

CHAPTER 22

AUTOPILOT

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CHAPTER 22

AUTOPILOT

22-00 Description

The optional, factory-installed autopilot system consists of two electric servo assemblies, a flight control computer, a control panel, and control buttons on the pilot's cyclic grip.

The autopilot system also utilizes the Attitude Heading Reference System (AHRS; refer to § 97-13).

Two electric servo assemblies attach via push-pull tubes to the bottom of the cyclic stick. One servo controls pitch and is installed in the control tunnel forward of the cyclic stick. The other servo controls roll and is installed under the pilot's seat. Electromagnetic clutches engage or disengage servo inputs from the cyclic control system when selected by the pilot.

The flight control computer is located on a forward panel under the pilot's seat. The control panel is located below the GPS in the instrument console.

The primary autopilot mode is Stability Augmentation System (SAS) mode. In SAS mode the autopilot senses aircraft attitude from the flight control computer and the AHRS. The computer controls servo inputs to the cyclic to maintain attitude.

Additional modes, which may be used simultaneously when in SAS mode, are described in the Normal Procedures section of the R66 Pilot's Operating Handbook (POH) Autopilot Supplement.

The control panel has a row of buttons to control autopilot modes and annunciators to indicate mode status. A dark annunciator indicates that a mode is off, a white annunciator indicates that a mode is armed or on standby, and a green annunciator indicates that a mode is active. The annunciators flash alternating white and green during start up.

The cyclic grip-mounted buttons are the TRIM and AP OFF buttons. The TRIM button is used to reset the trim attitude. The autopilot tries to maintain the attitude at which the button is released. In addition, holding the TRIM button for more than 1.25 seconds engages the system from standby mode. The AP OFF button allows disengagement with hands on controls.

Safety monitors automatically disengage individual modes or the entire system if a malfunction is detected. Audio warnings consisting of beeps in the headset accompany the safety monitors and are described in the Normal Procedures section of the POH Autopilot Supplement.

The autopilot is protected by a dedicated circuit breaker on the avionics bus (autopilot is not powered with the avionics master switch off).

A. Schematic

Refer to MM Figure 98-8 for autopilot installation electrical schematic.

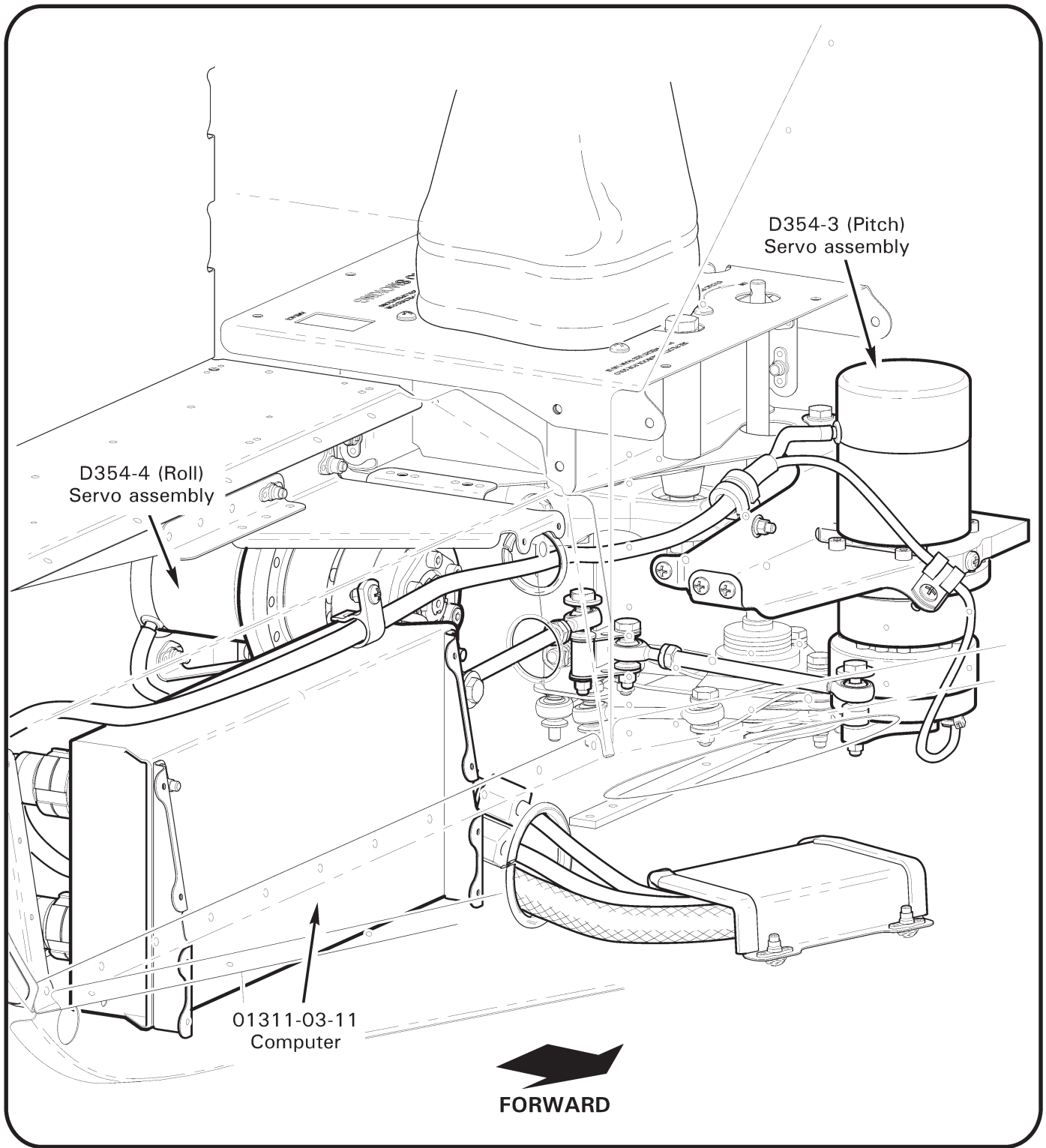


FIGURE 22-1 AUTOPILOT SYSTEM

22-10 (Pitch) Servo Assembly**A. Removal**

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Remove F680-3 and F445-1 collective covers and F444-1 cyclic cover. Hinge front right seat forward. Remove G702-7 cover assembly under pilot's seat.
3. Remove avionics and avionics trays as required from lower console.

CAUTION

Do not change the length of A336-8 push-pull tube and A127-3 rod ends center-to-center dimension (4.27–4.33 inches).

4. Position cyclic stick full aft and apply cyclic friction. Remove hardware (and C130-50 spacer) securing D354-3 (pitch) servo assembly arm to A336-8 push-pull tube's rod end.
5. Disconnect servo harness from 01311-03-11 flight control computer's J1 PITCH receptacle. Cut and discard ty-rap securing harness to M23190/1-2 clamp and pull harness through access holes into control tunnel.
6. Support servo and remove hardware securing servo's D353-4 brace to cyclic box and keel panels. Carefully remove servo from control tunnel.

B. Installation

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel. Position cyclic stick full aft and apply cyclic friction.
2. Position D354-3 (pitch) servo assembly in control tunnel and install hardware securing servo's D353-4 brace to cyclic box. Standard torque bolts per § 20-32 and torque stripe per Figure 5-1. Install screws securing brace to keel panels. Verify security.
3. Route servo harness through access holes and connect harness to 01311-03-11 flight control computer's J1 PITCH receptacle. Install ty-rap securing harness to M23190/1-2 clamp. Cinch ty-rap until snug without over-tightening, and trim tip flush with head. Verify harness security.
4. Install hardware (and C130-50 spacer) securing servo arm to A336-8 push-pull tube's rod end. Standard torque bolt per § 20-32 and torque stripe per Figure 5-1. Verify security.
5. Verify length of A336-8 push-pull tube and A127-3 rod ends center-to-center dimension is 4.27–4.33 inches.
6. Verify freedom of flight controls through full travel with and without friction applied.
7. Install avionics trays and avionics if removed. Verify security.
8. Push in AUTOPILOT circuit breaker (5 amp) at panel. Perform ground checks as appropriate per § 22-61.
9. Install G702-7 cover assembly under pilot's seat. Install F444-1 cyclic cover, and F445-1 and F680-3 collective covers. Verify security.

22-20 (Roll) Servo Assembly**A. Removal**

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Remove F680-3 and F445-1 collective covers. Remove G702-7 cover assembly under pilot's seat.

CAUTION

Do not change the length of A336-8 push-pull tube and A127-3 rod ends center-to-center dimension (4.17–4.23 inches).

3. Position cyclic stick full left and apply cyclic friction. Remove hardware securing D354-4 (roll) servo assembly arm to A336-8 push-pull tube's rod end.
4. Disconnect servo harness from 01311-03-11 flight control computer's J3 ROLL receptacle. Cut and discard ty-raps securing servo harness to autopilot harnesses.
5. Support servo and remove hardware securing servo's D352-14 block assembly to keel panel and D353-5 brace assembly. Carefully remove servo from under pilot's seat.

B. Installation

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel. Position cyclic stick full left and apply cyclic friction.
2. Position D354-4 (roll) servo assembly under pilot's seat and install hardware securing servo's D352-14 block assembly to keel panel and D353-5 brace assembly. Tighten screws. Verify security.
3. Connect servo harness to 01311-03-11 flight control computer's J3 ROLL receptacle. Install ty-raps securing servo harness to autopilot harnesses as required. Cinch ty-raps until snug without over-tightening, and trim tips flush with heads. Verify harness security.
4. Install hardware securing servo arm to A336-8 push-pull tube's rod end. Standard torque bolt per § 20-32 and torque stripe per Figure 5-1. Verify security.
5. Verify length of A336-8 push-pull tube and A127-3 rod ends center-to-center dimension is 4.17–4.23 inches.
6. Verify freedom of flight controls through full travel with and without friction applied.
7. Push in AUTOPILOT circuit breaker (5 amp) at panel. Perform ground checks as appropriate per § 22-61.
8. Install G702-7 cover assembly under pilot's seat. Install F445-1 and F680-3 collective covers. Verify security.

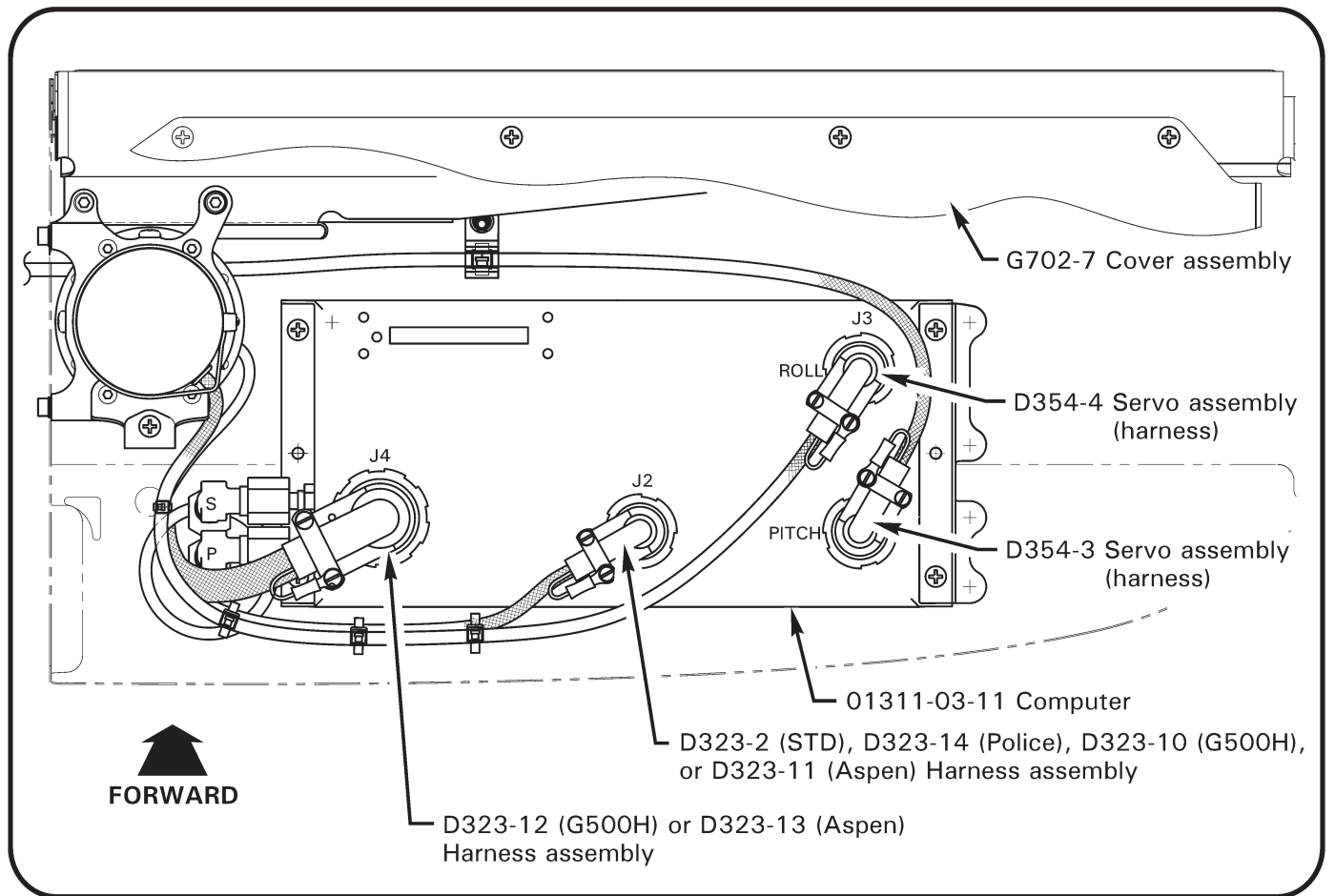


FIGURE 22-2 FLIGHT CONTROL COMPUTER

22-30 Flight Control Computer

A. Removal

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Remove G702-7 cover assembly under pilot's seat.
3. Disconnect D323 harness assemblies and D354 servo assembly harnesses from 01311-03-11 flight control computer's J1 PITCH, J2, J3 ROLL, and J4 receptacles.
4. Disconnect pitot and static tubes from computer. Plug elbows and tubes.
5. Support computer and remove screws securing computer to D358-1 support assemblies. Carefully remove computer from under pilot's seat.

22-30 Flight Control Computer (continued)**B. Installation**

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Position 01311-03-11 flight control computer under pilot's seat and install screws securing computer to D358-1 support assemblies. Tighten screws. Verify security.
3. Remove plugs and connect pitot and static tubes to computer. Perform pitot and static system leak checks per § 95-10.
4. Connect D323 harness assemblies and D354 servo assembly harnesses to computer's J1 PITCH, J2, J3 ROLL, and J4 receptacles. Install ty-raps securing harnesses as required. Cinch ty-raps until snug without over-tightening, and trim tips flush with heads. Verify harness security.
5. Verify freedom of flight controls through full travel with and without friction applied.
6. Push in AUTOPILOT circuit breaker (5 amp) at panel. Perform ground checks as appropriate per § 22-61.
7. Install G702-7 cover assembly under pilot's seat.

22-40 Control Panel**A. Removal**

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Loosen radio keys securing 01309-01-01 control panel from avionics tray.
3. Carefully unplug/remove control panel from tray.

B. Installation

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Carefully plug-in/install 01309-01-01 control panel in avionics tray.
3. Tighten radio keys securing control panel to tray. Verify security.
4. Push in AUTOPILOT circuit breaker (5 amp) at panel. Perform ground checks as appropriate per § 22-61.

22-50 Cyclic Grip Assembly

Refer to R66 Illustrated Parts Catalog (IPC) Figures 22-1 & 67-11.

A. Grip Angle Adjustment

1. Loosen cap screws securing pilot's cyclic grip, block assembly, and bar to grip weldment.
2. Rotate grip about weldment to desired angle. Special torque cap screws to 40 in.-lb.

B. Removal and Installation

Refer to § 67-12 for cyclic grip assembly removal and installation procedures.

To access grip switches:

1. Remove MS24693-S1 screws securing C214-27 plate to D379-1 grip. Remove switch nuts and lockwashers to free switches from plate.
2. Install switch lockwashers (new) and nuts and tighten switches to plate; verify switch security. Install screws securing plate to grip.
3. Turn battery switch on and perform ground checks as appropriate per § 22-61.

C. Schematic

Refer to MM Figure 98-1 for F024 electrical system schematic.

22-60 Maintenance

22-61 Scheduled Maintenance and Inspections

A. Ground Checks

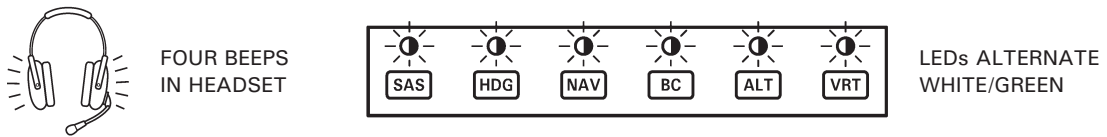
NOTE

Perform the following ground checks after component replacement or other repairs have been performed on the autopilot system. Perform ground checks after an accident or incident that may have affected autopilot or related equipment prior to return to service.

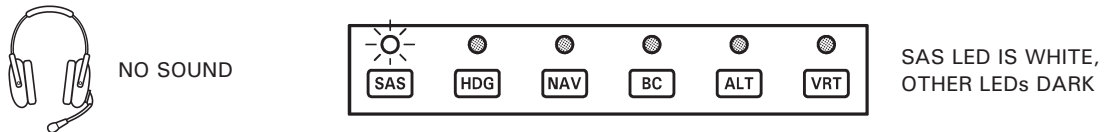
NOTE

Refer to § 22-62 for troubleshooting if any of the following ground checks cannot be verified.

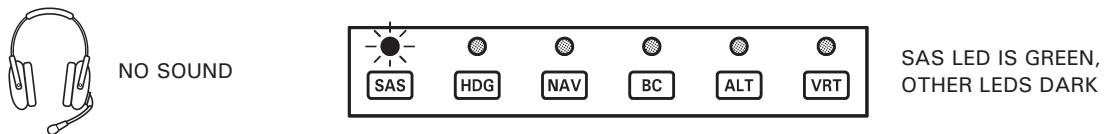
1. Turn battery & avionics switches on. Verify four beeps in headset and control panel LEDs alternate white/green:



2. Verify SAS enters standby mode approximately 6 seconds after attitude indicator caging flag exits window (pull and release caging knob if instrument bank angle exceeds 6 degrees). Verify no sound in headset and control panel SAS LED is white, other LEDs are dark:



3. Visually verify servo assembly arms do not move when moving cyclic.
4. Engage SAS mode (cyclic should feel "energized). Verify no sound in headset and control panel SAS LED is green, other LEDs are dark:

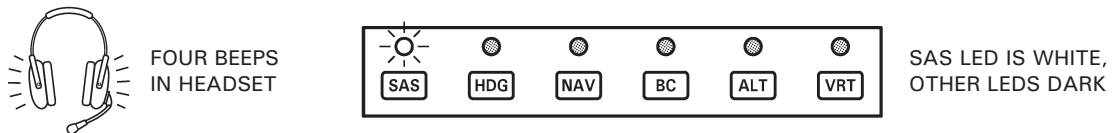


5. Install & activate hydraulic test pump (to simulate hydraulics-on operation) per § 12-34.
 - a. With SAS engaged, displace cyclic at least 1 inch from neutral position and verify SAS returns cyclic to neutral within ± 0.25 inch. Perform check for roll & pitch axes.
 - b. With SAS engaged, displace cyclic full deflection, and verify 2.5–3.5 lb force when displaced more than 1 inch from neutral position. Perform check for roll & pitch axes.

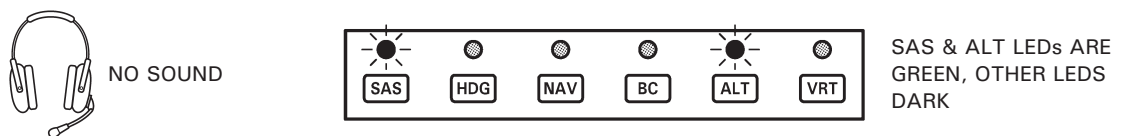
22-61 Scheduled Maintenance and Inspections (continued)

A. Ground Checks (continued)

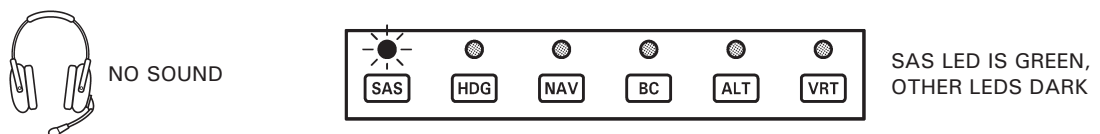
6. Refer to step 2. Engage SAS and verify SAS disengages when control panel's SAS button is depressed or when AP OFF button on the cyclic grip is depressed. Verify four beeps in headset and control panel SAS LED is white, other LEDs are dark:



7. Pressurize pitot system per § 95-10. Engage SAS and ALT modes. Verify no sound in headset and SAS & ALT LEDs are green, other LEDs are dark:



8. Disengage ALT mode. Verify no sound in headset and SAS LED is green, other LEDs are dark:



9. Refer to steps 7 & 8. Engage SAS and HDG modes. Verify no sound in headset and SAS & HDG LEDs are green, other LEDs are dark. Disengage HDG mode. Verify no sound in headset and SAS LED is green, other LEDs are dark.
10. Engage SAS, HDG, and ALT modes. Verify no sound in headset and SAS, HDG, and ALT LEDs are green, other LEDs are dark. Press AP OFF button on cyclic grip. Verify no sound in headset and SAS LED is green, other LEDs are dark.
11. Engage SAS, HDG, and ALT modes. Verify no sound in headset and SAS, HDG, and ALT LEDs are green, other LEDs are dark. Press AP OFF button twice on cyclic grip. Verify four beeps in headset and SAS LED is white, other LEDs are dark.

B. Scheduled Maintenance and Inspections

Every 100-hour or annual inspection:

1. Inspect condition of associated equipment. Verify proper installation and security of equipment.
2. Inspect wiring condition. Verify no loose, chafed, or broken wires or terminals. Verify neatness, proper routing and installation, and security.
3. Inspect pitot and static lines for obstructions, cracking, chafing, pinching or kinking. Verify integrity of pitot and static line connections. Verify line security.
4. Perform ground checks per Part A.

22-62 Special Maintenance and Inspections

A. Troubleshooting

CAUTION
Adjustment to autopilot equipment is not permitted.

PROBLEM	ACTION
Control panel lights do not illuminate or flash when master switch is turned on.	Verify computer is getting power.
	Return computer to RHC.
System does not enter standby-mode (lights flash continuously).	Verify attitude indicator bank angle less than 6 degrees.
	Verify attitude indicator output between 13 and 14 pins is less than 0.3 volts at connector.
	Check wiring between attitude indicator and computer.
	Contact RHC Technical Support.
SAS does not engage when TRIM button depressed for longer than 1.25 seconds; pressing TRIM button does not reset reference attitude; pressing TRIM button does not reset reference altitude in altitude hold.	Check wiring between TRIM button and computer.
	Verify integrity of TRIM button.
	Return computer to RHC.
SAS does not disengage when cyclic grip AP OFF button depressed.	Check wiring between AP OFF button and computer.
	Verify integrity of AP OFF button.
	Return computer to RHC.
SAS does not engage or disengage when control panel buttons pressed.	Engage and/or disengage SAS using cyclic grip buttons. If system responds properly, failure is in control panel or associated wiring to computer.
	Contact RHC Technical Support.
SAS does not hold pitch attitude, but holds roll attitude or vice versa.	Check servo-to-cyclic linkage.
	Check wiring between faulty servo and computer.
	Return faulty servo and computer to RHC.
SAS disengages unintentionally (accompanied by four beeps in headset).	Contact RHC Technical Support.
Autopilot mode disengages unintentionally, and reverts to SAS mode (accompanied by single beep in headset).	Determine if navigation signal may have gone invalid due to operational reason.
	Check wiring between appropriate instrument/avionics and computer.
	Check instrument/avionics for failure flags (steady and intermittent).

22-62 Special Maintenance and Inspections (continued)

A. Troubleshooting (continued)

PROBLEM	ACTION
Cyclic vibrates erratically, SAS does not disengage.	Manually override SAS, system should disengage automatically.
	Contact RHC Technical Support.
Helicopter enters low frequency pitch oscillation when ALT engaged; helicopter diverges nose-up or nose-down when ALT engaged.	Return computer to RHC.
ILS glideslope tracking performance is poor.	Check for excessive friction in longitudinal cyclic.
	Check GPS output to computer.
Cyclic force seems higher than normal with SAS disengaged.	Verify servo clutches are disengaged, and clutch arms do not move when SAS is Off or in standby-mode.
No aural warning in headset when SAS is disengaged.	Check wiring to unswitched audio input to audio panel.

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