Seatrack 320

Technical Manual

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1 INTRODUCTION

Seatrack 320, a tail buoy transponder unit (TBU), is a part of the Seatrack Tailbuoy Tracking System. In addition to Seatrack 320, the system consists of two more units, the Seatrack 220 and the Seatrack VCU 200, a vessel control unit (VCU) [1]. While the Seatrack 220 unit is developed for tail buoy operation, the Seatrack 320 unit is designed to resist the extreme shocks at a gun float.

Seatrack 320 and Seatrack 220 are designed to accurately track the position of distributed objects relative to that of a vessel and/or each other in real time. To accomplish this, the transponders are attached to the elements to be measured. Each transponder receives GPS L1 carrier and phase code and transmits it to the host vessel via UHF radio signals or a cable.

One or more Seatrack VCU 200 units are used on board to communicate with the transponders while a processing unit, e.g. with the Seadiff RNAV software, accurately processes the data and calculates the relative position. Data transmitted allow either psudo-range or RTK processing onboard the vessel, providing meter to centimetre level position accuracy.

The Seatrack 320 and Seatrack 220 units are self contained with all electronics and antennas integrated in the same physical unit. Only one cable (power) is connected to the unit and operation starts automatically upon power up. Both the polyethylene housing and the electronics are designed to withstand the challenging environments of marine seismic operations. The built-in 12-channel GPS receiver has a sophisticated anti-mulipath feature for maximum accuracy and minimum signal degradation.

The low power UHF radio and a TDMA (Time Division Multiple Access) protocol provide efficient communication between the vessel and the transponder. The Seatrack VCU 200 interfaces to a 1 PPS port for precision timing control to utilise the TDMA capability of the transponders. The TDMA technique makes it possible to allocate time slots for other systems operating at the same frequency, such as Seatrack III.

Up to 24 transponder units can share the same frequency utilising a two-second update rate. Key configuration parameters can be transmitted to each individual transponder using the Seatrack VCU 200 or a hand held terminal.

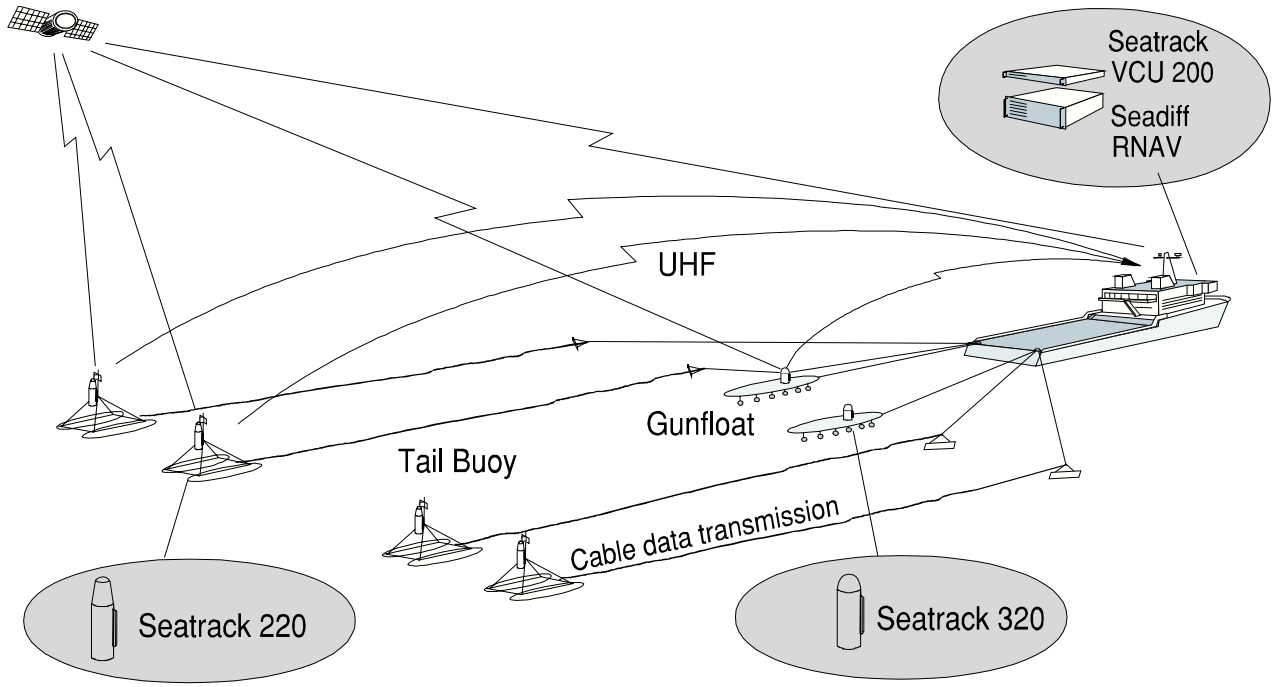

Figure 1 System overview

1.1 About this Manual

The purpose of this manual is to provide the user with sufficient information to operate the Seatrack Tailbuoy Tracking System.

This manual is organised into the following chapters:

Chapter 1 **Introduction** - A brief introduction to the system and an overview of this manual with abbreviations and acronyms.

Chapter 2 **Technical Data** - Describes detailed product specification, physical dimensions, required power and environmental restrictions, together with restrictions in use and guarantee.

Chapter 3 **Equipment Description** - Describes the system parts.

Chapter 4 **Operating Instructions**- Describes system configuration, installation and operation.

Chapter 5 **Troubleshooting** - Contains some hints for troubleshooting.

In this manual the following notations are used:

CAUTION

Is used to make the user aware of procedures and operational practice which, if not followed, may result in damage to the equipment.

Note A note text has this format and is used to draw the user's attention to special features or behaviour of the equipment.

1.2 References

[1] *Seatrack VCU 200 and Seatrack 220 Technical Manual*, Seatex 2000.
[2] *Seatrack III Technical Manual*, Seatex 2000.

1.3 Abbreviations and Acronyms

ECEF	Earth Centre Earth Fix
GPS	Global Positioning System
HHT	Handheld Terminal
NC	Not Connected
PDOP	Position Dilution of Precision
PPS	Pulse per Second
RF	Radio Frequency
SN	Signal/Noise Ratio
SV	Satellite Vehicle
TBD	To be Defined
TBID	Tailbuoy Identification Number
TBU	Tailbuoy Transponder Unit
TDMA	Time Division Multiple Access
VCU	Vessel Control Unit

2 TECHNICAL DATA

2.1 Health and Environment

Operation or troubleshooting of the Seatrack Tailbuoy Tracking System will not imply any risk of high voltages, explosions or exposure to gas.

2.2 Restrictions in Guarantee

The liability of Seatex is limited to repair of the Seatrack Tailbuoy Tracking System only under the given terms and conditions stated in the sales document. Consequential damages such as customer's loss of profit or damage to other system traceable back to Seatrack Tailbuoy Tracking System malfunction, are excluded. The warranty does not cover malfunctions of the Seatrack Tailbuoy Tracking System resulting from the following conditions:

a) Over-voltage or incorrect power consumption.

b) The TBU housing has been opened by the customer.

2.3 Performance Data

TBU

Position accuracy: ..... 3 m (2D, 95%)
Update rate: ..... 0.5 Hz
Sequencing: ..... Up to 24 TBU units sharing one frequency

Excessive multipath, GPS signal obstructions or interference will reduce the performance.

2.4 Physical Dimensions

TBU

Weight: ..... 5 kg
Diameter: ..... 150 mm
Overall diameter: ..... 190 mm
Length: ..... 800 mm
Colour: ..... White

HHT
Width: ..... 109.3 mm (4.3 inches)
Height: ..... 162.5 mm (6.4 inches)
Depth: .....25.4 mm (1 inch)
Weight: .....0.283 kg (10 oz)

2.5 Power

TBU
Input voltage: .....10-32 V DC
Power consumption: .....6 W

HHT
The HHT receives power from the TBU.

2.6 Environmental Specification

TBU
Enclosure material: .....Polyethylene
Enclosure protection: .....IP 68, 10 m
Operating temperature range: .....-10ºC to +55ºC
Storage temperature range: .....-30ºC to +70ºC
Humidity: ..... Max. 100% fully sealed

HHT
Operating temperature range: ..... 0ºC to +50ºC
Storage temperature range: .....-20ºC to +70ºC
Humidity: .....5% to 95% RH non-condensing

2.7 GPS Receiver

TBU
Type: .....Ashtech G12-L parallel channels
Frequency (reception only): .....1575.42 MHz ±10 MHz

Integrated Doppler can be utilised internally in the GPS receiver to smooth the pseudo-range measurements. Another option is to send raw pseudo-range and phase measurements.

Optional GPS receiver: .....Garmin GPS 25XL

2.8 Radio

TBU

Type: ..... Wood & Douglas RSX 450U
Modem: ..... 9600 GMSK
Frequency (programmable): ..... 450 - 470 MHz
Channel separation: ..... 25 kHz
Transmission power: ..... 0.5 W
Range: ..... Max. 15 km (line of sight)

2.9 Antennas

TBU

GPS antenna: ..... Trimble Hardmount
UHF antenna: ..... Procom HX 70/h-FME

The UHF antenna needs a ground plane. This is provided by the screening canister around the TBU.

2.10 TBU Connector Types

Standard

HHT connector: ..... Impulse IE.BH-8FS female
Power connector: ..... AGM-17x4F male

Optional

HHT and power connector: ..... Wetcon BH-12 MRX-SS

Specifications subject to change without prior notice.

3 EQUIPMENT DESCRIPTION

3.1 TBU System Description

The TBU comprises the following main parts:

- a motherboard for the electronics and the DC/DC power supply
- a Motorola MC 68332 processor
- a GPS receiver
- a GPS antenna
- a UHF telemetry transceiver
- a UHF antenna
- interconnecting cables

All units are assembled in a polyethylene housing. The internal mechanics are supported with anti-vibration, shock absorbing materials.

In addition to the TBU, the following items can be delivered with the units:

- power cable, 6 m
- handheld terminal with cable and connector

Figure 2 TBU housing

3.2 Handheld Terminal Description

The Termiflex ST 2000 works as a simple ASCII terminal, capable of simultaneously transmitting and receiving ASCII characters via one of the RS-232C ports of the TBU or the VCU [1]. Once power is connected, the terminal undergoes a series of self-tests to verify proper unit operation. No input is required during the self-test (approx. three seconds duration).

Figure 3 Handheld terminal

Normally, the HHT will be configured by Seatex before delivery. However, appendix B "HHT Configuration", gives a description on how to configure the terminal.

4 OPERATING INSTRUCTIONS

4.1 TBU Configuration and Installation

The procedure for configuring the TBU is as follows:

1. Connect power (10 to 32 V DC) and if required, the HHT. The unit will start automatically when power is connected. No interaction is required to start normal operation, but the TBU can be operated via the HHT.
2. Type the password to enter the setup menu. The password is "SEATEX". After the password has been typed, the software version, the TBU's identification number (TBID) and the current slot number will be displayed. The TBID is a unique number for the TBU and is equal to the serial number.
3. After the information page, a menu page will appear. All operations available in the program are operated from this page, see chapter 4.2 for available functions.
4. To select a page, press the letter in front of the menu text. To return to the menu, press ESC. (Use the SHIFT key before pressing ESC). With the keys T and Y the menu page scrolls up and down.
5. Check, and if necessary change, the following configuration parameters:
   - Slot
   - Frequency
   - Radio mode
   - Period
   - Periodic message

Note The slot number identifies the time-slot allocation for the TBUs operating on the same frequency. TBUs sharing the same frequency must not be configured with the same slot number.

Note A new configuration value will not be stored until you press ENTER. All configuration parameters are then stored in non-volatile memory.

6. After configuration, disconnect power and the HHT. Mount the TBU in a mast or a suitable location where the satellite signals will not be obstructed, see Figure 4.
7. The unit will start automatically with the new configuration when power is connected.

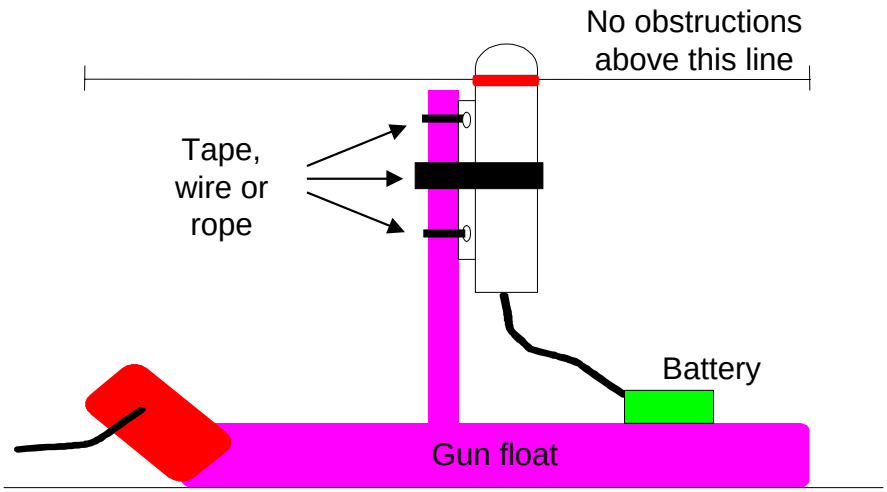

Figure 4 TBU installation

4.2 Configuration Functions

Different functions are available via the HHT. An overview is given in the table below.

Page	Content
A	Help
B	GPS*
C	Communication
D	Time/Battery
E	Slot
F	Radio Frequency
G	Radio Mode
H	Debug
I	Period
J	Periodic Message*
K	Sequence 1*
L	Sequence 1 Message*
M	Sequence 2*
N	Sequence 2 Message*
O	Port-1 Baud
P	Port-2 Baud
Q	Port-3 Baud
R	Reset
S	Backlight on/off
X	Log out from HHT

* Not applicable for the VCU HHT [1].

Table 1 Options in the Menu Page

Note When leaving Seatex, all setup and program configuration, except the slot number, have been carried out. The unit will start automatically when power is connected.

The use of the HHT functions is explained below.

4.2.1 A: Help

This is a help display page.

T	Page up
Y	Page down
ESC	Back to meny
ENTER	Select

In addition to the help keys explained above, the following is important when using the HHT:

- Press the SHIFT key before you use a key with red letters, for example ESC.
- It is not necessary to use the SHIFT key when pressing numbers.
- If you have made a mistake you can press ESC any time.
- Backspace can be used.
- A new configuration value will not be used until you press ENTER. All configuration parameters are then stored in non-volatile memory.

4.2.2 B: GPS

To see if the TBU is tracking satellites, select page B. The page will only show the Satellite Vehicle (SV) no. and Signal/Noise (SN) ratio for the six satellites with the highest elevation. It will also show how many satellites the TBU is tracking. The TBU will only transmit data for the eight satellites with the highest elevation.

A normal display of page B during operation could be as shown below:

GPS-INFO							
SV	30	12	06	13	24	20	- list of tracked satellites
SN	15	14	14	13	12	12	- list of signal/noise ratio
No. Sat.	9	GPS Time: 223098.00					- number of tracked satellites and GPS time in seconds

4.2.3 C: Communication

When the TBU is sending messages, page C displays the time since the last transmitted or received messages.

4.2.4 D: Time/Battery

After power up, the following text could be displayed on page D:

TIME / BATTERY	
Invalid Time:	00:01:26
Batt. In:	12.3 V
Batt. Out:	12.1 V
Temp:	24.5 C

- hours, minutes and seconds since booting

As soon as the radio starts sending, "GPS-time" will appear instead of "Invalid Time".

4.2.5 E: Slot

Choose page E to change slot numbers from the HHT. Select the wanted slot number and press ENTER to store the configuration.

Default value: Not defined. Any number can be set from factory.

Note Select a unique slot number for each TBU. Slot numbers between 0 and 25 can be used when the update rate is 0.5 Hz. The slot numbers 12 and 25 are reserved for the VCUs [1].

If two units are accidentally assigned to the same timeslot, at the same frequency, data will be lost. If one unit has a much stronger signal, e.g. has shorter range, it may be received correctly but will mask the data from the weaker unit. If the signal strengths are similar, data from both the units will be corrupted.

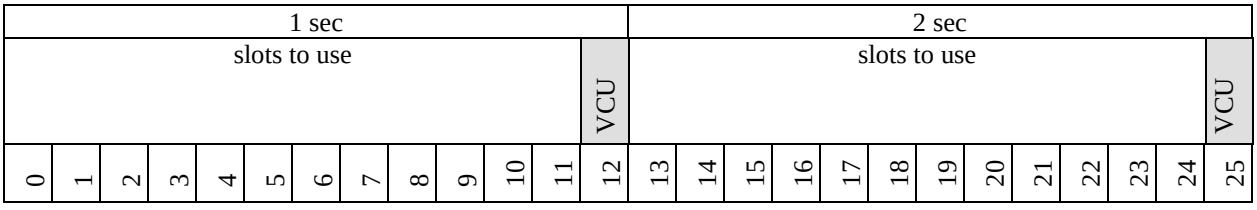

Figure 5 Slot description

4.2.6 F: Radio Frequency

The radio frequency can be set from the handheld terminal for both the TBU and the VCU [1]. Choose page F from the menu and set the frequency in kHz. Press ENTER to store the configuration. The frequency can be set from 457000 kHz to 459000 kHz in 25 kHz steps.

A normal display of page F during frequency setting is shown below:

```
RADIO FREQUENCY

Old  (kHz):  458675
New  (kHz):  457000
```

Default value: 458675

4.2.7 G: Radio Mode

The radio can be turned off/on or set in auto mode. In auto mode the radio will be turned off when the XON/XOFF communication is OK.

0 = Off
1 = On
2 = Auto

Default value: 2

4.2.8 H: Debug

This page is for debug purposes only. The following debug functions are available:

0 = No debug.
1 = Debug printouts can be seen on HHT.
2 = Debug printouts are sent to COM1.
4 = UHF TX debug. The radio will transmit the character X continuously. This function can be used to check the radio frequency and power.
8 = COM2 debug. All character input from HHT is sent to COM2 TX. All characters received on COM2 RX are presented on HHT.
16 = Turn relay 1 on.
32 = Turn relay 2 on.
64 = PPS debug. A "!" is printed each time a PPS interrupt occurs.
128 = Communication debug printouts.

Note Combinations of the above can/must be used. For example: To see the PPS printouts on HHT: Select debug function 65 (64+1).

Press ESC to terminate the debug mode. All debug flags will then be reset.

Default value: 0

4.2.9 I: Period

The update rate of transmitted messages.

Period values:
0 = Power save on: no periodic message will be sent.
1-12 = Period in seconds: the period is rounded to 1, 2, 3, 4, 6 or 12 seconds. If 5, 7, 8 or 9 is selected, period value will be 6. If 10 or 11 is selected, period value will be 12.

Default value: 2

4.2.10 J: Periodic Message Type

Specify the message type to be sent periodically:

0 = No periodic message transmission.
2 = GPS raw data: this message contains the number of satellites, a time tag and a set of data from each satellite.
3 = IRMA data: TBD
4 = Configuration: this message contains configuration data from the tail buoy.
5 = Status: this message contains CPU and GPS software version information, voltage and temperature measurements together with relay status information.
6 = ECEF Position: this message contains ECEF position and PDOP information.
9 = Standard message

Default value: 2

4.2.11 K, M: Sequence 1,2

The sequences make it possible to send more than one message type periodically. A sequence counter is incremented each time the periodic message is being transmitted. When the counter equals the specified value, the sequence message is transmitted instead of the periodic one. The counter is then zeroed.

Default value: 0

4.2.12 L, N: Sequence 1,2 Message Type

Specify the message type to be sent instead of the periodic one.

0 = No sequence message transmitted.
2 = GPS raw data: this message contains the number of satellites, a time tag and a set of data from each satellite.
3 = IRMA data: TBD.
4 = Configuration: this message contains configuration data from the tail buoy.
5 = Status: this message contains CPU and GPS software version information, voltage and temperature measurements together with relay status information.
6 = ECEF Position: this message contains ECEF position and PDOP information.
9 = Standard message

Default value: 0

Example
A TBU shall send raw data at 0.5 Hz, position data each minute and battery voltage once every five minutes.

The configuration would be as follows:

Period = 2	0.5 Hz
Periodic Message Type = 1	Raw Data
Sequence 1 = 30	Once every minute (Period * Sequence 1 = 2 * 30 = 60)
Sequence 1 Message Type = 6	ECEF Position
Sequence 2 = 150	Once every five minutes (Period * Sequence 2 = 2 * 150 = 300)
Sequence 2 Message Type = 5	Status

4.2.13 O, P, Q: Port-1-3 Baud

The baud rate for the serial ports can be selected according to the following table:

0 = 300 baud
1 = 600 baud
2 = 1200 baud
3 = 2400 baud
4 = 4800 baud
5 = 9600 baud
6 = 19200 baud
7 = 38400 baud

Use values in the range 4-6.

Default value: 5

4.2.14 R: Reset

Select between the following reset values:

1 = Reset CPU: the CPU will be reset and the GPS will go through a power off, power on sequence.
2 = Reset GPS receiver only.
3 = Reset GPS memory.

4.2.15 S: Backlight On/Off

Press S to turn HHT backlight on/off.

4.2.16 X: Log Out from HHT

Press X to log out from HHT.

4.3 Pin Configuration

4.3.1 TBU Pin Configuration

Standard HHT connector, Impulse IE.BH-8FS, pin configuration:

TBU Pin no.	Signal	Comments
1	TX	
2	RX	
3	+ 5 V	
4	GND	
5	RTS	Short to CTS
6	CTS	Short to RTS

Pin 7 and 8 are not used.

Standard power connector, AGM-17x4F, pin configuration:

TBU Pin no.	Signal	Comments
1	10 - 32 V DC	
2	TX Port 1	
3	GND	Power and signal ground
4	RX Port 1	

Optional HHT and power connector, Wetcon BH-12 MRX-SS, pin configuration:

TBU Pin no.	Signal	Comments
1	Power GND	Power supply
2	10 - 32 V DC	Power supply
3	Signal GND	
4	TX Port 1	
5	RX Port 1	
6	TX Port 2	
7	RX Port 2	
8	TX Port 3	Used for HHT
9	RX Port 3	Used for HHT
10	5 V DC	Power to HHT
11	Relay 1	
12	Relay 2	

4.4 Use of Seatrack 320 in Combination with Seatrack III

When using Seatrack 320 in combination with Seatrack III [2], the time slot configurations for the Seatrack III and Seatrack 320 units have to be in accordance with each other. While Seatrack 320 divides two seconds into 26 time slots and the time slots are numbered from 0 to 25, Seatrack III divides two seconds into eight time slots and the time slots are numbered from 1 to 8.

The following table gives the connection between the Seatrack III slots and the Seatrack 320 slots:

Seatrack III	Seatrack 320				
1	0	1	2	3	
2	3	4	5	6	
3	6	7	8	9	
4	9	10	11	12	13
5	12	13	14	15	16
6	16	17	18	19	
7	19	20	21	22	
8	22	23	24	25	

When selecting slot number, make sure none of the TBUs or VCUs [1] have the same slot number according to the table.

Example 1
If a Seatrack III buoy is configured to use slot 4, the slots 9 - 13 must not be used for a Seatrack 320 buoy using the same frequency.

Example 2
If Seatrack III buoys use slots 1-4, slots 14-25 can be used for Seatrack 320.

5 TROUBLESHOOTING

This part of the document is written for personnel with operator experience when a situation arises where assistance from service personnel may be required. The aim of this section is to identify the problem so that appropriate action can be taken.

Useful equipment for troubleshooting:
- Multimeter
- RF Powermeter/Communication Tester
- Terminal/PC
- UHF Radio for Listening (e.g. Yaesu FT-50)
- Tools

5.1 Hardware Troubleshooting

5.1.1 No Booting

- Turn the power OFF by removing the power cable. Wait a few seconds before reconnecting the power cable. The power connectors may be hard to mate and disconnect.
- Check that the power supply outputs correct voltage (10-32 V DC).
- If still no booting, contact Seatex.

5.1.2 Communication Problems between TBU and VCU

- Check that the TBU and VCU are correctly configured, see section 4.1 and [1].
- When no communication, there may be a jamming problem from 450 MHz mobile phones because it is transmitting in the same frequency range. When a jamming problem occurs, try to change frequency on the TBU and VCU, see section 4.1 and [1]. It is also important to set the VCU UHF antenna as far away as possible from other transmitting antennas.
- Connect a power meter between the TBU and the UHF antenna and measure the forward RF power. Use the debug **H** command, see section 4.2.8. The effect should be 0.5 W.
- Check the UHF antenna and the antenna cable connection. The connection should be sealed against water penetration.
- Radio transmission will not occur if the GPS receiver loses time synchronisation. Lost transmissions do not always indicate a radio fault. Reset the GPS receiver, see section 5.1.3 below.

5.1.3 No Position Fix/No GPS Data

- Turn the power OFF/ON to restart the GPS receiver by removing the power cable. The power must be OFF for more than five seconds before the unit is re-powered!
- Reset the GPS receiver by pressing the button **R** and select 2 on the terminal, see section 4.2.14. If the TBU has been transported over long distances, this often reduces the time before the first position fix.

5.2 TBU Repair

CAUTION

The TBU is not designed for service in the field. All repairs and modifications of the unit, except for installation of new software versions and setup of the system, have to be done by Seatex. Failed units shall be shipped back to Seatex for repair.

Note When leaving Seatex, the TBU is prepared for use, and filled with nitrogen. The unit must not be disassembled unless nitrogen is available to insert after service.

However, if repair is necessary the below procedure shall be followed:

- All work shall be carried out in a cool, dry atmosphere. The unit shall not be opened until it is fully adjusted to room temperature.
- To dismantle the unit, first remove the hose clamp and all of the screws, which pass through the sides of the case.
- Place a plank of softwood on the floor. Hold the unit vertically and strike the base of the case on the wood. The shock will usually cause the internal assembly to slide downwards, breaking the seal. All the internal components are contained within a screening can.
- Remove the special self-adhesive copper tape from the top and bottom of the canister and pull the electronics out of the canister.
- Repairs should be limited to exchanging modules between a pair of faulty units. It is not possible to repair individual electronic modules.

5.3 Assembling TBU After Repair

- Make sure all connectors are correctly connected.
- Check soldering on power-shielding box.
- Fit shielding canister around the unit.
- Add EMC tape around shielding canister ends.
- Check the four pieces of gasket tape used as shock absorbers at the antenna end.
- Check o-ring.
- Fill with nitrogen before closing the unit.
- Add Loctite on the set screws.
- Check external connectors.

Appendix A - Illustrations

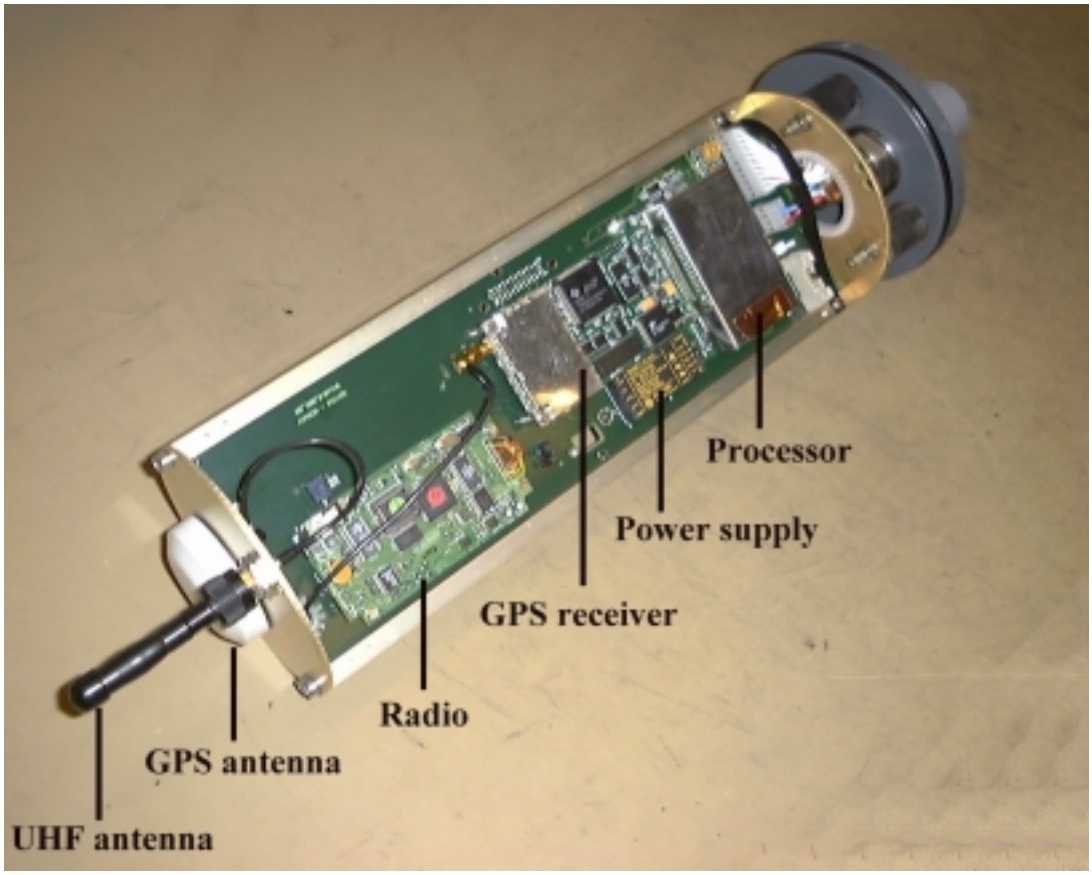

Figure 6 TBU without housing

Appendix B - HHT Configuration

The terminal setup mode is entered by pressing the lower left and lower right keys (**Z** and **ENTER**) while the unit undergoes the power up self-test. While in setup mode, incoming data are ignored.

When The Main Menu is entered, the text "MAIN MENU" will be shown on the top display line and the soft key labels "COM DSP KBD EXIT" will be shown on the bottom line. Switch between the different options be pressing **NXT** or **PRV**. All parameters must be set up as listed in Table 2.

Communication (COM) Setup:	
Baud rate	9600
Parity	NONE
Data, Stop bits	8,1
Display serial errors ?	YES
Aud serial errors ?	NO
Support XON/XOFF ?	NO

Display (DSP) Setup:	
Disp ctl chars ?	NO
Disp esc chars ?	NO
Cursor visible ?	YES
Auto line wrap ?	YES
New line on cr ?	NO
Display self-test ?	YES
Backlight on ?	YES
Backlight strength ?	OPTIONAL

Keyboard (KBD) Setup:	
Local echo ?	NO
Key repeat	SLOW
Audible keys ?	YES
Simplified KB ?	NO
Program function key F1?	< MAIN >
Exit the Main Menu by pressing	< EXIT>.
Save Changes ?	YES
Leave the Setup by pressing	<EXIT>

Table 2 Handheld Terminal Configuration Parameters

Index

V

Reader's Comments

Please help us to improve the quality of our documentation by returning your comments on this manual.

Your information on any inaccuracies or omissions (with page reference):

Please see next page

Your suggestions for improvements:

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