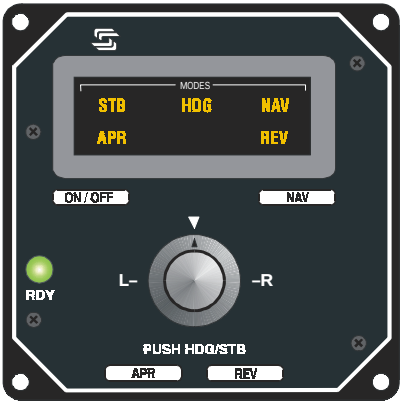
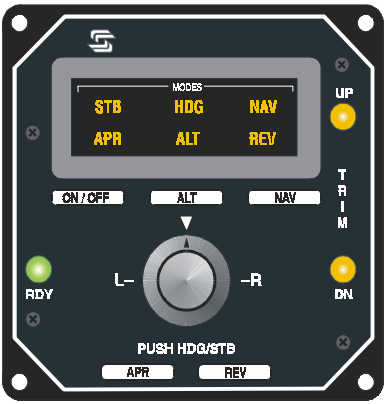
System 40/50 Autopilots
Pilot's Operating Handbook





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SECTION 1
INTRODUCTION

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1.0 Introduction

The primary purpose of the System 40/50 **Pilot Operating Handbook (POH)** is to provide pilots with step-by-step functional Preflight and In-Flight Operating Procedures for the installed system.

1.1 Notice

This manual may be used in conjunction with FAA approved autopilot Airplane Flight Manual Supplement (AFMS), Pilots Operating Handbook Supplement (POHS), or Supplemental Flight Manual (SFM). Refer to the specific AFMS, POHS, or SFM for your aircraft specific information and emergency operating procedures.

If the autopilot is to be used during Instrument Flight Rules (IFR) operations, we recommend that you develop a thorough understanding of the autopilot system, its functions, and characteristics in Visual Meteorological Conditions (VMC). Accomplish this before undertaking an IFR flight.

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SECTION 2
BLOCK DIAGRAM

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2.0 Block Diagrams

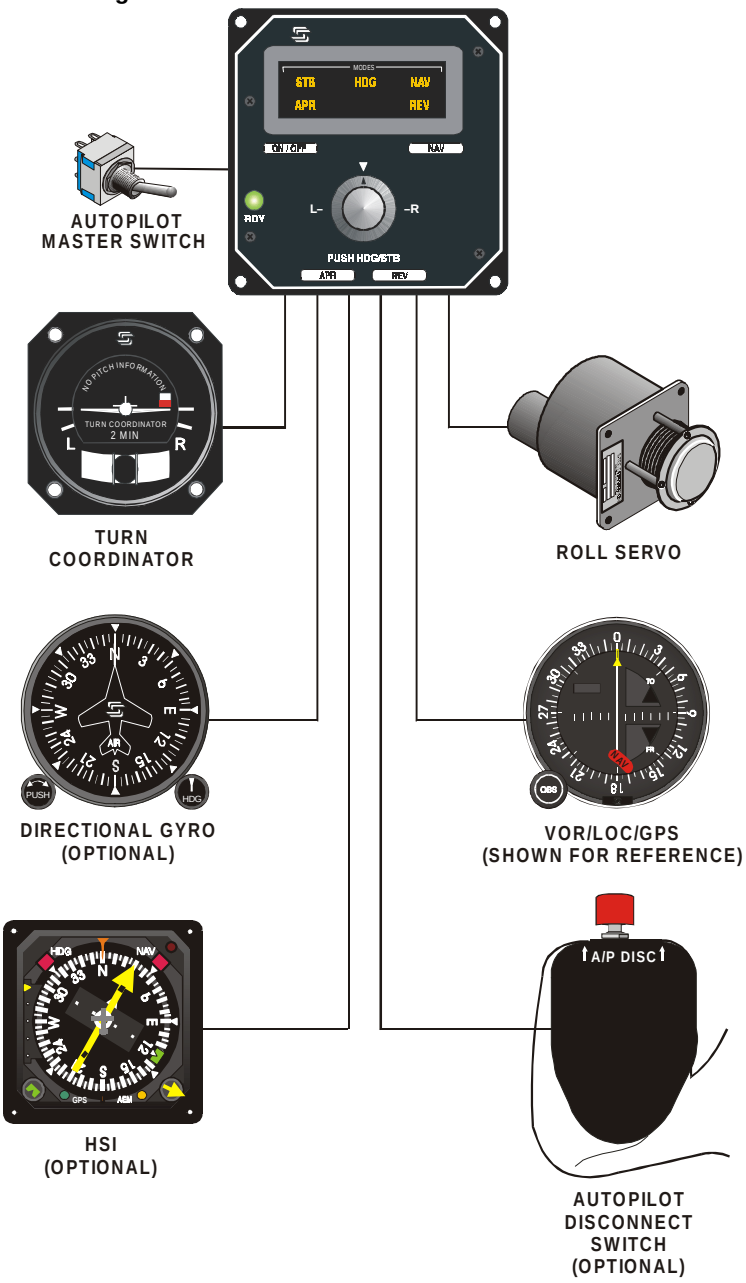

Fig. 2-1. System 40 Programmer/Computer

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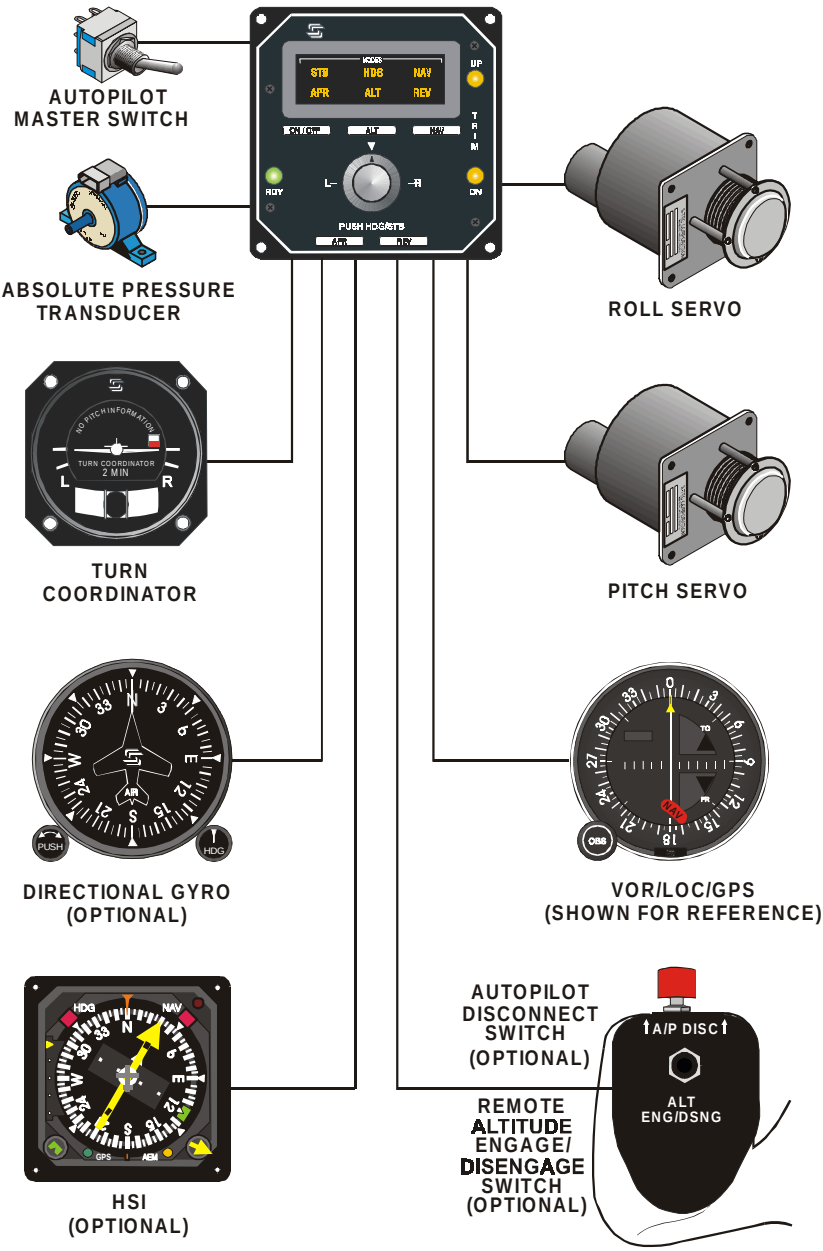

Fig. 2-2. System 50 Programmer/Computer

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SECTION 3
THEORY OF OPERATION

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3.0 Theory of Operation

3.1 System 40 Modes of Operation

NOTE: The Aircraft (AC) instrument light rheostat controls the annunciator and indicator brightness.

1. The System 40 provides the aircraft with Roll Axis control only.

2. The Turn Coordinator contains the Rate Gyro, Autopilot pick-off, Rate Gyro RPM detector, and an instrument power monitor that will flag if low system voltage occurs.

3. The System 40 Programmer/Computer, which contains the Roll Computer, receives power through the battery buss and connects to the panel mounted ON/OFF/TEST switch through the A/P circuit breaker (CB).

4. The Rate Gyro is the basic sensor for roll stabilization.

5. The Rate Gyro signal combines either with the Turn Command Knob, Heading Error Signal, or NAV inputs to generate a Roll Error signal, which then drives the roll servo as needed.

6. The System 40 operates in one of five Roll Modes, three of which are Navigation (NAV) Modes. The Roll modes are Stabilizer (STB) and Heading (HDG); the NAV Modes are Approach (APR), Navigation (NAV), and Reverse (REV).

7. The Programmer/Computer Unit provides the Mode Select Switches and annunciation for the system.

8. Mode Annunciation Window displays mode in use.

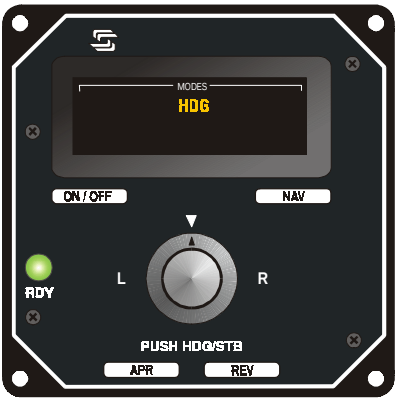
10. ON/OFF Mode Switch engages the roll system in the Stabilizer (STB) Mode. This allows use of the Turn Knob to command up to a standard rate turn. (90%).

11. Navigation Mode Switch (NAV) will engage the VOR/GPS/LORAN Tracking Mode. This provides low system gain for comfortable cross-country tracking.

12. Approach Mode Switch (APR) engages the VOR/GPS/LORAN or Localizer Tracking Mode. This provides a higher level of system gain for more active tracking of VOR, GPS or Localizer front course signals.

13. Reverse Approach Mode Switch (REV) will engage the Reverse Tracking Mode for use when tracking a localizer back course. This provides APR mode system gain with reverse needle sensing.

14. HDG/STB Turn Knob/Switch allows left or right proportional turn commands to the roll servo in the STB Mode only. It activates the turn command for roll axis maneuvers up to 90% of standard turn rate.



15. To engage the Heading Mode (HDG), if optional DG or HSI is installed, press and release the Turn Knob. To return to STB Mode, press and release the Turn Knob again. When the system is in a NAV Mode and there is a DG or HSI installed, press and release the Turn Knob to return to HDG Mode.

3.2 System 50 Modes of Operation

NOTE: The System 50 Roll Axis function is identical to the System 40. Refer to the System 40 section for Roll Axis procedures.

1. The System 50 incorporates an accelerometer and absolute pressure transducer as pitch sensors.

2. When the Altitude Hold Mode is engaged, an elevator trim sensor in the pitch servo will detect the elevator trim condition.

3. Green Ready Light (RDY) illuminates when autopilot is ready for engagement.

4. Select a Roll mode.

5. Altitude Mode Switch (ALT) when pressed and released engages or disengages the Altitude Hold mode.

6. If the aircraft requires elevator trim, the indicator on the programmer/ computer unit will illuminate to indicate the direction of trim required to return the elevator to the trimmed position.

7. Trim Down Light (DN) illuminates to indicate the need for nose down trim.

8. Trim UP Light (UP) illuminates the need for nose up trim.

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SECTION 4
PROCEDURES

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4.0 Procedures

4.1 System 40 Functional Pre-Flight Procedures

NOTE: There must be adequate aircraft DC voltage (14 or 28VDC) to perform these checks. Low voltage may adversely effect the Functional Pre-flight Procedures.

1. Position the Avionics Master Switch ON, then position the A/P Master Switch to ON.

2. Position the A/P Master Switch to Test. RDY, STB, HDG, NAV, APR, and REV annunciators will illuminate. The lights remain on until positioning the Test Switch ON or OFF.

3. Position the A/P Master Switch to ON after the Turn Coordinator has reached its' rated RPM. Observe that the green Ready (RDY) light is on.

4. Press the ON/OFF switch; the STB light illuminates. Rotate Turn Knob left then right; observe that the control wheel moves respectively. Center Turn Knob; control wheel stops.

5. Set DG or HSI (if installed) and place HDG bug under lubber line, push Turn Knob to engage HDG mode. Observe HDG annunciator illuminates . Move HDG bug left and right; observe that the control wheel follows.

6. Override Test: Grasp the control wheel; slowly override the roll servo left then right to ensure proper clutch action.

CAUTION

Control Wheel movements should be smooth. If any unusual noise or restriction occur, have the system inspected for proper installation and proper clutch setting, immediately. Have repaired as needed. Do not operate the Autopilot under these conditions.

7. Radio Check: Tune the NAV radio to a valid VOR signal. Press and release the NAV Mode Switch the NAV lamp illuminates. Move VOR OBS so that the CDI needle moves left and right. Observe the control wheel moves respectively. Perform the same tests for the REV and APR modes.

NOTE: In REV Mode, observe that the control wheel moves opposite of the NAV needle and with more authority than in the NAV Mode.

NOTE: In APR Mode, observe that the control wheel follows the radio needle movement and with more authority than in the NAV Mode.

8. Use one of the following to disconnect the A/P. Press and release the remote AP Disconnect Switch on the control wheel (if installed). Press and release the "ON/OFF" Switch on the Autopilot Programmer Unit. Move the Autopilot Master Switch to Off. Pull the A/P Circuit breaker.

4.2 System 40 In-Flight Procedures

1. A/P Master Switch ON; RDY light illuminates.
2. Trim aircraft to desired flight conditions. Maintain yaw trim during all autopilot operations.
3. Center Turn Knob, press and release ON/OFF Switch.
4. Set Turn Knob to level or turning flight, as desired.
5. Set HDG bug (if installed) to a desired heading, press and release the Turn Knob to engage HDG Mode.

4.3 VOR Tracking and VOR Approach

NOTE: The System 40/50 does not provide intercept capability but will accurately **track** a reliable navigation signal when following one of the procedures listed.

1. Tune the NAV receiver, verify a valid NAV Signal, and then select a Radial.
2. Maneuver aircraft to the selected radial within +/- one needle width and within 10 degrees of the course heading.
3. Press and release NAV Mode for VOR cross-country tracking.
4. Press and release APR Mode for VOR approaches and more sensitive tracking, such as LORAN/GPS tracking.

NOTE: Approach Mode may be used to track VOR radials cross-country if desired. Use of APR Mode for cross country tracking may result in some course scalloping if the VOR signal is weak or otherwise "noisy". In areas of poor signal quality, NAV Mode may provide more accurate tracking even with reduced gain.

4.4 Localizer Approach

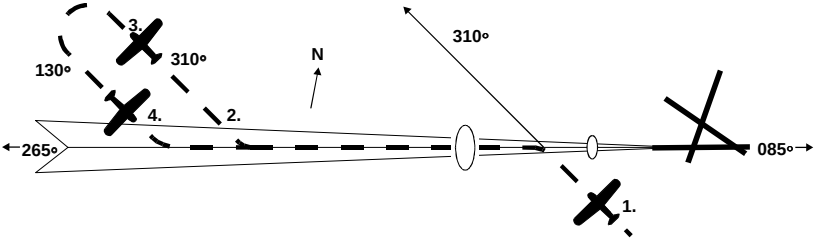
1. Tune the NAV receiver to desired Localizer frequency.
2. Maneuver aircraft to selected Localizer, within +/- one needle width and within 10 degrees of the course heading.
3. To track the Localizer **front course outbound**, maneuver to the Localizer center. When on the **OUTBOUND** heading, select **REV Mode**.
4. To track the Localizer **back courses inbound**, maneuver to the Localizer back course centerline. When on the **INBOUND** heading, select **REV Mode**.

4.5 GPS Tracking and GPS Approach

1. Enter desired waypoint in GPS receiver.
2. Maneuver aircraft to within +/- one needle width and within 10 degrees of the course heading.
3. Select APR Mode for GPS cross-country tracking or GPS Approach.

NOTE: When flying multiple waypoints repeat steps 2 & 3 for each leg if it involves more than 10 degrees of course change.

4.6 Procedure Turn Localizer Approach and Tracking with Standard DG



1. A. Tune navigation to LOC frequency. Verify signal.

   B. Select HDG Mode, position the aircraft on **OUTBOUND** LOC HDG.

   C. Select REV Mode, autopilot will track Localizer **OUTBOUND.**

2. A. Set HDG bug to **OUTBOUND** procedure turn HDG.

   B. Press HDG Mode Switch.

3. A. In 90 ° increments, set heading bug to **INBOUND** procedure turn heading.

4. A. Set heading bug to **INBOUND** LOC course heading.

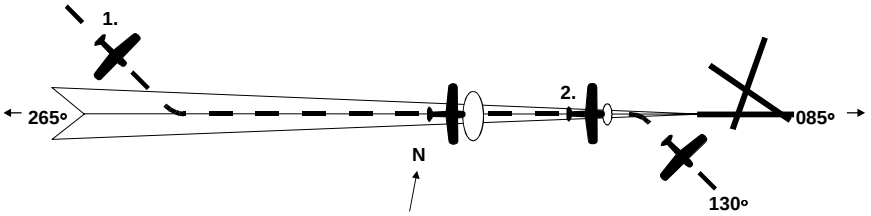
   B. When established on the Localizer inbound, press and release APR Mode Switch. Autopilot will track Localizer course to the airport.

If a missed approach is declared at the Middle Marker:

5. A. Disconnect the autopilot and stabilize the aircraft for a missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.7 Straight In Localizer Approach and Tracking with Standard DG



1. A. Tune navigation radio to Localizer frequency. Verify signal.

   B. Select the HDG Mode and position aircraft on the published LOC **INBOUND** heading course. (See note)

   C. Press and release APR Mode Switch. Autopilot will track the Localizer to the airport.

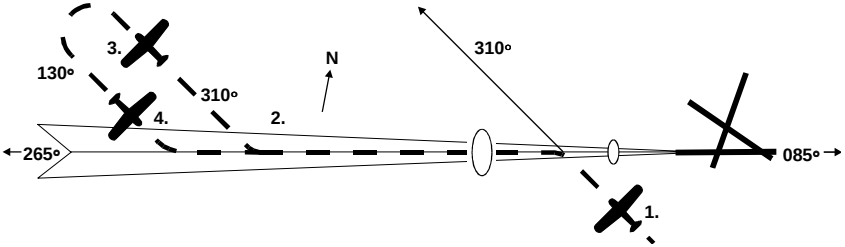
NOTE: In NO to LOW wind, turn to the published course for the airport. Engage APR Mode. With strong cross winds, select a HDG providing cross wind correction prior to engaging the APR Mode. **This is true for all Localizer Approach Procedures.**

If a missed approach is declared at the Middle Marker:

2. A. Disconnect the autopilot and stabilize the aircraft for a missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.8 Procedure Turn Localizer Approach and Tracking, Optional HSI



1. A. Tune navigation radio to LOC frequency.

   B. Set course pointer on published **INBOUND** LOC course HDG.

   C. Select HDG Mode and position aircraft on LOC **OUTBOUND**.

   D. Press and release REV Mode and the autopilot will track **OUTBOUND.**

2. A. Set heading bug to published **OUTBOUND** procedure turn heading.

   B. Press **HDG** Mode Switch.

3. A. In 90 ° increments, set heading bug to **INBOUND** procedure turn heading.

4. A. Set HDG bug to **INBOUND** LOC course heading.

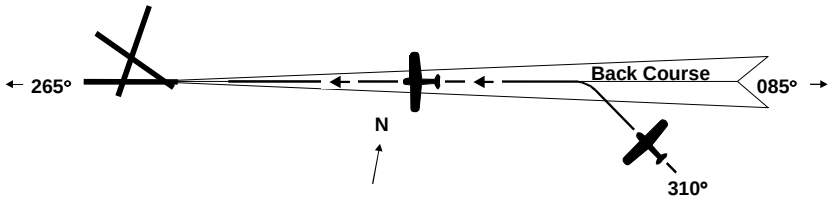
   B. When established on Localizer, press and release APR Mode Switch and the autopilot will track the Localizer to the airport.

If a missed approach is declared at the Middle Marker:

5. A. Disconnect the autopilot and stabilize the aircraft for a missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.9 Back Course Straight-In Approach, Optional HSI



Use the Reverse Mode to track the front course **OUTBOUND** or the back course **INBOUND** to the airport. Set the HSI Course Pointer to the front course **INBOUND** heading.

1. A. Tune navigation radio to LOC frequency.

   B. Set Course Pointer to published **INBOUND** front course heading.

   C. In HDG Mode, position the aircraft on the Localizer Back Course HDG to the airport.

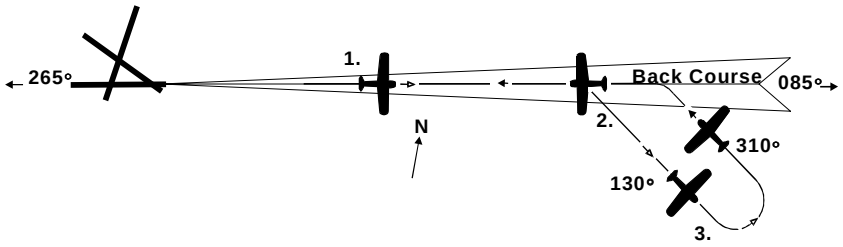
   D. Press and release the REV Mode Switch and the autopilot will track the Localizer to the airport.

If a missed approach is declared at the Middle Marker:

2. A. Disconnect the autopilot and stabilize the aircraft for a missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.10 Back Course Procedure Turn with Optional HSI



Use the Reverse Mode to track the front course **OUTBOUND** or the back course **INBOUND** to the airport. It is required to set the HSI Course Pointer to the front course **INBOUND** heading.

1. A. Tune the navigation receiver to LOC frequency.

   B. Set the course pointer to published **INBOUND** LOC front course heading.

   C. In HDG Mode, position the aircraft on the LOC back course.

   D. Press APR Mode Switch. Autopilot will capture and track back course **OUTBOUND.**

2. A. Set heading bug to published **OUTBOUND** procedure turn heading.

   B. Press HDG Mode Switch.

3. A. In 90° increments, set heading bug to **INBOUND** procedure turn heading.

   B. While still in the HDG Mode, position the aircraft on the Localizer back course to the airport.

   C. Press and release the REV Mode and the autopilot will track the Localizer back course to the airport.

If a missed approach is declared at the Middle Marker:

4. A. Disconnect the autopilot and stabilize the aircraft for the missed approach.

   B. After stabilized and in a climb, select the HDG Mode.

4.11 System 50 Functional Pre-Flight Procedures

NOTE: Refer to the System 40 Pre-Flight Procedures for Roll Command checks.

NOTE: During the functional checks, the system requires adequate DC voltage of 14 or 28 VDC minimum, as appropriate.

NOTE: The System 50 uses a vertical acceleration accelerometer to detect short-term AC motions, which, with the altitude transducer, controls AC Altitude. The accelerometer interrupts the pitch axis of the A/P any time the AC experiences a vertical acceleration of more than ±.6 "G" for more than .5 sec. The following procedure conducts a test of the automatic pitch interrupt feature. During the test the servo will engage and disengage automatically. If the test fails, the RDY light will not illuminate and the A/P will not engage.

1. Move A/P Master Switch to "TEST" position.

   A. Observe all lights and annunciators illuminate.

   B. Observe the following light sequence of the trim indicators: (Sequence requires 6-9 seconds).

      1. Initially, both trim UP & DN lights are illuminated. Pitch servo solenoid engages.

      2. UP light extinguishes. Pitch servo solenoid disengages.

      3. UP light illuminates. Pitch servo solenoid engages.

      4. DN light then extinguishes and will remain off. Pitch servo solenoid disengages.

      5. Observe that the green ready (RDY) light illuminates.

2. Move AP Master Switch to "ON" position.

NOTE: If the ready light does not illuminate after the test, this indicates a failure and the system requires service.

3. Engage STB Mode, move control wheel to the neutral position using the Left/Right Control knob.

NOTE: The A/P can be engaged and disengaged repeatedly without repeating the test sequence, unless electrical power is interrupted. If a power interruption occurs, accomplish the test again to get a RDY indication.

4. Move the Control Wheel to neutral elevator position.

5. Press and release the ALT Switch; ALT Annunciator illuminates. Move control wheel forward then AFT to override the Pitch Servo Clutch.

6. Engage Altitude Mode 15-20 sec. After successful completion of the Test sequence and engagement of the A/P in STB Mode.

CAUTION

Control wheel movements should be smooth. If any unusual noise or restrictions occur, immediately have the system inspected for proper installation and proper clutch settings.Have repaired as needed. Do not operate the Autopilot under these conditions.

7. Trim check: slowly apply back pressure to control wheel for 2-3 seconds. Observe the DN trim light illuminates. Slowly apply forward pressure to the control wheel for 2-3 seconds. DN light extinguishes and UP trim light illuminates. Move the control wheel to the center. UP light extinguishes.

8. Hold the control wheel, press and release the ON/OFF Switch, note that roll and pitch servos release. Move control wheel to confirm roll and pitch motions are free with no control restrictions or binding.

NOTE: If the optional Control Wheel disconnect switch is installed it may be used to disconnect the A/P for this check.

4.12 System 50 In-Flight Procedures

CAUTION

Conduct the required Pre-flight test, if necessary, in flight. However, the pitch servo will engage and disengage as part of the Self-Test. Therefore do not attempt flight maneuvers during the power-up test.

CAUTION

If the pilot fails to trim the aircraft, the UP or DN Trim Light will annunciate and after 4 seconds the trim light will flash.

1. Check the RDY light ON.
2. Trim aircraft for desired flight conditions. Maintain Yaw Trim during all Autopilot operations.
3. Center Turn Knob and press and release ON/OFF Switch.
4. Set Turn Knob to level flight or turn, as desired.
5. Set HDG bug to desired heading (if installed) and press and release Turn Knob to engage HDG Mode. Select headings as desired.

NOTE: Although the ALT Hold may be selected whether in a climb or descent, Step 6 is the preferred method for selecting ALT Hold to prevent the need for excessive trim corrections.

6. At the desired altitude, trim aircraft for level flight conditions, set power/elevator trim and engage ALT Hold.
7. Disengage ALT Mode to climb or descend.

NOTE: If the aircraft encounters turbulence, it is normal for the Trim Annunciator Lights to flicker. Elevator trim is only required if the Trim Annunciator Lights remain illuminated.

4.13 Emergency Procedures

This information is supplemental to and does not supercede or amend the information provided in the AFMS, POHS, SFM, for specific aircraft and autopilot installation manuals.

NOTE: If the aircraft does not have a copy of the required AFMS, POHS, or SFMs' please contact customer service and S-TEC will provide a copy at no cost. Have the aircraft make, model, and type of autopilot when calling for this supplement.

If the aircraft encounters any malfunctions with the A/P, follow the procedures below:

WARNING

In case of an autopilot malfunction, do not attempt to diagnose the problem in flight.

1. Immediately regain manual control of the aircraft by overriding the servo(s) and then disconnect the autopilot system.

NOTE: The system includes a friction override clutch on each servo. Overriding the Servo will not damage the system.

2. To disconnect the Autopilot, use one of the following means: Press and release the remote AP Disconnect Switch on the Control Wheel (if installed). Press and release the ON/OFF Switch on the Programmer/Computer. Move the Autopilot Master Switch to "OFF". Pull the autopilot circuit breaker.

3. If improper operations occur during an instrument approach, disconnect the system and fly a manual approach. If a failure occurs inside the Final Approach Fix, it is advisable to conduct a Missed Approach, notify the Air Traffic Control (ATC) of the problem and fly the approach manually seeking ATC's assistance as necessary.

4. If a particular mode of operation, including ALT Hold, develops a fault peculiar to that mode only, it is acceptable to operate the system in other modes as long as a determination can be made as to their satisfactory function.

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SECTION 5
APPENDICES

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Appendix A:
Specifications

System Requirements

Programmer/Computer

Power required	14/28 Vdc
Weight	2.2 lbs. (40), 2.8 lbs. (50)
Dimensions	3.28 x 3.28 x 7.4 in.
TSO	C9c

Directional Gyro (optional)

Power required	Vacuum or pressure, 4.5-5.2 Hg
Minimal air flow	2.2 CFM
Air filtration	3 Micron, 95%
Autopilot pick-off	AC, linear transformer, 5kHz, 8 VAC (pp) supplied by autopilot.
Weight	3.4 Lbs.
Dimensions	3.38 x 3.38 x 8.35 in.
Internal lights	14/28 Vdc

Roll Servo

Power required	14/28 Vdc
Current Requirements	Included in system requirements
Weight	2.9 lbs.
Dimensions	3.75 x 3.75 x 7.25 in.

Absolute Pressure Transducer

Power required	10 Vdc
Pressure Range	0-15 PSI Absolute
Overpressure	150% of operating maximum
Weight	0.2 lbs.

Pitch Servo

Same as Roll Servo

Turn Coordinator

Power required	14/28 Vdc
Flag Voltage Detector	9 Vdc (Approx.)
Tach RPM Detector	Normal less 10%
Current Requirements	.8 Amps/.4 AMPS
Dimensions	3.275 x 3.275 x 5.62 in.
Weight	1.8 lbs.

System Current Requirements

Average Operating Current

System	@14 Vdc	@28 Vdc
40	1.0 Amps	0.5 Amps
50	2.0 Amps	1.0 Amps

Max Current

System	@14 Vdc	@28 Vdc
40	3.0 Amps	2.0 Amps
50	5.0 Amps	3.0 Amps

SECTION 6
GLOSSARY

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GLOSSARY

Term	Meaning
AC	Aircraft
ALT	Altitude
AFMS	Airplane Flight Manual Supplement
A/P	Auto Pilot
CB	Circuit Breaker
CDI	Course Deviation Indicator
DG	Directional Gyro
FAA	Federal Aviation Administration
GPS	Global Positioning System
HDG	Heading
Hg	Mercury
HSI	Horizontal Situation Indicator
IFR	Instrument Flight Rules
IFP	In Flight Procedures
IMC	Instrument Meteorological Conditions
LOC	Localizer
LORAN	Long Range Navigation
NAV	Navigation
REV	Reverse
OBS	Omnibearing Selector
POH	Pilot's Operating Handbook
POHS	Pilot's Operating Handbook Supplement
PSI	Pounds Per Square Inch
RDY	Ready
SFM	Supplement Flight Manual
STB	Stabilizer
TSO	Technical Standard Order
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omnidirectional Radio Range

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