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# TRIO PRO PILOT AUTOPILOT AVIONICS ADDENDUM

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## 1.0 TRIO PRO PILOT AUTOPILOT AVIONICS ADDENDUM

This document is intended to provide supplemental information to the installers and users of the Trio Pro Pilot Autopilot. The Installation Instructions, Illustrated Parts Catalog, Airplane Flight Manual Supplement, and ICA should be referred to in all cases as they contain FAA approved data.

www.thestcgroupllc.com

## 2.0 GENERAL

Thank you for your purchase of the Trio Pro Pilot Autopilot.

This document is an informational supplement to the installation instructions for your aircraft type.

Contact the STC Group LLC directly for any approved data that you require.

## 3.0 SERVO GAIN ADJUSTMENT

Note: The Maintenance mode mentioned below is different from the preferences mode.

To enter preferences mode, press and hold the rotary encoder.

### 3.1 H NAV GAIN SETTING

**Note:**

If at any time during this procedure you get "lost" you can recycle power. If you change a setting and want to restore the defaults, you can accomplish a **RESTORE DEFAULTS** procedure as detailed below.

1. To ensure all autopilot (AP) gains and settings are initially at the factory defaults a **RESTORE DEFAULTS** will be the first item accomplished.
2. If you are certain that the defaults are correct you can skip this step.
3. If the RESTORE DEFAULTS is performed, you will need to reset the **MINIMUM** and **MAXIMUM** airspeed thresholds.

The RESTORE DEFAULTS procedure should only be conducted on the ground.


### 3.2 RESTORE DEFAULTS PROCEDURE

Several of the variables used to optimize Pro Pilot are captured to EEPROM (nonvolatile memory) during initial setup. Further, tracking gains that are set for differing flight conditions are also maintained in system EEPROM.

On rare occasion these values may become corrupt if a power transient occurs during an EEPROM write procedure, or the pilot may inadvertently change settings that cause poor autopilot performance. The restore default procedure allows a quick method to restore all these values back to their factory settings.

**It is good practice to record all the variable settings you change from the factory settings, so these may be replaced after the restore defaults procedure.**

The **RESTORE DEFAULTS** procedure allows either one or both **HNAV** or **VNAV** parameters to be reset.

To perform the **RESTORE DEFAULTS** procedure, perform the following steps:


1. Enter the **MAINTENANCE SETTINGS** from the normal navigation screens or the NO GPS screen by pressing the **ENCODER** and **VMODE** buttons simultaneously, then select the **RESTORE DEFAULTS** display. Entry to the MAINTENANCE SETTINGS from the ELEVATION SET screen will result in anomalous operation while in the MAINTENANCE SETTINGS.


2. Press and release the **H MODE** button. The arrow will be placed at the "**ALL**" setting field. Press the encoder knob to activate the restore. All lower display parameters will flash when the function is complete.
3. If it is desired to reset only the **H NAV** defaults, Press and release the **H MODE** button to position the cursor adjacent to **HNAV**. Press the **ENCODER** knob to activate. The **HNAV** display will flash when the function is complete.
4. If it is desired to reset only the **VNAV** defaults, Press and release the **H MODE** button again to position the cursor adjacent to **VNAV**. Press the encoder to activate. The **VNAV** display will flash when the function is complete.
5. Press the **H MODE** button until the right arrow is absent from the display.
6. Cycle power on the autopilot to exit the maintenance screens.

The **RESTORE DEFAULTS** procedure is complete.

## 3.3 INITIAL FLIGHT SETTINGS

Be sure to turn the AP on after engine start to stabilize the internal rate sensors before flight. Leave the autopilot ON unless otherwise noted

## 3.4 GROUND CHECKS

1. Center the aircraft ailerons and elevator. Engage the servos by pressing the HNAV and VNAV buttons. Check servo actuation, slip clutch operation and servo disconnect / release.

## 3.5 IN FLIGHT ADJUSTMENTS

**IMPORTANT:**

**IT IS STRONGLY RECOMMENDED THAT A SEPARATE PERSON BE EMPLOYED TO DO THE ACTUAL ADJUSTMENTS TO THE AUTOPILOT SYSTEM IN THE FOLLOWING STEPS. THERE WILL BE A LOT OF "HEAD IN THE COCKPIT" TIME INVOLVED IN THESE PROCEDURES SO SAFETY OF FLIGHT MUST BE MAINTAINED. A SEPARATE PERSON ACTUALLY DOING THE ADJUSTMENTS WILL ALSO MINIMIZE FLIGHT TIME WHILE INCREASING EFFICIENCY OF THE PROCEDURES.**

**NOTE:**

**ADJUSTMENTS TO THE GAIN SETTINGS TAKE EFFECT IMMEDIATELY UPON CHANGING THE PARAMETER. THERE IS NO NEED TO EXIT THE MAINTENANCE SCREENS WHILE PERFORMING THE GAIN ADJUSTMENTS**

**NOTE:**

**IF THE ARINC 429 GPSS IS ACTIVE IN THE SYSTEM ARCHITECTURE PERFORM THE PROCEDURE IN PARAGRAPH 3.6, HNAV SERVO GAIN ADJUSTMENT PRIOR TO PROCEEDING WITH THE BELOW PROCEDURE**

**NOTE:**

**IT IS IMPORTANT TO ADJUST THE CRS GAIN PRIOR TO ADJUSTING THE TRK GAIN. WHEN THE CRS GAIN HAS BEEN SATISFACTORILY ADJUSTED, DO NOT CHANGE IT WHEN ADJUSTING THE TRK GAIN.**

### 3.6 H NAV SERVO GAIN ADJUSTMENT USING GPSS (BLUE GPSS LED ON)

1. Select the **TRK mode** with the **SERVO ON** and stabilize on a ground track. There may be some oscillation at this point and it should be ignored.
2. Select the **MAINTENANCE SCREENS** and sequence to the **SET SERVO GAINS** menu.
3. Press the **H MODE** button until an arrow is in front of the **HNAV** gain.
4. Use the **ENCODER** to decrease or increase the gain in steps of 4 units until the oscillation stops or is minimized.
   a. You can fine tune the gain by increasing or decreasing the gain setting by one step after bracketing the gain using 4 units.
   b. A setting that is too low will cause a very long "hunting" from one side of the selected course to the other of more than two degrees and poor tracking and overshoot approaching and passing enroute waypoints.
   c. A setting that is too high will cause an oscillation of a shorter period across the selected course of two degrees or more.
   d. The setting is optimized when the selected course is maintained within +/- 1 degree in a very slow oscillatory fashion in smooth air conditions

**Note:**

**The oscillation not be noticeable to a pilot not specifically looking at the tracking performance numbers. All autopilots oscillate to some degree but this oscillation should not be distracting or noticeable during normal flight**

   e. Increase or decrease the gain to suit your personal preference.
   f. The autopilot may track perfectly for several minutes, then wander - 1 degree, back to zero for a minute, etc. Once this is achieved you can perform the **CRS** gain procedure to optimize tracking when using the RS-232 serial GPS data
   g. Exit the MAINTENANCE SCREENS menu by pressing and holding the **ENCODER** until the normal navigation screens appear.

## 3.7 CRS AND TRK MODE ADJUSTMENTS USING THE RS-232 SERIAL DATA

### CRS MODE ADJUSTMENTS USING THE RS-232 SERIAL DATA

1. Place the AP in the **CRS** mode and engage the servo. Let the aircraft track stabilize.
2. Enter the **MAINTENANCE SETTINGS** menus by pressing the **ENCODER** and **VMODE** buttons simultaneously, then select the **SET H NAV GAINS** screen.
3. If roll is oscillating adjust the **CRS** setting **UP** or **DOWN** to minimize.
4. If satisfactory tracking is obtained, switch the AP to the **TRK** mode and optimize the tracking using the **TRK** setting in the following paragraphs.
5. If satisfactory performance cannot be obtained return the settings to the factory defaults (TRK = 3, CRS = 3, PI = 9) and proceed to the **HNAV SERVO GAIN ADJUSTMENT** below. (See page 10)
6. The **PI** (Pull In) is usually OK.
   a. If the intercept after a switch from the INT mode to the TRK mode is too aggressive, lower this setting.
   b. If the intercept is "lazy" raise this setting. If still lazy bring the HNAV servo gain up a little (generally less than 4 clicks).

### TRK MODE ADJUSTMENTS USING THE RS-232 SERIAL DATA

Note:

The TRK gain is not used when GPSS is providing lateral navigation. If GPSS is being used for lateral navigation you will need to enter a track offset when using the TRK mode on the autopilot. This disables the GPSS input and forces the autopilot to use the serial data stream.

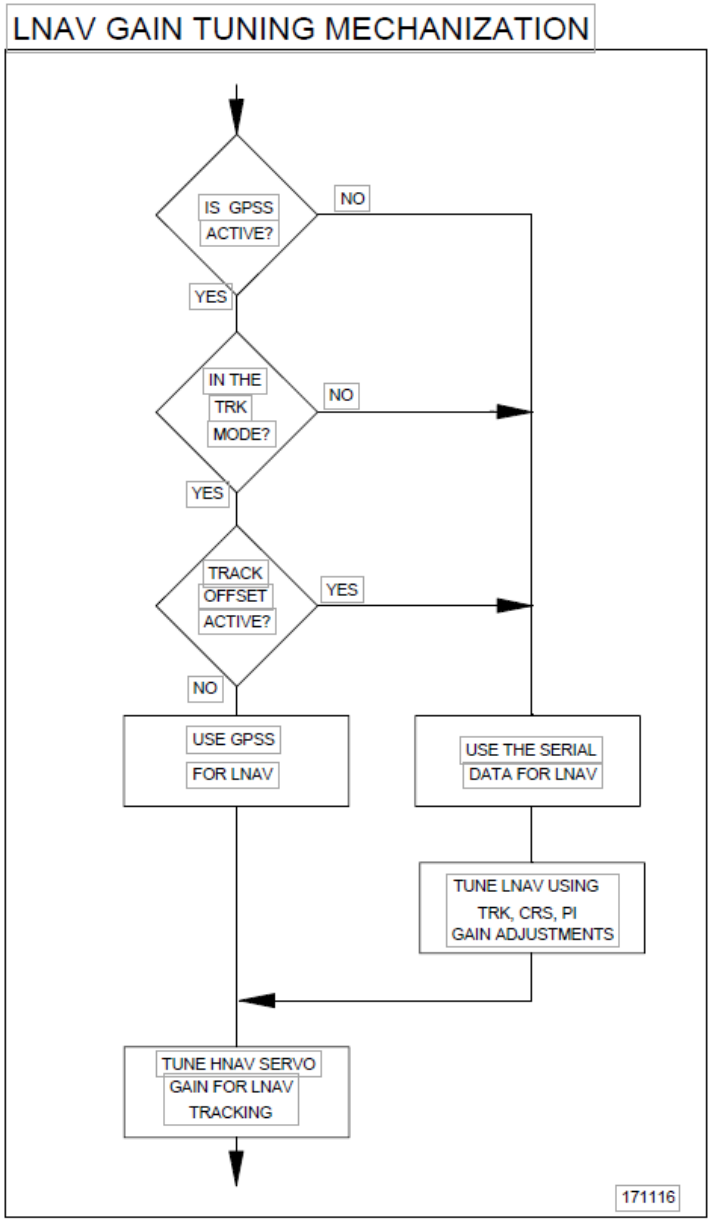
1. Select the **TRK** mode.

2. If GPSS is active **(**blue GPSS LED ON**)** enter a left or right 0.10 track offset (press and turn the ENCODER in the TRK mode) and observe the upper right display field

3. Enter the **MAINTENANCE SETTINGS** menus by pressing the **ENCODER** and **VMODE** buttons simultaneously, then select the **SET H NAV GAINS** screen.

4. Select the **TRK** gain by pressing the HMODE button and observing the arrow preceding the TRK field gain.

5. Minimize the track error (XTK) by adjusting the TRK gain typically one or two clicks up or down is all that is required if the HNAV servo gain has been tuned correctly.
6. A setting that is too low will cause oscillation back and forth across the DTK line in excess of 0.02 miles.



## 4.0 V NAV GAIN SETTING

This procedure is a method that should be used to tune the Altitude Hold (AH) Vertical Speed (VS) and Airspeed (AS) gains.

**Note:**

It is recommended that the auto trim *(experimental only)* be disabled during these procedures. This can be accomplished by minimizing the trim speed setting in the **MAINTENANCE SETTING** screens

### 4.1 VNAV SERVO GAIN SET PROCEDURE

1. With the AH, VS and AS settings at the factory defaults (45, 35, 35 respectively) stabilize the aircraft in roll and pitch at normal cruise speed with the autopilot disengaged.

**NOTE:**

**The following steps will activate the auto 180 function. During entry to the reversing turn observe the altitude drop (sag) when entering the turn. The acceptable drop in altitude is between 30 and 50 feet which should be recovered during the turn. At completion of the turn the altitude may rise slightly then stabilize on the entry altitude.**

7. Enter the AUTO 180 MODE by pressing and holding either the **HNAV** servo button **(left 180)** or the **VNAV** servo button **(right 180)** until the AUTO 180 is activated.

8. If the entry sag exceeds 50 feet or less than 20 feet terminate the auto 180 by turning the servos off.

9. Enter the MAINTENANCE SETTINGS and sequence to the SERVO GAIN SETS screen.

10. Press the **HMOD**E button twice placing the arrow at the VNAV gain field. Boost the current VNAV gain setting by 4 points if sagging more than 50 feet and decrease the setting by 4 if sagging less than 20 feet.

11. Exit the MAINTENANCE settings by pressing and holding the **ENCODER** until the normal nav screens appear.

12. Repeat the above steps until satisfactory performance is obtained.

### 4.2 VERTICAL SPEED GAIN SETTING

1. Perform all initial ground checks.
2. Place the aircraft in a stable pitch trim neural cruise configuration in the AH mode.
3. Select the vertical speed mode by pressing the VMODE button until the VS SET screen is active.
4. Rotate the ENCODER to set a 500 FPM climb rate.
5. Activate the climb by pressing the **ENCODER** knob.
6. The VS LED should be on steady orange

**NOTE:**

**The following steps assume the aircraft is PROPERLY TRIMMED for the climb rate selected. The aircraft should be manually trimmed for the selected climb rate. Failure to maintain a relatively good trim may cause the autopilot control system to exhibit a slight "bucking" motion during the climb.**

7. The aircraft should settle into a 500FPM rate of climb within about 10 seconds at the airspeed when the climb was entered.
8. If you observe significant deviation in smooth air from the selected climb rate perform the remaining steps.
9. If there is excess oscillation or the vertical rate is not achieving the selected value, enter the MAINTENANCE SETTINGS menus and select the VNAV GAIN SETS display page
10. Press the **VMODE** button to select the **VS** gain setting.
11. Adjust the gain setting five points up and evaluate the tracking performance. If the performance is degraded, readjust the gain setting 10 points lower. If the performance improves or there is no noticeable change, increase / decrease the setting an additional five points. Continue this process until an optimum value is reached.

### 4.3 AIRSPEED GAIN SETTING

**NOTE:**

**The aircraft vertical speed when entering the Airspeed, AS, mode must be greater than +/- 200FPM. If the vertical rate is less than this value, the system will revert to the Altitude Hold, AH, mode on release of the servo disconnect switch.**

1. Perform all initial ground checks.
2. Place the aircraft in a stable pitch neural cruise configuration
3. Engage the Altitude Hold, AH, mode
4. Press and hold the remote servo disconnect (**PCS**) switch.

5. The **servo will release** and **VNAV LED** will now flash.
6. Place the aircraft in either a climb or descent and release PCS switch at the desired airspeed

**NOTE:**

**The following steps assume the aircraft is PROPERLY TRIMMED for the selected airspeed. The aircraft should be manually trimmed for airspeed.**

7. The aircraft should track the desired airspeed within 2 or 3 knots in smooth air. If there is significant deviation from the selected airspeed, perform the remaining steps.
8. Enter the **MAINTENANCE SETTINGS** menus and select the **VNAV GAIN SETS** display page.
9. Press the **HMODE** button to select the **AS** gain setting.
10. Increase the gain setting five points and evaluate the tracking performance.
11. If the performance is degraded, decrease the gain setting **10 points**.
12. If performance improves or there is no noticeable change, increase or decrease the setting an additional **five points**.
13. Continue this process until an optimum value is reached.
14. Once the airspeed gain is bracketed you can increment or decrement one unit at a time to fine tune the gains.

## 5.0 SERVO ROTATION DETERMINATION

The servos as shipped are set for CW or CCW operation. In the event the servos must be configured for a different rotation an internal jumper provided on the servo Printed Circuit Board (PCB) needs to be fully installed. A spare label provided on the servo cover **must** be installed over the existing label. Refer to the ICA.

It easier to insert the jumper on the PCB before the servo is installed.

### 5.1 INSTALLING THE SERVO REVERSAL JUMPER

**Note:**
**Exercise caution when performing the following procedure.**

1. Carefully remove the servo cover.
2. Locate the jumper on the PCB directly behind the DB-9 connector on the PCB.
3. The jumper is located on one of the jumper pins, not across both pins.
4. Using a small pair of needle nose pliers or similar tool remove the jumper from the pin on which it is installed by pulling it straight up off the PCB.
5. Relocate the jumper over both the pins on the PCB and install it by pushing it down over both jumper pins.
6. Reinstall the servo cover.
7. Place the PN 310X0000 or 310X0000 label over the existing label.

## 6.0 WIRING HARNESS INSTALLATION

NOTE

Prior to plugging harness DB9 or DB37 into servos or autopilot control perform a full power, ground, and data test on the harness by ringing the wires from plug to plug using PRO PILOT WIRING HARNESS DWG 413000XX. Refer to Appendix A,

### 6.1 ROLL SERVO HARNESS INSTALLATION

1. Route Trio Harness roll servo wiring to roll servo location.
2. Take care to protect harness pins at end of harness.
3. Terminate supplied DB9 connector per Wiring diagram.
4. Attach DB 9 connector to Trio Roll Servo.
5. Secure harness cable end at the servo end.

### 6.2 PITCH SERVO HARNESS INSTALLATION

1. Route Trio Harness Pitch servo wiring to pitch servo location.
2. Take care to protect harness pins at end of harness.
3. Terminate supplied DB9 connector per Trio diagram.
4. Attach DB 9 connector to Trio Roll Servo.
5. Secure harness cable end at the servo end.

### 6.3 TRIO AUTOPILOT CONTROLLER

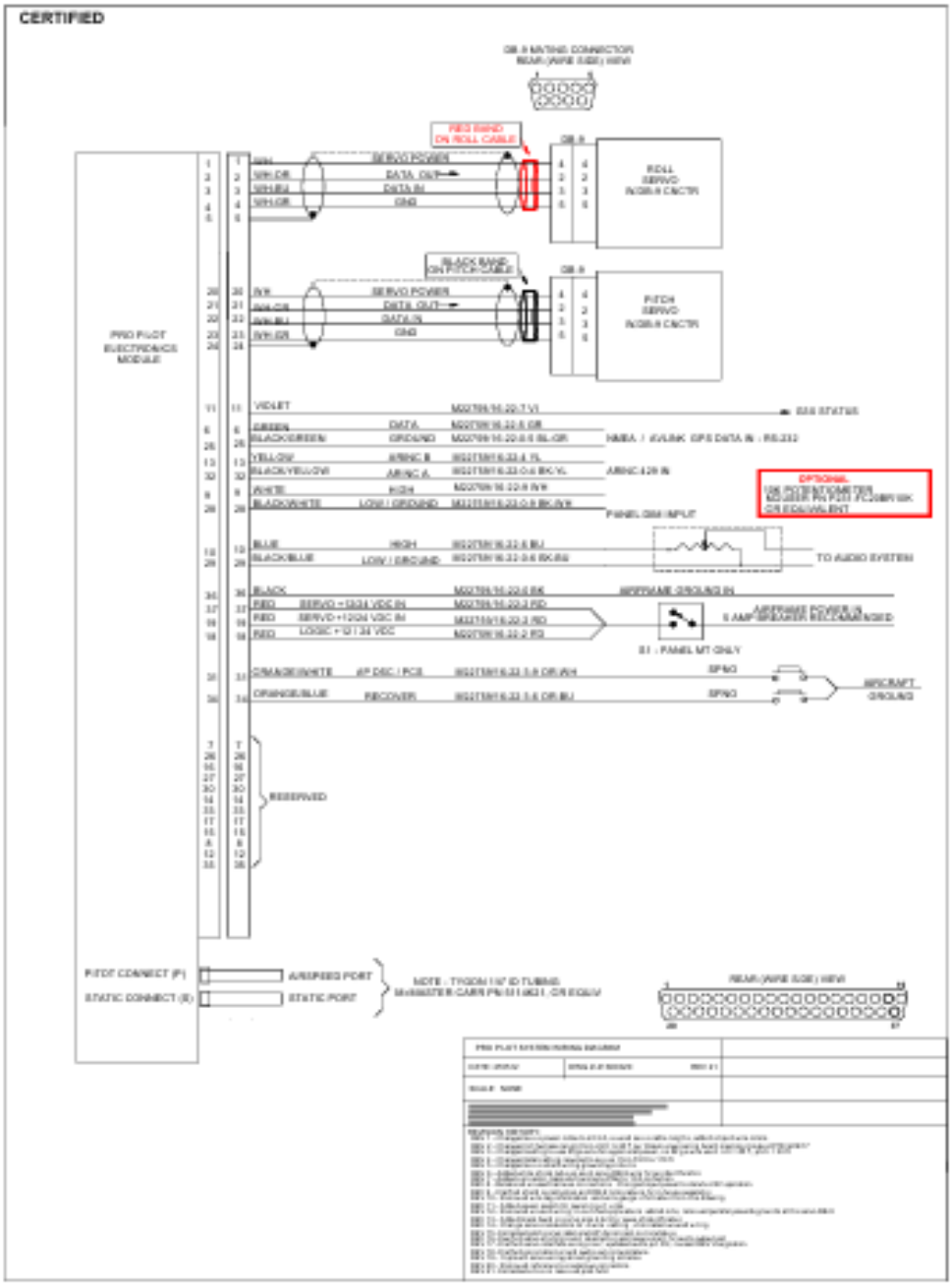
1. The Trio autopilot controller is ordered in Panel Mount or Instrument Mount versions.
2. Install the controller using best practices in either panel or hole locations. Refer to AC 43-13 for this step and all following steps.
3. Install the 5 ampere circuit breaker within easy reach of the pilot and label.
4. If a Panel Mount unit is ordered install the supplied power switch and label.
5. Terminate supplied DB37 connector wiring per the Trio drawing 413000XX.
6. If RS 232 is available from GPS terminate RS 232 wiring connections.
7. If ARINC 429 is available from GPS terminate ARINC 429 wiring connections.
8. If an EFIS is installed terminate wiring for EFIS control IAW drawing 415000XX.
9. Install the supplied PCS button on the left side of the pilots control yoke and label PCS.
10. Install Recover button in an available convenient location within easy reach of the pilot and label AP Recover.
11. Ensure that the analog alarm out is connected to the un-switched audio input on the Audio Panel.

Note: If your audio panel does not have un-switched audio input, attach the audio leads to the phone input of your intercom.

## 6.4 TRIO AUTOPILOT DATA CONNECTIONS

1. For the RS-232 connection set the output at the panel mounted GPS unit to "Aviation w/ no altitude" or NMEA 0183 OUT for the portable GPS
2. If your aircraft is equipped with a GPS that has ARINC 429, set unit to output "GAMA" Low Speed. The Trio Autopilot can run at Low and High Speed ARINC.
3. If your aircraft is equipped with an EFIS contact The STC Group LLC for specific installation instructions.
4. Prior to making the connections to the GPS unit in the aircraft determine what else is connected. It may be necessary to parallel the connections. If parallel connections are required, verify that the lines you are connecting to use, or can use, the same data format that is required. Both the RS-232 and the ARINC 429 can be paralleled with like connections.

## 7.0 APPENDIX A - PRO PILOT SYSTEM WIRING DIAGRAM



## 8.0 QUESTIONS AND ANSWERS FROM THE FIELD

**ARINC 429 and RS-232**

The Trio ProPilot™ uses both signals for the various modes in the autopilot. The RS-232 AVIATION **or NMEA 0183** format needs to be present at pin 6 of the autopilot.

When tuning the roll axis gains the GPSS (if available) will provide the navigation source. During tuning the blue GPSS LED should be on ( HNAV servo ON) or blinking (HNAV servo OFF). The autopilot should be placed in the TRK mode with no track offset (default condition) allowing the GPSS input to provide the Nav source A GOTO should be entered in the GPS, the maintenance screens entered and the HNAV servo gain adjusted for best roll performance. The RS-232 serial gains in the next paragraph are adjusted next.

The autopilot RS-232 serial link lateral gains (TRK, CRS, PI and HNAV SERVO GAIN) should now be adjusted. All these baseline gain settings use the serial data, not the GPSS input. In field experience if the tracking is satisfactory after tuning the GPSS gain (if GPSS is present) TRK, CRS, PI and HNAV SERVO GAIN the RS-232 navigation should work satisfactorily.

The RS-232 serial data TRK gain is only effective when using the serial link as the lateral navigation source. However, if the GPSS is active, GPSS automatically becomes the selected lateral navigation source in the TRK mode unless a track offset position (TOP) is active in the autopilot. GPSS provides a simple bank left - bank right control signal to the autopilot. The only way to manipulate this input is to do CRS, or INT functions so these two modes only use the serial inputs data. The TRK mode GPSS tracking tuning is only a function of the HNAV servo gain, nothing else. In order to force the serial data as the lateral tracking source in the TRK mode you can use the track offset function. Whenever there is a track offset lateral navigation is forced to the serial data. In this configuration you can adjust the RS-232 serial TRK gain. The attached graphic helps explain the implementation

**CRS Mode**

*Q We didn't see any interface to the Directional Gyro for the Heading bug. I guest this is built into the autopilot computer/control head. Please confirm.*

A The CRS mode on the autopilot allows flying vectors using GPS as the reference. It will also receive heading bug from an EFIS (Dynon/Aspen/G5/AV-30-C). Please refer to Avionics Compatibility List for approved GPS units and EFI systems.

## Automatic Trim

The Trio pitch servo generates a bi-polar DC trim motor drive signal on pins 1 and 6 of the DB-9 connector. The problem with implementation is regulatory, not technical. Adding this feature to a certified airframe is not allowable under the current STC.

The STC group has had discussions with the FAA regarding implementing auto trim and the FAA indicated to do this would require opening up the existing STC to add this feature. This process would likely result in a complete re-evaluation of the current STC and would be a very timely and costly process. The STC Group LLC is not actively seeking an auto trim STC amendment.

## AVIONICS COMPATIBILITY

*Q What Avionics can work with the Trio Autopilot?*

A Refer to Trio Autopilot Avionics Compatibility List Document 1006001 Rev E or latest FAA approved revision.

## WIRING DIAGRAMS

*Q I only see basic wiring in the installation manual do you have specific wiring for my configuration?*

A https://www.thestcgroupllc.com/pages/documentation

## 9.0 DATA INTERFACE TESTING

### 9.1 EFIS DATA TEST

**Step 1:** With GPS power OFF apply power to Trio Autopilot

**Step 2:** Press the Rotary Encoder to set the elevation and the autopilot will display "No GPS"

**Step 3:** PRESS and HOLD Trio Autopilot Encoder to enter the Preferences Mode

**Step 4:** Set "Select CRS Mode" to: = AUTO ENABLE or = EXT HDG ENABLE. (Pressing the HMODE Button will change the = to an > and allow you to change the mode. Once the mode is changed press HMODE to remove the > symbol)

**Step 5:** PRESS and HOLD encoder to exit Preferences Mode

**Step 6:** Place Source Select Switch to GPS and turn on GPS

**Step 7:** Navigate to the "Instrument Self-Test Page" on GPS

**Step 8:** If connected properly your CDI will receive a signal from the GPS and you will see a change on the CDI.

Trio Autopilot Annunciations when GPS is in "Instrument Self-Test Page"

**WAAS Unit** Blue GPSS and GPSV lights will illuminate and blink indicating the ARINC 429 connection and format is OK. No GPS message will clear - Green TRK light or Yellow CRS light will illuminate indicating the RS 232 connection and format is OK.

**Non WAAS Unit** Blue GPSS light will illuminate and blink indicating the ARINC 429 connection and format is OK. No GPS message will clear - Solid Green TRK light or Solid Yellow CRS light will illuminate indicating the RS 232 connection and format is OK.

**RS 232 ONLY Unit (Portable or VFR Only)** No GPS message will clear - Green TRK light or Yellow CRS light will illuminate indicating the RS 232 connection and format is OK. Step 9: Press Enter or Continue on GPS to exit the "Self-Test Page"

**Step 10:** Place Source Select Switch to EFIS

**Step 11:** With the Servo Off - ROTATE EFIS Heading Bug to 300. Autopilot reads: SEL = 300 HDG will read current aircraft heading on the ground.

**Step 12:** With the Servo Off - SET Altitude on EFIS to 10000 ft. After 3 second delay the autopilot will display VSP SUSP 500 Note: The VSP ft per min will come up as the preference set VS.

**Step 13:** Press VMODE one time and the autopilot screen should display ALT SUSP 10000

**Step 14:** Press VMODE a second time and the autopilot screen should display current altitude coming from the EFIS.

**Step 15:** Change Baro on EFIS – Change should register on the autopilot control head.

If step 8 PASSES the Trio Autopilot has been successfully wired and configured for GPS control.

If steps 10-15 PASS the Trio Autopilot has been successfully wired and configured for EFIS control.

## 9.2 GPS DATA TEST

**Step 1:** With GPS Power OFF apply power to Trio Autopilot

**Step 2:** Momentarily press the autopilot encoder (center) knob and the autopilot screen will display "No GPS"

**Step 3:** Apply power to GPS

**Step 4:** Navigate to the "Self-Test Page"

**Step 5:** If connected properly your CDI will receive a signal from the GPS and you will see a change on the CDI.

**Step 6:** If connected properly the Trio Autopilot will display the following:

**WAAS Unit**

Blue GPSS and GPSV lights will illuminate and blink indicating the ARINC 429 connection and format is OK.

No GPS message will clear - Green TRK light or Yellow CRS light will illuminate indicating the RS 232 connection and format is OK.

**Non WAAS Unit**

Blue GPSS light will illuminate and blink indicating the ARINC 429 connection and format is OK.

No GPS message will clear - Solid Green TRK light or Solid Yellow CRS light will illuminate indicating the RS 232 connection and format is OK.

**RS 232 ONLY Unit (Portable or VFR Only)**

No GPS message will clear - Green TRK light or Yellow CRS light will illuminate indicating the RS 232 connection and format is OK.

*Note: Some GPS units do not pass the necessary data to test the Trio Autopilot data on the self-test page.*

*Please contact The STC Group LLC if this test is unsuccessful.*

## 10.0 AVIONICS GROUND TESTING - INSTRUCTIONS FOR GROUND TESTING OF THE TRIO AUTOPILOT SERVO INSTALLATION

Perform the following testing after the autopilot system has been installed to verify correct servo operation and control authority.

1. Turn OFF the GPS attached to the autopilot.
2. Apply power to the autopilot system
3. When ELEVATION set is displayed, set the current field elevation and then press the ENCODER knob
4. Simultaneously press the ENCODER knob and the V MODE buttons
5. When MAINTENANCE SCREENS appear release the ENCODER and VMODE buttons.

### 10.1 VNAV SERVO TESTING

1. Using the ENCODER sequence to the VNAV SERVO SETS screen either by pressing the ENCODER or rotating the ENCODER clockwise.
2. Once on the VNAV SERVO SET screen press the lower left HMODE button.
3. An arrow should appear on the lower right display field before NM (or RV).
4. Move the elevator control to place the number field in the display to approximately 00.0.
5. Turn on the VNAV servo by pressing the upper right VNAV button.
6. The angular display should read 0.00 +/- 1.0 degrees.

**NOTE**

The elevator loads on the ground may cause the servo to slip when the servo is turned ON. In this case you will need to counterbalance the elevator to unload the imbalance. You may also manually place the elevator control at approximately 0.00 degrees and observe that the pitch servo motor is not running (servo clutch is not slipping).

7. Rotate the ENCODER clockwise and observe that the elevator is driven in a direction that puts the aircraft in a climb (yoke drives rearward).
8. This verifies that the servo direction is correct.
9. Rotate the ENCODER counterclockwise and observe that the elevator is driven in a direction that puts the aircraft in a dive (yoke dries forward).

10. This verifies that the servo direction is correct.
11. Press the ENCODER button. This drives the elevator control back to a zero-servo angle.

**NOTE**

The following steps verify that the servo slip clutch is functioning correctly and that the servo drives the control system adequately

12. Manually move the controls forward to the control system mechanical stop.
13. The servo will run with the clutch slipping when overridden.
14. Release the controls.
15. Verify the controls return to the zero position
16. Manually move the controls rearward to the control system mechanical stop.
17. The servo will run with the clutch slipping when overridden.
18. Release the controls.
19. Verify the controls return to the zero position.
20. Turn the VNAV servo OFF by pressing the VNAV button.
21. Press the HMODE button to remove the arrow from the display screen.

### 10.2 HNAV SERVO TESTING

1. Using the ENCODER sequence to the LNAV SERVO SETS screen either by pressing the ENCODER or rotating the ENCODER clockwise.
2. Once on the LNAV SERVO SET screen press the lower left HMODE button.
3. An arrow should appear on the lower right display field before **NM** (or **RV**).
4. Move the roll control to place the number field in the display to approximately 00.0
5. Verify that the ailerons are in their neutral position.
6. **If not, perform the following steps. Otherwise proceed to step 27**.
7. Move the roll control to place the ailerons in their exact neutral (**in trail**) position.
8. Observe that the **angular display readout is +/- 5.00 degrees**.
9. ***If the reading in step 26 is more than five degrees***, the roll linkage should be shortened or lengthened to obtain less than 5 degrees.
10. This can usually be accomplished by adjusting the rod end bearings on the roll servo control linkage.
11. Repeat steps 20 through 26 until this reading is as specified.
12. Turn on the HNAV servo by pressing the upper right HNAV button.

13. The angular display should read 0.00 +/- 1.0 degrees.
14. Rotate the ENCODER clockwise and observe that the controls are driven in a direction that puts the aircraft in a right turn.
15. This verifies that the servo direction is correct.
16. Rotate the ENCODER counterclockwise and observe that the controls are driven in a direction that puts the aircraft in a left turn.
17. This verifies that the servo direction is correct.
18. Press the ENCODER button.
19. This drives the roll controls back to a zero-servo angle.

**NOTE**

The following steps verify that the servo slip clutch is functioning correctly and that the servo drives the control system adequately.

20. Manually move the controls full right to the control system mechanical stop.
21. The servo will run with the clutch slipping when overridden.
22. Release the controls.
23. Verify the controls return to the zero position.
24. Manually move the controls full left to the control system mechanical stop.
25. The servo will run with the clutch slipping when overridden.
26. Release the controls.
27. Verify the controls return to the zero position.
28. Turn the HNAV servo OFF by pressing the HNAV button.
29. Press the HMODE button to remove the arrow from the display screen.

## 11.0 SERVO GAINS

| AIRCRAFT | HNAV | VNAV |
|---|---|---|
| CESSNA 150/152 | 20 | 20 |
| CESSNA 170B | 20 | 20 |
| CESSNA 172/175 | 20 | 20 |
| CESSNA 177 | 16 | 20 |
| CESSNA 180 | 20 | 20 |
| CESSNA 182 | 20 | 20 |
| CESSNA 185 | 20 | 20 |
| CESSNA 190/195 | 25 | 25 |
| GRUMMAN AA-5X | 19 | 19 |
| PIPER PA-24 | 10 | 20 |
| PIPER PA-28 | 24 | 24 |
| PIPER PA-32 | 24 | 24 |

***NOTE: THESE GAINS ARE THE RECOMMENDED SETTINGS FOR A STARTING POINT. PLEASE REFERENCE SECTION 3.0 AND SECTION 4.0 FOR MORE INFORMATION ON SETTING THE GAINS PROPERLY.***