



SkyView SE, *SkyView* Classic,
SkyView Touch, *SkyView* HDX



AF-5000 Touch Displays (OS:5),
AF-6000 Series

Autopilot In-Flight Tuning Guide

For Skyview Software Version 16.4
and AFS Software Version Vx16.10

102064-000

Revision D

9/8/2022

Copyright © 2022 by Dynon Avionics, Inc.

Dynon Avionics grants third parties' permission to print this document

Contact Information

Dynon Avionics, Inc.
19825 141st Place NE
Woodinville, WA 98072

Technical Support

Phone: +1 (425) 224-6736, 8:00 AM – 5:00 PM (Pacific Time) Monday – Friday
Email: support@dynon.com

Sales

Phone: +1 (425) 650-1269, 8:00 AM – 5:00 PM (Pacific Time) Monday – Friday
Email: sales@dynon.com

Find Us on the Web

dynon.com – Dynon homepage
dynon.com/docs – Product documentation
dynon.com/download – Software updates for products
dynon.com/support – Support resources
dynon.com/register – Register your Dynon Avionics product
shop.dynon.com – Dynon's *secure* online store

Stay in Touch

dynon.com/newsletter – Sign up to receive Dynon's newsletter
forum.flydynon.com – Dynon-hosted forum for customers and pilots
preflight.dynon.com – Dynon's blog
facebook.com/dynonavionics
instagram.com/dynonavionics
twitter.com/dynon

Videos and Training

youtube.com/DynonAvionics – Training, events, and other videos on YouTube

Copyright

©2022 Dynon Avionics, Inc. All rights reserved. No part of this manual may be reproduced, copied, transmitted, disseminated, or stored in any storage medium, for any purpose without the express written permission of Dynon Avionics. Dynon Avionics hereby grants permission to download a single copy of this manual and of any revision to this manual onto a hard drive or other electronic storage medium to be viewed for personal use, provided that such electronic or printed copy of this manual or revision must contain the complete text of this copyright notice and provided further that any unauthorized commercial distribution of this manual or any revision hereto is strictly prohibited.

Information in this document is subject to change without notice. Dynon Avionics reserves the right to change or improve its products and to make changes in the content without obligation to notify any person or organization of such changes. Visit the Dynon Avionics website (dynon.com) for current updates and supplemental information concerning the use and operation of this and other Dynon Avionics products.

Revision History

REV	DATE	APPROVED	DESCRIPTION OF CHANGE
A	6/1/2013	LED	Initial release
B	3/1/2014	LED	Updated for SV v10.0. <ul style="list-style-type: none"> Added BANK ANGLE LIMIT Mention of SV-AP-PANEL only active in EXPERT mode
C	12/1/2016	ECO 246525	<ul style="list-style-type: none"> Changed default value of VSI Gain
D	9/8/2022	ECO 380245	Reformatted document. <ul style="list-style-type: none"> Updated flow charts. Added tables with default values, and variable description. Created new step-by-step procedures for autopilot tuning methods. Added yaw damper information. Updated Section 2 to add additional detail and update criteria for autopilot testing performed prior to in-flight tuning. Added flight director check for heading mode Updated VOR intercept distance Updated for SV v16.4. <ul style="list-style-type: none"> Added lost motion compensation instructions Added AFS-specific parameters

DOCUMENT NAME	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	ii

Table of Contents

1	Introduction	4
1.1	Using this Manual.....	4
1.2	Document Iconography	4
1.3	Reference Documents.....	4
1.4	Glossary	4
2	Important Steps Prior to In-Flight Tuning.....	5
2.1	Servo Calibration.....	5
2.2	Auto-Trim Calibration	5
2.3	Servo to Flight Control Coupling Check.....	5
2.4	Autopilot Disconnect Test.....	6
2.5	Magnetometer Calibration	6
2.6	ADAHRS Zero-Pressure Calibration.....	6
2.7	Broken Shear Screw Test	6
3	Roll Axis Tuning.....	7
3.1	Tuning Procedures	7
3.2	Roll Axis Parameters.....	11
4	Pitch Axis Tuning.....	12
4.1	Tuning Procedures	12
4.2	Pitch Axis Parameters	16
5	Yaw Damper Tuning	17
5.1	Tuning Procedures	17
5.2	Yaw Damper Parameters	19
6	Lost Motion Compensation	20
6.1	Tuning Procedures	20

DOCUMENT NAME	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	iii

1 Introduction

This document is a supplemental reference to the *Skyview System Installation Guide* document.

1.1 Using this Manual

To reduce paper, Dynon does not provide a printed version of this manual. However, Dynon grants permission to third parties to print this manual, as necessary. The most recent PDF version is available for download at dynon.com/docs. This manual is updated periodically, and it is important to use the most recent version when installing SkyView components.

Dynon suggests keeping a PDF version of the manual on a smartphone, tablet, or laptop computer while installing and configuring SkyView. Using the manual electronically allows quick navigation of the document, figures to be viewed in color, and keyword searches.

1.2 Document Iconography

The following icons are used in this guide:



This icon denotes information that merits special attention.



This icon denotes a helpful tip.

1.3 Reference Documents

The following documents support the information in this document:

- *SkyView System Installation Guide*

1.4 Glossary

AFS	Advanced Flight Systems
AP	Autopilot
FD	Flight Director
ILS	Instrument Landing System
KIAS	Knots Indicated Airspeed
LPV	Localizer Performance VNAV
MSL	Mean Sea Level
GPS	Global Positioning System
NAV	Navigation
VOR	Very High Frequency Omnidirectional Range
VNAV	Vertical Navigation

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
4	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4and AFS Software Version Vx16.10

2 Important Steps Prior to In-Flight Tuning

It is essential for good autopilot performance to ensure the autopilot servos are properly installed and correctly connected to the aircraft's flight control systems. Poor installation, or incorrect connection may result in poor performance or safety hazards. Ensure the servos are installed in accordance with the instructions in the system installation manual. Additionally, the following steps will help verify the autopilot is mechanically suitable for in-flight tuning.

2.1 Servo Calibration

Prior to any in-flight testing, ensure that the autopilot servos have been properly calibrated. See the *Skyview System Installation Guide* document for further information.

2.2 Auto-Trim Calibration

If the aircraft is equipped with electric trim, ensure that the trim system has been properly calibrated and configured before in-flight tuning. See the *Skyview System Installation Guide* document for further information.

2.3 Servo to Flight Control Coupling Check

With the aircraft parked on level ground, and the engine off:

1. Center flight controls
2. Synchronize HDG and ALT bugs to present heading and altitude
3. Engage autopilot in HDG and ALT mode
 - Observe autopilot hold the controls stationary.
4. Have assistant manually apply simulated air loads to the flight control surfaces
 - Observe servos resist the simulated air loads,
 - Flight control surfaces should move very little before servo slips.

If the controls surfaces have significant movement when the simulated air loads are applied check that the servo mounting bracket is not exhibiting any deflection/bending. Ensure all interconnect hardware (such as bridal cables or pushrods) are tight and tensioned appropriately. Any significant sources of slop in the mechanical system between the autopilot servo and the flight control surface will cause degraded autopilot performance and makes precise autopilot tuning ineffectual. Acceptable slop values vary depending on aircraft make and model. Nominally, ± 2.5 degrees for ailerons and ± 4 degrees for elevator and rudder before servo slipping is considered acceptable in general cases. If slop cannot be reduced with adjustment of the flight control system adjust the Lost Motion Compensation setting for the affected axis using the instructions in Section 6.

DOCUMENT TITLE	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	5



2.4 Autopilot Disconnect Test

Prior to testing of the autopilot ensure that the autopilot quick-disconnect button is fully functional. With the aircraft parked on the ground, and the engine off:

1. Center the flight controls.
2. Engage the autopilot in any mode.
 - Observe the autopilot servos resist movement of the flight controls.
3. Press the autopilot disconnect button.
 - Observe the autopilot servos no longer resist movement of the flight controls.

2.5 Magnetometer Calibration

Prior to testing of the autopilot ensure that both a ground and in-flight magnetometer calibration are complete. See the *Skyview System Installation Guide* document for instructions. Failure to precisely calibrate the magnetometer will affect the performance of the HSI, which provides critical heading information to the autopilot. Erroneous heading information will cause degraded autopilot performance and makes precise autopilot tuning ineffectual.

2.6 ADAHRS Zero-Pressure Calibration

Prior to testing of the autopilot, ensure that a successful zero-pressure calibration has been completed. Failure to complete this test may reduce accuracy of the pitot static instruments which provide critical air data to the autopilot. Erroneous air data will cause degraded autopilot performance and makes precise autopilot tuning ineffectual.

2.7 Broken Shear Screw Test

Every Dynon autopilot servo contains a shear screw to mechanically limit the force the servo can provide. In the event this screw fails the affected axis will not function. To test for a broken shear screw:

1. Engage the autopilot in HDG and ALT mode.
2. Slowly apply pressure to each flight control until the servos slip.
3. Observe a distinct slip in the flight control. If no distinct slip is felt:
 - The shear screw may be broken,
 - Inspect the affected servo.

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
6	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10

3 Roll Axis Tuning

The roll axis should be tuned prior to tuning or engaging any other axis. Ensure all pre-flight items from Section 2 have been completed. Failure to complete pre-flight will prevent successful autopilot tuning.

3.1 Tuning Procedures

The following procedures should be conducted:

- in smooth air,
- with yaw damper disengaged,
- with autopilot set to expert mode.

3.1.1 Heading Mode

With the aircraft in trimmed, level flight:

1. Set all tuning parameters to default settings.
2. Align heading bug with present heading.
3. Engage autopilot in HDG mode.
 - Ensure yaw servo is not engaged (if installed).
 - Ensure pitch servo is not engaged (if installed).
4. Operate the aircraft at low speed (approximately 10 knots above the autopilot minimum airspeed)
5. Adjust **LOW SPEED ROLL SENSITIVITY** to achieve acceptable flight director tracking during heading changes.
 - If aircraft lags behind the flight director bars, increase ROLL SENSITIVITY.
 - If ailerons oscillate or move too abruptly, reduce ROLL SENSITIVITY.
6. Operate the aircraft at approximately 10 knots below the autopilot maximum airspeed.
7. Adjust **HIGH SPEED ROLL SENSITIVITY** to achieve acceptable flight director tracking.
 - If aircraft lags behind flight director bars, increase ROLL SENSITIVITY.
 - If ailerons oscillate or move too abruptly, reduce ROLL SENSITIVITY.
8. Operate the aircraft at regular cruising speed.
9. Adjust **ROLL GAIN** to achieve desired roll aggressiveness using 90 degree heading changes.
 - If aircraft rolls wings-level too late during heading intercept, increase ROLL GAIN.
 - If aircraft rolls wings-level too early during heading intercept, decrease ROLL GAIN.
 - If aircraft begins turn too aggressively, decrease ROLL GAIN.
 - If aircraft begins turn too slowly, increase ROLL GAIN.
10. If acceptable performance is not achieved, see troubleshooting steps in Section 3.1.5.

DOCUMENT TITLE	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	7

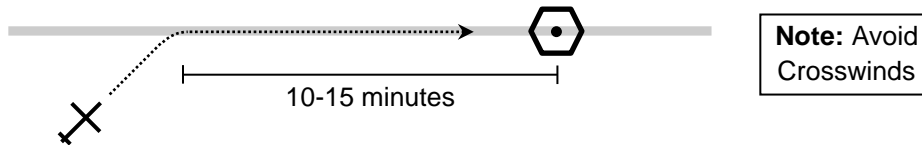
3.1.2 Track Mode

Autopilot performance in TRK mode is dependent on performance in HDG mode and GPS signal integrity. If autopilot is properly tuned in HDG mode, no changes should be necessary to achieve acceptable TRK mode performance. There are no settings available to the user that affect only track mode performance. If acceptable performance is not achieved see troubleshooting steps in Section 3.1.5.

3.1.3 VOR/LOC Navigation Mode

Autopilot performance in VOR or LOC navigation mode is dependent on performance in HDG mode and navigation signal integrity. Any changes to HDG mode tuning will affect performance in VOR or LOC navigation mode. To allow for best performance, tune the autopilot for VOR and LOC performance in calm winds. Crosswind correction is applied automatically during normal operation. Ensure default CDI GAIN and CDI DOT GAIN settings are loaded prior to commencing tuning. The following steps can be used to tune the response when tracking VOR or Localizer signals:

1. Position the aircraft approximately 10-15 minutes (at present groundspeed) from a VOR station.
2. Orient the aircraft to intercept a VOR course at approximately 45 degrees as shown below.



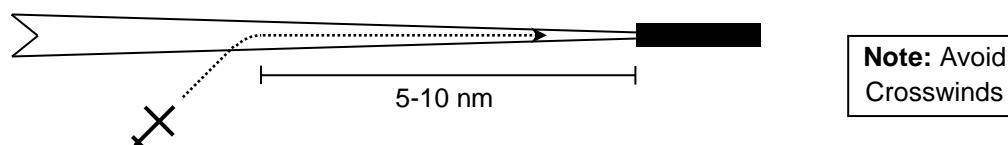
3. Adjust **CDI GAIN** to achieve good VOR intercept performance.
 - If aircraft overshoots course during intercept, decrease CDI GAIN.
 - If aircraft undershoots course during intercept, increase CDI GAIN.
 - If aircraft wanders off course after intercept, increase CDI GAIN.
4. Adjust **CDI DOT GAIN** to achieve good VOR tracking performance.
 - If aircraft oscillates while tracking course, increase CDI DOT GAIN.
 - If aircraft is too slow to adjust for tracking errors, reduce CDI DOT GAIN.

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
8	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4and AFS Software Version Vx16.10

3.1.4 GPS/GPSS/LNAV/LPV Navigation Mode

Autopilot performance in GPS/GPSS/LNAV/LPV navigation modes is dependent on performance in HDG mode and navigation signal integrity. Any changes to HDG mode tuning will affect performance in GPS/GPSS/LPV navigation mode. To allow for optimal tuning performance, tune the autopilot for GPS/GPSS/LNAV/LPV performance in calm winds. Crosswind correction is applied automatically during normal operation. Ensure default XTE GAIN and XTE DOT GAIN settings are loaded prior to commencing tuning. The following steps can be used to tune the response when tracking GPS-based signals:

1. Position the aircraft 5 to 10 miles from runway.
2. Orient the aircraft to intercept approach course at approximately 45 degrees as shown below.



3. Adjust **XTE GAIN** to achieve good intercept performance.
 - If aircraft overshoots course during intercept, decrease XTE GAIN.
 - If aircraft undershoots course during intercept, increase XTE GAIN.
 - If aircraft wanders off course after intercept, increase XTE GAIN.
4. Adjust **XTE DOT GAIN** to achieve good tracking performance.
 - If aircraft oscillates while tracking course, increase XTE DOT GAIN.
 - If aircraft is too slow to adjust for tracking errors, reduce XTE DOT GAIN.

DOCUMENT TITLE	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	9



3.1.5 Roll Tuning Troubleshooting

If performance is not acceptable, evaluate and perform the corresponding actions in the following table. If these actions do not resolve issues, contact Dynon Technical Support.

Issue	Action(s)
ROLL SLIP indications appear.	Increase ROLL TORQUE.
	Reduce ROLL SENSITIVITY
	Ensure flight controls are lubricated appropriately.
	Ensure flight controls are rigged appropriately.
	Contact Dynon Technical Support.
Aircraft slowly wanders in heading.	Check for loose servo mount bracketry.
	Check for loose flight control cables/pushrods.
	Check for poor magnetometer calibration.
	Ensure magnetometer is properly leveled.
	Ensure magnetometer is free from magnetic interference.
	Perform Servo to Flight Control Coupling Check (see Section 2.3).
	Increase ROLL SENSITIVITY.
	Adjust LOST MOTION COMPENSATION (see Section 6).
Contact Dynon Technical Support.	
Aircraft slowly oscillates in roll	See " <i>Aircraft slowly wanders in heading</i> ".
Autopilot jerks or is too aggressive	Reduce ROLL SENSITIVITY.
	Reduce ROLL GAIN.
	Reduce LOST MOTION COMPENSATION.
Autopilot does not move controls	Ensure shear screw is not broken (see Section 2.7).
ROLL SENSITIVITY maxed out	Increase capstan radius or move pushrod toward end of servo arm.
	Contact Dynon Technical Support

Table 1: Roll Axis Troubleshooting

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
10	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10

3.2 Roll Axis Parameters

Parameter	Description	Default	Min	Max
ROLL TORQUE	Maximum output torque of servo.	100	10	100
ROLL HIGH SPEED SENSITIVITY	Amount of servo motor travel relative to autopilot output signal for roll axis. Applied at maximum autopilot speed limit (as set in pitch servo settings). Linear interpolation between this setting and LOW SPEED SENSITIVITY based on airspeed. Larger numbers result in larger servo movements for a given autopilot signal.	10	1	50
ROLL LOW SPEED SENSITIVITY	Amount of servo motor travel relative to autopilot output signal for roll axis. Applied at minimum autopilot speed limit (as set in pitch servo settings). Linear interpolation between this setting and HIGH SPEED SENSITIVITY based on airspeed. Larger numbers result in larger servo movements for a given autopilot signal.	10	1	50
ROLL LOST MOTION COMPENSATION	Amount of servo travel to compensate for mechanical control system lost motion (aka backlash) between the servo and the control surface.	0	0	20
ROLL GAIN	Sets the overall roll error gain and feedforward signal gain. Large numbers result in more aggressive performance and increase autopilot response to roll errors.	0	0	5.0
CDI GAIN	Sets the autopilot response to course errors when navigating using VOR or LOC signals.	2.0	0.1	5.0
CDI DOT GAIN	Dampens the autopilot response to course errors when navigating using VOR or LOC signals	2.0	0.1	10.0
XTE GAIN	Sets the autopilot response to course errors when navigating using GPS signals. Higher values increase ground track correction per unit of course error.	0.00025	0.00000	0.01000
XTE DOT GAIN	Dampens the autopilot response to changes in course errors when navigating using GPS signals. Higher values add dampening.	0.0005	0.0000	1.0000
BANK ANGLE LIMIT	Bounds the desired autopilot bank angle.	30	5	45
*TURN RATE LIMIT	Limits the rate of turn the autopilot can command.			

Table 2: Roll Axis Parameters

*Only available in Advanced Flight Systems products

DOCUMENT TITLE	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	11

4 Pitch Axis Tuning

The pitch axis should be tuned after tuning the roll axis. Ensure all pre-flight items from Section 2 have been completed. Failure to complete pre-flight checks is likely to prevent successful servo tuning.

4.1 Tuning Procedures

The following procedures should be conducted in smooth air. Ensure that the high and low autopilot airspeed limits are set appropriately before beginning these procedures.

4.1.1 Airspeed Hold Mode

With the aircraft in trimmed, level flight:

1. Set all tuning parameters to default settings.
2. Engage autopilot in HDG + IAS mode.
3. Operate the aircraft at 15 knots above minimum autopilot operating speed.
4. Raise/lower IAS bug by 10 knots and adjust **LOW SPEED PITCH SENSITIVITY** so pitch of aircraft follows flight director bars.
 - If aircraft lags behind flight director bars, increase LOW SPEED PITCH SENSITIVITY.
 - If aircraft oscillates or feels twitchy in pitch axis, decrease LOW SPEED PITCH SENSITIVITY.
5. Operate the aircraft at 15 knots below maximum autopilot operating speed.
6. Raise/lower IAS bug by 10 knots and adjust **HIGH SPEED PITCH SENSITIVITY** so pitch of aircraft follows flight director bars.
 - If aircraft lags behind flight director bars, increase HIGH SPEED PITCH SENSITIVITY.
 - If aircraft oscillates or feels twitchy in pitch axis, decrease HIGH SPEED PITCH SENSITIVITY.
7. Operate the aircraft at normal cruising speed.
8. Raise/lower IAS bug by 10 knots and adjust **PITCH GAIN** so aircraft smoothly captures new airspeed setpoint.
 - If aircraft overshoots new airspeed setting, reduce PITCH GAIN.
 - If aircraft undershoots new airspeed setting, increase PITCH GAIN.
9. If acceptable performance is not achieved, see troubleshooting steps in Section 4.1.7.

4.1.2 Vertical Speed Mode

Performance in vertical speed mode is governed primarily by the quality of the airspeed hold mode tuning and performance. There are no specific tuning procedures for vertical speed mode performance.

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
12	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10

4.1.3 Altitude Hold Mode

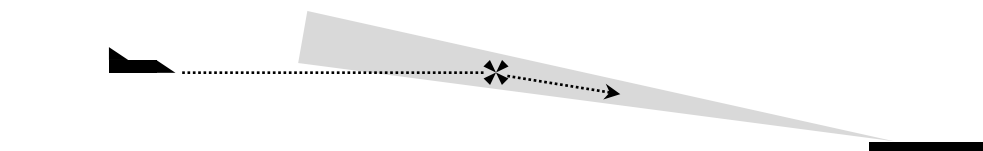
With the aircraft in trimmed, level flight:

1. Operate the aircraft at normal cruising speed.
2. Engage autopilot in HDG + ALT mode.
3. Increase altitude bug by 500 ft
4. Press NOSE UP to start VS climb at 500 fpm. Autopilot should automatically capture new altitude. Adjust **ALT GAIN** to control altitude intercept performance.
 - If aircraft levels-off too soon, increase ALT GAIN.
 - If aircraft overshoots new altitude, decrease ALT GAIN.
5. Once new altitude has been reached adjust **VSI GAIN** to fine tune altitude hold performance.
 - If aircraft oscillates about target altitude, increase VSI GAIN.
 - If aircraft is slow to make minor corrections for altitude errors, decrease VSI GAIN.
6. Conduct a 90 degree turn by moving the heading bug.
7. Adjust **G ERROR GAIN** during the turn to fine tune altitude hold performance.
 - If aircraft loses altitude during turn, increase G ERROR GAIN
 - If aircraft still loses altitude, increase G ERROR LIMIT
8. If acceptable performance is not achieved, see troubleshooting steps in Section 4.1.7.

4.1.4 VNAV (Glideslope/ILS) Mode

Performance in all vertical navigation modes is governed primarily by the quality of the airspeed hold mode tuning. The following settings adjust performance for the ILS glideslope mode. Conduct this test in smooth air.

1. Operate the aircraft at normal approach speed and configuration.
2. Capture and track an ILS localizer signal using NAV mode.
3. Arm the GS mode by pressing VNAV once a glideslope signal is displayed.



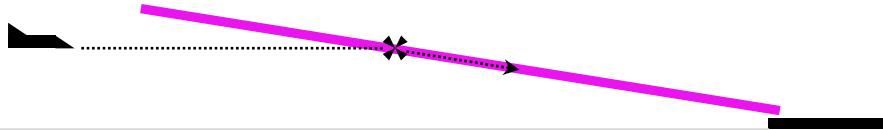
4. Adjust **VDI GAIN** for desired glideslope capture performance
 - If the aircraft overshoots the glideslope, reduce VDI GAIN.
 - If the aircraft undershoots or descends too early, increase VDI GAIN.
5. Adjust **VDI DOT GAIN** for desired glideslope tracking performance
 - If the aircraft oscillates above/below the glideslope, increase VDI DOT GAIN.
 - If the aircraft is too slow to recover from glideslope, deviations reduce VDI DOT GAIN.
6. If acceptable performance is not achieved, see troubleshooting steps in Section 4.1.7.

DOCUMENT TITLE	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	13

4.1.5 VNAV (Glidepath/GPS) Mode

Performance in all vertical navigation modes is governed primarily by the quality of the airspeed hold mode tuning. LPV approaches are recommended for use when tuning the autopilot due to their inherent vertical navigation performance and accuracy. The following settings adjust performance for the GPS glidepath mode. Conduct this test in smooth air.

1. Operate the aircraft at normal approach speed and configuration.
2. Capture and track a LPV approach course using NAV mode.
3. Arm the VNAV mode by pressing VNAV once a glidepath signal is displayed.



4. Adjust **VDI GAIN** for desired glideslope capture performance
 - If the aircraft overshoots the glideslope, reduce VDI GAIN.
 - If the aircraft undershoots or descends too early, increase VDI GAIN.
5. Adjust **VDI DOT GAIN** for desired glideslope tracking performance
 - If the aircraft oscillates above/below the glideslope, increase VDI DOT GAIN.
 - If the aircraft is too slow to recover from glideslope deviations, reduce VDI DOT GAIN.
6. If acceptable performance is not achieved, see troubleshooting steps in section 4.1.7.

4.1.6 Turbulence Tuning Procedure

The Dynon autopilot can be adjusted to compensate for small updrafts and downdrafts. These settings can be adjusted in light turbulence or left at default values if performance is acceptable.

1. Adjust **G ERROR LIMIT** for desired glideslope tracking performance in turbulence
 - If more aggressive correction is desired, increase G ERROR LIMIT.
 - If less aggressive correction is desired, decrease G ERROR LIMIT.

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
14	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10

4.1.7 Pitch Tuning Troubleshooting

If performance is not acceptable, evaluate and perform the corresponding actions in the following table. If these actions do not resolve issues, contact Dynon Technical Support.

Issue	Action(s)
PITCH SLIP indications appear.	Ensure aircraft is kept in trim during flight.
	Increase PITCH TORQUE.
	Reduce PITCH SENSITIVITY.
Aircraft slowly oscillates about airspeed setting.	Check for loose servo mount bracketry.
	Check for loose flight control cables/pushrods.
	Increase PITCH SENSITIVITY.
	Reduce PITCH GAIN.
Pitch servo quickly oscillates or is jerky.	Increase LOST MOTION COMPENSATION (see Section 6).
	Reduce PITCH SENSITIVITY.
Aircraft overshoots altitude bug.	Reduce PITCH SENSITIVITY.
	Reduce LOST MOTION COMPENSATION (see section 6).
Aircraft overshoots altitude bug.	Reduce ALT GAIN.
	Increase VSI GAIN.
Aircraft descends during turns.	Follow instructions in Section 4.1.3.
Aircraft undershoots altitude bug.	Increase ALT GAIN.
	Decrease VSI GAIN.
Pitch servo oscillates during instrument approaches or turbulence.	Decrease G ERROR GAIN.
	Decrease G ERROR LIMIT.
Aircraft oscillates about altitude bug.	Increase VSI GAIN.
	Follow instructions in Section 4.1.1.
	Ensure no ADAHRS vibration messages exist.
Autopilot does not move controls.	Ensure shear screw is not broken (see section 2.7).

Table 3: Pitch Axis Troubleshooting



4.2 Pitch Axis Parameters

Parameter	Description	Default	Min	Max
PITCH TORQUE	Maximum output torque of servo.	100	10	100
PITCH HIGH SPEED SENSITIVITY	Amount of servo motor travel relative to autopilot output signal for pitch axis. Applied at maximum autopilot speed limit. Linear interpolation between this setting and LOW SPEED SENSITIVITY based on airspeed. Larger numbers result in larger servo movements for a given autopilot signal.	10	1	50
PITCH LOW SPEED SENSITIVITY	Amount of servo motor travel relative to autopilot output signal for pitch axis. Applied at minimum autopilot speed limit. Linear interpolation between this setting and HIGH SPEED SENSITIVITY based on airspeed. Larger numbers result in larger servo movements for a given autopilot signal.	10	1	50
PITCH LOST MOTION COMPENSATION	Amount of servo travel to compensate for mechanical control system lost motion, or backlash, between the servo and control surface.	0	0	20
PITCH GAIN	Sets the error gain and feedforward signal gain. Large numbers result in more aggressive performance and increase autopilot response to pitch angle errors.	2.0	0.1	3.0
ALTITUDE GAIN	Sets the desired vertical speed based on feet of altitude error. Larger numbers cause bigger altitude correction efforts.	0.6	0.1	2.5
*ALTITUDE FILTERING	Adjust the time constant for filtering of altitude that feeds the autopilot.			
PULL RATE	Default g's to pull/push to correct for pitch errors.	1.0	1.0	2.0
VSI GAIN	Dampens the desired pitch angle based on vertical speed.	1.5	0.1	2.5
G ERROR GAIN	Sets the amount of pitch effort to compensate for thermals and added g-loading during turns.	1.0	0.0	4.0
G ERROR LIMIT	Bounds the amount of pitch effort to compensate for thermals and added g-loading during turns.	0.25	0.10	1.00
GSI GAIN	How much to change pitch rate based on glideslope error.	1.0	0.1	5.0
GSI DOT GAIN	Dampens pitch change based on glideslope error trend.	15	1	100
VDI GAIN	How much to change pitch rate based on glidepath error.	4.0	0.1	5.0
VDI DOT GAIN	Dampens pitch change based on glidepath error trend.	60	1	100

Table 4: Pitch Axis Parameters

* Only available on Advanced Flight Systems products.

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
16	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10

5 Yaw Damper Tuning

The yaw damper should be tuned after tuning the roll and pitch axis. Ensure all pre-flight items from Section 2 have been completed. Failure to complete pre-flight checks is likely to prevent successful servo tuning.

5.1 Tuning Procedures

The following procedures should be conducted in smooth air.

5.1.1 Manual Flight Yaw Dampening

With the aircraft in trimmed, level flight:

1. Operate the aircraft at 10 knots above minimum autopilot speed.
2. Engage the yaw damper only (pitch and roll disconnected)
3. Apply small ailerons inputs to perform a Dutch Roll maneuver at the aircraft resonate frequency.
4. Adjust **LOW SPEED YAW SENSITIVITY** to achieve satisfactory Dutch Roll damping.
 - If more rudder input is desired, increase LOW SPEED YAW SENSITIVITY.
 - If less rudder input is desired, decrease LOW SPEED YAW SENSITIVITY.
 - If rudder servo slips, decrease LOW SPEED YAW SENSITIVITY.
5. Set HIGH SPEED YAW SENSITIVITY to the same value as LOW SPEED YAW SENSITIVITY.
6. Operate aircraft at approximately 10 knots below the autopilot maximum airspeed.
7. Adjust **HIGH SPEED YAW SENSITIVITY** to achieve satisfactory yaw damping.
 - If rudder servo oscillates or is jerky, decrease HIGH SPEED YAW SENSITIVITY.
 - If rudder servo slips, decrease HIGH SPEED YAW SENSITIVITY.
8. If acceptable performance is not achieved, see troubleshooting steps in section 5.1.2.

DOCUMENT TITLE	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	17



5.1.2 Yaw Tuning Troubleshooting

If performance is not acceptable, evaluate and perform the corresponding actions in the following table. If these actions do not resolve issues, contact Dynon Technical Support.

Issue	Action(s)
YAW SLIP indications appear.	Ensure aircraft is kept in trim during flight.
	Increase YAW TORQUE.
	Reduce YAW SENSITIVITY.
Slip/skid ball slowly oscillates.	Check for loose servo mount bracketry.
	Check for loose flight control cables/pushrods.
	Increase YAW SENSITIVITY.
	Reduce RUDDER GAIN.
Yaw servo quickly oscillates or is jerky.	Reduce YAW SENSITIVITY.
	Reduce LOST MOTION COMPENSATION (see Section 6).
	Reduce RUDDER GAIN.
Yaw damper does not center the slip/skid ball.	Increase YAW SENSITIVITY.
	Increase RUDDER GAIN.
	Increase RUDDER RATE.
Autopilot does not move controls.	Ensure shear screw is not broken (see section 2.7).

Table 5: Yaw Damper Troubleshooting

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
18	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10

5.2 Yaw Damper Parameters

Menu Parameter	Description	Default	Min	Max
YAW TORQUE	Maximum output torque of servo.	100	10	100
YAW HIGH SPEED SENSITIVITY	Amount of servo motor travel relative to autopilot output signal for yaw axis. Applied at maximum autopilot speed limit. Linear interpolation between this setting and LOW SPEED SENSITIVITY based on airspeed. Larger numbers result in larger servo movements for a given autopilot signal.	10	1	50
YAW LOW SPEED SENSITIVITY	Amount of servo motor travel relative to autopilot output signal for yaw axis. Applied at minimum autopilot speed limit. Linear interpolation between this setting and HIGH SPEED SENSITIVITY based on airspeed. Larger numbers result in larger servo movements for a given autopilot signal.	10	1	50
YAW LOST MOTION COMPENSATION	Amount of servo travel to compensate for mechanical control system lost motion, or backlash, between the servo and control surface.	0	0	20
RUDDER GAIN	Sets the error gain and feedforward signal gain. Large numbers result in more aggressive damping performance and increase autopilot response to yaw excursions. Changing this setting is not recommended. Proportional gain for A_z gyro.	0.25	0.0	2.5
RUDDER RATE	How fast to apply ball-centering rudder input. Changing this setting is not recommended. Integral gain for the A_z gyro.	0.005	0.001	0.500
AY GAIN	Sets the output gain to the ball-centering rudder subroutine.	0.000	0.000	2.500
*RUDDER LEAD	Sets the amount of cross-mixing between roll error and rudder output.	0.0	0.000	9.900
*RUDDER LEAD LIMIT	Bounds the amount of cross-mixing between the roll error and rudder output.	1.0	0.0	9.9

Table 6: Yaw Damper Parameters

* Only available on Advanced Flight Systems products.

6 Lost Motion Compensation

Lost Motion Compensation is an autopilot feature which allows the autopilot to automatically compensate for flight control systems that do not have tight coupling between the autopilot servo and the flight control surface.



Lost Motion Compensation **SHOULD NOT** be used to compensate for improperly rigged control systems. Ensure your flight control system is properly adjusted before attempting to enable Lost Motion Compensation. Other autopilot tuning issues should be addressed before enabling this feature.

6.1 Tuning Procedures

The following procedures should be conducted in *very* smooth air with the aircraft properly trimmed for level flight.

6.1.1 Roll Axis Lost Motion Tuning

This procedure should only be used if the autopilot slowly oscillates about the commanded heading and all other roll tuning procedures and troubleshooting have failed to yield satisfactory results. Most properly rigged aircraft will not benefit from using this procedure. This setting is found in the roll axis autopilot settings menu.

1. Operate aircraft at slow cruising speed.
2. Engage autopilot in HDG and ALT mode.
3. Observe aircraft hold heading.
 - If aircraft holds heading within 1 degree then procedure is complete.
 - Otherwise, if aircraft slowly oscillates around heading, continue to next step.
4. Increase **LOST MOTION COMPENSATION** by 1 increment.
 - If flight controls begin to oscillate, reduce Lost Motion Compensation.
5. Go back to Step 3 and repeat as needed. A value of more than 5 is abnormal and suggests improper aircraft rigging.
6. If acceptable performance is not achieved, see roll axis troubleshooting steps in Section 3.1.5.

PAGE	DATE	REV	DOCUMENT #	DOCUMENT NAME
20	9/8/2022	Revision D	102064-000	Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10

6.1.2 Pitch Axis Lost Motion Tuning

This procedure should only be used if the autopilot slowly oscillates about the commanded airspeed or commanded altitude. This procedure should be executed only after all other pitch tuning procedures have failed to yield satisfactory results. Most properly rigged aircraft will not benefit from using this procedure. This setting is found in the pitch axis autopilot settings menu.

1. Operate the aircraft at normal cruise speed.
2. Engage the autopilot in HDG and IAS mode.
3. Observe aircraft hold altitude.
 - If aircraft holds airspeed to within 2 knots then procedure is complete.
 - Otherwise, if aircraft slowly oscillates around airspeed, continue to next step.
4. Increase **LOST MOTION COMPENSATION** by 1 increment.
 - If flight controls begin to oscillate, reduce Lost Motion Compensation.
5. Go back to Step 3 and repeat as needed. A value of more than 5 is abnormal and suggests improper aircraft rigging.
6. If acceptable performance is not achieved, see pitch axis troubleshooting steps in Section 4.1.7.

6.1.3 Yaw Axis Lost Motion Tuning

This setting is found in the yaw axis autopilot settings menu. This setting is experimental in nature. Set this value to 0.

DOCUMENT TITLE	DOCUMENT #	REV	DATE	PAGE
Autopilot In-Flight Tuning Guide For Skyview Software Version 16.4 and AFS Software Version Vx16.10	102064-000	Revision D	9/8/2022	21