SECTION 9 AUTOMATIC FLIGHT CONTROL SYSTEMS (OPTIONAL)

NOTE: *This section describes capabilities and functions of the optional Garmin GFC 500 autopilot system unless otherwise noted.*

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: *VOR, LOC, and GS modes are all GPS-aided. You must have a GPS position to use VOR, LOC, or GS modes.*

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 rolls commands are displayed on the PFD 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 flight director, 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. On G3X Touch™ installations that do not have a separate and independent Flight Director, the Flight Director is always coupled to the autopilot. The autopilot and optional yaw damper operate the flight control surface servos to provide automatic flight control.

AFCS AND YAW DAMPER OPERATION

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.

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. Torque values are set at installation. This allows the servos to be overridden in case of an emergency. Non-Garmin autopilot systems may not allow servos to be overridden, consult the non-Garmin autopilot documents for limitations.

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.

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.

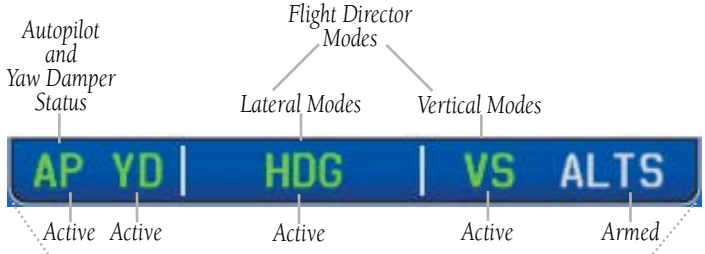
Yaw Axis

The optional 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.

G3X TOUCH AFCS STATUS BOX

The AFCS status box displays Autopilot (AP), Optional Yaw Damper (YD), Flight Director (FD) mode annunciations on the PFD, and Autopilot Preflight Test (PFT).

Autopilot (AP) status is displayed on the far left of the G3X Touch 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.



Autopilot Status Box

Autopilot Display

Autopilot Preflight Test

9.1 AFCS OPERATION

When a GMC AFCS Mode Control Unit is installed AFCS functionality is distributed across the following Line Replaceable Units (LRUs):

- GDU™ 4X0 Display Units
- GSU 25D ADAHRS Unit
- GMC AFCS Mode Control Unit
- GSA 28 AFCS Pitch/Roll/Yaw Damper/Pitch Trim servos

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

• **Flight Director (FD)** — Flight director operation takes place within the GDU™ 460. Flight director commands are displayed on the PFD. 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, roll, and yaw 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 provides trim capability for the pitch axis when the autopilot is not engaged.

The G3X Touch can also communicate with various non-Garmin autopilot units. With an appropriate non-Garmin autopilot installed and the G3X Touch Analog Autopilot Interface is configured (refer to the G3X Touch Installation Manual), the G3X Touch issues course and heading information to the autopilot unit. The autopilot unit is then responsible for moving the flight controls. The G3X Touch system will not display flight director, modes, or annunciations for a non-Garmin autopilot system.

NOTE: *Refer to the G3X Touch Installation Manual and the non-Garmin autopilot vendor documentation for information on installing and configuring the G3X Touch Analog Autopilot Interface.*

NOTE: *Refer to the non-Garmin autopilot vendor documentation for stand-alone autopilot functionality and control features.*

NOTE: *When the autopilot is engaged with auto trim enabled, moving the MET Switch will disengage the autopilot.*

AFCS PRE-FLIGHT ACTIONS

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

Before takeoff checklist - Garmin GFC 500:

1) Autopilot - ENGAGE (using AP 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 and audio alert is heard)

4) Verify yaw damper - OFF (if installed) (verify yaw damper disengages and audio alert is heard)

5) Flight director - SET FOR TAKEOFF (select TO 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)

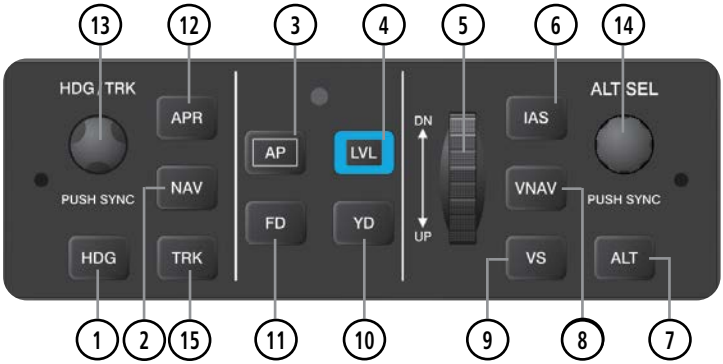
7) Elevator trim control - SET FOR TAKEOFF

AFCS CONTROLS

GMC 507 AFCS CONTROLS

The GMC 507 AFCS Control Units have the following controls:

(1) **HDG Key**	Selects/deselects Heading Select Mode
(2) **NAV Key**	Selects/deselects Navigation Mode. Cancels GS Mode if LOC Mode is either active or armed. Cancels GP Mode if GPS Mode is either active or armed. Cancels LOC Mode if GPS Mode is active and LOC Mode is armed.
(3) **AP Key**	Engages/disengages the autopilot
(4) **LVL 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
(13) **HDG/TRK Knob**	Selects the desired Heading/Track
(14) **ALT SEL Knob**	Selects the desired Altitude setting
(15) **TRK Key**	Selects/deselects Track (TRK) Mode



GMC 507 AFCS Control Unit

G3X TOUCH AUTOPILOT INTERFACE

Accessing the G3X Touch AFCS interface:

Touch the AFCS Status Box on the PFD.

Or:

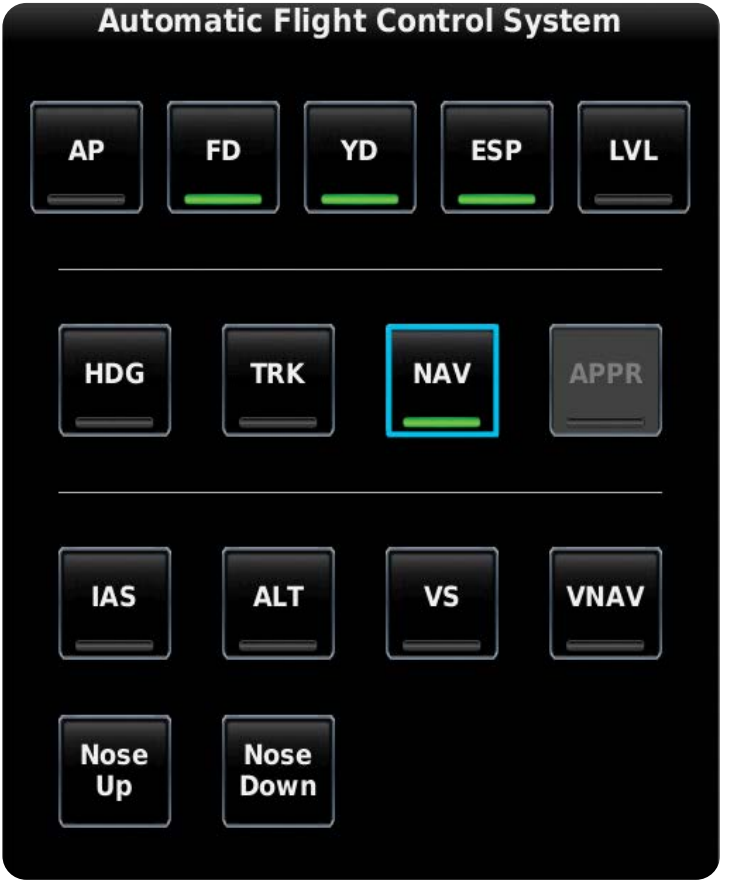
1) Press the **MENU** Key twice.

2) Touch the **Flight Controls** button.

See figure on following page to view on screen controls.

HDG	Selects/deselects heading mode
NAV	Selects/deselects navigation mode. Cancels GS Mode if LOC Mode is either active or armed. Cancels GP Mode if GPS Mode is either active or armed. Cancels LOC Mode if GPS Mode is active and LOC Mode is armed.
TRK	Selects/deselects track mode
AP	Engages/disengages the autopilot.
LVL	Engages the autopilot (if the autopilot is disengaged) in level vertical and lateral modes
Nose Up / Nose Down	Adjusts the vertical mode reference in Pitch Hold, Vertical Speed, Indicated Airspeed, and Altitude Hold modes
IAS	Selects/deselects Indicated Airspeed Mode
ALT	Selects/deselects Altitude Hold Mode

VNAV	Selects/deselects vertical navigation
or APPR	Selects/deselects approach mode
VS	Selects/deselects Vertical Speed Mode
FD	Activates/deactivates the flight director only



G3X Touch AFCS Controls

The following AFCS controls are located separately from the GDU and GMC 507 AFCS Control Unit:

AP DISC Button (Autopilot Disconnect)	Press and release the AP DISC Button to disengage the autopilot. Pressing and releasing the button again will acknowledge an autopilot disconnect alert and mute the associated aural tone. Pressing and holding the AP DISC Button will also interrupt Manual Electric Trim.
TO/GA Button (Takeoff/Go Around)	Selects flight director Takeoff (on ground) or Go Around (in air) Mode When properly configured with a GTN™, if an approach procedure is loaded, this switch also activates the missed approach when the selected navigation source is GPS or when the navigation source is VOR/LOC and a valid frequency has been tuned.
MET Switch (Manual Electric Trim)	Used to command manual electric trim for the pitch servo.

ENGAGING THE AUTOPILOT

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

DISENGAGING THE AUTOPILOT

NOTE: *When the autopilot is engaged with auto trim enabled, moving the MET Switch will disengage the AP.*

The Autopilot is manually disengaged by pushing the autopilot disconnect button on the pilot's flight controls or by pressing the **AP** Key on the GMC control unit. Manual disengagement is indicated by a five-second flashing yellow 'AP' annunciation and an aural alert. Cancel the aural alert by pressing and releasing the **AP** Button again or by touching the 'AP' annunciation in the Autopilot Status Box at the top of the PFD.

Automatic disengagement is indicated by a flashing red 'AP' annunciation and an aural alert. Touch to acknowledge or touch **Back** to acknowledge. Automatic disengagement occurs due to:

- System failure
- Invalid sensor data
- Inability to compute default autopilot modes

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 and aural alerting indicating autopilot disconnect.

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

4) Pull the appropriate Autopilot and Trim Switch (if installed) circuit breaker(s) to electrically isolate the servo and solenoid components.

5) Release the AP DISC Switch.

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 are 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.

FLIGHT DIRECTOR OPERATION

The flight director function provides pitch and roll commands to the pilot and autopilot, which are displayed on the PFD. 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.

Flight Director Indicator Type

The Flight Director Indicator Type controls whether the flight director command indicator on the PFD uses a single-cue or dual-cue presentation.

Setting the Flight Director Indicator Type:

1) From the PFD1, press the **MENU** Key twice to display the Main Menu.

2) Touch **Setup** > **Flight Director**.

3) In the Indicator Type field, touch **Single Cue** or **Dual Cue**.

ACTIVATING THE FLIGHT DIRECTOR USING THE GMC 507

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.

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

Control Pressed	Modes Selected			
	Lateral		Vertical	
VNV Key	Roll Hold (default)	ROL	Vertical Navigation*	VNAV
IAS Key	Roll Hold (default)	ROL	Indicated Airspeed	IAS
APR Key	Approach**	GPS VOR LOC	Pitch Hold (default)	PIT
NAV Key	Navigation**	GPS VOR LOC BC	Pitch Hold (default)	PIT
HDG Key	Heading Select	HDG	Pitch Hold (default)	PIT
TRK Key	Track Select	TRK	Pitch Hold (default)	PIT
LVL Key	Level Hold	LVL	Level Hold	LVL

**Valid VNV flight plan must be entered before* VNV *Key press activates flight director.*

***The selected navigation receiver must have a valid VOR or LOC signal or active GPS course before NAV or APR Key press activates flight director.*

Flight Director Activation (GMC 507)

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 (ADC) or navigation data (VOR, LOC, GPS, VNAV) 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.

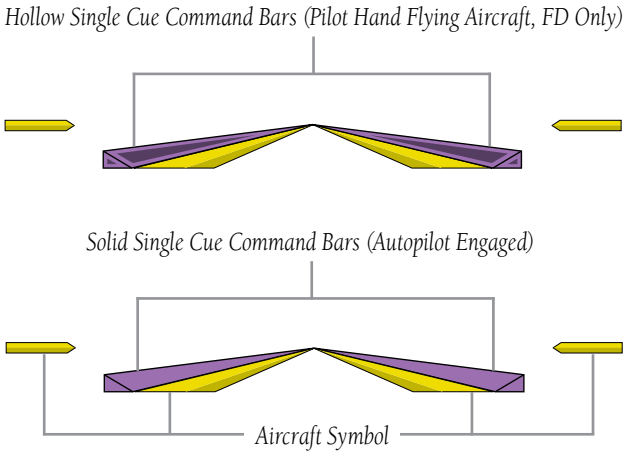
The flight director is automatically disabled if the attitude information required to compute the default flight director modes becomes invalid or unavailable.

Autopilot Manually Disengaged

COMMAND BARS

Single Cue

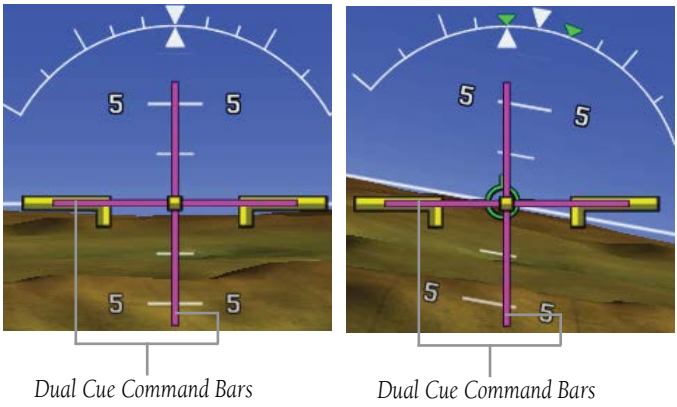
Upon activation of the flight director, Command Bars are displayed in magenta on the PFD. If the aircraft is being flown by hand, the command bars are displayed hollow. The Command Bars do not override the Aircraft Symbol. The Command Bars move together vertically to indicate pitch commands and bank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



Command Bars (Single Cue)

Dual Cue

The Dual Cue Command Bars are useful to visually separate pitch from roll when flying the aircraft by hand.



Command Bars (Dual Cue)

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

9.2 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 (GMC control unit) or the on-screen **VS MODE** 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.

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 (GMC 507) or **ALT** G3X Touch	ALT	nnnnn FT	
Vertical Speed	Maintains the current aircraft vertical speed; may be used to climb/descend to the Selected Altitude	**VS** Key (GMC 507) or **VS** G3X Touch	VS	nnnn FPM	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	nnn KT	1 kt

Vertical Mode	Description	Control	Annunciation	Reference Change Increment
Vertical Navigation	Captures and tracks descent legs of an active vertical profile	**VNAV** G3X Touch/ GMC 507	VNAV	
VNV Target Altitude Capture	Captures the Vertical Navigation (VNV) Target Altitude	**	ALTV	
Glidepath	Captures and tracks the SBAS glidepath on approach	**APR** Key (GMC 507) or **APPR** G3X Touch	GP	
Glideslope	Captures and tracks the ILS glideslope on approach		GS	
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	

* *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*

** *ALTV armed automatically under VNAV when VNV Target Altitude is to be captured instead of Selected Altitude*

Flight Director Vertical Modes

PITCH HOLD MODE (PIT)

When the flight director is activated (**FD** touched) 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 (GMC control unit) or by touching **Nose Up** or **Nose Down** on the G3X Touch.

Pitch Hold & Selected Altitude Capture Modes

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/GA (GMC control unit)
- Vertical Path Tracking (if the Selected Altitude is to be captured instead of the VNV Target Altitude)

The white 'ALTS' annunciation indicates Selected Altitude Capture Mode is armed. Touch the autopilot on the PFD and touch **ALT**. Use the large knob associated with the PFD and adjust the Selected Altitude until the Selected Altitude Capture Mode becomes active.

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. The Selected Altitude is shown as the Altitude Reference beside the 'ALTS' annunciation.

Automatic transition to ALTS Mode with ALT Mode armed

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.

Automatic transition to ALTS Mode with ALT Mode armed

Setting the selected altitude (Integrated Autopilot Interface):

Touch the Autopilot Status Box, and use the **Altitude** knob on the **PFD** to select the desired Selected Altitude.

Or:

Touch the Selected Altitude on the PFD, and use the keypad to enter the desired Selected Altitude.

Setting the selected altitude (GMC 507):

Press the **AP** key, and use the **ALT SEL Knob**.

Or:

Touch the Selected Altitude on the PFD, and use the keypad to enter the desired Selected 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.

ALTITUDE HOLD MODE (ALT)

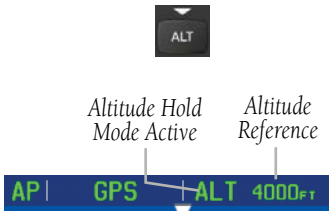
Altitude Hold Mode can be activated by touching **ALT** or **ALT** Key (GMC control unit); the AFCS maintains the current aircraft altitude (to the nearest 10 feet) as the Altitude Reference. The Altitude Reference, shown in the G3X Touch Autopilot Status Box, is independent of the Selected Altitude, displayed above the Altimeter. Altitude Hold Mode active is indicated by a green 'ALT' annunciation in the G3X Touch 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.

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 **Higher Alt** or **Lower Alt** or rolling the **NOSE UP/DN** Wheel (GMC control unit). Using this method, up to 200 feet of altitude change can be commanded. To change the Altitude Reference by more the 200 feet, climb/descend using another vertical mode (PIT, VS) to capture the desired Selected Altitude.



Altitude Hold Mode

VERTICAL SPEED MODE (VS)

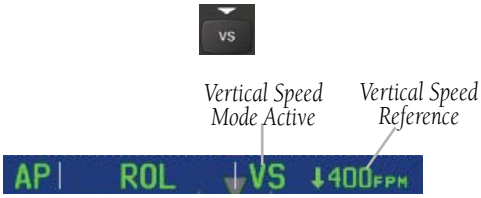
In Vertical Speed Mode, the flight director acquires and maintains a Vertical Speed Reference. Current aircraft vertical speed (to the nearest 100 fpm) becomes the Vertical Speed Reference at the moment of Vertical Speed Mode activation. This mode may be used for climb or descent to the Selected Altitude (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 (GMC control unit) or touching **VS**, 'VS' is annunciated in green in the Autopilot Status Box along with the Vertical Speed Reference. The Vertical Speed Reference is also displayed above the Vertical Speed Indicator. A Vertical Speed Reference Bug corresponding to the Vertical Speed Reference is shown on the indicator.

CHANGING THE VERTICAL SPEED REFERENCE

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

- Use the **NOSE UP/DN** Wheel (GMC control unit) or touch the autopilot, touch **VS**, and touch **Nose Up** or **Nose Down** to adjust the Vertical Speed Reference in increments of 100 fpm. The current Vertical Speed Reference is displayed in the G3X Touch Autopilot Status Box for 10 seconds after a change is made and as a reference bug on the Vertical Speed Indicator.



Vertical Speed Mode

INDICATED AIRSPEED MODE (IAS)

Indicated Airspeed Mode is selected by touching **IAS** on the **PFD** and selecting either **Faster** or **Slower**, or by pressing the **IAS** button on the GMC control unit and adjusting the **Nose UP/DN** Wheel. 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.

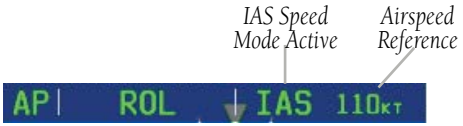
The Airspeed Reference is set to the current airspeed upon mode activation. Indicated Airspeed Mode is indicated by a green 'IAS' annunciation beside the Airspeed Reference in the Autopilot Status Box. The Airspeed Reference is also displayed as a cyan bug corresponding to the Airspeed Reference along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

NOTE: *If IAS Mode is selected while aircraft is stopped on ground, airspeed is set to* V_y.

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 or by touching **Nose Up** or **Nose Down** in the AFCS Window.



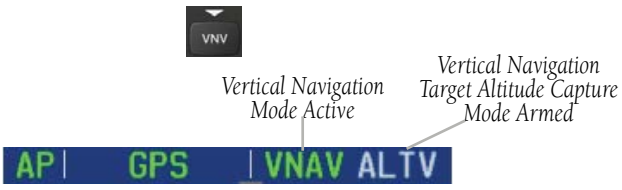
Indicated Airspeed Mode

VERTICAL NAVIGATION MODE (VNAV)

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

NOTE: *VNAV mode will not capture a descending profile unless the selected altitude is valid and at least 75 feet below the current aircraft altitude.*

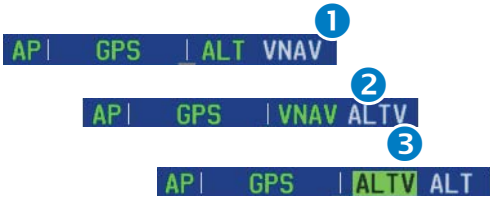
Vertical Navigation (VNAV) Mode is available for enroute/terminal cruise and descent operations any time that VNAV flight planning is available. Refer to Section 2.3 (Vertical Navigation) for more information.



Vertical Navigation Mode

Activating Vertical Navigation Mode:

1. When a flight plan is active, VNAV data is valid, and the **VNAV** Key is selected on the GMC 507 or G3X Touch, VNAV mode is armed in preparation for descent path capture. 'VNAV' is annunciated in white in the G3X Touch Autopilot Status Box. If applicable, the appropriate altitude capture mode is armed for capture of the VNAV Target Altitude (ALTV) or the Selected Altitude (ALTS), whichever is greater.
2. When a descent leg is captured (i.e., vertical deviation becomes valid), VNAV Mode is activated and tracks the descent profile. An altitude capture mode (ALTS or ALTV) is armed as appropriate.
3. When approaching the VNAV Target Altitude (or Selected Altitude) the system automatically transitions to ALTS or ALTV Mode with ALT Mode armed.



If the altimeter's barometric setting is adjusted while VNAV 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. If the change is made while nearing the VNAV waypoint, the aircraft may not reestablish on the descent path in time to level off at the VNAV Target Altitude. In this case, the autopilot will revert to Pitch Hold mode upon passing the VNAV waypoint, and Selected Altitude Capture (ALTV) mode will be automatically armed.

AUTOMATIC REVERSION TO PITCH HOLD MODE

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

- Vertical deviation exceeds 200 feet during an overspeed condition.
- Vertical deviation becomes invalid (the Deviation Indicator is removed from the PFD).

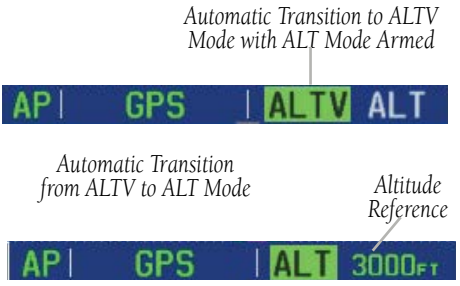
Following a reversion to Pitch Hold Mode, VNAV Mode and the appropriate altitude capture mode become armed to allow for possible profile recapture.

VNAV TARGET ALTITUDE CAPTURE MODE (ALTV)

VNAV Target Altitude Capture is analogous to Selected Altitude Capture Mode and is armed automatically after the **VNV** Key (GMC 305) or **VNAV** (GMC 307/507) is selected if the VNAV Target Altitude is to be intercepted before the Selected Altitude. The annunciation 'ALTV' indicates the VNAV Target Altitude is to be captured. Refer to Section 2.3 (Vertical Navigation) for more information on setting up the VNAV target altitude.

As the aircraft nears the VNAV Target Altitude, AFCS automatically transitions to VNAV Target Altitude Capture Mode with Altitude Hold Mode armed. This automatic transition is indicated by the green 'ALTV' annunciation flashing for up to 10 seconds and the appearance of the white 'ALT' annunciation.

At 50 feet from the VNAV Target Altitude, the AFCS automatically transitions from VNAV Target Altitude Capture to Altitude Hold Mode and selects the VNAV target altitude as the new Autopilot Altitude Reference. As Altitude Hold Mode becomes active, the white 'ALT' annunciation moves to the active vertical mode field and flashes green for 10 seconds to indicate the automatic transition.



Automatic Mode Transitions During Altitude Capture

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, LP+V, 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 (GMC control unit) or touch the autopilot, then touch **APPR** (only available when an external GPS navigation source (i.e., GTN or GNS Series) is configured).

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 Nonprecision Approaches (NPA) and are flown to an MDA even though vertical glidepath (GP) information may be provided.*

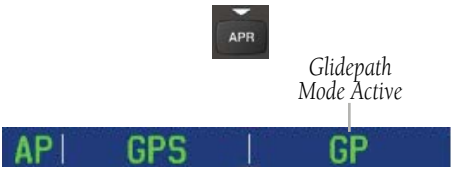
WARNING: *When flying an LNAV approach (with vertical descent angle) with the autopilot coupled, the aircraft will not level off at the MDA even if the MDA is set in the altitude preselect.*

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 (no 'SUSP' annunciation on the HSI).



Glidepath Mode

GLIDESLOPE MODE (GS)

NOTE: *Glideslope Mode requires a valid GPS position.*

Glideslope Mode is available for LOC/ILS approaches to capture and track the glideslope. When Glideslope Mode is armed (annunciated as 'GS' in white), LOC Approach Mode is armed as the lateral flight director mode.

Selecting Glideslope Mode:

1) EXTERNAL NAVIGATOR: Tune and activate the desired localizer frequency.

2) EXTERNAL NAVIGATOR: Ensure that LOC is the selected navigation source.

3) Press the **APR** Key (GMC control unit) or touch the autopilot and touch **APPR**. This simultaneously selects LOC and GS (Glideslope) Modes.

Or:

1) EXTERNAL NAVIGATOR: Tune and activate the desired localizer frequency.

2) EXTERNAL NAVIGATOR: Load the approach (LOC, ILS, LDA, SDF, etc.) into the flight plan.

3) Press the **APR** Key (GMC control unit) or touch the autopilot and touch **APPR**. This simultaneously selects LOC and GS (Glideslope) Modes.

Once LOC is the navigation source, the localizer and glideslope can be captured. Upon reaching the glideslope, the flight director transitions to Glideslope Mode and begins to capture and track the glideslope.

Glideslope Mode Armed

GO AROUND (GA) AND TAKEOFF (TO) MODES

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.

9.3 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.

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 Select	Captures and tracks the Selected Heading	**HDG** Key (GMC 507) or **HDG**	HDG
Track	Captures and tracks the Selected Ground Track	**TRK** Key (GMC 507) or **TRK**	TRK

Lateral Mode	Description	Control	Annunciation
Navigation, GPS	Captures and tracks the selected navigation source (GPS, VOR, LOC)	**NAV** Key (GMC 507) or **NAV**	GPS
Navigation, VOR Enroute Capture/Track			VOR
Navigation, LOC Capture/ Track (No Glideslope)			LOC
Navigation, Backcourse Capture/Track	Captures and tracks a localizer signal for backcourse approaches		BC
Approach, GPS	Captures and tracks the selected navigation source (GPS and LOC)	**APR** Key (GMC 507) or **APPR**	GPS
Approach, LOC Capture/Track (Glideslope Mode automatically armed)			LOC
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

The AFCS limits the turn rate to a standard rate turn (3 degs/sec) except in cases when the AFCS is following an external navigator providing GPS (bank angle) steering. In this case the turn rate is limited by the flight director maximum bank angle configuration setting.

Flight Director Lateral Modes

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.

Roll Hold Mode Annunciation

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

Roll Hold Mode Responses

Changing the Roll Reference

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

- To decrease the roll reference, turn the inner knob associated with the PFD right. The AFCS slowly decreases the bank angle. The current bank angle is held (if the bank angle exceeds 6°). If the bank angle is less than 6°, the AFCS will roll the aircraft wings level.

HEADING SELECT MODE (HDG)

Heading Select Mode is activated by touching the autopilot, then touching **HDG** or the **HDG** Key (GMC control unit). Heading Select Mode acquires and maintains the Selected Heading. The Selected Heading is shown by a cyan bug on the HSI and in the box to the upper left of the HSI.

Changing the Selected Heading

Changing the selected heading (Integrated Autopilot Interface):

1) Touch the Selected Heading on the PFD.

2) Enter the selected heading using the keypad and touch **Enter**.

Changing the selected heading (GMC 507):

1) Turn the **HDG Knob** to select the desired heading.

2) Press the **HDG** Key on the GMC control unit to activate HDG Mode.

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.

Heading Mode Annunciation

TRACK SELECT MODE (TRK)

The Track Select Mode is activated by touching the autopilot, then touching **TRK** on the **PFD** or pressing the **TRK** Key . Track Mode acquires and maintains the Selected Ground Track.

Changing the selected track:

1) Use the **HDG/TRK Knob** to select the desired ground track.

Or:

Touch the Selected Track on the PFD, Enter the selected track using the keypad and touch **Enter**.

2) Select **TRK** to activate TRK Mode.

Track Mode Annunciation

NAVIGATION MODES (GPS, VOR, LOC, BC)

NOTE: *When making a VOR or LOC approach, a valid GPS position is required.*

NOTE: *The selected navigation receiver must have a valid VOR or LOC signal or 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.*

NOTE: *When making a backcourse approach, set the Selected Course to the localizer front course.*

Pressing the **NAV** Key or touching **NAV** on the G3X Touch selects Navigation Mode. Navigation Mode acquires and tracks the selected navigation source (GPS, VOR, LOC). The flight director follows GPS roll steering commands when GPS is the selected navigation source. When the navigation source is VOR or LOC, the flight director creates roll steering commands from the Selected Course and deviation. Navigation Mode can also be used to fly non-precision GPS and LOC approaches where vertical guidance is not required.

Backcourse Navigation Mode captures and tracks a localizer signal in the backcourse direction. The annunciation 'BC' in the Autopilot Status Box indicates Backcourse Navigation Mode.

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

Navigation Mode Annunciation

When the CDI has automatically switched from GPS to LOC during a LOC/ILS approach, GPS Navigation Mode remains active, providing GPS steering guidance until the localizer signal is captured. LOC Navigation Mode is armed when the automatic navigation source switch takes place. If the **APR** Key is pressed or **NAV** is touched prior to the automatic navigation source switch, LOC Navigation Mode is armed.

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

- Different VOR tuned while in VOR Navigation Mode (VOR Navigation Mode reverts to armed)
- Navigation source manually switched
- During a LOC/ILS approach, the FAF is crossed while in GPS Navigation Mode after the automatic navigation source switch from GPS to LOC

LOC Mode is activated when the automatic navigation source switch takes place. If the **APR** Key is pressed or **APPR** is touched prior to the automatic navigation source switch, LOC Mode is armed.

In the right circumstances, LOC and GS Modes can be armed while GPS Mode is still active and the external navigator (GTN X50, GTN X50 Xi, or GNS X30 WAAS only) is set to GPS (not VLOC).

Arming LOC & GS Modes while GPS Mode is still active:

1) EXTERNAL NAVIGATOR: Tune and activate the desired localizer frequency.

2) EXTERNAL NAVIGATOR: Load the approach (LOC, ILS, LDA, SDF, etc.) into the flight plan.

3) G3X Touch: While GPS is still the selected navigation source on the external navigator, press the **APR** Key (GMC control unit) or touch **APPR** to arm LOC and GS (Glideslope) Modes even with GPS Mode still active. The external navigator will switch from GPS to VLOC automatically and the G3X Touch will capture the localizer and then the glideslope.

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

- Different VOR tuned while in VOR Navigation Mode (VOR Navigation Mode reverts to armed)
- Active navigation source manually switched
- Active flight plan is deleted (only GPS-based modes)
- GPS reception is lost

If VOR Navigation Mode is active and the VOR signal is lost, the autopilot reverts to Roll Hold Mode (wings rolled level) and reverts VOR Mode to armed in the event the VOR signal is reestablished.

OBS MODE

Enabling/disabling OBS Mode (without external GPS navigator):

1) While navigating a flight plan or Direct-to, touch **CRS** on the PFD.
2) Touch **Yes** on the 'Set OBS and hold?' window.
3) Enter the desired course to/from the waypoint using the keypad and touch **Enter**.
4) To cancel OBS Mode and return to automatic waypoint sequencing, touch **OBS** on the PFD.
5) Touch **Release OBS Hold**.

Or:

1) From the Active Flight Plan Page press the **MENU** Key while navigating a flight plan or Direct-to.
2) Touch **Set OBS and Hold**.
3) Touch **Sync Course** or enter the desired course to/from the waypoint using the keypad and touch **Enter**.
4) To cancel OBS Mode and return to automatic waypoint sequencing, press the **MENU** Key.
5) Touch **Release Hold**.

Enabling/disabling OBS Mode (with external GPS navigator configured):

1) Press the **OBS** Key on the external navigator. The 'Set OBS and Hold' Active Flight Plan Page menu option is now available.
2) From the Active Flight Plan Page press the **MENU** Key while navigating a flight plan or Direct-to.
3) Touch **Set OBS and Hold**.
4) Touch **Sync Course** or enter the desired course to/from the waypoint using the keypad and touch **Enter**.
5) To cancel OBS Mode and return to automatic waypoint sequencing, press the **MENU** Key.
6) Touch **Release Hold**.

VOR MODE FOR NAVIGATION

VOR Mode can be used for navigation when an external navigation receiver is configured.

Tracking Direct-to a VOR:

1) EXTERNAL NAVIGATOR: Tune and activate the desired VOR frequency. If a GTN or GNS series unit is not configured skip to Step 3.
2) EXTERNAL NAVIGATOR (GTN or GNS series units only): Ensure the 'VLOC' indication is showing in the lower-left corner. If not, press the CDI Key.
3) G3X Touch: Ensure that VOR1 or VOR2 is the selected navigation source. It should say 'VOR1' or 'VOR2' on the HSI and the needle should be green.
4) G3X Touch: From the PFD, touch the course on the PFD and touch **Sync Course**.
5) G3X Touch: Touch the autopilot on the PFD, then touch **NAV** to activate VOR Mode.

   Or:

   Press the **NAV** Key on the GMC control unit.

A green 'VOR' indication is displayed in the autopilot status bar and the flight director tracks the selected course to the VOR.

Intercepting and tracking a VOR radial:

1) EXTERNAL NAVIGATOR: Tune and activate the desired VOR frequency. If a GTN or GNS series unit is not configured skip to Step 3.
2) EXTERNAL NAVIGATOR (GTN or GNS series units only): Ensure the 'VLOC' indication is showing in the lower-left corner of the. If not, press the CDI Key.
3) G3X Touch: Ensure that VOR1 or VOR2 is the selected navigation source. It should say 'VOR1' or 'VOR2' on the HSI and the needle should be green.
4) G3X Touch: From the PFD, touch the course on the PFD and touch **Sync Course**.
5) G3X Touch: From the PFD, touch the autopilot and touch **NAV**.

   Or:

   Press the **NAV** Key on the GMC control unit.

If there is less than half-scale deviation when **NAV** is touched or the **NAV** Key is pressed, VOR Mode will activate (green text), intercept, and track the selected radial. If there is more than half-scale deviation when **NAV** is touched, VOR Mode will arm (white text) first, then activate when closer to the radial.

APPROACHES WITHOUT VERTICAL GUIDANCE

NOTE: *The selected navigation receiver must have a valid VOR or LOC signal or active GPS course for the flight director to enter Approach Mode.*

NOTE: *For the autopilot to enter a VLOC mode, the G3X Touch must have GPS reception, a valid navigation database, and the external navigation receiver must have a valid signal (VOR or LOC).*

Touch **NAV** or press the **NAV** Key (GMC control unit) to arm/activate VOR, LOC/BC, and GPS (LNAV only) lateral modes. Lateral modes acquire and track the selected navigation source (GPS, VOR, or LOC), depending on the loaded approach. These modes use the selected navigation receiver deviation and desired course inputs to fly the approach. Touch **NAV** when the CDI is greater than one dot to arm the selected modes (annunciated in white). Touch **NAV** when the CDI deviation is less than one dot to activate, capture and track the selected navigation source (GPS, VOR, or LOC).

Example	Control	Lateral Mode	Annunciation	Description
LNAV	**NAV** Key (GMC 507) **or** **NAV**	Approach, GPS	GPS	Captures and tracks the selected navigation source (GPS, VOR, LOC)
VOR		VOR Approach Capture/Track	VOR	
LOC		LOC Capture/Track (No Glideslope)	LOC	
BC		Backcourse Capture/Track	BC	Captures and tracks a localizer signal for backcourse approaches

Approaches without Vertical Guidance

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) G3X Touch: Ensure that GPS1 is the selected navigation source on the PFD.

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

5) G3X Touch: From the PFD touch the autopilot and touch **NAV** to activate GPS Mode.

Or:

Press the **NAV** Key on the GMC control unit.

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

VOR APPROACH

A VOR approach is flown using VOR Mode.

Selecting a VOR Approach:

1) EXTERNAL NAVIGATOR: Tune and activate the desired VOR frequency. If a GTN or GNS series unit is not configured skip to Step 3.

2) EXTERNAL NAVIGATOR (GTN or GNS series units only): Ensure the 'VLOC' indication is showing in the lower-left corner of the. If not, press the CDI Key.

3) G3X Touch: Ensure that VOR1 or VOR2 is the selected navigation source. It should say 'VOR1' or 'VOR2' on the HSI and the needle should be green.

4) G3X Touch: From the PFD touch the autopilot and touch **CRS**. Select the inbound approach course (radial).

5) G3X Touch: From the PFD, touch the autopilot and touch **NAV**.

Or:

Press the **NAV** Key on the GMC control unit.

If there is less than half-scale deviation when touching **NAV** or when the **NAV** Key is pressed, VOR Mode will activate (green text), intercept, and track the selected radial. If there is more than half-scale deviation when **NAV** is touched or when the **NAV** Key is pressed, VOR Mode will arm (white text) first, then activate when closer to the radial.

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

LOCALIZER APPROACH (NO GS)

LOC Mode is used to fly a localizer only approach (no glideslope).

Selecting LOC Mode for a localizer only approach:

1) EXTERNAL NAVIGATOR: Tune and activate the desired LOC frequency,

2) G3X Touch: Ensure that LOC1 is the selected navigation source. The HSI should automatically slew the needle to the correct course.

3) G3X Touch: From the PFD, touch the autopilot and touch **NAV** to activate LOC Mode.

Or: Press or the **NAV** Key on the GMC control unit.

If the localizer deviation is less than half-scale when **NAV** is touched or when the **NAV** Key is pressed, the autopilot will activate LOC Mode and track the localizer, otherwise LOC Mode is armed and the pilot is responsible for intercepting the localizer. In some cases it may be necessary to use HDG Mode with LOC Mode armed to follow a vector to the localizer.

BACKCOURSE APPROACH

NOTE: *When making a backcourse approach, set the Selected Course to the localizer front course.*

NOTE: *'BC' will not be displayed on the G3X Touch HSI.*

Backcourse Mode captures and tracks a localizer signal in the backcourse direction. Backcourse is indicated by 'BC' in the autopilot status box.

If GS and LOC Mode are armed, the flight director can only capture the localizer front course, indicated by 'LOC' in the autopilot status box. If only LOC Mode is armed (not GS Mode), the flight director will capture either the front course or the backcourse based on the angle at which the aircraft intercepts the localizer.

Selecting BC Mode:

1) EXTERNAL NAVIGATOR: Tune and activate the desired LOC frequency.
2) G3X Touch: Ensure that LOC1 is the selected navigation source. The HSI should automatically slew the needle to the correct course.
3) G3X Touch: From the PFD touch the autopilot then touch **NAV**.

   Or:

   Press the **NAV** Key on the GMC control unit.

   If the aircraft heading is within 75° of the localizer backcourse then BC Mode will be armed. If the aircraft heading is within 105° of the localizer front course, LOC Mode will be armed.

APPROACHES WITH LATERAL + VERTICAL GUIDANCE

Touch **APPR** or press the **APR** Key (GMC control unit) 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. When Glideslope (GS) Mode is armed for an ILS approach, LOC Mode is automatically armed. Touch **APPR** or press the **APR** Key (GMC control unit) when the CDI is greater than one dot to arm the selected modes (annunciated in white). Touch **APPR** or press the **APR** Key (GMC control unit) when the CDI deviation is less than one dot to activate, capture and track the selected navigation source.

Example	Control	Modes	Annunciation	Description
LPV, LP+V, LNAV/VNAV, LNAV+V	**APR** Key (GMC 507) or **APPR**	Lateral: GPS	GPS	Captures and tracks the lateral portion of a GPS approach
		Vertical: Glidepath	GP	Captures and tracks a WAAS approach glidepath
LOC, ILS, LDA, SDF	**APR** Key (GMC 507) or **APPR**	Lateral: Localizer	LOC	Captures and tracks the localizer
		Vertical: Glideslope	GS	Captures and tracks the glideslope

Lateral + Vertical Approaches

GPS APPROACH WITH VERTICAL GUIDANCE

NOTE: *To cancel Glidepath (GP) Mode without canceling 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, LP+V, 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) G3X Touch: Ensure that GPS1 is the selected navigation source on the PFD.
4) EXTERNAL NAVIGATOR: Select and activate the GPS approach using the PROC Key.
5) G3X Touch: From the PFD touch the autopilot then touch **APPR**.

   Or:

   Press the **APR** Key on the GMC control unit.

LOCALIZER WITH GLIDESLOPE

LOC Mode (lateral) and GS Mode (vertical) are both armed by touching **APPR** from the G3X Touch PFD or by pressing the **APR** Key on the GMC control unit. LOC/ILS approach captures are inhibited if the difference between aircraft heading and localizer course exceeds 105°.

***NOTE:** To cancel Glideslope (GS) Mode without canceling LOC Mode, touch **NAV** once. Pressing it a second time cancels LOC Mode.*

Selecting LOC Mode with GS Mode:

1) EXTERNAL NAVIGATOR: Tune and activate the desired LOC frequency.
2) G3X Touch: Ensure that LOC1 is the selected navigation source. The HSI should automatically slew the needle to the correct course.
3) G3X Touch: From the PFD touch the autopilot then touch **APPR**.

   Or:

   Press the **APR** Key on the GMC control unit.

   This simultaneously selects LOC Mode and GS (Glideslope) Mode. If the localizer deviation is less than half-scale when touching APPR or the APR Key is pressed, the autopilot will activate LOC Mode and track the localizer, otherwise LOC Mode is armed and the pilot is responsible for intercepting the localizer.

If the following occurs, the autopilot reverts to Roll Hold Mode (wings rolled level):

- Approach Mode is active and the Navigation source is manually switched

- The localizer signal is lost

If the Glideslope signal is lost , GS Mode will revert to Pitch Hold Mode and hold the last pitch attitude.

COUPLED ILS APPROACH WITH PROCEDURE TURN

NOTE: *Configuration of a combination GPS/VLOC external navigator (GPS 175, GNX™ 375, GTN, or GNS) is required for a coupled ILS approach.*

The combination GPS/VLOC external navigator (GPS 175, GNX 375, GTN, or GNS), G3X Touch, and autopilot can be used to fly a full ILS approach with procedure turn, from the enroute environment to the missed approach point.

Setting up a coupled ILS approach:

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

2) G3X Touch: Ensure that GPS1 is the selected navigation source on the PFD.

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

4) G3X Touch: From the PFD touch the autopilot and touch **NAV** to activate GPS Mode. The flight director should start navigating to the IAF (Initial Approach Fix).

Or:

Press the **NAV** Key on the GMC control unit.

5) EXTERNAL NAVIGATOR: Tune and identify the localizer frequency by pressing the VLOC Flip-flop Key. (Note: The external navigator should have automatically loaded the localizer frequency into the standby VLOC slot.)

6) G3X Touch: From the PFD touch the autopilot and touch **APPR** to arm LOC and GS modes. Touch **ALT**.

Or:

Press the **APR** Key on the GMC control unit.

GPS Mode is now active and LOC Mode is armed in the roll axis. ALT Mode is active and GS is armed in the pitch axis. The flight director should now navigate the entire approach from the IAF (Initial Approach Fix) to the MAP (Missed Approach Point) with the only adjustment being the throttle.

NOTE: *Check step #5 if the external navigator doesn't automatically switch from GPS to VLOC Mode shortly after turning inbound on the final approach course.*

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 canceled 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.

9.4 NON-GARMIN AUTOPILOTS

When interfacing the G3X Touch with a non-Garmin autopilot, the following applies:

- The PFD can be used to select 'Course' and 'Heading' for non-Garmin autopilots.
- G3X Touch cannot support NAV source selection between two external navigators for a non-Garmin autopilot, therefore installations with a non-Garmin autopilot are limited to one external navigator interface.
- The PFD supports GPS Steering (GPSS) mode which converts GPS roll steering commands into heading commands for non-Garmin autopilots that lack a GPS Navigation interface. GPSS mode is selected/deselected directly on the PFD. Either the internal G3X Touch flight plan can be used or the external flight plan from a compatible Garmin navigator. While GPSS mode is active on the G3X Touch PFD, the pilot must select 'GPS' as the active NAV source and 'Heading' mode on the non-Garmin autopilot.

GPS STEERING (GPSS)

NOTE: *GPS Steering is only applicable to non-Garmin autopilots.*

GPS Steering (GPSS) provides roll command signals calculated by the GPS navigator to the non-Garmin autopilot in order to allow the aircraft to anticipate turns, make smooth transitions when passing waypoints, and fly leg types such as procedure turns and holding patterns.

GPS Steering is enabled by selecting 'GPS' as the active navigation source, HDG mode on the non-Garmin autopilot, and touching **GPSS** on the PFD Options menu.

Enabling GPSS Mode:

1) From the PFD, touch the HSI to display the PFD Options menu.

2) Touch **GPS** from the 'CDI Source' options.

3) Touch **GPSS**.

When GPSS is enabled, the heading bug will change to a hollow outline, and a crossed-out heading bug symbol is displayed indicating the autopilot is not coupled to the heading bug. The heading bug is still controllable and may still be used for reference.

GPSS Enabled (PFD) **GPSS Enabled (PFD Options Menu)**

If the GPSS data is invalid (for example, if there is not an active GPS leg) or the selected HSI source on the G3X Touch is not GPS, the annunciated "GPSS" text will turn yellow and a zero turn command will be sent to the autopilot.

GPSS Invalid (PFD)