GFC 700 AUTOPILOT - TROUBLESHOOTING

1. General

A. This section gives the troubleshooting procedures for the Garmin GFC 700 AFCS. For a general overview of the GFC 700 Autopilot System refer to GFC 700 Autopilot - Description and Operation.

2. Garmin GFC 700 AFCS Troubleshooting

A. Tools and Equipment

NOTE: For the supplier publication part number and manufacturer data, refer to the Introduction - Supplier Publication List.

(1) Tools and Equipment

- Multimeter.

(2) Special Consumables

- None.

(3) Reference Material

- Garmin GFC 700 Automatic Flight Control System (AFCS) - Description and Operation
- Chapter 34, Garmin G1000 Integrated Avionics System - Adjustment/Test
- Model 208 Wiring Diagram Manual.

B. Do Garmin GFC 700 AFCS Preliminary Troubleshooting

(1) Make sure that the switches that follow are in the OFF position:

(a) BATTERY switch.

(b) EXTERNAL POWER switch.

(c) AVIONICS 1 and 2 switches.

(2) Connect external electrical power to the airplane.

(3) Make sure that all the circuit breakers on the Avionics circuit breaker panel are engaged.

(4) Put the switches that follow in the positions given:

(a) External POWER switch to the BUS position.

(b) BATTERY switch to the ON position.

(c) Avionics 1 and 2 switches to the ON position.

(5) When power is applied to the airplane the AFCS starts a preflight test (PFT) shown by an AFCS message (white) in the upper part of the primary flight display.

(6) Make sure that when the test is complete the message is removed from the PFD display.

(a) If the system fails the PFT, then the (white) PFT will be replaced by a (red) PFT or AFCS message. Troubleshoot the shown failure. Refer to PreFlight Test Message Troubleshooting.

(b) 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.

(7) Check the primary flight display crew alert system (CAS) window for messages to aid in troubleshooting the anomaly.

(8) Push the right-most softkey on the PFD and make sure that no messages show in the Alerts window.

(9) Refer to Chapter 34, Garmin G1000 Integrated Avionics System - Adjustment/Test G1000 System Status Page Check and do the steps that follow:

(a) Make sure that the correct part number and version software/configuration files are installed.

(b) Make sure the GSA LRU's have a check mark (green) next to their nomenclature on the list.

NOTE: This indicates the LRU is serviceable.

(c) Make sure that all the related systems are serviceable.

(d) The LRU serial number is shown.

NOTE: Serial number is not reported for the following equipment: COM1, COM2, GS1, GS2, GTX1, GTX 2 (OPT), NAV1, NAV2, AND WX500.

(10) If a serial number or a version number is dashed, (Refer to the Model 208 Wiring Diagram Manual, Chapter 20, Wiring - Maintenance Practices) and carefully examine the electrical wiring and components as follows:

(a) Remove electrical power from the airplane.

(b) Do a visual check of the electrical connectors and airplane electrical connectors for bent pins and pushed back pins.

1 If necessary, repair the damage.

(c) Make sure that electrical power and ground signals are present.

(d) Make sure that data bus lines are correctly terminated and secure.

CAUTION: Do not touch bus wiring to each other or to shield grounds. Damage to equipment or circuits can result.

(e) Use a multimeter to do a continuity check of the bus wires.

1 Make sure that there is continuity only from each wires' related pin end to end and to no other wires, airplanes grounds, or shields.

(f) Do a visual check of the wiring components and make sure that all applicable strapping is correct and any necessary G1000 system strapping is correct.

(g) Do a visual check of the wiring bundles for damage.

1 If necessary, repair or replace the wiring bundles. Refer to the Model 208 Wiring Diagram Manual, Chapter 20, Wiring - Maintenance Practices.

3. PreFlight Test Message Troubleshooting

A. Do the PreFlight Test Message Troubleshooting

(1) Get access to the GIA and GSA Maintenance Logs as follows:

NOTE: 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.

(2) Put the G1000 in configuration mode as follows:

(a) Disengage the PFD 1 circuit breaker found on the Avionics circuit breaker panel.

(b) On PFD 1 push the ENT key the same time you engage the PFD 1 circuit breaker.

1 Release the ENT key when INITIALIZING SYSTEM shows on PFD 1.

(c) Disengage the PFD 2 circuit breaker found on the Avionics circuit breaker panel.

(d) On PFD 2 push the ENT key the same time you engage the PFD 2 circuit breaker.

1 Release the ENT key when INITIALIZING SYSTEM shows on PFD 2.

(e) Disengage the MFD circuit breaker found on the Avionics circuit breaker panel.

(f) On the MFD push the ENT key the same time you engage the MFD circuit breaker.

1 Release the ENT key when INITIALIZING SYSTEM shows on the MFD.

(3) Use the FMS knob on PFD1 to display the Diagnostics Terminal Page in the system group.

NOTE: This page allows the technician to view maintenance logs associated with the GFC 700.

(a) Select GIA 1 or GIA 2 in the LRU window.

(b) In the SERVO window, select NONE to view the GIA Maintenance Log or choose a servo to view their logs.

(c) On the PFD, use the FMS knob to select, VIEW MAINTENANCE LOG in the COMMAND window.

(d) On the PFD, push the ENT key.

(4) When the Maintenance Log data starts to display in the OUTPUT window, you can see "More...press any key to continue..." at the bottom of the OUTPUT window.

(5) To see more data do the steps as follows:

(a) In the COMMAND window select VIEW MAINTENANCE LOG.

(b) Push the ENT key.

(c) To scroll through the OUTPUT list, push the OUTPUT softkey.

(6) Use the GIA Maintenance Log to view possible faults. Refer to Table 101.

Table 101. GIA Maintenance Log

GIA Maintenance Log Fault	Cause	Possible Solution
FCS Task not started: Bad gains.	The FCS task has not started because the gains are not present or have been corrupted.	1. Reload the gain files.
FCS Task not started: Gain structure out of range.	The FCS task has not started because the gains are not compatible with the GIA software.	1. Reload the gain files.
PFT FAIL: Timeout, <STEP>.	Preflight test has failed because the specified step has not passed in the allotted time.	1. Refer to the GIA 63W/64W preflight test steps Table 106.
PFT FAIL: Cross GIA Failed, State: <STEP>.	Preflight test has failed on opposite GIA. <STEP> specifies the preflight test step on selected GIA that was in progress when the preflight test failed on the opposite GIA.	1. Refer to the GIA 63W/64W preflight test steps Table 106.
PFT FAIL: <STEP>.	Preflight has failed because the step specified has failed.	1. Refer to the GIA 63W/64W preflight test steps Table 106.
AHRS MON invalid: <STATE>	The AHRS monitor has detected that the AHRS data is invalid.	1. Mon Prmtr Invalid: The ARINC 429 data used by one of the monitors has not been received. 2. Attitude Prmtr Invalid: The ARINC 429 pitch or roll angle has not been received. 3. Exceeded Attitude Limits: The pitch or roll angle has exceeded the engagement limits. 4. Cross Hdg Accel Fail: Cross heading acceleration monitor failed. 5. Vert Accel Fail: Vertical acceleration monitor failed. 6. Fltrd Cross Hdg Accel Fail: Filtered cross heading acceleration monitor failed. 7. Fltrd Vert Accel Fail: Filtered vertical acceleration monitor failed. 8. Roll Accel Fail: Roll acceleration monitor has failed. 9. Normal Accel Fail: Normal acceleration has failed. 10. Troubleshoot the AHRS.
Stuck switch invalidated parameter: <AXIS>.	A MET switch in the specified axis is stuck.	1. Troubleshoot the MET switches.
PRMTR:<PARAMETER> MODE: <MODE> Parameter lost.	The mode specified by <MODE> has been disengaged because the parameter specified by <PARAMETER> has become invalid.	1. AD TDM Comm Valid: The specified mode has been disengaged because communication with the servos, through the Time Division Multiplexer protocol, has been lost. 2. AP Pitch MET not stuck: The specified mode has been disengaged due to a stuck pitch MET.

(7) Use the Servo Maintenance (GSA) Fault Logs to view possible faults.

NOTE: There are two processor fault logs where faults are reported, the Monitor Processor and the Control Board Processor. The processors contains the logs found on these components processors: Pitch Servo, Roll Servo, Yaw and Pitch Trim Servo.

NOTE: There are two main groupings of faults that can occur in the monitor and control processor: The first grouping of faults can occur during the GSA unit PFT. If there is a fault during PFT the unit will not be able to transition to normal mode and the only way to clear this state would be to cycle unit power. The second grouping of faults can occur during normal mode. These faults generally cause a disconnect of power to the GSA and report that a fault has occurred to the GIA.

(8) For GSA fault troubleshooting do as follows:

(a) For GSA monitor processor faults refer to GSA monitor processor faults.

(b) For GSA control processor faults refer to GSA control processor faults.

(9) GSA monitor processor faults.

(a) For PFT faults, refer to Table 102.

Table 102. PFT Monitor Processor Faults

Monitor Processor PFT Step	Possible Solution
INTERNAL COMM FAIL	1. This can sometimes be a result of a failure on the other board. Check faults on other processor.
UNSW POWER INV	1. Check unit power and AP Disconnect power.
MON SOL PWR ON FAIL	1. Check unit power and AP Disconnect power.
CTL SOL PWR ON FAIL	1. Check unit power and AP Disconnect power.
SOL PWR FAIL	1. Check unit power and AP Disconnect power.
CERT DATA UNINSTALLED	1. Check unit power and AP Disconnect power.
STRAP CODE MISMATCH	1. Check unit power and AP Disconnect power.

(b) For normal mode faults refer to Table 103.

Table 103. Monitor Processor Normal Mode Faults

Monitor Processor Normal Mode Fault	Possible Solution
GIA DIS FAULT	1. Check the AP Disconnect power into the unit.
HOST DATA DIF	1. Check the AHRS wiring to the system.
HOST DATA INV	1. Check the AHRS wiring to the system.
SVO PWR INV	1. Check unit power and AP Disconnect power.
STRP CODE CHNG	1. Check the connector strap inputs to the unit.
MET STUCK SWTCH	1. Check the MET switch inputs into the system.
MET STATUS DIF	1. Check the MET switch inputs into the system.

(10) For GSA control processor faults, do as follows:

(a) For PFT faults, refer to Table 104.

Table 104. PFT Control Processor Faults

Control Processor PFT Step	Possible Solution
INTERNAL COMM FAIL	1. This can sometimes be a result of a failure on the other board. Check faults on other processor.
CTL MOT PWR ON FAIL	1. Check unit power and AP Disconnect power.
MON MOT PWR ON FAIL	1. Check unit power and AP Disconnect power.
HALL 1 FAIL	1. Check unit power and AP Disconnect power.

HALL 2 FAIL	1. Check unit power and AP Disconnect power.
HALL 3 FAIL	1. Check unit power and AP Disconnect power.
HALL 4 FAIL	1. Check unit power and AP Disconnect power.
HALL 5 FAIL	1. Check unit power and AP Disconnect power.
HALL 6 FAIL	1. Check unit power and AP Disconnect power.
CURR OFFST FAIL	1. Check unit power and AP Disconnect power.
SVO TYPE FAIL	1. Check unit power and AP Disconnect power.
CERT DATA UNINSTALLED	1. Upload the certification gain file to the Control board.
STRAP CODE MISMATCH	1. Check the connector strap inputs to the unit.

(b) For normal mode faults, refer to Table 105.

Table 105. Control Processor Normal Mode Faults

Control Processor Normal Mode Fault	Possible Solution
GIA DIS FAULT	1. Check the AP Disconnect power into the unit.
HOST DATA DIF	1. Check the AHRS wiring to the system.
HOST DATA INV	1. Check the AHRS wiring to the system.
SVO PWR INV	1. Check unit power and AP Disconnect power.
STRP CODE CHNG	1. Check the connector strap inputs to the unit.
MET STUCK SWTCH	Check the MET switch inputs into the system.
MET STATUS DIF	Check the MET switch inputs into the system.

(11) For GIA 63W/64W preflight test steps for PFT troubleshooting, Refer to Table 106.

Table 106. GIA 63W/64W Preflight Test Steps

PFT Test Step	Test Step Function	Possible Solution
Step 0: System initializing, make sure that the GFC is powered.	This step checks to ensure the GFC is powered up.	1. Make sure that the Configuration page shows that the GIA is connected to the autopilot disconnect on the GFC . 2. Make sure that the System Status page shows that all configured servos are communicating.
Step 1: System initializing, make sure that the GIA audio is valid.	This step checks to ensure the GIA audio region has been loaded and configured.	1. Load GIA audio files.
Step 2: System initializing, make sure the required servos are configured.	This step checks to ensure the current servo configuration matches the servo configuration specified in the certification gain file.	1. Reload the gain files again.
Step 3: System initializing, make sure selected side is online.	This step checks to make sure that the PFD is online and sending the selected AFCS side data over HSDB to the GIA.	1. Make sure that the PFD is powered on. 2. Make sure that the Ethernet connection from the PFD to the GIA is serviceable.

Step 4: System initializing, make sure that AHRS monitor is serviceable.	This step checks to make sure that the AHRS monitor is valid and not reporting an AHRS failure. Note: AHRS monitor will be assumed valid if on the ground.	1. Make sure that the GRS 77 and GDC 74A are powered on and sending valid data.
Step 5: System initializing, make sure that the configured servos are valid.	This step checks to make sure that that none of the servos are reporting any type of failure. Note that trim servos will report a failure on stuck MET switches.	1. Make sure that the MET switch is not stuck. 2. Cycle power on all the servos.
Step 6: System initializing, make sure cross GIA is valid.	This step checks to make sure that the cross-side GIA is online and communicating with all servos from ARINC 485 data lines. The cross-side GIA must also pass its AHRS monitoring.	1. Make sure that the GIA 1 and GIA 2 are each online and communicating with all the servos.
Step 7: Make sure that the cross GIA initialized.	This step checks to make sure that the cross-side GIA is initialized.	1. Make sure that the PFD 1, PFD 2 and the MFD are powered on.
Step 8: Make sure of the servo type.	This step checks to make sure that the servos are correct type.	1. Make sure that the servos are the correct type.
Step 9: Make sure that servo first certification data is correct.	This step checks to make sure that the servos and the GIAs have the same certification gains.	1. Load the certification gains to all GIAs and servos again.
Step 10:Make sure that servo second certification data is correct.	This step checks to make sure that the servos and the GIAs have the same certification gains.	1. Load the certification gains to all GIAs and servos again.
Step 11: Updating servo RTC.	This step sets the servo system time to the GIA system time.	1. None.
Step 12: Make sure of the servo PFT status.	This step checks to make sure that all servos have passed their own preflight test.	1. None.
Step 13: Make sure that the AP disconnect enabled.	This step checks to make sure that GIA 1, GIA 2, and all servos are connected to the 28 volt autopilot disconnect.	1. Make sure that the autopilot disconnect is connected to all GIAs and servos and is registering 28 volts. 2. Make sure that the autopilot disconnect switch is not pressed.
Step 14: Verify servo validity.	This step checks to ensure all servos are online and communicating with valid data.	1. Make sure that the all servos are powered on and communicating.
Step 15: Make sure that cross GIA PFT is completed.	This step checks to ensure the cross-side GIA is also on step 14.	1. Cycle power on all the servos and GIAs. 2. Make sure that the PFD 1 and 2 and the MFD are powered on.
Step 16: PFT completed.	The preflight test is successfully completed.	1. None.
Step 17: PFT failed.	The preflight test has failed.	1. Troubleshoot indicated failure.

4. PFD AFCS Field Message Troubleshooting.

A. Do the AFCS Field Message Troubleshooting. Refer to Table 107.

Table 107. AFCS Field Message AFCS Field Message

Message (Window Color)	Condition	Possible Solutions
AFCS (RED)	AFCS System Failure.	1. Make sure that the GIA 63W/64W units are serviceable. 2. Make sure that the GRS 77 AHRS units are serviceable. 3. Make sure that the GDC 74A Air Data Computer is serviceable. 4. Make sure that the GSA 80 and GSA 81 Servos are serviceable. 5. Make sure that there are no (red) Xs on the PFD's. 6. Make sure that there are no alert messages present in the PFD Alert window. Correct software or configuration errors that are shown. 7. Go to the AUX SYSTEM STATUS page on the MFD and make sure that all LRU's have a check (green). 8. If the OAT and TAS have a (red) X and the attitude indication is shown, troubleshoot the systems
PTCH (RED)	Pitch Axis Failure.	1. Go to the AUX SYSTEM STATUS page on the MFD and make sure that all LRU's have a check (green). 2. Check that the affected servo is receiving electrical power. 3. Check that the servo wiring and connector are serviceable. 4. Make sure that the PTRM switches are not stuck. 5. Replace applicable servo.
YAW (RED)	Yaw Axis Failure.	
PTRM (RED)	Pitch Trim Axis Failure.	
ROLL (RED)	Roll Axis Failure.	
?ELE (YELLOW)	Elevator Mistrim Down.	1. Make sure that the pitch trim servo is serviceable. 2. Go to the AUX SYSTEM STATUS page on the MFD and make sure that the servo shows online. 3. Make sure that the pitch trim servo is receiving electrical power. 4. Make sure that the pitch trim servo wiring and connector are serviceable. 5. Make sure that the aircraft trim control rigging is correct. 6. Replace the pitch trim servo.

?ELE (YELLOW)	Elevator Mistrim Up.	1. Make sure that the pitch trim servo is serviceable. 2. Go to the AUX SYSTEM STATUS page on the MFD and make sure that the servo shows online. 3. Make sure that the pitch trim servo is receiving electrical power. 4. Make sure that the pitch trim servo wiring and connector are serviceable. 5. Make sure that the aircraft trim control rigging is correct. 6. Replace the pitch trim servo.
AIL? (YELLOW)	Aileron Mistrim Right.	1. Check for possible fuel imbalance. 2. Make sure that the aileron control rigging is correct. 3. Replace the roll servo.
?AIL (YELLOW)	Aileron Mistrim Left	1. Check for possible fuel imbalance. 2. Make sure that the aileron control rigging is correct. 3. Replace the roll servo.
PFT (WHITE)	PreFlight Test	1. Cycle system power. 2. Make sure that the PFT is complete in two minutes. 3. If the PFT fails, follow the (red) AFCS troubleshooting procedures.
PFT (RED)	PreFlight Test	1. Cycle system power. 2. Make sure that the PFT is complete in two minutes. 3. If the PFT fails, follow the (red) AFCS troubleshooting procedures.

5. GMC 710 AFCS Controller CAS Message Troubleshooting

A. Do the GMC 710 AFCS Controller CAS Message Troubleshooting as follows:

(1) To troubleshoot GMC 710 CAS messages, refer to Table 108.

Table 108. GMC CAS Messages

GMC CAS Messages	Cause	Corrective Actions
GMC CNFG GMC config error. Config service req  d.	The G1000 has detected a GMC 710 configuration mismatch.	1. Load correct configuration in GMC. 2. Replace GMC. 3. Replace PFD 1 master configuration module.
GMC FAIL GMC is inoperative.	The G1000 has detected a failure in the GMC 710.	1. Troubleshoot GMC wiring and make sure it is serviceable. 2. Replace GMC.
MANIFEST GMC software mismatch, communication halted.	The system has detected an incorrect version loaded in the GMC 710.	1. Load correct software into GMC.