) ,  Y (m)  , Z (m)   , ROLL , PTCH ,WC,QF*CS
$PORE,01,072528,,000.0,000000.0,000000.0,00056.0,000.00,000.00,62,10*04

VRU offset calibration complete.
$PORE,01,072532,,077.6,000000.0,000000.0,00056.0,-00.03,000.01,50,10*17

 Returning from VRU auto calibration mode...
```

- HVO Toggles to the next orientation, NORM(BOW), STBD, AFT, or PORT.
- HVS Toggles Hydrophone VRU Status between ACTIVE and STATIC.
- VSC .20 Sets Remote VRU scale factor to 0.20 volts/degree
- VRF Toggles Remote VRU Function between linear and 10 sin (pitch/roll angle).
- VBU Toggles Remote VRU Bow Up Polarity between [+] and [-] .
- VPU Toggles Remote VRU Port Up Polarity between [+] and [-].

To view miscellaneous control code commands, type "HLP3." The following screen is displayed.

TYPE "HLP3" FOR MISCELLANEOUS CONTROL CODE FUNCTIONS.

```
HLP3
Control Codes, hold 'CTRL' or 'CNTL' key while pressing letter

CTRL - E            * Event Mark

CTRL - R            * 'DXON', enables rs232 target Data Output
CTRL - T            * 'DXOFF', disables rs232 target Data Output

CTRL - Q            * 'XON', enables rs232 Output Port
CTRL - S            * 'XOFF', disables rs232 Output Port

CTRL - C            * System Reset (use with care)

CTRL-D n (nn)       * Display or Enter Manual Depth (Trgt# (Depth))

CTRL-N n nn nn      * Input Artificial Trgt Nav data (Trgt# Bearing Rng)

CTRL-Z n            * Display INPUT and CALC'D Depth (Trgt#)
```

To disable the data output on the RS-232, press the letter "T" while holding down the control key. This stops the tracking data from being displayed on the screen. This is useful when invoking a HLP menu, allowing the operator to read the complete description without data overriding it. To enable the RS-232 data output following a CTRL-T command, perform a CTRL-R. To completely disable the RS-232 output port, type "CTRL-S," and to re-enable the port, type "CTRL-Q."

NOTE: The data buffer is cleared and most recent data is output following a CTRL-R or CRTL-Q.

NOTE: The Trackpoint echoes back a "$" following a CTRL command to indicate that the command was received.

CTRL-Z displays the input depth vs. the calculated depth. When a warning code 50 is shown on a target, the operator can type CTLR-Z to see the differences between the input depth and the system-calculated depth. Message is shown below.

```
$
TARGET #2  INPUT =   100.0  CALC'D =   718.7
```

CTRL-C resets the Trackpoint which starts again at the boot-up display.

CTRL-D allows inputting of a target's depth via the RS-232 port. This is a faster method of changing a target's depth rather than selecting a specific target (SEL) then changing its depth (DEP) all of which requires screen changing at the C/DM. This method does not toggle through the screen menus at the C/DM but only shows the new value in the status block.

To view the data sentence parameters, type "CTRL E" (Event Mark). The following header is displayed.

TYPE "CTRL E" FOR AN EVENT MARK HEADER.

```
ORE Trackpoint II Plus Model 4410D   Rev # 9.05   15 Oct 97   12:37:42
#   TOD    HDG     BRG        S.R.(m)    X (m)     Y (m)   Z (m)   TEL  ERR
```

CTRL-E sends out a data header to view the software revision, time & date, and format of the output data.

NOTE: The (m) following the Slant Range, X, Y, & Z data signifies whether the output units are in meters, feet or yards. Command "RSU" toggles between the various units.

CTRL-N allows inputting of an artificial target's data via the RS-232 port.

CTRL - N[tgt] [rge] [brg]CRLF

SP SP

SP = Space Character CRLF = Carriage Return & Line Feed The Trackpoint echoes back a "$" signifying receipt of valid data.

If the following is sent via an RS-232 peripheral...

"CTRL-N2 60 150"

The Trackpoint echoes back with a dollar sign and the received values as shown below.

```
$
 TARGET #2  BEARING = 60.0   HORZ RANGE = 150.0
```

To view the last three error code descriptions, type "HLP4." An example of an error code 6 is displayed below.

TYPE "HLP4" FOR ERROR CODE DESCRIPTIONS.

```
HLP4

ERROR CODE DESCRIPTIONS:

6. No valid replies.
```

HLP 4 displays up to the last three error codes that have occurred.

To perform a command unit Self Test from the RS-232 port, type "TST 1." The following screen is displayed.

TYPE "TST 1" TO PERFORM COMMAND UNIT SELF TEST.

```
TST 1  VALID

Initializing for Self Tests...

** Performing Self Tests **

Hit any key to exit test mode...

1. CPU (Central Processing Unit)          Passed
2. NPU (Numeric Processing Unit)          Passed
3. RAM (Random Access Memory)             Passed
4. CMOSRAM (Nonvolatile RAM)              Passed
5. SSD (Solid State Disk)                 Passed
6. Video Display                          Passed
7. Signal Processor communication         Passed
8. 1 Second Timer                         Passed


** Performing Self Tests **

Hit any key to exit test mode...

1. CPU (Central Processing Unit)          Passed
 etc.....
.
Re-starting, please stand by
```

This test is the same as the one invoked from the keypad under SELF-TEST/COMMAND UNIT. The tests are performed continuously until a key is pressed on the RS-232 terminal.

Tests 1, 2, 3, 4, & 5 are functions pertaining to the CPU board. If any of these tests FAILS, then replace the CPU board. Test 6 pertains to the VGA board mounted on the CPU board as a sub-module. This test always shows PASSED as it is a visual check from the front panel display. Tests 7 & 8 are functions of the Signal Processor Board. If either of these tests FAIL, replace the Signal Processor Board.

The Trackpoint resets following a COMMAND UNIT self-test (TST 1). Be sure to type "P" to boot up with the previous parameter settings. (If an AUTO INITIALIZING jumper is set on the Keybd “IN” header of the CPU board, the system will automatically boot up with either the Custom Defaults or ORE Defaults depending on the jumper setting thereby bypassing the Previous selection.)

To perform an internal Signal Processor board function, test type "TST 2 24." (The "24" following the TST 2 is the transmitter and receiver test frequency (in kHz) that the test is performed at.) An example of a test routine performed at 24 kHz is shown below.

TYPE "TST 2" (FREQUENCY) TO TEST SIGNAL PROCESSING BOARD.

```
TST 2 24    VALID

Built In Test (BIT) mode enabled, hit any key to exit...
 0    13:39:37   26      25.8    54.9    60.2    124.8    54.9    0.0    56
 0    13:39:39   26      25.7    54.6    45.1     93.6    54.6    0.0    56
 0    13:39:41   26      25.8    54.8    30.2     62.4    54.8    0.0    56
 0    13:39:43   26      25.8    54.6    15.1     31.2    54.6    0.0    56
 0    13:39:45   26     122.9    54.8     0.0     -0.0    54.8    0.0    56
 0    13:39:47   26     120.8    54.6     0.0     -0.0    54.6    0.0    56
 0    13:39:49   26     114.8    54.8     0.0     -0.0    54.8    0.0    56
 0    13:39:51   26     108.0    54.6     0.0     -0.0    54.6    0.0    56
 ⇧
      Returning from Built In Test (BIT) mode...

DONE
```

NOTE: The "0" in place of the target # indicates that the unit is in Self-Test mode.

This test is the same as the self-test invoked from the keypad under SELF-TEST/XMIT & RCV/DET. This test enables target #1 (FISH) only, all others are turned off for this test.

If the C/DM is not within viewing ability, then the only indication of passing self-test #2 (Signal Processor board test) is the RS-232 data output. Check the following....

- If data is present with a "0" in place of the target #, then the transmitter, receiver and detector are functioning properly. (Cannot differentiate which receiver detector is operational, #1 or #2 or both.)
- If the difference in time between each data line is approximately the repetition rate selected, then rate counter is operational.
- If X & Y parameters are zero, then phase counters are operational.
- If the slant range is approximately 55 meters, then the slant range counters are operational.
- If all tests above pass, then board passes self-test.

NOTE: It is possible to see occasional error code #1's in this mode. This is normal and does not indicate hardware failure.

3.12.5.2 NCSC COMMAND STRUCTURE

The NCSC RS-232 control method uses predefined packets of information to control operational parameters. These packets are used to perform SYSTEM and TARGET setup modifications. These packets are the same as defined in Trackpoint II revision 8.05, which corresponds to the NCSC modification. These input commands are accessible regardless of the setting of the RS232 Output Format.

NOTE: The only setup that is not duplicated exactly to the NCSC specification is in the FILTER LEVEL setting. The new filtering method precludes using the same five codes to control the new filter level. A translation table takes the five codes and changes the new filter level to a setting that is close to its original. See Target Setup Command 3 below.

TARGET SETUP COMMAND 1

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	START OF TEXT	ASCII START OF TEXT CHAR		N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-5	3	MESSAGE ID	ASCII CHARACTERS "TR1"		N/A
6	1	SPACE	ASCII SPACE CHARACTER		N/A
7	1	TARGET NUMBER	ASCII	0 TO 9	N/A
8	1	SPACE	ASCII SPACE CHARACTER		N/A
9-13	5	TURN AROUND TIME	ASCII	000.0 TO 125.0	ms
14	1	SPACE	ASCII SPACE CHARACTER		N/A
15-18	4	REPLY FREQUENCY	ASCII	22.0 TO 30.0	kHz
19	1	SPACE	ASCII SPACE CHARACTER		N/A
20-23	4	INTERROGATE FREQUENCY	ASCII	04.5 TO 30.0	kHz
24	1	SPACE	ASCII SPACE CHARACTER		N/A
25-26	2	REPETITION INTERVAL	ASCII	01 TO 20	SEC
27	1	SPACE	ASCII SPACE CHARACTER		N/A
28	1	TRACKING	ASCII	0=OFF, 1=ON	N/A
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-31	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
32	1	SPACE	ASCII SPACE CHARACTER		N/A
33	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHAR	N/A	
34	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

TARGET SETUP COMMAND 2

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	START OF TEXT	ASCII START OF TEXT CHARACTER	N/A	
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-5	2	MESSAGE ID	ASCII CHARACTERS "TR2"		N/A
6	1	SPACE	ASCII SPACE CHARACTER		N/A
7	1	TARGET NUMBER	ASCII	0 TO 9	N/A
8	1	SPACE	ASCII SPACE CHARACTER		N/A
9-13	5	DEPTH	ASCII	00000 TO 10000	METERS
14	1	SPACE	ASCII SPACE CHARACTER		N/A
15-19	5	MIN. XPONDER RANGE	ASCII	0000 TO 9500	METERS
20	1	SPACE	ASCII SPACE CHARACTER		N/A
21-22	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
23	1	SPACE	ASCII SPACE CHARACTER		N/A
24	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
25	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

TARGET SETUP COMMAND 3

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	START OF TEXT	ASCII START OF TEXT CHAR		N/A
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-5	3	MESSAGE ID	ASCII CHARACTERS "TR3"		N/A
6	1	SPACE	ASCII SPACE CHARACTER		N/A
7	1	TARGET NUMBER	ASCII	0 TO 9	N/A
8	1	SPACE	ASCII SPACE CHARACTER		N/A
9-12	4	TELEMETRY FREQUENCY	ASCII	21.0 TO 29.0	kHz
13	1	SPACE	ASCII SPACE CHARACTER		N/A
14-16	3	ZERO DELAY	ASCII	050 TO 500	ms
17	1	SPACE	ASCII SPACE CHARACTER		N/A
18-21	4	FULL SCALE DELAY	ASCII	0500 TO 1500	ms
22	1	SPACE	ASCII SPACE CHARACTER		N/A
23-26	4	SPAN	ASCII	0001 TO 5000	UNITS
27	1	SPACE	ASCII SPACE CHARACTER		N/A
28-29	2	PULSE WIDTH	ASCII	01-20	ms
30	1	SPACE	ASCII SPACE CHARACTER		N/A
31-34	4	PINGER REP RATE	ASCII	0400-1500	ms
35	1	SPACE	ASCII SPACE CHARACTER		N/A
36	1	TYPE	ASCII 0=TRANSPONDER,1=RESPONDER, 2=PINGER	N/A	
37	1	SPACE	ASCII SPACE CHARACTER		N/A
38	1	DEPTH SELECT	ASCII 0=MANUAL,1=ANALOG,2=TELEMETRY	N/A	
39	1	SPACE	ASCII SPACE CHARACTER		N/A
40	1	DEPTH MODE	ASCII 0=CALCULATED, 1=INPUT	N/A	
41	1	SPACE	ASCII SPACE CHARACTER		N/A
42	1	TELEMETRY	ASCII	0=OFF,1=ON	N/A
43	1	SPACE	ASCII SPACE CHARACTER		N/A
44	1	THRESHOLD LEVEL	ASCII 0=LOW,1=MD-LW, 2=MD-HI, 3=HIGH	N/A	
45	1	SPACE	ASCII SPACE CHARACTER		N/A
46	1	FILTERING LEVEL*	ASCII 0=OFF,1=LOW,2=MD-LW, 3=MD-HI,4=HIGH	N/A	
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48	1	SMOOTHING	ASCII	0=OFF,1=ON	N/A
49	1	SPACE	ASCII SPACE CHARACTER		N/A
50	1	KEYING	ASCII	0=INT,1=EXT	N/A
51	1	SPACE	ASCII SPACE CHARACTER		N/A
52-53	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
54	1	SPACE	ASCII SPACE CHARACTER		N/A
55	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
56	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

* See translation table below for actual filter settings.

FILTER LEVEL TRANSLATIONS FOR CHAR #46, TGT SETUP CMND 3				
FILTER LEVELS		FUNCTION		
Old FILTER Level Setting	New FILTER Level Setting	Velocity Filter	Range Gating	Smoothing ON
0	1	OFF	+/- 16 ms	5
1	1	OFF	+/- 16 ms	5
2	1	OFF	+/- 16 ms	10
3	4	4.5 m/s	+/- 7 ms	5
4	4	4.5 m/s	+/- 7 ms	10

The differences between the old Vs the new Filter Level settings will be at the lower settings where the original NCSC filter settings enabled velocity filtering and the new filter levels enable the range gating. The original Range Gate window was +/- 50 ms and is now +/- 16 ms for filter levels 0-2 and +/- 8 ms for filter levels 3 & 4. The original NCSC specification had a setting of “0” whereby the filter was disabled. The revision 9.02 & 9.05 filter setting of “0” has the Range Gate enabled.

SYSTEM SETUP COMMAND 1

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	START OF TEXT	ASCII START OF TEXT CHARACTER	N/A	
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-5	3	MESSAGE ID	ASCII CHARACTERS "SY1"		N/A
6	1	SPACE	ASCII SPACE CHARACTER		N/A
7-12	6	X HYDROPHONE OFFSET	ASCII	-999.9 TO +999.9	M
13	1	SPACE	ASCII SPACE CHARACTER		N/A
14-19	6	Y HYDROPHONE OFFSET	ASCII	-999.9 TO +999.9	M
20	1	SPACE	ASCII SPACE CHARACTER		N/A
21-26	6	Z HYDROPHONE OFFSET	ASCII	-999.9 TO +999.9	M
27	1	SPACE	ASCII SPACE CHARACTER		N/A
28-32	5	BEARING OFFSET	ASCII	000.0 TO 359.9	DEG.
33	1	SPACE	ASCII SPACE CHARACTER		N/A
34-39	6	ANALOG DEPTH MIN DEPTH	ASCII	0000.0 TO 9999.9	M
40	1	SPACE	ASCII SPACE CHARACTER		N/A
41-47	7	ANALOG DEPTH MAX DEPTH	ASCII	00000.0 TO 10000.0 M	
48	1	SPACE	ASCII SPACE CHARACTER		N/A
49	1	COMPASS ON OR OFF	ASCII	0=OFF,1=ON	N/A
50	1	SPACE	ASCII SPACE CHARACTER		N/A
51-52	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
53	1	SPACE	ASCII SPACE CHARACTER		N/A
54	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
55	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

SYSTEM SETUP COMMAND 2

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	START OF TEXT	ASCII START OF TEXT CHARACTER	N/A	
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-5	3	MESSAGE ID	ASCII CHARACTERS "SY2"		N/A
6	1	SPACE	ASCII SPACE CHARACTER		N/A
7-12	6	VELOCITY OF SOUND	ASCII	1000.0 TO 2000.0	M/S
13	1	SPACE	ASCII SPACE CHARACTER		N/A
14-15	2	SALINITY	ASCII	00 TO 40	PPT
16	1	SPACE	ASCII SPACE CHARACTER		N/A
17-18	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
19	1	SPACE	ASCII SPACE CHARACTER		N/A
20	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
21	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

SYSTEM SETUP COMMAND 3

BYTE	LENGTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	START OF TEXT	ASCII START OF TEXT CHARACTER	N/A	
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3-5	3	MESSAGE ID	ASCII CHARACTERS "SY3"		N/A
6	1	SPACE	ASCII SPACE CHARACTER		N/A
7-8	2	HOURS	ASCII	00 TO 23	HRS
9	1	SPACE	ASCII SPACE CHARACTER		N/A
10-11	2	MINUTES	ASCII	00 TO 59	MIN
12	1	SPACE	ASCII SPACE CHARACTER		N/A
13-14	2	SECONDS	ASCII	00 TO 50	SEC
15	1	SPACE	ASCII SPACE CHARACTER		N/A
16-17	2	MONTH	ASCII	01 TO 12	MONTH
18	1	SPACE	ASCII SPACE CHARACTER		N/A
19-20	2	DAY	ASCII	01 TO 31	DAY
21	1	SPACE	ASCII SPACE CHARACTER		N/A
22-23 (25)	2 (4)	YEAR	ASCII	00 TO 2099	YEAR
24 (26)	1	SPACE	ASCII SPACE CHARACTER		N/A
25-26 (28)	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
27 (29)	1	SPACE	ASCII SPACE CHARACTER		N/A
28 (30)	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
29 (31)	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

The numbers in parenthesis ( ) are the extended characters if the year is sent to the Trackpoint in 4 digits vs 2.

The “SY3” command has been modified to allow 4-digit entry of the year. The existing 2-digit year value remains valid also. If the system receives 4-digits within the year field (before the trailing space

character is received) it will accept the value with the following rules applying. If the year is less than or equal to 1950 it assumes it is 20XX. If it is greater than 1950 then it assumes it is 19XX. If it receives only two digits that are less than or equal to 50 it assumes it is 20XX. If it is greater than 50 then it assumes it is 19XX.

ACK/NACK MESSAGE

BYTE	LEN GTH	DATA WORD	REPRESENTATION	RANGE	UNITS
1	1	START OF TEXT	ASCII START OF TEXT CHARACTER	N/A	
2	1	SPACE	ASCII SPACE CHARACTER		N/A
3	1	ACK/NACK	ASCII ACK=VALID RS-232 MESSAGE RECEIVED	N/A	
			ASCII NACK=INVALID RS-232 MESSAGE RECEIVED		
4	1	SPACE	ASCII SPACE CHARACTER		N/A
5-6	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
7	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
8	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

ACK = ASCII 006 decimal = 06 hexadecimal
NAK = ASCII 021 decimal = 15 hexadecimal

3.13 LED and AUDIO SIGNALS

The LED and audio signals help the operator monitor the tracking operation.

TRANSMIT LED's (Green)
The upper green LED in the lower left corner of the C/DM front panel indicates the transmitter output when a transponder is selected under the TARGET TYPE menu. The duration of the LED flash is the same as the transmit pulse, and therefore, the greater the transmit pulse width, the brighter the corresponding LED flash appears. (For example, when the transmitter pulse width is 2 ms the LED appears faint; when the pulse width is 10 ms the flash appears much brighter.)

The lower green LED in the lower left corner flashes whenever a NORMal KEY OUT occurs. A NORMal KEY signal is output during a transmit (transponder interrogation) or an isolated key output (responder interrogation). If a transponder target type is chosen the lower green LED flashes in sync with the upper transmit LED. If a responder target is chosen the NORMal KEY OUT LED flashes in sync with the ISOLATED KEY OUT.

DETECTED SIGNAL LED's (Red)
The red LED's in the upper left corner of the C/DM front panel indicate detected signals. The brightness (duration) of the flash gives some indication of the strength of the incoming signal at a particular threshold level, and become slightly dimmer at increasing threshold levels.

For tracking a transponder or responder the upper LED represents detection of the interrogated target. If telemetry is activated the LED flashes twice, indicating the primary and telemetry signal detection of that target. The bottom LED represents the detection for a pinger. However, if two pingers are being tracked, then the top LED represents the first pinger and the bottom LED represents the second pinger in the status block.

AUDIO SIGNAL
The audio signal is a direct representation of the strength of a signal within the frequency range(s) being tracked, whether or not the signal is detected. For example, a signal whose frequency is 1 or even 2 kHz from the receiver frequency can be heard, but not detected, and will sound noticeably lower in volume than a signal at the correct frequency.

The pitch of the audio signal is related to the frequency bands of the receiver, so that if two targets are being tracked, they can be distinguished by their relative pitches.

3.14 ACOUSTIC PROBLEMS AFFECTING OPERATION

The most significant acoustic problem encountered in any tracking operation is multi-path. As explained in section 2.1, multi-path occurs when an acoustic signal traveling through water encounters a surface having a different density and is reflected and then received by the tracking system in addition to the direct (desired) signal.

Typical reflectors include ships' hulls, gas pipelines, marine risers and other subsea structures. The air-water interface is an important acoustic reflector; air and gas bubbles, the ship's wake and the water surface are potential causes of multi-path. A sharp thermocline, causing a marked change in water density, can also act as a reflector.

Since a reflected signal exhibits the same acoustic characteristics as the original signal, the tracking system can have difficulty differentiating between the two. Filtering and threshold levels can screen out

false signals in many cases. In a high multi-path environment (or a hydrophone without enough clearance around it) however, contaminated signals may be detected and the operator will observe erratic bearing and possible range values for the target being tracked.

The Trackpoint II LED's and audio signals can help to identify multi-path problems. (Section 3.13 describes the significance of these signals in detail.) Multiple LED and audio signals may indicate that the system is detecting reflected signals.

A reflection off an object very close to the hydrophone, however, can be received so closely behind the direct signal that it is impossible for the human eye and ear to discern a separation between the corresponding LED and audio signals. Although this type of multi-path is not apparent from observing the LED's or listening to the audio, it may affect tracking by mixing with the original signal, resulting in an incorrect or erratic bearing. (See MIN XPONDER RANGE.)

A reflection off an object farther away may produce a distinct, separate signal and be accepted in addition to the original signal, resulting in a mixture of correct and incorrect readings.

In general, proper installation of the hydrophone reduces the incidence of multi-path interference/signal contamination. The hydrophone should be mounted well below the hull, to allow for the direct arrival of signals from the beacon, and as far as possible from sources of electrical and mechanical noise (main engines, generators, echo sounder transducers, etc.) or turbulence caused by the ship's wake, propellers, etc.

3.14.1 MULTI-PATH PROBLEMS IN PINGER MODE

A pinger is a free-running beacon that emits an acoustic signal at a specific frequency at a steady repetition rate. Ideally, each consecutive signal is received by the hydrophone without interruption and used to determine target bearing and range. In a real operating environment, however, the acoustic signals sent by the pinger may be affected by multi-path. When this occurs, the operator may observe erratic or unreliable bearings, and the detected signal LED may indicate that the system is detecting signals which do not correlate with the known pinger pulse repetition rate.

If you suspect that multi-path is interfering with tracking, try the following:

1. Change the receiver threshold level.

A strong multi-path signal from a nearby reflector may interfere with the original signal. A lower threshold, which detects the incoming signal earlier, before interference from the multi-path signal, may solve this problem.

Alternatively, bounced signals travel farther than direct signals, they suffer a reflection loss and have more time to attenuate, and should therefore be weaker than the direct signal. If the multi-path signal is caused by a distant or weak reflector, you may be able to raise the threshold level enough to reject the weaker reflected signal and still accept the direct signal.

2. Slow the pinger repetition rate.

Slowing the repetition rate allows bounces and reverberations time to die out between pings, and increases the probability that the next signal the hydrophone receives is a direct signal from the pinger. As acoustic signals in the 20-30 kHz range attenuate fairly rapidly, a slight decrease in repetition rate should be effective.

If you are using the ORE Model 269A pinger, you can easily slow the repetition rate by opening the pinger and resetting the internal switches. Refer to the Model 269A operating manual. The same is true for the ORE Model 4320A Multibeacon (pinger configuration).

3. Lower the pinger's output level.

This step is recommended only if slowing the repetition rate does not eliminate the problem.

A standard tracking pinger in the 22-30 kHz range typically puts out about 84 dB, which translates to an operating range of approximately one to two kilometers. Lowering this initial output reduces the operating range, but may allow reflected signals to attenuate to a point below the receiver threshold level, and to be rejected by the tracking system. If you do not need the full 1000 to 2000 meter operating range, this action can be very effective. The ORE Model 4320A Multibeacon has the capability of reducing the output source level.

If your pinger does not have an output selector switch, you can lower the output somewhat by shifting the pinger several kHz away from the preset frequency. This detunes the transducer, lowering output power.

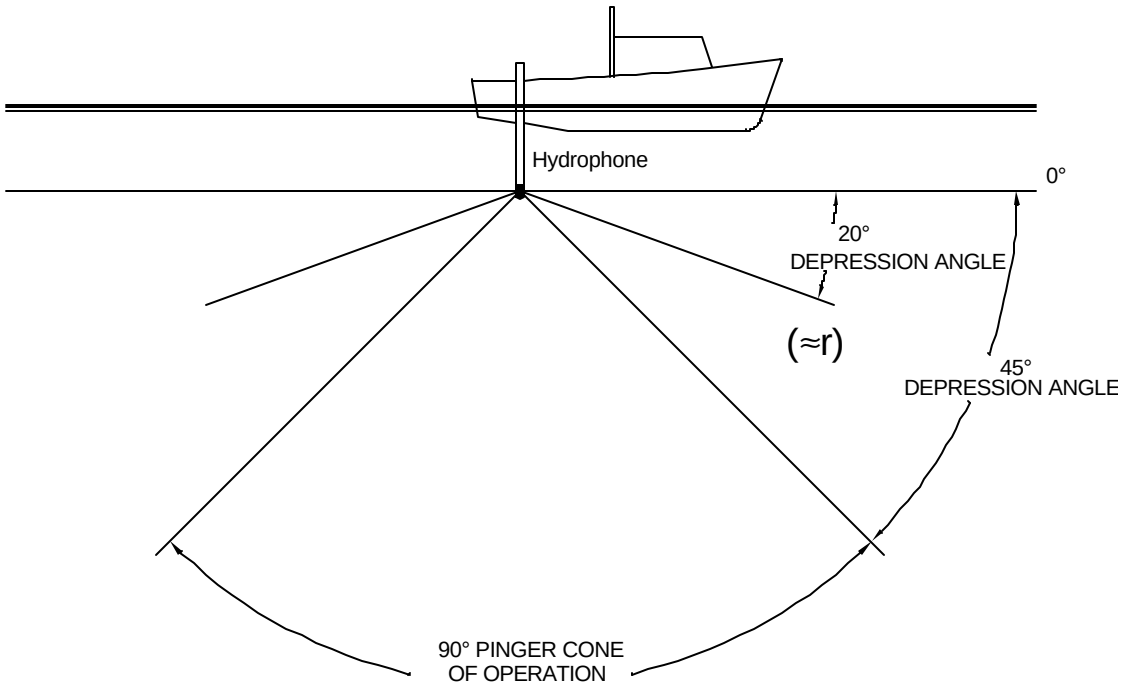
NOTE: The Trackpoint receiver frequency must also be changed to match the new pinger output frequency.

3.14.2 PINGER CONE OF OPERATION

The "cone of operation" describes a characteristic of **ALL** ultra-short baseline hydrophones that limits system performance in **pinger mode**. Various cones of operation are illustrated in Figure 3-30.

Because a **pinger** does not provide enough information to measure horizontal range directly, Trackpoint II uses measured bearing and depression angles and externally input depth to calculate the horizontal position of a pinger. However, the hydrophone's ability to measure the depression angle deteriorates rapidly when the **pinger** is within 45 degrees of the horizon. Calculation of the horizontal position range is therefore also degraded, although bearing data remains good.

If you plan to operate outside the 90-degree cone of operation as shown in Figure 3-30, a **transponder or responder** is recommended.



Normal mode of operation for **pingers** is within the 90 degree cone, (depression angle> 45 degrees). If the calculated depression angle is between 20 to 45 degrees, the displayed range is "≈ r" where "r" is the calculated range with some uncertainty. If the calculated depression angle is less than 20 degrees, the displayed range is "-.-" to symbolize that the range cannot be determined.

Note: This applies to the system ONLY when it is used to track free-running pingers.

CONE OF OPERATION FOR PINGER MODE

Figure 3-30

3.14.3 ACOUSTIC PROBLEMS IN TRANSPONDER MODE

A transponder emits an acoustic signal of a known frequency in response to an acoustic interrogation pulse sent from the Trackpoint II transmitter. The primary advantage of using a transponder is that the target range can be measured directly from the round-trip travel time of the acoustic signals. A transponder, therefore, is **NOT** subject to the "cone of operation" limitation that applies when a pinger is used.

A potential (minor) disadvantage in using a transponder is that both the interrogate pulse and the transponder's response may be subject to multi-path.

A high noise and/or multi-path environment may cause any of the following situations:

A. Transponder cannot "hear" interrogate pulse.

In an extremely noisy environment, it may be impossible for the transponder to distinguish an interrogate pulse in the noise flooding its receivers. In the worst case, the transponder simply won't reply, and is essentially lost for tracking purposes. A pinger or responder is a better choice for such an environment.

B. Transponder accepts noise or extraneous signals at the correct interrogate frequency.

In this case, transponder replies will be random and uncoordinated with the interrogate pulses. The operator may observe correct bearing information although range is random and incorrect. To determine whether this is the case, turn the Trackpoint II transmitter off and observe whether the transponder is still replying. If it is, the operator should try to identify and eliminate the source of the false interrogate signal or noise. If the source cannot be eliminated, it will be necessary to change the interrogate frequency, or switch to pinger or responder operation, or possibly reduce the sensitivity or frequency of the transponder receiver. It is also possible that there is an interference signal from some other sound source that is the multiple of the Multibeacon frequency causing the detection rather than the Multibeacon tiggering on noise. If it is another sound source then it usually is of a repetitive nature, whereas if the Multibeacon is triggering on noise the detection is more random.

C. Reflected interrogate signals cause extra transponder replies.

Most transponders are designed with a 'lock-out' (usually 1.5 - 1.75 seconds), or limit on the rate at which the transponder can reply, to prevent this from occurring. The operator should be aware of such a limitation, so that he does not interrogate at a rate too fast for the transponder.

In rare circumstances, the transponder can be replying to a distant reflection of the interrogate signal in addition to the direct signal. (The reflected signal comes in after the lock-out.) If this is the case, the operator will observe correct bearing values with erratic ranges as above, but the transponder will stop replying when the Trackpoint II transmitter is turned off, and begin replying when the transmitter is turned back on, still with erratic ranges. If this is occurring, the operator should lower the output power of the Trackpoint transmitter by changing the output jumper on the transmitter board, or increase the transponder's lock-out time and use a longer interrogate interval.

D. Transponder replies accurately, but signals are distorted by multi-path.

When multi-path is affecting transponder replies, try the following:

1. Lower the hydrophone further from the hull or away from the reflecting object.

Usually multi-path comes from a reflection off the hull or from an object close to the hull and arrives at the hydrophone within one millisecond or two of the direct arrival.

2. Lower the threshold setting.

A higher threshold setting causes the signals to detect later. This causes the system to process data that has a higher probability of contamination due to a reflection.

If the reflector is very close, the multi-path signal may be interfering with the original signal, and a lower threshold may improve the situation by detecting earlier, before the reply pulse is corrupted by multi-path. (See MIN XPONDER RANGE.)

3. Lower the transponder output power.

If changing the threshold does not eliminate the problem, lowering the transponder output, if possible, may allow the reflected signal to attenuate to a level where it is rejected by the system, but still receive the direct signal. This is usually only a problem in fresh water where there is less sound absorption than in sea water.

NOTE: In operation with a transponder, you may see more than one flash of the detected signal LED following each flash of the Trackpoint II transmit LED. The audio may sound like a series of echoes, or a quick double pulse (like the double report of a rifle shot). These are indications of multi-path but do not necessarily indicate a problem, since in transponder or responder mode, with filtering on, Trackpoint II ignores all but the first signal received within the range gate window (provided the range is greater than the MIN XPONDER RANGE).

E. Transponder responds inaccurately (case B or C) and hydrophone receives reflected signals.

If the operator observes both erratic range and erratic bearing values, the problem is most likely some combination of multi-path interference, and the operator should try the following:

1. Lower the interrogation repetition rate. In most cases, one signal every three seconds should give any transmitted or received multi-path bounces time to fade out before the next signal is initiated.

2. If a slower repetition rate does not solve the problem (or if the repetition rate is already slower than two or three seconds), the operator should try to isolate the sources of multi-path and resolve the independent factors using the above guidelines.

F. Transponder responds correctly and hydrophone receives correctly giving accurate slant ranges but erratic bearings.

This is usually a sign of low signal to noise ratio at the hydrophone. The hydrophone receives the signal and causes a valid detection but the data processing performed on the wideband signal is not consistent enough for a bearing calculation. In this case the detected signal is usually flagged with a low quality factor. To improve Signal to Noise ratio at the hydrophone:

1. Use a “louder” sound source. If the configuration is fixed can a directional beacon with higher source level be used?

2. Lower the hydrophone to reduce ship radiated noise.

3. Check that hydrophone shaft is not strumming or vibrating excessively. This causes excess noise at hydrophone. If hydrophone pole is vibrating but not strumming try shock mounting hydrophone. (rubber bushings between top of Hydrophone Model 4610B and shaft). If pole is strumming, change configuration (shorten the shaft, but watch out for reflections) or add fairing to shaft.

3.14.4 ACOUSTIC PROBLEMS IN RESPONDER MODE

A responder replies acoustically to an electrical interrogation pulse from the Trackpoint II transmitter. Like a transponder, a responder provides the timing information needed to measure horizontal range directly, but the interrogation pulse is not subject to the acoustic interference associated with a transponder. However, because a responder must be electrically connected to the tracking system, it may not be a feasible option for some operations.

When operating in the responder mode, multi-path interference is limited to cases where the direct arrival of the acoustic reply is blocked or reflected.

If this occurs, it may be necessary to reconfigure the system so that the C/DM hydrophone is in a position to receive the direct signal. For example, the hydrophone may not be mounted far enough below the ship's keel to receive a direct signal from a responder on the other side of the ship.

Avoid an operation where a towfish is tracked behind the vessel near the water surface, so that the direct signal from the beacon is reflected or attenuated by the ship's wake. Either tow the fish off-center, out of the ship's wake, or sink the responder below the wake.
When operating in and around subsea structures, there is always a number of locations where there is no direct path between the responder and the hydrophone, and the operator should expect occasional multi-path interference in these situations. A lower filter setting may help somewhat under these conditions by detecting earlier.

See section 3.14.3, D, E & F as they apply to responders also.

3.15 ERROR AND WARNING CODES

A number of situations can occur which either prevent calculation of the position or can lead to misrepresentation of the data.

If calculations cannot be performed on the data received, a message is displayed in the status block or in the tracking window if the Track view mode is enabled, and an ERROR CODE is sent out on the RS-232. (Format 1 does not contain error codes.)

Other error codes that are displayed on the status line and sent out on RS-232 are warnings.

Pressing the HELP key twice when an error code is displayed will show a brief description of the error condition.

BRIEF ERROR CODE LISTING	
CODE	DESCRIPTION

TARGET ERRORS:

0 (null character)	No errors detected.
1	Unusable signal received.
2	Signal timing error.
3	Range cannot be determined.
4	Low Quality Factor.
5	Target velocity excessive.
6	No recent replies.
7	Minimum range error.
8	Simultaneous reply error.
9	Transmitter Inoperative.
10	Travel time less than turn around time
14	Measured Slant Range > MAX SLANT RNG parameter
15	Measured Bearing outside BEARING LIMITS parameter

TELEMETRY ERRORS:

22	Telemetry Signal Timing Error.
23	Telemetry timing out of range.
24	Telemetered depth greater than slant range.
26	No recent telemetry replies.

WARNINGS:

50	Target input depth not within normal limits of the calculated depth.
51	Pinger D.A. < 20°, with hydrophone offsets.
52	Pinger D.A. < 20°.
53	Pinger D.A. 20° - 45°. Position " ≈ ".
54	Target Centered Mode Canceled.
55	Compass not active.
56	Transponder or Responder D.A. < 45° (Cannot calculate depth).
57	Depth > Slant Range.
59	No External Key Received within wait period. Target has been internally keyed.
60	System ignores the phase count depression angle and uses the slant range and input depth to calculate horizontal range.
61	Horizontal range calculated to be greater than slant range.
62	(RS232 o/p only) System performing auto offset function.
64	Low Quality Factor

NOTE: Error codes less than 20 result in no new position updates, while error codes of 21 or greater are warnings. Error conditions 1 - 9 signify that the output data is not valid. These error codes appear on the RS-232 port if the selected Format is either 1EC or 2EC. If any of these errors are detected, the error data is sent out the RS-232 under the assumption that the interfacing communications system has been programmed to ignore this data and extract only the possible good data, such as compass heading or slant range. Only Formats 1 and 2 output data when it is valid (no errors 1 - 9). Formats 1 and 2 show warnings only.

EXPLANATION OF ERROR CODES	
CODE	DESCRIPTION

0 No error. The error code zero (0) does not appear on the screen or sent out the RS-232 interface, but is a null character, indicating no error.

1 Unusable signal received. Signal received, but Trackpoint unable to calculate a position. This could have been due to acoustic noise contaminating the incoming signal or to other causes. The red LED and the audio may show valid detection of a signal. No position is plotted.

2 Signal timing error. Signal was received, but ten consecutive signals from a pinger or six from a transponder or responder were outside of range gate timing window. (All filter levels) This does not necessarily indicate a problem, since the signals may be echoes, which should be rejected. Alternatively, the range gate may have lost its lock on the signal and several more pings may be required for the range gate to re-acquire the target. No position is plotted.

3 Range cannot be determined. This occurs in transpond or respond mode if the calculated range is zero. This can happen if a pinger is designated as a responder or transponder and the transmitter is not turned on. No position is plotted.

4 Low Quality Factor. The signal of the present reply had a quality factor that was lower than the average of the previous five replies. No position is plotted.

5 Target velocity excessive. Target velocity, based on the change in horizontal position since the last up-date exceeds 10 knots. This filter takes advantage of the fact that tracked targets cannot move very fast. This error can occur at any filter level except "OFF." No position is plotted.

NOTE: A rapidly turning ship can make the target appear to move fast and can cause this error.

6 No recent replies. This message appears if, in any mode, no detected signal has occurred for 16 seconds.

#	TOD	HDG	BRG	S.R.	X	Y	Z	TEL	ERR
1	02:12:04		-.-	-.-	-.-	-.-	-.-	-.-	6
1	02:12:06		-.-	-.-	-.-	-.-	-.-	-.-	6

When an Error Code 6 occurs, -.- lines are sent out the RS-232 as shown above to indicate invalid data within those data fields.

7 Minimum range error. This occurs when in transponder or responder modes. If the measured slant range is less than the entered MIN XPONDER RANGE, the message "SLANT RANGE < ENTERED MIN" is displayed in the status area. No position is plotted.

CODE	DESCRIPTION

8 Simultaneous reply error. Two replies from separate targets are detected at the same time, normally when a pinger is running asynchronously with a transponder or responder. Although the system can detect two replies, it can only deal with one set of phase measurements instantaneously.

Because two replies cannot be dealt with simultaneously the data sent out the RS-232 port would not be correct. In this circumstance the following format for a target with a simultaneous reply error (8) is sent out the RS-232 port. Note target number 3.

#	TOD	HDG	BRG	S.R.	X	Y	Z	TEL	ERR
1	10:35:14	30.0	90.0	300.0	290.0	0.0	77.1	77.1	
2	10:35:16	30.0	120.0	300.0	251.0	-145.0	77.1	77.1	
3	10:35:18		-.-	-.-	-.-	-.-	-.-	- .-	8
4	10:35:20	30.0	180.0	300.0	0.0	-290.0	77.1	77.1	
1	10:35:22	30.0	90.0	300.0	290.0	0.0	77.1	77.1	
5	10:35:23	30.0	210.0	300.0	-145.0	-251.0	77.1	77.1	
6	10:35:25	30.0	240.0	300.0	-251.0	-145.0	77.1	77.1	
1	10:35:27	Etc.							

9 No transmit. CPU did not receive a transmit indication from the Signal Processing Board. Check that XMIT AND KEY OUT are turned on or, if EXTERNAL KEY is enabled, that an external key is present.

10 Travel time less than turn around time. The reply was detected within a time period less than the entered turnaround time. Check turn around time setting within C/DM & beacon.

14 Maximum Slant Range Exceeded: The MAX SLANT RNG filtering function compares the reply's slant range against this value. If the slant range is greater than the entered value the status block shows an error code #14. If the RS232 Format is set to an "EC" format it also outputs the last good position and tags it with an error code #14. See section 3.7

15 Bearing LImit Exceeded: The BEARING LIMIT function is enabled only in Fish Track mode, when the angle to the target is fairly well known. The system checks to see whether the target is within the parameters as set by the BEARING LIMITS. This function is only applicable to targets with a depression angle of less than 45°. If a target is outside the set limits then the system displays an error code #15, "BEARING LIMIT EXCEEDED". These limits are always referenced to the vessel, whether compass mode is ON or OFF.

22 Signal timing error. Telemetry signal was received but 6 consecutive signals were outside of the range gate timing window. Flags operator to check parameter set up of telemetry signal timing (depth or data).

EXPLANATION OF ERROR CODES

CODE	DESCRIPTION

23 Telemetry timing out of range. Telemetry time is either less than the entered '0' Delay or greater than the full scale span.

24 Telemetered depth greater than slant range. Telemetered depth less hydrophone depth offset, if utilized, is greater than the measured slant range.

26 No recent telemetry replies. No telemetry signal has been received for at least 16 seconds.

50 This warning occurs in transponder or responder mode when the target input depth is not within 10% of the calculated depth, when in calculated depth mode, or within 2% of the calculated depth when in the input depth mode. The warning is triggered when the target depression angle is greater than 40° (from the horizontal). The system calculates the depth at that point and compares it to the input depth (manual, analog or telemetered); if in error the warning 50 appears to alert the operator that the input depth may be in error and that a large excursion of the target position may occur.

51 This warning applies only when hydrophone offsets are entered and when tracking a pinger where its depression angle is < 20° from the horizontal. Its purpose is to notify the on-line computer system, via the RS-232, that all ranges and x or y coordinates to that target are minimum values and generally do not indicate actual ranges. I.e., use this data cautiously. At small depression angles (less than 20 degrees from the horizontal), measurement of depression and subsequent calculation of horizontal range is highly inaccurate; as a result, the X and Y hydrophone offsets are ignored for the pinger only, and its bearing is displayed relative to the actual hydrophone location (and North if the compass is enabled). Its actual range cannot be computed. See Figure 3-31 for an example. This warning applies to the individual target only.

NOTE: The pinger's bearing data does not degrade in this mode.

#	TOD	HDG	BRG	S.R.	X	Y	Z	ERR
1	10:35:14		359.8	-.-	-.-	-.-	300.0	51
2	10:35:16		210.7	812.2	-71.2	-120.5	800.0	

52 This warning is set when the target is a pinger and the depression angle is less than 20 degrees from the horizontal. Its purpose is to notify the on-line computer system, via the RS-232, that all ranges and x or y coordinates to that target are minimum values and generally do not indicate actual ranges. I.e., use this data cautiously. The status block and RS-232 data show the same format as in error code 51. The bearing is referenced to the hydrophone location (and North if compass is enabled). This warning applies to the individual target only.

NOTE: The pinger's bearing data does not degrade in this mode.

53 This warning is set when the target is a pinger and the depression angle is between 20° and 45°. In this condition, position accuracy is degraded and the ranges in the status block are preceded by an approximate "≈" symbol. This warning applies to the individual target only.

ERROR CODE 51 EXAMPLE

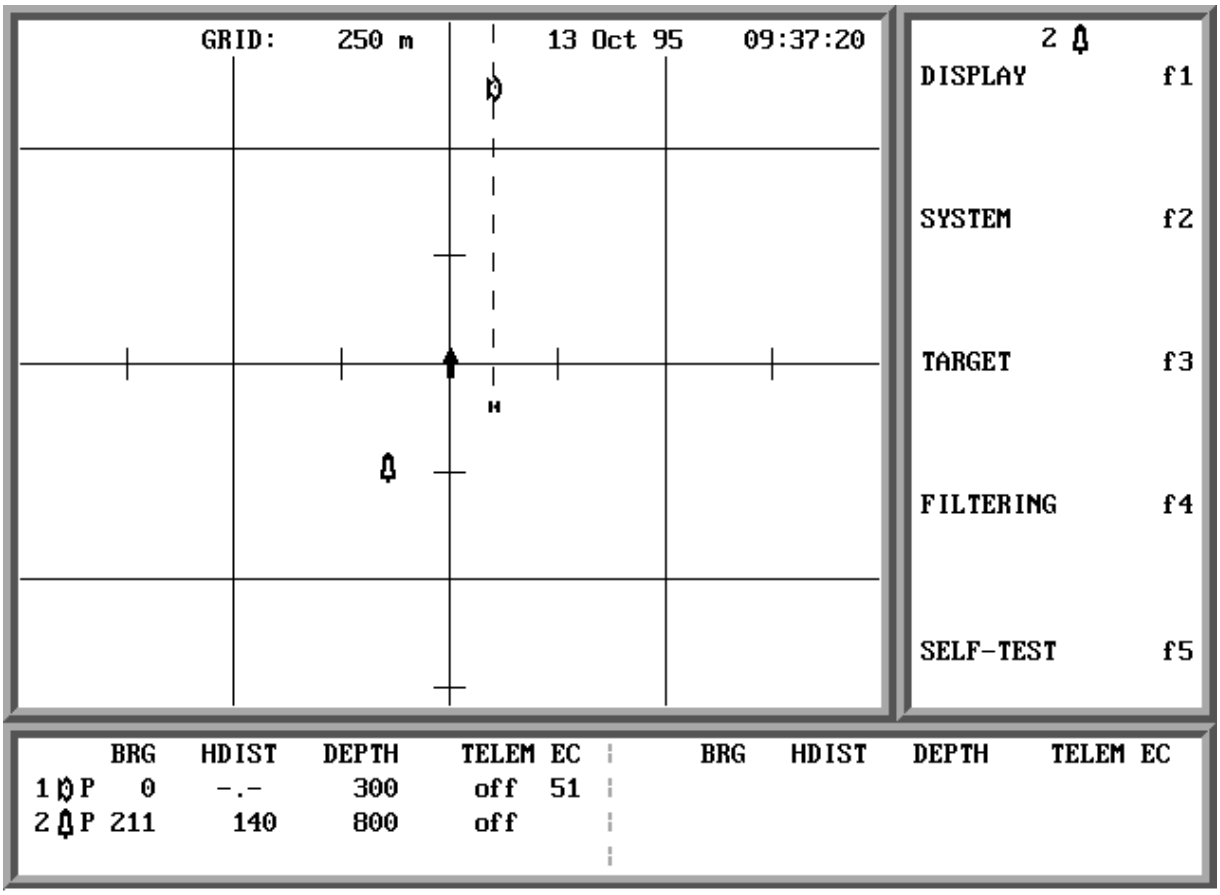


Figure 3-31

EXPLANATION OF ERROR CODES	
CODE	DESCRIPTION

54 In target-centered display mode, if the true position of the centered target is not known, target center mode is canceled. A message is flashed which must be acknowledged. The system does NOT change back to target-centered mode when the problem is resolved. The problem conditions are:

A. No recent reply from centered target.
B. When centered target is a pinger and depression angle is less than 20 degrees from the horizontal.

THE FOLLOWING MESSAGE IS SEEN FLASHING UNDER STATUS BLOCK AND REQUIRES OPERATOR ACKNOWLEDGMENT VIA KEYPAD.

"Target center mode canceled. Press ENTER or HELP."

NOTE: This alarm cannot be acknowledged from the RS-232 port.

55 When Compass mode is on and the compass bearing has not changed recently, this error code warns that the compass may not be operational. Also, the bearing value in the top left corner of the display changes from white to the selected target color when error 55 occurs.

When a pinger depression angle is < 20° from the horizontal, the pinger's position cannot be determined. The Trackpoint shows its bearing accurately with respect to the hydrophone and places the pinger off-screen along with the trailing dotted line. The transponder position remains with respect to the reference point. The error code 51 warns that the pinger's position can no longer be calculated, so refer to its bearing value as an indication of position.

56 When tracking a transponder or responder in calculated depth mode and the target's depression angle is < 45° from the horizontal, this error code warns that the system is no longer calculating depth in determining target position. The system is using the input depth (manual, analog or telemetered) and the measured slant range to determine target position. (Also see warning code 50.) Refer to section 3.4.3 for explanation of depth MODE.

57 This warning occurs when the input depth of the target is greater than the measured slant range. This can occur when the target depression angle is between 0 and 45° in calculated depth mode or between 0 and 70° when in input depth mode.

#	TOD	HDG	BRG	S.R.	X	Y	Z	TEL	ERR
1	02:12:07		0.1	204.1	-.-	-.-	250.0	0.0	57
1	02:12:08		0.0	204.2	-.-	-.-	250.0	0.0	57

When an Error Code 57 occurs, a -.- is sent out the RS-232 as shown above to indicate invalid data within the x and y data fields.

EXPLANATION OF ERROR CODES	
CODE	DESCRIPTION

58 Reserved.

59 Reserved in revision 8.05.

60 This warning occurs if in INPUT mode and either ANALOG or TELEMETRY depth is selected. If the system calculates a depression angle using the slant range and the input depth to be less than 45° but the measured depression angle given the phase counts from the hydrophone is > 70° (sound appears to be coming from below the hydrophone due to high multi-path environment, e.g., directional beacon pointing up in shallow water) then the system ignores the phase count depression angle and uses the slant range and input depth to calculate horizontal range.

61 Horizontal range greater than slant range.

62 (RS232 o/p only) System performing auto offset function. When the auto offset function is enabled the system reverts to the BIT mode and outputs data from a false target. The warning code alerts the operator that the data being sent out is only valid for the pitch and roll data. It is measuring the static offsets.

64 Low Quality Factor. The signal of the present reply had a quality factor that was lower than the average of the previous five replies.

3.16 SHUTDOWN

The LINE switch on the Command/Display Module shuts power off. It is important to bear in mind that the parameters in use when power is turned off can be automatically recalled, using PREVIOUS SETUP or CUSTOM SETUP option when power is next turned on. This is true in the case of inadvertent power shut off, as well as intended power off. See Appendix A for DEFAULT settings. See section 5.9 for Custom and ORE default jumper settings.

SECTION FOUR

PRINCIPLE OF OPERATION

4.0 PRINCIPLES OF OPERATION

Trackpoint II measures and analyzes sound waves sent from an acoustic sound source that is attached to a target. The signal is received by a hydrophone to determine target position relative to the tracking ship. The hydrophone converts the received acoustic signals into electrical signals and sends them to the Trackpoint II microprocessors.

The Trackpoint II system uses an ultra-short baseline, phased-array hydrophone containing sound transducing elements arranged at the vertices of an equilateral triangle. Each element is spaced less than half a wavelength away from each of the other elements in the array. When a sound wave impinges upon the array it strikes one element first, then one of its neighbors, and finally the remaining element. The sound wave, as sensed by any element in the array, will appear out of phase with the wave as sensed by the other elements in the array. The phase differences between the elements in the array provide the information required to calculate a three-dimensional vector from the array to the sound source.

Three types of sound sources are used with the Trackpoint II system: pingers, transponders and responders. A pinger emits a sound pulse at a predetermined frequency, repeated at a set interval. The hydrophone receives the pulse and determines bearing and depression angle. Transit time of the pulse is unknown.

A transponder emits a sound pulse in response to a specific acoustic interrogation pulse from the controller transmitter. A responder emits a sound pulse via a wire connecting the responder and the C/DM when electrically triggered by the C/DM. The system now has timing information to calculate directly the slant range of the target, assuming the average velocity of sound in the water column and the turnaround time of the transponder or responder are known.

In either pinger or transponder/responder mode, the relative bearing and depression angle of the target being tracked are determined by measuring the phase differences of the sound waves for each hydrophone element. The bearing of the target is measured in degrees relative to the hydrophone heading. The depression angle is formed by the intersection of a horizontal plane and a line drawn from the vessel reference point to the target. Once these values are determined, the rest of the positioning parameters can be calculated.

NOTE: The term "vessel reference point" denotes the point relative to which all measurements are calculated. The actual position of the vessel reference point is determined by hydrophone offsets entered into the system (see Figure 4-1). If no offsets are entered, the hydrophone itself is considered the vessel reference point. This is the case in Figure 4-2, which illustrates the positioning parameters that the system calculates.

The slant range is the straight line distance from the vessel reference point to the target. When a sound source other than a pinger is used, the travel time of the sound wave between the sound source and the hydrophone is used to calculate the slant range directly. The horizontal range is the projection of the slant range on a horizontal plane.

In PINGER mode, horizontal range (HR) is calculated by:

$$HR = \frac{Z}{\tan \beta}$$

where Z is the target depth and β is the depression angle.

Slant range (SR) is calculated by:

$$SR = \frac{Z}{\sin \beta}$$

where Z is the target depth and β the depression angle.

In TRANSPONDER or RESPONDER mode, slant range (SR) is calculated from the known speed of sound in the water column (V), the transponder or responder turnaround time (D) and the measured time (T) between transmitted pulse and received reply by:

$$SR = V \times \frac{(T - D)}{2}$$ in transponder mode, and:

$$SR = V \times (T - D)$$ in responder mode.

Horizontal range (HR) is calculated by one of three methods, depending on the calculated value of the depression angle (β) from the horizontal and the depth MODE.

A. In CALCULATED depth MODE and when the target is within a 90 degree cone (value of (β) greater than 45 degrees), horizontal range (HR) is calculated by:

$$HR = SR \cos \beta$$

This is the normal situation, where the target is within a 45 degree angle from the vertical axis of the hydrophone.

B. In CALCULATED depth MODE and outside a 90 degree cone (values of (β) less than 45 degrees), as the target moves to positions which are between the hydrophone horizon and a 45 degree depression angle, the measured accuracy degrades due to physical constraints of the measuring hydrophone. (As the target approaches the horizon, the angle becomes unmeasurable.) In this situation, the input target depth (Z) (manual, analog or telemetry) is used to calculate horizontal range by:

$$HR = SR \cos \left(\sin^{-1} \frac{Z}{SR}\right)$$

C. In INPUT depth MODE and when the target is within a 40 degree cone (value of (β) greater than 70 degrees), slight variations between the slant range and the input depth will cause large horizontal position differences. In this situation the horizontal range is calculated by:

$$HR = \frac{Z}{\tan \beta}$$

D. In INPUT depth MODE and when the target is outside the 40-degree cone (value of (β) less than 70 degrees), the horizontal range is calculated by:

$$HR = SR \cos\left(\sin^{-1} \frac{Z}{SR}\right)$$

To eliminate the sharp boundary at 45- and 70-degree depression angles, hysteresis is incorporated into the software.

In Figure 4-2, the values X, Y, and Z are RS-232C outputs. (These values are distinct from the X, Y and Z offsets shown in Figure 4-1.) The distance X is the projection of the horizontal range on a vertical plane perpendicular to the centerline of the vessel and passing through the vessel reference point. The distance Y is the projection of the horizontal range on a vertical plane parallel to the centerline of the ship and passing through the target. X and Y and HR form a right triangle. Depth (Z) is the depth of the target below the water surface.

Under ideal conditions the transducing element plane is parallel to the surface of the water and perpendicular to a vertical plane through the vessel centerline. In a real application, the vessel and hydrophone will be in motion, and the system must therefore correct measurements taken from the hydrophone for pitch and roll.

The rotation of the vessel about its X-axis, a line drawn perpendicular to the vessel centerline at its midpoint, is known as pitch. Roll is the rotation of the vessel about the vessel centerline, or Y-axis. The Vertical Reference Unit measures pitch and roll in degrees, with zero degrees being the "at rest" position, and calculates the necessary compensation. For dynamic motion compensation an ORE Model 4414B Dynamic Motion Sensor is recommended.

The system microprocessors, located in the Command/Display Module, receive information from the hydrophone array for each received pulse. They convert that information into a real-time graphic representation of the tracked target(s) relative to the vessel reference point, shown in the display-screen tracking window. Digital values are continuously updated in the status block (see Figure 3-4).

Figure 4-3, the C/DM Block Diagram, presents an overview of the Trackpoint II C/DM. The individual components of the system function as described in the following sections.

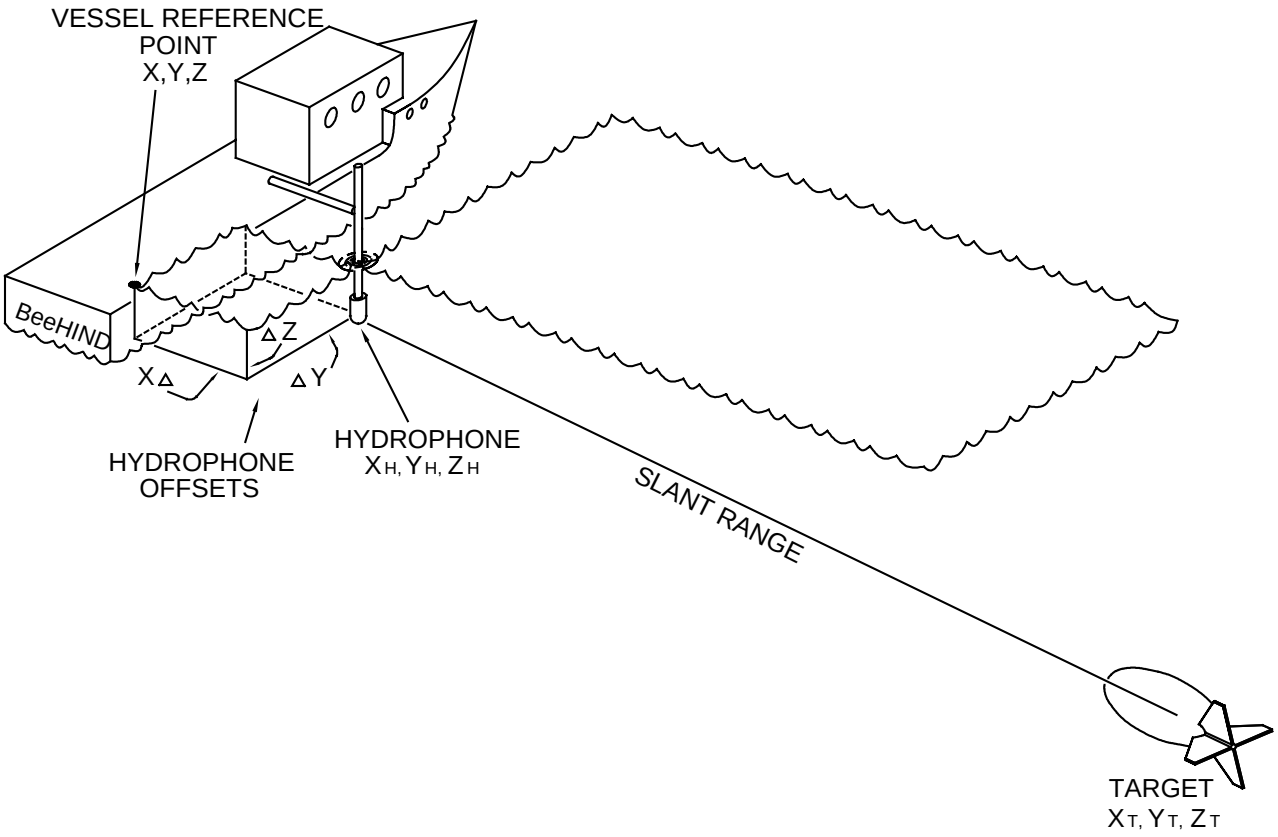

VESSEL REFERENCE
POINT
X,Y,Z
BeeHIND
ΔZ
XΔ
ΔY
HYDROPHONE
OFFSETS
HYDROPHONE
XH, YH, ZH
SLANT RANGE
TARGET
XT, YT, ZT

Figure 4-1

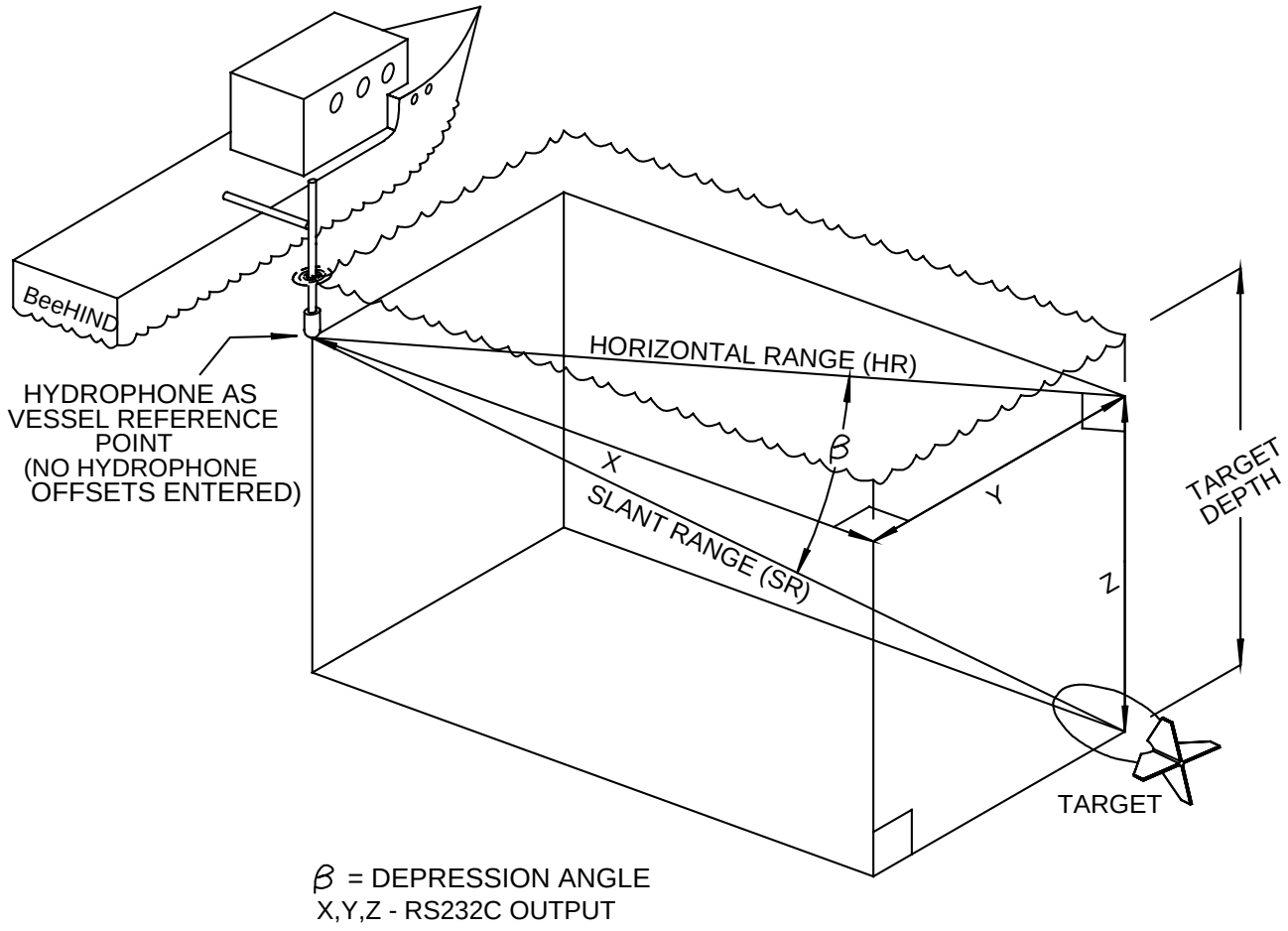

BeeHIND
HYDROPHONE AS
VESSEL REFERENCE
POINT
(NO HYDROPHONE
OFFSETS ENTERED)
HORIZONTAL RANGE (HR)
β
X
SLANT RANGE (SR)
Y
Z
TARGET
DEPTH
TARGET
β = DEPRESSION ANGLE
X,Y,Z - RS232C OUTPUT

Figure 4-2

4.1 HYDROPHONE/VRU ASSEMBLIES

Model 4610B Hydrophone & VRU Assembly

The hydrophone assembly (Figure 4-4) consists of the hydrophone and the pressure case/electronics. In the hydrophone, the three receiving elements, the transmitting element, and the temperature sensor are potted and attached to the PVC base, and connected to the electronics. In the pressure case/electronics package, each of the three elements feeds its own Amplifier Board. Each board consists of an amplifier stage, followed by a bandpass filter, set for 22 kHz - 30 kHz (or 8 kHz - 14 kHz for the low-frequency hydrophone, or 35 - 45 kHz for the hi-frequency hydrophone), followed by further gain. A precision temperature sensor, embedded in the PVC hydrophone base, provides an analog signal which is buffered and scaled on the Father Board and also sent to the Signal Processor Board (SPB). The internal Vertical Reference Unit (VRU) provides analog signals corresponding to pitch and roll that are also sent to the SPB (+/- 10 VDC). Power for the amplifiers and drivers is regulated on the Father Board from the raw power sent down from the SPB.

Model 4211A Hydrophone

The Model 4211A Hydrophone is approximately 3-inches in diameter. Refer to Figure 4-5. The potted end is the same as in the 4610B with three receiving elements, transmitting element and temperature sensor potted to an aluminum silicon bronze base. The only electronics internal to the hydrophone is a set of three preamplifiers with unity gain. These amplifiers drive the signal up the deck cable to the Model 4740A VRU/Amplifier unit. A precision temperature sensor, located on one of the Amplifier boards, provides an analog signal which is also sent to the 4740A.

Model 4740A VRU/Amplifier

The Model 4740A VRU/Amplifier contains the same electronics as the 4610B Hydrophone consisting of three Amplifier Boards, a Father Board and an internal VRU but is packaged in a metal NEMA type enclosure for bulkhead mounting.

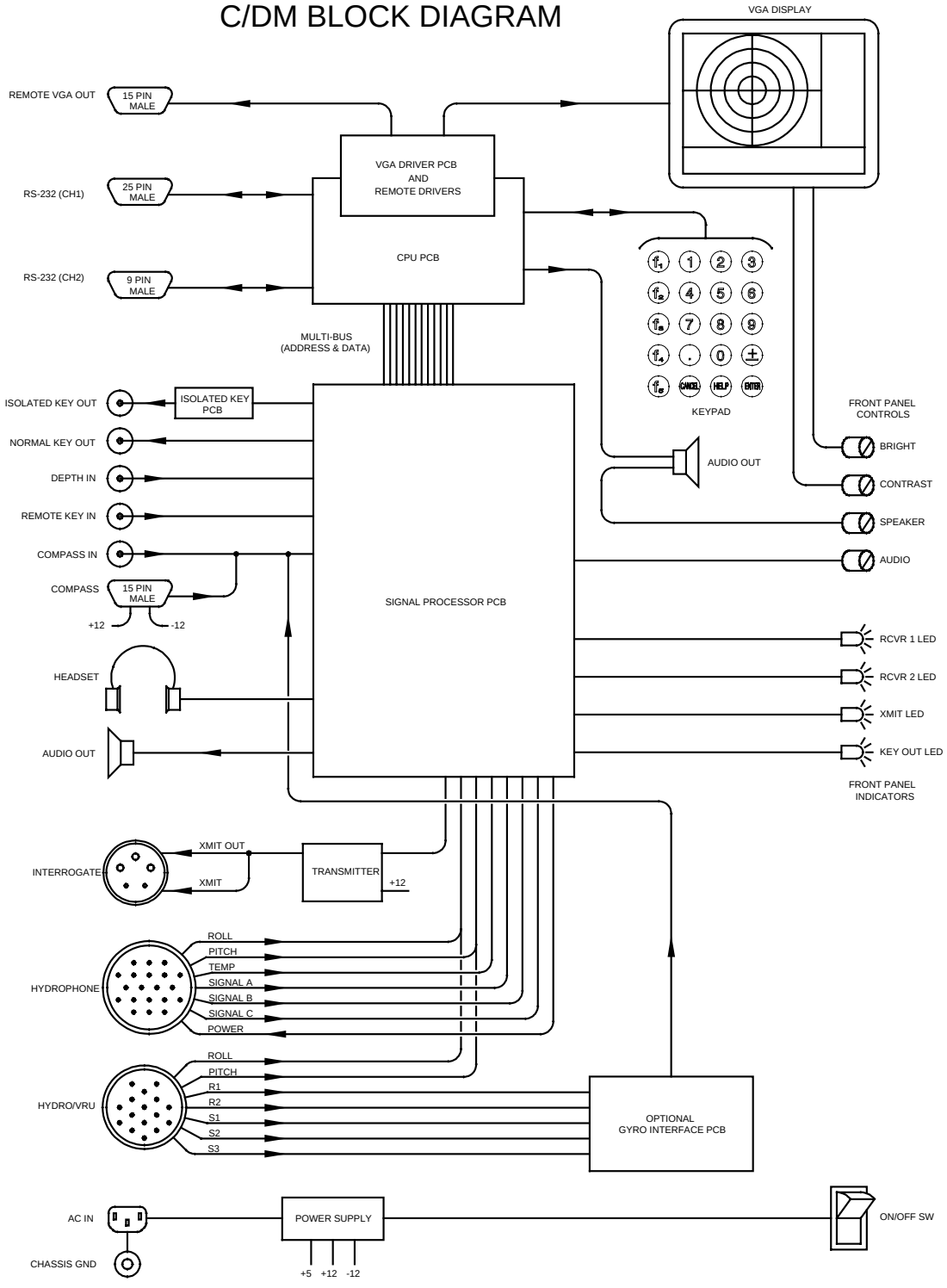
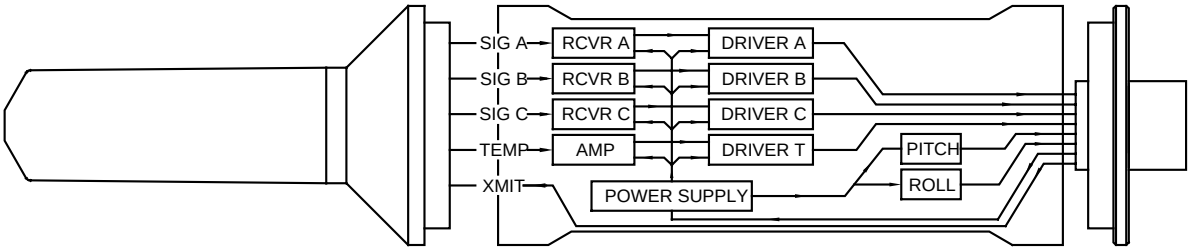
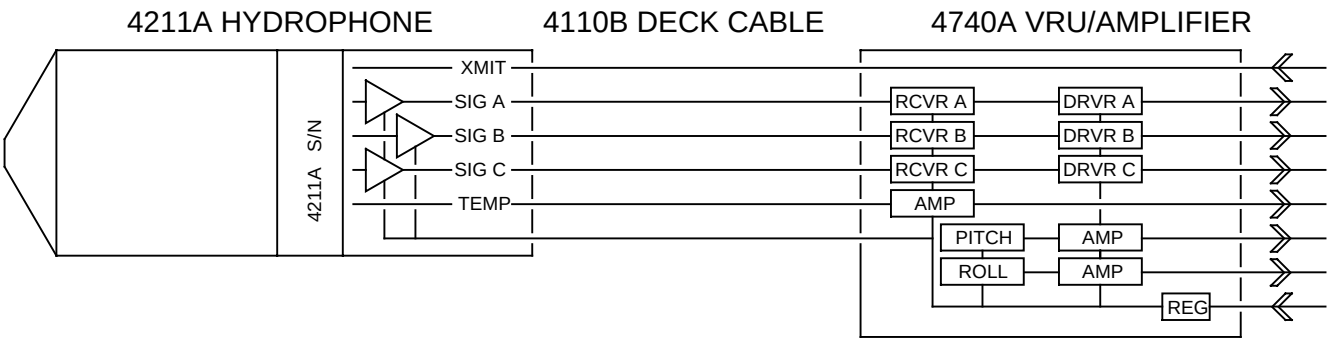

C/DM BLOCK DIAGRAM
VGA DISPLAY
REMOTE VGA OUT
15 PIN MALE
VGA DRIVER PCB AND REMOTE DRIVERS
RS-232 (CH1)
25 PIN MALE
CPU PCB
RS-232 (CH2)
9 PIN MALE
MULTI-BUS (ADDRESS & DATA)
KEYPAD
ISOLATED KEY OUT
ISOLATED KEY PCB
NORMAL KEY OUT
DEPTH IN
REMOTE KEY IN
COMPASS IN
COMPASS
15 PIN MALE
+12
-12
AUDIO OUT
FRONT PANEL CONTROLS
BRIGHT
CONTRAST
SPEAKER
AUDIO
SIGNAL PROCESSOR PCB
HEADSET
AUDIO OUT
RCVR 1 LED
RCVR 2 LED
XMIT LED
KEY OUT LED
FRONT PANEL INDICATORS
INTERROGATE
XMIT OUT
XMIT
TRANSMITTER
+12
HYDROPHONE
ROLL
PITCH
TEMP
SIGNAL A
SIGNAL B
SIGNAL C
POWER
HYDRO/VRU
ROLL
PITCH
R1
R2
S1
S2
S3
OPTIONAL GYRO INTERFACE PCB
AC IN
CHASSIS GND
POWER SUPPLY
+5 +12 -12
ON/OFF SW

Figure 4-3



4610B HYDROPHONE BLOCK DIAGRAM

Figure 4-4



HYDROPHONE & VRU BLOCK DIAGRAM

Figure 4-5

4.2 SIGNAL PROCESSOR BOARD

Each of the three signals is sent via current loop to the Signal Processor Board and clipped by the receiver. The phase differences between the leading edges of the signals are measured and stored for later transmission to the main CPU board. When a valid signal is detected (Section 4.3), the Signal Processor Board transfers the RAM contents, starting with the most recent phase count data, to the main CPU via multibus (Section 4.4.)

4.3 DETECTION CIRCUITRY

One of the input signals is used in the detection circuitry. It is mixed with a Local Oscillator, then fed to a sharply tuned filter. The filter outputs go to a peak detector/threshold system, which can generate an interrupt for the CPU. The detector outputs also control the front panel LED's, and the peak detector circuit provides signals for the audio generators. The audio circuitry provides an indication of the strength of the signal received at the chosen frequency.

4.4 DATA TRANSFER

When the interrupt generated by the detection circuitry is recognized by the CPU, the following sequence of events occurs, resulting in the transfer of all of the raw data over multibus to the main CPU board. All counting and data collection is halted, the VRU, COMPASS, ANALOG DEPTH and TEMP signals are digitized and stored, and an interrupt is sent to the main CPU board to initiate data transfer. The main CPU board, when ready, will read the raw data, including VRU, COMPASS, ANALOG DEPTH and TEMP data. At the end of the transfer, data acquisition is begun again.

4.5 TRANSMIT SIGNAL

Transmitter parameters, such as frequency, repetition rate, and pulse duration, are entered via the keyboard and immediately sent to the SPB, where generation of the transmit signals occurs. The frequency is latched, and a Phase Lock Loop generates the actual signal. The repetition rate and duration are controlled by a Programmable Interval Timer. An external input can also be used to trigger the transmitter (for transponder operation) or isolated key out (for responder operation) in place of the internal repetition rate generator.

In transponder or responder mode, the transmit signal starts a timer, which is stopped and read after receipt of a valid reply. This timer determines the transit time which is translated by the main CPU board into slant range.

4.6 GYRO (synchro) TO ANALOG CONVERTER (OPTIONAL)

The marine gyro compass is a north seeking type gyro which maintains its reference to north. A shaft couples the gyro to a synchro. As the vessel turns the shaft is rotated with respect to north. A synchro device then transforms the shaft angle to an electrical output. The synchro is energized by an AC signal usually 60 Hz or 400 Hz. The output signals from the synchro, S1, S2 and S3, are sinusoidal waveforms at its AC line reference frequency. The amplitudes of S1, S2 and S3 are proportional to the synchro shaft angle. These gyro output signals are input to the Synchro to Analog Converter Module (S/AC) on the Gyro Interface Board, P/N 4410-0049.

The Gyro Interface Board converts the S1, S2 and S3 synchro signals to an analog voltage. The main module that converts the synchro signals to an analog voltage is U4. The output of U4 varies from 0 to +10 VDC (which = 0° to 359.9°). The linear amplifiers U5 A & B, and its associated circuitry, attenuate U4's output to 5 VDC and also provides a zero adjustment to compensate for any offsets within the converter or amplifiers.

SECTION FIVE

MAINTENANCE

5.0 MAINTENANCE

Trackpoint II requires no scheduled maintenance except for an occasional cleaning of the intake fan filter and cleaning of the optical glass CRT filter/screen.

The hydrophone assembly should be rinsed with fresh water following each use, to remove any salt water and fouling build-up.

If the system is not be used for an extended period, all components should be stored in the original packing case, or secured and covered with plastic, if the original materials are not available.

After shipping, or following a storage period, the SELF-TEST diagnostics can be run when the system is ready for operation.

************ WARNING ************

There are NO operator servicable parts inside unit. All servicing must be performed by qualified service personnel

5.1 FAN FILTER CLEANING

To clean the intake fan filter (labeled AIR IN on Figure 1-2, Command/Display Module Back Panel), remove the four screws fastening it to the rear panel and detach the screen. Use compressed air to blow out dust clogging screen or wash it thoroughly with solvent and a brush. It is important to keep the filter clean, as the C/DM will overheat if sufficient cooling air is not available. Repeat for exhaust filter also.

5.2 CRT CLEANING

The CRT filter/screen on the Command/Display Module is optically-coated safety glass. Proper cleaning requires the use of a good-quality lens-cleaning cloth and fluid, such as is used on camera lenses. Ordinary glass cleaners leave streaks on the glass, and use of some solvents may damage the optical coating. To clean the inside of the filter/screen and the CRT screen itself follow the procedure below.

1. Remove top cover.
2. Remove alarm and keyboard cables from CPU Board.
3. Remove the two stainless steel clips holding the front panel to the side panels. Use a screwdriver to wedge between the side panel and the clip forcing the clip up and out of its key slots. The clips will move up about 1/2 inch. Grasp the top of the clips and wiggle the them out of their locking pins with a motion toward the rear of the unit. (The clips have a tapered key-hole type slot at the top and an tapered open slot at the bottom. The unit is designed so that the slots slide into two pins mounted in the back of the front panel handles. This clip and pin arrangement hold the front panel captive to the side panels.)
4. Fold down the front panel to gain access to the CRT and front panel filter/screen.
5. Clean both as described above.
   If the front panel feels loose at any time the pins may need tightening. Remove the clips, fold down front panel and tighten the four pins with a slotted screwdriver. Re-assemble in reverse order.

5.3 HYDROPHONE CALIBRATION EPROM(S)

The hydrophone assembly is calibrated at the factory. The calibration consists of generating a set of EPROM's (only one EPROM for calibrations prior to rev 8 firmware) that plug into the CPU board of the C/DM to compensate for the variances from hydrophone to hydrophone. When ordered as a system, the EPROM's are installed in the C/DM at the factory. If a hydrophone assembly is ordered separately, it will come with its own set of EPROM's, and must be installed into the C/DM to which the hydrophone is connected.

Install the hydrophone calibration EPROM's as follows:

NOTE: If a model 4211A and separate Model 4740A VRU/Amplifier is being used, they are shipped and factory calibrated as matched sets, and replacement of the EPROM requires that the factory know the serial number of the 4740A also. It goes without saying that 4740A's cannot be interchanged (other than for testing/troubleshooting) without affecting system accuracy. Therefore, when servicing the Hydrophone with customer supplied spare parts, it is necessary to change out both the Hydrophone and the VRU/Amplifier, and, of course, the correct EPROM's.

1. Unplug power to the Command/Display Module.

2. Remove top cover from the C/DM. Loosen the four card-file PC hold-down screws. Slide PC hold-down brackets away from PC card handles. Disconnect CPU-J4, CPU-J1 and CPU-J3 from the CPU board (see Figure 5-1) and VI-P2 & P3 from the Video Interface Board. Remove the CPU/VGA board assembly from the card file. Remove the five nylon screws holding the Video Interface board to the CPU board. Pry the Video Interface board connector away from the CPU board socket. Locate UB1 and UD1 on the CPU board (top left corner). See **Figure 5-2**.

NOTE: Old EPROM's from 4410A->C were labeled U46 and U47. Due to the new boards in the 4410D, U46 is now UB1 and U47 is UD1. The old EPROM's were 28-pin type. The new EPROM's for the 4410D units must be 32-pin types. An older hydrophone with 28-pin calibration EPROM's cannot be used with the new 4410D C/DM. The EPROM's must be exchanged for 32-pin types. Contact ORE for details. (In order to burn new 32-pin calibration EPROM's the factory either must have the old set of EPROM's to read the data from or must be given the S/N of both the hydrophone and the electronics.)

3. Unplug UD1 and UB1 from its socket using the IC puller provided with the system spares kit. Insert new EPROM's into UD1 and UB1 sockets using caution not to bend the EPROM's leads. After insertion, check to make sure that all the leads are in their sockets.

NOTE: A small notch on the case of the EPROM must be closer to the left edge of the board, similar to all the other IC's on that board. See below.

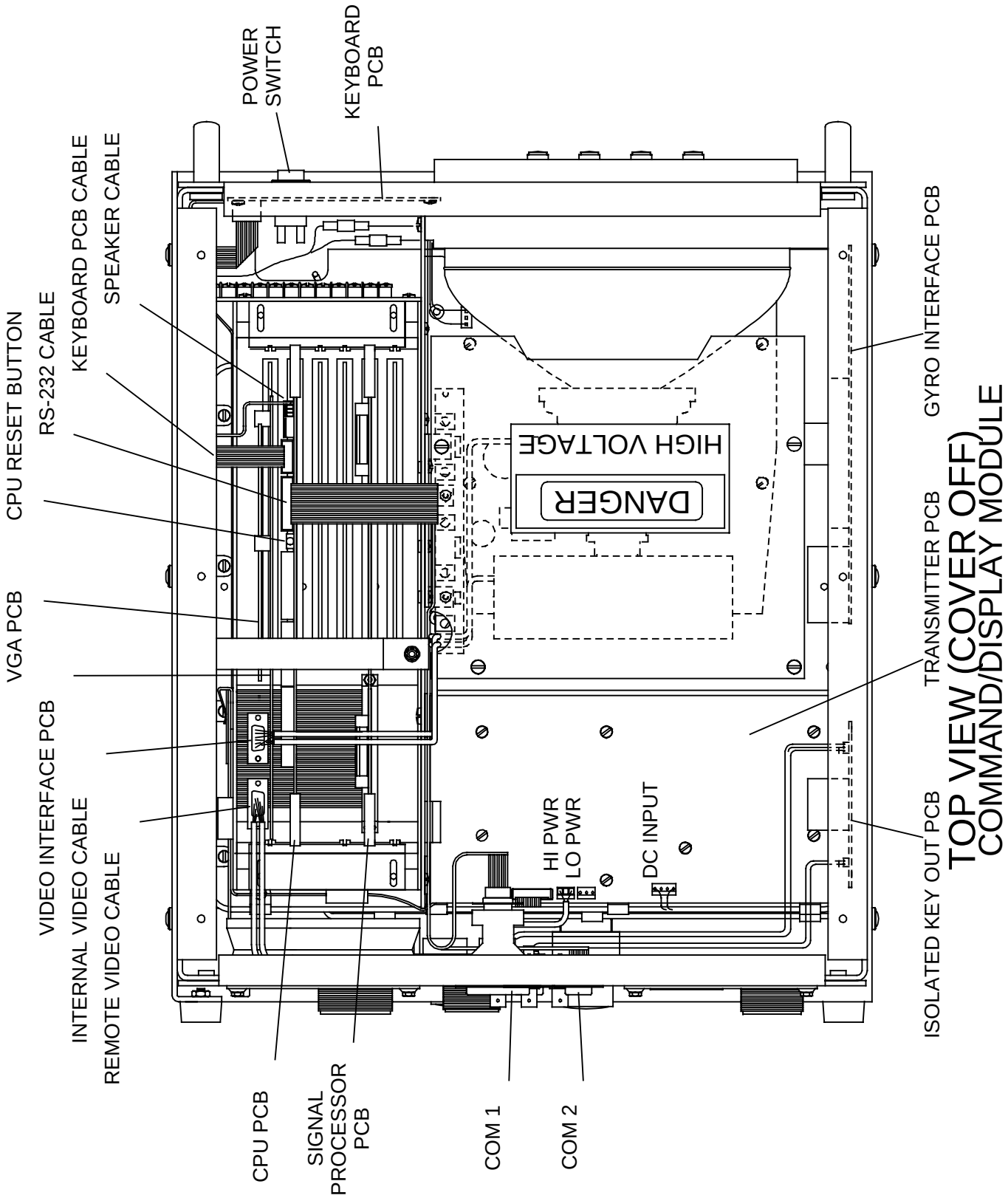

POWER SWITCH
KEYBOARD PCB
KEYBOARD PCB CABLE
SPEAKER CABLE
CPU RESET BUTTON
RS-232 CABLE
VGA PCB
VIDEO INTERFACE PCB
INTERNAL VIDEO CABLE
REMOTE VIDEO CABLE
GYRO INTERFACE PCB
TRANSMITTER PCB
ISOLATED KEY OUT PCB
HIGH VOLTAGE
DANGER
HI PWR
LO PWR
DC INPUT
CPU PCB
SIGNAL PROCESSOR PCB
COM 1
COM 2
TOP VIEW (COVER OFF)
COMMAND/DISPLAY MODULE

Figure 5-1

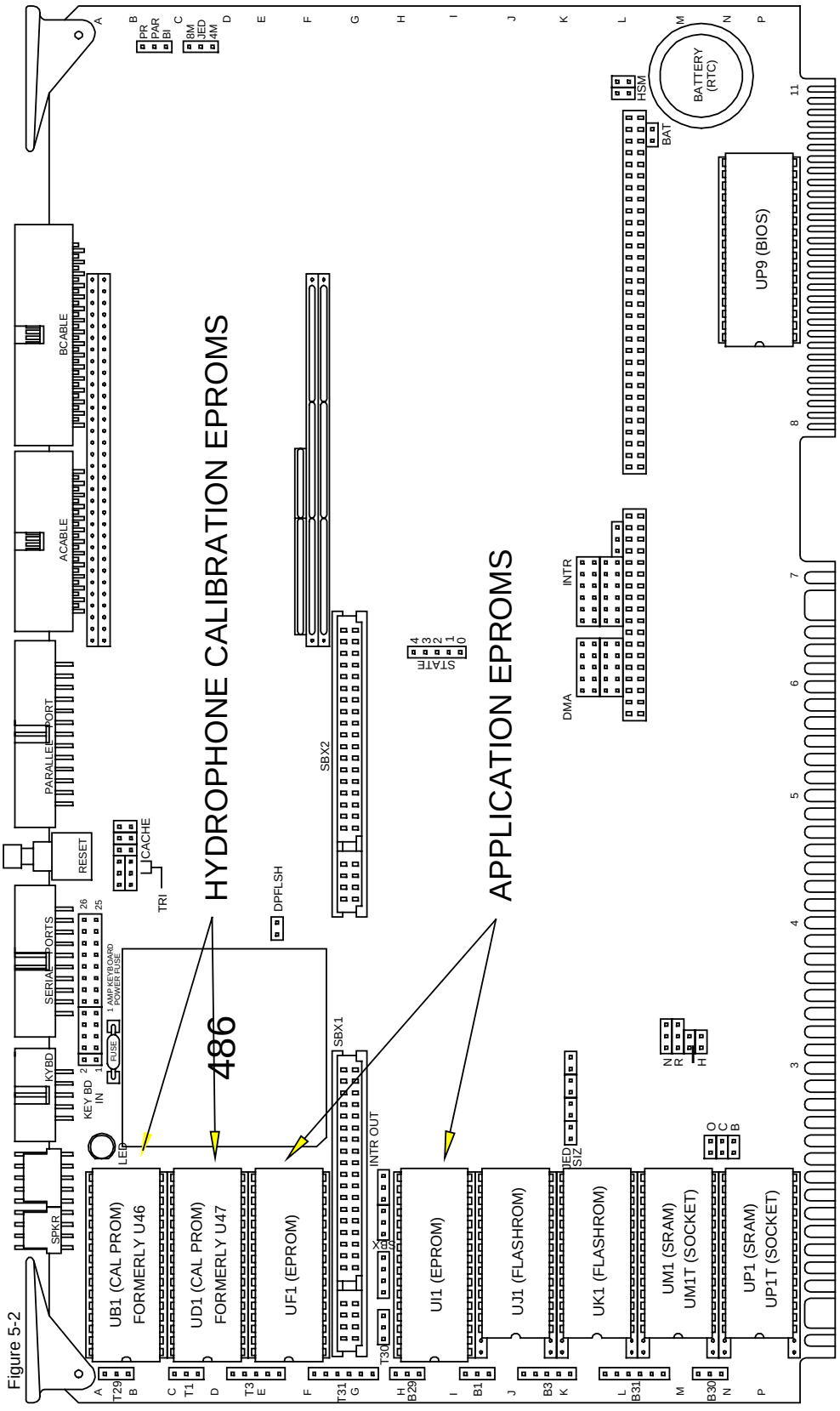
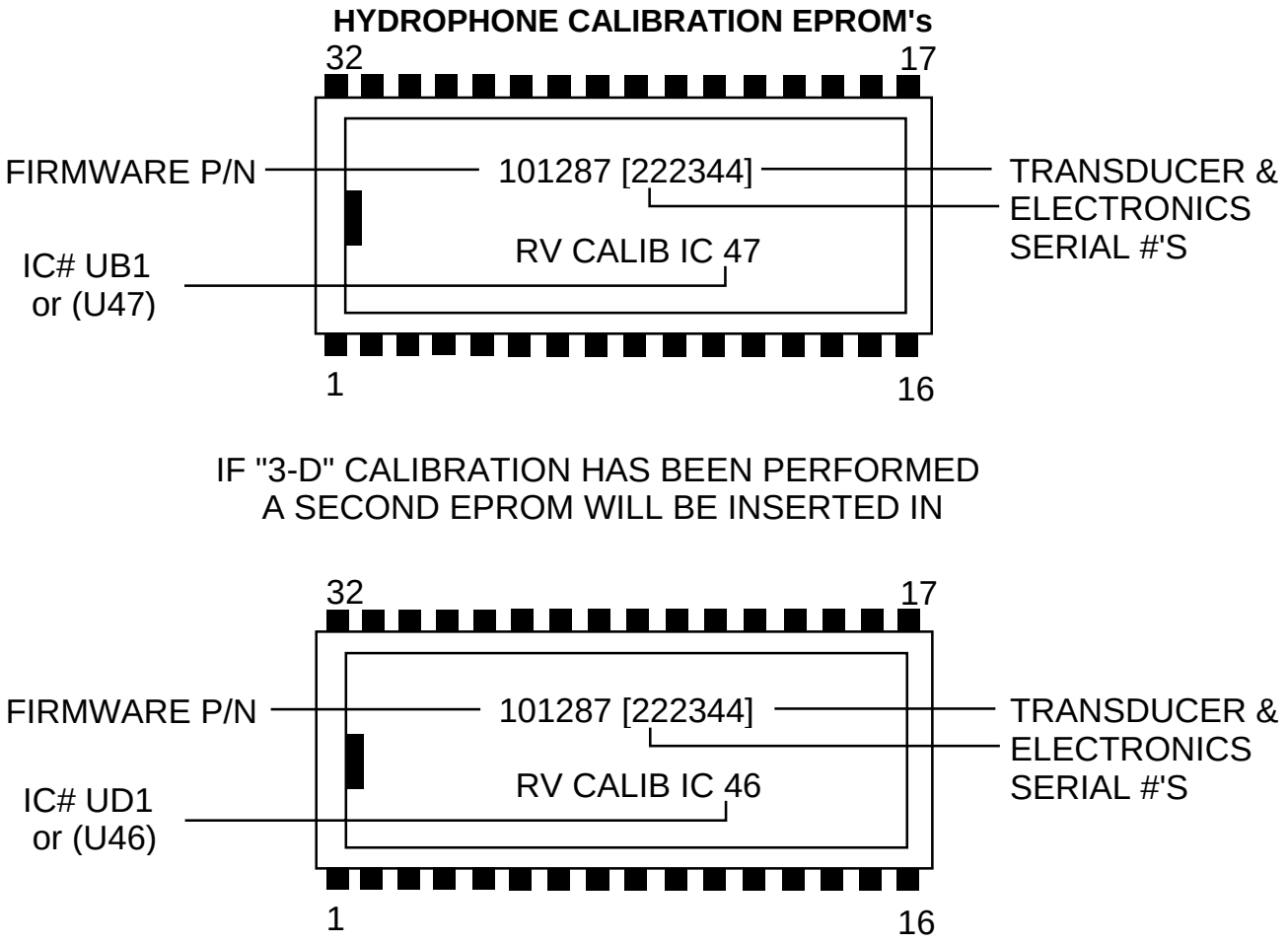


Figure 5-2

Figure 5-2



4. Reverse order for re-assembly.

5. To check that the EPROM's have been installed correctly, select DISPLAY CONFIGURATION SYSTEM. The hydrophone serial number will be displayed for verification.

5.4 FUSE REPLACEMENT

The fuse is in the AC-IN plug on the rear panel. Disconnect the line cord before servicing the fuse. Snap open the cover located above the AC-IN plug to replace the fuse. Replace fuse with proper value as listed below.

3.15 Amp slow blow (5 x 20 mm)

5.5 CARD FILE PCB (Printed Circuit Board) REMOVAL

1. Remove the top cover from the C/DM. Loosen the four card-file PC hold-down screws. Slide PC hold-down brackets away from PC card handles. See Figure 5-1.

2. Disconnect any connectors associated with the particular PCB or connectors that cross over the board preventing removal. Lift up on the handles of the board to remove from cardfile.

Note: The CPU board contains lithium back-up batteries for the clock. It is a 3.6v unit composed of $Li/SOCL_2$ and is hermetically sealed.

5.6 PCB HANDLING

When removed from the C/DM card file, the PCB's should be stored or shipped in anti-static bags. Never stack one PCB on top of another. Always separate PCB's with suitable packing material.

5.7 TROUBLESHOOTING

Should a problem arise during operation, refer to the following troubleshooting guide to determine possible cause and recommended action. In most cases, the problem will be easily resolved. If the action recommended by the troubleshooting guide does not correct the problem, or if recommended action is to contact ORE Offshore, Division Accusonic Technologies, Inc. technical assistance will be provided by the nearest office:

ORE Offshore
Div. Accusonic Technologies, Inc.
25 Bernard St. Jean Drive
Falmouth, Massachusetts 02536 USA
Phone: (508) 495-6600
Fax: (508) 495-6699
e-mail: sales@ore.com

ORE Offshore
Div. Accusonic Technologies, Inc.
10450 Stancliff, Suite 115
Houston, Texas 77099 USA
Phone: (281) 879-7277
Fax: (281) 879-9213
e-mail: sales@orehouston.com

NOTE: If possible, always start troubleshooting using the internal self test diagnostics in the 4410D. While this does not test the hydrophone, VRU/Amplifiers or cables, it does a complete checkout of the internal working of the CD/M, and is fully automatic once initiated.

Several of the troubleshooting steps refer to an "Air Test". This can be done in several ways, but the basic requirement is to gain access to the hydrophone so that a pinger, transponder or responder which is known to be good can be placed with it's transducer immediately adjacent to or touching the hydrophone. The range and particularly bearing data achieved with this test will not be meaningful. However, the audio output should be heard, and the display should update, albeit at a short range. (It may be necessary to reduce the minimum range parameter). In some cases, it is possible to separate the target from the hydrophone by several feet, in which case the displayed range should increase. Because the velocity of sound in air is about 4 times slower than water, 3-4 feet of separation should produce displayed ranges of 15 feet or so.

5.8 TROUBLESHOOTING GUIDE

NOTE: When troubleshooting and/or checking out the system, be aware that there are two basic system configurations possible.

In one case, the Model 4410D CD/M is connected to a Model 4610B Hydrophone via a Model 4110B Deck Cable.

In other configurations, the 4410D is connected by a 4110B deck cable to a Model 4740A Remote VRU/Amplifier, which, in turn is connected via an identical deck cable to a Model 4211A Hydrophone. In some cases, the cable lengths are changed and there may be additional junction boxes along the cable. However, the wiring is the same in all cases.

The combination of the 4211A and 4740A perform the identical functions as the 4610B hydrophone assembly, but they are physically separated so that the diameter of the hydrophone can be reduced to 3 inches for thru-hull installations, and the VRU/Amplifier can be located in a more optimum location nearer to the ships pitch/roll center. This is a more typical configuration for permanent installations in larger ships. A separate manual is provided for the thru-hull deployment system.

5.8.1 No Display

SYMPTOM	POSSIBLE CAUSES	ACTION
No display	No power.	Check power cable to monitor and fuse. (Fuse is located towards the right front corner of the monitor PC board.)
No display or unusable display	Video connector loose.	Check and reset connector.
	Graphics board loose.	Check connector between VGA board and CPU board.
	Loose boards/bad contacts.	Reseat all boards.
	Defective boards.	Replace CPU/VGA assembly.
	Dirty fan filter.	Clean fan filter & or CRT
		(see sections 5.1 & 5.2)
	Dirty CRT and or Filter/Screen	Clean CRT and Filter/Screen (see sections 5.1 & 5.2)
	Defective monitor.	Contact ORE.

5.8.2 No Keypad Response

SYMPTOM	POSSIBLE CAUSES	ACTION
No keypad response immediately after power-up.	Keypad cable or connector loose or defective.	Reseat connectors on keypad and CPU board.
	Defective keypad.	Contact ORE.

5.8.3 No Tracking

SYMPTOM	POSSIBLE CAUSES	ACTION
No LED, no audio, clock OK	No active sound source in water.	Try with known working beacon. Check Frequency settings.
	Faulty deck cable connections or water in connector.	Check connectors at Command/Display Module and hydrophone and/or remote VRU/Amplifier if so equipped.
	Hydrophone remote VRU/Amplifier or cable defective.	Substitute with spare.
No LED, some audio	Signal present, but not strong enough to be detected.	Use higher output (Source Pressure Level) beacon.
	Wrong frequency.	Check frequency of receiver and source.
	Threshold too high.	Lower THRESHOLD.
LED OK, audio OK, clock OK	Data very poor, rejected by main CPU. (E.C.#1)	Check acoustic conditions for excessive noise, multipath, etc.
	Target designated as responder or transponder when it should be a pinger.	Check and re-designate target type if necessary.
Any of above conditions, but clock NOT running	System shutdown due to excessive signal detects.	1. Power Down; select PREVIOUS SETUP. 2. Power Down; select DEFAULT SETUP.
	Defective CPU Board.	Replace board.
	Defective Signal Procesor Board.	Replace board.

5.8.4 Poor Operation

5.8.4.1 Pinger Mode

SYMPTOM	POSSIBLE CAUSES	ACTION
Erratic operation, unreliable bearings:		
LED OK, audio OK, screen updates coincide with LED and audio	Close multi-path interfering with original signal.	Examine geometry - is hydrophone too close to hull or other reflector (less than one meter)? Lower Threshold.
LED and audio indicate echoes, multiple screen updates	Strong multi-path occurring much later than original signal.	Check for reflectors that may be extending path length. Increase Threshold to reject smaller multi-path signals. Choose slower XMIT INTERVAL, to allow all echoes to fade before new ping occurs.
Multiple updates with no LED or audio, and no active sound source	Electrical interference causing false signal detection.	Shut down motors, radar and radio equipment in order to isolate the source.
Steady, reliable operation with consistently wrong bearings	Straight-line path shadowed; detecting a bounce.	Examine geometry of system in operation.
	Incorrect hydrophone offsets.	Set ALL offsets to zero to confirm that this is the problem, then carefully re-enter offsets.
No Audio, No Tracking, No Updates	Defective hydrophone assembly	Air test hydrophone with known good pinger. (See section 3.5.1 & 3.14)

SYMPTOM	POSSIBLE CAUSES	ACTION
Steady, reliable bearings, with erratic ranges	Outside cone: as the measured depression angle from the horizon nears zero, late range deteriorates rapidly. If the calculated depression angle is less than about 20 degrees, the displayed range is "- . -", and the slant range is three times the input depth. Between 20 and 45 degrees, the displayed range is "≈r", where "r" is the calculated range, but with some uncertainty.	
	If multi-path causes the calculated depression angle to move among the various cones, the displayed range will appear to be extremely erratic.	Raising the THRESHOLD may lessen the chance of detecting the multi-path signal and thereby improve performance.

5.8.4.2 Dual Pinger Tracking

SYMPTOM	POSSIBLE CAUSES	ACTION
See all of above, plus....		
Steady, reliable operation with occasional periods of no updating of one or both targets or targets swapping place	This occurs when the REP INTERVAL of the two pingers is such that the signals occasionally coincide with (walkover) each other. Depending on the relative REP INTERVAL, this can last for many seconds and occur with periods of tens of seconds to minutes.	Changing the REP INTER-VAL of one of the pingers may reduce this problem.

5.8.4.3 TranSponder/Responder Modes

SYMPTOM	POSSIBLE CAUSES	ACTION
Erratic, unreliable bearings:		
LED OK, audio OK, single update for each transmit	Shadowing (detecting a bounce instead of a direct signal.) Range may be steady but incorrect.	Examine geometry of system and hydrophone location.
LED OK, audio indicating echoes, multiple updates after first good LED and audio indication	Target designated as a BEACON. In transponder or responder mode, no detects or updates can occur between first valid signal and next transmit.	Check target configuration and re-designate if necessary.
	Excess transmitter power echoing from various reflectors.	Reduce transmitter power. (Move output plug on Transmitter module to "reduced output" position)
	If target is in transponder or responder mode and problem still occurs, Signal Processing Board (SPB) is defective.	Replace Sig. Processing Board (SPB).
Erratic bearings and ranges	Detect occurring before valid signal:	
	Responder feedback.	If in respond mode, increase PULSE WIDTH.
	Acoustic noise.	Raise THRESHOLD.
	Electrical interference.	Shut down all possible sources to confirm cause of problem.
No Audio, No Tracking, No Updates	Defective hydrophone or VRU/Amplifier	Air test with known good transponder, responder or pinger. (See sections 3.5.2 & 3.14.3)
	Defective cable	Check continuity of cable (s).
		Replace Hydrophone and/or VRU/Amp.
		Replace Cables.
Erratic ranges	Internal transmit and external input both on.	Use either internal transmit or external input. (To use external input, set EXT KEY IN.)

SYMPTOM	POSSIBLE CAUSES	ACTION
Bearing OK, range consistent, but incorrect.	Incorrect SPEED OF SOUND.	Correct SPEED OF SOUND.
	Incorrect TURNAROUND time.	Correct TURNAROUND time.
	TRANSMITTER REP INTERVAL too fast, detecting multipath from previous signal.	Use slower REP INTERVAL.
No signal, but transmit OK	Wrong TRANSMITTER frequency; transponder not hearing.	Enter correct FREQUENCY.
	PULSE WIDTH too short to activate transponder.	Enter correct PULSE WIDTH.
Transponder Mode: Minimum Range Error or detection occurs immediately following transmit interrogation (occurs without beacon or hydrophone in water)	The interrogation frequency or a harmonic* of the interrogation frequency is causing a false detection.	Check that this it the problem by changing the interrogation frequency.

*A harmonic is a multiple of the interrogation frequency. For example, the second harmonic of 17 kHz is 34 kHz and the third harmonic is 51 kHz. The symptom described above occurs if the second, third harmonic or even fourth harmonic is the frequency that the Trackpoint is either listening for or is 12 kHz above what it is listening for. For example, if the Trackpoint hydrophone is a 35 - 45 kHz unit, the transponder has a transmit frequency of 39 kHz and an interrogation frequency of 17 kHz, the 17 kHz transmission from the Trackpoint causes its receiver to detect following the output burst. This is because the third harmonic of 17 kHz is 51 kHz which is 12 kHz above the Trackpoint's listening frequency. The same symptom occurs if a 45 kHz transmit beacon has an interrogation frequency of 19 kHz. The third harmonic or multiple of 19 kHz is 57 kHz. This is 12 kHz above the Trackpoint's listening frequency of 45 kHz. Also avoid an xponder with a 18 kHz interrogate frequency and 24 kHz reply frequency.

5.8.5 No Transmit

SYMPTOM	POSSIBLE CAUSES	ACTION
No transmit LED	If TRANSMITTER parameters set correctly, then SPB is defective.	Replace SPB.
Transmit LED OK, but no sound from transmitter board inside C/DM (may need to remove cover to hear it)	Connector to transmitter board loose or defective.	Check connector and plug.
	Transmitter board defective board.	Replace transmitter
Transmit LED OK, but no sound from transmitting transducer.	Output plug on transmitter board defective or loose.	Check plug and/or wires.
	Cable defective.	Check continuity of cable.
	Transmitting transducer defective.	Contact ORE.

5.8.6 Miscellaneous

SYMPTOM	POSSIBLE CAUSES	ACTION
Changing target data has no effect on target.	Changing data for wrong target.	Verify that correct target is chosen. Check symbol at top of menu block.)
RS-232C problems	Incorrect parameters	Enter correct parameters.
	Loose RS-232C connector inside C/DM.	Reseat connector.
	Signals not on proper pins.	Use a breakout box* to determine which signals are operating. Try swapping pin connections according to Figure 3-20. Start by swapping pins 2 & 3 first, then 4 & 5, then 6 & 20. Refer to section 3.12.

* A breakout box is a device that monitors interface signals and allows signals to be enabled, disabled, crossed over (swapped), and bussed.

5.9 CUSTOM DEFAULT PARAMETERS

The operator can save a set of custom parameters for a specific application to non-volatile memory (FlashROM). The operator can either initialize using these parameters by selecting DEFAULT (f5) and then CUSTOM (f2) at the opening screen or set a jumper on the CPU to configure the unit to automatically boot-up using these custom set of parameters. Refer to section 3.1 for boot-up options.

5.9.2 SAVING of CUSTOM PARAMETERS

The CUSTOM parameters are saved in FlashROM which is located on the CPU Board. See Figure 5-2 for location of FlashROM (UJ1 and UK1). To initially setup the CUSTOM DEFAULTS, first bring the system up in the "ORE" DEFAULTS (f5, f3) so that the system parameters are at a known state (refer to Table of Data Ranges and Default Settings). Then set up the system for a particular application. Once the tracking configuration has been determined save the parameters to flashROM by pressing (from the main menu) f5 - SELF TEST, f3 - (no menu heading shown), then pressing 7 0 9 and ENTER. A message appears at the bottom of the tracking window stating "Current Setup Saved to FlashROM." (This may take a while). The flashROM can be written to up to 100,000 times and has a data retention of 10 years. If the data saved within the flashROM is corrupt or if no flashROM is installed the DEFAULT menu will only show f1 - PREVIOUS and f3 - DEFAULT, not allowing a choice for f2 - CUSTOM DEFAULT selection. See Figure 3-2B.

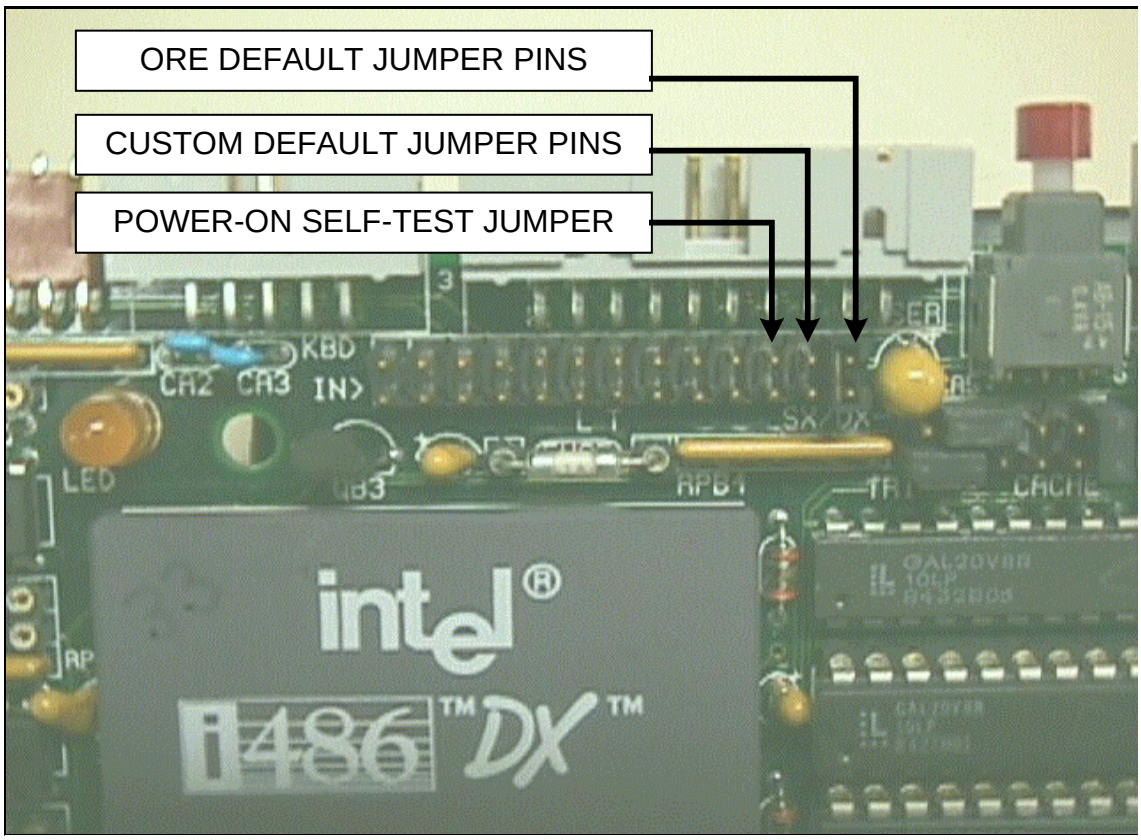
5.9.3 AUTO INITIALIZING

For the system to automatically initialize using either the CUSTOM DEFAULT parameters or the ORE DEFAULT parameters, a shorting jumper is inserted onto a set of pins on the Keybd "IN" connector located on the CPU board. If the jumper is set for CUSTOM DEFAULTS, the opening screen shows the ORE logo and a message stating that the system is "Loading Custom Defaults". See Figure 3-3A. The "IN" connector is located at the top left corner of the CPU board. It is a 26-pin header located just above the 486 CPU. See Figure 5-3. To have the system setup using the CUSTOM default parameters, (as saved by customer in flashROM) insert a jumper (P/N 531220-3) onto pins 23 and 24 of the Keybd "IN" header. It is also possible to have the system initialize using the "ORE" default parameters by inserting a jumper (P/N 531220-3) onto pins 25 and 26 instead of 23 & 24. If the jumper is set for "ORE" DEFAULTS, the opening screen shows the ORE logo and a message stating that the system is "Loading ORE Defaults".

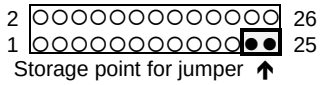
5.9.4 POWER-ON SELF-TEST

To have the C/DM initiate a self-test upon boot-up, place a shorting jumper on pins 21 and 22 of the KeyBd "IN" header. The C/DM boots-up using the parameters as configured (Previous, ORE Default or Custom) then performs a single Command Unit Self-Test. After completion of self-test the unit reverts to the tracking/menu screen. This jumper is exclusive of the Auto Initializing jumper and can be set independently of the jumper on pins 23 &24 or 26 &25.

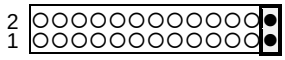
CUSTOM AND ORE DEFAULT JUMPER SETTINGS



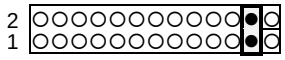
NORMAL JUMPER SETTING WHICH ALLOWS OPERATOR SELECTION OF PREVIOUS OR DEFAULT PARAMETERS



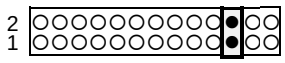
ORE DEFAULT JUMPER SETTING



CUSTOM DEFAULT JUMPER SETTING



POWER ON SELF-TEST JUMPER SETTING



KEYBD "IN" HEADER

Figure 5-3

APPENDIX A

TABLES

APPENDIX A

TABLE OF DATA RANGES, UNITS AND DEFAULT SETTINGS					
VARIABLE OR PARAMETER	LOWER LIMIT	UPPER LIMIT	UNITS	INCREMENTS	DEFAULT SETTING
DISPLAY					
GRID TYPE					RECTANGULAR
RECTANGULAR SCREEN	(Cartesian Coordinate)				
% X AXIS OFFSET	0	± 90	percent	1 percent	0%
% Y AXIS OFFSET	0	± 70	percent	1 percent	0%
GRID COLOR					BLUE
BACKGROUND					NORMAL
TARGET COLOR					RED
TEXT COLOR					GREEN
CENTER OBJECT					BOAT
SCALING UNITS					METERS
FULL SCALE	10	10,000	meters	1 meter	1000 METERS
	33	32,800	feet	1 foot	
	11	10,936	yards	1 yard	
GRID SPACING	(polar) 1/20th [1]	1/4th [2]	m, ft or yd	1 meter or	250 METERS
	(rect.) 1/20th [1]	1/3th [2]		1 foot	
STATUS FORMAT					BRG,HD,DPTH,TEL

NOTE 1: ... of full scale or 1m (3.3 ft) whichever is larger NOTE 2: ... of full scale

SYSTEM					
TRANSMITTER CONTROL					OFF-ON-INTERNAL
HYD X, Y, DEPTH OFFSETS	-1000	1000	meter	0.1 meter	0.0 METERS
	-3280.8	3280.8	feet	0.1 foot	
	-1093.6	1093.6	yards	0.1 yard	
HYDROPHONE ANALOG DEPTH OFFSET					
MINIMUM VOLTAGE	0.0	5.9	Volts	0.1V	0.0V
MAXIMUM VOLTAGE [3]	0.1	6.0	Volts	0.1V	5.0V

NOTE 3: Maximum Voltage must be > Minimum Voltage

VARIABLE OR PARAMETER	LOWER LIMIT	UPPER LIMIT	UNITS	INCREMENTS	DEFAULT SETTING
SYSTEM (continued)					
MINIMUM DEPTH	0.0	9,999.9	meters	0.1 meter	0.0 METERS
	0.0	32,799.9	feet	0.1 feet	
	0.0	10,935.9	yards	0.1 yard	
MAXIMUM DEPTH [4]	0.1	10,000	meters	0.1 meter	100 METERS
	0.1	32,800	feet	0.1 feet	
	0.1	10,936	yards	0.1 yard	
HYD BEARING OFFSET	-359.9	359.9	degrees	0.1 degree	0.0 DEG
VRU PITCH, ROLL OFFSET	± 0.01	± 45.00	degrees	0.01 degree	0.0 DEG
REMOTE VRU					
SCALE	0.01	10.00	volts/deg	0.01 v/deg	0.20 VOLTS/DEG
FUNCTION					LINEAR
BOW & PORT UP POL.					(+)
INVERT HYDROPHONE					OFF
ANTENNA X & Y OFFSET	-999.9	999.9	meter	0.1 meter	0.0 METERS
	-3280.5	3280.5	feet	0.1 foot	
	-1093.5	1093.5	yards	0.1 yard	
TIME/DATE					Current (EST)
ACOUSTIC DATA					
SPEED OF SOUND	1000	2000	m/sec	0.1 m/sec	1500 M/S
	3281	6561	ft/sec	0.1 ft/sec	
	1094	2187	yd/sec	0.1 yd/sec	
WATER TEMPERATURE	-4.0	40.0	degrees C	0.1° C	12.0°C
WATER SALINITY	0	40	ppt	1 ppt	35 ppt
COMPASS					OFF
MINIMUM VOLTAGE	0.0	5.9	Volts	0.1 V	0.0V
MAXIMUM VOLTAGE [3]	0.1	6.0	Volts	0.1 V	5.0V
BEARING OFFSET	-359.9	359.9	degrees	0.1 degree	0.0 DEG
RS-232 TGT DATA					NORTH REF.
NMEA INPUT FORMAT					“HDG”

NOTE 3: Maximum Voltage must be > than the min.voltage.
NOTE 4: Maximum Depth must be > Minimum depth

VARIABLE OR PARAMETER	LOWER LIMIT	UPPER LIMIT	UNITS	INCREMENTS	DEFAULT SETTING
SYSTEM (continued)					
PLOTTING					
PRIORITY TARGET					OFF
TRACK PLOTTING					OFF
TRACK LENGTH					255 POINTS
VESSEL LENGTH / WIDTH	0.0	500.0	meters	0.1 meters	0.0 METERS
	0.0	1640.4	feet	0.1 feet	
	0.0	546.8	yards	0.1 yards	
COM1 SETUP					
BAUD RATE	300	19200	bits/sec	0.5 bits/sec	9600 BAUD
DATA BITS	7	8	bits		8 DATA BITS
STOP BITS	1	2	bits		1 STOP BIT
COM2 SETUP					
BAUD RATE	300	19200	bits/sec	0.5 bits/sec	4800 BAUD
DATA BITS	7	8	bits		8 DATA BITS
STOP BITS	1	2	bits		1 STOP BIT
RS-232 OUTPUT					
TGT POS UNITS					METERS
TGT POS O/P FORMAT					STANDARD
COM1 O/P INTERVAL					2 SECONDS
COM1 DATA OUT					ON

TARGET					
TARGET CHOICE					FISH
REPLY FREQUENCY					(#; .9”, 1.4”, .62”, .5” sp)
(0.9” spacing)	22	30	kHz	0.5 kHz	#1; 23, 8, 31, 35
(1.4” spacing)	8	14	kHz	0.5 kHz	#2; 25, 9, 32, 36
(0.62” spacing)	31	37	kHz	0.5 kHz	#3; 27, 9.5, 33, 37
(0.5” spacing)	35	45	kHz	0.5 kHz	#4; 29, 10.5, 34, 38
					#5; 30, 11, 35, 39
					#6; 22, 12,, 36, 40

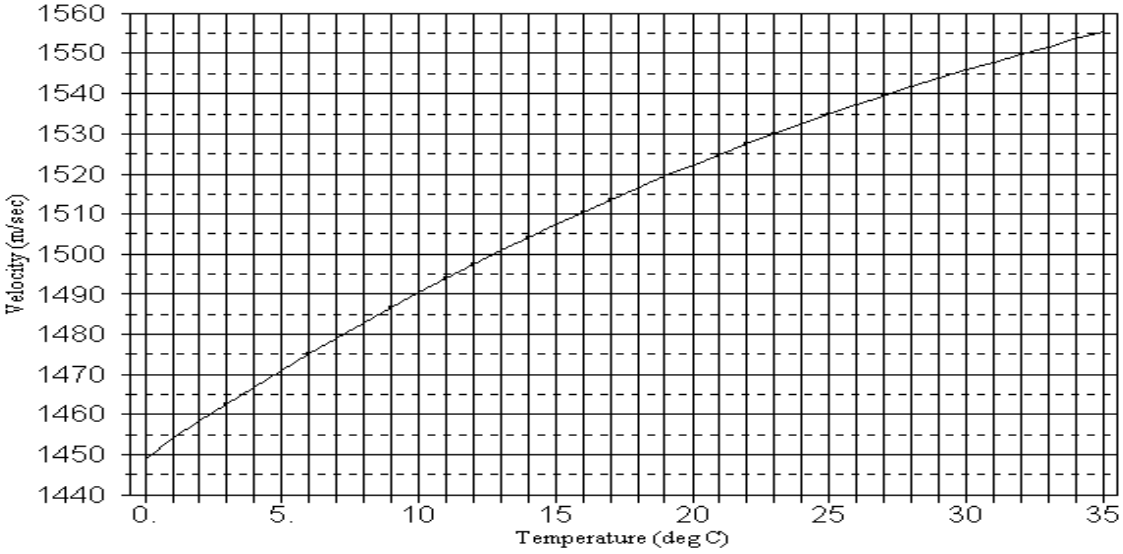
					#7; 24, 12.5, 37, 41
					#8; 26, 13.5, 31, 42
					#9; 28, 14, 32, 43
VARIABLE OR PARAMETER	LOWER LIMIT	UPPER LIMIT	UNITS	INCREMENTS	DEFAULT SETTING
TARGET(continued)					
TARGET TYPE (1-9)					TRANSPONDER
TURN-AROUND-TIME	0	125.0	milliseconds	0.1 ms	15 MS
ARTIFICIAL TARGET					OFF
FISH TRACK MODE					OFF
TARGET DEPTH					MANUAL
ANALOG DEPTH					OFF
MINIMUM VOLTAGE	0.0	5.9	Volts	0.1 Volts	0.0 VOLTS
MAXIMUM VOLTAGE [3]	0.1	6.0	Volts	0.1 Volts	5.0 VOLTS
MINIMUM DEPTH	0.0	9,999.9	meters	0.1 meter	0.0 METERS
	0.0	32,799.9	feet	0.1 feet	
	0.0	10,935.9	yards	0.1 yards	
MAXIMUM DEPTH [4]	0.1	10,000.0	meters	0.1 meter	100 METERS
	0.1	32,800.0	feet	0.1 feet	
	0.1	10,936.0	yards	0.1 yards	
LAST POSITION					OFF
TELEMETRY					OFF
FREQUENCY					SEE NOTE 5
ZERO DELAY	50	500	milliseconds	1 ms	100 MS
FULL SCALE DELAY	500	1500	milliseconds	1 ms	1000 MS
SPAN	1	5000	Units	1 Unit	1000 UNITS [6]
TRACKING					OFF
INTERROGATE DATA					
FREQUENCY	4.5	30.0	kHz	0.5 kHz	Rply Frq 23, Int =17
					Rply Frq 25, Int = 19
					Rply Frq 27, Int =17
					Rply Frq 29, Int =19
					Rply Frq 30, Int =17
					Rply Frq 24, Int =17
					Rply Frq 26, Int =19,
					Rply Frq 28, Int =19

NOTE 3: Maximum Voltage must be > than the min.voltage.
NOTE 4: Maximum Depth must be > Minimum depth
NOTE 5: The Telemetry Frequency is set to 1 kHz lower than the reply frequency.
NOTE 6: Units are whatever telemetry gauge is calibrated to. E.g., depth- meters, temp- degrees, heading- degrees, etc..

VARIABLE OR PARAMETER	LOWER LIMIT	UPPER LIMIT	UNITS	INCREMENTS	DEFAULT SETTING
TARGET(continued)					
XMIT INTERVAL	1.0	20.0	Seconds	0.1 seconds	2.0 SECONDS
PULSE WIDTH	1.0	15.0	milliseconds	0.1 ms	5.0 MS
TARGET ALARMS					OFF
SLANT RANGE	0	10,000	Meters	1 Meter	0.0 METERS
	0	32,808	Feet	1 Ft	
	0	10,936	Yards	1 Yard	
BEARING	0.0	359.9	degrees	0.1 Degrees	0.0 to 0.0 DEGREES
DEPTH	0	10,000	Meters	1 Meter	0.0 METERS
	0	32,808	Feet	1 Ft	
	0	10,936	Yards	1 Yard	
ELAPSED TIME	0	480	minutes	1 Minute	0 MINUTES

FILTERING					
SMOOTHING					5
FILTER LEVEL					6
THRESHOLD					LOW
QF FILTERING					ON
LIMITS					
MIN XPONDER RNG	0.0	1,000.0	Meters	0.1 Meters	1.0 METER
	0.0	3,280.0	Feet	0.1 Feet	
	0.0	1,093.3	Yards	0.1 Yards	
MAX SLANT RNG	0.0 = OFF	8000.0	Meters	0.1 Meters	0.0 METERS = OFF
	0.0	26,246.7	Feet	0.1 Feet	
	0.0	8748.9	Yards	0.1 Yards	
BEARING LIMITS	0.0	359.9	Degrees	0.1 Degrees	0.0 to 0.0 DEG

Sound Velocity



Variation of SALINITY	
ppt	m/sec
1	-47.2
3	-44.1
5	-41.0
7	-37.9
9	-34.9
11	-31.9
13	-29.0
15	-26.1
17	-23.3
19	-20.5
21	-17.8
23	-15.1
25	-12.5
27	-9.9
31	-7.3
33	-4.8
35	-2.4
37	0
39	+2.4
41	+4.6
43	+6.9
45	

Variation of DEPTH	
meters	m/sec
0	+0
50	+0.8
100	+1.6
200	+3.2
300	+4.9
400	+6.5
500	+8.1
1000	+16.3

The calculation of Sound Velocity is from the following equation*:

$$C = 1449.2 + 4.67T - 0.0569T^2 + 0.00029T^3 + (1.39 - 0.012T) * (S - 35) + 0.01625D$$

Where C = Sound Velocity in meters/second
T = Water Temperature in degrees cent.
S = Water Salinity in parts per thousand
D = Water Depth in meters

* Urich R.J.: Principles of Underwater Sound

APPENDIX B

PARTS LIST

APPENDIX C

DIAGRAMS AND SCHEMATICS

APPENDIX D

WARRANTY

Warranty Statement

On standard catalogue products, ORE Offshore warrants the products delivered under this contract to be free from defects in material and workmanship at the time of delivery to the EXW point specified in this order, its liability under this warranty being limited to repairing or replacing, at ORE Offshore's option, items which are returned to it prepaid within twelve (12) months from delivery to the BUYER and found to ORE Offshore's satisfaction, to have been so defective. On services, ORE Offshore warrants that all work performed by its employees will be done in a workmanlike manner, ORE Offshore's liability under this warranty is limited to remedying at its expense any work found to ORE Offshore's satisfaction not so performed, provided however, ORE Offshore is notified of any claims within three (3) months from the date work is performed. Any products manufactured by others and resold by ORE Offshore shall bear the warranty of the original manufacturer, to the extent that such warranties may be legally transferred, assigned and passed on to BUYER. ORE Offshore assumes no responsibility for the performance of products manufactured to BUYER's design or specification, nor for defects in raw material, parts, or subassemblies furnished by BUYER or his agents.

This warranty is in lieu of, and excludes any other warranties, whether statutory, expressed or implied, and the goods are accepted by BUYER with that understanding. ORE Offshore MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND SPECIFICALLY, ORE OFFSHORE MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ORE Offshore's liability on any claim of any kind, including negligence, for loss or damages arising out of, connected with or resulting from this AGREEMENT, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair or use of any GOODS or services covered by or furnished under this AGREEMENT shall in no case exceed the price allocable to the item or service or part thereof which gives rise to the claim. In the event ORE Offshore fails to manufacture or deliver GOODS required to be manufactured or delivered hereunder, or manufactures such GOODS in a defective manner, ORE Offshore's exclusive liability and BUYER's exclusive remedy whether at law or in equity shall be the release of BUYER from the obligation to pay the purchase price. Any product or service repaired or replaced under this warranty shall be warranted for the unexpired portion of the original warranty period only.

IN NO EVENT SHALL ORE OFFSHORE BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Incoming Inspection

If shipment is incomplete or has been visibly damaged in transit, have the transportation agent note the complaint on the freight bill. If damage is not discovered until the carton is opened call the Transportation Company and request an inspection by the carrier or their agent for concealed damage. This must be done within 15 days. Do not destroy carton or packing until inspected.

Damage Claims

File all claims against CARRIER enclosing proper documentation. In accordance with I.C.C. regulations, it is the responsibility of the CONSIGNEE to file the claim if shipment is made EXWorks point of origin. Factory responsibility CEASES when carrier accepts the merchandise in good order, and title to the merchandise passes to the consignee.

Returning Goods

No returns will be accepted unless prior authorization has been received from Seller and an ORE Offshore, Return Merchandise Authorization (RMA) Number has been assigned.

Return Shipment

Store the packing crate and its packing material in a dry place for reshipment or future storage. Make sure when replacing unit that it is kept from shifting inside the box.

ORE Offshore
4 Little Brook Road P.O. Box 848
West Wareham, Massachusetts 02576 USA
Phone: (508) 291-0960
Fax: (508) 291-0975
Email: info@ore.com

APPENDIX E

CARE OF CABLES

CARE OF CABLES

Refer to caution below for disassembly of underwater cable connections.

> C A U T I O N
>
> Whenever underwater connectors are disassembled, or pressure cases opened, water is drawn into the cavity formed by the separating parts. This water, particularly salt water, enters as a fine spray and coats the electrical contacts and other parts inside. It is extremely important to minimize this buildup of moisture and salt, as it causes corrosion and voltage breakdown, particularly on power leads which have high voltages present. Therefore a thorough cleaning is required, preferably immediately after opening the parts. It is also helpful to rinse in fresh water and remove excess water from parts prior to opening.

NOTES FOR PROPER CARE OF UNDERWATER CABLES:

DO	Lubricate connectors before mating.
DO	Keep cables free from dirt and salt.
DO	Secure cables with tie wraps or tape so they won't work free.
DO	Route cables where they won't get pinched or crushed by deployment or moving machinery.
DO	Periodically clean cable contacts with a cleaner/degreaser. Lubricate with clean lubricant after cleaning.
DO	Check cables with a VOM & megger periodically for electrical integrity.
DON'T	Walk on cables.
DON'T	Bend cables near the connectors.
DON'T	Use damaged cables with bad or questionable contacts. They will damage their mating half.
DON'T	Hang things on cables.
DON'T	Use cables for towing or pulling.
DON'T	Bend the connectors when mating or disconnecting.
DON'T	Clean cables with light hydrocarbon solvents (i.e. acetone, lacquer thinner, paint thinner).