CHAPTER 22

AUTOPILOT

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CHAPTER 22

AUTOPILOT

22-00 Introduction

Two different autopilot systems are available as optional equipment on R66 helicopters.

Refer to § 22-10 for Garmin Flight Control System (FCS).

Refer to § 22-20 for HeliSAS (Stability Augmentation System).

22-10 Garmin Flight Control System (FCS)

22-11 Description

The Garmin GFC 600H Helicopter Flight Control System (FCS), consists of a GMC 605H Mode Controller, two GFS 83 servos for pitch & roll, an optional third servo for yaw, a GSU 75H ADAHRS (Air Data and Attitude Heading Reference System), GPS from a GTN, and a collective position sensor. Power to the FCS is provided through the AUTOPILOT FCS circuit breaker and avionics master switch.

The GMC 605H Mode Controller, located in the center console, is one means for the pilot to interface with the GFC 600H system. The GMC 605H Mode Controller displays active modes, references, and Crew-Alerting System (CAS) messages. Bezel keys provide a means to engage/disengage the FCS system and individual modes.

The GFS 83 is an electromechanical “smart” servo which activates the flight controls and also performs many FCS processing functions. The GFS 83 servos are installed in parallel with the primary flight controls, resulting in cyclic movement (2-axis), and antitorque pedal movement (3-axis only) directly proportional to movement of the servo. The GFS 83 provides fly-through capabilities, meaning that the pilot can override the system at any time by flying through any control forces which may be present. Upon releasing the controls, the system will return to its commanded references.

The GFS 83 servos installed for pitch and roll are a direct-drive style. This servo provides a fail-passive damping feature which reduces attitude deviation in the event of servo disconnect while the pilot’s hands are not on the controls. In the event of a mechanical jam in the servo, the pilot must apply sufficient force to the affected rotorcraft flight control to break the shear fuse at the output shaft of the servo, removing the servo from the control system and allowing free movement of the flight control. Some residual friction will be felt in the control axis after breaking the shear fuse.

Refer to R66 Pilot’s Operating Handbook (POH) Garmin GFC 600H Supplement for illustration of relative control forces.

For the optional 3-axis installation, a mechanically-clutched GFS 83 servo is installed for yaw. This servo contains a mechanical clutch to engage the motor drive to the servo output.

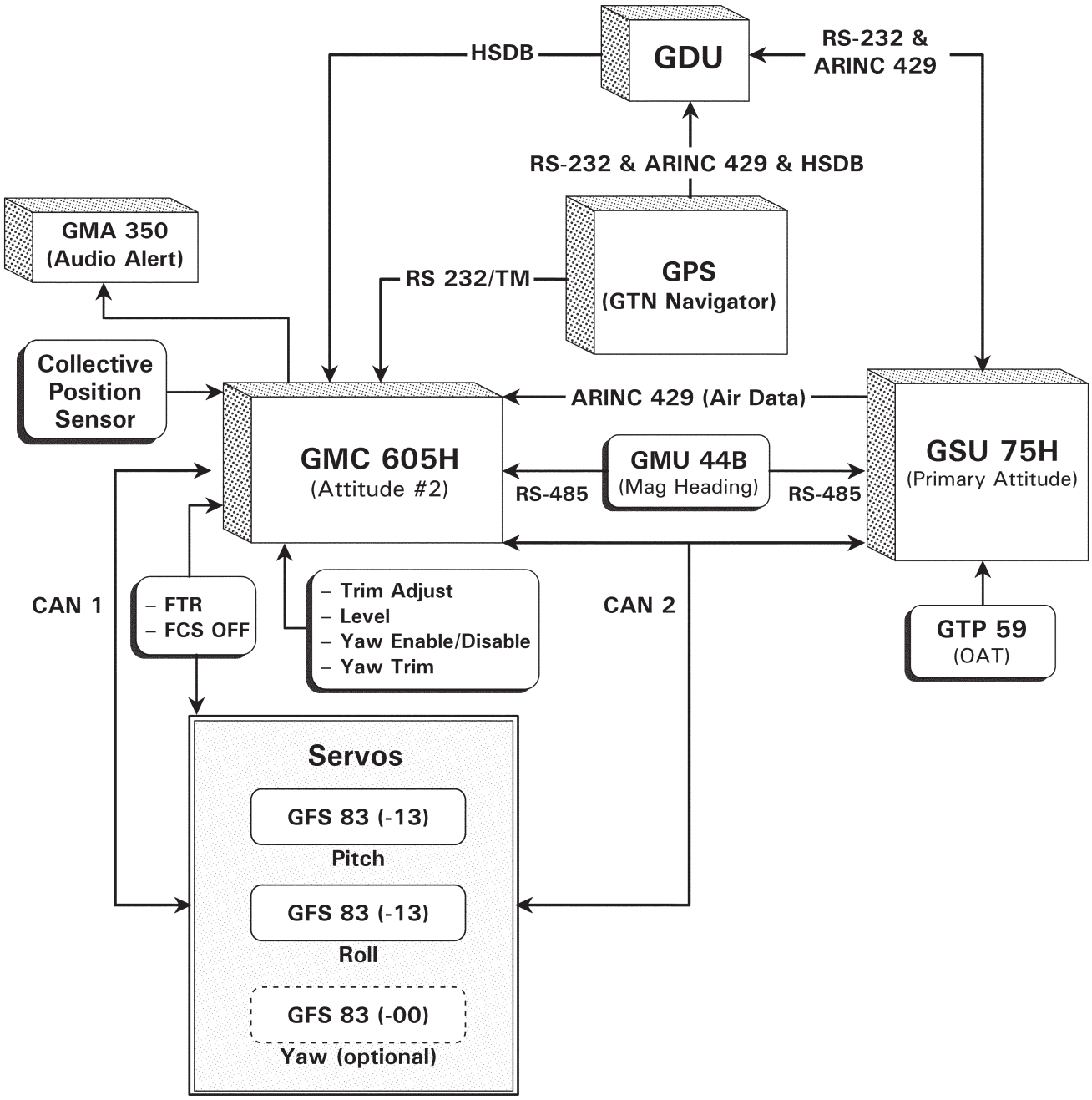


FIGURE 22-1 GARMIN FLIGHT CONTROL SYSTEM (FCS) – BLOCK DIAGRAM

22-11 Description (continued)

The GFC 600H system uses a minimum of two attitude sources and one air data source. A Garmin GSU 75H ADAHRS provides the primary attitude data and air data. The GMC 605H Mode Controller provides the second attitude source which is used to monitor the primary attitude source.

A Garmin GPS position source provides aiding to AHRS and is required for the ground Speed Hold (GSPD) and hover position hold (HOV), along with GPS navigational data for upper modes.

A position sensor provides collective position to the GFC 600H to improve system performance and aid in determining if the helicopter is on the ground.

Refer to R66 POH Section 9, Garmin GFC 600H Supplement, for operational details.

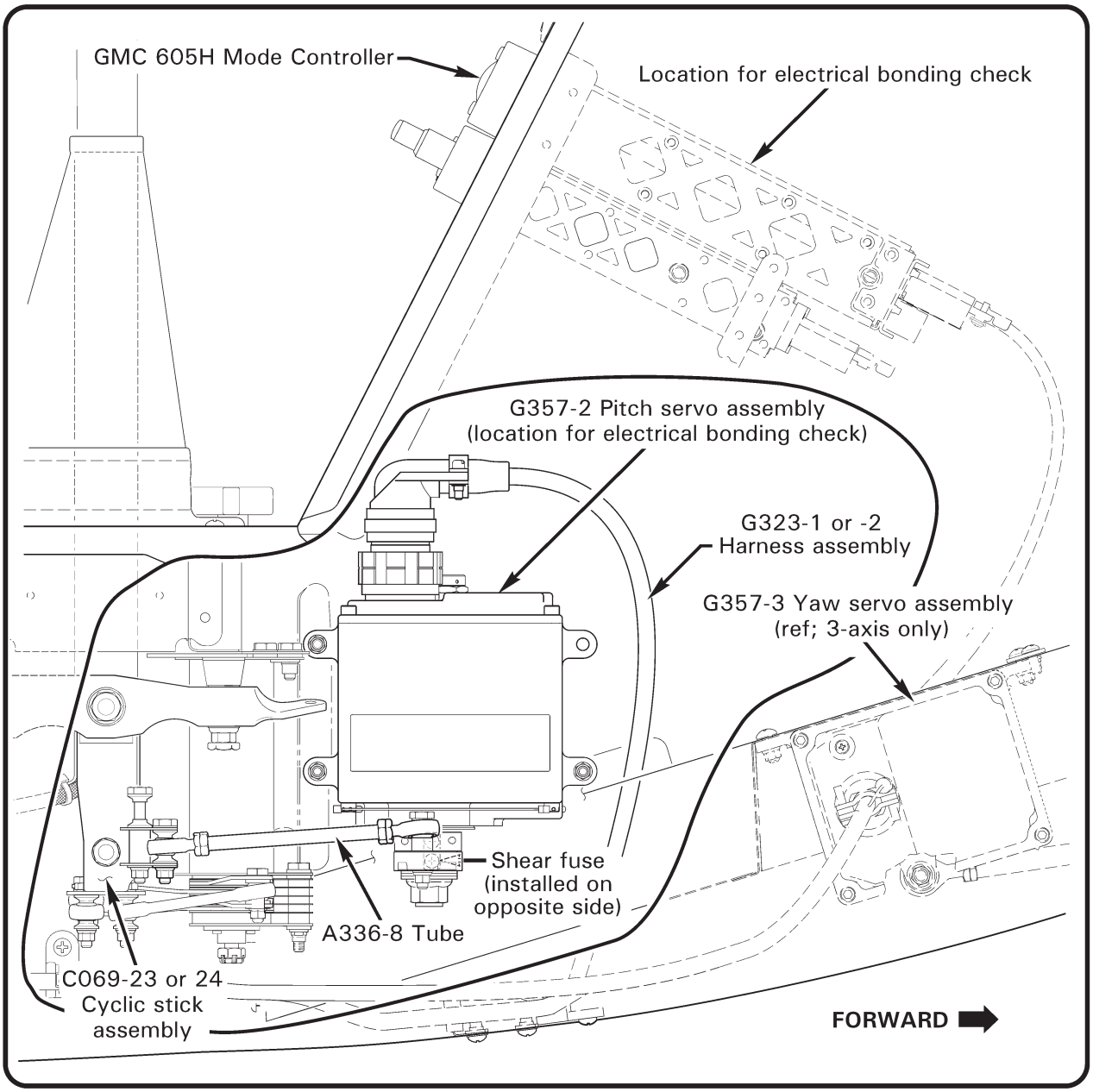


FIGURE 22-2 GARMIN FCS – PITCH SERVO ASSEMBLY

22-12 Garmin FCS – Servo Assemblies

22-12-1 Garmin FCS – Pitch Servo Assembly

A. Removal

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.
2. Refer to Figure 22-2 and IPC Figure 6-1. Remove hardware securing F680-3 cover and F445 collective covers, F640 avionics face, and F444 cyclic cover.

22-12-1 Garmin FCS – Pitch Servo Assembly (continued)

A. Removal (continued)

3. Remove avionics from lower console. Remove hardware securing avionics trays and remove trays from lower console.
4. Disconnect G323-1 or -2 harness assembly from servo assembly.
5. Position cyclic stick approximately mid-travel, longitudinally. Remove hardware (and C130-64 spacer) securing A336-8 tube's forward rod end to G357-2 servo assembly output arm.
6. While supporting servo, remove hardware and A130-35 spacers securing servo to F359-1 panel. Carefully remove servo from control tunnel.

B. Installation

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.
2. Verify A336-8 tube dimension is 4.60 ± 0.03 inches between rod end centers.
3. Position G357-2 servo assembly in control tunnel and install hardware and A130-35 spacers securing servo to F359-1 panel. Standard torque screws per § 20-32 and torque stripe per Figure 5-1. Verify security.
4. Install hardware (and C130-64 spacer) securing A336-8 tube's forward rod end to servo assembly output arm. Standard torque bolt per § 20-32 and torque stripe per Figure 5-1.
5. Perform servo-to-cabin electrical bonding check per § 22-16-3 Part B.
6. Connect G323-1 or -2 harness assembly to servo assembly. Verify harness security.
7. Move flight controls through full travel. Verify no binding or interference.
8. Install hardware securing avionics trays to lower console. Perform rack-to-cabin electrical bonding check per § 22-16-3 Part B.
9. Install avionics in appropriate location, if removed.
10. Refer to Figure 22-2 and IPC Figure 6-1. Install hardware securing F444 cyclic cover, F640 avionics face, and F445 and F680-3 collective covers.
11. If installing a replacement servo, or if servo has had maintenance performed, load software per § 22-16-1 Part C.
12. Perform servo range calibration per § 22-16-2 Part A.

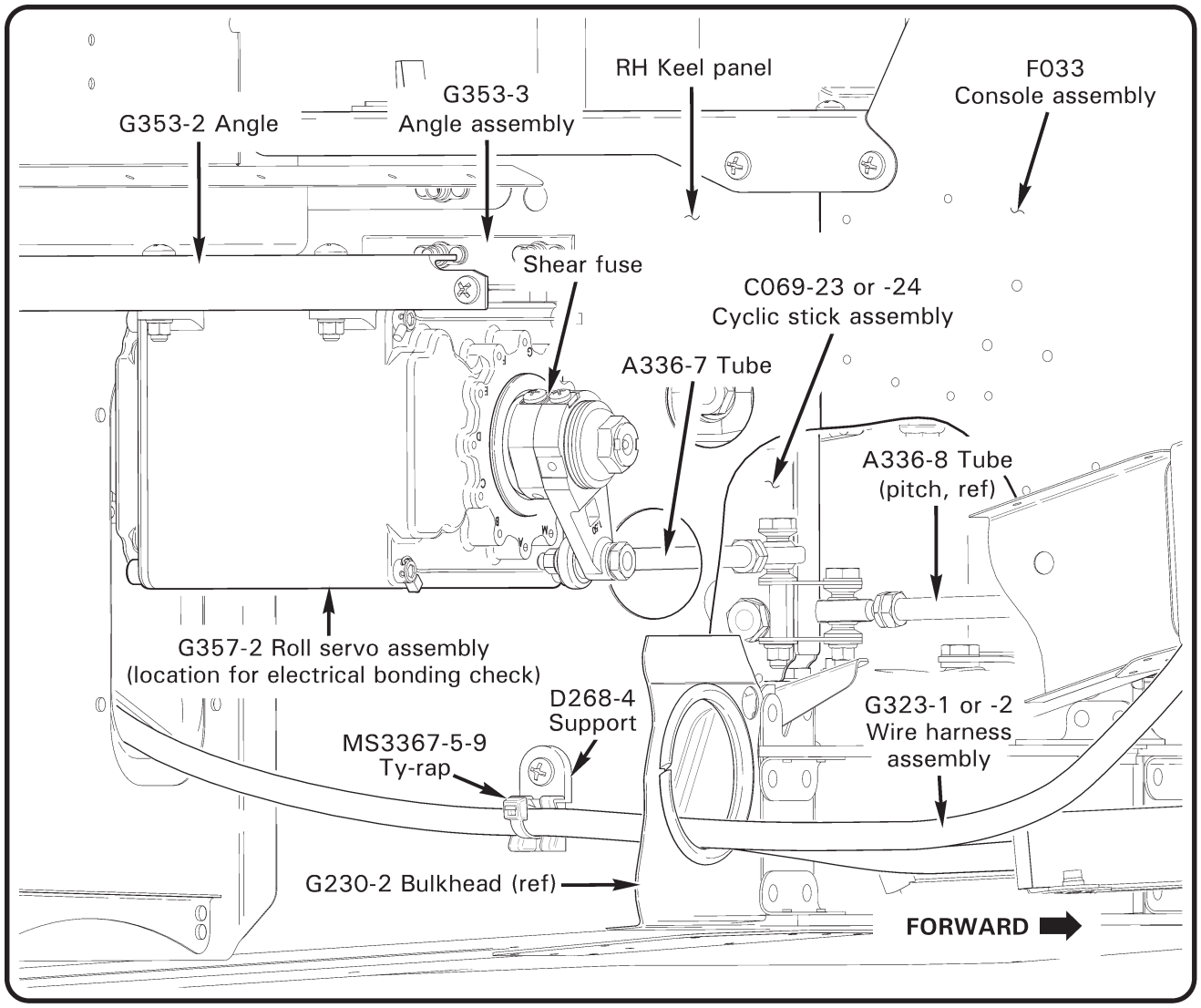


FIGURE 22-3 GARMIN FCS – ROLL SERVO ASSEMBLY

22-12-2 Garmin FCS – Roll Servo Assembly

A. Removal

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.
2. Refer to Figure 22-3 and IPC Figures 6-1, 6-11, and 6-13. Remove hardware securing F680-3 cover, F445 collective covers, and F794-1 panel.
3. Hinge front right seat forward. Remove hardware securing G702-14 cover assembly under pilot's seat and remove cover from helicopter.
4. Disconnect G323-1 or -2 harness assembly from G357-1 roll servo assembly.

22-12-2 Garmin FCS – Roll Servo Assembly (continued)

A. Removal (continued)

5. Position cyclic stick full forward and apply cyclic friction. Remove hardware (and C130-51 spacer) securing A336-7 tube's rod end to C069-23 or -24 cyclic stick assembly.

6. Refer to Figure 22-3. While supporting servo, remove screws securing G353-2 angle and G353-3 angle assembly and remove servo from under seat.

B. Installation

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel. Position cyclic stick full forward and apply cyclic friction.

2. If not previously accomplished, install hardware (and A130-20 and -35 spacers) securing G353-2 angle and G353-3 angle assembly to G357-1 servo assembly. Standard torque screws per § 20-32 and torque stripe per Figure 5-1.

3. Verify A336-7 tube dimension is 5.44 ± 0.03 inches between rod end centers.

4. If not previously accomplished, install hardware securing A336-7 tube's rod end to servo assembly's output arm. Standard torque hardware per § 20-32 and torque stripe per Figure 5-1.

5. Refer to Figure 22-3. Position servo assembly under pilot's seat, ensure A336-7 tube is thru hole in F293-2 panel and install screws securing G353-2 angle and G353-3 angle assembly to cabin. Verify security.

6. Install hardware (and C130-51 spacer) securing A336-7 push-pull tube's rod end to C069-23 or -24 cyclic stick assembly. Standard torque bolt per § 20-32 and torque stripe per Figure 5-1.

7. Perform servo-to-cabin electrical bonding check per § 22-16-3 Part B.

8. Connect G323-1 or -2 harness assembly to servo assembly. Verify harness security.

9. Move flight controls through full travel. Verify no binding or interference.

10. Refer to Figure 22-3 and IPC Figures 6-1, 6-11, and 6-13. Install screws securing G702-14 cover assembly under pilot's seat. Install F445, F680-3 collective covers, and F794-1 panel. Verify security.

11. If installing a replacement servo, or if servo has had maintenance performed, load software per § 22-16-1 Part C.

12. Perform servo range calibration per § 22-16-2 Part A.

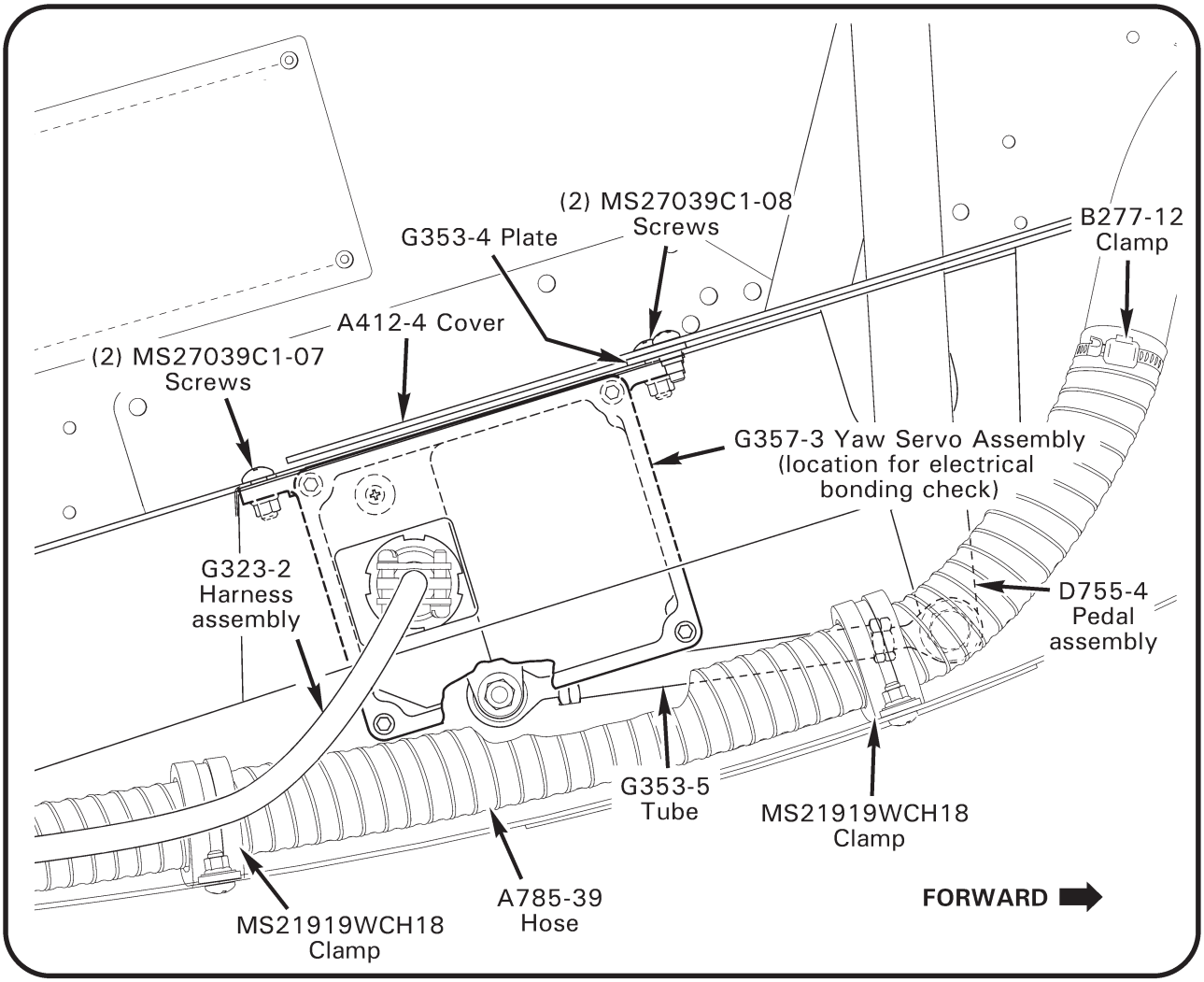


FIGURE 22-4 GARMIN FCS – YAW SERVO ASSEMBLY (3-AXIS INSTALLATION ONLY)

22-12-3 Garmin FCS – Yaw Servo Assembly (3-Axis Installation Only)

A. Removal

NOTE
G357-3 yaw servo assembly is required in the Garmin FCS 3-axis system. Removing yaw servo does not reconfigure the 3-axis to a 2-axis system.

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.
2. Refer to Figure 22-4. Remove pilot side carpet and scuff plate from floor per § 25-30. Remove screws securing A412-4 cover and C795-1 cover.
3. Loosen B277-12 clamp and remove (2) MS21919CHW18 clamps securing A785-39 hose. Gently move hose clear from under G357-3 servo assembly.

22-12-3 Garmin FCS – Yaw Servo Assembly (3-Axis Installation Only; continued)

A. Removal (continued)

4. Remove hardware securing C343-11 push-pull tube assembly and G353-5 tube's rod end to D755-4 pedal assembly.
5. Remove hardware securing F349-1 support assembly to lower console. Lift and temporarily secure support assembly to allow for servo assembly removal.
6. Disconnect G323-2 harness assembly from servo assembly.
7. While supporting servo assembly, remove screws and D210-3 nuts securing servo to floor and remove servo thru inspection hole in chin.

B. Installation

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.
2. Verify G353-5 tube dimension is 5.10 ± 0.03 inches between rod end centers.
3. If not previously accomplished, install hardware (and C130-15 spacer) securing G353-5 push-pull tube's rod end to G357-3 yaw servo assembly's output arm.
4. Insert servo assembly thru inspection hole in chin and position in floor. Install (2) MS27039C1-07 screws, (2) MS27039C1-08 screws, and (4) D210-3 nuts securing G353-4 plate and servo assembly to floor. Standard torque screws per § 20-32.
5. Position F349-1 support assembly in lower console. Install hardware securing support assembly to lower console.
6. Install hardware securing G353-5 tube's rod end and C343-11 push-pull tube assembly to D755-4 pedal assembly. Standard torque bolt per § 20-32. Install stamped nut, standard torque per § 20-32, and torque stripe per Figure 5-1.
7. Install A785-39 hose on G400-1 tee assembly and tighten B277-12 clamp. Install (2) MS21919CHW18 clamps securing hose to chin.
8. Perform servo-to-cabin electrical bonding check per § 22-16-3 Part B.
9. Connect G323-2 harness assembly to servo assembly. Verify harness security.
10. Move flight controls through full travel. Verify no binding or interference.
11. Refer to Figure 22-4. Install screws securing A412-4 cover and C795-1 cover. Install carpet and scuff plate per § 25-30.
12. If installing a replacement servo, or if servo has had maintenance performed, load software per § 22-16-1 Part C.
13. Perform servo range calibration per § 22-16-2 Part A.

22-12-4 Garmin FCS – Pitch and Roll Servo Output Arm Friction Adjustment

> NOTE
>
> Output arm friction adjustment is required after any disassembly of servo output arm, replacement of suspect or worn shear fuse, or when directed by § 22-16-3 scheduled inspections.

1. Remove pitch or roll servo assembly per §§ 22-12-1 or 22-12-2, as required.
2. Remove (2) 211-A0020-26 screws securing 117-01067-05 shear fuse to output hub and output arm. Verify shear fuse is not cracked or damaged.

> NOTE
>
> To prevent shaft rotation, use a back-up wrench on output hub when applying torque to output arm or D210-8 nut.

3. Set torque wrench to 60 in.-lb during initial setup, or set torque wrench to recorded value determined in step 8.
4. Using a torque-indicating wrench with an attached 9/16 crowfoot wrench, measure and record breakaway torque required to begin rotating output arm clockwise.
5. Loosen D210-8 nut to realign output arm, then retorque nut using same torque wrench setting used for previous step.
6. Using a torque-indicating wrench, measure and record breakaway torque required to begin rotating output arm counterclockwise.
7. Calculate average breakaway torque required to rotate arm in both directions:

$$\frac{\textit{(clockwise breakaway torque + counterclockwise breakaway torque)}}{2} = _____ \text{ avge in.-lb}$$

8. If average breakaway torque is:
   a. Between 120–150 in.-lb, record final torque wrench setting used and proceed to step 9.
   b. Below 120–150 in.-lb, incrementally increase torque wrench setting and temporarily record new torque value, then repeat steps 3 thru 8 using new torque wrench setting.
   c. Above 120–150 in.-lb, incrementally decrease torque wrench setting and temporarily record new torque value, then repeat steps 3 thru 8 using new torque wrench setting.
9. Loosen D210-8 nut to realign output arm to output hub.
10. Install (2) 211-A0020-26 screws securing 117-01067-05 shear fuse to output arm and hub.
11. Using a backup wrench on output hub, torque D210-8 nut using final torque wrench setting required to obtain 120–150 in.-lb average breakaway torque.

22-12-5 Garmin FCS – Shear Fuse

CAUTION

If shear fuse was broken by a pilot overcoming a mechanical jam in the servo, the servo must be replaced prior to the next flight.

A. Removal

1. Remove pitch or roll servo assembly per §§ 22-12-1 or 22-12-2, as required
2. Remove (2) 211-A0020-26 screws securing 117-01067-05 shear fuse to output hub and output arm. Discard shear fuse if cracked or deformed.

B. Installation

1. Align slots in output hub and output arm.
2. Install (2) 211-A0020-26 screws securing 117-01067-05 shear fuse to output hub and output arm.
3. As required, reinstall pitch or roll servo assembly per §§ 22-12-1 or 22-12-2 and perform servo range calibration per § 22-16-2 Part A.

22-12-6 Garmin FCS – Servo Range Verification

1. Using avionics switch, power on GMC 605H mode controller in configuration mode per § 22-16-1.
2. Refer to Figure 22-7. Navigate to GFC menu, SERVOS page.
3. Use the NOSE UP/DN thumbwheel to highlight:
   a. PITCH→STAT, then move cyclic stick full forward & aft and verify GMC displays POSTN 0% thru 100%.
   b. ROLL→STAT, then move cyclic stick full left & right and verify GMC displays POSTN 0% thru 100%.
   c. YAW→STAT (3-axis installation only), then move pedals full left & right and verify GMC displays POSTN 0% thru 100%.
4. If the GMC 605H displays OOR before reaching flight control stop, perform servo range calibration per § 22-16-2 Part A.
5. Using avionics switch, power off GMC 605H to exit configuration mode.

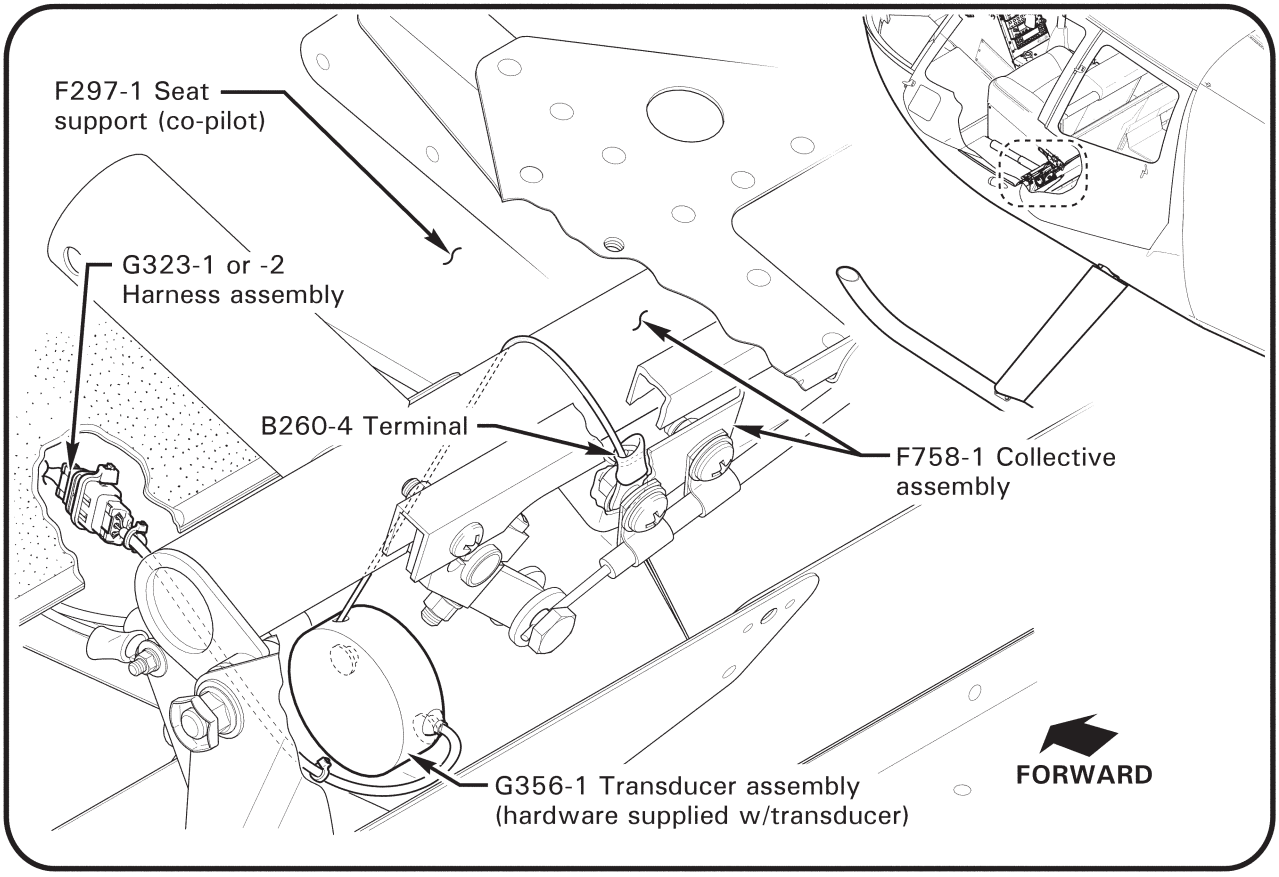


FIGURE 22-6 GARMIN FCS – G356-1 TRANSDUCER ASSEMBLY

22-13 Garmin FCS – Collective Position Sensor (G356-1 Transducer Assembly)

A. Removal

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.
2. Refer to IPC Figures 6-1 & 6-3. Remove co-pilot collective stick. Remove F680-1 cover and F461 cover.
3. Hinge front left seat forward and raise collective.
4. Refer to Figure 22-6. Cut and discard ty-raps as required and disconnect G356-1 transducer assembly harness from G323-1 or -2 harness assembly.

CAUTION

Only extend transducer cable enough to install on collective stick; overextending cable will damage transducer. Transducer cable must retract slowly; allowing cable to freely retract can damage transducer.

22-13 Garmin FCS – Collective Position Sensor (G356-1 Transducer Assembly; continued)

A. Removal (continued)

5. Temporarily secure transducer's cable to collective stick using a strip of tape. Remove fastener securing B260-4 terminal and outboard AN742-3 clamp to collective stick assembly. Grasp cable, remove tape, allow cable to retract slowly into transducer housing.

6. Remove hardware securing transducer to seat support and remove transducer.

B. Installation

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.

2. Hinge front seat forward and raise collective.

3. Refer to Figure 22-6. Position G356-1 transducer assembly on seat assembly and install hardware (do not overtighten) securing transducer. Verify security.

> **CAUTION**
>
> Only extend transducer cable enough to install on collective stick; overextending cable will damage transducer. Transducer cable must retract slowly; allowing cable to freely retract can damage transducer.

4. Route transducer cable around collective stick assembly and temporarily secure transducer's cable to collective using a strip of tape. Install hardware securing B260-4 terminal and outboard AN742-3 clamp to collective, verify security and remove temporary tape.

> NOTE
>
> If C522-10 (throttle) control cable moved from original position, perform FCU throttle control rigging per § 76-11.

5. Connect transducer assembly at electrical connector and lock connectors using MS3367-4-9 ty-rap. Install MS3367-4-9 ty-raps securing wiring to seat, as required. Cinch ty-raps until snug without over-tightening and trim tips flush with heads.

6. Refer to IPC Figures 6-1 & 6-3. Install hardware securing F680-1 cover and F461-1 Cover. Verify security.

7. Install F758-2 or -4 collective stick assembly, if required.

8. Perform collective position sensor calibration per § 22-16-2 Part B.

C. Schematic

Refer to Figure 98-8A for Garmin Flight Control System (FCS) electrical system schematic.

22-14 Garmin FCS – GMC 605H Mode Controller

A. Removal

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.
2. Using a 3/32 inch hex drive tool loosen radio key locking GMC 605H mode controller to avionics tray.
3. Carefully unplug/remove mode controller from avionics tray.

B. Installation

1. Turn battery & avionics switches off and pull open AUTOPILOT FCS (5 amp) circuit breaker on circuit breaker panel.
2. Refer to Figure 22-2. Carefully plug/install GMC 605H mode controller into appropriate location in avionics tray.
3. Tighten radio key securing mode controller to avionics tray.
4. If installing a replacement mode controller, or if controller has had maintenance performed, load software per § 22-16-1 Part C and verify configuration settings per § 22-16-1 Part B.
5. Refer to Table 22-1. Perform required post-installation calibrations.
6. Perform FCS Preflight Test (PFT) per § 22-17-2 Part A.

22-15 Garmin FCS – Cyclic Grip Assembly

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

To access grip switches:

1. Remove MS24693-S1 screws securing C214-28 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 verify cyclic grip switches function properly.

C. Schematic

Refer to Figure 98-8A for Garmin Flight Control System (FCS) electrical system schematic.

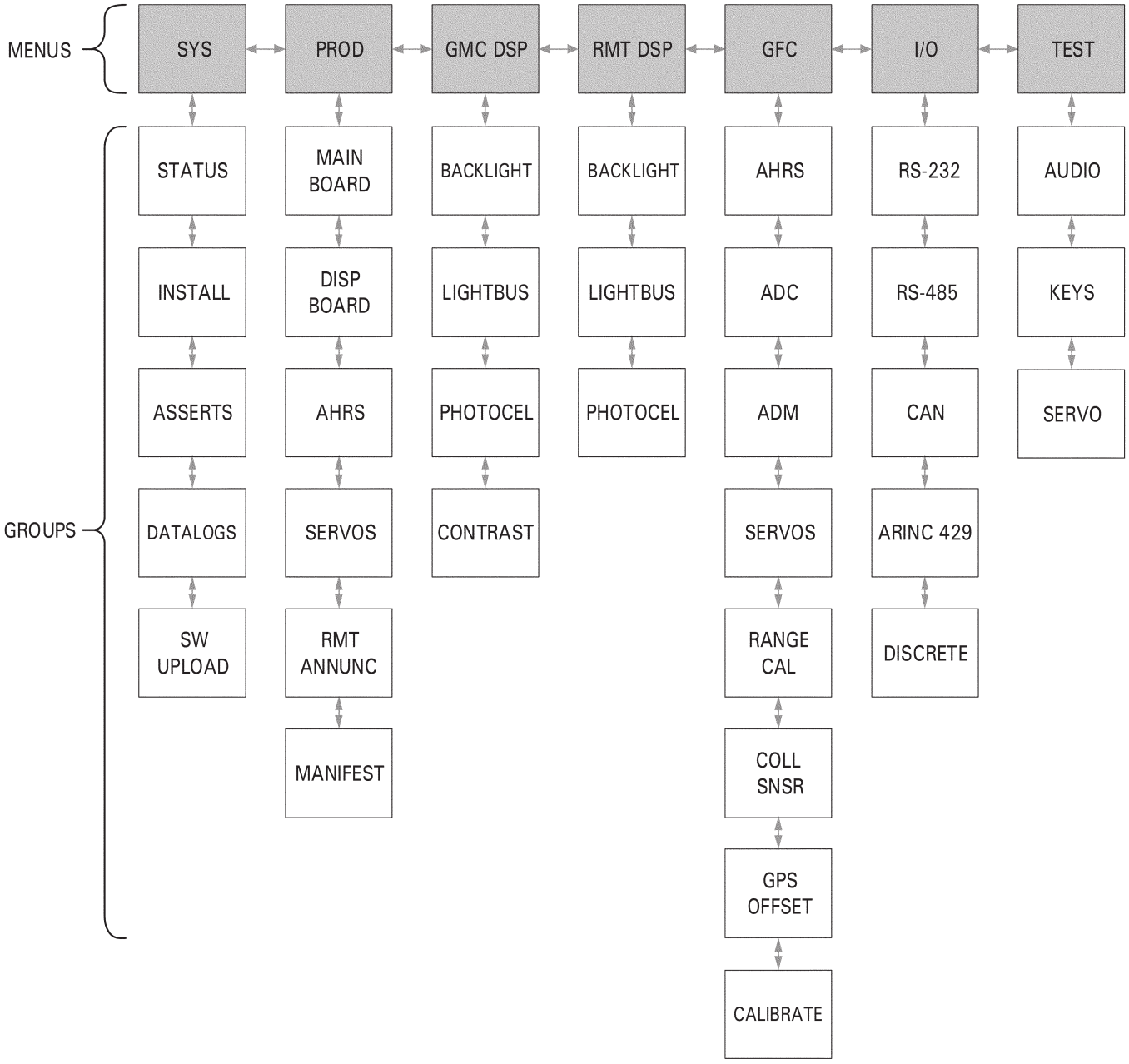


FIGURE 22-7 GARMIN FCS – CONFIGURATION MODE MAP

22-16 Garmin FCS – Maintenance and Inspections

22-16-1 Garmin FCS – Configuration

Modern avionics software is complex and subject to rigorous testing by RHC to assure proper function and integration in the aircraft. Only specified software versions and software configurations have been FAA-approved for installation in Robinson helicopters. Software updates should not be attempted without a thorough understanding of approval status and compatibility. Technical support from either RHC or the avionics manufacturer will likely be required. In some cases, updating software for one item of avionics may require additional avionics to be updated to assure compatibility.

As long as RHC-installed equipment is functioning properly, there is no continuing airworthiness requirement to check or update software levels in Robinson helicopters; RHC will issue an SB (or FAA will issue an AD) for any mandatory updates.

Refer to https://robinsonheli.com > Customer Support > Avionics Support > Avionics Software page for approved software configurations.

A. Configuration Mode

Configuration mode provides the means to load software, troubleshoot installation issues, set airframe specific configuration settings and perform required calibration procedures for the system.

1. Turn off avionics switch or pull open AUTOPILOT FCS (5 amp) circuit breaker to power off GMC 605H mode controller.
2. Press and hold the LVL key on the GMC 605H and turn avionics switch on or push in AUTOPILOT FCS (5 amp) circuit breaker to power on the GMC 605H.
3. Release the LVL key when the splash screen is displayed.
4. Press the NAV key to continue to configuration mode.
5. Use the IAS and VS keys on the GMC 605H to move the cursor to the left or right, respectively. The VS key is also used to accept the desired selections.
6. Use the NOSE UP/DN thumbwheel to scroll up and down thru the menu and page selections. The wheel is also used for configuration acknowledgment.
7. To exit Configuration mode, power off the GMC 605H.

22-16-1 Garmin FCS – Configuration (continued)

B. Configuration Settings

1. Power on the GMC 605H mode controller in configuration mode per § 22-16-1.
2. Refer to Figure 22-7. Navigate to SYS menu, INSTALL group, and set/verify each value below:

SYS menu					
INSTALL group					
PTRM	=	**NO**	VNAV	=	**NO**
Yaw Damper	=	**YES (3-axis)** **NO (2-axis)**	COL SNSR	=	**POT**
			CBN PRSSR	=	**NONE**
GI 285	=	**NO**	EIS	=	**NONE**
HSI/DG	=	**GDU**	RAD ALT	=	**NO**
Flt Dir	=	**NO**	YTRM	=	**NO**
GPS ROLSTR	=	**YES**	VDI	=	**YES**
GPS Dev	=	**ANGULR**			

3. Refer to Figure 22-7. Navigate to GMC DSP menu and set/verify the values for each group below:

GMC DSP menu	
BACKLIGHT Page SOURCE = **PHOTOCELL** TRANSITION = **25**	
LIGHTBUS DISP Page	LIGHTBUS KEYS Page
X1:0 = Y1:1 **X2:19 = Y2:10** **X3:20 = Y3:15** **X4:100 = Y4:30**	**X1:0 = Y1:1** **X2:19 = Y2:10** **X3:20 = Y3:15** **X4:100 = Y4:30**
PHOTOCELL DISP Page	PHOTOCELL KEYS Page
X1:0 = Y1:1 **X2:19 = Y2:10** **X3:20 = Y3:15** **X4:100 = Y4:30**	**X1:0 = Y1:1** **X2:19 = Y2:10** **X3:20 = Y3:15** **X4:100 = Y4:30**
CONTRAST Page OFFSET = **0**	

22-16-1 Garmin FCS – Configuration (continued)

B. Configuration Settings (continued)

4. Refer to Figure 22-7. Navigate to GFC menu, GPS OFFSET group, and set/verify each value below:

GFC menu		
GPS OFFSET group		
HSDB	=	**ANT 2** (connected GTN in T/C bay1)
	=	**ANT 3** (connected GTN in T/C bay3)
RS232 4	=	**ANT 2** (connected GPS in T/C bay1)
	=	**NONE** (GPS not in T/C bay1)
RS232 5	=	**ANT 3** (connected GPS in T/C bay3)
	=	**NONE** (GPS not in T/C bay3)

5. Refer to Figure 22-7. Navigate to TEST menu, AUDIO group, and set/verify each value below:

TEST menu		
AUDIO page - AP DISCONNECT TONE		
VOLUME	=	**0**

6. Power off the GMC 605H to exit configuration mode.

22-16-1 Garmin FCS – Configuration (continued)

C. GFC 600H System Software Loading

NOTE

Garmin provides GFC 600H system software to authorized dealers and service centers through the Garmin Dealer Resource Center website.

1. Download applicable GFC 600H system software from the Garmin Dealer Resource Center website.
2. Connect a blank USB 2.0 flash drive to computer.
3. Run downloaded executable file and follow on-screen prompts to prepare USB flash drive.
4. Safely eject USB flash drive from computer.
5. Verify there is no electrical power to GFC 600H system by pulling AUTOPILOT FCS (5 amp) circuit breaker.
6. Connect USB flash drive to GMC 605H mode controller using USB adapter cable (Garmin P/N 320-00726-01).
7. Power on GMC 605H in configuration mode per § 22-16-1.
8. Refer to Figure 22-7. Navigate to SYS menu, then SW UPLOAD page.
9. Use NOSE UP/DN thumbwheel to highlight SW Upload and press VS key to initialize software upload.
10. Press NAV key to load all software components, do not select individual components. Press NAV key to initiate software load.

NOTE

When the software upload process is complete, the GMC 605H will restart in Configuration mode and "SOFTWARE UPLOAD SUCCESSFUL" will be displayed. If any errors occur during upload, view and record software parts that did not load successfully.

11. Select continue. GMC 605H will load additional software regions and reboot to start-up screen. Do not remove power. Verify loader card version displayed on GMC 605H splash screen is correct per R66 Pilot's Operating Handbook (POH) Garmin GFC 600H Supplement Section 1.

22-16-1 Garmin FCS – Configuration (continued)

C. GFC 600H System Software Loading (continued)

12. Power on GMC 605H in configuration mode per § 22-16-1.
13. Refer to Figure 22-7. Navigate to PROD menu and verify software version on each page matches those listed in the appropriate helicopter delivery range at: https://robinsonheli.com > Customer Support > Avionics Support > Avionics Software and Approximate Helicopter Delivery Dates.
14. Power off GMC 605H to exit configuration mode.

D. Datalogs and Assert Logs

NOTE
Datalogs and assert logs may be downloaded and used to aid in troubleshooting.

1. Connect USB flash drive to GMC 605H mode controller using USB adapter cable (Garmin P/N 320-00726-01).
2. Power on GMC 605H in configuration mode per § 22-16-1.
3. Refer to Figure 22-7. Navigate to SYS menu then ASSERTS page or DATALOGS page, as required.
4. Select DOWNLOAD ASSERTS or DOWNLOAD, as applicable.
5. Follow instructions displayed on GMC 605H to complete download.
6. Power off GMC 605H to exit configuration mode.

Conditions that may require post-installation calibration	GMC 605H Pitch/Roll Calibration	GSU 75H Pitch/Roll Calibration	Magnetic Interference Test	GMC 605H & GSU 75H Magnetometer Calibration	GSU 75H / GMU 44B Heading Offset Calibration
GMC 605H was removed (original unit) and the avionics tray was **NOT** removed and/or loosened.	No				
GMC 605H was removed (original unit) and the avionics tray **WAS** removed and/or loosened.	Yes	No	No	Yes	Yes
GMC 605H was replaced (new unit), repaired, or exchanged.	Yes	Yes	Yes	Yes	Yes
GMC 605H configuration module was replaced.	Yes	No	No	Yes	Yes
GMU 44B was removed (original unit) and/or replaced (new unit), or the area near the GMU 44B location was degaussed.	No	No	Yes	Yes	Yes
GSU 75H was removed (original unit) and the avionics tray was **NOT** removed and/or loosened.	No				
GSU 75H was removed (original unit) and the avionics tray **WAS** removed and/or loosened.	No	Yes	No	Yes	Yes
GSU 75H was replaced (new unit), repaired, or exchanged.	No	Yes	No	Yes	Yes
GSU 75H configuration module was replaced.	No	Yes	Yes	Yes	Yes

TABLE 22-1 GARMIN FCS – POST-INSTALLATION CALIBRATIONS

22-16-2 Garmin FCS – Calibration

NOTE

All components and flight controls must be installed and properly torqued before performing any calibration procedures.

A. Servo Range Calibration

1. Apply external power to helicopter.

CAUTION

Do not use excessive force when moving flight controls. The GFS 83 servos create resistance in flight controls, abrupt movement may damage the shear fuse.

2. Pressurize hydraulics per § 12-34 steps 1 thru 3. Move flight controls thru full travel to ensure there is no interference or binding.
3. Power on the GMC 605H mode controller in configuration mode per § 22-16-1.
4. Refer to Figure 22-7. Navigate to GFC menu, RANGE CAL group, then select appropriate PITCH/ROLL/YAW page.
5. Use NOSE UP/DN thumbwheel to highlight SAVE STRAP and press the VS key.
6. Wait at least 10 seconds before continuing.
7. Use NOSE UP/DN thumbwheel to hightlight START, press the VS key to start, and follow the on-screen instructions. GMC 605H will display CALIBRATION IN PROGRESS.
8. Move cyclic stick full forward and aft for pitch calibration, or left and right for roll calibration, or move pedals from stop to stop for yaw calibration. Select STOP when complete.
9. Verify GMC 605H reports that the range calibration was completed.
10. Perform steps 4 thru 9 for each required servo.

CAUTION

Do not remove FCS power immediately after performing servo range calibration. Wait a minimum of 30 seconds before removing power to prevent servos from becoming inoperable.

11. Power off the GMC 605H to exit configuration mode.
12. Disconnect hydraulic pump per § 12-34.
13. Remove external power from helicopter.

22-16-2 Garmin FCS – Calibration (continued)

B. Collective Position Sensor (G356-1 Transducer) Calibration

1. Apply external power to helicopter.
2. Power on the GMC 605H mode controller in configuration mode per § 22-16-1.
3. Refer to Figure 22-7. Navigate to GFC menu, COLL SNSR page.
4. Use the NOSE UP/DN thumbwheel to highlight START under BEGIN CALIBRATION and press the VS key.
5. Move collective stick full up and full down per calibration instructions on the GMC 605H display.
6. Press the VS key to save the calibration.
7. After the GMC 605H reports successful calibration, move collective stick full up and verify the GMC 605H displays COLL: 100%, then move collective stick full down and verify the GMC 605H displays COLL: 0%.

NOTE
If at collective full down the GMC 605H displays "N/A", contact RHC Technical Support.

8. Power off the GMC 605H to exit configuration mode.

C. Pitch/Roll Offset Calibration

1. Ensure aircraft is on level ground.
2. Power on GMC 605H mode controller into configuration mode per § 22-16-1 Part A.
3. Refer to Figure 22-7. Navigate to GFC menu, CALIBRATE group, then P/R page.
4. Press VS key to highlight 1/9 (page), then use NOSE UP/DN thumbwheel to view pages 2 thru 8 and perform each action as required.
5. Scroll to 9/9 (page), then use the thumbwheel and VS key to START TEST.
6. When complete, use NOSE UP/DN thumbwheel to highlight QUIT, then press the VS key to quit.

22-16-2 Garmin FCS – Calibration (continued)

D. Magnetometer Calibration

NOTE
Garmin FCS magnetometer calibration requires simultaneous GMU 44 or GMU 44B magnetometer calibration; refer to § 97-62 Part F Magnetometer Calibration.

NOTE
Perform this procedure during flight check.

1. If not previously accomplished, perform Pitch/Roll Offset Calibration per § 22-16-2 Part C.
2. Ensure aircraft is positioned on a compass rose heading 360° (magnetic north), or select a magnetically clean location and use a calibrated sight compass.
3. Power on GMC 605H mode controller in configuration mode per § 22-16-1 Part A.
4. Refer to Figure 22-7. Navigate to GFC menu→CALIBRATE group→MAG group, then highlight 1/11 (page).
5. Use the NOSE UP/DN thumbwheel to view each page and verify all pre-calibration steps are completed.
6. Press VS key to indicate START TEST.
7. Scroll down one notch to highlight START TEST and press VS key to start.
8. With appropriately rated person at controls, start helicopter. Have pilot hover→turn 30°→land helicopter as required by GMC 605H mode controller's on-screen instructions; repeat until GMC 605H indicates that calibration is complete.
9. Press VS key to complete calibration when indicated.
10. Have pilot complete flight check if required, or land and shutdown helicopter.

22-16-3 Garmin FCS – Inspections

A. Scheduled Inspections

INSPECTION	PROCEDURE	INTERVAL
Visual	Visually inspect all servos, mode controller, collective sensor, tubes & rod ends, and attached LRUs for security. Inspect visible wiring; verify security and no damage. Verify shear fuses on pitch and roll servos are intact with no signs of wear. Gently pull collective sensor cable slightly and allow to retract slowly to verify operation.	Every 100-hour/annual inspection.
AHRS magnetic field model update	Contact Garmin for new magnetic field model.	Every 5 years.
Electrical bonding	Disconnect battery per § 96-10. Disconnect G323-1 or -2 harness from component to be tested. Using milliohm meter, verify: • GMC-to-avionics tray is < 5.0 mOHM, • Avionics tray-to-cabin ground stud is < 5.0 mOHM, or • Servo-to-cabin ground stud is < 2.5 mOHM. Repair electrical bonding as required. Connect G323-1 or -2 harness. Connect battery per § 96-10.	Every 600 flight hours or 5 years, whichever occurs first.
Pitot-static system	Perform pitot-static system checks per § 95-30.	Every 2 years.
Servo arm friction verification	Perform servo arm friction adjustment per § 22-12-4 to verify friction.	Every 600 flight hours or 2 years, whichever occurs first.

B. Special Inspections

INSPECTION	PROCEDURE	INTERVAL
Lightning strike	Perform visual inspection. Perform electrical bonding inspection. Inspect equipment for signs of arcing. Inspect OAT probe for damage. Perform GMC 605H and GSU 75H magnetometer calibration.	After suspected lightning strike.
Electrical bonding	Disconnect battery per § 96-10. Disconnect G323-1 or -2 harness from component to be tested. Using milliohm meter, verify: • GMC-to-avionics tray is < 5.0 mOHM, • Avionics tray-to-cabin ground stud is < 5.0 mOHM, or • Servo-to-cabin ground stud is < 2.5 mOHM. Repair electrical bonding as required. Connect G323-1 or -2 harness. Connect battery per § 96-10.	After component was removed or replaced.
Hard landing	Perform visual inspection per Part A.	After hard landing.
Display or status LED inoperative	Display or FCS status LED are inoperative, remove and install new GMC 605H per § 22-14.	On condition.

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22-17 Garmin FCS – Ground Checks

22-17-1 Garmin FCS – Configuration Mode Functional Checkout

CAUTION

Do not pressurize hydraulic system while any hydraulic system component is disconnected or removed.

A. Servo Directionality Verification

1. Apply external power to helicopter.
2. Pressurize hydraulics per § 12-34 steps 1 thru 3.
3. Rotate cyclic friction knob full off. Move flight controls thru full travel to ensure there is no interference or binding.
4. Power on the GMC 605H mode controller in configuration mode per § 22-16-1.
5. Wait for GDU attitude display to align fully.
6. Position collective stick full down and apply friction.
7. Refer to Figure 22-7. Navigate to TEST menu, SERVO group.
8. Press the VS key to indicate START TEST, scroll up one notch to highlight START TEST, then press the VS key to begin.
9. Verify each trim switch direction annunciates properly on the GMC 605H and helicopter controls move in the correct direction. Press FTR or FCS OFF switch between directions to stop all motion.

Trim Direction	Annunciation	Control Movement
Cyclic – TRIM ADJUST: Right	ROLL: RIGHT	Cyclic Right
Cyclic – TRIM ADJUST: Left	ROLL: LEFT	Cyclic Left
Cyclic – TRIM ADJUST: Up	PITCH: DOWN	Cyclic Forward
Cyclic – TRIM ADJUST: Down	PITCH: UP	Cyclic Aft
Yaw – YAW TRIM: Left	YAW: LEFT	Left Pedal Forward
Yaw – YAW TRIM: Right	YAW: RIGHT	Right Pedal Forward

10. When all directions and switches have been verified, press the VS key on the GMC 605H, then use the NOSE UP/DN thumbwheel to highlight END TEST and press the VS key.
11. Power off the GMC 605H to exit configuration mode.
12. Disconnect hydraulic pump per § 12-34.
13. Remove external power from helicopter.

22-17-1 Garmin FCS – Configuration Mode Functional Checkout (continued)

B. Servo Wiring Verification

1. Apply external power to helicopter.
2. Power on the GMC 605H mode controller in configuration mode per § 22-16-1.
3. Refer to Figure 22-7. Navigate to GFC menu, SERVOS group.
4. Select PITCH MON1 page and verify the following:
   a. The AP DISC status is a checkmark.
   b. When holding the pilot grip FCS OFF switch, the AP DISC status changes to an "X", and when released the status returns to a checkmark.
   c. When holding the copilot grip FCS OFF switch, the AP DISC status changes to an "X", and when released the status returns to a checkmark.
5. Repeat step 2 for ROLL MON1 and YAW MON1 (3-axis installation only).
6. Select the PITCH MON2 page and verify the following:
   a. The FTR status is an "X".
   b. When holding the pilot grip FTR switch, the FTR status changes to a checkmark, and when released the status returns to an "X".
   c. When holding the copilot FTR switch, the FTR status changes to a checkmark, and when released the status returns to an "X".
7. Repeat step 4 for ROLL MON2 and YAW MON2 (3-axis installation only).
8. Power off the GMC 605H to exit configuration mode.
9. Remove external power from helicopter.

22-17-1 Garmin FCS – Configuration Mode Functional Checkout (continued)

C. GMC 605H Discrete Wiring Verification

1. Apply external power to helicopter.
2. Power on GMC 605H mode controller in configuration mode per § 22-16-1.
3. Refer to Figure 22-7. Navigate to I/O menu, DISCRETE group, then IN page.
4. Press VS key to highlight page number, then use NOSE UP/DN thumbwheel to scroll thru pages to locate each discrete channel (CH).
5. Scroll to page containing (CH 11) AP DISCONNECT function. Press and release pilot, then copilot grip FCS OFF switches while observing GMC display; verify "ACTV" toggles from "Y" to "N" while pressing each FCS OFF switch.
6. Scroll to page containing each of the following channels/functions and verify each function toggles from “N” to “Y” while pressing associated switch:

I/O CH	Switch	Function Name
3	Pilot/copilot grip FTR	PILOT FTR CYCLIC
24	Pilot/copilot grip LVL	LVL ENGAGE 1
4	YAW TRIM left	YAW TRIM LEFT
10	YAW TRIM right	YAW TRIM RIGHT
5	Pilot grip TRIM ADJUST down	PILOT P TRIM UP
6	Pilot grip TRIM ADJUST up	PILOT P TRIM DN
12	Pilot grip TRIM ADJUST left	PILOT R TRIM LEFT
13	Pilot grip TRIM ADJUST right	PILOT R TRIM RGHT

7. 3-axis systems only: Scroll to page containing (CH 16) YD AUTO ENGAGE function. Toggle FCS YAW switch to ENABLE and verify "ACTV" indicates "Y". Toggle FCS YAW switch to DISABLE and verify "ACTV" indicates "N".
8. Power off GMC 605H to exit configuration mode.
9. Remove external power from helicopter.

D. Audio Test

1. Apply external power to helicopter.
2. Power on GMC 605H mode controller in configuration mode per § 22-16-1.
3. Refer to Figure 22-7. Navigate to TEST menu, AUDIO group.
4. Press VS key to select PLAY and verify autopilot disconnect audio tone is playing in headset.
5. Use NOSE UP/DN thumbwheel to highlight STOP, then press VS key to stop.
6. Power off GMC 605H to exit configuration mode.
7. Remove external power from helicopter.

22-17-2 Garmin FCS – Normal Mode Functional Checkout

A. FCS Preflight Test

1. Turn battery and avionics switches on.
2. Verify loader card version displayed on GMC 605H mode controller splash screen is correct per R66 Pilot's Operating Handbook (POH) Garmin GFC 600H Supplement Section 1.
3. Press the NAV key to continue into normal mode.
4. Verify the following annunciations and displays:
   a. "PFT" is displayed on the GMC 605H in green text.
   b. "PFT" is displayed on the PFD in inverse video white.
5. Verify the following sequence of events during PFT:
   a. The yellow LEDs are illuminated momentarily, followed by the red LEDs being illuminated momentarily next to the FCS key on the GMC 605H.
   b. "FCS TEST OK" is played through the headsets.
6. Verify the following annunciations and displays after PFT completion:
   a. "PFT" is not displayed on the GMC 605H or PFD.
   b. "MANIFEST" is not displayed on the GMC 605H.
   c. "PFT FAIL" is not displayed on the GMC 605H or PFD.
   d. "FCS FAIL" is not displayed on the GMC 605H or PFD.

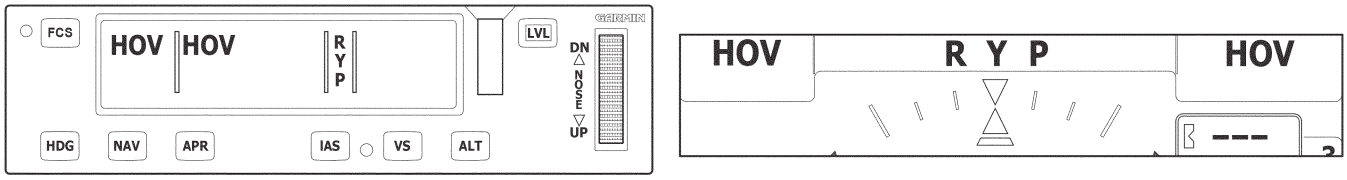
NOTE

If GPS is not available, a persistent "PFT" may appear. Refer to § 22-18 for troubleshooting.

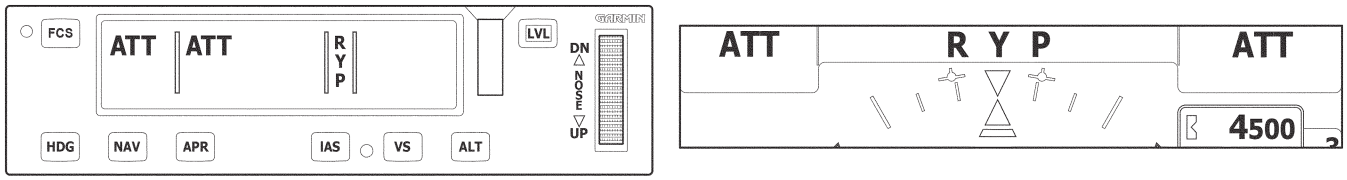
22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

B. Servo Engagement/Disengagement

1. Apply external power to helicopter.
2. Turn battery and avionics switches on and verify PFT passes per Part A.
3. Press the FCS key on the GMC 605H mode controller. Verify the LED is illuminated green and the following annunciations and displays:



If GPS is valid



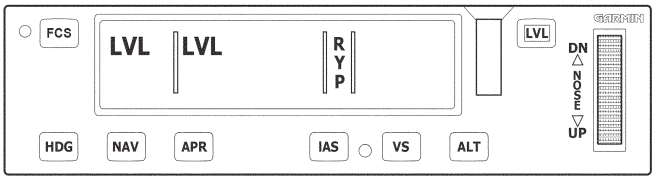
If GPS is not valid

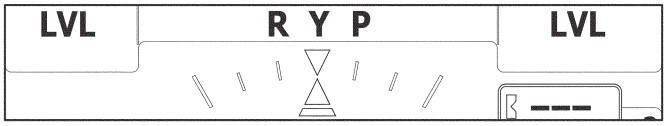
5. Disengage the system by pressing the FCS key on the GMC 605H.
6. Verify the following ("Y" will only be displayed in 3-axis installation):
   a. "FCS" status indication light flashes yellow.
   b. A two-tone aural (high/low) is played through the headsets.
   c. "R", "Y", and "P" annunciations flash yellow until removed on the GDU .
   d. After 10 seconds, all FCS annunciations should be removed from the PFD and GMC 605H.
7. Press and hold the pilot grip FTR switch to re-engage the system.
8. Verify the following ("Y" will only be displayed in 3-axis installation):
   a. "R", "Y", "P", and "ATT" are displayed on the GMC 605H.
   b. "R", "Y", and "P" are displayed on the top of the PFD in green text.
9. Press and hold the pilot grip FCS OFF switch to disengage the system.
10. Verify the following ("Y" will only be displayed in 3-axis installation):
    a. "FCS" status indication light flashes yellow.
    b. A two-tone aural (high/low) is played through the headsets.
    c. "R", "Y", and "P" annunciations flash yellow until removed on the GDU.
11. Repeat steps 7 through 10 for copilot grip controls, if installed.
12. Turn battery and avionics switches off.
13. Remove external power from helicopter.

22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

C. GFC 600H Mode Operation Tests

1. Apply external power to helicopter.
2. Turn battery and avionics switches on and verify PFT passes per Part A.
3. Press the LVL key on the GMC 605H.
4. Verify the following ("Y" will only be displayed in 3-axis installation):

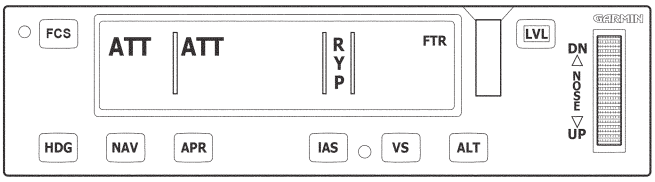


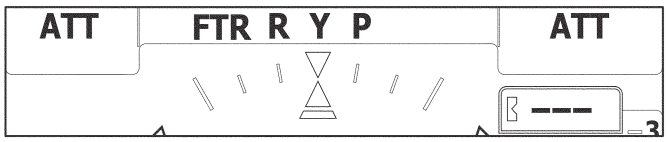


5. Press the pilot grip TRIM ADJUST up (nose down) with LVL | LVL active.
6. Verify LVL is no longer the active mode for P and R.

> NOTE
>
> If the GFC 600H system is receiving valid GPS, the GMC 605H mode controller will engage HOV mode and display GSPD |GSPD in the pitch and roll fields; if GPS is not valid, the pitch and roll modes will be displayed as ATT.

7. Repeat steps 3 through 6 using pilot grip and copilot grip LVL switches.
8. Press & hold the pilot grip FTR switch and verify the following annunciations and displays ("Y" will only be displayed in 3-axis installation):





9. Repeat step 8 for copilot grip FTR switch, if installed.
10. Turn battery and avionics switches off.
11. Remove external power from helicopter.

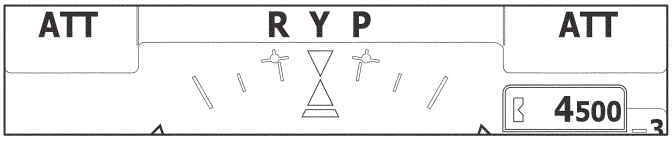
22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

D. Upper Mode Tests

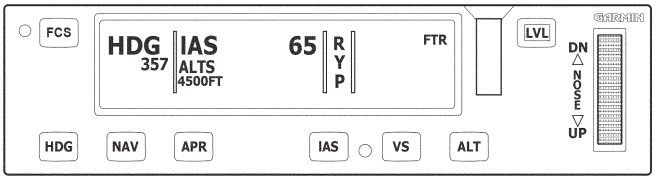
NOTE

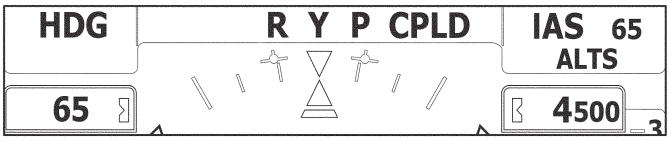
The following procedure requires air data test equipment (Barfield DPS450 pitot-static test set or equivalent). Operate test equipment per manufacturer's instructions.

1. Apply external power to helicopter.
2. Pressurize hydraulics per § 12-34 steps 1 thru 3.
3. Rotate cyclic friction knob full off. Move flight controls thru full travel to ensure there is no interference or binding.
4. Set the air data test equipment to 3000 feet altitude & 65 knots airspeed and allow the air data test set to stabilize at the target altitude and airspeed.
5. Engage the GFC 600H system by pressing the FCS key or press and hold the FTR switch.
6. Lift collective stick mid-travel or until the GMC no longer displays "ON GROUND".
7. Rotate the heading bug on the HSI to the current helicopter heading.
8. Move the Selected Altitude Bug to 4500 feet altitude.
9. Press and release the FCS OFF switch to ensure that no upper mode is active.



10. Press the HDG and IAS keys to couple the upper modes. Verify the following annunciations and displays ("Y" will only be displayed in 3-axis installation):





11. Verify cyclic stick is stationary.

NOTE

There may be slight cyclic lateral motion if the helicopter is not on level ground.

22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

D. Upper Mode Tests (continued)

NOTE

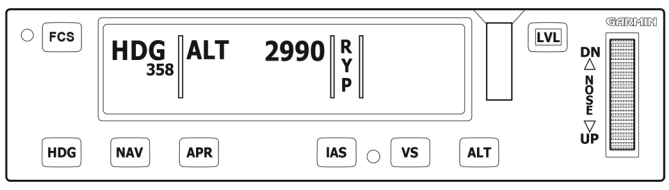
The following steps test lateral coupled upper modes.

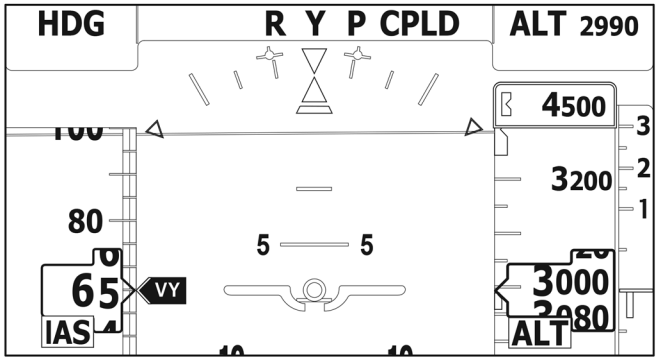
12. Adjust the heading bug on the HSI to the left and verify cyclic stick moves left.
13. Adjust the heading bug on the HSI to the right and verify cyclic stick moves right.
14. Restore the heading bug on the HSI to the current helicopter heading and verify cyclic stick is centered.
15. Using the TRIM ADJUST switch, press left and verify the heading bug adjusts counter-clockwise on the HSI and the cyclic stick moves left.
16. Using the TRIM ADJUST switch, press right and verify the heading bug adjusts clockwise on the HSI and the cyclic stick moves right.
17. Restore the heading bug on the HSI to the current helicopter heading and verify cyclic stick is centered.

NOTE

The following steps test vertical coupled upper modes.

18. Rotate the NOSE UP/DN thumbwheel in the NOSE UP direction to decrease the IAS reference and verify cyclic stick moves aft.
19. Rotate the NOSE UP/DN thumbwheel in the NOSE DN direction to increase the IAS reference and verify cyclic stick moves forward.
20. Repeat steps 18 and 19 using the pilot grip TRIM ADJUST switch.
21. Press and hold the FTR switch and center the cyclic stick. This will restore the IAS reference to 65 knots.
22. Press the ALT key on the GMC. Confirm that the pitch reference matches the current altitude on the tape. The altitude reference will be displayed on the PFD next to the ALT mode annunciation and on the GMC in the pitch mode field.

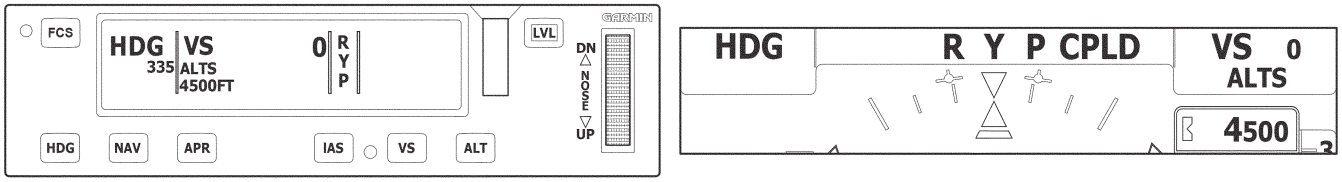




22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

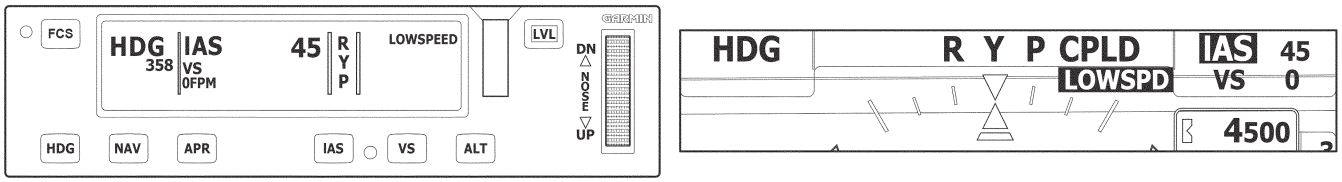
D. Upper Mode Tests (continued)

23. Press the VS key on the GMC. VS should engage with a reference of 0 FPM. Confirm the active pitch mode is VS.

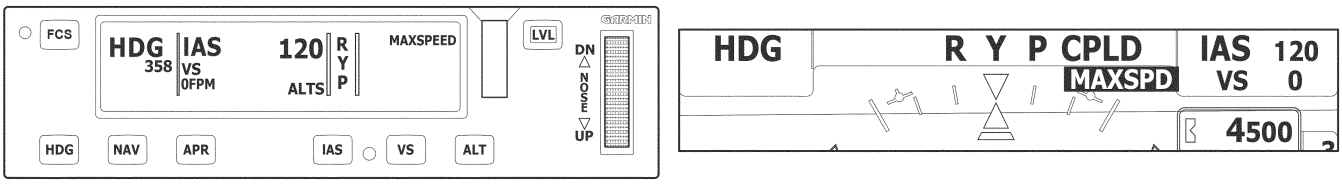


24. Decrease airspeed to 40 KTS indicated airspeed using air data test equipment.

25. Confirm the system enters low speed protection. In this mode of operation, the active mode on the GMC and GDU will show "IAS" with a reference of 45 KTS. If the system does not immediately enter low speed protection mode, adjust the VS reference in the direction of pitch up (positive) until the system annunciates "LOW SPD".



26. Increase airspeed to Vne using air data test equipment and confirm the system enters MAXSPEED. If this does not occur, use the NOSE UP/DN thumbwheel to increase the pitch down (negative) VS reference until the system enters MAXSPEED.



27. Increase airspeed on the test set to above Vne and verify the "OVERSPEED" aural is played through the pilot headset.

28. De-select VS so that the pitch mode is in ATT.

29. Return air data test equipment to ground and remove equipment from helicopter per manufacturers instructions.

30. Turn battery and avionics switches off.

31. Disconnect hydraulic pump per § 12-34.

32. Remove external power from helicopter.

22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

E. (VOR) NAV and APR Mode Tests

NOTE
The following procedure requires air data test equipment (Barfield DPS450 pitot-static test set or equivalent). Operate test equipment per manufacturer's instructions.

NOTE
Perform the following procedures using Viavi Aeroflex IFR-4000 test equipment (or equivalent) per manufactures instructions.

1. Apply external power to helicopter.
2. Pressurize hydraulics per § 12-34 steps 1 thru 3.
3. Rotate cyclic friction knob full off. Move flight controls thru full travel to ensure there is no interference or binding. Center the cyclic stick.
4. Set the air data test equipment to 3000 feet altitude & 65 knots airspeed and allow the air data test set to stabilize at the target altitude and airspeed.
5. Engage the GFC 600H system by pressing the FCS key or press and hold the FTR switch.
6. Lift collective stick mid-travel or until the GMC no longer displays "ON GROUND".
7. Rotate the heading bug on the HSI to the current helicopter heading.

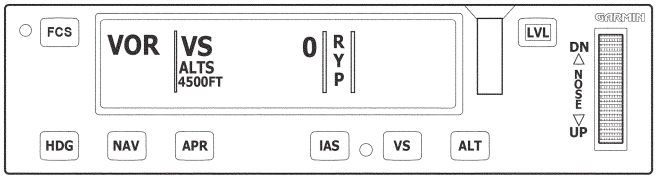
NOTE
The following steps test VOR NAV mode.

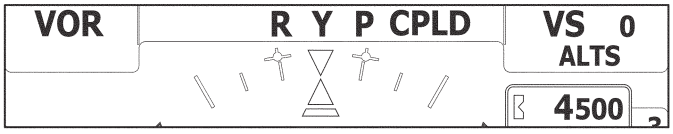
8. Simulate a VHF Omni Directional Radio Range (VOR) signal using the ramp test equipment.
9. Tune the NAV receiver to the simulated VOR frequency.
10. Set the Course Deviation Indicator (CDI) to VLOC.
11. Rotate the heading bug on the Horizontal Situation Indicator (HSI) to the current helicopter heading.
12. Rotate the course pointer bug on the CDI to the simulated VOR bearing.
13. Verify full scale deflection of the CDI by varying the selected course or the simulated VOR bearing at least 15° left and right.
14. Set the course pointer at least 15° from the simulated VOR bearing (left or right).

22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

E. (VOR) NAV and APR Mode Tests (continued)

15. Press and release the FCS OFF switch to ensure that no upper mode is active.
16. Press the HDG key to couple the upper mode.
17. Press the NAV key.
18. Verify the following annunciations and displays ("Y" will only be displayed in 3-axis installation):
    a. The status LED illuminates green next to the FCS key on the GMC 605H.
    b. "HDG" is displayed above "VOR" on the GMC 605H.
    c. "HDG", "R", "Y", "P", and "CPLD" are displayed in green text and "VOR" displayed in white text on the PFD.
19. Verify cyclic stick is stationary.
20. Slowly rotate the course pointer on the CDI toward the simulated VOR bearing, until the course pointer is within approximately 5° of the helicopter heading.
21. Verify the following annunciations and displays are present:
    a. A flashing "VOR" is displayed in place of HDG on the GMC 605H for approximately 3 seconds then stops flashing.
    b. A flashing "VOR" in green text is displayed in place of HDG on the PFD for approximately 3 seconds then stops flashing.





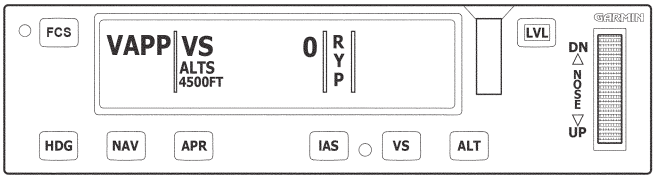
22. Alter the course on the CDI by at least 10° to the left of the simulated VOR bearing and verify the cyclic stick moves right.
23. Alter the course on the CDI by at least 10° to the right of the simulated VOR bearing and verify the cyclic stick moves left.
24. Restore the course pointer bug on the CDI to the simulated VOR bearing.
25. De-select the lateral mode by pressing the NAV key. "ATT" should be annunciated in the Roll field on the GMC and PFD.
26. Center the cyclic stick. If necessary, press the FTR switch to reset the ATT reference to keep the cyclic stick centered.

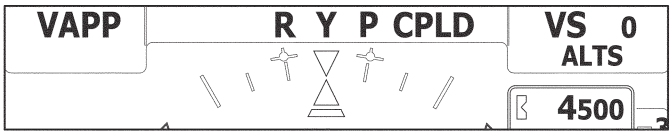
22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

E. (VOR) NAV and APR Mode Tests (continued)

NOTE
The following steps test VOR APR mode (VAPP).

27. Press the APR key.
28. Verify the following annunciations and displays ("Y" will only be displayed in 3-axis installation):





CDI is centered.

29. Confirm cyclic stick is stationary.
30. Press the HDG key on the GMC to return the active roll mode to HDG.
31. Continue testing per Part F, as required, or return air data test equipment to ground and remove equipment from helicopter per manufacturers instructions.
32. Turn battery and avionics switches off.
33. Disconnect hydraulic pump per § 12-34.
34. Remove external power from helicopter.

22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

F. (LOC) NAV and APR Mode Tests

NOTE
The following procedure requires air data test equipment (Barfield DPS450 pitot-static test set or equivalent). Operate test equipment per manufacturer's instructions.

NOTE
Perform the following procedures using Viavi Aeroflex IFR-4000 test equipment (or equivalent) per manufactures instructions.

1. Apply external power to helicopter.
2. Pressurize hydraulics per § 12-34 steps 1 thru 3.
3. Rotate cyclic friction knob full off. Move flight controls thru full travel to ensure there is no interference or binding. Center the cyclic stick.
4. Set the air data test equipment to 3000 feet altitude & 65 knots airspeed and allow the air data test set to stabilize at the target altitude and airspeed.
5. Engage the GFC 600H system by pressing the FCS key or press and hold the FTR switch.
6. Raise collective stick mid-travel or until the GMC no longer displays "ON GROUND".
7. Rotate the heading bug on the HSI to the current helicopter heading.

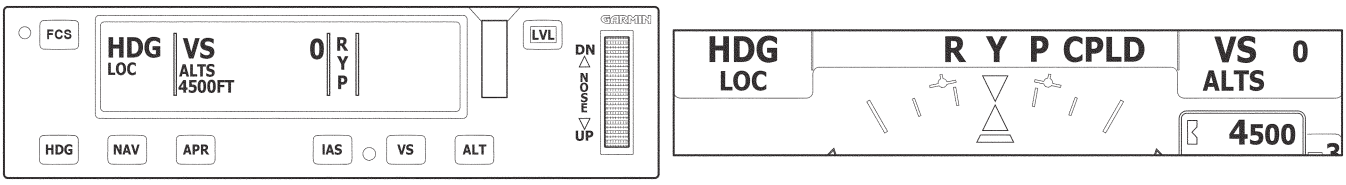
NOTE
The following steps test LOC NAV mode.

8. Simulate a localizer signal using the ramp test equipment.
9. Tune the NAV receiver to the simulated localizer frequency.
10. Set the CDI to VLOC.
11. Rotate the course pointer on the CDI to the current helicopter heading.
12. Simulate 2 dots (left or right) localizer deviation using the ramp test equipment.
13. Press and release the FCS OFF switch to ensure that no upper mode is active.
14. If HDG is not coupled, press the HDG key to couple the upper mode.
15. Press the NAV key.

22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

F. (LOC) NAV and APR Mode Tests (continued)

16. Verify the following annunciations and displays ("Y" will only be displayed in 3-axis installation):



17. Confirm cyclic stick is stationary.
18. Slowly center the localizer deviation using the ramp test equipment.
19. Verify the following annunciations and displays:
    a. A flashing "LOC" is displayed in place of HDG on the GMC 605H for approximately 3 seconds then stops flashing.
    b. A flashing green "LOC" is displayed on the PFD for approximately 3 seconds then stops flashing.

> NOTE
>
> LOC should capture around 1 dot deviation.

20. Apply fly-right localizer deviation (aircraft left-of course) using the ramp test equipment and verify cyclic stick moves right.
21. Apply fly-left deviation (aircraft right-of course) using the ramp test equipment and verify cyclic stick moves left.
22. Center the localizer deviation on the ramp test equipment.
23. De-select NAV mode on the GMC 605H.
24. Center the cyclic stick.

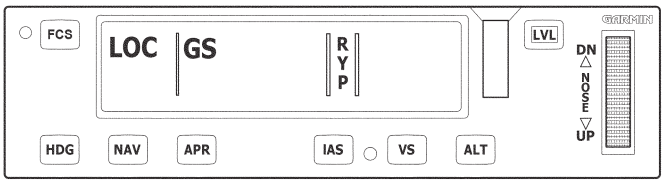
> NOTE
>
> The following steps test LOC/GS APR mode.

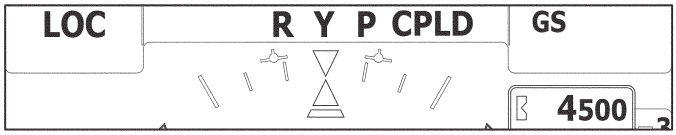
25. Rotate the course pointer on the CDI to the current helicopter heading.
26. Ensure the system has a valid and centered GS signal on the CDI.
27. Press the APR key.

22-17-2 Garmin FCS – Normal Mode Functional Checkout (continued)

F. (LOC) NAV and APR Mode Tests (continued)

28. Verify the following annunciations and displays ("Y" will only be displayed in 3-axis installation):





NOTE

The following steps test GPS NAV mode.

29. Set the CDI to GPS.
30. Enter a Direct To flight plan to a single waypoint on the GPS navigator that is generally in front of the helicopter and in line with the current helicopter heading.
31. Ensure the GPS navigator is navigating to the selected waypoint and the CDI is centered.
32. Press the NAV key on the GMC.
33. Verify the following annunciations and displays ("Y" will only be displayed in 3-axis installation):
    a. "GPS" is displayed on the GMC 605H.
    b. "GPS", "P", "Y", "R", and "CPLD" are displayed in green text on the PFD.
34. Return air data test equipment to ground and remove equipment from helicopter per manufacturers instructions.
35. Turn battery and avionics switches off.
36. Disconnect hydraulic pump per § 12-34.
37. Remove external power from helicopter.

22-18 Garmin FCS – Troubleshooting

This section describes possible symptoms associated with the Garmin GFC 600H FCS and provides corresponding actions for troubleshooting. After completing the recommended action, perform ground checks per § 22-17. If any system messages persist after performing the associated troubleshooting actions, contact RHC Technical Support.

A. GMC 605H Mode Controller LED Indicator

LED (Button)	INDICATOR STATE	STATUS
FCS	Green	FCS engaged (normal operation)
	Amber	Manual disconnect (normal operation)
	Red	The FCS has automatically disengaged from the Flight Director commands. This may be due to an internal failure, loss of AHRS data inputs, or the servos are exceeding their engagement limits. Refer to Part C for troubleshoot procedures.

B. General Troubleshooting

SYMPTOM	RECOMMENDED ACTION
The FCS will not engage (FCS LED on GMC 605H does not illuminate green).	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • Verify security of GMC 605H, GFS 83, GSU 75H, and GMU 44B electrical connectors. • Ensure wiring is not damaged. • Verify the FCS OFF and FTR switches on cyclic are not stuck or shorted. • Verify wiring of FCS OFF and FTR switches from AUTOPILOT FCS (5 amp) circuit breaker to the GMC 605H and GFS 83. • Ensure all post-installation calibrations were successfully completed.
GMC 605H display is blank.	• Ensure the AUTOPILOT FCS (5 amp) circuit breaker is closed. • Verify security of GMC 605H electrical connectors. • Ensure the GMC 605H wiring is correct.
PFT will not pass (displayed on GMC 605H or GDU).	• Ensure the AUTOPILOT FCS (5 amp) and EFIS (5 amp) circuit breakers are closed. • Verify security of GMC 605H, GFS 83, GSU 75H, and GMU 44B electrical connectors. • Ensure wiring is not damaged. • Ensure the GFS 83 servo strapping for each control axis is correct. • Ensure servos were installed in the correct location if removed from helicopter. • Ensure push-pull tubes and servo connections are secure. • Verify the FCS OFF and FTR switches on cyclic are not stuck or shorted. • Verify wiring of FCS OFF and FTR switches to the AUTOPILOT FCS (5 amp) circuit breaker and GMC 605H & GFS 83. • Ensure post-installation calibrations were performed if GMC 605H, GFS 83, and GSU 75H/GMU 44B were replaced or repaired by Garmin.
Servos will not engage (“P”, “R”, or “Y” will not display on GMC 605H when FCS button is pressed).	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • Contact RHC Technical Support.

22-18 Garmin FCS – Troubleshooting (continued)

B. General Troubleshooting (continued)

SYMPTOM	RECOMMENDED ACTION
A System Message is displayed on the GMC 605H or GDU (if installed).	• Troubleshoot the alert message using Part C.
R, Y, or P servo annunciations are displaying out of detent.	• Verify cyclic friction is off. The system may be detecting a hands on condition due to excessive friction in cyclic controls. • Verify that each AHRS (GSU 75H and GMC 605H) were calibrated at the same time and the aircraft was level at the time of calibration. • Press FTR. This will reset the reference to the current attitude. This should not be used as an initial troubleshooting step as it may not resolve the primary reason for the out of detent annunciation.
No FCS Data (On GDU)	• GDU not receiving data from the GMC. • Verify GMC is powered on. • Verify wiring between GMC and GDU. • Contact RHC Technical Support if issue persists.
Servo information is not being reported in Configuration mode	• Verify security of GFS 83 electrical connectors.
GMC 605H display does not show any status in Normal mode and the system will not engage.	• Reload software and ensure there are no software failures. • Contact RHC Technical Support if issue persists.
Yaw does not engage and/or disengage.	• Verify FCS YAW enable/disable switch is not broken. • Verify wiring of FCS YAW and YAW TRIM switches to GMC 605H.

C. Crew Alerting System (CAS) Message Troubleshooting

CAS MESSAGE	POSSIBLE CAUSE	ACTION
PFT FAIL (FCS LED – Red)	• FCS OFF and/or FTR switch to the GMC 605H and GFS 83 FCS OFF pins are not powered. • Blown B304-25 fuse assembly. • Servos are not communicating or are wired incorrectly for the configured control axis position. • Invalid configuration or software loaded. • Configured gains in the GMC 605H don't match the gains in the GFS 83 servos. • Internal unit failure. • Invalid attitude data (includes AHRS monitor and attitudes outside the engage limits).	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • Verify security of GMC 605H, GFS 83, GSU 75H, and GMU 44B electrical connectors. • Ensure wiring is not damaged. • Test or replace B304-25 fuse assembly. • Ensure the FCS OFF and FTR switches on cyclic are not stuck or shorted. • Verify wiring of FCS OFF and FTR switches to the AUTOPILOT FCS (5 amp) circuit breaker and GMC 605H & GFS 83. • Troubleshoot the GSU 75H and GMU 44B per Part E. • Reload software and ensure there are no software failures. • Contact RHC Technical Support.

22-18 Garmin FCS – Troubleshooting (continued)

C. Crew Alerting System (CAS) Message Troubleshooting (continued)

CAS MESSAGE	POSSIBLE CAUSE	ACTION
PFT	PFT will not pass.	• Ensure push-pull tubes and servo connections are secure. • Verify the GFS 83 servo strapping is properly configured per § 22-17 Part A. • Ensure post-installation calibrations were performed if GMC 605H, GFS 83, and GSU 75H/ GMU 44B were replaced or repaired by Garmin. The following can indicate that the servo is out of its calibrated range: • Verify servo output arm is installed in the correct orientation. • Confirm shear fuses have not been broken on pitch and roll servos. • Servo range can be confirmed in servo data diagnostic pages. If an OOR indication is shown at any point when sweeping the controls full travel, then a new range calibration will need to be performed.
FCS FAIL (FCS LED – Red)	• Loss of attitude data (includes AHRS monitor and attitudes outside the engage limits). • Servos Failure. • FCS OFF switch in an invalid state. • Post installation calibration not complete.	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • Verify security of GMC 605H, GFS 83, GSU 75H, and GMU 44B electrical connectors. • Ensure wiring is not damaged. • Verify wiring of FCS OFF and FTR switches to the AUTOPILOT FCS (5 amp) circuit breaker and GMC 605H & GFS 83. • Troubleshoot the GSU 75H and GMU 44B per Part E. • Verify pitch and roll shear fuses have not been broken. • Contact RHC Technical Support.
ADC FAIL	Air Data inputs have failed.	• Ensure the GMC 605H and GSU 75H connectors are securely mated to the units. • Ensure wiring is not damaged. • Ensure the pitot-static system is free of debris and obstructions. • Troubleshoot the GSU 75H and GMU 44B per Part E.
FTR	FTR switch stuck.	• Ensure the FTR switch on cyclic is not stuck or shorted.

22-18 Garmin FCS – Troubleshooting (continued)

C. Crew Alerting System (CAS) Message Troubleshooting (continued)

CAS MESSAGE	POSSIBLE CAUSE	ACTION
LMTQ FAIL	• Invalid attitude data (includes AHRS monitor and attitudes outside the engage limits). • Air Data inputs have failed. • Servos Failure. • FCS OFF and/or FTR switch in an invalid state.	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • Verify security of GMC 605H, GFS 83, GSU 75H, and GMU 44B electrical connectors. • Ensure wiring is not damaged. • Ensure the FCS OFF and FTR switches on cyclic are not stuck or shorted. • Verify wiring of FCS OFF and FTR switches to the AUTOPILOT FCS (5 amp) circuit breaker and GMC 605H & GFS 83. • Troubleshoot the GSU 75H and GMU 44B per Part E. • Contact RHC Technical Support.
YAW FAIL	• Invalid attitude data (includes AHRS monitor and attitudes outside the engage limits). • Air Data inputs have failed. • Servos Failure. • FCS OFF, FTR, and/or Yaw ENABLE/DISABLE switch in an invalid state.	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • Verify security of GMC 605H, GFS 83, GSU 75H, and GMU 44B electrical connectors. • Ensure wiring is not damaged. • Ensure the FCS OFF and FTR switches on cyclic are not stuck or shorted. • Verify wiring of FCS OFF and FTR switches to the AUTOPILOT FCS (5 amp) circuit breaker and GMC 605H & GFS 83. • Troubleshoot the GSU 75H and GMU 44B per Part E. • Contact RHC Technical Support.
MANIFEST	One or more of the GFC 600H units is not reporting the expected software and/or gains version to the GMC 605H.	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • Reload software and ensure there are no software failures. • Contact RHC Technical Support.
COLL FAIL	Collective Position Sensor (G356-1 transducer) has failed or Collective Position Sensor has moved beyond its calibrated range.	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • Ensure the GMC 605H, GFS 83, and G356-1 transducer connectors are securely mated to the units. • Ensure wiring is not damaged. • Verify wire on string pot is taut and crimp has not allowed the wire to slip. • Recalibrate the collective position sensor (G356-1 transducer) per § 22-16-2 Part B. • If message persists, replace G356-1 transducer assembly per § 22-13.

22-18 Garmin FCS – Troubleshooting (continued)

C. Crew Alerting System (CAS) Message Troubleshooting (continued)

CAS MESSAGE	POSSIBLE CAUSE	ACTION
AHRS DGRD	GMC 605H Air Data, GPS, or Magnetometer sensor inputs are not being used. This can indicate a magnetic anomaly or loss of data input to the system. This message is not considered abnormal when on the ground or near structures with ferrous materials.	If a persistent message is observed in-flight, consider the following actions: • Confirm from RS-232 Port 4 or Port 5 I/O diagnostics that the GMC 605H is receiving a valid MapMX signal (check mark displayed). • Review Internal AHRS diagnostics in Configuration mode. Review the Label 271 status pages to confirm that the internal AHRS is receiving air data and GPS and that the magnetometer is not indicating any abnormal faults.
GPS DATA	The FCS is not receiving valid GPS data or required GPS aiding data.	Verify HSDB wiring and RS-232 wiring from the interfaced GPS receiver.
FCS SWITCH	The FCS OFF switch has been active for >15 seconds. The switch is disabled while this message is displayed.	• Ensure FCS OFF switch is not physically stuck. • Verify wiring for both NC and NO poles for the FCS OFF switches.
<PIT or ROLL> BEEP	The cyclic TRIM ADJUST switch has been active for >30 seconds.	• Ensure the switch is not physically stuck. • Verify wiring for pilot and copilot trim switches.
YAW BEEP	The YAW TRIM switch has been active for >30 seconds.	• Ensure the switch is not physically stuck. • Verify wiring for YAW TRIM switch.
LVL SWITCH	The LVL switch has been active for >30 seconds.	• Ensure the LVL switch is not physically stuck. • Verify wiring for LVL switches.
NO ATT	The GMC 605H internal AHRS board has not aligned. If the message persists, this can indicate a configuration error with the AHRS board. This message may be presented intermittently while PFT is being executed.	• If message persists without resolution, confirm the GMC internal AHRS is receiving GPS, Air Data, and Magnetometer data. • Review Internal AHRS diagnostics in Configuration mode. Review the Label 271 status pages to confirm that the internal AHRS is receiving air data and GPS and that the magnetometer is not indicating any abnormal faults. • If it can be determined that all source data is being provided, a new pitch/roll calibration and magnetometer calibration may be required. • Contact RHC Technical Support.
• FCS KEY • HDG KEY • NAV KEY • APR KEY • IAS KEY • VS KEY • ALT KEY • LVL KEY	Annunciated key on the GMC 605H is stuck in the pressed state.	• Press the annunciated key to cycle its operation. • Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker and verify PFT passes. • If message persists, replace the GMC 605H.

22-18 Garmin FCS – Troubleshooting (continued)

D. GMC 605H Configuration Mode Test Faults

ANNUNCIATED FAULT	POSSIBLE CAUSE	ACTION
TEST FAILED: TIMEOUT	Data communications failure: GMC internal AHRS did not respond for test/procedure before timeout.	• Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker. • Ensure the GMC 605H, GFS 83, GSU 75H and GMU 44B connectors are securely mated to the units. • Ensure wiring is correct.
TEST FAILED: INVALID READY STATE	The GMC 605H internal AHRS orientation configuration is invalid or experienced an internal fault.	• Ensure that the configuration settings are correct per § 22-16-1 Part B. • Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker. • Reload software per § 22-16-1 Part C. • Contact RHC Technical Support.
TEST FAILED: AIRCRAFT IN MOTION	• Helicopter is moving. • GMC 605H is being subjected to excessive vibration. • The GMC 605H is not receiving valid GPS or Air Data. • An internal error has occurred with the GMC 605H AHRS sensor.	• Ensure the helicopter is stationary. • Ensure the GMC 605H is mounted securely and is sufficiently rigid. • Ensure a valid GPS and Air Data source is available to the GMC 605H. • Ensure that the configuration settings are correct per § 22-16-1 Part B. • Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker. • Ensure the GMC 605H, GFS 83, GSU 75H, and GMU 44B connectors are securely mated to the units. • Ensure wiring is correct. • Contact RHC Technical Support.
TEST FAILED: GMU NOT CALIBRATED	GMU 44B magnetic calibration is not done.	• Complete magnetometer calibration and retry procedure. • If message persists, return GMU 44B unit to RHC.
TEST FAILED: GRS NOT CALIBRATED	The GMC internal AHRS has experienced a calibration error.	Replace the GMC 605H unit.
TEST FAILED: GMC AHRS PIT/ROL NOT CALIBRATED	The GMC internal AHRS pitch/roll calibrations have not been completed.	• Complete pitch/roll calibration then retry procedure. • If message persists, contact RHC Technical Support.
TEST FAILED: INVALID TILT	The internal GMC 605H AHRS sensor has experienced an accelerometer failure.	• Ensure that the configuration settings are correct per § 22-16-1 Part B. • Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker. • Contact RHC Technical Support. • If message persists, replace the GMC 605H unit.

22-18 Garmin FCS – Troubleshooting (continued)

D. GMC 605H Configuration Mode Test Faults (continued)

ANNUNCIATED FAULT	POSSIBLE CAUSE	ACTION
TEST FAILED: GPS & GMU MEASUREMENT FAILURE	The GMC is not receiving GPS and GMU sensor data.	• Ensure the helicopter is stationary. • Ensure the GMC 605H is mounted securely and is sufficiently rigid. • Ensure a valid GPS and Air Data source is available to the GMC 605H. • Ensure that the configuration settings are correct per § 22-16-1 Part B. • Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker. • Ensure the GMC 605H, GFS 83, GSU 75H, and GMU 44B connectors are securely mated to the units. • Ensure wiring is correct. • Contact RHC Technical Support.
TEST FAILED: MAGNETOMETER MEASUREMENT FAILURE	The GMC is not receiving GMU sensor data.	
TEST FAILED: GPS MEASUREMENT FAILURE	The GMC is not receiving GPS data.	
TEST FAILED: UNKNOWN MEASUREMENT FAILURE	The GMC is receiving GPS and GMU sensor data, but data is invalid.	
TEST FAILED: UNKNOWN FAILURE	An internal error has occurred with the GMC 605H AHRS sensor.	• Ensure that the configuration settings are correct per § 22-16-1 Part B. • Pull open AUTOPILOT FCS (5 amp) circuit breaker and wait for display to turn off completely. Push in circuit breaker. • Reload software per § 22-16-1 Part C. • Contact RHC Technical Support. • If message persists, replace the GMC 605H unit.
TEST FAILED: INVALID PITCH OFFSET	The pitch offset value is outside the predefined range (e.g., a zero pitch/roll calibration with a non-zero pitch value).	• Ensure the helicopter is level and repeat the calibration test. • If message persists, replace the GMC 605H unit.
TEST FAILED: INVALID ROLL OFFSET	The roll offset value is outside the predefined range (e.g., a zero pitch/roll calibration with a non-zero roll value).	• Ensure the helicopter is level and repeat the calibration test. • If message persists, replace the GMC 605H unit.
TEST FAILED: RESULT NOT SAVED	The GMC 605H has experienced an internal non-volatile memory error.	• Replace GMC 605H configuration module. • Contact RHC Technical Support.
TEST FAILED: CRC FAILED	The GMC 605H received invalid data.	• Ensure that the configuration settings are correct per § 22-16-1 Part B. • Ensure a valid GPS and Air Data source is available to the GMC 605H. • Ensure the GMC 605H, GFS 83, GSU 75H, and GMU 44B connectors are securely mated to the units. • Ensure wiring is correct.

22-18 Garmin FCS – Troubleshooting (continued)

D. GMC 605H Configuration Mode Test Faults (continued)

ANNUNCIATED FAULT	POSSIBLE CAUSE	ACTION
TEST FAILED: • MAG-FIELD RETURNED BAD RESULTS • HORIZONTAL MAG FIELD TOO SMALL • PHASE I / II NOT COMPLETED FAST ENOUGH • TOO MANY STATIONS AROUND COMPASS ROSE • NOT ENOUGH N,E,S,W STATION DATA • COMPUTED MAGNETIC OFFSETS ARE TOO LARGE • SITE DOESN'T HAVE UNIFORM MAGNETIC FIELD • SITE MAG FIELD DIFFERENT FROM IGRF MODEL	• GMC is not receiving valid GPS, air data, and/or magnetometer data. • Helicopter is not in a magnetically clean area. • Post-install calibrations were not completed.	• Ensure that the configuration settings are correct per § 22-16-1 Part B. • Ensure a valid GPS and Air Data source is available to the GMC 605H. • Ensure the GMC 605H, GFS 83, GSU 75H and GMU 44B connectors are securely mated to the units. • Ensure wiring is correct. • Ensure helicopter is in an area free of magnetic interference and away from ferrous metal objects. • Ensure all calibration procedures were completed in order.

E. AHRS/ADC Faults

FAULT MESSAGE	POSSIBLE CAUSE	ACTION
AHRS 1/2 reports an in-tarmac magnetic anomaly	The AHRS has detected an in-tarmac anomaly at the given location.	• If this error shows up repeatedly, conduct the magnetic interference check. • If fault persists, contact RHC Technical Support.
AHRS 1/2 reports a local earth magnetic anomaly	The AHRS has detected a local earth anomaly at the given location.	• If this error shows up repeatedly, conduct the magnetic interference check. • If fault persists, contact RHC Technical Support.
AHRS 1/2 magnetic model database needs update	The designated AHRS Magnetic Model is out-of-date.	• Update the magnetic model database. • If fault persists, contact RHC Technical Support.
AHRS 1/2 not receiving valid magnetometer data	Communication lost with GMU 44B or GMU 44B installation incorrect.	• If other ADC or AHRS faults are present, correct those first. • Verify ADC 1/2 configuration and wiring. • If fault persists, contact RHC Technical Support.
ADC 1/2 error correction inoperative	The alert flag has been set by the ADC.	• If other ADC or AHRS faults are present, correct those first. • Verify ADC 1/2 configuration and wiring. • If fault persists, contact RHC Technical Support.
Service required	ADC loss of communication or no GTP 59 signal.	• Verify ADC power. • Inspect ADC/AHRS wiring and connections. • Inspect GTP 59 connections and wiring. • If fault persists, contact RHC Technical Support.

22-18 Garmin FCS – Troubleshooting (continued)

F. Post Installation Calibration Troubleshooting

ANNUNCIATED FAULT	POSSIBLE CAUSE	ACTION
ERROR – Error occurred while starting <procedure name>	The GSU 75H experienced a mode swap error (i.e., sensor is not in configuration mode to perform the post-install procedure).	• Ensure 60 seconds has passed from navigating from the Main Menu to the AHRS Menu and rerun procedure. • Cycle power to the sensor.
Cannot start <procedure name> until aircraft is stationary	Helicopter is not stationary.	• Ensure helicopter is stationary. • Ensure GPS has an unobstructed view of the sky. • Ensure the GSU 75H is not subject to excessive vibration. • Rerun procedure.
Timeout occurred while starting <procedure name>	AHRS did not respond for test/procedure before internal timeout.	Cycle power to the GSU 75H and ensure 60 seconds has passed from navigating from the Main Menu to the AHRS Menu and rerun procedure.
Unable to begin <procedure name>	AHRS did not respond with correct calibration procedure reply.	Cycle power to the GSU 75H and ensure 60 seconds has passed from navigating from the Main Menu to the AHRS Menu and rerun procedure.
Timeout occurred while completing <procedure name>	AHRS did not reply complete for the test/procedure before timeout.	• Ensure the GSU 75H is receiving valid GPS and Magnetometer (green check). • Cycle power to unit and retry procedure.

22-18 Garmin FCS – Troubleshooting (continued)

G. Upload and Download Troubleshooting

ANNUNCIATED FAULT	POSSIBLE CAUSE	ACTION
Invalid <any region> download	Region read error	Cycle power on the GSU 75H and retry download.
Error upload/downloading <any region>: <reason>	Fail	Cycle power on the sensor and retry download.
	File open failure	Ensure the download location is valid and has read/write access.
	Empty region	Data does not exist or is corrupt and retry download.
	Region not fully downloaded	Cycle power to the sensor and retry download.
	Timeout	Cycle power to the sensor and retry download.
	• Unit disconnected OR • Dropping packets due to poor connection	Cycle power to the sensor and retry download.
No flight logs downloaded. Press OK to return...	The GSU 75H did not respond with flight log before timing out.	Cycle power on the sensor and retry download.
Flight Log download was not successful: Download directory is invalid	Download location is not valid to save file.	Ensure the download location is valid and has read/write access and retry download.
Flight Log download was not successful: Unexpected error	Issue populating the flight log table.	Cycle power on the sensor and retry download.
Unable to start Flight Log download: No flight logs selected	No flight log was selected to download.	Select a flight log and retry download.
Download AHRS Config is corrupt. Please upload valid AHRS Config and try again.	AHRS config is corrupt or invalid.	• Upload a new AHRS config file and retry. • Ensure AHRS configuration matches airframe configuration. Resetting configuration may be necessary if reloading a config file.
Cannot upload an AHRS Config with invalid AHRS Orientation. Please select valid AHRS orientation and try again.	AHRS orientation not selected in AHRS configuration settings.	Ensure that the configuration settings are correct per § 22-16-1 Part B.

22-20 HeliSAS (Stability Augmentation System)

22-21 HeliSAS – Description

The HeliSAS autopilot system consists of two electric servomotors, a flight control computer, an autopilot control panel, and control buttons on the cyclic grip. One servomotor controls pitch and is installed in the control tunnel forward of the cyclic stick. The other servomotor controls roll and is installed under the pilot's seat. The servomotors are connected to the cyclic through electromagnetic clutches.

The flight control computer is installed on the forward panel under the pilot's seat, and the autopilot control panel is installed in the avionics stack.

The autopilot senses aircraft attitude using a combination of sensors in the flight control computer and an independent onboard attitude source such as the Attitude Heading Reference System (AHRS) for the Primary Flight Display (PFD). The computer then sends signals to the servomotors which are connected to the bottom of the cyclic in the control tunnel.

The primary autopilot mode is Stability Augmentation System (SAS) mode which maintains a steady helicopter attitude by applying corrective inputs to the cyclic. This is felt as a light cyclic centering force. Additional modes may be layered on top of SAS mode and are described below. The pilot can override as desired for maneuvering without disengaging the system. Only a few pounds of force at the cyclic are required for override, and the system will not disconnect due to pilot cyclic inputs.

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.

When the avionics master is switched on, the autopilot performs a self-test and then enters SAS standby mode. All of the control panel indicators flash alternating white and green during the self-test. Four headset beeps occur at the beginning of the self-test as a check of the aural warning function. The SAS annunciator on the control panel turns steady white when the self-test is complete.

> NOTE
>
> Autopilot will not enter standby mode if attitude indicator is not functioning or indicated bank angle is greater than 6 degrees.

The autopilot SAS mode is engaged either by pressing the SAS button on the control panel or by pressing the TRIM button on the cyclic for more than 1.25 seconds. Additional modes are engaged by pressing the appropriate button on the control panel. The additional modes are disabled and will not engage at airspeeds below 44 KIAS or above 140 KIAS.

22-21 HeliSAS – Description (continued)

To disengage any mode, push the appropriate button on the control panel.

NOTE

Disengaging SAS mode will also disengage all other modes.

Modes may also be disengaged using the AP OFF button on the cyclic. If only SAS mode is engaged, push the AP OFF button once to disengage. If additional modes are engaged, push the AP OFF button once to disengage all modes except SAS and a second time to disengage SAS mode, or push and hold the AP OFF button to disengage all modes including SAS.

NOTE

SAS disengagement should always be accompanied by four beeps in the headset. If beeps do not occur, maintenance is required.

Safety monitors automatically disengage individual modes or the entire system if a fault is detected. Automatic disengagement of SAS mode (or the entire system) is indicated by four beeps in the headset. Automatic disengagement of any mode other than SAS is indicated by a single beep in the headset. There is no audio indication for intentional disengagement of modes other than SAS.

NOTE

The system also automatically reverts to SAS mode at airspeeds below 44 KIAS or above 140 KIAS, accompanied by a single beep. The high speed limit is not intended to provide V_{ne} protection. It is the pilot's responsibility to observe V_{ne} limits.

The TRIM button is used to re-set the target attitude (to re-trim) while in SAS mode. Use a small amount of force to override the autopilot and then push and release the TRIM button at the new desired condition. If the force to override is objectionable, the TRIM button may be held down during maneuvers. The system will re-trim to the attitude at which the TRIM button is released. For Version 52, stick forces felt during override will gradually wash out to near zero without use of TRIM button if override is maintained.

NOTE

The system will not re-trim to angles more than approximately 10° in pitch or roll.

22-21 HeliSAS – Description (continued)

NOTE

When engaging SAS mode from standby, for angles of less than approximately 10° in pitch and roll, SAS holds the current angles. If either pitch or roll is larger than approximately 10°, the system assumes an unusual attitude and gently levels the helicopter.

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

Heading Mode (HDG) – maintains the heading selected by the heading bug on the directional gyro or Horizontal Situation Indicator (HSI) display. Aircraft can be steered using the heading bug.

Altitude Mode (ALT) – maintains altitude at the time of engagement or of last TRIM button release. The target altitude is reset each time the TRIM button is pressed and released.

NOTE

The autopilot uses pitch attitude to maintain altitude or follow an approach glidepath. It does not have any control of power setting. The pilot must manage power with the collective to control speed and rate of climb or descent. Make small, smooth power changes to allow the system to adjust to new power settings.

Navigation Mode (NAV) – tracks the active GPS or VLOC course displayed on the Course Deviation Indicator (CDI). If no CDI is installed, NAV will only track the active GPS course displayed on the GPS.

NAV may be armed prior to intercepting the active course. NAV annunciator is white when NAV is armed and turns green at course intercept. If HDG is active when NAV is armed, the autopilot will fly the selected heading until course intercept. If HDG is not active, the autopilot will select a 45° intercept angle.

22-21 HeliSAS – Description (continued)

Vertical Navigation Mode (VRT) – tracks an ILS glideslope or GPS approach vertical guidance. Arm VRT (annunciator turns white when armed) prior to intercepting the glidepath. VRT annunciator will turn green at glidepath intercept.

NOTE

Pushing the ALT button while VRT is armed or active will turn off VRT. VRT must be re-armed or re-engaged as desired.

NOTE

Reducing power to approach setting just prior to glidepath intercept is recommended.

Speed Mode (SPD) (Version 52 only)

Speed mode uses cyclic pitch to control airspeed. Exact behavior varies with configuration of airspeed and altitude bugs on the PFD as described below.

The altitude bug is displayed above the altitude tape and the airspeed bug is displayed above the airspeed tape. The appearance of all dashes or a blank field indicates a bug is not set.

If an airspeed bug is not set, selecting SPD holds the current airspeed. The target speed is reset each time the trim button is pressed and released.

If an airspeed bug is set, selecting SPD holds airspeed at the bug setting. Changing the bug will change the target airspeed.

If an altitude bug is set, selecting SPD will also arm ALT (ALT LED white) for altitude capture. The mode will switch from SPD to ALT if the selected altitude is crossed. There will be a brief period in capture mode with the ALT LED flashing white/green.

NOTE

Do not change the selected altitude during ALT capture (ALT LED flashing white/green). System may pitch up or down to chase bug and may not capture altitude.

NOTE

Different brands of PFD behave differently in terms of bug settings at power up and how bugs are manually set. Refer to PFD manufacturer's documents for proper use. Verify desired bug settings before engaging SPD mode.

22-21 HeliSAS – Description (continued)

Backcourse Mode (BC) (Version 51 only) – reverse CDI sensing for backcourse approaches. Course on HSI should be set so that tail of course pointer points toward runway (set to inbound front course).

Airspeed Protection (Version 52 only) – Minimizes the possibility of the ALT mode to fly the helicopter to an airspeed below 44 KIAS due to insufficient power, or the VRT mode to fly the helicopter to an airspeed above 140 KIAS due to excess power when flying a precision approach glideslope. When triggered, it causes the longitudinal mode to change from ALT (at low airspeed) or VRT (at high airspeed) to SAS mode with a commanded pitch attitude of 2 degrees nose down. Since the mode change is not commanded by the pilot, a single warning beep is annunciated.

A. Removable Flight Controls

On later aircraft, disconnect the electrical connector for the left-hand trim button located near the quick release pin before removing the left cyclic grip. Reconnect the connector when installing the left cyclic grip.

B. Schematic

Refer to Figures 98-8B & 98-8C for D325-1 autopilot (HeliSAS) electrical schematic.

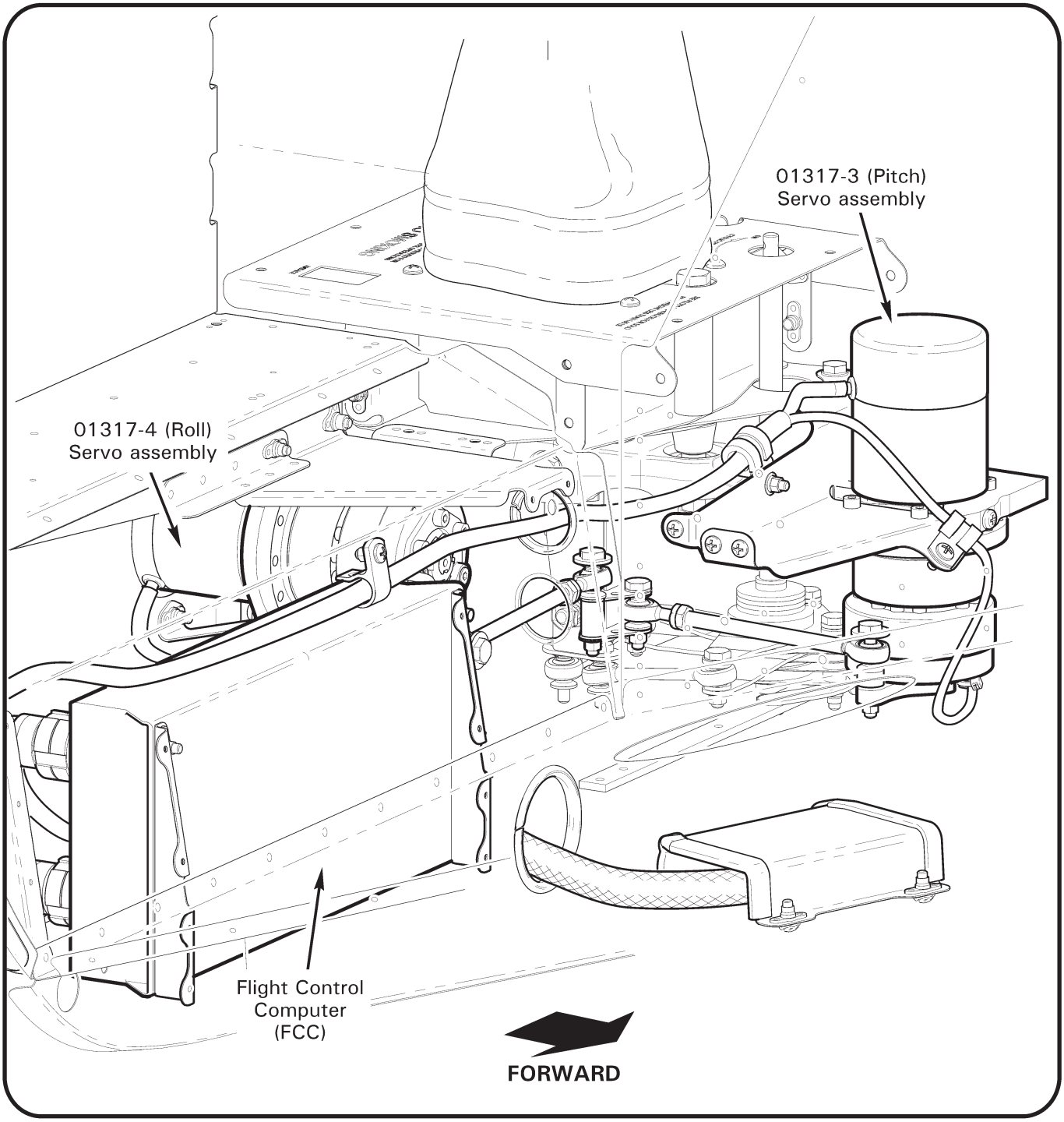


FIGURE 22-8 HELISAS AUTOPILOT SYSTEM

22-22 HeliSAS – (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 collective covers and F444-1 cyclic cover. Hinge front right seat forward. Remove G702 cover assembly under pilot's seat.
3. Remove avionics and avionics trays as required from lower console.

CAUTION

For pitch servo, adjust length of A336-8 push-pull tube assembly to 4.20 ± 0.03 inches between rod end centers.

4. Position cyclic stick full aft and apply cyclic friction. Remove hardware (and C130-50 spacer) securing 01317-3 (pitch) servo assembly arm to A336-8 push-pull tube's rod end.
5. Disconnect servo harness from flight control computer's J1 PITCH receptacle. Cut and discard ty-rap(s) securing harness to M23190/1-2 clamp(s) and pull harness through access holes into control tunnel.
6. Support servo and remove hardware securing servo's 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 01317-3 (pitch) servo assembly in control tunnel and install hardware securing servo's 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 flight control computer's J1 PITCH receptacle. Install ty-rap(s) securing harness to M23190/1-2 clamp(s). Cinch ty-raps until snug without over-tightening, and trim tips flush with heads. 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 assembly connected to pitch servo is 4.20 ± 0.03 inches between rod end centers.
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 § 22-27 Part A.
9. Install G702 cover assembly under pilot's seat. Install F444-1 cyclic cover, and F445 and F680-3 collective covers. Verify security.

22-23 HeliSAS – (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 collective covers. Remove G702 cover assembly under pilot's seat.

CAUTION

For roll servo, adjust length of A336-8 push-pull tube assembly to 4.30 ± 0.03 inches between rod end centers.

3. Position cyclic stick full left and apply cyclic friction. Remove hardware securing 01317-4 (roll) servo assembly arm to A336-8 push-pull tube's rod end.
4. Disconnect servo harness from 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 block assembly to keel panel and 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 01317-4 (roll) servo assembly under pilot's seat and install hardware securing servo's block assembly to keel panel and brace assembly. Tighten screws. Verify security.
3. Connect servo harness to 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 assembly connected to roll servo is 4.30 ± 0.03 inches between rod end centers.
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 § 22-27 Part A.
8. Install G702 cover assembly under pilot's seat. Install F445 and F680-3 collective covers. Verify security.

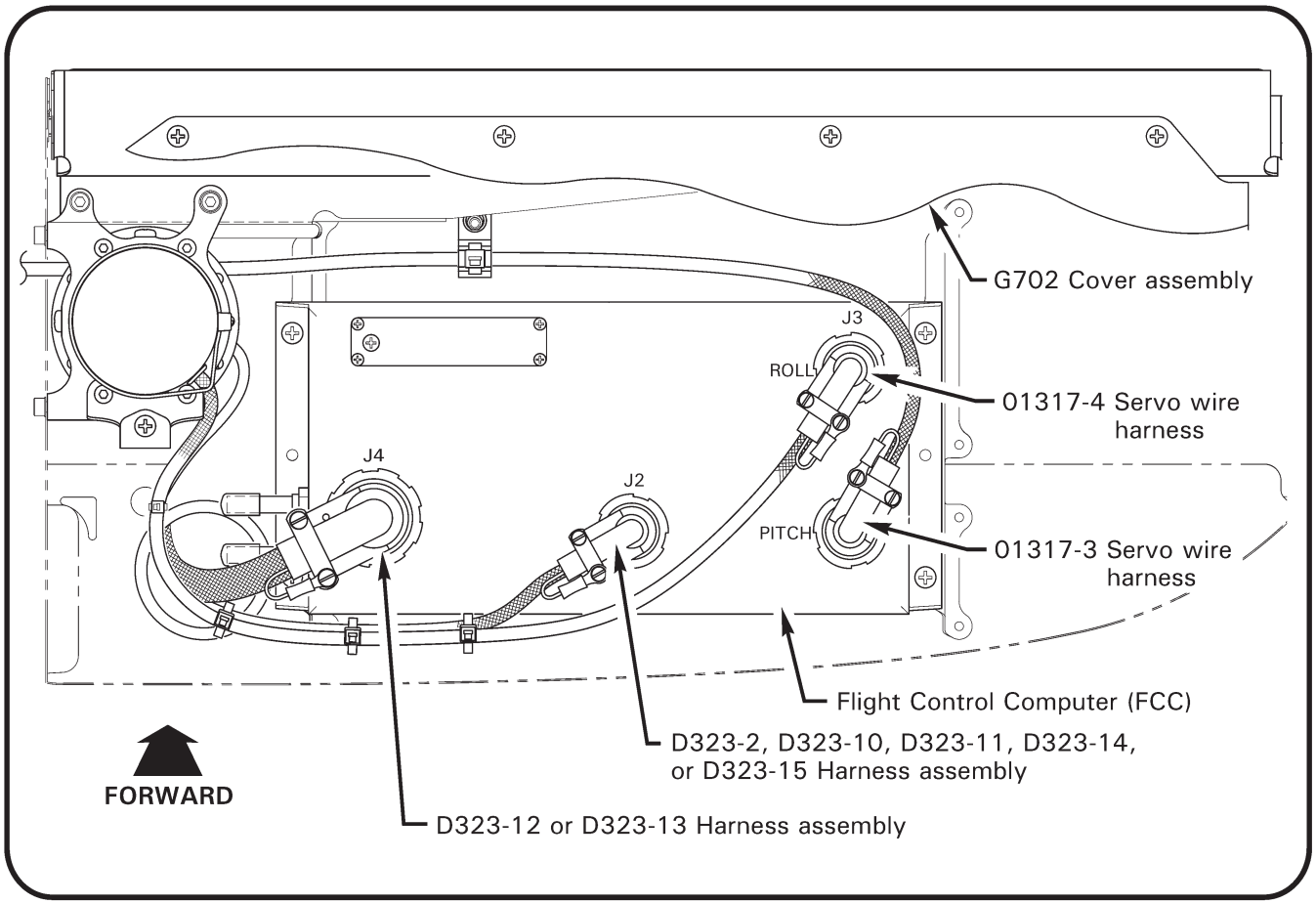


FIGURE 22-9 FLIGHT CONTROL COMPUTER

Version 51	
FCC part number	01311-03-11
Control panel part number	01309-01-01

Version 52	
FCC part number	01311-02-111
Control panel part number	01309-03-01

TABLE 22-2 SOFTWARE VERSIONS AND EQUIPMENT PART NUMBERS

22-24 HeliSAS – Flight Control Computer (FCC)

NOTE

Refer to Table 22-2. Flight control computer (FCC) and control panels for Software Version 51 and Software Version 52 are not interchangeable. Verify part number compatibility prior to installation.

22-24 HeliSAS – Flight Control Computer (FCC; continued)

A. Removal

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

B. Installation

NOTE

Prior to installation, verify affected FCCs were upgraded per R66 SB-37.

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Position flight control computer under pilot's seat and install screws securing computer to D358 support assemblies. Tighten screws. Verify security.
3. Ensure pitot and static ports on FCC are capped.
4. Connect D323 harness assemblies and 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 § 22-27 Part A.
7. Install G702 cover assembly under pilot's seat.

22-25 HeliSAS – Control Panel

NOTE

Refer to Table 22-2. Flight control computer (FCC) and control panels for Software Version 51 and Software Version 52 are not interchangeable. Verify part number compatibility prior to installation.

22-25 HeliSAS – Control Panel (continued)

A. Removal

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Loosen quarter-turn fasteners securing control panel to console assembly.
3. Carefully unplug harness from control panel and remove panel.

B. Installation

1. Turn battery & avionics switches off and pull out AUTOPILOT (5 amp) circuit breaker at panel.
2. Carefully plug-in harness to control panel.
3. Tighten quarter-turn fasteners securing control panel to console assembly. Verify security.
4. Push in AUTOPILOT circuit breaker (5 amp) at panel. Perform ground checks as appropriate per § 22-27 Part A.

22-26 HeliSAS – Cyclic Grip Assembly

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

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 § 22-27 Part A.

C. Schematic

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

22-27 HeliSAS – Maintenance

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 any incident that may have affected autopilot or related equipment prior to return to service.

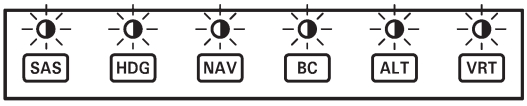
NOTE

Refer to § 22-27 Part B 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:



FOUR BEEPS IN HEADSET



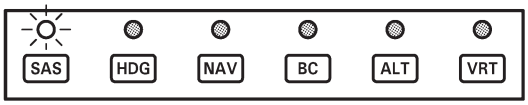
LEDs ALTERNATE WHITE/GREEN

(01309-01-01 control panel shown)

2. Verify SAS enters standby mode approximately 6 seconds after PFD aligns. Verify no sound in headset and control panel SAS LED is white, other LEDs are dark:



NO SOUND



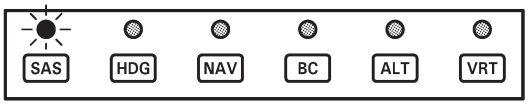
SAS LED IS WHITE, OTHER LEDs DARK

3. With cyclic friction full off, verify cyclic moves freely within hydraulic servo longitudinal and lateral deadbands.

4. Engage SAS mode (cyclic should feel "energized"). Verify no sound in headset and control panel SAS LED is green, other LEDs are dark:



NO SOUND



SAS LED IS GREEN, OTHER LEDS DARK

5. With SAS engaged, displace cyclic at least 1 inch from neutral position and verify a vibrating resistance is encountered. Perform check for roll & pitch axes.

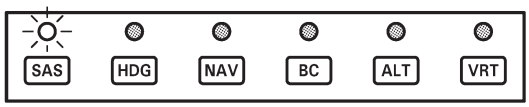
22-27 HeliSAS – Maintenance (continued)

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:



FOUR BEEPS IN HEADSET

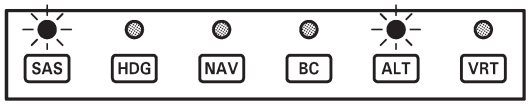


SAS LED IS WHITE, OTHER LEDS DARK

7. Perform pitot system leak test per § 95-30 and, while airspeed indicates > 50 knots: Engage SAS and ALT modes. Verify no sound in headset and SAS & ALT LEDs are green, other LEDs are dark:



NO SOUND

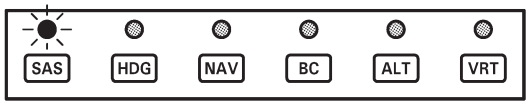


SAS & ALT LEDs ARE GREEN, OTHER LEDS DARK

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



NO SOUND



SAS LED IS GREEN, OTHER LEDS 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.

22-27 HeliSAS – Maintenance (continued)

B. 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).
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.

22-27 HeliSAS – Maintenance (continued)

B. Troubleshooting (continued)

PROBLEM	ACTION
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.

Intentionally Blank