GENESYS AEROSYSTEMS
a Moog Company

S-TEC 2500R, S-TEC 4000R, or S-TEC 5000R Autopilot with Genesys Aerosystems EFIS

Pilot Operating Guide and Reference

S-TEC 2500R/S-TEC 4000R/S-TEC 5000R
Digital Flight Control System Autopilot

Integrated with Genesys Aerosystems EFIS
with software 9.0A or higher

Doc No 87307

This pilot guide must be carried in the aircraft and 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 aircraft specific information, such as unique ground tests, limitations, and emergency procedures.

For service or repairs, contact an authorized Genesys Aerosystems dealer. For product support, contact Genesys Aerosystems.

One S-TEC Way, Municipal Airport, Mineral Wells TX 76067
Phone: (800) 872-7832
www.genesys-aerosystems.com

Revision Record

Retain this record in front of manual.		
Revision Number	**Revision Date**	**Notes/Pages changed, added, or deleted by current revision**
1st Ed	Jun 2020	
2nd Ed	Aug 2022	

Table of Contents

Section 1 Overview

Section 2 Pre-Flight Procedures

Section 3 Normal In-Flight Procedures

Section 4 Emergencies

Section 5 Glossary

List of Figures and Tables

Section 1 Overview

1.1. DOCUMENT ORGANIZATION

Section 1 Overview

Section 2 Pre-Flight Procedures

Section 3 Normal In-Flight Procedures

Section 4 Emergencies

Section 5 Glossary

1.2. PURPOSE

This pilot operating guide provides pre-flight and in-flight operating procedures for the S-TEC 2500R, S-TEC 4000R, or S-TEC 5000R autopilot (AP) when integrated with the Genesys Aerosystems Electronic Flight Information System (EFIS) with software releases 9.0A or higher.

NOTE:

The autopilot assists pilots 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 in conditions requiring Instrument Flight Rules (IFR).

1.3. GENERAL CONTROL DESCRIPTION

The autopilot is a two- or three-axis attitude-based system, which controls the pitch, roll, and yaw (if applicable) axes through modes of operation, which are annunciated on the EFIS integrated display unit (IDU). Some aircraft configurations do not have a yaw damper (YD) installed. In these cases, the YD button is blank and references in this manual to yaw are not applicable.

When in control of the roll axis, the autopilot senses roll attitude, roll rate, heading error, and course error inputs from the air data, attitude, and heading reference system (ADAHRS), and course deviation input from the selected navigation receiver.

When in control of the pitch axis, the autopilot senses pitch attitude, pitch rate, pressure altitude, indicated airspeed (IAS), vertical speed

(VS), and vertical acceleration inputs from the ADAHRS. The autopilot tracks glide slope (GS) deviation input from the selected GS receiver and vertical deviation from the Flight Management System (FMS) to follow a VNAV profile.

When in control of the yaw axis, the autopilot senses a yaw rate and acceleration input from the ADAHRS.

These sensed data provide feedback to the autopilot, which controls the aircraft through the use of servos coupled to the control systems. The roll servo is coupled to the ailerons; the pitch servo is coupled to the elevator; and the yaw servo is coupled to the rudder.

The autopilot senses an out of trim condition about the axis whenever a sensor in the servo is activated. In response to this, the autopilot drives the trim servo (coupled to trim actuators) in the proper direction until the aircraft is in trim.

The autopilot also includes an altitude preselect function, if applicable.

1.4. PRINCIPAL MODES OF OPERATION

Autopilot Mode (AP): Engages autopilot servos.

Flight Director Mode (FD): Drives steering command bars.

Pitch Hold Mode (PITCH): Holds pitch attitude.

Roll Hold Mode (ROLL): Holds roll attitude.

Yaw Damper Mode (YD): Dampens excessive adverse yaw and coordinates turns (if installed).

Heading Mode (HDG): Turns onto a selected heading and holds it.

Navigation Mode (NAV): Intercepts and tracks a LOC front course, VOR or laterally steers along a flight plan and/or approach defined by GPS.

Approach Mode (APR): Intercepts and tracks a LOC front course, back course, or VOR with increased sensitivity.

Glide Slope Mode (GS): Intercepts and tracks glide slope.

Back Course Mode (BC): Intercepts and tracks a LOC back course inbound or track a LOC front course outbound.

Level Mode (LVL): Returns aircraft to wings level flight and a configured pitch angle for the aircraft (see AFMS) for pitch angle value.

Indicated Airspeed Mode (IAS): Holds indicated airspeed.

Vertical Speed Mode (VS): Holds vertical speed.

Altitude Hold Mode (ALT): Holds altitude.

VNAV Mode (VNV): Flies an FMS VNAV climb or descent profile and GPS approach vertical guidance.

Control Wheel Steering Mode (CWS): Used to temporarily disengage servos and manually maneuver the aircraft or hold a new ROLL attitude, PITCH attitude, IAS, VS, or altitude.

Takeoff-Go-Around Mode (G/A): Disengages AP mode and/or engages FD mode in a wings level and pitch up attitude specific to the aircraft type (see AFMS) until another mode is selected.

Half Bank Mode (HB): Reduces commands in HDG and GPS/FMS steering by half.

Automatic Trim Mode: Automatically trims.

1.5. SYSTEM DESCRIPTION

1.5.1. System Architecture

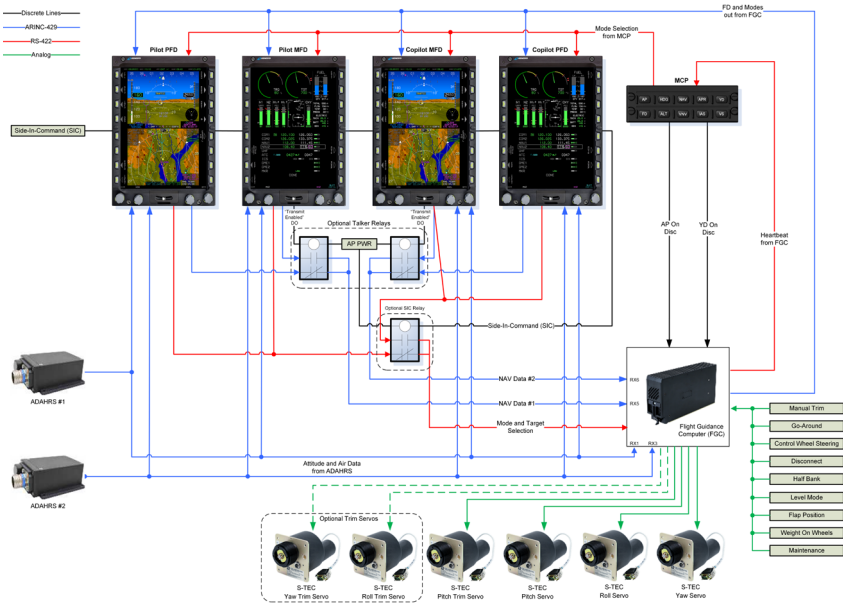


Figure 1-1: System Block Diagram

1.5.2. Flight Guidance Computer (FGC)

The FGC is the main processing unit for the autopilot system. It controls all of the input/output processing, control law calculation, and drives up to six servos (pitch, roll, and optional yaw and trim for each axis). The FGC requires navigational and target data to provide the correct servo drive signals. Mode selection may be controlled through the Mode Control Panel (MCP).

Figure 1-2: FGC

1.5.3. Air Data Attitude Heading Reference System (ADAHRS)

The ADAHRS is a device that incorporates an Air Data Computer (ADC) and an Attitude Heading Reference System (AHRS) within a single enclosure. It provides airspeed, altitude, attitude, and heading along with rate and acceleration calculations. The ADAHRS houses 2 separate sensor boards, one for AHRS and one for ADC. The ADAHRS system also uses a Magnetic Sensing Unit (MSU) and an Outside Air Temperature (OAT) probe.

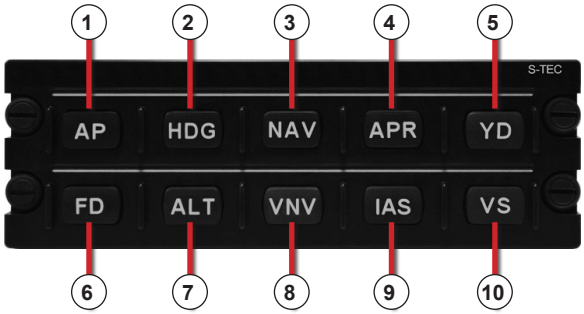
Figure 1-3: ADAHRS

1.5.4. Servo Assemblies

The autopilot servos are used to move the aircraft control cables. They are driven by the FGC using pulse width modulated (PWM) signals. The pulse width modulation allows the FGC greater control over the speed of servo during fluctuations in aircraft voltage.

Figure 1-4: Servo Assemblies

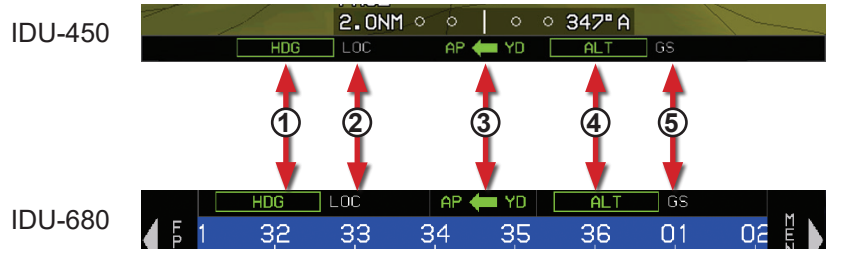
1.5.5. Mode Control Panel (MCP)



1) Autopilot Mode (AP) button
2) Heading Mode (HDG) button
3) Navigation Mode (NAV) button
4) Approach Mode (APR) button
5) Yaw Damper Mode (YD) button (if YD is installed, otherwise blank)
6) Flight Director Mode (FD) button
7) Altitude Hold Mode (ALT) button
8) Vertical Navigation Mode (VNV) button
9) Indicated Airspeed Mode (IAS) button
10) Vertical Speed Mode (VS) button

Figure 1-5: MCP

1.5.6. EFIS Autopilot Annunciations



1) Active Lateral Mode
2) Armed Lateral Mode
3) CWS/AP/FD/YD and Side-in-Command (SIC) status
4) Active Vertical Mode
5) Armed Vertical Mode

Figure 1-6: Primary Flight Display (PFD) Mode Annunciation

Table 1-1: Lateral Engaged Mode Annunciations

Mode	Description
~~XXXX~~	Failure to initialize
INIT	Lateral mode initializing
MAINT	Lateral mode maintenance required
	Lateral mode AP Ready (blank display)
APR:BC NAV:BC	Approach or navigation mode/back course tracking sub-mode
NAV:FMS	Approach or navigation mode/FMS sub-mode
APR:LOC NAV:LOC	Approach or navigation mode/localizer sub-mode
APR:VOR NAV:VOR	Approach or navigation mode/VOR sub-mode
HDG	Heading mode
ROLL	Roll hold mode
G/A	Go-Around mode

Table 1-2: Lateral Armed Mode Annunciations	
Mode	**Description**
	None
APR:BC NAV:BC	Approach or navigation mode/back course tracking sub-mode armed
APR:LOC NAV:LOC	Approach or navigation mode/localizer sub-mode armed
APR:VOR NAV:VOR	Approach or navigation mode/VOR sub-mode armed

Table 1-3: Vertical Engaged Mode Annunciations	
Mode	**Description**
	Failure to initialize
INIT	Vertical mode initializing
MAINT	Vertical mode maintenance required
	Vertical mode AP Ready (blank display)
ALT	Altitude hold mode
IAS	Indicated airspeed mode
VS	Vertical speed mode
GS	Glide slope mode
PITCH	Pitch mode
G/A	Go-Around mode
VNV:HOLD	Vertical navigation mode/VNAV altitude hold sub-mode
VNV:IAS	Vertical navigation mode/indicated airspeed sub-mode
VNV:PATH	Vertical navigation mode/vertical path sub-mode
VNV:VS	Vertical navigation mode/vertical speed sub-mode

Table 1-4: Vertical Armed Mode Annunciations	
Mode	**Description**
	None
ALT	Altitude hold mode armed
GS	Glide slope mode armed
VNV:HOLD	Vertical navigation mode/VNAV target hold mode armed
VNV:IAS	Vertical navigation mode/indicated airspeed sub-mode armed
VNV:PATH	Vertical navigation mode/vertical path sub-mode armed
VNV:VS	Vertical navigation mode/vertical speed sub-mode

Section 2 Pre-Flight Procedures

NOTE:

Aircraft specific pre-flight checks are detailed in the AFMS and should be carried out before every flight. Any failures or unexpected behavior must be rectified before flight. Before flight, verify the AP and YD modes are disengaged and that all trim systems are set for takeoff.

Full system voltage (at least 22 volts) is required for this test, either by running the aircraft engine or by using a suitable auxiliary power unit to power the aircraft systems. During initialization, the aircraft must not be moved.

1) Avionics, AP, and Trim master switches ON.

2) Autopilot initializing self-test.

After power has been applied to the system, the autopilot performs a power on self-test. **INIT** in the EFIS autopilot mode annunciation panel indicates the self-test is in progress.

Figure 2-1: Lateral Mode Initializing

Once the system has successfully passed the self-test, **INIT** extinguishes, leaving the autopilot mode annunciation panel blank. The system is ready to accept commands.

Figure 2-2: Lateral Mode Ready (Blank Display)

If the system fails initialization, it is indicated by a red **X** on both sides of the EFIS autopilot mode annunciation panel.

Figure 2-3: Failure Indication

3) 

Verify the Side-in-Command switch is pointing to desired side.

Figure 2-4: Side-in-Command

NOTE:

The following tests should be conducted with the aircraft controls held neutral to prevent the weight of the control surfaces from making a constant command for pitch trim while the ground test is being performed. As the tests are conducted, allow the autopilot to move the aircraft controls while supporting it in the pitch axis.

4) Press AP.
   - **AP** and **YD** (if installed) are annunciated on the EFIS and servos engage.
   - **ROLL** and **PITCH** are annunciated; FD command bars appear on the EFIS.
5) Autopilot override test.
   - With AP mode engaged, grasp the aircraft controls, and slowly overpower the roll and pitch servos to ensure proper clutch action. Control movements should be smooth. If any unusual noise or feel occurs, inspect the servo installation, and repair as needed.
6) Center heading bug.
7) Press HDG.
   - **HDG** is annunciated on the EFIS.
8) Move heading bug left and right.
   - Aircraft controls and FD command bars follow heading bug.
9) Press IAS.
   - **IAS** is annunciated on the EFIS.
   - Selected IAS indicates lowest speed allowed (as configured) is displayed on EFIS.
   - Aircraft controls drive forward.
10) Press VS.
   - **VS** is annunciated on the EFIS.

– Increase selected VS on EFIS until **500** is displayed. FD command bars move up, and pitch control moves slowly aft.

– Decrease selected VS on EFIS until **-500** is displayed. FD command bars move down, and pitch control moves slowly forward.

11) Press ALT.

– **ALT** is displayed on EFIS.

– Slowly pull aft on pitch control. Auto-trim runs nose down after 3 seconds.

– Slowly push forward on pitch control. Auto-trim runs nose up after 3 seconds.

12) Press and hold CWS button.

– **CWS** is annunciated on the EFIS.

– All servos disengage and controls are free.

– Release CWS button. Servos re-engage.

13) Press AP DISC TRIM/INTR button (on aircraft control).

– All servos disengage; controls are free.

14) Press Go-Around (G/A) button.

– **FD** is annunciated on the EFIS. **G/A** annunciates as the active lateral and vertical modes. The steering command bars move to wings level and a pitch up attitude specific to the aircraft type (see AFMS).

– All servos disengage; controls are free.

15) Manual electric trim test.

a) Verify trim master switch on.

– Move each segment of the manual electric trim switch forward and aft without the other (one side at a time); trim does not run.

– Move both segments forward. Trim runs nose down.

– Move both segments aft. Trim runs nose up.

b) Run manual electric trim switch nose up or down.

- Press and hold AP DISC TRIM/INTR button while running manual trim; trim motion stops.
- Release AP DISC TRIM/INTR button while attempting to run manual trim; trim motion resumes.
- Set trim for takeoff.

16) Verify autopilot mode.

- Verify the autopilot is in AP READY or FD only mode (PITCH and ROLL or G/A mode, as desired) prior to takeoff.

CAUTION:

Do not operate aircraft until abnormal or unusual conditions are resolved.

NOTE:

Before flight, verify AP and YD modes are disengaged and that all trim systems are set for takeoff.

Section 3 Normal In-Flight Procedures

3.1. ENGAGING THE AUTOPILOT (AP)

During normal operation, with the autopilot in AP Ready state:

1) Pressing AP also engages FD mode and YD mode (if installed) simultaneously. The system engages in ROLL and PITCH modes. Roll and pitch attitudes are the attitudes present when the button was pressed, except when engaging AP from G/A mode (§ 3.10.2).

2) FD mode may be toggled ON/OFF independently by pressing FD.

3) YD mode may be toggled ON/OFF independently by pressing YD.

Engaged **CWS**, **AP**, **FD**, and **YD** modes are annunciated on the EFIS. Display of **CWS** takes precedence over **AP**. Display of **AP** takes precedence over **FD**. Active lateral and vertical modes are depicted in a green box when AP mode is engaged, or unboxed when FD mode is engaged with AP mode disengaged. Active lateral and vertical modes flash for 10 seconds at 1Hz when activated and are green. Armed lateral and vertical modes are white. In the event of a signal loss (VOR, LOC, BC, GS, or FMS), the associated mode annunciation flashes at 2Hz.

Figure 3-1: AP Annunciation

AP Mode ON/
FD Mode ON

- Pitch and Roll servos are engaged.
- Drives flight director bars.
- Envelope protection is active (§ 3.6.2).

Figure 3-2: FD Annunciation (AP Mode Off)

AP Mode OFF/
FD Mode ON

- Pitch and Roll servos are disengaged.
- Drives flight director bars.
- Envelope protection is passive (§ 3.6.1).

YD Mode ON

- Yaw servo is engaged.

3.2. DISCONNECTING THE AUTOPILOT

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

1) Press remote AP DISC TRIM/INTR button located on the yoke;
   - A brief press and release disconnects AP, leaving FD and YD engaged (as configured).
   - Hold AP DISC TRIM/INTR down for approximately 2 seconds to disengage AP, FD, YD and return to AP Ready.
2) Set AP master switch to OFF position;
3) Pull the AP circuit breaker;
4) Press AP when AP mode is engaged.

A voice alert and/or alert tone is sounded upon disconnect.

NOTE:

The autopilot also disconnects under the following circumstances:

1) When the manual electric trim switch is pressed.
2) When the autopilot detects a fault in the system or an attitude mis-compare.
3) When G/A button is pressed.

3.3. AUTOPILOT OPERATION (AP)

The autopilot interprets the steering commands calculated for the selected lateral and vertical modes and sends drive signals to the pitch, roll, and yaw servos. The servos control the connected aircraft flight surfaces to fly the flight profile. The flight director display provides a visual indication of how accurately the autopilot is tracking the lateral and vertical commands.

Active envelope protection (§ 3.6.2) is operating when AP mode is engaged.

3.4. FLIGHT DIRECTOR OPERATION (FD)

The flight director (FD) calculates the lateral and vertical movement required for the aircraft to follow the selected flight profile. The flight

profile is determined by the autopilot lateral and vertical modes selected, and data from the FMS.

When FD mode is engaged, steering command bars appear on the EFIS. Hand fly the aircraft with steering command bars and activate lateral and vertical modes as desired. Press AP to engage AP mode at any time.

Passive envelope protection (§ 3.6.1) is operating when the autopilot is in FD Only mode (AP Mode OFF/FD Mode ON). To disengage FD mode press FD or press AP DISC/TRIM INTR button for approximately 2 seconds.

NOTE:

When using FD mode on take-off, the autopilot should be in ROLL and PITCH modes or Take-Off-Go-Around (G/A) mode.

NOTE:

If the pilot does not track the steering cues when operating in FD Only mode, the steering command bars continue to increase the lateral and vertical commands to intercept the calculated flight profile.

It is recommended to sync up the aircraft attitude with the steering command bars or select a new mode before engaging AP mode to avoid aggressive banks or pitch changes.

3.5. YAW DAMPER OPERATION (YD)

NOTE:

Not applicable to aircraft without optional yaw damper installed.

Press YD to engage YD mode. **YD** appears on the EFIS. Press YD again to disengage YD. YD normally engages with AP mode but may be engaged or disengaged at any time, independent of AP mode. Therefore, it is essential YD mode is always disengaged prior to takeoff and landing. It may be necessary to manually adjust rudder trim in response to changes in phase of flight or aircraft configuration. When

disengaging YD mode in flight maintain pressure on rudder controls and make trim adjustments as required.

Use the YD in flight as follows:

1) Trim aircraft for phase of flight (climb, cruise, etc.) with rudder trim.

2) Press YD to engage YD.

3) To disengage YD for landing press YD or AP DISC TRIM/INTR button.

CAUTION:

AP and YD modes must always be disengaged prior to takeoff and landing.

3.6. ENVELOPE PROTECTION

The autopilot protects against underspeed, overspeed, and excessive bank conditions using the envelope protection feature. The envelope speed limits vary between airframes, depending on stall speeds, V_{NE}, V_{MO}, M_{MO}, and whether the aircraft is approved for flight-into-known-icing (FIKI). Specific limits are stated within the relevant AFMS. Envelope protection is in Active mode when AP mode is engaged, Passive mode when FD Only mode is engaged, or off when in AP Ready, or powered off.

3.6.1. Passive Envelope Protection

Passive envelope protection is operating when FD mode is engaged. Passive envelope protection provides audible alarms and voice alerts when limitations are reached.

1) **Underspeed** alert activates if the aircraft speed reaches the low-speed limit, which triggers an audible alarm followed by an “Airspeed, Airspeed” voice alert. Alerts continue until the aircraft speed is increased beyond the underspeed recovery limit, as stated in the AFMS.

2) **Overspeed** alert activates if the aircraft speed reaches the high-speed limit, which triggers an audible alarm followed by an “Overspeed, Overspeed” voice alert. Alerts continue until the aircraft speed is reduced below the overspeed recovery limit, as stated in the AFMS.

3) **Excessive Bank** alert activates if the aircraft's roll attitude exceeds 60 degrees, which triggers an audible alarm followed by an "Attitude, Attitude" voice alert. Alerts continue until the aircraft roll attitude is reduced below 60 degrees.

3.6.1.1. Passive Envelope Protection on Approach

When in FD Only mode (AP not engaged) the overspeed and underspeed audible alarms and voice alerts are disabled when in any of the approach modes (APR:BC, APR:LOC, APR:VOR, or NAV:FMS with VNV:PATH). This allows pilots to hand fly slower approaches, but retain flight director command bar guidance, and avoid nuisance speed callouts if AP mode is disengaged at minimums but the FD remains engaged.

3.6.2. Active Envelope Protection

Active envelope protection is operating anytime AP mode is engaged. Active envelope protection provides audible alarms, voice alerts, and servo control input when limitations are reached. Although excessive bank is still active, it is not relevant while AP mode is engaged as the autopilot is already under control of bank commands. During active envelope protection roll commands are reduced by half.

The **underspeed** alert activates if the aircraft speed reaches the low-speed limit, which triggers an audible alarm followed by an "Airspeed, Airspeed" voice alert. AP mode automatically commands the aircraft to pitch down in order to increase airspeed to the underspeed recovery limit.

To recover the aircraft from an underspeed alert:

1) Hold down the CWS button (§ 3.10.1) and increase aircraft speed beyond the underspeed recovery limit as stated in the AFMS, manage power, pitch, and roll as necessary for safe operation.

2) If required, manually fly back onto the desired course, then release CWS to let the autopilot resume the previous active lateral and vertical modes. Adjust power, selected lateral, and vertical mode targets as necessary for safe operation.

The **overspeed** alert activates if the aircraft speed reaches the high-speed limit, which triggers an audible alarm followed by an "Overspeed, Overspeed" voice alert. AP mode automatically commands the aircraft to pitch up in order to decrease airspeed to the overspeed recovery limit.

To recover the aircraft from an overspeed alert:

1) Hold down the CWS button and reduce aircraft speed below the overspeed recovery limit as stated in the AFMS, manage power, pitch, and roll as necessary for safe operation.

2) If required, manually fly back onto the desired course, and then release CWS to let the autopilot resume the previously active lateral and vertical modes. Adjust power, selected lateral, and vertical mode targets as necessary for safe operation.

3.6.2.1. Approach Envelope Transition

When interfaced with a RAD ALT envelope protection is inhibited below 500' AGL. Without an interfaced RAD ALT, once the autopilot captures a glide slope, indicated by **GS** displayed in the active vertical mode section of the EFIS, the autopilot enters approach envelope transition (AET). A transition point is calculated as 1000' below the glide slope capture point and automatically switches to passive envelope protection once the transition point is reached.

It is recommended to capture the glide slope at 1500' AGL so envelope protection switches to passive mode at 500' AGL. This eliminates active envelope protection pitch commands when reducing airspeed in preparation landing. AP and YD modes must be disengaged prior to landing.

For temporary deviations or recovery from speed protection, it is best practice to use CWS to avoid cancelling the current approach mode and AET calculations.

NOTE:

Changing active modes or disconnecting the autopilot cancels AET and resets the transition point. If AP and approach mode are re-engaged and the glide slope re-captured, AET becomes active and a new transition point is calculated.

CAUTION:

The autopilot deviates when tracking a glide slope in order to protect airspeed and prevent a potential stall. The pilot is responsible for maintaining the aircraft speed within the envelope limits stated in the applicable AFMS while in AP mode.

3.6.3. "AP ICE SPEED" (FIKI Aircraft Only)

Aircraft approved for Flight Into Known Icing (FIKI) may have different underspeed limits for when the aircraft icing system is operating or not. Aircraft with this optional input have an LED on the panel labeled "AP ICE SPEED." All underspeed and overspeed limits are stated within the AFMS.

NOTE:

FIKI approved aircraft without the "AP ICE SPEED" option default to the higher underspeed protection limit as stated in the AFMS.

The "AP ICE SPEED" LED illuminates when the aircraft de-icing system switch is ON and indicates the underspeed protection limit has changed to accommodate the increase in aircraft stall speed when flying into icing conditions.

With the "AP ICE SPEED" LED extinguished, the underspeed limit is lower and based upon the aircraft stall speed in a normal configuration.

3.7. AP LATERAL MODES

All modes may be selected by pressing the appropriate button on the autopilot. A second press of the active mode button deselects the mode, and the autopilot reverts to the armed lateral mode, or ROLL if there is no armed lateral mode. For example, if the active mode is heading (HDG) mode press HDG to deselect HDG and activate ROLL.

3.7.1. Roll Hold Mode (ROLL)

ROLL mode is the default lateral mode for the initial press of AP or FD from an AP Ready state. ROLL can also be activated by deselecting the current active mode. In ROLL, the autopilot holds the current roll attitude. Control wheel steering (CWS) (§ 3.10.1) may be used to establish the aircraft on a new roll attitude. Losing a valid signal, changing NAV sources, or changing SIC while in NAV or APR results in reversion to this mode.

Figure 3-3: ROLL Mode

3.7.2. Heading Mode (HDG)

Set the heading bug to desired heading on the EFIS. Press HDG to activate heading mode and track the heading bug. With any heading bug change, the aircraft turns, intercepts, and tracks the new heading. Heading bug symbol characteristics depend on if heading mode is active or not.

Figure 3-4: Heading Mode

Table 3-1: Characteristics of Heading Bug Symbol

Condition	Appearance
HDG Mode Active (Heading Bug)	
HDG Mode NOT Active (HDG Preselect Bug)	

If installed, half bank (§ 3.10.5) may be used in conjunction with heading mode or GPS/FMS for improved passenger comfort.

3.7.3. Navigation Mode and Sub-Modes (NAV)

Use NAV to enter multiple NAV modes (NAV:VOR, NAV:LOC, NAV:BC, and NAV:FMS) depending on selected navigation source. Starting from ROLL, NAV mode activates immediately, and the aircraft turns to a 45° intercept angle.

If installed, half bank (§ 3.10.5) may be used in conjunction with heading mode or GPS/FMS for improved passenger comfort.

NOTE:

In all cases, the NAV button press is ignored when attempting to activate NAV without a valid signal, and the autopilot commands wings level flight.

3.7.3.1. HDG Mode Active with NAV Mode Armed

When a pilot selectable intercept angle is desired, such as being vectored by ATC, an intercept angle other than 45° may be selected. Starting from HDG, NAV mode arms, and the aircraft continues to track the selected heading until intercept.

Figure 3-5: NAV Mode Armed

1) Select navigation radio frequency, set OBS source to VLOC and set the course pointer to the desired course.
2) Press HDG to activate heading mode and set the heading bug to desired intercept angle.
3) Press NAV to arm NAV mode (NAV:VOR, NAV:LOC, NAV:BC).
4) NAV mode automatically activates upon course capture.

If desired, when NAV is the armed mode, press HDG to deselect HDG. NAV becomes the active mode, and a default intercept angle is calculated.

NOTE:

The point an armed mode becomes active varies from 7% to 85% CDI deflection depending on intercept angle, aircraft position, and rate of closure to the course.

3.7.3.2. NAV:FMS Current Track Intercepts

When intercepting a FMS flight plan press NAV. NAV:FMS mode activates immediately. If the current aircraft track is within 135° of course, it is maintained until intercept. If beyond 135°, aircraft turns to a 45° intercept angle.

Figure 3-6: NAV Mode

3.7.3.3. Tracking a VOR (NAV:VOR)

1) Select VOR frequency, set OBS source to VLOC and set the course pointer to the desired course.

2) Select course intercept method:

a) **Heading Bug (Vectors)**: Set heading bug to desired intercept heading. Press HDG, to activate HDG. Press NAV to arm NAV; OR

b) **Straight-In**: If not in HDG mode, press NAV. **NAV:VOR** flashes for 10 seconds. Aircraft intercepts the selected radial at a 45° angle.

3) 

If armed, NAV:VOR automatically activates at the course capture point.

Figure 3-7: NAV:VOR

Once captured, the autopilot establishes the crosswind correction and tracks the course.

NOTE:

At point of station passage, the autopilot recognizes the condition and holds the last known course. Either allow the aircraft to pass over the station and pick it up again on the other side or select another VOR to track.

3.7.3.4. Tracking a Localizer (NAV:LOC)

Behavior is identical to NAV:VOR (§ 3.7.3.3). Tune the intended ILS frequency, set OBS source to VLOC on the EFIS, and set course pointer to the desired course. Press NAV to arm or activate NAV:LOC.

Figure 3-8: NAV:LOC

3.7.3.5. Tracking a Back Course (NAV:BC)

Behavior is identical to NAV:VOR (§ 3.7.3.3), except the CDI reads, and the autopilot tracks, with reverse sensing. Tune intended ILS frequency, set OBS source to VLOC on the EFIS, and set course pointer 180° from the desired course. Press NAV to arm or activate NAV:BC.

Figure 3-9: NAV:BC

3.7.3.6. Tracking a GPS/FMS Flight Plan (NAV:FMS)

NAV:FMS

Used to track the GPS signal via roll steering to a waypoint. To track a GPS signal in NAV mode, program a valid waypoint or flight plan into the FMS. Set OBS source to NAV:FMS on the EFIS and press NAV to activate NAV:FMS.

Figure 3-10: NAV:FMS

NAV mode activates immediately, **NAV:FMS** flashes for 10 seconds. If the current aircraft track is within 135° of course, track is maintained until intercept. If beyond 135°, aircraft turns to a 45° intercept angle. Behavior when starting from ROLL or HDG is identical.

3.8. VERTICAL MODES

All vertical modes may be selected by pressing the appropriate button on the autopilot. A second press of the active mode button deselects the mode, and the autopilot reverts to the armed vertical mode, or PITCH if there is no armed vertical mode. For example, if the active mode is VS, press VS to deselect VS and activate PITCH.

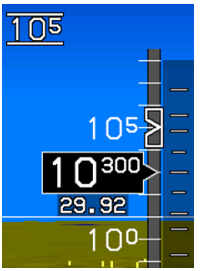
3.8.1. Altitude Preselect

ALT

The altitude preselect function allows for preselection of a target altitude and the speed (if within the aircraft's capabilities) or pitch angle at which the aircraft climbs or descends until the altitude is automatically captured.

Figure 3-11: ALT Mode Armed

1) Set the desired altitude target using the ALT bug on the EFIS.
2) Climb or descend by activating VS, IAS, or PITCH mode:
   a) PITCH mode – Use CWS to establish desired climb or descent angle; OR
   b) IAS or VS mode – Set and adjust the IAS or VS bug on the EFIS.



When a preselected altitude exists, a hollow preselected altitude bug appears on the altitude scale. The bug changes to filled-white during altitude capture.

In addition, the preselected altitude bug value is annunciated in white at the top of the altitude scale.

Figure 3-12: Preselected Altitude Bug

Audible alerts and voice alerts sound at 1000 ft. and 200 ft. from the target altitude, “One Thousand to Go” and “Two Hundred to Go,” respectively. At the capture point, the autopilot begins a scheduled reduction in vertical rate and enters a capture mode to transition smoothly to ALT hold mode.

When the aircraft reaches the target altitude, the voice alert, “Altitude,” sounds, and ALT hold mode activates.

3.8.2. Pitch Hold Mode (PITCH)

Pitch hold mode is the default vertical mode for the initial press of AP or FD from an AP Ready state. PITCH can also be activated by deselecting the current active vertical mode. In PITCH, the autopilot holds the current pitch attitude. Control wheel steering (CWS) (§ 3.10.1) may be used to establish the aircraft on a new pitch attitude.

Figure 3-13: PITCH Mode

If a valid altitude target bug is selected, the aircraft automatically levels off at the selected altitude target (§ 3.8.1) and ALT hold becomes the active vertical mode.

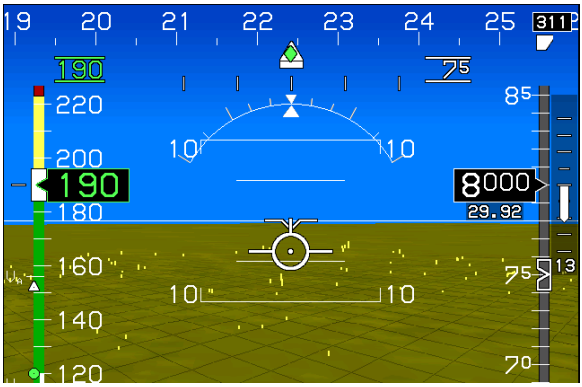
NOTE:

If PITCH mode was activated by pressing the remote level mode button or Take-Off-Go-Around (G/A) button, the altitude target is not captured until a new vertical mode (IAS or VS) or a new pitch attitude is selected with CWS.

3.8.3. Indicated Air Speed Mode (IAS)

Set an IAS bug on the EFIS and press IAS to activate IAS mode. In this mode, the FGC tracks the EFIS airspeed bug. If an altitude preselect target is active, the aircraft automatically levels off and captures the altitude target (§ 3.8.1).

Figure 3-14: IAS Mode

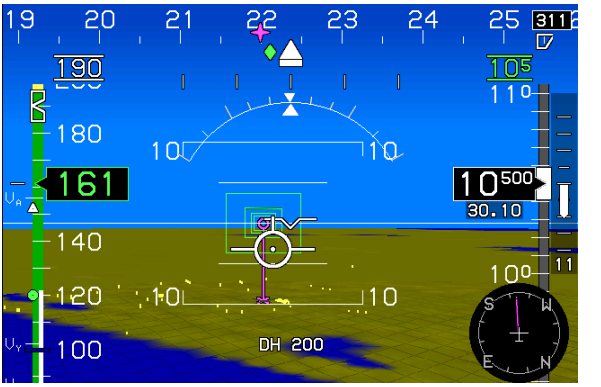


Airspeed captured at 190 KIAS with 7,500' preselected descent altitude.

Selected airspeed is active (filled-white IAS bug and green bug value at the top of the airspeed scale).

Altitude is preselected (hollow-white altitude bug and white bug value at the top of the altitude scale).

Figure 3-15: Airspeed Descent



Altitude captured at 10,500' with 190 KIAS preselected descent speed.

Selected altitude is active (filled-white altitude bug and green bug value at the top of the altitude scale).

Speed is preselected (hollow-white IAS bug and white bug value at the top of the airspeed scale).

Figure 3-16: Preselected Descent Speed

CAUTION:

Engine power and airspeed must be monitored when IAS mode is active since insufficient power at low airspeeds may cause the aircraft to stall and the autopilot to disconnect. Although the autopilot should limit the airspeed to 3-5 kts below the aircraft's maximum operating airspeed (V_{MO}), large power changes at higher airspeeds may cause the aircraft to momentarily exceed V_{MO}.

3.8.4. Vertical Speed (VS) Mode

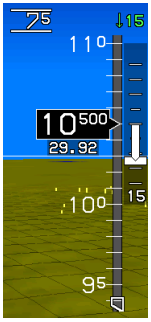
Press VS to activate VS mode to synchronize the VS to the existing aircraft vertical speed. If desired, press VS again to deselect VS mode activate PITCH. The commanded VS and direction are displayed on the EFIS. Select a new VS using the EFIS VS bug. The maximum VS limits vary from 3000 to 5000 fpm depending on aircraft type.

Figure 3-17: VS Mode

If an altitude target is active, the aircraft automatically levels off and transitions to ALT hold at the selected altitude target (§ 3.8.1).

NOTE:

During a climb, if the commanded VS exceeds the actual VS by 300 fpm for a period of 10 seconds, **VS** flashes 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 VS with the EFIS bug until **VS** stops flashing. CWS may be used to lower the aircraft nose and set a new VS target.

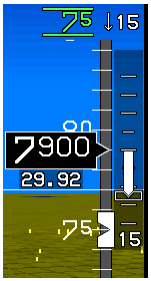


VS descent to 7,500'.

Selected VS is active (filled-white VS bug and green bug value at the top of the VS scale).

Altitude is preselected (hollow-white ALT bug and white bug value at the top of the altitude scale).

Figure 3-18: Vertical Speed Descent



Commencing altitude capture from VS descent to 7,500'.

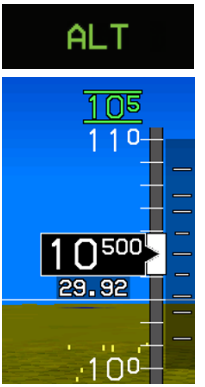
Selected VS is inactive (hollow-white VSI bug and white bug value).

Selected altitude is active (filled-white ALT bug and green bug value).

Selected altitude display flashes during capture.

Figure 3-19: Commencing Altitude Capture from Vertical Speed Descent

3.8.5. Altitude Hold Mode (ALT)



ALT hold mode is activated either by pressing ALT or automatically upon capturing an altitude bug from PITCH, IAS, VS, or VNAV modes. Modification of the altitude bug, after altitude capture, does not change ALT hold mode. The autopilot holds the aircraft at the captured altitude until a new vertical mode is selected (VS, IAS, VNAV, or PITCH). The altitude bug is filled-white when in ALT hold and the bug value is annunciated in green at the top of the altitude scale.

Figure 3-20: Altitude Hold

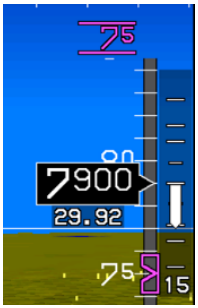
NOTE:

When the aircraft has entered ALT hold mode and then subsequently exceeds a distance of ±200 ft. from the captured altitude, the voice alert, “Check Altitude,” sounds.

3.8.6. VNAV Mode and Sub-Modes (VNV)

In VNAV mode, the EFIS issues commands to follow a VNAV profile to capture altitude constraints in a FMS flight plan. For VNAV to be available, a VNAV target altitude must be programmed in the FMS for an airport or waypoint, OBS source must be set to FMS, and the active lateral mode must be NAV. EFIS commands to the FGC to automatically handle the transitions.

VNAV AVAIL appears on the EFIS to indicate VNAV guidance is available but not currently in use by the autopilot. Press VNV to activate VNV. VNV can be deselected by activating another vertical mode (IAS, VS, ALT, LVL, GA), or capturing an intervening altitude target bug.



In VNAV mode, a VNAV bug appears, and the VNAV target altitude appears at the top of the altitude scale.

When climbing or descending to the VNAV altitude, a hollow-magenta VNAV bug appears on the altitude scale. The VNAV bug value is annunciated in magenta at the top of the altitude scale. Upon capturing the VNAV altitude the bug changes to filled-magenta and the bug value at the top of the altitude scale changes to green.

Figure 3-21: VNAV Bug and Annunciation

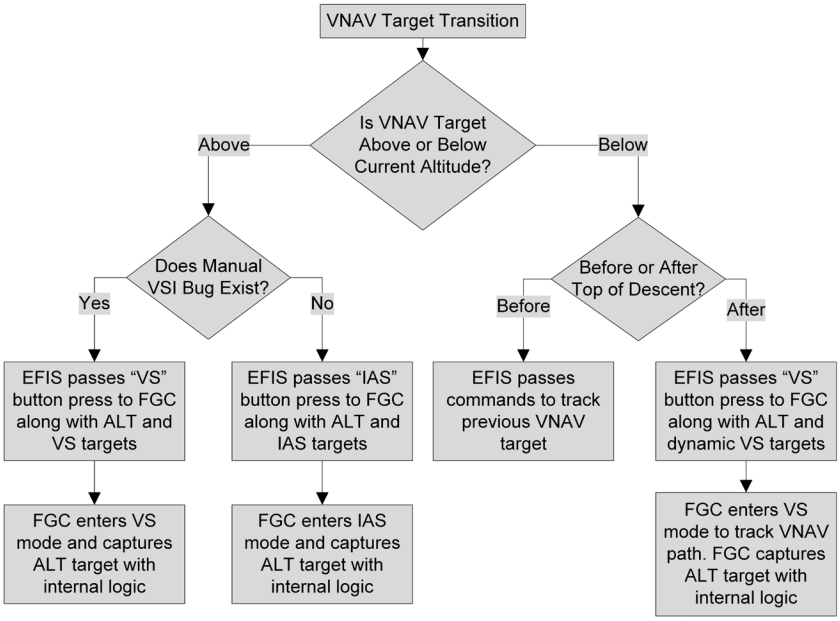


Figure 3-22: VNAV Target Transition

In addition, it is possible to set an intermediate altitude bug for a different preselected altitude between the aircraft altitude and the VNAV target altitude. This can be used when you have a VNAV waypoint programmed however ATC has not yet cleared you to the VNAV target altitude. This is referred to as an "intervening" altitude bug when VNAV system is commanding a:

1) Climb (VNV:IAS or VNV:VS), and preselected altitude is above aircraft altitude but below VNAV altitude target; OR

2) Descent (VNV:PATH), and preselected altitude is below aircraft altitude but above VNAV altitude target.

If an intervening preselected altitude exists, the EFIS levels off at that altitude. Otherwise, the EFIS levels off at the VNAV target altitude. The intent is for the FGC to automatically capture the appropriate intervening altitude or VNAV altitude. If an intervening altitude is captured, the EFIS acknowledges the FGC action by transitioning from VNAV mode to ALT mode.

The automatic sub-modes of VNAV are as follows.

3.8.6.1. VNV:PATH Descent

VNAV Path sub-mode activates when a VNAV descent path is captured. VNV:PATH becomes active and displays in the active vertical mode window, indicating the autopilot is tracking the path towards the next VNAV waypoint level off. In this mode, the EFIS dynamically calculates VS targets that result in tracking the profile descent. This mode is geographically based not performance based (angular decent).

Figure 3-23: VNAV Path

The autopilot automatically transitions to VNAV hold mode upon leveling off on each step down of the VNAV descent profile indicating the autopilot is following the programed VNAV descent profile.

3.8.6.2. VNV:HOLD

VNAV hold sub-mode activates upon leveling off and capturing a VNAV waypoint altitude target.

Figure 3-24: VNAV Hold

3.8.6.3. VNV:VS Climb

When in VNAV hold sub-mode, the EFIS arms VNAV VS sub-mode 30 seconds prior to reaching a VNAV climb segment if a VS target is set.

Figure 3-25: VNAV VS

VNAV VS sub-mode activates when a VNAV climb path is captured, and a VS target is set in the EFIS menu system. A manual IAS target and VS target are mutually exclusive.

3.8.6.4. VNV:IAS Climb

When in VNAV hold sub-mode, the EFIS arms VNAV IAS sub-mode 30 seconds prior to reaching a VNAV climb segment if a valid VS target bug is not set.

Figure 3-26: VNAV IAS

VNAV IAS sub-mode activates when a VNAV climb path is captured and an airspeed target exists. Airspeed targets exist under the following circumstances:

1) A manual IAS target is created on the EFIS; OR

2) If neither a manual IAS target nor VS target exists, an automatic IAS target is created based on climb airspeed in the aircraft limits.

3.9. APPROACH MODE AND SUB-MODES (APR)

Set OBS source to desired valid approach navigation source on the EFIS. Press APR to arm or activate APR mode. Starting from ROLL, APR mode activates immediately, and the aircraft turns to a default intercept angle, typically 45°.

When a pilot selectable intercept angle is desired, such as being vectored by ATC, an intercept other than 45° may be selected. Starting from HDG, APR mode arms, and the aircraft continues to track the selected heading until intercept. The heading bug should be set to an angle that intercepts the course or, if desired, press HDG to deselect HDG, activate APR, and use a default intercept angle.

The selected navigation source determines what the autopilot follows and is displayed on the EFIS (APR:VOR, APR:LOC, and APR:BC).

CAUTION:

AP and YD modes must always be disengaged prior to takeoff and landing.

NOTE:

In all cases, the APR button press is ignored when attempting to activate APR without a valid signal or when the OBS source is FMS. GPS/FMS approaches should be flown in NAV:FMS and VNV:PATH.

NOTE:

The airspeed must be kept within the envelope speeds stated within the AFMS during coupled approaches. Active envelope protection (§ 3.6.2) may deviate the aircraft from the glide slope path to remain within the airspeed envelope range to maintain safety of flight and reduce the risk of stall.

NOTE:

It is recommended to capture the glide slope at 1500 feet AGL to avoid active envelope protection operation below 500 feet AGL.

NOTE:

Holds and procedure turns must be flown in NAV:FMS. APR should be selected for analog approaches (APR:VOR, APR:LOC, APR:BC) when on, or turning to intercept to the final inbound course.

NOTE:

Approach modes use a higher gain set than Navigation modes for more precise tracking where a signal may be more sensitive such as a localizer.

3.9.1. VOR Approach APR:VOR

A VOR may be tracked in APR mode and APR should only be activated when cleared for the approach and on or turning to intercept the final inbound course. APR mode provides greater control and authority than tracking in NAV mode.

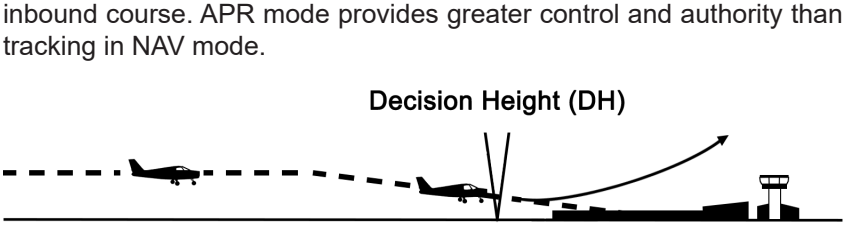


Figure 3-27: VOR Approach

1) Select VOR frequency, set OBS source to VLOC and set the course pointer to the desired course.

2) When cleared for the approach and on, or turning to intercept the final inbound course select course intercept method:

   a) **Heading Bug (Vectors)**: Set heading bug to desired intercept heading. Press HDG to activate HDG. Press APR to arm APR:VOR; OR

   b) **Straight-In**: If not in HDG mode, press APR to activate APR mode. **APR:VOR** flashes for 10 seconds. Aircraft intercepts the selected radial at a 45° angle.

3) APR:VOR If armed, APR:VOR automatically activates and tracks the radial at the course capture point. **APR:VOR** is annunciated on the EFIS.

Figure 3-28: APR:VOR

4) Once captured, the autopilot establishes the crosswind correction and tracks the course.

5) There is no vertical guidance on a VOR approach. Use PITCH, IAS, or VS mode to descend.

6) At the DH or MAP, disengage the AP (and YD if landing) to execute either a go-around (G/A) or manual landing, respectively.

3.9.2. ILS Approach (APR:LOC)

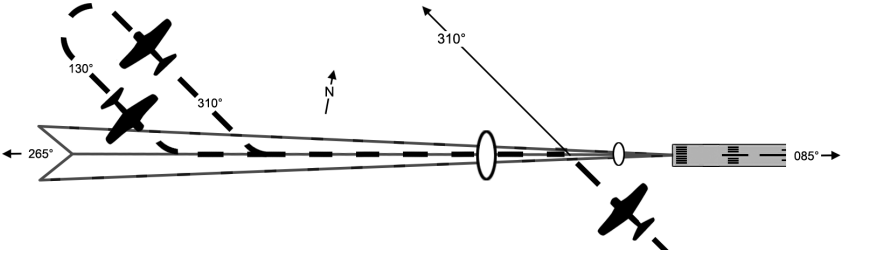


Figure 3-29: ILS Approach with Procedure Turn

NOTE:

Holds and procedure turns must be flown in NAV:FMS. APR should be selected when on or turning to intercept to the final inbound course.

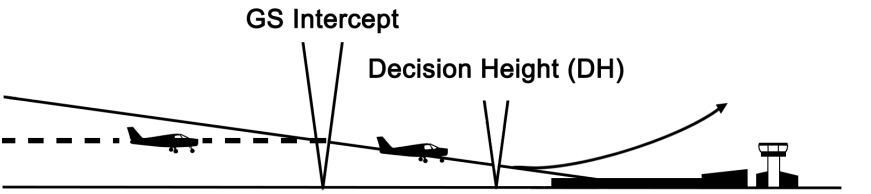


Figure 3-30: Straight-In ILS Approach

1) Select ILS frequency, set OBS source to VLOC and set the course pointer to the inbound LOC course.

2) When cleared for the approach and on, or turning to intercept the final inbound course select course intercept method:

   a) **Heading Bug (Vectors)**: Set heading bug to desired intercept heading. Press HDG to activate HDG. Press APR to arm APR; OR

   b) **Straight-In**: If not in HDG mode, press APR to activate APR. **APR:LOC** flashes for 10 seconds. Aircraft intercepts the selected radial at a 45° angle.

3) 

If armed, APR automatically activates and tracks once the aircraft captures the inbound course. **APR:LOC** is annunciated on the EFIS.

Figure 3-31: APR:LOC

4) 

Glide slope automatically arms, and then captures once the aircraft is within approximately ½ dot from the GS centerline. During GS capture, a VS descent proportional to the aircraft speed is established. Recommended GS capture altitude is 1500 feet AGL. At the FAF the glide path is captured and tracked, **GS** is annunciated, and the VDI changes to show glide slope (GS). (See EFIS pilot guide for PFD display symbology.)

Figure 3-32: GS

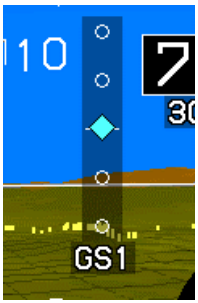


Figure 3-33: Glide Slope

5) At the DH or MAP, disengage the AP (and YD if landing) to execute either a go-around (G/A) or manual landing, respectively.

3.9.3. Back Course Approach (APR:BC)

Used to intercept and track an ILS back course related to an ILS approach. Behavior is identical to APR:LOC (§ 3.9.2), except the CDI reads and the autopilot tracks with reverse sensing and GS is neither armed nor activated.

Figure 3-34: APR:BC

Tune the ILS frequency, set OBS source to VLOC on the EFIS, and set course pointer 180° from the desired course. Press APR to arm or activate APR:BC. There is no vertical guidance on a BC approach. Use PITCH, IAS, or VS mode to descend.

3.9.4. GPS/RNAV Approach (NAV:FMS VNV:PATH)

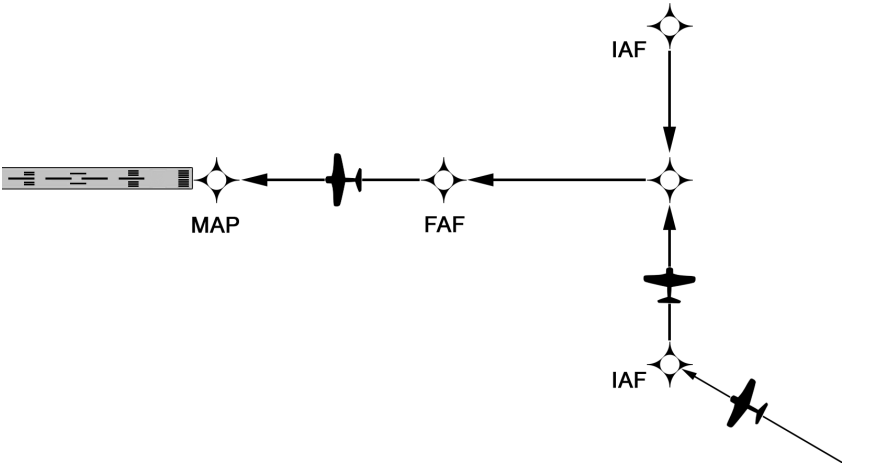


Figure 3-35: RNAV Approach Procedure

NOTE:

In all cases, the APR button press is ignored when attempting to activate APR without a valid signal or when the source is FMS. GPS/FMS approaches should be flown in NAV:FMS and VNV:PATH.

1) 

Program approach into the FMS, set the OBS source to FMS, press NAV to navigate to desired waypoint or leg. **NAV:FMS** flashes for 10 seconds.

Figure 3-36: NAV:FMS

2) Track the approach in NAV:FMS (§ 3.7.3.6).

3) 

Press VNV to enter VNAV mode and descend to FMS flight plan and approach waypoints with VNAV attributes (§ 3.8.6.1). Upon descent, **VNV:PATH** is annunciated, and the VDI shows enroute VNAV descent (VNV-B). (See EFIS pilot operating guide for PFD symbology.)

Figure 3-37: VNV:PATH

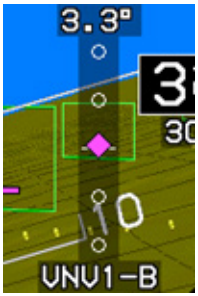


Figure 3-38: Enroute VNAV Descent

4) 

At the FAF the glide path is captured and tracked, **VNV:PATH** is annunciated, and the VDI changes to show glide path (LPV or VNV-G).

Figure 3-39: VNV:PATH

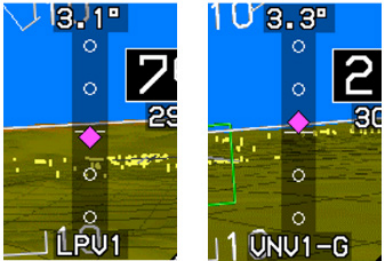


Figure 3-40: Final Approach Segment

5) At the DH or MAP, disengage the AP (and YD if landing) to execute either a go-around (G/A) or manual landing, respectively.

If it becomes necessary to cancel vertical guidance, press VNV to deselect VNAV modes or select another vertical mode (G/A, VS, IAS or ALT). Lateral guidance is maintained in NAV:FMS.

3.10. ADDITIONAL MODES

3.10.1. Control Wheel Steering (CWS)

CWS allows the pilot to manually control the aircraft without disengaging AP mode to maneuver around obstacles such as weather or traffic, or to set new targets (ROLL, PITCH, IAS, VS, or ALT) when in AP or FD modes. If envelope protection is active, CWS can be used to establish the aircraft back inside the safe envelope – without disengaging AP or FD mode.

Figure 3-41: CWS

Press and hold the CWS button to activate control wheel steering mode. CWS flashes on the EFIS, while an audible alert sounds. In addition, both the pitch and roll servos disengage. Maneuver the aircraft as desired, and then release the CWS button to deactivate CWS mode. CWS extinguishes, and both servos re-engage.

When CWS is deactivated the autopilot resumes operation in the previous lateral and vertical modes:

1) If HDG, NAV, APR, or REV mode was active, the autopilot returns to tracking the selected source.

2) If IAS, VS, or ALT mode was active, the autopilot holds the new IAS, VS, or altitude, respectively.

3) If ROLL or PITCH mode was active, the autopilot holds the new roll attitude or pitch attitude, respectively.

4) If G/A (§3.10.2) mode was active, the autopilot holds the new roll and pitch attitudes, and if a valid altitude target is set, arms alt preselect.

3.10.2. Takeoff-Go-Around Mode (G/A)

The G/A button may be used when a missed approach is required, or to setup the flight director guidance for takeoff. Once pressed, AP mode disengages, any previous active or armed modes are deselected, and flight director engages in G/A mode. The steering command bars are referenced to wings level and a pitch up attitude specific to the aircraft type (see AFMS) and **G/A** is annunciated on the EFIS.

Figure 3-42: G/A

AP mode may be engaged once established in a stabilized climb and above the minimum height, as stated in the AFMS, to hold the G/A attitude. Use HDG to follow a preselected heading bug or NAV to laterally fly a missed approach procedure or flight plan from the FMS. Vertical maneuvering (climb rates and level-off altitudes) are the responsibility of the pilot. To arm a valid altitude preselect target, a new vertical mode must be selected or a new attitude set using CWS. Altitude targets are not automatically armed while the autopilot is in G/A mode.

To deselect G/A mode activate new lateral and vertical modes or use CWS to select new ROLL and PITCH attitudes.

3.10.3. Emergency Level Mode (LVL)

Emergency level (LVL) mode is designed to bring the aircraft to wings level and a pitch attitude specific to the aircraft type (see AFMS) from any AP ready or active state. LVL mode holds a specific configured attitude, depending on flight conditions, altitude and ground tracking may vary.

Press the external Level Mode button to engage emergency LVL mode. The autopilot automatically deselects any active modes and engages the pitch and roll servos to bring the aircraft to wings level and the configured pitch angle for the aircraft.

Activation of LVL mode is indicated by active modes changing to ROLL and PITCH, and the flight director setting to wings level and the configured pitch angle for the aircraft. LVL mode may be activated or deactivated at any time, regardless of active modes, or from AP Ready. If AP mode was not engaged prior to activating Level mode **AP** does not annunciate on the EFIS, but the “Level Mode, Engage Autopilot” voice alert repeats.

To resume normal AP functionality and cancel the audible alert, AP mode must be manually engaged by pressing AP or deactivating LVL mode using the AP DISC/TRIM INTR button.

3.10.4. Side-in-Command (SIC)

The SIC switch changes the digital data port to the autopilot between the pilot and co-pilot side. SIC is displayed as a steady green arrow pointing to the side in command.

Figure 3-43: Side-in-Command

3.10.5. Half Bank (HB) Mode

Half bank mode (HB) is an optional switch/annunciator that limits the AP's authority and improves passenger comfort. From HDG or NAV:FMS mode press the external Half Bank switch to engage HB. When HB is engaged, the autopilot limits the commanded bank angle and maximum command bank angle by 50%. Half Bank mode status is annunciated on the external switch.

3.11. TRIM

3.11.1. Automatic Trim Annunciations

In AP mode, with the trim master switch in the ON position, automatic trim is enabled. When AP mode is automatically trimming the aircraft, if the trim servo running exceeds a preset threshold of time, a voice alert of "Trim in Motion" repeats and (**TRIM MOTION ↑**) is annunciated on the EFIS. As soon as the aircraft has been sufficiently trimmed, and the servo stops running, the trim annunciation extinguishes, and the audible alert ceases.

Trimming UP

Trimming DOWN

Figure 3-44: Automatic Pitch Trim Annunciations

3.11.2. Manual Trim Annunciations

When the trim master switch is OFF, or if trim is not responding, the autopilot indicates when it is necessary to trim the aircraft. If pitch is mis-trimmed for a period of 3 seconds (i.e., trim is not responding), an audible alert of "Check Pitch Trim" repeats and (**CHECK PITCH TRIM ↑)** is annunciated on the EFIS. Trim must be manually manipulated to correct the out of trim condition. As soon as the aircraft has been sufficiently trimmed, the trim annunciation extinguishes.

Trim UP Needed

Trim DOWN Needed

Figure 3-45: Manual Trim Annunciations

3.11.3. Manual Electric Trim

The manual electric trim switch, located on the control wheel/stick, should only be used to trim the aircraft when AP mode is disengaged. Attempting to use it otherwise disconnects AP but FD mode remains engaged (if previously engaged). To trim the aircraft nose up, press aft and maintain pressure on both segments of the manual electric trim switch. To trim the aircraft nose down, press forward and maintain pressure on both segments of the manual electric trim switch.

3.11.4. Disconnect Automatic Trim

Disconnect the automatic trim function by any of the following:

1) Press/Hold remote AP DISC/TRIM INTR button; OR

2) Set trim master switch to OFF position.

3.12. MODE FAILURE ANNUNCIATIONS

Refer to the EFIS pilot guide for a full list of EFIS messages, warnings, and cautions.

3.12.1. APR Tracking Failure Annunciation

If the NAV signal is lost, **APR:LOC** flashes quickly (approximately 2 Hz) while the NAV signal is invalid.

Figure 3-46: APR Tracking Failure

3.12.2. Glide Slope Tracking Failure Annunciation

If tracking GS and GS CDI exceeds 50% deviation for five seconds or if the fault is due to the GS flag signal (lost signal), **GS** flashes quickly (approximately 2 Hz) indicating it is failed.

Figure 3-47: Glide Slope Tracking Failure

If the GS signal is lost before GS capture, the autopilot remains in the active vertical mode. If the GS signal is lost after GS capture, the autopilot seeks to maintain the pitch attitude present at signal loss.

3.12.3. VOR Station Passage

When tracking in NAV or APR mode and the aircraft passes over the VOR “cone of confusion,” lateral mode flashes quickly (approximately 2Hz), while lateral deviation is invalid. The AP maintains the course until the NAV signal becomes valid when it returns to tracking from the VOR station.

Figure 3-48: Lateral Mode Failure (VOR)

Section 4 Emergencies

4.1. GENERAL

If the autopilot is not behaving properly, the pilot must disconnect it using AP DISC TRIM/INTR, turning off the AP master, and/or pulling AP circuit breaker (CB).

4.2. TRIM RUNAWAYS

In the event of a trim malfunction, two possible events may occur:

1) If AP mode is engaged and trim begins to run un-commanded up and down, the autopilot fights the trim movement and eventually trips the internal fuse (approximately 3 seconds), stopping trim movement. In this case, turn off the trim master switch or pull trim CB, and re-engage AP. The pilot must manually trim the aircraft.

2) If AP mode is not engaged and trim begins to run un-commanded, press and hold the AP DISC TRIM/INTR to interrupt power to the trim servo. Turn off the trim master switch or pull trim CB. The pilot must manually trim the aircraft. AP mode use is not inhibited with the trim off, but the pilot should manually trim in response to the autopilot trim annunciations on the EFIS.

4.3. HARDOVERS

Every effort has been made to minimize the possibility of a hardover condition (servo runaway). On the very remote chance a hardover occurs, the autopilot has built in limiters to mitigate the severity of response. The autopilot inhibits (but does not disconnect) the pitch servos if G-loading exceeds ±0.6 G's from normal flight, or if the pitch rate exceeds 4°/sec. In roll, the servo is inhibited (but not disconnected) if the roll rate exceeds 10°/sec. If such an event occurs and is not the result of turbulence, the pilot should immediately disengage the autopilot.

4.4. SOFTOVERS

A softover is defined as an attitude failure that occurs so slowly that the pilot may not be aware of it. The autopilot is protected in two ways from such an event. A mis-compare of the pitch or roll axis of more than 5° disconnects the autopilot. Additionally, the autopilot is disconnected at 38° roll and/or 22° pitch if the aircraft is not recovering (AP mode limits attitude to 30° roll and 17° pitch). The pilot should determine the cause of the problem before re-engaging AP mode.

4.5. MULTI-AXIS HARDOVERS

The autopilot is protected from multi-axis hardovers as well and disconnects if it finds two servos driving in one direction for three seconds.

4.6. SERVO CLUTCHES AND SPEEDS

The system incorporates slip clutches on all servos to allow the pilot to overpower the autopilot, trim, and yaw systems. Servo speeds are limited to reduce the effect of hardover conditions to constrain the aircraft excursion due to a hardover condition.

Section 5 Glossary

Term	Meaning
ADAHRS	Air Data Attitude Heading Reference System
AET	Approach Envelope Transition
AFM	Aircraft Flight Manual
AFMS	Aircraft Flight Manual Supplement
AGL	Above Ground Level
ALT	Altitude
AP	Autopilot
AP DISC	Autopilot Disconnect
APU	Auxiliary Power Unit
APR	Approach
BC	Back Course
CB	Circuit Breaker
CDI	Course Deviation Indication
CWS	Control Wheel Steering
DFCS	Digital Flight Control System
DISC	Disconnect
EFIS	Electronic Flight Instrument System
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FD	Flight Director
FGC	Flight Guidance Computer
FPM	Feet–per–Minute
FMS	Flight Management System
GA	Go-Around
GPS	Global Positioning System
GS	Glide Slope
HB	Half Bank
HDG	Heading
HITS	Highway in the Sky

KIAS	Knots Indicated Airspeed
IAS	Indicated Airspeed
IDU	Integrated Display Unit
ILS	Instrument Landing System
INIT	Initializing
INTR	Interrupt
LOC	Localizer
LVL	Level
MCP	Mode Control Panel
M_{MO}	Maximum operating limit speed
MSL	Mean Sea Level
NAV	Navigation
OBS	Omnibearing Selector
PFD	Primary Flight Display
PGS	Pseudo-Glide Slope
REV	Reverse
SIC	Side-In-Command
VDI	Vertical Display Indicator
VLOC	VOR or LOC Frequency
VMC	Visual Meteorological Conditions
V_{MO}	Maximum operating limit speed
VNAV	Vertical Navigation
VNV	Vertical Navigation
VOR	Very High Frequency Omnidirectional Radio Range
V_{REF}	Calculated reference speed for final approach
VS	Vertical Speed
V_S	Stall speed
YD	Yaw Damper

87307

To stay up to date with current Genesys product news and information, visit **https://genesys-aerosystems.com/support/warranty-information**.