

S-TEC

Pilot's Operating Handbook Fifty Five X

Cirrus SR20/22 Aircraft
SR20: SN 1337 and Above
SR22: SN 0435 and Above



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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), installed in the Cirrus SR20/22 aircraft (A/C), and integrated with the Avidyne Primary Flight Display (PFD), as well as the Garmin 400/500 Series or 400W/500W Series Navigation Receiver.

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 Cirrus SR20/22 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. The roll trim cartridge is coupled to the ailerons. The pitch trim cartridge and pitch servo (selected aircraft only) are coupled to the elevator. Activation of roll axis control must always precede activation of pitch axis control.

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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/GPS Course

Approach (APR) Mode

Used to Intercept and Track a LOC/GPS Front Course Inbound

Reverse (REV) Mode

Used to Intercept and Track a LOC Back Course Inbound

Global Positioning System Steering (GPSS) Mode

Used to Laterally Steer along a Course defined by GPS

1.4.2 Pitch Axis Control

Altitude Hold (ALT) Mode

Used to Hold Altitude

Vertical Speed (VS) Mode

Used to Hold Vertical Speed

Glideslope (GS) Mode

Used to Intercept and Track Glideslope

Note:

Glidepath can herein this document be used interchangeably with Glideslope.

1.5 Block Diagram

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

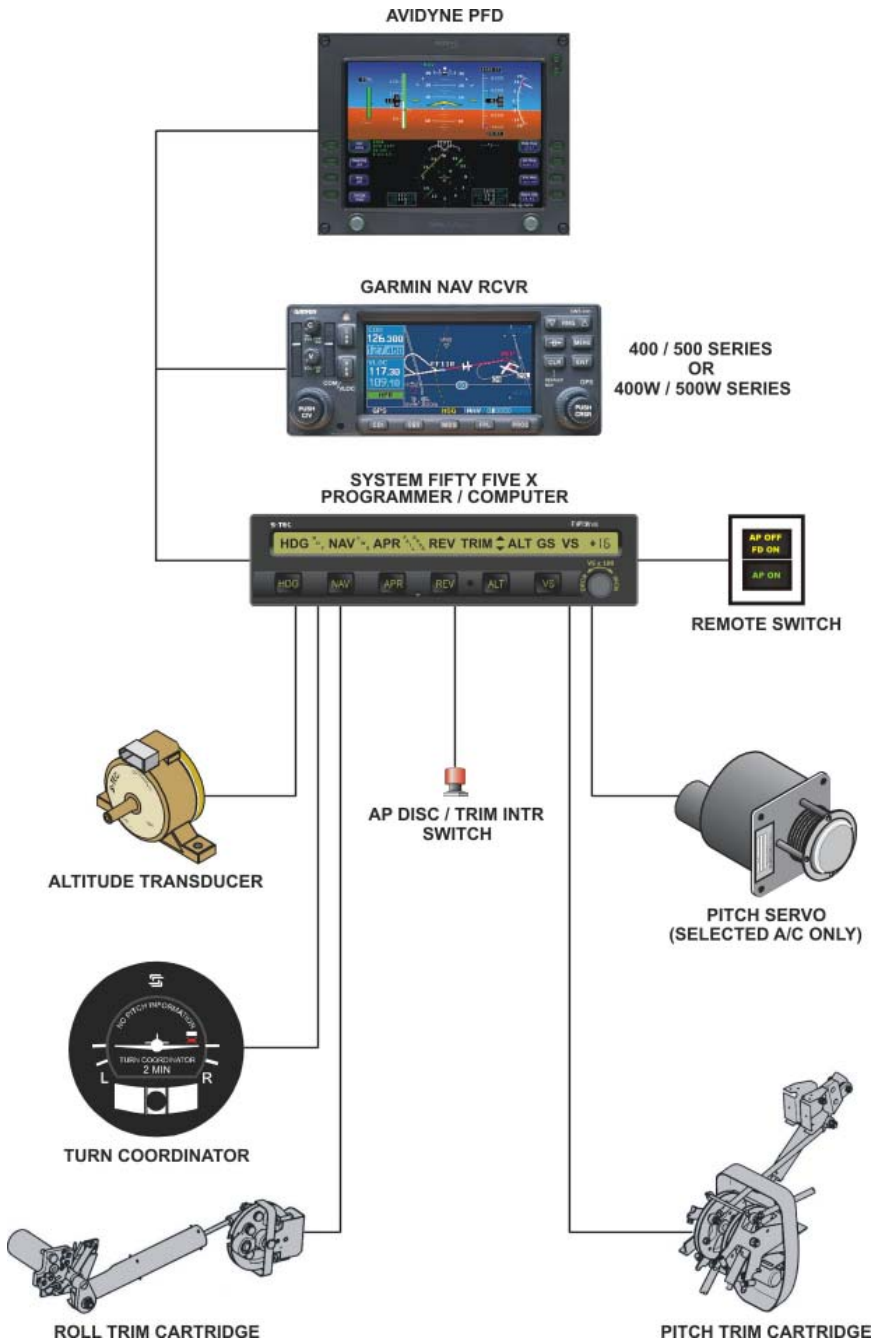


Fig. 1-1. System Fifty Five X Block Diagram

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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
<p>1. Set Battery Master Switch to ON position.</p>	<p>All annunciations appear on AP display as shown in Fig. 2-1, and then extinguish.</p> <p>Software revision number briefly appears on AP display as shown in Fig. 2-2, and then extinguishes.</p> <p>INITIAL AHRS ALIGNMENT message appears on PFD display, as shown in Fig. 2-3.</p> <p>RDY annunciation alone re-appears on AP display within 3 minutes, as shown in Fig. 2-4 (Notes 1, 2).</p> <p>Once AHRS has completed its alignment, AP RDY annunciation appears on PFD display as shown in Fig. 2-5.</p>

Notes:

1. Should a failure be detected, the FAIL annunciation alone will re-appear on the AP display as shown in Fig. 2-6, and the autopilot will not operate. In addition, the AP FAIL annunciation will appear on the PFD, as shown in Fig. 2-7.

2. Should the rate gyro internal to the Turn Coordinator fail to reach sufficient speed, the AP display will remain blank indefinitely and the autopilot will not operate. This typically indicates that the Turn Coordinator needs repair.



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

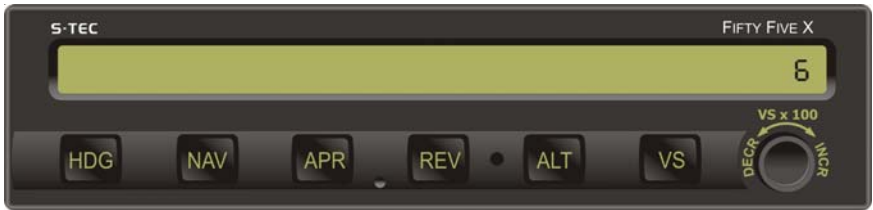


Fig. 2-2. AP Display, Software Revision Number



Fig. 2-3. PFD Display, INITIAL AHRS ALIGNMENT Message

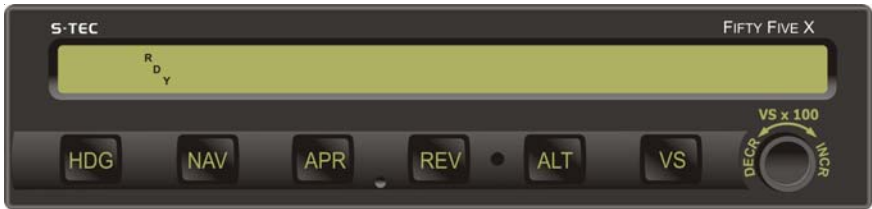


Fig. 2-4. AP Display, RDY Annunciation



Fig. 2-5. PFD Display, AP RDY Annunciation



Fig. 2-6. AP Display, FAIL Annunciation



Fig. 2-7. PFD Display, AP FAIL Annunciation

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, and not the PFD.

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

ACTION	RESPONSE
1. Move A/C Control Sidestick left and right, to sense its freedom of movement about roll axis.	-----
2. Set PFD Hdg Bug under Lubber Line.	-----
3. Press HDG mode selector switch to engage heading mode.	<p>HDG annunciation alone appears on AP display, as shown in Fig. 2-8.</p> <p>HDG annunciation appears on PFD display and Hdg Bug is magenta, as shown in Fig. 2-9.</p>
4. Turn PFD Hdg Bug to the left side of Lubber Line.	A/C Control Sidestick moves to the left.
5. Turn PFD Hdg Bug to the right side of Lubber Line.	A/C Control Sidestick moves to the right.
6. Set PFD Hdg Bug under Lubber Line.	A/C Control Sidestick Stops.
7. Move A/C Control Sidestick forward and aft, to sense its freedom of movement about pitch axis (A/C with Pitch Servo Only).	-----
8. Press ALT mode selector switch to engage altitude hold mode.	<p>ALT annunciation appears with HDG on AP display, as shown in Fig. 2-10.</p> <p>ALT annunciation appears with HDG on PFD display, along with AP in upper right-hand corner, as shown in Fig. 2-11.</p> <p>FD Steering Command Bars on PFD display appear and are magenta, as shown in Fig. 2-11.</p>



Fig. 2-8. AP Display, HDG Mode Engaged (Pre-Flight)



Fig. 2-9. PFD Display, HDG Mode Engaged (Pre-Flight)

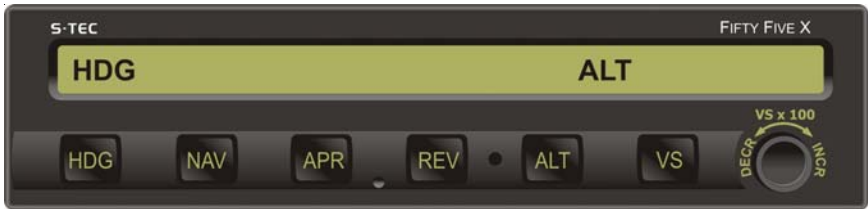


Fig. 2-10. AP Display, HDG and ALT HOLD Modes Engaged (Pre-Flight)



Fig. 2-11. PFD Display, HDG and ALT HOLD Modes Engaged (Pre-Flight)

Table 2-2. Pre-Flight Test (continued from page 2-7)

ACTION	RESPONSE
9. Attempt movement of A/C Control Sidestick forward and aft (A/C with Pitch Servo Only).	A/C Control Sidestick's reduced freedom of movement indicates that Pitch Servo is engaged. Pitch Servo can be overridden. If not, disconnect autopilot and do not use.
10. Set PFD VSI Bug to 0 FPM.	-----
11. Press VS mode selector switch to engage vertical speed mode.	VS annunciation appears with HDG on AP display, as shown in Fig. 2-12. VS annunciation appears with HDG on PFD display, and VSI bug is magenta as shown in Fig. 2-13.
12. Set PFD VSI Bug to 500 FPM climbing.	A/C Control Sidestick moves in aft direction.
13. Set PFD VSI Bug to 500 FPM descending.	A/C Control Sidestick moves in forward direction.
14. Set PFD VSI Bug to 0 FPM.	A/C Control Sidestick stops.
15. Move A/C Control Sidestick as far aft as possible (A/C with Pitch Servo Only).	After 3 seconds, TRIM ∨ annunciation appears on AP display. After 7 seconds, TRIM ∨ annunciation flashes.
16. Move A/C Control Sidestick as far forward as possible (A/C with Pitch Servo Only).	After 3 seconds, TRIM ^ annunciation appears on AP display. After 7 seconds, TRIM ^ annunciation flashes.
17. Move A/C Control Sidestick aft until TRIM ^ annunciation is extinguished (A/C with Pitch Servo Only).	-----

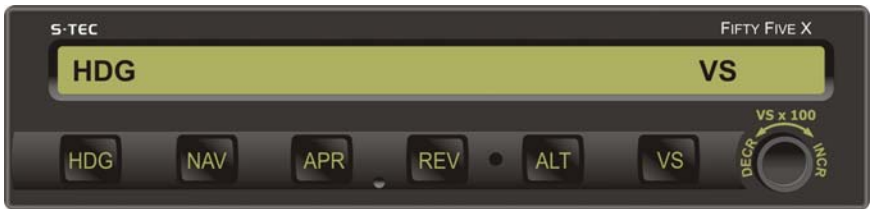


Fig. 2-12. AP Display, HDG and VS Modes Engaged (Pre-Flight)



Fig. 2-13. PFD Display, HDG and VS Modes Engaged (Pre-Flight)

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

ACTION	RESPONSE
<p>18. Set PFD Alt Bug to higher altitude, and then engage Altitude Pre-Select Function by simultaneously pressing VS and ALT mode selector switches.</p>	<p>A/C Control Sidestick moves in aft direction.</p> <p>ALT and VS annunciations appear on AP display.</p> <p>ALT and VS annunciations appear on PFD display.</p> <p>Alt Bug and VSI Bug on PFD display change to full magenta fill.</p> <p style="text-align: center;">Note:</p> <p><i>If ALT Bug or VSI Bug does not change to full magenta, or if no AP annunciation appears on PFD, then reset PFD circuit breakers, disconnect autopilot, and return to step 1.</i></p>
<p>19. Press Remote AP OFF / FD ON Switch.</p>	<p>AP ON Switch annunciation is extinguished.</p> <p>AP OFF / FD ON Switch annunciation appears and is amber.</p> <p>FD annunciation appears on PFD display in upper right-hand corner, and is green.</p> <p>FD Steering Command Bars on PFD change to green.</p>
<p>20. Move A/C Control Sidestick forward and aft (A/C with Pitch Servo Only).</p>	<p>A/C Control Sidestick's freedom of movement indicates that Pitch Servo is disengaged.</p>
<p>21. Press ALT mode selector switch to engage altitude hold mode.</p>	<p>ALT annunciation appears with HDG on AP display, and VS annunciation is extinguished.</p>
<p>22. Turn PFD Hdg Bug to the left side of Lubber Line.</p>	<p>FD Steering Command Bars on PFD slowly move to a left turn position.</p>
<p>23. Turn PFD Hdg Bug to the right side of Lubber Line.</p>	<p>FD Steering Command Bars on PFD slowly move to a right turn position.</p>

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

ACTION	RESPONSE
24. Rotate Modifier Knob ½ turn CW.	FD Steering Command Bars on PFD slowly move to a pitch up position.
25. Rotate Modifier Knob 1 turn CCW.	FD Steering Command Bars on PFD slowly move to a pitch down position.
26. Press VS mode selector switch to reset Modifier Knob.	-----
27. Press forward and maintain pressure on Manual Electric Trim Switch (A/C with Pitch Servo Only).	A/C trims nose down.
28. Release Manual Electric Trim Switch (A/C with Pitch Servo Only).	A/C stops trimming.
29. Press aft and maintain pressure on Manual Electric Trim Switch (A/C with Pitch Servo Only).	A/C trims nose up.
30. Release Manual Electric Trim Switch (A/C with Pitch Servo Only).	A/C stops trimming.
31. Press Remote AP ON Switch to engage AP mode.	<p>AP OFF / FD ON Switch annunciation is extinguished.</p> <p>AP ON Switch annunciation appears and is green.</p> <p>FD annunciation on PFD changes to AP.</p> <p>FD Steering Command Bars on PFD change to magenta.</p>
32. Attempt movement of A/C Control Sidestick forward and aft (A/C with Pitch Servo Only).	A/C Control Sidestick's reduced freedom of movement indicates that Pitch Servo is engaged.

Table 2-2. Pre-Flight Test (continued from page 2-13)

ACTION	RESPONSE
<p>33. Press AP DISC / TRIM INTR Switch, to disconnect autopilot.</p> <p style="text-align: center;">Note:</p> <p><i>Pressing and holding AP DISC / TRIM INTR Switch will limit audible alert to a single “beep”.</i></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> <p>FD Steering Command Bars on PFD are extinguished.</p>
<p>34. Trim A/C for takeoff.</p>	<p style="text-align: center;">-----</p>

SECTION 3 IN-FLIGHT PROCEDURES

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3.1 Normal Operating Procedures

3.1.1 Heading (HDG) Mode

Set the PFD Hdg Bug to the desired heading on the compass card, and press the HDG mode selector switch to engage the heading mode. HDG annunciation will appear as shown in Fig. 3-1. The autopilot will turn the aircraft onto the selected heading and hold it. A new heading can be subsequently selected by setting the PFD Hdg Bug to the desired heading. A typical view of the PFD with the heading mode engaged is shown in Fig. 3-2.

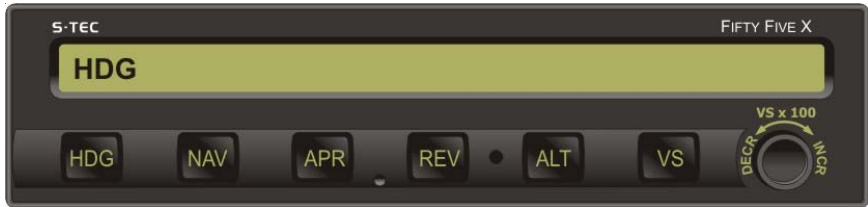


Fig. 3-1. AP Display, HDG Mode Engaged



Fig. 3-2. PFD Display, HDG Mode Engaged

3.1.2 Navigation (NAV) Mode

Select a VOR frequency on the Navigation Receiver. Set the PFD CRS Pointer to the desired course on the compass card, and press the NAV mode selector switch to engage the navigation mode. The NAV annunciation will appear as shown in Fig. 3-3.

If the Left/Right Needle is at full scale (100%) deflection from center, the autopilot will establish the aircraft on a 45° intercept angle relative to the selected course. If the Left/Right Needle is less than 100% deflection from center, the autopilot may still establish an intercept angle of 45°, provided the aircraft's closure rate to the selected course is sufficiently slow. Otherwise, the intercept angle will be less than 45°. A typical view of the PFD during this stage of the intercept sequence is shown in Fig. 3-4.

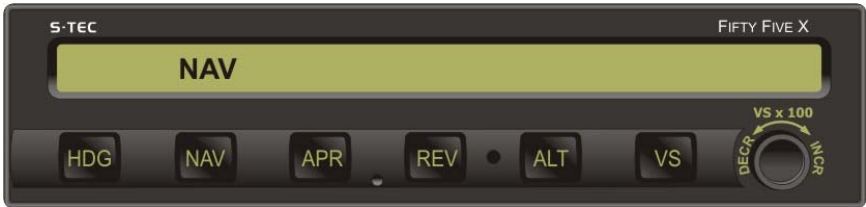


Fig. 3-3. AP Display, NAV Mode Engaged



Fig. 3-4. PFD Display, NAV Mode Engaged, A/C on 45° Intercept Angle

As the aircraft approaches the selected course, the autopilot will sense the corresponding rate at which the Left/Right Needle approaches center (closure rate), and gradually shallow the intercept angle as the autopilot turns the aircraft onto the course. A typical view of the PFD during this stage of the intercept sequence is shown in Fig. 3-5. The point at which this turn begins is variable, depending upon the closure rate. Although closure rate is principally a function of airspeed, the distance of the aircraft from the ground station also has an effect. However, the turn will always begin between 100% and 20% of Left/Right Needle deflection from center, or Course Deviation Indication (CDI).

During this stage of the intercept sequence, the autopilot operates at maximum gain and sensitivity to closure rate. In addition, the autopilot will limit the aircraft's turn rate to 90% of a standard rate turn.

When the aircraft arrives at 15% CDI needle deflection, the course is captured. At course capture, a step reduction in autopilot gain occurs; however, the PFD CRS Pointer 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 HIGH GAIN condition.

Fifteen seconds after course capture, a second step reduction in autopilot gain occurs, and will limit the aircraft's turn rate to 45% of a standard rate turn. 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 INTERMEDIATE GAIN condition.



Fig. 3-5. PFD Display, NAV Mode Engaged, A/C Turning onto Course

Thirty seconds after course capture, the autopilot will establish 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. In addition, the sensitivity to closure rate is reduced once more. The overall authority of the autopilot during this final stage of the intercept sequence is called the LOW GAIN condition. This marks the end of the intercept sequence, and the beginning of tracking. A typical view of the PFD during tracking is shown in Fig. 3-6.

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 PFD CRS Pointer is within 5° of the selected course, and the CDI needle deflection is less than 10%, the autopilot will immediately establish the LOW GAIN condition upon engagement of the NAV mode.

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



Fig. 3-6. PFD Display, NAV Mode Engaged, A/C Tracking Course

The NAV annunciation will flash whenever the 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 LOW GAIN condition and within 50% CDI needle deflection, to track in the higher authority INTERMEDIATE GAIN condition, press the APR mode selector switch to engage the approach mode. This is acknowledged as shown in Fig. 3-7.

While tracking in either the LOW GAIN or INTERMEDIATE GAIN condition, if a new course is selected that is different from the original course by 10° or more, the autopilot will revert to the HIGH GAIN condition.

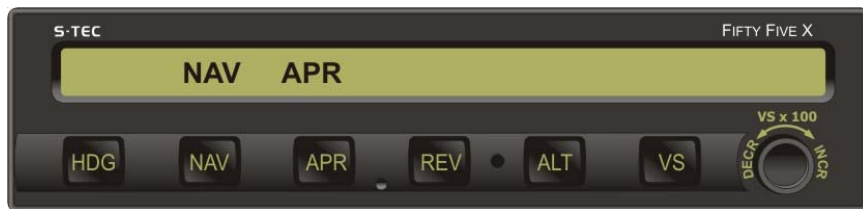


Fig. 3-7. AP Display, APR Mode Engaged

3.1.2.1 Pilot Selectable Intercept Angle

To select an intercept angle other than 45° , set the PFD Hdg 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. Set the PFD CRS Pointer to the desired course. Press and hold the HDG mode selector switch, and press the NAV mode selector switch to engage the heading mode and arm the navigation mode. HDG and NAV annunciations will appear as shown in Fig. 3-8.

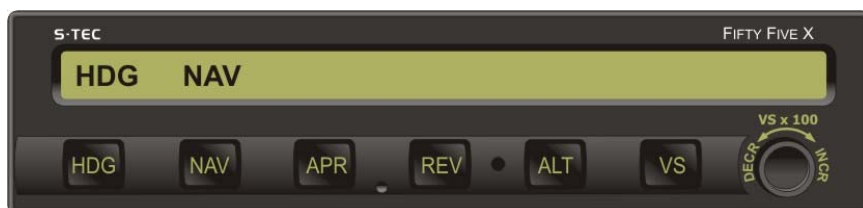


Fig. 3-8. AP Display, HDG Mode Engaged, NAV Mode Armed

The autopilot will establish the aircraft on the selected intercept angle (heading). A typical view of the PFD during this stage of the intercept sequence is shown in Fig. 3-9. The autopilot will hold this heading until the autopilot must turn the aircraft onto the selected course, to prevent overshoot. At this point in the intercept sequence, the HDG annunciation will extinguish to indicate engagement of the navigation mode.



Fig. 3-9. PFD Display, HDG Mode Engaged, NAV Mode Armed

3.1.3 Global Positioning System Steering (GPSS) Mode

The GPSS mode should be used anytime the selected navigation source is the Global Positioning System (GPS).

Engagement of the GPSS mode requires pressing the NAV mode selector switch twice, unless the NAV mode is engaged. If the NAV mode is engaged, press the NAV mode selector switch once to engage the GPSS mode. The NAV and GPSS annunciations will appear as shown in Fig. 3-10.



Fig. 3-10. AP Display, GPSS Mode Engaged

The autopilot will laterally steer the aircraft along a predefined course programmed into the Navigation Receiver, 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 the GPSS mode of operation, the autopilot will not accept any course error input from the PFD CRS Pointer. A typical view of the PFD with the GPSS mode engaged is shown in Fig. 3-11.



Fig. 3-11. PFD Display, GPSS Mode Engaged

If there are no programmed course segments in the Navigation Receiver upon attempted engagement of the GPSS mode, the FAIL annunciation will appear, NAV and GPSS annunciations will flash, and the autopilot will hold the aircraft's wings level.

With the GPSS mode engaged, the autopilot is also capable of executing the following procedures if programmed into the Navigation Receiver:

Procedure Turns, Approaches, Missed Approaches, Holding Patterns

However, the autopilot will not automatically fly vertical profiles (reference section 3.5.2).

3.1.3.1 Pilot Selectable Intercept Angle

To select a course intercept angle, set the PFD Hdg 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 press the NAV mode selector switch twice to engage the HDG mode and arm the GPSS mode. HDG, NAV, and GPSS annunciations will appear as shown in Fig. 3-12.



Fig. 3-12. AP Display, HDG Mode Engaged, GPSS Mode Armed

The autopilot will establish the aircraft on the selected intercept angle (heading). A typical view of the PFD during this stage of the intercept sequence is shown in Fig. 3-13. The autopilot will hold this heading until the autopilot must turn the aircraft onto the course segment to prevent overshoot. At this point in the intercept sequence, the HDG annunciation will extinguish to indicate engagement of the GPSS mode.



Fig. 3-13. PFD Display, HDG Mode Engaged, GPSS Mode Armed

3.1.4 Altitude Hold (ALT) Mode

The altitude hold mode can only be engaged if a roll mode (HDG, NAV, APR, GPSS, REV) is 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. 3-14. The autopilot will hold the aircraft at its current absolute pressure altitude. The captured 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 ± 360 feet from the original captured altitude. A typical view of the PFD with the altitude hold mode engaged is shown in Fig. 3-15. Engagement of the altitude hold mode will reset the PFD Alt Bug to the captured altitude.

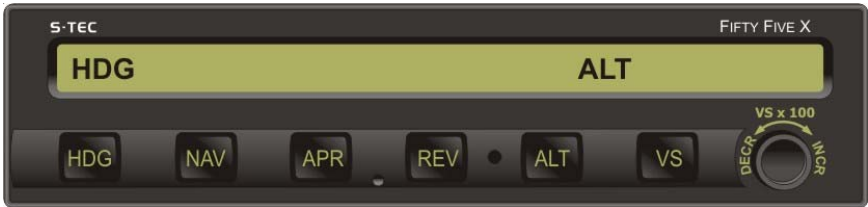


Fig. 3-14. AP Display, HDG and ALT HOLD Modes Engaged



Fig. 3-15. PFD Display, HDG and ALT HOLD Modes Engaged

3.1.5 Vertical Speed (VS) Mode

Caution:

The vertical speed mode may be used for establishing and maintaining a PILOT selected vertical speed. The autopilot receives no airspeed information; therefore, it is the responsibility of the pilot to manage the vertical speed selection within the operating limits of the aircraft's capabilities. Selection of a vertical speed outside the capability of the aircraft can create a condition of reduced airspeed, and possibly lead to an aircraft stall condition.

3.1.5.1 Normal Operation

The vertical speed mode can only be engaged if a roll mode (HDG, NAV, APR, GPSS, REV) is engaged. With a roll mode engaged, set the PFD VSI Bug to the desired vertical speed, and press the VS mode selector switch to engage the vertical speed mode. The VS annunciation will appear as shown in Fig. 3-16. If within the aircraft's capabilities, the autopilot will attain and hold the aircraft at the vertical speed for which the VSI Bug is set. A typical view of the PFD with the heading and vertical speed modes engaged is shown in Fig. 3-17.

During a climb, should the aircraft become unable to hold the commanded 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 this event, immediately increase the aircraft's thrust if possible, reduce the commanded vertical speed using the PFD VSI Bug, or both, until the VS annunciation stops flashing.

Note:

In the event of a PFD failure, refer to paragraph 3.1.5.2 for operation of the vertical speed mode.

3.1.5.2 VS Mode Operation during PFD Failure

The vertical speed mode can only be engaged if a roll mode (HDG, NAV, APR, GPSS, REV) is engaged. With a roll mode engaged, press the VS mode selector switch to engage the vertical speed mode. VS and current vertical speed annunciations will appear on the autopilot display, as shown in Fig. 3-18. The current vertical speed appears as a number in units of FPM x 100, along with either a "+" prefix to indicate a climb, or a "-" prefix 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 vertical speed. The 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 ± 1600 FPM.



Fig. 3-16. AP Display, HDG and VS Modes Engaged



Fig. 3-17. PFD Display, HDG and VS Modes Engaged



Fig. 3-18. AP Display, HDG and VS Modes Engaged, PFD Failure

3.1.6 Altitude Pre-Select Function

The Altitude Pre-Select Function allows the pilot to pre-select a target altitude and the vertical speed (if within the aircraft's capabilities) at which the aircraft will climb or descend, until that altitude is captured.

Engage a roll mode (HDG, NAV, APR, GPSS, REV). Set the PFD Alt Bug to the target altitude and the PFD VSI Bug to an acceptable vertical speed. Press and hold the VS mode selector switch, and press the ALT mode selector switch to engage the vertical speed mode and arm the altitude hold mode. ALT and VS annunciations will appear as shown in Fig. 3-19. If within the aircraft's capabilities, the autopilot will attain and hold the aircraft at the vertical speed for which the VSI Bug is set. A typical view of the PFD with the autopilot in this configuration is shown in Fig. 3-20.

As the aircraft approaches the target altitude, a scheduled reduction in the vertical speed will automatically occur to ensure that there is no adverse acceleration at the point of capture. Once the target altitude has been captured, the VS annunciation will extinguish to indicate engagement of the ALT mode, as shown in Fig. 3-21.

Note:

Prior to altitude capture, with the VS mode engaged and the ALT mode armed, the PFD VSI Bug and/or PFD Alt Bug can be changed at any time, causing the autopilot to respond accordingly.

Note:

During the pre-select sequence, with the VS mode engaged and the ALT mode armed, the following are subject to occur:

- 1. Pressing the ALT mode selector switch once will disengage the VS mode, and engage the ALT mode. Consequently, the VS annunciation will extinguish, the PFD VSI Bug will reset to 0 FPM, and the Alt Bug will reset to the captured altitude. Finally, this may cause some adverse acceleration, as the autopilot works to hold the aircraft at the captured altitude.***
- 2. Pressing the VS mode selector switch once will disarm the ALT mode, but leave the VS mode engaged. Consequently, the ALT annunciation will extinguish.***

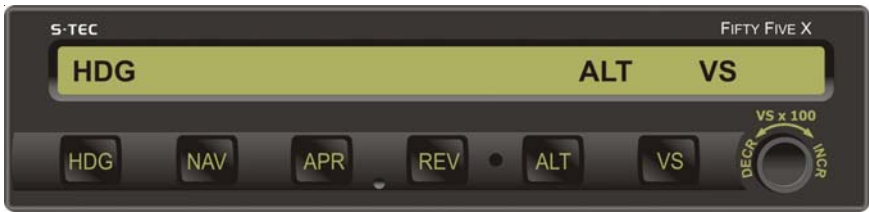


Fig. 3-19. AP Display, HDG and VS Modes Engaged, ALT HOLD Mode Armed



Fig. 3-20. PFD Display, HDG and VS Modes Engaged, ALT HOLD Mode Armed



Fig. 3-21. AP Display, HDG and ALT HOLD Modes Engaged

3.1.7 Autotrim (A/C with Pitch Servo Only)

When the Remote AP ON Switch has been selected (reference section 3.4.1), and both a roll mode (HDG, NAV, APR, REV, GPSS) and a pitch mode (ALT, VS, GS) are engaged, the autopilot will provide an annunciation whenever it is automatically trimming the aircraft. A pitch mode can only be engaged after a roll mode has been engaged.

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 the autopilot is automatically trimming the aircraft in the indicated direction. This is shown in Fig. 3-22. If the autopilot is still in the process of automatically trimming the aircraft after four more seconds, the annunciation will flash. When the aircraft has been sufficiently trimmed, such that the pitch servo loading is below the preset threshold, the annunciation will extinguish.



Fig. 3-22. AP Display, HDG and ALT HOLD Modes Engaged, Autotrim in Progress

3.1.8 Manual Electric Trim

A Remote Manual Electric Trim Switch is located on each Control Sidestick. It can only be used to trim the aircraft from the RDY, or when the Remote AP OFF / FD ON Switch has been selected. To trim the aircraft nose up, press aft and maintain pressure on the Remote Manual Electric Trim Switch. To trim the aircraft nose down, press forward and maintain pressure on the Remote Manual Electric Trim Switch.

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3.2 Precision Approach Procedures

3.2.1 Straight-In ILS Approach

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. 3-23. A typical view of the PFD during this stage of the ILS approach sequence is shown in Fig. 3-24.

The GS mode must be armed prior to engagement. Once the following conditions have existed simultaneously for a period of one second, the GS annunciation will appear to acknowledge that the GS mode has automatically armed, as shown in Fig. 3-25:

1. APR mode engaged
2. ALT mode engaged
3. NAV Flag out of view
4. GS Flag out of view
5. LOC frequency channeled
6. A/C within 50% needle deflection of LOC centerline
7. A/C more than 10% needle deflection below GS centerline

A typical view of the PFD during this stage of the ILS approach sequence is shown in Fig. 3-26.

The armed GS 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 GS mode, press the APR mode selector switch again. The GS annunciation will immediately extinguish, but re-appear after 1 second.

With the GS mode armed, once the aircraft arrives at 5% below the GS centerline, the ALT annunciation will extinguish to indicate engagement of the GS mode, as shown in Fig. 3-27. This marks the end of the intercept sequence, and the beginning of tracking. A typical view of the PFD during this stage of the ILS approach sequence is shown in Fig. 3-28.

Note:

If the approach positions the aircraft slightly above the GS centerline, press the ALT mode selector switch to immediately engage the GS mode.

Caution:

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

The GS annunciation will flash whenever the Glideslope Deviation Indication (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) or Missed Approach Point (MAP), disconnect the autopilot to execute either a manual landing or go-around, respectively.

A pictorial of this procedure is shown in Fig. 3-29.



Fig. 3-23. AP Display, NAV, APR, and ALT HOLD Modes Engaged



Fig. 3-24. PFD Display, NAV, APR, and ALT HOLD Modes Engaged



Fig. 3-25. AP Display, NAV, APR and ALT HOLD Modes Engaged, GS Mode Armed



Fig. 3-26. PFDisplay, NAV, APR, and ALT HOLD Modes Engaged, GS Mode Armed



Fig. 3-27. AP Display, NAV, APR, and GS Modes Engaged



Fig. 3-28. PFD Display, NAV, APR, and GS Modes Engaged

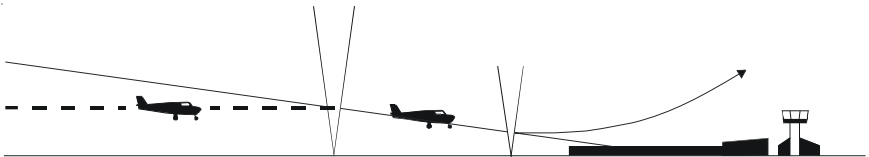


Fig. 3-29. Straight-In ILS Approach

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 HDG mode still engaged. Set the PFD VSI Bug to the desired vertical descent speed, and press the VS mode selector switch to engage the VS 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 APR 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 GS (reference section 3.2.1).

With the GPSS mode engaged, the autopilot is capable of executing this entire approach sequence if it is programmed into the Navigation Receiver. Once inbound, with the conditions of section 3.2.1 satisfied and the Navigation Receiver set to VLOC, engage the APR mode to 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. Set the PFD CRS Pointer to the FRONT INBOUND LOC course on the compass card. Press the REV mode selector switch to engage the APR mode. REV and APR annunciations will appear as shown in Fig. 3-30. The autopilot will intercept and track the BACK INBOUND LOC course. A typical view of the PFD during tracking is shown in Fig. 3-31.



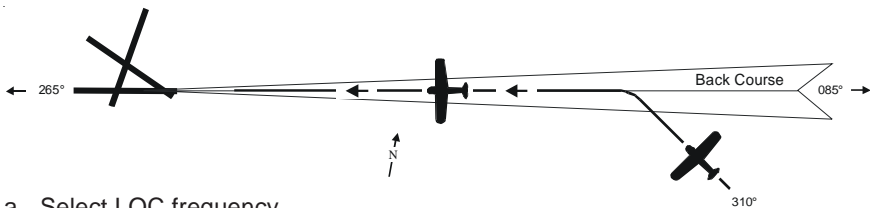
Fig. 3-30. AP Display, APR Mode Engaged, Back Course

The REV annunciation will flash whenever the 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. 3-32.



Fig. 3-31. AP Display, APR Mode Engaged, Back Course



- Select LOC frequency.
- Set PFD CRS Pointer to FRONT INBOUND LOC course.
- Press REV mode selector switch to engage APR mode.
- Intercept and track BACK INBOUND LOC course.

Fig. 3-32. Straight-In Back Course Approach

3.3.2 Back Course Approach with Procedure Turn

Select the LOC frequency on the Navigation Receiver. Set the PFD CRS Pointer to the FRONT INBOUND LOC course on the compass card. Press the NAV mode selector switch to engage the APR mode. NAV and APR annunciators will appear as shown in Fig. 3-33. The autopilot will intercept and track the BACK OUTBOUND LOC course.



Fig. 3-33. AP Display, APR Mode Engaged, Track LOC Back Course Outbound

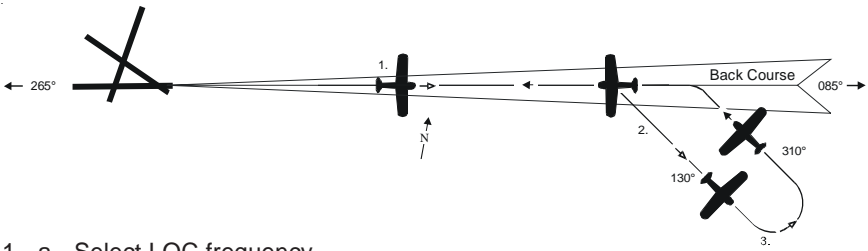
At the appropriate time, set the PFD Hdg Bug to the BACK OUTBOUND PROCEDURE TURN heading, and press the HDG mode selector switch to engage the heading mode. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the PFD Hdg Bug in two successive 90° increments, to establish the aircraft on the BACK INBOUND PROCEDURE TURN heading. Press the REV mode selector switch to engage the APR mode. REV and APR annunciators will appear as shown in Fig. 3-34. The autopilot will intercept and track the BACK INBOUND LOC course.



Fig. 3-34. AP Display, APR Mode Engaged, Track LOC Back Course Inbound

A summary pictorial of this procedure is shown in Fig. 3-35.

For 400W/500W Series equipped aircraft, with the GPSS mode engaged, the autopilot is capable of executing this entire approach sequence if it is programmed into the Navigation Receiver. Once on the BACK INBOUND LOC course (subsequent to position 3 in Fig. 3-35) and with the Navigation Receiver set to VLOC, engage the REV mode to complete the back course approach.



1.
 - a. Select LOC frequency.
 - b. Set PFD CRS Pointer to FRONT INBOUND LOC course.
 - c. Press NAV mode selector switch to engage APR mode.
 - d. Intercept and track BACK OUTBOUND LOC course.
2.
 - a. At the appropriate time, set PFD Hdg Bug to BACK OUTBOUND PROCEDURE TURN heading.
 - b. Press HDG mode selector switch to engage heading mode.
3.
 - a. Turn PFD Hdg Bug in two successive 90° increments, to establish aircraft on BACK INBOUND PROCEDURE TURN heading.
 - b. Press REV mode selector switch to engage APR mode.
 - c. Intercept and track BACK INBOUND LOC course.

Fig. 3-35. Back Course Approach with Procedure Turn

3.3.3 Straight-In LOC Approach

Select the LOC frequency on the Navigation Receiver. Set the PFD CRS Pointer to the FRONT INBOUND LOC course on the compass card. Press the NAV mode selector switch to engage the APR mode. NAV and APR annunciators will appear as shown in Fig. 3-36. The autopilot will intercept and track the FRONT INBOUND LOC course.

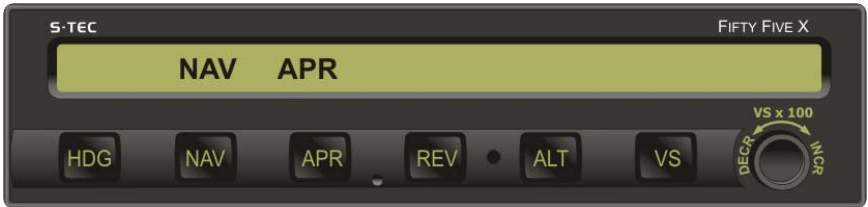
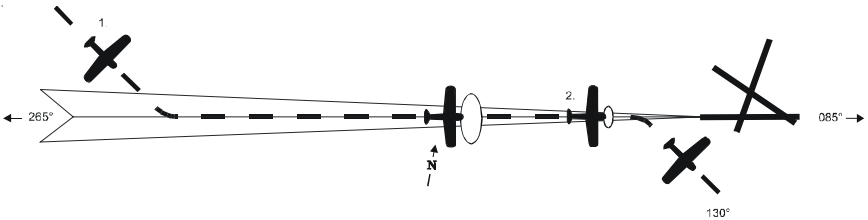


Fig. 3-36. AP Display, APR Mode Engaged, Track LOC Front Course Inbound

A summary pictorial of this procedure is shown in Fig. 3-37.



1. a. Select LOC frequency.
 - b. Set PFD CRS Pointer to FRONT INBOUND LOC course.
 - c. Press NAV mode selector switch to engage APR 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 PFD Hdg Bug to missed approach heading.
 - d. Press HDG mode selector switch to engage heading mode.

Fig. 3-37. Straight-In LOC Approach

3.3.4 Straight-In VOR Approach

Select the VOR frequency on the Navigation Receiver. Set the PFD CRS Pointer to the FRONT INBOUND VOR course on the compass card. Press the APR mode selector switch to engage the APR mode. NAV and APR annunciators will appear as shown in Fig. 3-38. The autopilot will intercept and track the FRONT INBOUND VOR course.

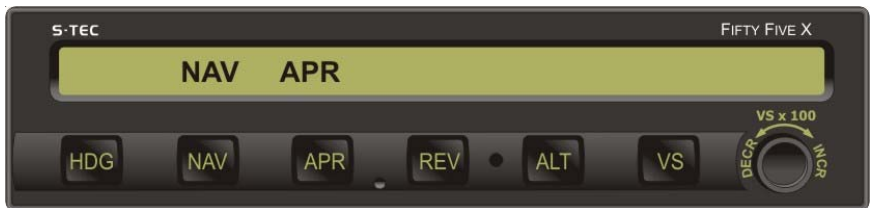
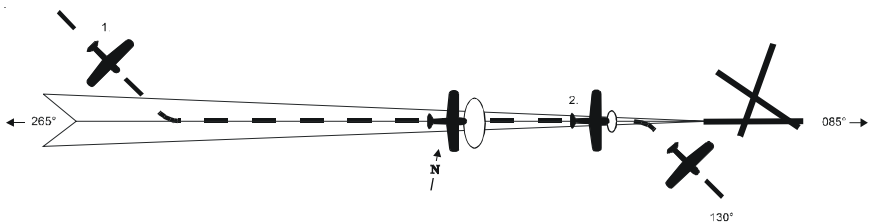


Fig. 3-38. AP Display, APR Mode Engaged, Track VOR Front Course Inbound

A summary pictorial of this procedure is shown in Fig. 3-39.



1. a. Select VOR frequency.
 - b. Set PFD CRS Pointer to FRONT INBOUND VOR course.
 - c. Press APR mode selector switch to engage 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 PFD Hdg Bug to missed approach heading.
 - d. Press HDG mode selector switch to engage heading mode.

Fig. 3-39. Straight-In VOR Approach

3.3.5 LOC Approach with Procedure Turn

Select the LOC frequency on the Navigation Receiver. Set the PFD CRS Pointer to the FRONT INBOUND LOC course on the compass card. Press the REV mode selector switch to engage the APR mode. REV and APR annunciations will appear as shown in Fig. 3-40. The autopilot will intercept and track the FRONT OUTBOUND LOC course.



Fig. 3-40. AP Display, APR Mode Engaged, Track LOC Front Course Outbound

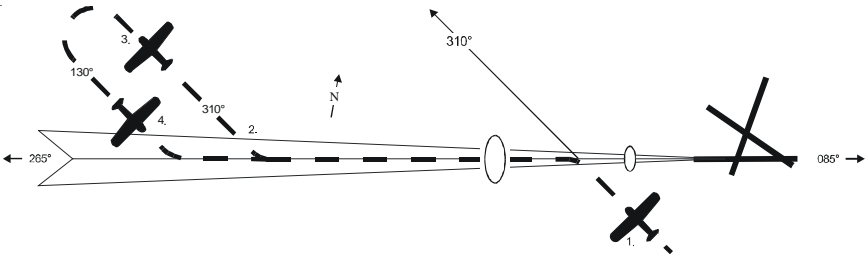
At the appropriate time, set the PFD Hdg Bug to the FRONT OUTBOUND PROCEDURE TURN heading. Press the HDG mode selector switch to engage the heading mode. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the PFD Hdg Bug in two successive 90° increments, to establish the aircraft on the FRONT INBOUND PROCEDURE TURN heading. Press the NAV mode selector switch to engage the APR mode. NAV and APR annunciations will appear as shown in Fig. 3-41. The autopilot will intercept and track the FRONT INBOUND LOC course.



Fig. 3-41. AP Display, APR Mode Engaged, Track LOC Front Course Inbound

A summary pictorial of this procedure is shown in Fig. 3-42.

For 400W/500W Series equipped aircraft, with the GPSS mode engaged, the autopilot is capable of executing this entire approach sequence if it is programmed into the Navigation Receiver. Once on the FRONT INBOUND LOC course (subsequent to position 4 in Fig. 3-42) and with the Navigation Receiver set to VLOC, engage the APR mode to complete the front course approach.



1. a. Select LOC frequency.
 - b. Set PFD CRS Pointer to FRONT INBOUND LOC course.
 - c. Press REV mode selector switch to engage APR mode.
 - d. Intercept and track FRONT OUTBOUND LOC course.
2. a. At the appropriate time, set PFD Hdg Bug to FRONT OUTBOUND PROCEDURE TURN heading.
 - b. Press HDG mode selector switch to engage heading mode.
3. a. Turn PFD Hdg Bug in two successive 90° increments, to establish aircraft on FRONT INBOUND PROCEDURE TURN heading.
4. a. Press NAV mode selector switch to engage approach mode.
 - b. Intercept and track FRONT INBOUND LOC course.
 - c. At middle marker, if missed approach is declared, disconnect autopilot.
 - d. Stabilize aircraft.
 - e. Set PFD Hdg Bug to missed approach heading.
 - f. Press HDG mode selector switch to engage heading mode.

Fig. 3-42. LOC Approach with Procedure Turn

3.3.6 VOR Approach with Procedure Turn

Select the VOR frequency on the Navigation Receiver. Set the PFD CRS Pointer to the FRONT INBOUND VOR course on the compass card. Press the REV mode selector switch to engage the REV mode. The REV annunciation will appear as shown in Fig. 3-43. The autopilot will intercept and track the FRONT OUTBOUND VOR course.



Fig. 3-43. AP Display, REV Mode Engaged, Track VOR Front Course Outbound

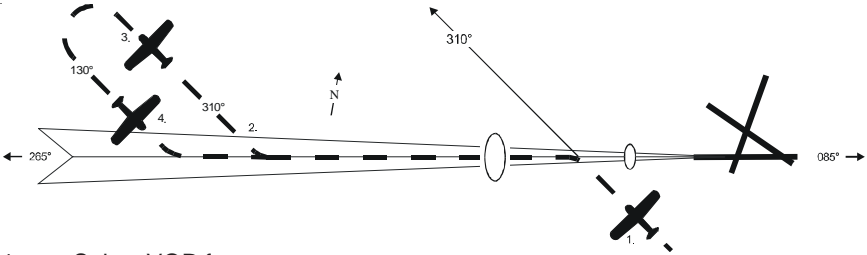
At the appropriate time, set the PFD Hdg Bug to the FRONT OUTBOUND PROCEDURE TURN heading. Press the HDG mode selector switch to engage the heading mode. Hold this heading until the point at which it is time to turn the aircraft again. At that point, turn the PFD Hdg Bug in two successive 90° increments, to establish the aircraft on the FRONT INBOUND PROCEDURE TURN heading. Press the APR mode selector switch to engage the APR mode. NAV and APR annunciations will appear as shown in Fig. 3-44. The autopilot will intercept and track the FRONT INBOUND VOR course.



Fig. 3-44. AP Display, APR Mode Engaged, Track VOR Front Course Inbound

A summary pictorial of this procedure is shown in Fig. 3-45.

For 400W/500W Series equipped aircraft, with the GPSS mode engaged, the autopilot is capable of executing this entire approach sequence if it is programmed into the Navigation Receiver. Once on the FRONT INBOUND VOR course (subsequent to position 4 in Fig. 3-45) and with the Navigation Receiver set to VLOC, engage the APR mode to complete the front course approach.



1. a. Select VOR frequency.
 - b. Set PFD CRS Pointer to FRONT INBOUND VOR course.
 - c. Press REV mode selector switch to engage REV mode.
 - d. Intercept and track FRONT OUTBOUND VOR course.
2. a. At the appropriate time, set PFD Hdg Bug to FRONT OUTBOUND PROCEDURE TURN heading.
 - b. Press HDG mode selector switch to engage heading mode.
3. a. Turn PFD Hdg Bug in two successive 90° increments, to establish aircraft on FRONT INBOUND PROCEDURE TURN heading.
4. a. Press APR mode selector switch to engage APR mode.
 - b. Intercept and track FRONT INBOUND VOR course.
 - c. At middle marker, if missed approach is declared, disconnect autopilot.
 - d. Stabilize aircraft.
 - e. Set PFD Hdg Bug to missed approach heading.
 - f. Press HDG mode selector switch to engage heading mode.

Fig. 3-45. VOR Approach with Procedure Turn

3.3.7 GPSS Approach (Lateral Guidance Only)

Press the NAV mode selector switch twice to engage the GPSS mode (reference section 3.1.3). The autopilot will laterally steer the aircraft along a predefined approach, which has been programmed into the Navigation Receiver. To control the assigned altitudes and rates of descent, use the Altitude Pre-Select Function (reference section 3.1.6). For 400/500 Series equipped aircraft, to make any procedure turns, engage the heading mode and use the PFD Hdg Bug (reference section 3.1.1). Upon completion, re-engage the GPSS mode.

3.4 Flight Director (FD) Operation

The 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), superimposed upon a pitch ladder, comprise the FD. The FD operates in the AP mode or the FD mode. Although the ARS is always yellow, the color of the Steering Command Bars is different for each mode of operation.

3.4.1 AP Mode

Press the Remote AP ON Switch, and engage a roll and pitch AP mode. In this case, the Steering Command Bars are magenta. The autopilot steers 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 the roll and pitch commands. A typical view of the PFD while in AP mode is shown in Fig. 3-46.



Fig. 3-46. PFD Display, HDG and ALT HOLD AP Modes Engaged

3.4.2 FD Mode

Press the Remote AP OFF / FD ON Switch, and engage a roll and pitch mode to enable the FD mode. In this case, the Steering Command Bars are green. 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 PFD in FD only mode is shown in Fig. 3-47.



Fig. 3-47. PFD Display, FD Only Mode Engaged

3.5 WAAS Procedures

3.5.1 GPS Approach (With Vertical Guidance)

For 400W/500W Series equipped aircraft, when conducting a WAAS approach, if the GPSS mode remains engaged, then the autopilot will execute the entire lateral procedure automatically (i.e., intercept and track front outbound course, complete procedure turn, intercept and track front inbound course).

For 400W/500W Series equipped aircraft, the autopilot will follow the vertical commands sent from the PFD. The vertical approaches the autopilot will follow include:

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

Note:

LPV approaches require the appropriate approved equipment.

In order to intercept and fly the GPS generated glidepath, the autopilot must be in APR mode once the final approach course has been intercepted. The approach should be flown like a straight-in ILS (reference 3.2.1).

Caution:

The autopilot will not automatically level off at DH or MDA. The pilot must maintain awareness of altitude, and disconnect the autopilot at DH or MDA for either a landing or go-around.

3.5.2 Missed Approach

During a missed approach, once the aircraft is established in a climb, engaging the GPSS mode will cause the aircraft to follow the missed approach procedure if it is programmed into the Navigation Receiver.

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

3.6 Autopilot Disconnect

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

1. Press Remote AP DISC / TRIM INTR Switch.
2. Pull AP Circuit Breaker.
3. Stall Warning is activated.

SECTION 4 OPERATING PARAMETERS

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4.1 Roll Axis Limits

Turn Rate

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

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

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

110% Standard Rate Turn (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

±0.6 g disregarding 1 g due to gravity

Vertical Speed

1600 FPM Climbing or Descending

Modes

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

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SECTION 5 GLOSSARY

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Term	Meaning
A/C	Aircraft
AHRS	Attitude and Heading Reference System
ALT	Altitude
AP	Autopilot
APR	Approach
ARS	Aircraft Reference Symbol
ASI	Airspeed Indication
CDI	Course Deviation Indication
CW	Clockwise
CCW	Counter-Clockwise
CRS	Course
DH	Decision Height
DISC	Disconnect
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FD	Flight Director
FPM	Feet-per-Minute
FT	Feet
GDI	Glideslope Deviation Indication
GPS	Global Positioning System
GPSS	Global Positioning System Steering
GS	Glideslope
HDG	Heading
hPa	Hecto Pascal
HSI	Horizontal Situation Indicator
IFR	Instrument Flight Rules
ILS	Instrument Landing System
inHg	Inches of Mercury
INTR	Interrupt
KTS	Knots
LNAV	Lateral Navigation
LNAV+V	Lateral Navigation with Advisory Vertical Guidance
LOC	Localizer
LPV	Localizer Performance with Vertical Guidance
MAP	Missed Approach Point
mbar	Millibars
MDA	Minimum Descent Altitude
NAV	Navigation
PFD	Primary Flight Display
PN	Part Number
POH	Pilot's Operating Handbook
RCVR	Receiver
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
VSI	Vertical Speed Indication
WAAS	Wide Area Augmentation System

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