EFIS Autopilot

Installation Manual

8300-057 Rev C

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INSTALLATION MANUAL

FOR

EFIS Autopilots

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OPERATION OF THE BASIC FLIGHT INSTRUMENT

As with our autopilot products, extensive attention has been given to providing the simplest operation. No sequential pressing of buttons is required to reach basic control functions and no additional button pressing is required to set values. Starting with a clean sheet of paper the layout of controls (two knobs and five soft keys) is sufficient to handle all EFIS and built in autopilot control functions.

On the basic flight instrument, the right hand knob is primarily dedicated to setting the barometer and the left hand knob is primarily dedicated to setting the direction bug. Pressing the ALT soft key sets the altitude bug to the 100 foot mark nearest the present altitude. This setting is entered into the active state by pressing the right hand knob. If the intent is to select an altitude the ALT button is pressed and the right hand knob is rotated to select the desired altitude. (With the knob out, steps are 500 feet and with the knob depressed, steps are 100 feet.) When the altitude has been set, press the knob to ENTER the value. It will be noted that when any value is to be set a screen showing the selection to be made will appear above the appropriate knob.

When the aircraft is within 30 miles of the destination fix, the CRS label will display on the soft key at the far left. To select an arrival course different from the enroute course on the HSI press CRS and then rotate the left hand knob. When the course is set press the knob to ENTER. A computer generated arrival procedure in which steering from the enroute course to the selected runway is described in the special functions section.

Just above the left knob is the label [DIM] in small print. To set the dimmer, press and release the knob, then rotate to set the desired light intensity. When this is done, press and release the knob to exit the set mode.

When there is NO GPS the directional gyro operates in the free gyro mode, and the label above the far left soft key is SET DG. When this button is pressed, the left knob is used to set the DG to the magnetic compass. As is the case with any free gyro this procedure is to be repeated periodically as required.

OPERATION OF THE EFIS PILOT

When the autopilot is not engaged operation and labels are the same as the basic EFIS except for the presence of the AP button. When the autopilot is engaged, the right hand knob is dedicated to selecting vertical speed. The [BARO] label is now just above the right knob. To adjust the barometer, press and release the knob to enter the Baro set mode, and then rotate the knob, press and release the knob to ENTER. The button to the left of AP is labeled with NAV or GPSS. This mode is turned on or off by pressing the knob. Rotation of the directional knob also turns off the NAV or GPS mode. When GPSS mode is engaged GPSV appears above the button to the right of AP. Further information on GPS steering is in the special functions section.

Mechanical Installation Considerations

PROGRAMMER INSTALLATION

Mounting Considerations

The EFIS Series unit is designed to mount in the aircraft instrument panel within view and reach of the pilot. The primary unit location should minimize pilot head movement when transitioning between looking outside of the cockpit and viewing/operating the EFIS Series unit. Maximum recommended viewing angle should be no more than 20 deg. The maximum mounting angle the EFIS can accommodate is 12 degrees longitudinal axis and 0 degrees lateral axis. The location should be such that the EFIS Series unit is not blocked by the glare shield on top, or by the throttles, control yoke, etc. on the bottom. Use aircraft installation standards for mounting and support of the EFIS programmer.

Wiring Considerations

Use AWG #24 or larger wire for all connections unless otherwise specified. The standard solder pin contacts supplied in the connector kit are compatible with up to AWG #18 wire. In cases where some installations have more than one component sharing a common circuit breaker, sizing and wire gauge is based on, length of wiring and current draw on units. In these cases, a larger gauge wire such as AWG #20 may be needed for power connections. Do not attach any wires to the outside of the EFIS or route high current wires within six (6) inch of the programmer. Ensure that routing of the wiring is not exposed to sources of heat, RF or EMI interference. Check that there is ample space for the cabling and mating connectors. Avoid sharp bends in cabling and routing near aircraft control cables. Do not route the COM antenna coax near any EFIS components.

RFI/EMI considerations

The EFIS programmer is shielded and does not generate any appreciable level of electromagnetic interference. Moreover, the servo lines (except for power and ground) are low-current and cannot contribute to RF interference. The servo power and ground lines do have switching currents through them, but so long as there are no parallel runs of servo power and ground lines with such things as poorly-shielded antenna lines or strobe light power lines, there is no need to shield the servo harnesses. The EFIS itself has been internally protected from RF interference and has been tested under fairly extreme conditions, such as close proximity to transmitting antennas. However, it is always good practice to insure that such antennas are properly shielded and not routed directly over or under sensitive panel-mounted electronic equipment. Most problems in this area are the result of improper RF shielding on transmitting antennas, microphone cables, and the like. The most sensitive input to the autopilot is the Control Wheel Switch input. This line should **not** be routed in parallel with transmitting antennas or other sources of known RF interference. The CWS wire should be shielded with the shield connection to pin 19 of the autopilot connector or a close suitable ground point.

Pitot and Static Connections

The TruTrak EFIS require connections to the Pitot and static lines, see page 8. The preferred method of this connection would be tee fittings near the aircraft's airspeed indicator. The importance of a good static port and line cannot be overstated. In some cases, problems can be caused by having a large number of devices connected to a single, insufficient, static port. In other cases, the static line itself is adequate but there are one or more devices connected to the same line, one of which has a large static reservoir. A simple remedy for this problem if it occurs is a tee-fitting near the static port, and a dedicated line to the EFIS only or a dedicated static port close to the autopilot. Obviously, an insufficiently-large orifice coupled with large static reservoirs can aggravate the problems associated with lag.

Servo Installation

> The installation information in this section is extremely important and must be **clearly understood** by the installer. Improper servo installation or failure to observe and diagnose installation problems prior to flight can result in extremely serious consequences, **including loss of ability to control the aircraft**. If there are any questions on the part of the installer it is mandatory to resolve these questions prior to flight of the aircraft.

Most modern experimental aircraft use push-pull tubes to drive the primary controls. These tubes generally have a total travel of 3" or less; therefore, it is best to connect the autopilot servo to the primary control by the same method. This connection consists of an arm on the servo connected by a push-pull rod to the primary control. Rod-end bearings are required on each end of the push-pull rod. The servo arm must not rotate even near to the point called OVER CENTER, the point at which the primary aircraft control would lock up. Some aircrafts mechanical primary control installations will not allow this to occur and do not need the servo stops. This is a condition that would result from the servo being back driven when the pilot operates the controls, or from the servo itself driving the controls to a stop. To protect against this mechanical stops are supplied with the servos. These stops are drilled so that they can be mounted at different angles as required (18° intervals)

In addition to the proper use of the stop it is important to know the amount of travel on the primary control that the servo can handle. With the push rod connected to the outermost hole (1 ½") the travel on the primary cannot exceed 2 ½", the intermediate hole 2 1/16", and the inner hole 1 5/8". It is important to note that at the neutral point of the control the SERVO ARM must be PERPENDICULAR to the push rod, and that the stop must be mounted so as to limit travel as near as possible to equal amounts in both directions. In certain factory-designed installations there may be well-proven exceptions. There will be installations in which space does not permit the use of the stop. When this is done the aircraft's primary control stops must be positive and care must be taken to be sure that at the neutral point the servo arm is perpendicular to the push rod, and that the travel limits of the servo arm are not exceeded. There are installations in which the travel of the push-pull tube exceeds the allowable 2 ½". For such installations, the drive can be applied to a bell crank at a radius point that moves the desired 2 ½" of maximum allowed travel in the outermost hole of the arm.

When there is no way to have a drive point of less than 2 ½" or when the primary control is cable-driven it is necessary to use the capstan-cable servo drive. When this is done the servo should be mounted so that the 1/16" diameter cable which wraps around the capstan when extended parallel to the primary cable is approximately 3/16" from the primary cable. If the primary control travel does not exceed 5" the cable locking pin will be 180° away from the point at which the cable leaves the capstan. When the primary control is at the neutral point this means the total cable wrap around the capstan is 360°. If the primary control travel is greater than 5" the cable wrap is 720°and the pin is adjacent to the output point when the primary control is at the neutral point.

The cable clamps when properly installed will not slip and thus get loose, but it is desirable to NICO press or swedge a fitting on to the cable so as to provide added assurance that the cable will not become slack. If the bridle cable is not sufficiently tight there will be lost motion in the autopilot drive. This will result in hunting (oscillation).

THE DISPLAY

Consider first the pitch display. Motion of the pitch display short term is gyroscopic as it must be to fly in IMC. Long term it is VSI. This is a special case of a presentation used in the military called VELOCITY VECTOR. This display has two advantages. The first is that it provides an instantaneous vertical speed presentation. The second is that when the reference airplane is on the horizon the aircraft is neither climbing nor descending. This eliminates the need for adjusting the position of the pitch reference airplane to compensate for the angle the fuselage is flying. The resulting benefit of this concept is that it makes holding altitude easier (not only in straight flight but also in turns). It is a fact that next to AOA, airspeed provides the best warning of approaching a stall. For this reason the airspeed pointer flashes red when a pre-set minimum airspeed safely above a stall is reached. There are critics of this concept who believe that attitude is an indicator of approaching a stall. NOT SO, attitude alone is not at all such an indicator.

The HSI is placed below the horizon as in the larger more expensive displays. It is in the form of an ellipse for two reasons. First, an ellipse when compared with a circle of the same height provides a broader scale at the top where it is read. Second, it looks as a circle would when laid out on the ground ahead of the aircraft. When a DIRECT TO or FLIGHT PLAN is set into the GPS this display becomes an HSI. The boldness of this high quality display in combination with its location enhances the fly ability of the overall instrument. Finally, the HSI contains features that make functions available that are not found in other low cost systems. These are described in other sections.

The analog presentations of airspeed and altitude are based on the belief that in some cases round is better. It will be noted that after having tried other presentations the automobile industry is back to round instruments. Nothing in the modern world of vertical tapes compares with the dynamic effect of a white needle moving around a black altimeter dial. As a target altitude is approached it is natural for the pilot to slow the needle velocity so as to arrive at the altitude without overshoot. The difference is that in this system the dials rotate about fixed pointers, but the relative motion retains the same effect as the moving pointer. In addition, the rotating altimeter dial further enhances the motion factor. To satisfy personal preference the display can be switched back and forth between round and rectangular, even in flight. Of those who have tried both the choices have been almost unanimous in favor of the round.

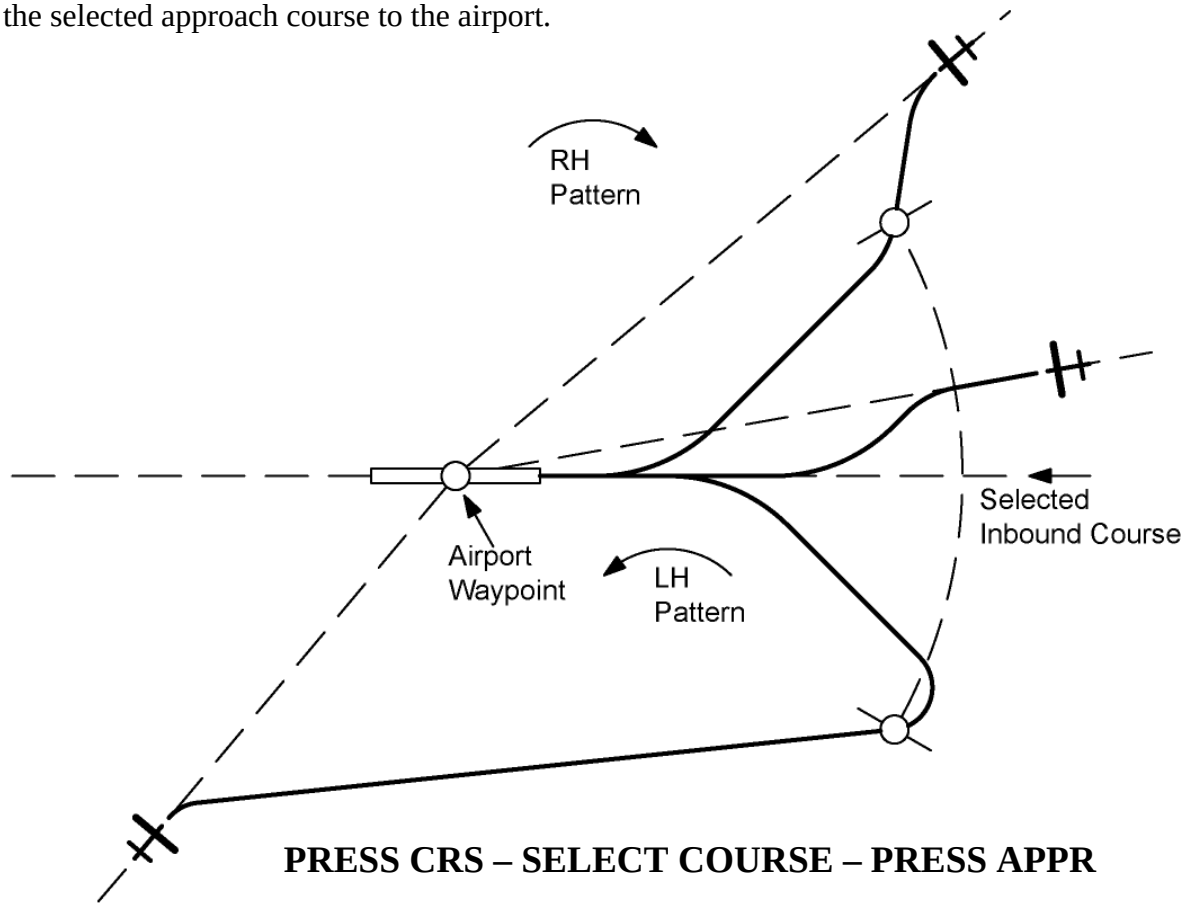
Within the bank angle scale indicators are inserted which show the angle for a standard rate turn. These indicators move outward on the bank angle scale as airspeed increases. Placed above the bank angle scale is an inclinometer that looks just like a conventional ball in a curved tube.

Still another convenient feature is the optional presentation of important engine data in the pilot's direct field of vision displayed across the top of the instrument.

Automatic Arrival Transition

In an aircraft tracking a course inbound to a destination airport, the letters CRS will appear above the far left soft key when the distance becomes less than 30 miles. When CRS is showing, the autopilot can be programmed to fly a transition from the enroute arrival course to a selected arrival course set into the HSI. This is not intended to be used in an IFR approach but instead as a convenience for the low time pilot in arriving at an un-familiar airport or for the over loaded pilot in marginal VFR weather.

To initiate the automatic arrival mode, press CRS, select the desired inbound course, and click the APPR button. The autopilot will now fly the entire arrival path to the desired runway. An additional feature of the automatic arrival mode can be used to position the aircraft according to the desired right or left hand pattern. After setting the inbound course press enter instead of APPR to remain in track mode. Once the desired aircraft position is established, press CRS then APPR to initiate the automatic arrival. This procedure works regardless of the direction of the inbound course and that of the selected approach course to the airport.



PRESS CRS – SELECT COURSE – PRESS APPR

Operating controls

As with our autopilot products, extensive attention has been given to providing the simplest operation. No sequential pressing of buttons is required to reach basic control functions and no additional button pressing is required to set values.

Button labels	–	White - mode is **OFF** Green - mode is **ON**
Click	–	Momentarily push and release any knob or button
Press	–	Push and hold any knob or button for 2 seconds and release
Enter	–	Click appropriate knob

BARO & TRK SELECTION

In the TruTrak EFIS display, both barometer **BARO** and direction **TRK** are set by rotation of dedicated knobs.

DIMMING

Dimming of the display is accomplished by a Click of the left knob **[DIM]** and then rotating the knob Counter Clock wise to reduce the display illumination. External dimmer input will only control the button illumination.

DIRECTION GYRO

Normally this adjustment will not be necessary, as the HSI will be slaved to a GPS NMEA source. If there is a loss of the GPS source then the internal gyro backup will maintain the DG. Click the soft key (button) beneath **SET DG** provides a screen for correction of any drift in the DG that may occur by rotating the left knob to set the DG, and then click ENTER.
Natural progression will be reduced with repeated DG SET.

ALTITUDE BUG

Click the soft key beneath **ALT** provides a screen for selecting the altitude bug. The GREEN BUG on the altimeter will move to the closes 100 ft mark of the current altitude. Then rotating the right hand knob **SELECT ALT** will allow the altitude to be selected. Each step of the rotary encoder moves the bug 500 ft. while depressing the knob and rotating provides 100 ft. steps and then click ENTER. The altitude bug will never move out of view but will remain ether at the top of the altimeter to indicate selected altitude is above current altitude or the bottom to indicate selected altitude is below current altitude. The selected altitude setting can always be seen above the **SEL** or **ALT** after selection on the display.

GPS INFORMATION

The HSI requires GPS NMEA information to function correctly. If the primary serial connection and communication protocols have been setup correctly, the EFIS display will display GPS/HSI information as shown. If not then the Display will show **NO GPS** and only the DG will be operational.
When a flight plan has been entered into the GPS, the HSI will display a Course to the first waypoint. The deviation bar will offset to show the aircraft present position compared to the desired track. The small yellow diamond shaped bug is the DIRECTION TO WAYPOINT bug.

Setting the HSI CRS pointer is accomplished by clicking the soft key beneath **CRS** to enter the set up screen. Rotation of the left knob selects the course, click ENTER to set.

All EFIS with RS-232 (NMEA) input will have GPS NAV (NAV) but will overfly the waypoint then intercept new the track at about a 45 degree angle.

The EFIS AP IV has the ability to perform GPSS and GPSV commands from the programming of the GPS unit communicating across ARINC wires to the EFIS AP. The GPSV requires a GPS approach to communicate GPSV information to the EFIS AP IV. Valid information is required to allow the GPSV button to be engaged. When GPSS and/or GPSV are engaged the steering commands come from the flight plan programmed in the GPS. See page 15.

AP IV SHOWN

SETUP SCREENS

STYLE, ATT, ZERO, INFO, UNITS, BALL, ALERTS, SPEEDS, SERIAL, LAT AP, YD, VRT AP, AUDIO

To enter the setup screen the press the right knob until **SETUP** shows below the HSI then click the soft key below **SETUP** at the same time. Click the button below any selection to enter and adjust that function. Click the **MORE** button or rotate the right knob to progress through the different setup selections.

With a dual EFIS system, most setting that apply to both the EFIS or EMS will change on both units when set on one.

Rotate the right knob **NEXT** on the first page to enter the AP setup pages .

Click the right knob to return to the main screen.

STYLE

Click ether **ROUND** gauge or **RECT** tape style airspeed and altimeter gauges.

Click the right knob to return to the **SETUP** screen.

ATT & ZERO

Click **ATT, ON** or **OFF** to selected aircraft attitude indication on the EFIS horizon.
The attitude can be zeroed for level flight for different aircraft by clicking the **ZERO** soft key button at any time.

INFO

This button will display the information about all the components that are connected to the EFIS communication buss, Serial numbers, Software version, and Model type. The LEFT KNOB must be clicked to return to the main page.

UNITS

Under this button the **UNIT** of Measure for the **BARO** (IN HG, MBAR) or **DIST** (NM, MI, KM) readouts can be set.

BALL

After installation in the aircraft, center the ball by rotating the right knob.

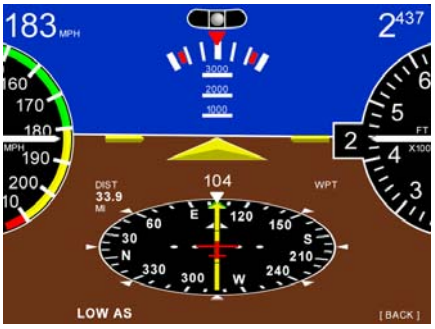
Click the right knob to return to the **SETUP** screen.

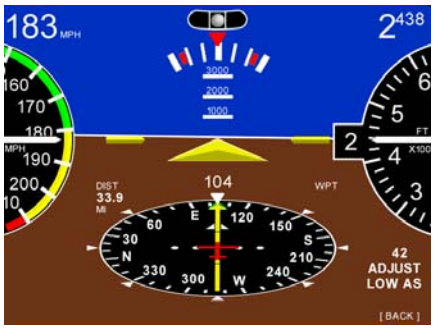
ALERTS

LOW AS will set the airspeed warning or off if set to “0” airspeed.

The airspeed that is selected by the right knob will cause the needle on the airspeed gauge to flash red below your selected airspeed.

Click the right knob to return to the **SETUP** screen.





SPEEDS

Set for aircraft before first flight!

VSO Bottom of the white arc.
The stall speed or the minimum steady flight speed in the landing configuration.

VS Bottom of the green arc.
The stall speed or the minimum steady flight speed clean configuration.

VFE Top of the white arc.
Maximum flap extended speed.

VNO Top of the green arc.
Maximum structural cruise speed.

VNE Red line, Top of yellow arc.
Never exceed speed.

Click the right knob to return to the **SETUP** screen.

SERIAL

Select ether 4800 or 9600 Baud for correct GPS RS 232 communications.

Click the right knob twice to return to the **MAIN** screen.

AUTO PILOT SETTINGS

LAT AP

VRT AP

ACTIVITY

(Setting range 0 – 36) The velocity at which the servo moves the control surface. The higher the number the more movement you will see in the control surface. With a standard servo (DSB-X, DSP-X) you should start at 0 then work your way up in flight to set the level for your aircraft. The High Torque Servo (DSB-HB, DSB-HC) has a different gear ratio, so an Activity setting of 12 will be equal to about 0. With too low a setting the aircraft will hunt slowly and appear to be lazy. With too high a setting the aircraft will hunt rapidly, and appear nervous and jittery.

MICRO

(Setting Range 0-31) This is used to remove the significant lost motion in the control system, usually a cable control system. Most aircraft do not need this changed from 0. An example of when one might need to adjust microactivity is if flying in still air, there is a very slight wing rock that cannot be solved by adjusting the ACTIVITY setting.

ROLL

(Setting Range 0-4) Most aircraft do not need this changed from 0. Only aircraft type like CT & CUB that have adverse Yaw with turns (rudder assist). We recommend factory assistance before adjusting this value.

BANK

(Setting Range Low – MED – High) This setting limits the maximum bank angle of the aircraft to approximately 13 degrees at the low setting, 18 degrees at the medium setting, and 24 degrees at the high setting.

STATIC

(Setting Range Low – MED – High) This setting is used to compensate for lag in the aircraft static system. This setting is usually not adjusted. This value is used to remove very slow hunting, of more than 15 to 30 feet, in altitude hold when adjusting the activity setting does not solve the problem. This is NOT the setting to adjust if there is slight nose bobble in still air; the setting for that situation is HALF STEP. We recommend factory assistance before adjusting this value.

HALF-ST
(Setting Range N or Y) This setting will cause the servo to take smaller steps, but will also reduce the torque available. Normally this setting is "N", if the aircraft nose moves up and down very slightly in VERY calm air, and it can be verified that the servo is only moving one step for each "bobble" of the nose, then select "Y". Only very light aircraft that are extremely pitch sensitive will need to adjust this setting.

SPEEDS (AP)

MIN AS
(Setting Range 0 – 300) This setting is the minimum airspeed in knots that the autopilot will fly the aircraft. Example: If the aircraft is climbing and the power setting is not adequate to maintain selected vertical speed setting, the autopilot will lower the nose until MIN AIRSPD setting is met. The FD "Fly Bar" will also indicate a decent needed and flash red until airspeed is restored.

MAX AS
(Setting Range 0 – 300) This setting is the maximum airspeed in knots that the autopilot will fly the aircraft. Example: If the aircraft is in a decent and the power is not reduced so as to keep the airspeed below the MAX AIRSPD setting, the autopilot will raise the nose until MAX AIRSPD setting is met.

Y D
(Setting Range N or Y) This setting indicates if the aircraft has a Yaw Damper system installed.

YAW CENTR
(Setting Range -8 – 8) This setting is used to have the Yaw Damper keep the aircraft slip/skid indicator centered when the Yaw system is engaged. Allow a few seconds for the Yaw System to respond to the new setting.

YAW ACTVTY
(Setting Range 0 – 12) The velocity at which the servo moves the control surface. The higher the number the more movement you will see in the control surface.

AUDIO
(Setting Range 0 – 32) This location turns the audio on or off or controls the volume of the Speech.

EFIS SOFTWARE UPDATES

Compact Flash Card Slot

The EFIS software is updated by inserting a Compact Flash card (CE) in the back top slot. With the back of the card up. Software is available from TruTrak to install on a flash card. Then apply power to the EFIS and monitor the screen. Follow the instructions on the screen. When power is reapplied to the EFIS, the new software will be installed.
If more than one unit is updated the software load will take longer.

Confirm the update by watching the display lower left side on startup for the version number change.

PITOT **STATIC**

ENGINE INFORMATION

With the optional Engine Data Module coupled to the EFIS the display will be able to show engine information at the top. Detailed information is located under the **PAGE** button.

The first page after power-up will show the timer page so that the fuel and or trip information can be updated before engine start.
The HSI information can always be returned to by clicking the **MAIN** button.

FLIGHT DIRECTOR

The magenta wings that come up when the FD button is pressed will show the aircraft positioning to follow to maintain TRK, VSI, NAV, etc. commands. All the pilot has to do is keep the triangle in the wings as they move to follow the commands the pilot told the EFIS to perform. Example: A change in TRK will command the wings to bank in the direction to acquire the new TRK. A command to climb to a new altitude will cause the wings to move up on the horizontal plane to acquire the new altitude.

VNAV

VNAV (vertical navigation) is the ability to command the EFIS AP to fly to a specified altitude in a specified distance (max 99 miles). Maximum VS descent is 750 ft/min.

Click the ALT button and set your new altitude **below** your current altitude, do **NOT** click [ENTER]. Click the DIST button to select the distance to the new altitude, Click the right knob [ENTER].
The display will show VNAV and the altitude and distance to the new altitude hold.
When the aircraft reaches the new altitude, the EFIS will enter altitude hold.

SL30 NAV

With the serial wires from the SL30 to the EFIS connected. The EFIS will display the VOR / ILS NAV information on the HSI. This information does not command the FD or AP. With a valid SL30 NAV input, an ILS or VOR will be displayed over the CRS label. Press and Hold the CRS button to display the information on the HSI. The OBS radial will be displayed on the SL30 also.
The SL30 must be set for SERIAL output.

AP LEVEL BUTTON (option)

The AP LEVEL button must be installed in easy reach of both the pilot and copilot positions. When depressed, the AP button will always do the same function. **The Auto Pilot and FD will engage and capture current Track and Altitude.** If the Auto Pilot is engaged, the AP will change to Track and Altitude hold.

Any manual input change, other than TRK change, on the EFIS AP after the AP LEVEL button has been press will return the AP to normal function.

The CWS if installed will function as normal.

GPSS / GPSV APPROACH

EFIS AP IV ONLY

Program the GPS for an approach to the airport and activate the procedure.

Engage ether the AP for autopilot control or the FD for hand flight.

Select GPSS and engage ALTitude hold in the EFIS AP IV.

Turning to inbound course.

Fly the approach along the GPSS approach path. After the aircraft is on long final, the GPS will send a valid GPSV signal. The EFIS will display the GPSV (white) to the right of the AP/FD label.
If the signal is not valid the GPSV will display GV FLG.
When in a holding pattern the display will be GV HLD.

Press and release the button below GPSV to engage GV ARM.

At the time the Glide Path meets the aircraft. See GP scale left of HSI.

The GV ARM will change to GPSV and the aircraft will pitch down or the FD wings will drop to follow the GP.

The GO AROUND will be displayed and then start flashing for a GO around decision action, if needed.

When the GO AROUND button is Clicked, the EFIS AP / FD will change to TRK mode and pitch up VS 500 fpm.

The EFIS will **NOT** follow the Departure Hold flight plan.

Must be performed before first flight

Once wiring and servo installation are completed, the autopilot should be tested in the aircraft **while on the ground**. The first step is to enter the setup modes on the autopilot and set all parameters to their correct values. Apply power to the EFIS autopilot. After approximately five seconds, the EFIS autopilot is ready to be setup for operation.

Follow the SETUP SCREENS section above to set the different settings.

Be sure and Set the airspeeds for your aircraft before first flight!

The next step in the checkout procedure is to verify that all servos run, and in the correct direction. Power up the EFIS autopilot and wait approximately five seconds for EFIS warm-up. Then CLICK the AP button to engage the autopilot. At this point, the **TRK** and the **AP** will turn green and with AP III and IV, the SET BARO will change to SEL **VS** to indicate that they are autopilot controls on the display; the selected vertical speed ("SEL **VS**") will be shown below the **VS** on the right. For autopilots with option II, you must engage the ALT hold by clicking the ALT button. Then push down on the tail (empennage) or lift up if a tail dragger and watch the elevator movement. The elevator MUST move in the direction that you are moving the empennage. If AP III or IV then use the Vertical Speed knob to set selected vertical speed to zero if not there already. The pitch servo should stop, or move only very slowly. Now rotate the knob clockwise until several hundred feet per minute is showing on the SEL **VS** field. At this point, the pitch servo should be moving the control yoke or stick **back**, in an effort to raise the nose of the aircraft. Similarly, rotate the knob counter clockwise until minus several hundred feet per minute is showing on the SEL **VS** field, the pitch servo should be moving the controls **forward** to lower the nose of the aircraft. If direction is incorrect, install or remove the jumper between pins 1 and 2 of the autopilot connector.

The roll servo should also be responding at this time, rotate the left knob to move the green bug back to 0 if not there already. The servo should stop or move only very slowly. Rotated the knob clockwise from the current selected **TRK** to a selected a TRK to the right, the control yoke or stick MUST move in such a way as to roll the aircraft to the right. Conversely, a rotation of the knob counter clockwise will move the controls in the opposite direction to attempt a roll towards the left. If servo direction is not correct, the wires going to pins 4 and 5 of the roll servo (pins 32 and 33 on the main connector) must be reversed to achieve the correct response. If a servo does not move at all, double check the wiring, power and ground to the servos. If a servo jitters but does not actually rotate, check the wiring on the four servo drive lines (pins 2, 3, 4, and 5 on the servo) to that servo for continuity and correctness. If the servo does not seem to have any torque, check the relevant torque control line for continuity and correctness. The voltage on pin 6 of the servo should be approximately 5 volts, with the AP engaged. Also if there is not adequate current on the power and ground wires the servo will not move without help.

At this time, check that the servo arm or capstan is properly operating the controls. For servo installations using an arm, check that as the controls go from limit to limit the arm of the servo remains in the operating range of the servo (a maximum of 100 degrees total rotation) and that when the controls are centered, the connecting pushrod is approximately perpendicular to the arm of the servo. For capstan systems, insure that the cabling remains at proper tension and is properly secured as the servo moves the controls from stop to stop. Insure that the servo remains secure in its mounting and does not flex its mounting bracket as it drives the control to its stops. For installations using an arm, insure that as the servo moves the control towards the end of control travel it does not cause the main control's torque tube

to flex in any way that could cause control system lockup at the extremes of servo travel. Insure that any "lost motion" in the linkages is eliminated or minimized, in order to maximize the performance of the autopilot. Lost motion (dead zone) will result in wandering or slow "hunting" behavior in flight.

The next step in the check-out procedure is to verify that the serial input from the GPS receiver is being properly received and interpreted. With the aircraft outside of any building, power up the GPS receiver and the autopilot. While the GPS is acquiring, the display will show NO GPS FIX. After the GPS receiver acquires its position, the autopilot will display the valid position data is available. If the display shows NO GPS, even after it is known that the GPS unit has a position fix, the problem must be diagnosed and corrected.

Summary:

ENGAGE AUTOPILOT WITH FLIGHT CONTROL CENTERED, ROTATE LEFT KNOB CLOCKWISE A FULL ROTATION. THE FLIGHT CONTROL MUST MOVE TOWARD RIGHT. ROTATE LEFT KNOB COUNTER CLOCKWISE, FLIGHT CONTROL MUST MOVE BACK TOWARD LEFT.

ROTATE RIGHT KNOB TO 1000' UP. FLIGHT CONTROL MUST MOVE BACK. ROTATE RIGHT KNOB TO 1000' DOWN. FLIGHT CONTROL MUST MOVE FORWARD.

Yaw Damper Ground Checkout

For an EFIS with a Yaw Damper, the next step in the checkout procedure is to verify operation of the yaw damper.

Set the YD ACTIVITY in the EFIS to 15. Manually center the rudder and then engage the yaw damper by clicking the AP button on the EFIS. Note: Any time the autopilot is off in normal flight the yaw damper may be toggled on and off using the YD key, so long as the aircraft is not flying slower than the preset minimum airspeed.

The aircraft should be on a level surface (with its "ball" centered) for this adjustment. With the toggle switch on the YD controller "OFF" for centering (leveling). Adjust the leveling potentiometer (which protrudes from the face of the yaw damper module) to stop the movement of the servo (rudder). Once the proper adjustment is done, switch the toggle switch toward "gyro on". Push the tail away from you and confirm that the rudder moves in the direction that you pushed the tail (empennage). Press the AP button to disengage the yaw damper, re-enter the YD setup with the above procedure, advance to the and set YD ACTIVITY value to zero. This insures that the yaw damper adjustments do not complicate the first test flight of the autopilot, confirm that the minimum airspeed is set to the desired value for actual flight. This should be an indicated airspeed (in knots) which is safely above the stall but not below normal approach or climb out speeds. Make sure that the toggle switch on the Yaw Damper controller is toggled toward "gyro on" for flight.

With autopilot and yaw is engaged push on tail and rudder must move in direction you have pushed.

First Flight

The first flight should be done after having completed all the setup and testing on the ground. For the first flight, it is important that the GPS unit is properly functioning with the EFIS.

The two activity adjustments (LAT ACTVTY and VRT ACTVTY) determine how briskly the autopilot responds to roll and pitch disturbances. They can be adjusted, in flight, over a wide range; thus the autopilot can be tailored to adapt to any aircraft installation.

Each of the two activity adjustments covers a numeric range of 0 to 36. Unless the value for a particular aircraft is provided by TruTrak, it is advisable to start with a setting of zero and work up from there. Most installations would ultimately require somewhat higher settings.

Prior to takeoff on the first flight, a barometer set will be required; the default value will always be 29.92.

On the first flight, manually fly the aircraft to a suitable area for testing. Engage the autopilot using the AP button. Observe that the TRK GREEN BUG now shows the captured present ground track and the SEL (selected vertical speed) field shows the approximate present rate of climb or descent in feet per minute. Use the right knob to set the selected vertical speed to zero. Press the right knob for a few seconds until SETUP is shown on the display in the same location that AP was, click the soft key below to enter the setting for the AP. Select the LAT AP then ACTVTY, default is 3. Rotate the knob to select the value zero (0), and observe the resulting control movement. It is best if these adjustments are made in conditions of moderate turbulence (the EFIS loves turbulence) so as to make it easy to observe the response of the autopilot to disturbances. Increase the value one setting at a time, taking time to observe an increasing level of control response. At some point, if too high a setting is chosen, the autopilot will be jittery and over-active. Back the setting down until the autopilot is responsive but not over-active. It will be noted that a fairly limited range of activity setting will be acceptable; too low a value will result in sluggish response, while too high a value will result in nervous, inappropriate response. Within this acceptable range there is room for individual preference; some people prefer a more aggressive autopilot than others. It should be noted that any builder can accomplish this adjustment procedure and no professional is required. Once the desired LAT ACTVTY level is established, click the right knob to return to the setup screen.

MICRO setting in most aircraft will be left at zero (0). Micro activity is used only in aircraft in which a slow wing rock has been observed in very still air. Sometimes there will be a small amount of lost motion in an aircrafts control system, and the micro activity setting is a way to compensate for the lost motion. Once the desired MICROACTIVITY has been selected, click the right knob to return to the setup screen.

The HALF-STEP setting in most cases will not need to be changed. If the half step setting is set to ON, then the roll servo will now have higher resolution, and take smaller steps. While this setting will make the servo take smaller steps, it will decrease the amount of available torque. This setting should be left at OFF, unless it is observe that the wing moves up and down very slightly while in straight and level flight in very still air. Once this setting has been done, click the right knob to return to the setup screen.

BANK selection screen default is MED. Set the desired bank angle that is comfortable, options are LO about 12.5 degs, MED about 19 degs, and HI about 25 degs. Once the BANK ANGLE has been selected, click the right knob to return to the setup screen.

Having set the autopilot for its proper roll response, it is time to move to the pitch axis adjustments. Click the VRT AP button that is shown on the first set up screen. Then click ACTVTY, in the same manner as was done for the roll axis, use the knob to find a setting which results in the appropriate response. Again, too high a value will be jittery or oscillatory and too low a setting will be sluggish and unresponsive. Having found the desired VRT ACTIVITY setting, click the right knob to return to the setup screen.

MICRO setting in most aircraft will be left at zero (0). Micro activity is used only in aircraft in which a slow pitch rock has been observed in very still air. Sometimes there will be a small amount of lost motion in an aircrafts control system, and the micro activity setting is a way to compensate for the lost motion. Once the desired MICROACTIVITY has been selected, click the right knob to return to the setup screen.

The HALF-STEP setting in most cases will not need to be changed. If the half step setting is set to ON, then the roll servo will now have higher resolution, and take smaller steps. While this setting will make the servo take smaller steps, it will decrease the amount of available torque. This setting should be left at OFF, unless it is observe that the wing moves up and down very slightly while in straight and level flight in very still air. Click the right knob if the setting was not changed, to return to the setup screen.

STATIC LAG setting it is set to LOW at the factory but can vary between LOW, MED, or HIGH to suit a particular static system. LOW value assumes a static system with very little "lag"; the HIGH value assumes a fairly large amount of lag. To diagnose the lag of a particular system, it is necessary to be in the altitude hold mode of the autopilot, prior to setting the STATIC LAG.

Once the autopilot is in altitude hold mode, re-enter the vertical setup mode. In still air, straight and level flight, in altitude hold mode, observe whether the altitude appears to oscillate, or "hunt" **slowly** up and down. If this is the case, it may be caused by several factors, one of which is the amount of lag in the static system. Increasing the STATIC LAG value to MED or HIGH may cure the problem; however this should be set to the smallest value that satisfactorily flies the aircraft in the pitch axis, as the larger the value the less responsive the autopilot will be to vertical commands or altitude error. Other possible causes of hunting in altitude hold are "lost motion" in the aircraft controls or too low a level of vertical activity setting. Excessive lag in the static system itself can be caused by undersized static ports, improperly placed ports, long static lines, or especially by attached equipment with large static reservoirs. The autopilot can be adapted to cover a wide range of static systems, but in truly extreme cases it may be necessary to provide a separate static line for the autopilot so that other equipment attached to the port does not degrade the autopilot's performance. Click the right knob twice to return to the **MAIN** screen.

Yaw Damper First Flight

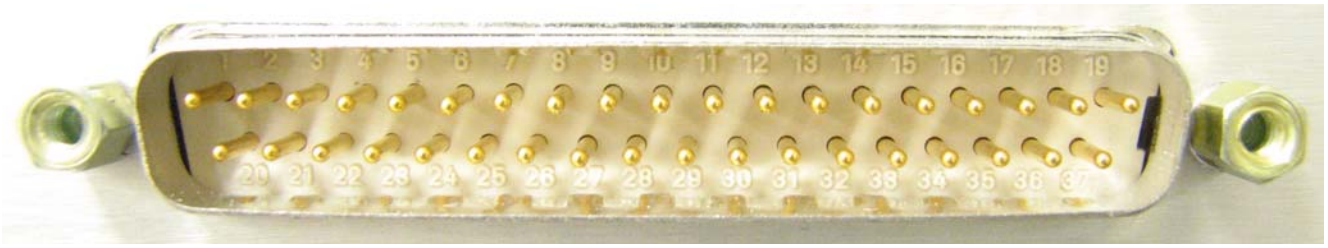
The Yaw Damper system requires adjustment of the yaw damper parameters. With the autopilot disengaged, level the aircraft and hand-fly the aircraft in still air. Press YD to engage the yaw damper. Then enter the setup screen for the YD. Select CENTR, Centering is adjustable from -8 to 8 and has enough authority to move the ball approximately one and one half times the width of the ball in either direction. (Coarse adjustment was made using the potentiometer in the yaw damper module during the earlier Initial Checkout Procedure.) Adjust the centering so that the ball is centered. Once the YD LEVELING has been set, click to return to the setup screen. The next field, ACTVTY, determines how aggressively the yaw damper responds to yaw disturbances. Yaw damper activity can range from 0 (off) to 12 (extremely aggressive). For this purpose it is best to find light to moderate turbulence so the effects can be properly observed. Having found suitable conditions, use the knob to gradually increase the value of YD ACTIVITY in order to obtain an appropriate level of response to yaw disturbances. Too high a value will result in rapid oscillation, while too low a value will essentially disable the quick response of the yaw damper to turbulence. Within the acceptable range of operation, there is still room to account for personal preferences. So long as the yaw damper's ACTVTY value is not so high as to cause oscillation, the response is simply set according to preference and comfort. Once the ACTVTY has been set, click the right knob twice to exit the setup mode.

The normal operation of the autopilot will turn the yaw damper on any time the autopilot is engaged and the yaw damper will stay on after the autopilot is disengaged. During final approach and the diminishing of the airspeed below the MIN AIRSPD setting, the yaw damper will automatically disengage. To disengage the yaw damper prior to that point, simply use the YD button to toggle the yaw damper off.

Electrical Pin-out

EFIS with Yaw Damper will be covered in this manual.

The table below provides a brief explanation of each pin function on the main 37-pin connector P101.



P101 Autopilot Rear Connector (Viewed from rear of autopilot) or wire side of connector.

P101 Pin	Function		Notes
1	Dedicated ground connection for Pitch Reverse Jumper.		
2	**Pitch Reverse Jumper**, present or absent, as follows:	Direction of servo arm / capstan rotation (as viewed from face of the servo body) for **UP** elevator	
	Pin 2 open (no connect):	Servo CCW (counter-clockwise) ➔ UP	
	Pin 2 Jumper to pin 1:	Servo CW (clockwise) ➔ UP	
3	SL 30 RS-232 Output.		SL-30 NAV pin 4 RX
4	Dimmer connection		
5	**Yaw Damper Activity**. A signal from the autopilot which sets the amount of response the yaw damper exhibits to azimuth disturbances and "ball" deflection.		EFIS with Yaw Damper only
6	**Yaw Damper Centering**. A signal from the autopilot which is used for fine adjustment of the "ball" in a yaw damper.		EFIS with Yaw Damper only
7	AP illumination, To AP LEVEL Button lamp		
8	**Yaw Damper Activate**. A signal from the autopilot which turns on the yaw damper function.		EFIS with Yaw Damper only
9	No Connection		
10	**Pitch Servo Torque Control**. A signal from the autopilot to the pitch servo which sets the amount of torque to be delivered by the servo.		
11	**Pitch Servo Trim Sensor**. A signal from the pitch servo to the autopilot which indicates an out-of-trim condition and its direction.		
12	**Autopilot Master** (+12 to +28 V DC). The autopilot itself draws less than 3 ampere. Most of the current required by the autopilot system is used by the servos (up to 1.5A per servo).		
13	**Audio signal Out**. This pin may be wired to an unswitched input of an audio panel. The autopilot uses various voice or tones to denote specific events (loss of GPSS, capture Glideslope, etc). Volume is adjustable within a setup screen of the autopilot.		
14	**Pitch Servo control lines**. These lines cause the stepping motor in the pitch servo to run in the appropriate direction at the desired velocity. They are small-signal lines and do not have any substantial current-carrying capability or require any special shielding. Connect to pitch servo as shown on wiring diagram.		Do <u>not</u> attempt to reverse servo direction by swapping wires
15			
16			
17			
18	AOA Future Use		Unavailable at this time
19	**Ground Connection**. Provide #20 AWG to common grounding point.		
20	CWS / AP LEVEL Button.		
21	No Connection		Unavailable at this time
22	ALT RS232 OUT.		Unavailable at this time

Autopilot Rear Connections to P101 (Continued)

P101 Pin	Function	Notes
23	SPARE SWT	Unavailable at this time
24	No Connection	
25	**Primary Serial Input**. Baud rate selectable, 4800 or 9600 baud. Automatically decodes NMEA-0183, Garmin Aviation Format, or Apollo/UPSAT Moving-Map or GPSS format. Provides directional reference to the autopilot.	
26	**ARINC-A** Digital differential signals from Garmin, Sierra, or other panel-mount receiver	
27	**ARINC-B** which provide directional steering commands (GPSS) to autopilot	
28	**Roll Servo Torque Control**. A signal from the autopilot to the roll (aileron) servo which sets the amount of torque to be delivered by the servo.	
29	No Connection	
30	SL 30 RS-232 IN.	SL-30 NAV pin 5 TX
31	EDM Power Only	EDM Power only
32 33 34 35	**Roll (aileron) Servo control lines**. These lines cause the stepping motor in the roll servo to run in the appropriate direction at the desired velocity. They are small-signal lines and do not have any substantial current-carrying capability or require any special shielding. Connect to roll servo as shown on wiring diagram.	Reverse servo direction if necessary by swapping wires on pin 32 and 33.

Wiring to roll servo J201			Direction of servo arm / capstan rotation (as viewed from face of the servo body) for **RIGHT** aileron
J101	Pin 32	Pin 33	
Standard	J201-4	J201-5	Servo CCW (counter-clockwise) ➔ RIGHT
Reversed	J201-5	J201-4	Servo CW (clockwise) ➔ RIGHT

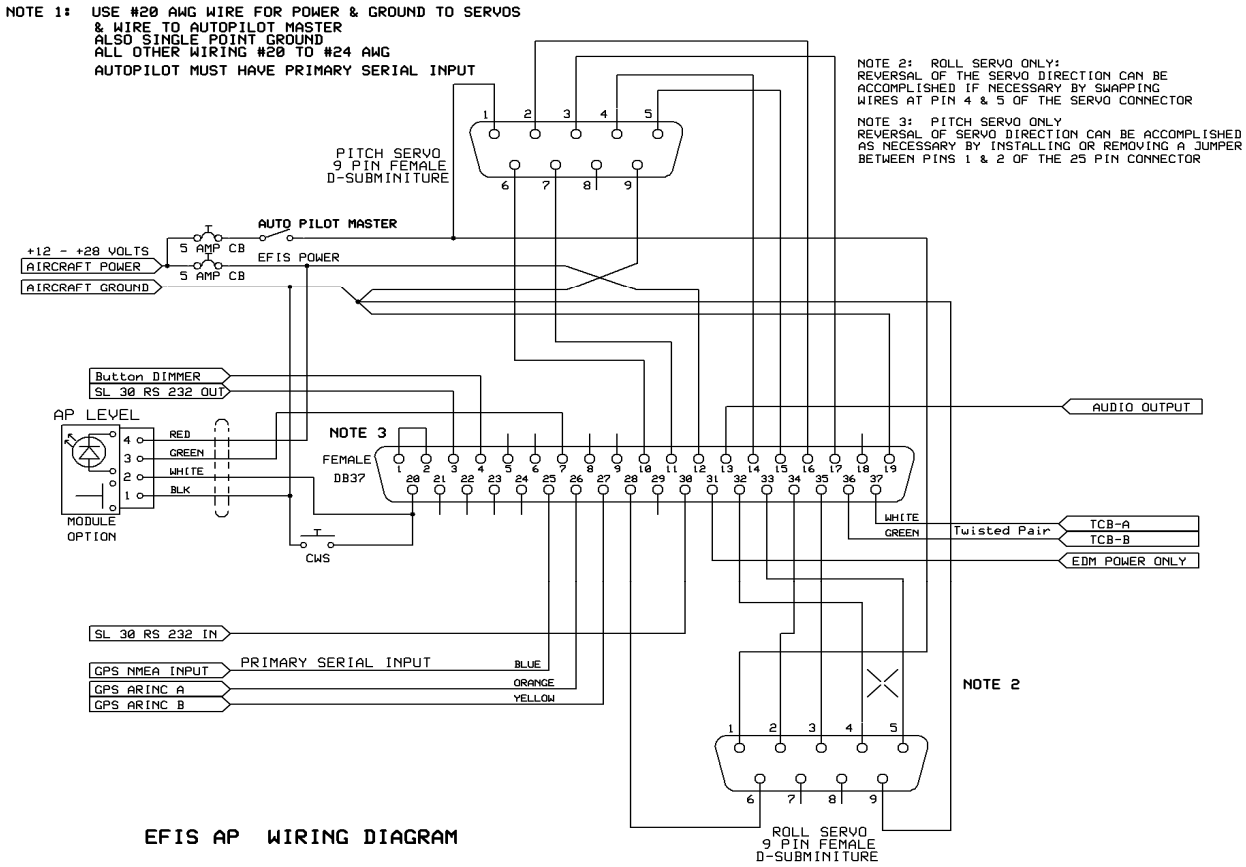
EFIS AP P101	Pins	King KMD 150	Garmin GPS III	Garmin GPS 92	Garmin GPS 195	Garmin GPS 196	Garmin 295	Garmin 296	Garmin 396	Garmin 496	AvMap EKP IV
RS 232	25	11	Data out	Data out	Blue wire	Blue wire	Blue wire	Blue wire	Blue wire	Blue wire	Data out
ARINC A	26	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
ARINC B	27	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C

See your GPS operation or installation guide for current interface information.

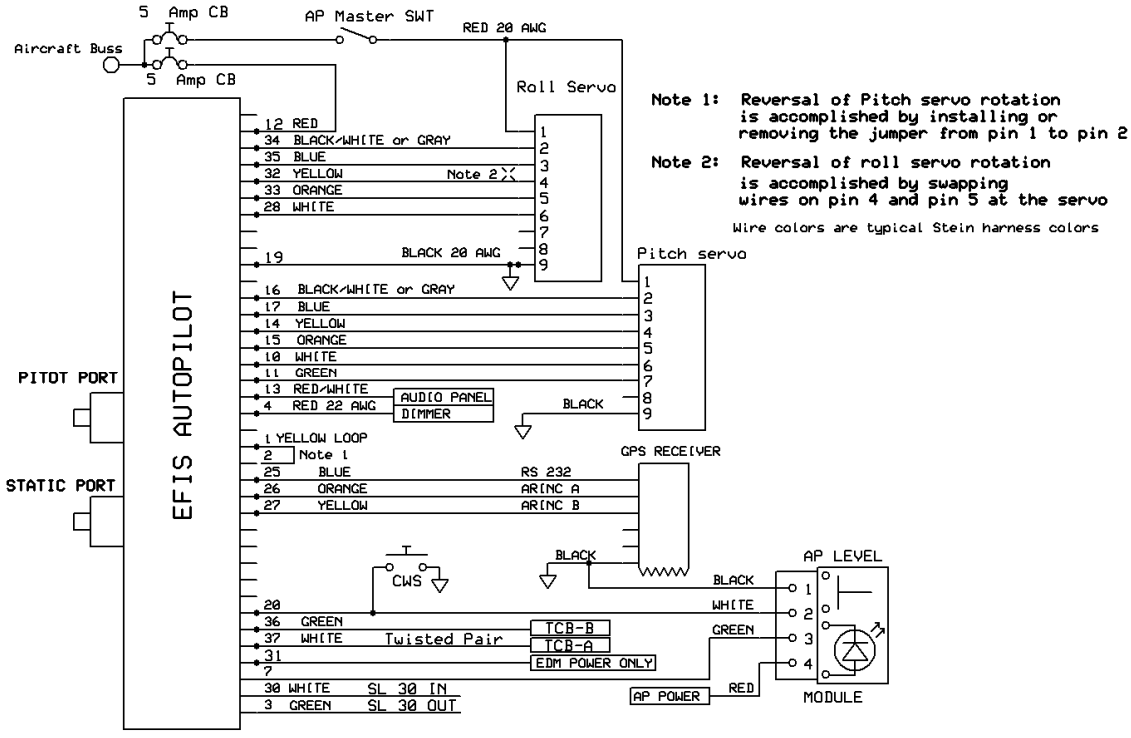
EFIS AP P101	Pins	Garmin 155XL	Garmin 200XL	Garmin 300XL	Garmin GX 50-65	Garmin GNS 480	Garmin 430 P4001	Garmin 530 P5001
RS 232	25	19	19	19	5 / 22	P1- 22	56	56
ARINC A	26	16	16	16	N/C	P5 - 4	46	46
ARINC B	27	15	15	15	N/C	P5 - 24	47	47

EFIS AP SERIES	CURRENT DRAW LOW BRIGHT	CURRENT DRAW HIGH BRIGHT	WEIGHT	DIMENSIONS Behind panel
ALL	1.07 Amps @ 12v 0.65 Amps @ 24v	2.02 Amps @ 12 v 1.15 Amps @ 24v	2.33 lbs High bright 1.95 lbs Low bright	6.375W x 5.75H x 3.625D

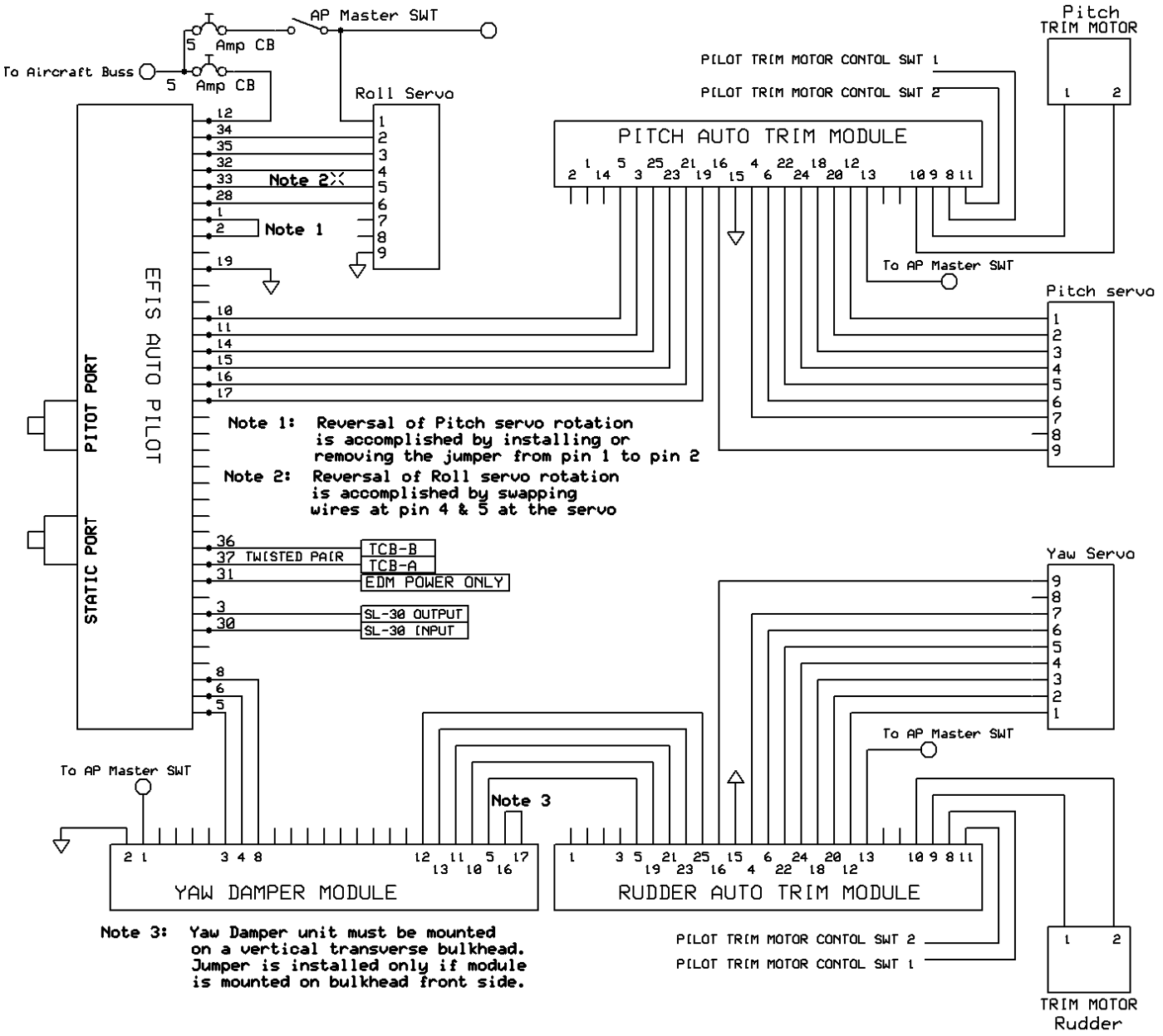
EFIS AP Basic Wiring Diagram

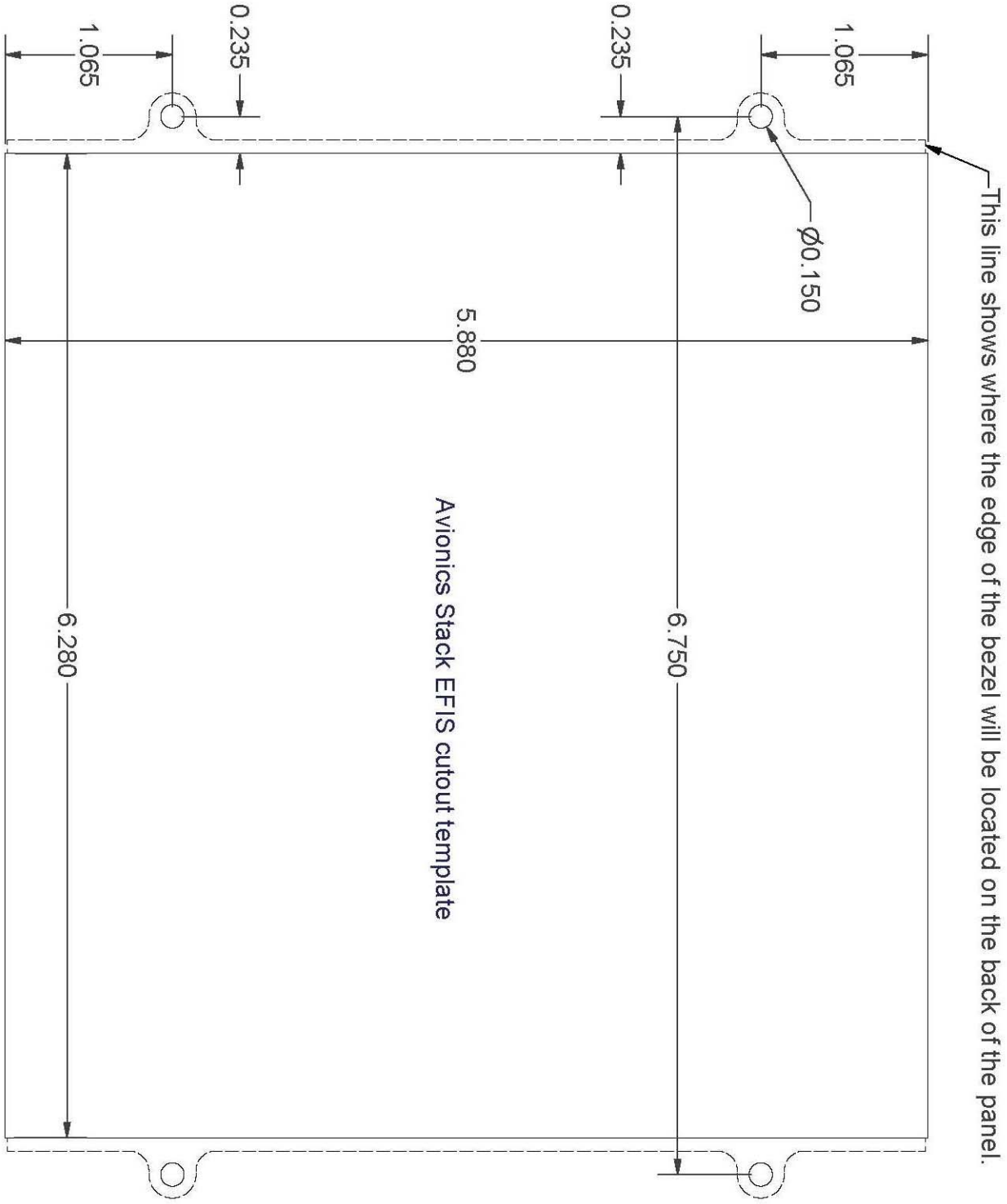


EFIS AP Block Diagram

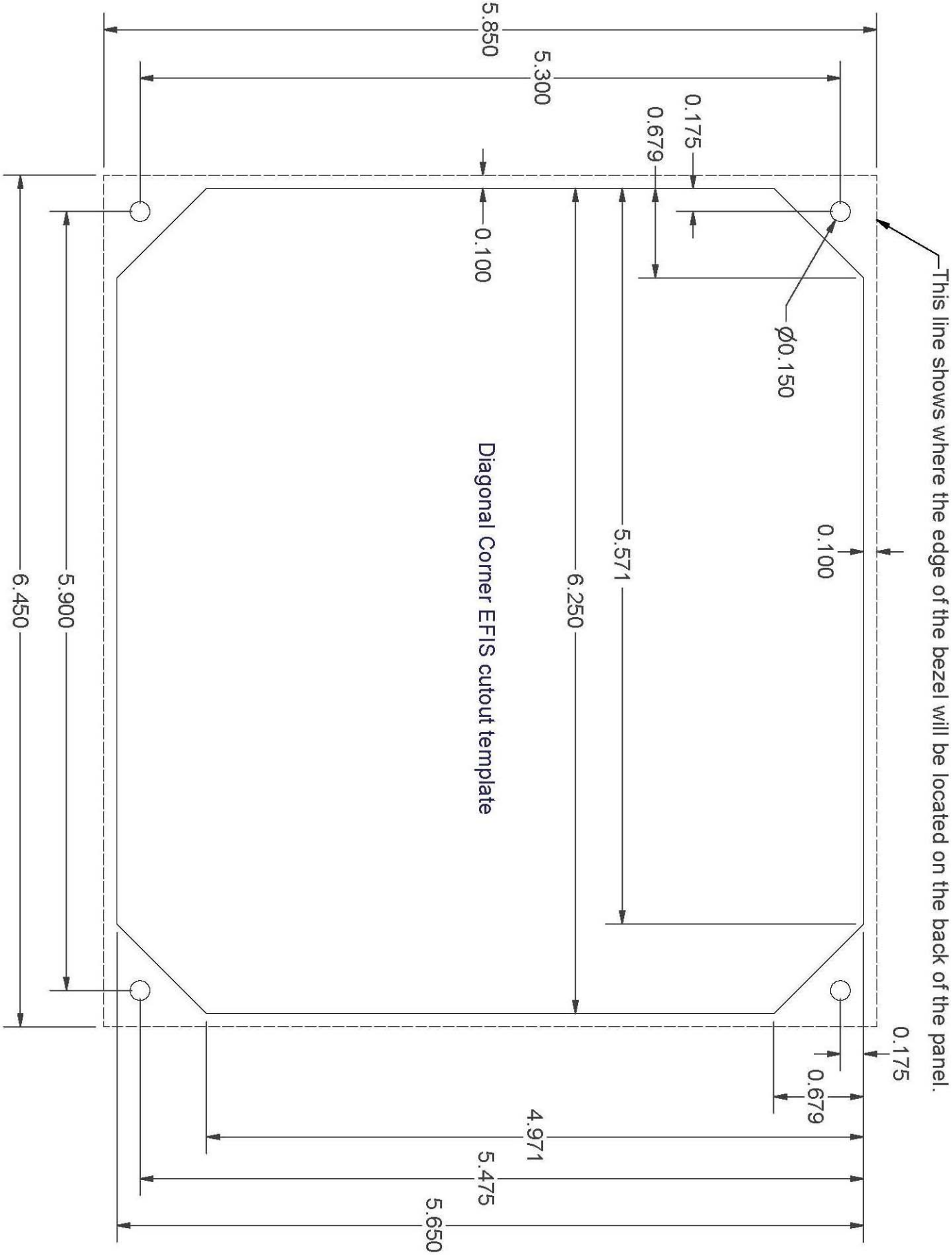


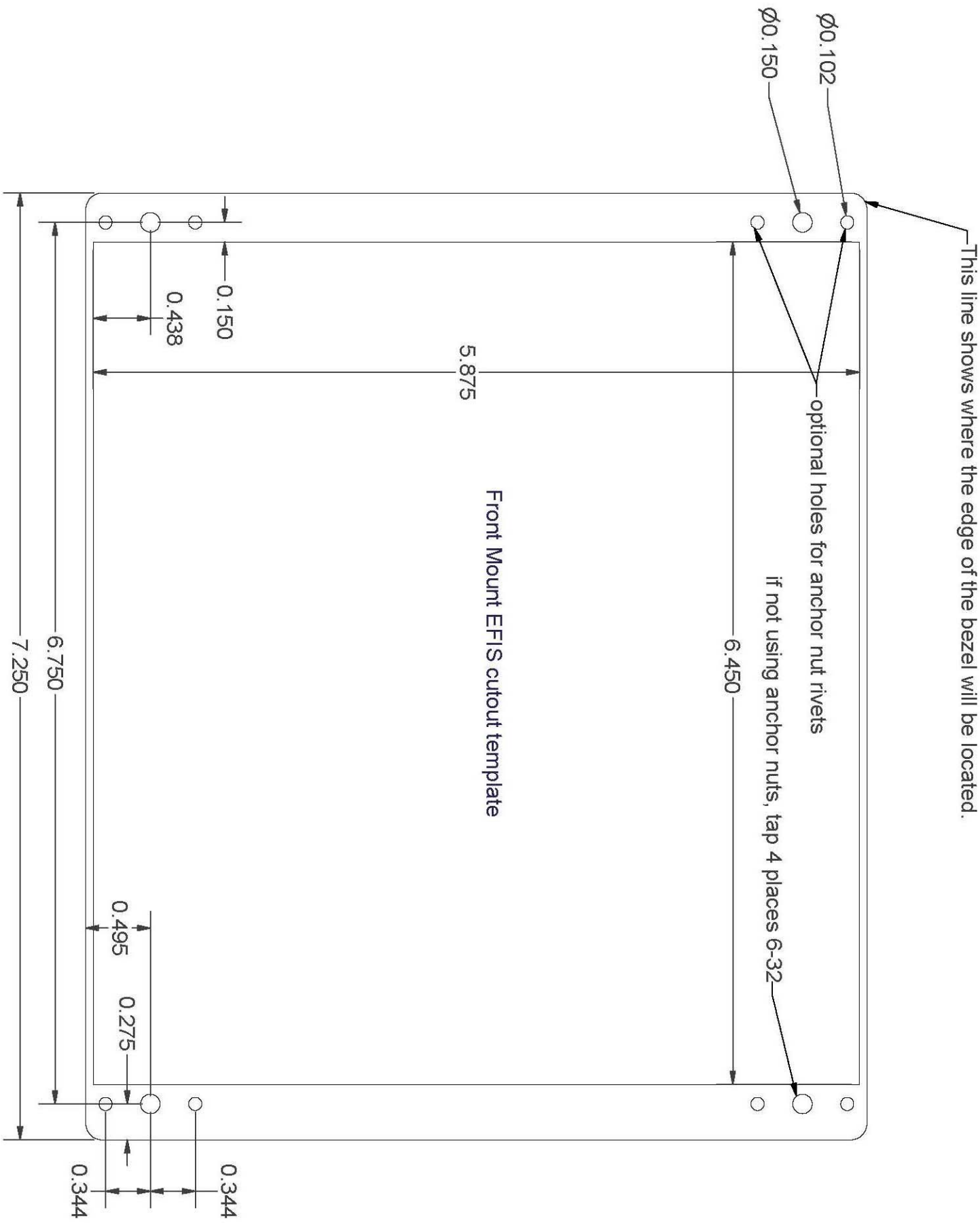
EFIS AP with Options





Panel Templates


5.850
5.300
0.175
0.679
0.100
Ø0.150
This line shows where the edge of the bezel will be located on the back of the panel.
Diagonal Corner EFIS cutout template
6.450
5.900
5.571
6.250
0.100
0.175
0.679
4.971
5.475
5.650


Ø0.150
Ø0.102
This line shows where the edge of the bezel will be located.
optional holes for anchor nut rivets
if not using anchor nuts, tap 4 places 6-32
Front Mount EFIS cutout template
0.150
0.438
5.875
6.450
7.250
6.750
0.495
0.275
0.344
0.344

AP I Quick Reference

Button labels	–	White - mode is **OFF**, Green - mode is **ON**
Click	–	Momentarily push and release any knob or button
Press	–	Push and hold any knob or button for 2 seconds and release
Enter	–	Click knob labeled **[Enter]**

Basic Operation

Barometer adjust	–	Rotate right knob
Track bug adjust	–	Rotate left knob
Altimeter bug adjust	–	Click **ALT** button, bug will synchronize to nearest 100 feet Rotate right knob to select new altitude (Depress knob for 100 ft resolution) Click **[Enter]**
Altimeter bug cancel	–	Click **ALT** button
Dimmer function	–	Click left knob to enter setup mode Rotate left knob to set desired brightness Click **[Enter]**
Nav mode	–	Click **NAV** button
Nav mode cancel	–	Click **NAV** button or rotate left knob (Track bug adjust)

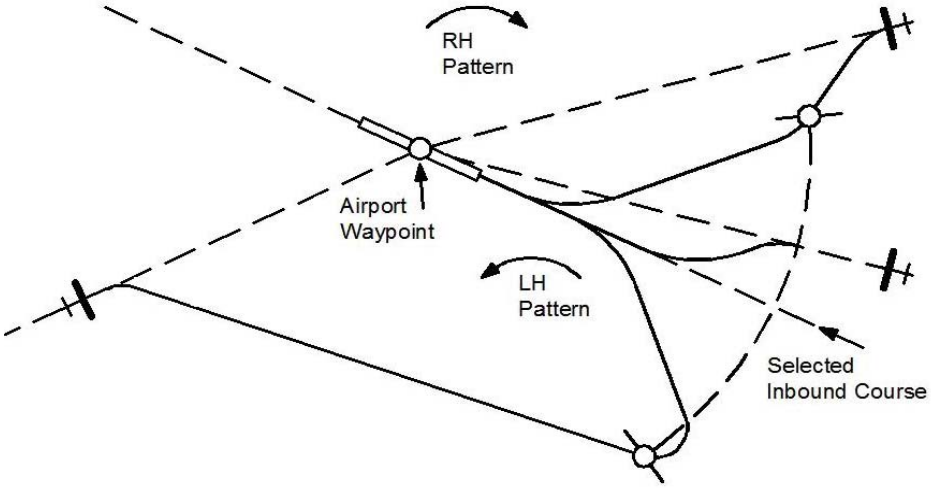
Autopilot and Flight Director Operation

Autopilot on / off	–	Click **AP / FD** button – on, Click **AP / FD** button – off
Flight Director on / off	–	Press **AP / FD** button – on, Press **AP / FD** button – off
Track select	–	Rotate left knob
Nav mode	–	Click **NAV** button
Nav mode cancel	–	Click **NAV** button or rotate left knob (Track select)
Altitude select	–	Click **ALT** button, bug will synchronize to (only available in FD) nearest 100 feet Rotate right knob to select new altitude (Depress knob for 100 ft resolution) Click **[Enter]** (VS is fixed at +/- 500 FPM)
Barometer adjust	–	Rotate right knob
Dimmer function	–	Click left knob to enter setup mode. Rotate left knob to set desired brightness Click **[Enter]**

Arrival Transition

(Note: Operation is the same regardless of AP or FD being on or off)

Arrival Transition	–	Click **CRS** Rotate left knob to set HSI course pointer to selected runway direction Click **APPR**



AP II Quick Reference

Button labels	–	White - mode is **OFF**, Green - mode is **ON**
Click	–	Momentarily push and release any knob or button
Press	–	Push and hold any knob or button for 2 seconds and release
Enter	–	Click knob labeled **[Enter]**

Basic Operation

Barometer adjust	–	Rotate right knob
Track bug adjust	–	Rotate left knob
Altimeter bug adjust	–	Click **ALT** button, bug will synchronize to nearest 100 feet Rotate right knob to select new altitude (Depress knob for 100 ft resolution) Click **[Enter]**
Altimeter bug cancel	–	Click **ALT** button
Dimmer function	–	Click left knob to enter setup mode Rotate left knob to set desired brightness Click **[Enter]**
Nav mode	–	Click **NAV** button
Nav mode cancel	–	Click **NAV** button or rotate left knob (Track bug adjust)

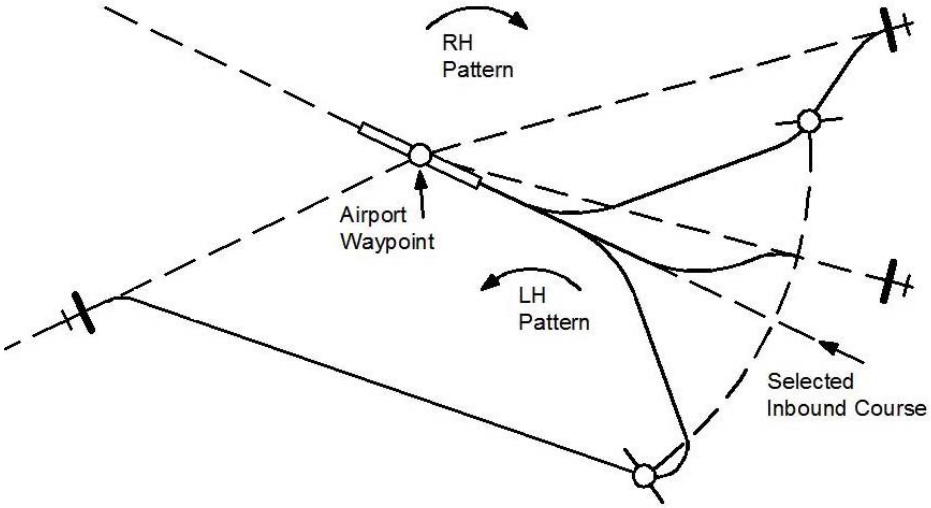
Autopilot and Flight Director Operation

Autopilot on / off	–	Click **AP / FD** button – on, Click **AP / FD** button – off
Flight Director on / off	–	Press **AP / FD** button – on, Press **AP / FD** button – off
Track select	–	Rotate left knob
Nav mode	–	Click **NAV** button
Nav mode cancel	–	Click **NAV** button or rotate left knob (Track select)
Altitude hold	–	Click **ALT** button, AP will synchronize to nearest 100 feet
Barometer adjust	–	Rotate right knob
Dimmer function	–	Click left knob to enter setup mode. Rotate left knob to set desired brightness Click **[Enter]**

Arrival Transition

(Note: Operation is the same regardless of AP or FD being on or off)

Arrival Transition	–	Click **CRS** Rotate left knob to set HSI course pointer to selected runway direction Click **APPR**



AP III Quick Reference

Button labels	–	White - mode is **OFF**, Green - mode is **ON**
Click	–	Momentarily push and release any knob or button
Press	–	Push and hold any knob or button for 2 seconds and release
Enter	–	Click appropriate knob

Basic Operation

Barometer adjust	–	Rotate right knob
Track bug adjust	–	Rotate left knob
Altimeter bug adjust	–	Click **ALT** button, bug will synchronize to nearest 100 feet Rotate right knob to select new altitude Push Enter
Altimeter bug cancel	–	Click **ALT** button
Dimmer function	–	Click left knob to enter setup mode Rotate left knob to set desired brightness Push Enter
Nav mode	–	Click **NAV** button
Nav mode cancel	–	Click **NAV** button or rotate left knob (Track bug adjust)

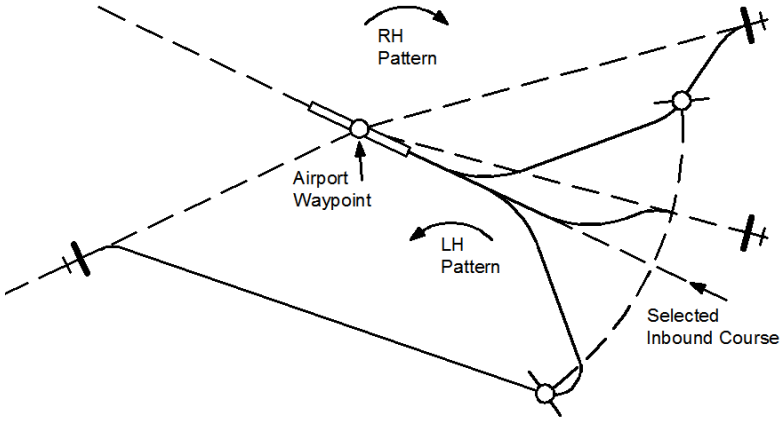
Basic Autopilot and Flight Director Operation

Autopilot on / off	–	Click **AP–FD** button – on, Click **AP–FD** button - off
Flight Director on / off	–	Press **AP–FD** button – on, Press **AP–FD** button - off
Track select	–	Rotate left knob
Nav mode	–	Click **NAV** button
Nav mode cancel	–	Click **NAV** button or rotate left knob (Track select)
Altitude select	–	Click **ALT** button, bug will synchronize to nearest 100 feet Rotate right knob to select new altitude Push Enter (Initial VS is +/- 500 FPM)
Vertical speed adjust	–	Rotate right knob
Barometer adjust	–	Click right knob to enter setup mode Rotate right knob to adjust barometer setting Push Enter
Dimmer function	–	Click left knob to enter setup mode. Rotate left knob to set desired brightness Push Enter

Arrival Transition

(Note: Operation is the same regardless of AP or FD being on or off)

Arrival Transition	–	Click **CRS** Rotate left knob to set HSI course pointer to selected runway direction Click **APPR**



AP IV Quick Reference

Button labels	–	White - mode is **OFF**, Green - mode is **ON**
Click	–	Momentarily push and release any knob or button
Press	–	Push and hold any knob or button for 2 seconds and release
Enter	–	Click knob labeled **[Enter]**

Basic Operation

Barometer adjust	–	Rotate right knob
Track bug adjust	–	Rotate left knob
Altimeter bug adjust	–	Click **ALT** button, bug will synchronize to nearest 100 feet Rotate right knob to select new altitude (Depress knob for 100 ft resolution) Click **[Enter]**
Altimeter bug cancel	–	Click **ALT** button
Dimmer function	–	Click left knob to enter setup mode. Rotate left knob to set desired brightness Click **[Enter]**
Nav mode	–	Click **NAV** button
Nav mode cancel	–	Click **NAV** button or rotate left knob (Track bug adjust)

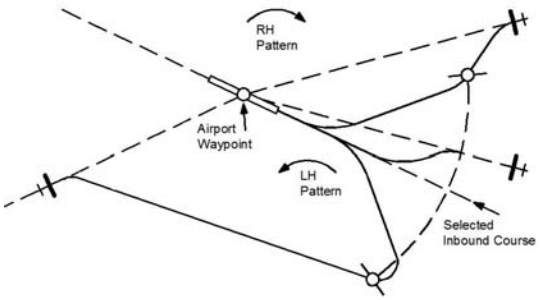
Autopilot and Flight Director Operation

Autopilot on / off	–	Click **AP / FD** button – on, Click **AP / FD** button – off
Flight Director on / off	–	Press **AP / FD** button – on, Press **AP / FD** button – off
Track select	–	Rotate left knob
Nav mode	–	Click **NAV** button
Nav mode cancel	–	Click **NAV** button or rotate left knob (Track select)
GPS Steering	–	Click **GPSS** button
GPS Steering cancel	–	Click **GPSS** button or rotate left knob (Track select)
Altitude select	–	Click **ALT** button, bug will synchronize to nearest 100 feet Rotate right knob to select new altitude (Depress knob for 100 ft resolution) Click **[Enter]** (Initial VS is +/- 500 FPM)
Vertical speed adjust	–	Rotate right knob
VNAV	–	Click **ALT,** Rotate right knob to select altitude below current (Depress knob for 100 ft resolution) Click **DIST,** Rotate right knob to select desired distance, Click **[Enter]**
WAAS approach	–	Click **GPSS** (**GPSV** will appear when available) Click **GPSV** (Glide slope scale will appear)
Missed approach	–	Click **GO AROUND** (Enters Track select and + 500 FPM climb)
Barometer adjust	–	Click right knob to enter setup mode, Rotate right knob to adjust barometer setting Click **[Enter]**
Dimmer function	–	Click left knob to enter setup mode Rotate left knob to set desired brightness Click **[Enter]**

Arrival Transition

(Note: Operation is the same regardless of AP or FD being on or off)

Arrival Transition	–	Click **CRS,** Rotate left knob to set HSI course pointer to selected runway direction Click **APPR**



TruTrak Flight Systems No Penalty Upgrade Policy

As the product line continues to grow, it becomes increasingly difficult to maintain a simple upgrade policy. We do want to reward our repeat customers by allowing a lower cost upgrade from one system to another; however we are not able to offer this across the board on all products. If you are considering an upgrade, please call and we will give you a quote on what this would cost. Many products that we sell today are upgradeable for only the difference in system price. Because we continually strive to have the most up to date products possible, we occasionally have to discontinue products. We will continue to offer discounted upgrades even for our discontinued products.

RETURN MERCHANDISE POLICY AND PROCEDURE

Under no circumstances should products be returned to TruTrak without first obtaining a Return of Merchandise Authorization number (RMA #) from TruTrak. An RMA# may be obtained by contacting us at 866-878-8725.

Products that do not have an RMA # will not be processed.

Please include documentation stating the reason for the return and describing any symptoms, failure modes, suspected causes of damage, diagnostics performed, data collected, etc.

Product(s) should be packaged in their original shipping containers. In lieu of this, they should be very carefully packaged in containers suitable to protect them during transit. For your protection, items should be insured for the full value. Note that damage caused during shipping will not be repaired under warranty.

The outside of the box must be clearly marked with the RMA # issued by TruTrak and the RMA # must also be noted on the return documents.

Products will be returned to the customer at no charge via FedEx Ground or UPS Ground. If customer requests expedited shipping (2nd Day or Overnight) they will be charged the shipping cost and must supply a credit card number.

INTERNATIONAL SHIPMENTS:

TruTrak sends all International shipments with an insurance value on all products. TruTrak pays for shipping only. The customer is responsible for any and all additional fees, duties, taxes associated with the shipment.

When sending products to Trutrak for repair or otherwise please be advised that the customer is responsible for all charges and fees associated with shipment. For your protection, items should be insured for the full value.

Trutrak states on all product returns "WARRANTY REPAIR AT NO CHARGE TO CUSTOMER. A COMMERCIAL INVOICE VALUE OF $___ GIVEN FOR INSURANCE PURPOSES ONLY"

Please keep in mind that your government or another entity in your country may impose a charge for custom and/or brokerage fees, duties and taxes on items received from the US. These charges do not originate from our company nor do we benefit from them in any way. You are responsible for payment of all custom and brokerage fees, duties and taxes that may be imposed when these goods are imported into your country.

Send ALL return shipments to:
TruTrak Flight Systems, Inc.,
1500 South Old Missouri Road
Springdale, AR 72764 USA
Attention: Returns Dept. RMA#

Warranty On TruTrak Flight Systems Products

We here at TruTrak Flight Systems know how important it is to feel as though the customer is purchasing a product that the manufacturer is going to stand behind. For this reason we want offer more than the basic one year warranty that is standard to this industry. The warranty on all TruTrak products will be three years from the date of purchase. Abuse and misuse of a product are not covered under this warranty. Modification to a product may void the warranty, as well as carry a penalty when upgrading to another product. This three year warranty will be for all products except the Pictorial Turn & Bank, which will continue to have a warranty of one year from the date of purchase.

TruTrak Flight Systems, Inc.
1500 S. Old Missouri Rd.
Springdale AR 72764

(479) 751-0250
FAX (479) 751-3397

www.trutrakap.com