

G5 User's Manual



INSTALLATION MANUAL

PILOT'S GUIDE

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This manual reflects the operation of System Software version 2.20 or later. Some differences in operation may be observed when comparing the information in this manual to earlier or later software versions.

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BATTERY WARNINGS:

If these guidelines are not followed, the lithium-ion battery may experience a shortened life span or may present a risk of damage to the device, fire, chemical burn, electrolyte leak, and/or injury.

- *Do not leave the battery exposed to a heat source or in a high temperature environment. To help prevent damage, store the battery out of direct sunlight.*
- *For maximum battery longevity, store within a temperature range of 32° to 77°F (from 0° to 25°C).*
- *Do not use a sharp object to remove the battery.*
- *Do not disassemble, puncture, damage, or incinerate the device or battery.*
- *Keep the battery away from children.*
- *Only replace the battery with the approved replacement from Garmin. Using another battery presents a risk of fire or explosion. To purchase a replacement battery, see you Garmin dealer or the Garmin website.*
- *Contact your local waste disposal department to dispose of the device and battery in accordance with applicable local laws and regulations.*



WARNING: *To reduce the risk of unsafe operation, carefully review and understand all aspects of the G5 User's Manual documentation and the Pilot's Operating Handbook of the aircraft. Thoroughly practice basic operation prior to actual use. During flight operations, carefully compare indications from the G5 to all available flight displays. For safety purposes, always resolve any discrepancies.*



WARNING: *The altitude calculated by the G5 internal GPS receiver is geometric height above Mean Sea Level and could vary significantly from the altitude displayed by pressure altimeters. Always use the pressure altitude display, when available, for determining or selecting aircraft altitude.*



WARNING: *The United States government operates the Global Positioning System and is solely responsible for its accuracy and maintenance. The GPS system is subject to changes which could affect the accuracy and performance of all GPS equipment.*



WARNING: For safety reasons, the G5 operational procedures must be learned on the ground.



WARNING: This product, its packaging, and its components contain chemicals known to the State of California to cause cancer, birth defects, or reproductive harm. This Notice is being provided in accordance with California Proposition 65. If you have any questions or would like additional information, please refer to our website at www.garmin.com/prop65



CAUTION: The display uses a lens with a special coating that may be sensitive to skin oils, waxes, and abrasive cleaners. **CLEANERS CONTAINING AMMONIA WILL HARM THE ANTI-REFLECTIVE COATING.** It is very important to clean the lens using a clean, lint-free cloth and a cleaner that is specified as safe for anti-reflective coatings. Avoid any chemical cleaners or solvents that can damage plastic components.



CAUTION: The G5 does not contain any user-serviceable parts. Repairs should only be made by an authorized Garmin service center. Unauthorized repairs or modifications could result in permanent damage to the equipment and void both the warranty and the authority to operate this device under FAA, FCC, and other applicable regulations.



NOTE: The G5 is a non-TSO certified product that has not received FAA approval or endorsement. Consequently the G5 is not type-certificated and is not suitable for installation in type-certificated aircraft.



NOTE: The term LRU, as used throughout this manual is an abbreviation for Line Replaceable Unit. LRU is used generically in aviation for a product (such as a GSA 28 or GMC 307) that can be readily "swapped out" (usually as a single component) for troubleshooting/repair.



NOTE: *The G5 has a very high degree of functional integrity. However, the pilot must recognize that providing monitoring and/or self-test capability for all conceivable system failures is not practical. Although unlikely, it may be possible for erroneous operation to occur without a fault indication shown by the G5. It is thus the responsibility of the pilot to detect such an occurrence by means of cross-checking with all redundant or correlated information available in the cockpit.*



NOTE: *All visual depictions contained within this document, including screen images of the G5 display, are subject to change and may not reflect the most current G5 functionality.*



NOTE: *Use of polarized eyewear may cause the display to appear dim or blank.*

FCC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

LICENSE AGREEMENT AND WARRANTY

CONTACT GARMIN

Contact Garmin if you have any questions while using the G5. In the USA contact Garmin Product Support by phone: (913) 397-8200 or (800) 800-1020, Monday–Friday, 8 AM–5 PM Central Time; or go to www.garmin.com/support.

In Europe, contact Garmin (Europe) Ltd. at +44 (0) 870.8501241 (outside the UK) or 0808 2380000 (within the UK).

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LIMITED WARRANTY

The Garmin G5 and other G3X LRUs are warranted to be free from defects in materials or workmanship for two years from the date of purchase. Within the applicable period, Garmin will, at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer shall be responsible for any transportation cost. This warranty does not apply to: (i) cosmetic damage, such as scratches, nicks and dents; (ii) consumable parts, such as batteries, unless product damage has occurred due to a defect in materials or workmanship; (iii) damage caused by accident, abuse, misuse, water, flood, fire, or other acts of nature or external causes; (iv) damage caused by service performed by anyone who is not an authorized service provider of Garmin; or (v) damage to a product that has been modified or altered without the written permission of Garmin. In addition, Garmin reserves the right to refuse warranty claims against products or services that are obtained and/or used in contravention of the laws of any country.

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International Purchases: A separate warranty may be provided by international distributors for devices purchased outside the United States depending on the country. If applicable, this warranty is provided by the local in-country distributor and this distributor provides local service for your device. Distributor warranties are only valid in the area of intended distribution. Devices purchased in the United States or Canada must be returned to the Garmin service center in the United Kingdom, the United States, Canada, or Taiwan for service.



Part Number	Change Summary
190-02072-00	Initial release.

Rev	Date	Description
A	April, 2016	Production Release.
B	April, 2016	Updates to Installation Manual section.

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SECTION 1 INSTALLATION MANUAL

1.1 INSTALLATION INFORMATION

1.1.1 G5 OVERVIEW

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. With integrated attitude/air data sensors and GPS, the G5 replaces traditional electromechanical standby instruments by combining essential information into one easy-to-read display. The G5 additionally provides backup autopilot control allowing coupled GPS approaches to be flown or continued in the event of primary flight display shutdown. In the case of aircraft power loss, the optional battery backup sustains the G5 flight display with up to 4 hours of emergency power. Two G5 units installed in the same aircraft will communicate with one another and with the G3X system.

1.1.2 INVENTORY OF MATERIALS

This manual provides all of the mechanical and electrical information required for the installation of the G5. This manual is intended to be a step-by-step guide to the installation, therefore it is important that the steps in all sections be performed in order. All materials that are required/optional for the installation of the G5 are listed in this section (as such, some of the information in this section is repeated in following sections).

Before beginning the G5 installation, it is recommended that the installer perform a complete inventory of all materials listed in this section (some materials are optional and may not be applicable to the installation). Section 1.1 should be used to verify that all components ordered from Garmin have been delivered correctly, and to identify any required materials that are not provided by Garmin.

1.1.3 UNPACKING THE UNIT

Carefully unpack the equipment and make a visual inspection of all contents for evidence of damage incurred during shipment. If any component of the G5 is damaged, notify the carrier and file a claim. To justify a claim, save the original shipping container and all packing materials. Do not return any equipment to Garmin until the carrier has authorized the claim.

Retain the original shipping containers for storage. If the original containers are not available, a separate cardboard container should be prepared that is large enough to accommodate sufficient packing material to prevent movement.

1.1.4 REQUIRED GARMIN EQUIPMENT

1.1.4.1 G5 INSTALLATION EQUIPMENT

Table 1-1 G5 Installation Equipment

LRU	Assembly Part Number	Unit Only Part Number
G5, Unit Only	010-01485-00	011-03809-00
Installation Kit, G5	010-12493-10	011-03892-00
Battery Pack, G5	010-12493-00	011-03893-00

1.1.4.2 OPTIONAL GPS ANTENNA

A Garmin or non-Garmin GPS antenna is optional for G5 installations when not using the G5's internal GPS antenna. See Section 1.4 for supported antennas and antenna requirements.

1.1.4.3 OPTIONAL GARMIN LRUS

The G5 can be installed in a standalone configuration or as part of the G3X system. Optional Garmin LRUs (Line Replaceable Units) that can be installed with the G5 in the standalone configuration are listed below. If any of these LRUs are to be used in this installation, verify that all required installation materials such as connector kits have been acquired. Refer to the G3X Installation Manual (190-01115-01) for additional installation information for these LRUs and for the G3X system.

Optional Garmin LRUs:

- GAD 29 ARINC 429 Adapter
- GMC 305 Mode Controller
- GMC 307 Mode Controller
- GSA 28 Servo Actuator

1.1.5 REQUIRED NON-GARMIN EQUIPMENT

1.1.5.1 WIRING/CABLING CONSIDERATIONS

The installer will provide all wiring and cabling unless otherwise noted.

1.1.5.2 CONTACT AND CRIMP TOOLS

Table 1-2 lists recommended crimp tools used to build the wiring harnesses for the G5, other equivalent tooling may also be used.

Table 1-2 Pin Contact and Crimp Tools Part Numbers

Contact Type	Garmin Contact Part Number	Recommended Positioner	Recommended Insertion/Extraction Tool	Recommended Hand Crimping Tool
Socket, Size 20, 20-24 AWG	336-00022-02	M22520/2-08, Daniels K13-1	M81969/1-04 for size 22D pins and M81969/1-02 for size 20 pins	M22520/2-01



NOTE: *Non-Garmin part numbers shown are not maintained by Garmin and consequently are subject to change without notice.*

1.1.5.3 BNC CONNECTORS

BNC connectors may be required to terminate the antenna cable, depending upon which antenna is used. Check the GPS antenna installation instructions for detailed information.

1.1.5.4 HEX DRIVER

A 3/32" hex drive tool is required to secure the G5 to the panel as described in Section 1.3, G5 Installation.

1.1.5.5 SD CARD

A microSD™ card can be used with the G5 for software updates and data logging. Garmin recommends SanDisk® brand SD cards up to 32 GB.

1.1.5.6 PNEUMATIC HOSES AND CONNECTORS

Air hoses and fittings are required to connect pitot and static air to the G5. The G5 has a female 1/8-27 ANPT fitting for each pitot and static port. Use appropriate aircraft fittings to connect to pitot and static system lines.

1.1.6 OPTIONAL EQUIPMENT (NON-LRU)

1.1.6.1 ANTENNA BRACKETS/DOUBLER PLATES

See the G3X Installation Manual (190-01115-01) for detailed information.

1.1.6.2 SILICON FUSION TAPE

Use Garmin Part Number 249-00114-00 or similar to wrap the wiring/cable bundles.

1.1.7 GARMIN SOFTWARE AND DOCUMENTS

The G5 unit software and a panel cut-out DXF file are available for free download from www.garmin.com.

1.2 INSTALLATION PREPARATION

This section provides electrical and mechanical information needed for planning the physical layout of the G5 installation. Use the information in Section 1.2 to become familiar with all aspects of the installation before actually beginning the physical installation of any equipment into the aircraft. Garmin recommends that the installer become familiar with all sections of this document before beginning the installation. In general terms, the below steps are recommended to be followed in order.

- 1) Inventory of all needed parts
- 2) Planning/layout of the installation
- 3) Installation of LRUs, antennas, and sensors
- 4) Construction of wiring harness, cables, and connectors
- 5) Software installation/configuration
- 6) Post-installation checkout procedure and calibration

1.2.1 ELECTRICAL CONSIDERATIONS

This section presents information required for planning the electrical layout of the G5 installation.



CAUTION: *To avoid damage to the G5 and other LRUs, take precautions to prevent Electro-Static Discharge (ESD) when handling connectors and associated wiring. ESD damage can be prevented by touching an object that is of the same electrical potential as the LRU before handling the LRU itself.*

1.2.1.1 POWER SPECIFICATIONS

The G5 is capable of operating at either 14 or 28 VDC. Table 1-3 lists the supply voltage and current draw information for the G5. Use this information when determining power supply requirements. All installed electrical appliances must be considered when determining total power requirements.

The specified current draw listed in Table 1-3 is measured with the display backlight set to 100%.

Table 1-3 G5 Power Requirements

14 V (Maximum)	14 V (Typical)	28 V (Maximum)	28 V (Typical)
3.4 W, 0.250 Amp	2.8 W, 0.200 Amp	3.4 W, 0.125 Amp	2.80 W, 0.100 Amp

1.2.2 WIRING/CABLING CONSIDERATIONS

Section 1.5 lists the pin information for the G5 and Section 1.6 contains interconnect drawings. It is recommended that all LRUs be installed prior to constructing the wiring harnesses and cables.

Use MIL-W-22759/16 (or other approved wire) AWG #22 or larger wire for all connections unless otherwise specified. The supplied standard pin contacts are compatible with up to AWG #20 wire. In cases where some installations have more than one LRU sharing a common circuit breaker, sizing and wire gauge is based on aircraft circuit breaker layout, length of wiring, current draw on units, and internal unit protection characteristics. Do not attempt to combine more than one unit on the same circuit breaker.

RG400 or RG142 coaxial cable with 50 Ω nominal impedance and meeting applicable aviation regulations should be used when installing an optional external GPS antenna.

1.2.2.1 WIRING HARNESS INSTALLATION

Use cable meeting the applicable aviation regulation for the interconnect wiring. Any cable meeting specifications is acceptable for the installation. When routing cables, observe the following precautions:

- All cable routing should be kept as short and as direct as possible.
- Check that there is ample space for the cabling and mating connectors.
- Avoid sharp bends in cabling.
- Avoid routing near aircraft control cables.
- Avoid routing cables near heat sources, RF sources, EMI interference sources, power sources (e.g. 400 Hz generators, trim motors, etc.) or near power for fluorescent lighting.
- Route the GPS antenna cable as far as possible away from all COM transceivers and other antenna cables.

The installer shall supply and fabricate all of the cables. Electrical connections are made through the D subminiature connector. Section 1.5 defines the electrical characteristics of all input and output signals. Required connectors and associated hardware are supplied with the connector kit.

Contacts for the connectors must be crimped onto the individual wires of the aircraft wiring harness.

Table 1-2 lists contact part numbers (for reference) and recommended crimp tools.



CAUTION: Check wiring connections for errors before connecting any wiring harnesses. Incorrect wiring could cause internal component damage.

1.2.2.2 BACKSHELL ASSEMBLY

The installation kit includes the backshell assembly. Garmin’s backshell connectors give the installer the ability to quickly and easily terminate shield grounds at the backshell housing. Instructions needed to install the Jackscrew Backshell and Shield Block Ground can be found in the G3X Installation Manual (190-01115-01).

1.2.2.3 CAN BUS CONSIDERATIONS

The CAN (controller area network) bus (Figure 1-1) is an interface format used to establish communication between several LRUs. Each end of the CAN Bus “backbone” must be terminated by a 120 Ω resistor. Each node length (distance from CAN bus backbone to each LRU) must be 0.3 meters or less in length (keeping the node lengths as short as practicable is recommended). There is no minimum node length.

The G5 installation kit provides a DB-9 CAN Bus terminator that contains a 120 Ohm resistor connected between pins 1 and 2 (Figure 1-2). The GSA 28 servos contain a 120 Ohm resistor inside the unit that provides the termination when pin 3 is connected (outside of the unit) to pin 4 (Figure 1-3).



NOTE: Use only two CAN Bus terminations per installation. Using less than or more than two terminations (one at each end of the backbone) will make the CAN Bus unusable or unreliable.

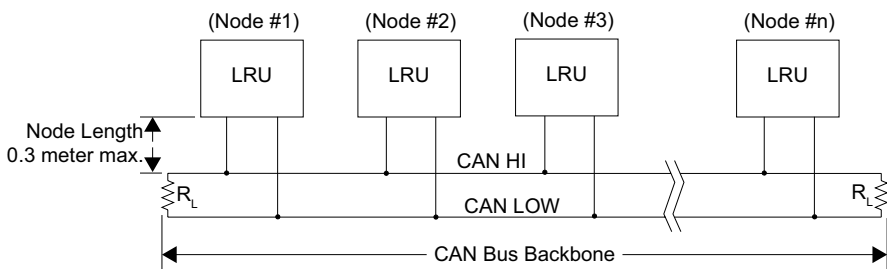


Figure 1-1 CAN Bus Configuration

The following items should be considered when installing/removing/replacing LRUs on the CAN bus:

- 1) CAN bus node connections must be made on the connector of each LRU that connects to the CAN bus, do not tie CAN bus nodes from individual LRUs together into a single connection point.
- 2) Keep all node lengths as short as practical.
- 3) If a G5 or GAD 29 (that was used as a CAN bus termination) is removed, the CAN bus will remain terminated as long as the CAN bus terminator (Figure 1-2) is left connected.
- 4) A removal adapter (011-03158-00) is provided (with each GSA 28 connector kit) that can be used when a GSA 28 is removed. The adapter keeps that node on the CAN bus in the same state as when the servo was connected (either terminated or un-terminated). The adapter also allows trim signals to pass through when the servo is removed.



NOTE: The 120 Ω termination resistors described in the preceding paragraphs are “built-in” to the termination methods shown in the following figures. Do not install a separate “discrete” 120 Ω resistor to terminate the CAN bus in addition to the termination methods shown in Figure 1-2 and Figure 1-3.

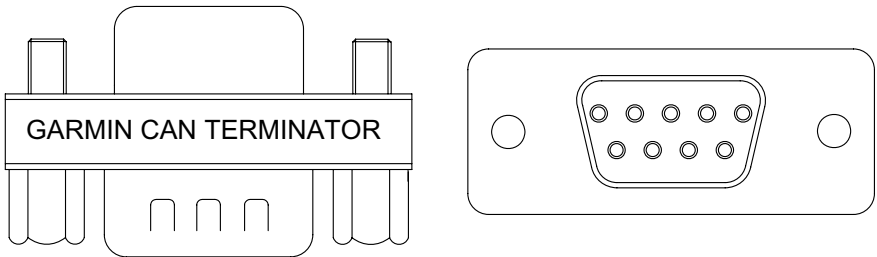


Figure 1-2 CAN Bus Termination (011-02887-00) for the G5 and GAD 29

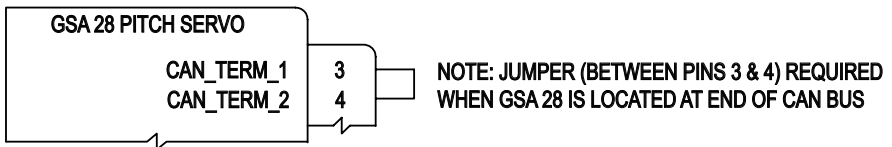


Figure 1-3 CAN Bus Termination for the GSA 28

1.2.2.4 CABLE CONNECTOR INSTALLATION

A coaxial cable connection is required for the optional external GPS antenna.

- 1) Route the coaxial cable to the unit location. Secure the cable in accordance with good aviation practices.
- 2) Trim the coaxial cable to the desired length and install the BNC connector. If provided, follow the connector manufacturer's instructions for cable preparation.

1.2.3 MECHANICAL CONSIDERATIONS

This section presents all information required for planning the physical layout of the G5 installation.

1.2.3.1 PHYSICAL SPECIFICATIONS

Use Table 1-4 to determine panel requirements. All width, height, and depth measurements are taken with unit mounting ring and connectors (if applicable).

Table 1-4 G5 Physical Specifications

Configuration	Width	Height	Depth*	Unit Weight	Weight of Unit and Connector**
G5	3.42 in	3.60 in	2.61 in	0.55 lb	0.70 lb
G5 with Battery	3.42 in	3.60 in	3.03 in	0.83 lb	0.98 lb

*Depth behind aircraft panel

**Weight includes mounting ring

1.2.3.2 COOLING REQUIREMENTS

While no forced cooling air is required for the G5, it is highly recommended that the air behind the panel be kept moving (by ventilation or a fan). Units tightly packed in the avionics stack heat each other through radiation, convection, and sometimes by direct conduction. Even a single unit operates at a much higher temperature in still air than in moving air. Fans or some other means of moving the air around electronic equipment are usually a worthwhile investment.



NOTE: Avoid installing LRUs near heat sources. If this is not possible, ensure that additional cooling is provided. Allow adequate space for installation of cables and connectors. The installer will supply and fabricate all of the cables. All wiring should be in accordance with FAA AC 43.13-1B and AC 43.13-2B.

1.2.3.3 COMPASS SAFE DISTANCE

After reconfiguring the avionics in the cockpit panel, if the unit is mounted less than 12 inches from the compass, recalibrate the compass and make the necessary changes for noting correction data.

1.3 G5 INSTALLATION

The G5 can be installed as a standalone flight display or a fully integrated backup instrument in the G3X system. This section contains general information as well as installation information for the G5.



Figure 1-4 G5 Unit View

1.3.1 PRIMARY FUNCTIONS

- Attitude (roll, pitch, and yaw)
- Air data (altitude and airspeed)
- Slip/skid and turn coordinator
- GPS (ground speed and ground track)
- Autopilot control (when installed with optional equipment)
- Optional battery backup with up to 4 hours of emergency power
- RS-232 and CAN communication interfaces

1.3.2 GENERAL SPECIFICATIONS

See Section 1.2.1.1 for power/current specifications, and Section 1.2.3.1 for dimension/weight specifications.

1.3.3 INSTALLATION INFORMATION

1.3.3.1 REQUIRED EQUIPMENT

The installation kit (Table 1-5) is required to install the unit, one kit is required for each G5 installed. The G5 Mounting Ring is included in the installation kit to mount the G5 to the aircraft panel and to reinforce the panel cutout in thin panel installations. The installation kit is not included with the G5.

Table 1-5 Contents of the G5 Installation Kit (011-03892-00)

Item	Garmin P/N	Quantity
Connector Kit, 9 Pin, w/CAN Term	011-03002-00	1
Mounting Ring, G5	115-02251-03	1
Screw, 6-32, 0.500"	211-60207-12	3

Table 1-6 Contents of the Connector Kit (011-03002-00)

Item	Garmin P/N	Quantity
Sub-Assy, Bkshl w/Hdw, Jackscrew, 9 pin	011-01855-00	1
Sub Assy, CAN Termination Kit	011-02887-00	1
Conn, Rcpt, D-Sub, Crimp Socket, 9 Ckt	330-00625-09	1
Contact, Sckt, D-Sub, Crimp, Size 20, 20-24 AWG	330-00022-02	9

1.3.3.2 ADDITIONAL EQUIPMENT REQUIRED

A 3/32" hex drive tool is required to secure the G5 to the panel as described in Section 1.3.6.3 and shown in Figure 1-7.

Air hoses and fittings are required to connect pitot air and static air to the G5. The G5 uses a female 1/8-27 ANPT fitting for each of these ports. Use appropriate aircraft fittings to connect to pitot and static system lines.

1.3.4 UNIT INSTALLATION

Fabrication of a wiring harness is required. Sound mechanical and electrical methods and practices are recommended for installation of the G5. Refer to Section 1.2.2 for wiring considerations, and to Section 1.5 for pinouts.

Connector kits include backshell assemblies. Garmin's backshell connectors give the installer the ability to quickly and easily terminate shield grounds at the backshell housing. Instructions needed to install the Jackscrew Backshell and Shield Block Ground can be found in the G3X Installation Manual (190-01115-01).

1.3.4.1 MOUNTING REQUIREMENTS

The G5 includes an extremely sensitive inertial measurement unit, consider the following when selecting a mounting location:

- The G5 should be mounted to the aircraft panel with the connector facing toward the front of the aircraft.
- Mount the G5 with the connector aligned to within 1.0° of the longitudinal axis of the aircraft (display bezel parallel to the wing spar).
- Mount the G5 to the aircraft panel. To avoid degraded accuracy, the aircraft panel should be rigid and panel flexing should be minimized.
- The G5 should be mounted within 13 feet (4.0 meters) longitudinally of the aircraft CG (center of gravity). In cases where the longitudinal distance from the CG is planned to be greater than 6.5 feet (2.0 meters), it is preferable to mount the G5 forward of the aircraft CG, if possible, to improve autopilot performance.
- To prevent degraded accuracy, avoid placing the G5 near areas that are prone to severe vibration.
- Do not use shock mounting to mount the G5. Shock mounts used for other types of inertial systems are not acceptable for the G5. The G5 should be rigidly mounted to the aircraft panel.
- The G5 must be leveled to within 30.0° of the flight level cruise attitude. An aircraft leveling and offset calibration procedure must additionally be carried out prior to flight.
- The mounting location for the G5 should be protected from rapid thermal transients, in particular large heat loads from nearby high-power equipment.
- Avoid placing the G5 within 1 inch of magnetically mounted antennas, speaker magnets, or other strongly magnetic items.

1.3.4.2 UNIT MOUNTING

For final installation and assembly, refer to the outline and installation drawings in Section 1.3.7.

- 1) Mount the G5 in a suitable location using the installation kit (Table 1-5) per the requirements in Section 1.3.4.1.
- 2) Assemble the wiring harness and backshell connector.
- 3) Assemble the pneumatic hoses and connector.
- 4) Connect the CAN terminator if required (see Section 1.2.2.3).
- 5) Connect the backshell connector and hoses.

1.3.4.3 PNEUMATIC PLUMBING

The G5 has two ports that are connected to the aircraft's pitot and static pressure sources. The ports are labeled on the unit using the abbreviations "P" and "S" respectively (Figure 1-5). The pressure ports have 1/8-27 ANPT female threads. The mating fitting must have 1/8-27 ANPT male threads.



NOTE: *The temporary port plugs attached to the pressure ports on a new G5 are not suitable for flight and must be removed prior to the installation of G5 into the aircraft.*

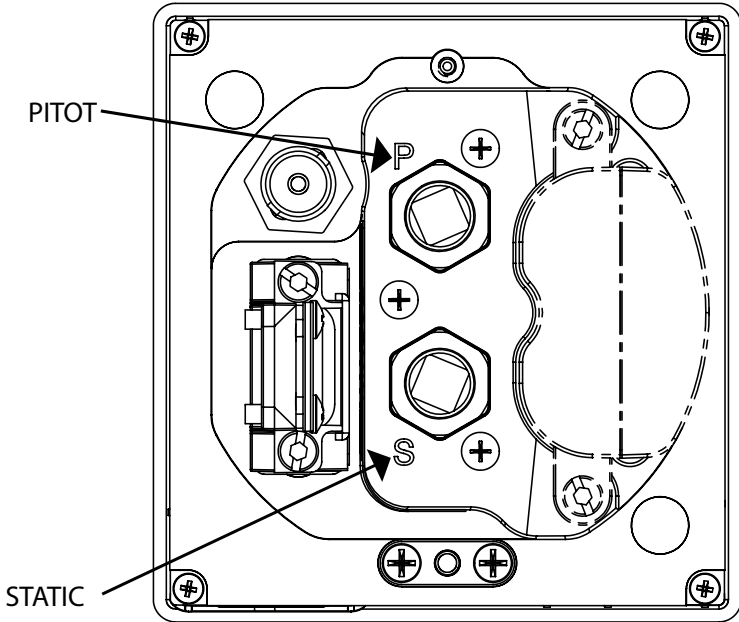


Figure 1-5 G5 Air Hose Fitting Locations

Use appropriate air hoses and fittings to connect the pitot and static lines to the unit. Avoid sharp bends in the tubing and attempt to route hoses away from aircraft control cables. The G5 should not be at the low point of the pneumatic plumbing lines to avoid moisture or debris collecting at or near the unit. Ensure that no deformations of the airframe surface have been made that would affect the relationship between static air pressure and true ambient static air pressure for any flight condition. Refer to part 43, Appendix E for approved practices while installing hoses and connections.



NOTE: A G5 installed as a standalone unit may optionally be configured to disable its internal air data sensors. In this case, no connection to the aircraft's pitot/static system is required. If not connected, the pitot/static fittings on the G5 should be covered with dust caps. A G5 with air data disabled does not support autopilot functionality.

1.3.4.4 PNEUMATIC CONNECTIONS

The following steps should be used to aid in the fabrication of pneumatic hose connections and in attaching the aircraft pitot pressure source and aircraft static pressure sources to the G5.



NOTE: Whenever the aircraft is connected to a pitot-static tester, such as during Part 43 Appendix E altimeter tests, the pitot port must be covered by a pitot adapter that is controlled by the pitot-static tester. Failure to do so will result in overpressuring and damaging the internal airspeed sensor.



NOTE: Use of different colored tubing is recommended for static and pitot plumbing to avoid plumbing connection errors. Incorrect plumbing connections will result in erroneous air data information calculated by the G5.

Observe the following cautions when connecting pneumatic lines:

- 1) Make sure the aircraft static pressure port is plumbed directly to the unit static pressure input port and the aircraft pitot pressure port is plumbed directly to the unit pitot pressure input port.
- 2) Seal the threads of pneumatic fittings at the connector ports. Use caution to ensure there are no pneumatic leaks.
- 3) Use care to avoid getting fluids or particles anywhere within the pneumatic lines connected to the G5.

1.3.5 ANTENNAS

Refer to Section 1.4 for antenna installation information.

1.3.6 MOUNTING INSTRUCTIONS

Refer to Section 1.3.7 for outline and installation drawings.



NOTE: In addition to the mounting requirements listed in Section 1.3.4.1, it is critical that the G5 is installed perpendicular to the aircraft's longitudinal axis (display bezel parallel to the wing spar) and as close to level in the roll axis as possible. Small roll offsets, and pitch offsets up to 30°, can be corrected for during calibration.

1.3.6.1 PANEL CUTOUT TEMPLATE

The G5 Mounting Ring (115-02251-03) or Figure 1-13 can be used as a template when marking the panel for cutout. See Figure 1-12 for complete cutout dimensions (the dimensions on Figure 1-12 are to verify the accuracy of the printout only).

1.3.6.2 MOUNTING RING INSTALLATION

Secure the mounting ring to the aircraft panel using the supplied #6-32 pan head Phillips mounting screws. Evenly torque the mounting screws to 10-12 in-lbs.

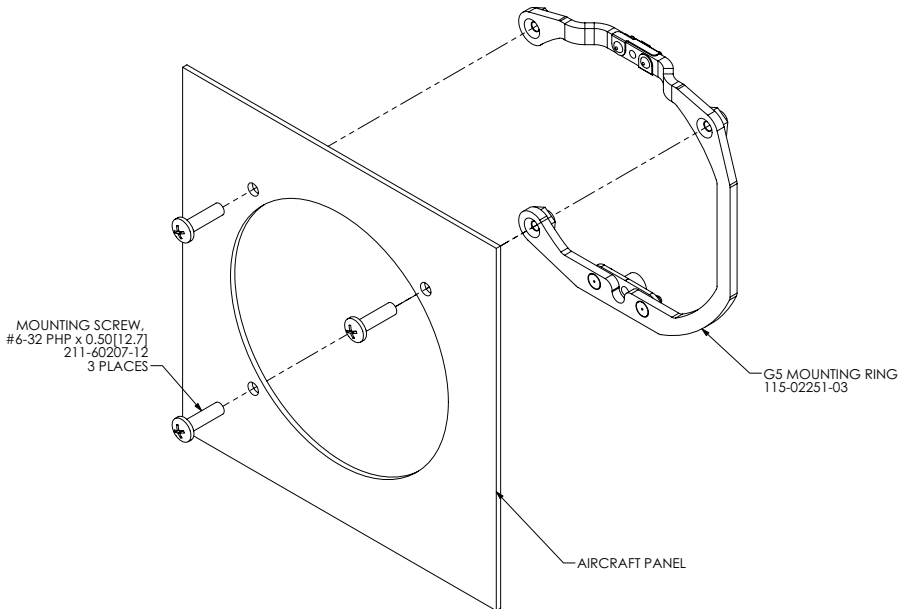


Figure 1-6 G5 Mounting Ring

1.3.6.3 UNIT INSTALLATION

The G5 is installed by inserting the alignment pin located at the top of the unit into the mating hole in the mounting ring, pushing the unit flush with the instrument panel, and fastening the captive 3/32" hex socket head screw to the mounting ring as shown in Figure 1-7. To fasten the captive screw to the mounting ring, insert a 3/32" hex drive tool through the access hole in the front cover of the G5 as shown in Figure 1-8. Torque the captive mounting screw to 10-12 in.-lbs.

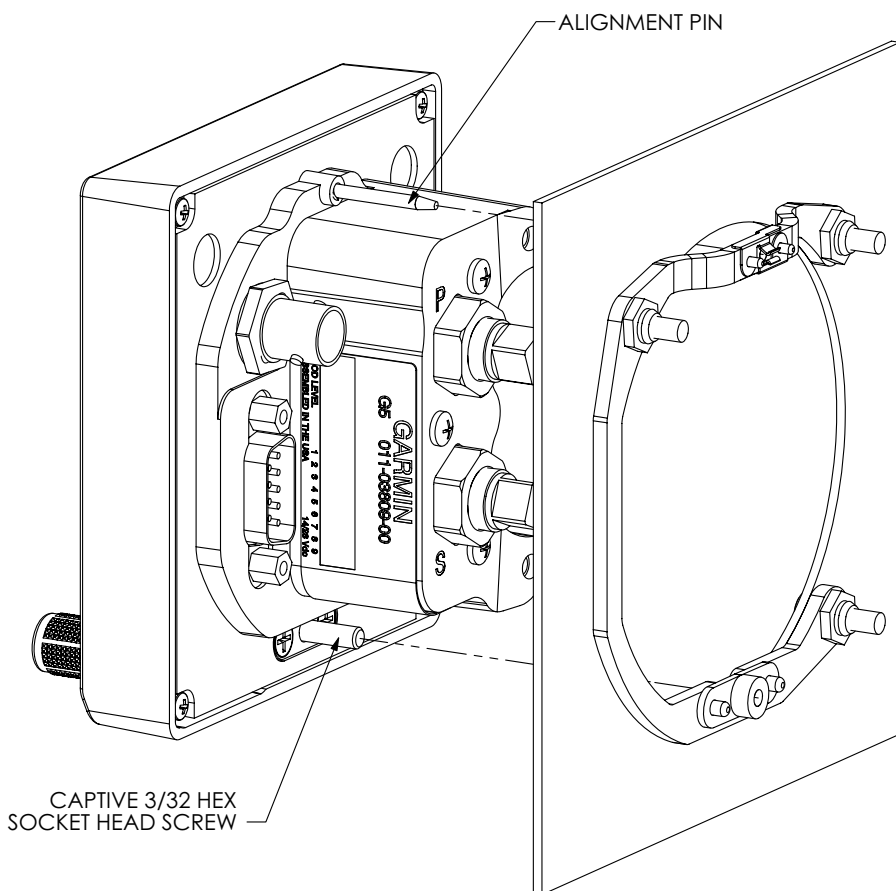


Figure 1-7 G5 Alignment Pin

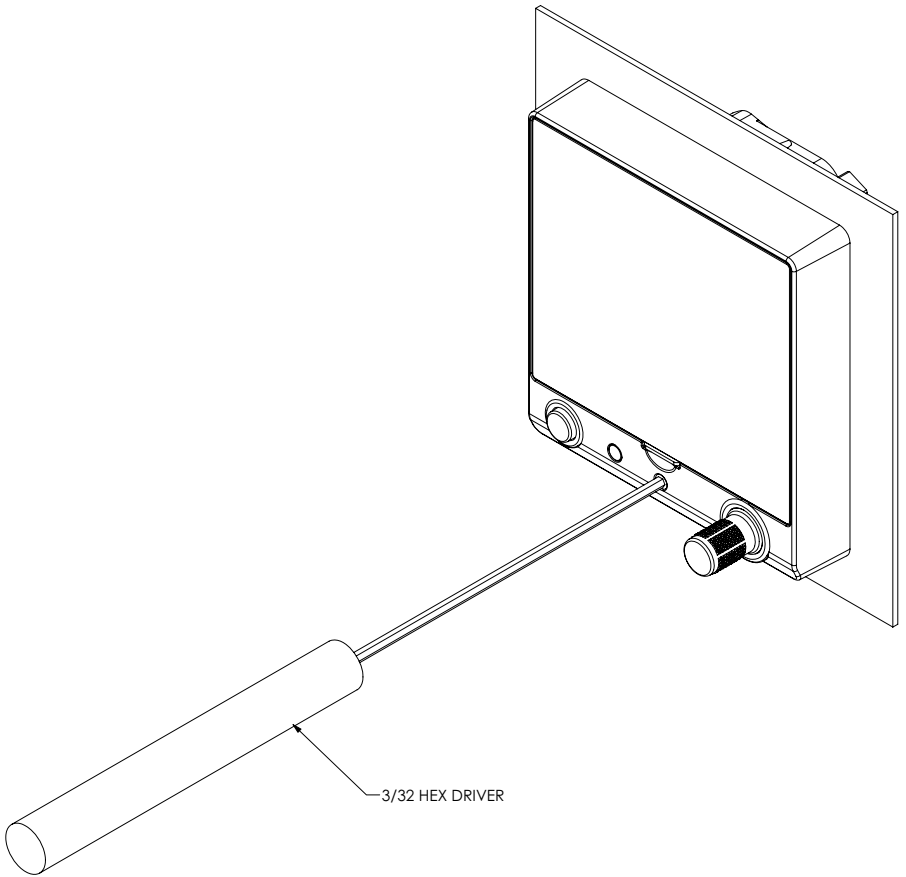


Figure 1-8 G5 Hex Driver Insertion

1.3.6.4 CAPTIVE MOUNTING SCREW REPLACEMENT

The captive 3/32" hex socket head screw can be used for panel thicknesses up to 0.150". For installations with a panel thickness greater than 0.150", the captive mounting screw can be replaced with a standard #6-32 hex socket head screw. To replace the screw, remove the two #4-40 flat head Phillips mount plate screws, the G5 screw mount plate, and the captive screw as shown in Figure 1-9. Reverse this process to install the longer #6-32 hex socket head screw. Ensure correct orientation of the screw mount plate before applying 6-8 in-lb. of torque to the #4-40 mount plate screws.



NOTE: Standard #6-32 hex socket head screws use a 7/64" hex drive feature. The access hole in the G5 bezel is large enough to accommodate this increase in hex tool size.

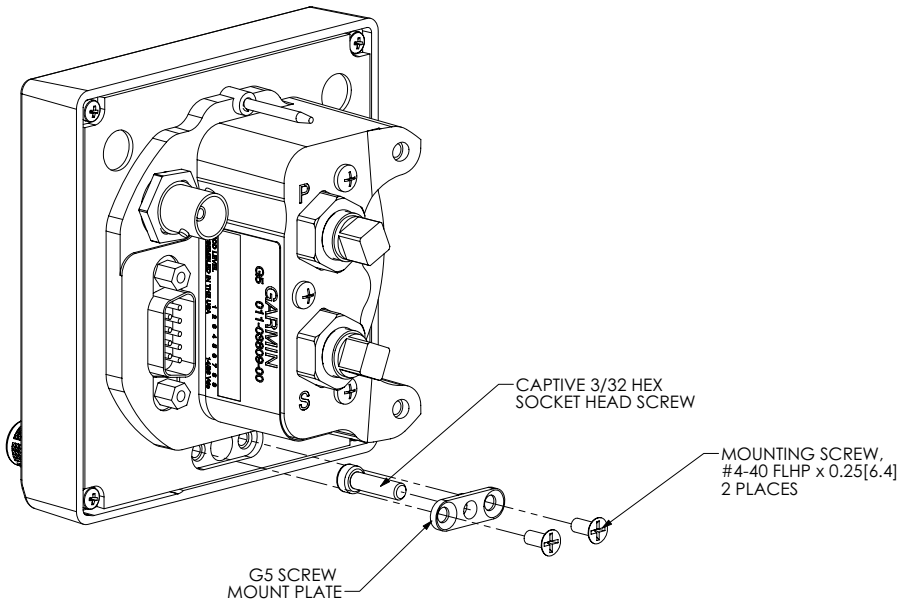
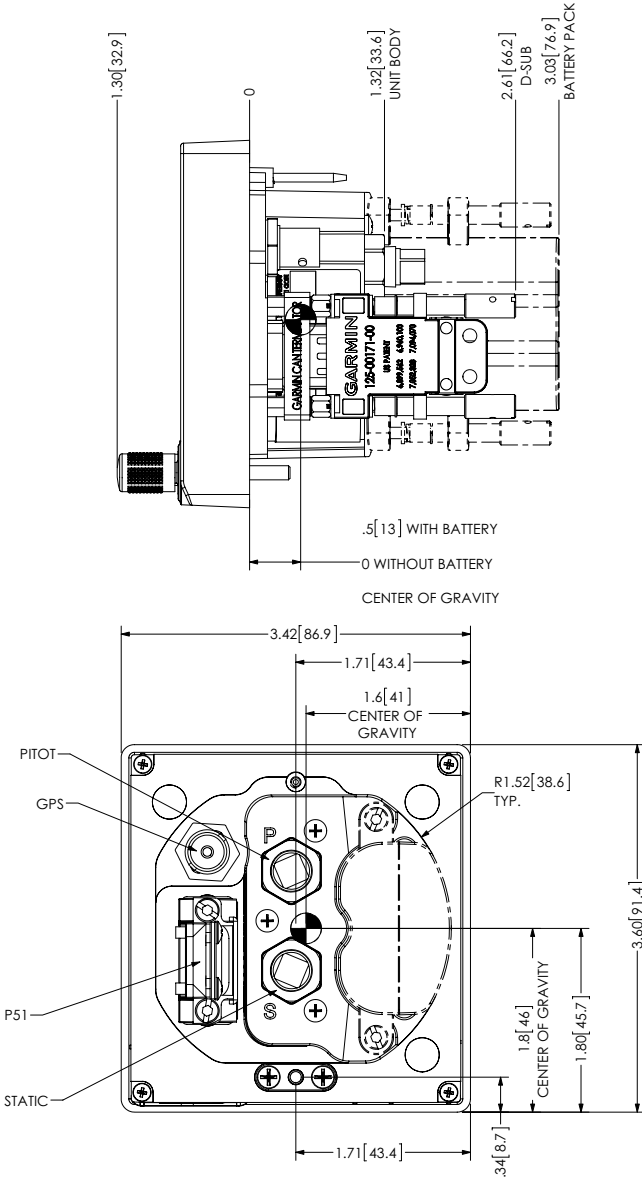


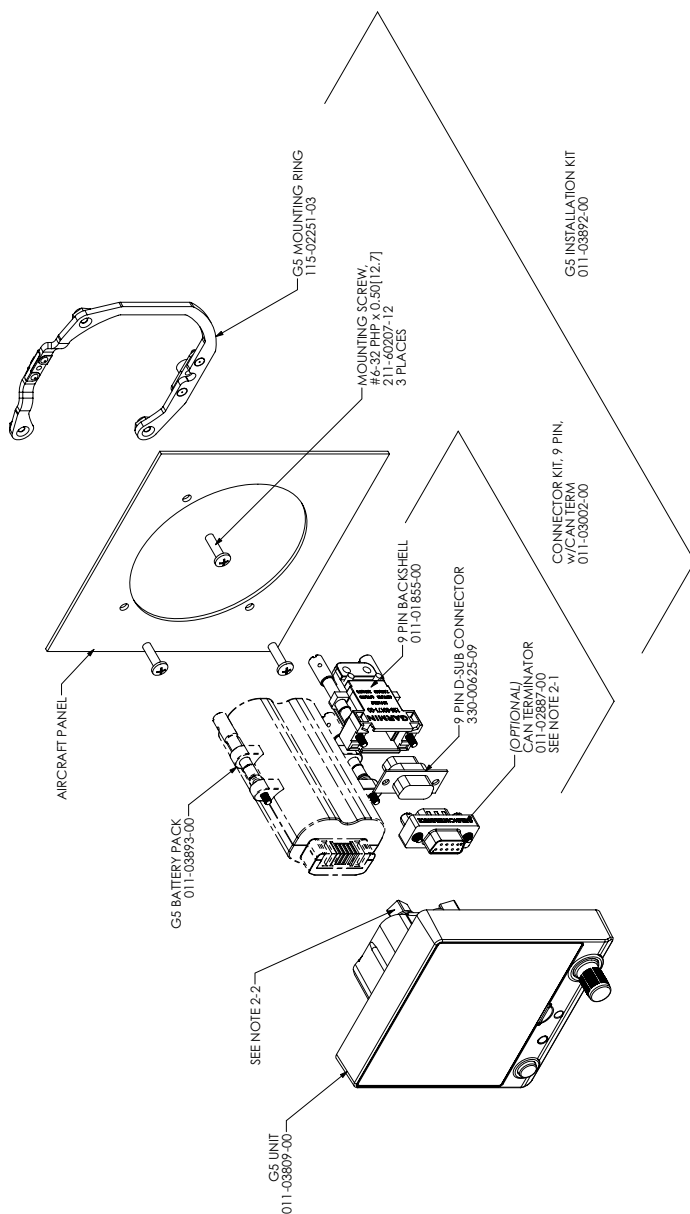
Figure 1-9 G5 Captive Mounting Screw Replacement

1.3.7 OUTLINE AND INSTALLATION DRAWINGS



NOTES:
 1-1. DIMENSIONS: INCHES[mm]. METRIC VALUES ARE FOR REFERENCE ONLY.
 1-2. DIMENSIONS ARE NOMINAL AND TOLERANCES ARE NOT IMPLIED UNLESS SPECIFICALLY STATED.

Figure 1-10 G5 Outline Drawing



NOTES:

- 2-1. DEPENDING ON HOW THE SYSTEM IS PHYSICALLY WIRED, THIS TERMINATOR MAY OR MAY NOT BE NEEDED IN THE INSTALLATION. THE CAN BUS MUST BE TERMINATED AT ONLY THE TWO MOST EXTREME POINTS ON THE CAN BACKBONE. IF USED WITH THE G3X SYSTEM REFER TO THE G3X INSTALL MANUAL FOR SPECIFIC GUIDANCE ON CAN BUS WIRING.
- 2-2. ALL RED PLUGS MUST BE REMOVED AND DISCARDED. THEY ARE NOT TO BE USED FOR CAPPING AND SEALING UNUSED PORTS.

Figure 1-11 G5 Installation Drawing

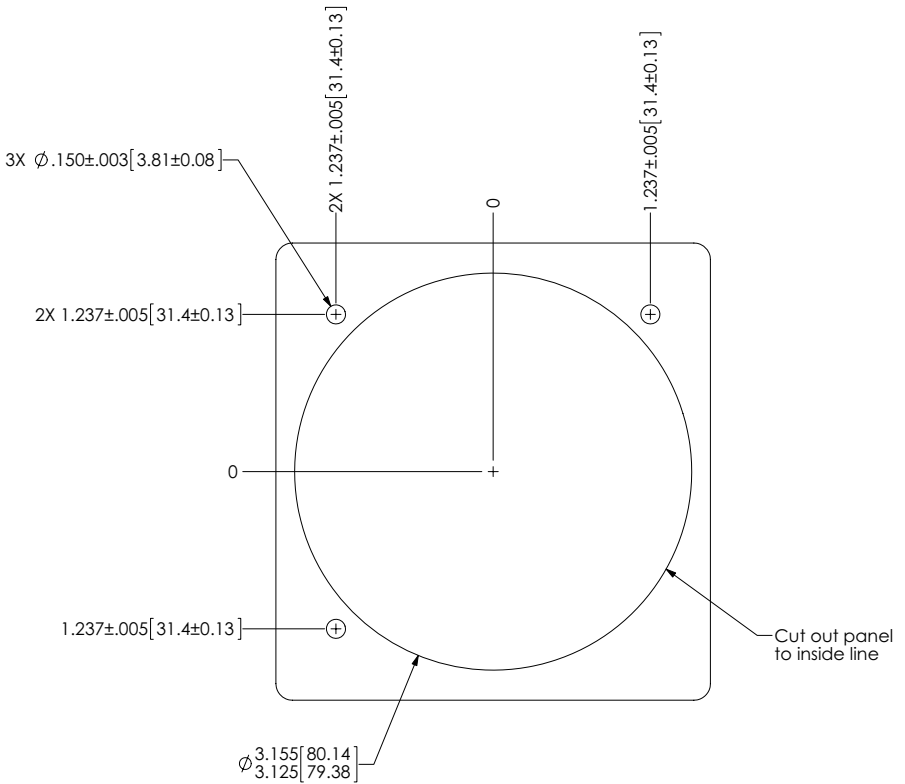
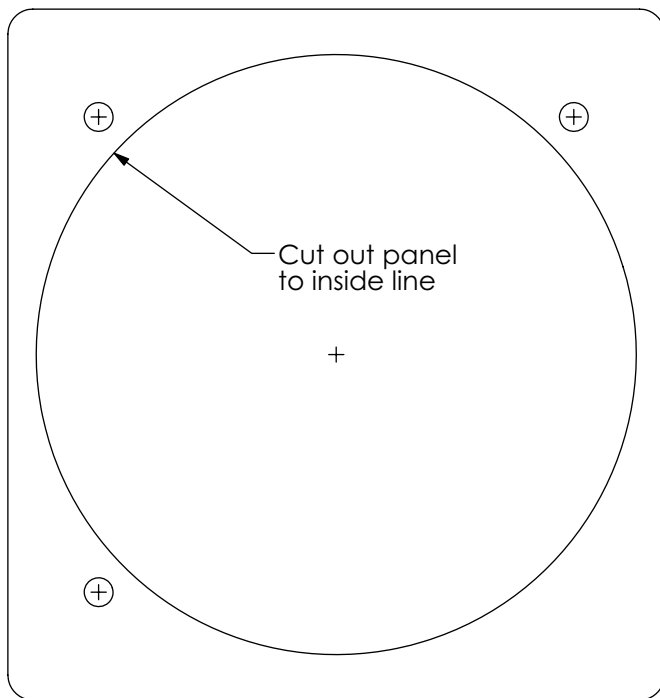


Figure 1-12 G5 Panel Cutout Measurements (Not to Scale)

**IMPORTANT!**

Ensure the Page Scaling setting is set to NONE when printing this page. Verify dimensions of printed template are accurate before cutting panel.

For mounting holes, drill out with #25 drill bit and use Garmin mounting ring P/N 115-02251-03.

For panel cutout, drill out with a 3.125" diameter bimetal hole saw.

The outline in this drawing is identical to the outline of the actual bezel.

Figure 1-13 G5 Panel Cutout Drawing (Template)

1.4 GPS ANTENNA INSTALLATION

This section contains general information as well as installation information for GPS antennas. Garmin recommends the antennas shown in Table 1-8. However, any equivalent antenna that meets the specifications listed in Table 1-9 will work with the G5.

The G5 can receive GPS position information using the unit's internal antenna or by connecting an external antenna. It is recommended to verify the ability of the G5 to receive GPS information via the unit's internal antenna as GPS reception quality is dependent upon the installation. The G5 will share GPS information with any connected GDU 37X or GDU 4XX.

The G5 can additionally receive GPS position information from a GPS 20A, GDU 37X, or GDU 4XX. A minimum of one GPS antenna is required for G5 installations receiving GPS information from another LRU. Additional GPS antennas may be used for redundancy, but are not required.

A GPS 20A (and connected GPS/WAAS antenna) can be used as the sole GPS source for a G3X system, however it is recommended to also install a GPS antenna on a G5 or GDU 37X/4XX for redundancy. If the G5's GPS receiver is not used in a particular installation, it may be disabled in configuration mode (see Section 1.7.4.11).

The GPS receiver in the G5 is WAAS enabled, therefore, any antenna meeting the specifications in Table 1-9 is capable of receiving both GPS and WAAS signals when connected to the G5. However, only the GA35 and GA36 meet the requirements of TSO/ETSO-C144.

1.4.1 NON-GARMIN ANTENNAS

Table 1-7 lists non-Garmin antennas currently supported by the G5. For non-Garmin antennas, follow the manufacturer's installation instructions. It is the installer's responsibility to ensure that their choice of antenna meets FAA standards according to the specific installation.

Table 1-7 Supported Non-Garmin Antennas

Model	Mount Style	Conn Type	Antenna Type	Mfr	Antenna Part Number	Garmin Order Number
Comant 2480-201 VHF/GPS*	Screw Mount, Teardrop Footprint	BNC/TNC*	VHF COM/GPS	Comant	CI 2480-201	N/A

*The GPS antenna connector is TNC type. The VHF COM antenna connector is BNC type.

1.4.2 GARMIN ANTENNAS



NOTE: See the G3X Install Manual (190-01115-01) for detailed GPS antenna installation information. All antenna mounting and unit installation recommendations applicable to the GDU37X/4XX also apply to the G5.



NOTE: It is the installer's responsibility to ensure that their choice of antenna meets FAA standards according to the specific installation.

Table 1-8 Supported Garmin Antennas

Model	Part Number	Install Manual	Mounting Configuration
GA26C	011-00149-04	190-00082-00	Flange, Magnetic, or Suction Cup Mounts (in-cabin)
GA35	013-00235-0X	190-00848-00	Thru-Mount (tear drop form factor)
GA36	013-00244-0X	190-00848-00	Thru-Mount (ARINC 743 form factor)
GA56	011-00134-00	190-00094-00	Stud Mount (tear drop form factor)

Table 1-9 GPS Antenna Minimum Requirements

Characteristics	Specifications
Frequency Range	1565 to 1585 MHz
Gain	16 to 25 dB typical, 40 dB max
Noise Figure	Less than 4.00 dB
Nominal Output Impedance	50 Ω
Supply Voltage	4.5 to 6.5 VDC
Supply Current	up to 60 mA

1.5 G5 PINOUT

Use the information in this section (along with other applicable sections/appendices in this document) to construct the wiring required for the G5 installation.

1.5.1 J51

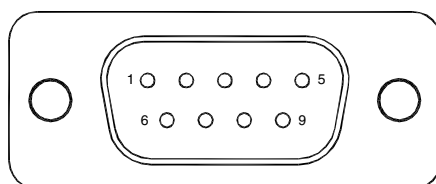


Figure 1-14 J51 on the G5

Table 1-10 J51 Pin Descriptions

Pin	Pin Name	I/O
1	CAN-H	I/O
2	CAN-L	I/O
3	UNIT ID	In
4	RS-232 RX 1	In
5	RS-232 TX 1	Out
6	SIGNAL GROUND	--
7	AIRCRAFT POWER 1	In
8	AIRCRAFT POWER 2	In
9	POWER GROUND	--

1.5.1.1 AIRCRAFT POWER

The G5 can operate using power from one or both inputs (AIRCRAFT POWER 1 and AIRCRAFT POWER 2). The pins are internally connected using diodes to prevent current from flowing between the two power inputs. AIRCRAFT POWER 2 is for connecting to an alternate power source, such as on aircraft with two electrical buses.

1.5.1.2 RS-232

The G5 has one RS-232 channel that may be used to output and/or receive data from another device. Refer to Section 1.7.4.9 for detailed information.

1.5.1.3 CAN BUS

The G5 CAN bus conforms to the BOSCH standard for Controller Area Network 2.0-B and ISO 11898. See Section 1.2.2.3 for details. The CAN bus connection on the G5 can be used for the following:

- Connection to the G3X system
- G5/G5 interconnect (non-G3X system)
- G5/GSA 28 interconnect (non-G3X system)
- G5/GAD 29 interconnect (non-G3X system)

1.5.1.4 UNIT ID

The G5 detects its assigned unit type at startup by checking the UNIT ID pin. This pin can be strapped into the following configurations. A maximum of two G5 units may be used in a single installation.

Table 1-11 Unit ID Configurations

Unit ID	Comment
G5 #1	Leave pin 3 unconnected
G5 #2	Ground pin 3 to pin 6 or pin 9

1.6 G5 INTERCONNECT DRAWINGS

NOTES:

1. UNLESS OTHERWISE NOTED, ALL STRANDED WIRE MUST CONFORM TO MIL-W-22759/16 OR EQUIVALENT.
2. UNLESS OTHERWISE NOTED, ALL SHIELDED WIRE MUST CONFORM TO MIL-C-27500 OR EQUIVALENT.
3. UNLESS OTHERWISE NOTED, ALL WIRES ARE 22 GAUGE MINIMUM.
4. SYMBOL DESIGNATIONS



TWISTED SHIELDED 3 CONDUCTOR
SHIELD TERMINATED TO GROUND



TWISTED SHIELDED PAIR
SHIELD TERMINATED TO GROUND



GARMIN SHIELD BLOCK GROUND



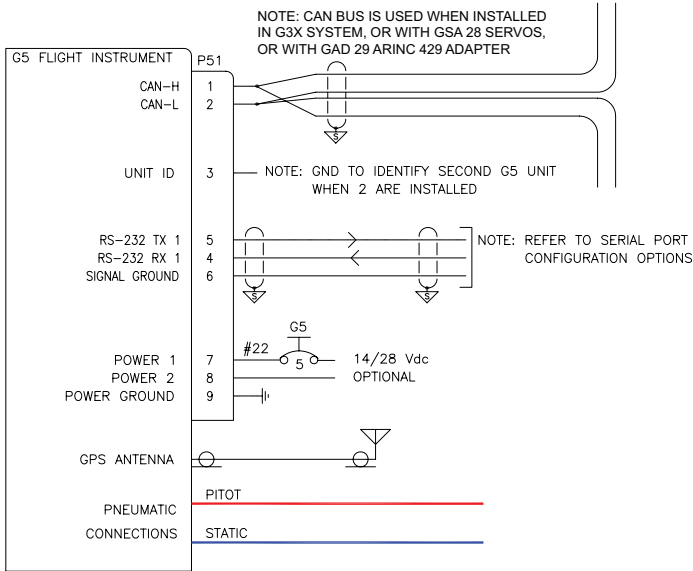
AIRCRAFT GROUND



COAXIAL CABLE

5. UNLESS OTHERWISE NOTED, ALL SHIELD GROUNDS MUST BE MADE TO THE RESPECTIVE UNIT BACKSHELLS. ALL OTHER GROUNDS SHOULD BE TERMINATED TO AIRCRAFT GROUND AS CLOSE TO THE RESPECTIVE UNIT AS POSSIBLE.
6. REFER TO THE G3X INSTALLATION MANUAL (190-01115-01) FOR INSTALLATION AND WIRING GUIDANCE FOR ALL LRUS EXCEPT THE G5.
7. A GAD 29 A429 INTERFACE CONNECTED TO THE CAN BUS IS REQUIRED WHEN A GNS 4XX/5XX OR A GTN 6XX/7XX NAVIGATOR IS USED.

Figure 1-15 G5 Interconnect Notes



CONFIGURATION GUIDANCE

1. G3X

- A. NO CONFIGURATION REQUIRED

2. G5

- A. SELECT STANDALONE CONFIGURATION WHEN NOT USED WITH G3X SYSTEM

Figure 1-16 G5 Interconnect Diagram

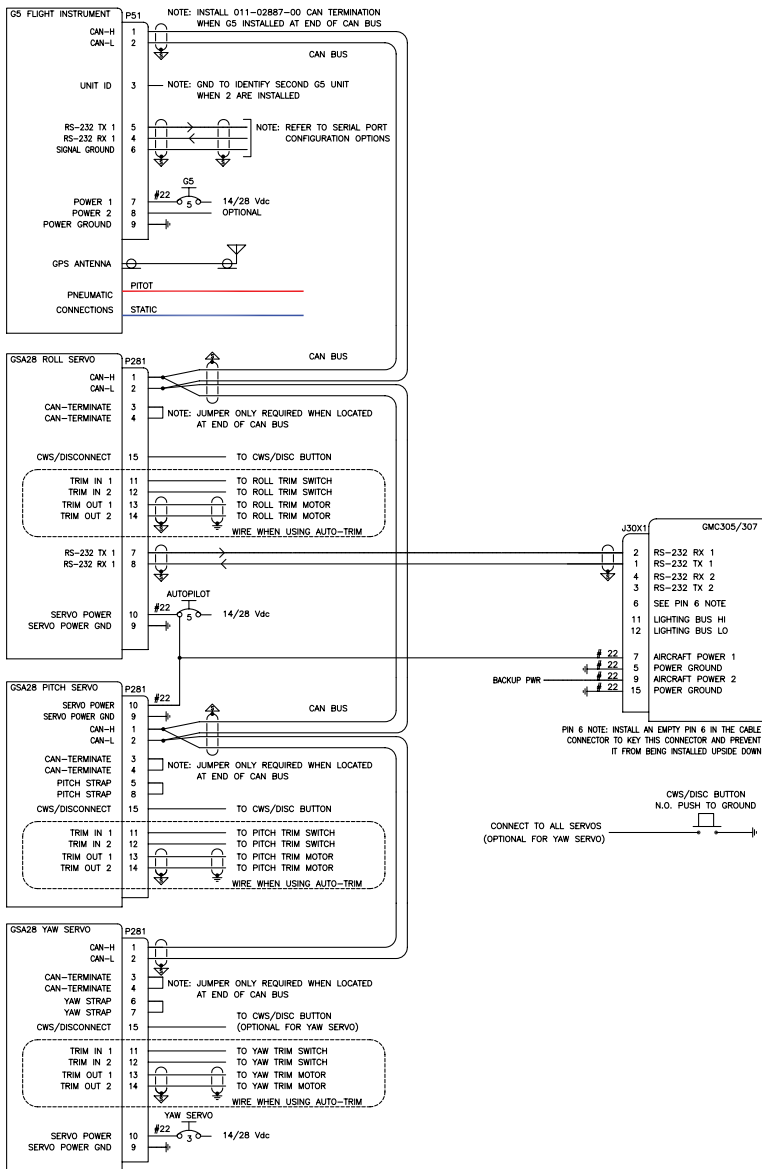


Figure 1-17 G5 with Autopilot Interconnect Diagram

1.7 G5 CONFIGURATION AND POST INSTALLATION CHECKOUT

The checkout procedures in this section are recommended to be performed after installing the G5. The calibration procedures are required to be performed after installing the G5. It is assumed that the person performing these checks is familiar with the aircraft, has a working knowledge of typical avionics systems, and has experience using the test equipment defined in this section.



NOTE: See Section 2 Pilot's Guide for G5 operational instructions.



NOTE: Some procedures in this section require that the GPS receiver is receiving sufficient satellite signal to compute a present position. This requires outdoor line-of-site to GPS satellite signals or a GPS indoor repeater.



NOTE: As these procedures involve engine run-up and moving the aircraft, it is recommended that the installer read this entire section before beginning the checkout procedure.



NOTE: All test equipment should have current calibration records.



CAUTION: Be sure to check all aircraft control movements before flight is attempted to ensure that the wiring harness does not touch any moving part.

1.7.1 RECOMMENDED TEST EQUIPMENT

The following test equipment is recommended to conduct and complete all post installation checkout procedures in this section:

- Pitot/static ramp tester
- Digital Multi-Meter (DMM)
- Ground power unit capable of supplying 14/28 Vdc power to the aircraft systems and avionics
- Outdoor line-of-sight to GPS satellite signals or GPS indoor repeater
- Digital Level or equivalent

1.7.2 CONFIGURATION MODE

All of the configuration and calibration procedures in this section are performed in configuration mode. To enter configuration mode, hold down the knob while powering on the G5.

1.7.3 SOFTWARE LOADING PROCEDURE

G5 software loading can be performed in either normal or configuration mode. Manually loading software to the G5 is not required when the G5 is installed as part of a G3X system.

- 1) Power on the G5, then insert a properly formatted microSD™ card into the microSD™ card slot.



NOTE: *It is also acceptable to insert the microSD™ card before powering on the unit.*

- 2) A software update pop-up will appear on the screen, select OK to begin the update.



NOTE: *The software update pop-up will only be displayed if the version of software to be loaded is newer than the version currently on the unit.*

- 3) The unit will reboot to the software update screen and the software update will begin automatically. This screen will show the progress of the software update.

- 4) Ensure power is not removed while the update is being performed.
- 5) The unit will reboot after the update is complete.
- 6) The new software version will be displayed while the unit powers on or in the configuration mode menu.

1.7.4 CONFIGURATION PAGES

1.7.4.1 DEVICE INFORMATION PAGE



NOTE: When a G5 is installed as part of a G3X system, some configuration pages are not available because configuration settings are automatically transferred from the GDU displays to the G5.

The Device Information Page is used to display LRU (device) specific information such as the software versions of devices connected to the G5. The devices listed on this page are dependent upon the installation type (G3X System Backup or Standalone Instrument). Faults are indicated by a red "X" next to the affected LRU.

1.7.4.2 ATTITUDE AND AIR DATA CONFIGURATION PAGES

There are two configuration pages for the G5 Attitude and Air Data, these pages are used to configure user display preferences and to complete the post-installation calibration procedures.

Attitude Sensors: (standalone installation only) Select "Disabled" to disable the G5's internal air data sensors and hide airspeed, altitude, and vertical speed information on the PFD. This option is intended for G5 installations where the pitot/static inputs are not connected.

Vertical Speed Indicator: From the Air Data Page in configuration mode, the Vertical Speed Indicator can be configured to display +/- 1500 fpm, +/- 2000 fpm, or +/- 3000 fpm

1.7.4.2.1 G5 POST-INSTALLATION CALIBRATION PROCEDURES

After mechanical and electrical installation of the G5 has been completed, prior to operation, a set of post-installation calibration procedures must be carried out. Table 1-12 describes the required and optional calibration procedures.

Table 1-12 Post-Installation Calibration Procedure Summary

Calibration Procedure	Procedure Name	Procedure Description	Installations Requiring Procedure
A	Pitch/Roll Offset Compensation	Level aircraft	Procedure A is required for all installations
B	Engine Run-Up Vibration Test	Validate vibration characteristics of installation	Procedure B is required for all installations
C	Air Data Static Pressure Calibration	Altitude re-calibration	Procedure C is only used when the G5 has failed a periodic altimeter test

1.7.4.2.2 CALIBRATION PROCEDURE A: PITCH/ROLL OFFSET COMPENSATION BY AIRCRAFT LEVELING



NOTE: This procedure requires orienting the aircraft to normal flight attitude. This can be done by using jacks or placing wood blocks under the nose-wheel, for example. As another example, if the number of degrees 'nose high' the aircraft flies in straight and level cruise is known, a digital level can be used to orient the aircraft to normal flight attitude prior to the calibration.



NOTE: The G5 must be leveled within 30.0° of the aircraft in-flight level cruise attitude. In-flight level cruise attitude is not necessarily the same as the level reference provided by the manufacturer (such as fuselage longerons).

- 1) Select the Attitude configuration page.
- 2) Select Calibrate Pitch/Roll.

- 3) Ensure that aircraft and the unit comply with all on-screen instructions then select Start.
- 4) A progress screen will then be displayed. There is a 30 second countdown timer for the procedure that resets when the aircraft moves.
- 5) When the calibration is complete, a successful status message will be displayed along with the new pitch and roll offsets.



NOTE: The pilot may adjust the displayed pitch attitude in normal mode. The maximum amount of pitch display adjustment available in normal mode is $\pm 5.0^\circ$. This feature should not be used to compensate for a non-conforming installation that does not meet the requirements of the pitch/roll offset compensation calibration procedure.



NOTE: In a G3X system, or a non-G3X system with multiple G5 units, if the pitch/roll offset procedure is performed for one unit, it should be performed on all other G3X AHRS units or G5 units before moving the aircraft.

1.7.4.2.3 CALIBRATION PROCEDURE B: ENGINE RUN-UP VIBRATION TEST



NOTE: Calibration Procedure B is required for all installations to validate the vibration characteristics of the installation.

Passing the Engine Run-Up Vibration test does not remove the requirement to rigidly mount the G5. The Engine Run-Up Vibration Test is intended to help discover mounting issues but successful completion of the test does not validate the mounting of the G5, and does not account for all possible vibration profiles that may be encountered during normal aircraft operation

- 1) Select the Attitude configuration page.
- 2) Select Vibration Test.
- 3) Ensure the aircraft complies with all on-screen instructions, then select Start.
- 4) Gradually increase engine power from idle to full power and back over the course of 1-2 minutes. A progress screen will be displayed showing the status of the test.

- 5) Select Done when the test has been completed. Passing results will be indicated by a green check mark and failures will be indicated by a red "X". If failures are indicated, repeat the test. If failures persist, the installation should be considered unreliable until the source of the vibration problem is identified and remedied. Record the out of range limit values for future reference.

The following are potential causes for failures of the engine run-up test:

- a) Excessive flexing of the G5 mechanical mounting with respect to airframe (see Section 1.3.4.1 for applicable mounting requirements and instructions).
- b) Vibration or motion of the G5 caused by neighboring equipment and/or supports.
- c) Mounting of the G5 in a location that is subject to severe vibrations (e.g. close to an engine mount).
- d) Mounting screws and other hardware for G5 not firmly attached.
- e) Absence of recommended mounting supports.
- f) G5 connector not firmly attached to unit.
- g) Cabling leading to the G5 not firmly secured to a supporting structure.
- h) An engine/propeller combination that is significantly out of balance.



NOTE: *In some aircraft, attempting the engine run-up test on a day with very strong and/or gusty winds may cause the test to occasionally fail. However, windy conditions should not be taken as evidence that the test would pass in calm conditions; an actual pass is required before the installation can be considered adequate.*

1.7.4.2.4 CALIBRATION PROCEDURE C: AIR DATA STATIC PRESSURE CALIBRATION

The Air Data configuration page has a selection for static pressure calibration. This procedure is used to perform an altimeter re-calibration. The altitude pressure sensor used in the G5 is very low drift and does not typically require re-calibration.



NOTE: *This calibration is only used when the G5 fails a periodic altimeter test and should only rarely, if ever, be used.*

The static pressure calibration requires the use of a pressure control system (test set) with an altitude accuracy of at least ± 5 ft at sea level and ± 20 ft at 30,000 ft. It is necessary to re-calibrate to sea level (0 ft), 10,000 ft, 20,000 ft, and optionally to 30,000 ft. The operator is allowed to finish the calibration at the end of the 20,000 ft calibration if the 30,000 ft calibration is not desired.



CAUTION: *To avoid damaging the G5 pressure sensors, both the pitot and static ports must be connected to the test set.*

- 1) Select the Air Data configuration page.
- 2) Select Calibrate Static Pressure.
- 3) Ensure all on-screen instructions have been complied with, then press Start.
- 4) At each calibration point the display will present a screen indicating the pressure altitude to set. Once the altitude is set, select Ready to calibrate this pressure.
- 5) During the calibration at each pressure, the pressure must be held constant for 30 seconds for the calibration step to be successful. The calibration may be cancelled at any point should the test setup require adjustment before repeating. A progress screen will be displayed showing the status of the test.
- 6) Select Done when the static pressure calibration is successfully completed.

1.7.4.3 FLIGHT CONTROLS CONFIGURATION PAGE

1.7.4.3.1 GENERAL AUTOPILOT DESCRIPTION

The GSA 28 based autopilot system is a fully integrated, high performance autopilot that can control up to three axes of an aircraft. Each GSA 28 servo is also capable of managing the trim control for its axis. The following four subsections (roll, pitch, yaw, and trim) are provided to aid the pilot/installer in understanding/configuring the Garmin GSA 28 autopilot system.

A GMC 30X is required to use the G5 autopilot controls.

Roll Servo

All GSA 28 autopilot systems require a servo to control the roll axis of an aircraft. A single axis GSA 28 installation that controls only the roll axis is sometimes referred to as a "wing-leveler".

The roll servo follows roll steering commands from the G5 so the airplane will hold a desired roll angle, follow a desired heading, or follow the lateral component of a flight plan.

During the flight test phase of the autopilot checkout, the roll servo aggressiveness will be adjusted to get the desired in-flight performance. The roll servo gain setting is used to set the aggressiveness of the roll servo. A larger number will cause the roll servo to more aggressively control the aircraft, and a smaller number will cause the roll servo to less aggressively control the aircraft.

Pitch Servo

Most GSA 28 autopilot systems consist of both a roll and pitch servo allowing for full 2-axis control of the aircraft.

The pitch servo follows vertical guidance commands from the G5 so the airplane will hold a desired pitch angle, vertical speed, airspeed, or altitude, or follow the vertical component of a flight plan.

Vertical control of the aircraft is all based on controlling the pitch angle with two additional sub-modes for vertical speed and airspeed. What this means is that the basic pitch mode performance must be properly adjusted before changing settings that adjust the vertical speed and airspeed based modes.



NOTE: Ensure pitch mode functionality is properly adjusted before attempting to adjust vertical speed or airspeed mode performance

During the flight test phase of the autopilot checkout, the pitch servo aggressiveness will be adjusted to get the desired in-flight performance. The pitch servo gain setting is used to set the aggressiveness of the pitch servo. A larger number will cause the pitch servo to more aggressively control the aircraft, and a smaller number will cause the pitch servo to less aggressively control the aircraft.

Yaw Damper

The GSA 28 autopilot system can be expanded to support a yaw damper. A yaw damper will control the rudder to try and compensate or remove aircraft body yaw (tail wagging). The yaw damper will also try to null the lateral acceleration (center the ball) over the long term. The ball centering portion of the yaw damper is not a replacement for proper rudder trim.



NOTE: Yaw damper functionality requires a GMC 30X mode control panel with a YD button.

During the flight test phase, the yaw damper is configured and set up after the basic two axis pitch and roll performance has been properly configured. This is done so the pilot can focus on properly adjusting the performance of each individual component of the autopilot system without trying to tune them all at once.



NOTE: Ensure basic autopilot functionality is properly adjusted before using the yaw damper.

During the flight test phase of the autopilot checkout, the yaw servo aggressiveness will be adjusted to get the desired in-flight performance. The yaw servo gain setting is used to set the aggressiveness of the yaw servo. A larger number will cause the yaw servo to more aggressively control the aircraft, and a smaller number will cause the yaw servo to less aggressively control the aircraft.

Trim Control

The GSA 28 autopilot servos can be used to control the trim system in an aircraft. When the autopilot is disengaged, the servos can adjust the trim speed based on the current aircraft airspeed. This allows the trim to run slower at high airspeeds and faster at low airspeeds. When the autopilot is engaged in the air, the servos can adjust the trim control to minimize the force on the primary controls. This helps ensure the aircraft will be properly trimmed when the autopilot is later disengaged.

During the flight test phase, the trim system is configured and set up after the primary autopilot performance has been properly configured. This is done so the pilot can focus on properly adjusting the performance of the primary autopilot system without having the autotrim functionality interfere.



NOTE: *Ensure basic autopilot functionality is properly adjusted before enabling trim control for any servo.*

1.7.4.3.2 ON GROUND INITIAL CHECKOUT



NOTE: *The following post installation checkout must be followed after every completed installation. These steps should be followed when using a Garmin mounting kit or non-Garmin mounting parts to install the GSA 28.*

After mounting the GSA 28, please complete the following steps prior to completing the first flight with the GSA 28.

- 1) Verify that the flight controls can move from stop to stop without binding or interference. Check that the GSA 28 output mechanism and added linkage do not come in contact with any part of the airframe while traveling through its full range of motion.
- 2) Verify that the travel of the flight controls is being limited by the airplane's primary stops and not the secondary stops provided by the GSA 28 stop bracket.
- 3) Ensure the structural integrity of the mounting bracket is adequate for the application and well secured to the airframe. Bracket deflection caused by normal servo loading and aircraft acceleration/vibration should be minimal. Also verify there are no cracks or sharp inside corners that could lead to fatigue failures.
- 4) Verify the fasteners used to mount the servo to the airframe are installed and have been tightened.
- 5) Make sure the AP DISC wire is correctly wired and tested.
- 6) If powering the servo through a "pullable" circuit breaker (recommended), ensure the circuit breaker is both accessible and easily identifiable to the pilot.
- 7) Repeat steps 1-6 for all GSA 28 servos in the aircraft.

1.7.4.3.3 STEP BY STEP ON-GROUND SETUP

Servo Wiring Checkout

The first phase of setting up the autopilot system is to verify the proper wiring of the GSA 28 servos while on the ground.

- 1) If the installation is a 1-axis (roll only) autopilot, use the Flight Controls configuration page to configure the autopilot servos for roll only.
- 2) If the installation is a 2-axis (pitch and roll) autopilot, use the Flight Controls configuration page to configure the autopilot servos for pitch and roll.
- 3) If the installation is a 3-axis (pitch, roll, and yaw) autopilot, use the Flight Controls configuration page to configure the autopilot servos for pitch and roll and enable the yaw damper.
- 4) Ensure the pitch, roll, and yaw servos are properly communicating by checking the Device Information configuration page. Each device should have a green check mark next to it.
- 5) Select the Autopilot Roll Servo configuration page and verify the proper trim activity with the servo connected to an auxiliary trim motor.
 - a) Center the aileron trim switch to input no trim command. Verify the aileron trim switch is not moving. Verify the roll servo is properly indicating no trim activity.
 - b) Use the aileron trim switch to input a roll right trim command. Verify the aileron trim switch properly moves for roll right trim. Verify the roll servo is properly indicating roll right trim activity.
 - c) Use the aileron trim switch to input a roll left trim command. Verify the aileron trim switch properly moves for roll left trim. Verify the roll servo is properly indicating roll left trim activity.
 - d) If the aileron trim response is reversed, select Reverse for the Trim Motor Direction, then repeat all of step 5.
- 6) Select the Autopilot Pitch Servo configuration page and verify the proper trim activity with the servo connected to an auxiliary trim motor.
 - a) Center the elevator trim switch to input no trim command. Verify the elevator trim switch is not moving. Verify the pitch servo is properly indicating no trim activity.

- b) Use the elevator trim switch to input a nose up trim command. Verify the elevator trim switch properly moves for nose up trim. Verify the pitch servo is properly indicating nose up trim activity.
 - c) Use the elevator trim switch to input a nose down trim command. Verify the elevator trim switch properly moves for nose down trim. Verify the pitch servo is properly indicating nose down trim activity.
 - d) If the elevator trim response is reversed, select Reverse for the Trim Motor Direction, then repeat all of step 6.
- 7) Select the Yaw Damper configuration page and verify the proper trim activity with the servo connected to an auxiliary trim motor.
 - a) Center the aircraft rudder trim switch to input no trim command. Verify the rudder trim switch is not moving. Verify the yaw servo is properly indicating no trim activity.
 - b) Use the rudder trim switch to input a yaw right trim command. Verify the rudder trim switch properly moves for yaw left trim. Verify the yaw servo is properly indicating yaw right trim activity.
 - c) Use the rudder trim switch to input a yaw left trim command. Verify the rudder trim switch properly moves for yaw left trim. Verify the yaw servo is properly indicating yaw left trim activity.
 - d) If the rudder trim response is reversed, select Reverse for the Trim Motor Direction, then repeat all of step 7.
- 8) Select the Autopilot Roll Servo configuration page to configure the servo direction.
 - a) Set the Servo Direction to Normal. The servo arm should move clockwise to cause a bank left aileron movement and the servo arm should move counterclockwise to cause a bank right aileron movement.
 - b) Set the Servo Direction to Reverse. The servo arm should move clockwise to cause a bank right aileron movement and the servo arm should move counterclockwise to cause a bank left aileron movement.

- 9) Select the Autopilot Pitch Servo configuration page to configure the servo direction.
- a) The Servo Direction should be set to Normal. The servo arm should move clockwise to cause a nose down elevator movement and the servo arm should move counterclockwise to cause a nose up elevator movement.
 - b) The Servo Direction should be set to Reverse and the servo arm should move clockwise to cause a nose up elevator movement and the servo arm should move counterclockwise to cause a nose down elevator movement.
- 10) Select the Yaw Damper configuration page to configure the servo direction.
- a) The Servo Direction should be set to Normal. The servo arm should move clockwise to cause a nose left rudder movement and servo arm should move counterclockwise to cause a nose right rudder movement.
 - b) The Servo Direction should be set to Reverse. The servo arm should move clockwise to cause a nose right rudder movement and the servo arm should move counterclockwise to cause a nose left rudder movement.
- 11) Set the Trim Motor Control to Disabled using the Autopilot Roll Servo, Autopilot Pitch Servo, and Yaw Damper configuration pages as applicable.



NOTE: *Initial autopilot tuning is done with the trim control disabled to avoid the autotrim function from interfering with the initial autopilot tuning.*

- a) By disabling the trim motor control, this will disable autotrim and airspeed scheduled trim, but the pilot can still control trim in the aircraft using the normal manual electric trim inputs. Autotrim and airspeed scheduled trim will be setup later in the autopilot setup procedure.
- 12) The proper minimum and maximum airspeed limits for the pitch servo can be set in the Autopilot Pitch Servo configuration page. The pitch servo will lower or raise the nose of the aircraft to try and keep it inside these airspeed limits.
- a) The minimum airspeed limit should be set above the stall speed of the aircraft with some margin.
 - b) The maximum airspeed limit should be set below the never exceed speed of the aircraft with some margin.

1.7.4.3.4 AUTOPILOT SETUP

The next phase of setting up the Garmin autopilot system is to verify the proper functionality of the autopilot system on the ground in normal mode. This phase of the checkout requires a valid ground track and pitch output from the G5. This means the post installation procedures must have already been completed on the G5 before performing the on ground autopilot normal mode checkout.

- 1)** Leave the autopilot disengaged and verify the controls can be manipulated smoothly with no control system binding.
- 2)** Engage the autopilot in TRK/PIT mode and command a nose down, left bank.
 - a)** Press the AP button on the GMC 30X.
 - b)** Press the HDG button on the GMC 30X.
 - c)** Push the knob on the G5 to access the menu.
 - d)** Select Track from the menu on the G5.
 - e)** Push and hold the knob on the G5 to center the HDG bug.
 - g)** Rotate the knob on the G5 counterclockwise to command a left turn.
 - g)** Rotate the wheel on the GMC 30X down to command a pitch downward.
- 3)** Verify the stick properly moves in a direction that would cause the aircraft to pitch down and roll to the left smoothly with no control system binding.
- 4)** Engage the autopilot in TRK/PIT mode and command a nose down, right bank.
 - a)** Press the AP button on the GMC 30X.
 - b)** Press the HDG button on the GMC 30X.
 - c)** Push the knob on the G5 to access the menu.
 - d)** Select Track from the menu on the G5.
 - e)** Push and hold the knob on the G5 to center the HDG bug.
 - f)** Rotate the knob on the G5 clockwise to command a right turn.
 - g)** Rotate the wheel on the GMC 30X down to command a pitch downward.
- 5)** Verify the stick properly moves toward the nose and toward the right wing smoothly with no control system binding.

- 6)** Engage the autopilot in TRK/PIT mode and command a nose up, right bank.
 - a)** Press the AP button on the GMC 30X.
 - b)** Press the HDG button on the GMC 30X.
 - c)** Push the knob on the G5 to access the menu.
 - d)** Select Track from the menu on the G5.
 - e)** Push and hold the knob on the G5 to center the HDG bug.
 - f)** Rotate the knob on the G5 clockwise to command a right turn.
 - g)** Rotate the wheel on the GMC 30X up to command a pitch upwards.
- 7)** Verify the stick properly moves toward the tail and toward the right wing smoothly with no control system binding.
- 8)** Engage the autopilot in TRK/PIT mode and command a nose up, left bank.
 - a)** Press the AP button on the GMC 30X.
 - b)** Press the HDG button on the GMC 30X.
 - c)** Push the knob on the G5 to access the menu.
 - d)** Select Track from the menu on the G5.
 - e)** Push and hold the knob on the G5 to center the HDG bug.
 - f)** Rotate the knob on the G5 counterclockwise to command a left turn.
 - g)** Rotate the wheel on the GMC 30X up to command a pitch upwards.
- 9)** Verify the stick properly moves toward the tail and toward the left wing smoothly with no control system binding.
- 10)** If the stick position does not move in the correct direction, correct the roll and pitch servo directions documented in the Servo Wiring Checkout.
- 11)** Engage the autopilot and verify it can be overpowered in both the pitch and roll axis. If the autopilot cannot be overpowered, use the Autopilot Roll Servo and Autopilot Pitch Servo configuration pages to reduce the Maximum Torque setting for the associated servo.
- 12)** Engage the autopilot and verify that it properly disconnects with a short press and release of the CWS/DISCONNECT button.

1.7.4.3.5 YAW DAMPER SETUP

The next phase of setting up the Garmin autopilot system is to verify the proper functionality of the yaw damper system on the ground in normal mode. This phase of the checkout requires a valid output from the G5. This means the post installation procedures must have been completed on the G5 before performing the on ground autopilot normal mode checkout.

- 1) Leave the yaw damper disengaged and verify the rudder pedals can be manipulated smoothly with no control system binding.
- 2) Engage the autopilot in YD mode.
- 3) Press the YD button on the GMC 30X.
- 4) Verify the rudder properly moves to the correct direction by standing by the tail of the aircraft, facing the vertical stabilizer, and pushing on the fuselage. The rudder should move AWAY from you (the rudder should move in the same direction that the rear fuselage is moving):
 - a) If the rudder does not move the correct direction, correct the yaw servo direction documented in the Servo Wiring Checkout.
- 5) Engage the yaw damper and verify it can be overpowered in the yaw axis using rudder pedal inputs. If the autopilot cannot be overpowered, use the Yaw Damper configuration page to reduce the Maximum Torque setting for the yaw damper servo.
- 6) The CWS/DISCONNECT input can optionally be connected to the Yaw Damper. If this connection was made, engage the yaw damper and verify that it properly disconnects with a short press and release of the CWS/DISCONNECT button.

1.7.4.3.6 STEP BY STEP IN-AIR AUTOPILOT SETUP

The next phase of setting up the Garmin autopilot system is to verify and tune the proper functionality of the autopilot system while airborne. Refer to Section 1.7.4.3.1 for general autopilot use and functionality.



WARNING: *This stage of the flight test involves allowing the GSA 28 autopilot servos to manipulate the flight control surfaces of the aircraft. Extreme caution should be used during the initial engagement of the autopilot system. The pilot should always have easy access to the autopilot disconnect button to disconnect the autopilot and take control of the aircraft at anytime.*

At a minimum, please follow the following safety guidelines before the initial autopilot engagement:

- Quick access to autopilot disconnect
- Safe altitude above and away from all terrain and obstacles
- No air traffic in the area
- Safe airspeed below maneuvering speed (VA)



NOTE: *If desired, in the following procedures, the expert configurations can be accessed from the Autopilot Roll Servo, Autopilot Pitch Servo, and Yaw Damper configuration pages.*

Roll Servo

- 1) Use the Setup page in normal mode to adjust the roll servo gain setting.
 - a) Engage the autopilot in ROL/PIT mode with the aircraft approximately level.
 - i) Press the AP button on the GMC 30X to engage the AP.
 - ii) Press the YD button on the GMC 30X to DISENGAGE the YD.
 - b) Press the knob of the G5 to access the menu.
 - c) Select Setup from the menu.
 - d) Select the Autopilot Roll Servo page.
 - e) Select the Servo Gain entry.
 - f) Adjust the servo gain so that the aircraft properly responds to the roll guidance from the flight director.

- i) Overpower the autopilot to fly away from the current flight director commanded roll.
 - ii) Release the controls and monitor the autopilot response and closure back to the commanded roll.
 - iii) Set the servo gain higher to make the autopilot more aggressive.
 - iv) Set the servo gain lower to make the autopilot less aggressive.
- 2) The roll servo has additional expert configurations that can be adjusted to achieve the desired lateral mode performance. These settings are detailed in Table 1-14 and should only be adjusted after studying the descriptions to properly understand their effect on the roll servo.

Pitch Servo

- 1) Use the Setup page in normal mode to adjust the pitch servo gain setting.
- a) Engage the autopilot in ROL/PIT mode with the aircraft approximately level.
 - i) Press the AP button on the GMC 30X to engage the AP.
 - ii) Press the YD button on the GMC 30X to disengage the YD.
 - b) Press the knob on the G5 to access the menu.
 - c) Select Setup from the menu.
 - d) Select the Autopilot Pitch Servo page.
 - e) Select the Servo Gain entry.
 - f) Adjust the servo gain so that the aircraft properly responds to the pitch guidance from the flight director.
 - i) Overpower the autopilot to fly away from the current flight director commanded pitch.
 - ii) Release the controls and monitor the autopilot response and closure back to the commanded pitch.
 - iii) Set the servo gain higher to make the autopilot more aggressive.
 - iv) Set the servo gain lower to make the autopilot less aggressive.
- 2) The pitch servo has additional expert configurations that can be adjusted to achieve the desired vertical mode performance. These settings are detailed in Table 1-15 and should only be adjusted after studying the descriptions to properly understand their effect on the pitch servo.

Pitch Servo Gain

The pitch servo gain settings should be configured only after the pitch/roll servo max torque and servo gains have been set per the preceding pages.

The minimum maximum airspeed limit entries set the limits of the autopilot vertical authority. The autopilot will limit the pitch control to stay within these airspeed limits.

The vertical speed gain entry is one of the most important gains in the system since it controls the behavior of the VNAV, ALT, and VS modes and also largely determines how well the plane flies approaches with vertical guidance.

The vertical speed gain is adjusted in a very similar manner to the pitch servo gain. Engage the autopilot in ROL/VS mode in level flight (vertical speed approximately zero).

Adjust the vertical speed gain so that the aircraft properly responds to the VS guidance from the flight director.

- 1) Overpower the autopilot to fly away from the current flight director commanded vertical speed.
- 2) Release the controls and monitor the autopilot response and closure back to the commanded vertical speed.
- 3) Set the vertical speed gain higher to make the autopilot more aggressive if it feels "lazy" or not as responsive as desired.
- 4) Set the vertical speed gain lower to make the autopilot less aggressive if the control is too "harsh" or more responsive than desired.

The vertical acceleration gain can often be left set at 1.00, but can be used to improve altitude captures when climbing or descending in VS or VNAV mode.

- 1) Climb to an altitude target in VS mode and observe the altitude capture.
- 2) Set the vertical acceleration gain higher if the aircraft objectionably overshoots the altitude target before leveling off at the correct altitude.
- 3) Set the vertical acceleration gain lower if the aircraft objectionably undershoots the altitude target before leveling off at the correct altitude.

Similar to the vertical speed gain, the airspeed gain can be used to improve airspeed hold performance when needed.

Pitch Gain has advanced and expert configurations that can be adjusted to achieve the desired performance. These settings are detailed in Table 1-15 and should only be adjusted after studying the descriptions to properly understand their effect on pitch gain.

Yaw Damper Setup

The next phase of setting up the Garmin yaw damper system is to verify and tune the proper functionality of the yaw damper system in the air.



WARNING: *This stage of the flight test involves allowing the GSA 28 autopilot servos to manipulate the flight control surfaces of the aircraft. Extreme caution should be used during the initial engagement of the autopilot system. The pilot should always have easy access to the autopilot disconnect button to disconnect the autopilot and take control of the aircraft at anytime.*

At a minimum, please follow the following safety guidelines before the initial autopilot engagement:

- Quick access to autopilot disconnect
 - Safe altitude above and away from all terrain and obstacles
 - No air traffic in the area
 - Safe airspeed below maneuvering speed (VA)
- 1) Use the Setup page in normal mode to adjust the yaw damper gain setting.
 - a) Press the knob on the G5 to access the menu.
 - b) Select Setup from the menu.
 - c) Select the Yaw Damper page.
 - d) Select the Servo Gain entry.

- e) Adjust the servo gain so that the aircraft properly responds to the yaw body rates (tail wagging).
 - i) Engage the autopilot in LVL mode with the aircraft approximately level.
 - ii) Press the LVL button on the GMC 30X to engage the AP in LVL mode.
 - iii) Press the YD button on the GMC 30X to disengage the YD.
 - iv) Fly a yaw doublet and engage the YD as the ball swings through the center.
 - 1) Use the right foot rudder to swing the ball left.
 - 2) Use the left foot rudder to swing ball back right.
 - 3) Engage the YD by pressing the YD button on the GMC 30X as the ball swings through the center.
 - 4) Set the servo gain so the established yaw body rate from the yaw doublet is properly dampened out.
 - a) Set the servo gain higher to make the yaw damper more aggressive (if needed).
 - b) Set the servo gain lower to make the yaw damper less aggressive (if needed).
- 2) The yaw servo has additional expert configurations that can be adjusted to achieve the desired yaw damping performance. These settings are detailed in Table 1-16 and should only be adjusted after studying the descriptions to properly understand their effect on the yaw servo.

1.7.4.3.7 STEP BY STEP TRIM SYSTEM SETUP

On-ground Setup

After setting up and testing the GSA 28 based autopilot and yaw damper systems, the pilot can configure the trim system.

- 1) Set the Trim Motor Control to Enabled using the Autopilot Roll Servo, Autopilot Pitch Servo, and Yaw Damper configuration pages for all servos that are connected to auxiliary trim motors.
 - a) The recommended setting the Fastest Trim Motor Speed is 100% (this value will be adjusted during the in air setup).
 - b) The recommended setting the Slowest Trim Motor Speed is 25% (this value will be adjusted during the in air setup).



NOTE: *The Maximum Trim Run Time entry allows optional configuration of a time limit for use with a manual electric trim. When the manual trim input switch is pressed, the electric trim motor will stop running after the time limit expires, and will not run again until the trim input switch is released and pressed again. This can help prevent "trim runaway" caused by a stuck trim input switch. If the maximum trim motor run time is not set, the electric trim motor will run indefinitely as long as the manual trim input switch is held. Trim run time has no effect on auto trim.*

- 2) Return to the Flight Controls configuration page to set the airspeed thresholds for the fastest and slowest trim movement.
 - a) The recommended setting for the Trim High Airspeed Threshold is the airspeed typically used to fly the normal aircraft landing pattern.
 - b) The recommended setting for the Trim Low Airspeed Threshold is the airspeed typically used for cruise flight.
- 3) Re-verify proper trim movement in described in Section 1.7.4.3.3.

1.7.4.3.8 IN AIR SETUP

The next phase of setting up the GSA 28 based trim control system is to verify and set the proper functionality of the trim system in the air. Refer to Section 1.7.4.3.1 for general autopilot use and functionality.



WARNING: *This stage of the flight test involves allowing the GSA 28 autopilot servos to manipulate the flight control surfaces of the aircraft. Extreme caution should be used during this phase of the flight test. The pilot should always have easy access to the autopilot disconnect button to disconnect the autopilot and take control of the aircraft at anytime.*

At a minimum, please follow the following safety guidelines before the initial autopilot engagement:

- Quick access to autopilot disconnect
 - Safe altitude above and away from all terrain and obstacles
 - No air traffic in the area
 - Safe airspeed below maneuvering speed (VA)
- 1) Use the Setup page in normal mode to adjust the trim motor speed to get the desired manual electric trim response.
 - a) Press the knob on the G5 to access the menu.
 - b) Select Setup from the menu.
 - c) Note the low and high airspeed threshold settings on this page.
 - d) Select the Autopilot Roll Servo, Autopilot Pitch Servo, or Yaw Damper pages as applicable.
 - e) Adjust the trim motor speeds at the two airspeed thresholds to get a desirable trim response.
 - i) Trim aircraft using manual electric trim inputs
 - ii) Trim response should not be overly slow
 - iii) Trim response should not be overly fast

1.7.4.3.9 AUTOPILOT CONFIGURATION OPTIONS

The installer needs to make the following autopilot configuration selections when setting up the GSA 28 based autopilot system.

Flight Controls Configuration Page

These selections are made in configuration mode using the Flight Controls page.

Table 1-13 Flight Controls Configuration Settings

Configuration Setting	Description
Control Wheel Steering	<p>The CWS/DISCONNECT discrete input to the GSA 28 servos is connected to a momentary pushbutton which can function either as a dedicated Autopilot Disconnect (AP DISC) button, or as a combined Autopilot Disconnect / Control Wheel Steering (AP/CWS) button.</p> <p>Regardless of configuration, a short press and release of the AP DISC or AP/CWS button will disengage the autopilot if it is engaged.</p> <p>If Control Wheel Steering is enabled, pressing and holding the AP/CWS button places the autopilot into CWS mode. In CWS mode, the servos are temporarily disengaged, allowing hand-flying of the aircraft to a new aircraft attitude while the AP/CWS button is held. When the AP/CWS button is released, the autopilot exits CWS mode and the flight director synchronizes to the current aircraft attitude (if applicable for the current flight director mode).</p> <p>If Control Wheel Steering is disabled, CWS is not supported and the AP button serves as a dedicated AP DISC button only. The AP DISC button will disconnect the autopilot any time it is pressed, regardless of how long it is held.</p>

<p>Engage AP Via CWS Input</p>	<p>If Control Wheel Steering is enabled, the AP/CWS button can optionally be configured to engage the autopilot when pressed and held.</p> <p>If Engage AP Via CWS Input is enabled, the autopilot will automatically engage when the AP/CWS button is pressed and held.</p> <p>If Engage AP Via CWS Input is disabled, pressing the AP/CWS button while the autopilot is not engaged has no effect. In this state, the autopilot can only be engaged using the GMC 30X AP button.</p>
<p>Trim Airspeed Thresholds</p>	<p>The GSA 28 servos are capable of airspeed scheduling the aircraft's manual electric trim.</p> <p>The Airspeed Threshold Fastest Movement setting is the airspeed in which the trim motor will be moved at its fastest setting. This should be the lower of the two airspeeds.</p> <p>The Airspeed Threshold Slowest Movement setting is the airspeed in which the trim motor will be moved at its slowest setting. This should be the higher of the two airspeeds.</p>

Roll Servo Configuration Page

The installer needs to make the following roll servo configuration selections when setting up the GSA 28 based autopilot system. All selections are available in configuration mode using the Autopilot Roll Servo Configuration page. Selections available in the normal mode Setup menu are noted with an asterisk in Table 1-14.

Table 1-14 Autopilot Roll Servo Configuration Settings

Configuration Setting	Description
Maximum Torque*	<p>The GSA 28 roll servo has a configurable maximum torque setting. This determines how much torque the servo will output before the electronic slip clutch begins to slip.</p> <p>The Maximum Torque setting should be set high enough to not slip during in-flight air loading, but low enough for the pilot to override the autopilot if required.</p> <p>The Maximum Torque setting can be adjusted from 15% to 100% in 5% steps.</p>
Servo Gain*	<p>The GSA 28 roll servo has a configurable servo gain setting. This determines how aggressively the roll servo will move the aileron surfaces.</p> <p>The Servo Gain should be set high enough to properly fly the desired roll, heading, and track, but low enough to avoid being overly aggressive in the aileron movements.</p> <p>The servo gain setting can be adjusted from 0.00 to 10.00 in steps of 0.05.</p>
Servo Direction	<p>The GSA 28 roll servo has a configurable servo direction.</p> <p>The Servo Direction should be set to Normal if a clockwise movement of the servo arm causes a bank left aileron movement.</p> <p>The Servo Direction should be set to Reverse if a counterclockwise movement of the servo arm causes a bank left aileron movement.</p> <p>After selecting the proper servo direction, the installer should engage the autopilot system in normal mode and verify proper aileron response by using TRK mode and rotating the track bug left and right of the current track.</p>

<p>Clutch Monitor</p>	<p>The GSA 28 roll servo has the ability to monitor itself for a stuck clutch situation.</p> <p>If the servo has a large amount of side loading (typically due to a capstan installation), this can occasionally lead to invalid stuck clutch failures.</p> <p>The Clutch Monitor should be enabled for all control arm installations.</p> <p>The Clutch Monitor can be disabled for capstan installations with larger side loads to prevent invalid stuck clutch failures.</p>
<p>Trim Motor Control</p>	<p>The GSA 28 roll servo has the ability to control an auxiliary roll trim motor.</p> <p>The Trim Motor Control should be enabled if the GSA 28 roll servo is connected to an auxiliary trim motor.</p> <p>The Trim Motor Control should be disabled if the GSA 28 roll servo is not connected to an auxiliary trim motor.</p>
<p>Trim Motor Direction</p>	<p>The GSA 28 roll servo has a configurable trim motor direction. Select the Normal or Reversed setting depending on which is required for the proper trim motor movement when using the aircraft trim motor switches on the ground with the autopilot disengaged (servos powered).</p>
<p>Trim Motor Speed</p>	<p>The GSA 28 roll servo will control the aileron trim on the aircraft.</p> <p>The Fastest Trim Motor Speed percentage is the speed at which the roll servo will run the auxiliary trim motor when at or below the corresponding airspeed.</p> <p>The Slowest Trim Motor Speed percentage is the speed at which the roll servo will run the auxiliary trim motor when at or above the corresponding airspeed.</p>

<p>Slowest Auto Trim Motor Speed (expert configuration)</p>	<p>The GSA 28 roll servo has the ability to drive the auxiliary trim motor at various speeds.</p> <p>The Slowest Auto Trim Motor Speed should be set so the auxiliary trim motor will move as slowly as possible. The slowest possible movement will ensure that there is no noticeable aircraft response when the auxiliary trim motor is run during autotrim.</p> <p>The Slowest Auto Trim Motor Speed can be adjusted from 5% to 100% in 5% steps.</p>
<p>Maximum Trim Run Time</p>	<p>The GSA 28 servos can limit the maximum continuous run time of the trim motor. This can be used to help prevent the potential for a trim runaway situation.</p> <p>The Maximum Trim Run Time Limit is the maximum amount of time the trim servo will be run continuously when a manual electric trim input is detected. If the maximum time is exceeded, the pilot will need to release the Manual Electric Trim (MET) control and then reassert it to continue running trim.</p>
<p>Fine Adjust Amount (expert configuration)</p>	<p>The GSA 28 roll servo is capable of making very small adjustments to fine tune the aileron position. The Fine Adjust Amount is the amount in which these adjustments are made. Use the Fine Adjust Amount and Fine Adjust Time to correct very small oscillations in the aircraft.</p> <p>Fine Adjust Amount is an expert configuration setting, and should generally be not be changed by the installer. The default value is 0.</p>
<p>Fine Adjust Time (expert configuration)</p>	<p>The GSA 28 roll servo is capable of making very small adjustments to fine tune the aileron position. The Fine Adjust Time is the rate in which these adjustments are made. Use the Fine Adjust Amount and Fine Adjust Time to correct very small oscillations in the aircraft.</p> <p>Fine Adjust Time is an expert configuration setting, and should generally be not be changed by the installer. The default value is 0.20.</p>

Pitch Servo Configuration Page

The installer needs to make the following pitch servo configuration selections when setting up the GSA 28 based autopilot system. All selections are available in configuration mode using the Autopilot Pitch Servo page. Selections available in the normal mode Setup menu are noted with an asterisk in Table 1-15.

Table 1-15 Autopilot Pitch Servo Configuration Settings

Configuration Setting	Description
Maximum Torque*	<p>The GSA 28 pitch servo has a configurable maximum torque setting. This determines how much torque the servo will output before the electronic slip clutch begins to slip.</p> <p>The Maximum Torque setting should be set high enough to not slip during in-flight air loading, but low enough for the pilot to override the autopilot if required.</p> <p>The Maximum Torque setting can be adjusted from 15% to 100% in 5% steps.</p>
Servo Gain*	<p>The GSA 28 pitch servo has a configurable servo gain setting. This determines how aggressively the pitch servo will move the elevator surfaces.</p> <p>The Servo Gain should be set high enough to properly fly the desired pitch, vertical speed, and altitude, but low enough to avoid being overly aggressive in the elevator movements.</p> <p>The servo gain setting can be adjusted from 0.00 to 10.00 in steps of 0.05.</p>

<p>Servo Direction</p>	<p>The GSA 28 pitch servo has a configurable servo direction. The Servo Direction should be set to Normal if a clockwise movement of the servo arm causes a nose down elevator movement.</p> <p>The Servo Direction should be set to Reverse if a counterclockwise movement of the servo arm causes a nose down elevator movement.</p> <p>After selecting the proper servo direction, the installer should engage the autopilot system in normal mode and verify proper elevator response by rotating the pitch reference up and down from the current pitch.</p>
<p>Clutch Monitor</p>	<p>The GSA 28 pitch servo has the ability to monitor itself for a stuck clutch situation.</p> <p>If the servo has a large amount of side loading (typically due to a capstan installation), this can occasionally lead to invalid stuck clutch failures.</p> <p>The Clutch Monitor should be enabled for all control arm installations.</p> <p>The Clutch Monitor can be disabled for capstan installations with larger side loads to prevent invalid stuck clutch failures.</p>
<p>Trim Motor Control</p>	<p>The GSA 28 pitch servo has the ability to control an auxiliary pitch trim motor.</p> <p>The Trim Motor Control should be enabled if the GSA 28 pitch servo is connected to an elevator trim motor.</p> <p>The Trim Motor Control should be disabled if the GSA 28 pitch servo is not connected to an auxiliary trim motor.</p>
<p>Trim Motor Direction</p>	<p>The GSA 28 pitch servo has a configurable trim motor direction. Select the Normal or Reversed setting depending on which is required for the proper trim motor movement when using the aircraft trim motor switches on the ground with the autopilot disengaged (servos powered).</p>

<p>Trim Motor Speed</p>	<p>The GSA 28 pitch servo will control the elevator trim on the aircraft.</p> <p>The Fastest Trim Motor Speed percentage is the speed at which the pitch servo will run the auxiliary trim motor when at or below the corresponding airspeed.</p> <p>The Slowest Trim Motor Speed percentage is the speed at which the pitch servo will run the auxiliary trim motor when at or above the corresponding airspeed.</p>
<p>Slowest Auto Trim Motor Speed (expert configuration)</p>	<p>The GSA 28 pitch servo has the ability to drive the auxiliary trim motor at various speeds.</p> <p>The Slowest Auto Trim Motor Speed should be set so the auxiliary trim motor will move as slowly as possible. The slowest possible movement will ensure that there is no noticeable aircraft response when the auxiliary trim motor is run during autotrim.</p> <p>The Slowest Auto Trim Motor Speed can be adjusted from 5% to 100% in 5% steps.</p>
<p>Maximum Trim Run Time</p>	<p>The GSA 28 servos can limit the maximum continuous run time of the trim motor. This can be used to help prevent the potential for a trim runaway situation.</p> <p>The Maximum Trim Run Time Limit is the maximum amount of time the trim servo will be run continuously when a manual electric trim input is detected. If the maximum time is exceeded, the pilot will need to release the Manual Electric Trim (MET) control and then reassert it to continue running trim.</p>
<p>Fine Adjust Amount (expert configuration)</p>	<p>The GSA 28 pitch servo is capable of making very small adjustments to fine tune the elevator position. The Fine Adjust Amount is the amount in which these adjustments are made. Use the Fine Adjust Amount and Fine Adjust Time to correct very small oscillations in the aircraft.</p> <p>Fine Adjust Amount is an expert configuration setting, and should generally be not be changed by the installer. The default value is 0.</p>

<p>Fine Adjust Time (expert configuration)</p>	<p>The GSA 28 pitch servo is capable of making very small adjustments to fine tune the elevator position. The Fine Adjust Time is the rate in which these adjustments are made. Use the Fine Adjust Amount and Fine Adjust Time to correct very small oscillations in the aircraft. Fine Adjust Time is an expert configuration setting, and should generally be not be changed by the installer. The default value is 0.20.</p>
<p>Minimum Airspeed Limit*</p>	<p>The GSA 28 pitch servo has a configurable minimum airspeed limit. This determines the lowest airspeed the pitch servo will allow the aircraft to fly at. If the speed drops below this limit, the pitch servo will lower the nose of the aircraft to keep the airspeed at or above the Minimum Airspeed Limit.</p> <p>The Minimum Airspeed Limit should be set above the aircraft stall speed with some margin.</p>
<p>Maximum Airspeed Limit*</p>	<p>The GSA 28 pitch servo has a configurable maximum airspeed limit. This determines the fastest airspeed the pitch servo will allow the aircraft to fly at. If the speed rises above this limit, the pitch servo will raise the nose of the aircraft to keep the airspeed at or below the Maximum Airspeed Limit.</p> <p>The Maximum Airspeed Limit should be set below the aircraft maximum speed with some margin.</p>
<p>Vertical Speed Gain*</p>	<p>The GSA 28 pitch servo is capable of holding the aircraft at a desired vertical speed.</p> <p>The Vertical Speed Gain should be increased if the aircraft struggles to hold the desired vertical speed target when the flight director is in VS, ALT, or LVL modes.</p> <p>The Vertical Speed Gain should be decreased if the aircraft is overly aggressive when trying to hold the desired vertical speed.</p>

<p>Vertical Acceleration Gain*</p>	<p>The GSA 28 pitch servo is capable of holding the aircraft at a desired vertical speed.</p> <p>The Vertical Acceleration Gain should be increased if the aircraft is overshooting the desired vertical speed target when closing on the bug when the flight director is in VS mode.</p> <p>The Vertical Acceleration Gain should be increased if the aircraft appears to back off from the desired vertical speed target when closing on the bug.</p>
<p>Airspeed Gain*</p>	<p>The GSA 28 pitch servo is capable of holding the aircraft at a desired airspeed.</p> <p>The Airspeed Gain should be increased if the aircraft is lazy and struggles to hold the desired airspeed target when the flight director is in IAS mode.</p> <p>The Airspeed Gain should be decreased if the aircraft is overly aggressive when trying to hold the desired airspeed target.</p>
<p>Airspeed Acceleration Gain (expert configuration)</p>	<p>The GSA 28 pitch servo is capable of holding the aircraft at a desired airspeed.</p> <p>The Airspeed Acceleration Gain should be increased if the aircraft is overshooting the desired airspeed target when closing on the bug when the flight director is in IAS mode.</p> <p>The Airspeed Acceleration Gain should be increased if the aircraft appears to back off from the desired airspeed target when closing on the bug.</p>
<p>Airspeed Tracking Gain (expert configuration)</p>	<p>The GSA 28 pitch servo is capable of holding the aircraft at a desired airspeed.</p> <p>The Airspeed Tracking Gain should be increased if the aircraft is overly sluggish while tracking airspeed when the airspeed error is less than 5 knots.</p> <p>The Airspeed Tracking Gain should be decreased if the aircraft is overly aggressive while tracking airspeed when the airspeed error is less than 5 knots.</p>

Yaw Damper Configuration Page

The installer needs to make the following yaw damper configuration selections when setting up the GSA 28 based autopilot system. All selections are available in configuration mode using the Yaw Damper page. Selections available in the normal mode Setup menu are noted with an asterisk in Table 1-16.

Table 1-16 Yaw Damper Configuration Settings

Configuration Setting	Description
Maximum Torque*	<p>The GSA 28 yaw damper has a configurable maximum torque setting. This determines how much torque the servo will output before the electronic slip clutch begins to slip.</p> <p>The Maximum Torque setting should be set high enough to not slip during in-flight air loading, but low enough for the pilot to override the autopilot if required.</p> <p>The Maximum Torque setting can be adjusted from 15% to 100% in 5% steps.</p>
Servo Gain*	<p>The GSA 28 yaw damper has a configurable servo gain setting. This determines how aggressively the yaw servo will move the rudder surface.</p> <p>The Servo Gain should be set high enough to dampen the yaw rates, but low enough to avoid being overly aggressive in the rudder movements.</p> <p>The servo gain setting can be adjusted from 0.00 to 10.00 in steps of 0.05.</p>
Servo Direction	<p>The GSA 28 yaw damper has a configurable servo direction.</p> <p>The Servo Direction should be set to Normal if a clockwise movement of the servo arm causes a nose left rudder movement.</p> <p>The Servo Direction should be set to Reverse if a counterclockwise movement of the servo arm causes a nose left rudder movement.</p> <p>After selecting the proper servo direction, the installer should engage the yaw damper in normal mode and verify proper rudder response by the tail of the aircraft back and forth.</p>

Clutch Monitor	<p>The GSA 28 yaw damper has the ability to monitor itself for a stuck clutch situation.</p> <p>If the servo has a large amount of side loading (typically due to a capstan installation), this can occasionally lead to invalid stuck clutch failures.</p> <p>The Clutch Monitor should be enabled for all control arm installations.</p> <p>The Clutch Monitor can be disabled for capstan installations with larger side loads to prevent invalid stuck clutch failures.</p>
Trim Motor Control	<p>The GSA 28 yaw damper has the ability to control an auxiliary rudder trim motor.</p> <p>The Trim Motor Control should be enabled if the GSA 28 yaw damper is connected to an elevator trim motor.</p> <p>The Trim Motor Control should be disabled if the GSA 28 yaw damper is not connected to an auxiliary trim motor.</p>
Trim Motor Direction	<p>The GSA 28 yaw servo has a configurable trim motor direction. Select the Normal or Reversed setting depending on which is required for the proper trim motor movement when using the aircraft trim motor switches on the ground with the autopilot disengaged (servos powered).</p>
Trim Motor Speed	<p>The GSA 28 yaw servo will control the rudder trim on the aircraft.</p> <p>The Fastest Trim Motor Speed percentage is the speed at which the yaw damper will run the auxiliary trim motor when at or below the corresponding airspeed.</p> <p>The Slowest Trim Motor Speed percentage is the speed at which the yaw damper will run the auxiliary trim motor when at or above the corresponding airspeed.</p>

<p>Slowest Auto Trim Motor Speed (expert configuration)</p>	<p>The GSA 28 yaw damper has the ability to drive the auxiliary rudder trim motor at various speeds.</p> <p>The Slowest Auto Trim Motor Speed should be set so the auxiliary trim motor will move as slowly as possible. The slowest possible movement will ensure that there is no noticeable aircraft response when the auxiliary trim motor is run during autotrim.</p> <p>The Slowest Auto Trim Motor Speed can be adjusted from 5% to 100% in 5% steps.</p>
<p>Maximum Trim Run Time</p>	<p>The GSA 28 servos can limit the maximum continuous run time of the trim motor. This can be used to help prevent the potential for a trim runaway situation.</p> <p>The Maximum Trim Run Time Limit is the maximum amount of time the trim servo will be run continuously when a manual electric trim input is detected. If the maximum time is exceeded, the pilot will need to release the Manual Electric Trim (MET) control and then reassert it to continue running trim.</p>
<p>Ball Centering Gain (expert configuration)</p>	<p>The GSA 28 yaw damper is capable of zeroing the aircraft's lateral acceleration or centering the ball as well as dampening aircraft yaw rates.</p> <p>Ball Centering Gain is an expert configuration setting and should only be changed by the installer if the yaw damper is not properly zeroing the aircraft's lateral acceleration.</p> <p>Increasing the Ball Centering Gain will cause the yaw damper to more aggressively respond to non-zero lateral acceleration. Decreasing the Ball Centering Gain will cause the yaw damper to respond less aggressively to non-zero lateral acceleration.</p>
<p>Yaw Rate Filter Constant (expert configuration)</p>	<p>The GSA 28 yaw damper is capable of dampening yaw body rates to keep the aircraft from shaking its tail. The Yaw Rate Filter Constant is used to filter the aircraft yaw body rate.</p> <p>Yaw Rate Filter Constant is an expert configuration setting, and should generally be not be changed by the installer. The default value is 0.08.</p>

Yaw
Acceleration
Filter Constant
(expert
configuration)

The GSA 28 yaw damper is capable of zeroing the lateral acceleration of the aircraft. The Yaw Acceleration Filter Constant is used to filter the aircraft lateral acceleration.

Yaw Acceleration Filter Constant is an expert configuration setting, and should generally be not be changed by the installer. The default value is 0.16.

1.7.4.4 FLIGHT DIRECTOR CONFIGURATION PAGE

This page allows for configuration of certain options for the flight director. It will only appear in installations that include an autopilot.

Table 1-17 Flight Director Configuration Settings

Configuration Setting	Description
Indicator Type	Controls whether the flight director command indicator on the PFD uses a single-cue or dual-cue presentation.
Altitude Controls	Select Normal (default) or Simplified. Selecting Simplified results in a simpler set of behaviors for altitude hold mode. When Altitude Controls is set to Normal, ALT Mode User Select Action and ALT Mode User Up/Down Action will appear. When Altitude Controls is set to Simplified, the ALT Mode User Select Action and ALT Mode User Up/Down Action fields do not appear. In their place selections for the default climb and descent vertical speeds are displayed.
ALT Mode User Select Action	Select Normal or Sync Selected Altitude. This setting controls the actions that occur when the user selects altitude hold mode by pressing the ALT key on the GMC 30X. When set to Sync Selected Altitude, the selected altitude (altitude bug) will be automatically set to the current aircraft altitude when the user selects altitude hold mode manually by pressing the ALT key on the GMC 30X.
ALT Mode User Up/Down Action	Select Normal or Select VS Mode. This setting controls the actions that occur when the flight director is in altitude hold mode and the user moves the pitch wheel on the GMC 30X. When set to Select VS Mode, moving the pitch wheel on the GMC 30X results in a change to VS mode for a climb or descent to a new altitude.
Maximum Bank Angle	Used to limit the maximum roll attitude commanded by the flight director for aircraft that have unusual attitude limitations. This setting should not be adjusted from the default of 30° except for very high performance aircraft that have bank angle limitations at high speeds.

1.7.4.5 AIRSPEED CONFIGURATION PAGE

This page allows for configuration of the reference speeds. The aircraft Vspeeds can be entered using the knob on the G5.

To clear a reference field:

- 1) Highlight the desired reference speed field.
- 2) Rotate the knob counterclockwise until a blank field is displayed.

1.7.4.6 UNITS CONFIGURATION PAGE

This page allows for configuration of the displayed units for the items listed in the Units page accessed in configuration mode.

1.7.4.7 DISPLAY CONFIGURATION PAGE

This page allows for configuration of the default page displayed at unit power on. The options for Powerup Page are PFD or HSI. The HSI page cannot be configured as the default powerup page on the #1 G5 if it is installed as part of a G3X system.

1.7.4.8 BACKLIGHT CONFIGURATION PAGE

Table 1-18 Backlight Configuration Settings

Configuration Setting	Description
Current Mode	Used to set the backlight mode to automatic or manual. This setting is also available at any time by pressing the power button. Automatic mode sets the backlight intensity (display brightness) based on the photocell (ambient light sensor) input on the G5. Manual mode allows for setting the backlight intensity by changing the Backlight percentage directly. Manual brightness control is available at any time by pressing the power button.
Default Mode	Used to set the backlight mode that will be active each time the unit is powered on.
Photocell Input	Displays the current input on the unit's light sensor (0-100%).
Display/Manual Brightness	Displays the current backlight level (0-100%). Naming convention depends on the current backlight mode selected.
Minimum Display Brightness	Sets the minimum display brightness setting that will occur in automatic mode. The default value is 20%.
Maximum Display Brightness	Sets the maximum display brightness setting that will occur in automatic mode. The default value is 100%.
Filter Time Constant	Adjusts the speed (in seconds), that the brightness level responds to changes in the photocell input.

1.7.4.9 RS-232 CONFIGURATION PAGE

This page allows for configuration of the serial communication port on the G5. Both the input and output serial port formats can be configured independently. Some input/output formats will also allow for a configurable baud rate.

A green checkmark will appear next to the input format selection when the RS-232 port is receiving valid data. A green checkmark will not appear if data has not yet been received by the unit. A red "X" is displayed if no data has been received after an initial time-out period, or if data has been received and then interrupted.

Table 1-19 RS-232 Configuration Settings

Configuration Setting	Description
Garmin Instrument Data	Used for connecting to compatible Garmin LRUs (e.g. GMC 30X).
NMEA	Supports the input and output of standard NMEA 0183 version 3.01 data at a configurable baud rate of either 4800 or 9600. The G5 outputs GPS data via NMEA sentences.
Aviation	The proprietary format used for input of navigation data to the G5 at a fixed baud rate of 9600 from an FAA certified Garmin panel mount unit. If the external GPS navigator supports both the Aviation and MapMX formats, the MapMX format is recommended.
MapMX	The preferred input format when interfacing with an external navigator. This format is only available from Garmin units equipped with a WAAS GPS receiver.
Garmin VHF Nav Radio	Receives lateral and vertical NAV deviation signals as an input format. Transmits frequency tuning and radial selection data to a GNC 255 or SL 30 NAV radio as an output format.
Altitude Encoder	Outputs altitude encoder data to a compatible transponder. Both Icarus and Shadin-format messages are output when using this format

1.7.4.10 ARINC 429 CONFIGURATION PAGE

This page allows for configuration of the 2 ARINC 429 output and 4 ARINC 429 input ports on the GAD 29.

Table 1-20 ARINC 429 Outputs

Configuration Setting	Description
EFIS/Air data	Outputs EFIS and air data labels to a 4XX/5XX series unit. The transmitted labels are as follows:
	203 Pressure Altitude
	204 Baro Corrected Altitude
	206 Indicated Airspeed
	212 Vertical Speed
	235 Baro Setting (BCD)
	371G Manufacturer ID
377 Equipment ID	

Table 1-21 ARINC 429 Inputs

Configuration Setting	Description
Garmin GPS (SDI 1)	Receives GPS labels from a GNS 400/500, GNS 480, or GTN 600/700 series unit.
Garmin VOR/ILS (SDI 1)	Receives VOR/ILS labels from a GNS 400/500, GNS 480, or GTN 600/700 series unit.

1.7.4.11 GPS CONFIGURATION PAGE

This page allows for the configuration and of the G5 GPS. The internal GPS receiver can be enabled and disabled. The GPS data fields on the PFD can be shown or hidden.

This page also displays the status of the G5's internal GPS receiver. The GPS Status displays the status of the GPS signal acquisition. If using the internal GPS receiver, ensure a valid GPS fix can be obtained (indicated by the a green checkmark). The status of the external GPS antenna (if equipped) is also displayed.

1.7.4.12 TEST THE GPS RECEIVER FOR COM INTERFERENCE

This test must be conducted outside, as the use of a GPS repeater inside a hangar may result in a failed test.

- 1) Ensure a valid GPS position fix is obtained by monitoring the GPS status. The following status indications are valid fixes for this test.
 - 3D GPS
 - 3D DIFFERENTIAL
- 2) Select 121.150 MHz on the COM transceiver.
- 3) Transmit for a period of 30 seconds while monitoring the GPS status.
- 4) During the transmit period, verify that the GPS status does not lose a valid GPS position fix.
- 5) Repeat steps 2 through 4 for the following frequencies:
 - 121.175 MHz
 - 121.200 MHz
 - 131.250 MHz
 - 131.275 MHz
 - 131.300 MHz
- 6) Repeat steps 2 through 5 for all other installed COM transceivers (if applicable).

- 7) If an installed COM supports 8.33 MHz channel spacing, increase the transmit period to 35 seconds and repeat steps 3 through 5 for the following frequencies:
 - 121.185 MHz
 - 121.190 MHz
 - 130.285 MHz
 - 131.290 MHz
- 8) Repeat step 7 for all other installed COM transceivers supporting 8.33 MHz channel spacing (if applicable).



NOTE: *The signal strength bars at the bottom of the GPS configuration page are a real-time representation of GPS signal strength, which may be useful for troubleshooting a failed COM interference test.*

1.8 TROUBLESHOOTING

In this manual, the term 'Red-X' refers to a red "X" that appears on different areas of the display to indicate the failure of that particular function.

For additional assistance, contact your local avionics dealer. If further help is needed, contact Garmin Aviation Product Support at US Toll Free Number 1-888-606-5482, or US 1-913-397-8200.



NOTE: The information in this section is for troubleshooting use only and does not supersede any approved maintenance or other installation instructions.

1.8.1 GENERAL TROUBLESHOOTING

- 1) Review the airframe logbook to verify if any G5 or other avionics or electrical maintenance had been performed recently that may have contributed to the failure.
- 2) Check for loose wire terminals on the circuit breaker connections on the power wire(s) causing intermittent power connections. Also, check for intermittent circuit breakers.
- 3) Have ground power put on the aircraft.
- 4) Turn on the G5 and record the system software version displayed on the start up page.
- 5) After the system is initialized, note any Red-X's on the display or anywhere in the configuration mode menus.

If the failure cannot be verified, proceed to the following physical inspection.

- 1) Power cycle the G5 or any affected LRU by removing aircraft power, waiting 30 seconds, then reapplying power.
- 2) Check that all connectors are fully seated, and that the jack screw connectors are fully tightened on both sides of all connectors.
- 3) Check for a loose wire harness that is able to move around during flight. This condition may cause the wire to pull on or vibrate the connector, making intermittent connections.

- 4) Ensure that the G5 or any affected LRU is mounted securely. Use the appropriate tool to check the tightness of all mounting hardware.
- 5) Look for any heavy objects that may not be fastened tight to the aircraft structure that could be inducing vibration in the G5's attitude sensors.
- 6) Look for evidence of water or fluid contamination in the area around the G5 or any affected LRU.
- 7) Unplug the connector on the G5 or any affected LRU and check for bent pins.
- 8) Inspect the wire harness clamp on the rear of all connectors to verify that it is not too tight and smashing/shorting the wires. If the wire clamp is installed upside down, it has sharp edges that can cut into the wires. Verify the presence of protective wire wrap between the wires and the clamp.

If the condition is not resolved by following the preceding instructions, contact Garmin Product Support for additional assistance. A Garmin Field Service Engineer may ask the technician to download the fault logs to a PC and email the logs back to Garmin to help determine if the condition is caused by a G5 LRU or in the aircraft.

1.8.2 SD CARD SLOT

A stuck or sticking microSD™ card issue can sometimes be caused by the card thickness variability (especially if there is more than one label on the card). This is usually caused by the card sticking in the overlay opening, not by the card sticking to the socket inside the unit. Try another card (without a label if possible) to confirm the problem before returning. If the second card sticks, the microSD™ socket board inside the unit may be misaligned with the overlay and the G5 will require repair. If the thickness of the card was the cause, see if more than one label was on the card. If the labels weren't the cause, determine what brand of microSD™ card was being used (Garmin recommends using SanDisk® brand cards).

1.8.3 AIR DATA TROUBLESHOOTING

Under normal operating conditions, the G5 provides the following air data information:

- Indicated Airspeed (IAS)
- Barometric Altitude
- Vertical Speed



NOTE: IAS information can only be displayed at speeds greater than 20 knots.

If the airspeed and/or altitude is failed and shows a Red-X condition:

- 1) Inspect the pitot/static plumbing integrity.
- 2) Inspect the pitot/static ports and all associated equipment.
- 3) If the problem persists replace the G5 with a known good unit.

1.8.4 ATTITUDE FAILURE TROUBLESHOOTING

Prior to troubleshooting an attitude or heading failure, gather answers to the following questions. This information may be helpful to the installer/pilot, the avionics dealer, or to Garmin Aviation Product Support in troubleshooting the failure.

- 1) What specifically was the nature of the failure? Was it a Red-X of only heading, only GPS track, only pitch/roll, or a combination?
- 2) If there was a Red-X of pitch or roll information, did the unit display an alignment message (which is indicative of a reset), or a failure message (which is indicative of an invalidated output)?
- 3) What exactly was the aircraft doing in the two minutes that preceded the failure (taxing on the ground, flying straight-and-level flight, turning, climbing, etc)? If the problem occurred on the ground, was it within 100 feet of a hanger using GPS repeaters?
- 4) How long did the failure last? Was it brief or sustained? Was it repetitive in nature? If it was repetitive, about how many times did it happen? Did it happen on more than one day?
- 5) Was the problem correlated with a specific maneuver or a specific geographic area?

- 6) Can the problem be repeated reliably?
- 7) Did the onset of the problem occur shortly after a software upload to the G5?
- 8) Was there a loss of the GPS position lock?

1.8.5 G5 DATA LOGGING

Data logging on the G5 may be used to help troubleshoot issues. Operational data can be gathered from the G5 during flight or on ground and is stored in *.csv log files on the microSD™ card. To enable logging on the G5, in configuration mode, navigate to Device Information, Diagnostics, Data Log and select Enabled for the Data Card Log field.

1.8.6 SENDING TROUBLESHOOTING DATA TO GARMIN

To assist with troubleshooting an issue, it may be helpful to send pictures and/or the log files stored on the microSD™ card to Garmin. This data can be especially useful to troubleshoot autopilot or AHRS related issues. This data can be sent to g3xpert@garmin.com for troubleshooting assistance.

1.9 MAINTENANCE

1.9.1 INSPECTIONS/CONTINUED AIRWORTHINESS/ MAINTENANCE

Periodic maintenance for the G5 is limited to the air data system as listed in Section 1.9.1.2. All other maintenance is "on condition" only. Instructions for Continued Airworthiness (ICA) are not required per 14 CFR Part 21 for these products as they have received no FAA approval or endorsement. Garmin recommends that the G5 be inspected for proper operation, secure attachment, integrity of connectors and wiring, cleanliness, leakage of hoses and tubes, and any evidence of damage as part of the required annual or periodic aircraft inspection. For more general inspection guidance, please refer to the applicable sections of CFR Part 43 Appendix D and Chapter 12 of AC 43.13-1B.

1.9.1.2 G5 AIR DATA PERIODIC MAINTENANCE

Per Part 43 Appendix E, paragraph (b)(2), Garmin recommends a test procedure equivalent to part 43 Appendix E, paragraph (b)(1) with two exceptions. The tests of sub-paragraph (iv) (Friction) and (vi) (Barometric Scale Error) are not applicable because the digital outputs of the G5 are not susceptible to these types of errors. This procedure is recommended when the static system is opened up (i.e. whenever the G5 is removed or replaced). Garmin also recommends that a leak test be performed following any maintenance action in which the pitot system is opened up.



NOTE: *If the G5 is moved or replaced, the Post Installation Calibration Procedures (Section 1.7.4.2.1) must be repeated.*

1.9.2 RETURN TO SERVICE INFORMATION

These return to service procedures are intended to verify the serviceability of the appliance only. These tests alone do not verify or otherwise validate the airworthiness of the installation.



NOTE: A pitot/static check as outlined in 91.411 and Part 43 Appendix E must be completed if the pitot/static lines are broken.

1.9.2.1 ORIGINAL G5 IS REINSTALLED

No software or calibration is required if the original G5 is reinstalled in its original mounting location.

1.9.2.2 NEW G5 IS INSTALLED

Any time a new G5 is installed, or an existing G5 is moved to a different mounting location, the pitch/roll offset calibration procedure (Section 1.7.4.2.2) must be performed. The correct G5 software version will automatically be loaded into the G5 from a connected GDU (if applicable). If a GDU is not connected, the unit software will need to be loaded via the front-facing microSD™ card slot. All unit configuration options will need to be selected as the G5 does not support a config module.

1.10 PERFORMANCE SPECIFICATIONS/LICENSING/COMPLIANCE

1.10.1 GPS SPECIFICATIONS

Table 1-22 G5 GPS Specifications

Characteristics	Specifications
Acquisition Time	a) Warm Start (position known to 10 nm, time known to 10 minutes, with valid almanac and ephemeris): Less than 5 seconds b) Cold Start (position known to 300 nm, time known to 10 minutes, with valid almanac): Less than 45 seconds c) AlwaysLocate™ (with almanac, without initial position or time): Less than 60 seconds
Update Rate	5/second, continuous
Positional Accuracy	<10 meters

1.10.2 ENVIRONMENTAL SPECIFICATIONS

The G5 has an operating temperature range of -20°C to +60°C. The G5 will prevent operation from the battery when the battery is outside of this temperature range. For maximum battery longevity, store the within a temperature range of 32° to 77°F (from 0° to 25°C).

1.10.3 PERFORMANCE SPECIFICATIONS

Table 1-23 G5 Performance Specifications

Characteristics	Specifications
Pressure Altitude Range	-1,400 feet to 30,000 feet
Vertical Speed Range	±20,000 feet per minute
Airspeed Range	300 knots (indicated)
Mach Range	<1.00 mach
Pitch/Roll Range	±360°
Pitch/Roll Accuracy	±2° (straight and level flight) ±3.5° (normal dynamic maneuvering)*
Rotation Rate Range	±499°/s per second (automatic recovery when exceeded)
Backup Battery (Optional)	Rechargeable Lithium-ion
Battery Life	Up to 4 hours

*Normal dynamic maneuvering is defined as bank angles less than 35° and pitch angles less than 15°.

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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. 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



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 32G.

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 large 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.



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



NOTE: *Magnetic Heading is available only when the G5 is installed as part of a G3X system and magnetometer data from another ADAHRS unit is available.*

When installed as a backup instrument in a G3X/G3X Touch system, the G5 can display magnetic heading information received from other AHRS (Attitude/Heading Reference System) and magnetometer devices on the common CAN network. 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

The G5 has two main pages, the HSI Page and the PFD Page. The HSI Page can only be accessed from the PFD Page if:

- A GPS or navigation data source is configured (ARINC 429 or RS-232).

AND

- The G5 is not configured as the #1 backup unit **OR** a GDU is present.



PFD Page



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.



PFD Page Menu

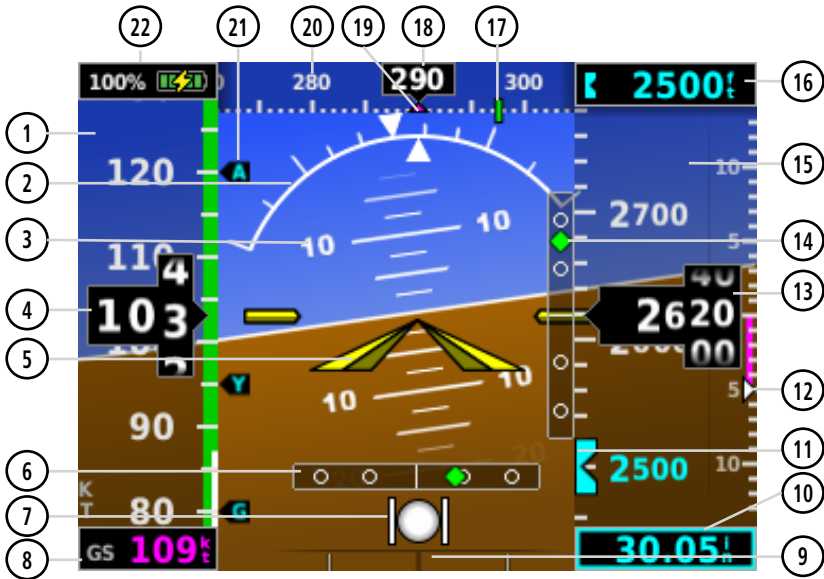


HSI Page Menu

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.



G5 PFD Flight Instruments

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

2.6.1 AIRSPEED INDICATOR

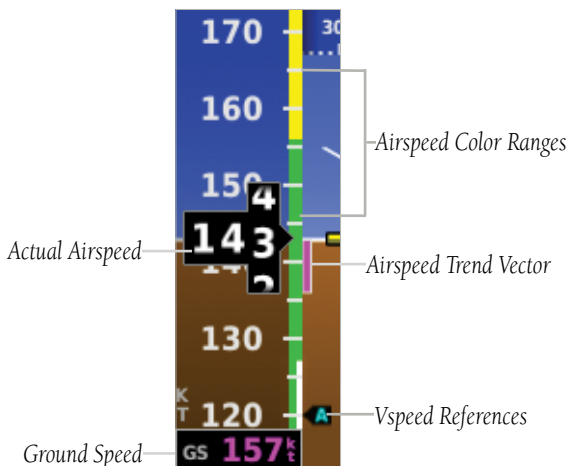


NOTE: The G5 Vspeed Reference values depend upon the aircraft's specific system configuration and may vary from the examples discussed in this section.

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.



Airspeed Indicator

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



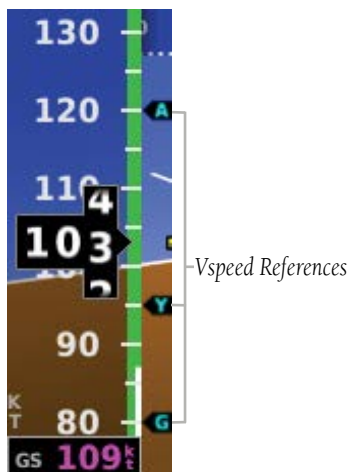
NOTE: Mach number data is only available when the G5 is installed as part of a G3X/G3X Touch system and is receiving air temperature data from another ADAHRS.

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}.

VSPPEED REFERENCE

Vspeed references including V_{NE}, V_{no}, V_{so}, V_{s1}, V_{fe}, V_a, V_x, V_y, V_{se}, 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.



Vspeed References

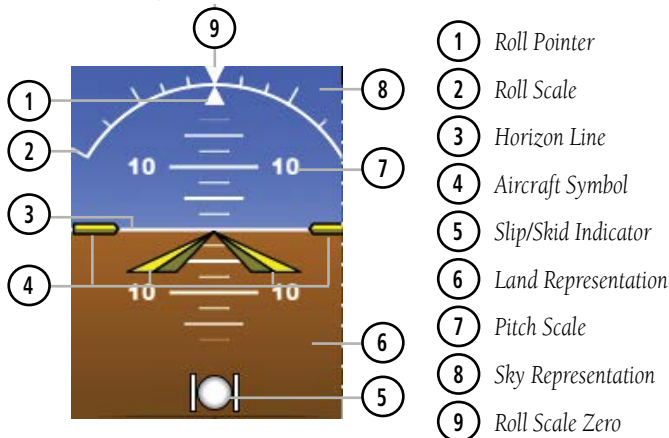
2.6.2 ATTITUDE INDICATOR

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.

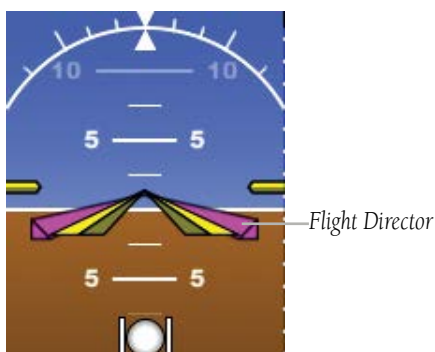
The horizon line is part of the pitch scale. Pitch markings occur at 2.5° intervals through all pitch ranges. Refer to the Installation Manual section to configure the pitch scale.

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.

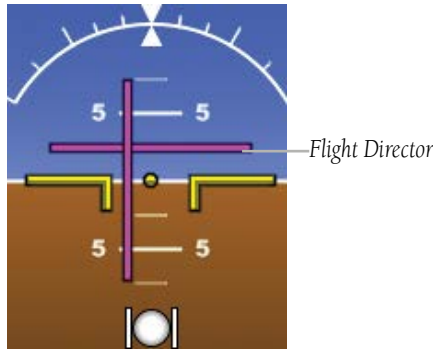
Slip/skid is indicated by the location of the ball.



Attitude Indicator



Attitude Indicator with Flight Director (Single Cue)



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

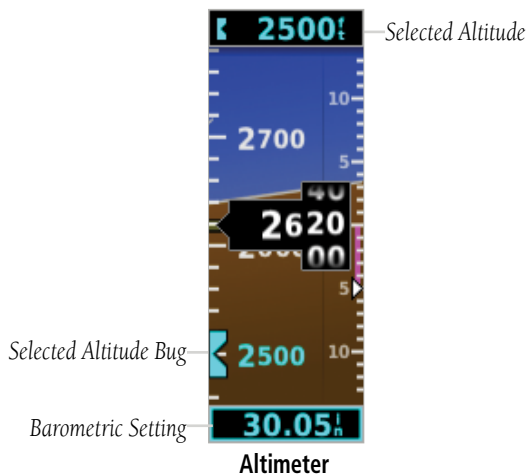
- 1) Press the Knob to display the Menu.
- 2) Select **Altitude** and use the Knob to change the Selected Altitude.

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



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:

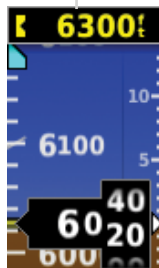
Turn the Knob to set the barometric pressure.

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 1000 feet of the Selected Altitude, the Selected Altitude (shown above the Altimeter) flashes for 5 seconds.
- When the aircraft passes within 200 ft 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.

Deviation of ± 200 ft



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.



Turn Rate Trend Vector
Turn Rate Indicator (Standard Rate Tick Marks)

Turn Rate Indicator

2.6.5 HEADING/GROUND TRACK (PFD PAGE)



NOTE: Heading is displayed if magnetometer data is available from another ADAHRS 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

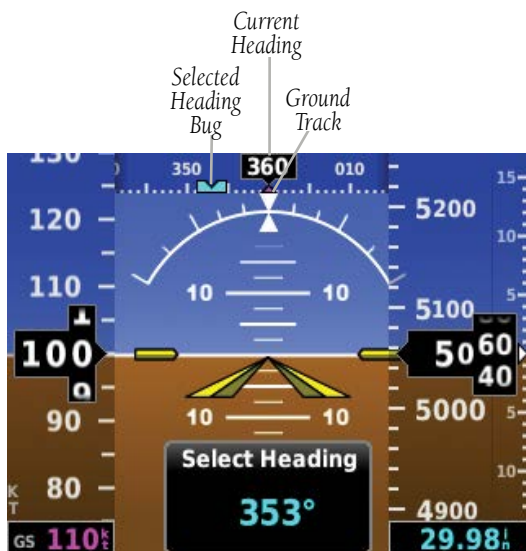
- 1) Press the Knob to display the Menu.
- 2) Select **Heading** or **Track** and use the Knob to change the Selected Heading or Track.

Syncing to the current heading or ground track:

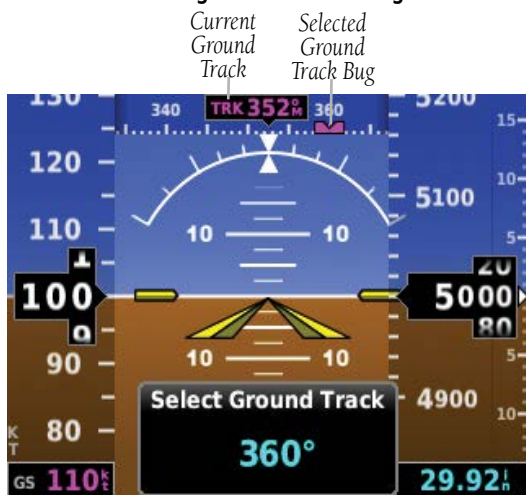
Press the HDG Knob on the GMC 307.

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.



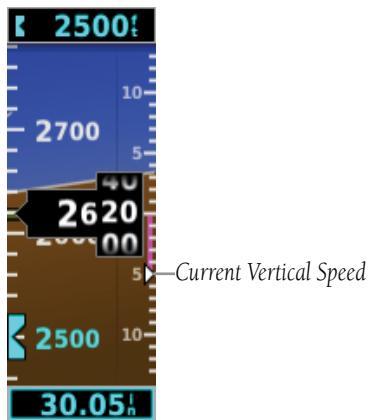
PFD Page - Selected Heading



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).



Vertical Speed Indicator

2.6.7 PFD PITCH ATTITUDE OFFSET

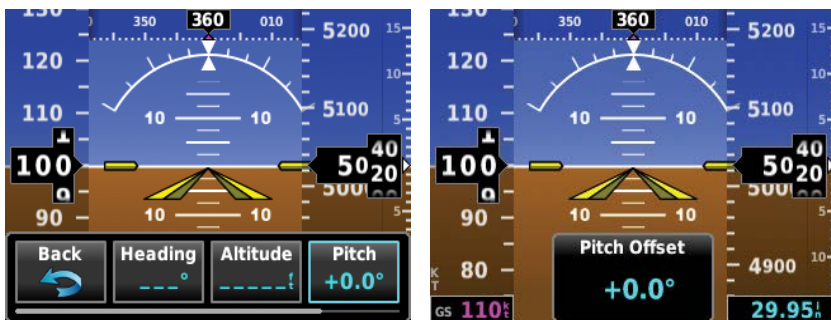
The Pitch attitude offset function allows the yellow aircraft symbol on the attitude indicator to be adjusted up or down much like the aircraft on a mechanical attitude indicator. The pitch attitude can be adjusted as much as +/- 5°. The pitch offset is synchronized between the G5 and the other displays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

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.



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 is accessible if a source of GPS or navigation data is configured (ARINC 429 or RS-232) AND the G5 is not configured as the #1 backup unit or a GDU is present.



- | | |
|-------------------------------------|--------------------------------------|
| 1) Distance To Waypoint | 7) Course Deviation Indicator (CDI) |
| 2) Battery Status Indicator | 8) Lateral Deviation Scale |
| 3) Aircraft Symbol | 9) Selected Heading/Ground Track Bug |
| 4) Rotating Compass Rose | 10) Current Heading/Ground Track |
| 5) Ground Speed | 11) Current Track |
| 6) Selected Heading or Ground Track | |

Horizontal Situation Indicator (HSI)

Displaying the HSI page from the PFD page:

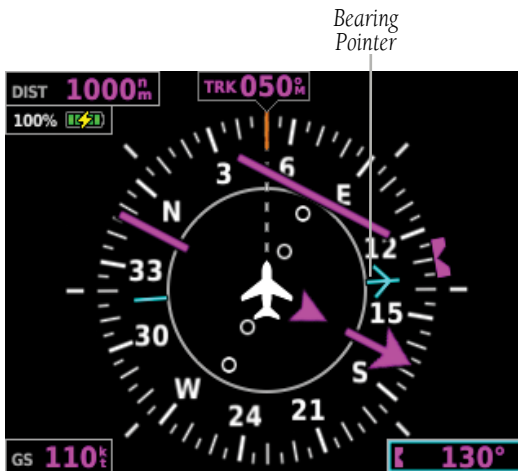
- 1) From the PFD Page press the **Knob** to display the Menu.
- 2) Select **HSI**.

2.7.1 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.

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).



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.



Bearing Pointer Menu Option

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 another ADAHRS 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



NOTE: If the G5 is installed as part of a G3X/G3X Touch system, navigation data (both horizontal and vertical) will not appear on the G5 if any GDU displays are operational.

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.



Course Deviation Indicator

Course Deviation Indicator (PFD Page)



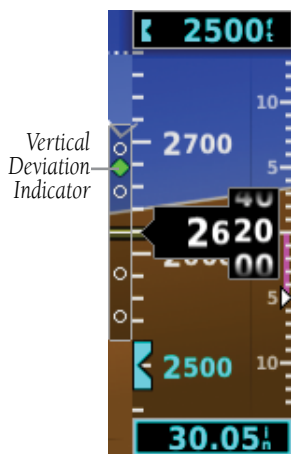
Course Deviation Indicator

Course Deviation Indicator (HSI Page)

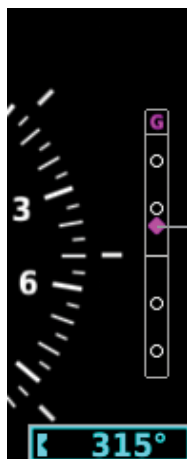
2.8.2 VERTICAL DEVIATION INDICATOR AND VNAV INDICATOR



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.



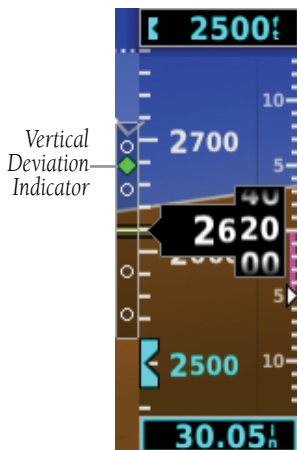
Vertical Deviation Indicator Position (PF D Page)



Vertical Deviation Indicator Position (HSI Page)

GLIDESLOPE - ILS SOURCE

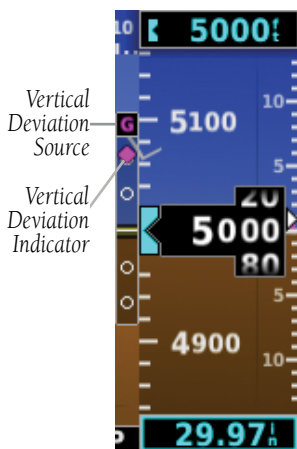
The Vertical Deviation (Glideslope) Indicator (VDI) appears to the left of the altimeter whenever an ILS frequency is tuned in the active NAV field of an external navigator. A green diamond acts as the VDI Indicator, like a glideslope needle on a conventional indicator. If a localizer frequency is tuned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



Vertical Deviation Indicator (Glideslope-ILS Source)

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.



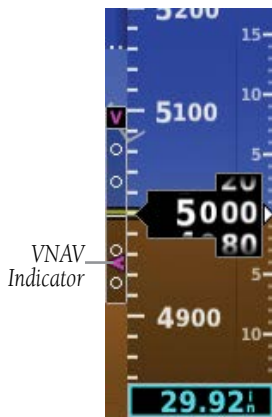
Vertical Deviation Indicator (Glidepath-GPS Source)

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.



VNAV Indicator

2.8.3 COURSE SELECTION

When the G5 is receiving VOR or LOC 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.



VLOC Course on PFD Page

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 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.

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.

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.

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 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.



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, TRK, GPS, VS, IAS, ALT, ALTS, GP, and VNAV.
- GP mode requires ARINC 429 data from an IFR navigator.
- The HDG button on the GMC is used for TRK mode.
- 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

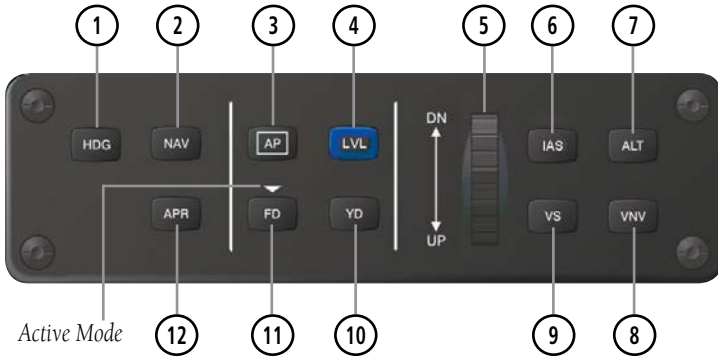
2.9.7 AFCS CONTROLS

GMC 305/307 AFCS CONTROLS

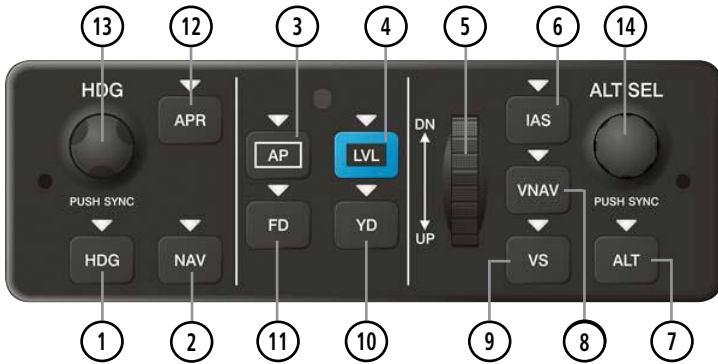
The GMC 305/307 AFCS Control Units have the following controls:

- ① **HDG Key** Selects/deselects Heading Select Mode
- 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



GMC 305 AFCS Control Unit



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 config 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 config 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 config 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).

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):

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

Engaging the Autopilot

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

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.

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).

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.

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.

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.

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.

Flight Director Activation (GMC 305/307)

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.

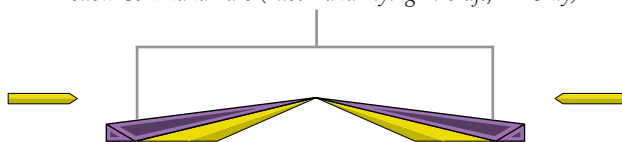
If the information required to compute a flight director mode becomes invalid or unavailable, the flight director automatically reverts to the default mode for that axis. A flashing yellow mode annunciation and annunciator light indicate loss of sensor or navigation data required to compute commands. 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.

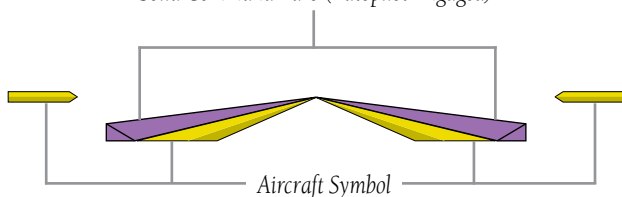
COMMAND BARS

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.

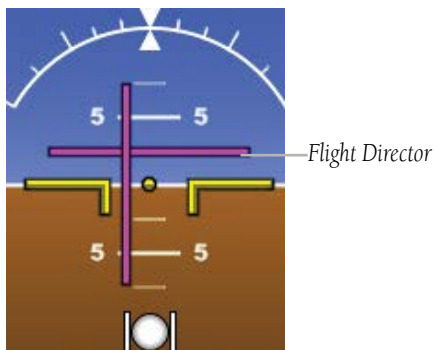
Hollow Command Bars (Pilot Hand Flying Aircraft, FD Only)



Solid Command Bars (Autopilot Engaged)



Command Bars (Single Cue Flight Director)



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.

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.

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 Mode	Description	Control	Annunciation	Reference Change Increment
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).*

Flight Director Vertical Modes

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.

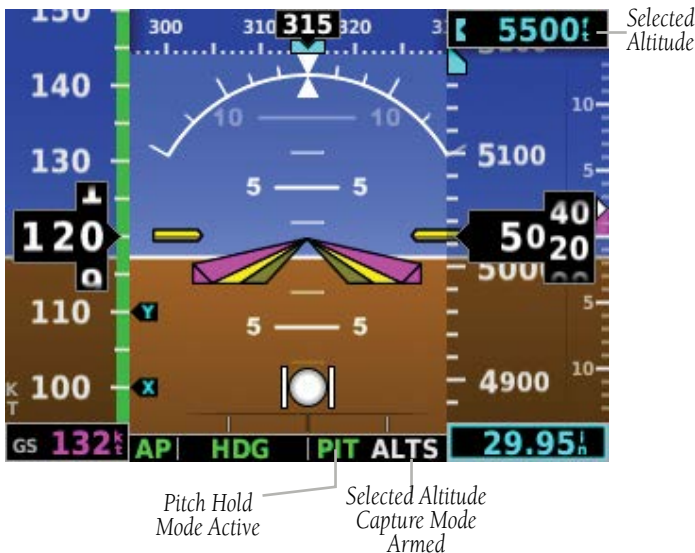
In Pitch Hold Mode, the flight director maintains a constant pitch attitude. The pitch reference is set to the aircraft pitch attitude at the moment of mode selection. If the aircraft pitch attitude exceeds the flight director pitch command limitations, the flight director commands a pitch angle equal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



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/Go Around
- Vertical Path Tracking

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



AP | ROL | VS ALTS

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.

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.

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.



Altitude Hold
Mode Active



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, '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.

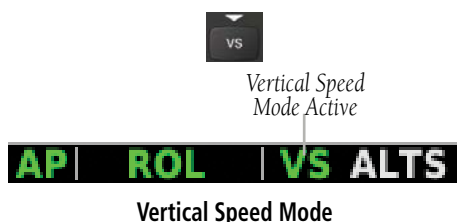


Vertical Speed Reference on PFD Page

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.



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.

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.



Indicated Airspeed Reference on PFD Page

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.



Vertical Navigation Mode Active



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.

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.

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.

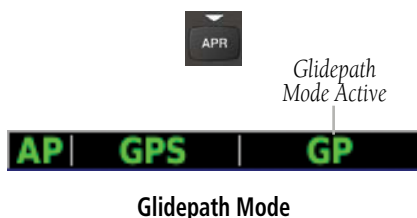


WARNING: When flying an LNAV approach (with vertical descent angle) with the autopilot coupled, the aircraft will not level off at the MDA even if the MDA is set in the altitude preselect.

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.



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.

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	HDG*
Track	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*

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

Flight Director Lateral Modes

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.

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.

AP | ROL | PIT

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:

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

HEADING SELECT MODE (HDG)



NOTE: HDG mode is only available 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.



Heading Mode Annunciation

TRACK MODE (TRK)

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.



Track Mode Annunciation

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.



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

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.

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

Approach 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) 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.

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.

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

Lateral + Vertical Approaches



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.

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

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 config 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)

Message	Comments
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

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