

GARMIN Ltd. or its subsidiaries  
c/o GARMIN International, Inc.  
1200 E. 151st Street  
Olathe, Kansas 66062 U.S.A.

**FAA APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT**

**GFC 500 Autopilot with ESP**

**Installed in**

**Piper PA-28-180 / 160 / 150 / 140**

*And*

**Piper PA-28-181 / 161 / 151**

**Dwg. Number: 190-02291-07 Rev. 9**

This Supplement must be attached to the FAA Approved Airplane Flight Manual when the GFC 500 Autopilot system is installed in accordance with STC SA01866WI. The information contained herein supplements the information of the basic Airplane Flight Manual. For Limitations, Procedures, and Performance information not contained in this Supplement consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA approved sections of this supplement are labeled as "FAA APPROVED". Sections not labeled "FAA APPROVED" are provided for guidance information only.

**Airplane Serial Number:** \_\_\_\_\_

**Airplane Registration Number:** \_\_\_\_\_

**FAA Approved By:** Paul Mast

**Paul Mast  
ODA STC Unit Administrator  
Garmin International, Inc  
ODA-240087-CE**

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Garmin International, Inc.  
1200 E. 151<sup>st</sup> Street  
Olathe, KS 66062 USA  
Telephone: 913-397-8200  
[www.garmin.com](http://www.garmin.com)

**Garmin International, Inc**  
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## Table of Contents

<b>Section 1 – General</b> .....	<b>1-1</b>
<b>USE OF THE SUPPLEMENT</b> .....	<b>1-1</b>
<b>ABBREVIATIONS AND TERMINOLOGY</b> .....	<b>1-2</b>
<b>INSTALLED EQUIPMENT INTERFACES</b> .....	<b>1-3</b>
<b>INSTALLED FEATURES CHECKLIST</b> .....	<b>1-4</b>
<b>Section 2 – Limitations</b> .....	<b>2-1</b>
<b>Section 3 – Emergency Procedures</b> .....	<b>3-1</b>
<b>AUTOPILOT MALFUNCTION / PITCH TRIM RUNAWAY</b> .....	<b>3-1</b>
<b>AUTOPILOT FAILURE / ABNORMAL DISCONNECT</b> .....	<b>3-2</b>
<b>PITCH TRIM FAILURE</b> .....	<b>3-2</b>
<b>ESP ACTIVATION</b> .....	<b>3-2</b>
<b>OVERSPEED PROTECTION (MAXSPD)</b> .....	<b>3-3</b>
<b>UNDERSPEED PROTECTION (MINSPD)</b> .....	<b>3-3</b>
<b>Section 3A – Non-Normal Procedures</b> .....	<b>3-5</b>
<b>AUTOPILOT PRE-FLIGHT TEST FAIL</b> .....	<b>3-5</b>
<b>MANUAL AUTOPILOT DISCONNECT</b> .....	<b>3-5</b>
<b>LOSS OF NAVIGATION INFORMATION</b> .....	<b>3-5</b>
<b>LOSS OF AIRSPEED DATA</b> .....	<b>3-6</b>
<b>LOSS OF ALTITUDE DATA</b> .....	<b>3-6</b>
<b>LOSS OF GPS INFORMATION</b> .....	<b>3-6</b>
<b>HEADING DATA SOURCE FAILURE</b> .....	<b>3-7</b>
<b>ELEVATOR MISTRIM (AUTOTRIM)</b> .....	<b>3-7</b>
<b>Section 4 – Normal Procedures</b> .....	<b>4-1</b>
<b>GFC 500 POWER UP</b> .....	<b>4-1</b>
<b>FLIGHT DIRECTOR / AUTOPILOT NORMAL OPERATING PROCEDURES</b> .....	<b>4-1</b>
<b>VERTICAL MODES</b> .....	<b>4-2</b>
<b>VERTICAL SPEED (VS) MODE</b> .....	<b>4-2</b>
<b>INDICATED AIRSPEED (IAS) MODE</b> .....	<b>4-2</b>
<b>ALTITUDE HOLD (ALT) MODE, MANUAL CAPTURE</b> .....	<b>4-2</b>
<b>VERTICAL NAVIGATION (VNAV)</b> .....	<b>4-3</b>
<b>GO AROUND</b> .....	<b>4-4</b>
<b>MANUAL PITCH TRIM WITH AUTOPILOT ENGAGED</b> .....	<b>4-4</b>
<b>LATERAL MODES</b> .....	<b>4-5</b>
<b>HEADING MODE (HDG)</b> .....	<b>4-5</b>

TRACK MODE (TRK) .....	4-5
NAVIGATION (VOR).....	4-5
NAVIGATION (GPS).....	4-6
<b>APPROACHES .....</b>	<b>4-7</b>
ILS.....	4-7
LOC (GS out).....	4-8
GPS Approach (LPV, LNAV/VNAV, LP+V, or LNAV+V) .....	4-9
GPS Approach (LP, LNAV).....	4-9
BC .....	4-10
VOR Approach.....	4-11
<b>DISABLING ESP.....</b>	<b>4-12</b>
<b>Section 5 – Performance .....</b>	<b>5-1</b>
<b>Section 6 – Weight and Balance .....</b>	<b>6-1</b>
<b>Section 7 – System Description.....</b>	<b>7-1</b>
<b>AFCS OVERVIEW .....</b>	<b>7-1</b>
<b>AUTOPILOT CONTROL UNIT AND DISPLAY .....</b>	<b>7-4</b>
<b>PREFLIGHT TEST .....</b>	<b>7-7</b>
<b>MESSAGES AND ANNUNCIATIONS .....</b>	<b>7-7</b>
<b>LIGHTING.....</b>	<b>7-8</b>

## SECTION 1 – GENERAL

The information in this supplement is FAA-approved material and must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual (POH/AFM) when the airplane has been modified by installation of the Garmin GFC 500 Autopilot system in accordance with Garmin International, Inc. approved data.

The information in this supplement supersedes or adds to the basic POH/AFM only as set forth below. Users of the manual are advised to always refer to the supplement for possibly superseding information and placarding applicable to operation of the airplane.

### USE OF THE SUPPLEMENT

The following definitions apply to WARNINGS, CAUTIONS and NOTES found throughout the supplement:

#### **WARNING**

Operating procedures, techniques, etc., which may result in personal injury or loss of life if not carefully followed.

#### **CAUTION**

Operating procedures, techniques, etc., which may result in damage to equipment if not carefully followed.

#### **NOTE**

Operating procedures, techniques, etc., which is considered essential to emphasize.

## ABBREVIATIONS AND TERMINOLOGY

The following glossary is applicable within the airplane flight manual supplement

<b>AFCS</b>	Automatic Flight Control System	<b>LNAV/VNAV</b>	Lateral Navigation / Vertical Navigation Approach
<b>AFM</b>	Airplane Flight Manual	<b>LOC</b>	Localizer (no glideslope available)
<b>AFMS</b>	Airplane Flight Manual Supplement	<b>LP</b>	Localizer Performance
<b>AGL</b>	Above Ground Level	<b>LP+V</b>	Localizer Performance with Advisory Vertical Guidance
<b>AHRS</b>	Attitude and Heading Reference System	<b>LPV</b>	Localizer Performance with Vertical Guidance
<b>ALT</b>	Altitude	<b>LVL</b>	Level
<b>AP</b>	Autopilot	<b>MDA</b>	Minimum Descent Altitude
<b>APR</b>	Approach	<b>MPH</b>	Miles per Hour
<b>ATC</b>	Air Traffic Control	<b>PFT</b>	Preflight Test
<b>BC</b>	Back Course Approach	<b>POH</b>	Pilot's Operating Handbook
<b>CDI</b>	Course Deviation Indicator	<b>STC</b>	Supplemental Type Certificate
<b>DA</b>	Decision Altitude	<b>TO</b>	Takeoff
<b>DISC</b>	Disconnect	<b>TRK</b>	Track
<b>DWG</b>	Drawing	<b>VHF</b>	Very High Frequency
<b>ESP</b>	Electronic Stability and Protection	<b>VOR</b>	VHF Omni-directional Range
<b>FAA</b>	Federal Aviation Administration	<b>VS</b>	Vertical Speed
<b>FAF</b>	Final Approach Fix		
<b>FD</b>	Flight Director		
<b>GA</b>	Go Around		
<b>GFC 500</b>	Garmin Autopilot		
<b>GMC 507</b>	Autopilot Mode Control Panel		
<b>GNSS</b>	Global Navigation Satellite System		
<b>GPS</b>	Global Positioning System		
<b>GS</b>	Glideslope		
<b>GSA</b>	Garmin Servo Actuator		
<b>HDG</b>	AFCS heading mode		
<b>IAS</b>	Indicated Airspeed		
<b>ILS</b>	Instrument Landing System		
<b>INT</b>	Interrupt		
<b>KIAS</b>	Knots Indicated Airspeed		
<b>KT</b>	Knot		
<b>LNAV</b>	Lateral Navigation		
<b>LNAV+V</b>	Lateral Navigation with Advisory Vertical Guidance		



## INSTALLED EQUIPMENT INTERFACES

The following is the list of installed equipment and functions associated with the GFC 500 Autopilot installation in this airplane.

*Table 1-1: Table of Installed Equipment Interfaces*

<b>DEVICE TYPE</b>	<b>Manufacturer / Model</b> If not installed, note N/A	<b>Additional Information</b>
GPS Navigator #1		Is Navigator #1 interfaced to GFC 500? <input type="checkbox"/> YES <input type="checkbox"/> NO
VHF Nav Radio #1		Is VHF Nav Radio #1 interfaced to GFC 500? <input type="checkbox"/> YES <input type="checkbox"/> NO
VHF Nav Radio #2		
Pitch Trim Servo		

## INSTALLED FEATURES CHECKLIST

The checked autopilot modes and features are available on this aircraft.

### Basic AP Features

- Flight Director
- Electric Pitch Trim
- Overspeed Protection
- Underspeed Protection

### Electronic Stability and Protection

- Pitch/Roll Attitude
- High Speed Protection
- Low Speed Protection

### Vertical Autopilot Modes

- Pitch (PIT)
- Level (Zero vertical speed)
- Go Around (GA)
- Altitude Hold
- Vertical Speed
- Altitude Capture via Altitude Preselect
- Indicated Airspeed (IAS)
- Vertical Navigation (VNAV)
- GPS Approach Glidepath
- ILS Glideslope

### Lateral Autopilot Modes

- Roll (ROL)
- Level (Wings Level)
- Go Around (GA)
- Heading
- Track
- GPS Navigation
- VHF Navigation
- Approach Mode
  - GPS
  - VOR/LOC

## SECTION 2 – LIMITATIONS

The Garmin G5 Electronic Flight Instrument Pilot's Guide for Certified Aircraft, part number 190-01112-12 Rev B (or later approved revisions), must be immediately available to the flight crew (when G5 is installed).

The Garmin G3X Touch Pilot's Guide for Certified Aircraft, part number 190-02472-00, Rev A (or later approved revisions) must be immediately available to the flight crew (when G3X EFIS system is installed).

The Garmin GI 275 Pilot's Guide for Certified Aircraft, part number 190-02246-01, Rev B (or later approved revisions) must be immediately available to the flight crew (when GI 275 system is installed). This AFMS is applicable to the software versions shown below:

<b>Software Item</b>	<b>Software Version (or later FAA Approved version for this STC)</b>
G5 Software Version	8.20
G3X Software Version	9.15
GI 275 Software Version	2.60

A pilot must be seated in the left pilot's seat, with seatbelt fastened, during all autopilot operations.

Do not use autopilot during takeoff and landing.

The GFC 500 AFCS preflight test must complete successfully prior to use of the autopilot, flight director or manual electric trim.

The maximum fuel imbalance with the autopilot engaged is 10 gallons.

The autopilot must be disengaged below 200 feet AGL during approach operations and below 800 feet AGL during all other operations.

The GFC 500 autopilot is approved for Category 1 precision approaches and non-precision approaches only.

<b>Autopilot Engagement Speed</b>	
Minimum	65 KIAS (75 MPH)
Maximum	140 KIAS (160 MPH)

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## SECTION 3 – EMERGENCY PROCEDURES

Some emergency situations require immediate memorized corrective action. These steps are printed in bold in the emergency procedures and should be accomplished without the aid of the checklist.

### AUTOPILOT MALFUNCTION / PITCH TRIM RUNAWAY

If the airplane deviates unexpectedly from the planned flight path:

1. **Control Wheel**.....**GRIP FIRMLY**
2. **AP DISC / TRIM INT Button** .....**PRESS AND HOLD**  
(Be prepared for high elevator control forces)
3. **Aircraft Attitude**.....**MAINTAIN / REGAIN AIRCRAFT CONTROL**

#### NOTE

Do not release the AP DISC / TRIM INT Button until after pulling the AUTOPILOT Circuit Breaker.

4. Elevator Trim.....**RE-TRIM** if necessary using Elevator Trim Control Wheel
5. AUTOPILOT Circuit Breaker.....**PULL**

#### NOTE

Pulling the AUTOPILOT circuit breaker will render the autopilot and ESP inoperative.

6. AP DISC / TRIM INT Button.....**RELEASE**

#### WARNING

In flight, do not overpower the autopilot. The trim will operate in the direction opposing the overpower force, which will result in large out-of-trim forces.

Do not attempt to re-engage the autopilot or use manual electric pitch trim until the cause of the malfunction has been corrected.

# AUTOPILOT FAILURE / ABNORMAL DISCONNECT

(Red AP in autopilot status box on display, continuous aural disconnect tone.)

1. AP DISC / TRIM INT Button or:
  - a. G5 Knob
  - b. G3X Autopilot Status Bar
  - c. GI 275 Knob or Autopilot Status Button..... PRESS AND RELEASE  
(to cancel disconnect tone)
2. Aircraft Attitude..... MAINTAIN / REGAIN AIRCRAFT CONTROL

## NOTE

The autopilot disconnect may be accompanied by a red AFCS in the autopilot status box, indicating the automatic flight control system has failed. The flight director will not be available and the autopilot cannot be re-engaged with this annunciation present.

If the disconnect is accompanied by an amber AP with a red X, the autopilot will not be available however the flight director will still be functional.

In the event of a GMC failure, pressing the G5 knob, GI 275 knob or autopilot status button, or G3X Autopilot status bar will acknowledge the disconnect tone.

# PITCH TRIM FAILURE

(Red PTRIM on G5, GI 275, or G3X display.)

This failure will only occur if the optional pitch trim servo is installed.

1. Indicates a failure of the pitch trim servo.
2. Control Wheel ..... GRIP FIRMLY
3. AP DISC / TRIM INT Button..... PRESS and RELEASE  
(Be prepared for high elevator control forces)
4. Elevator Trim..... AS REQUIRED USING ELEVATOR TRIM CONTROL WHEEL

## NOTE

The autopilot may be re-engaged. Refer to the normal procedures section of this AFMS, MANUAL PITCH TRIM WITH AUTOPILOT ENGAGED.

# ESP ACTIVATION

1. Power..... AS REQUIRED
2. Aircraft Attitude..... MAINTAIN / REGAIN AIRCRAFT CONTROL

## NOTE

If ESP is active for approximately 10 seconds, the autopilot will automatically engage in LVL mode, an aural 'ENGAGING AUTOPILOT' will be played, (or a Sonalert tone will sound for installations without a supported audio panel) and the autopilot will roll the wings level and fly at zero-vertical speed. Refer to Section 7, System Description for further information.

ESP will be disabled by pressing and holding the AP DISC / TRIM INT button. Releasing the button will allow ESP to function.

## OVERSPEED PROTECTION (MAXSPD)

(MAXSPD displayed on G5, GI 275, or G3X, AIRSPEED – AIRSPEED Aural sounds.)

1. Power.....**REDUCE**
2. Aircraft Attitude and Altitude.....**MONITOR**

After overspeed condition is corrected:

3. Autopilot .....RESELECT VERTICAL AND LATERAL MODES (if necessary)
4. Power .....ADJUST as necessary

### NOTE

Autopilot Overspeed Protection Mode provides a pitch up command to maintain 140 KIAS (160 MPH).

## UNDERSPEED PROTECTION (MINSPD)

(MINSPD displayed on G5, GI 275, or G3X, AIRSPEED – AIRSPEED Aural sounds.)

1. Power.....**INCREASE POWER AS REQUIRED TO CORRECT UNDERSPEED**
2. Aircraft Attitude and Altitude.....**MONITOR**

After underspeed condition is corrected:

3. Autopilot .....RESELECT VERTICAL AND LATERAL MODES (if necessary)
4. Power .....ADJUST as necessary

### NOTE

Autopilot Underspeed Protection Mode provides a pitch down command to maintain 65 KIAS (75 MPH).

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## SECTION 3A – NON-NORMAL PROCEDURES

### AUTOPILOT PRE-FLIGHT TEST FAIL

(Amber AP with a red X in G5, GI 275, or G3X autopilot status box.)

1. Indicates the AFCS system failed the automatic Pre-Flight test. The autopilot, ESP, and electric elevator trim are inoperative.

### MANUAL AUTOPILOT DISCONNECT

If necessary, the autopilot may be manually disconnected using any one of the following methods:

1. AP DISC / TRIM INT Button..... PRESS and RELEASE  
(Pilot's control wheel)
2. AP Key ..... PRESS
3. Pitch Trim Switch ..... ACTIVATE
4. AUTOPILOT Circuit Breaker..... PULL

### LOSS OF NAVIGATION INFORMATION

(Amber GPS, VOR, LOC, or BC flashes for 10 seconds on G5, GI 275, or G3X.)

#### NOTE

If a navigation signal is lost while the autopilot is tracking it, the autopilot will roll the aircraft wings level and default to roll mode (ROL).

1. GMC 507 Mode Panel..... SELECT HDG mode and SET desired heading
2. NAV Source ..... SELECT a valid NAV source
3. NAV Key..... PRESS

If on an instrument approach at the time the navigation signal is lost:

4. Missed Approach Procedure..... EXECUTE (as applicable)

## LOSS OF AIRSPEED DATA

(Red X through airspeed tape on the G5, GI 275, or G3X display, amber AP with a red X in autopilot status box.)

### NOTE

If airspeed data is lost while the autopilot is tracking airspeed, the flight director will default to pitch mode (PIT).

1. AP DISC / TRIM INT Button..... PRESS AND RELEASE  
(to cancel disconnect tone)
2. Aircraft Attitude..... MAINTAIN / REGAIN AIRCRAFT CONTROL
3. Manual Elevator Trim..... TRIM as required

### NOTE

The autopilot cannot be re-engaged. The flight director is available however IAS mode cannot be selected. Loss of airspeed will be accompanied by a red PTRIM indication on the G5, GI 275, or G3X (if a pitch trim servo is installed).

## LOSS OF ALTITUDE DATA

(Red X through altitude tape on the G5, GI 275, or G3X display.)

### NOTE

If altitude data is lost while the autopilot is tracking altitude, the autopilot will default to pitch mode (PIT).

1. Autopilot ..... SELECT different vertical mode

## LOSS OF GPS INFORMATION

(GPS position information is lost to the autopilot.)

### NOTE

If GPS position data is lost while the autopilot is tracking a GPS, VOR, LOC or BC course, the autopilot will default to roll mode (ROL). The autopilot will default to pitch mode (PIT) if GPS information is lost while tracking an ILS. The autopilot uses GPS aiding in VOR, LOC and BC modes.

1. Autopilot .....SELECT different lateral and vertical mode (as necessary)

If on an instrument approach:

- AP DISC / TRIM INT button .....PRESS, Continue the approach manually  
Or
- Missed Approach Procedure ..... EXECUTE (as applicable)

## HEADING DATA SOURCE FAILURE

Without a heading source to the navigator, GPSS will not be provided to the autopilot for heading legs. Navigator map cannot be oriented heading up.

Track information will be displayed on the G5, GI 275, or G3X.

1. Autopilot ..... SELECT different lateral mode (as necessary)

## ELEVATOR MISTRIM (AUTOTRIM)

(Amber TRIM UP or TRIM DOWN displayed on the G5, GI 275, or G3X.)

Indicates a mistrim of the elevator while the autopilot is engaged. If a pitch trim servo is not installed, refer to the normal procedures section of this AFMS, MANUAL PITCH TRIM WITH AUTOPILOT ENGAGED. If a pitch trim servo is installed, the autopilot will normally trim the airplane as required. However, during rapid acceleration, deceleration, configuration changes, or near either end of the elevator trim limits, momentary illumination of this message may occur. If the autopilot is disconnected while this message is displayed, high elevator control forces are possible.

### WARNING

Do not attempt to overpower the autopilot in the event of a pitch mistrim. The autopilot servo will oppose pilot input and will cause pitch trim to run opposite the direction of pilot input. This will lead to a significant out-of-trim condition, resulting in large control wheel force when disengaging the autopilot.

If a pitch trim servo is not installed:

1. Refer to the normal procedures section of this AFMS, MANUAL PITCH TRIM WITH AUTOPILOT ENGAGED.

If a pitch trim servo is installed:

### NOTE

Momentary display of the TRIM UP or TRIM DOWN message during configuration changes or large airspeed changes is normal.

1. Control Wheel ..... GRIP FIRMLY

### WARNING

Be prepared for significant sustained control forces in the direction of the mistrim annunciation. For example, TRIM DOWN indicates nose down control wheel force will be required upon autopilot disconnect.

2. AP DISC / TRIM INT Button ..... PRESS AND RELEASE
3. Manual Elevator Trim ..... RE-TRIM as required

Electric pitch trim should be considered inoperative until the cause of the mistrim has been investigated and corrected.

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## SECTION 4 – NORMAL PROCEDURES

### GFC 500 POWER UP

During the preflight test the G5, GI 275, or G3X will display PFT in the autopilot status box. When the GFC 500 passes preflight test, PFT will be removed from the autopilot status box.

### FLIGHT DIRECTOR / AUTOPILOT NORMAL OPERATING PROCEDURES

Autopilot/Flight Director mode annunciations are displayed at the top of the G5 Electronic Flight Instrument, at the top of the G3X Electronic Flight Instrument System PFD, or at the bottom of the GI 275 Electronic Flight Instrument ADI. Green text indicates active autopilot/flight director modes. Armed modes are indicated in white text. Normal mode transitions will flash inverse video for 10 seconds before becoming steady. Abnormal mode transitions will flash for 10 seconds in amber text before the default mode is annunciated as the active mode in green text. Default autopilot/flight director modes are Roll (ROL) and Pitch (PIT) modes.

The autopilot status box displays the autopilot engagement status as well as armed and active flight director modes.

**Autopilot Engagement with Flight Director Off** — Upon engagement, the autopilot will be set to hold the current attitude of the airplane if the flight director was not previously on. In this case, 'ROL' and 'PIT' will be annunciated.

**Autopilot Engagement with Flight Director On** — If the flight director is on, the autopilot will smoothly pitch and roll the airplane to capture the FD command bars. The prior flight director modes remain unchanged.

**Autopilot Disengagement** — The most common way to disconnect the autopilot is to press and release the AP DISC / TRIM INT button located on the control yoke. An autopilot disconnect tone will sound and an amber AP will be annunciated on the G5, GI 275, or G3X autopilot status box. Other ways to disconnect the autopilot include:

- Pressing the AP Key on the GMC 507 Mode Controller
- Operating the Electric Pitch Trim Switch (located on the control wheel)
- Pulling the AUTOPILOT circuit breaker

In the event of unexpected autopilot behavior, press and holding the AP DISC / TRIM INT button will disconnect the autopilot and remove all power to the servos.

## VERTICAL MODES

### VERTICAL SPEED (VS) MODE

1. Altitude Preselect ..... SET to Desired Altitude
2. Press VS Key, autopilot synchronizes to the airplane's current vertical speed.
3. Vertical Speed Reference .....ADJUST using UP / DN Wheel
4. Green ALT..... VERIFY Upon Altitude Capture

### INDICATED AIRSPEED (IAS) MODE

1. Altitude Preselect ..... SET to Desired Altitude
2. Press IAS Key, autopilot synchronizes to the airplane's current indicated airspeed.
3. AIRSPEED Reference .....ADJUST using UP / DN Wheel
4. Adjust throttle as required ..... INCREASE POWER to climb  
DECREASE POWER to descend
5. Green ALT..... VERIFY Upon Altitude Capture

### ALTITUDE HOLD (ALT) MODE, MANUAL CAPTURE

1. When at the desired altitude .....PRESS ALT key

The autopilot will hold the altitude at which the ALT key was pressed.

If climbing or descending at a high rate when the ALT key is pressed, the airplane will overshoot the reference altitude and then return to it. The amount of overshoot will depend on the vertical speed when the ALT key is pressed.

The altitude reference is displayed in the autopilot status box. The reference may be changed by +/- 200 FT using the UP / DN wheel.

## VERTICAL NAVIGATION (VNAV)

1. Navigation Source..... SELECT CDI to GPS
2. Vertical Navigation Profile .....LOAD into the GPS navigator's flight plan
3. Altitude Preselect ..... SET to the vertical clearance limit  
When ATC clearance received.
4. GMC 507 Mode Panel..... PRESS VNAV

### NOTE

Vertical navigation will not function for the following conditions:

- Selected navigation source is not GPS navigation. VNAV will not function if the navigation source is VOR or Localizer.
- VNAV is not enabled on the GPS Navigator
- If the altitude preselect is not set below the current aircraft altitude.
- No waypoints with altitude constraints in the flight plan
- Glideslope or Glidepath is the active flight director pitch mode.
- OBS mode is active
- Dead Reckoning mode is active
- Parallel track is active
- Aircraft is on the ground

Vertical navigation is not available between the final approach fix (FAF) and the missed approach point (MAP)

ALTV will be the armed vertical mode during the descent if the altitude preselect is set to a lower altitude than the VNAV reference altitude. This indicates the autopilot / flight director will capture the VNAV altitude reference. ALTS will be the armed mode during the descent if the altitude preselect is set at or above the VNAV reference altitude, indicating that the autopilot / flight director will capture the altitude preselect altitude reference.

## GO AROUND

1. GO AROUND button .....PRESS – Verify GA / GA on G5, GI 275, or G3X  
autopilot will not disengage
2. Autopilot (if engaged) .....VERIFY airplane pitches up following flight director command bars
3. Power .....APPLY Go Around power
4. GMC 507 Mode Panel.....PRESS NAV to couple to selected navigation source  
OR  
PRESS HDG to Fly ATC Assigned Missed Approach Heading
5. Altitude Preselect .....VERIFY  
Set to appropriate altitude.

### NOTE

The pilot is responsible for initial missed approach guidance in accordance with published procedure. When the GA button is pressed the Flight Director command bars will command go-around pitch attitude and wings level. The pilot must select the CDI to the appropriate navigation source and select the desired lateral and vertical flight director modes.

## MANUAL PITCH TRIM WITH AUTOPILOT ENGAGED

(Amber TRIM UP or TRIM DOWN displayed on G5, GI 275, or G3X.)

If the aircraft is not equipped with a pitch trim servo, the pilot must manually adjust the pitch trim when airspeed and aircraft configuration changes are made. A message will be displayed on the G5, GI 275, or G3X display to indicate the pitch servo is holding sustained force, and the pilot must manually trim the aircraft.

1. If TRIM UP message is displayed .....MANUALLY TRIM nose up
2. If TRIM DOWN message is displayed ..... MANUALLY TRIM nose down



## LATERAL MODES

### HEADING MODE (HDG)

1. HDG Key ..... PRESS  
The autopilot will turn the airplane in the direction of the heading bug.
2. HDG/TRK Knob ..... Rotate to set heading bug to desired heading.
3. When the airplane reaches the heading bug, the autopilot will roll the wings level to track the reference.

### TRACK MODE (TRK)

1. TRK Key ..... PRESS  
The autopilot will turn the airplane in the direction of the track bug.
2. HDG/TRK Knob ..... Rotate to set track bug to desired track.
3. When the airplane reaches the track bug, the autopilot will roll the wings level to track the reference.

### NAVIGATION (VOR)

1. Navigation Source. .... SELECT CDI to VHF NAV  
Tune and identify the station frequency.
2. Course Pointer ..... SET CDI to the Desired Course
3. Intercept Heading ..... ESTABLISH in HDG, TRK or ROL mode
4. NAV Key ..... PRESS

#### NOTE

If the Course Deviation Indicator (CDI) is greater than one dot from center, the autopilot will arm the VOR mode. The pilot must ensure that the current heading will result in a capture of the selected course. If the CDI is one dot or less from center, the autopilot will enter the capture mode when the NAV key is pressed.

## NAVIGATION (GPS)

1. Navigation Source ..... SELECT CDI to GPS
2. Waypoint ..... SELECT on Navigation Source
3. Course Pointer ..... VERIFY CDI set to the Desired Course
4. Intercept Heading ..... ESTABLISH in HDG or ROL mode
5. NAV Key ..... PRESS

### NOTE

If the Course Deviation Indicator (CDI) is greater than one dot from center, the autopilot will arm the GPS mode. The pilot must ensure that the current heading will result in a capture of the selected course. If the CDI is one dot or less from center, the autopilot will enter the capture mode when the NAV key is pressed.

# APPROACHES

## ILS

1. Navigation Source..... SELECT CDI to VHF Nav  
Tune and Identify an ILS station frequency.
2. CDI ..... SET to front LOC course
3. Ensure that the current heading will result in a capture of the selected course.
4. Press APR Key ..... VERIFY LOC and GS ARMED
5. Verify ..... Airplane Captures and Tracks LOC and GS
6. Set Missed Approach Altitude in Altitude preselect.
7. At Decision Altitude (DA),
  - AP DISC / TRIM INT button ..... PRESS, Continue visually for a normal landing  
Or
  - GO AROUND (GA) button..... PRESS, Execute Missed Approach Procedure
  - Apply GA power.

### NOTE

Pressing the GA button will not disconnect the autopilot. Select NAV or HDG mode to fly the missed approach procedure.

If the Course Deviation Indicator (CDI) is greater than half scale deflection, the autopilot will arm the LOC mode. The pilot must ensure that the current heading will result in a capture of the selected course. If the CDI is within half scale deflection, the autopilot will enter the capture mode when the APR key is pressed.

When the selected navigation source is an ILS, glideslope coupling is automatically armed when the APR key is pressed. The glideslope cannot be captured until the localizer is captured. The autopilot can capture the glideslope from above or below the glideslope.

## LOC (GS out)

1. Navigation Source..... SELECT CDI to VHF Nav  
Tune and Identify an ILS station frequency.
2. Course Pointer ..... SET to front LOC course
3. Ensure that the current heading will result in a capture of the selected course.
4. Press NAV Key ..... VERIFY LOC ARMED
5. Verify ..... Airplane Captures and Tracks LOC Course
6. Once airplane is in ALT mode inbound to the FAF, set the altitude preselect to the next required step down altitude. Use VS mode to descend airplane along the vertical step downs and to the MDA.
7. When in ALT mode at the MDA, set missed approach altitude in the altitude preselect.
8. At Missed Approach Point,
  - AP DISC / TRIM INT button ..... PRESS, Continue visually for a normal landing  
Or
  - GO AROUND (GA) button..... PRESS, Execute Missed Approach Procedure
  - Apply GA power.
  - Set missed approach altitude in the altitude preselect.

### NOTE

Pressing the GA button will not disconnect the autopilot. Select NAV or HDG mode to fly the missed approach procedure.

## GPS Approach (LPV, LNAV/VNAV, LP+V, or LNAV+V)

1. Navigation Source..... SELECT CDI to GPS
2. Course Pointer ..... VERIFY CDI set to the Desired Course
3. Ensure that the current heading will result in a capture of the selected course.
4. Press APR Key ..... VERIFY GPS and GP ARMED
5. Verify ..... Airplane Captures and Tracks GPS and GP
6. Press ALT Key to level off at the MDA for a LP+V or LNAV+V approach
7. At DA (LPV or LNAV/VNAV approach), or MDA and Missed Approach Point (LP+V or LNAV+V)
  - AP DISC / TRIM INT button ..... PRESS, Continue visually for a normal landing  
Or
  - GO AROUND (GA) button..... PRESS, Execute Missed Approach Procedure
  - Apply GA power.
  - Set missed approach altitude in the altitude preselect.

### NOTE

Pressing the GA button will not disconnect the autopilot. Select NAV or HDG mode to fly the missed approach procedure.

## GPS Approach (LP, LNAV)

1. Navigation Source..... SELECT GPS on the CDI
2. Course Pointer ..... VERIFY CDI set on the Desired Course
3. Ensure that the current heading will result in a capture of the selected course.
4. Press NAV Key ..... VERIFY GPS ARMED
5. Verify ..... Airplane Captures and Tracks GPS Course
6. Once airplane is in ALT mode inbound to the FAF, set the altitude preselect to the next required step down altitude. Use VS mode to descend airplane along the vertical step downs and to the MDA.
7. When in ALT mode at the MDA, set missed approach altitude in the altitude preselect.
8. At Missed Approach Point,
  - AP DISC / TRIM INT button ..... PRESS, Continue visually for a normal landing  
Or
  - GO AROUND (GA) button..... PRESS, Execute Missed Approach Procedure
  - Apply GA power.
  - Set missed approach altitude in the altitude preselect.

### NOTE

Pressing the GA button will not disconnect the autopilot. Select NAV or HDG mode to fly the missed approach procedure.

## BC

1. Navigation Source..... SELECT CDI to VHF Nav  
Tune and Identify an ILS station frequency
2. Course Pointer ..... SET CDI to LOC Front Course
3. Ensure that the current heading will result in a capture of the selected course.
4. Press NAV Key ..... VERIFY BC ARMED  
(when heading is within 75 degrees of BC course)
5. Verify ..... Airplane Captures and Tracks BC Course
6. Once airplane is in ALT mode inbound to the FAF, set the altitude preselect to the next required step down altitude. Use VS mode to descend airplane along the vertical step downs and to the MDA.
7. When in ALT mode at the MDA, set missed approach altitude in the altitude preselect.
8. At Missed Approach Point:
  - AP DISC / TRIM INT button ..... PRESS, Continue visually for a normal landing  
Or
  - GO AROUND (GA) button..... PRESS, Execute Missed Approach Procedure
  - Apply GA power.
  - Set missed approach altitude in the altitude preselect.

### NOTE

Pressing the GA button will not disconnect the autopilot. Select NAV or HDG mode to fly the missed approach procedure.

## VOR Approach

1. Navigation Source..... SELECT CDI to VHF Nav  
Tune and identify the station frequency
2. Course Pointer .....SET CDI to the Desired Course
3. Ensure that the current heading will result in a capture of the selected course.
4. Press NAV Key ..... VERIFY VOR ARMED
5. Verify .....Airplane Captures and Tracks VOR Course
6. Once airplane is in ALT mode inbound to the FAF, set the altitude preselect to the next required step down altitude. Use VS mode to descend airplane along the vertical step downs and to the MDA.
7. When in ALT mode at the MDA, set missed approach altitude in the altitude preselect.
8. At Missed Approach Point:
  - AP DISC / TRIM INT button ..... PRESS, Continue visually for a normal landing  
Or
  - GO AROUND (GA) button..... PRESS, Execute Missed Approach Procedure
  - Apply GA power.
  - Set missed approach altitude in the altitude preselect.

### NOTE

Pressing the GA button will not disconnect the autopilot. Select NAV or HDG mode to fly the missed approach procedure.

## DISABLING ESP

ESP can be disabled on the G5 attitude indicator with the following procedure. ESP will default to “Enabled” on the next power cycle.

1. G5 Knob ..... PRESS
2. ESP ..... SELECT
3. G5 Knob ..... PRESS

ESP can be disabled on the G3X with the following procedure. ESP will default to “Enabled” on the next power cycle.

1. Autopilot Status Box ..... TOUCH
2. ESP Button ..... TOUCH
3. Back Button ..... PRESS

ESP can be disabled on the GI 275 with the following procedure. ESP will default to “Enabled” on the next power cycle.

1. GI 275 Knob ..... PRESS and HOLD
2. Options ..... SELECT
3. ESP Button ..... SELECT
4. Back Button ..... PRESS and HOLD

ESP can be disabled, but only while in the air, with the following procedure. ESP will default to “Enabled” on the next power cycle.

1. AP DISC switch ..... PRESS and HOLD for 5 seconds



## SECTION 5 – PERFORMANCE

No Change.

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## SECTION 6 – WEIGHT AND BALANCE

No change to loading information. Refer to current weight and balance report and equipment list for changes to empty weight/moment and installed equipment.

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# SECTION 7 – SYSTEM DESCRIPTION

## AFCS OVERVIEW

The GFC 500 is a digital Automatic Flight Control System (AFCS). It is a two-axis autopilot and flight director system which provides the pilot with the following features:

**G5 Outputs to Autopilot** — The G5 flight instrument (when installed) provides attitude, rate, and acceleration information to the servos. Additionally, indicated airspeed, vertical speed, pressure altitude and GPS information are sent to the autopilot for mode control.

**G3X Outputs to Autopilot** — The G3X electronic flight instrument system provides attitude, rate, and acceleration information to the servos. Additionally, indicated airspeed, vertical speed, pressure altitude and GPS information are sent to the autopilot for mode control.

**GI 275 Outputs to Autopilot** — The GI 275 electronic flight instrument system provides attitude, rate, and acceleration information to the servos. Additionally, indicated airspeed, vertical speed, pressure altitude and GPS information are sent to the autopilot for mode control.

**Flight Director (FD)** — The flight director processing occurs in the G5, GI 275, or G3X instrument. Selected modes for the flight director are displayed on the G5, GI 275, or G3X autopilot status box.

The flight director provides:

- Command Bars showing pitch/roll guidance
- Vertical / lateral mode selection and processing

**Autopilot (AP)** — Autopilot operation occurs within the pitch, roll, and optional pitch trim servo. It also provides servo monitoring, and automatic flight control in response to flight director steering commands, attitude and rate information, and airspeed.

**Optional Electric Pitch Trim** — The pitch trim servo provides manual electric pitch trim capability when the autopilot is not engaged. The trim servo provides automatic pitch trim when the autopilot is engaged and the airplane is in the air. Automatic trim functionality is disabled on the ground.

**GMC 507** — Pilot commands to the autopilot and flight director are entered through the GMC 507 autopilot mode panel. The GMC 507 contains internal sensors which calculate the aircraft attitude, attitude rate and accelerations. These inertial sensors are completely independent from the sensors within the G5, GI 275, or G3X and the rest of the autopilot system, and are not used for the flight director, autopilot, trim or ESP functions. They are used solely to provide independent monitoring of the GFC 500.

**Airspeed and Altitude Information** — The GFC 500 requires airspeed and altitude information from the G5 instrument, the GI 275 system, or the G3X system.

Other components of the AFCS include the GSA 28 pitch, roll, and optional pitch trim servo that also contain autopilot processors, control wheel mounted elevator trim switch (if trim servo is installed), control wheel mounted autopilot disconnect and trim interrupt button (AP DISC / TRIM INT), and a Go-Around (GA) button.

**Underspeed Protection (USP)** — The GFC 500 will provide Underspeed Protection when the autopilot is engaged.

When the minimum airspeed of 65 KIAS (75 MPH) is reached, a visual MINSPD message will appear above the airspeed tape and the autopilot will lower the nose to maintain 65 KIAS (75 MPH). An aural “AIRSPEED, AIRSPEED” voice alert will sound for installations connected to an audio panel.

Underspeed Protection is inhibited when the airspeed exceeds 70 KIAS (80 MPH).

**Overspeed Protection (OSP)** — The GFC 500 will provide Overspeed Protection when the autopilot is engaged.

When the maximum airspeed of 140 KIAS (160 MPH) is reached, visual MAXSPD message will appear above the airspeed tape and the autopilot will raise the nose of the aircraft to avoid exceeding 140 KIAS (160 MPH). An aural “AIRSPEED, AIRSPEED” voice alert will sound for installations connected to an audio panel.

Overspeed Protection is inhibited when the airspeed is below 135 KIAS (155 MPH).

**Coupled Go-Around** — Pressing the GA button will not disengage the autopilot. Instead, the autopilot will attempt to capture and track the flight director command bars. If insufficient airplane performance is available to follow the commands, the autopilot will enter Underspeed Protection mode at the minimum airspeed.

**Electronic Stability and Protection (ESP)** — The GFC 500 will provide Electronic Stability and Protection when the autopilot is not engaged.

Electronic Stability and Protection (ESP) uses the autopilot servos to assist the pilot in maintaining the airplane in a safe flight condition within the airplane's normal pitch, roll and airspeed envelopes.

Electronic Stability and Protection is activated when the pilot allows the airplane to exceed one or more conditions beyond normal flight as defined below:

- Pitch attitude beyond normal flight (+20°, -15°)
- Roll attitude beyond normal flight (45°)
- High airspeed beyond normal flight (above  $V_{NE} + 1$  KIAS [1 MPH])
- Low airspeed below normal flight (below  $V_s + 5$  KIAS [5 MPH])

ESP requires:

- Pitch and Roll servos are installed and functioning
- Autopilot not engaged
- The GPS altitude above ground is more than 200 feet (for low airspeed mode)
- Aircraft is within the autopilot engagement envelope (+/-50° in pitch and +/-75° in roll)

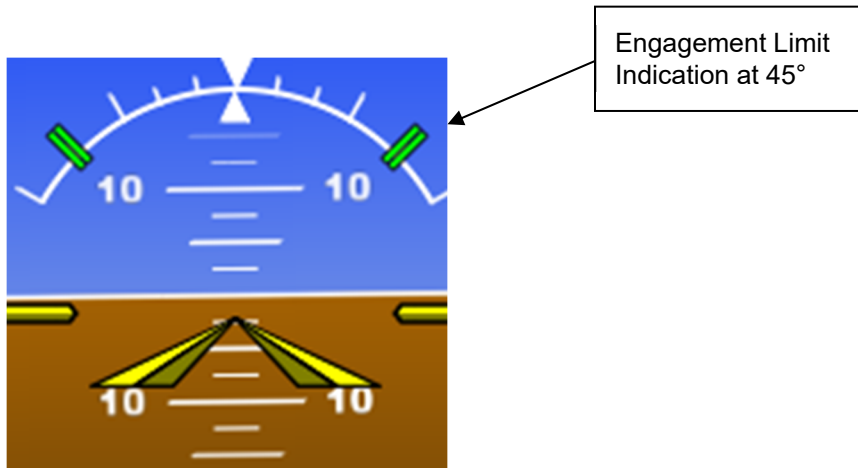
Protection for excessive Pitch, Roll, and Airspeed is provided when the limit thresholds are first exceeded, which engages the appropriate servo in ESP mode at a nominal torque level to bring the airplane back within the normal flight envelope. If the airplane deviates further from the normal flight envelope, the servo torque will increase until the maximum torque level is reached in an attempt to return the airplane into the normal flight envelope. Once the airplane returns to within the normal flight envelope, ESP will deactivate the autopilot servos.

When the normal flight envelope thresholds have been exceeded for more than 10 seconds, ESP Autolevel Mode is activated. Autolevel Mode engages the autopilot to bring the airplane back into straight and level flight based on 0° roll angle and 0 FPM vertical speed. An aural, "ENGAGING AUTOPILOT" (or a Sonalert tone), sounds and the Flight Director mode annunciation will indicate LVL for the pitch and roll modes.

Any time an ESP mode is active, the pilot can interrupt ESP by using the Autopilot Disconnect (AP DISC / TRIM INT) switch, or simply override ESP by overpowering the autopilot servos. The pilot may also disable ESP through the G5, GI 275, or G3X menu.

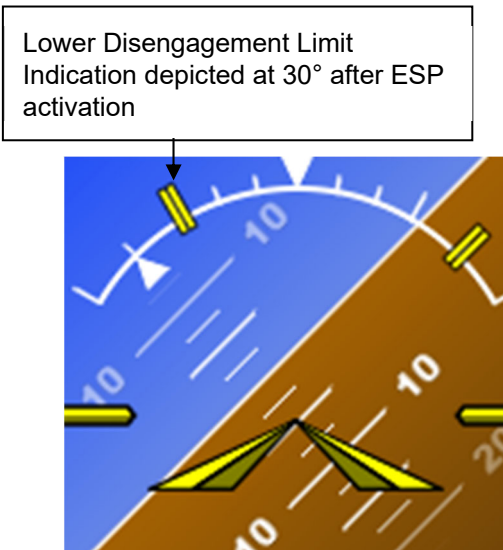
The engagement and disengagement attitude limits are displayed with double hash marks on the roll indicator depending on the airplane attitude and whether or not ESP is active in roll. When ESP is inactive (roll attitude within nominal limits) only the engagement limit indications are displayed in order to reduce clutter on the roll indicator.

Display symbology implemented for ESP is illustrated in the following figures.



*Figure 7-1: Nominal Roll Attitude ESP Engagement Limit Indications*

Once ESP becomes active in roll, the engagement limit indication that was crossed (either Left or Right) will move to the lower disengagement limit indication. The opposite roll limit remains at the engagement limit.



*Figure 7-2: Engagement Limit Indications Upon ESP Activation*

## Disconnect Methods

The following conditions will cause the autopilot to automatically disconnect:

- Electrical power failure, including pulling the AUTOPILOT circuit breaker.
- Internal autopilot system failure (including internal AHRS failure).

The following pilot actions will cause the autopilot to disconnect:

- Pressing the red AP DISC / TRIM INT button on the pilot's control wheel.
- Actuating the manual electric trim switch (if installed).
- Pushing the AP Key on the GMC 507 mode controller when the autopilot is engaged.
- Pulling the AUTOPILOT circuit breaker.

The red AP DISC / TRIM INT button on the pilot's control wheel will interrupt power to the manual electric trim for as long as the switch is depressed.

## AUTOPILOT CONTROL UNIT AND DISPLAY

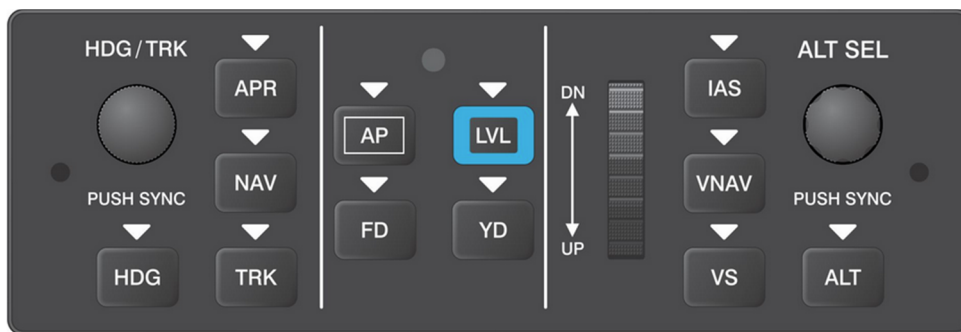


Figure 7-3: GMC 507 Control Unit (Reference Only)



Figure 7-4: G5 Display (Reference Only)



The following tables list the available AFCS vertical and lateral modes with their corresponding controls and annunciations. The UP/DN wheel can be used to change the vertical mode reference while operating in Pitch Hold, Vertical Speed, Altitude Hold, or IAS mode. Increments of change and maximum ranges of values for each of these references using the UP/DN wheel are also listed in the table.

### AFCS VERTICAL MODES

Vertical Mode	Control	Annunciation	Reference Range	Reference Change Increment
Pitch Hold	(default)	PIT	20° Nose Up 15° Nose Down	0.5°
Selected Altitude Capture	*	ALTS		
Altitude Hold	<b>ALT</b> Key	ALT nnnnn		10 FT
Vertical Speed	<b>VS</b> Key	VS nnnn	-2000 to +2000 FPM	100 FPM
IAS Hold	<b>IAS</b> Key	IAS nnn	65 to 140 KIAS 75 to 160 MPH	1 KT 1 MPH
Vertical Path Tracking (VNAV)	<b>VNV</b> Key	VNAV		
VNAV Target Altitude Capture	**	ALTV		
Glidepath	<b>APR</b> Key	GP		
Glideslope		GS		
Takeoff or Go Around	<b>GA</b> Button	TO or GA	7°	
Level (LVL)	<b>LVL</b> Key	LVL	Zero Vertical Speed	
ESP High Pitch Engagement			ESP High Pitch Attitude engages at 20° nose up	
ESP Low Pitch Engagement			ESP Low Pitch Attitude engages at 15° nose down	
ESP High Airspeed Engagement			ESP High Airspeed engages at above $V_{NE} + 1$ KIAS (1 MPH)	
ESP Low Airspeed Engagement			When above 200 FT AGL, ESP Low Airspeed engages at below $V_s + 5$ KIAS (5 MPH). (This mode only available if height above terrain is available from a compatible Garmin GPS).	

\* ALTS arms automatically when PIT, VS, IAS, or GA is active.

\*\* ALTV arms automatically if the VNAV Target Altitude is to be captured instead of the Selected Altitude.

## AFCS LATERAL MODES

Lateral Mode	Control	Annunciation	Maximum Roll Command Limit
Roll Mode	(default)	ROL	30°
Heading Select	<b>HDG</b> Key	HDG	30°
Track Select	<b>TRK</b> Key	TRK	30°
Navigation, GPS Arm/Capture/Track	<b>NAV</b> Key	GPS	30°
Navigation, VOR Enroute and Approach Arm/Capture/Track		VOR	30°
Navigation, LOC Arm/Capture/Track (No Glideslope)		LOC	30°
Backcourse Arm/Capture/Track		BC	30°
Approach, GPS Arm/Capture/Track (Glidepath Mode Automatically Armed, if available)	<b>APR</b> Key	GPS	30°
Approach, ILS Arm/Capture/Track (Glideslope Mode Automatically Armed)		LOC	30°
Takeoff or Go Around	<b>GA</b> Button	TO or GA	Wings Level
LVL (Level)	<b>LVL</b> Key	LVL	Wings Level
ESP Roll Attitude Engagement	ESP Roll Attitude engages at 45°		

The autopilot may be engaged within the following ranges:

Pitch 50° nose up to 50° nose down

Roll ±75°

If the above pitch or roll limits are exceeded while the autopilot is engaged, the autopilot will disconnect. Engaging the autopilot outside of its command limits, but within its engagement limits, will cause the autopilot to return the aircraft within command limits. The autopilot is capable of commanding the aircraft in the following ranges:











Pitch 20° nose up to 15° nose down

Roll ±30°

## PREFLIGHT TEST

During the preflight test the G5, GI 275, or G3X will display PFT in the autopilot status box. The PFT annunciation is removed at the completion of the preflight test. If GFC 500 fails the PFT, a yellow AP with a red X is displayed in the autopilot status box on the G5, GI 275, or G3X.

## MESSAGES AND ANNUNCIATIONS

Autopilot Messages	
AFCS Controller Key Stuck	The system has sensed a key input on the GMC 507 for 30 seconds or longer.
AFCS Controller Audio Database Missing	The audio database is missing from the GMC 507. The aural voice alerts will not be heard.
Servo Clutch Fault	One or more autopilot servos has a stuck clutch. The servo needs service.
Servo Trim Input Fault	The inputs to the trim system are invalid. The trim system needs service.
Autopilot Annunciations	
	Autopilot has failed. Autopilot and trim are inoperative and flight director is not available.
	Autopilot normal disconnect.
	Autopilot abnormal disconnect.
	Autopilot has failed. The autopilot is inoperative. FD modes may still be available.
	Autopilot Overspeed Protection mode is active. Autopilot will raise the nose to limit the aircraft's speed.
	Autopilot Underspeed Protection mode is active. Autopilot will lower the nose to prevent the aircraft's speed from decreasing.
	Autopilot preflight test is in progress.
	Pitch Trim Fail – Manual Electric Pitch Trim is inoperative.
	Elevator Trim Down – Autopilot is holding elevator nose down force. The pitch trim needs to be adjusted nose down.
	Elevator Trim Up – Autopilot is holding elevator nose up force. The pitch trim needs to be adjusted nose up.

## **LIGHTING**

When the aircraft's dimming bus is selected off, or full dim, GMC 507 mode control panel lighting is controlled by integrated photocells which sense the ambient cockpit lighting.