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OPERATION AND MAINTENANCE MANUAL

FOR THE EDGETECH

USBL BROADBAND ACOUSTIC TRACKING SYSTEM (BATS)

(Includes Desktop Models 4460C, 4213C-B and 4113C-DT

And Portable Models 4461C, 4213C-B and 4113C)

EdgeTech, 4 Little Brook Road, West Wareham, MA 02576 USA

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Record BATS Configuration Data

BATS Transceiver Model: _____S/N: _____ Hydrophone Model: _____S/N: _____

(Frequency Band: 8-16kHz [_____]; 17-30kHz [_____]; Other _____)

Deck Cable Model: _____ Length: _____

Beacon Model: _____ S/N: _____ Rcv Freq: _____ Xmt Freq: _____ or Xmt Code: _____

Beacon Model: _____ S/N: _____ Rcv Freq: _____ Xmt Freq: _____ or Xmt Code: _____

Beacon Model: _____ S/N: _____ Rcv Freq: _____ Xmt Freq: _____ or Xmt Code: _____

Beacon Model: _____ S/N: _____ Rcv Freq: _____ Xmt Freq: _____ or Xmt Code: _____

Beacon Model: _____ S/N: _____ Rcv Freq: _____ Xmt Freq: _____ or Xmt Code: _____

Beacon Model: _____ S/N: _____ Rcv Freq: _____ Xmt Freq: _____ or Xmt Code: _____

Beacon Model: _____ S/N: _____ Rcv Freq: _____ Xmt Freq: _____ or Xmt Code: _____

Beacon Model: _____ S/N: _____ Rcv Freq: _____ Xmt Freq: _____ or Xmt Code: _____

IP Address of the Transceiver: 192.168.3.9 or _____ . _____ . _____ . _____

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GLOSSARY OF TERMS

NAME	DESCRIPTION
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.)
BATS	Stand for **B**roadband **A**coustic **T**racking **S**ystem. EdgeTech's Model 4460C or 4461C USBL Tracking System. A Spread Spectrum, high accuracy, USBL Tracking System. For survey quality underwater navigation.
Beacon	Any underwater sound source. Sometimes abbreviated as "BCN".
Bearing	Typically used when referencing target position with respect to local coordinates, for example with respect to the hydrophone or vessel bow.
Broadband	A signaling method in which the frequency is spread across a wider band. This would typically provide for higher data rates in communications but in the case of the BATS provides for improved detection and higher noise rejection.
Consecutive Tracking	Tracking of more than one target by alternating (cycling through) the interrogation signals between all of the targets.
Depression Angle	The downward angle measured from the plane of the hydrophone receive elements to the target. (0 deg. to 90 deg.)
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.
IPS	IPS is a Windows® based program that interfaces to DGPS and Trackman for lat/long positioning. (**I**ntegrated **P**ositioning **S**ystem)
Pinger	An underwater sound source which transmits at a fixed preset rate, asynchronously to a tracking device. (Not available on BATS.)
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".
Simultaneous Tracking	Ability to track more than one target at the same time, either by triggering synchronously or asynchronously as long as the replies do not arrive at the

	hydrophone at the same time.
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 BATS 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.
Trackman	EdgeTech's Windows® based USBL Interface Software. Communicates with the BATS Transceiver to allow modification of the target & system parameters and also outputting of processed data to Navigation packages.
TrackPoint 3	EdgeTech's Model 4450A 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 opposed 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** * * * * * * * * * * *

NOTE: 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

The Model 4460C has the same features and functions as the 4460B but internally has a new CPU and IDE interface. These new components allow for faster data processing with reduced stress on the internal CPU.

1. GENERAL INFORMATION

The EdgeTech Broadband Acoustic Tracking System (BATS) is an Ultra Short BaseLine (USBL) underwater tracking/navigation system. The O EdgeTech BATS consists of a hull mounted Transducer (Model 4213C-B), that is both a listening Hydrophone and an Interrogator, a Deck Cable (Model 4113C), Transceiver (Model 4460C) and a PC (Customer or EdgeTech Supplied).

For a complete system from EdgeTech the BATS topside electronics are available in a 19-inch rack type enclosure[1]. It consists of three 2U rack modules in a 6U Equipment Case containing the Transceiver (Model 4460B), the Rack Mount PC (running Windows) (Model 4451A) and a Keyboard/Display (Model 4452A). See Figures 1-1 and 1-2. The Transceiver is also available as a Desk Top version (a 3.5 inch high chassis, 2U rack height), with a Laptop PC (EdgeTech or Customer supplied). Another configuration of the BATS is a Portable version (Model 4461A) with a Laptop PC (EdgeTech or Customer supplied). The Human Machine Interface (HMI) software (installed on the PC) is called "Trackman".

Transceiver

The Transceiver, Model 4460C, is the heart of the BATS. It is an integrated, **U**ltra-**S**hort **B**ase**L**ine (USBL) acoustic signal processor designed to operate with up to four targets for a wide range of subsea navigation and relocation tasks. It is contained in a 2U rack mount chassis and interfaces to the Hydrophone/Interrogator and also the PC (running Windows software). The Transceiver Module contains a receiver, digitizer and CPU along with a data acquisition module for external interface to NMEA and analog sensors. It also contains the transmitter and power supplies. The Transceiver receives signals **from** the Transducer's three element listening array (Hydrophone) and also Transmits signals **to** its interrogation element.

The Transceiver interfaces to the EdgeTech USBL Hydrophone Model 4213C-B via its deck cable Model 4113C. The Transceiver receives the signals from the Transducer and sends the raw data to the PC for calculation of target position. The target types consist of transponders or responders (Beacons).

Transducer (Hydrophone/Interrogator)

The Transducer, Model 4213C-B, is 2.875 inches (7.3cm) diameter by 17.53 inches (44.53cm) in length and is calibrated in the 17 to 30kHz frequency band for the receiver and tuned to 15 to 23kHz for the transmitter. The Model 4213C-B-LF is the same size but is calibrated in the 8 to

[1] * The 19-inch rack is a standard from EIA 310-D, IEC 60297 and DIN 41494 SC48D. One "Unit" in a rack is 1.75 inches tall, 2U is 3.50 inches etc. The 19-inches refers to the rack width.

16kHz frequency band for the receiver and tuned to 12 to 17kHz for the transmitter. For the 4213C-B-V1634, which is larger (4.5 inches diameter X 17.5" Long) and has a lower frequency interrogation element , the transmission is tuned in the 10-14kHz band.

Keyboard/Mouse and Display

The **Keyboard & LCD Monitor** (Model 4452A) are an integrated unit packaged in a 2U (3.5 inch height) rack mount chassis. The LCD monitor and Keyboard are on rack slides which lock in the out position. The LCD monitor is on friction hinges and can be positioned at any angle. The Keyboard/Mouse provide user interface to the Trackman program.

Computer

The **Rack Mount PC** (Model 4451A) is a 2U chassis containing a P4 Processor (minimum), Windows® XP operating system and the Trackman (Human-Machine Interface, (HMI)) software. The "Trackman" software is EdgeTech's Windows® based USBL user-interface software. Trackman communicates with the BATS' USBL Processor Module to allow modification of the target & system parameters and also outputting of processed USBL data to Navigation software such as the EdgeTech IPS software. The PC (Model 4451A) communicates with the USBL Processor Module (Model 4460B) via its Ethernet port. The PC sends commands / parameter setup data **to** the USBL Processor Module and receives raw beacon-position data **from** the USBL Processor Module. The PC sends formatted beacon position data out its RS232 ports to interface to a Navigation System or the case of the IPS software it can connect internally via an IP address and port#.

Trackman Software

The "Trackman" software is EdgeTech's Windows® based USBL user-interface software. Trackman communicates with the BATS' USBL Processor Module to allow modification of the target & system parameters and also outputting of processed USBL data to Navigation software such as the EdgeTech IPS software.

IPS Software

The IPS software integrates the USBL data and the DGPS data to display and output tracked target data relative to Latitude and longitude. The IPS is a Windows® based software and can be installed on the same PC as the Trackman software.

Compatibility with older Trackpoint Systems

Beacons - The BATS can track the older Legacy beacons but with no improvement in range or accuracy from the older Trackpoint systems.

Hydrophone & Amplifier/VRU Model 4211A & 4740A from TP2 or 3 – Requires re-calibration of Hydrophone and modification to the 4740A Amplifier/VRU. Can use same Deck Cables, Model 4110B. (Contact EdgeTech for more information.)

Hydrophone Model 4213C from TP3P - Requires re-calibration of Hydrophone. Can use same Deck Cable, Model 4113C.

Hydrophone Model 4610B – Not Compatible.

Beacons

The Model 4370A series of beacons are compatible with the BATS. They can be configured for Transponder or Responder operation. They typically output a 10ms discrete chirp signal. This means that the composite signal is made up of a series of discrete frequencies.

External Sensors

The EdgeTech MRU (Motion Reference Unit) Model 4760B provides dynamic pitch and roll compensation for the BATS.

1.1 LIST OF TYPICAL BATS EQUIPMENT

A typical Rack Mount BATS consists of the following equipment. See Figure 1-3.

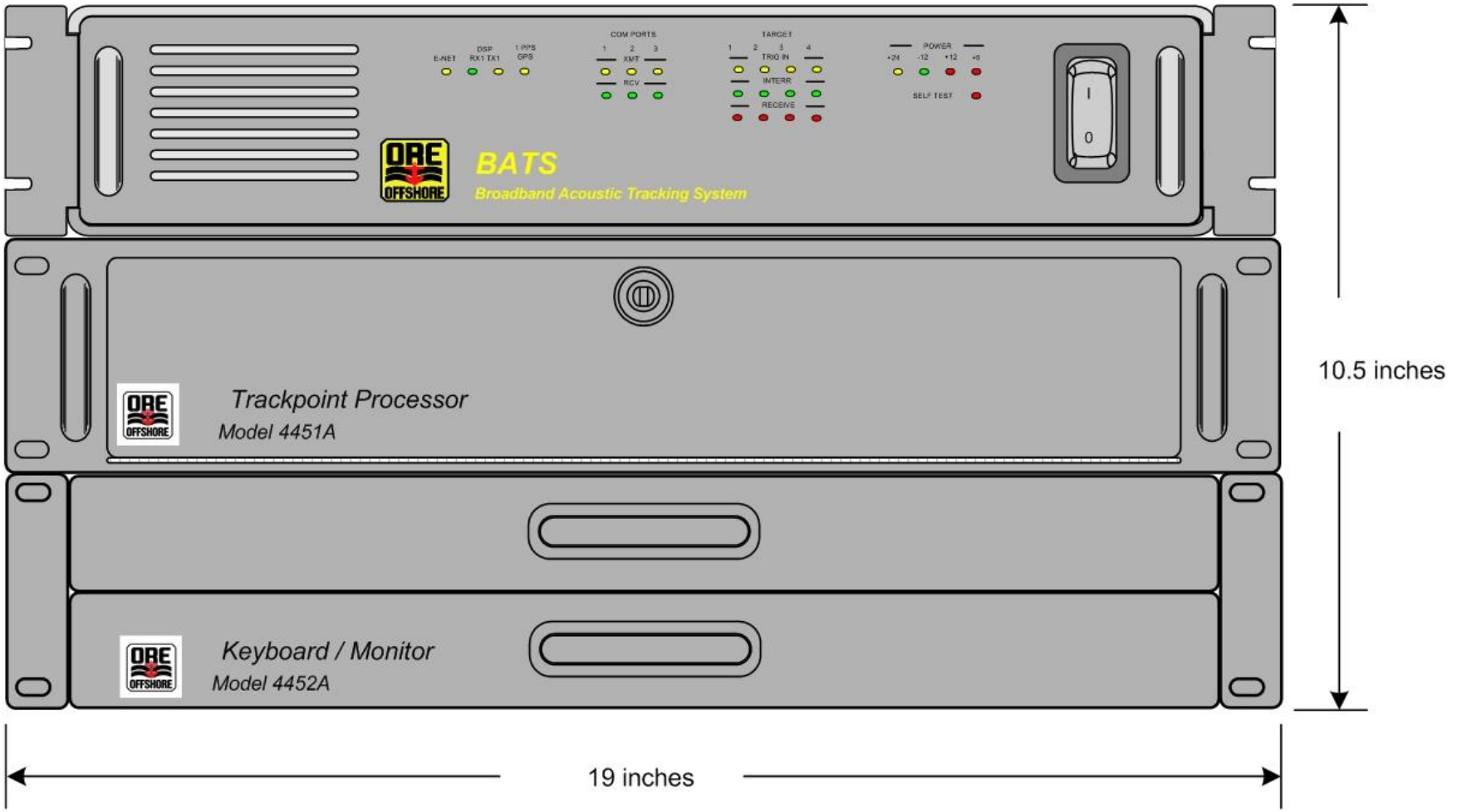
ITEM	PART NUMBER	DESCRIPTION	QTY
Shipboard:			
1.	0003222	(1) MODEL 4460C BATS USBL TRANSCEIVER MODULE (1) MODEL 4451A PC (1) MODEL 4452A KEYBOARD/LCD MONITOR (1) RACK ENCLOSURE	1
2.	0007978	MODEL 4213C-B HYDROPHONE (17-30 kHz)	1
3.	0002935	MODEL 4113C-DT DECK CABLE	1
4.	0009638	MOTION REFERENCE UNIT	1
Subsea:			
5.	0009612	MODEL 4370A MULTIBEACON	1
6.	0007968	MODEL 4324C CHARGER	1

or… System configured as a desk top unit with customer furnished Laptop or PC. See Figure 1-4.

ITEM	PART NUMBER	DESCRIPTION	QTY
Shipboard:			
1.	0003221	(1) MODEL 4460C BATS USBL PROCESSOR MODULE	1
2.	0007978	MODEL 4213C-B HYDROPHONE (17-30 kHz)	1
3.	0002935	MODEL 4113C-DT DECK CABLE	1
4.	0009638	MOTION REFERENCE UNIT	1
Subsea:			
5.	0009612	MODEL 4370A MULTIBEACON	1
6.	0007968	MODEL 4324C CHARGER	1

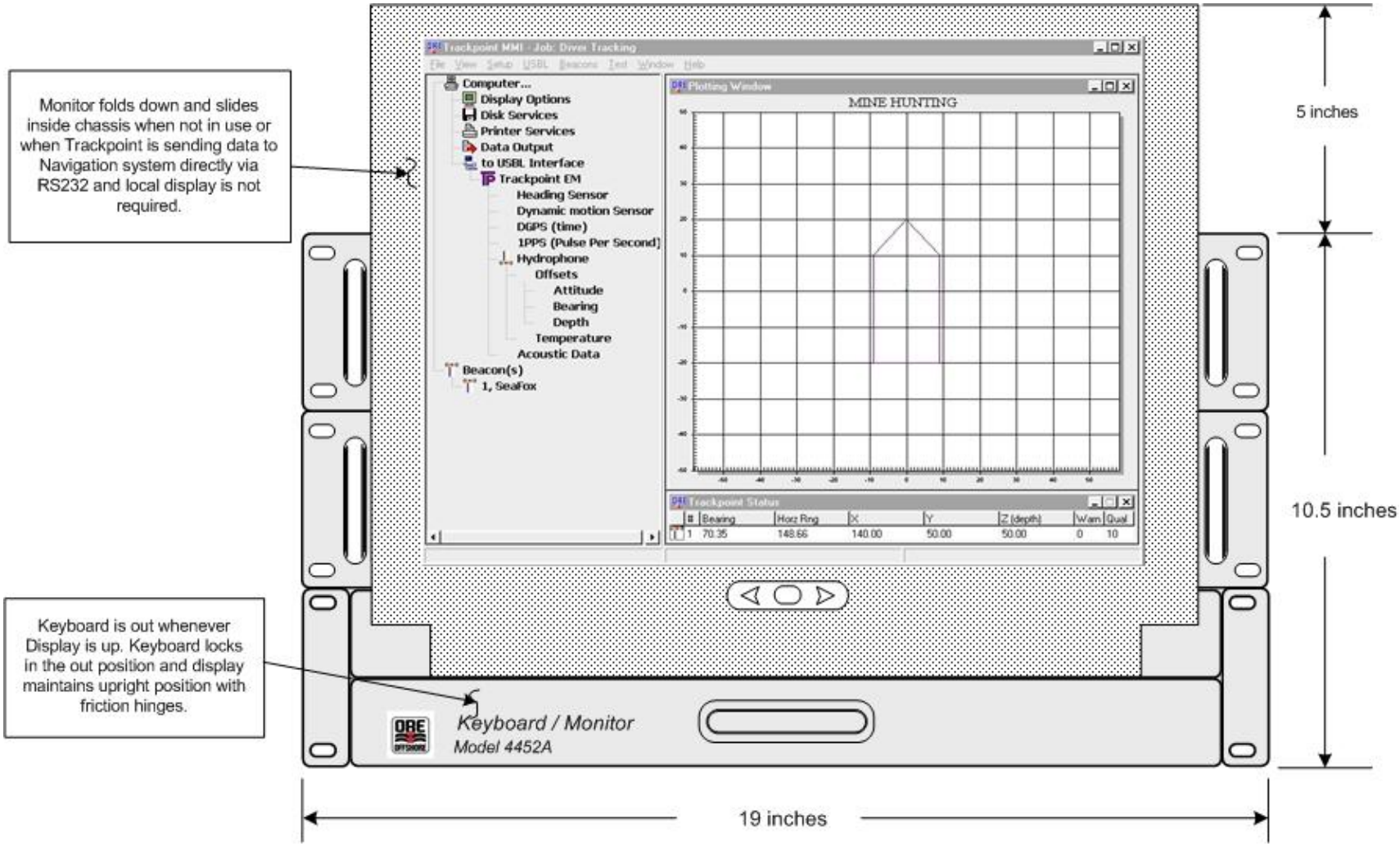
or… Portable System with customer furnished Laptop or PC. See Figure 1-5.

ITEM	PART NUMBER	DESCRIPTION	QTY
Shipboard:			
1.	0003223	(1) MODEL 4461A PORTABLE BATS TRANSCEIVER	1
2.	0007978	MODEL 4213C-B HYDROPHONE (17-30 kHz)	1
3.	0002935	MODEL 4113C DECK CABLE	1
4.	0009638	MOTION REFERENCE UNIT	1
Subsea:			
5.	0009612	MODEL 4370A MULTIBEACON	1
6.	0007968	MODEL 4324C CHARGER	1



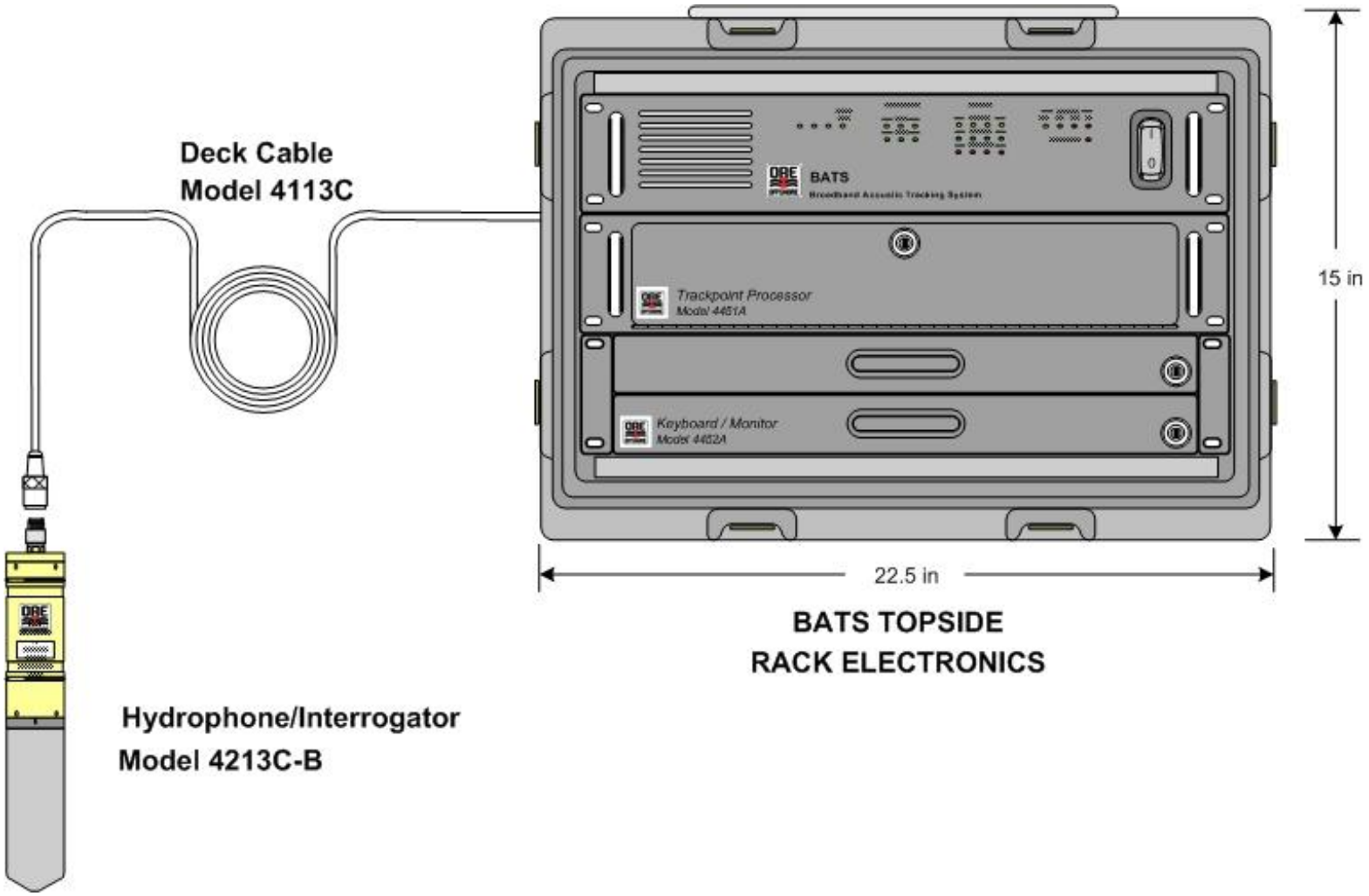
BATS CONSOLE - FRONT VIEW

FIGURE 1-1



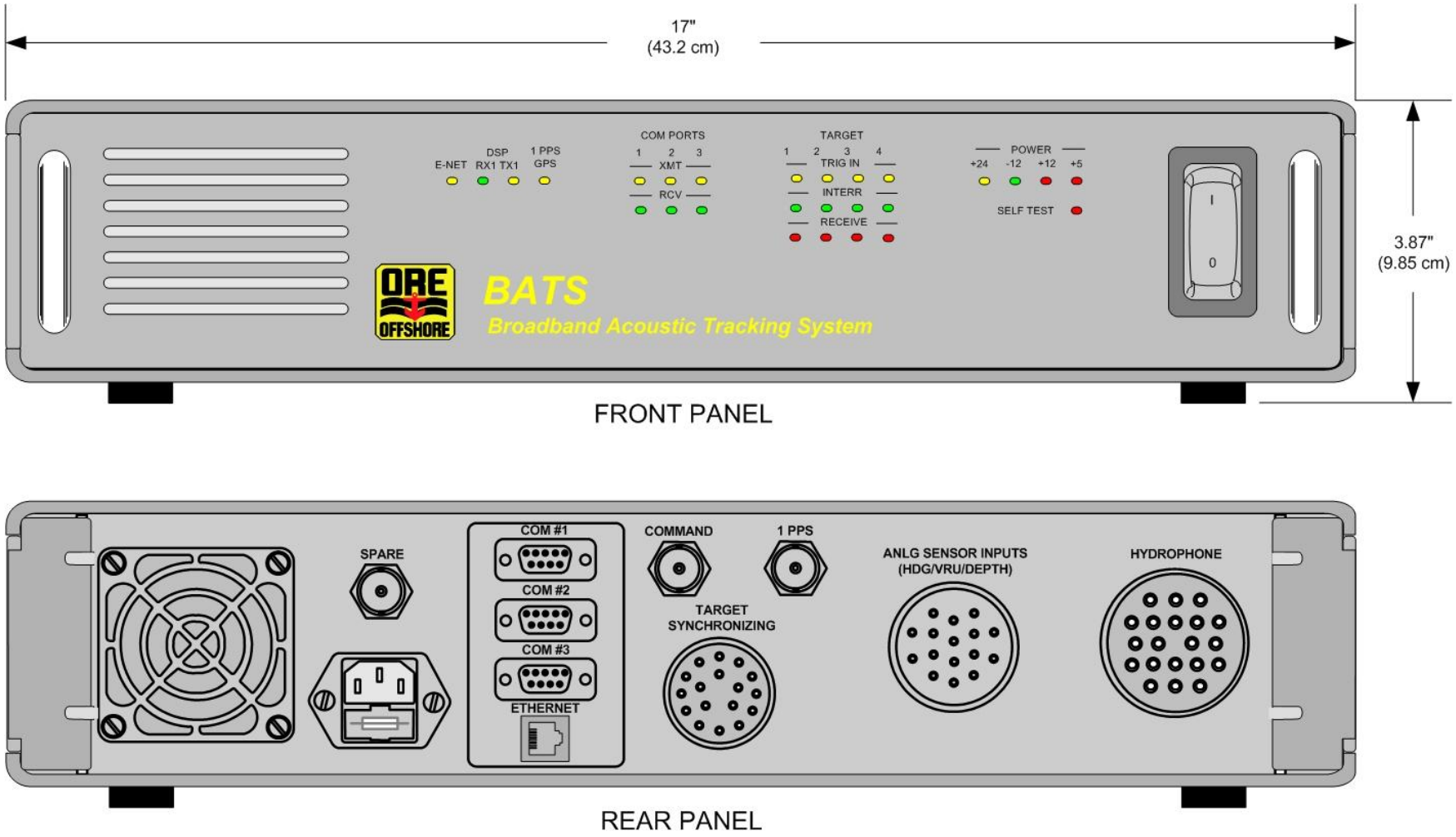
BATS CONSOLE, VIEW WHEN IN OPERATION

FIGURE 1-2



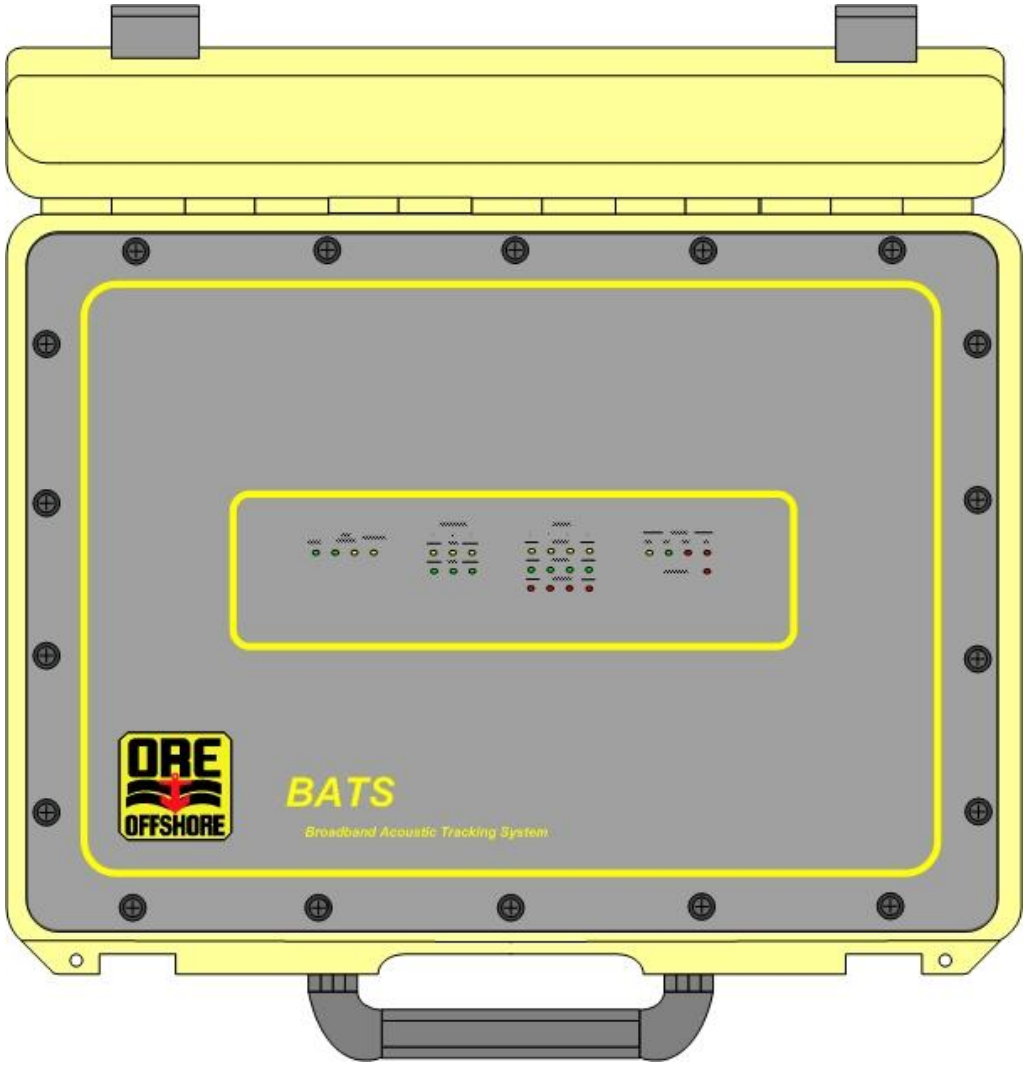
BATS COMPONENTS

FIGURE 1-3



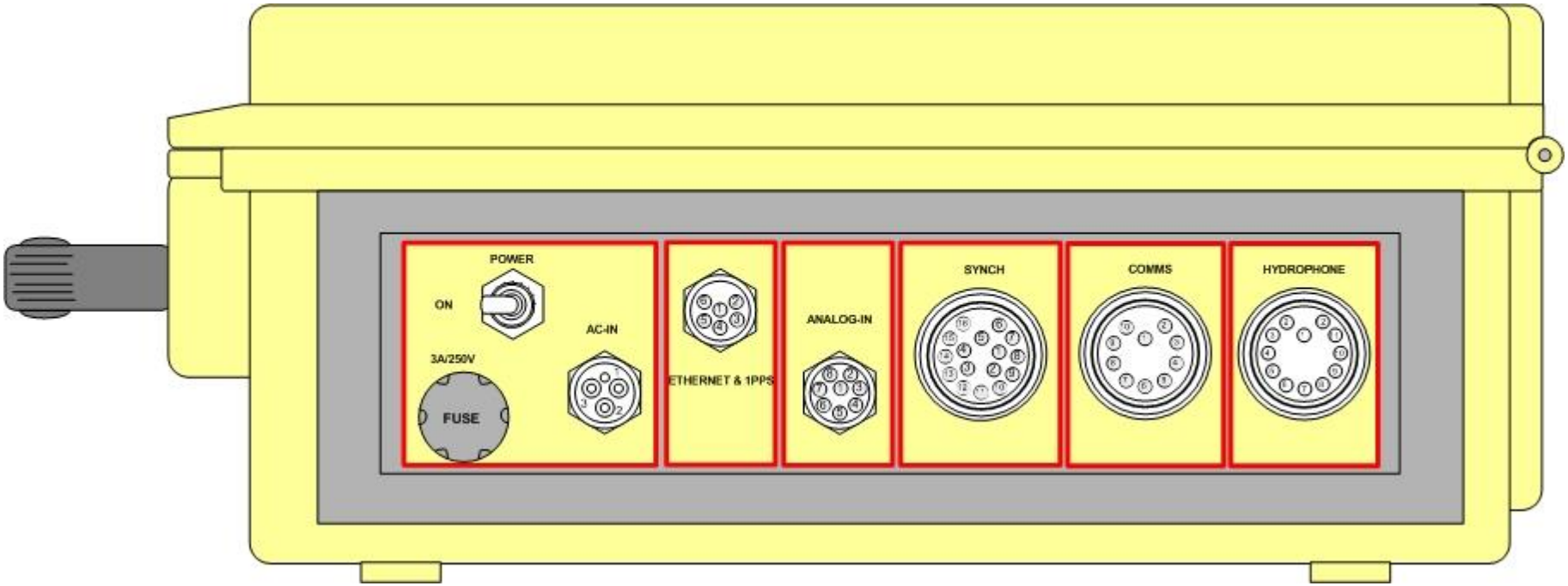
BATS DESKTOP CONFIGURATION: FRONT & REAR VIEW

FIGURE 1-4



PORTABLE BATS TRANSCEIVER

FIGURE 1-5



PORTABLE BATS TRANSCEIVER SIDE PANEL

FIGURE 1-6

1.2 DESK TOP SYSTEM SPECIFICATIONS

BATS DESK TOP OR RACK MOUNT SPECIFICATIONS	
SYSTEM ACCURACY	**SPECIFICATION**
Transponder/Responder - Absolute Accuracy in Horizontal Position (over entire hemisphere)	± 0.5% RMS of Slant Range (Does not include motion.)
Repeatability Accuracy	± 0.25% RMS of Slant Range
Angular Resolution	0.08°
Slant Range Accuracy	± 0.3 meter RMS (assuming correct speed of sound)
Slant Range Resolution	0.1 meter
RECEIVE SIGNAL SPEC	
Frequency	MF Range; 17-30kHz or LF Range; 8-16kHz
Signal Coding Structure	Various ➡ CW, Chirp (linear), Chirp (stepped or discrete tones), PSK Phase Shift Keying), M-FSK (Multiple - Frequency Shift keying) , (Hydroid's REMUS (codes 1-4)
Signal to Noise Ratio required	Typically >20dB (in 17-30kHz band or 8-16kHz band)
TRANSCEIVER MODULE	**MODEL 4460C (19" Rack Mount)**
Processor(s)	mPGA 478 Socket, Intel Celeron M/Pentium M processor w/ FSB400MHz
RS232 Ports	3 - COM1: GPS Time, COM 2 & 3: P/R & Compass
Chassis	2U rack Height, Black
Dimensions	W 18.9" (48 cm) x H 3.46" (8.8 cm) x D 20" (50.8 cm)
Weight	21 lbs
Power	115/230 VAC, 60 W
Sub-assemblies	DSP, Target Acquisition Module, Peripheral Interface Card, Transmitter, SBC, IDE, A2D & Power Supply
Sequential Tracking	Up to 4 Targets
DIFF KEY INPUT – RESPONDER (4)	
Via rear panel Synchronization connector	Accepts single ended or differential signal input to an opto-coupler. pulse widths min = 200 micro-seconds pulse width max = up to the width of the transmit-out burst

TRIGGER OUT	
Via rear panel Synchronization connector	Sync for Responder operation; Differential Output (0-5VDC) Either side can be used as a positive or negative TTL pulse when used with GND.
ANALOG INPUTS	
Analog Voltage input for Depth	Uni-polar 0-6VDC
Analog Voltage input for Compass	Uni-polar 0-6VDC
Analog Voltage input for Pitch & Roll	±10VDC input
Absolute Accuracy (±10VDC, -10° to 50°C)	0.27%
Resolution of A/D Converter	A/D converter = 16-bits
RS-232 PORTS	
Comport #1	GPS Time Input – ZDA or GGA
Comport #2	Compass Input, typically
Comport #3	Pitch/Roll Input, typically
1-PPS INPUT	
Via rear panel BNC	Accepts a 1-PPS trigger from GPS; Opto-coupler input. Requires ZDA and GGA input also.
ETHERNET	
Via Rear Panel Connector	Provides communications with PC (Data & Commands)
TRANSMITTER SPECS	
Frequency	MF: 15-23kHz, LF: 13-17kHz
Pulse Width	1-15ms in 0.1 ms increments
Repetition Rate	0.5 to 60 seconds
Signal Coding Structure	Various – CW, Chirp (linear), PSK, FSK, REMUS (codes 1-4)
Output Power	100 or 400 Watts into 300Ω Load
Sound Pressure Level (Hydrophone Interrogator)	MF: 17-20kHz, @ 400W - Nominal 192dB re 1μPa @ 1m LF: 13-17kHz, @ 400W - Nominal 192dB re 1μPa @ 1m
HYDROPHONE/INTERROGATOR	**MODEL 4213C-B**
Diameter	2.9 inches (7.4 cm)
Height	19.4 inches (49.3 cm)
Weight	10 lbs (4.5kg)

Temperature Rating	Operating: -4° to 40° C Storage: -40° to 70° C
Frequency	MF: 17-30kHz or LF: 8-16kHz
DECK CABLE	**MODEL 4113C-DT**
Length	50ft (15m) or 100ft (30m)
Diameter	Dry End: 2.35 in (6cm) Wet End: 1.38 in (3.5cm)
Weight	50ft - 7 lbs (3.2kg) or 100ft - 14 lbs (6.4kg)

RACK MOUNT SYSTEM OPTIONAL COMPONENTS	
KEYBOARD/MOUSE/LCD MODULE	**MODEL 4452B**
Interfaces with PC for Communication and Display. (Runs EdgeTech's Trackman Software which interfaces with the BATS.)	
LCD Panel	17" LCD panel
Display type	TFT/LCD active matrix color
Display Area	304.1mm(H) x 228.1mm(V)
Viewing angle	130° (Horiz.)/110° (Vert.)
Resolution	1024 x 768
Contrast ratio	300:1 typical
Brightness	250 cd/m^2 typical
Pixel pitch	0.297mm (H) x 0.297mm (W)
Panel color	16.7 million display colors
Back Light	4 CCFTs (Cold Cathode Fluorescent tube)
Synchronization Range	Horizontal: 48.36-60 KHz; Vertical: 56-75 KHz
Storage temp.	-25ºC to 60ºC
Operating temp.	0ºC to 50ºC
MTBF	35,000 hours
Video Input Signal	Analog RGB 0.7Vp-p
Video Input Conn	15-pin D-Sub connector
Chassis	2U rack Height, Black
Dimension	W 17.3" (44 cm) x H 3.46" (8.8cm) x D 23.7" (60.2 cm)
Weight	30 lbs (13.6 kg)

Power supply:	110V 220V AC Input, 12V 5A Output (≈75W)
PC	**MODEL 4451A**
Power Supply	300 Watt ATX Power Supply
Processor	Minimum: Intel P4- 1GHz Socket 370
Single Board Computer	Socket 370 Single Board Computer, P4, 100MHz FSB, w/ AGP Video, Ethernet, 2-RS232 ports, 1-Parallel port, PS2-Key\Mouse
Memory	Minimum: 1GB
Hard Drive	Minimum: 80 GB IDE Hard Drive, 7200 RPM
Floppy Drive	1.44 MB, 3 1/2"
CD/DVD Drive	56X CD-R0M, R/W DVD
RS232 Ports	4 total (Baud Rates adjustable from 2400 to 115k)
For Example…	Depth Sensor Input – Receive NMEA depth data from a Tow Vehicle or ROV.
…or	Tracking Data Output – Send Tracked Target data to a Navigation Software package for integration with GPS. (If using EdgeTech's IPS software it can run on this same computer as the Trackman Software.
Parallel Port	1
Operating System	MS Windows XP Professional
Ethernet Port (1)	Communication with BATS Transceiver (Rack Mount or Portable)
Chassis	Industrial 2U Rack Height, Black, Fan & Filter, Front door protects disk drives Front panel supports keylock and power switch, reset button & keyboard connector Automatic fan-failure detection
Dimensions	W 18.9" (48cm) x H 3.4" (8.6cm) x D 17.1" (43.4cm)
Weight	Approx. 25 lbs
Power	115/230 VAC, 200 W
Shock	10 G acceleration peak to peak (11 ms)
Vibration	5~17Hz, 0.1 "double amplitude displacement; 17~640Hz, 1.5 G acceleration peak to peak

MISCELLANEOUS	XCEIVER, PC, KEYBD DISPLAY
CONSOLE PHYSICAL SPECIFICATIONS	NOT INCLUDING RACK ENCLOSURE
Height	10.5 inches (26.7cm)
Width	17 inches (43 cm)
Depth	20 inches (51 cm)
Weight	Estimate : 95 lbs (43kg)
Weight with 6U Rack Enclosure	107 lbs (48.5)
ENVIRONMENTAL SPECS	
BATS Console Temperature Rating	Operating: 0° to 50° C; Storage: -25° to 60° C
Hydrophone Temperature Rating	Operating: -4° to 40° C, Storage: -40° to 70° C
POWER REQUIREMENTS	
Voltage	115-230 AC (auto switching)
Frequency	50-60 Hz
Power	325 Watts

1.3 PORTABLE SYSTEM SPECIFICATIONS

BATS PORTABLE SPECIFICATIONS	
SYSTEM ACCURACY	**SPECIFICATION**
Transponder/Responder - Absolute Accuracy in Horizontal Position (over entire hemisphere)	± 0.5% RMS of Slant Range (Does not include motion.)
Repeatability Accuracy	± 0.25% RMS of Slant Range
Angular Resolution	0.08°
Slant Range Accuracy	± 0.3 meter RMS (assuming correct speed of sound)
Slant Range Resolution	0.1 meter
RECEIVE SIGNAL SPEC	
Frequency	MF Range; 17-30kHz or LF Range; 8-16kHz
Signal Coding Structure	Various ➡ CW, Chirp (linear), Chirp (stepped or discrete tones), PSK Phase Shift Keying), M-FSK (Multiple - Frequency Shift keying) , (Hydroid's REMUS (codes 1-4)
Signal to Noise Ratio required	Typically >20dB (in 17-30kHz band or 8-16kHz band)

TRANSCEIVER MODULE	**MODEL 4461C (Portable)**
Processor(s)	mPGA 478 Socket, Intel Celeron M/Pentium M processor w/ FSB400MHz
RS232 Ports	3 - COM1: GPS Time, COM 2 & 3: P/R & Compass
Enclosure	Watertight Material: HPX® High Performance Resin Color: Yellow
Dimensions	W 19.2" (48.8 cm) x H 7.3" (18.5 cm) x D 15.2" (38.6 cm)
Weight	23.5 lbs (10.7 kg)
Power	115/230 VAC, 60 W
Sub-assemblies	DSP, Target Acquisition Module, Peripheral Interface Card, Transmitter, SBC, IDE, A2D & Power Supply
Sequential Tracking	Up to 4 Targets
DIFF KEY INPUT – RESPONDER (4)	
Via rear panel Synchronization connector	Accepts single ended or differential signal input to an opto-coupler. pulse widths min = 200 micro-seconds pulse width max = up to the width of the transmit-out burst
TRIGGER OUT	
Via rear panel Synchronization connector	Sync for Responder operation; Differential Output (0-5VDC) Either side can be used as a positive or negative TTL pulse when used with GND.
ANALOG INPUTS	
Analog Voltage input for Depth	Uni-polar 0-6VDC
Analog Voltage input for Compass	Uni-polar 0-6VDC
Analog Voltage input for Pitch & Roll	±10VDC input
Absolute Accuracy (±10VDC, -10° to 50°C)	0.27%
Resolution of A/D Converter	A/D converter = 16-bits
RS-232 PORTS	
Comport #1	GPS Time Input – ZDA or GGA
Comport #2	Compass Input, typically
Comport #3	Pitch/Roll Input, typically

1-PPS INPUT	
Via rear panel BNC	Accepts a 1-PPS trigger from GPS; Opto-coupler input. Requires ZDA and GGA input also.
ETHERNET	
Via Side Panel Connector	Provides communications with PC (Data & Commands)
TRANSMITTER SPECS	
Frequency	MF: 15-23kHz, LF: 13-17kHz
Pulse Width	1-15ms in 0.1 ms increments
Repetition Rate	0.5 to 20 seconds
Signal Coding Structure	Various – CW, Chirp (linear), PSK, FSK, REMUS (codes 1-4)
Output Power	100 or 400 Watts into 300Ω Load
Sound Pressure Level (Hydrophone Interrogator)	MF: 17-20kHz, @ 400W - Nominal 192dB re 1μPa @ 1m LF: 13-17kHz, @ 400W - Nominal 192dB re 1μPa @ 1m
HYDROPHONE/INTERROGATOR	**MODEL 4213C-B**
Diameter	2.9 inches (7.4 cm)
Height	19.4 inches (49.3 cm)
Weight	10 lbs (4.5kg)
Temperature Rating	Operating: -4° to 40° C Storage: -40° to 70° C
Frequency	MF: 17-30kHz or LF: 8-16kHz
DECK CABLE	**MODEL 4113C**
Length	50ft (15m) or 100ft (30m)
Diameter	1.38 in (3.5cm)
Weight	50ft- 7 lbs (3.2kg) or 100ft - 14 lbs (6.4kg)

Transceiver to PC S/W Requirement Spec

Set up of parameters for the BATS is via Windows based software (Trackman). Command and configuration via a menu driven parameter listing. This Windows based software performs the following functions, data display, multiple target plotting, command and configuration setup, and beacon position output to a Navigation Processor. The software receives the raw phase / timing data from the USBL Processor Module and uses it to calculate the final X, Y & Z position of each target. This

calculated position is typically sent to a Navigation software package / processor for positioning of targets in latitude /longitude coordinates.

OPTIONAL:

MRU	MODEL 4760B
Material	Aluminum Silicon Bronze
Connector	Subconn MCBH6M
Temperature	-4° to 40°C
Pressure Depth	2000 meters
Input Voltage	8 to 30 VDC
Input Power	0.75 Watts
Communications	RS232
Baud Rate	38.4 or 115.2k baud
Output Rate	up to 32 updates per second
Output Sentence	$POREM Format

SECTION TWO

INSTALLATION

2. INSTALLATION

This section includes instructions for implementing a 4213C Hydrophone mounting assembly, making proper attachment of the 4113C Deck Cable and also the Transceiver side panel interface connections.

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/INTERROGATOR 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 BATS 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, propellers, thrusters, echo-sounder transducers, main engines, generators and other underwater acoustic generating 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.

* 1 meter = (1.33 milliseconds x 1500 meters/second) ÷ 2 way travel time

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

NOTE: In some applications even though the hydrophone is over one meter directly away from the hull, a signal can be reflected from an area along the keel and arrive within 1.3 ms of the direct arrival thus causing interference. In these instances the hydrophone should be lowered further away from the hull.

2.1.1 4213C SUGGESTED HYDROPHONE MOUNTING ASSEMBLY

The main function of the mounting assembly is to support the hydrophone vertically in the water and orient it with respect to the bow of the vessel. See Figure 2-1 for Hydrophone dimensions. 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 BATS Hydrophone varies with the size of the surface vessel and the intended application.

Transiting to/from operating locations with the hydrophone deployed is not recommended.

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 (referenced by the index mark) should align with vessel heading. The mount should be fabricated to allow the rotation of the hydrophone to correct for any bearing misalignment during installation (see section **2.4.1** Bearing Offset Adjustment). Some locking arrangement should be used to maintain the calibrated bearing.
6. Forward and aft guys are used to hold the mounting pipe in vertical position.

See Figure 2-2 for example of mounting arrangement.

The Model 4213C Hydrophone can be mounted to an angle bracket which mounts to the end of a suitable length of pipe or assembled into a machined end of pipe or shaft. Choose the size and material of the pipe according to the application. The Hydrophone can survive up to 10knots as long as shaft/pipe does not strum or vibrate.

2.1.2 ATTACHING HYDROPHONE TO ANGLE MOUNT

The hydrophone centerline, or zero bearing, is indicated by the index mark (mark is just above the potted section of the hydrophone which is aligned with the slot in the pressure case as opposed to the pin which faces aft or 180° from bow reference) and is generally aligned so that it corresponds to the vessel heading. Most operations requiring a portable tracking system will be on various vessels of opportunity, and require a quick and temporary mounting. See Figure 2-2 and 2-3 for a typical hydrophone mounting arrangement.

Fasten the hydrophone, Model 4213C, to an angle bracket (not supplied), (see Figure 2-4 Hydrophone Mount Angle Bracket, 4213BM0010 as an example) aligning the slot in the PVC base with the "V" in the bracket. Using screw clamps secure the hydrophone to the proposed angle bracket. Align the screw clamps with the grooved areas on the hydrophone case.

Feed the deck cable, Model 4113C or 4113C-DT, through the hydrophone extension pipe. Connect the deck cable to the hydrophone. See Figures 2-5 and 2-6 for the Model 4113C and 4113C-DT cable assemblies.

The Deck Cable mates to the Hydrophone by lining up the pins in both connectors and pushing together. The mated connection is then held together with the locking sleeves. The following are guidelines from the manufacturer.

- Align indexes on connectors and mate with minimum twisting and flexing
- Care must be taken not to damage contacts in unmated connectors
- Contact surfaces must be dry prior to mating.
- Lubricate mating surfaces with 3M Silicone Spray or equivalent* (see caution below). DO NOT GREASE. Connectors must be lubricated on a regular basis.
- Avoid contact with solvents.
- Grip main body of connector during mating or unmating. Do not pull on the cable to disconnect.
- Avoid sharp bends at cable entry to connector.
- Elastomers can be seriously degraded if exposed to direct sunlight or high ozone levels for extended periods of time.

C A U T I O N

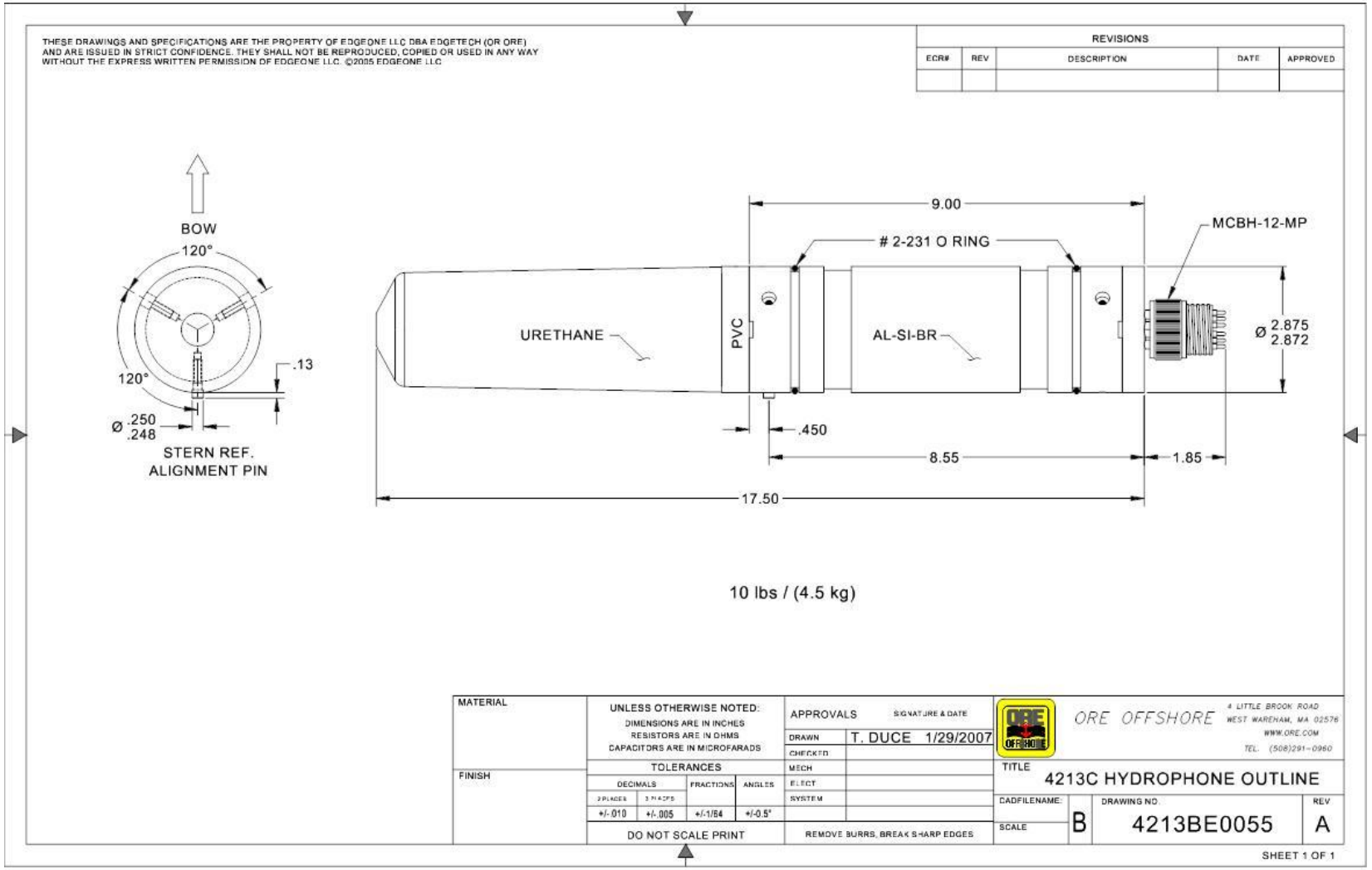
* When mating connectors DO NOT allow any silicone spray (or grease) to contact the black potting of the hydrophone. Should silicone come in contact with the hydrophone potting, proper sound transfer from water to hydrophone will be prevented. Attempting to remove silicone from the hydrophone can damage the potting material.

NOTE: If you are using an extension 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 may not pass through when the bolts are in place. 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.

Fasten the hydrophone and angle bracket to the extension pipe. Use screw eyes or other fasteners for fore and aft guy attachments.

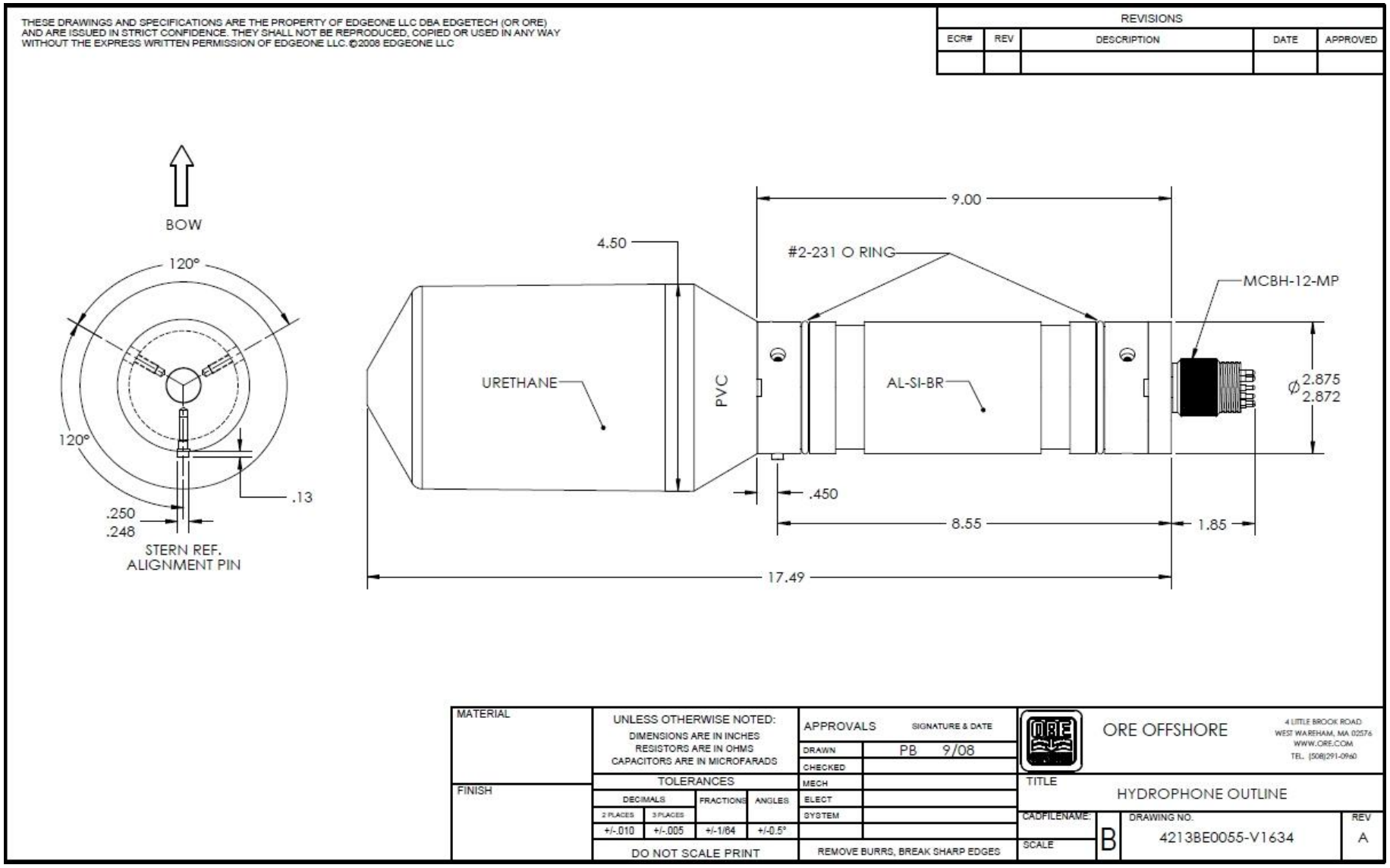
Using the "V" of the angle bracket as a guide, align the hydrophone (mark is facing forward) with the vessel centerline as closely as possible. Lock in place.

Use some variation of the procedure in **2.4.1** to remove hydrophone bearing offset.



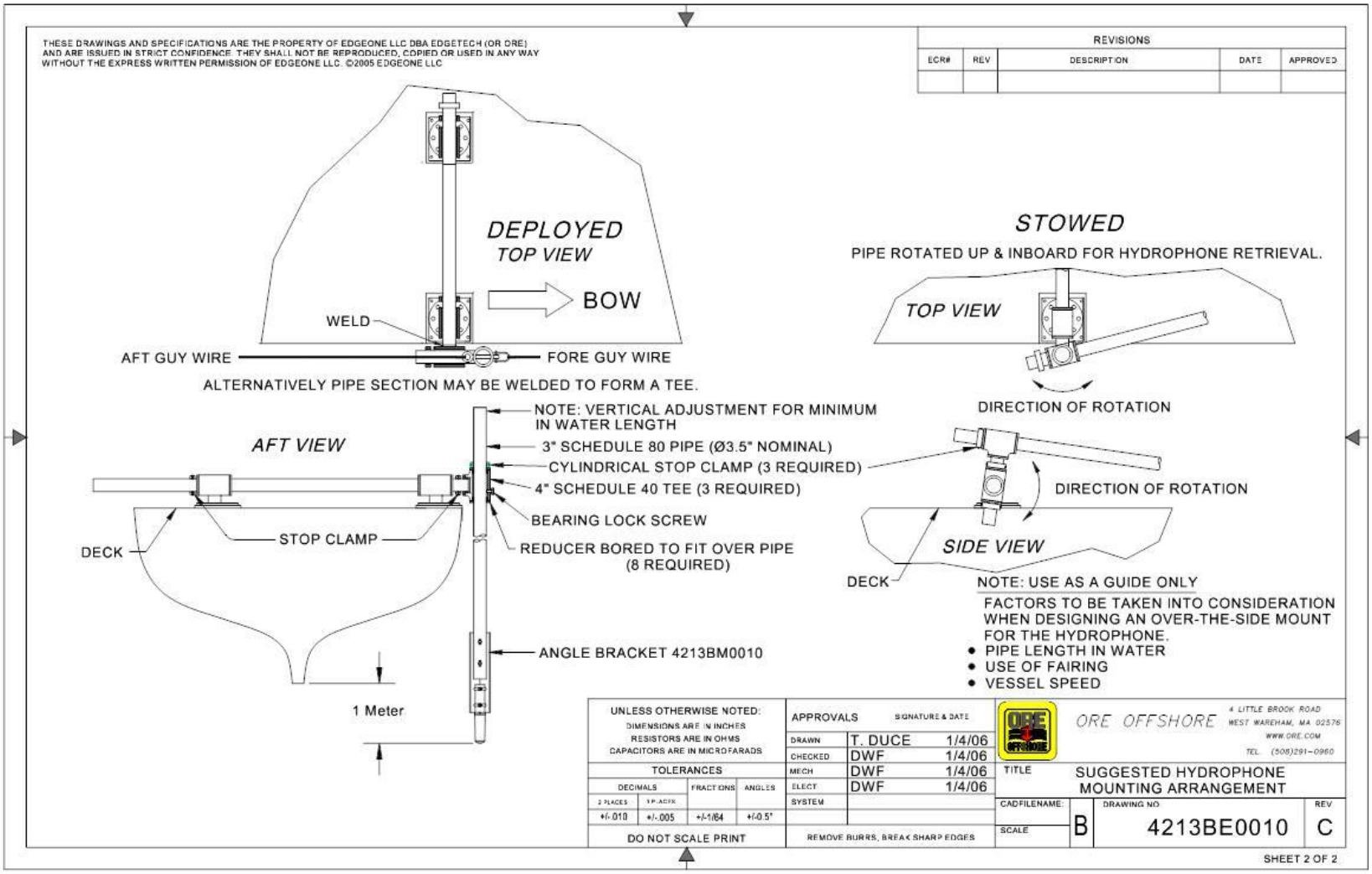
4213BE0055 – Hydrophone Outline Drawing

FIGURE 2-1



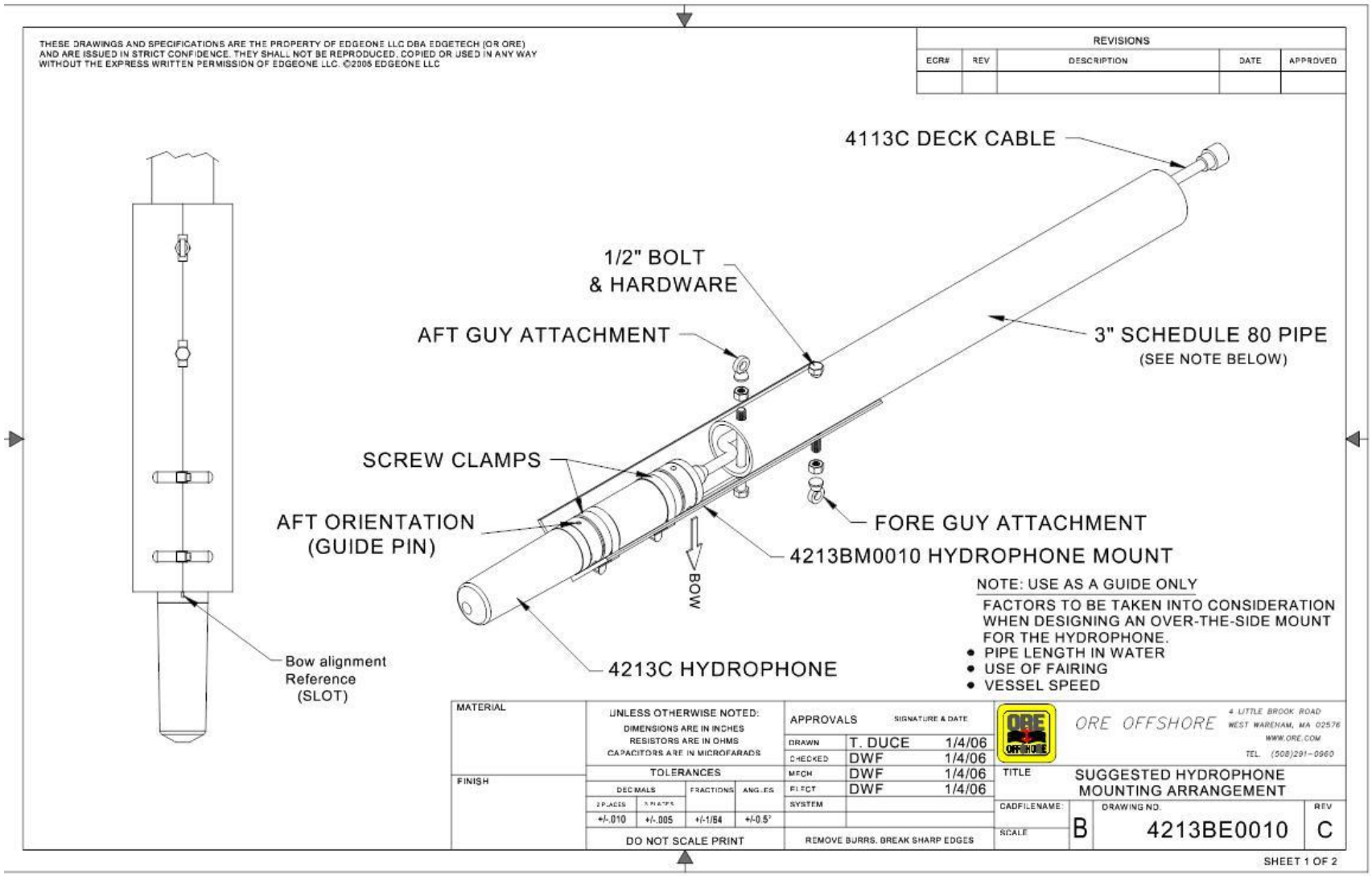
4213BE0055–V1634 Hydrophone Outline Drawing

FIGURE 2-1A



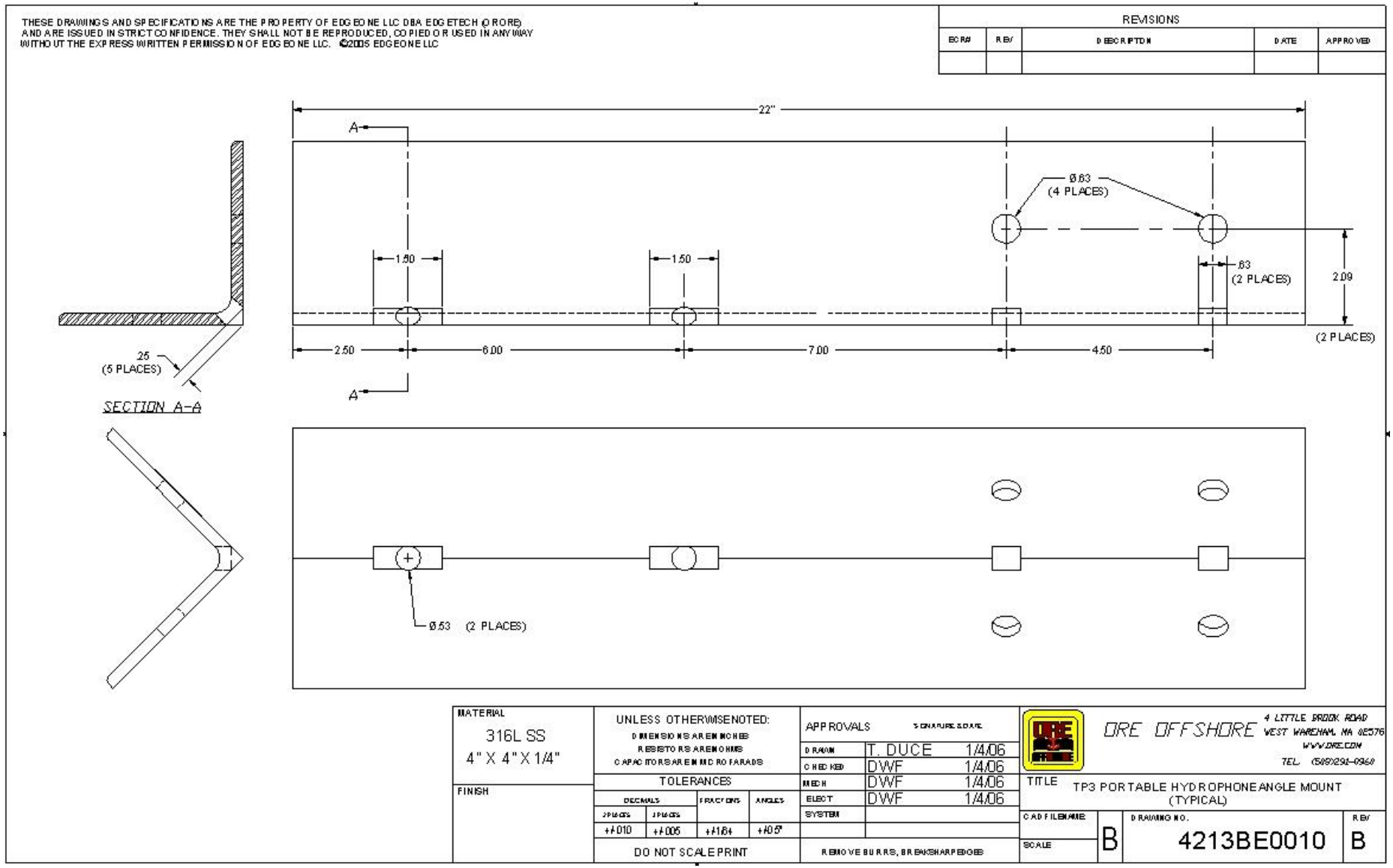
4213BE0010 – Pg 1 - HYDROPHONE MTG ARRANGEMENT

FIGURE 2-2



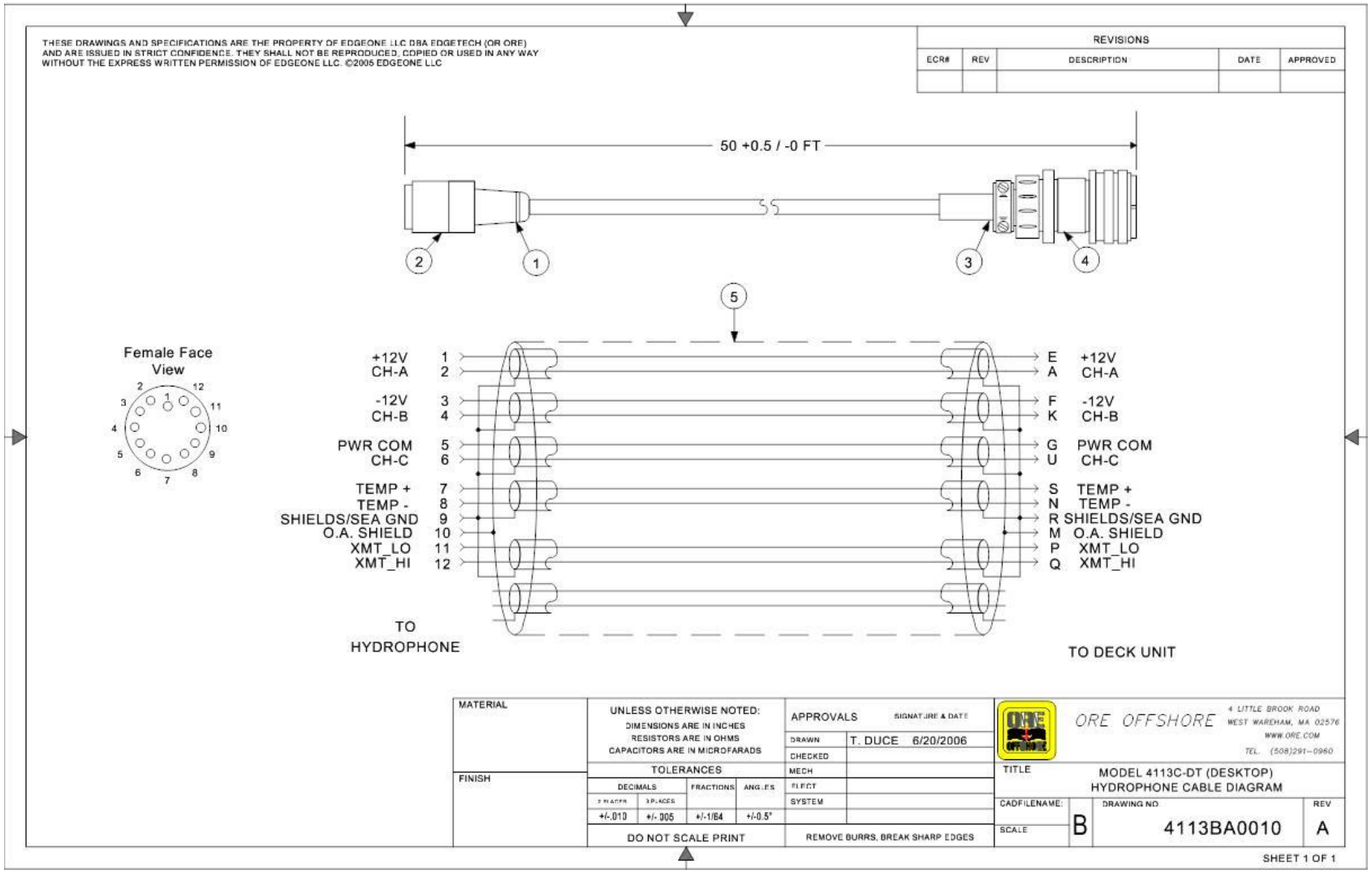
4213BE0010 - Page 2 Pipe & Angle Bracket arrangement

FIGURE 2-3



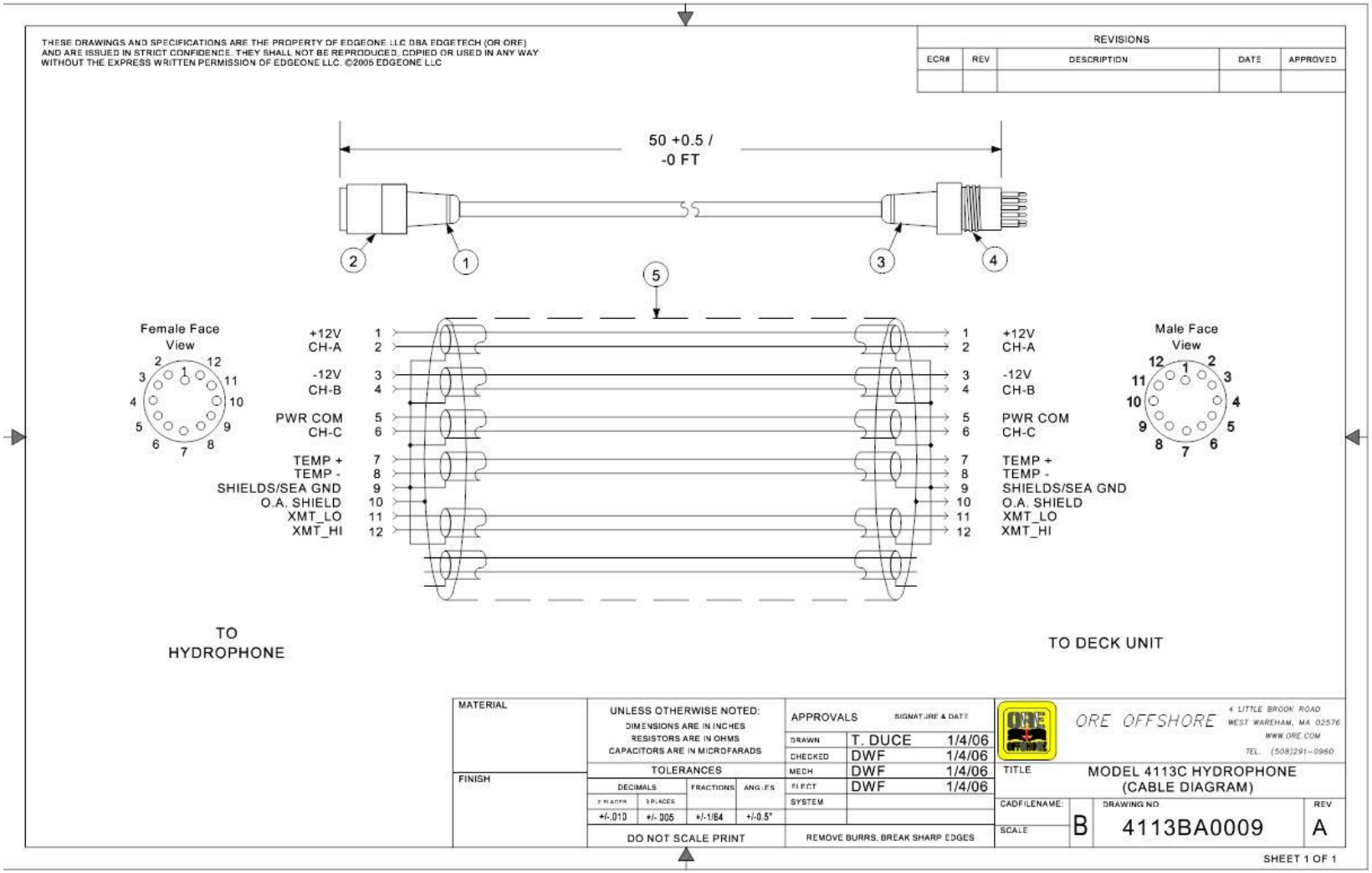
4213BM0010 - Angle Bracket Drawing

FIGURE 2-4



Deck Cable for Desktop, 4113BA0010

FIGURE 2-5



Deck Cable for Portable, 4113BA0009

FIGURE 2-6

2.1.3 4213C-B SUGGESTED MTG FOR SEALED SHAFT INSTALLATION

The Model 4213C Hydrophone can also be installed 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. This allows for ease of deployment, recovery and maintenance of the hydrophone. Figure 2-7 (4213CM0053) shows the suggested machining dimensions necessary for mounting the hydrophone to an extension shaft (Flanged). An example of a gate valve type mounting arrangement for Hydrophone installation is shown in Figure 2-8 (4630CM0154). A complete installation is shown in Figure 2-9. For information on the Model 4630D Motorized Gate Valve System contact EdgeTech.

NOTE: The slot opposite the "BOW" alignment mark in the staff is for the AFT alignment pin.

The hydrophone extension shaft 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 PC to correct for these offsets. Refer to section 2.4.

The Deck Cable mates to the Hydrophone by lining up the pins in both connectors and pushing together. The mated connection is then held together with the locking sleeves. The following are guidelines from the manufacturer.

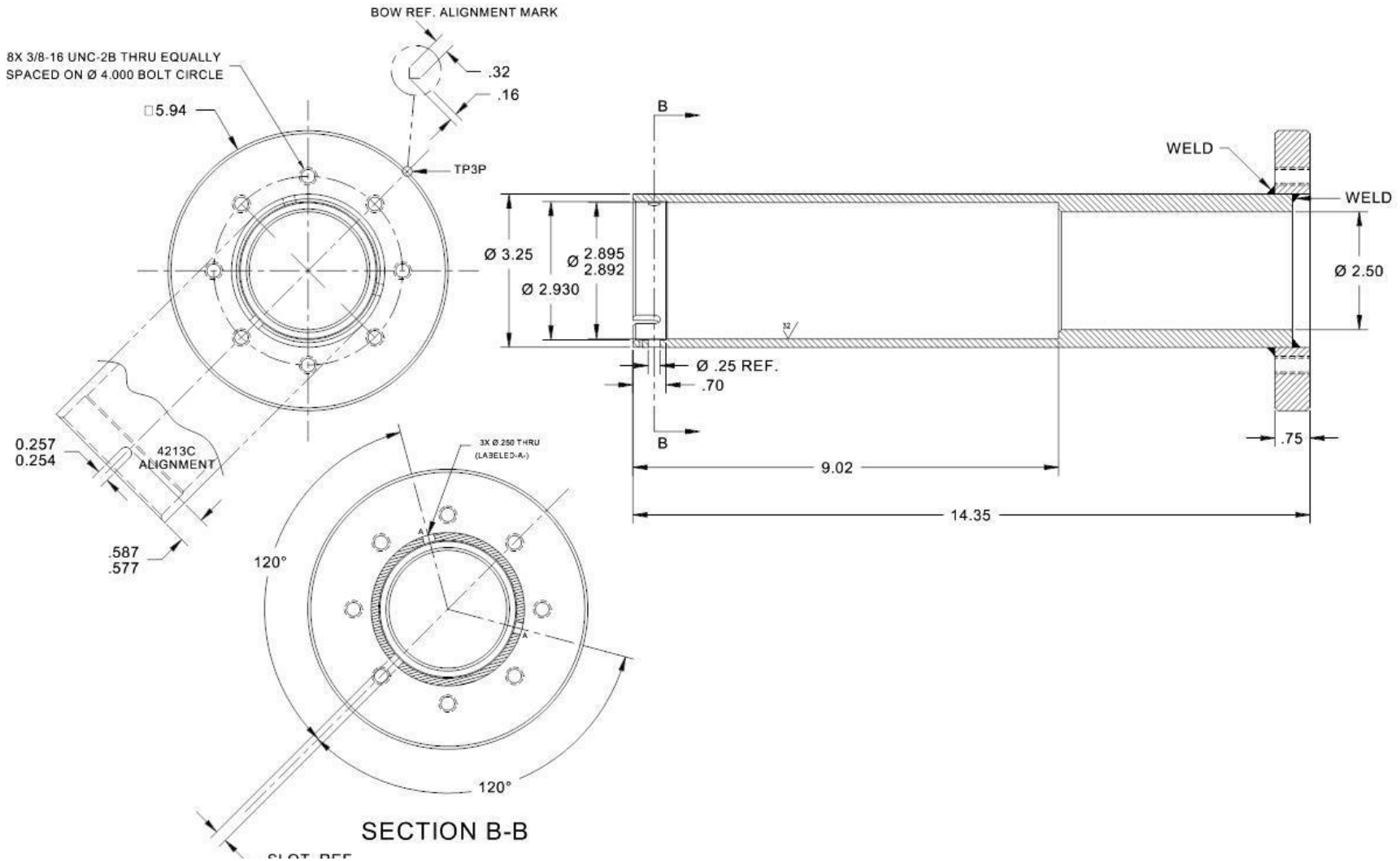
- Align indexes on connectors and mate with minimum twisting and flexing
- Care must be taken not to damage contacts in unmated connectors
- Contact surfaces must be dry prior to mating.
- Lubricate mating surfaces with 3M Silicone Spray or equivalent* (see caution below). DO NOT GREASE. Connectors must be lubricated on a regular basis.
- Avoid contact with solvents.
- Grip main body of connector during mating or unmating. Do not pull on the cable to disconnect.
- Avoid sharp bends at cable entry to connector.

- Elastomers can be seriously degraded if exposed to direct sunlight or high ozone levels for extended periods of time.

C A U T I O N

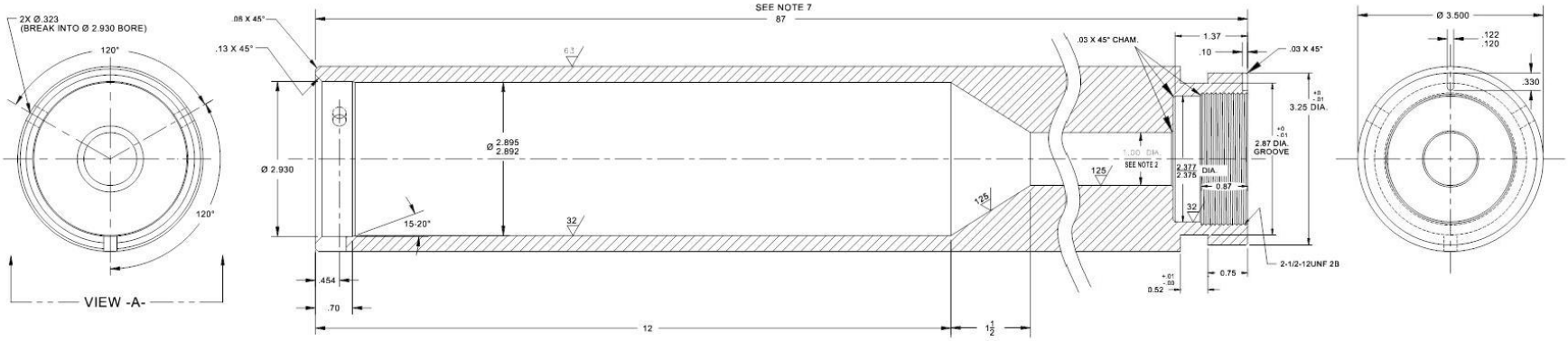
* When mating connectors DO NOT allow any silicone spray (or grease) to contact the black potting of the hydrophone. Should silicone come in contact with the hydrophone potting, proper sound transfer from water to hydrophone will be prevented. Attempting to remove silicone from the hydrophone can damage the potting material.

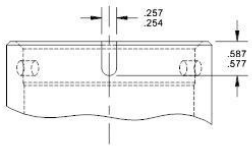
See Figures 2-8 and 2-9 for the Model 4113C and 4113C-DT cable assemblies.



4213CM0053 - Suggested Mounting Arrangement in Machined Shaft – Flange OTS

FIGURE 2-7





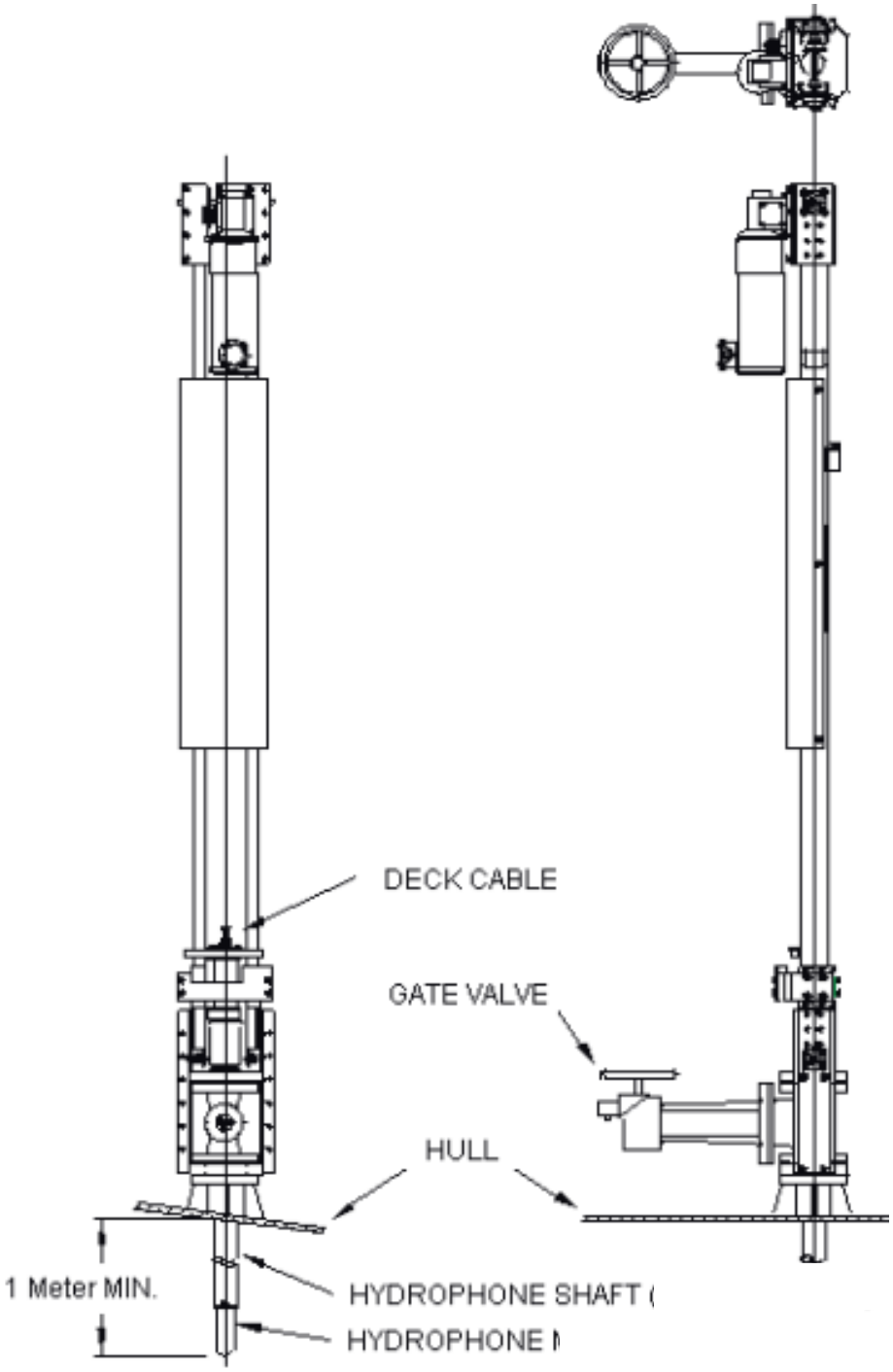
VIEW -A-

NOTES:

1. MATERIAL: 3-5/8" DIA. 316 STAINLESS STEEL BAR.
2. IF 1.00 DIA. IS DRILLED FROM OPPOSITE ENDS OF SHAFT, HOLES TO BE ALIGNED WITHIN .03 IN. IMPORTANT: REMOVE SHARP EDGES AT HOLE INTERSECTION TO AVOID DAMAGING THE .88 DIA. POLYURETHANE JACKETED CABLE THAT WILL BE PASSING THROUGH SHAFT.
3. REMOVE ALL BURRS and SHARP EDGES.
4. EXTERIOR FINISH: SURF. ROUGHNESS AS SHOWN; PROTECT EXTERIOR FROM JAW MARKS, STEADY REST GROOVES, ETC.
5. PROTECT 32 uin O_i-RING SURFACE AREAS.
6. PACKAGE TO PROTECT SURFACES and PIPE ENDS.
7. LENGTH TO BE DETERMINED. HYDROPHONE MUST BE AT LEAST 1 METER FROM ANY REFLECTIVE SURFACE WHEN SHAFT IS FULLY DEPLOYED.

4450CM0154 - Suggested Hydrophone Shaft Machining – Through Hull

FIGURE 2-8



GATE VALVE TYPE INSTALLATION

FIGURE 2-9

2.2 BATS DESK TOP CONSOLE (TRANSCEIVER)

The convenience and comfort of the operator are the primary considerations for installing the Desk Top console & PC. The BATS consists of a single 2U enclosure (3.5 inches high each), configurable for either Rack mount or Desktop operation, and couples to a Customer Furnish PC or laptop. Place the unit where it is most conveniently operated (LED's visible) and protected from foul weather and sea spray. E.g., Indoors on a bench top. See Figure 1-4. Typically a Laptop can be placed on top of the BATS Console. A typical rack mount setup for the three Modules is shown in Figure 1-1.

The system requires the following inter-connections along with a suitable power source and free access for connecting the deck cable.

Interface connections:

- Line Voltage/AC power (100-240VAC auto switching)
- Ethernet from Transceiver to PC/ Laptop
- Transceiver (Model 4460C) to Hydrophone Deck Cable (Model 4113C-DT)
- Trigger/Sensor Interface Cable (optional)
- Motion Reference Interface (Analog or RS232) (optional)

2.2.1 BATS - LINE VOLTAGE (IEC CONNECTOR)

The BATS line voltage can be in the range of 98 to 132 or 170 to 264; 50 or 60 Hz. 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 system does not automatically switch to the lower range, it must be turned off and on again. Connect the desk top unit to a suitable power source using the IEC AC cable.

*** * * * * * * * * * * * WARNING * * * * * * * * * * * ***

If using an inverter to power the Deck Unit from a battery, make sure that the inverter's ground contact is tied to the sea water. This connects the box/chassis to the sea water potential and not float to a dangerous potential.

2.2.2 BATS - ETHERNET CABLE WIRING (BETWEEN BATS & PC)

Connect the Ethernet cable (provided) between the BATS console (rear panel) and the PC. The Ethernet cable is 10-base-T and runs at 100MHz. A straight through cable is required (cross-over is performed inside the BATS console).

2.2.3 BATS - HYDROPHONE CABLE

Connect the Hydrophone/Interrogator Deck Cable Model 4113C-DT (Figure 2-8) from the Hydrophone to the Transceiver Model 4460C.

The Deck Cable mates to the Transceiver by lining up the MS connector on the CABLE with the HYDROPHONE input connector on the BATS unit. Thread the collar / locking sleeve down over the bulkhead connector on the Transceiver pushing in on the connector body while turning locking sleeve.

2.2.4 BATS – RACK MOUNT PC AND KEYBOARD/DISPLAY

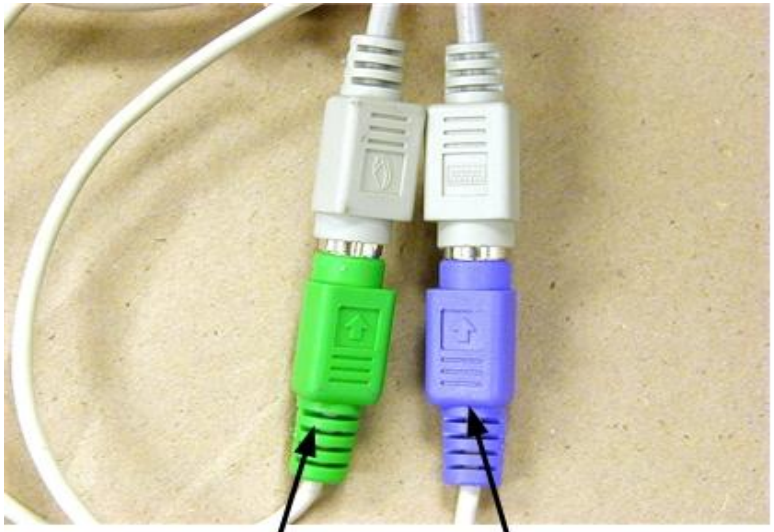
2.2.4.1 VIDEO (PC TO KYBD/DISPLAY)

Connect the "Y" cable from the Processor K/M Combo connector to the Keyboard/Display Mouse connector and Keyboard connector. The Green Keyboard/Display cable goes to the Mouse connector on the Processor's K/M Combo cable and the Blue goes to the Keyboard connector on the Processor's K/M Combo cable. See Figure 2-10 and 2-11.

OPTIONAL INTERFACE INTER-CONNECTS

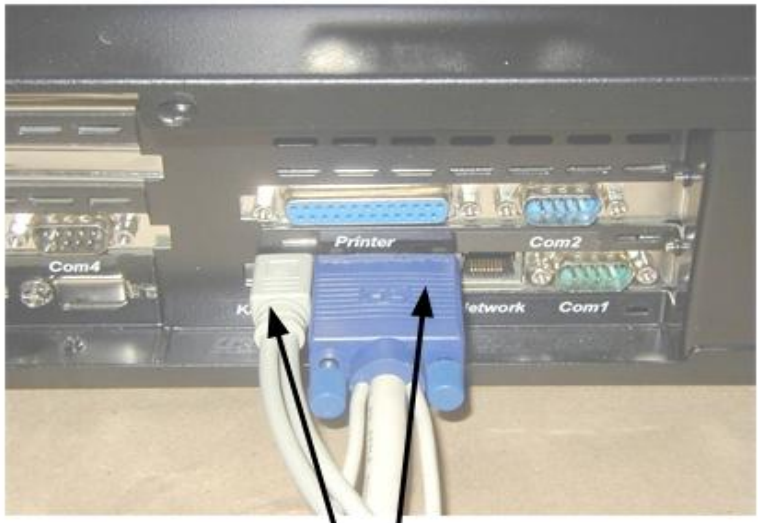
2.2.5 BATS – COM#1 CABLE WIRING (RESERVED FOR GPS TIME, 4450A)

The COM#1 input port is only used for inputting the GPS sentences into the BATS to synchronize the GPS time to the BATS time. Install a 9-pin (F) to 9-pin (F) communications cable between the 4460C 9-pin (M) COM1 connector to the GPS' 9-pin (M) connector (GPS connector type may vary between manufacturers, refer to the GPS manual for pin outs to determine if a null modem is required). See Figure 2-12 for rear panel connectors. Refer to section 3 to configure BATS for GPS time sync.



GREEN CONNECTOR TO MOUSE

PURPLE CONNECTOR TO KEYBOARD

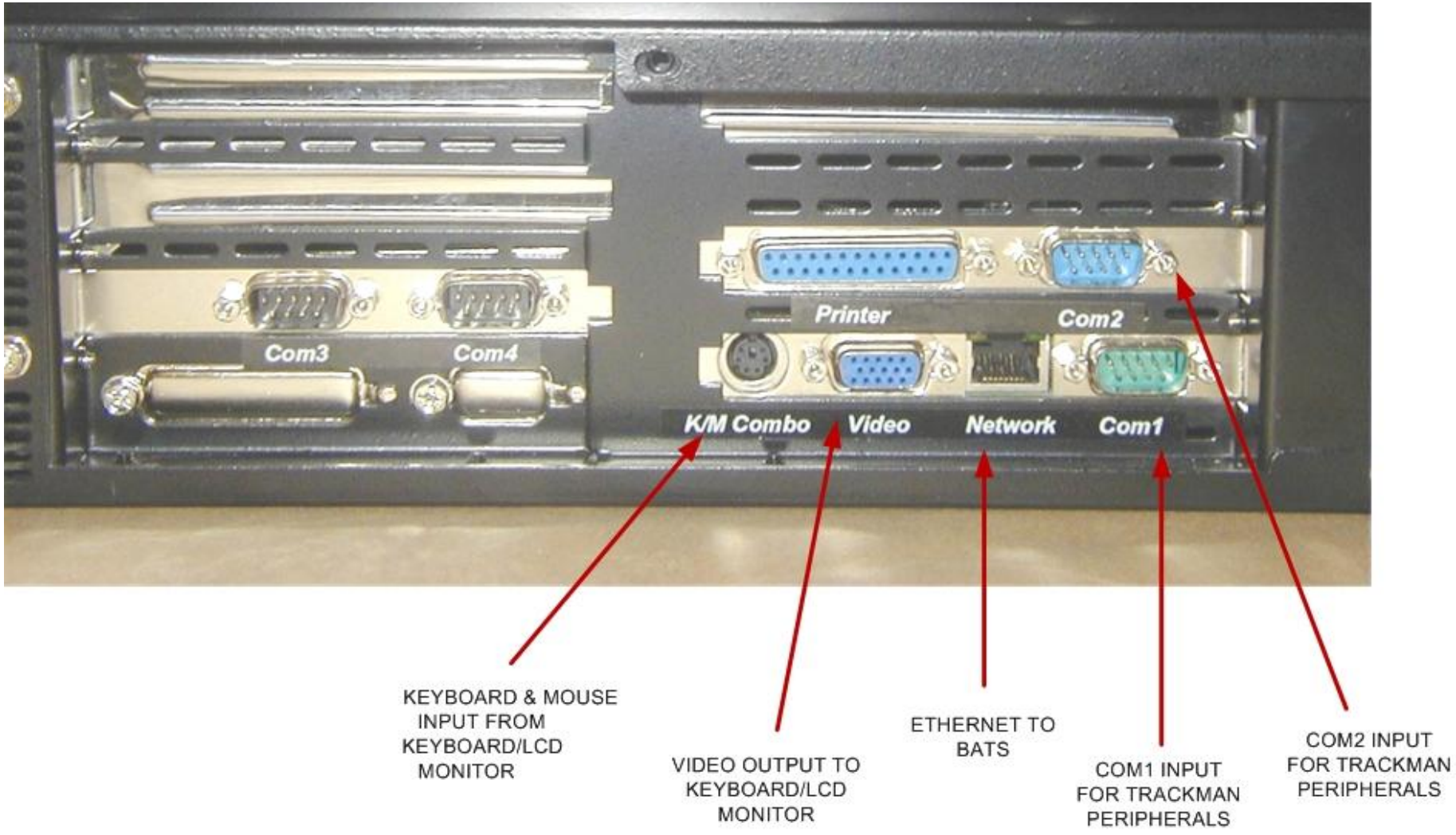


KVM CABLE CONNECTION AT REAR PANEL OF PROCESSOR

PROCESSOR MODULE MODEL 4451A KVM CABLE INSTALLATION

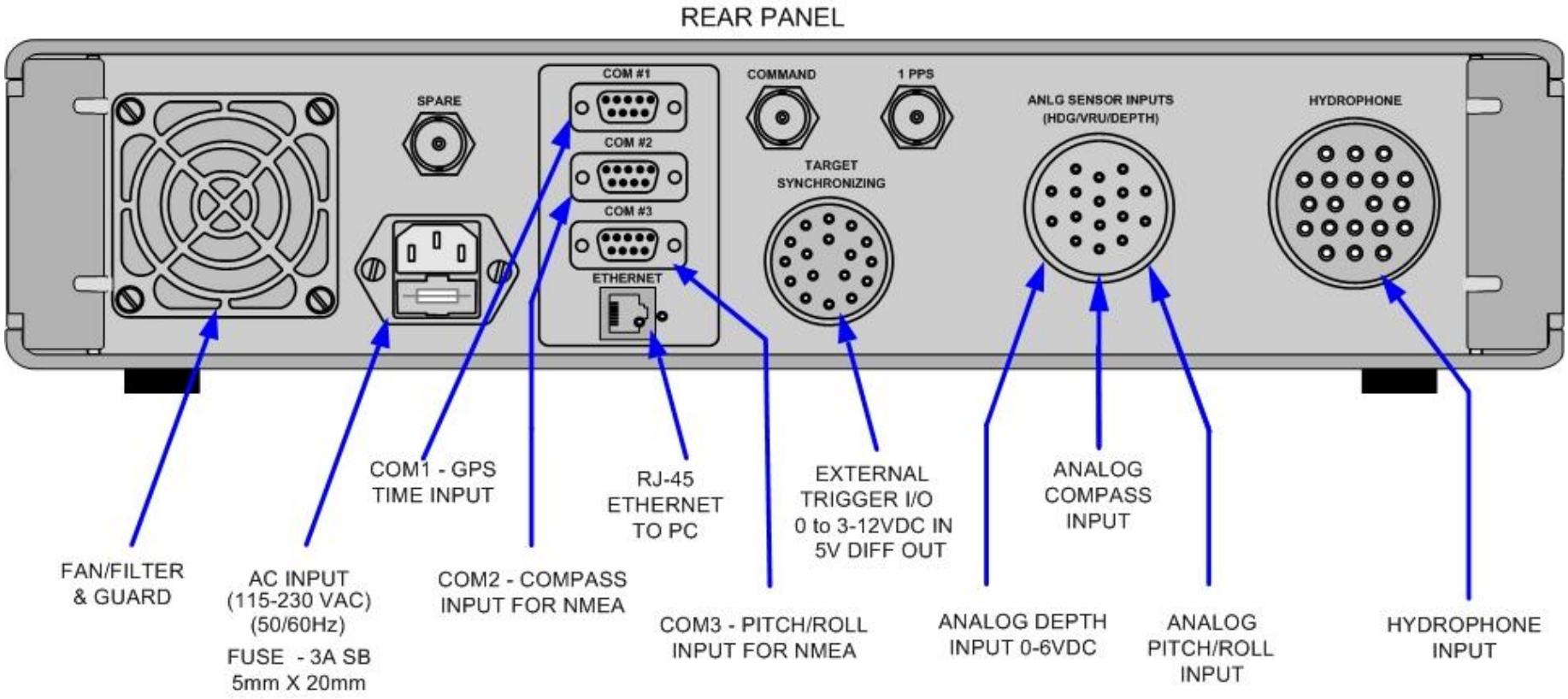
VIDEO KEYBOARD/MOUSE CONNECTIONS

FIGURE 2-10



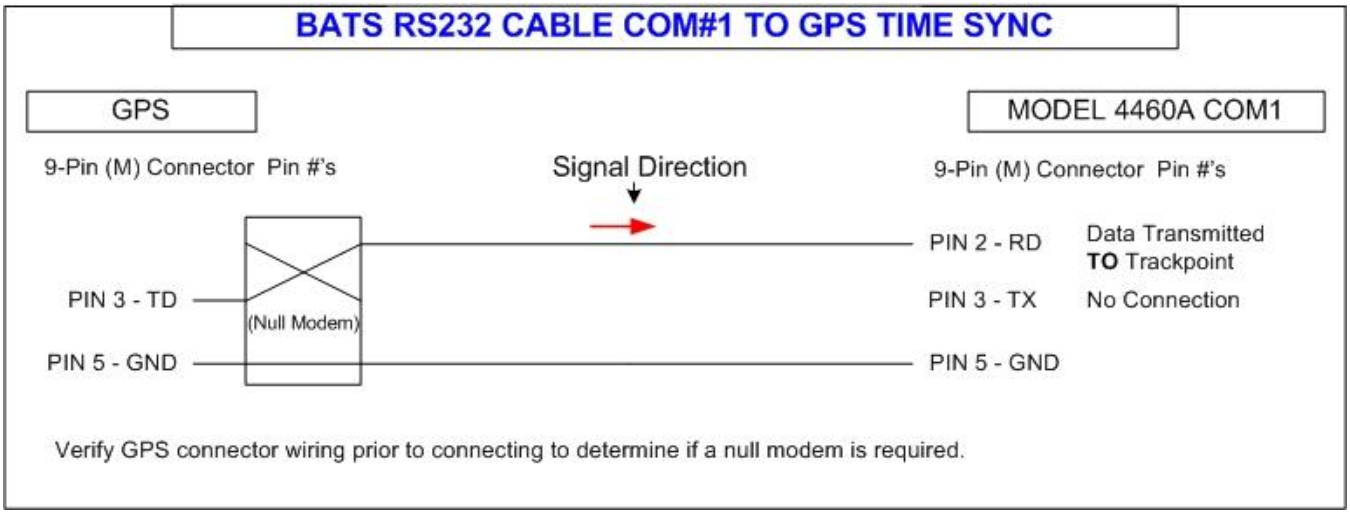
RACKMOUNT PC REAR PANEL CONNECTIONS

FIGURE 2-11



BATS SIGNAL INTERFACE MODULE REAR PANEL CONNECTIONS

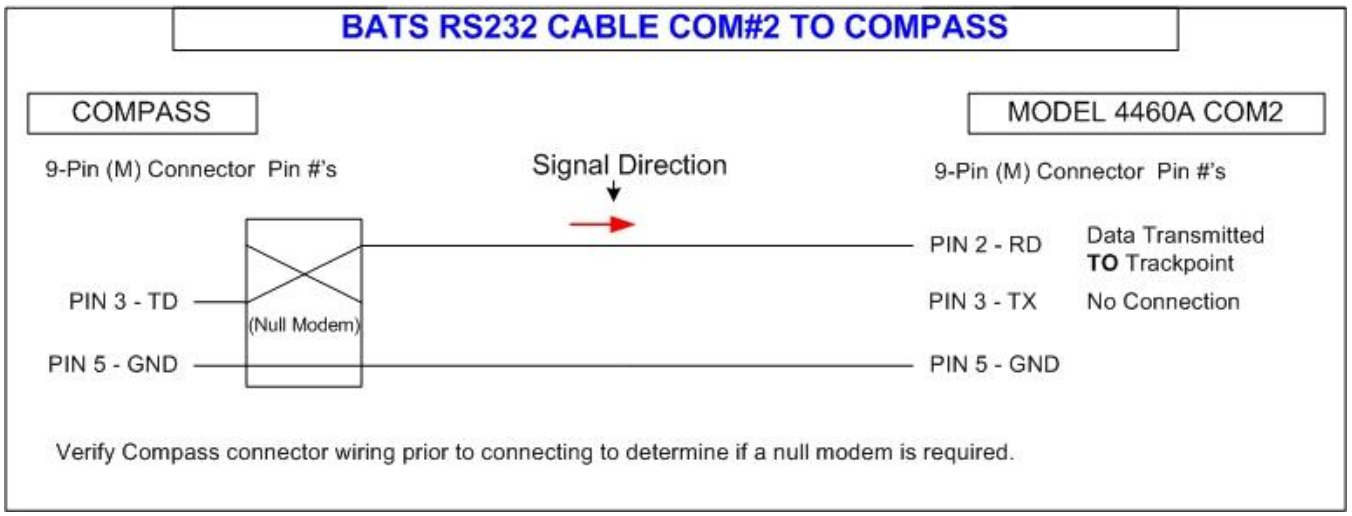
FIGURE 2-12



2.2.6 BATS - COM#2 COMPASS NMEA INPUT

(Cable Wiring; 9-PIN MALE `D' CONNECTOR)

The Transceiver (Model 4460C) COM #2 I/O port is wired the same as a PC ("DTE", Data Terminal Equipment). It is used for the input of NMEA compass data. See Figure below for wiring. See section 3 for NMEA formats accepted. May require a Null Modem depending on the Compass wiring.



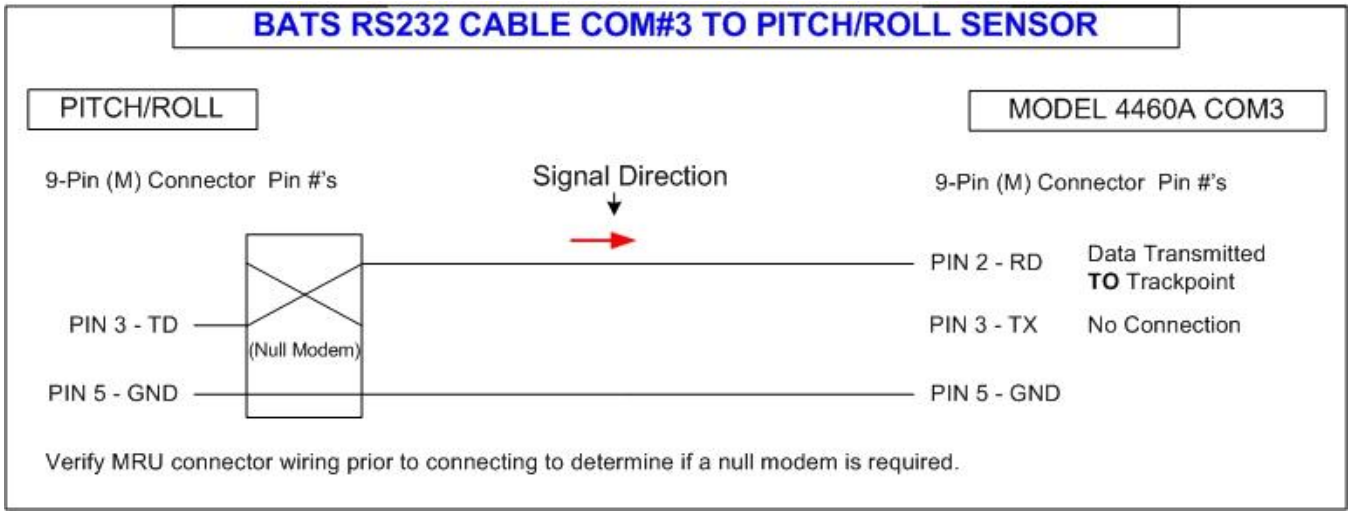
2.2.7 BATS - COM#3 PITCH/ROLL NMEA INPUT

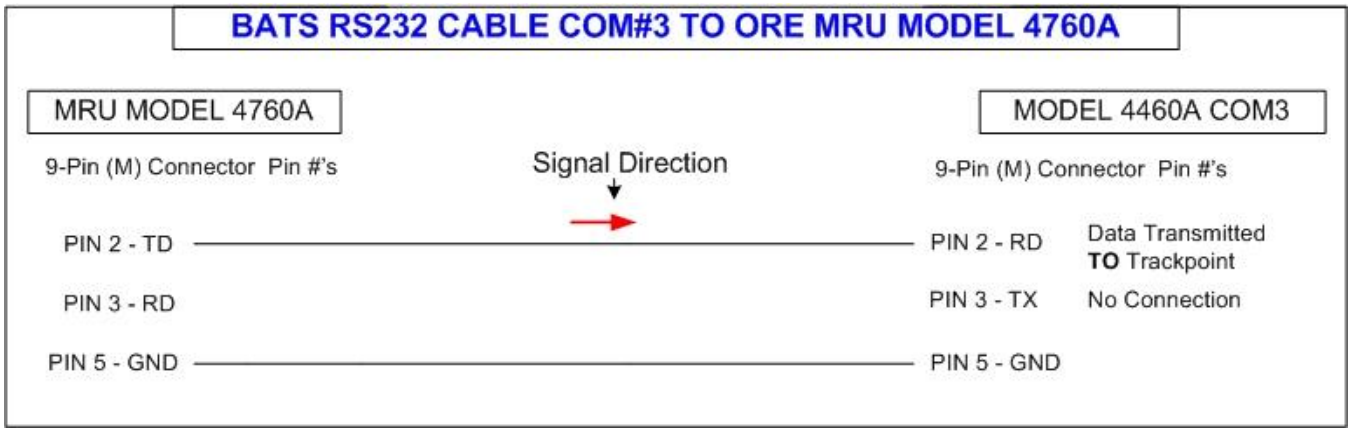
(Cable Wiring; 9-PIN `D' CONNECTOR)

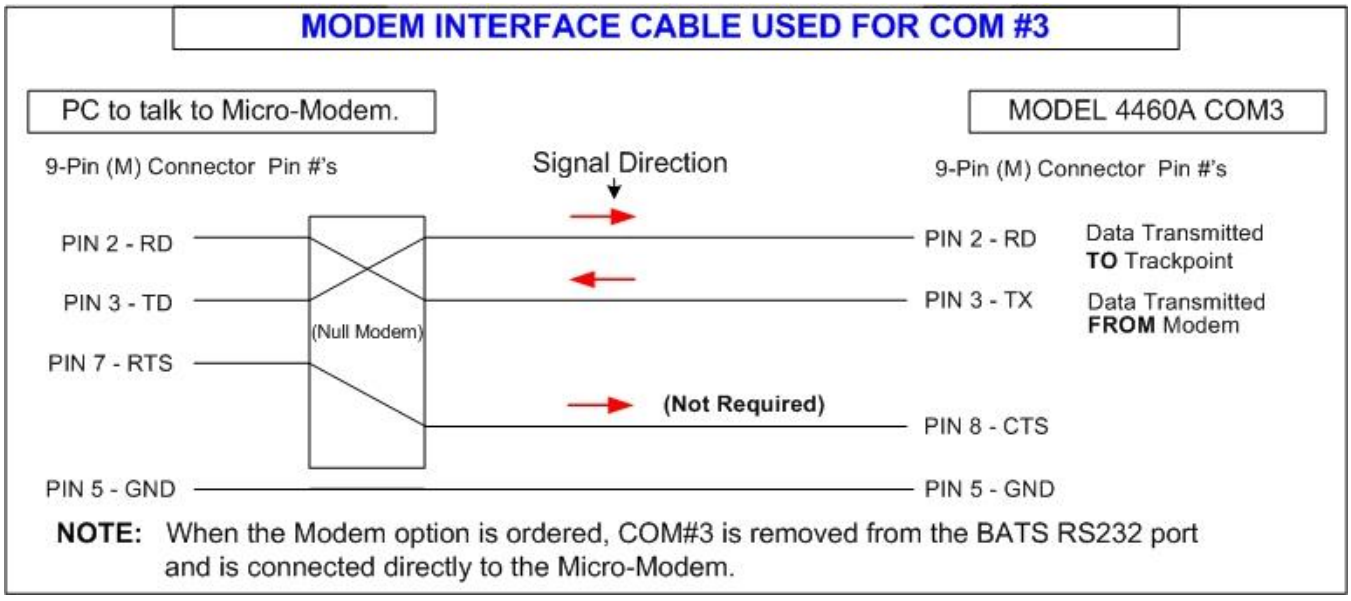
The Transceiver (Model 4460C) COM #3 I/O port is wired the same as a PC ("DTE", Data Terminal Equipment). It is used for the input of NMEA Pitch and Roll sensors. See Figure below for wiring.

If an EdgeTech MRU is interfaced to COM#3 the wiring has been crossed-over in the MRU so that a null modem is not required.

If the BATS is configured with the Micro-Modem option, COM #3 is used for the Modem Communications only and COM#3 is no longer available to the BATS.







2.2.8 BATS - SYNCHRONIZATION INTERFACE

The SYNC connector on the BATS Transceiver allows input of an external trigger source and also outputs a Sync pulse on each interrogation. For example, a tow fish responder that triggers the beacon can also trigger the Transceiver to Sync the two units together. Also, a responder on an ROV can be triggered via the differential signal at the SYNC connector. See Figure 2-13 for connections and Figure 2-14 (4450BA0079) for the provided cable assembly. The mating connector is a MS3106A-20-29P.

2.2.8.1 INPUT TRIGGER

The Transceiver can be externally triggered via the "SYNC" connector located on the rear panel of the desk top unit. A synchronization cable is provided (4450BA0079) for Trigger In, Trigger_Out1 and /Trigger_Out1. See Figure 2-14. This can be connected between an external key source (trigger source can range from TTL to +15V) and the BATS Transceiver. Connect the external trigger between the TRIG-IN1-LO and the TRIG-IN1-HI[2]. The external trigger for Target #1 becomes the master for all other targets when in this mode. All other targets switch to external mode, (via Trackman Software) synching from the trigger #1's source. Set the Trigger edge that you want to trigger the unit with in the Trackman Software. See section 3.

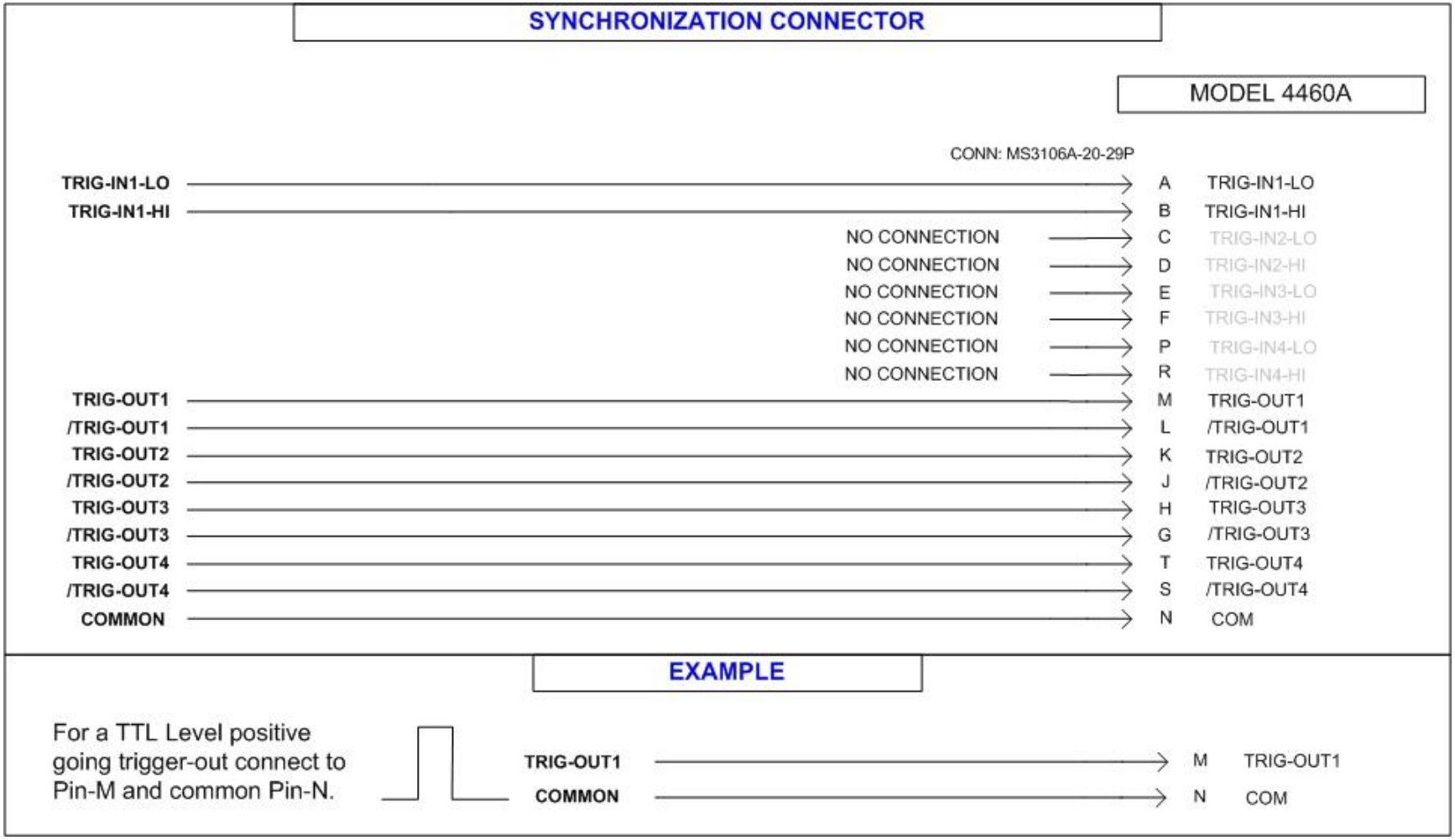
[2] NOTE: The REMOTE-IN trigger is optically coupled.

2.2.8.2 TRIGGER OUT

A synchronization cable is provided (4450BA0079) for Trigger In, Trigger_Out1 and /Trigger_Out1. See Figure 2-10. The TRIGGER out consists of a positive going TTL pulse on one BNC and a negative going TTL pulse on another. By using both positive and negative signals, a differential TTL-compatible pulse, occurring at the time of interrogation for a transponder or a responder, is available. This TRIGGER out pulse is present simultaneously with the leading edge of each interrogation pulse. The output can be configured as differential or positive / negative single ended when used with the COMMON line. See Figure 2-13. The Trigger_Out4 and /Trigger_Out4 can be programmed within the Peripheral Interface Card to either output a trigger or connect it to GND. The Gnd connection can then be used to reference any of the pos or neg triggers for single ended operation. Jumper JP15 from 1-2 for Trigger_Out4 or 2-3 for GND. Jumper JP18 from 1-2 to output /Trigger_Out4 or 2-3 for GND.

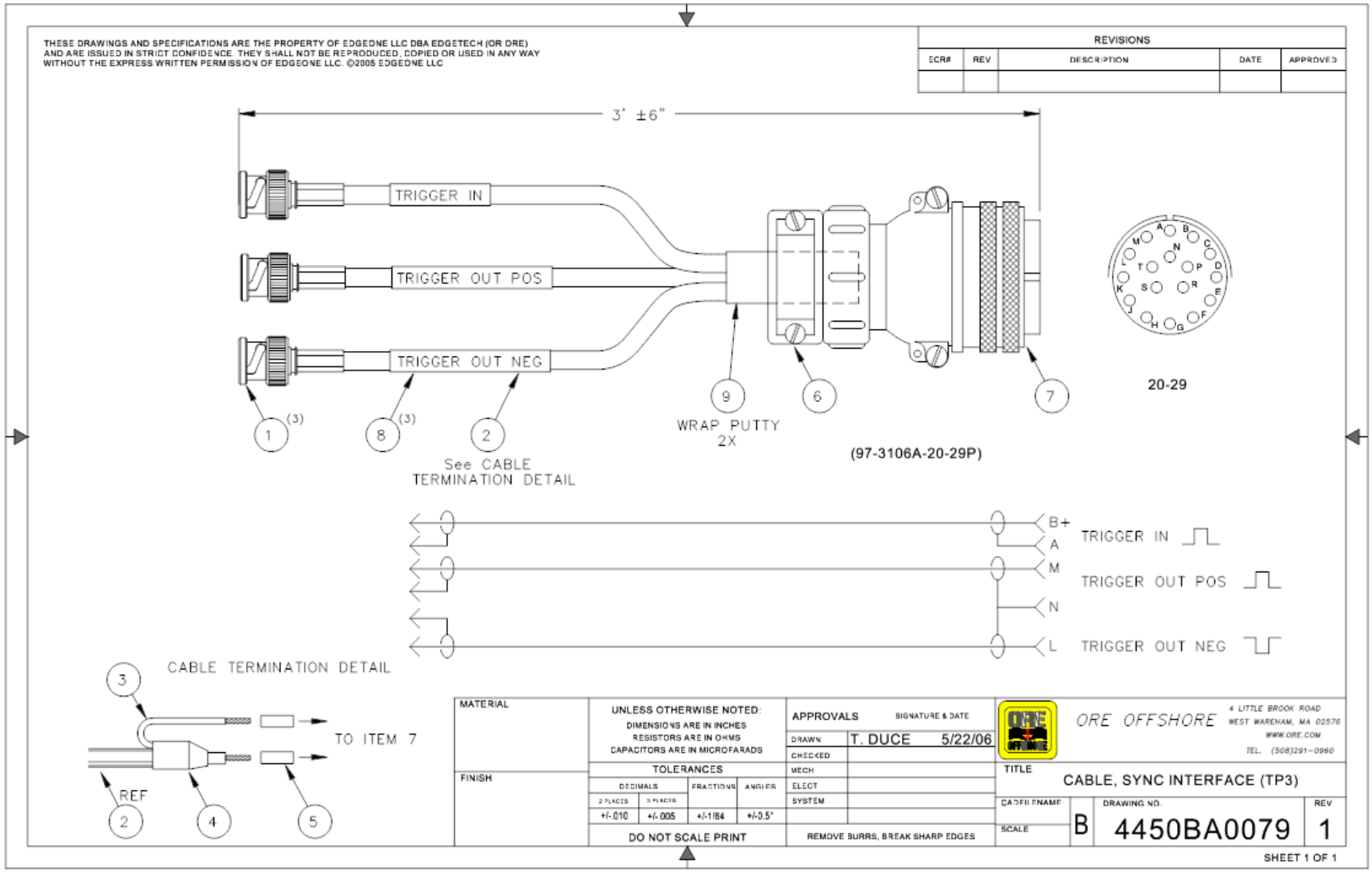
2.2.9 BATS - ANALOG SENSOR INTERFACE

The ANALOG input connector allows input of an analog signal from a compass, dynamic motion sensing system, (analog pitch and roll signals from an external sensor such as the EdgeTech Model 4414B), and also the depth signal from an underwater vehicle. An interface cable is provided, 4410BA0123, for inputting analog pitch and roll sensors to the BATS. See Figure 2-15 for connections and 2-16 for the 4410AB0123 cable Assembly. The mating connector is a MS3106B-24-5S from Amphenol. The 4760B MRU uses this interface to provide +12VDC to the unit while the RS232 connects to COM #3.



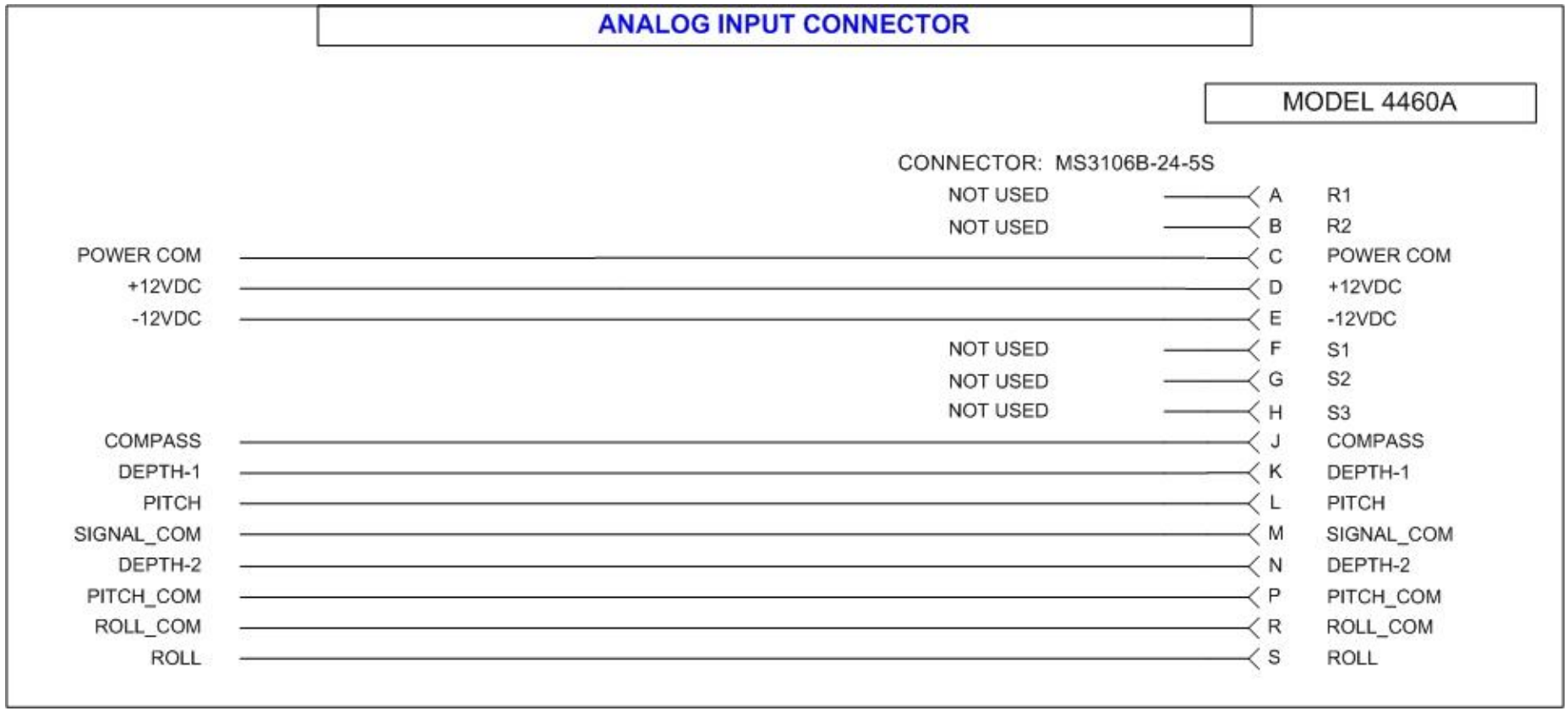
SYNC INTERFACE CONNECTOR ON DESK TOP UNIT

FIGURE 2-13



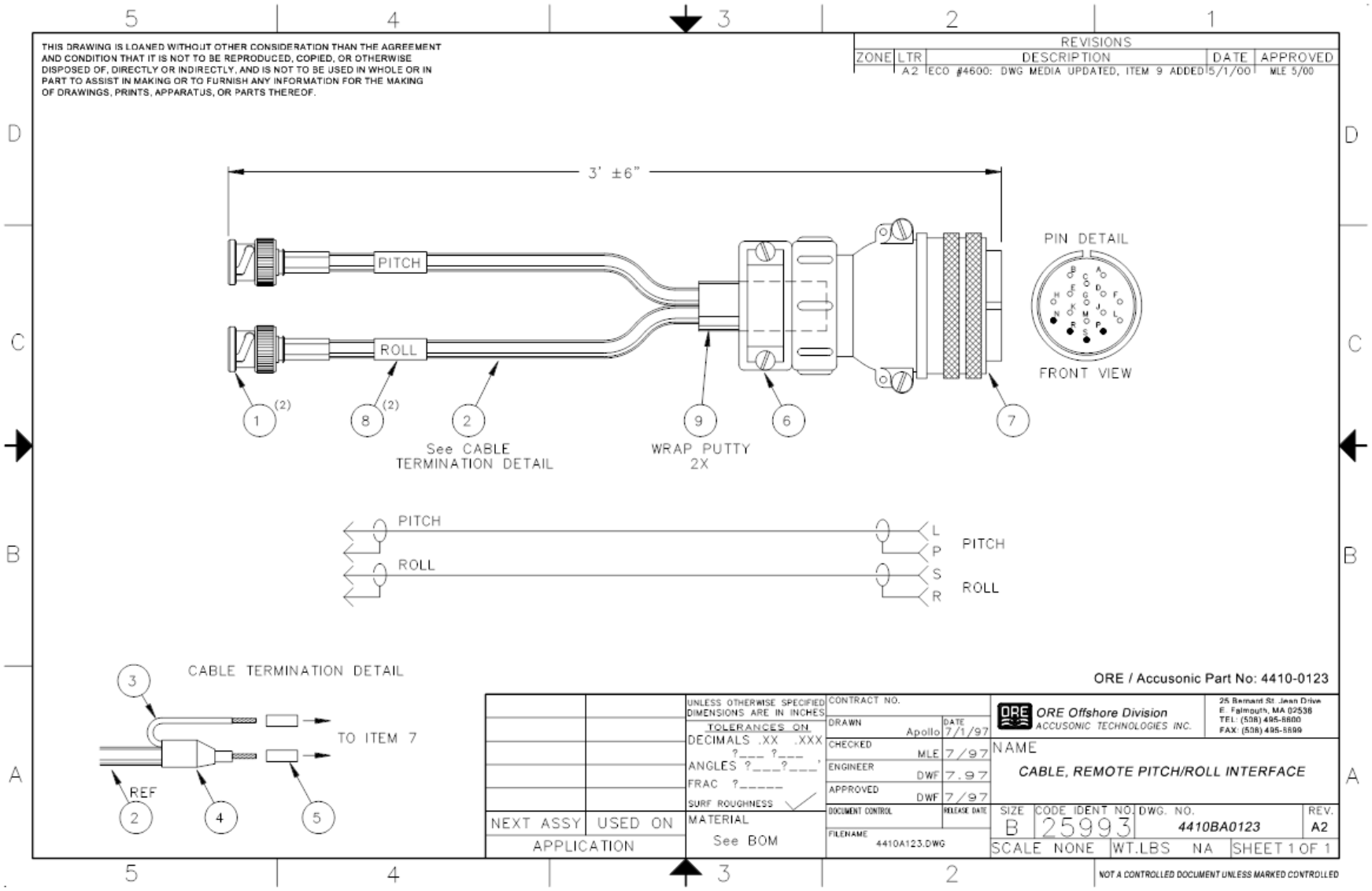
SYNC INTERFACE CONNECTOR (DESK TOP CONSOLE)

FIGURE 2-14



ANALOG INTERFACE CONNECTOR (DESK TOP CONSOLE)

FIGURE 2-15



ANALOG INTERFACE CONNECTOR (DESK TOP CONSOLE)

FIGURE 2-16

2.2.9.1 DEPTH INPUTS

The analog output voltage from a depth sensor (typically located on a vehicle being tracked) connects to the ANALOG input connector located on the rear panel of the Transceiver. See Figure 1-4. The BATS converts this analog voltage (0 - 6 VDC maximum) to a target depth.

2.2.9.2 ANALOG COMPASS INPUT

The analog output voltage from a compass (0 - 6 VDC maximum) connects to the COMPASS input of the ANALOG connector. See Figure 2-15. The BATS converts this analog voltage to a vessel heading in degrees.

2.2.9.3 VRU INTERFACE (MODEL 4414B)

The VRU input of the ANALOG connector accepts PITCH and ROLL analog signals from an external dynamic motion sensing system, such as the EdgeTech Model 4414B. The pitch and roll signals compensate target position for vessel motion. The analog inputs can accept voltages up to +/-10 VDC. See Figure 2-16 for supplied cable assembly. 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 Transceiver 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 LINEAR is 0.2 V/degree (+/- 10VDC = +/-50°). (optional scaling is 10 sin σ)

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 software (Trackman) 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 EdgeTech 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.

When using the Model 4730B VRU setup the Attitude Sensor for Internal. This automatically sets up the parameters to agree with this standard EdgeTech sensor.

Connect the pitch signal to pin-L and the roll signal to pin-S. Connect the analog commons to pins-P & R respectively.

Also see the newer EdgeTech MODEL 4760B MRU. It uses MEMS technology to provide very accurate pitch and roll data. It connects to the Analog Connector for its power and to COM#3 for its data.

2.3 PORTABLE BATS TRANSCEIVER

The Portable BATS Transceiver (Model 4461A) is splash proof when the case cover is closed and interface cables are mated properly. A laptop or PC is required to interface to the unit via Ethernet port. The Ethernet cable (4450BA0133) provided is 16 feet (5m) long (Figure 2-13). Make sure the laptop or PC is well protected unless it is also splashproof.

The Portable BATS requires the following inter-connections along with a suitable power source and free access for connecting the interface cables. All interface connections are made on the right side of the unit via underwater connectors. See Figure 1-6. The ON/OFF switch and fuseholder are also located on same panel. The system LED's are located under the top cover. Once setup has been completed (setup LED's have been confirmed) the cover can be closed and the unit is extremely splash proof.

The unit can accept input Voltages ranging from 100 to 240VAC, 50-60 Hz, and automatically switches between the ranges.

Interface connections:

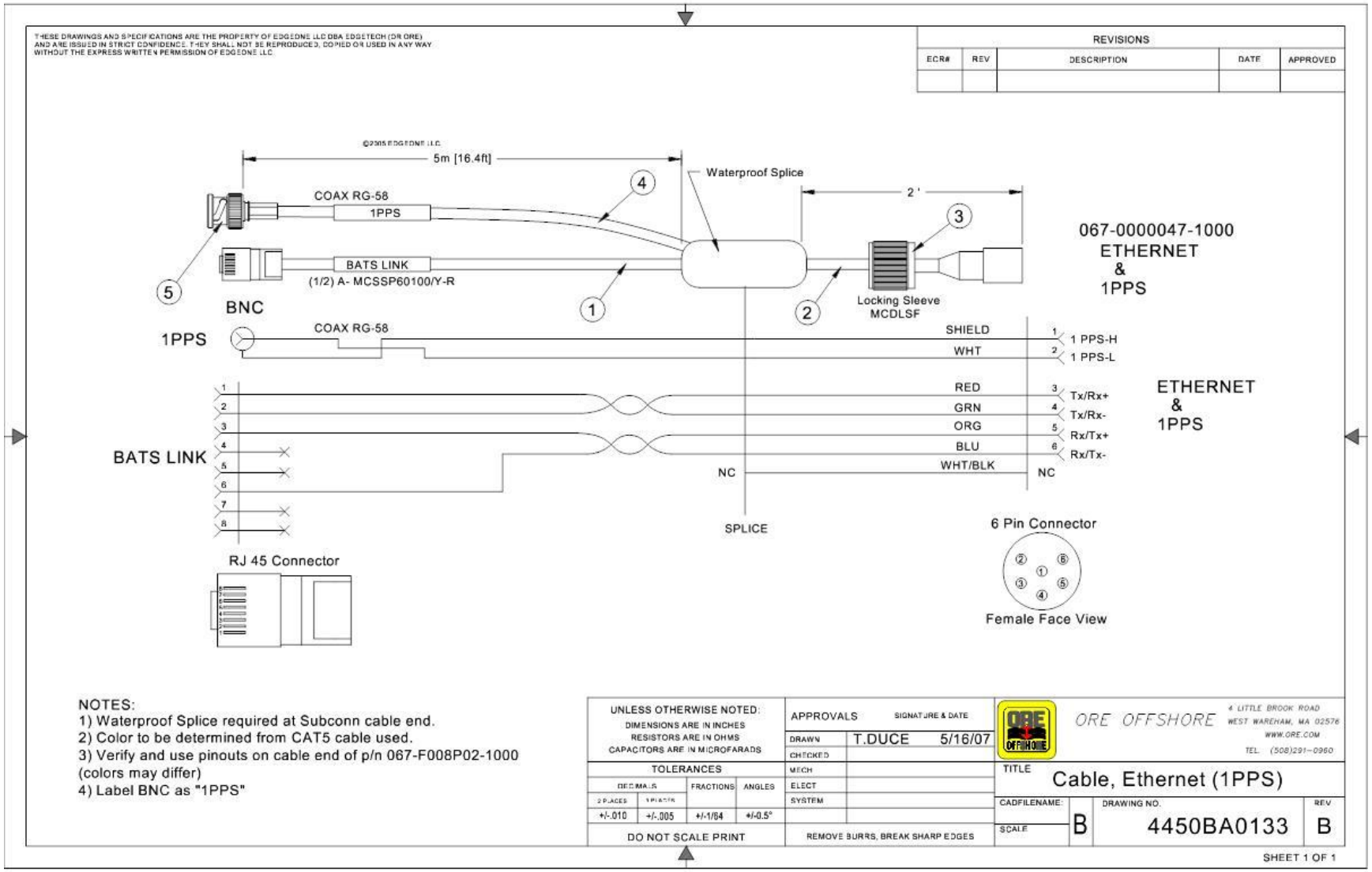
- Line Voltage/AC power (100-240VAC auto switching) (Figure 2-15)
- Ethernet from Transceiver to PC/ Laptop (Figure 2-13)
- Transceiver (Model 446A1) to Hydrophone Deck Cable (Model 4113C) (Figure 2-7)
- Trigger/Sensor Interface Cable (optional) (Figure 2-17)

2.3.1 PORTABLE BATS LINE VOLTAGE

The Portable's line Voltage can be in the range of 100 to 240; 50 or 60 Hz. 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 system does not automatically switch to the lower range, it must be turned off and on again. Connect the Portable Transceiver from the Power Cord (Figure 2-15; B958608) to a suitable power source.

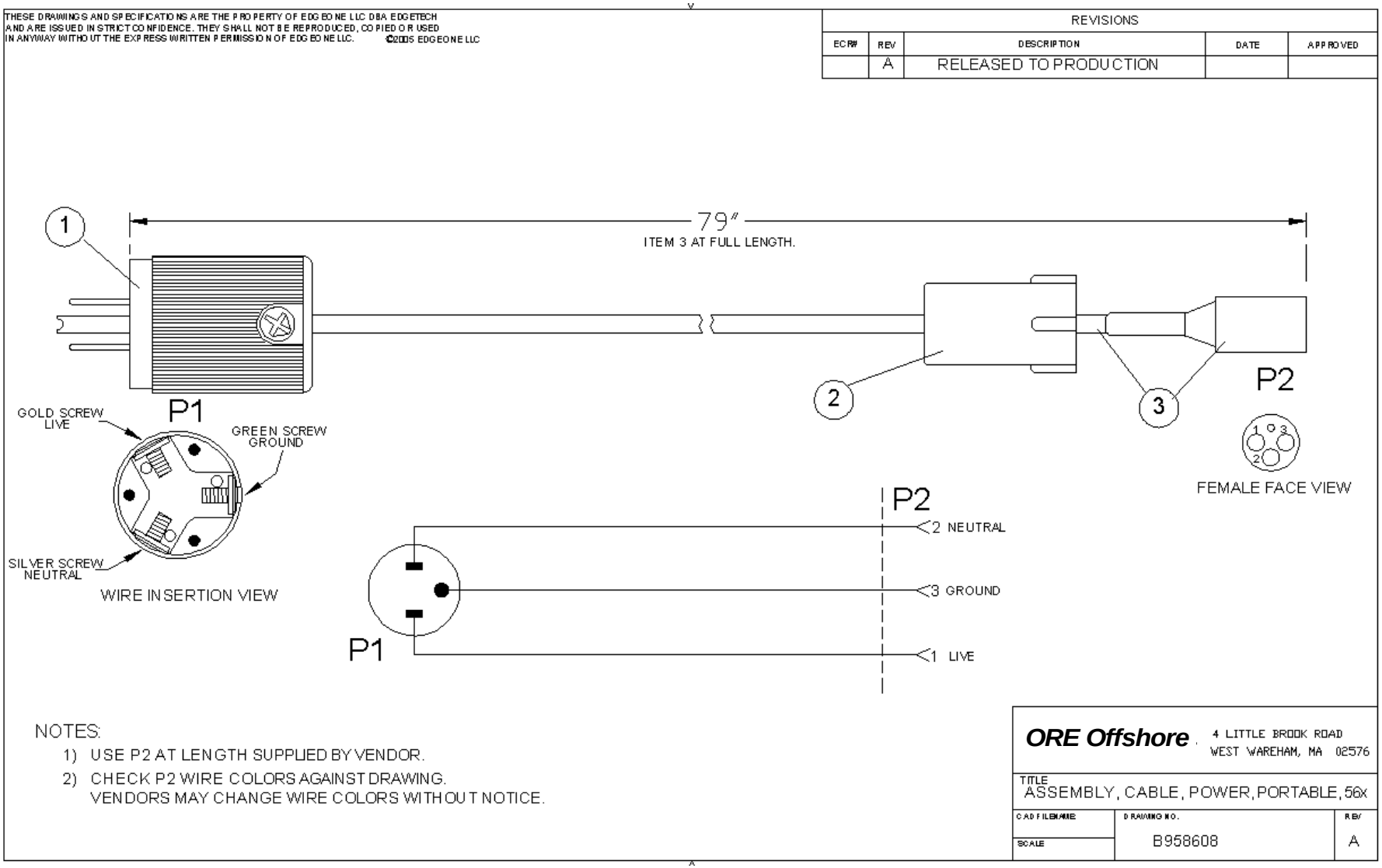
*** * * * * * * * * * * * WARNING * * * * * * * * * * * ***

If using an inverter to power the Transceiver from a battery, make sure that the inverter's ground contact is tied to the sea water. This connects the box/chassis to the seawater potential and not float to a dangerous potential.



TP3 PORTABLE - COMMS CONNECTOR; 4450BA0044

FIGURE 2-17



BATS PORTABLE AC CORD; B958608

FIGURE 2-19

2.3.2 PORTABLE BATS - ETHERNET CABLE WIRING

Connect the Ethernet Cable (4450BA0133) to the Transceiver's "ETHERNET & 1PPS" underwater connector. See Figure 2-17. At the other end connect the "BATS LINK" cable (RJ45 Jack) to the PC. This TCP/IP communication link configures the Transceiver (target & system parameters) using the BATS Windows® Configuration management software, "Trackman". The Transceiver also sends target data to the PC for further processing and display.

2.3.3 PORTABLE BATS - HYDROPHONE CABLE

Connect the Hydrophone Deck Cable Model 4113C (Figure 2-6) from the Hydrophone to the Transceiver Model 4461A.

The Deck Cable mates to the Transceiver by lining up the pins in both connectors and pushing together. The mated connection is then held together with the locking sleeves. The following are guidelines from the manufacturer.

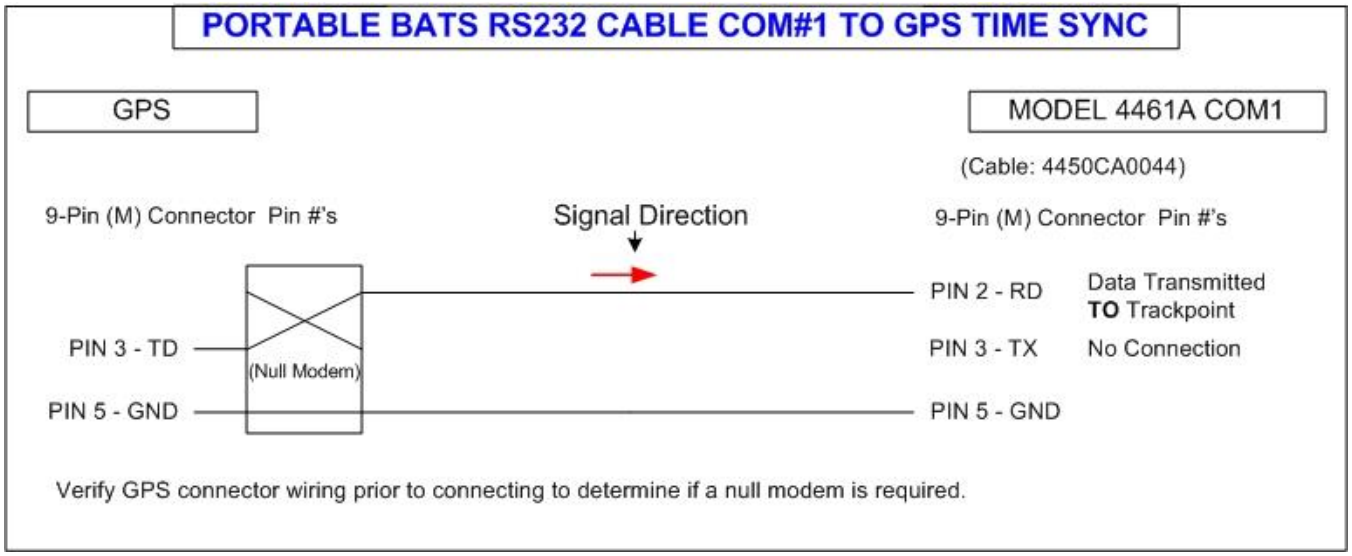
- Align indexes on connectors and mate with minimum twisting and flexing
- Care must be taken not to damage contacts in unmated connectors
- Contact surfaces must be dry prior to mating.
- Lubricate mating surfaces with 3M Silicone Spray or equivalent. DO NOT GREASE. Connectors must be lubricated on a regular basis.
- Avoid contact with solvents.
- Grip main body of connector during mating or unmating. Do not pull on the cable to disconnect.
- Avoid sharp bends at cable entry to connector.
- Elastomers can be seriously degraded if exposed to direct sunlight or high ozone levels for extended periods of time.

NOTE: Do NOT allow Silicone Spray to come in contact with the Hydrophones potting.

OPTIONAL INTERFACE INTER-CONNECTS

2.3.4 PORTABLE BATS – COM#1 CABLE WIRING (GPS TIME)

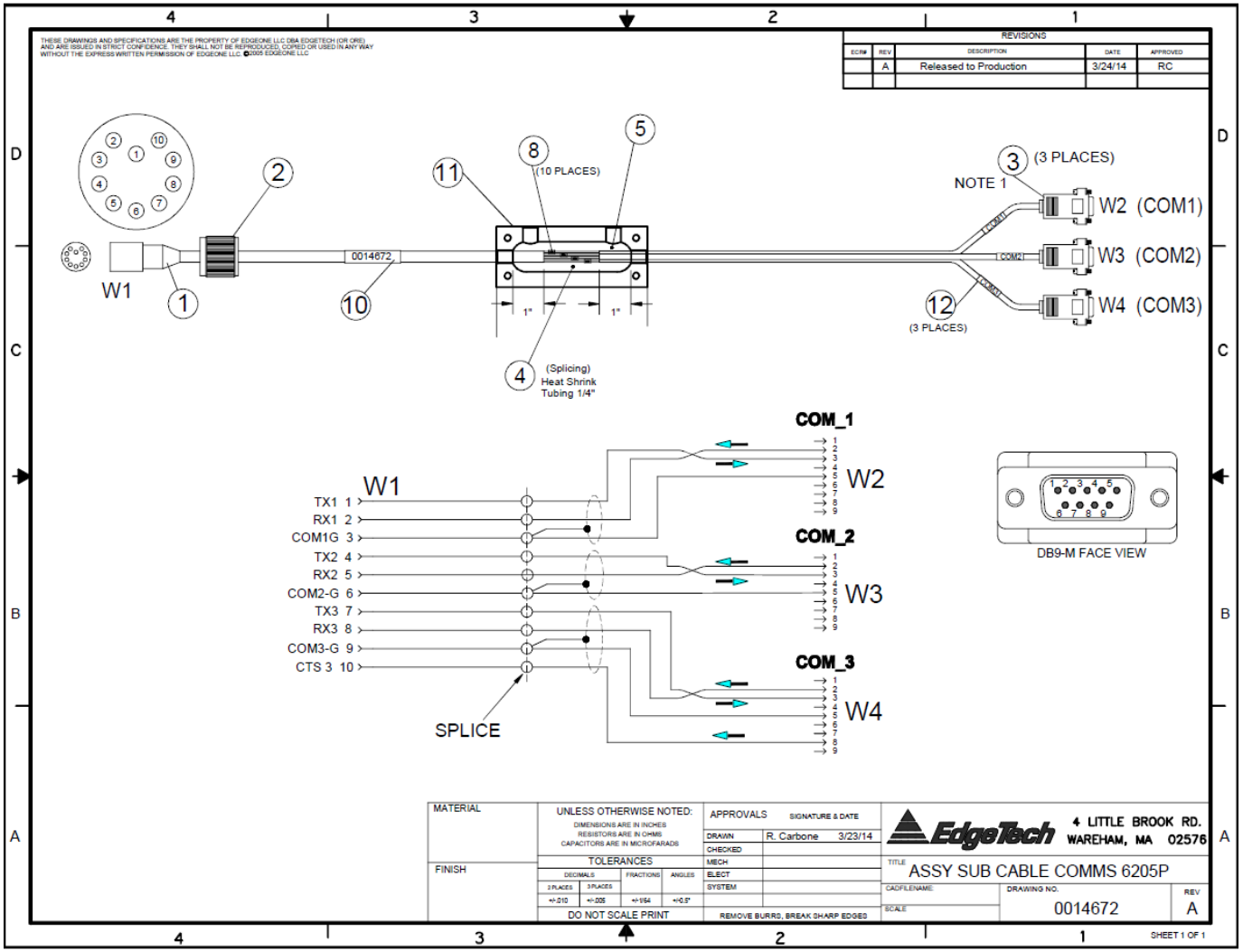
The COM#1 input port is only used for inputting the GPS sentences into the BATS to synchronize the GPS time to the BATS time. An Interface Cable is provided, 4450CA0044, to allow connection to the systems three comports. Install a 9-pin (F) cable from the COM1 port of the 4450CA0044 COMS Cable and the GPS RS232 output. (GPS connector type may vary between manufacturers, refer to the GPS manual for pin outs to determine if a null modem is required). See Figure 1-6 for side panel connectors. Refer to section 3 to configure BATS for GPS time sync. See Figure 2-20 for Serial Cable Assembly.



2.3.5 PORTABLE BATS - COM#2 COMPASS NMEA INPUT

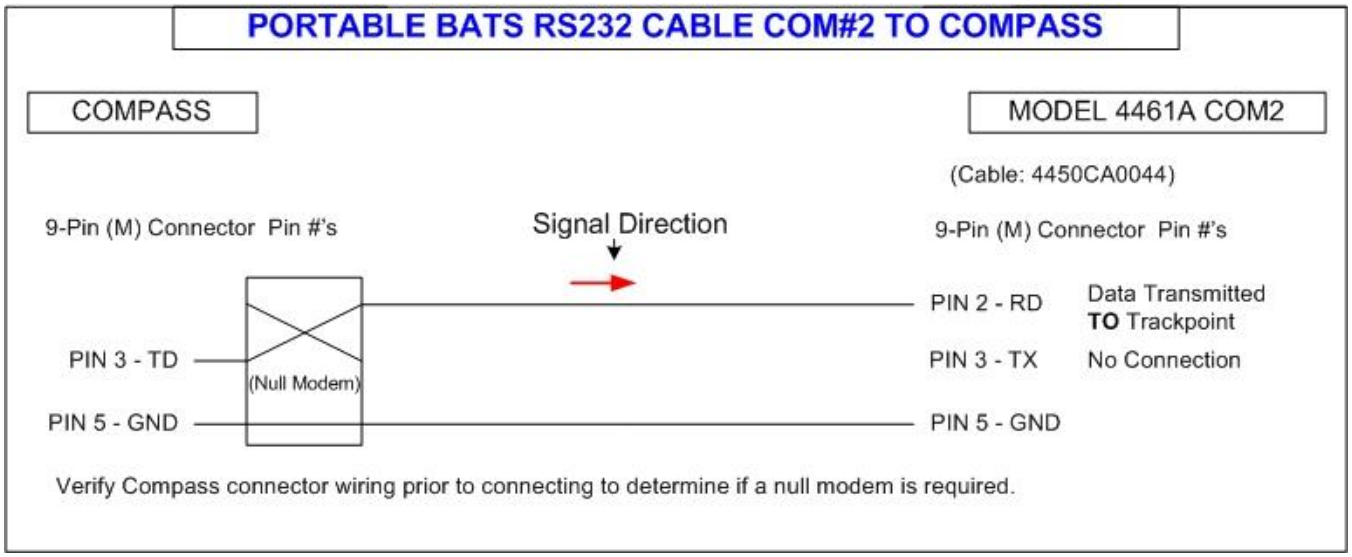
(Cable Wiring; 9-PIN MALE `D' CONNECTOR, Figure 2-20, 4450CA0044)

The Portable Transceiver (Model 4461A) COM #2 Input port is wired the same as a PC ("DTE", Data Terminal Equipment). It is used for the input of NMEA compass data. See Figure below for wiring. See section 3 for NMEA formats accepted. May require a Null Modem depending on the Compass wiring.



BATS-PORTABLE COMMS CABLE

FIGURE 2-20



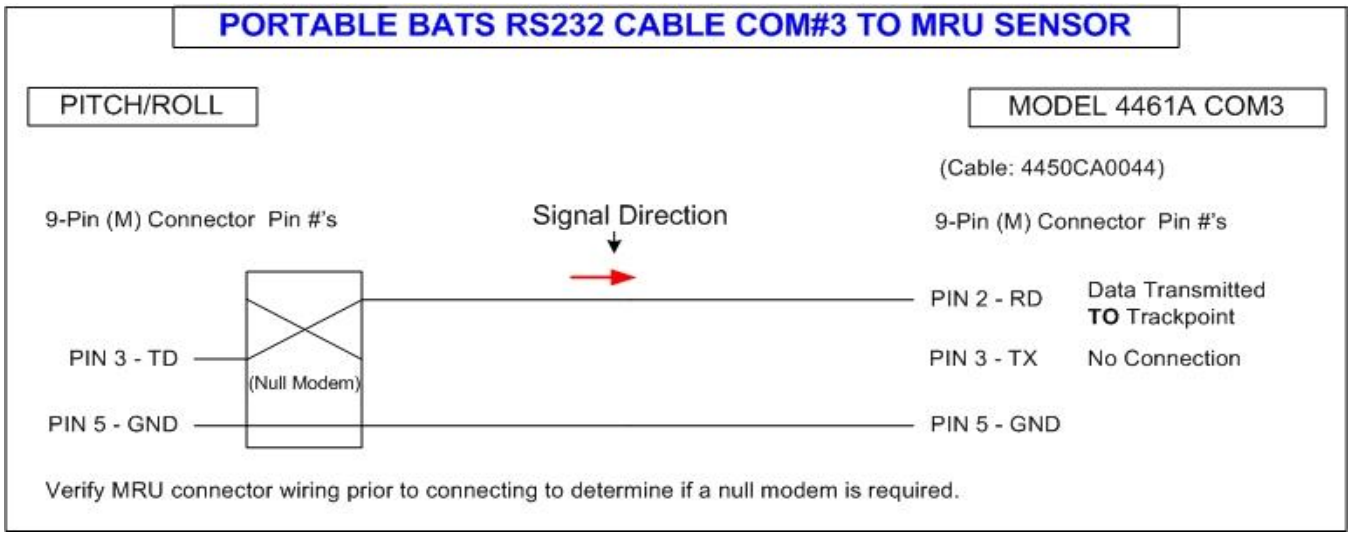
2.3.6 PORTABLE BATS - COM#3 PITCH/ROLL NMEA INPUT

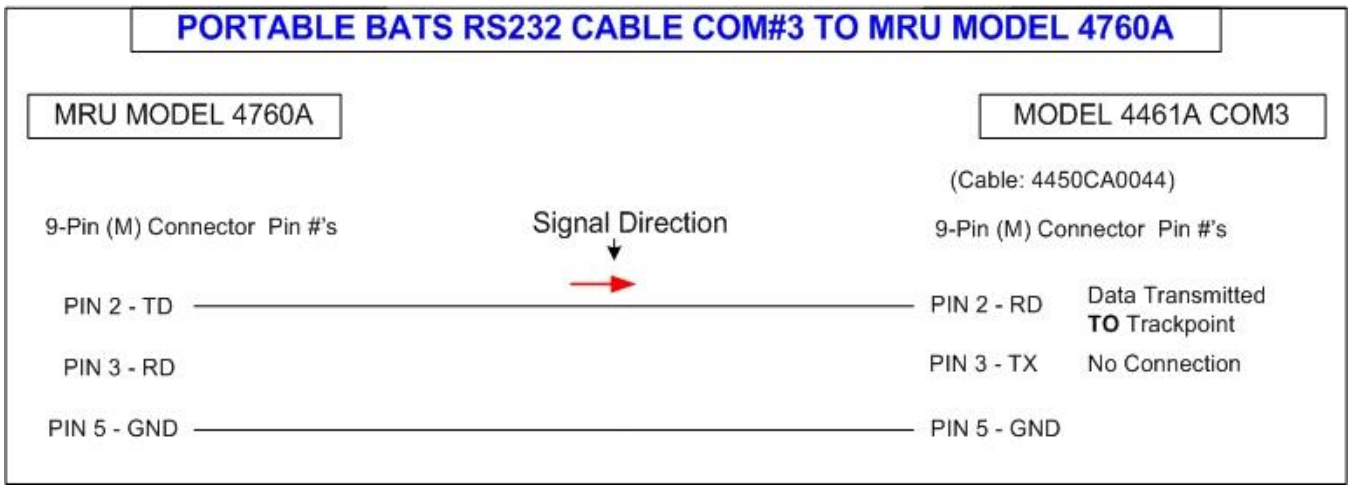
(Cable Wiring; 9-PIN `D' CONNECTOR, Figure 2-20, 4450CA0044)

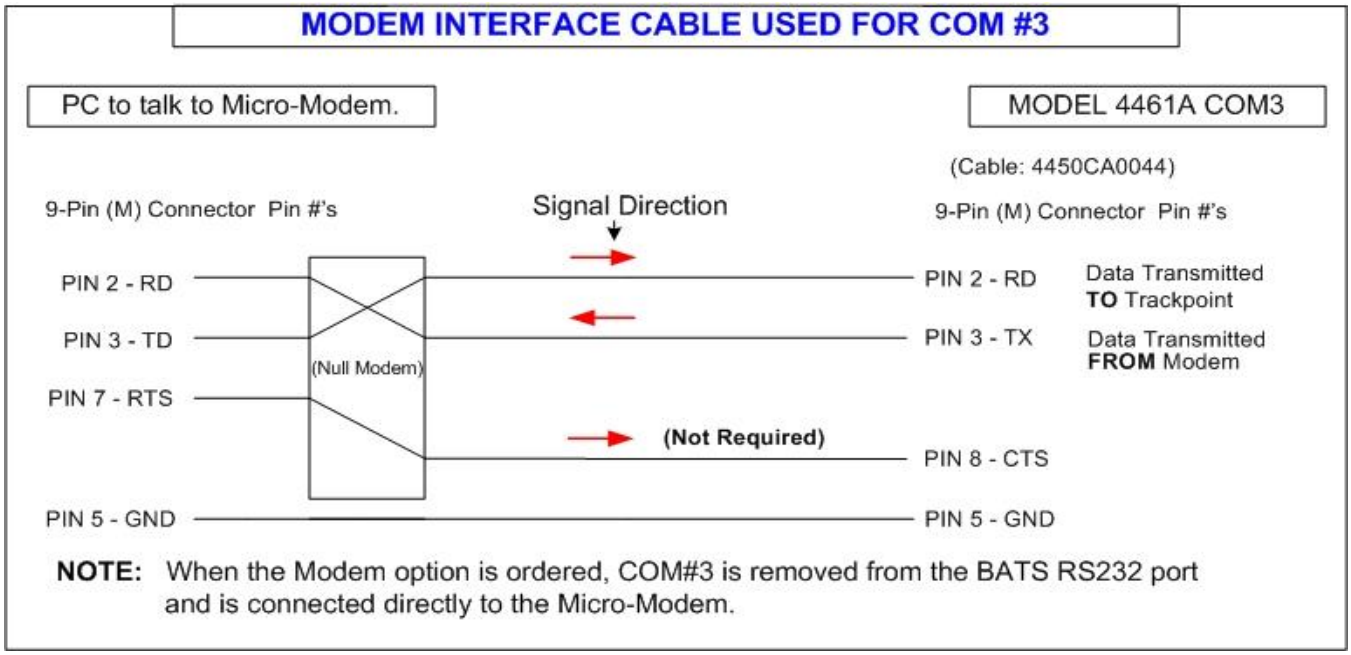
The Transceiver (Model 4461A) COM #3 I/O port is wired the same as a PC ("DTE", Data Terminal Equipment). It is used for the input of NMEA Pitch and Roll sensors. See Figures below for wiring.

If an EdgeTech MRU is interfaced to COM#3 the wiring has been crossed-over in the MRU so that a null modem is not required.

If the PORTABLE BATS is configured with the Micro-Modem option, COM #3 is used for the Modem Communications only and COM#3 is no longer available to the BATS.

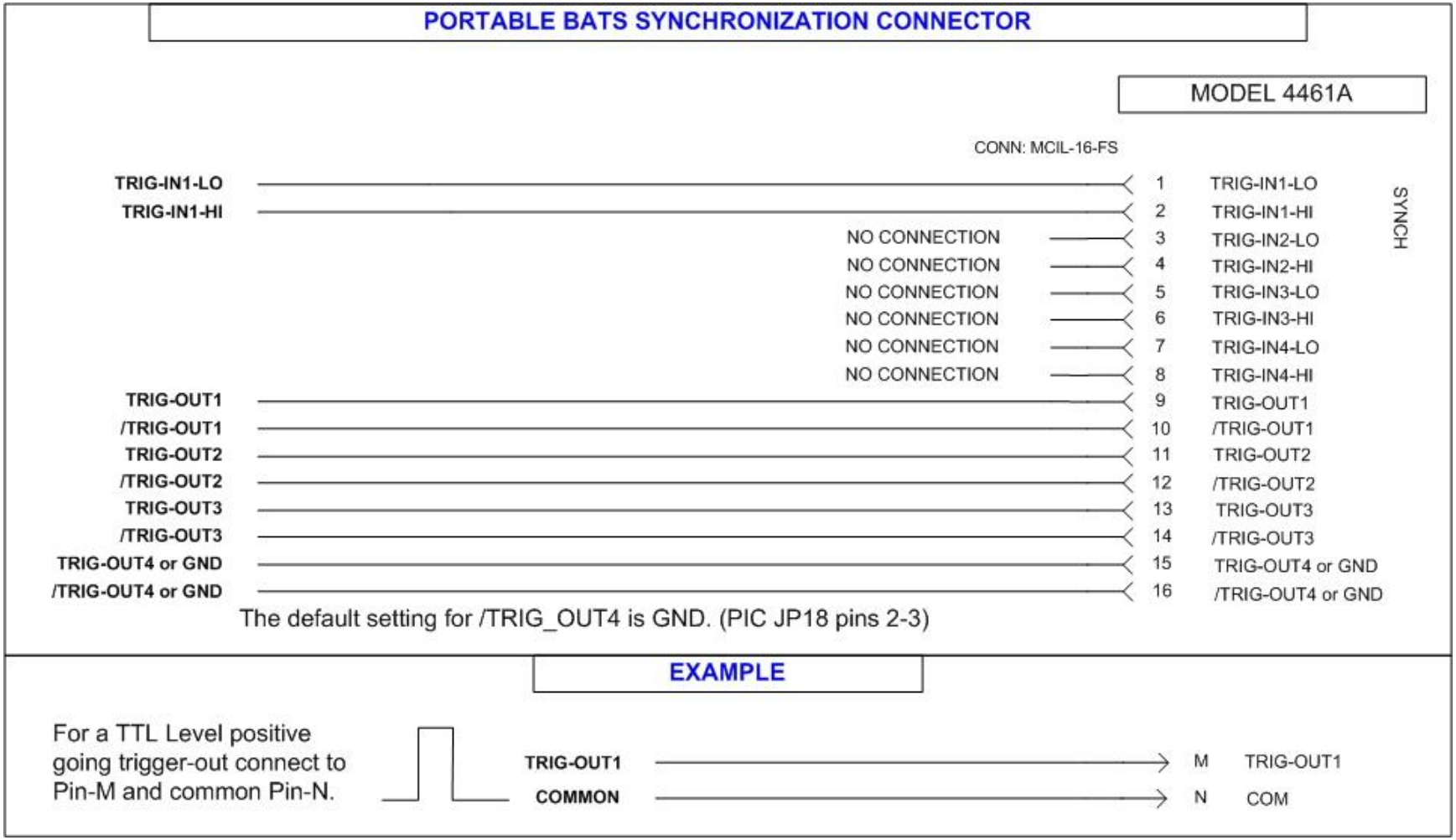






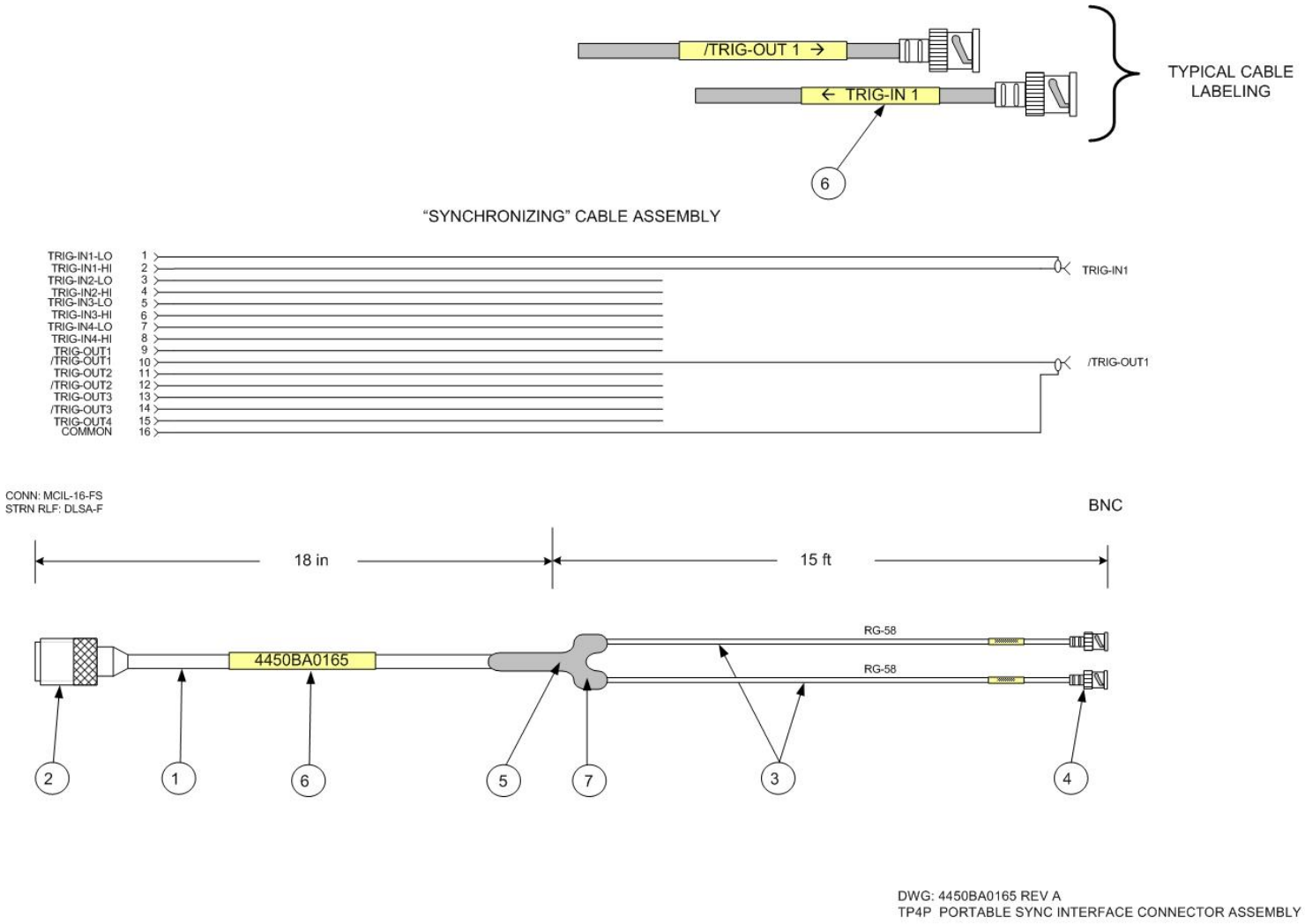
2.3.7 PORTABLE BATS - SYNCHRONIZATION INTERFACE

The SYNC connector on the BATS Transceiver allows input of an external trigger source and also outputs a Sync pulse on each interrogation. For example, a tow fish responder that triggers the beacon can also trigger the Transceiver to Sync the two units together. Also, a responder on an ROV can be triggered via the differential signal at the SYNC connector. See Figure 2-21 for connections and typical cable assembly (optional). The mating cable assembly is 4450BA0165. See Figure 2-22.



BATS-PORTABLE SYNC CONNECTOR

FIGURE 2-21



BATS-PORTABLE SYNC CABLE; 4450CA0165

FIGURE 2-22

2.3.7.1 INPUT TRIGGER

The Transceiver can be externally triggered via the "SYNC" connector located on the side panel of the Portable unit. A synchronization cable is provided (4450BA0165) for Trigger In and /Trigger_Out1. See Figure 2-22. This can be connected between an external key source (trigger source can range from TTL to +15V) and the BATS Transceiver. Connect the external trigger between the TRIG-IN1-LO and the TRIG-IN1-HI[3]. The external trigger for Target #1 becomes the master for all other targets when in this mode. All other targets switch to external mode, (via Trackman Software) synching from the trigger #1's source. Set the Trigger edge that you want to trigger the unit with in the Trackman Software. See section 3.

2.3.7.2 TRIGGER OUT (NEG)

A synchronization cable is provided (4450BA0165) for Trigger In and /Trigger_Out1. See Figure 2-22. The TRIGGER out is a negative going TTL pulse occurring at the time of interrogation for a transponder or a responder. This TRIGGER out pulse is present simultaneously with the leading edge of each interrogation pulse.

2.3.8 PORTABLE BATS - ANALOG SENSOR INTERFACE

The ANALOG input connector allows input of an analog signal from a compass, dynamic motion sensing system, (analog pitch and roll signals from an external sensor such as the EdgeTech Model 4414B), and also the depth signal from an underwater vehicle. For the Analog Input connections see Figure 2-23. An interface cable is provided, see Figure 2-24, 4450BA0166, for inputting analog pitch and roll sensors to the BATS. The 4760B MRU uses this interface to provide +12VDC to the unit while the RS232 connects to COM #3.

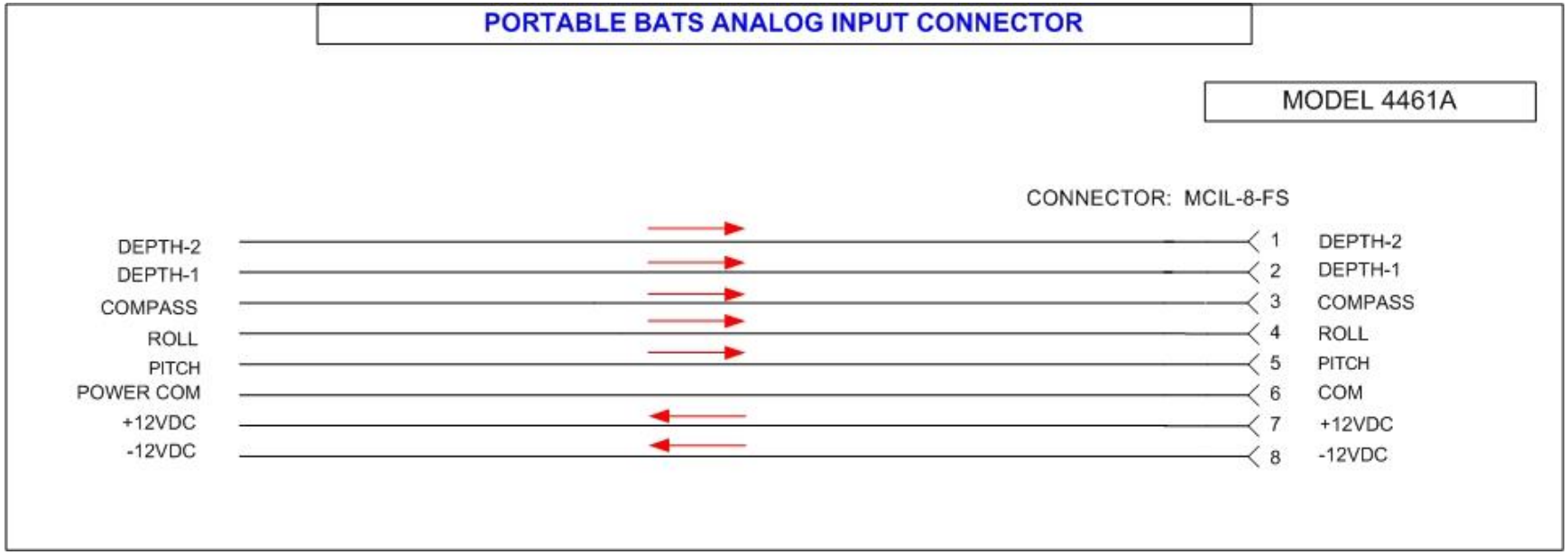
2.3.8.1 DEPTH INPUTS

The analog output voltage from a depth sensor (typically located on a vehicle being tracked) connects to the ANALOG input connector located on the rear panel of the Transceiver. See Figure 2-19. The BATS converts this analog voltage (0 - 6 VDC maximum) to a target depth.

2.3.8.2 ANALOG COMPASS INPUT

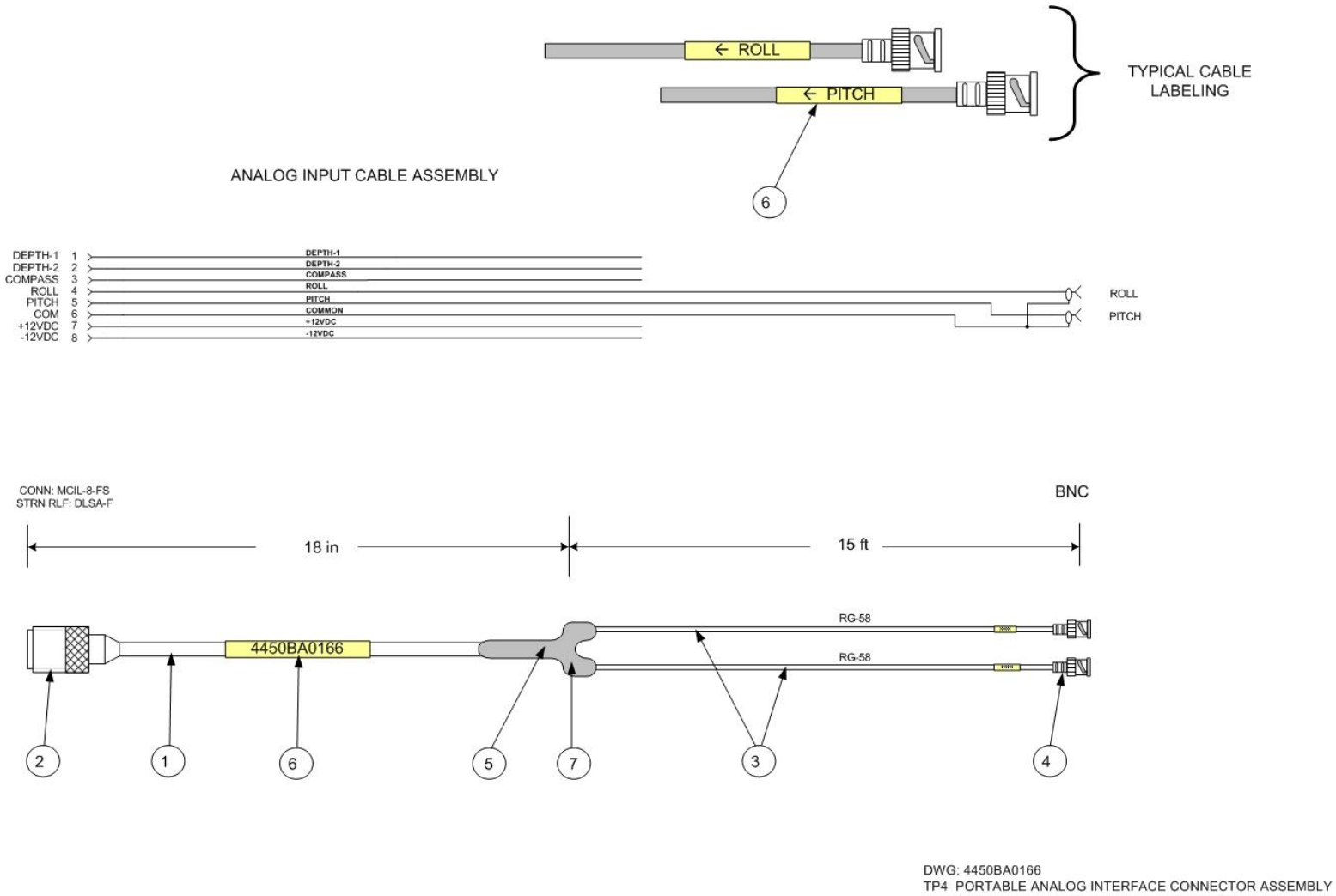
The analog output voltage from a compass (0 - 6 VDC maximum) connects to the COMPASS input of the ANALOG connector. See Figure 2-23. The BATS converts this analog voltage to a vessel heading in degrees.

[3] NOTE: The REMOTE-IN trigger is optically coupled.



BATS-PORTABLE ANALOG CONNECTOR

FIGURE 2-23



BATS-PORTABLE ANALOG CONNECTOR

FIGURE 2-24

2.3.8.3 VRU INTERFACE (MODEL 4414B)

The VRU input of the ANALOG connector accepts PITCH and ROLL analog signals from an external dynamic motion sensing system, such as the EdgeTech Model 4414B. (See Figure 2-24.) 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 Transceiver 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 LINEAR is 0.2 V/degree (+/- 10VDC = +/-50°). (optional scaling is 10 sin σ)

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 software (Trackman) 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 EdgeTech 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.

When using the Model 4730B VRU setup the Attitude Sensor for Internal. This automatically sets up the parameters to agree with this standard EdgeTech sensor.

Connect the pitch signal to pin-L and the roll signal to pin-S. Connect the analog commons to pins-P & R respectively.

Also see the newer EdgeTech MODEL 4760B MRU. It uses MEMS technology to provide very accurate pitch and roll data. It connects to the Analog Connector for its power and to COM#3 for its data.

2.4 HYDROPHONE OFFSETS

The BATS 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 2-1, 2-2 & 2-3), 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 repeatedly returns 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.

2.4.1 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 2-25.

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 2-25.) 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 System on and set it up to track the beacon in use. If you have aligned the mounting bracket correctly, the system tracks 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. Bearing Offset can be entered under the USBL HYDROPHONE PARAMETER menu.

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. For example, a minus 5 degrees would subtract 5 degrees from the target (beacon) bearing while a positive 5 degrees would add to the present target bearing. See Figure 2-26.

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 2-25).

   The target bearing should now be 180 degrees on the Trackman 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 2-25). The target bearing display should now read either 090 or 270 degrees, depending on which side of the vessel the mounting is located.

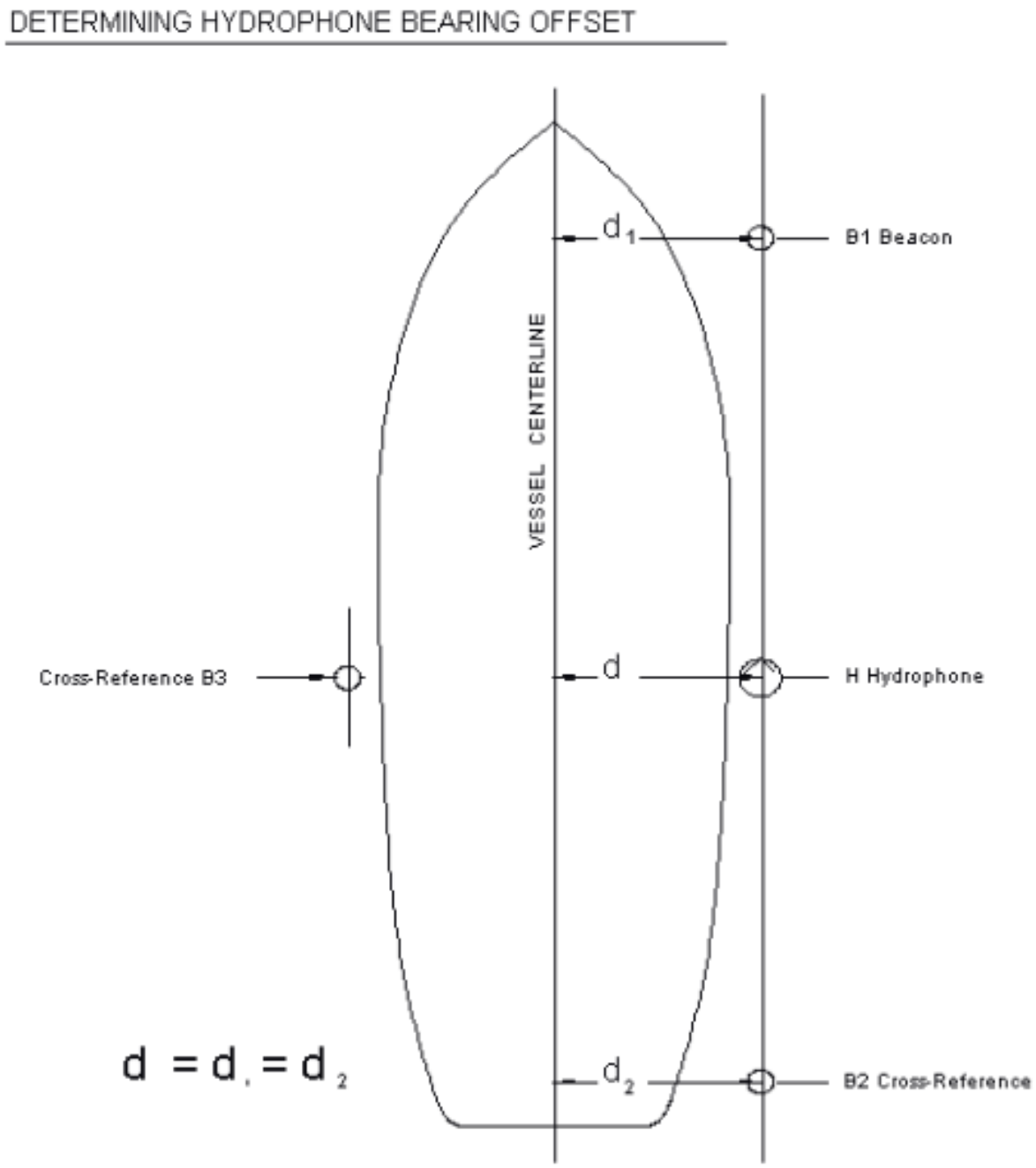
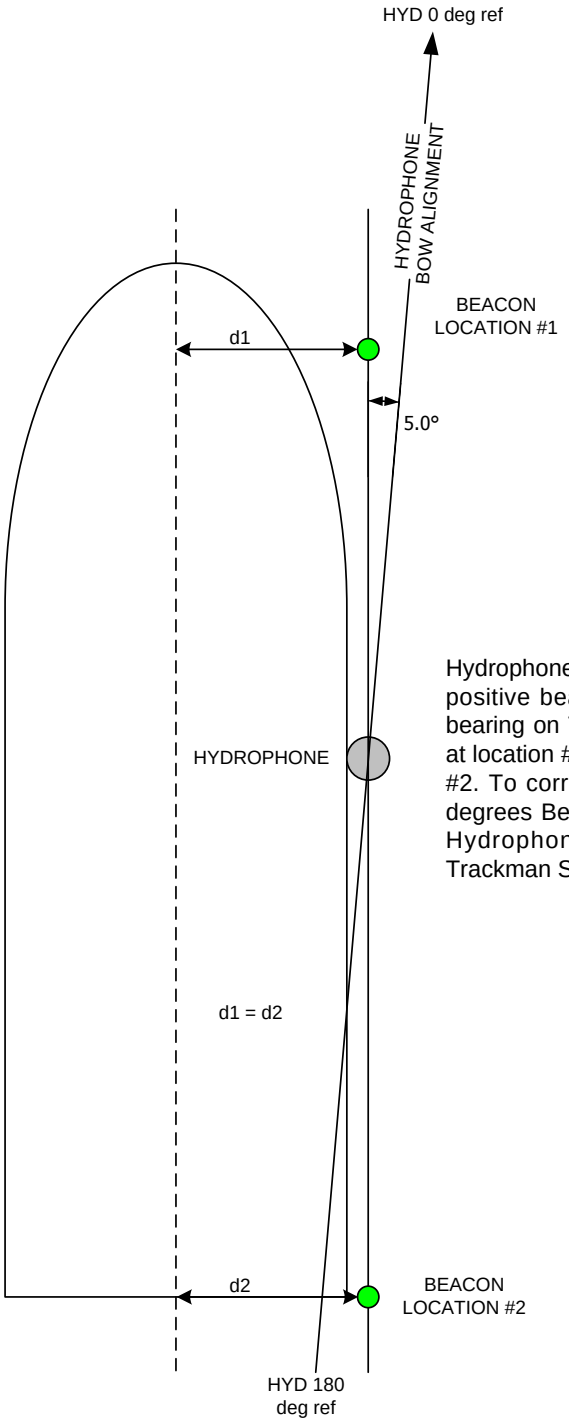

DETERMINING HYDROPHONE BEARING OFFSET
VESSEL CENTERLINE
d1
B1 Beacon
Cross-Reference B3
d
H Hydrophone
d = d1 = d2
d2
B2 Cross-Reference

FIGURE 2-25



Hydrophone is mounted with a 5 degrees positive bearing offset. Target (beacon) bearing on Trackpoint reads 355 degrees at location #1 and 175 degrees at location #2. To correct for this enter a positive 5 degrees Bearing Offset under the USBL Hydrophone Parameters menu in the Trackman Software.

FIGURE 2-26

2.4.2 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 BATS. See EdgeTech Model 4414B Motion Sensing System. Connect the analog outputs from the Motion Sensor to the rear panel Gyro/VRU input connector.

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".)

NOTE: The Trackman Software 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.

In Figure 2-26, 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 2-27). The Y coordinate is the distance parallel to or along the centerline (dy_H in Figure 2-27).

   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 2-27, the hydrophone is aft of the pitch / roll center, and the Y offset is -10 meters.

B. Enter the offsets at the Trackman and observe the display to verify that the hydrophone is being offset in the proper directions. Figure 2-27 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.

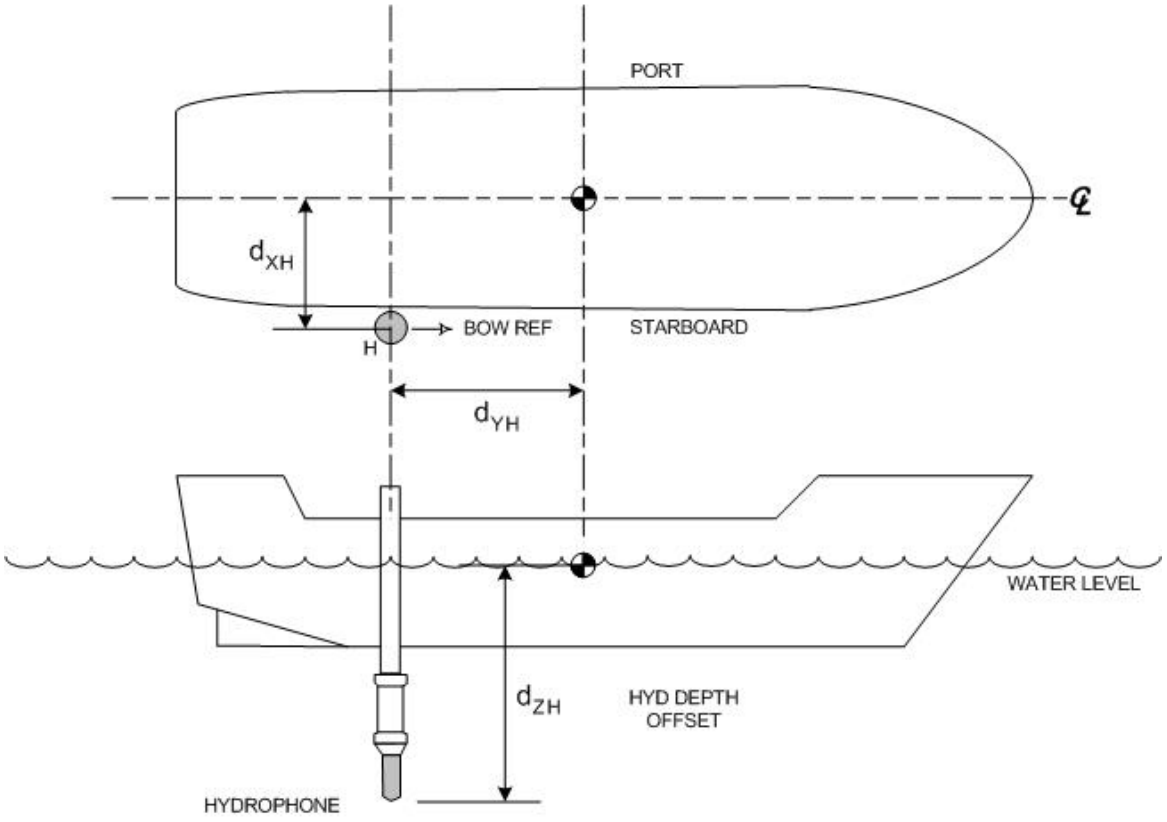
C. Hydrophone Depth is the depth of the hydrophone below the surface of the water. (Refer to Figure 2-27.) Depth is entered as a positive value.

The BATS 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), BATS ignores the entered X and Y offsets so that it can display a correct bearing relative to the hydrophone. Refer to section 3.6, error code 51.

DETERMINING X, Y & Z HYDROPHONE OFFSETS

FIG- URE 2-27



H = HYDROPHONE
dXH = +7M ; HYDROPHONE "X" OFFSET
dYH = -10M ; HYDROPHONE "Y" OFFSET
dZH = 6M ; HYDROPHONE "Z" OFFSET
◓ = PITCH/ROLL CENTER OF VESSEL

NOTE

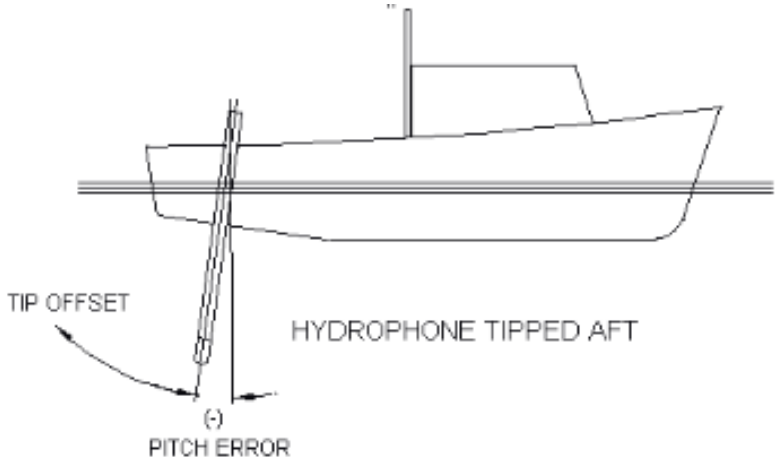
The X and Y coordinates of the USBL Hydrophone are different from the X and Y MRU coordinates of the ORE Motion Reference Unit (Model 4760A). The Z axis polarity is also different. (The Hydrophone Z Offset is always positive below the water surface while the MRU Offset below the water surface is negative.) Refer to MRU Manual for entering offsets into the MRU.

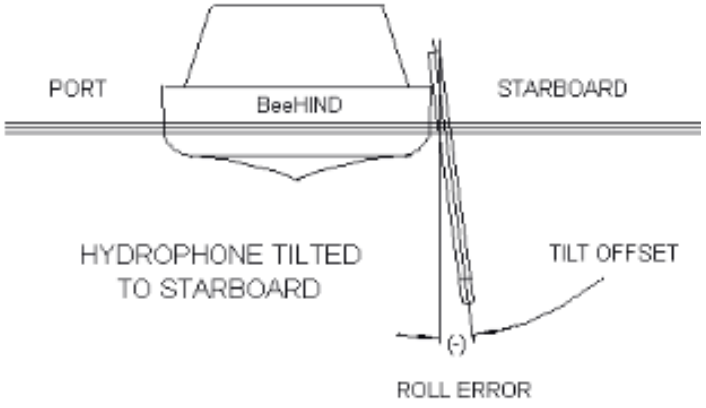
2.4.3 HYDROPHONE-VRU OFFSET

The VRU offset is the difference in angle between the installed hydrophone and vertical (static offset). (It can also represent the offset between the Remote Dynamic Motion Sensor and the Hydrophone.) 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 (or difference between DMS and Hydrophone).

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.

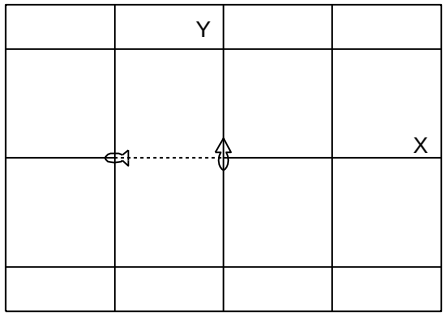
ORIENTATION: Change the VRU ORIENTATION if the Model 4740A VRU/Amplifier is mounted on a surface other than bow facing. For example, if the arrow at the top of the unit is pointing towards starboard then change the ORIENTATION parameter to starboard.





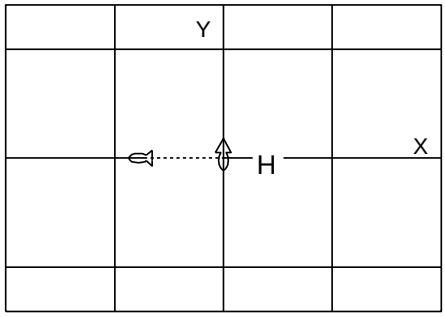
ENTERING X AND Y OFFSETS

TRACKING WINDOW
GRID SPACING 25yd



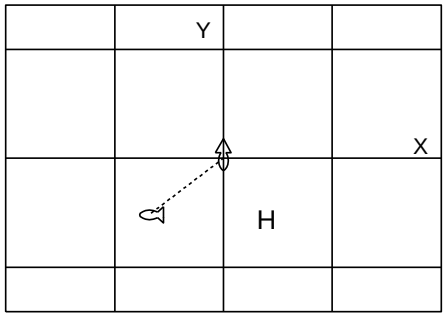
X OFFSET = 0yd
Y OFFSET = 0yd

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 2-28

2.5 SOFTWARE INSTALLATION

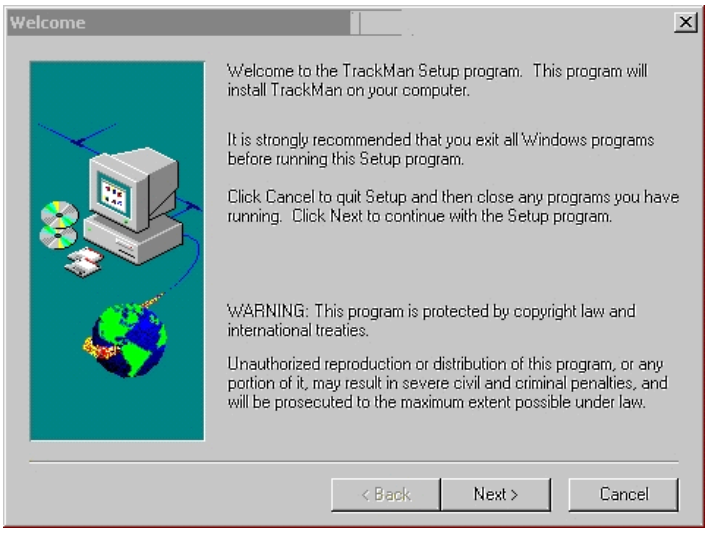
The BATS control and display software, "Trackman", is provided on a cd. The minimum hardware requirements are…

Operating System	Win-2000 or XP (XP recommended)
Hardware Platform	A PC with Pentium-3 or better processor, SVGA graphics (the software will run on 640 x 480 VGA, but this is not recommended) and at least 512 Megabytes of RAM is required as a minimum or 1GByte recommended for optimal performance of the TRACKMAN software. An Ethernet Port. A CD ROM drive in order to install the software.

2.5.1 INSTALLATION FROM CD

Boot up pc and insert the "Trackman" cd into cd-rom drive.

The "TRACKMAN" CD contains the following files for installation.



```
_SETUP.1
_SETUP.DLL
_INST32I.EX_
_ISDEL.EXE
SETUP.EXE
DISK1.ID
AUTORUN.INF
SETUP.INI
SETUP.INS
SETUP.ISS
_SETUP.LIB
SETUP.PKG
```

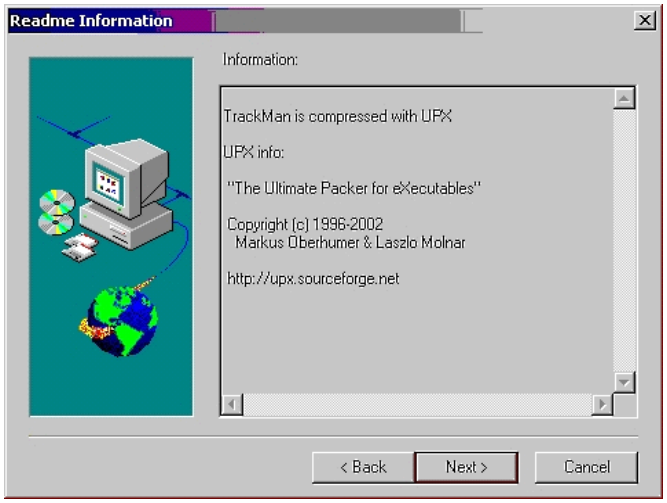
As long as the CD drive recognizes the "autorun.inf" file the installation program begins automatically. If not, then from the "RUN" line in Windows, type in the drive letter of the CD ROM drive and the file name "setup.exe". E.g., E: setup.exe.

Once the installation program has started you will see the following dialog boxes.

Welcome screen with note on exiting all programs prior to installation.

Readme information on the Packer used to compress the files.

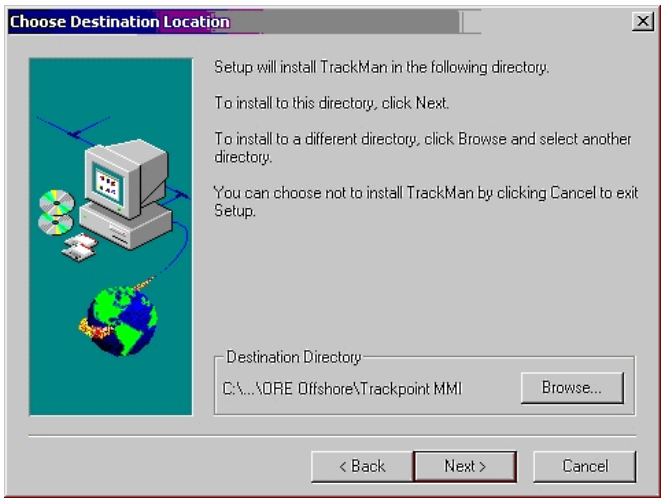
Hit Next button to continue.



Destination of the files to be installed. You can either use the default folder of C:\PROGRAM FILES\ORE OFFSHORE\ TRACKPOINT MMI or the folder of your choice. Hit Browse button to select different folder.

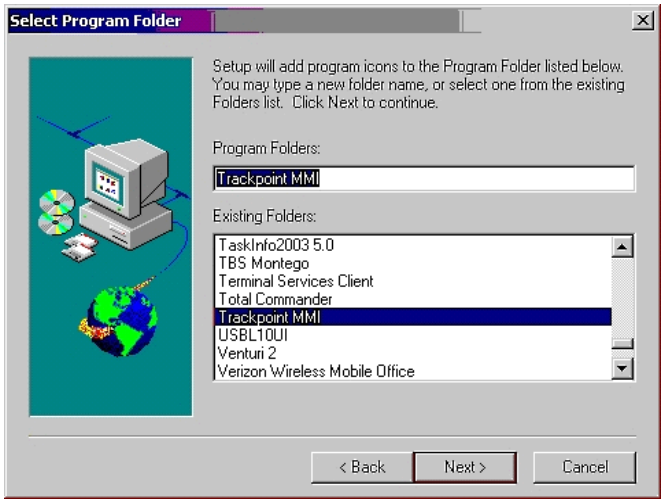
(**Note:** MMI = Man Machine Interface)

Hit Next Button to continue.

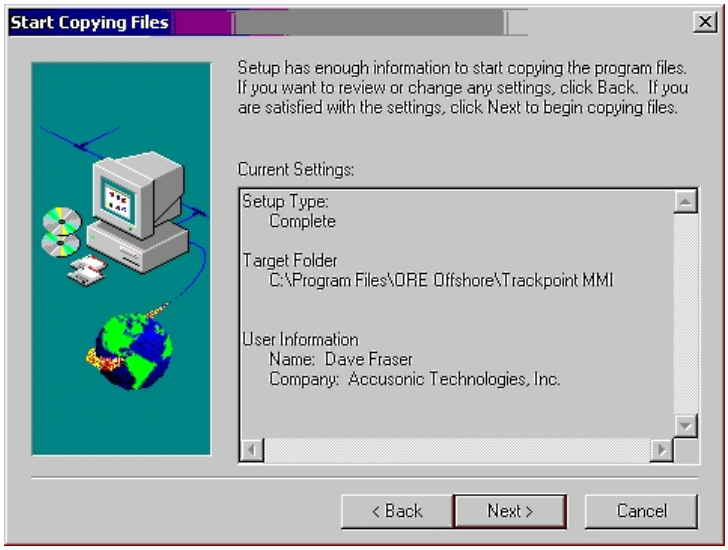


The name for the Program Folder that the Trackman application will be installed under is shown next. The Default Folder name is TRACKPOINT MMI. Type in a new folder name under the Program Folders: edit box to change the Program Folder name. (The default name is recommended for ease of upgrading in future.)

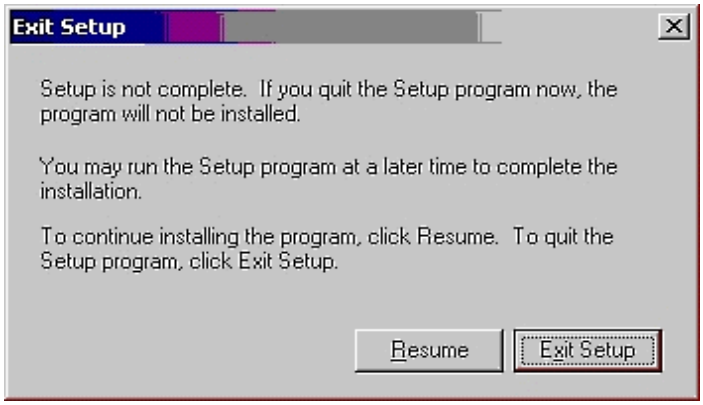
HIT NEXT BUTTON TO CONTINUE.



The installation program displays the Target Folder path that it will create and install program into. If these settings are OK then hit the Next button to continue.



Once installation begins you still have the option to cancel the install prior to it finishing. Click the Cancel button to stop the install. You then have the option of Resuming the install or Exiting the install program.



The installation program creates a TrackPoint MMI item under the Programs menu.

2.5.2 CALIBRATION FILES

Copy the CAL Files located on the CD to the Trackman PC (Laptop) or Model 4451A under the following directory;

c:\Program Files\ORE Offshore\Trackpoint MMI\CalFiles**InUseCAL***.bhi

c:\Program Files\ORE Offshore\Trackpoint MMI\CalFiles**InUseCAL***.blo

SECTION THREE

OPERATION

3. OPERATION

Once Trackman software is installed (if PC not supplied) and all cables are connected as per section 2;

Open up display panel and keyboard. Turn on Display/Keyboard from rear of unit.

Turn on Transceiver from front of unit.

Turn on Processor from rear of unit and then open up front panel access with key. Press momentary switch at left. See Figure 3-1.

MODEL 4451A "ON" SWITCH

FIGURE 3-1

The Windows® operating system boots-up and starts the EdgeTech BATS Interface (TRACKMAN) program. The Trackman program automatically sends the previously setup system and target parameters to the Transceiver upon start-up[4]. The Transceiver returns the status of the system and it is displayed on the screen. (Also, see "Get BATS Config" under SETUP menu). In a rack mount configuration supplied by EdgeTech, if the power is removed from the unit, the PC automatically starts and boots into the TRACKMAN program without operator intervention upon return of power.

[4] It takes approximately 35 seconds for the Transceiver to boot-up. Wait at least 30 seconds after booting the PC before setting parameters within TRACKMAN.

NOTE: The Hydrophone calibration data is used by the Trackman software. A set of calibration files (included with every Hydrophone) is copied into its directory. Changing of the Hydrophone requires that the two files that comprise the calibration factors be installed into the Trackman PC's folder; C:\Program Files\ORE Offshore\Trackpoint MMI\CalFiles\InUseCAL\.

The BATS Transceiver, Model 4460C, front panel is shown in Figure 3-2. The front panel contains an ON/OFF switch and LED indicators for troubleshooting system. (The indicators are the same for the Portable BATS Model 4461A.) The LED indicators are described as follows…

POWER

+5	When illuminated, indicates that the +5V supply is operational.
+12	When illuminated, indicates that the +12V supply is operational.
-12	When illuminated, indicates that the -12V supply is operational.
+24	When illuminated, indicates that the +24V supply is operational.

SELF TEST

When illuminated, indicates when performing its internal self test function.

TARGETS

TRIG IN (1,2,3,4)	When illuminated (yellow), indicates that a trigger has been received from an external source.
INTERR (1,2,3,4)	When illuminated (green), indicates when a beacon has been interrogated, either Internally or Externally (1, 2, 3 or 4
RECEIVE (1,2,3,4)	When illuminated (red), indicates when a beacon reply has been received from the indicated Target Acquisition Module (1, 2, 3 or 4). [5]

COM PORTS

XMT (1,2,3)	When illuminated (yellow), indicates that the Transceiver has Transmitted data from its COM PORT #1, 2 or 3.
RCV (1,2,3)	When illuminated (green), indicates that the Transceiver has Received data into its COM PORT #1, 2 or 3.
1PPS GPS	When illuminated (yellow), indicates that the Transceiver has received the 1 PPS signal from a GPS timing sync module.

[5] The LED indication will be approximately 1 interrogation cycle behind in time as all processing /detection takes place at the end of the cycle.

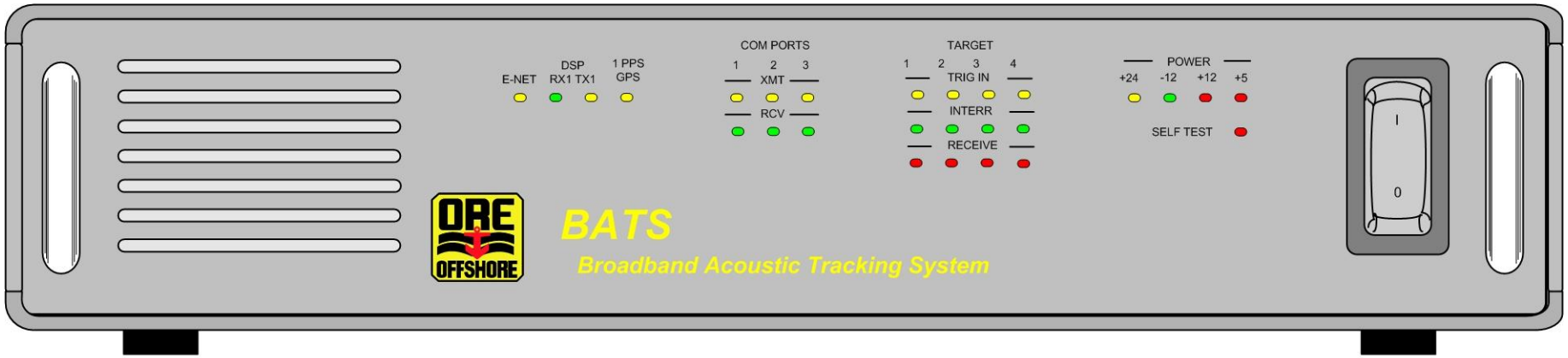
DSP

RX1 When illuminated (green), indicates that the internal data acquisition DSP card is receiving data from the internal SBC (Single Board Computer) . It illuminates when the Trackman software sends a system parameter to the Transceiver.

TX1 When illuminated (yellow), indicates that the internal data acquisition DSP card is transmitting data to its internal SBC. It illuminates when the the DSP is sending data to the SBC.

E-NET

When illuminated/flashing indicates activity on the Ethernet lines. If no flashing or continuous illumination then usually indicates a hardware Ethernet connection problem. Some flashing but no connection usually indicates a software setting, IP address or Port number is wrong.



FRONT PANEL

MODEL 4460B FRONT PANEL

FIGURE 3-2

3.1 "TRACKMAN" SOFTWARE PHILOSOPHY

I know from experience that sometimes you can just run a program and everything seems intuitive from the start. Other programs you struggle through and nothing makes sense as far as the menu structure. I am going to give a brief overview of our design philosophy and how and why it was developed this way. So, when you are plucking through the menus saying to yourself "What was that person thinking?" maybe this will help! If not, send us an email. Criticism accepted! This software has been designed and tested on various computers and operating systems. It can run under Windows® 95, 98, ME, NT, 2000, and XP. Even given all our testing, I am sure there are some combinations of hardware and software that will cause some quirks in its operation, but for the majority of machines it is stable. See section 2 for recommended hardware and operating systems.

The "Trackman" (originally **Track**Point Data/Control **Man**ager) software evolved from EdgeTech's earlier TrackPoint II USBL system. It was designed to allow an interface between any of our new or future USBL products. It also has a means to communicate with Navigation software (e.g., IPS) on the same PC using UDP or TCPIP, that is sending the USBL data to a software port and having the Navigation software read it directly without having to go through hardware ports. This Trackman program can then be hidden[6] (minimized) once the USBL System has been setup and the Navigation software run as the primary display. See SETUP menu. The basic menu structure is shown below.

- **File Menu** Similar Windows environment FILE pull down menu. Controls typical PC interface items such as disk services and printer, etc. Exit also.
- **View Menu** Having to do with the viewing of the screen either plotting or setup.
- **Setup Menu** This is for system setup not related to the USBL system or BATS Transceiver. Beacons, PC, etc.
- **USBL Menu** Allows setup of items pertaining to the USBL Transceiver.
- **Test Menu** Built-in test or simulated target.
- **Window Menu** Allows various modes of tiling (Tile Custom & Auto Tile Custom) the windows, Tracking, Project, etc.
- **Help** Various Help Topics

[6] There is a feature ("Update While Hidden" function) that allows the Trackman software to not update the plotting while hidden (minimized). This saves a lot of processing power for use in other programs such as the Integrated Navigation programs. Trackman's main function is then to just collect and process data and pass it on to an Integrated Navigation Software package.

Menu Structure:

File Menu

Create New Job	Creates a new job configuration
Open Existing Job	Opens an existing job configuration
Disk Services	Open Disk Services dialog
Printer Services	Open Printer Services dialog
Exit	Exits the application

View Menu

Display Options	Open Display Options dialog
Project	Brings the Project Tree into view when not docked
Clear Grid	Clear the Plotting Grid
Clear Status Bar	Clear all Status Bar messages

Setup Menu

Beacon Wizard	Opens the Beacon Wizard dialog
Beacon List	Opens the Beacon List
Devices List (ports)	Open the Device List
Data Output	Opens to Output section of Device List
Attitude Sensor Setup	Opens up the Pitch/Roll Sensor Setup dialog
Compass Setup	Opens the Compass Setup dialog
Reset Devices/Ports	Shuts down and re-enables all Devices
Reset Grid/Graphics	Clears the graphics in the Grid Area
Find BATS	Trackman Searches for BATS devices on a network
Hints (Tool Tips)	Enable/Disable Tool Tips
Update While Hidden	When Trackman is hidden (tool bar) shuts down the graphics to reduce processing overhead and sends only updates out its communications ports.

USBL Menu

GPS/TimeSync	Open GPS/TimeSync dialog
Hydrophone	Open Hydrophone dialog
Acoustic Data	Open Acoustic Data dialog
Send BATS Config	Sends configuration to TrackPoint
Get Sensor Data	Retrieves Sensor Data from TrackPoint III
Get Status	Obtains the Status of the TrackPoint III Transceiver

Window Menu (All) Enhanced Windows MDI 'Window' menu

Help Menu

Contents	Display Help File contents page
Error Codes	Display Error Code info
About	Display the About Box

Other items of interest…

Jobs: Stores all the setup parameters to a "Jobs" folder/file.

Project Tree: A Project Tree was developed as a graphical view of the parameters that normally would change via the standard menus. It is a drag & drop window that can move or be hidden. The Computer icon is shown at the top as the primary unit. This is the hardware platform that runs this software. Under the Computer are it peripherals, display, disk services, printer, etc. The Device List shows in a table[7] all the peripheral ports that communicate with the PC including the USBL System (BATS). A device can be any peripheral associated with the USBL System. It can communicate via its serial ports or TCP, UDP or UDP Broadcast. The Data Output icon brings up the same Device table but goes directly to the Device output line within the table. Just click on the line or hit Enter and the setup dialog box is displayed to allow setup of a port to output the tracking data. (We could have left this out and just showed the Device List but felt this brings attention to the operator to make sure the Data Output port is setup for the job.) The "to USBL Interface" is only for graphical representation of a port going to a USBL device (COM port). The "BATS" is only for graphical representation of the Transceiver. Under the "BATS" are the items associated directly with it. It shows the typical items that the operator should setup for USBL operation; GPS/TimeSync (format of data input), Hydrophone parameters, Acoustic Data (Speed of sound in water, temperature, etc.). The GPS is used for time syncing only. It does not reference the data to Latitude /Longitude. Typical ZDA or GGA sentence received uses the first character in sentence as the sync pulse for the time received in the sentence. This sets the clock within the Transceiver to better than 50ms accuracy. The time that is on each beacon's output sentence is the time that each reply was received.

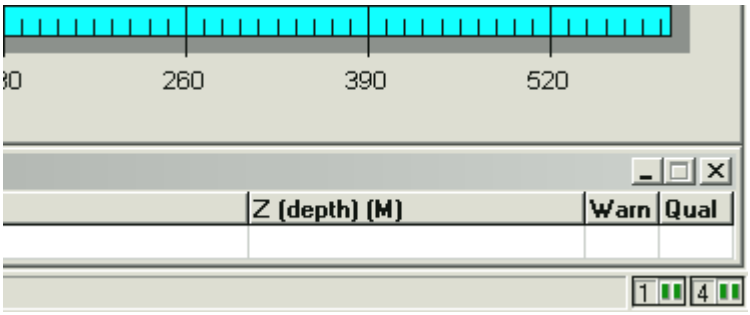
Sensor Setup: This is a system input setup dialog. Sensor inputs can be either from Heading Sensor (an analog or serial input to the Transceiver or serial only to the PC) or an Attitude Sensor (internal to BATS Hydrophone if applicable or a remote analog sensor input to the Transceiver or NMEA into either USBL or Trackman PC).

Beacons: Clicking on the Beacon(s) icon brings up a table for beacon entry. It also provides a quick view of the Beacon parameter settings. Click on any line within the Beacon Setup Table to bring up its dialog setup box.

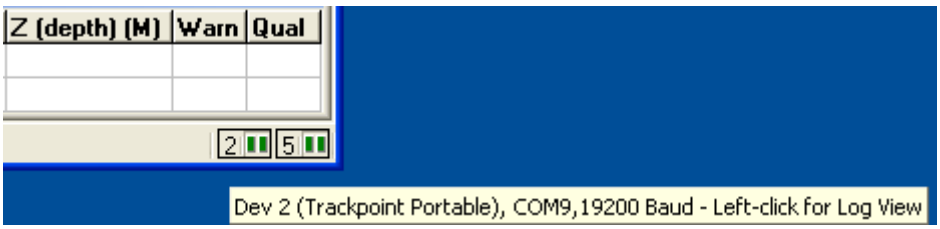
ORE ICON: Right clicking on the ORE icon on the task bar brings up a menu to allow closing of Trackman, showing the About box, or disabling the screen saver. For example, disabling the screen saver can be useful when tracking your ROV and the screen saver decides to start the starfield[R] display just when you are trying to see where your ROV is with respect to the boats prop! Click on "Disable Screen Saver" to prevent screen saver from turning on.

Device List Status Blocks: 

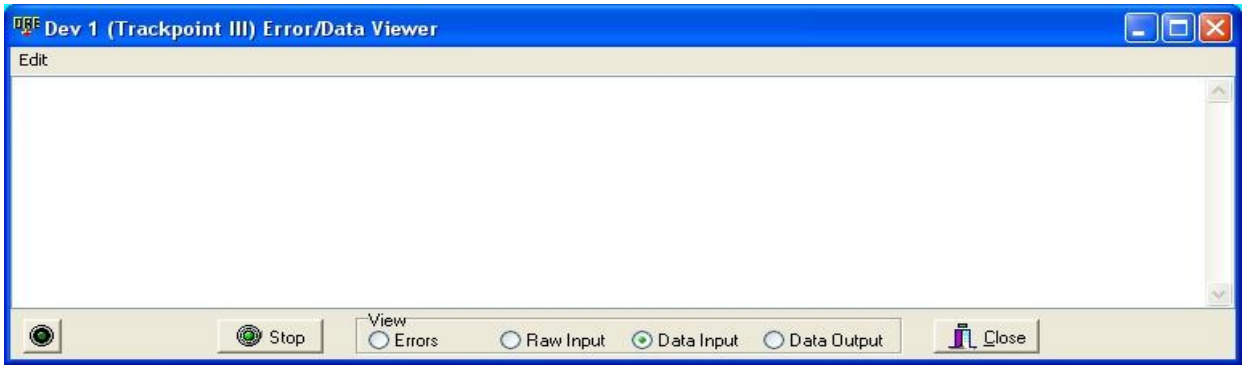
[7] When the table is displayed the "Trackman" GUI is minimized.



The communication function within Trackman is an ActiveX module. Internal to Trackman it is called the "TrakComX" module (TrakComX.ocx). It is used for communication with various "devices" over Serial (COM) Ports or TCP_IP Sockets. Each "device" (BATS, depth sensor, compass, gyro, GPS, etc.) that Trackman connects to creates a 'copy' of TrakComX for that "device". (See Technical Note below.) A "Status Block" for each of the devices is shown in the lower right corner of the screen (Trackman Status Bar). It shows the Device number along with a simulated "LED" that blinks with the input or output of data. For example, two of these are shown above, one for "device" 1 and one for "device" 4: The two small green rectangles on the right side of each window act as transmit and receive indicators (left is transmit, right is receive) that 'flash' to indicate activity. The yellow background behind a number indicates an error has occurred on that device. Left-clicking on the number brings up the Error/Data Viewer window which can be used to display a running list of errors of the received data. Putting cursor over the device number shows a tool tip for that device giving device name, port number and baud rate.



Error/Data Viewing Window



Technical Note:

A software function within Trackman called TrakComX (aka a 'WinPort'), handles both Serial Ports and Sockets, each WinPort can handle a single Serial Port or Socket. Due to hardware constraints in Windows, if a Serial Port is already in use by an existing copy of WinPort an attempt to create a new copy using the same Serial Port will fail. This means that two copies of WinPort can NOT share a Serial Port!

Unfortunately, since many of the "devices" that we want to connect to are in fact individual pieces of hardware, they often share a common serial or network "bus" with many different style packets from the different "devices" running down the same wire. This means that some of the different "devices" we are trying to connect to may be on the same Serial Port such that if we were to try and use a separate copy of WinPort for each copy of TrakComX on that Serial Port all but the first one will fail.

Our way around this is to manage a 'pool' of WinPorts that allow copies of TrakComX, that require the same Serial Port, to share a copy of WinPort. Each time a TrakComX copy is created, the "pool" is checked to see if an existing copy of WinPort is already handling the new TrakComX copy's desired Serial Port, and if so, the existing WinPort is 'shared' by the new copy of TrakComX.

3.2 "TRACKMAN" MAIN WINDOW

Application Overview

The TrackMan Windows application provides a user-friendly interface for managing the EdgeTech BATS or BATS Portable USBL (Ultra Short Base Line) underwater navigation systems.

The interface to the BATS is via the Ethernet port. Other peripherals (Compass, Motion, or Depth Sensors) may connect via a COM (serial) port connection or a TCP/IP socket. This interface is handled by the TrakComX ActiveX control internal to Trackman.

From the application, the user can enter parameters by clicking on items displayed on a convenient tree diagram (the Project Tree) on the left side of the main screen. Data is displayed in one or more MDI child windows, such as the Plotting Grid, on the right side of the main screen.

If the application is being used only as an interface between BATS and another navigation application, it can be hidden from view via a left-click on the Tray Icon (the ORE icon in the System Tray area at the right end of the Task Bar). When hidden, a left-click on the Tray Icon will bring it back into view. Right-clicking the Tray Icon brings up a menu providing the ability to disable the screen saver, view the About Box, or close the application.

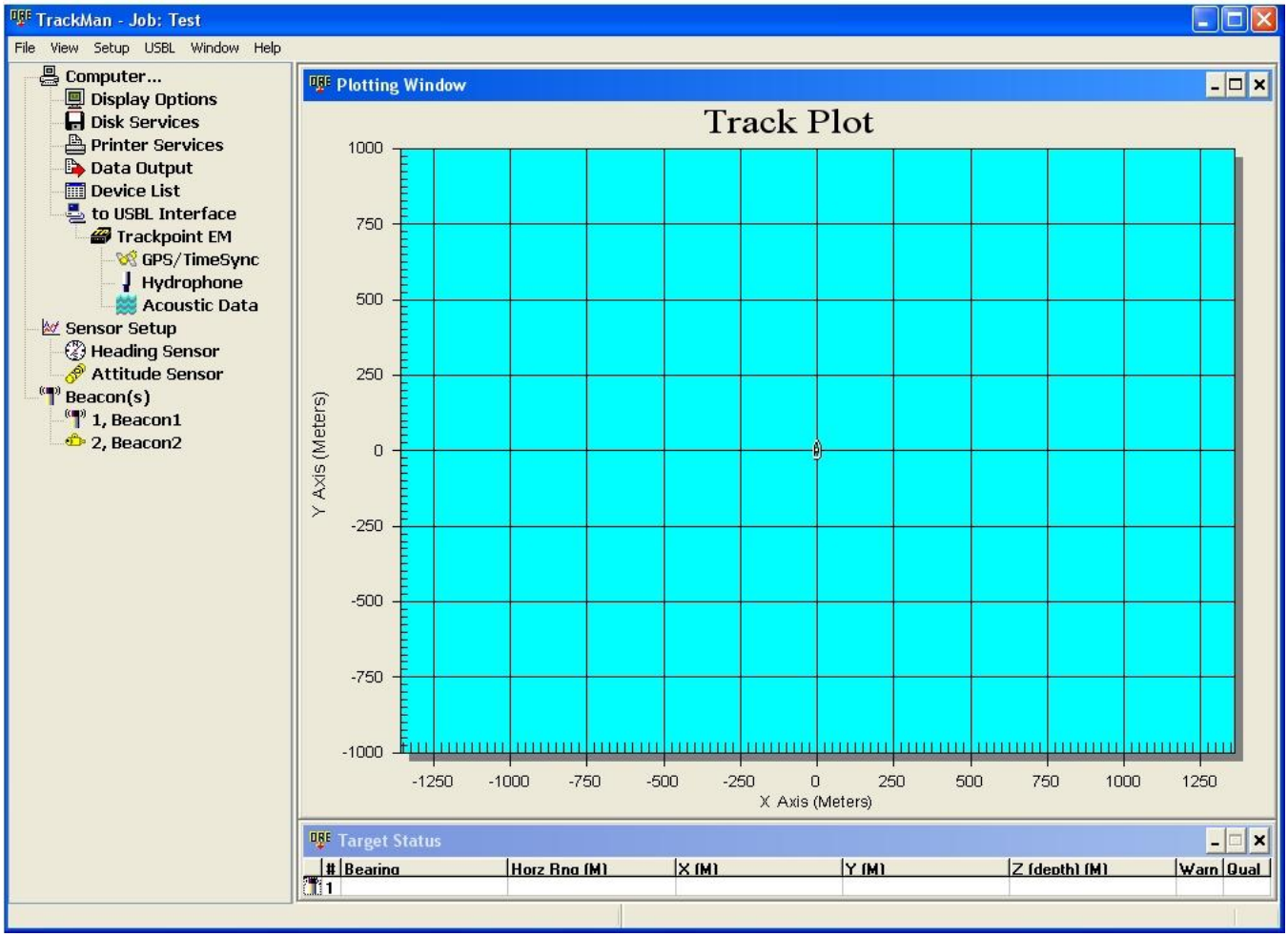
From the PC, start the Trackman application by navigating to the Program Folder [TrackPoint TRACKMAN] and clicking on the TrackMan application button. The main window is displayed. See figure below. It shows the Project Tree diagram on the left. The tree provides quick access to various configuration information. Clicking on most items will pop up a dialog window associated with that item.

Trackman starts running the previous "Job" that was saved. The Trackman software is a Windows based application that provides a remote interface from a PC to the BATS Transceiver providing target display and data output.

Project Tree Window

The Project Tree Window provides the user with a tree-oriented view of the system. The tree's nodes indicate the relationships of the various components. Most of the nodes provide direct access (via the keyboard or via mouse double-clicks) to related setup dialog windows.

Computer Node - This node displays various sub-nodes (Display Options, Disk Services, etc.) that provide access to basic system services as well as sub-nodes for access to the USBL Interface dialogs.



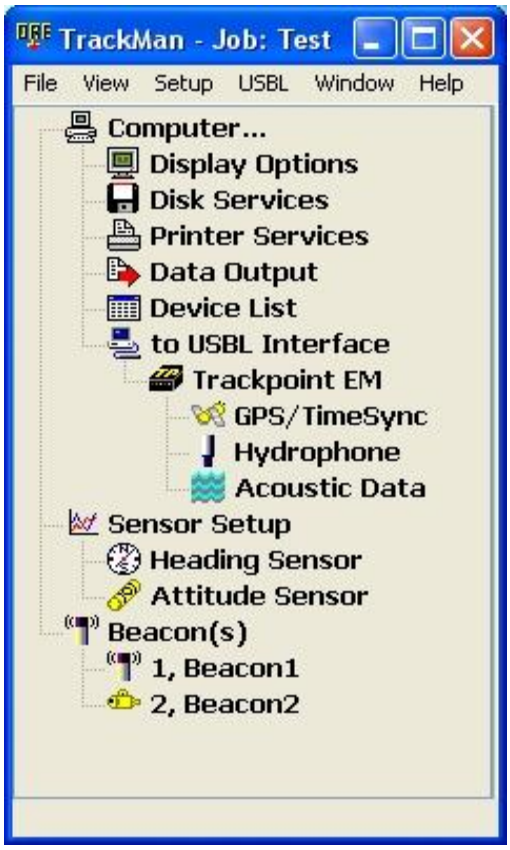
TRACKMAN BOOT-UP SCREEN

Sensor Setup Node – Displays setup paths for the various input sensors such as Compass and Pitch/Roll.

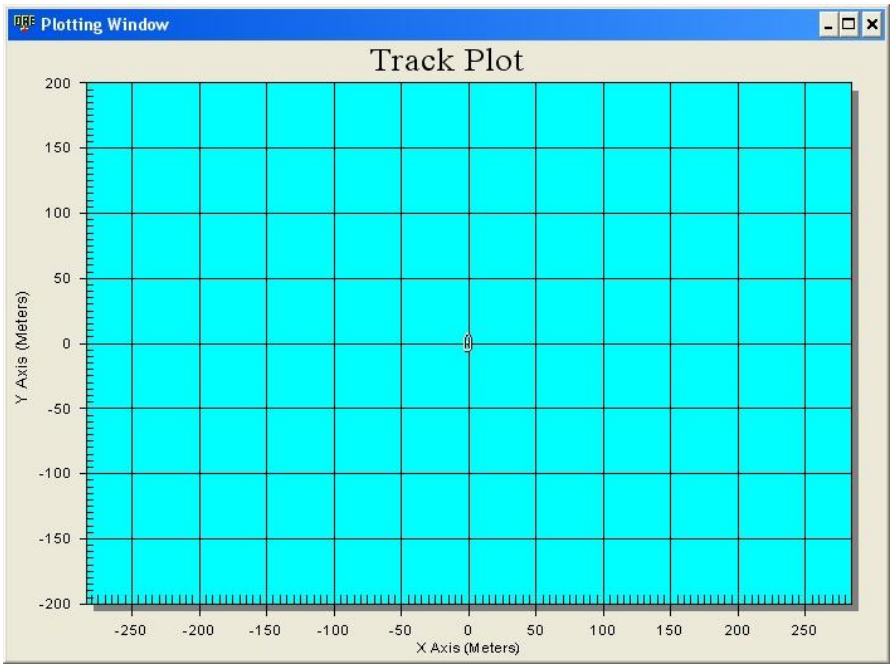
Beacon Node - The Beacon node provides access to the Beacon List window (via the 'Beacon(s)' entry) as well as individual access to the Beacon Setup dialog window for previously defined beacons whose names show as sub-nodes to the Beacon Node.

The Project Tree window can be undocked from the Main Window making the entire client area of the Main Window available for MDI Child Windows (such as the Plotting Grid). To undock hold down the right mouse button while over the Project Tree, move the mouse pointer outside the Main Window's boundary, and release the mouse button. To re-dock hold down the right mouse button while over the Project Tree, move the mouse pointer inside the Main Window's boundary, and release the button. The undocked ('floating') Project Tree window can be brought into view at any time via the 'Project' entry of the Main Menu's ' View' menu, or via the System Menu's or Tray Menu's 'View Project' entry.

Project Tree: Press and Hold right mouse button. Drag Project Block off to the side. The Block can then be closed out by clicking on the ☒ or hidden by changing the Trackman main screen to full ☐. It can be viewed again by selecting View from main menu and then "Project". Dragging Project Block back over grid area using right mouse button and releasing causes block to re-position itself next to the grid. The project block menu is a quick way to access many of the setup parameters required within the USBL system. The Computer refers to the PC which can have many peripherals (shown as sub-sets) such as; Display, Disks, Printer, Data Output (Device List) and an interface to configure the USBL parameters (BATS). The BATS sub-set parameters consist of heading sensor, Hydrophone and Acoustic Data. Separate from the Computer and TrackPoint are the Beacons.



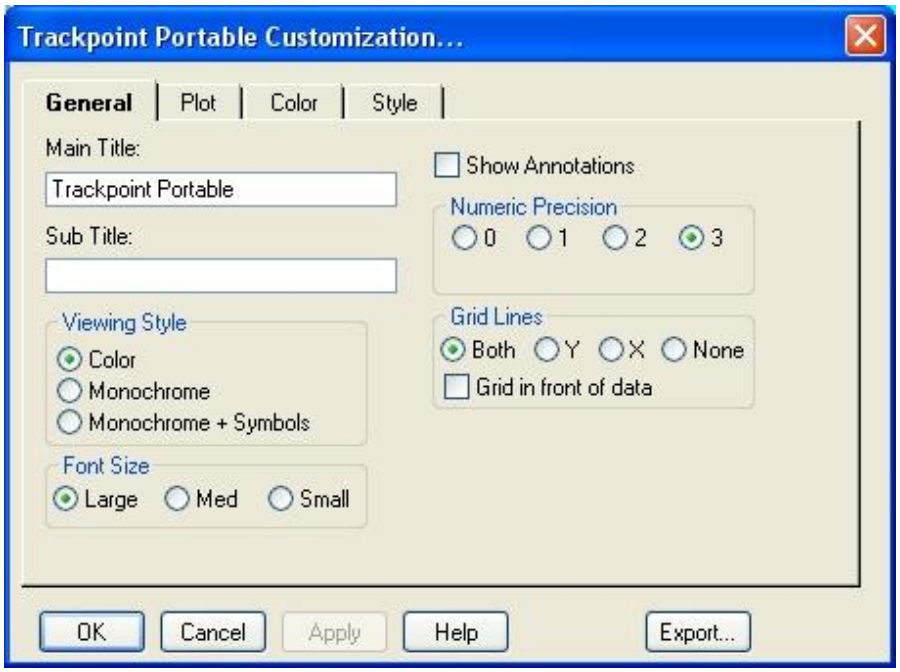
Plotting Window: The Plotting Window shows the vessel symbol, all target positions and also the Hydrophone position. The grid Full Scale and Spacing is settable via the View / Display Options menu along with vessel height and width. The Plotting Window can also be re-sized within the constraints of the main window area or minimized ▁, expanded ❐ or zoomed out to full screen ☐.



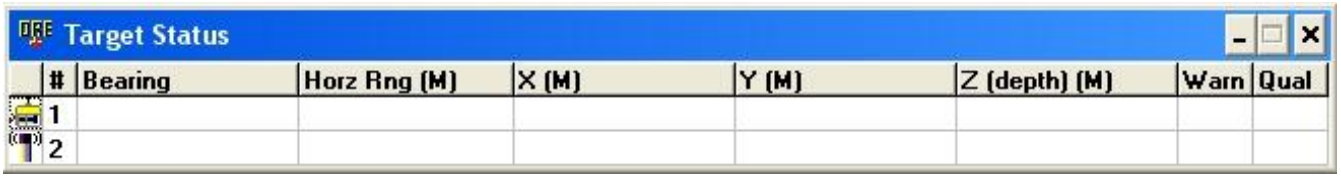
Plot Screen Options:

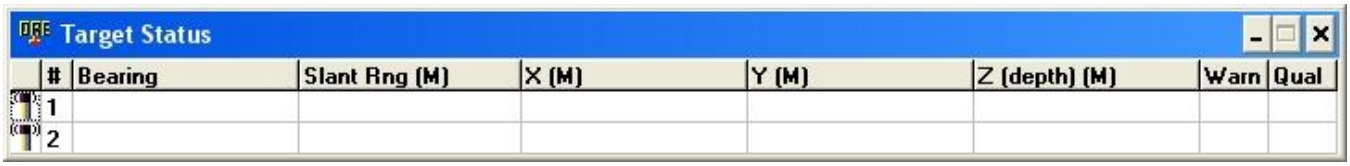
Right click on Plotting Window to bring up the Grid Customization dialog box. This allows entry of the main title of the grid area, Viewing Style, Font Size, Grid colors, Styles, etc.

NOTE: Some functions are not available within the Track Plot Customization window.



Target Status: This block shows the processed USBL data for each target. This Block can be resized to show any number of targets at one time by right clicking on edge of window and dragging up or down. The Status Parameters consist of Target Symbol/ Number, Bearing, Horizontal Distance, X, Y, Depth, Warning Code and Quality Factor. If you right click on the Horz Rng header the field toggles to Slant Range. Right clicking again changes it back to Horz Rng.



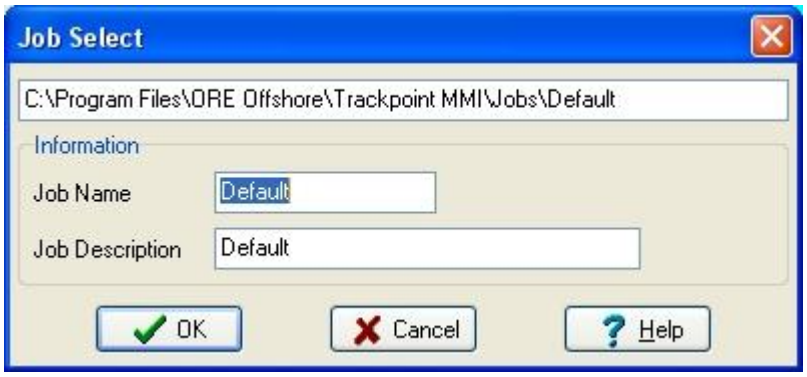


3.3 "TRACKMAN" MAIN & SUB-MENUS

The Trackman main menu Pull-Down Lists are shown above. The sub-menus are displayed once the main menus are selected with mouse or keypad. When using keypad… press and release the Alt key and the main menu is selected with the primary character underlined for each menu. For example, the File menu has the "F" underlined. Pressing the "F" key selects that menu. View = V, etc.

3.3.1 FILE MENU

File **→ Create New Job Folder**

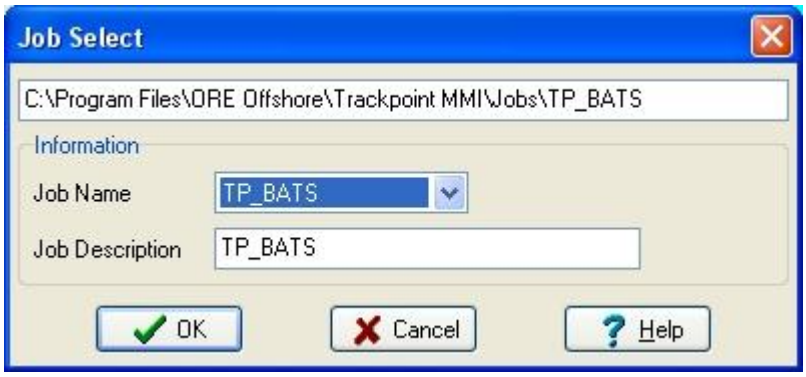


The Job entry dialog window is used to define a new job or to access and/or modify an existing job. Each job has it's own complete set parameter files saved in a separate sub-folder.

As a 'Job Name' is typed in, the 'Job Description' entry and the 'Job Folder' entry automatically update with the 'Job Folder' using the 'Job Name' as it's sub-folder name. A more complete Job Description can be typed in if desired.

To select an existing job, simply browse to it's folder in the folder tree at the bottom of the dialog and hit the OK button.

File ➪ Open Existing Job Folder

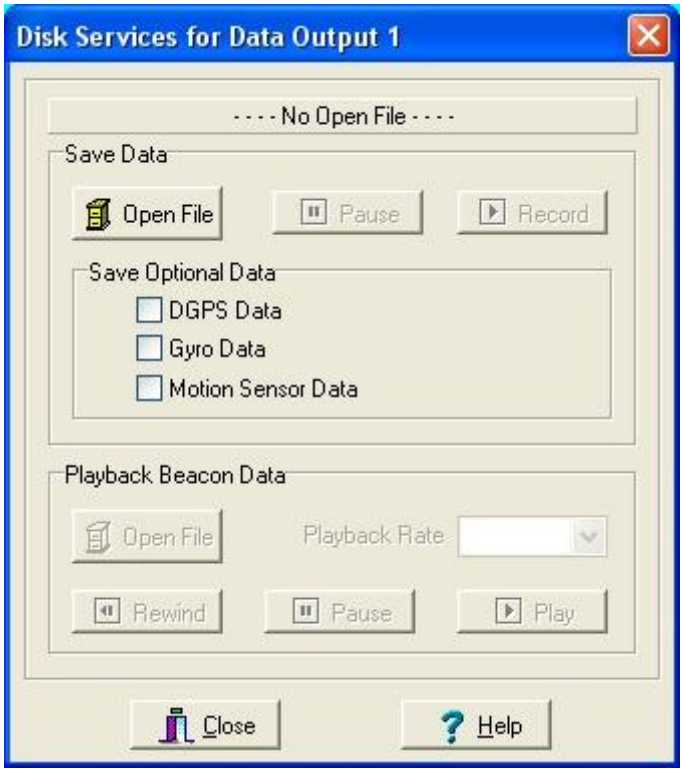


The Job entry dialog window is used to define a new job or to access and/or modify an existing job. Each job has it's own complete set of parameter files saved in a separate sub-folder.

Select a job from the 'Job Name' pull down menu. The 'Job Description' is then displayed for that job. Select OK to set the system up using those previously set parameters.

The 'Job Description' of the active job appears in the Title Bar of Trackman's Main Window. See below.

File ➪ Disk Services



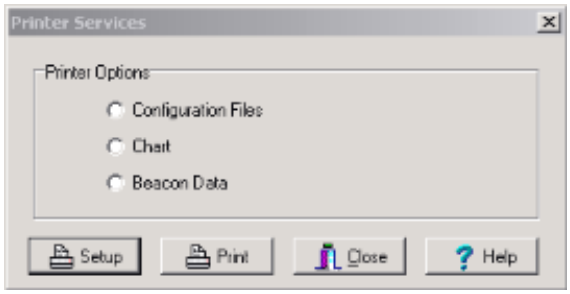
Disk Services requires that at least one Device is selected. For example, when Devices is selected, a BATS device must have a connection type other than 'none' selected. (Playback, COM port or IP(net)). The Disk Services dialog controls the 'Record and Play' operations for saving and playing back an EdgeTech specific data files. If a device is active it shows up in the pull-down menu at right. If no devices are active then a Dialog box as shown below is displayed. The system then prompts for display of the Device List, allowing operator to enable various I/O devices/RS232 port data. Once enabled the devices are shown in the pull-down menu at the right. See Setup/Device List (ports) for setup of ports. Only one device can be enabled for saving to disk.

Click on "Open File" and the standard Windows® dialog box pops up. Enter in File name and click "Open". The data present on that port will

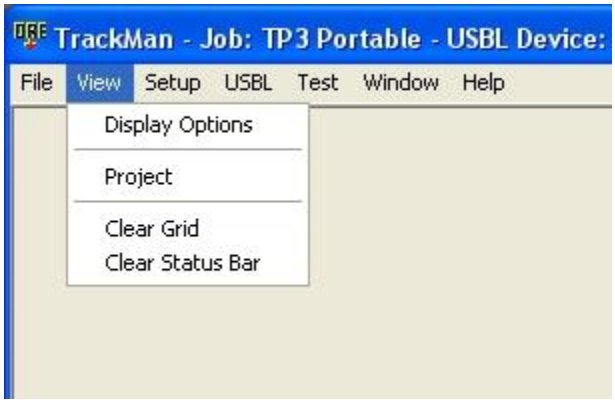
now be saved to disk once the RECORD button is pressed. (Save Optional Data will be a future item.) At any time the saving to disk can be paused by clicking on the "Pause" button. "Resume" re-starts logging to disk again. The file is saved with a ".ore" extension. It is saved in the same directory that the "Job" was created under. To Playback target position, go into the DEVICE LIST and set the TrackPoint device to PLAYBACK mode. Go back into the DISK SERVICES and click on "Open File" under the Playback Beacon Data and select file. Click Open and then set Playback Rate. The data will be read at that rate and displayed in the grid.

File ➪ **Printer Services**

This dialog is used to select and set up a printer as well as to choose what information is to be printed. It calls the standard Windows Printer Selection and Set-up dialogs.

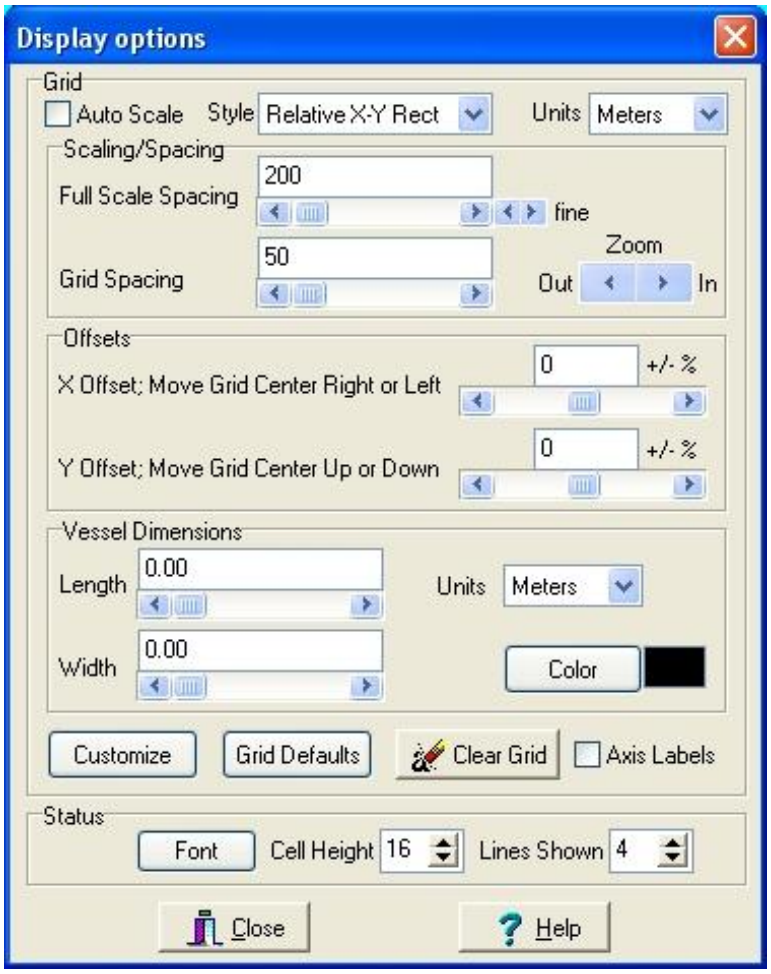


3.3.2 VIEW MENU



View **Display Options**

The Display Options dialog is used to control the Plotting Grid parameters. This dialog pops-up to the left of the Grid (if possible) such that the user can see the changes as they are being made.



Grid/Auto Scale: Select "Auto Scale" to have the system automatically adjust to changes in the Full Scale Spacing. The scale is dependent on the Horizontal Distance to the farthest target.

While in Auto Scale mode, the Full Scale Spacing value is updated such that the user can 'freeze' its value by shutting Auto Scale off when the Spacing looks right.

Grid/Style: Select the Grid Style either Relative X-Y Rectangular or Relative X-Y Polar.

Grid/Units: Select from the pull-down menu the units that you want the scale to be referenced to; either meters, feet, yards or fathoms.

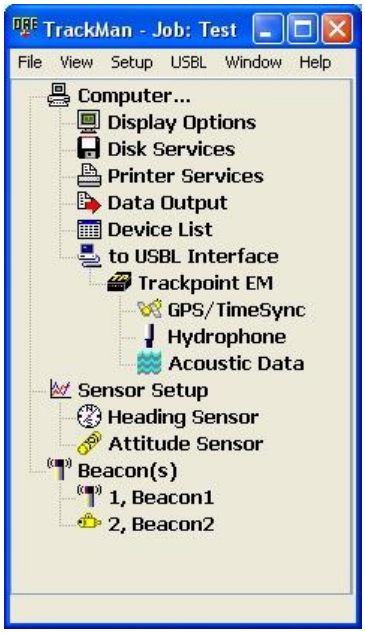
Grid/Scaling, Spacing & Zoom: To manually select the Grid and Full Scale Spacing use the scroll bar arrows next to each of the parameters. To move the bar/value quickly point to the bar with the mouse, then click and hold the left mouse button down while 'dragging" bar right or left. Use the "fine" adjustment buttons as a vernier. Use the Zoom buttons to change the Full Scale and Grid Spacing values by 2 or 1/2.

Grid/Offsets: The X-Offset parameter moves the grid center position to the right or left and the Y-Offset parameter moves the grid center position up or down. This is useful when tracking a target in only one quadrant of the vessel. Click on the buttons to change the percentage of movement about the center of the grid.

Grid/Vessel Dimensions: The outline of a ship/boat can be displayed in the center of the grid using the Vessel Dimension settings. Move the scroll bar or click the buttons to vary the Length and Width values. Select from the pull-down menu the units that the vessel is to be referenced to; either meters, feet or yards. Select the vessel symbol line color using the color button.

View **Project**

Brings up the Project Tree (if hidden).



View **Clear Grid**

Clears the target trails in the Plotting Window.

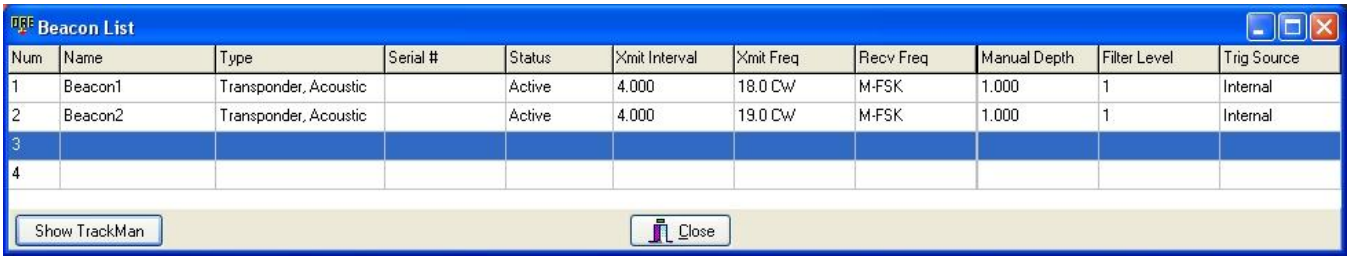
View **Clear Status Bar**

Clears Status Bar at bottom of page.

3.3.3 SETUP MENU

Setup **Beacon List**

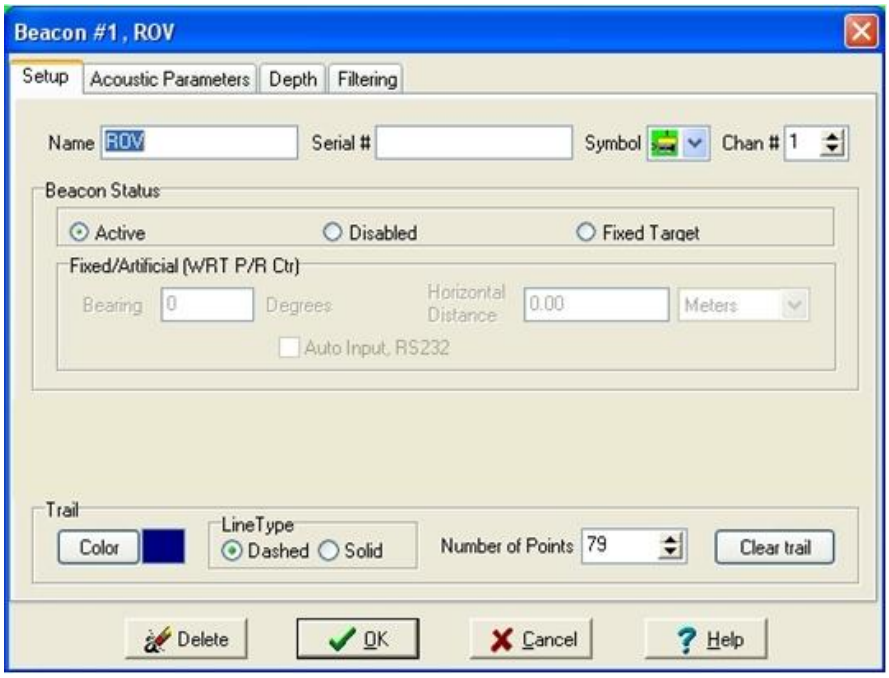
The Beacon List window displays all beacons at once, in a table layout, showing their parameters of primary interest. (Clicking on the Beacon's icon within the Project Tree is a quick key to displaying the Beacon List. Beacon(s)) Having a single window that allows the user to see the operating frequencies and parameters of all the available beacons makes it possible to compare parameters and change any that may conflict. Double-clicking on an entry in the list (or using the arrows keys to move to the desired entry and hitting 'Enter') displays up the Beacon Setup dialog for that entry. If the entry in the list was 'empty', the Setup dialog comes up in 'Adding a New Beacon' mode. Entries may be moved to a new position in the list (thereby obtaining a new beacon number) by cut-and-paste (Ctrl-X / Ctrl-V) keyboard operations. Cut-and-paste operation only available within beacons 1-4 or within beacons 5-7. (Cannot copy simultaneous to consecutive tracked beacons or vice versa.) **Refer to Section 3.4 for Beacon List examples.**



The 4460B can have up to 4 programmed beacons. All four can be active at any one time.

Adding a new beacon, Dialog Box

🗀 **Setup Tab**



Name: This is the operators name for the beacon being tracked, e.g. Towfish.

(**NOTE:** Cannot have two beacons with same name.)

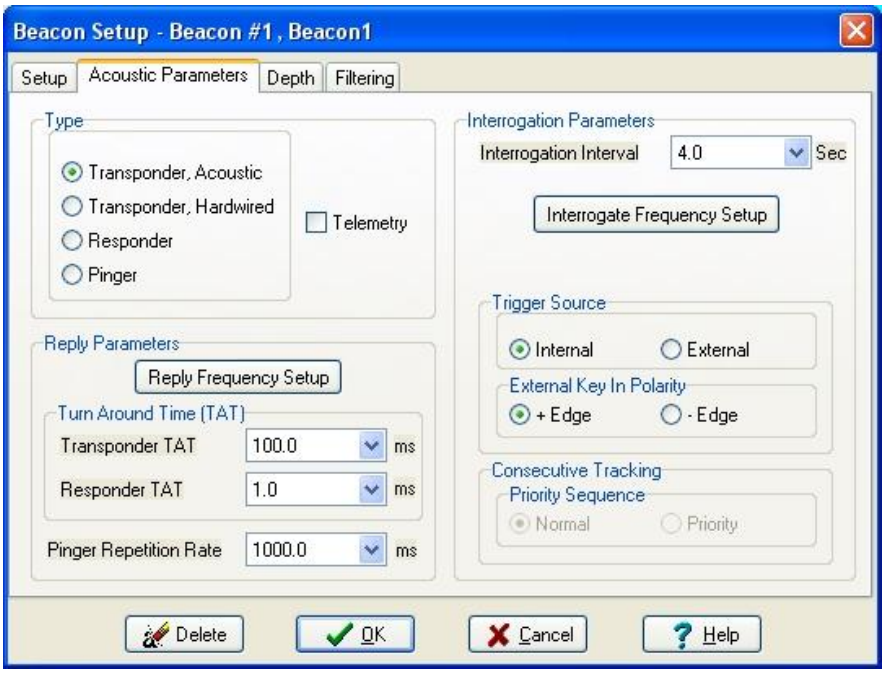
Serial Number: Serial Number of the beacon as a record of use.

Symbol: Scroll bar allows selection of a symbol to represent the beacon in use.

Beacon Status: Selects either Active, Disabled or Fixed Target. For a fixed target to be displayed in the grid also enter in bearing and horizontal distance of the target. Enter in the position with respect to the center of the vessel (assumed pitch/roll center also).

Trail: The target positions are plotted and a line drawn from point to point. Select the color of the "trail", the line type and the number of points to store. To clear the trail click on the "Clear Trail" button. To have no trail then set to one.

🗀 Acoustic Parameters Tab



Type: Selects target type, either Transponder (acoustic), Transponder (Hardwired), Responder or Pinger. If the Transponder or Responder has Time-Decode Telemetry then click on the Telemetry box. If a Pinger is not received an error code #6 is displayed after 12 seconds.

NOTE: When a target is designated as a Pinger it is the only target that can be enabled at one time. Disable any other targets.

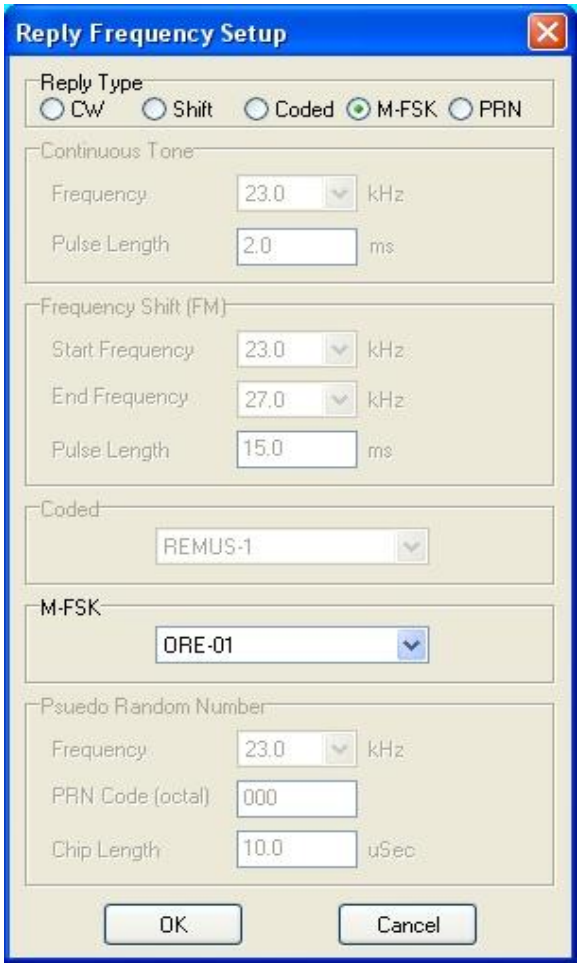
A Transponder is an underwater beacon that is interrogated (Triggered) acoustically. It usually requires a single frequency or tone at a minimum pulse length before it will respond with its reply frequency. A Turn-Around-Time must be selected in order for the system to calculate an accurate slant range. A Responder is triggered electrically. For example, if tracking an ROV or Towfish, utilize the umbilical cable for sending down a key pulse to fire the unit. This provides a more stable track as you do not have the jitter in range due to the receiver as in the Transponder. A Pinger requires that the operator know the repetition interval of the beacon. Select the interval from the pull down list under reply parameters[8].

[8] When tracking a Pinger the system requires an interrogation interval be entered at the same rate as the repetition interval. The system automatically sets the interrogation interval from the entered repetition interval.

Reply Frequency Setup Parameters: This is the Reply Frequency of the beacon. Select the Reply Type; CW (continuous wave/tone), Shift (linear frequency shifted, also known as chirp or FM), Coded (special such as Remus codes), M-FSK (multiple- frequency shift keyed; typical for Model 4370A beacons) and PRN (pseudo random number generated codes).

CW (tone)

The CW waveforms are typical of the ORE legacy beacons, Model 4320 or 4330 series (see note below). The burst is a single frequency with a typical pulse length of 1.3ms. Select the frequency in 500Hz increments and the correct pulse length[9].



SHIFT

The shift waveforms are a linearly changing frequency over a specific pulse width. Enter in the start frequency and the end frequency in kHz along with the exact pulse length in ms. For example, an Edgetech Model 4200 Towfish with responder option produces a waveform starting at 24kHz and ending at 28kHz with a pulse length of 10.000ms.

M-FSK

These waveforms change frequencies in discrete steps instead of in a linear progression as in the shifted types. The MFSK codes are shown in Appendix E.

CODED

These are proprietary codes of Hydroid's REMUS underwater vehicles and transponders. They have specific interrogation and reply PRN type codes.

REMUS-1

REMUS-2

REMUS-3

REMUS-4

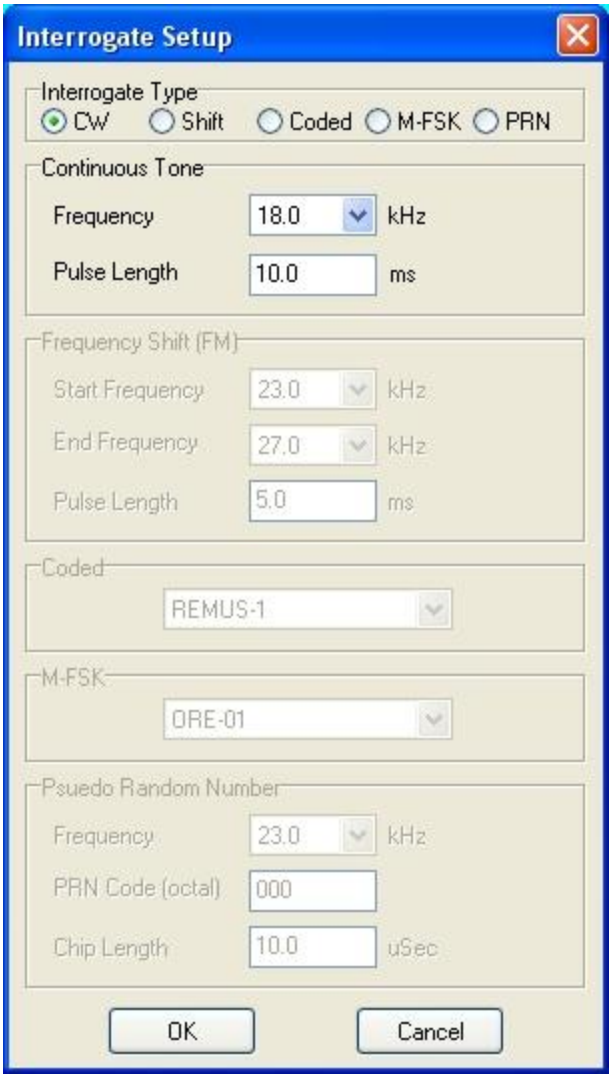
[9] The CW output type beacons such as the Model 4330B as used in the Trackpoint 2 or 3 will not provide any improvement in performance with BATS. These should only be used in an emergency not in normal operation.

PRN

Pseudo Random Number codes. These consist of a single frequency but with 180° phase shifts at various bits within the sequence. Enter the frequency in kHz (in 1 Hz increments), the PRN code in octal and chip length in micro-seconds increments (minimum chip length is 100.000 microseconds). The PRN code describes the phase shifting pattern. The chip length is the waveform period times the number of cycles.

Interrogation Parameters: The Interrogation Parameters consist of the Interrogation Interval, the Interrogation Frequency and Trigger Source.

Select the Interrogation Interval (based on the slant range to the target) in seconds and the Pulse Width necessary to interrogate the beacon in milliseconds. (In high multi-path environments it may be beneficial to decrease pulse width to prevent multiple triggering of the transponders.) Select whether the beacon is being triggered internally by the BATS or by an external source. If external then select the edge that the BATS should synchronize the timing with (+) or (-). If multiple targets are enabled then a specific Beacon can be set as a "Priority" which alternates interrogations between all the other active targets.



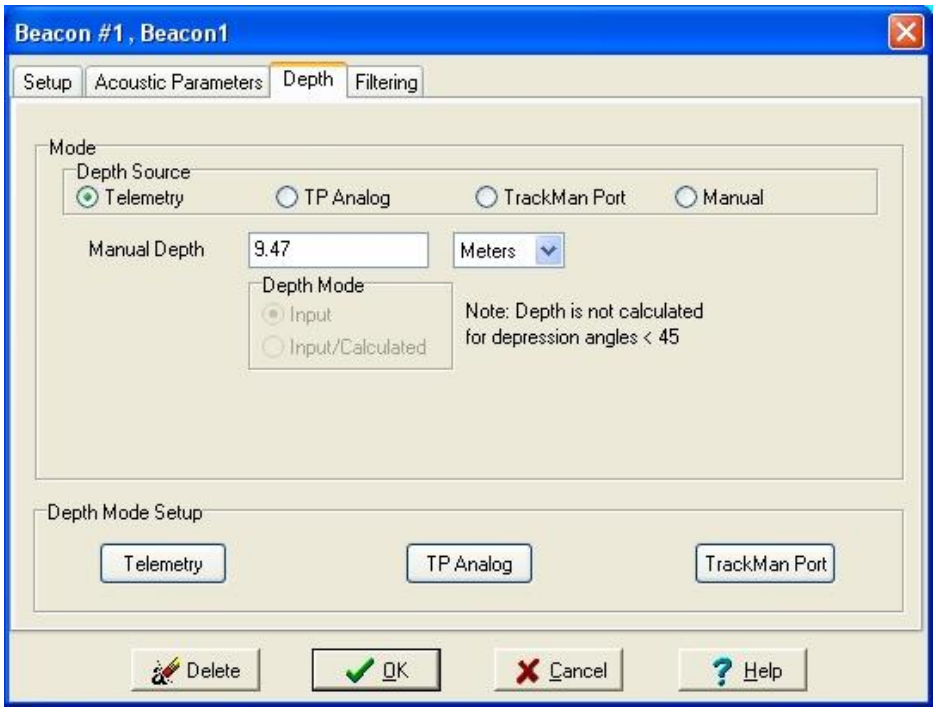
If two or more targets have the same interrogation frequency/code then the targets will be tracked simultaneously. If the Interrogation Frequencies are different then they will be tracked sequentially.

Trigger Source: Select either Internal or External trigger source[10].

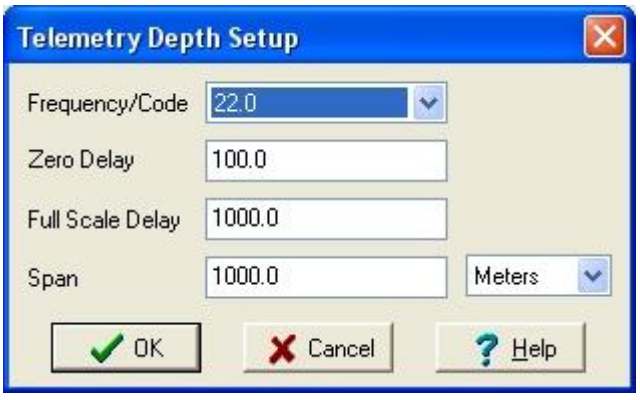
External Key-In Polarity: Select either (+) or (-) edge external trigger source.

[10] Only Target #1 can be set to external trigger mode, becoming the master for all other targets.

🗀 Depth Tab



The Depth Tab configures the target depth function. Select the Mode in which the depth is input from; Telemetry, Analog, Serial Port (PC), Manual. If the Beacon is a (time-proportional) Depth Telemetry version then select "Telemetry" and then under "Depth Mode Setup" configure the Beacon's Telemetry parameters. If depth is via an analog sensor, e.g., an ROV or SSS vehicle, then select "Analog" and then under "Depth Mode Setup" configure the Beacon's Analog parameters. The analog port is available at the GYRO connector on the rear panel of the BATS Desktop or the side panel of the Portable unit. If the target's depth is available via a serial port, select "Serial Port" and then under "Depth Mode Setup" configure the Beacon's Comport parameters. Select the Depth Input sentence, DBS, DBT, PEIV1 or DPT. (See formats below.) This Serial port is available only at the PC's serial input not the Transceiver's.[11]



In the TELEMETRY mode the depth is taken from a depth telemetering transponder. The transponder sends two replies to the Transceiver 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. The "Telemetry Depth Setup" menu is used in conjunction with "Telemetry Mode". It contains parameters to allow the operator to change the telemetry

[11] If the entered depth is not correct the calculated horizontal range will also be incorrect.

reply frequency, and also to change the zero delay, full-scale delay and span. When Telemetry Depth is selected, a 'T' appears next to the depth value in the Status Block when the telemetered value is being used in the horizontal range calculations. If the system is using a calculated[12] depth then a `C' appears next to the depth value. If the depth telemetry replies are not received, the last valid telemetry reply is used for the depth. If telemetry replies return, system reverts back to depth telemetry. If not using a Telemetry Beacon then depth should be changed to Manual or Analog.

Serial Port Depth Input - DBS, DBT, PEIV1, DPT

DBS - Depth Below Surface

```
        1  2  3  4  5  6 7
        |  |  |  |  |  | |
$--DBS,x.x,f,x.x,M,x.x,F*hh<CR><LF>
```

Field Number:

1) Depth, feet (Referenced to Water surface)
2) f = feet
3) Depth, meters
4) M = meters
5) Depth, Fathoms
6) F = Fathoms
7) Checksum

DBT - Depth below transducer

```
        1  2  3  4  5  6 7
        |  |  |  |  |  | |
$--DBT,x.x,f,x.x,M,x.x,F*hh<CR><LF>
```

Field Number:

1) Depth, feet (Referenced to Water surface)
2) f = feet
3) Depth, meters
4) M = meters
5) Depth, Fathoms
6) F = Fathoms
7) Checksum

[12] The System can only calculate depth when the depression angle is greater than 45°. (Depression Angle is defined as 0° at surface and increases to 90° directly below the hydrophone.) When target is not within this 90° cone below the hydrophone an alternate depth must be used; Analog, Telemetry or Manual.

PEIV1 - Depth of Target (EIVA Navipak)

```
        1   2  3
        |   |  |
$PEIV1,x.x,yy*hh<CR><LF>
```

1) Depth, meters (Referenced to Water surface)
2) Target Number 01-99
3) Checksum

DPT - Depth - Deviation & Variation

```
         1   3  4
         |   |  |
$--DPT,x.x,x.x*hh<CR><LF>
```

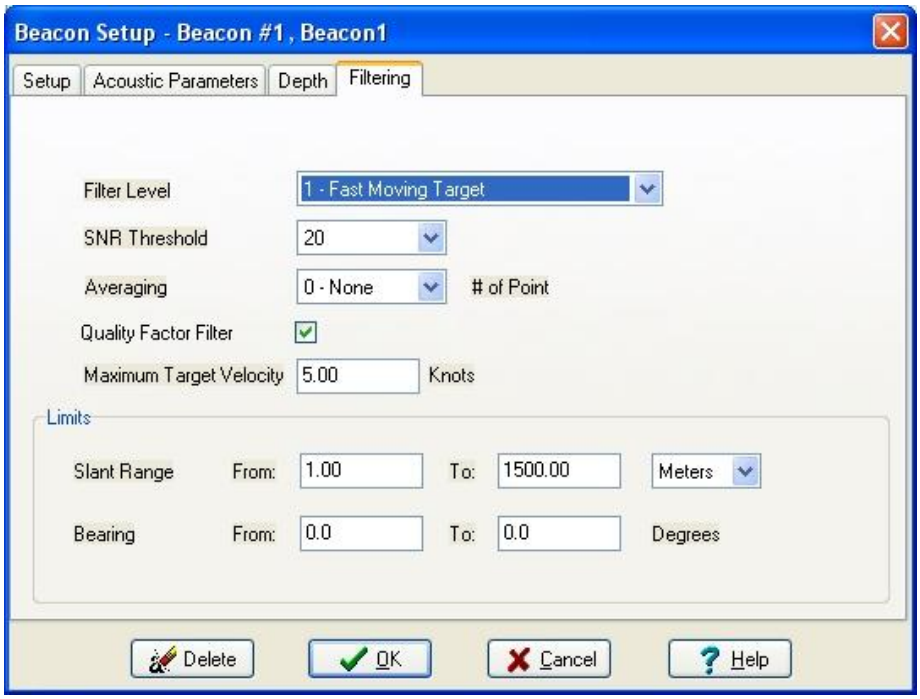
Field Number:

1) Depth, meters (Water depth below TP3 Hydrophone)
2) Offset from transducer, Positive means distance from transducer to water line negative means distance from transducer to keel
3) Checksum

NOTE: Offsets are not used. The BATS uses Depth to the transducer in its calculations.

🗀 Filtering Tab

The "Filtering Tab" allows each beacon to have individual filtering parameters, configuring each beacon for its own tracking scenario. Select Filter Level for the beacon in use. In the case of a fast moving target set the level between 1 and 5 with 1 being for minimal filtering and 5 being for moderate filtering. For slower moving targets set level between 6 and 10 with the filtering parameters increasing to maximum at 10. To set limits on known target locations modify the Slant Range and Bearing parameters.



When ✓ OK is selected the Trackman program sends the parameters to the Transceiver. This delay causes the dialog box to remain on screen for a few seconds following the command.

FILTERING provides operator a choice of various combinations of averaging, filtering, threshold settings and also limits on certain parameters. Filtering includes averaging, target velocity checking, range gating, signal threshold, minimum xponder range, maximum xponder range and signal rejection via signal quality checking. The filtering parameters are individual per target.

Filter Level: The Filter Level setting is variable from 1 to 10. 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. The parameter settings for the range blanking 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. 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. Also see error code #5.

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

FILTER LEVEL/RANGE (blanking) GATE (Transponders & Responders Only)

If there is more than one sequential target the range blanking gate value is multiplied by the number of targets (e.g., filter level 2 with 4 targets enabled equates to a blanking gate of 80 meters before the average target range). If the blanking gate exceeds the current range average then it is set to a minimum (1m). The range average for each target is weighted based on the number of good replies for that target. If there are no recorded good replies then the routine uses 100% weight on the current value and is scaled down for up to 4 replies (e.g., if there have been 4 or more consecutive good replies each new reply contributes 25% to the average). As replies are missed, more weight gets added to the new reply. If there are more than 2 missed replies, the blanking gate opens up by a factor of 2, until we exceed a maximum (currently 4) where it is wide open.

TARGET FILTERING FUNCTION			
Filter Level	**Blanking Gate opens prior to average reply (meters)** (based on 1500m/s speed of sound)	**Velocity Filtering** (4.5 m/s = 10 knots; 2.3 m/s = 5 knots)	**Average Weighting** Ratio of the weight of the previous reply to the 10th reply Vs Filter Level [3]
1	-25 meters (-16 ms) x # Active targets [1]	OFF	4.0:1
2	-20 meters x # Active targets [1]	OFF	3.3:1
3	-15 meters x # Active targets [1]	OFF	2.8:1
4	-10 meters x # Active targets [1]	4.5 m/s + X % SR [2]	2.5:1
5	-5 meters x # Active targets [1]	4.5 m/s + X % SR [2]	2.3:1

6	-25 meters x # Active targets [4]	4.5 m/s + X % SR [2]	2.1:1
7	-20 meters x # Active targets [4]	2.3 m/s + X % SR [2]	2.0:1
8	-15 meters x # Active targets [4]	2.3 m/s + X % SR [2]	1.9:1
9	-10 meters x # Active targets [4]	2.3 m/s + X % SR [2]	1.8:1
10	-5 meters (-3.3 ms) x # Active targets [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 affect 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

RANGE GATE AND TELEMETRY (Transponders & Responders Only)

When telemetry is enabled the system also blank-gates on the telemetry reply. On the primary or navigation reply the Transceiver accepts only the first signal arriving at the hydrophone following the opening of the blanking gate and ignores signals for ≈ 80 milliseconds following it. When the telemetry gate opens the Transceiver 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.

FILTER LEVEL/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, Transceiver 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 re-

plies 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.

FILTER LEVEL/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.

SNR Threshold: The threshold setting is normally set to 20dB (default). Raise the threshold if the system is triggering on noise, usually indicated by erratic slant ranges. Use caution when setting threshold lower than 20dB. I.e., if you know the approximate position of the target and you want to get the maximum range then it may be possible to lower threshold in the presence of low noise. 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. The lowest threshold setting increases the sensitivity of detection by recognizing smaller signals. In a high-noise environment this can lead to erratic readings. Higher threshold settings decrease the possibility of detecting on noise, but can lead to occasional missed valid signals and also late detections causing erratic bearings. A lower threshold setting is usually the best choice, but trial will lead to the optimum threshold setting for a given application.

Averaging: The Averaging parameter is variable from 0 (off) to 10. It is independent of the Filter Level setting in that you can select the buffer size in which to 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 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. 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 (8-10) the aver-

aging is almost linear across all replies while at the lower filter levels the weight is higher on the most recent reply. Averaging 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.

QF Filtering: QF Filtering is a toggle function that turns QF Filtering on or off. 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 throughout 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 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.

This function filters the data depending on the Quality Factor of the signal received. 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.

Maximum Target Velocity: Select the Maximum Target Velocity (+/-) if using a PRN or Remus type codes (as they are susceptible to Doppler shift). If the target, for example, is a towfish (which has very little relative movement between target and Hydrophone) the MTV can be kept at 5 knots or less. By keeping the MTV below 5 knots the processing load on the Transceiver is minimized.

Target Limits: The Slant Range Limit (Minimum Transponder or Responder Range) function works in conjunction with the range gating (blanking) system based on the target slant range. The range (blanking) gate is a hardware lockout that "opens up" and allows signals to be detected from the hydrophone. The time that the blanking gate opens is based on the Filter Level and the time the last reply was received. If a condition occurs where the blanking gate end time is less than the Slant Range Limit's (**from** value) then the blanking gate overrides the Slant Range Limit's (**from** value). This in effect locks-out all signals from the hydrophone prior to the end of the blanking gate. If the system loses tracking due to the Slant Range Limit (**from** value) 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 blanking 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 Slant Range Limit's (**from** value) then the error code #6 is changed to #7. The Slant Range Limit's (**from** value) can vary from 1 to 1000 meters.

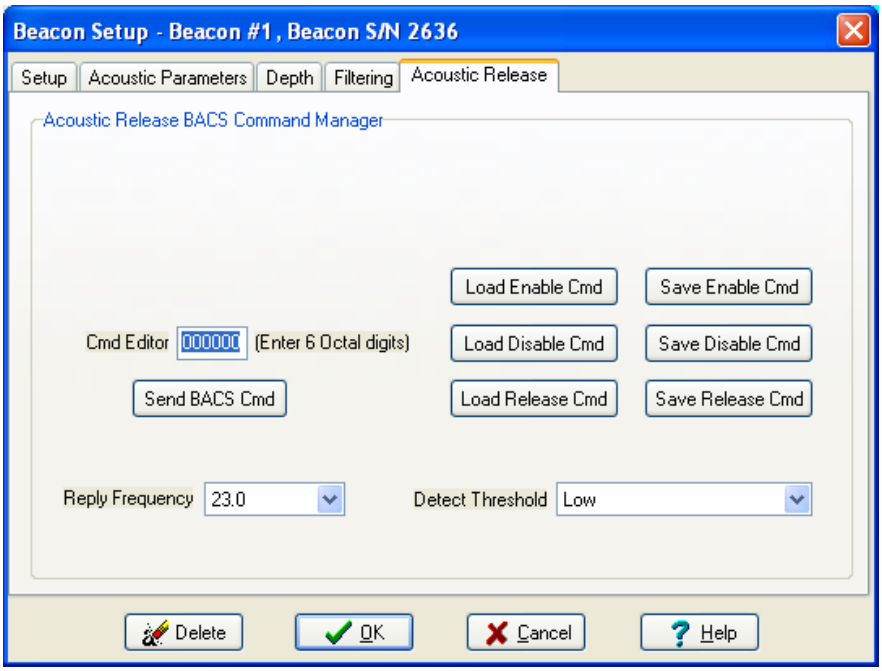
NOTE: If you are operating with a known minimum range, for example with an ROV near the bottom in 500 meters of water, then the Slant Range Limit's (**from** value) could be set for 450 meters. This would provide an effective "range gate" without the attendant target acquisition and re-acquisition time of the normal range gate. Of course, as you recover the ROV you will have to reset the Slant Range Limit's (**from** value) to track the ROV to the surface.

The Slant Range Limit's (**to** value) (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 Slant Range Limit's (**to** value) can vary from 0 m which is OFF to 10 to 10000 meters.

The BEARING LIMIT 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 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.

🗀 Acoustic Release Tab

The "Acoustic Release Tab" allows Commandable Beacons / Releases to be commanded directly from within the BATS unit using the interrogation element within the Hydrophone to send the BACS commands and the "A" channel receive element to provide the feed-back from the Commandable Beacon.



1.) Activate the Target. Navigate to the Acoustic release tab within the Beacon setup dialog.

2.) Set the Reply frequency to the Beacon's (Acoustic Release) feed-back or "acknowledgment" CW tone. Set threshold to med-high. If more *...*...* appear during the reply acknowledgement than should be then raise threshold and conversely if no *...*...* appear then lower threshold.

3.) In the Command Editor window type in the beacons "Enable" Command and then click on the Save Enable Cmd button.

4.) Continue the same for the "Disable" and the "Release" commands. The commands are now stored in the Trackman's ini file.

5.) To "Enable" the beacon (allows it to respond to an interrogation) click on the Load Enable button then click on Send BACS Cmd. The BATS Hydrophone will transmit the "Enable" code to the Beacon and if successful will return with a series of CW tones. Each tone reception will be displayed as a * character in the Trackman window.

For the EdgeTech PORT Acoustic Release, the acknowledgment pings for the Acoustic Commands received are shown in table below;

Command	Frequency	Time between Pings (sec)	Number of Pings when release is Vertical	Number of Pings when release is tilted >45°
ENABLE	NOTE 1	2	6	3
DISABLE	NOTE 1	2	NOTE 2	NOTE 2
RELEASE	NOTE 1	2	6	3

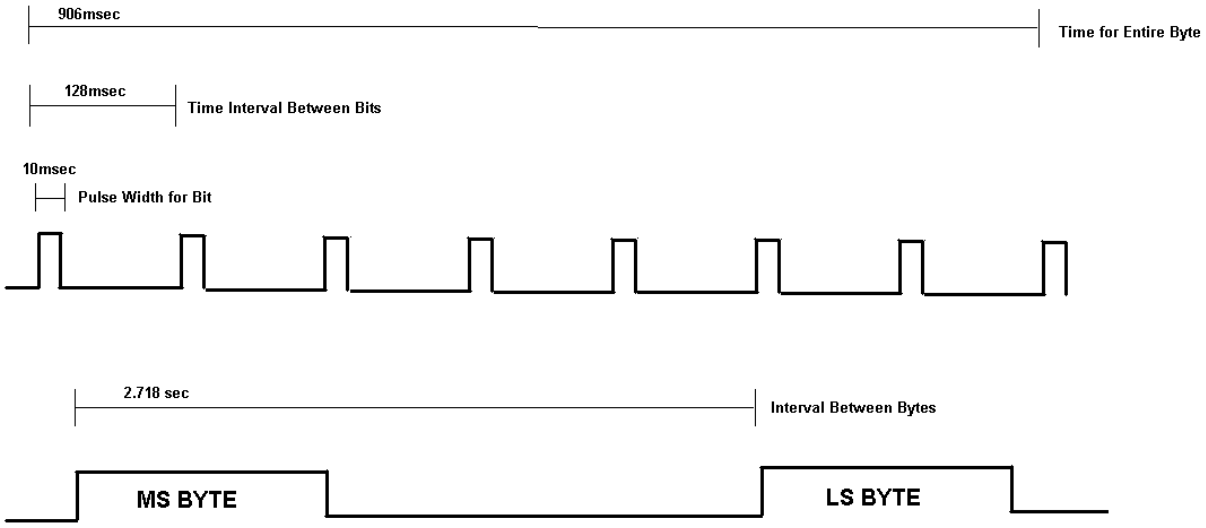
NOTE 1: Tone is a CW burst whose frequency is noted on the supplied Configuration Sheet.

NOTE 2: Battery Indication: When a DISABLE command is received at the Acoustic Release the acknowledgement replies indicate battery condition rather than tilt. The PORT returns 6 pings for a full battery with successively lower energy for 5, 4, & 3 pings. When down to 2 pings the battery is almost drained. If you have an indication of 2 pings then it would be prudent to release the unit and recover unit to change out the batteries.

Octal codes representing F1 – F4 are shown below. A diagram showing the timing of an octal code is also shown below.

Code (Octal)	Frequency Number	Desired Frequency
100 000	F1	17483
177 777	F2	17986
600 000	F3	18519
677 777	F4	19084
Not currently used	F5	19685

TIMING FOR TARCOMM (IN ACOUSTIC RELEASE COMMAND MODE)

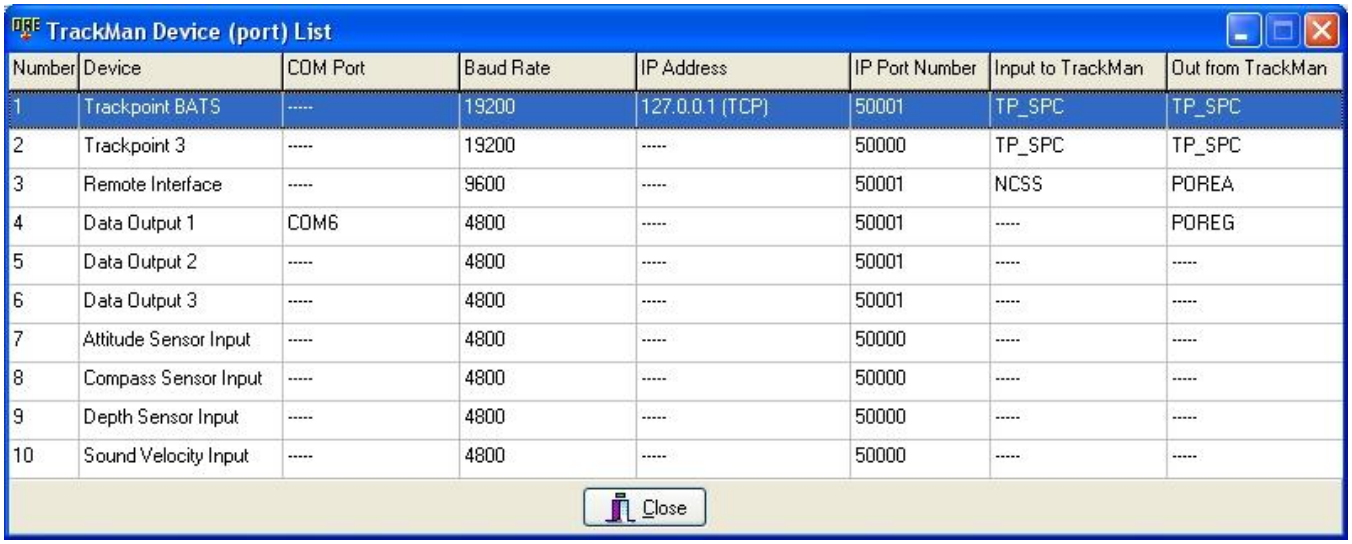


Setup ➪ **Device List (Ports)**

When selected, the Device List dialog box is displayed and the main window minimizes. (This is the same as double-clicking on the Device List within the Project Box.) When closing the Device List window, the main window is displayed again.

The Device List shows the list of all peripherals or I/O to the Processor. (FYI: The Device List is read from a "devices.ini" file stored under the ORE TrackPoint folder within the Program Files folder. These are EdgeTech configured files and should not require modification.)

Device (ports) Setup dialog box: This box allows setup of the various I/O to the Processor.



Number	Device	COM Port	Baud Rate	IP Address	IP Port Number	Input to TrackMan	Out from TrackMan
1	Trackpoint BATS	-----	19200	127.0.0.1 (TCP)	50001	TP_SPC	TP_SPC
2	Trackpoint 3	-----	19200	-----	50000	TP_SPC	TP_SPC
3	Remote Interface	-----	9600	-----	50001	NCSS	POREA
4	Data Output 1	COM6	4800	-----	50001	-----	POREG
5	Data Output 2	-----	4800	-----	50001	-----	-----
6	Data Output 3	-----	4800	-----	50001	-----	-----
7	Attitude Sensor Input	-----	4800	-----	50000	-----	-----
8	Compass Sensor Input	-----	4800	-----	50000	-----	-----
9	Depth Sensor Input	-----	4800	-----	50000	-----	-----
10	Sound Velocity Input	-----	4800	-----	50000	-----	-----

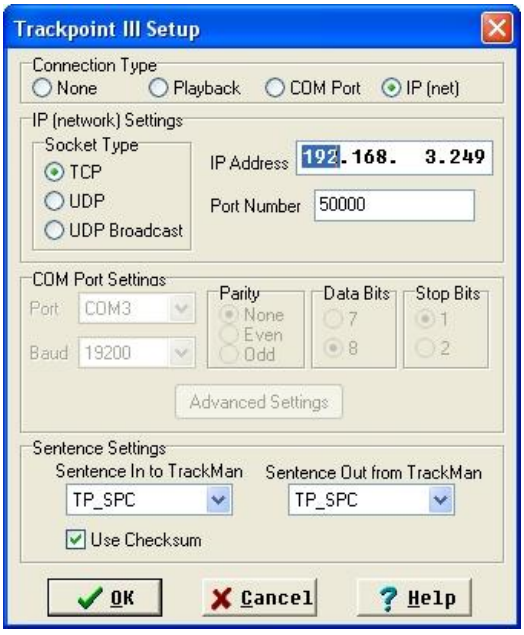
Double-clicking on an entry in the list (or using the arrows keys to move to the desired entry and hitting 'Enter') brings up the Device Setup dialog for that entry.

TrackPoint BATS:

Click on the TrackPoint BATS "Device List" line and then double click to bring up the Setup Dialog Box.

Setup this dialog as listed below. This port is required to communicate with the BATS Transceiver.

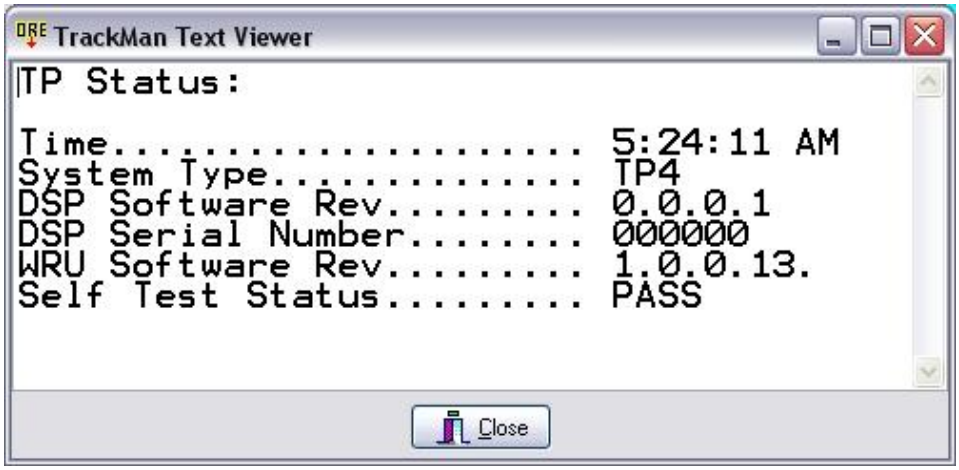
The **"Sentence Input to Trackman"** is the data format that is coming **from** the BATS USBL Transceiver to the PC. The **"Sentence Output from Trackman"** is the data format that is sent from the PC (on this same port) to the BATS Transceiver.



The setup parameters for the **TrackPoint BATS** Device are…

- **Connection Type** IP (net)
- **IP Network Settings** TCP
- **IP Address** 192.168.3.X (X usually = 9 but check on top cover of the BATS Transceiver for IP address.)
- **Port Number** 50001
- **Sentence Input to Trackman** TP_SPC (TrackPoint Signal Processor Commands)
- **Use Checksum** Yes
- **Sentence Output from Trackman** TP_SPC (TrackPoint Signal Processor Commands)

Once this connection protocol has been setup perform a "Find BATS" command under the setup main menu. Trackman will then find any BATS on the network connection. Click on "connect to" to make connection to the BATS. Under the USBL main menu click on "get Status". If communications have been established the "Get Status" box will be shown

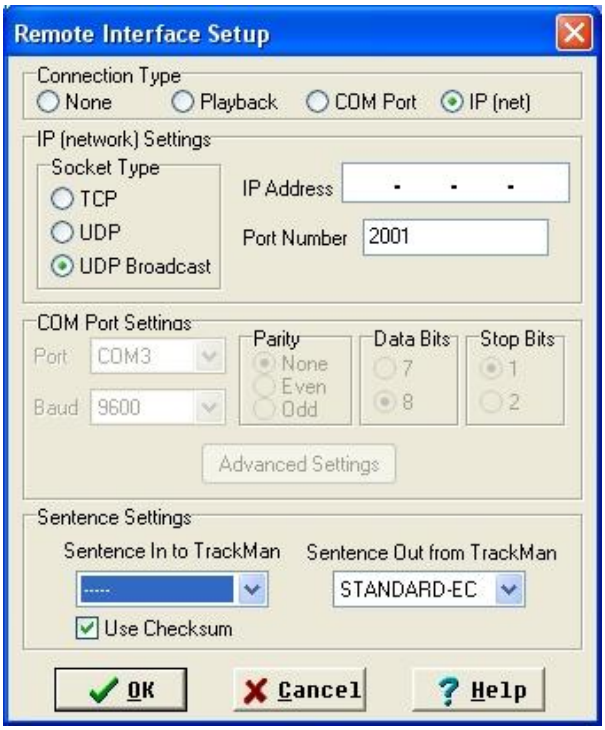


Remote Interface:

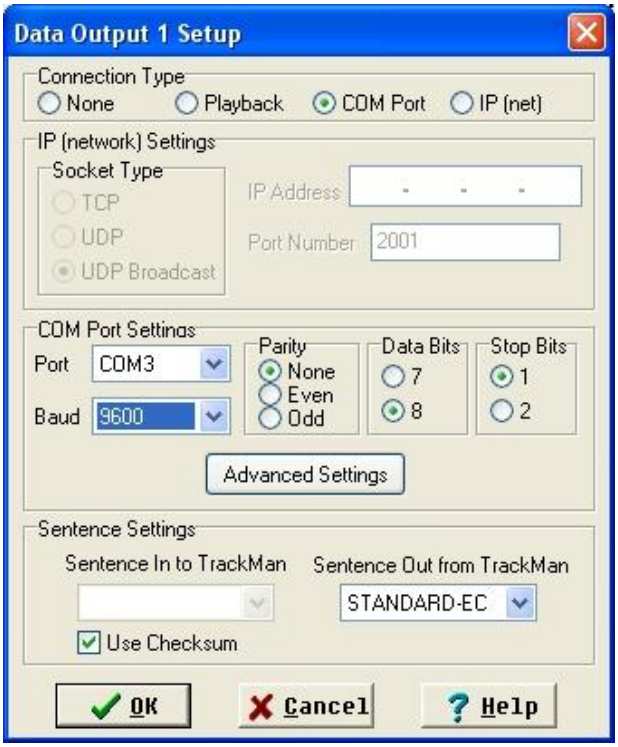
Not common. The Remote Interface port is typically for an output to a navigation system that also communicates with Trackman. Setup the Remote Interface device to output the format that is compatible with the navigation software. The Connection Type can be either "COM Port" or "IP (net)".

The Sentence Input to Trackman can either be "NCSS" or SPC. This is the data format that is coming from the Remote Control Module (another PC) to this PC or laptop. These are not typical and are only used for special applications. Leave as "----". For data output only see **Data Output** below. **The Sentence Output from Trackman** is the data format sent from the PC to the Navigation System. The list of formats available are; PORE, POREB, POREG, SNTTM, STANDARD, STANDARD-EC, STD W/PR, STD-EC W/PR, NCSS, NCSS-EC, NUWC, NUWC-EC, REV 4 & REV 4-EC.

Remote Interface Dialog Box



Setup **Data Output**



Data Output Setup is similar to the Remote Device Setup. A separate COM port can be configured to only output data (no control input). There is no Sentence Input to Trackman as in the Remote Interface Setup.

Setup the **Data Output** dialog to output the format that is compatible with the navigation software.

The Connection Type can be either "COM Port" or "IP (net)".

TCP/IP & UDP Protocols

The global network we all know as the Internet transfers information between computers using a protocol (a set of rules) known by the acronym TCP/IP which stands for Transmission Control Protocol/Internet Protocol.

All Internet transfers use IP (Internet Protocol) as the basic underlying method of 'packaging' data to be transferred.

Above that underlying packaging 'layer' of operation there are two general methods of transferring data.

The first method, which is the one most of us know from 'surfing the Web', involves making a point-to-point connection when transferring data. This point-to-point connection uses the TCP (Transmission Control Protocol) part of TCP/IP. It's a lot like making a phone call, when the other person answers the phone your connection is acknowledged and you can transfer data back-and-forth (talk) point-to-point.

The second method, called a datagram or connection-less interface, is a simple 'pack it up and ship it out' technique that essentially works like mailing a letter. With a datagram you don't make a connection with the receiver, you simply send your data and assume that it will get where you're sending it. In the Internet world a protocol known as UDP (User Datagram Protocol) is used to transfer data in this way.

One of the advantages of UDP is that you can send data to more than one receiver at a time since there's no need to establish a point-to-point connection. This technique is known as UDP broadcast mode. Using UDP broadcast mode an application acts much like a radio station, it broadcasts data on a specific IP port and anyone who wants to 'listen' to the data 'tunes in' to that port. There's no

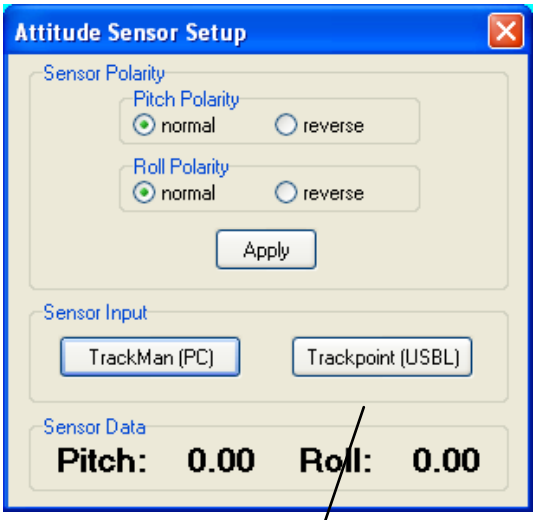
need to make a point-to-point connection so there's no connection to break when a listener stops listening.

Normally, the Trackman is the "CLIENT" while the software you are connecting to is a "SERVER". If the interface software[13] requires that Trackman be a SERVER then click on the check box below the IP Address.

The Sentence Output from Trackman is the data format sent from the PC to the Navigation System. The list of formats available are; PORE, POREB, POREG, SNTTM, STANDARD, STANDARD-EC, STD W/PR, STD-EC W/PR, NCSS, NCSS-EC, NUWC, NUWC-EC, REV 4 & REV 4-EC.

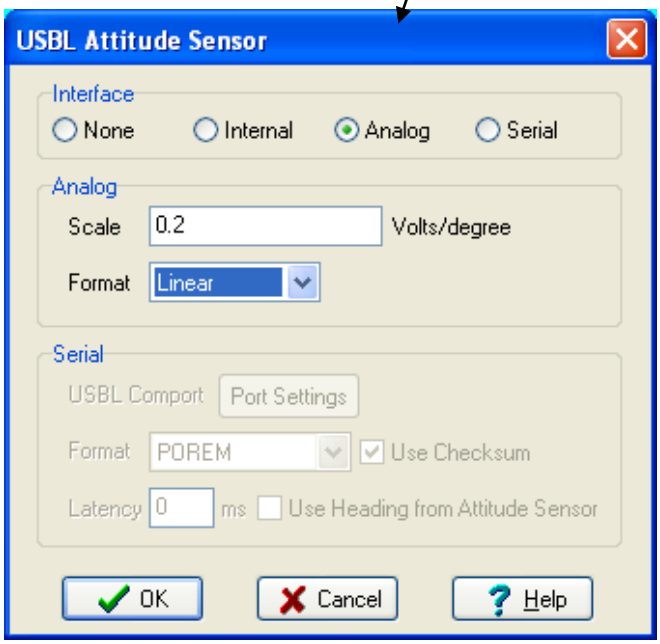
[13] Hypack software requires Trackman be set up as a SERVER.

Setup ➪ Attitude Sensor Setup



This is the System Level Attitude Sensor setup. (Same as clicking on the Attitude Sensor line in the Project Tree.)

The pitch and roll signals compensate target position for vessel motion. The analog inputs [Trackpoint (USBL)] 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 into the TP3 can be reversed and compensated for in the USBL ATTITUDE SENSOR POLARITY dialog box. Normal polarity for pitching bow up is (+) and for rolling port side up is (+). The VRU scaling can also be modified under the USBL ATTITUDE SENSOR menu. Normal scaling is 0.2 V/degree (+/- 10VDC = +/-50°). This dialog also allows the selection of the Compass Sensor Input to be either from Trackman (PC) or (TrackPoint (USBL)).



NOTE: For a Remote VRU the normal Voltage polarity for pitching BOW UP is [+]. The normal voltage polarity for rolling PORT UP is [+]. 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 EdgeTech 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.

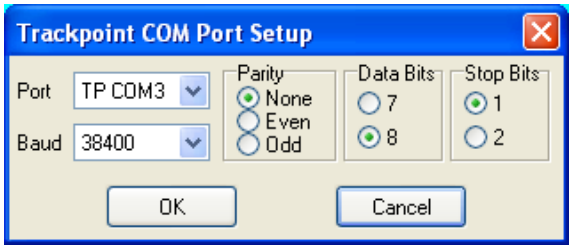
For the **Trackpoint (USBL)** "BATS" there are three types of Attitude Sensors that can be interfaced to the system are; **Internal**, **Analog** or **Serial**.

The INTERNAL selection is not valid with BATS at this time.

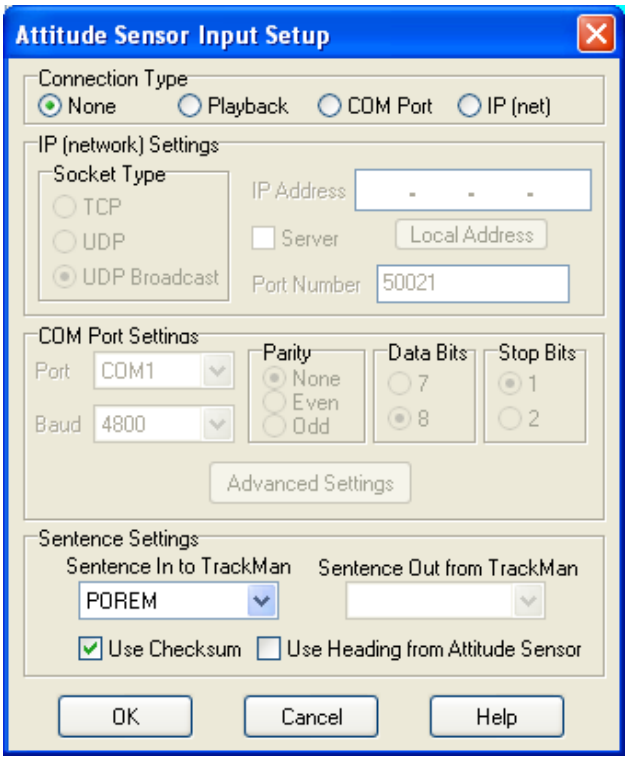
Select ANALOG when using an external sensor with an analog output. The scaling can then be modified to be compatible with the external sensor. For example, a Model 4414B Pitch/Roll sensor.

Select SERIAL when using a sensor that outputs the data serially. For example, an NMEA format from an EdgeTech Model 4760B MRU ($POREM output). The various formats available at the Trackpoint (USBL) COM ports 2 or 3 are…

- TSS1
- TSS HHRP
- PRDID
- CDL/MDL
- PSXN (Seatex)
- POREM



Configure the Port Settings by selecting the COM Port that the data is input to the BATS device. (COM 2 or COM3) Next select the Port #, Baud Rate, Parity, Data Bits and Stop Bits. Note that the baud rate is limited to 38400 and the data rate is limited to 12Hz on these ports for the Model 4460A and 100Hz and 115.2k for Models 4460B and Model 4460C.



If the data is input via the **Trackman PC** then select from the Attitude Sensor Setup box the Trackman (PC) button. The Attitude Sensor Input Setup box is displayed. Select COM Port button at the top and then select the COM Port settings. Port #, Baud Rate, Parity, Data Bits and Stop Bits. Next select the format from the Sentence Settings. The various formats available are…

- POREM
- POREI
- TSS1
- PRDID
- PSXN

The data on these ports can typically be up to 115,200 baud and rates greater than 100Hz.

Sentence Formats:

POREM – Pitch, Roll and Heading

```
            1         2         3         4       5     6     7 8
            |         |         |         |       |     |     | |
$POREM,+XXX.XX,+XXX.XX,+XXX.XX,+XXX.XX,XXX,+XX.XXX*CS<CR><LF>
```

Field Number:

1) Pitch (degrees)
2) Roll (degrees)
3) Temperature (degrees C)
4) Heading (degrees) [14]
5) Error Code
6) Heave (meters)
7) "*" end of sentence delimiter
8) CS = CheckSum

TSS1 – Heave, Roll, and Pitch

```
1 2   3 45   6 78   9 11   1
| |   | ||   | ||   | 01   2
| |   | ||   | ||   | ||   |
:XXAAAASMHHHHQMRRRRSMPPPP<CR><LF>
```

Field Number:

1) Start Character ":"
2) Horizontal Acceleration
3) Vertical Acceleration
4) Space Character
5) Space if positive, Minus if negative
6) Heave (centimeters) (N/A) (positive is above datum)
7) Status Flag
8) Space if positive, Minus if negative
9) Roll X 100 degrees [15]
10) Space Character
11) Space if positive, Minus if negative
12) Pitch X 100 degrees [2]

---

[14] If using heading also, make sure to check the "Use Heading From Attitude Sensor" box.

[15] Roll and pitch measurements are in degrees in the range –99.99° to +99.99°. Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.

TSS HHRP2 –Heave, Roll, Pitch and Heading

```
1   2  34   5  67   8  91   1  1
|   |  ||   |  ||   |  |0   1  2
|   |  ||   |  ||   |  ||   |  |
```

:DDDDSMHHHHQMRRRRSMPPPPM<CR><LF>

Field Number:

1) Start Character ":"
2) Heading X 100 degrees [16]
3) Space Character
4) Space if positive, Minus if negative
5) Heave (centimeters) (N/A) (positive is above datum)
6) Status Flag
7) Space if positive, Minus if negative
8) Roll X 100 degrees [17]
9) Space Character
10) Space if positive, Minus if negative
11) Pitch X 100 degrees [4]
12) Heading Status (N/A)

PRDID - Pitch, Roll and Heading

```
          1         2       3      4
          |         |       |      |
```

$PRDID,+XX.XX,+XX.XX,XXX.XX*CS<CR><LF>

Field Number:

1) Pitch (+ or -)
2) Roll (+ or -)
3) Heading [3]
4) CS = CheckSum [18]

[16] If using heading also, make sure to check the "Use Heading From Attitude Sensor" box.

[17] Roll and pitch measurements are in degrees in the range –99.99° to +99.99°. Positive roll is port-side up, starboard down. Positive pitch is bow up, stern down.

[18] The TSS MAHRS and others may not use the Checksum field. Uncheck the "Use Checksum" box as required.

PSXN - Pitch, Roll, Heading and Heave

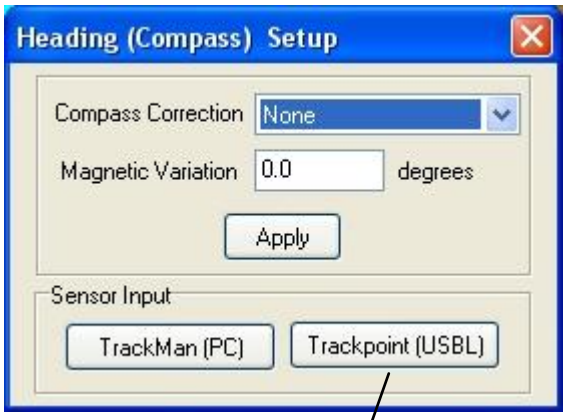
```
        1      2         3         4
        |      |         |         |
$PSXN,23,-xx.xx,-xx.xx,xxx.xx,,*CS<CR><LF>
```

Field Number:

1) Message 23
2) Roll (degrees) (Positive Port Side Up) (N/A)
3) Pitch (degrees) (Positive Bow Up) (N/A)
4) Heading, True (Degrees) [19]
5) Heave (meters) (Positive Up) (N/A)
6) CS = CheckSum

[19] If using heading also, make sure to check the "Use Heading From Attitude Sensor" box.

Setup **Compass Setup**



This is the System Level Heading sensor setup. (Same as clicking on the Heading Sensor line in the Project Tree.)

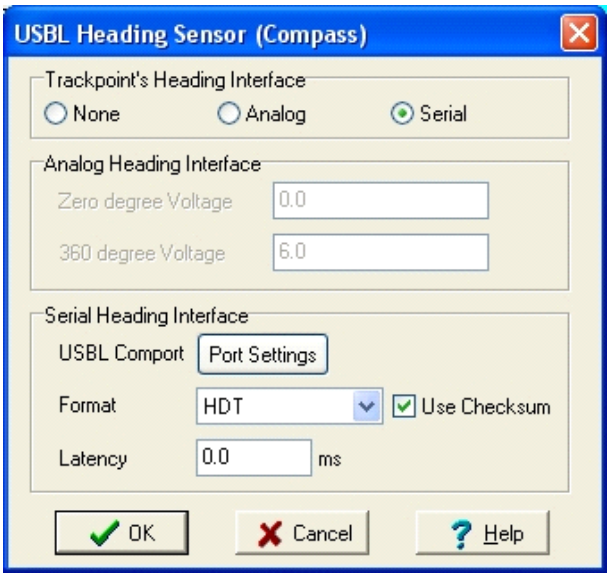
The heading data can be set to off (None), Grid Only, Data Output Only or Both Data Output and Grid. If for example, the Navigation System was to correct for compass heading and not BATS then set the North Reference to Grid only. The RS-232 data would not be corrected for North but the Target position on the grid would be.

The Compass Correction can either be…

- None
- Data O/P Only
- Grid Only
- Both Data O/P & Grid

Enter in the magnetic variation in degrees.

This dialog also allows the selection of the Compass Sensor Input to be either from Trackman (PC) or Trackpoint (USBL) (BATS Transceiver).



Clicking on the "TrackPoint (USBL)" button brings up the "USBL Heading Sensor (Compass)" dialog box. Select **None** (to turn off) or the interface required, either **Analog** as input to the BATS Transceiver's SYNC connector located on the side panel or the **Serial** port which accepts NMEA compass sentences. The Serial input goes into the DB-9 COMMS connector located on the side panel also of the Portable or rear panel of the Desktop.

When the compass is enabled (either Analog or Serial, Trackman (PC) or TrackPoint (USBL) Transceiver), the RS-232 target position data is automatically switched to north referenced. 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 selecting Compass Setup from the main Setup Menu. Click the pull-down menu of the dialog box and select where the Compass Correction should be applied; **None, Data O/P Only, Grid Only, Both Data O/P & Grid**. The "Grid Only" function is used in situations where Trackman

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 Trackman's RS-232 data does not need to be corrected for North reference. However, Trackman requires a compass input to compensate for vessel motion within its filtering algorithms. By selecting "Grid Only" the target data on the Trackman screen remains referenced to North while the RS-232 data is referenced to the bow of the vessel thus allowing both Trackman and the navigation system to function properly. To have the Trackman Heading correction applied along with the RS-232 Data Output then select "Both Data O/P & Grid".

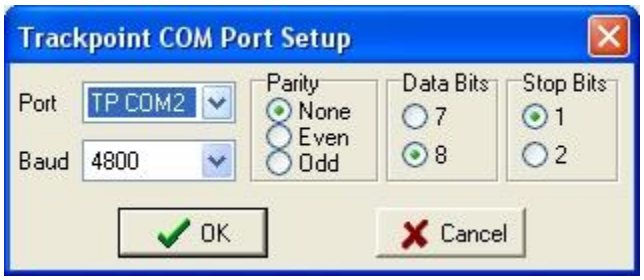
NOTE: When the Compass Correction function is set to "Grid Only", the RS-232 data is averaged (when smoothing is enabled). However, the positional data on the Trackman display is only smoothed or averaged prior to the target's compass correction resulting in positional changes directly related to the change in compass heading. When the Compass Correction function is set to "Grid Only" the target position is averaged after the compass has corrected the data for North Reference resulting in a more "smoothed" target position on the Trackman screen.

Analog: For the Analog Heading Sensor electrical interface see Installation, Section 2 above. The Transceiver converts the analog Voltage to a ship's heading in degrees.

In the "Zero degree Voltage" box enter the minimum Voltage that corresponds to zero degrees. (Range 0 - 5.99VDC) In the "360 degree Voltage" box enter the maximum Voltage that corresponds to 359.99 degrees. (Range 0.1 - 6.0VDC)

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.

Serial: See section 2 (Installation) for wiring the compass to the Transceiver COMMS connector. Click on "Port Settings" to select the TrackPoint (BATS) Transceiver comport that the compass connects to. (COM2 or COM3) Set the baud rate, Parity, Data Bits and Stop Bits to agree with the compasses serial port protocol. Refer to section 2 for COM Port wiring for the COMMS connector. Select OK when done.



Format: The Input Format allows selection of either "HDT", "HDM" or "HDG" NMEA formats. Press OK to use the set parameters or Cancel to ignore.

For further information on the NMEA standard contact; NMEA, 7 Riggs Ave., Severna Park, MD 21146 U.S.A., Tel: 410-975-9425, http://www.nmea.org, E-Mail: info@nmea.org

For further information on the TCM-2 format contact; PNI Corporation 133 Aviation Blvd, Suite 101 Santa Rosa, CA 95403 USA, Tel: 707-566-2260, Fax: (707)566-2261, http://www.pnicorp.com/, E-Mail: CustomerService@pnicorp.com

The following describes the format of each of the NMEA and the TCM-2 compass sentences. If the "Use Checksum" is checked, and the checksums do not agree, the data is ignored. If the "Use Checksum" is not checked 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 and Magnetic heading information except on the NMEA ORE format.

The Heading data is continuously received from the Transceiver's ComPort but only updates when a valid target has been detected. The Model 4460B can accept heading information at data rates up to 100Hz and baud rates up to 115.2k.

The various formats the system can receive are shown below;

HDT - Heading, True

```
          1   2 3
          |   | |
$--HDT,x.x,T*CS<CR><LF>
```

Field Number:

1) Heading, degrees True
2) T = True
3) * = EOS Delimiter & CS = CheckSum

The Trackman software displays the heading data on the screen and adds a suffix "T" to indicate heading is True.

HDM - Heading, Magnetic

```
          1   2 3
          |   | |
$--HDM,x.x,M*CS<CR><LF>
```

Field Number:

1) Heading, degrees Magnetic
2) M = Magnetic
3) * = EOS Delimiter & CS = CheckSum

The Trackman software displays the heading data on the screen and adds a suffix "M" to indicate heading is Magnetic.

HDG - Heading, Deviation and Variation

```
          1    2   3   4   5  6
          |    |   |   |   |  |
$--HDG,x.x,x.x,a,x.x,a*CS<CR><LF>
```

Field Number:

1) Magnetic sensor heading, degrees
2) Magnetic variation, degrees, E/W
3) E = east, W = west
4) Magnetic variation, degrees, E/W
5) E = east, W = west
6) * = EOS Delimiter & CS = CheckSum

Trackman 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 Trackman displays an "M" after the heading data on the display screen. If the sentence contains variation information it calculates the true heading and Trackman displays a "T" after the heading data indicating True heading.

PRDID - Pitch, Roll and Heading

```
          1         2       3     4
          |         |       |     |
$PRDID,+xx.xx,+xx.xx,xxx.xx*CS<CR><LF>
```

Field Number:

1) Pitch (+ or -)
2) Roll (+ or -)
3) Heading [20]
4) * = EOS Delimiter & CS = CheckSum [21]

[20] This is typically a Pitch and Roll sentence with an optional Heading output. The data string will include gyro heading information only if it is available. If there is no heading information available, the heading field will be null.

[21] The TSS MAHRS and others may not use the Checksum field. Uncheck the "Use Checksum" box as required.

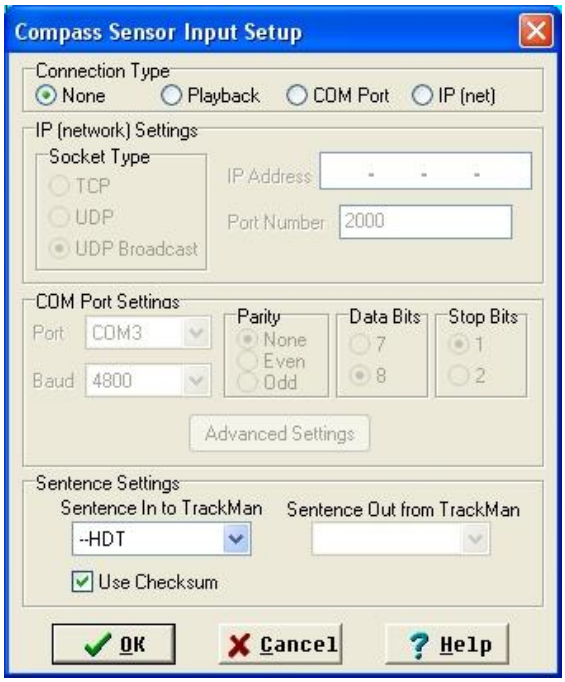
PSXN - Pitch, Roll, Heading and Heave

```
        1      2        3        4
        |      |        |        |
$PSXN,23,-xx.xx,-xx.xx,xxx.xx,,*CS<CR><LF>
```

Field Number:

1) Message 23
2) Roll (degrees) (Positive Port Side Up) (N/A)
3) Pitch (degrees) (Positive Bow Up) (N/A)
4) Heading, True (Degrees)
5) Heave (meters) (Positive Up) (N/A)
6) * = EOS Delimiter & CS = CheckSum

To setup a Compass Sensor that is **input to the PC**, (Trackman Software is installed on this PC) click on the "Trackman (PC)" button. (This is the same as clicking on the Device List and selecting Compass Setup.) A dialog box labeled "Compass Sensor Input Setup" is displayed. This only allows input via RS232 serial port or an IP socket. No Analog function. Setup the port to agree with the compass' parameters. See *Setup* ➪ Data Output above for IP (net) description.



COM Port Settings: See section 2 (Installation) for wiring the compass to the Deck Unit COMMS connector. Select the TrackPoint 3 Deck Unit comport that the compass connects to (COM2 or COM3). Set the baud rate, Parity, Data Bits and Stop Bits to agree with the compass' serial port protocol.

Sentence: The Input Format allows selection of either "HDM", "HDT", "HDG", "PRDID" or "PSXN" NMEA formats. Press OK to use the set parameters or Cancel to ignore.

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>

Trackman 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 Trackman.

Setup **Reset Devices /Ports**

Resets the COM and TCP/IP ports within the Trackman PC.

Setup **Reset Grids/Graphics**

Resets the graphics "engine" within the Trackman PC.

Setup **Hints (Tool Tips)**

Enables the tool tips. Toggles on or off.

Setup **Update While Hidden**

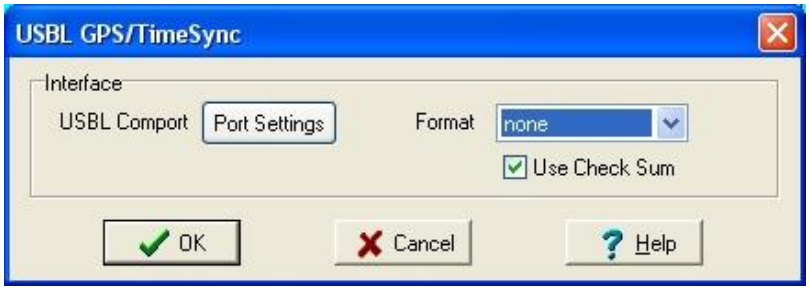
When the Trackman application is minimized it can either continue plotting so that the data can be seen once it is resumed (✓ Update While Hidden) or the application can stop plotting the data and when resumed the screen will have no data points shown. This saves processing time when interfacing to a navigation program that is running on the same PC.

3.3.4 USBL MENU

Pertains to functions/parameter settings on the BATS Transceiver.

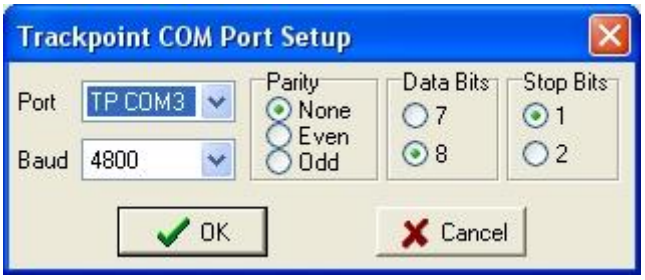
***USBL* ➔ GPS/Time Sync**

From the USBL main menu select **GPS/Time Sync** to bring up the USBL GPS/Time Sync setup parameter dialog box.



Comport#1 on the BATS Transceiver is reserved for the GPS time. By clicking on the "Port Settings" button another dialog appears in which to set the comport specific parameters.

Select either the ZDA format or the GGA format.



When ZDA or GGA is selected the Time coming from the SPC packet is ignored so that it does not update from the PC. "Time" on the Transceiver is synchronized with the GPS time. The Transceiver synchronizes all sensor data and target detection to this time. For example, when the target reply is detected the raw data is automatically time-stamped to within 50ms of the GPS time. The same for all the analog sensor data and the compass serial port data.

Example of ZDA sentence.

$--ZDA,hhmmss.ss,xx,xx,xxxx, xx,xx*hh

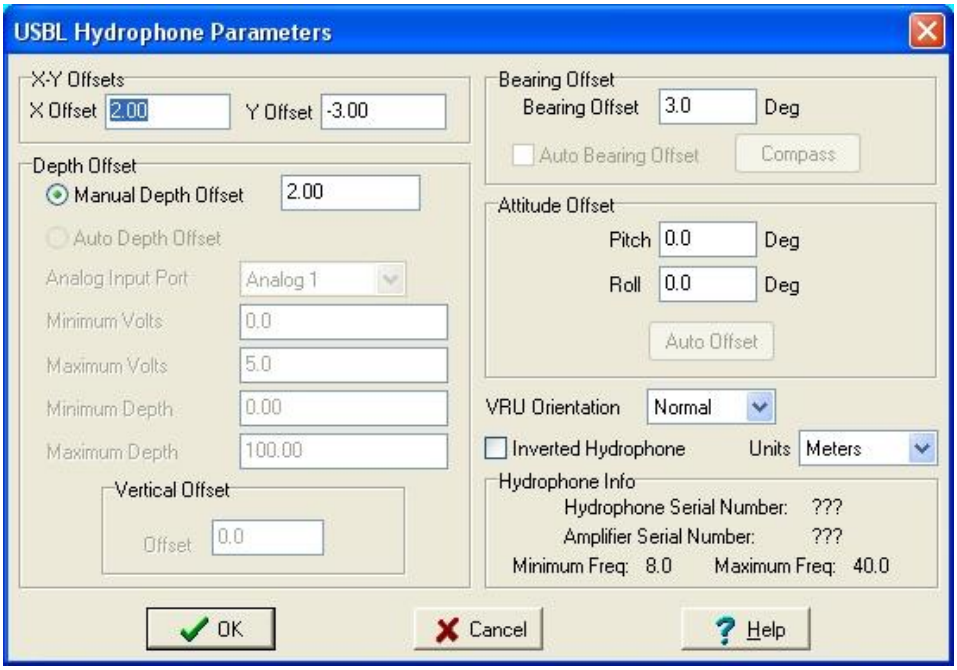
Example of GGA sentence.

$GPGGA,174007,4131.4511,N,07040.3336,W,1,6,01.0,000003.1,M,-00033.7,M*hh

All serial sensor data into the USBL or Trackman interface is time tagged and the closest point to the reply detection is used for motion compensation.

USBL **Hydrophone**

From the USBL main menu select **Hydrophone** to bring up the USBL Hydrophone setup parameter dialog box.



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 BATS. See ORE Model 4414B Motion Sensing System or Model 4760B.

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).

Bearing Offset: The Bearing Offset is the rotational offset between the hydrophone's acoustic zero-degree line and the vessel's centerline. See section 2.4.1 for this installation setting. Enter the Bearing Offset as determined in Section 2.4.1.

X & Y Offsets: Determine X and Y offsets for the hydrophone in relation to the pitch / roll center as explained in section 2.4.2. To enter hydrophone offsets, select HYDROPHONE from the Project Tree. A dialog box consisting of X, Y, DEPTH and BEARING offsets are displayed. Enter the X and Y Offsets as determined in Section 2.4.2.

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". Once the X and Y Offsets are entered and the dialog box closed, a small "Hydrophone" symbol appears in the Plotting Window and moves in relation to the X and Y offsets that are input. This "Hydrophone" symbol represents the actual position of the hydrophone. The ships reference point remains in the center of the tracking display.

NOTE: The Trackman software 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.

NOTE: The X and Y coordinates of the USBL Hydrophone are different from the X and Y MRU coordinates of the EdgeTech Motion Sensor Unit (Model 4760B). The Z axis polarity is also different. (The Hydrophone Z Offset is always positive below the water surface while the MRU Offet below the water surace is negative.) Refer to MRU Manual for entering offsets into the MRU.

Depth Offset: Manually enter the depth offset as determined in section 2.4.2. This is the Depth of the hydrophone from the water surface (which is assumed to be on the same plane as the pitch/roll center of the vessel) to the tip of the hydrophone. Manual mode only. Auto Offset is used only in special cases.

Attitude Offset: This is the (static) vertical offset of the hydrophone in degrees.

Enter the hydrophone attitude error corrections in degrees. It is 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°.

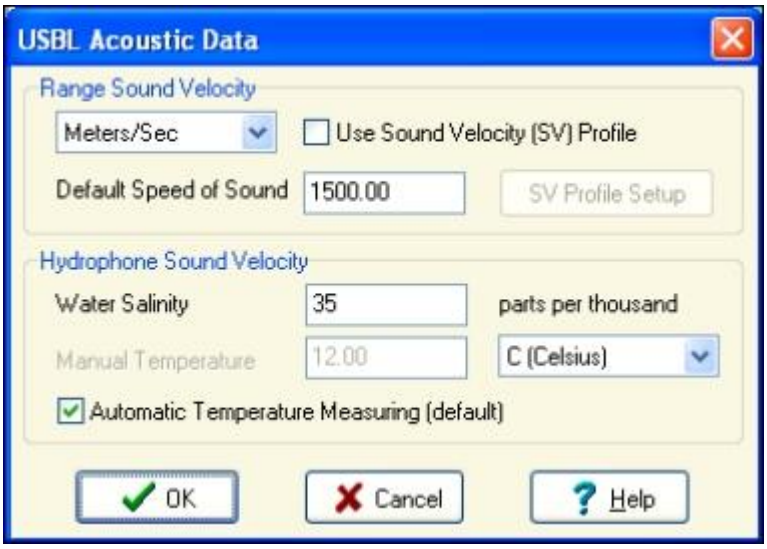
The attitude (pitch/roll) offset errors follow the polarity convention of; vessel Bow up = [+], Port up = [+]. For example, if the combined hydrophone shaft and vessel trim causes the Hydrophone (4610B or 4211A) mounted on the end of the staff) to tilt towards the port side (has the same affect as tilting 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. Also, refer to section 2.4.3.

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

Units: Sets the units that the dimensional offsets are relative to; Meters, feet or Yards.

Orientation: If an EdgeTech remote Pitch and Roll sensor is used, such as the Model 4730A, 4740A or 4760B-V the system can allow for different mounting configurations of these VRU assemblies. 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. The software can compensate for four different mounting arrangements. The VRU ORIENTATION function allows a VRU assembly to be mounted in the NORMAL position with the assembly's directional arrow facing towards the bow, or mounted to STARBOARD, AFT or PORT.

USBL **Acoustic Data**



Brings up Acoustics Data dialog box. (Same as Acoustic Data in Project Tree) This data is used within Trackman to correct positional data based on the acoustic parameters. Enter the average water column Speed of Sound in meters/ second or feet/ second or click the Use Sound Velocity (SV) Profile check box to enter in the profile or import a file containing the profile. The default value is 1500 m/s. The slant range is calculated using this value and the acoustic travel time. Enter the Water Salinity at the hydrophone in part per thousand. Default is 35 ppt. The TrackPoint hydrophone measures the temperature automatically. This box should be checked. If not available then a manual temperature at the hydrophone can be entered in degrees Celsius or Fahrenheit.

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

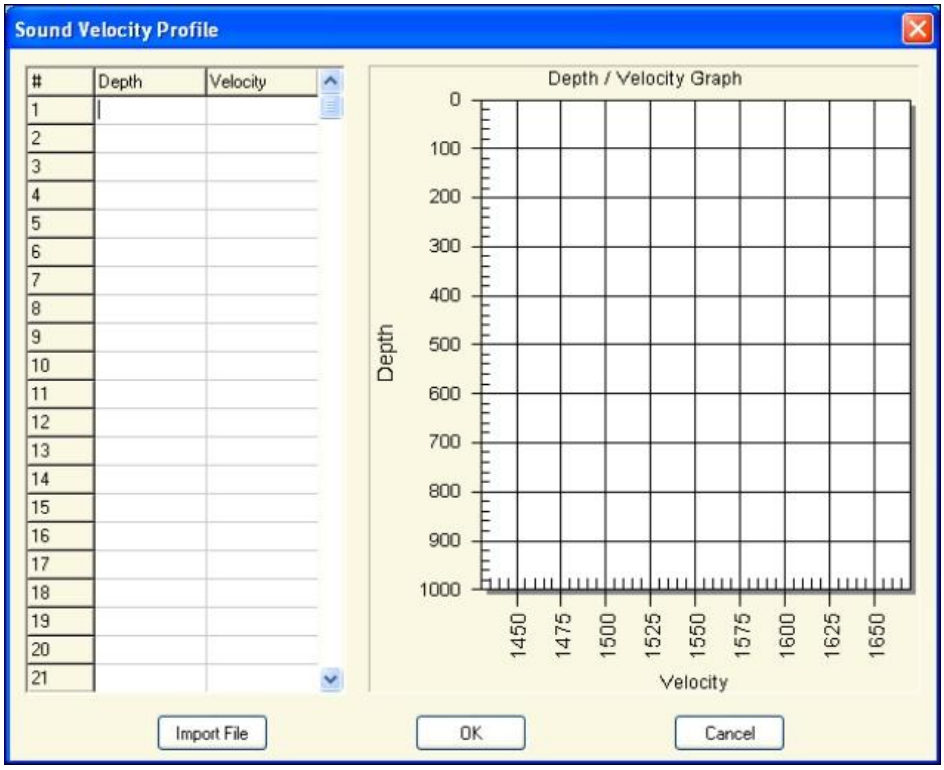
NOTE: The WATER TEMPERATURE and SALINITY parameters do not affect speed of sound calculations. It is used for phase correction (depression angle) at the water / hydrophone interface.

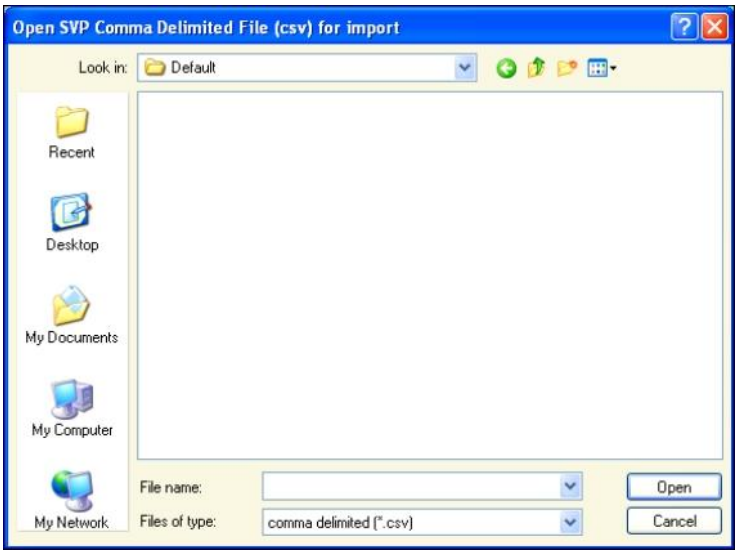
Sound Velocity Profile

A single velocity profile can be entered by hand or loaded from a file. At each depth there is a sound velocity value. The data is being assumed to represent the sound velocity layers for the entire region within which you are operating. Therefore, it is assumed that there is no effect on bearing in this model. A non-direct sound wave segment could not be re-directed to the receive point (from a bearing point-of-view) since the effect is only on z-axis. The only two parameters that require correction are the **slant-range (SR)** and **depression angle (DA)**.

If the SVP data is available in a printout then manually enter the data within the Sound Velocity Profile chart below. For example, in layer #1 enter in the **Depth** and the **Velocity** associated with that layer. Continue entering data, filling in the chart down to the depth required. If the data entered for the Velocity is between 1400 and 1700 then it is assumed the data is in meters/second. If the Velocity values are between 4592 and 5576 then the data is assumed to be in feet/second. The data entered will be shown in the corresponding Graph. The data entered will be saved as a csv file under the current Jobs folder. For example, ..\Jobs\TP3\CurrentSvp.csv.

If the profile is available in a csv formatted file then it can be imported, in most cases. Trackman makes some assumptions when importing the SVP files. If there are only 2 fields separated by commas (prior to a carriage return line feed), it assumes the data is in the format of Depth, Velocity. If there are 3 fields then it assumes the data is in the format of Index, Depth, Velocity



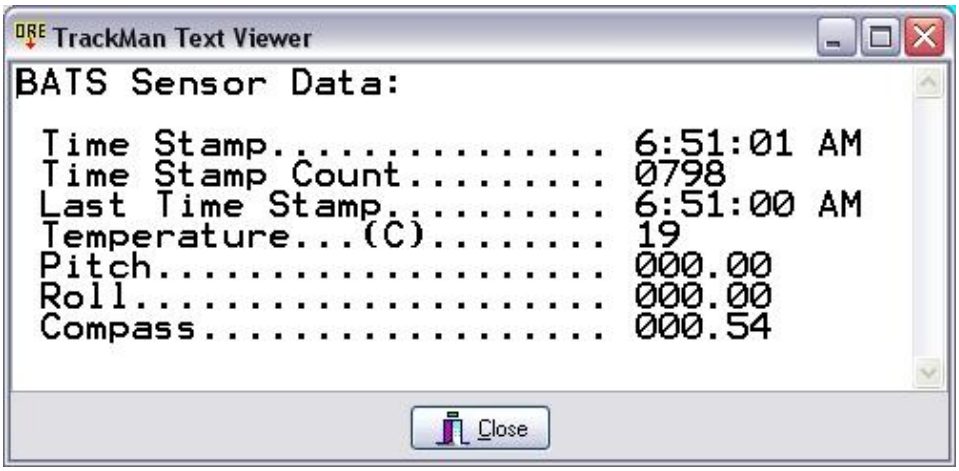


USBL ➘ Send TrackPoint (BATS) Config

Synchronizes the BATS Transceiver with the saved parameters from Trackman.

USBL ➘ Get Sensor Data

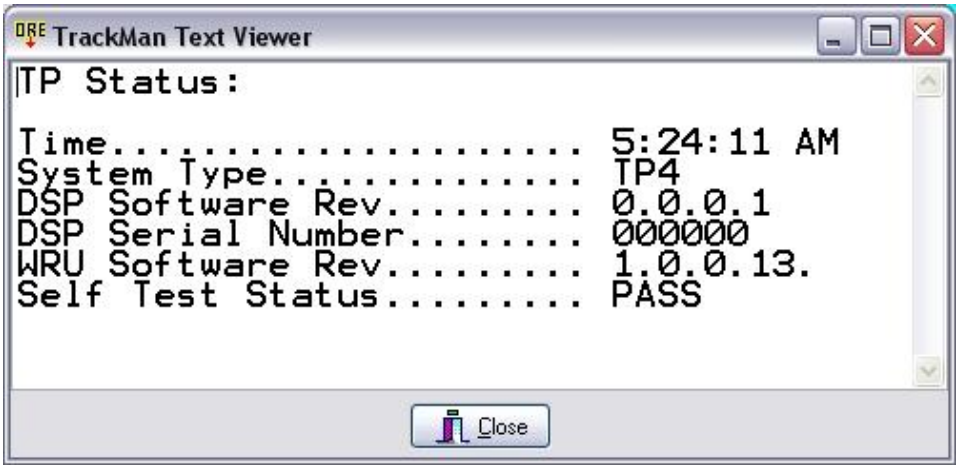
Queries the Transceiver to read the analog sensor inputs and display their values. The A/D data is read once per command. It is possible to repeat the command while leaving the box on the screen.



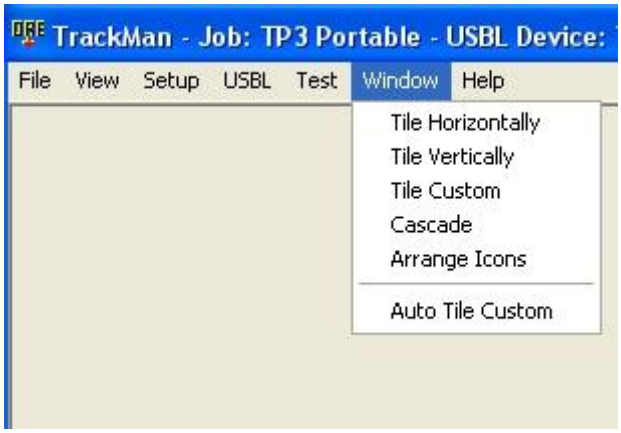
Timed Stamp: The time the analog data was read
Time Stamp Count: The difference between the BATS' CPU clock and DSP clock.
Last Time Stamp: The last time stamp occurrence.
Temperature: The BATS Hydrophone Temperature in degrees C.
Pitch/Roll: The analog pitch value in degrees.
Compass: The analog compass in degrees.

USBL ➘ Get Status

Obtains the Status of the BATS Transceiver. Displays the Time, System Type , Revision of the DSP Software, DSP Serial Number, BATS CPU software revision and a Self Test indication.



3.3.5 WINDOW MENU



WINDOW **Tile Horizontally**

Tiles the Plotting Window and Status Block Horizontally.

WINDOW **Tile Vertically**

Tiles the Plotting Window and Status Block Vertically.

WINDOW **Tile Custom**

Tiles the Plotting and Status Blocks (child windows) to optimally fit the main window (client window).

WINDOW **Cascade**

Places Plotting Window and Status Block one behind the other.

WINDOW **Arrange Icons**

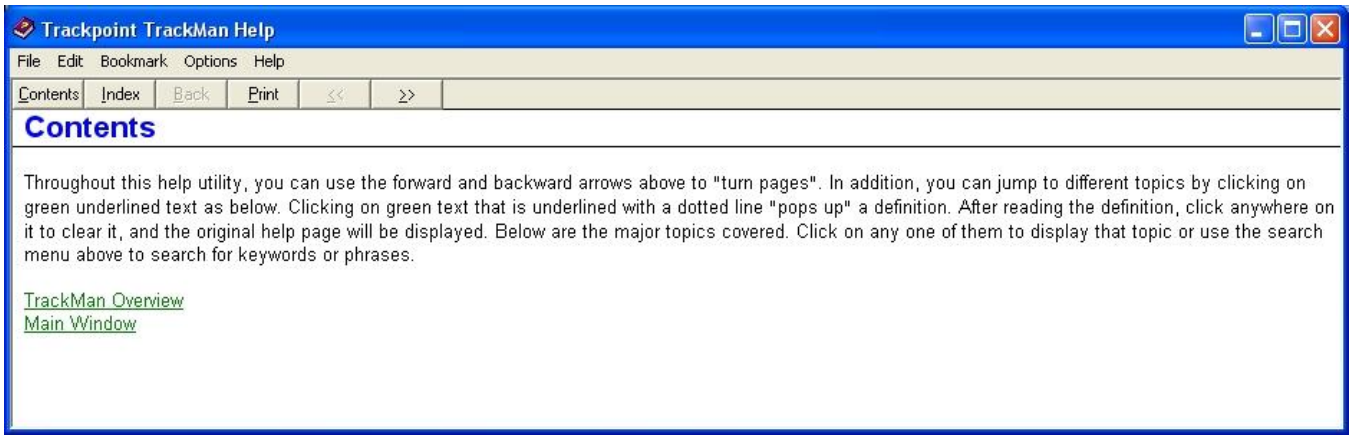
Not available.

WINDOW **Auto Tile Custom**

A check box to enable the Custom Tiling. If not checked, when main window is re-sized the plotting and status blocks will have to be re-sized manually to fit in the main window again.

3.3.6 HELP MENU

***HELP* Contents**



***HELP* About**

Shows the Trackman version number and the Processor's Physical Memory (RAM) in % used.

3.4 TRACKING TRANSPONDERS, RESPONDERS AND PINGERS

The BATS tracks up to four (4) Beacons (non-telemetry) simultaneously, consecutively or a combination of simultaneously/consecutive targets.

"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):

4 Transponders

1 Responder

1 Responder and 3 Transponders

1 Pinger

1 Externally Triggered Responder or Transponder (Target Channel #1 becomes the master trigger for all other targets enabled)

Rules…

- Only target #1's Trigger Input can be used as the external trigger source.
- Once target #1 is configured for external trigger mode (BEACON/ACOUSTIC PARAMETERS tab) all other targets are triggered externally also.
- Internal or External Triggering: As long as the targets interrogation frequencies are different the system will sequence through all the targets, interrogating one at a time.
- Internal or External Triggering: If any targets interrogation frequency are the same, the system will process the replies simultaneously[22].
- The receive LED flashes at the beginning of the next interrogation cycle. All processing is performed at the end of the interrogation cycle to determine detection. When targets are being tracked in sequence it will appear as if the previous reply arrived late when in fact it was only delayed due to processing.
- Receive LED's will not flash for the telemetry reply.
- Internal or External Triggering: A trigger out key is available on each targets interrogation cycle. This can be used to trigger responder type targets.

[22] When tracking simultaneously there is a chance of the beacon replies arriving at the hydrophone at the same time. In these cases the data will be corrupt and the result is typically a low quality factor which causes that errant data point to be filtered out. In a dynamic tracking environment this usually occurs sporadically and does not disturb the tracking of the targets.

To track multiple targets (simultaneously) the BATS sequences through the various **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. When the BATS sees that the same interrogation frequency has been selected for a series of targets it automatically processes the reply frequencies from the beacon within the same interrogation cycle.

Example #1:

Transponder #1 - Interrogation Freq.: 16 kHz, Reply Freq.: M-FSK ORE-01

Transponder #2 - Interrogation Freq.: 16 kHz, Reply Freq.: M-FSK ORE-02

Transponder #3 - Interrogation Freq.: 16 kHz, Reply Freq.: M-FSK ORE-03

Transponder #4 - Interrogation Freq.: 16 kHz, Reply Freq.: M-FSK ORE-04

NOTE: If the repetition interval is set to 4 seconds, Trackman updates each transponder position every 4 seconds.

Example #2:

Transponder #1 - Interrogation Freq.: 17 kHz, Reply Freq.: M-FSK ORE-01

Transponder #2 - Interrogation Freq.: 18 kHz, Reply Freq.: M-FSK ORE-01

Transponder #3 - Interrogation Freq.: 19 kHz, Reply Freq.: M-FSK ORE-02

Transponder #4 - Interrogation Freq.: 20 kHz, Reply Freq.: M-FSK ORE-02

3.4.1 TRANSPONDER MODE

Acoustic Transponder Mode

To establish tracking in the **Transponder** mode, the Transponder's interrogation frequency must be in the frequency band of the Hydrophone's interrogation transducer[23] and transponder(s) must be operational and in the water.

From the Beacon dialog box select the **SETUP** tab and then select Active target. Select the target symbol that you want the target to be represented by. Enter a name for the target. From the Beacon **ACOUSTIC PARAMETER** Tab set target type to Transponder, under "Reply Parameters" select the Reply frequency/Code and the Turn Around Time, under "Interrogation Parameters" enter the interrogation Interval, the Interrogation Frequency/ Pulse Width or code. (This information is found the Multibeacon Label, 4370X) Select Trigger source, internal or external. From the DEPTH tab select depth mode or enter in depth manually.

[23] The interrogation transducer inside the Model 4610B hydrophone has an optimal frequency range of 17 to 20 kHz.

Interrogation Interval 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 it's possible to decrease the Interrogation Interval to less than two seconds as the Interrogation Interval for a single target is 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 Interrogation Interval accordingly.)

NOTE: With EdgeTech Model 4370 series of transponders, pulse widths of less than 5 msec may not properly interrogate the transponder.

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 Project Tree select "Acoustic data". Input 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.)

If the Sound Velocity Profile is known it can either be entered manually or imported from the file. Check the SV Profile box and click on the "SV Profile Setup" button.

Target Depth

The target depth parameter can either be manually entered, telemetered or input via analog-in Depth BNC. Choose the method used to update the depth parameter.

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 Target #1 green Interrogate LED flashing for each interrogate signal transmitted, and the red Receive LED flashing for each signal received[24].
- With a transponder at close range the Quality Factors should typically be 9's or 10's.

Hardwired Transponder Mode

The Hardwired Transponder mode feature is used where a burst or tone from the transmitter triggers a transponder via an umbilical. A high level transmit burst from a transmitter 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. When a target is set up as a Hardwired Transponder, 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 hardwired transponder's receiver. See Note [25].

3.4.2 RESPONDER MODE

To establish tracking in the responder mode, the proper cable connection must be made at the Transceiver. Connect the Trigger out signal from the SYNC connector of the Transceiver to the Responder or Responder umbilical cable. To output a differential signal to the Responder connect the TRIG-OUT1 (pin-M) and /TRIG-OUT1 (pin-L) lines to the Responder. To send a positive going pulse connect the TRIG-OUT1 (pin-M) and COM (pin-N) signals to the Responder and to send a negative going pulse connect the /TRIG-OUT1 and COM signals to the Responder. The TRIG-OUT signal levels can either be +5 TTL or +12VDC, as selectable on the internal Peripheral Interface Card (PIC) within the Transceiver. Default setting is +5V or TTL compatible.

The TRIG-OUT pulse NOT ISOLATED and it occurs on both the transponder (transmit) and responder trigger cycles.

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, 3.3.2, 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 and the Pulse Turn Around Time must be entered.

It is not necessary to set a transmitter frequency for a Pulse Mode responder. The Interrogation Interval must be set for the maximum range encountered to the responder. E.g., @ 1500 me-

[24] The receive LED flashes at the beginning of the next interrogation cycle. All processing is performed at the end of the interrogation as detection is not known until after the next interrogation.

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

ters/second velocity of sound and an Interrogation 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. Select Trigger Source, either Internal or External.

3.4.3 FIXED (ARTIFICIAL) TARGET

From the Beacon Parameter dialog box select SETUP Tab and choose a target number/symbol. Under Beacon Status select Fixed Target. In the box below it enter in the target's bearing and horizontal distance. Select BEARING and enter a value between 0° and 359°, select HORZ RANGE and enter a value between 1 and 10000 meters.

The total number of targets allowed is four, therefore if two targets are actively being tracked then up to two Artificial targets can be enabled. A horizontal range and bearing to a target (with respect to the pitch/roll center of the vessel) 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 BATS hydrophone and the sonar/radar transducer (E.g., an offset must be applied so that the data is relative to the vessel's pitch/roll center). This corrected data is then sent to the Trackman via the RS-232 port or manually updated from the keypad/mouse.

If the Transceiver 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 corrected and plotted at 120°.

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.

◎ BATS Beacon List setup when tracking 4 Transponders consecutively

Scenario: 4 Divers each have a Transponder attached to them and the system tracks in sequence to obtain an update of all divers in about 14 seconds.

Beacon#	1	2	3	4	1	etc.	
Time	2	2	2.5	3.5	2	etc.	seconds
Xmit Frequency	17	19	18	20	17	etc.	kHz

- All Beacons are internally triggered. Each Beacon's interrogation rate is adjusted for its intended range. Xmit (interrogation) Interval must be longer than the maximum slant range to the target. E.g., A two-way travel time for a transponder at 1000m is approximately 1.4 seconds ((1000 meters / 1500 meter/second) * 2) = 1.33 seconds).
- Beacon LED's (Trigger-In, Interrogate, Receive) shows status of each beacon Interrogation Interval every 9 seconds.
- Trigger-Out signal is transmitted at the time of each beacon interrogation LED flash.

Num	Target Name	Type	Serial#	Chan#	Status	Xmit Interval	Xmt Freq	Recv Freq	Pulse Width	Manual Depth	Filter Level	Trigger	
1	Beacon1	Transponder, Acoustic		1	Active*	2	17 CW	M-FSK	5	10	4	Internal	
2	Beacon2	Transponder, Acoustic		1	Active	2	19 CW	M-FSK	5	15	4	Internal	
3	Beacon3	Transponder, Acoustic		1	Active	2.5	18 CW	M-FSK	5	20	4	Internal	
4	Beacon4	Transponder, Acoustic		1	Active	3.5	20 CW	M-FSK	5	25	4	Internal	

◎ BATS Beacon List setup when tracking 1 Responder with an external trigger.

Scenario: Side Scan Sonar triggers the Responder at the rate as set by the side scan sonar transmitter. Trigger output from the SSS Transceiver goes into Trigger In 1 of BATS.

- External triggering: Only Target #1 can be externally triggered. All other targets (if enabled) are forced to external trigger mode.
- Beacon 1 LED's (Trigger-In (yel), Interrogate (grn), Receive (red)) show status.
- Trigger-In 1 (External trigger) initiates interrogation of Beacon. Trigger-Out 1 signal is transmitted at the time of each interrogation LED flash. Trigger Input rate must be longer than the maximum slant range to the target. E.g., A one-way travel time for a responder at 1000m is approximately 0.7 seconds (1000 meters / 1500 meter/second = 0.66 seconds).

Num	Target Name	Type	Serial#	Chan#	Status	Xmit Interval	Xmt Freq	Recv Freq	Pulse Width	Manual Depth	Filter Level	Trigger	
1	Beacon1	Responder		1	Active	1	N/A	M-FSK	5	10	4	**External**	
2				1									
3				1									
4				1									

◎ BATS Beacon List setup when tracking one pinger

Scenario: Tracking a lost Pinger on the seabed. (not common)

- Only one Beacon can be enabled when in Pinger mode (Can be any one of the Beacons 1-4) Enter in the repetition rate of the beacon.
- Beacon 1 LED (Receive) shows status
- Trigger-In 1 Not applicable. Trigger-Out 1 Not applicable.
- The interrogation rate is set to the pingers repetition rate. The Interrogation rate should be asynchronous to the pinger. This provides an internal trigger to the system thus initiating the data processing for the target.

Num	Target Name	Type	Serial#	Chan#	Status	Xmit Interval	Xmt Freq	Recv Freq	Pulse Width	Manual Depth	Filter Level	Trigger	
1				1									
2				1									
3				1									
4	Beacon4	Pinger		1	Active	N/A	N/A	27 CW	N/A	25	4	N/A	

◎ BATS Beacon List setup when tracking 4 Transponders simultaneously.

Scenario: 4 Divers each have a Transponder strapped to them and the system tracks simultaneously to obtain an update of all divers in 2 seconds.

- All beacons have same interrogation frequency but different reply codes/frequencies.
- Beacon 1 triggered internally. If the other channels interrogation frequency is set the same then the system knows to look for replies from the other channels during the same transmission. (All Beacons are triggered by the same 17kHz interrogation from Beacon 1. Xmit (interrogation) Interval must be longer than the slant range of the furthest target. E.g., If the furthest diver is less than 1000m then a two-way travel time for a transponder at 1000m is approximately 1.4 seconds ((1000 meters / 1500 meter/second) * 2) = 1.33 seconds). NOTE: Most transponders lockout for at least 1.5 seconds. This would be the minimum interrogation interval possible.
- Beacon 1 LED's (Trigger In, Interrogate, Receive) show status for Channel 1
- Beacon 2 LED's (Trigger In, Interrogate, Receive) show status for Channel 2
- Beacon 3 LED's (Trigger In, Interrogate, Receive) show status for Channel 3
- Beacon 4 LED's (Trigger In, Interrogate, Receive) show status for Channel 4
- Trigger-Out 1 signal is transmitted at the time of each interrogation LED flash. (Trigger-In 1 (External trigger) is possible when tracking one Beacon on this channel but is not applicable when tracking Beacons consecutively on this channel.)

Num	Target Name	Type	Serial#	Chan#	Status	Xmit Interval	Xmt Freq	Recv Freq	Pulse Width	Manual Depth	Filter Level	Trigger	
1	Beacon1	Transponder, Acoustic		1	Active	2	17 CW	M-FSK1	5	10	4	Internal	
2	Beacon2	Transponder, Acoustic		2	Active		17 CW	M-FSK2	5	15	4	Internal	
3	Beacon3	Transponder, Acoustic		3	Active		17 CW	M-FSK3	5	20	4	Internal	
4	Beacon4	Transponder, Acoustic		4	Active		17 CW	M-FSK4	5	25	4	Internal	

3.5 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 and an ERROR CODE is sent out on the RS-232.

Other error codes that are displayed on the status line and sent out on RS-232 are warnings.

BRIEF ERROR CODE LISTING	
CODE	**TARGET ERROR DESCRIPTION**
	FATAL ERRORS (1-19, NO POSITION PLOTTED)
0 (null character)	No errors detected.
1	Unusable signal received.
2	Range-gate (or Pinger time-gate) error
3	Range cannot be determined. (Usually 0m slant range)
4	Quality Factor less than average of 5 previous replies.
5	Excessive Target velocity (Any filter level above 3)
6	No recent replies.
7	Measured slant range less than MIN XPNDR RNG
8	Simultaneous reply interference error
9	Reserved.
10	Travel time less than turn around time (No reply received)
14	Measured Slant Range > MAX SLANT RNG parameter
15	Measured Bearing outside BEARING LIMITS parameter
	WARNINGS: (≥20, POSITION PLOTTED)
21	Telemetry Signal Unusable.
22	Telemetry Signal Timing Error.
23	Telemetry timing out of range (Check Telemetry Settings)
24	Telemetered depth greater than slant range.
26	No recent telemetry replies
50	Target input depth not within normal limits of the calculated depth.
51	Pinger Dep Angle < 20°, Due to range uncertainty, only bearing from HYD. shown
52	Pinger D.A. < 20°, Due to range uncertainty, only pinger's bearing shown.
53	Pinger D.A. 20° - 45°. Range is approximated. Position symbol " ≈ ".
54	
55	
56	Warning: No longer using calculated depth. (Transponder or Responder D.A. < 45°)
57	Warning: Input depth exceeds measured slant range. (Depth > Slant Range)
59	

BRIEF ERROR CODE LISTING	
CODE	**TARGET ERROR DESCRIPTION**
60	Warning: Measured depression angle questionable (using calculated value) System ignores the phase count depression angle and uses the slant range and input depth to calculate horizontal range.
61	Warning: Horiz range greater than slant range (Using slant range)
62	
64	Warning: Quality Factor is less than average of previous 5 replies
~~70~~	~~Warning: no recent GPS time sync received~~
71	Warning: Depth exceeds last Velocity Profile entry, new profile may be needed
72	Warning: Velocity Profile error, profile will not be used

ERROR CODE CHANGES FOR 4460B	
CODE	**TARGET ERROR DESCRIPTION**
	FATAL ERRORS (1-19, NO POSITION PLOTTED)
0 (null character)	No errors detected.
1	Navigation SNR below threshold setting
16	Signal Acquisition Aborted (# samples < req by Min Search Rge) (no detect)
17	Navigation Quality Factor below min QF threshold
18	Max Interchannel Time Exceeded
	WARNINGS: (≥20, POSITION PLOTTED)
73	No Recent GPS Sentence Received
74	No Recent Pitch/Roll Sentence Received
75	No Recent Compass Sentence Received

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. **4460B:** Navigation SNR below threshold setting **SUGGESTION:** Lower the Signal To Noise threshold in Trackman for that target. (Perform a noise level test by turning off the beacon and lowering the threshold until the system false detects. Raise Threshold 5dB above the false detect level.) Put Beacon back in and try again. If still not detecting then noise could be too high or range is excessive for that beacon or the beacon's battery (if applicable) is getting low.
2	Range-gate (or Pinger time-gate) error. (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 filter levels 5 to 10. No position is plotted. **NOTE:** A rapidly turning ship can make the target appear to move fast and can cause this error. To alleviate this, integrate a compass into TrackPoint.
6	No recent replies. This message appears if, in any mode, no detected signal has occurred for 16 seconds. **SUGGESTION:** Check to see if the beacon is in the water. Check Trackman setting VS Beacon label to make sure it is being interrogated with the correct frequency. Check to make sure the Beacon receive code is correct.

#	TOD	HDG	BRG	S.R.	X	Y	Z	TEL	ERR
1	02:12:04		-.-	-.-	-.-	-.-	-.-	-.-	6
1	02:12:06		-.-	-.-	-.-	-.-	-.-	-.-	6

EXPLANATION OF ERROR CODES	
CODE	**DESCRIPTION**
	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. **SUGGESTION:** Check the "Limits" parameters under the Beacon Setup dialog/ Filtering Tab. Make sure slant range to beacon is greater than the minimum range setting.
8	Simultaneous reply interference error. Two replies arrived at same time and cannot be processed. No position is plotted.
10	Travel time less than turn around time (TAT). Either the reply was detected within a time period less than the entered turnaround time or no valid reply was detected and system triggered on noise within the TAT. **SUGGESTION:** Check the "Reply Parameters" under the Beacon Setup dialog/ Acoustic Parameters Tab. Make sure the beacon's Turn Around Time is entered correctly for the beacon Type in use (Transponder VS Responder). Check Beacon's TAT. Check Beacon setup parameters.
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.
16	MODEL 4460B: Processing was interrupted by sending parameter changes to BATS, System or Target parameters. Next interrogation cycle should clear error.
17	MODEL 4460B: BATS Low Quality Factor on the Navigation Reply (So as not to be confused with 04, as determined by Trackman.) QF was less than the QF Threshold **SUGGESTION:** Usually means a high multipath environment. Check the Min Quality Factor setting in the Expert menu to see if it is up too high (2 = default). Check that the Hydrophone is installed correctly and that there is enough clearance between Hydrophone tip and water surface and the sea floor. Check that the receive code is correct for the beacon. It is possible that the signal has two correlation peaks and the wrong peak is being selected. Open up the reverse time direct path search parameter to 5ms in the expert menu (2.5ms = default). Raise or lower the Direct path Min Amplitude Fraction in the expert menu (0.4 = default).

EXPLANATION OF ERROR CODES	
CODE	**DESCRIPTION**
	Raise or lower the Excluded Peak Width Fraction (1.50 = default)
18	MODEL 4460B: Max Interchannel Time Exceeded (To differentiate from EC 01 and EC 16.) **SUGGESTION:** High Multipath may cause this error. This is a check for detection on two channels, verifying that the time between the two are less than the parameter setting of 2.5ms.
	WARNINGS ONLY (> 20)
21	Unusable Telemetry Signal received. (Uses previous depth) MODEL 4460B: Telemetry SNR Below Threshold Setting **SUGGESTION:** Lower the Signal To Noise Threshold in Trackman (Beacon Setup dialog/ Filtering Tab) for that target. If still not detecting then noise could be too high or range is excessive for that beacon or the beacon's battery (if applicable) is getting low. If Navigation SNR is OK then make sure the Telemetry frequency/code is correct. or… MODEL 4460B: Quality Factor < min QF Threshold **SUGGESTION:** Usually means a high multipath environment. Check the Min Quality Factor setting in the Expert menu to see if it is up too high (2 = default). Check that the Hydrophone is installed correctly and that there is enough clearance between Hydrophone tip and water surface and the sea floor. Check that the receive code is correct for the beacon. It is possible that the signal has two correlation peaks and the wrong peak is being selected. Open up the reverse time direct path search parameter to 5ms in the expert menu (2.5ms = default). Raise or lower the Direct path Min Amplitude Fraction in the expert menu (0.4 = default). Raise or lower the Excluded Peak Width Fraction (1.50 = default). If Navigation QF is OK OK then make sure the Telemetry frequency/code is correct.
22	Reserved.
23	Telemetry timing out of range. Telemetry time is either less than the entered '0' Delay or greater than the full scale span. **SUGGESTION:** Check the "Zero Delay" parameter under the Beacon Setup dialog/ Depth Tab. Make sure Zero Delay setting agrees with Beacon label. Perform a Zero Offset adjustment by setting beacon to a known minimum depth and adjust the Zero Delay to agree with the actual depth. This will take out any temperature offsets in the gauge. **SUGGESTION:** Check the "Full Scale Delay" parameter under the Beacon Setup dialog/ Filtering Tab. Make sure Full Scale Delay setting agrees with Beacon label. Check that the beacon's depth did not exceed the gauge depth rating.
24	Reserved.
26	No recent telemetry replies. No telemetry signal has been received for at least 16 seconds. **SUGGESTION:** If the Navigation reply is being received then check Trackman setting (Bea-

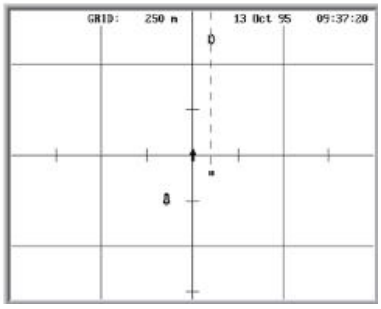
EXPLANATION OF ERROR CODES	
CODE	**DESCRIPTION**

con Setup dialog/ Depth Tab, Telemetry/Reply Frequency Setup) VS Beacon label to make sure the Telemetry code is correct. If no Navigation Reply received then refer to the "No Nav Signal Detected" (06) first.

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 Pinger Only: 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.

ERROR CODE 51 EXAMPLE



NOTE: The pinger's bearing data does not degrade in this mode.

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	

51 (cont.) 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.

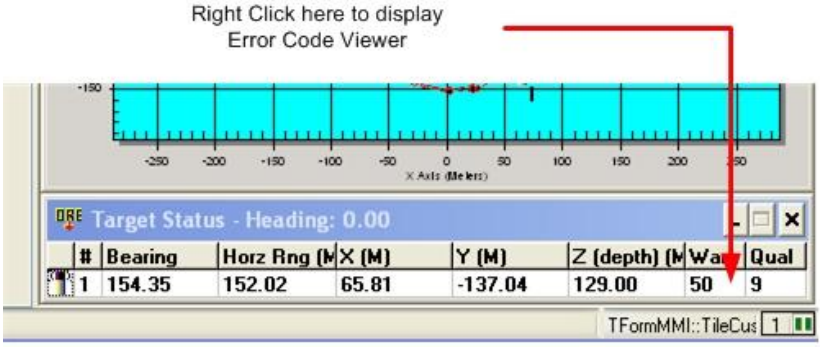
EXPLANATION OF ERROR CODES	
CODE	**DESCRIPTION**
52	This warning is set when the target is a pinger and the depression angle is less than 20 degrees from the horizontal. Its purpose is to notify the on-line computer system, via the RS-232, that all ranges and x or y coordinates to that target are minimum 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.
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.
55	Reserved.
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. 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.

#	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

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. (Using Slant Range)
62	Reserved.
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.

EXPLANATION OF ERROR CODES	
CODE	**DESCRIPTION**
70	Reserved.
71	Depth exceeds last Velocity Profile entry, new profile may be needed.
72	Velocity Profile error, profile will not be used.
73	No GPS Sentence Received
74	No Pitch/Roll Sentence Received
75	No Compass Sentence Received

MODEL 4460B: New Feature…



Error Code Viewer

3.6 TROUBLESHOOTING ACOUSTIC PROBLEMS

3.6.1 TRANSPONDER MODE

A transponder emits an acoustic signal of a known frequency in response to an acoustic interrogation pulse sent from the BATS Transceiver. 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 (over a responder) 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 BATS Transceiver 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 is 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 triggering 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 observes correct bearing values with erratic ranges as above, but the tran-

sponder will stop replying when the BATS 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 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 (in slant range) , 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 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.

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 pole is strumming, change configuration (shorten the shaft, but watch out for reflections) or add fairing to shaft.

3.6.2 ACOUSTIC PROBLEMS IN RESPONDER MODE

A responder replies acoustically to an electrical interrogation pulse from the transceiver. 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 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.

3.7 RS-232C INTERFACE, BATS TRANSCEIVER

The BATS Transceiver uses the standard EIA RS-232C serial communications interface to communicate with other peripherals such as GPS TimeSync (COM1), heading or pitch/roll sensors. These can be configured from the individual Devices setup dialog boxes. The interface to Trackman is via the Ethernet port.

COM#1 "USBL to GPS Time"

COM1 is reserved for the GPS/TimeSync interface. To configure the GPS Time interface, from the Project Tree select GPS/TimeSync from the Main menu go to USBL/GPS Time Sync. Set the BAUD RATE, the number of DATA BITS required and the number of STOP BITS for the device in use. Connect the COMMs Interface cable (9-pin DEC) between the Transceiver and the GPS device. Data rate is limited to 16 Hz.

COM#2 or COM#3 "Sensor to USBL"

For a Heading device interface, select from the Project Tree "Heading Sensor" or from the Main Menu go to SETUP/Compass Sensor. For a motion sensor, select from the Project Tree "Attitude Sensor" or from the Main Menu go to SETUP/Attitude Sensor Setup. Data rate is limited to 16 Hz.

The NMEA mode allows input of various NMEA compass sentences or motion sensor sentences, with or without checksum verification, "HDT", "HDM", "TCM-2" or "HDG" NMEA formats. Set up COM port #2 for Compass input under the menu SETUP/COMPASS SETUP/TRACKPOINT (USBL). Select Serial and then Port Settings. This allows the operator to configure the port's Baud Rate, Data Bits and Stop Bits.

ETHERNET Port

The BATS Transceiver's RJ-45 is wired as a cross-over device so that interfaces directly to a PC. If the ENET LED is illuminated on the front panel of the Transceiver then the hardware connection is good. If communications cannot be established then check the PC's IP address and subnet mask.

PC's IP usually 192.168.3.X (X = anything but what the Transceiver's address is. Subnet mask of 255.255.255.0. Port Number 50001. Other IP addresses can be set into the Transceiver, e.g., if using a local network on a vessel. Contact EdgeTech for details.

3.7.1 HARDWARE

COM#1 "USBL Transceiver"

GPS/TimeSync - The Transceiver's COM#1 interface is designed to act as a Data Terminal Equipment (DTE) (E.g. Processor Module or PC), If interfacing to a module that has the same protocol, a null modem is required between the two devices.

COM#2 "USBL Transceiver"

The COM#2 port is used typically for a compass input. No data is transmitted from this port. The hardware is setup for bi-directional communications but the Transceiver does not utilize its transmit capabilities. The Transceiver's COM#2 interface is designed to act as a Data Terminal Equipment (DTE) (E.g. Processor Module or PC), If interfacing to a module that has the same protocol, a null modem is required between the two devices.

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. 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.)

COM#3 "USBL Transceiver"

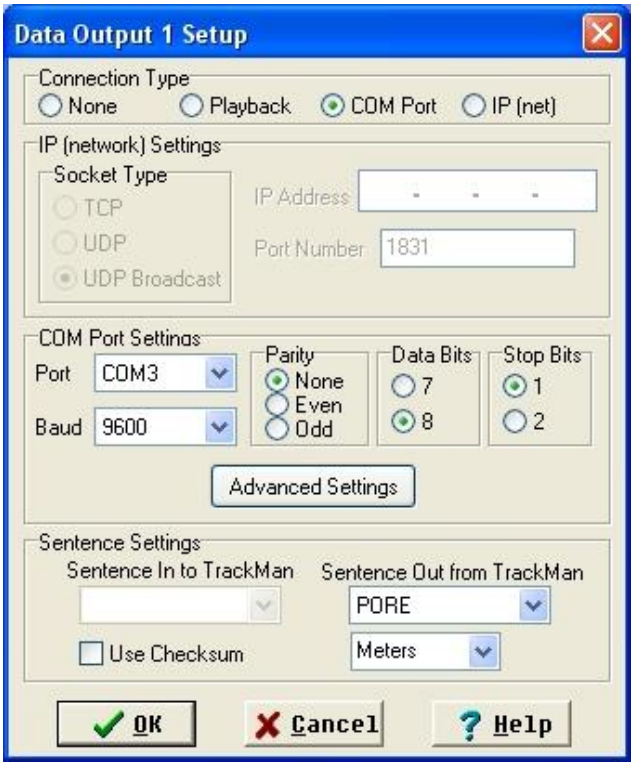
The COM#3 port is used typically for a motion sensor input. No data is transmitted from this port. The hardware is setup for bi-directional communications but the Transceiver does not utilize its transmit capabilities. The Transceiver's COM#2 interface is designed to act as a Data Terminal Equipment (DTE) (E.g. Processor Module or PC), If interfacing to a module that has the same protocol, a null modem is required between the two devices.

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. 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.)

3.7.2 TRACKMAN (PC) RS-232 DATA OUTPUT FORMATS

Trackman (PC) can output various target data formats. From the Trackman Device (port) List select Data Output1 and then from the dialog box select "Sentence Output from Trackman". A List of available output formats are shown below.

- PORE (NMEA ORE)
- POREB
- POREG
- SNTTM
- STANDARD
- STANDARD-EC
- STD W/PR
- STD-EC W/PR
- NCSS
- NCSSS-EC
- NUWC
- NUWC-EC
- Rev 4
- Rev 4-EC



Some of the formats can have their range parameters changed from either Meters, Feet, or yards.

NMEA Formats

General Statement on NMEA Formats: The NMEA data sentences are output in accordance with the NMEA standard. The electrical protocol can either be RS232 or RS422 depending on the output device of the transmitting unit. Not discussed here. Complete NMEA specification is available in "NMEA 0183, version 3.0". Standard is published by National Marine Electronics association, http://www.nmea.org/0183.

The output sentences are a proprietary message which is denoted by the "P" character following the start of message "$" sign. The "ORE" is the manufacturers three character mnemonic code. The letter following the "ORE" is the specific output message identifier for particular format shown.

Data fields in the sentence follow a "," delimiter and consist of ASCII characters (from 20 – 127 decimal or from HEX 14 to HEX 7E). Because of the presence of variable fields and null fields, specific data fields may only be located within a sentence by observing the field delimiters ",". Therefore, it is essential for the LISTENER to locate fields by counting delimiters rather than counting total number of characters received from the start of the sentences.

The Checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," delimiters between but not including the "$" and the "*" delimiters. The hexadecimal value of the most significant and least significant 4 bits of the result are converted to two ASCII characters (0-9, A-F) for transmission. The most significant value is transmitted first. The receiving application should calculate the checksum of the message and compare it to the received checksum.

3.7.2.1 "PORE" DATA OUTPUT PARAMETER DESCRIPTION

Format "PORE" or NMEA ORE is a 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. 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.

Sample…

```
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
```

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

3.7.2.2 "POREB" DATA OUTPUT FORMAT

Applicable To: TP3 Model 4450A, TP3P Model 4430C, BATS Model 4460C & BATS-P Model 4461C

Message Name: **POREB**

Sample;

$POREB,TG,HHMMSSHH,QF,EC,-BRG-,-DA-,--SR--,-SS-,TP,-TELM-*CS$^{C}_{R}{}^{L}_{F}$

$POREB,01,07253784,10,50,075.2,39.1,1572.5,1510,18,0328.4*16

"$POREB" RS-232 PARAMETER DESCRIPTION

TARGET NUMBER: The ***TARGET NUMBER*** (#) represents the various target symbols and can range from 0 to 10. The zero is output when in the self-test mode to indicate that the RS-232 data is simulated.

TIME: The ***TIME*** value is related to the time of signal reception. It is synchronous with the 24-hour time on the screen of the Trackman display. The accuracy of the time as output is within 1 second of the actual time of reply. (In future this will be interfaced to the GPS 1PPS and will be accurate to within approximately 20ms.)

QUALITY FACTOR: 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 throughout the reply burst the quality factor is very high. If the phase counts have jitter or are inconsistent then the quality factor is low.

ERROR CODE: The ***ERROR CODE*** or ***WARNING CODE*** 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.

TARGET BEARING: The ***BEARING*** output in degrees is a relative bearing from the Hydrophone to the target. The target bearing is corrected for the entered hydrophone offsets, when 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.

DEPRESSION ANGLE: The ***DEPRESSION ANGLE*** is the angle from the horizon to the point directly below the hydrophone. It is in degrees.

SLANT RANGE: The ***SLANT RANGE*** is the measured travel time between the hydrophone and the transponder. It is only output in meters. 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.)

SPEED OF SOUND: The ***SPEED OF SOUND*** is the entered value from either the keyboard or the RS232.

TEMPERATURE: The ***TEMPERATURE*** is the value as measured at the Hydrophone by the temperature sensor.

TELEMETRY DATA: The ***TELEMETRY*** 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 TELEMETRY number is the instantaneous depth value, while Z is the averaged depth value used for positioning calculations.

TRACKING DATA MESSAGE FOR FORMAT "NMEA" $POREB					
BYTE SEE NOTE 1	LENGTH	DATA WORD	REPRESENTATION	DATA FIELD 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	B	ASCII "B" CHARACTER	NA	NA
7	1	COMMA	ASCII "," CHARACTER	NA	NA
8-9	2	TARGET NUMBER	ASCII	00➔99	NA
10	1	COMMA	ASCII "," CHARACTER	NA	NA
11-12	2	HOURS	ASCII	00➔23	HOURS
13-14	2	MINUTES	ASCII	00➔59	MINUTES
15-16	2	SECONDS	ASCII	00➔59	SECONDS
17-18	2	1/100 SECONDS	ASCII	00➔99	1/100 SEC.
19	1	COMMA	ASCII "," CHARACTER	NA	NA
20-21	2	QUALITY FACTOR	ASCII	01➔10	NA
22	1	COMMA	ASCII "," CHARACTER	NA	NA
23-24	2	ERROR CODE	ASCII	Null➔99 SEE NOTE 2	NA
25	1	COMMA	ASCII "," CHARACTER	NA	NA
26-30	5	TARGET BEARING	ASCII	000.0➔359.9	DEGREES
31	1	COMMA	ASCII "," CHARACTER	NA	NA
32-35	6	DEPRESSION ANGLE	ASCII	00.0➔89.9	DEGREES
36	1	COMMA	ASCII "," CHARACTER	NA	NA
37-43	7	SLANT RANGE	ASCII	0000.00➔9999.99	METERS
44	1	COMMA	ASCII "," CHARACTER	NA	NA
45-48	4	SPEED OF SOUND	ASCII	1300➔1600	METERS/SEC
49	1	COMMA	ASCII "," CHARACTER	NA	NA
50-53	4	TEMPERATURE	ASCII	-10➔40	° CELSIUS
54	1	COMMA	ASCII "," CHARACTER	NA	NA
55-60	6	TELEMETRY DATA	ASCII	0000.0➔9999.9	METERS
61	1	EOS CHARACTER	ASCII "*" CHARACTER	NA	NA
62-63	2	CHECK SUM	ASCII	00➔FF	NA
64	1	CARRIAGE RETURN	ASCII CARR RET CHAR.		NA
65	1	LINEFEED	ASCII LINEFEED CHAR.		NA

NOTE 1: The data field byte length shown is the maximum length. Be aware that each Data field may vary in the number of characters/length or could be nulled.

NOTE 2: Error Code 0 = Null Character

Example of Format: ($POREB)

$POREB,TG,HHMMSSHH,QF,EC,-BRG-,-DA-,--SR--,-SS-,TP,-TELM-*CS$^{C}{}_{R}{}^{L}{}_{F}$

$POREB,01,07253784,10,50,075.2,39.1,1572.5,1510,18,0328.4*16

With no error code, field is nulled…

$POREB,01,07253784,10,,075.2,39.1,1572.5,1510,18,0328.4*16

3.7.2.3 "POREG" DATA OUTPUT FORMAT

Applicable To: TP3 Model 4450A, TP3P Model 4430C, BATS Model 4460C & BATS-P Model 4461C

Output sentence for Format NMEA "G" (Trackman Out Only)

Message Name: **POREG**

$POREG RS-232 Parameter Description

TARGET NUMBER: The ***TARGET NUMBER*** (#) represents the various target symbols and can range from 00 to 99. ("00" is the simulated target.) The zero is output when in the self-test mode to indicate that the RS-232 data is simulated.

TIME: The ***TIME*** value is related to the time of signal reception at the Hydrophone. In BATS the reply detect is accurate to within approximately 35ms. (**NOTE:** The time at which the sentence is transmitted from BATS is one interrogation cycle behind the actual detect time. E.g., if Interrogation rate is 3 seconds then the time the data is sent out the RS232 port is about 3 seconds after the reply detection. But, the time that is attached to the target position sentence is the actual time that the reply arrived at the hydrophone.)

PHASE A, B, C: The Phase is the time-counts between each element based on the element spacing and the phase counter clock (50MHz).

TARGET QUALITY FACTOR: The ***TARGET 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 target's signal. If the phase counts are consistent on all three channels throughout the reply burst the quality factor is very high. If the phase counts have jitter or are inconsistent then the quality factor is low. (**NOTE:** In BATS there is a minimum QF threshold that is set to 3. If the data processed has a QF of 3 or lower the position will not be plotted. See advanced users guide to over-ride this value in Trackman software.)

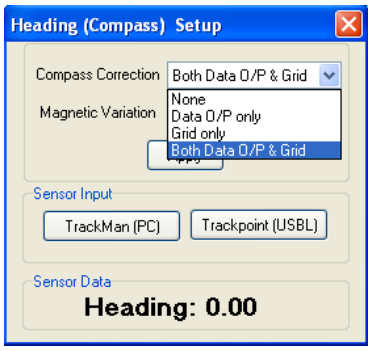
ERROR CODE: The ***ERROR CODE*** or ***WARNING CODE*** is a one- or two- digit error code indicating that the data received could not be used for a valid position fix, or it can represent a warning to let an operator know that the position accuracy could be compromised. See section 3.5.

TARGET SLANT RANGE: The Target ***SLANT RANGE*** is the measured travel time between the hydrophone and the transponder. It is output only in meters. 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.)

TARGET DEPRESSION ANGLE: The Depression Angle encompasses the angle starting from the horizontal plane of the hydrophone (0 degrees) and continuing to the point directly below the hydrophone (90 degrees). The ***TARGET DEPRESSION ANGLE*** is the angle measured from the hydrophone's horizontal plane to the target line of sight (Raw DA). (Raw Depression Angle is the default. No Pitch, Roll or Compass corrections applied. Could also be corrected – when Pitch, Roll, Heading and Hydrophone offsets are applied. See format adjusters below within the SENT_OUT.INI file.)

TARGET BEARING: The ***TARGET BEARING*** output in degrees is a relative bearing from the Hydrophone to the target (Raw BRG). (Raw Bearing is the default. No Pitch, Roll or Compass corrections applied.) Could also be corrected – when Pitch, Roll, Heading and Hydrophone offsets are applied. See format adjusters below within the SENT_OUT.INI file.)

X, Y, Z: Horizontal position and depth of Target output in Meters. Corrected for Compass (if "DATA O/P" is selected in Trackman program) and also Pitch / Roll. It is also offset to the vessel's center of gravity when Hydrophone X, Y & Z offsets are entered. The "Z" or depth value is referenced to the water surface.



HEADING: The Compass / Gyro value (degrees) as input either via NMEA sentence (from BATS or Trackman PC) or via the ANALOG input in BATS.

PITCH: The ***PITCH*** value (degrees) as input either via an NMEA (BATS or Trackman) or via the ANALOG (BATS) input. 0 degrees is horizontal, a positive pitch is bow up.

ROLL: The ***ROLL*** value (degrees) as input either via an NMEA (BATS or Trackman) or via the ANALOG (BATS/TP3) input. 0 degrees is horizontal, a positive roll is port side up.

TEMPERATURE: The ***TEMPERATURE*** is the value as measured at the Hydrophone by the temperature sensor. In degrees Celsius. (Not used for Speed of Sound measurements.)

OPTIONAL…

SIGNAL to NOISE RATIO: This figure is the Signal To Noise ratio of the received signal in dB. Signal is compared against the noise around the detected signal. (I.e., signal is compared against an instantaneous noise figure rather than averaged.) If value is less than the Target's threshold value then target will be output with an Error Code 01. (Target default threshold is 20dB but can be raised or lowered from the Trackman users menu.)

To add the SNR figure to the end of the $POREG sentence modify the following file; c:\Program Files\ORE Offshore\Trackpoint MMI\SENT_OUT.INI. Under [$POREG] … add **,G031** to the end of the sentence format structure as shown below.

```
[POREG]
FormatMask=3
StartOfMsg=$
Format=POREG
Delimiters=,*
PositionMask1=0
PositionMask2=0
PositionMask3=0
Types=cxtxxxxxxxxxxxxx
NMEA_Format=I02I,U002,404I,504I,604I,Q02I,E02I,SM52,A022,B032,XM62,YM62,DM52,C032,P032,R032,tC3I,G031
```

Format Adjusters…

A	Depression Angle Raw
a [lc]	Depression Angle Corrected (Corrected for P/R, offsets, Hyd_X, Y, Z, etc.)
B	Bearing (target) Raw
b [lc]	Bearing (target) Corrected (Corrected for P/R, Compass offsets, Hyd_X, Y, Z, etc.)
X	X Position (Corrected for P/R, offsets, Hyd_X, Y, Z, etc.)
Y	Y Position (Corrected for P/R, offsets, Hyd_X, Y, Z, etc.)
p [lc]	Position Units (M=Meters, Y=Yards, f=Feet)

To change the depression angle to a corrected value, modify sent_out.ini file to , a022

To change the bearing angle to a corrected value, modify sent_out.ini file to , b022

To change the X, Y, Z meters to feet, modify sent_out.ini file to ,Xf62

TRACKING DATA MESSAGE FOR FORMAT "POREG" (ORE special for analyzing data)					
BYTE	**LENGTH**	**DATA WORD**	**REPRESENTATION**	**DATA FIELD 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	G	ASCII "G" CHARACTER	NA	NA
7	1	COMMA	ASCII "," CHARACTER	NA	NA
8-9	2	TARGET NUMBER	ASCII	00 to 99	NA
10	1	COMMA	ASCII "," CHARACTER	NA	NA
11-12	2	TIME TAG HRS	ASCII	00 to 23	Hours
13-14	2	TIME TAG MIN	ASCII	00 to 59	Minutes
15-16	2	TIME TAG SEC	ASCII	00 to 59	Seconds
17	1	PERIOD	ASCII " . " CHARACTER	NA	NA
18-19	2	TIME TAG 1/100 SEC	ASCII	00 to 99	Hundredths of Sec.
20	1	COMMA	ASCII "," CHARACTER	NA	NA
21-24	4	PHASE "A" DATA	ASCII	0000 to 4096	Counts $A_0 \Rightarrow A_{11}$
25	1	COMMA	ASCII "," CHARACTER	NA	" , "
26-28	4	PHASE "B" DATA	ASCII	0000 to 4096	Counts $B_0 \Rightarrow B_{11}$
30	1	COMMA	ASCII "," CHARACTER	NA	" , "
31-34	4	PHASE "C" DATA	ASCII	0000 to 4096	Counts $C_0 \Rightarrow C_{11}$
35	1	COMMA	ASCII "," CHARACTER	NA	NA
36-37	2	QUALITY FACTOR	ASCII	01-10	NA
38	1	COMMA	ASCII "," CHARACTER	NA	NA
39-40	2	ERROR CODE	ASCII	00 to 99	NOTE 1
41	1	COMMA	ASCII "," CHARACTER	NA	NA
42-49	8	SLANT RANGE	ASCII	00000.00 to 99999.99	Meters
50	1	COMMA	ASCII "," CHARACTER	NA	NA
51-55	5	DEPRESSION ANGLE	ASCII	00.00 to 89.99	Degrees (NOTE 2)
56	1	COMMA	ASCII "," CHARACTER	NA	NA
57-62	5	BEARING	ASCII	000.00 to 359.90	Degrees (NOTE 3)
63	1	COMMA	ASCII "," CHARACTER	NA	NA
64-72	9	X	ASCII	-09999.99 to 009999.99	Meters
73	1	COMMA	ASCII "," CHARACTER	NA	NA
74-82	9	Y	ASCII	-09999.99 to 009999.99	Meters
83	1	COMMA	ASCII "," CHARACTER	NA	NA
84-91	8	Z	ASCII	00000.00 to 09999.99	Meters
92	1	COMMA	ASCII "," CHARACTER	NA	NA
93-98	6	HEADING	ASCII	000.00 to 359.99	Degrees (NOTE 3)
99	1	COMMA	ASCII "," CHARACTER	NA	NA
100-105	6	PITCH	ASCII	-89.99 to 89.99	Degrees (NOTE 4)
106	1	COMMA	ASCII "," CHARACTER	NA	NA
107-112	6	ROLL	ASCII	-89.99 to 89.99	Degrees (NOTE 5)
113	1	COMMA	ASCII "," CHARACTER	NA	NA
114-116	3	TEMPERATURE	ASCII	-10 to +50	Degrees C
117	1	EOS CHAR	ASCII "*" CHARACTER	NA	EOS CHAR
118-119	2	CHECKSUM	ASCII	00 to $FF_{(H)}$	NOTE 6
120	1	CARRIAGE RETURN	ASCII	ASCII CAR RET CHAR	
121	1	LINE FEED	ASCII	ASCII LINE FEED CHAR	

Example of Format: NMEA ORE"G" Sentence

$POREG,##,HHMMSS.SS,PHSA,PHSB,PHSC,QF,EC,SLANT_RG,-DPA-,-BRNG-,--X (m)--,--Y (m)--,

--Z(m)--,-HDNG-,-PTCH-,-ROLL-,TMP*CS $_{R}$$_{F}$

$POREG,01,235959.99,0780,0230,0000,10,00,01024.40,29.54,101.51,000874.22,-00172.33,

00505.44,125.88,-00.03,-00.02,-05*16 $_{R}$$_{F}$

NOTE 1: Error Codes [0 = null character]

NOTE 2: Degrees [Depression Angle as measured from Horizontal]

NOTE 3: NMEA or analog

NOTE 4: Pitch Angle [Pitch of vessel, 0 is horiz, bow up is positive Pitch]

NOTE 5: Roll Angle [Roll of vessel, 0 is horiz, port up is positive Roll]

NOTE 6: The Checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," delimiters between but not including the "$" and the "*" delimiters.

NOTE 7: The data field byte length shown is the maximum length. Be aware that each Data field may vary in the number of characters/length or could be nulled.

3.7.2.4 "TTM" DATA OUTPUT FORMAT

Applicable To: TP3 Model 4450A, TP3P Model 4430C, BATS Model 4460C & BATS-P Model 4461C

Message Name: **SNTTM**

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
```

3.7.2.5 "STANDARD" DATA OUTPUT FORMAT

Applicable To: TP3 Model 4450A, TP3P Model 4430C, BATS Model 4460C & BATS-P Model 4461A

Message Name: **STANDARD**

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 [1]
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-37	8	X	ASCII	+/- 10000.0	METERS [1]
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-46	8	Y	ASCII	+/- 10000.0	METERS [1]
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-54	7	Z	ASCII	0.0-10000.0	METERS [1]
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 [2]	N/A
67	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
68	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

NOTE 1: 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).

NOTE 2: 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
```

3.7.2.6 "STANDARD-EC" DATA OUTPUT FORMAT

Applicable To: TP3 Model 4450A, TP3P Model 4430C, BATS Model 4460C & BATS-P Model 4461C

Message Name: **STANDARD**

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 [1]
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-37	8	X	ASCII	+/- 10000.0	METERS [1]
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-46	8	Y	ASCII	+/- 10000.0	METERS [1]
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-54	7	Z	ASCII	0.0-10000.0	METERS [1]
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 [2]	N/A
67	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
68	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

NOTE 1: 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).

NOTE 2: 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
```

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 "-.-".

3.7.2.7 "STD W/PR" DATA OUTPUT FORMAT

Applicable To: TP3 Model 4450A, TP3P Model 4430C, BATS Model 4460C & BATS-P Model 4461C

Message Name: **STD W/PR**

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 [1]
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-37	8	X	ASCII	+/- 10000.0	METERS [1]
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-46	8	Y	ASCII	+/- 10000.0	METERS [1]
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-54	7	Z	ASCII	0.0-10000.0	METERS [1]
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 [2]	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

NOTE 1: 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).

NOTE 2: 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
```

3.7.2.8 "STD-EC W/PR" DATA OUTPUT FORMAT

Applicable To: TP3 Model 4450A, TP3P Model 4430C, BATS Model 4460C & BATS-P Model 4461C **Message Name:** **STD-EC W/PR**

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 [1]
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-37	8	X	ASCII	+/- 10000.0	METERS [1]
38	1	SPACE	ASCII SPACE CHARACTER		N/A
39-46	8	Y	ASCII	+/- 10000.0	METERS [1]
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48-54	7	Z	ASCII	0.0-10000.0	METERS [1]
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 [2]	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

NOTE 1: 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).

NOTE 2: 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
```

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 "-.-".

3.7.2.9 "NCSC" DATA OUTPUT FORMAT

Applicable To: (Models 4410C-V1302)

Message Name: **NCSC**

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 [1]
23	1	SPACE	ASCII SPACE CHARACTER		N/A
34-41	8	X	ASCII	+/- 10000.0	METERS [1]
42	1	SPACE	ASCII SPACE CHARACTER		N/A
43-50	8	Y	ASCII	+/- 10000.0	METERS [1]
52	1	SPACE	ASCII SPACE CHARACTER		N/A
53-59	7	Z	ASCII	0.0-10000.0	METERS [1]
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 [2]	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

NOTE 1: 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.

NOTE 2: 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.

3.7.2.10 "REV-4" DATA OUTPUT FORMAT

Applicable To: Standard TrackPoint's

Message Name: **REV-4**

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
```

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
```

3.7.2.11 "NUWC-1" DATA OUTPUT FORMAT

Applicable To: Special NUWC TrackPoint Format – (Modified from the TP2 version)

Message Name: **NUWC-1**

TRACKING DATA MESSAGE FOR FORMAT "NUWC-1"

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	PERIOD	ASCII PERIOD CHARACTER, "."		N/A
12-13	2	TIME TAG 1/100 SEC	ASCII	00 to 99	HUNDREDTHS of SEC.
14	1	SPACE	ASCII SPACE CHARACTER		N/A
15-17	3	COMPASS HEADING	ASCII	0-359	DEGREES
18	1	SPACE	ASCII SPACE CHARACTER		N/A
19-23	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
24	1	SPACE	ASCII SPACE CHARACTER		N/A
25-28	4	DEPRESSION ANGLE	ASCII	0.0-89.9 [1]	DEGREES
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-36	7	SLANT RANGE	ASCII	0.0-10000.0	METERS [2]
37	1	SPACE	ASCII SPACE CHARACTER		N/A
38-45	8	X	ASCII	+/- 10000.0	METERS [2]
46	1	SPACE	ASCII SPACE CHARACTER		N/A
47-54	8	Y	ASCII	+/- 10000.0	METERS [2]
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-62	7	Z	ASCII	0.0-10000.0	METERS [2]
63	1	SPACE	ASCII SPACE CHARACTER		N/A
64-71	8	TELEMETRY	ASCII	+/- 99999.9	UNITS
72	1	SPACE	ASCII SPACE CHARACTER		N/A
73-74	2	WARNING CODE	ASCII	20-99 [3]	N/A
75	1	SPACE	ASCII SPACE CHARACTER		N/A
76-80	5	ROLL	ASCII	+/- 0.0-45.0	DEGREES
81	1	SPACE	ASCII SPACE CHARACTER		N/A
82-86	5	PITCH	ASCII	+/- 0.0-45.0	DEGREES
87	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
88	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

NOTE 1: Depression Angle is the raw value before offset correction.

NOTE 2: The Slant Range X,Y & Z data can either be in meters, yards or feet. Leading zeroes following the ones digit are suppressed and replaced by spaces (except for the time).

NOTE 3: Error Code 0 = Null Character

Example:

#	TOD	HDG	BRG	DEPA	S.R.(m)	X (m)	Y (m)	Z (m)	TEL	WARN	RL	PT
1	15:32:59.83	359	356.3	XX.X	196.0	-11.0	168.7	100.0	0.0	50	0.0	-0.0

TRACKING DATA MESSAGE FOR FORMAT "NUWC-1 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	PERIOD	ASCII PERIOD CHARACTER, "."		N/A
12-13	2	TIME TAG 1/100 SEC	ASCII	00 to 99	HUNDREDTHS of SEC.
14	1	SPACE	ASCII SPACE CHARACTER		N/A
15-17	3	COMPASS HEADING	ASCII	0-359	DEGREES
18	1	SPACE	ASCII SPACE CHARACTER		N/A
19-23	5	TARGET BEARING	ASCII	0.0-359.9	DEGREES
24	1	SPACE	ASCII SPACE CHARACTER		N/A
25-28	4	DEPRESSION ANGLE	ASCII	0.0-89.9 [1]	DEGREES
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-36	7	SLANT RANGE	ASCII	0.0-10000.0	METERS [2]
37	1	SPACE	ASCII SPACE CHARACTER		N/A
38-45	8	X	ASCII	+/- 10000.0	METERS [2]
46	1	SPACE	ASCII SPACE CHARACTER		N/A
47-54	8	Y	ASCII	+/- 10000.0	METERS [2]
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-62	7	Z	ASCII	0.0-10000.0	METERS [2]
63	1	SPACE	ASCII SPACE CHARACTER		N/A
64-71	8	TELEMETRY	ASCII	+/- 99999.9	UNITS
72	1	SPACE	ASCII SPACE CHARACTER		N/A
74-75	2	WARNING AND ERROR CODE	ASCII	01-99 [3]	N/A
75	1	SPACE	ASCII SPACE CHARACTER		N/A
76-80	5	ROLL	ASCII	+/- 0.0-45.0	DEGREES
81	1	SPACE	ASCII SPACE CHARACTER		N/A
82-86	5	PITCH	ASCII	+/- 0.0-45.0	DEGREES
87	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
88	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

NOTE 1: Depression Angle is the raw value before offset correction.

NOTE 2: The Slant Range X,Y & Z data can either be in meters, yards or feet. Leading zeroes following the ones digit are suppressed and replaced by spaces (except for the time).

NOTE 3: Error Code 0 = Null Character

Example:

#	TOD	HDG	BRG	DEPA	S.R.(m)	X (m)	Y (m)	Z (m)	TEL	WARN	RL	PT
1	15:32:59.83	359	356.3	XX.X	196.0	-11.0	168.7	100.0	0.0	50	0.0	-0.0

TRACKING DATA MESSAGE FOR FORMAT "NUWC-1 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	PERIOD	ASCII SPACE CHARACTER, "."		N/A
12-13	2	TIME TAG 1/100 SEC	ASCII	00 to 99	HUNDREDTHS of SEC.
14	1	SPACE	ASCII SPACE CHARACTER		N/A
15-17	3	COMPASS HEADING	ASCII (could be -.- or blank or hdg)	-.-, 0-359,null	DEGREES
18	1	SPACE	ASCII SPACE CHARACTER		N/A
19-20	2	TARGET BEARING	ASCII SPACE CHARACTER		N/A
21	1	TARGET BEARING	ASCII MINUS CHARACTER (2D h)	-	N/A
22	1	TARGET BEARING	ASCII PERIOD CHARACTER (2E h)	.	N/A
23	1	TARGET BEARING	ASCII MINUS CHARACTER (2D h)	-	N/A
24	1	SPACE	ASCII SPACE CHARACTER		N/A
25	1	DEPRESSION ANGLE	ASCII SPACE CHARACTER		N/A
26	1	DEPRESSION ANGLE	ASCII MINUS CHARACTER (2D h)	-	N/A
27	1	DEPRESSION ANGLE	ASCII PERIOD CHARACTER (2E h)	.	N/A
28	1	DEPRESSION ANGLE	ASCII MINUS CHARACTER (2D h)	-	N/A
29	1	SPACE	ASCII SPACE CHARACTER		N/A
30-33	4	SLANT RANGE	ASCII SPACE CHARACTER		N/A
34	1	SLANT RANGE	ASCII MINUS CHARACTER (2D h)	-	N/A
35	1	SLANT RANGE	ASCII PERIOD CHARACTER (2E h)	.	N/A
36	1	SLANT RANGE	ASCII MINUS CHARACTER (2D h)	-	N/A
37	1	SPACE	ASCII SPACE CHARACTER		N/A
38-42	5	X	ASCII SPACE CHARACTER		N/A
43	1	X	ASCII MINUS CHARACTER (2D h)	-	N/A
44	1	X	ASCII PERIOD CHARACTER (2E h)	.	N/A
45	1	X	ASCII MINUS CHARACTER (2D h)	-	N/A
46	1	SPACE	ASCII SPACE CHARACTER		N/A
47-51	5	Y	ASCII SPACE CHARACTER		N/A
52	1	Y	ASCII MINUS CHARACTER (2D h)	-	N/A
53	1	Y	ASCII PERIOD CHARACTER (2E h)	.	N/A
54	1	Y	ASCII MINUS CHARACTER (2D h)	-	N/A
55	1	SPACE	ASCII SPACE CHARACTER		N/A
56-59	4	Z	ASCII SPACE CHARACTER		N/A
60	1	Z	ASCII MINUS CHARACTER (2D h)	-	N/A
61	1	Z	ASCII PERIOD CHARACTER (2E h)	.	N/A
62	1	Z	ASCII MINUS CHARACTER (2D h)	-	N/A
63	1	SPACE	ASCII SPACE CHARACTER		N/A
64-68	5	TELEMETRY	ASCII SPACE CHARACTER		N/A
69	1	TELEMETRY	ASCII MINUS CHARACTER (2D h)	-	N/A
70	1	TELEMETRY	ASCII PERIOD CHARACTER (2E h)	.	N/A
71	1	TELEMETRY	ASCII MINUS CHARACTER (2D h)	-	N/A
72	1	SPACE	ASCII SPACE CHARACTER		N/A
73-74	2	ERROR CODE	ASCII	06	N/A
75	1	SPACE	ASCII SPACE CHARACTER		N/A
76-77	2	ROLL	ASCII SPACE CHARACTER		N/A
78	1	ROLL	ASCII MINUS CHARACTER (2D h)	-	N/A
79	1	ROLL	ASCII PERIOD CHARACTER (2E h)	.	N/A
80	1	ROLL	ASCII MINUS CHARACTER (2D h)	-	N/A
81	1	SPACE	ASCII SPACE CHARACTER		N/A
82-83	2	PITCH	ASCII SPACE CHARACTER		N/A
84	1	PITCH	ASCII MINUS CHARACTER (2D h)	-	N/A
85	1	PITCH	ASCII PERIOD CHARACTER (2E h)	.	N/A
86	1	PITCH	ASCII MINUS CHARACTER (2D h)	-	N/A
87	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A
88	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 "-.-".

3.7.2.12 RS-232 PARAMETER DESCRIPTION

These are the descriptions of the parameters used in the Format Sentences above unless otherwise listed.

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 Trackman PC. It is equal to the time that the Trackman PC received the acoustic reply. When synchronized with the GPS clock the accuracy of the time as output is within 50 milliseconds 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 Status Display of the Trackman PC'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 **DEPRESSION ANGLE** output on REV4 formats is the depression angle calculated from the final horizontal distance and the depth (either input or calculated depth). The depression angle output on the **NUWC** formats is the angle as measured by the hydrophone's three elements but it has been corrected for pitch and roll motion. It is not compensated by the hydrophone X,Y,Z deviation, caused by the offset between hydrophone and vessel pitch / roll center. (I.e., the arc that the hydrophone swings through during vessel motion.) System takes wherever the hydrophone was when the reply was received and reconverts depression angle based on a gravity level measurement at that position.

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, NUWC or NUWC-EC 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: Filter settings 6-10 cause the analog or telemetry depth (Z) to average the last three readings. Filter settings 1-5 do not average the input depth.

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 EdgeTech 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.

3.7.2.13 TRACKMAN REMOTE INTERFACE

The Trackman Program can accept commands from a remote PC along with sending target data out on the same port. From the DEVICE LIST select Remote Interface from the list. Set the connection Type, the IP settings or COM port settings, and the Sentence Settings. The command "Sentence In to Trackman" format can either be TP-SPC (EdgeTech Proprietary) or NCSC. The "Sentence Out from Trackman" can be any of the ones from the DATA OUTPUT as shown above. (Future option.)

3.7.2.14 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.

NOTE: The only setup that is not duplicated exactly to the NCSS 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.

The following commands are in the process of being updated to fit in with the BATS parameters. Do not use at this time.

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=TRANS,1=RESP, 2=PINGER, 3=HW TRANS	⇦	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 See Note Below	⇦	N/A
47	1	SPACE	ASCII SPACE CHARACTER		N/A
48	1	SMOOTHING	ASCII A-J = Averaging of 1-10	⇦	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	N/A
54	1	SPACE	ASCII SPACE CHARACTER		N/A
55	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	N/A
56	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

#46 = A-J = Filter Level 1-10 w/o QF; Q-Z = Filtering Level 1-10 with QF on.

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	METERS
13	1	SPACE	ASCII SPACE CHARACTER		N/A
14-19	6	Y HYDROPHONE OFFSET	ASCII	-999.9 TO +999.9 M	METERS
20	1	SPACE	ASCII SPACE CHARACTER		N/A
21-26	6	Z HYDROPHONE OFFSET	ASCII	-999.9 TO +999.9 M	METERS
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	METERS
40	1	SPACE	ASCII SPACE CHARACTER		N/A
41-47	7	ANALOG DEPTH MAX DEPTH	ASCII	00000.0 TO 10000.0 M	METERS
48	1	SPACE	ASCII SPACE CHARACTER		N/A
49	1	COMPASS OFF, ANAL,NMEA	ASCII 0=OFF, 1= Analog, 2= NMEA	0 TO 2	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	M/Sec
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 Trackman in 4 digits vs 2.

For data sent to Trackman, 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 accepts 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.

SYSTEM SETUP COMMAND 4

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 "SY4"			N/A
6	1	SPACE	ASCII SPACE CHARACTER			N/A
7-13	7	ANALOG1 MIN. UNITS	ASCII		0 TO 9999.9	N/A
14	1	SPACE	ASCII SPACE CHARACTER			N/A
15-21	7	ANALOG1 MAX. UNITS	ASCII		0 TO 9999.9	N/A
22	1	SPACE	ASCII SPACE CHARACTER			N/A
23-26	4	ANALOG1 MIN. VOLTS	ASCII		0.00 to 5.99	V
27	1	SPACE	ASCII SPACE CHARACTER			N/A
28-31	4	ANALOG1 MAX. VOLTS	ASCII		0.10 to 6.00	V
32	1	SPACE	ASCII SPACE CHARACTER			N/A
33-34	2	ANALOG USE AS…	ASCII	See Note below	00 to 02	N/A
35	1	SPACE	ASCII SPACE CHARACTER			N/A
36-42	7	ANALOG1 MIN. UNITS	ASCII		0 TO 9999.9	N/A
43	1	SPACE	ASCII SPACE CHARACTER			N/A
44-50	7	ANALOG1 MAX. UNITS	ASCII		0 TO 9999.9	N/A
51	1	SPACE	ASCII SPACE CHARACTER			N/A
52-55	4	ANALOG1 MIN. VOLTS	ASCII		0.00 to 5.99	V
56	1	SPACE	ASCII SPACE CHARACTER			N/A
57-60	4	ANALOG1 MAX. VOLTS	ASCII		0.10 to 6.00	V
61	1	SPACE	ASCII SPACE CHARACTER			N/A
62-63	2	ANALOG USE AS…	ASCII	See Note Below	00 to 10	N/A
64	1	SPACE	ASCII SPACE CHARACTER			N/A
65-66	2	CHECKSUM	16 BIT BINARY SUM OF BYTES		N/A	N/A
67	1	SPACE	ASCII SPACE CHARACTER			N/A
68	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER		N/A	N/A
69	1	LINEFEED	ASCII LINEFEED CHARACTER			N/A

#33 = 0
#34 = 0=Off, 1=Compass, 2=Hydrophone

#62 = 0
#63 = 0-8 represents Target #'s 1-9; 10 = Hydrophone

SYSTEM SETUP COMMAND 5

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 "SY5"		N/A
6	1	SPACE	ASCII SPACE CHARACTER		N/A
7	1	RS232 UNITS	ASCII 0=M,1=F, 2=Y	0 to 2	N/A
8	1	SPACE	ASCII SPACE CHARACTER		N/A
9-10	2	RS232 FORMAT	ASCII See Note Below.	00 TO 99	N/A
11	1	SPACE	ASCII SPACE CHARACTER		N/A
12	1	COMPASS SELECT	ASCII 0=Off, 1=Analog, 2=NMEA	0 to 2	N/A
13	1	SPACE	ASCII SPACE CHARACTER		N/A
14-19	6	COMPASS OFFSET	ASCII	0.0 TO -359.9	DEG
20	1	SPACE	ASCII SPACE CHARACTER		N/A
21-22	2	COMPASS NMEA FORMAT	ASCII 0=HDG,1=HDT, 2=HDM, 3=VHW, 4=VTG	00 to 99	N/A
23	1	SPACE	ASCII SPACE CHARACTER		N/A
24	1	TARGET REF (BOW/NORTH)	ASCII 0 = Bow, 1 = North	0 TO1	N/A
25	1	SPACE	ASCII SPACE CHARACTER		N/A
26-31	6	HYD VRU PITCH ERROR	ASCII	0.00 TO -44.9	DEG
32	1	SPACE	ASCII SPACE CHARACTER		N/A
33-38	6	HYD VRU ROLL ERROR	ASCII	0.00 TO -44.9	DEG
39	1	SPACE	ASCII SPACE CHARACTER		N/A
40	1	VRU STATUS	ASCII 0=Static, 1= Active	0 TO 1	N/A
41	1	SPACE	ASCII SPACE CHARACTER		N/A
42	1	HYD ORIENTATION	ASCII 0=Normal, 1=Starboard, 2=Aft, 3=Port	0 TO 3	N/A
43	1	SPACE	ASCII SPACE CHARACTER		N/A
44-47	4	REMOTE VRU SCALE	ASCII	0.00 TO 9.99	N/A
48	1	SPACE	ASCII SPACE CHARACTER		N/A
49	1	VRU FUNCTION	ASCII 0=Linear, 1=10*sin	0 TO 1	N/A
50	1	SPACE	ASCII SPACE CHARACTER		N/A
51	1	REM VRU BOW UP POL.	ASCII 0 = (-), 1 = (+)	0 TO 1	N/A
52	1	SPACE	ASCII SPACE CHARACTER		N/A
53	1	REM VRU PORT UP POL.	ASCII 0 = (-), 1 = (+)	0 TO 1	N/A
54	1	SPACE	ASCII SPACE CHARACTER		N/A
55-56	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
57	1	SPACE	ASCII SPACE CHARACTER		N/A
58	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
59	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

SYSTEM SETUP COMMAND 6

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 "SY6"		N/A
6	1	SPACE	ASCII SPACE CHARACTER		N/A
7-12	6	ANT X OFFSET **(N/A)**	ASCII	-999.9 TO 999.9	UNITS
13	1	SPACE	ASCII SPACE CHARACTER		N/A
14-19	6	ANT Y OFFSET **(N/A)**	ASCII	-999.9 TO 999.9	UNITS
20	1	SPACE	ASCII SPACE CHARACTER		N/A
21	1	HYD DEPTH SEL	ASCII 0=Manual, 1=Analog via Compass BNC Input, 2 = Analog via Depth BNC Input	0 TO 2	N/A
22	1	SPACE	ASCII SPACE CHARACTER		N/A
23-24	2	CHECKSUM	16 BIT BINARY SUM OF BYTES	N/A	
25	1	SPACE	ASCII SPACE CHARACTER		N/A
26	1	CARRIAGE RETURN	ASCII CARRIAGE RETURN CHARACTER	N/A	
27	1	LINEFEED	ASCII LINEFEED CHARACTER		N/A

ACK/NACK MESSAGE

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	1	ACK/NACK	ASCII ACK=VALID RS-232 MESSAGE RECEIVED ASCII NACK=INVALID RS-232 MESSAGE RECEIVED	N/A	
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

3.8 SHUTDOWN

To turn off system, exit Trackman and then Shut Down PC via Windows "START" button. The power will automatically be shut off to the Processor, the Keyboard/Monitor goes into low power mode and the BATS can then be turned off from the front panel power switch.

SECTION FOUR

PRINCIPLES OF OPERATION

4. PRINCIPLES OF OPERATION

BATS (Broadband Acoustic Tracking System) 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 amplifies the received acoustic signals and sends them to the Transceiver and then to the PC for further processing by the Trackman Software.

The BATS 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, appears 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 BATS: 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 Signal Interface Module (SIM) when electrically triggered by the SIM. 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:

Z

$$HR = SR \cos\left(\sin^{-1} \frac{\quad}{SR}\right)$$

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 causes 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 are 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 EdgeTech Model 4760B MRU (Motion Reference Unit) is recommended. This would typically be interfaced to the Trackman PC.

The Embedded PC, located in the Transceiver, 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.

Figures 4-3A & B, the Transceiver Block Diagram, presents an overview of the BATS. The individual components of the system function as described in the following sections.

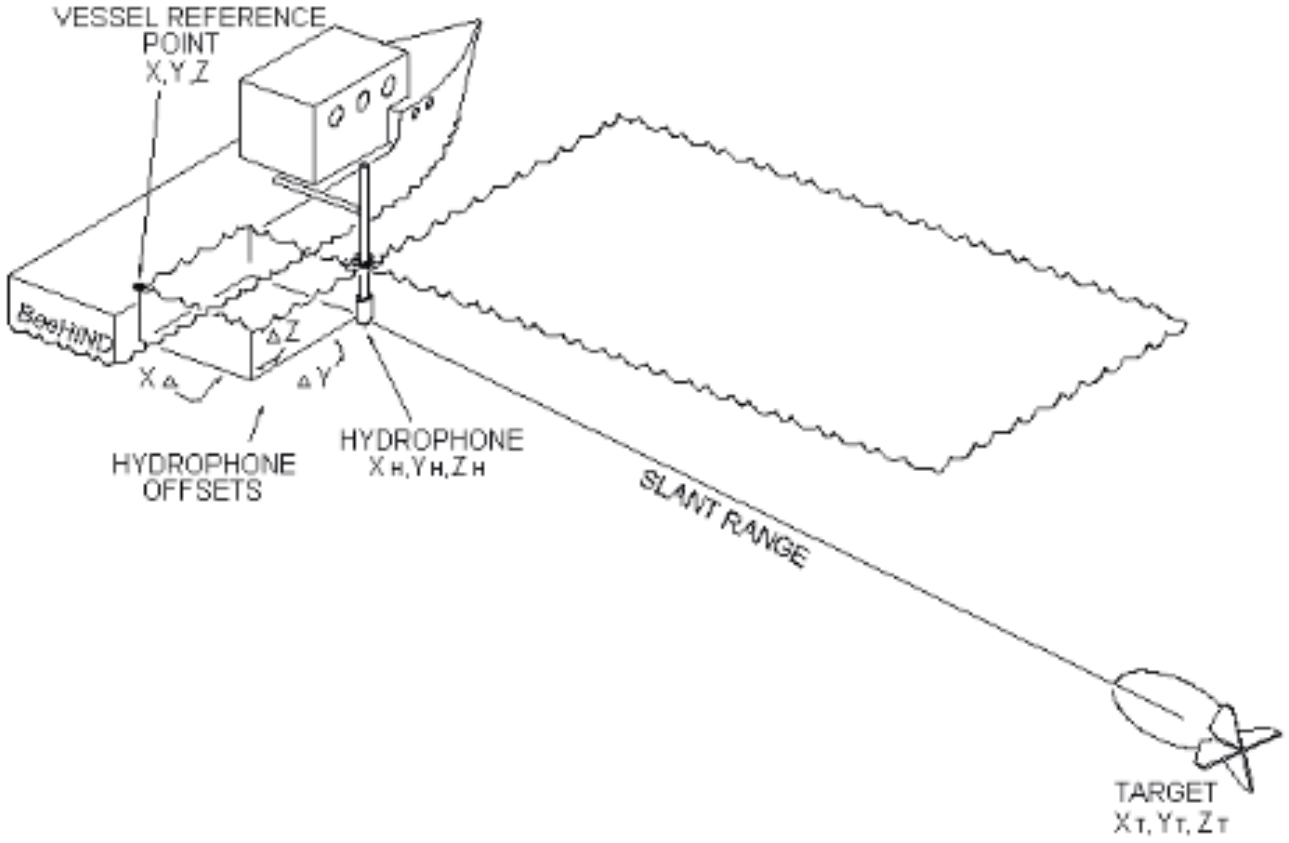


Figure 4-1

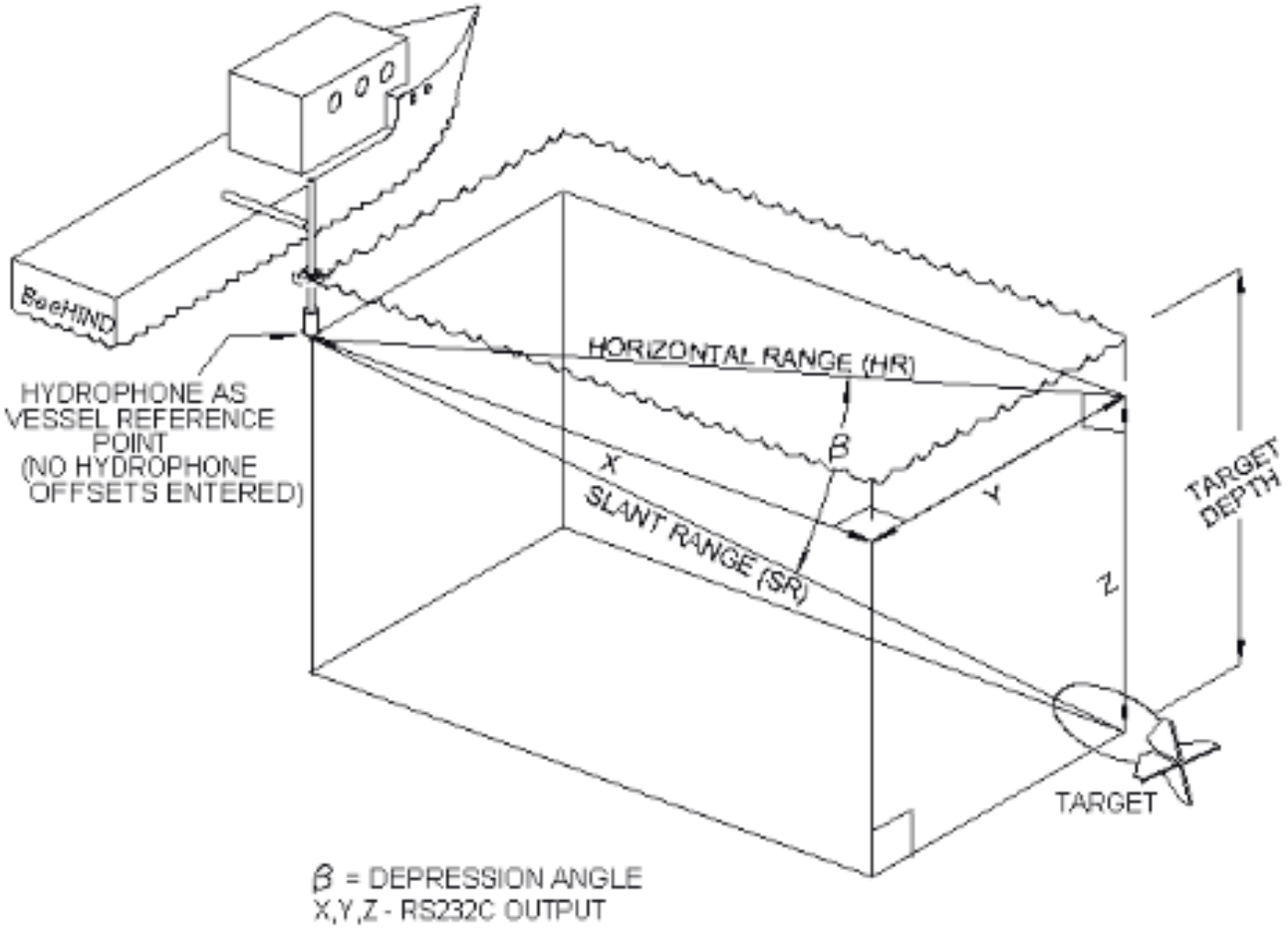

BeeHIND
HYDROPHONE AS VESSEL REFERENCE POINT (NO HYDROPHONE OFFSETS ENTERED)
HORIZONTAL RANGE (HR)
β
X
SLANT RANGE (SR)
Y
Z
TARGET DEPTH
TARGET
β = DEPRESSION ANGLE
X,Y,Z - RS232C OUTPUT

Figure 4-2

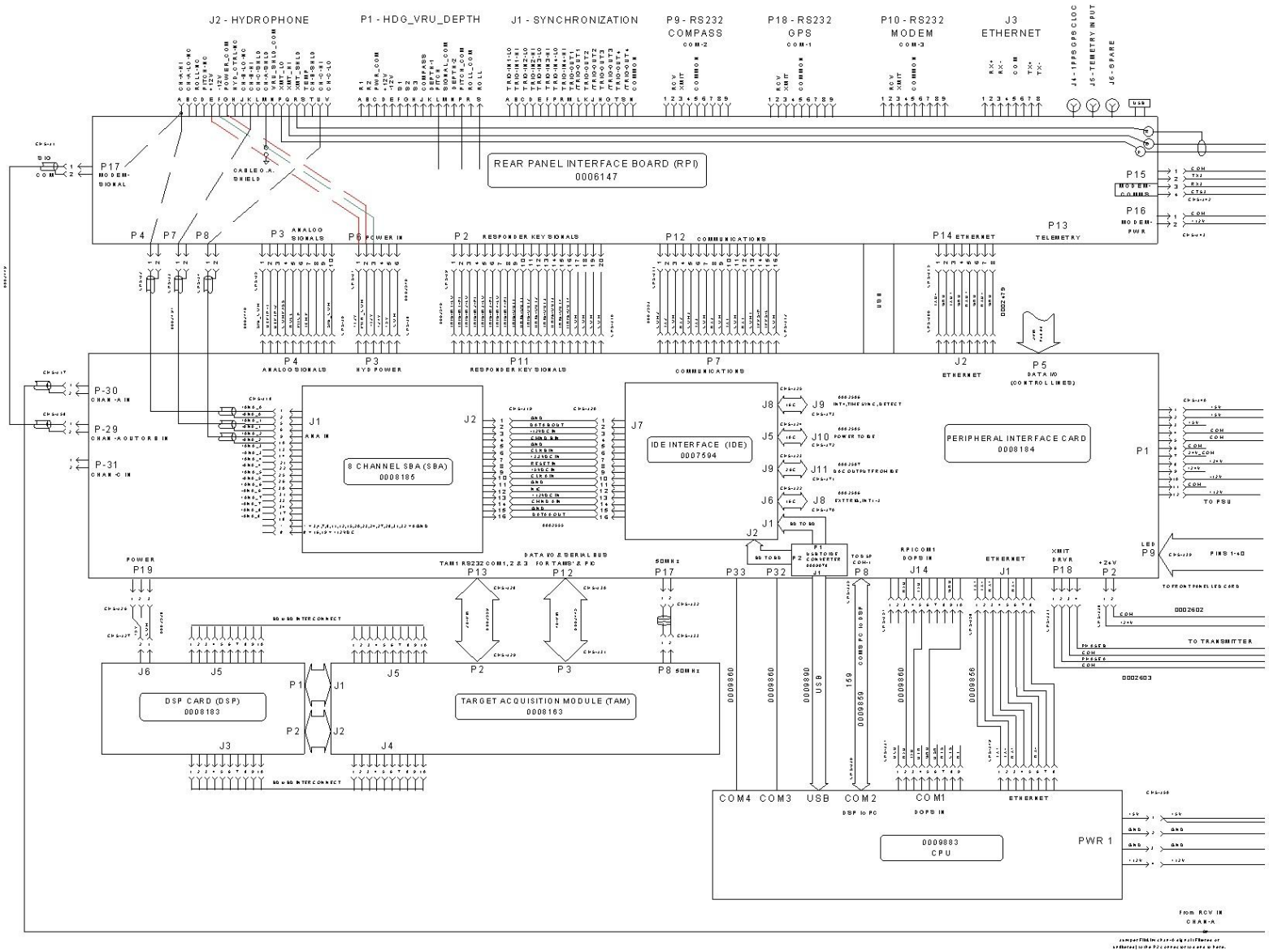
4.1 HYDROPHONE

Model 4213C-B Hydrophone Assembly

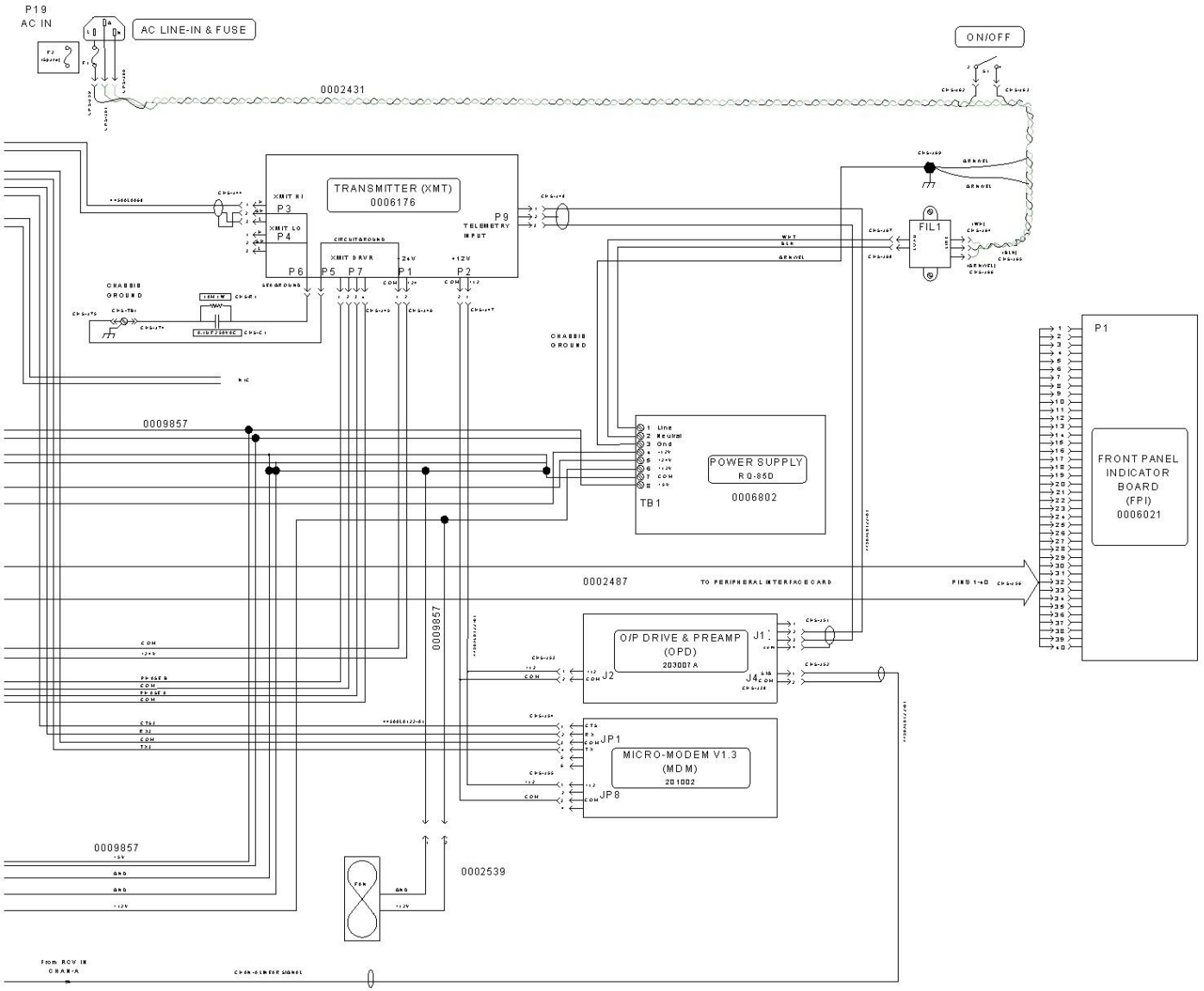
The hydrophone assembly consists of the hydrophone and the pressure case/electronics. In the hydrophone, the three receiving elements and the transmitting element are potted and attached to the PVC base, and connected to the electronics. In the pressure case/electronics package, each of the three elements feeds its own Amplifier on the Amplifier Board. A precision temperature sensor, located on the Amplifier Board, provides an analog signal which is sent to the Transceiver. The medium frequency unit is calibrated from 17 to 30kHz and the Low is calibrated from 8 to 16kHz.

Model 4211A-B Hydrophone

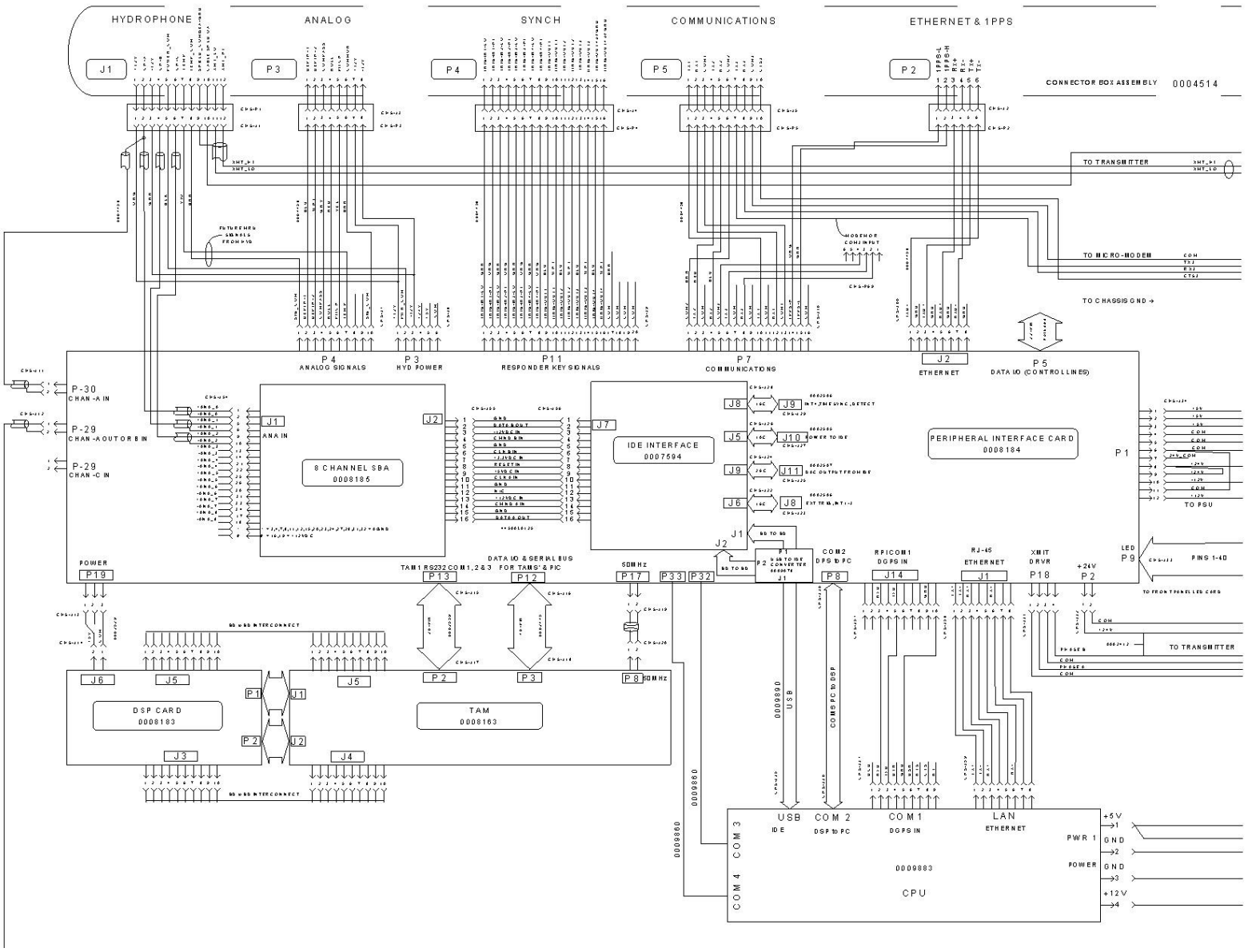
For existing Model 4630 Gate Valve installations, the Model 4211A Hydrophone can also be used to interface to the BATS. The mounting/mechanical dimensions are the same as the 4211B but the connector has been change to the 4213C-B type.



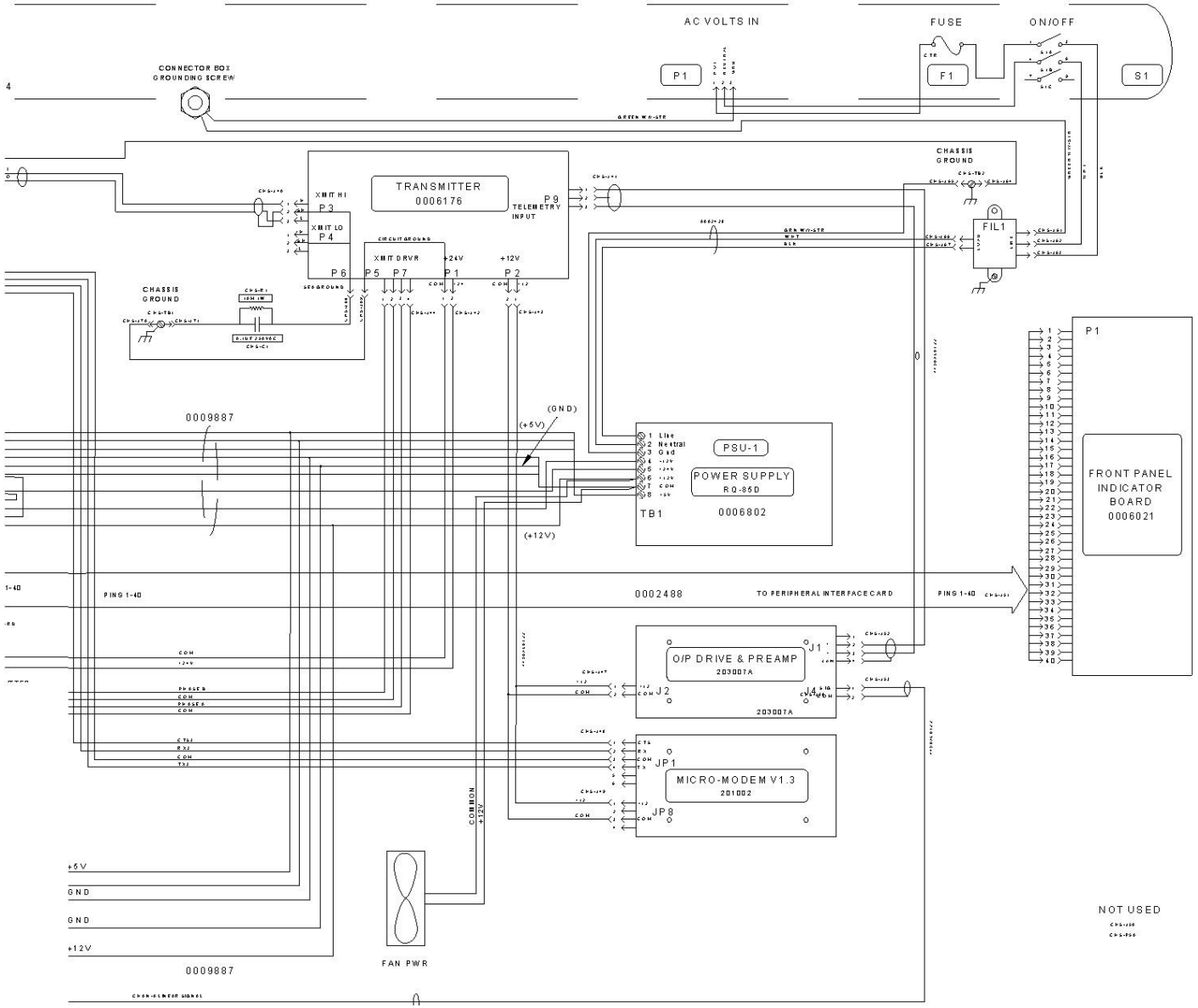
BATS BLOCK DIAGRAM
FIGURE 4-3A



BATS BLOCK DIAGRAM
FIGURE 4-3B



PORTABLE BATS BLOCK DIAGRAM
FIGURE 4-4A



PORTABLE BATS BLOCK DIAGRAM
FIGURE 4-4B

SECTION FIVE

MAINTENANCE

5. SYSTEM MAINTENANCE

5.1 CALIBRATION FILES

The hydrophone assembly is calibrated at the factory. The Trackman Software uses the Hydrophone calibration files to correct for the offsets within the Hydrophone. The calibration files consist of two binary files; XXXXYYYY.bhi & XXXXYYYY.blo. These files contain offsets which compensate for the variances from hydrophone to hydrophone. When ordered as a system, these files are installed in the PC at the factory. If a hydrophone assembly is ordered separately, it comes with a floppy or CD with a set of files on it, and must be installed into the PC to which Trackman Software is installed.

The CAL file's first 4 characters are the Transceivers "Input & A/D" PCB S/N's (if applicable) and the last 4 are the Hydrophone S/N's. The extensions of the two files are .blo and .bhi. (Binary Low byte 1-8 and Binary Hi byte 9-16.) For example…

00001038.bhi

00001038.blo

If the Transceiver S/N's are 0000 then the Hydrophone can be used with any BATS Transceiver. (There are no phase errors within the A/D Card.)

The CAL Files reside on the Trackman PC (Laptop) or Model 4451A under;

c:\Program Files\ORE Offshore\Trackpoint MMI\CalFiles**InUseCAL***.bhi

c:\Program Files\ORE Offshore\Trackpoint MMI\CalFiles**InUseCAL***.blo

If a new Hydrophone is used with the system, the set of Calibration files from the new Hydrophone must be copied into this directory. Only one set of *.bhi & *.blo files can reside under this directory. Move the older CAL files under a new directory called…

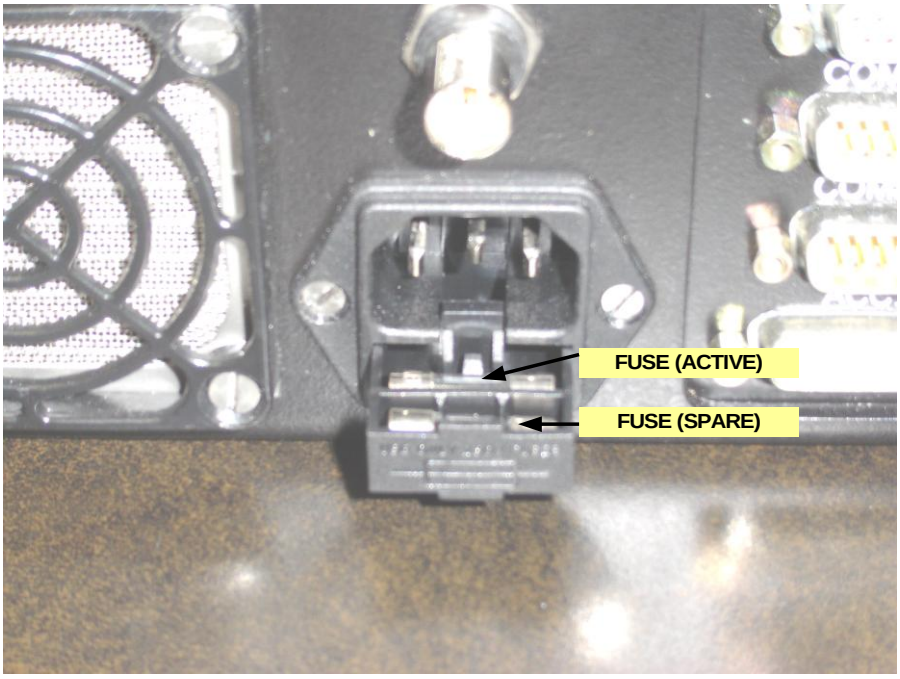
c:\Program Files\ORE Offshore\Trackpoint MMI\CalFiles**OldCALFiles**

The original CAL files are also located on the CD that came with the system in case the Trackman Software is installed on a new PC.

5.2 FUSE REPLACEMENT (RACKMOUNT)

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 below the AC-IN plug to replace the fuse. Replace fuse with proper value as listed below.

3 Amp slow blow (5 x 20 mm)



The Portable units fuse is located on the right side connector panel. It is a sealed screw-on fuse receptacle and is a 3AG type fuse. (1.25 X ¼")

5.2.1 PRINTED CIRCUIT BOARD (PCB) REMOVAL/REPLACEMENT

1. Remove the top cover from the Transceiver. See Figure 5-2.
2. Disconnect any connectors associated with the particular PCB or connectors that cross over the board preventing removal. Remove screws holding in PCB. Remove PCB.

NOTE: The Peripheral Interface Card (PIC) contains lithium back-up batteries for the clock. It is a 3.6v unit composed of Li/$SOCL_2$ and is hermetically sealed.

5.2.2 PCB HANDLING

When removed from the Chassis, 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.

5.3 PROCESSOR MODULE (PC)

The Model 4451A Processor Module is a PC with a Pentium 4 Processor running a Windows® 2000 or XP Professional Operating System. It automatically logs on as "administrator" with a Password of "ORE". The TRACKMAN software starts automatically as soon as the system has completed its boot process.

CAUTION

If an operator closes or minimizes the Trackman application the system resumes to the "Desktop" and the user has full rights to modify any Windows® settings.

APPENDIX A

CARE OF CABLES

APPENDIX-A CARE OF CABLES

GENERAL NOTES:

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).

APPENDIX B

STATIC DISCHARGE

APPENDIX-B ELECTROSTATIC DISCHARGE (ESD)

The printed circuit boards within the TrackPoint 3 console can be damaged by ESD. Many of the electronic components are sensitive to electrostatic discharge. Some devices can be damaged by a potential as low as 30Volts. People are a prime source of device-damaging electrostatic potentials. Activities such as walking or working at a bench can generate thousands of Volts of static potential. This charge is transmitted to a person's conductive perspiration layer, and when a charged person handles a static sensitive device, the component may be damaged by either direct or indirect discharge of the static potential to the device.

NOTE: A person typically will not feel static discharge until the potential approaches 3500 Volts.

An electronic device exposed to static discharge may not be affected at all and will work perfectly throughout a normal life cycle. It may, however, function normally for a while, but because of degradation in the internal layers of the device, its life expectancy may be reduced. The ESD event initiates a device weakness that degrades and causes failure with continued use.

RULE 1: Assume all electronic (solid state) components are sensitive to ESD damage.

RULE 2: Never touch a sensitive component or assembly unless properly grounded. When handling circuit assemblies or when working with them, always use the appropriate grounding procedure: wrist strap connected to ground or heelstrap with a grounded dissipative floormat.

RULE 3: Never transport, store, or handle sensitive components or assemblies except in a static-safe environment. Use static shielding bags when transporting circuit boards.

If a grounded dissipative floor-mat or wrist-strap is not available then at the very least, when swapping out Printed Circuit Boards, discharge yourself to the chassis of the unit. Lift out circuit board from chassis and immediately put it on a conductive surface. Remove the new circuit board from its anti-static bag only after grasping the anti-static bag (with PCB inside) and the chassis. Remove board and place directly inside chassis. Put replaced board in the spare's anti-static bag for transport/storage.

APPENDIX C

WARRANTY

APPENDIX-C WARRANTY STATEMENT

On standard catalogue products, EdgeTech 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 EdgeTech's option, items which are returned to it prepaid within twelve (12) months from delivery to the BUYER and found to EdgeTech's satisfaction, to have been so defective. On services, EdgeTech warrants that all work performed by its employees will be done in a workmanlike manner, EdgeTech's liability under this warranty is limited to remedying at its expense any work found to EdgeTech's satisfaction not so performed, provided however, EdgeTech is notified of any claims within three (3) months from the date work is performed. Any products manufactured by others and resold by EdgeTech shall bear the warranty of the original manufacturer, to the extent that such warranties may be legally transferred, assigned and passed on to BUYER. EdgeTech 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. EdgeTech MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND SPECIFICALLY, EDGETECH MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. EdgeTech'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 EdgeTech fails to manufacture or deliver GOODS required to be manufactured or delivered hereunder, or manufactures such GOODS in a defective manner, EdgeTech'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.

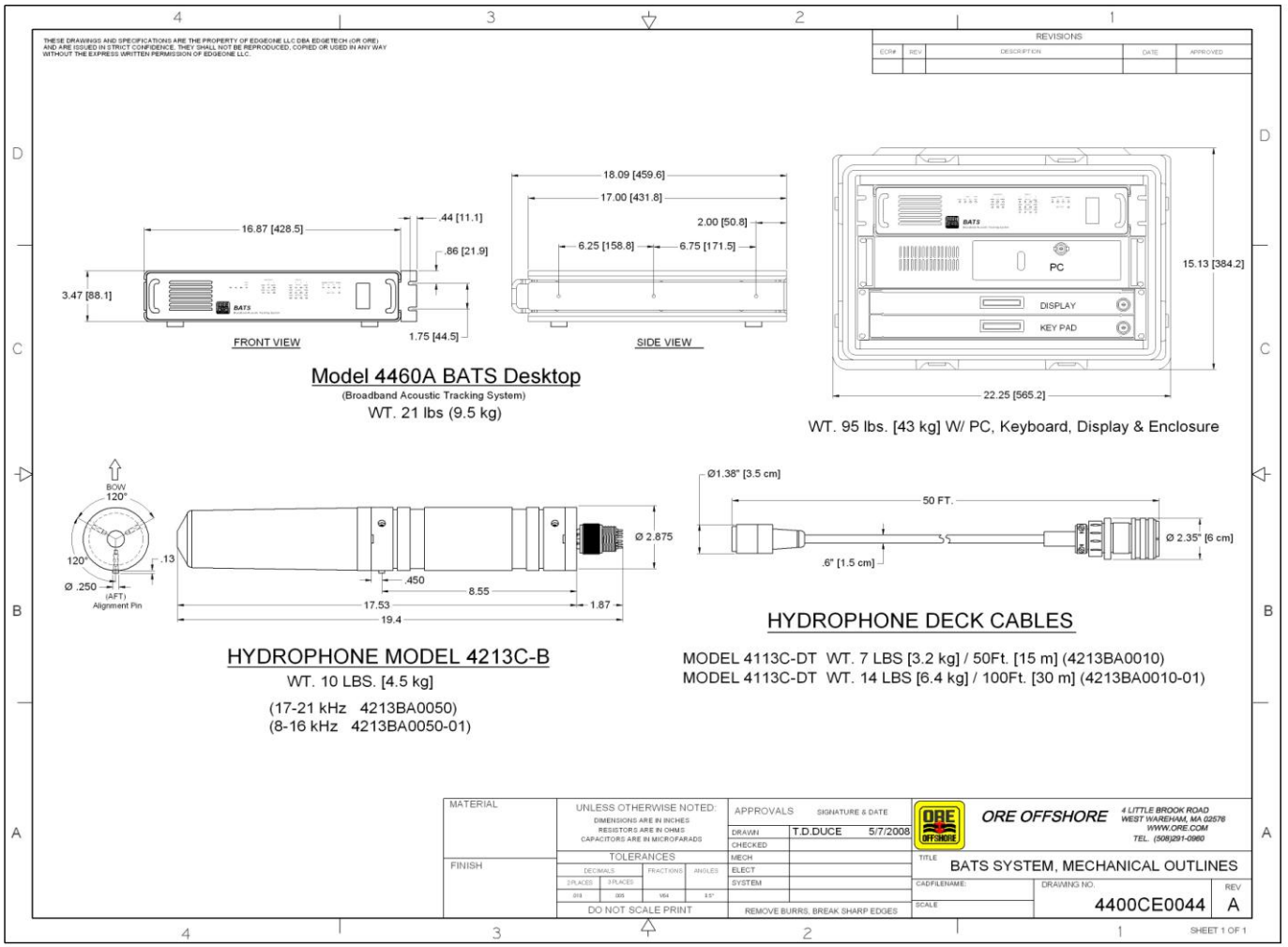
IN NO EVENT SHALL EDGETECH BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

APPENDIX D

DRAWINGS

APPENDIX-D DRAWINGS

D1	4400CE0044	BATS Mechanical Outlines
D2	4400CE0045	BATS Portable Mechanical Outlines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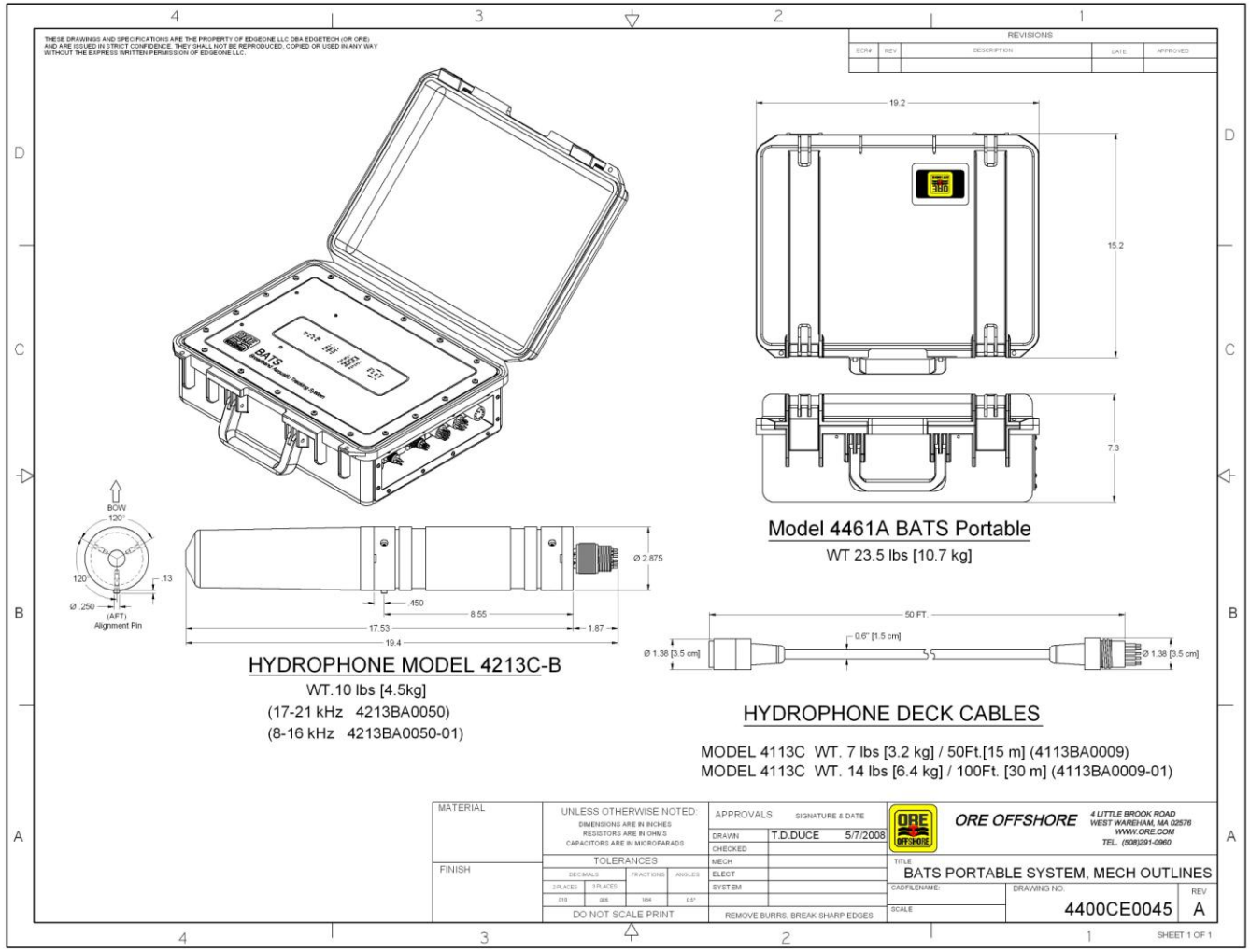
REVISIONS
ECR# REV DESCRIPTION DATE APPROVED
16.87 [428.5]
.44 [11.1]
.86 [21.9]
3.47 [88.1]
1.75 [44.5]
FRONT VIEW
18.09 [459.6]
17.00 [431.8]
2.00 [50.8]
6.25 [158.8]
6.75 [171.5]
SIDE VIEW
Model 4460A BATS Desktop
(Broadband Acoustic Tracking System)
WT. 21 lbs (9.5 kg)
PC
DISPLAY
KEY PAD
15.13 [384.2]
22.25 [565.2]
WT. 95 lbs. [43 kg] W/ PC, Keyboard, Display & Enclosure
BOW
120°
120°
.13
Ø .250
(AFT)
Alignment Pin
Ø 2.875
.450
8.55
17.53
1.87
19.4
HYDROPHONE MODEL 4213C-B
WT. 10 LBS. [4.5 kg]
(17-21 kHz 4213BA0050)
(8-16 kHz 4213BA0050-01)
Ø1.38" [3.5 cm]
50 FT.
.6" [1.5 cm]
Ø 2.35" [6 cm]
HYDROPHONE DECK CABLES
MODEL 4113C-DT WT. 7 LBS [3.2 kg] / 50Ft. [15 m] (4213BA0010)
MODEL 4113C-DT WT. 14 LBS [6.4 kg] / 100Ft. [30 m] (4213BA0010-01)
MATERIAL
FINISH
UNLESS OTHERWISE NOTED:
DIMENSIONS ARE IN INCHES
RESISTORS ARE IN OHMS
CAPACITORS ARE IN MICROFARADS
TOLERANCES
DECIMALS FRACTIONS ANGLES
3 PLACES 2 PLACES
.010 .005 1/64 0.5°
DO NOT SCALE PRINT
APPROVALS SIGNATURE & DATE
DRAWN T.D.DUCE 5/7/2008
CHECKED
MECH
ELECT
SYSTEM
REMOVE BURRS, BREAK SHARP EDGES
ORE OFFSHORE
4 LITTLE BROOK ROAD
WEST WAREHAM, MA 02576
WWW.ORE.COM
TEL. (508)291-0960
TITLE
BATS SYSTEM, MECHANICAL OUTLINES
CADFILENAME:
DRAWING NO.
4400CE0044
REV
A
SCALE
SHEET 1 OF 1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REVISIONS
ECR# REV DESCRIPTION DATE APPROVED
BATS
19.2
15.2
7.3
Model 4461A BATS Portable
WT 23.5 lbs [10.7 kg]
BOW
120°
120°
.13
Ø .250
(AFT)
Alignment Pin
Ø 2.875
.450
8.55
1.87
17.53
19.4
HYDROPHONE MODEL 4213C-B
WT.10 lbs [4.5kg]
(17-21 kHz 4213BA0050)
(8-16 kHz 4213BA0050-01)
50 FT.
0.6" [1.5 cm]
Ø 1.38 [3.5 cm]
Ø 1.38 [3.5 cm]
HYDROPHONE DECK CABLES
MODEL 4113C WT. 7 lbs [3.2 kg] / 50Ft.[15 m] (4113BA0009)
MODEL 4113C WT. 14 lbs [6.4 kg] / 100Ft. [30 m] (4113BA0009-01)
MATERIAL
FINISH
UNLESS OTHERWISE NOTED:
DIMENSIONS ARE IN INCHES
RESISTORS ARE IN OHMS
CAPACITORS ARE IN MICROFARADS
TOLERANCES
DECIMALS FRACTIONS ANGLES
2 PLACES 3 PLACES
.01 .005 1/64 0.5°
DO NOT SCALE PRINT
APPROVALS SIGNATURE & DATE
DRAWN T.D.DUCE 5/7/2008
CHECKED
MECH
ELECT
SYSTEM
REMOVE BURRS, BREAK SHARP EDGES
ORE OFFSHORE
4 LITTLE BROOK ROAD
WEST WAREHAM, MA 02576
WWW.ORE.COM
TEL. (508)291-0960
TITLE
BATS PORTABLE SYSTEM, MECH OUTLINES
CADFILENAME:
DRAWING NO:
4400CE0045
REV
A
SCALE
SHEET 1 OF 1

APPENDIX E

EDGETECH BEACON REPLY/INTERROGATE FREQUENCIES AND CHANNEL CODES

APPENDIX-E ORE M-FSK WAVEFORMS, PRN CODES

ORE M-FSK SPREAD SPECTRUM WAVEFORMS

CODE	FREQUENCY BAND (kHz)	PULSE WIDTH (ms)	NOTES
ORE-01	22.936 – 27.174	10.13	Omni
ORE-02	27.174 – 22.936	10.13	Omni
ORE-03	17.007 – 21.008	11.17	Omni
ORE-04	21.008 – 17.007	11.17	Omni
ORE-05	24.038 – 28.090	9.88	Directional (Typ)
ORE-06	28.090 – 24.038	9.88	Directional (Typ)
ORE-07	17.007 – 21.008	16.76	Directional (Typ)
ORE-08	21.008 – 17.007	16.76	Directional (Typ)
ORE-09	19.920 – 23.923	10.35	Omni
ORE-10	23.923 – 19.920	10.35	Omni
ORE-11	25.773 – 29.762	10.14	Omni
ORE-12	29.762 – 25.773	10.14	Omni
ORE-13	Reserved		Omni
ORE-14	Reserved		Omni
ORE-15	Reserved		Omni
ORE-16	Reserved		Omni
ORE-17	12.019 – 16.025	10.20	Omni
ORE-18	16.025 – 12.019	10.20	Omni
ORE-19	12.019 – 16.025	16.30	Directional (Typ)
ORE-20	16.025 – 12.019	16.30	Directional (Typ)

PRN REPLY FREQUENCY CHANNEL CODES

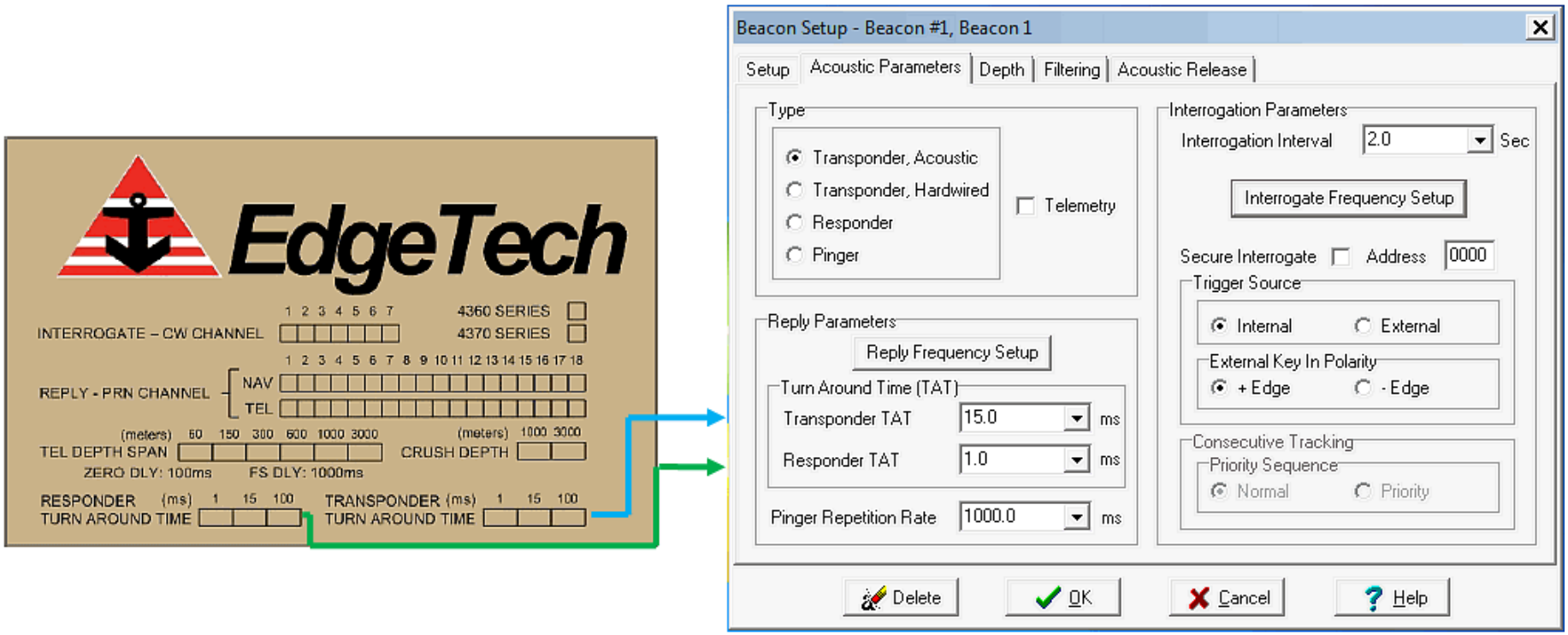
CODE	FREQUENCY (kHz)	CHIP LENGTH (us)	OCTAL CODE
1	22.727	352.00	045
2	24.510	326.40	051
3	26.042	345.60	057
4	27.473	327.60	067
5	24.510	326.40	073
6	26.042	345.60	075
7	25.773	349.20	045
8	27.174	331.20	051
9	28.735	348.00	057
10	25.773	349.20	073
11	27.174	331.20	075
12	22.727	528.00	045
13	24.510	489.60	051
14	26.042	494.20	057
15	27.473	509.60	067
16	25.773	504.40	045
17	27.174	515.20	051
18	28.735	522.00	057
19	22.727	352.00	075
20	27.473	327.60	045
21	28.735	348.00	075

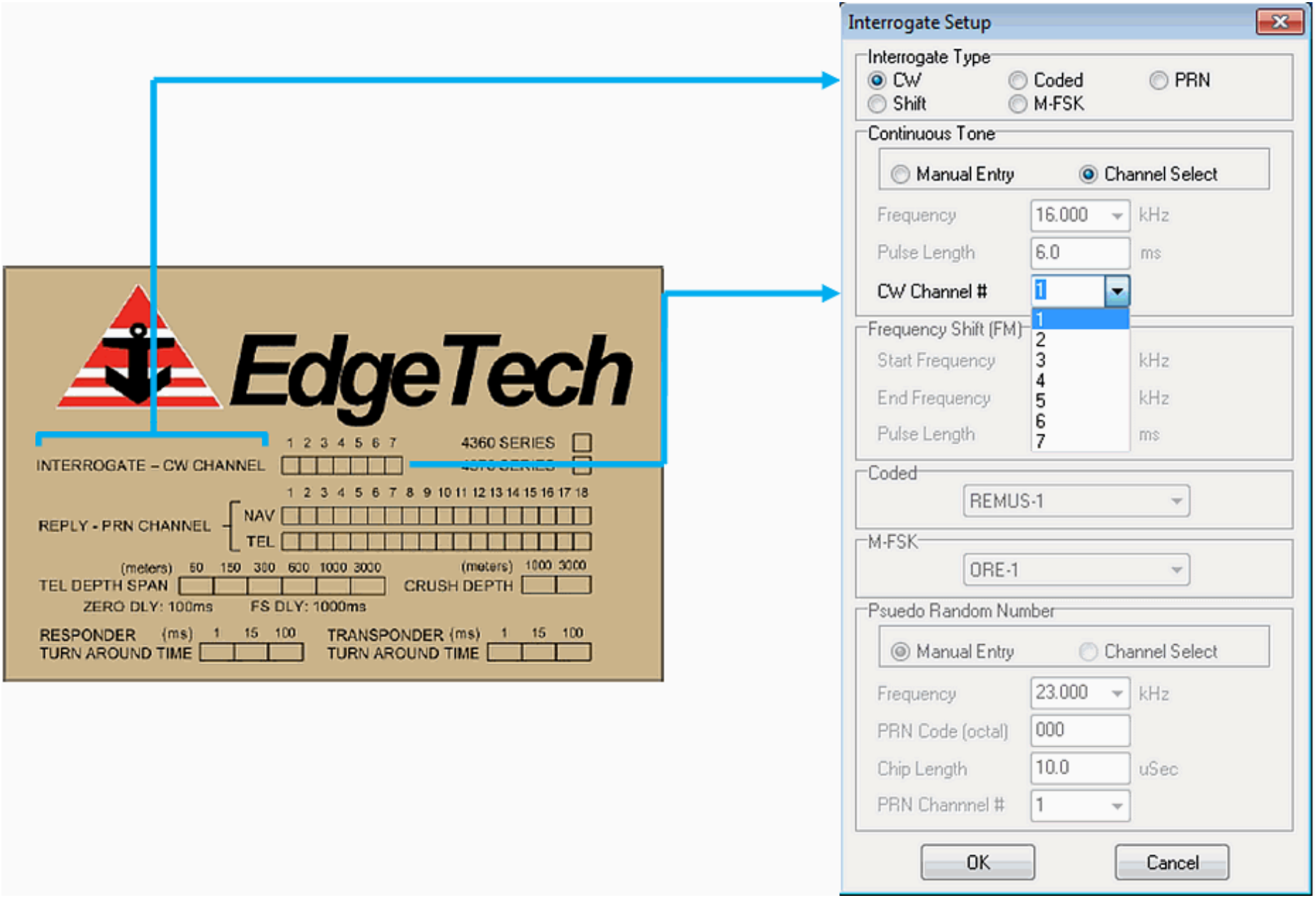
CW INTERROGATE FREQUENCY CHANNEL CODES

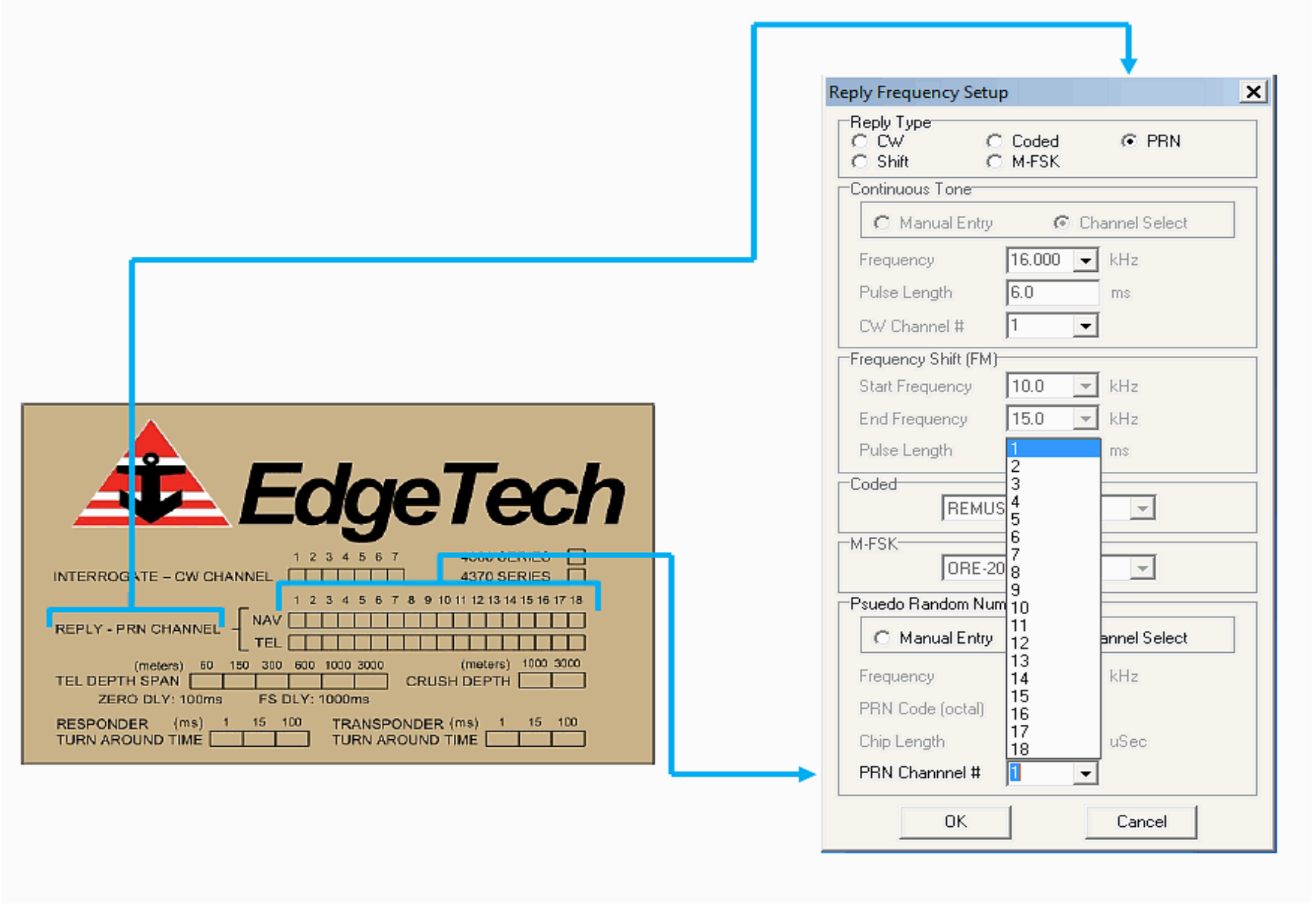
CODE	FREQUENCY (kHz)	PULSE WIDTH (ms)
1	16.0	6
2	17.0	6
3	18.0	6
4	19.0	6
5	20.5	6
6	21.5	6
7	22.5	6

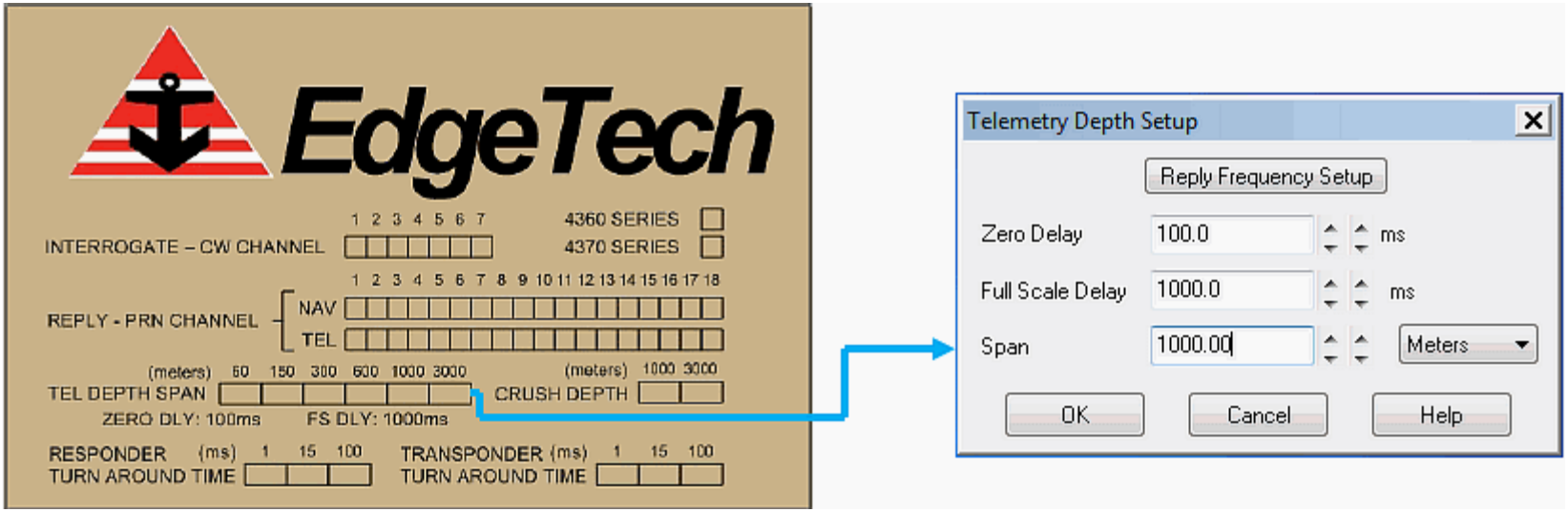
APPENDIX F

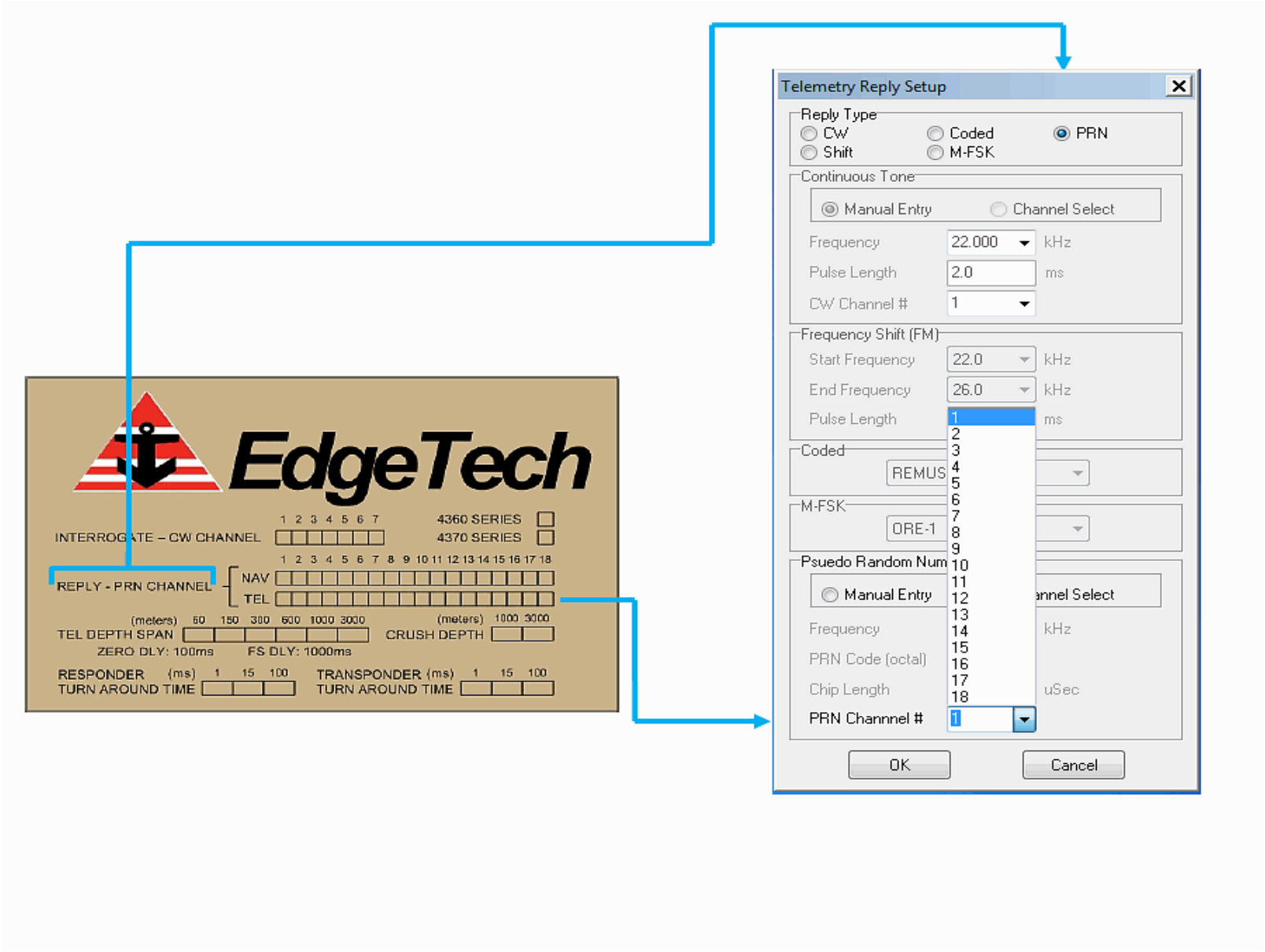
BATS / TRACKMAN BEACON SETUP GUIDE


EdgeTech
1 2 3 4 5 6 7
4360 SERIES
INTERROGATE – CW CHANNEL
4370 SERIES
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
REPLY - PRN CHANNEL
NAV
TEL
(meters) 60 150 300 600 1000 3000
(meters) 1000 3000
TEL DEPTH SPAN
CRUSH DEPTH
ZERO DLY: 100ms
FS DLY: 1000ms
RESPONDER (ms) 1 15 100
TURN AROUND TIME
TRANSPONDER (ms) 1 15 100
TURN AROUND TIME
Beacon Setup - Beacon #1, Beacon 1
Setup
Acoustic Parameters
Depth
Filtering
Acoustic Release
Type
Transponder, Acoustic
Transponder, Hardwired
Responder
Pinger
Telemetry
Reply Parameters
Reply Frequency Setup
Turn Around Time (TAT)
Transponder TAT
15.0
ms
Responder TAT
1.0
ms
Pinger Repetition Rate
1000.0
ms
Interrogation Parameters
Interrogation Interval
2.0
Sec
Interrogate Frequency Setup
Secure Interrogate
Address
0000
Trigger Source
Internal
External
External Key In Polarity
+ Edge
- Edge
Consecutive Tracking
Priority Sequence
Normal
Priority
Delete
OK
Cancel
Help


EdgeTech
INTERROGATE – CW CHANNEL
1 2 3 4 5 6 7
4360 SERIES
REPLY - PRN CHANNEL
NAV
TEL
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
(meters) 50 150 300 600 1000 3000
TEL DEPTH SPAN
(meters) 1000 3000
CRUSH DEPTH
ZERO DLY: 100ms
FS DLY: 1000ms
RESPONDER (ms) 1 15 100
TURN AROUND TIME
TRANSPONDER (ms) 1 15 100
TURN AROUND TIME
Interrogate Setup
Interrogate Type
CW
Coded
PRN
Shift
M-FSK
Continuous Tone
Manual Entry
Channel Select
Frequency
16.000
kHz
Pulse Length
6.0
ms
CW Channel #
1
1
2
3
4
5
6
7
Frequency Shift (FM)
Start Frequency
kHz
End Frequency
kHz
Pulse Length
ms
Coded
REMUS-1
M-FSK
ORE-1
Psuedo Random Number
Manual Entry
Channel Select
Frequency
23.000
kHz
PRN Code (octal)
000
Chip Length
10.0
uSec
PRN Channnel #
1
OK
Cancel


EdgeTech
INTERROGATE – CW CHANNEL
1 2 3 4 5 6 7
4370 SERIES
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
REPLY - PRN CHANNEL
NAV
TEL
(meters) 60 150 300 600 1000 3000
TEL DEPTH SPAN
(meters) 1000 3000
CRUSH DEPTH
ZERO DLY: 100ms
FS DLY: 1000ms
RESPONDER (ms) 1 15 100
TURN AROUND TIME
TRANSPONDER (ms) 1 15 100
TURN AROUND TIME
Reply Frequency Setup
Reply Type
CW
Coded
PRN
Shift
M-FSK
Continuous Tone
Manual Entry
Channel Select
Frequency
16.000
kHz
Pulse Length
6.0
ms
CW Channel #
1
Frequency Shift (FM)
Start Frequency
10.0
kHz
End Frequency
15.0
kHz
Pulse Length
ms
Coded
REMUS
M-FSK
ORE-20
Psuedo Random Num
Manual Entry
nnel Select
Frequency
kHz
PRN Code (octal)
Chip Length
uSec
PRN Channnel #
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
OK
Cancel


EdgeTech
1 2 3 4 5 6 7
4360 SERIES
INTERROGATE – CW CHANNEL
4370 SERIES
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
REPLY - PRN CHANNEL
NAV
TEL
(meters) 60 150 300 600 1000 3000
(meters) 1000 3000
TEL DEPTH SPAN
CRUSH DEPTH
ZERO DLY: 100ms
FS DLY: 1000ms
RESPONDER (ms) 1 15 100
TURN AROUND TIME
TRANSPONDER (ms) 1 15 100
TURN AROUND TIME
Telemetry Depth Setup
Reply Frequency Setup
Zero Delay
100.0
ms
Full Scale Delay
1000.0
ms
Span
1000.00
Meters
OK
Cancel
Help


EdgeTech
1 2 3 4 5 6 7
4360 SERIES
INTERROGATE – CW CHANNEL
4370 SERIES
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
REPLY - PRN CHANNEL
NAV
TEL
(meters) 60 150 300 600 1000 3000
(meters) 1000 3000
TEL DEPTH SPAN
CRUSH DEPTH
ZERO DLY: 100ms
FS DLY: 1000ms
RESPONDER (ms) 1 15 100
TURN AROUND TIME
TRANSPONDER (ms) 1 15 100
TURN AROUND TIME
Telemetry Reply Setup
Reply Type
CW
Coded
PRN
Shift
M-FSK
Continuous Tone
Manual Entry
Channel Select
Frequency
22.000
kHz
Pulse Length
2.0
ms
CW Channel #
1
Frequency Shift (FM)
Start Frequency
22.0
kHz
End Frequency
26.0
kHz
Pulse Length
ms
Coded
REMUS
M-FSK
ORE-1
Psuedo Random Num
Manual Entry
nnel Select
Frequency
kHz
PRN Code (octal)
Chip Length
uSec
PRN Channnel #
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
OK
Cancel