Aero Experiments

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More on the Garmin GPSmap 76S

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Steve Seibel
steve at aeroexperiments.org
www.aeroexperiments.org

1) Introduction

This article is intended to supplement the related article on this website entitled "Using a GPS in soaring flight", by providing some additional information that is specific to the Garmin GPSmap 76S. Again, our focus will be mostly on using the GPS during soaring flight, but much of the information given here will pertain to other applications as well, including powered flight.

In this article, we'll use the phrase "GPS" as shorthand for a GPS receiver, along with the associated display screen, etc.

The software version on the GPSmap 76 examined for this article was 4.00.

2) The main advantage of the GPSmap 76S over the newer GPSmap 76C/Cx/CS/CSx or GPSmap 60/60C/Cx/CS/CSx: a larger map screen with room for more numerical data fields.

One of the strongest features of the Garmin GPSmap 76S is its ability to display 6 or even 9 numerical data fields on the map screen, while still leaving plenty of screen area for the actual map display. The newer GPSmap 76C/Cx/CS/CSx or GPSmap 60/60C/Cx/CS/CSx GPS's have a slightly smaller map screen, and have much larger numerical data fields, and can only display 4 numerical data fields on the map screen, and even this configuration uses a large fraction of the space that would normally be devoted to the actual map display. For this reason, I find the Garmin GPSmap 76S to be better suited for use in soaring and powered flight than the newer GPSmap 76C series or GPSmap 60 series GPS's. Pilots with poor near vision who value large numerical displays may feel otherwise, as they may not place much value on this capability to display multiple small data fields. For more detailed notes on map screen sizes, see the related article on this website entitled "Map screen size comparison of some handheld Garmin GPS units with numerical data fields enabled: GPSmap 76S, GPSmap 76C series, GPSmap 60 series, and Etrex series".

3) Some advantages of the newer GPSmap 76C/Cx/CS/CSx or GPSmap 60/60C/Cx/CS/CSx over the GPSmap 76S

Of course, the newer GPSmap 76C/Cx/CS/CSx or GPSmap 60/60C/Cx/CS/CSx do offer some significant advantages over the older GPSmap 76S. These include: color ("C" units only), a very sensitive receiver that offers superior reception inside of buildings or vehicles where some metal structure may block the view of the satellites ("x" units only), much larger internal memories, the ability to accept SD memory cards ("x" units only), ports for USB connectors, an alphanumeric "virtual keyboard" that makes it easy to quickly enter waypoint names, the ability to average the GPS's present location over time to increase accuracy when marking a new waypoint when the GPS is stationary, and the ability to enter the battery type so that the battery strength indicator reads accurately for

NiMH, NiCad, and Lithium batteries. Also, on the newer GPSmap 76C/Cx/CS/CSx or GPSmap 60/60C/Cx/CS/CSx, the compass-like heading display indicator can be configured either with a "bearing" pointer, or as an HSI-style display with a "course" pointer that shows the distance "off course" from a fixed course line. This is of little value during soaring flight but would be useful at times during powered flight. Also, on the newer GPSmap 76C/Cx/CS/CSx or GPSmap 60/60C/Cx/CS/CSx, it is very easy to find the bearing and distance to a waypoint: simply call up a list of nearest waypoints (or an alphabetical list of waypoints), and move the cursor over one of them to highlight that waypoint. This can be helpful in an emergency. The GPSmap76S cannot show the bearing and distance to a waypoint unless the GPS is actively navigating toward that waypoint. We'll mention some of these points again below.

4) Sections of this article that also apply to the newer GPSmap 76C/Cx/CS/CSx and GPSmap 60/60C/Cx/CS/CSx

Some of the sections of this article that also apply fully to the newer GPSmap 76C/Cx/CS/CSx and GPSmap 60/60C/Cx/CS/CSx, except for some of the specific button-pressing instructions, include "Routes", "Mounting and antenna performance", "Notes on the various display screens", "Creating waypoints, panning the map screen, etc", "Turning off the magnetic compass", "'Track', 'bearing', 'heading', and 'course'", "'Current glide ratio' and 'glide ratio to destination' displays" ("S" units only), and "'Estimated time of arrival' computer",

Some of the other sections of this article that apply at least in part to the newer GPSmap 76C/Cx/CS/CSx and GPSmap 60/60C/Cx/CS/CSx include "Notes on the map display screen" (except for the comments on the multiple numerical data fields, and the "heading" line), and "'Celestial' features" (except that the 60-series GPS's lack the "tides" option, and the GPSmap 76C/Cx/CS/CSx and GPSmap 60/60C/Cx/CS/CSx can be configured to show "sunrise" and "sunset" in the numerical data fields on the map screen, compass screen, or elsewhere.)

I'm not completely familiar with how the newer GPSmap 76C/Cx/CS/CSx and GPSmap 60/60C/Cx/CS/CSx deal with "active logs", "saved tracks", track points, etc., and how these units interact with the "MapSource" computer program, but I suspect that most of the comments on these topics in this article will also apply to these newer GPS units as well.

5) "Routes"

One thing the reader won't find in this article is a close examination of the "route" feature of the GPSmap 76S. A good understanding of this feature may be helpful for a contest soaring task involving several waypoints, or during a cross-country flight in an airplane. I prefer to simply use my GPS in the basic "goto" mode. If need to change my target destination during the course of a flight, I manually set the GPS to "goto" the new waypoint at the appropriate moment. The GPSmap 76 is designed in a way that makes this easy to do.

6) Mounting and antenna performance

All the Garmin GPSmap 76-series and GPSmap 60-series GPS units have a quad-helix antenna. With this antenna, the best satellite reception occurs when the GPS unit is oriented with its long axis running vertically, but the reception will still be fairly good when the GPS unit is oriented with its long axis running horizontally. If the GPS unit is oriented with its long axis running horizontally, the satellite reception will be nearly the same regardless of whether the GPS unit is mounted with its display face pointing straight up or is mounted with its display face pointing sideways. I've made a mount that attaches to the right down tube of my hang glider and holds my variometer and GPS. I mount both these instruments with their long axes oriented horizontally and their displays facing sideways (i.e. toward me.) I've never had any problems with getting adequate satellite reception when the GPSmap 76S was mounted in this manner.

For use inside an aircraft where some amount of overhead metal structure may block the view of the satellites, pilots may want to consider using the GPSmap76S is conjunction with an external antenna. Another alternative would be to use the GPSmap 76Cx/CSx or GPSmap 60 Cx/CSx. These "x" models have a particularly sensitive receiver which does a particularly good job of receiving satellite signals inside of structures. I've generally had acceptable results using the GPSmap 76S with no external antenna inside of a high-winged airplane, simply holding the unit in one hand, but I've occasionally had to reach forward and hold the unit in an awkward fashion to keep it far enough forward in the windscreen area to get uninterrupted satellite reception. If this GPS were mounted in some kind of fixed mount above the instrument panel, well forward in the windscreen area, then the satellite reception would undoubtedly be adequate for VFR use even without any kind of external antenna.

When satellite reception is marginal, the "vertical speed" and "current glide ratio" functions will be the first functions to fail. For more on this, see the section of this article entitled "'Current glide ratio' and 'glide ratio to destination' displays".

7) Notes on the various display screens

As described in the related article on this website entitled "Using a GPS in soaring flight", the map display screen is very useful. The compass-like heading display screen can also be useful in situations. I never use the elevation screen in flight. I use the highway screen simply as a place to display additional numerical data fields that don't fit on the other screens.

8) Notes on the map display screen

As noted above, one of the chief advantages of the GPSmap 76S over the newer GPSmap 76C/Cx/CS/CSx, GPSmap 60/60C/Cx/CS/CSx 76CSx, and other similar products is the GPSmap 76S's ability to show 6 or even 9 small numerical data fields on the map screen, with plenty of screen area left over for the map display itself. For soaring, I configure my GPSmap76S with 6 small numerical data fields on the map screen, which I devote to "speed" (i.e. groundspeed), "track" (i.e. direction of travel over the ground), "distance to waypoint", "bearing" (i.e. direction to waypoint), "current glide ratio", and "glide ratio to destination". For flight in a light plane, I configure the GPSmap76S to show 9 small numerical data fields on the map screen. I devote the additional 3 fields to show "time of day", "estimated time of arrival", and one other parameter of interest.

The "navigation status" field on the map screen of some handheld Garmin GPS units (e.g. any of the Etrex series GPS's) displays the name of the target waypoint, the distance to the target waypoint, and the ETE to the target waypoint. The GPSmap 76S does not have a "navigation status" field of this type. If the user wants to see the distance to the target waypoint and/or the ETA at the target waypoint, he should configure one or two of the other numerical data fields on the map screen to display these values. The GPSmap 76S cannot display the ETE to the target waypoint. To see the name of the target waypoint, the user can push the "page" button to scroll to the screen with the compass-like display, or to the highway screen, both of which display the name of the target waypoint. Perhaps in a future software upgrade a "navigation status" field of the type described above will become available on the map screen of the GPSmap 76S. This "navigation status" field could appear in the part of the map display screen that is currently used for the "next street" feature, which is of no interest in flight. This is the same part of the display screen that is reserved for displaying the lat/lon of the pointer when the map is being "panned".

When optimally configured, the map screen contains all the information that is present on the compass-like display screen, and more. I always set up the map screen of my GPSmap 76S to include the "bearing" line which represents the direction to the target waypoint, and also the "heading" line which represents the current heading, or when the magnetic compass function is disabled (as it always should be during flight), the current direction of travel over the ground. Aligning the "heading" line with the "bearing" line ensures that I am travelling directly toward my target destination. Oddly, the representation of this "heading" line is only about 6 miles long and so is barely visible when the map is zoomed out to a large scale. Most other Garmin GPS's that I'm familiar with, including the GPSmap76C series, the GPSmap 60 series, and the Etrex series, all lack this "heading" line; the orientation of the little triangle-shaped "current position" icon gives the same information.

I always set the map screen of my GPSmap 76S to show the "track log", and often zoom the map in to the 300' scale so I can see individual thermalling circles. I don't set the map screen of my GPS to show a "course" line; this is of no value during soaring flight. We'll discuss the "course" line a bit more in the section of this article entitled "'Track', 'bearing', 'heading', and 'course'".

On the GPSmap 76S, the track log, bearing line, and course line are turned on or off (or set to appear only when the map is zoomed in to a given scale) at the "line" tab of the "setup map" menu, while the "heading" line is turned on or off (or set to appear only when the map is zoomed in to a given scale) at the "other" tab of the "setup map" menu.

9) Creating waypoints, panning the map screen, etc

The buttons on the GPSmap 76S are very easy to use, even with a gloved hand while flying. Only 2 simple operations are required to create a waypoint in flight: simply hold the "enter" button down for 2 seconds till the unit beeps, and then push the enter button one more time. It is also very easy to "pan" the map screen. Simply push the top, bottom, left, or right edge of the large "rocker" button. Scrolling through the screens is easy as well—the "page" button moves forward through the various screens and the "quit" button moves backwards through the various screens. Activating a "goto" function in flight is easy as well.

10) Turning off the magnetic compass

The magnetic compass sensor should be switched off before flight, since it is subject to the same banking-related errors that a conventional wet compass is subject to, and will behave very erratically during turns. It is important that the magnetic compass sensor remain off even if the groundspeed happens to drop near zero momentarily. A GPS-driven heading display will naturally behave erratically whenever the groundspeed approaches zero, but in the context of a vehicle that turns by banking, the situation becomes even worse if the heading display is switching back forth between being driven from the GPS satellites and being driven by the magnetic compass sensor.

With the GPSmap 76S, 2 different conditions must be satisfied for the magnetic compass to be activated. If either of these two conditions is not met, the magnetic compass will remain off.

The first of these conditions is that the time-speed interlock must be satisfied. On the "setup" screen, there is a "compass" tab. Clicking on this "compass" tab reveals the time-speed interlock parameters. The text reads: "Heading data source. Use GPS if speed is above (X). Use compass if below (X) for at least (Y)." (The letters "X" and "Y" do not actually appear in the text.) To ensure that the magnetic compass stays off, I set X equal to the lowest possible value, which is 0 mph, and I set Y equal to the greatest possible value, which is 3 minutes. If I wanted to ensure that the magnetic compass stayed on, I would set X equal to the greatest possible value, which is 99 mph, and I would set Y equal to the smallest possible value, which is 5 seconds. Note that these conditions would not be adequate to ensure that the compass stayed on during flight in a light airplane, as the speed would often be greater than 99 mph. However, there is no reason to use the magnetic compass feature during flight in a light airplane.

The second condition that must be met for the magnetic compass to be activated is that what we'll call the "compass on/off toggle" must be set to the "on" position. The position of this "toggle", which can be either "on" or "off", is displayed on the "compass" tab of the "setup" menu. The user can change the position of this toggle simply by clicking on it. There is another way to change the position of this toggle without going into the setup menu at all: if the user simply holds the "page" button down for two seconds, the position of the "compass toggle" will flip from "off" to "on" or vice versa, and a message will appear on the screen. This message can be slightly misleading: if the position of the compass toggle has been flipped from "off" to "on", a message will appear on the screen that implies that the magnetic compass has in fact been activated, but in reality the magnetic compass will not be activated unless the time-speed interlock has also been satisfied. The practical ramification of all this is as follows—if while scrolling through the various features, the user sees an unwanted message saying "compass on" or "compass off", it means that he has accidentally changed the position of the "compass toggle" by holding down the "page" button for several seconds. He can ignore this message, or he can quickly put the "compass toggle" back to its original position by holding down the "page" button for several more seconds. One consequence of allowing the "compass toggle" to remain in the "on" position during flight is that after landing, when the time-speed interlock is no longer satisfied because the GPS unit is no longer in motion, the magnetic compass will turn on, creating an unwanted drain on the batteries. When the compass toggle is in the "on" position, this also causes the compass to be active whenever the GPS unit has lost the satellite lock, as well as during the initial start-up phase when the GPS unit has not yet acquired a satellite lock, regardless of how the time-speed interlock parameters have been set. Again, this could create an unwanted drain on the batteries.

As long as the user doesn't intentionally or accidentally switch the compass toggle to the "on" position by holding down the "page" button for several seconds, the magnetic compass sensor will stay off at all times, regardless of any other factors.

If the GPS unit is being used for hiking or for other applications where the magnetic compass feature might be occasionally wanted, the user should set the time-speed interlock parameters in such a way that they are easily satisfied (e.g. "X" = 99 mph, "Y" = 5 seconds). The user can save battery power by leaving the compass toggle "off" most of the time. Holding the "page" button down for a few seconds to switch the compass toggle back to the "on" position is an easy way to switch the compass "on" when it is needed (and then back off again when it is no longer needed), as long as the time-speed interlock has been set appropriately.

The GPSmap 76S normally displays a small compass icon on the lower left corner of the map display screen and heading display screen when the magnetic compass sensor is actually active. However in some situations, such when the magnetic compass sensor switches on because the GPS unit has lost its satellite lock, this icon does not appear even though the magnetic compass sensor is active. This is probably a software bug. This means that there could be some confusion about whether the magnetic compass sensor is active or not. Here's one clue: whenever the magnetic compass sensor is active, if the GPS unit is not held perfectly level, a "hold level" warning will appear in small print at the lower left corner of the map screen, or in large print on the heading display screen.

Here's one additional issue that doesn't pertain to flight, but does pertain to using the magnetic compass sensor when the GPS unit is stationary: on the Garmin GPSmap 76S, if the "speed" filter (controlled at the "units" tab of the "setup" menu) is set to "user" rather than "auto", and is set to a low value such as the minimum value of "2 seconds" rather than a higher value, there will be relatively little filtering of the speed data. This means that random fluctuations in the satellite signals will cause the “speed” sensed by the GPS to occasionally rise to a non-zero value even when the GPS unit is not in motion. This in turn means that if the speed interlock has been set to the lowest possible value of as “0 mph” rather than a higher value such as “1 mph”, the magnetic compass sensor will frequently switch itself off even when the GPS unit is not actually in motion. If desired, this problem can be cured by changing the speed filter from “user 2 seconds” to a significantly higher value, or to “auto”, or by setting the compass speed interlock at some value that is slightly higher than zero (e.g. 1 mph).

Conversely, users who want the magnetic compass sensor to stay off will appreciate the non-zero speed values that occasionally appear when the speed filter is set at “user 2 seconds”.

11) “Track”, “bearing”, “heading”, and “course”

GPS users should understand that in the absence of a magnetic compass function, a GPS unit cannot really measure “heading”, only direction of travel over the ground.

With the GPSmap 76S, Garmin distinguishes between the “track”, which is the current direction of travel over the ground, and the “heading”, which is the direction that the nose of the aircraft (or more precisely, the “nose” of the GPS) is pointing. When the magnetic compass is switched off—which it always should be during flight—then the “heading” reverts to being equivalent to the “track”. (With the newer GPSmap 76C/Cx/CS/CSx, the “track” terminology is dropped, but the term “heading” still is used to mean the direction that the nose of the GPS is pointing whenever the magnetic compass sensor is active, and the direction of travel over the ground whenever the magnetic compass sensor is not active.)

The heading indicator display—i.e. the display that looks like a compass—displays “heading”, as defined above. When the magnetic compass is not active, the “heading” will be the current direction of travel over the ground, as noted above.

The “bearing” is the direction to the target waypoint at any given moment.

Now we’ll take a moment to define the concept of a “course” line, as used by Garmin in the context of the GPSmap 76 series and other similar handheld GPS units: at the moment that a “goto” function is activated, a fixed “course” line is created, which is the line extending from the aircraft’s location at moment that the “goto” function was started, to the target waypoint. Once a “goto” function has been activated, as the aircraft continues to fly, the “bearing” to the target waypoint may change, but the “course” line remains completely fixed in space, until the navigation to the waypoint is discontinued or re-started with the same waypoint or with a different waypoint. Even if the aircraft strays “off course” by many miles, the numerical reading in the “course” data field (if present) will remain fixed until the navigation to the waypoint is discontinued or re-started with the same waypoint or with a different waypoint.

I noted earlier that I always set up the map screen of my Garmin GPSmap 76S to include the “bearing” line which represents the current direction to the target waypoint, and also the “heading” line which represents the current heading, or when the magnetic compass function is disabled (as it always should be during flight), the current direction of travel over the ground. With GPSmap 76S, the user can also configure the GPS so that a “course line” either does, or does not, appear on the map screen when the GPS is navigating toward a waypoint. The difference between the “course line” and the “bearing line” is that the “course line” remains fixed in place on the map, while the “bearing line” moves so that one end is always attached to the aircraft icon, while the other end remains fixed at the destination waypoint. By going to the “Line” tab of the “Map Setup” screen, the user can switch the “course line” “on”, or “off”, or can set the course line to appear only when the map is zoomed to a scale that is equal or less than some desired value. I usually leave this “course line” turned off, and I almost never display the “course” in one of the numerical data fields on the map screen. Many other Garmin handheld GPS’s, such as the newer GPSmap 76C/Cx/CS/CSx and GPSmap 60/60C/Cx/CS/CSx, and the Etrex series, can display either a “bearing” line or a “course” line on the map screen, but not both at once..

The GPSmap 76S’s heading indicator display—i.e. the display that looks like a compass—also features a “bearing” pointer. The GPSmap 76S’s heading indicator display cannot be configured to show a “course” pointer. Some GPS’s, including the Garmin Etrex series and the newer GPSmap 76C/Cx/CS/CSx and GPSmap 60/60C/Cx/CS/CSx, feature a heading indicator display screen that can be configured either with a “bearing” pointer, or as an HSI-style display with a “course” pointer that shows the distance “off course” from a fixed course line. This is of little value during soaring flight, but could be quite useful when flying a powered aircraft along defined airways.

12) “Current glide ratio” and “glide ratio to destination” displays

Garmin handheld GPS's with barometric pressure sensors, including the Garmin GPSmap 76S, GPSmap76C/Cx/CS/CSx, the GPSmap60/60C/Cx/CS/CSx, and the Etrex Vista/Vista C/CX, include "current glide ratio" and "glide ratio to destination" displays. These functions are quite useful. By comparing the two numbers, one can get a sense of whether the glider will reach the target with altitude to spare, or will not have enough altitude to reach the target.

The “current glide ratio” display on these GPS’s is extremely responsive. This is a mixed blessing. In very smooth air, the effects of a change in airspeed can be seen almost instantly, after waiting just a few seconds for the aircraft's sink rate to stabilize. In turbulent air the display is so “twitchy” that it is not really very useful for fine-tuning the pilot’s choice of speed-to-fly. It would be nice if the user could select for the “current glide ratio display” to be averaged over a slightly longer time interval on these GPS’s, so that it would function more like the digital “current glide ratio” display on some GPS-compatible variometers like the Brauniger IQ Comp GPS. This would make the “current glide ratio” display slightly more useable for fine-tuning the pilot’s choice of speed-to-fly. However, even in turbulent air, and even given the “twitchiness” in the “current glide ratio” display, a rough comparison of the “current glide ratio” with the “glide ratio to destination” will give a good idea of whether or not the glider is currently on a glide path that will reach the target destination with altitude to spare or fall short of the target destination, assuming that the current atmospheric conditions will continue all the way to the target.

A "glide ratio to destination" display is always intrinsically much more stable than a "current glide ratio" display, because the "glide ratio to destination" function depends only on the glider's position in space relative to the target, not on the glider's horizontal and vertical velocities. The “glide ratio to destination” display is not dependent upon an accurate measurement of the glider’s vertical speed at any given moment. An updraft or downdraft can produce a very large, immediate change in the “current glide ratio”, but will only produce a gradual change in the “glide ratio to destination.”

A long-term trend in the “glide ratio to destination” function gives a pilot some useful information. For example, in a sailplane, if a pilot sees the “glide ratio to target” slowly scroll from “30” down to “25” over the course of several minutes, this indicates that the glider will overfly the target with altitude to spare, assuming that the current atmospheric conditions continue all the way to the target. Conversely, if the pilot sees the “glide ratio to target” slowly scroll from “30” up to “35” over the course of several minutes, this indicates that the glider will run out of altitude before reaching the target, assuming that the current atmospheric conditions continue all the way to the target. For hang gliding and paragliding applications where glide ratios are often below 10:1 and can even drop to 5:1 or less when a strong headwind is present, a “tenths” digit in the “glide ratio to destination” display is very useful for helping a pilot to detect slow trends in the “glide ratio to destination” display. For example, if over a period of several minutes, the “glide ratio to destination” figure slowly scrolls from "4.8" to "4.7" to "4.6", this lets the pilot know that he will overfly the target with altitude to spare, assuming that the current atmospheric conditions continue all the way to the target. On the other hand, if over a period of several minutes, the “glide ratio to destination” figure slowly scrolls from "4.7" to "4.8" to "4.9", this lets the pilot know that he will not be able to reach the target, if the current atmospheric conditions continue all the way to the target. For hang gliding and paragliding applications, a “glide ratio to destination” display is significantly more useful if it has a “tenths” digit, than if it does not.

The “glide ratio to destination” display on handheld Garmin GPS’s with pressure sensors does not include a “tenths” digit. Perhaps in a future software update for these GPS units, Garmin will create a “tenths” digit for the “glide ratio to destination” function, at least in cases where the glide ratio to destination has dropped below 10:1. In fact this would be my number one suggestion to Garmin for improving the functionality of their GPS’s for hang gliding and paragliding applications.

Pilots may occasionally encounter a rather peculiar problem with the “current glide ratio” function on handheld Garmin GPS’s with barometric pressure sensors-- if the satellite reception is poor, the “vertical speed” display will scroll to zero and the “current glide ratio” display will scroll to infinity. For more, see the related article on this website entitled “Notes on the glide ratio functions of some Garmin GPS receivers with pressure sensors”. For most soaring applications, the satellite reception is good enough that this problem is rarely encountered.

13) Battery life indicator

The battery life indicator on the GPSmap 76S cannot be adjusted to read correctly when NiMh, NiCad, or Lithium batteries are used instead of alkaline batteries. The battery life indicator will read too high when NiCad batteries are in use, and even more so when Lithium batteries are in use, which means that there is some danger of the batteries being exhausted unexpectedly. The battery life indicator will read too low when NiMH batteries are in use, which means that there will actually be more battery life left than the battery life indicator suggests.

14) “Celestial” features

The “tides” option in the “celestial” menu is very useful as it graphically illustrates the rise and fall of the tide at selected stations. The sunrise and sunset and moonrise and moonset calculators are also very useful.

Unlike many other Garmin handheld GPS’s units, including the GPSmap 76C/Cx/CS/CSx, on the GPSmap 76S the numerical data fields on the map screen, compass screen, or highway screen cannot be configured to show “sunrise” or “sunset”.

15) “Estimated time of arrival” computer

The “estimated time of arrival” computer isn’t useful for soaring flight, but it is useful during cross-country flight in an airplane, where it seems to be quite accurate. The “estimated time of arrival” computer even seems quite accurate during most driving situations, even when it is not possible to travel directly toward the destination (e.g. the roads run north-south and east-west and the destination lies to the northwest.) The computer doesn’t seem to rely too heavily on the velocity made good toward the destination at any given moment. The behavior of the "estimated time of arrival" computer seems roughly consistent with the following model: an eta computer could be programmed to assume that the vehicle will continue travelling at its current speed and direction until the target destination lies abeam the current direction of travel, and then will turn 90 degrees and travel directly toward the target destination, keeping the same forward speed.

The GPSmap 76S does not have an "estimated time enroute" feature.

16) "Battery saver" mode

When the GPS is set to "battery saver", the "battery saver" mode becomes active when the GPS has been stationary or has been moving at a nearly constant speed and direction for a certain time period, which appears to be somewhere between 10 and 30 seconds. Therefore the "battery saver" mode reduces battery consumption when an aircraft is stationary on the ground before take-off. I suspect that the "battery saver" mode rarely becomes active during soaring flight. Therefore I suspect that setting the GPS to "battery saver" does not extend the battery life very much during soaring flight. By the same token, I suspect that setting the GPS to "battery saver" will only rarely cause a noticeable decrease in the responsiveness of the GPS during soaring flight. I suspect that the battery saver mode will not become active during most situations when a pilot desires maximum accuracy from his GPS, such as when checking the wind velocity by allowing the aircraft's heading to slowly change and noting the groundspeed. It appears that the "battery saver" mode does not become active when an external power cord is attached to the GPS. During side-by-side comparisons, I've noticed that the "battery saver" mode on my Etrex Vista becomes active much less often than does the "battery saver" mode on my Etrex Legend. This may indicate that on pressure-sensor equipped Garmin GPS's, the "battery saver" mode does not become active when the elevation or rate of climb is changing.

17) Notes on track logs: "active logs" and "saved tracks"

We'll now turn our attention to the track logs generated by the Garmin GPSmap 76S. The GPSmap 76S generates two different kinds of track logs, both of which can be accessed by downloading the GPS data to the "MapSource" program. We'll call these two different types of track logs the "active logs" and the "saved tracks".

The phrase "active log" never appears on anywhere on the screen of the GPSmap 76S, but will be familiar to anyone who has downloaded data from the GPSmap 76S to MapSource, as we'll see shortly. A new "active log" begins every time the GPS unit acquires a satellite lock, or loses the satellite lock, or is put into "GPS off" mode. (After the unit loses the satellite lock or is put into "GPS off" mode, the location is assumed to be fixed at the last known position, but new altitude data continues to be recorded, unless the altimeter has been turned "off" at the "altimeter" tab of the "setup" menu, which is now possible due to a recent change in the operating software. Unlike some other Garmin handheld GPS's, the GPSmap 76S has no "track log off" function, which stops the recording of new "active logs" even when the unit is receiving good data from the GPS satellites.) Each "active log" is comprised of many individual "track points". For each "active log" track point, the GPS records time and date as well as location. When an "active log" is viewed with the "MapSource" computer program, each "active log" track point is displayed along with the date, clock time (in hours, minutes, and seconds), altitude, leg length (i.e. distance to the next track point), leg time, leg speed, leg course (which in this context means the direction of travel to the next track point), and position (latitude and longitude).

The "active logs" are not listed on the GPS's "tracks" menu. However the "active logs" are used to draw the "breadcrumb trail" on the map screen of the GPS: the "breadcrumb trail" represents all the active logs that are currently stored in the GPS, and shows everywhere that the GPS has been since the track log was last cleared (or at least back to the oldest "active log" track point that has not yet been overwritten by newer track points). On the GPSmap 76S, the "breadcrumb trail" that depicts the "active logs" is a sparse dotted line, while "saved tracks" are depicted by a heavy solid line. The "active logs" are also used to draw the altitude-versus-time plot or altitude-versus-distance plot on the "altitude" screen of the GPS. Again, these plots show the entire history since the last time that the track log was cleared, back to the oldest "active log" track point that remains in the "active log" memory.

When GPS data is downloaded to MapSource, the "active logs" appear on MapSource's "tracks" page, and have names like "ACTIVE LOG", "ACTIVE LOG 001", "ACTIVE LOG 002", etc. In MapSource, the user can re-name the active logs if he wishes. In MapSource, the user can also select a specific active log to display as a track on the map or as an altitude-versus-distance plot. MapSource cannot display an altitude-versus-time plot. With MapSource, several different "active logs" can be joined together into one. Active logs can be uploaded from MapSource to the GPS, as we'll see in a later section of this article..

The GPSmap 76S can store up to 10,000 "active log" track points in all. The fraction of the "active log" memory that has been used up is displayed near the top of the "tracks" menu screen near the words "track log". In the case of the GPSmap 76S, this "track log" memory indicator never reads 100%, so a reading of 99% should be assumed to indicate that the active log memory area is full. Deleting some of the "saved tracks" that appear on the "tracks" menu screen has no influence on the amount of memory that is available for recording new "active logs"—the "saved tracks" and the "active logs" are stored in different memory areas, and the memory indicator near the top of the "tracks" menu screen refers only to the memory used by the "active logs", not to the memory used by the "saved tracks." If the user has selected the "wrap when full" option on the "set up track log" menu, then once the "active log" memory space is full, the oldest "active log" will began to be over-written in a point-by-point fashion (i.e. the entire oldest "active log" will not disappear in one instant). Pushing the "clear" button on the "tracks" menu screen will erase all the active logs and reset the "track log" memory indicator to zero. Pushing the "clear" button on the "tracks" menu screen will not erase any of the "saved tracks" that are listed on the "tracks" menu screen. We'll discuss the "saved tracks" in more detail shortly. After downloading the track log to a computer, it's a good idea to push the "clear" button on the "tracks" menu screen to erase all the active logs, so that the "track log" memory indicator will be reset to zero.

In the "track log setup" menu, the user can control how often a new track point is added to the current "active log". The user can specify a time interval or a distance interval for adding new points to the "active log". However, I prefer to use a third option called "auto".

One of the chief advantages of the "auto" mode is that new active log points are added very infrequently (often only 2 per minute) when the GPS is not moving, so the user can switch the GPS on well before starting a flight and not worry that the active log memory is being needlessly consumed. The only time this is not true is when the wind is gusty. The barometric pressure sensor is affected by wind gusts, which create apparent changes in altitude, and trigger the recording of more track points.

In the "auto" mode, the GPS creates new "active log" track points at whatever rate is needed to create a high-resolution trace of the flight path. New "active log" track points are added much more frequently when the direction of travel is rapidly changing (e.g. when a glider is thermalling) than when the direction of travel is nearly constant. New "active log" track points are also added much more frequently when the speed of travel is rapidly changing (e.g. when an aircraft is flying in circles at a constant bank angle and airspeed, in a strong wind) than when the speed of travel is nearly constant. Even if the vertical speed is roughly constant, new "active log" track points are added much more frequently when the altitude is changing than when the altitude is nearly constant. If the vertical speed is changing rapidly rather than constant, new “active log” track points appear to be recorded more frequently than when the vertical speed is constant.

In the “auto” mode, the user can also select whether the “active log” track points are added “most often”, “more often”, “normal”, “less often”, or “least often”. In some Garmin GPS units such as the Etrex Legend, I’ve found a marked difference (e.g. a factor of 2.4 or more) in the recording frequency between the “auto, most often” mode and the “auto, least often” mode. Oddly enough, in the case of the GPSmap 76S and the Etrex Vista, the recording interval in the “auto, least often” mode seems to often be only about 1.4 times as long as the recording interval in the “auto, most often” mode, and often—especially during thermal flights with a great deal of circling-- the difference in the length of the recording interval between these two modes sometimes becomes almost negligible (e.g. a factor of 1.2). Also, with these 2 GPS units, there seems to be very little difference in the length of the recording interval between the “auto, normal” mode and the “auto, least often” mode. With these 2 GPS units, when the “active log” track memory is starting to fill up, switching from “auto, most often” to “auto, normal” or “auto, least often” will not necessarily produce a dramatic increase in the amount of flight time that will fit into the remaining portion of the “active log” track memory.

Here are some examples of typical “active log” recording intervals for the GPSmap 76S or Etrex Vista in the “auto, most often” mode:

Example 1: shortest recording interval seen during a typical thermalling flight in a hang glider: one “active log” track point every second, which if sustained indefinitely, would yield only 2.8 hours of recording time. I’ve only seen this high recording rate sustained for a minute or two at a time, typically during strong thermal climbs in strong wind.

Example 2: average recording interval over the entire length of a typical thermalling flight in a hang glider: one “active log” track point every 2 to 3 seconds, yielding 5.6 to 8.3 hours of recording time. I’ve never seen the recording interval averaged over an entire flight in a hang glider drop below one “active log” track point every 2 seconds, so I suspect that a pilot can always count on at least 5.6 hours of recording time for a hang gliding flight.

Example 3: average recording interval during a ridge-soaring flight in a hang glider: one “active log” track point every 3.5 seconds or longer, yielding 9.7 or more hours of recording time.

Example 4: average recording interval over the entire length of a typical local thermalling flight in a low-performance sailplane: one “active log” track point every 2 to 3 seconds, yielding 5.6 to 8.3 hours of recording time

Example 5: average recording interval during a flight segment in a light plane where the heading was roughly constant and the vertical speed changed frequently: one “active log” track point every second, yielding 2.8 hours of recording time

Example 6: average recording interval during a prolonged full-power climb in a light plane, with a roughly constant airspeed and heading and vertical speed: one “active log” track point every 1.5 seconds, yielding 4.2 hours of recording time

Example 7: average recording interval during a high-speed flight segment in a light plane, where the speed, heading, and altitude were roughly constant: one “active log” track point every 5 seconds, yielding over 13 hours of recording time.

Example 8: average recording interval while driving a car at highway speeds over a road with many long, straight, flat sections: one “active log” track point every 4 seconds, yielding over 11 hours of recording time

It’s interesting to speculate whether a paraglider, hang glider, or sailplane would tend to experience the shortest “active log” recording interval during thermalling flight. I suspect that a lower-speed aircraft would generally experience a shorter “active log” recording interval than a higher-speed aircraft, because the lower-speed aircraft experiences a higher turn rate for a given bank angle than a higher-speed aircraft does. However, a given angular change in heading creates a greater change in predicted position when the speed of travel is high than when the speed of travel is low, so perhaps the “active log” recording interval during circling flight ends up being relatively independent of airspeed. I’ve collected less data for sailplanes than for hang gliders, but as far as I’ve been able to tell, the average “active log” recording interval for both of these aircraft types has been roughly similar during thermalling flight.

In summary, when using the “auto, most often” mode a pilot can generally expect to get at least 5.5 hours of “active log” recording time for most flights in light airplanes, sailplanes, hang gliders, and paragliders, and can generally expect over 9 hours of “active log” recording time while ridge-soaring. However in certain situations the “active log” track recording interval can fall to one point every second, which only yields 2.8 hours of recording time. It would be very unusual for the GPS to use this high recording rate over the length of an entire flight, but this might be possible if the flight followed a very unusual profile such as series of extremely rapid climbs and descents, e.g. during aerobatics. Switching to the “auto, least often” recording mode will produce some increase in the amount of available recording time, but the increase will not necessarily be very large. If a pilot wants to be sure that the GPS will retain a set of “active logs” that span the entire length of a flight, he should set the GPS to the “time” mode rather than the “auto” mode if the flight will likely be longer than 5.5 hours, or in the case of a ridge soaring flight in a hang glider, longer than 9 hours, or in the case of a flight involving an unusual number of very rapid climbs and descents (e.g. during aerobatics), longer than 2.8 hours.

During the course of a long flight, if a pilot is concerned about over-writing the start of the first “active log”, he can bring up the “tracks” menu to see what fraction of the “active log” memory remains, and he can then change the “active log” track recording interval if necessary. Of course, this strategy only works if the pilot has selected the “clear track log” option before flight, or after the last time he downloaded the GPS data to a computer, so that there are no old unwanted “active logs” sitting in the “active log” memory area.

I normally set my GPS to record in the “auto, most often” mode. If my actual time in flight exceeds 5 hours (or 9 hours during a ridge-soaring flight in a hang glider), I make a point of checking the amount of space remaining in the “active log” memory every half hour or so. If I see that the “active log” memory is approaching 90% full, I change the “active log” recording interval to the “time, 20 seconds” mode. With 1000 “active log” track points remaining, this yields 20,000 seconds or 5.6 hours of additional recording time.

When the “active log” memory is running low, another alternative is to simply use the “save track” option in flight. As we’ll see in a moment, the “saved tracks” created by this method are separate from the “active logs” that we’ve been discussing, and contain less detail than the “active logs”, but at least some record of the start of the flight will be preserved even if the corresponding “active log” track points are overwritten.

Of course, another strategy is simply to use the “time” recording mode rather than the “auto” recording mode. For example, a recording interval of 3, 4, or 5 seconds will allow the GPS to retain “active logs” spanning 8.3 hours, 11.1 hours, or over 12 hours respectively, and a recording interval of 10 seconds will allow the GPS to retain “active logs” spanning more than 24 hours. One of these might be a good setting for a second, “backup” GPS. For a multi-day flying trip where the user has no access to a computer for downloading GPS data, an even longer recording interval might be appropriate.

None of these adjustments to the rate at which new track points are added to the “active log” has any effect on the rate at which the map display screen is updated, or on the rate at which the numerical data display fields are updated, or on the rate at which new data is sent out through the data port to an attached variometer, barograph, etc. The numerical data fields, moving map screen, and compass-like display screen all appear to be updated about once per second, regardless of the rate at which new track points are added to the "active log".

The very latest leg of the "breadcrumb trail" on the GPS's map screen is anchored at one end to the last "active log" track point, and is attached the other end to the moving triangular icon representing the current position of the GPS. This means that if the GPS is set to record new "active log" track points at a very low rate, the latest leg of the "breadcrumb trail" on the GPS's map screen will not always offer an accurate depiction of the current direction of travel over the ground. In this case, the orientation of the triangular icon representing the current position of the GPS will still continue to show the current direction of travel over the ground.

As an aside, the GPSmap 76's pressure-versus-time plot, as opposed to the elevation-versus-time plot or elevation-versus-distance plot, appears to be based upon a separate log that is distinct from the "active logs" that we've been discussing here. This separate log is not cleared when the active log is cleared via the "clear" button on the "tracks" menu. This separate log is not downloaded to MapSource along with the other "active logs".

The second major type of track log generated by the Garmin GPSmap 76S contains less detail than the "active logs" that we've been discussing up to this point. We'll call these other track logs the "saved tracks". "Saved tracks" have names like "20-JUN-06 02", or whatever name the user substituted while saving the track. Like "active logs", "saved tracks" are comprised of many individual "track points". For each "saved track" track point, the GPS records only the position, not the date or time. When a "saved track" is viewed in "MapSource", each "saved track" track point is displayed along with the altitude, leg length (i.e. distance to the next track point), leg course (which in this context means the direction of travel to the next track point) and position (latitude and longitude). Since the "saved track" points contain no time or date information the date, clock time, leg time, and leg speed cannot be displayed.

A "saved track" only samples a small portion (often 1/5 or less) of the track points that make the corresponding "active logs". A new "saved track" begins every time the user presses the "save" button on the "tracks" menu screen. One "saved track" can cover many days and can sample points from many different "active logs". If the user selects the "save all" motion, then the new "saved track" will encompass all the "active logs", i.e. the new "saved track" will encompass the entire length of the "breadcrumb trail" that appears on the map screen of the GPS. The GPS will also suggest other shorter intervals such as "save since noon", etc. Pressing the "save" button on the "tracks" menu screen to create a new "saved track" has no effect on the amount of memory space left for recording "active logs". Pushing the "clear" button on the "tracks" menu screen will erase all the "active logs" and reset the "active log" track log memory indicator to zero, but this will not erase any of the "saved tracks". Up to 10 "saved tracks" may be stored in the memory of the GPSmap 76S. The "saved tracks" currently stored in memory are listed on the "tracks" menu page.

When the GPS is saving a "saved track", the more track points in the corresponding "active logs", the smaller the fraction of these points that will be incorporated into the "saved track". The maximum number of points that can ever be incorporated into a "saved track" is 750. In practical terms, this means that a saving a fresh "saved track" after each flight will capture much more resolution in the "saved track" than will waiting until the "active log" track memory is nearly full after several days of flying and then saving the entire "active log" as a single "saved track". Since the active logs can span up to 10,000 track points, and a "saved track" can only include up to 750 track points, the latter course of action would mean that the resulting "saved track" would only capture about 7% of the track points in the corresponding set of "active logs".

When a pilot presses the "save" button on the "tracks" menu screen, creating a "saved track", and then selects the "show on map" option so that that "saved track" remains visible on the map screen of the GPS, he may notice that there are really two different track lines that lay on top of each other. One of these lines is the "breadcrumb trail" or "active log", denoted on the GPSmap 76S by a dotted line. This line is usually quite smooth even during tight circling maneuvers. The other of these lines is the "saved track", denoted on the GPSmap 76S by solid line, which contains many fewer track points and therefore may be much more "jagged" in appearance than the "active log", especially during circling maneuvers. As the pilot continues to use the GPS, eventually that portion of the "breadcrumb trail" or "active log" will be overwritten (assuming that the user has selected the "wrap when full" option) and only the coarser "saved track" will remain.

Any given "saved track" will only be visible on the map screen of the GPSmap 76S if two conditions are met. One, the "saved tracks" option on the "line" tab of the "setup map" menu screen must be set to a scale that is equal to or larger than the current scale of the map screen. (Setting this parameter to the largest possible value of 800 miles will help ensure that this condition is always met.) And two, the "show on map and highway" box must be checked on the detailed menu for that track, which can be accessed from the "setup track log" option of the "tracks" menu screen. This box is checked by default when "saved tracks" are downloaded from "MapSource" to the GPS, but not when a new "saved track" is created by using the "save" button on the "tracks" menu screen.

Likewise, when GPS data is downloaded to MapSource, a careful examination of the MapSource map screen will reveal that there are often two track lines overlain on top of each other. Again, the smoother line is the "active log", and the coarser line is the "saved track". (If the user has pressed the "save" button on the "tracks" menu several times, there may be several different "saved tracks" that sample all sample a given "active log", in which case there will be several different track lines all overlain on top of each other.) Of course, if the "active log" track memory became full and began to overwrite itself before the GPS data was downloaded to MapSource, then the "active log" for a particular segment of a "saved track" may be absent. Similarly, if the user has not exercised the "save track" option before downloading the data to MapSource or before a given portion of the "active log" track memory was overwritten, then there may be no "saved track" encompassing a particular "active log".

Since the "active logs" contain more detail than the "saved tracks", the only real reasons to use the "save" button on the tracks menu screen to create a "saved track" are to capture some of the corresponding the "active log" points before they are over-written, or to create a single record that encompasses an entire flight (which may include many different "active logs" if the satellite lock was lost and re-acquired several times), or to attach a name to a track for future reference. However, in Map Source, several "active logs" can be consolidated into a single record, and any name the user desires can be attached to any "active log" or "saved track". Therefore if the user is in the habit of downloading the GPS data to a computer at the end of each flight or at the end of each flying day, and is able to capture all of the "active log" track points before any are overwritten, there is no real need to use the "save" button on the tracks menu screen. On the other hand, if the user does not plan to download the GPS data to a computer very often, or if the user simply doesn't care to preserve the high level of detail (i.e. the high resolution, and the time and date information) that is characteristic of the "active logs", then he'll likely want to use the "save tracks" feature at the end of each flight or at the end of each flying day to capture a subsample of the "active log" track points in the form of a "saved track" before that portion of the "active log" is overwritten. At this time, it's often convenient to give a descriptive name to the "saved track" that is being saved, so that when the GPS data is downloaded to MapSource at some later time, it is immediately clear what the various "saved tracks" represent. (Bear in mind that the individual track log points for the "saved tracks" contain no time or date information.) As we've already noted, saving a fresh "saved track" at the end of each flight will sample a higher fraction of the "active log" track points than will waiting to save a "saved track" when the "active log" memory is nearly full after several days of flying. Conversely, since the GPS can only hold 10 "saved tracks", if the goal is to extend the GPS's memory as far as possible without regard to the level of detail that is captured, the user should set the track log to record very infrequently, and then should wait until the “active log” track memory is nearly full to use the “save tracks” feature to capture a subsample of those “active log” track points in the form of a single “saved track”. Then the user should clear the “active log” track memory, erasing the “active logs” or “breadcrumb trail”, and repeat the process when the “active log” track memory becomes full again. With this procedure, the GPS’s memory may be stretched to encompass many days of flying. However, the user should remember that each “saved track” contains no information as to time or date, other than whatever information the user has included in the title.

In actual practice, I make a point of saving a new “saved track” after each flight. At the end of a day of flying, I download the tracks to a computer, which also captures not only the “saved tracks”, but also all the “active logs”, that are associated with that day of flying. Then I go through the downloaded “active logs” and “saved tracks” in MapSource and delete any that are of no lasting interest. Finally I select the “clear track log” option on the “tracks” menu of the GPS, which deletes all the active logs in the GPS’s memory. This isn’t really necessary, because those active logs would eventually be overwritten with new data, but it prevents me from downloading the same “active logs” to a computer on some later date, which would use unnecessary memory space. Also, by not keeping old “active logs” in the GPS’s memory, I ensure that should I find myself in the middle of a very long flight, I can easily check to see if the “active log” points corresponding to the beginning of that flight are in any danger of being over-written, and taken action accordingly.

When the “save tracks” option is used to create a “saved track”, the user is often presented with a choice of two different starting times that are only one minute apart. Often these correspond to the last time that the GPS was switched on, and the time the GPS acquired a satellite lock after being switched on. By selecting the later of these two times as the starting time for the saved track, the user can often avoid incorporating erroneous points that were associated with some previous position. This isn’t very important, but it does prevent the “distance versus altitude” plot for the “saved track” from having a large flat stretch at the start, representing the distance between the previous location that the GPS was used, and the actual location where the GPS was last switched on.

When multiple “saved tracks” are created on one day, the GPSmap 76S will suggest names like “20-JUN-06”, followed by “20-JUN-06 02”, followed by “20-JUN-06 03”, etc. We’ll call the suffix “02” or “03” in the above example the “sequence number”. Saved tracks are always assigned the lowest “sequence number” that is available, which means that under certain specific circumstances, the “saved tracks” can end up not being numbered chronologically. For example if the user does 3 “save track” operations, and then deletes the second “saved track”, and then does one more “save track” operation, the 4th “saved track” will be assigned the now-vacant sequence number of “02” rather than “04”, even though an earlier “saved track” still holds the “03” sequence number.

18) Notes on waypoints

As noted above, with the GPSmap 76S it is very easy to create a waypoint, even while flying. Simply hold the “enter” button down for 2 seconds, and then push the enter button one more time. With each waypoint, the GPS saves the position (latitude and longitude), altitude, and date and time of creation.

Waypoints are not automatically incorporated as track points in the “active log” or “saved tracks”.

The date and time (to the nearest minute) of creation of the waypoint are saved. This data can be viewed on the waypoint properties screen of the GPSmap 76S, or on the waypoint properties screen of MapSource.

Unlike some other GPS's such as the GPSmap76C series and the Etrex series, on the GPSmap 76S, calling up a list of nearest waypoints (or an alphabetical list of waypoints) and highlighting one of them does not immediately yield the bearing to that waypoint and the distance to that waypoint. Only the latitude and longitude and elevation of that waypoint will be displayed. To find the bearing and distance to a waypoint, the user will actually need to initiate a "goto" function toward that waypoint, and will need to have a numerical data field on the map screen (or elsewhere) configured to "bearing", and will need to have a second numerical data field on the map screen (or elsewhere) configured to show "distance." Pilots who envision describing their position in an emergency (e.g. after deploying a reserve chute) by giving the bearing and distance to a known waypoint should make sure that they have numerical data fields devoted to "bearing" and "distance" on the map screen or on some other screen.

19) Notes on the speed filter

The "speed" filter is controlled at the "units" tab of the "setup". When the GPS is stationary and the speed filter is set to the lowest possible value of "user, 2 seconds", the numerical display field for "speed" will occasionally show a non-zero reading. When the GPS is stationary and the compass sensor is not active, the heading display will fluctuate much more when the speed filter is set to the lowest possible value of "user, 2 seconds" than when the speed filter is set to some higher time value, or when the speed filter is set to "auto". When the GPS is stationary, the breadcrumb trail (zoomed all the way in to the 20' scale) will also show much more movement when the speed filter is set to the lowest possible value of "user, 2 seconds" than when the speed filter is set to some higher time value, or when the speed filter is set to "auto". When the track log recording interval has been set to "auto" in the "track log setup" menu, and the GPS is stationary, new "active log" track points will be recorded more frequently when the speed filter is set to the lowest possible value of "user, 2 seconds" than when the speed filter is set to some higher time value, or when the speed filter is set to "auto". During actual flight, with the track log recording interval set to the "auto, most often" setting, I haven't determined whether the "user, 2 seconds" speed filter setting yields any fewer "active log" track points than "auto" speed filter setting does. I also have not determined whether, during actual flight, the "user, 2 seconds" speed filter setting results in faster updates of the "heading" display than the "auto" speed filter setting does. Just in case, I usually leave the speed filter set for "user, 2 seconds", to capture the highest resolution in the track log and ensure that the heading display is updated as quickly as possible. Again, I haven't determined that the "auto" speed filter setting would be any less satisfactory. I haven't noticed that the heading display of my Etrex Vista, which has no user-selectable filtering time, is any less the responsive than the heading display of my GPSmap 76S (set to "user, 2 seconds" speed filtering) is. Setting the speed filter to "auto" does minimize the amount of track log memory that is needlessly used when the GPS is stationary, at least in cases where the active log recording interval has been set to "auto" rather than set at a fixed time interval. But this isn't really a very significant advantage in most situations, because when the active log recording interval has been set to "auto", the rate at which new active log track points are recorded when the GPS is stationary is always much lower than the recording rate during flight, regardless of the speed filter setting.

20) List of settings

Here is a list of some of the settings I use for my GPSmap 76S. Bear in mind that selecting "800 miles" means that a feature will always be shown and selecting "20 feet" means that a feature will almost never be shown.

On the "map screen" menu: next street feature "hidden". I configure the map screen to show two small rows of data fields. This yields 6 fields, which I devote to "speed", "distance to destination", "heading", "bearing", "glide ratio", and "glide ratio to destination". Or for flight in an airplane, I configure the map screen to show 3 small rows of data fields. This yields 9 fields, which I configure to show all the parameters listed above, plus "time of day", "estimated time of arrival", and one other parameter of interest.

On the "General" tab of the "Setup map" menu: detail "normal", orientation "north up", colors "land", auto zoom "off".
On the "Map" tab of the "Setup map" menu: basemap "on", MapSource "on", lat/lon grid "off", grid labels "auto".
On the "Waypoints" tab of the "Setup map" menu: waypoints text "large" zoom "auto", active route waypoint text "large" zoom "800 mi."
On the "Line" tab of the "Setup map" menu: track log "800 mi.", saved tracks "800 mi.", course lines "off", bearing line "800 mi."
On the "Other" tab of the "Setup map" menu: accuracy circle "on", heading line "on", lock to roads "off".

On the "Setup track log" menu: recording "Wrap when full", record method "Auto", interval "Most often".

On the "General" tab of the "Setup" menu: mode "Normal" or "Battery saver", WAAS "Enabled", backlight timeout "2 minutes" (or "Stays on" for night use).
On the "Altimeter" tab of the "Setup" menu: altimeter auto calibration "off" (or occasionally "on" for operation in areas where I can't set the altimeter to match a known reference altitude), altimeter "on", barometer mode "Variable elevation".
On the "Compass" tab of the "Setup" menu: compass "off", heading data source 1) use GPS if speed is above "0 mph", 2) use compass if below 0mph for at least "3 minutes".
On the "Units" tab of the "Setup" menu: direction display "Numeric degrees", speed filter "User", seconds "2".
On the "Location" tab of the "Setup" menu: location degrees and decimal minutes, map datum "WGS 84", north reference "true" (or occasionally "magnetic" for cross-country use in a light airplane.)
On the "Interface" tab of the "Setup" menu: serial data format "NMEA" for connection to my variometer, or "Garmin" for downloading data to a computer with MapSource or uploading data from MapSource.

I configure the compass-like display screen to show 2 large numerical data fields, which I devote to "speed" and "heading". I configure the highway screen to show 9 small numerical data fields, which I devote to any parameter of interest that is not already displayed on the numerical data fields of the map screen or the compass-like display screen—this typically includes "time of day".

21) Additional notes on track logs: uploading "active logs" and "saved tracks" from MapSource 6.9.1 to the GPSmap 76S

As noted above, when GPS data is downloaded to MapSource, the "active logs" as well as the "saved tracks" appear on MapSource's "tracks" page. The "active logs" have names like "ACTIVE LOG", "ACTIVE LOG 001", "ACTIVE LOG 002", etc. The "saved tracks" have names like "20-JUN-06 02", or whatever name the user substituted while saving the track. In MapSource, the user can re-name any "active log" or "saved track". In MapSource, several different "active logs" and/or "saved tracks" can be joined together into one single "active log" or "saved track".

In MapSource, the user can also select a specific "active log" or "saved track" to display as a track on the map or as an altitude-versus-distance plot. MapSource cannot display an altitude-versus-time plot.

In MapSource, parts of "active logs" (including the time and date information) can be spliced into "saved tracks" (which lack time data), and vice versa. The actual position data for individual track log points cannot be changed, but track points can be deleted. This will create a change in the leg length and leg course values displayed for the preceding track point, as well as the leg time and leg speed values (if present.). Note that now the distinction between “active logs” and “saved tracks” is starting to blur—once we start to manipulate tracks in MapSource, splicing pieces of “saved tracks” into “active logs” or vice versa, we no longer can categorize a track segment as a “saved track” or an “active log” depending on whether time and date information is present or not.

In fact as far as MapSource is concerned, there is no distinction at all between an “active log” and a “saved track”. However, as data is uploaded from MapSource to the GPSmap 76S, the GPS will treat the data differently depending upon whether it recognizes the segment as an “active log” or as a “saved track”.

When data is uploaded from MapSource to the GPSmap 76S, any segment whose name begins with the words “active log” (not case-sensitive) is treated as an “active log”, and any segment whose name does not begin with the words “active log” is treated as a “saved track”. This is true even if the “active log” was originally a “saved track” whose name has been changed to begin with the words “active log”, or vice versa. This is also true even if the “active log” has had bits of “saved tracks” spliced into it, or vice versa. So the ultimate definition of an “active log” is any track segment whose name begins with the phrase “active log” (not case-sensitive), and the ultimate definition of a “saved track” is any track segment whose name does not begin with the phrase “active log”. To take a rather complicated example, if the user goes into the “saved tracks” menu screen of the GPSmap 76S and changes the name of one of the “saved tracks” to “ACTIVE LOG”, and then downloads that track segment to “MapSource”, then if that segment is ever uploaded back to the GPSmap 76S, the uploaded segment will be treated as an “active log” rather than a “saved track”!

In addition to the limit of 10,000 total “active log” track points that can be stored in the memory of the GPSmap 76S, there may be a limit to the total size of any one “active log” that can be uploaded successfully from MapSource to the GPSmap 76S, but I’ve not encountered this limit in actual practice.

As an “active log” is uploaded from MapSource, its name will not appear on the “saved tracks” screen, but the “tracks log” memory indicator will show an increase in the amount of memory that is currently in use, and the segment will appear on the “plot versus distance” page of the elevation screen, and the segment will be visible in the “breadcrumb trail” that represents the cumulative total of all the “active logs” in memory. This is all characteristic of the way that the GPSmap 76S treats any “active log”. However, the GPSmap 76S has an odd quirk: the time-related and date-related data normally present in an “active log” are not preserved when the “active log” is uploaded from MapSource to the GPSmap 76S. The uploaded “active log” will contain altitude and position data only, just like the “saved tracks” normally do. This means that the uploaded “active log” will be illustrated on the “plot versus distance” version of the “elevation” screen, but cannot be illustrated on the “plot versus time” version of the “elevation” screen. Also, as an “active log” (e.g. “ACTIVE LOG 004” or “active log great flight June 6”) is uploaded from MapSource to the GPS, its name will be automatically modified to the standard “active log” format of the words “ACTIVE LOG” followed by three numbers (e.g. perhaps becoming “ACTIVE LOG 041”), and these three numbers will be consecutive to the numbers of all the other “active logs” currently in memory. In essence, the uploaded “active log” is treated as if it is fresh data with no past history. The “active logs” in memory are normally numbered from oldest to newest (e.g. “ACTIVE LOG” followed by “ACTIVE LOG 001” followed by “ACTIVE LOG 002”, where “ACTIVE LOG” is the oldest and “ACTIVE LOG 002” is the newest), but when an older “active log” is uploaded from MapSource to the GPSmap 76S, it will receive a number consecutive to all the other “active logs” in memory at that moment, even if it actually represents a much older track segment. On the “plot versus distance” version of the “elevation” screen, from left to right, the “active logs” with the lowest numbers are illustrated first, followed by the “active logs” with the highest numbers (e.g. “ACTIVE LOG”, followed by “ACTIVE LOG 001”, followed by “ACTIVE LOG 002”, etc.) When all the “active logs" have been generated internally by the GPS, this means that the "plot versus distance" version of the elevation screen will run in chronological order (oldest to newest) from left to right, but when "active logs" have been uploaded from MapSource, this is no longer the case, since a newly uploaded track will appear on the right side of the "plot versus distance" version of the elevation screen, even if it represents very old data. If the same "active log" is uploaded multiple times from MapSource, it will appear multiple times on the "plot versus distance" version of the elevation screen. All in all, the GPSmap 76S is not really designed to deal well with "active logs" that are uploaded from MapSource to the GPS.

We've noted that when data is uploaded from MapSource to the GPSmap 76S, any segment that does not begin with the name "active log" (not case-sensitive) is uploaded as a "saved track" rather than an "active log". As a "saved track" is uploaded, its name will appear on the "saved tracks" screen, and the "tracks log" memory indicator will not show an increase in the amount of the "tracks log" memory that is currently in use. The segment will not appear on the "plot versus distance" or "plot versus time" page of the elevation screen. The segment will not be visible in the "breadcrumb trail" that represents the cumulative total of all the "active logs" in memory. All this is characteristic of how the GPSmap 76S handles any "saved track", regardless of whether it is created internally by the GPS or uploaded from MapSource. Like all other "saved tracks", the uploaded "saved track" will not contain any time-related or date-related information, even if time-related and date-related information was present when the segment resided in MapSource. (This situation could arise if the segment was originally an "active log", whose name was then changed so that it no longer began with the words "active log", which would then turn the segment into a "saved track" as far as the GPSmap 76S is concerned.) The GPSmap 76S handles "saved tracks" uploaded from MapSource without any problems, just as if they had been generated internally rather than uploaded. If the name of the "saved track" was longer than 13 characters when it resided it MapSource, it will be truncated at 13 characters after transfer to the GPSmap 76S, and lower case letters in the name will be converted to capital letters.

We've mentioned that the maximum number of points can be incorporated into a "saved track" is 750. If the user attempts to upload a longer "saved track" from MapSource to the GPS, a "track truncated" message will appear on the screen of the GPS after the first 750 points are transferred. However, "active logs" can be much longer than 750 points. If the user wants to transfer a "saved track" that is longer than 750 points (perhaps because it has been made from several "saved tracks" that have been spliced together in MapSource) from MapSource to the GPS, here's a handy trick. First, "clear" the GPS's "active log" memory by using the "clear" button on the "tracks" menu screen. Then in MapSource, change the name of the segment of interest from the "saved track" format to the "active log" format (e.g. simply "active log".) Then transfer the segment over to the GPS. Naturally, the segment will transfer as an "active log" rather than a "saved track". Once the segment has been transferred to the "active log" memory of the GPS, press the "save" option on the GPS's "tracks" menu screen to create a "saved track". Choose the "save entire log" option. The resulting "saved track" will represent a subsample of the track points from the newly transferred "active log", and though the full length of the segment will be present with no truncation at the end, the segment will be comprised of no more than 750 track points.

22) Additional notes on MapSource 6.9.1

We've referred to MapSource frequently above. In all cases the specific version of interest was MapSource 6.9.1.

I now always save MapSource files as "Garmin GPS Database Version 2 (*.gdb)", which is the latest file version offered by MapSource 6.9.1. I'm not familiar with the differences between files of this type, and the two earlier file versions also offered as "save" options by MapSource 6.9.1. These 2 earlier file versions are "Garmin GPS

Database Version 1 (*.gdb)", and "MPS Files (*.mps)". I used the *.mps file version in the past with an older version of MapSource, and haven't had any problems re-saving these older files as the newer Version 2 (*.gdb) files, nor have I noticed that this has created any changes in the files.

Here are a few additional tips on the MapSource program:

When data is being transferred from a GPS to the MapSource computer program, and the computer involved is running on an external power supply rather than on internal batteries, a momentary interruption of power to the computer will cause the transfer to fail. Before resuming the transfer, the GPS should be turned off and then back on; otherwise the subsequent transfer will also fail. When there is a high risk that the computer's power supply will be momentarily interrupted (e.g. when running off an inverter in a car) it's often best to disconnect the power supply before beginning the transfer of data.

When viewing downloaded GPS data in MapSource, if the file contains a large number of waypoints, the identifying labels for the waypoints may obscure most of the other information on the map screen, including the downloaded tracks. An easy way to make all the waypoints disappear is to go to the box labeled "show waypoints in category...", and enter a category for which there are no waypoints (e.g. "Category 16".)

In MapSource, if you right-click on a track or waypoint or route on the left side of the screen, that feature will be highlighted in yellow on the map. However, that feature may lie beyond the borders of the map, in which case it will not be visible. If you go to the left side of the screen and left-click on a waypoint or track or route, or a group of multiple waypoints or multiple tracks or multiple routes, and then choose the "show on map" option, the map will automatically switch to a view that is centered around the selected features, and will automatically change to a scale that will show all the selected features in their entirety. The same thing happens when you select the "show on map" button on the "track properties" screen or the "waypoint properties" screen.

On MapSource's map screen, if you place the arrow pointer on particular track segment, and then right-click on that point, and then select the "track properties" option, the "track properties" screen will appear. The "track properties" screen is a list of every track point in a given track. The track segment on which you've right-clicked will be highlighted on the "track properties" screen. This is a handy way to find the altitude or lat/lon associated with a given point on a track. If available—i.e. if the track originated as an "active log" rather than a "saved track"—the "track properties" screen will also show the speed at that particular point in the track.

On MapSource's "track properties" screen, if you click on a particular track point or group of track points, that track point or group of track points will be highlighted on the map screen. (As long as the "track properties" screen is open, unfortunately you won't be able to manipulate any other screens, but you can move the "track properties" screen to one side to get a view of the other screens.) If the "center map on selected item(s)" box is checked, the map will move to center around the selected items. If you click on the "show on map" button on the "track properties" screen, the map screen will automatically change to a scale that shows the entire track that is being featured on the "track properties" screen. This is not always desirable—avoid clicking on the "show on map" button on the track properties screen if you want to keep the map zoomed in to scale that is too large to show the entire track in question. When you click on a particular track point on the "track properties" screen, sometimes the highlighted track point will be lost amidst the clutter on the map. Choosing the "center map on selecting item(s)" box and then zooming the map in will reveal the highlighted track point. However, you'll have to close the "track properties" screen before you can zoom the map in. After zooming the map in, you can easily bring up the "track properties" screen again, as described above.

As noted above, often several tracks will lie on top of each other. Typically one will originate from an "active log" and one or more others will originate from a "saved track". In this case it can be helpful to make a copy of the MapSource file and delete all the "saved tracks" from that copy, so that only the "active logs" remain. This allows you to easily click on a track and bring up the "track properties" screen for the associated "active log", rather than accidentally bringing up the "track properties" screen for a "saved track", which contains less information (fewer track points and no time, date, or speed information.)

On MapSource's "track properties" screen, the "show profile" button brings up a graph of altitude versus time. There's no easy way to pick a point on this altitude profile and highlight it on the "track properties" screen or on the map. By scanning through the altitude information on the "track properties", it's possible to find the track points associated with altitude peaks, and then locate these points on the map.

In MapSource, individual waypoints or sets of waypoints can be cut, copied, or pasted from one file to another. One very handy feature is the ability to select waypoints or tracks or routes or maps with the pointer tool on the map, rather than from the alphabetical lists of waypoints, tracks, and routes. To do this, first make sure that the desired category (maps, waypoints, routes, or tracks) is "on top" of the other categories on the left side of the screen. Then click on the pointer tool (the icon looks like an arrow), and draw a box around the area of interest on the map. All the waypoints, routes, and tracks in the area of interest will be highlighted in yellow on the map. (More precisely, the entire length of all the routes and tracks that pass though the area of interest will be highlighted in yellow on the map, along with all the waypoints that lie in the area of interest.) Then go to the left side of the screen. You can left-click on the "up" and "down" arrows to scroll up or down through the list of whichever feature is "on top" (waypoints, routes, or tracks), but don't try to click on the index tabs to change which feature is on top, or you'll have to start over. We'll assume now that "waypoints" are on top; if "routes" or "tracks" are "on top" a similar procedure will apply. When you find one of the waypoints that lies within the block of area that you've outlined on the map, it will be highlighted in light purple. All the other waypoints that lie within the box you've outlined on the map are also highlighted in purple, though they may not be all visible at once on the left side of the screen. On the left side of the screen, right-click on any of these highlighted waypoints (being careful not to accidentally click on any waypoint that is not highlighted) and you'll get a menu of options that includes "cut", "copy", "paste", and "delete". Whichever option you choose will be applied to all the highlighted waypoints, i.e. to all the waypoints that lie within the block that you've outlined on the map. This is a very good way to quickly choose all the waypoints that lie within one particular geographic region.

23) Additional links

For more GPS-related information, see the following articles on the Aeroexperiments website:

"Using a GPS in soaring flight"

"Notes on the glide ratio functions of some Garmin GPS receivers with pressure sensors, including the GPSmap 76S/CS/CSX, GPSmap 60CS/CSX, and Etrex Vista/Vista C/Cx"

"Map screen size comparison of some handheld Garmin GPS units with numerical data fields enabled: GPSmap 76S, GPSmap 76C series, GPSmap 60 series, and Etrex series"

"More on the Garmin Etrex Vista"