

400/500 SERIES FDE PREDICTION INSTRUCTIONS

 **NOTE:** These instructions assume the user has experience operating the applicable 400/500 Series Unit and is familiar with the operation of RAIM. The figures in this addendum are derived from the 400/500 Series units. The information in this document applies to all 400/500 units unless otherwise stated.

FAULT DETECTION AND EXCLUSION (FDE)

The GARMIN 400/500 Series Main and GPS Software version 3.00 and higher (Figure 1) incorporate Fault Detection and Exclusion (FDE) display interface and control, satisfying the requirements for “GPS as a Primary Means of Navigation for Oceanic/Remote Operations” per FAA Notice N8110.60.

FDE consists of two distinct parts, fault detection and fault exclusion. The fault detection part detects the presence of an unacceptably large pseudorange error (and presumably, position error) for a given mode of flight. Upon the detection, fault exclusion follows and excludes the source of the unacceptably large pseudorange error, thereby allowing navigation to return to normal performance without an interruption in service. To enhance safety, FDE functionality is provided for other phases of flight (non-precision approach, terminal, en route). The FDE functionality for non-oceanic flight phases adheres to the same missed alert probability, false alert probability, and failed exclusion probability specified by N8110.60.

The following 400/500 Series Units are affected:

- GPS 400
- GNC 420/420A
- GNS 430/430A
- GPS 500 (TAWS)
- GNS 530/530A (TAWS)



Figure 1. Software Version Screen

PRE-DEPARTURE VERIFICATION OF FDE

An FDE prediction must be performed prior to departure for a flight plan involving:

- Oceanic/Remote operation where GPS is to be the sole source of navigation per FAA Notice 8110.60
- U.S. Area Navigation (RNAV) routes, Standard Instrument Departures (SIDs), or Standard Terminal Arrival Routes (STARs) if a NOTAM indicates a GPS satellite (or satellites) is scheduled to be out-of-service, per FAA AC 90-100 “U.S. Terminal and En Route Area Navigation (RNAV) Operations”

Prior to departure, the operator must use the FDE Prediction Program supplied with the 400/500 Trainer Software to demonstrate that there are no outages in the capability to navigate on the specified route of flight (the FDE Prediction Program determines whether the GPS constellation is robust enough to provide a navigation solution for the specified route of flight).

FDE PREDICTION PROGRAM

Your 400/500 Series Trainer software includes an FDE Prediction Program to meet the requirements for GPS as a primary means of navigation for oceanic/remote operations (reference FAA Notice 8110.60). The oceanic flight phase occurs on your 400/500 Series unit when you are more than 200 nautical miles from the nearest airport. All operators using the 400/500 Series unit as primary means of navigation in oceanic/remote areas under FAR parts 91, 121, 125 and 135 must utilize the FDE Prediction Program prior to conducting a flight in these areas.

All operators must also utilize the FDE Prediction Program prior to navigation on U.S. RNAV routes, SIDs, and STARs if a NOTAM indicates a GPS satellite (or satellites) is scheduled to be out-of-service (reference FAA AC 90-100).

FDE is an acronym for Fault Detection and Exclusion. The detection function refers to the capability to detect a satellite failure which can affect navigation. The exclusion function refers to the capability to exclude one or more failed satellites and prevent them from affecting navigation. The FDE function is built into the 400/500 Series unit and does not require pilot interaction. In contrast, the FDE Prediction Program does require pilot interaction and must be used prior to oceanic/remote area flights, and for U.S. RNAV routes, SIDs, and STARs to predict FDE availability. The FDE Prediction Program allows you to specify the planned ground speed, route space, and maximum allowable outage. When provided through NOTAM or other sources, satellites with known failures can be excluded through the program's setup function.

To use the FDE Prediction Program, begin by entering the intended flight plan into the 400/500 Series Trainer software. The FDE Prediction Program uses this information to analyze satellite coverage along your intended route of flight.

To create a flight plan prior to using the FDE Prediction Program:

1. With the 400/500 Series Trainer running and the simulated 400/500 Series unit on, click on the unit's FPL button to display the flight plan pages.
2. Click on the clockwise arrow of the unit's small right knob to display the list of saved flight plans.
3. Click on the unit's MENU button, then click on the clockwise arrow of the unit's large right knob to highlight "Create New Flight Plan?". Click on the unit's ENT button to begin creating a new flight plan.
4. Use the unit's small and large right knobs to enter the identifier of the first flight plan waypoint. Click on the unit's ENT button once the identifier for the desired waypoint is displayed.
5. Repeat step #4 to enter each additional flight plan waypoint, ending at the final destination airport.

Prior to running the FDE Prediction Program, the flight plan created in the preceding steps needs to be activated. The FDE Prediction Program only works with the currently active flight plan.

To activate a saved flight plan:

1. With the 400/500 Series Trainer running and the simulated 400/500 Series unit on, click on the unit's FPL button to display the flight plan pages.
2. Click on the clockwise arrow of the unit's small right knob to display the list of saved flight plans.
3. Click on the unit's small right knob to enable the cursor, then click on the clockwise arrow of the large right knob to highlight the desired saved route.
4. Click on the unit's MENU button, then click on the clockwise arrow of the unit's large right knob to highlight "Activate Flight Plan?". Click on the unit's ENT button to activate the flight plan. The active flight plan page will be displayed (Figure 2).



Figure 2. Active Flight Plan Page

To run the FDE Prediction Program:

1. With the 400/500 Series Trainer running, the simulated 400/500 unit on, and the desired flight plan active, select the 'Options' menu in the upper left corner (Figure 2).
2. Select 'Fde Prediction Program'. The FDE Prediction Program window will appear (Figure 3), listing the flight plan waypoints and the current time as the departure time.

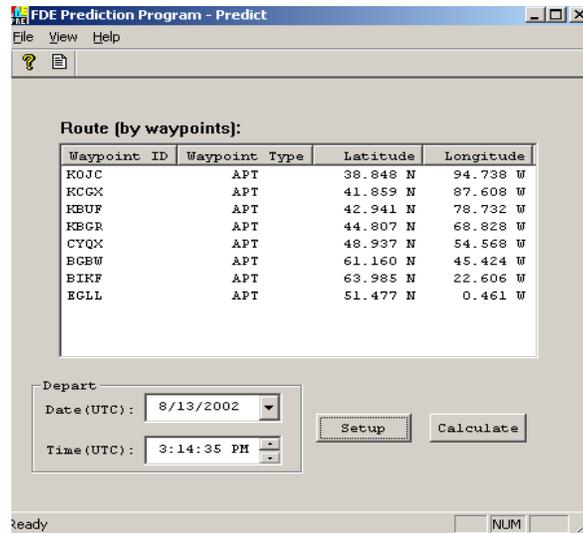


Figure 3. FDE Prediction Window

3. To change the departure date, click on the down arrow adjacent to the 'Date (UTC)' field. A calendar window appears. Click on the left or right arrows to select a different month (if desired), then click on the desired date.
4. To change the departure time, click on the hours, minutes or seconds fields adjacent to the 'Time (UTC)' field. Click on the up or down arrows to change the displayed time.
5. To change the planned ground speed, route space or maximum allowed outage, click on the 'Setup button'. A setup window is displayed (Figure 4). Click on the field for the desired item, then enter the desired value.

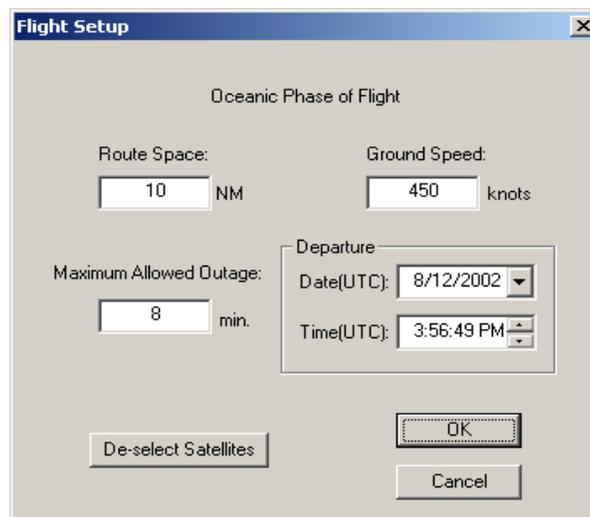


Figure 4. Flight Setup Window

 **NOTE:** Although the Flight Setup window refers to Oceanic Phase of Flight, the prediction will be correct even when Route Space of 1 or 2 NM is selected for U.S. RNAV routes, SIDs, or STARs.

6. To deselect satellites from the setup window, click on 'De-select Satellites', then click on the box adjacent to any satellite you do not wish to use. A satellite is deselected when a check mark does not appear in the box adjacent to that satellite (Figure 5).

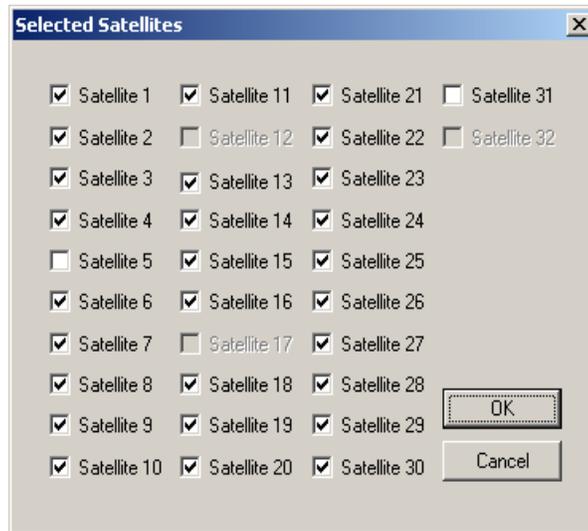


Figure 5. Selected Satellites Window

 **NOTE:** Satellites that are unavailable will be 'greyed-out', with no check marks. Satellites labeled as 'Poor Health' will default to unchecked status.

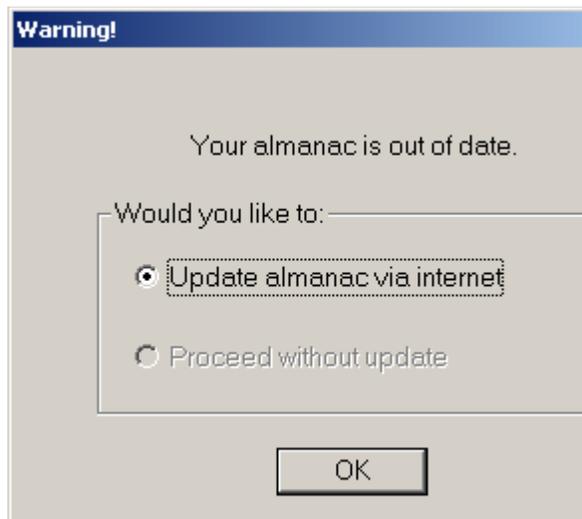


Figure 6. Almanac Warning

 **NOTE:** To ensure accuracy of results, the almanac data used for FDE prediction needs to be recent. If the information is out of date, the FDE Prediction Program will automatically prompt you to update the almanac data (Figure 6). An internet connection is required to use this feature (see following instructions).

- To calculate FDE availability, select the 'Calculate' button from the main FDE Prediction Program window (Figure 3). A 'Calculation is complete' message will appear when the FDE prediction is complete (Figure 7).

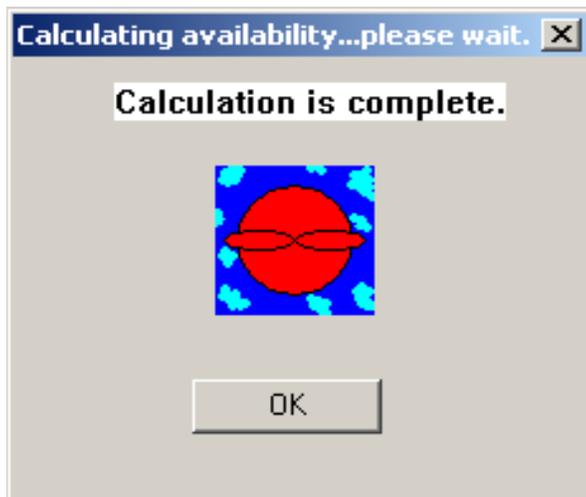


Figure 7. Calculation Complete Screen

- The Calculation Results window (Figure 8) appears after clicking the OK button on the 'Calculation is complete' message screen. The results can be viewed, or printed for later reference.

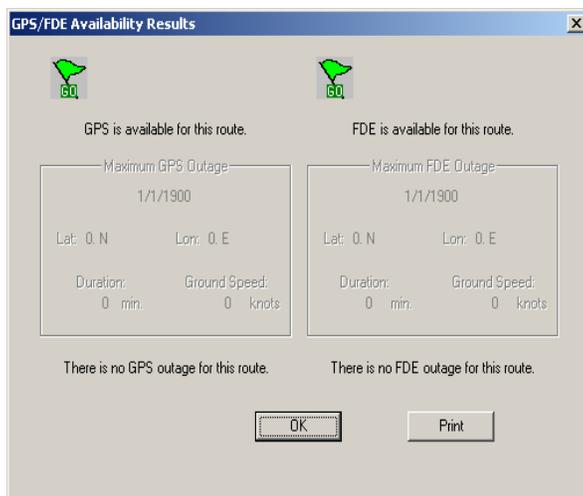


Figure 8. Calculations Results Window

To view FDE Prediction Program results:

- Select the View menu from the main FDE Prediction Program window (the results also appear automatically after clicking the OK button on the 'Calculation is complete' message screen).
- Select Results. A window will appear, showing the calculation results (Figure 8).
- To print the calculation results, click on the Print button.

 **NOTE:** The 'FDE is available for this route' result must be displayed for Oceanic, and U.S. RNAV routes, SIDs, or STARs navigation in compliance with FAA Notice N8110.60 and FAA AC 90-100.

To manually update almanac data:

- Select the Help menu from the main FDE Prediction Program window (Figure 3).
- Select Update Almanac. The program will automatically search the internet and download the most recent data.

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