Beacon-on-a-Belt
Receiver Manual

Trimble™

Beacon-on-a-Belt (BoB)

Receiver Manual

Trimble™

Version 1.0
Part Number 38602-00-ENG
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About This Manual

Welcome to the *Beacon-on-a-Belt (BoB) Receiver Manual*. This manual describes how to install, set up, and use the Trimble Beacon-on-a-Belt (BoB) receiver.

Even if you have used other Global Positioning System (GPS) products before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product.

If you are not familiar with GPS or DGPS, visit our web site for an interactive look at Trimble and GPS at:

- www.trimble.com

The following sections provide you with a guide to this manual, as well as to other documentation that you may have received with this product.

Related Information

Other sources of related information are:

- Release notes – the release notes describe new features of the product, information not included in the manuals, and any changes to the manuals.
- Update notes – there is a warranty activation sheet with this product. Send it in to automatically receive update notes containing important information about software and hardware changes. Contact your local Trimble Dealer for more information about the support agreement contracts for software and firmware, and an extended warranty program for hardware.
- ftp.trimble.com – use the Trimble FTP site to send files or to receive files such as software patches, utilities, service bulletins, and FAQs. Alternatively, access the FTP site from the Trimble web site at www.trimble.com/support/support.htm.
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Document Conventions

The document conventions are as follows:

Convention	Definition
Italics	Identifies software menus, menu commands, dialog boxes, and the dialog box fields.
Helvetica Narrow	Represents messages printed on the screen.
Helvetica Bold	Identifies a software command button, or represents information that you must type in a software screen or window.
'Select *Italics* / *Italics*'	Identifies the sequence of menus, commands, or dialog boxes that you must choose in order to reach a given screen.
[Ctrl]	Is an example of a hardware function key that you must press on a personal computer (PC). If you must press more than one of these at the same time, this is represented by a plus sign, for example, [Ctrl]+[C].
(ENTER)	Is an example of a hardware key (hard key) that you must press on the GeoExplorer 3 keypad.
(A)	Is an example of a hardware key (hard key) that you must press on the Beacon-on-a-Belt receiver.

CHAPTER

1

Introduction

In this chapter:

- Introduction
- Standard BoB Receiver Features
- Trimble Mapping Systems
- Communication Options

Introduction

The Beacon-on-a-Belt (BoB) receiver is a belt-mounted Minimum Shift-Keying (MSK) beacon receiver for tracking broadcasts from Differential GPS (DGPS) radiobeacons that conform to the International Association of Lighthouse Authorities (IALA) standard.

Standard BoB Receiver Features

The BoB receiver uses advanced digital-signal processing techniques to track and demodulate signals from DGPS radiobeacons. The radiobeacons operate in the Medium Frequency (MF) band from 283.5 to 325 kHz.

The BoB receiver is CE Mark compliant and provides the following features:

- Dual-channel MSK beacon receiver and combined antenna capable of tracking DGPS radiobeacon signals operating in the Medium Frequency (MF) band from 283.5 to 325 kHz
- Two operating modes: Best and Fixed
- Fast acquisition of differential beacon signals
- Immunity to MSK jamming signals
- Advanced techniques for combatting atmospheric noise in the beacon receiver
- Almanac monitoring to accelerate switching between beacon signals
- PC-BoB configuration and diagnostics software
- User-upgradeable receiver firmware

Trimble Mapping Systems

The BoB receiver operates with the following Trimble Mapping Systems designed for effective geographic data acquisition:

- GeoExplorer® 3 Mapping System
- Geo*Explorer* II Receiver
- GPS Pathfinder® Pro XL Receiver System

Teamed with any of these, it offers unsurpassed flexibility when choosing a source for real-time differential corrections.

With a combined receiver and antenna, the BoB receiver is all you need for the flexibility of receiving MSK beacon differential corrections. It is Trimble’s most versatile MSK beacon system.

Communication Options

The BoB receiver combines the high performance dual-channel MSK beacon receiver and a beacon antenna into a single unit. This is packaged in a light-weight, durable, weatherproof housing that fits neatly into a belt mounted pouch. It is available in two communication options:

- Cable-free
- Cable-only

Cable-Free

The BoB receiver communicates to the GeoExplorer 3 data collector through a one-way radio link. This operates in the license-free (North America) band at 916 MHz. The radio link is designed to operate to a range of 10 ft. (3 m), although operation up to 50 ft. (15 m) is possible in some environments.

Cable-Only

You require a null modem cable (part number 18532) to connect the BoB receiver to the data collector in areas where the one-way radio link (916 MHz) is not license-free, or if you are using the Pathfinder Pro XL Receiver System or the Geo*Explorer* II receiver.

The port settings for cabled communication with the BoB receiver are:

Baud	2400
Data Bits	8
Stop Bits	1
Parity	N

CHAPTER

2

Understanding Differential GPS

In this chapter:

- Introduction
- Differential GPS Navigation Components
- Advanced DGPS System Components
- Real-Time DGPS
- Sources of DGPS Error
- Postprocessed Real-Time (PPRT)
- Worldwide DGPS Beacon Coverage
- Signal Processing

Introduction

Differential GPS (DGPS) is the most accurate form of GPS navigation and data collection. It corrects the effects of errors caused by the ionosphere, troposphere, and other GPS system errors. For more information, see Sources of DGPS Error, page 26.

This form of GPS positioning requires a source of DGPS corrections and a communication link for delivering these corrections to compatible DGPS receivers. The International Association of Lighthouse Authorities (IALA) has established a standard for modulating DGPS corrections in the RTCM SC-104 format on marine radio beacon broadcasts using Minimum Shift-Keying (MSK) modulation.

The differential radio beacons are a subset of the large number of existing marine radio beacons, which operate in the 283.5 to 325 kHz band. The BoB receiver is a radio beacon receiver that tracks and decodes differential beacon broadcasts conforming to the IALA standard. It outputs the DGPS corrections in the RTCM SC-104 format through a cable-free link, or using a cable, to the connected data collector.

This chapter provides a brief overview of DGPS navigation and an introduction to the advanced operating characteristics of the BoB receiver.

Differential GPS Navigation Components

Real-time DGPS beacons require three components for a complete system:

- Base station
- Transmitter
- Rover

The components are shown in Figure 2.1 and described in the following sections.

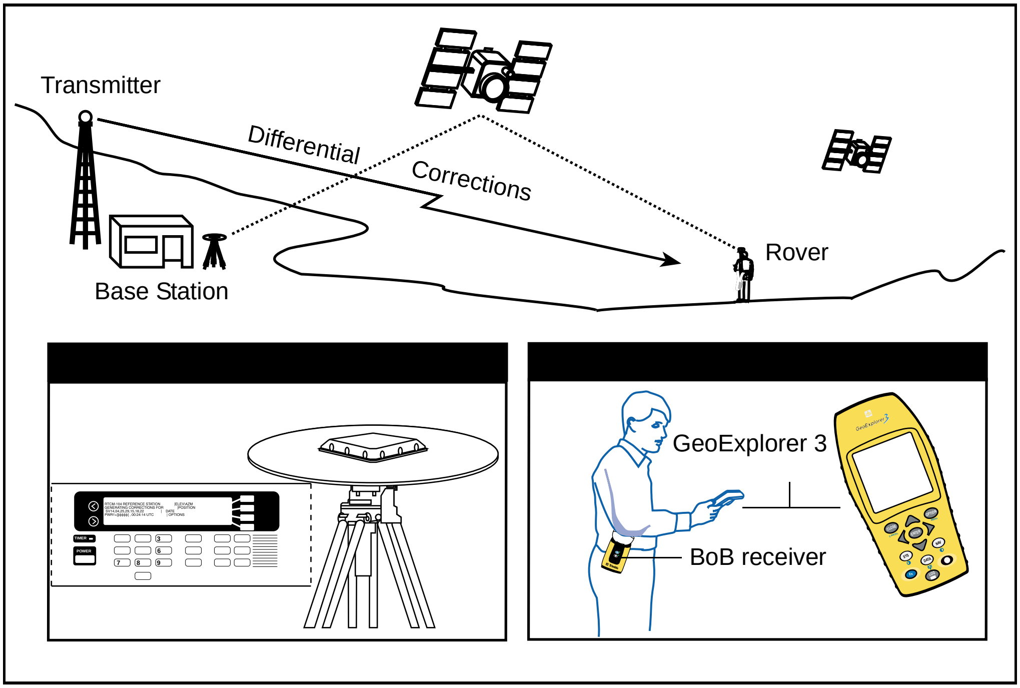


Figure 2.1 Components of a DGPS System

Base Station

DGPS relies on GPS error corrections calculated by a base station placed at a precisely known location. These corrections are based on the differences between the actual and observed ranges to the tracked satellites, and are known as the pseudorange corrections (PRC).

Transmitter

For marine navigation, the IALA established a standard for broadcasting DGPS corrections over existing marine radio beacons. The GPS error corrections from the base station are modulated on the radio beacon broadcast using Minimum Shift Keying (MSK) modulation.

Note – *Only a subset of all marine radio beacons are DGPS base stations. Check with your local IALA authority to determine DGPS coverage in your area.*

Rover

The rover comprises two receivers linked together:

- a DGPS beacon receiver
- a mobile GPS receiver

The DGPS beacon receiver (such as the BoB receiver) receives signals from the base station and communicates these signals to the other receiver (the mobile GPS receiver, such as the GeoExplorer 3 data collector).

DGPS beacon receiver

The BoB receiver is a DGPS beacon receiver that tracks and demodulates the DGPS broadcasts from differential beacons conforming to the IALA standard. It outputs the GPS corrections in the industry standard RTCM SC-104 format. RTCM SC-104 is accepted by most differential-capable mobile GPS receivers.

Mobile GPS receiver

The mobile GPS receiver applies the DGPS corrections output from the DGPS beacon receiver to achieve accurate position and velocity measurements. The level of accuracy depends on the mobile GPS receiver and the measurement methodology used. Trimble offers several mobile GPS receivers with DGPS capability, such as the GeoExplorer 3 data collector.

Error sources common to both base and roving receivers can include the ionosphere and troposphere.

***Note –** As you increase the distance between the base station and the rover, you decrease your ability to reduce these errors.*

Advanced DGPS System Components

In addition to the three components discussed in Differential GPS Navigation Components, page 18, a DGPS service may have the following advanced components as an integral part of the DGPS system it operates:

- Integrity monitor
- Control Station

The following sections describe each component.

Integrity Monitor

An integrity monitor is a precisely located GPS receiver and MSK beacon receiver that applies differential corrections. The differentially corrected position is compared to its known location to determine if the corrections broadcast from the base station are within a preset tolerance.

Control Station

Some DGPS services maintain centralized control sites to administer the DGPS system components.

Real-Time DGPS

In real-time DGPS the base station calculates and broadcasts through radio signals the correction for each satellite as it receives the data. This correction is received by the rover and applied to the position it is calculating. As a result, the position displayed by the controlling software and logged to the data file is a differentially corrected position.

You must maintain signal contact with the base station. If you lose contact, the rover stops computing positions or computes positions with non-DGPS accuracy. The action the receiver takes depends on the positioning mode, configured in the controlling software.

You can always collect base data for postprocessing, even if you are using the BoB receiver for real-time differential operation.

Then, back in the office, you can:

- differentially correct positions not corrected in the field using real-time differential operation
- reprocess positions that were differentially corrected in real-time to improve their accuracy.

Frequency of Message Output

The frequency, or rate, at which the RTCM differential correction messages are output from the base station affects the accuracy of the GPS positions recorded by the rover.

The longer it takes for up-to-date information to get from the base station to the rovers, the less accurate the information is.

This period of delay, known as latency, can be caused by several factors. The following sections describe these factors.

Transmission rate

The rate at which the RTCM message is output from the transmitting station affects the accuracy of real-time DGPS positions. Rovers receive corrections from transmitters outputting at 9600 baud faster than from transmitters outputting at 50 baud.

Number of RTCM messages

The number of RTCM messages generated by the base station in each transmission and received by the rover GPS receiver has an effect on the latency of the correction. Rover receivers collecting transmissions from stations outputting only one or two messages experience lower latencies than from stations outputting five or six messages.

Base station correction output rate

The rate at which the base stations generate corrections to be output is the most important factor determining the accuracy of positions collected at the rover. Most base stations generate corrections every 5 seconds. However, some generate corrections only every 20 or 30 seconds.

Between RTCM correction messages, the GPS receiver has to extrapolate the corrections from the most recent RTCM message. The longer the receiver has to extrapolate before getting new correction information, the greater the GPS position error.

RTCM Message Types

Real-time DGPS requires that a Type 1 or several Type 9 messages are received by the rover to provide a DGPS solution. These messages are similar in content, but depending on the rate of output and the strength of the signals output from the base station, can affect the accuracy of positions recorded by the rover. The following sections describe each message.

RTCM Type 1 message

The RTCM Type 1 message is the primary message type that provides the pseudorange and range rate corrections for any DGPS-capable receiver. Type 1 messages contain every correction for each of the satellites in view by the base station. If the base station is tracking nine satellites, each Type 1 message contains nine pseudorange corrections and nine range rate corrections. The length of the message depends on the number of satellites tracked by the base station.

RTCM Type 9 message

The RTCM Type 9 message serves the same purpose as the Type 1 message. It contains the differential corrections. However, unlike Type 1 messages, Type 9 messages do not require a complete satellite set to be transmitted at once. Type 9 messages group corrections together in smaller groups until all the corrections are sent by different Type 9 messages. Also, corrections from partial Type 9 messages can be applied as soon as they are received. This further reduces the effects of message latency.

Example

Suppose a base station, tracking 8 satellites, sends out the corrections in three separate messages:

- the first two messages contain the pseudorange information for 3 satellites
- the third message contains information for 2 satellites.

With Type 1 messages, the receiver has to wait until it receives the information for all satellites before it can correct a particular position (greater latency).

With Type 9 messages, the receiver can use the information as soon as the first packet arrives (less latency).

For a detailed explanation of all RTCM SC104 messages, refer to the RTCM paper 15-96/SC104-139.

RTCM Type 59 message

The RTCM Type 59 message communicates proprietary information. The BoB receiver uses Type 59 messages to transmit proprietary status information to the GeoExplorer 3 data collector. For further information about the Type 59 message, refer to the Help within the PC-BoB software.

Accuracy of the Beacon Base Station Position

If you determined the position of the beacon base station with approximate coordinates, the corrections transmitted by the base station will reflect this. The positions recorded by the rover are offset by that amount.

To determine the accuracy of your local DGPS base station coordinates, contact your provider.

Datum of Corrections

Errors can occur if the beacon base station uses a datum other than the RTCM SC-104 standard (WGS-84) as the basis for the DGPS corrections. The error introduced by using a beacon that transmits coordinates using a different datum are generally quite small. However, in some places the margin of error can be 5–10 m. You can only set the controlling software to collect postprocessable real-time data.

Sources of DGPS Error

Pseudorange errors can come from several sources. Some errors, such as satellite clock errors, are common to both the base station and the rover receivers. These errors can be reduced using differential corrections. Errors that are not common to both the base station and rover receivers include multipath and receiver noise. These errors cannot be removed using differential corrections.

Each satellite broadcasts orbital and satellite clock data based on predicted behavior. If the orbit of a satellite does not behave as predicted, an error in the pseudorange results. The commonality of the orbital error between two receivers depends on the distance between the receivers and the direction of the orbital error. Because GPS satellites orbit at high altitude, pseudorange errors caused by orbital prediction errors are nearly identical between two receivers within 100 km of each other. These errors can be removed using DGPS, however, at greater distances between receivers, orbital errors become noticeably different for each receiver, and so become more difficult to resolve with differential correction.

The atmosphere also affects GPS satellite signals. Most good GPS receivers apply an approximate correction factor (except in the DGPS mode) to offset the atmospheric effects, but the correction factor cannot always account for all of the error.

Other sources of pseudorange error include ionospheric delay, tropospheric delay, multipath, and receiver noise. DGPS removes most of the errors due to ionospheric and tropospheric delay as long as the distance between the base station receiver and rover is not too large.

Postprocessed Real-Time (PPRT)

If you have access to a base station that logs data for postprocessing, you can use the BoB receiver and GeoExplorer 3 data collector to log additional data so that GPS positions corrected in real-time can be postprocessed in the office.

Postprocessing RTCM-corrected GPS positions is worthwhile if the beacon you are using is a considerable distance from where you collected the data (and your postprocessing base station is nearer), or if the beacon is inaccurate for reasons such as those listed under Real-Time DGPS, page 22.

A typical application can use free real-time services (such as the U.S. Coast Guard DGPS Service) to get typical accuracies of 1–10 m in real-time, depending on your receiver. By logging PPRT, you can postprocess your data in the office to get better accuracy.

Worldwide DGPS Beacon Coverage

For an up-to-date list of beacon stations around the world:

- Refer to the Trimble web page:
  - trimble.com/gis/beacon/
- Contact your authorized Trimble Dealer.

Signal Processing

The BoB receiver MSK signal processing occurs in four stages:

- MSK pre-filtering
- MSK analog-to-digital conversion
- MSK digital signal processing
- MSK I/O processing

The following sections describe each stage.

MSK Pre-filtering

The MSK pre-filter rejects additional interference in the MF signal picked up by the antenna cable or not attenuated by the pre-amp filter.

MSK Analog-to-Digital Conversion

The analog MF signals are converted into digital signals for the digital signal processing stage. Unlike most other receivers, the MSK receiver uses a wide-band conversion. This technique improves acquisition performance by letting a broader range of beacon signals pass to the signal processing stage for evaluation.

MSK Digital Signal Processing

Controlled by proprietary processing algorithms, the MSK digital signal processor (DSP) does the following actions:

- digitally filters the wide-band sample
- selects the best beacon signal
- passes the selected signal through a matched filter to the I/O processor.

The DSP also measures signal level, noise level, and frequency offset.

During the signal acquisition process, the DSP uses a 128-point Fast Fourier Transform (FFT) algorithm for checking the spectral content of the digitized signal. The station selection algorithm orders the beacon signals by relative strength.

By filtering and squaring the signals before the FFT stage, the DSP determines the MSK modulation rate and the transmitter versus receiver frequency offset for a particular beacon.

This signal-processing technique permits rapid acquisition of the most powerful MSK signal and automatic identification of the modulation rate.

In tracking mode, the DSP rejects out-of-channel interference by selectively filtering the desired MSK signal. This technique lets the MSK receiver track a weak differential beacon when there are much stronger signals from other radiobeacons.

The DSP applies dual, low-noise, second order phase-locked loops for tracking the MSK carrier and symbol phases.

The DSP coherently demodulates the MSK signal using a MSK matched filter. The matched filter offers optimal performance in a Gaussian noise environment. In addition, the DSP employs a proprietary noise cancellation technique for combating impulse noise.

MSK I/O Processing

The MSK I/O processor monitors the integrity of the data signal from the DSP, formats the RTCM SC-104 data messages, and outputs the data.

CHAPTER

3

Basics of Operation

In this chapter:

- Introduction
- The BoB Receiver Front Panel
- Operating the BoB Receiver
- Button Control
- Dual Press Button Control
- Displaying and Changing the BoB Receiver Configuration
- Receiving Data from a Data Collector
- The BoB Receiver Cabling
- BoB Pouch
- Optional External Power Kit

Introduction

This chapter explains how to use the Beacon-on-a-Belt (BoB) receiver. It also provides details about the equipment associated with the BoB receiver.

The BoB Receiver Front Panel

The four operating controls on the front panel of the BoB receiver are:

- Power button (⏻)
- Beacon button (⌂)
- Power LED (dual-color light emitting diode)
- Beacon status LED (dual-color light emitting diode)

Figure 3.1 shows the layout of the panel.

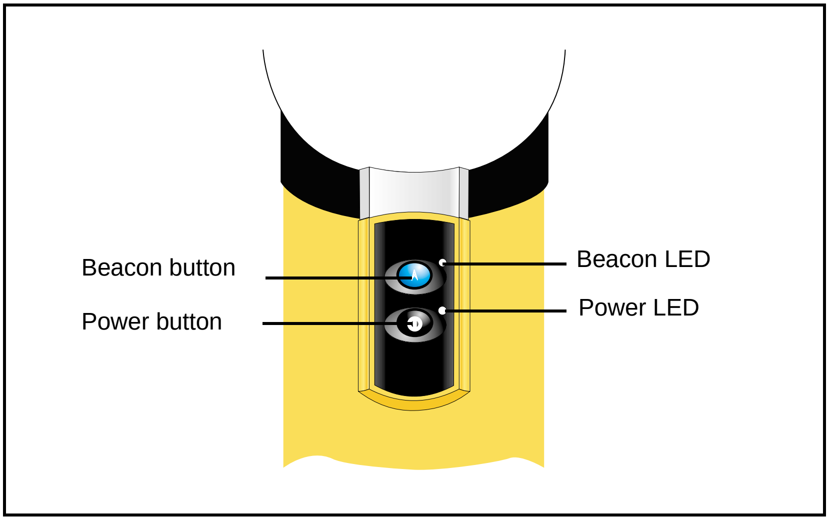


Figure 3.1 Front Panel Layout

From this panel you can:

- power up and down the BoB receiver
- switch between Best and Fixed modes
- reset the receiver to its defaults
- scan through:
  - your list of frequencies
  - the range of beacon transmissions currently available

You can also see:

- if the BoB receiver is switched on or off
- if the battery level is low
- the beacon tracking status

Operating the BoB Receiver

The BoB receiver tracks frequencies using either Best or Fixed mode. From the PC-BoB software, you configure and control the list of frequencies that can be tracked, and the startup mode.

Tip – Typically, you have either a very short list of frequencies to include (that is, one to five stations) or a very long list of frequencies to include (that is, you exclude only one or two dominant stations). With a short list, you can operate in either Best mode or Fixed mode. With a very long list, use Best mode.

Best Mode

Operating in Best mode lets the BoB receiver track the best signal it can find. It determines the best signal from one of the following:

- the distance to the beacon
- the power of the signal from the beacon

If you specify a filter, the BoB receiver is limited to searching for the best beacon from the list of included frequencies. It also continually tracks for the second best signal, so if the best signal is lost or degrades, it can switch to the secondary signal in a seamless manner.

With a position and beacon almanac

When the BoB receiver has a position and has received a Type 7 beacon almanac message, the best mode operates by tracking the closest beacon.

To send a position to the BoB receiver when it is connected to a GeoExplorer 3 via the wireless link, or is cabled to another Trimble GPS receiver use the PC-BoB Office software.

The PC-BoB software lets you send an initial position (which BoB uses along with the beacon almanac) to calculate which beacon is the closest. If the BoB receiver is connected to a GeoExplorer 3 via a cabled link then it receives an updated position automatically every 60 seconds.

The BoB receiver will switch to track the next closest beacon if the signal on the primary channel:

- has a very low signal-to-noise ratio (SNR)
- has more than 10 percent parity errors and contains no valid RTCM message greater than 15 seconds
- has no valid corrections (Type 1 or Type 9 messages) for more than 60 seconds
- becomes unhealthy (when you specify healthy stations only)

Without a position or beacon almanac

When the BoB receiver does not have a position or a beacon almanac, the best mode operates by tracking the beacon with the strongest signal.

When it first starts up, the BoB receiver conducts a wide band fast fourier transform (WBFFT) scan. This is a scan of all beacon frequencies from which the strongest beacon signal is determined. The primary channel locks onto the best frequency, while the second channel continues to search for the next best signal.

The BoB receiver switches to track the next strongest beacon if the signal on the primary channel:

- has a very low SNR
- has more than 10 percent parity errors and contains no valid RTCM message for greater than 15 seconds
- has no valid corrections (Type 1 or Type 9 messages) for more than 60 seconds
- becomes unhealthy (when you specify healthy stations only)

Fixed Mode

When operating in Fixed mode, the BoB receiver locks onto a particular frequency until you do one of the following:

- A short press of the button. The BoB receiver stays in Fixed mode and moves to the next frequency in the list.
- A long press of the button. The BoB receiver changes to Best mode.
- A very long press of both buttons. The BoB receiver returns to the default settings.

***Note –** You can always go from Best to Fixed mode with a short press of the button. The BoB receiver then continues tracking the frequency that is being tracked in Best mode.*

When the BoB receiver starts up in Fixed mode, it begins to search the initial frequency defined by the PC-BoB software. A short press of the button tracks a new frequency based on the following rules:

- If the list of Included beacons contains less than 42 frequencies, a short press moves the BoB receiver to the next frequency in the list (sorted numerically) regardless of the presence or quality of a signal at that frequency.
- If the list of Included beacons contains 42 or more frequencies (or no list is provided, which means that all frequencies are enabled) then the second channel tracks the next frequency in the list for which a signal can be detected.

Default Operation

The BoB receiver default operation is Best mode with all frequencies enabled.

To change this default, do one of the following:

- Select a list of frequencies and a startup mode using the PC-BoB software and transfer this information to the BoB receiver. For more information, see the PC-BoB Help.
- Control the BoB receiver using the button.

To restore the default settings:

- Press both buttons together for 5 seconds.

  This operation resets the configuration of the BoB receiver, including clearing any configuration you may have transferred from the PC-BoB software. It also clears the current almanac.

RTCM Message Support

All RTCM messages are passed to the destination device (for example, the GeoExplorer 3 data collector). The destination device filters out all of the unnecessary messages.

Note – *Many GPS devices use only the Type 1 or Type 9 RTCM messages for real-time differential correction. Other RTCM messages contain beacon status information. Type 59 messages (BoB receiver proprietary messages) are used by the GeoExplorer 3 data collector to display important beacon signal status information.*

Integrity Monitoring

In both Best and Fixed operating modes, the BoB receiver continuously monitors the integrity of the RTCM data it receives from the differential radiobeacon. If the BoB receiver detects more than 10 percent of parity errors in the data stream, the MSK receiver automatically switches to a different radiobeacon (provided the BoB receiver is operating in Best mode) where a different radiobeacon is available. In Fixed mode, the BoB receiver does not output messages with parity errors, but the receiver stays locked onto that station.

Status Indication

The two light emitting diodes (LEDs) on the front panel show the operating status of the BoB receiver. Table 3.1 describes the Power LED, and Table 3.2 the Beacon LED.

Table 3.1 Power LED Operational Status

Color	Off	On	Blinking	Strobe Flash
Green (internal power)	Unit is switched ***off***	Unit is ***on*** and battery is not low	Unit is ***on*** and battery low (less than 10% energy remaining)	N/A
Orange (external power)	Unit is switched ***off***	Unit is ***on*** and is fully charged	Unit is ***on*** and charging	Unit is ***off*** and charging

Table 3.2 Beacon LED Operational Status

Color	Off	On	Blinking
Green (Best Mode)	Failure (if power LED is ***on*** or flashing)	Locked onto signal and with good RTCM data being sent to the GPS receiver	Unit is either searching the frequency band, or is tracking a signal, but not using the signal
Orange (Fixed Mode)	Failure (if power LED is ***on*** or flashing)	Locked onto signal and with good RTCM data being sent to the GPS receiver	Unit is either searching the frequency band, or is tracking a signal, but not using the signal

Table 3.3 shows the events indicated by the LEDs flashing.

Table 3.3 Events Indicated by Flashing LEDs

Event	LED
Cable-free enabled	Beacon LED flashes green at 4 Hz for one second
Cable-free disabled	Beacon LED flashes orange at 4 Hz for one second
Reset to Factory Defaults initiated	Both LEDs flash green at 2 Hz for two seconds

Button Control

There are two buttons on the BoB receiver:

- Power
- Beacon

These are described in the following sections.

Power Button

Table 3.4 describes the function when you press the button.

Table 3.4 Power Button Functions

Length of press	Description
Short (less than 0.25 second)	A short press switches the BoB receiver ***on***. If the BoB receiver is already on, no operation occurs.
Long (1 second)	A long press switches the BoB receiver ***off***. If the BoB receiver is already off, this operation switches the BoB receiver on.

Beacon Button

Table 3.5 describes the functions when you press the button.

Table 3.5 Beacon Button Functions

Length of press	Description
Short (less than 0.25 seconds)	In Best mode, a short press switches the BoB receiver to Fixed mode and locks the frequency to the frequency currently being tracked. Each subsequent short press moves the BoB receiver to the next frequency in the list of enabled frequencies.
Long (1 second)	A long press switches the operating mode of the BoB receiver from Fixed to Best and selects the current best frequency. If the BoB receiver is already operating in Best mode, it switches the BoB receiver to Fixed mode and locks the frequency to the frequency currently being tracked.
Very long (10 seconds)	A very long press toggles the cable-free transmission ***on*** or ***off***. You can also do this from the PC-BoB software.

Dual Press Button Control

To reset the BoB receiver to factory defaults, press both buttons simultaneously for 5 seconds. All station filters are removed, as is the initial position if one has been sent. The beacon almanac is also cleared.

Displaying and Changing the BoB Receiver Configuration

To display and change the current BoB receiver configuration, run the PC-BoB software.

The PC-BoB software provides all the functionality you need to configure the BoB receiver for use with Trimble mapping receivers. For more information about the PC-BoB software, see Chapter 4, The PC-BoB Software.

Receiving Data from a Data Collector

When operating cable-free, it is not possible to transmit data from the GeoExplorer 3 to the BoB receiver.

When operating with a cable, the BoB receiver accepts GPS position and time information from a data collector (such as GeoExplorer 3 data collector) in the form of the NMEA-GGA message. This is to update the initial position and assist in determining the nearest beacon reference station.

The BoB Receiver Cabling

The BoB receiver communicates with the GeoExplorer 3 data collector using a cable-free communications link, or a cable connection, as shown in Figure 3.2.

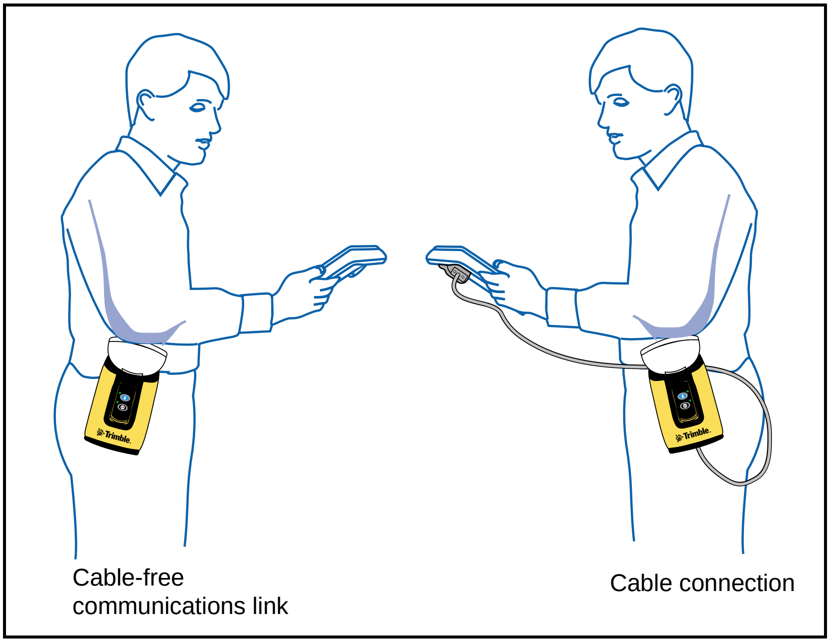


Figure 3.2 BoB Receiver Cabling

BoB Pouch

The BoB receiver comes equipped with an ergonomic pouch, shown in Figure 3.3. It carries the BoB receiver and Quick Reference Card in the field.

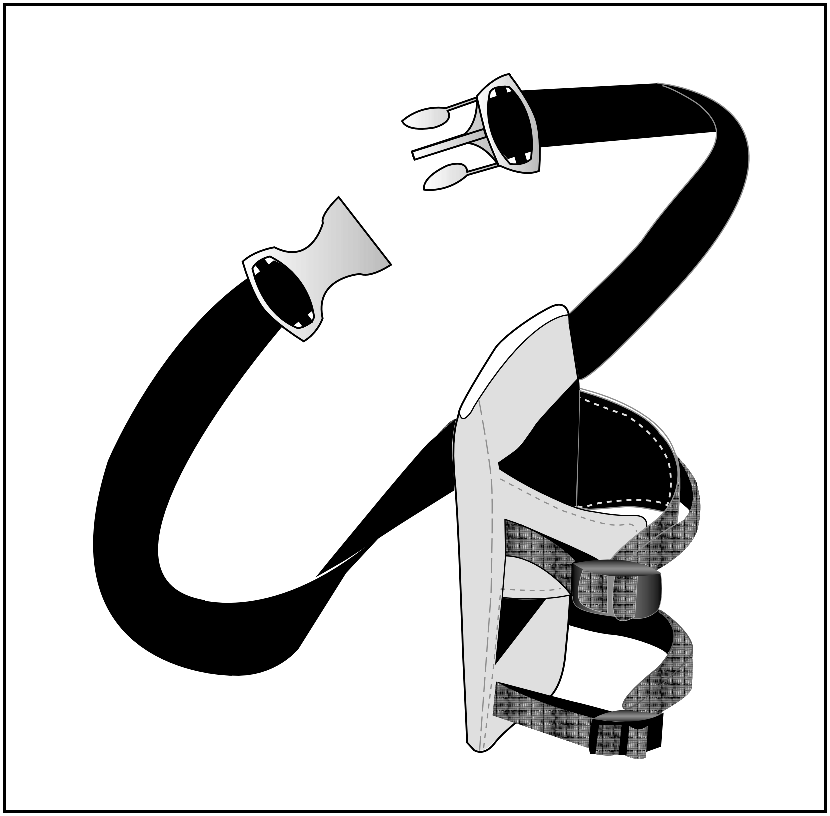


Figure 3.3 BoB Pouch

Optional External Power Kit

The standard BoB receiver system comes with a factory-installed, lithium-ion battery. Fully charged, this provides power to the BoB receiver for up to 10 hours.

If you need longer battery life, purchase the external power kit. This lets you power the BoB receiver from a rechargeable 12 volt camcorder battery or from a vehicle.

The external power kit includes:

- a shoulder carrying pouch
- a 12 volt camcorder battery and charging cable
- a vehicle power adapter

CHAPTER

4

The PC-BoB Software

In this chapter:

- Introduction
- Installing the PC-BoB software
- Running the PC-BoB Software
- Menu Summary

Introduction

This chapter describes the PC-BoB software used to configure the BoB receiver.

With the PC-BoB software you can:

- configure:
  - a single frequency for the BoB receiver to track
  - a set of discrete frequencies for the BoB receiver to track in the form of an inclusion/exclusion filter list
  - the BoB receiver to track monitored or unmonitored, healthy or unhealthy beacon signals
- display:
  - the channel tracking status
  - a count of individual RTCM messages
  - the time the last RTCM message was received
  - FFT diagnostics
  - status information on the BoB receiver and the PC-BoB software
  - the power status of the BoB receiver
- send an initial position to allow the BoB receiver to determine the distance to the beacon stations (latitude and longitude in the WGS-84 datum only)
- list the stations identified in the BoB receiver's internal database and display distance and range details
- reset the BoB receiver to factory defaults
- enable the cable-free link when connected to the BoB receiver (unless the cable-free link is physically disabled)
- log a text file with diagnostic information (RTCM output stream)

For more information, refer to the Help within the PC-BoB software.

Installing the PC-BoB software

The PC-BoB software version v1.00 is distributed on CD-ROM.

To install the PC-BoB v1.00 software:

1. Insert the PC-BoB CD into the CD-ROM drive.

   The Setup program should start automatically. If it does not, select Start / Run, to display the Windows Run dialog, and type **d:\Setup.exe** in the *Open* field (where d: is the letter of your CD drive).

2. Follow the PC-BoB Installshield wizard instructions to install the PC-BoB software.

   The following languages are available for installation: English; Spanish; or Portuguese.

3. Select your desired language from the *Choose Setup Language* dialog.

   The *Software License Agreement* dialog appears.

4. If you accept the terms of the license agreement, click **Yes**.

   You must accept the terms of the license agreement to install the PC-BoB software.

The PC-BoB software is compatible with Microsoft Windows 95, 98, 2000, WindowsME, and Windows NT 4.0 (service pack 4 or greater). The PC-BoB software does not support Windows 3.1, or Windows NT version 3.51.

You must be logged on with administrator privileges when installing under Windows NT or Windows 2000, otherwise, system files and registry entries cannot be properly installed.

Running the PC-BoB Software

To run the PC-BoB v1.00 software from the Start menu select Start/Programs/PC-BoB/PC-BoB.

Alternatively, double-click on the PC-BoB desktop icon. By default, the PC-BoB software attempts to autoconnect to the BoB receiver.

Menu Summary

The PC-BoB software has four menus:

These menus are summarized in the following sections. For more information, refer to the Help within the PC-BoB software.

Comms Menu

Use the Comms menu to:

- connect or disconnect the BoB receiver
- select communication parameters for the PC
- reset the BoB receiver to factory defaults
- exit the PC-BoB software

Beacon Menu

Use the Beacon menu to:

- configure the station filter and initial position of the BoB receiver
- view status information of the BoB receiver and RTCM messages
- diagnose signal interference problems that can occur

Window Menu

Use the Window menu to:

- manage the display of windows on the PC-BoB desktop
- list currently open windows or dialogs

Help Menu

The Help menu provides information on the:

- PC-BoB software commands
- Trimble website

APPENDIX

A

Upgrading Firmware

In this appendix:

- Introduction
- Equipment Required for Installation
- Upgrading the Firmware

Introduction

This appendix provides instructions for connecting the BoB receiver to an office computer and upgrading the firmware.

Equipment Required for Installation

For the upgrades and installation to proceed, the WinFlash™ software (used to install the BoB receiver firmware) must be installed on your office computer. It is available, along with the BoB receiver firmware, from the World Wide Web (www.trimble.com). If you do not have access to the World Wide Web, contact your local Trimble dealer to receive the BoB receiver installation disks.

To use the WinFlash software with the BoB receiver you need the following equipment:

- an IBM-compatible personal computer running Windows 95, Windows 98, or Windows NT, with at least one available serial RS232 port and at least 10 MB of free hard disk space
- your BoB receiver
- null modem cable, part number 43377
- BoB power supply, part number 39180
- a 9-pin to 25-pin converter (this is only required if your computer has a 25-pin serial port connector on its COM1 or COM2 ports)
- CD-ROM drive (if you do not have access to the World Wide Web)

Warning – You must have all of the equipment listed above ***before*** you start to install the firmware. ***Do not*** substitute other equipment. By using the recommended equipment and following these instructions you can quickly and reliably perform the process. If you use inappropriate equipment, or do not follow these instructions, you may be unable to install the firmware successfully. Also, you may lose the current firmware in your BoB receiver. You will then need to return your BoB receiver to Trimble for servicing.

Upgrading the Firmware

To upgrade the firmware of the BoB receiver ensure you have the equipment listed in Equipment Required for Installation, page 52, then do the following:

1. Connect external power to the BoB receiver with the BoB receiver power supply (P/N 39180) and turn the BoB receiver on.
2. Connect the BoB receiver to the COM1 or COM2 serial port of the office computer using the supplied null modem cable (part number 43377).

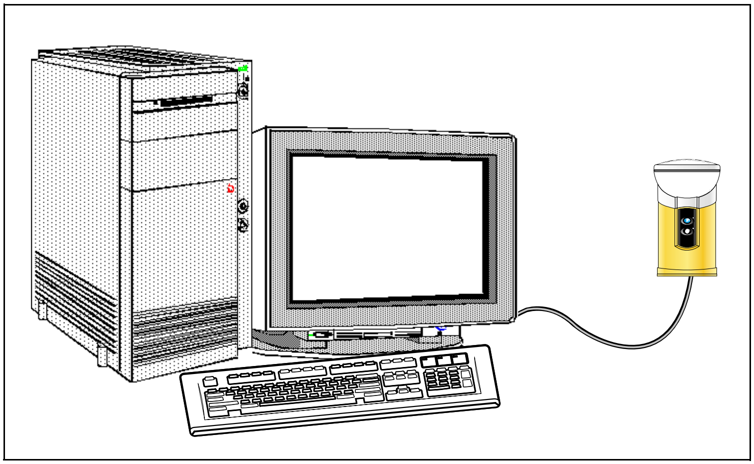
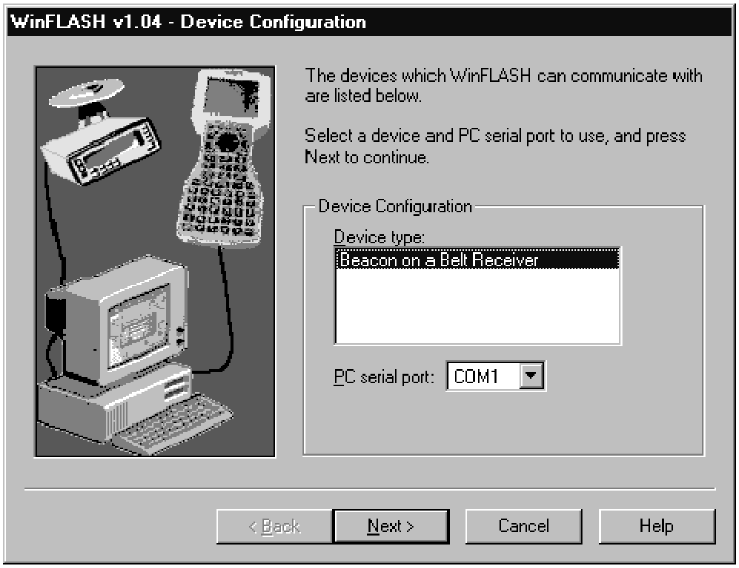


Figure A.1 Upgrading the firmware of the BoB Receiver

3. Switch on the office computer (if it is not already on).

   For the firmware installation to proceed, the WinFlash software (used to install the BoB receiver firmware) must be installed onto your office computer, along with the BoB receiver firmware you want to install. The WinFlash program and BoB firmware can be installed from the World Wide Web or from the installation CD (if you do not have Internet access).

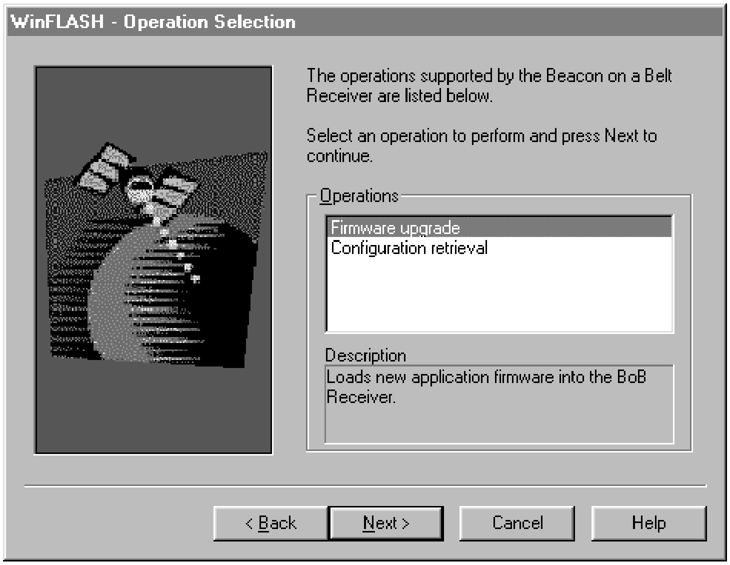
4. Start the WinFlash software. To do this, from the Windows Start menu, select *Programs* / *WinFlash*.



5. Select the BoB receiver as the device type and specify the office computer serial port to which your BoB receiver is connected.

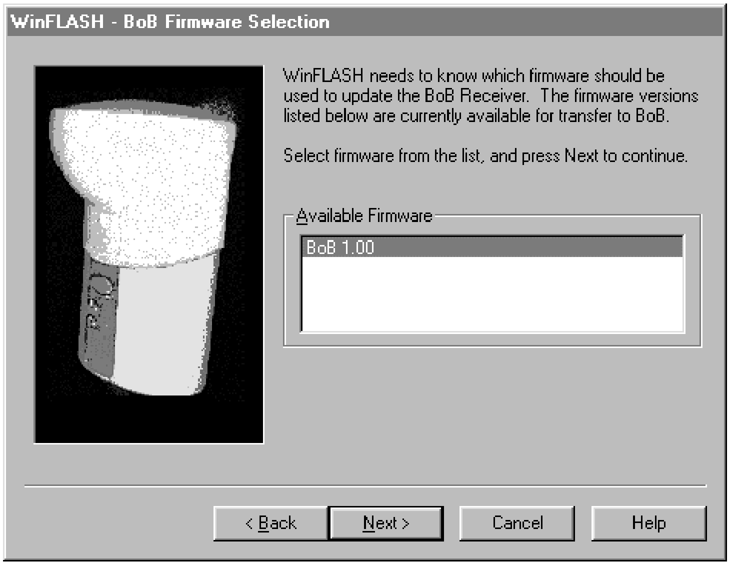
6. Click **Next**.

   The *Operation Selection* dialog appears:



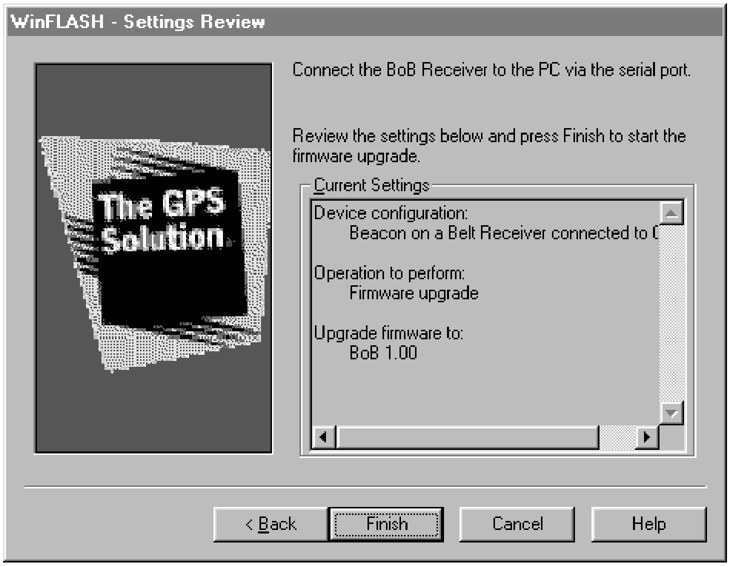
7. Select the firmware upgrade option and click **Next**.

The BoB receiver firmware *Selection* dialog appears, similar to the following:



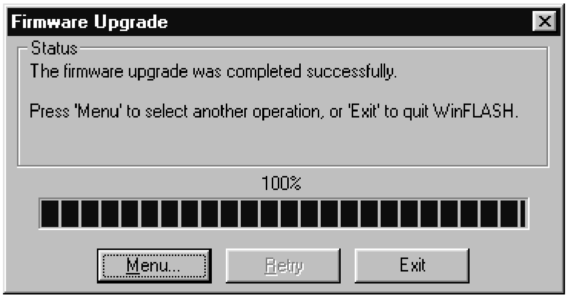
8. Select the BoB receiver firmware version that you want to install and click **Next**.

   The *Settings Review* dialog appears:



9. Review the current settings and click **Finish**. The program initiates communication with the BoB receiver.

   The installation takes about five minutes. Typically, the transfer of the firmware to the Bob receiver proceeds automatically. When the installation is complete, the following dialog appears on your computer:



10. Click **Exit** to close the WinFlash program.

    Your BoB receiver restarts and automatically starts the newly installed firmware.

Warning – Do not stop the firmware installation process on the office computer or the BoB receiver once it has started. Doing so may corrupt the firmware. If this occurs, attempt the install process again and contact Trimble Support if necessary.

APPENDIX

B

Troubleshooting

In this appendix:

- Introduction

Introduction

Use this appendix to identify and solve common problems that may occur. Please read this appendix before you contact technical support.

Figure B.1 Troubleshooting

The BoB receiver will not ...	Possible cause	Action
... turn ***on***	Flat battery	Do one of the following: • Charge battery overnight • Use an external power source
... connect with cable-free link	There is an interference source[1] disrupting the cable-free link	Do one of the following: • Use the serial clip to cable the BoB receiver to the GeoExplorer 3 • Remove or move away from the interference source
	The cable-free link is permanently disabled	In some countries it is illegal to operate the BoB cable-free connection. BoB receivers sold in these countries have the cable-free link permanently disabled.
	The GeoExplorer 3 is not configured to use the cable-free link	In SYS / Setup / Configurations / Comms / set “RTCM Input” to “Cable-free BoB”.
	The GeoExplorer 3c option does not support the cable-free link	Contact your local Trimble dealer to upgrade your GeoExplorer 3c to a GeoExplorer 3.
... connect with the cable link	Serial port settings are not correctly configured	Set the RTCM Input source correctly on your GPS data collector. Consult your GPS data collector’s user manual for the correct configuration. The BoB receiver communicates at a baud rate of 2400, with 8 data bits, 1 stop bit and no parity.
	Faulty cabling	Check/test cabling and connections. Consult your GPS data collector user manual for the correct configuration. Replace where necessary.

Figure B.1 Troubleshooting (Continued)

The BoB receiver will not ...	Possible cause	Action
... get real-time corrections when in Fixed Mode	The BoB receiver has been set to track a frequency that has a weak signal. This may be because you have moved to the edge of the beacon coverage, or because local conditions for beacon reception are poor.	Use Best Mode: • To switch to Best Mode, use a long (1 second) press of the Beacon Button. The BoB receiver tracks the best signal. Once it has lock on a signal, you can switch back to Fixed Mode and the BoB receiver will maintain its lock on the new station.
	There is an interference source[1] disrupting the beacon signal.	Remove or move away from the interference source.
	The beacon station is unmonitored or unhealthy and BoB is set to use beacons only if they are healthy.	To use an unmonitored beacon station, specify this in the station filter sent from PC-BoB. It is not recommended to use an unhealthy beacon signal.
	The beacon station has been excluded by the station filter sent from PC-BoB	Reset the BoB receiver. Do one of the following: • Hold the beacon and power buttons down for 5 seconds • Send a new filter from the PC-BoB software that includes the beacon station you would like to track

Figure B.1 Troubleshooting (Continued)

The BoB receiver will not ...	Possible cause	Action
... track in Best Mode	There is an interference source[1] disrupting the beacon signal.	Remove or move away from the interference source.
	You have moved out of beacon range	To receive corrections you must be within the advertised broadcast range of a beacon.
	The beacon station is unmonitored or unhealthy and BoB is set to use beacons only if healthy.	To use an unmonitored beacon station you need to specify this in the station filter sent from the PC-BoB software. It is not recommended to use an unhealthy beacon signal.
	The beacon station has been excluded by the station filter sent from PC-BoB	Reset the BoB receiver. Do one of the following: • Hold the beacon and power buttons down for 5 seconds • Send a new filter from the PC-BoB software that includes the beacon station you would like to track.
...track one beacon station in Best Mode (that is, there is excessive switching between beacon stations in Best Mode)	You are in an area where equally good signals are available from more than one beacon station.	Switch to Fixed Mode. • Use a short (<1 second) press of the beacon button to select the beacon station you would prefer to use.

[1] Sources of Interference

- Interference can come from a number of sources and can affect either beacon signal reception by the BoB receiver, or the cable-free connection between the BoB receiver and the GeoExplorer 3. GPS receivers, cell phone towers, electric motors, car engines, or another beacon receiver are all potential sources of interference.

- When two cable-free BoB receivers are operating in the same area they may interfere with one another. In this circumstance turn off one of the BoB units, as one cable free BoB can communicate with more than one GeoExplorer 3. Alternatively use the cable. This removes interference from another BoB receiver operating in close proximity.
- Beacon interference is best diagnosed using the PC-BoB software's FFT diagnostic graphs. When interference is present, more noise appears on the graph. This obscures the beacon station signals which you can normally distinguish as peaks on the graph.

Figure B.2 shows a normal FFT graph.

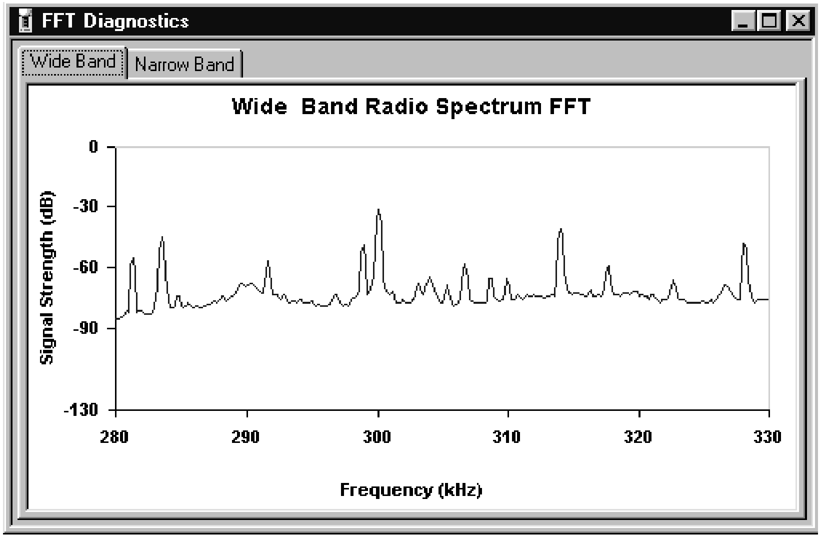


Figure B.2 FFT Diagnostics – Normal Conditions

Figure B.3 shows the FFT diagnostics graph for a signal experiencing interference.

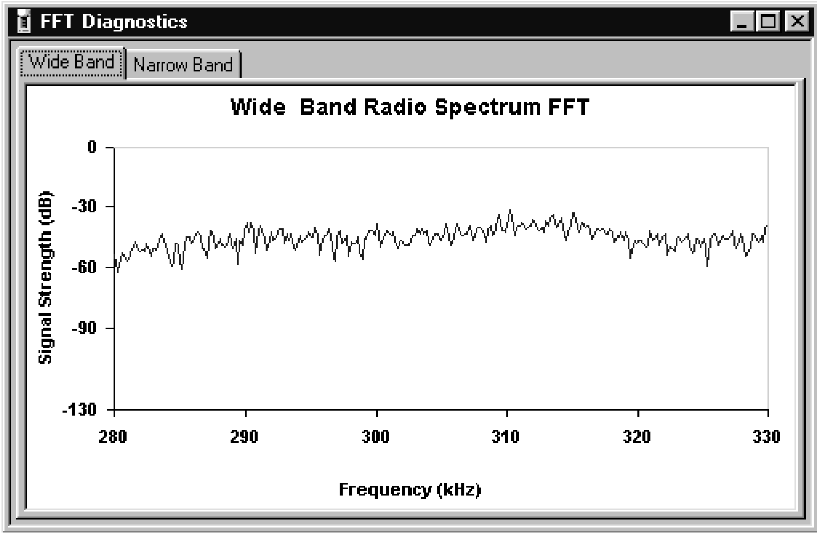


Figure B.3 FFT Diagnostics – Signal Experiencing Interference

For more information, refer to the Help within the PC-BoB software.

APPENDIX

C

Specifications

In this appendix:

- Introduction

Introduction

Table C.1, Table C.2, and Table C.3 list the specifications for the BoB receiver and the pinout diagrams for the BoB system cables.

Table C.1 BoB Receiver Specifications

Parameter	Specification
General	Fully sealed, dust proof, waterproof, shock resistant
Size	20.6cm (8.1’’) H x 10.7cm (4.2’’)W x 10.7cm (4.2’’) D (at antenna)
Weight	1.16kg (2.56lbs)
Power	1.5 W
Temperature	Operating: –10C to +50C (+14F to +122F) Storage: -20C to +70C (-4F to +158F)
Humidity	Up to 99% non-condensing
Start time	< 10sec, typical.
Channels	2
Frequency	Range: 283.5-325kHz Spacing: 500Hz
MSK modulation	50, 100 & 200 b/s autoselection
Output protocol	RTCM SC-104
Input protocol	NMEA 0183
Port Settings	2400 Baud, 8 Data bits, 1 Stop bit, No parity

Table C.2 BoB Receiver Serial Port Pinout (P/N 38508)

Pin	Signal
1	
2	RX
3	TX

Table C.2 BoB Receiver Serial Port Pinout (P/N 38508) (Continued)

Pin	Signal
4	
5	GND
6	
7	
8	
9	

Table C.3 Null Modem Cable Pinout (P/N 43377)

Pin #	Signal		Pin #	Signal
1	EVENT IN	→	1	CD
2	TXD	←	3	RXD
3	RXD	→	2	TXD
4				
5	SIG GND	→	5	SIG GND
6	DSR		6	DSR
7	PWR ON	→	8	RTS
8	CHG CTRL	→	7	DTR
9				

Glossary

baseline — The three-dimensional vector distance between a pair of stations for which simultaneous GPS data has been collected and computed using carrier-phase processing.

base station — Also called a reference station. A receiver that is set up at a known location specifically to collect data for differentially correcting rover files. The base station calculates the error for each satellite and, through differential correction, improves the accuracy of GPS positions collected at unknown locations by a roving GPS receiver. You can use a Trimble GPS Community Base Station or a Trimble GPS receiver in base station mode.

beacon almanac — This almanac provides the location, frequency, service range, and health information for a given network of radio beacons equipped to transmit differential GPS data.

data collector — A handheld, lightweight data entry computer. Trimble GPS data collectors include the TSC1 and the GeoExplorer 3.

differential correction (Differential GPS, DGPS) — The process of correcting GPS positions at an unknown location with data collected simultaneously at a known location (base station). Differential correction usually applies to receivers that use C/A code positioning techniques. The process of differentially correcting one receiver's location relative to another's can be done during postprocessing or in real-time, if radios are used.

In postprocessed DGPS the base station logs the measurements in a computer file so rover users can differentially correct their data upon return to the base station. In real-time DGPS, the base station calculates and broadcasts the error for each satellite as each measurement is received, permitting rover users to see differentially corrected data immediately.

frequency band A range of frequencies in a particular region of the electromagnetic spectrum.

frequency spectrum The distribution of amplitudes as a function of frequency of the constituent waves in a signal.

Global Positioning System (GPS) A GPS system consists of a space segment (up to 24 NAVSTAR satellites in 6 different orbits), the control segment (5 monitor stations, 1 master control station and 3 upload stations), and the user segment (GPS receivers).

NAVSTAR satellites carry extremely accurate atomic clocks and broadcast coherent simultaneous signals.

pseudorange A distance measurement based on the correlation of a satellite transmitted code and the local receiver's reference code, that has not been corrected for errors in synchronization between the transmitter's clock and the receiver's clock.

Radio Technical Commission for Maritime Services (RTCM) A commission set up to define a differential data protocol to relay GPS correction messages from a monitor station to a field user. RTCM SC-104 recommendations define the correction message format and correction message types.

Reference station See **base station**.

RF Radio Frequency.

rover
Any mobile GPS receiver collecting data during a field session. The receiver's position can be computed relative to another, stationary GPS receiver (base station).

Selective Availability (S/A)
Artificial degradation of the satellite signal by the U. S. Department of Defense (DoD). A DoD program to control the accuracy of pseudorange measurements, where the user receives a false pseudorange in error by a controlled amount. The error in position caused by S/A can be up to 100 meters. Differential GPS techniques can reduce these effects for local applications.

Signal-to-Noise Ratio (SNR)
Also called signal level or signal strength. Arbitrary strength units used to determine the strength of a radio beacon signal. SNR ranges from 0 (no signal) to around 35. SNRs lower than 6 are considered unusable.

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W

Reader Comment Form

Beacon-on-a-Belt (BoB) Receiver Manual

March 2001 **Part Number 38602-00-ENG** **Revision A**

We appreciate your comments and suggestions for improving this publication.

I use the following Trimble product____

for____

Please circle a response for each of the statements below:

1 = Strongly Agree 2 = Agree 3 = Neutral 4 = Disagree 5 = Strongly Disagree

The manual is well organized.	1	2	3	4	5
I can find the information I want.	1	2	3	4	5
The information in the manual is accurate.	1	2	3	4	5
I can easily understand the instructions.	1	2	3	4	5
The manual contains enough examples.	1	2	3	4	5
The examples are appropriate and helpful.	1	2	3	4	5
The layout and format are attractive and useful.	1	2	3	4	5
The illustrations are clear and helpful.	1	2	3	4	5

The manual is: too long just right too short

Please answer the following questions:

Which sections do you use the most? ____________________________________

What do you like best about the manual? ______________________________

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