

GFC 700 AUTOPILOT - DESCRIPTION AND OPERATION

1. General

- A. The Garmin G1000 GFC 700 Automatic Flight Control System (AFCS) is a three-axis fail-safe digital flight control system. The GFC 700 refers to a fully integrated autopilot and flight director (FD) system, with functions provided by multiple G1000 LRUs. The LRU's include, the GMC 710 AFCS Mode Controller, three Garmin Display Units (GDU), Primary Flight Display, pilot (PFD 1), copilot (PFD 2), and the Multi Function Display (MFD), two Garmin Integrated Avionics Units (GIA) 63W No. 1 and No. 2, two Garmin Servo (GSA) 80 and two Garmin Servo Gearbox Mount GSA 81 Torque Servos and four Garmin Servo Mount (GSM) 85/85A or four GSM 86 (depending on serialization).
- B. On the pilot and copilot's control wheel each there are three switches that interface with the GFC 700 AFCS. One switch is the Autopilot Disconnect Switch, one is the Control Wheel Steering Switch, and the other is a two part Manual Electric Trim (MET) switch.
- C. The Go Around (GA) Switch is built into the main power lever on the throttle quadrant.

2. Description

- A. The following functions are provided by the GFC 700:
 - Flight Director
 - Autopilot
 - Yaw Damper
 - Autotrim in the Pitch Axis
 - Manual Electric Trim in the Pitch Axis.
- B. GMC 710 AFCS Mode Controller
 - (1) The flight crew controls the GFC 700 Autopilot system functions with the Garmin GMC 710 AFCS Mode Controller, found above the MFD at the center of the instrument panel. The GMC 710 is connected to the PFD's through two RS 232 buses. The GMC 710 has all the controls to set the different flight modes. The mode logic and the FD computations are performed by the GIA 63W based on the currently selected flight modes.
- C. PFD (Primary Flight Display)
 - (1) All the GFC 700 data is shown on the PFD's. The AFCS mode annunciations are shown on the upper-center area of the PFD whenever the FD or the autopilot is active. Roll modes are shown on the left side, and pitch modes on the right. Armed modes are shown (white) on the outer edge of the AFCS annunciation field of the PFD. Active modes are shown (green) next to the armed modes.
- D. Torque Servos
 - (1) The Pitch and Pitch trim servos are the low-torque GSA 81 servos.
 - (2) The Roll and Yaw servos are the high-torque GSA 80 servos.
 - (3) The GSM 85/85A/86 servo gearbox is mounted to the aircraft structure, via a mounting bracket, and is responsible for transferring the output torque of the GSA 80/81 servo actuator to the mechanical flight control surface linkage.
 - (4) Communication interfaces to the G1000 LRUs are both GIA's through the RS 485 data busses and other servos.
- E. Autopilot/trim Disconnect Switches.
 - (1) The autopilot/trim disconnect switches are push type switches that are installed on the top of the outboard sides of the pilot's and the copilot's control wheels. The switches are momentary switches that are spring-loaded to the disengaged position. When the switch is pushed in, it is engaged. When the switch is released, it is disengaged.
- F. Control Wheel Steering Switches
 - (1) The control wheel steering switches are push type switches that are installed on the top of the outboard sides of the pilot's and the copilot's control wheels. The switches are momentary switches that are spring-loaded to the disengaged position. When the switch is pushed and held in, it is engaged. When the switch is released, it is disengaged.

3. Operation

- A. The GFC 700 auto flight system receives power through the A/P CONT and SERVOS circuit breakers, found on the AVIONICS circuit breaker panel. When power is applied to the aircraft, each part of the GFC 700 AFCS will begin a basic self test to ensure that the system is functioning properly. Before, during, and after this process is being performed, there are visual and aural cues to associate with this test.

- B. The Preflight Test (PFT) is done by both GIA's at startup, and needs to pass both GIA's before the autopilot can be engage. The PFT is only started if the Attitude and Heading Reference System (AHRS) has aligned, and the GIA's and servos are configured, and the certification gains are valid. Before the PFT begins, the red AFCS message is displayed in the upper center region of the PFD. The red AFCS is displayed while the main system is still powering up, when the AFCS begins its PFT, the red AFCS message is replaced by a white PFT message. At the conclusion of the test, the white PFT message is removed. If the system fails the PFT, then the white PFT is replaced by a red PFT or AFCS message. If the test is successful, no additional messages will be displayed in the place of the white PFT; in addition, a two-tone aural message, repeated three times, will annunciate the test's successful completion.
- (1) After the system PFT has passed, it will be performed again if a servo resets, if the autopilot servo breaker is reset or the cross-side GIA restarts it.
 - (2) Generally, the PFT failure fault is logged in the GIA Maintenance Log and not in the Servo Maintenance Logs unless the GIA log fault identifies a servo problem.
- C. The Garmin GFC 700 FD functions are accomplished by both GIA's that use data from the G1000 system, including air data, attitude, and navigation data, to calculate commands for display to the pilot and for the Autopilot. FD command bars and mode annunciations are sent to the PFD through a high-speed Ethernet connection for display to the pilot. The FD operates independently of the Autopilot, and allows the pilot to hand-fly the command bars, if necessary.
- D. The Garmin GFC 700 command data is given to the four torque servos. FD data is processed by the four servos for aircraft flight control surface commands. The autopilot cannot operate unless the FD is engaged. The following is a summary of the autopilot functions provided by each LRU:
- GDU PFD - Displays the FD command bars and the autopilot mode annunciations.
 - GMC 710 AFCS Controller - Supplies controls for the autopilot functions.
 - GIA 63W No.1 and No. 2 - Performs mode logic and FD computations based on the currently selected flight modes.
 - GSA 80 - Actuates the Roll and Yaw control surfaces based on information received from the GIA's, the GRS 77 AHRS, and the other servos.
 - GSA 81 - Actuates the Pitch and Pitch trim control surface based on information received from the GIA's, the GRS 77 AHRS, and the other servos.
- E. The control wheel switches do the functions that follow:
- (1) The autopilot/trim disconnect switches are used to let the pilot or the copilot disengage the autopilot or stop a runaway from any of the trim actuators. When the switch is pushed, the autopilot will disengage. The pilot or the copilot can push and hold the switch to stop a runaway from one of the trim actuators until the related circuit breaker is disengaged.
 - (2) The control wheel steering switches are used to let the pilot or the copilot change the airplane's heading when the autopilot is engaged. When the switch is pushed, the autopilot servo clutches will release to let the pilot or the copilot change the airplane's heading. When the switch is released, the servo clutches will engage and the airplane will continue at the new heading.
 - (3) The Manual Electric Trim switches are used to position the elevator trim tabs if the autopilot is not engaged. They can be used to disengage the autopilot when it is engaged.
- F. The throttle quadrant switches do the functions that follow:
- (1) Go Around Switch - Disengages the autopilot and selects flight director Go Around Mode. If an approach procedure is loaded this switch also activates the missed approach when the selected navigation source is GPS or when the navigation source is VOR/LOC and a valid frequency has been tuned.