GBR 21

Beacon Receiver

Owner's Manual & Reference

GARMIN®

Warranty Information

Every GARMIN product is built to exacting standards to provide years of trouble-free service. GARMIN warrants this product to be free from defects in materials and workmanship for one year from the date of purchase.

GARMIN Corporation will at its sole option, repair or replace any components which fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor. The customer is, however, responsible for any transportation costs. This warranty does not cover failures due to abuse, misuse, accident or unauthorized alteration or repairs. GARMIN Corporation assumes no responsibility for special, punitive or consequential damages, or loss of use.

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE, AND IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING ANY LIABILITY ARISING UNDER WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, WHICH MAY VARY FROM STATE TO STATE.

To obtain warranty service, see your local dealer or call the GARMIN Customer Service department for a returned merchandise tracking number. The unit should be securely packaged with the tracking number clearly marked on the outside of the package, and sent freight prepaid and insured to a GARMIN authorized warranty service facility.

GARMIN is fully committed to your satisfaction as a customer. If you have any questions regarding the GBR 21, please contact our Customer Service department at:

GARMIN International, Inc.
1200 East 151st Street
Olathe, KS 66062-3426
(913) 397-8200
FAX (913) 397-8282

© 1997 GARMIN Corporation
1200 E. 151st Street, Olathe, KS 66062-3426, USA

GARMIN (Europe) LTD, Unit 5, The Quadrangle, Abbey Park Industrial Estate, Romsey, SO51 9AQ, UK

Web Site Address: www.garmin.com

All rights reserved. No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose without the express written permission of GARMIN.

Information in this document is subject to change without notice. GARMIN reserves the right to change or improve their products and to make changes in the content of this material without obligation to notify any person or organization of such changes or improvements.

May, 1997 190-00069-00 Rev. B Printed in Taiwan.

Cautions

All differential beacon receivers use correction data determined at the beacon transmitter site via a GPS receiver(s). The GPS system is operated by the government of the United States which is solely responsible for its accuracy and maintenance. The DGPS beacon transmitters are operated by the U.S. Coast Guard (or similar government agency in other countries) which is responsible for its accuracy and maintenance. The Global Positioning System and the Differential Global Positioning System are under development and are subject to changes which could affect accuracy and performance of all DGPS equipment. Although the GBR 21 is a precision electronic NAVigation AID (NAVAID), any NAVAID can be misused or misinterpreted, and therefore become unsafe. Use the GBR 21 at your own risk. To reduce this risk, carefully review and understand all aspects of this Owner's Manual and carefully compare indications from your GPS receiver to all available navigation sources including the information from other NAVAIDs, visual sightings, charts, etc. For safety, always resolve any discrepancies before continuing navigation.

NOTE: This device complies with Part 15 of the FCC rules. Operation of this device is subject to the following conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The GARMIN GBR 21 does not contain any user-serviceable parts. Repairs should only be made by an authorized GARMIN service center. Unauthorized repairs or modifications could void your warranty and authority to operate this device under Part 15 regulations.

Table of Contents

List of Figures

Differential GPS (DGPS) is a technique used to improve the accuracy of the Global Positioning System. DGPS reduces the effects of Selective Availability, propagation delay, etc. and can improve position accuracy to better than 10 meters (2 drms).

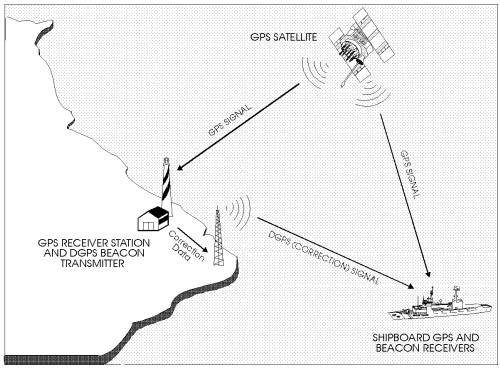


Figure 1: The DGPS System

A DGPS system consists of the following:

- DGPS Beacon Transmitter and GPS Receiver at a known location
- Shipboard DGPS Beacon Receiver
- Shipboard GPS Receiver (DGPS capable)
- GPS Satellites

The DGPS Beacon Transmitter is placed at a known location (i.e., the exact position of the site has been previously determined). At the beacon transmitter site, the GPS satellites are monitored using a GPS receiver(s). This receiver is equipped to calculate "pseudorange" corrections for each satellite received. A pseudorange correction is the difference between the distance to the satellite (from the beacon site) as measured by the GPS receiver, and the actual distance to the satellite based on the known location of the beacon site.

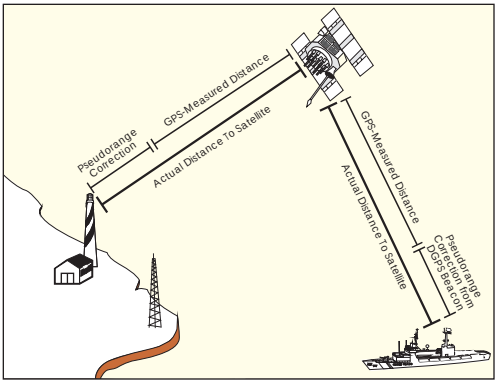


Figure 2: Calculating Pseudorange Corrections

Once pseudorange corrections have been calculated for each satellite, the DGPS Beacon Transmitter broadcasts the data as part of its beacon signal using an RTCM SC-104 format. Should the beacon site GPS receiver fail, or otherwise be unable to provide pseudorange corrections, the beacon transmitter is equipped to provide a warning signal ("integrity warning") to prevent invalid correction data being applied to the shipboard GPS receiver.

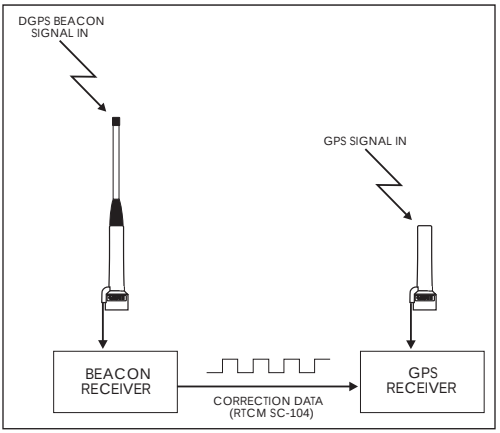


Figure 3: Shipboard DGPS System

Aboard ship, the beacon signal is received by the DGPS Beacon Receiver. The beacon receiver demodulates this signal and the resulting digital pseudorange corrections are transmitted to the shipboard GPS receiver via a direct wire connection. (Again, this data is in an RTCM SC-104 format.)

The shipboard GPS receiver is also receiving the GPS satellites. As it calculates its position, the pseudorange correction for each corresponding satellite is reapplied providing the same corrections required at the DGPS Beacon Transmitter site. Satellites received by the shipboard GPS receiver, but not by the GPS receiver at the beacon transmitter site, will not have corresponding pseudorange corrections. When three or more satellites received by the shipboard GPS receiver have corresponding pseudorange corrections, the result is a highly accurate position reading. The more satellites with pseudorange corrections, the more accurate the position.

SOURCES OF ERROR

Using a DGPS Beacon Receiver with your existing GPS Receiver can provide substantial improvements in accuracy; however, there may be occasions when the best possible accuracy will not occur. Several factors, which you should be aware of, can contribute to a degraded DGPS accuracy.

Loss of DGPS Beacon Signal - Obviously, the lack of DGPS correction data will result in reduced accuracy. Accuracy will be the same as if no beacon receiver was being used. Several conditions can cause a loss of the beacon signal:

- Poor data or ground connections between the beacon receiver and the GPS receiver can result in intermittent or non-existent correction data.

- The range of a DGPS beacon transmitter (see the accompanying Beacon Reference Card) is typically a few hundred miles, or less. Beyond this range, the beacon signal cannot be reliably received.

- Interference to the beacon signal can be experienced during periods of thunderstorm activity. Other sources of static interference, such as alternator motors and ignition systems, can also affect signal reception. Alternator/ignition interference can be minimized through proper shielding of the ship's wiring, by using an EMI/RFI filter, and by mounting the beacon receiver's antenna away from these sources of interference (see page 12).

Multipath - Multipath error occurs when the GPS signal is reflected before it reaches the GPS receiver. The reflected signal takes slightly longer to reach the GPS receiver than a non-reflected signal. This added time delay results in position error. (The distance to each satellite is calculated based upon the time it takes the GPS signal to reach the GPS receiver.)

Multipath error can be minimized by mounting the GPS antenna at a location which minimizes the potential for reflected signals. Generally, the GPS antenna should be mounted on a large, flat horizontal surface and away from any vertical structure (cabin walls, large mast, etc.) which could reflect the GPS signal.

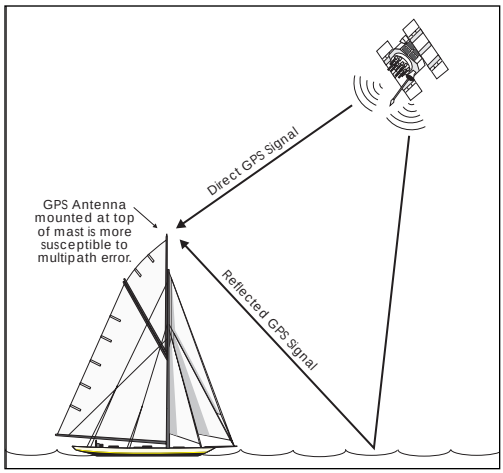


Figure 4: Multipath Error

Number of Satellites Visible - As previously stated, the number of satellites available can affect position accuracy. To apply the pseudorange corrections provided for the satellites received at the beacon transmitter station, the same satellites (at least in part) must be received by your GPS receiver. And, certainly, if there aren't enough satellites to determine a GPS position, there aren't enough satellites to calculate a DGPS position.

Satellite Geometry - A minimum of 3 satellites are required to determine a 2D (horizontal) position. At times, additional satellites are required due to their placement with respect to each other. This relative placement is referred to as "satellite geometry". Ideal satellite geometry exists when the satellites are located at wide angles with respect to each other. When satellites are located closer together, in our view of the sky, satellite geometry is considered poor.

This same requirement applies to DGPS. If pseudorange corrections are available for three different satellites, but they are all located in the same general area, the DGPS corrections will be minimal. However, if the same three satellites are placed farther apart, in several very different directions from our position, the pseudorange corrections will have a much greater effect and our position accuracy will be greatly improved.

CAPABILITIES

The GBR 21 offers a host of powerful capabilities to enhance the performance and accuracy of your GARMIN GPS receiver:

- **Performance -** Single channel operation provides high-sensitivity manual tuning throughout the beacon broadcast band.
- **Ease of Use -** Operation is controlled using the Beacon Receiver Setup and Beacon Log pages on your GPS unit.
- **Convenience -** May be remotely mounted in an out-of-the-way location. Receiver status information is displayed directly on the GPS unit.

The GBR 21 may be used with a variety of GARMIN GPS receivers. The list below identifies most, but not all, compatible models. If your GPS receiver is not listed, you may check with your GARMIN dealer or contact GARMIN product support at 1-800-800-1020 to verify compatibility.

- ***GPS II/II+***
- ***GPS 12/12XL***
- ***GPS 38/40***
- ***GPS 45/45XL***
- ***GPS 50/75***
- ***GPS 65***
- ***GPS 120/125***
- ***GPSCOM 170***
- ***GPSMAP 130/135***
- ***GPSMAP 175***
- ***GPSMAP 210/220***
- ***GPSMAP 230***

- **Low Power Consumption -** Draws approximately 130 milliamps during normal operation.

- **Interfaces -** User-selectable operation for 4800 or 9600 baud.

- **Accuracy -** Improves position accuracy of GPS unit to better than 10 meters (2 drms).

PACKAGE CONTENTS

Your GARMIN GBR 21 package includes:

- GBR 21 unit
- Power/Data Cable
- Antenna coupler w/ 30' cable
- Antenna
- Owner's Manual
- Beacon Reference Card

This package provides the materials required to permanently install the GBR 21 and connect it to your GARMIN GPS unit. In addition to supplying power to the GBR 21, the power/data cable is used to interface the GBR 21 to the GPS unit. The receiver may be powered by an external 10-18 VDC power source. Power to the receiver should be controlled by an on/off switch (not included), such as an accessory switch on the control console.

The receiver may be mounted at a remote location, under the dash or behind a panel. However, you may wish to mount the receiver at a location that allows easy viewing of the LED status light for immediate indication of receiver status.

The following items are required to complete the installation of your GBR21:

- Antenna mount (standard 1-inch, 14 threads per inch)
- Hardware (to secure the GBR 21)
- On/off switch (to control power to the GBR 21)

The GBR 21 may be mounted on any flat surface. Select the mounting location according to your preferences – either an out-of-the-way location (such as under the dash) or at an accessible location where the LED status light will be visible. Keep in mind that from this mounting location cables will be routed to the antenna and to the GPS unit.

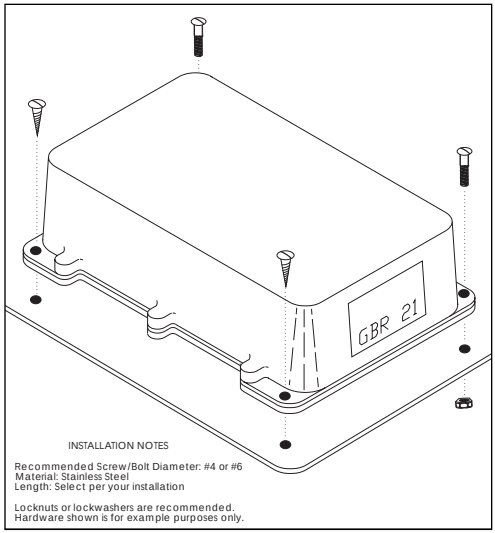


Figure 5: Mounting the Receiver

A primary consideration when installing the receiver is to **select a location away from interference sources**. Static interference generated by your vessel's alternator or ignition system can degrade the receiver's performance.

1) Drill the mounting holes (4) for the GBR 21 according to the mounting hardware that will be used. Mounting hardware is not included with the GBR 21. You should select the mounting hardware suitable for your installation. Stainless steel (#4 or #6 diameter) hardware is recommended. A mounting template is provided inside the back cover of this manual.

2) Mount the GBR 21 at this location using the selected hardware.

3) Connect the power/data cable to the GBR 21, observing the proper polarity as indicated by the notch in the connector.

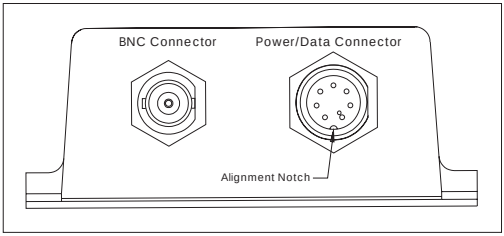


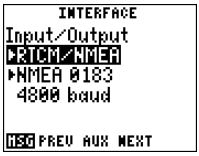
Figure 6: GBR 21 Cable Connections

4) Connect the RED wire from the power/data cable to an accessory switch on the dash. If an accessory switch is not available, a standard SPST switch may be used (not included).

5) Connect the other end of the accessory switch to the ship's **positive** 10-18 Volt DC power source.

6) Connect the BLACK wire from the power/data cable to vessel ground (or the **negative** terminal of the ship's 10-18 Volt DC power source).

The Interface Setup Page may be selected from the Auxiliary Menu on the GPS 65/ 75. For additional instructions, see the owner's manual for your GPS receiver.



From the Input/Output Settings Page, select 'RTCM/NMEA' and 'NMEA 0183' to properly communicate with the GBR 21.

MOUNTING THE ANTENNA

The supplied antenna coupler fits a standard 1-inch antenna mount (not included). Like the receiver, the antenna should be placed away from all sources of interference. As a rule of thumb, mount the antenna at least three feet from all other antennas and the vessel's electrical system components (alternator/ignition system). Position the antenna so that a clear view in all directions is obtained.

The antenna coupler is supplied with 30 feet of RG58 cable attached. When routing the cable to the GBR 21, observe the same precautions followed when choosing mounting locations for the receiver and the antenna: Avoid routing the cable near the vessel's alternator or ignition system components.

A ground strap is attached to the antenna coupler. For proper operation, the ground strap must be connected to vessel ground. If the coupler is not adequately grounded, the beacon signal may be too weak for the GBR 21 to provide reliable correction data.

1) Secure the antenna mount at the desired mounting location.

2) Thread the antenna coupler onto the antenna mount and hand tighten until snug. Do not over-tighten. Thread antenna onto coupler.

3) Connect the antenna coupler's ground strap to vessel ground. A ground connection can usually be made by connecting to metal frame components or an engine block.

4) Route the antenna cable to the GBR 21. Excess cable may be coiled together and secured in an inconspicuous location.

5) Connect the antenna cable to the BNC connector on the GBR 21.

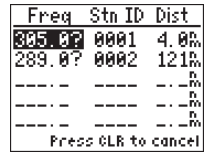
CONNECTING THE GBR 21 TO YOUR GPS UNIT

The final step in installing the GBR 21 is to connect the receiver's DATA IN, DATA OUT and GROUND (Return) lines to your GPS unit. The GBR 21 is designed to transmit/receive data at 4800 or 9600 baud (bits per second). The receiver defaults to 4800 baud, which is suitable for use with all GARMIN GPS receivers. The 9600 baud option is provided to allow the receiver to be used with some newer models and other manufacturers' GPS units.

Two *ground* wires are provided on the power/data cable. For reliable communication, it is essential that the GBR 21 and the GPS unit share the same ground. This ground connection acts as the (current) Return line. You may connect either the YELLOW wire or the BLACK wire from the power/data cable to the ground wire of the GPS unit.

NOTE: Some non-GARMIN GPS units may have a separate data line labeled “RETURN”, “DATA GROUND” or “DATA -”. If one of these lines exist, connect the YELLOW wire from the power/data cable to it.

Use the Beacon Receiver Setup Page to enter the beacon operating frequency and bit rate for the nearest DGPS beacon site. This information is automatically tranferred to the GBR 21.



The Beacon Log Page lists the last five beacon frequencies used. As an alternative to re-typing the frequency and bit rate each time, you may select a beacon from this list.

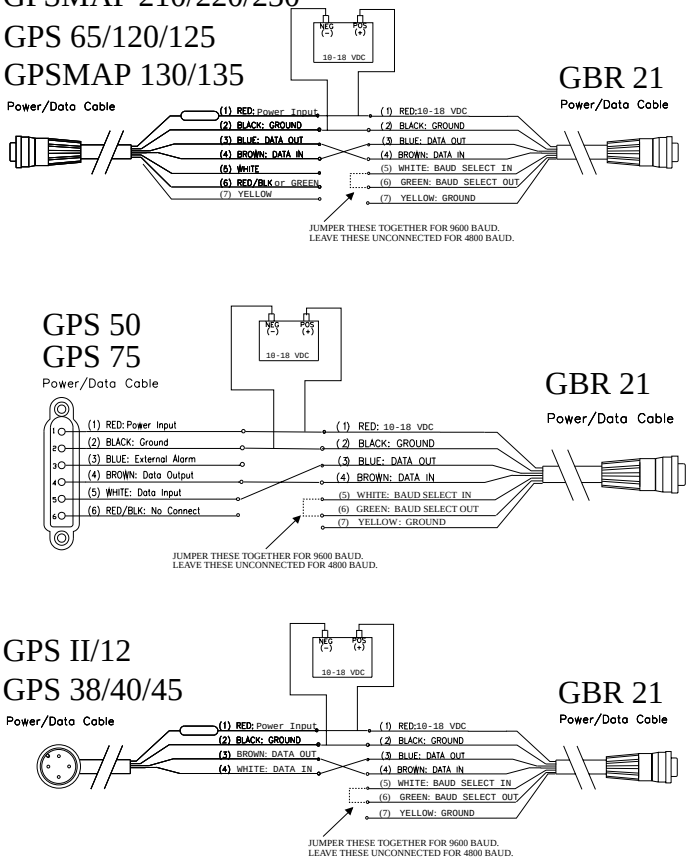


Figure 7: Sample Wiring to GARMIN GPS Units

1) Connect the BLUE wire from the GBR 21's power/data cable to the DATA INPUT line of the GPS unit.

2) Connect the BROWN wire from the power/data cable to the DATA OUTPUT line of the GPS unit.

3) Connect the YELLOW (or BLACK) wire from the power/data cable to the GROUND wire of the GPS unit. If the BLACK wire is already connected to the same ground terminal as the GPS unit, no additional connection is required (unless a separate RETURN line is provided by the GPS unit).

4) If 9600 baud operation is required, connect the WHITE and GREEN power/data cable wires together. For 4800 baud operation (default), leave these wires disconnected.

USING THE GBR 21

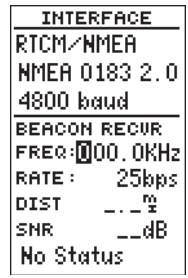
When using the GBR 21, all tuning/operation functions are controlled by the GPS unit. Your GARMIN GPS unit provides a Beacon Receiver Setup Page and, in some cases, Beacon Log Page for this purpose. The operating instructions provided below are generalized to cover several different GARMIN models. For additional information on operating your GPS unit with the GBR 21, refer to the owner's manual for your GPS unit.

1) Turn the power on to the GBR 21. The LED status light will flash indicating power has been applied, but no beacon signal is being received.

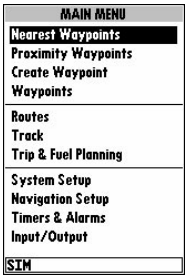
2) Turn the GPS unit on.

3) From the Interface Setup Page, select an RTCM input. If a baud rate selection is also provided, specify 4800 or 9600 baud, as appropriate. (NOTE: On GARMIN GPS units, RTCM input/NMEA 0183 output should be selected. The baud rate will be set to 4800. If additional devices, such as an autopilot or plotter, are connected to the GPS unit, they must be set to work with NMEA 0183 as well.)

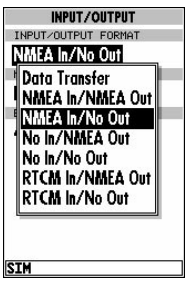
The Interface Setup Page may be selected from the Main Menu on the GPS 38/40/45. For additional instructions, see the owner's manual for your GPS receiver.



With RTCM input and NMEA 0183 output selected, the beacon receiver information also appears on the Interface Setup Page. Use this screen to tune the GBR 21.



The Main Menu Page on the GPSMAP 130/ 135/175/230. Select 'Input/Output' to make the desired interface settings.



From the Input/Output Settings Page, select 'RTCM In/NMEA Out' to properly interface with the GBR 21.

4) From the Beacon Receiver Setup Page, enter the "Tuned To:" frequency and the "Bit Rate" for the nearest DGPS beacon transmitter. (Refer to the Beacon Reference Card for this information.)

5) Once the frequency and bit rate have been entered, "Tuning" will be displayed at the bottom of the page.

6) If the beacon signal is received by the GBR 21, the "SNR" field will display a signal-to-noise ratio and "Receiving" will appear at the bottom of the page. The LED status light on the receiver will change from flashing to constantly on, indicating the signal is being received.

   If the beacon signal is received, but no DGPS correction data is included, the message "No Data" will appear at the bottom of the page. The LED status light on the receiver will continue to flash.

   If no beacon signal is received, the "SNR" field will remain blank, "No Status" will appear at the bottom of the page, and the LED status light will continue to flash.

7) To select another beacon transmitter, enter a new frequency and bit rate.

8) A list of the last five beacon frequencies used is provided on the Beacon Log Page. As an alternative to re-entering frequency and bit rate information each time you use the GBR 21, you may select a beacon from this list. (NOTE: The Beacon Receiver Setup Page will automatically default to the last beacon transmitter used each time the GPS unit is turned on.)

9) Select the Satellite Bar Graph Page. A "D" will appear at the bottom of the signal strength bar for each satellite with a corresponding differential correction. This page is useful for determining the quality of differential coverage available. (Remember, the more satellites with corresponding differential corrections, the more accurate your position will be.)

PHYSICAL

Size:	5.2"L x 3.6"W x 1.5"H (132mm x 91mm x 38mm)
Weight:	6.8 ounces (0.193 kg)

POWER

Voltage:	10 - 18 volts DC using supplied power/data cable
Current Drain:	130 mA

SIGNAL PROCESSING

Frequency Range:	283.5 - 325.0 kHz
Minimum Signal:	10 uV
Acquisition Time:	15 seconds

DATA PROCESSING

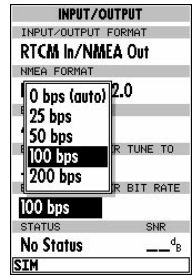
Demodulation:	MSK (Minimum Shift Keying)
MSK Bit Rates:	25, 50, 100, 200 bps

INTERFACES

Input:	RS-232 or NMEA 0183 4800 or 9600 baud (jumper selectable)
Input Sentences:	Binary (Magnavox), $PSLIB (Starlink)
Output:	RS-232 4800 or 9600 baud (jumper selectable)
Output Sentence:	RTCM SC-104 (6 of 8 bit format)

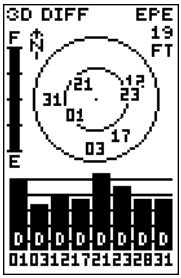
ANTENNA COUPLER

Diameter:	1.6" (41mm) base, .6" (15mm) top
Height:	4.8" (122mm) without antenna 16.8" (427mm) with antenna



After entering the beacon's operating frequency, set the bit rate as indicated on the Beacon Reference Card. Beacon information is also available from the other sources listed on the card.

Troubleshooting Chart

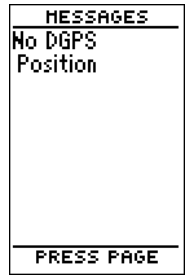


The receiver status indication at the top left of the Satellite Status Page will indicate '3D Diff' or '2D Diff' when differential corrections are available. A 'D' appears at the bottom of the signal strength bar for each satellite with a corresponding differential correction.

PROBLEM	POSSIBLE CAUSE
Accuracy not as expected	Poor satellite geometry/ coverage exists. Interference to GPS antenna and/or beacon antenna exists. Portable antenna being used on GPS unit. Use remote antenna. Multipath signals being received by GPS unit.
Beacon signal weak or intermittent	Beacon transmitter out of range. Antenna coupler not securely grounded. Check ground strap. Interference from ship's electrical system, thunderstorm activity, or another source is inhibiting signal lock on.
LED status light flashing	Beacon signal weak or not received. RTCM data not being received. Wrong bit rate selected on GPS unit. Wrong frequency selected on GPS unit.
No beacon signal	Beacon transmitter out of range. Wrong frequency or bit rate selected. Antenna coupler not securely grounded. Check ground strap. Interference from ship's electrical system, thunderstorm activity, or another source is preventing signal lock on. Antenna cable damaged.

Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE
Receiver will not power on	Power switch/wiring faulty. Fuse/breaker blown (if used).
"No DGPS Position" displayed on GPS unit	Beacon transmitter is not transmitting correction data. Insufficient correction data provided by beacon transmitter.
"No RTCM Input" displayed on GPS unit	GBR 21 is not wired correctly to GPS unit. Wrong baud rate selected for GPS unit or GBR 21.
"No RTCM/NMEA 0183 Interface Selected" appears on GPS unit instead of Beacon Setup Page	RTCM input/NMEA output has not been selected on Interface Setup Page.
"RTCM Input Failed" displayed on GPS unit	Beacon transmitter out of range. Intermittent connection between GBR 21 and GPS unit. Check wiring. Interference from ship's electrical system, thunderstorm activity, or another source is preventing signal lock on.

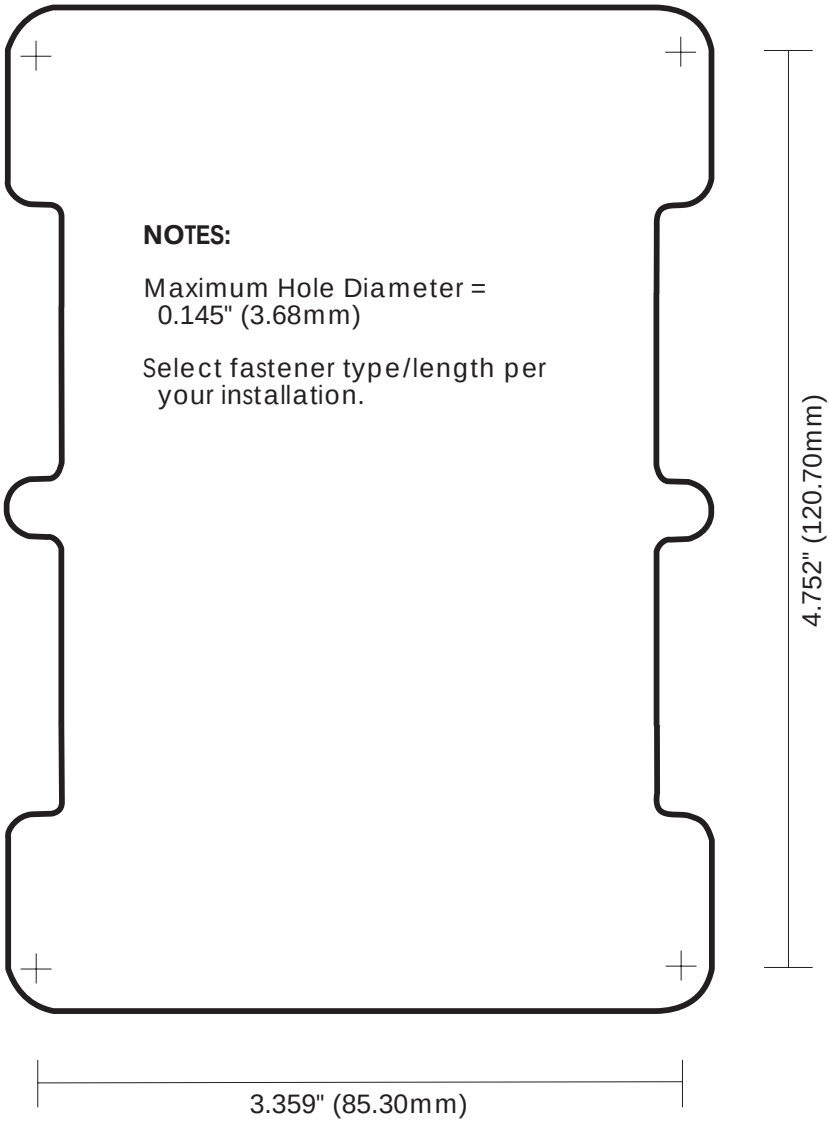


If the 'No DGPS Position' message is displayed on your GPS receiver, correction data may not be available. This may be due to a missing or weak beacon signal.

Check the Satellite Status Page too. There may not be enough satellites available with correction data.

Index

Mounting Template



© 1997 GARMIN Corporation
1200 E. 151st Street, Olathe, KS 66062-3426, USA

GARMIN (Europe) LTD
Unit 5, The Quadrangle, Abbey Park Industrial Estate
Romsey, SO51 9AQ, UK

Web Site Address: www.garmin.com

Part No. 190-00069-00 Rev. B Printed in Taiwan