KAP 140 Two Axis Operation

The KAP 140 is a digital, panel-mounted autopilot system for light aircraft.

Two-axis Flight Control Computer

Full Two-Axis KAP 140 Display

1. PITCH AXIS, (**P**) ANNUNCIATOR - When illuminated, indicates failure of the pitch axis and will disengage the autopilot when the failure occurs and not allow engagement of the pitch axis.

2. AUTOPILOT ENGAGE/DISENGAGE (**AP**) BUTTON - When pushed, engages autopilot if all logic conditions are met. The autopilot will engage in the basic roll (ROL) mode which functions as a wing leveler and in the vertical speed (VS) hold mode. The commanded vertical speed will be displayed in the upper right corner of autopilot display area. The captured VS will be the vertical speed present at the moment of AP button press. When pressed again, will disengage the autopilot. For software version 03/01 and later, the **AP** button must be pressed and held for 0.25 seconds to engage the autopilot.

3. ROLL AXIS (**R**) ANNUNCIATOR - When illuminated, indicates failure of the roll axis and will disengage the autopilot and not allow engagement.

4. HEADING (**HDG**) MODE SELECTOR BUTTON - When pushed, will arm the Heading mode, which commands the airplane to turn to and maintain the heading selected by the heading bug on either the DG or HSI. A new heading may be selected at any time and will result in the airplane turning to the new heading. Button can also be used to toggle between HDG and ROL modes. This button will engage the autopilot in units with software prior to software version 03/01.

5. NAVIGATION (**NAV**) MODE SELECTOR BUTTON - When pushed, will arm the navigation mode. The mode provides automatic beam capture and tracking of VOR, LOC or GPS as selected for presentation on the HSI or CDI. NAV mode is recommended for enroute navigation tracking. NAV mode may also be used for front course LOC tracking when GS tracking is not desired.

6. APPROACH (**APR**) MODE SELECTOR BUTTON - When pushed, will arm the Approach mode. This mode provides automatic beam capture and tracking of VOR, GPS, LOC, and Glideslope (GS) on an ILS, as selected for presentation on the HSI or CDI. APR mode is recommended for instrument approaches.

7. BACK COURSE APPROACH (**REV**) MODE SELECTOR BUTTON - When pushed, will arm the Back Course approach mode. This mode functions similarly to the approach mode except that the autopilot response to LOC signals is reversed, and GS is disabled.

8. ALTITUDE HOLD (**ALT**) MODE SELECT BUTTON - When pushed, will select the Altitude Hold mode. This mode provides tracking of the reference altitude. The reference altitude is the altitude at the moment the ALT button is pressed. If the ALT button is pressed with an established VS rate present, there will be altitude overshoot (approximately 10% of the VS rate), with the airplane returned positively to the reference altitude. This button will engage the autopilot in units with software prior to software version 03/01.

9. VERTICAL TRIM (**UP/DN**) BUTTONS - The action of these buttons is dependent upon the vertical mode present when pressed. If VS mode is active, button strokes will increment the vertical speed commanded either up or down at the rate of 100 ft/min per button press, or at the rate of approximately 300 ft/min per second if held continuously. If ALT mode is active, incremental button strokes will move the altitude hold reference altitude either up or down at 20 feet per press, or if held continuously will command the airplane up or down at the rate of 500 ft/min, synchronizing the altitude hold reference to the actual airplane altitude upon button release.

10. VERTICAL SPEED DISPLAY - Displays the commanded vertical speed in VS mode.

11. PITCH TRIM (**PT**) ANNUNCIATION - A flashing PT with arrows indicates the direction of required pitch trim. A solid PT without an arrow head is an indication of a pitch trim fault. During manual electric trim operation (autopilot disengaged), detection of a stuck MET switch will be indicated by a solid PT. When the fault is corrected, the annunciation will extinguish.

12. PITCH MODE DISPLAY - Displays the active and armed pitch modes (VS, ALT ARM, ALT, and GS.

13. ROLL MODE DISPLAY - Displays the active and armed roll modes (ROL, HDG, NAV ARM, NAV, APR ARM, APR, REV ARM, REV, GS ARM). Also displayed will be flashing AP annunciation (5 seconds) at each autopilot disconnect accompanied by an aural tone (for 2 seconds).

14. AUTOPILOT ENGAGED (**AP**) ANNUNCIATION - Illuminates whenever the autopilot is engaged. Flashes during pilot initiated or automatic disengagement. Only applicable for software versions 03/01 or later.

System Operating Modes

The lateral modes (HDG, NAV, APR and REV) operate identically as described in the KAP 140 Single Axis Operating Modes section. Please refer to that section for text descriptions of lateral mode operation.

Vertical Speed (VS) Mode

The Vertical Speed (**VS**) mode allows variable vertical speed climbs and descents. The **ALT** button toggles between altitude hold and vertical speed modes.

*Note: The KAP 140 engages into **VS** mode as a default.*

To operate in the **VS** mode (with autopilot currently disengaged):

1. **AP** button - Press. Note **ROL**, **VS** and current vertical speed is displayed. If no other modes are selected the autopilot will operate in the **ROL** and vertical speed hold modes. For software version 03/01 and later, the **AP** button must be pressed and held for 0.25 seconds to engage the autopilot.

2. **UP** or **DN** button - Select desired climb or descent rate. Each button stroke will increment the vertical speed commanded up or down by 100 ft/min per button press, or at the rate of approximately 300 ft/min per second if held continuously.

To initiate a climb or descent from Altitude Hold (**ALT**) mode:

1. **ALT** button - Press. Note **ALT** changes to **VS** and current vertical speed is displayed.

2. **UP** or **DN** button - Select desired climb or descent rate. Each button stroke will increment the vertical speed commanded up or down by 100 ft/min per button press, or at the rate of approximately 300 ft/min per second if held continuously.

Note: When operating at or near the best rate of climb airspeed, at climb power settings, and using vertical speed hold, it is easy to decelerate to an airspeed where continued decreases in airspeed will result in a reduced rate of climb. Continued operation in vertical speed mode can result in a stall.

Altitude Hold (ALT) Mode

The Altitude Hold (**ALT**) mode maintains the pressure altitude acquired upon selection of altitude hold. The **ALT** button toggles between altitude hold and vertical speed modes.

To operate in the **ALT** mode (with autopilot currently in the Vertical Speed mode):

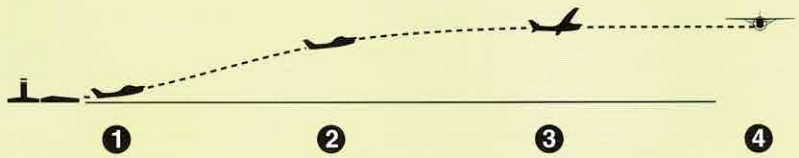
1. **ALT** button - Press. Note **ALT** is annunciated and autopilot maneuvers to maintain pressure altitude acquired at button selection.

2. **UP** or **DN** button - Select to change altitude. Incremented button strokes will move the reference altitude by 20 feet per press, or if held continuously will command a 500 ft/min altitude change, acquiring a new reference altitude upon button release.

Note: Incremented altitude changes should be limited to 500 ft. of change.

OPERATIONS WITH THE KAP 140

Takeoff And Climb To Assigned Altitude



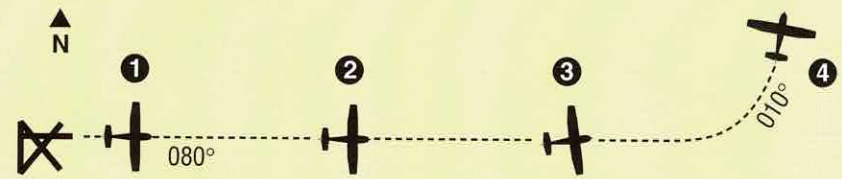
1. The aircraft is well off the ground and established at a safe climb rate.

   The heading bug on the DG or HSI is turned to the desired heading of 080° (runway heading).

   By depressing the **HDG** button on the KAP 140, the autopilot engages into the heading and vertical speed modes and maintains the selected heading of 080° and current rate of climb.

   *Note: Press and hold the **AP** button for 0.25 seconds to engage the autopilot (applicable only to software version 03/01 and later).*

2. The heading bug on the DG or HSI is turned to the new desired heading of 010° and the aircraft begins to respond with an immediate left turn.



OR

3. The autopilot is responding to the heading select mode with a left bank. The climb rate has been decreased, using the **DN** button, in preparation for level off.

OR

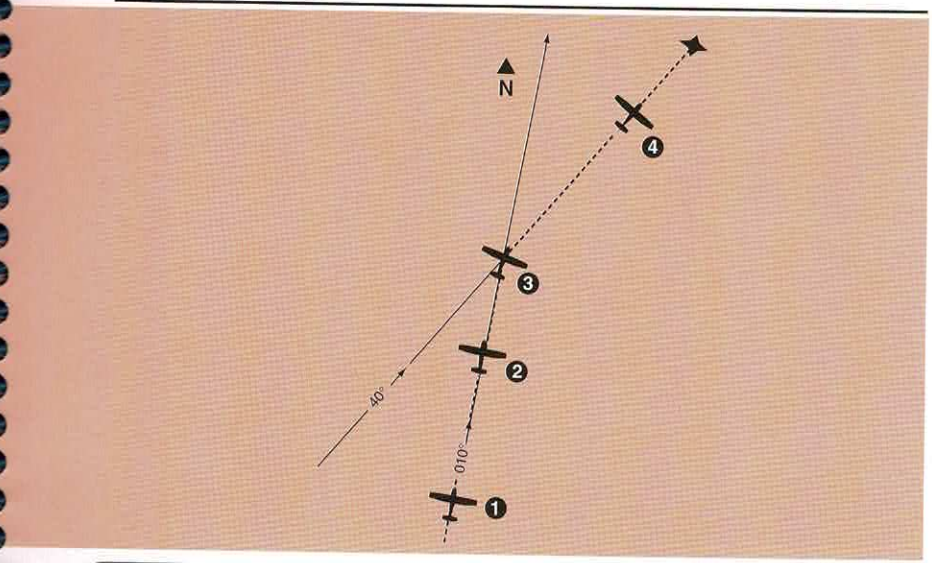
4. The autopilot has completed the turn and is now established on a 010° heading. Desired altitude has been reached, altitude hold (**ALT**) has been engaged and the aircraft maintains the reference altitude.

GPS Capture Using DG

** Description of GPS operation based on Bendix/King GPS receiver. Others may require different operation.*

1. Continuing on heading 010°, a GPS waypoint is established. A 30° intercept is desired.

2. The **HDG** button is depressed to select **ROL** mode which will allow an "all angle intercept". GPS data is selected for the CDI and the OBS is set to 040°. The **NAV** button is depressed and **NAV ARM** is annunciated. **ROL** will change to **HDG** and flash for five seconds. **ROL** will then be redisplayed. While the **HDG** annunciation is flashing, move the heading bug to the desired course of 040°. The aircraft will remain wings level until the capture point.



3. When the computed capture point is reached, the **ROL** annunciation changes to **NAV** and a right turn is initiated by the autopilot.

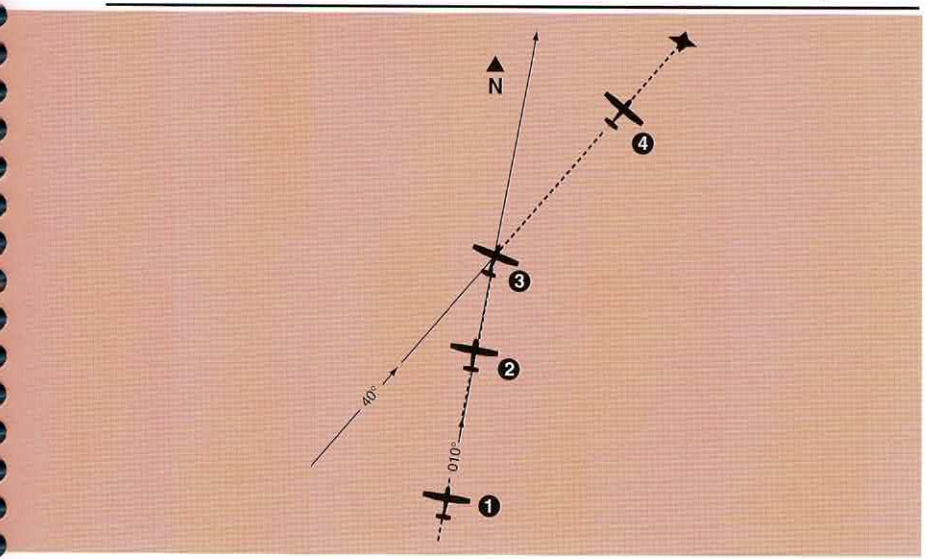
4. The turn is complete and the autopilot is tracking the GPS course.

GPS Capture Using HSI

** Description of GPS operation based on Bendix/King GPS receiver. Others may require different operation.*

1. Continuing on heading 010°, a GPS waypoint is established. A 30° intercept is desired.

2. GPS data is selected for the HSI. The course pointer is set to 040°. The **NAV** button is depressed and **NAV ARM** is annunciated.



3. When the computed capture point is reached, the **HDG** annunciation changes to **NAV** and a right turn is initiated by the autopilot.

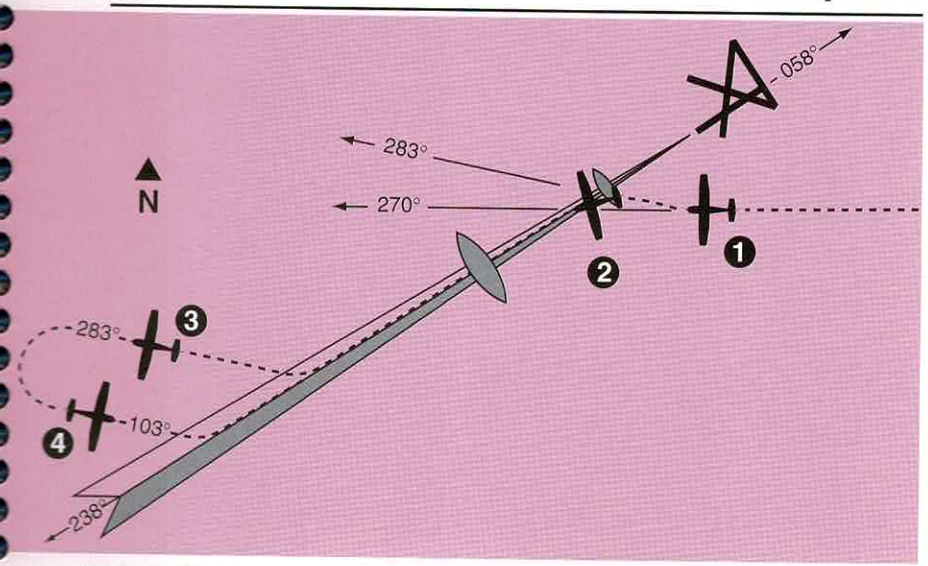
4. The turn is complete and the autopilot is tracking the GPS course.

Outbound On Front Course For Procedure Turn To ILS Approach Using DG

1. The aircraft is heading 270° with heading and altitude hold engaged. To intercept and fly the ILS front course outbound, set the front course on the OBS and depress the reverse course (**REV**) button. The **HDG** annunciation will flash for five seconds then extinguish. While the **HDG** annunciation is flashing, move the heading bug to the front course 058°. Since **HDG** was active upon selection of **REV**, the autopilot will initiate a 45° intercept to the localizer. In this case, the aircraft will turn to 283°.

2. When the computed capture point is reached, auto-intercept mode is cancelled and reverse localizer mode is automatically activated and a left turn outbound on the localizer is initiated by the autopilot.

Note: The left-right deviations of the CDI course deviation needle are reversed (you must turn right to center a deviation of the index to the left). This needle reversing takes place because you are flying outbound on a front course.



3. At the desired point, **HDG** mode is used to initiate the procedure turn. Select **HDG** and set the heading bug to 283°. During the procedure turn outbound, the CDI course index goes off scale to the right. The aircraft is flying away from the localizer centerline at a 45° angle on a selected heading of 283°.

* Check the heading displayed on the DG against the magnetic compass and reset if necessary.

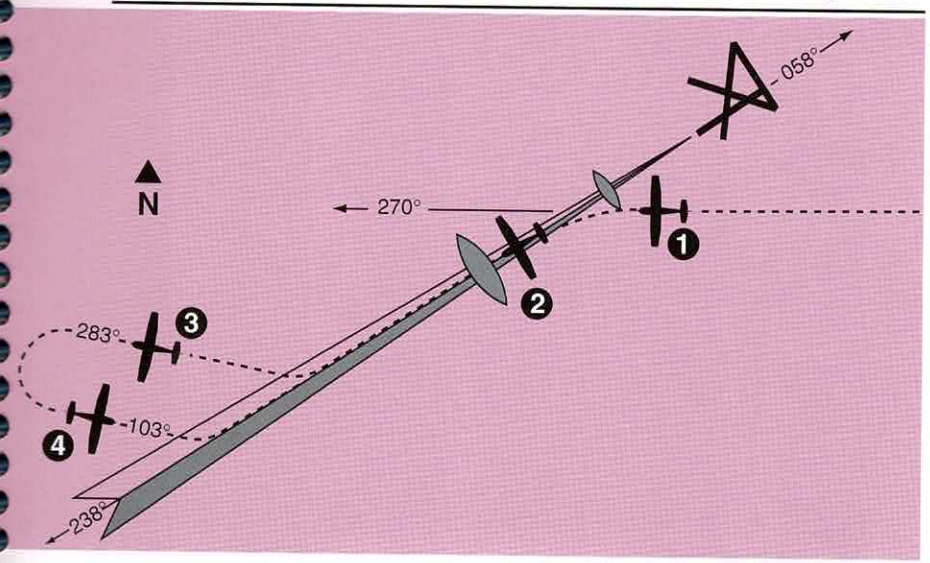
4. Now you have reset the heading bug to 103° and made a 180° turn to this heading. This 103° heading will intercept the front course of 058°. You must now select the approach mode by depressing the **APR** button on the KAP 140. * The **HDG** annunciation will flash for five seconds then extinguish. While the **HDG** annunciation is flashing, move the heading bug to the front course 058°. Since the 45° intercept is 103°, the aircraft will not turn until the front course is captured.

Outbound On Front Course For Procedure Turn To ILS Approach Using HSI

1. The aircraft is heading 270° with heading and altitude hold engaged. To intercept and fly the ILS front course outbound, set the front course on the HSI and depress the back course (**REV**) button. The back course (**REV**) mode is selected to go outbound on the front course. The capture point is now being computed based on closure rate.

2. When the computed capture point is reached, **HDG** mode is cancelled and reverse localizer mode is automatically activated and a left turn outbound on the localizer is initiated by the autopilot.

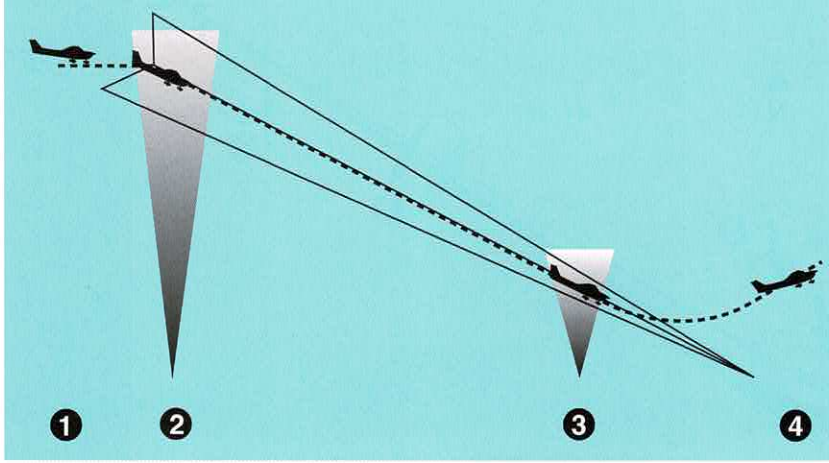
Note: The left-right deviations of the HSI course needle operate just as though you were flying a front course approach.



3. At the desired point, **HDG** mode is used to initiate the procedure turn. Select **HDG** and set the heading bug to 283°. During the procedure turn outbound, the deviation bar shows that the aircraft is flying away from the localizer centerline at a 45° angle on a selected heading of 283°.

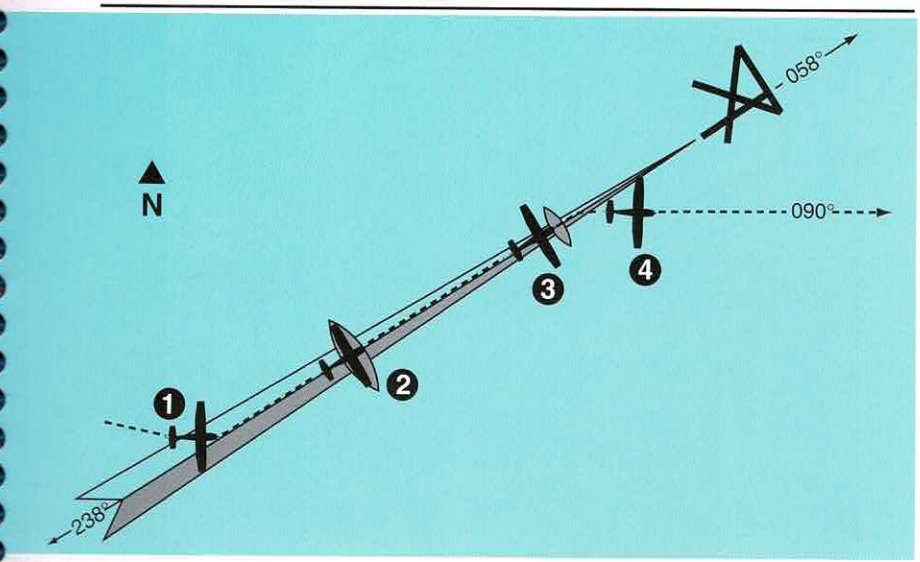
4. Now you have reset the heading bug to 103° and made a 180° turn to this heading. The 103° heading will intercept the front course of 058°. You must now select the approach mode by depressing the **APR** button on the KAP 140. Automatic capture of the localizer will occur.

Front Course ILS Approach Using DG



1. Continuing the maneuver on page 66, APR coupling occurs (**HDG** annunciation changes to **APR**), and the glideslope mode is automatically armed. The autopilot will capture the localizer and the CDI course index will center.

2. The autopilot is following the localizer. At the outer marker, the glideslope deviation needle is at midscale. Altitude hold is automatically disengaged when the glideslope is captured. The **ALT** annunciator extinguishes and **GS** is displayed. The autopilot will make pitch and bank changes as necessary to maintain localizer and glideslope.

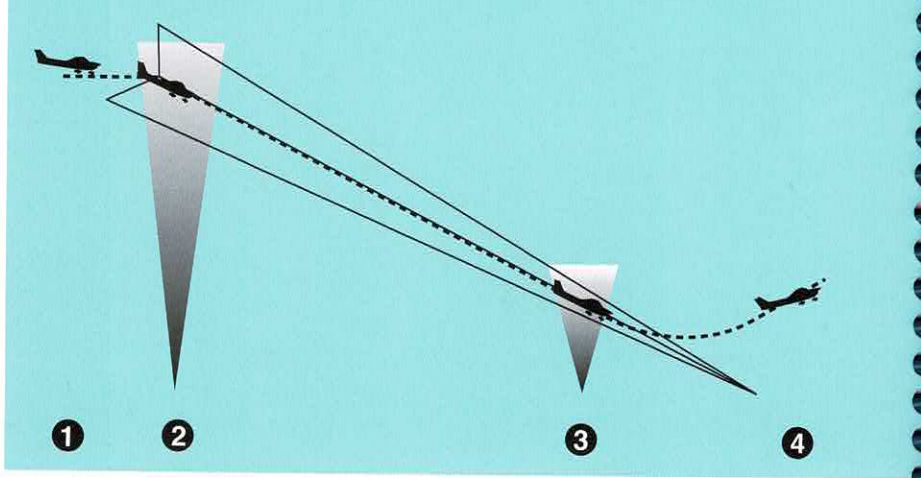


3. At the middle marker, the pilot disengages the autopilot with the button on the control wheel. This cancels all operating modes. The flashing **AP** annunciationa are displayed and a disconnect tone will sound.

4. The pilot initiates the missed approach and stabilizes the aircraft in the climb. The heading bug is set to the missed approach heading of 090°. By depressing the **HDG** button on the KAP 140, the autopilot engages into the heading and vertical speed modes, commencing a right turn to a heading of 090° and maintaining the rate of climb existing at engagement.

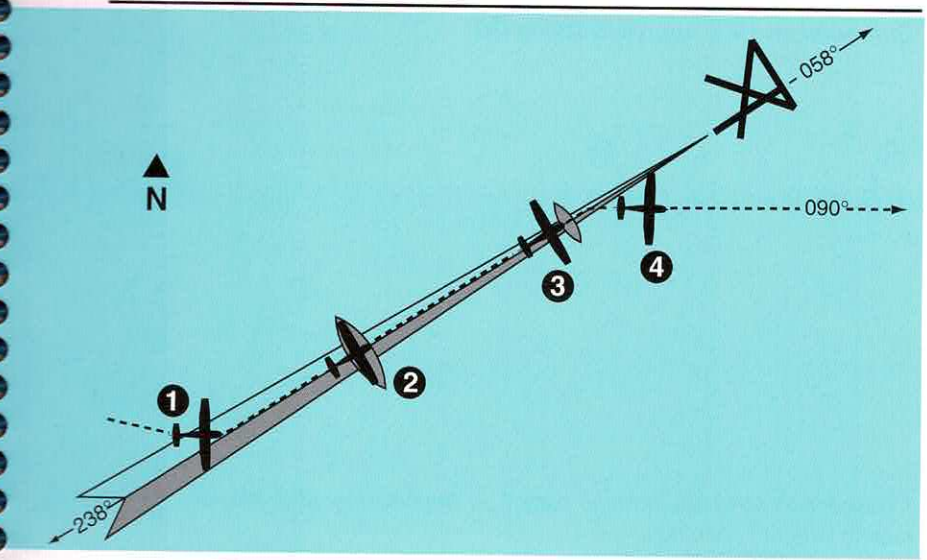
   *Note: Press and hold the **AP** button for 0.25 seconds to engage the autopilot (applicable only to software version 03/01 and later).*

Front Course ILS Approach Using HSI



1. Continuing the maneuver on page 68, APR coupling occurs (**HDG** annunciation changes to **APR**), and the glideslope mode is automatically armed. The autopilot will capture the localizer and the CDI course index will center.

2. The autopilot is following the localizer. At the outer marker, the glideslope deviation needle is at midscale. Altitude hold is automatically disengaged when the glideslope is captured. The **ALT** annunciator extinguishes and **GS** is displayed. The autopilot will make pitch and bank changes as necessary to maintain localizer and glideslope.



3. At the middle marker, the pilot disengages the autopilot with the button on the control wheel. This cancels all operating modes. The flashing **AP** annunciations are displayed and a disconnect tone will sound.

4. The pilot initiates the missed approach and stabilizes the aircraft in the climb. The heading bug is set to the missed approach heading of 090°. By depressing the **HDG** button on the KAP 140, the autopilot engages into the heading and vertical speed modes, commencing a right turn to a heading of 090° and maintaining the rate of climb existing at engagement.

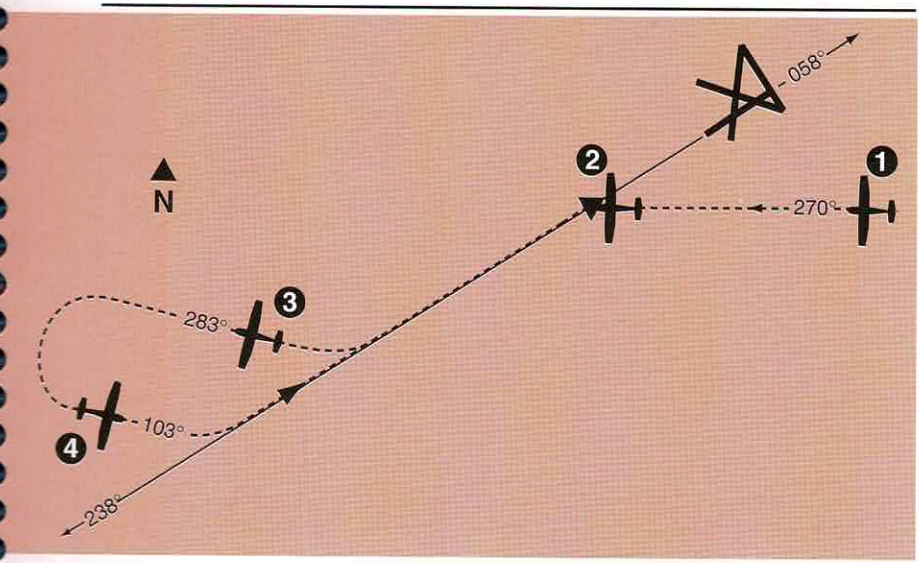
*Note: Press and hold the **AP** button for 0.25 seconds to engage the autopilot (applicable only to software version 03/01 and later).*

Outbound on GPS Approach Using DG

** Description of GPS operation based on Bendix/King GPS receiver. Others may require different operation.*

1. The aircraft is in **APR** mode approaching the IAF. Approach arm is indicated on the GPS annunciator.*

2. Upon waypoint alerting at the IAF, the heading bug is set to 238°, the GPS's Leg/OBS mode switching is set to OBS mode and the OBS is set to 238°. The autopilot initiates a left turn to track the 238° GPS course.



3. At the desired point, heading mode is used to initiate the procedure turn. During the procedure turn outbound, the deviation bar shows that the aircraft is flying away from the GPS course at a 45° angle on a selected heading of 283°.

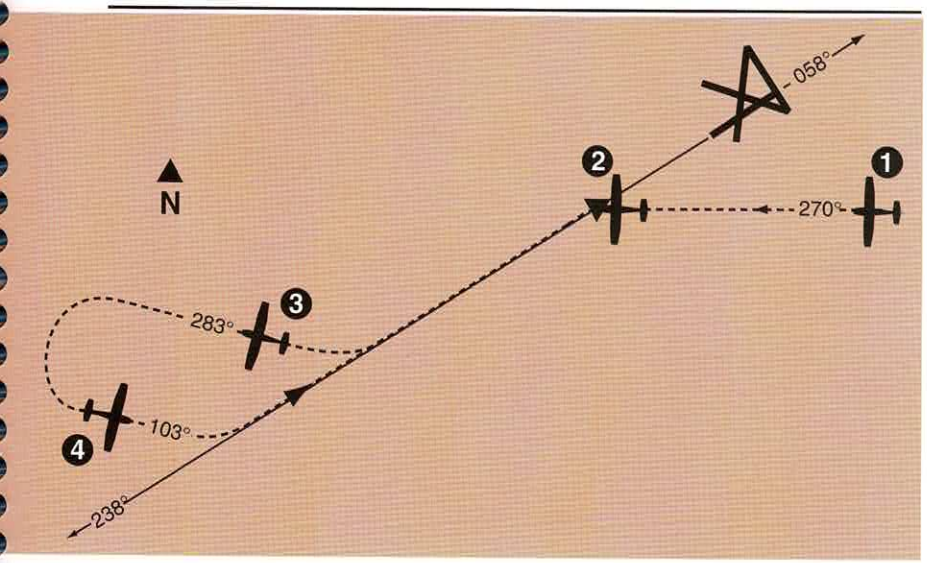
4. The heading bug has been set to 103° and the aircraft has made a left turn to this heading. The GPS's Leg/OBS mode switching is set to Leg mode and the OBS is set to 058°. Select approach mode by depressing the **APR** button. The **HDG** annunciation will flash for five seconds then extinguish. Move the heading bug within five seconds to 058°. Since the 45° intercept is 103°, the aircraft will not turn until the course is captured.

Outbound on GPS Approach Using HSI

** Description of GPS operation based on Bendix/King GPS receiver. Others may require different operation.*

1. The aircraft is in **APR** mode approaching the IAF. Approach arm is indicated on the GPS annunciator.*

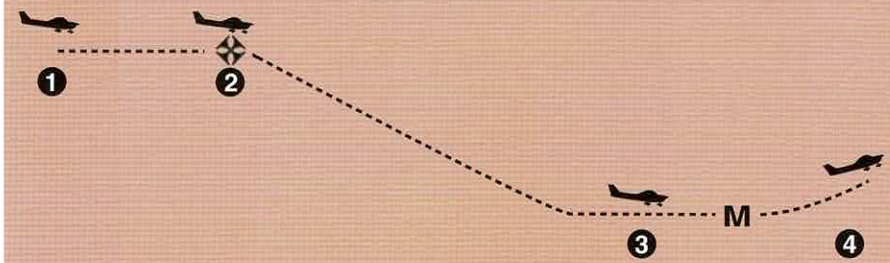
2. Upon waypoint alerting at the IAF, the course pointer is set to 238°, the GPS's Leg/OBS mode switching is set to OBS mode. The autopilot initiates a left turn to track the 238° GPS course.



3. At the desired point, heading mode is used to initiate the procedure turn. During the procedure turn outbound, the deviation bar shows that the aircraft is flying away from the GPS course at a 45° angle on a selected heading of 283°.

4. The heading bug has been set to 103° and the aircraft has made a left turn to this heading. The GPS's Leg/OBS mode switching is set to Leg mode and the course pointer is set to 058°. Select approach mode by depressing the **APR** button.

Inbound on GPS Approach Using DG

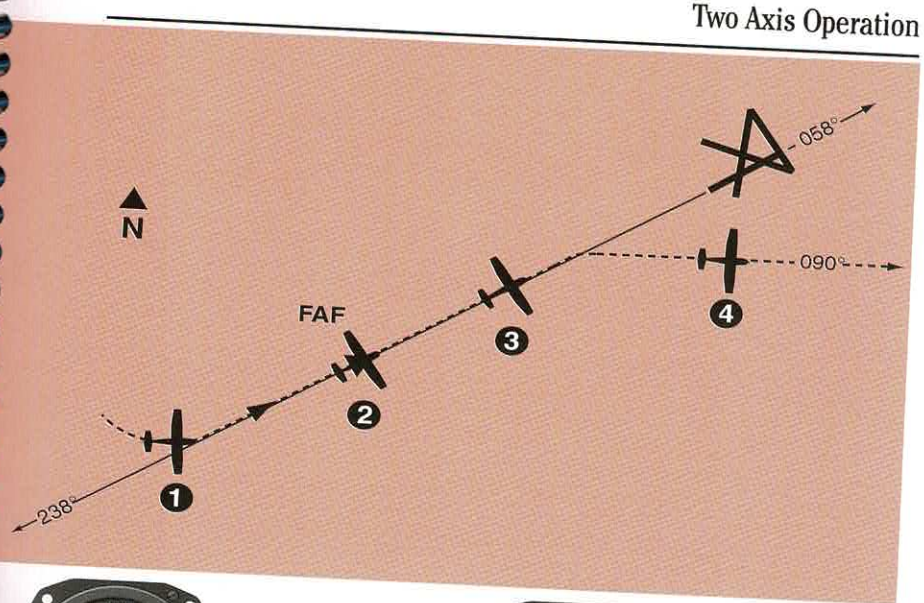


** Description of GPS operation based on Bendix/King GPS receiver. Others may require different operation.*

1. Continuing the maneuver on page 74, **APR** mode capture occurs. The autopilot initiates a left turn to track the 058° GPS course. * Approach active is indicated on the GPS annunciator.

2. At the FAF, **ALT** is depressed to activate vertical speed mode. The desired descent rate is obtained using the **DN** button.

   Remember, speed needs to be controlled with the throttle.

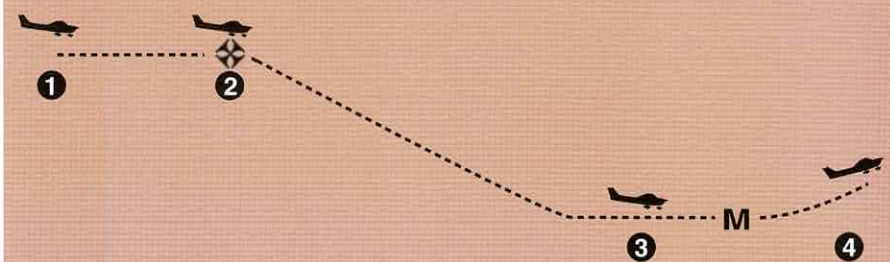


3. At the MDA, the **ALT** button is depressed causing the autopilot to level off and maintain a constant altitude. At the MAP the pilot disengages the autopilot with the button on the control wheel. A flashing **AP** annunciation is displayed and a distinctive tone will sound.

4. The pilot initiates the missed approach and stabilizes the aircraft in the climb. The heading bug is set to the missed approach heading of 090°. By depressing the **HDG** button on the KAP 140, the autopilot engages into the heading mode, commencing a right turn to a heading of 090°.

*Note: Press and hold the **AP** button for 0.25 seconds to engage the autopilot (applicable only to software version 03/01 and later).*

Inbound on GPS Approach Using HSI

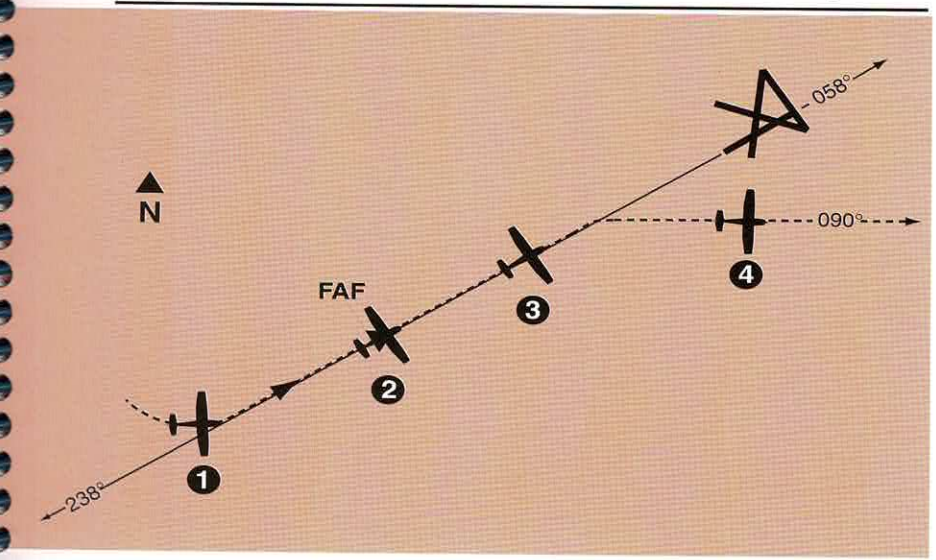


** Description of GPS operation based on Bendix/King GPS receiver. Others may require different operation.*

1. Continuing the maneuver on page 76, **APR** mode capture occurs. The autopilot initiates a left turn to track the 058° GPS course. * Approach active is indicated on the GPS annunciator.

2. At the FAF, **ALT** is depressed to activate vertical speed mode. The desired descent rate is obtained using the **DN** button.

   Remember, speed needs to be controlled with the throttle.



3. At the MDA, the **ALT** button is depressed causing the autopilot to level off and maintain a constant altitude. At the MAP the pilot disengages the autopilot with the button on the control wheel. A flashing **AP** annunciation is displayed and a distinctive tone will sound.

4. The pilot initiates the missed approach and stabilizes the aircraft in the climb. The heading bug is set to the missed approach heading of 090°. By depressing the **HDG** button on the KAP 140, the autopilot engages into the heading and vertical speed modes, commencing a right turn to a heading of 090° and maintaining the rate of climb existing at engagement.

   *Note: Press and hold the **AP** button for 0.25 seconds to engage the autopilot (applicable only to software version 03/01 and later).*

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