2.29.6 GLOBAL POSTITIONING SYSTEM

The Global Positioning System (GPS) consists of a GPS-4000A Sensor Unit (Receiver), installed in the nosecone avionics bay, and a GPS Antenna installed on the top of the fuselage.

The GPS-4000A processes the signals received from the antenna to provide various navigation data (three-dimensional position / velocity and time) to the IAPS data concentrator.
The GPS Receiver is mainly used as FMS position sensor.

The GPS receiver control and data display is performed by the Control Display Unit.

Refer to the Collins "Pro Line 21 Avionics System Operator's Guide, for the Piaggio P.180 Avanti", doc. n. 523-0806484, for details about GPS Operations.

The GPS-4000A receiver may be self-tested when the aircraft is on the ground. Access is required to the receiver, to momentarily push the TEST button on the GPS-4000A front panel with power applied to the system. The GPS-4000A front panel LED indicator, LRU STATUS and ANTENNA FAIL, are energized for self-test mode operation only. The above indicators are disabled for all other test operations (power-up and continuous BIT). The self-test takes approximately less than 15 seconds for the GPS-4000A to complete the sequence.

The GPS-4000A Sensor Unit is powered by the Right Avionics Dual Feed Bus through the GPS1 3-ampere circuit breaker on the copilot's C/B panel.

2.30. FLIGHT GUIDANCE SYSTEM

The APS-300 Flight Guidance System (FGS) is an integrated Autopilot and Flight Director system and consists of the following equipment:

– two Flight Guidance Computers (FGC),

– one Flight Guidance Panel (FGP),

– three Primary Servos (Aileron, Pitch and Yaw).

These units provide the AP/YD engage and flight guidance control functions.
The FGS is a dual system: left (pilot side) system and right (copilot side) system. The two systems operate together to drive the servos and the pitch trim system.

The Flight Guidance Panel allows input of autopilot and yaw damper engage commands and flight director modes selection. The FGP provides AP/YD engage logic to the FGCs and clutch (engage) power to the servos. The FGP knobs control the speed reference, preselect altitude, heading, and course outputs to the DCPs.

The FGC receives flight director mode select data, VS/pitch commands, and autopilot engage logic from the FGP, attitude and heading data from the onside AHRS, and crosstalk data from the cross-side FGC.
The FGC applies flight director commands and autopilot/yaw damper mode/ status data to the onside PFD.

The three servos are used to manage airplane control surfaces in roll, pitch and yaw axis, each receiving differential motor drive from FGCs, as well as clutch (engage) power, and providing a rate feedback analog to the computation circuits in both computers.

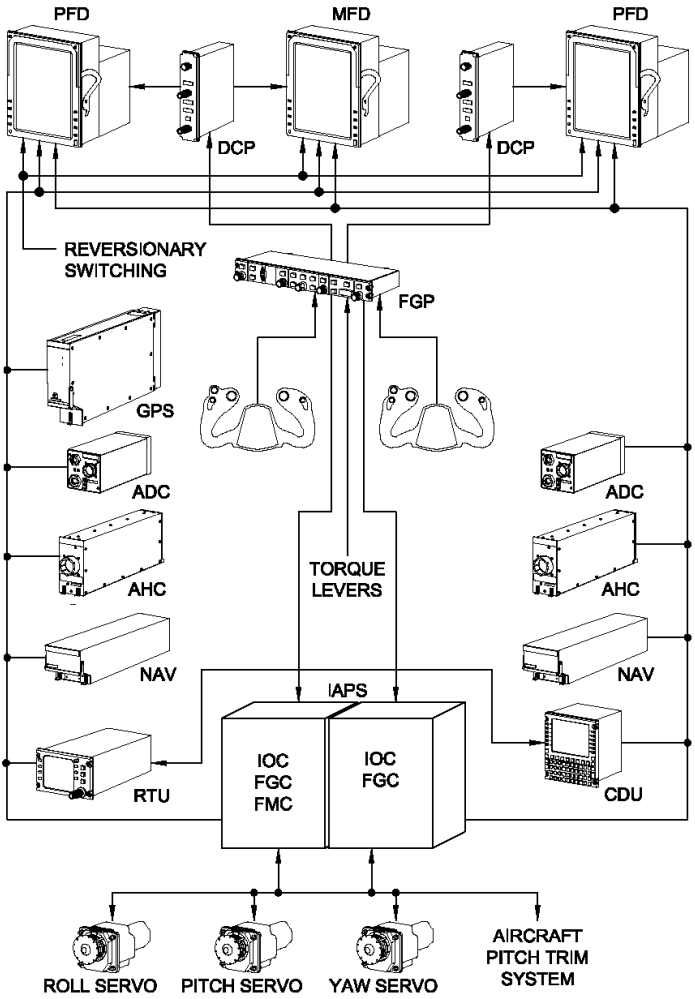

Figure 2.30-1. Flight Guidance System block diagram

OPERATIONS

The Flight Guidance Panel (FGP) provides autopilot and yaw damper control and Flight Guidance mode selection.

The Autopilot is engaged by pushing the AP switch (push on/push off) on the FGP.
Engagement of the Autopilot shall also engage the Yaw Damper, however, the Yaw Damper may be disconnected, either manually or automatically, independent of the Autopilot.
The Yaw Damper can be engaged by pushing the YD switch (push on/push off) on the FGP.
Both AP and YD can be engaged only if the YD/AP DISC BAR is in the up position and there are no excessive attitudes, rates, or accelerations present and system monitors do not detect any failure which will prevent safe engagement.

When the Autopilot is engaged the automatic pitch trim is enabled.

Divider lines separate lateral and vertical modes and also Autopilot and Flight Director functions on the FGP.
The Flight Guidance Panel contains the lateral and vertical mode select switches (push on/push off), the VS/pitch wheel, autopilot/yaw damper engage switches, FD switches, and various control knobs (each knob has a push switch in the center).

GA mode is selected by an external switch located on the pilot side of the left power lever.

When a mode is selected, incompatible modes shall automatically clear.
If the FGS determines that conditions are acceptable for a given mode, the appropriate mode indicators shall be displayed on the PFD.

The PFDs display the FGS mode messages and the FD command bars.
The mode messages show above the attitude ball on the PFDs when either FD is selected or the AP is engaged.
The FD command bars show in magenta over or about the black and white aircraft symbol in the attitude ball.

The Flight Guidance Panel includes the following controls:

– AP Engage Button: push the AP engage button to engage the autopilot. The autopilot will engage if:

  a. AP DISC switch-bar is raised

  b. no unusual attitudes/rates exist

  c. FGC monitoring does not detect any autopilot faults

  When engaged, the autopilot flies flight director commands from the coupled side. The coupled side is the one selected by the CPL button when the autopilot is engaged.
  The PFD shows a green AP ⟵ (coupled to left side) or AP ⟶ (coupled to right side) annunciation.
  Push the autopilot disconnect button, the manual pitch trim switch, or manually lower the AP DISC switch-bar to disengage the autopilot. The autopilot automatically disengages if the FGC autopilot monitors detect a failure.
  The PFD shows a red AP annunciation after an autopilot disengage.
  Push autopilot disconnect or Go Around (GA) button to cancel flashing and aural disconnect warning. The autopilot does not necessarily disengage if the yaw damper is disengaged.

– YD Engage Button: push the YD engage button to engage or disengage the yaw damper. The PFD shows a YD annunciation. The yaw damper may be engaged without engaging the autopilot. If the AP button is pushed, the autopilot and yaw damper are both engaged.

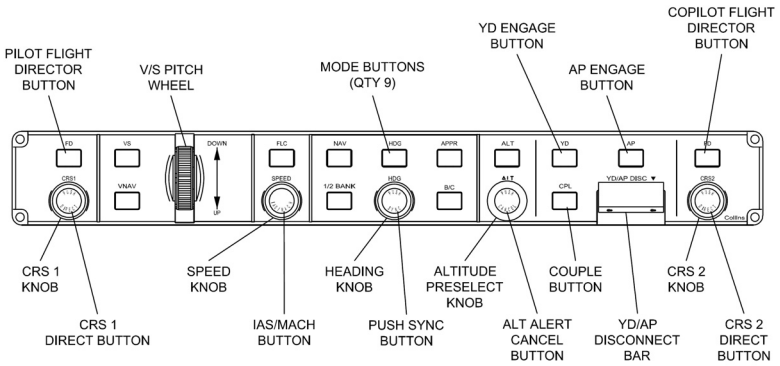

Figure 2.30-2. Flight Guidance Panel

– CPL (Couple) Button: the CPL button selects the master FGC computer. Push the CPL button to transfer to the other FGC. The master FGC provides the flight guidance signals to command the servos. Both FGCs provide the actual servo drive.

– AP/YD Disconnect Bar: manually lower the AP DISC switch-bar to disengage the autopilot. When the switch-bar is down, a red band becomes visible to indicate the disengage position. Manually raise the switch-bar to enable the autopilot to be engaged. Note that this switch-bar is not held by a solenoid and remains where last positioned.

– Flight Director Mode Select:
The pilot and copilot mode selectors are identical and completely independent. Flight director modes are selected by push on/push off buttons. When a mode selects, incompatible modes automatically clear. A divider line separates the lateral and vertical modes.
Lateral modes are: roll hold, heading select (HDG), back course (B/C), approach (APPR), go around, half bank, and NAV.
Vertical modes are: pitch hold, altitude hold, vertical speed (VS), preselect altitude, flight level change (FLC), vertical navigation (VNAV), approach, and go around (GA Vertical). Go around is also a lateral and vertical mode.

– Flight Director Buttons: two FD buttons are installed. The left side button controls the left side (PFD) flight director; the right side button controls the right side (PFD) flight director.
These buttons can turn a flight director on and off. Each Flight Director follows commands from the onside flight guidance channel and the selected flight guidance channel provides steering commands to the Autopilot during independent channel operation. At power-up, the flight director is off. The flight director automatically turns on when the autopilot is engaged, or when a vertical or lateral mode is selected. Push the other FD button to alternately turn the (offside) flight director on and off. The FD button of a coupled flight director is not functional.

– V/S Pitch Wheel: turn the V/S pitch wheel to change the vertical reference value used by vertical speed and pitch modes. This wheel is not functional when glideslope is captured.
In VS mode, turn this wheel to change the vertical speed reference value.
When not in VS mode, turn the wheel to input a pitch "take command" function. The pitch mode is selected and any active vertical mode (except GS capture) clears. Turn the wheel to change the pitch reference value. Move the wheel forward to command pitch-down, or backward to command pitch-up attitude.

– ROLL Mode (no button): Roll mode is the basic lateral operating mode, and occurs automatically when no other lateral mode is active and the flight director is on. ROLL annunciates on the PFD.

If roll attitude is more than 5 degrees from level when roll mode is selected, the FGC generates commands to maintain the roll angle. If roll attitude is less than 5 degrees (level), the FGC generates commands to maintain heading.
When not engaged, push the remote SYNC button to synchronize the roll reference to the current roll angle (or heading).

– HDG Button: push the HDG button to alternately select or deselect heading mode.
HDG annunciates on the PFD. The FGC generates commands to capture and maintain the selected heading. This value is marked on the large displays by a heading bug, and can be changed using the HDG knob.

– HDG (Heading) Knob: turn the HDG knob to change the selected heading (shown on the large displays). This knob simultaneously controls the heading bug on both left and right side displays. Clockwise rotation increases the selected heading angle.

– HDG PUSH SYNC Button: push the (center) PUSH SYNC button to synchronize the heading bug to the current aircraft heading. This switch syncs the heading bug on the left and right side displays.

– 1/2 BANK Button: push the 1/2 BANK button to alternately select or deselect half bank mode.
The 1/2 BANK mode draws a white arc above the roll scale representing ±15°. This mode limits the maximum bank angle command to half the normal value.
Half-bank mode automatically selects as the aircraft climbs through 18 500 feet pressure altitude, or if the aircraft is above this altitude when the flight director is turned on. Half-bank automatically clears as the aircraft descends through 18500 feet.

– APPR Button: push the APPR button to alternately select or deselect approach mode.
The type of approach is determined by the active navigation source and annunciates on the PFD (APPR FMS, APPR VOR1, APPR LOC2, etc.).
APPR mode arms when the button is pushed, and automatically captures when capture conditions are met. Before capture, the system operates in a heading select submode.In a FMS approach, the FMC computer determines the capture point. After capture, the FMS outputs the lateral bank commands to the FGC.
In a non FMS approach, the FGC does an all-angle adaptive capture. The FGC arms for glideslope capture (if GS is valid) after a front course localizer capture. At glideslope capture, the FGC generates commands to maintain flight on the glidepath.

– B/C Button: push the B/C button to select Back Course mode.
The back course mode message B/C shows in green on the PFD after

capture.
Back course (B/C) mode generates commands to capture and track the localizer back course. Glide slope operation is inhibited when back course mode is active. B/C mode arms when selected. Prior to capture, flight guidance continues to operate in heading select mode. If flight guidance was operating in NAV mode, capturing/tracking the FMS, with a localizer as the preselect NAV source, it continues to capture/track the FMS and also arm for a localizer capture (this provides an FMS to LOC capture capability).

– NAV Button: push the NAV button to alternately select or deselect navigation mode.
The FGC/FMC generates lateral commands to fly the active navigation course. The navigation source is selected from the PFD NAV SOURCE menu.
The (active course) NAV identifier annunciates on the PFD (FMS, VOR1, LOC2, etc.). NAV mode arms when the button is pushed, and automatically captures when capture conditions are met. Before capture, the system operates in a heading select submode. If FMS is the active NAV source, the FMC determines the capture point.
After capture, the FMS outputs the lateral bank commands to the FGC.
If FMS is not the active NAV source, the FGC does an all angle adaptive capture. After capture, the FGC generates commands to maintain the NAV course. This course may be changed using a CRS knob.

– CRS Knobs: two course knobs are installed. Turn the CRS 1 knob to change the left-side active navigation course on the pilot PFD.
Turn the CRS 2 knob to change the right side active course (copilot PFD). Clockwise rotation increases the selected course angle.

– CRS Direct Buttons: push a (center) PUSH DIRECT switch to zero course deviation and automatically select a course directly to the tuned NAV station.

– PITCH Mode (no button): Pitch mode is the basic vertical operating mode, and occurs automatically when no other vertical mode is active and the flight director is on.
PITCH annunciates on the PFD. The FGC generates commands to maintain the pitch (reference) angle existing when pitch mode is selected.
Turn the VS/pitch wheel to change the pitch reference value. When not engaged, push the remote.

– SYNC Button: push to synchronize the pitch reference to the current pitch angle.

– VS Button: push the VS button to alternately select or deselect vertical speed mode.
VS and the vertical speed reference value annunciate on the PFD. An up arrow also annunciates for positive VS; a down arrow annunciates for

negative VS. The FGC generates commands to maintain the vertical speed (reference) existing when VS mode is selected.
Turn the VS/pitch wheel to change the vertical speed reference value. When not engaged, push the remote SYNC button to synchronize the VS reference to current vertical speed.

– VNAV Button: push the VNAV button to alternately arm or clear vertical navigation mode. VNV annunciates on the PFD.
The FMC determines the VNAV capture point. After capture (VNV annunciates in green), the FMC outputs the vertical steering commands to the FGC. VNAV mode automatically cancels when the vertical waypoint is reached.

– FLC Button: push the FLC (flight level change) button to capture and track an IAS or Mach reference airspeed.
The mode takes into account the need to climb or descend to bring the airplane to the preselected altitude or VNAV altitude depending which is active and the airplanes ability (e.g. thrust level) to accomplish the maneuver. The airspeed reference may be adjusted by turning the SPEED knob on the FGP, synchronized by the FGC, or adjusted by the FMS when in VNAV modes.

– SPEED Knob: turn the SPEED knob to change the IAS or Mach reference value.
This value shows by the IAS or MACH mode annunciation on the PFD. Clockwise rotation increases the airspeed or Mach speed reference.

– IAS/MACH Button: push the (center) IAS/MACH switch to select Mach mode from IAS mode, or to select IAS mode from Mach mode.
Refer to SPEED knob description.

– ALT Button: push the ALT button to alternately select or deselect altitude hold mode. ALT annunciates on the PFD. The FGC generates commands to maintain the pressure altitude existing when ALT mode is selected.
When not engaged, push the remote SYNC button to synchronize the altitude reference to current altitude. Altitude hold mode automatically selects if the preselect altitude setting (ALT knob) is changed while in altitude preselect track. Altitude preselect mode (no button) In altitude preselect mode, the operator selects a desired altitude and the FGC generates commands to fly to and maintain that altitude. Turn the ALT knob to select the desired preselect altitude.

– ALTITUDE PRESELECT Mode: automatically arms when the ALT knob is turned, when go around is cleared, or when the flight director is turned on (except in overspeed or go around mode). ALTS annunciates in white on the PFD.
Altitude preselect capture occurs when the aircraft altitude nears the

preselect altitude. The capture point depends on closure rate. ALTS CAP annunciates in green on the PFD. If the ALT knob is turned during the capture maneuver, pitch mode selects and altitude preselect mode rearms. If ALTS CAP has been annunciated and then is cleared without going to arm or track mode, an ALTS annunciation flashes yellow for 10 seconds to show altitude abort.
Altitude preselect track occurs after the aircraft becomes established at the preselected altitude. ALTS annunciates in green on the PFD. If the ALT knob is turned during track, altitude hold mode selects and altitude preselect mode rearms.

– ALTITUDE PRESELECT Knob: turn the ALT knob to adjust the preselect altitude (shown on PFD). Clockwise rotation increases the preselect altitude. Turn the ALT knob to adjust the preselect altitude in 1000 foot increments. Push the ALT knob in and turn to adjust the preselect altitude in 100 foot increments.

– ALT ALERT CANCEL Button: push the (center) PUSH CANCEL switch to cancel aural and visual altitude alerts.

Refer to the Collins "Pro Line 21 Avionics System Operator's Guide, for the Piaggio P.180 Avanti", doc. n. 523-0806484, for more details about FGS Operations.