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RAYSTAR 590 GPS NAVIGATOR

# "IMPORTANT NOTICE"

This device is only an aid to navigation. Its accuracy can be affected by many factors including equipment failure or defects, environmental conditions, and improper handling or use. It is the user's responsibility to exercise common prudence and navigation judgment. This device should not be relied on as a substitute for such prudence and judgement.

## **PURPOSE**

# THIS MANUAL CONTAINS IMPORTANT INFORMATION ON THE INSTALLATION, OPERATION, AND MAINTENANCE OF YOUR EQUIPMENT

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# SECTION I GENERAL INFORMATION

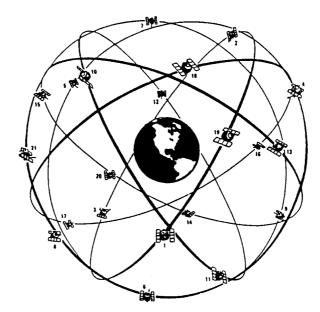
#### 1.1 INTRODUCTION

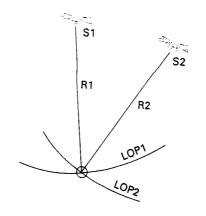
The Navstar/GPS system is a satellite-based radio navigation system designed to provide global, continuous 24 hour-per-day, all weather, accurate position data for navigators worldwide.

The GPS (Global Positioning System) is based on a GPS receiver's ability to accurately measure the propagation time of signals transmitted from orbiting satellites.

The satellites transmit accurately timed signals along with a navigation message which includes the satellite's position (orbit or ephemeris data), precise time (clock) correction signals, and almanac data for the complete constellation.

The Raystar 590 receiver measures time-of-arrival of each satellite signal, and together with the navigation message data, calculates the range to each tracked satellite. If the range to the satellites is known, then the position of your vessel can be determined by triangulation of the range data from a number of satellites simultaneously in view.





The complete constellation will consist of 21 primary satellites and three backups in 6 orbital paths. Four satellites will be in each path, separated in distance so that at least four satellites are able to be seen at any time from any point on the earth.

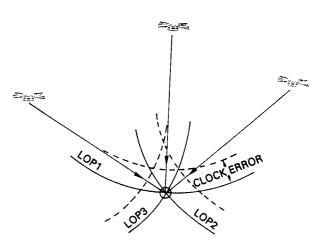
The satellites continuously broadcast their navigation messages at a frequency of 1575.42 MHz (for civilian use). The message is repeated every 30 seconds. Superimposed on the navigation message is a high rate C/A (coarse acquisition) code used for precise positioning measurements and positive satellite **identification**. The C/A ID code permits the user to determine and select the "best satellites" to use in position calculations.

If it were possible to measure "true satellite ranges" directly, it would only be necessary to track data from any two satellites to obtain a vessel's latitude/longitude.

In actual practice, for marine navigation, a minimum of <u>three</u> satellites are normally required to be tracked in order to eliminate the receiver's own internal clock timing bias error which is factored into the various range calculations.

The Raystar 590 tracks up to five satellites (when they are visible) and uses the best for position fixes.

By using four satellites the processor can determine the amount of clock errors in each range calculation. The bias is factored equally from each range solution until the LOP's intersect.



Continuous tracking of each satellite signal allows the receiver to perform this timing adjustment process and provide accurate range measurements to the satellite.

A number of different receiver design methods have been developed for performing the GPS acquisition and tracking function. The major differences in design are in the number of receiving channels and signal processing channels used in each receiver. The Raystar 590 uses high-speed multiplexed scanning in a single channel receiver. This design method provides fast efficient acquisition and accurate position determination.

Logically grouped Silicon Rubber keypads provide positive control while the LCD display gives navigation information using large, easy-to-read characters.



The Navigate-Position mode shows position in Latitude/Longitude, the symbol and name of a destination waypoint, as well as own vessel's course and speed.

The Navigate-Plot mode shows waypoint location with symbols, own vessel's track, and Events marks along the track.

The CDI (Course Deviation Indicator) display gives a steering guide to keep you on-course to your waypoint destination.

With its intelligent on-screen user prompting, the Raystar 590 will provide you with many pleasant years of safe and dependable GPS navigation.

# 1.2 GENERAL SPECIFICATIONS

Receiver type

: Hi-Speed Multiplex

Frequency

: 1575.42 MHz +/-1MHz (C/A code), L1

Sensitivity

: -143 dBm

Dynamic Range

: 25 dB

Signal Acquisition

: Automatic and Computer controlled

Time of first fix

: 3 minutes (max); less than 2 min typical

Maximum dynamics

: Velocity 300 km/hr (162 knots); acceleration,

5 meters/sec

Maximum No. of tracked

satellites

: 5

Almanac update

: Automatic

Fix update rate

: 1 per second

Accuracy \*(demonstrated)

Position

: 15 m RMS (L1, C/A code, HDOP < 2.5 without SA)

Speed

: 0.2 knots RMS (L1, C/A code, HDOP < 2.5 without SA)

\* Accuracy figures may vary in accordance with final DOD GPS system specifications for civilian use, when SA (Selective Availability) is fully implemented.

Compass variation

: Automatic / Manual

Antenna

: L1, Circularly polarized

Digital outputs (6pin)

: "Data out 1" ----NMEA0180, NMEA0183, JRC selectable

: "Data out 2" ----NMEA0180, NMEA0183, JRC selectable

Ext Buzzer out/Event mark

input (4pin)

: External buzzer output (contact closure)

: External event mark input (Protect available)

Memory back-up

: Internal battery

Power supply

: 10 to 40 VDC (floating) (10W)

Display

:  $101 \times 82$  mm (128 × 160 dots) STN LCD

Back lighting

: Provided by Green, EL panel (LCD Lamp)

Set by keyboard High or Low

LCD contrast

: Setting via keyboard

Keyboard

: 23 keys (Silicone rubber)

Map scale

: 1, 2, 5, 10, 20, 50 and 100 NM

Plot points

: 300 points

Memory interval ......

Time:

30 sec., 1min., 3min., 5min.,

10min., 30min., OFF

Distance:

0.2NM, 0.5NM

Auto start/stop:

freeze at below 0.03' (lat/1on)

Waypoints (Event Marks): 500 memory locations; (up to 100 event marks can be

stored and protected).

Waypoints can be named using up to 49 alphanumeric characters and symbols. Name is limited to 16 characters

in two rows.

Console mounting kit

: Option

Construction

: Meets USCG waterproof standards

Displayed Data

Type of data

Lat/Long

: N or S + 6 digits, .01 min resolution

E or W + 7 digits, .01 min resolution

(0.001 min for present lat/Long position)

Height

: 4 digits, 1 meter resolution.

Waypoints

: L/L displayed. Auto route sequencing available.

Bearing & Range

: Bearing & Range to waypoint

Trip Distance

: Total distance from present position to end of route.

Time to Go

: Remaining time to WPT at current speed

Speed & Course

: 1) 0.1kt/Course = 1° resolution

2) Velocity towards destination

3) Velocity along route

4) Course made good

Cross Track Error

: Cross track error from current route.

Time Functions

: Standard clock with date/time in UTC or Local; Stop watch,

Timer. Continuous operation via internal battery.

Corrections

: 1) Magnetic Variation, Auto/manual

2) Position offset via; Manual/Auto entry for L/L

Alarms

: Arrival, Anchor, XTE, Boundary, 2D FIX, NO FIX

Memory Protection

: Internal memory protected by battery for about 3 years.

#### Mechanical:

Main Unit : Type NNN-4110R

Rear Panel Connections: A) Power Connector, 2 Pin

B) Data output, 6 Pin

C) External Buzzer/Event mark, 4 Pin

D) Antenna RF Connector

E) Ground, Wingnut + Screw

Dimensions :  $13.4 \text{ H} \times 21.2 \text{ W} \times 9.4 \text{ D} \text{ cm} \text{ (less mounting yoke)}$ 

 $(5.3 \text{ H} \times 8.4 \text{ W} \times 3.7 \text{ D inches})$ 

Weight : 2.0 Kg Approximately

Temperature :  $0^{\circ}$ C to +  $50^{\circ}$ C ( $32^{\circ}$ F to + $122^{\circ}$ F)

Antenna Unit : Splash/Sprayproof design

Cable Type : 5D-2V, 50 ohm co-axial, white pvc

Cable length : 15 meters (49 ft)

Dimensions : 197 H  $\times$  108 W mm (7.7"  $\times$  4.2")

Weight : .4 Kg (without cable)

Temperature : -25°C to +70°C (-13F to +158F)

# SECTION II INSTALLATION

Although your Raystar 590 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 installation of the Raystar 590 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 the interior packing material until the unit has been satisfactorily 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

Table 2.1 indicates a listing of items that are included with your New GPS. If you are missing any items, please notify your dealer immediately.

Item No.	Description	Q'ty	Туре	Remark
1	Receiver Indicator	1	NNN-4110R	
2	Antenna with 15m (49ft) Coaxial Cable	1	NAY-4110R	
3	DC. Power Cable	1	CFQ-3598	
4	RF Connector	1	N-P-5 SJAAE 00051	
5	Spare Part Fuse (2A)	1	MF60NR-2A 5ZFADOC	2015
6	Self Bonding Tape	1	9645	
7	Yoke for Raystar590	1	MTD005120 ✓	
8	Yoke Knob	2	MPTG02440	
9	Instruction Manual	1	DC51-JLR-4110R 🗸	
10	Bridge Card	1	DC81-JLR-4110R	
11	Connector, 4 Pin-Data	1	G263129-17	
12	Connector, 4 Pin-Aux	1	G263129-10	

**Table 2.1 Equipment Supplied** 

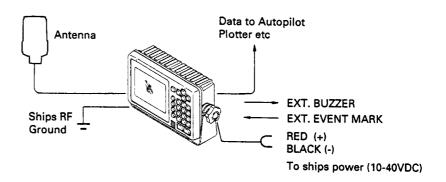


Figure 2.1 Typical System Diagram

## 2.2 RECEIVER INSTALLATION

## 2.2.1 Mounting the Receiver Unit

The most important considerations for mounting the receiver will be:

- A. To choose the best location for operation and viewing.
- B. Best protection afforded to the GPS unit from the environment.
- C. Furtherest separation from interference sources.

Typically the GPS receiver can be mounted in its yoke assembly to a chart tabletop, suspended from an overhead location, or attached onto a bulkhead.

In fact, the unit is so compact that you may choose to flush mount the unit using the Optional Console Mounting Kit M95972.

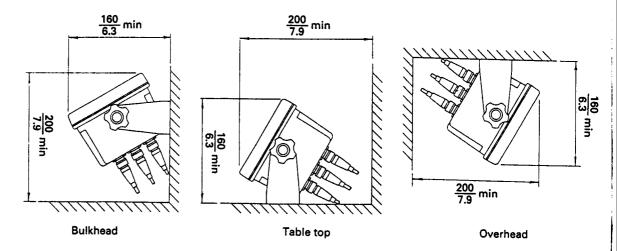
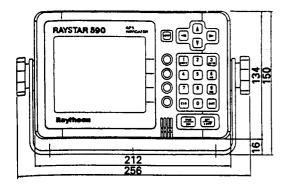
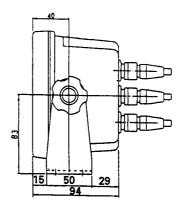


Figure 2.2 Recommended Minimum Clearances for Yoke Mounting





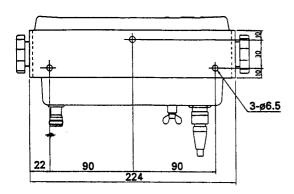


Figure 2.3 Outline Dimensions

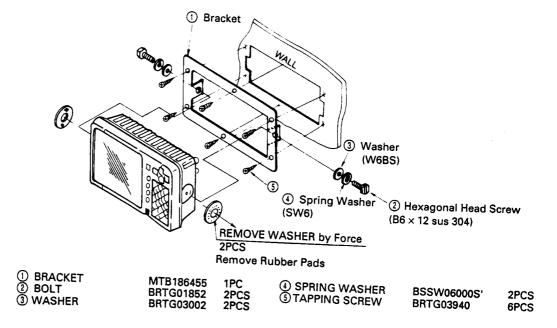


Figure 2.4 Console Mounting Kit. M95972

# 2.2.2 Console Mounting

1. Select the location for the GPS. A clear, <u>flat area of at least</u> 10 1/2" wide by 7 1/2" high having at least 7" of clear depth behind the panel is required.

#### CAUTION

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

- 2. Unpack the trim ring kit and confirm that all hardware is present.
- 3. Place the ring on the desired location on the panel. Using the inside of the ring, trace a cut-out guide. Remove the ring.
- 4. Drill a pilot hole inside of the cut-out guide area.
- 5. Using an appropriate saw, cut along the outside of the cut-out line.
- Remove the yoke knobs, the yoke, and the plastic spacers from the GPS cabinet.
   Check that the GPS will fit into the cut-out area.
- 7. Install the power and antenna coupler cables in the console.
- 8. Slip the trim ring onto the GPS from the rear. Make sure the rounded tabs face the rear of the GPS.
- 9. Install the GPS using the clamps and hardware supplied in the kit. A suitable sealant may be used between the trim ring and console to prevent moisture entry. The trim ring should be secured to the console with the countersunk flathead

screws.

10. Connect the power and antenna cable.

#### 2.3 INSTALLING THE ANTENNA UNIT

#### 2.3.1 Determining the Location

In general, the GPS antenna needs to be located in an area that is completely clear of obstructions of any type so it can receive signals from the satellites directly and without interference or re-radiation of those signals from surrounding structures. You may determine the best antenna location by selecting a mounting site that meets the following criteria as closely as possible:

- 1. The location should be at a high point on the vessel and have as clear a view from horizion to horizion as possible.
- 2. The location should be separated away from;
  - a. All High power Transmitting antennas
  - b. The radiation plane of any shipboard radars.
  - c. 15 feet from any INMARSAT antenna
  - d. 10 feet from any DF loop antennas

If an ideal site cannot be determined you might have to make some compromises in selecting the best possible location. It may be best to temporarily hook up the antenna and test the unit for reasonable performance in the intended mounting position before permanently siting the antenna unit. A poor location can result in intermittent reception, which increases the time for a position fix and dilutes the accuracy.

# 2.3.2 Mounting the Antenna Unit

The antenna unit is a very compact (9") and lightweight (less than 1 pound) unit. The Raystar 590 is provided with 15 meters (49 ft) of 50 ohm 5D-2V co-ax cable to complete the typical GPS installation. If additional cable is required to reach between the antenna and receiver units, RG-10/UY (or equivalent) 50 ohm low loss cable should supplement the supplied cable. If the overall length is greater than 20 meters, the 5D-2V cable should be cut approximately 1 meter from where it exits the coupler bottom, and a waterproof in-line Type N connector should be fixed to the cable end. Then low-loss heavy-duty RG-10/UY cable should make up the additional length needed.

The maximum recommended cable length is 50 meters (150 feet). Figure 2.5 shows the layout and dimensions for the antenna unit.

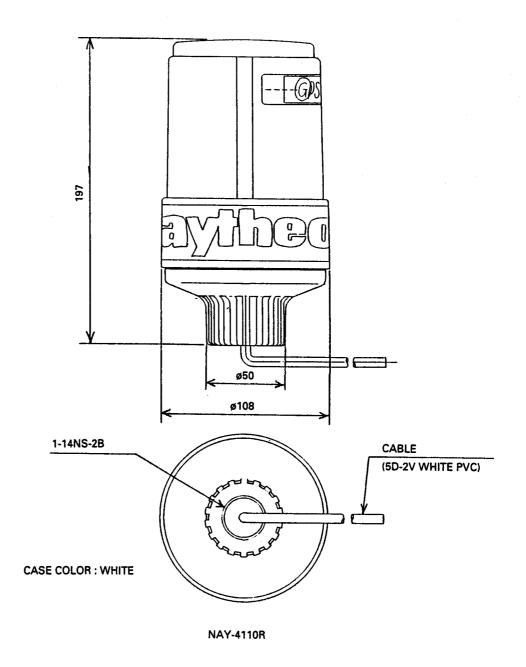
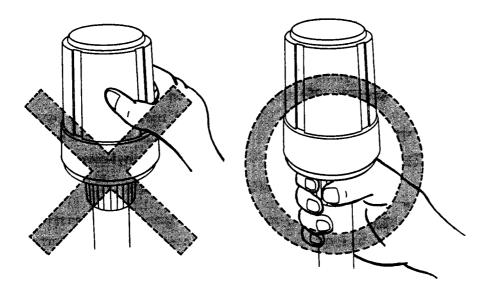


Figure 2.5 Antenna Installation Data



When mounting the antenna on an extension mast or mount, care should be taken so that the cable is not twisted unnecessarily. It may be easier to screw the extension mast or mount into the antenna after the cable has been passed through. It is recommended that the antenna be hand tightened by it's base or may be snugged up using the correct size pliers with the jaws protected.

Figure 2.6 Proper Method for Tightening the Antenna

#### 2.3.3 Completing the Cable Run

The Raystar 590 is provided with 15 meters (49 ft) of 50 ohm 5D-2V co-ax cable to complete the typical GPS installation. Also packaged with the unit is one N-P-5 RF connector to be installed at the end of the cable after the cable has been installed.

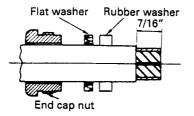
In general, when installing the cable, the cable should be run separately from other ship's electrical cabling, to avoid picking up mutually coupled interference from the other cables.

The cable should run as directly to the equipment as possible and, with the exception of a small amount of slack at each end for service requirements, any extra cable should be cut off. The cable should be supported along its length with adequate cable clamps or tyraps.

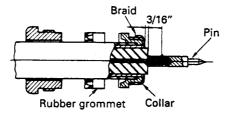
If the required cable length is greater than 50 feet, RG-10/u cable (or equivalent) may be used up to a maximum recommended length of 150 feet. Suitable "N" type connectors for use with RG-10 sized cable should be used.

# 2.3.4 Installing the Antenna Connector

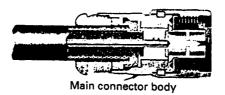
The following instructions are provided to assist you in the assembly of the N-P-5 RF connector.



Prepare the cable by removing 7/16" of the vinyl covering. Slip the end cap nut and washer over the jacket as shown.



Fold back the shield and remove 3/16 to 1/4" of the dialectric from the cable end. Fold the shield forward and install the rubber grommet and collar as shown. Dress the shield back over the collar. Solder the pin onto the center conductor.



Install the main connector body onto the cable assembly gently and screw the end cap nut into the connector body.

After installing the connector, check the connection with an ohmeter for an "open" or "Short circuit" condition.

#### 2.4 CONNECTIONS

Figure 2.7 shows the location of the various rear panel connectors on the Raystar 590 receiver unit. The individual connections made to each receptacle are covered in the sections that follow.

#### IMPORTANT INFORMATION

The antenna unit requires 5VDC from the GPS power supply to operate the preamplifier in the antenna. This voltage is supplied through the coax cable to the antenna unit. To protect the GPS power supply, it is recommended that before connecting the antenna cable to the connector on the GPS chassis, that a check with an ohmmeter should be made to assure that there is no short circuit or open connection to the antenna unit. A properly made connection will measure 50 ohms (approximately) between the center conductor and the outer shell of the connector.

#### 2.4.1 Antenna

After checking antenna cable as per above information, connect to ANT connector on rear panel of Raystar 590.

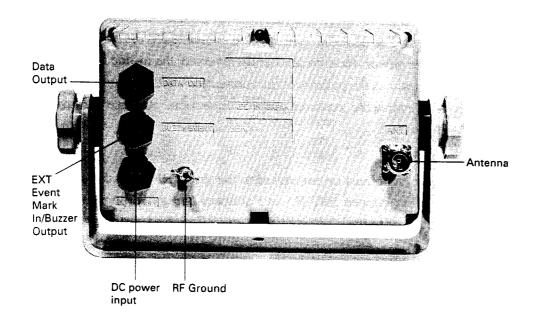
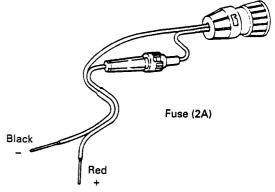


Figure 2.7 Cabling Diagram

#### 2.4.2 Power Input

The Raystar 590 can operate as long as the DC supply is maintained between 10 and 40VDC.



Power cable CFQ-3598

A 6 foot power cable assembly is supplied with your GPS unit. In most cases this will be adequate to reach the source of DC power.

The power leads should normally be routed to the ship's DC power distribution panel on larger boats. The GPS is fused at 2 amps, so connection to a 5 amp or (maximum of) 10 amp circuit breaker is recommended. On smaller vessels the power leads may be connected directly to the main battery isolation switch or breaker.

Although the GPS's power consumption is only 10 watts, if the power cable leads need to be extended more than 10 feet, the wire size of the leads should be increased accordingly to minimize line losses. For runs of 20-30 feet #12 AWG is recommended.

Observe proper polarity! The RED wire must be connected to the Positive (+) source terminal; The BLACK wire must be connected to the Negative (-) source terminal. If the power leads are accidently 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.

#### 2.4.3 Grounding

This equipment must be connected to the ship's RF ground system. Use the shortest possible copper BRAID and connect the grounding terminal of the receiver/processor to the closest point of the RF ground system.

## 2.4.4 To Assemble the Watertight Connectors (6 Pin and 4 Pin)

- 1. Feed the end of the cable through the backshell, rubber grommet and coupling ring in the order and position shown in Fig. 2.8.
- 2. Strip cable as shown in Fig. 2.9 and begin soldering conductors to pins of the connector as required and shown in the following tables and diagrams.
- 3. Slide the coupling ring over the body of the connector and beyond the locking projections on each side. It may be necessary to rotate the ring for it to pass by the tabs.
- 4. Push the rubber grommet forward as far as possible to seat snugly against the connector body.
- 5. Push the back shell all the way forward. It must first compress the grommet, then be twisted over the (2) locking posts on the connector body. This is a tight connection. For leverage, it may be helpful to first insert and lock the connector into its mating plug on the GPS back panel.

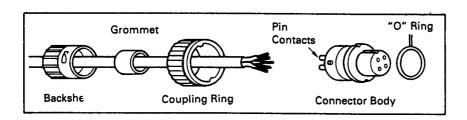


Fig. 2.8 Assembling the Connectors

Cable Stripping Dimensions

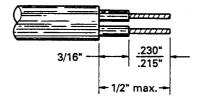


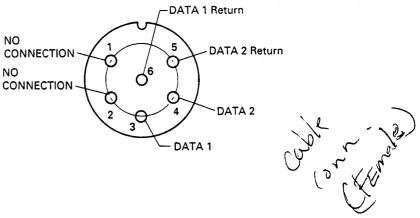
Fig. 2.9

#### 2.4.5 Interface to External Navaids

When using NMEA 0183 format, the Raystar 590 can provide data for up to 3 receivers or up to 5 receivers when using NMEA 0180 at one time for each output (DATA 1 or DATA 2).

Be sure that all devices connected to the same data port (autopilots, plotters, video sounders, radars) are using the same data format. The 6 pin connector on the rear panel is designated for this purpose.

#### Do NOT ground the data or data return lines at the receivers.



6 Pin Connector G263129-17

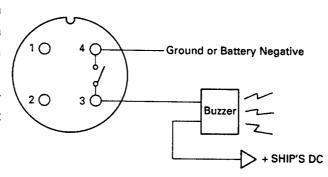
Pin No. DATA OUT CONNECTOR	
1 NO CONNECTION	
2 CHASSIS GROUND	
3	"DATA OUT 1"; NMEA0180, 0183, JRC
4	"DATA OUT 2"; NMEA0180, 0183, JRC
5 DATA OUT 2-RETURN	
6	DATA OUT 1-RETURN

#### 2.4.6 External Alarm

The Raystar 590 can operate an external buzzer alarm through the 4 pin connector on the rear panel designated for this purpose. Devices connected to this

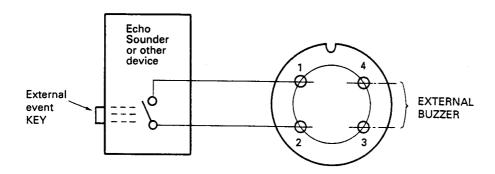
output are limited to an operating voltage of less than 24 VDC and a maximum current of less than 100mA.

A 12VDC self oscillating buzzer can be obtained at most electronics parts stores.



#### 2.4.7 External Event Mark

The same 4 pin connector is used to accept an input of an external event mark from a fishfinder such as the Raytheon V720, V820, or V860 Video Echo sounders. When the signal is received at the GPS, the ships present position will be "saved" into one of the temporary memories (400 to 499) as a waypoint. You can transfer this event location later into one of the GPS's permanent memories, if you desire, whenever time permits.



Pin NO	Buzz/EVENT CONNECTOR	
1	External Event input	
2	Ground	
3	External Buzzer output	
4	Ground	

The external event mark input signal is a contact closure for ground. Do not input more than 5 VDC onto the connection.

#### A. Outputs

The Raystar 590 has two data output available on the rear panel at the 6 pin connector. These outputs can produce NMEA 0180, NMEA 0183, or JRC Serial Data formats. The type of data available at each port is assigned in the Special Function mode (SF). The procedure is as follows:

① Selection for "DATA 1" output

Press MODE

Press NAVIGATE

Press SF

Press DATA

Press DAT 1 until the desired data format is highlighted

Press ENT

0180, 0183 or JRC will appear successively on the screen after pressing **DAT 1** key. As delivered from the factory the unit is set for NMEA 0183 data output.

② Selection for "DATA 2" output

Press MODE

Press NAVIGATE

Press SF

Press DATA

Press DAT 2 until the desired data format is highlighted

Press ENT

In the NMEA 0183 data outputs at "DATA 1" or "DATA 2" the sentences sent are RMC, RMB, VTG, BWC, GLL, XTE, and APB.

RMC — GPS navigation information

RMB — Generic navigation data

VTG — SOG/COG

BWC — Great circle, bearing and distance to destination

GLL — Present position fix

XTE - Cross track error

APB - Autopilot data

# SECTION III OPERATION

#### 3.1 INTRODUCTION

Operation of the Raystar 590 GPS Navigator is easy and straightforward because of the use of numerous prompts and English menus. The approach you should take in becoming familiar with its operation in one of relaxed confidence. The unit is "user friendly", and you will master it quickly.

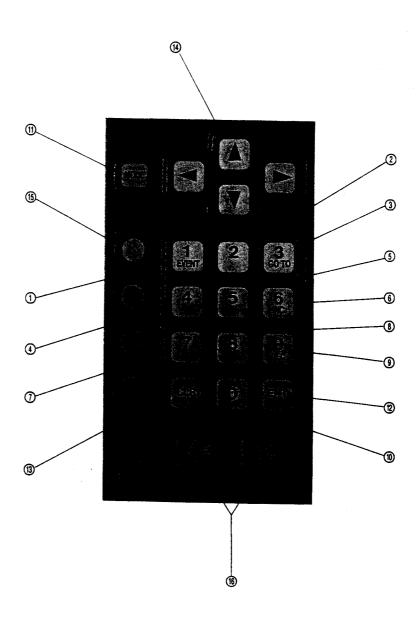
This section of the manual is organized to take you through the basics first. As you progress through this section, take the time to practice each function of your Raystar 590. Study the illustrations and repeat the operations until you're comfortable and confident. Time spent in becoming familiar with the unit will strengthen your knowledge and skill in using this full featured GPS Navigator where it counts ----- afloat.



Figure 3.1 Raystar 590 Controls and Indicators

# 3.2 THE KEYBOARD

# A. Key Layout



#### B. The Keyboard

The following table lists the Raystar 590 keys.

Operation

- Selects the digit "1" or Stores an instant waypoint at present position (WPT 400 499)
- ② 2 Selects the digit "2"
- 3 Selects the digit "3". Sets route from current position to selected WPT
- 4 Selects the digit "4"
- 5 Selects the digit "5"
- 6 Selects the digit "6". Increases plotter Range, Contrast, or inserts a waypoint into a Route
- 7 Selects the digit "7"
- 8 Selects the digit "8"
- 9 Selects the digit "9". Decreases Range, Contrast, or deletes a waypoint from a Route
- ① Selects the digit "0"
- 1) MODE Selects the operating mode
- 12 ENT To enter data
- (13) CLR Clears erroneous data entries
- Moves the cursor or scrolls waypoints
- (§) © © © Select menu (soft key) items; "Man-over-board" function
- Turns power ON or OFF, DIM key for backlight (high/low)
  CONT sets LCD contrast level.

#### 3.3 OPERATION

#### 3.3.1 Turning the Unit On and Off

To turn "ON", press the **PWR** key (hold down for about 1 second). To turn "OFF", press  $\frac{PWR}{DIM} + \frac{OFF}{CONT}$  keys together.

#### 3.3.2 Contrast Adjustment

- 1. To adjust the contrast level, press the OFF key.

  The contrast instruction menu will be displayed.
- 2. Press the  $\frac{6}{|NC|}$  or the  $\frac{9}{|DEC|}$  key to change contrast for best visibility.
- 3. Press OFF again to remove the contrast menu.

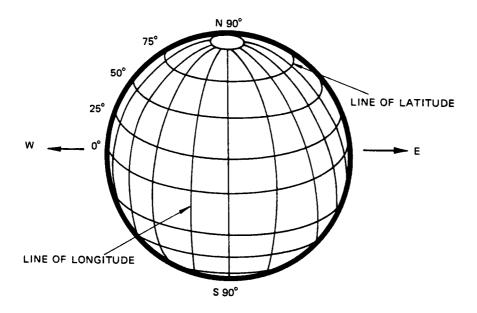
#### 3.3.3 Backlight

The keyboard can control the choice of either high or low display backlighting. Press PWR to select high level or low level lighting, alternately.

#### 3.4 INITIALIZING THE GPS

Your GPS will be set up for fully automatic operation once you have entered the following pieces of information. Your vessel's approximate geographical position in latitude and longitude within 1°, your antenna height, and the UTC date and time. Once you've entered this information into the GPS, the GPS will "remember" the entries, so that the next time you use the GPS, the only thing you'll have to do is just turn it "on". In a few minutes your position will be displayed.

NOTE: Latitude lines run from East to West on a chart. Longitude lines run North to South.

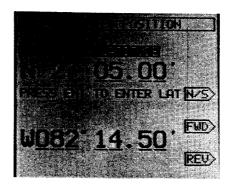


#### 3.4.1 Entering Estimated Position

When you turn on your GPS for the very first time the "Estimated Position" entry page will be displayed. If the vessel has moved some distance without turning on the GPS, you may need to re-enter the initial position.

- A. Press the **MODE** key. The mode menu appears.
- B. Select SATELLITE STATUS (Press the soft key)
- C. Press **EST** Key at Signal Status Display.

You will then see this display.



To enter you estimated position, just type in the latitude and longitude values using the corresponding numeric keys for your latitude first; followed by your longitude numbers.

#### Position:

D. To enter Latitude; enter the digits with the numeric keys.

EX: Press 4,0,0,0,0,0 for N 40°00.00', ENT .

Before you press the  $\boxed{\text{ENT}}$  key, be sure to check that the direction symbol is correctly indicated for your position. If not, press  $\boxed{\text{N/S}}$  for "N" or "S" if necessary.

If you make a mistake.....

Just press the FWD or REV keys to move the blinking underline cursor to fix errors. You can also press the CLR key to restart the entire entry.

E. To enter Longitude; enter digits with the numeric keys.

EX: Press 0,7,1,0,0,0,0 for W 71°00.00', ENT .

If you are entering the longitude, press W/E for "W" or "E" if necessary. Also, check that your estimated position entry is within 1° of your actual position.

NOTE: For longitudes less than 100° you must begin the entry with a "0".

#### Antenna Height:

F. To enter antenna height the antenna height above sea level is entered in meters (3.28 ft = 1 meter)

EX: 3 for 3.0 meters

If you make a mistake...

The **CLR** key can be used to restart the entry.

#### Time:

To enter UTC date and time; enter the digits with the numeric keys. First enter year, month, and date;

EX: 9, 1, 0, 1, 2, 0 ,ENT, for 1991 January 20.

Followed by the time UTC (GMT) in hours and minutes.

EX: 1, 0, 4, 0, ENT, for 10:40.

If you make a mistake...

Just press the FWD or REV keys to move the cursor prompt to fix error. You can also press the CLR key to restart the entire entry.



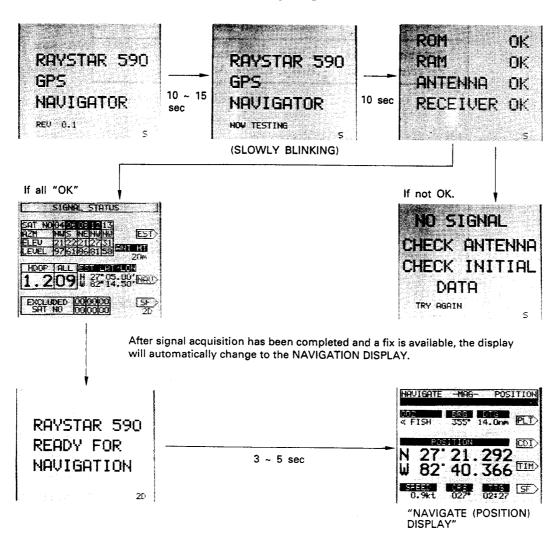
When **ENT** is pressed following the UTC date and time entry, the display resets to the normal "Auto Start up Sequence".

#### 3.4.2 Auto Start-up Sequence

Once you have entered your estimated Lat/Long position, the Raystar 590 will begin operation at each power up with an automatic testing program just to assure that everything is in order for normal operation. If during the self check any abnormal condition is detected, a message will be displayed on screen.

If all tests are good, in 1 to 3 minutes the normal navigation-position display will appear.

#### Display Screens for the Auto Start-up Sequence



Each time you turn the Raystar 590 on, the GPS will run through the Auto Start Up Sequence. This program can be interrupted anytime by pressing the **MODE** key, and selecting the desired display mode.

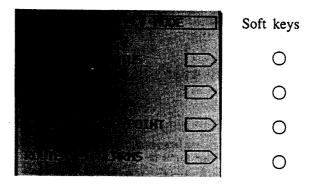
#### 3.4.2.1 Abnormal Self Test Results

If the Self Test results indicate a "No Good" (NG) condition, the table below provides some hints to locate the possible fault.

INDICAT	NOI	REMEDY	
ROM	NG	Try "Master Reset" (page 3-15) Return for service	
RAM	NG	Try "Master Reset" (page 3-15) Return for service	
Antenna	NG	Check antenna connection (See section 2.3.4)	
Antenna Receiver	NG NG	Check Estimated Position Entry, Check Antenna	

#### 3.4.3 Selecting The Operating Modes

Press MODE The "Select mode" page appears as shown below.



The four main operations of the Raystar 590 appear on the display when the **MODE** key is pressed. You can select any of these operations by pressing the corresponding key at the right of the display panel.

The Satellite Signal Status display is used to check on the receiving conditions for the signals being tracked by the GPS.

You can use the SF (Special Function) softkey to access (less frequently used) set-up functions.

This is the normal Navigation operating mode. You can select Position Data, Plot, or CDI and perform normal navigation operations from any of these displays.

You can use the SF (Special Function) softkey to access (less frequently used) set-up functions.

This operating mode is reserved for storing waypoints into memory. You can name, store, copy, protect, erase and list waypoints in these displays.

This operating mode is used to make, edit, or designate a route plan to follow forward or backward. You can set Arrival, XTE, Anchor Limit or Boundary Alarms here.

SATELLITE STATUS

**NAVIGATE** 

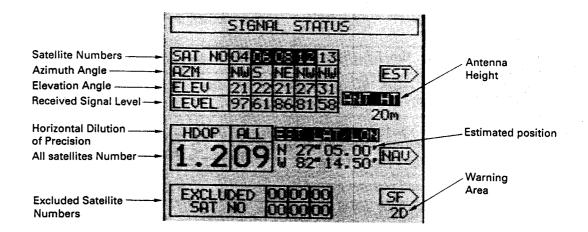
STORE/LIST WAYPOINTS

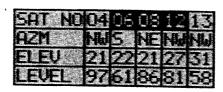
ROUTE/SET ALARMS

Any time you find that you have chosen a set-up menu in error, don't panic, just press the **MODE** key to get back to the desired operating pages.

The paragraphs that follow review these four basic mode operations thoroughly. We will begin with the "Satellite Status" mode. Press the **SATELLITE STATUS** softkey for the following display:

#### 3.5 SATELLITE STATUS MODE





The Satellite Signal Display shows you the receiving conditions for GPS.

The received Satellite numbers appear in the top row. The Satellite numbers being used to calculate your Position are highlighted.

The second row shows the Azimuth Angles of the received satellites.

The third row shows the Elevation Angles of the satellites.

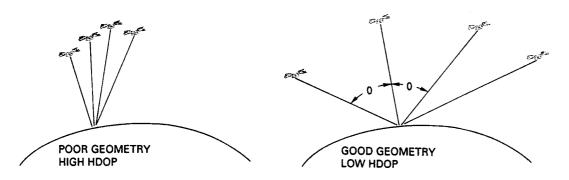
The fourth row shows the received signal levels (SNR's) of the satellites.



The box area along the middle of the display shows the HDOP (Horizontal Dilution of Precision) and the total number of Satellites "In Use" in the GPS system.

The HDOP (Horizontal Dilution of Precision), is a measure of the expected navigation fix accuracy.

This HDOP is based on the geometry of the satellites position relative to the user. Good geometry (wide spacing) will yield a small HDOP value, thus a more accurate position fix. Conversely, poor satellite geometry (close spacing) yields a large HDOP number, and a less accurate position fix. For simplicity purposes, we can equate good satellite geometry to good Loran C crossing line angles. The greatest accuracy occurs when the lines cross each ofher at 90 angles.



#### HORIZONTAL DILUTION OF PRECISION (HDOP)

During the GPS system build-up period, there may be periods each day when few satellites are in view or periods when several satellites are in view with poor geometry. The Raystar 590 can be programmed to provide navigation fixes based on a pre-determined HDOP accuracy level.

There are 3 selections of HDOP sensitivity;

Fix	Quality	HDC	<u>P</u>	
1	FINE	Less	than	5
2	MEDIUM	Less	than	10
(3)	COARSE	Less	than	20

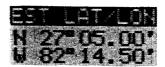
During the GPS system build-up phase it is recommended that the Raystar 590 be set to the "MEDIUM" level. Once the full world wide coverage is in place, then the "FINE" level setting should be selected.

The area along the bottom of the display shows any excluded Satellite Numbers. Occasionally a GPS satellite may develop a temporary technical problem where erroneous navigation data may be transmitted. Under these conditions, the satellite is judged "unhealthy" and advisories are issued in "Notice to Mariners" to avoid the use of the "unhealthy" satellites.

The Raystar 590 will automatically exclude a satellite that is set "unhealthy" by the GPS system office. However, in the event that this does not occur, you can manually de-select visible satellites at any time in the Special Function mode of the Satellite Status display.



The Estimated Position entry is also displayed for your convenience to confirm that the entry is correct for your location. If you should trailer your boat several hundred miles, the Estimated Position entry may need to be updated in order for the GPS to find your new position.



Pressing the soft keys next to the arrows will select the next display for you.

#### \*\*\*\*\* SATELLITE STATUS LAYOUTS \*\*\*\*\*

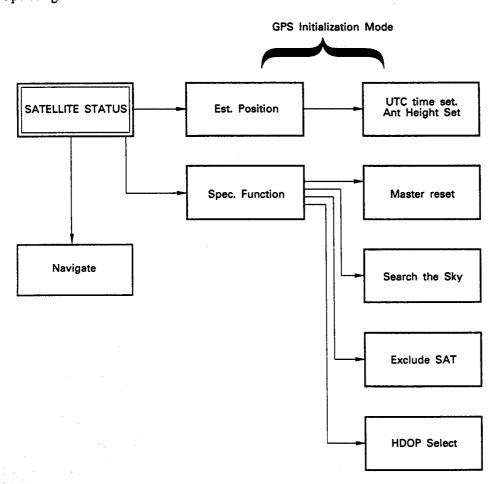
The Satellite Status Display has three menu keys on the display right edge. They are:

(1) **EST** : This key selects the Estimated Position display used to enter your initial position, your antenna height, and UTC time.

(2) NAV : This key takes you directly to the Navigate-Position display.

(3) SF>: This key selects Special Functions to change set-up conditions.

The diagram below shows the pages that are part of the Satellite Signal Status Operating Mode.



#### 3.5.1 The EST Key

When the EST key is pressed you are in the Initialization Mode of the GPS. To edit your Estimated Position, UTC Time, or Antenna Height see Section 3.4.1 on page 3-5 of this manual for instructions.

#### 3.5.2 The NAV Key

Pressing this softkey places the Navigate-Position display on the screen. NAVIGATION MODE is explained in Section 3.6 page 3 - 18.

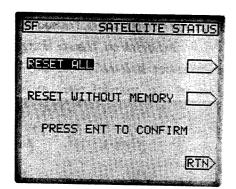
## 3.5.3 Satellite Status - Special Function

The SF (Special Function) key directs you to a mode that you will use very infrequently, but which contains some important operations.

They are Master Reset, Search the Sky, HDOP Select, and Exclude Sat (ellites). Press SF for the Special Function display.

SF	SF	TELLIT	E STE	TUS
MASTER	RESE	Γ	Г	\ \ \
SEARCH	THE (	SKU	F	$\equiv$
			L -	—/ 二
HDOP S			L	>
EXCLUD	e sat			$\Rightarrow$

- (1) MASTER RESET: This operation can reset the GPS to the "Factory set-up" condition, or may be used to reset the processor without effecting the Waypoint or Route memories.
- (2) **SEARCH THE SKY**: This operation collects all satellite orbit information.
- (3) **HDOP SELECT**: This operation selects "HDOP Mode" and "Ant Mode".
- (4) **EXCLUDE SAT**: This operation excludes visible satellites with manual exclusion.



#### A. Master Reset

Clears all waypoints from memories

Press MASTER RESET, ENT,

the Master Reset display appears.

If you wish to clear all waypoints and Route Memories.

Press **RESET ALL**, **ENT**.

If you wish to reset the GPS's processor without all waypoint and Route Memories.

Press **RESET WITHOUT MEMORY**.

If you press the MASTER RESET key accidently, and wish to escape, press the CLR key.

#### B. SEARCH THE SKY

When a Master Reset has been executed, all the satellite orbit information currently stored will be erased from the memory. New satellite orbit information must be downloaded from the satellites for current position calculations.

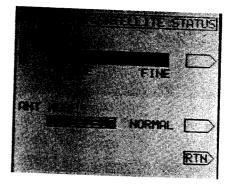
To refresh the orbit information in the Raystar 590:

- 1. Press the **MODE** key for the main menu.
- 2. Select "Satellite Status"
- 3. Press the **SF** softkey.
- Press the SEARCH THE SKY softkey.
   "Collecting" will be displayed on the screen. (This process may take up to 30 minutes.)

# C. HDOP SELECT $\varepsilon$ ANT MODE

- 1. To change the quality of the fix data (HDOP)
  - a. Press the **MODE** key for the main menu.
  - b. Select Satellite Status.
  - c. Press the **SF** softkey.
  - d. Press the **HDOP SELECT** softkey.

The "HDOP SELECT" display appears:



There are 3 selections of HDOP sensitivity;

To select "HDOP LEVEL"; Press  $\bigcirc$  repeatedly for choice. (COARSE  $\rightarrow$  MED  $\rightarrow$  FINE)

Fix Quality	HDOP VALUE			
① FINE	Less than 5			
② MEDIUM	Less than 10			
③ COARSE	Less than 20			

When the desired HDOP level has been highlighted, press RTN to return to the Satellite Status display.

#### 2. ANT MODE

To select "ANT MODE" 2D Select or NORMAL

Press ANT MODE

Press **RTN**: Return to "SATELLITE STATUS" display.

NOTE: In the case of "2D SELECT", it is necessary to enter the accurate antenna height.

"2 D SELECT" is recomendable when use this equipment on board.

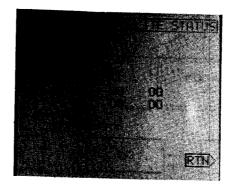
#### D. EXCLUDE SAT

You may deselect visible satellites which are judged to be emitting unreliable signals due to a malfunction. You can exclude up to six satellites from which reception of signals should be inhibited.

When the full satellite constellation is available in 1991 and the older test satellites are retired, this function will be rarely needed.

- 1. Press the **MODE** key for the main menu.
- 2. Select "Satellite Status".
- 3. Press the **SF** softkey.
- 4. Press the **EXCLUDE SAT** softkey.

The "EXCLUDE SAT" display appears:

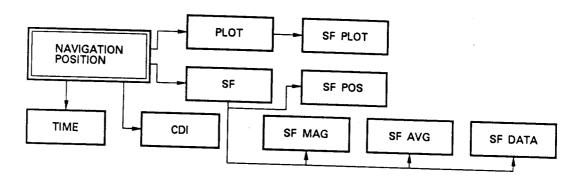


- 1 To set the number of Exclusion Satellite: 02. Press 0, 2, ENT
- ② To modify the number of satellite just use the ⊲⊳/\(\preceq\) keys to position the cursor at the location of the number you want to fix, and then type the correct value.
- Press RTN to return to the "SATELLITE STATUS" display.

## 3.6 NAVIGATION MODE

"NAVIGATE" is the main operating mode that you will use most of the time on your Raystar 590. In "NAVIGATE", you can choose to see digital "Position Data" or a Track Plot with Position Data, or a CDI (Course Deviation Indicator) Mode. Each type of navigation display is available by pressing one of the keys at the right of the display panel.

The diagram below shows the "NAVIGATE" functions with its four main displays and SF (Special Function) pages which permit the set-up of conditions which effect navigation.

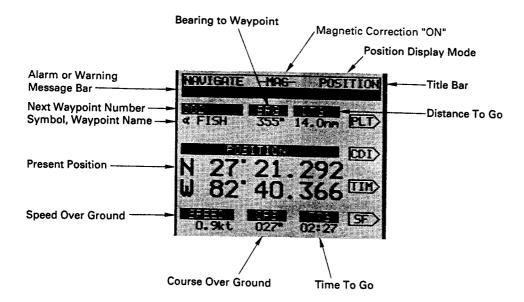


\*\*\*\*\* NAVIGATION MODE PAGE LAYOUTS \*\*\*\*\*

# THE FIRST NAVIGATE DISPLAY IS NAVIGATE-POSITION.

Press MODE and Select "Navigate", and the Navigate-Position display appears.

#### 3.6.1 Navigate-Position



Across the top of the Navigate-Position display is the title bar which confirms which display you are using. In the center of the title bar an -MAG- indicator will be displayed when a magnetic variation correction is being applied to your heading and bearing readouts.

The next bar down is the "Alarm" or "Warnings" Message bar.

This bar is used to alert you if the signal conditions of the satellites fall to unacceptable values for reliable position calculations.

The next line shows information concerning the waypoint that is selected. The waypoint number and symbol, the bearing from your present position, and the distance to go are displayed on this line.

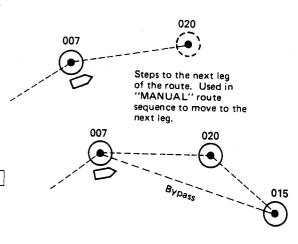
The position display uses the large characters to show your latitude and longitude.

The bottom line shows the vessel's (SOG) Speed Over Ground, (COG) Course Over Ground, and the (TTG) Time To Go to the designated waypoint.

The arrow menus at screen right will take you directly to the Plot, CDI, Time or Special Function (SF) set-ups/screens, when you press the corresponding function key.

When you are using the Navigate Position page some typical operations include:

- Go To a Waypoint ① (ex; GO TO, 0, 0, 3, ENT for Wpt 003)
- 2 If following a route:
  - a. To change the leg of the route Press DEC, ENT
  - b. To by-pass the next waypoint Press  $\frac{6}{\text{iNC}}$ , **ENT**
  - c. Restart a Route Press GO TO, Wpt #, ENT
  - d. To cancel the route sequence Press  $\frac{3}{60 \text{ to}}$ , CLR, ENT.



Press  $\frac{3}{60 \text{ ro}}$ , Wpt #, ENT

Store an Instant Waypoint (EVENT) at present position 3 Press EVENT Present Position will be stored in temporary memories 400 ~ 499 and marked on the plot as a diamond shaped ( $\diamondsuit$ ) symbol.

#### 3.6.2 Navigate-Special Function

Press SF for the Special Function display.

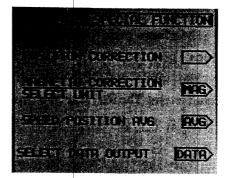
(1) Position correction

Press POSITION CORRECTION>

(2) Magnetic Correction/
Select
(Distance/Speed) Units
Press MAG>

(3) Speed/Position Averaging Press AVG>

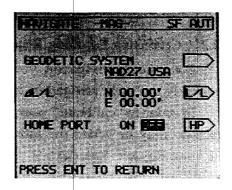
(4) Data Output Format
Press DATA



You can see by the menu that to change a specific item you would just press the key corresponding to that item.

First, press the **POSITION CORRECTION** key to correct your position readouts.

As the title bar indicates, this is the Navigate SF (special function) display. Before we make any choices, please read the following the information about correcting your position in L/L.



## 3.6.2.1 Geodetic Data Corrections

In preparing charts or maps, cartographers rely on a particular geodetic datum or "scaling system" on which to calibrate the Latitude/Longitude coordinate structure onto their charts. The type of datum used is normally listed in the table located on the chart.

Mariners may find considerable errors (up to 200 meters) in plotting own ships' position if their charts were created using one type of geodetic data system while the GPS navigator is busy calculating positions using another data system. The Raystar 590 can be programmed to provide position calculations utilizing one of seven different geodetic data systems.

	They are	①	WGS-84	(normal	ly used)	2	WGS-72		
	(			(for JA		4	NAD-27 US	SA (for	USA)
	(	(5)	NAD-27	CAN (f	or CANA	DA and	ALASKA)	(101	00/1)
	(	6	EUROPI	EAN 50	(for EUR	OPE)	/		
	(	7	AUSTRA	AL 66 (f	or AUSTF	RALIA)			
(1)	To change	e the	e Geodet	ic data					
	Press	$\supset$			to scro	ll throug	h the choices	. Whe	n vour
	selection	is di	splayed	Press [	ENIT	Ū			. Jour

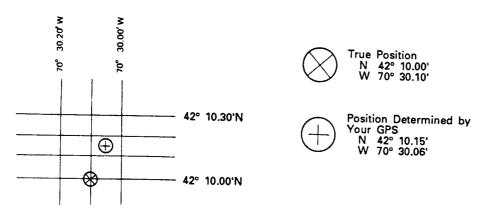
## 3.6.2.2 Correcting Lat/Long Readouts

For precise navigation you will need to calibrate GPS's position data correctly, to your navigation charts.

In order to "calibrate" your GPS to the navigation charts, fixed correction factors may be added (or subtracted) from your Latitude/Longitude readout in your Raystar 590.

## 3.6.2.2.1 Manual Lat/Long Correction

The most accurate method of calibrating your GPS to a chart is to actually run to a sea buoy or to a fixed, charted landmark and measure the exact difference between the charted position of the landmark and your GPS readout.



In the example the actual buoy Latitude is N 42° 10.00' the GPS Latitude shows N 42° 10.15' (.15' too far South) the actual buoy Longitude is W 70° 30.10' the GPS Longitude shows W 70° 30.06' (.04' too far East)

#### Example:

- 1 : To make a manual position correction Press A/M > to "MAN"
- ② : To correct L/L manually (by S 0.15', E 0.04)

  Press L/L key

  Press N/S, 0, 0, 1, 5, ENT, W/E, 0, 0, 0, 4, ENT

  (To change N to S and vice versa)

Note: Enter the latitude offset difference into the GPS; use "N" direction if the GPS reads less; "S" direction if the GPS reads a higher value. Measure the difference in longitude; if the GPS reads less use "W" direction, if the GPS reads higher use "E" direction.

#### 3.6.2.3 "Home Port" Correction

This convenient feature works this way:

Most boaters know the exact coordinates of their marina or slip. This position can be entered as your "estimated position" data.

When your GPS is turned "ON" in your slip and the "Home Port" correction is turned "ON", the GPS compares your home port entry to the GPS's L/L displayed position.

Any difference between the two positions is used to correct the GPS readouts for that day.

Accuracy of Home Port correction should yield medium to high accuracy results.

The most important thing to remember about using Home Port correction is that it only works correctly if you power up the GPS from the same location every time. It should not be used if you cruise to another location and then turn the GPS to "off" and then "on" again.

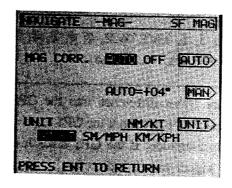
Home Port Correction

Enter exact L/L position of slip in Satellite Status Estimated Position. Then in the SF menu, Press HP > for ON

## 3.6.2.4 Magnetic Correction (SF MAG) Display

When you press the MAG key, the SF MAG display appears. On this display you can correct course and bearing data to account for magnetic variation at the ships location automatically.

## NAVIGATE (SF MAG) DISPLAY



(1) Magnetic Variation Correction

Bearing Data may appear in "True" or "Magnetic" degrees in the Raystar 590. In general, if you have a magnetic compass on your vessel for steering or when you are using your GPS to steer to a waypoint or to operate with your autopilot, you will want this information to be in "Magnetic". This is accomplished by adding a variation correction factor to the GPS's normal "True" bearing data.

Note: True bearings are displayed when the Magnetic Correction Mode is "off".

Your Raystar 590 can automatically apply magnetic variation correction values from an internal D.M.A. correction table.

Four soft-keys are available on this display as follows:

- (1) AUTO: To turn Magnetic Correction Mode to Automatic or OFF
- (2) MAN : To input Magnetic values manually
- (3) UNIT : Select display units of nautical miles/knots, statute miles/miles per hour or kilometers per hour
- (4) +/- : To select + or values for manual magnetic correction

#### Example:

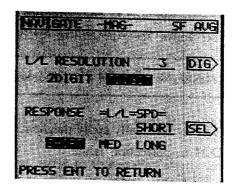
- 1 To set Magnetic Correction to Automatic press AUTO to "AUTO".
- To set Magnetic values manually (-6°) press MAN. "AUTO" goes to "OFF".

  +/->, (To change from + to -)

  -, 0, 6, ENT = 6 E correction
- To select display unit press **UNIT** until desired choice appears next to unit key.
- 4 To return to the "Navigate-Position" display, Press ENT .

## 3.6.2.5 Averaging (SF AVG) Display

This display is selected, when you press AVG key on the "Navigate (Special Function) Display".



This equipment calculates the position, speed and course based on signals sent from GPS satellites, but the measurement data can fluctuate in accordance with the signal strength and geometry of the GPS satellite. To smooth these random variations, you may select any of the three time constants.

The greater the time constant, the smaller the variations in the position, speed and bearing readouts. If a short time constant is selected, the variation becomes greater, but you can follow rapid course/speed changes of the ship more quickly.

For both your position/course and speed readouts, there are three display responses or "averaging" periods available for selection.

- A. 0 or Short Responsive but somewhat erratic
- B. Medium Good response; more stable
- C. Long Slower response; very stable.

Two soft keys are available on this display as follows:

- (1) SEL : Select response time of L/L, Course, and DTG readout. Usually set to 0, for best response.
- (2) DIG : Select resolution of present L/L. Usually set to 3 digit.

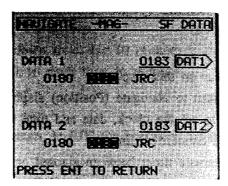
#### Example:

- 1 To change the response time of L/L (Short  $\rightarrow$  Med  $\rightarrow$  Long) Press SEL repeatedly for choice
- ② To change the resolution of present L/L display (2 DIGIT  $\rightarrow$  3 DIGIT) Press  $\boxed{\text{DIG}}$  for choice
- 3 To return to the "Navigate-Position" display.

  Press **ENT**

#### 3.6.2.6 Data Output (SF Data) Display

This display is selected by pressing the **DATA** key on the "NAVIGATE (SPECIAL FUNCTION)" Display.



The Data Display lets you program the type of data outputs going to external devices, like radar, echo sounder, plotters and autopilots.

The Raystar 590 has three types of data output formats available:

- 1. NMEA 0180 for simple autopilot use
- 2. NMEA 0183 for radars, fishfinders, plotters, autopilots, etc.
- 3. JRC for JRC products

Two soft keys are available on this display:

- (1) DAT 1 : Selects output format for port Data 1.

  Press the key until your choice is highlighted on line next to the key.
- (2) DAT 2: Selects output format for port Data 2.

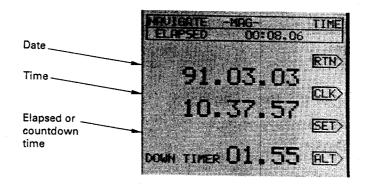
  Press the key until your choice is highlighted on line next to the key.

Example: Press DAT 1 .... Press .... Press .... Press .... Press .... JRC

Press **ENT** to return to Navigate.

#### 3.6.3 Navigate-Time

The Navigate-Time display is selected by pressing the TIM key on the "Navigate-Position" display.



Four soft keys appear on this display.

- (1) RTN : To return to Navigate (Position) display.
- (2) CLK : Used to set the clock, date and time
- (3) SET : To set countdown timer
- (4) Elapsed time will be retained and displayed (even when using the countdown feature) in the window at the top of the display.

#### Example:

To set the GMT (Greenwich Mean Time) date and time (90/4/11 18:00)

Press CLK, 9,0,0,4,1,1, ENT, (year, month, date) 1,8,0,0, ENT (time in 24 hour format)

To operate the elapsed time

Press ALT to activate the elapsed timer at the bottom of the display.

2 To start Elapsed timer.

Press ENT

- To stop Elapsed timer
  Press ENT again
- To start LAP time
  Press CLR
- To stop LAP time
  Press CLR
- 6 To clear Elapsed timer
  Press CLR
- To operate the Countdown timer, press ALT to put the countdown timer on the bottom of the display.

To set the countdown timer for 10 minutes:

Press SET, 1, 0, to enter time in minutes

Press **ENT** to start.

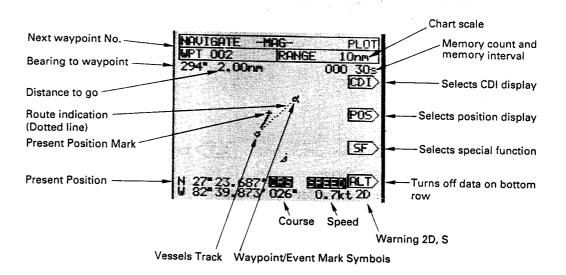
Press **ENT** to pause.

Press **ENT** to restart At 0.00 the beeper will alarm. Press **CLR** to silence the alarm.

#### 3.6.4 Navigate-Plot

The Navigate Plot map is activated by pressing the PLT key on the Navigate-Position display or on the CDI display.

The Plot display shows your vessels position, the locations of waypoints and event marks, and your memorized vessel track line.



The displayed data is

(1)	WPT	Your selected destination waypoint
(2)	BRG	Bearing to the destination waypoint
(3)	DTG	Distance to go to your destination waypoint
(4)	Chart Scale	Display range on plotter, as a radius from the center of the display
(5)	Track	Your vessel track
(6)	Waypoints	All waypoints within the display range will show as symbols.
(7)	Warning	If the GPS is unable to compute a correct position or if the GPS is two dimensional fixing a warning will appear in the lower right corner of the plot display.

An "S" indicats that the unit cannot compute its position due to an incorrect estimated LAT/LON. "2D" indicates that the unit is two- dimensional fixing (with a potential dilution of accuracy).

#### Example:

- 1 Change Plot Scales
  Press for longer range; Press DEC for smaller ranges
  The available plot scale sizes are 1, 2, 5, 10, 20, 50 and 100 nautical miles.
- ② GO TO a Waypoint

  Press 3 Wpt #, ENT. (ex GO TO, 0, 0, 3, ENT for Wpt #003)

  OR: Press GO TO and ▲ / ▼ (for Wpt #). then press ENT.
- 3 Store an Instant Waypoint (EVENT)

  Press 1 Present Position will be stored in temporary memories from 400 ~ 499, and will be marked on the plot with diamond symbol at the present position of your vessel.
- Erase Event Mark on Plot
  Press CLR key
  Event mark turns off

Event Mark number appears

- (5) Remove CRS/SPD/POSITION digital display.

  Press ALT key

  Bottom row of graphics (position, course, speed) disappears so that more plot area may be seen.
- 6 Recenter own ship
  Press ENT

# 3.6.5 Navigate-Plot (Special Function)

Press SF for the Special Function menu of Plot Mode.

There are two operations controlled in the Special Function screen of the Plot Mode:

- A. Controlling the Track Memory Interval.
- B. Erasing the Track memory.

Internal Track Memory Interval:

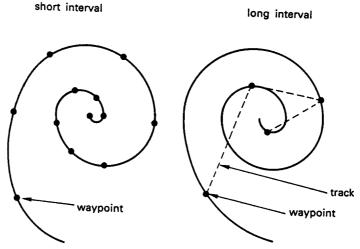
One of the most important features of the Raystar 590 Plot Mode is the ability of the plotter to record points along your vessels track and "save" them in its internal memory.

This memorized data is used to generate the ships track whenever the screen is centered, or whenever the range scale is changed.

The GPS can remember up to 300 of these track points. Depending on the length of the overall track line that you wish to record, you can save Track memory space by choosing to enter position data at longer or shorter intervals of time, or at discrete intervals of distance traveled.

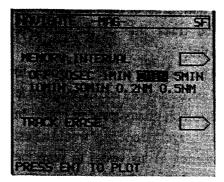
For example, if a very complicated route with many turns is contemplated, it will be necessary to store the ships position data, after in order to have enough data, then enter it at a later time to recreate the track on a different range scale.

The trade off for frequent storage of your position is that the Track memory is quickly used up.



1. Press MEMORYINTERVAL key for choice.

The window shifts to highlight your choice. When the desired interval is selected, press **ENT**. On the plot screen below the scale characters in the upper right corner is a counter showing Track Memory points used and the selected track recording interval.



When you have completed recording the desired trackline, return to the SF menu and turn the track interval to OFF to erase the track memory.

If, in the course of plotting a trackline, you stop moving for some reason, the Auto plot Start/Stop circuit will operate and prevent the recording of Track Line memory points from being laid on top of each other on the plot screen. Since there are only 300 Track Line points available, when Track Point #301 is recorded, it will replace Point 01. So, to store important tracks, it is best to remember to turn the interval off as soon as you have completed the track.

#### 2. Track memory erase

All track Line memory can be erased by using the Plot-SF screen.

To Erase all track lines press TRACK ERASE

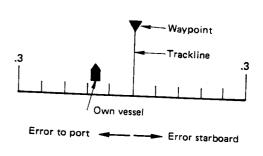
Press CLR.

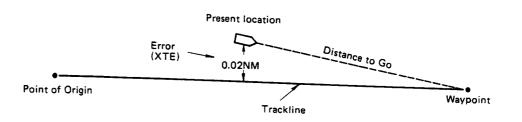
To return to Plot press **ENT**.

## 3.6.6 Navigate-CDI

The CDI display provides a graphic presentation of deviations from the desired track line to the selected waypoint.

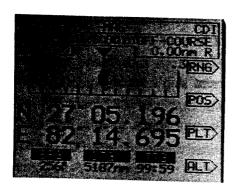
The scale shows the waypoint, to trackline, own vessel and the magnitude and direction of any steering error. In normal usage, the operator would adjust the steering of his vessel to keep the boat symbol on the track line. The values of the CDI scale can be changed by pressing the RNG key. The scale can be set to .1NM (fine) or .3NM (coarse).





Pressing ALT alternates navigation information on the bottom row. The POS and PLT keys select the other navigation displays directly.

## CDI - COURSE DEVIATION DISPLAY



Summary of operations on CDI display

- ① CDI Range scale
  Press RNG for .1 or .3nm scale.
- 2 For digital display of CRS/SPD, VTD/CMG/VAR, BRG/DTG/TTG. Press ALT ALT ... to alternate the readouts.

3 Starting New Waypoint

Press **GO TO** Wpt #, **ENT**. (ex; GO TO, 0, 0, 5, ENT for Wpt # 005) OR:

Press GO TO and ▲ / ▼ (for Wpt #). The press ENT.

4 Store an Instant Waypoint (EVENT)

Press  $\frac{1}{\text{EVENT}}$  Present Position will be stored in temporary memories from 400 - 499 and marked on the plot display with a diamond

symbol.

The displays in CDI are

(1) Position : Ship's present position.

(2) Waypoint : Indicates destination Waypoint No.

(3) Course Deviation: Indicates direction and magnitude off your desired course. Indicator

(4) CMG : Course Made Good.

(5) VTD : Velocity Toward Destination.

(6) VAR(7) BRG: Velocity Along Route.: Bearing to destination

(8) DTG : Distance to go to destination

(9) TTG : Time to go until arrival at destination

(10) CRS : Present course over ground
 (11) SPEED : Present speed over ground

Course Made Good, Velocity Along Route and Velocity Toward Destination are terms which have the following meaning.

- (1) Course Made Good (CMG):

  Bearing from the starting waypoint to your current position.
- (2) Velocity Along Route (VAR):

  Component along the route of current ship's speed
- (3) Velocity Toward Destination (VTD):

  Component toward destination of current ship's speed

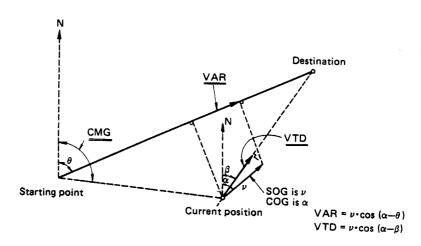


Figure 3.2 Drawing of CMG, VAR and VTD

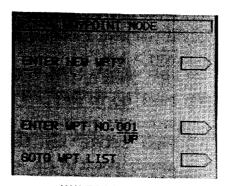
#### 3.7 WAYPOINT MODE

One of the main operations in the Raystar 590 is storing waypoints into the GPS's internal memory. Press the MODE key and select "Store/List Waypoints".

The first panel that appears is the Waypoint Directory.

The Raystar 590 has 500 internal memories for storing waypoint position coordinates. 100 of these memories are used as "Temporary" memories to store Event mark position data. Temporary memorized data may be transferred into the normal waypoint memories for more permanent storage.

The Waypoint Directory steers you to inputing waypoint data or to the waypoint list where you can examine waypoints already in memory.



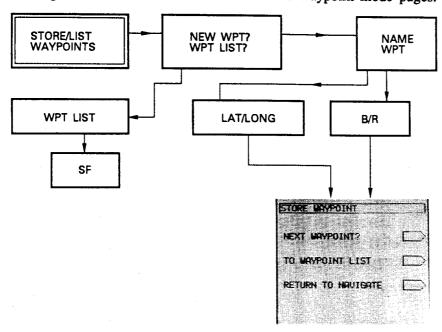
WAYPOINT DIRECTORY

- "U" INFORMATION STORED IN WPT MEMORY
- 'P" -INFORMATION PROTECTED FROM CHANGE

If the letter "U" appears below the Wpt # on the display, it signifies that the Waypoint has been "Used"; which means that a Lat/Lon has already been memorized into the Waypoint number.

If the letter "U" and "P" appear below the Waypoint, it signifies that the Wpt # has been "Used" (Lat/Lon memorized) and is "Protected".

The diagram below shows the structure of the waypoint mode pages.



Each waypoint has a specific memory location number (from 001 to 499). If you are planning to input a new waypoint into your GPS, you can designate the waypoint into which the data will be stored, or you may just use the next available empty waypoint memory.

There are three ways to select the waypoint number:

- (1) Press ENTER NEW WPT? : Selects next available waypoint memory.
- (2) If you have a location preference, type desired Wpt # ---; press ENTER WPT key.

(EX: Press 0, 1, 0, **ENTER WPT**), key for Wpt # 010.)

(3) Press GO TO WPT LIST ; use ▲/▼ key to highlight desired memory in number block.

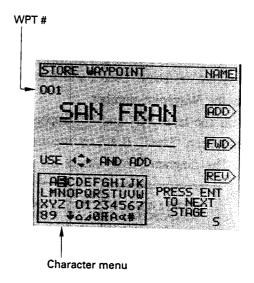
Press "STORE" key. Use this method when you want to edit information already stored in the waypoint memory.

#### 3.7.1 Storing a Waypoint

This menu is used to select various symbols and letters to "NAME" the waypoint for subsequent position and plot screens. The name can consist of up to 16 characters in two 8 character rows. The first character selected is used to identify the waypoint on the plot display.

A typewriter-styled character menu appears in the left corner of the screen. Using the UP/DOWN or LEFT/RIGHT direction keys, position the block cursor over the desired character.

Press ADD to insert the character at the blinking cursor location.



Repeat this operation, selecting characters, blanks or symbols, until the name is completed.

NOTE: If you make a mistake, just position the blinking underline cursor over the error with the REV key and "ADD" the correct character in its place. If you wish to start again, just press CLR. The blinking cursor will reset to the first character position.

Since the first character space is used as the symbol for the plot screen, plan to select an appropriate symbol type or number from the menu for this purpose when naming the WPT.

When the name and symbol are all set, press **ENT**. Another menu will appear and ask if you wish to store latitude/longitude, or bearing and range from your present position.

#### 3.7.1.1 Store Waypoint (L/L) Display

If you wish to enter your waypoint position in Latitude/Longitude (L/L). Press  $\lceil L/L \rangle$  key.

#### STORE WAYPOINT (L/L)



#### A. L/L Entry Display

Three soft-keys are available on this display as follows.

(1) N/S (E/W): To change  $N \leftrightarrow S$  or  $E \leftrightarrow W$  in setting latitude or longitude.

(2) **FWD** : To move the character cursor forward.

(3) **REV** : To move the character cursor in the reverse direction.

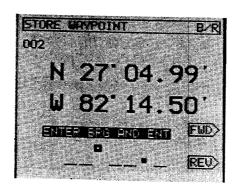
#### Example:

- ① To set N27°10.15' and W82°10.25'
  Press 2, 7, 1, 0, 1, 5, ENT
  Press E/W , 0, 8, 2, 1, 0, 2, 5, ENT
  (  $\hookrightarrow$  change  $E \rightarrow W$ )
- 2 To fix an error. Use FWD or REV key to set cursor to error. Press the correct entry key to fix error.
- ③ To modify N27°10.15' to N27°11.15'
  Press FWD , FWD , FWD , 1, ENT
- 4 If longitude is ok, just press **ENT** to complete the entry and advance to the Store Waypoint-Go To directory menu.

## 3.7.1.2 Store Waypoint (B/R) Display

If you know the bearing and distance from your present position (for example from a rader target display) It can be used to create a waypoint. Press  $\boxed{B/R}$ .

## STORE WAYPOINT (B/R) DISPLAY



C. B/R Entry Display

#### Entry by Bearing and Range

When defining a waypoint by bearing and distance from present position it is important to stay the bearing sequence consistant.

If you are using magnetic bearings in the Raystar 590 (MAG AUTO) and you want to transfer a bearing taken from rader target, you must convert the rader relative bearing (relative to ship's bow) to magnetic unless you are using one of Raytheon's "X" Series of radars connected to a fluxgate compass.

To determine the magnetic bearing to a waypoint or target you simply "add" the normal radar's relative bearing to your magnetic ship compass heading. The result is the magnetic heading to enter into the GPS. The same holds true for a bearing taken visually with a pelorus.

#### Example:

1 To enter a waypoint in Bearing/Range from your current position; (Radar Bearing = 45°, Range = 10.0NM

> Magnetic variation at present position is  $10^{\circ}$  EAST. Magnetic bearing is  $45 - 10 = 35^{\circ}$  magnetic.)

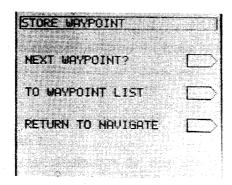
Press 0, 3, 5, ENT.

Press 1, 0, 0, ENT

- 2 To modify data
  - a. Select character to change with the FWD or REV keys.
  - b. Insert new character or

    Press CLR key to restart the entire entry
- ③ To go to "STORE WAYPOINT" display. Press **ENT**.

After you have completed entering your waypoint coordinates, the Raystar 590 will display a menu to direct you to the next operation.



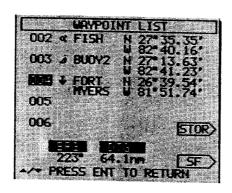
If you want to enter another waypoint, press NEXT WAYPOINT. This key returns you to the waypoint-name page and advances the waypoint to the next memory number.

If you want to recheck your entry, press the TO WAYPOINT LIST key. If you are finished, press RETURN TO NAVIGATE key. This will return you to the Navigate-Position display.

Before making your selection, please wait until the "PLEASE WAIT" message has disappeared. If you do not wait, the GPS may fail to record your waypoint in memory.

### 3.7.2 Waypoint List Operations

The Waypoint List lets you scroll through the contents of the waypoint memories. You may select any of these waypoints to edit or erase on this page. Pushing the key lets you "scroll up" the list to examine the waypoints near the end of the list. Pushing the key lets you "scroll down" the list to see the waypoints near the top of the list.



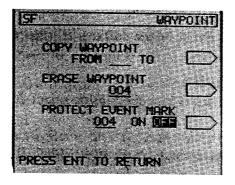
#### **OPERATIONS:**

- ① Use ▲/▼ to scroll contents of waypoint list.
- 2 Press STORE to edit data in selected Wpt memory. Returns to Store waypoint-name menu display at selected waypoint number.
- Tress SF if you wish to Copy, erase or protect event marks or waypoints.

#### 3.7.3 Waypoint List-Special Function

If you press the SF key on the Waypoint List display, you can perform some additional operations with the stored waypoint data. They include:

- A. Copying a Waypoint from one memory into another.
- B. Erasing a Waypoints
- C. Protecting Waypoint Data from being erased or overwritten.



#### 3.7.3.1 Copying Waypoints

To copy waypoints from one memory location to another just type in the waypoint From followed by the waypoint To and then press the Copy softkey.

Ex: 0, 0, 3, 0, 1, 5, COPY (From 003 to 015)

## 3.7.3.2 Erasing Waypoints

To erase a waypoint;

- A. First select the "Waypoint to erase" on the Waypoint List with the up/down keys or use the GO TO, XXX, keys.
  - Confirm that the waypoint is not protected:
- B. Press the SF softkey. Check that the waypoint shown at Erase Waypoint is correct.
- C. Press the Erase Waypoint softkey to erase waypoint.

#### **CAUTION**

If the waypoint to be erased is programed as

- 1. A leg of a route plan or
- 2. Selected as your current destination the display will <u>FLASH A WARNING</u> "WAYPOINT IN USE", to alert you to these conditions.

## 3.7.3.3 Protecting Waypoints

If you want to protect certain important waypoints from being accidently changed, you can manually "protect" the memory contents in the following way;

- A. First select the "waypoint to protect" on the Waypoint List with the up/down keys or the GO TO, XXX, key.
- B. Press the SF softkey. Check that the waypoint shown at Protect Waypoint \_\_\_\_ is correct.
- C. Press the Protect Event Mark softkey to select ON.

A "P" will appear next to the waypoint on the Waypoint List and on the Waypoint Mode pages.

The protection feature is cancelled if you select OFF with the Protect Event Mark softkey.

The waypoint data cannot be changed while it is protected.

## 3.7.3.4 Changing/Editing Waypoint Data

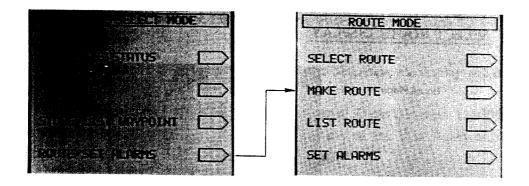
Frequently you will find that it is necessary to update position information in a waypoint memory as you are sitting next to the waypoint or to add a name or symbol to a waypoint entered as an "Event". In these cases you can always make the needed changes by selecting the waypoint number on the Waypoint List and then by pressing the STORE softkey.

There are two conditions to check before you begin editing. They are:

- 1. Is the waypoint "protected"? If so, first unprotect the waypoint in SF on the Waypoint List.
- 2. Is the "WAYPOINT IN USE" message flashing on the NAME WAYPOINT screen? If so, make sure that the change you are making will not upset any route plan (which contains this waypoint) adversely. If this waypoint is selected as your destination, we recommend first that you temporarily choose a different waypoint destination on the NAVIGATE-POSITION page before proceeding to edit the waypoint data.

As you proceed through the NAME WAYPOINT page to the L/L or B/R entry page, if the data is already correct on any of the pages, just press the ENT key to move on to the next screen and edit the data as necessary.

# 3.8 ROUTE/SET ALARM MODE ROUTE MODE DISPLAY

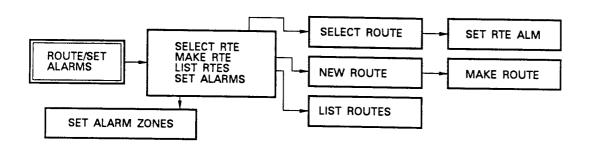


If you wish to select a Route or set Alarm values press the MODE key for the mode display. Press ROUTE/SET ALARM key. For the ROUTE mode directory.

Four operations are available on this display as follows.

- (1) **SELECT ROUTE** : The "SELECT ROUTE" display let's you select one of
  - the programmed route plans to follow.
- (2) MAKE ROUTE : Selects "MAKE ROUTE" display. On this display you can create a route plan.
- (3) LIST ROUTE : Select "LIST ROUTE" display. Shows you the route plans
- and waypoint legs.

  (4) SET ALARMS : The "SET ALARMS" display let's you set the alarm distance
  - values.

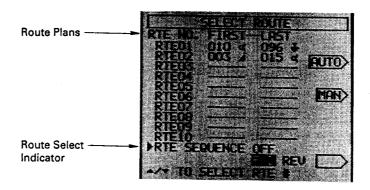


ROUTE/SET ALARMS MODE PAGE LAYOUT

#### 3.8.1 Select Route

This display is selected by pressing the **SELECT ROUTE** key.

#### SELECT ROUTE DISPLAY



On this display, you can select one of the route plans to follow, either automatically or manually. The difference between "Automatic" or "Manual" route sequencing is that in "Automatic" the GPS automatically switches to the next waypoint, while in manual route sequence, the operator steps the GPS to the next waypoint in the route manually.

Three soft-keys are available on this display as follows.

(1) AUTO : To set automatic route sequence.

(2) MAN : To set manual route sequence.

(3) SEL (FWD/REV): To select forward or reverse route sequence.

#### Standard Operations:

① Select a Route:

Use the ▲/▼ keys to set the indicator to the route you wish to follow:

② Follow FWD/REV

With FWD/REV key: Select FWD if you wish to go from first point to

Select REV to follow route from last point to first.

3 To Follow a Route

Press AUTO for Automatic Route Sequence

or,

Press MAN for Manual Route Sequence

To Turn Route Sequence OFF Use ▼ key to select "RTE Sequence OFF". Press ENT. or;

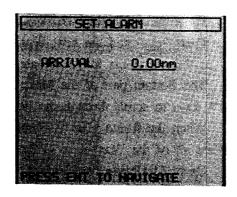
Cancel Route Sequence from Navigation Page by pressing GO TO, CLR, ENT keys.

If you have selected an Auto or Manual Route Sequence, the display will change to the Set Alarm page.

The Set Alarm Mode asks you to enter the Arrival Alarm Distance. This distance is the point at which the loran will alert you to arrival and if in Automatic Route Sequence, will switch to the next leg automatically.

Use the numeric keypad to insert the desired distance.

EX: Press ARRIVAL 0, 0, 5, for 0.05NM. Press ENT. When distance value is correct. The Route Sequence will be on and the selected route will be displayed on the Navigate-Position Page at the Waypoint block. When ENT is pressed the display will return to the Navigate-Position page.



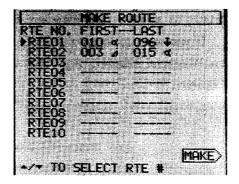
#### 3.8.2 Make Routes

#### To make a Route plan

Press the MODE key for the menu.

Select ROUTE/SET ALARMS.

Select MAKE ROUTE.



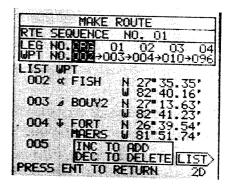
The Make Route display lets you assign the Waypoint numbers to the legs in the route plan.

The page is made in 3 parts.

The leg panel lets you decide which leg of the route to program.

Use the / keys to chose the leg. The first leg is "OR" or origin. At this leg you should list the first waypoint in the route plan.

The panel directly below the leg panel is the Waypoint # panel. To enter a Waypoint # to a leg of a route.



Press the 6 (include) key, Wpt #. Select the next leg with the key.

Press 6 and the next Wpt #. Repeat this process until you have included all of the waypoints for the Route plan.

The Bottom part of the Make Route panel is the Waypoint list. Use the  $\blacktriangle$  /  $\blacktriangledown$  keys to scroll through the list to pick the waypoints for your Route plan.

When the Route plan has been completed you can press the LIST soft key to see all of the Waypoints in the Route plan.

On the List Route display use the  $\triangle$  /  $\bigvee$  key to scroll through the list of Waypoints. Use the  $\bigcirc$  /  $\triangleright$  direction keys to select other Route plans to examine.

After you have reviewed the contents of the Route plan you may wish to edit the Route plan by deleting specific waypoints. To do this, press the MAKE key if you are on the Route List display.

Use the direction key to select the leg of the route to be deleted. Press (delete) to remove the unwanted waypoint.

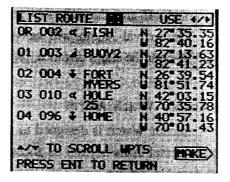
If you want to insert a different waypoint, press (include) followed by the new Waypoint number. Again the List Route page can confirm that your Route plan is correct.

#### 3.8.3 List Route

The list route page can be accessed directly by pressing the **MODE** key for the menu.

Press ROUTE/SET ALARMS

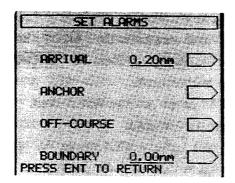
Press LIST ROUTE the same List Route page appears as is used in the Make Route mode. All operations are the same.



#### 3.8.4 Set Alarms

The Raystar 590 can provide four types of alarms for specific navigation purposes. They are: Arrival, Anchor, XTE (Cross Track Error) and Boundary. To set any of these alarms press the MODE key for the mode menu. Press ROUTE/SET ALARMS.

Press SET ALARMS for the alarm page.



#### The Arrival Alarm

The Arrival Alarm can be set to alert you when you are within a specified distance from your waypoint. The Arrival Alarm can be set from 0.01NM to 9.99NM.

To set the Arrival Alarm, press the ARRIVAL softkey. Enter the desired alarm distance.

EX: ARRIVAL > 0, 0, 5, ENT for 0.05NM alarm zone

Using the above example the Arrival Alarm will now sound at 0.05 nautical miles from the waypoint. The arrival alert will be displayed at the bottom of the screen and an audible beeper will sound. To silence the audio beep press the CLR key.

This Arrival Alarm distance will remain in the GPS's memory even if the unit is turned off and the power is removed.

The Arrival Alarm will activate in any mode of the GPS's operation.

To clear the alarm distance, press the ARRIVAL softkey and Press 0, 0, 0, ENT.

#### The Anchor Watch Alarm

Anchor Watch is designed to monitor the position of the vessel while at anchor. If the vessel drifts beyond its anchor chain limit, the alarm sounds, notifying the crew of possible danger.

The unit determines whether the vessel has drifted beyond the limits of the circle imposed by the Anchor Watch function relative to the present waypoint (anchor point). The radius of the circle imposed can be inputed in increments of one hundredths of nautical miles (0.01NM which is approximately equal to 60 ft. or 18 meters).

So the first step when entering an anchor watch alarm is to store your present position in a waypoint location and call up that waypoint location as your destination. This will give your GPS a reference point to monitor the distance of any drift from your present position. This present position should be entered as you drop anchor by pressing the **EVENT** key.

To set the Anchor Watch area press the MODE key and select ROUTE/SET ALARMS. Press SET ALARMS. Press the ANCHOR softkey and enter the numeric values for your anchor limit.

EX: To enter 0.15NM as an Anchor Watch limit. Press 1, 5.

Press ENT to return to Navigate.

On Navigate page press  $\frac{3}{60 \text{ To}}$ , XXX (event #), ENT

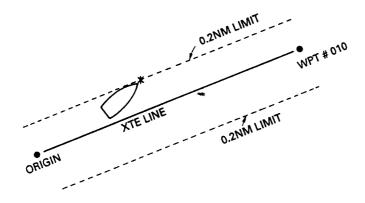
The Anchor Watch Alarm limit we have just entered will now stay in the unit's memory even when the unit is turned OFF or power removed.

When the Anchor Alarm is set and activated, "ANCHOR" will appear at the bottom of the display and the audible alarm will sound. To silence the audible alarm press CLR. The alarm will operate regardless of the function your unit is in. To disable the Anchor Alarm distance, press MODE and select ROUTE/SET ALARMS and SET ALARMS and press ANCHOR key. Enter 0, 0, 0 value and press ENT.

#### The OFF Course Alarm

The OFF-Course Alarm (XTE) - can be set to alert you if you deviate a specified amount (0.01 to 9.99) NM from your track to your destination.

To set the OFF-Course Alarm, press the MODE key and SELECT ROUTE/SET ALARMS. Press SET ALARMS. Press the OFF-COURSE softkey and enter the desired warning distance. Press ENT to return to navigate.



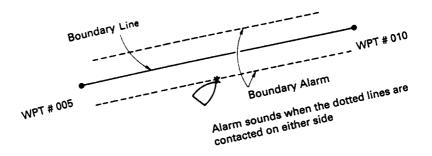
**OFF-Course Alarm** 

Now, if the vessel strays from the route more than the preset distance, the XTE alarm will appear at the bottom of the display and the audible alarm will sound. Press CLR to silence the alarm. This alarm distance will stay in memory and be used whenever steering to any waypoint you select. To disable the alarm distance, press the MODE key and select ROUTE/SET ALARMS. Press SET ALARMS. Press OFF-COURSE and enter 0, 0, 0 with the numeric keys. Press ENT to return to Navigate.

#### The Boundary Alarm

This very special alarm can be used when you need to define a Boundary line between two points that you wish to avoid. The alarm will sound if you come within the set limit of the defined Boundary line.

To select the two waypoints you wish to use:



#### **Boundary Alarm**

Press the MODE key for the mode menu. First, we must assign the two points which will define the beginning and the ending of the line bisecting the hazardous area. This can be assigned in an available route memory.

- 1. First assign both waypoint locations into available waypoint memories.
- 2. Select an available route plan and make a route with one waypoint as the origin and the other waypoint as leg 1.
  - 1 Select ROUTE ALARMS . Press MAKE ROUTE
  - 2 Designate a route plan and press MAKE
  - 3 Press the key and enter the first waypoint. Press key for leg 01. Press and then key in the waypoint of the second waypoint.
- 3. Now press the MODE key and select ROUTE/SET ALARMS again. Press SELECT ROUTE >

Select the route plan number holding the two waypoints for the Boundary line.

Press MAN and press ENT. Now the Boundary line is set.

4. Press Mode key for ROUTE/SET ALARMS. Press SET ALARMS. Press BOUNDARY and enter the desired clearance distance from the center of the hazardous area.

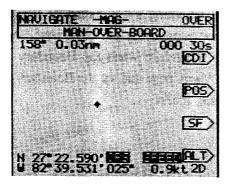
Press ENT to return to Navigation display.

The Boundary Alarm is now set. The display shows the route containing the boundary line is activated. If the vessel contacts the perimeter of this area, the alarm will sound and **BOUNDARY** appears on the bottom of the display. Press **CLR** to silence the audible alarm.

When the Boundary Alarm has been set, selecting a destination as a waypoint will cause the Boundary Alarm to discontinue monitoring the designated area and cancel the route plan containing the points. Therefore when the Boundary Alarm is no longer planned for use, return to the set Alarm page and set the Boundary Alarm distance value to 0.00NM to fully disable this alarm.

#### 3.9 "MAN-OVER-BOARD" Function

This function is used for life saving in case of a "MAN-OVER-BOARD" situation. Press any two green function keys simultaneously and the "MAN-OVER-BOARD" display will appear.

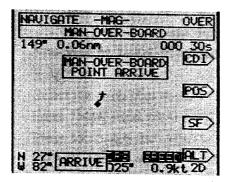


The "MAN-OVER-BOARD" display is a specialized "PLOT" display. The "MAN-OVER-BOARD" point is set as a waypoint (flashin  $\diamondsuit$ . The plot scale size will be fixed at 1 nautical mile, and remain until the mode is changed. The memory interval remains selecable. When you are within 0.1 nautical mile of the "MAN-OVER-BOARD" point, the Arrival Alarm will appear and the alarm will sound.

#### **EXAMPLE**

① To set the "MAN-OVER-BOARD" function.

Press any two green function keys simultaneously.



②To clear the "MAN-OVER-BOARD" display.

Press any two green function keys simultaneously.

The "MAN-OVER-BOARD" point is not memorized into the GPS's internal memories.

# SECTION IV MAINTENANCE

#### IMPORTANT NOTE

This GPS should only be serviced by your authorized Raytheon dealer. Repair attempts by unauthorized service personnel will void the equipment's warranty.

#### 4.1 GENERAL

Maintaining satisfactory operation of your Raystar 590 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.

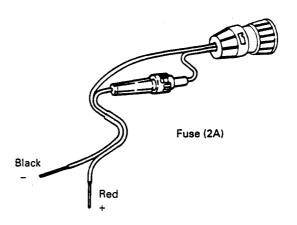
- Use a soft clean cloth for cleaning the surface filter, control panel, etc. Do not use abrasive cleansers, chemical cleaners or solvents. Use glass cleaners or suitable general purpose detergent.
- · Check for evidence of corrosion. Clean as required.
- Periodically check tightness of cable connectors. Examine cables for evidence of chafing or abrasion.
- · Make sure connections to the ships power source are tight and clean.

#### 4.2 REPLACING THE FUSE

Your Raystar 590 has Fuse Protection in the power cable assembly.

The fuse is a 2 Amp fuse and protects the ship's input lines in the event of an over current condition in the Raystar 590.

In the event of power failure of the Raystar 590, the fuse should be checked and replaced if necessary by twisting and decoupling the fuse holder in the power cable.



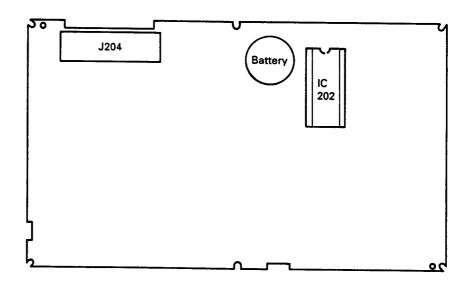
Power cable CFQ-3598

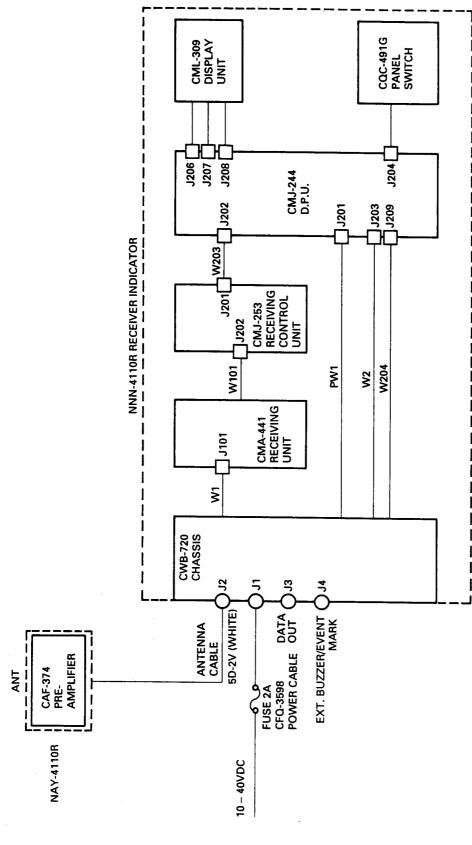
#### 4.3 REPLACING THE BATTERY

The estimated life span of the internal memory battery is from three to five years. To insure trouble free operation it is suggested that the battery be replaced every three years with an exact replacement lithium battery.

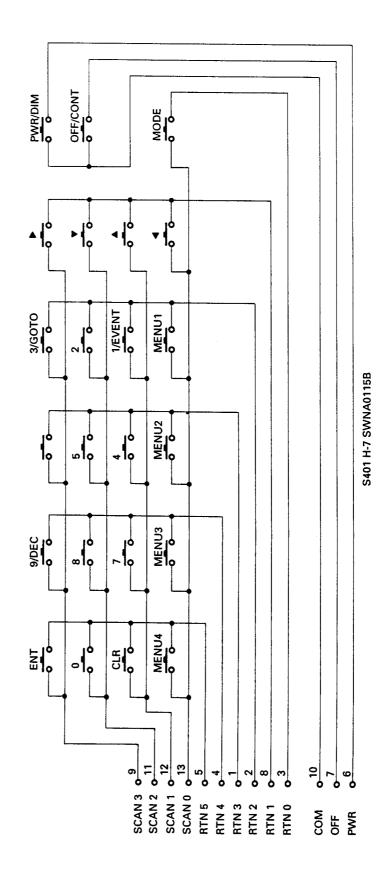
The lithium battery is soldered onto the processor PCB.

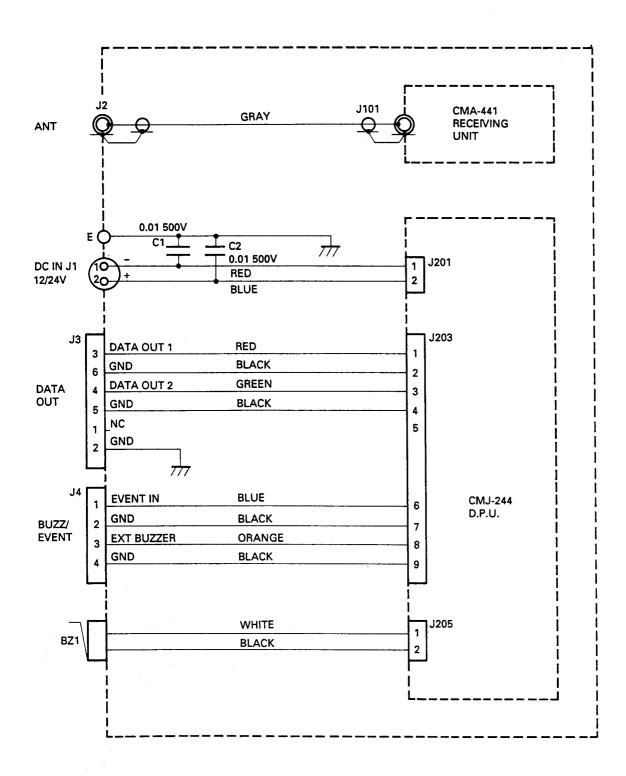
The correct replacement battery is listed on the Parts List in Section 5. It is recommended that the batteries be replaced by your authorized Raytheon dealer or the Raytheon Service Center.



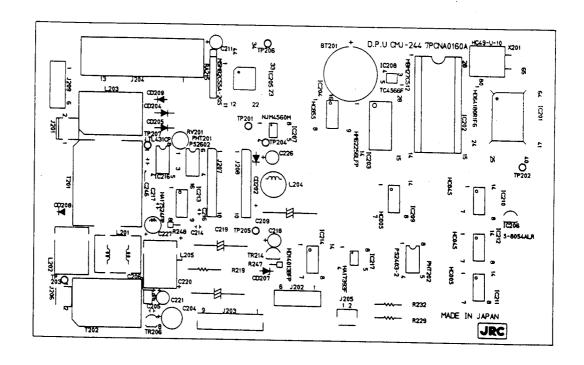


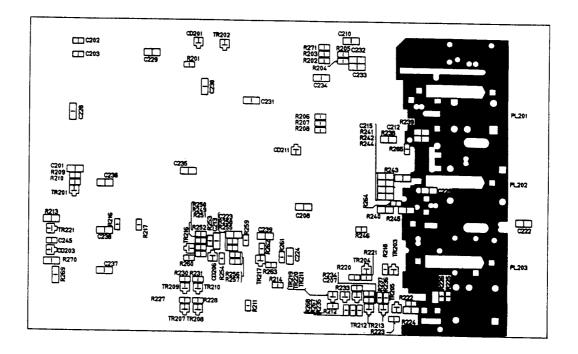
RAYSTAR 590 GPS NAVIGATOR BLOCK DIAGRAM





CWB-720 CHASSIS





PARTS LAYOUT OF CMJ-244 D.P.U.

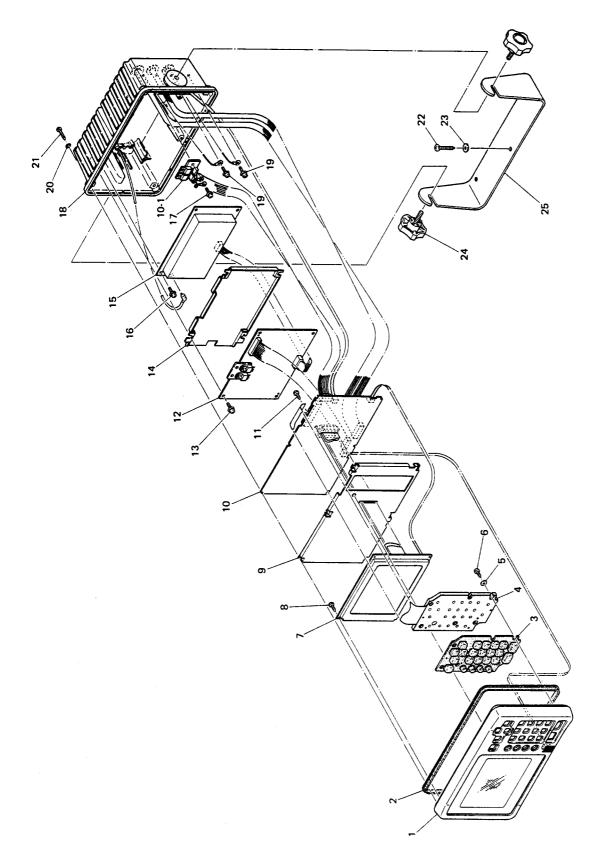


Fig. 4.1 Disassembling Diagram of Receiver Indicator

# (Mechanical) Parts of RAYSTAR 590

ITEM	NAME	Q'TY	JRC PART NUMBER	DESCRIPTION
1	Front Panel Ass'y	1	MPBC09493	with Buzzer
2	Packing, Rubber	1	MPPK01620 ~	
3	Contact Rubber	1	MTV003688 ~	
4	Flat Key Switch	1	CQC-491G ~	
5	Flat Washer	7	BSFW02600B	
6	Tapping Screw	7	BRTG04299	
7	LCD Display Unit	1	CML-309 /	
8	Tapping Screw	4	BRTG02970 ~	
9	Shield Cover	1	MTD005080	
10	Data Processor Unit	1	CMJ-244	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
10-1	Data Processor Unit	1	CMJ-244-1	
11	Tapping Screw	1	BRTG02970 /	
12	Receiving Control Unit	1	CMJ-253	
13	Screw	6	BSNC03008B /	
14	Shield Cover	1	MTD005121	
15	Receiving Unit	1	CMA-441 /	
16	Screw	4	BSNC03008B /	
17	Screw	3	BSNC03008B /	
18	Rear Cover Ass'y	1	MDYW03569 🗸	with Connectors & Cables
19	Screw	2	BSNC03008B /	
20	Packing, Rubber	6	MPPK01715	
21	Tapping Screw	6	BRTG03435	
22	Tapping Screw	3	BRTG03052 ~	
23	Flat Washer	3	BSFW05000B	
24	Knob-Bolt	2	MPTG02440	
25	Yoke	1	MTD005120	

# SECTION V REPLACEMENT PARTS

No.	PART NUMBER	DESCRIPTION	CODE
1	NAY-4110R	Antenna Coupler (with Standard Cable)	NAY-4110R
2	CAF-374	Preamplifier PCB	CAF-374
3	MPBP03099	Coupler (Case)	
4	MTV003680	Coupler (Base)	
5	CMA-441	Receiving Unit PCB 🛩	
6	CMJ-253	Receiving Control Unit PCB	
7	CMJ-244	Data Processor Unit PCB	
8	CML-309	LCD Display Unit ~	
9	CQC-491G •	Panel Switch Unit	
10	MTD005120	Yoke Bracket -	
11	MPTG024 <del>40</del>	Yoke Knob	
12	CFQ-3598 •	Power Cable (2m) w/Conn.	
13	CR2032-1HS	Lithium Battery	5ZBAB00047 ~
14	DC51-JLR-4110R	Instruction Manual	7ZPNA0103 ~
15	DC81-JLR-4110R	Bridge Card	7ZPNA0104 🗸
16	MF60NR-2A	Fuse	5ZFAD00015~
17	HJ80110/AF4220G30	Lamp for Keyboard	5WAAB00344
18	G263129-17	Connector, Data, 6-pin	
19	G263129-10	Connector, Aux., 4-pin	

CFQ3702 usc CFQ-393598

## **ROUTE LOG**

ROUTE NO.	DESCRIPTION
DATE	DESCRIPTION
WAYPOINT NO.	WAYPOINT DESCRIPTION

## **ROUTE LOG**

ROUTE NO.	DESCRIPTION
DATE	
WAYPOINT NO.	WAYPOINT DESCRIPTION

# Raytheon

# Limited Warranty Certificate

## **Dealer Distributor / Light Marine Products**

Raytheon Marine Company warrants all parts of each new light marine product to be of good materials and workmanship, and will repair or exchange any parts proven to be defective under normal use at no charge for a period of 24 months from the date of sale to end user or 30 months from the date of shipment by Raytheon, whichever expires first, except as provided below. High seas products, (Pathfinder/ST, 12" and 16" Bright Display Radars, Raycas ARPA, Raypath ARPA, Fathometer, Satcom, Doppler Speed Logs, Auto Pilots and Gyro Systems) are covered by a separate warranty policy.

Defects will be corrected by an authorized Raytheon Marine Company dealer. There will be no charge for labor during normal working hours for a period of 12 months from date of sale to end user or 18 months from date of shipment by Raytheon, except as provided below, and during this period Raytheon Marine Company will, for certain products, assume travel costs (auto mileage and tolls only) of its authorized dealers up to a total of 100 round trip miles and two hours travel unless otherwise agreed by Raytheon Marine Company in writing. For service outside normal working hours, the overtime premium portion is not covered by this warranty.

### Warranty Limitations

There is no travel allowance for certain products with a suggested retail price below \$2500.00. These products must be forwarded to an authorized dealer or service center of Raytheon Marine Company, at owner's expense and will be returned via surface carrier at no cost to the owner. Travel costs other than auto mileage, tolls and two hours travel time are specifically excluded on all products. The excluded travel cost includes but is not limited to: taxi, launch fees, aircraft rental, subsistence, customs, shipping and communication charges.

Raytheon Marine Company warranty policy does not apply to equipment which has been subjected to accident, shipping damage, abuse, incorrect service, alterations, corrosion, or service by non-authorized service personnel, or misuse, or on which the serial number plate has been removed, altered or mutilated.

Except where Raytheon Marine Company or its authorized dealer has performed the installation, it assumes no responsibility for damage incurred during installation.

This warranty does not cover routine system checkout or alignment/calibration, unless required by replacement or part(s) in the area being aligned.

A suitable proof of purchase, showing date, place and serial number must be made available to the authorized Raytheon Marine Company dealer at the time or request for Warranty service.

Magnetrons, cathode ray tubes (CRT), hailer horns and transducers are warranted for 12 months from date of sale. These items must be returned to a Raytheon Marine Company factory service center.

Chart paper, lamps, fuses, batteries, stylii, stylus/drive belts, radar mixer crystals/diodes, snapin impeller carriers, impellers, impeller bearings and impeller shafts are consumable items, and are specifically excluded from this warranty.

All costs associated with transducer replacement, other than the cost of the transducer itself, are specifically excluded from this warranty.

#### TO THE EXTENT CONSISTENT WITH STATE AND FEDERAL LAW:

- (1) THIS WARRANTY IS STRICTLY LIMITED TO THE TERMS INDICATED HEREIN, AND NO OTHER WARRANTIES OR REMEDIES THEREUNDER SHALL BE BINDING ON RAYTHEON MARINE COMPANY INCLUDING WITHOUT LIMITATION ANY WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
- (2) Raytheon Marine Company shall not be liable for any incidental, consequential or special (including punitive or multiple) damages.
- All Raytheon Marine Company products sold or provided hereunder are merely aids to navigation. It is the responsibility of the user to exercise discretion and proper navigational skill independent of any Raytheon equipment.

should the need arise.

# Raytheon

### **Factory Service Center**

Raytheon Marine Company 1521 So 92nd Place Seattle WA 98108 USA Tel 206 763 7500

Welcome to the growing number of proud Raytheon Marine Product users. It is with great pleasure that we welcome you and trust that you will have many hours of happy sailing with a product designed with your particular needs in mind.

We would ask that you please complete the following form, detach and mail the card portion immediately so a record of your purchase may be recorded for future reference,

Purchased From \_\_\_\_\_Purchase Date \_\_\_\_ Installed by \_\_\_\_\_ Equipment Model/ No. \_\_\_\_\_Serial No./s Owner's Name \_\_\_\_\_ Mailing Address\_\_\_\_ This portion of card should be completed and retained by the owner. G261292 Rev - (3/90) To validate warranty, fill in requested information below and mail to address shown on front. Model and serial number must be entered. Purchased from \_\_\_\_\_Purchase Date\_\_/\_/\_ Dealer Address\_\_\_\_\_ Installed by \_\_\_\_\_ Equipment Model/ No. \_\_\_\_ Serial No. Owner's Name

Mailing Address

 	,
BUSINESS DEDLY MAIL	NO POSTAGE NECESSARY IF MAILED
BUSINESS REPLY MAIL FIRST CLASS PERMIT NO. 10 HUDSON, NH 03051-9988	IN THE UNITED STATES
POSTAGE WILL BE PAID BY ADDRESSEE	
Raytheon Marine Company Attn.: Warranty Department 46 River Road Hudson, NH 03051-9988 USA	
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