NORTHSTAR
TECHNOLOGIES

961X/XD
GPS CHART NAVIGATOR

INSTALLATION MANUAL

Revision A
Part Number GM1708

Northstar Technologies
30 Sudbury Road
Acton, Massachusetts 01720

www.northstarcmc.com
Service: 978/897-0770
Sales: 978/897-6600

Limited warranty policy

Northstar Technologies warrants the Northstar 961 to be free from defects in materials and workmanship for a period of two (2) years. This warranty applies to the original purchaser and to any subsequent owner during the warranty period, which begins on the date of shipment of the unit, F.O.B. Acton, Massachusetts, to an authorized Northstar dealer.

Systems may not be returned to Northstar without a Returned Materials Authorization (RMA) number. Call the Northstar dealer or Northstar for instructions.

During the unit's warranty period, Northstar will repair or replace, at its option, any part of the unit it finds to be defective due to faulty material(s) or workmanship. All such repairs and/or replacements will be promptly performed by Northstar free-of-charge to the owner, excluding freight costs incurred in shipping to the factory. Return shipments from Northstar to points within the United States are made via ground transportation, freight prepaid. Special shipping charges (overnight, two-day, and so on) are the responsibility of the owner.

To be covered by this warranty, the Northstar equipment must have been in normal use. This warranty does not apply to units with defects caused by improper installation, physical damage, abuse, tampering, lightning or other abnormal electrical discharge, or to units with defaced or altered serial numbers, or to units repaired by unauthorized persons or repaired in a manner that violates Northstar's recommended service procedures.

All repairs and/or replacements made under this warranty must be performed at Northstar's facilities in Acton, Massachusetts. Performance of warranty work elsewhere will not be authorized, and Northstar will not pay for any charges for such work. Northstar will not be responsible for payment of any charges imposed by a Northstar dealer or other party for services requested by and/or performed for a unit's owner in connection with this warranty. Such services might include removal of the unit from a vessel, inspection, packaging, handling, reinstallation, and the like.

Northstar Technologies assumes no responsibility for any consequential losses of any nature with respect to any of its products or services sold, rendered, or delivered. The foregoing is the only warranty expressed or implied. No other warranty exists.

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SECTION ONE - Introduction

Welcome

The *Northstar 961 Installation Manual* describes how to install the entire *961* system (control head, processor, and antenna). It describes the physical, mechanical, and electrical characteristics of the unit, as well as how to select the right location, and mount and wire the system. This manual also describes how to interface, troubleshoot, and maintain the Northstar *961* GPS chart navigator. For complete details on operating the unit, see the *Northstar 961 Operations and Reference Manual* (part number GM1700).

The terms "unit" and "*961*" are used throughout this manual to refer to the *961* GPS chart navigator. The *961*X is differential-ready so you can interface it to an external differential receiver. The *961*XD has a built-in differential receiver. Unless specifically indicated, all information in this manual refers to both the *X* (non-differential) and *XD* (differential) versions of the unit.

Who should read this manual

The *Northstar 961 Installation Manual* is intended for marine technicians who are configuring and installing the *961* GPS chart navigator.

CAUTION!

To obtain the best performance from your 961, Northstar strongly recommends that you have an authorized Northstar dealer perform the installation. Proper installation of the Northstar 961 is of utmost importance to accurately receive and effectively use GPS signals under a variety of weather conditions.

Scope of this manual

In this manual, you'll find information on the following procedures:

- choosing a location
- mounting and wiring the unit
- installing the antenna
- testing the unit
- interfacing the *961* to other instruments
- troubleshooting the unit
- configuring the NMEA output ports
- setting the auxiliary port

- setting pulses per nautical mile (PPNM)
- service functions
- maintaining the unit
- installing software updates and saving and restoring the database

The unit's technical specifications can be found in Appendix A at the back of this manual.

The rest of this section explains how to obtain technical support and how to return a unit for service.

Getting technical support

After you've followed the instructions in this installation guide, if you require additional technical support or have any other service-related questions, you can contact either your dealer or the Northstar Service Department. Northstar's Service Department can be reached by email, fax, U.S. mail, or phone as described in the table below. Whether you send an email or fax, or write or phone, please have the unit's serial number available, and be as complete and accurate as possible when describing the problem so that a service technician can research the problem and provide the quickest possible response.

You can email the Service Department directly from Northstar's website. The address is www.northstarcmc.com. From here, you also can access additional technical information under either the Manuals or Support links.

Northstar's Service Department is available between 9:00 AM and 5:00 PM Eastern Time, Monday through Friday, excluding major holidays.

Table 1: Contacting Northstar

Email: Service: service@northstarcmc.com Sales: sales@northstarcmc.com
Fax: Service: 978/897-1595 Sales: 978/897-7241
Telephone: Main number: 978/897-6600 or 800/628-4487 Sales: 978/897-0770 Service: 978/897-6600
U.S. mail: 30 Sudbury Road Acton, MA 01720
Website: www.northstarcmc.com (you can send email to Northstar directly from this site)

Hearing from you

Your feedback is important and helps ensure that this manual is a valuable resource for all marine technicians. Send your questions, comments, or suggestions about this manual to:

service@northstarcmc.com

Servicing the unit

Repair of the unit is performed only at the Northstar factory. Service includes a complete hardware and software check-out.

NOTE:
Field repairs are not authorized and will void the warranty!

For a system under warranty, shipping charges to the factory are the only cost for factory repair. Repaired units will be returned via prepaid economy ground freight (units returned overseas are chargeable).

Units and accessories returned for warranty repair that are determined to be without fault are subject to a handling charge.

Returning a unit for service

Before returning the unit to the Northstar factory, to prevent delays it is critical that you first obtain a Return Materials Authorization (RMA) number from the Northstar Service Department. If you purchased your unit through a dealer, call the dealer and provide your serial number so they can get you an RMA number.

Shipments without a proper RMA number will not be accepted!

CAUTION!

You may want to ensure that the user has backed-up any of their waypoints and routes before returning the unit for repair; see "Saving and restoring databases and system logs" beginning on page 63 for information on backing up waypoints and routes.

The unit is covered by a two-year hardware-only warranty, which, in summary, states that if the unit is returned to the factory by the owner or dealer during the warranty period, Northstar will repair or replace, free of charge, any part found to be defective due to faulty materials or workmanship, if the system has been properly installed and hasn't been abused. See the *Limited Warranty Policy* at the front of this manual for further details. The only cost to the owner will be the one-way shipping charges and any associated charges that may be imposed by the dealer. If you have overnight or second-day shipping requirements, before shipping the unit, please call the factory for turnaround time, freight charges, and payment arrangements.

The unit should be shipped only in a properly designed carton with packing material. Shipments to the Northstar factory should be made to the following address:

Northstar Technologies
Service Department
30 Sudbury Road
Acton, MA 01720 USA

Ordering information

To order spare parts or replacement/missing parts, call the Northstar Sales Department at 978-897-0770.

SECTION TWO - Installation

This chapter includes all the information needed to install the *961*. It begins with a review of the system components and then provides information on basic installation and powering on the unit. The rest of the chapter describes how to wire the unit, install the antenna, and troubleshoot. Proper installation of the Northstar *961* is of utmost importance to accurately receive and effectively use GPS signals under a wide variety of weather conditions.

Safety considerations

WARNING!

Be sure to turn the power off at the main switchboard before starting the installation. Further, it is highly recommended that you post a sign by this switch telling others to keep power off while you're performing the installation. If power is left on or turned on during the installation, fire, electrical shock, or other serious injury may occur.

WARNING!

Be sure that the voltage of the power supply is compatible with the unit's voltage rating, which can be found on the label at the rear of the unit. Connecting to the wrong power supply can result in fire or damage to the equipment.

Be sure to ground the equipment in order to prevent electrical shock or mutual interference.

WARNING!

Be sure to use the proper fuse. Using the incorrect fuse can result in fire or damage to the equipment.

CAUTION!

Make sure that the 961 does not interfere with any of the on-board systems. Check all other systems to ensure that their performance doesn't degrade when the unit is turned on.

CAUTION!

The 961 processor can only be mounted horizontally due to its rubber vibration mounts.

CAUTION!

If you must cut the processor's 10-foot power cord shorter, be sure to keep the external fuse intact. If the power cable must be longer than 10 feet, use a heavier gauge wire for those applications and be sure to use an external fuse.

System overview

The unit is shipped ready to install and operate.

It is recommended that you follow the steps below:

1. Check the shipping carton for any damage, and immediately report any damage to the carrier. Save all packing material in case you have to return the unit to the factory for repair or evaluation. For return procedures, see "Returning a unit for service" beginning on page 3.
2. Unpack the cartons. Compare the *961 Packing List* (P/N GM1703), included in the *961*'s packaging against the contents in those cartons and with what you ordered.
3. Make sure you have the tools necessary to complete the installation.
4. After reviewing the components, next, review the components of a proper installation. For details, see "Installation considerations" beginning on page *6*.
5. Choose the best location to mount the control head(s) and processor. For suggestions and further information, see "Choosing a system location" beginning on page *9*.
6. Choose the best location to mount the antenna. For suggestions and further information, see "Installing the antenna" beginning on page 14.
7. Review the section on wiring the system. For details, see "Wiring the *961*" beginning on page 12.
8. Install the control head(s), processor, and antenna. (You may want to temporally install the antenna, then try operating the *961* to ensure the antenna location works well before permanently installing the antenna.)
9. Turn on the unit. For details, see "Turning the unit on and off" beginning on page *26*.
10. To ensure that the system is installed correctly and running properly, perform a functional test. For details, see "Testing and troubleshooting the *961*" beginning on page 32.
11. If desired, interface the NMEA output ports; for details, see "Configuring the NMEA output ports" beginning on page 46. If desired, interface the auxiliary port, see "Setting the auxiliary port" beginning on page 53.

Installation considerations

CAUTION!

The following basic installation considerations aren't a substitute for all the details in SECTION TWO. To ensure that you meet all critical installation parameters, be sure to read and follow everything in this section.

Ensuring a proper 961 installation

To ensure a proper installation, it is highly recommended that you perform all of the following activities before starting the installation:

- preview/survey the vessel's layout and existing equipment
- review all the installation materials
- review all the installation requirements, including:
  - the physical requirements (spacing, location with regard to other equipment, etc.)
  - the electrical and electronic requirements (interference between other pieces of equipment, power requirements, etc.)

Although the unit itself is very straightforward and easy-to-understand, it has a few basic requirements that must be met before safe and proper operation can be assured. The major parts of the rest of this section address several topics regarding the *minimum* installation requirements for the unit to:

- minimize electrical wiring hazards
- be mounted correctly
- accurately receive GPS and DGPS signals
- navigate safely

Avoiding shortcuts

The majority of installation problems are caused by shortcuts taken with system cables. When installing your 961, be sure to:

- assemble the connectors carefully
- don't make sharp bends in the cables
- leave service and drip loops
- tie-wrap all cables to keep them secure
- if cables are lengthened, seal all wiring splices

Using the GPS antenna (AN150)

The "active" GPS antenna is best mounted in the clear, and low on the vessel to avoid extra motion from pitching and rolling. It should be mounted lower than directional high-power transmitting antennas such as radar or satcom. The length of coaxial cable to the "active" AN150 antenna (supplied with the unit) must be a minimum of 20 feet, but not more than 100 feet. Coil up any unused length of cable; **do not cut it to less than 20 feet!** Be sure that all cable connectors are securely fastened, and that the cable itself is not subject to any tight bends.

For complete details about installing the AN150, see "Installing the antenna" beginning on page 14.

Using DGPS with an AN150 and 8410 ACU

If the unit is equipped with a differential receiver *(and you're using the AN150 GPS antenna, not the AN205-P GPS/DGPS combo antenna)*, this receiver must be connected to a Northstar 8410 differential Antenna Coupling Unit (ACU). The ACU's four-foot whip antenna should be mounted as high as conveniently possible (but not at the highest point) and as far away as possible from other antennas. The ACU can be mounted on a standard marine antenna mount (1" diameter, 14 threads per inch).

For complete details about installing the AN150/8410 ACU, see "Installing an 8410 ACU (for use with the AN150 only)" beginning on page 22.

Using the DGPS antenna (AN205-P)

For complete details about installing the AN205-P, see "Installing the antenna" beginning on page 14.

Bench-testing the 961

It is recommended that you bench-test the unit before installing it on the vessel. Bench testing ensures that the equipment is fully operational, and allows the GPS receiver to collect its almanac and ephemeris data for the installed location, which results in less on-board installation time.

Choosing a system location

The *961* consists of two major parts—a processor and a control head. The *961* supports two fully functional control heads (the second head is optional). The *961* system comprises the processor and control head, GPS receiver, optional differential receiver, controls, and the specially-coated display screen.

Mounting the control head

You can either yoke- or flush-mount the control head: Use the yoke-mount kit as a framework for holding the control head, or flush-mount the control head directly onto a flat surface of your choice. Using the Northstar-supplied yoke mounting kit usually provides a quicker and less expensive installation than a flush-mount installation.

Regardless of the type of mount, here are a few helpful hints about where to mount the control head. Choose the mounting location carefully—before any drilling or cutting takes place. Choose a location that:

- is convenient, accessible, and within comfortable reach
- gives you easy access to the function keys
- is where you can clearly see the display screen from your normal vantage point when navigating
- for best display contrast, is viewed from below, looking up at the display screen
- provides a reasonably direct path for running the required electrical cables
- has minimal glare from windows or other bright objects (even though the unit has a high-contrast, anti-reflective LCD screen that's specially coated and readable in direct sunlight, you'll want to make the screen as visible as possible)
- if flush-mounting the head, make sure you choose an area that's well-ventilated; poor ventilation may cause overheating, resulting in potential backlighting problems

Yoke mounting

For yoke mounts, leave ample room—usually two inches—all around the sides and top to avoid crowding the unit. Also allow a clearance of at least 2½ inches in the rear just for the cables and connectors. For the recommended yoke-mount installation dimensions, see Figure 1, and Figure 2.

Before drilling holes, rotate the unit to the desired angle to ensure proper clearance for cables and operation of the unit.

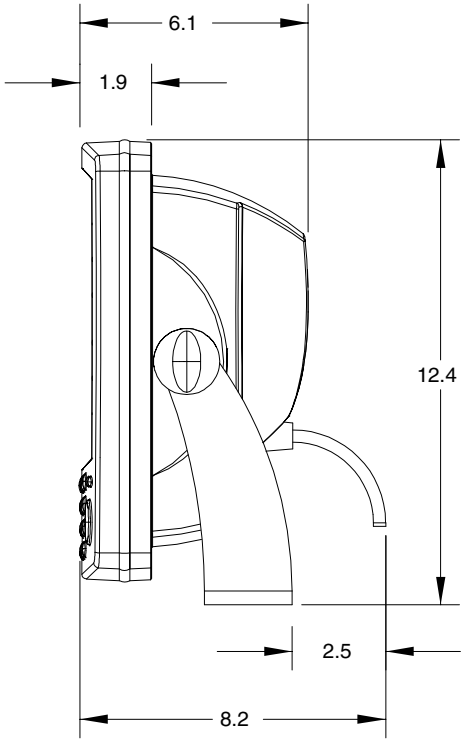


Figure 1: 961 control head yoke-mount dimensions (side)

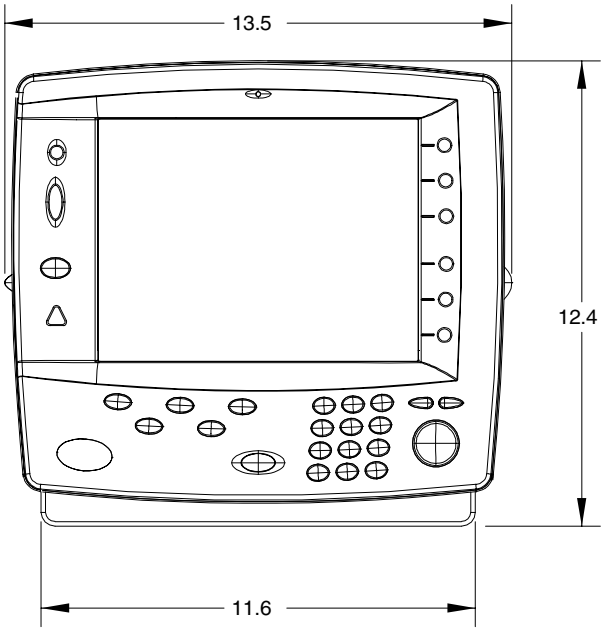


Figure 2: 961 control head yoke-mount dimensions (front)

Flush mounting

For flush-mounting the unit, allow at least 2½-inch clearance at the rear for cables and connectors.

For the recommended flush mounting drilling dimensions, see Figure 3 below. For the full-size version of the flush-mount installation measurements and instructions, refer to the full-size flush-mount template (P/N GT1600) included in the 961 shipping carton.

CAUTION!

When flush-mounting, be sure to mount the unit on a flat surface. Mounting on a curved surface can distort or break the plastic and cause a breech in the waterproof seal.

Make sure you provide for adequate ventilation, especially if the unit is installed in a closed area that's usually poorly ventilated. Poor ventilation will cause the head to overheat, which in turn may cause the display screen to darken.

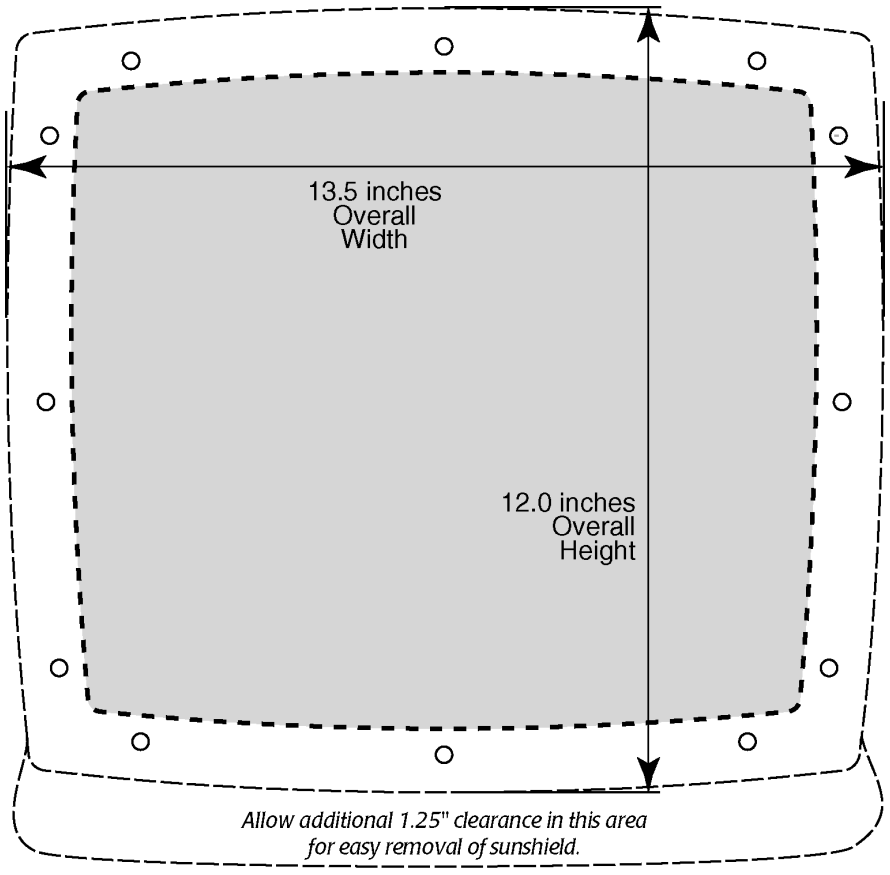


Figure 3: 961 control head flush-mount drilling dimensions

Installing the processor

For the processor installation measurements and instructions, refer to the full-size flush-mount templates, "961 Processor Mounting Template, top view" (P/N GM1700) and the "961 Processor Mounting Template, front view" (P/N GM 1701) included in the 961 shipping carton.

To properly install the processor, you must first install the mounting bracket to the surface of the vessel, then attach the processor to the bracket.

Processor installation tips

- check the dimensions of the processor mounting bracket; these dimension are provided on the enclosed template.
- follow the recommended clearance around the sides and front of the unit.
- install the processor in a spacious, well-ventilated area to minimize heat-related problems.
- mount the processor on a hard, solid, vibration-free surface of at least 3/4-inch thickness. If the surface is carpeted, make sure that the carpet doesn't block the bottom ventilation holes or interfere with the mounting plate vibration/shock mounts.
- 10-foot power cable goes to 10-36 Volts DC.

Wiring the 961

The majority of installation problems are caused by shortcuts taken with system cables. When installing the unit, be sure that you:

- assemble connectors carefully
- don't make sharp bends
- leave service and drip loops
- tie-wrap all cables to keep them secure
- if cables are lengthened, seal all wiring splices

The 961 operates on DC power from a 10-volt minimum to a 40-volt maximum connected by at least 16-gauge wire. The 10-foot power cable supplied with your 961 should be long enough for most installations, but if you must lengthen the power cable, you can extend it to a maximum of 25 feet without adversely affecting the 961's operation. For lengths up to 15 feet, the power connections to the battery must use 16-gauge wire or heavier. For lengths of 15 feet or more, use 14-gauge wire or heavier.

Regardless of the length of the cable, you should use a 20-amp external fuse as an added safety precaution ((the 961 has an external fuse in its standard 10-foot power cable). The external fuse protects the vessel wir-

ing and prevents electrical fires. The power wiring should be connected directly to the battery when possible for optimum noise immunity.

CAUTION!

Ensure that fuse or circuit-breaker protection is provided at the power source. If you must cut the processor's 10-foot power cable shorter, be sure to keep the external fuse intact. If the power cable must be longer than 10 feet, use a heavier gauge wire for those applications, and be sure to use an external fuse.

Electrical power requirements

The *961* is a negative-ground system. After the processor has been installed–but before you turn the *961* on–verify that the wires in the 10-foot power cable are connected as follows:

- Red – positive (+) 10 to 40 Volts DC (VDC)
- Black – negative (–)

Wiring the system

The back of the processor, with all the proper wiring and connections, is shown in "Figure 4: Processor connectors (back of unit)" below.

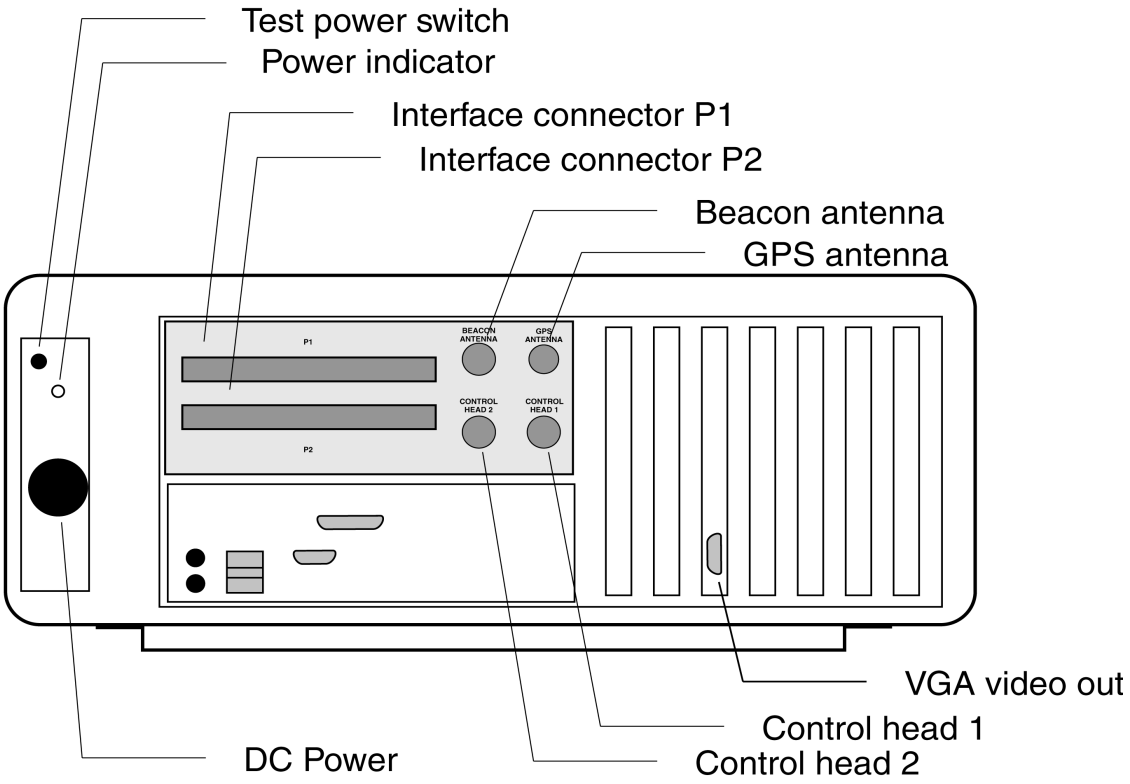


Figure 4: Processor connectors (back of unit)

Connectors

- Power connector (3-wire)
- TNC connector (control head #1)
- TNC connector (control head #2)
- I/O #1 interface connector (18-wire)
- I/O #2 interface connector (18-wire)
- GPS antenna connector (BNC)
- DGPS antenna connector (UHF)
- PC connectors (variable)
- VGA

Installing the antenna

Choosing an antenna

Three antenna choices are available for the *961*X or *961*XD:

- one for reception of GPS-only signals (the standard one-piece "active" AN150 antenna)
- one for reception of both GPS and DGPS signals (a two-piece antenna system comprising the standard AN150 GPS antenna and the 8410 DGPS coupler)
- one for reception of both GPS and DGPS signals (optional one-piece AN205-P "combination" antenna)

Choosing an antenna location

Choosing the AN150 antenna location

The GPS receiving antenna is a vital link between the unit's receiver and the outside world. Aesthetics and easy access should be secondary to providing strong and reliable GPS signals to the unit's receiver. You should select a location for the antenna that meets the following requirements:

- The antenna should have a reasonably clear view of the horizon, but be no higher than necessary (side-to-side motion of the antenna caused by rolling of the vessel may degrade the SOG and COG readings); however, the antenna should be 12 to 18 inches above the surrounding surfaces to avoid interference.
- The antenna must be out of the radiation path of any on-board radar sets or strong magnetic fields.
- The antenna must be lower than any INMARSAT communications antenna.
- The antenna should be as far as possible from other high-power transmitting antennas.
- Watch out for electromagnetic "shading" of antennas from rigging, other vessels, shoreline buildings, and so on. Secure the cable well.

To avoid mutual interferences among different antennas on the vessel, refer to the drawing of recommended separation distances in Figure 5: 'Separation distances between antennas,' below.

Figure 5 shows the minimum recommended distances for the separation of the GPS antenna from other antennas and physical mounting surfaces. Under normal circumstances, following these guidelines usually result in a relatively trouble-free installation.

The installer may want to adjust these distances, however, depending on the particular equipment and how it is configured. Since each installation is unique—according to the wishes of the customer—this information should be used only as a guideline. It is not absolution in determining the best locations for every possible equipment configuration.

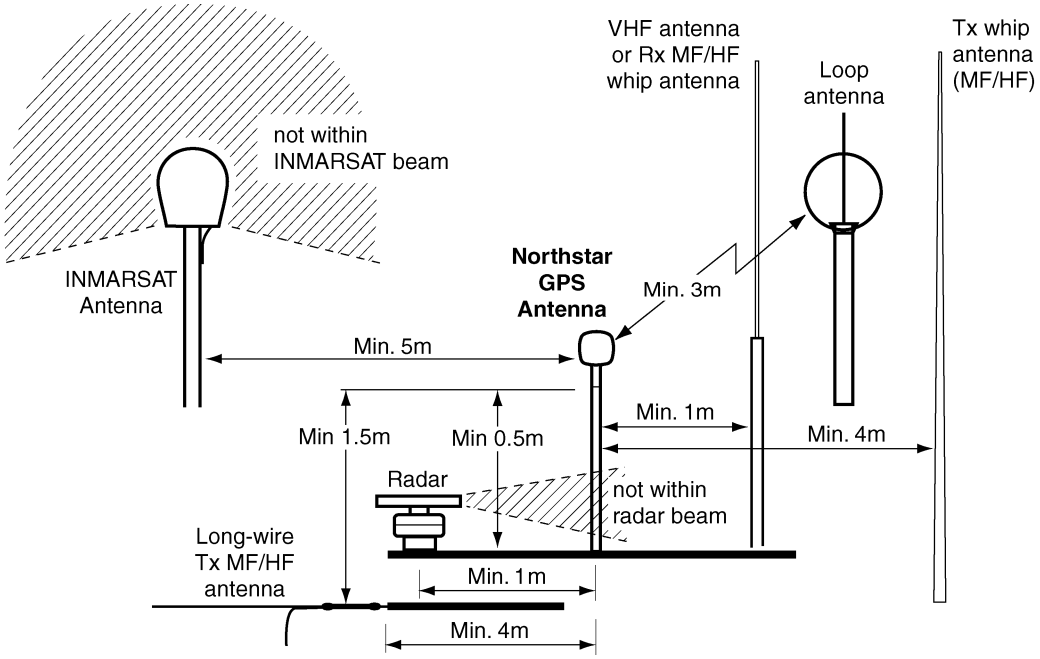


Figure 5: Separation distances between antennas

NOTE:
Be especially careful about the distance between the combo antenna and any sources of magnetic interference (for example, the INMARSAT antenna).

Choosing the AN205-P combination antenna location

A combination GPS/DGPS antenna is available for applications involving serious grounding problems (which creates noise issues with the beacon receiver), where optimum portability is required, or when only a single

antenna is desired. The AN205-P doesn't require any ground and is portable, an advantage when it must be moved from one vessel to another. The "combo" antenna should be located where it has a clear view of the horizon, but is not the highest point on the vessel. Keep the combo antenna at least six feet away from objects that can "shade" GPS or differential signals.

If poor GPS Signal-to-Noise Ratio (SNR) readings are obtained after the unit has been running for several minutes, check that you have the proper length of cable, and verify the quality of the antenna location and the quality and proper termination of the connectors. SNR should be as high as possible. Values of 15 and higher are preferable; anything below 10 could indicate poor reception.

About the antenna cabling

Supplied with your 961 system is a 50 foot-length of RG-59 coaxial cable to use with either the AN150 or the AN205-P. *The length of coax cable to the AN150 antenna must be no less than 50 feet and no more than 100 feet; to the AN205-P, no less than 20 feet and no more than 50 feet.* When installing antenna cable, don't bend it tightly in any places, and fasten the cable along its length to avoid chafing or whipping of any kind. *Coil up any unused length of cable.* Secure the cable well (the center conductor is solid wire), and securely fasten all cable connectors.

Installing the AN150 antenna

Whereas a loran or differential antenna should be mounted high on the vessel for best performance, the GPS antenna should be mounted as low as possible and out in the open to avoid "shading" (placement of the antenna where it is partially obscured by another object from the signals it must receive). If mounting on top of a tower or mast, understand that the unit will be affected by the pitch and roll of the vessel. Often the bow or stern will provide a location where shading is minimized, while serving to keep the antenna low. Be sure that any directional L-band transmitting antennas (such as radar or satellite communication antennas) can never point at the GPS antenna--its internal preamplifier is quickly destroyed by such radiation.

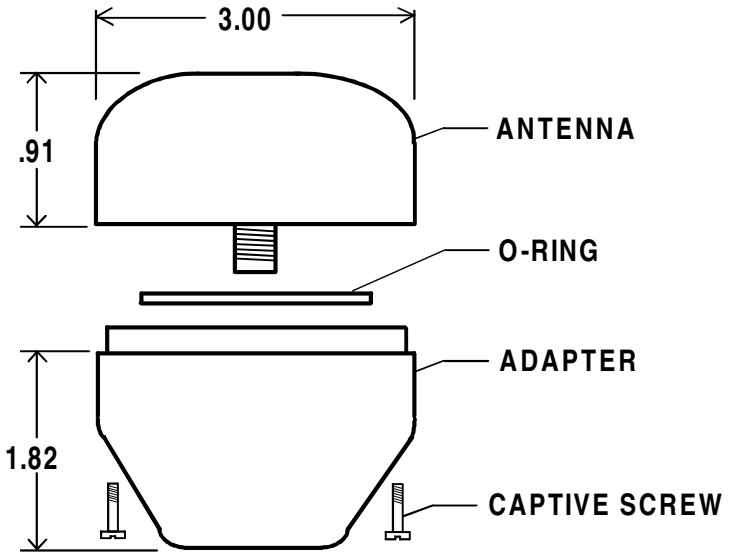


Figure 6: GPS-only antenna (AN150)

Wiring the AN150 antenna

Supplied with the antenna is a 50-foot length of RG-59 coaxial cable for use with either the GPS-only AN150 "active" antenna (as well as the GPS/DGPS AN205-P "combo" antenna).

CAUTION!

The GPS-only antenna must be used with a minimum of 20 feet of cable, and no more than 100 feet. Any unused length must be coiled up; do not cut it to less than 20 feet!

Mounting the AN150 antenna

Tools needed:

- flat-bladed screwdriver
- knife blade
- Amphenol crimp tools

One TNC connector is pre-attached to the antenna-end of the RG-59 coaxial cable. Connection to the antenna itself involves the following steps:

1. Remove the antenna base by loosening the four captive screws in the base.
2. Screw the base onto the top of the antenna mount (standard 1"-14 marine thread).

3. Feed the open end of the supplied coax cable down through the antenna base and through the hollow core of the antenna mount.
4. Affix the TNC connector-end of the coax to the mating connector inside the upper half of the GPS antenna. Be sure to tighten it securely, as vibration can loosen the connection over time. In addition, protect the coax-to-antenna connection with liquid electrical tape or self-vulcanizing electrical tape.
5. Align the upper half of the antenna with the bottom half and tighten the four screws. Be careful not to over-tighten the screws, as this may deform the watertight seal between the two antenna halves.
6. Make a termination for a male BNC connection—as described in the following steps—then connect the antenna to the female BNC connection at the back of the unit.
    1. Strip cable jacket to the following dimensions (in inches), as illustrated in Figure 7: 'Stripping the coax cable jacket,' below: a=0.57, b=0.34, c=0.14, d=0.43. Do not nick the center conductor.

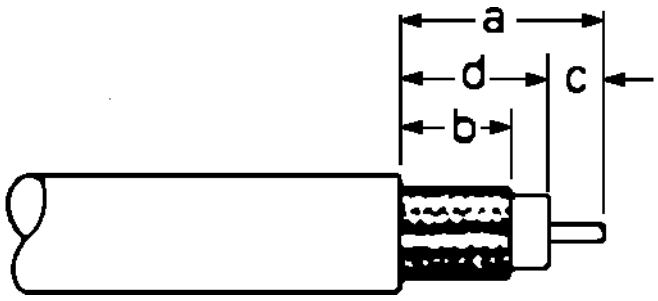


Figure 7: Stripping the coax cable jacket

    2. See Figure 8: 'Flared cable braid,' below: Slide outer ferrule on as shown. Slightly flare the end of cable braid, as shown, to facilitate insertion into inner ferrule.

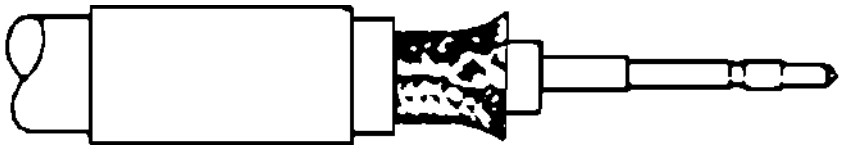


Figure 8: Flared cable braid

    3. Place center contact onto center conductor so that it butts against the cable dielectric. Crimp the contact in place using Amphenol tool handle #227-944 and Cavity B of Die Set 227-980-3.
    4. Install cable assembly into body assembly so inner ferrule slides over dielectric and under braid. Push cable

assembly forward until contact seats in insulator. Slide outer ferrule over braid and up against connector body. Crimp outer ferrule using Cavity A of tools specified above. The connector ferrule-to-cable junction can be sealed and protected using adhesive-lined heat shrink.

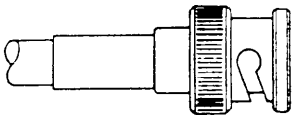


Figure 9: Completed BNC connector

Installing the AN205-P antenna

The combo antenna provides for an easier, more compact, and better-looking installation, and in many cases, the loop antenna design improves the noise rejection of signals interfering with differential signals.

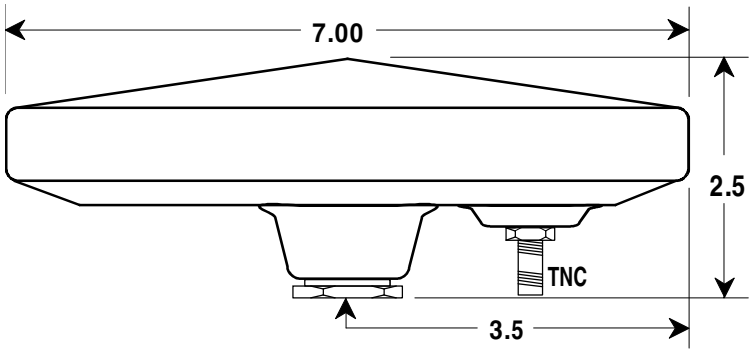


Figure 10: Combo GPS/DGPS antenna (AN205-P)

CAUTION!

The combo antenna must be used with a minimum of 20 feet of cable, and no more than 100 feet. Any unused length must be coiled up; do not cut it to less than 20 feet!

Wiring the AN205-P antenna

When you use the AN205-P combo antenna, a cable "splitter" is required to separate the signal path of the single cable from the antenna into two cables for connection to the *961*. For the proper installation of the splitter, refer to "Figure 11: Correct AN205-P (combo antenna) splitter wiring" below. The splitter should be located near the unit for convenience, but may be situated virtually anywhere along the length of the maximum 100 feet of RG-59 GPS cable, without appreciable signal loss. Note, how-

ever, that the splitter isn't weatherproof and should be placed in a protected area where it won't be subjected to direct water splash or spray.

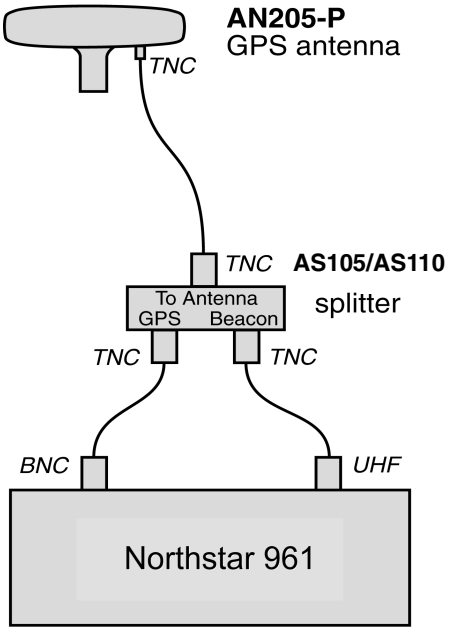


Figure 11: Correct AN205-P (combo antenna) splitter wiring

Avoid tight bends when installing any antenna cable. Be sure to fasten the cable along its length to avoid chafing or whipping of any kind.

After the antenna has been mounted and the cable has been cut to length–not less than 20 feet–install the supplied TNC connector at the other (*961X*) end. See Figure 12, Figure 13, and Figure 14 below. A satisfactory crimp for this connector may be made with a commonly available, high-quality crimping tool designed for use with TNC connectors.

NOTE:
Be sure that you properly install the TNC connector: Most system failures—whether continuous or intermittent—can be traced to poor connector installation.

Mounting the AN205-P antenna

1. Strip cable jacket to the following dimensions (in inches), as illustrated in Figure 12: 'Stripping the coax cable jacket,' below: a=0.57, b=0.34, c=0.14, d=0.43. Do not nick the center conductor.

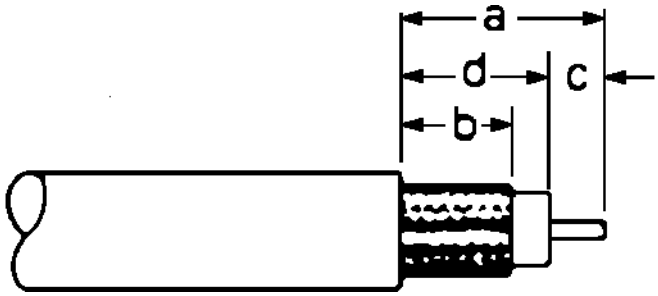


Figure 12: Stripping the coax cable jacket

2. "Figure 13: Flared cable braid" below: Slide outer ferrule on as shown. Slightly flare the end of cable braid, as shown, to facilitate insertion into inner ferrule.

Figure 13: Flared cable braid

3. Place center contact onto center conductor so that it butts against the cable dielectric. Crimp the contact in place using Amphenol tool handle #227-944 and Cavity B of Die Set 227-980-3.
4. "Figure 14: Completed TNC connector" below: Install cable assembly into body assembly so inner ferrule slides over dielectric and under braid. Push cable assembly forward until contact seats in insulator. Slide outer ferrule over braid and up against connector body. Crimp outer ferrule using Cavity A of tools specified above. The connector ferrule-to-cable junction can be sealed and protected using adhesive-lined heat shrink.

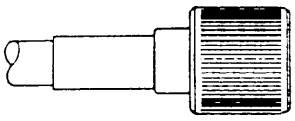


Figure 14: Completed TNC connector

Installing an 8410 ACU (for use with the AN150 only)

If you want to receive differential corrections with the *961* and you're using the AN150 antenna, you must use the Northstar 8410 Antenna Coupling Unit (ACU). Although similar in appearance to Northstar loran ACUs, only the unit labeled "8410" will work with the internal DGPS receiver. The ACU also serves as a sturdy mounting base for the whip antenna.

Mounting the 8410

The Northstar 8410 differential receiver antenna should be mounted as high as conveniently possible (but not at the highest point) and as far away as possible from other antennas. If you have several possible antenna locations, you may evaluate each by operating the unit with the DGPS antenna temporarily mounted in each location.

The best location is one providing the lowest "noise" count (atmospheric impulse noise generated by thunderstorms and other conditions, including vessel-generated noise and any on-board interference) and highest Signal-to-Noise Ratio (SNR). You can view both of these values after you turn the unit's power on; see "Turning the unit on" beginning on page 26.

Another major concern, precipitation static (called "P-static"), must be addressed when installing the differential antenna. The 8410 receives weak AM signals and can be sensitive to nearby noise sources and P-static. P-static generally appears only during rain or snow; consequently, it can easily be overlooked during installation. Much like a loran antenna, the effects of P-static are minimized if the differential antenna is mounted so that it isn't the highest metallic object on the vessel. The highest metal object acts much like a lightning rod, attracting tiny static discharges in the atmosphere. If the differential receiver antenna is the highest object, these discharges can totally override the differential signals and cause poor operation in bad weather. The optimum antenna location is high and clear for fair-weather operation, but below the top of a metal mast or other antenna for best foul-weather operation. On sailing vessels, the ACU might be mounted on top of a low mast, or on the stern rail if no other suitable location is available.

The 8410 differential receiver ACU can be mounted on a standard marine antenna mount (one inch diameter, 14 threads per inch).

For special applications involving serious grounding problems, or where optimum portability is required, you can use the AN205-P combination GPS/DGPS antenna; for details, see "Installing the AN205-P antenna" beginning on page 19.

The ACU consists of two pieces, the body and the base. The circuitry is sealed in a rugged, waterproof, fiberglass polycarbonate body, the upper end of which is threaded to accept a standard 4-foot whip antenna. A large female thread is molded into the lower portion, or base, of the ACU

body into which the upper half is secured (see Figure 15, “ACU Assembly”). A gasket and rubber O-ring on the upper half provide weathertight sealing when the two halves are secured. The bottom of the base is threaded (1"–14) to mount onto an antenna mast or onto a standard deck mount.

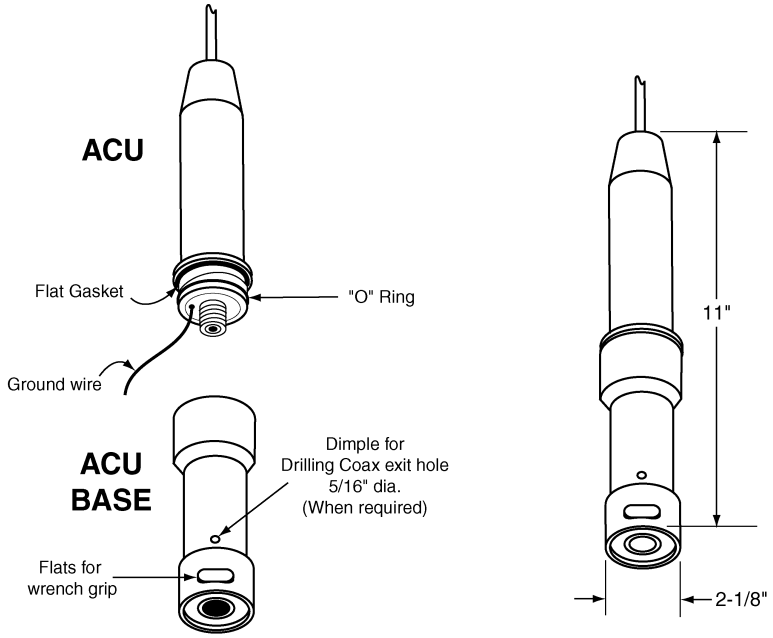


Figure 15: ACU assembly

CAUTION!

Maintaining the ACU’s weathertight seal between its upper and lower halves requires only hand-tightening the two together. Using a wrench or other tool may distort the gasket or housing/ rubber O-ring inside, or break the coupler base.

The ACU connects to the 961X with RG-58U coaxial cable, which carries signals to the differential receiver and DC power to the ACU amplifier. See Figure 16 below for the correct AN150/8410 wiring. A 25-foot length of this cable is supplied with the unit; this cable may be extended up to a length of 300 feet. The cable passes up through the hollow ACU base and connects to the PL-259 (UHF) connector at the bottom of the ACU. For UHF connector preparation, see“Differential GPS antenna cable connectors” beginning on page 25.

NOTE:
This connection must be made before *the ACU is screwed into its base.*

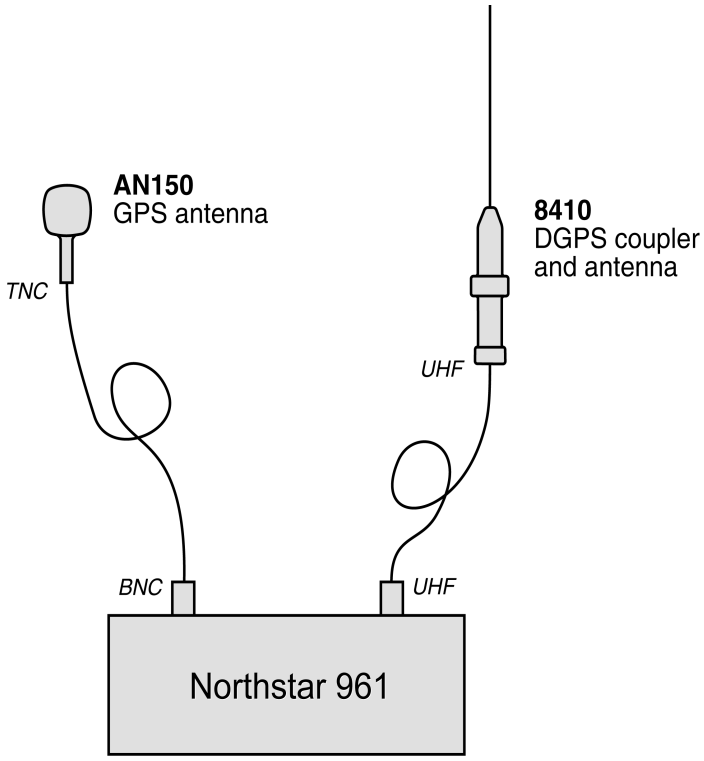


Figure 16: Correct AN150 and 8410 wiring

RF grounding

The grounding system is an equal partner with the antenna in producing quality differential beacon signals for the *961* differential receiver. Lack of proper grounding can adversely affect differential signal strength, as well as SNRs, and is the most common source of problems with differential antenna installations. The same grounding techniques that have worked well for loran systems will work equally well for differential antenna systems. Essentially, the ground system provides a secure connection to a large electrical mass; ideally, the earth itself. On a vessel, this means establishing electrical contact with "seawater" ground. On a steel vessel, a good connection to the hull or steel pilothouse is sufficient. Wood or fiberglass vessels require a metal ground plate or a thru-hull fitting. If the metal ground plate is impractical, the engine block or the negative (–) battery terminal can sometimes be used, but only as a last choice due to stray electrical noise that may be present at these locations.

The 8410 ACU has a separate black ground wire inside the coupler base, this wire should be connected to an electrically quiet ground location. This wire is the AC signal ground connection from the antenna input circuit. The purpose of bringing it out is to make available a separate signal ground path. Use #16 AWG minimum for grounding. If possible, use a grounding "strap" that is designed for this purpose.

Other electrical equipment onboard can cause large amounts of electrical noise, even at points that appear well-grounded. Try several ground points (ground plate, vessel ground, engine block, and so on) to determine which works best under different conditions.

WARNING!

Whenever any antenna is disconnected from on-board equipment, be sure to ground the antenna shield in order to discharge extremely large static voltages that can quickly build up on an ungrounded antenna system. These voltages are hazardous to personnel and equipment!

Differential GPS antenna cable connectors

Both ends of the differential beacon receiver antenna cable end in UHF connectors. To prepare UHF connectors, follow the assembly instructions in Figure 17. For best results, coat these connectors with silicone dielectric grease (DC 4 or equivalent) to protect the connector junction against water intrusion and surface corrosion of the contacts.

In addition, the connector area including the shield-to-connector junction and jacket-to-crimp ferrule area can be protected with liquid electrical tape (Starbright Liquid Tape comes in color-coordinating black or white), or self-vulcanizing electrical tape (Tommy Tape).

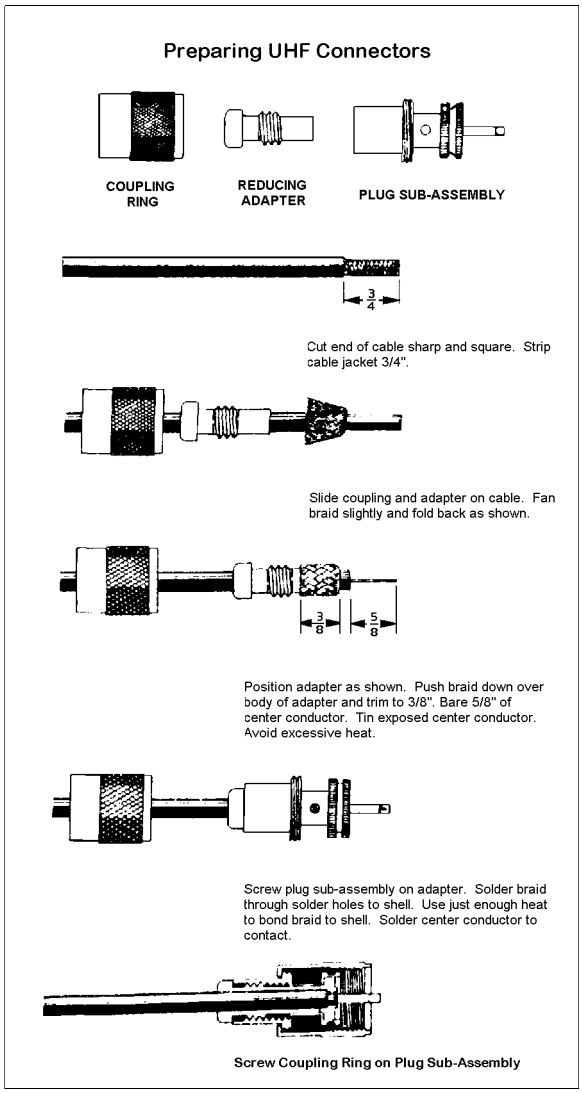


Figure 17: PL-259 (UHF) connector

Turning the unit on and off

Turning the unit on

To activate the unit, briefly press the **PWR** key. This activates the control head and the processor. After several minutes, the INITIAL STARTUP screen appears (as shown in Figure 18 below). This screen displays for about five to ten seconds. The unit will then perform a series of system self-tests in which it checks critical components and functions for any errors, as shown in Figure 19.

Figure 18: Initial startup screen

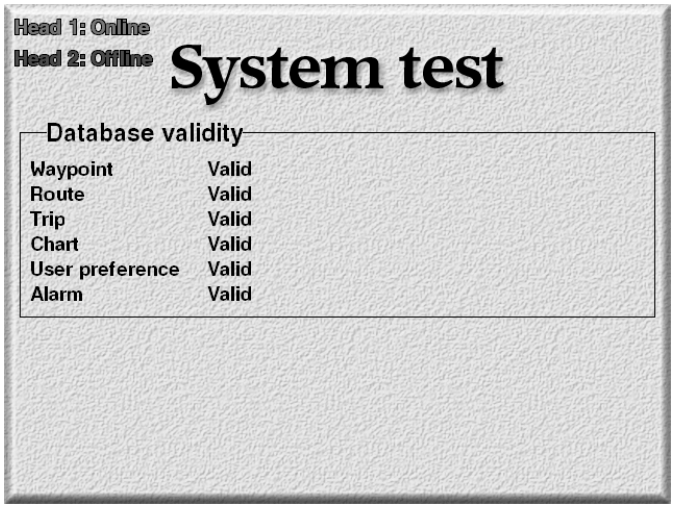


Figure 19: System test screen

After the SYSTEM TEST screen, the *961* automatically displays the OWNER'S MESSAGE screen, as shown in Figure 20, for about 10 seconds. For information on creating a personal owner's message (such as the owner's name and name of the vessel), see "System security" in the *Northstar 961 Operations and Reference Manual* (GM1700).

Figure 20: Owner's message screen

NOTE:
A brief warm-up period may be required for the unit's display screen to achieve its full intensity, if the unit's power has been off and its display screen is "cold."

Advisory message

After the OWNER'S MESSAGE screen, the special advisory message is displayed as a precautionary reminder that the unit's chart cartography must not be relied upon as the sole means of safe navigation. Although every effort has been made to ensure that the data used by the unit is as close to paper charts as possible, errors and omissions are inevitable. **Therefore, extreme care must be used when navigating by means of electronic charts.** It is the captain's responsibility to cross-check the 961 against other sources of navigation data. To proceed, accept the advisory message by pressing any key.

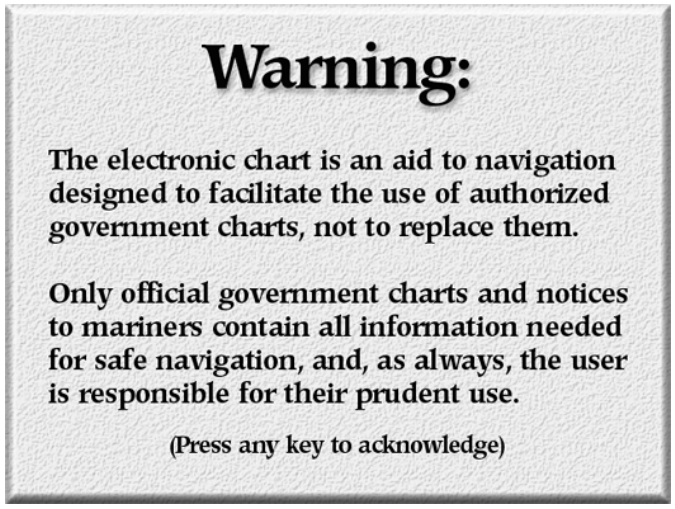


Figure 21: Advisory message

If chart CDs for your geographical area have been installed onto the *961*'s hard drive, and after the unit acquires GPS signals, you'll see your vessel symbol centered on the CHART screen at your present position. Until the *961* acquires GPS signals, the small position-fix circle will be located at the last known position.

If there aren't any charts covering your geographic location installed on the hard drive, the *961* displays a plotter grid instead of a chart.

For new units only

When you first turn your *961* on, you'll see your present vessel position at the center of the chart, represented as a small circle. A *961* that recently has been used either *at* or *near that same position* will usually be ready to navigate within several minutes.

If the *961* doesn't acquire GPS signals soon enough, however, your last position fix (from the last time the unit ran) will be represented by a small position-fix circle; you'll see an alarm message in the upper portion of the CHART screen, and you'll hear the GPS alarm beep. This sequence often occurs when a *961* is used for the first time in a new location hundreds of miles from where it was last used, and means you're being notified that the *961* is searching for the necessary satellites. This take should take two to five minutes to acquire, after which the *961* is ready to navigate.

GPS signals

The *961* uses a high-performance GPS receiver as its primary source of position data. Calculated directly from the received satellite data are your present position in lat/lon coordinates, time of day and date, speed-over-ground (SOG) and course-over-ground (COG), and an estimate of the *961*'s accuracy.

Once the unit is turned on and has acquired satellite data, you can check the quality of the GPS signals being received by viewing the various satellites' SNR (Signal-to-Noise Ratio) readings.

GPS receiver status summary

To display information about the GPS satellites, press the **STAR** key to display the SERVICE MENU screen, then press the **GPS STATUS** key. The *961* displays the GPS SATELLITE STATUS screen, showing the status of the GPS receiver. This screen also displays the status of the DGPS receiver, if installed (*961*XD).

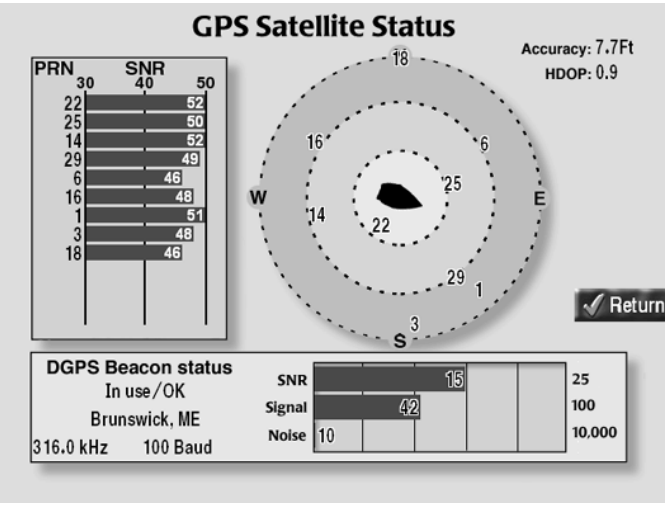


Figure 22: GPS satellite status screen

The GPS SATELLITE STATUS screen shows the received Signal-to-Noise Ratio (SNR) for each satellite (up to 12), and a map indicating where the satellites are now located in the sky. Satellites are identified by their pseudorandom number (PRN), a two-digit number assigned by the U.S. government. The center of the satellite map represents the center of the sky, and the outer ring is the horizon. The view is looking down from above, with East to your right and West to your left.

Also displayed on the screen is the following GPS data:

- ACCURACY
- HDOP (horizontal dilution of precision)

Accuracy is the estimated accuracy of the GPS system to be expected at the current time. Your position readings should be more accurate than this estimate *95* percent of the time.

HDOP is a technical measure of how good the satellite pattern is in the sky for fix-taking purposes. HDOP depends on how many operational satellites are in view and where they're currently located. HDOP is calculated from the satellites' current positions, not on actual received signals,

and doesn't consider atmospheric conditions, Selective Availability, and signal interference, all of which affect accuracy. HDOP can range from an ideal value of slightly less than one, up to a poor value of 10 or more; any value less than two indicates excellent performance.

Lat/lon coordinates

On the CHART screen INFO BARS, the *961* displays lat/lon as degrees, minutes, and thousandths of minutes. To display this data, press the **INFO** key several times. After press the first **INFO** key, a second **INFO** key is displayed, letting you display additional data on the second INFO BAR.

SOG and COG

You can display SOG and COG in the INFO BAR on the CHART screen, or on the 3-D STEER screen or numeric STEER screen. To display SOG and COG on either the STEER or 3-D STEER screens, press the **STEER** key once or twice.

SOG and COG readings result from ongoing measurements derived from the satellite signals; SOG speed is updated every second. You can set the *961* to display its SOG and COG readings more smoothly by setting the GPS speed averaging value up to 10 seconds. Increasing this averaging time, however, may reduce overall reaction time. For more details about GPS speed averaging value, see Chapter 14 in the *Northstar 961 Operations and Reference Manual* (GM1700).

Loran-C TDs

The *961* also calculates Loran-C TDs from the GPS coordinates, and displays them on the CHART-screen INFO BARs. For more details, see "Viewing loran TDs" in Chapter 5 of the *Northstar 961 Operations and Reference Manual* (GM1700).

About auto-dimming mode

If you don't touch any key on the control head for one hour or more, its LCD screen automatically dims to about half its normal brightness (based on its current brightness), if required by the system. Pressing any key at any time automatically restores the display's previous brightness level. This function helps maintain the integrity of the display screen and reduce power consumption when the *961* is on for many hours at a time. It is still recommended, however that you keep the lighting level lower when you don't actually need it.

Turning the unit off

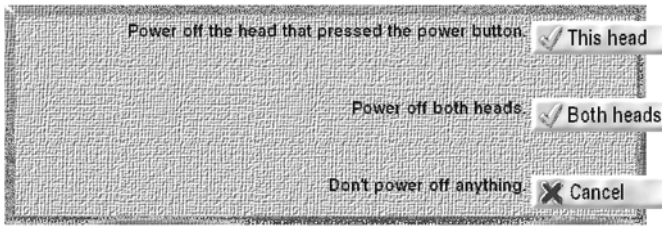
The procedure for turning off a system with two control heads is slightly different than turning off a system with one head.

To turn off an entire system (both the head and the processor) with one control head:

1. Press and hold the **PWR** key for three seconds, and the *961* will turn off.

To turn off an entire system (the two heads and the processor) with two control heads that are on:

1. Press and hold the **PWR** key for approximately two seconds until the POWER-OFF dialog appears, as shown.



2. To turn off only one head (where you pressed the **PWR** key, press the **THIS HEAD** key. Otherwise, to turn off the entire system, press the **BOTH HEADS** key.

Testing and troubleshooting the 961

To test the system after installation, first apply power to the control head: Pressing the control head's **PWR** key automatically turns the entire system on, including the processor. Next, check for the presence of GPS and DGPS signals: For GPS signals, the time-to-first-fix (TTFF) is about two to five minutes; for DPGS signals, it may take at least 20 minutes for the first channel of the *961*'s internal beacon receiver to lock onto a transmitter–keep checking for the presence of the word DGPS in the upper-left corner of the CHART screen.

Troubleshooting common installation problems

Typical problems you may encounter during or after the installation process are outlined in Tables 2, 3, and 4. If you've followed the troubleshooting steps below and are still experiencing difficulties, call the Northstar Service Department at *978-897-6600* and ask to speak with a marine service technician.

Table 2: Troubleshooting the installation

Problem Area	Symptom	Possible Solutions/Reasons
POWER	Pressing the **PWR** button doesn't power-up the unit.	• Check the fuse and the power to the head.

Table 2: Troubleshooting the installation (continued)

Problem Area	Symptom	Possible Solutions/Reasons
POWER (cont'd)	The control head powers-up, but not the processor (the processor's power indicator at the back of the unit is not lit).	• Check the fuse and the power to the processor. • Check the coax cable between the head and the processor. • Set the **TEST-POWER** switch on the processor to the TEST position; if the processor doesn't power-up, then power to the processor is faulty, or the entire unit may be defective.
POWER (cont'd)	The control head powers up, beeps, and the backlight can be operated up and down, but there isn't any video.	• Verify that the processor's power indicator at the back of the unit is lit. • Check the fuse and the power to the processor. • Check the coax cable between the head and the processor and make sure it's properly terminated and connected. If a spare known-good cable is available, temporarily substitute it to see if the problem goes away.
DISPLAY	There is continuous or intermittent system failure as evidenced by the display screen flashing a "plaid" or multi-colored "waffle weave" pattern.	• Verify that the processor's power indicator at the back of the unit is lit. • Check the fuse and the power to the processor. • Check the coax cable between the head and the processor and make sure it's properly terminated and connected. If a spare known-good cable is available, temporarily substitute it to see if the problem goes away. • If a test setup with a VGA monitor and keyboard is available, call Northstar technical support for guidance concerning in-depth troubleshooting of the system to determine if the problem is the display or the processor.
	There is continuous or intermittent system failure as evidenced by the display screen flashing a pulsing white flash in a continuous repeating pattern.	• This may be radar interference; for additional guidance, see Table 4, "Troubleshooting the radar interface," on page 42.

Table 2: Troubleshooting the installation (continued)

Problem Area	Symptom	Possible Solutions/Reasons
DISPLAY (cont'd)	The display screen dims, either slightly or more, after the unit has been on for a certain time.	• The unit may be implementing its auto-dimming mode, which occurs when no keys have been pressed for an hour or more (pressing any key restores the previous brightness level). When this occurs the display screen dims to about half its normal brightness (based on its current brightness). Auto-dimming helps maintain the integrity of the display and reduce power consumption when the unit is on for many hours at a time. • The unit may be running too hot based on its current environment. In this case, the display screen dims only about or notch or so, which is normal.
	If the display screen dims and also displays the error message "unit too hot, backlighting dimmed."	• There are two covered external fans at the back of the control head. When one or both of these fans needs servicing, the 961's backlighting dims substantially to reduce the unit's overall temperature. These fans are dealer-serviceable; call your Northstar dealer.
PROCESSOR System lock-ups	Software-related: System locks up under certain conditions, such as when configuring screens, routes, or waypoints. This maybe followed by a colored screen indicating that you may want to call the Northstar Service Department to report an EIP (software) error.	• Install the latest software upgrade (to order, call the Northstar Service Department).

Table 2: Troubleshooting the installation (continued)

Problem Area	Symptom	Possible Solutions/Reasons
PROCESSOR (cont'd) System lock-ups	Vibration-related: The system locks up while underway under certain conditions. Systems tend to lock up on those vessels that are 35-55 feet in length with varying beam widths, having twin large displacement engines, moving approximately 20 to 35 knots, and with their processors installed at/or below the water-line and close the outside hull.	• Vibration induced into the hull and surrounding structure from the engine and the running gear. • The action of the waves against the hull while the vessel is underway at a medium-to-high rate of speed. • Cavitation of the water pumps in jet boat propulsion systems. • Incorrect installation practices, including improperly fitted lower attachment clips for the internal hard drive assembly. If this is the case, to remedy the problem, ensure that the tabs are engaged and tightly secured in their respective slots on the power-supply frame so that the bottom of the drive mounting bracket is properly restrained. Use the mounting bracket with the ME500-series vibration mount.
PROCESSOR (cont'd) System lock-ups	Hardware-related: The system locks up on a random basis with no apparent pattern.	• Ensure that the processor internal cooling fans are operating and that the processor is not overheating. If you can not comfortably place your hand on the top of the processor when it is operating then it is most likely overheating and the reason needs to be determined and corrected. Make sure that the compartment where the processor is mounted has adequate ventilation to prevent heat build up.

Table 2: Troubleshooting the installation (continued)

Problem Area	Symptom	Possible Solutions/Reasons
PROCESSOR (cont'd) Configuration	No GPS or DGPS	• Possible incorrect installation of the AS110/AS105 splitter cables; they may be reversed at the splitter for the GPS and differential output ports going to the 961XD processor. • For verification and troubleshooting of the antenna system, see Table 3, "Troubleshooting the GPS/DGPS antenna installation," on page 39. • The 961XD processor BIOS may be improperly configured. This normally wouldn't occur unless the BIOS memory battery has failed or the BIOS settings were intentionally changed. Consult with the Northstar Service Department for information on how to troubleshoot and correct this problem.
DGPS (DIFFERENTIAL)	There's no DGPS indicator on the Chart screen, and: The BEACON RX SELF-TEST AND SOFTWARE message says FAILED (press the **STAR** key to access the SERVICE MENU screen, then press the **GPS STATUS** key).	• Wait 30 minutes after start-up (only if a new unit). • Check for an open or shorted beacon-antenna cable connector. • Check for proper ground. • The Northstar 8410 ACI or the 961 processor may be defective; call the Northstar Service Department.

Table 2: Troubleshooting the installation (continued)

Problem Area	Symptom	Possible Solutions/Reasons
DGPS (cont'd)	There's no DGPS indicator on the Chart screen, and: The BEACON RX SELF-TEST AND SOFTWARE message reads PASSED, AND THE DGPS STATUS message reads SEARCHING.	• Wait 30 minutes after start-up (only if a new unit) so the receiver can find a differential transmitter within range) check local knowledge or transmitters). • Check for high noise level, possibly due to a storm front, or for local interference at the marina or on the vessel. See the *Northstar 961 Operations and Reference Manual (GM1700)* for details about noise-level meanings. • Turn off power to each and all of the vessel's other instruments, one at a time, to isolate the source of the interference. • Try manually selecting and setting a DGPS beacon station to be used to see if the signal can be received. • Consult the Coast Guard's Local Notice to Mariners to determine if there may be a scheduled maintenance outage for the station you're trying to use. • For additional guidance, call the Northstar Service Department.
DGPS (cont'd)	There's no DGPS indicator on the CHART screen, and: The BEACON RX SELF-TEST AND SOFTWARE reads PASSED, and the DGPS STATUS message reads OLD CORRECTIONS.	• No DGPS corrections have been received, and the system has returned to non-differential operation. You may be out of range of a transmitter, or if you're experiencing bad weather, noise may be interfering. In either case, you must wait.
DGPS (cont'd)	There's no DGPS indicator on the CHART screen, and: The BEACON RX SELF-TEST AND SOFTWARE reads PASSED, and the DGPS STATUS message reads POOR DOPS.	• Wait for the satellite configuration to automatically update, which should only take a few minutes.
DGPS (cont'd)	There's no DGPS indicator on the CHART screen, and: BCN UNHEALTHY is displayed.	• Wait—the transmitter is switching to another beacon. You can try manually switching to another transmitter.

Table 2: Troubleshooting the installation (continued)

Problem Area	Symptom	Possible Solutions/Reasons
INTERFERENCE	Electrical, magnetic, or radio frequency (RF) energy is interfering with the reliable operation of the unit as shown by high levels of noise on the DGPS status screen.	• Turn off power to each and all of the vessel's other instruments and systems, one at a time, to isolate the source of the interference. • Attempt to eliminate the noise through earth grounding or RF filtering techniques as appropriate to the type of noise encountered.
GPS	The head and processor power up, but poor GPS SNR readings are obtained even after running the unit for several minutes.	• Check that you have the proper length of cable and that all connections are clean and secure. • Verify the quality of the antenna location (the antenna should have a clear view of the sky). For the correct antenna placement, see Figure 5. • See Table 3, "Troubleshooting the GPS/DGPS antenna installation," on page 39.

Troubleshooting the GPS/DGPS antenna installation

In the following table (troubleshooting the GPS/DGPS antenna installation), the Northstar AN150 refers to the 12-dB GPS antenna, the Northstar 8410 coupler with whip antenna refers to the beacon receiver whip-type (E-field) antenna, and the Northstar AN205-P refers to the combination (combo) GPS/DGPS loop antenna with splitter. Whenever possible, the best and most efficient way to troubleshoot is to use a known-good set of cables, a splitter for combo antennas (when applicable), and working antennas as spares for swapping.

NOTE:
Concerns for the AN205-P that aren't explained in the GPS/DGPS antenna troubleshooting table below include the fact that mounting a loop-type antenna in close proximity to a radome (radar-set antenna) can cause signal degradation or a complete loss of the beacon signal. The klystron or magnetron contained in the radar antenna produces a very dense magnetic field whether or not the radar set is turned on. These magnetic field effects are also present during the operation of the servo motors located on gyro-stabilized TV or IMARSAT communications dish platforms. Signal degradation checks should be performed before finalizing the installation.

Table 3: Troubleshooting the GPS/DGPS antenna installation

Antenna	Symptom	Possible Solutions/Reasons
GPS ANTENNA	Poor or no GPS signal while using the AN150 antenna.	• Turn off any onboard transmitting devices. • Check for 5.5 VDC at antenna with and without antenna load connected.[a] • Check for 5.5 VDC at 961 processor BNC connector (1710 board).
	If 5.5 VDC low or missing with load connected:	• It indicates a bad connector installation, bad 1710 board, or bad AN150 antenna.
	If 5.5 VDC low is missing with load disconnected:	• It indicates a bad 1710 board. Replace the 1710 board.
	If 5.5 VDC is present:	• It indicates a bad AN150. Replace the AN150.
DGPS ANTENNA	No GPS or DGPS	• Bad splitter configuration.[b] • Splitter cables may be reversed for GPS and DGPS output.
DGPS ANTENNA (cont'd)	Poor or no GPS signal while using the AN205-P antenna with splitter:	• Check installation for correct cabling. • Check for 7.75 VDC at antenna with and without antenna load (cables and splitter) connected.[c] (Use "T" connectors to measure VDC under load.) • Check for 7.75 VDC at 961 processor UHF connector.
	If 7.75 VDC is low or missing with load connected:	• It indicates a bad connector installation, bad 1710 board, bad AN2*xx*. The load is too great or the 1710 board is defective.
	If 7.75 VDC is low or missing with load disconnected:	• It indicates a bad 1710 board.
	If 7.75 VDC is present at processor UHF connector but not at antenna:	• It indicates bad cabling, bad connectors, or a bad splitter.

Table 3: Troubleshooting the GPS/DGPS antenna installation (continued)

Antenna	Symptom	Possible Solutions/Reasons
DGPS ANTENNA (cont'd)	No beacon signal (applies to all DGPS antennas):	• Press the **STAR** key to display the SETUP MENU screen, then press the **RECEIVER SETUP** key. Check that the DGPS SYSTEM option and BEACON FREQ options are set to "on," and that the BAUD RATE option is set to "auto." • Press the **STAR** key to display the SETUP MENU screen, then press the **PRODUCT INFO** key. Check that the BCN RCVR ST reads "PASSED."
	If the BCN RCVR ST reads "failed:"	• Check the coax and antenna for open/short, and check for 7.75 VDC at the UHF connector, under load.
	If the coax and antenna are okay and there is 7.75 VDC:	• The 1710 board in the processor may be bad.

Table 3: Troubleshooting the GPS/DGPS antenna installation (continued)

Antenna	Symptom	Possible Solutions/Reasons
DGPS ANTENNA (cont'd)	High beacon SNR or low signal.	• Turn off all electrical devices and equipment on the vessel, then check for improvement. Check fluorescent lights, gauges, and so forth. Be creative! Check for power-line interference by moving away from the dock and/or the marina. Verify that the antenna is mounted in accordance with the recommendations shown in Figure 5.
	When vessel interference is still present:	• Isolate to the interfering device, with breaker panel if necessary.
	When the source of the interference is found:	• Experiment with different grounding locations (the best ground is the ocean). Drop a temporary wire attached to 8410 black wire over the side of the vessel to see if the interference source can be fixed by grounding techniques. • Disconnect shore power and move away from the dock and/or marina (power lines and lights can cause interference). • Temporarily relocate the 8410 or combo antenna as far away from the interfering source as possible, and monitor the effect on reception. If it improves, consider relocating the antenna or try to determine if the interference can be eliminated at its source. • Normally, noise that affects an 8410 DGPS coupler won't affect a combo antenna and vice versa. Consider temporarily changing antenna types to determine the effects on signal reception.
DGPS ANTENNA (cont'd)	Poor, intermittent, or no beacon signal using a known-good loop or combo antenna.	• Check the proximity of the antenna to radar antennas or other transmitting devices, such as INMARSAT. A radome can affect H-field antennas even when power is off. Hint: To test for the best location, move the antenna and coax to temporary locations using an over-the-deck length of coax, then relocate as necessary.

a. The GPS receiver AA180 supplies the 5.5 VDC to the AN150 active GPS antenna.

b. Testing the GPS portion of the splitter and a combo antenna: When using a combo antenna and splitter, the splitter gets 7.75 VDC from the beacon receiver, and then feeds the combo pre-amp with that same voltage level. The splitter must have this 7.75 VDC supplied to the differential port in order for the GPS and the differential signal to be passed through the splitter. To test the GPS portion of the combo antenna, disconnect the splitter and plug the combo antenna directly into the GPS BNC connector (provided that the 5.5 VDC is present). This troubleshooting technique effectively eliminates the splitter from the equation. If the splitter is bad, GPS may not work when connected normally (provided that the 7.75 VDC from the beacon receiver is present). Note that the combo antenna should never be plugged directly into the GPS port under normal circumstances because the voltage feeding the amplifier is too low and this will result in low GPS signal levels being sent to the GPS receiver.

c. The beacon receiver (8500) supplies the 7.75 VDC to the 8410 (in the case of a whip-type antenna installation), or the splitter (in the case of a combo antenna installation), which in turn feeds the combo antenna.

Table 4: Troubleshooting the radar interface

Component	Symptom	Possible Solutions/Reasons
961 CONTROL HEAD	The display is either knocked out completely, or the screen flashes after the radar is turned on (a white flash corresponds to each revolution of the radar, when the radar range is set to 6 nm or above).	• Stand directly in front of the display to determine if the problem is related to interference to the control head. • Put the radar into "standby" mode; if the display still flashes, a non-radar type of interference is occurring. • Call the Northstar Service Department to determine if the necessary internal radar shielding has been installed. If yes, ensure that the 961 head (and processor) aren't in the direct path of the radar aperture. • Ensure that there's a maximum separation between the 961 control head/processor and the radar cables. Whenever possible, run the cables of the radar and the 961 on opposite sides of the vessel.
961 PROCESSOR	The display is either knocked out completely, or the screen flashes after the radar is turned on (a white flash corresponds to each revolution of the radar, when the radar range is set to 6 nm or above).	• Stand directly in front of the processor to determine if the problem is related to interference to the processor. • Be sure that the processor is mounted as far away vertically from the radome. The best location for the processor is out of the weather, so try to mount it in the salon or as low as possible. • Determine if the 961 processor has the RF-125 shielding modification installed (if you need assistance, call the Northstar Service Department).

Table 4: Troubleshooting the radar interface (continued)

Component	Symptom	Possible Solutions/Reasons
RADAR DEVICE	There's bearing-pulse interference from the radar (this also applies to depth sounders).	• The radar's scanning cables may be too closely bundled with the 961's control head-to-processor coax cable: Run the cables of the radar and the 961 on opposite sides of the vessel. • The 961 display-to-processor coax cable may be damaged or improperly terminated. Temporarily substitute a known-good cable to determine if the cable is defective. • The radar scanner cable may be damaged, improperly terminated, or the system/vessel grounds need attention. • Ensure that the radar display is properly grounded to an earth ground. • There maybe a lack of or improper shielding for the radar's scanning cable. Inspect the radar scanning cable-to-scanner base grounding for a low impedance connection (less than .5 ohms (1/2) between the display end and the scanner base termination is optimal; if it's higher, consult the radar manufacturers). Shielding material can be used to attenuate interference effects. Lead, copper, and Mu metal (Mu is the most expensive) are all good choices for flat-sheet shielding. There are a number of different sheet, strap, or mesh copper products that can be purchased off-the-shelf. Also, a tinned "expando sleeve" type copper braided strap can be used for shielding cable bunches as long as it is not exposed to saltwater or corrosive environments. There are numerous different sizes of grounding plates available for installation outside the vessel hull, in water, that provide a good "seawater-earth" grounding plate.

SECTION THREE - Interfacing

This chapter includes the information needed to interface the *961* to other equipment on the vessel. Major topics include:

- interfacing the unit
- setting PPNM
- configuring the NMEA output ports
- setting the auxiliary port

Interfacing the unit

The unit is easily interfaced to other equipment as described below. NMEA 0183 is the most common interface data format used with installations, and it is a widely-accepted standard of data transfer between most all types of marine electronics today, enabling completely different instruments to "speak" a common language.

The unit has the following ports:

- three bi-directional NMEA input/output ports
- one bi-directional auxiliary (aux) port that you can use for communicating data to or from other instruments.

Connector pin wiring

A list of wire designations for the interface connector is displayed on the unit's PORT SETUP screen, accessed from the SERVICE MENU screen by pressing the **PORT SETUP** key.

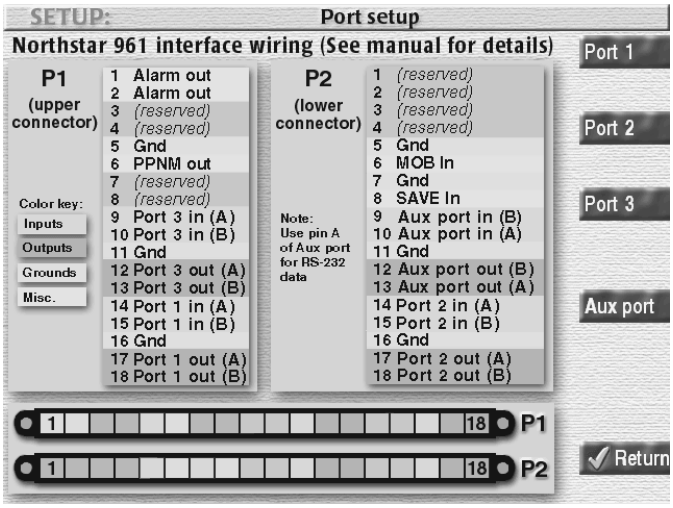


Figure 23: Interface cabling wiring screen

Table 5: Interface cable wiring

Plug 1		Plug 2	
Pin	**Function**	**Pin**	**Function**
1	Alarm Out	1	Reserved
2	Alarm Out	2	Reserved
3	Reserved	3	Reserved
4	Reserved	4	Reserved
5	Gnd	5	Gnd
6	PPNM Out	6	MOB In
7	Reserved	7	Gnd
8	Reserved	8	SAVE In
9	Port 3 In (A)	9	Aux Port In (B)
10	Port 3 In (B)	10	Aux Port In (A)
11	Gnd	11	Gnd
12	Port 3 Out (A)	12	Aux Port Out (B)
13	Port 3 Out (B)	13	Aux Port Out (A)
14	Port 1 In (A)	14	Port 2 In (A)
15	Port 1 In (B)	15	Port 2 In (B)
16	Gnd	16	Gnd
17	Port 1 Out (A)	17	Port 2 Out (A)
18	Port 1 Out (B)	18	Port 2 Out (B)

Configuring the NMEA output ports

Each output port can be programmed to meet most any special requirements of devices that conform to the NMEA 0183–and other–data format specifications. The service function described below allows the selection of the specific 0183 sentences that will be transmitted by the *961*.

1. Press the **STAR** key until you see the SERVICE MENU screen.
2. Press the **PORT SETUP** key to display the PORT SETUP OPTION screen.
3. Press the **PORT 1, PORT 2**, or **PORT 3** key. A list of configurable port options (identical for all three ports) is displayed, as shown below.

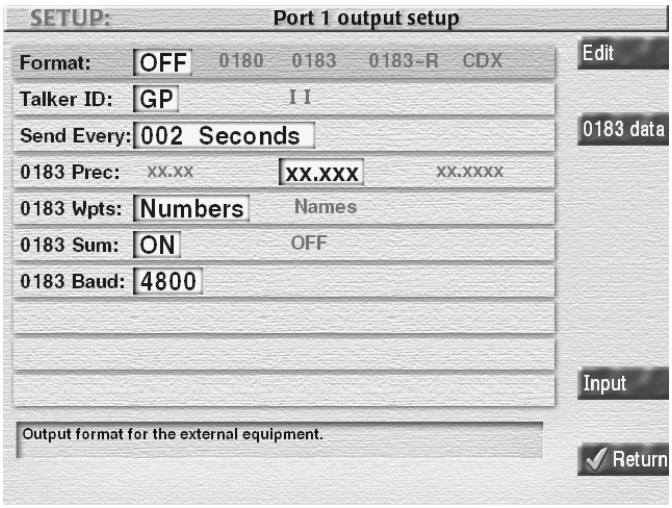


Figure 24: Port 1 output setup screen

Check the installation instructions of the equipment to which you're interfacing for any special requirements. The Northstar factory settings will be adequate for most peripheral equipment, but the following options are available, if needed:

Table 6: Port setup options

Parameter	Options
OUTPUT FORMAT (see below)	choose OFF, 0180, 0183, 0183-R, or CDX
NMEA 0183 Talker ID (see page 51)	choose GP or II to make the unit look like a GPS receiver or an "integrated instrument" (II)
NMEA 0183 lat/lon precision (see page 52)	choose hundredths of minutes, thousandths of minutes, or ten-thousandths of minutes
OUTPUT RATE (see page 53)	choose 1 to 199 seconds
NMEA 0183 waypoint ID as (see page 53)	choose NAMES or NUMBERS for the identifier of waypoints sent to the external device
NMEA 0183 checksums (see page 53)	choose ON or OFF for compatibility with some older devices
NMEA 0183 baud rate	The baud rate is fixed at 4800

NOTE:
If you're viewing and editing information on the PORT OUTPUT SETUP screen, and you press one of the five function keys to view other data, the 961 immediately cancels your edit-in-progress so that you can view the data requested by your function keypress. To resume editing at the PORT OUTPUT screen, you must return to that screen and re-enter the data that you lost when you pressed the function key. To purposely cancel an edit-in-progress, however, you'd normally press the ***CANCEL*** *key.*

Setting the output format

The unit will output navigation data in any of several standard formats as required by the receiving, or "listener," device. Upon pressing the **EDIT** menu key at this option, you'll find the following choices available: NMEA 0180, NMEA 0183, (DATAMARINE) CDX, 0183-R, and OFF.

- NMEA 0180 is an infrequently-used format, developed in the late 1970's and required by certain older autopilots.
- NMEA 0183 V2.1 is a general-use interface output format is used by most autopilots, radars, plotters and other equipment. The NMEA 0183 Version 1.5 sentences (BWC, GLL, and RNN) enable the 961 to be backward-compatible with marine equipment previously designed for this earlier version of 0183. For details on using the 0183 format, see "About NMEA 0183 and RAY 0183" starting on page 48.
- 0183 RAY is used when transmitting/receiving position information to/from Raytheon equipment. It uses Raytheon's non-standard NMEA 0183 checksum, where, on output, the checksum is not included, and on input to the 961, the checksum is ignored. (It should be noted that, with the checksum ignored on input, there is a possibility of the unit receiving contaminated NMEA data when it is connected to an external Raytheon loran.) Format is supported on PORT 1, PORT 2, and PORT 3.
- DATAMARINE CDX is required by Datamarine's cross-track error indicators, the latest of which display distance and bearing to the waypoint.
- The Off setting helps to isolate noise problems potentially caused by I/O.

About NMEA 0183 and RAY 0183

Displaying NMEA output sentences

When you select either NMEA 0183 or NMEA 0183 RAY as the output format, you can display all the available NMEA 0183 sentences that the 961 can output. From the PORT 1, PORT 2, or PORT 3 output screens, high-

light the FORMAT field (for either 0183 or 0183 RAY), then press the **0183 DATA** key to display the sentences.

Figure 25: Port 1 output setup (sentences) screen

About the NMEA TLL sentence

The *961* also supports the NMEA TLL sentence, sometimes referred to as the "rattle" sentence. This sentence allows the *961* to communicate its position to an interfaced radar device, which tracks a user-defined target. In turn, the interfaced radar device communicates to the *961* the target's position in lat/lon coordinates so that you can see the target symbol displayed right on the *961*'s CHART screen. To have the TLL sentence input properly, you must set to "output" the port to which you are connecting.

Three-letter abbreviations identify each sentence and are listed alphabetically. The meanings of the NMEA 0183 three-letter identifiers are described in the table below.

Table 7: NMEA 0183 sentence identifiers

0183 identifier	Meaning
APB	Autopilot Sentence "B"
BOD	Bearing to Destination
BWC	Bearing & Distance to Wpt. (Great Circle)
BWC V1.5	Bearing & Distance to Wpt. (Great Circle), version 1.5
GGA	GPS Fix Data
GLC	Geographic Position, Loran-C
GLL	Latitude/Longitude
GLL V1.5	Latitude/Longitude, version 1.5
GSA	GPS DOP and Active Satellites

Table 7: NMEA 0183 sentence identifiers

0183 identifier	Meaning
GSV	GPS Satellites In View
HSC	Heading Steering Command
MSS	MSK Receiver Signal Status
RMA	Recommended Min. Sentence A
RMB	Recommended Min. Sentence B
RMC	Recom. Min. Specific GPS/Transit Data
RNN V1.5	Navigation Route, version 1.5
VTG	SOG/COG
WCV	Waypoint Closure Velocity (SOA)
WPL	Waypoint Location
XTE	Cross-track Error
ZDA	Estimated Time of Arrival
ZTG	Time-To-Go

Modifying NMEA output sentences

On the screen, the highlighted sentences will be output, as shown earlier in Figure 25. Some devices can't handle all of these sentences correctly, so you can use this screen to customize the output by turning individual sentences on or off. In general, you might want to turn on only those sentences used by the particular equipment to which you're interfacing the *961*.

Figure *26* shows the PORT 1 OUTPUT SETUP screen where you can set the output sentences to the factory default settings.

Figure 26: Port 1 output setup screen

To set the output sentences to the factory default settings, press the **DEFAULTS ON** key. To turn on only a select few sentences, press the **CLEAR ALL** key, then turn the desired sentences back on.

To modify the unit's NMEA 0183 sentence output format, first follow the above description to display the 0183 sentence screen, then perform the following steps:

1. At the PORT 1 OUTPUT SETUP (SENTENCES) screen, display the list of sentences, then press the **EDIT** key.
2. Press the **CURSOR PAD** to select the desired sentence.
3. Press the **ON/OFF** key.
4. Press the **ACCEPT** key.
5. Repeat for each sentence requiring modification. Press the **RETURN** menu key to go back to the PORT OUTPUT SETUP screen.

Choosing the NMEA 0183 talker ID

Part of the NMEA 0183 standard requires that the equipment you are interfaced to—the "listener"—know what type of device is transmitting the data. The talker ID tells the listener that it is receiving information from a navigation source (the *961*) and not a communications or sensor device, which transmit completely different—and therefore unusable—forms of data.

The "talker ID" enables you to configure the *961*'s output data to tell the listener it is receiving data from either a GPS (GP) navigator or Integrated Instrument (II). The choice you make depends on what the listener device is expecting.

1. Check the listener device's instruction manual to determine which "talker ID" codes it will respond to.

2. At the PORT OUTPUT SETUP screen, select the desired port, then highlight the TALKER ID field.
3. Press the **EDIT** key, and highlight the desired ID.
4. Press **ACCEPT** key (or **CANCEL** to leave the option unchanged). The interfaced equipment will now receive the 0183 data in the specified talker ID.

Setting NMEA 0183 lat/lon precision

For added versatility in communicating with a variety of other devices, you can control how precisely the *961* outputs its lat/lon information.

The choice you make is dependent upon the equipment to which you're outputting NMEA data. The *961* conforms to the NMEA version 2.1 standard, and is also compatible with version 1.5. Equipment typically benefiting the most from three and four decimal places of precision are electronic and pen plotting devices. However, most all older devices designed to operate with the original 0183, and other formats, can only function with two-place precision. Refer to the manufacturer's instructions for the number of digits of precision required for that particular device.

The factory setting is .XXX' (thousandths of minutes). To change the lat/lon precision setting:

1. From the PORT SETUP screen, select the desired port by pressing the **PORT 1**, **PORT 2**, or **PORT 3** key. At the PORT OUTPUT SETUP screen, highlight the 0183 PREC field, then press the **EDIT** key.
2. Press the **CURSOR PAD** to select the following options:
   - XX.XX ' (lat/lon precision to two decimal places / hundredths of minutes / or 60 feet)
   - XX.XXX ' (three decimal places / thousandths of minutes / or 6 feet)
   - XX.XXXX ' (four decimal places / ten-thousands of minutes / or roughly ½ foot)
3. Press the **ACCEPT** key (or **CANCEL** to leave the option unchanged).

NOTE:

Setting the output precision to three or four decimal places doesn't mean that the 961 will navigate with that accuracy. Position information can be output and displayed to four decimal places, but the user's actual ability to navigate with such accuracy is limited by the accuracy of the GPS system; see Chapter 2 of the Northstar 961 Operations and Reference Manual *(GM1700) for more information. Therefore, specifying more decimal places in the data output doesn't necessarily result in greater navigating accuracy, but it may improve the smoothness of plotted data.*

Changing the output rate

The *961* normally uses a two-second update interval for data transmission. Some applications require a longer update period, so the *961* lets you increase that span to *199* seconds. You can choose a one-second interval, but at that rate, the bandwidth of 4800-baud NMEA data only allows the output of a reduced set of sentences.

To change the output rate:

1. From the PORT OUTPUT SETUP screen, press the **CURSOR PAD** to highlight the SEND EVERY field.
2. Enter a number, then press the **ACCEPT** key (or press **CANCEL** to leave the option unchanged).

Changing the NMEA 0183 waypoint ID

Many marine electronic devices (such as radars and electronic plotters) can display your waypoint names, rather than a number, if they're output by the *961*.

If the peripheral equipment has this capability, at the PORT OUTPUT SETUP screen, change the *961*'s 0183 WAYPTS field from NUMBERS to NAMES, by highlighting the field, making the change, and pressing the **ACCEPT** key. The listening device will now display the nine-character waypoint names. Included spaces will be output. When exporting to another device, be aware that the numerical identifiers aren't assigned sequentially and may be re-used by the system on a random basis.

> **NOTE:**
> *Be sure to verify this capability in the listening device before changing the* 0183 WAYPTS *field. Most older equipment won't understand this identifier, and using it may cause problems with the display of the waypoint information.*

Setting the NMEA 0183 checksums

Certain older devices may not accept sentences containing the NMEA 0183 checksum that's output by the *961*. In such cases, the device may not operate properly, if at all.

If you encounter difficulty when interfacing to older equipment, the *961* offers you the flexibility of turning off the NMEA 0183 checksum:

1. At the PORT OUTPUT SETUP screen, press the **CURSOR PAD** to highlight the 0183 SUM field, then press the **EDIT** key.
2. Press the **CURSOR PAD** to change the setting from ON to OFF.
3. Press the **ACCEPT** key (or press **CANCEL** to leave the option unchanged).
4. Press the **RETURN** key to go back to the PORT SETUP screen.

Setting the auxiliary port

The auxiliary (aux) port is a general-purpose port used to transmit differential corrections (interfacing with an external device that accepts SC-104

differential corrections). If the *961* already has an internal differential receiver, you can use the aux port to transmit its differential corrections to another device that accepts them.

To access the aux port options:

1. Press the **STAR** key to access the SERVICE MENU screen.
2. Press the **PORT SETUP** key, then press the **AUX PORT** key. The *961* displays the AUXILIARY PORT SETUP screen with configurable options for format and baud rate.

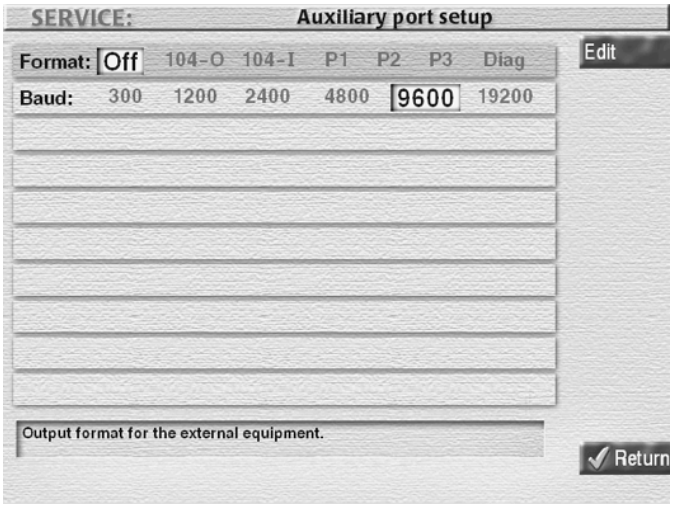


Figure 27: Auxiliary port setup screen

The following configuration parameters are available, as outlined in Table 8, detailed in the text that directly follows:

- output format
- NMEA 0183 baud rate

Table 8: Aux port setup parameters

Parameter	Options
Output format	Choose 104-O (out), 104-I (in), P1 (port 1), P2 (port 2), P3 (port 3), or DIAG (diagnostic)
NMEA 0183 baud rate	Choose 300, 1200, 2400, 4800, 9600, or 19200

To change the aux port settings:

1. Press the **CURSOR PAD** down to highlight either FORMAT or BAUD, then press the **EDIT** key.
2. Press the **CURSOR PAD** left or right to highlight the desired setting, then press the **ACCEPT** key (or press **CANCEL** to leave the option unchanged).

Aux port format

Outputting DGPS corrections to another source

SC-104 OUT outputs differential corrections from your *961*XD's internal differential receiver to an external device that accepts the standard SC-104 data stream. When using the SC-104 OUT setting, be sure that the BAUD setting also matches the baud rate requirements of the receiving device.

Diagnostics

The aux port's DIAG option is for factory diagnosis of *961* operating parameters. Do not turn this function on.

Port off

Use the OFF setting when the aux port's input or output functions aren't needed.

Aux port baud rate

The aux port's baud rate must match the external device's baud rate; refer to the external device's instructions for the correct baud rate setting, then follow the instructions on the previous page for changing an aux port setting.

Setting PPNM

To access the pulses per nautical minute (PPNM) options:

1. Press the **STAR** key to access the SERVICE MENU screen.
2. Press the **PORT SETUP** key, then press the **PPNM** key.
3. The *961* displays the PPNM OUTPUT SETUP screen with options for number of pulses, pulse-time minimum, and pulse-separation minimum.

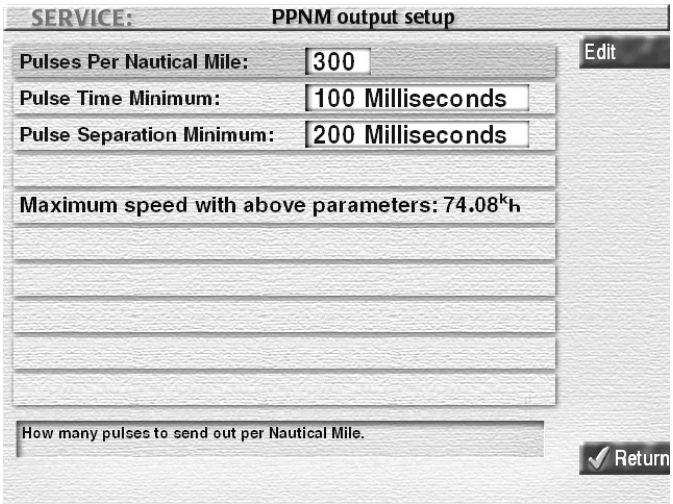


Figure 28: PPNM output setup screen

The following configuration parameters are available as outlined in Table 9 below.

Table 9: PPNM output setup parameters

Parameter	Options
Pulses per nautical mile	Enter 1 to 999 pulses
Pulse time minimum	Enter 1 to 999 milliseconds
Pulse separation time	Enter 1 to 999 milliseconds

The 961's PPNM default settings are 200 ppnm, 100 milliseconds, and 200 milliseconds.

To change the PPNM settings:

1. Press the **CURSOR PAD** down to highlight PULSES PER NAUTICAL MILE, PULSE TIME MINIMUM, or PULSE SEPARATION MINIMUM, then press the **EDIT** key.
2. Enter the desired parameters, then press the **ACCEPT** key (or press **CANCEL** to leave the option unchanged).

Using VGA output

The 961XD supports an external VGA monitor output from the female 15-pin standard VGA video connector located on the back of the processor (See Figure 14 on page 21). Conversion of the signal to an NTSC or PAL video output is possible using VGA converters. Use a VGA-to-NTSC/PAL converter that doesn't require separate software. This should be plug-and-play hardware for standard VGA video input conversion, supporting frame buffering at 75-Hz refresh rate. Also, consider the requirements for power: A unit requiring a DC power source is less likely to cause interference.

SECTION FOUR - Service/Maintenance

Service functions

This section explains the options at the SERVICE MENU screen for viewing product information, configuring the receivers, viewing GPS status, and saving and restoring databases and system logs. The port setup option is also introduced here, but described in detail in this manual in "Section Three, Interfacing."

Viewing product information

The *961*'s PRODUCT INFORMATION screen provides you with access to current information about the *961*'s control head, processor, GPS receiver, and DGPS receiver (if installed). To display these functions, press the **STAR** key until you reach the SERVICE MENU screen, then press the **PRODUCT INFORMATION** key to display the following screen:

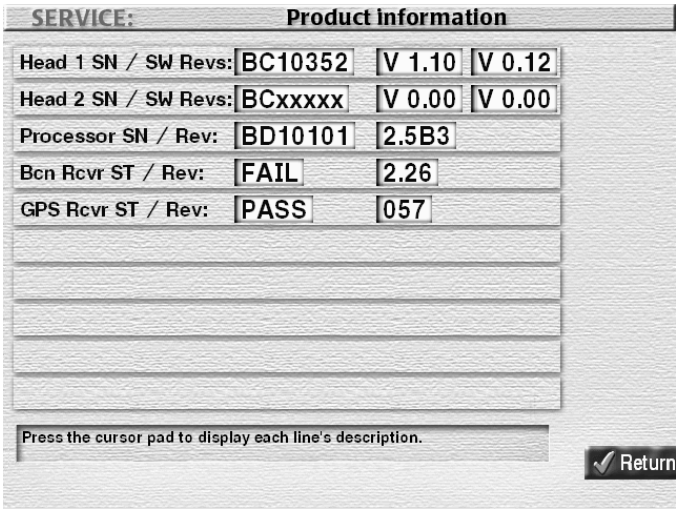


Figure 29: Product information screen

Viewing head 1 serial number and software revision

The complete *961* system comprises two or three serial numbers—one for each control head and one for the processor. The serial number of the control head is affixed to the back of the unit, and also is permanently programmed into the *961*'s database. You can view this serial number at the PRODUCT INFORMATION screen, in the HEAD 1 SN/SW REVS field.

Viewing head 2 serial number and software revision

For systems with two control heads, each head has its own serial number located at the back of the unit. You can view this serial number at the PRODUCT INFORMATION screen, in the HEAD 2 SN/SW REVS field.

Processor serial number and software revision

The serial number of the processor is affixed to the back of the unit, and also has been permanently programmed into the unit's database. You can view this serial number at the PRODUCT INFORMATION screen in the PROCESSOR SN/REV field.

Serial numbers ending with the letter **D** indicate that the unit contains an internal DGPS differential receiver.

Beacon receiver self-test and software revision

The *961* automatically self-tests the internal beacon receiver, if installed, each time you power-up the unit. The BCN RCVR ST/ REV field displays the software version used by your *961*'s DGPS receiver (if installed), as well as the self-test message PASS or FAIL. If all test parameters are met, the field says PASS. If the differential receiver fails any of the test criteria, the field says FAIL. If the field says FAIL, the *961* won't be receiving DGPS signals; for details about troubleshooting the DGPS receiver, see "Testing and troubleshooting the *961*" beginning on page 32. In many cases, the reason for the failure is an open or shorted antenna cable, which can be repaired in the field. If this isn't the source of the failure, call the Northstar Service Department for further instructions.

If a beacon receiver isn't installed, this field is blank.

GPS receiver self-test and software revision

The GPS RCVR ST/REV field displays the software version used by your *961*'s GPS receiver, as well as the self-test message PASS or FAILED. This field should read PASS, not FAIL. If the *961* displays the message FAIL, return the *961* to Northstar for service.

Configuring the receivers

The *961*'s RECEIVER INFORMATION screen provides you with access to several of the *961*'s GPS and DGPS (if installed) receiver functions. To display these functions, press the **STAR** key until you reach the SERVICE MENU screen, then press the **RECEIVER SETUP** key.

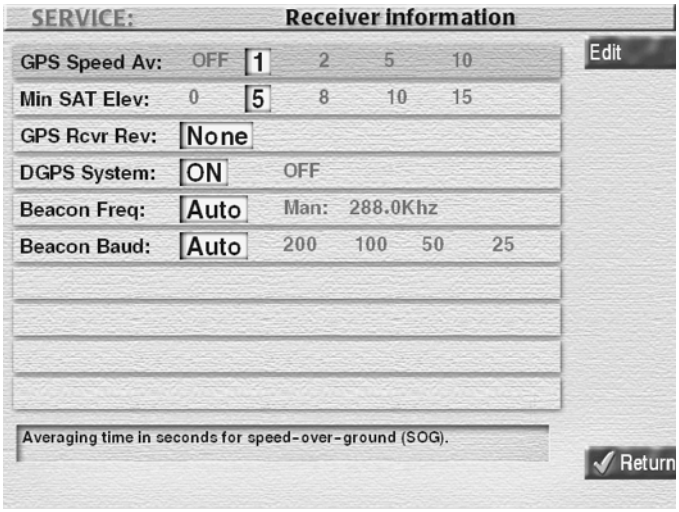


Figure 30: Receiver information screen

NOTE:
If you're viewing and editing information on the RECEIVER INFORMATION *screen, and you press one of the five function keys to view other data, the 961 immediately cancels your edit-in-progress so that you can view the data requested by your function keypress. To resume editing at the* RECEIVER INFORMATION *screen, you must return to that screen and re-enter the data you lost when you pressed the function key. To purposely cancel an edit-in-progress, however, you'd normally press the* **CANCEL** *key.*

Changing GPS speed averaging value

When you aren't using DGPS or you're out of range, you may notice that the SOG readings obtained from the GPS satellite system are slightly erratic, varying by up to several knots. The *961*'s GPS SPEED AV function often can improve the steadiness of these readings, although you'll see a slightly longer display-reaction time when the speed changes.

With GPS speed averaging, you can select the time over which the *961* averages your speed, with available values between one and ten seconds. A longer averaging time is useful at lower speeds when you require the highest accuracy. With this high degree of accuracy, you'll see a steady display of your speed that's slow to change. A shorter averaging time, however, provides less accuracy and a quicker-changing display of your speed.

You also can turn off speed averaging completely for the quickest possible display-reaction time.

You can change the speed averaging value at any time without affecting other navigation functions.

To change the speed averaging value:

1. At the RECEIVER INFORMATION screen, press the **CURSOR PAD** to highlight the GPS SPEED AV field, then press the **EDIT** key.
2. Press the **CURSOR PAD** left or right to select an averaging time in seconds of 1, 2, 5, 10, or OFF.
3. Press **ACCEPT** to make the change, or **CANCEL** to leave the option unchanged.

Adjusting satellite elevation

You can prohibit the *961* from tracking satellites that are close to the horizon and don't provide high accuracy. The tracking of low satellites during GPS calculations is used primarily for technical applications, in which the *961* must track all visible satellites, regardless of how low they're situated.

In other cases, however, when high-precision fixes are necessary, the advanced user can change this option to hide any low satellites. This option prevents the use of low satellites as sources of GPS position information, and avoids potential errors.

You can adjust this option to 0°, 5°, 8°, 10°, or 15°; however, Northstar recommends that you leave this option at the factory setting of 10°.

To change the satellite elevation:

1. At the RECEIVER INFORMATION screen, press the **CURSOR PAD** to highlight the MIN SAT ELEV field, then press the **EDIT** key.
2. Press the **CURSOR PAD** left or right to select either 0, 5, 8, 10, or 15 degrees.
3. When done, press the **ACCEPT** key, or **CANCEL** to leave the option unchanged.

Viewing the GPS software version

The software version of the GPS receiver is indicated in the GPS RCVR REV field.

Setting DGPS operation

You can enable or disable the use of differential information.

1. At the RECEIVER INFORMATION screen, press the **CURSOR PAD** to highlight the DGPS SYSTEM field, then press the **EDIT** key.
2. Press the **CURSOR PAD** left or right to select either ON or OFF.
3. When done, press the **ACCEPT** key (or **CANCEL** to leave the option unchanged).

Setting beacon frequency and baud rate

You can set the receiver to operate automatically or be controlled manually.

Automatic tuning

Northstar's two-channel differential receiver enters automatic differential mode as soon as corrections are received, and doesn't require any further supervision for differential operation, automatically tuning to the appropriate differential frequency as you move from one differential coverage area to another or as weather conditions change. First, it finds the differential frequency and data transfer (baud) rate, then it receives data fully automatically. The receiver constantly evaluates available radio beacon signals for signal quality, and selects only the best station. The receiver is prepared to switch to another frequency automatically, as you travel, as conditions require.

The unit maintains automatic operation by using its two independent receiver channels: Channel 1 tracks the best available differential signal (the one with the lowest data error rate) and sends the demodulated DGPS corrections to the *961*'s GPS receiver. Channel 2 continuously scans the entire differential frequency band (283.5 to 325 kHz), locating and measuring received DGPS differential signals, which is then stored as a DGPS differential directory in its battery-powered memory.

If the signal that's received and monitored by Channel 1 degrades for any reason, such as bad weather between you and the transmitter, the unit tries to select a better frequency from the differential directory it has compiled. This feature enables it to switch to the best differential signal—*before* affecting your GPS accuracy.

For normal operation, Northstar recommends that you leave both beacon frequency and baud rate at the AUTO setting. Generally, you'll use automatic mode for everything except specialized applications.

To choose automatic mode:

1. At the RECEIVER INFORMATION screen, press the **CURSOR PAD** to highlight the BEACON FREQ field, then press the **EDIT** key.
2. Press the **CURSOR** pad left to highlight the AUTO field, then press the **ACCEPT** key (or **CANCEL** to leave the option unchanged).

Manual tuning

You can override the receiver's selection of automatic differential stations at any time. Under manual control, you manually set the differential frequency and baud rate to tune in a particular differential transmitter. In manual mode, the differential receiver outputs DGPS corrections only from the selected station. Although the need for manual operation is rare, it is easily accessed at the RECEIVER INFORMATION screen. Here, you

can set the differential frequency to any value between 283.5kHz and 325kHz. You can set the baud rate to any of the four standard rates: 25 bps, 50 bps, 100 bps, or 200 bps.

To choose manual mode:

1. At the RECEIVER INFORMATION screen, press the **CURSOR PAD** to highlight the BEACON FREQ field, then press the **EDIT DATA** key. the cursor defaults to the MAN field.
2. Use the **KEYPAD** to enter the desired frequency.
3. When done, press the **ACCEPT** key (or **CANCEL** to leave the option unchanged).

Manually setting baud rate

It is strongly recommended that you leave the beacon baud rate setting at AUTO. To manually set the baud rate for the selected differential frequency:

1. At the RECEIVER INFORMATION screen, press the **CURSOR PAD** to highlight the BEACON BAUD field, then press the **EDIT** key.
2. Press the **CURSOR PAD** left or right to highlight 200, 100, 50, or 25 bps.
3. When done, press the **ACCEPT** key (or **CANCEL** to leave the option unchanged).

Viewing GPS status

The *961*'s GPS SATELLITE STATUS screen lets you see a display of all available satellites, including their signal strength and your expected accuracy, as well as the frequency, baud rate, and status of DGPS transmitters (*961*XD only). To display this information, press the **STAR** key until you reach the SERVICE MENU screen, then press the **GPS STATUS** key.

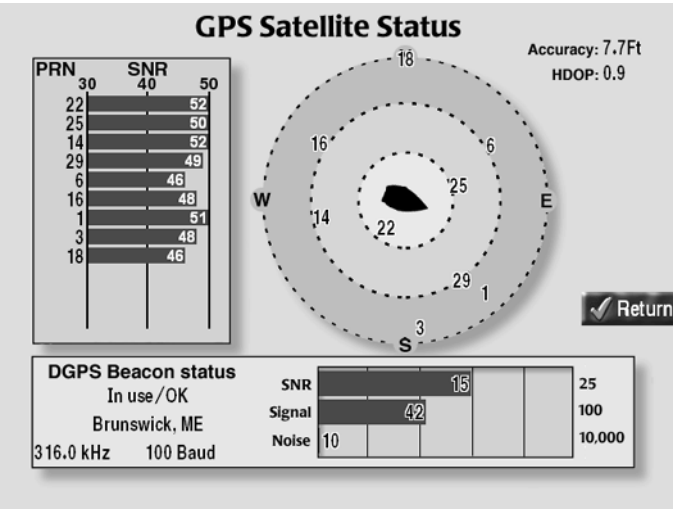


Figure 31: GPS satellite status screen

For an overview of GPS and DGPS, see "Introducing GPS and DGPS" in Chapter 2 of the *Northstar 961 Operations and Reference Manual* (GM1700). For details about the GPS satellite status screen, see "Understanding Position Coordinates" in Chapter 5 of the *Northstar 961 Operations and Reference Manual* (GM1700).

Changing port setup

The PORT SETUP option lets you connect, or interface, directly with a variety of external devices, such as autopilots, radars, depth sounders, personal computers, and so on.

You make the connection through any of four data transmission ports located at the back of the *961*: three NMEA ports and one aux port. Each can operate independently, giving you the flexibility to control four separate devices simultaneously. The ports are also independently configurable to meet the specifications of most peripheral navigation equipment, a feature that ensures a customized setup for virtually any NMEA 0183-compatible device. Once configured, the *961* will continuously send a stream of data to the device(s).

For complete details about changing port setup options to interface your *961* with other equipment, see Section Three, Interfacing."

Saving and restoring databases and system logs

The DATABASE FUNCTION screen provides access to several database maintenance options. To display these options, press the **STAR** key until you reach the SERVICE MENU screen, then press the **DATABASES AND LOG** key.

Saving and restoring a 961 database

You can easily save, or backup, your entire database of user-defined waypoints and routes as well as your user preferences, to either floppy or Zip disks. (User preferences are the display, navigation, chart, receiver, and port-setup features of your *961*.) The *961* is sold with a standard 1.44-MB floppy disk drive. If you want a larger capacity, removable storage disk drive, you must order the 100-MB Zip drive to replace the *961*'s standard floppy drive.

After saving, you can then restore these databases back to the *961*. Why save and restore? One, you may want to keep separate sets of waypoints and routes for different cruising areas so you won't have to sort through one large database of waypoints and routes to select the ones you want (even though the *961*'s search function is always quick and easy). Two, if you ever have to return the *961* to the factory for service, it's a good idea to have a separate copy of your waypoints, routes, and user preferences from the system's hard drive, since it's possible that this information may be lost during repair.

A blank, properly formatted floppy disk always has enough space to store your backed-up databases (a Zip disk also has enough space). If you receive the message "Unable to copy data to the removable disk," check if the disk is write-protected: To change the write-protection status of a floppy disk, use the tip of a pen to switch the position of the small square on the outer corner of the disk.

NOTE:
The save and restore function isn't designed to be used for your tracks, charts, alarm settings, or the trip. This data can't be saved to either type of disk as described above.

Saving a database

To save the waypoint and route or user preference databases to a disk:

1. Press the **STAR** key until you reach the SERVICE MENU screen, then press the **DATABASES AND LOG** key. The DATABASE FUNCTION screen appears.

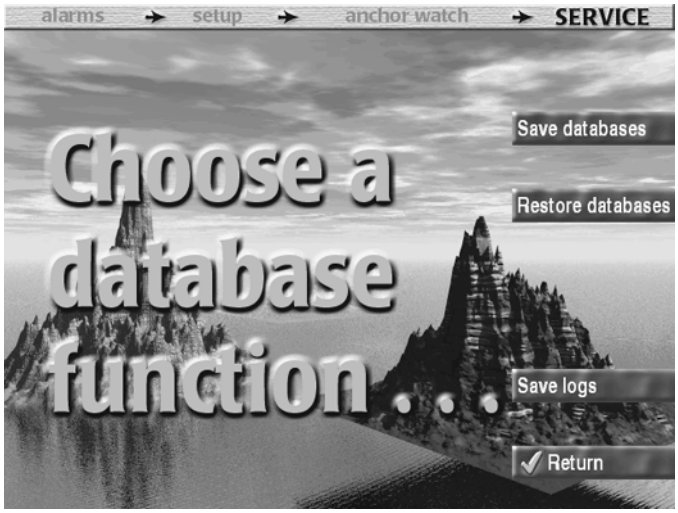


Figure 32: Database function screen

2. Press the **SAVE DATABASES** key. The SELECT DATABASE TO SAVE dialog box appears.

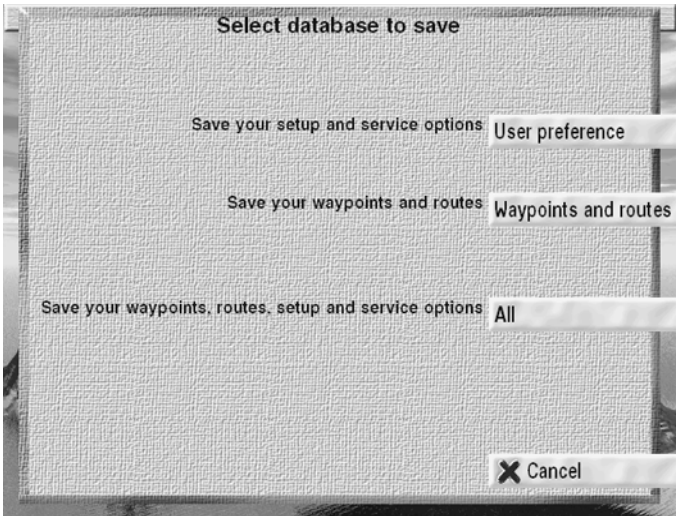


Figure 33: Select database to save dialog box

> To save only your setup and service options (user preferences), press the **USER PREFERENCE** key.

> To save only your waypoints and routes, press the **WAYPOINTS AND ROUTES** key (the *961* always saves waypoints and routes together, since routes are comprised of waypoints).

> To save all of the above, press the **ALL** key.

The SAVE DATA dialog box appears, defined as either user preference data, waypoint and route data, or all data, depending on which of the above options you chose.

3. Insert the disk into the drive (either a floppy disk or a Zip disk), then press the **CONFIRM** key. The SAVING DATA dialog box appears (defined as either user preference data, waypoint and route data, or all data), asking you to wait while the *961* saves the data. This dialog box is followed by the SUMMARY OF DATA SAVED dialog box, showing the number of files saved.
4. Press the **CONFIRM** key to return to the DATABASE FUNCTION screen.

Restoring a database

To restore a previously saved database to the *961* (note that after you restore a database, you must restart the *961* for the system to "accept" the restored database):

1. Press the **STAR** key until you reach the SERVICE MENU screen, then press the **DATABASES AND LOGS** key.
2. At the DATABASE FUNCTION screen, press the **RESTORE DATABASES** key. This key only appears after you've saved a database to the *961* (a database that hasn't been saved can't be restored). The SELECT DATABASE TO RESTORE dialog box appears.

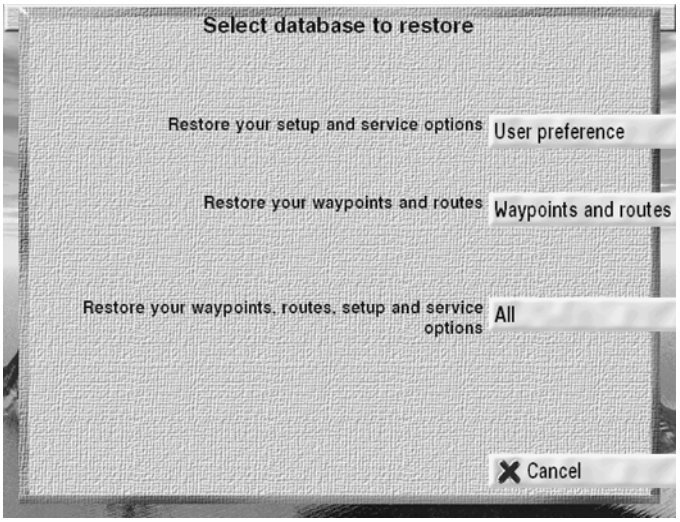


Figure 34: Select database to restore dialog box

> To restore only your setup and service options (user preferences), press the **USER PREFERENCE** key.

> To restore only your waypoints and routes, press the **WAYPOINTS AND ROUTES** key (the *961* always restores waypoints and routes together, since routes are comprised of waypoints).

> To restore all of the above, press the **ALL** key.

The RESTORE DATA dialog box appears, defined as either user preference data, waypoint and route data, or all data, depending on which of the above options you chose.

3. Insert the disk into the drive (either a floppy disk or a Zip disk), then press the **CONFIRM** key. The RESTORING DATA dialog box appears (defined as either user preference data, waypoint and route data, or all data), asking you to wait while the *961* restores the data. This dialog box is followed by the SUMMARY OF DATA RESTORED dialog box, showing the number of files restored.
4. Press the **CONFIRM** key to return to the DATABASE FUNCTION screen. *To use the restored database, you must restart the 961*: Press the **PWR** key to turn the *961* off, then press it again to restart. The *961* will now use the restored database.

Undoing a restore

After the *961* restores a database, you'll have the option to undo the restore operation. As long as the *961* power is on, you'll always have this option; however, *if you restart the 961 by turning it off and then on, you'll lose the option to undo the restore.*

1. At the DATABASE FUNCTION screen, press the **UNDO RESTORE** key. This key only appears after you've restored a database to the *961* (a database that hasn't been restored can't be undone). The SELECT A RESTORED DATABASE TO UNDO dialog box appears. Depending on

which database you've just restored, press either the **USER PREFERENCE** key, the **WAYPOINTS AND ROUTES** key, or the **ALL** key. In the sample screen below, only the **USER PREFERENCE** key appears.

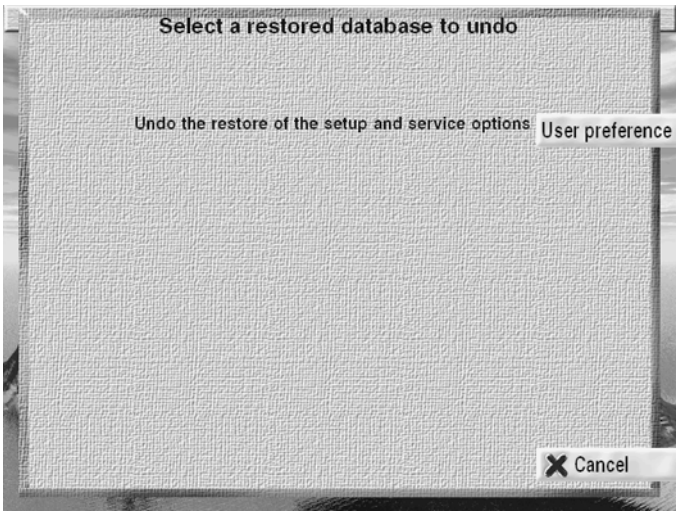


Figure 35: Select a restored database to undo dialog box

2. Press the **CONFIRM** key. The *961* removes the restore files from the database.

Saving log data

Occasionally, the *961* may have a problem that requires looking at its log files to determine the cause. If this happens, you'll be prompted to save the *961*'s log files, which should then be sent to the Northstar Service Department. If you have any questions, call Northstar and ask to speak with a marine service technician.

To save the log files:

1. Press the **STAR** key until you reach the SERVICE MENU screen, then press the **DATABASES AND LOG** key.
2. At the DATABASE FUNCTION screen, press the **SAVE LOGS** key. The SAVE LOG DATA dialog box appears.

Figure 36: Save log data dialog box

3. Insert the disk into the drive (either a floppy disk or a Zip disk), then press the **CONFIRM** key. The SAVING LOG DATA dialog box appears, asking you to wait while the *961* saves the log data. This dialog box is followed by the SUMMARY OF LOG DATA dialog box, showing the number of log files saved.
4. Press the **CONFIRM** key to return to the DATABASE FUNCTION screen.

Maintenance functions

Cleaning the 961

To clean the glass lens of the control head, use a commercially available glass cleaner. Periodically, dust the processor, especially around its floppy or Zip drive, and the CD-ROM drive.

Installing 961 software updates

Periodically, you'll receive a notice from Northstar about the release of a new version of *961* software. When you receive this notice, call the Northstar Service Department to request the current software update on CD-ROM (installation instructions are provided with the CD). To ensure that you receive the correct CD-ROM, however, be sure to give the Northstar service technician your current software version. To access this information about your unit, press the **STAR** key to display the SERVICE MENU screen, then press the **PRODUCT INFORMATION** key; the software version number is located in the PROCESSOR SN/REV field.

APPENDIX A - Technical Specifications

Northstar 961

Power

Power Source:	10-36 VDC
Power Consumption:	80-110W @ 24V
Fuse:	Standard supplied fuse: 3 amps
Operating Power:	100 watts nominal (single head)

GPS receiver

Type:	12-channel, continuous tracking
	L1 Frequency, C/A code (SPS)
Sensitivity:	$C/N_0 > 34$dB-Hz
Navigation Accuracy:	
	3m 2DRMS with Differential
	100m 2DRMS w/o Differential (S/A on)
Navigation Update Rate:	1 per second
Time To First Fix:	30 seconds (typical)
Dynamics:	Velocity:1800 km/h
	Acceleration:4g
	Jerk:2 m/sec^3
Operating Modes:	2D nav, 3 or more satellites; 3D nav, 4 or more satellites visible
SC-104: types,	Processes all USCG SC-104 message
	including 1-9

Interfacing

- IR link on control heads
- Three bi-directional NMEA I/O ports
- One bi-directional aux port
- Two fully functional control head ports
- 200 PPNM speed output
- VGA output
- External MOB input
- External alarm output

- External SAVE input
- Waypoint download capability
- Operating software upload (updates)
- NMEA output sentences: APB, BOD, BWC, GGA, GLC, GLL, GSA, GSV, HSC, MSS, RMA, RMB, RMC, WCV, WPL, XTE, VTG, ZDA, ZTG. (Conforms to NMEA v 2.0 and later. Supports 1.5 GLL, BWC, RNN.)
- NMEA input sentences: TLL, WPL, and others

Physical features

Control head

- Waterproof control head
- Unsurpassed sunlight viewability
- Two fully functional control heads (second head optional)
- 640 x 480 pixel (10.4-inch diagonal), high temperature, backlit transmissive, 65,536 color LCD
- Flush- and yoke-mounts standard
- High contrast, anti-reflection screen
- Large, easy-to-use backlit controls
- Control heads connect with single RG-59 coax cable
- Two audio beepers for alarms and configuration of action
- Protective plastic cover

Processor

- CD-ROM drive for charts and software upgrades
- 4.3 GB hard drive
- Standard 1.44 MB floppy backup drive
- Optional 100 MB Zip drive (replaces floppy drive)

Environmental

Head

- Waterproof– meets IEC 529 IPX-6
- Temperature: 0ºC – 55ºC maximum; 95 percent relative humidity, non-condensing

Processor

- Temperature– 0º to 50ºC maximum

Internal beacon receiver specifications (961XD)

Signal processing	Noise Blanker:	Predictive variable length
	Signal Detection:	Acquisition via FLL, tracking via PLL
	Turning Resolution:	< 2 Hz
	Type:	2-channel, fully automatic
	Frequency Range:	283.5–325.0 kHz (includes European frequencies)
	Minimum Signal Strength:	<5µV/m @ 100bps
	Dynamic Range	> 100 dB
	Adjacent Channel Rejection:	> 50 dB @ 1 kHz
	Acquisition Time	15 seconds
Data processing	Demodulation:	MSK (Minimum Shift Keying)
	Bit Rates:	25, 50, 100, 200 (automatically selected)
	Data Decoding:	2 parallel matched digital filters
Power	Power consumption:	2 watts

AN150 Active GPS Antenna

Height:	2.7 inches
Diameter:	3.0 inches
Weight:	0.5 pounds

8410 Antenna Coupling Unit

Height:	11 inches
Diameter:	2.6 inches
Weight:	1.5 pounds
DGPS Whip Antenna:	48-inch fiberglass whip (not supplied) (Shakespeare 4' #173 loaded, or Radio Shack #21-934)

AN205-P GPS/DGPS antenna

- Frequency: 1575 MHz ±2 MHz
- Finish: Outdoor Weatherable Polymer
- Polarization: Right-Hand Circular
- Weight: 22 Ounces
- Axial Ration: 3 dB Max.
- Dimensions: 152 mm(W) x 152 mm(L) x 67 mm(H) 6.00″(W) x 6.00″(L) x 2.63″(H)
- Altitude: 12,000 Feet
- Noise Figure: 2.5 dB Max.
- Temperature: -40° C to +70° C
- Impedance: 50 Ohm
- VSWR: <2.0 : 1
- Band Rejection: 35dB @ 1625 MHz
- Power Handling: 1 Watt
- Gain, beacons: 20 dB
- Gain, GPS: 23 dB