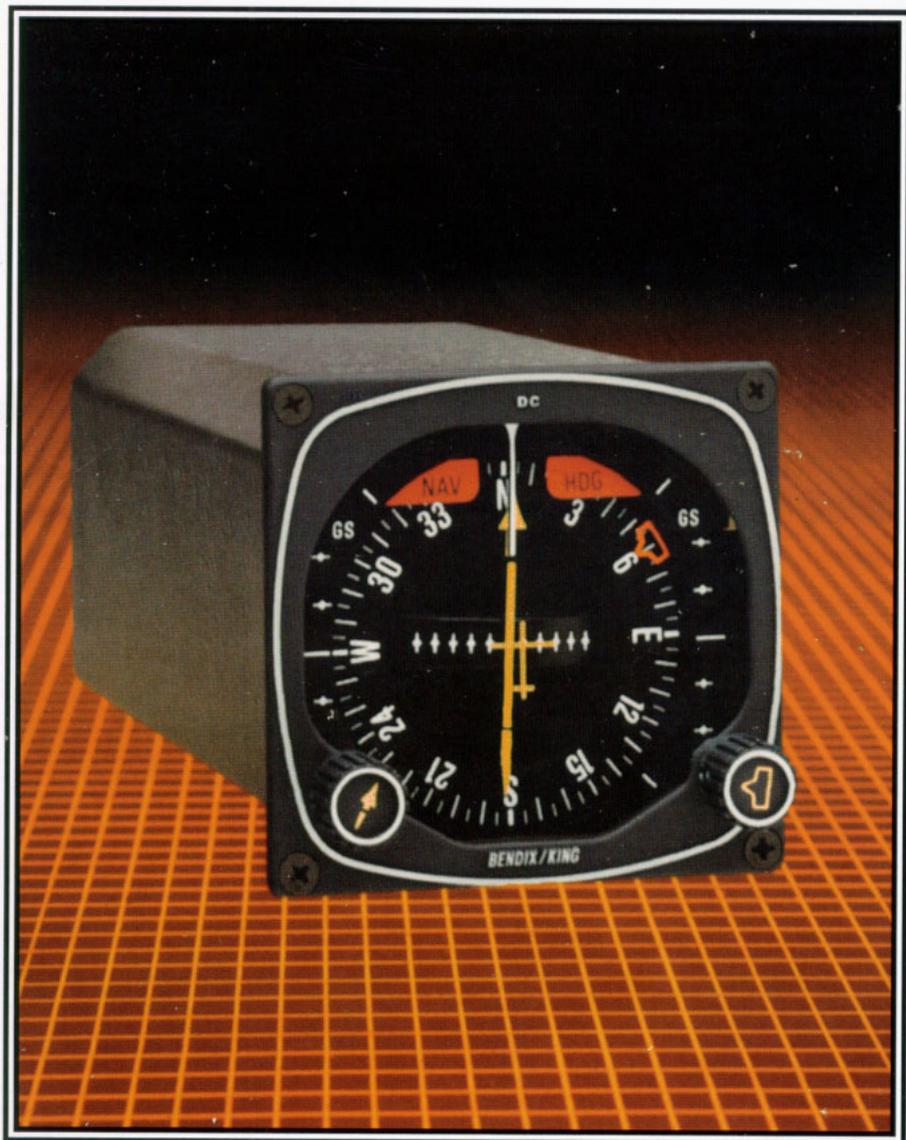


# Pilot's Guide

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## KCS 55A

Bendix/King Compass System



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# INTRODUCTION

## **Silver Crown KCS 55A Compass System**

The King KCS 55A Compass System provides the pilot with a simple, comprehensive visual display of the aircraft's heading and position in relation to a desired course.

But the KCS 55A is considerably more than a visual display; it's a complete slaved compass system that includes a magnetic slaving transmitter, a slaving control and compensator unit, a directional gyro for stabilization of the system, an optional autopilot adapter and the Pictorial Navigation Indicator (PNI) itself.

The panel-mounted KI 525A PNI combines the display functions of the standard Directional Gyro with VOR/LOC course deviation indication and Glideslope deviation and flag into one compact display. Consequently, pilot workload is considerably reduced and visual coordination between several separate indicators is eliminated.

The KI 525A simplifies course orientation, intercept and tracking and will generally result in better piloting technique and skill.

# This is the complete KCS 55A System:

## PANEL DISPLAY



The KI 525A Pictorial Navigation Indicator is the panel display for the KCS 55A compass system. By combining the display functions of the standard Directional Gyro, the VOR and LOC deviation indicator with Glideslope display, the KI 525A simplifies navigation and reduces cockpit workload.



The KA 51B Slaving Control and Compensator Unit is panel-mounted and provides a means of selecting either the "slaved gyro" or "free gyro" modes. The free gyro mode allows manual slaving when fully automatic operation is not desired. The unit also contains a meter which indicates when there is a difference between the KI 525A compass card and the aircraft's magnetic heading. Options to the KA 51B include vertical or horizontal mounting. When space behind the panel is restricted, the compensator unit may be removed and remote mounted.

## REMOTE UNITS

The KMT 112 Magnetic Slaving Transmitter senses the direction of the earth's magnetic field and continuously transmits this information through the slaving circuitry to the Directional Gyro which is automatically corrected for precession or "drift". This sensor is mounted remotely... usually in a wingtip... to eliminate the possibility of magnetic interference.

The KG 102A Directional Gyro provides gyro-stabilization for the system and contains the slaving circuitry necessary for operation of the system. This unit is remote-mounted.

The KA 52 or KA 57 Autopilot Adapters are optional remote-mounted units that convert direct current heading select and course select signals from the KI 525A into alternation current signals that are compatible with most aircraft auto-pilot or flight director systems.





**Lubber Line** — A fixed white marker at the top of the display that indicates aircraft magnetic heading on the Compass Card.

**Symbolic Aircraft** — A fixed representation of the actual aircraft. This miniature aircraft always points toward the top of the display and the Lubber Line.

**Selected Course Pointer** — On this two-part arrow, the “head” indicates the desired VOR or Localizer course and the “tail” indicates the reciprocal. This pointer is set by rotating the Course Select Knob.

**Course Select Knob** — Used to rotate the Selected Course Pointer to the desired course on the Compass Card. This knob corresponds to the Omni Bearing Selector (OBS) on standard NAV indicators.

**VOR/RNAV and LOC Deviation Bar** — This bar corresponds to the “left/right” needle on standard Course Deviation Indicators. When the aircraft is precisely on the VOR radial or Localizer course, it forms the center section of the Selected Course Pointer and will be positioned under the Symbolic Aircraft. When off course or approaching a new course, it will move to one side or the other. Since the entire VOR and Localizer display rotates with the Compass Card, the angular relationship between the Deviation Bar and the Symbolic Aircraft provides a pictorial symbolic display of the aircraft’s position with respect to the selected course.

**Deviation Scale** — when tuned to a VOR frequency, each white dot represents  $2^\circ$  of deviation left or right of course. When tuned to a Localizer, the deviation is  $1/2^\circ$  per dot. In RNAV “APPR” mode the scale is  $1/4$  nm per dot. In RNAV “ENROUTE” mode the scale is 1nm per dot.

**Heading Select Bug** — A movable marker on the outer perimeter of the display, used primarily to select the desired heading you wish to fly. This desired heading can be coupled into the Autopilot or Flight Direction with the appropriate Autopilot adapter to provide the “heading select” function.

**Heading Select Knob** — Used to rotate the Heading Select Bug to a desired point on the Compass Card.

**To-From Indicator** — A white triangle near the center of the display that indicates, with reference to the OBS setting, whether the aircraft is flying to or from the selected VOR/RNAV station.

**Dual Glideslope Pointer** — Chartreuse triangular pointers on either side of the display. These pointers drop into view when a usable glideslope signal is received and go out of view when the Glideslope signal becomes marginal. During an ILS approach, these pointers represent the vertical orientation of the aircraft with respect to the center of the Glideslope beam. When on Glideslope, the pointers will align with the center markers on the Glideslope scale.

**Glideslope Deviation Scale** — White dots on each side of the display which, in conjunction with the Glideslope pointers, indicate either “too high”, “too low”, or “on Glideslope” during an ILS approach.

**Compass Warning Flag** — A red flag labeled “HDG” becomes visible in the upper right quadrant of the display whenever the electrical power is inadequate or the directional gyro is not up to speed.

**NAV Warning Flag** — A red flag labeled “NAV” becomes visible in the upper left quadrant of the display whenever an unusable VOR or Localizer signal is being received.

## KA 51B Slaving Meter/Compensator



**Slaving Meter** — This meter indicates the difference between the displayed heading and the magnetic heading. Right deflection indicates a clockwise error of the compass card. Left deflection indicates a counterclockwise error of the compass card. Whenever the aircraft is in a turn and the card rotates, this meter will show a full deflection to one side or the other.

**Note:** During level flight it is normal for the meter needle to continuously move from side to side and to be fully deflected during a turn. If the needle stays fully deflected, left or right, during level flight, the Free Gyro mode can be used to center it, as described below.

**Slave and Free Gyro Locking Switch** — When in the “slave” position, the system is in the slaved gyro mode. When the switch is in the “free” position (not engaged), the system is in the free gyro mode.

**Clockwise Adjustment** — When the system is in the free gyro mode, the clockwise manual heading drive switch will rotate the compass card to the right to eliminate left compass card error.

**Counterclockwise Adjustment** — When the system is in the free gyro mode, the counterclockwise manual heading drive switch will rotate the compass card to the left to eliminate right compass card error.

## OPERATING INSTRUCTIONS

1. Until power is applied to the KCS 55A System, and the directional gyro is up to speed, a red flag labeled “HDG: will be visible in the upper right quadrant of the KI 525A Indicator. In operation, this warning flag will be visible whenever the power being supplied is inadequate or the gyro is not up to speed.
2. With power application to the KCS 55A System, and gyro operating speed, the red “HDG: flag will disappear from view.
3. If the KCS 55A System is in the slaved gyro mode, the compass card will automatically fast slave at the rate of 180 degrees per minute toward the magnetic heading. (Immediately after applying power, this compass card movement should be quite visible.) It will continue to fast slave until the proper magnetic heading is indicated, after which

it will slave at a constant rate of 3 degrees per minute to keep the system aligned with the earth's magnetic field.

4. If the KCS 55A System is in the free gyro mode, check the slaving meter to determine whether there is right or left deflection. Then move the manual slave switch the appropriate direction to center the needle and properly align the system with the earth's magnetic field.

5. Until a usable navigation signal is being received by the KCS 55A system, a red flag labeled "NAV" will be visible in the upper left quadrant of the KI 525A Indicator. In operation, this warning flag will be visible whenever an inadequate navigation signal is being received.

6. For normal navigation, set the NAV receiver to the desired VOR or Vortac station and the red navigation flag (NAV) will disappear from view if a usable signal is being received.

7. Rotate the Course Select knob to position the Selected Course Pointer to the desired VOR course.

8. The VOR Deviation Bar represents the selected course and the relationship of this bar to the symbolic aircraft in the center of the instrument visually presents the actual relationship of the selected course to your aircraft position. (in other words, if the symbolic aircraft on the display indicate approaching the deviation bar at 45°, that is the angle at which your aircraft is actually approaching the selected course.)

9. To prepare for an ILS approach, tune the NAV receiver to the desired frequency. If a usable Localizer signal is being received, the NAV warning flag will disappear.

10. For a front or back course approach, rotate the Course Select knob to set the course Pointer on the front Localizer course. As with normal navigation (#6 above), the LOC Deviation Bar represents the desired course. The relationship between this bar and the symbolic aircraft gives a true picture of where your aircraft is located with respect to the Localizer course. Following this procedure provides the correct sensing whether flying a front or back course approach.

11. The Glideslope Deviation pointers will become visible on both sides of the display when a usable Glideslope signal is received. If they do not come into view, a usable Glideslope signal is not being received.

12. The Glideslope pointers indicate the relative position of the Glideslope path with respect to the aircraft.

(In other words, if the pointers are above the center marker, the aircraft is below the Glideslope.)

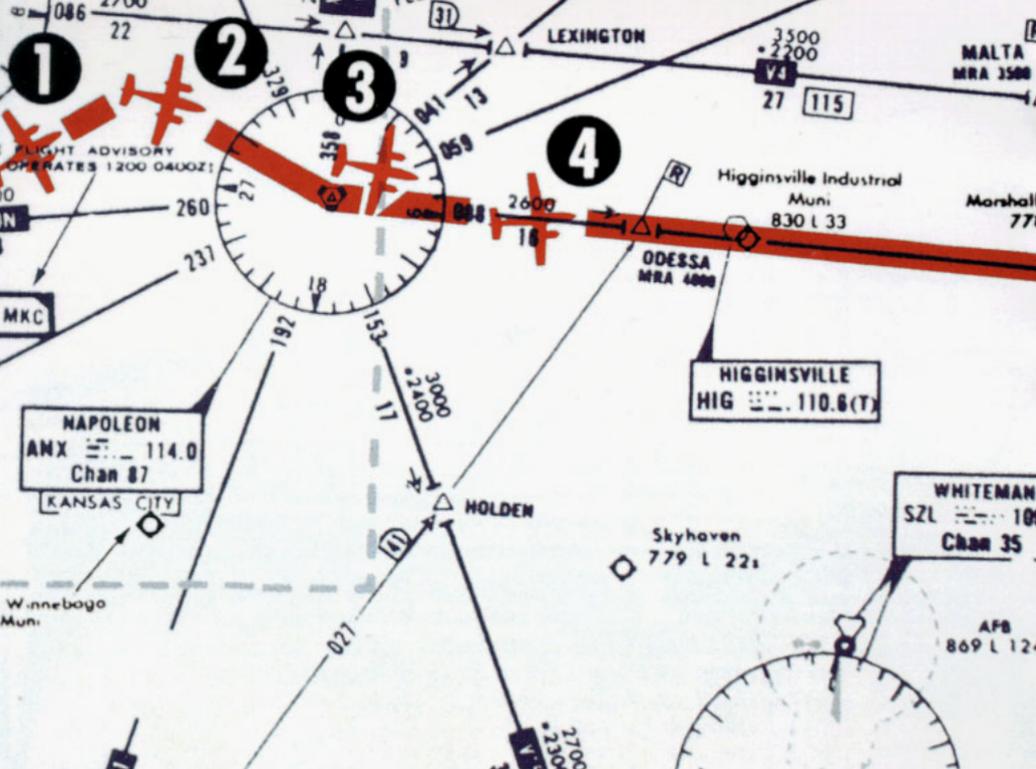
### **Abnormal Circumstances**

- If the Warning Flag (HDG) appears during operation, the Compass Card indications will be in error. Power may be removed from the KG 102A Directional Gyro by pulling the appropriate circuit breaker. The VOR/LOC Deviation Bar, the NAV flag, and the To/From Indicator will remain in operation.
- If the Navigation Warning Flag (NAV) appears during operation, there are five possibilities: (1) the NAV receiver is not turned on, (2) the NAV receiver is improperly tuned, (3) the ground VOR or LOC station is malfunctioning or not in operation, (4) the NAV receiver is malfunctioning, or (5) the aircraft is out of range of the selected ground station. (The Compass Card will continue to display the aircraft heading even if a usable NAV signal is not being received.)
- If the Glideslope pointers remain out of view during a front course ILS approach, either the aircraft Glideslope receiver or the ground station Glideslope transmitter is malfunctioning. Glideslope is usually not available during a back course approach. (The VOR and LOC course display will continue to function normally even if usable Glideslope signal is not being received.)
- A continuous large deflection of the Slaving Meter or large discrepancies between the Magnetic Compass and the KI 525A Compass Card may indicate a failure in the slaving system. If a slaving failure should occur, the free/slave gyro switch should be pulled and moved to the "free" position to select the free gyro mode. Then, by moving the adjustment switch to the Clockwise or Counterclockwise position, the Compass Card can be rotated to the correct heading as indicated on the alcohol compass. The KCS 55A System will continue to function normally except the heading information will be solely derived from the KG 102A Directional Gyro: there will be no automatic correction and periodic adjustments must be made manually to correct for precession.

**Note:** It is desirable to disconnect the autopilot under the following conditions:

1. HDG flag comes into view
2. System is in Fast Slave
3. System is in Free Gyro mode  
and being manually slaved.

Therefore, the system has the capability to supply the autopilot with an automatic disconnect signal under these conditions.



## Procedures with the KCS 55A

The following seven pages depict a normal flight departure from MKC enroute to STL via Victor Airway V-12. The charts shown here are for illustration purposes only and the photographs of the KI 525A PNI will give you an idea of how simple and comprehensive the display really is.



1.

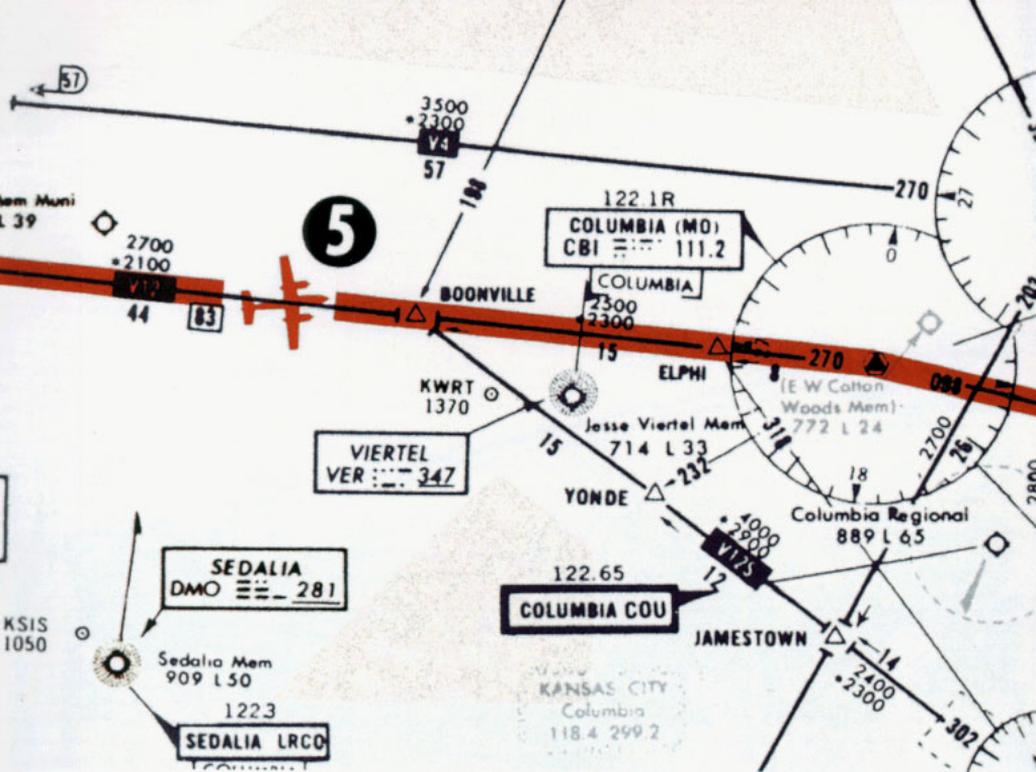
### Vectors to Intercept a Radial

After takeoff from Kansas City, we select a heading of 060 degrees with the heading bug to intercept the 110 degree course to Napoleon (ANX) VOR. Selected course pointer is set on 110 degrees with the course knob. The KI 525A Pictorial Navigation Indicator conveniently and accurately displays the intercept angle.



2.

The VOR deviation bar begins to center as we approach the 110 degree course to Napoleon. The KI 525A PNI makes it possible to intercept the course smoothly, without overshooting or bracketing. One method of doing this is to adjust your heading so that the top of the deviation bar always touches the lubber line. As your aircraft heading approaches the new course, the deviation bar will swing towards the center and the angle of intercept will decrease.



**3.**

**Turn to Intercept a Victor Airway**

The "TO" indicator starts to swing to "FROM" as you fly over the Napoleon VORTAC station. At this time, set the selected course on the V-12 course of 088 degrees.

As you begin your left turn to track V-12, notice that the KI 525A PNI continuously displays an accurate picture of the relationship between your aircraft and the ANX 088 degree radial. Once again, you can make a precise, coordinated course interception by adjusting your heading to keep the top of the deviation bar touching the lubber line.



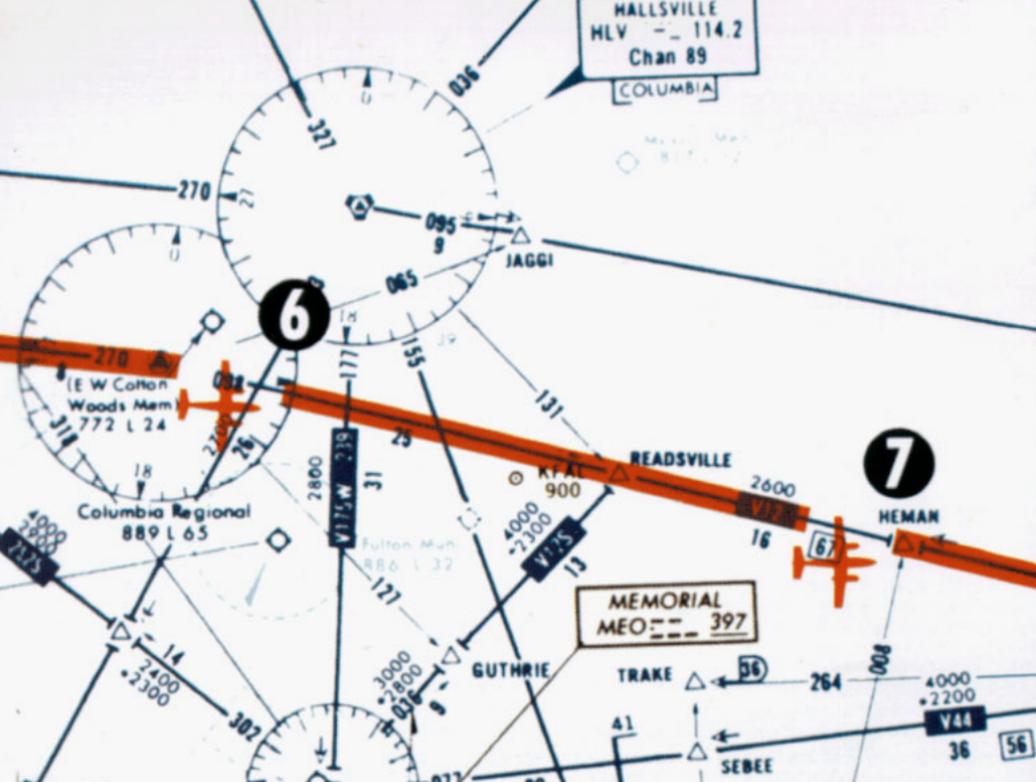
**4.**

When the deviation bar is centered and aligned with the course arrow, you are on course. Notice that correction for wind drift-in this case, a 080 degree heading on a 088 degree course-is completely automatic as long as you keep the deviation bar centered.



**5.**

About midway between Napoleon and Columbia (CBI), you switch to the CBI VOR and the TO/FROM indicator immediately swings to "TO". Also note the course arrow should be moved from 088 degrees to 090 degrees which is the V-12 course to CBI.



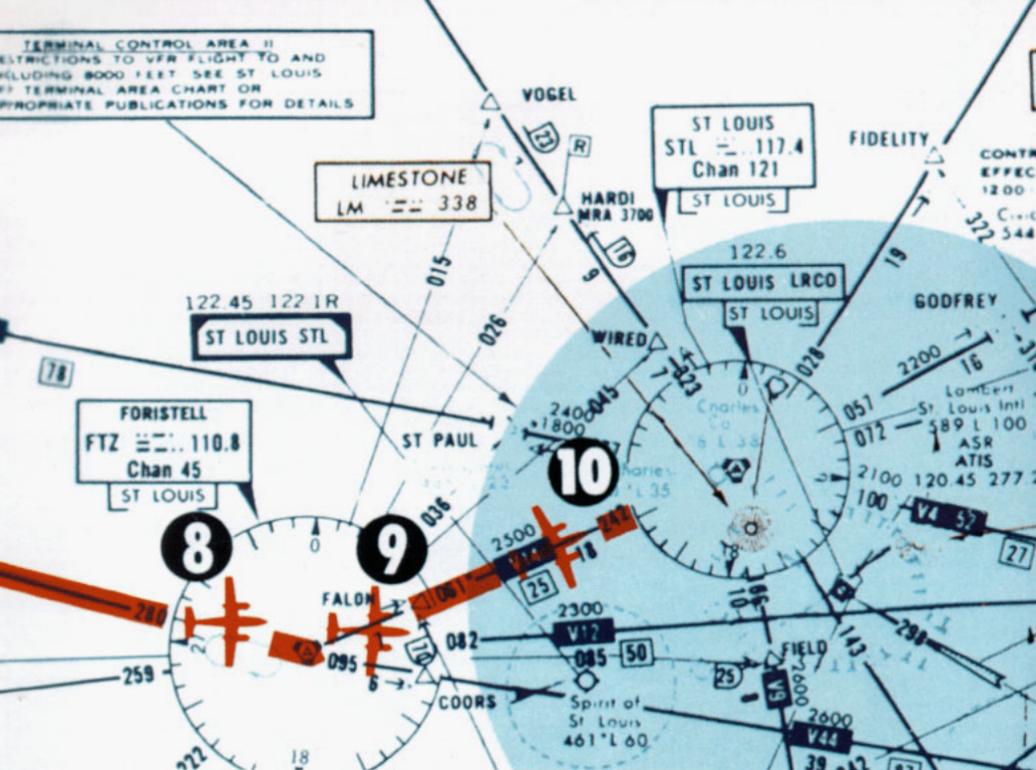
**6.**

As you fly over the Columbia station, the TO/FROM indicator changes to "FROM". Since the outbound course for V-12 from Columbia to Foristell (FTZ) is 098 degrees, you now set the selected course pointer on 098 degrees, you now set the selected course pointer on 098 degrees and fly to keep the deviation bar centered.



**7.**

Near the Heman intersection you switch to Foristell VORTAC and move the course arrow to 100 degrees, which is the V-12 inbound course to FTZ. The TO/FROM indicator change to "TO".



**8.**

**Airway Interception**

Your clearance is V-12 to Forstell, then V-14 to the St. Louis (STL) VORTAC, direct Lambert Field. Approaching the FTZ station, the heading bug is on 100 degrees as a reference for the V-12 course or as heading command for the autopilot, if used. Select the St. Louis VOR-TAC on the NAV receiver and set the course pointer on the STL 062 degree course.



**9.**

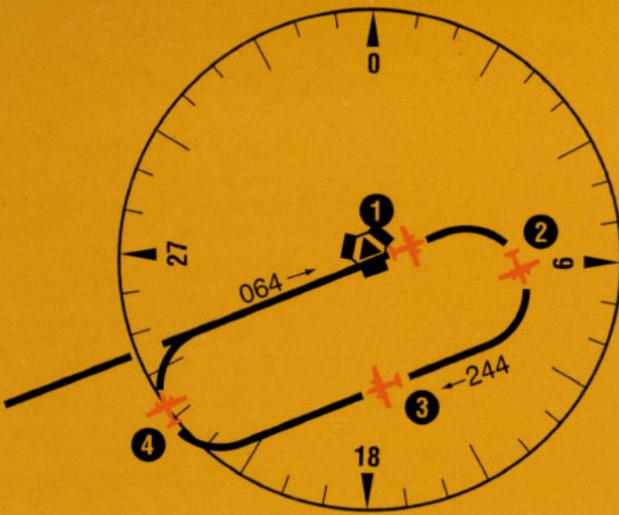
As you cross the Forstell VOR-TAC, the deviation bar will align with the course arrow. Now set the heading bug to 062 degrees and turn left to follow V-14 to the STL VORTAC.



**10.**

You are now established on V-14, flying to the STL VORTAC. Once again, if you fly to keep the deviation bar centered, correction for wind drift will automatically be accomplished.

**NOTE:** For system limitations refer to your Flight Manual Supplement.



## Holding Pattern



1. Approaching the STL VORTAC, the controller asks you to hold Southwest of the VORTAC on the 244° radial, right turns. You are now over the station with a 064° course selected (the TO/FROM indicator has swung to "FROM"). (Set your Heading Bug to the reciprocal...or outbound heading...244° for easy reference and begin your right-turn holding pattern.)



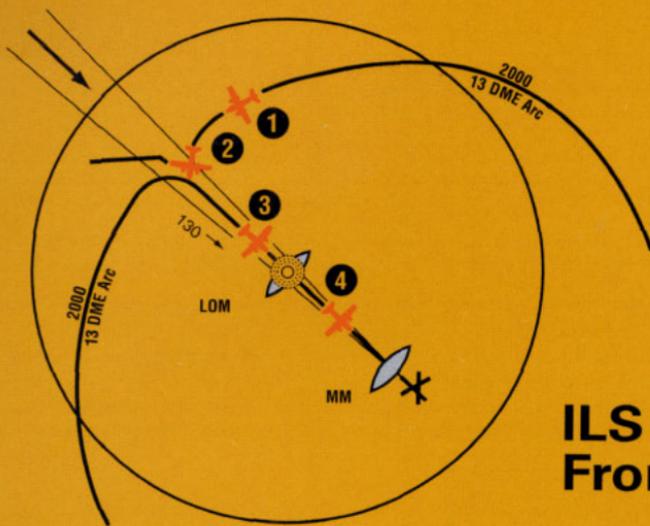
2. Halfway through the outbound turn, the KI 525A display shows the Deviation Bar behind the symbolic aircraft. You know, therefore, that you must eventually fly back to the radial in order to be on course during the inbound leg of the holding pattern.



3. Outbound, you are using the Heading Bug as a reference for 244°. The 244° radial is off the right wing and parallel to your outbound course.



4. Halfway through your turn to the inbound 064° course, the KI 525A shows the symbolic aircraft approaching the Deviation Bar at a right angle. By keeping the top of the Deviation Bar on the Lubber Line, you can complete your turn and roll out precisely on course.



## ILS Approach— Front Course



1. You are vectored from the holding pattern to the 13-mile DME arc. The aircraft is turning, with the Heading Bug set on  $170^\circ$  to intercept the Localizer. You have already set the Selected Course Pointer on the inbound ILS course  $130^\circ$  and the KI 525A shows the Localizer course is directly ahead. The Glideslope pointers came into view when the ILS frequency was tuned, since a usable Glideslope signal is being received.



2. Capturing the ILS course can be accomplished without overshooting or bracketing with the same technique you used in intercepting an enroute course: simply keep the top of the Deviation Bar on the Lubber Line and coordinate your turn until the bottom of the bar is aligned with the Course Arrow. Each dot on the LOC Deviation Scale represents  $1/2^\circ$  deviation when tuned to an ILS frequency.



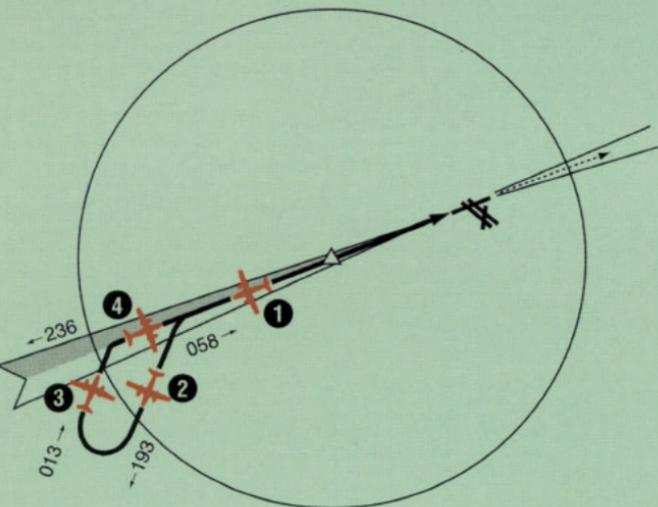
3. The KI 525A shows you that you have intercepted the Localizer course. The Glideslope pointers have started to center, although the display indicates your aircraft is still below the glide-path at this point.



4. You are now centered on the Localizer and the Glideslope. Once again, the KI 525A shows your aircraft is crabbed about  $005^\circ$  to the right to maintain the Localizer course.

## ILS Approach— Back Course

If a back course approach is required, it can be accomplished as easily as a front course approach. The Course Arrow should always be set on the Front course inbound Localizer heading. This will result in conventional pictorial deviation sensing even on back course. The KI 525A display gives you an accurate picture of where you are at all times during the approach and the procedure turn.



1. You are outbound on the back Localizer course, having already set the Selected Course pointer to the inbound front course at 238°. The Heading Bug is preset at 193° for the procedure turn. (Since there is usually no Glideslope signal on a back course, the Glideslope pointers are out of sight.)



2. During the procedure turn outbound, the deviation bar shows pictorially that the aircraft (as represented by the symbolic aircraft in the center of the KI 525A) is flying away from the Localizer centerline at 45° angle when the heading marker is under the Lubber Line. Note that left-right deviations of the course bar give "fly-to" indicators, just as on the front course.

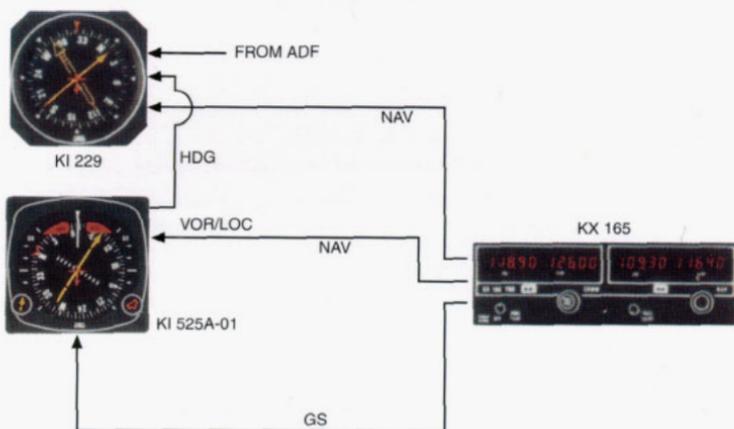


3. Now you've reset the Heading Marker to 013°, and made a 180° turn to this Heading. This 013° heading will intercept the back course. The KI 525A clearly pictures the course you are to intercept and the angle of interception.



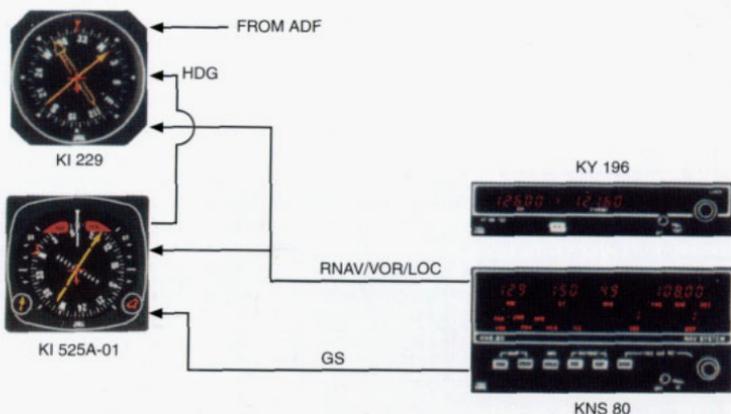
4. You have smoothly intercepted the back course. Since the Course Arrow is set on the front course (238°) the KI 525A shows a true picture of the situation...flying inbound on the back course. You may reset the Heading Marker to 058° for easy reference.

## King TSO'd digital Silver Crown NAV/COMM Systems



This system diagram may help you understand how the different units of the digital Silver Crown KX 165 system work together to provide a complete 200-channel NAV system with HSI and RMI...plus 720-channel COMM capability.

## King Silver Crown NAV/RNAV/COMM System



The system diagram shows you how much King's digital Silver Crown has simplified addition of Area Navigation to your avionics capabilities. The KNS 80 provides a 200-channel VOR/LOC receiver, a 40-channel Glideslope receiver, a 200-channel DME and an RNAV Computer for storage of 4 complete waypoints (frequency, distance and bearing). It also has an integral LOC converter, so it provides complete RNAV/VOR/LOC/GS input to the KI 525A PNI. 720 channels COMM is provided by the KY 196.

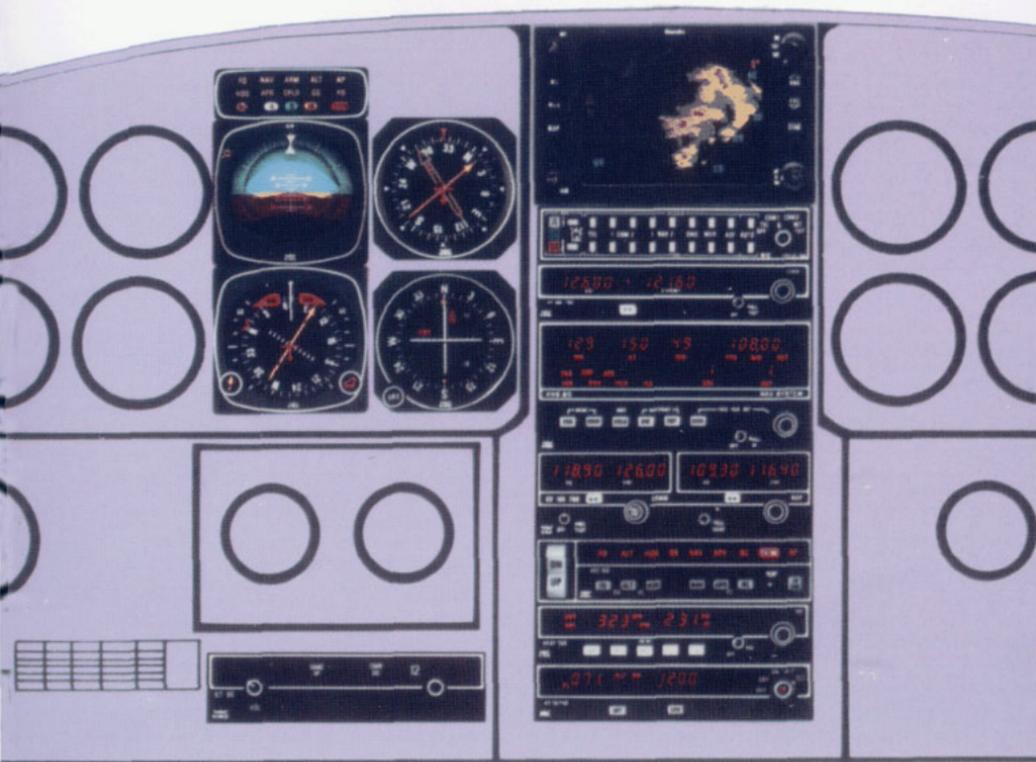
## **Couple the King KCS 55A with your Autopilot or Flight Control System.**

The low cost, slaved Pictorial Navigation System, with remote electric gyro, provides selected heading and course outputs for most Autopilots and Flight Directors.

To fly a heading, select your desired heading on the Heading "Bug". With Heading mode engaged, your Autopilot or Flight Director commands the proper bank to fly the selected heading. To fly a VOR, RNAV or LOC course, select the desired course on the Course Arrow. With Radio Coupling mode engaged, your Autopilot or Flight Director commands the proper bank to make good the selected track with automatic correction for crosswind.

To provide heading and course coupling of the King Silver Crown Compass System to your Autopilot or Flight Director, King offers two optional, remote-mounted Autopilot Adapter units (KA 52 or KA 57). These Adapters convert DC heading and course select signals from the KI 525A PNI into AC signals compatible with most aircraft Autopilots and Flight Directors.

## An example of a complete King Silver Crown System.



This entire system has been designed to relieve the pilot's workload and make cockpit management easier and more efficient. Combined functions such as NAV/RNAV/GS DME and ADF/ Flight Time/Elapsed Time reduce installation time and save space and weight. The "stay-ahead" standby frequency selection with "flip-flop" transfer feature adds convenience and extra operational flexibility.

These new generation Silver Crown avionics demonstrate King's continuing leadership in state-of-the-art electronic design and the full utilization of microprocessor and display technology to bring you tomorrow's avionics today. Capabilities of these units include:

- 240-mile display Weather Radar
- Audio Control Console with push-button transmitter and receiver selection and built-in Marker Beacon receiver with automatically dimmed lights
- 720-channel VHF COMM
- Integrated NAV/RNAV/DME/GS system with storage for 4 complete waypoints
- #2 Digital NAV/COMM with 720 channel COMM, 200-channel NAV, and 40-channel Glideslope
- Pictorial Navigation Indicator with gyro-slaved magnetic heading
- VOR/LOC/Glideslope Indicator
- Digital ADF with elapsed and flight timers
- Radio Magnetic Indicator (RMI)
- Full capability Class 1 Transponder
- KFC 150 Flight Control System
- Airborne Radiotelephone



## King KCS 55A System Specifications

### TSO Compliance:

TSO C6c

RTCA Environmental Categories

KI 525A, KA 51B: DAMAAAXXXXXX

KG 102A, KA 52: BAJAAAXXXXXX

KMT 112: BASAAAXXXXXX

### System Accuracy:

Accurate to within 2 degrees of local magnetic heading.

### Power Requirements:

13.75 VDC  $\frac{(15.8 \text{ max.})}{(11.0 \text{ min.})}$  1.73 amps

or

27.5 VDC  $\frac{(31.6 \text{ max.})}{(22.0 \text{ min.})}$  1.73 amps

### Slaving Rate:

Normal: 3 degrees per minute

Fast: 180 degrees per minute

### Warm-up Time:

Varies from one minute at +55°C to 5 minutes at -46°C

### Altitude:

-1,000 to +40,000 feet

### KI 525A

### Size:

3.375 x 3.550 x 7.305 inches, nominal  
(8.57 x 9.02 x 18.05 centimeters)

### Weight:

3.94 pounds (1.786 kilograms)

### Mounting:

Flanged mounted through front of the instrument panel.

### NAV Receiver/VOR Converter

#### Signal Inputs:

VOR/LOC deviation meter:

150±20 microamperes through a resistance of 1000±30 ohms for a full scale deflection of five dots.

To-From pointers: 200±40 microamperes through a resistance of 200±30 ohms for full deflection.

NAV warning flag: Disappears from view with an input of 210±30 microamperes through a resistance of 1000±30 ohms.

Glideslope deviation pointer: 150±20 microamperes through a resistance of 1000±30 ohms for a full scale deflection of three dots.

Course resolver: Omrange zeroed at 300 degrees for 30 Hz. Electrically equivalent to Clifton TSC-11-F-08.

**Signal Outputs:**

Heading synchro transmitter: Output equal to 206 millivolts per degree of heading rotation. Requires external 26 volt AC excitation. Selected heading error output: An internally excited transducer which supplies an error output equal to 0.6 volts D.C. per degree of displacement from the lubber line.

**KG 102A****Size:**

5.370 x 7.790 x 4.290 inches, nominal (13.64 x 19.79 x 10.90 centimeters)

**Weight:**

4.3 pounds (1.95 Kilograms)

**Mounting:**

Shock mount supplied with system.

**KMT 112****Size:**

3.37 dia. x 1.81 high, nominal (8.55 dia. x 4.64 high, centimeters)

**Weight:**

0.3 pounds (150 grams)

**Mounting:**

Rigid mount with three #6 nonmagnetic screws in a remote magnetically stable area.

**KA 51B****Size:**

1.20 x 2.12 x 3.01 inches, nominal (3.05 x 5.38 x 7.62 centimeters)

**Weight:**

0.2 pounds (0.09 Kilograms)

**Mounting:**

Flanged mounted through the front of the instrument panel.

**KA 52 and KA 57****Size:**

1.259 x 3.172 x 4.016 inches, nominal (3.20 x 8.06 x 10.20 centimeters).

**Weight:**

0.4 pounds (170 grams).

**Mounting:**

Rigid mount with four #6 screws.

**Signal Inputs:**

Heading select D.C. input from the KI 525A.

Course datum D.C. input from the KI 525A.

A.C. reference input from the aircraft autopilot system at 5 volts R.M.S. minimum.

**Signal Outputs:**

Heading select A.C. output transformer isolated and phase locked to the reference input signal.

Course datum A.C. output transformer isolated and phase locked to the reference input signals.

**WARNING:** Avionics installations require special skills, tools and test equipment. The famous King full year warranty system is valid only for equipment installed by an authorized Kings Sales and Service Center.

# **BENDIX/KING**

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