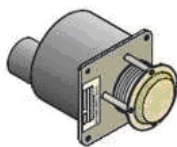
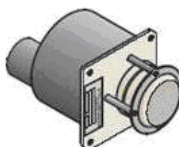
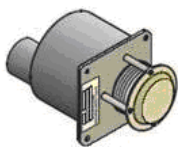
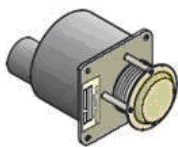




Digital Flight Control System - 2nd Generation (DFCS-2G / AP1950)

Pilot's Operating Handbook



Page Intentionally Blank

Table of Contents

Sec.		Pg.
1	Overview.....	1-1
	1.1 Document Organization.....	1-3
	1.2 Purpose.....	1-3
	1.3 General.....	1-3
	1.4 DFCS-2G Components.....	1-4
	1.5 System Description.....	1-4
	1.6 System Block Diagram.....	1-5
	1.7 Self Test.....	1-6
2	Pre-Flight Procedures.....	2-1
	2.1 Pre-Flight Procedures.....	2-3
3	In-Flight Procedures.....	3-1
	3.1 Normal Operating Procedures.....	3-3
	3.2 Pre-Flight Programming.....	3-3
	3.3 Control Wheel Steering Button (CWS).....	3-4
	3.4 Autopilot (AP) Engage/Disengage Button.....	3-4
	3.5 Flight Director (FD) Mode.....	3-4
	3.6 Yaw Damper (YD) Button.....	3-4
	3.7 Heading (HDG) Mode.....	3-5
	3.8 Pilot Selectable Intercept Angles (using HDG Mode).....	3-6
	3.9 Navigation (NAV) Mode.....	3-7
	3.9.1 Nav-VOR.....	3-7
	3.9.2 Glide-slope Disable.....	3-7

3.9.3	NAV-GPS.....	3-7
3.10	Approach (APR) Mode.....	3-8
3.10.1	VOR Approach.....	3-8
3.10.2	ILS Approach.....	3-8
3.10.2.1	Glide-slope Arming and Capture.....	3-8
3.10.3	APR Tracking Failure Annunciation.....	3-9
3.10.4	Glideslope Tracking Failure Annunciation.....	3-9
3.10.5	GPS Approach - Standard EFIS.....	3-10
3.10.6	GPS Approach - Genesys Aerosystems EFIS.....	3-10
3.10.7	Selecting Missed Approach Altitude.....	3-10
3.11	Vertical Speed (VS) Mode.....	3-10
3.12	Indicated Air Speed (IAS) Mode.....	3-11
3.13	Altitude Selector/Alerter Function.....	3-11
3.14	Altitude Capture (ALT-CAP) Mode.....	3-12
3.15	Altitude Hold (ALT) Mode.....	3-12
3.16	Vertical Modifier (UP/DN) Buttons (if equipped).....	3-12
3.16.1	Pitch Mode Active.....	3-12
3.16.2	IAS Mode Active.....	3-12
3.16.3	VS Mode Active.....	3-12
3.16.4	ALT Mode Active.....	3-13
3.17	Autotrim.....	3-13
3.18	Manual Electric Trim.....	3-13
3.19	Go-Around Button.....	3-14
3.20	Voice Annunciations/Alerts.....	3-14

	S-TEC
4	Non-Normal Procedures Failures.....4-1
4.1	General.....4-3
4.2	Trim Runaways.....4-3
4.3	Hardovers.....4-3
4.4	Softovers.....4-3
4.5	Servo Clutches and Speeds.....4-3
5	Certification Basis.....5-1
5.1	Certification.....5-3
6	Glossary.....6-1

List of Figures

Fig.	Pg.
1-1	DFCS-2G Control Panel.....1-4
1-2	System Block Diagram.....1-5
3-1	Yaw Damper Trim Control Knob.....3-5
3-2	Pilot Selectable Intercept Angles (using HDG Mode).....3-6
3-3	Capturing Glideslope.....3-9

Page Intentionally Blank

SECTION 1 OVERVIEW

Page Intentionally Blank

1.1 Document Organization

Section 1 Overview

Section 2 Pre-Flight Procedures

Section 3 Normal In-Flight Procedures

Section 4 Non-Normal Procedures - Failures

Section 5 Certification Basis

Section 6 Glossary

1.2 Purpose

This Pilot's Operating Handbook (POH) provides pre-flight and in-flight operating procedures for the S-TEC - 2nd Generation (DFCS-2G / AP1950).

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) and Aircraft Flight Manual Supplement (AFMS) for DFCS-2G. Refer to the applicable AFM or AFMS for A/C specific information, such as unique ground tests, limitations, and emergency procedures.

1.3 General

DFCS-2G is an attitude-based flight control system that provides a significant reduction in pilot workload. This is a three-axis attitude based Digital Flight Control System (DFCS) for aircraft equipped with a compatible Electronic Flight Instrument System (EFIS).

The system consists of a remote mounted Flight Guidance Computer (FGC), a Mode Control Panel (MCP), a remote mounted Yaw Damper Amplifier, and four servos (Roll, Pitch, Yaw, Trim). The modes (HDG, NAV, ALT, etc) are selected via the MCP and sent to the EFIS via RS-422 data. The EFIS takes the mode selection data and combines them with the vertical targets (ALT, IAS, VS, etc) and transmits this data as one data stream to the FGC via RS-422.

The system provides roll, pitch, and yaw modes with altitude, vertical speed, and other navigation targets being provided from the compatible EFIS. The autopilot utilizes the ADAHRS data for attitude reference and other navigation inputs (i.e. glideslope and localizer deviations, heading and course errors, etc.) from the EFIS system to manipulate the flight controls of the aircraft via the servo motors.

Sensing for trim annunciation and automatic elevator trim is provided by the pitch servo. Drive for the trim servo is provided by the FGC.

The yaw damper provides yaw axis stabilization by means of a remote mounted sensor / amplifier and a rudder servo. The yaw damper also uses a separate panel mounted yaw damper trim control knob for centering.

1.4 DFCS-2G Components

The DFCS-2G system consists of the following components:

- Dual Processor Fail Passive Digital Flight Control Computer (FCC).
- DFCS-2G Mode Control Panel (MCP) to select modes.
- Servo-actuators – One each for the pitch, roll, trim, and yaw axes.
- Compatible Dual-Side EFIS – ARINC 429 channel for navigation data and RS-422 channels for modes and targets data.
- An Air Data and Attitude Heading Reference System (ADAHRS) is used to supply attitude and air data to the DFCS-2G FGC and the EFIS System.

1.5 System Description

The main function of the system is to calculate and provide guidance for flying the aircraft along lateral and vertical flight profiles set by the pilot. This guidance can drive the servos, or drive the command bar on the EFIS, or both. With the Autopilot engaged (AP Mode), the autopilot's guidance commands the servos which move the flight controls of the aircraft. This in turn controls the aircraft via the roll and pitch axes. In Flight Director mode (FD), the autopilot's guidance drives command bars on the EFIS, which directs the pilot to manually steer the aircraft along the lateral and vertical flight profiles. With both modes active, the autopilot will fly the aircraft using the servos, as well as display the command bar guidance for reference.

The DFCS-2G Control Panel (MCP) is used to engage the autopilot modes.



Fig. 1-1. DFCS-2G Control Panel

Available modes may include altitude hold, heading hold, navigation signal tracking, and approach guidance depending on installed avionics. The NAV mode will track whatever course is active on the EFIS display (VLOC or GPS). The Approach (APR) button is used for tighter tracking required for instrument approaches.

A mode may be disengaged by pressing the associated button on the MCP. If any of the autopilot modes are armed or active, pressing the yoke-mounted AP DISC button once disengages all autopilot modes and subsequent disconnect alarms will be sounded. If the cyclic-mounted AP DISC button is kept pressed after the autopilot disengages or if it is pressed again after the autopilot is disconnected, the disconnect alarms will be truncated.

1.6 System Block Diagram

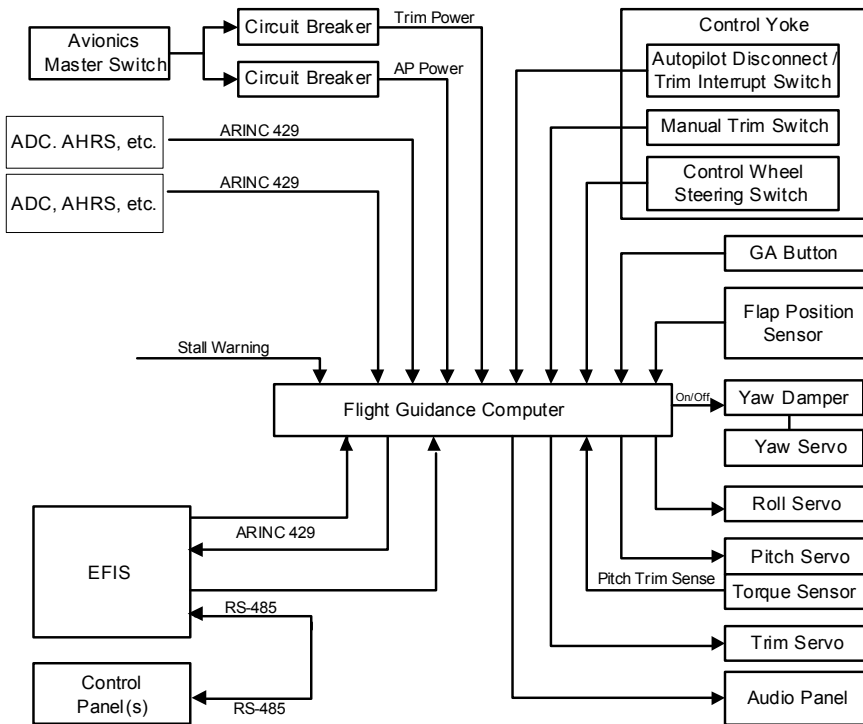


Fig. 1-2. System Block Diagram

1.7 Self Test

After power has been applied to the system, the autopilot will perform a power on self test. The FGC will send a message to the display system that will indicate the self test is in progress. Once the system has successfully passed the self test, the FGC will send a message to the display system that will indicate the ADAHRS is initializing if the attitude and/or air data sources have not gone valid yet. This will remain displayed until the ADAHRS has completed its initialization, or until the system detects a failure condition. During this period, the system will not allow any mode to function. After the successful completion of both the self-test and subsequent ADAHRS initialization, the FGC will send a message to the display system that will indicate the autopilot is ready. The system is now ready to accept commands.

If the system fails initialization it will annunciate the failure. The FGC will send a message to the display system that will indicate the autopilot has failed and will not allow any mode to function. If the Air Data Attitude Heading and Reference System (ADAHRS) malfunctions, The FGC will send a message to the display system that will indicate the attitude has failed and will not allow any mode to function.

Note:

Whether the Air Data or the Attitude fails, the system will still indicate an "ATTITUDE FAIL" even for Air Data failures.

SECTION 2

PRE-FLIGHT PROCEDURES

Page Intentionally Blank

2.1 Pre-Flight Procedures

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

- 1) Autopilot Master Switch.....**ON**
- 2) Trim Master Switch.....**ON**
- 3) Avionics Master Switch.....**ON**
- 4) Autopilot Self-Test.....**COMPLETE**
- 5) ADAHRS Initialization.....**COMPLETE**
 - Autopilot Ready is indicated on the display.

Note:

If the system fails to initialize, it will indicated Autopilot has failed or the Attitude has failed and not allow any mode to function.

- 6) AP Button.....**PRESS**
 - (AP, FD, and YD Indicators illuminate and servos engage)
 - (Roll and Pitch annunciate. Steering bar comes into view on EFIS display)
- 7) HDG Bug.....**CENTER**
- 8) HDG Button.....**PRESS**
- 9) Move HDG bug left and right.
- 10) Aircraft controls and steering bars should follow HDG Bug.
- 11) Aircraft controls and steering bars should follow Navigation Deviations.

Note:

It is difficult to test the autopilot NAV, APR, and REV functions during a pre-flight test without a VOR signal generator, therefore, these functions may be left for in-flight evaluation. If a signal generator is available it may be used to simulate deviations that would be found on a normal approach procedure.

- Set L/R deviation greater than 50% left of right.
- Set GS Deviation greater than 50% up (aircraft below the GS).
- Engage HDG/APR and ALT modes.
- Verify AP (command bars and/or servo drive) follows HDG bug at this point.
- Decrease L/R deviation to less than 5%.
- Verify HDG drops as active mode and APR takes over from armed to active.
- Verify AP follows L/R deviation.
- Verify GS is now armed with ALT as the active mode.
- Decrease GS Deviation to less than 5%.
- Verify ALT drops as active mode and GS takes over from armed to active.
- AP will drive down as the pitch attitude of the aircraft is level rather than a nose down configuration. GS deviation will appear to have no affect, therefore further evaluation of GS is required in flight.

12) IAS Button.....**PRESS**

- Selected IAS indicates lowest speed allowed (i.e. 90) on the EFIS display.

13) VS Button.....**PRESS**

- Selected VS indicates "0" on the EFIS display.
- Increase selected VS on the EFIS display until 500 is displayed. Steering Bar moves up and pitch control moves slowly AFT (pilot may have to assist a heavy yoke).
- Decrease selected VS on the EFIS display -500 is displayed. Steering bar moves down and pitch control moves slowly FWD.

14) ALT Button.....**PRESS**

- ALT HOLD is displayed on the EFIS display.
- Slowly pull AFT on pitch control. Auto-trim runs nose down after 3 seconds and the EFIS display indicates trim is in motion (along with direction of travel) with a corresponding aural annunciation.
- Slowly push FWD on pitch control. Auto-trim runs nose up after 3 seconds and the EFIS display indicates trim is in motion (along with direction of travel) with a corresponding aural annunciation.

15) EFIS Display.....**SET**

Set altitude to field elevation or set BARO to current baro setting.

- a. Select VS Mode on the autopilot.
- b. Using the altitude selector (bug) on the EFIS display, select an altitude 100' below field elevation.
- c. Using the BARO knob on the EFIS display slowly reduce altitude to the same as the selected altitude.
- d. The FGC should send a message to the display system that will indicate the Altitude has been captured and is being held when the two altitudes match.

- 16) CWS Button.....**PRESS and HOLD**
- CWS Annunciator is displayed on the EFIS display, and an aural tone is heard.
 - All servos disengage and controls are free.
 - Release CWS button. Servos re-engage.
- 17) YD Button.....**PRESS**
- Rotate trim knob CW; right rudder pedal moves slowly FWD.
 - Rotate trim knob CCW; left rudder pedal moves slowly FWD.
 - Re-center trim knob.
- 18) AP DISC Switch (on control wheel).....**PRESS**
- Verify all Autopilot modes except FD disconnect, followed by aural tone and voice annunciation.
 - All servos disengage; controls are free.
- 19) Go-Around Button.....**PRESS**
- FD Annunciator is displayed on the EFIS display, Roll and Pitch annunciate and pitch steering bar moves to up position.
 - All servos disengage; controls are free.
- 20) Manual Electric Trim Test
- a. Trim Master (ON/OFF) Switch.....**PUSH ON**
 - Move each segment of the Manual Electric Trim Switch FWD and AFT without the other (one side of the switch at a time); trim should not run.
 - Move both segments FWD.
 - Trim should run nose down.
 - Move both segments AFT.
 - Trim should run nose up.
 - Move both segments AFT.
 - Trim should run nose up.
 - b. Manual Electric Trim Switch.....**Run Trim Nose Up or Down**
 - Press and Hold AP DISC TRIM/INTR switch while running manual trim; trim motion should stop.
 - Release switch while attempting to run manual trim; trim motion should resume.

21) Autopilot Override Test

With the autopilot engaged, grasp the control wheel and slowly overpower the roll and pitch servos to ensure proper clutch action. Also, overpower the rudder servo if yaw damper is installed. Control movements should be smooth. If any unusual noise or feel occurs, inspect the servo installation and repair as needed.

Caution:

Do not operate aircraft until abnormal or unusual conditions resolved.

Note:

This completes the pre-flight procedures. Before flight, verify that the autopilot, including yaw damper, is disengaged and that all trim systems are set for takeoff.

SECTION 3 IN-FLIGHT PROCEDURES

Page Intentionally Blank

3.1 Normal Operating Procedures

In order to use the autopilot, it must have successfully passed the "Power On Self-test", the ADAHRS initialization process, and be indicating the Autopilot is Ready on the EFIS display.

All of the modes of operation (except for AP and FD) can be divided into two types (Lateral and Vertical). A lateral mode cannot be engaged without a vertical mode also engaged and vice versa.

A lateral or vertical mode is considered active when it is providing guidance, regardless of whether that guidance is driving a servo and the movement of the flight director command bar, or simply driving the movement of the flight director command bar.

A lateral or vertical mode is considered armed when it is waiting for a capture criteria to be met, or a capture point to be reached before it automatically becomes the active mode. The annunciator for an armed mode is typically displayed in white or smaller letters or unboxed annunciation next to the active mode on the EFIS display. See the interfacing EFIS Pilot's Operating Handbook (POH) for annunciation details.

3.2 Pre-Flight Programming

The autopilot can be programmed before flight to a specific heading, IAS, vertical speed, or altitude, as desired. Press the Flight Director (FD) button. The autopilot will initialize in the ROLL and PITCH modes and the steering bars on the EFIS display will appear. The desired modes may now be selected.

The pilot may also choose to activate the Go-Around button that engages the FD, with steering bars, to a preset pitch-up attitude with wings level. ROLL and PITCH modes will be displayed.

After takeoff, the pilot can either hand-fly the aircraft utilizing the FD Steering Bars or press the AP button which engages the autopilot servos. The autopilot will now take over control of the aircraft.

Caution:

Verify that the aircraft is at a safe altitude and synchronized with the steering bar commands before engaging the autopilot. AP will synchronize to aircraft conditions present when AP is engaged.

Note:

The CWS Mode is inhibited when the autopilot is in NAVLOC or APRLOC Modes (such as when conducting a localizer or ILS approach).

3.3 Control Wheel Steering Button (CWS)

The Autopilot is equipped with a Control Wheel Steering (CWS) Mode that can be activated by a switch on the control yoke after the autopilot has been engaged.

When pressed and held, CWS will flash on the autopilot display and the servos will disengage allowing the pilot to maneuver the aircraft as desired. When released, the servos will re-engage.

If the autopilot was in ROLL and PITCH Mode when the CWS was activated, it will synchronize to the new roll and pitch attitude when released (within the roll and pitch limits). If the autopilot was in HDG, NAV, APR, or REV Mode, it will seek to recapture that mode upon release of the CWS switch. If it was in any of the other pitch modes (IAS, VS, or ALT), it will synchronize to the new IAS, VS, or ALT targets upon release (compatible EFIS must sync targets being transmitted to the AP to the current condition when CWS is pressed).

3.4 Autopilot (AP) Engage / Disengage Button

When the AP button is pressed, the Autopilot, Flight Director (FD), and Yaw Damper (YD) engage. These modes will be annunciated on the EFIS display. The system will engage in the ROLL, PITCH, and YAW DAMPER modes. The roll and pitch attitudes will be the attitudes present at the moment the A/P button was pressed, except when engaging the autopilot from Go-Around mode. If the A/P button is pressed a second time, the autopilot will disengage leaving the FD and YD functions active. A disengage tone will sound for 3 seconds followed by an Autopilot Disconnect voice annunciation. Moving the manual trim will accomplish the same thing.

3.5 Flight Director (FD) Mode

The Flight Director is automatically activated and the Steering Bars come into view by pressing the AP button. To use the Flight Director only (autopilot servos disengaged), press the AP button again which disengages the AP mode but leaves the FD and YD modes engaged or engage the FD from the Autopilot Ready mode by pressing the FD button. The pilot will be required to hand fly the aircraft by reference to the steering bars and can program lateral and vertical modes as desired. To engage the autopilot at anytime, simply press the AP button.

3.6 Yaw Damper (YD) Button

Pressing the YD button will engage the Yaw Damper and annunciate the mode on the EFIS display. Depressing the YD button a second time will disengage the Yaw Damper and extinguish the mode on the EFIS display. The YD normally engages with the autopilot but can be pressed ON or OFF at anytime completely independent of the autopilot. Therefore, it is essential that the YD always be disengaged for takeoff and landing.

The Yaw Damper uses an external Yaw Damper trim control knob (example shown in Figure 3-1 below) that is not integral with the autopilot controller. Counter-Clockwise rotation of the control inputs left rudder; clockwise rotation inputs right rudder. Use the Yaw Damper in flight as follows:

- 1) Trim aircraft for phase of flight (climb, cruise, etc) with rudder trim.
- 2) Adjust the Yaw Damper trim control knob to center position.
- 3) Engage the Yaw Damper by pressing the YD button on the autopilot.
- 4) Make small YD trim adjustments as necessary using the YD trim control knob to keep slip/skid ball centered.
- 5) Disconnect Yaw Damper for landing.

Note:

The Yaw Damper Trim Control Knob is a rudder centering device with limited authority and does not automatically trim the rudder tab. Therefore, after making large power, flight profile, or aircraft configuration changes, it is advisable to disconnect the yaw damper and check basic aircraft rudder trim, retrim if necessary and then re-engage the yaw damper.

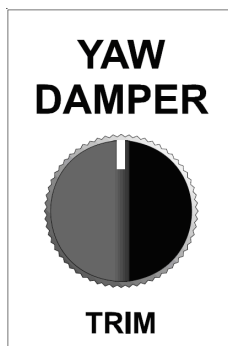


Fig. 3-1. Yaw Damper Trim Control Knob

3.7 Heading (HDG) Mode

Press the HDG button to engage the Heading Mode. In this mode the system will track the heading bug on the EFIS display. Any heading bug change will cause the aircraft to turn, intercept, and track the new heading. Depressing the HDG button a second time will cancel the mode and default back to ROLL Mode. For best results, do not make heading changes of more than 150° at a time.

3.8 Pilot Selectable Intercept Angles (using HDG Mode)

When intercepting a navigation signal while using NAV or APR modes, the pilot may choose to select an intercept angle other than the standard 45°. To accomplish this, first select the HDG mode, then the mode to be used (NAV or APR). If the CDI is more than 50% deflected, the heading mode will stay active.

As the CDI deflection diminishes to approximately 50% or less, the HDG annunciator will extinguish allowing the selected navigation mode to capture. The Navigation Mode (NAV) will move from the "armed" position to the "active" position on the EFIS display.

If making intercepts at sharp angles, high airspeeds or close to the Final Approach Fix (FAF), the pilot should expect some course over-shoot. For best results, intercept angles should be kept to 90° or less.

For the standard 45° intercept, engage the desired navigation mode with the ROLL mode active. If the CDI deflection is more than 50%, a 45° angle will be assumed. If less than approximately 50%, the selected navigation mode will capture and begin to turn the aircraft on course.

Note:

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

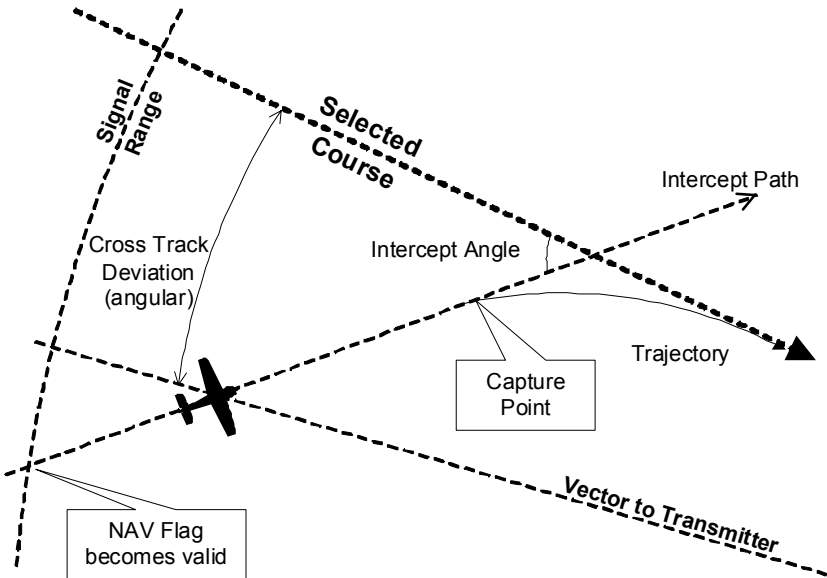


Fig. 3-2. Pilot Selectable Intercept Angles (using HDG Mode)

3.9 Navigation (NAV) Mode

The navigation mode can command up to 30° bank angles and is used primarily for intercepting and tracking VOR or GPS signals (see Fig. 3-2).

3.9.1 NAV-VOR

To Intercept and track a VOR signal, first tune the appropriate frequency on the navigation radio. Verify that the navigation source selector on the GPS receiver is set to VOR. Set the course pointer on the EFIS display to the desired course and press the NAV button. At this point, the pilot has the option of a 45° intercept or a selected angle intercept. (See "Pilot Selectable Intercept Angles" section in this manual for the correct procedure.)

If for example, a pilot selected intercept angle is desired when navigating to a "vectors to final" approach course, engage the NAV mode with HDG displayed, thus arming the NAV mode but leaving the HDG active. As the aircraft nears the approach course, HDG will extinguish, allowing NAV to capture.

GPS/FMS navigation, including enroute and approach operations, may be done in either the NAV or APR Mode since GPS/FMS roll steering is available in both modes.

3.9.2 Glide-slope Disable

Although the APR Mode is normally used for ILS operations, the NAV Mode is used in one instance that may be required during an ILS approach. If required to hold at the OUTER MARKER, the pilot can use the NAV Mode when tracking the localizer inbound to prevent glide-slope capture that would normally occur if using the APR Mode.

When cleared for the approach, the pilot should then select the APR Mode which will enable the autopilot to capture glide-slope and perform the normal ILS tracking functions.

3.9.3 Nav-GPS

To track a GPS signal in the NAV mode, first program a valid waypoint or flight plan into the GPS navigator. Position the NAV source selector on the GPS receiver to the GPS position and press the NAV button. The autopilot will display NAV with a sub-mode (NAVGPSS, NAVFMS, etc) indicating that it is in the GPS/FMS roll steering mode and is tracking to the waypoint.

If the NAV signal is invalid when the NAV or APR button is pressed, the mode annunciator will flash on the EFIS display. The system will annunciate a failure in the same manner if tracking in NAV or APR and the CDI exceeds 50% deviation for 15 seconds.

If the NAV signal becomes invalid while engaged, NAV or APR will alternately flash with FAIL on the EFIS display. The autopilot will continue tracking the course arrow.

Note:

The autopilot will only respond to steering signals contained in the GPS/FMS data base. Procedure turns and holding patterns may not be in the data base. Therefore, the pilot may use the autopilot HDG Mode to maneuver the aircraft around a procedure turn or a holding pattern.

3.10 Approach (APR) Mode

The approach mode can command up to 30° banks and is normally used for VOR, GPS, LOCALIZER, and ILS approaches.

3.10.1 VOR Approach

Tune VOR frequency of intended use into the VOR receiver. Verify that the NAV source selector on the GPS/FMS is in the NAV or VOR position. Set the course pointer on the EFIS display to the desired course.

For pilot selected intercept angles, use the procedure described in "Pilot Selectable Intercept Angles" in this manual. If desiring to use the standard 45° intercept angle, select APR from ROLL Mode. When maneuvering around a procedure turn, the pilot may use the HDG Mode and then reselect APR Mode when inbound to the airport.

3.10.2 ILS Approach

Set the course pointer on the ILS front course INBOUND heading. Select APR on the autopilot with ROLL displayed for the standard 45° intercept angle. When the CDI deflection is approximately 50% or less, APR will move to the capture position. For pilot selected intercept angles, use the procedure described in "Pilot Selectable Intercept Angles" in this manual.

When maneuvering on a procedure turn or a holding pattern, the pilot may select the HDG Mode and then when intercepting the LOCALIZER inbound, reselect the APR Mode.

3.10.2.1 Glide-slope Arming and Capture

APR Mode also allows arming of glide-slope when the following conditions are met: an ILS frequency is tuned, localizer deviation is less than 50% full scale deflection, glide-slope deviation indicator is from 100% full scale up to 15% full scale up for 2 seconds, and the autopilot is in any PITCH mode (IAS, VS, ALT or PITCH). Glide-slope will capture when the deviation indicator is within the window of 15% above to 20% below the center reference point (approximately 1/2 dot on the most CDIs).

Recommended glide-slope flight procedure is to extend approach flaps once established on the localizer and before reaching the OUTER MARKER. Extend the landing gear at glide-slope capture and adjust power in small increments to maintain the desired airspeed (see the Aircraft Flight Manual Supplement for recommended airspeed and permissible flap settings during the approach).

Capturing a glide-slope transitions through three steps:

- GS Arm with another vertical mode active. Typically level altitude hold is set up to fly underneath the Glideslope, but GS can be captured from VS with ALT/GS armed, IAS with ALT/GS armed, PITCH with ALT/GS armed.
- GS Capturing occurs when GS is Armed and GS Deviation has decreased to less than 25%. In this transitional mode, the autopilot will fly a negative vertical speed relative to the airspeed in order to make a smooth capture out of level flight.
- GS Mode (GS is captured) when the GS Deviation is within 5% or the system has been capturing GS (descending at a negative vertical speed relative to the airspeed) for more than 10 seconds.

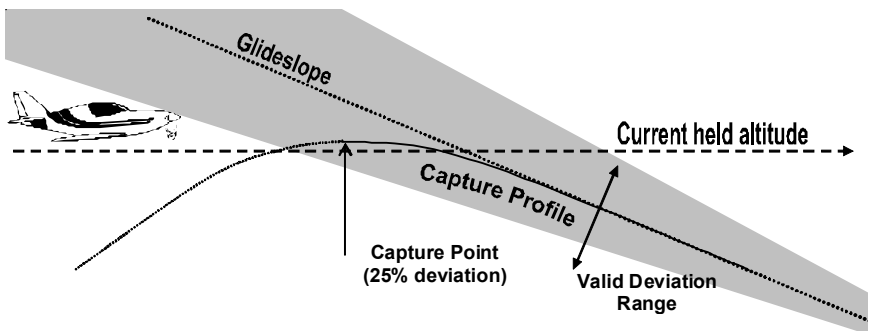


Fig. 3-3. Capturing Glideslope

3.10.3 APR Tracking Failure Annunciation

If tracking in the APR mode and the CDI exceeds 50% deviation for 5 seconds, APR will flash. If the NAV signal is lost, APR will flash alternately with FAIL and the FD command bars will blink on the EFIS display.

3.10.4 Glideslope Tracking Failure Annunciation

GS will flash on the EFIS display if tracking glideslope and the GS CDI exceeds 50% deviation for 5 seconds. GS will flash alternately with FAIL and the FD command bars will blink if the fault is due to the appearance of the GS FLAG (lost signal).

If the glideslope signal is lost before GS capture, the autopilot will remain in the active Vertical Mode. If the glide-slope signal is lost after GS capture, the autopilot will seek to maintain the pitch attitude present at signal loss. The pilot should execute a missed approach.

3.10.5 GPS Approach - Standard EFIS

GPS/FMS roll steering is also available in the APR Mode. To use the APR Mode for a GPS approach, use the same procedure found in the NAV section. At this time, this system has no provisions for the vertical portion of the GPS Approach unless interfaced to a Genesys Aerosystems EFIS. Roll steering can be used to track the lateral portion of a GPS approach, but vertical portion must in one of altitude preselect modes (IAS, VS, etc) or Pitch hold mode.

3.10.6 GPS Approach - Genesys Aerosystems EFIS

Set the procedure approach up in the IDU. Engage the Autopilot in NAV and VNV modes. The autopilot will follow the approach profile in the IDU including the altitude set-downs using the Lateral and Vertical steering commands from the Genesys Aerosystems EFIS.

3.10.7 Selecting Missed Approach Altitude

When conducting an ILS approach, it is recommended the pilot set the missed approach altitude into the altitude selector of the EFIS display (altitude bug) once established on final approach altitude and before glide-slope capture for possible use at a later time. At the Missed Approach Point (MAP), press the GO-AROUND button.

This will disengage the autopilot and engage the Flight Director in the ROLL and PITCH Modes with pitch-up indication on the EFIS display. The pilot should fly the aircraft by reference to the steering command bars. If missed approach altitude was set into the altitude selector of the EFIS display (altitude bug) previously by the pilot, the autopilot may be set to climb to capture the altitude in VS or IAS modes. If it is desired to use the autopilot to fly the aircraft rather than using the FD bars as a reference, the pilot may press the AP button when a safe altitude has been reached.

3.11 Vertical Speed (VS) Mode

Press the VS button to engage the VS Mode. The commanded vertical speed and direction will be displayed on the EFIS display. The vertical speed will synchronize to the existing aircraft vertical speed when engaged in VS mode. Select a new vertical speed via the EFIS display VS selector (VS bug). The maximum vertical speed limits vary from 2000 FPM to 4000 FPM depending on aircraft type. Vertical Speed Mode is normally used to capture a pre-selected altitude, although the IAS Mode and basic PITCH mode with ALT armed can be used, if desired.

Pressing the VS Mode button once engaged in VS Mode (VS mode to off) will leave the autopilot in the PITCH Mode. VS will flash the mode annunciation on the EFIS display in a climb when there is a 300 FPM error between commanded and actual vertical speed that exists for more than 10 seconds. If VS command numbers are inconsistent with the Target Altitude, the commanded VS numbers and VS arrow will flash on the display.

3.12 Indicated Air Speed (IAS) Mode

The Airspeed Hold Mode will synchronize to the current aircraft airspeed when engaged. Select a new airspeed via the EFIS display IAS selector (IAS bug). The IAS Mode instead of the VS Mode can be used to capture a pre-selected altitude, if desired.

Pressing the IAS button once engaged in IAS Mode (IAS mode to off), will leave the autopilot in the basic PITCH Mode.

3.13 Altitude Selector / Alerter Function

Select the desired altitude (preselect) on the EFIS display (Altitude bug). Once the desired altitude is selected, press the VS or IAS button which engages the Vertical Speed or IAS Modes with ALT mode armed. Modify the selected vertical speed or selected indicated airspeed (VS or IAS bug), as necessary, on the EFIS display to obtain the desired rate of climb or descent to capture the selected altitude.

The autopilot will give an aural annunciation at 1000 ft. and 200 ft. before reaching the altitude. When on altitude, the autopilot will give an aural annunciation of "Altitude". It will also annunciate "Check Altitude" if the aircraft departs from the selected altitude by 200 ft.

When capturing an altitude with VS Mode, the rate of closure is reduced as the target altitude is approached for a smooth capture.

When capturing an altitude with IAS Mode, at approximately 500 ft. before the target altitude, the autopilot will begin reducing the rate of closure for a smooth capture. At this point, the vertical speed will be displayed instead of IAS.

If the airplane is at the target altitude when VS, IAS, or PITCH Mode is engaged, the altitude target is automatically cancelled since it is assumed the pilot's intention is to depart from the current altitude.

Caution:

The pilot should carefully monitor airspeed and power when in the Vertical Speed Mode. Too much climb VS may cause the aircraft to stall and disconnect the autopilot; while too much descent VS may cause the aircraft to exceed VMO. There is no airspeed limit protection when in the VS Mode in the autopilot (FGC) itself. However some interfacing EFIS systems (such as the Genesys Aerosystems EFIS) protect against overspeeds by limiting the VS command from the display while monitoring the IAS. It is necessary to understand the capabilities of the interfacing EFIS to know whether there is protection or not. In any case, even if the interfacing EFIS has this protection, large power changes may cause the aircraft to exceed these limits momentarily. The autopilot (FGC) itself is designed to limit the aircraft to a safe airspeed (approximately 3 to 5 knots from VMO) in IAS Mode, however to capture an altitude target from IAS, the system will switch to Capture Mode just before capturing the selected altitude. During this period, IAS control is not active and will not regulate the airspeed. It is recommended practice to monitor speed and power in climbs and descents using the autopilot to capture an altitude.

3.14 Altitude Capture (ALT-CAP) Mode

ALT-CAP is the transitional mode that provides guidance to change the vertical speed in proportion to the decreasing difference between the selected altitude and the aircraft's changing altitude in order to smoothly capture the selected altitude.

This mode is automatically activated once the aircraft is flying toward the selected altitude and the aircraft's actual altitude is close enough to the selected altitude that the autopilot needs to start changing the vertical speed so that a smooth capture of the selected altitude is made.

The altitude capture mode is automatically deactivated and the altitude hold mode is automatically activated once the selected altitude is reached.

3.15 Altitude Hold (ALT) Mode

Pressing the ALT button will cause the autopilot to capture the existing altitude at engagement. If climbing or descending when altitude hold is engaged, some altitude overshoot can be expected with a smooth return to the target altitude.

3.16 Vertical Modifier (UP / DN) Buttons (if equipped MCP installed)

If a MCP equipped with UP/DN modifier buttons is installed, the response of these buttons is dependent on the following vertical modes.

3.16.1 Pitch Mode Active

Successive presses of the UP/DN button will increase or decrease the attitude hold reference by approximately 0.25 degrees-per-press. If the button is held down for 3 or more seconds the system will modify the pitch attitude at a rate of approximately 0.75 degrees-per-second.

3.16.2 IAS Mode Active

Successive presses of the UP/DN button will increase or decrease the IAS hold reference. Pressing the UP or DN button will increase or decrease, respectively, the IAS by one knot per-button-press. Holding the UP or DN button down for 3 or more seconds will cause the IAS to change at a rate of 5 knots-per-second.

3.16.3 VS Mode Active

The first button press of the UP or DN button rounds the VS to the nearest 100 feet per minute (fpm). Successive button presses increase or decrease the vertical speed reference either up or down at a rate of 100 fpm, per-button-press. If the button is held down for 3 or more seconds, the system modifies the rate at 300 fpm, per each second while the button is held down.

3.16.4 ALT Mode Active

If ALT Mode is active, successive button presses of the UP or DN button increases or decreases the altitude hold reference, up or down, by 20 feet per-button-press. If the button is held down for 3 or more seconds, the system modifies the reference altitude, up or down, at the rate of 40 ft. each second the button is held down up to 500 ft. from the reference altitude.

3.17 Autotrim

With Automatic Trim functioning properly, the aircraft elevator trim will be maintained automatically when the Trim Master Switch is ON. When the trim is in motion, the FGC will send a message to the display system that will indicate trim is in motion. Typical display implementation of this data is as follows:

- A Trim UP/DN annunciation appears solid after 3 seconds.
- Begins flashing after 7 seconds and continues flashing until condition removed.
- A voice annunciated "Trim-In-Motion" begins after 12 seconds and continues until the condition is removed (trim sensors in pitch servo).

When the Trim Master Switch is OFF, or Trim fails, the autopilot will revert to the trim prompts. The FGC will send a message to the display system that will indicate trim is recommended. Typical display implementation of this data is as follows:

- A Trim UP/DN appears flashing after 3 seconds with a voice "Check Pitch Trim".
- Continues flashing and voice until condition removed (trim sensors in pitch servo).

3.18 Manual Electric Trim

The autopilot is equipped with a Manual Electric Trim system that is controlled by a two-segment switch on the pilot's and copilot's control wheels. Move both switch segments FWD for nose down trim and AFT for nose up trim. Activation of this switch disconnects the autopilot if it is engaged. The pilot's trim switch will over-ride the copilot's trim switch.

The FGC will send a message to the display system that will indicate trim has been activated. Typical display implementation of this data is to flash a trim annunciation directly at the closure of the manual trim switches and stay for the duration of the manual trimming.

3.19 Go-Around Button

The Go-Around (GA) button, when pressed, engages the Flight Director in a pitch-up attitude, specific to the aircraft type, with wings level in the roll axis. The pilot should fly the aircraft with reference to the steering bars displayed on the EFIS display. Pressing the GA button will disengage the autopilot and cancel all armed modes. It will also cancel any preselected altitudes.

3.20 Voice Annunciations / Alerts

The system includes a digitally sampled feminine voice to annunciate important conditions.

"TRIM IN MOTION, TRIM IN MOTION..."

If the pitch trim runs for more than 12 seconds, the system will voice annunciate this message and continue as long as the trim is running.

"CHECK PITCH TRIM"

The system will voice annunciate this message if an out of trim condition has existed for 3 seconds.

"ALTITUDE 1000 TO GO"

The system will voice annunciate 1000 ft. before approaching the selected altitude.

"ALTITUDE 200 TO GO"

The system will voice annunciate 200 ft. before approaching the selected altitude.

"ALTITUDE"

The system will voice annunciate when on altitude.

"CHECK ALTITUDE"

The system will voice annunciate this message, after the system aural tone, if the aircraft departs the selected altitude by 200 ft. or more.

"AUTOPILOT DISCONNECT"

The system will voice annunciate after the system aural alert tone indicating that the autopilot has been disengaged.

AUTOPILOT DISCONNECT (TONE)

When the autopilot disconnects, an aural beep will sound for approximately 6 seconds. This tone can be shortened by holding the disconnect button.

SECTION 4 NON-NORMAL PROCEDURES FAILURES

Page Intentionally Blank

4.1 General

If the autopilot, for whatever reason, is not behaving properly, the pilot must disconnect it using the AP Disconnect, turning OFF the AP MASTER or pulling AP circuit breaker (CB).

4.2 Trim Runaways

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

If the autopilot is engaged and the trim begins to run uncommanded up and down, the autopilot will fight the trim movement and eventually trip the AP CB (approximately 3 seconds), stopping trim movement. In this case, the Trim Master Switch can be turned off, or the trim CB pulled, and the AP re-engaged. The pilot will now have to manually trim the aircraft.

If the autopilot is not engaged and the trim begins to run uncommanded, the pilot's first reaction is to push and hold the AP Disconnect. This will interrupt power to the trim servo. The Trim Master can then be turned OFF and the Trim CB pulled. The pilot must manually trim the aircraft. AP use is not inhibited with the trim OFF, but the pilot should manually trim in response to the AP Trim annunciations.

4.3 Hardovers

S-TEC has made every effort to minimize the possibility of a hardover condition (servo runaway). On the very remote chance that a hardover occurs, the AP has built in limiters to mitigate the severity of response. The AP will inhibit (but not disconnect) the pitch servos if the G loading exceeds ± 0.6 G's from normal flight, or if the pitch rate exceeds $4^\circ/\text{sec}$. In roll, the servo will be inhibited (but not disconnected) if the roll rate exceeds $10^\circ/\text{sec}$. If such an event occurs and is not the result of turbulence, the pilot should immediately disconnect the AP.

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 AP is protected in two ways from such an event. A miscompare of the pitch or roll axis of more than 5° will disconnect the AP. Additionally, the autopilot will be disconnected at 38° of roll and / or 22° of pitch if the aircraft is not recovering (the AP limits attitude to 30° of roll and 17° of pitch). The pilot should determine the cause of the problem before re-engaging the AP.

4.5 Servo Clutches and Speeds

The System incorporates slip clutches on all four servos to allow the pilot to overpower the autopilot, trim, and yaw system. The servo speeds are limited to reduce the effect of hard over conditions in order to constrain the aircraft excursion due to a hard over condition. Servo speeds are chosen and the clutch torque settings are set for each aircraft model such that the hard over requirements in AC 23-17A section 1329(3)(b) will be met.

Page Intentionally Blank

SECTION 5 CERTIFICATION BASIS

Page Intentionally Blank

5.1 Certification

- The system has been determined to meet all necessary safety requirements, and has TSO C9c & C52b approval.
- Electrical and Environmental categories are in accordance with RTCA DO-160E as follows:
 - a. [D2X]BBB[SM]XXXXXXBBZ[CC][WR]M[A2E3X]XXXX
 - b. Software approval is in accordance with RTCA DO-178B, Level C.
 - c. Hardware approval for micro-coded components are in accordance with RTCA DO-254, Level C.

Page Intentionally Blank

SECTION 6 GLOSSARY

Page Intentionally Blank

Term	Meaning
A/C	Aircraft
ADAHRS	Air Data Attitude Heading Reference System
ADJ	Adjustment
AFM	Aircraft Flight Manual
AFMS	Aircraft Flight Manual Supplement
ALT	Altitude
AP	Autopilot
APR	Approach
ARS	Aircraft Reference Symbol
BARO	Barometric
CAP	Capture
CB	Circuit Breaker
CCW	Counter–Clockwise
CDI	Course Deviation Indication
CRS	Course
CW	Clockwise
CWS	Control Wheel Steering
DFCS	Digital Flight Control System
DG	Directional Gyro
DH	Decision Height
DISC	Disconnect
EFIS	Electronic Flight Instrument System
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FCC	Flight Control Computer
FD	Flight Director
FGC	Flight Guidance Computer
FPM	Feet–per–Minute
FMS	Flight Management System
FT	Feet
GA	Go Around
GDI	Glideslope Deviation Indication
GPS	Global Positioning System
GPSS	Global Positioning System Steering
GS	Glideslope
HDG	Heading
HSI	Horizontal Situation Indicator
IAS	Indicated Airspeed
IDU	Integrated Display Unit
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INTR	Interrupt
KTS	Knots

S-TEC

LOC	Localizer
MAP	Missed Approach Point
MCP	Mode Control Panel
MDA	Minimum Descent Altitude
NAV	Navigation
NM	Nautical Miles
OBS	Omnibearing Selector
PLX	Parallax
PN	Part Number
POH	Pilot's Operating Handbook
RDY	Ready
REV	Reverse
RTCA	Radio Technical Commission for Aeronautics
TSO	Technical Standard Order
VLOC	VOR or LOC Frequency
VMC	Visual Meteorological Conditions
VMO	Maximum Operating Limit Speed
VNAV	Vertical Navigation
VOR	Very High Frequency Omnidirectional Radio Range
VS	Vertical Speed
YD	Yaw Damper



Information contained in this document is subject to change without notice. © 2016 S-TEC. All rights reserved. Printed in the United States of America. S-TEC and the S-TEC logo are registered trademarks of S-TEC.

Notice:

Contact S-TEC Customer Support at 800-872-7832 for a Service Repair Order (SRO) number prior to the return of any component for any reason.

**One S-TEC Way
Municipal Airport
Mineral Wells, TX 76067-9236
Tel: 800-872-7832
Fax: 940-325-3904
www.genesys-aerosystems.com
S-TEC PN 87298**