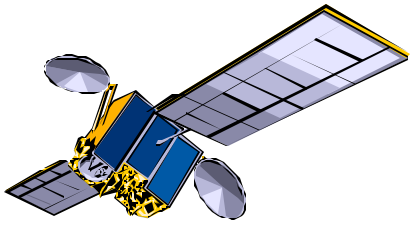
GPS Basics



Using Your GPS

As a crewmember you may be using the GPS to monitor the vessel's progress or even to guide the vessel along an intended track. The GPS is a remarkable navigation aid and it has taken much of the mystery out of fixing your position. Yet in a coastal environment the GPS system error can vary and this error combined with operator error can easily place your vessel in the wrong spot. The GPS may indicate that you are in safe water while in reality; you are heading into the rocks

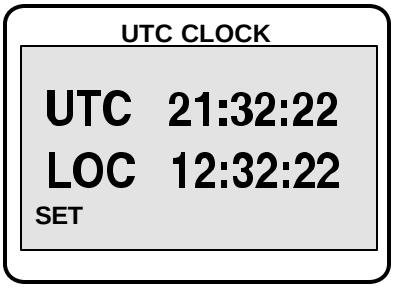
This section outlines some of the features that most GPS receivers have in common. Generic menus are used as examples for the different features so that a new user can read this section then practice using the functions on their own GPS.

GPS receivers come in different shapes and sizes and recently many companies are making inexpensive portable models that can be used on land or sea. Every make and model is different, therefore the only way to become a skilled GPS user is to spend a few hours with the owner's manual and the machine itself pushing buttons and practicing the menu routines.

Initialize the Receiver

Each receiver has a specific set up routine outlined in the owners manual. These steps should be followed carefully for mistakes in the set-up can induce errors in the system.

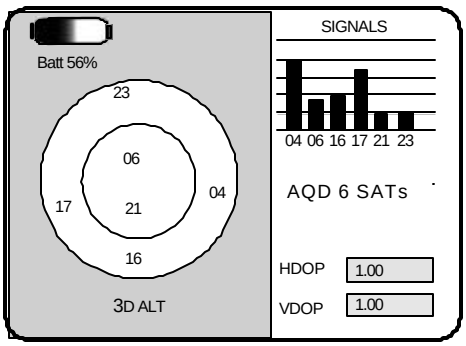
When the GPS is new or has been moved more than 500 miles since its last use it will need time to initialize. It may prompt you to enter an approximate position and a country code. You may be asked to enter the time and your time zone. The GPS system relies on the science of measuring small amounts of time difference so it is a good idea to ensure that the clock is set correctly.



GPS receivers are subject to errors and therefore positions should not be solely based on one source of information. When underway do not fall into the trap of following the GPS arrows, look up and use your eyes, your chart, and the radar to constantly monitor the progress of your vessel.

The Satellite Page

This page gives you an idea of what satellites are acquired and how strong the signals from them are. The receiver requires three strong signals for a two dimensional position and four signals for a three dimensional position. The circles represent the altitude (angular



height from the horizon) of each satellite. The middle of circle is higher and the outside of the circle is lower on the horizon. There will be some measure of position accuracy on this

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screen. This will indicate the quality of the position information based on a few factors. Satellites can become masked (obstructed) or lose their signal strength, and the receiver may not have strong enough signals or geometry to maintain an accurate position.

During initialization the receiver is gathering ephemeris (schedule) information from the satellites and storing that information in the memory for the next time you use it. The next start up will acquire a position much

Position Errors

HDOP

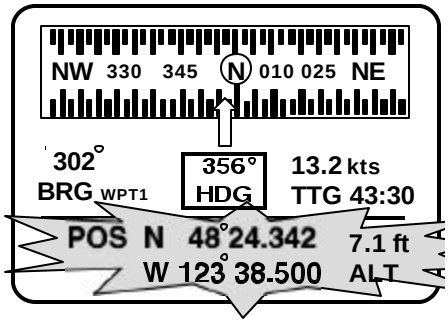
Horizontal Dilution of Position or HDOP is a measure of the quality of geometry. Signal geometry is good if you have satellites that are received from high and low altitudes. If the satellites are grouped too close together then your position accuracy becomes diluted, and HDOP goes up. Ideal reception occurs at an HDOP of 1.0 that's three satellites at 120? and one directly overhead. Questionable positions are at anything over 3.0 and when HDOP reaches over 5.0 the receiver will alert the user that the position is unreliable.

Geometric Quality (GQ) and Estimated Position Error (EPE)

These are two other measures of position accuracy found in many receivers and they usually will indicate the position accuracy within a range of metres.

If a GPS is getting bad data then it will do one of two things:

Sound or flash a warning alarm and switch to DR (dead reckoning) mode. This is when the receiver guesses your new position based on your course and speed from your old position. As the Royal Majesty (see story p. _____) discovered, a GPS in DR mode can be a dangerous thing if you do not know that it is guessing.



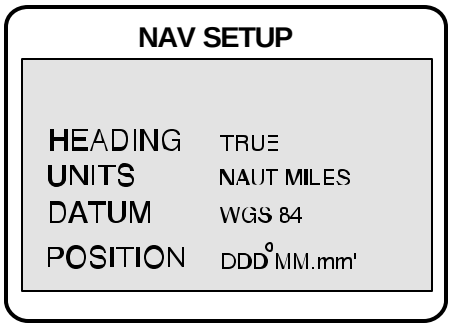
Flashing Coordinates can indicate Old data or an inaccurate position

Stop Updating

Most GPS receivers, when given old data will simply stop updating the position and start to flash or sound an alarm.

NOTE: Every crewmember should be familiar with the receiver's method of indicating an inaccurate position.

Navigation Set-up:



The owner's manual will guide you through setting up the proper datum and units.

Getting the right datum is a critical step that can't be overlooked when setting up your receiver. If your chart is based on NAD 27 and your GPS is set for WGS 84 then the GPS will indicate you are in the wrong spot on the chart. Most receivers will be set on WGS 84 as a default but have over a hundred different datums in the memory bank. Read your owners manual and follow the steps to setting the receiver to the correct datum and as you change charts don't forget to check your new chart for the datum it uses.

GPS Drill: Accuracy and System Check

Checking the accuracy of your system is part of a routine of constant vigilance. Before getting underway and while underway, crewmembers can practice the accuracy check by following these steps:

1. Switch to the position page and write down the position coordinates and compare those with the other position information at hand. (Radar, Compass bearings, Loran C).
2. Call up the satellite page and check your position error (EPE,GQ, or HDOP). How many satellites are you tracking?
3. Call up the Nav set-up page and check the system's chart datum and compare that with the datum used on your chart.

Using Common GPS Features

Waypoints and Routes (The specific menu routines for these functions can be found in the GPS owner's manual)

Waypoints are positions entered into the memory of a GPS receiver or chart plotter. A string of waypoints that is used to get somewhere is called a route. The individual paths between waypoints are the legs of the route. Most functions of the GPS are based around these three features.

Entering Waypoints

Most systems allow the user to enter waypoints using a few methods. Here are three common methods.

1. Name the waypoint and enter the latitude and longitude of the desired spot
2. Enter your present position and name the waypoint
3. Use a cursor on an electronic chart or plotter display to mark a spot and enter it as a waypoint.

NOTE: When naming waypoints, use geographical references to identify that position instead of numbers and letters (if your machine will allow this). This makes the waypoints easier to recognise in the memory and easier to place logically into routes (e.g. Henry Point ; Lama Pass East).

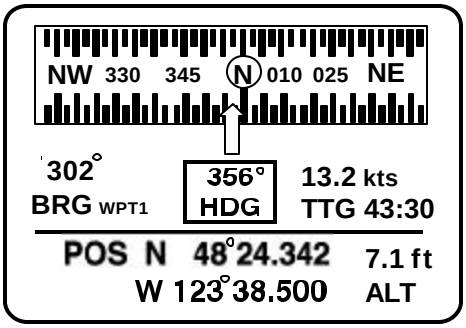
Routes

Routes can be used for regular trips that the vessel makes or for planning a passage in which you need to follow a specific path. A route is simply a list of linked waypoints that connect together. If you have a bank of stored waypoints in the memory then you can create a route by stringing them together and naming that route (e.g. Masset to Triple Island). The GPS will mathematically calculate the distances and courses to follow for each leg of the route, even without a position fix. You can use this list of leg courses and distances to verify your chartwork and make notes for your passage plan

When Underway

Position Screen

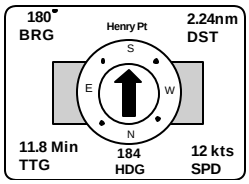
The position screen is the main screen that can be used to steer, fix your position and check the general status of the system. All the essential navigation information is here. Not all systems have the compass graphic but they will list your heading information



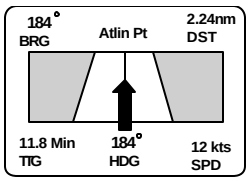
somewhere on this screen.

Navigation Screens

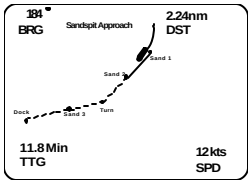
Most GPS systems have a few navigation screens to choose from, they are usually variations on the same three themes, compass screen, road screen and plotter screen. When following a route, going to a waypoint or fixing your position you can toggle back and forth to each of these screens.



Compass



Road



Plotter

Common GPS Abbreviations

Abbreviations	Meaning
ALT	Altitude
AQR	Acquiring
BRG	Bearing to a position
DST	Distance to a position
ETA	Estimated time of arrival
EPE	Estimated position error
Ft	Feet
GQ	Geometric quality
HDG	Heading of vessel over Ground
Kts	Nautical miles per hour
M	Metres
MAG	Magnetic
NM	Nautical mile
SAT	Satellite
SPD	Speed of vessel over ground
TRK	Track of vessel over ground
TRU	True
TTG	Time to go until arrival at position
WPT	Waypoint
XTE	Cross Track Error

Compass Screen

This screen displays your course in reference to the cardinal points of the compass and an arrow will indicate the direction of your waypoint. This screen is easy to see and the large arrow in the middle makes it a useful quick reference while steering. It will give you the direction of your track over ground and this can be compared to your magnetic compass or gyrocompass heading.

Road Screen

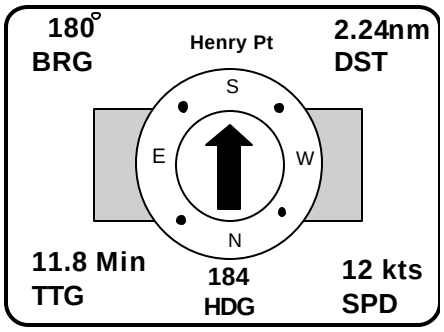
The road screen is designed to give the navigator an idea of how far the vessel has strayed off of the intended track (XTE or cross track error). The width of the road can be set to any desired value. The waypoint is indicated at the end of the road and the BRG is the course to steer to the waypoint. SPD and HDG are speed and heading calculated over the ground and the vessels movement through the water may be different. The road screen is effective in determining exactly how much you are being pushed off of your course.

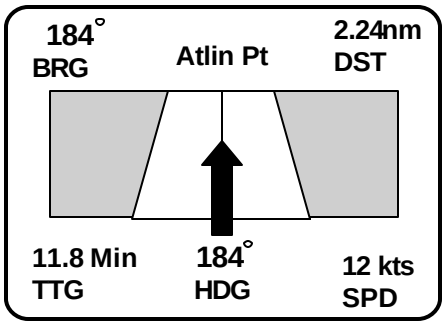
Cross Track Error

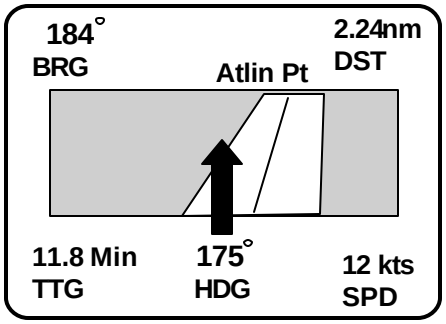
Wind, current or an unplanned course alteration can put you off of your intended track. When your vessel is being set off track, the road will move sideways and the end of the road indicates the direction in which you must steer to get back on the track to your waypoint. Not all screens have an arrow to indicate your heading but you can use this arrow to estimate a course to swing back to your track and then steer to the waypoint.

Plotter Screen

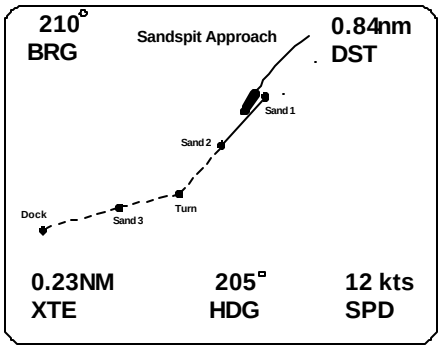
The plotter screen is great for seeing where you have been. When following a course, searching a shoreline or running an open water search pattern, the plotter will show your path over the ground. The plotter will also display your route or string of waypoints and provide a graphical reference of where your vessel is on the route. This screen can also be helpful when estimating your cross track error and let you steer back to your intended track







If the road width is set at 1 mile then this vessel is a ¼ mile off of the track. And heading in the wrong direction.



GO TO

This function allows the user to set a direct path to a position manually entered by coordinates, a plotter or a stored waypoint.

MOB (Man Overboard Board)

If someone falls over the side or you just need to mark a spot quickly and steer back to it then the MOB button will set your system to focus on that spot and provide a course to steer, distance to and time to go before you get there.

Creating a Route

Once you have waypoints in your systems memory you may wish to use them to create a route or make an entirely new route from different waypoints. When you select a string of positions and link them together the system will calculate the courses to steer between them and the distances of the legs. You can select and change the waypoint order and follow this route in either direction. Sometimes you may wish to delete or add a waypoint in a route.

RT SANDSPIT

WPT	BRG	DST
SAND 1 SAND 2	210	1.1NM
SAND 2 TURN	220	1.0 NM
TURN SAND 3	265	0.8 NM
SAND 3 DOCK	263	0.5 NM

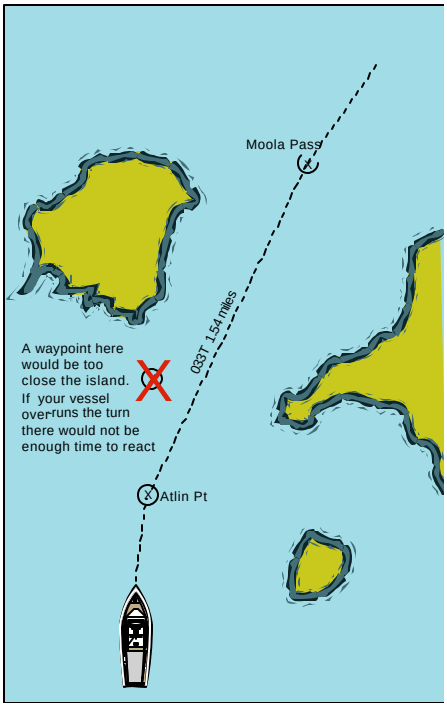
Route Planning

When you plan your routes, place the waypoints in open clear water to make sure that your course lines for the legs of your route pass through safe water When planning turns at the beginning of the next leg, place the waypoint in a spot that will forgive errors

GPS systems can be very accurate but not very smart:

The GPS only knows mathematical differences between coordinates on a sphere and it uses that and your position information to steer you to those points. The machine does care if there are rocks, islands or continents in your way. It will quite happily steer you through the middle of these things.

Placing your Waypoints

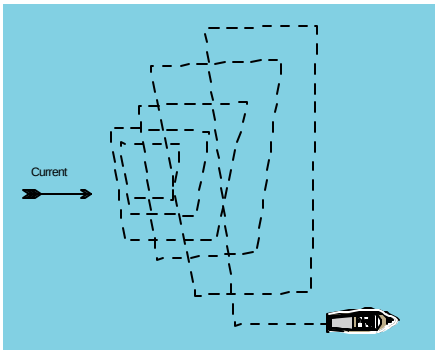


The waypoints are placed in clear water and named using a geographical reference not a number or letter.

Using the GPS in searches

The GPS can be used in many ways during a search. If the JRCC provides the coordinates of a vessel in trouble or the commence search point for a search you can enter that position as a waypoint and hit the GOTO button for a direct line to that spot, provided the path is clear of dangers. In islands or along a shoreline, you can create a route with that position as the end of your last leg.

Using the GPS to run open water search patterns may not be good idea. The GPS does everything in reference to the ground and not the surface of the water. When searching for a person or object on the water you want your search pattern moving with the water surface and not staying with the ground. By using a stopwatch and timing your search legs, you will keep your pattern on the surface, and when you look at your GPS plotter your ground track will be skewed in the direction of your current. If you use the GPS to guide your vessel



through the pattern, the pattern will stay still while your search target may be drifting away.