

Introduction to the KAP-140 Autopilot

This note describes the basic operation of the Bendix/King KAP-140 autopilot that all EFA's new Cessnas are equipped with. There are 3 different versions, but almost all aircraft have the most capable version. Understanding its basic functions will not only let you get full value out of the airplanes you're flying, it will make your flying easier and much safer. The autopilot is an invaluable aid to reducing your workload in busy periods and in emergencies.

This note assumes you have a picture of the front display or are at a unit, and are flying an HSI-equipped aircraft.

Who's In Charge?

The autopilot always controls both aileron and elevator/trim. You cannot use it to control only one axis. *Never* try to overpower any control. Either it is flying the entire airplane, or you are. It may fight you with trim adjustments that can eventually put the airplane into an unsafe attitude. If you do not like or understand everything it is doing, disconnect it. In addition, the autopilot knows nothing about pitch or airspeed. It will happily stall the airplane trying to achieve your altitude or climb instructions, or overspeed the airplane while following descent instructions.

Turned Off -- Or Is It?

Unless power is removed by pulling its circuit breaker, the autopilot is always doing something. Even when turned off, the autopilot always has an altitude alerter function active, showing an altitude in feet on the front, and controlled by the knobs. This will annunciate (beep) when you get within 1000 feet of the indicated altitude, and again if you move 200 feet away from that altitude. In other words, it's an altitude bug with an audible alarm.

If you don't want this function, turn the altitude setting to something very high. Do not disable it with the circuit breaker.

To sense altitude, the autopilot has its own internal pressure sensor, and must know the current altimeter setting. When external power is applied (avionics master on), it will show the last altimeter setting blinking. Moving the knobs will set this, stop the blinking, and after a few seconds it will switch to the altitude alerter altitude display.

To reset the altimeter setting in flight, press the BARO button and change the setting with the knobs. It will automatically switch back to the altitude display after a few seconds.

To turn the autopilot on, press the AP button for 1 second. It requires a slightly long press to make sure you don't turn it on by accident when adjusting the throttle directly below.

Basic Modes

The display shows which mode it is in. You must pay attention to this, and understand what it is currently doing before trying to change it.

Aileron Control Modes

The autopilot controls ailerons with several modes. It is always doing one of these:

ROL - wing leveler (using Turn Coordinator)

HDG - Follows heading bug on HSI.

NAV - Tracks the HSI's centered CDI needle. Doesn't intercept, just tracks it.

APR - IFR function, not covered here.

REV - IFR function, not covered here.

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Pressing the HDG button activates HDG mode, or if already in HDG, switches to ROL. Unless you want to track a navigation aid, these are the only two aileron control modes you'll use. ROL is fine for briefly keeping the aircraft stable while you are busy with something else, but HDG is more useful for longer periods.

Elevator/Trim Control Modes

The autopilot controls elevator and trim with two modes. It is always doing one of these two:

VS – vertical speed hold. Maintains climb or descent rate.

ALT – altitude hold. Maintains current altitude. This is *NOT* the same as the altitude alerter display.

The function of the white UP and DN (up/down) buttons depend on the elevator/trim mode.

- In VS mode- the first press will show current feet per minute rate. Subsequent presses will change the current rate by 100 fpm. The display will return to altitude alerter display after a few seconds.
- In ALT mode- each press will change the current altitude being held by 20 feet up or down. The change will not be displayed anywhere.

Each press of the ALT button switches between VS and ALT modes, displayed on front. ALT will hold current altitude, and VS will hold last specified vertical speed rate. Typical actions:

- To level out at the current altitude, activate ALT mode. It may overshoot slightly if a high-rate climb or descent is in progress, then return. Fine-tune the altitude with the UP & DN buttons. Adjust throttle.
- To establish a climb or descent, activate VS mode if not already on, and set the desired climb or descent with U & /DN buttons. Adjust throttle.

Not realizing it has a climb or descent-- or doesn't when you want one-- is a common and confusing mistake in VS mode, because it does not continually show the VS rate. Get into the habit of making sure you know what the VS rate is when you activate VS mode in any way.

In ALT mode, it holds the altitude sensed when you press the ALT button. It *is not* paying any attention to the altitude alerter altitude displayed. It *does not* show you the altitude it is holding. Look at the aircraft's altimeter for that.

Turn On

When turned on, it always starts in ROL and VS modes. It will keep wings level, and hold whatever vertical speed exists the moment you turn it on. If you hit an updraft and it sees 1000 fpm the instant you turn it on, that's what it will try to hold. It will momentarily show fpm when activated, and you can also check it by pressing the UP & DN buttons once.

When Things Get Strange

For basic autopilot operation, the above is all that's needed. If you use the wrong control, you'll put it in other states that you may not understand. The easiest way to recover is to turn it off and back on into the starting ROL & VS mode. A good recovery sequence is:

- Press yoke disconnect button to turn off.
- Press AP button to turn on again.
- ALT button to capture current altitude.
- HDG if desired to track the heading bug.
- Fine-tune altitude with UP & DN buttons.

Intercepting and Tracking Courses

The autopilot can track courses received by the HSI. If the HSI CDI needle is already centered when the NAV button is pressed, the autopilot will immediately switch to NAV mode, and start to track the course information by steering to keep the needle centered.

If the CDI is not centered, the current aileron mode will continue, and NAV ARM will be displayed in addition to the current aileron mode. This is a monitoring mode that will make it switch to NAV when the needle is centered—if ever. Here's the catch- with an HSI, you must tell it how to intercept. So the proper procedure to track a course is:

- Autopilot in HDG mode
- Press NAV. If on course, it will immediately jump to NAV mode. If not, it will stay in HDG mode with NAV ARM displayed.
- If needed, set a course with the heading bug that will result in an intercept.
- When the needle centers, it will switch from HDG & NAV ARM to just NAV, and steer as needed to stay on the course.

If the aircraft is equipped with a Heading Indicator (vs. HSI), it will attempt to intercept the course on its own, and does not need the heading bug. See the KAP-140 User Guide for more information if using Heading Indicators (Directional Gyroscopes).

When flying a flight plan the autopilot will steer to track each leg. It is recommended that you retune the OBS at each course change. Some systems apparently require this, some do not. In any case, it's good practice for situational awareness.

Intercepting and Holding Altitudes

This is the most confusing operation. Remember that up until now the altitude alerter display, controlled with the knobs, has done nothing for us. If the altitude alerter display is already set to the desired target altitude, you can press the ARM button to tell it to stop at that altitude when it gets there. Then you must tell it how to get there, by setting a VS climb or descent towards the altitude alerter altitude. It will first display VS and ALT ARM. When the selected altitude is reached, it switches from VS and ALT ARM to only ALT mode, and like before, no longer uses the altitude alerter value except as an audible altitude bug. The ALT ARM mode, then, is similar to the NAV ARM mode- a monitoring mode that will switch it to ALT mode when the target is reached.

If you are in ALT mode and press ARM, it will stay in ALT and ALT ARM forever, because you haven't told it to go to the target altitude. If you are in VS mode with movement away from the desired altitude, or 0 fpm rate, you will also stay in VS and ALT ARM forever. You must tell it to establish a climb or descent towards the target altitude to intercept it; it won't do that automatically.

Here's the most confusing part of the autopilot operation. If the autopilot is already on, turning the altitude alerter knobs will activate ALT ARM, exactly as if you pressed ARM. This is convenient if you are changing altitudes- you don't need to press the ARM button. Set the new altitude, press the VS button to go into VS mode, then press the white UP & DN buttons to initiate a climb or descent towards the desired altitudes. It's confusing because if you turn the knobs mistakenly, say instead of pressing the UP & DN buttons, you'll activate ALT ARM.

Most people get confused using the autopilot because of this feature. They don't understand that they must tell it how to intercept an altitude, and whether to use the UP & DN buttons vs. rotating knobs.

So a typical procedure for changing altitudes when stable in ALT mode is:

- Set new desired altitude in altitude alerter with knobs. This will activate ALT ARM automatically.
- Press ALT button to switch into VS mode, then set desired climb/descent rate with UP & DN buttons.
- Adjust throttle as needed.
- When target altitude is reached, it will automatically switch to ALT mode.
- Adjust throttle again.

Turning It Off

There are 6 ways to disable the autopilot. In order of preference:

- Yoke disconnect button.
- AP button on unit.
- Any use of electric trim.
- Pulling autopilot circuit breaker.
- Turning Avionics Master switch off.
- Turning aircraft Master switch off.

Final Cautions

- The autopilot does what you tell it. It does not know about airspeed and does not control the throttle. You must do this.
- The autopilot will fight you for control, and may put the elevator trim in a dangerous state if you try to overpower it. Hands off the yoke when it's on.
- Autopilots sometimes lose the nav course. Never stop monitoring it, and if it does not appear to be doing what you want, disable it immediately and hand fly.

Disclaimer:

This document is meant only to be a supplement to any official training materials handbooks on the autopilot. Executive Flyers Aviation (EFA) does not make any claims that this is sufficient information to become proficient with the system. EFA does not take any responsibility for the use or misuse of the system.

