

FAA-APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT

FOR

Make and Model Airplane

Reg. No.: _____

Ser. No.: _____

This supplement must be attached to the FAA-Approved flight manual when the TruTrak Vizion Autopilot is installed in accordance with STC SA04231CH. The information contained in this document supplements or supersedes the basic manual only in those areas listed. For limitations, procedures, performance, and loading information not contained in this supplement, consult the basic Airplane Flight Manual.

FAA APPROVED: _____

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Document Revision History

Rev	Issue Date	Pages Affected	Description	FAA Approved	Approval Date
Init	6-14-17	All	Document created		
B	7-10-17	7, 10	Added Emergency procedure for out of trim, added altimeter sync to operating procedures.	Timothy P. Smyth ACE-115C	7-10-17
C	3-29-19	All	Updated cover page, ToC, limitations, emergency procedures, and updated normal procedures.	Ryan Bruce Nelson AIR-713	4-1-19
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1. General

The TruTrak Vizion autopilot is a two-axis autopilot, which connects to the ailerons and elevator. In all installations with a basic GPS, the following features are available, other modes may be possible depending on installed equipment:

- Emergency Level (AP Level)
- AEP (Automatic Envelope Protection)
- Control Wheel Steering
- Track Select
- GPS Nav Mode
- GPSS (GPS Steering)
- Bank Angle Select
- Vertical Speed Select
- Altitude Hold
- Altitude Select

The Vizion autopilot does not replace any of the primary aircraft flight instruments; it is the pilot's primary responsibility to fly the aircraft in accordance with the information displayed on the primary flight instruments.

2. Limitations

2.1. Software Requirements

The Vizion autopilot controller software version may be PV.30, or PV.40.

2.2. Airspeed Limitations

The Vizion autopilot system has a built-in minimum and maximum airspeed feature, which will keep the autopilot from flying the aircraft into both under-speed or over-speed conditions. In order to provide minimum and maximum airspeed protection, the autopilot is connected to the aircraft pitot / static system. The autopilot shall not be engaged outside of the minimum and maximum airspeed values.

- The minimum airspeed value is set in the autopilot controller during installation, this value is required to be at 1.3 times V_s .
 - The autopilot may NOT follow the prescribed vertical path, as it is now holding the minimum safe airspeed instead of flying the selected vertical speed. This airspeed is also the lower limit that the AEP (Automatic Envelope Protection) mode will activate. **CAUTION: this may result in a descent of the aircraft when a climb is selected**
- The maximum airspeed is set in the autopilot controller during installation, this value is required to be at .9 times V_{ne} .
 - The autopilot may NOT follow the prescribed vertical path, as it is holding the maximum safe airspeed instead of the selected vertical speed. **CAUTION: this may result in a climb of the aircraft when a descent is selected**

2.3. Altitude Limitations

The Vizion autopilot system has an altitude engage / disengage height limit. This limit shall be used for all modes of flight. For Climb, Cruise, Maneuvering, and Descent phases of flight, the recognition time of autopilot failure is assumed to be 3 seconds with recovery initiated 1 second after recognition.

- The minimum autopilot operating altitude is 700 feet AGL.
- The AEP (Automatic Envelope Protection) mode shall not be used during takeoff.
- Maximum altitude loss with an autopilot malfunction during the Climb, Cruise, Maneuvering, Descent phases of flight: **250 feet**

2.4. Other Limitations

- This autopilot has not been evaluated by the FAA to meet the certification requirements for coupled instrument procedures, including coupled approaches. Therefore, these types of procedures are not authorized without further evaluation and approval.
- After a GPS failure, the only lateral autopilot mode available is the BANK mode.
- When engaged, the autopilot only captures current vertical speed if the aircraft is travelling 500 fpm or greater if Vizion SW version is PV.30, or the pre-set default vertical speed if Vizion software version is PV.40. Otherwise, it will level off.

2.5. Kinds of Operations

No Change.

3. Emergency Procedures

3.1. Vizion Autopilot Controller Failure

In the event that the autopilot deviates from the expected flight path, the Vizion autopilot failure disconnect steps are:

1. Control wheel.....Grip firmly
2. Autopilot..... Disconnect using CWS Switch
3. Autopilot MASTER Switch.....OFF

CAUTION- Do not attempt to re-engage the autopilot until the cause of the deviation has been corrected.



Figure 3.1a
(annunciator may or may not be illuminated)

Note: In the event that there is an internal autopilot controller failure, the autopilot will disconnect servo control and flash between a white screen and the words SENSOR ERROR on the display screen. This error screen is shown in figure 3.1a

3.2. Autopilot Servo Jam / Stuck

In the event that a servo does jam or lockup, the following procedure shall be followed:

4. Control wheel.....Grip firmly
5. Autopilot.....Disconnect using CWS Switch
6. Autopilot MASTER Switch.....OFF

3.3. Aircraft Out of Trim After Autopilot Disengage

In the event that the aircraft is out of trim upon autopilot disengage, the following procedure shall be followed:

1. Control WheelGrip Firmly
2. Pitch Forces.....Override as Required
3. Pitch Trim.....As Required

3.4. Un-commanded Engagement of AEP (Automatic Envelope Protection)

In the event of a controller or sensor failure which results in inappropriate or unwanted engagement of the AEP mode the following procedure shall be used:

1. Control wheel.....Grip firmly
2. AEP Mode.....Disconnect
3. Autopilot MASTER Switch.....OFF

4. Normal Procedures

4.1. Autopilot Pre-Flight Checklist

1. Autopilot MASTER.....ON
2. Autopilot Software Version.....Verify PV.30 or PV.40
Note: During the first three seconds after power applied to autopilot, verify software version **PV.30 or PV.40** in lower right portion of autopilot display
3. Autopilot Altimeter.....Sync to Aircraft Altimeter
If Autopilot is connected to Aspen 1000, E5, or G5, the altimeter will automatically sync to the barometer on those devices, and the altimeter sync menu will not be available.
Note: Momentarily press and release ALT button two times and Set altitude to match barometer corrected aircraft altimeter
Then momentarily press and release knob
4. GPS Status.....Verify * or +
Note: GPS OK and flashing * or + means GPS communication is working properly and GPS has a fix. Flight is allowed if there is no GPS communication, but autopilot lateral modes may be limited.
5. Autopilot Preflight Test Status.....AP OFF
Note: AP OFF means the autopilot has passed the automatic pre-flight test and is ready to be engaged.
If the system fails the automatic pre-flight test, the autopilot will be inoperative and will display the screen in figure 4.1a



Figure 4.1a

4.2. Emergency Level Mode

In this mode the autopilot commands zero degrees of bank and zero vertical speed. It is designed to stabilize the aircraft in order to allow the pilot time to regain control due to an inadvertent unusual attitude entry.

The Emergency Level mode should not be used beyond 90 degrees of bank and 45 degrees of pitch. The AP LVL mode is activated by pressing the **BLUE AP LVL** button.

In the event that the Emergency Level mode is required, the following procedure shall be followed:

1. **AP LVL** button..... Press to Engage
2. Throttle.....as Required

Once the aircraft is stabilized, the pilot should immediately navigate the aircraft to a safe flight path and altitude. Once activated, Emergency Level can be disabled using the disconnect button / CWS button or by removing power from Vizion autopilot system using Autopilot (AP) MASTER switch, which removes power from the Vizion autopilot.

4.3. Aspen Mode

When an Aspen 1000 or Aspen E5 is installed along with the autopilot, the following features / capabilities are added:

- Automatic altimeter / barometer synchronization from Aspen
- Heading bug command from Aspen
- Lateral GPS Steering pass-through from Aspen

Aspen / GPS source switch

When the switch is in the Aspen position, the autopilot has the ability to follow the above commands from the Aspen.

To use Aspen mode, the follow procedure shall be followed:

1. **AP Source switch**..... Select Aspen
2. Autopilot.....Momentarily press and release MODE button

To return to Track select mode from Aspen mode, the following procedure shall be followed:

1. **AP Source switch**..... No change required
2. Autopilot.....Momentarily press and release MODE button

When the switch is in the GPS position, the autopilot has the ability to follow the commands from the GPS.

Note: When the Aspen / GPS source switch is in the GPS position, automatic altimeter / barometer synchronization will not work.

To follow commands directly from the GPS, the following procedure shall be followed:

1. **AP Source switch**..... Select GPS
2. Autopilot.....Momentarily press and release MODE button

4.4. G5 Mode

When a Garmin G5 is installed along with the autopilot, the following features / capabilities are added:

- Automatic altimeter / barometer synchronization from G5
- Heading bug command from G5
- Altitude bug command from G5

G5 / GPS source switch

When the switch is in the G5 position, the autopilot has the ability to follow the above commands from the G5.

To use G5 mode, the following procedure shall be followed:

1. **AP Source switch**..... Select G5
2. Autopilot.....Momentarily press and release MODE button

To return to Track select mode from G5 mode, the following procedure shall be followed:

1. **AP Source switch**..... No change required
2. Autopilot.....Momentarily press and release MODE button

When the switch is in the GPS position, the autopilot has the ability to follow the commands from the GPS.

Note: When the G5 / GPS source switch is in the GPS position, automatic altimeter / barometer synchronization will not work.

To follow commands directly from the GPS, the following procedure shall be followed:

1. **AP Source switch**..... Select GPS
2. Autopilot.....Momentarily press and release MODE button

5. Performance

No change

6. Weight and Balance

See current aircraft weight and balance data.

7. System Description



Not shown: CWS switch and Emergency Level button

Refer to Vizion PMA Operation Manual (TruTrak Doc Number 167) for a more detailed description of the functions and operations of the Vizion autopilot system.

The Vizion autopilot can be defined as being an orthogonal rate system. This means that solid-state MEMS gyroscopic rate sensors are installed so as to sense motion about each of the major axes (roll, yaw, and pitch). These sensors generate the fast signal responses necessary to create an autopilot with the best possible dynamic performance.

The Autopilot (AP) MASTER switch controls power to the Vizion controller / display unit, the roll servo, and the pitch servo. Selecting the Autopilot (AP) MASTER Switch OFF will remove power from these three items will fully disconnect the entire system, including the trim sensor, which is power from the pitch servo.

The Autopilot (AP) circuit breaker supplies power to the Vizion controller / display unit, the roll servo, and the pitch servo. Removing power from these three items will fully disconnect the entire system, including the trim sensor, which is power from the pitch servo.

7.1. CWS (Control Wheel Steering)

The CWS button or autopilot disconnect switch disengages the autopilot system, but the Vizion controller / display unit, the roll servo, and the pitch servo still receive their primary power from the Autopilot (AP) MASTER Switch/ Autopilot circuit breaker.

- A momentary press and release of the CWS button will disconnect the autopilot.
- If the autopilot is engaged and controlling the aircraft flight path, pressing and holding the CWS button will result in the activation of the CWS mode, which allows the pilot to manually fly the aircraft to a new desired track and vertical speed. Upon release of the CWS button when in CWS mode, the autopilot will synchronize to the current track and vertical speed.

CAUTION: The autopilot will re-engage at current vertical speed if it is greater than 500 fpm with Vizion SW version PV.30, or the pre-set default vertical speed with Vizion software version PV.40. If the current vertical speed is less than 500 fpm with Vizion software version PV.30, or the pre-set default vertical speed with Vizion software version PV.40 when autopilot is re-engaged, vertical speed will be set to zero and it will level off at current altitude.

7.2. Loss of Electrical Power

In the event that the Vizion autopilot system loses electrical power, there is no backup battery and the system will disconnect and turn over control to the pilot. If power can be restored, the autopilot will automatically go through the power up and automatic pre-flight test procedure and be ready for flight within three seconds. There may be a slight gyro offset causing reduced system accuracy if the aircraft is turning or climbing significantly during the power up time. No pilot action is required in this case, as the Vizion autopilot will automatically reduce the offset and the system accuracy will be back to normal within approximately five minutes.

7.3. Pitot / Static System

The Vizion autopilot is connected to the aircraft pitot / static system for use in the airspeed protection modes (these airspeed protection modes are only active when the autopilot is engaged), sensing of aircraft vertical speed, the internal autopilot altimeter (which must be synchronized to the current aircraft altitude periodically and prior to take-off), and for autopilot gyro gain adjustment.

7.4. AEP (Automatic Envelope Protection)

By default, the AEP mode is NOT active at power-up of the Vizion Autopilot, this mode must be engaged by the pilot in order for this system to begin providing bank angle protection. AEP is a safety feature in which the autopilot, when not engaged and flying the aircraft, is capable of monitoring the current bank angle of the aircraft and

if the bank angle exceeds forty (40) degrees, the autopilot will modulate the drive to the servos to apply a corrective force to the aircraft controls to drive bank angle to less than forty (40) degrees.

Use of this mode does not take the aircraft away from the pilot, as a traditional autopilot engage would, it is a reduced torque that is quickly pulsed to the servo, allowing the pilot to continue to fly the aircraft at any desired bank angle. The result of this drive is similar to the autopilot applying a force into the controls instead of a traditional displacement. This mode is designed to alert the pilot of overly high bank angles but not to take the aircraft away from the pilot.

- This feature can be turned on and off by the pilot at any time the autopilot is not engaged, using the MODE button. AEP can also be disconnected by turning off the Autopilot (AP) MASTER Switch.
- AEP cannot be engaged while the autopilot is engaged.
- Regardless of mode selection, AEP will not activate when the aircraft is below the programmed minimum airspeed.
- Regardless of mode selection, AEP will not activate while the autopilot is engaged and flying the aircraft.

7.5. Sensor Error

The primary method of alerting the pilot to a failure of the Vizion autopilot system is the unexpected movement or lack of movement of the primary aircraft control yoke or stick.

The secondary method of alerting the pilot to an autopilot system failure is an autopilot display disagreement with the primary aircraft flight instruments or aircraft deviation from the expected or prescribed flight path.

A third indication of failure is on the Vizion autopilot controller display screen. In the event that there is an internal autopilot controller failure, which would prohibit the continued safe use of the Vizion autopilot system, the autopilot will disconnect servo control and flash between a white screen and the words SENSOR ERROR on the display screen. This error screen is shown in figure 7.5a



Figure 7.5a

7.6. Servo Jam

The Vizion autopilot servo has many built-in safety features to prevent a jammed or stuck servo, in the event that a servo does jam, or the autopilot controller doesn't properly release the autopilot servo, the indications of failure are listed below:

- The primary method of alerting the pilot of a jammed servo is the additional unexpected drag or friction in the aircraft control system.
- The secondary method of alerting the pilot to a jammed servo is lack of movement of the primary aircraft control yoke or stick.
- A third method of alerting the pilot to an autopilot system failure is an autopilot display disagreement with the primary aircraft flight instruments or aircraft deviation from the expected or prescribed flight path.

7.7. Loss of GPS Signal

In the event of a loss of the GPS signal connected to the either the serial and / or the ARINC ports on the Vizion autopilot controller, the autopilot display will alert the pilot that the primary / current method of autopilot control has changed. In the event of a loss of GPS signal, the Vizion autopilot system may still be operated, but at a reduced functionality.

After a loss of GPS failure, the only lateral autopilot mode available is the BANK mode. All other normal autopilot modes are still available for use (CWS, Emergency Level, Vertical Speed Select, Altitude Hold, Altitude Select, and Min / Max Airspeed). When in Bank mode, rotating the knob will command a selected bank angle.

- If the autopilot is in Track mode when the GPS signal loss occurs, the progression will be as shown in figure 7.7a.



Figure 7.7a

- If the autopilot is in GPS Nav mode when the GPS signal loss occurs, the progression will be as shown in figure 7.7b.

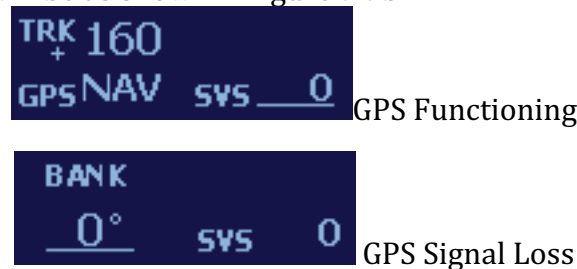


Figure 7.7b

- If the autopilot is in GPS Steering mode when the GPS signal loss occurs, the progression will be as shown in figure 7.7c.

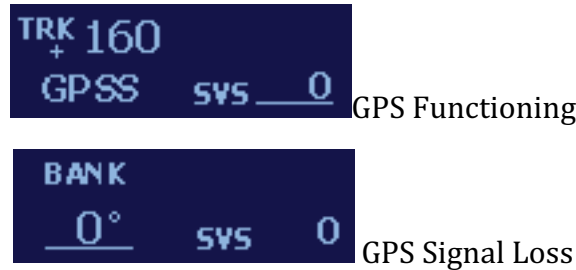


Figure 7.7c

7.8. Trim Sensing

The Vizion autopilot system contains a trim sensor built into the pitch servo pushrod. This sensor determines when there are forces in the pitch axis, which the pilot can trim away by manually moving the aircraft pitch trim.

Figure 7.8a shows the screen with trim UP annunciated.

Note: the letters UP are shown with an arrow pointing up above them. This indicates the need for nose UP trim.

Figure 7.8b shows the screen with trip DOWN annunciated.

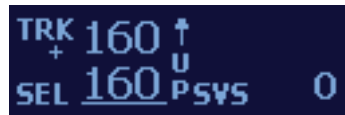


Figure 7.8a

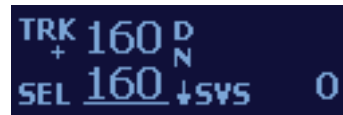


Figure 7.8b

- This system does NOT provide any sort of automatic trim adjustment. The pilot is solely responsible for maintaining a properly trimmed aircraft.
- This system does NOT sense trim in ANY axis except for the pitch axis.

7.9. System Messages

The Vizion autopilot display system messages to the pilot. The following table shows messages which alert the pilot / user to an error or mode change and their meaning:

Message	Meaning
POWER UP	Power has been applied to the Vizion autopilot controller. The autopilot will automatically initiate the pre-flight test procedure.
VZ.XX	This is the software version of the Vizion autopilot controller. XX will be a numeric value.
NO GPS	The autopilot is not receiving a GPS signal. This is displayed only when the autopilot is not engaged.
NO FIX	The autopilot is receiving a GPS signal, but there is no position fix or guidance provided to the autopilot. This is displayed

Message	Meaning
	only when the autopilot is not engaged. A flashing period (.) will accompany the NO FIX message.
BANK	The autopilot is engaged and is either not receiving a GPS signal or the GPS does not have a position fix.
GPS OK	The autopilot is receiving a GPS signal, AND there is a valid position fix or guidance provided to the autopilot. This is displayed only when the autopilot is not engaged. A flashing star (*), flashing plus (+), flashing (E), or flashing (A) will accompany the GPS OK message.
TRK XXX <u>SEL XXX</u>	Shown on the left half of the autopilot display: The autopilot is following the internal track selector. When <u>SEL XXX</u> is <u>underlined</u> , rotation of the knob will change the selected track.
TRK XXX GPS NAV	Shown on the left half of the autopilot display: The autopilot is following an external GPS flight plan from an approved GPS.
TRK XXX GPSS	Shown on the left half of the autopilot display: The autopilot is following an external GPS Steering signal from an approved GPS.
SEL XXXX SVS XXX	Shown on the right half of the autopilot display: The autopilot is in altitude select and is following a commanded vertical speed. When <u>SEL XXX</u> is <u>underlined</u> , rotation of the knob will change the selected altitude. When <u>SVS XXX</u> is <u>underlined</u> , rotation of the knob will change the selected vertical speed.
ASPEN HDG	Shown on the left half of the autopilot display: The autopilot is following the external heading bug commands from an Aspen Evolution 1000 Pro or Evolution E5. The vertical axis of the autopilot functions as it would when the autopilot is in GPS Steering or GPS Nav.
EXT HDG	Shown on the left half of the autopilot display: The autopilot is following the external heading bug commands from an approved source (other than Aspen 1000 Pro or E5). The vertical axis of the autopilot functions as it would when the autopilot is in GPS Steering or GPS Nav.
EXT ALT	Shown on the top right half of the autopilot display: The autopilot is following the external altitude bug commands from an approved source (other than Aspen 1000 Pro or E5). The roll axis of the autopilot will be in EXT HDG mode.
MIN AS	The autopilot is maintaining the minimum safe airspeed. The autopilot will NOT follow the prescribed vertical path. This airspeed is also the lower limit that the AEP (Automatic Envelope Protection) mode will activate. CAUTION: this may result in a descent of the aircraft when a climb is selected
MAX AS	The autopilot is maintaining the maximum safe airspeed. The autopilot will NOT follow the prescribed vertical path.

Message	Meaning
	CAUTION: this may result in a climb of the aircraft when a descent is selected
AEP STBY	AEP (Automatic Envelope Protection) Mode is ARMED and monitoring the bank angle of the aircraft and will activate if the bank angle of the aircraft passes above 40° of bank. This mode must be purposely activated by pilot by pressing the MODE button with the autopilot not engaged. Note that AEP will not activate if the aircraft is below the programmed minimum airspeed.
AEP OFF	AEP (Automatic Envelope Protection) Mode is OFF and will not provide assistance in the event that the bank angle of the aircraft is greater than 40° of bank. This is the DEFAULT mode, and each time power is cycled, the autopilot will always default to AEP OFF.
AEP ACTIVE	AEP monitors the aircraft bank angle; if the bank angle exceeds 40°, AEP will show AEP ACTIVE on the display of the autopilot as well as use the autopilot roll servo to both nudge the aircraft back to a safe bank angle and to inform the pilot that the bank angle limit has been reached. There will also be a long, single tone sent to the buzzer (if equipped) when AEP is active.
SENSOR ERROR	The autopilot has detected a failure, either during the pre-flight test or during normal use, which makes continued operation of the system unsafe. The autopilot will disconnect and the pilot must manually fly the aircraft. This error will continue to flash until power is removed from the autopilot controller.

There may be other messages, which the system sends to the pilot and these are outlined in the Vizion PMA Operation Manual (TruTrak Doc. Number 167), which must be kept in the aircraft.

7.10. Autopilot Control Information

Arm AEP (Automatic Envelope Protection)

With Autopilot NOT engaged, momentarily press and release MODE button –
CAUTION: AEP shall not be engaged prior to take-off.

Disconnect AEP (Automatic Envelope Protection)

With Autopilot NOT engaged, momentarily press and release MODE button
Or
Remove power using Autopilot MASTER switch or Autopilot circuit breaker

Engage Autopilot

Momentarily press and release knob
or
Momentarily press and release Emergency Level (AP LVL) button

Disengage Autopilot

Press knob for 2 seconds
or
Momentarily press and release CWS switch
or
Remove power using Autopilot MASTER switch or Autopilot circuit breaker

Lateral Modes

Track Mode

Rotate knob to select desired track

GPS Nav Mode (GPS navigators without GPSS output)

Momentarily press and release MODE button to follow flight plan from GPS.

GPS Steering Mode (GPS Navigators with GPSS)

Momentarily press and release MODE button to follow flight plan on GPS.

ASPEN HDG Bug Mode (ARINC connection with ASPEN – if equipped)

Select AP ARINC source – **ASPEN**
Momentarily press and release MODE button to follow heading bug / GPSS pass-through from Aspen.

G5 HDG / ALT Bug Mode (ARINC connection with G5 – if equipped)

Select AP ARINC source – **G5**
Momentarily press and release MODE button to follow heading bug / altitude bug from G5.

Gyro Back-Up Mode (Bank) – Only with GPS failure
Rotate knob to select desired bank angle (up to 30 degrees)

Vertical Modes

Altitude Hold Mode

Automatically entered when target altitude is reached

or

1. Momentarily press and release ALT button
2. Momentarily press and release knob (without adjusting target altitude)

Altimeter/Barometer Sync – MUST BE DONE PRIOR TO ALTITUDE SELECT!

1. Momentarily press and release ALT button two times
2. Set altitude to match barometer corrected aircraft altimeter
3. Momentarily press and release knob

Note: If AP connected to Aspen 1000, Aspen E5, or Garmin G5, and AP ARINC source switch is set to Aspen or G5, Altimeter is automatically synchronized to the Aspen 1000, E5, or G5 and the altimeter sync menu will not be available.

Altitude Select Mode

1. Momentarily press and release ALT button
2. Select altitude, Momentarily press and release knob
3. Select vertical speed, Momentarily press and release knob

Any other more complex modes are described in the Vizion PMA Operation Manual (TruTrak Doc. Number 167)