

# **Adjusting Autopilot Gain Settings**

Trouble shooting Autopilot Gain settings can be somewhat complicated because you have multiple things that can be controlling the AP in the plane.

You need to verify each if the following, do not move the next step until you are completely satisfied that the AP works correctly.

## Step 1 Autopilot Controls the Plane in AP mode

When you press the AP button on the autopilot it should fly the plane in GPS ground track mode and vertical speed mode. This mode is completely independent of the EFIS and only uses the GPS signal from your 430W for stability and ground track.

- Does the plane hold altitude?
- Does the plane hold GPS ground track?
- If you turn the AP knob to a new track over 90 degrees away does the plane capture the new track without overshooting?
- Both left and right?
- Does it seem to capture the new ground track without hesitation or sluggishness?
- If you adjust the AP vertical speed to +/- 500 ft/min does the plane capture and hold the vertical speed?
- If you adjust the AP vertical speed to +/- 100 ft/min does the plane capture and hold the vertical speed?

The Gain settings in the autopilot are the only settings that should be adjusted to make the plane fly good in AP mode.

## Step 2 Autopilot Controls the Plane in EFIS Heading and Altitude Bug mode

When you press the EFIS button on the autopilot it should fly the plane in EFIS bug mode as long as the EFIS AP/FD is in bug mode. In this mode the EFIS is sending Roll and Vertical Speed commands to the AP to make the plane follow the heading and altitude bugs. In this mode the AHRS pitch has nothing to do with autopilot control, it is only using altitude and vertical speed to control the planes altitude.

- The EFIS AP/FD settings should be LAT HDG & VER ALT
- You AP/FD mode boxes under the altitude tape should both be yellow.
- Does the plane hold to the altitude bug?
- Does the plane hold Heading bug?
- If you turn the Heading bug to a new heading over 90 degrees away does the plane capture the new heading without overshooting?
- Both left and right?
- Does it seem to capture the new heading without hesitation or sluggishness?
- Adjust the vertical speed bug on the EFIS to 500 ft/min

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- If you adjust altitude bug to a new altitude over 1000ft away does the plane capture and hold the new altitude?
- Does the plane hold the commanded vertical speed when the new altitude is over 2000ft away?

The Gain settings in the EFIS should be adjusted to make the plane fly good in EFIS bug mode.

## Step 2a Adjusting Autopilot Lateral Gain Settings

When you adjust the heading bug to a new heading over 90 degrees away the plane should capture the new heading with minimal overshoot.

There are two Gain settings that control how the airplane responds in Lateral control.

EFIS ROLLGAIN ; This is set in the EFIS AP/FD -> SETTINGS -> LATERAL -> ROLLGAIN AP Lateral Activity ; This is set in the Autopilot

The EFIS ROLLGAIN controls how far the airplane should bank for a new heading. The AP Lateral Activity controls how fast the autopilot roll servo responds to roll commands.

## STEP 1 ADJUSTING THE AP SETTINGS

- 1. Verify that the AP LAT Torque is set to 12
- 2. Engage the Autopilot using the AP button so that the aircraft is following the heading knob on the Autopilot.
- 3. Adjust the LAT ACT on the autopilot so that the aircraft performs well when you turn to a new heading using the AP knob. You should make turns of over 90 degrees and continue to adjust until you are satisfied with the results.

## STEP 2 ADJUSTING THE EFIS SETTINGS

You can check the current commanded bank angle being sent from the EFIS to the AP from the check list page, it is displayed as AP ROLL. The EFIS uses the following calculation for AP Roll angle.

AP ROLL = (Heading Bug – Magnetic Heading) \* EFIS ROLLGAIN

Heading Bug	090
Magnetic Heading	360
EFIS ROLLGAIN	.05

AP ROLL = (90 – 360) x .05 = -13.5 degrees of bank angle

The EFIS limits the maximum bank angle to what is required for a standard rate turn.

- 4. Engage the Autopilot using the EFIS button so that the aircraft is following the heading bug on the EFIS.
- 5. Adjust the ROLLGAIN on the EFIS so that the aircraft performs well when you turn to a new heading. You should make turns of over 90 degrees and continue to adjust until you are satisfied with the results.

If the EFIS ROLLGAIN is set too low the airplane will tend to be sluggish and slow to respond to new headings. If the EFIS ROLLGAIN is set too high the airplane will tend to overshoot the heading bug and be jittery.

- The EFIS AP/FD settings should be LAT HDG & VER ALT
- You AP/FD mode boxes under the altitude tape should both be yellow.
- Does the plane hold to the altitude bug?
- Does the plane hold Heading bug?
- If you turn the Heading bug to a new heading over 90 degrees away does the plane capture the new heading without overshooting?
- Both left and right?
- Does it seem to capture the new heading without hesitation or sluggishness?
- Adjust the vertical speed bug on the EFIS to 500 ft/min
- If you adjust altitude bug to a new altitude over 1000ft away does the plane capture and hold the new altitude?

## Step 3 Autopilot Controls the Plane in EFIS NAV and Altitude Bug mode

When you press the EFIS button on the autopilot it should fly the plane in GPS NAV mode and altitude bug mode as long as the EFIS AP/FD is in LAT NAV and VER ALT bug mode. In this mode the EFIS is sending Roll commands from the 430W and Vertical Speed commands from the EFIS to the AP to make the plane follow the 430W flight plan and altitude bug. In this mode the AHRS pitch and roll has nothing to do with autopilot control, it is only using altitude and vertical speed to control the planes altitude and the roll steering commands from the 430W are controlling lateral roll.

- The EFIS AP/FD settings should be LAT ARM (will switch to NAV) & VER ALT
- You AP/FD mode boxes under the altitude tape should be magenta on the left and yellow on the right once the plane is tracking the GPS.
- Turn the Heading bug to your current heading
- Enter a waypoint in the 430W and do a -D-> ENTER
- Press EFIS on the autopilot
- The plane should follow the heading bug until the plane track is within +- 30 degrees of the GPS course and the CDI needle is within 60% deflection.
- Does the plane follow the GPS course?
- Does the plane round the corners between GPS way points? It should follow the 430W dotted rounded corners.

The GPSS Gain and LAT Activity setting in the autopilot should be adjusted to make the plane fly good in EFIS NAV mode. Once the lateral goes from ARM to NAV the EFIS is only passing the steering command from the 430W, the 430W is doing all the steering independent of the EFIS.

## Step 4 Autopilot Controls the Plane in EFIS NAV and Vertical NAV mode (GPS LPV Approach)

When you press the EFIS button on the autopilot it should fly the plane in GPS NAV mode and GPS vertical NAV mode as long as the EFIS AP/FD LAT NAV and VER NAV mode. In this mode the EFIS is sending Roll and deviation commands from the 430W to the AP to make the plane follow the 430W flight plan and vertical GPS glide slope. In this mode the AHRS pitch and roll has nothing to do with autopilot control, the roll steering commands from the 430W and glide slope deviation are controlling lateral roll and vertical position.

- The EFIS AP/FD settings should be LAT ARM (will switch to NAV) & VER ARM
- You AP/FD mode boxes under the altitude tape should be magenta on the left and right once the plane is tracking the 430W GPS.
- Turn the Heading bug to your current heading and Altitude bug to your current altitude.
- Select an Approach on the 430W and activate it.
- Press EFIS on the autopilot
- The plane should follow the heading bug and altitude bug until the plane track is within +- 30 degrees of the GPS course and the CDI needle is within 60% deflection.
- Verify that the Minimum Altitude bug is set for the approach in the EFIS, the AP will not let the plane fly below the MINS bug! If you engage the AP and the plane starts climbing check the MINS bug...
- Verify that you are going to intercept the LPV glide slope from below, if you are above the glide slope when you start getting the VDI needle on the EFIS the AP will not capture it!
- When you get the VDI needle on the EFIS the plane should fly into the glide slope and then capture and start to descend following the VDI needle.

The GPSS Gain and LAT Activity setting in the autopilot should be adjusted to make the plane fly good in EFIS NAV mode. Once the EFIS goes from ARM to NAV the EFIS is only passing the steering command from the 430W, the 430W is doing all the steering independent of the EFIS.

EFIS S/N:	
EFIS Software Version:	
Customer Name:	
Phone Number:	
Aircraft Type:	
Magnetometer Location:	
Picture of the Magnetometer Location	

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