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FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT  
or  
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL  
for  
GARMIN 400W SERIES GPS-WAAS NAVIGATION SYSTEM  
as installed in  
Piper PA-28-181

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Make and Model Airplane

Reg. No.           N 2912m           S/N           28-7890279          

This document serves as an Airplane Flight Manual Supplement or as a Supplemental Airplane Flight Manual when the aircraft is equipped with the Garmin 400W Series unit. This document must be carried in the airplane at all times when the Garmin 400W Series unit is installed in accordance with STC SA01933LA-D.

The information contained herein supplements or supersedes the information made available to the operator by the manufacturer in the form of clearly stated placards, markings, or manuals or in the form of an FAA approved Airplane Flight Manual, only in those areas listed herein. For limitations, procedures and performance information not contained in this document, consult the basic placards, markings, or manuals or the basic FAA approved Airplane Flight Manual.

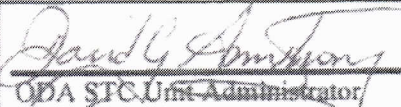
FAA Approved By: 

David G Armstrong  
ODA STC Unit Administrator  
Garmin International, Inc.  
ODA-240087-CE

Date:           7/31/04

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B	All	7/31/09	Added '-D' to STC number, added LP approach type	 <u>David G. Armstrong</u> ODA STC Unit Administrator ODA-240087-CE Garmin International, Inc.

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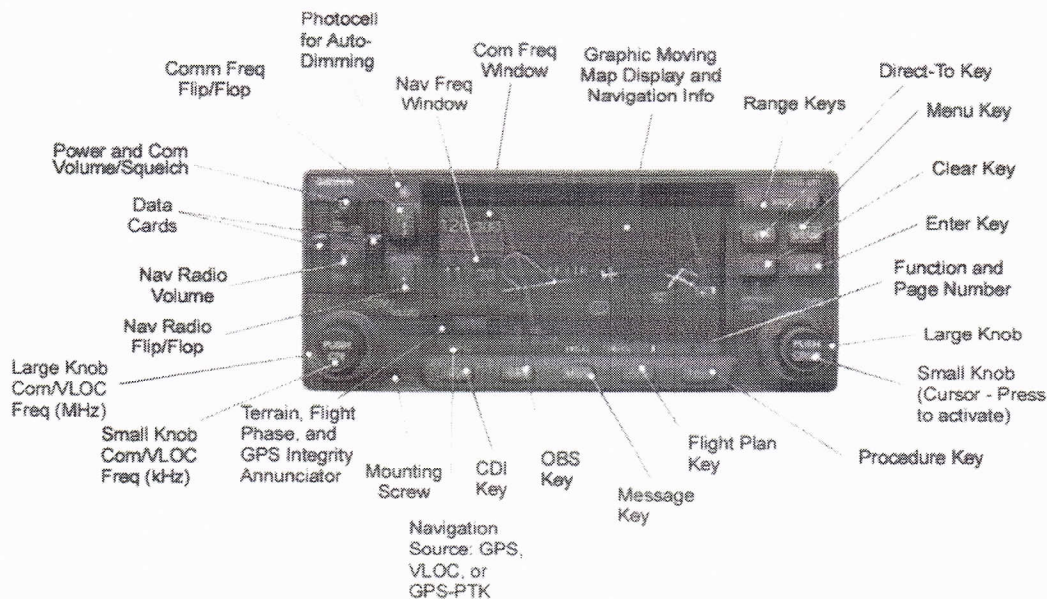
**Section 1. GENERAL**

**1.1 Garmin 400W Series GPS/WAAS Nav Com**

The Garmin 400W Series GPS/WAAS Navigator is a panel-mounted product that contains a GPS/WAAS receiver for GPS approved primary navigation, under TSO C146a (plus optional VHF Com and VHF Nav radios) in an integrated unit with a moving map and color display. The 400W Series unit features a graphical display which may also be used to depict traffic, weather, or terrain data.

The navigation functions are operated by dedicated keys and graphical menus which are controlled by the buttons and the dual concentric rotary knob along the bottom and right side of the display.

Optional VHF Com and VHF Nav radio functions are controlled via dedicated buttons and knobs on the left side of the display and adjacent to frequencies they are controlling.



**Figure 1 - 400W Series Control and Display Layout**



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**1.2 Operation**

**GPS/WAAS TSO-C146a Class 3 Operation:** The Garmin 400W Series unit, when installed in accordance with STC SA01933LA-D, uses GPS and WAAS (within the coverage of a Space-Based Augmentation System complying with ICAO Annex 10) for enroute, terminal area, non-precision approach operations (including "GPS", "or GPS", "RNAV", "LNAV", and "LP" approaches), and approach procedures with vertical guidance (including "LNAV/VNAV" and "LPV").

Navigation is accomplished using the WGS-84 (NAD-83) coordinate reference datum. GPS navigation data is based upon use of only the Global Positioning System (GPS) operated by the United States of America.

**1.3 Class II Oceanic, Remote, and other Operations:**

The Garmin 400W Series, as installed, has been found to comply with the requirements for GPS primary means of Class II navigation in oceanic and remote airspace, when used in conjunction with WAAS Garmin Prediction Program part number 006-A0154-03. Oceanic operations are supported when the 400W Series unit annunciates OCN. This provides an alarm limit of four NMI and a mask angle of five degrees. The 400W series unit also has the ability to predict RAIM availability at any waypoint in the database or if WAAS corrections are expected to be absent or disabled. This AFMS does not constitute an operational approval for Oceanic or Remote area operations. Additional equipment installations or operational approvals may be required.

- a) Oceanic navigation requires an additional approved long range oceanic and/or remote area navigation system with independent display, sensors, antenna, and power source. (It may be a second 400W/500W Series unit.)
- b) Redundant VHF Com and VHF Nav systems may be required for other than U.S. 14 CFR Part 91 operations. Check foreign regulation requirements as applicable. (It may be a second 400W/500W Series unit.)
- c) Operations approval *may* be granted for the use of the 400W Series unit RAIM prediction function in lieu of the Prediction Program for operators requiring this capability. Refer to your appropriate civil aviation authorities for these authorizations.

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**Section 2. LIMITATIONS**

**2.1 Pilot's Guide**

The GARMIN 400W Series Pilot's Guide, part number and revision listed below (or later applicable revisions), must be immediately available for the flight crew whenever navigation is predicated on the use of the 400W Series unit.

- 400W Series Pilot's Guide & Reference P/N 190-00356-00 Rev E
- 400W/500W Series Optional Displays P/N 190-00356-30 Rev F
- 400W/500W Series Display Interfaces P/N 190-00356-31 Rev B

This AFM supplement does not grant approval for IFR operations to aircraft limited to VFR operations. Additional aircraft systems may be required for IFR operational approval. Systems limited to VFR shall be placarded in close proximity to the 400W Series unit  
**"GPS LIMITED TO VFR USE ONLY"**.

**2.2 System Software:**

The system must utilize the Main and GPS software versions listed below (or later FAA approved versions). The software versions are displayed on the self-test page immediately after turn-on for approximately 5 seconds or they can be accessed in the AUX pages.

Subsequent software versions may support different functions. Check the 400W Series Pilot's Guide for further information.

**Table 1 - Approved Software Versions**

Software Item	Approved Software Version <i>(or later FAA approved versions for this STC)</i>	
	SW version	As displayed on unit
Main SW Version	3.30	3.30
GPS SW Version	3.2	3.2



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**2.3 Navigation Database**

The 400W Series unit database card must be installed. (IAW the TSO deviations granted to Garmin for the 400W unit, navigation database cards may not be marked with the part number. The software automatically precludes invalid databases for use by the 400W)

- a) IFR enroute and terminal navigation is prohibited unless the pilot verifies the currency of the database or verifies each selected waypoint for accuracy by reference to current approved data.
- b) GPS instrument approaches using the 400W Series units are prohibited, unless the 400W Series unit's approach data is verified by the pilot or crew to be current. Instrument approaches must be accomplished in accordance with an approved instrument approach procedure that is loaded from the 400W Series unit database.
- c) Installations with dual 400W/500W Series units will only crossfill between units when they contain the same database cycle. Updating of each database must be accomplished on the ground prior to flight.

**2.4 Terrain Database**

The 400W Series unit supports Terrain and requires a Terrain database card to be installed in order for the feature to operate. The table below lists compatible database cards for the 400W series. Each of the data base cards contains the following data:

- a) The Terrain Database has an area of coverage from North 75° Latitude to South 60° Latitude in all longitudes.
- b) The Airport Terrain Database has an area of coverage that includes the United States, Canada, Mexico, Latin America, and South America.
- c) The Obstacle Database has an area of coverage that includes the United States, and is updated as frequently as every 56 days.

**NOTE:** The area of coverage may be modified as additional terrain data sources become available.



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**Table 2 – Approved Terrain Database Cards**

<b>Part Number</b>	<b>Description</b>
010-10201-20	Data Card, TAWS / Terrain, 128MB
010-10201-21	Data Card, TAWS / Terrain, 256MB

**2.5 Navigation**

No navigation is authorized north of 89° (degrees) north latitude or south of 89° (degrees) south latitude.

**2.6 Approaches**

- a) During GPS approaches, the pilot must verify the 400W Series unit is operating in the approach mode. (LNAV, LNAV+V, L/VNAV, LP, or LPV)
- b) When conducting approaches referenced to true North, the heading selection on the AUX pages must be adjusted to TRUE.
- c) Accomplishment of an ILS, LOC, LOC-BC, LDA, SDF, MLS, VOR approach, or any other type of approach not approved for GPS overlay, is not authorized with GPS navigation guidance.
- d) Use of the GNS 430W VOR/LOC/GS receiver to fly approaches not approved for GPS requires VOR/LOC/GS navigation data to be present on the external indicator (i.e. proper CDI source selection).
- e) For aircraft with remote source selection annunciation or remote GPS navigation annunciations installed, conducting IFR approaches is prohibited if the remote annunciation is found to be inoperative during pre-flight. (This limitation does not prohibit the conduct of an IFR approach if the required remote annunciation fails during flight. The indications provided on the 400W Series unit display may be used as a backup).
- f) Except in emergency conditions, IFR approaches are prohibited whenever any physical or visual obstruction (such as a throw-over yoke) restricts pilot view or access to the 400W Series unit or the affected CDI.

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**2.7 Autopilot Coupling**

IFR installations of a Garmin 400W Series unit allow the operator to fly all phases of flight based on the navigation information presented to the pilot; however, not all modes may be coupled to the autopilot. All autopilots may be coupled in Oceanic (OCN), Enroute (ENR), and Terminal (TERM) modes; however, the FAA requires that vertical coupling of an autopilot for approaches be demonstrated to meet their intended function and provide safe and proper operation to published minimums. This installation is limited to:

- No limitations for autopilot coupling.
- Lateral GPS coupling (LNAV only). For 430W units: The GS of an ILS (VLOC) may be coupled to the autopilot without any limitations.

This limitation may be removed after an FAA Flight Test demonstration. Contact Garmin International, Tech Support for additional information.

**2.8 Terrain Display**

Terrain refers to the display of terrain information. Pilots are NOT authorized to deviate from their current ATC clearance to comply with terrain/obstacle alerts. Terrain unit alerts are advisory only and are not equivalent to warnings provided by TAWS. Navigation must not be predicated upon the use of the terrain display.

The terrain display is intended to serve as a situational awareness tool only. By itself, it may not provide either the accuracy or the fidelity on which to base decisions and plan maneuvers to avoid terrain or obstacles.

**2.9 VNAV**

VNAV information may be utilized for advisory information only. Use of VNAV information for Instrument Approach Procedures does not guarantee Step-Down Fix altitude protection, or arrival at approach minimums in a normal position to land.

**2.10 Weather Display**



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If an optional weather receiver is interfaced to the 400W Series unit, the weather information displayed is limited to supplemental use only and may not be used in lieu of an official weather data source.

**2.11 Traffic Display**

Traffic may be displayed on the 400W Series unit when connected to an approved optional TCAS, TAS, or TIS traffic device. These systems are capable of providing traffic monitoring and alerting to the pilot. Traffic shown on the display may or may not have traffic alerting available. The display of traffic is an aid to visual acquisition and may not be utilized for aircraft maneuvering. Display of this traffic data and related operations are described in the 400W Series unit Pilot's Guide.



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**Section 3. EMERGENCY PROCEDURES**

**3.1 Emergency Procedures**

No change.

**3.2 Abnormal Procedures**

- a) If the Garmin 400W Series unit GPS navigation information is not available, or is invalid, utilize other remaining operational navigation equipment installed in the airplane as appropriate. If the 400W Series unit loses GPS position and reverts to Dead Reckoning mode (indicated by the annunciation of "DR" in the lower left of the display), the moving map will continue to be displayed. Aircraft position will be based upon the last valid GPS position and estimated by Dead Reckoning methods. Changes in airspeed or winds aloft can affect the estimated position substantially. Dead Reckoning is only available in Enroute mode; Terminal and Approach modes do not support DR.
- b) If a "Loss of Integrity" (INTEG) message is displayed during:
  - Enroute/Terminal: continue to navigate using GPS equipment and periodically cross-check the GPS guidance to other approved means of navigation.
  - GPS Approach: GPS approaches are not authorized under INTEG - Execute missed approach or revert to alternate navigation.
- c) During a GPS LPV precision approach or GPS LNAV/VNAV approach, the 400W Series unit will downgrade the approach if the Vertical alarm limits are exceeded. This will cause the vertical guidance to flag as unavailable. The procedure may be continued using the LNAV only minimums.
- d) During a GPS LP approach, the 400W Series may downgrade the approach prior to the Final Approach Fix if alarm limits are exceeded. If this occurs, a message will be displayed advising the pilot to use LNAV minimums. If alarm limits are exceeded after the Final Approach Fix, the 400W Series unit will flag the lateral guidance and generate a system message "ABORT APPROACH loss of navigation". Immediately upon viewing the message the unit will revert to Terminal alarm limits. If the position integrity is within these limits lateral guidance will be restored

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and the GPS may be used to execute the missed approach, otherwise alternate means of navigation should be utilized.

- e) During any GPS approach in which precision and non-precision alarm limits are exceeded, the 400W Series unit will flag the lateral guidance and generate a system message "ABORT APPROACH loss of navigation". Immediately upon viewing the message the unit will revert to Terminal alarm limits. If the position integrity is within these limits lateral guidance will be restored and the GPS may be used to execute the missed approach, otherwise alternate means of navigation should be utilized.



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**Section 4. NORMAL PROCEDURES**

Refer to the 400W Series unit Pilot's Guide defined in paragraph 2.1 on page 6 of this document for normal operating procedures. This includes all GPS operations, VHF COM and NAV, and Multi-Function Display information. For information on TIS traffic, or data linked weather see the Pilot's Guide addendum for optional displays. For information on active traffic sensor or Stormscope operation and displays see the Pilot's Guide addendum for display interfaces.

Although intuitive and user friendly the 400W Series unit requires a reasonable degree of familiarity to prevent operations without becoming too engrossed at the expense of basic instrument flying in IMC and basic see-and-avoid in VMC. Pilot workload will be higher for pilots with limited familiarity in using the unit in an IFR environment, particularly without the autopilot engaged. Garmin provides excellent training tools with the Pilot's Guide and PC based simulator. Pilots should take full advantage of these training tools to enhance system familiarization. Use of an autopilot is strongly encouraged when using the 400W Series unit in IMC conditions

**4.1 Approaches with Vertical Guidance**

The 400W Series unit supports three types of GPS approaches with vertical guidance: LPV approaches, LNAV/VNAV (annunciated as L/VNAV) approaches, and LNAV approaches with advisory vertical guidance (annunciated as LNAV+V). For LNAV approaches with advisory vertical guidance, the 400W Series will annunciate LNAV+V indicating vertical guidance is available. LNAV minimums will be controlling in this case.

***NOTE:***

If flying an LPV or LNAV/VNAV approach, be prepared to fly the LNAV only approach prior to reaching the final approach fix (FAF). If the GPS integrity is not within vertical approach limits, the system will flag the vertical guidance. This may be annunciated by a downgrade to LNAV message.

For additional information on approaches with vertical guidance refer to the 400W Series unit Pilot's Guide.



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**4.2 Approaches without Vertical Guidance**

The 400W Series unit supports Localizer Performance approaches (annunciated as LP). Published LP minimums will be controlling in this case.

***NOTE:***

If flying an LP approach, be prepared to fly the LNAV only approach prior to reaching the final approach fix (FAF). If the GPS integrity is not within LP approach limits, the system will notify the pilot by a downgrade to LNAV message.

For additional information on LP approaches refer to the 400W Series unit Pilot's Guide.

**4.3 Autopilot Operation**

The Garmin 400W Series may be coupled to an optional autopilot if installed in the aircraft when operating as prescribed in the LIMITATIONS section of this manual. For lateral guidance, some installations may utilize GPSS or GPS Roll Steering in lieu of the analog deviation information. If an HSI is used with GPSS engaged, the pilot should rotate the course pointer as prompted on the 400W Series unit to prevent loss of situational awareness and to prevent the aircraft from turning inappropriately if the autopilot is switched from digital (GPSS) to analog mode. For autopilot operational instructions, refer to the FAA approved Flight Manual or Flight Manual Supplement for the autopilot.

**4.4 Coupling the Autopilot during approaches**

The Garmin 400W Series supports analog and digital (GPSS) control interfaces to an optionally installed autopilot. Some autopilots revert to ROLL mode (wings level) and/or flag a NAV failure if the digital data becomes unavailable or is inhibited. The CDI selection of VLOC should inhibit the digital control interface. When switching between GPS and VLOC the pilot should be aware that the autopilot may need to be re-engaged into APR or NAV mode after changing the CDI source.

Autopilot coupling to GPS vertical guidance requires that the autopilot be engaged in an analog APR mode identical to coupling to an ILS. Some autopilots may revert to ROLL mode when the navigation outputs of the 400W Series unit sequence to the final approach fix. In these installations

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the unit will be configured to PROMPT the pilot to "Enable the autopilot approach outputs" in order to prevent the autopilot from entering ROLL mode without the pilot being aware of the transition.

- This installation prompts the pilot and requires the pilot to enable the A/P outputs just prior to engaging the autopilot in APR mode.
- This installation supports a seamless transition from digital (GPSS) to analog guidance for the autopilot. To capture the vertical guidance, the pilot may engage the autopilot in APR mode at any time when the GPS Glide Slope (VDI) becomes valid (displayed without a FLAG).
- This installation interfaces to the autopilot in analog mode only. To capture the vertical guidance, the pilot may engage the autopilot in APR mode at any time when the GPS Glide Slope (VDI) becomes valid.
- The autopilot does not support any vertical capture or tracking in this installation.



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Analog only autopilots should use APR mode for coupling to LNAV approaches. Autopilots which support digital roll steering commands (GPSS) may utilize NAV mode and take advantage of the digital tracking during LNAV only approaches.

**4.5 WFDE Prediction Program**

The Garmin WAAS Fault Detection and Exclusion (WFDE) Prediction Program is required for Remote/Oceanic operations.

The Prediction Program should be used in conjunction with the Garmin 400W/500W Simulator. After entering the intended route of flight in the Simulator flight plan the pilot selects the FDE Prediction Program under the Options menu of the Simulator program.

For detailed information refer to the WFDE prediction program instructions (190-00643-01). The availability of FDE is only required for Oceanic or Remote operations.

**Section 5. PERFORMANCE**

No change.

**Section 6. WEIGHT AND BALANCE**

See current weight and balance data.

**Section 7. SYSTEM DESCRIPTIONS**

See Garmin 400W Series unit Pilot's Guide for a complete description of the 400W Series unit.