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Choosing your next GPS

By Capt. Bill Brogdon

People occasionally ask me which GPS receiver to buy. It isn't a question with one right answer, but studying the receivers in detail will help you make an informed decision. There is an almost bewildering array of choices, even within one brand name. Some manufacturers offer a large list of receivers with a longer list of features. But which are most valuable to you?

When faced with such a large number of features, it helps to consider them in turn and list the important ones. I like to construct a chart or matrix to compare information easily. You spreadsheet jockeys are already planning how to do this, but paper works just as well.

First, don't worry about differences in accuracy. Ordinary marine GPS receivers all deliver accuracy of about 22 yards. Accuracy is better much of the time, but over a day we see positions at a fixed point wander within about a 20-25 yard radius. There are some receivers that do a bit better, usually expensive survey-grade models. In addition, two receivers at the same location may show positions that differ by 20 yards or so. Accuracy information remains a bit uncertain; it comes from several independent sources. Some 16 months after removing the deliberate accuracy degradation called Selective Availability, the Department of Defense still hadn't issued a revised Signal Specification to show the changed accuracy of GPS.

Second, the number of receiver channels doesn't make much difference. All receivers now have eight or more channels to receive from as many satellites simultaneously. With 27 satellites on orbit, there are seldom more than 10 high enough above the horizon to transmit useful signals. It does make a difference how many of the "visible" satellites the receiver uses to calculate fixes, but you may find it difficult to determine how many a particular receiver actually uses. Most receivers select the best three satellites for a latitude-longitude fix, and the best four to include altitude. The best receivers use all visible satellites for lines (or rather spheres) of position.

<u>Display and data entry</u>

The size and visibility of the display in sunshine and at night are critical. If you're getting a bit long in the tooth, get a GPS receiver that has large numbers and a high-contrast screen, or you'll be reaching for reading glasses every time you need to glance at the receiver. I suggest that you get a fixed-mount unit with a big screen. But if you use an open skiff and also hike in the back country, you might want to get a portable GPS receiver. If you do, be sure to determine if you need an adapter cable to get power from the boat battery. Remember, when hiking you just turn the receiver on from time to time; aboard a boat, you'll leave it on continuously.

Data entry keys also are important. Most GPS receivers come with a "wobble button" but without number keys. If you enter a waypoint from a chart or one measured with another receiver, you have to step through the numbers. You also have to step through the letters one by one to enter the waypoint name. Enter just a dozen or so waypoints from your old receiver or from a list, and you'll wish you had never seen a wobble button. This is a mystery to me; tiny cell phones and $4 calculators all have number keys, but most GPS receivers don't. As of now, the only moderately priced GPS

receivers with number keys are the ICOM GP270ML and the Si-Tex GPS90 and GPS90D. Pay more and gain more features; Shipmate and Northstar also make receivers that have number keys.

Plotters

Nearly all of today's GPS receivers have plotters of some type, which are very useful. The simplest ones are "track plotters": screens that show the boat's path by a series of dots that some call a "bread-crumb trail." They also show the boat, waypoints, and a line from a start position to the destination waypoint. As simple as they are, these track plotters are extremely useful, particularly for retracing your previous track. Track plotters are especially valuable for returning to an inlet in the fog, finding a submerged rock, or fishing in a certain area. Again, the display size is important; fixed-mount receivers with large screens show far more detail than portable ones.

The next, more complex group of GPS receivers includes "outline plotters." These plotters show essential charted objects, such as aids to navigation and shorelines. Some of them show more detail, but the information is far more sparse than a paper chart. They require a data card to show the charted information, and there are many different data card formats. The data cards cost $100 and up, and you should replace them periodically to display new, updated information.

Then there are the "chart plotters," which show an electronic representation of a paper chart. Having a GPS position shown on a screen with a chart is a big advantage. These are the top-of-the-line in information, capability and cost. They usually use CDs for data. And their information gets out of date, too. Some programs are designed to use a laptop computer with input from any GPS or Loran-C receiver. This makes a fine combination for a larger boat. You can revert to using the navigation receiver alone, as well as the computer.

WAAS and DGPS

There are two enhancements that improve both the accuracy and the reliability of GPS: differential GPS and WAAS. The Coast Guard broadcasts DGPS corrections over modified radiobeacons, and a GPS receiver applies the corrections to each of the satellites it uses. This improves accuracy to about five to ten meters, according to the Coast Guard. DGPS also can detect the occasional out-of-tolerance satellite and direct the receiver to not use it. All modern GPS receivers can use corrections from DGPS, and most of them require a separate specialized receiver and whip antenna for the DGPS modified radiobeacon signals. A few have built-in receivers for the DGPS signals, though they still require a separate whip antenna.

The WAAS system transmits similar corrections to DGPS, but from a geostationary satellite and on the GPS frequencies. Thus, a WAAS-augmented GPS receiver doesn't need a separate antenna for WAAS. Raytheon (now Raymarine) introduced the first marine WAAS-augmented GPS receiver in the summer of 2000, and many companies now offer them. WAAS is a worthwhile feature on a GPS receiver and should become relatively inexpensive. GPS accuracy with WAAS corrections is as good as, maybe slightly better than, DGPS — but both enhancements give remarkable performance. This is particularly noticeable in speed indications, significantly more accurate with DGPS or WAAS than with raw GPS. If you lose the correction signals, the WAAS receiver reverts to raw GPS, which these days is quite good for position and timing. WAAS is not yet certified for use in safety-critical applications, but it is in operation a high percentage of the time.

Ease of use

Next we come to an important part of the decision: How easy to use is the receiver? I suggest you go to a store with a wide variety of GPS receivers in operation and attempt to do the most frequent tasks on the ones that you like:
• look at each receiver manual
• copy a waypoint into memory
• save the present position as a waypoint
• set a waypoint as the destination
• check to see the signal status

These comprise about 90 percent of the things you must do with a receiver. You will discover rather quickly whether or not that receiver has a clear, well-organized manual and a simple, logical sequence of operations. Some use far more direct menu sequences than others for routine tasks. Others chase you around your elbow. Bear in mind that different people think differently; you may prefer a sequence of operations that someone else dislikes.

In addition to ease of operation, you may have some favorites among the receiver's features. I value a receiver that allows me to calculate the distance and direction between any two waypoints. This makes it easy to check speed on previous legs of a trip, use scratch waypoints, and look ahead from the next waypoint. With some receivers, it's easy; with others, you can do it only by going to the planning mode. With others still, it's impossible; you can calculate the distance and direction only from the present position to any waypoint.

Extras

Many portable receivers need power supply cables, a mount of some type, and an external antenna to work well aboard a boat. Of course if you have a center console you don't need a separate antenna, but the power cable and receiver holder are not included with many receivers. Check those costs. Using any GPS receiver with a plotter or to show positions on radar requires a data cable. Be sure to figure that into the cost of the receivers you are considering.

If you plan to use the new GPS receiver to send data to other equipment, such as a radar or an autopilot, be sure to check the data transmission interfaces. The NMEA 0183 interface has been in use for a long time, and National Marine Electronics Association has released the new NMEA 2000, which will be far more capable of transmitting data among units of electronic equipment built to comply with its standard. Several companies now use proprietary interface standards, so you are limited to equipment from that manufacturer in order to use their interface.

Performance indicators

Receivers have various methods of indicating GPS performance. Many receivers have "sky maps" and bar graphs to show which satellites are in view and which are being received. Ashore, the bar graphs are quite handy to show signal strength changes due to trees, buildings and other obstructions. At sea, signal strength is usually high. And receivers can calculate performance measures. The best measures, in my opinion, are dilution of position numbers.

We can compare DOP roughly with the change in accuracy of a visual fix with different line of position crossing angles. A visual fix with two LOPs is most accurate when the lines cross at 90. This corresponds to a low DOP number. Two visual LOPs crossing at 30, by contrast, produce a less accurate fix and would correspond to a high DOP number. When GPS receivers show DOP of around 2 or less, as is now frequent, accuracy is very high. On those occasions when the receiver shows DOP of 6 or higher,

GPS accuracy is questionable, and you should be very careful to verify your boat's position with another method.

Many GPS receivers calculate estimated position error numbers. In contrast with DOP, EPE is calculated by many different methods. In an attempt to make their receivers look better, manufacturers calculated EPE as if the deliberate accuracy reduction of Selective Availability was not in effect. Before the Air Force turned off SA May 1, 2000, EPE usually indicated better accuracy than was actually available.

Now that SA is off, many receivers indicate ridiculously low EPE. If the receiver you choose shows EPE and not DOP, I suggest that you don't expect EPE to give any absolute measure of accuracy. For example, a receiver may give an EPE of 3 feet when the system is actually delivering an accuracy of 15 yards. Use EPE as a relative measure only. If it usually gives EPE of around 6 feet, then be cautious when it shows 45 feet. Neither of these numbers is accurate, but the relative difference indicates a significant change in accuracy.

List the features

If you are considering several receivers — a good idea — start compiling information about them in a usable form. Try listing the significant features in columns, with each receiver's information on a single line, so that you can see all of the important features without shuffling papers. Following such a format also ensures that you investigate all-important features for each receiver.

With that done, select the receiver that gives the best mix of features for your needs, for the price. You won't find one that is tops in every category, but you can find the one that is good in enough categories for your uses. At a minimum, you won't have any unpleasant surprises after you buy the receiver.

Capt. Bill Brogdon's book, "Boat Navigation for the Rest of Us," (International Marine, 2001, $19.95) gives more information about this and many other subjects.