

# S-TEC

## Pilot's Operating Handbook Fifty Five X



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# **SECTION 1 OVERVIEW**

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## 1.1 Document Organization

Section 1 Overview

Section 2 Pre-Flight Procedures

Section 3 In-Flight Procedures

Section 4 Operating Parameters

Section 5 Glossary

## 1.2 Purpose

This Pilot's Operating Handbook (POH) provides Pre-Flight and In-Flight operating procedures for the S-TEC System Fifty Five X Autopilot (AP).

### **Note:**

***This POH must be carried in the A/C and made available to the pilot at all times. It can only be used in conjunction with the Federal Aviation Administration (FAA) approved Aircraft Flight Manual (AFM) or Aircraft Flight Manual Supplement (AFMS). Refer to the applicable AFM or AFMS for A/C specific information, such as unique ground tests, limitations, and emergency procedures.***

### **Note:**

***The System Fifty Five X autopilot is a tool provided to aircraft owners, that serves to assist them with cockpit workload management. The ability of the autopilot to provide optimum assistance and performance is directly proportional to the pilot's knowledge of its operating procedures. Therefore, it is highly recommended that the pilot develop a thorough understanding of the autopilot, its modes, and operating procedures in Visual Meteorological Conditions (VMC), prior to using it under Instrument Flight Rules (IFR).***

## 1.3 General Control Theory

The System Fifty Five X is a rate based autopilot. When in control of the roll axis, the autopilot senses turn rate, as well as closure rate to the selected course, along with the non-rate quantities of heading error, course error, and course deviation indication. When in control of the pitch axis, the autopilot senses vertical speed, acceleration, and closure rate to the selected glideslope, along with the non-rate quantities of altitude and glideslope deviation indication. These sensed data provide feedback to the autopilot, which processes them in order to control the aircraft through the use of mechanisms coupled to the control system. In most aircraft, the roll servo is coupled to the ailerons. The pitch servo is coupled to the elevator. Activation of roll axis control must always precede activation of pitch axis control.

The optional autotrim function senses when the aircraft needs to be trimmed about the pitch axis, and responds by driving the trim servo in the proper direction to provide trim. The trim servo is coupled to the elevator trim tabs.

The optional yaw damper senses excessive adverse yaw about the yaw axis, and responds by driving the yaw servo in the proper direction to provide damping. The yaw servo is coupled to the rudder.

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## **1.4 Modes of Operation**

### **1.4.1 Roll Axis Control**

#### Heading (HDG) Mode

Used to Turn onto a Selected Heading and Hold it

#### Navigation (NAV) Mode

Used to Intercept and Track a VOR Course

#### Navigation Approach (NAV APR) Mode

Used to Intercept and Track a LOC and VOR Front Course Inbound

#### Reverse (REV) Mode

Used to Intercept and Track a VOR Back Course Inbound

#### Reverse Approach (REV APR) Mode

Used to Intercept and Track a LOC Back Course Inbound

#### Navigation Global Positioning System Steering (NAV GPSS) Mode

Used to Laterally Steer along a Course defined by GPS

#### Control Wheel Steering (CWS) Mode

Used to Simultaneously Hold Turn Rate and Vertical Speed

### **1.4.2 Pitch Axis Control**

#### Altitude Hold (ALT HOLD) Mode

Used to Hold Altitude

#### Vertical Speed (VS) Mode

Used to Hold Vertical Speed

#### Glideslope (GS) Mode

Used to Intercept and Track Glideslope

## **1.5 Block Diagram**

The System Fifty Five X Block Diagram is shown in Fig. 1-1.

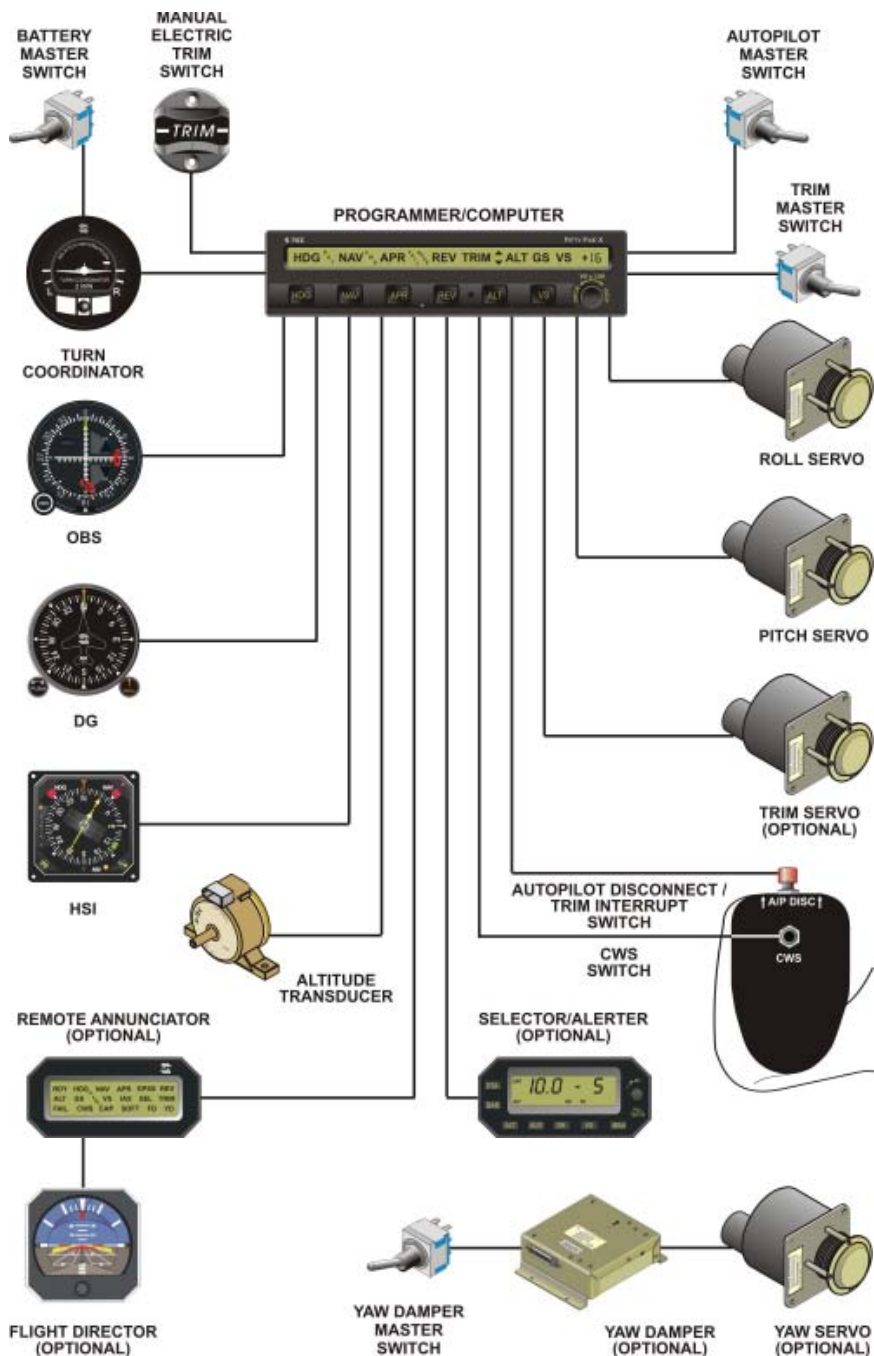


Fig. 1-1. System Fifty Five X Block Diagram

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## **SECTION 2**

# **PRE-FLIGHT PROCEDURES**



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## 2.1 Power-Up Test

Perform the actions shown in Table 2-1. For each action, verify the corresponding response where applicable.

**Table 2-1. Power-Up Test**

ACTION	RESPONSE
1. Set Yaw Damper Master Switch to OFF position (if installed).	-----
2. Set Trim Master Switch to OFF position (if installed).	-----
3. Set Battery Master Switch to ON position.	-----
4. Set Avionics Master Switch to ON position.	-----
5. Set Autopilot Master Switch to one of the following positions, whichever is applicable:  FD/AP (Flight Director Installed)  AP (No Flight Director)	<p>All annunciations appear on AP display as shown in Fig. 2-1 for 10 seconds, and then extinguish.</p> <p>For Programmer/Computers with serial number greater than 3001, software revision number briefly appears on AP display between 10 and 20 seconds following power-up, as shown in Fig. 2-2.</p> <p>RDY annunciation alone re-appears on AP display within 3 minutes, as shown in Fig. 2-3 (Notes 1, 2).</p>

**Notes:**

1. Should a Programmer/Computer failure be detected, the FAIL annunciation alone will re-appear on the AP display as shown in Fig. 2-4, and the autopilot will not operate.

2. Should a Turn Coordinator failure be detected, the AP display will remain blank indefinitely as shown in Fig. 2-5, and the autopilot will not operate.



Fig. 2-1. AP Display, All Annunciations at Power-Up



Fig. 2-2. AP Display, Software Revision Number



Fig. 2-3. AP Display, Ready for Operation



**Fig. 2-4. AP Display, Programmer/Computer Failure**



**Fig. 2-5. AP Display, Turn Coordinator Failure**

## 2.2 Pre-Flight Test

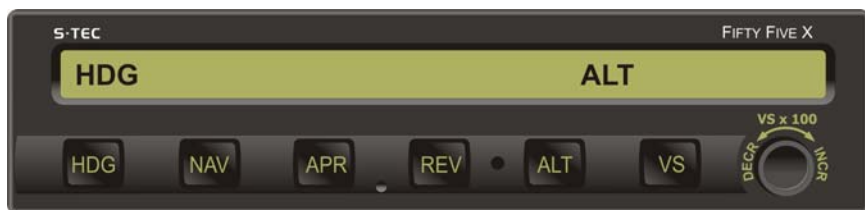
Prior to takeoff and with engine running, perform the actions shown in Table 2-2. For each action, verify the corresponding response where applicable. All actions pertaining to mode selector switches apply to the autopilot bezel.

**Table 2-2. Pre-Flight Test (continued on page 2-8)**

ACTION	RESPONSE
1. Move A/C Control Wheel left and right, to sense its freedom of movement about roll axis.	-----
2. Set Heading Bug under Lubber Line.	-----
3. Press HDG mode selector switch to engage heading mode.	HDG annunciation alone appears on AP display, as shown in Fig. 2-6.
4. Attempt movement of A/C Control Wheel left and right.	A/C Control Wheel's reduced freedom of movement indicates that Roll Servo is engaged.  Roll Servo can be overridden. If not, disconnect autopilot and do not use.
5. Turn Heading Bug to the left side of Lubber Line.	A/C Control Wheel turns to the left.
6. Turn Heading Bug to the right side of Lubber Line.	A/C Control Wheel turns to the right.
7. Set Heading Bug under Lubber Line.	A/C Control Wheel stops.
8. Move A/C Control Wheel forward and aft, to sense its freedom of movement about pitch axis.	-----
9. Press ALT mode selector switch to engage altitude hold mode.	ALT annunciation appears with HDG on AP display, as shown in Fig. 2-7.
10. Attempt movement of A/C Control Wheel forward and aft.	A/C Control Wheel's reduced freedom of movement indicates that Pitch Servo is engaged.  Pitch Servo can be overridden. If not, disconnect autopilot and do not use.



**Fig. 2-6. AP Display, HDG Mode Engaged (Pre-Flight)**



**Fig. 2-7. AP Display, HDG and ALT HOLD Modes Engaged (Pre-Flight)**

**Table 2-2. Pre-Flight Test (continued from page 2-6)**

ACTION	RESPONSE
11. Press/Hold CWS Switch to arm control wheel steering mode.	CWS, VS, and +0 (or $\pm 1$ ) annunciations only appear on AP display, as shown in Fig. 2-8.
12. Move A/C Control Wheel left and right.	A/C Control Wheel's increased freedom of movement indicates that Roll Servo is disengaged.
13. Move A/C Control Wheel forward and aft.	A/C Control Wheel's increased freedom of movement indicates that Pitch Servo is disengaged.
14. Release CWS Switch to engage control wheel steering mode.	-----
15. Attempt movement of A/C Control Wheel left and right.	A/C Control Wheel's reduced freedom of movement indicates that Roll Servo is engaged.
16. Attempt movement of A/C Control Wheel forward and aft.	A/C Control Wheel's reduced freedom of movement indicates that Pitch Servo is engaged.
17. Rotate AP Modifier Knob CW until +5 (500 FPM climbing) is commanded, as shown in Fig. 2-9.	A/C Control Wheel moves in aft direction.
18. Rotate AP Modifier Knob CCW until -5 (500 FPM descending) is commanded, as shown in Fig. 2-10.	A/C Control Wheel moves in forward direction.
19. Rotate AP Modifier Knob CW until +0 (0 FPM) is commanded.	A/C Control Wheel stops.
<p><i>Note: If it is not possible to select a local VOR frequency on Navigation Receiver, then proceed to step 30. Otherwise, proceed to step 20.</i></p>	



**Fig. 2-8. AP Display, CWS Mode Armed or Engaged, 0 FPM (Pre-Flight)**



**Fig. 2-9. AP Display, CWS Mode Engaged, 500 FPM Climbing (Pre-Flight)**



**Fig. 2-10. AP Display, CWS Mode Engaged, 500 FPM Descending (Pre-Flight)**



**Table 2-2. Pre-Flight Test (continued from page 2-8)**

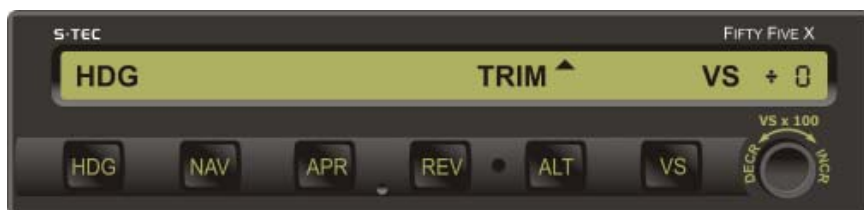
<b>ACTION</b>	<b>RESPONSE</b>
20. Select local VOR frequency on Navigation Receiver.	-----
<i>Note: Proceed to either step 21 (HSI) or step 26 (DG).</i>	
21. Turn Course Pointer until CDI needle is centered.	-----
22. Press NAV mode selector switch to engage navigation mode.	NAV, VS, and +0 annunciations only appear on AP display, as shown in Fig. 2-11.
23. Turn Course Pointer left until CDI needle deflection is 2 dots right of center.	A/C Control Wheel turns to the right.
24. Turn Course Pointer right until CDI needle deflection is 2 dots left of center.	A/C Control Wheel turns to the left.
25. Turn Course Pointer left until CDI needle is centered.	A/C Control Wheel stops.
<i>Note: Proceed to step 30.</i>	
26. Press NAV mode selector switch to engage navigation mode.	NAV, VS, and +0 annunciations only appear on AP display, as shown in Fig. 2-11.
27. Turn OBS until CDI needle deflection is 2 dots right of center.	A/C Control Wheel turns to the right.
28. Turn OBS until CDI needle deflection is 2 dots left of center.	A/C Control Wheel turns to the left.



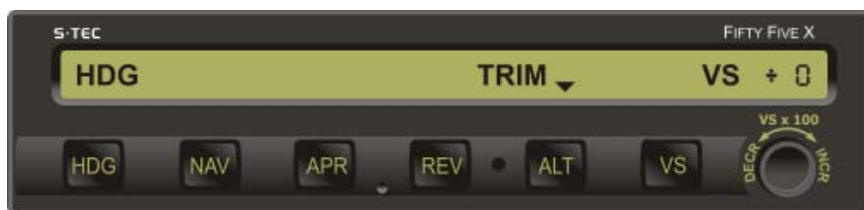
**Fig. 2-11. AP Display, NAV and VS Modes Engaged, 0 FPM (Pre-Flight)**

**Table 2-2. Pre-Flight Test (continued from page 2-10)**

ACTION	RESPONSE
29. Turn OBS until CDI needle is centered.	A/C Control Wheel stops.
30. Press HDG mode selector switch to engage heading mode.	HDG, VS, and +0 annunciations only appear on AP display.
31. Move A/C Control Wheel as far forward as possible.	<p>After 3 seconds, TRIM ^ annunciation appears on AP display, as shown in Fig. 2-12a.</p> <p>After 7 seconds, TRIM ^ annunciation flashes.</p>
32. Move A/C Control Wheel as far aft as possible.	<p>After 3 seconds, TRIM v annunciation appears on AP display, as shown in Fig. 2-12b.</p> <p>After 7 seconds, TRIM v annunciation flashes.</p>
33. Move A/C Control Wheel forward until TRIM v is extinguished.	HDG, VS, and +0 annunciations only appear on AP display.
<p><i>Note: If autopilot is equipped with autotrim, then proceed to step 34. Otherwise, proceed to step 38 only if autopilot is equipped with a Remote Annunciator, and A/C is equipped with a Flight Director. If this is not the case, then proceed to step 60.</i></p>	
34. Set Trim Master Switch to ON position.	-----



a. HDG and VS Modes Engaged, 0 FPM, TRIM UP Required



b. HDG and VS Modes Engaged, 0 FPM, TRIM DN Required

Fig. 2-12. AP Display, Manual Trim Prompts (Pre-Flight)

**Table 2-2. Pre-Flight Test (continued from page 2-12)**

ACTION	RESPONSE
35. Move A/C Control Wheel as far forward as possible.	<p>After 3 seconds, TRIM ^ annunciation appears on AP display as shown in Fig. 2-13a, and Elevator Trim Wheel begins to run nose up with increasing speed.</p> <p>After 7 seconds, TRIM ^ annunciation flashes.</p>
36. Move A/C Control Wheel as far aft as possible.	<p>After 3 seconds, TRIM ∇ annunciation appears on AP display as shown in Fig. 2-13b, and Elevator Trim Wheel begins to run nose down with increasing speed.</p> <p>After 7 seconds, TRIM ∇ annunciation flashes.</p>
37. Move A/C Control Wheel forward until TRIM ∇ is extinguished.	HDG, VS, and +0 annunciations only appear on AP display.
<p><i>Note: If autopilot is equipped with a Remote Annunciator, and A/C is equipped with a Flight Director, then proceed to step 38. Otherwise, proceed to step 50.</i></p>	
38. Set Autopilot Master Switch to FD position.	<p>Audible Alert sounds a periodic tone.</p> <p>FD annunciation appears on Remote Annunciator, along with HDG and VS, as shown in Fig. 2.14.</p>
39. Move A/C Control Wheel left and right.	A/C Control Wheel's increased freedom of movement indicates that Roll Servo is disengaged.
40. Move A/C Control Wheel forward and aft.	A/C Control Wheel's increased freedom of movement indicates that Pitch Servo is disengaged.



a. HDG and VS Modes Engaged, 0 FPM, TRIM UP in Progress



b. HDG and VS Modes Engaged, 0 FPM, TRIM DN in Progress

Fig. 2-13. AP Display, Automatic Trim Advisements (Pre-Flight)



Fig. 2-14. Remote Annunciator Display, HDG, VS, and FD Modes Engaged (Pre-Flight)

**Table 2-2. Pre-Flight Test (continued from page 2-14)**

ACTION	RESPONSE
<i>Note: If autopilot is equipped with autotrim, then proceed to step 41. Otherwise, proceed to step 42.</i>	
41. Move A/C Control Wheel as far forward or aft as possible.	After 3 seconds, Elevator Trim Wheel does not begin to run, indicating that Trim Servo is disengaged.
42. Turn Heading Bug to 45° left of Lubber Line, to command a left turn.	FD Steering Command Bars slowly move to a left bank position.
43. Turn Heading Bug to 45° right of Lubber Line, to command a right turn.	FD Steering Command Bars slowly move to a right bank position.
44. Rotate AP Modifier Knob CW until +15 (1500 FPM climbing) is commanded.	FD Steering Command Bars slowly move to a pitch up position.
45. Rotate AP Modifier Knob CCW until -15 (1500 FPM descending) is commanded.	FD Steering Command Bars slowly move to a pitch down position.
46. Set AP Master Switch to FD/AP position.	FD annunciation is extinguished on Remote Annunciator.
47. Attempt movement of A/C Control Wheel left and right.	A/C Control Wheel's reduced freedom of movement indicates that Roll Servo is engaged.
48. Attempt movement of A/C Control Wheel forward and aft.	A/C Control Wheel's reduced freedom of movement indicates that Pitch Servo is engaged.
<i>Note: If autopilot is equipped with autotrim, then proceed to step 49. Otherwise, proceed to step 60.</i>	

**Table 2-2. Pre-Flight Test (continued from page 2-16)**

<b>ACTION</b>	<b>RESPONSE</b>
49. Move A/C Control Wheel as far forward or aft as possible.	After 3 seconds, Elevator Trim Wheel begins to run, indicating that Trim Servo is engaged.
50. Press either forward or aft on both segments of Manual Electric Trim Switch.	<p>Autopilot disconnects as follows:</p> <p>RDY annunciation flashes and Audible Alert sounds a periodic tone, while all other annunciations are extinguished.</p> <p>After 5 seconds, RDY annunciation stops flashing but remains, and Audible Alert is squelched.</p>
51. Press/Hold either forward or aft on only one segment of Manual Electric Trim Switch, but not both.	Elevator Trim Wheel does not begin to run.
52. Press/Hold forward on both segments of Manual Electric Trim Switch.	Elevator Trim Wheel runs nose down at full speed, and TRIM annunciation appears flashing as shown in Fig. 2-15.
53. Press/Hold AP DISC / TRIM INTR Switch.	Elevator Trim Wheel stops.
54. Release AP DISC / TRIM INTR Switch.	Elevator Trim Wheel resumes running nose down at full speed.
55. Release Manual Electric Trim Switch.	<p>Elevator Trim Wheel stops.</p> <p>TRIM annunciation is extinguished.</p>
56. Press/Hold aft on both segments of Manual Electric Trim Switch.	Elevator Trim Wheel runs nose up at full speed, and TRIM annunciation appears flashing as shown in Fig. 2-15.





**Fig. 2-15. AP Display, Manual Electric Trim in Progress (Pre-Flight)**

Table 2-2. Pre-Flight Test (continued from page 2-17)

ACTION	RESPONSE
57. Press/Hold AP DISC / TRIM INTR Switch.	Elevator Trim Wheel stops.
58. Release AP DISC / TRIM INTR Switch.	Elevator Trim Wheel resumes running nose up at full speed.
59. Release Manual Electric Trim Switch.	Elevator Trim Wheel stops.  TRIM annunciation is extinguished.
<i>Note: If autopilot is equipped with a Yaw Damper, then proceed to step 61. Otherwise, proceed to step 70.</i>	
60. Press AP DISC / TRIM INTR Switch.  <p style="text-align: center;"><b>Note:</b></p> <p><b><i>Press/Hold AP DISC / TRIM INTR Switch to limit Audible Alert to a single “beep”.</i></b></p>	Autopilot disconnects as follows:  RDY annunciation flashes and Audible Alert sounds a periodic tone, while all other annunciations are extinguished.  After 5 seconds, RDY annunciation stops flashing but remains, and Audible Alert is squelched.
<i>Note: If autopilot is equipped with a Yaw Damper, then proceed to step 61. Otherwise, proceed to step 70.</i>	
61. Actuate A/C Rudder Pedals alternately in succession, to sense their freedom of movement about yaw axis.	-----
62. Set Yaw Damper Master Switch to ON position.	-----
63. Turn Yaw Trim Knob until A/C Rudder Pedals stop.	-----

**Table 2-2. Pre-Flight Test (continued from page 2-19)**

<b>ACTION</b>	<b>RESPONSE</b>
64. Attempt actuation of A/C Rudder Pedals alternately in succession.	A/C Rudder Pedals' reduced freedom of movement indicates that Yaw Servo is engaged.  Yaw Servo can be overridden. If not, set Yaw Damper Master Switch to OFF position, and do not use.
65. Turn Yaw Trim Knob fully CCW.	Left A/C Rudder Pedal slowly moves forward.
66. Turn Yaw Trim Knob fully CW.	Right A/C Rudder Pedal slowly moves forward.
67. Turn Yaw Trim Knob CCW until A/C Rudder Pedals stop.	-----
68. Set Yaw Damper Master Switch to OFF position.	-----
69. Actuate A/C Rudder Pedals alternately in succession.	A/C Rudder Pedals' increased freedom of movement indicates that Yaw Servo is disengaged.
70. Trim A/C for takeoff.	-----

# **SECTION 3**

## **IN-FLIGHT PROCEDURES**

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### 3.1 Normal Operating Procedures

#### 3.1.1 Heading (HDG) Mode

Set the Heading Bug to the desired heading on the compass card (HSI or DG), and then press the HDG mode selector switch to engage the heading mode. The HDG annunciation will appear as shown in Fig. 3-1, to acknowledge that this mode is engaged. The autopilot will turn the aircraft onto the selected heading and hold it. A new heading can be subsequently selected by setting the Heading Bug to it.

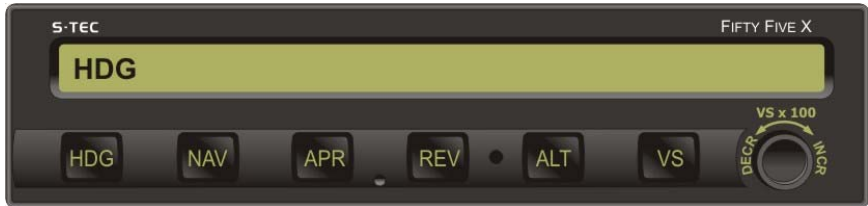


Fig. 3-1. AP Display, HDG Mode Engaged

#### 3.1.2 Navigation (NAV) Mode

Select the VOR frequency on the Navigation Receiver.

##### Heading System HSI

Set Course Pointer to desired course on compass card.

##### Heading System DG

Set Heading Bug and OBS to desired course on each respective compass card.

Press the NAV mode selector switch to engage the navigation mode. The NAV annunciation will appear as shown in Fig. 3-2, to acknowledge that this mode is engaged.



Fig. 3-2. AP Display, NAV Mode Engaged

If the Course Deviation Indication (CDI) is at full scale (100%) needle deflection from center, then the autopilot will establish the aircraft on a 45° intercept angle relative to the selected course. Even if CDI needle deflection is less than 100%, the autopilot may still establish an intercept angle of 45°, provided that the aircraft's closure rate to the selected course is sufficiently slow. Otherwise, the intercept angle will be less than 45°.

As the aircraft approaches the selected course, the autopilot senses the corresponding rate at which CDI needle deflection approaches center (closure rate), in order to initiate the aircraft's turn onto the course at the proper point, and thereby prevent overshoot. The point at which this turn begins is variable, being further from the course at faster closure rates, and closer to the course at slower closure rates. Although closure rate is principally a function of groundspeed, the distance of the aircraft from the VOR station also has an effect. Nevertheless, the turn will always begin between 100% and 20% CDI needle deflection.

During this stage of the intercept sequence, the autopilot operates at maximum gain and sensitivity to closure rate. In addition, it limits the aircraft's turn rate to 90% of a standard rate turn, although for some higher performance (turboprop) aircraft this is 75%.

When the aircraft arrives at 15% CDI needle deflection, the course is captured. At that instant, a step reduction in autopilot gain occurs, so that the Course Pointer (HSI) or Heading Bug (DG) has sufficient authority to complete the intercept. In addition, the sensitivity to closure rate is reduced. The overall authority of the autopilot during this stage of the intercept sequence is called the CAP condition, which is acknowledged only on the optional Remote Annunciator, as shown in Fig. 3-3.

Fifteen seconds after course capture, a second step reduction in autopilot gain occurs, to limit the aircraft's turn rate to 45% of a standard rate turn, although for some higher performance (turboprop) aircraft this is 37.5%. In addition, the sensitivity to closure rate is reduced again. The overall authority of the autopilot during this stage of the intercept sequence is called the CAP SOFT condition, which is acknowledged only on the optional Remote Annunciator, as shown in Fig. 3-4.

Thirty seconds after course capture, the autopilot establishes the required crosswind correction angle.

Seventy five seconds after course capture, a third step reduction in autopilot gain occurs, to limit the aircraft's turn rate to 15% of a standard rate turn, although for some higher performance (turboprop) aircraft this is 12.5%. In addition, the sensitivity to closure rate is reduced once more. This is acknowledged by the extinguishment of the CAP annunciation on the optional Remote Annunciator, as shown in Fig. 3-5. It marks the end of the intercept sequence, and the beginning of tracking. The overall authority of the autopilot during tracking is called the SOFT condition.

The pilot should make speed, distance, and time considerations during the 75 second period from course capture to the beginning of tracking, to account for the aircraft's position. For example at 115 kts, a distance of 2.4 nautical miles will be traveled in 75 seconds.

If it should happen that the Course Pointer (HSI) or Heading Bug (DG) is already within 5° of the selected course, and CDI needle deflection is less than 10%, then the autopilot will immediately establish the SOFT condition upon engagement of the navigation mode.

While tracking in the SOFT condition, the autopilot ignores short term CDI needle deflections (excursions), to thereby inhibit aircraft scalloping during VOR station passage. Should CDI needle deflection exceed 50% for a period of 60 seconds, the autopilot will revert to the CAP SOFT condition as a means to re-establish the aircraft on course.

The NAV annunciation will flash whenever CDI needle deflection exceeds 50%, or the NAV Flag is in view. In the latter event, the FAIL annunciation will also appear.

While tracking in the SOFT condition and within 50% CDI needle deflection, should it be desired to track in the higher authority CAP SOFT condition instead, press the APR mode selector switch to engage the navigation approach (NAV APR) mode. This is acknowledged as shown in Fig. 3-6 and Fig. 3-7.

While tracking in either the SOFT or CAP SOFT condition, if a new course is selected that is different from the original course by  $10^\circ$  or more, then the autopilot will revert to the CAP condition.



**Fig. 3-3. Remote Annunciator Display, NAV Mode Engaged, CAP Condition**



**Fig. 3-4. Remote Annunciator Display, NAV Mode Engaged, CAP SOFT Condition**



**Fig. 3-5. Remote Annunciator Display, NAV Mode Engaged, SOFT Condition**





**Fig. 3-6. AP Display, NAV APR Mode Engaged**

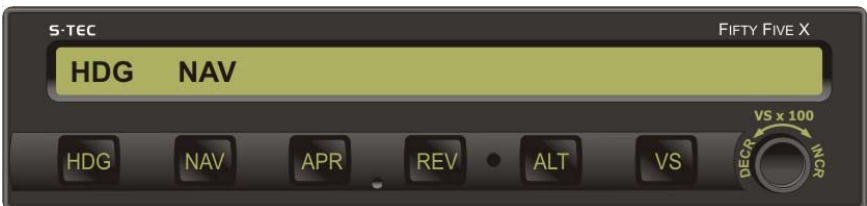


**Fig. 3-7. Remote Annunciator Display, NAV APR Mode Engaged, CAP SOFT Condition**

### 3.1.2.1 Pilot Selectable Intercept Angle

To select an intercept angle other than 45°, set the Heading Bug to the desired intercept heading on the compass card, such that the difference between this heading and the desired course is the intercept angle. Then set the Course Pointer (HSI) or OBS (DG) to the desired course. Press and hold the HDG mode selector switch, and then press the NAV mode selector switch to engage the heading mode and arm the navigation mode. The HDG and NAV annunciations will appear as shown in Fig. 3-8, to acknowledge this.

The autopilot will establish the aircraft on the selected intercept angle (heading), until it must turn the aircraft onto the selected course to prevent overshoot. At that point in the intercept sequence, the HDG annunciation will extinguish to indicate engagement of the navigation mode. At the moment this occurs, if the heading system is a DG, immediately set the Heading Bug to the course in order to input a course error to the autopilot. Otherwise, the autopilot will lack sufficient authority to turn the aircraft onto the course.



**Fig. 3-8. AP Display, HDG Mode Engaged, NAV Mode Armed**

### 3.1.3 Navigation Global Positioning System Steering (NAV GPSS) Mode

Program a predefined course into the GPS Navigation Receiver, comprised of course segments connected by waypoints. Press the NAV mode selector switch twice to engage the navigation global positioning system steering mode, unless the navigation mode is already engaged. In the latter event, only press the NAV mode selector switch once. The NAV and GPSS annunciations will appear as shown in Fig. 3-9, to acknowledge that this mode is engaged. The autopilot will laterally steer the aircraft along the predefined course, and limit its turn rate to either:

- 130% of a standard rate turn (Prog/Comp Hardware Mod Code AM and below)
- 90% of a standard rate turn (Prog/Comp Hardware Mod Code AN and AP)
- 110% of a standard rate turn (Prog/Comp Hardware Mod Code AR and above)

During this mode of operation, the autopilot will not accept any course error input from the Course Pointer (HSI) or Heading Bug (DG).

If it should happen that a predefined course has not been programmed into the GPS Navigation Receiver upon attempted engagement of the navigation global positioning system steering mode, then the NAV and GPSS annunciations will flash, and the autopilot will hold the aircraft's wings level.



**Fig. 3-9. AP Display, NAV GPSS Mode Engaged**

### 3.1.3.1 Pilot Selectable Intercept Angle

To select an intercept angle, set the Heading Bug to the desired intercept heading on the compass card, such that the difference between this heading and the next course segment is the intercept angle. Press and hold the HDG mode selector switch, and then press the NAV mode selector switch twice to engage the heading mode and arm the navigation global positioning system steering mode. The HDG, NAV, and GPSS annunciations will appear as shown in Fig. 3-10, to acknowledge this.

The autopilot will establish the aircraft on the selected intercept angle (heading), until it must turn the aircraft onto the next course segment to prevent overshoot. At that point in the intercept sequence, the HDG annunciation will extinguish to indicate engagement of the navigation global positioning system steering mode.



**Fig. 3-10. AP Display, HDG Mode Engaged, NAV GPSS Mode Armed**

### 3.1.4 Altitude Hold (ALT HOLD) Mode

The altitude hold mode can only be engaged if a roll mode (HDG, NAV, NAV APR, REV, REV APR, NAV GPSS) is already engaged. With a roll mode engaged and the aircraft at the desired altitude, press the ALT mode selector switch to engage the altitude hold mode. The ALT annunciation will appear as shown in Fig. 3-11, to acknowledge that this mode is engaged. The autopilot will hold the aircraft at its current (captured) altitude. This altitude may be modified for barometric pressure changes, by rotating the Modifier Knob either clockwise (CW) for an increase in altitude, or counter-clockwise (CCW) for a decrease in altitude. Each detent equals 20 feet, and the range is  $\pm 360$  feet from the original captured altitude.



Fig. 3-11. AP Display, HDG and ALT HOLD Modes Engaged

### 3.1.5 Vertical Speed (VS) Mode

**Caution:**

***The vertical speed mode is used to establish and hold a PILOT selected vertical speed. Since the autopilot receives no airspeed information, it is the responsibility of the pilot to ensure that the vertical speed selection is within the operating limits of the aircraft's capabilities. Selection of a vertical speed beyond the capability of the aircraft can create a condition of reduced airspeed, and possibly lead to a stall condition.***

The vertical speed mode can only be engaged if a roll mode (HDG, NAV, NAV APR, REV, REV APR, NAV GPSS) is already engaged. With a roll mode engaged and the aircraft at the desired vertical speed, press the VS mode selector switch to engage the vertical speed mode. The VS annunciation will appear as shown in Fig. 3-12, to acknowledge that this mode is engaged, along with the current vertical speed. The latter appears as a number in units of FPM x 100, prefixed by either a "+" to indicate a climb, or a "-" to indicate a descent (i.e., for example, +5 indicates 500 FPM climbing, if within the aircraft's capabilities). The autopilot will hold the aircraft at its current (captured) vertical speed. This vertical speed may be modified by rotating the Modifier Knob. In a climb, rotating the Modifier Knob clockwise (CW) increases the climb rate, whereas rotating it counter-clockwise (CCW) decreases the climb rate. In a descent, rotating the Modifier Knob CCW increases the descent rate, whereas rotating it CW decreases the descent rate. Each detent equals 100 FPM, and the range is  $\pm 1600$  FPM from the original captured vertical speed.

During a climb, should the aircraft become unable to hold the captured vertical speed for a period of fifteen seconds, the VS annunciation will flash as an alert to the potential for an impending stall condition. In that event, immediately increase the aircraft's thrust if possible, reduce the commanded vertical speed using the Modifier Knob, or both, until the VS annunciation stops flashing.

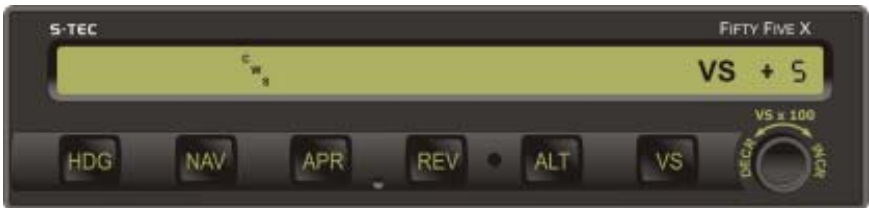


**Fig. 3-12. AP Display, HDG and VS Modes Engaged**

### 3.1.6 Control Wheel Steering (CWS) Mode

The control wheel steering mode can only be engaged if a roll mode (HDG, NAV, NAV APR, REV, REV APR, NAV GPSS) and pitch mode (ALT HOLD, VS, GS) are already engaged. With a roll and pitch mode engaged, press and hold the remote CWS Switch located on the Control Wheel. This disengages both the roll and pitch servos. Maneuver the aircraft to the desired attitude, and allow it to stabilize there for 2-3 seconds. Release the switch to engage the control wheel steering mode. This re-engages both the roll and pitch servos. The CWS annunciation will appear as shown in Fig. 3-13, to acknowledge that the CWS mode is engaged, along with the VS annunciation and current (captured) vertical speed. The latter appears as a number in units of FPM x 100, prefixed by either a "+" to indicate a climb, or a "-" to indicate a descent (i.e., for example, +5 indicates 500 FPM climbing, if within the aircraft's capabilities). The autopilot will hold the aircraft at its current (captured) turn rate and vertical speed.

If it should happen that the aircraft's turn rate is initially greater than 90% of a standard rate turn at the desired attitude, then the autopilot will limit it to 90% upon engagement of the CWS mode, although for some higher performance (turboprop) aircraft this is 75%.



**Fig. 3-13. AP Display, CWS Mode Engaged**

### 3.1.7 Elevator Trim

#### 3.1.7.1 Manual Elevator Trim

If the autopilot is not equipped with autotrim, or is so equipped but the Trim Master Switch is in the OFF position, and a pitch mode (ALT HOLD, VS, GS) is engaged, then the autopilot will provide an annunciation whenever it is necessary to manually trim the aircraft about the pitch axis using the Elevator Trim Wheel.

Should the pitch servo loading exceed a preset threshold for a period of three seconds, the autopilot will annunciate either TRIM  $\wedge$  or TRIM  $\vee$  as a prompt to trim the aircraft in the indicated direction. This is shown in Fig. 3-14. In addition, an audible alert will sound a periodic tone. If no action is taken after four more seconds, then the annunciation will flash and the audible alert will be squelched. Once the aircraft has been sufficiently trimmed, such that the pitch servo loading is below the preset threshold, the annunciation will extinguish.



a. TRIM UP Required



b. TRIM DN Required

**Fig. 3-14. AP Display, Manual Trim Prompts**

### 3.1.7.2 Automatic Elevator Trim

If the autopilot is equipped with autotrim, the Trim Master Switch is in the ON position, and a pitch mode (ALT HOLD, VS, GS) is engaged, then the autopilot will provide an annunciation whenever it is automatically trimming the aircraft about the pitch axis.

Should the pitch servo loading exceed a preset threshold for a period of three seconds, the autopilot will annunciate either TRIM  $\wedge$  or TRIM  $\vee$  as an advisement that it is automatically trimming the aircraft in the indicated direction. This is shown in Fig. 3-15. In addition, the Elevator Trim Wheel will run either nose up or nose down, respectively, with increasing speed. If the autopilot is still in the process of automatically trimming the aircraft after four more seconds, then the annunciation will flash. Once the aircraft has been sufficiently trimmed, such that the pitch servo loading is below the preset threshold, the annunciation will extinguish and the Elevator Trim Wheel will stop.



a. TRIM UP in Progress



b. TRIM DN in Progress

**Fig. 3-15. AP Display, Automatic Trim Advisements**

### 3.1.7.3 Manual Electric Elevator Trim

If the autopilot is equipped with autotrim, then there will also be the remote Manual Electric Trim Switch located on the Control Wheel. This switch can be used to trim the aircraft about the pitch axis from the RDY, or when only a roll mode (HDG, NAV, NAV APR, REV, REV APR, NAV GPSS) is engaged, provided that the Trim Master Switch is in the ON position.

To trim the aircraft nose up, press aft and hold both segments of the Manual Electric Trim Switch. The TRIM annunciation will appear flashing as shown in Fig. 3-16, and the Elevator Trim Wheel will run nose up at full speed. Upon release of this switch, the TRIM annunciation will extinguish and the Elevator Trim Wheel will stop.

To trim the aircraft nose down, press forward and hold both segments of the Manual Electric Trim Switch. The TRIM annunciation will appear flashing as shown in Fig. 3-16, and the Elevator Trim Wheel will run down at full speed. Upon release of this switch, the TRIM annunciation will extinguish and the Elevator Trim Wheel will stop.

Should the Manual Electric Trim Switch ever be actuated when a pitch mode (ALT HOLD, VS, GS) is engaged, the autopilot will disconnect.



**Fig. 3-16. AP Display, Manual Electric Trim in Progress**

## **3.2 Precision Approach Procedures**

### **3.2.1 Straight-In ILS Approach**

#### **3.2.1.1 Software Revision 5 and Above**

Execute a straight-in intercept and track of the FRONT INBOUND LOC course (reference section 3.3.3), while holding the approach altitude. The NAV, APR, and ALT annunciations will appear as shown in Fig. 3-17.

Once the following conditions have existed simultaneously for a period of one second, the GS annunciation will appear to acknowledge that the glideslope mode has automatically armed, as shown in Fig. 3-18:

1. NAV APR mode engaged
2. ALT mode engaged
3. NAV Flag out of view
4. GS Flag out of view
5. LOC frequency selected
6. A/C within 50% CDI needle deflection of LOC centerline
7. A/C more than 10% Glideslope Deviation Indication (GDI) needle deflection below GS centerline

The armed glideslope mode can be subsequently disabled by pressing the APR mode selector switch. The GS annunciation will flash to acknowledge this. To then re-arm the glideslope mode, press the APR mode selector switch again. The GS annunciation will immediately extinguish, but re-appear after one second.

With the glideslope mode armed, once the aircraft arrives at 5% GDI needle deflection below the GS centerline, the ALT annunciation will extinguish to indicate engagement of the glideslope mode, as shown in Fig. 3-19.



**Note:**

***If the approach positions the aircraft slightly above the GS centerline, then manual engagement of the glideslope mode can be instantly achieved by pressing the ALT mode selector switch.***

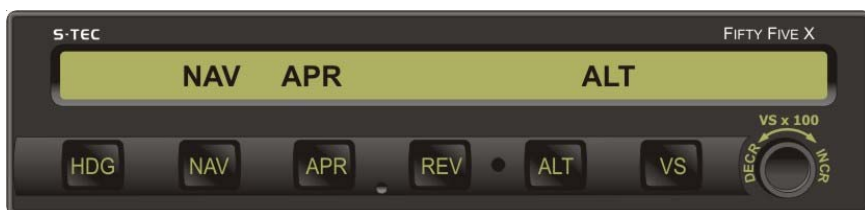
**Caution:**

***Manual engagement of the glideslope mode above the GS centerline will result in the aircraft moving aggressively toward the GS centerline. DO NOT manually engage the glideslope mode if the aircraft is more than 20% above the GS centerline.***

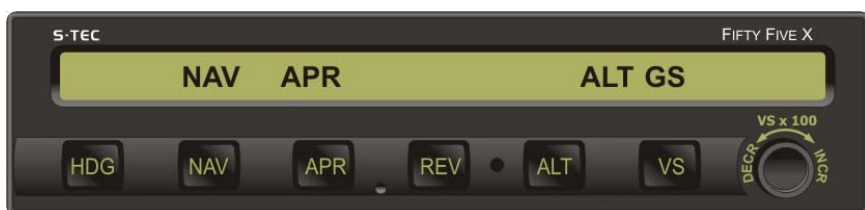
The GS annunciation will flash whenever GDI needle deflection exceeds 50%, or the GS Flag is in view. In the latter event, the FAIL annunciation will also appear.

At the Decision Height (DH), disconnect the autopilot to execute either a landing or Go-Around (GA).

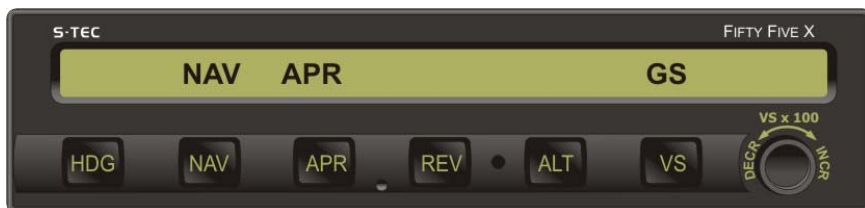
A pictorial of this procedure is shown in Fig. 3-20.



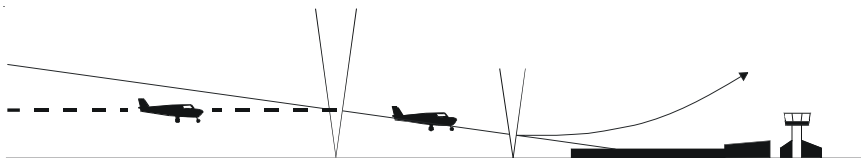
**Fig. 3-17. AP Display, NAV APR and ALT HOLD Modes Engaged**



**Fig. 3-18. AP Display, NAV APR and ALT HOLD Modes Engaged, GS Mode Armed**



**Fig. 3-19. AP Display, NAV APR and GS Modes Engaged**



**Fig. 3-20. Straight-In ILS Approach**

### **3.2.1.2 Software Revision 4 and Below**

Execute a straight-in intercept and track of the FRONT INBOUND LOC course (reference section 3.3.3), while holding the approach altitude. The NAV, APR, and ALT annunciations will appear as shown in Fig. 3-17.

Once the following conditions have existed simultaneously for a period of ten seconds, the GS annunciation will appear to acknowledge that the glideslope mode has automatically armed, as shown in Fig. 3-18:

1. NAVAPR mode engaged
2. ALT mode engaged
3. NAV Flag out of view
4. GS Flag out of view
5. LOC frequency selected
6. A/C within 50% CDI needle deflection of LOC centerline
7. A/C more than 60% Glideslope Deviation Indication (GDI) needle deflection below GS centerline

If the last condition cannot be met because the aircraft is too near the GS centerline, then manual arming of the glideslope mode can be instantly achieved by pressing the ALT mode selector switch.

The armed glideslope mode can be subsequently disabled by pressing the APR mode selector switch. The GS annunciation will flash to acknowledge this. To then re-arm the glideslope mode, press the APR mode selector switch again. The GS annunciation will immediately extinguish, but re-appear after ten seconds.

With the glideslope mode armed, once the aircraft arrives at 5% GDI needle deflection below the GS centerline, the ALT annunciation will extinguish to indicate engagement of the glideslope mode, as shown in Fig. 3-19.

**Note:**

***If the approach positions the aircraft slightly above the GS centerline, then manual engagement of the glideslope mode can be instantly achieved by pressing the ALT mode selector switch.***

**Caution:**

***Manual engagement of the glideslope mode above the GS centerline will result in the aircraft moving aggressively toward the GS centerline. DO NOT manually engage the glideslope mode if the aircraft is more than 20% above the GS centerline.***

The GS annunciation will flash whenever GDI needle deflection exceeds 50%, or the GS Flag is in view. In the latter event, the FAIL annunciation will also appear.

At the Decision Height (DH), disconnect the autopilot to execute either a landing or Go-Around (GA).

A pictorial of this procedure is shown in Fig. 3-20.

### **3.2.2 ILS Approach with Procedure Turn**

Execute a procedure turn intercept and track of the FRONT INBOUND LOC course (reference section 3.3.5) above the approach altitude, just until the aircraft is established on the FRONT INBOUND PROCEDURE TURN heading, with the heading mode still engaged. Establish the desired vertical descent speed, and then press the VS mode selector switch to engage the vertical speed mode. Upon reaching the approach altitude, press the ALT mode selector switch to engage the altitude hold mode. Press the NAV mode selector switch to engage the navigation approach mode, such that the autopilot will execute a straight-in intercept and track of the FRONT INBOUND LOC course (reference section 3.3.3). Execute a straight-in intercept and track of the glideslope (reference section 3.2.1).

For those aircraft equipped with the Garmin 400W/500W Series GPS Navigation Receiver or equivalent unit, with the NAV GPSS mode engaged, the autopilot is capable of executing the entire lateral approach sequence if it has been programmed into the Navigation Receiver.

Once on the FRONT INBOUND LOC course, with the Navigation Receiver set to VLOC and conditions 2 thru 7 of section 3.2.1 satisfied, press the NAV mode selector switch to engage the NAV APR mode and complete the ILS approach.

## **3.3 Non-Precision Approach Procedures**

### **3.3.1 Straight-In Back Course Approach**

Select the LOC frequency on the Navigation Receiver.

#### Heading System HSI

Set Course Pointer to FRONT INBOUND LOC course on compass card.

### Heading System DG

Set Heading Bug to BACK INBOUND LOC course on compass card.

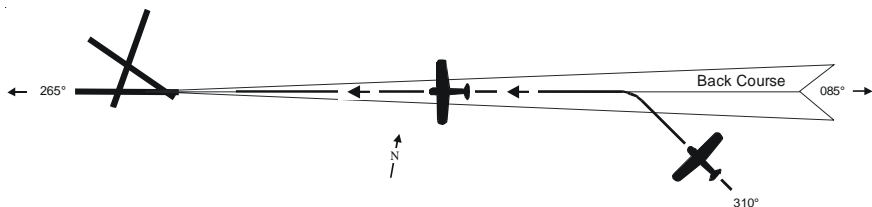
Press the REV mode selector switch to engage the reverse approach mode. The REV and APR annunciations will appear as shown in Fig. 3-21, to acknowledge that this mode is engaged. The autopilot will intercept and track the BACK INBOUND LOC course. If the heading system is a DG, then the autopilot will fly the aircraft in the direction opposite to that of CDI needle deflection.

The REV annunciation will flash whenever CDI needle deflection exceeds 50%, or the NAV Flag is in view. In the latter event, the FAIL annunciation will also appear.

A summary pictorial of this procedure is shown in Fig. 3-22.



**Fig. 3-21. AP Display, REV APR Mode Engaged, Track LOC Back Course Inbound**



- Select LOC frequency.
- Heading System HSI  
Set Course Pointer to FRONT INBOUND LOC course.  
Heading System DG  
Set Heading Bug to BACK INBOUND LOC course.
- Press REV mode selector switch to engage reverse approach mode.
- Intercept and track BACK INBOUND LOC course.

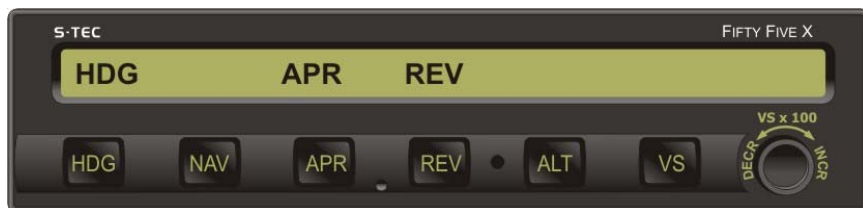
**Fig. 3-22. Straight-In Back Course Approach**

### 3.3.1.1 Pilot Selectable Intercept Angle

To select an intercept angle, set the Heading Bug to the desired intercept heading on the compass card, such that the difference between this heading and the BACK INBOUND LOC course is the intercept angle. If the heading system is an HSI, set the Course Pointer to the FRONT INBOUND LOC course on the compass card.

Press and hold the HDG mode selector switch, and then press the REV mode selector switch to engage the heading mode and arm the reverse approach mode. The HDG, APR, and REV annunciations will appear as shown in Fig. 3-23, to acknowledge this.

The autopilot will establish the aircraft on the selected intercept angle (heading), until it must turn the aircraft onto the BACK INBOUND LOC course to prevent overshoot. At that point in the intercept sequence, the HDG annunciation will extinguish to indicate engagement of the reverse approach mode. At the moment this occurs, if the heading system is a DG, immediately set the Heading Bug to the BACK INBOUND LOC course, in order to input a course error to the autopilot. Otherwise, the autopilot will lack sufficient authority to turn the aircraft onto the course.



**Fig. 3-23. AP Display, HDG Mode Engaged, REV APR Mode Armed**

### 3.3.2 Back Course Approach with Procedure Turn

Select the LOC frequency on the Navigation Receiver.

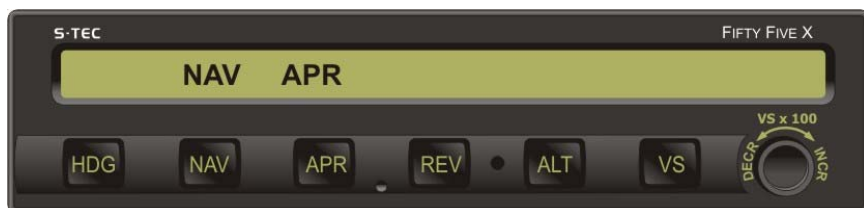
#### Heading System HSI

Set Course Pointer to FRONT INBOUND LOC course on compass card.

#### Heading System DG

Set Heading Bug to FRONT INBOUND LOC course on compass card.

Press the NAV mode selector switch to engage the navigation approach mode. The NAV and APR annunciators will appear as shown in Fig. 3-24, to acknowledge that this mode is engaged. The autopilot will intercept and track the BACK OUTBOUND LOC course.



**Fig. 3-24. AP Display, NAV APR Mode Engaged, Track LOC Back Course Outbound**

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At the appropriate time, set the Heading Bug to the BACK OUTBOUND PROCEDURE TURN heading, and then press the HDG mode selector switch to engage the heading mode. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the Heading Bug in two successive 90° increments, to establish the aircraft on the BACK INBOUND PROCEDURE TURN heading.

### Heading System HSI

Course Pointer remains unchanged on compass card.

### Heading System DG

Set Heading Bug to BACK INBOUND LOC course on compass card.

Press the REV mode selector switch to engage the reverse approach mode. The REV and APR annunciators will appear as shown in Fig. 3-25, to acknowledge that this mode is engaged. The autopilot will intercept and track the BACK INBOUND LOC course. If the heading system is a DG, then the autopilot will fly the aircraft in the direction opposite to that of CDI needle deflection.

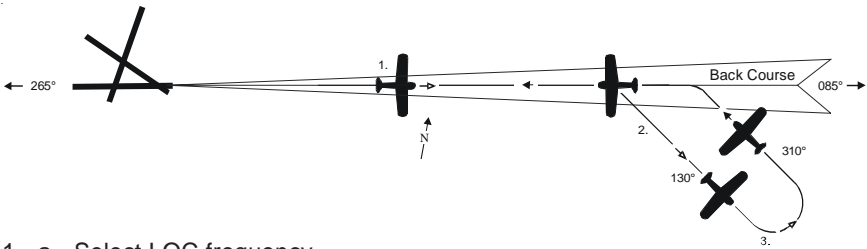


**Fig. 3-25. AP Display, REV APR Mode Engaged, Track LOC Back Course Inbound**

A summary pictorial of this procedure is shown in Fig. 3-26.

For those aircraft equipped with the Garmin 400W/500W Series GPS Navigation Receiver or equivalent unit, with the NAV GPSS mode engaged, the autopilot is capable of executing this entire lateral approach sequence if it has been programmed into the Navigation Receiver.

Once on the BACK INBOUND LOC course, and with the Navigation Receiver set to VLOC, press the REV mode selector switch to engage the REV APR mode and complete the back course approach.



1. a. Select LOC frequency.
- b. Heading System HSI  
Set Course Pointer to FRONT INBOUND LOC course.  
Heading System DG  
Set Heading Bug to FRONT INBOUND LOC course.
- c. Press NAV mode selector switch to engage navigation approach mode.
- d. Intercept and track BACK OUTBOUND LOC course.
2. a. At appropriate time, set Heading Bug to BACK OUTBOUND PROCEDURE TURN heading.
- b. Press HDG mode selector switch to engage heading mode.
3. a. Turn Heading Bug in two successive 90° increments, to establish aircraft on BACK INBOUND PROCEDURE TURN heading.
- b. Heading System HSI  
Course Pointer remains unchanged.  
Heading System DG  
Set Heading Bug to BACK INBOUND LOC course.
- c. Press REV mode selector switch to engage reverse approach mode.
- d. Intercept and track BACK INBOUND LOC course.

**Fig. 3-26. Back Course Approach with Procedure Turn**



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### 3.3.3 Straight-In LOC Approach

Select the LOC frequency on the Navigation Receiver.

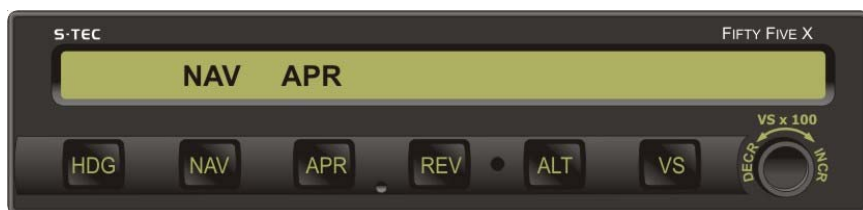
#### Heading System HSI

Set Course Pointer to FRONT INBOUND LOC course on compass card.

#### Heading System DG

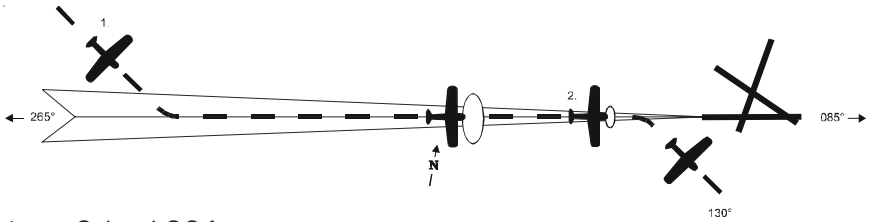
Set Heading Bug to FRONT INBOUND LOC course on compass card.

Press the NAV mode selector switch to engage the navigation approach mode. The NAV and APR annunciators will appear as shown in Fig. 3-27, to acknowledge that this mode is engaged. The autopilot will intercept and track the FRONT INBOUND LOC course.



**Fig. 3-27. AP Display, NAV APR Mode Engaged, Track LOC Front Course Inbound**

A summary pictorial of this procedure is shown in Fig. 3-28.



1. a. Select LOC frequency.  
 b. Heading System HSI  
 Set Course Pointer to FRONT INBOUND LOC course.  
Heading System DG  
 Set Heading Bug to FRONT INBOUND LOC course.
- c. Press NAV mode selector switch to engage navigation approach mode.
- d. Intercept and track FRONT INBOUND LOC course.
2. a. At middle marker, if missed approach is declared, disconnect autopilot.
- b. Stabilize aircraft.
- c. Set Heading Bug to missed approach heading.
- d. Press HDG mode selector switch to engage heading mode.

**Fig. 3-28. Straight-In LOC Approach**

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### 3.3.4 Straight-In VOR Approach

Select the VOR frequency on the Navigation Receiver.

#### Heading System HSI

Set Course Pointer to FRONT INBOUND VOR course on compass card.

#### Heading System DG

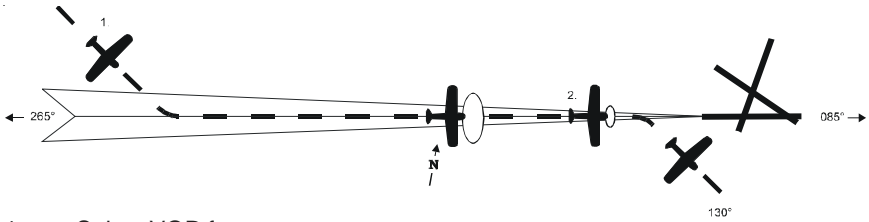
Set Heading Bug and OBS to FRONT INBOUND VOR course on each respective compass card.

Press the APR mode selector switch to engage the navigation approach mode. The NAV and APR annunciations will appear as shown in Fig. 3-29, to acknowledge that this mode is engaged. The autopilot will intercept and track the FRONT INBOUND VOR course.



**Fig. 3-29. AP Display, NAV APR Mode Engaged, Track VOR Front Course Inbound**

A summary pictorial of this procedure is shown in Fig. 3-30.



1. a. Select VOR frequency.
- b. Heading System HSI  
Set Course Pointer to FRONT INBOUND VOR course.
- Heading System DG  
Set Heading Bug and OBS to FRONT INBOUND VOR course.
- c. Press APR mode selector switch to engage navigation approach mode.
- d. Intercept and track FRONT INBOUND VOR course.
2. a. At middle marker, if missed approach is declared, disconnect autopilot.
- b. Stabilize aircraft.
- c. Set Heading Bug to missed approach heading.
- d. Press HDG mode selector switch to engage heading mode.

**Fig. 3-30. Straight-In VOR Approach**

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### 3.3.5 LOC Approach with Procedure Turn

Select the LOC frequency on the Navigation Receiver.

#### Heading System HSI

Set Course Pointer to FRONT INBOUND LOC course on compass card.

#### Heading System DG

Set Heading Bug to BACK INBOUND LOC course on compass card.

Press the REV mode selector switch to engage the reverse approach mode. The REV and APR annunciations will appear as shown in Fig. 3-31, to acknowledge that this mode is engaged. The autopilot will intercept and track the FRONT OUTBOUND LOC course. If the heading system is a DG, then the autopilot will fly the aircraft in the direction opposite to that of CDI needle deflection.



Fig. 3-31. AP Display, REV APR Mode Engaged, Track LOC Front Course Outbound

At the appropriate time, set the Heading Bug to the FRONT OUTBOUND PROCEDURE TURN heading, and then press the HDG mode selector switch to engage the heading mode. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the Heading Bug in two successive 90° increments, to establish the aircraft on the FRONT INBOUND PROCEDURE TURN heading.

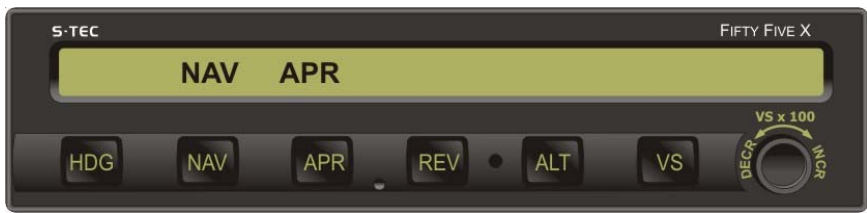
#### Heading System HSI

Course Pointer remains unchanged on compass card.

#### Heading System DG

Set Heading Bug to FRONT INBOUND LOC course on compass card.

Press the NAV mode selector switch to engage the navigation approach mode. The NAV and APR annunciators will appear as shown in Fig. 3-32, to acknowledge that this mode is engaged. The autopilot will intercept and track the FRONT INBOUND LOC course.

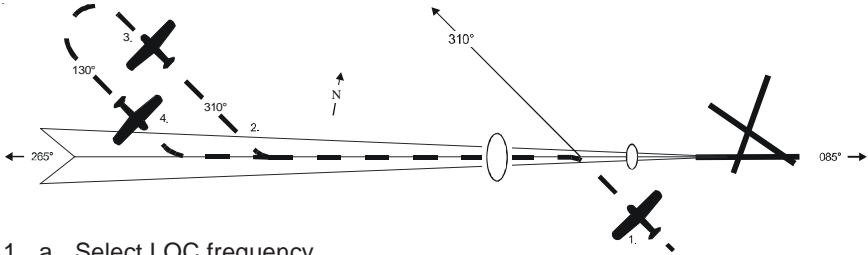


**Fig. 3-32. AP Display, NAV APR Mode Engaged, Track LOC Front Course Inbound**

A summary pictorial of this procedure is shown in Fig. 3-33.

For those aircraft equipped with the Garmin 400W/500W Series GPS Navigation Receiver or equivalent unit, with the NAV GPSS mode engaged, the autopilot is capable of executing this entire lateral approach sequence if it has been programmed into the Navigation Receiver.

Once on the FRONT INBOUND LOC course, with the Navigation Receiver set to VLOC, press the NAV mode selector switch to engage the NAV APR mode and complete the front course approach.



1. a. Select LOC frequency.
- b. Heading System HSI  
Set Course Pointer to FRONT INBOUND LOC course.
- Heading System DG  
Set Heading Bug to BACK INBOUND LOC course.
- c. Press REV mode selector switch to engage reverse approach mode.
- d. Intercept and track FRONT OUTBOUND LOC course.
2. a. At appropriate time, set Heading Bug to FRONT OUTBOUND PROCEDURE TURN heading.
- b. Press HDG mode selector switch to engage heading mode.
3. a. Turn Heading Bug in two successive 90° increments, to establish aircraft on FRONT INBOUND PROCEDURE TURN heading.
4. a. Heading System HSI  
Course Pointer remains unchanged.
- Heading System DG  
Set Heading Bug to FRONT INBOUND LOC course.
- b. Press NAV mode selector switch to engage navigation approach mode.
- c. Intercept and track FRONT INBOUND LOC course.
- d. At middle marker, if missed approach is declared, disconnect autopilot.
- e. Stabilize aircraft.
- f. Set Heading Bug to missed approach heading.
- g. Press HDG mode selector switch to engage heading mode.

**Fig. 3-33. LOC Approach with Procedure Turn**

### 3.3.6 VOR Approach with Procedure Turn

Select the VOR frequency on the Navigation Receiver.

#### Heading System HSI

Set Course Pointer to FRONT INBOUND VOR course on compass card.

#### Heading System DG

Set Heading Bug and OBS to BACK INBOUND VOR course on each respective compass card.

Press the REV mode selector switch to engage the reverse mode. The REV annunciation will appear as shown in Fig. 3-34, to acknowledge that this mode is engaged. The autopilot will intercept and track the FRONT OUTBOUND VOR course.



**Fig. 3-34. AP Display, REV Mode Engaged, Track VOR Front Course Outbound**



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At the appropriate time, set the Heading Bug to the FRONT OUTBOUND PROCEDURE TURN heading, and then press the HDG mode selector switch to engage the heading mode. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the Heading Bug in two successive 90° increments, to establish the aircraft on the FRONT INBOUND PROCEDURE TURN heading.

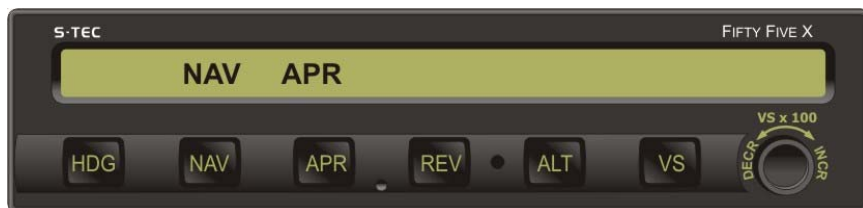
### Heading System HSI

Course Pointer remains unchanged on compass card.

### Heading System DG

Set Heading Bug and OBS to FRONT INBOUND VOR course on each respective compass card.

Press the APR mode selector switch to engage the navigation approach mode. The NAV and APR annunciators will appear as shown in Fig. 3-35, to acknowledge that this mode is engaged. The autopilot will intercept and track the FRONT INBOUND VOR course.

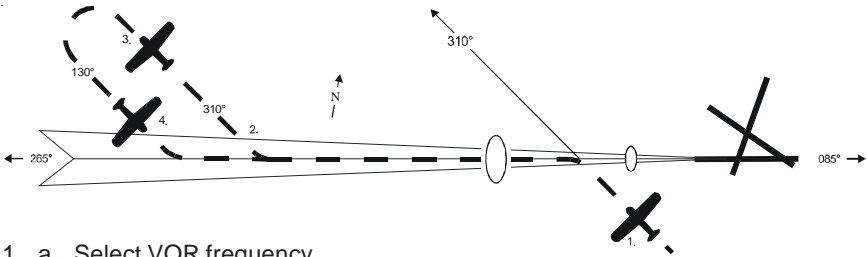


**Fig. 3-35. AP Display, NAV APR Mode Engaged, Track VOR Front Course Inbound**

A summary pictorial of this procedure is shown in Fig. 3-36.

For those aircraft equipped with the Garmin 400W/500W Series GPS Navigation Receiver or equivalent unit, with the NAV GPSS mode engaged, the autopilot is capable of executing this entire lateral approach sequence if it has been programmed into the Navigation Receiver.

Once on the FRONT INBOUND VOR course, with the Navigation Receiver set to VLOC, press the APR mode selector switch to engage the NAV APR mode and complete the front course approach.



1. a. Select VOR frequency.
- b. Heading System HSI  
Set Course Pointer to FRONT INBOUND VOR course.
- Heading System DG  
Set Heading Bug and OBS to BACK INBOUND VOR course.
- c. Press REV mode selector switch to engage reverse mode.
- d. Intercept and track FRONT OUTBOUND VOR course.
2. a. At appropriate time, set Heading Bug to FRONT OUTBOUND PROCEDURE TURN heading.
- b. Press HDG mode selector switch to engage heading mode.
3. a. Turn Heading Bug in two successive 90° increments, to establish aircraft on FRONT INBOUND PROCEDURE TURN heading.
4. a. Heading System HSI  
Course Pointer remains unchanged.
- Heading System DG  
Set Heading Bug and OBS to FRONT INBOUND VOR course.
- b. Press APR mode selector switch to engage navigation approach mode.
- c. Intercept and track FRONT INBOUND VOR course.
- d. At middle marker, if missed approach is declared, disconnect autopilot.
- e. Stabilize aircraft.
- f. Set Heading Bug to missed approach heading.
- g. Press HDG mode selector switch to engage heading mode.

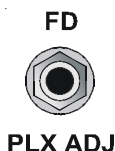
**Fig. 3-36. VOR Approach with Procedure Turn**

### 3.3.7 NAV GPSS Approach (Lateral Guidance Only)

Program a predefined approach into the GPS Navigation Receiver. Press the NAV mode selector switch twice to engage the navigation global positioning system steering mode (reference section 3.1.3). The autopilot will laterally steer the aircraft along the predefined approach. To control the assigned altitudes and rates of descent, use the altitude hold mode (reference section 3.1.4) and vertical speed mode (reference section 3.1.5), respectively. For those aircraft *not* equipped with the Garmin 400W/500W Series GPS Navigation Receiver or equivalent unit, to make any procedure turns, engage the heading mode and use the Heading Bug (reference section 3.1.1). Upon completion, re-engage the navigation global positioning system steering mode.

### 3.4 Flight Director Operation

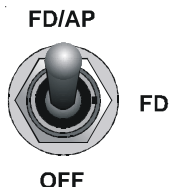
The optional Flight Director (FD) is a display of the flight profile. It is commanded by the autopilot. A pair of Steering Command Bars and an Aircraft Reference Symbol (ARS) are the principal FD components of interest. The position of the Steering Command Bars can be adjusted by the pilot, using the Parallax Adjustment shown in Fig. 3-37. The FD operates in either the FD/AP mode or the FD mode.



**Fig. 3-37. FD Parallax Adjustment**

#### 3.4.1 FD/AP Mode

Set the Autopilot Master Switch to the FD/AP position, as shown in Fig. 3-38. Engage a roll mode (HDG, NAV, NAV APR, REV, REV APR, NAV GPSS) and pitch mode (ALT HOLD, VS, GS). The autopilot will steer the aircraft toward the Steering Command Bars, until the ARS is tucked into them. The FD provides a visual indication of how accurately the autopilot is tracking its own roll and pitch commands. A typical view of the FD with the FD/AP mode engaged is shown in Fig. 3-39.



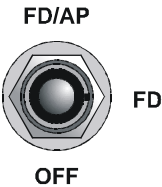
**Fig. 3-38. AP Master Switch, FD/AP Mode Engaged**



**Fig. 3-39. FD Display, FD/AP Mode Engaged**

**3.4.2 FD Mode**

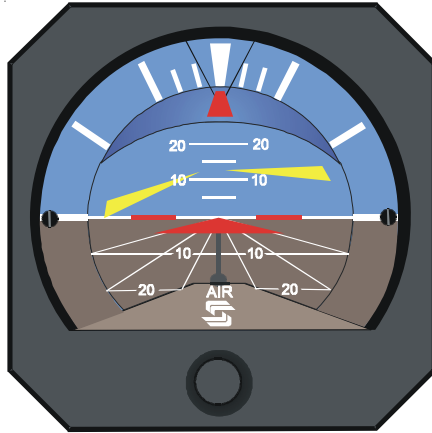
With the Autopilot Master Switch in the FD/AP position, together with a roll mode (HDG, NAV, NAV APR, REV, REV APR, NAV GPSS) and pitch mode (ALT HOLD, VS, GS) engaged, set the Autopilot Master Switch to the FD position as shown in Fig. 3-40. An audible alert will sound, the roll servo and pitch servo will disengage, and the FD annunciation will appear on the Remote Annunciator as shown in Fig. 3-41, to acknowledge that the FD mode is engaged. The pilot must steer the aircraft toward the Steering Command Bars, until the ARS is tucked into them. The FD provides a visual indication of how accurately the pilot is tracking the autopilot's roll and pitch commands. A typical view of the FD with the FD mode engaged is shown in Fig. 3-42.



**Fig. 3-40. AP Master Switch, FD Mode Engaged**



**Fig. 3-41. Remote Annunciator Display, FD Mode Engaged**



**Fig. 3-42. FD Display, FD Mode Engaged**

### **3.5 Wide Area Augmentation System (WAAS) Procedures**

#### **3.5.1 GPS Approach (With Vertical Guidance)**

For those aircraft equipped with the Garmin 400W/500W Series GPS Navigation Receiver or equivalent unit, when conducting a WAAS approach with the NAV GPSS mode engaged, the autopilot will execute the entire lateral approach sequence (i.e., intercept and track front outbound course, complete procedure turn, intercept and track front inbound course).

In addition, the autopilot will execute the following vertical approaches:

1. LPV (precision and LNAV/VNAV)
2. LNAV+V (non-precision)

Once on the front inbound course, the NAV APR mode must be engaged in order to intercept and track either GPS glideslope listed above. The remainder of the approach should be flown like a Straight-In ILS (reference section 3.2.1).

#### **Caution:**

***The aircraft will not automatically level off at the Decision Height (DH) or Minimum Descent Altitude (MDA). The pilot must maintain an awareness of their altitude at all times, and disconnect the autopilot at DH or MDA for either a landing or Go-Around (GA).***

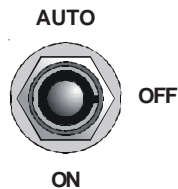
### 3.5.2 Missed Approach

During a missed approach, once established in a climb, engaging the NAV GPSS mode will cause the aircraft to follow the missed approach procedure, if it has been programmed into the Garmin 400W/500W GPS Navigation Receiver.

If the missed approach procedure includes holding, then the autopilot will enter the aircraft into the holding pattern. In that event, maintain vertical speed and altitude using the VS and ALT HOLD modes, respectively.

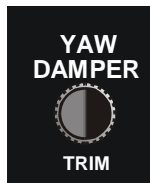
### 3.6 Yaw Damper Operation

The optional Yaw Damper serves to dampen excessive adverse yaw. It operates in either the AUTO mode or ON mode, depending upon the position of the Yaw Damper Master Switch shown in Fig. 3-43.



**Fig. 3-43. Yaw Damper Master Switch**

The Yaw Damper Trim Knob, shown in Fig. 3-44, is used to center the slip/skid ball when the yaw servo is engaged.



**Fig. 3-44. Yaw Damper Trim Knob**

### **3.6.1 AUTO Mode**

With the Yaw Damper Master Switch in the AUTO position, the yaw servo will become automatically engaged whenever a roll mode (HDG, NAV, NAV APR, REV, REV APR, NAV GPSS) is engaged.

### **3.6.2 ON Mode**

With the Yaw Damper Master Switch in the ON position, the yaw servo will be engaged at all times, entirely independent of autopilot operation.

### **3.6.3 Yaw Damper Trim**

With the yaw servo engaged, rotate the Yaw Damper Trim Knob to center the slip/skid ball.

## **3.7 Autopilot Disconnect**

The autopilot can be disconnected by any of the following means:

1. Press remote AP DISC / TRIM INTR Switch located on Control Wheel.
2. Press either forward or aft on both segments of remote Manual Electric Trim Switch located on Control Wheel, whenever a pitch mode (ALT HOLD, VS, GS) is engaged.
3. Set AP Master Switch to OFF position.
4. Pull AP Circuit Breaker.

## **3.8 Automatic Trim Disable**

In the event of a trim runaway, the automatic trim function can be disabled by executing the following sequence:

1. Press/Hold remote AP DISC / TRIM INTR Switch located on Control Wheel.
2. Set Trim Master Switch to OFF position.
3. Pull Trim Circuit Breaker.

## **SECTION 4**

# **OPERATING PARAMETERS**



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## 4.1 Roll Axis Limits

### Turn Rate

Piston A/C:

90% Standard Rate Turn (HDG, NAV, NAV APR, REV, REV APR, CWS Modes)

Turboprop A/C:

75% Standard Rate Turn (HDG, NAV, NAV APR, REV, REV APR, CWS Modes)

All A/C:

130% Standard Rate Turn (NAV GPSS Mode) for Programmer/Computers with Hardware Mod Code AM and below.

90% Standard Rate Turn (NAV GPSS Mode) for Programmer/Computers with Hardware Mod Code AN and AP.

110% Standard Rate Turn (NAV GPSS Mode) for Programmer/Computers with Hardware Mod Code AR and above.

## 4.2 Pitch Axis Limits

### Altitude

32,000 FT

### Vertical Force Due to Acceleration

$\pm 0.6$  g disregarding 1 g due to gravity

### Vertical Speed

1600 FPM Climbing or Descending

### Modes

A pitch mode (ALT HOLD, VS, GS) can only be engaged after a roll mode (HDG, NAV, NAV APR, REV, REV APR, NAV GPSS) has been engaged.

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# **SECTION 5 GLOSSARY**

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<b>Term</b>	<b>Meaning</b>
A/C	Aircraft
ADJ	Adjustment
ALT	Altitude
AP	Autopilot
APR	Approach
ARS	Aircraft Reference Symbol
CAP	Capture
CDI	Course Deviation Indication
CW	Clockwise
CWS	Control Wheel Steering
CCW	Counter–Clockwise
CRS	Course
DG	Directional Gyro
DH	Decision Height
DISC	Disconnect
FAA	Federal Aviation Administration
FD	Flight Director
FPM	Feet–per–Minute
FT	Feet
GA	Go Around
GDI	Glideslope Deviation Indication
GPS	Global Positioning System
GPSS	Global Positioning System Steering
GS	Glideslope
HDG	Heading
HSI	Horizontal Situation Indicator
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INTR	Interrupt
KTS	Knots
LNAV	Lateral Navigation
LNAV+V	Lateral Navigation with Advisory Vertical Guidance
LOC	Localizer
LPV	Lateral Precision with Vertical Guidance
MAP	Missed Approach Point
MDA	Minimum Descent Altitude
NAV	Navigation
NM	Nautical Miles
OBS	Omnibearing Selector
PLX	Parallax
PN	Part Number
POH	Pilot's Operating Handbook
RDY	Ready
REV	Reverse
VLOC	VOR or LOC Frequency
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation
VOR	Very High Frequency Omnidirectional Radio Range
VS	Vertical Speed
YD	Yaw Damper

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