

GBR 21

beacon receiver

owner's
manual
and
reference
guide



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To obtain warranty service, call the GARMIN Customer Service department (913/397.8200) for a returned merchandise authorization 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 warranty service station. A copy of the original sales receipt is required as the proof of purchase for warranty repairs. GARMIN retains the exclusive right to repair or replace the unit or software or offer a full refund of the purchase price at its sole discretion. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

Cautions

All differential beacon receivers decode 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 their 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 their 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 a DGPS system is a precision electronic NAVigation AID (NAVAID), any NAVAID can be misused or misinterpreted, and therefore become unsafe. Use the DGPS system 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.

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*Screen examples apply to models 130/135/175/180/185/230/235

**Screen examples apply to models III/III+/12Map/NavTalk

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.
- **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 & whip antenna or GA 22/23 H-field beacon antenna w/ 30' cable
- 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.

Capabilities & Package Contents

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+/III/III+/III Pilot
- GPS eMap/eTrex/NavTalk
- GPS StreetPilot/ColorMap
- GPS 12/12XL/12CX/12Map
- GPS 38/40
- GPS 45/45XL/48
- GPS 50/75
- GPS 65
- GPS 89/90/92/95
- GPS 120/125
- GPSCOM 170/190
- GPSMAP 130/135/180/185
- GPSMAP 162/168
- GPSMAP 175/195/295
- GPSMAP 210/220/215/225
- GPSMAP 230/235

Mounting the Receiver

Mounting the Receiver

Please read through these instructions thoroughly before attempting installation. Make sure you completely understand these instructions before you begin. When in doubt, seek professional assistance.

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 GBR 21:

- 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)

It is recommended that the system be temporarily hooked up with the wiring and unit placement approximating the desired final installation. Then check operation with potential local interfering equipment turned on and off. For example, other electronic equipment, fan motors, engine ignition, alternators or generators can be sources of interference.

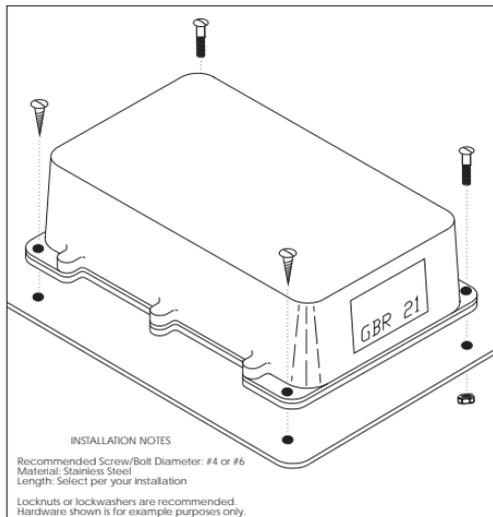


Figure 1: Mounting the Receiver

Mounting the Receiver

If a problem is found, try altering the location of the unit or wiring. Often moving the antenna a few feet away from the source of interference will solve the problem. When a suitable configuration is found, a permanent installation should be made.

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.

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.

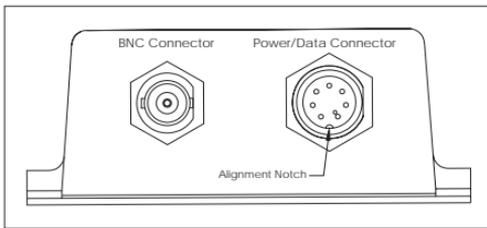


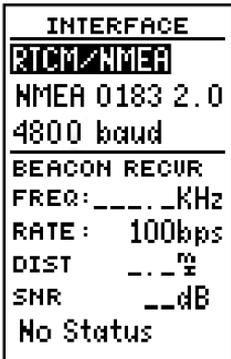
Figure 2: GBR 21 Cable Connections

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).

Mounting the Antenna



The Interface Setup Page may be selected from the Main Menu on the GPS 12/12XL/48. For additional instructions, see the owner's manual for your GPS receiver.



From the Interface Page, select 'RTCM/NMEA' and 'NMEA 0183 2.0' 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 general rule, 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 the clearest 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, except on the GA 22/23 H-field antennas. For proper operation, the ground strap must be connected to a vessel (earth) ground. Do not ground the coupler to the electrical system. If the coupler is not adequately grounded, the beacon signal may be too weak for the GBR 21 to provide reliable correction data.

Note: The GA 22/23 H-field antennas do not require grounding.

1. Secure the antenna mount at the desired mounting location.
2. Thread the antenna coupler/GA 23 onto the antenna mount and hand tighten until snug. Do not over tighten. Thread whip antenna onto coupler.
3. Connect the antenna coupler's ground strap to a vessel (earth) ground. A ground connection can usually be made by connecting to a thru-hull fitting, engine block, dynaplate or body of a metal vehicle.
4. Route the antenna cable to the GBR 21. Excess cable should be coiled together and secured in an inconspicuous location. *Modifications to the DGPS antenna cable could result in undesired operation of the GBR 21.*
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 manufacturer's 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.

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.

Connecting GBR and GPS

INTERFACE	
RTCM/NMEA	
NMEA 0183 2.0	
4800 baud	
BEACON RECUR	
FREQ: 304.0KHz	
RATE: 100bps	
DIST	__%
SNR	__dB
Tuning	

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 transferred to the GBR 21.

Connecting GBR and GPS

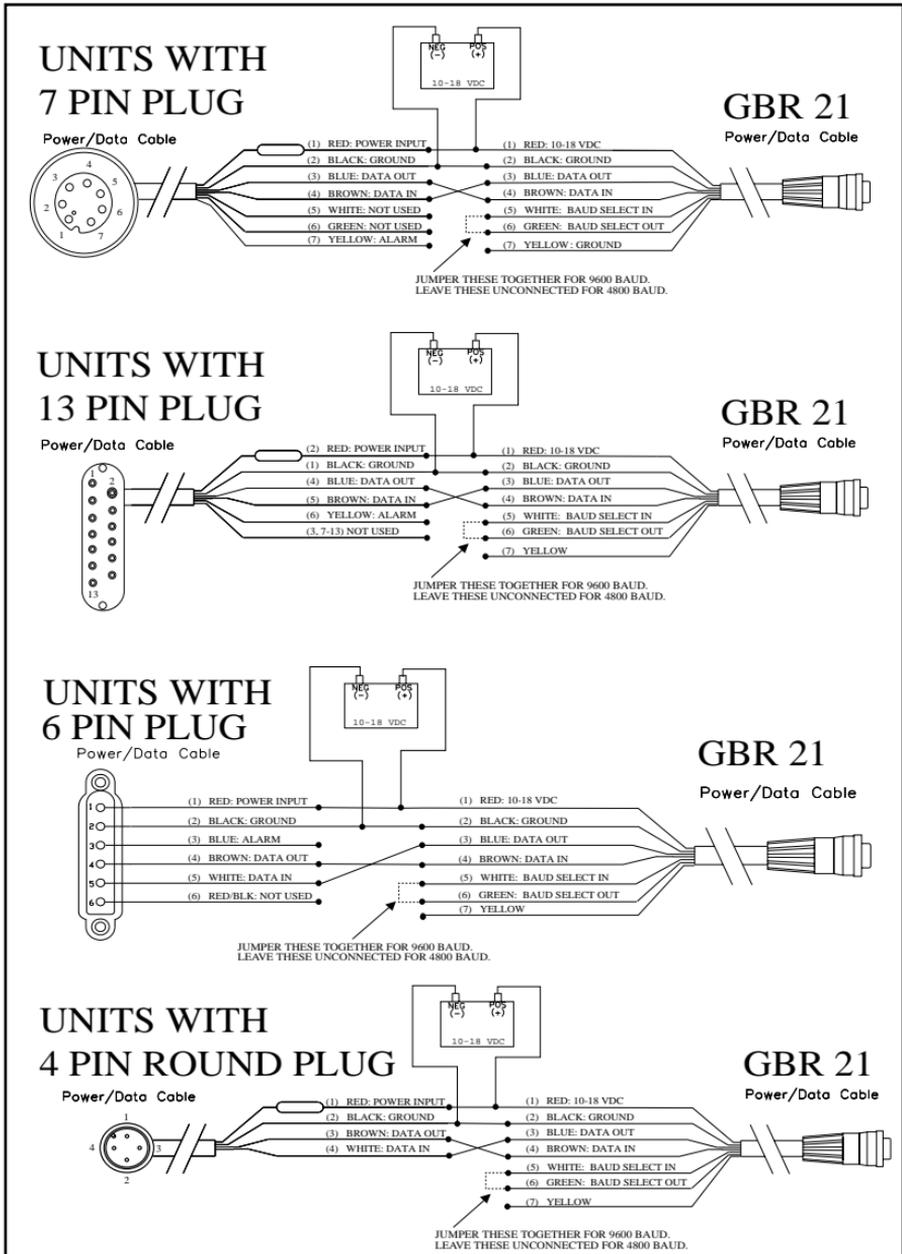


Figure 3: Sample Wiring to GARMIN GPS Units

Using the GBR 21

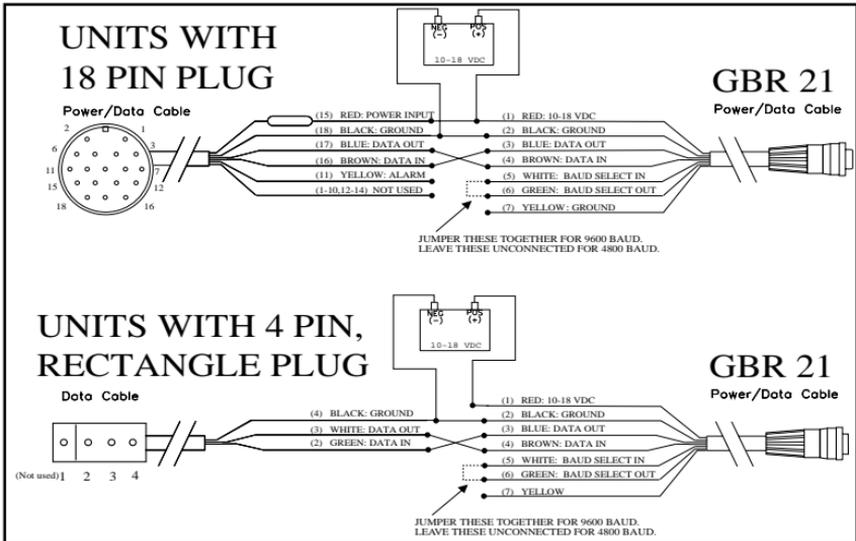


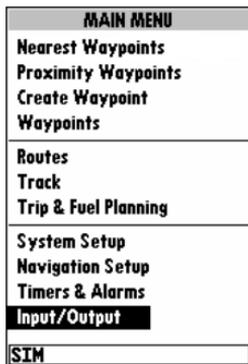
Figure 3 (cont.): Sample Wiring to GARMIN GPS Units

Using the GBR 21

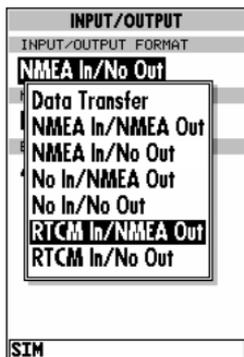
When using the GBR 21, all tuning/operation functions are controlled by the GPS unit. Your GARMIN GPS unit provides a Beacon Receiver Setup Page and, in some cases, Beacon Log Page for this purpose. The operating instructions provided below are generalized to cover several different GARMIN models. For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

Using the GBR 21



The Main Menu Page on the GPSMAP 130/135/175/180/185/230/235. 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.

autopilot or plotter, are connected to the GPS unit, they must be set to work with NMEA 0183 as well.

(Note: On some newer model Garmin GPS receivers, you may set the interface to "Garmin Bcn Rcvr". There is also a scan option which will automatically scan for a DGPS frequency and bit rate. Please refer to your GPS owner's manual for using this function. If this setting is used, you may skip step 4.)

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 SNR scale ranges from zero (no reception) to 30 (best reception). 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. Some Garmin units have a list of the last five beacon frequencies used on the Beacon Log Page. As an alternative to reentering 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.)

- 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 or "3D Differential" will be displayed at the top of the satellite page. 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.)

DGPS: How It Works

Differential GPS (DGPS) is a technique used to improve the accuracy of the Global Positioning System. DGPS reduces the effects of Selective Availability(SA), ionospheric variations and can improve position accuracy to better than 10 meters.

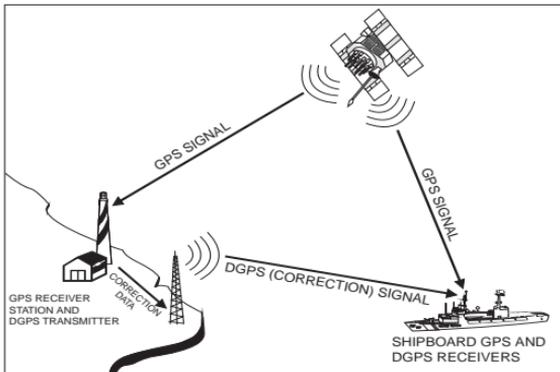


Figure 4: The DGPS System

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

DGPS: How It Works

INPUT/OUTPUT	
INPUT/OUTPUT FORMAT	
RTCM In/NMEA Out	
NMEA FORMAT	
0 bps (auto)	2.0
25 bps	
50 bps	R TUNE TO
100 bps	R BIT RATE
200 bps	
100 bps	
STATUS	SNR
No Status	___ dB
SIM	

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.

DGPS: How It Works



The Main Menu Page on the GPS III/III+/12Map/Navtalk. Select 'Setup' to make the desired interface settings.



From the Interface Page, select 'RTCM/NMEA' to properly interface with the GBR 21.

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. This receiver is equipped to calculate corrections for each satellite received. The 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. These corrections are communicated to the users GPS set through the DGPS Beacon Station and the GBR 21. The users GPS set then uses the corrections to remove errors from its measurements. Satellites received by the shipboard GPS receiver, but not by the GPS receiver at the beacon transmitter site, will not have corresponding corrections. When three or more satellites received by the shipboard GPS receiver have corresponding corrections, the result is a highly accurate position reading. The more satellites with corrections, the more accurate the position.

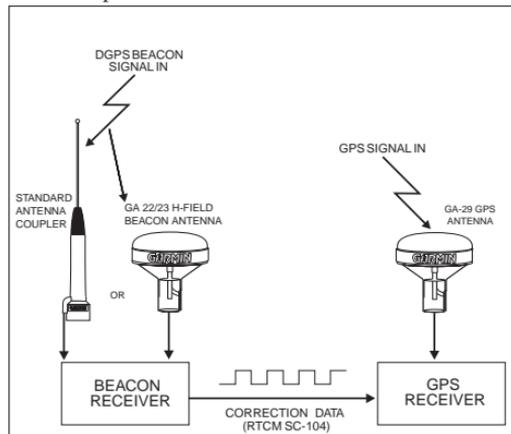


Figure 5: Shipboard DGPS System

The GBR 21 receives RTCM-SC-104 format signals from ground based DGPS Beacon Stations operating in the 283.5 kHz to 325.0 kHz frequency band, with MSK modulation and data rates of 25,50,100, or 200 bits per second. These stations are typically operated by government agencies such as the U.S. Coast Guard.

Individual stations vary and the user may wish to verify the suitability of the signal for the intended application with the station operator. The station power is normally set to provide a usable range somewhere near 300 km. Other factors such as local interference, lightning, time of day and season, and if the path to the station is over ground or water, and antenna selection or installation affect the usable signal range.

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 receiver and the GPS receiver can result in intermittent or nonexistent 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.

Sources of Error

The screenshot shows the 'Position Interface' screen with the following settings:

Format	
RTCM/NMEA	
Baud Rate	
4800	
Beacon	Bit Rate
322.0 Hz	100
Status	
Tuning	
SNR	Distance
--- dB	--- mi

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.

The screenshot shows the 'Beacon Log' screen with the following data:

Frequency	Distance
322.0 Hz	--- mi
305.0 Hz	--- mi
304.0 Hz	--- mi
--- Hz	--- mi
--- Hz	--- mi
--- Hz	--- mi
SNR	Distance
--- dB	--- mi

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

Sources of Error

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.

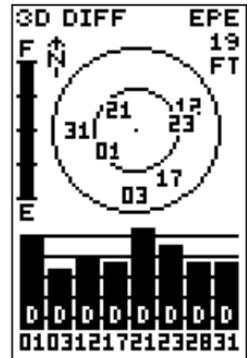
Number of Satellites Visible— As previously stated, the number of satellites available can affect position accuracy. To apply the corrections provided for the satellites received at the beacon transmitter station, the same satellites (at least in part) must be received by your GPS receiver. And, certainly, 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 4 satellites are required to determine a 3D 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 in a line, satellite geometry is considered poor.

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

Problem	Possible Cause
1) Receiver will not power on (No LED)	Power switch/wiring faulty. Fuse/breaker blown (if used).
2) LED status light flashing	RTCM data not being received from broadcast site. Wrong bit rate selected on GPS unit. Wrong frequency selected on GPS unit. GBR 21 not wired properly with GPS unit. Check wiring. Also refer to Troubleshooting problems 6 and 7.
3) “No DGPS Position” displayed on GPS unit	Not enough data is available to compute a DGPS position. Please refer to Troubleshooting problems 6 and 7.
4) “No RTCM Input” displayed on GPS unit	Beacon receiver is improperly connected or baud rates do not match. Please refer to Troubleshooting problems 6 and 7.
5) “RTCM Input Failed” displayed on GPS unit	Intermittent connection between GBR 21 and GPS unit. Check wiring and/or beacon antenna connections. Interference from ship’s electrical system, thunderstorm activity, or another source is preventing signal lock-on. Also refer to Troubleshooting problems 6 and 7.

Troubleshooting Chart

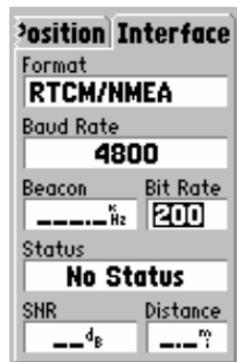


The receiver status indication at the top left of the Satellite Status Page will indicate '3D Diff' or '2D Diff' when differential corrections are available. A 'D' appears at the bottom of the signal strength bar for each satellite with a corresponding differential correction.

Troubleshooting Chart



If the 'No Differential GPS 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, not enough GPS satellites or bad wiring connection between the GBR 21 and GPS.



If either 'No Status', 'None', or 'Check Wiring' messages appear (depending upon model of GPS) see Troubleshooting problem number 7.

Problem	Possible Cause
6) GPS interface status screen displays "No data" or "No Signal"	Wrong frequency or bit rate selected on GPS unit. Antenna coupler not securely grounded. Check ground strap. Beacon transmitter not transmitting correction data.
7) GPS interface status screen displays "None", "No Status" or "Check Wiring"	GBR 21 not wired properly with GPS unit. Check wiring. No power to GBR 21. See Troubleshooting problem 1. Problem with DGPS antenna grounding or damage. Baud rates do not match. Beacon transmitter out of range. Try a different station.
8) Beacon signal weak or not received.	Antenna coupler not securely grounded. Check ground strap. Interference from ship's electrical system, thunderstorm activity, or another source is inhibiting signal lock on. Also refer to Troubleshooting problems 6 and 7.
9) 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. Too far from DGPS transmitter or not tuned to closest station.

GBR 21 Specifications

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 μ V

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

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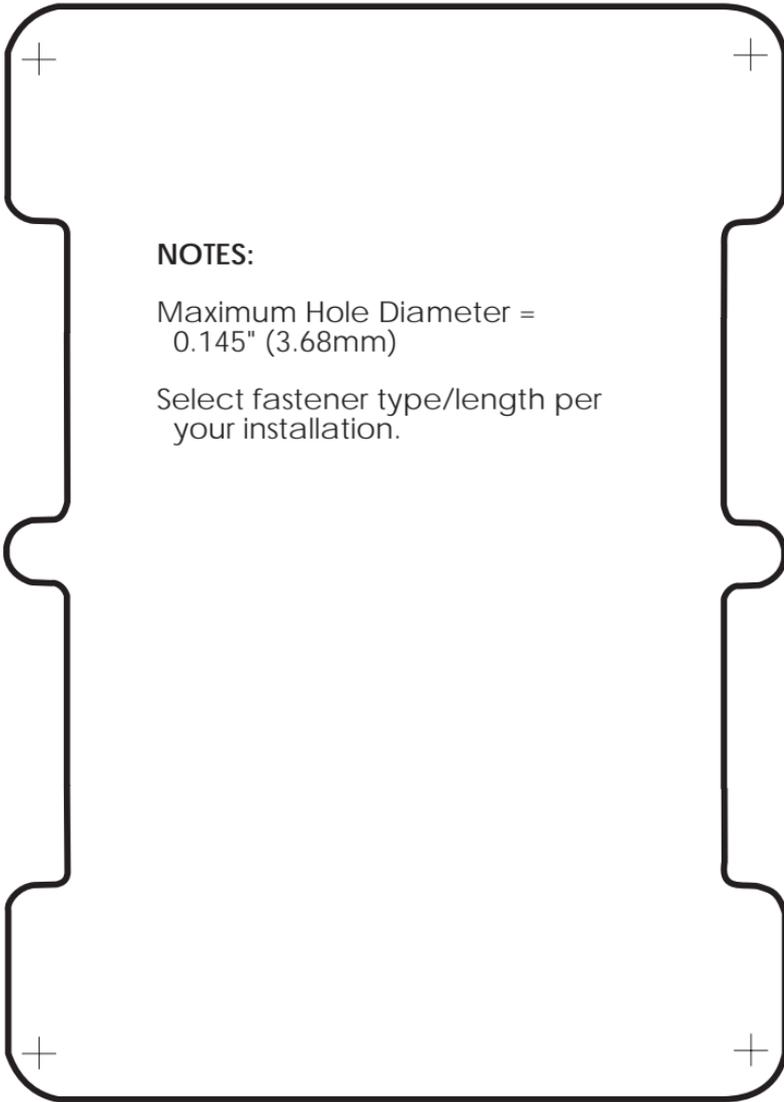
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Mounting
Template



4.752" (120.70mm)

3.359" (85.30mm)



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Part Number 190-00069-00 Rev. C