NORTHSTAR ✳
TECHNOLOGIES, Inc.

958 INTEGRATED NAVIGATION SYSTEM
INSTALLATION MANUAL

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Part Number GM958IM Revision A1

Limited warranty policy

Northstar Technologies, Inc. warrants the Northstar 958 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.

Contents

SECTION ONE: Introducing the 958

Checking the 958 package

The Northstar *958* is a full-featured color GPS navigation system that you can connect to a wide variety of optional equipment, including the Northstar 490 echo sounder; Northstar radar; and VGA output equipment, such as the Northstar 1201 remote display. Other optional interfaces include any NTSC-compatible video input equipment, such as a video camera, TV, DVD, or VHS, and the optional Northstar 2701 DGPS/WAAS receiver (instead of the 2201 or 2301) for WAAS/GPS/radiobeacon differential. For installation instructions for the Northstar 490 or Northstar radars, see the *Northstar 490 Installation Manual* (P/N GM491) or the *Northstar Radar Installation Manual* (P/N GMKRadIM).

Table 1: 958 parts list

Part name	Part number	Qty
958 unit		1
flush-mount hardware kit	957PK	1
flush-mount gasket	HG366	1
10-foot interface cable	WA215	1
10-foot power cable with 10-amp fuse	WA535-D	1
sunshield	XP600	1
warranty registration card	GD671	1
Northstar 958 Installation Manual	GM958IM	1
Northstar 958 Flush-Mounting Template	GT958	1
Northstar 958 Operator's Manual	GM958UM	1
WAAS/GPS antenna	2201 or 2301	1
50-foot data/power cable	958POD-CA	1
10-32 UNF mounting screws (2201-only)	HS520	3
washers (2201-only) for deck mounting	HW500	3
cable heat shrink	HM1005	1

Table 1: 958 parts list

Part name	Part number	Qty
cable heat shrink	HM509	1
6-pin cable connector for AUX port	KS672	1
beacon receiver, including:	2701 (optional)	1
GPS/DGPS antenna 50-foot AN205-P antenna cable 10-foot pre-finished data/power cable	AN205-P WC-256 958BDM-CA	1 1 1
958 yoke-mount kit	601 YOKE-IK (optional)	1
remote control and batteries	958RC (optional)	1
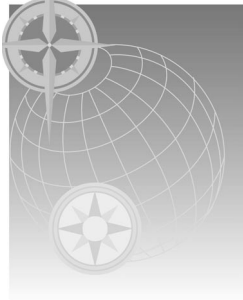
SECTION TWO: Installing and wiring the 958

WARNING! ⚠	*Before starting the installation, be sure to turn power off. Further, Northstar highly recommends keeping power off while you're installing the system. If power is left on or turned on during the installation, fire, electrical shock, or other serious injury may occur. Be sure that the voltage of the power supply is compatible with the 958's voltage rating of 10 to 36 volts DC. Connecting to the wrong power supply can cause fire or damage to the equipment. Be sure to ground the equipment to prevent electrical shock and mutual interference. Be sure to use the proper fuse. Using the wrong fuse can cause fire or damage to the 958.*

Bench-testing the 958

Northstar recommends bench-testing the 958 before installing it onto the vessel. Bench testing ensures that the equipment is fully operational, and lets the 2201/2301 antenna or 2701 beacon receiver collect the current almanac and ephemeris data for the installed location, which results in less on-board installation time.

Mounting the 958

CAUTION! ⚠	*Proper installation of the Northstar 958 is critical to accurately receive and effectively use GPS/WAAS signals under a wide variety of weather conditions.* *Keep the following safe compass distance from the 958: 1.0m standard, 0.8m steering.*

Choosing the best 958 location

Choose the mounting location carefully–before you drill or cut. The display screen is high-contrast and anti-reflective, and is viewable in direct sunlight, but for best results, install the 958 out of direct sunlight. See the figure below for additional mounting recommendations.

Regardless of the type of mounting, the 958 should be installed in an accessible location (dry) where the operator can easily use the controls and clearly see the display screen. Be sure to leave a direct path for all of the cables.
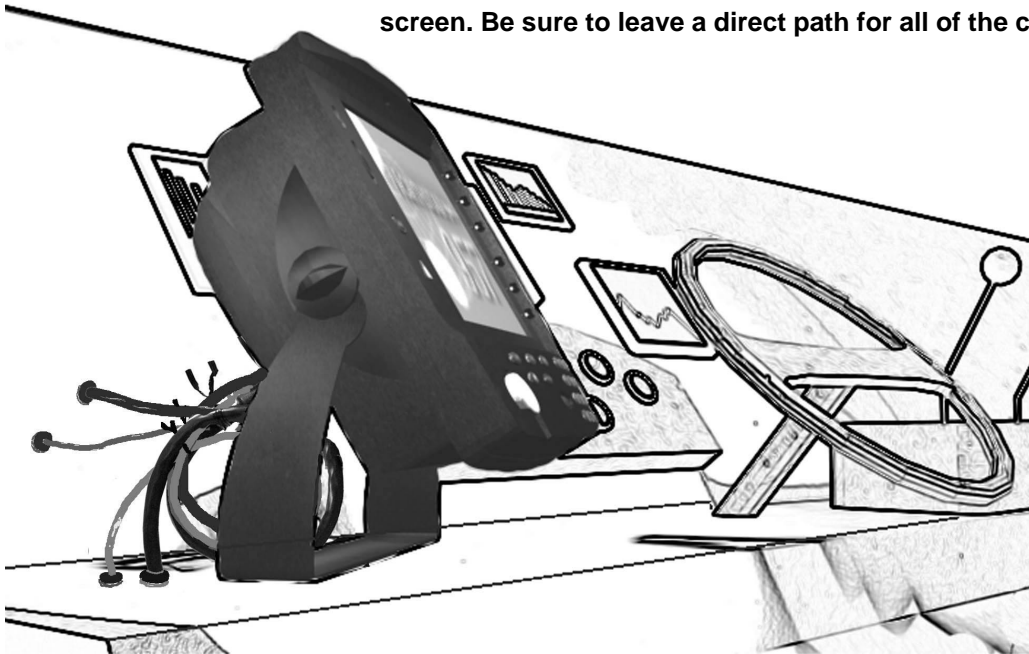
Regardless of the type of mounting, the location should have minimal glare from windows or bright objects. If the 958 is yoke-mounted low, tilt the 958 back for best viewing contrast.
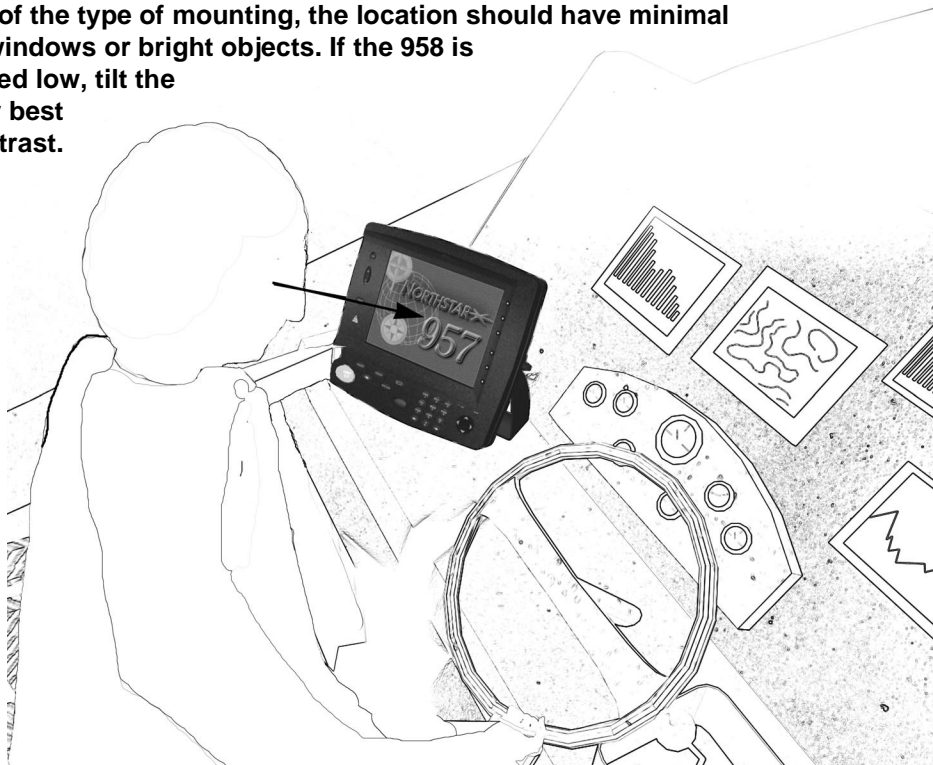
Figure 1: Mounting recommendations

Flush-mounting the 958

When flush mounting, leave **at least two and a half inches of clearance space** behind the mounting panel for all of the cables and connectors. Flush mounting requires good ventilation behind the mounting panel. Poor ventilation will cause the 958 to overheat, which, in turn, may cause the display screen to darken. For overall width and height requirements, see the *Northstar 958 Flush-Mounting Template* (P/N GT958), which you can use to drill the mounting holes and cut the mounting panel in the exact recommended locations.

CAUTION! ⚠	*When flush mounting, be sure to mount the 958 on a flat surface. Mounting on a curved surface can break or distort the plastic and break the waterproof seal. Do not overtighten the mounting screws; you may damage the case and compromise its waterproof seal. This type of physical damage will void the warranty.*

Yoke-mounting the 958

For the recommended mounting clearances, see Figure 2 and Figure 3 below.
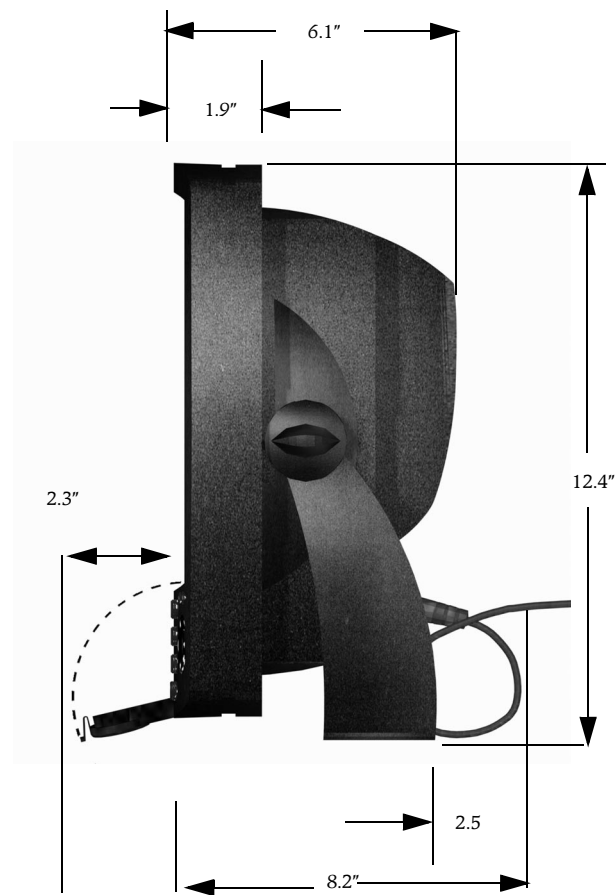
Figure 2: 958 yoke-mount dimensions (side)
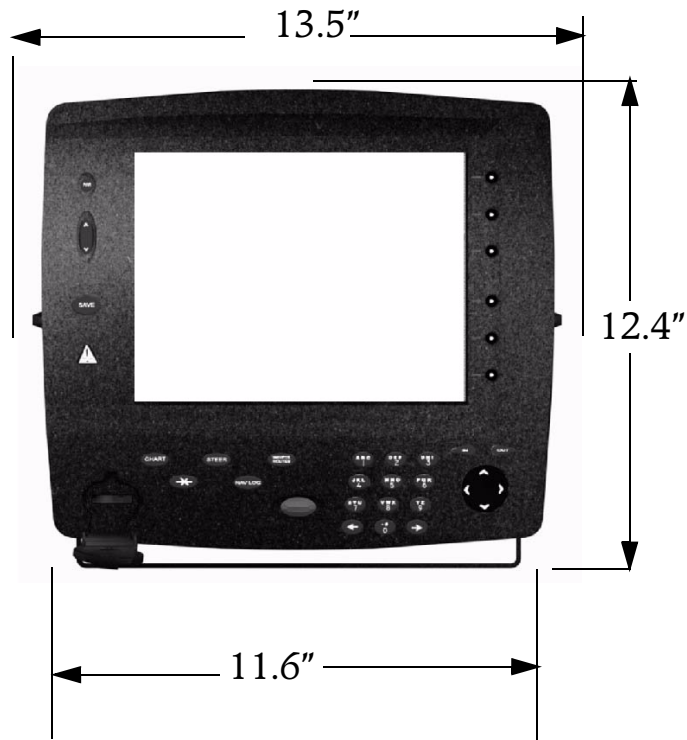
Figure 3: 958 yoke-mount dimensions (front)

Wiring the 958

Avoiding cable wiring shortcuts

Most installation problems are caused by shortcuts taken with system cables. When wiring the 958, follow the guidelines in Figure 4 and Figure 5 below.
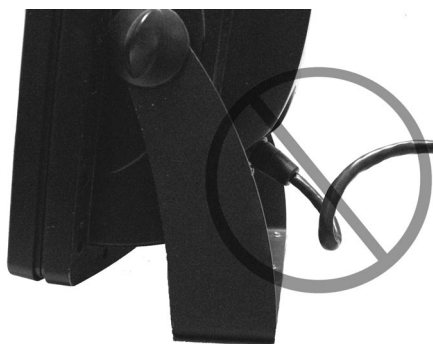
DON'T DO THIS!

Don't make sharp bends in the cables

Don't run cables in
a way that allows water to flow down

Figure 4: Incorrect cable wiring

.

DO THIS!

- Do make drip and service loops
- Do tie-wrap all cables to keep them secure
- If cables are shortened, lengthened, or re-terminated, do seal and protect all wiring connections
- Do leave room at the back to service the 958

Figure 5: Correct cable wiring

Understanding the interface connectors

All of the 958's interface connectors are shown in Figure 6: "Interface connectors (back of 958)," below. The function of these connectors is described in Table 2, below.

AUX connector   VGA connector

Power connector   GPS connector   NMEA connector   VIDEO connector

Figure 6: Interface connectors (back of 958)

TABLE 2: Interface connector functions

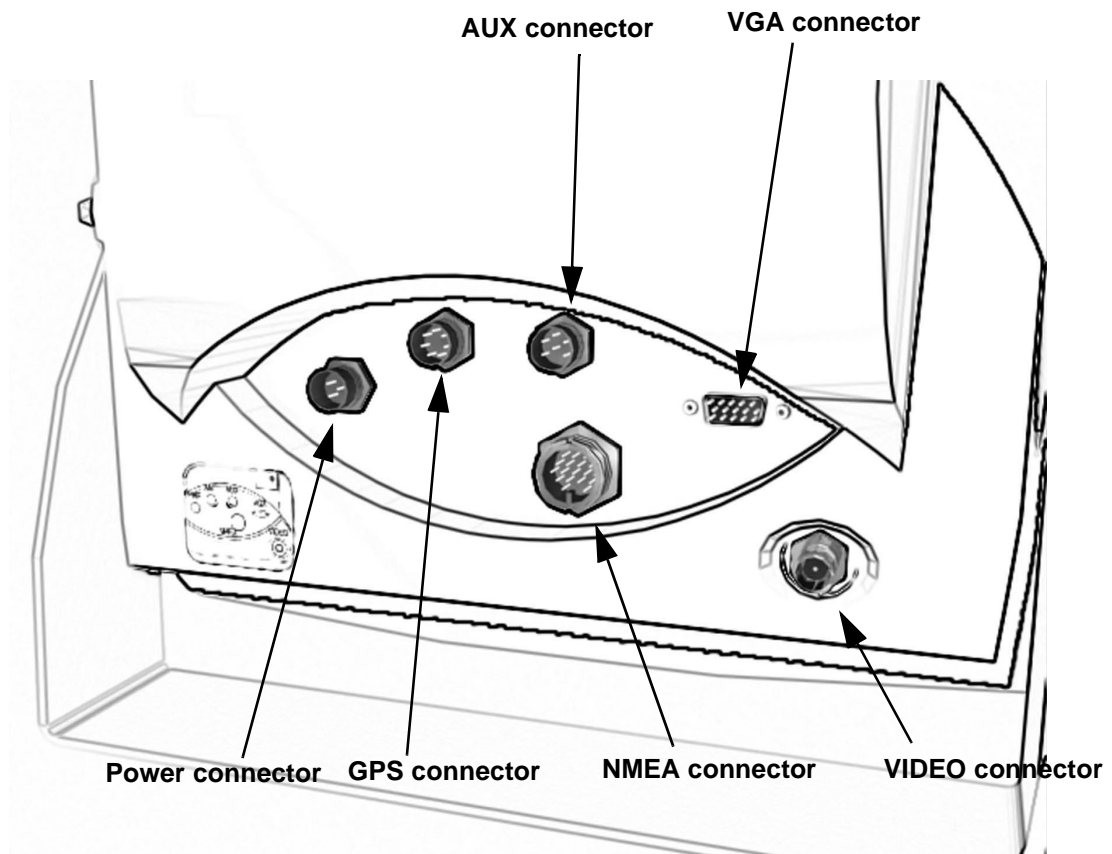| Connector name	Connector function(s)	Connects to...
NMEA (NMEA I/O) (18-pin port)	NMEA 1 input/output ------------->	NMEA devices: radar, autopilot, etc.
	NMEA 2 input/output ------------->	Same as NMEA 1
	Honk alarm/200 ppnm ------------>	Remote honk alarm (or speed indicator)
GPS (Antenna) (7-pin RS232 port)	GPS/WAAS input/output --------->	2201 or 2301 GPS antenna - or - Northstar 2701 beacon receiver (optional)
	Beacon input/output ------------->	
AUX (Auxiliary) (6-pin auxiliary NMEA port)	RS-422/NMEA input/output ----->	Northstar 490 echo sounder (optional) - or - A second 958 (or to a Northstar 957/952/ 951/941) to transfer waypoints and routes
PWR (Power)	Power	10 to 36 VDC, 50 watts
VGA (15-pin port)	Video output	Remote display
VIDEO (coaxial)	Video input	Any NTSC-compatible device

Electrical power requirements

Power source

The 958 is a negative-ground system that's reverse-polarity protected. Power requirement is 10 VDC minimum to 36 VDC maximum with at least 16-gauge connecting wire.

CAUTION! ⚠	*As a good safety practice, Northstar strongly recommends that you connect the 958 to a circuit breaker or 20-amp fuse at the power source (battery).*

Connecting the 958 to ship's power

The 958 ships with a 10-foot power cable that you can lengthen to a **maximum** of 25 feet:

- for a cable length up to 15 feet, the power connections must use 16-gauge connecting wire or heavier
- for a cable length from 15 to 25 feet, use 14-gauge connecting wire or heavier

If you lengthen the power cable, use an external fuse at the battery end as an added safety precaution. **The fuse size should match the size of the wiring on the vessel**. See the NMEA or American Boating and Yachting Counsel specifications to find the correct fuse for your cable.

For the best protection from noise, connect the power cable directly to the battery or dedicated electronics buss. The green ground wire should be connected to ship's ground directly. The power cable has an inline fuse to protect the vessel's wiring, and prevent electrical fires and damage to the 958. If you shorten this cable, be sure to keep the inline fuse intact. The wires in the power cable must be connected as follows.

- red → positive(+)
- black → negative(–)
- green → ship's ground

NOTE:	*Ground the 958 to the vessel to eliminate interference. Without an earth grounding, performance may be reduced. Secure the green wire to the vessel's nearest grounding point. If a noise-free earth grounding point isn't available, cap and insulate the green wire—it shouldn't be used when an earth ground isn't available, or with systems using "floating" grounds.*

SECTION THREE: Installing and wiring the 2201 or 2301

Checking the 2201 and 2301 parts

Northstar 2201

Northstar 2301

3 mounting screws and 3 washers (2201 only)

50-foot cable with two finished waterproof 7-pin connectors

Figure 7: 2201 and 2301 components

NOTE:	*You can shorten the cable, but do not lengthen it. **The cable must be a maximum of 50 feet.***
	Do not open the 2201: There aren't any serviceable parts inside. Unauthorized tampering will automatically void the warranty.

Mounting and wiring

Choosing the best mounting location

Before you drill or cut, choose a mounting location that meets the following criteria. The 2201 and 2301 should be mounted:

- where there's enough mounting clearance to easily connect the cable.

- low on the vessel, since side-to-side motion caused by the vessel's rolling can degrade speed-over-ground (SOG) and course-over-ground (COG) readings.

- below the radiation plane of any INMARSAT or radar antennas, and away from any other high-power transmitting antennas (see Figure 8 on page 13).

- high enough to provide an unblocked view of the sky in all directions, and that minimizes or eliminates any objects that block the 2201 and 2301's view of the sky (the 2201 and 2301 use satellites down to zero degrees elevation or to the horizon).

- away from masts or objects that could "shadow" the 2201/2301, but where there's an adequate view of the sky.

NOTE:	*Before permanently installing the 2201 or 2301, try temporarily installing it and using the 958 to see if the location works well.*
	The 2201 and 2301 are installed differently. The 2201 is mounted directly onto a standard antenna mount, and its cable is routed entirely on the outside from the external connector to the connector on the 958. The 2301 uses a mount with an extension, and the cable is routed through the inside of the extension.

To avoid mutual interference among different antennas on the vessel, see the recommendations in Figure 8 below. This figure shows the minimum distances that should separate GPS/WAAS antennas from other antennas and physical mounting surfaces. Normally, these guidelines produce a relatively trouble-free installation; however, since every installation is unique, you may want to adjust these distances to the particular equipment.
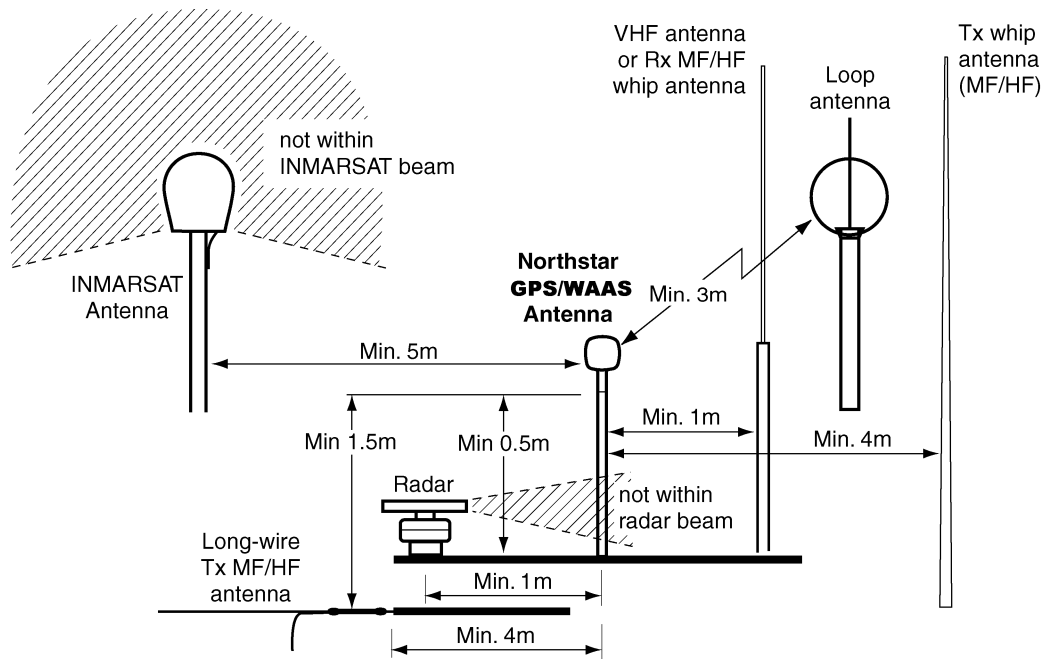
Figure 8: Recommended separation distances between antennas

Mounting and wiring the 2201

To mount the 2201 onto a deck or any other flat surface:

1. Using the three screws and washers provided, mount the 2201 onto the flat surface using three holes on a 1.75-inch diameter circle (see Figure 9 below).
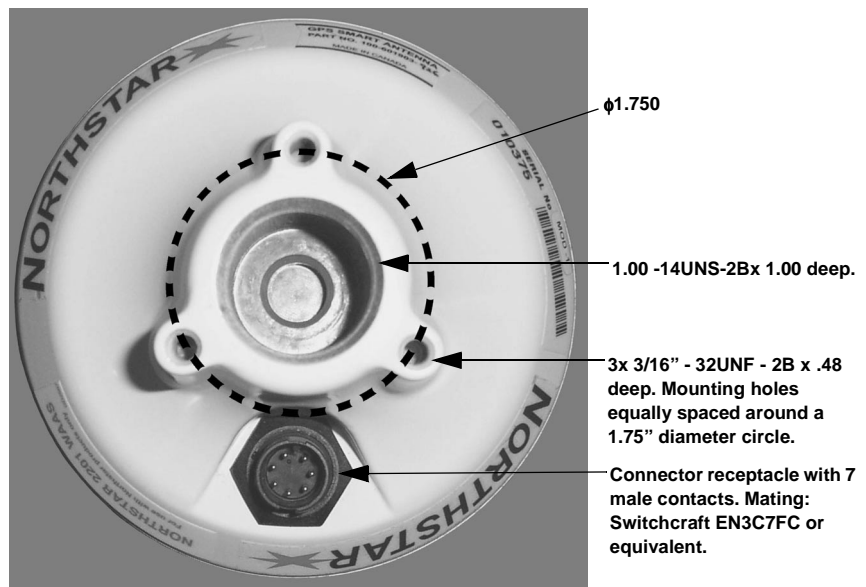
Figure 9: Mounting the 2201 on a flat surface (viewed from below)

2. Make sure the 2201 has enough clearance for you to easily connect the cable. For example, mount the 2201 on the edge of the deck, or drill a small hole in the deck or other surface to allow the cable to pass through.

To mount the 2201 on a standard antenna mount:

1. Using the 1"x 14 marine-industry standard UNS thread mounting, install the base of the 2201 onto a standard antenna mount. **Do not overtighten or you may damage the housing!**
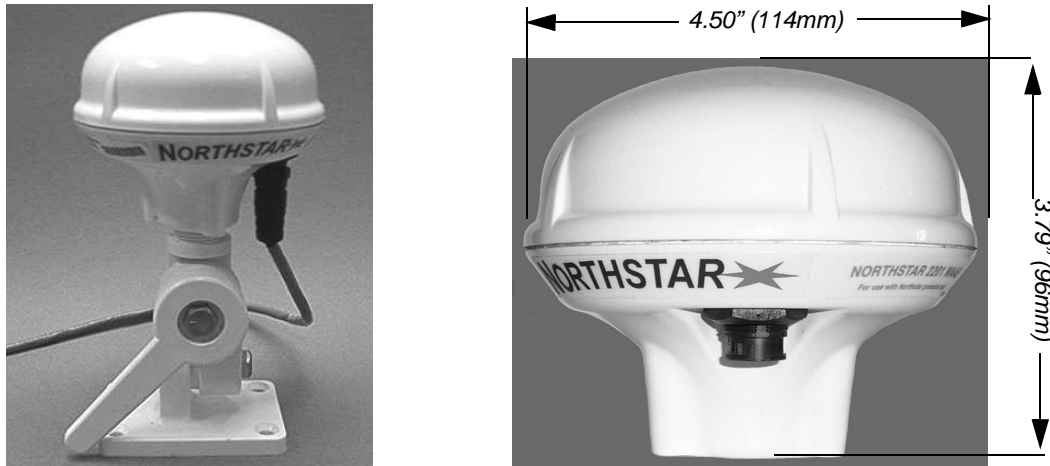
Figure 10: Using a standard antenna mount

2. To avoid stressing the 2201's connector with the weight of the cable, use a tie-wrap or similar near the 2201 to hold the cable's weight.

3. Plug the 2201 end of the cable into the 2201, and the 958 end into the connector labelled "GPS." Coil any extra cable away from the 2201. Don't pinch the cable or make any sharp bends. Don't run the cable where it interferes with any controls.

Mounting and wiring the 2301

The 2301 is mounted onto a standard antenna mount. To complete this installation, you'll also need a standard antenna mount, mounting extension, and mounting adapter.

1. Antenna mount
2. Mounting extension
3. Hole in mounting extension
4. Mounting adapter
5. Base of 2301
6. 2301 connector
7. Top of 2301 (antenna)
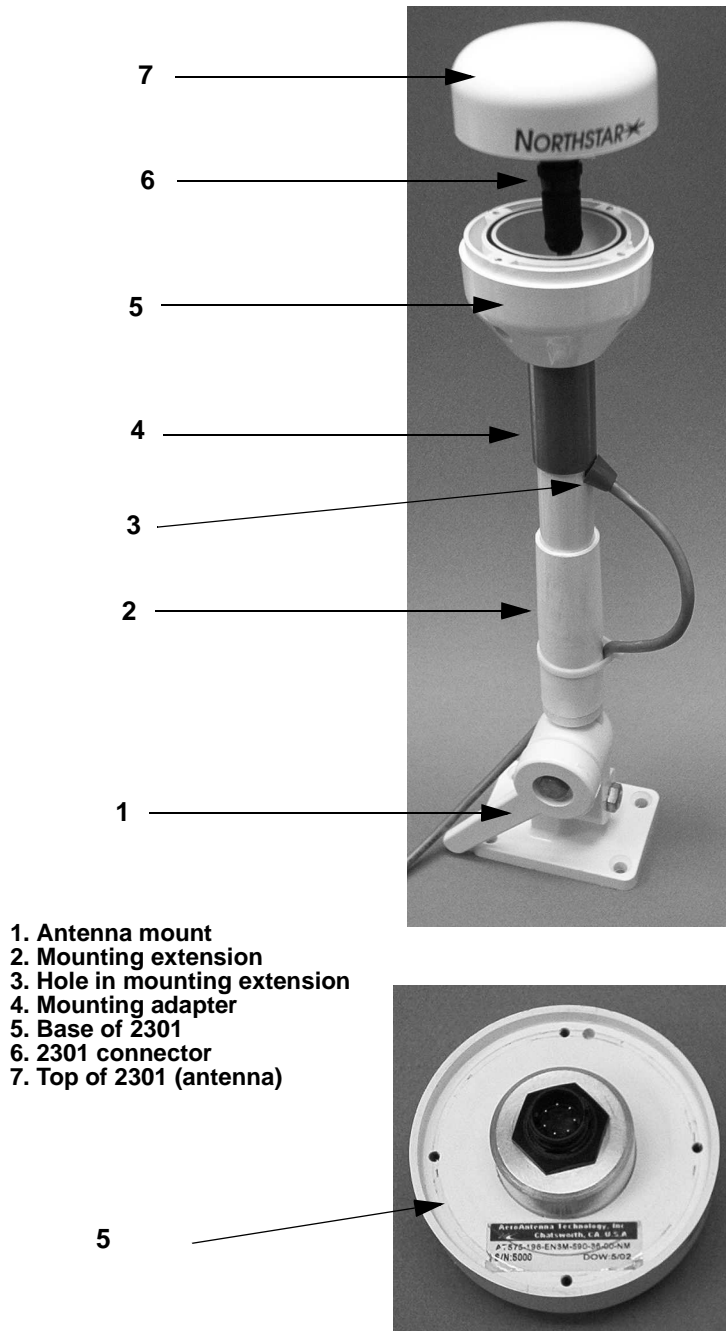
To install the 2301:

1. Install a 1" x 14 UNF thread antenna mount in the desired location.
2. Screw a mounting extension onto the antenna mount.
3. Feed the 2301 cable through the hole in the mounting extension, bringing cable up through the hollow core of the extension and out the top.
4. Screw a mounting adapter onto the extension, bringing cable up through hollow core of the adapter and out the top.
5. Screw the 2301's bottom half (base) onto mounting adapter.
6. Plug the cable's connector into connector on the 2301's base.
7. Place the 2301's top half (antenna) onto base.
8. Align top half of the 2301 with the base, and tighten with four supplied screws. *Do not over-tighten the screws or you may damage the housing.* Use a tie-wrap or similar near the 2301 to hold the cable and help avoid stressing the 2301's connector with the cable's weight. Coil any extra cable away from the 2301. Don't pinch the cable or make any sharp bends. Don't run the cable where it interferes with any controls.
9. Plug the 958 end of the cable into the connector labelled "GPS."

Figure 11: Mounting the 2301 on an antenna mount

Re-fabricating the 958 connector

If you ever want to shorten the antenna cable, or remove its connector to make more room to run the cabling, you can remove the connector from the 958 end and then replace it:

1. After shortening or snaking the cable, slide the available heat shrink tubing onto the cable, then slide the connector backshell onto the cable, as shown below.
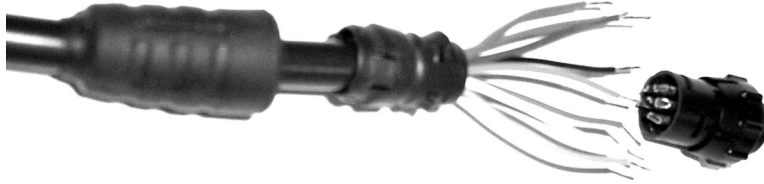
2. Prepare each wire for insertion into its solder cup by stripping it and tinning it.
3. Carefully solder each wire to the appropriate cup, as described in Table 3 below.
4. Slide the backshell down the cable and screw it onto the connector body. It should be hand tight.
5. Using the supplied screws, screw the strain relief onto the backshell.
6. Slide the heat shrink tubing onto the connector. Be sure to leave room for the locking collar to retract.
7. Heat the shrink tubing until it shrinks around the connector, providing a watertight seal.

For the pin numbers and functions for the 958 end of the cable, see Table 3 below.

TABLE 3: Wiring connections for 2201/2301 cable

Description	Wire color	Pin
RS232 RX1 (Main receive port)	Blue	1
RS232 RX2 (Aux receive port)	Orange	2
RS232 TX1 (Main transmit port)	Green	3
Signal gnd	Brown	4
Remote power-on Ship's power control	Black	5
Power gnd (system gnd)	White	6
Power in (9-36 VDC)	Red	7

SECTION FOUR: Installing and wiring the 2701

CAUTION! ⚠	*Do not open the 2701: There aren't any serviceable parts inside. Unauthorized tampering will automatically void the warranty.*

Mounting and wiring the 2701

Choosing the best 2701 mounting location

The 2701 is housed in a rugged aluminum enclosure with a mounting flange, gaskets, and watertight connectors. Though designed to withstand the marine environment, the unit is not completely waterproof; protect it by installing it where water won't contact it directly or enter it through data/power or antenna cables.

Mounting and wiring the 2701

You can mount the 2701 either horizontally or vertically using the appropriate mounting holes; see Figure 12 on the next page.

Keyhole slots at the rear will help if you're installing the 2701 where access is limited and it's hard to start the mounting screws at the obstructed end. Securely tighten all mounting screws to avoid vibration-related problems.

Figure 12: 2701 case and mounting dimensions

Connecting the 2701 to the 958

The pre-finished 958BDM-CA cable connects the 958 with the 2701. Plug the cable's 25-pin connector into the 2701 and the 7-pin connector into the 958 connector labelled "GPS." If you must remove one of the connectors, re-fabricate the cable using the wiring connections described below.

TABLE 4: Wiring connections for 2701 cable

958 connector (7-pin)	2701 connector (25-pin)	Function
1	7	GPS RX1 (Blue)
2	21	BDM RX1 (Orange)
3	6	GPS TX1 (Green)
4	20	BDM TX1 (Brown)
5	12	Power CTL (Black or Gray)
6	13	GND (White)
7	25	Power + (Red)
6	NC	Drain Wire
NC	KS131	Foil Shield

Installing the AN205-P antenna

Choosing the best antenna mounting location

The 2701 operates with Northstar's AN205-P "combo" GPS/DGPS antenna. For mounting recommendations, see see "Choosing the best mounting location" beginning on page 12.

NOTE:	Before permanently installing the AN205-P, try temporarily installing it and using the 958 to see if the antenna location works well.

CAUTION! ⚠	Don't mount the antenna near rotating warning beacons or strobe lights, electric motors, fluorescent lights, or other RF sources. These can create RF interference to the differential reception.

If position data is intermittent, make sure you have the proper cable length, and check the quality of the antenna location and the quality and proper termination of the connectors. Also, make sure that the 2701's ground lug terminal is securely connected with a heavy gauge conductor to ship's ground.

Use the locking nut shown to prevent rotation of the antenna or bottoming out of the mounting stanchion into the threaded mount portion of the antenna. If done with enough force, either of these may break the antenna.
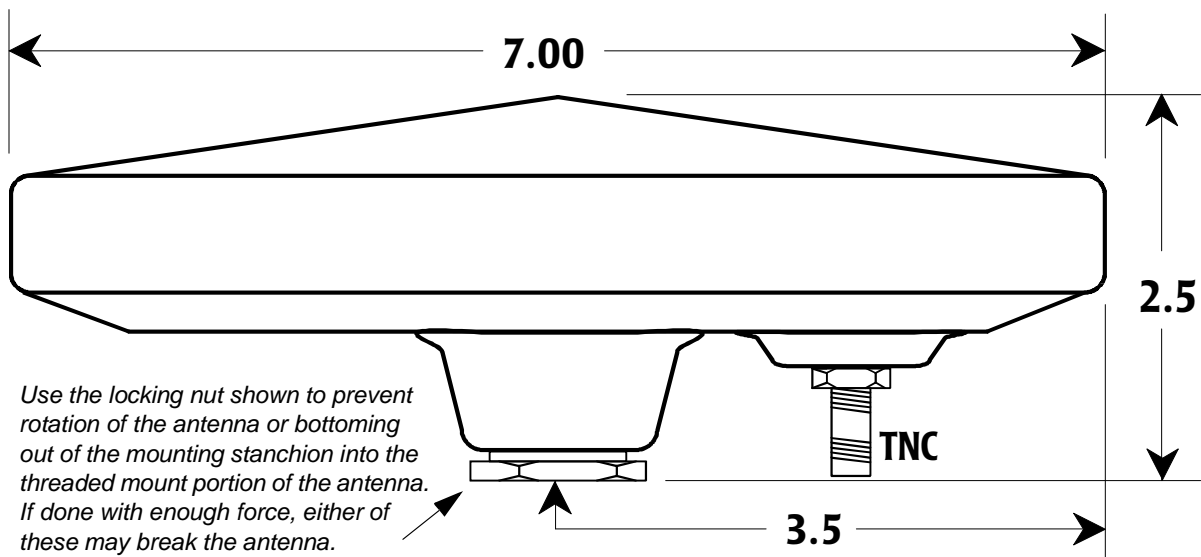
Figure 13: Northstar AN205-P antenna dimensions

Connecting the 2701 to the antenna

The 50-foot antenna cable connects the 2701 with the AN205-P antenna. The cable length must be a maximum of 50 feet, but can be shortened to the desired length. Don't make any tight bends in the cable, and fasten it along its length to avoid chafing or whipping or any kind. Coil up any unused length of cable. Be sure that the cable connectors are securely fastened. NOTE: Installations that require a cable length from 50 to 100 feet should order the AN206 combo antenna and a 100-foot length of coaxial cable from the Northstar Sales Department.

SECTION FIVE: Checking out the system

Turning the 958 on and off

To turn on the 958, briefly press the **PWR** key. The 958 emits several short beeps as it displays the START-UP screen, then performs a series of self-tests to check its critical components and functions. Next, a message is shown as a reminder against relying on the 958's chart cartography as the only means of safe navigation.

To see DGPS status, on the GPS POSITION screen, press **DGPS INFO** to display the DGPS STATUS screen. Check for low noise levels and mid-range SNR readings.

To see information about signals from the satellites, press **SAT INFO**.
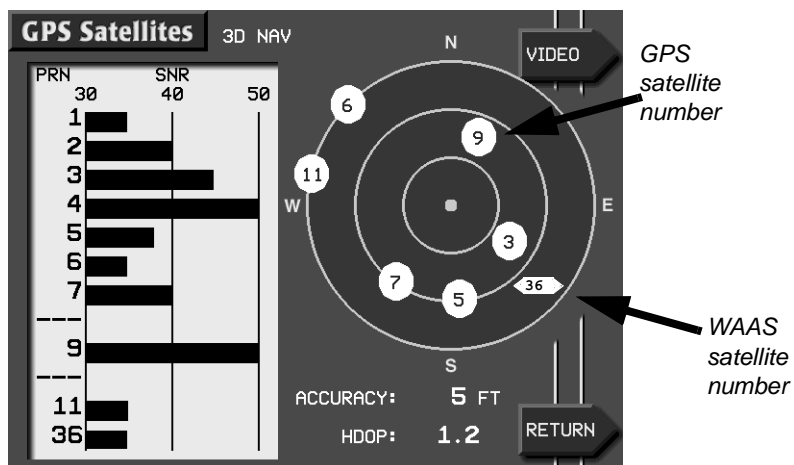
Figure 14: Satellites on the GPS satellites screen

The satellite map on the GPS SATELLITES screen shows the current location of the satellites in the sky. The 958 displays GPS satellites as circles; WAAS satellites as hexagons. You can check the quality of their signals by looking at each satellite's Signal-to-Noise Ratio (SNR). The higher the ratio, the better the quality.

Although the U.S. government identifies WAAS satellites by their pseudo random number (PRN)—a three-digit number ranging from 120 to 138—the 958 identifies them by two-digit numbers ranging from 33 to 51. For example, the satellite for the Atlantic Operating Region (AOR) is PRN 122, which the 958 displays as 35. See Table 5 below for the satellite identification numbers that may be displayed on the 958's screen.

TABLE 5: Satellite identification numbers

PRN	120	121	122	123	124	125	126	127	128	129
ON GPS SATS SCREEN	33	34	35	36	37	38	39	40	41	42

PRN	130	131	132	133	134	135	136	137	138	
ON GPS SATS SCREEN	43	44	45	46	47	48	49	50	51	

Selecting differential options

The *958* has several settings for differential reception. To select one, press the **STAR** key to display the OPTIONS/SERVICE INFO screen, then press the **RECEIVER OPTIONS** key to display the RECEIVER OPTIONS screen. The DIFFERENTIAL OPERATIONS field offers the following options (depending on the equipment connected to the *958*):

- DISABLED - to turn off all differential corrections

- RADIO BEACON - to force radiobeacon differential **if** the *958* is connected to a radiobeacon source (for example, the 2701)

- WAAS - to force WAAS differential corrections **if** the *958* is connected to a WAAS-capable unit (for example, the 2201, 2301, or 2701)

- AUTO - (the default setting) to prefer WAAS differential corrections, but **if** the *958* is connected to the optional 2701, the *958* will automatically switch to radiobeacon corrections **if and when** WAAS becomes unavailable or is less accurate than radiobeacon

Installation-test checklist

To check-out the *958* system after installation:

1. Turn on the *958*, then check for the presence of GPS, WAAS, or DGPS signals.
2. Review the functions: With a chart cartridge inserted, check that the CHART screen is displayed.
3. Confirm that the DIFFERENTIAL OPERATIONS option is at the desired setting. If not, press the **STAR** key to display the OPTIONS/SERVICE INFO screen, then press the **RECEIVER OPTIONS** menu key to display the RECEIVER OPTIONS screen. Press the **EDIT** key, change it to the desired setting, then press the **ENTER** key.

For more in-depth information about troubleshooting the *958* installation, see "SECTION SEVEN: Troubleshooting and servicing the *958* system" starting on page 35.

SECTION SIX: Interfacing the 958 system

Wiring the connector pins

TABLE 6: NMEA connector pins

Description	Wire color	Pin
NMEA port 1 input A	brown	3
NMEA port 1 input B	blue	1
NMEA port 1 input ground	white with blue stripe	4
NMEA port 1 output A	violet	12
NMEA port 1 output B	gray	7
NMEA port 1 output ground	blue with white stripe	8
NMEA port 2 input A	white with brown stripe	6
NMEA port 2 input B	brown with white stripe	2
NMEA port 2 input ground	white	5
NMEA port 2 output A	yellow	15
NMEA port 2 output B	orange	11
NMEA port 2 output ground	black	10
RS-232 ground	tan	17
RS-232 RX	green	16
RS-232 TX	red	18
External ground/foil drain	white with orange shield	9
Reserved	orange with white stripe	13
Honk out/200 PPNM (pulses per nautical mile)	pink	14
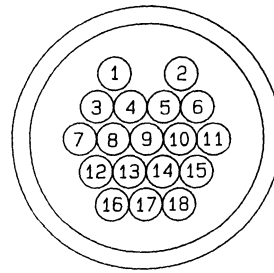
Figure 15: NMEA connector pin configuration

TABLE 7: Aux connector pins

Description	Wire color	Pin
Shield/Gnd	brown	1*
Remote On Gnd	green	1*
Remote On	white	2
NMEA AUX In (B)	black	3
NMEA AUX Out (B)	orange	4
NMEA AUX Out (A)	violet	5
NMEA AUX In (A)	blue	6
* Pin 1 on the AUX port requires two connections from the cable. The red wire is not connected on the 958 end, and should be insulated and capped. For the aux port pin configuration, see Figure 17 on page 32.		

Configuring the NMEA output ports

You can set each output port to meet the requirements of devices that conform to the NMEA 0183 or other data-format specifications: Press **STAR** to display the OPTIONS/SERVICE INFO screen, then press **PORT SETUP OPTIONS** to display the PORT SETUP OPTIONS screen. Press **PORT 1 SETUP** or **PORT 2 SETUP** to display a list of data-format control options, as shown below.
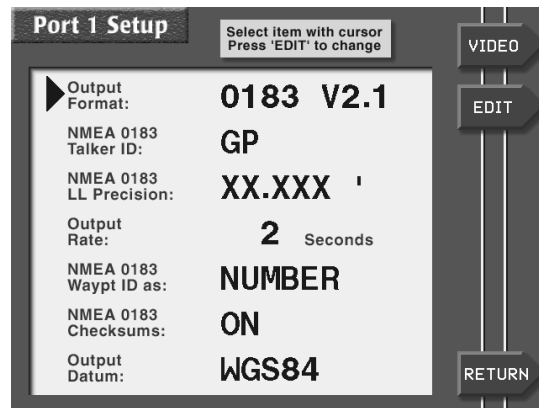
The devices interfacing with the 958 may have special requirements; check their installation instructions. The factory settings are fine for most devices, but the following are available, if needed.

TABLE 8: Setup options for the NMEA port

Setting	Choices
OUTPUT FORMAT (see below)	For port 1, choose NONE, 0183 RAY, or 0183 V2.1. For port 2, choose the above plus RADAR
NMEA 0183 TALKER ID (see page 27)	choose GP, LC, or II, to make the 958 look like a GPS receiver, Loran-C receiver, or an "integrated instrument"
NMEA 0183 LL PRECISION (see page 27)	choose hundredths of minutes, thousandths of minutes, or ten-thousandths of minutes
OUTPUT RATE (see page 28)	choose 2 to 999 seconds for the interval at which data is sent to the external device
NMEA 0183 WAYPT ID AS (see page 28)	choose NAME or NUMBER for the identifier of waypoints sent to the external device
NMEA 0183 CHECKSUMS (see page 28)	choose ON or OFF for compatibility with some older devices
OUTPUT DATUM (see page 28)	choose from a list of datums to apply to your lat/lon coordinates, if necessary

Choosing the output format

The 958 outputs navigation data in any of several standard formats as required by the receiving, or "listener," device. The OUTPUT FORMAT option provides the following choices:

- **None** turns the outputs off for when the 958 isn't connected to an external device.


- **0183 Ray** is used when transmitting/receiving position information to or from Raytheon equipment. In Raytheon's NMEA 0183 format, the checksum isn't used. (Note: Since the checksum isn't used, the *958* may receive incorrect NMEA data when connected to an external Raytheon loran.)

- **NMEA 0183 Version 2.1** is a general-use interface output format used by most autopilots, radars, plotters, and other equipment. (NMEA 0183 Version 1.5 sentences—BWC, GLL, and RNN—allow backwards compatibility with marine equipment designed for this earlier version of 0183).

- **Radar** is used when the *958* is connected to a Northstar radar.

Displaying NMEA output sentences

When you select 0183 or 0183 RAY as the output format (after pressing the **EDIT** menu key) and press **ENTER**, a screen is displayed showing all the NMEA 0183 sentences the *958* can output.
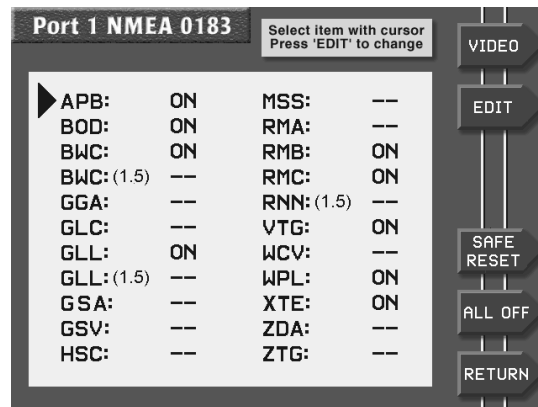
Three-letter abbreviations identify each sentence and are listed alphabetically. (For the meaning of these sentences, see the NMEA interface specifications document published by the NMEA.) The sentences to be output are followed by the word ON; those that won't be output have two dashes indicating that they're off. Some devices can't handle all these sentences correctly, so you can customize the output here by turning individual sentences on or off. In general, you may want to turn on only those sentences used by the particular equipment interfaced to the *958*.

Turning NMEA output sentences on and off

To turn on or off the *958*'s NMEA 0183 sentences, first follow the above description to display the 0183 SENTENCE screen, then press the **CURSOR PAD** to highlight the sentence you want to turn on or off, then press **EDIT**. Press the **CURSOR PAD** to toggle the sentence on or off, and press **ENTER** to make your selection (or **CLEAR** to leave it unchanged). Repeat for each sentence as desired. When you're done, press **RETURN** to go back to the PORT SETUP screen.

NOTE:	*The NMEA ON/OFF item list controls only the Version 2.01 GLL and BWC items, not the 1.5 version of these items. Thus, ON/OFF changes made to the Version 1.5 GLL and BWC output items have no effect on the data actually output unless you select that particular format version.*

If you want to set all the sentences to the factory settings for recommended output, press the **SAFE RESET** menu key. If you want to turn on only a select few sentences for output, press the **ALL OFF** menu key to turn off all sentences, then turn the desired ones back on.

Choosing the talker ID

The NMEA 0183 standard requires that the equipment you're interfaced to–the "listener"–knows what type of device is transmitting the data. The *958*'s talker ID tells the listener that it is receiving information from a navigation source, not a communications or sensor device–which transmits completely different forms of data. Certain listening devices will only accept navigation data identified as coming from loran (LC), GPS (GP), or an integrated instrument (II). The *958* lets you set its talker ID to LC, GP, or II to match 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 1 SETUP or PORT 2 SETUP screen, press the **CURSOR PAD** to highlight the NMEA 0183 TALKER ID option, then press the **EDIT** menu key.
3. Scroll through the three choices using the **CURSOR PAD** to make your selection, and press the **ENTER** key. The interfaced equipment will now receive the 0183 data in the correct nav-source format.

Choosing the lat/lon precision

For more flexibility when communicating with a variety of other devices, you can set the precision level of the 0183 position information output by the *958*. The choice you make depends on the equipment to which you're outputting the NMEA data (for the number of digits of precision required for that particular device, see the manufacturer's instructions). You have three choices:

- XX.XX ' (lat/lon precision to two decimal places/hundredths of minutes/or 60 feet)

- XX.XXX ' (lat/lon precision to three decimal places/thousandths of minutes/or 6 feet; this is the factory setting)

- XX.XXXX ' (lat/lon precision to four decimal places/ten-thousands of minutes/or roughly ½ foot)

The *958* conforms to the NMEA version 2.00 standard, and is also compatible with version 1.50. Electronic and pen plotting devices typically benefit the most from three and four decimal places of precision. However, many older devices (and some current autopilots) designed to operate with the original 0183 and other formats can only function with two-place precision.

NOTE:	*Position information can be output and displayed to four decimal places, but the ability to actually navigate with such accuracy is limited by the accuracy of the Loran and GPS systems. Therefore, choosing more decimal places doesn't necessarily increase navigating accuracy.*

Choosing the output rate

The default rate for standard NMEA 0183 output is two seconds. The 958 lets you use a one-second update interval, a rate of 1 Hz, under limited circumstances, for NMEA and diagnostic data output. Using the 1-Hz output option requires some thought when specifying either NMEA 0183 (NMEA version 2.0) or Raytheon (RAY 0183). Because there isn't enough time to transmit all available sentences within one second, you must select for output only those that are needed. If you select more sentences than can be output in one second, the 958 displays the following error message: SORRY, CAN'T DO THAT. TOO MANY SENTENCES FOR 1 SEC INTERVAL

In this case, you must select fewer sentences.

There are some applications that need a longer update period. In that case, you can increase the span to 999 seconds.

Choosing the waypoint identification (ID)

Many marine devices can display waypoint names if they're output by the 958. At the PORT 1 SETUP or PORT 2 SETUP screen, highlight the NMEA 0183 WAYPT ID AS option, then press the **EDIT** menu key. Change the option from NUMBER to NAME, and press the **ENTER** key when done. If capable, the listening device will now display six-character waypoint names.

NOTE:	*Be sure to see if the listening device can do this before you change the* NMEA WAYPT ID AS *option. Many older devices won't understand this identifier, and using it may cause problems with displaying waypoint information or when following routes.*
	There is no standard for identifying how numbers should be assigned when converting waypoints from names to numbers. When you export waypoint information as numbers to a peripheral device, be aware that numbers aren't sequentially defined and may be re-used on a random basis.

Choosing the checksum setting

Some older devices may not accept sentences containing the NMEA 0183 checksum that's output by the 958. In such cases, the device may not work properly or at all. If you have problems interfacing to older equipment, the 958 lets you turn off the NMEA 0183 checksum: At the PORT 1 SETUP or PORT 2 SETUP screen, press the **CURSOR PAD** to highlight the NMEA 0183 CHECKSUMS option, then press **EDIT**. Press the **CURSOR PAD** to change the setting from **ON** to **OFF,** then press **ENTER**.

Selecting an independent NMEA output-port datum

You can adjust the geodetic datum for NMEA 0183 ports 1 and 2, separately from the datum you choose for position display. At the PORT SETUP 1 or PORT SETUP 2 screen, highlight the OUTPUT DATUM option, then press **EDIT**. Scroll through the choices to make your selection. To apply this chosen datum to the lat/lon coordinates in the NMEA 0183 output sentences, press the **ENTER** key.

Using 200 ppnm output

The 958 provides an open-collector transistor output (on pin 14) that's programmed to produce 200 pulses per nautical mile. The emitter of the NPN transistor is connected to ground, and its collector connects to the output pin (see Figure 16: "Wiring for 200 PPNM output," below). The output can sink 100mA, and can withstand a maximum positive voltage of 50 volts.If the output connects to an inductive device (for example, a relay), a spike suppression diode such as a 1N4001 should be connected across the load. Cathode connects to the power side of the device and anode connects to the output pin side. The output is normally open, switching to ground for 80ms. It supports speeds from zero to 100 knots (clamps at 100kt).
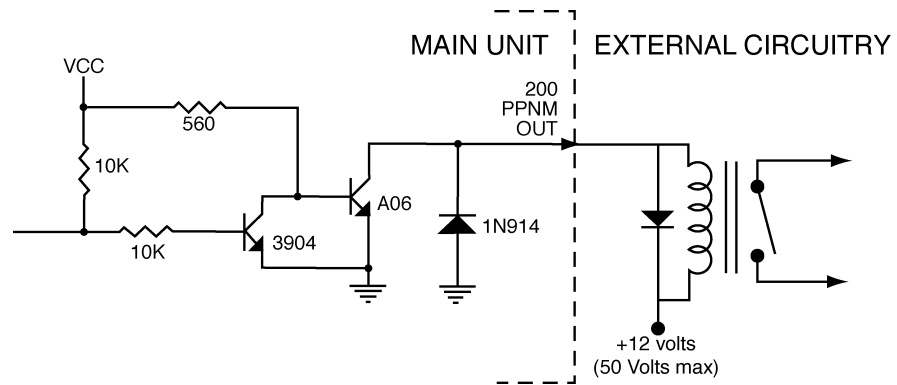
Figure 16: Wiring for 200 PPNM output

Configuring the RS-232 port

The RS-232 port on the NMEA connector is used to interface to any any compatible SC104 output or a PC for downloading waypoints or for uploading 958 software updates. The following sections describe the RS-232 port's settings for SC-104 in, and copy port 1 and 2.

Using SC-104 in

THE SC-104 IN setting lets the 958 accept optional differential corrections from any source that transmits the standard SC-104 data stream. When using SC-104 IN, be sure that the BAUD RATE setting also matches the beacon receiver's baud rate requirements.

Using copy port 1 and copy port 2

The COPY PORT setting lets you interface the 958 to many PC's without using an RS422-to-RS232 converter. Many PC application programs can be used for waypoint/route loading, chart programs, data logging, etc. This function "copies" the output of the specified port 1 or port 2 data format (NMEA 0183 or Raytheon 0183) to the RS-232 port's output for direct connection to the computer.

1. Press **STAR** to display the OPTIONS/SERVICE INFO screen, then press **PORT SETUP OPTIONS**.
2. Press **PORT 1 SETUP** or **PORT 2 SETUP** to confirm that the port you want to copy is now set to output the desired data format. If necessary, make changes now by

pressing **EDIT**, pressing **ENTER** when done, and **RETURN** to go back to the PORT SETUP OPTIONS screen.

3. If necessary, change the RS-232 SETUP option to display the appropriate COPY PORT 1 or COPY PORT 2 selection by pressing **EDIT**, then pressing the **CURSOR PAD** to change the selection, then pressing **ENTER**. The unit will now copy and output the specified port's data format through the RS-232 port to an external device.

NOTE:	*The RS-232 diagnostic port may overflow—when it's configured to either* COPY PORT1 *or* COPY PORT2, *and one of the copied ports is in 0183 output mode—unless the diagnostic port's baud rate is fast enough to handle the number of characters. Because the diagnostic port's baud rate can now be changed, the 958 will always display this precautionary message before you actually reset the baud rate:* WARNING: ALL SENTENCES MAY NOT TRANSMIT AT DIAG BAUD RATE. PRESS "ENTER" TO CONTINUE

Using the port off setting

Use this setting when you don't need the RS-232 port's input or output functions.

About the diagnostic setting

This setting is only used for troubleshooting at the Northstar factory. Do not use this setting.

Connecting the 958 to a remote display

The 958's VGA connector is used to connect it with a remote display, such as the Northstar 1201 or 1202. Northstar doesn't supply the connecting cable since the cable requirements vary with each particular installation. The VGA connector accepts the 15-pin connector from a standard VGA cable. Check the manufacturer's instructions for further cabling and setup details. If you're connecting to the Northstar 1201 or 1202, see the *Northstar 1200 Series Display Owner's Guide (part number GM1200UG).*

Connecting the 958 to a video camera

The 958's VIDEO connector is used to connect to any NTSC-compatible device, such as a video camera. Northstar doesn't supply the connecting cable since the cable requirements vary with each particular installation. Check the manufacturer's instructions for further cabling and setup details.

After you've connected the 958 to the video device, check the connection by pressing the **VIDEO** menu key (available on most 958's screens) to see the video image. For instructions on moving the image and changing its size, see the *Northstar 958 Operator's Manual (part number GM958UM).*

Connecting two Northstar units

You can connect two 958's (or a 958 to a 957) and then transfer one of the unit's waypoints and routes into the other. To connect the 958's, you must fabricate an interface cable and terminate both its ends with the supplied 6-pin solder-cup style cable connectors. This data-transfer cable is not included with the 958. You must select a cable; use only shielded, twisted pair.

You can also connect a 958 with a Northstar 952, 951, or 941, also using your own data-transfer cable. Each 952, 951, and 941 that you want to transfer waypoints and routes to or from **must** be using software version 3.12 or higher.

Assembling the cable

To assemble the cable:

1. Cut the cable to the desired length.
2. Slide the following parts onto each end of the cable, in the following order:
- connector backshell

- rubber-strain relief boot that fits inside the backshell

- twist lock (also known as a quarter turn), ensuring that it's facing in the correct direction.

3. Trim and prepare the wires for soldering to the connector body.
4. Terminate the cable, as described below.

Terminating the cable

To terminate the cable:

1. Terminate and solder the appropriate wires to the appropriate pins:
- For wiring two 958's or a 958 to a 957, see Figure 17 on page 32 and Table 9 on page 32.

- For wiring a 958 to a 952/951/941, see Figure 18 on page 33 and Tabl e10 on page 34.

2. Move to Step #3 on page 34.

Shield termination

958 6-PIN AUX CONNECTOR

957/958 6-PIN AUX CONNECTOR

Pin number

Pin number

Ground/shield	**1**	**1** Ground/shield
No connect	**2**	**2** No connect
Aux input B	**3**	**3** Aux input B
Aux output A	**4**	**4** Aux output A
Aux output B	**5**	**5** Aux output B
Aux input A	**6**	**6** Aux input A
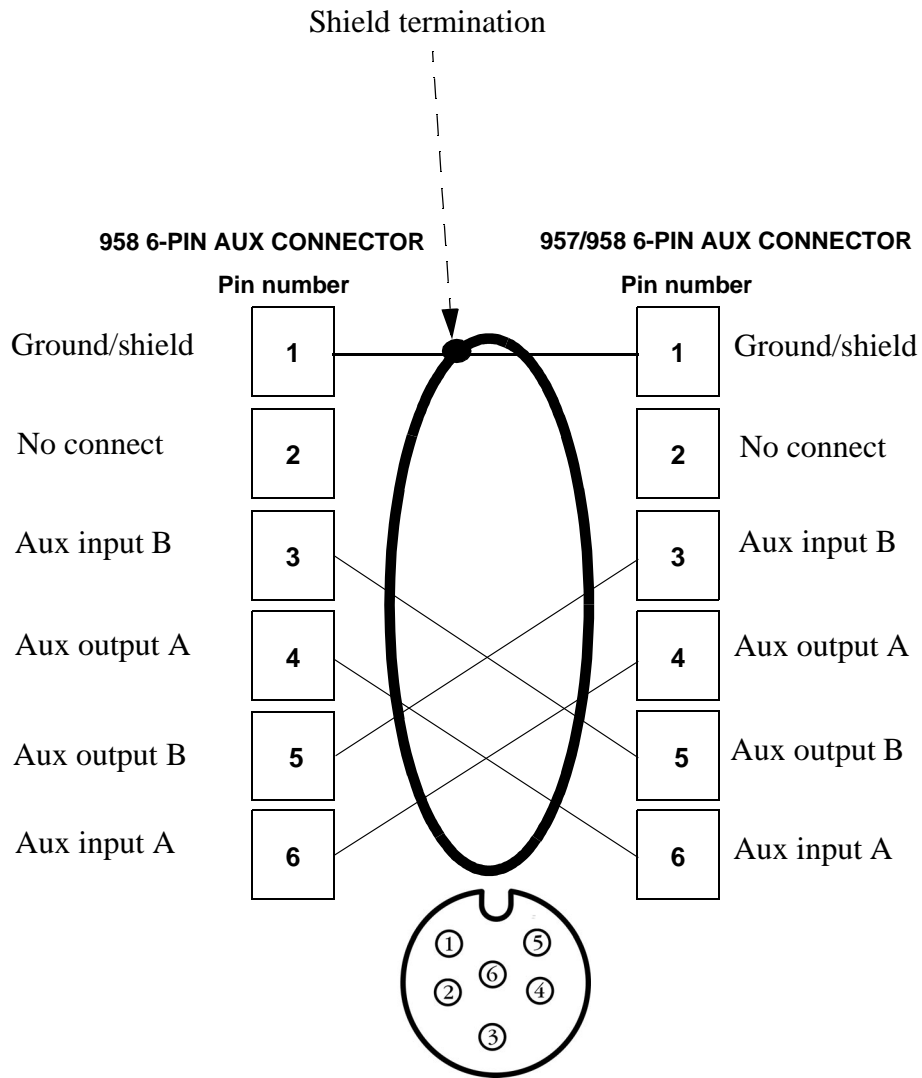
Figure 17: 957/958 aux ports' interface diagram (wiring side view, solder cup)

TABLE 9: 958-to-958 wiring

958 Pin #	Function	958 Pin #	Function
1	Ground shield	1	Ground shield
2	No connect	2	No connect
3	Aux In B	5	Aux Out B
4	Aux Out A	6	Aux In A
5	Aux Out B	3	Aux In B
6	Aux In A	4	Aux Out A

952/951/941 10-PIN
AUX CONNECTOR
Pin number

No connect	1	Shield termination
No connect	2	
No connect	3	
No connect	4	

958 6-PIN
AUX CONNECTOR
Pin number

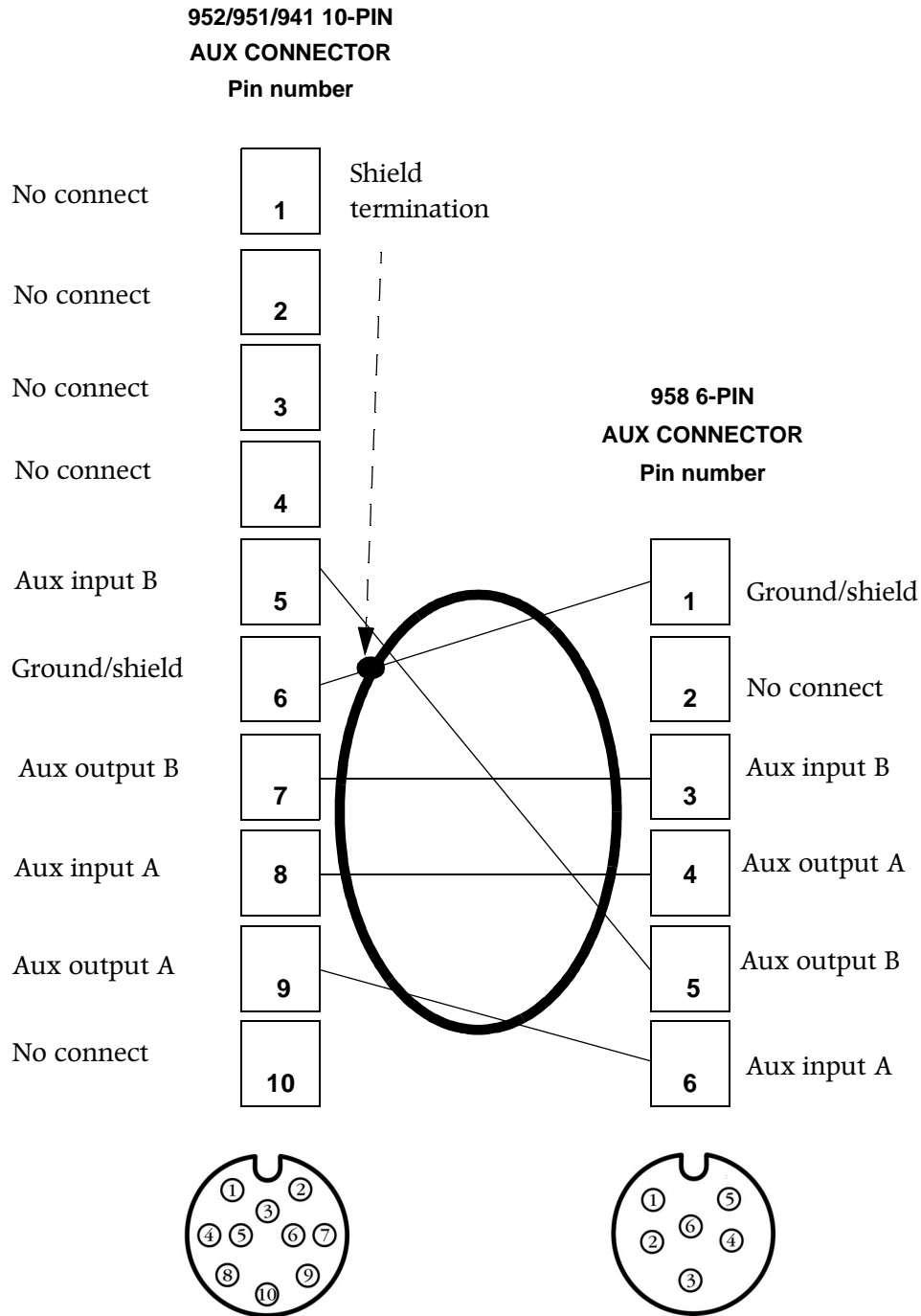| No connect			
Aux input B	5	1	Ground/shield
Ground/shield	6	2	No connect
Aux output B	7	3	Aux input B
Aux input A	8	4	Aux output A
Aux output A	9	5	Aux output B
No connect	10	6	Aux input A

Figure 18: 952/951/941 and 958 aux ports' interface diagram (wiring side view, solder cup)

TABLE 10: 952/951/941 to 958 wiring

952 951 941 Pin #	Function	958 Pin #	Function
5	Aux In B	5	Aux Out B
6	Ground shield	1	Ground shield
7	Aux Out B	3	Aux In B
8	Aux In A	4	Aux Out A
9	Aux Out A	6	Aux In A
*Pins 1, 2, 3, 4 and 10 on the 941/951/952 aux connector, and pin 2 on the 958 aux connector, aren't used.			

3. Slide the twist lock onto the connector body.

4. Screw the connector backshell to the connector body, and tighten.

5. Install the strain- relief clamp with two screws.

6. Connect each end of the cable into the 6-pin ports at the back of the 958, or connect one end of the cable into the 10-pin port at the back of the 941, 951, or 952.

7. Turn both units on, and test for the proper cable connection: a) Press **WAYPTS/ ROUTES**; b) Press **IMPORT/EXPORT**; c) Press **IMPORT DATA** or **EXPORT DATA**; d) Press **TEST COMM**. The message should read REMOTE LINK OK. If so, the hardware connection is done and the two units can now transfer all waypoints and routes between them.

Setting the anchor-watch alarm honk

The anchor-watch alarm function is used to set the 958 to honk, in addition to beep, once you connect a honker to pin #14 on the NMEA connector. See Figure 19 below for wiring to support the 958's external honk feature. You can use Radio Shack part number 273-060 or an equivalent. A continuous honking sequence will begin, either when the vessel moves outside the specified anchor-alarm radius or when the navigation source becomes unavailable—once you've set the anchor-watch alarm to honk. For details, see the *Northstar 958 Operator's Manual* (part number GM958UM).
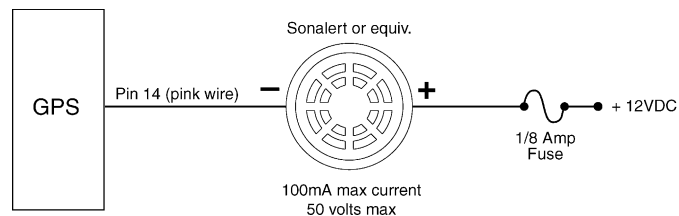
Figure 19: Pin14 honk alarm connection

SECTION SEVEN: Troubleshooting and servicing the 958 system

Troubleshooting installation problems

CAUTION! ⚠	*Make sure that the 958 doesn't interfere with any other on-board systems. Check all other systems to ensure that their performance doesn't degrade when the 958 is turned on.*

TABLE 11: Troubleshooting the 958 installation

Problem Area	Symptom	Possible Solutions/Reasons
POWER	• *Pressing the **PWR** key doesn't start the 958*	• *Check the fuse and the power to the 958.*
DISPLAY	• *The 958 powers up, beeps, but there isn't any video.*	• *The display may have failed. Call your Northstar dealer or the Northstar Service Department.*

TABLE 11: Troubleshooting the 958 installation (cont.)

Problem Area	Symptom	Possible Solutions/Reasons
DISPLAY (cont.)	• *The display screen dims, either slightly or more, after the 958 has been on for a certain time.*	• *The 958 may be going into auto-dimming mode. Auto-dimming helps maintain the integrity of the display and reduce power consumption when the 958 is on and running too hot for its current environment. In this case, the display screen may automatically dim.*
	• *The message* 8117 FAILURE *appears where the video input image should be.*	• *The internal 8117 video chip has failed; contact the Northstar Service Department. (This failure affects only the video image, nothing else.)*
	• *Color bars appear where the video overlay image should be.*	• *Check that the video image is turned on (press* **STAR** *to display the* VIDEO SETUP *screen).* • *Check the cables and the connectors.* • *Check that the video equipment is working properly.*
SYSTEM System lock-ups	Hardware-related: • *The system locks up on a random basis with no apparent pattern.*	• *Possible internal failure; call your Northstar dealer or the Northstar Service Department.*
	• *The system locks up when using a chart card.*	• *Possible bad chart card. Remove the card, and inspect the pin area of the card and the 958 for damage. If the pins in the 958 are bent or damaged, to prevent further damage, don't insert another card. If you're sure the card pins aren't bent, try inserting a new card (turn power off before inserting).*
	• *System fails any initial self-tests.*	• *Possible internal failure; call your Northstar dealer or the Northstar Service Department.*

TABLE 12: Troubleshooting the 2201 and 2301 installation

If . . .	Then . . .
Satellite signals are often lost, or the 2201 works while you're travelling in one direction, but not the opposite one.	The 2201 or 2301 may be partially shaded by metallic objects around it. Re-position or raise the 2201 or 2301 away from the object for a better satellite view. Signals may be lost when the 2201 or 2301 is under a bridge or when shielded by buildings.
Poor SNR readings are obtained even after running the 958 for several minutes	Check the quality of the antenna location—the antenna should have a clear view of the sky. For the correct antenna placement, see Figure 8 on page 13. Make sure the antenna is clean, and not covered with ice, snow, or exhaust soot.
You're having difficulty obtaining WAAS satellites	Check that WAAS is available in your operating area. Reset the 958's satellite elevation setting to its default (10 degrees). Check that the 958's DIFFERENTIAL OPERATIONS option is set to either WAAS or AUTO.
The following error message appears on the 958 display: COMM FAIL	 With power on, check the antenna and wiring connections. Disconnect the 2201 or 2301 from the 958, then measure the 7-pin 2201/2301 connector for 10 - 36 volts at pin 7, ground at pin 6. Check the 2201 or 2301's remote-on: Pin 5 should measure less than 5 ohms to ground. After testing above, re-connect the cable and press the **PWR** key to turn the 958 off, then turn it back on again.
TOO FEW SATS	Check if anything is blocking the 2201 or 2301's view of the sky. The almanac may not be complete; allow up to 30 minutes for full initial acquisition.

TABLE 13: Troubleshooting the 2701 and AN205-P installation

If . . .	Then . . .
Satellite signals are often lost, or the AN205-P works while you're travelling in one direction, but not the opposite one.	The antenna may be partially shaded by metallic objects around it. Re-position or raise the antenna away from the object for a better satellite view. Signals may be lost when the antenna is under a bridge or when shielded by buildings.
Poor SNR readings are obtained even after running the 958 for several minutes	Check the quality of the antenna location—the antenna should have a clear view of the sky. Make sure the antenna is clean, and not covered with ice, snow, or exhaust soot.
You're having difficulty obtaining WAAS satellites	Check that WAAS is available in your operating area. Reset the 958's satellite elevation setting to its default (10 degrees). Check that the 958's DIFFERENTIAL OPERATIONS option is set to either WAAS or AUTO.
The following error message appears on the 958 display: COMM FAIL	With power on, check the antenna and wiring connections. Disconnect the 2701 from the 958, then measure the 25-pin 2701 connector for 10 - 36 volts at pin 25, ground at pin 13. Check the 2701's remote-on: Pin 12 should measure less than 5 ohms to ground. After testing above, re-connect the cable and turn the 958 off, then turn it back on again.
TOO FEW SATS	Check if anything is blocking the 2701's or antenna's view of the sky. The almanac may not be complete; allow up to 30 minutes for full initial acquisition.

Getting technical support

Contacting Northstar

After you've followed the instructions in this manual, if you need technical assistance or have any other service-related questions, you can contact the Northstar Service Department. Please be as complete and accurate as possible when describing the problem so that a service technician can research the problem and provide the quickest response. You can reach Northstar's Service Department by email, fax, U.S. mail, or phone as described in Table 14 below. Northstar's Service Department is available between 9:00 AM and 5:00 PM Eastern Time, Monday through Friday, excluding major holidays. To buy spare, replacement, or missing parts, and to get brochures and product information, contact the Northstar Sales Department.

NOTE:	*Please have the 958's serial number — available on the back or on the* OPTIONS/SERVICE INFO *screen — ready before contacting Northstar's Service Department.*

TABLE 14: Contacting Northsta r

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
U.S. mail: 30 Sudbury Road Acton, MA 01720 USA
Website: www.northstarcmc.com (you can send email to Northstar directly from this site, and access additional technical information and download manuals in PDF form under either the ___*Manuals*___ or ___*Support*___ links).

Hearing from you

Your feedback is important and helps Northstar ensure that this manual is a valuable resource for all marine technicians. Email your comments or suggestions about this manual to the following address: manuals@northstarcmc.com.

Using the Dealer Express web pages

Northstar dealers can get service information online by going to the Dealer Express area on Northstar's website. Contact Northstar for your dealer password before clicking on the Dealer Express link. This area includes the following topics:

- service bulletins (for known issues and solutions)
- software update information (for new software features)
- service request form (for sending systems back)
- service status request form (for systems currently under repair)
- warranty registration form (for registering new products)

Obtaining software updates

Periodically, Northstar posts software-update addenda on its website (www.northstarcmc.com) under the **_Manuals_** link.

For dealers

Once Northstar has posted an addendum to its website, you can call the Northstar Sales Department to order the corresponding software update, or download the update from the Dealer Express area of the website.

For operators

958 operators should contact their respective dealer for software updates. Northstar does not recommend that operators install software updates. If an update is installed incorrectly by mistake, you may lose data and the 958 may not work properly. Software updates aren't covered by the Northstar warranty.

Returning a 958 for service

958 repairs are performed only by authorized Northstar dealers or at the Northstar factory. Service includes a complete hardware and software check-out. For a system under warranty, shipping charges to the factory are the only cost for factory repair. The repaired 958 will be returned via prepaid economy ground freight (units returned overseas are chargeable). The 958 and any accessories returned for warranty repair that are determined to be without fault are subject to a handling charge.

NOTE:	*For 958's still under warranty, field repairs aren't authorized and will void the warranty! Please contact the Northstar Customer Service Department if you need clarification, or need assistance with having repairs done.*

NOTE:	*Before returning the 958 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 the 958 was purchased through a dealer, call the dealer with the 958 serial number so they can help you get an RMA number. Shipments without a proper RMA number will not be accepted.*

CAUTION! ⚠	*You may want to back-up any user-defined waypoints and routes before returning the 958 for repair. See the Northstar 958 Operator's Manual for details.*

The 958 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 958 should be shipped only in a properly designed carton with packing material, and to the Northstar factory at the following address: Northstar Technologies Service Department, 30 Sudbury Road, Acton, MA 01720 USA.
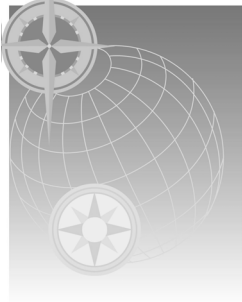
APPENDIX A: 958 system technical specifications

TABLE 15: 958 technical specifications

Physical features/environmental	Interfacing
Waterproof control head	Two bi-directional NMEA I/O ports, 1 AUX port
10.4" diagonal color LCD	Two bi-directional RS-232 ports
Unsurpassed sunlight viewability	Interfaces to optional Northstar 490 for fishfinding or to an optional Northstar radar
640x480 pixel, hi-temp, backlit, transmissive color LCD	Waypoint upload/download capability to a PC (with appropriate software)
Flush mount standard	
High-contrast anti-reflective screen	One VGA out port (connects to Northstar 1201 monitor and others)
Waterproof chart cartridge door	
Large, easy-to-use backlit controls	One VIDEO in port
Easy interfacing I/O plugs	NMEA input sentences: WPL and others
0 degrees Celsius - 55 degrees Celsius max 95% relative humidity, noncondensing	200 PPNM speed output
	Honk output
10 - 36 volts DC power, 50 watts	NMEA output sentences: APB, BOD, BWC, GGA, GLC, GLL, GSA, GSV, LCD, HSC, MSS, RNN, RMC, RMA, RMB, VTG, WCV, XTE, ZDA, ZTG. (Conforms to NMEA v 2.0 and later. Supports 1.5 GLL and BWC.)
	Accepts most external loran receivers
	Waypoint and route transfer between two 958's (or a 957 and a Northstar 941/951/952)

TABLE 16: 2201/2301 technical specifications

Physical features	Interfacing
Self-contained 12-channel L1 GPS/WAAS pod antenna-receiver. Dimensions: 4.5" (114mm) diameter x 3.79" (96mm) high. Weight: 1.2 lb. maximum excluding cable (0.55 kg). Cable (normal installation): 22 Ga conductors foil-shielded cable, environmentally sealed (50-foot cable supplied). Mounting: 1-14 UNS threads x 1" deep for mast mounting, and 3 x 10-32 UNF screws for deck mounting (2201-only). Connector receptacle with 7 male contacts. Mating: Switchcraft EN3C7FC or equivalent.	Prime power:10 to 36 VDC (12V and 24V system). 2.4 watts typical at 12V. Reverse polarity protected and load dump protected. Input messages:Auxiliary (RTCM SC104) messages 1, 3, 9. Output messages: NMEA GGA, GSA, GSV, RMC, VTG, ZDA, GLL. Serial communications: RS-232 asynchronous data port, Main port IN/OUT plus AUX input; 19,200 baud standard (both ports user-selectable from 300 to 19,200 baud). Default baud rate = 9600.
Performance	**Environmental**
Acceleration: 4 Gs (39.2 m/s^2), Jerk: 2 m/s^3 Velocity: 1852 km/h (514 m/s) max. Position accuracy: <3 m 2dRMS. Time-to-first-fix (TTFF): Hot start - 20 seconds typical, with current almanac. Warm start - 45 seconds typical, with current almanac. Cold start - 2 minutes typical, with no almanac. Re-acquisition time: <1 second typical to re-acquire (five-second obscuration). 3 seconds typical to re-acquire (60-minute obscuration). Channel allocation: 10 GPS channels plus two WAAS satellites. Coarse acquisition: C/A code (1.023 MHz chip rate), code and carrier phase tracking. Sensitivity: -135 dBm (antenna input level).	Operating temperature: -30 to +75°C (standard). Storage temperature: -55 to +90°C. Humidity: SAE J1455/4.2 Procedure I/II. Waterproof: Fully sealed unit. Meets MIL-STD 810E method 512.3 (equivalent to 6-foot, 30-minutes submersion). Shock: MIL-STD 810E Method 506.4, Procedure I, IV. Vibration: MIL-STD 810E Method 514.4 Category 8. Salt spray: MIL-STD 810E Method 509.3 (48 hours). Sand and dust: MIL-STD 810E Method 510.3. ESD: IEC 1000-4-2 level 2 (-8 kV to +8 kV). EMI: FCC Class B, European CE, 89/EEC EN55022 class B, EN50082-1. Ultraviolet light protection: ASTM G53-88.

TABLE 17: 2701 technical specifications

Physical features	Interfacing
Dimensions: 2.0" high x 4.68" wide x 8.9" deep Weight: 2 pounds	Primary power: 10 to 40 VDC (12V and 24V systems). 10 watts typical. RS-232, GPS, and beacon receiver comm ports
Performance	**Environmental**
Velocity: 1852 km/h (514 m/sec) max. Acceleration: 4 Gs (39.2 m/sec^2, Jerk: 2 m/sec^3 Position accuracy: < 1 m circular error probability (CEP), DGPS; < 2 m circular error probability (CEP), WAAS. Time-to-first-fix (TTFF): Hot start - 20 seconds typical, with current almanac, position, time, and ephemeris. Warm start - 45 seconds typical, with current almanac, position, time, and ephemeris. Cold start - 2 minutes typical, no almanac, position, and time. With WAAS acquisition, add 30 seconds typical (max. 1 minute) Re-acquisition time: < 1 second typical to re-acquire (5-second obscuration); 3 seconds typical to re-acquire (60-minute obscuration). Channels allocation: 10 GPS channels plus two WAAS satellites.	Operating temperature: Receiver: 0 degrees C to +50 degrees C. Antenna/preamp: -40 degrees C to +50 degrees C.

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