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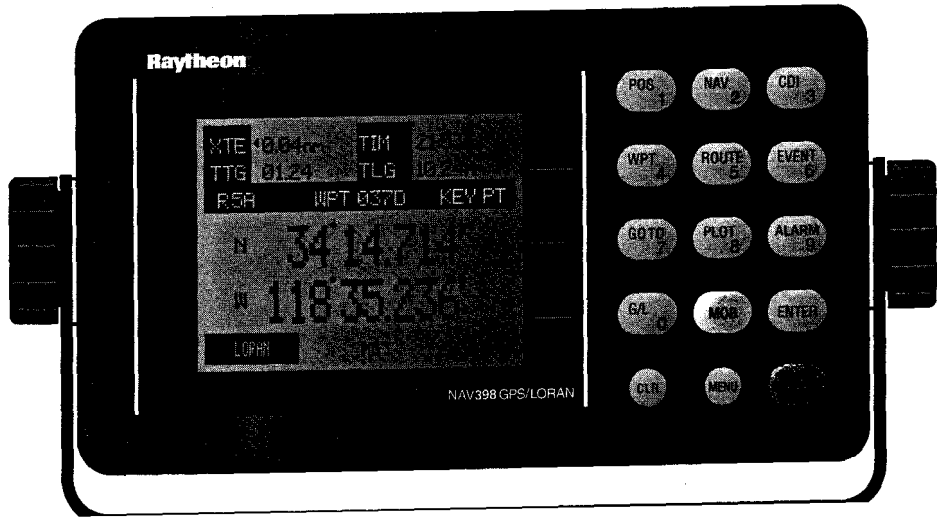
Raytheon

NAV398 GPS/LORAN

GPS/LORAN

OPERATION MANUAL



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SECTION 1

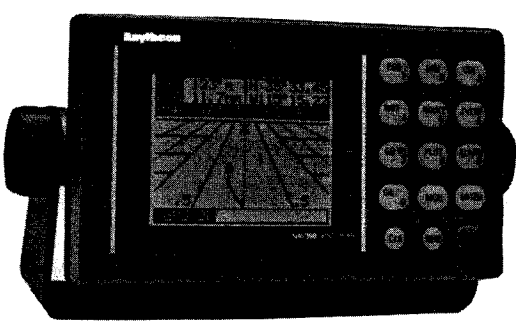
INTRODUCTION

1 .O General

Congratulations on selecting Raytheons' NAV 398 for Loran-C/GPS navigation aboard your vessel. We are sure you will enjoy using this ultra modern, full function, and compact navigation system. The NAV 398, with its' large STN LCD display, excellant graphics, on-sceen prompts, and oversized soft silicon keys, provide simple operations to guide you through the various navigation functions. From the moment you turn on the NAV 398, you will be surprised at how easy it can be to use this Loran-C or GPS Navigator.

The NAV 398 is a feature-packed Navigator that operates with inputs from the Raynav 508 or 508A Loran-C sensors, or with the Raystar 108 8-Channel GPS sensor, or with both sensors together. One key press gives you quick access to either navigation system.

The NAV unit includes storage for up to 500 waypoints and 10 route plans in the NAV unit's internal memories. The EVENT key stores your present position as a waypoint instantly with a single key press. The MOB (Man-Overboard) key not only stores an instant position with one key press, but activates a special display to steer you back to the MOB location. A special Dynamic CDI display provides a 3-D effect for steering to destinations in the route; even showing turns in the route and waypoints along the way.



1.1 About This Manual

The purpose of this manual is to provide you with the most important information for obtaining the best operation and performance from your NAV unit. Please take the necessary time to read the various sections.

In the event that you are using a Loran-C Navigator for the first time, please refer to the Raynav 508/508A Loran-C Sensor instruction manual for basic loran information. The Introduction section of the 508 manual includes a listing of common Loran C Terminology used with loran.

If your NAV398 is using the RAYSTAR 108 GPS Sensor, the Raystar 108 instruction manual includes a general description of the GPS system which may also be helpful. The Raystar 108 GPS sensor is compatible with Raytheon's Differential Beacon Receiver. If you have added the DGPS Receiver to your system, a simple explanation of the US Coast Guard's DGPS system is included in that manual for your reference.

Section 2 of this manual contains important information concerning the installation of your new NAV unit. Although the typical installation might seem straightforward and simple, we highly recommend that this section be read completely and the guidelines for installation be closely followed to assure a more trouble free and efficient operation of your new unit.

Section 3 covers the Operations of the NAV 398 and is intended to get you thoroughly familiar with the unit's controls and display formats. The NAV 398 uses many on-screen prompts to help guide you through operations and logical key operations, which should be easy to remember.

The best way to learn about your NAV 398 is to dive right in. You can't damage the unit by randomly pressing the keys, so don't be afraid to experiment. If at any time the results appear confusing, just press the **EXIT** key and start again.

Section 4 contains technical information concerning some basic care and maintenance for your unit. In the event that the unit should ever require repairs, it is recommended that these services be provided by an Authorized Raytheon repair facility or by the Raytheon Factory Service Center.

Before proceeding to install this unit, please take a few moments to fill out the warranty registration card located behind the front cover of this manual. You must return this card to Raytheon Marine Company to assure the registration of the warranty for your NAV unit. The postage is prepaid if the card is mailed within the USA.

SECTION 2

INSTALLATION

2.0 General

Although your **NAV 398** is designed to the highest levels of quality and performance, it can best attain those standards only when it has been properly installed. This section provides the user with practical guidelines to assist in the planning and the installation of the **NAV 398** aboard your vessel.

2.1 Unpacking and Inspection

Use care when unpacking the unit from its shipping carton to prevent damage to the contents. It is also good practice to save the carton and interior packing material until the unit has been installed on the vessel. The original packing material should be used in the unlikely event that it is necessary to return the unit to the factory.

2.1.1 Equipment Supplied

The table below lists items that are included with your **NAV 398.** If an item is missing, contact your Raytheon dealer for assistance.

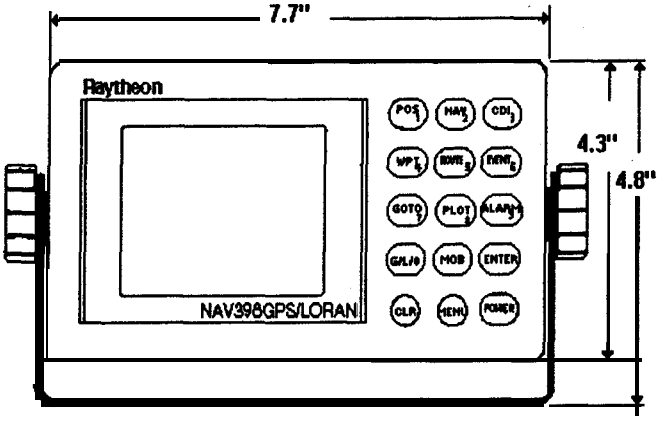
Item	Description	Part Number	Quantity
1	**NAV 398** Display	G263746-1	1
2	Power Cable	CQC-4737	1
3	Instr. Manual	G263746-5	1
4	Spare Fuse	MF60NR-2A	2
5	Yoke Bracket	MTD005707	1
6	Yoke Knobs	MPTG30012	2
7	Hardware Kit		1

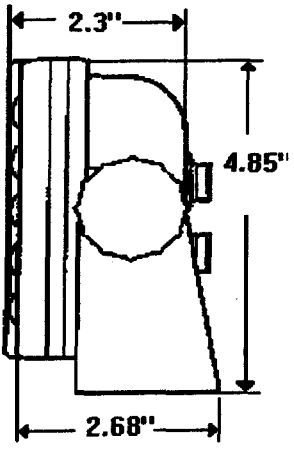
2.2 Display Installation

2.2.1 Choosing a Location

When choosing the location to mount the NAV Display unit, please consider the following criteria for the site:

- The best location to provide ease of operation and viewing of the unit.
- The best location to provide protection from the elements of the environment. Even though the NAV 398 is designed to meet the toughest USCG waterproofing specifications, common sense dictates that it should be mounted, whenever possible, so that it is not exposed to the direct effects of salt spray or the hot sun.
- The best location with the most separation from sources of interference.





The unit can be mounted to a chart tabletop, suspended from the overhead, or attached to a bulkhead using the yoke bracket supplied.

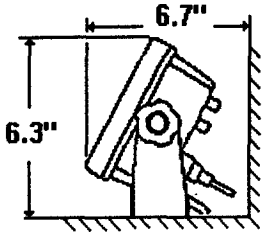
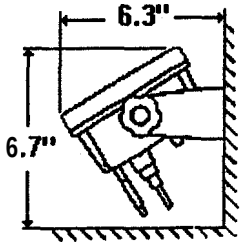
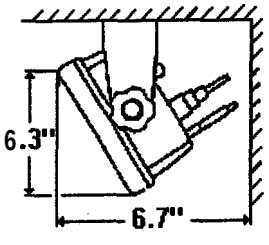


TABLE TOP



BULKHEAD

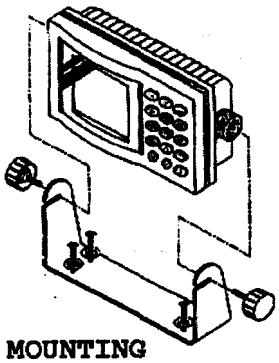


OVERHEAD

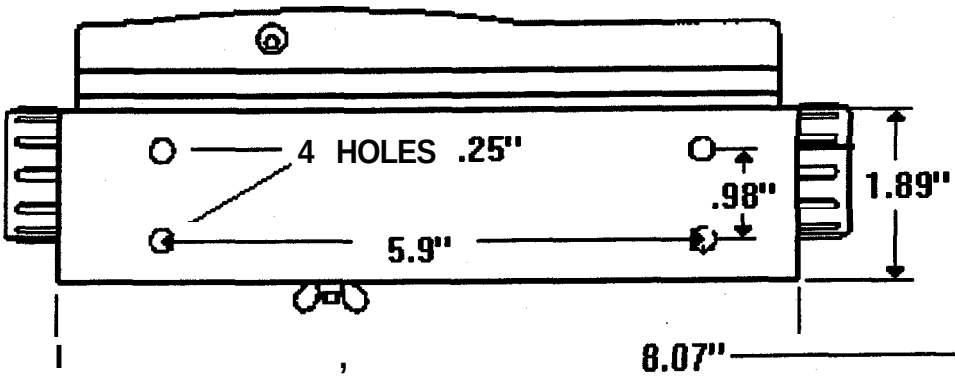
2.2.2 Mounting the NAV Unit

Use the following steps for yoke mounting of the NAV Unit:

1. Loosen the yoke knobs on each side of the unit. and remove the mounting yoke bracket.
2. Position the bracket to the mounting surface and mark the holes for the mounting screws.
3. Mount the bracket with the screws supplied.
4. Slide the unit back into the yoke and secure in the desired viewing position by tightening the yoke knobs.

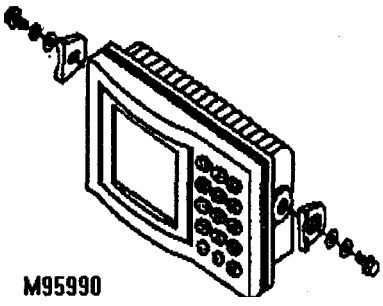


MOUNTING
IN THE YOKE BRACKET

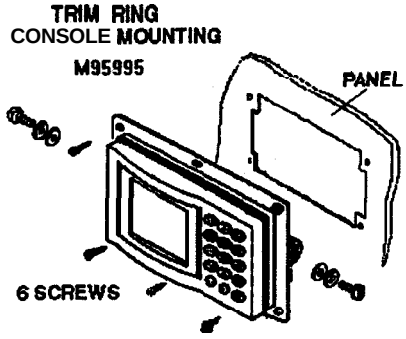


2.2.3 Flush Mounting

The display can also be flush mounted in a console using the Optional Flush Mount Kit (M95990) or the Trim Ring Kit (M95995) to give a more finished look to your installation.



FLUSH MOUNT KIT



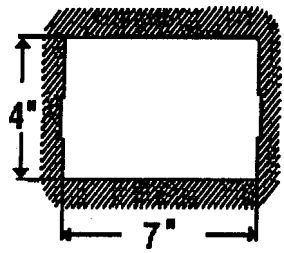
1. Select the desired flush mounting location. A clear, flat area of at least 9” wide by 5” high having at least 5” of clear depth behind the panel is

required. When using the Trim Ring Kit, add 3/4" to the width and height clearance dimensions.

CAUTION

Make sure there are no hidden electrical wires or other items behind the desired location before proceeding. Check to see that free access for mounting and cabling is available.

2. Using the dimensions for the cutout hole shown, draw the pattern for the cutout hole on the console.



3. Drill two 1/2" pilot holes inside the cutout guide area at diagonal corners.

4. Using an appropriate saw, cut along the outside of the cutout line.

5. Remove the yoke knobs and the yoke and the rubber spacers from the cabinet. If using the Flush Mount Kit verify that the unit fits correctly into the cutout. If using the Trim Ring Kit, attach the Trim Ring, then test fit into the cutout. It may be necessary to notch out some clearance in the cutout to pass the trim ring hardware through the panel.

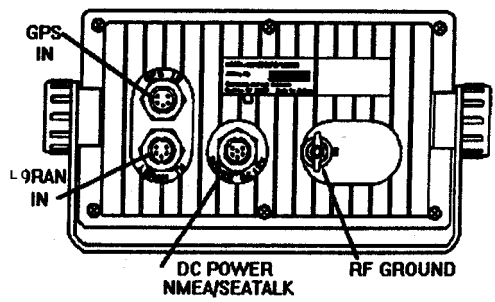
7. Complete the installation of the DC power cable, data output, and sensor wiring into the console as per section 2.4 of this chapter. Be sure to allow some slack in the cables for service to the equipment when necessary.

8. Connect all cables to the unit rear panel.

9. Insert the NAV unit into the panel. Use a flat washer, locking washer, and nut on each stud and secure to the console. In some cases you may prefer to apply a light coat of RTV sealant around the cutout to seal the console.

2.3 Electrical Connections

The standard connections which are normally made to enable the NAV 398 to operate are the ship's DC power, to either a Raynav 508 or 508A Loran-C sensor or to a Raystar 108 GPS sensor or both. The NAV unit can also supply NMEA data to other equipments. The next sections discuss how to make these connections.

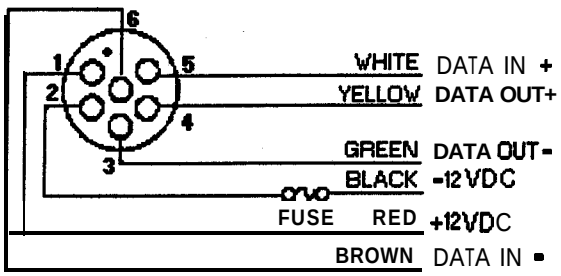


2.3.1 Power Input

The **NAV 398** is intended for use on vessels with 12 VDC power systems and can operate as long as the DC supply is maintained between 10 and 16 volts. The DC power system can be "negative" ground or have both positive and negative supply lines "floating" above ground. The **NAV 398 is not intended for use on "positive" ground vessels.**

A 6 foot cable assembly containing wiring for the DC power and Data Output is supplied with your display unit and in many cases will be adequate to reach near the source of the 12 VDC power.

For best noise immunity from other shipboard electronics, if possible, avoid grouping the power connections on the same circuit breaker with radar, radio, or echo sounder power leads. The NAV unit's wiring should be kept separate as much as possible from other devices.



Power Cable Wiring Diagram

Although the **NAV** unit's power consumption is typically less than 5 watts, if the power leads need to be extended more than 10 feet, the wire size of the leads should be increased accordingly to minimize line losses. For cable runs of 20 - 35 feet #12 AWG wire is recommended.

OBSERVE PROPER POLARITY!

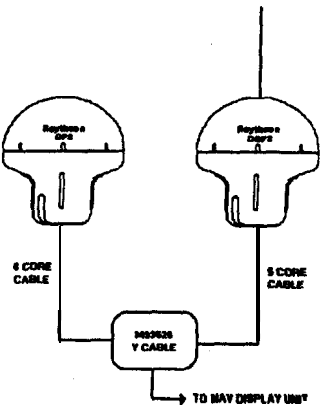
The **RED** wire should be connected to **the POSITIVE (+) source terminal; the BLACK** wire should be connected to **the NEGATIVE (-) source** terminal If the power leads are accidentally reversed, the in-line fuse will blow. If this happens, recheck the polarity of the connections with a voltmeter (VOM) and, if necessary, reverse the leads for proper connection. Replace the fuse.

2.3.2 Sensor Connections

The sensor units used with the **NAV 398** normally obtain their 12VDC operating power input from the **NAV** unit and, when the **NAV** unit has been turned ON, the sensors can then proceed to locate and track signals and

provide ship's L/L position data on their own without other input requirements.

In a typical installation, the **6-pin GPS** sensor connector is plugged directly into **the jack labeled "GPS"** on the rear of the cabinet. The 5 **Pin plug** of the **Loran-C** sensor is connected to the **jack labeled "LORAN".**



If you are using the **Raystar** 108 GPS sensor together with the DGPS Beacon Receiver, the **"Y"** cable lead marked "Display" plugs into the GPS jack.

2.3.3 Interface to External Navaids

The Power cable assembly (shown in the figure) includes two wires which can provide an output of NMEA 0183 formatted data or **SeaTalk data** for other navigational equipment such as radars, auto-pilots, video sounders, and plotters. Since the NAV unit outputs one data or the other, the same connections are used for either NMEA or **SeaTalk** data. The wires are marked and colored as follows:

YELLOW = DATA+
GREEN = DATA -

The **NAV 398** may supply NMEA 0183 data for up to three external equipments. Navaid devices connected to this output can receive the following NMEA 0 183 sentences:

If LORAN Sensor is in use:
GLL, GTD, RMA, RMB, VTG, **APA,** APB, BWC.

If GPS Sensor is in use:
GLL, RMC, RMB, VTG, **APA,** APB, HSC, BWC.

When **SeaTalk** data is used, the **NAV** unit provides: magnetic variation, COG, Cross-Track error, Lat./Long, GPS status data (including HDOP, fix status), SOG, **waypoint** #, bearing, and distance, Arrival alarm, and MOB signals to the **SeaTalk** bus.

External navigation equipment requiring NMEA 0183 data inputs normally obtain their required data via connection to the **NAV 398** data output (yellow **&** green) wires. However, some users may wish to operate the GPS (or Loran) sensor unit directly with other navigational equipment capable of

accepting position data in the NMEA format. Please refer to the Raystar 108 or Raynav 508/508A instruction manuals for details on making this type of interconnection.

Data Input

One feature of the NAV398 is to transfer the waypoint and route memory contents of the internal memory to external computer files and to re-load the memory from the computer.

Downloading of files occurs through the Data Output connections (Green and Yellow wires). To Upload files into the NAV unit the Data Input wires of the power cable assembly should be used. Make connections as follows:

DATA IN + = WHITE
DATA IN - = BROWN

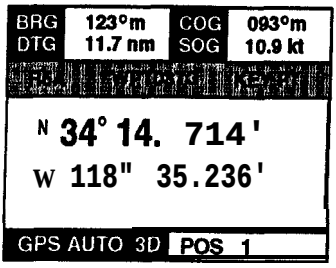
The data Input must be in the NMEA 0 183 format using the WPL and RTE sentences.

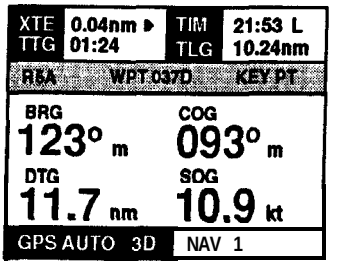
2.3.4 Ground Connection

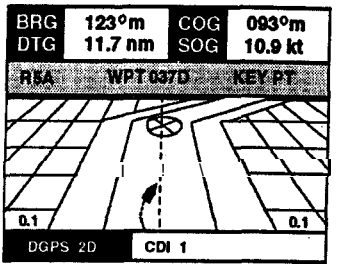
One important need in any installation is to obtain the cleanest, noise-free signals possible, for measuring and calculating your position. Part of this requirement can be met by assuring a proper connection from your NAV unit to the ship's ground system. The ground system provides both a completion of the signal path for the sensor and a drain for noise sources.

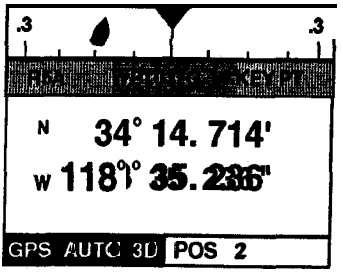
There are two separate wires labeled "GROUND" in the cable assembly. Both the WHITE and BROWN wires should be connected to the nearest connection point of the ship's RF ground system.

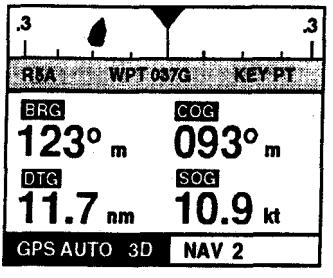
Normally, on a steel hull boat, a good clean connection to the ship's hull makes a sufficient ground. On fiberglas or wood hull vessels, connection to a ground plate or to the engine block or other bonded groundwork should provide acceptable grounding.

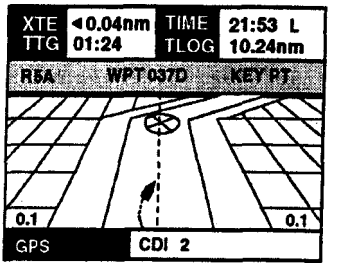


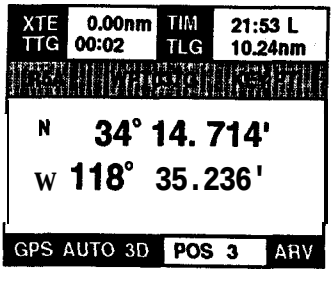


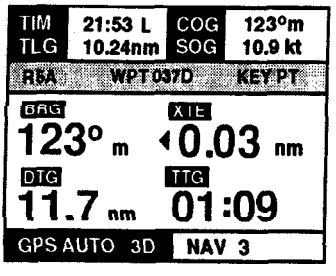


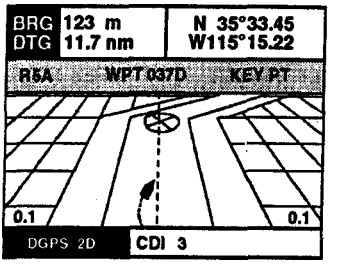


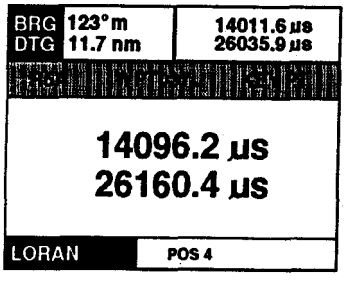


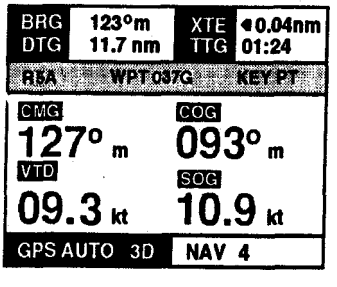


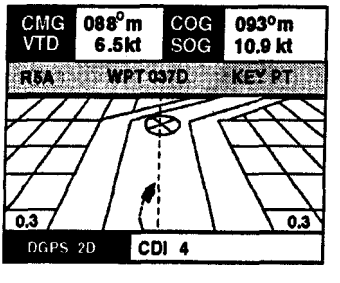


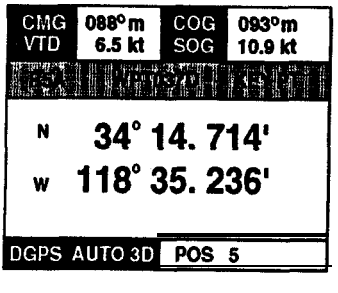


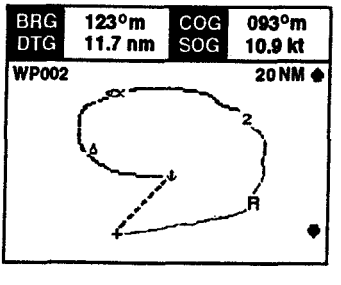


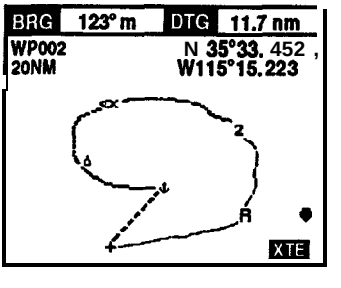












MAIN DISPLAY MODES - NAV 398

SECTION3

OPERATION

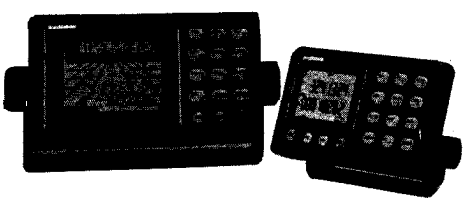
3.1 General

This chapter provides instructions for the operation of your new NAV 398 LCD NAVigator unit.

We think you will find the operation of the NAV 398 to be easy and straightforward. The approach to take in becoming familiar with it's operation is one of relaxed confidence. The unit is quite "user friendly" and relies on screen prompting to guide you through the operations and set-up menus.

As you progress through the operating section, take time to practice each function of your NAV398. Study the illustrations and repeat operations, if necessary, until you have become comfortable and confident. Time spent in becoming familiar with the unit will strengthen your knowledge, confidence, and skill in using this full-featured NAVigator where it counts....afloat.

Thank you for selecting one of Raytheon's fine NAVigation products. Great care and effort has been put into providing you with a useful, attractive design. We are sure it will provide many years of valuable NAVigation data and trouble free operation.

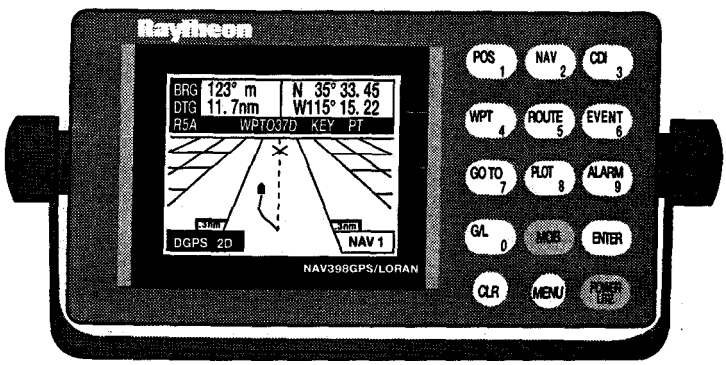


3.2 The Keyboard

The NAV 398 is designed for simple operation, but if you should ever become confused over which display you are on or, if you get lost while performing various operations or entries,usually pressing the CLEAR key will always return you to the Position display or the familiar Main menu.

One other item to remember about the keyboard is that a "valid" or correct key press is confirmed by a single audio "beep" tone, while if an invalid or wrong key is pressed, a series of multiple "beeps" will be heard. If this happens, just check the screen again and pick the proper key operation.

The keyboard consists of 15 silicon rubber keys. Some of the keys carry dual labels such as **POS/1** or **WPT/4** keys and are normally used to enter the main operations of the NAV unit. The numeric operation of the key is used once you have entered the main operation. Notice that some keys such as **ENTER** and **CLEAR** or **MENU** have only one label and perform only one operation when depressed. When Menus are on screen, the **WPT/4**, **GOTO/7**, and the **G/L/0** keys are softkeys used to activate selections on the menus.



KEY	PURPOSE
PWR/LITE	Turns power On/Off; activates Contrast/Lite menu .
ENTER	Accepts data for entry;
CLR	Reverts to Main menu or POS display; resets numeric values to 0; silences audio beeper.
POS/1	Selects Position displays; selects digit 1.
NAV/2	Selects NAVigation displays; selectsdigit 2.
CDI/3	Selects a waypoint as a destination;selects digit 3.
WPT/4	Selects Waypoint entry function; selects digit 4.
ROUTE/5	Selects Route functions; selects digit 5.
EVENT/6	Memorizes ship's present position into designated Waypoint memory; selects digit 6.
GOTO/7	Selects destination waypoints; selects digit 7.
PLOT/8	Selects Plot Mode display; selects digit 8.
ALARM/9	Selects Alarm menu; selects digit 9.
G/L/0	Selects Loran C or GPS operations; selects digit 0.
MENU	Selects menu operations.
MOB	Selects Man-Overboard special alarm function.

3.3 Basic Operations

Now that the NAV unit has been properly installed and the keypad layout has been described, we should be ready to begin learning the basic operations of the unit. So, let's press the power key and get going!

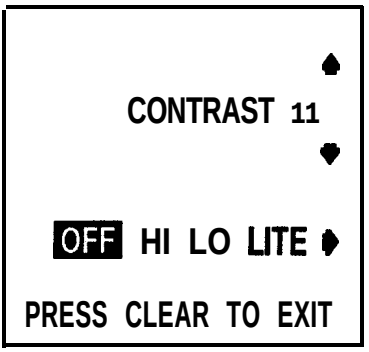
3.3.1 Turning Unit On/ Off

To turn the unit ON, press the PWR key.

To turn the unit OFF, press the PWR key and ENTER keys simultaneously. The LCD screen will go blank and the unit will be OFF.

3.3.2 Contrast/Backlighting Level

The LCD display contrast level and the keypad illumination may be adjusted for dusk or night use and viewing. While the unit is ON, just press the PWR key to turn the backlighting menu On. The Backlighting menu is only temporary and will disappear when 7 seconds have elapsed with no keys pressed.



3.3.2.1 Contrast Setting

When the BackLight menu appears, use the WPT/4 and GOTO/7 keys to vary the contrast level of the LCD for best viewing. The level ranges from 0 to 15. The WPT/4 key increases the contrast level; GOTO/7 key decreases the contrast level, as the arrows indicate.

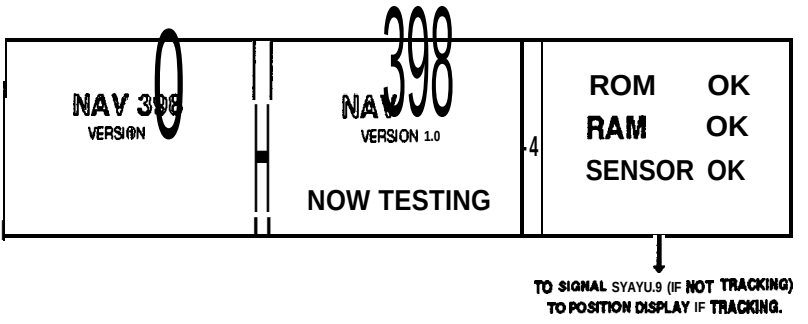
3.3.2.2 Backlighting

Use the G/L/0 key to highlight HI, LOW, or OFF. The selection becomes the active choice when it is backlighted in the menus.

3.3.3 Auto Start-up

Each time the NAV 398 is turned "ON", the NAV 398 ID screen indicates operation has begun. While this screen is in view, the NAV 398 is beginning an internal self-test to verify that the Loran-C sensor, GPS sensor, or both (if connected) are working, as well as testing its own internal memories.

The NAV 398 ID screen usually appears for about 3 seconds. The smaller characters on this screen show the version of the operating software program used inside the NAV unit. This version number is handy information to remember should a problem develop within the unit.



The ID screen is then followed by a second screen which advises that the SELF TEST is in process, and a third screen prints the SELF TEST results .

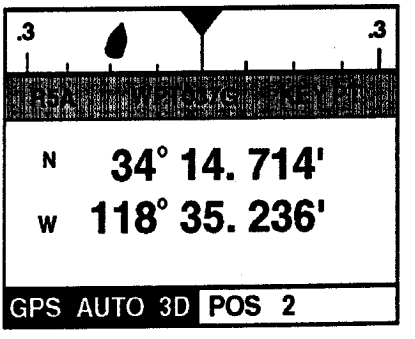
The Auto Start-up program can be interrupted anytime by pressing the **CLEAR**, **POS /1**, **NAV/2**, **CDI/3** or **PLOT/8** *keys.*

The Signal Status screen provides a readout or the progress made by the sensors in acquisition and tracking of the signals. Once full signal lock-on has been achieved, the screen switches to the POSition display, the Auto Startup sequence is completed, and normal operation is underway.

3.3.4 Selecting Loran/GPS Mode

One key feature of the NAV 398 is that the unit can be either a loran or GPS depending on the type of sensor that is connected, or both, if a sensor for each system is attached. Normally, if only one sensor is used, the unit detects the type of sensor and automatically puts the NAV unit into the correct system mode during the Auto Start-up program. If both the RayNAV 508/A Loran-C and Raystar 108 GPS sensors are connected, each system will always be operating and normally tracking signals and either system can provide your position and NAVigation data instantly.

The **G/L/0** key is used to toggle the unit between the two system sensors. The systems can be changed anytime you are on the POSition, NAVigation, CDI, or PLOT modes.



When the GPS mode is selected, "GPS" characters become illuminated along the bottom left edge of the LCD display and the latitude/longitude position and ship's course and speed data is then GPS derived.

If the Differential Beacon Receiver is connected and tracking the beacon signal **"DGPS"** is indicated in the message window. The latitude/longitude readouts will include the differential corrections for greater accuracy.

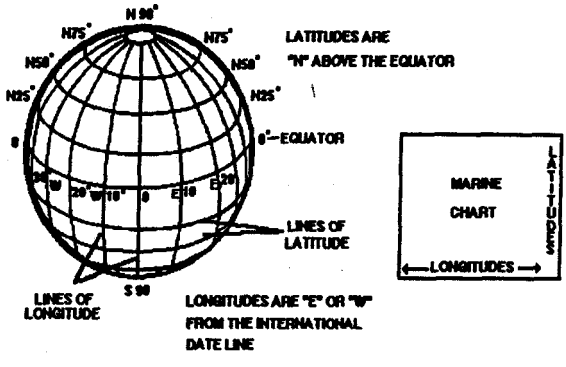
When the Loran-C mode is selected, the "LORAN" characters will be illuminated along in the message window of the display and the L/L position and ship's course and speed data is then Loran-C derived.

When both GPS and Loran sensors are connected, the **NAV unit** always selects the sensor that was "last used" when the power is turned ON. If its the very first time the unit is used and both sensors are connected, the GPS is always selected as the priority system.

3.4 Initializing Sensors

Although the **RayNAV** 508 Loran and **Raystar** 108 GPS sensors are capable of finding the latitude/longitude position once they have been powered up, at the very first power-up following installation or after a Master Reset, the position finding process may take up to 30 minutes or more. This startup time can be reduced to some degree by entering initialization information into the sensor's memory. The process for initializing each sensor appears in the following paragraphs.

The very first time the **NAV** unit is operated, or following a Master reset of the unit, the screen will prompt you to enter your "estimated latitude" coordinate followed by entry of the "estimated longitude" coordinate., Once you've entered this information into the sensors via the **NAV 398, the** sensors should be able to find your location more rapidly.

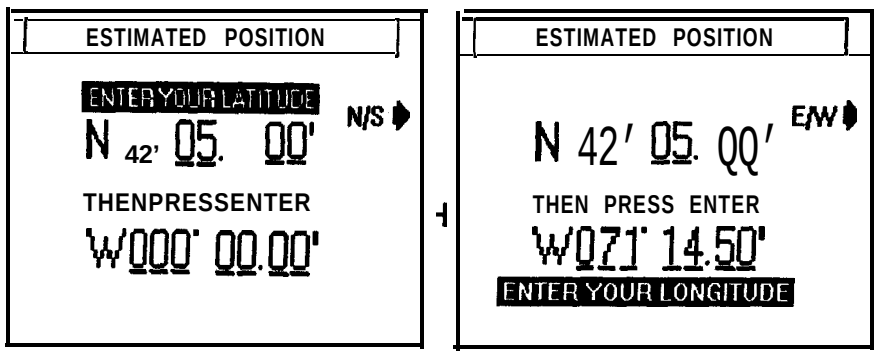


The loran sensor only needs the initial L/L input and should typically lock-in in 3 to 5 minutes. The GPS sensor also needs the initial L/L input and prefers to have the Date and Time and Antenna height information as well for quick acquisition and tracking.

The sensors always store the Lat/Lon position in memory. The next time you use the NAV unit, the only thing you'll have to do is just turn it "ON". In a few minutes your position will be displayed.

3.4.1 Estimated Latitude

With the "ESTIMATED POSITION" screen displayed, enter the latitude of your position, using six digits. It is a good idea to enter your position to within one degree of latitude. When the numbers are correct, press ENTER.



ENTERING INITIAL POSITION

If you're new to navigation terminology, please refer to the Globe figure on the previous page for verifying that the coordinate to be entered is truly your latitude.

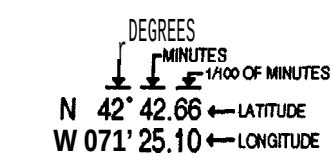
Check to see that the direction symbol "N" is correctly indicated to the left of your latitude entry on the screen. If "S" is displayed, press the N/S softkey to change the symbol to "N". Press ENTER when the direction is correct.

Example: Press 4,2,0,5,0,0, ENTER, ENTER, for N 42° 05.00'

If you make a mistake in entering your estimated latitude, press the CLEAR key and start the entry again. When the entry is correct, press ENTER to accept the entry.

3.4.2 Estimated Longitude

When ENTER is pressed to finish your latitude entry, the message on the display screen will change to "ENTER YOUR LONGITUDE". Asbefore, enter your estimated longitude numeric value, this time using seven digits-with an accuracy within



How to read a Lat/Long

one degree of longitude. For longitudes of less than 100 degrees, begin the entry with "0".

After you press the ENTER key, check to see that the direction symbol "W" is correctly indicated to the left of your longitude entry. If "E" is displayed, press the E/W softkey the symbol to "W" or vice versa. If the direction is correct, press ENTER.

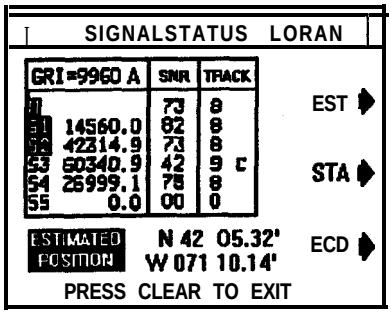
Example: 0,7,1,1,4,5,0, ENTER, ENTER for W 71^{o} 14.50'

If you make any mistakes while entering your longitude, press the CLEAR key and retype the entry. Then press ENTER to complete the estimated position entry.

When ENTER is pressed to finish your longitude entry, the estimated LAT/LON entry is complete and the display will return to the Auto Start-up sequence at the Status page for sensor in use.

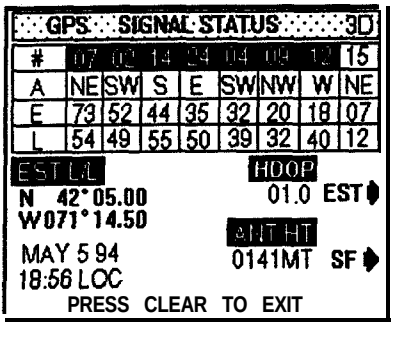
3.4.3 The Status Page

The STATUS screens show the condition of the acquisition and tracking of signals for the sensor in use.



In normal tracking operation for loran, the GRI chain and secondary signals received are indicated in the status box. The most important information are the status numbers to the right of the SNR characters. These numbers show the progress of the acquisition program towards signal lock-on. When 8's are indicated for the Master and selected Secondaries, the loran is "Locked-on" and tracking the loran signals. At that point the screen automatically will switch to the Position screen and navigation is available.

In normal tracking operation for GPS, there is only ONE important indicator indicating that the GPS is "Locked-on" and tracking the satellite signals. That indicator is when the satellite ID number becomes a reversed "Block" character. When four or more signals are in this state, the screen will switch to the Position screen and navigation is now available.



More information on the Status and signal tracking screens appears later in this chapter.

3.5 Main Display Modes

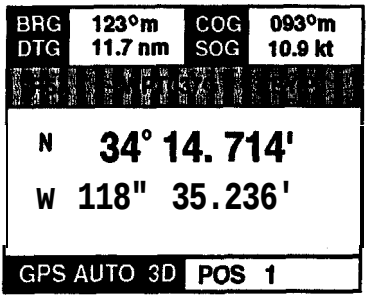
The NAV 398 has FOUR Main Display modes used most often during normal navigation. They are the POS (Position), NAV (NAVigation), CDI Graphic , and PLOT Tracking display modes. These modes can be selected directly by pressing:

POS/1 the POS mode displays
NAV/2 the NAV screens
CDI/3 the CDI displays
PLOT/8 for the Plot screens

3.5.1 The POSition Display Mode

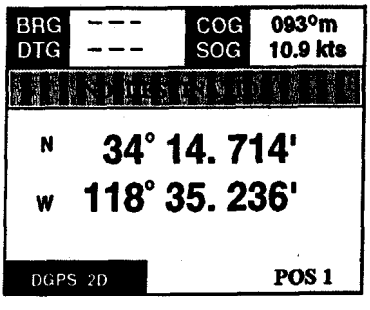
There are FIVE different POS displays. The POS display is changed from POS1 to POS2, POS 3, etc. by pressing the **POS/1** key. The POS screen always shows the selected "POS" page number in the lower right corner of the screen. Each press of the **POS/1** key toggles the displays.

The POS screens always show your vessel's present position coordinates in the large 7-segment readouts of either Lat/Lon or loran TDs. Each POS screen combines different navigation information with the position coordinates. The POS Lat/Lon display may look differently if you have selected the higher resolution readouts for your Lat/Lon in the GPS Setup menu. The NAV 398 can show GPS L/L to a resolution of 0.001 of a minute.



The POS 1 screen combines the most essential information together on-screen of your position in the large digits, bearing and distance to the destination waypoint, and vessels' course and speed over the ground.

The number and name of your waypoint destination is also displayed, as well as the selected route plan number that is currently active. If no destination waypoint is selected, the BRG and DTG values will be blank, and "NO DESTINATION" appears in the waypoint data bar.

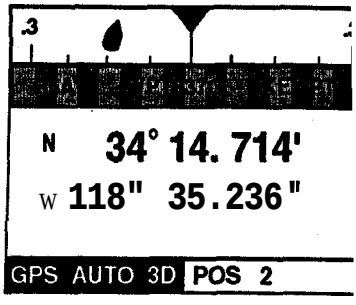


Along the bottom row, the sensor "in use" is indicated in the highlighted block. If the Raynav 508 is used, "LORAN" appears in the block. If the **Raystar** 108 is used, "GPS" appears together with the current GPS Fix mode type. If the Differential Beacon Receiver is connected and a beacon is received and differential corrections are included, **"DGPS"** will be indicated.

Whenever any alarm signals or warnings are activated, they will appear in a "blinking block" to the right of the page ID indicator and accompanied by the audible beeper.

POS 2

When **the** POS/1 **key** is pressed, **the** POS 2 screen **appears.**



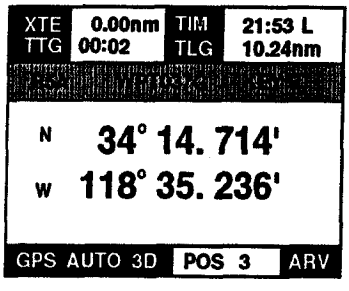
Across the top line of this display a **CDI** (Course Deviation Indicator) appears. The **CDI** will only be active after waypoints have been entered into the NAV unit memories, and one has been selected as the destination waypoint.

The **CDI** is made up of a "boat-like" symbol and a scale depicting your vessel's deviation from an intended track line to the destination. On this **CDI** screen, the ship symbol changes its "angle" to show if the vessel is tending to close to the track line, stay even with the line, or move further OFF the line.

The **CDI** range scale can be changed in the UNITS section of the System Setups menu to set the width of the **CDI** lane between plus or minus **0.1, 0.3,** or **0.5nm** from the track line. For example: When the scale is set to O.lnm, the increments of the scale are **.025** or approximately 150 feet to each mark.

POS 3

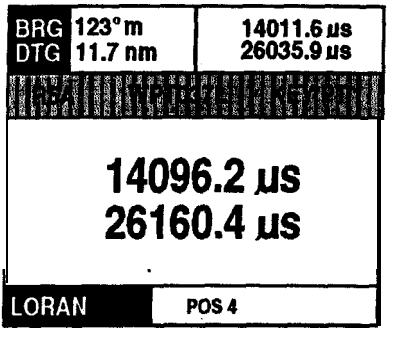
If you press **the** POS/1 key again, the POS 3 screen appears.



The POS 3 display swaps the **CDI** scale for the digital version of the Cross Track error value **(XTE),** Time-to-go to **waypoint** (TTG), local Time, and Trip Log distance. On this screen you can see a sample of the alarm readout appearing to the right of the page ID in the bottom row.

POS 4

The POS 4 screen brings up the coordinates of the destination **waypoint** to the screen so you can compare the numbers. **TDs** are shown here because matching the TD coordinates is an ideal way to return to a favorite wreck for fishing, **TDs** are stored in the **waypoint** memories any time you save a location as an Event or by direct entry of **TDs** as a **waypoint** location. **TDs** are not saved when **Lat/Lons** are entered as waypoints.



Note also, that the sensor mode in use here is the Loran-C. The NAV 398, when operating in the GPS mode can convert the GPS **Lat/Lon** readouts into GPS/Loran Time Differences (TDs). Some users may find this calculation useful to reference with their old loran coordinate logs.

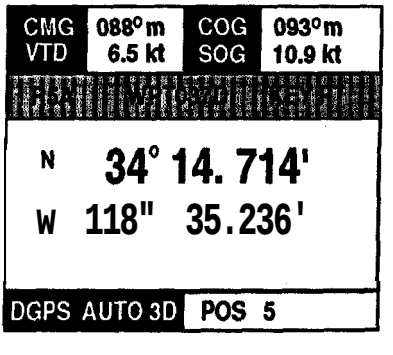
The Loran GRI and the desired TD lines must be intitially entered in the GPS Setup mode before this conversion page can work properly. However having entered the required initial data, the conversion program can operate.

CAUTION

When **TDs** readouts are the result of calculations made from GPS derived **Lat/Lon** data, the GPS signals are not subject to the same propagation errors as loran signals and therefore will not match actual loran TD measurements precisely. The TD readouts obtained from GPS are for relative comparison only.

POS 5

If you press the **POS/1** key one more time, the POS 5 screen appears and the readouts now include displays of the course-made-good (CMG), and velocity-towards-destination (VTD). This readouts show the overall course direction that you have made since starting towards the current destination and your apparant speed. The readouts are of particular interest to sailboaters.

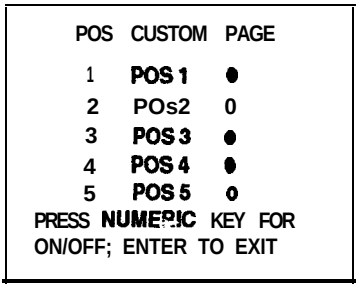


Anytime you switch from the Display modes to other functions and return 'to the same mode, the last selected screen reappears. However, when the power is turned OFF and then ON again, the last used POS screen is always selected.

We've seen 5 different Position screens so far. There are also 4 Navigation screens and 4 CDI screens. Having so many screens of information available sounds great, but there may be a few screens you will seldom use. The NAV 398 includes a means to customize the unit to enable only your favorite screens. This is covered in the next section.

3.5.2 Customizing Display Modes

You can choose to show only your favorite displays in any mode by pressing and holding the particular mode key down for about 3 seconds. When you hear the second beep, the mode custom page will appear.



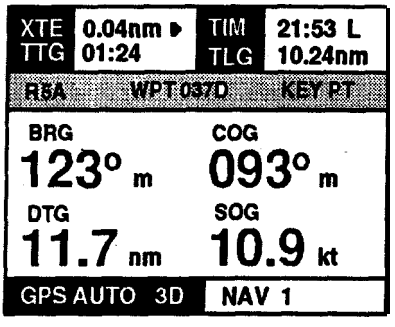
For example: Press and hold the POS/1 key down for the beep. The POS custom page will appear.

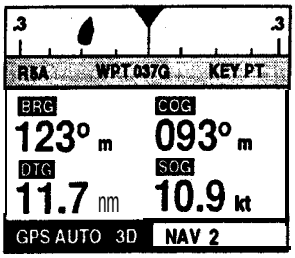
Initially all the POS screens will be ON. This is indicated by the black dot after the page name. To turn a page OFF, press the corresponding number key. (Press 2 to turn OFF page 2) The dot will now be hollow indicating the page is OFF. The unit will permit you to turn OFF all displays in a mode, except one. One display in every mode must be used. Press ENTER when the menu is all set to return to the last used page of the mode.

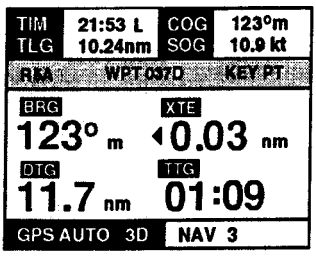
You can always re-enter the Custom menu anytime and turn pages ON or OFF. This is a convenient way for you to enable and quickly access the most important pages without a lot of button pushing. Use the NAV/2 key to customize the NAV screen selections. Use the CDI/3 key for the CDI screens.

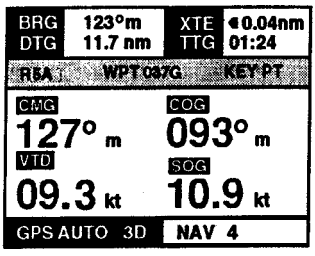
3.5.3 NAVigation Display Mode

There are 4 NAVigation displays. They are labeled NAV1 NAV2, NAV 3, etc. along the bottom of the screens. Pressing the NAV/2 key selects the NAV display mode and toggles fromone NAV screen to the next. The NAV displays feature large digits of the vessels' course and speed, bearing and range to waypoints, and other navigation data.









Generally, the NAV screens are more useful once a **waypoint** has been entered into the units' memories . Once a **waypoint** destination is selected, the **NAV1** display will feature large readouts of the destination Bearing **(BRG)and** Distance-to-go **(DTG)** to the **waypoint** combined with the Course and Speed readouts. . The readouts in the upper section of the display show the XTE,TTG, local time, and trip log distance.

The **NAV 2** display includes the same **CDI** (Course Deviation Indicator) on the top line as on the POS screens, if a **waypoint** has been selected as a destination.

Press the **NAV/2** key to select the **NAV3** display which features large readouts of the **waypoint** BRG and DTG again, but combined with the digital XTE OFF Course distance in 0.01 **nm** units and steering direction indicator plus the Time-to-go (TTG) readouts.

The NAV 4 screen combines the Course-made-good (CMG) and **velocity-**to- destination **(VTD)** readouts with the COG and SPD readouts in the large digits. The **waypoint** data is displayed in the upper boxes.

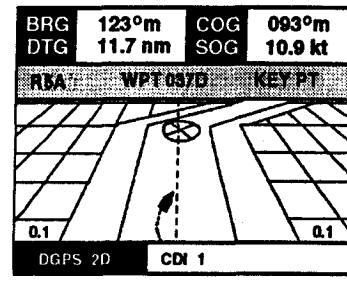
The flexibility of the **NAVdisplays** should be apparant now with so many combinations of the important navigation data available. Use all of the displays, or use the Custom menu for NAV to select only your favorite screens for viewing.

3.5.4 CDI Display Mode

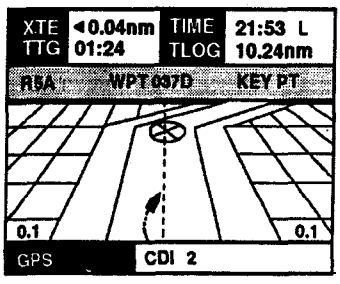
If the NAV screens are more useful once a **waypoint** has been entered into the units' memories, the graphic **CDI** displays are totally dependent on **waypoint** navigation.

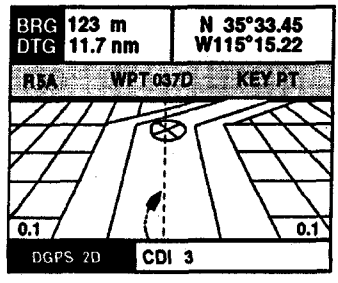
The key element of this display mode is the active view of steering down the track lane towards the destination waypoint. As the vessel moves along, the boat symbol orients itself to the track line showing the displacement from

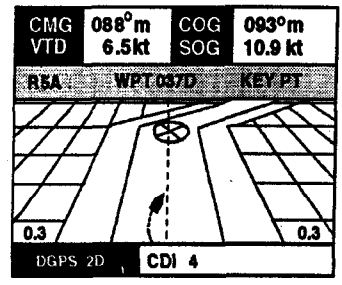
the line and whether the vessel is closing, paralleling, or opening away from the line. A bit of the vessel track history appears behind the boat symbol.



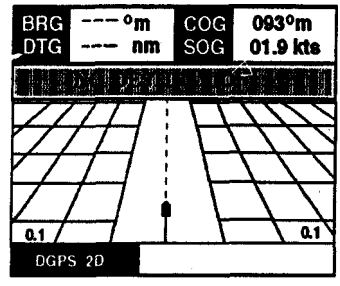
Up ahead, the **waypoint** destination is in view. If the destination is identified by a symbol or name, the first character will be blinking near the target area. Nearby **waypoint** symbols (two closest to vessel) may be in view on the screen if they are within range. If a route plan is ON, the direction of the next leg is indicated by the slant of the track beyond the destination symbol.







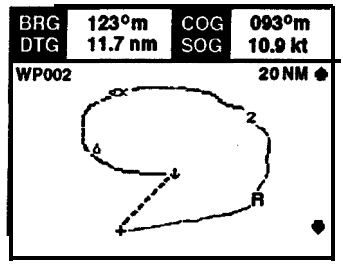
The various **CDI** screens combine navigation readouts with the active **CDI** graphic display. If for some reason a **waypoint** is not selected, the BRG and DTG readouts will be blank, **WPT NO DEST** appears in the message window, and the destination target symbol is not displayed.



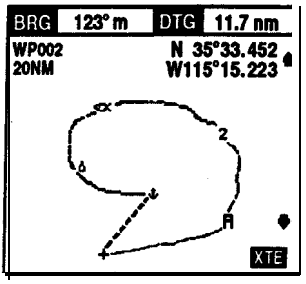
3.5.5 Plot Display Mode

One of the most useful modes is the Tracking Plotter or Plot mode. Using this mode you can record and retrace your vessels' track to your best fishing **spots...and** back home again. The Tracking Plotter also displays the symbols or first letters and marks of waypoints and events used to mark your favorite fishing locations on the plot screen.There are two Plot displays. The Plot Mode is activated by pressing the **PLOT/8** key.

The Plot 1 display appears as shown in the figure. The location of your vessels' position is indicated by a blinking "+". In addition, waypoints, event marks, and the memorized vessel track line that is within the range of the plot area will be shown, as well as your current **fishfinding** information.



The PLOT 2 screen re-arranges the BRG and DTG readouts and adds the vessels' current position data to the screen. The L/L readout can be turned OFF in the PLOT DISPLAY menu for better viewing.

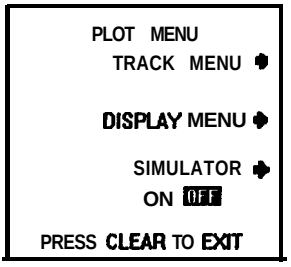


Plot Scales

The Plot size or scaling can be changed to show the navigation area of interest by pressing the **softkeys** indicated by **the UP or DOWN arrows.** Plot scales available for the plot screen are 0.125, 0.25, 0.5, 1, 2, 5, 10, 20, 50, 100, or 200 NM. The selected Plot scale range is shown in the upper right corner of the Plot display next to the UP arrow, for reference.

Recording a Track Line

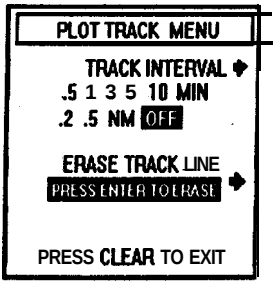
The Track Plotter normally draws tracking lines on the Plot screen as the vessel moves along. However, these track lines are only "temporary" and are always lost whenever changing plot scales, changing operating modes, or upon turning the **NAVunit** OFF or ON... UNLESS you decide to record the track line to memory.



You can record and save a single important vessel track of your vessel's trip to keep in memory so when you return home you may retrace the same route. Recording a track is easily done by pressing **the MENU** key while on the Plot Display mode. The Plot menu appears.

Press **the TRACK MENU softkey** to select the Track Menu.

The plotter can remember up to 300 track points, so the recording interval selected will be important in determining how quickly track memory will be used. Use a shorter time interval if the vessel's route has several turns or bends' such as in rivers and waterways for saving track with more detail. Longer time recording intervals can be used when the trip is going to be generally a straight line for long distances. The best recording interval for long trips is "by distance" travelled. The recording intervals. can be selected in units of Time or Distance:



TIME INTERVALS: 30 seconds, **1, 3, 5,** and 10 minutes.
DISTANCE INTERVALS: 0.2 or 0.5 nautical miles.
OFF is normally selected when track recording is not required.

Press the [TRACK INTERVAL] softkey until the desired memory interval is highlighted by the block. Now track recording will be ON.

The NAV unit has Auto Start/Stop plotting built in. So, if you should stop along the way to fish, and forget to turn the track recording interval off, the tracker should automatically stop plotting until you're moving again.

All track points recorded will be "saved" in track memory until erased, or unless overwritten by new track data. When track points are overwritten, the newest track point #301 will replace old track point #1, track point #302 replaces #2, etc.

When you are finished recording the track, re-enter the TRACK menu and select "OFF" with the TRACK INTERVAL softkey to turn the memory recording interval to "OFF".

Press the [CLEAR] key twice when you are ready to return to the previous display mode to back out of the menus.

Erasing a Track Line

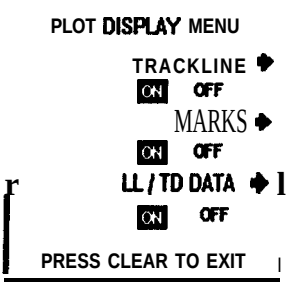
Since only one track line can be stored to memory at any time in the NAV unit, it's a good idea to erase the old track from memory before starting to record a new track plot.

Just select TRACK menu from the PLOT menu by pressing the [TRACK] softkey. Press the [ERASE TRACK LINE] softkey and then press the [ENTER] key to actually confirm that you wanted to erase the track memory. When [ENTER] is pressed, all track data will be erased.

Press the [CLEAR] key when ready to return to the previous display mode twice to back out of the menus.

Plot Display Menu

If the Plot screen becomes cluttered with the event and waypoint symbols, the memorized track line, or the Position readouts. The PLOT DISPLAY menu provides options to turn marks, track or data ON or OFF.

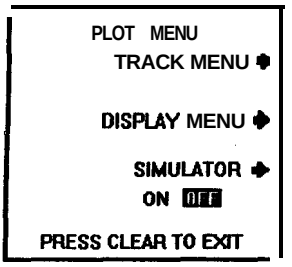


[TRACK LINE]	Track	ON/OFF
[MARKS]	Waypoints & Marks	ON/ OFF
[L/L TD DATA]	Position readout	ON/ OFF

Press CLEAR twice to return to the last selected display mode.

3.5.6 Simulator Mode

The NAV 398 includes a simulator mode which can show simulated readouts on the various screens. There are dynamic simulated screens for both loran and GPS and can be used to demonstate navigation to waypoints and following route plans.

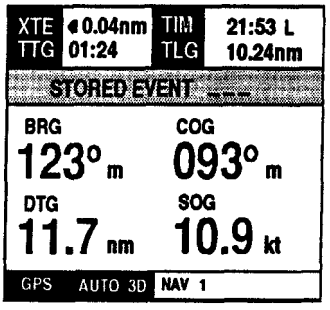


To turn the simulator ON, be in Plot mode and press the MENU key . Press the SIMULATOR softkey to ON. Conversely, to turn OFF the simulator, press the SIMULATOR softkey a second time. When the simulator mode is ON, "SIM" flashes on the various display screens.

3.5.7 Display Mode Operations

While you are on any of the POS, NAV, CDI, or PLOT display modes you can perform the following operations:

- **Save an Event....Press the EVENT/6 key.** The Event message will appear and show the saved memory #.
- GO TO a Destination...Press the GOTO key. Enter the waypoint # using three digits and then press ENTER.



3.5.7.1 Saving Events

You can save your present position for future use as a waypoint when you are in any of display modes. The EVENT data will be stored sequentially into the next available waypoint memory just like a normal waypoint.

Just press the EVENT/6 key. A prompt appears to permit you to select any other memory # location. If no keys are pressed in live seconds, the message will show the Event memory number and then disappear.

If during the 5 second period you type in a different memory number and press the ENTER key, the Event will be saved into the memory that you have designated. If the memory number you typed was the same number as your current destination, upon pressing the ENTER key the screen alerts you by showing "DEST PT" flashing. If you typed the memory number by mistake and really don't want to overwrite your destination point, just press the CLEAR key. If you DO want to update the current destination coordinates,

then go ahead and press the ENTER key. The memory will be updated, and the screen returns back to the last POS, NAV, CDI, or PLOT display.

One caution on saving Events. For maximum accuracy, it's best to be sitting next to the desired location and let the readouts settle down for a few seconds before pressing the EVENT/6 key. If you are flying by a buoy at high speed, the readouts will be displaying a position lagging behind the boat a short distance. The faster you are moving, the greater the lag error will be.

Each time you store an event, the coordinates can be remembered as either a loran, GPS, or DGPS position. Since there will be absolute position differences when using the different systems, the NAV 398 memorizes the type of position data (L, G, or DG) recorded for each event and shows the indicator on the screens when the Event is used for a destination waypoint. The indicators L, G, or DG appear immediately after the WPT characters on the screen. In this way, the operator can use the matching systems to return to Event locations more accurately.

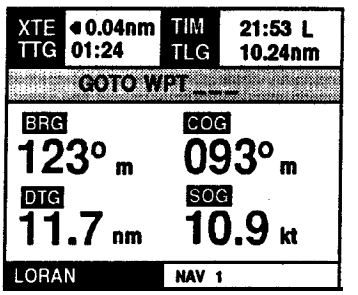
It's a very good idea to write the Event numbers and location descriptions onto your paper waypoint log for future reference at the first opportunity.

3.5.7.2 GOT0 Destinations

After waypoints have been stored into the NAV unit memories, they can then be selected for use as direct destinations. The GOTO/3 key permits the operator to quickly select a waypoint destination. The GOT0 mode works this way:

Press the GOTO/3 key.

Initially, when the GOTO/3 key is pressed, the "GOT0 WPT ___" message appears in the destination window area so you can input the desired destination memory number. The message will show three dashed lines until the first character is entered. Use the numeric keys to type in the desired memory number.



Example: Type 6GO ENTER for waypoint number 6.

When the ENTER key is pressed, the desired waypoint becomes the destination waypoint. If you are on the NAV or CDI screens, the display will change the bargraph appearing on the top of the NAV screen and put the boat symbol

on track in the center. The XTE value will be set to "0.00 nm" since the vessel is ON the track line.

Ideally, the helmsman sets the vessel's heading with his steering compass or autopilot to the bearing shown for the waypoint destination and begins watching the CDI scale at the top of the NAV display, the XTE digital value, or the active graphic CDI screen.

The helmsman then provides steering correction to keep the boat symbol on the track line or if watching the digital XTE values, keep the digital value at or near O.OOnm. This should take the vessel in the most direct path to the destination waypoint while correcting for wind and current offsets along the way. A good check point of correct steering is that your COG readout eventually reads the original bearing to the waypoint, even though your actual compass heading may be somewhat different.

Sometimes when steering to destinations it may be necessary to change heading to avoid obstacles or other vessels in your path. Having deviated off of your intended track, in many cases it's easier just to start a new track from where you are, than to return to the old track-to-waypoint.

To start a new track, just press the GOTO/3 key, followed by the numbers of the same waypoint. Then press the ENTER key and the NAV unit will recalculate bearings, distance and TTG for the new track to the old destination waypoint. The vessel is now ON the origin of the new intended track line and the new bearing and distance to the destination is displayed. The XTE value will be reset to "0.00 nm" since the vessel is ON the new line.

Sometimes you may prefer to turn OFF the waypoint destination calculation and CDI displays. To turn OFF the GOT0 operation press the GOTO/3 key and type 0, ENTER. "WPT NO DEST" will appear on the displays in the message area and waypoint data will disappear from the NMEA 0 183 data output.

If you have not yet stored any waypoints, you will hear multiple beeps when the GOTO/3 key is pressed. You will need to first save an Event or enter some waypoint coordinates directly into the waypoint memories using one of the methods discussed in section 3.6 of this chapter. The GOTO/3 key will also give an error signal if you select an empty memory number by accident. Waypoint coordinates must be stored in the memory before it can be selected as a destination.

3.6 Entering Waypoints

3.6.1 General Waypoint Information

One of the key operations of the NAV 398 is to guide you to planned or pre-programmed **waypoint** destinations from your present position. Waypoints can be entered into your 398 unit by using one of the following four methods:

- Storing **au "Event"** (instantly saves ship's present position as you pass a buoy, enter a channel, or are sitting on top of a great fishing spot).
- Direct entry of **Latitude/Longitude** coordinates taken from marine charts or light list, etc.
- Direct entry of **Time Difference (TD's)** coordinates. These are usually from a chart or a friend's loran.
- By using Range and Bearing from your present position.

The NAV 398 has 500 internal **waypoint** memories for storing **waypoint** position coordinates. These memories are numbered from #001 to 499. Whenever you decide to enter new **waypoint** position data, or recall old **waypoint** information, the **waypoint** memory location number has to be entered first. This is necessary so the NAV unit can place or retrieve the information from the correct memory.

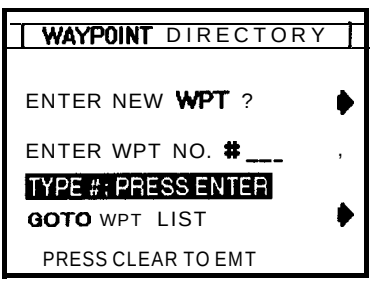
Since there are so many **waypoint** memories, it's usually a good idea to make a paper log of your stored **waypoint** data. The log should include the Name of the waypoint, its Memory #, L/L and TD coordinates, the source of the position data, and may be even the normal bearing and range from your slip.

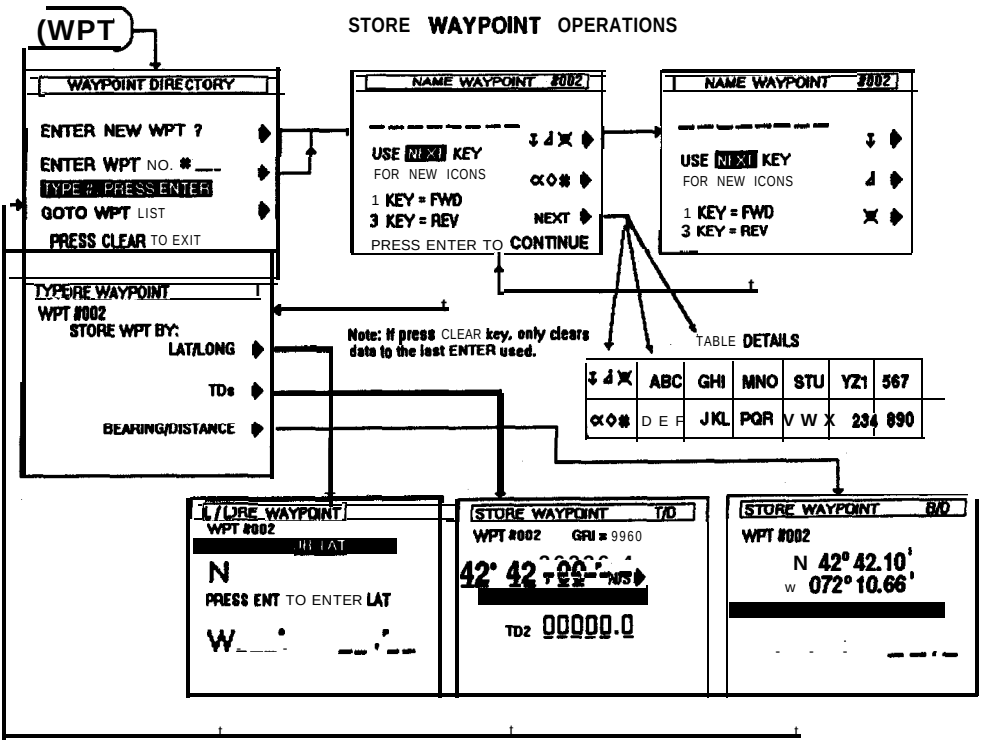
Some owners use certain numeric blocks of the memory locations to store certain **waypoint** groups that make up trips or route plans. In this way, favorite trips are saved and used over and over again by the number grouping selected. Of course, the paper log book helps keep things straight for everyone.

3.6.2 Waypoint Directory

To gain access to the **STORE WAY POINT** operation, press the [WPT/4] key.

The **WAYPOINT DIRECTORY** appears on the screen. The directory is used exclusively to pick one of the memory locations for storing your





waypoint coordinate data. Pressing one of the **softkeys** will help you make that selection.

ENTER NEW WPT? Pressing this **softkey** selects next available empty **waypoint** memory.

ENTER WPT NO. __ If you want to store **waypoint** data into a particular memory #, press the **ENTER WPT #** **softkey,** type the desired Wpt memory #(X, X, X,), then press **ENTER**.

Example: Press **ENTER WPT #**, **0,** 1, 0, **ENTER**, for Wpt. **#10.**

If you happen to pick a memory number where the **waypoint** is "write protected", the contents of the memory may not be changed or overwritten until the protection feature is removed. In this case, pressing **the ENTER key** will emit multiple beeps indicating an error.

If the memory is protected, you can always enter a different memory number or go to the **waypoint** list for a look at the available **waypoint** memories.

GOTO WAYPOINT LIST Press this **softkey** to see a directory of the **waypoint** memories.

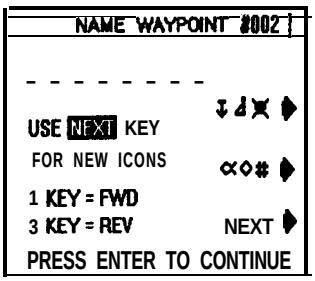
When the **WAYPOINT LIST** page appears, use the **1** (up) **/ 3** (down) numeric keys (one at a time) to scroll through the memory listings in either direction. When either key is held down, the scrolling operation speeds up so memories can be accessed more quickly.

If you want to store a new **waypoint** or edit the existing information of a selected (highlighted) **waypoint** memory, place the desired memory number in the highlighted **MEMORY #** block. Then press the **EDIT** key. You can quickly change the name, symbol, or coordinate data of any **waypoint** memory this way.

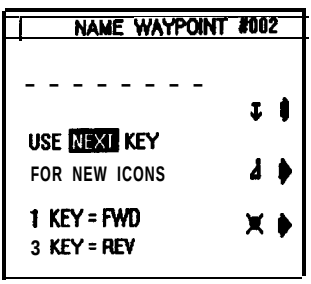
3.6.3 Naming Waypoints

As soon as a **waypoint** memory location is selected by one of the methods available from the **Waypoint** Directory, the **NAME WAYPOINT** display appears.

On this display you can select various symbols and/or letters to **"NAME"** the waypoint. The name can consist of up to 8 characters. Each character "selected" at the **FIRST prompt position** will be used to designate that waypoint on the Plot display. **Softkeys** provide a quick means to select the various characters or symbols for the name.



Find the desired symbol or character in the groups next to the arrows on the screen. If the character is in the group, press the **softkey** indicated by the arrow. The characters in the group will be re-distributed next to the arrows so you may choose the character **directly**.

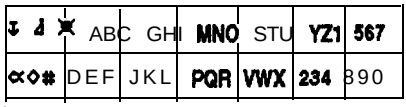


If you do not see the character needed for the name, press the **NEXT softkey** to select new character groups. The groups will appear in pairs as shown in the figure.

Repeat this operation, selecting characters or symbols and pressing the softkeys, until the name is completed. To leave a space, you may press the **1 (FWD)** key to skip past a entry prompt or place the character cursor over

any blank space in the typewriter box and then press the **softkeys** required to add the character.

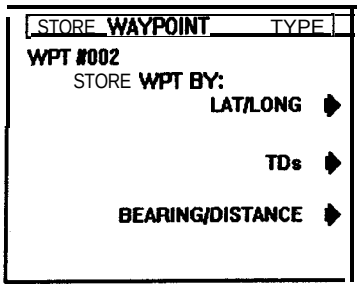
If you make a mistake, just position the blinking cursor over the incorrect character with the **3** (REV) key and re-type the **correct** character in its place.



When the NAME is complete, press the **ENTER** key. If you want to bypass this page without naming the **waypoint** until later, just press the **ENTER** key. In the meantime, this "unnamed" **waypoint** will be designated by a "diamond" shapped symbol on the plot screen.

3.6.4 Storing Waypoints

Once the **ENTER** key is pressed on the NAME WAYPOINT display changes to the STORE **WAYPOINT** TYPE screen so you can select the type of coordinate data to enter.



If you wish to enter the **waypoint** coordinates in Latitude/ Longitude, press the **LAT/LONG** softkey.

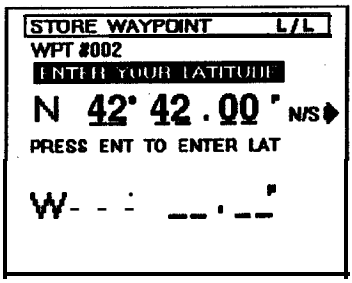
To enter the **waypoint** coordinates in Loran-C Time Differences, press the **TDs** softkey.

To enter a **waypoint** position as a bearing and range from your present position, press the **BEARING/DISTANCE** softkey.

3.6.4.1 Storing by LAT/LON

Enter the **waypoint** Latitude coordinates by typing the numeric value in degrees, minutes and hundreths of minutes. Press **ENTER** when the value is correct and **ENTER** again if the direction is OK. Use the **softkey** to select "N" or "S", if necessary.

Example: Press **2, 7, 1, 0, 1 , 5, ENTER ENTER**
Latitude = N 27° 10.15'



If you are editing or correcting an existing **waypoint** and the Latitude is already correct, just press **ENTER ENTER** to advance directly to the Longitude entry.

Enter the waypoint Longitude coordinates by typing the numeric value. Begin with a "0" if the Longitude is less than 100°. Press [ENTER] when the value is correct and [ENTER] again if the direction is displayed correctly. If the indicated direction is incorrect, press the softkey for "E" or "W".

Example: Press 0, 8, 2, 1, 0, 2, 5, [ENTER] [ENTER] Long. = W 82° 10.25'

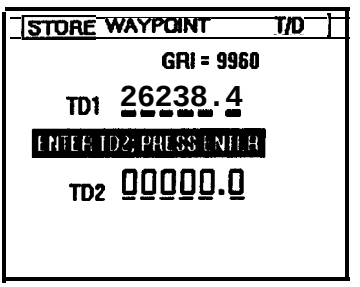
When [ENTER] is pressed, a "CALCULATING" message appears on the display while the unit is storing the new waypoint and then the screen changes back to the Waypoint Directory.

If you want to enter another waypoint, press [ENTER NEW WAYPOINT?]. This key returns you to the NAME WAYPOINT page and advances the waypoint memory number to next available memory. To designate a particular memory number to continue waypoint entries, press [ENTER WPT NO.] If you want to recheck the new entry, press [GOTO WAYPOINT LIST] key.

Press [CLEAR] if you are finished. This will return you back to the previous display mode.

3.6.4.2. Storing by TDs

To enter the waypoint coordinates in Loran-C Time Differences, on the STORE WAYPOINT menu press the [TDS] softkey.



Enter the TD 1 coordinate by typing in the numeric value using all six digits. Press [WPT #0022] when the TD1 value is OK.

Example: Press 2, 7, 1, 0, 1, 5, [ENTER].
TD1 = 27101.5us

Enter the TD2 coordinate by typing the numeric value in using six digits. Press [ENTER] when the TD2 value is OK.

Example: Press 4, 4, 2, 1, 0, 2, [ENTER]. TD2 = 44210.2us

When [ENTER] is pressed, now calculate a "corrected" L/L to store as the waypoint. During the calculation process the unit will display a "CALCULATING" message on the screen. Please wait for the message to disappear before continuing.

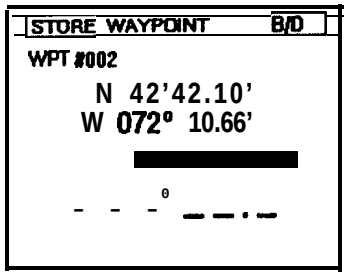
3.6.4.3 Storing by Bearing/distance

Occasionally, you may wish to enter a **waypoint** into memory by describing the waypoint's position as a bearing and distance from your own current position. This is easily accomplished with your NAV unit.

However, while describing a range or distance from your vessel should not be a problem, it is important to make sure your "bearing" information is in "magnetic" IF the magnetic variation is "ON".

If you wish to enter a **waypoint** position as a bearing and range from your present position, press the **BEARING/DISTANCE** softkey on the **STORE WAYPOINTTYPE** menuscreen.

First, type the numeric value of the **BEARING (BRG)** information. Begin the entry with **"0"** if the bearing is less than 100^0. Press **ENTER** when the bearing value is displayed correctly.



Example: Press **0, 4, 5, ENTER** for Bearing = 45^0

Now **the DISTANCE (RNG)** can be entered using three digits (up to 99.9). If the range is less than 10.0 miles, type a **"0"** first, followed by the remaining two digits. Press **ENTER** when **the DISTANCE** value is displayed correctly.

Example: Press **0, 6, 4, ENTER** for Range = 6.4 nm.

If you make an error entering the numeric value, press **the CLEAR** key. Then retype the correct value.

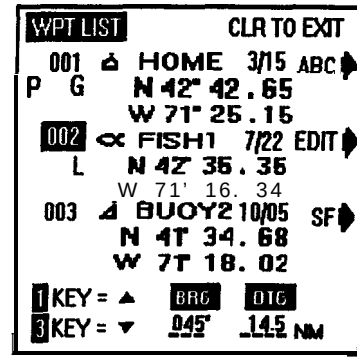
When **ENTER** is pressed, the display will calculate a L/L to store as the waypoint. During this time, the unit will display a **"CALCULATING" message.** Please wait for the message to disappear before continuing to the next operation. The screen will change back to the **Waypoint** Directory.

3.6.5 Waypoint List Operations

As mentioned earlier, the **Waypoint** List lets you scan through the contents of the **waypoint** memories. You can select any of the stored waypoints to Edit, Copy, Protect, Measure or Erase from this page. In addition the **waypoint** list, which is normally arranged in sequential memory # order, may be re-sorted alphabetically by name for ease in locating specific waypoints using **the ABC** softkey.

3.6.5.1 Selecting Waypoints

To control the positioning of the list contents, the **1** (up) key lets you look at the listed waypoints at the top of the list; the **3** (down) key lets you look at waypoints down the list. The **waypoint # appearing** in the highlighted block is the "selected" **waypoint** and is the **waypoint** that can be operated on if the **EDIT** or **SF** keys are pressed.



3.6.5.2 Editing Waypoints

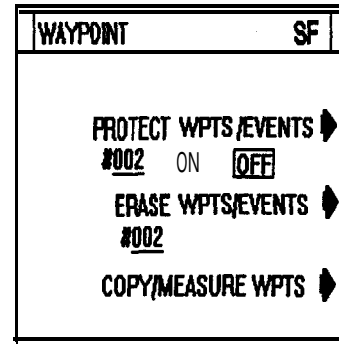
To add a name or symbol, or edit the L/L coordinate data to **any** selected waypoint, just select-the **waypoint** using either method listed above. When the memory # is highlighted, press the **EDIT** key. This returns you to the **NAME WAYPOMT** display so you can make the necessary changes. To Copy, Erase, or Protect a particular **waypoint** or event mark just select the **waypoint** using either method listed above. Press the **SF** key and the display changes **to WAYPOINT-SF.**

3.6.5.3 SF Operations

If you press the **SF** key on the **Waypoint** List display, you can perform some additional operations with the stored **waypoint** data including the following:

A. Protecting Waypoints

While on the **Waypoint** List, place the number of the **waypoint** to be "Protected" in the highlighted box on the **Waypoint** List. Press the **SF** softkey.



On the **WAYPOINT SF** screen **confirm** that number shown under **PROTECTWPTSEVENTS** is correct. Press the **PROTECT EVENT MARK** softkey to turn "ON" the Protection feature.

When a **waypoint** memory is "Protected" the character **"P"** is displayed on **the WAYPOINT LIST** and **Waypoint** Directory screens, and the **waypoint** may not be overwritten with new coordinate data until the protection is first turned OFF or if a "Master Reset" of the unit is performed.

B. Erasing a Waypoint

While on the **Waypoint** List, place the number **of the waypoint** to be "erased" in the highlighted box. Then press the ❑ softkey for the **WAYPOINT - SF** menu.

On the **WAYPOINT** SF screen, confirm that the number shown under ERASE WAYPOMT is correct. Also verify that the **Waypoint** Protection feature for the selected **waypoint** is OFF. Press the **ERASE WAYPOINT** softkey. The **waypoint** will be erased.

WARNING !

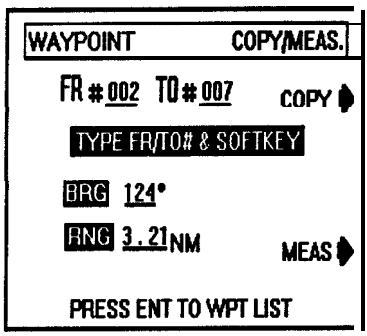
Make sure that the **waypoint** to be erased is NOT selected as your current destination. Only waypoints protected "manually" cannot be accidentally erased.

C. Copying Waypoints

Waypoints can easily be transferred from one memory location to another using the COPY feature. To Copy waypoints: Press the **SF** softkey on the **Waypoint** List. On the Waypoint- SF menu press **COPY/MEASURE WPTS** softkey. When the **COPY/MEAS.** screen appears, press the **COPY** softkey. Then type the **waypoint** # (from) and press **ENTER.** Then press the **waypoint** # (to) and press **ENTER** again.

Example: COPY 3, ENTER 1, 5, ENTER

Wpt #3 is now copied into wpt #15.



D. Measuring between Waypoints

You can easily measure the bearing and range between any two waypoints stored in memory by pressing the **COPY/MEASURE WPTS** softkey on the **WAYPOINT** - SF screen.

When the **COPY/MEAS.** WAYPOINTS screen appears, press the **MEAS.** softkey. Then type the number of the "FROM" **waypoint** and **ENTER** followed by the number of the "TO" waypoint. Press the **ENTER** key a l c u l a t e d bearing and range will then be displayed.

If you want to measure additional points, press the **MEAS.** softkey again. The Fr and To digits will clear and you may re-enter a new pair of numbers. Press **ENTER** for the new Bearing/Range calculation.

Press **ENTER** when you are finished to return to the **Waypoint** List.

3.7 Setting Alarms

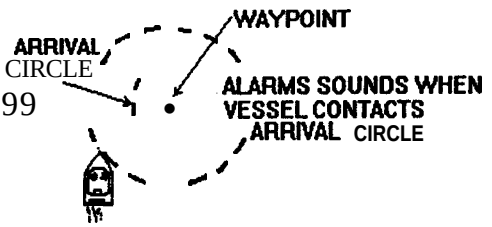
The NAV 398 has three operator programmable alarms that you can set to advise you when limits have been reached. The types of alarms available are:

- ARRIVAL- Arrival at a waypoint.
- ANCHOR - Exceeds Anchor drift limit.
- OFF COURSE- Straying too far from track.

Whenever an alarm is set and activated, the audible beeper will sound and the alarm characters will blink on-screen. You can set an Arrival alarm or Anchor alarm, but not both types together. Press the CLEAR key to silence the audio alarm.

3.7.1 The Arrival Alarm

The Arrival alarm can be set to alert you when you are within a specified distance from your waypoint. The arrivalalarmcanbesetErom0.01 to9.99 nautical miles (run).

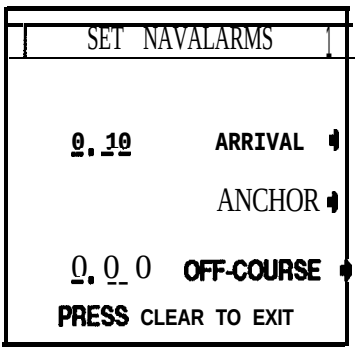


To set an Arrival alarm:

Press the ALM/9 key. The SET NAV ALARMS screen appears. This is the alarm set-up screen. Press the ARRIVAL softkey. Then enter the distance value for the desired arrival alarm zone with the numeric keys. Press to finish the entry and exit back to the last used display mode.

Example: To set an Arrival zone of 0.06 nautical miles; Press ALM/9, press 0 , 1 , 0 , ENTER.

There are several factors which should be considered when setting the arrival alarm zone distance. Among these factors are: the speed your vessel is or will be traveling, the weather conditions (foggy, rain, clear, etc.), and your familiarity with the surroundings.

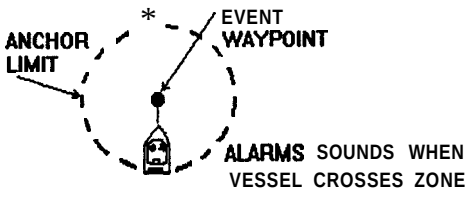


A vessel traveling at 30 knots, will travel 180,000 ft/hour, 3000 ft/minute, or 50 ft/sec., so an arrival alarm set to 0.0 lnm gives you 1.2 seconds to react. If the alarm were set to 0.2nm, (1200 ft) you will have 24 seconds to decide your course of action. In the NAV 398 the arrival

alarm is initially set to 0.10 nm from the factory to provide an arrival alert in the event that one is not set by the operator.

3.7.2 The Anchor Alarm

The anchor alarm is intended to be used to monitor your vessel's position while at anchor. If the vessel begins to drift beyond the entered distance of the anchor alarm, the alarm will sound off and notify the crew of the possible dragging of the anchor.



The distance value to input for the anchor alarm zone depends on many factors, such as the amount of anchor line out and the depth, the proximity of other objects or vessels, and weather conditions. However, the incremental distance that can be entered is 0.01 nautical mile steps which is equivalent to approximately 60 feet or 18 meters per step.

The first task, when entering an anchor watch alarm, is to press the EVENT/6 key as you drop anchor to store your present position as a waypoint. Make a mental note of the EVENT memory # (number), The number appears for approximately 3 seconds on the display and certainly is the last used waypoint. If you miss seeing the number, just check the waypoint list. The stored Event will be the highlighted waypoint on the list.

Press the ALM/9 key. Press the ANCHOR softkey. Use the numeric keys to enter the drift limit distance. Input values can range from .01 to 9.99 nautical miles. Press ENTER when the value is correct to set the anchor watch alarm.

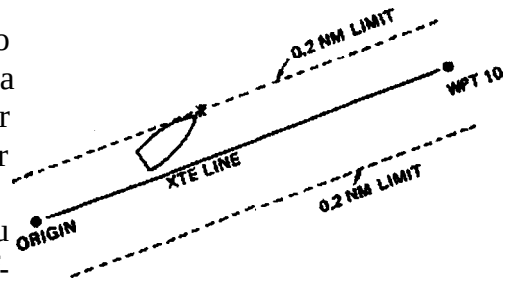
Now press the GOTO/3 key, and enter the EVENT # that you've just saved to be your destination waypoint and then press ENTER. The anchor watch is now set and will be monitoring the anchor drop point.

Example: To set an anchor limit of 100 yards, (.05nm at 2000 yd/nm),type 0, 5, ENTER for .05nm (300 feet).

In the event that you drift beyond the distance set for the anchor watch alarm, the audio beeper will sound and the ANC characters will be indicated on-screen in the alarm warning area. Press CLEAR to silence the audible alarm.

3.7.3 Off-Course Alarm

The Off-Course alarm can be used to alert you when you are steering to a specific **waypoint** destination if your vessel strays too far away from your intended track line to the selected waypoint. This is particularly useful if you are using an autopilot to monitor its effectiveness.



To set the Off-Course alarm, press the **ALM/9** key. Press the **OFF COURSE** softkey. Using the numeric keys, enter the desired distance that represents the maximum margin that you would allow for being off course, then press the **ENTER** key to set the alarm into operation.

Example: Press 0, 1, 0, **ENTER**, for an XTE alarm of 0.1 nm.

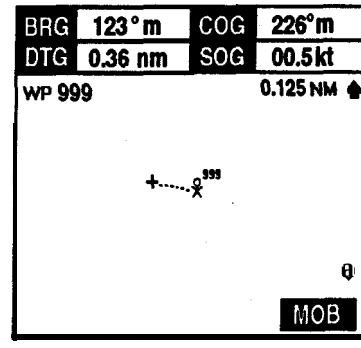
Whenever the XTE alarm is set and the XTE distance exceeds the alarm value, the alarm will be activated, the audible beeper will sound and XTE characters will appear on-screen in the alarm warning area. Press **CLEAR** to silence the audio beeper.

The values set for the alarms will remain in memory until changed by the operator. As mentioned earlier, you can set the arrival alarm or the anchor alarm, but not both. The alarms can be set to OFF anytime by accessing the desired alarm in menu and entering "0" as the alarm value.

3.8 Man-overboard Mode

This important feature is useful if, while underway, something or someone falls overboard. Press the **MOB/8** key . This puts the NAV unit into the special MOB display mode and a series of special operations begin.

The MOB display appears and shows the position where the event occurred as **waypoint #999.** Own ship and the MOB are joined by a dotted line and constant readings of BRG and DTG are provided to the MOB position. The Plot scale is automatically set to the **0.5nm** scale for the optimum view, although the scale can be set for the amount of detail required for recovery.



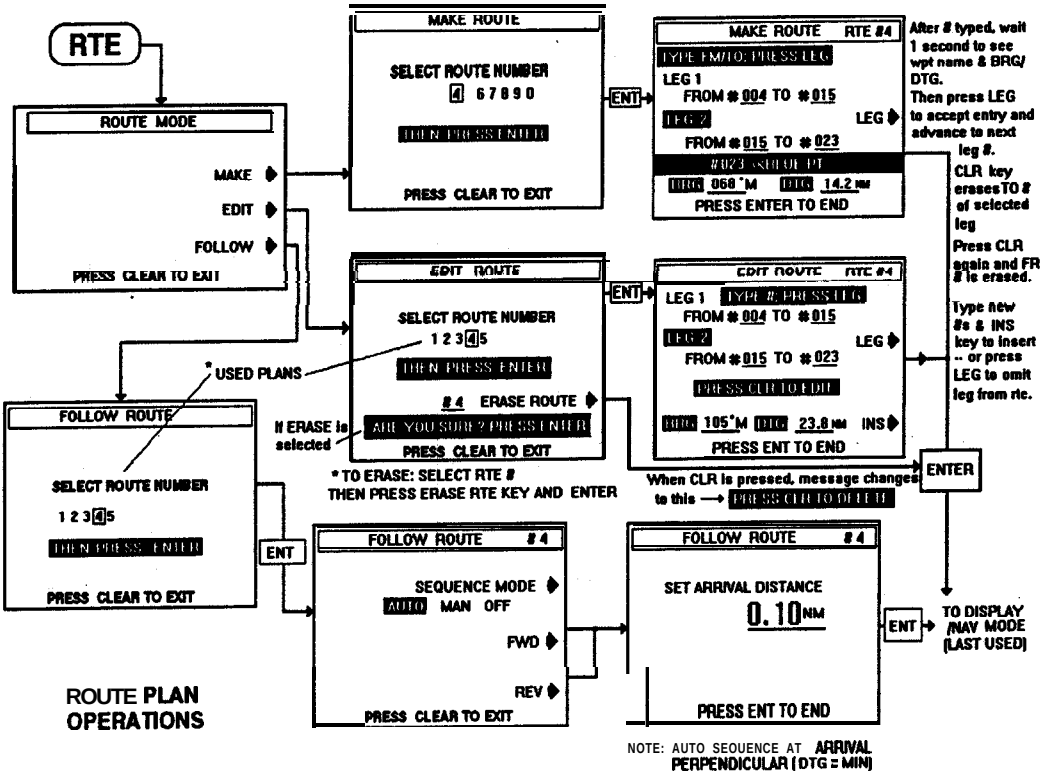
The arrival alarm is preset to 0. lnm and activates whenever you are within this area relative to the MOB. As always, press the CLEAR key to silence the audible alarm.

To Cancel the MAN-Overboard function and return to the Position display**Press** and hold the **MOB/8** key for about 3 to 4 seconds until a second beep is heard and the MOB characters disappear from the screen.

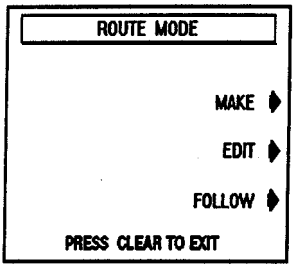
NOTE: The MOB location is not "Saved" to memory permanently and the location will be lost when the MOB mode is cancelled. If you will need to retain the location for some reason, mark the location with the **EVENT** key after the mode is cancelled.

3.9 Route Plans

The NAV 398 allows you to create up to 10 route plans using a maximum of 200 waypoints or 20 per each route. When the **ROUTE** key is pressed, the display will show the Route Mode menu, which will allow you to choose to Make, Follow, or Edit a route plan. The figure below provides an overview of the screens that are used for implementing the various route functions.

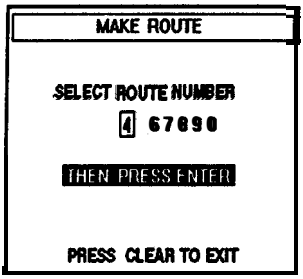


3.9.1 Making Route Plans.



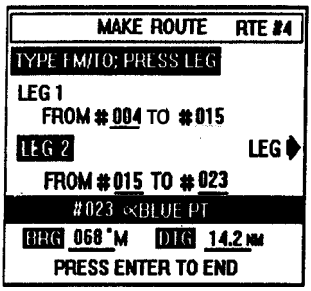
Press the ROUTE/5 key and the "ROUTE MODE _" screen appears. Press the MAKE softkey.

When the MAKE key is pressed, the MAKE ROUTE Selection screen appears to prompt you to choose a route number for your route plan. Choose any number from those listed on the screen and press ENTER.



Example: 4, ENTER, for route plan 4.

The display willchangeto the MAKE ROUTELEGS display and prompt you to enter your starting waypoint. Enter the waypoint # of the first point in the route. Then press ENTER. memory number you typed does not contain waypoint data, the unit will emit multiple beeps when ENTER is pressed and return the prompts to ---.



Example: Type 4, ENTER for waypoint # 004.

The screen will show the From waypoint as 004 and add the "TO" entry line for the next waypoint number entry. Type the digits of the next point in the route plan. If you make a mistake, press the CLEAR key and re-type the number.

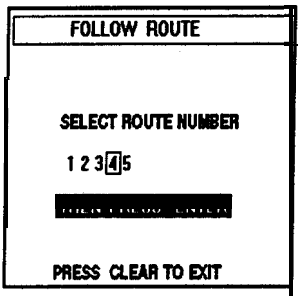
Example: Type 1, 5, ENTER for waypoint # 0 15.

The Name of the waypoint, and BRG/DTG of the leg will be calculated and displayed in the lower section of the screen. If the waypoint is correct, press the ENTER key and the display will change showing the "From" waypoint now as #0 15. The prompt "LEG" now appears and to enter the next waypoint in your route plan press the LEG softkey.

LEG 002 now appears and the last waypoint you entered has become the "From" waypoint in leg 2. Type in the digits of the next waypoint #023 and press ENTER. The LEG prompt re-appears again for adding LEG 003. Press the LEG softkey again to continue adding waypoint legs into the route plan.

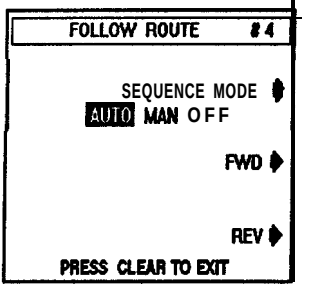
When you have completed the entry of all the waypoints for a particular route plan, just press the ENTER key. The new route plan will be stored and the display will promptly return to the last used Display mode.

3.9.2 FollowRoute Plans



Once a route plan has been made and saved into memory, it can be recalled to Followed or to be Edited. Press the ROUTE/5 key. The ROUTE MODE screen will appear. Press the FOLLOW softkey.

When the FOLLOW ROUTE Selector screen appears use the numeric keys to type the number of the route plan to FOLLOW.



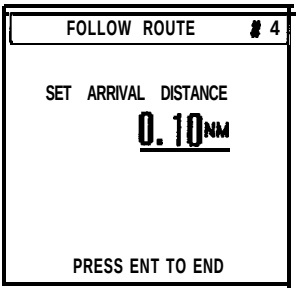
Example Press **4**, ENTER for route plan # 4.

The FOLLOW ROUTE Setup screen appears. Once route plans have been made, this screen permits engagement of route sequence operation.

The SEQUENCE MODE softkey enables you to select the type of waypoint sequencing mode between AUTO or MANUAL. The other choice turns the route sequence mode to OFF. Press the SEQUENCE MODE softkey to highlight the desired sequencing mode.

AUTO SEQUENCING mode automatically steps from one waypoint to the next when the arrival perpedicular point has been detected.

In MANUAL SEQUENCING mode, the unit sounds the arrival alarm and the operator will manually press the ENTER key to step to the next leg in the route plan when it is safe to do so.



When the Sequencing mode is decided, the next step is to decide to follow the route in the Forward direction (first to last), or to follow the route in Reverse (last to first). Just press the FWD or REV direction softkey to advance to the next screen.

The last display shows the Arrival alarm distance that will be used to alert you as each waypoint is approached. You may accept the limit by pressing the ENTER key or enter a limit of your choice on this screen. To enter a new arrival zone limit, type the numbers of the desired limit distance and press the ENTER key.

When is pressed the route sequence mode will be ON. The route number will be displayed in the left corner of the waypoint information bar on the POS, NAV, or CDI screens and the first point of the route plan becomes your initial destination, unless you happen to already be at the first point of the route.

While you are following the route plan you may press the ENTER key anytime to bypass the next point in the route plan.

Turning the Route OFF

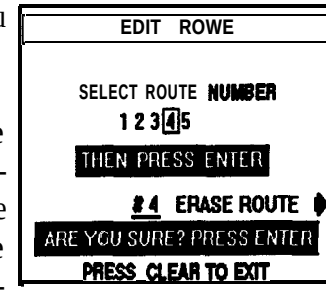
The route plan can be conveniently turned OFF anytime by pressing the ROUTE/5 key. Select FOLLOW. On the FOLLOW ROUTE screen press the SEQUENCE MODE softkey to OFF.

One other method of turning the route sequence to OFF is a bit indirect but if you press the GOTO key to select any waypoint that is not part of the route plan, or press GOTO, 0, ENTER, the route will be turned OFF.

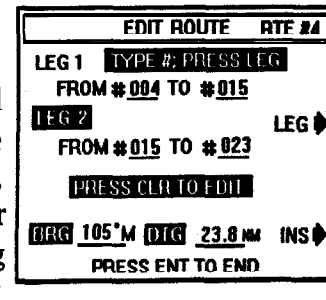
3.9.3 Editing Route Plans

The EDIT ROUTE mode is used to INSERT or DELETE waypoints in a route plan or to ERASE a route plan in its' entirety.

Press the ROUTE/5 key. Press the EDIT softkey. When the EDIT ROUTE Selection screen appears, select the route number you wish to edit. Press ENTER.



On the EDIT ROUTE screen the route legs can be examined and the bearing and distance of the highlighted leg of the route plan displayed. If changes are necessary, you can insert or delete waypoints in the legs in a route by performing the following key operations:



The EDIT ROUTE display shows the Route # and the leg containing the first two waypoint #'s in the route. To see other waypoints in the legs of the route, press the LEG softkey. UP and DOWN arrows appear on the screen for scrolling the route legs. Place the leg of interest in the highlighted block to check the bearing and distance.

Press the ENTER key puts the screen into an Edit condition so you can INSERT or DELETE waypoints. Notice that two softkeys LEG and INS (insert) appear on the screen.

To INSERT a Waypoint

For example; to insert a new waypoint between waypoints #006 and #036, press LEG and the DOWN arrow until you see the leg containing Fr 006/ to 036. If this is where you would like to INSERT the new waypoint, Press the INS softkey Type the new waypoint number (# 002) and press ENTER. The new waypoint will now appear between 006, 002, 036.

To DELETE a Waypoint

To delete a waypoint from a route plan, press the LEG key until the leg where the waypoint shouid be deleted is displayed. For example; to delete waypoint #036 in the example above, press ENTER until you see Fr 006/ to 036. Then press CLEAR to EDIT and press CLEAR again to DELETE #036. The FROM waypoint 036 will disappear the route string will be joined less waypoint 036 (deleted from route; not from waypoint memory).

BE CAREFUL when leaving the EDIT screen. When you are finished, press the ENTER key to end the editing session and return to the Display mode. If you press the CLEAR key here (which is normally done on other menus) you will accidently remain in the EDIT screen and continue deleting waypoints from the route against your will.

3.9.4 Erasing Route Plans

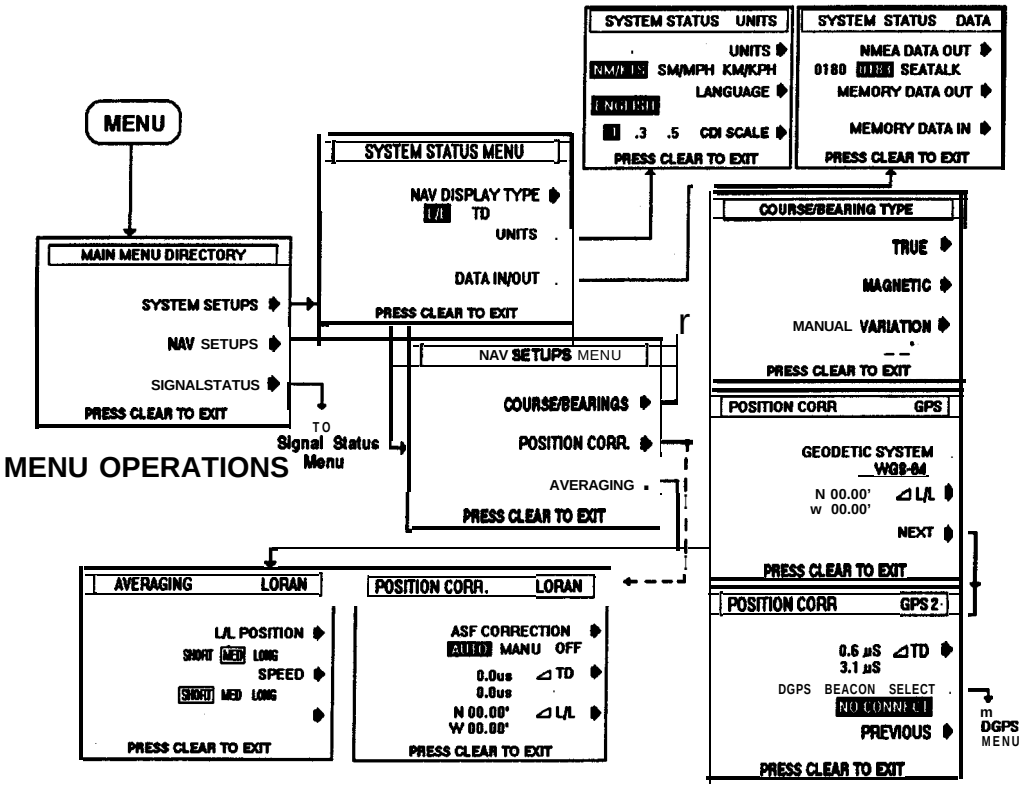
To ERASE a route plan, select the Route mode with the ROUTE/5 key. s s EDIT on the ROUTE MODE Directory. Type in the route number to be erased and then press the # ERASE ROUTE softkey. The message "SURE? PRESS ENTER" will appear. To ERASE the route, press ENTER. have a change of heart, press CLEAR to abandon the ERASE request and return to the Display mode.

3.10 The MENU Key

One of the smallest, but most important keys on the NAV 398 is the MENU key. This key controls access to the screens which set up the operating parameters for the sensors, the display system, and for the navigation calculations and readouts,

In the Menu pages you will find that the operations are very simple and direct and the most difficult task will be to remember which menu holds the

function or setup that requires change. The paragraphs that follow will endeavor to provide simple guidelines for you.



3.10.1 Main Menu Directory

The figure above shows the selection paths that are available when the **MENU key** is actuated. The System setups control Data Inputs/ Outputs, Units of Measure and Language. The NAV setups change the parameters for calculating and displaying the navigation data. Items that can be altered are Course & Bearing readouts, Speed averaging, and Position corrections. The Signal Status screens display the signal reception and tracking status and allow initialization input and manual control functions.

When the **MENU key** is pressed and the MAIN MENU Directory is displayed, pressing the indicated **softkeys** will place you in the secondary **menus.** When you are ready to leave the secondary menu, press the **CLEAR** key. You will be returned to the MAIN MENU Directory.

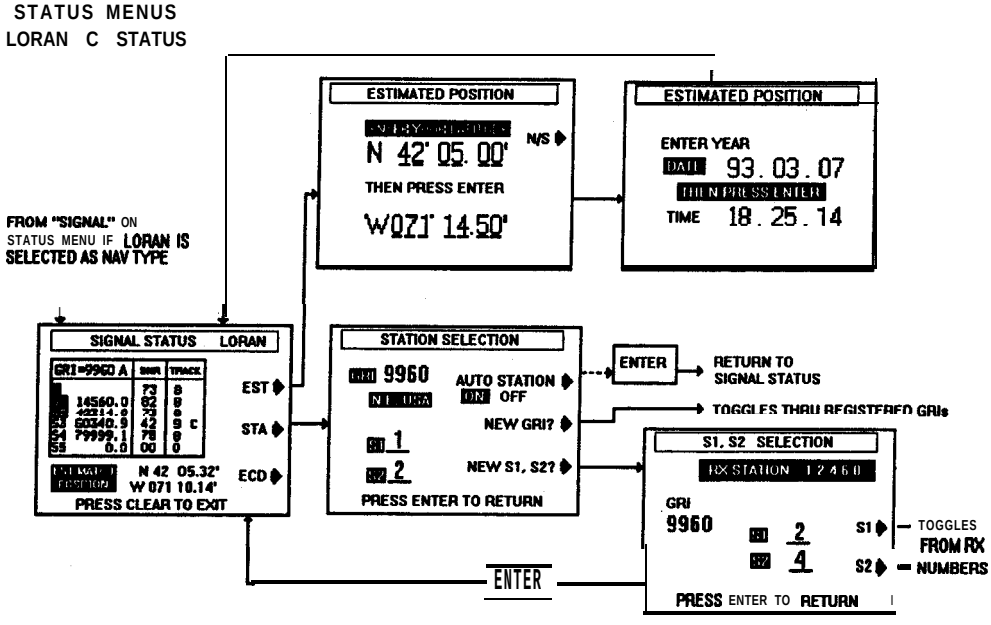
If you are finished with setups in the menus, press the **CLEAR** key one more time to return back to the last Display mode screen.

3.10.2 Signal Status Pages

The **SIGNAL STATUS** displays are used to show the conditions of signal acquisition and tracking of the attached sensors and thereby indicate the quality of the position fix. If the **NAV** unit is using both a loran and GPS sensor, the status of the sensor in use is always displayed. You may choose GPS or Loran operation while in the normal Display modes by pressing the **G/L/0** y .

3.10.2.1 Loran Signal Status

When operating in the Loran-C mode and the **SIGNAL STATUS** softkey is pressed, the first screen advises which type of "stats" you will be looking at. The **"LORAN STATUS"** screen will appear as shown in the figure below.



On this display the characters show the selected GRI and the Secondaries being received and used for L/L calculations in the Signal box (prominently featured on the page). The Master (M) station is shown first in the box. As each Secondary signal is received it becomes listed in the box. The signals appear in the list in the order in which they are received and not necessarily in numerical order.

The selected GRI number appears in the top section of the box. An "A" may appear to the right of the GRI to indicate that the 508 sensor is operating in the automatic GRI and secondary selection mode. If the "A" is not ON, the sensor is in the "manual" Station selection mode.

As you may remember from reading the basic loran information in the RayNAV 508 manual, the secondaries get their numbers by using the first digit of their normal time delay. On this display you actually see the TDs of all the loran signals, but the two "S" numbers highlighted in the reverse block characters at the left side are the stations being used to get your Lat./Long readout. So in the Status page example in the preceeding figure, the "1", "4" line and the "6" lines are being received.

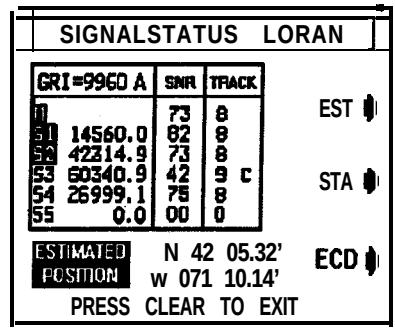
SNR Display

You can see a display of the SNR's (signal-to -noise ratio) levels for the Master and all received secondaries in the SNR column. The SNR level is important because it affects the quality of the position fix and certainly acquisition time.

The time required to select the correct cycle of the received loran signal is directly related to the received strength of the signal (SNR). If the signals are very weak, it usually takes much longer to "Lock-on" and track the signals and display your position. The table below shows the general range for SNR levels vs time of acquisition.

SNR Table

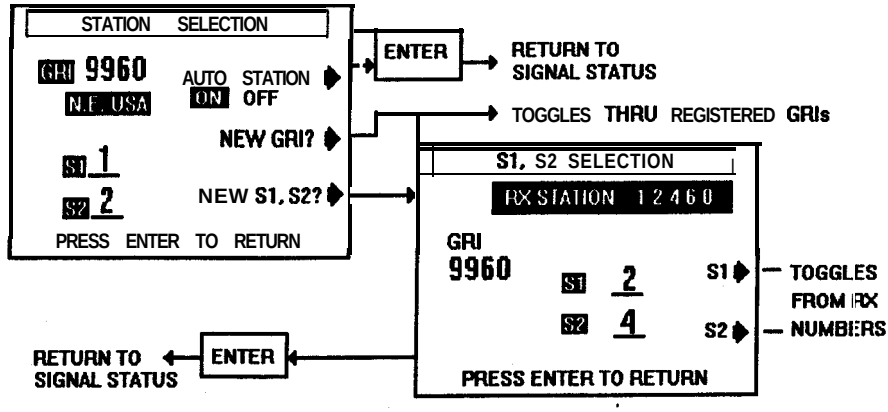
SNR LEVEL	STATUS	TIME TO LOCK
70 - 99	Good	Up to 3 minutes
50 - 69	Fair	Up to 7 minutes
15-49	Poor	Unpredictable
o- 14	Bad	Try the GPS



Track Status

The Track Status numbers appearing in the right hand column labled "TRACK" vary from 0 to 8's during the acquisition process with an "8" indicating that the loran is "Locked-on" and tracking that particular station.

When one of the signals disappears or becomes too weak to be tracked, the corresponding status number may go to "9" until the signal is recovered. If the signal is not recovered within 5 minutes, the signal will be considered "lost" and status number reverts to 0 (re-initiating search).



3.10.2.3 Station Selection Mode

If for some reason the SNR values or the Track Status of the SELECTED stations in the Automatic Station Select mode are poor and the loran will not lock-on, you can choose Manual Station mode and make station selections manually using the signals that are received in good quality. Just press the **STA** key

When you see the "STATION SELECTION" screen, you only need to press either the **NEW GRI?** softkey to select a different GRI from the internal GRI list or the **NEW S1,S2?** softkey to change the secondaries stations only.

Selecting GRIs Manually

The **NEW GRI?** softkey toggles through the list in numerical order. The GRI names appear on the screen directly below the GRI number on the screen. If you're not sure which GRI to enter, the list of worldwide loran GRI's appears below.

WORLDWIDELORANCCHAINS

4990	C.PACIFIC	8000	CHEUROPE
5930	E.CANADA	8290	NO.CEN.USA
5970	E.ASIA(CO.LION	8940	FRENCH
5990	W.CANADA	8970	GREATLAKES
7170	SAUDIARABIASO.	8990	ARABIANORTH
7270	NEWFOUNDLAND EC	9610	SO.CENUSA
7950	CHAYKA E.ASIA	9940	WESTCOASTUSA
7960	GULFOFALASKA	9960	NEUSA
7970	**NORWEGIAN CHAIN**	9970	**NW PACIFIC**
7980	S.E.USA	9980	ICELAND
7990	MEDITERRANEANSEA	9990	NORTHPACIFIC
5980	ATTUCHAWKA	7930	LABRADOR(OffAirin **Nov 94)**

Selection of Secondaries

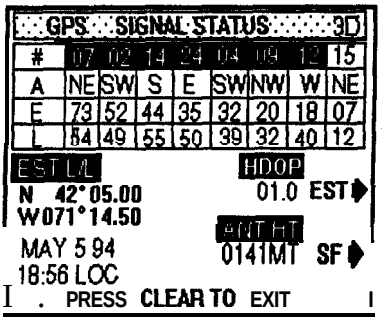
When [NEW S1,S2?] softkey is pressed, the screen will change to the " S 1, S2 Selection" screen. On this page the top line of large characters shows the received secondary stations from the selected GRI.

To enter the two secondary stations for S 1 and $2 that you would prefer to use for your Lat/Lon calculations, Press the [S1] softkey for a NEW S 1 station and using the numeric keys, type the number of the desired station. Then press [ENTER]. The softkey arrows will return. At this point you may coose a new S2 or press [ENTER] one more time to return to the Signal Status page.

For S2, press the [S2] softkey and using the numeric keys, type the number of the desired station for S2. Then press [ENTER].

Example: [S1] 2, [ENTER] for S 1 of 2
[S2] 4, [ENTER] for S2 of 4

Press [ENTER] when finished to return to the . Signal Status page.



3.10.2.4 GPS Signal Status

When in the GPS mode and the [MENU] key is pressed and [SIGNAL STATUS] is' selected from the Menu Directory, the GPS Status screen will appear and show the GPS satellite signals.

The "Satellites Tracked" display shows the identification numbers(ID) of the satellites being received, tracked, and used for L/L calculations in the reverse block characters. The Raystar 108 sensor is usually tracking 4-6 satellites at any one time and can track up to eight, if visible. So, seeing 6 to 8 blocks illuminated is not at all unusual.

In the column below each Sat ID # you can see see the individual satellite's azimuth angle, it's elevation angle from the horizon, and signal level (SNR). The data is displayed for all satellites being received.

Below the Status box the HDOP number appears and provides the current fix quality. This rates both the strength of the satellite signals as well as the geometry of the satellite positions. Typical HDOP numbers for a good fix are 2 or less. Fair HDOP values are 4 or less; Poor HDOPs are over 5.

In the title box, the fix type is displayed at the right end. Here, you will see either 3D or 2D characters. The 2D mode is a two-dimensional position fix mode that will not factor the calculated altitude (antenna height) into the L/L position solution. AUTO mode calculates altitude. Generally, the 2D mode works the best for marine navigation.

The Status display also includes readouts of your estimated position, local date and time, and antenna height.

There are two **softkeys** on the GPS Status screen. The **EST softkey** accesses the GPS sensor Initialization sequence. The **SF softkey** permits special setups that effect the GPS position fixing or readout displays. The next sections cover the GPS initialization sequence.

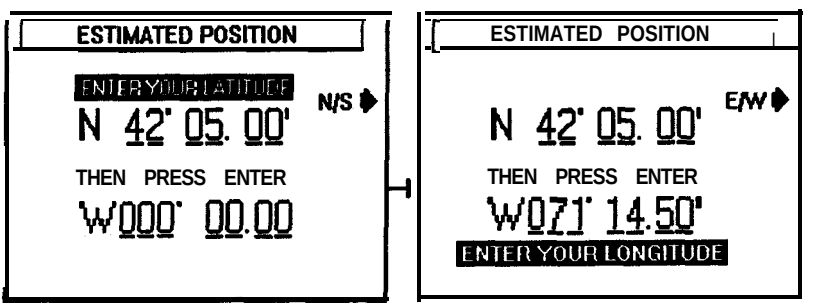
3.10.2.5 Initializing GPS Sensors

The following paragraphs describes the series of initialization inputs to be checked when your NAV unit is to be operated with the RAYSTAR 100 or RAYSTAR 108 GPS Sensors. It is important to note that initialization entries should be only made when the appropriate sensor is connected.

. When the **MENU** key is pressed and **SIGNAL STATUS** is selected from the Menu Directory while using the GPS mode, the GPS Status screen will appear and show the GPS satellite signals. Press the **EST softkey** to start the sequence of initial entries. The first screen appears as below:

Estimated Position

When the EST LATITUDE message appears, the current Latitude entry will be displayed. To update the entry, you should always re-type the correct, numbers for you latitude using the numeric keys. Even if the entry is OK, we recommend that you do not bypass this entry, by pressing the **ENTER key**.



ENTERING INITIAL POSITION

Example: Press 4,2,0,5, 0,0, ENTER, ENTER, for N42°05.00'

Check the direction displayed to the left of the Latitude. Use the N/S key to change "S" to "N" or vice versa. Press ENTER to save the Latitude.

Estimated Longitude

The prompt now moves to request your Longitude entry . Type in the correct longitude value. Add a "0" for Longitudes below 100 degrees. Press ENTER.

Example: Press 0,6,9,5,9,8,5, ENTER, ENTER, for W69° 59.85'

Check the direction displayed to the left of the Longitude. Press the E/W key to change "W" to "E" or vice versa. Press ENTER to complete the longitude entry.

When ENTER is pressed to complete your Longitude entry, you will be prompted to enter the antenna height.

Antenna Height Entry

The display changes and prompts to "ENTER ANT HEIGHT" above sea level in METERS (3.28 feet = 1 meter) or in "FEET". Enter the numeric value of you antennas height above the water. Then press ENTER. When the MT/FT softkey appears on the screen, press the softkey only if you want to change the units from meters to feet or vice versa. The currnt units selection appears after the antenna height digits on the display. Then press ENTER again.

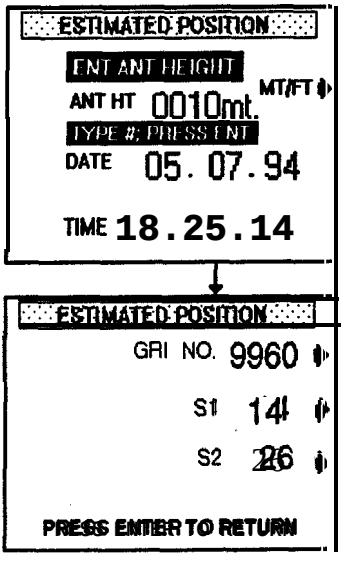
When ENTER is pressed to accept your antenna height, the unit will advance the message prompt to request the date entry.

Date Entry

For this entry you need to type in sequence the two digits of the Month, followed by two digits for the Day, followed by two digits for the current Year. When the readout looks OK, press ENTER

For May 7,94, press 0, 5, 07, 94 ENTER

When (ENTER7 is pressed to accept the Date entry, the display advances to enter the Local time.



NOTE: RETURNS TO SIGNAL STATUS

Local Time Entry

When ENTER is pressed to accept the Date entry, the display will prompt you to enter Local time. Enter the hour and minutes (+/- 15 minutes) using the 24 hour format. In the 24 hour format, 9:00a.m. is shown as 0900, 3:00p.m. is 1500, 10:00p.m. is 2200. Since each entry is two digits, enter "0" first when the hour or the minutes value is less than 10.

Example: Press 0, 9, 0, 5, ENTER for 9:05a.m.
or
Press 1, 3, 0, 7, ENTER for 1:07p.m.

The last screen of this sequence prompts you to enter the GRI number of' the loran chain serving your area and the first two digits of the TDs that would normally be used in that area.

Loran GRI Selection

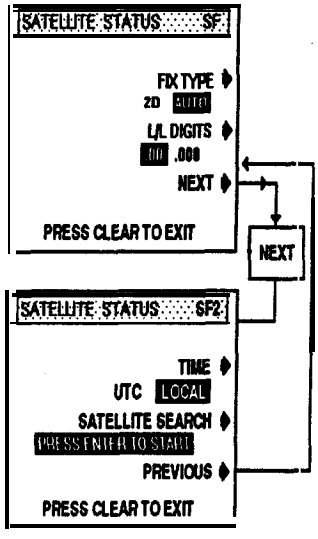
When the GRI entry prompt appears, the GRI that serves the area of your esitmated L/L position will appear in the entry window. If the GRI is correct then it is only necessary to designate the TD numbers.

Press S1 softkey and type two digits of first TD. Press ENTER When the softkey arrows re-appear, press the S2 softkey and type the two digits of S2. Then press ENTER to input the S2 entry.

If the GRI number was not correct, press the GRI softkey. Re-type the desired GRI number. Then press ENTER are finished, follow the message at the bottom of the page to press the ENTER key and return back to the GPS Signal Status page.

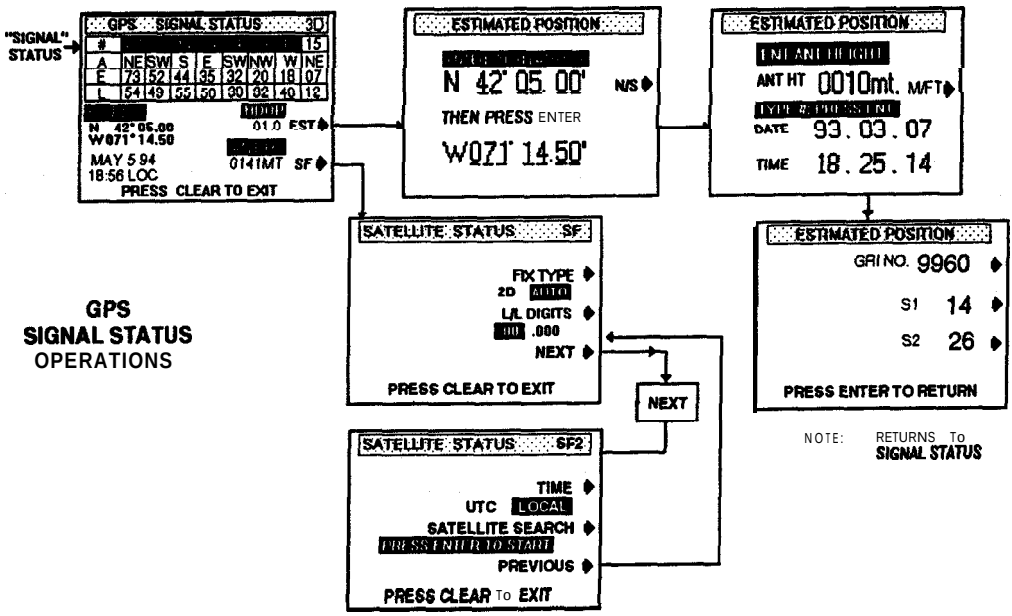
3.10.2.6 SF for GPS Status

On the GPS Signal Status screen one key re-mains. The softkey is the SF (special functions) key.



GPS Fix Mode

When the SF key is pressed, the first of two SF menus (shown in the figure) appear. Here you may select the type of GPS fix. The choices are **2D** and **AUTO (3D).** The **2D** mode is recommended for marine use, Press the softkey for 2D fix mode.



Press the **CLEAR** key to return to the Main Menu Directory.

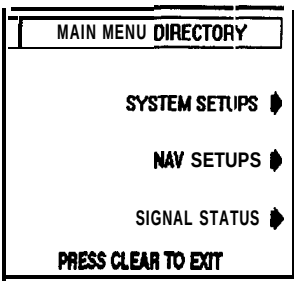
L/L Digits (L/L Resolution)

The next item of the SF menu selects the latitude/longitude readout resolution . The readouts can display to 1/100ths of a minute or 1/1000ths of a minute. The readouts are set to .OO' from the factory. Press the **L/L DIGITS** softkey for .OOO readouts.

When the **NEXT** softkey is pressed , the SF2 menu will appear. On this menu you can set the Time & Date readouts on the GPS Signal Status page to show the UTC Time & Date when the **TIME** softkey is pressed.

The last menu item starts the SATELLITE SEARCH mode. when this softkey is pressed it is requesting the GPS sensor to refresh its almanac data in memory. The message prompt will ask you to press the **ENTER** key if you wish to proceed. Press **CLEAR** if you choose to abandon a SATELLITE SEARCH. The accumulation of almanac data normally takes anywhere from 15 minutes up to 30 minutes.

3.10.3 System Setups



In the System Set-up menu the type and style of the various readouts and messages can be set to your preference. This menu also controls the Data input/Output parameters. To see the System menu, from the POS, NAV, or CDI screen press the MENU key. On the Main MenuDirectory,press the SYSTEM SETUP softkey.

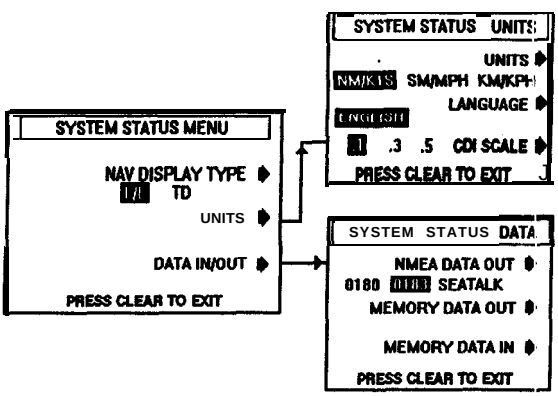
3.10.3.1 Display Type

The first item on the **SYSTEM STATUS** menu is the **NAV DISPLAY TYPE** selection. When the NAV DISPLAY TYPE softkey is pressed, the position coordinates will be shown in TD coordinates if TD is highlighted. When L/L is selected, all position coordinates appear in Latitude/ Longitude coordinate format.

3.10.3.2 Units Menu

When the UNITS softkey is pressed on the system status menu, a second menu **SYSTEM UNITS** appears. On this screen the units for distance and speed, language, and CDI scaling may be selected.

The UNITS key appears again on the UNITS menu and this time toggles the selection of NM/KTS, SM/MPH, or KM/KPH for distance/speed units. Press UNITS until the desired units are highlighted.



Language

Each time the LANGUAGE key is pressed one of six languages may be selected for the text on displays and in menus. English is the default language. As the key is pressed DEUTSCH, FRANCE, ESPANOL, NORSK, and ITALIAN maybeselected.

CDI Scale Range

This menu item sets the span of the CDI scale used on all CDI displays in CDI, NAV, and POS modes. The selections available are 0.1, 0.3, and 0.5 nm. These are scale limits as measured from midscale to each end. The value highlighted in the block is the selected value. Press the CDI SCALE softkey to highlight your choice.

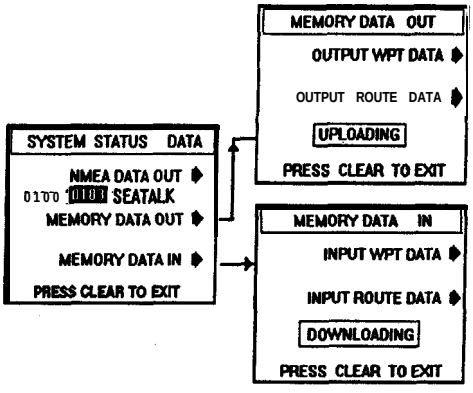
3.10.3.3 DATA IN/OUT Menus

When you are on the SYSTEM SETUP menu and press the **DATA** IN/OUT **softkey** the SYSTEM STATUS- DATA menu will appear. This menu will control the format of the data to output and execute the transfer of waypoints and routes in and out of the NAV unit.

To select the Data output format **NMEA** DATA **OUT softkey** to highlight 0 180, or 0 183 NMEA data formats. The next press of the **softkey** will select **SeaTalk** data format.

NMEA 0 180 is an old data format that is intended to provide XTE steering data to older autopilots.

NMEA0183 is the current standard data interface used between marine electronic equipments. The list of NMEA 0 183 sentences outputted by the NAV 398 can be found on page **2-6** of this manual.



SEATALK is a bi-directional data format used for communication between **Autohelm** Instruments and Raytheon marine products.

Press the **NMEA** DATA **OUT softkey** to highlight your choice.

MEMORY DATA OUT

This menu item enables the transfer of **waypoint** and route data from internal memory of the NAV unit to a PC file. The data is output in the NMEA 0 183 format standard using the WPL and RTE sentences. This mode can be most useful to download the memory contents for editing and reloading. The mode is also useful to save a file record of the memories in the event a Master Reset must be executed.

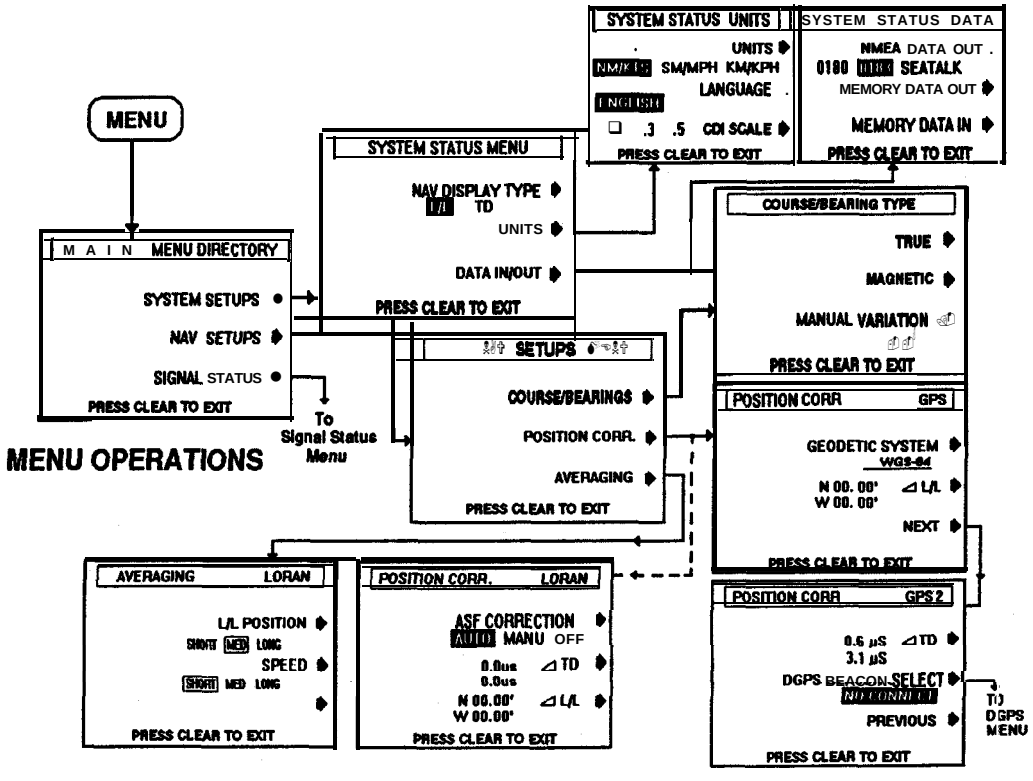
To transfer the Memory Data out, press the **MEMORY** DATA **OUT softkey.** The MEMORY DATA OUT screen will appear. The Data output connections (Yellow **&** Green wires of the power cable) should be connected to the **COM1** or COM2 input of your PC. Verify that the line settings are set for: 8 Bit, 4800 baud, no parity, 1 start bit, 1 stop bit.

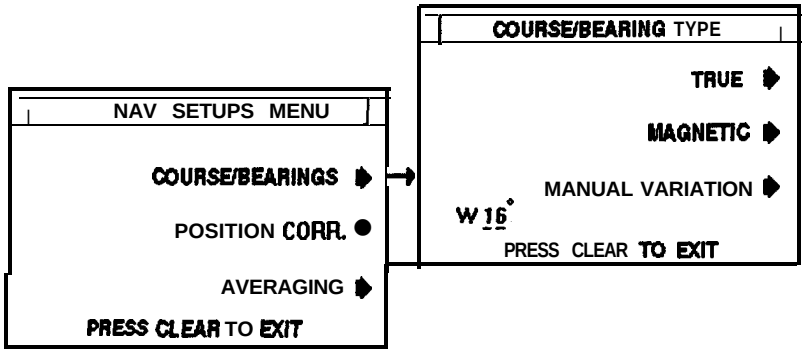
Designate a drive, path, and file for the data to be saved into. When the PC is all Set, press the [OUTPUT WPT DATA] or the [OUTPUT ROUTE DATA] softkeys to begin the memory transfer. The screen will show the message "SENDING WP DATA OUT" and a" UPLOADING" willblinkonthescreenduring the transfer process. The time to upload the data will depend on the number of memory elements to transfer since up to 500 memories may be involved. The UPLOADING message will go out when the transfer is completed.

MEMORYDATAINPUT

When you are ready to transfer the PC files of route plans or waypoints into the NAV unit memories, please verify that the Data Input connections in the power cable assembly are now connected to the PC COM1 or COM2 port.

If everythings connected correctly, on the SYSTEM STATUS DATA menu, press the MEMORY DATA IN softkey. The screen will show the message "LOADING WP DATA IN" and " DOWNLOADING" will blink on the screen during the transfer process. The time to download the data will depend on the number of memory elements to transfer since up to 500 memories may be involved and the transfer rate is one memory per second. The DOWNLOADING message will go out when the transfer is completed.





3.10.4 NAV Setups Menu- Loran

NAV Setups for Loran include making choices of bearing types, position corrections, and averaging constants for smooth (but responsive) readouts.

3.10.4.1 True/Magnetic Modes

As with most navaids, Course and Bearing readouts can appear referenced to True North or Magnetic North on the screen. When the **COURSE/BEARINGS softkey** is pressed the **COURSE/BEARINGTYPE** menu permits selection of True or Magnetic readouts. On the menu:

Press the **TRUE softkey** for True Bearings.
Press the **MAGNETIC key** for Automatic Magnetic Bearings
Press the **MANUAL VARIATION softkey** for manual Magnetic bearings

True North mode

When the unit is shipped from the factory the readouts for Course and Bearing are displayed in "Magnetic North". To display "True North" data' it is necessary to de-activate the "AUTO" Magneticvariation mode. Press the **TRUE key** and Course and Bearing readouts will *now be* in degrees "True". The **"mag"** indicators, on the screen, will become **"t"s.**

Magnetic North Mode

When the MAGNETIC or MANUAL VARIATION keys are pressed, the unit will produce magnetic courses and bearings. The primary difference between these two modes is that the variation values often **change as you cruise** from area to area. The automatic variation program selected **by the MAGNETIC softkey** can adjust for these changes. The Manual variation mode uses a fixed value that is usually accurate for a specific area.

Manual Magnetic Variation

In rare cases the Auto Mag Variation may be off by a degree in certain **Lat/Lon** locations. In this case, you could turn **OFF** the Auto magnetic

program and use your own entered value for the variation by selecting the MANUAL VARIATION softkey.

When the MANUAL VARIATION key is pressed, you must first decide whether the direction of the variation is East or West. The direction already selected is displayed at the left side of the screen. Press the E/W softkey if the direction should be changed and then press the ENTER key. "00" appears next to the direction character.

Now type the numeric value of variation and press ENTER. The unit will now be in magnetic mode, but using a fixed variation value. When the ENTER key is pressed, the entered variation will now be applied to all Course and Bearing readouts. Press the CLEAR key and you will shift back to the mMain menu directory. Press CLEAR a second time to get back to the last used display mode.

3.10.4.2 Position Corrections- Loran

The NAV 398 unit has Position corrections that are available for use with Loran-C navigation and corrections that apply to GPS navigation. If you happen to be using both senors in your system, the menus that appear on the screen will be determined by the sensor that is currently selected for use. To apply corrections to the loran L/L you will need to be sure the unit is in the loran mode. Conversely, be in GPS mode to do GPS corrections.

The NAV 398 includes automatic correction programing for both the Loran and the GPS modes and these programs are normally operating when the unit comes from the factory.

Loran Position Corrections

When the loran sensor measures the loran signal time differences, the TD's received are rarely perfect by the time they reach your boat. They usually contain some errors to signal timing developed as the signals travel across land due to various distortions of the terrain along the path of the radio waves. Fortunately, the error values are generally known for most of the loran coverage areas and a table of corrections (ASF) is built into your loran sensor.The ASF program helps to correct the loran time differences so the Lat/Lon readouts will match marine chart coordinates and your GPS more closely.

The NAV unit only uses Lat/Lon for waypoint navigation calculations. When navigating to and from waypoints, the loran performs its bearing and distance, TTG, XTE calculations by comparing the Lat/Lon values. Upon

arrival at the waypoint, the ships' L/L must match WPT L/L. If the ship's displayed L/L is ASF corrected, the waypoint memory must have corrected L/L coordinates if you are to arrive at the same location again. The NAV 398 takes care of this automatically for you.

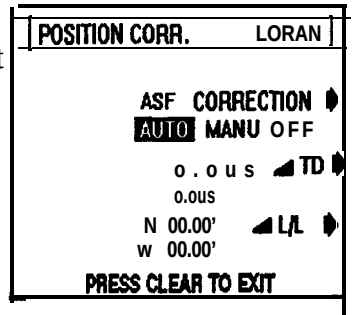
If you see some difference between the waypoint's L/L in memory and the ship's position at the waypoint location, we suggest that you save the waypoint as an Event, while sitting next to the mark. This will put a corrected position into the waypoint memory and will permit the repeatable accuracy of loran (+/- 50 feet) to guide you to the same location the very next time.

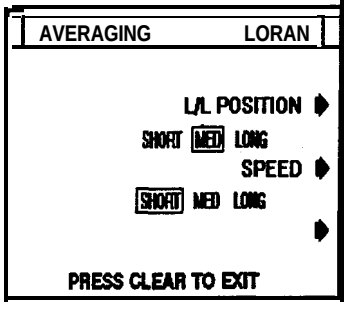
Auto ASF

Normally the ASF program is set to Automatic when the 508/A sensor leaves the factory. However you should check the POSITION CORR. menu and verify that the program is ON at the first opportunity. On the Main Menu Directory, press the POSITION_CORR. softkey. On the menu verify that the ASF correction is highlighted at AUTO. Pressing the softkey steps the selections from AUTO to MANUal to OFF, etc.

Manual TD Corrections

Although adding TD correction values to correct your Lat/Lon position is not a common practice, there are times when TDs of a fixed landmark are available. It is fairly easy to correct your Lat/Lon reading using TD difference values. The procedure for making manual TD corrections appear in the following example:





Example: The actual TD readings given on a chart for a sea buoy are 13900.7us and 25590.0us. The loran display reads 13899.5us for S 1 and 25590.2us for S2 while sitting next to the buoy.

13900.7 Chart	25590.0 Chart
-13899.5 TD readout	25590.2 TD readout
1.2 S1 correction	-0.2 S2 correction

After subtraction, the values 1.2us for S1 and -0.2us for S2 were obtained and can now be entered manually for the ASF values. To enter these values, select the POSITION CORR. menu . Press the ASFCORRECTION softkey to highlight MANU and press the ◢ TER key. will be highlighted to indicate numeric values should now be entered.

Type in the numeric value 1, 2 and press ENTER. In our example the correction was a plus value. So, even though the " +/-" prompt just came on-screen, just press the ENTER key again for the +1.2us TD 1 correction.

When ENTER is pressed, the display continue with entering the offset value for TD2. Type in the numeric value 0, 2. Press ENTER. This time press the +/_ softkey, since the correction was a minus value. Then press ENTER to store the -0.2us TD2 value.

Manual L/L Corrections

Instead of using the Auto ASF program or the manual TD offset values, the L/L coordinates may be corrected manually. The process is similar to making manual TD correction entries, and is accomplished in the following manner:

First go to a fixed navigation point and read your current L/L position from the loran display. Extract the L/L coordinates of the fixed point from your marine chart. Subtract the two Latitudes and the two Longitudes from each other to determine the appropriate correction to be entered into the NAV unit.

Example:	N42 42.23' Loran	W071 24.54' Loran
	N42 42.08' Chart	W071 24.50' Chart
	-. 15' (South)	-.04' (East)

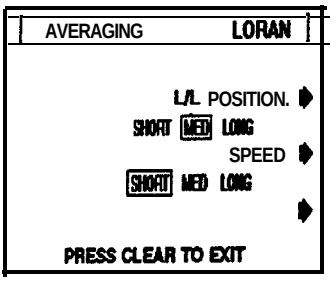
After you have calculated your correction, select the POSITION CORR. menu. Press the L/L softkey to highlight ◢L/L .

Type in the value of Latitude Offset 1, 2, 6. Press the ENTER key. "N/S" appears at the center softkey position. Since our sample offset is to the South, press the N/S softkey to change the direction for the latitude correction to "S". Then press ENTER.

When ENTER is pressed, the display will expect you to enter the value of the Longitude Offset with the numeric keys. Type in 1, 0, 5. Press ENTER and the "E/W" characters appear again at the center softkey position. This time the correction is to be subtracted. Use the E/W key to select E (-) for the longitude correction before pressing ENTER.

Press the CLEAR key to return back to the Main Menu Directory. You could press CLEAR one more time to go back to the display mode. However, this time press the NAV SETUP softkey again so we cm check the AVERAGING menu for Loran.

3.10.4.3 Averaging for Loran



On the **LORAN AVERAGING** menu we can select averaging periods for the Loran L/L readouts and one for the Speed readouts. Averaging periods of **SHORT, MEDIUM, LONG,** canbeselected.

Press the **L/L POSITION** softkey repeatedly to scroll the selections for the position readout. Press the **SPEED** softkey repeatedly to scroll the selections for the Speed readout.

"SHORT"- Shortest averaging, quickest response, slightly erratic readings.
"MEDIUM"-Gives smooth readings with more response.
"LONG''-Longest averaging period. Gives smoothest readings.

Generally for Loran , For L/L Short or Medium averaging is recommended. For Speed, Medium or Long is recommended.

When correct, press **CLEAR** to return to the Main Menu Directory.

3.10.5 NAV Setups - GPS

This section covers the **NAV SETUP** menus that are particular to GPS operation. The **COURSE/BEARINGS** menu of the NAV SETUPS menu happens to have the same operations for both Loran and GPS. The operations for selecting magnetic bearings were covered in section 3.10.4.1. However, for GPS operations, the **POSITION CORR.** and **AVERAGING** menus are unique to GPS and are discussed in the following paragraphs.

3.10.5.1 Position Corrections - GPS

In the NAV 398 there are actually three forms of correction available in the GPS mode. They are:

- Geodetic datum
- Manual L/L correction
- Manual TD correction

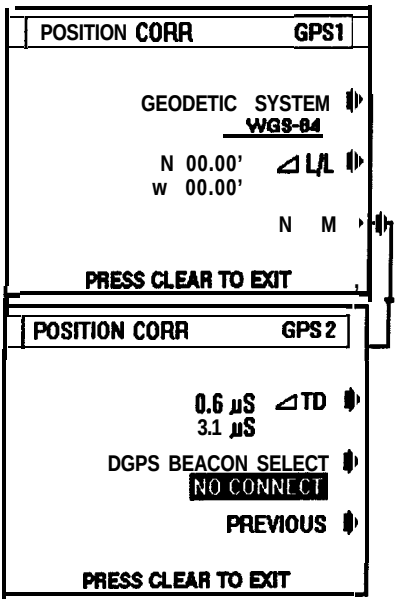
When the GPS sensor converts the ranging measurements from the satellites into **Lat/Lon** coordinates it uses a mathematical formula (or datum) to arrive at the L/L solution. In preparing charts or maps, cartographers also rely on a particular mathematical formula or geodetic datum (scaling system)on which to calibrate the Latitude/Longitude coordinate structure of the charts. The type of datumused to make the chart is normally listed on the chart in the table area.

Geodetic Datums

Mariners may find considerable errors (up to 200 meters) in plotting own ship's position if their charts were created using one type of geodetic data system while the GPS calculates positions using another data system.

The NAV 398 can program the RAYSTAR 108 to provide position calculations utilizing several geodetic data systems. For maximum plotting accuracy, you should set the GPS to match the datum used for your marine chart. The datums available in the Raystar 108 are listed below and in Table A on the following page:

1. WGS-84
2. WGS-72
3. BESSEL (JAPAN)
4. NAD-27 (USA)
5 NAD-27 (CANADA)
6. EURO-50 (Europe)
7. AUST-66 (Australia)
8. OSGB-36
9. NAD-83
10. Other datums (see table)



When the POSITION CORR. GPS1 menu is displayed the screen displays the current Geodetic datumused by the GPS sensor. To move through the datum list and select a different datum, press and hold the GEODETIC SYSTEM softkey down to scroll the datum list.

Datums named on the list above will appear first in the sequence. When the two digit numbers appear, continue holding the key until the desired number is displayed. The numbers correspond to the datums listed on Table A. When the datum or datum number you desire is displayed, it will become the datum used for L/L calculations.

If you are finished with this menu, press the CLEAR key to return to the MAIN MENU Directory. Press CLEAR one more time to get back to the normal navigating screens.

Table A: ADDITIONAL GEODETIC DATUMS

NO.	DATUM AREA	SERVICE AREA
11	ADINDAN	Ethiopia and Sudan
12	ARC 1950	Botswana
13	AUSTRALIAN GEODETIC 1984	Australia
14	BERMUDA 1957	Bermuda Islands
15	BOGOTA OBSERVATORY	Colombia
16	CAMP0 INCHAUSPE	Argentina
17	CHATHAM 197 1	Chatham Island
18	CHUO ASTRO	Paraguay
19	CORREGO ALEGRE	Brazil
20	DJAKARTA (VATAVIA)	Sumatra
21	EUROPEAN 1979	Europe
22	GEODETIC DATUM 1949	New Zealand
23	GUAM 1963	Guam
24	HAYFORD 1910	Finland
25	HJORSEY 1955	Iceland
26	INDIAN	Ireland
28	KERTAU 1948	West Malaysia & Singapore
29	L.C. 5 ASTRO	Cayman Brac Island
30	LIBERIA 1964	Liberia
31	LUZON	Philippines
32	MERCHICH	Morocco
33	MINNA	Cameroon
34	NAHRWAN	Oman
35	NAPARIMA, BWI	Trinidad & Tobago
36	OLD EGYPTIAN	Egypt
37	OLD HAWAIIAN	Hawaiian Islands
38	PICO DE LAS NIEVES	Canary Islands
39	PROV.SO.AMERICAN 1956	South America
40	PROV. SOUTH CHILEAN	South Chile
41	PUERTO RICO	Puerto Rico and Virgin Islands
42	QORNOQ	South Greenland
43	RT90	Sweden
44	SANTA BRAZ	Sao Maguel. Santa Maria Is
45	SOUTH AMERICAN 1969	South America
46	SOUTHWEST BASE	Faial, Graciosa, Pico, Sao Jorge & Terceira Island
47	TIMBALAI 1984	Brunei & East Malaysia

Manual Lat/Lon Corrections

Although its not very likely that you will choose to correct your GPS L/L position with any type of manual corrections, the means to do so is included in the NAV 398 menus. Manual corrections would not be efficient because the variable errors introduced by the "selective availability" mode to the GPS satellites negates such fine calibration attempts. GPS fix improvements are much more likely to occur when the differential Beacon receiver is providing dynamic corrections to the GPS sensor.

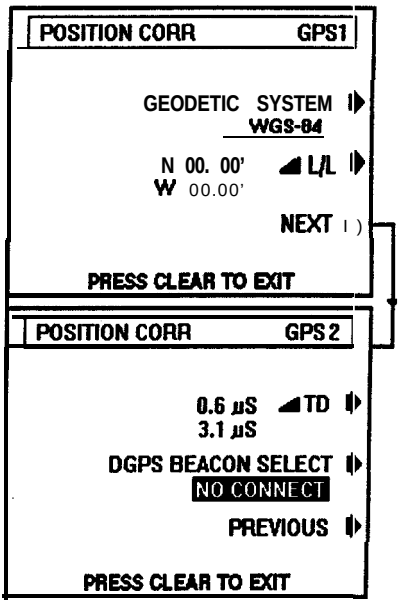
However, to "calibrate" your GPS to the NAVigation charts by using fixed. correction factors added or subtracted to Lat/Lon readouts use the ◢L/L correction procedure for loran operation described in paragraph 3.13.2.4. to determine the needed correction values. Please refer to the description in that section for further details.

Press the softkey. The ◢ L/L characters will become highlighted by a reverse block.

Type the numbers of the Lat correction value and press ENTER. The N/S prompt appears. Use the softkey, if necessary, to set the desired direction. Then press ENTER.

Now type the digits for the Longitude correction and press ENTER. The E/W prompt now appears. Use the softkey again to set the correct direction, if necessary. Then press the ENTER key to finish inputing the correction.

The L/L position correction that is entered for GPS is only used for GPS mode. If a L/L correction is made for the loran sensor, that correction value is only used for the loran.



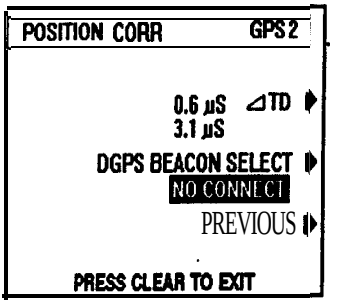
Correction for GPS TDs

When the NEXT key is pressed on the POSITION CORR. GPS 1 menu the GPS2 menu appears. The first softkey ◢TD can be used to input some offsets to the TD readouts that are converted from the GPS L/L coordinates. Essentially this menu entry functions in the same manner as the TD corrections for Loran already discussed in section 3.13.2.3. Please refer again to the instructions provided in that section.

3.10.5.2 Differential Beacon Operation

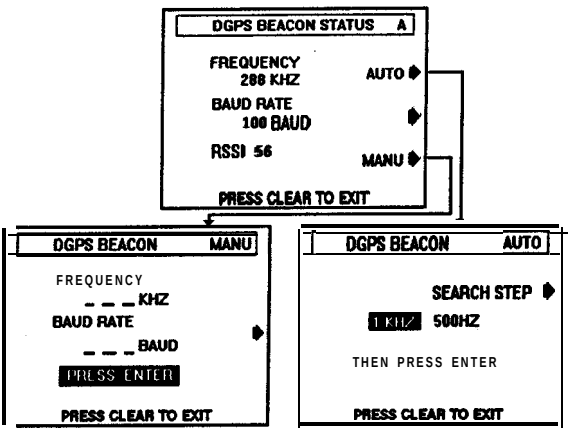
Ordinarily the Raytheon DGPS Beacon receiver works automatically to find and track the radiobeacon providing differential GPS corrections in your area. When the beacon is being received, "DGPS" is displayed in the message area at the bottom of the various display modes.

The Beacon receiver is capable of operation in a Manual Tuning mode via the NAV 398 menu. To access the DGPS menus, the DGPS beacon receiver must be connected, receiving a beacon signal, and providing correction signals to the GPS sensor. The message "NO CONNECT" will not appear and when the DGPS BEACON SELECT softkey is pressed, the DGPS menus will appear.



The BEACON STATUS A display is the first screen. The "A" indicates the receiver is operating in the automatic mode. The frequency of the beacon is displayed.

Each beacon operates at an assigned frequency. Usually beacons operating in the same area are assigned different frequencies, so they are easily identified.



The baud rate of the data transmission is displayed. Although the baud rate can range between 50 to 300 baud, most beacons are currently transmitting at 100 baud.

The third item on the screen is "RSSI". The RSSI is the signal strength of the received signal.

If the AUTO softkey is pressed you can set the frequency steps the beacon receiver should use in its' search mode. The selections are 1 Khz or 500 Hz steps. Although a few beacons operate at XXX.5 Khz intervals, most beacons operate at XXX Khz. So, setting this to 1Khz will provide a faster search and acquisition of the beacon in AUTO mode.

When the [MANU] softkey is pressed the screen changes so you may type in the frequency and baud rate of your desired beacon.

DGPS Beacon Transmitter	Freq	Baud
Portsmouth, N. H.	288	100
Cape Henry, Va.	289	100
Montauk Point, N. Y.	293	100
English Turn, La.	293	200
Galveston, Tx.	296	100
Cape Henlopen, De.	298	100
Wildwood, N. J.	301	100
Aransas Pass, Tx	304	100
Alexandria, Va.	305	100
Whitefish, Mi.	318	100

On this menu you should type the frequency and press the [ENTER] key. Then type in the baud rate and press the [ENTER] key. When the-key is pressed following the baud rate entry, the screen will return to the last used display mode screen.

Initially manual tuning to beacons is probably unnecessary. As the DGPS system becomes more developed and beacons are more numerous towards 1996, it is possible that more than one strong beacon signal may be picked up in some areas. Manual tuning assures that only the desired beacon will be received.

3.10.5.3 Averaging for GPS

When, in GPS mode, the AVERAGING GPS screen appears, you can see that only one averaging filter is used for both the L/L position readouts and the Speed readouts for the GPS mode.

Pressing the softkey changes the averaging selection for readouts between SHORT, MED, and LONG . When the desired Averaging level is highlighted by the block, press the [CLEAR] key to step back to the Main Menu Directory.

Press [CLEAR] one more time to get back to the normal display modes.

SECTION4

MAINTENANCE

4.1 General

Maintaining satisfactory operation of your NAV 398 can depend on how well you care for the equipment. The simple maintenance tips that follow can save you time and money, as well as prevent unnecessary premature failures.

- Always keep the equipment as clean as possible.

Use a soft clean cloth for cleaning the surface filter, control panel, etc. Do not use abrasive cleansers, chemical cleaners or solvents. Use glass cleaners or a suitable general purpose detergent.

- Periodically check the system hardware.

Inspect antennas and mounts, making sure all components are free of corrosion and mounted securely. Examine all cables for evidence of chafing or abrasions. Make sure connections to the ship's DC power and RF ground system are clean and tight. A light coating of a high insulation silicon grease (such as Dow Corning DC-4) on connector pins can protect the plug contacts from corrosion.

4.2 Replacing The Fuse

Your NAV 398 has its fuse protection in the power cable assembly. The fuse is a 2 amp fuse and protects the ship's DC power line in the event of an over current condition in the NAV 398. A replacement fuse is included with the spare parts kit supplied with your NAV unit.

If the NAV 398 will not turn "ON", the fuse should be checked and replaced, if necessary. The fuse is released from the fuse holder by gripping each end of the fuse holder assembly, slightly press the two sections together, and then apply a half twist counter-clockwise to the cap end. After replacing the fuse in the holder re-assemble the fuse holder by applying pressure in the reverse direction.

4.3 Replacing The Battery

Both the NAV 398 and the RAYSTAR 108 GPS sensor units contain internal memories to store your position and other set-up information. A lithium back-up battery keeps this memory information intact even when the units are disconnected from the ship's battery.

The estimated life span of the internal memory battery is from three to five years. If a battery should fail, the memory contents will be lost.

While both the NAV 398 and RAYSTAR 108 GPS sensor can be operated without their batteries, the 298 would not retain its waypoint memory, and the RAYSTAR 108 would require a time consuming cold start-up each time you use the units. This would be extremely inconvenient. To insure trouble-free operation, it is recommended that the battery be replaced every three years with an exact replacement lithium battery by your Authorized Raytheon dealer or by the Raytheon Factory Service Center.

4.4 Master Reset

The NAV 398 unit is a microprocessor based equipment, and like most computers, it runs smoothly and efficiently in normal use. However, under extremely rare conditions, (for example: during very low and intermittent DC input power conditions, such as while starting engines) the unit could "hang up" or "freeze". If this condition should occur, re-boot the NAV 398 with a Master Reset when the DC power condition has been normalized.

There are two types of Master Resets available:

- **Hard Reset -** Clears all waypoint memories and resets the unit to the default settings.
- **Soft Reset -** Only resets the default settings, but does not effect the waypoint memories.

Typical Default Settings:

Latitude Direction = North	Longitude Direction = West
Magnetic Variation = On	Position Corrections = Off
Averaging L/L = Med	Units = NM/KTS
Display Mode = "NAV 398"	Arrival Alarm = 0.10 nm
Backlighting = Off	Other Alarms = 0.00 nm

Hard reset only:

Waypoint Memories = 0 Route Plan Memories = 0

WPT Destination = 00 (No XTE bargraph or digits)

HARD RESET: Turn the unit to OFF with the PWR key. Press and hold the POS/1 key and press the PWR key to turn the unit ON.

SOFT RESET: Turn the unit to OFF with the PWR key. Press and hold the CDI/3 key and press the PWR key to turn the unit ON.

In each case following the reset, the NAV 398 display changes to **"Ent Lat"** screen of the the Auto Start-up sequence and will prompt you to re-enter the Latitude and Longitude initial position coordinates.

4.5 Troubleshooting Chart

SYMPTOM	CHECK
No Power Input	Check in-line fuse. If blown, replace with 2 Amp fuse.
Not Receiving SNR readings = 0	Check Sensor connections. Check Signal Status. Check Initial settings. Check Est. L/L entry. Check GRI is correct.
Lat/Lon reading does not change.	Check Est. L/L entry. Re-enter if error of more than 2 degrees.
Lat/Lon readings have constant error.	Check position corrections for invalid entries.
WPT BRG incorrect. DTG appears correct.	Check magnetic correction is ON. Check if ASF is ON; Is WPT correct?

4.6 SPECIFICATIONS

4.6.1 General

Memories:

Waypoint	500; Name WPTs w/8 characters.
Event Marks:	Saves to next available WPT memory. or user select, w/date stamp & Nav type
Waypoint Entry:	L/L, TDs,
Route Plans:	10 plans; up to 20 waypoints max.
Ships' Track:	300 point memory

Sensor Inputs:	Loran-C, GPS
Alarms:	Waypoint Arrival, Anchor Drift, Cross-Track-Error, Man-Overboard, "NO FIX" for poor signal inputs.
Data Output:	Single Port; NMEA 0180/0183 & SeaTalk; NMEA 0 183 includes GLL, GTD, VTG, APB, RMC , BWC, RMA, and RMB.
Data Output Rate:	Every 2 seconds for RMA or RMC, & RMB every 4 seconds for all other data.
Data Input:	From GPS Sensor; accepts NMEA 0183 GLL, VTG, RMC, GGA. From Loran Sensor; accepts NMEA 0 183 GLL, GTD, VTG,RMA, Data Input Port; NMEA 0183 WPL, RTE
Display type:	STN LCD, Dot Matrix 240 x 240dots
Display Backlighting:	FL panel
Memory Back-up:	Lithium Battery, 3-5 years
Input Voltage:	10-16 VDC
Power Consumption:	Less than 6 watts

4.6.2 Display Data

Latitude/Longitude:	N or S + 6 digits, .001 min. resolution E or W + 7 digits, .001 min. resolution
TD Pair:	6 digits, 0.1 us resolution, for each selected Time Difference.
Stations:	GRI and Selected Secondaries.
Satellite Data:	Sat ID, Azimuth, Elevation, SNR, HDOP
Waypoints:	Lat/Lon and TD coordinates displayed.
Bearing & Range:	Bearing & Range to waypoints, and between waypoints in a route plan.
Time-To-Go:	Remaining time to waypoint at current speed in hours and minutes.
Speed & Course:	SOG & COG calculated from L/L position changes; Averaging period selectable.
Receiving Status:	Tracking status, SNR, and ECDs of MASTER and selected secondaries.
Cross-track-error:	Shows distance off-course in 0.01nm increments.
Corrections:	1) Magnetic Variation, Auto/Manual 2) Position Offset (ASF) via: a. Auto DMA ASF program (Note: upgraded to most recent tables)

	b. Manual entry for L/L or TDs
Man-Overboard Mode:	Range, bearing, COG & SOG, and alarms for emergency search conditions.
Languages:	English, French, Spanish, Norwegian, Italian, German
Warning Indicators:	"ERR" for Low SNR, Blink, Cycle selection, no L/L solution. On-screen indicator and audible alert for Arrival, XTE, or Anchor Watch alarms.

4.6.3 Physical and Environmental

Operating Temperature:	0° to 50° C (32° to 122 ° F)
Weight:	1.4kg. (3 lb)
Dimensions:	11.05H x 195.5 W x 6.8D cm 4.35H x 7.7W x 2.7D inches

Specifications are subject to change without notice