SECTION 2 PILOT'S GUIDE

The G5 is an electronic instrument display capable of operating as a standalone flight display or a fully integrated backup instrument for G3X systems. It features a bright, sunlight readable, 3.5-inch color display which is sized to fit in a standard 3-1/8-inch instrument cutout.

When installed as part of a G3X system, the G5 provides a redundant source of attitude and air data to the G3X displays, and additionally provides backup autopilot control allowing coupled GPS approaches to be flown or continued in the event of primary flight display is unavailability. The G5 additionally provides backup autopilot control allowing coupled GPS approaches to be flown or continued in the event of primary flight display loss. In the case of aircraft power loss, the optional battery backup sustains the G5 flight display with up to 4 hours of emergency power.

2.1 BEZEL OVERVIEW

Figure 2-1 G5 Bezel Overview

Power Button		Press to turn unit ON. Press and hold for 5 seconds to turn unit OFF. Once on, press to adjust the backlight.
microSD™ Card Slot		Insert microSD card to update software and log data.
Knob	**Press**	Press to access the Menu. From the Menu, press to select the desired menu item. Press to accept the displayed value when editing numeric data or selecting from a list.
	Turn	From the Main Menu, turn the Knob to move the cursor to the desired menu item. From the PFD Page, rotate to adjust the barometric setting. From the HSI Page, rotate to adjust the heading or track bug. Turn to select the desired value when editing numeric data or selecting from a list.

2.2 MICRO-SD™ CARDS

The G5 data card slot uses micro Secure Digital (SD) cards. The microSD™ card can be used for software updates and data logging. The maximum supported card size is 32GB.

Installing an microSD™ Card:

1) Insert the microSD™ card in the microSD™ card slot with the card contacts facing down (the card should be flush with the face of the bezel).
2) To eject the card, gently press on the microSD™ card to release the spring latch.

2.3 SYSTEM POWER-UP

During system initialization, the G5 displays the message 'ALIGNING' over the attitude indicator. The G5 should display valid attitude typically within the first minute of power-up. The G5 can align itself both while taxiing and during level flight.

2.4 OPERATION

NOTE: *Refer to the Installation portion of this manual for information on configuring the G5.*

2.4.1 G5 ANNUNCIATIONS

When a G5 function fails, a Red-X is typically displayed over the instrument(s) or data experiencing the failure. Upon G5 power-up, certain instruments remain invalid as equipment begins to initialize. All instruments should be operational within one minute of power-up. If any instrument remains flagged, and it is not likely an installation related problem, the G5 should be serviced by a Garmin-authorized repair facility .

Figure 2-2 G5 Failure Annunciations

2.4.2 G5 ATTITUDE

The G5 calculates aircraft attitude using information from its built-in inertial sensors. Any failure of the inertial sensors results in loss of attitude and information (indicated by Red-X flags over the PFD attitude display). If the G5 senses that the attitude solution is valid, but not yet within the internal accuracy limits, "ALIGNING" is displayed. The G5 can align itself both while taxiing and during level flight.

The G5 will also use GPS and airspeed data to provide the most accurate attitude information. If none of these additional sources of information are available, attitude calculations will still be valid but accuracy may be slightly affected.

2.4.3 G5 HEADING

Magnetic heading is available in a standalone installation with a magnetometer, and when the G5 is configured as a backup in a G3X/G3X Touch system and the G5 is receiving magnetic heading data from an ADAHRS unit. If magnetic heading input data is not available, the G5 will display GPS-derived ground track instead.

The G5 corrects for shifts and variations in the Earth's magnetic field by applying the Magnetic Field Variation Database. The Magnetic Field Variation Database is derived from the International Geomagnetic Reference Field (IGRF). The IGRF is a mathematical model that describes the Earth's main magnetic field and its annual rate of change. The database is updated approximately every 5 years via a software update. Failure to update this database could lead to erroneous heading information being displayed to the pilot.

If the G5 senses that the magnetic heading measurement is valid, but possibly outside of the internal accuracy limits, the numeric heading is displayed in yellow.

2.4.4 BACKLIGHT INTENSITY

When set to Auto, the backlight is automatically adjusted according to ambient light conditions. When set to Manual, the backlight level is set by the pilot.

Adjusting backlight intensity:

1) While the unit is turned on, press the **Power** Button.
2) Turn the Knob to adjust the backlight intensity.
3) Press the Knob to close the backlight page.

Setting the backlight intensity to automatic:

1) While the unit is turned on, press the Power Button.
2) Press the **Power** Button again to select **Auto**.
3) Press the Knob to close the backlight page.

2.5 ACCESSING FUNCTIONALITY

2.5.1 PAGES

NOTE: *The G5 will automatically return to the PFD Page when the aircraft enters an unusual attitude (if enabled in the system configuration). Refer to the Installation Manual section for more information.*

The G5 has two main pages, the HSI Page and the PFD Page. The HSI Page can be accessed from the PFD Page (unless it has been disabled in configuration).

Figure 2-3 PFD Page

Figure 2-4 HSI Page

Displaying the HSI page from the PFD page:

1) From the PFD Page press the **Knob** to display the Menu.
2) Use the Knob to select **HSI**.

NOTE: *The G5 can be configured to power-up on either the PFD or HSI page (if allowed by the current system configuration). Refer to the Installation Manual section for more information.*

2.5.2 MENU

Press the Knob to access the G5 Menu. Navigate the menu by rotating the Knob and make selections by pressing the Knob.

Figure 2-5 PFD Page Menu

Figure 2-6 HSI Page Menu

2.6 PFD PAGE

The G5 PFD Page displays a horizon, airspeed, attitude, altitude, vertical speed, heading, and course deviation information. The following flight instruments and supplemental flight data are displayed on the PFD Page.

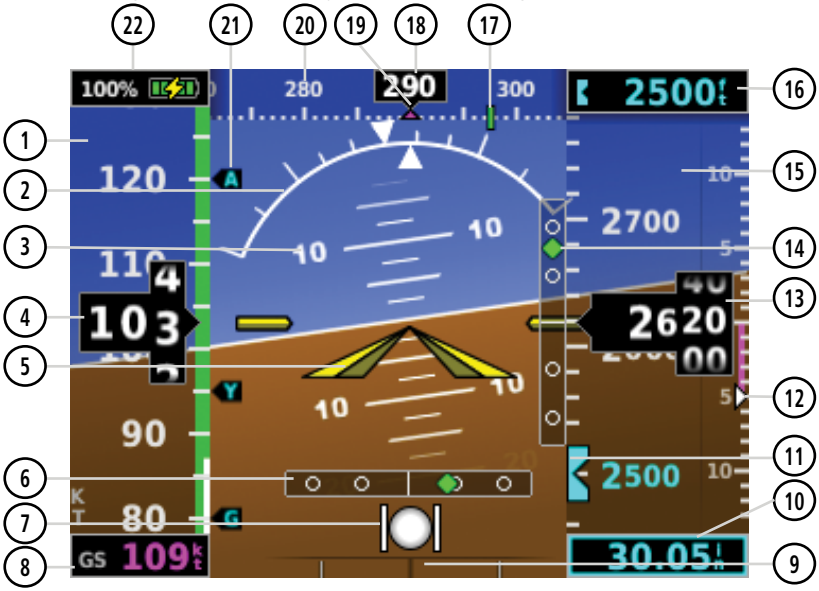


Figure 2-7 G5 PFD Flight Instruments

1. *Airspeed Indicator*
2. *Attitude Indicator*
3. *Pitch Scale*
4. *Current Airspeed*
5. *Aircraft Symbol*
6. *Course Deviation Indicator*
7. *Slip/Skid Indicator*
8. *Ground Speed (GS)*
9. *Turn Rate Indicator*
10. *Altimeter Barometric Setting*
11. *Selected Altitude Bug*
12. *Vertical Speed Indicator*
13. *Current Altitude*
14. *VNAV Indicator or Vertical Deviation Indicator*
15. *Altimeter*
16. *Selected Altitude*
17. *Navigation Course*
18. *Current Heading or Ground Track*
19. *Ground Track*
20. *Heading or Ground Track*
21. *Vspeed Reference*
22. *Battery Status Indicator*

2.6.1 AIRSPEED INDICATOR

NOTE: *The G5 Vspeed Reference values depend upon the aircraft's specific system configuration and may vary from the examples discussed in this section.*

The Airspeed Indicator displays airspeed on a rolling number gauge using a moving tape. The numeric labels and major tick marks on the moving tape are marked at intervals of 10 knots. Speed indication starts at 30 knots, with 60 knots of airspeed viewable at any time. The actual airspeed is displayed inside the black pointer. The pointer remains black until reaching never-exceed speed (V_{NE}), at which point it turns red.

A color-coded (red, white, green, yellow, and red/white "barber pole") speed range strip is located on the moving tape. The colors denote flaps operating range, normal operating range, caution range, and never-exceed speed (V_{NE}). A red range is also present for low speed awareness.

The Airspeed Trend Vector is a vertical, magenta line, extending up or down on the airspeed scale, shown to the right of the color-coded speed range strip. The end of the trend vector corresponds to the predicted airspeed in 6 seconds if the current rate of acceleration is maintained. If the trend vector crosses V_{NE}, the text of the actual airspeed readout changes to yellow. The trend vector is absent if the speed remains constant or if any data needed to calculate airspeed is not available due to a system failure.

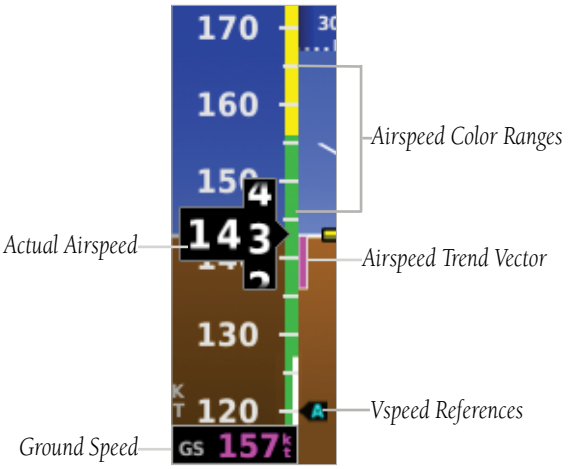


Figure 2-8 Airspeed Indicator

2.6.1.1 V_{NE} ADJUSTED FOR TRUE AIRSPEED OR MACH NUMBER (OPTIONAL)

NOTE: *Mach number data is only available when the G5 is installed as part of a G3X/G3X Touch system and is receiving air temperature data from an ADAHRS.*

The airspeed indicator can optionally be configured to display V_{NE} adjusted for true airspeed or maximum Mach number (MMO). This is useful in aircraft where true airspeed or Mach number must be kept below a certain limit. If configured, the G5 can display V_{NE} based on TAS or Mach in addition to IAS, which will cause the displayed value for V_{NE} to be reduced at high altitudes. A solid red band is used between the TAS or Mach limit and the actual indicated value for V_{NE}.

2.6.1.2 VSPEED REFERENCE

Vspeed references including V_{NE}, V_{no}, V_{so}, V_{s1}, V_{fe}, V_a, V_x, V_y, V_{Yse}, V_g, V_r, can be configured to display on the G5, refer to the Installation Manual section for more information.

When airspeed is present, the Vspeeds configured are displayed at their respective locations to the right of the airspeed scale, otherwise the Vspeeds are displayed at the bottom of the airspeed indicator.

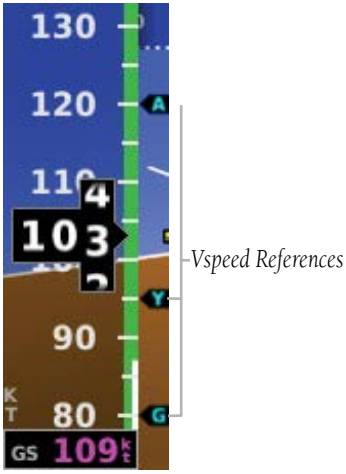


Figure 2-9 Vspeed References

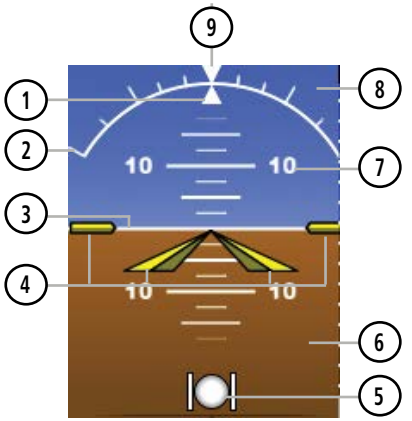
2.6.2 ATTITUDE INDICATOR

Attitude information is displayed over a virtual blue sky and brown ground with a white horizon line. The Attitude Indicator displays the pitch (indicated by the yellow symbolic aircraft on the pitch scale), roll, and slip/skid information.

The horizon line is part of the pitch scale. Pitch markings occur at 2.5˚ intervals through all pitch ranges. Refer to the Installation Manual section to configure the pitch scale.

The inverted white triangle indicates zero on the roll scale. Major tick marks at 30˚ and 60˚ and minor tick marks at 10˚, 20˚, and 45˚ are shown to the left and right of the zero. Angle of bank is indicated by the position of the pointer on the roll scale.

Slip/skid is indicated by the location of the ball.



1 *Roll Pointer*
2 *Roll Scale*
3 *Horizon Line*
4 *Aircraft Symbol*
5 *Slip/Skid Indicator*
6 *Land Representation*
7 *Pitch Scale*
8 *Sky Representation*
9 *Roll Scale Zero*

Figure 2-10 Attitude Indicator

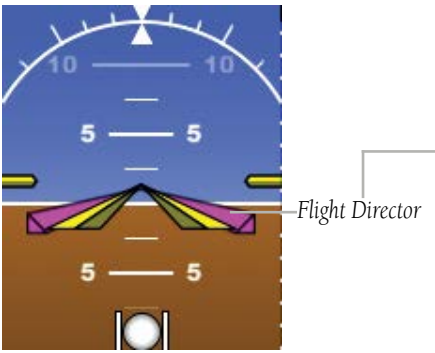


Figure 2-11 Attitude Indicator with Flight Director (Single Cue)

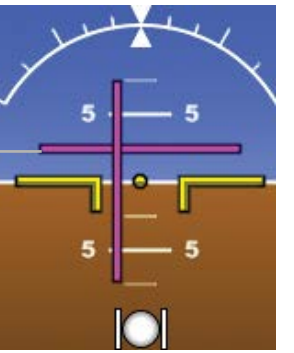


Figure 2-12 Attitude Indicator with Flight Director (Dual Cue)

2.6.3 ALTIMETER

The Altimeter displays 400 feet of barometric altitude values at a time on a rolling number gauge using a moving tape. Numeric labels and major tick marks are shown at intervals of 100 feet. Minor tick marks are at intervals of 20 feet. The current altitude is displayed in the black pointer.

The Selected Altitude is displayed above the Altimeter in the box indicated by a selection bug symbol. A bug corresponding to this altitude is shown on the tape; if the Selected Altitude exceeds the range shown on the tape, the bug appears at the corresponding edge of the tape.

The Selected Altitude is synchronized between the G5 and the other displays in a G3X/G3X Touch system.

Setting the selected altitude:

Rotate the ALT SEL Knob on the GMC 307.

Or

1) Press the Knob to display the Menu.

2) Select **Altitude** and use the Knob to change the Selected Altitude.

Syncing to the current altitude:

Press the ALT SEL Knob on the GMC 307.

Or

1) Press the Knob to display the Menu.

2) Select **Altitude** and press and hold the Knob to sync the Selected Altitude to the current altitude

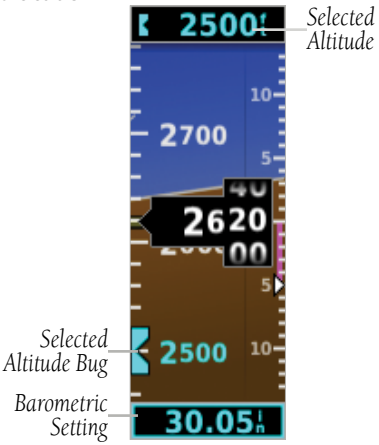


Figure 2-13 Altimeter

2.6.3.1 BAROMETRIC PRESSURE

The barometric pressure setting is displayed below the Altimeter in inches of mercury (in Hg) or hectopascals (hPa) when metric units are selected. The barometric pressure setting is synchronized between the G5 and the other displays in a G3X/G3X Touch system.

Selecting the altimeter barometric pressure setting:

Turn the Knob to set the barometric pressure.

2.6.3.2 ALTITUDE ALERTING

The Altitude Alerting function provides the pilot with a visual alert when approaching the Selected Altitude. Whenever the Selected Altitude is changed, the Altitude Alerter is reset. The following will occur when approaching the Selected Altitude:

- Passing within 1,000 feet of the Selected Altitude, the Selected Altitude (shown above the Altimeter) flashes for 5 seconds.
- When the aircraft passes within 200 feet of the Selected Altitude, the Selected Altitude flashes for 5 seconds to indicate that the aircraft is approaching the selected altitude.
- After reaching the Selected Altitude, if the pilot flies outside the deviation band (±200 Feet of the Selected Altitude), the Selected Altitude changes to yellow text on a black background, flashes for 5 seconds.

Figure 2-14 Altitude Alerting Visual Annunciation

2.6.4 TURN RATE INDICATOR

The Turn Rate Indicator is located at the bottom of the PFD Page. Tick marks to the left and right of the displayed heading denote standard turn rates (3 deg/sec). A magenta Turn Rate Trend Vector shows the current turn rate. A standard-rate turn is shown on the indicator by the trend vector stopping at the standard turn rate tick mark.

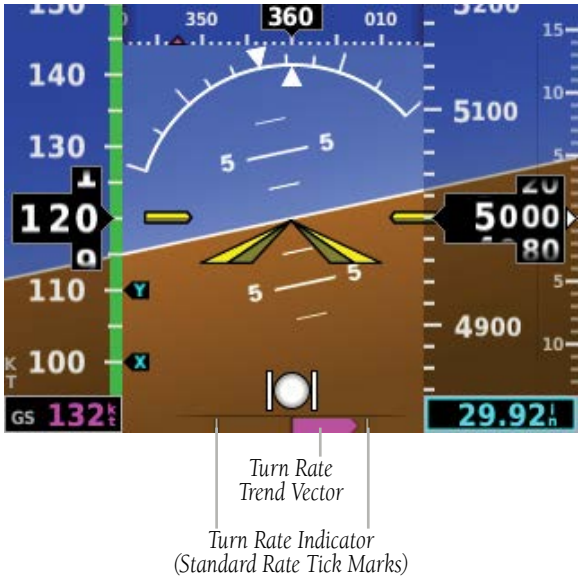


Figure 2-15 Turn Rate Indicator

2.6.5 HEADING/GROUND TRACK (PFD PAGE)

NOTE: *Heading is displayed if magnetometer data is available from a magnetometer via the CAN network. Otherwise, Ground Track is displayed.*

A Heading/Ground Track Tape is displayed at the top of the PFD Page and displays numeric labels every 10°. Major tick marks are at 5° intervals and minor tick marks at 1° intervals. The current track is represented by a magenta triangle. The Heading/Ground Track Tape also displays the navigation course.

When displaying the Selected Heading, a light blue bug on the tape corresponds to the Selected Heading. When displaying Ground Track, a magenta bug is displayed on the tape. The selected heading is synchronized between the G5 and the other displays in a G3X/G3X Touch system.

Adjusting the selected heading or ground track:

Use the HDG Knob on the GMC 307.

Or

1) Press the Knob to display the Menu.
2) Select **Heading** or **Track** and use the Knob to change the Selected Heading or Track.

Syncing to the current heading or ground track:

Press the HDG Knob on the GMC 307.

Or

1) Press the Knob to display the Menu.
2) Select **Heading** or **Track** and press and hold the Knob to sync the selected heading or ground track to the current heading or ground track.

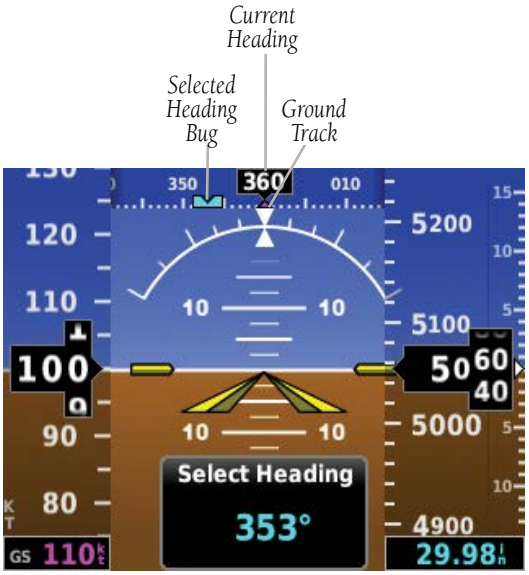


Figure 2-16 PFD Page - Selected Heading

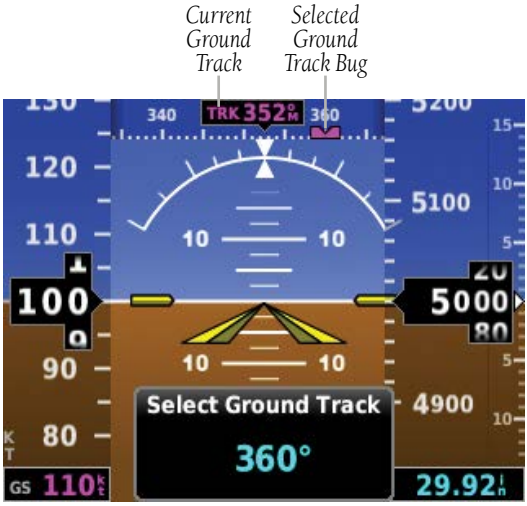


Figure 2-17 PFD Page - Selected Ground Track

2.6.6 VERTICAL SPEED INDICATOR (VSI)

The Vertical Speed Indicator displays the aircraft vertical speed using a non-moving tape with minor tick marks every 100 feet. The current vertical speed is displayed using a white arrow along the tape. From the Air Data Page in configuration mode, the Vertical Speed Indicator can be configured to display ± 1500 fpm, ± 2000 fpm, or ± 3000 fpm (refer to the Installation Manual section for more information).

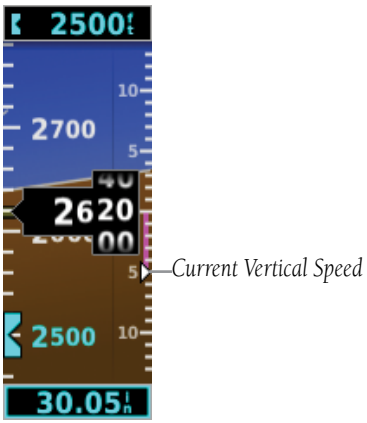


Figure 2-18 Vertical Speed Indicator

2.6.7 PFD PITCH ATTITUDE OFFSET

NOTE: *PFD Pitch Attitude Offset can be configured as disabled in configuration mode.*

The Pitch attitude offset function allows the yellow aircraft symbol on the attitude indicator to be adjusted up or down much like the aircraft on a mechanical attitude indicator. The pitch attitude can be adjusted as much as ± 5°. The pitch offset is synchronized between the G5 and the other displays in a G3X/G3X Touch system. This function can be disabled in configuration mode.

Changing the PFD pitch attitude offset:

1) From the PFD Page, press the Knob to display the Menu.
2) Select **Pitch** and use the Knob to select the desired Pitch Offset.

Centering the PFD pitch attitude offset:

1) From the PFD Page, press the **Knob** to display the Menu.
2) Select **Pitch** and press and hold the Knob to center the Pitch Offset.

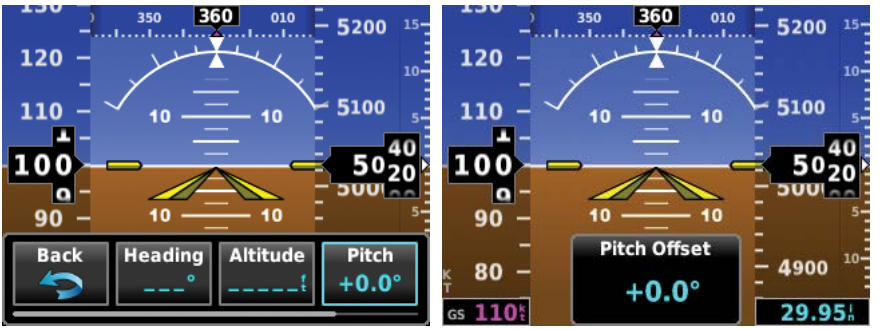


Figure 2-19 Pitch Offset

2.6.8 BATTERY STATUS INDICATOR

The current charge level of the battery is indicated by the filled-in portion of the battery icon. The battery icon turns yellow or red to indicate a low-battery condition.

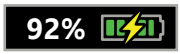
41%-100%

21%-40%

0%-20%

When the G5 is powered by the battery, the estimated time until the battery is empty is displayed. Otherwise, the current charge level of the battery in percent is displayed as a numeric value.

When the G5 is connected to external power and the battery is being charged, a lightning bolt symbol appears over the battery icon.



Charging

Other battery indications:

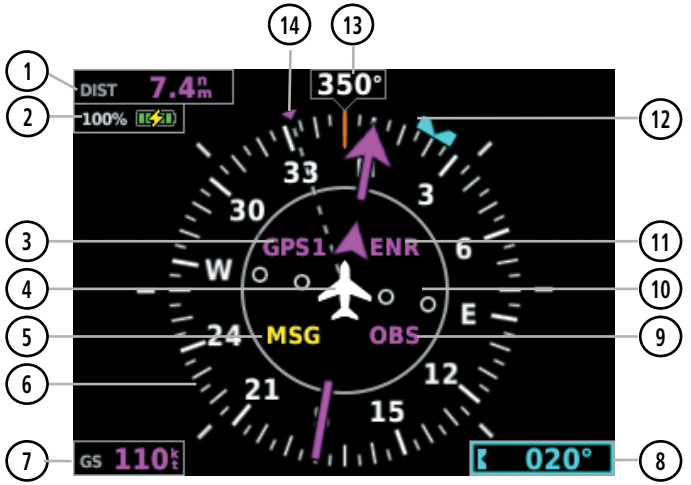

Battery charger hardware fault, or temperature too high or low to safely charge the battery.

Battery fault.

Battery is not present (appears only when the battery status field has been configured to always appear).

2.7 HSI PAGE

NOTE: *The HSI Page can be configured as disabled in configuration mode.*



1. *Distance To Waypoint*
2. *Battery Status Indicator*
3. *Navigation Source*
4. *Aircraft Symbol*
5. *Navigator Messages*
6. *Rotating Compass Rose*
7. *Ground Speed*
8. *Selected Heading or Ground Track*
9. *OBS Annunciator*
10. *Course Deviation Indicator (CDI)*
11. *GPS CDI Scale*
12. *Selected Heading/Ground Track Bug*
13. *Current Heading/Ground Track*
14. *Current Track*

Figure 2-20 Horizontal Situation Indicator (HSI)

(3) Nav Source Annunciations				(11) GPS CDI Scale Annunciations		
GPS/ GPS1/ GPS2	VLOC/ VLOC1/ VLOC2	VOR/ VOR1/ VOR2	LOC/ LOC1/ LOC2	LP	LPV	LNAV
				LNAV/VNAV	LNAV+V	APR
				TERM	ENR	OCN
				VFR (0.25nm, 1.25nm, 5.00nm)		

(5) Navigator Messages Annunciations			
LOI	Loss of GPS Integrity	MSG	Pending Nav Message
DR	GPS Dead-Reckoning Mode	WPT	Waypoint Arrival

NOTE: *The VFR CDI Scale is displayed when the G5 is connected to a GPS navigator via RS-232 only, or if ARINC 429 GPS navigation data is unavailable.*

2.7.1 HORIZONTAL SITUATION INDICATOR (HSI)

The Horizontal Situation Indicator (HSI) on the HSI Page displays a rotating compass card in a heading-up orientation. Letters indicate the cardinal points and numeric labels occur every 30˚. Major tick marks are at 10˚ intervals and minor tick marks at 5˚ intervals. The current track is represented on the HSI by magenta triangle and a dashed line. The HSI also presents course deviation, bearing, and navigation source information.

Displaying the HSI page from the PFD page:

1) From the PFD Page press the Knob to display the Menu.

2) Select HSI.

2.7.1.1 BEARING POINTER

A bearing pointer can be displayed on the HSI for NAV (VOR) and GPS sources. The bearing pointer is light blue. The bearing pointer never overrides the CDI and is visually separated from the CDI by a white ring (shown when the bearing pointer is selected but not necessarily visible due to data unavailability).

Figure 2-21 HSI Page with Bearing Pointer

Enabling/disabling the bearing pointer:

1) From the HSI Page, press the **Knob** to display the Menu.
2) Turn the **Knob** to highlight **Bearing Pointer**.
3) Press the **Knob** to enable or disable the Bearing Pointer.

Figure 2-22 Bearing Pointer Menu Option

2.7.1.2 COURSE DEVIATION INDICATOR (CDI)

The HSI contains a Course Deviation Indicator (CDI) with a Course Pointer. The course pointer (GPS or VLOC) points in the direction of the selected course.

The Course Deviation Indicator (CDI) moves left or right from the course pointer along a lateral deviation scale to display aircraft position relative to the course. If the course deviation data is not valid, the CDI is not displayed.

The CDI is capable of displaying two sources of navigation: GPS or NAV (VOR, localizer) depending on the external navigator(s) configured (refer to the G5 Installation Manual Section for more information). Color indicates the current navigation source: magenta (for GPS) or green (for VOR and LOC). The full-scale limits for the CDI are defined by a GPS-derived distance when coupled to GPS. When coupled to a VOR or localizer (LOC), the CDI has the same angular limits as a mechanical CDI.

2.7.2 HEADING/GROUND TRACK (HSI PAGE)

The Selected Heading or Ground Track is shown to the right of the HSI. The light blue bug (heading) or magenta bug (ground track) on the compass rose corresponds to the Selected Heading or Ground Track.

NOTE: *Heading is displayed if magnetometer data is available from a magnetometer via the CAN network. Otherwise, Ground Track is displayed.*

Adjusting the selected heading or ground track from the HSI page:

Use the HDG Knob on the GMC 307.

Or

From the HSI Page, turn the Knob to adjust the selected heading or ground track.

Syncing to the current heading or ground track from the HSI page:

Press the HDG Knob on the GMC 307.

Or

From the HSI Page, press and hold the Knob to sync to the current heading or ground track.

2.8 NAVIGATION

A G5 installed as part of a G3X system with multiple navigation sources will only display data from the #1 navigation source. If the navigation source is a GNS/GTN unit, both GPS and VLOC data can be displayed. Displayed navigation information is also dependent upon the selection on the navigation configuration page.

Table 2-1 Navigation Data Functions

Installation Type Setting	Navigation Data Behavior
G3X System Backup (with Navigation Data configuration mode set to Always Display)	Always displays navigation data.
G3X System Backup (with Navigation Data configuration mode set to Auto)	Displays navigation data only when the navigation data source selected on the G3X PFD is the same as the navigation data available to the G5. (If no G3X displays are present, this will function as if Navigation Data is set to Always)
Standalone Instrument	Always displays navigation data

2.8.1 COURSE DEVIATION INDICATOR (CDI)

The PFD Page displays the Course Deviation Indicator (CDI) below the slip/skid indicator. The HSI Page displays the CDI on the Horizontal Situation Indicator.

The Course Deviation Indicator (CDI) move left or right along a lateral deviation scale to display the aircraft position relative to the course. If the course deviation data is not valid, the CDI is not displayed.

The CDI is capable of displaying two sources of navigation: GPS or NAV (VOR, localizer) depending on the external navigator configured (refer to the Installation Manual section for more information). Color indicates the current navigation source: magenta (for GPS) or green (for VOR and LOC). The full-scale limits for the CDI are defined by a GPS-derived distance when coupled to GPS. When coupled to a VOR or localizer (LOC), the CDI has the same angular limits as a mechanical CDI.

Changing the navigation source (GPS, VOR, LOC, or VLOC):

Use the associated external navigator to toggle between GPS and VOR/LOC source types. Refer to the appropriate external navigator Pilot's Guide for more information.

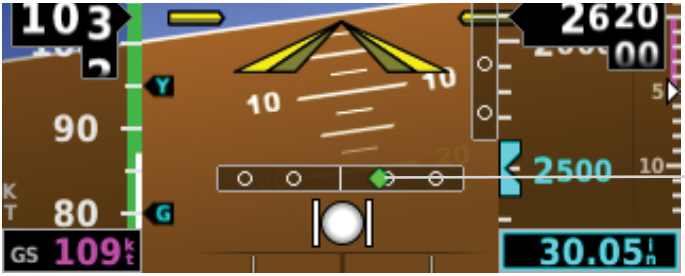


Figure 2-23 Course Deviation Indicator (PFD Page)

Figure 2-24 Course Deviation Indicator (HSI Page)

2.8.2 VERTICAL DEVIATION INDICATOR AND VNAV INDICATOR

NOTE: *An external navigator (i.e. GTN/GNS, GNC 255, or SL30 Nav/Comm Transceiver) must be configured to receive glideslope and/or glidepath vertical deviation indications.*

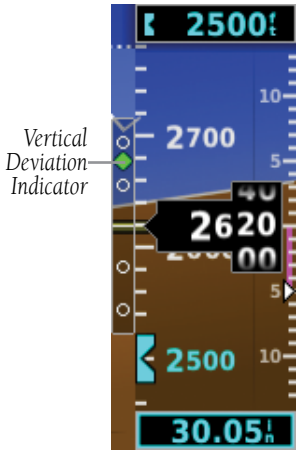


Figure 2-25 Vertical Deviation Indicator Position (PFD Page)

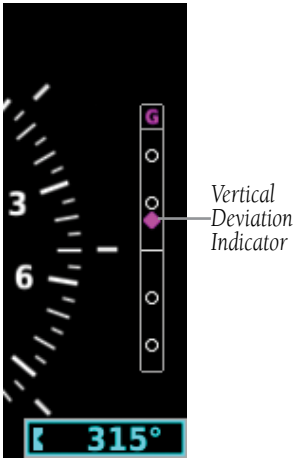


Figure 2-26 Vertical Deviation Indicator Position (HSI Page)

2.8.2.1 GLIDESLOPE - ILS SOURCE

The Vertical Deviation (Glideslope) Indicator (VDI) appears to the left of the altimeter whenever an ILS frequency is tuned in the active NAV field of an external navigator. A green diamond acts as the VDI Indicator, like a glideslope needle on a conventional indicator. If a localizer frequency is tuned and there is no glideslope signal, "NO GS" is annunciated.

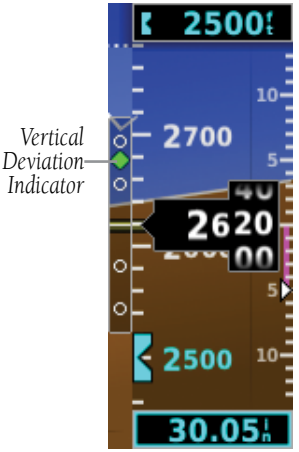


Figure 2-27 Vertical Deviation Indicator (Glideslope-ILS Source)

2.8.2.2 GLIDEPATH - GPS SOURCE

The Vertical Deviation (Glidepath) Indicator (VDI) also appears to the left of the altimeter during a GPS approach. The glidepath is analogous to the glideslope for GPS approaches supporting WAAS vertical guidance (LNAV+V, L/VNAV, LPV). The Glidepath Indicator appears on the G5 as a magenta diamond. If the approach type downgrades past the final approach fix (FAF), "NO GP" is annunciated.

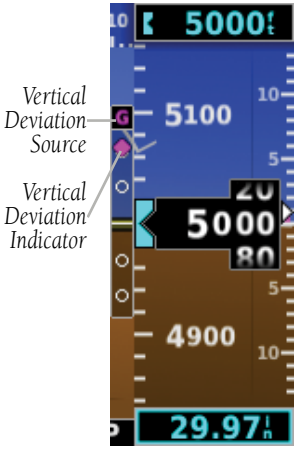


Figure 2-28 Vertical Deviation Indicator (Glidepath-GPS Source)

2.8.2.3 VNAV INDICATOR

NOTE: *VNAV deviation is only displayed when the G5 is receiving NMEA RS-232 data from a portable GPS.*

The magenta chevron (VNAV Indicator) to the left of the altimeter on the Vertical Deviation Scale displays the VNAV profile.

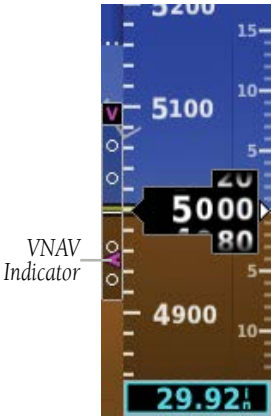


Figure 2-29 VNAV Indicator

2.8.3 COURSE SELECTION

When the G5 is receiving VOR, LOC, or GPS data, a **Course** menu option is displayed.

Setting the course for a VOR or localizer:

1) From the PFD Page, press the Knob to display the Menu.
2) Select **Course** and use the Knob to adjust the course.

Figure 2-30 VLOC Course on PFD Page

Setting the OBS course:

1) From the PFD Page, press the Knob to display the Menu.
2) Select **Course** and use the Knob to adjust the course.

2.9 AUTOMATIC FLIGHT CONTROL SYSTEM (OPTIONAL)

NOTE: *The approved Pilot's Operating Handbook (POH) always supersedes the information in this Pilot's Guide.*

NOTE: *Refer to the approved Pilot's Operating Handbook (POH) for emergency procedures.*

NOTE: *The G5 flight director does not support VOR, LOC, and GS modes.*

NOTE: *A GMC controller is required for G5 AFCS functionality.*

2.9.1 AFCS SYSTEM ARCHITECTURE

An Automatic Flight Control System (AFCS) is typically comprised of two major components: A Flight Director (FD) and Autopilot servos. The Flight Director provides pitch and roll commands to the autopilot servos. These pitch and roll commands are displayed on the PFD Page as Command Bars. When the Flight Director is active the pitch and roll commands can be hand-flown by the pilot or when coupled with the autopilot, the autopilot servos drive the flight controls to follow the commands issued by the Flight Director. The Flight Director operates independently of the autopilot servos, but in most cases the autopilot servos can not operate independent of the Flight Director.

2.9.1.1 AUTOPILOT AND YAW DAMPER OPERATION

The autopilot and optional yaw damper operate the flight control surface servos to provide automatic flight control. The autopilot controls the aircraft pitch and roll attitudes following commands received from the flight director. Pitch, Roll, and Yaw (if installed) autotrim provides trim commands to each servo to relieve any sustained effort required by the servo(s). Autopilot operation is independent of the optional yaw damper.

The optional yaw damper reduces Dutch roll tendencies, coordinates turns, and provides a steady force to maintain directional trim. It can operate independently of the autopilot and may be used during normal hand-flight maneuvers. Yaw rate commands are limited to 6 deg/sec by the yaw damper.

2.9.1.2 FLIGHT CONTROL

Pitch and roll commands are provided to the servos based on the active flight director modes. Yaw commands are provided by the yaw servo. Servo motor control limits the maximum servo speed and torque. This allows the servos to be overridden in case of an emergency.

2.9.1.3 PITCH AXIS AND TRIM

The autopilot pitch axis uses pitch rate to stabilize the aircraft pitch attitude during flight director maneuvers. Flight director pitch commands are rate and attitude-limited, combined with pitch damper control, and sent to the pitch servo motor. The pitch servo measures the output effort (torque) and optionally provides this signal to the pitch trim motor. The pitch servo commands the pitch trim motor to reduce the average pitch servo effort.

2.9.1.3.1 Roll Axis

The autopilot roll axis uses roll rate to stabilize aircraft roll attitude during flight director maneuvers. The flight director roll commands are rate- and attitude-limited, combined with roll damper control, and sent to the roll servo motor.

2.9.1.3.2 Yaw Axis

The yaw damper uses yaw rate and roll attitude to dampen the aircraft's natural Dutch roll response. It also uses lateral acceleration to coordinate turns and reduce or eliminate the need for the pilot to use rudder pedal force to maintain coordinated flight during climbs and descents.

2.9.2 CONTROL WHEEL STEERING (CWS) (OPTIONAL)

Control Wheel Steering allows the aircraft to be hand-flown without disengaging the AFCS. Press and hold the autopilot CWS Button (if equipped) to temporarily disengage the pitch and roll servos from the flight control surfaces and hand-fly the aircraft. The G5 autopilot control is synchronized to the aircraft attitude during Control Wheel Steering. The green 'AP' annunciation is temporarily replaced by a white 'CW' for the duration of Control Wheel Steering maneuvers.

In most scenarios, releasing the CWS Button reengages the Autopilot with a new reference. Refer to (Vertical Modes) and (Lateral Modes) for Control Wheel Steering behavior in each mode.

2.9.3 G5 AFCS STATUS BOX

The AFCS status box displays Autopilot (AP) and Flight Director (FD) mode annunciations on the PFD Page.

Autopilot (AP) status is displayed on the far left of the G5 Autopilot Status Box. Lateral modes are displayed in the center, and vertical modes are displayed on the right. Armed modes are displayed in white and active in green.

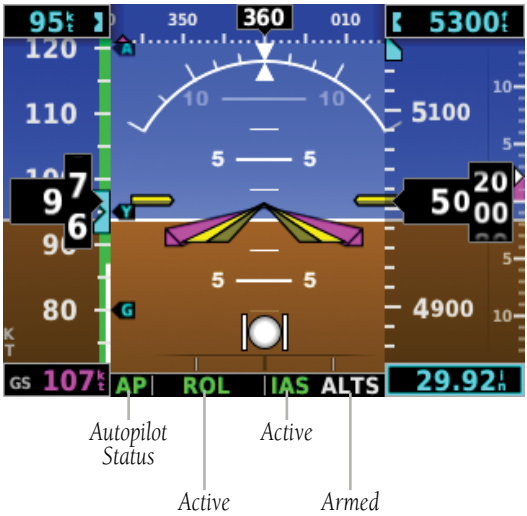


Figure 2-31 Autopilot Status Box

2.9.4 G5 AFCS CONFIGURATION

The G5 can be configured as a standalone unit or as a backup unit for a G3X or G3X Touch system.

When configured as a standalone unit with a GMC controller and GSA servos:

- The G5 supports the following modes: LVL, PIT, ROL, HDG (for installations with a magnetometer), TRK (for installations without a magnetometer), GPS, VS, IAS, ALT, ALTS, GP, and VNAV.
- GP mode requires ARINC 429 data from an IFR navigator.
- VNAV mode requires RS-232 data from a portable GPS.

When configured as a backup unit for a G3X or G3X Touch system:

- The G5 supports the following modes: LVL, PIT, ROL, HDG, TRK, GPS, VS, IAS, ALT, ALTS, TO, GA, and GP.
- GP mode requires ARINC 429 data from an IFR navigator.
- TRK mode is selected using the HDG Button on the GMC and is only available when magnetic heading is unavailable.

2.9.5 AFCS OPERATION

NOTE: *When the G5 is configured as part of a G3X/G3X Touch system, the G5 can be used to drive the autopilot and flight director only when all GDUs are removed from the network.*

AFCS functionality is distributed across the following Line Replaceable Units (LRUs):

- GMC 305/307 AFCS Mode Control Unit
- GSA 28 AFCS Pitch/Roll/Yaw Damper (optional) servos.

The AFCS system can be divided into these main operating functions:

• **Flight Director (FD)** — Flight director commands are displayed on the display The flight director provides:

– Command Bars showing pitch/roll guidance

– Vertical/lateral mode selection and processing

– Autopilot communication

• **Autopilot (AP)** — Autopilot operation occurs within the pitch and roll servos. It also provides servo monitoring and automatic flight control in response to flight director steering commands, Air Data and Attitude and Heading Reference System (ADAHRS) attitude, rate information, and airspeed.

• **Yaw Damper (YD**) — The yaw servo (optional), is self-monitoring and provides Dutch roll damping and turn coordination in response to yaw rate, roll angle, lateral acceleration, and airspeed. If installed the YD comes on when the autopilot is engaged and stays on after disengaging the autopilot. The YD can be turned on/off independent of the autopilot using the **YD Key**.

• **Manual Electric Trim (MET)** — Manual electric trim may provide trim capability for any properly configured axis (pitch, roll, or yaw) when the autopilot is not engaged.

NOTE: *Refer to the G5 Installation Manual Section for information on installing and configuring the G5 Integrated Autopilot Interface.*

2.9.6 AFCS PRE-FLIGHT ACTIONS (STANDALONE INSTALLATION)

To ensure that the Automatic Flight Control System (AFCS) is operating properly prior to flight, perform the following Garmin recommended preflight checks.

Before takeoff checklist:

1) Autopilot - ENGAGE (using AP/CWS button, or **AP** button on mode controller)
2) Flight controls - CHECK (verify autopilot can be overpowered in both pitch and roll)
3) **AP** DISC button - PRESS (verify autopilot disengages)
4) Yaw damper - OFF (if installed) (verify yaw damper disengages)
5) Flight director - SET FOR TAKEOFF (select IAS or VS mode or push FD Button to turn off the Flight Director)
6) Flight controls - CHECK (verify autopilot servos are disengaged from pitch, roll, and yaw controls, and all controls move freely)
7) Elevator trim control - SET FOR TAKEOFF

2.9.7 AFCS CONTROLS

2.9.7.1 GMC 305/307 AFCS CONTROLS

The GMC 305/307 AFCS Control Units have the following controls:

1	**HDG Key**	Selects/deselects Heading Select Mode. (Used for TRK Mode in installations without a magnetometer)
2	**NAV Key**	Selects/deselects Navigation Mode. Cancels GP Mode if GPS Mode is either active or armed.
3	**AP Key**	Engages/disengages the autopilot
4	**LVL (Level) Key**	Engages the autopilot (if the autopilot is disengaged) in level vertical and lateral modes
5	**NOSE UP/DN Wheel**	Adjusts the vertical mode reference in Pitch Hold, Vertical Speed, Indicated Airspeed, and Altitude Hold modes
6	**IAS Key**	Selects/deselects Indicated Airspeed Mode
7	**ALT Key**	Selects/deselects Altitude Hold Mode
8	**VNV Key**	Selects/deselects Vertical Path Tracking Mode for Vertical Navigation flight control
9	**VS Key**	Selects/deselects Vertical Speed Mode
10	**YD Key** (if installed)	Engages/disengages the yaw damper
11	**FD Key**	Activates/deactivates the flight director only Pressing once turns on the director in the default vertical and lateral modes. Pressing again deactivates the flight director and removes the Command Bars. If the autopilot is engaged, the key is disabled.
12	**APR Key**	Selects/deselects Approach Mode (GP mode only)
13	**HDG Knob**	Selects the desired Heading*
14	**ALT SEL Knob**	Selects the desired Altitude setting*

*GMC 307 only

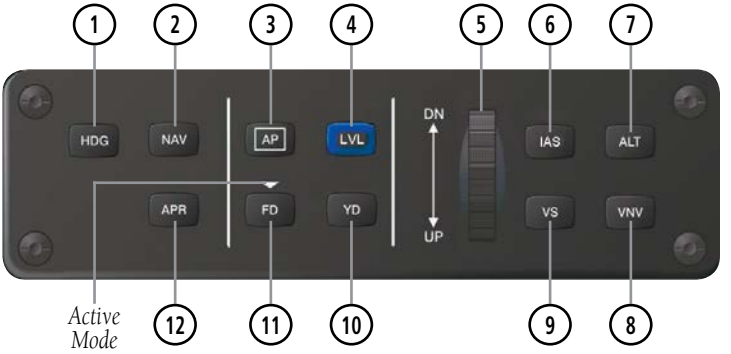


Figure 2-32 GMC 305 AFCS Control Unit

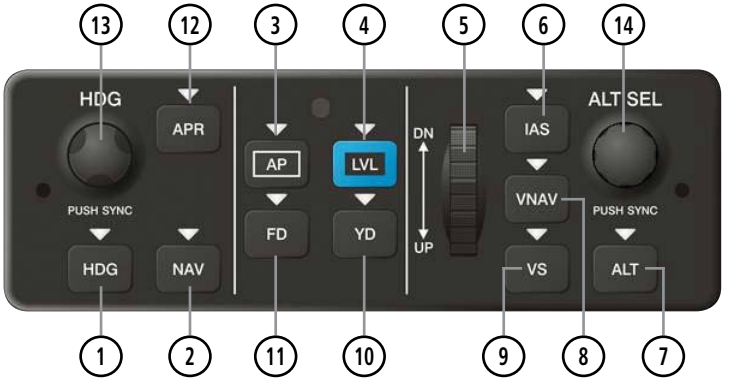


Figure 2-33 GMC 307 AFCS Control Unit

The following AFCS controls are located separately from the G5 and GMC 305/307 AFCS Control Unit:

CWS/AP DISC Button (Autopilot Disconnect)	An AP DISC/CWS Button is located on the pilot's control stick. This button combines the functions of Autopilot Disconnect and Control Wheel Steering. (Note: the Control Wheel Steering function can be disabled in configuration mode, which causes the button to perform the Autopilot Disconnect function only) Press and release the AP DISC/CWS Button to disengage the autopilot. Pressing and holding the AP DISC/CWS Button when the autopilot is engaged will temporarily disengage the pitch and roll servos and interrupt autotrim operation. The pilot can then hand-fly the aircraft to a new attitude and release the AP DISC/CWS button to re-engage the autopilot servos and synchronize the flight director to the aircraft's new attitude. The ability to use Control Wheel Steering may be disabled in configuration mode if desired. If the configuration supports it, pressing and holding the AP DISC/CWS button while the autopilot is not engaged will cause the autopilot to engage. If the flight director was previously off, the default FD modes (PIT and ROL) will be selected. The ability to engage the autopilot using the CWS button may be disabled in configuration mode if desired.
TO/GA Button (Takeoff/Go Around)	Selects flight director Takeoff or Go Around Mode (only applies to a G5 installed as part of a G3X/G3X Touch system).
MET Switch (Manual Electric Trim)	Used to command manual electric trim for any properly configured servo (pitch, roll, or yaw).

2.9.7.2 ENGAGING THE AUTOPILOT

Selection of the control listed below (when the Autopilot is not engaged) will engage the Autopilot with the listed lateral and vertical modes (some modes may require an external navigator):

Table 2-2 Engaging the Autopilot

Control	Modes Selected			
	Lateral		Vertical	
	Mode/Annunciation		Mode/Annunciation	
CWS Button (if equipped) (press and hold)	Roll Hold	ROL	Pitch Hold	PIT
HDG	Heading	HDG	Pitch Hold	PIT
NAV	Navigation	GPS	Pitch Hold	PIT
ALT	Roll Hold	ROL	Altitude Hold	ALT
VS	Roll Hold	ROL	Vertical Speed	VS
VNAV	Roll Hold	ROL	Vertical Navigation	VNAV
APPR	Approach	GPS	Glidepath	GP

Navigation and Approach Modes must have an active GPS course to activate the autopilot.

2.9.7.2.1 ENGAGING THE AUTOPILOT (GMC 305/307)

An initial press of the **AP** Key on the GMC 305/307 will activate the Flight Director and engage the autopilot in the default PIT and ROL modes.

2.9.7.3 DISENGAGING THE AUTOPILOT

The Autopilot is manually disengaged by pressing the autopilot disconnect button on the control stick or yoke or by pressing the **AP** Key on the GMC 305/307. Manual disengagement is indicated by a five-second flashing yellow 'AP' annunciation. Cancel the aural alert by pressing and releasing the **AP/CWS** Button again.

Automatic disengagement is indicated by a flashing red 'AP' annunciation. Automatic disengagement occurs due to:

- System failure
- Invalid sensor data
- Inability to compute default autopilot modes
- Detection of a GDU display on the CAN network (when installed as part of a G3X/G3X Touch system).

2.9.7.3.1 DISENGAGING THE AUTOPILOT WHEN A MALFUNCTION IS SUSPECTED

If an autopilot failure or trim failure is suspected to have occurred, perform the following steps:

1) Firmly grasp the control wheel.

2) Press and hold the AP DISC Switch. The autopilot will disconnect and power is removed from the trim motor. Power is also removed from all primary servo motors and engaged solenoids. Note the visual alerting indicating autopilot disconnect.

3) Retrim the aircraft as needed. Substantial trim adjustment may be needed.

4) Pull the appropriate circuit breaker(s) to electrically isolate the servo and solenoid components.

5) Release the AP DISC Switch.

2.9.7.3.2 Overpowering Autopilot Servos

In the context of this discussion, "overpowering" refers to any pressure or force applied to the pitch controls when the autopilot is engaged. A small amount of pressure or force on the pitch controls can cause the autopilot automatic trim to run to an out-of-trim condition. Therefore, any application of pressure or force to the controls should be avoided when the autopilot is engaged.

Overpowering the autopilot during flight will cause the autopilot's automatic trim to run, resulting in an out-of-trim condition or cause the trim to hit the stop if the action is prolonged. In this case, larger than anticipated control forces may be required after the autopilot is disengaged.

The following steps should be added to the preflight check:

1) Check for proper autopilot operation and ensure the autopilot can be overpowered.

2) Note the forces required to overpower the autopilot servo clutches.

2.9.8 FLIGHT DIRECTOR OPERATION

NOTE: *Refer to the Installation Manual section for AFCS setup information.*

The flight director function provides pitch and roll commands to the pilot and autopilot, which are displayed on the PFD Page. With the flight director active, the aircraft can be hand-flown to follow the path shown by the Command Bars. The Flight Director has the following maximum commands: pitch (-15°, +20°) and roll (30°) angles.

2.9.8.1 ACTIVATING THE FLIGHT DIRECTOR

An initial press of a key listed in the table below (when the flight director is not active) activates the flight director in the listed modes. The flight director may be turned off and the Command Bars removed from the display by pressing the **FD** Key again. The **FD** Key is disabled when the autopilot is engaged.

Table 2-3 Flight Director Activation (GMC 305/307)

Control Pressed	Modes Selected			
	Lateral		Vertical	
FD Key	Roll Hold (default)	ROL	Pitch Hold (default)	PIT
AP Key	Roll Hold (default)	ROL	Pitch Hold (default)	PIT
TO/GA Button	Takeoff (on-ground) Go Around (in-air)	TO GA	Takeoff (on-ground) Go Around (in-air)	TO GA
ALT Key	Roll Hold (default)	ROL	Altitude Hold	ALT
VS Key	Roll Hold (default)	ROL	Vertical Speed	VS
VNV Key	Roll Hold (default)	ROL	Vertical Navigation*	VNV
IAS Key	Roll Hold (default)	ROL	Indicated Airspeed	IAS
APR Key	Approach**	GPS	Pitch Hold (default)	PIT
NAV Key	Navigation**	GPS	Pitch Hold (default)	PIT
HDG Key	Heading Select	HDG***	Pitch Hold (default)	PIT
LVL Key	Level Hold	LVL	Level Hold	LVL

**Must be receiving VNAV data from a portable GPS via RS-232 before* VNV *Key press activates flight director.*

The selected navigation receiver must have an active GPS course before* ***NAV *or* ***APR*** *Key press activates flight director.*

**** HDG mode is only available when magnetic heading data is being received from an ADAHRS unit, when the G5 is installed as a backup unit in a G3X/G3X Touch system.*

2.9.8.2 FLIGHT DIRECTOR MODES

Flight director modes are normally selected independently for the pitch and roll axes. Unless otherwise specified, all mode keys are alternate action (i.e., press on, press off). In the absence of specific mode selection, the flight director reverts to the default pitch and/or roll modes.

Armed modes are annunciated in white and active in green in the AFCS Status Box. Under normal operation, when the control for the active flight director mode is pressed, the flight director reverts to the default mode(s) for the axis(es). Automatic transition from armed to active mode is indicated by the white armed mode annunciation moving to the green active mode field and flashing for 10 seconds.

If the information required to compute a flight director mode becomes invalid or unavailable, the flight director automatically reverts to the default mode for that axis. A flashing yellow mode annunciation and annunciator light indicate loss of sensor or navigation data required to compute commands. When such a loss occurs, the system automatically begins to roll the wings level (enters Roll Hold Mode) or maintain the pitch angle (enters Pitch Hold Mode), depending on the affected axis. The flashing annunciation stops when the affected mode key is pressed or another mode for the axis is selected. If after 10 seconds no action is taken, the flashing annunciation stops.

The flight director is automatically disabled if the attitude information required to compute the default flight director modes becomes invalid or unavailable.

2.9.8.3 COMMAND BARS

Upon activation of the flight director, Command Bars are displayed in magenta on the PFD Page. If the aircraft is being flown by hand, the command bars are displayed hollow. The Command Bars do not override the Aircraft Symbol. The Command Bars move together vertically to indicate pitch commands and bank left or right to indicate roll commands.

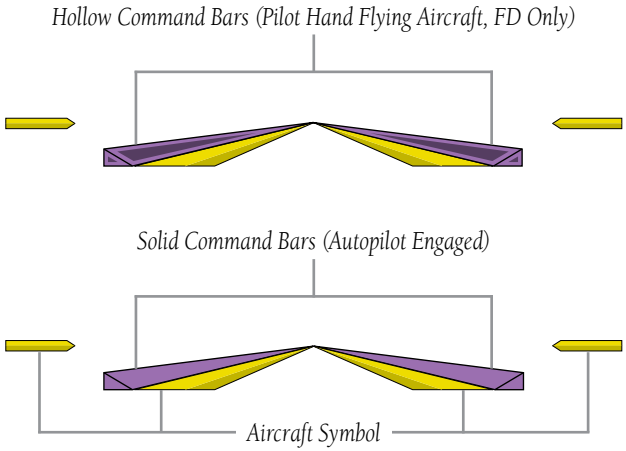


Figure 2-34 Command Bars (Single Cue Flight Director)

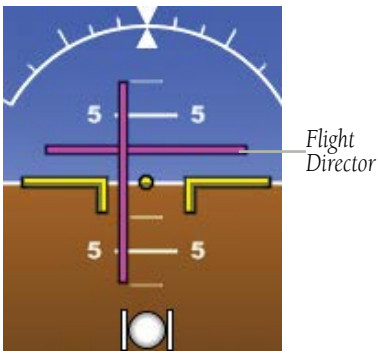


Figure 2-35 Flight Director (Dual Cue)

If the attitude information being sent to the flight director becomes invalid or unavailable, the Command Bars are removed from the display.

2.9.8.4 FLIGHT DIRECTOR ALTITUDE CONTROLS

CAUTION: *The following settings change the Flight Director operation. Before changing these settings become familiar with how these changes affect the use of the Flight Director.*

NOTE: *Refer to the Installation Manual section for information on changing the Flight Director Altitude Controls.*

The Flight Director Altitude Controls allow the user to select **Normal** or **Simplified**.

When Altitude Controls are set to **Normal**, the following additional selections appear:

- **ALT Mode User Select Action**: Determines the behavior of the Flight Director when the user selects Altitude Hold Mode by pressing the ALT key on the GMC. The following two options are available:
  - **Normal**: The Flight Director enters Altitude Hold (ALT) Mode.
  - **Sync Selected Altitude**: The Flight Director enters Altitude Hold (ALT) Mode and the Selected Altitude (Altitude Bug) changes to the current aircraft altitude.
- **ALT Mode User Up/Down Action**: Determines the behavior of the Flight Director when the Flight Director is in Altitude Hold (ALT) Mode and the user moves the pitch wheel on the GMC. The following two options are available:
  - **Normal**: Adjusts the Target Altitude in 10-foot increments, up to ±200 feet from the original Target Altitude.
  - **Select VS Mode**: The Flight Director changes from Altitude Hold (ALT) Mode to Vertical Speed (VS) Mode and initiates a climb or descent. Subsequent vertical speed adjustments are in increments of 100 fpm. The Default Vertical Speed that is used for the initial climb or descent is set using a pair of fields that appear when **Select VS Mode** is selected.

When Altitude Controls are set to **Simplified**, Altitude Hold (ALT) Mode behavior differs in the following ways:

***NOTE:** With Altitude Controls set to **Simplified**, the user will not be able to pre-select a new altitude while ALT mode is already active.*

- Selecting Altitude Hold (ALT) Mode causes the Selected Altitude (Altitude Bug) to change to the current aircraft altitude.
- There is no longer a difference between the Selected Altitude (Altitude Bug) and the Target Altitude for Altitude Hold (ALT) Mode.
- After Altitude Hold (ALT) Mode captures the Selected Altitude, subsequent changes to the Selected Altitude will cause ALT Mode to climb or descend towards the new Selected Altitude.
    - Subsequent vertical speed adjustments are in increments of 100 fpm, with the exception that the user cannot adjust the target vertical speed to a value that would cause the aircraft to fly away from the Selected Altitude.
    - Unlike **Select VS Mode** described previously, this option does not switch to VS mode. Instead, it displays a vertical speed bug.
    - The initial vertical speed used for climb or descent towards the new altitude is determined by the Default Vertical Speed fields as described previously.
- When Altitude Hold (ALT) Mode has captured the Selected Altitude, the vertical speed bug is removed and vertical speed adjustments have no effect.

2.9.9 VERTICAL MODES

The table lists the vertical modes with their corresponding controls and annunciations. The mode reference is displayed next to the active mode annunciation for Altitude Hold, Vertical Speed, and Indicated Airspeed modes. The **NOSE UP/DN** Wheel can be used to change the vertical mode reference while operating under Pitch Hold, Vertical Speed, Indicated Airspeed, or Altitude Hold modes. Increments of change of values for each of these references using the **NOSE UP/DN** Wheel, are also listed in the table.

Table 2-4 Flight Director Vertical Modes

Vertical Mode	Description	Control	Annunciation	Reference Change Increment
Pitch Hold	Holds the current aircraft pitch attitude; may be used to climb/descend to the Selected Altitude	(default)	PIT	0.5°
Selected Altitude Capture	Captures the Selected Altitude	*	ALTS	10 ft
Altitude Hold	Holds the current Altitude	**ALT** Key	ALT	
Vertical Speed	Maintains the current aircraft vertical speed; may be used to climb/descend to the Selected Altitude	**VS** Key	VS	100 fpm
Indicated Airspeed (IAS)	Maintains the current aircraft airspeed in IAS while the aircraft is climbing/descending to the Selected Altitude	**IAS** Key	IAS	1 kt
Vertical Navigation	Captures and tracks descent legs of an active vertical profile	**VNV** Key (GMC 305/307)	VNV***	
Glidepath	Captures and tracks the SBAS glidepath on approach	**APR** Key (GMC 305/307)	GP	
Takeoff	Commands a constant pitch angle and wings level on-ground in preparation for takeoff	**GA** Button	TO**	
Go Around	Commands a constant pitch angle and wings level in the air		GA**	

* *ALTS armed automatically when PIT, VS, IAS, or GA active, and under VNAV when Selected Altitude is to be captured instead of VNV Target Altitude*

** *TO and GA modes are only displayed when the G5 is configured as a backup unit in a G3X/G3X Touch system.*

*** *VNV mode (only available as part of a standalone G5 installation when receiving NMEA RS-232 data from a portable GPS).*

2.9.9.1 PITCH HOLD MODE (PIT)

When the flight director is activated (**FD** key pressed) or when the Autopilot is activated, Pitch Hold Mode is selected by default. Pitch Hold Mode is indicated as the active vertical mode by the green 'PIT' annunciation. This mode may be used for climb or descent to the Selected Altitude (shown above the Altimeter), since Selected Altitude Capture Mode is automatically armed when Pitch Hold Mode is activated.

In Pitch Hold Mode, the flight director maintains a constant pitch attitude. The pitch reference is set to the aircraft pitch attitude at the moment of mode selection. If the aircraft pitch attitude exceeds the flight director pitch command limitations, the flight director commands a pitch angle equal to the nose-up/down limit.

Changing the pitch reference:

When operating in Pitch Hold Mode, the pitch reference can be adjusted by using the **NOSE UP/DN** Wheel.

Or

Hold the Control Wheel Steering (CWS) Button (if equipped, and the autopilot unit supports CWS), establish the desired pitch attitude, then release the CWS Button.

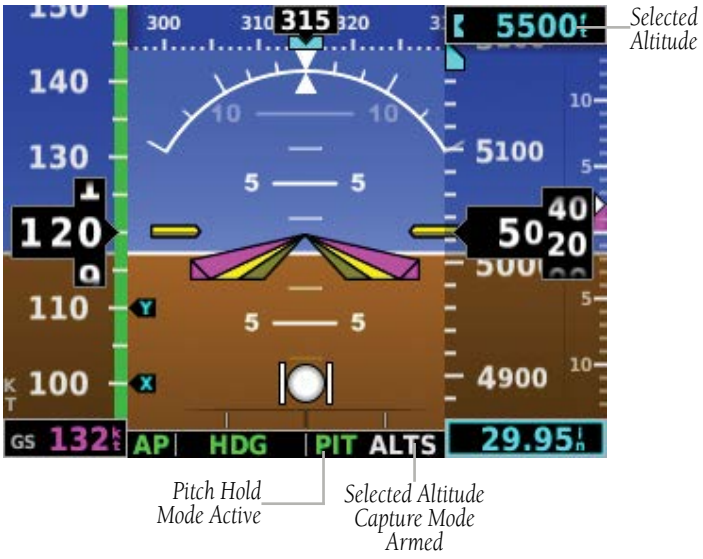


Figure 2-36 Pitch Hold & Selected Altitude Capture Modes

2.9.9.2 SELECTED ALTITUDE CAPTURE MODE (ALTS)

Selected Altitude Capture Mode is automatically armed with activation of the following modes:

- Pitch Hold
- Vertical Speed
- Indicated Airspeed
- TO/Go Around
- Vertical Path Tracking

The white 'ALTS' annunciation indicates Selected Altitude Capture Mode is armed.

As the aircraft nears the Selected Altitude, the flight director automatically transitions to Selected Altitude Capture Mode with Altitude Hold Mode armed. This automatic transition is indicated by the green 'ALTS' annunciation flashing for up to 10 seconds and the appearance of the white 'ALTS' annunciation.

At 50 feet from the Selected Altitude, the flight director automatically transitions from Selected Altitude Capture to Altitude Hold Mode and holds the reference altitude. As Altitude Hold Mode becomes active, the white 'ALTS' annunciation moves to the active vertical mode field and flashes green for 10 seconds to indicate the automatic transition.

Setting the selected altitude:

Use the **ALT SEL Knob** on the GMC 307 to adjust the selected altitude.

Or

1) Press the Knob to display the Menu.
2) Select **Altitude** and use the Knob to change the Selected Altitude.

Syncing to the current altitude:

Press the Knob on the GMC 307.

Or

1) Press the Knob to display the Menu.
2) Select **Altitude** and press and hold the Knob to sync the Selected Altitude to the current altitude

Changing the Selected Altitude while Selected Altitude Capture Mode is active causes the autopilot to revert to Pitch Hold Mode with Selected Altitude Capture Mode armed for the new Selected Altitude.

2.9.9.3 ALTITUDE HOLD MODE (ALT)

Altitude Hold Mode can be activated by pressing the **ALT** Key; the AFCS maintains the current aircraft altitude (to the nearest 10 feet) as the Altitude Reference. Altitude Hold Mode active is indicated by a green 'ALT' annunciation in the G5 Autopilot Status Box.

Altitude Hold Mode is automatically armed when in Selected Altitude Capture Mode. Selected Altitude Capture Mode automatically transitions to Altitude Hold Mode when within 50 feet of the Selected Altitude. In this case, the Selected Altitude becomes the Altitude Reference.

2.9.9.3.1 Changing the Altitude Reference

When operating in Altitude Hold Mode, the Altitude Reference can be adjusted in the following ways:

- The Altitude Reference can be adjusted up or down in 10-foot increments by rolling the **NOSE UP/DN** Wheel. Using this method, up to 200 feet of altitude change can be commanded. To change the Altitude Reference by more the 200 feet, use the CWS button (if equipped) as described below, or climb/descend using another vertical mode (PIT, VS) to capture the desired Selected Altitude.
- If the aircraft is equipped with a CWS Button, pressing the CWS Button allows the aircraft to be hand-flown to a new Altitude Reference. When the CWS Button is released at the desired altitude, the new altitude is established as the Altitude Reference.

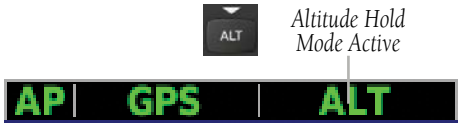


Figure 2-37 Altitude Hold Mode

2.9.9.4 VERTICAL SPEED MODE (VS)

In Vertical Speed Mode, the flight director acquires and maintains a Vertical Speed Reference. Current aircraft vertical speed (to the nearest 100 fpm) becomes the Vertical Speed Reference at the moment of Vertical Speed Mode activation. This mode may be used for climb or descent to the Selected Altitude (shown above the Altimeter) since Selected Altitude Capture Mode is automatically armed when Vertical Speed Mode is selected.

When Vertical Speed Mode is activated by pressing the **VS** Key, 'VS' is annunciated in green in the Autopilot Status Box. The Vertical Speed Reference is also displayed below the Vertical Speed Indicator. A Vertical Speed Reference Bug corresponding to the Vertical Speed Reference is shown on the indicator.

Figure 2-38 Vertical Speed Reference on PFD Page

2.9.9.4.1 Changing the Vertical Speed Reference

The Vertical Speed Reference may be adjusted in the following ways:

- Use the **NOSE UP/DN** Wheel to adjust the Vertical Speed Reference in increments of 100 fpm.
- Press the CWS Button (if equipped) and hand-fly the aircraft to a new Vertical Speed Reference. When the CWS Button is released, the aircraft's vertical speed (to the nearest 100 fpm) is established as the new Vertical Speed Reference.

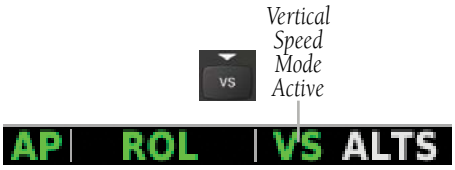


Figure 2-39 Vertical Speed Mode

2.9.9.5 INDICATED AIRSPEED MODE (IAS)

Indicated Airspeed Mode is selected by pressing the **IAS** Key on the GMC. This mode acquires and maintains the Airspeed Reference (IAS) while climbing or descending. When Indicated Airspeed Mode is active, the flight director continuously monitors Selected Altitude, airspeed and altitude.

The Airspeed Reference is set to the current airspeed upon mode activation. Indicated Airspeed Mode is indicated by a green 'IAS' annunciation in the Autopilot Status Box. The Airspeed Reference is also displayed as a light blue bug corresponding to the Airspeed Reference along the airspeed tape.

Engine power must be adjusted to allow the autopilot to fly the aircraft at a pitch attitude corresponding to the desired flight profile (climb or descent) while maintaining the Airspeed Reference.

2.9.9.5.1 Changing the Airspeed Reference

The Airspeed Reference (shown in both the Autopilot Status Box and above the Airspeed Indicator) may be adjusted by using the **NOSE UP/DN** Wheel.

Figure 2-40 Indicated Airspeed Reference on PFD Page

2.9.9.6 VERTICAL NAVIGATION MODE (VNV)

NOTE: *If another vertical mode is touched while VNV Mode is selected, VNV Mode reverts to armed.*

NOTE: *Pressing the CWS Button (if equipped) while VNV Mode is active does not cancel the mode. The autopilot guides the aircraft back to the descent path upon release of the CWS Button.*

Vertical Navigation (VNV) Mode is available for enroute/terminal cruise and descent operations any time that VNAV input data is being received.

Figure 2-41 Vertical Navigation Mode

Activating vertical navigation mode:

1) When a flight plan is active, VNAV data is valid, and the **VNV** Key is selected, VNV mode is armed in preparation for descent path capture. 'VNV' is annunciated in white in the G5 Autopilot Status Box.

2) When a descent leg is captured (i.e., vertical deviation becomes valid), VNV Mode is activated and tracks the descent profile.

3) Level off when approaching the Selected Altitude.

If the altimeter's barometric setting is adjusted while VNV mode is active, the autopilot increases/decreases the descent rate by up to 500 fpm to re-establish the aircraft on the descent path (without commanding a climb). For large changes, it may take several minutes for the aircraft to reestablish on the descent path.

2.9.9.6.1 Automatic Reversion to Pitch Hold Mode

Several situations can occur while VNV Mode is active which cause the AFCS to revert to Pitch Hold Mode:

- The aircraft does not level off at the selected altitude.
- Vertical deviation exceeds 200 feet during an overspeed condition.
- Vertical deviation becomes invalid (the Deviation Indicator is removed from the PFD Page).

Following a reversion to Pitch Hold Mode, VNV Mode becomes armed to allow for possible profile recapture.

2.9.9.7 GLIDEPATH MODE (GP) (WITH EXTERNAL WAAS ENABLED IFR NAVIGATOR ONLY)

Glidepath Mode is used to track a WAAS or other satellite-based augmentation system SBAS generated glidepath. When Glidepath Mode is armed, 'GP' is annunciated in white in the Autopilot Status Box.

Selecting glidepath mode:

1) EXTERNAL NAVIGATOR: Ensure a GPS approach with vertical guidance (LPV, LNAV/VNAV, LNAV +V) is loaded into the active flight plan. The active waypoint must be part of the flight plan (cannot be a direct-to a waypoint not in the flight plan).
2) Ensure that GPS is the selected navigation source.
3) Press the **APR** Key.

NOTE: *Some RNAV (GPS) approaches provide a vertical descent angle as an aid in flying a stabilized approach. These approaches are NOT considered Approaches with Vertical Guidance (APV). Approaches that are annunciated on the HSI as LNAV or LNAV+V are considered Non-precision Approaches (NPA) and are flown to an MDA even though vertical glidepath (GP) information may be provided.*

WARNING: *When flying an LNAV approach (with vertical descent angle) with the autopilot coupled, the aircraft will not level off at the MDA even if the MDA is set in the altitude preselect.*

Upon reaching the glidepath, the flight director transitions to Glidepath Mode and begins to capture and track the glidepath.

Once the following conditions have been met, the glidepath can be captured:

- The active waypoint is at or after the final approach fix (FAF).
- Vertical deviation is valid.
- The CDI is at less than full-scale deviation.
- Automatic sequencing of waypoints has not been suspended.

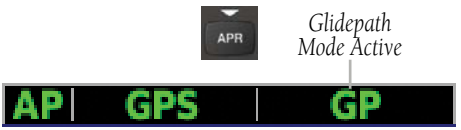


Figure 2-42 Glidepath Mode

2.9.9.8 GO AROUND (GA) AND TAKEOFF (TO) MODES

NOTE: *TO and GA modes are only available when the G5 is configured as a backup unit in a G3X/G3X Touch system.*

Go Around and Takeoff modes are coupled pitch and roll modes and are annunciated as both the vertical and lateral modes when active. In these modes, the flight director commands a constant set pitch attitude and keeps the wings level. The GA Switch is used to activate both modes. The mode entered by the flight director depends on whether the aircraft is on the ground or in the air.

Takeoff Mode provides an attitude reference during rotation and takeoff. This mode can be selected only while on the ground by pushing the **TO/GA** Button. The flight director Command Bars assume a wings-level, pitch-up attitude.

Pressing the **TO/GA** Button while in the air activates the flight director in a wings-level, pitch-up attitude, allowing the execution of a missed approach or a go around. Go Around Mode arms Selected Altitude Capture Mode automatically, and attempts to modify the aircraft attitude (i.e., with the **NOSE UP/DN** Wheel) will result in reversion to Pitch and Roll Hold modes.

2.9.10 LATERAL MODES

The following table lists the lateral modes and respective control(s) and annunciation. Refer to the vertical modes section for information regarding Takeoff and Go Around Modes.

Table 2-5 Flight Director Lateral Modes

Lateral Mode	Description	Control	Annunciation
Roll Hold	Holds the current aircraft roll attitude or rolls the wings level, depending on the commanded bank angle	(default)	ROL
Heading (Installations with a magnetometer)	Captures and tracks the Selected Heading	**HDG** Key	HDG
Track (Installations without a magnetometer)	Captures and tracks the Selected Ground Track	**HDG** Key	TRK
Navigation, GPS	Captures and tracks the selected navigation source (GPS)	**NAV** Key	GPS
Approach, GPS	Captures and tracks the selected navigation source (GPS)	**APR** Key	GPS
Takeoff	Commands a constant pitch angle and wings level on-ground in preparation for takeoff	**TO/GA** Button	TO*
Go Around	Commands a constant pitch angle and wings level in the air		GA*

** TO, and GA modes are only available when the G5 is configured as a backup unit in a G3X/G3X Touch system.*

The CWS Button (if equipped) does not change lateral references for HDG or NAV modes. The autopilot guides the aircraft back to the Selected Heading/Course upon release of the CWS Button.

2.9.10.1 ROLL HOLD MODE (ROL)

NOTE: *If Roll Hold Mode is activated as a result of a mode reversion, the flight director rolls the wings level.*

When the flight director is activated or switched, Roll Hold Mode is selected by default. This mode is annunciated as 'ROL' in the Autopilot Status Box. The current aircraft bank angle is held, subject to the bank angle condition.

Figure 2-43 Roll Hold Mode Annunciation

Table 2-6 Roll Hold Mode Responses

Bank Angle	Flight Director Response
< 6°	Rolls wings level
6 to 20°	Maintains current aircraft roll attitude
> 20°	Limits bank to 20°

2.9.10.1.1 Changing the Roll Reference

When operating in Roll Hold Mode, the roll reference can be adjusted in the following ways:

- Hold the CWS Button (if equipped), establish the desired bank angle, then release the CWS Button.

2.9.10.2 HEADING SELECT MODE (HDG)

NOTE: *HDG mode is available in a standalone installation with a magnetometer and when the G5 is configured as a backup in a G3X/G3X Touch system and the G5 is receiving magnetic heading data from an ADAHRS unit.*

Heading Select Mode is activated by pressing the **HDG** Key. Heading Select Mode acquires and maintains the Selected Heading. The Selected Heading is shown by a light blue bug on the HSI and in the box on the bottom right of the HSI.

Changing the selected heading:

1) Press the Knob to display the Menu.

2) Select **Heading** and use the Knob to change the Selected Heading.

Or

Rotate the **HDG Knob** (GMC 307 only).

Activating heading mode:

Press the **HDG** Key on the GMC.

Holding the CWS Button (if equipped) and hand-flying the aircraft does not change the Selected Heading. The autopilot guides the aircraft back to the Selected Heading upon release of the CWS Button.

Turns are commanded in the same direction as Selected Heading Bug movement, even if the bug is turned more than 180° from the present heading (e.g., a 270° turn to the right). However, Selected Heading changes of more than 330° at a time result in turn reversals.

Figure 2-44 Heading Mode Annunciation

2.9.10.3 TRACK MODE (TRK)

NOTE: TRK Mode is only available if a magnetometer is not configured.

Track Mode is activated by pressing the **HDG** Key. Track Mode acquires and maintains the Selected Ground Track. The Selected Ground Track is displayed as a magenta bug on the HSI and in the box on the bottom right of the HSI.

Changing the selected ground track:

1) Press the Knob to display the Menu.

2) Select **Track** and use the Knob to change the Selected Ground Track.

Or

Rotate the **HDG Knob** on the GMC.

Activating track mode:

Press the **HDG** Key on the GMC.

Holding the CWS Button (if equipped) and hand-flying the aircraft does not change the Selected Ground Track. The autopilot guides the aircraft back to the Selected Ground Track upon release of the CWS Button.

Turns are commanded in the same direction as Selected Ground Track Bug movement, even if the bug is turned more than 180° from the present heading (e.g., a 270° turn to the right). However, Selected Ground Track changes of more than 330° at a time result in turn reversals.

Figure 2-45 Track Mode Annunciation

2.9.10.4 NAVIGATION MODE (GPS)

NOTE: *The navigation receiver must have an active GPS course for the flight director to enter Navigation Mode.*

NOTE: *When intercepting a flight plan leg, the flight director gives commands to capture the active leg at approximately a 45° angle to the track between the waypoints defining the active leg. The flight director does not give commands fly to the starting waypoint of the active leg.*

Pressing the **NAV** Key selects Navigation Mode. Navigation Mode acquires and tracks the navigation source. The flight director follows GPS roll steering commands when GPS is the navigation source. Navigation Mode can also be used to fly non-precision GPS approaches where vertical guidance is not required.

If the Course Deviation Indicator (CDI) shows greater than one dot when the **NAV** Key is pressed, the selected mode is armed. If the CDI is less than one dot, Navigation Mode is automatically captured when the **NAV** Key is pressed. The armed annunciation appears in white to the left of the active roll mode.

Figure 2-46 Navigation Mode Annunciation

If Navigation Mode is active and either of the following occur, the AFCS reverts to Roll Hold Mode (wings rolled level):

- Active navigation source manually switched
- Active flight plan is deleted
- GPS reception is lost

2.9.10.5 GPS APPROACHES WITHOUT VERTICAL GUIDANCE

***NOTE:** The selected navigation receiver must have an active GPS course for the flight director to enter Approach Mode.*

Press the **NAV** Key to arm/activate GPS (LNAV only) lateral mode. The lateral mode acquires and tracks the selected navigation source, depending on the loaded approach. Press **NAV** when the CDI is greater than one dot to arm the selected mode (annunciated in white). Press **NAV** when the CDI deviation is less than one dot to activate, capture and track the selected navigation source.

Table 2-7 Approach without Vertical Guidance

Example	Control	Lateral Mode	Annunciation	Description
LNAV	**NAV** Key	Approach, GPS	GPS	Captures and tracks the selected navigation source (GPS)

2.9.10.6 GPS APPROACH WITHOUT VERTICAL GUIDANCE

A GPS approach without vertical guidance (LNAV) is flown using GPS NAV Mode.

Selecting a GPS Approach without vertical guidance:

1) EXTERNAL NAVIGATOR: Ensure a GPS approach without vertical guidance (LNAV) is loaded into the active flight plan.

2) EXTERNAL NAVIGATOR: Ensure the 'GPS' indication is showing in the lower-left corner. If not, press the CDI Key.

3) EXTERNAL NAVIGATOR: Select and activate the GPS approach using the PROC Key.

4) Press the **NAV** Key.

5) Adjust the aircraft's pitch axis as required.

2.9.10.7 GPS APPROACHES WITH LATERAL + VERTICAL GUIDANCE

Press the **APR** Key to arm/activate both lateral and vertical modes for approach. When Glidepath (GP) Mode is armed for a GPS approach with vertical guidance, GPS Mode is automatically armed. Press the **APR** Key when the CDI is greater than one dot to arm the selected modes (annunciated in white). Press the **APR** Key when the CDI deviation is less than one dot to activate, capture and track the selected navigation source.

Table 2-8 Lateral + Vertical Approaches

Example	Control	Modes	Annunciation	Description
LPV, LNAV/ VNAV, LNAV+V	**APR** Key	Lateral: GPS	GPS	Captures and tracks the lateral portion of a GPS approach
		Vertical: Glidepath	GP	Captures and tracks a WAAS approach glidepath

***NOTE:** To cancel Glidepath (GP) Mode without cancelling GPS Mode, **NAV** once. Pressing it a second time cancels GPS Mode.*

When Glidepath (GP) Mode is armed for a GPS approach with vertical guidance, GPS Mode is automatically armed.

Selecting a GPS approach with vertical guidance:

1) EXTERNAL NAVIGATOR: Ensure a GPS approach with vertical guidance (LPV, LNAV/VNAV, LNAV+V) is loaded into the active flight plan.
2) EXTERNAL NAVIGATOR: Ensure the 'GPS' indication is showing in the lower-left corner. If not, press the CDI Key.
3) EXTERNAL NAVIGATOR: Select and activate the GPS approach using the PROC Key.
4) Press the **APR** Key.

2.9.10.8 LEVEL MODE

Level Mode is coupled in pitch and roll modes and is annunciated as both the vertical and lateral modes when active. Pressing the **LVL** Key engages the autopilot in Level vertical and lateral modes. Level Mode does not track altitude or heading. When the **LVL** Key is pressed all armed and active modes are cancelled and the autopilot and flight director revert to LVL mode for pitch and roll. While in level mode, all other modes are available by pressing the corresponding button.

2.10 SYSTEM MESSAGES

Table 2-9 System Messages

Message	Comments
Critical battery fault! Powering off...	Battery has a critical fault condition and the unit is about to power off to avoid damage to the battery.
Battery fault	Battery has a fault condition - examine fault display in configuration mode and contact Garmin if it persists.
Battery charger fault	Battery charger has a fault condition - examine fault display in configuration mode and contact Garmin if it persists.
Low battery	Battery charge level is low
Hardware fault	Unit has a hardware fault - contact Garmin for service
Power supply fault	Unit power supply fault detected - contact Garmin for service if it persists
Unit temperature limit exceeded	Unit is too hot or too cold
Network address conflict	Another G5 with the same address is detected on the network (most commonly a wiring error on one of the units)
Communication error	General communication error (most commonly appears in conjunction with Network Address Conflict message)
Factory calibration data invalid	Unit calibration data not valid - return to Garmin
Magnetic field model database out of date	Internal magnetic field database is out of date - software update required
Using external GPS data	GPS data from another network LRU is being used. The unit's internal GPS receiver is enabled, but unable to establish a GPS fix
Servo clutch fault	An autopilot servo is reporting a clutch monitor fault

2.11 AFCS ALERTS (OPTIONAL)

AFCS Alerts

2.11.1 STATUS ALERTS

If the commanded operation cannot be achieved due to the limitations configured, the following messages can be displayed over the pitch ladder. The annunciation is removed once the condition is resolved.

Alert Condition	Annunciation	Description
Up-elevator Trim Required	**TRIM UP**	The autopilot does not have the required elevator authority to reach the desired flight condition.
Down-elevator Trim Required	**TRIM DOWN**	

Status Alerts

2.11.2 SPEED ALERTS

If the remote autopilot unit supports speed alerts and the airspeed limitations configured have been reached, the following messages can be displayed over the pitch ladder. The annunciation is removed once the condition is resolved.

Alert Condition	Annunciation	Description
High speed Protection	**MAX SPEED**	Autopilot unit will raise the nose to limit the aircraft's speed.
Low speed Protection	**MIN SPEED**	Autopilot unit will lower the nose to prevent the aircraft's speed from decreasing.

Speed Alerts

APPENDIX A RS-232 TEXT OUTPUT FORMAT

A.1 ELECTRICAL INTERFACE

The output signals are compatible with RS-232C. Data is generated at the configured baud rate with a word length of 8 bits, one stop bit, and no parity.

A.1.1 GENERAL MESSAGE OUTPUT FORMAT

The general text output message format is as follows:

- Escape character ('=' symbol [0x3D hex])
- ID character
- Version character
- Data characters (length determined by message ID)
- Checksum (2-character [1-byte] ASCII hex value that is the sum of all previous bytes including the escape character)
- Carriage return (0x0D hex)
- Line feed (0x0A hex)

An exception to the above is the GPS Data message, which is backwards compatible with the Garmin Simple Text Output format described at: http://www8.garmin.com/support/text_out.html. The GPS Data message has the following format:

- Escape character ('@' symbol [0x40 hex])
- Data characters
- Carriage return (0x0D hex)
- Line feed (0x0A hex)

All text output messages use only printable ASCII characters. For all messages, a value that is out of range, missing, not configured, uncalibrated, or otherwise invalid is indicated by replacing the corresponding bytes within the message with the underscore character ('_' symbol [0x5F hex]).

A.1.2 ATTITUDE/AIR DATA MESSAGE FORMAT

The Attitude/Air Data message is transmitted approximately 10 times per second.

Table A-1 Attitude/Air Data Message Format

Field Name	Offset	Width	Units	Notes	Min	Max
Escape Character	0	1		'='		
Sentence ID	1	1		'1'		
Sentence Version	2	1		'1'		
UTC hour	3	2	hours		00	23
UTC minute	5	2	minutes		00	59
UTC second	7	2	seconds		00	59
UTC second fraction	9	2	10 ms		00	99
Pitch	11	4	0.1 degrees	positive = up	-900	+900
Roll	15	5	0.1 degrees	positive = right	-1800	+1800
Heading	20	3	degrees	magnetic (G3X backup install only)	000	359
Airspeed	23	4	0.1 knots		0000	9999
Pressure altitude	27	6	feet		-01000	+60000
Rate of turn	33	4	0.1 deg/sec	positive = right	-999	+999
Lateral acceleration	37	3	0.01 G	positive = leftward	-99	+99
Vertical acceleration	40	3	0.1 G	positive = upward	-99	+99
Unused	43	2				
Vertical speed	45	4	10 fpm	positive = up	-999	+999
Unused	49	3				
Altimeter setting	52	3	0.01 inHg	offset from 27.50°	000	400
Checksum	55	2	ASCII hex	sum of prev bytes		
CR/LF	57	2		0x0D/0x0A		
Total Length	59					

A.1.3 GPS DATA MESSAGE FORMAT

The GPS Data message is transmitted once per second.

Table A-2 GPS Data Message Format

Field Name	Offset	Width	Units	Notes	Min	Max
Escape character	0	1		'@'		
UTC year	1	2	years	last two digits of UTC year	00	99
UTC month	3	2	months		01	12
UTC day	5	2	days		01	31
UTC hour	7	2	hours		00	23
UTC minute	9	2	minutes		00	59
UTC second	11	2	seconds		00	59
Latitude hemisphere	13	1		'N' = north		
				'S' = south		
Latitude degrees	14	2	degrees		0	90
Latitude minutes	16	5	0.001 minutes	minutes x 1000	0	59999
Longitude hemisphere	21	1		'E' = east		
				'W' = west		
Longitude degrees	22	3	degrees		0	180
Longitude minutes	25	5	0.001 minutes	minutes x 1000	0	59999

Table A-2 GPS Data Message Format

Field Name	Offset	Width	Units	Notes	Min	Max
Position status	30	1		'g' = 2D GPS position 'G' = 3D GPS position 'd' = 2D diff GPS position 'D' = 3D diff GPS position 'S' = simulated position '_' = invalid position		
Horizontal position error	31	3	meters		000	999
Altitude	34	6	meters	Height above/below MSL	-99999	+99999
East/west velocity direction	40	1		'E' = east 'W' = west		
East/west velocity magnitude	41	4	0.1 m/ sec		0000	9999
North/south velocity direction	45	1		'N' = north 'S' = south		
North/south velocity magnitude	46	4	0.1 m/ sec		0000	9999
Vertical velocity direction	50	1		'U' = up 'D' = down		
Vertical velocity magnitude	51	4	0.01 m/ sec		0000	9999
CR/LF	55	2		0x0D/0x0A		
Total length	57					

T

V

W

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