Magellan GPS Satellite Navigator

Reference Guide

Welcome from the Magellan crew.

With the purchase of a Magellan GPS satellite receiver, you have joined the thousands of people who enjoy using GPS in their professional and recreational activities.

Since we introduced our first product more than five years ago, Magellan has established a reputation for product excellence and customer support. Our customers include sailors, commercial fishermen, pilots, geologists, explorers, surveyors, and the Allied Forces in Desert Storm. Your receiver represents the next generation of GPS technology — technology that is combined with our hallmark durability and ease of use, which have evolved over years of field experience.

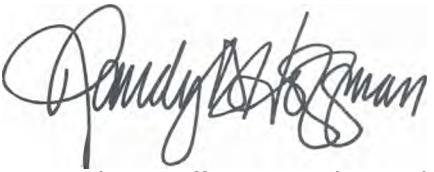
With your receiver are two documents: the *Reference Guide* and the *Field Guide.*

> Like the Magellan GPS receiver, the *Field Guide* is tough and ready to go where ever your adventures take you. Printed on waterproof "paper", its purpose is to explain how to operate the receiver — in any weather. When not in use, the *Field Guide* fits neatly in the carrying case that is provided with the receiver.
>
> The *Reference Guide,* which you are reading now, provides Background information that will give you a deeper technical appreciation of the receiver and the GPS technology in general.

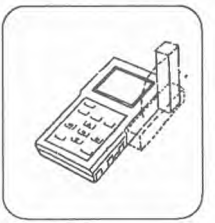
Where ever your outdoor recreation excursions take you, we hope your Magellan receiver will add to your fun and safety.

So that your experiences contribute to the next generation of Magellan receivers, I need to hear from you. All comments will be considered for incorporation into future products. Address your letters to me at Dept. 3-A.

Yours truly,



Randy D. Hoffman, President and CEO
Magellan Systems Corporation
Dept. 3-A
960 Overland Court
San Dimas, CA 91773



WARNINGS

USE GOOD JUDGEMENT

This product is an excellent navigation aid, but does not replace the need for careful orienteering and good judgement. Never rely solely an one device for navigating.

USE CARE

The Global Positioning System (GPS) is operated by the U.S. Government, which is solely responsible for the accuracy and maintenance of GPS.

The accuracy of position fixes can be affected by the periodic adjustments to GPS satellites made by the U.S. Government and is subject to change in accordance with the Department of Defense civil GPS user policy and the Federal Radionavigation Plan.

USE CAUTION

Accuracy can also be affected by poor satellite geometry. When the accuracy warnings appear an the screen, use the data with extreme caution.

USE PROPER ACCESSORIES

Use only Magellan cables and antennas; the use of non-Magellan cables and antennas may severely degrade performance or damage the receiver, and will void the warranty.

1 First-Time GPS Users

This section is to help readers who are new to navigation or to electronic navigation equipment. It explains terms that are commonly used by navigators worldwide and some basic concepts of navigation, such as position fixes and coordinates.

Navigation

Navigation is getting from one place to another. It is also knowing where you are in relation to the path between those locations. At its most basic, navigation is getting from here to there and home again. At its most advanced, navigation has been called both an art and a science.

In the past, people left markers — blazes cut into trees, sticks laid out in a particular pattern, or even small piles of stones — to mark a location or to show the correct path to an important position. Later, these paths were charted. This eventually developed into the maps and charts we use today.

Today, markers can be made electronically with a GPS receiver, even at sites that do not permit leaving physical marks, such as on a lake. You can mark a path even in featureless terrain by making electronic blazes (called waypoints) and storing them in the receiver's memory. These electronic markers can be used to return to your starting position, and can be reused again and again.

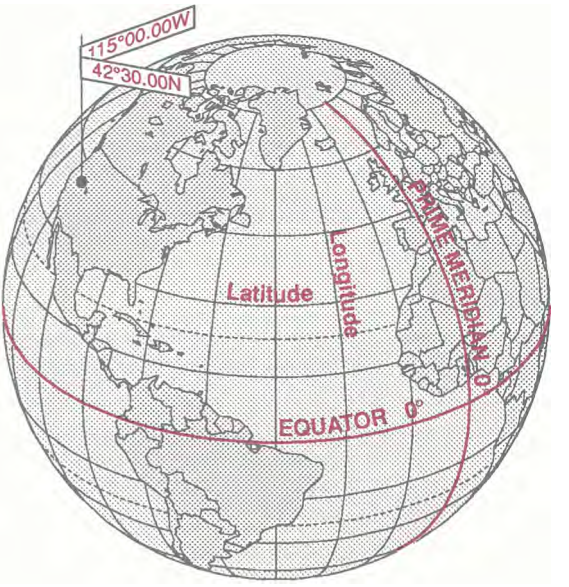
All you have to do to make full use of this wizardry is become familiar with a few terms and what they mean.

Latitude and Longitude

A *position* is a location that can be described in a unique, numerical way. The format that is used to describe a position is called a coordinate system. The most common coordinate system in use today is Latitude/Longitude (Lat/Lon).

Lat/Lon projects lines of latitude (parallels) and lines of longitude (meridians) onto the earth. Lines of latitude are the equator and the horizontal lines that are "parallel" to it. Lines of longitude are the vertical lines that are perpendicular to the equator and pass through the poles. A position is described as the intersection of a line of latitude and a line of longitude.

This is much like describing a position in a city by the street intersection, but "Fifth and Main" can describe more than one location, since these are commonly used designations. Lat/Lon uses numbers and hemisphere to describe each position in a unique way. Using Lat/Lon coordinates, no position can be confused with any other.



In Lat/Lon, positions are described as being so many degrees north or south of the equator (up to the poles, which are 90°N and 90°S; the equator is 0° latitude), and so many degrees east or west of the Prime Meridian, which is 0° longitude. (The Prime Meridian passes through Greenwich, England.) Parts of a degree are minutes; there are 60 minutes (written as 60') to a degree. Minutes can also be divided into smaller units. Fractions of a minute can be expressed as decimals or as seconds. (There are 60 seconds to one minute written as 60"). So a Lat/Lon position coordinate can be expressed in two ways, which your Magellan GPS receiver displays as 25°47.50 or 25°47'30.

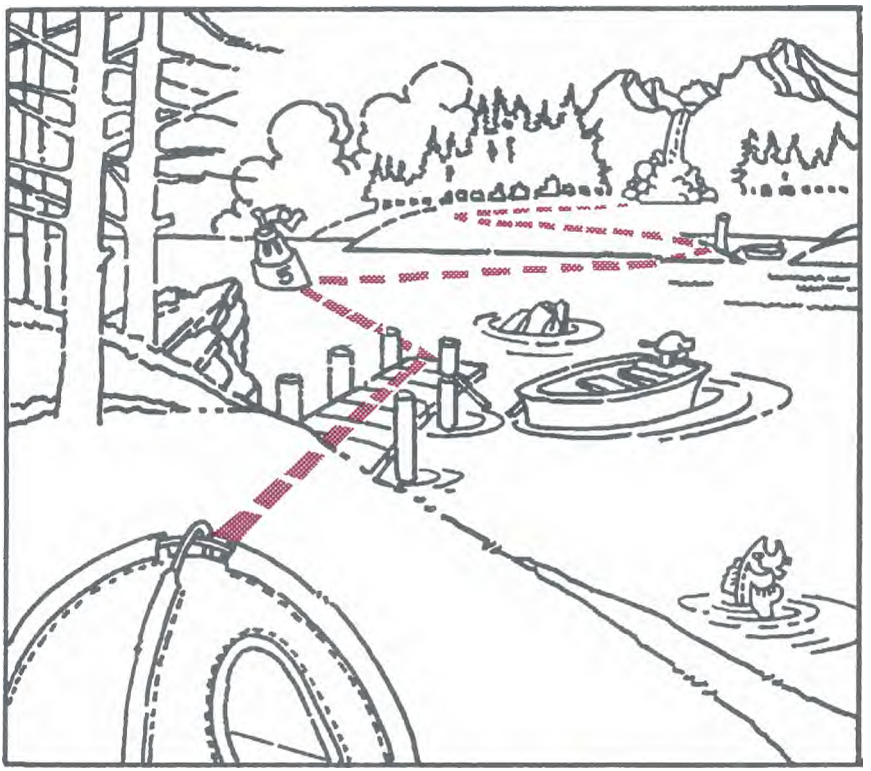
The Magellan GPS receiver can also display coordinates in another common coordinate system — UTM, or Universal Transverse Mercator. UTMs are described at the end of this section.

Using Position Fixes to Record Your Movement

A *position fix* is the coordinates of a location as determined by your GPS receiver, positioning with a map and compass, or some other orientation technique. It "fixes" your position to a specific place. If the fix is saved (either by writing it down or by storing it in the receiver's memory), the fix becomes a *waypoint.* The difference between a fix and a waypoint is that the waypoint can be recalled for use at a later time.

Imagine that you are camping in the area illustrated on the next page. Before setting out to explore the area, you determine the position of your camp (latitude/longitude) by obtaining a position fix, which you store as waypoint

"CAMP." As you walk to your skiff at the dock, the receiver continues to obtain position fixes; these are "updates" to the first fix obtained. Once at the dock, you save the current position fix as waypoint "DOCK." Instead of travelling directly across the lake to the inlet on the other side, you make a detour to the buoy to avoid an area you know is too shallow for your craft. Save the position fix at the buoy as waypoint "BUOY." You now continue to the inlet, where you tie up your skiff and save another position fix as waypoint "INLET."

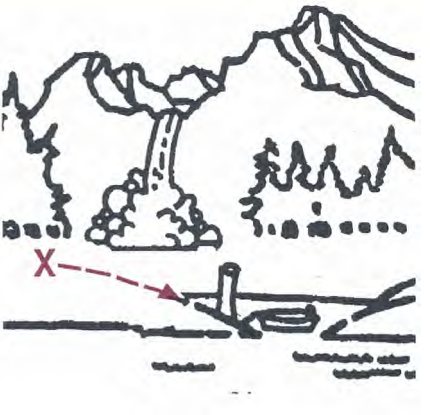


The position fixes that are saved as waypoints (CAMP, DOCK, BUOY, and INLET) can be used as electronic markers to record where you've been. These waypoints can also be used to guide you back to your camp.

Navigating Home With Waypoints

When it's time to return to your camp, you decide to establish your course and navigate with the GPS receiver. Becoming familiar with the receiver now may help you on a later trip if weather conditions (cloud cover, rain, etc.) should make using your own navigation skills difficult, or if you need navigation assistance in an emergency.

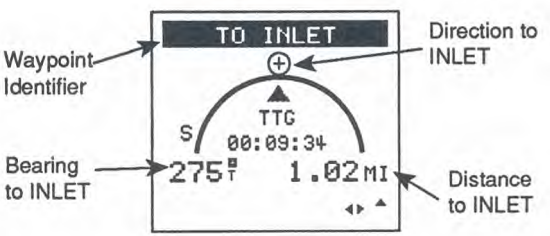
The first thing you have to do is to return to your skiff, which you do by getting a current position fix, then setting a Direct-To course. A Direct-To course is a straight line from your current position to the waypoint you select. Here, the Direct-To course is to waypoint "INLET".



The Direct-To function will tell you the distance and bearing from the present position to INLET. Bearing is the relative direction of the destination with respect to north.

Distance is a great circle measurement, which means that it is the shortest distance between two points along the curved surface of the earth. Measurements made on a map are rhumb line measurements, or the shortest distance between two points on a flat surface. When projected back to the globe, it is apparent that the rhumb line measurement is both less direct and longer than the great circle measurement, though the difference between the two may be slight over short distances.

As you move toward INLET, you have both speed and direction of movement. Speed is SOG, or speed over ground (sometimes referred to as groundspeed).



The direction you are moving is your track, or COG (course over ground). In this example, COG is about 275°T. If you stay on your intended course, COG will be the same as bearing to the intended destination.

Time to go (TTG) is based on the distance to the destination and how quickly you are moving toward it.

If you stray off course while using the GPS receiver, the receiver will indicate the degree and direction of your error, and a steering correction. (This is described in more detail in *Navigating with a Route.)*

Setting a Route with Stored Waypoints

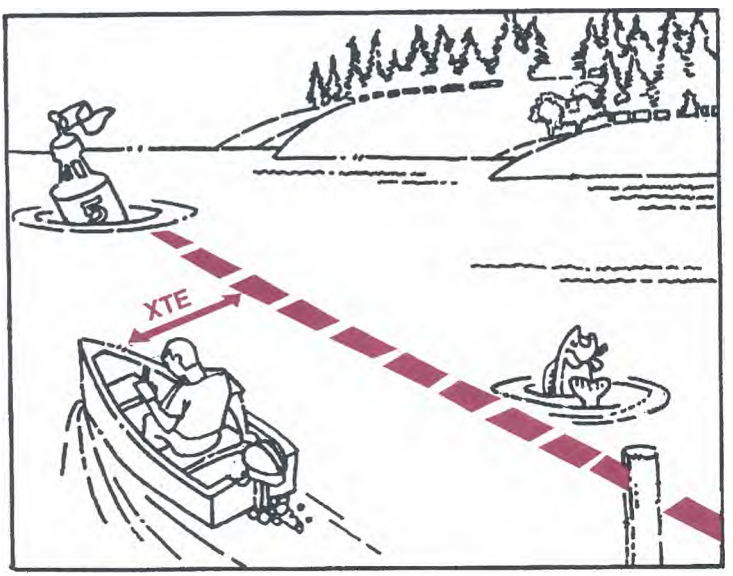
To navigate safely from the inlet to the dock, you set a route from INLET to BUOY, then to DOCK. A route is required to help you avoid the shallow area or any rocks that you may not see when visibility is poor.

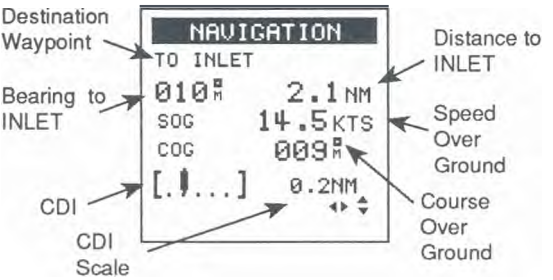
A route is a planned course from one place to another. It is often divided into shorter units, called legs.

Navigating with a Route

To be sure that you avoid shallow or rocky areas, you must stay on course. Any time you stray from the courseline of the current leg, the Magellan GPS receiver will display a cross track error, or XTE.

XTE is the distance between you and the courseline, measured as a perpendicular from the courseline to your current position. It also indicates whether you are to the right or left of the courseline. XTE does not include any variable for the direction you or your craft are actually facing.





The Magellan GPS receiver displays XTE graphically on a course deviation indicator, or CDI. The CDI displays the courseline at the center of a scale, and your current position relative to the courseline is shown as a symbol. When you are to the left of the courseline, the symbol is to the left of the CDI's center.

As you travel, the navigation displays will be updated with each position fix update. You will always know where you are in relation to your destination and courseline. When you get within 500 feet of the leg's destination, the receiver will display "CLOSE" at the bottom of the screen. When you are within 200 feet of the destination, "ARRIVED" is displayed.

If you are on a multileg route, the receiver will switch legs when you cross an imaginary line that is perpendicular to the courseline and bisects the destination waypoint.

Entering a Waypoint

It is not necessary to visit a place for its coordinates to be in the receiver's memory. You can obtain coordinates from a friend or pick them up from a map and key them into the receiver as a waypoint.

Please refer to *Tutorial* in this guide to key in a waypoint. Refer to *Reading a Map* to get waypoint coordinates from a map.

UTM Coordinates

Another commonly used coordinate system is UTM (Universe Transverse Mercator), which is generally found on land-based maps and quad sheets that are produced by government map providers. On land, you may find that UTM coordinates are easier to use than Lat/Lon.

UTM coordinates are easy to use, but since the model it is based on is somewhat abstract, this section is a very simplified introduction to UTM.

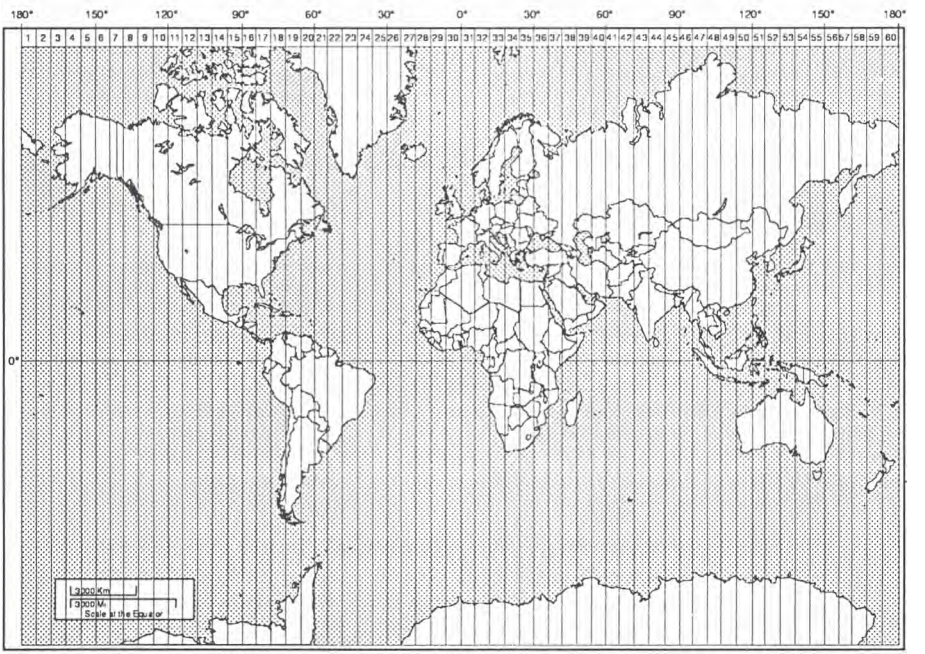
Instead of projecting an imaginary grid of intersecting lines onto the globe, UTM projects sections of the globe onto a flat surface. Each of these sections is called a "zone." There are 60 zones to cover the entire earth between 84°N and 80°S (polar areas are not described by UTM). Each zone is 6° wide as projected from the earth's center.

A UTM position is described by three elements; the zone it is in, the easting, and the northing. Eastings and northings measure how far into a zone a position is in meters. Eastings are an east/west measurement, and correspond roughly to longitude. Northings are a north/south measurement, and correspond to latitude.

This chart shows Magellan's position described in both Lat/Lon and UTM coordinates. Your GPS receiver can display coordinates in all of the manners shown.

LAT/LON	
DEG/MIN	DEG/MIN/SEC
34°06.58N	34°06'35"N
117°49.56W	117°49'34"W

UTM
11 4 23 818 E
37 74 624 N



NOTE: The area described by the UTM coordinate system extends to 84°N and to 80°S.

APPLICATIONS

In addition to the use described in the preceding example, the Magellan GPS receiver is ideally suited to a wide variety of outdoor activities, including:

Backpacking — you have the freedom to explore places that are off the beaten path or snow-covered areas with the security of knowing that you can easily return to the trail with either the Direct-To or Backtrack™ features.

Cross Country Skiing — find your way in any weather conditions, even if snow fall obscures your trail or in poor visibility.

Hunting —scout a potential hunting area before the season starts, and save promising locations or important landmarks as waypoints. You will then be able to reach any of these waypoints or return to base, even before dawn or in poor weather.

Fishing (salt or fresh water) — save your favorite fishing spots in the receiver's memory as waypoints, even when fishing on a boat other than your own. Travel to or from these waypoints even in fog.

Sailing and Boating — the portable receiver is ideal for use in rental or vacation craft. The receiver includes an MOB (man overboard) feature under the Direct-To function.

Gliding and Hang Gliding — navigate with greater safety when cloud cover sets in or the weather changes suddenly.

Canoeing and Kayaking — enter hazards and portages as waypoints to monitor how close you are to them. Note your progress along the river in unfamiliar surroundings. Locate rendezvous sites easily.

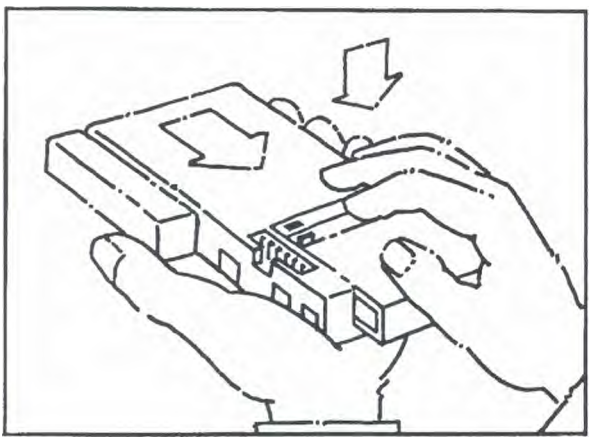
2 General Usage

POWER

The receiver is powered by three AA batteries. It can also be powered from an external DC power source by using the optional Magellan Power/Data Cable.

Batteries. We suggest using AA alkaline batteries to power the receiver. (Magellan Systems recommends Eveready Energizer™ batteries.) Alkaline batteries will power the receiver for 5 hours or more of continuous operation.

To insert batteries, remove the battery tray as illustrated and insert batteries as indicated within the battery tray.



When the battery power level drops, a warning message will appear on all displays (LOW BATT). The receiver still has sufficient power to operate for up to 30 minutes if alkaline batteries are being used.

When the batteries no longer hold enough power to operate the receiver, the receiver turns itself off. The batteries will still be able to maintain the memory for a time, but the receiver can be operated only if external power is supplied or if fresh batteries are installed.

NOTE

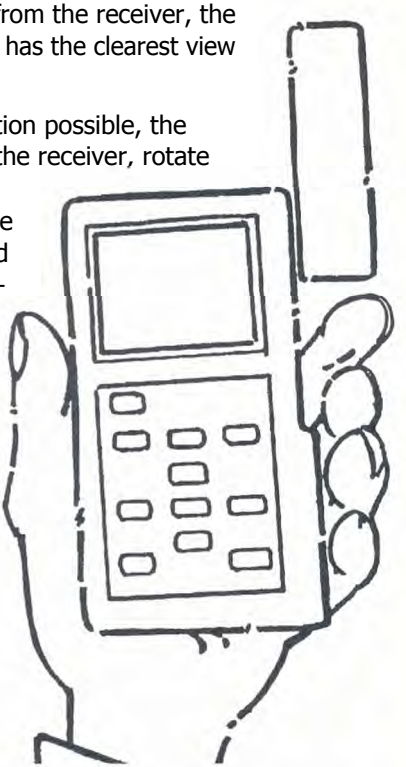
Batteries are not recharged in the receiver.

It is possible to use rechargeable batteries, but there are a couple of things you should be aware of when using them. Commercially available NiCad batteries typically have poor power performance after repeated use, and rechargeable alkaline batteries maintain only 50% of the useful life of standard alkaline batteries. Rechargeables also have a very sudden power drop at the end of their charge. The drop may be so sudden that the battery warning is not displayed, although memory can be maintained for a while.

External Power. The receiver can be connected to an external DC power supply with the optional Power/Data Cable. The cable converts DC power to a level usable by the receiver, and can also be used to output positioning data for use by electronic navigation equipment that conforms to NMEA standards. (Do not use a non-Magellan cable, which may damage the receiver and will void the warranty.)

THE ANTENNA

The receiver has an attached quadrifilar antenna, which rotates 360°. Using the extension cable and suction cup provided with the optional Mounting Kit, the antenna can also be removed from the receiver and temporarily mounted to any convenient surface. (The antenna is removed by rotating it until its base is parallel with the display, then pulling it away from the receiver.) Since it can be used detached from the receiver, the antenna can always be placed wherever it has the clearest view of the sky.



In order to provide the best signal reception possible, the antenna must be vertical. If attached to the receiver, rotate the antenna from its storage position to the upright position. If detached from the receiver, the antenna should be mounted as vertically as possible with the connecting cable at the bottom.

GPS signals will pass through glass and canvas (such as bimini tops). You may experience some signal loss in areas of heavy foliage. (Do not stand under a tree in full leaf.) Signals will not go through metal, and you are unlikely to obtain signals in a permanent structure. Signals can be temporarily blocked by trees, masts, and people. If you are unable to obtain satellite signals when out of doors, try moving slightly to get a better view of the sky. If the receiver is being operated in a covered location (such as a navigation station), you may want to use the optional External Antenna Kit. (Use only a Magellan antenna; the use of a non-Magellan antenna may greatly degrade the performance of the receiver.)

The best results will be obtained when the antenna has a clear, unobstructed view of the sky.

INITIALIZATION

Initialization is the preparation you do before the receiver is used for the first time or after memory loss. It should also be done when the receiver is moved 300 miles or more from its last position fix. You can enter only the initial position and the current date and time, or you can completely customize how the receiver displays information.

This section describes how to enter the initial position, time, and date. Once they have been entered, the receiver will check its internal almanac to determine which satellites are likely to be visible at its location. (An almanac is a schedule of where each satellite in the system is at any time.) The receiver will locate these satellites and display a first position fix within a few minutes, if you are in an unobstructed environment. Once the receiver has obtained its first position fix at first use or after a memory loss, the time to first fix will be shorter.

Not initializing the receiver will greatly increase the time to first fix.

NOTE

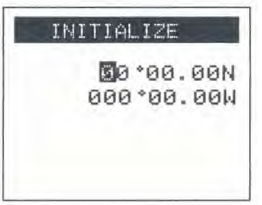
If you do not initialize the receiver before using it for the first time, after a memory loss, or after moving it 300 miles or more from its last position fix, the receiver will require 15 minutes or more to locate and acquire enough satellites to display a position fix. If you do not know your coordinates, most atlases list the latitude and longitude of major cities in their index, or use the city cross-reference on the (separate) Magellan Initialization Map to identify a location near you.

Initial Position. By entering an initial position you are informing the receiver of approximately where it is; you should know this position within 300 miles (approximately 480 km). If you do not know your coordinates, refer to the City Reference Chart to key in the coordinates of the nearest City.

To enter an initial position:

1. Press **AUX/SETUP,** and the **LEFT ARROW.** "INITIALIZE" is highlighted. Press **ENTER.**

2. The initial position is displayed as zero position coordinates in Lat/Lon and degrees/minutes.



3. Press the **UP/DOWN ARROWS** to enter the first digit of your latitude. (Data entry is described in more detail in *Tutorial.)* Press the **RIGHT ARROW** to move the cursor to the next digit and repeat. If necessary, change the displayed hemisphere (N or S) by moving the cursor to the hemisphere and pressing the **UP/DOWN ARROW.** Press **ENTER** to save the entry.

4. Enter your longitude in the same manner as the latitude. Press **ENTER** to save the entry.

5. Key in your elevation (mean sea level) in feet. If necessary, toggle the ± elevation prefix with the **UP/DOWN ARROW.** Press **ENTER.**

   The unit of measure for elevation can be changed later in SETUP. If you know what your altitude is in feet, enter it now; the receiver will automatically make all necessary conversions if you later change the unit of measure to meters.

NOTE

If an elevation is not entered here, the receiver will assume that it is at sea level (0 feet). If you are not at sea level, this may affect the accuracy of the position fixes computed by the receiver, depending on the elevation mode selected. Refer to *Elevation Mode* for more information.

6. Next, the receiver displays prompts for current time input. Key in the local time on an AM/PM clock and press **ENTER.**

NOTE

Once the receiver has collected time from a satellite, time and date will be displayed as part of INITIAL POSITION only when you first turn the receiver on.

The Magellan GPS receiver can display time on a 24-hour local clock, a 12-hour local clock (AM/PM), or UT. UT, or Universal Time Coordinated, is the time that is current at the Prime Meridican. Local 24-hour and UT clocks are selected elsewhere in SETUP.

7. Date appears after time has been entered. Key in the current local date (day/month/year) and press **ENTER.** The date can also be displayed as month/day/year; that format is selected in SETUP.

NOTE

If you do not make time and date entries, the receiver will require additional time to search for satellites before computing its first position fix. Time and date will then be displayed in UT.

SETUP

Much of the information the receiver displays can be changed to suit your specific needs. All customizing is done from the SETUP menu.

Once a setting is changed in SETUP, it remains changed until memory is lost or cleared, or until the setting is changed manually. To exit the SETUP feature, press any of the three function keys, or press ENTER to return to the SETUP menu.

Coordinate System. This changes which coordinate system is used to display the position fix, waypoints, and last fix Buffer.

1. From the SETUP menu, use the **DOWN ARROW** to highlight "COORD. SYSTEM" and press **ENTER.**

2. Press the **UP/DOWN ARROW** to toggle between Lat/Lon and UTM. (Default is Lat/Lon displayed as degrees/minutes.) Press **ENTER.**

3. If Lat/Lon was selected, the receiver shows the two available display options. Press the **UP/DOWN ARROW** to select degrees/minutes or degrees/minutes/seconds.

4. Press **ENTER** to return to the SETUP menu.

North Reference. This is often referred to as magnetic variation. The receiver should be set to use the same reference as your other navigation aids.

1. From the SETUP menu, highlight "NORTH REF." and press **ENTER.**

2. Press the **UP/DOWN ARROW** to toggle between true and magnetic. (Default is magnetic.) Select magnetic if you are using a compass. Select true if you are using a map or chart without any other navigational aids.

3. Press **ENTER** to return to the SETUP menu.

Time Display. The receiver stores time as UT, but can also display time in the local clock by computing and storing an offset that is applied to UT before display. If you select a local clock display, you may choose AM/PM or 24-hour.

1. From the SETUP menu, highlight "TIME DISPLAY" and press **ENTER.**

2. Press the **UP/DOWN ARROW** to toggle between local (24 hour), local (AM/PM), and UT. (Default is UT.)

3. Press **ENTER.** It you selected local time, key in the current time. If AM/PM was selected, use the **UP/DOWN ARROW** to select AM or PM. Press **ENTER** again.

NOTE

This feature cannot be accessed until UT has been entered by the user or the receiver has collected time from a satellite.

The receiver will accept any local time you enter, but will round off your entry to the nearest half-hour UT offset, and will use the minutes and seconds collected from the satellites.

Map Datum. A map datum is a set of mathematical assumptions on which measurements and positions on the surface of the earth are based. There are a number of datums in common use, each based on a different set of values and measurements.

The Magellan GPS receiver can display position fixes in twelve of the most commonly used datums. (Default is WGS84.) Using an incorrect datum may cause the receiver to display position coordinates that differ from those on the map. Whenever possible, set the receiver to use the datum that was used to create the map or chart you are using; this information can be found in the legend.

If your map's datum is not defined in the receiver, you may be able to identify a defined datum that is very close to it. Locate a nearby landmark on your map and obtain a position fix there. Compare the coordinates to the ones on the map, then select another datum. Use the datum that produces position coordinates that are closest to the ones on the map.

If you are not sure which datum was used to create your map, try the procedure above, or use the datum the describes the area you are in. For example, use NAD27 if you are in North America. When in doubt, use WGS84.

Datum	Full Name	Area
WGS84	World Geodetic System	Worldwide
AUS84	Australian 1984	Australia and Tasmania Isl.
EUROP	European 1950	Austria, Belgium, Denmark, Finland, Germany, Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, & Switzerland
CAPE	Cape	South Africa
GRB36	Ordnance Survey of Great Britain, 1936	England, Isle of Man, Scotland, Shetland Islands, & Wales
KKJ		Finland
NAD27	North American 1927	Contiguous U.S., Bahamas, Canada, Caribbean, Cuba
OHAWA	Old Hawaiian	Kauai, Oahu, Maui, Hawaii
RT90		Sweden
SAM56	Provisional South American 1956	Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, & Venezuela
SAM69	South American 1969	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Trinidad and Tobago, & Venezuela
TOKYO	Tokyo	Japan, Korea, & Okinawa

1. From the SETUP menu, highlight "MAP DATUM" and press **ENTER.**
2. The first four datums are displayed. Press the **DOWN ARROW** to scroll through the 12 datums until the desired one is highlighted.
3. Press **ENTER** to return to the SETUP menu.

Elevation Mode. This setting determines whether the receiver will compute position only or position and elevation. The 2D mode is recommended for use at sea, where 2D will provide the best accuracy and often the best performance. The 3D mode is recommended for land use. Automatic (AUTO) switches between 3D and 2D, depending an the number of visible satellites. (Default is 2D.)

Position accuracy in 2D Operation is affected by the accuracy of the elevation entered during initialization. An accurate elevation will produce more accurate position fixes.

1. From the SETUP menu, highlight "ELEV. MODE" and press **ENTER.**
2. Press the **UP/DOWN ARROW** to select the desired operating mode.
3. Press **ENTER** to return to the SETUP menu.
4. Press the **UP ARROW** to access INITIALIZE. Key in the current elevation, then press **ENTER** to return to the SETUP menu.

Distance Units. The receiver can display distance and Speed measurements as nautical miles (NM) and knots, statute miles (ST. MILES) and miles per hour, or kilometers (KM) and kilometers per hour. (Default is statute miles and miles per hour.)

1. From the SETUP menu, highlight "DIST. UNITS" and press **ENTER.**
2. Press the **UP/DOWN ARROW** to toggle between NM/KNOTS, ST.MILES/MPH, and KM/KPH.
3. Press **ENTER** to return to the SETUP menu.

Elevation Units. Elevation can be displayed as feet or meters. (Default is feet.)

1. From the SETUP menu, highlight "ELEV. UNITS" and press **ENTER.**
2. Press the **UP/DOWN ARROW** to select meters or feet.
3. Press **ENTER** to return to the SETUP menu.

Backlight Brightness. The intensity of the backlight can be adjusted. This is most easily done when the backlight is on. (Default is high.)

1. From the SETUP menu, highlight "LIGHT BRT." and press **ENTER.**
2. Press the **UP/DOWN ARROW** to toggle between LOW and HIGH.

   It is best to select LOW on extremely dark nights, when you want to preserve your night vision.
3. Press **ENTER** to return to the SETUP menu.

Contrast. Contrast the difference in intensity between the characters and the display's background. You may select low, medium, or high contrast. (Default is medium.)

1. From the SETUP menu, highlight "CONTRAST" and press **ENTER.**
2. Press the **UP/DOWN ARROW** to toggle between LOW, MEDIUM, and HIGH.
3. Press **ENTER** to return to the SETUP menu.

THE AUXILIARY FUNCTIONS

Auxiliary functions are miscellaneous operating features. In general, these are features that are not used as often as navigation or position.

To access an AUX function:

1. Press **AUX/SETUP,** then the **RIGHT ARROW.**
2. The receiver displays the AUX menu. Press the **UP/DOWN ARROW** to select the desired option, then press **ENTER.**

Any changes made to an auxiliary function are retained until the receiver's memory is lost or cleared, or until the setting is changed by the user.

Softlock™. When activated, softlock prevents the receiver from being turned on unless a specific key sequence (AUX, RIGHT ARROW, CLEAR) is pressed on power-up. (This key sequence is displayed on power-on when Softlock has been turned on.) This prevents the receiver from being turned an accidentally.

Sampling. Sampling causes the receiver to turn itself on every 10 minutes, compute a position fix, store the fix in the buffer, and turn itself off. Sampling will continue until it is turned off or until the battery warning is displayed.

In order to use this feature, the receiver must remain in an open area with the antenna upright and fully visible to the sky. If the antenna can't see enough

of the sky to locate and acquire sufficient satellites, the receiver will be unable to obtain a position fix. The receiver should also be set to either 2D or 3D operation (not AUTO) for the best results. If 2D is selected, be sure the elevation at INITIAL POSITION is correct.

When sampling is set, a warning message appears on the power-down display. Be sure to leave the receiver where it can obtain fixes.

Clear Memory. This feature erases all of the waypoints, routes, and backtrack buffer, and returns all SETUP and AUX settings to default.

Clear Memory can be accessed without going through the AUX menu. Memory can be cleared at any time — even when the receiver is off — by pressing AUX/SETUP, NAV/ROUTE, CLEAR, and ENTER at the same time. If the receiver is being carried in a pack or the carrying case, always be sure the keys face a hard surface that is unlikely to press against the keys in this manner; the *Field Guide* should be adequate.

WARNING

Do not use this feature unless you **really** want to erase everything in the receiver's memory. Guard against accidental activation by placing a firm, flat object against the keys when the receiver is carried in a pack.

Once memory is cleared, the receiver will turn itself off. To continue operating, you must turn the receiver on again.

Erase Waypoints. You may erase all waypoints in the receiver's memory. This will also delete any existing route.

NMEA. NMEA is the communication standard for electronic marine navigation equipment. The receiver can output positioning information in the 0183 format of the NMEA standard to support navigation aids such as autopilots and moving maps. This requires that:

- the receiver be connected to the NMEA device with the Power/Data Cable (refer to *Optional Accessories)*
- the NMEA device must use the 0183 format
- the GPS receiver is on and computing fixes before the dataport and device are turned on

In order to support this equipment, the receiver must operate continuously. This can be a very heavy drain on the receiver's batteries; if supporting an NMEA device, consider operating from external Power.

Velocity Averaging. As you use the receiver, you may notice that the velocity measurements fluctuate. This is caused by selective availability (SA). (SA is described in Chapter 4.)

Velocity Averaging minimizes this effect by displaying an averaged speed measurement.

There are three Velocity Averaging settings:

- OFF (no averaging) is most useful in high-dynamic environments where a rapid response to changes in COG or SOG are required.
- 20 SECONDS is useful in low-dynamic environments where such a rapid response to changes in COG and SOG is not necessary. Such environments include bicycling.
- 60 SECONDS is used in low-dynamic environments where immediate changes in COG aor SOG are relatively unimportant, such as hiking.

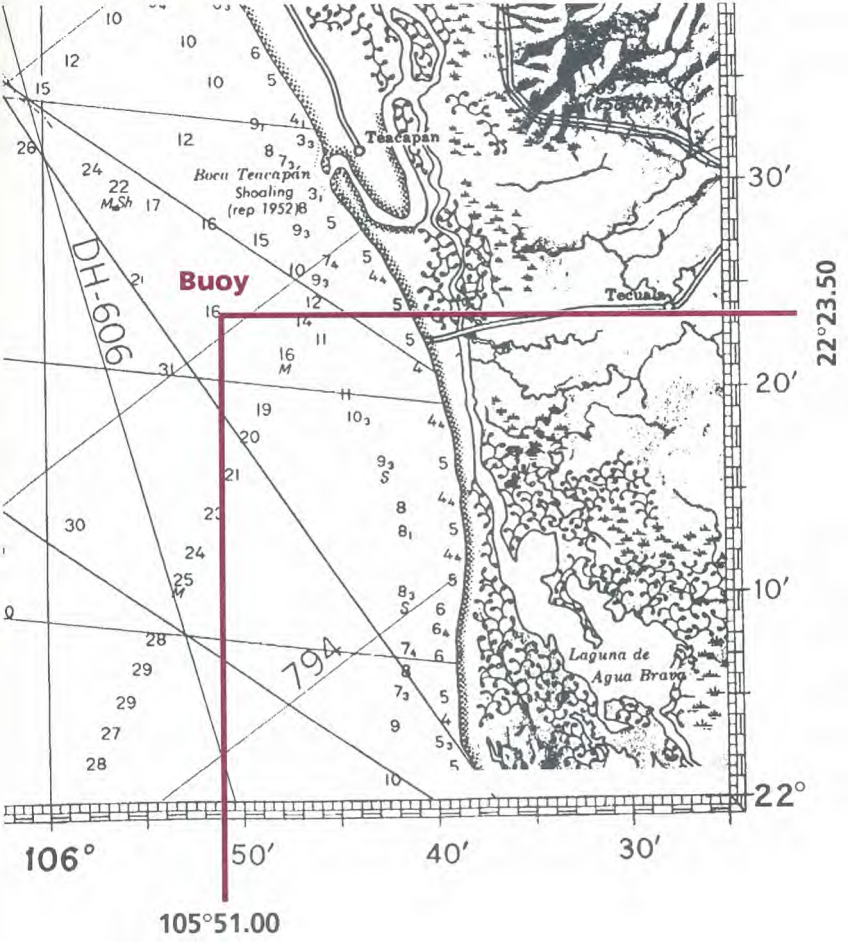
MAP READING

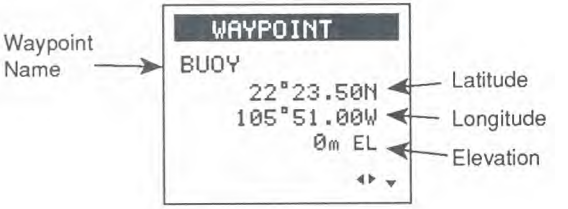
Knowing how to read maps and charts will allow you to locate the position coordinates displayed by the GPS receiver on a map and to determine coordinates for locations you want to visit without already having been there. You will also be able to identify the best and safest path from one place to another.

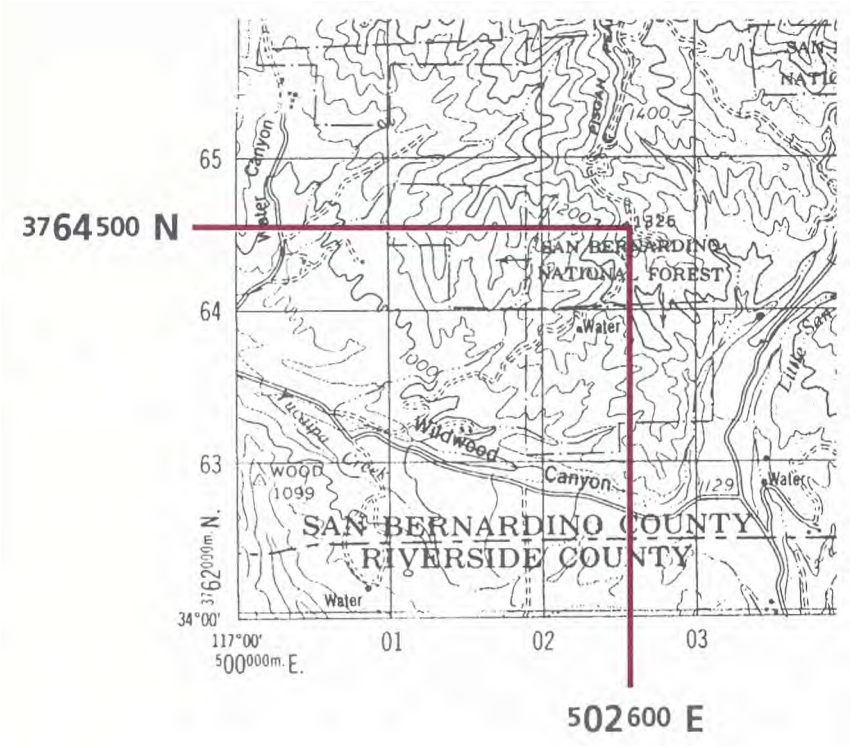
Magellan Satellite Navigators can provide position output in two different coordinate systems, Lat/Lon and UTM.

Charts use the Lat/Lon coordinate system, an example of which is presented below. To determine the coordinates of a specific location or to reference a position to a map use the scale along the edge of the map as illustrated.

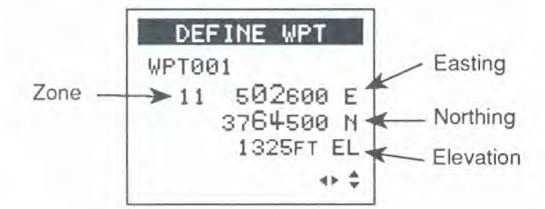
Many land-based maps use UTM coordinates as illustrated on the map below. The method used to determine coordinates of a location is the same as described previously under Lat/Lon, the only difference being the scale along the edge of the map.


Buoy
Tecapan
Boca Tecapan
Shoaling
(rep 1952)
Tecuala
Laguna de
Agua Brava
DH-606
794
30′
20′
10′
22°23.50
22°
106°
50′
40′
30′
105°51.00


Waypoint
Name
WAYPOINT
BUOY
22°23.50N
105°51.00W
0m EL
Latitude
Longitude
Elevation



SPHEROID ..... CLARKE 1866
GRID ..... 1,000 METER, UTM ZONE 11 (BLACK NUMBERED LINES)
PROJECTION ..... TRANSVERSE MERCATOR
VERTICAL DATUM ..... NATIONAL GEODETIC VERTICAL DATUM OF 1929
HORIZONTAL DATUM ..... 1927 NORTH AMERICAN DATUM
CONTROL BY ..... USGS, NOS/NOAA, AND USCE
PRINTED BY ..... DEFENSE MAPING AGENCY HYDROGRAPHIC/TOPOGRAPHIC

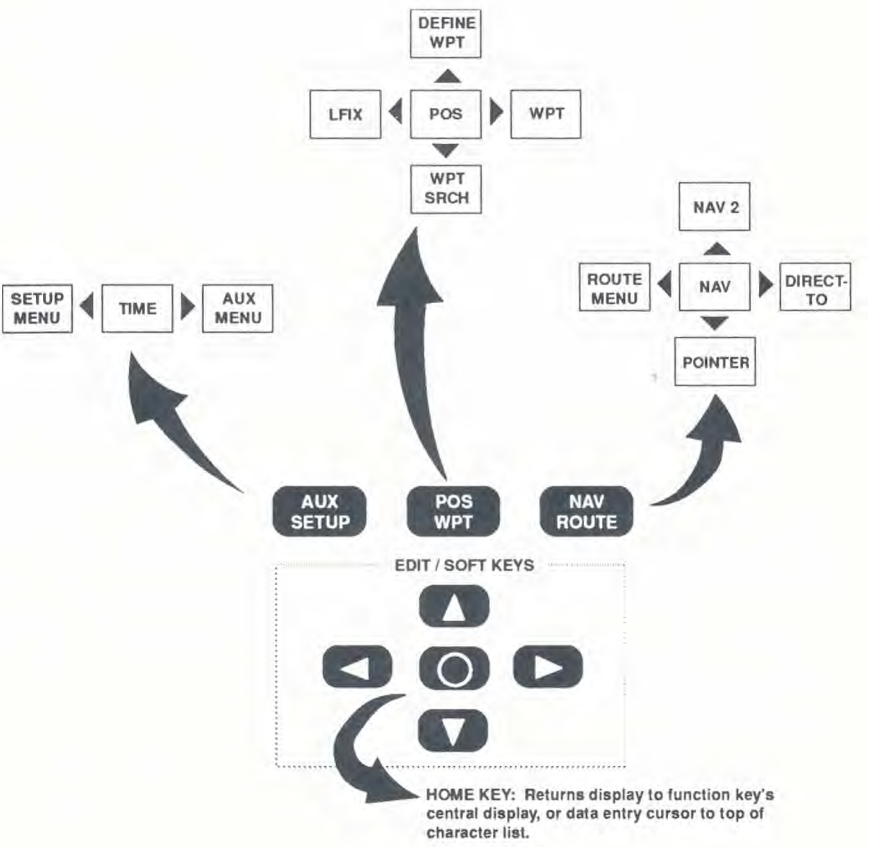


3 Tutorial

This tutorial is designed to Show you how to

- enter, rename and delete waypoints
- create and reverse routes
- set a Direct-To route
- set an MOB route

It is easiest to use this tutorial if the receiver has no waypoints or route in memory. The receiver should be initialized or have obtained a position fix. If you haven't already done so, refer to *Initialization* to enter an initial position and current date and time



WAYPOINTS

Waypoints are accessed with the POS/WPT key.

1. Press **POS/WPT,** followed by **CLEAR.** The receiver displays "DEFINE WAYPOINT" and the cursor is active an the first line.

2. Press the **RIGHT/LEFT ARROWS** to see how the cursor moves. Press the **UP ARROW** to scroll through the characters (letters and numbers) in order. Press the **DOWN ARROW** to scroll through in reverse order. Notice that when you hold either arrow down the display character jumps by three (for example, from A to D to G). Press the center key (0) to insert a blank space. (A blank is available only when entering waypoint names. It cannot be used when entering coordinates). You will use these arrows to enter data, such as the initial position and waypoints.

NOTE

Character order for fields that accept both letters and numbers is (space), 1-9, 0, A-Z. Character order for fields that accept numbers only (position coordinates) is 0-9. The ○ key can also be used as a home key, to move directly to the top of the character list.

3. Key in "SEATTL" as we will be entering coordinates for Seattle, Washington. Press **ENTER** to move to the next line.

NOTE

Waypoints can also be given receiver-generated names. This is done by pressing **ENTER** without making an entry. The receiver will assign the letters WPT plus a 3-digit number to the waypoint; the numbers are assigned in numerical order. The receiver can store up 100 waypoints.

4. Enter the coordinates for latitude. The latitude for Seattle is 47°27.00 N. Key in 47 27. If necessary, move the cursor to the hemisphere space and press the **UP/DOWN ARROW** to select N. (The receiver will automatically fill any blank entry fields at the end of a coordinate with zeros.) Press **ENTER** to move to the next line.

5. Enter the coordinates for longitude. The longitude for Seattle is 122°18.50 W. Key in 122 18 5. If necessary, move the cursor to the hemisphere space and press the **UP/DOWN ARROW** to select W. Press **ENTER** to move to the next line.

6. Enter the elevation. Elevation is the height above or below mean sea level; locations that are below sea level are indicated by a negative elevation. Select the ± prefix by pressing the **UP/DOWN ARROW,** then move the cursor three spaces to the right and key in "429". Press **ENTER** to store the waypoint.

7. Repeat steps 1 through 6 to enter waypoint "VANCVR" (Vancouver, British Columbia) at 49°04.70N 123°08.90W and 260 feet.

To view the two waypoints in the receiver's memory, press **POS** and use the **RIGHT ARROW** to scroll through the waypoint library.

Try copying one of the waypoints. Display waypoint VANCVR and press **ENTER.** Key in a different name, such as "VNCOUV", and press **ENTER.** The cursor moves into the coordinates. If you like, you can change any of the displayed values now by using the arrows. Press **ENTER** to move the cursor from line to line.

In fact, some people use this technique to enter new waypoints —they find it easier to edit an existing waypoint or current position than keying everything in. There are two ways to do this. You can duplicate a waypoint as described above and key in edit changes, or you can edit the current position by pressing **POS, UP ARROW.** Whichever method you choose, be sure to select a unique name for the new waypoint before editing the position coordinates.

Waypoints are deleted by pressing **CLEAR** while they are displayed. With waypoint VNCOUV still an the screen, press **CLEAR.** The receiver displays a warning, asking if you really want to delete this waypoint. Press the **UP/DOWN ARROW** to select YES or NO, then press **ENTER.**

NOTE

Entering waypoints in UTM coordinates is very similar. Please refer to the *Entering UTM Coordinates* at the end of this chapter.

ROUTES

A route is planned course of travel that is defined by a series of waypoints. To create a route, you must already have waypoints stored in the receiver's memory.

To create a route:

1. Press **NAV/ROUTE,** then the **LEFT ARROW.**
2. The route menu is displayed. Since there are no routes in the receiver's memory, only two options are displayed, "SET ROUTE" and "BACKTRACK." Use the **UP/DOWN ARROW** to high light "SET ROUTE" and press **ENTER.**
3. The receiver displays a FROM field and a TO field, with the cursor active in the FROM field. The FROM field is the starting position. Select the FROM-waypoint by pressing the **RIGHT ARROW** to scroll through the waypoint library. Press **ENTER** when waypoint SEATTL is displayed.

NOTE

To use the present position or a last fix in a route, you must save it as a waypoint first.

4. The receiver moves the cursor to the TO field. Select the destination of the first leg in the same way. For now, display waypoint VANCVR. As soon as a waypoint is displayed in the TO-field, the receiver shows bearing and distance from the FROM-waypoint to the displayed waypoint. If the waypoints were entered correctly above, bearing and distance from waypoint SEATTL to waypoint VANCVR should be 321°m (magnetic) and 119 miles. Press **ENTER** to select the displayed waypoint.

5. The receiver saves VANCVR as the destination of the first leg, and also as the FROM-waypoint of the next leg. **The TO-next leg.** If you were to continue adding waypoints to the route, you would have a multileg route of up to 15 legs.

   Since we aren't adding any more waypoints now, press **ENTER** again. The receiver saves the route, activates it for navigation, and displays the Navigation screen.

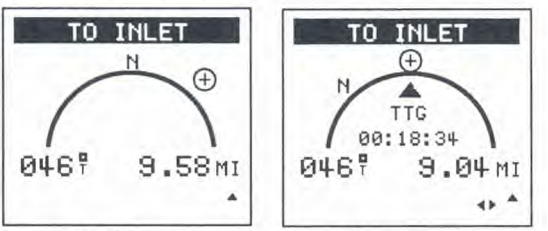
6. Any route can also be reversed so your original starting position becomes the destination. To reverse a route, press **NAV/ROUTE,** then the **LEFT ARROW** twice. Use the **UP/DOWN**

ARROW to highlight "REVERSE ROUTE." (Since a route has been entered, both "REVERSE ROUTE" and "CLEAR ROUTE" are now options.) Press **ENTER,** and the route is autotmatically reversed.

READING THE POINTER DISPLAY

The receiver has three different navigation displays. Navigation (the central display of the NAV/ROUTE key), Navigation2 (**NAV, UP ARROW)** which displays navigation information textually, and the Pointer display **(NAV, DOWN ARROW),** which displays the information graphically.

As explained in the *Field Guide*, the Pointer screen displays only bearing and distance to the destination until you start moving, when it becomes both a compass and a direction indicator that will graphically point you toward your destination.



Stationary Moving > 1 mph

The example on the following page illustrates how to use this display when navigating on a route.

DIRECT-TO

A Direct-To route is a 1-leg route from the present position to any waypoint. The receiver must have an initial position or a current position fix to use this feature.

To enter a Direct-To route:

1. Press **NAV/ROUTE** and the **RIGHT ARROW.** The receiver displays MOB and the waypoint library. (The FROM-waypoint is always the present position.)
2. Press the **DOWN ARROW** to select the TO-waypoint, then press **ENTER.**

   Since you already set a route, the receiver asks if you want to delete the current route. Select YES to delete the route and continue on the Direct-To route, or NO to remain on the current route.

Within 200 feet (0.038 miles) the message CLOSE is replaced by ARRIVED. You will now be within visual distance of CAMP. Due to SA, the navigation information may fluctuate.

When you are within 500 feet (0.10 miles) of your destination the message CLOSE appears.

Make note of the direction to steer and the TTG once you get within 500 feet to the destination as the effects of SA become more pronounced. (Refer to Chapter 4 for a description of SA.) More experienced navigators will note the way to walk and start counting down their paces (or the direction to steer and count down the seconds).

Should your destination be exactly north of your present position the pointer and the ⊕ will align and the N (or S if travelling south) will disappear under the icon.

When you are in a direct line to the destination the ⊕ will be directly at the top of the arch.

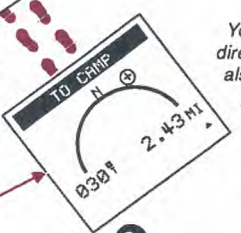
As you move, the ⊕ indicates the direction to the destination. The distance ticks down, as does the TTG.

When ⊕ is at the base of the semicircle, the destination's bearing is between 90° and 270°. Turn at least 90° to the left or right to correct your steering.

REMEMBER:
Always aim the pointer in the direction of travel in order to get a true heading.

Begin moving. *As soon as you reach a speed of 1 mph, the display changes.* The pointer icon (▲) and the TTG field appears, and the N/S indicator moves to the actual direction of N or S. The ⊕ icon also moves, keeping its relationship to N or S. You can now steer in the direction of the ⊕ to find your way to camp.

Press the DOWN ARROW from the central Navigation display. Note that the Pointer screen looks like the Bearing/Distance display in Waypoint and Lastfix. The ⊕ icon graphically shows the bearing of the destination with respect to north or south (N/S), which is centered at the top of the arch.

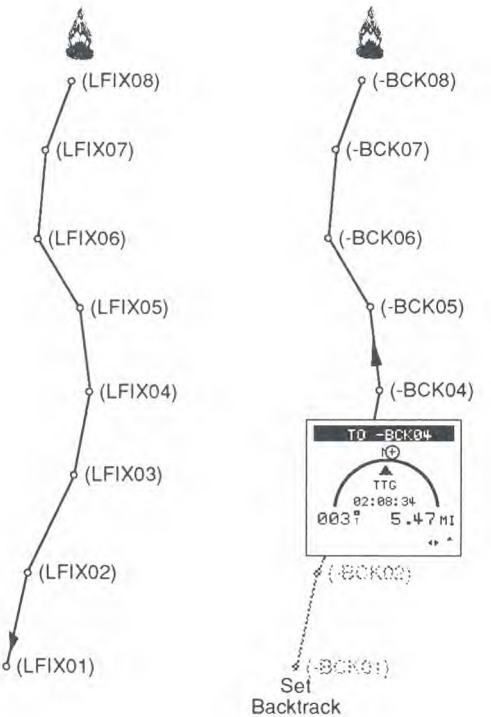


You cannot use this screen for direction information unless you also have a compass to orient yourself to north or south.

Navigation at its simplest. After turning the receiver on, set a Direct-To route to the previously saved waypoint, CAMP.

BACKTRACK

Backtrack is similar to Direct-To, but is better suited to longer distances. Before leaving your camp, clear all of the last fixes in the buffer. As you travel, the receiver will automatically save one position fix every 10 minutes to the buffer (if the receiver is on). If you prefer, set Sampling to on (with AUX); every 10 minutes the receiver will turn itself on to collect a position fix, which will be saved to the buffer. (As many as 15 fixes can be saved in the buffer.) When you are ready to return to camp, choose BACKTRACK from the Route menu. The receiver will create a multi-leg route that retraces your path from the present position to the oldest position fix in the buffer. You may use any of the Navigation displays as you travel on this route.



Backtrack Example

MOB

MOB, or man overboard, causes the receiver to save the position that is current when the feature is accessed, and to create a 1-leg route back to that position.

Unlike a Direct-To route, the MOB route is updated with each position fix update, so your distance, bearing, and other navigation information is always referenced to your current position, not to the position you held when you began.

An initial position or a current position fix is required to use this feature.

To enter an MOB route:

1. Press **NAV/ROUTE** and the **RIGHT ARROW.** The receiver displays MOB and the waypoint library. MOB should be highlighted. Press **ENTER.**

REMEMBER —

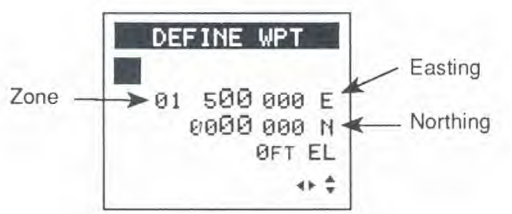
The navigation displays provide a lot of information, but most of it is related to the destination of a route, a Direct-To route, a Backtrack route, or an MOB route. The receiver cannot determine bearing or cross track error without a destination. Nor can it determine SOG or COG unless you are moving at least 1 mph. Both a destination and movement are required to determine VMG, steering, ETA, and TTG. Due to the nature of the government-imposed SA error (see Chapter 4), navigation displays when you are within 200 feet of the destination will be jumpy.

ENTERING UTM COORDINATES

You may occasionally have to enter waypoints using UTM coordinates. Maybe someone will give them to you or the only available map of the area you are in uses UTM. If you like, you can enter the waypoints as UTM coordinates, then use SETUP to return to a Lat/Lon display. The receiver will automatically convert all stored positions, including the waypoints, to Lat/Lon for display.

To enter UTM coordinates:

1. Select UTM coordinates in SETUP.
2. Press **POS/WPT,** then **CLEAR.** Key in a waypoint name, followed by ENTER, or press ENTER without making an entry to use a receiver-generated name.



3. Select the hemisphere the waypoint is in. Press the **RIGHT/LEFT ARROW** to select NORTH or SOUTH, then press **ENTER.**
4. Key in the 1- or 2-digit zone and press **ENTER.**
5. Key in the easting and press **ENTER.**
6. Key in the northing and press **ENTER.**
7. Key in the elevation and press **ENTER,** or press **ENTER** without making an entry to use 0 feet.

4 Global Positioning System

WHAT IS GPS?

GPS is a constellation of navigation satellites that orbit the earth. The precise time and position information transmitted by these satellites is used by a GPS receiver to triangulate a position fix.

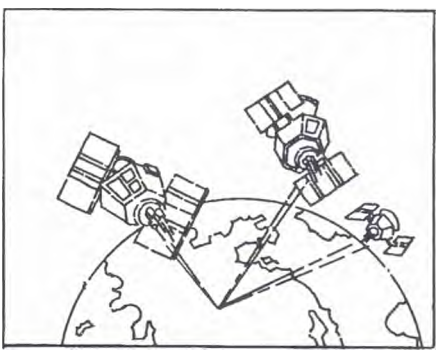
The system is expected to be completed during 1994, and will provide continuous, 24-hour 3D (position plus elevation) coverage anywhere on the earth.

GPS was developed by the United States Department of Defense to provide consistent, reliable navigation information that is unaffected by rough terrain and bad weather, and is highly resistant to multipath errors and interference.
The DoD continues to administer and control the Global Positioning System.

Although GPS was developed as a military navigation system, its civilian and commercial uses were recognized. The satellites therefore transmit two codes, a military-only encrypted code (PPS) and a civilian-access, Standard Positioning Service (SPS) code. All commercial and consumer GPS receivers are SPS receivers.

HOW DOES GPS WORK?

Each GPS satellite transmits its precise location (position and elevation) and the start time of the transmission. A GPS receiver acquires the signal, then measures the interval between transmission and receipt of the signal to determine the distance between the receiver and the satellite: this is ranging. Once the receiver has computed range for at least three satellites, its location on the surface of the earth can be determined.



Each satellite transmits two types of data, almanac and ephemeris. Almanac data is general information on the location and health of each satellite in the constellation. Since it contains general information, an almanac can be collected from any satellite. A receiver with a current almanac in its memory knows where in the sky to look for satellites, given its last known position and the time of day. Ephemeris data is the precise satellite positioning information that is used for ranging. Each satellite transmits its own ephemeris data.

Both almanac and ephemeris data are required for a GPS receiver to locate and acquire satellites quickly and compute a position fix.

ACCURACY

GPS positioning with an SPS receiver that is intended for general use will produce accuracies of 25 meters or better.

In fact, SPS receivers have proven to be far more accurate than anyone anticipated. DoD has decided that 25-meter accuracy is a potential risk, and has introduced Selective Availability (SA) to maintain a military advantage. SA is a random error that is introduced to the SPS code ephemeris data and reduces the accuracy of any SPS receiver. The size of the error changes, but rarely exceeds 100 meters.

The DoD civil GPS user policy is that GPS accuracy as affected by SA is sufficient for general navigation. In an open environment, it usually is. Even with SA, a GPS receiver will bring you within visual range of a destination or target, and GPS remains the best available source of accurate, repeatable navigation and positioning information.

MORE INFORMATION

For information relating to the operation of your Magellan GPS recevier, call Magellan at (909) 394-5000 and ask for Customer Service.

General information on the Global Positioning System and satellite status is available from the Civil GPS Information Center (GPSIC) in Virginia. It is operated by the United States Coast Guard for the Department of Transportation, and was established to provide information and to serve as a point of contact. There are three ways to telephone the GPSIC:

1. 24-hour recorded message at 703-313-5905
2. computer bulletin board at 703-313-5910
   (parameters: 8 data bits, 1 stop bit, no parity)
3. 24-hour live Operator at 703-313-5900

Navtech provides seminars (for a fee) and books on GPS and navigation. The Navtech bookstore can be reached at 800-NAV-0885 or 703-931-0500, or at FAX 703-931-0503.

A variety of newspaper and magazine articles have been written on GPS in the lastfew years. One is "The GPS Navigation System" in the June 1992 issue of *Popular Electronics.* Check your local library.

There are other sources for GPS information, ranging from free, governmentally produced literature to purchased professional literature and seminars. The geography department of your local college or the local office of the National Geodetic Survey may be able to help you locate additional sources of general or technical information.

5 Specifications

TECHNICAL NOTES

Specifications

Size	6.125" x 3.5" x 1.25", not including antenna (15.6 cm x 8.9 cm x 3.2 cm)
Weight	14 ounces (0.397 kg), with batteries installed
Temperature:	
operating	14°F to 140°F (-10°C to 60°C)
storage	-40°F to 167°F (-40°C to 75°C)
Case	waterproof (non-submersible)
Antenna	detachable quadrifilar

Operating Characteristics

Accuracy:	
position	12 meters RMS in 3D Operation without SA
velocity	0.5 meters/second RMS
Speed limit	up to 951 miles per hour (1,530 kilometers per hour)
Elevation limit	57,414 feet (17,500 meters)
Time to First Fix:	
cold start*	2 minutes or less
warm start*	40 seconds or less
after memory loss	15 minutes or more
Update rate	every second

* In a warm start, the receiver has obtained a position fix within the last 2 hours. In a cold start, the receiver has been idle for 2 hours or longer.

NOTE

The receiver's performance is enhanced when it is brought to ambient air temperature before obtaining position fixes or exposure to moisture.

PACKING LIST

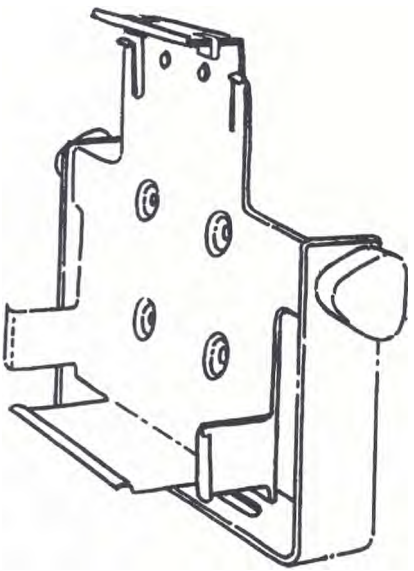
The following items should be in your package:

- GPS satellite navigator
- carrying case
- lanyard strap
- reference guide
- field guide
- warranty card
- Magellan Initialization Map

If any of these items is missing, please contact your local Magellan dealer or distributor.

OPTIONAL ACCESSORIES

In addition to the items provided with the receiver, optional accessories are also available.



Mounting Kit

Includes a mountable bracket for hands-free operation, an 11-16 VDC Power/Data Cable, the Antenna Extension Cable, and the Antenna Suction Cup Mount. The Extension Cable and Suction Cup Mount are required to operate with the quadrifilar antenna detached. Do not alter the length of the antenna extension cable or use a non-Magellan cable, as this may adversely affect receiver sensitivity.

External Antenna

An external antenna that is mounted to a range pole or vehicle roof in order to provide satellite signals to the receiver when being operated in a sheltered location. Does not require a separate power source. Comes with 30 feet of connecting cabling and mounting hardware.

Magnetic Mount for External Antenna

A magnetic mounting device used to temporarily mount the external antenna to a flat metal surface.

6 Troubleshooting

frozen display, keypad does not respond

Remove the batteries and wait for the receiver to turn off. (If operating from external power, disconnect power before removing the batteries.)

OR

Use the four-finger reset (AUX, NAV, CLEAR, and ENTER, pressed together).

> **NOTE**
>
> The reset will clear the receiver's memory.

no power

Check how the batteries were inserted into the tray; are they oriented correctly? The batteries may also have run down completely.

If operating from external power, the receiver may not have been hooked up correctly, or the external power source is not operating. Check the connections, and be sure the external power source is operating correctly.

> **NOTE**
>
> Use only the Magellan Power/Data Cable to connect the receiver to external power.

position fix doesn't change

If the old data icon (hourglass) is displayed, the signal from one or more satellites has been lost, and the receiver has been unable to reacquire or replace it. The displayed fix is at least 10 seconds old, and should not be used for navigation.

If there is no old data icon, the display may be frozen. Try pressing any key to change the display. If the display cannot be changed, refer to "frozen display."

position fix fluctuates	Small changes in the position coordinates and elevation are normal. They are caused by several variables, including the geometric quality of the fix and the effects of SA. (Geometric quality is a measurement of the probable accuracy of a fix)

Serial No.	Date Purchased
Place of Purchase	

960 Overland Court, San Dimas, CA 91773
(909) 394-5000

22-60005-012