

GACE Flying Club

Flight Deck Automation in N5312S

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Flight Deck Automation Agenda

- What is Flight Deck Automation? Why use it? What are the components?
- When to use Flight Deck Automation
- Our equipment – Cessna NAV II with Bendix/King KLN 94, KAP 140, KMD 550
- KAP 140 Autopilot introduction – system components and limitations
- KAP 140 Preflight
- KAP 140 LATERAL AND VERTICAL MODES IN DETAIL
- What “ARMED” and “CAPTURED” means
- The buttons and knobs
- Recognizing the autopilot modes and how to make changes, group oral quiz
- Course Intercept with arbitrary intercept angle
- Review the KLN 94 GPS
- Flight plan review
- Approaches and missed approaches
- Caveats
- Sample VFR flight (ISP to PSM)
- Sample IFR flight (HFD to ISP)

Automation

- *Automation* is the allocation of functions to machines that would otherwise be allocated to humans. The term is also used to refer to the machines which perform those functions. Flight deck automation, therefore, consists of machines on the flight deck which perform functions otherwise performed by pilots. Current flight deck automation includes autopilots, flight management systems, electronic flight instrument systems, and warning and alerting systems.
- When do you use it? Or, when would you like to use it?
- Why use it and how does it help us as pilots?



Equipment N5312S

- Cessna NAV II package
 - KLN 94 GPS
 - KAP 140 Autopilot
 - KMD 550 multifunction display



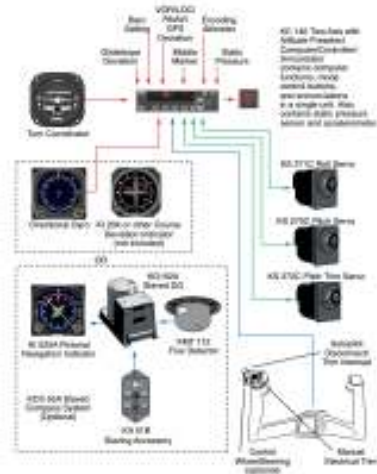
KAP 140 Autopilot

- Single Axis
- Dual Axis
- Dual Axis w/ altitude preselect
- Rate based (using turn coordinator) for roll axis
- Pitch axis derived from pressure sensor (internal altimeter) and accelerometer
- No direct dependence on vacuum system



KAP 140 Architecture

- The autopilot system consists of various components
- Note Servos – two way communications to autopilot computer
- What instrument is missing from the picture that you may have expected to be part of the system?



KAP 140 Two-Axis/Altitude Preselect System Diagram

KAP 140 Servos/Roll Steering

- Let's review page 263 of online IM
- Compare pages 263 and 264
- Our S/N is 172S9285
- Which system do we have and what is the difference?

KAP 140 Limitations

- Let's review page 271 of the online IM
- Take-aways:
 - Note airspeeds and flap settings
 - The autopilot may be used down to 200 feet AGL for approaches and may not be used below 800 AGL for all other phases of flight
 - You must do the preflight test prior to using

KAP 140 Preflight

- Let's review page 271 of the online IM
- Note that the autopilot disconnect button is also the pitch trim interrupt button, if held down.
- What are we testing here and why is it important?

KAP 140 Emergency Procedures

- Let's review page 272 of the online IM
- Consider these 4 steps as "memory items"
- See the effects of instrument losses on autopilot operation on page 276. Let's review them.
- Can the autopilot be used with a failed attitude indicator? How about a complete vacuum system failure?

KAP 140 Lateral and Vertical Modes

- Let's get the modes down first. Then we will talk about the buttons.
- Think in terms of lateral and vertical modes – separately and independently
- Review the sections of the display
- Lateral: HDG, ROL, NAV, APR, REV
- Vertical: VS, ALT, GS
- When ON, the autopilot is ALWAYS in some lateral mode and some vertical mode at the same time (e.g., the servos on both axes are energized)



Lateral Modes

- ROL
 - At power on, the default lateral mode is ROL
 - ROL in the KAP 140 means “level the wings” as determined by the turn coordinator
 - There is no PIP (pilot input parameter) associated with ROL
 - When the autopilot is in ROL mode, it will level the wings. If there is a disturbance, it will re-level the wings irrespective of heading
- HDG
 - Heading mode, intuitive, fly the selected heading
 - Required PIP = the desired heading selected with the heading bug
 - If there is a disturbance, the autopilot will turn the plane to fly the selected heading

Lateral Modes (Cont.)

- **APR**
 - Approach mode, will track a VOR, LOC or GPS course with higher lateral sensitivity
 - It has a vertical mode component: GS (glide slope) when used with an ILS
 - If an ILS is present, both lateral and vertical tracking occur simultaneously
 - If no ILS (or GS) is present, vertical navigation is performed using standard vertical modes
 - PIP = desired inbound course (not heading) set on heading bug
- **REV**
 - Similar to APR, but sensing is reversed
 - Used for LOC BC approaches
 - GS is disabled
 - PIP = the front inbound course on heading bug

Vertical Modes

- **VS – Vertical Speed**
 - Default vertical mode at power on
 - PIP = Desired vertical speed
 - VS is determined by internal pressure sensor
- **ALT – Altitude Hold**
 - Holds the altitude as it was captured when ALT mode was selected (as determined by internal pressure sensor)
- **GS – Glide Slope**
 - Tracks the Glide Slope on an ILS
 - Altitude preselector is ignored

Altitude Preselector

- The Altitude Preselect function allows capturing of a desired altitude and transitioning the autopilot into altitude hold mode from vertical speed mode. Manual input of desired altitude is accomplished through the rotary knobs on the faceplate of the KAP 140.
- Let's review some scenarios



KAP 140 Engage and Disengage

- To turn the unit on, press the AP button for 0.25 seconds, you will see the default modes displayed and the servos will energize (the autopilot now has control of pitch and roll).
- To turn the unit off, press the autopilot disconnect button. Using the electric trim, pressing the AP button, pulling the circuit breaker and some autopilot failures will cause the unit to disconnect as well.

KAP 140 Buttons and Knobs

Let's go around the horn:

- AP - Autopilot engage/disengage button
- HDG - Toggles between HDG and ROL modes
- NAV - Either engages or arms the NAV mode depending on present course deviation
- APR - Approach mode, used for all approaches (except BC), arms APR mode for course intercept
- REV - Reverse approach mode (back course)
- ALT - Toggles between Altitude Hold and VS modes.
- Up/Down - In VS mode, increases or decreases the desired VS in 100 foot increments
- Up/Down - In ALT mode, adjusts the held altitude up or down by 20 feet per button push. Used for tweaking your held altitude.
- ARM - when in VS mode, arms the ALT mode per the selected altitude set in the preselector
- BARO - sets local pressure

Quiz



Course Intercept

- Course intercept is to be done from ROL mode only, not from HDG mode
- Example: Fly heading to intercept the active leg of the GPS flight plan
 - Set the desired course to be intercepted in the NAV1 OBS
 - Fly HDG mode to establish any intercept angle (usually a vector from ATC)
 - Press HDG to switch to ROL mode
 - Press NAV – note the NAV ARM annunciator and HDG flashing
 - You have five second to set the desired course (not heading) on the heading bug, the flashing HDG will stop and ROL will be redisplayed
 - The autopilot will compute the time to turn to intercept the course. When this point is reached, ROL will change to NAV and the turn will commence
- The same procedure applies to intercepting and tracking a VOR radial.

Approach Course Intercept

- Course intercept is to be done from ROL mode only, not from HDG mode
- Example: Fly heading to intercept an ILS localizer
 - Set the desired course to be intercepted in the NAV1 OBS
 - Fly HDG mode to establish any intercept angle (usually a vector from ATC)
 - Press HDG to switch to ROL mode
 - Press APR – note the APR ARM annunciator and HDG flashing
 - You have five second to set the desired course (not heading) on the heading bug, the flashing HDG will stop and ROL will be redisplayed
 - The autopilot will compute the time to turn to intercept the course. When this point is reached, ROL will change to APR and the turn will commence
- If flying a full ILS, the GS ARM indication will be presented as well. (Note that GS ARM appears in the lower lateral section). The vertical mode will change to GS upon capture of glide slope. The altitude preselector is ignored once GS capture occurs.

KMD 550

- Great tool for situational awareness
- Confirm flight plan depiction
- Confirm correct track & present position



Flight plans/KLN 94 Review

- What is the waypoint stack for the following route: KHFD MAD V1 BELTT KISP
- How about this route:
 - KISP HTO V308 ORW ORW011 HFD053 DREEM KLWM
- Flight plan 0 is the active flight plan and is always depicted on the KMD 550
- For GPS approaches – LNAV only
- Always load the approach – even for an ILS
- If doing simple “direct to” navigation, and you see TMI on the KMD 550, why is that?

Approaches and missed approaches

- VFR – take the plane when you want.
Downwind at the latest is a good rule of thumb.
- Visual Approach (IFR) – Keep coupled or hand fly. Use your judgement.
- ILS – disconnect at or before DA
- Non-precision – disconnect when leaving MDA and maneuvering for landing.
- Missed approaches must be hand-flown until established in the climb.
- In all cases, don't exceed any limitations as outlined in the POH.

Quick Quiz (Instrument Students)

- What are the approach minimums when flying N5928E?
- What are the approach minimums when flying N5312S?
- What approach options are you presented with after selecting this approach on the KLN94?



Chair Flying

- Let's chair fly two flights. One simple VFR flight and one short IFR flight
- VFR – ISP to PSM
- IFR – HFD to ISP



Conclusion and Suggestions

- Flight automation can greatly reduce pilot workload and risk
- It frees you to look at the big picture of your flight
- Conversely, using flight automation can be a distraction if you are not proficient
- Practice in VFR conditions
- Have another pilot with you
- Monitor: Always confirm what you want is what you are getting
- Caveats: Remember to arm the altitude after turning on the autopilot, REMEMBER THE RUDDER
- Enjoy the benefits of Flight Automation in N5312S!

Are we there yet?



How's the weather doing?





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Thank You!

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30