

What's New with the 400W / 500W Series

New Operational Characteristics of the
WAAS GNS 400W/500W Series Units
versus
the Classic 400/500 Series Units



This document is written for:

- Garmin GPS 400W, GNC 420W/420AW, and GNS 430W/430AW Main System Software Version 2.00
- Garmin GPS 500W & GNS 530W/530AW Main System Software Version 2.00

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190-00356-06 Rev A
December 2006

Printed in U.S.A.

The 400W/500W series of navigators with WAAS now offer many enhancements over the previous non-WAAS models. Advancements include new WAAS-enabled GPS antenna, receiver, and associated software. The 400W/500W series system complies with WAAS TSO C146a and also includes a significant hardware upgrade with a new and much faster micro-processor. A terrain database for terrain awareness is included as a standard feature and now provides even greater detail. The WAAS GPS receiver now allows you to use the 400W/500W series unit for primary navigation and use GPS with vertical guidance for LPV, L/VNAV, and LNAV+V approaches. Non-precision approaches are annunciated as LNAV approaches. The Comparison of Features Summary table provides a quick view of the differences and is followed by a more detailed description of feature changes.

Comparison of Features Summary

	Feature	Classic 400/500	New 400W/500W
1	TSO	C129a – Supplemental navigation	WAAS TSO C146a – Primary navigation
2	WAAS Capable	No	Yes
3	Approach Annunciations	C129a non-precision annunciations	C146a precision annunciations of LPV, L/VNAV, LNAV+V, LNAV, and MAPR
4	SBAS Selection	No	Yes for WAAS
5	GPS Position Calculation Rate	Once per second	Five times per second
6	GPS Software	Level-C	Level-B. More robust
7	Vectors-To-Final	Yes	Auto-Suspend (SUSP) is active for Vectors To Final (VTF) until on the "TO" side of the FAF and the aircraft ground track is within a 45° course of the published in bound course. At this point, the SUSP annunciation will automatically extinguish.
8	GPS/WAAS-Based Vertical Guidance	No	GPS WAAS provides vertical guidance on the available GPS approaches
9	Holding Patterns	Yes	Holding pattern depiction on the Nav mode moving map shows aircraft position and provides active guidance
10	Autopilot Roll Steering	Yes	Includes active guidance during holding patterns and procedure turns
11	OBS Operation	Yes	OBS/SUSP behavior around the MAP is different
12	Hold to Altitude	Yes	Hold to Altitude legs will now use baro-corrected altitude if it is available
13	Parallel Track	No	Yes
14	Magnetic Variation Options	True, Magnetic, or User	True or Magnetic

	Feature	Classic 400/500	New 400W/500W
15	Terrain Database	Optional	Standard. Increased resolution.
16	Dead Reckoning (DR)	No	Yes
17	Satellite Status Page	Yes	Enhanced with new colors and 3D differential fix notation.
18	Graphics Speed	Good	Much better
19	Crossfill	Yes	12x faster
20	XM Radio Audio and Weather	Limited, NEXRAD, METARs, no audio control	Yes - Adds TAFs, TFRs, NEXRAD Coverage, and audio controls
21	KAP140/KFC225 Autopilot Operation-Compatible	Yes	Annunciation added
22	GDL Configuration	No	GDL 69/69A
23	GDL 69/69A Data Link Diagnostics	No	Yes
24	Traffic Range Rings	Yes	The numeric values for Traffic Range rings vary with the installed traffic source.
25	Installation	Individual aircraft field approval.	Approved Model List for more than 900 aircraft when installed per the STC.
26	How Can I Tell If I Have A WAAS Unit	N/A	View the first screen in the start-up routine. Check other features.

Detailed Description of Feature Changes

1. TSO

TSO C-129/C-129a allowed the use of GPS for supplemental navigation for non-precision approaches. An installation meeting TSO-146a requirements allows the use of your 400W/500W navigators as the primary navigation device for precision approaches.

See your dealer for detailed information about how the new TSO affects the operation of your aircraft.

2. WAAS Capable

WAAS (Wide Area Augmentation System) is a system to provide improved integrity and accuracy of GPS signals used for navigation. "Wide Area" refers to a network of ground reference stations that cover the entire U.S. and some of Canada and Mexico. Implemented by the FAA (Federal Aviation Administration) for aviation users, these reference stations are located at precisely surveyed spots and compare GPS distance measurements to known values. Each reference station is linked to a master station, which puts together a correction message and broadcasts it via satellite. The corrected differential message is then broadcast through one of two geostationary satellites. The information is compatible with the basic GPS signal structure, which means any WAAS-enabled GPS receiver can read the signal. WAAS capable receivers typically have accuracies of one meter horizontally and 2 meters vertically.

Basically, it's a system of satellites and ground stations that provide GPS signal corrections, giving you even better position accuracy. How much better? Try an average of up to five times better. A WAAS-capable receiver can give you a position accuracy of better than two meters 95 percent of the time. And you don't have to purchase additional receiving equipment or pay service fees to utilize WAAS. WAAS also provides the capability of quickly determining when signals from a given

satellite are wrong and removing that satellite from the navigation solution.

The Federal Aviation Administration (FAA) and the Department of Transportation (DOT) are developing the WAAS program for use in precision IFR approaches. Without WAAS, GPS alone does not meet the FAA's navigation requirements for accuracy, integrity, and availability. WAAS corrects for GPS signal errors caused by ionospheric disturbances, timing, and satellite orbit errors, and it provides vital near real-time integrity information regarding the health of each GPS satellite.

Currently, WAAS satellite coverage is only available in North America. There are no ground reference stations in South America, so even though GPS users there can receive WAAS, the signal has not been corrected and thus would not improve the accuracy of their unit. For some users in the U.S., the position of the WAAS satellites over the equator makes it difficult to receive the signals when trees or mountains obstruct the view of the horizon. WAAS signal reception is ideal for aviation applications. Your Garmin 400W/500W series system provides for primary GPS navigation in areas where no WAAS coverage is available using a Fault Detection and Exclusion (FDE) RAIM algorithm.

Other governments are developing similar Satellite-Based Augmentation Systems (SBAS). In Asia, it's the Japanese Multi-Functional Satellite Augmentation System (MSAS), while Europe has the Euro Geostationary Navigation Overlay Service (EGNOS). Once these systems are fully tested and operational, your 400W/500W series system will be capable of using these systems.

GPS Accuracy

GPS Condition	Accuracy Level
Accuracy of the original GPS system, which was subject to accuracy degradation under the government-imposed Selective Availability (SA) program.	100 meters
Typical GPS position accuracy without SA.	15 meters
Typical differential GPS (DGPS) position accuracy.	3-5 meters
Typical WAAS position accuracy.	< 1.25 meters

WAAS Channels

WAAS channel numbers are shown on Airport Approach pages in the Waypoint page group. The WAAS approach reference ID is displayed in the top left corner of the map. The approach service level is shown in the lower right corner of the map. Service level annunciations available are: LPV, L/VNAV, LNAV+V, or LNAV.

3. Approach Annunciations

LPV, L/VNAV, LNAV+V, LNAV, and MAPR will appear in the flight phase annunciation window.

Annunciation	Description
LPV	Follow lateral and vertical guidance to LPV minimums.
L/VNAV	GPS approach identified in the database as LNAV/VNAV. Fly to LNAV/VNAV minimums.
LNAV+V	Non-precision GPS approach with advisory vertical guidance. Note that some LNAV/VNAV approaches are not yet marked in the database as such and will show up as LNAV+V. If the chart shows the approach as LNAV/VNAV, it can be flown to LNAV/VNAV minimums.
LNAV	Non-precision GPS approach or non-GPS approach, such as ILS or Localizer.
MAPR	Missed Approach, indicates the system is providing missed approach integrity and CDI full-scale deflection ± 0.3 NM. This also shows that the pilot has initiated a Missed Approach by pressing the OBS key after crossing the MAP.

4. SBAS selection

The SBAS (Space-Based Augmentation System) menu option allows you to enable or disable the use of WAAS satellites. If WAAS is disabled, the unit will not be able to fly vertically guided GPS approaches (LPV, LNAV/VNAV, or LNAV+V). If WAAS was previously disabled, it may take several minutes to achieve a 3D-Diff fix after re-enabling WAAS.

See the section on SBAS Selection of the Setup 2 Page in the Aux Pages chapter of the Pilot's Guide for more details.

5. GPS Position Calculation Rate

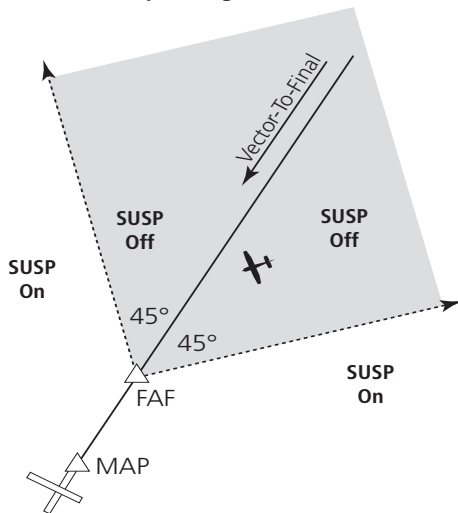
The WAAS GPS receiver calculates its position five times per second rather than once per second like the Classic C-129/C-129a GPS systems. This, together with the enhanced vertical accuracy and other system enhancements, allows for vertical approach guidance.

6. GPS Software

The GPS software of the Classic 400/500 series met the requirements for Level-C. The new 400W/500W meets the more rigorous requirements of Level-B, where required.

7. Vectors-To-Final

Auto-Suspend (SUSP) is active for Vectors To Final (VTF) until on the “TO” side of the FAF and the aircraft ground track is within a 45° course of the published in-bound course. At this point, the suspend annunciator will automatically extinguish.



Vector-To-Final Suspend Operation

Remember, don't press OBS or you will have to reload the approach, unless you desire to sequence to the final approach segment in the active flight plan.

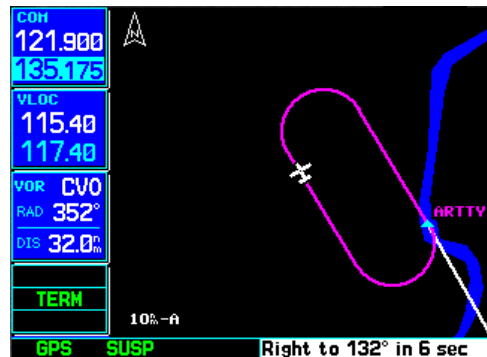
See the section on Vectors to Final in the Procedures chapter of the Pilot's Guide for more details.

8. GPS/WAAS-Based Vertical Guidance

The WAAS GPS receiver now allows you to use the 400W/500W series unit for primary navigation and use GPS with vertical guidance for LPV, L/VNAV, and LNAV+V approaches.

9. Holding Patterns

The Holding pattern depiction on the Nav mode moving map shows the aircraft position and provides active guidance, with roll steering autopilot-equipped aircraft.



Guidance provided along the holding pattern

See the section on Flying an Approach with a Hold in the Procedures chapter of the Pilot's Guide for more details.

10. Autopilot Roll Steering

Roll steering guidance is now provided for procedure turns and holding patterns. The holding pattern now depicts the actual location and shape of the holding pattern while providing real-time display of your position.

See the Procedures chapter of the Pilot's Guide for more details.

11. OBS Operation

SUSP after canceling OBS when on From side of OBS path – The change in behavior is this: When you put the 400W/500W-series unit into OBS mode and the course selected places the aircraft onto the from side and then you cancel OBS, the OBS course is retained but the unit indicates that sequencing is suspended by annunciating SUSP. Note that you can still change the course to the OBS waypoint as long as you haven't cancelled OBS, but once you have it will annunciate SUSP. The WAAS TSO requires the unit to annunciate when leg sequencing is suspended, so this is the reason the SUSP annunciation is active. The classic product behaved the same way but did not indicate that sequencing was suspended and when pressing the **OBS** key, it would return to OBS mode on the same waypoint. With the 400W/500W-series unit, pressing the **OBS** key when the SUSP annunciation is above it will allow leg sequencing to occur immediately.

See the Q & A comments about using the **OBS** key in Appendix C - Troubleshooting Q&A of the Pilot's Guide for more details.

12. Hold to Altitude

The Hold to Altitude legs now use baro-corrected altitude if it is available (similar to Fix to Altitude legs). This means that if baro-corrected altitude is available and the required altitude is reached for the hold, the 400W/500W-series unit will automatically unsuspend and then sequence to the next leg after the hold fix is crossed. If baro-corrected altitude is not available, then the behavior is the same as the Classic – the user needs to press OBS to sequence past the hold.

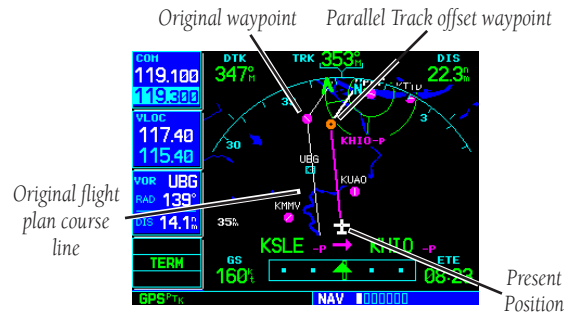
See the section on *Flying an Approach with a Hold* in the *Procedures* chapter of the Pilot's Guide for more details.

13. Parallel Track

Parallel Track allows you to create a parallel course offset of 1 to 99 NM to the left or right of your current flight plan. After setting a parallel track to your current flight plan, a magenta parallel track active leg line will be drawn offset from the original by the selected distance. The original course line will appear in white. The aircraft will navigate to the parallel track course line.

Points to remember with Parallel Track:

1. You must have an active flight plan.
2. The current leg must support parallel track.
3. Parallel track is not allowed for the active leg of an approach.
4. Parallel track is not allowed if the active leg is not a track-to-fix or direct-to-fix leg.
5. Parallel track may be allowed but not the selected offset distance.
6. Parallel Track offset waypoint is indicated with a “-p” suffix.



After setting a parallel track to your current flight plan, a magenta parallel track line will be drawn offset from the original by the selected distance. The original course line will be drawn in white. The aircraft will navigate to the parallel track course line.

Navigating Along A Parallel Track

See the section on *Parallel Track* in the *Flight Plan* chapter of the Pilot's Guide for more details.

14. Magnetic Variation Options

Magnetic variation has been simplified to the choices of Magnetic and True.

See the section on Units/Position of the Setup 1 Page in the Aux Pages chapter of the Pilot's Guide for more details.

15. Terrain Database

The Terrain function in Nav mode is now a standard feature. The extensive database aids in terrain awareness. TAWS remains as an option in the 500W series.

See the section on Terrain Operation in the Nav Pages chapter of the Pilot's Guide for more details.

16. Dead Reckoning (DR)

Dead reckoning is the process of continuing navigation based on your last known position using your current heading, speed, time, and distance to be traveled after a loss of GPS navigation on an active flight plan. Navigation using dead reckoning is therefore only an estimate and requires that you maintain the course and speed shown on your 400W/500W unit. Dead reckoning should not be used if any other means of navigation is available, such as a VOR or pilotage.

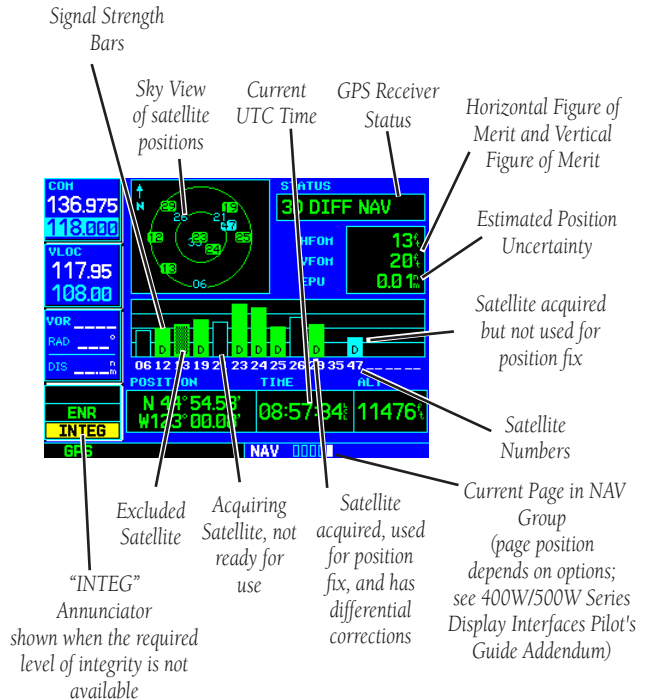
Dead reckoning becomes active after a loss of GPS position while you are navigating using an active flight plan. A pop-up message will appear and requires pilot input to clear the message. Dead reckoning is not available if you are in terminal or approach modes.

When Dead Reckoning is active, the ownship icon color is changed to yellow and the To/From flag is removed from the CDI. The Dead Reckoning annunciator (DR) appears on the left side of the map display when GPS position is unavailable and the unit is in Dead Reckoning mode. All external outputs dependent on GPS position are flagged.

See the section on Dead Reckoning in the Nav Pages chapter of the Pilot's Guide for more details.

17. Satellite Status Page

The Satellite Status page has been redesigned to provide WAAS GPS information.



Satellite Status Page Description

See the section on the Satellite Status Page in the Nav Pages chapter of the Pilot's Guide for more details.

18. Graphics Speed

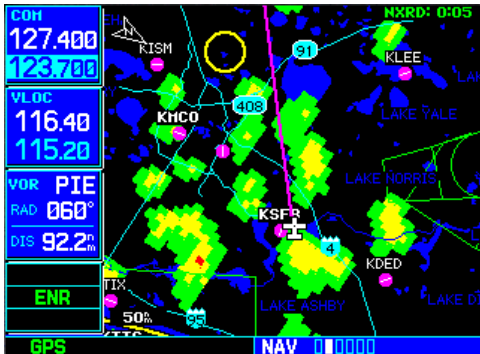
The graphics speed for redrawing the display is much improved. This is especially evident on the Map and Terrain displays.

19. Crossfill

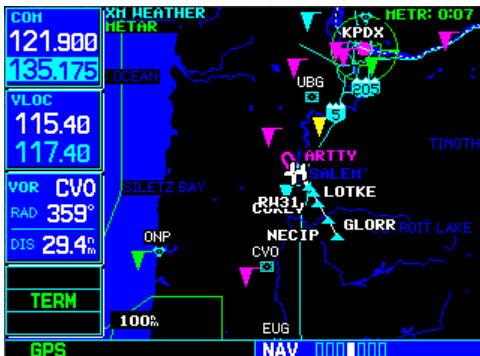
Crossfill operation in the 400W/500W series units is now 12x faster than in the Classic units. The databases of the 400/500 series and the 400W/500W series are incompatible, so you may not mix systems.

20. XM Radio Audio and Weather

XM Weather is available through the XM Satellite Radio Service when activated in the optional installation of the GDL 69 or 69A. Textual and graphic weather products such as NEXRAD graphic weather with precipitation type, radar coverage, TFRs, TAFs, and METARs symbols are displayed in the NAV function. The types of products available depend on the subscription service with XM Satellite Radio.



XM NEXRAD Weather



Graphic METARs



Textual METARs

Audio entertainment is available through the XM Satellite Radio Service when activated in the optional installation of the GDL 69A. The 400W and 500W series units serve as the display and control head for your remotely mounted GDL 69A. XM Satellite Radio allows you to enjoy a variety of radio programming over long distances without having to constantly search for new stations. Based on signals from satellites, coverage far exceeds land-based transmissions. When enabled, the XM Satellite Radio audio entertainment is accessible in the AUX function.



XM Satellite Radio Audio

See the section on XM Radio in the 400W/500W Series Garmin Optional Displays Pilot's Guide Addendum - p/n 190-00356-30 for more details.

21. KAP140/KFC225 Autopilot Operation-Compatible

Autopilot outputs for the King KAP140/KFC225 autopilots are activated manually by the pilot after being prompted during the approach procedure. Since these autopilots revert to roll mode-wings level when transitioning to approach mode, it is important for the pilot to be part of the decision process of when to make this control change. After enabling outputs, the 400W/500W-series unit will provide guidance information to the autopilot.

The 400W/500W-series unit must be configured during installation to interface with these autopilots. Guidance to the FAF is active as indicated by Approach mode annunciation (LPV, L/VNAV, LNAV+V, or LNAV).

See the section on Enabling Autopilot Outputs in the Procedures chapter of the Pilot's Guide for more details.

22. GDL Configuration

The GDL 69/69A receives broadcast weather data from a service of XM Satellite Radio, Inc. The GDL 69A also can receive audio entertainment broadcasts.

See the section on XM Radio in the 400W/500W Series Garmin Optional Displays Pilot's Guide Addendum - p/n 190-00356-30 for more details.

23. GDL 69/69A Data Link Diagnostics

Diagnostics for the GDL 69/69A are available for viewing in the Aux pages of the 400W/500W series units.

See the section on XM Radio in the 400W/500W Series Garmin Optional Displays Pilot's Guide Addendum - p/n 190-00356-30 for more details.

24. Traffic Range Rings

The numeric values for Traffic Range rings vary with the installed traffic source.

See the section on Traffic in the 400W/500W Series Garmin Optional Displays Pilot's Guide Addendum - p/n 190-00356-30 and the 400W/500W Series Display Interfaces Pilot's Guide Addendum - p/n 190-00356-31 for more details.

25. Installation

The 400W/500W series products are certified with an AML (Approved Model List) STC. There are more than 900 aircraft on the approved list. This allows the aircraft on the AML to be installed via the STC, that may result in cost and time savings in the installation process for the aircraft owner. See your dealer for details about your aircraft installation.

26. How Can I Tell If I Have A WAAS Unit

At the beginning of the start-up screens, the model number of the unit will have a "W" at the end of the number.



There are a couple of screens you can check quickly. The Satellite Status page has changed. Under Status, the WAAS units will show values for HFOM, VFOM, and EPU. The SBAS Selection page is only available for WAAS units; see item 4.



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