Pilot's Guide

KNS 81

Bendix/King VOR/LOC/GS/RNAV Integrated NAV System with 10-Waypoint Capability

Table of Contents

Introduction

The KNS 81 Integrated NAV System combines a TSO'd 200-channel VOR/LOC receiver, a TSO'd 40-channel Glideslope receiver, and a digital RNAV computer with capability for preselection, storage and display of 10 NAV frequencies and/or complete RNAV waypoint parameters.

When teamed with a compatible Digital DME and indicator, the KNS 81 lets you put all your DME or waypoint information right in front of you for easy scanning. Add a course deviation indicator (CDI or HSI) and a Marker Beacon receiver display unit and you have a complete NAV/RNAV/ILS/DME system.

The KNS 81 is compact and lightweight, measuring only 2 inches high (5.08 cm) and weighing just 5 pounds (2.3 kg). It is the end result of full utilization of state-of-the-art electronics, including extensive use of microprocessors throughout the unit.

The KNS 81 requires only 15 watts input power and will operate on any DC voltage from 11 to 33 volts, with no modifications or accessories.

And since the KNS 81 RNAV computer incorporates a non-volatile memory, you can store NAV frequencies and waypoint parameters indefinitely without batteries of any kind.

The purpose of this Pilot's Guide is to acquaint you with the operation and controls of the KNS 81. You will be as impressed by the simplicity of its operation and the ease with which you can use it as you will be pleased with its reliable performance and flexible capabilities.

NOTE: The FAA and most foreign aircraft regulatory agencies require the operator to be familiar with the approved Flight Manual Supplement/Pilot's guide prior to flight. It is recommended that this Pilot's Guide be read completely prior to system operation.

Systems planning for efficiency.

The KNS 81 is a self-contained panel-mounted navigational system consisting of a VOR/LOC receiver, an RNAV computer, and a Glideslope receiver.

When teamed with other compatible avionics—a CDI or HSI indicator, digital DME and indicator, and Marker Beacon receiver and lights—the KNS 81 provides the nucleus for a versatile and comprehensive NAV/RNAV/DME/ILS system with all the capabilities needed for efficient operation in today's air traffic environment. Special versions of the KNS 81 having a graphics output are also compatible with the EHI 40 and EHI 50 Electric HSIs and also with the GC 381A Radar Graphic System. The KNS 81 interfaces with the following avionics:

CDI/HSI
KI 206; KI 202; KNI 520; KI 525/KI 525A; KPI 550A/KPI 551A; KPI 550/KPI 551 (when factory-modified to KPI 550A/KPI 551A); KPI 552; KPI 553A (when used with the Gold Crown KDM 706/706A DME or KTU 709 TACAN systems)

EHSI
EHI 40; EHI 50

DME INTERROGATOR
KN 63; KDM 706/706A

DME INDICATOR
KDI 572; KDI 573; KDI 574; KPI 553A

WEATHER RADAR/GRAPHICS
RDS 81 Weather Radar with GC 381A Radar Graphics Unit

Recommended Compatible Systems:

The KDI 572 is a digital DME panel indicator that features simultaneous display of distance, groundspeed, and time-to-station. It features large, easy-to-read gas discharge numerics that automatically dim according to ambient light conditions.

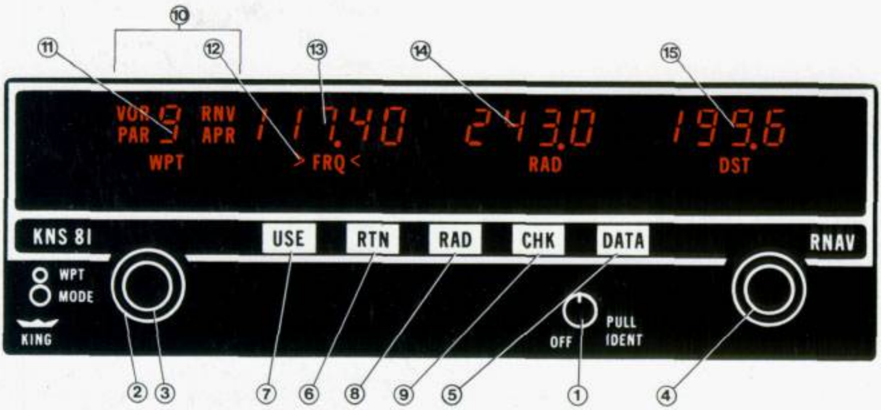
The KI 206 is a VOR/LOC/GS Course Deviation Indicator that provides a rectilinear display of NAV/RNAV/GS/LOC deviation.

The KI 525A is the slaved Pictorial Navigation Indicator for the Silver Crown KCS 55A Compass System. It provides a complete picture of the navigation situation during VOR, RNAV, or ILS operations. It replaces the Directional Gyro and CDI in your panel.

The KN 63 is a 100-watt, remote-mounted Silver Crown DME that saves panel space by utilizing the compact KDI 572 panel-mounted indicator. The KN 63 features all solid-state construction and is TSO'd.

EHI 40/50: Special versions of the KNS 81 having a graphics output are capable of interfacing directly with the EHI 40 (shown) or EHI 50 Electronic Horizontal Situation Indicators.

Controls, Functions, and Displays



General:

The numerical displays on the KNS 81 are 7-segment gaseous discharge lights. Operating modes and status information are annunciated by individually lighted abbreviations and legends.

The KNS 81 illustration above shows all displays and legends lighted. In actual operation, only the appropriate operating displays and legends are annunciated. Using the illustration as a reference, here is a brief description of each control and display.

Controls:

1) Power ON/OFF and Volume Control—Turn clockwise for "power on" and volume increase. Pull out for VOR/LOC IDENT tone.

2) Mode Select Knob—This knob changes the operating mode from VOR (direct to or from a VOR or VORTAC station with angular course width deviation) to VOR/PAR (direct to or from a VORTAC, with linear crosstrack deviation ± 5 nm) to RNV (direct to waypoint with linear crosstrack deviation ± 5 nm) to RNV/APR (direct to a waypoint with linear crosstrack deviation ± 1.25 nm) and then back to the VOR mode. When an ILS frequency is entered with the Data Input Knob the system will automatically go to the ILS mode regardless of the mode annunciated. When the ILS frequency is removed from the input, the system will revert back to the mode it was in previously.

3) Waypoint Select Knob—Selects any one of ten "data storage bins" in which VOR/LOC frequencies, with or without waypoint coordinates, have been inserted. Each "storage bin" can be called up as required from 0 to 9, or 9 to 0.

4) Data Input Knobs—Two concentric knobs used for selection of VOR/LOC frequency, waypoint radial and waypoint distance. DME is channeled with selection of the paired VOR frequency. The internal Glideslope is channeled with selection of the paired LOC frequency. Turn these knobs to enter desired data into the RNAV computer as follows:

Frequency Selection; *The large knob controls the 10 and 1 MHz digit in the display. The small knob controls the 0.1 and 0.05 MHz digit and channels FRQ in 0.05 MHz steps in either the "in" or "out" position.*

Radial Selection: *The large knob changes the 10° and 100° digit of the display. The small knob changes the 1° digit in the "in" position and the 0.1° digit in the "out" position.*

Distance Selection: *The large knob changes the 100 and 10 nm digit of the display. The small knob changes the 1 nm digit in the "in" position and the 0.1 nm digit in the "out" position.*

5) DATA Button—A momentary push button, the DATA Button moves the Caret (> <) Display from FRQ to RAD to DST and back to FRQ so you will always know which waypoint parameter the Data Input Knobs are addressing.

6) RTN (Return) Button—A momentary push button that switches the display to the active waypoint, VORTAC, or ILS frequency. This button is useful after you have entered new data for other waypoints and want to return to the navigation data presently in use.

7) USE Button—After calling up a previously entered RNAV waypoint, VORTAC or ILS frequency with the Waypoint Select Knob, depressing this momentary push button will put in use that waypoint, VOR, VORTAC, or ILS frequency.

8) RAD (Radial) Button—This two-position button is normally operated in the outer position. When depressed (inner position), the remote digital DME indicator will display the radial you are on (from the active waypoint or VORTAC station) instead of groundspeed and time to station. This feature can be helpful in many navigation situations. This feature becomes inoperative in DME hold mode or when DME is tuned from another NAV receiver.

9) CHK (Check) Button—Pressing this momentary push button displays the aircraft's present position from the VORTAC by replacing the waypoint parameters normally displayed over RAD and DST on the KNS 81 display with the radial and distance from the VORTAC station

Displays:

10) System Status Displays—Complete mode annunciation tells you what mode (VOR, VOR/PAR, RNV, or RNV/APR) is active. Note: When an ILS Frequency is selected, the system automatically goes into the ILS mode regardless of what mode is annunciated.

11) WPT (Waypoint) Display—Shows the waypoint number of the waypoint data storage bin that is being displayed on the KNS 81's digital readout. When the displayed waypoint number is different from the active waypoint, the WPT will blink.

12) Caret Display (><)—Indicates the waypoint parameter (frequency, radial, or distance) that the Data Input Knobs are controlling. The Caret Display cycles from FRQ to RAD to DST and back to FRQ as the Data Button is pressed.

13) FRQ (Frequency) Display—Shows the frequency entered into the system for VOR, VORTAC or Localizer stations with the Data Input Knobs. When selecting a frequency, the Carets must be below the frequency display.

14) RAD (Radial) Display—Shows the VORTAC station radial on which the waypoint is located and is selected by the Data Input Knobs when the Caret is below the radial display. When the CHK button is pressed, this area will display the radial from the VORTAC station to the aircraft—an aid in determining crossfixes and position reports. (Note: In the VOR mode, this display will show dashes to indicate that RNAV radial information is irrelevant.)

15) DST (Distance) Display—Shows the distance the waypoint is offset from the VORTAC station and is selected by the Data Input Knobs when the Caret is below the distance display. To help determine crossfixes and position reports, this area will display the distance from the VORTAC station to the aircraft when the CHK button is pressed. (Note: In the VOR mode, this display will show dashes to indicate that RNAV distance information is irrelevant.)

Remote DME Displays

With the KNS 81 system, all DME information is presented simultaneously on a separate panel-mounted indicator. In order to generate precise DME Data, the remote-mounted DME unit electronically converts into distance the elapsed time required for signals to travel to and from the ground station. The resulting computation is then presented in nautical miles on the DME panel display. This distance, commonly referred to as "slant range" distance, should not be confused with actual along-the-ground distance. The difference between actual ground distance and slant range distance is smallest at low altitude and long range; greatest at close range to the VORTAC facility. However if the range is 3 times the altitude or greater, this slant range error is negligible.

NM (Nautical Miles) Display—In the VOR and VOR/PAR modes, the DME indicator displays slant range distance to the VORTAC station—or dashes when the DME goes into search. In the RNV and RNV/APR modes, the DME indicator displays distance to the waypoint; dashes are displayed if the DME is in search, or if the VOR indicator flags.

KT (Knots) Display—In the VOR and VOR/PAR modes, the DME displays groundspeed to or from the VORTAC station or dashes when the DME goes into search. If the RAD button on the KNS 81 is pressed, the display indicates the radial from the VORTAC station instead of groundspeed. In the RNV and RNV/APR modes, groundspeed to or from the active waypoint is displayed and dashes appear when the DME goes into search or when the signal is unusable. If the RAD button is pressed while in these modes, the display indicates the radial from the waypoint instead of groundspeed.

MIN (Minutes) Display—In the VOR and VOR/PAR modes, the DME displays time to or from the VORTAC station or dashes when the DME goes into search. If the RAD button is pressed, the display shows the letter "F" to indicate "radial *from* the VORTAC station." In the RNV and RNV/APR modes, time to or from the active waypoint is displayed and dashes appear when the DME goes into search. If the RAD button is pressed, the display shows the letter "F" to indicate "radial *from* the waypoint."

Remote CDI-HSI Controls, Displays

OBS (Omni Bearing Selector) Knob—This control selects the desired course to or from the VORTAC station or waypoint.

Course Deviation—Full-scale sensitivity factors are as follows: VOR mode—±10°; VOR/PAR mode—±5 nm; RNV mode—±5 nm; RNV/APR mode—±1.25 nm; ILS mode—3 to 6° (depending on ground facility).

Flag Operation—In the VOR mode the CDI-HSI will be flagged when a usable signal is not within range. In the VOR/PAR, RNV, and RNV/APR modes, the instrument will be flagged if the VOR or DME data is invalid. In the ILS mode, it will be flagged if the Localizer or Glideslope data is invalid. When flagged, the needle on the CDI-HSI will center until a suitable signal is received to activate it and unflag the instrument.

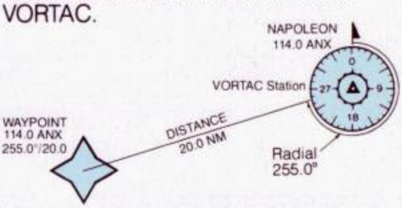
RNAV Review

Area navigation (RNAV) is a method of point-to-point navigation along any desired course within the service area of a VOR/DME station, without the need for flight over the station. This course is plotted with "waypoints."

What is a waypoint?

A waypoint is defined as a geographic position located within the service area of a VORTAC station. It may be used for route definition and/or progress reporting. A waypoint is often called a "phantom" station because it provides the RNAV user with the same navigation information that a real VORTAC station at that location would provide.

A waypoint is described by its radial and distance from the selected VORTAC station. The waypoint below is located on the 255.0° radial at a distance of 20.0 nm from the ANX VORTAC.



Reaching out with waypoints.

Some pilots have a tendency to plot waypoints close together—a technique that involves unnecessary planning and execution. Good RNAV technique suggests that you should "reach out" with the waypoints by placing them at least 100 nm or so apart. Experience will tell you what your technique should be. But the whole idea behind RNAV is to reduce pilot workload and shorten flight time. Remember, when selecting a waypoint from a particular VORTAC, the aircraft must be in the service range of the VORTAC for proper operation.

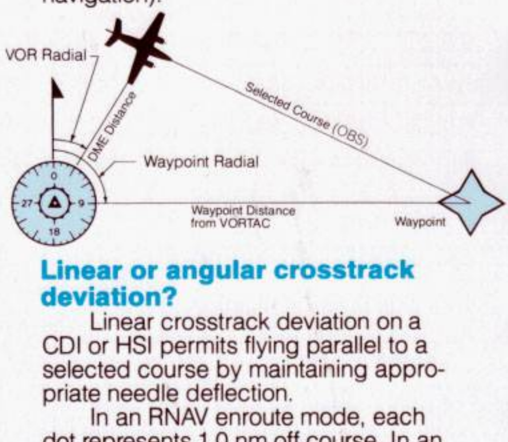
RNAV Geometry.

From basic geometry we know that if two sides of a triangle and the angle they form are given, the other sides and angles can be calculated. This is what the RNAV computer does.

Calculations based on waypoint radial, waypoint distance, and crosstrack deviation are supplied by the RNAV computer as solutions to continuously changing trigonometric equations during flight.

Known inputs to the RNAV computer are: (1) the VORTAC station radial that passes through the waypoint; (2) the distance from the VORTAC station to the waypoint; (3) the radial from the VORTAC station that the aircraft is on at any particular point in time; (4) the DME distance from the VORTAC station to the aircraft, and (5) the selected course (OBS) to the waypoint.

The RNAV computer continuously processes this information to supply the aircraft distance from the waypoint and crosstrack deviation of the aircraft from the selected course in nautical miles (linear deviation instead of the angular deviation used in conventional VOR navigation).

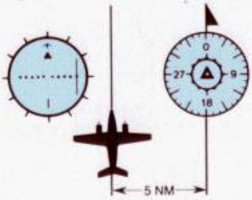


Linear or angular crosstrack deviation?

Linear crosstrack deviation on a CDI or HSI permits flying parallel to a selected course by maintaining appropriate needle deflection.

In an RNAV enroute mode, each dot represents 1.0 nm off course. In an RNAV approach mode, each dot represents 0.25 nm off course.

In a VOR mode, the RNAV computer is by-passed so that deviation



Linear Crosstrack Deviation

from the selected course is conventional angular crosstrack deviation expressed in degrees off course (one dot equals 2°).

In a VOR/PAR mode, you have in effect put the waypoint over the VORTAC station and will, therefore, be provided linear crosstrack deviation as in an RNAV enroute mode. Remember, VOR *and* DME information must be provided to the KNS 81 to operate in this mode.

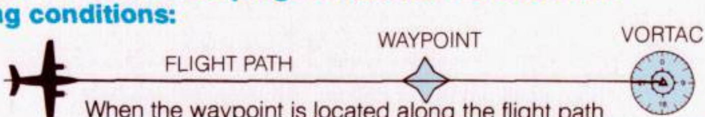
Variations in along track distance.

Under certain conditions, VOR scalloping can contribute significant variation in smoothness of the along track distance while operating in the RNAV modes.

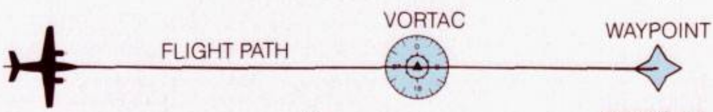
VOR scalloping is defined as an imperfection or deviation in the received VOR signal that causes radials to deviate from their standard track. VOR scalloping is generally the result of reflection from buildings or terrain. This deviation or scalloping effect causes the CDI needle to slowly or rapidly shift from side to side.

Factors contributing to VOR scalloping include: (1) VORTAC location in mountainous terrain when not a Doppler VOR; (2) snow cover on the ground around a VORTAC station.

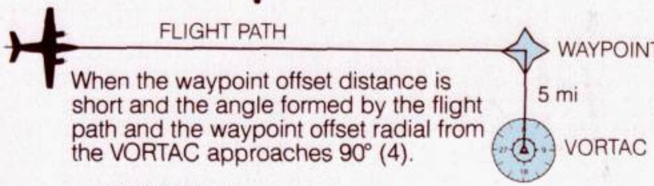
The effects of VOR scalloping are minimized under the following conditions:

1.


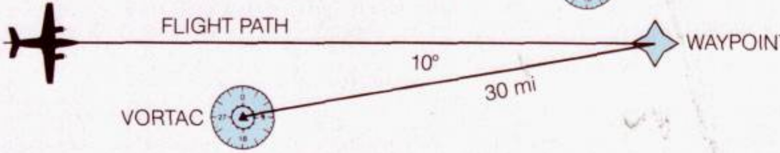
When the waypoint is located along the flight path either in front (1), behind (2), or at the VORTAC (not illustrated). The waypoint may also be located on the flight path with the VORTAC behind the airplane and the waypoint in front (3).

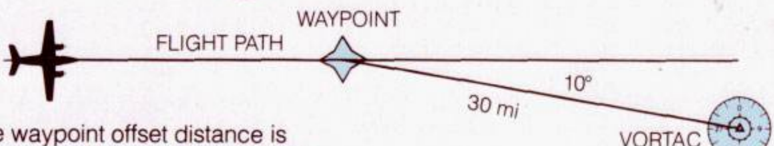
2.


3.


4.


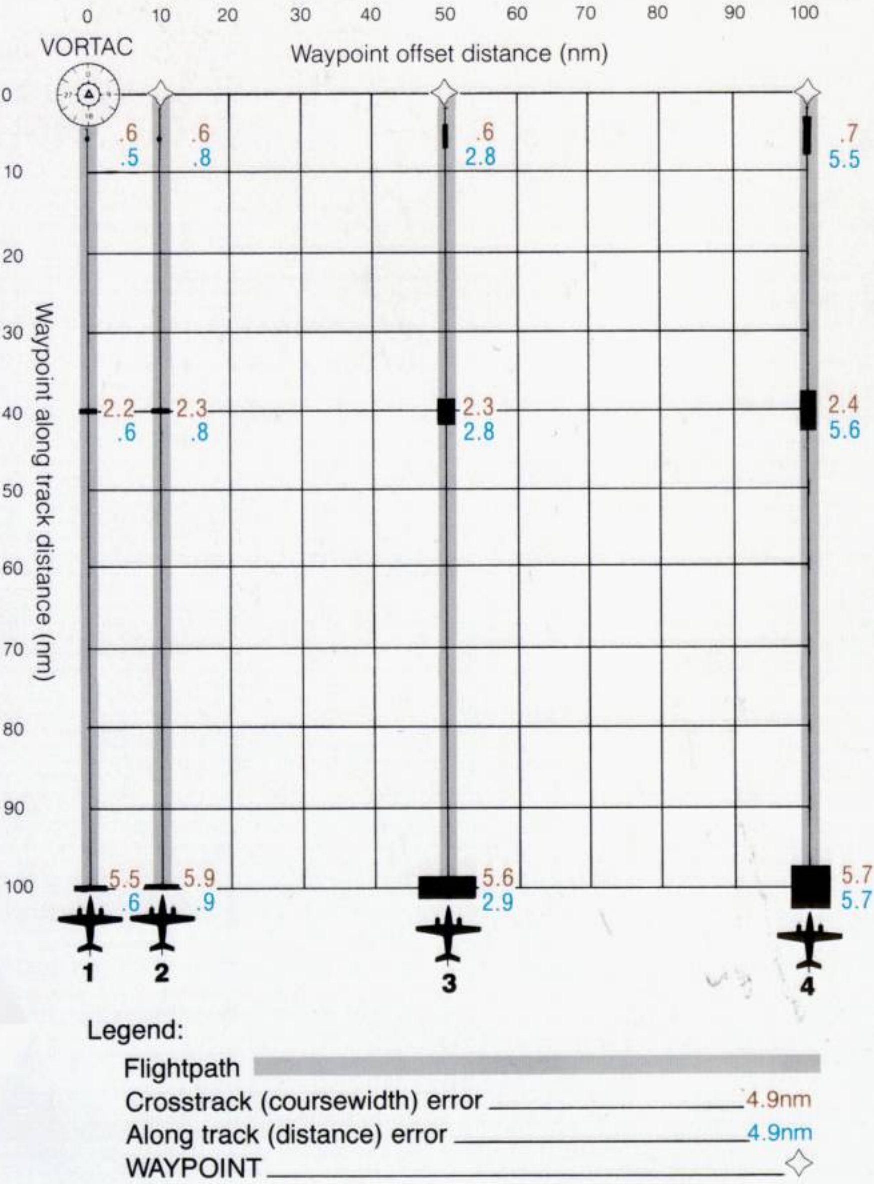
When the waypoint offset distance is short and the angle formed by the flight path and the waypoint offset radial from the VORTAC approaches 90° (4).

5.


6.


When the waypoint offset distance is long and the angle formed by the flight path and the waypoint offset radial is small (5) (6). (Note: When the angle is large, the distance needs to be short. Conversely, when the distance is long, the angle needs to be small. Another way of saying this is that the along track distance will have the least variation if the geometry is such that DME information is the major factor in computing along track distance.)

Along Track/Crosstrack Error



This illustration shows the along track and crosstrack errors that can occur with the RNAV working with a conventional VORTAC ground station.

How to interpret the Along Track/Crosstrack Error chart

The illustration shows four flight paths to waypoints being offset varying distances from the VORTAC. You will note that in flight path 1 the offset distance is zero; the waypoint, in other words, is located over the VORTAC. In this case, the along track and crosstrack error is minimal. This is because the along track error is totally derived from the DME and the crosstrack error is from the VOR.

Please note that the along track and crosstrack errors increase in flight paths 2, 3, and 4 as the waypoint offset perpendicular to the flight path increases. For example, on flight path 4—where the waypoint is offset 100 nm perpendicular to the flight path and the aircraft is 100 nm from the waypoint—the aircraft can be anywhere within a 5.7 nm square when the crosstrack needle is centered and the along track (distance) indicator is showing exactly 100 nm to go.

In summary, the illustration shows that the accuracy of the RNAV system is poorest when the waypoint offset distance and the aircraft distance from the VORTAC station is large. On the other hand, the RNAV accuracy is greatest when the waypoint offset distance and the distance from the VORTAC station is small.

KNS 81 System applications

In addition to conventional VOR/DME/LOC/GS functions, the KNS 81 System provides many advantages related to RNAV navigation:

Direct route navigation from point of origin to destination—without following the frequently circuitous Victor airways—is a basic use of RNAV. Determine your most direct route and set up as many as 10 waypoints at intervals along that route. (Remember: The KNS 81 stores all of the waypoint parameters needed—radial, distance, *and* frequency. Other systems store only radial and distance, thereby requiring you to change both the radial/distance data and the frequency in order to activate a new waypoint.)

Location of airfields that are not equipped with navigation aids is a common use of RNAV. Simply locate the airfield on your navigation chart and place a waypoint at that location.

Set up a holding pattern at any geographic point convenient to you or ATC. Establish a waypoint at that location, then fly your pattern just as if it were a real VORTAC station, using your course deviation needle and DME for reference.

Locate weather breaks reported by Flight Service or Air Traffic Control. Establish a waypoint at that location and fly directly to it.

Determine penetration time of ADIZ or restricted areas. Establish a waypoint at your planned point of penetration, then fly directly to that waypoint. You will be provided continuous distance and time-to-waypoint information with your KNS 81.

A parallel route to an airway may be established simply by using the KNS 81 in the VOR/PAR mode and maintaining a constant course deviation on your CDI (1 nm per dot, up to ±5 nm full-scale). A parallel route to the airway but farther out may be accomplished by establishing waypoints the same distance out from each of the VORTAC stations that define the airway.

Position reports requested by ATC often come during periods of heavy pilot workload. With the KNS 81, you can use the CHK Button feature to get an immediate readout of radial and distance from the VORTAC station even when in the RNAV mode.

Radial from the waypoint, VORTAC or VOR If you wish to know the radial from the waypoint, VORTAC or VOR without disturbing your OBS, simply depress the RAD Button and the system will provide you with distance and radial information from a waypoint or VORTAC station.

RNAV charts for RNAV Approaches SIDs, and STARs are available from NOS or Jeppesen.

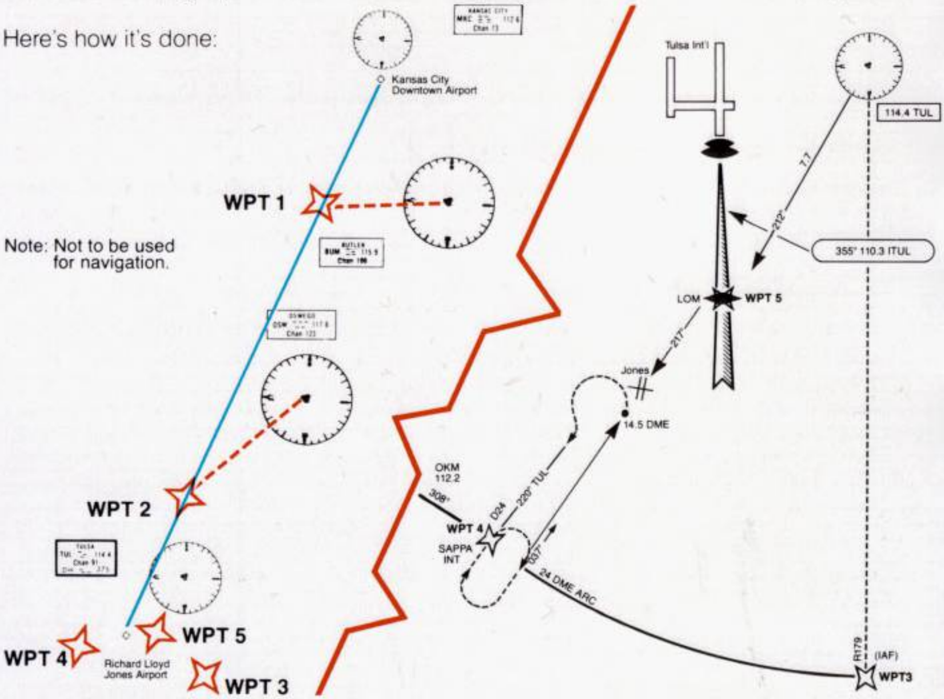
Learning to use the KNS 81

The KNS 81 Integrated NAV System is remarkably versatile and easy to use. After you have experienced a few flights with it, you will begin to develop flight management techniques that will greatly relieve your workload during both IFR and VFR operations.

To illustrate some of the ways you can use the KNS 81, imagine that you have charted a flight plan from Kansas City Downtown Airport direct to Richard Lloyd Jones, Jr. Airport in Tulsa. In anticipation of possible below minimums conditions on arrival, you have prepared for a missed approach to Jones and a subsequent ILS approach to Runway 35R at Tulsa International.

Even before starting the engines in Kansas City, the necessary data can be programmed into the KNS 81 computer.

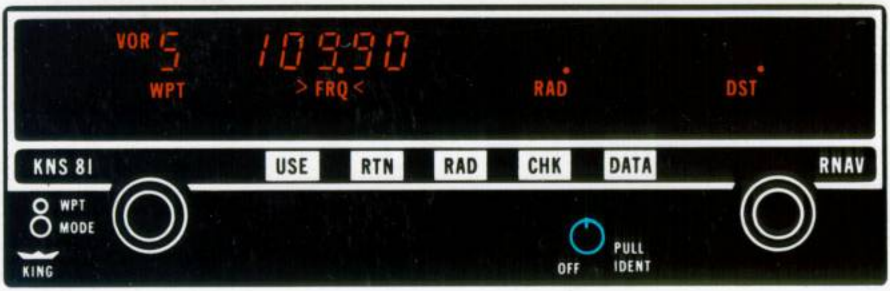
Here's how it's done:



WAYPOINT	STATION	FREQUENCY	RADIAL	DISTANCE	APPLICATION
1	BUM	115.90	264.0°	23.4 nm	Enroute Navigation
2	OSW	117.60	225.0°	25.0 nm	Enroute Navigation
3	TUL	114.40	179.0°	24.0 nm	Initial Approach Fix for DME-Arc
4	TUL	114.40	220.0°	24.0 nm	Entrance to Holding Pattern
5	TUL	114.40	212.0°	7.7 nm	Locator Outer Marker
6	I-TUL	110.30	(N/A)	(N/A)	ILS Frequency
7	—	—	—	—	Available for Use
8	—	—	—	—	Available for Use
9	—	—	—	—	Available for Use

Waypoint data entered

Programming the waypoints



Turn on the KNS 81

Turn the system on by rotating the Power/Volume Control clockwise.

When the system is first turned on, the information being displayed prior to the last shutdown will be displayed again. In this example, the information is the ILS frequency (109.9) at Kansas City Downtown Airport.

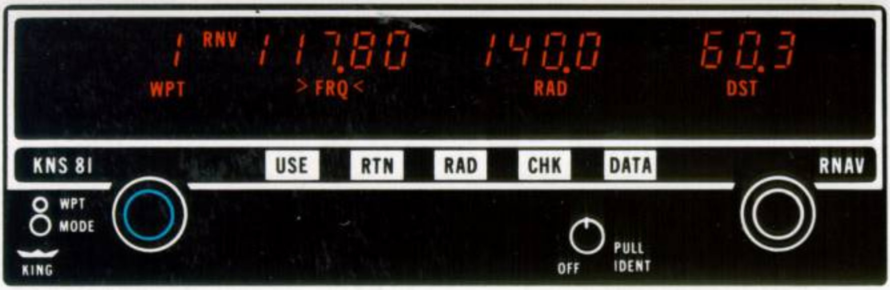
Notice that no other information is displayed. This is because the system automatically goes into the ILS mode whenever an ILS frequency is dialed in, thereby eliminating the need for radial and distance data. When the ILS frequency is removed from the input, the system reverts back to the mode annunciated and displays the appropriate information.

The KNS 81 has a nonvolatile memory and will retain programmed data indefinitely through power shutdowns. No batteries are necessary.

Select the navigation mode

Since data storage bin 1 is to be used for enroute RNAV operation, program the computer appropriately by turning the Mode Select Knob until "RNV" appears on the System Status Display.

In addition to the RNV and RNV/APR modes, you may also select from a VOR mode (direct to a VOR station) or a VOR/PAR mode (parallel to the selected course or Victor airway with linear crosstrack deviation).



Select the first data storage bin

Turn the Waypoint Select Knob either clockwise or counterclockwise until the number "1" is displayed above the legend "WPT". This provides access to the first of ten data storage bins.

The legend "WPT" will immediately start blinking to indicate that the data displayed is not the active data. It will continue to blink until the USE Button is pressed to call the data storage bin being displayed into active use.

Notice that the ILS frequency display has been replaced with other information. This is because the ILS frequency is contained in storage bin 5 and the system has been switched to storage bin 1—which in this example still contains data for a previous RNAV approach to the Downtown Airport Initial Approach Fix.

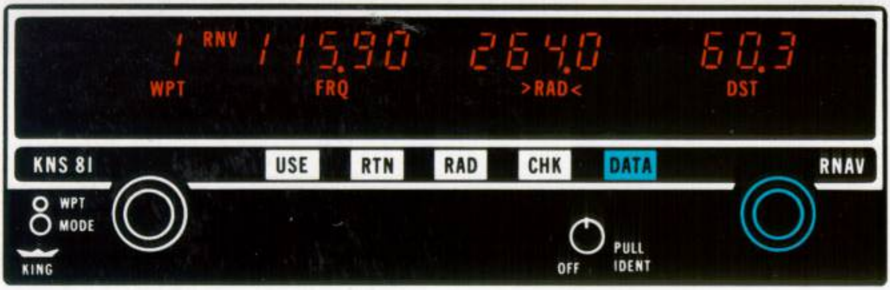
In order to program the system's memory with the new data for storage bin 1, the old data will be changed—or updated—one piece at a time.

Select the frequency

According to the flight plan, the first station to be used is Butler VORTAC (115.90/BUM).

Prepare this information for programming by turning the large Data Input Control knob until "115" appears on the display. Then turn the small knob until "90" appears. The frequency is now stored in the system.

When the DATA Button is pressed, the Caret Display will automatically move from FRQ to RAD, indicating that you may now update the information for the waypoint's radial.



Select the radial

Using the Data Input Knobs, dial in the waypoint's radial (264.0°) from the VORTAC station. The large knob changes the 10° and 100° digits, while the small knob changes the 1° digit when it is in the "in" position, and the 0.1° digit when it is in the "out" position.

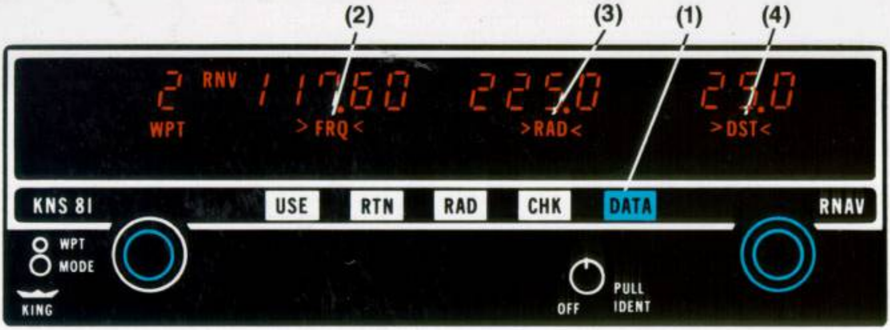
By pressing the DATA Button, the Caret Display will automatically move from RAD to DST so that you can now update the DST (distance) information.

Select the distance

Once again using the Data Input Knobs, dial in the distance from the VORTAC station to the waypoint (23.4 nm in this example). The large knob changes the 10 and 100 nm digits, while the small knob changes the 1 nm digit when it is in the "in" position, and the 0.1 nm digit when it is in the "out" position.

The legend "WPT" is still blinking so, you can either move on to program the second storage bin, or you can press the USE Button to call the first storage bin into active service and thereby cause the WPT display to stop blinking. Upon pushing the USE Button, the Caret Display will return to its "rest" position under "FRQ".

Note: The navigation mode (VOR, VOR/PAR RNV, RNV/APR) is not stored with the waypoint information. With the exception of automatic selection of ILS mode, the pilot must manually select the appropriate navigation mode desired using the larger concentric knob on the lower left of the KNS 81.



Program the second data storage bin

The second group of waypoint parameters may be entered into the system's memory in the same fashion. The usual procedure is to change to the next WPT number and then by depressing the DATA Button (1), move the caret from FRQ (2) to RAD (3) to DST (4)—although any sequence may be used as long as the WPT number is selected first.

In the photo above, waypoint 2 of our example—25 nm on the 225.0° radial of OSWEGO VORTAC (117.6/OSW)—has already been programmed and the KNS 81 system is ready to accept other waypoints and their parameters.

Pre-flight system check

Before takeoff, check to be sure that RNV is still the active mode and that waypoint 1 is the in "USE" or active waypoint.

(Since you have already pressed the USE Button on waypoint 1, it should be the active waypoint . . . unless you have pressed the USE Button while another waypoint number was displayed. If waypoint 1 is still the active, any other waypoint number being displayed will be blinking. By pressing the RTN Button, you can cause the display to return to the active waypoint.)

Notice that the remote, panel-mounted DME is displaying dashes in all windows. This indicates that it is in search. When you reach line-of-sight altitude, the DME will lock on and provide distance, groundspeed, and time to the waypoint or VORTAC station depending on operational mode selected. The CDI or HSI will also be flagged until both VOR and DME are valid.

Navigating to waypoint 1

After takeoff, you receive departure vectors to the southwest of Kansas City and then a clearance to proceed under your own navigation direct to the first RNAV waypoint.

At this point, your DME is providing information regarding distance, groundspeed, and time to waypoint 1. Since the aircraft is not yet flying directly to the waypoint, only distance information is valid. Remember that groundspeed and time-to-station information are accurate only when flying directly to or from the station or waypoint.

But in order to fly direct to the waypoint and eliminate an inconvenient dogleg, it would be helpful to know precisely what heading you should pick up. The KNS 81 can provide this information.

Getting a waypoint radial reading

With the KNS 81 in RNV mode, press the two-position RAD Button to its "in" position and the remote DME display changes from distance, groundspeed, and time-to waypoint—to distance and radial from the waypoint—in this case, 005°. Simply use the OBS knob on your CDI to place the reciprocal of that radial (185°) under the lubber line and fly to center the needle. If you do not wish to use this feature, you can turn the OBS knob until the needle centers and the TO-FROM indicator is signalling "To". This will be your course direct to WPT #1.

(At this time, you may also want to check the ident of the VOR station by pulling the Power/Volume Control to its "out" position. When the station has been identified, you can return the control to its "in" position to mute the ident tones.)

Waypoint passage

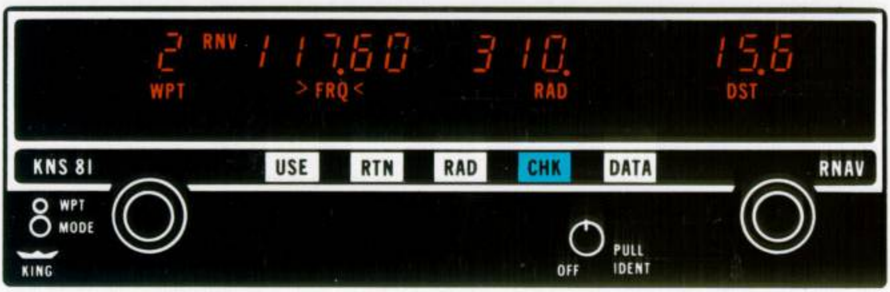
You are now passing over waypoint 1. The TO/FROM flag on your CDI shifts to the FROM position and the needle holds steady. If the Autopilot is coupled to NAV, waypoint passage will be smooth, with the wings remaining level.

From this point, your flight plan calls for a course of 192° direct from waypoint 1 to Jones Airport in Tulsa. Use your OBS knob to place 192° under the lubber line, fly to center the needle, and continue on the outbound course from waypoint 1.

Changeover to waypoint 2

At about 35 nm outbound from waypoint 1, you prepare for changeover to waypoint 2. Just turn the Waypoint Select Knob until the number "2" is displayed, along with the waypoint parameters programmed earlier. Since waypoint 1 is still the active waypoint, the "WPT" display is blinking.

When you are ready for changeover, press the USE Button and waypoint 2 will become active. The DME display will display dashes for a few seconds, then will begin to display distance, groundspeed, and time information to the new waypoint.



Making a fast position report

With the KNS 81, you don't need to switch from the RNAV operation mode in order to give the controller an accurate position report. Instead, you are able to respond immediately.

In the above photo, your aircraft is located 29.2 nm DME from waypoint 2. But where is it in relationship to the VORTAC station? Just press the momentary CHK Button on the KNS 81 and you get the answer above the RAD and DST legends on the KNS 81—15.6 nm on the 310° radial—without disturbing the OBS or the distance to the waypoint displayed on the remote DME indicator.

Reaching waypoint 3

You have switched over to waypoint 3 and kept the needle centered. Now you are coming up on the waypoint, which was placed at the location of the Initial Approach Fix for a 24-nm DME-Arc approach to Jones Airport in Tulsa.

Navigating a DME-Arc

In order to fly the DME-Arc approach, press the DATA button until the carets rest under the RAD legend. As you pass the original 3rd waypoint, change the radial to 189°, recenter the needle on the CDI and fly to keep the needle centered on the CDI. Continue using this technique of moving the waypoint along the Arc until reaching the 217° radial for your turn inbound.

Completing the approach

As you turn inbound on the 217° radial and start your descent, switch the KNS 81 to the VOR mode and set the OBS to the proper inbound course for the approach (037°) and make the approach as you normally would.

By depressing the RAD button on the KNS 81 during the approach, you get not only distance to the VORTAC but digital radial in addition to course deviation on the CDI.

Continue your approach toward the missed approach point at 14.5 DME.

A waypoint at the holding pattern

When you reach the missed approach point and still do not have the runway in sight, the approach plate calls for a "climbing left turn to 2400 ft. via TUL VORTAC R-220 to Sappa Intersection and hold."

Upon turning and intercepting the R-220 switch to waypoint 4 (already programmed for the entrance to the holding pattern), press the USE Button, and turn the Mode Select Knob to the RNV mode.

This will allow you to navigate directly to the holding pattern and hold at the intersection the same way you would hold over a VOR or VORTAC.

A waypoint at the outer marker

While being vectored from the holding pattern to the Outer Compass Locator or LOM for the Tulsa International approach, you can use the KNS 81 to tell you where you are at all times.

Remaining in the RNV mode, call up waypoint 5—the one you programmed earlier to mark the position of the Tulsa International LOM—and press the USE button. In this configuration the remote DME indicator will display distance to the LOM. By pressing the RAD button, the radial from the waypoint (the LOM) will also be displayed.

With the OBS set to the inbound LOC course the displaced needle of the CDI will display the distance from the extended LOC since in the RNAV mode, one dot deviation equals one nm off course.

And pressing the CHK Button periodically provides you with an instant display of the radial and distance from the VORTAC station.

Tuning the ILS frequency

As you approach the LOM, turn to waypoint 6, and depress the USE button for the ILS frequency you programmed before your departure. You'll probably want to tune the VORTAC on your number 2 NAV receiver and place the switch on your remote DME indicator to the "2" position so that the DME will continue to provide you with distance information to the TUL VORTAC throughout the approach. Fly the approach into Tulsa International.

You can see from this representative flight that the KNS 81 is easy to use and makes your IFR flying easier and more efficient. The above examples are just some of the many uses you'll find for the KNS 81.

A word on DME Hold.

If you prefer, instead of switching the DME over to your number 2 NAV receiver during the ILS approach, you can keep it locked onto the VOR frequency indicated on your KNS 81 by using the DME Hold function on the KDI 572 remote indicator. It's simply a matter of remembering to put the KNS 81 in the VOR mode first and flipping the DME selector switch into the HLD position before changing over from the VOR to the ILS frequency. You'll still get distance information to the VORTAC throughout the approach.

But while it's a useful convenience to have in a situation like this, **a word of caution** is advised regarding the use of DME Hold with the KNS 81's other operating modes.

Since the DME Hold switch in effect isolates certain DME functions from the logic of the KNS 81's RNAV computer, the information being processed is rendered incomplete. Thus, it is recommend that DME Hold be used only in connection with straight VOR/ILS navigation, and not with RNAV or its related modes.

For example, here's what you can expect to see when DME Hold is activated on each of the KNS 81's operating modes.

In VOR Mode, of course, the system will continue to operate normally, as described above. The CDI-HSI will provide regular VOR/ILS navigation, and the KDI 572 remote DME indicator will continue to display distance, groundspeed and time to VORTAC.

However, when the CHK Button is pressed with the system in DME Hold, only the radial portion of the position check will be displayed on the KNS 81. The distance portion will display dashes to indicate that DME information is not available to the KNS 81. Nevertheless, the remote KDI 572 indicator will continue to display the complete distance, groundspeed and TTS sequence.

The function of the RAD Button is rendered inoperative in the DME Hold mode. Information displayed on the KDI 572 will not be affected by the position of the RAD button.

In VOR/PAR Mode, which requires RNAV inputs, use of DME Hold will make the navigation signal unusable. The CDI-HSI will be flagged and its indicator needle will center and become inactive. Otherwise, the display functions of the KNS 81 and KDI 572 will react in much the same way as they did in the VOR Mode. Again, depressing the RAD button will have no effect on the information displayed.

In RNAV and RNAV/APR Modes, the use of DME Hold will render the Area Navigation computer's output invalid. Thus, the CDI-HSI will be flagged and its indicator needle will center and become inactive. In addition, all indications except for a flashing RNV mode annunciation will be blanked from the KDI 572 DME indicator. As a result, when the CHK button is pressed, only the frequency and radial are displayed on the KNS 81.

As you can see, the DME Hold function expands the KNS 81's capabilities in certain VOR/ILS operations, but severely limits them in regard to Area Navigation. Consequently, you'll want to use the DME Hold switch with discretion in all but a few recommended situations in order to gain maximum utility from your KNS 81 system.

KNS 81 Integrated NAV System Specifications

Size (including mounting rack):
- Length . . . . 11.48"(29.16 cm)
- Height . . . . 2.00"(5.08 cm)
- Width . . . . 6.31"(16.03 cm)
- Weight . . . . 5.0 lbs. (2.3 kg)

Power Requirement: 11 to 33 VDC, 15 watts maximum
- 13.75 VDC@1.0 amps
- 27.50 VDC@0.5 amps

TSO Compliance:
- NAV: C40a (DO-153A)
- LOC: C36c, Class D, Cat II (DO-131A)
- GS: C34c, Class D, Cat II (DO-132A)
- RNAV: Per FAA AC 90-45A

NAV RECEIVER AND CONVERTER

Frequency Range: 200 channels, 108.00 to 117.95 with 50 kHz spacing (crystal controlled synthesizer)

Sensitivity: 2.0 μv max. (hard) will provide a flyable course indication

Selectivity: 6db@ ± 17.4 kHz, 80 db @ ± 42.0 kHz

Spurious Responses: At least 60 db down

VOR Accuracy: Typically less than ± 1° error

RNAV SECTION

Number of Waypoints: 10

Waypoint Distance: Selectable on digital display, zero to 199.9 nm in 0.1 nm increments

Waypoint Radial: Selectable on digital display from zero to 359.9° in 0.1° increments

Bearing and Distance Accuracy: Meets FAA Advisory Circular 90-45A accuracy requirements

Course Width, VOR Mode: ± 10.0°

Course Width, VOR Parallel Mode: ± 5.00 nm

Course Width, RNAV Enroute Mode: ± 5.00 nm

Course Width, RNAV Approach Mode: ± 1.25 nm

EXTERNAL OUTPUTS

RNAV, ILS, APP External Annunciator:
- Active State: less than 0.3V@75 ma
- Off State: High impedance (more than 100K ohm)
- 33V max.

OBS Resolver: 30 Hz ORZ resolver meeting ARINC requirements

Course Deviation: up to 5 floating 1,000 ohm loads

VOR/LOC Warning Flags: up to 5 floating 1,000 ohm loads

NAV Audio Output: 50 mw min. into 500 ohm (volume control)

GLIDESLOPE SECTION

Frequency Range: 40 channel, 329.15 to 335.00 MHz with 150 kHz spacing

Sensitivity: 10 μv or less for 60% of standard deflection

Selectivity: less than 6 db@ ± 21 kHz, at least 40 db@ 129 kHz off channel

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