BENDIX/KING

KNS 660 PILOT'S GUIDE

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OPERATIONAL REVISION STATUS (ORS)

IMPORTANT

THIS KNS 660 PILOT'S GUIDE IS APPLICABLE TO KNS 660 SYSTEMS WITH THE FOLLOWING LEVELS OF OPERATIONAL REVISION STATUS (ORS).

ORS 02, 05, or 06

The ORS level is annunciated on the Self Test page each time the KNS 660 system is turned on. While all KNS 660's with like ORS levels have the same general operational characteristics as explained in this manual, it is still the pilot's responsibility to review the aircraft's KNS 660 Flight Manual Supplement for unique characteristics which may be applicable to the aircraft's KNS 660 installation.

EXPLANATION OF DIFFERENCES IN ORS LEVELS

ORS 02: Operational characteristics applicable to installations incorporating various combinations of the following navigational sensor inputs: VOR/DME, TACAN, OMEGA/VLF, and Inertial Reference Units.

ORS 05: Operational characteristics are similar to ORS 02 with the exception of differences in the compatable navigation sensor inputs. KNS 660 systems with ORS 05 are compatable with the ANI/ONI 7000 LORAN Navigational Sensor and all the navigational sensors used on ORS 02 systems with the exception that Inertial Reference Units are not used.

ORS 06: Operational characteristics are similar to ORS 02 with the exception of differences in the compatable navigation sensor inputs. KNS 660 systems with ORS 06 are compatable with Global Positioning System navigation sensors, in addition to all navigational sensors used on ORS 02 systems. Information related to inappropriate sensor selection for different phases of flight will be displayed to insure that ORS 06 KNS 660 systems meet the navigational accuracy criteria of TSO C115.

NOTE

ALL NAVIGATION DATA PRESENTED BOTH IN THE TEXT AND IN THE ILLUSTRATIONS OF THIS PILOT'S GUIDE IS INTENDED FOR EXAMPLE ONLY AND, THEREFORE, IS NOT TO BE USED FOR ACTUAL NAVIGATION.

INTRODUCTION

You are about to learn how to operate one of the most sophisticated Navigation Management systems ever designed for any class of aircraft. As you probably already know, the KNS 660 has tremendous navigational and flight planning capabilities. Although it was designed so that its operation is as logical and straightforward as possible, you'll want to study this Pilot's Guide in detail before using the KNS 660 in order to make maximum utilization of its extensive features.

Whether you have thousands of hours using keyboard navigation systems or this is your first opportunity to use one, this Pilot's Guide has been written and organized to lead you comfortably through mastering the KNS 660's capabilities to whatever level you require. Because an aircraft cockpit seldom offers an ideal classroom learning environment, several hundred figures and illustrations have been included in this Pilot's Guide to maximize its usability for home study. The better the job you do of familiarizing yourself with the KNS 660, the better you'll be able to utilize its powerful features and the more pleased you will be with the system.

This Pilot's Guide is divided into ten sections plus appendices. In general, it is organized so that to derive maximum benefit from it, you start at the first section and proceed to Section VII in the order presented. Section VIII, Ferry Operation, is a stand alone section. If your KNS 660 system has the optional OMEGA/VLF sensor and if this is your first experience in using OMEGA/VLF you may wish to start with a review of Section IX which explains a few of the basics of that type of navigation. Section X provides a basic explanation of the NAVSTAR Global Positioning System. At various times you may wish to refer to Appendix A which illustrates the meaning of some of the navigational terms relevant to the KNS 660 and to Appendix B and Appendix C which contain catalogs of two types of messages.

Section I provides a brief description of the components which make up a KNS 660 system. It also shows the system architecture and illustrates what is meant by the term "multi-sensor navigation system".

Section II contains several basic concepts of operation which are imperative for you to understand in order to make full use of the KNS 660 system. This Section is important because it helps present "the big picture" of the system which will greatly aid you in understanding the details of operation explained in later sections of this Pilot's Guide.

Section III gives a description of each of the keys on the Control Display Unit (CDU). In Section IV you will see the format and type of information presented on each "page" of the Cathode Ray Tube (CRT) display.

For the purposes of easier learning, this Pilot's Guide structures normal operation of the KNS 660 into three levels. Section V contains Level I operation which explains the basics of using the KNS 660 for DIRECT TO enroute navigation. Section VI (Level II Operation) continues with additional information used in enroute navigation and explains how the KNS 660 may be utilized for terminal and approach navigation. Level III operation is contained in Section VII which provides information on more advanced navigation procedures as well as explanation of additional features such as Frequency Management, Trip Planing and Fuel Planning. At the end of Sections V and VI are examples of system operation which demonstrate many of the concepts presented in these sections.

Section VIII, Ferry Operation, is intended only for those persons who have a one time immediate requirement to use the KNS 660 as an aid in VFR navigation and who will not be using the KNS 660 on a continuing basis. As mentioned earlier, Section IX is a summary of information which may be helpful to you concerning OMEGA/VLF navigation.

Section X provides information on the NAVSTAR Global Positioning System.

Okay--turn to Section I and let's get started.

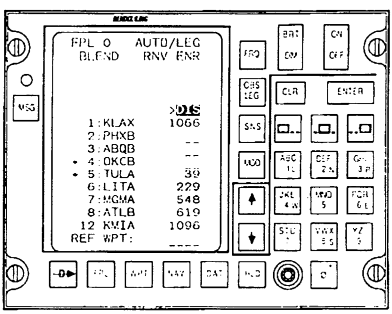
I Components

SECTION I

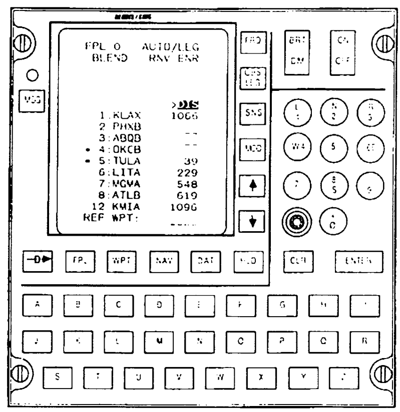
THE KNS 660 SYSTEM COMPONENTS AND DESCRIPTION

The KNS 660 is an integrated, long range, multi-sensor flight management system developed to meet the needs of a wide range of corporate, airline, and military aircraft operators. It consists of a cockpit mounted control display unit (CDU), the KCU 567 or KCU 568, a remote-mounted navigation computer, the KNC 667, and when configured with the optional OMEGA/VLF, an E-Field or H-Field antenna. A Rubidium Frequency Standard is also available as an additional option when the system contains the OMEGA/VLF.

CONTROL DISPLAY UNITS



KCU 567



KCU 568

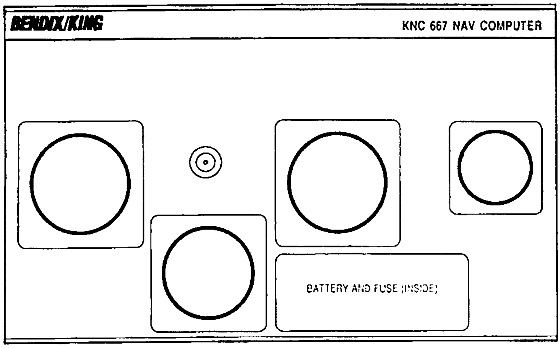
You will use the cockpit mounted Control Display Unit (CDU) as a means of communicating with the KNS 660 system. All manual data entry as well as system, sensor, and mode control is made via the CDU. A choice of two CDU's provides exactly the same control and display capabilities for the KNS 660 system. The KCU 567 offers combined alpha-numeric keys and is 4.5 inches in height while the KCU 568 has separate alpha keys and numeric keys and is 6.0 inches in height.

Both CDU's utilize the same rectangular 4 inch diagonal monochromatic Cathode Ray Tube (CRT). This large CRT provides sixteen lines of data display and a more flexible and efficient data presentation than systems using smaller CRT's. Its advantage to you is that it allows more information to be displayed per "page " and thus fewer "pages" for you to have to change back and forth between in order to view the required information.

Both CDU's utilize dedicated special function keys which are separated from the alpha-numeric keys. The benefit to you is a reduced number of keystrokes required for operation as well as a reduction in having to learn how keys serve multiple functions.

KNS 660 SYSTEM COMPONENTS AND DESCRIPTION

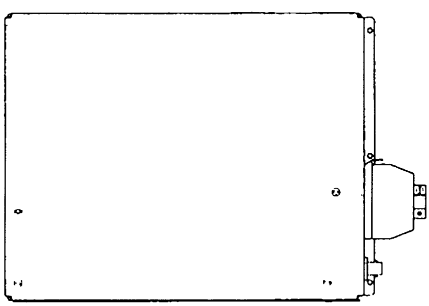
KNC 667 NAVIGATION COMPUTER



KNC 667

You will probably see the KNC 667 Navigation Computer only rarely since it is remote-mounted in your aircraft. Actually, it contains the sophisticated computational power and memory which allows the KNS 660 system to perform the powerful navigation functions required for your aircraft. The KNC 667 contains the navigation computer and the navaid/airport Data Base as well as the flight plan and waypoint memory. The optional OMEGA/VLF receiver is also contained within the KNC 667. The KNC 667 also provides direct interface with all the inputs and outputs of the various units which can be interfaced with the KNS 660 system.

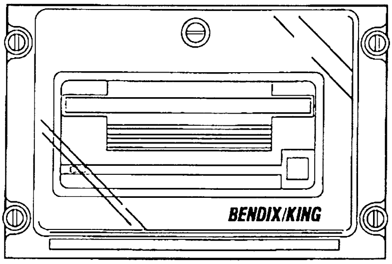
KNR 620 VOR SENSOR (Optional)



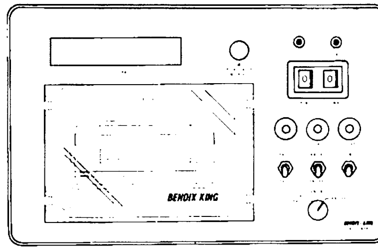
KNR 620

Your KNS 660 system may contain a dedicated KNR 620 VOR Sensor which is mounted directly on top of the KNC 667 navigation computer.

KDL 569 DATA LOADER (Optional)



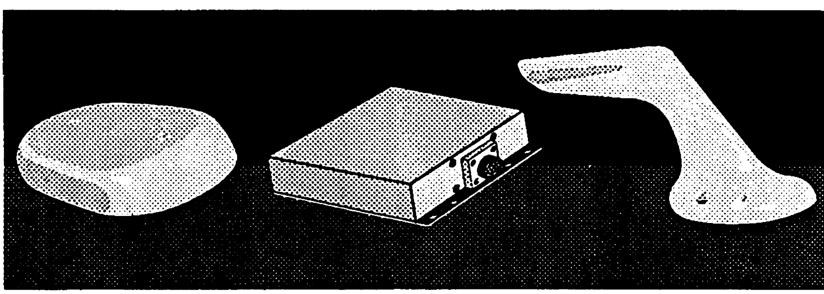
KDL 569



KDL 569R

The KNS 660 comes with a standard Data Base self contained in the KNC 667. This Data Base is updated using the KDL 569 Data Loader and a 3.5 inch floppy diskette which is sent directly to subscribers every 28 days. The KDL 569 may be either Dzus mounted in the aircraft or mounted in a BENDIX/KING supplied portable case (KDL 569R). Both KDL 569 configurations allow users to easily and conveniently update the KNS 660 Data Base themselves right in their aircraft any time the aircraft is on the ground.

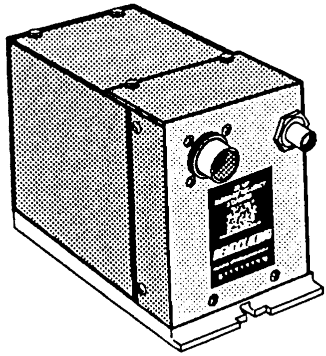
OMEGA/VLF ANTENNAS (Optional)



H-FIELD EXTERNAL H-FIELD BRICK E-FIELD

If your KNS 660 system contains the optional OMEGA/VLF it may be configured with a variety of OMEGA/VLF antennas to meet the installation requirements of your aircraft. The E-Field blade antenna is mounted external to the aircraft. The "brick" type H-Field antenna is internally mounted while the "teardrop" type H-Field antenna is externally mounted.

RUBIDIUM FREQUENCY STANDARD (Optional)



KA 167

The KA 167 Rubidium Frequency Standard allows the OMEGA/VLF to navigate with a minimum of two usable OMEGA/VLF signals, (i.e., two OMEGA signals or two VLF signals or one of each). Without the KA 167 three usable signals are required for OMEGA/VLF operation.

Two or more KNS 660 systems can not be interfaced simultaneously with a single KA 167.

KNS 660 SYSTEM ARCHITECTURE

The KNS 660 system is designed to be a building block system in that it can be configured with a variety of position sensors as well as a variety of display devices. Any one of many possible configurations may be present in a given installation. The primary benefit of this architecture is the flexibility that allows you to tailor the system to meet your specfic mission requirements. You may use the KNS 660 system to manage the entire range of navigational functions including long range great circle navigation, terminal and approach navigation, and vertical navigation. In addition, complete management of Comm, NAV, and ADF frequencies as well as transponder codes may be accomplishied from the CDU when configured with the appropriate avionics.

NOTICE

THE SPECIFIC CAPABILITIES OF THE KNS 660 DEPEND UPON THE PARTICULAR CONFIGURATION OF THE KNS 660 SYSTEM IN YOUR AIRCRAFT AS WELL AS THE COMPATIBILITY OF EQUIPMENT TIED TO THE KNS 660. REFER TO THE FLIGHT MANUAL SUPPLEMENT FOR YOUR AIRCRAFT TO LEARN THE CAPABILITIES AND LIMITATIONS APPLICABLE TO YOUR SPECIFIC INSTALLATION.

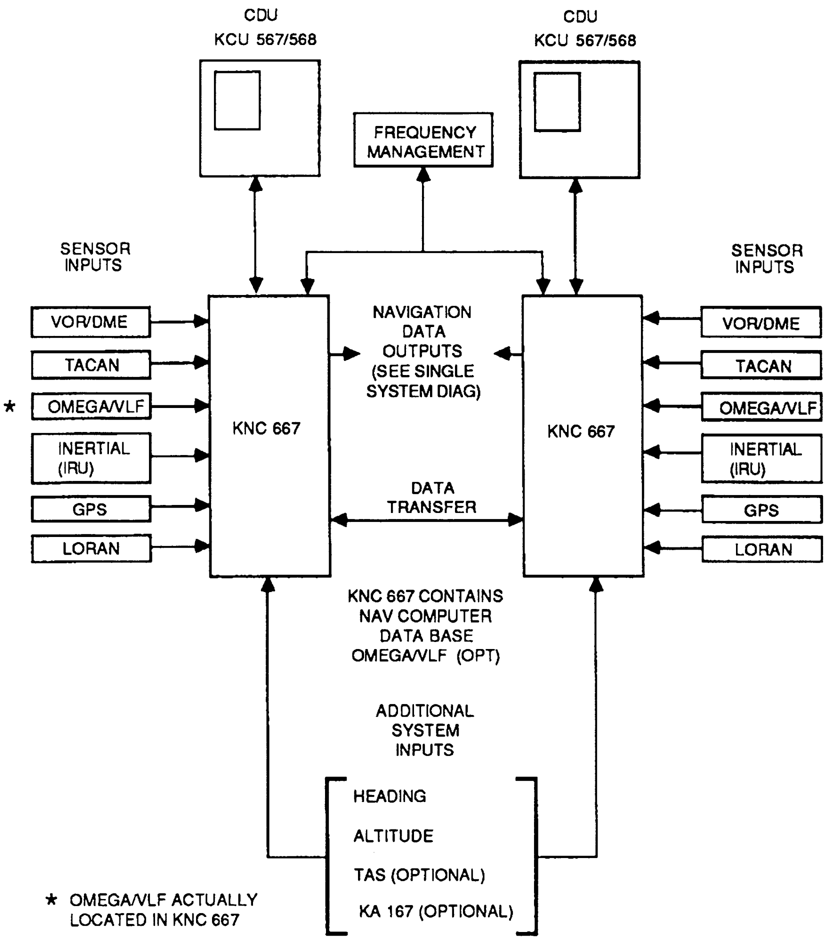
Specifically, there are versions of the KNS 660 which will accept navigation inputs from the following choice of sensors.

VOR	-	BENDIX/KING VNS 41, KNR 634/634A, Collins VIR 32
DME	-	BENDIX/KING DMS 44 A, KDM 706A, Collins DME 42
TACAN	-	BENDIX/KING KTU 709
OMEGA/VLF	-	A BENDIX/KING design optimized to provide a sensor function only. Its location is internal to the KNC 667 computer.
INERTIAL	-	Honeywell Laser Inertial Reference Unit (IRU)
GPS	-	BENDIX/KING KLN 670 remote mount Global Positioning System sensor or GPS sensor internal to the KNC 667.
LORAN	-	ANI/ONI 7000 LORAN-C Navigator

In addition, the KNS 660 uses aircraft heading and altitude inputs and will also use true airspeed (TAS) if available. With the exception of OMEGA/VLF and GPS, each of the sensors used is mounted external to the KNC 667 Navigation computer. Note that the standard Data Base is mounted internal to the KNC 667.

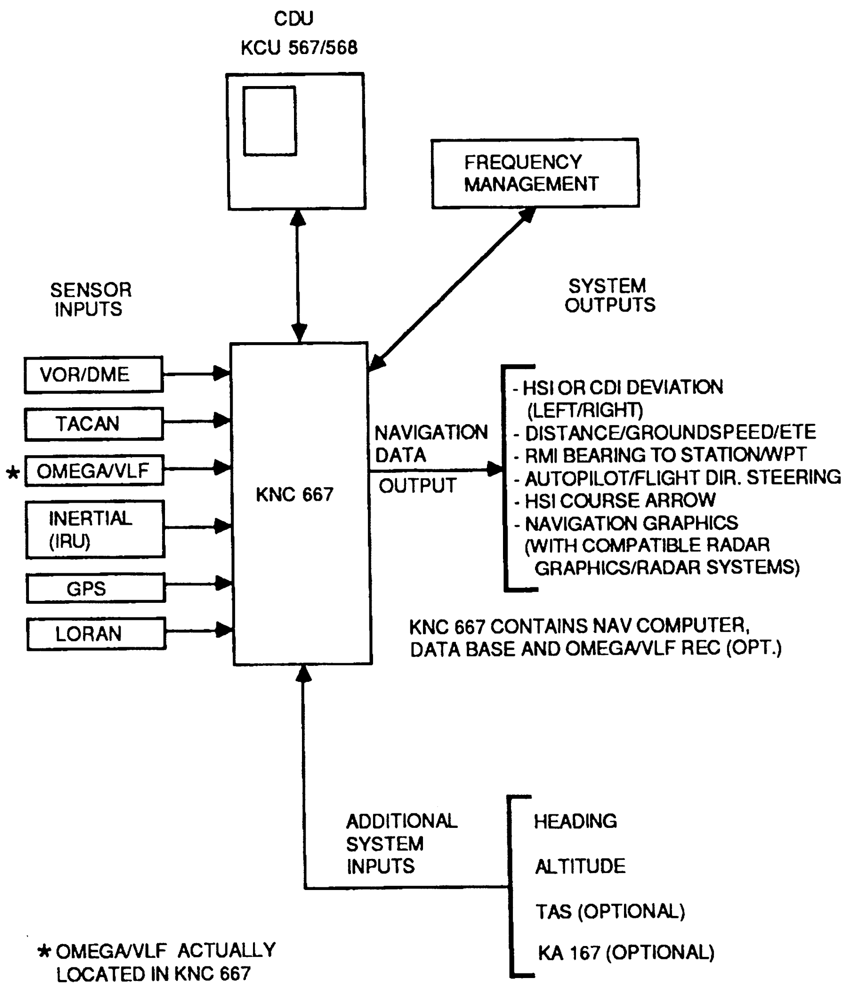
KNS 660 SYSTEM COMPONENTS AND DESCRIPTION

DUAL KNS 660 SYSTEM



Your particular KNS 660 system may have one or more of the possible navigation sensors shown. Even if the KNS 660 is configured as a minimum system (VOR/DME sensors) without a "long range" sensor such as OMEGA/VLF or GPS, this system is still quite capable of providing excellent long range great circle navigation over any part of the world where adequate VOR/DME service is provided.

SINGLE KNS 660 SYSTEM



A Dual KNS 660 system in your aircraft would provide greater redundancy and the ability to meet certain regulatory and operational requirements.

II Concepts

SECTION II

CONCEPTS OF OPERATION

Remember back in your early flight training days (way. . . back then) how your flight instructor used to diagram on the blackboard or on a sheet of scrap paper things like "ground reference maneuvers" or Chandelles and Lazy Eights? There was little use in trying to fly the maneuvers until you understood the concept of what you were trying to accomplish. Likewise in learning to use the KNS 660. Understanding several elementary yet important concepts will make your continued learning of the KNS 660 much easier.

EARTH ORIENTED NAVIGATION

An important concept to understand is that of Earth Oriented Navigation. Regardless of which navigation sensors are used, the KNS 660 is, in general, an Earth Oriented Navigation system. This means that the system keeps track of its present position in terms of the earth's latitude and longitude coordinate system. (Figure 2-1).

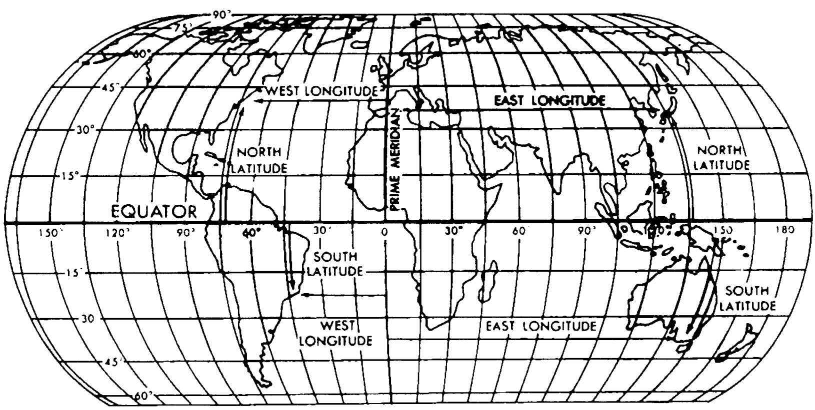


Figure 2-1

The significance of this fact is that you, the pilot, must tell the system "where you want to go" in a latitude and longitude (lat/long) format or in a format that the KNS 660 can convert to latitude and longitude. Also, the position sensors providing input to the KNS 660 must tell the system "where they are" in a lattitude/longitude format or in a format the system can convert to lat/long. Some examples will help illustrate these points.

If you input to the system that your destination is KMKC (Kansas City Downtown Airport), the KNS 660 can query its Data Base (memory of navaids, airports, etc.) to learn that the latitude and longitude coordinates of the KMKC Airport Reference Point (ARP) are North 39° 07.4' and West 94° 35.6'. Thus an identifier of an airport or a navaid is an example of a format the system can use since it defines a unique latitude and longitude on the surface of the earth. Oh, but you say, what if the Data Base contains the same identifier for more than one navaid?

EARTH ORIENTED NAVIGATION (Cont'd)

Yes, it does occur and when it does the KNS 660 will ask you to select the country of the navaid you wish to use. You could, of course, just input the lat/long of KMKC directly; but that's not taking advantage of the Data Base which is one of the KNS 660's most powerful features. Another example of an acceptable earth oriented format for inputting the KNS 660 would be to tell the system you wanted to define a waypoint which is located 25.0 miles on the 180° radial from TUL (Tulsa VORTAC). Again, the system looks up the latitude and longitude of TUL in its Data Base. It then computes the latitude and longitude of a point 25.0 nm and 180° from TUL which is the waypoint you defined.

The following are examples of earth oriented waypoints.

Example 1:	ATL	—	The identifier of Atlanta VORTAC. The Data Base furnishes the lat/long.
Example 2:	KLAX	—	The identifier of Los Angeles Int'l. Airport. The Data Base furnishes the lat/long of the Airport Reference Point (ARP).
Example 3:	AA1 N 37° 53.4' W 105° 40.3'	—	A pilot named waypoint defined in lat/long.
Example 4:	NATL TUL 217° 13.5 nm	—	A pilot named waypoint defined in terms of Tulsa VORTAC at an offset of 217° and 13.5 nm.
Example 5:	AA2 KDEN 92.0° 6.2 nm	—	A pilot named waypoint defined in terms of Stapleton Int'l. Airport (ARP) in Denver at an offset of 92.0° and 6.2 NM.

There is one exception to the rule of the KNS 660 always providing earth oriented navigation. You will learn in Section VII that a Localizer frequency may be entered directly from the CDU when the system is to be used for shooting an ILS or a localizer approach.

The position sensors connected to the KNS 660 must also input to the system in a latitude and longitude format or in a format that the KNS 660 can convert to latitude and longitude. OMEGA/VLF and Inertial sensors by their very nature determine position in latitude and longitude. The KNS 660 can use these position inputs directly. On the other hand, you've probably been using VOR/DME or possibly TACAN for years and never had either of these sensor systems display position in terms of latitude and longitude. So how does the KNS 660 determine your present position in latitude and longitude from VOR/DME? The key is a latitude/longitude conversion computer contained within the KNS 660. This conversion computer acquires from the Data Base the latitude and longitude of each of the NAV stations (VORTAC, VOR/DME, TACAN, etc.) from which it is receiving information.

EARTH ORIENTED NAVIGATION (Cont'd)

At the same time the conversion computer is receiving angle and distance information supplied from the NAV receiver and DME (or from multiple DME stations). The KNS 660 is capable of determining its present position by using distance and angle (also referred to as Rho-Theta) from one NAV station or by using distance-distance (referred to as Rho-Rho) from two DME stations. Refer to Figure 2-2.

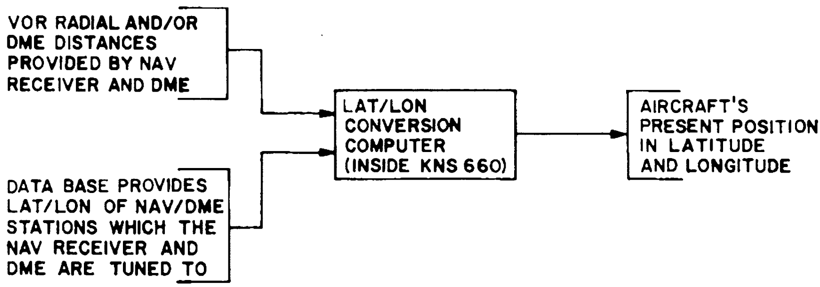


Figure 2-2

NOTE

THE KNS 660 CONTAINS AN AUTOMATIC MAGNETIC VARIATION PROGRAM WHICH FUNCTIONS BETWEEN THE LATITUDES OF NORTH 70° AND SOUTH 60°. FOR FLIGHT OUTSIDE OF THESE AREAS THE SYSTEM MUST CONTAIN A SOURCE OF TRUE HEADING (AN INERTIAL REFERENCE UNIT) AND TRUE HEADING MUST BE SELECTED ON THE NAV 2 PAGE (REFER TO SECTION VII)

METHODS OF OPERATION

An understanding of the two primary Methods of Operation is essential for proper operation of the KNS 660. The two Methods of Operation are Automatic Leg and Manual Omnibearing Selection. They are annunciated on the CDU display as AUTO/LEG and OBS, respectively, and are selected using the OBS/LEG key on the CDU. By selecting AUTO/LEG or OBS you are instructing the navigation computer in the KNS 660 to function as either a point-to-point Great Circle computer or as a conventional "TO-FROM" pilot-selected-course computer. An optional third Method of Operation, Automatic Three-Dimensional Leg (annunciated AUTO 3D) is selectable on some KNS 660 installations and is just an extension of AUTO/LEG operation.

NOTE

YOU CAN DETERMINE IF YOUR SYSTEM IS CAPABLE OF AUTO 3D OPERATION BY REPEATEDLY PRESSING THE OBS/LEG KEY ON THE CDU WITH THE SYSTEM TURNED ON. IF THE TOP LINE ON THE RIGHT SIDE OF THE CDU DISPLAY CYCLES FROM OBS TO AUTO/LEG TO AUTO 3D AND BACK TO OBS YOUR SYSTEM HAS AUTO 3D CAPABILITY. IF THE DISPLAY CYCLES ONLY BETWEEN OBS AND AUTO/LEG THE SYSTEM DOES NOT HAVE AUTO 3D CAPABILITY.

AUTO/LEG METHOD OF OPERATION

The AUTO/LEG Method of Operation is used almost exclusively for enroute navigation. It is not used for shooting an approach. There may be some occasions, however, where OBS operation is used for enroute navigation. Any one of the sensors configured in a KNS 660 system may be selected for use in AUTO/LEG operation including BLEND which uses position inputs from all available sensors.

The best way of explaining the characteristics of AUTO/LEG operation is with an example. Refer to Figure 2-3 for the following discussion of AUTO/LEG operation. The illustration represents an active KNS 660 Flight Plan consisting of three waypoints.

NOTE

IT IS POSSIBLE TO OPERATE THE KNS 660 IN THE FOLLOWING OPERATIONAL STATUS:

METHOD OF OPERATION:	AUTO/LEG (or AUTO 3D)
SENSOR:	VOR (or TACAN)
MODE:	RNV APR

THIS IS NOT THE CORRECT OPERATIONAL STATUS FOR SHOOTING AN RNAV APPROACH. THIS OPERATIONAL STATUS IS INTENDED ONLY FOR USERS WHO HAVE DEVELOPED (AND HAD APPROVED BY THE APPROPRIATE AUTHORITIES) SPECIALIZED INSTRUMENT APPROACHES WHICH CAN UTILIZE THIS FUNCTION OF THE KNS 660.

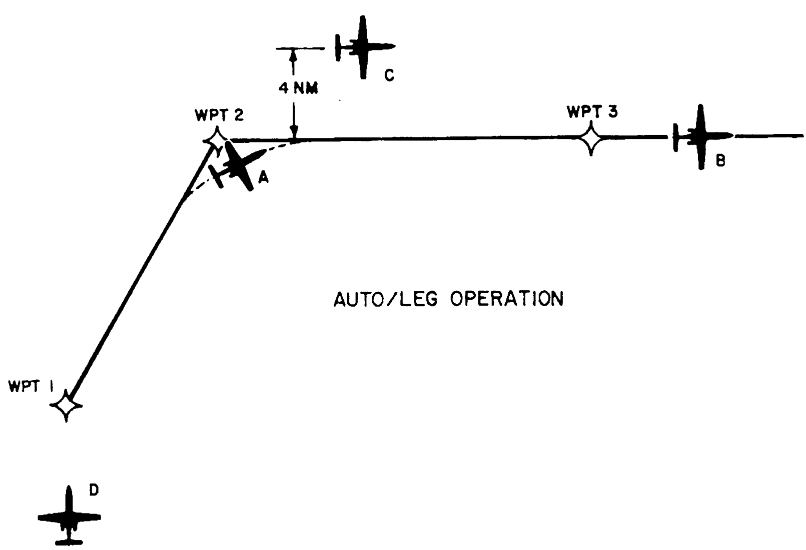


Figure 2-3

AUTO/LEG METHOD OF OPERATION (Cont'd)

1. Great Circle Navigation

In the AUTO/LEG Method of Operation, the system operates along Great Circle legs defined by waypoint pairs of the active flight plan. As you probably know, Great Circle navigation is the shortest distance between two points located on the Earth's surface. To fly a Great Circle course between two points you may be flying a constantly changing course. A good way to demonstrate this point is with a world globe and a piece of string. You can determine the Great Circle route between Kansas City, Missouri and Singapore by stretching the string over the globe between these two points. Notice that you would start the flight on a Northwesterly course, which gradually becomes due Westerly and finally Southwesterly by the time you reach Singapore!

If the aircraft were to take off from waypoint 1 in the illustration, the KNS 660 would provide Great Circle navigation between waypoint 1 and waypoint 2. As the aircraft reached waypoint 2, the system would provide Great Circle Navigation between waypoint 2 and waypoint 3.

When the DIRECT TO [—D→] feature of the KNS 660 is used in AUTO/LEG operation, the system provides Great Circle navigation from the point the DIRECT TO operation was activated to the DIRECT TO waypoint. DIRECT TO operation is presented in Section V.

2. Turn Anticipation and Automatic Waypoint Sequencing

Upon approaching a waypoint the KNS 660 will generate a curved path segment to ensure a smooth transition (no overshoot within reasonable limits of course angle change) between adjacent courses. The transition course is based upon the aircraft's actual groundspeed and the amount of course angle change. After passing the midpoint in a transition segment, the KNS 660 automatically sequences to the next leg. In the illustration the transition course is represented with a dashed line. Before the aircraft actually reaches waypoint 2, it begins flying the transition course. When the aircraft is half way through the transition course (location A) the system automatically sequences to the second leg and the system will now provide Great Circle navigation from waypoint 2 to waypoint 3.

In DIRECT TO operation the system provides turn anticipation and automatic waypoint sequencing only when the DIRECT TO waypoint is part of the active flight plan. When the DIRECT TO waypoint is reached in this case, the system provides normal navigation along the rest of the flight plan.

3. Waypoint Alerting

In order to notify the pilot that automatic waypoint sequencing and a leg change are about to occur, the KNS 660 activates a waypoint alert annunciator which is typically mounted in the aircraft panel. Activation occurs approximately 15 seconds before turning onto the transition course. If the aircraft is approaching the last non-ILS waypoint in the flight plan or is approaching a DIRECT TO waypoint which is not part of the active flight plan, activation begins approximately 90 seconds before reaching the waypoint.

AUTO/LEG METHOD OF OPERATION (Cont'd)

4. Automatic Course Slewing

If the system is configured with a compatible HSI or EHSI, the KNS 660 will automatically keep the course select arrow slewed to the correct Great Circle course. Upon reaching a leg change point, the system will drive the course select arrow on the HSI to the Great Circle course defined by the new active pair of waypoints. If the KNS 660 is configured with an HSI which doesn't have a compatible driven course select arrow the pilot must manually set the course on the HSI.

5. Automatic Navaid Selection and Tuning of VOR Navigation receiver and DME (Refer to the note on Page 2-4.)

If the system is configured with the appropriate VOR and DME sensors the KNS 660 will automatically provide all navaid selection and tuning. If VOR has been chosen as a sensor (either VOR alone or BLEND) the system may use the angle provided by the VOR navigation receiver and the distance from the DME to determine position (Rho-Theta Navigation). However, it may instead use the DME distances from two separate navaids to determine position (Rho-Rho navigation).

Since Rho-Rho Navigation provides a more accurate determination of position, the system will Rho-Rho Navigate in AUTO/LEG operation whenever conditions are appropriate for it to do so. Rho-Rho Navigation is provided by the system the vast majority of the time when the aircraft is at altitudes with good DME (or TACAN) coverage. The system will automatically switch back and forth between Rho-Rho and Rho-Theta Navigation as necessary. The bottom of the VOR/DME Status page, described in Section IV, tells if the system is providing Rho-Rho or Rho-Theta Navigation, although it's usually immaterial to the pilot.

Another possible configuration is for the KNS 660 system to have the OMEGA/VLF sensor and/or the Inertial sensor with a DME sensor but no VOR sensor. In this case the DME sensor is able to provide Rho-Rho position updates to these sensors.

The important point to remember here is that when operating in AUTO/LEG you do not specify which navaids the system is to use. The KNS 660 will automatically chose and tune whatever navaids are required to provide navigation to the active waypoint.

6. Automatic Tuning of TACAN

The discussion presented in paragraph 5 applies to TACAN if a TACAN sensor is configured in a KNS 660 installation. Both Rho-Theta and Rho-Rho navigation are possible.

7. Last Course Continuation

If for some reason the pilot of the aircraft in Figure 2-3 continued flying past the last waypoint in the flight plan (location B), the KNS 660 would continue to provide navigation along the same course it had used just prior to crossing waypoint 3.

AUTO/LEG METHOD OF OPERATION (Cont'd)

8. Orientation to Proper Flight Plan Leg

   If the aircraft in Figure 2-3 had departed from location C (instead of from waypoint 1 as in our earlier example) using the same flight plan, the system would have automatically oriented itself along the closest leg of the flight plan. In this case the system would have chosen waypoint 3 as the active TO waypoint. It would indicate to the pilot that the aircraft was four nautical miles to the left of the Great Circle course between waypoint 2 and waypoint 3.

   On the other hand, if the aircraft in Figure 2-3 had departed from location D, the KNS 660 would provide Great Circle navigation from its present location to waypoint 1. Normal turn anticipation and waypoint sequencing would occur upon reaching waypoint 1.

9. Sensor/Mode Combinations

   Not all combinations of sensors (VOR, OMEGA, INS, etc.) and modes (RNAV Enroute, RNAV Approach, and NAV) can be used in AUTO/LEG operation. The appropriate combinations are described in Section V.

OBS METHOD OF OPERATION

The OBS Method of Operation is often used when operating in the terminal navigation environment and must be used when shooting instrument approaches. There are instances when it may be used in the enroute navigation environment, also. If the KNS 660 is installed in the aircraft as an independent long range NAV, the OBS Method of Operation may rarely be used. However, if the system is installed as the primary number one (or number two) NAV in the aircraft, it may be commonly used. Using OBS operation is quite similar to using traditional VOR/DME area Navigation equipment. Any of the sensors included in the KNS 660 installation can be used including BLEND. The illustration in Figure 2-4 and the description which follows explain the concept of OBS operation.

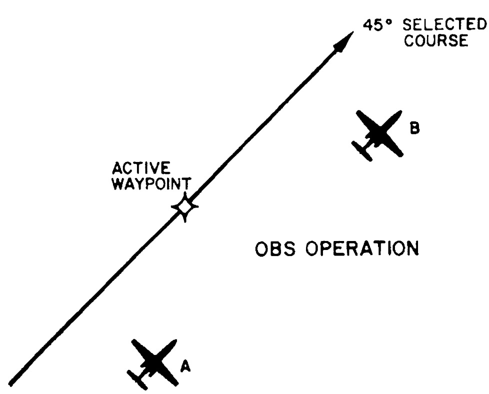


Figure 2-4

OBS METHOD OF OPERATION (Cont'd)

1. Manual Course Selection

   The pilot must manually select the course TO or FROM the active waypoint. The course may be selected using one of these procedures: (note that not all of these procedures are applicable to every KNS 660 installation. Refer to Section VI for specific instructions.)

   a. Using the CDU keyboard to enter the course on the top line of the display.

   b. Using the course select knob on the HSI.

   c. Using the [—D→] Direct To key on the CDU to automatically center the course arrow on the HSI with a TO indication.

   d. Using the remote course select knob located on the aircraft's console or instrument panel.

   In Figure 2-4 the pilot has selected a course of 45°. If the aircraft were at location A, the HSI would be indicating TO with the D-bar to the left of center. If the aircraft were in location B, the HSI would be indicating FROM with the D-bar to the left of center.

2. Manual Waypoint Selection

   The pilot must manually choose the active waypoint. There is no automatic waypoint sequencing or turn anticipation in OBS operation.

3. Waypoint Alerting

   In order to notify the pilot that waypoint passage is about to occur, the KNS 660 activates a waypoint alert annunciator which is usually mounted in the aircraft panel. Activation occurs approximately 90 seconds before reaching the waypoint.

4. 200 Nautical Mile Limitation

   Regardless of the sensor being used, operation in OBS should be avoided when greater than 200 NM from the active waypoint. This is due to extremely high D-Bar sensitivity to selected course values a long range.

5. Mandatory Waypoint Reference for VOR Sensor

   When using the VOR sensor (either individually or in BLEND) the pilot must specify a reference navaid which is the particular navaid to be used in defining the waypoint. The KNS 660 system will tune the VOR navigation receiver and the DME to only this reference navaid. This is unlike the AUTO/LEG operation where the KNS 660 automatically chooses which navaids (VORTAC's, VOR/DME's TACAN's, etc.) to use. If the active waypoint is a navaid the system automatically chooses this navaid as the reference navaid. However, if the active waypoint is not a navaid (an airport or intersection, for example) the pilot must specify which navaid the system is to use. The reference navaid is specified on the Waypoint page for the active waypoint and is described in Section V, "Defining Waypoints".

OBS METHOD OF OPERATION (Cont'd)

The system will never Rho-Rho navigate in OBS operation. It is important to understand only the concept at this time. The actual procedures for using the KNS 660 for OBS operation are explained in Section VI.

6. Sensor/Mode Combinations

   Not all combinations of sensors (VOR, OMEGA, INS, etc.) and modes (RNAV Enroute, RNAV Approach, and NAV) may be used in OBS operation. The appropriate combinations are outlined in Section V.

DATA BASE CONCEPTS AND RULES

Utilization of a Data Base is a key factor in allowing the KNS 660 to be such a powerful, yet easy-to-use navigation system. Just what is a Data Base? It's an area of electronic memory used to store a large catalog of navigational data. The KNS 660 comes standard with a self-contained Data Base.

There are two primary ways that the Data Base is used by the KNS 660. The first way can be thought of as a sophisticated "look-up" table. Rather than having you manually locate and then enter the latitude and longitude for a specific waypoint such as Tulsa International Airport, the Data Base allows you to simply enter an alpha-numeric ICAO identifier such as KTUL and have the Data Base automatically look up and display the associated latitude and longitude. It's obvious that the Data Base saves a lot of tedious latitude/longitude entry and also greatly reduces the potential for data input mistakes.

The other primary way the KNS 660 uses the Data Base is to allow navigation with the VOR and DME (or TACAN) sensors as was discussed in METHODS OF OPERATION. To do so, navaids must be loaded in the Data Base. In AUTO/LEG Method of Operation the KNS 660 constantly searches the Data Base for navaids (VORTAC's VOR/DME's, TACANS, etc.) close to the aircraft's present position. Since all the navaid's associated data such as frequency, type, class, elevation, magnetic variation, and location is stored in the Data Base, the KNS 660 can automatically (1) determine which navaids to tune for maximum accuracy, (2) channel the VOR NAV receiver and DME to the appropriate frequencies and (3) evaluate the radial and distance information from the VOR NAV receiver and DME to determine the aircraft's present latitude and longitude. In OBS Method of Operation the use of the Data Base is similar except that the KNS 660 channels the VOR NAV receiver and DME only to the navaid specified in the REF NAME field on the Waypoint page.

The information stored in the Data Base would eventually become obsolete if there wasn't some means to update it. For example, VORTAC's can move or change frequency, new runways at an airport can add outer markers and change the airport reference points, airways and approaches change along with their associated intersections, and on and on. The Data Base is updated using a 3.5 inch diskette and the KDL 569 Data Loader shown in Section I. The actual update procedures are contained in Section V.

KING DATA BASE REVISION CYCLE

Every 28 days, several days prior to the effective date of the next revision, a diskette is sent to each KNS 660 Data Base subscriber which includes a complete set of new worldwide data. The update should be accomplished using the procedures in Section V anytime before the effective date of the revision. If the KNS 660 isn't in operation at 0000 GMT on the effective date, the system automatically switches to the revised data. If the KNS 660 is in operation at 0000 GMT on the effective date, the system automatically switches to the revised data the next time it is turned on. If for some reason the KNS 660 does not get updated with the latest diskette revision data prior to the effective date, the system will continue to function but will provide a message informing the user that the Data Base is outdated.

A small battery housed internal to the KNC 667 keeps the Data Base alive when power is removed from the system. Typical battery life is 6 years. When only a small amount of battery life remains (about one week) the system will display a message informing the user that the Data Base battery is low. The unit should then be taken to an authorized BENDIX/KING Service Center to have the battery replaced.

CONFIGURING THE DATA BASE

The floppy diskette contains worldwide navigation data. The International Civil Aviation Organization (ICAO) and Aeronautical Radio, Inc. (ARINC) break the world into ten geographic regions. The KNS 660 Data Base is organized using these ten geographical regions and they are shown in Figure 2-5. The boundaries shown are approximate and if more detail is required the latest revision of ICAO Document 7910 should be consulted.

The following are the geographic regions:

USA	Mid East
Canada	Africa
Latin America	Eastern Europe
Europe	Pacific
South America	South Pacific

The floppy diskette contains the following navigational elements for each of these ten regions. More complete definitions of these elements are contained in Section IV under the Review Elements page.

1. Navaids (VORTAC's, VOR/DME's, VOR's, ILS/DME'S, DME's, an TACAN's).
2. Airports having a hard surface runway at least 4,000 ft. in length.
3. Airports having a hard surface runway at least 3,000 ft. in length.
4. Runway Thresholds
5. Outer Markers
6. High Altitude Waypoints

CONFIGURING THE DATA BASE (Cont'd)

7. Low Altitude Waypoints

8. SID/STAR Waypoints

9. Approach Intersections

10. Multiple Waypoints (waypoints which serve as members of any combination of items 6, 7, 8 and 9).

All the worldwide navigation data contained on the floppy diskette may not fit in the KNS 660's internal Data Base at one time. Due to the duplication of ICAO identifiers in various geographical regions, operators may find it inconvenient to load all worldwide data simultaneously. It is possible to choose which geographical regions and which navigational elements within those geographical regions are desired to be loaded in the Data Base. The diskette can be used as many times as necessary during the 28 day period. Therefore, if the aircraft is to fly to an area of the world not currently loaded in the Data Base it is a simple matter to reconfigure the Data Base for new geographical areas and new navigational elements and reload the Data Base with the KDL 569 Data Loader. The procedures for configuring the Data Base and loading it into the KNS 660 are contained in Section V.

VLF STATION DATA

In addition to the navigation data previously described, the King Data Base also contains data for the Navy controlled network of VLF stations. Any changes to VLF station data are automatically accounted for in a routine diskette updating of the Data Base.

LORAN CHAIN DATA

KNS 660 systems with ORS 05 store information in the Data Base about LORAN ground stations and chains. This information is automatically updated with a routine diskette update.

ENTERING ICAO IDENTIFIERS

To access data from the KNS 660 Data Base it is necessary to use International Civil Aviation Organization (ICAO) identifiers. ICAO is an official internationally accepted reference for this data. BENDIX/KING obtains the information contained on the floppy diskette from companies which specialize in gathering and publishing airborne navigation data. In most cases the proper ICAO identifiers may be taken directly from Jeppesen-Sanderson publications such as high altitude charts, low altitude charts, area charts, approach plates, SID's, STAR's and other references.

NOTE:

NAVAIDS or Intersections may change location (sometimes in excess of 100 nautical miles), with the ICAO identifier staying the same, from one Data Base cycle to the next. The user should always verify the position of all waypoints in a previously stored flight plan, prior to use, to assure that the resulting flight path across the ground will be as expected.

DATA BASE GEOGRAPHICAL REGIONS

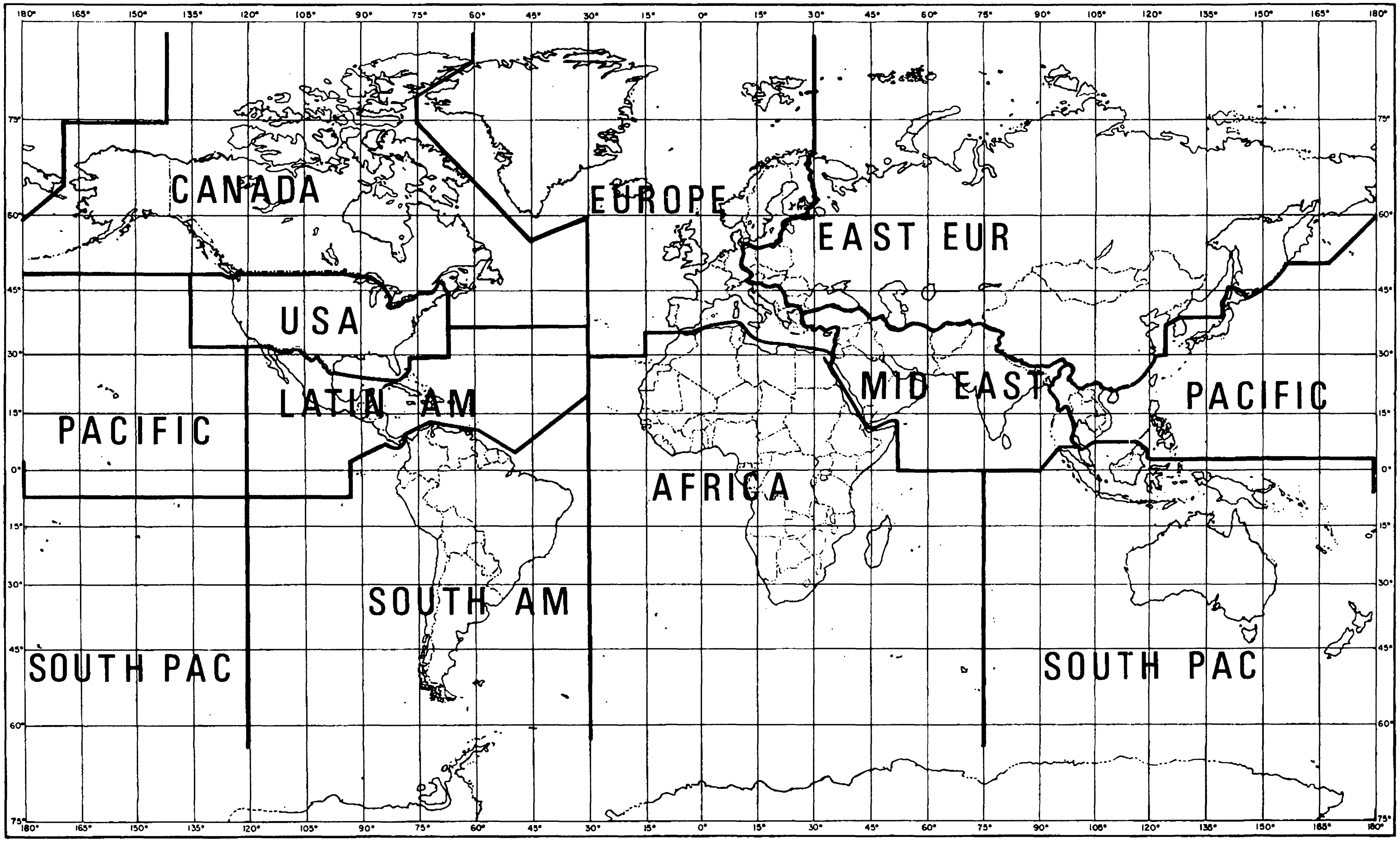


Figure 2-5

ENTERING ICAO IDENTIFIERS (Cont'd)

Airport ICAO Identifiers

Airport reference points are stored by the airport ICAO identifier. The majority of airport identifiers have four letters beginning with a prefix letter that corresponds to the geographic area in which it is located (Example: KJFK). The prefix letter for the Continental United States is "K" and the prefix letter for Hawaii and Alaska is "P". Not all airports' identifiers are four letters, however. Airport identifiers exist which are combinations of three or four letters and number (Examples: 3LA, 7TX6, M33).

The majority of Continental United States airports listed in Jeppesen-Sanderson publications, for example are in the offical ICAO format. The exception is an airport identifier which consists of three letters only with no numbers.

NOTE

IN THE CASE OF AN AIRPORT IDENTIFIER WHICH CONSISTS OF ONLY THREE LETTERS, IT IS NECESSARY TO ADD THE "K" AS A PREFIX TO THE THREE LETTERS.

For example, the Jeppesen approach plate airport diagram shows the airport identifier for Chanute, Kansas as CNU. It is necessary in this case to add the "K" prefix to make the identifier KCNU. All other types of Continental USA airport identifiers are entered as printed on the approach plate airport diagram.

Navaids

Most navaid identifiers are made up of three letters, but combinations of two or three letters and numbers also exist. (Examples: ANX, BR)

Waypoints

Most waypoints (High altitude, low altitude, multiple and approach intersections) consists of five letters. There exist, however, some waypoint identifiers which consists of combinations of three to five letters and numbers. (Examples: GOONI, D3N, L121)

Runway Thresholds and Outer Markers

Runway Thresholds and Outer Markers are not stored in the King Data Base by ICAO identifiers. Access is from the appropriate airport Waypoint page. The procedures for calling up Runway Thresholds and Outer Markers are contained in Section V.

On-Airway NDB's

NDB's which are located on an airway are contained in the Data Base whenever any type of waypoint (HI ALT, LO ALT, SID/STAR, or APR INTRSC) has been loaded into the Data Base. On-airway NDB's are accessed by the two or three character identifier plus an "NB" suffix. For example: To GNI add the NB suffix. Therefore, GNINB is entered as the waypoint name.

WAYPOINTS AND FLIGHT PLANS

In addition to the Data Base memory just described, the KNS 660 has additional non-volatile memory capacity which you will utilize for storing such things as waypoints, flight plans, and other user defined data. Actual operational procedures for implementing the concepts presented here are contained in Section V, VI, and VII. The illustration in Figure 2-6 depicts the total KNS 660 memory stucture. As can be seen, the largest block of memory is dedicated to the Data Base containing the published navigation data.

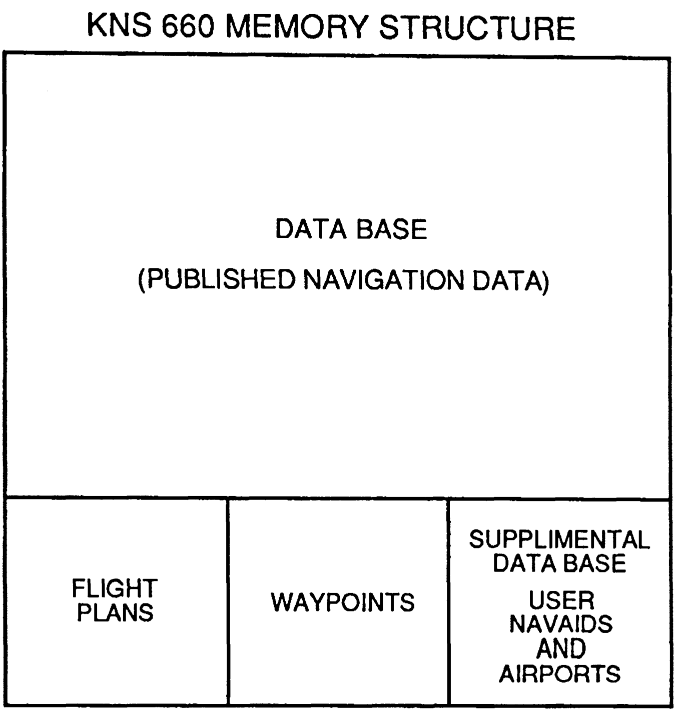


Figure 2-6

Waypoints

This block of memory can store waypoints which may then be used in flight plans and in other places where they are used in the system.

WAYPOINTS AND FLIGHT PLANS (Cont'd)

Flight Plans

Flight plans consisting of up to 25 waypoints each can be stored in this block of memory. Flight plans are created using waypoints which come from the block of waypoints.

Supplemental Data Base

This block of memory serves as a supplement to the main Data Base. It exists so that you may manually store in memory any combination of navaids and airports which aren't contained in the main Data Base. For example, if one of the navigational elements you have loaded in the main Data Base is airports having runways of at least 4000 feet and you want to add additional smaller airports, they can be stored in this block of memory. This information is utilized by the KNS 660 exactly the same as information from the main Data Base. Loading of this supplemental Data Base is described in Section VII.

WAYPOINT RELATIONSHIPS

As shown in Figure 2-7, data used to define the system waypoints may come from several sources. First of all, anytime you create a waypoint of your own definition (as opposed to creating a waypoint from data in the Data Base), it gets stored as part of the memory block containing the waypoints even if it is not used in a flight plan. These pilot created waypoints are shown in Figure 2-7 as the undefined shaped area within the waypoints. Other sources for defining waypoints are from the main Data Base and from the supplemental user navaid and airport Data Base. However, unlike the pilot-created waypoints, data from these two sources doesn't get stored as part of the waypoints unless it is actually used in a flight plan. The bottom of Figure 2-7 illustrates the numerous functions you will learn to use that draw from the same waypoint block.

As waypoints are created you can easily monitor the waypoint capacity remaining. For the moment turn to Section IV and the description of the Waypoint Page to see what a this page looks like. Notice that the bottom line of the page displays 44 WPT AVAIL. This means that in this example there is room for 44 more waypoints. Eventually, the waypoint capacity may become filled, meaning that you will have to delete some of the waypoints from the system. The procedure for doing so is explained in Section VI.

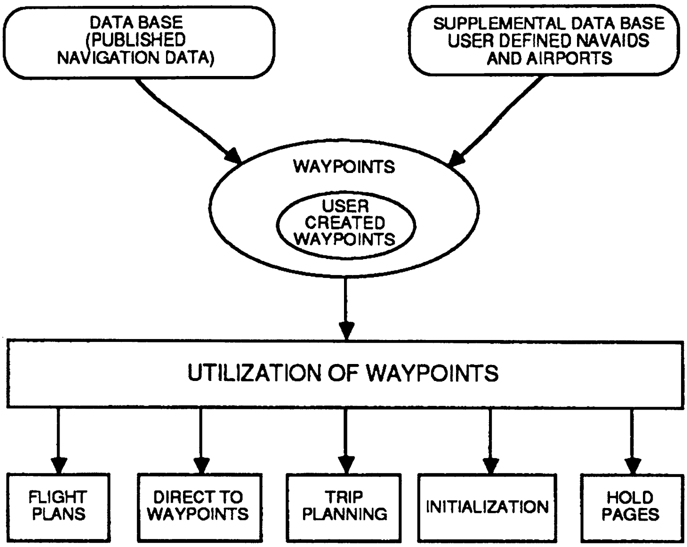


Figure 2-7

DATA BASE SIZE

Two sizes of the Data Base are available for most flavors of the KNC 667. Both Data Bases contain 10,000 storage blocks. The Expanded Data Base, which is the larger of the two, quadruples the size of each storage block. The Expanded Data Base is offered as a product inprovement and is retrofittable to most existing KNC 667 computers. The Expanded Data Base allows more published navigation data to be stored at one time in the KNS 660 memory and also increases the number of waypoints and flight plans that can be stored. With the Expanded Data Base, it is currently possible to have all world wide data loaded simultaneously. Refer to Figure 2-8 for a comparison of Data Base memory sizes.

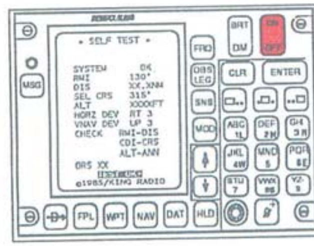
KNS 66Ø DATA BASE MEMORY SIZE COMPARISON		
DATA TYPE	STANDARD DATA BASE	EXPANDED DATA BASE
PUBLISHED NAVIGATION DATA	1Ø,ØØØ BLOCKS (768 Kbits)	1Ø,ØØØ BLOCKS - (EACH BLOCK 4 TIMES LARGER THAN STANDARD DATA BASE) (3.Ø72 Mbits)
WAYPOINTS	8ØØ	3,ØØØ
FLIGHT PLANS (25 WAYPOINTS EACH)	1ØØ	4ØØ
USER NAVAIDS AND AIRPORTS	175	2ØØ
TOTAL DATA BASE CAPACITY	96Ø Kbits	3.84Ø Mbits

Figure 2-8

SECTION III

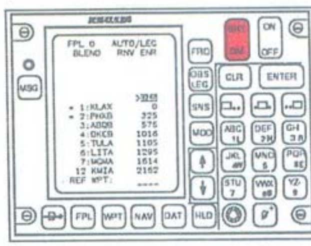
DESCRIPTION OF CDU CONTROLS

ON/OFF Switch



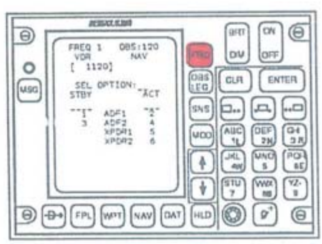
A rocker type switch which, when pressed at the top, turns the KNS 660 system on and initiates the self test process. When pushed at the bottom and held for approximately 2 seconds, the unit turns off. Prior to turning off, a caution message is presented on the screen.

Brightness Control Switch



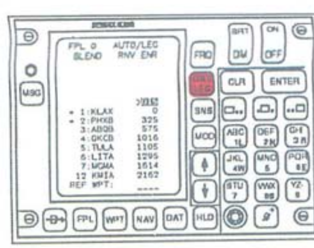
A rocker type switch which, when pressed at the top, increases the picture brightness and message light intensity in incremental steps to the maximum level. When pushed at the bottom, the brightness is decreased in incremental steps to the minimum level. When the unit is turned on the brightness is preset to 80% of the maximum level.

Frequency Key



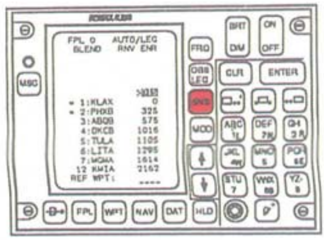
Selects the two frequency pages which allow frequency management of compatible BENDIX/KING Gold Crown III Avionics. This feature is further described in Section VII. The frequency key may not be present on systems without frequency management capability.

OBS/LEG Key



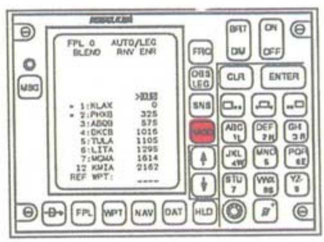
Selects the KNS 660 Method of Operation. Each key push selects the next Method of Operation in the sequence of OBS, AUTO/LEG, AUTO 3D and back to OBS. The AUTO 3D Method of Operation is an installation option. If a KNS 660 system is not configured for AUTO 3D operation, the sequence is OBS, AUTO/LEG, and OBS. See Section II for further explanation of Method of Operation.

Sensor Key **SNS**



Selects the active sensor to be used for navigation. Alternate key strokes will select individual sensors (such as VOR, OMEGA, TACAN, or INS) or BLEND, depending upon the actual sensors configured with a particular KNS 660 system. For example, when the VOR sensor is selected, navigation is solely based upon available VOR/DME signals. When the OMEGA sensor is selected, navigation is based upon available Omega and VLF signals. When the BLEND sensor is selected, navigation is based on a computer blend of position inputs from all active sensors.

Mode Key **MOD**

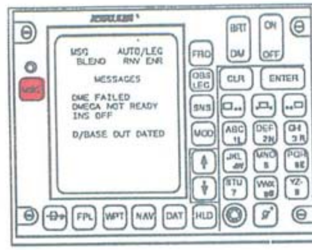


Allows selection of NAV, RNV ENR (RNAV Enroute), or RNV APR (RNAV Approach) Modes of Operation. When NAV is selected, normal angular HSI D-Bar sensitivity occurs (±10° full scale). When RNV ENR is selected the D-Bar indicates ±5 NM full scale and when in RNV APR the D-Bar indicates ±1.25 NM full scale. When an ILS frequency is selected, the sensor annunciated is ILS, the Method of Operation is OBS and ILS will be displayed as the Mode of Operation. When the OMEGA, INS, or BLEND sensor is selected, RNV ENR is automatically selected as the only Mode of Operation.

NOTE

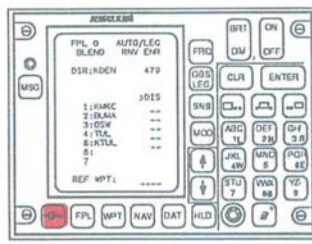
ONLY CERTAIN METHOD OF OPERATION/SENSOR/MODE COMBINATIONS CAN BE SELECTED. REFER TO "ESTABLISHING THE CORRECT KNS 660 OPERATIONAL STATUS" IN SECTION V FOR FURTHER EXPLANATION.

Message Key MSG



When pressed, selects the Message page (alternate action: press to select, press again to deselect). Used by pilot to acknowledge a MSG light (Located above the MSG key plus some installations require a remote MSG light). The MSG light goes out only after the message has been satisfactorily acknowledged. For additional information see Message Page in Sections IV and V.

Direct To Key

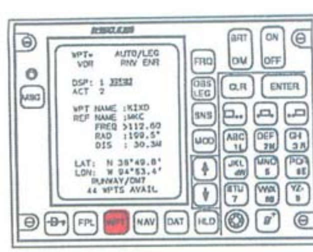


When pressed, allows selection of DIRECT TO operation. May be used at anytime after system initialization. This feature is further described in Section V.

Flight Plan Key FPL

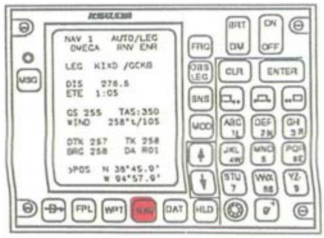
Used to select viewing of the active Flight Plan page (FPL Ø) or the Flight Plan Menu pages (FPLS). Repeated presses of this key will cycle through the FPL Ø page and all FPLS pages and then back to the FPL Ø page. If the CDU is displaying a page other than the FPL Ø page or a FPLS page, pressing the FPL key once will display the FPL Ø page. See Section IV for specific information on these pages.

Waypoint Key WPT



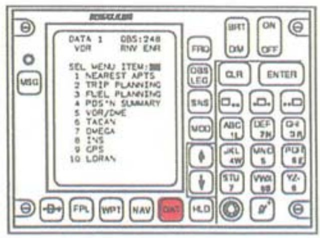
The WPT key has two functions first, to cycle through the Waypoint pages associated with the active Flight Plan (FPL Ø) and second, to display the Waypoint pages of other waypoints in the system. Procedures for use of the Waypoint key are contained in Sections V and VI.

Navigation Key NAV



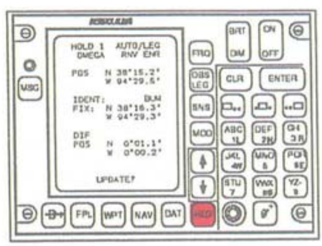
Pressing this key allows viewing of the two NAV pages (NAV 1) and (NAV 2). The NAV 1 page is displayed by pressing the NAV key once and the NAV 2 page is displayed by pressing the NAV key again (alternate action). Explanations of the two NAV pages are contained in Section IV.

Data Key DAT



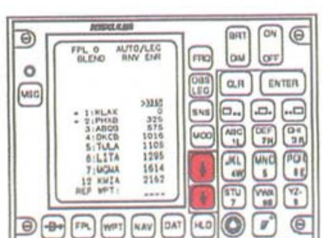
Used for viewing the two Data Menu pages (DATA 1) and (DATA 2). Also used for returning from lower level Data pages to higher level Data pages. Each of the Data Menu pages and the specific Data pages are described in Section IV. Operational information for the Data pages is contained in Sections V, VI, and VII.

Hold Key HLD



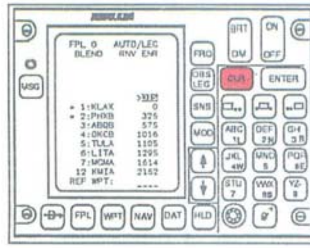
Pressing the HLD key allows the CDU to display the two Hold pages (HOLD 1) and (HOLD 2). The HOLD 1 page is displayed the first time the HLD key is pressed and the HOLD 2 page is displayed when the HLD key is pressed again (alternate action). The HOLD functions are used for updating the KNS 660 present position and for creating a waypoint at the aircraft's present position. The operation of the HLD key is described in Section VII.

Cursor Keys [↓] [↑]



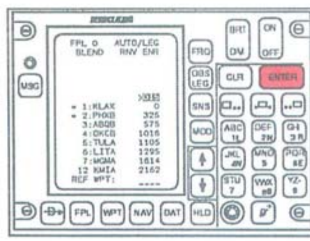
These keys are used to position the Cursor (a bright inverse video rectangle) over information in a line or portion of a line on the CDU in order to approve or change that information. If the Cursor is out of view it can be brought onto the screen at the top or bottom by using the down [↓] or the up [↑] Cursor keys.

Clear Key CLR



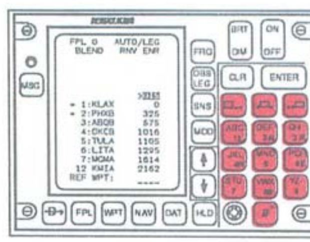
This key can be used to clear a single character in a data field, a complete data field, or an entire page depending on the procedure used. See Section V for detailed procedures. It is also used on nonenterable fields preceded by a right caret ">" to cycle between two or more related selections. (See Cyclic Field, under DATA KEYBOARDS AND DATA ENTRY PROCEDURES in Section V.

Enter Key ENTER



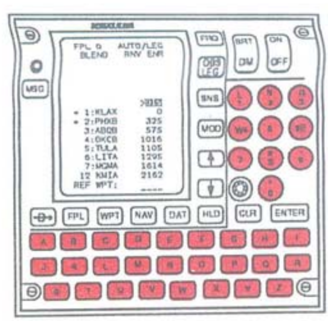
Used to insert the data displayed under the Cursor or a complete page of information into the computer memory. Also used to select various menu items and to approve specific Cursor statements.

Alpha-numeric Entry Keys (KCU 567)



Thirteen alpha-numeric entry keys are used on the KCU 567 to enter numerals 0 through 9, North, South, East, West, Left, Right, Minus (−), Plus (+), and the letters A through Z. The KCU 567 uses combination alpha-numeric keys in conjunction with special Left, Right, and center character position keys. Details of data entry procedures are contained at the beginning of Section V.

Alpha-numeric Entry Keys (KCU 568)



The KCU 568 has 36 alpha-numeric keys, 10 of which are used to enter numerals 0 through 9 and 26 keys which are dedicated to entering the characters A through Z. Eight of the 10 numeric keys also can be used to enter: North, South, East, West, Left, Right, Minus (−), and Plus (+). Details of data entry procedures are contained at the beginning of Section V.

SECTION IV

PAGE DISPLAY DEFINITIONS

The CDU presents information to the pilot arranged like pages in a book. Individual displays on the CDU are therefore referred to as pages. This section describes each of the KNS 660 pages of information. It is intended as a reference for explaining the meaning of the data contained on the pages and not as operational instruction. If this is your first time through this pilot's guide you may just want to browse through this section for now. You can then return to this section for reference as required.

With the exception of the Self Test page and the System Failed page, each page has a header at the top which is in the following format:

PAGE NAME	METHOD OF OPERATION
SELECTED SENSOR	MODE OF OPERATION

The header fields are described as follows:

PAGE NAME

The name of the page that is being displayed will be shown. The following is a list of possible page names that can appear in the PAGE NAME field:

NAV 1
NAV 2
WPT
DUPL
FPLS
FPL #
FPL Ø
FREQ 1
FREQ 2
INIT
HOLD 1
HOLD 2
DATA
MSG
DATA 1
DATA 2

METHOD OF OPERATION

The METHOD OF OPERATION field (selected with the OBS/LEG Key) displays the selected Method of Operation as described in Section II. This field normally displays either OBS or AUTO/LEG. If the KNS 660 is configured with the optional AUTO 3D feature either OBS, AUTO/LEG, or AUTO 3D may be displayed in this field.

PAGE DISPLAY DEFINITIONS

SELECTED SENSOR

The SELECTED SENSOR field displays the sensor you have chosen to provide navigation inputs to the KNS 660. The sensor key is used to make the sensor selection. The SELECTED SENSOR field will only display sensors that are actually present with your specific KNS 660 installation. The following is the list of possible sensor annunciations:

BLEND - System uses position inputs from all available sensors.

VOR - VOR and DME

TACAN - Tactical Air Navigation

OMEGA - OMEGA and VLF

INS - Inertial Navigation System (Displayed when the Inertial Reference Unit (IRU) has been selected).

ILS - Instrument Landing System (Displayed when a localizer frequency is active).

LORAN - LORAN (Systems with ORS 05 only)

GPS - NAVSTAR Global Positioning System (Systems with ORS 06 only)

MODE OF OPERATION

The mode of operation of the system is displayed in this field. Possible modes of operation displayed are the following:

RNAV ENR - RNAV Enroute (±5 NM full scale D-bar sensitivity).

RNAV APR - RNAV Approach (±1.25 NM full scale D-bar sensitivity).

NAV - Navigation (±10° full scale D-bar sensitivity).

ILS - Instrument Landing System (Displayed when a localizer frequency is active).

SELF TEST PAGE

```
* SELF TEST *

SYSTEM         OK
RMI          130°
DIS        XX.XNM
SEL CRS      315°
ALT       XXXXFT
HORZ DEV     RT 3
VNAV DEV     UP 3
CHECK     RMI-DIS
          CDI-CRS
          ALT-ANN
ORS XX
      TEST OK?
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```

The first page of information presented when the unit is turned on. Following an automatic self test the status of the system is displayed as well as a list of navigation data for the pilot to verify on actual aircraft instruments and displays.

SYSTEM OK - Indicates that the unit has passed the self test.

RMI 130° - The aircraft's RMI needle should be pointing to 130°.

DIS XX.XNM - The aircraft's DME display should agree (within 0.1 NM) with the distance shown on the Self Test Page.

SEL CRS 315° - The course arrow on the HSI should be indicating 315° (HSI's having driven course arrows).

ALT XXXX FT - The aircraft's altitude. The altitude displayed here may differ substantially from the aircraft's actual altitude depending on the type of altitude input to the KNS 660 (i.e. pressure altitude vs. baro-corrected altitude) and depending on the electrical format of the altitude input. For non-VNAV installations the altitude displayed should be within 150ft of the aircraft's actual MSL altitude if the altitude input to the KNS 660 is actual altitude or within 150ft of the pressure altitude if the altitude input to the KNS 660 is pressure altitude. For KNS 660 installations having VNAV, the altitude displayed should be within 40ft of the altitude displayed on the aircraft's altimeter. If the system has no altitude input the altitude field will be dashed.

HORZ DEV RT 3 - The deviation bar on the HSI or CDI should be 3 dots to the right of center (or an indication of 3NM to the right of center).

VNAV DEV UP 3 - If the installation is configured for vertical navigation, the VNAV indicator should be displaying an up 3 dot deflection (or an indication of 600ft. below the desired vertical flight path).

SELF TEST PAGE (Cont'd)

CHECK
RMI–DIS
CDI–CRS
ALT–ANN - A reminder to the pilot to check the applicable data values displayed on the CDU with the actual aircraft instruments. The remote annunciators should also be illuminated.

ORS XX - Operational Revision Status. A control number which indicates what level of operational capabilities are applicable to a specific KNS 660 system.

TEST OK? - Cursor position used to approve the Self Test page.

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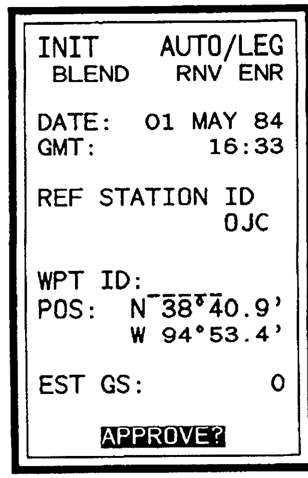
```
 * SELF TEST *

SYSTEM       OK
RMI        130°
DIS        XX.XNM
SEL CRS    315°
ALT        XXXXFT
HORZ DEV   RT 3
VNAV DEV   UP 3
CHECK    RMI-DIS
         CDI-CRS
         ALT-ANN
ORS XX
     TEST OK?
©1985/KING RADIO
```

INITIALIZATION PAGE



The Initialization page will be displayed after the Self Test page is approved.

DATE: 13 MAY 84 - Greenwich date in the order of day-month-year. The first three letters of each month are used for month abbreviations.

GMT: 16:33 - Greenwich Mean Time in hours and minutes.

The correct date and GMT are retained even when aircraft power is removed.

REF STATION ID, OJC - The NAVAID having radial and distance capability which is closest to the KNS 660's last computed position before power was removed. This field will be blank if there are no useable navaids within 200 nautical miles of the last known position.

WPT ID: - A data entry field where the waypoint identifier of the aircraft's present position may be entered.

POS: N 38° 49.9'
W 94° 53.4' - The last known computer generated present position.

EST GS: Ø - Estimated ground speed manually entered. Should be 0 if the aircraft is on the ground or a close estimate if in flight.

APPROVE? - Used to approve the data on the page and enter the data into the computer memory. Other pages are not accessable until this step is completed.

OMEGA RESTART INITIALIZATION PAGE

If the system has an OMEGA/VLF sensor which is in NAV status and power to the KNS 660 is lost for more than seven seconds but less than seven minutes and the selected sensor is BLEND or OMEGA, an OMEGA Restart Initialization page will be displayed instead of the normal Initialization page.

```
INIT        AUTO/LEG
 OMEGA      RNV ENR

 OMEGA RESTART

LAST GMT     15:17
LAST KNOWN PRES
POS:   N 38°49.9'
       W 94°53.4'

GMT:         15:22
ESTIMATED PRES
POS:   N 38°09.6'
       W 94°57.8'

     APPROVE?
```

LAST GMT 15:17 - The Greenwich Mean Time when power was lost.

LAST KNOWN PRES POS - The calculated position of the system when power was lost.

GMT: 15:22 - The present Greenwich Mean Time.

ESTIMATED PRES POS: - The dead reckoning calculated position. If this is incorrect the correct position can be entered on the HOLD 1 or HOLD 2 page.

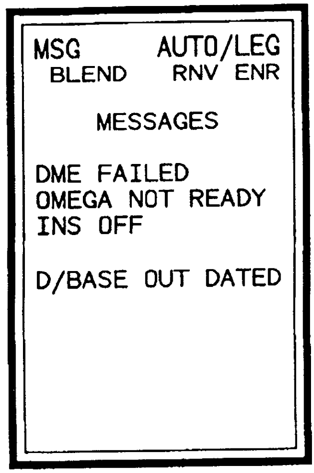
APPROVE? - The cursor position used to approve the OMEGA Restart Initialization page.

Issued: 18 JAN 88

MESSAGE PAGE

The Message (MSG) annunciators come on whenever there is a situation that requires the pilot's attention. The MSG annunciators will flash continuously until acknowledged by pressing the MSG key, which also displays the Message page. The Message page lists the various messages which are applicable to the unit's operation at that time. A complete listing of the various messages and ther meaning can be found in Appendix B.

After viewing the message, the operator may either select a new page by pressing another page key or by pressing the MSG key which will return to the previous page. In either case, the Message light will be extinguished unless there is a situation which requires operator action. In this case the Message light will remain on solid until the operator action is taken. Whenever new messages are displayed which have never been seen by the operator, they are separated from the previously viewed messages by a blank line.



PAGE DISPLAY DEFINITIONS

FLIGHT PLAN PAGES

FLIGHT PLAN MENU PAGE

```
FPLS       AUTO/LEG
 OMEGA      RNV ENR

SEL FPL:___

   0>KIXD /KLAX
   1 KIXD /KICT
   2 KIXD /KPIE
  33 KIXD /KVRP
  84 KIXD /KDEN *
  96 KLAX /KDEN
 103 KDEN /MEM
 602 KMEM /OA6
 822 KLAX /KJFK
 999 KHPN /KIXD
   91 FPLS AVAIL
```

The Flight Plan Menu Pages FPLS display a listing of the flight plans contained in KNS 660 memory. The flight plans are listed in increasing order of flight plan number. When initialization is complete, the first Flight Plan Menu Page appears. A maximum of 100 flight plans may be listed by the flight plan numbers 0 to 999. If more than 9 flight plans are stored, then successive presses of the FPL key will display additional FPLS pages containing the remaining stored flight plans.

SEL FPL: - The desired flight plan number is entered into this field. The flight plan number selected does not have to be displayed on this page.

Ø> KIXD/KLAX - The 0 indicates the flight plan number. Flight plan 0 is the active flight plan and is displayed on each Flight Plan Menu Page. The > notes that another operation can be performed by pressing the CLR key while the cursor is over this field. In this case it will enable the option to store Flight Plan 0 in any unused flight plan position.

KIXD represents the first waypoint and KLAX the last waypoint in this flight plan.

84 KIXD /KDEN * - As before, the 84 indicates the flight plan number, KIXD is the first waypoint in the flight plan and KDEN is the last waypoint in the flight plan. The asterisk (*) indicates that this is a protected flight plan.

91 FPLS AVAIL - The number of empty flight plans available.

FLIGHT PLAN # PAGE

```
FPL 822 AUTO/LEG
 OMEGA    RNV ENR

ACTIVATE?
INVERT?
NEXT PAGE?      DIS
   1:KLAX
   2:PDZB        40
   3:HECE       109
   4:TBCB       375
   5:FMNB       532
   6:TBEB       748
   7:GCKC       891
   8:ICTA      1034
   9:BUMA      1184
 REF WPT:      ----
```

FPL 882 (Example only) - Indicates the displayed flight plan number. Each Flight Plan page may be called up via the Flight Plan Menu page. A flight plan is limited to a maximum of 25 waypoints. An asterisk after FPL (example FPL*882) would indicate that this is a protected flight plan.

ACTIVATE? - This flight plan can be made active by placing the cursor over ACTIVATE? and pressing ENTER.

INVERT? - The option of activating this flight plan in inverted order is available (first waypoint becomes the last and last waypoint becomes the first) by placing the cursor over INVERT? and pressing ENTER.

NEXT PAGE? - When more than nine waypoints are used in a flight plan, the next page (or pages) can be displayed by placing the cursor over NEXT PAGE? and pressing ENTER. From the last page of the flight plan this procedure is used to return to the first page of the flight plan.

1: KLAX - Indicates the first waypoint in this flight plan.

2: PDZB 4Ø - Indicates the second waypoint and the distance from the initial waypoint to this waypoint.

9: BUMA 1184 - Indicates the last waypoint on this page. The distance displayed adjacent to each waypoint on these pages is the distance from the first waypoint to each waypoint along the flight plan route.

REF WPT: A data entry field where a reference navaid or airport identifier may be entered to create an on course waypoint.

FLIGHT PLAN 0 PAGE

The Flight Plan 0 Page FPL Ø is a display of the active flight plan and its associated data.

DIR: SVNTH 63 - This line is present only when Direct To Operation is being used. The Direct To waypoint name and distance to this waypoint are displayed (top screen). Estimated Time of Arrival (ETA) and Estimated Time Enroute (ETE) to the Direct To waypoint may also by displayed. (See >DIS below).

>DIS - A cyclic field which changes from distance >DIS (top screen) to estimated time of arrival >ETA (middle screen) to estimated time enroute >ETE (bottom screen). If the installation is configured for AUTO 3D operation and the AUTO 3D Method of Operation has been selected then the field will cycle to >ALT after >ETE. As with all cyclic fields, the field is changed by positioning the cursor over the field and pressing the CLR key.

The distances displayed under the >DIS column beside each waypoint are the cumulative distances from the aircraft's present position to each waypoint along the flight plan route.

When operating in the AUTO/LEG or AUTO 3D Method of Operation and not utilizing the Direct To function, the distance traveled along the flight plan from the first waypoint is displayed next to the first waypoint.

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR

DIR:SVNTH        63

                >DIS
   1:FIRST        --
   4:FOURT        --
   5:FIFTH        --
   6:SIXTH        --
 * 7:SVNTH        63
   8:EIGHT       236
   9:NINTH       450
  10:TENTH       635
  15:LAST       1224
REF WPT:        ----
```

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR


DEP 1015Z
                >ETA
   1:FIRST    ----Z
   4:FOURT    ----Z
   5:FIFTH    ----Z
 * 6:SIXTH    ----Z
 * 7:SVNTH    1130Z
   8:EIGHT    1158Z
   9:NINTH    1233Z
  10:TENTH    1302Z
  15:LAST     1439Z
REF WPT:       ----
```

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR


     FLT   1:05
                >ETE
   1:FIRST    --:--
   4:FOURT    --:--
   5:FIFTH    --:--
 * 6:SIXTH    --:--
 * 7:SVNTH      :10
   8:EIGHT      :38
   9:NINTH     1:13
  10:TENTH     1:43
  15:LAST      3:19
REF WPT:       ----
```

FLIGHT PLAN 0 PAGE (Cont'd)

>ETA - This column (top screen) displays the estimated time of arrival in GMT and is based on the current ground speed and distance to each waypoint from the aircraft's present position.

>ETE - This column (middle screen) displays the estimated time enroute to each waypoint based on the current ground speed and distance to each waypoint from the aircraft's present position.

>ALT - This column (not shown) displays the selected altitudes associated with the flight plan waypoints.

DEP - The departure time is the GMT that the system first calculated a ground speed greater than 50 knots. DEP is displayed only when ETA has been selected (top screen).

FLT - The total elapsed time in flight. The elapsed time begins when the system first calculates a ground speed of 50 knots. FLT is displayed only when ETE is selected (middle screen).

1 FIRST - The first waypoint is displayed at the top of the list of waypoints regardless of the number of waypoints (1-25) in FPL 0. This line can become a non-enterable cursor field and display WPT? when used for manual scrolling of the waypoints as explained in Section VI.

* 7: SVNTH - (bottom screen). A single * designates the Direct To waypoint if it is part of FPL 0. A single * also designates the active waypoint when in OBS Method of Operation.

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR

DEP 1015Z
                >ETA
   1:FIRST    ____
   4:FOURT    ____Z
   5:FIFTH    ____Z
 * 6:SIXTH    ____Z
 * 7:SVNTH    1130Z
   8:EIGHT    1158Z
   9:NINTH    1233Z
  10:TENTH    1302Z
  15:LAST     1439Z
REF WPT:       ____
```

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR

    FLT   1:05
                >ETE
   1:FIRST    __:__
   4:FOURT    __:__
   5:FIFTH    __:__
 * 6:SIXTH    __:__
 * 7:SVNTH      :10
   8:EIGHT      :38
   9:NINTH     1:13
  10:TENTH     1:43
  15:LAST      3:19
REF WPT:       ____
```

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR

DIR:SVNTH        63

                >DIS
   1:FIRST       __
   4:FOURT       __
   5:FIFTH       __
   6:SIXTH       __
 * 7:SVNTH       63
   8:EIGHT      236
   9:NINTH      450
  10:TENTH      635
  15:LAST      1224
REF WPT:       ____
```

FLIGHT PLAN 0 PAGE (Cont'd)

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR

DEP 1015Z
                >ETA
   1:FIRST
   4:FOURT     ----Z
   5:FIFTH     ----Z
*  6:SIXTH     ----Z
*  7:SVNTH     1130Z
   8:EIGHT     1158Z
   9:NINTH     1233Z
  10:TENTH     1302Z
  15:LAST      1439Z
REF WPT:        ----
```

* 6: SIXTH
* 7: SVNTH - (bottom screen). When the system is in AUTO/LEG or AUTO 3D operation and the Direct To feature is not being utilized, a pair of * designate the active FROM waypoint (top *) and TO waypoint (bottom *). Thus, the * pair defines the active flight plan leg. The * pair changes automatically as the aircraft moves along the flight plan.

15 LAST - The last waypoint in FPL 0, and its associated distance, estimated time of arrival, or estimated time enroute are displayed at the bottom of the list of waypoints. This line can become a non-enterable cursor field and display WPT? when used for manual scrolling of the waypoints as explained in Section VI.

REF WPT: - A data entry field where a reference navaid or airport identifier may be entered to create an on course waypoint.

WAYPOINT PAGE

```
WPT*        AUTO/LEG
 VOR         RNV ENR

DSP:  1  USE?
ACT   2

WPT NAME  :KIXD
REF NAME  :MKC
    FREQ  >112.60
    RAD   :199.5°
    DIS   : 30.3M

LAT:   N 38°49.8'
LON:   W 94°53.4'
   RUNWAY/OM?
  44 WPTS AVAIL
```

The Waypoint page is used to display, verify, and create waypoints for use in the operation of the system.

WPT* - If the displayed waypoint has a protected status, an asterisk * will appear next to the WPT page field.

DSP: 1 - Indicates the displayed waypoint number from the active flight plan. A "D" would indicate that the waypoint being displayed is a Direct To waypoint which is not part of the active flight plan. If the displayed waypoint is not part of the active flight plan and is not a Direct To waypoint, dashes will be displayed. The field may be used to display a waypoint from Flight Plan 0 by entering the desired waypoint number into this data entry field.

ACT 2 - Indicates the active waypoint number from the active flight plan. If the Direct To feature is being used and the Direct To waypoint is not contained in the active flight plan, then a "D" will be displayed.

USE? - Asking the operator if they want to make the displayed waypoint the active waypoint. To do so the cursor is positioned over this field and the ENTER key is pressed.

WPT NAME: KIXD - The identifier or name of the displayed waypoint. From 1 to 5 alpha-numeric characters are used to identify a waypoint.

REF NAME: MKC - Reference facility identifier. The operator may enter a navaid, airport, or any other waypoint stored in memory within 200NM of the waypoint being defined. However, to utilize the VOR sensor (VOR or BLEND sensor selected) while operating in OBS Method of Operation the REF NAME entry must be a navaid identifer. In OBS operation the reference Navaid is the only station tuned by the VOR navigation receiver and the DME (or TACAN).

FREQ 112.6Ø - Frequency of the reference navaid. If the reference facility input is a navaid, its frequency is automatically entered. When the reference facility identifier entered is not a navaid, blanks are displayed.

WAYPOINT PAGE (Cont'd)

```
WPT          OBS:317
 TACAN       RNV ENR

DSP:__  USE?
ACT  2

WPT NAME :KIXD
REF NAME :GVW
    CHNL > 23X
    RAD  :260.6°
    DIS  : 15.6M

LAT:   N 38°49.8'
LON:   W 94°53.4'

  44 WPTS AVAIL
```

CHNL > 23X - When equipped with the optional TACAN sensor, a caret (>) will be displayed between FREQ and the frequency field. With the cursor over the frequency field the CLEAR key is used to select either frequencies or TACAN channels. The system will remain in the FREQ or CHNL select mode until changed by the operator.

RAD : 199.5°
DIS : 30.3M - Radial and distance from the reference facility to the waypoint.

LAT: N 38° 49.8'
LON: W 94° 53.4' - Position of the waypoint presented as latitude and longitude coordinates using degrees, minutes and tenths of minutes.

RUNWAY/OM? - This cursor field allows selection of runway thresholds and outer markers. It appears whenever the Data Base is loaded with runway thresholds and/or outer markers and when the identifier displayed in the WPT NAME field is an airport.

44 WPTS AVAIL - When the Waypoint page is initially displayed (after having been previously approved) the number of memory locations available for waypoint storage is displayed.

APPROVE? - Following the first data entry on the Waypoint page the WPTS AVAIL will be removed. The APPROVE? field (not shown) will then appear.

When clearing a Waypoint page, the interrogative field DELETE? (not shown) will appear in place of APPROVE?

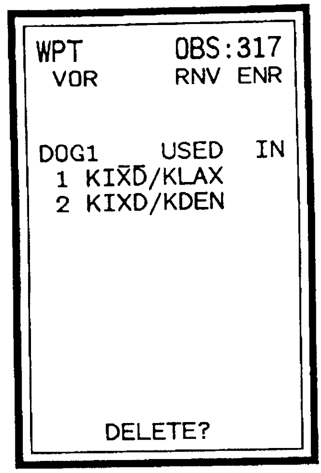
WAYPOINT USED-IN PAGE

The Waypoint Used-In page is used for deleting a waypoint from the system as described in Section VI.

DOG1 __ USED IN - The identifier of the waypoint to be deleted.

1 KIXD/KLAX - The flight plan numbers in which a waypoint to be deleted is presently used and the associated flight plan's first/last waypoints.

DELETE? - With the cursor over this field the waypoint is deleted by pressing the ENTER key.



WAYPOINT RUNWAY/OUTER MARKER PAGE

When the selected waypoint is an airport and the Data Base contains runway and/or outer marker information the message RUNWAY/OM? will appear at the bottom of the Waypoint page.

The Runway/Outer Marker page can then be selected. A runway or outer marker may be selected from the listing on this page using the procedure described in Section V, "Menu Selection Field".

SEL RW/OM: __ - The menu number to the left of the desired runway threshold or outer marker may be entered in this field.

NEXT PAGE? - If all the runway thresholds and outer markers aren't contained on one page this field is used to view the remainder which are contained on another page.

1 RW18L - The menu number 1 is assigned to the runway threshold for Runway 18 Left in this example.

7 OM18R - The menu number 7 is assigned to the outer marker for Runway 18 Right in this example.

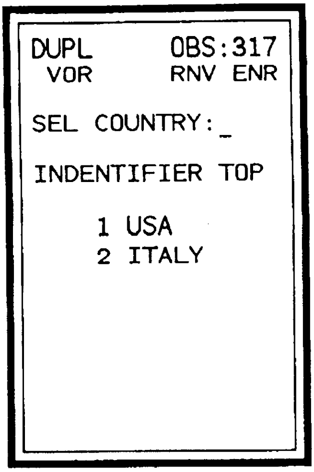
```
WPT          OBS:317
 VOR         RNV ENR

  SEL RW/OM :_
   NEXT PAGE?_

    1 RW18L
    2 RW18L
    3 RW29L
    4 RW29R
    5 RW31
    6 OM18L
    7 OM18R
    8 OM29L
    9 OM29R
```

WAYPOINT DUPLICATION PAGE

When an identifier is entered in a waypoint identifier field and multiple definitions for this identifier exist in the system Data Base, the Waypoint Duplication page will be displayed.



SEL COUNTRY: - The number associated with the desired country may be entered in this field.

IDENTIFIER TOP - The identifier having multiple definitions stored in the Data Base.

1 USA
2 ITALY - A listing of the countries containing the same waypoint identifier. If an identifier for an interSection has been entered, a "T" or an "E" will be displayed next to the country name (not shown) to indicate that the intersection is Terminal or Enroute.

PAGE DISPLAY DEFINITIONS

NAV PAGES

There are two NAV pages (NAV 1 and NAV 2) alternately selected by pressing the NAV key. Appendix A contains a diagram defining many of the terms and abbreviations used on the NAV pages.

```
NAV 1       OBS:317
 VOR        RNV ENR

USE  1   ID KIXD

DIS     22.8
ETE    :05

GS 265    TAS:350
WIND    258°t/105

BRG 345   HDG 280


>POS    RAD  199°
:MKC    DIS  30.8
```

NAV 1 PAGE

The NAV 1 Page format varies somewhat depending on whether the Method of Operation is OBS or AUTO/LEG (or AUTO 3D).

OBS Method of Operation

USE 1 - The active waypoint number. When using the Direct To feature DIR is displayed.

ID KIXD - The identifier of the active waypoint.

DIS 22.8 - Distance to the active waypoint in nautical miles.

ETE :Ø5 - Estimated time enroute to the active waypoint in hours and minutes. This value is based on the present calculated ground speed, assuming that the actual track is equal to the bearing to the waypoint.

GS 265 - Ground speed in knots.

TAS: 35Ø - The colon (:) appears making this an enterable data field only when there is no true airspeed source available. A true airspeed may be manually entered so that the system can make a wind calculation. When a true airspeed source is available the true airspeed from that source is displayed. The colon (:) is then not displayed and this is no longer an enterable data field.

WIND 258°t/1Ø5 - The computed wind using the TAS. Displayed in degrees true and knots. This field will display dashes if the computed wind is less than 10 knots.

BRG 345 - The bearing from the aircraft's present position to the active waypoint.

HDG 28Ø - The current aircraft heading.

NAV 1 PAGE (Cont'd)

>POS RAD 199°
:MKC DIS 30.8 - The aircraft's present position displayed in terms of a navaid, and the radial and distance from it. Another navaid identifier may be manually input and the present position will be referenced to that facility. If the navaid is manually changed, the system will resume automatic navaid selection for this field in approximately one minute.

>POS N 38° 45.6'
W 90° 57.8' - The aircraft's present position coordinates in latitude and longitude.

The operator may change the present position back and forth as desired between the navaid identifier, radial, and distance format and the latitude/longitude format by placing the cursor over the >POS field and pressing the CLEAR key.

When an ILS frequency is active (top screen) the POS block displays the ILS frequency and the radial and distance display dashes.

```
NAV 1        OBS:317
 VOR         RNV ENR

USE  1   ID KIXD

DIS      22.8
ETE     :05

GS 265     TAS:350
WIND     258°t/105

BRG 345    HDG 280


>POS     RAD  199°
:MKC     DIS  30.8
```

```
BRG 345    HDG 280


>POS    N 38°45.6'
        W 94°57.8'
```

```
NAV 1        OBS:355
 ILS           ILS

DIR   11090

DIS     ___._
ETE    _:__

GS         TAS:150
WIND__    ___°t/___

BRG ___    HDG 180


 POS     RAD  ___°
11090    DIS  ___._
```

NAV 1 PAGE (Cont'd)

AUTO/LEG Method of Operation

```
NAV 1     AUTO/LEG
 OMEGA     RNV ENR

LEG   KIXD /GCKB

DIS    276.5
ETE   1:05

GS 255     TAS:350
WIND    258°t/105

DTK 257     TK 258
BRG 258     DA R01

>POS    N 38°45.9'
        W 94°57.9'
```

LEG KIXD/GCKB - Active Leg of Flight Plan. When operating Direct To a waypoint, DIR and the waypoint identifier are displayed.

DIS 276.5 - Same as OBS Method of Operation.

ETE 1:05 - Same as OBS Method of Operation.

GS 255 - Same as OBS Method of Operation.

TAS: 350 - Same as OBS Method of Operation.

WIND 258°t/105 - Same as OBS Method of Operation.

DTK 257 - Desired Track. The Great Circle course in degrees along the active leg of the flight plan.

TK 258 - Actual Track. The track the aircraft is flying over the ground.

BRG 258 - Same as OBS Method of Operation.

DA R01 - The Drift Angle left or right in degrees. If the aircraft's actual track over the ground is to the right of the aircraft's heading a right (R) drift angle is indicated. If the track is to the left of the aircraft's heading a left (L) drift angle is indicated.

POS - Same as OBS Method of Operation.

NAV 2 PAGE

```
NAV 2      AUTO/LEG
 OMEGA      RNV ENR

LEG   KIXD /GCKB

ACT              SEL
---    ---       ---
L 3.2  XTK:  R  0.0
       ---
E 5.4  REF       MAG
       ---
16000  ALT
```

LEG KIXD/GCKB - Same as NAV 1 page, both for OBS and AUTO/LEG Methods of Operation.

ACT - This column header indicates that data in this column is actual.

SEL - This column header indicates that data in this column is pilot selectable.

L 3.2 XTK: R Ø.Ø - The data to the left side of XTK: is the actual cross track error, which is the lateral displacement of the aircraft in nautical miles left or right of the desired track.

If parallel track operation is desired, the selected cross track may be entered to the right of the XTK: field. The selected cross track distance provides steering to a left or right offset course parallel to the desired track.

E 5.4 REF MAG - The data to the left of REF is the actual magnetic variation in degrees computed for the present position of the aircraft.

The data to the right of REF is the system compass mode. BRG, DTK, HDG, and TK are referenced with respect to the displayed system compass mode. If no IRU is configured with the system this field displays MAG (magnetic compass mode) and can not be altered. If an IRU sensor is present this field is selectable between MAG and TRUE (True North system compass mode) by placing the cursor over the field and pressing the CLEAR button to obtain the desired system compass mode. A caret (>) then precedes this field to annunciate the selectable feature.

16ØØØ ALT - Present aircraft altitude. Displayed in non-VNAV installations only (top screen). This altitude should agree within 150ft of the aircraft's actual altitude or pressure altitude depending upon which type altitude is used as an input to the KNS 660. Therefore, it is used only for verification that the system has a valid altitude input and should not be used as an alternate display of actual altitude.

NAV 2 PAGE (Cont'd)

```
NAV 2     AUTO/LEG
 OMEGA     RNV ENR

LEG   EMP   /HOOZE

ACT              SEL
---     ---      ---
R 0.0  XTK:  R 0.0
        ---
E 5.8  REF       MAG
        ---
       VNAV-ON
       WPT:  HOOZE
25000  ALT:  11000
 80.2  OFST:-  2.0
  1.7  ANG:    1.7
```

VNAV - ON - This field and the associated VNAV lines below it are displayed only when the KNS 660 is configured for vertical navigation. VNAV-ON is displayed whenever the pilot has initiated a VNAV problem and the KNS 660 is computing deviation from a pilot defined vertical path. VNAV-OFF is displayed when the system is configured for VNAV but the pilot has not initiated a VNAV problem. A detailed description of VNAV operation is contained in Section VII.

WPT: HOOZE - A waypoint named HOOZE has been selected as the vertical waypoint.

25ØØØ ALT: 11ØØØ - The number displayed to the left of ALT: is the actual present aircraft altitude in feet. The number to the right of ALT: is the pilot selected altitude for the vertical waypoint.

8Ø.2 OFST: - 2.Ø - The data to the left of OFST: is the along-track distance from the present position to the vertical waypoint (or offset vertical waypoint if selected). The pilot may enter an along-track offset (NM) in the data field to the right of OFST:. A positive number puts the offset vertical waypoint past the vertical waypoint and a negative number puts the offset vertical waypoint between the aircraft and the vertical waypoint.

1.7 ANG: 1.7 - The data to the left of ANG: is the actual vertical angle between the present aircraft position and the active vertical waypoint (or offset vertical waypoint if the pilot selects an along track offset). In manual VNAV operation the pilot may select a vertical angle in the data entry field to the right of ANG:. The pilot may also select a vertical angle in this field in AUTO 3D operation in order to initially acquire the 3D vertical profile.

HOLD PAGES

HOLD 1 PAGE

The HOLD 1 Page is used to check position accuracy, to update the KNS 660 position or to create a waypoint at the aircraft's present position. Procedures for use of the HOLD 1 Page are contained in Section VII. Reference "Manually Updating The System Position" and "Creating A Present Position Waypoint".

```
HOLD 1   AUTO/LEG
 OMEGA    RNV ENR

POS     N 38°15.2'
        W 94°29.5'

IDENT:         BUM
FIX:    N 38°16.3'
        W 94°29.3'

DIF
POS     N  0°01.1'
        W  0°00.2'


      UPDATE?
```

POS N 38° 15.2'
W 94° 29.5' - The present position calculated by the KNS 660 which was frozen in this display when the HOLD key was pressed.

IDENT: BUM - The waypoint identifier of the fix contained in KNS 660 memory that was over flown to check or update position. If the identifier entered here is not contained in memory this becomes the identifier of a waypoint with the coordinates displayed adjacent to POS.

FIX: N 38° 16.3'
W 94° 29.3' - The actual coordinates of the position overflown.

DIF N Ø° Ø1.1'
E Ø° ØØ.2' - The difference in position between the KNS 660 calculated position and the FIX position in degrees, minutes and tenths of minutes.

UPDATE? - A cursor field used to update the KNS 660 position when the ENTER key is pressed.

HOLD 2 PAGE

The HOLD 2 Page is used to update the KNS 660 position. The HOLD 2 Page is also used to make manual altitude, heading, or ground speed entries when required by the system. Detailed procedures for use of the HOLD 2 Page are contained in Section VII.

```
HOLD 2   AUTO/LEG
 OMEGA    RNV ENR

 UPDATE AT FIX


IDENT:        BUM
FIX:  N 38°16.3'
      W 94°29.3'
MAN HDG:       °t
MAN ALT:       FT
EST GS:
UPDATE WHEN OVER
  POSITION FIX

    UPDATE?
```

IDENT: BUM - The waypoint identifier of a point to be overflown for position updating.

FIX: N 38° 16.3'
W 94° 29.3' - The actual coordinates of the point to be overflown for position updating.

MAN HDG: °t - This field will be present on the HOLD 2 Page only if all of the system's heading source inputs fail. The pilot may manually enter the aircraft's heading referenced to True North in this data field.

MAN ALT: FT - This field will be present only if all of the system's altitude source inputs fail. The aircraft's altitude may then be manually entered in this data field.

EST GS: - This field will be present if the OMEGA receiver requires dead reckoning inputs to gain navigational status. The estimated ground speed may then be manually entered in this data field.

UPDATE WHEN OVER
POSITION FIX - A non-cursor field to remind the pilot that the update of the system using the HOLD 2 Page is done <u>when over</u> the position fix.

UPDATE? - A cursor field used to update the KNS 660 position when the ENTER key is pressed. This field does not affect the operation of the MAN HDG:, MAN ALT:, or EST GS fields.

FREQUENCY PAGES

FREQUENCY 1 PAGE

```
FREQ 1      OBS:120
 VOR          NAV
[  1120]

 SEL OPTION:__
STBY            ACT

 _1_   ADF1     _2_
  3    ADF2      4
       XPDR1     5
       XPDR2     6
```

The FREQ 1 Page is only used and is only capable of being displayed if the KNS 660 is configured for frequency management capability. Refer to "Frequency Management" in Section VII for operational procedures.

[1120] - Transponder code or frequency entered in the scratch pad area (line three) of display.

SEL OPTION: __ - The appropriate menu number choice may be entered in this field.

STBY - Menu numbers chosen from under this column will result in the scratch pad frequency being loaded into the standby window of the appropriate control head.

ACT - Menu numbers chosen from this column will result in the scratch pad frequency or transponder code being loaded into the appropriate control head's active window.

1 ADF1 2
3 ADF2 4
XPDR1 5
XPDR2 6 - All external control heads whose frequency/code ranges are valid for the current scratch pad entry are displayed. The menu numbers displayed to the left and right of the control heads are used to input the pilot's choice into the SEL OPTION field.

The FREQ 1 Page is not accessible with ORS 05 level KNS 660 systems.

FREQUENCY 2 PAGE

```
FREQ 2      OBS:120
 VOR        RNV ENR
[ 11890]
  FREQ SUMMARY

ADF1   :       0368
ADF2   :       0980
NAV1   :
NAV2   :     112.60
XPDR1  :       1120
XPDR2  :       4353
COMM1  :     118.30
COMM2  :     124.30
```

The FREQ 2 Page is used only if the KNS 660 is configured for frequency management. Reference "Frequency Management" in Section VII for operational procedures.

[1189Ø] - Frequency or transponder code entered in the scratch pad area (line three) of display.

FREQ SUMMARY - A non-cursor field which indicates that the listing below is all control heads connected for frequency managment capability and their respective active frequencies/codes.

ADF1 : Ø368 - Each of the control heads tied to the frequency management is listed along with its respective active frequency/code. The frequency/code fields are manually enterable.

NAV1 : - When the number one VOR NAV receiver is being used as a sensor for the KNS 660, a dot is displayed to indicate that data cannot be entered in this field. If the NAV CTL function is activated thereby removing the number one VOR NAV receiver as a KNS 660 sensor, the active NAV 1 frequency will be displayed and this will be an enterable data field.

DATA PAGES

There are two Data Menu pages used to select the actual Data Pages used in the operation of the KNS 660 system. The DATA 1 Menu Page is presented here first, followed by the secondary data pages associated with it. After that, the DATA 2 Menu Page is presented followed by the secondary pages associated with it.

```
DATA 1      OBS:248
 VOR        RNV ENR

SEL MENU ITEM:█
 1 NEAREST APTS
 2 TRIP PLANNING
 3 FUEL PLANNING
 4 POS'N SUMMARY
 5 VOR/DME
 6 TACAN
 7 OMEGA
 8 INS
 9 GPS
10 LORAN
```

DATA 1 MENU PAGE

The DATA 1 Menu Page lists the actual data pages which can be selected from this page. For items 5 thru 10, only the sensors which are interfaced with the particular system will be displayed. Not all sensors shown in this example can be configured with a single KNS 660 system. Specific Data pages are selected by entering the corresponding menu number into the SEL MENU ITEM: data field and pressing the ENTER key. They may also be selected by placing the cursor over the menu item and pressing the ENTER key.

NOTE

IF THE SYSTEM HAS A DME SENSOR FOR RHO-RHO UPDATING OF THE OMEGA OR IRU SENSORS BUT HAS NO VOR SENSOR THEN MENU ITEM 5 IS DME.

PAGE DISPLAY DEFINITIONS

NEAREST AIRPORTS PAGE

The Nearest Airport page may be called up at any time to provide the three airports from the Data Base closest to the aircraft's present position (within 200NM).

NEAREST AIRPORTS
AS OF 14:05 GMT - The GMT of the last time the Data Base was queried for the three nearest airports. The Data Base is queried approximately every two minutes.

IDENT BRG DIS

KMCI 277 6 - The ICAO identifiers for the three nearest airports are displayed along with the respective bearing and distance to these airports from the aircraft's present position. The bearing and distance displayed are real time data.

4: - This field provides a means to determine the bearing and distance to <u>any</u> airport entered which is listed in the Data Base or any user defined airport.

```
DATA          OBS:315
 VOR          RNV ENR

NEAREST AIRPORTS
 AS OF 14:05 GMT

 IDENT    BRG    DIS

1 KMCI    277      6
2 KKCK    179      8
3 KMKC    175      9
4:
```

TRIP PLANNING MENU PAGE

The Trip Planing Menu Page is a secondary menu which allows the pilot to choose from three different types of Trip Planning.

SEL MENU ITEM: - The menu number of the desired kind of trip planning can be entered in this data field.

1 WPT REL TO
PRESENT POS - Trip planning from the aircraft's present position to another waypoint.

2 WPT TO WPT
ANALYSIS - Trip planning between any two waypoints.

3 FPL ANALYSIS - Trip planning of one of the flight plans stored in the FPLS pages.

```
DATA        AUTO/LEG
 VOR         RNV APR

 TRIP PLANNING
   MENU PAGE

SEL MENU ITEM:█

 1 WPT REL TO
   PRES POS
 2 WPT TO WPT
   ANALYSIS
 3 FPL ANALYSIS
```

WAYPOINT RELATIVE TO PRESENT POSITION TRIP PLANNING PAGE

WPT NAME: KICT - Desired waypoint identifier.

LAT: N 37° 39.Ø'
LON: W 97° 26.Ø' - The waypoint location presented in latitude and longitude coordinates.

DIS 139.9 NM - The distance in nautical miles from the aircraft's present position to the selected waypoint. Not updated as the present position changes.

BRG 234.3° TO - The bearing in degrees from the aircraft's present position to the selected waypoint. Not updated as the present position changes.

ENTER GS: 35Ø KT - The aircraft's estimated ground speed for the trip can be entered in this data field.

ETE Ø:24 H:M - The estimated time enroute in hours and minutes for the trip based on the ground speed input above.

```
DATA        AUTO/LEG
 VOR         RNV APR

 TRIP PLANNING

   WPT REL TO
PRESENT POSITION

WPT NAME  :KICT
LAT:   N 37°39.0'
LON:   W 97°26.0'

DIS       139.9  NM
BRG       234.3° TO
ENTER GS:   350KT
ETE        0.24 H:M
```

WAYPOINT TO WAYPOINT TRIP PLANNING PAGE

FROM WPT: KIXD
TO WPT: KICT - The desired TO and FROM waypoints. If a waypoint is not contained in the Data Base, the WPT page will appear so the waypoint may be further defined.

DIS 139.5NM - The distance in nautical miles between the two waypoints.

BRG: 235.1° TO - The bearing in degrees from the FROM waypoint to the TO Waypoint.

ENTER GS: 4Ø5KT - The aircraft's estimated ground speed for the trip can be entered in this data field.

ETE Ø:21 H:M - The estimated time enroute for the trip based on the ground speed input above.

```
DATA          AUTO/LEG
 VOR           RNV APR

 TRIP PLANNING

    WPT TO WPT


FROM WPT:   KIXD
 TO  WPT:   KICT


DIS        139.5   NM
BRG        235.1°  TO
ENTER GS:     405KT
ETE         0.21 H:M
```

FLIGHT PLAN ANALYSIS
TRIP PLANNING PAGE

```
DATA          AUTO/LEG
 VOR           RNV APR

 TRIP PLANNING

  FPL ANALYSIS


ENTER FPL: 56
  KIXD /KLAX



DIS     1172.7    NM
ENTER GS:     405KT
ETE     2:54     H:M
```

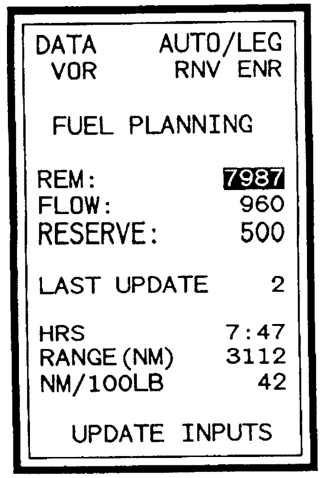
ENTER FPL: 56
KIXD/KLAX - The flight plan number of a flight plan listed on any Flight Plan Menu page may be input in the data field. The first and last waypoint identifiers from that flight plan are then displayed.

DIS 1172.7NM - The distance in nautical miles between the two waypoints along the flight plan route.

ENTER GS: 405KT - The aircraft's estimated ground speed for the trip can be entered in this data field.

ETE 2:54 H:M - The estimated time enroute in hours and minutes for the trip based on the ground speed input above.

FUEL PLANNING PAGE



REM: 7987 - The total fuel remaining in pounds. Must be manually input. Automatically counts down as a function of time and the manually entered fuel flow.

FLOW: 96Ø - The total fuel flow in lbs/hr. Must be manually input.

RESERVE: 5ØØ - The desired fuel reserve in pounds. Must be manually input.

LAST UPDATE 2 - Time in minutes since the pilot has updated any of the fuel planning data. After 15 minutes the HRS, RANGE, and NM/100LB fields blank and an UPDATE INPUTS message flashes at the bottom of the page.

HRS 7:47 - The endurance in hours and minutes based upon the manually input fuel remaining, fuel flow and fuel reserve data.

RANGE(NM) 3113 - The range in nautical miles based upon the endurance above and the aircraft's present ground speed as calculated by the KNS 660.

NM/1ØØLB 42 - The aircraft's fuel economy in nautical miles per 100 lbs. of fuel based upon the present ground speed and manually input fuel flow.

UPDATE INPUTS - This flashing message appears only if the above data has not been updated for 15 minutes.

PAGE DISPLAY DEFINITIONS

POSITION SUMMARY PAGE

The Position Summary page displays the aircraft's position in latitude and longitude coordinates as determined by each of the sensors configured in the KNS 660 installation. Only the sensors actually included in the particular installation are displayed on this page. An asterisk (*) appearing below a sensor name indicates that no actual position data is being derived from that sensor, but sufficient previous data is available for the KNS 660 to calculate a sensor position with good confidence.

```
DATA      AUTO/LEG
 BLEND     RNV  ENR

 POS'N SUMMARY
POS     N 38°49.2'
        W 94°53.3'

VOR     N 38°49.2'
 *      W 94°53.3'

OMEGA   N 38°49.3'
        W 94°53.2'

INS     N 38°49.4'
        W 94°53.4'
    NEXT PAGE?
```

POS N 38° 49.2'
W 94° 53.3'- The aircraft's presen t position coordinates based on inputs from the pilot selected sensor. When BLEND sensor has been selected this position is a computer optimized position which blends the position information from all the sensors.

VOR N 38° 49.2'
* W 94° 53.3'- The aircraft's presen t position coordinates based on inputs from the VOR and/or DME sensors. If the system has a DME sensor for Rho-Rho updating of the OMEGA or IRU sensors but has no VOR sensor then VOR is replaced by DME. The asterisk (*) appearing below VOR is described in the first paragraph above.

OMEGA N 38° 49.3'
W 94° 53.2' - The aircraft's present position coordinates based on inputs from the OMEGA/VLF sensor. If the OMEGA/VLF Status page displays AUTO/UPDATE, then the OMEGA coordinates displayed on this page have been updated. Under any other conditions the coordinates presented here are purely from the OMEGA/VLF sensor.

INS N 38° 49.4'
W 94° 53.4' - The aircraft's present position coordinates based on inputs from the Inertial Reference Unit.

NEXT PAGE? - If more than three position sensors are included in the KNS 660 installation, the remaining sensors are displayed on the next page and the NEXT PAGE? field appears. The next page is displayed by placing the cursor over this field and pressing the ENTER key.

VOR/DME STATUS PAGE

The VOR/DME Status page may be used to monitor the VOR and/or DME stations being used by the system.

```
DATA        AUTO/LEG
 VOR         RNV ENR

     VOR/DME

VOR 1     REC MKC
 202.2°     112.60

DME 1     REC MKC
  30.3NM   112.60

DME
 ___._NM___ ____
            ___.__

   RHO-THETA
```

VOR 1 REC MKC
202.2° 112.60 - Indicates that the NAV sensor is tuning Kansas City VORTAC (MKC) whose frequency is 112.60 MHz (Top screen). REC indicates that a valid (not flagged) signal is being received and 202.2° is the station radial on which the aircraft is located. If the system has a DME sensor for Rho-Rho updating of the OMEGA or IRU sensors but has no VOR sensor then these two lines are blank.

DME 1 REC MKC
30.3NM 112.60 - Indicates that the DME sensor is tuning Kansas City VORTAC (MKC) on the DME frequency paired with 112.60MHz (Top screen). REC indicates a valid (not flagged) signal is being received and 30.3NM is the distance from this station to the aircraft.

DME ___ ___
___._NM ___.__ - Indicates that valid DME distance is not being received from a second station (Top screen). The system is therefore providing Rho-Theta navigation data.

DME 2 REC TOP
50.6NM 117.80 - When valid DME data is received from a second DME station (bottom screen) this area displays REC, the identifier and frequency of the station utilized, and the aircraft's distance from the station. Under these conditions, the system is providing Rho-Rho navigation data.

```
DATA        AUTO/LEG
 VOR         RNV ENR

     VOR/DME

VOR 1     REC MKC
 182.4°     112.60

DME 1     REC ANX
  36.1NM   114.00

DME 2     REC TOP
  50.6NM   117.80

     RHO-RHO
```

When the system is providing Rho-Rho navigation it is not unusual for the VOR station identifier to be different from either of the DME station identifiers. It is also possible under valid Rho-Rho conditions for the VOR data to be blanked or flagged. It is normal during Rho-Rho operation for the DME stations to temporarily flag due to recalculation of optimum station pair.

VOR/DME STATUS PAGE (Cont'd)

RHO-THETA - (Top screen)
RHO-RHO - (Bottom screen) This field displays the mode that the VOR/DME software is in. That is, when RHO-THETA is displayed the system is trying to use radial and distance information to determine position and when RHO-RHO is displayed the system is trying to determine position from two distance inputs. This field will be blank when the system's filtered position calculation is being utilized. The word NONE can also be displayed in this field under certain conditions such as: (1) when the KNS 660 is in AUTO/LEG operation but the aircraft is out of range of any usable NAV stations. (2) When the KNS 660 is in OBS operation and the active waypoint doesn't contain a reference navaid. (3) When the KNS 660 is in OBS operation and there is no active waypoint.

```
DATA        AUTO/LEG
 VOR         RNV ENR

      VOR/DME

VOR 1      REC MKC
 202.2°     112.60

DME 1      REC MKC
  30.3NM    112.60

DME
 ---.-NM---  ----
            ---.--

    RHO-THETA
```

```
DATA        AUTO/LEG
 VOR         RNV ENR

      VOR/DME

VOR 1      REC MKC
 182.4°     112.60

DME 1      REC ANX
  36.1NM    114.00

DME 2      REC TOP
  50.6NM    117.80

      RHO-RHO
```

TACAN STATUS PAGE

When a TACAN sensor is installed as part of a KNS 660 installation, the TACAN Status page may be monitored to view the status of the TACAN stations being used by the system.

```
DATA      AUTO/LEG
 TACAN     RNV ENR

      TACAN

TACAN      REC GVW
 120.3°        23X

DME 1      REC GVW
  53.7NM    108.60

DME      ___  ____
___._NM   ___.__

   RHO-THETA
```

TACAN REC GVW
120.3° 23X - Indicates valid (not flagged) TACAN bearing information is being received from GVW whose TACAN channel is 23X (Top screen). The aircraft is located on the 120.3° radial from GVW.

DME 1 REC GVM
53.7NM 108.60 - Indicates valid (not flagged) distance information is being received from GVW whose paired VHF frequency is 108.60 MHz (Top screen). The aircraft is 53.7NM from GVW.

DME ___
___._NM ___.__ -Indicates that valid DME distance is not being received from a second station (Top screen). The system is therefore providing Rho-Theta navigation data.

```
DATA      AUTO/LEG
 TACAN     RNV ENR

      TACAN

TACAN     ____  ___
___._           ___

DME 1      REC ANX
  36.1NM    114.00

DME 2      REC TOP
  50.6NM    117.80

     RHO-RHO
```

DME 2 REC TOP
50.6NM 117.80 - When valid DME data is received from a second DME station (bottom screen) this area displays REC, the identifier and paired VHF frequency of the station utilized, and the aircraft's distance from the station. Under these conditions, the system is providing Rho-Rho navigation data. When the system is providing Rho-Rho navigation the TACAN bearing data is dashed out. See explanation of RHO-THETA, RHO-RHO, and NONE from previous page.

OMEGA/VLF STATUS PAGE

```
DATA      AUTO/LEG
 OMEGA     RNV ENR

  OMEGA STATUS
>AUTO/UPDATE
 SYNC        NAV
    OMEGA/VLF
 OMEGA        VLF
NOR 32     NOR 42
LIB-38*    GBR 44
HAW 98     HAW 86
NDK 99     WAS 93
LRN 26*    MAR 96
ARG 42     MAI 98
AUS 64     AUS-51*
JPN 39     JPN 47
```

If the OMEGA/VLF sensor option is installed, the OMEGA/VLF Status Page may be displayed to monitor the status of the OMEGA/VLF or to make operational selections affecting the OMEGA/VLF.

> AUTO UPDATE - Normally this line will display AUTO UPDATE which means that the DME sensor updates the OMEGA system when Rho-Rho navigation is being provided. By placing the cursor over this field and pressing the CLEAR key this field will cycle between AUTO UPDATE and NO AUTO UPDATE. The OMEGA system is not being updated when NO AUTO UPDATE is selected. The system always defaults to AUTO UPDATE when power is removed and later turned back on. If the OMEGA system requires a re-lane operation this line will display RE-LANE?. To select the OMEGA re-lane operation, the pilot places the cursor over RE-LANE? and presses the ENTER key. The system then displays the Re-lane Page described in the following pages.

SYNC - This field can indicate either SYNC or NO SYNC. NO SYNC will appear until the received OMEGA stations are sorted out and identified. At that time SYNC will be displayed.

NAV - This field can indicate INIT, NAV, WARN or FAIL. INIT will be displayed until the present position is determined, then NAV will be displayed. WARN will be displayed whenever the number of useable stations being received is less than three unless the system is equipped with the optional rubidium frequency standard when only two stations are required. FAIL will be displayed whenever the present position cannot be determined either due to an equipment failure or due to the number of stations presently received. The KNS 660 should not be used for navigation purposes when relying on the OMEGA/VLF sensor and INIT, WARN, or FAIL are displayed.

OMEGA/VLF - Indicates the primary and secondary sensors being used by the OMEGA/VLF system, where the leftmost sensor displayed is the primary one when two sensors are being used. The following fields are used: VLF, VLF/OMEGA, OMEGA or OMEGA/VLF.

OMEGA/VLF STATUS PAGE (Cont'd)

```
DATA        AUTO/LEG
 OMEGA      RNV ENR

  OMEGA STATUS
>AUTO/UPDATE
 SYNC         NAV
    OMEGA/VLF
 OMEGA        VLF
NOR 32      NOR 42
LIB-38*     GBR 44
HAW 98      HAW 86
NDK 99      WAS 93
LRN 26*     MAR 96
ARG 42      MAI 98
AUS 64      AUS-51*
JPN 39      JPN 47
```

OMEGA VLF - The identifiers and associated data under the OMEGA column pertain to the OMEGA stations. The identifiers and associated data under the VLF column pertain to the VLF stations. The locations of the station identifiers are as listed below. Additional information is contained in Section IX.

OMEGA Stations

NOR - Norway
LIB - Liberia
HAW - Hawaii
NDK - North Dakota
LRN - LaReunion
ARG - Argentina
AUS - Australia
JPN - Japan

VLF Stations

The system will automatically choose to display the closest eight VLF stations to the aircraft's position from the list below.

NOR - Norway
GBR - Great Britain
HAW - Hawaii
WAS - Washington
MAR - Maryland
MAI - Maine
AUS - Australia
JPN - Japan
PRT - Puerto Rico

LIB-38* GBR 44 - Columns 1 through 3 display the three letter station identification of the OMEGA station.

Column 4 displays either a blank space or a minus sign. A minus sign indicates that the pilot has manually deselected the station. The station may be deselected by placing the cursor over this field and pressing the 9/- key and the ENTER key. If the entry is pilot deselected, the deselection can be removed by placing the cursor over the – (minus sign) and pressing the 0/+ key and the ENTER key.

OMEGA/VLF STATUS PAGE (Cont'd)

```
DATA       AUTO/LEG
 OMEGA      RNV ENR

  OMEGA STATUS
>AUTO/UPDATE
 SYNC       NAV
   OMEGA/VLF
 OMEGA       VLF
NOR 32     NOR 42
LIB-38*    GBR 44
HAW 98     HAW 86
NDK 99     WAS 93
LRN 26*    MAR 96
ARG 42     MAI 98
AUS 64     AUS-51*
JPN 39     JPN 47
```

Columns 5 and 6 display a quality factor number from 0 to 99 that is representative of the signal to noise ratio of the OMEGA station. The system will utilize the OMEGA station if the number is above 30. If the station is deselected, either manually or by the OMEGA/VLF system, the number displayed is invalid.

Column 7 displays an asterisk or a blank space. An asterisk indicates that the OMEGA system has automatically deselected the station for use or the station has been manually deselected. The system will automatically deselect stations based on distance (too close or too far) and on other criteria relating to signal interference. A blank space indicates that the system is able to use the station.

Columns 10-12 display the three letter station identification of the VLF station.

Column 13 displays either a blank space or a minus sign. A minus sign indicates that the pilot has manually deselected the station. The station may be deselected by placing the cursor over this field and pressing the 9/— key and the ENTER key. If the station is pilot deselected, it can be restored by placing the cursor over the — (minus sign) and pressing the 0/+ key and the ENTER key.

Columns 14 and 15 display a quality factor number from 0 to 99 that is representative of the signal to noise ratio of the VLF station. The system will utilize the VLF station if the number is greater than 50. If the station is deselected, either manually or by the OMEGA/VLF system, the number displayed is invalid.

Column 16 displays an asterisk or a blank space. An asterisk indicates that the OMEGA/VLF system has automatically deselected the station for use or the station has been manually deselected. The system will automatically deselect stations based on distance (too close or too far) and on other criteria relating to signal interference. A blank space indicates that the system is able to use the station.

OMEGA RE-LANE PAGE

```
DATA      AUTO/LEG
 OMEGA     RNV ENR

 RE-LANE OMEGA
 SELECT ON POS

  CURRENT POS?
     N 38°49.9'
     W 94°53.4'

  RE-LANE POS?
     N 38°57.0'
     W 94°53.4'
```

Under certain rare conditions it is possible for the OMEGA/VLF system to detect an uncertainty in its calcuated position. Under these specific conditions the system will illuminate the message light and give the pilot a message stating:

```
OMEGA RE-LANING
SEL OMG DATA PAG
```

The pilot should then select the OMEGA/VLF Status Page. When the system annunciates the above message the OMEGA/VLF Status Page will display RE-LANE? instead of AUTO UPDATE or NO AUTO UPDATE. To select the OMEGA relane operation, the cursor is placed over the RE-LANE? field and the ENTER key is pressed. The OMEGA Re-lane Page is then displayed.

CURRENT POS?
N 38° 49.9'
W 94° 53.4' - The normal OMEGA/VLF derived position coordinates of the aircraft's present position.

RE-LANE POS?
N 38° 57.Ø'
W 94° 53.4' - An alternative OMEGA determination of the aircraft's present position based upon OMEGA data only.

The pilot should determine which of the two positions is correct by comparision with other KNS 660 sensor solutions, other navigation equipment on board the aircraft, or by visual reference to known positions on the ground. Selection is made by placing the cursor over the interrogative field of the desired position and pressing the ENTER key.

PAGE DISPLAY DEFINITIONS

LORAN STATUS PAGE
(ORS 05 Level systems only)

If an ANI/ONI 7000 LORAN is part of the KNS 660 system installation, the LORAN Status Page may be used to monitor the status of the LORAN. The following information is displayed on the LORAN Status Page:

```
LORAN     RNV ENR

  LORAN STATUS
XXXXX 0105 YYYY
EPE____._ NM

TRIAD SELECT?
 VIEW CHAIN?


GRI         STNS
9980        MVWXYZ
----        ------
----        ------
----        ------
```

XXXXX Ø1Ø5 YYYY - The XXXXX field may display either AUTO or TRIAD in those installations that do not contain a LORAN Control Display Unit. AUTO indicates the the LORAN sensor is in automatic chain selection mode as opposed to dedicated triad mode. TRIAD is displayed when the LORAN sensor is operating in dedicated triad mode. When TRIAD is flashing, this is an indication that one or more of the designated triad stations has not been acquired. The XXXXX field will be blank or display APR in installations containing a LORAN Control Display Unit when approach mode is selected with the LORAN Control Display Unit. The center field of this line, 0105, displays the software identification number for the ANI/ONI 7000 LORAN interface software. The YYYY field of this line will display INIT, NAV, WARN, or FAIL. INIT indicates the LORAN is still trying to acquire stations and therefore, position data is not available. NAV indicates a valid position input is being received from the LORAN. WARN indicates the LORAN is still providing position data but the accuracy is questionable. FAIL indicates no valid position data is being received from the LORAN.

EPE ___.__NM - The estimated Position Error furnished by the LORAN is displayed in nautical miles.

TRIAD SELECT? - This line only appears in installations not containing a LORAN Control Display Unit. Placing the cursor over this field and pressing the ENTER key will cause the Triad Selection Page to be displayed.

LORAN STATUS PAGE (Cont'd)

```
LORAN     RNV ENR

  LORAN STATUS
XXXXX 0105 YYYY
EPE____._ NM

TRIAD SELECT?
 VIEW CHAIN?


GRI          STNS
9980         MVWXYZ
----         ------
----         ------
----         ------
```

VIEW CHAIN? - Placing the cursor over this field and pressing the ENTER key will cause the LORAN Chain Page to be displayed.

The area of the page between VIEW CHAIN? and GRI STNS may display detailed messages about the status of the LORAN. No more than two of the following messages will be displayed simultaneously.

HARDWARE FAIL - A failure has occurred in the LORAN hardware which has caused a loss of position data.

HARDWARE ERROR - A failure has occurred in the hardware which has not caused loss of position data but position is suspect and should be checked.

INSUF STATIONS - An insufficient number of LORAN stations is being received for determining position.

POS UNCONVERGED - The LORAN lat/long solution in unconverged. No lat/long available.

OUTSIDE LOR AREA - The aircraft is outside of the LORAN operating area.

POOR GEOMETRY - The system is in a poor geometry area. Position is available, but is suspect and should be checked.

GRI STNS
9980 MVWXYZ - The GRI's (Group Repitition Intervals) of the chains in use are displayed below GRI. In this example, the LORAN is using a chain with a GRI of 9980μS. The specific stations of the chain which are being received are displayed under STNS.

LORAN CHAIN PAGE
(ORS 05 Level systems only)

```
DATA      AUTO/LEG
 LORAN     RNV ENR

  LORAN CHAIN
 AUTO         NAV
GRI:8990
>N. SUDIA ARABIA

STN

 M
 V
-W*
 X*
-Y*
 Z
```

The LORAN Chain Page can be used to view the LORAN chains known to the KNS 660 system. Information about LORAN chains is stored in the KNS 660 Data Base and updated automatically whenever the Data Base update procedure described in Section V is accomplished. A second use of the LORAN CHAIN Page is to allow manual selection or deselection of stations within a chain which will be used for navigation.

AUTO NAV - This line of information is the same as the corresponding line on the LORAN Status Page, except the software identification number is not displayed.

GRI:8990 - By placing the cursor over this field and using the keyboard and the ENTER key, GRI's may be entered as four digit numbers. If a GRI known to the KNS 660 system has been entered, the corresponding name for the chain will appear below the GRI. Entry of invalid or unknown GRI's will cause INVALID GRI to be displayed in the scratch pad area.

> N. SAUDI ARABIA - The name associated with a GRI of 8990. By placing the cursor over this field and repeatedly pressing the CLR key, the names and corresponding GRI's for all known chains will be displayed.

STN - The station identifiers for the selected chain are shown below this field. A hyphen (—) displayed to the left of the station identifier indicates the pilot has manually deselected the station. A blank to the left of the station identifier indicates the pilot has not deselected the station. A blank to the right of a station identifier indicates it is being used for navigation. An asterisk indicates the station is not being used for navigation.

TRIAD SELECTION PAGE
(ORS 05 Level systems only)

This page is only accessible in those KNS 660 systems including an ANI/ONI 7000 LORAN sensor without a LORAN Control Display Unit. This page is used to select dedicated triad mode of navigation for the LORAN sensor and to store up to five dedicated triads in the KNS 660 system Data Base. Systems with an ANI/ONI 7000 Control Display Unit installed accomplish this function with the ANI/ONI 7000 Control Display Unit.

```
DATA      AUTO/LEG
 LORAN     RNV ENR

  TRIAD SELECT
> AUTO          NAV
SEL TRIAD:1
GRI:9990   MXYZ
>NORTH PACIFIC
STA:MXZ

  GRI     STA
1:9990   :MXZ
2:9970   :MWZ
3:----   :---
4:----   :---
5:----   :---
```

>AUTO NAV - By moving the cursor over the >AUTO field and pressing the CLR key, the dedicated triad mode will be selected and this field will now display >TRIAD. >TRIAD will flash until a dedicated triad is selected and acquired by the LORAN. A second push of the CLR key will return to automatic chain selection and the field will once again display >AUTO. The right hand portion of this line will display NAV, WARN, INIT, or FAIL depending on the status of the LORAN sensor.

SEL TRIAD: 1 - A previously stored dedicated triad may be selected by placing the cursor over the 1 field and using the keyboard to select the desired triad by pressing a number key (1 through 5) and then the ENTER key.

GRI:9990 MXYZ
>NORTH PACIFIC
STA:MXZ - These three lines are used to display the selected dedicated triad or store a dedicated triad in conjunction with the SEL TRIAD: field. The GRI of the selected chain is shown (GRI: 9990) along with all stations within the chain (MXYZ). The corresponding name (NORTH PACIFIC) of the selected chain is displayed also. STA:MXZ displays the specific stations comprising the selected dedicated triad. The master station (M) must always be selected in a dedicated triad so it is automatically included.

TRIAD SELECTION PAGE (Cont'd)

```
GRI        STAT
1:999Ø     MXZ
2:997Ø     MWX
3:         M
4:         M
5:         M
```

- In this example, two of five possible dedicated triads are stored in the KNS 660 Data Base. Dedicated triad number 1 is stored as GRI 9990, the NORTH PACIFIC chain, and stations M, X, and Z. Similarly, dedicated triad number 2 is stored as GRI 9970 and stations M, W, and X. In this example, up to three additional dedicated triads can be stored.

```
DATA      AUTO/LEG
 LORAN    RNV  ENR

  TRIAD SELECT
> AUTO         NAV
SEL TRIAD:1
GRI:9990   MXYZ
>NORTH PACIFIC
STA:MXZ

  GRI    STA
1:9990  :MXZ
2:9970  :MWZ
3:____  :___
4:____  :___
5:____  :___
```

INS STATUS PAGE

```
DATA        AUTO/LEG
 INS         RNV ENR

     INS PAGE
   >AUTO/UPDATE
POS     N 38°49.9'
        W 94°53.4'

 GS           405
 TK           275°
 HDG          271°
 OBSERVED      4.1'
    DRIFT      5.3'

 MODE          NAV
 HDG SEL        °m
```

If an Inertial Reference Unit (IRU) is included as part of a KNS 660 installation, the INS Status page may be used to monitor the status of the IRU. The INS Status page displays the following items:

>AUTO UPDATE - Normally this line will display AUTO UPDATE which means that the DME sensor updates the displayed position of the IRU when Rho-Rho navigation is being provided. Placing the cursor over this field and pressing the CLR key changes this field to NO AUTO UPDATE where the displayed IRU position is not updated.

POS N 38° 49.9'
W 94° 53.4' - The aircraft's present position in latitude and longitude as determined by the IRU. This position does not reflect Rho-Rho updating.

GS 405 - Groundspeed in knots as determined by the IRU.

TK 275° - Track angle as determined by the IRU.

HDG 271° - Aircraft heading referenced to True North as determined by the IRU.

OBSERVED 4.1'
DRIFT 5.3' - The difference in minutes between the system's Rho-Rho computed latitude and longitude position and the IRU's raw (not Rho-Rho updated) latitude and longitude position.

MODE NAV - The system modes are OFF, ALIGN, NAV and ATT.

HDG SEL: ___°m - Used to reinitialize the IRU in flight as an attitude reference only. Allows magnetic heading to be manually entered through the KNS 660 when the IRU is in the ATT mode.

PAGE DISPLAY DEFINITIONS

GPS STATUS PAGE
(ORS 06 Level systems only)

```
DATA      AUTO/LEG
 GPS       RNV ENR

  GPS STATUS
STATE          NAV
EPE        XXXXXX
     RESTART?
 SAT SNR ELE HLT
   3  31  46  WK
   6  44  23  GD
   7  39  70  GD
*  17  32   9  BD
*  21  39  35  BD
- --  --  --  --
- --  --  --  --
- --  --  --  --
```

If a NAVSTAR Global Positioning System (GPS) sensor is included in the KNS 660 system, the GPS STATUS Page can be used to monitor the status of the GPS sensor.

STATE NAV - This line indicates the status of the GPS sensor. In addition to NAV, the GPS sensor may be in any one of the following states:

INIT - In process of initialization

STS - In process of Searching The Sky

ACQ - In process of acquiring satellites

TRN - Transiitioning between acquisition and NAV

NAV - In the navigation mode

NAV DAT - In process of data collection

WARN - Degraded position information is being supplied

FAIL CPU - CPU or 429 receiver has failed (catastrophic)

FAIL MEM - Memory has failed (catastrophic)

FAIL REC - Receiver hardware has failed (catastrophic).

EPE - The estimated position error for the GPS sensor is displayed on this line. It is units of feet rather than nautical miles due to the higher accuracy available from the GPS system.

RESTART? - This field will appear if the GPS sensor is in an INIT, STS, ACQ, TRN, FAIL CPU, FAIL MEM, or FAIL REC state. Moving the cursor over this field when it appears and pressing the ENTER key will cause the GPS RESTART Page to be displayed.

GPS STATUS PAGE (Cont'd)

SAT	SNR	ELE	HLT
3	31	46	WK
6	44	23	GD
7	39	70	GD
*17	32	9	BD
*21	39	35	BD

- This area of the GPS Status Page provides information on up to eight of the NAVSTAR GPS satellites visible to the GPS sensor. Below the column labled SAT, appear the numerical designations of various satellites visible to the GPS sensor. an asterisk to the far left of the identifier indicates that the GPS sensor is not using the specific satellite in its position solution. The SNR column provides signal strength information for individual satellites. Typical SNR values will be in the 30 to 55 range. The elevation above the horizon for each satellite is provided in the ELE column. Elevation is displayed in degrees and will typically be in the range of 5° to 90°. The last column, HLT, indicates the health state of each satelite. Three states are possible: (1) GD - signal is good, (2) WK - signal is weak, and (3) BD - signal is bad

```
DATA        AUTO/LEG
 GPS         RNV ENR

  GPS STATUS
STATE          NAV
EPE         XXXXXX
     RESTART?
 SAT  SNR  ELE  HLT
    3   31   46   WK
    6   44   23   GD
    7   39   70   GD
*  17   32    9   BD
*  21   39   35   BD
-  --   --   --   --
-  --   --   --   --
-  --   --   --   --
```

GPS RESTART PAGE

(ORS 06 Level systems only)

This page is used to re-initialize (RESTART) the GPS sensor.

DATE: Ø2 NOV 87 - Greenwich date in the order of day-month-year.

GMT: 16:33 - Greenwich Mean Time in hours and minutes

WPT ID: KIXD - A data entry field where the present position waypoint identifier may be entered.

POS: N 38° 49.9'
W 94° 53.4' - The latitude and longitude of the aircraft's present position derived from either other position sensor data or the WPT ID: entry described above, or manually entered data.

MODE> NORMAL - This field allows one of three restart modes, NORMAL, COLD, or SEARCH SKY (Search The Sky) to be selected.

EST GS: Ø - Estimated groundspeed is manually entered.

```
DATA          OBS:020
 GPS          RNV ENR

  GPS RESTART

DATE:    02 NOV 87
GMT:         16:33

WPT ID:KIXD
POS:   N 38°49.9'
       W 94°53.4'

MODE>     NORMAL
EST GS :       0

     APPROVE?
```

DATA 2 MENU PAGE

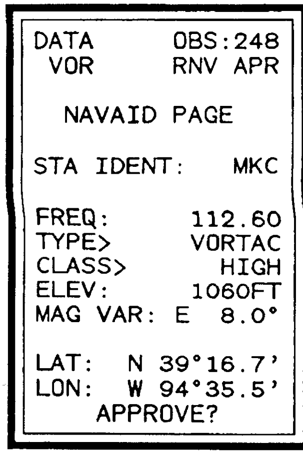
This DATA 2 Menu Page lists the actual data pages which can be selected from its menu. Specific Data pages are selected by entering the corresponding menu number into the SEL MENU ITEM: data field and pressing the ENTER key. They may also be selected by placing the cursor over the menu item and pressing the ENTER key.

```
DATA 2      OBS:248
 VOR        RNV APR

SEL MENU ITEM:█

  1 NAVAID PAGE
  2 AIRPORT PAGE
  3 DATE/TIME
  4 CDU DATA XFR
  5 UPDATE D/BASE
  6 UPDATE FP/WPT
  7 UNUSED WPTS
  8 USER NAVAIDS
  9 USER AIRPORTS
```

NAVAID PAGE



This page is used to display the frequency, type, class, elevation, magnetic variation, latitude and longitude of a selected navaid. If the selected navaid is contained in the Data Base, the above information will be displayed when the navaid identifier is input into the Station Identifier Field. A User Defined Navaid can be created by entering the above data into their respective fields and approving the page.

STA IDENT: MKC - Navaid identifer.

FREQ: 112.60 - Navaid frequency or TACAN channel depending on which format is selected on the Waypoint page. When TACAN channel is selected, FREQ: will be replaced with CHNL:.

TYPE> VORTAC - Displays the type of navaid. Also used when a user navaid is being defined, as a cyclic field in conjunction with the CLEAR key to choose the type of navaid from among the following choices: DME, VOR/DME, VORTAC, TACAN, ILS/DME or VOR.

CLASS> HIGH - Displays the class of navaid. Also used when a user navaid is being defined. It is a cyclic field and is modified with the CLEAR key to choose the class of navaid from the following choices: LOW, HIGH, TERMINAL, and UNDEFINED.

ELEV: 1060 FT - The elevation (to the nearest 10 feet) of the navaid being displayed or defined.

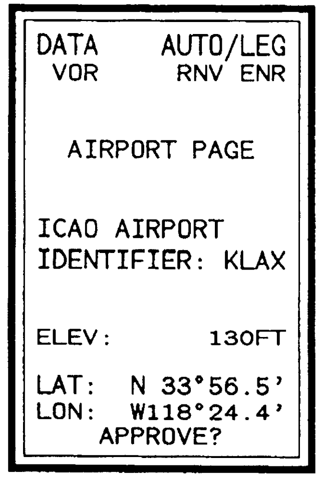
MAG VAR: E 8.0° - The published magnetic variation in degrees of the navaid being displayed or defined.

LAT: N 39° 16.7'
LON: W 94° 35.5' - The position of the navaid in latitude and longitude.

APPROVE? - A cursor field used to approve a user defined navaid.

AIRPORT PAGE

The Airport Page is used to display the elevation and the position of the airport reference point (ARP) of a selected airport. If the selected airport is contained in the Data Base, the above information will be displayed when the airport ICAO identifer is input. User Defined airports can be created by inputting the above data into their respective fields and approving the page.



ICAO AIRPORT
IDENTIFIER : KLAX - Airport ICAO identifer or other user defined airport identifier.

ELEV: 130 FT - Airport elevation to the nearest 10 feet referenced to sea level.

LAT: N 33° 56.5'
LON: W 118° 24.4' - Position in latitude and longitude of the airport reference point (ARP).

APPROVE? - A cursor field to used to approve a user defined airport.

PAGE DISPLAY DEFINITIONS

DATE/TIME PAGE

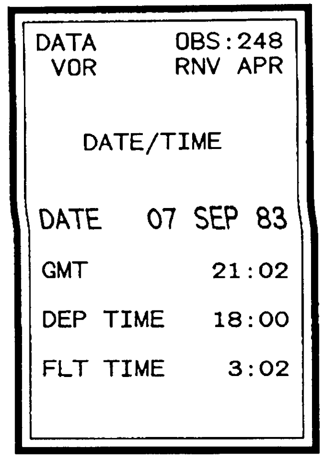
The data displayed on the Date/Time Page is for reference only and can not be changed from this page.

DATE Ø7 SEP 83 - The current Greenwich date in the sequence day-month-year.

GMT 21:Ø2 - The current Greenwich Mean Time.

DEP TIME 18:ØØ - The departure time which is defined as the time (GMT) the system first calculated a ground speed that exceeded 50 KT.

FLT TIME 3:Ø2 - The flight time in hours and minutes, which is defined as the elapsed time since the system first calculated a ground speed that exceeded 50 KT.



CDU DATA TRANSFER PAGE

The CDU Data Transfer Page is used in dual KNS 660 installations to transfer all flight plans, waypoints, and user defined navaids and airports from one KNC 667 in the installation to the other. Operational procedures are contained in Section VII.

SEL MENU ITEM: - The number associated with the desired menu item may be entered in this field.

1 RECEIVE - Used to make one unit of a Dual KNS 660 installation the receive system.

2 TRANSMIT - Used to make one unit of a Dual KNS 660 installation the transmit system.

Other data is displayed on this page during an actual CDU data transfer and is explained in Section VII.

```
DATA        AUTO/LEG
 VOR         RNV APR

   CDU DATA XFR

SEL MENU ITEM:█

   1 RECEIVE
   2 TRANSMIT



PRESS ANY KEY TO
CANCEL RECEIVE
```

UPDATE DATA BASE PAGE

```
DATA        OBS:248
 VOR        RNV APR

 UPDATE D/BASE

SEL MENU ITEM:█
 1 REVIEW D/BASE
 2 SELECT D/BASE

   NEXT UPDATE
    30 JUL 84

   LOAD D/BASE?
*ON GROUND ONLY
*AFTER D/BASE
 SELECT COMPLETE
```

This page serves as a master menu for initiating three types of Data Base operations: (1) reviewing the present configuration of what is currently loaded in the Data Base (2) modifying the configuration of what is to be loaded into the Data Base and (3) loading the Data Base with the data loader. Operational procedures for these Data Base managment functions are described in Section V, Normal Operation Level I.

SEL MENU ITEM: - The number associated with the desired menu item can be entered in this field.

1 REVIEW D/BASE - This menu item is selected to display additional Data Base review pages which are used to review what is presently loaded in the Data Base. The pages accessed via this menu item are the Review Data Base page and the Review Elements page.

2 SELECT D/BASE - This menu item is selected to display additional Data Base modification pages which are used to configure the Data Base prior to being loaded with the data loader.

NEXT UPDATE
Ø2 MAR 84 - A non-enterable cursor field which displays the Greenwich date when the next 28 day Data Base revision update is due.

LOAD D/BASE? - A flashing cursor field used to initate a loading of the Data Base with the data loader.

*ON GROUND ONLY
*AFTER D/BASE
SELECT COMPLETE - A non-enterable cursor field displaying an advisory message to the pilot that the Data Base is to be loaded only while the aircraft is on the ground and only after the Data Base configuration has been verifed or modified as desired.

REVIEW DATA BASE PAGE

This page is used to review those regions of the world having data presently loaded in the Data Base. The world is divided into 10 regions (per ARINC 424) all of which are displayed on this page. The Data Base cannot be modified, from this page. Operational information for the Data Base pages is contained in Section V.

```
DATA         AUTO/LEG
 VOR          RNV ENR

 REVIEW D/BASE

SEL MENU ITEM:__
 1 USA              *
 2 CANADA           *
 3 LATIM AM         *
 4 EUROPE
 5 SOUTH AM
 6 MID EAST
 7 AFRICA
 8 EAST EUR
 9 PACIFIC
10 SOUTH PAC
```

SEL MENU ITEM: - The number associated with the desired geographic region can be entered in this field to display the region's Review Elements page.

1 USA * - The asterisk (*) denotes that data from the United States is presently loaded in the Data Base. The specific data loaded for the United States is displayed on the Review Elements page.

5 SOUTH AM - No asterisk denotes that no data for South America is presently loaded in the Data Base.

REVIEW ELEMENTS PAGE

This page is used to review the navigational elements loaded in the Data Base for a particular region of the world. The Data Base cannot be modified from this page. Additional information concerning Data Base operational procedures is contained in Section V.

```
DATA          OBS:248
 VOR          RNV APR

USA            D/BASE

NAVAID              *
APT>4000FT          *
APT>3000FT
RW THRESHOLD        *
OUTER MKR
HI ALT WPT
LO ALT WPT
SID/STAR
APR INTRSC

 MULT WPT
```

USA - The region of the world being reviewed.

NAVAID * - Navaids include VORTAC's, VOR/DME's , VOR's, TACAN's, DME's, and ILS DME's. The asterisk (*) denotes that navaids for the USA are presently loaded in the Data Base.

APT>4000 FT * - Airports having a hard surface runway at least 4000 ft. in length. The Asterisk (*) denotes that these airports for the USA are presently loaded in the Data Base.

APT>3000 FT - Airports having a hard surface runway at least 3000 ft. in length. Only one of the two airport elements may be selected. No asterisk denotes the element is not presently contained in the Data Base.

RW THRESHOLD * - Runway thresholds for which there exists verifed latitude and longitude coordinates (In this example for APTS > 4000FT). Meaning of * is as above.

OUTER MKR - Outer markers.

HI ALT WPT - High altitude waypoints are named intersections which appear on high altitude enroute charts.

LO ALT WPT - Low altitude waypoints are named intersections which appear on low altitude enroute charts.

SID/STAR - Standard Instrument Departure (SID) and Standard Terminal Arrival Route (STAR) waypoints and intersections.

REVIEW ELEMENTS PAGE (Cont'd)

APR INTRSC - Approach intersections are named intersections which appear on instrument approach charts. They do not include outer markers since outer markers are a separate category.

MULT WPT - Multiple waypoints. Waypoints which are used for multiple functions. For example if a waypoint serves as both a low altitude waypoint and as an approach interSection it is considered a multiple waypoint. Also, multiple waypoints include on-airway NDB's. If any type of waypoint (HI ALT, LO ALT, SID/STAR, or APR INTRSC) is loaded in the Data Base the multiple waypoints are automatically included.

```
DATA          OBS:248
 VOR          RNV APR

USA            D/BASE

NAVAID              *
APT>4000FT          *
APT>3000FT
RW THRESHOLD        *
OUTER MKR
HI ALT WPT
LO ALT WPT
SID/STAR
APR INTRSC

  MULT WPT
```

PAGE DISPLAY DEFINITIONS

SELECT DATA BASE PAGE

This page is used to select regions of the world from which data will be loaded in the Data Base. It is one of two pages used to configure the Data Base to the aircraft's specific requirements prior to using the data loader to actually load the data into the Data Base. Operational information for the Data Base pages is contained in Section V.

SEL MENU ITEM: - The number associated with the desired menu item can be entered in this field.

The regions of the world are the same as those on the Review Data Base page. The meaning of the asterisk (*), however, is different. On this page the * denotes those regions of the world which will be loaded by the data loader. The * on the Review Data Base page denotes those regions of the world which are currently loaded in the Data Base.

```
DATA        AUTO/LEG
 BLEND       RNV ENR

 SELECT D/BASE

SEL MENU ITEM:__
 1 USA            *
 2 CANADA         *
 3 LATIM AM       *
 4 EUROPE
 5 SOUTH AM
 6 MID EAST
 7 AFRICA
 8 EAST EUR
 9 PACIFIC
10 SOUTH PAC
```

SELECT ELEMENTS PAGE

DATA	AUTO/LEG
BLEND	RNV ENR
USA	D/BASE
1557 BLKS	AVAIL
NAVAID	1547*
APT>4000FT	1802*
APT>3000FT	3025
RW THRSHLD	2041
OUTER MKR	482*
HI ALT WPT	212*
LO ALT WPT	1384
SID/STAR	129
APR INTRSC	2170
MULT WPT	2221*

This page is used to select the navigation elements for a particular region of the world which will be loaded into the Data Base with the data loader. Additional information concerning Data Base operational procedures is contained in Section V.

USA - The region of the world for which navigation elements are being selected for loading into the Data Base.

1557 BLKS AVAIL - The number of blocks of Data Base memory remaining (for entire Data Base - not just region being displayed. The number decreases each time an element below is selected.

NAVAID 1547* - The Data Base elements (NAVAID, RW THRSHLD, OUTER MKR, etc.) listed are the same ones described on the Review Elements page. The number to the right of the element is the number of blocks required to store the element in the Data Base memory for the region of the world displayed on line four. No numbers appear next to RW THRSHLD or OUTER MKR until one of the two APT (airport) elements has been selected. Whenever any or all of the waypoint elements (HI ALT WPT, LO ALT WPT, SID/STAR, or APR INTRSEC) are selected, the MULT WPT is automatically included. In fact, MULT WPT cannot be selected unless at least one of the four waypoint elements is selected. The asterik * denotes those elements which are being selected to be loaded into the Data Base with the data loader. An element without a * has not been selected.

PAGE DISPLAY DEFINITIONS

UPDATE FLIGHT PLAN AND WAYPOINT PAGE

This page is used to load a new set of previously generated flight plans, waypoints, and user defined navaids and airports from the Data Base loader into KNS 660 memory. It is also used to store the current flight plans, waypoints, and user defined navaids and airports contained in the KNS 660 on a data loader diskette for later use. Precedures for these two operations are contained in Section VII.

```
DATA        AUTO/LEG
 VOR         RNV ENR

 UPDATE FP/WPT



    LAST UPDATE
     30 AUG 87

    LOAD FP/WPT?
    SAVE FP/WPT?

*  ON GROUND ONLY
```

LAST UPDATE
3Ø APR 84 - The Greenwich date that the last data loader update to the flight plans and waypoints was made.

LOAD FP/WPT? - A flashing cursor field used to load flight plans, waypoints, and user defined navaids and airports from the data loader diskette into the KNS 660 memory.

SAVE FP/WPT? - A flashing cursor field used to save the current flight plans, waypoints, and user defined navaids and airports contained in the KNS 660 on a data loader diskette.

* ON GROUND ONLY - A non-enterable cursor field advising the pilot that the above operations are to be performed only while the aircraft is on the ground.

UNUSED WAYPOINTS PAGE

DATA	AUTO/LEG
VOR	RNV ENR
UNUSED WPTS	
PREVIOUS PAGE?	
BURET	
MK1	
PLNIA	
NEXT PAGE?	

This page displays in alphabetical order the identifiers of user created waypoints that are not currently being used in any existing flight plan and are not in a protected status. If the KNS 660 is put into system protect mode (Reference "Protected Flight Plan And Waypoint Operations" in Section VII), this page will also show protected waypoints which are not being used in any flight plan.

This page can be used to delete unused waypoints from the system by placing the cursor over the waypoint identifier and pressing the CLEAR key and then the ENTER key.

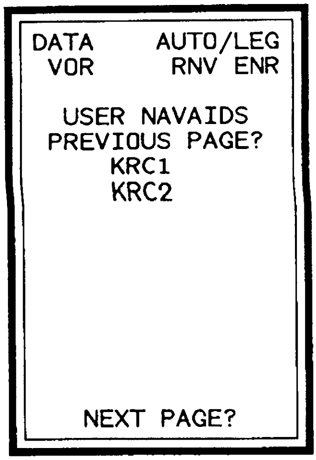
PREVIOUS PAGE? - A cursor field used to display the previous page of unused waypoints when there is more than one page of these waypoints.

BURET
MK1
PLNIA - Examples of unused waypoint identifiers.

NEXT PAGE? - A cursor field used to display the next page of unused waypoints when there is more than one page of these waypoints.

USER DEFINED NAVAIDS PAGE

This page is used to view the identifiers of the navaids contained in the supplemental Data Base memory which have been defined by the user. The identifiers are listed in alphabetical order. This page is also used to delete these user navaids from the supplemental Data Base.



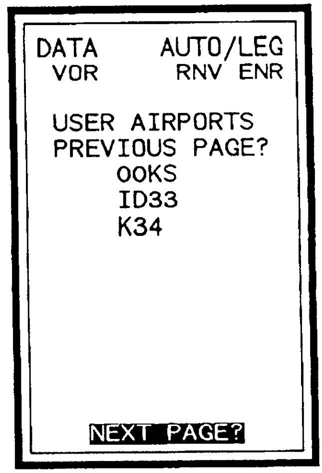
PREVIOUS PAGE? - A cursor field used to display the previous page of user defined navaids when there is more than one page of these navaids.

KRC 1
KRC 2 - Examples of user defined navaid identifiers.

NEXT PAGE? - A cursor field used to display the next page of user defined navaids when there is more than one page of these navaids.

USER DEFINED AIRPORTS PAGE

This page is used to view the identifers of airports contained in the supplemental Data Base memory which have been defined by the user. The identifiers are listed in alphabetical order. This page is also used to delete these user defined airports from the supplemental Data Base.



PREVIOUS PAGE? - A cursor field used to display the previous page of user defined airports when there is more than one page of these airports.

ØØKS
ID33
K34 - Examples of user defined airport identifiers.

NEXT PAGE? - A cursor field used to display the next page of user defined airports when there is more than one page of these airports.

SECTION V

NORMAL OPERATION LEVEL I

GENERAL

This section is the first of three sections in a building block type of KNS 660 operational learning process. The objective of this first section is to give the pilot the minimum basic information required to operate the KNS 660 for DIRECT TO enroute navigation.

NOTE

FOR INFORMATION ON ITEMS UNIQUELY APPLICABLE TO A SPECIFIC AIRCRAFT CONSULT THE AIRCRAFT'S KNS 660 AIRPLANE FLIGHT MANUAL SUPPLEMENT.

The sections containing the Normal Operation Level II and Level III may be used at anytime to supplement the information in this section.

DATA KEYBOARDS AND DATA ENTRY PROCEDURES

The following terminology is used throughout this Pilot's Guide concerning data entry into the Control Display Unit (CDU). Don't worry if it doesn't all make perfect sense to you right now. You will understand the terms as they are used in context as specific operations are described.

Cursor - The cursor is an inverse video (dark letters on a light background) where data is entered or changed. Placement of the cursor on the display in the desired location is accomplished by pressing the cursor [↓] or [↑] keys. Pressing the ENTER key will move the cursor down if the cursor is positioned over a data entry field or a cyclic field (see below for field definitions).

Data Entry Field - The Data Entry Field is an area of a page where data can be entered from the keyboard. A Data Entry Field is always preceded by a colon ":". An example of a Data Entry Field is WPT ID: on the Initialization page described in Section IV.

Cyclic Field - The Cyclic Field is a non-enterable field which is preceded by a right caret ">". The cursor is placed over the Cyclic Field and the CLR key is pressed to select beween two or more selections. An example of a Cyclic Field is >DIS on the Flight Plan Ø Page described in Section IV.

Interrogative Field - The Interrogative Field is a non-enterable field which is followed by a question mark "?". The cursor is placed over the Interrogative Field and the ENTER key is pressed to denote a positive response. An example of an Interrogative Field is TEST OK? on the Self Test Page described in Section IV.

Menu Selection Field - The Menu Selection Field occurs whenever a menu selection is displayed. A menu selection is an item preceded by a numeric identifier in a list of two or more items. A menu item selection can always be made in either of two ways: (1) by entering the number of the selected item in the Menu Selection Field and then pressing the ENTER key, or (2) by placing the cursor over the selected menu item and then pressing the ENTER key. An example of a Menu Selection Field is SELCOUNTRY: ___ on the Waypoint Duplication Page described in Section IV.

DATA KEYBOARDS AND DATA ENTRY PROCEDURES (Cont'd)

Scratch Pad - The scratch pad area is located on the left side of the third line from the top of each page. It consists of up to six characters plus the brackets as shown on the lower left screen. When there is no information in the scratch pad this area of the screen is normally blank. As you will see shortly, the scratch pad can be used to create and hold keyboard data entries to be used at a later time.

The third line from the top of each page is also used to display Scratch Pad Error Messages when keyboard entry mistakes are made. If data is entered into a data field and the entry is invalid, the cursor field will blink and a message in inverse video (similar to cursor) will be shown on line three of the display indicating the reason that the entry was not valid. The screen on the lower right shows an example of a Scratch Pad Error Message because an illegal data was entered. Some messages will remain on for five seconds while others will remain on until another key is pressed. Some of these messages occur for keyboard actions other than data entry errors.

IMPORTANT NOTE

A complete listing of these "Scratch Pad" Error Messages is contained in Appendix C. Do not confuse these messages with the messages associated with the Message light and Message key which are annunciated on the Message Page as described later in this section.

```
 FPL 0   AUTO/LEG
 BLEND    RNV ENR
[123456]


             >DIS
   1:KDFW       0
   2:TUL      207
   3:KMCI     400
   4:
   5
   6
   7

REF WPT:     ____
```

```
INIT      AUTO/LEG
 BLEND     RNV ENR
ILLEGAL ENTRY
DATE:   30 FEB 85
GMT:        21:58

REF STATION ID
            OJC

WPT ID:____
POS:   N 38°49.9'
       W 94°53.4'

EST GS:         0

      APPROVE?
```

KCU 567 (CDU) ALPHA-NUMERIC ENTRY

Thirteen alpha-numeric keys are used to enter numerals 0 to 9, North, South, East, West, Left, Right, Minus (−), Plus (+), and the letters A through Z.

The KCU 567 uses combination alpha-numeric keys in conjuction with special left, right, and center character position keys. Alpha character entry with the KCU 567 is accomplished by pressing the desired alpha-numeric key followed by pressing one of the character position keys to obtain the desired alpha character. For example, to enter an "A" you would first press the [ABC] key and then press the [▯..] key. To enter a "B" you would first press the same [ABC] key followed by pressing the [.▯.] key. Likewise, to enter a "C" you would first press the [ABC] key and then press the [..▯] key. As you can see, it consistently takes two key presses for each alpha character.

KCU 568 CDU ALPHA-NUMERIC ENTRY

This unit has 36 alpha-numeric keys, 10 of which are used to enter numerials 0 through 9 and 26 keys which are dedicated to entering the characters A through Z. Eight of the 10 numeric keys also can be used to enter: North, South, East, West, Left, Right, Minus (−), and Plus (+).

KEYBOARD DATA ENTRY COMMON TO BOTH CDU'S

Specific numeric keys on both CDU's have a special secondary functions. The following numeric keys have additional secondary functions. These functions are clearly indicated on the appropriate keys.

[ABC 1L]	L	(Left)	[PQR 6E]	E	(East)
[DEF 2N]	N	(North)	[VWX 8S]	S	(South)
[GHI 3R]	R	(Right)	[YZ− 9]	−	(Minus)
[JKL 4W]	W	(West)	[0 +]	+	(Plus)

The KNS 660 is programmed to automatically accept these selections only when they are required information for a particular data entry field. These selections are used with specific operations and are described later.

NORMAL KEYBOARD DATA ENTRY

The KNS 660 is capable of accepting keyboard data entry when you use the following procedure.

1. Move the cursor to the desired data entry field using cursor or keys as necessary (Figure 5-1).

2. Enter the necessary alpha-numeric characters until requirements for the data entry field are met (Figure 5-2). In a field which requires an N (North), S (South), E (East), W (west), R (Right), L (Left), + (Plus), or – (Minus), the first entry into that field must be the proper special symbol which is a second function of a numeric key.

3. Press the ENTER key. If the entry is valid, the cursor will move to the next cursor position or off the page (Figure 5-3). If the entry is invalid, the cursor field will blink and a message in reverse video will be shown on line 3 (scratch pad area) of the display indicating the reason that the entry was not valid. As previously mentioned, a listing of these messages is contained in Appendix C.

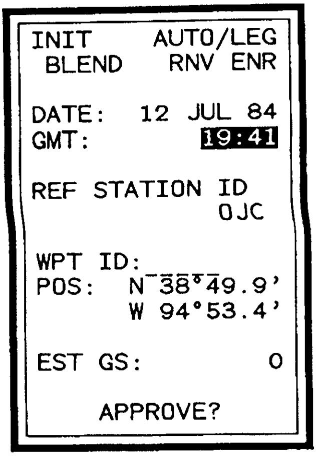


Figure 5-1

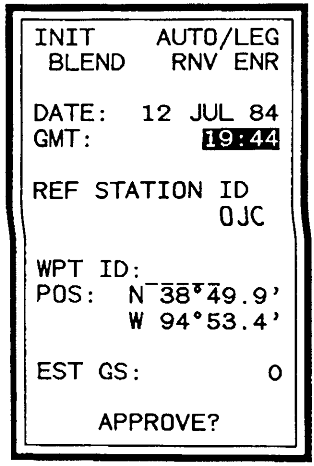


Figure 5-2

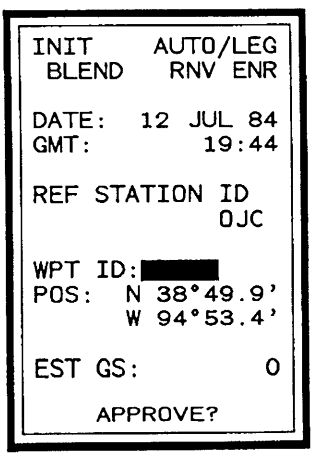


Figure 5-3

KEYBOARD DATA ENTRY USING THE SCRATCH PAD

The KNS 660 is also capable of accepting keyboard entry when the scratch pad entry procedure below is used.

1. With the cursor off the page or on a non-enterable cursor field, enter the necessary alpha-numeric characters until you have filled the intended data entry field as desired. The data will appear in the scratch pad in inverse video (Figure 5-4).

2. Press the ENTER key. The data will change to normal video surrounded by brackets "[ ]" and the cursor will go off the page (Figure 5-5).

3. Move the cursor using the cursor [↓] or [↑] keys to the desired data entry field (Figure 5-6). (Changing pages will not erase the scratch pad field.)

4. Press the ENTER key. The data will transfer from the scratch pad to the cursor if the data is valid for the field. The scratch pad will then be blanked (Figure 5-7).

5. Press the ENTER key a second time to enter the data into the system. The cursor will move to the next data entry field position or off the page (Figure 5-8). Invalid data entries will cause error messages to be displayed in the scratch pad area as previously described.

```
INIT      AUTO/LEG
 BLEND     RNV ENR
 [ 1944]
DATE:    12 JUL 84
GMT:         19:41

REF STATION ID
               OJC

WPT ID:____
POS:   N 38°49.9'
       W 94°53.4'

EST GS:          0

     APPROVE?
```

Figure 5-4

```
INIT      AUTO/LEG
 BLEND     RNV ENR
 [ 1944]
DATE:    12 JUL 84
GMT:         19:41

REF STATION ID
               OJC

WPT ID:____
POS:   N 38°49.9'
       W 94°53.4'

EST GS:          0

     APPROVE?
```

Figure 5-5

```
INIT      AUTO/LEG
 BLEND     RNV ENR
 [ 1944]
DATE:    12 JUL 84
GMT:         19:41

REF STATION ID
               OJC

WPT ID:____
POS:   N 38°49.9'
       W 94°53.4'

EST GS:          0

     APPROVE?
```

Figure 5-6

```
INIT      AUTO/LEG
 BLEND     RNV ENR

DATE:    12 JUL 84
GMT:         19:44

REF STATION ID
               OJC

WPT ID:____
POS:   N 38°49.9'
       W 94°53.4'

EST GS:          0

     APPROVE?
```

Figure 5-7

```
INIT      AUTO/LEG
 BLEND     RNV ENR

DATE:    12 JUL 84
GMT:         19:44

REF STATION ID
               OJC

WPT ID:
POS:   N 38°49.9'
       W 94°53.4'

EST GS:          0

     APPROVE?
```

Figure 5-8

CORRECTING DATA ENTRY ERRORS

1. If the cursor is over a data entry field in which you have started to make alpha-numeric entries but have not yet pressed the ENTER key, pressing the CLR key will clear one character at a time.

   For example, if you were entering the identifier for Los Angeles International Airport (KLAX) and input the first three characters as KLB (Figure 5-9) instead of KLA, pressing the CLR key once would clear only the B (Figure 5-10). Pushing it again would clear the L, etc.

2. With the exception of making changes to a flight plan, if entered data already exists in a data entry field which needs to be changed (Figure 5-11) you may simply start over and enter new alphanumeric characters over the existing ones in the data entry field to be changed (Figure 5-12) and press ENTER (Figure 5-13).

3. Section VI explains the procedures for making changes in a flight plan.

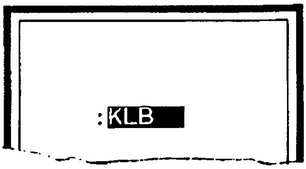


Figure 5-9

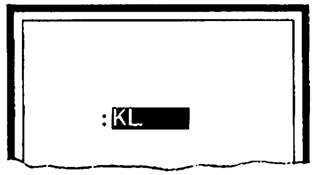


Figure 5-10

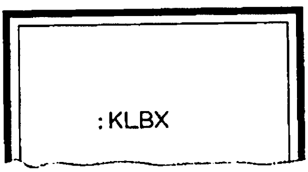


Figure 5-11

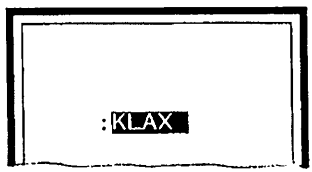


Figure 5-12

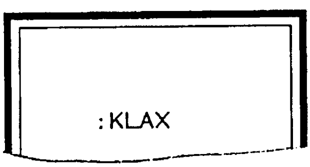


Figure 5-13

BASIC KNS 660 OPERATION

TURN SYSTEM ON

1. ON-OFF rocker switch - PRESS top half. If system hasn't been recently used allow 8 to 10 seconds for CRT to become illuminated.

2. BRT-DIM rocker switch - ADJUST screen brightness as desired. (Refer to Section III)

SELF TEST

When the KNS 660 is turned on, an automatic self test routine is initiated. If a particular system fault is found during the self test routine a SYSTEM FAILED page (not shown) is displayed. If this particular system fault is not found the Self Test page is presented with the cursor over TEST OK? and the following procedure needs to be followed (Figure 5-14):

1. Self Test page - CHECK that SYSTEM OK is being displayed. (If SYSTEM FAIL is displayed, turn the KNS 660 off and then back on using the ON/OFF rocker switch. If SYSTEM FAIL is still displayed the KNS 660 requires service and must not be utilized).

2. Navigation instruments - CHECK as prompted by Self Test page. Verify that the appropriate aircraft instruments and displays agree with the data displayed on the Self Test Page.

   1) RMI pointer on 130°.

   2) DME display agrees ± 0.1NM.

   3) Course selector slewed to 315° (only on HSI's with driven course arrow).

   4) Check displayed altitude against altimeter. Refer to Section IV.

   5) Course deviation indicator displaying 3 dots (or 3nm) right.

   6) VNAV deviation indicating 3 dots up (or 600 ft.) if equipped with VNAV option.

```
  * SELF TEST *

SYSTEM        OK
RMI           130°
DIS           XX.XNM
SEL CRS       315°
ALT          XXXXXFT
HORZ DEV      RT 3
VNAV DEV      UP 3
CHECK        RMI-DIS
             CDI-CRS
             ALT-ANN
ORS XX
      TEST OK?
©1985/KING RADIO
```

Figure 5-14

3. Remote Annunciators - CHECK ON.

4. ENTER key - PRESS to verify satisfactory completion of Self Test page items. If the cursor was not over the TEST OK? field use the cursor [↓] or [↑] keys to position the cursor over TEST OK? before pressing ENTER. The Initialization page (INIT) will now appear.

INITIALIZATION

The Initialization page (INIT) is used to tell the KNS 660 what day it is, what time it is and where the aircraft is located. The importance of position accuracy in initialization is dependent on which sensors are configured with the KNS 660. If only VOR/DME or TACAN navigation sensors are tied to the KNS 660 the initialization position is not as critical. You may use Procedure A as an easy method for initialization although Procedures B or C may also be used and take very little more time.

If the KNS 660 is configured with a long range sensor (OMEGA/VLF or IRU) the initialization position is more critical since it is possible that the amount of initialization error will be carried by the system throughout the flight. Therefore, Procedure B or C should be used if the system contains a long range sensor.

Using the ICAO Airport Identifier of the departure airport (Procedure B) is usually a sufficiently accurate position for the OMEGA/VLF or IRU sensors and is a good compromise of ease of initialization versus accuracy. However, it is even better to use Procedure C and enter the actual latitude and longitude of the aircraft's exact present position.

NOTE

SINCE ALL SENSORS TIED TO THE KNS 660 SYSTEM ARE INITIALIZED AT THE SAME TIME, YOU SHOULD CHOOSE THE INITIALIZATION PROCEDURE REQUIRED FOR THE MOST POSITION CRITICAL SENSOR.
IN DUAL KNS 660 INSTALLATIONS EACH KNS 660 SYSTEM MUST BE INITIALIZED INDIVIDUALLY.

```
INIT      AUTO/LEG
 BLEND     RNV ENR

DATE:   01 MAY 84
GMT:        16:33

REF STATION ID
              OJC

WPT ID:
POS:   N 38°49.9'
       W 94°53.4'

EST GS:         0

      APPROVE?
```

Figure 5-15

INITIALIZATION (Cont'd)

Normally, the current date and current time are displayed on the upper portion of the Initialization Page. Also the aircraft's position when the KNS 660 was last turned off or the last known computer generated present position will be contained in the unit's memory and will be displayed. Under these conditions the Initialization Page will appear like Figure 5-15 shown on the previous page.

Initialization Procedure A - For use with KNS 660 systems with VOR/DME or TACAN as the only navigation sensors.

1. DATE:-CHECK. If incorrect, place cursor over date field and enter the Greenwich date in the sequence day-month-year (Refer to Section IV).

2. GMT:-CHECK. If incorrect, place cursor over GMT field and enter the correct Greenwich Mean time (Refer to Section IV).

NOTE

THE REF STATION ID REPRESENTS THE CLOSEST NAVAID TO THE LAST POSITION AS DETERMINED BY THE KNS 660. THIS NAVAID HAS BOTH BEARING AND DISTANCE CAPABILITIES.

3. REF STATION ID-CHECK. If the navaid displayed will be within line-of-sight range of the aircraft shortly after takeoff, use the cursor ([↓] or [↑]) keys to position the cursor over APPROVE? If the navaid displayed will not be in range shortly after takeoff or you are not sure then use procedure B or C for initialization.

4. APPROVE? - PRESS ENTER to approve initialization data. The first Flight Plan Menu Page (FPLS) will now appear.

INITIALIZATION (Cont'd)

Initialization Procedure B - Using a known ICAO Airport identifier or waypoint identifier. May be used for any sensor configuration tied to the KNS 660.

1. DATE: - CHECK. If incorrect, place cursor over date field and enter the Greenwich date in sequence day-month-year (Refer to Section IV).

2. GMT: - CHECK. If incorrect, place cursor over GMT field and enter correct Greenwich Mean time. (Refer to Section IV).

3. POS: - CHECK the last known KNS 660 generated position. If incorrect, follow procedure below:

   A. Cursor [↓] or [↑] key - PRESS so that the Cursor field appears over the WPT ID: data field (Figure 5-16).

   B. ICAO Airport Identifier or Waypoint Identifier - INPUT (Figure 5-17).

   C. ENTER key - PRESS to enter the identifier. The Waypoint page will now automatically be displayed (Figure 5-18).

      1) If the waypoint identifier is contained in system memory (true if waypoint latitude and longitude are listed on Waypoint page).

         a. Cursor [↓] or [↑] key - PRESS, if necessary, so that the cursor field appears over APPROVE?

         b. ENTER key - PRESS. The Initialization page will appear again with the cursor over APPROVE? (Figure 5-19). Continue with Step 4.

      2) If the waypoint identifier is not contained in memory (No latitude and longitude entry and the cursor over REF NAME: field).

         a. REF NAME: - INPUT the identifier of a navaid or location contained in system memory from which the new waypoint can be referenced.

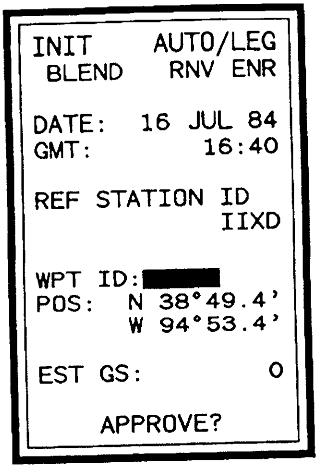


Figure 5-16

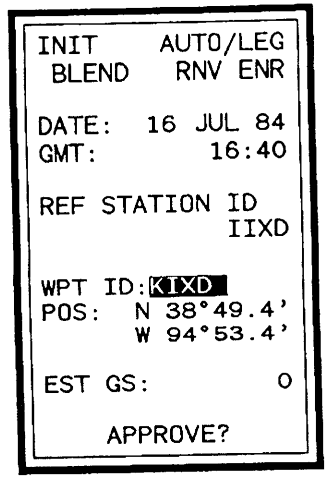


Figure 5-17

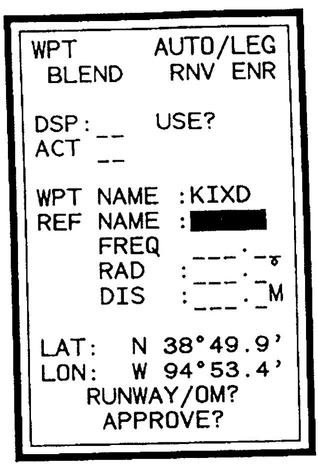


Figure 5-18

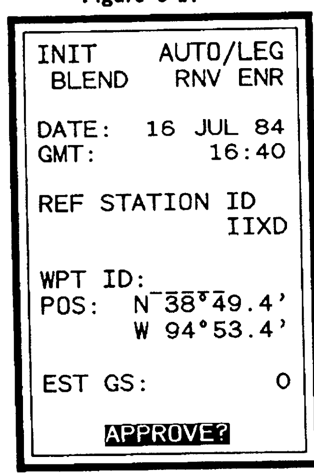


Figure 5-19

INITIALIZATION (Cont'd)

b. ENTER key - PRESS to enter the identifier. The cursor will advance to the RAD: field.

c. RAD: - INPUT the radial in degrees and tenths of a degree from the navaid or location in the REF NAME field to the waypoint being defined.

d. ENTER key - PRESS to enter the radial into memory. The cursor will advance to the DIS: field.

e. DIS: - INPUT the distance to the nearest tenth of a nautical mile from the navaid or location in the REF NAME data field to the waypoint being defined.

f. ENTER key - PRESS to enter the distance into memory. The cursor will advance to the LAT: field, which is computed from radial and distance entered above.

g. ENTER key - PRESS twice to advance the cursor to the APPROVE? field.

NOTE

THE ABOVE STEPS a. THRU g. MAY BE SKIPPED AND THE LATITUDE AND LONGITUDE INPUT DIRECTLY IF KNOWN.

h. ENTER key - PRESS to approve the Waypoint page. The Initialization page will appear with the cursor over APPROVE?

4. EST GS:

A. If on the ground verify that 0 is displayed.

B. If in flight, PRESS cursor [↑] key to position cursor over EST GS: data field, INPUT estimated ground speed, then PRESS ENTER.

5. APPROVE? - PRESS ENTER to approve all of the data on the Initialization page and enter the data into memory. The first of the Flight Plan Menu pages (FPLS) will now appear.

INITIALIZATION (Cont'd)

Initialization Procedure C - Using a known latitude and longitude of present position. May be used for any sensor configuration tied to the KNS 660.

1. DATE: - CHECK. If incorrect, place cursor over date field and enter the Greenwich date in sequence day-month-year (Refer to Section IV).

2. GMT: - CHECK. If incorrect, place cursor over GMT field and enter correct Greenwich Mean time (Ref. Page 4-5)

3. POS: - CHECK the last known KNS 660 generated position. If incorrect, follow the procedure below:

   A. Cursor [↓] or [↑] key - PRESS so that the cursor appears o ver the latitude position of the POS: field (Figure 5-20).

   B. Latitude - INPUT. Use North or South key first (Ref. Page 5-5), followed by the latitude in degrees, minutes and tenths of a minute (Figure 5-21).

   C. ENTER key - PRESS to enter the latitude into memory. cursor will advance to longitude field (Figure 5-22).

   D. Longitude - INPUT. Use East or West key first, followed by the longitude in degrees, minutes and tenths of minute (Figure 5-23).

   E. ENTER key - PRESS to enter the longitude into the memory. cursor will advance to the Ground Speed field (Figure 5-24).

4. EST GS:

   A. If on the ground, verify that 0 is displayed and PRESS ENTER. The cursor will advance to the APPROVE? field (Figure 5-25).

   B. If in flight, INPUT estimated ground speed, then PRESS ENTER. The cursor will advance to the APPROVE? field.

5. APPROVE? - PRESS ENTER to approve all of the data on the Initialization page and enter the data in memory. The first page of the Flight Plan Menu (FPLS) will now appear.

```
INIT        AUTO/LEG
 BLEND       RNV ENR

DATE:    16 JUL 84
GMT:         16:40

REF STATION ID
              OJC

WPT ID:
POS:     N 38°49.4'
         W 94°53.6'

EST GS:          0

    APPROVE?
```

Figure 5-20

```
INIT        AUTO/LEG
 BLEND       RNV ENR

DATE:    16 JUL 84
GMT:         16:40

REF STATION ID
              OJC

WPT ID:
POS:     N 38°49.9'
         W 94°53.6'

EST GS:          0

    APPROVE?
```

Figure 5-21

```
INIT        AUTO/LEG
 BLEND       RNV ENR

DATE:    16 JUL 84
GMT:         16:40

REF STATION ID
             ----

WPT ID:
POS:     N 38°49.9'
         W 94°53.6'

EST GS:          0

    APPROVE?
```

Figure 5-22

```
INIT        AUTO/LEG
 BLEND       RNV ENR

DATE:    16 JUL 84
GMT:         16:40

REF STATION ID
             ----

WPT ID:
POS:     N 38°49.9'
         W 94°53.4'

EST GS:          0

    APPROVE?
```

Figure 5-23

```
INIT        AUTO/LEG
 BLEND       RNV ENR

DATE:    16 JUL 84
GMT:         16:40

REF STATION ID
             ----

WPT ID:
POS:     N 38°49.9'
         W 94°53.4'

EST GS:          0

    APPROVE?
```

Figure 5-24

```
INIT        AUTO/LEG
 BLEND       RNV ENR

DATE:    16 JUL 84
GMT:         16:40

REF STATION ID
             ----

WPT ID:
POS:     N 38°49.9'
         W 94°53.4'

EST GS:          0

    APPROVE?
```

Figure 5-25

REVIEWING THE DATA BASE

The configuration of the main Data Base can be reviewed at any time after initialization. Since so many of the KNS 660 capabilities depend upon the Data Base it is important to review which geographic regions and which navigational elements within these geographic regions are actually loaded in the Data Base.

CAUTION

IT IS HIGHLY DESIRABLE TO REVIEW THE DATA BASE PRIOR TO TAKE OFF BECAUSE THE KNS 660 SYSTEM CANNOT PROVIDE A NAVIGATION FUNCTION WHILE THE DATA BASE IS BEING LOADED.

1. DAT key - PRESS twice or as required to display the DATA 2 Menu page (Ref. Figure 5-26 and Section IV).

2. Menu item 5 - SELECT using the Menu Selection Field procedure (Ref. Page 5-3). The Update Data Base page will be displayed (Ref. Figure 5-27 and Section IV).

3. Menu item 1 - SELECT. The Review Data Base page will be displayed (Ref. Figure 5-28 and Section IV). Only the geographic regions followed by an * are presently contained in the main Data Base.

4. Desired geographic region - SELECT. The Review Elements page for the selected geographic region will be displayed (Ref. Figure 5-29 and Section IV). Only the navigational elements followed by an * are presently contained in the main Data Base.

5. DAT key - PRESS to return to the Review Data Base page. The navigational elements stored for each of the other geographic regions with asterisks can be viewed by repeating steps 4 and 5 as many times as necessary.

```
DATA 2      OBS:248
 VOR        RNV  APR

SEL MENU ITEM:█

 1 NAVAID PAGE
 2 AIRPORT PAGE
 3 DATE/TIME
 4 CDU DATA XFR
 5 UPDATE D/BASE
 6 UPDATE FP/WPT
 7 UNUSED WPTS
 8 USER NAVAIDS
 9 USER AIRPORTS
```

Figure 5-26

```
DATA        OBS:248
 VOR        RNV  APR

 UPDATE D/BASE

SEL MENU ITEM:█
 1 REVIEW D/BASE
 2 SELECT D/BASE

  NEXT UPDATE
   30 JUL 84

  LOAD D/BASE?
*ON GROUND ONLY
*AFTER D/BASE
 SELECT COMPLETE
```

Figure 5-27

```
DATA      AUTO/LEG
 VOR        RNV ENR

 REVIEW D/BASE

SEL MENU ITEM:__
 1 USA            *
 2 CANADA         *
 3 LATIM AM       *
 4 EUROPE
 5 SOUTH AM
 6 MID EAST
 7 AFRICA
 8 EAST EUR
 9 PACIFIC
10 SOUTH PAC
```

Figure 5-28

```
DATA        OBS:248
 VOR        RNV  APR

USA          D/BASE

NAVAID            *
APT>4000FT        *
APT>3000FT
RW THRESHOLD      *
OUTER MKR
HI ALT WPT
LO ALT WPT
SID/STAR
APR INTRSC

  MULT WPT
```

Figure 5-29

ESTABLISHING THE CORRECT KNS 660 OPERATIONAL STATUS

Establishing the correct Operational Status means selecting the proper Method of Operation, Sensor, and Mode combination for the desired navigational phase of flight. The KNS 660 allows the Operational Status combinations presented in the tables below. Consult the aircraft's Flight Manual Supplement for the combinations approved in a specific installation.

OBS METHOD OF OPERATION							
SENSOR	BLEND	VOR	TACAN	OMEGA	LORAN	INS	GPS
MODE	RNV ENR RNV APR*	RNV ENR RNV APR NAV	RNV ENR RNV APR NAV	RNV ENR	RNV ENR RNV APR	RNV ENR	RNV ENR RNV APR

* ORS 06 Systems only

AUTO/LEG OR AUTO 3D METHOD OF OPERATION							
SENSOR	BLEND	VOR	TACAN	OMEGA	LORAN	INS	GPS
MODE	RNV ENR RNV APR*	RNV ENR RNV APR	RNV ENR RNV APR	RNV ENR	RNV ENR RNV APR	RNV ENR	RNV ENR RNV APR

* ORS 06 Systems only

For example, you could select AUTO/LEG, OMEGA, and RNV ENR as a valid Operational Status. However, the system would not allow AUTO/LEG, OMEGA and RNV APR.

LORAN sensor capability requires an ORS 05 level KNS 660 system. Refer to the Introduction Section at the front of this manual. RNV APR with LORAN sensor selected requires a LORAN Control Display Unit. Refer to Section VII.

GPS (Global Positioning System) sensor compatibility requires an ORS 06 level KNS 660 system. Refer to the Introduction Section at the front of this manual.

NOTE

IT IS POSSIBLE TO OPERATE THE KNS 660 IN THE FOLLOWING OPERATIONAL STATUS:

METHOD OF OPERATION: AUTO/LEG or AUTO 3D
SENSOR: VOR, TACAN, LORAN, GPS, or BLEND
MODE: RNV APR

THIS IS NOT THE CORRECT OPERATIONAL STATUS FOR SHOOTING AN RNAV APPROACH. THIS OPERATIONAL STATUS IS INTENDED ONLY FOR USERS WHO HAVE DEVELOPED (AND HAD APPROVED BY THE APPROPRIATE AUTHORITIES) SPECIALIZED INSTRUMENT APPROACHES WHICH CAN UTILIZE THIS FUNCTION OF THE KNS 660.

ESTABLISHING THE CORRECT KNS 660 OPERATIONAL STATUS (Cont'd)

NOTE (Cont'd)

WHEN THE KNS 660 IS IN THIS OPERATIONAL STATUS, THE NORMAL AUTO/LEG CHARACTERISTICS OF TURN ANTICIPATION, AUTOMATIC WAYPOINT SEQUENCING, WAYPOINT ALERTING, AND AUTOMATIC COURSE SLEWING OCCUR. HOWEVER, AUTOMATIC NAVAID SELECTION DOES NOT OCCUR. THE USER MUST SPECIFY A REFERENCE NAVAID FOR EACH WAYPOINT IN THE REF NAME FIELD OF EACH WAYPOINT PAGE. THIS REFERENCE NAVAID IS THE PARTICULAR NAVAID WHICH THE VOR NAVIGATION RECEIVER AND DME WILL BE TUNED TO WHEN THIS WAYPOINT IS ACTIVATED.

The system is so designed that when establishing the Operational Status, the key sequence should be:

1. OBS/LEG - Method of Operation.
2. SNS - Sensor
3. MOD - Mode

This key sequence will always allow a desired valid Operational Status to be chosen. Notice that this is also the order the keys physically appear (from top to bottom) on the CDU.

Selecting The Method Of Operation

The concepts of the Method of Operation and its importance were described in Section II. The Method of Operation is selected as follows:

OBS/LEG key - PRESS. This key will alternately select the Method of Operation in the sequence: OBS, AUTO/LEG, OBS. If the system is configured for AUTO 3D operation then the sequence is: OBS, AUTO/LEG, AUTO 3D, OBS. When an ILS freqeuncy is made active, the Method of Operation automatically becomes OBS.

Selecting The Active Sensor

The number of sensors available for selection depends upon which sensors have been installed as part of the KNS 660 system. BLEND may be used with any installed sensor combination. In BLEND, position information from all the available sensors is used.

SNS key - PRESS. This key will alternately select the active sensor in the sequence: BLEND, VOR, TACAN, OMEGA, LORAN, INS, GPS, BLEND. When a particular sensor is not installed that sensor will be deleted from the sequence. When an ILS frequency is made active, the sensor automatically becomes ILS.

ESTABLISHING THE CORRECT KNS 660 OPERATIONAL STATUS (Cont'd)

Selecting the Mode

As shown by the tables on the previous page, RNV ENR is the only mode available unless the selected sensor is VOR, TACAN, LORAN, or GPS. When either VOR, TACAN, LORAN, or GPS is the selected sensor, the RNV APR mode is available. The third mode, NAV, is only available when the selected sensor is VOR or TACAN and the Method of Operation is OBS. If an invalid Operational Status has been selected the mode will default to RNV ENR. See Section III for definitions of modes.

MOD key - PRESS. This key will alternately select the active mode in the sequence: RNV ENR, RNV APR, NAV, RNV ENR subject to the hierarchy described above. If an ILS frequency is made active the mode becomes ILS.

NOTE

IT IS POSSIBLE TO OPERATE THE KNS 660 IN THE FOLLOWING OPERATIONAL STATUS:

METHOD OF OPERATION: AUTO/LEG or AUTO 3D
SENSOR: VOR, TACAN, LORAN, GPS or BLEND
MODE: RNV APR

THIS IS NOT THE CORRECT OPERATIONAL STATUS FOR SHOOTING AN RNAV APPROACH. THIS OPERATIONAL STATUS IS INTENDED ONLY FOR USERS WHO HAVE DEVELOPED (AND HAD APPROVED BY THE APPROPRIATE AUTHORITIES) SPECIALIZED INSTRUMENT APPROACHES WHICH CAN UTILIZE THIS FUNCTION OF THE KNS 660.

WHEN THE KNS 660 IS IN THIS OPERATIONAL STATUS, THE NORMAL AUTO/LEG CHARACTERISTICS OF TURN ANTICIPATION, AUTOMATIC WAYPOINT SEQUENCING, WAYPOINT ALERTING, AND AUTOMATIC COURSE SLEWING OCCUR. HOWEVER, AUTOMATIC NAVAID SELECTION DOES NOT OCCUR. THE USER MUST SPECIFY A REFERENCE NAVAID FOR EACH WAYPOINT IN THE REF NAME FIELD OF EACH WAYPOINT PAGE. THIS REFERENCE NAVAID IS THE PARTICULAR NAVAID WHICH THE VOR NAVIGATION RECEIVER AND DME WILL BE TUNED TO WHEN THIS WAYPOINT IS ACTIVATED.

ESTABLISHING THE CORRECT KNS 660 OPERATIONAL STATUS (Cont'd)

Examples of Proper Operational Status Selection

If no rho-theta (VOR/DME) or rho-rho (DME/DME) position data is available to the KNS 660 system, IFR navigation predicated on the KNS 660 system is not recommended in APPROACH or TERMINAL airspace.

Similarly, if rho-theta is the only position input available to the KNS 660 system, enroute operation on Jet (J) or Victor (V) airways should utilize the OBS Method of Operation whenever the distance from the aircraft to the reference ground station exceeds approximately 68.7NM. If rho-rho, OMEGA, INS, LORAN, or GPS position data is available, either AUTO/LEG or OBS Method of Operation is appropriate for operation on any portion of J or V Airways.

When operating on random routes, and rho-theta is the only position data available, it is recommended that the flight plan route remain within 93NM of reference VOR/DME stations to assure good navigational accuracy. If rho-rho, OMEGA, INS, LORAN, or GPS position data is available, navigational accuracy will be maintained regardless of the distance to reference ground stations.

The following table presents typical examples of proper Operational Status for several navigational phases of flight.

	Enroute: Airways, flight plans or Direct To	Enroute: Intersecting a specified VOR radial TO or FROM	VOR Approach	RNAV Approach	ILS
Method of Operation	AUTO/LEG	OBS	OBS	OBS	OBS
Sensor	BLEND	VOR	VOR	VOR	ILS
Mode	RNV ENR	NAV	NAV	RNV APR	ILS

DEFINING WAYPOINTS

There are numerous KNS 660 functions which will require you to define waypoints. You have already defined a waypoint if you initialized the system using initialization procedure B or C. In this Section of the Pilot's Guide describing Level I operation, you will be required to define waypoints when DIRECT TO operation is discussed. There will be additional cases where it is required in Level II and Level III operations which are contained in Section VI and VII, respectively. The Data Base makes defining a waypoint so quick and easy that in most cases you won't even think of it as a separate operation. As with most aspects of KNS 660 operation, it takes far less time to perform the operation than it takes to describe it in this Pilot's Guide.

In "Waypoints and Flight Plans" contained in Section II you learned that the block of 800 waypoints could be defined using information from the main Data Base and supplemental Data Base or from information which you created yourself. Information stored in the Data Base is just a handy aid in helping you define a waypoint. Regardless of whether the waypoint information comes from the Data Base or whether you create it, a waypoint is not defined until the Waypoint page is approved. Before learning the procedures for defining a waypoint, you should review the Waypoint page definition in Section IV.

Procedures For Defining A Waypoint

Defining a waypoint is initiated by inputting a waypoint identifier into a data entry field on one of the following pages:

Initialization
Flight Plan #
Flight Plan 0
Waypoint
HOLD 1
HOLD 2
Waypoint Relative to Present Position Trip Planning
Waypoint to Waypoint Trip Planning

DEFINING WAYPOINTS (Cont'd)

The following procedures assume that the pilot has keyed in a waypoint identifier on one of the pages listed above and has pressed the ENTER key.

A. If a navaid waypoint identifier was entered, the Waypoint page will be displayed with the proper data for the navaid filled in and the cursor positioned over APPROVE? (Figure 5-30). If multiple definitions exist in the Data Base for the navaid identifier entered, the Waypoint Duplication page will be displayed as described in Section IV. The pilot is then required to select the desired country. The countries will be displayed such that the first country in the list contains the navaid closest to the aircraft's present position.

   ENTER key - PRESS to approve the Waypoint page. The page on which the waypoint is being utilized will now reappear.

B. If a non-navaid identifier was entered which exists in the main Data Base or supplemental Data Base the Waypoint page will be displayed with the latitude and longitude fields already filled and the cursor over the REF NAME field (Figure 5-31).

   1. REF NAME: - INPUT the identifier of a navaid which is contained in system memory (Figure 5-32).

   2. ENTER key - PRESS to enter the identifier. The system will automatically fill the remaining fields on the Waypoint page and the cursor will be positioned over APPROVE? (Figure 5-33).

   3. ENTER key - PRESS to approve Waypoint page.

```
WPT        AUTO/LEG
 BLEND      RNV ENR

DSP: 6   USE?
ACT  6

WPT NAME  :MLU
REF NAME  :MLU
    FREQ   117.20
    RAD   :000.0°
    DIS   :   0.0M

LAT:  N 32°31.0'
LON:  W 92°02.1'

      APPROVE?
```

Figure 5-30

```
WPT        AUTO/LEG
 BLEND      RNV ENR

DSP:__   USE?
ACT  6

WPT NAME  :KMKC
REF NAME  :
    FREQ   ___.__
    RAD   :___._°
    DIS   :___._M

LAT:  N 39°07.4'
LON:  W 94°35.5'
    RUNWAY/OM?
     APPROVE?
```

Figure 5-31

```
WPT        AUTO/LEG
 BLEND      RNV ENR

DSP:__   USE?
ACT  6

WPT NAME  :KMKC
REF NAME  :MKC
    FREQ   ___.__
    RAD   :___._°
    DIS   :___._M

LAT:  N 39°07.4'
LON:  W 94°35.5'
    RUNWAY/OM?
     APPROVE?
```

Figure 5-32

```
WPT        AUTO/LEG
 BLEND      RNV ENR

DSP:__   USE?
ACT  6

WPT NAME  :KMKC
REF NAME  :MKC
    FREQ   112.60
    RAD   :172.0°
    DIS   :   9.4M

LAT:  N 39°07.4'
LON:  W 94°35.5'
    RUNWAY/OM?
     APPROVE?
```

Figure 5-33

DEFINING WAYPOINTS (Cont'd)

C. If a non-navaid identifier was entered which has multiple definitions existing in the main Data Base, the Waypoint Duplication page will automatically be displayed. The Waypoint Duplication page will list the countries containing the non-navaid identifier such that the location closest to the aircraft's present position is at the top of the list. An example of multiple definitions would be where an ICAO intersection identifier is utilized in more than one country. It is also possible for an intersection identifier to be utilized more than once in the same country. Note that the procedure below is different than the procedure previously described for multiple navaid identifiers.

1. Desired country - SELECT from the list on the Waypoint Duplication page. As a possible aid in making the selection, a "T" (for Terminal Waypoint) or "E" (for Enroute Waypoint) is displayed to the right of the country name. When the ENTER key is pressed a Waypoint page will be displayed. A latitude and longitude will be displayed at the bottom of the page and the rest of the fields will be blank.

2. WPT NAME: INPUT a unique one to five character alph-numeric identifier (one not contained anywhere else in system memory). Note that you must assign a unique identifier. It can not be the actual ICAO waypoint or intersection identifer. When the ENTER key is pressed the cursor will advance to the REF NAME field.

3. REF NAME: - INPUT the identifier of a navaid which is contained in system memory.

4. ENTER key - PRESS to enter the identifier. The system will automatically fill in the remaining fields on the Waypoint page and the cursor will be positioned over APPROVE?

5. ENTER key - PRESS to approve the Waypoint page. The page on which the duplicate non-navaid identifier was originally entered will now reappear with the data entry field filled with the unique pilot assigned identifier instead of the duplicate identifier. To use this non-navaid waypoint in the future, input the unique pilot assigned identifier.

DEFINING WAYPOINTS (Cont'd)

D. If a non-navaid identifier was entered which doesn't exist in system memory (main Data Base, supplemental Data Base or user created waypoint) the Waypoint page will be displayed with all data entry fields blank except WPT NAME: and the cursor will be positioned over REF NAME: (Figure 5-34).

1. If the waypoint is to be defined in terms of a known radial and distance from a navaid or location identifier already in memory proceed as follows. If it is to be defined in terms of a known latitude and longitude proceed to paragraph D.2.

a. REF NAME: - INPUT the identifier of a navaid or location contained in system memory (Figure 5-35).

b. ENTER key - PRESS to enter the identifier. The cursor will be positioned on the RAD: data entry field (Figure 5-36). If a navaid was entered in the REF NAME: field, its frequency (or TACAN channel) will be automatically entered.

c. RAD: - INPUT the radial in degrees and tenths of a degree from the navaid or location in the REF NAME: field to the waypoint being defined (Figure 5-37).

d. ENTER key - PRESS to enter the radial into memory. The cursor will advance to the DIS: field.

e. DIS: - INPUT the distance to the nearest tenth of a nautical mile from the navaid or location in the REF NAME field to the waypoint being defined (Figure 5-38).

f. ENTER key - PRESS to enter the distance into memory. The cursor will advance to the LAT:
field. The system has calculated the latitude and longitude of the waypoint being defined from the identifier, radial and distance input above.

g. ENTER key - PRESS twice to advance the cursor to the APPROVE? field (Figure 5-39).

h. ENTER key - PRESS to approve the Waypoint page. The page on which the waypoint is being utilized will now reappear.

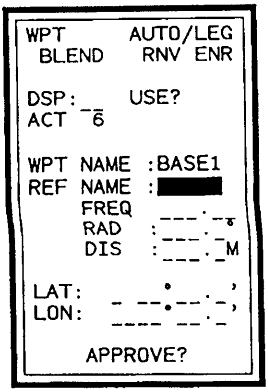


Figure 5-34

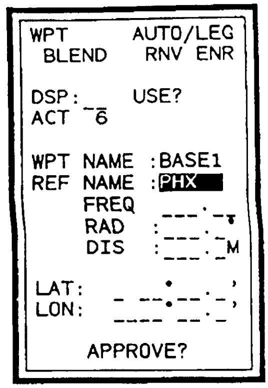


Figure 5-35

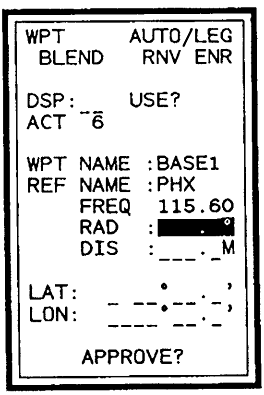


Figure 5-36

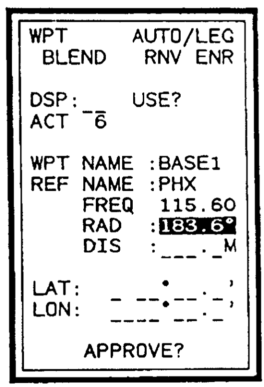


Figure 5-37

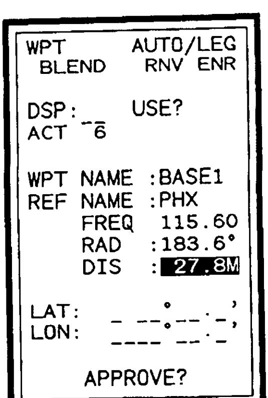


Figure 5-38

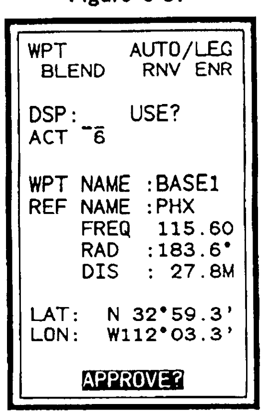


Figure 5-39

DEFINING WAYPOINTS (Cont'd)

2. If the waypoint is to be defined in terms of a known latitude and longitude proceed as follows:

   a. Cursor [↓] or [↑] key - PRESS repeatly until cursor is positioned over the LAT: data entry field (Figure 5-41).

   b. LAT: - INPUT the latitude of the waypoint being defined (Figure 5-42).

   c. ENTER key - PRESS to enter the latitude into memory. The cursor will advance to the LON: field (Figure 5-43).

   d. LON: - INPUT the longitude of the waypoint being defined.

   e. ENTER key - PRESS to enter the longitude into memory. The cursor will advance to the APPROVE? field.

   f. Cursor [↓] or [↑] key - PRESS to position the cursor ov er the REF NAME: field.

   g. REF NAME: - INPUT the identifier of a navaid which is contained in system memory (Figure 5-44).

   h. ENTER key - PRESS to enter the identifier. The system will automatically fill the remaining fields on the Waypoint page and the cursor will be positioned over APPROVE? (Figure 5-45).

   i. ENTER key - PRESS to approve Waypoint page. The page on which the waypoint is being utilized will now reappear.

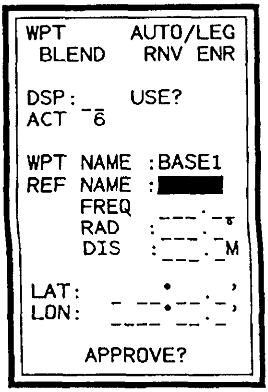


Figure 5-40

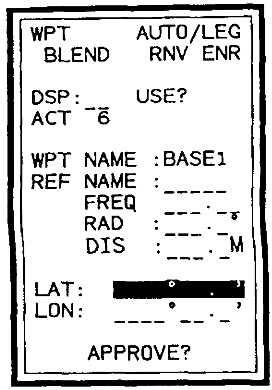


Figure 5-41

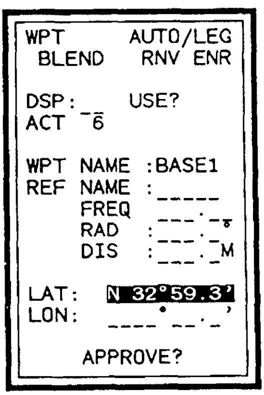


Figure 5-42

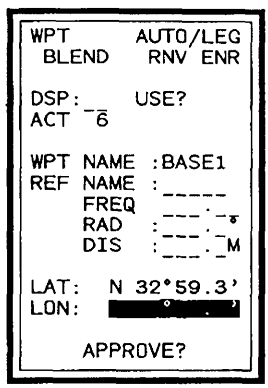


Figure 5-43

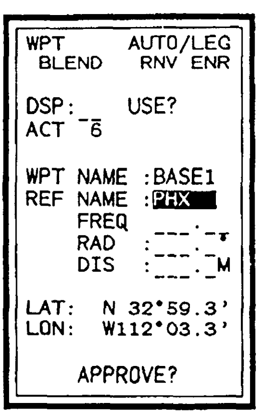


Figure 5-44

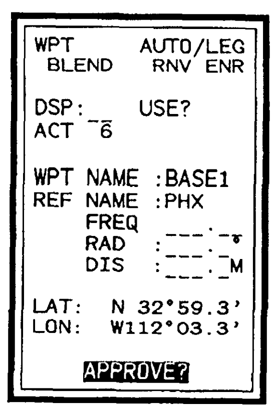


Figure 5-45

DEFINING WAYPOINTS (Cont'd)

E. Defining a Runway Threshold or ᴗ .. Marker as a waypoint. To define a Runway Threshold or Outer Marker as a waypoint the Data Base must be configured to include either or both of these items. The associated ICAO airport identifier must first be entered into a data entry field on one of the pages listed under Procedures for Defining a Waypoint. The Waypoint page for the airport identifier will then be displayed.

1. Cursor [↓] or [↑] key - PRESS to position the cursor ov er the RUNWAY/OM? field (Figure 5-46).

2. ENTER key - PRESS to select the Waypoint Runway/Outer Marker page (Ref. Figure 5-47 and Section IV).

3. SEL RW/OM: - SELECT the desired Runway Threshold or Outer Marker using the procedure described in Menu Selection Field in this section. A Waypoint page will then be displayed with the latitude and longitude fields properly filled and the rest of the fields blank. The cursor will be positioned over WPT NAME: (Figure 5-48).

4. WPT NAME: - INPUT a unique one to five character alpha-numeric identifier (one not contained anywhere in memory). Assigning a unique identifier makes this a user created waypoint. In most cases it works well to assign the actual ICAO identifier for an Outer Marker. When the ENTER key is pressed the cursor will advance to the REF NAME: field (Figure 5-49).

5. REF NAME: - INPUT the identifier of a navaid which is contained in system memory (Figure 5-50).

6. ENTER key - PRESS to enter the identifier. The system will automatically fill in the remaining fields on the Waypoint page and the cursor will be positioned over APPROVE? (Figure 5-51).

7. ENTER key - PRESS to approve Waypoint page. The page on which the airport identifier was originally entered will now reappear with the data entry field filled with the identifier of the Runway Threshold or Outer Marker instead of the airport.

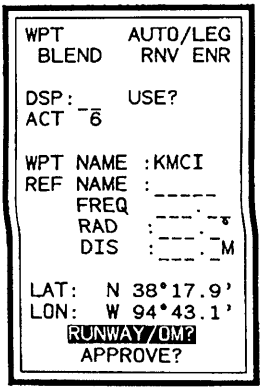


Figure 5-46

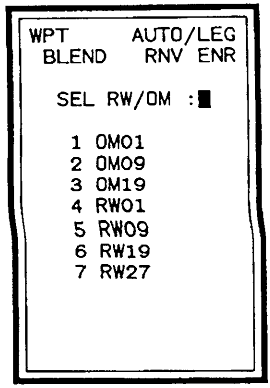


Figure 5-47

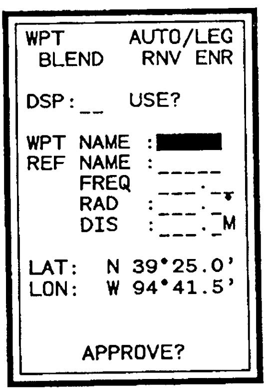


Figure 5-48

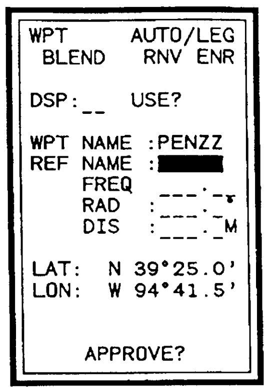


Figure 5-49

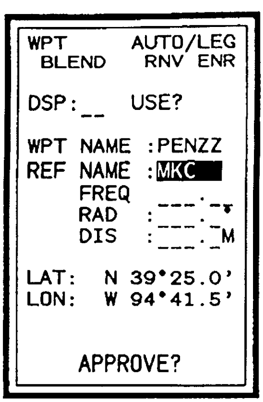


Figure 5-50

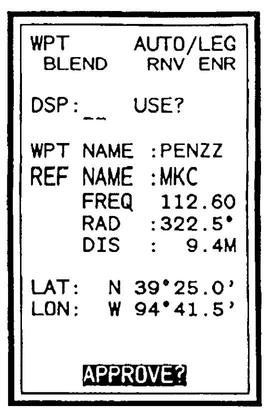


Figure 5-51

DEFINING WAYPOINTS (Cont'd)

Use Of The Waypoint Page "REF NAME" Data Field

Notice that in the previous procedures for defining waypoints (paragraphs A - E), each of the Waypoint pages ended up with a reference identifier entered into the REF NAME data field. In procedure "A" (defining a navaid as a waypoint) the same navaid identifier that appeared in the WPT NAME field was automatically entered into the REF NAME field by the system. Although the other procedures (B, C, D.1, D.2, and E) directed the user to manually enter a reference identier into the (REF NAME data field, there are only three cases where it is mandatory to do so:

1. With the KNS 660 in OBS Method of Operation, in order to use the VOR or TACAN sensors (either individually selected or in BLEND) the Waypoint page for the active waypoint must contain the identifier of a reference navaid in the REF NAME field. The reference navaid is the only navaid to which the KNS 660 will tune the VOR navigation receiver and DME (or TACAN) under these conditions.

2. In order to utilize procedure D.1 (defining a waypoint in terms of a known radial and distance from a navaid or location already in memory) the desired identifier must be entered into the REF NAME data field in order to define the waypoint location.

3. With the KNS 660 in the AUTO LEG or AUTO 3D Methods of Operation, the RNV APR mode can be used only if the selected sensor is VOR or TACAN and the Waypoint pages for the active waypoints contain a navaid identifier in the REF NAME data field. See note bottom of Page 5-23.

   If the conditions are other than the three above, the REF NAME data field, and therefore the associated FREQ, RAD, and DIS data fields serve no required purpose and may be left blank at the user's discretion.

   If a Waypoint page contains a reference identifier, a new reference identifier may be substituted as follows:

1. Cursor [↓] or [↑] key - PRESS as required until the cursor is positioned over existing reference identifier in the REF NAME data field.

2. New reference identifier - INPUT into the REF NAME data field directly over the existing identifier.

3. ENTER key - PRESS to enter the new reference identifier. The FREQ, RAD, and DIS fields will automatically be modified with appropriate data and the cursor will be positioned over APPROVE?

4. ENTER key - PRESS to approve the new Waypoint page.

When a Waypoint page reference identifier is changed, it is changed everywhere that waypoint is used in the system. For example, assume that the waypoint KMKC is contained in flight plans 0, 6, 12, and 30. If the reference identifier is changed from MKC to ANX for the KMKC waypoint in flight plan 0, it is also changed to ANX in flight plans 6, 12, & 30.

DIRECT TO OPERATION

The DIRECT TO function is one of the KNS 660's most powerful features and allows navigation from the aircraft's present position direct to a waypoint. DIRECT TO operation is subject to the characteristics of the selected Method of Operation which were described in Section II.

Selecting DIRECT TO Operation

The DIRECT TO function can be initiated from any page once the KNS 660 initialization is complete. The two primary methods of selecting DIRECT TO operation are presented here. A third procedure is described in Section VI and can be useful when flight plans are being used.

A. DIRECT TO operation when the cursor is not positioned over a Waypoint Identifier.

1. DIRECT TO [-D→] key - PRESS. The FPL 0 page will be displayed with the DIRECT TO field DIR near the top (Figure 5-52).

2. Waypoint Identifier - INPUT in the DIR: data entry field (Figure 5-53).

3. ENTER key - PRESS. The Waypoint page will appear (Figure 5-54).

4. Waypoint page Information - INPUT as required. (Ref. Figure 5-55 and "Procedures For Defining a Waypoint", Page 5-24).

5. APPROVE? - PRESS ENTER to approve the Waypoint page. The FPL 0 page will appear and the Direct To waypoint identifier will be presented. (Figure 5-56) When the selected sensor is providing valid navigation data to the KNS 660 the distance to the waypoint will also be displayed (Figure 5-57). If the FPL 0 page contains a list of waypoints they should be ignored for now. Flight plans will be discussed in Section VI.

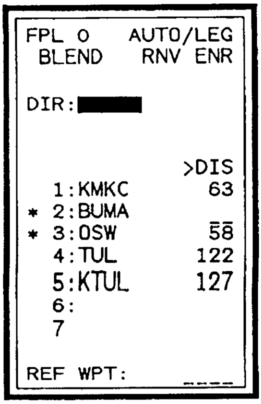


Figure 5-52

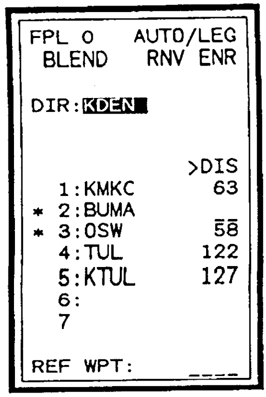


Figure 5-53

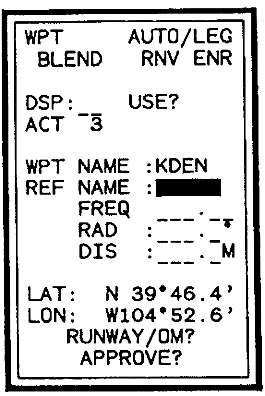


Figure 5-54

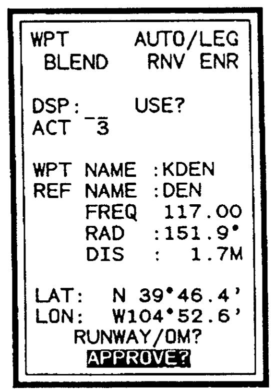


Figure 5-55

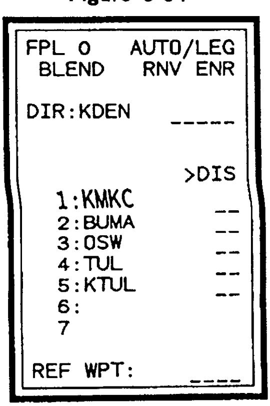


Figure 5-56

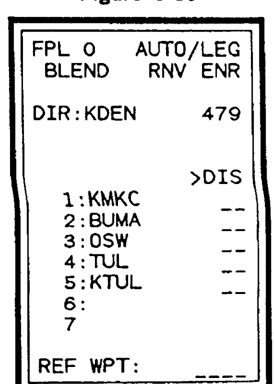


Figure 5-57

DIRECT TO OPERATION (Cont'd)

B. DIRECT TO operation when the cursor is positioned over a Waypoint identifier.

1. Cursor [↓] or [↑] - PRESS so that the cursor appears over the desired waypoint identifier (Figure 5-58). Figure 5-58 shows the Nearest Airport page described in Sections IV and VII but the page that the waypoint is located on is immaterial.

2. DIRECT TO [-D→] key - PRESS. The FPL 0 page will be displayed with the DIRECT TO field DIR near the top. The waypoint identifier will be displayed in the DIR data entry field (Figure 5-59).

3. ENTER key - PRESS. The Waypoint page will appear (Figure 5-60).

4. Waypoint page Information - INPUT as required. (Ref. Figure 5-61 and "Procedures For Defining a Waypoint" Page 5-29).

5. APPROVE? - PRESS ENTER to approve the Waypoint page. The FPL 0 page will appear and the Direct To waypoint identifier will be presented (Figure 5-62). When the selected sensor is providing valid navigation data to the KNS 660, the distance to the waypoint will also be displayed (Figure 5-63). If the FPL 0 page contains a list of waypoints they should be ignored for now. Or, the waypoints may be cleared from the FPL 0 page by moving the cursor off the screen and pressing the CLR key followed by the ENTER key. Flight Plans will be discussed in Section VI.

A new DIRECT TO Waypoint can be entered by:

Using the procedures described in paragraphs A and B to enter a new DIRECT TO waypoint identifier over the existing one.

or

Using the cursor [↓] or [↑] keys to position the cursor over the existing DIRECT TO waypoint identifer and entering a new waypoint identifier over the old one.

```
DATA         AUTO/LEG
 BLEND        RNV ENR

NEAREST AIRPORTS
 AS OF 13:38 GMT

 IDENT    BRG    DIS

1 KFSK    160     18
2 KNVD    113     31
3 KCNU    224     39
4:
```

Figure 5-58

```
FPL 0      AUTO/LEG
 BLEND       RNV ENR

DIR:KFSK         ----

                 >DIS
  1:KMKC           63
* 2:BUMA           --
* 3:OSW            58
  4:TUL           122
  5:KTUL          127
  6:
  7
REF WPT:         ----
```

Figure 5-59

```
WPT         AUTO/LEG
 BLEND        RNV ENR

DSP:_      USE?
ACT  3

WPT NAME  :KFSK
REF NAME  :
    FREQ   ---.--
    RAD   :---.-°
    DIS   :---.-M

LAT:   N 37°47.7'
LON:   W 94°46.2'
    RUNWAY/OM?
     APPROVE?
```

Figure 5-60

```
WPT         AUTO/LEG
 BLEND        RNV ENR

DSP:_      USE?
ACT  3

WPT NAME  :KFSK
REF NAME  :OSW
    FREQ   117.60
    RAD   :020.3°
    DIS   : 43.3M

LAT:   N 37°47.7'
LON:   W 94°46.2'
    RUNWAY/OM?
     APPROVE?
```

Figure 5-61

```
FPL 0      AUTO/LEG
 BLEND       RNV ENR

DIR:KFSK         ----

                 >DIS
  1:KMKC           --
  2:BUMA           --
  3:OSW            --
  4:TUL            --
  5:KTUL           --
  6:
  7
REF WPT:         ----
```

Figure 5-62

```
FPL 0      AUTO/LEG
 BLEND       RNV ENR

DIR:KFSK           18

                 >DIS
  1:KMKC           --
  2:BUMA           --
  3:OSW            --
  4:TUL            --
  5:KTUL           --
  6:
  7
REF WPT:         ----
```

Figure 5-63

DIRECT TO OPERATION (Cont'd)

Using DIRECT TO Operation

A. AUTO/LEG operation - The general characteristics of the AUTO/LEG Method of Operation were described in Section II, and apply directly to DIRECT TO operation.

B. OBS operation - The general characteristics of the OBS Method of Operation were described in Section II, Page 2-11 and apply directly to DIRECT TO operation.

   Once the DIRECT TO function has been selected in OBS operation, the course arrow is automatically slewed to center the D-Bar with a TO indication. However, the course may then be changed to a new desired course TO or FROM the waypoint using one of the procedures described Section VI.

   Remember that in order to use the VOR sensor in OBS operation, the Waypoint page must contain the navaid identifier in the REF NAME: field for the navaid which the VOR Nav receiver and DME (or TACAN) will actually utilize.

C. Recentering the D-Bar - The D-Bar may be recentered at any time by placing the cursor over the DIR waypoint field and pressing the ENTER key.

D. A new DIRECT TO waypoint can be made active by using either of the two procedures previously described under "Selecting DIRECT TO Operation".

E. If the KNS 660 system is configured with an HSI which does not have a compatible driven course arrow then the pilot must manually set the course arrow to the correct position. When the KNS 660 is in the AUTO LEG (or AUTO 3D) Method of Operation the correct value of where to set the HSI course arrow is displayed in the desired track (DTK) field located on the NAV 1 page. If the pilot fails to position the HSI course arrow to the correct value the CDU will display a message on the Message page stating: ADJUST HSI CRS. During an extended flight in AUTO LEG operation the desired track may change significantly. Whenever the difference between the actual desired track (DTK) and the selected course on the HSI exceeds five degrees the ADJUST HSI CRS message will be displayed. The pilot should then view the DTK field on the NAV 1 page and reset the HSI course arrow to the value.

DIRECT TO OPERATION (Cont'd)

In using DIRECT TO operation with the KNS 660 in the OBS Method of Operation the pilot should manually adjust the HSI course arrow until the deviation bar centers with the TO-FROM needle indicating TO. The pilot may view the bearing (BRG) field on the NAV 1 page, if desired, to aid in knowing where to set the course arrow.

F. Predeparture with OMEGA sensor - If the KNS 660 contains the OMEGA sensor do not take off until the OMEGA has reached NAV status (usually less than three minutes). When NAV status is reached the Message light will annunciate and when the MSG key is pressed the Message page will display: OMEGA NAV READY. Pressing the MSG key again will return the system to the previously displayed page.

G. ETA, Departure Time, ETE, and Flight Time Information. The above information may be displayed as follows:

1. Cursor [↓] or [↑] key - PRESS so the cursor appears over the >DIS field on the FPL 0 page (Figure 5-64).

2. CLR key - PRESS once. The >DIS field will change to >ETA (Estimated Time of Arrival). The ETA in GMT to the waypoint and the departure time DEP in GMT are presented (Figure 5-65). The departure time is that GMT time at which the system first calculated a system ground speed of 50 knots.

3. CLR Key - PRESS once. The >ETA field will change to >ETE (Estimated Time Enroute). The ETE in hours and minutes to the waypoint and the flight time FLT since departure will be presented in hours and minutes (Figure 5-66).

By pressing the CLR key while the cursor is over >ETE the field will change once again to >DIS. Therefore, use of the clear key will cycle thru in a sequence >DIS, >ETA, >ETE, >DIS. When equipped for the optional AUTO 3D Method of Operation, selected altitude >ALT will also appear in the >DIS, >ETA, >ETE, >ALT, >DIS sequence. AUTO 3D operation is described in Section VII and is not applicable to the DIRECT TO function.

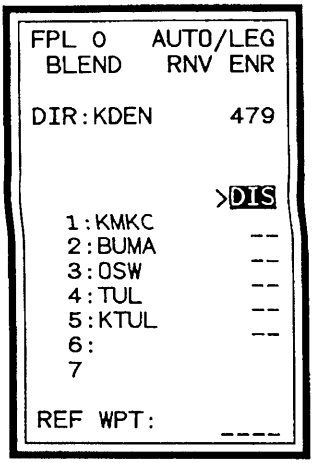


Figure 5-64

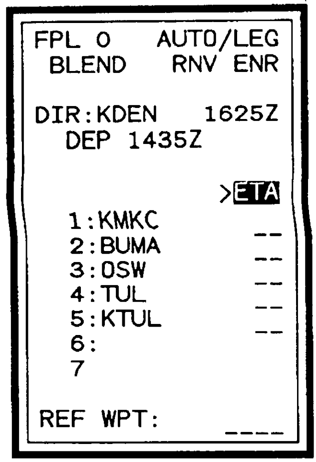


Figure 5-65

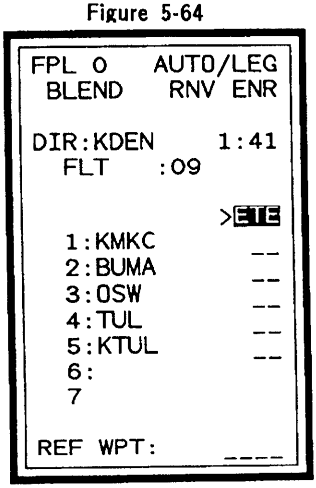


Figure 5-66

DIRECT TO OPERATION (Cont'd)

G. NAV 1 and NAV 2 pages - These two pages are displayed using the NAV key. Repeated presses of this key cycles between the NAV 1 page (Figure 5-67) and NAV 2 page (Figure 5-68). Important naviga- tional data such as present position and cross track error is displayed on these two pages. The NAV 1 and NAV 2 pages are described in Section IV. Pressing the FPL key once will return the system to the FPL 0 page. The type of information displayed at the bottom of the NAV 2 page varies depending on whether or not the system is configured for VNAV as described in Section IV.

```
NAV 1     AUTO/LEG
 OMEGA     RNV ENR

DIR   KIXD

DIS    276.5
ETE   1:05

GS 255    TAS:350
WIND    258°t/105

DTK 257    TK 258
BRG 258    DA R01

>POS    N 38°45.9'
        W 94°57.9'
```

Figure 5-67

```
NAV 2     AUTO/LEG
 OMEGA     RNV ENR

DIR   KIXD

ACT            SEL
---    ---     ---
L 3.2 XTK:  R 0.0
       ---
E 5.4 REF      MAG
       ---
16000 ALT
```

Figure 5-68

MESSAGE LIGHT AND MESSAGE PAGE

When there is a situation which requires the pilot's attention, the Message light on the left side of the CDU and the remote mounted message annunciator (if installed) will flash continuously until the MSG key is pressed. When the MSG key is pressed the Message page is displayed and the MSG light and remote annunciator are lighted continuously. After viewing the message, pressing the MSG key will return to the previous page or a new page may be selected by pressing another page key. In either case, the Message light will be extinguished unless there is a situation which requires pilot action. In this case, the Message light will remain on solid until the pilot's action is taken. Whenever new messages are displayed, they are separated from the previously viewed messages by a blank line. A Catalog of Messages which can be displayed on the Message page is contained in Appendix B. A sample Message page is shown in Figure 5-69 below.

```
MSG        AUTO/LEG
 BLEND      RNV ENR

      MESSAGES

DME FAILED
OMEGA NOT READY
INS OFF

D/BASE OUT DATED
```

Figure 5-69

TURNING SYSTEM OFF

To turn the KNS 660 off press the bottom portion of the ON-OFF rocker switch for approximately two seconds until the system shuts off. During this period the CDU displays the message shown in Figure 5-70.

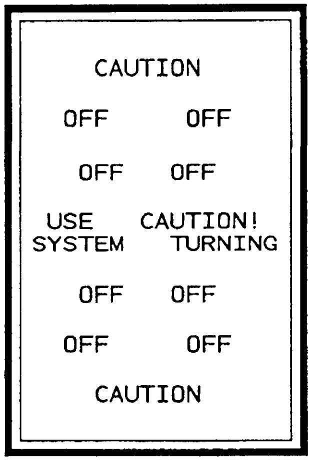
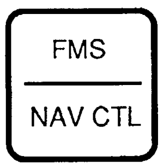


Figure 5-70

USE OF THE NAV CONTROL FUNCTION

The NAV control (NAV CTL) function is an installation option. Its purpose is to provide a quick and straightforward means of removing the VOR navigation receiver and DME (or TACAN) sensors from the KNS 660 system so that they can be channeled from a conventional control head (frequency selector). Also, the HSI and the DME indicator are typically now provided navigation data directly from the VOR navigation receiver and DME (or TACAN) instead of from the KNS 660.

The NAV control function is activated by pressing a remote, alternate action switch similar to the switch shown below which is typically located on the aircraft's instrument panel. Normally, FMS is annunciated to indicate that the VOR navigation receiver and the DME are serving as sensors for the KNS 660 Flight Management System (FMS). When NAV CTL is annunciated, the NAV control function is active and the VOR and DME are channeled from the NAV control head.



IMPORTANT NOTE

THE EXACT FUNCTIONS OF NAV CONTROL SWITCHING CAN VARY GREATLY AMONG INSTALLATIONS. BECAUSE OF THE POSSIBLE VARIATIONS IN NAV CONTROL SWITCHING WITH THE HSI, DME INDICATORS, RMI AND OTHER INSTRUMENTS IT IS IMPORTANT TO REFER TO THE AIRCRAFT'S FLIGHT MANUAL SUPPLEMENT FOR SPECIFIC DETAILS.

The NAV control function could be helpful if the KNS 660 was installed in the aircraft as the pilot's primary navigation system in addition to being the long range navigation system. If, for example, a pilot was about to shoot an instrument approach and then received clearance for a difference approach at the last minute, the NAV CTL function could be selected and the new frequency quickly entered on the standard NAV control head.

USE OF THE NAV CONTROL FUNCTION (Cont'd)

The KNS 660 system can continue to navigate when the NAV control function is selected only if long range sensors such as OMEGA/VLF or an IRU are configured as part of the system. These sensors will continue to provide the KNS 660 position inputs when the NAV control function is selected.

However, if the KNS 660 system has only VOR/DME (or TACAN) sensor inputs when the NAV CTL function is selected, it will no longer have any sensor position inputs and in a short time will flag. (i.e. it will no longer be able to navigate). If the NAV control function is later deselected, the system may or may not be able to re-establish the aircraft's present position and continue normal operation. The following guidelines apply.

A. If the system is still within line-of-sight range of the navaids which were being used for navigation (OBS OR AUTO/LEG) prior to the system flagging, then the system will correctly re-establish the aircraft's present position unaided by the pilot.

B. If the system is now out of line-of-sight range of the navaids being utilized prior to the system flagging, the pilot is required to take one of the following actions to aid the KNS 660 system in resuming navigation.

   1. Update the system's position using one of the two Hold pages described in Section VII.

   2. Put the system in OBS operation and use the DIRECT TO function by inputting the identifier of nearby VORTAC or VOR/DME into the DIR data entry field. When the system displays bearing and distance to this navaid the system can be reconfigured to the desired Operational Status.

   3. Turn the KNS 660 system off and then back on. Re-initialize the system to a location nearby the aircraft's present position.

CONFIGURING AND LOADING THE DATA BASE

As explained in "DATA BASE CONCEPTS AND RULES" in Section II, a 3.5 inch Data Base revison diskette containing worldwide navigation data is sent to subscribers every 28 days. The Data Base may be reconfigured and reloaded as many times as desired during each 28 day period.

CAUTION

MAKE ABSOLUTELY CERTAIN THAT THE REQUIRED GEOGRAPHIC REGIONS AND NAVIGATIONAL ELEMENTS WITHIN THOSE REGIONS ARE LOADED IN THE DATA BASE BEFORE TAKEOFF SINCE THE SYSTEM CANNOT PROVIDE A NAVIGATION FUNCTION WHILE THE DATA BASE IS BEING LOADED.

CONFIGURING THE DATA BASE

Since not all the worldwide data on the revision diskette can be contained at one time in the main Data Base it is necessary to select which geographic regions and which navigational elements within these geographic regions will be loaded into the Data Base.

CAUTION

IF THE VOR AND DME (OR TACAN) SENSORS ARE TO BE UTILIZED, NAVAIDS FOR THE GEOGRAPHIC REGIONS IN WHICH FLIGHT IS TO OCCUR MUST BE LOADED IN THE DATA BASE.

The Data Base does not need to be reconfigured if there are no configuration changes from the previous loading of the Data Base. In other words, if the Data Base is to be loaded with the exactly the same geographic regions and navigational elements as it was loaded with the previous time, you may proceed with "Loading the Data Base" which follows these procedures.

Before starting, KNS 660 system must be turned on and initialization must be complete. The KDL 569 Data Loader must be connected to the KNS 660. If the KDL 569 Data Loader is mounted in the aircraft, it is already internally connected to the system. If the Data Loader is mounted in the portable case (KDL 569R) then follow this procedure and refer to Figure 5-71.

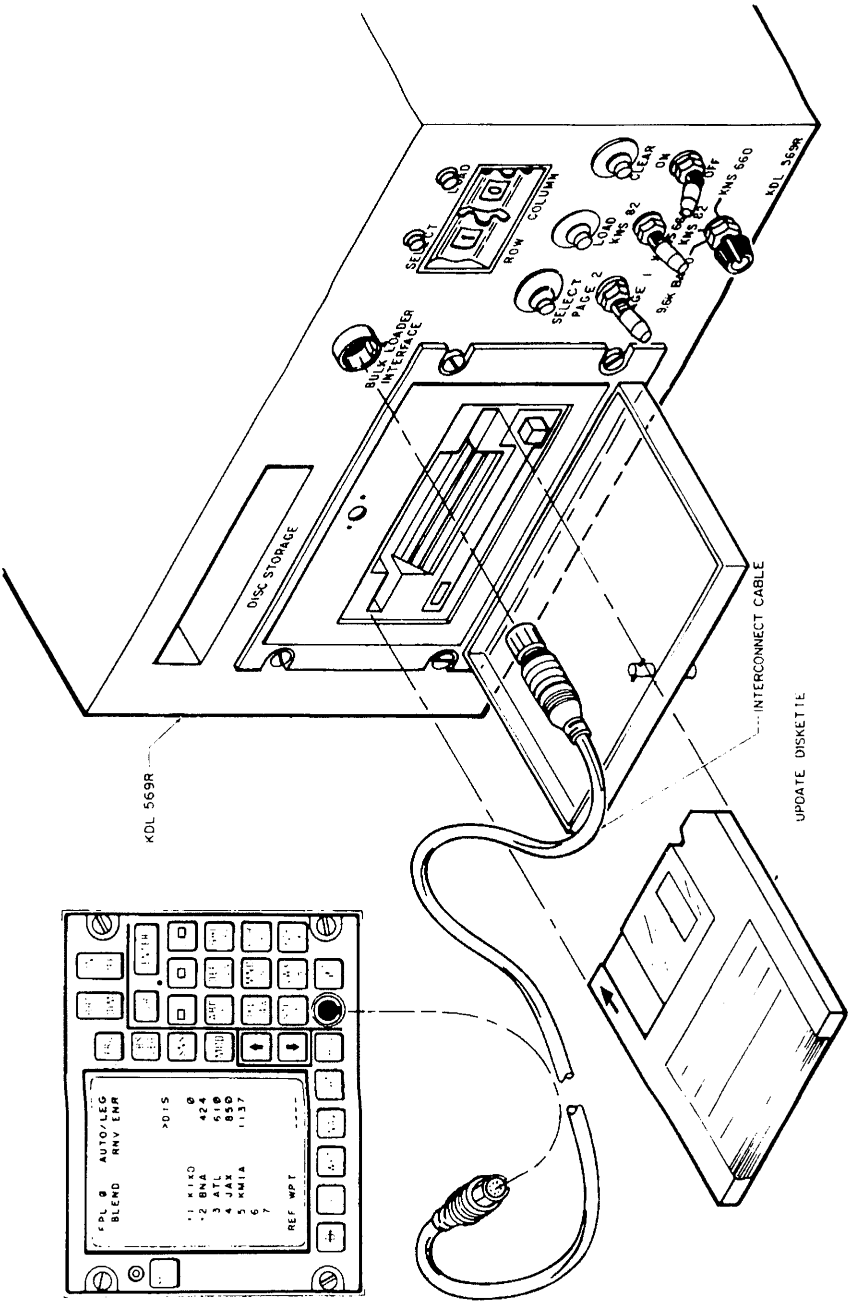

DISC STORAGE
BULK LOADER INTERFACE
KDL 569R
INTERCONNECT CABLE
UPDATE DISKETTE
ROW
COLUMN
CLEAR
KNS 660
KDL 569R

Figure 5-71

CONFIGURING THE DATA BASE (Cont'd)

1. Remove the Data Loader interconnect cable from the lid of the portable case.

2. Plug one end of the interconnect cable (both ends are identical) into the connector labeled "BULK LOADER INTERFACE" which is located on the panel of the portable case.

3. Plug the remaining end of the interconnect cable into the connector on the front of the KCU 567 or KCU 568 CDU.

4. Turn the three-position rotary switch located on the panel of the portable case to the "KNS 660" position.

5. Position the toggle switch located directly above the rotary switch to the "KNS 660" position.

6. Position the PAGE 1 - PAGE 2 toggle switch located on the panel of the portable case to the "PAGE 1" position.

7. Position the ON-OFF toggle switch located on the panel of the portable case to the "ON" position.

8. The other switches located on the front panel of the portable case are not used with the KNS 660 at this time and their positions are immaterial.

CONFIGURING THE DATA BASE (Cont'd)

The best way to explain the procedure for configuring the Data Base is with an example. In this example you have determined what is presently loaded in the main Data Base by following the procedures previously described in "REVIEWING THE DATA BASE". You found the following to be loaded.

USA	LATIN AM	SOUTH AM
Navaids	Navaids	Navaids
Airports >3000ft.	Airports >3000ft.	Airports >3000ft.
Runway Thresholds		
Outer Markers		

Since the majority of your upcoming flying will be in the USA but will include a trip to Europe, you desire to configure the Data Base as follows:

USA	CANADA	EUROPE
Navaids	Navaids	Navaids
Airports >4000ft.	Airports >4000ft.	Airports >4000ft.
Outer Markers		Outer Markers
High Altitude WPTS		
Low Altitude WPTS		

1. Data Loader cover - OPEN.

2. Update diskette - INSERT into Data Loader. The end of the diskette having the sliding metal shutter is inserted into the Data Loader first. An arrow is located on the top left side of most diskettes and should be pointed to the back of the Data Loader as the diskette is inserted. Push the diskette into the Data Loader until the diskette locks into place. The diskette will not lock into place if it is positioned incorrectly.

3. DAT key - PRESS twice or as required to display the DATA 2 Menu page. The DATA 2 Menu page is described in Section IV.

4. Menu item 5 - SELECT using the Menu Selection Field Procedure (Ref. Page 5-3). The Update Data Base page will be displayed. The Update Data Base page is described in Section IV.

CONFIGURING THE DATA BASE (Cont'd)

5. Menu item 2 - SELECT. The Select Data Base page will be displayed (Figure 5-72).

   You will now delete the geographic areas no longer required.

6. Cursor [~] key - PRESS to position cursor over LATIN AM.

7. CLR key - PRESS to delete the asterisk * following LATIN AM.

   Follow the procedures in items 6 and 7 to delete the asterisk * following SOUTH AM.

   You will now configure the Data Base for Canada.

8. Menu item 2 - SELECT. The Modify Elements page for Canada will now appear (Figure 5-73). The 2851 BLKS AVAIL displayed means that there are presently 2851 blocks of Data Base memory remaining (for entire Data Base, not just for Canada).

NOTE

THERE ARE A TOTAL OF 10,000 BLOCKS OF DATA BASE MEMORY. THESE BLOCKS CAN BE FILLED WITH ANY COMBINATIONS OF GEOGRAPHIC REGIONS AND NAVIGATIONAL ELEMENTS WITHIN THOSE REGIONS (SUBJECT TO THE LIMITATIONS DESCRIBED BELOW) AS LONG AS THE TOTAL BLOCKS CHOSEN DO NOT EXCEED 10,000.

```
DATA       AUTO/LEG
 BLEND      RNV ENR

 SELECT D/BASE

SEL MENU ITEM:__
 1 USA          *
 2 CANADA
 3 LATIM AM     *
 4 EUROPE
 5 SOUTH AM     *
 6 MID EAST
 7 AFRICA
 8 EAST EUR
 9 PACIFIC
10 SOUTH PAC
```

Figure 5-72

```
DATA       AUTO/LEG
 BLEND      RNV ENR

CANADA       D/BASE
 2851 BLKS  AVAIL
NAVAID          250
APT>4000FT      228
APT>3000FT      305
RW THRSHLD     ----
OUTER MKR      ----
HI ALT WPT      113
LO ALT WPT      308
SID/STAR          5
APR INTRSC      108

 MULT WPT       420
```

Figure 5-73

CONFIGURING THE DATA BASE (Cont'd)

9. Cursor [↓] or [↑] key - PRESS, if necessary, to position cursor over NAVAID.

NOTE

THE DEFINITIONS OF EACH OF THE NAVIGATIONAL ELEMENTS ARE CONTAINED IN SECTION IV, REVIEW ELEMENTS PAGE.

The number 250 to the right of NAVAID is the number of blocks of Data Base memory required to load Canadian navaids.

10. ENTER key - PRESS once to select Canadian navaids (Figure 5-74).

The number of blocks available has now decreased by the 250 taken by Canadian navaids and indicates 2601 are still available.

NOTE

WITH THE EXCEPTION OF THE 10,000 BLOCKS OF DATA BASE MEMORY, THE REST OF THE NUMBERS USED ARE FOR EXAMPLE ONLY AND WILL PROBABLY DIFFER FROM THOSE DISPLAYED DURING AN ACTUAL CONFIGURING OF THE DATA BASE.

Follow the procedure in items 9 and 10 to select APT> 4000FT for Canada.

11. DAT key - PRESS once to return to the Modify Data Base page. Asterisks will now be positioned to the right of USA and CANADA (Figure 5-75).

12. Menu item 4 - SELECT. The Modify Elements page for Europe will be displayed.

Follow the procedure in items 9 and 10 to select the NAVAID, APT >4000FT, and OUTER MKR elements for Europe (Figure 5-76).

NOTE

NO NUMBERS ARE DISPLAYED NEXT TO THE RW THRSHLD AND OUTER MKR ELEMENTS AND THEREFORE THEY MAY NOT BE SELECTED UNTIL ONE OF THE TWO AIRPORT ELEMENTS (APT >4000FT OR APT >3000FT) HAS BEEN SELECTED.

```
DATA       AUTO/LEG
 BLEND      RNV  ENR

CANADA       D/BASE
 2851 BLKS  AVAIL
NAVAID         250*
APT>4000FT     228
APT>3000FT     305
RW THRSHLD     ----
OUTER MKR      ----
HI ALT WPT     113
LO ALT WPT     308
SID/STAR         5
APR INTRSC     108

 MULT WPT      420
```

Figure 5-74

```
DATA       AUTO/LEG
 BLEND      RNV  ENR

 SELECT D/BASE

SEL MENU ITEM: __
 1 USA            *
 2 CANADA         *
 3 LATIM AM
 4 EUROPE
 5 SOUTH AM
 6 MID EAST
 7 AFRICA
 8 EAST EUR
 9 PACIFIC
10 SOUTH PAC
```

Figure 5-75

```
DATA       AUTO/LEG
 BLEND      RNV  ENR

EUROPE       D/BASE
  672 BLKS  AVAIL
NAVAID         836*
APT>4000FT     650*
APT>3000FT     654
RW THRSHLD     757
OUTER MKR      215*
HI ALT WPT     150
LO ALT WPT     212
SID/STAR       142
APR INTRSC      29

 MULT WPT      810
```

Figure 5-76

<u>CONFIGURING THE DATA BASE</u> (Cont'd)

13. DAT key - PRESS once to return to the Modify Data Base page. Asterisks will now be positioned next to USA, CANADA, and EUROPE.

You will now configure the elements for USA.

14. Menu item 1 - SELECT. The Modify Elements page will be displayed, indicating the information which is presently configured for the USA (Figure 5-77).

```
DATA       AUTO/LEG
 BLEND      RNV ENR

USA          D/BASE
  672 BLKS  AVAIL
NAVAID        1547*
APT>4000FT  1802
APT>3000FT  3025*
RW THRSHLD  2089*
OUTER MKR    488*
HI ALT WPT   212
LO ALT WPT  1384
SID/STAR     129
APR INTRSC  2170

 MULT WPT   2221*
```

Figure 5-77

Comparing what elements are presently loaded for the USA with what elements are desired you determine that APT >3000FT and RW THRSHLD need to be deleted. Also, the OUTER MKR element will need to be deleted because it is associated with APT >3000FT.

15. Cursor [˜] or [||] key - PRESS to position cursor over APT >3000FT.

16. CLR key - PRESS to delete APT >3000FT for the USA.

You will notice that deleting the airports also deletes the Runway Thresholds and Outer Markers. This is because the system is capable of storing Runway Thresholds and Outer Markers only for the selected airport element (APT >4000FT or APT >3000FT). If no airport element is selected then no Runway Thresholds, or Outer Markers can be selected.

The number of available blocks of Data Base memory is now 6274.

CONFIGURING THE DATA BASE (Cont'd

17. APT>4000FT and OUTER MKR - Select following the procedure in items 9 and 10. The number of available blocks of Data Base memory is now 3990.

18. Cursor [˜] key - PRESS to position cursor over HI ALT WPT.

19. ENTER key - PRESS to select high altitude waypoints and multiple waypoints (Figure 5-78).

NOTE

THE FIRST TIME ANY ONE OF THE WAYPOINT ELEMENTS (HI ALT WPT, LO ALT WPT, SID/STAR, OR APR INTRSC) FOR A GEOGRAPHIC REGION IS SELECTED, THE MULT WPT ELEMENT IS ALSO AUTOMATICALLY SELECTED. THE NUMBER OF BLOCKS OF DATA BASE MEMORY REQUIRED FOR THIS FIRST WAYPOINT ELEMENT SELECTION IS THE NUMBER OF BLOCKS REQUIRED FOR THE DESIRED WAYPOINT ELEMENT PLUS THE NUMBER FOR THE MULT WPT ELEMENT. A MULTIPLE WAYPOINT IS ONE WHICH SERVES THE FUNCTION OF AT LEAST TWO TYPES OF WAYPOINTS. AN EXAMPLE OF A MULTIPLE WAYPOINT IS ONE WHICH SERVES AS BOTH A HIGH ALTITUDE WAYPOINT AND A LOW ALTITUDE WAYPOINT. THE MULT WPT ELEMENT CANNOT BE SELECTED BY ITSELF.

```
DATA       AUTO/LEG
 BLEND      RNV ENR

USA          D/BASE
 1557 BLKS AVAIL
NAVAID        1547*
APT>4000FT 1802*
APT>3000FT 3025
RW THRSHLD 2041
OUTER MKR     482*
HI ALT WPT    212*
LO ALT WPT 1384
SID/STAR       129
APR INTRSC 2170

 MULT WPT   2221*
```

Figure 5-78

CONFIGURING THE DATA BASE (Cont'd)

20. LO ALT WPT - SELECT following the procedure in items 9 and 10.

The number of available blocks of Data Base memory is now 173.

Note that although this is all the information you originally intended to configure for the Data Base, you still have adequate capacity for SID and STAR waypoints. When SID/STAR is selected the display will look like the screen in Figure 5-79.

If you attempt to select an element for which an adequate number of Data Base memory blocks does not exists, a Scratch Pad message will be displayed stating SPACE NOT AVAIL.

```
DATA        AUTO/LEG
 BLEND       RNV ENR

USA           D/BASE
   44 BLKS AVAIL
NAVAID        1547*
APT>4000FT  1802*
APT>3000FT  3025
RW THRSHLD  2041
OUTER MKR     482*
HI ALT WPT    212*
LO ALT WPT  1384*
SID/STAR      129*
APR INTRSC  2170

 MULT WPT     2221*
```

Figure 5-79

21. DAT key - PRESS once to return to the Modify Data Base page and PRESS again to return to the Update Data Base page.

LOADING THE DATA BASE

Before loading the Data Base:

- The aircraft must be on the ground.
- Initialization must be complete.
- The KDL 569 Data Loader must be connected to the KNS 660 as described on Page 5-55.
- The update diskette must be inserted into the Data Loader as described in steps 1 and 2 of "Configuring the Data Base".
- The Data Base must be configured as desired. As previously discussed, the last Data Base configuration is stored and therefore, if exactly the same geographic regions and navigational elements are to be loaded, then no additional Data Base configuring is required.

Start by displaying the Update Data Base page.

1. DAT key - PRESS twice or as required to display the DATA 2 Menu page. The DATA 2 Menu page is described in Section IV.
2. Menu item 5 - SELECT using the Menu Selection Field Procedure (Ref. Page 5-2). The Update Data Base page will now be displayed (Figure 5-80).
3. Cursor [ˆ] or [||] key - PRESS to position cursor over LOAD D/BASE? (Figure 5-81).

```
DATA          OBS:248
 VOR          RNV APR

 UPDATE D/BASE

SEL MENU ITEM:█
 1 REVIEW D/BASE
 2 SELECT D/BASE

  NEXT UPDATE
   30 JUL 84

  LOAD D/BASE?
*ON GROUND ONLY
*AFTER D/BASE
 SELECT COMPLETE
```

Figure 5-80

```
DATA          OBS:248
 VOR          RNV APR

 UPDATE D/BASE

SEL MENU ITEM:
 1 REVIEW D/BASE
 2 SELECT D/BASE

  NEXT UPDATE
   30 JUL 84

  LOAD D/BASE?
*ON GROUND ONLY
*AFTER D/BASE
 SELECT COMPLETE
```

Figure 5-81

LOADING THE DATA BASE (Cont'd)

4. ENTER key - PRESS to initiate Data Base loading.

   While the Data Base is being loaded the Scratch Pad area will display D/BASE ACCESSED. When loading is completed the Scratch Pad area will display XFER COMPLETED.

5. KDL 569 Reject button - PUSH to unlock diskette. Remove diskette from Data Loader and close clear protective cover.

CAUTION

LEAVING UPDATE DISKETTES INSERTED IN KDL 569 DATA LOADER FOR EXTENDED PERIODS OF TIME WILL CAUSE EXCESSIVE WEAR TO OCCUR TO DATA LOADER. ALSO, FAILING TO KEEP THE CLEAR PROTECTIVE COVER CLOSED COULD ALLOW A FOREIGN SUBSTANCE TO CAUSE DAMAGE TO THE DATA LOADER MECHANISM OR ELECTRONICS.

NOTE:

NAVAIDS or Intersections may change location (sometimes in excess of 100 nautical miles), with the ICAO identifier staying the same, from one Data Base cycle to the next. The user should always verify the position of all waypoints in a previously stored flight plan, prior to use, to assure that the resulting flight path across the ground will be as expected.

SAMPLE TRIP #1

The following is a brief example of how the KNS 660 may be utilized on an actual trip. This example demonstrates several of the key points explained in Section V. It is assumed in this example that the Data Base has been loaded with appropriate data for the trip and that the pilot has previously reviewed what is loaded in the Data Base.

The trip to be flown will be from Tulsa, Oklahoma (KTUL) to Chattanooga, Tennessee (KCHA). The KNS 660 will be used for this trip to provide enroute navigation only.

Pre-departure

1. Turn the KNS 660 on by pressing the top of the ON/OFF switch. After a few seconds the screen will be illuminated and the Self Test page will be displayed.

2. Adjust the screen brightness to the desired level with the BRT/DIM switch.

3. Verify that the aircraft's displays and annunciators match those called out on the Self Test page. If so, approve the Self Test page by pressing the ENTER key once. The Initialization page will be displayed.

4. Verify that the date and time displayed on the Initialization page are correct. If not, enter the correct information.

5. Position the cursor over the WPT ID field and key in K T U L. Press the ENTER key and the Waypoint page for Tulsa International Airport will be displayed. Position the cursor over the APPROVE? field, if it is not there already, and press the ENTER key. The Initialization page will again be displayed with the latitude and longitude of the Airport Reference Point (ARP) for Tulsa International Airport showing in the POS: field. Press the ENTER key once to approve the Initialization page. The Flight Plan Menu page will be displayed.

SAMPLE TRIP #1

6. Establish the correct Operational Status of the system using the OBS/LEG key to select the Method of Operation, the SNS key to select the active sensor, and the MOD key to select the mode. Since the KNS 660 will be utilized only for enroute navigation, the following Operational Status is selected:

Method of Operation:	AUTO/LEG
Sensor:	BLEND
Mode:	RNV ENR

7. Press the [-D→] key to display the FPL 0 page with the cursor over the DIR: data entry field. Key in K C H A and press the ENTER key. The Waypoint page for Lovell Field in Chattanooga will be displayed. If desired, enter the identifier for Chattanooga VORTAC (CHA) in the REF NAME field and press the ENTER key. With the cursor over the APPROVE? field press the ENTER key to approve the Waypoint page. The FPL 0 page will be displayed.

8. Since this trip does not utilize the waypoints comprising FPL 0, the waypoints may be cleared from the page, if desired, by moving the cursor off the screen and pressing the CLR key followed by the ENTER key.

9. The HSI or CDI NAV flag will pull from view and distance to Chattanooga will be displayed next to KCHA on the screen when at least one position sensor (VOR, TACAN, or OMEGA) is providing valid inputs to the KNS 660. If the KNS 660 system has VOR or TACAN sensors only, line-of-sight altitude with an appropriate navaid must be reached before the system will begin navigation. If the system contains the OMEGA sensor do not take-off until getting the "OMEGA NAV READY" message on the Message page.

ENROUTE

1. After take-off from Tulsa you receive substantial vectoring to the south of the desired course to Chattanooga. To recenter the indicator D-Bar and proceed direct from the aircraft's present position to Chattanooga, place the cursor over KCHA located next to DIR: on the FPL 0 page and press the ENTER key.

SAMPLE TRIP #1

2. The departure time (DEP) leaving Tulsa and the estimated time of arrival (ETA) for Chattanooga can be displayed by placing the cursor over the DIS field on the FPL 0 page and pressing the CLR key once. The length of time since departure (FLT) and the estimated time enroute (ETE) to Chattanooga can be displayed by pressing the CLR key a second time.

3. Additional navigation data such as desired track and bearing to Chattanooga as well as the aircraft's present position can be displayed on the NAV 1 page by pressing the NAV key once. Pressing the NAV key again will display the NAV 2 page which displays information such as cross track error. Pressing the FPL key once will return the system to the FPL 0 page.

4. A new DIRECT TO waypoint may be activated at any time by first pressing the [-D→] key. Then enter a new waypoint identifier over KCHA in the DIR: data field and press the ENTER key. The new waypoint is activated when its Waypoint page is approved.

AFTER LANDING

The KNS 660 can be turned off using the normal Avionics Master Switch or by pressing the bottom of the ON/OFF switch and holding for approximately two seconds.

SECTION VI

NORMAL OPERATION LEVEL II

GENERAL

This section is the second of three sections in a building block type of KNS 660 operational learning process. The primary objective of this section is to familiarize the pilot with all aspects of operating from flight plans. This section also describes using the KNS 660 in the terminal and approach environment and discusses additional waypoint operations.

NOTE

FOR INFORMATION ON ITEMS UNIQUELY APPLICABLE TO A SPECIFIC AIRCRAFT CONSULT THE AIRCRAFT'S KNS 660 AIRPLANE FLIGHT MANUAL SUPPLEMENT.

The sections containing the Normal Operation Level I and Level III may be used at any time to supplement the information in this section.

CREATING AND MODIFYING A NUMBERED FLIGHT PLAN

The KNS 660 is capable of storing up to 100 flight plans (400 with the Expanded Data Base). The advantages of creating flight plans are: (1) The entire route of flight for the upcoming trip can be created and stored prior to departure to reduce pilot workload while enroute; (2) The routes for frequently made trips need to be created just once and may then be recalled as required for later use. A flight plan can contain up to 25 waypoints, subject to not exceeding the system's waypoint capability.

To create a flight plan one begins on the Flight Plan Menu (FPLS) pages. After system initialization the first Flight Plan Menu page is automatically displayed. The FPL key can be used any time to view the Flight Plan Menu pages as well as the Flight Plan 0 (active flight plan) page. Repeated presses of the FPL key will cycle through Flight Plan 0 and all the Flight Plan Menu pages. There can be from 1 to 12 Flight Plan Menu pages depending upon the number of flight plans which have been stored. The flight plans are listed in increasing numeric order. Numbers not assigned to a flight plan are not displayed.

At the time of creation, each of the flight plans must be assigned a number between 1 and 999 (0 is automatically assigned to the active flight plan). It may be desirable to manage the Flight Plan Menu pages by assigning flight plan numbers in an organized fashion. For example, the block of numbers 1 to 50 might be reserved for flight plans departing from or for the aircraft's home base. Likewise, other blocks of numbers could be reserved for flights departing from or for particular airports or regions. If the aircraft flies scheduled commercial flights, the actual flight number could be assigned as the flight plan number.

The following procedure is used to create numbered flight plans. (A numbered flight plan is any flight plan other than the active flight plan which is always Flight Plan 0).

CREATING A NUMBERED FLIGHT PLAN ON A FLIGHT PLAN # PAGE

1. FPL key - PRESS as necessary to select the desired Flight Plan Menu (FPLS) page (Figure 6-1).

2. Flight Plan Number - SELECT a flight plan number which has not previously been used (Ref. Section V, "Menu Selection Field"). When the ENTER key is pressed a Flight Plan # page without any waypoints will appear (Figure 6-2). The cursor will be over the first waypoint field. (A previously used flight plan number can be used but the flight plan will have to be cleared before continuing. Ref. "Clearing a Numbered Flight Plan").

3. Waypoint identifier - INPUT and PRESS the ENTER key. The Waypoint page or Waypoint Duplication page will appear. Although not necessary, it is usually desirable to make the first waypoint the departure airport.

4. Waypoint page information - INPUT. (Ref. Section V, "Procedures For Defining a Waypoint.")

5. APPROVE? - PRESS ENTER to approve the Waypoint page. The Flight Plan # page will appear showing the first waypoint identifier and the cursor will be over the second waypoint field (Figure 6-3).

   Steps 3, 4, and 5 can be repeated until the desired number of waypoints is entered up to maximum number of 9. After the Waypoint page for the ninth waypoint is approved the Flight Plan # page will appear with the cursor over the NEXT PAGE? field (Figure 6-4). To enter waypoint 10, PRESS the ENTER key. A second page containing space for waypoints 10 - 18 will appear. The cursor [↓] key will have to be pressed once to position the cursor over the waypoint 10 field (Figure 6-5). Waypoints 10 - 18 are entered in the same manner as the first 9.

   When the first 18 waypoints have been entered the cursor will again appear over the NEXT PAGE? field. Pressing the ENTER key will display a third Flight Plan # page containing space for waypoints 19 - 25 which may be entered as before (Figure 6-6).

   The cursor may be positioned over the NEXT PAGE? field whenever there are more than 9 waypoints in a Flight Plan and the ENTER key pressed to cycle between the Flight Plan # pages that contain waypoints.

```
FPLS      AUTO/LEG
 BLEND    RNV  ENR

SEL FPL:

  0>KSAT /KCVG
 11 KLAX /KFSO
 14 KLAX /KDAL
 15 KLAX /KSAT
 34 KLAX /KOMA
 43 KIXD /KMEM
 47 KIXD /KTUL
 54 KPHX /KDEN
 55 KPHX /KATL
 99 KPHX /KMKC
  80 FPLS AVAIL
```

Figure 6-1

```
FPL 23   AUTO/LEG
 BLEND    RNV  ENR

ACTIVATE?
INVERT?
               DIS
   1:
   2
   3
   4
   5
   6
   7
   8
   9
REF WPT:      ____
```

Figure 6-2

```
FPL 23   AUTO/LEG
 BLEND    RNV  ENR

ACTIVATE?
INVERT?
               DIS
   1:FIRST
   2:
   3
   4
   5
   6
   7
   8
   9
REF WPT:      ____
```

Figure 6-3

```
FPL 23   AUTO/LEG
 BLEND    RNV  ENR

ACTIVATE?
INVERT?
NEXT PAGE?     DIS
   1:FIRST
   2:SECND     102
   3:THIRD     203
   4:FOURT     406
   5:FIFTH     543
   6:SIXTH     687
   7:SVNTH     820
   8:EIGHT     998
   9:NINTH    1266
REF WPT:      ____
```

Figure 6-4

```
FPL 23   AUTO/LEG
 BLEND    RNV  ENR

ACTIVATE?
INVERT?
NEXT PAGE?     DIS
  10:
  11
  12
  13
  14
   15
   16
  17
  18
REF WPT:      ____
```

Figure 6-5

```
FPL 23   AUTO/LEG
 BLEND    RNV  ENR

ACTIVATE?
INVERT?
NEXT PAGE?     DIS
  19:NINTN    2985
  20:TWNTY    3130
  21:TWONE    3311
  22:TWTWO    3562
  23:TWTHR    3684
  24:TWFOR    3840
  25:TWFIV    3993


REF WPT:      ____
```

Figure 6-6

STRINGING FLIGHT PLANS

There may be occasions when it is desirable or required to define and utilize two numbered flight plans for a particular flight. For example, if the flight route is to contain more than 25 waypoints, two flight plans would be required. Also, SID's and STAR's could be created as individual flight plans which would be used at the end of another flight plan. Whenever two numbered flight plans are to be used consecutively in flight, it is a good idea to make the first waypoint of the second flight plan the same as the last waypoint of the first flight plan. This procedure normally allows more flexibility in making the transition between flight plans.

ADDING WAYPOINTS TO A NUMBERED FLIGHT PLAN

A. To add a waypoint to the end of a numbered flight plan use the procedures just described in "Creating A Numbered Flight Plan On A Flight Plan # Page".

B. To add a waypoint to the beginning or middle of a numbered flight plan use the following procedure.

1. Cursor [↓] or [↑] key - PRESS as necessary to position the cursor over the waypoint identifier which you desire to follow the waypoint being added (Figure 6-7).

2. Waypoint identifier - INPUT (Figure 6-8). When the ENTER key is pressed the Waypoint page (or Waypoint Duplication page) will appear.

3. Waypoint page information - INPUT as required.

4. APPROVE? - PRESS the ENTER key to approve the Waypoint page. The waypoint will be inserted in the flight plan in the desired location (Figure 6-9).

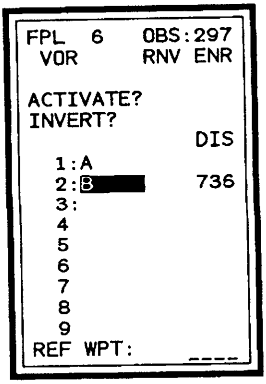


Figure 6-7

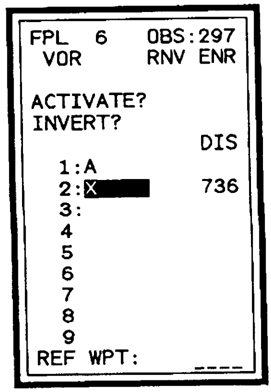


Figure 6-8

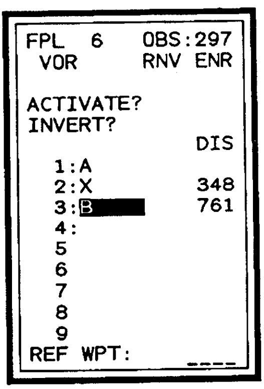


Figure 6-9

CREATING A REFERENCE WAYPOINT

Creating a Reference Waypoint is a method of adding to the flight plan a waypoint which lies on the Great Circle route between two previously designated waypoints. This feature may be utilized on the ground as an aid in defining a route before filing a flight plan or in the air as an easy way to comply with an ATC request for additional waypoints.

An example will illustrate the Reference Waypoint feature.

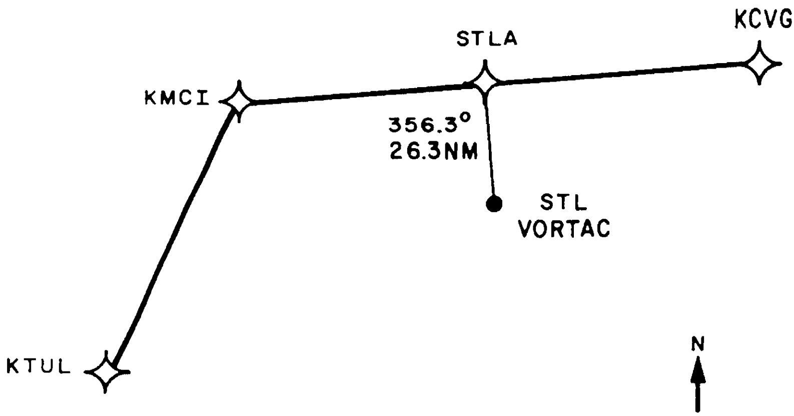


Figure 6-10

A flight plan is being created from Tulsa International Airport (KTUL) to Greater Cincinnati International Airport (KCVG) with an intermediate stop at Kansas City International Airport (KMCI). A Reference Waypoint is desired using St. Louis VORTAC.

NOTE

THE REFERENCE FACILITY USED TO DEFINE A REFERENCE WAYPOINT MUST BE A NAVAID OR AIRPORT CONTAINED IN THE MAIN OR SUPPLEMENTAL DATA BASE. ALSO IT MUST BE POSITIONED WITHIN 200 NAUTICAL MILES OF THE FLIGHT PLAN ROUTE SUCH THAT A LINE CAN BE DRAWN FROM THE REFERENCE FACILITY PERPENDICULAR TO THE FLIGHT PLAN ROUTE.

CREATING A REFERENCE WAYPOINT (Cont'd)

1. Cursor [↓] or [↑] key - PRESS as necessary to position the cursor over the REF WPT field on the Flight Plan # page).

2. Reference Facility Identifier - INPUT into the REF WPT field (Reference Figure 6-11).

3. ENTER key - PRESS to display the Waypoint page (Reference Figure 6-12). The cursor will be positioned over the APPROVE? field. The system will automatically name and define a reference waypoint.

   WPT NAME :STLA - The Reference Waypoint name. Each time a Reference Waypoint is created the waypoint will be named using the NAVAID or Airport Reference Facility Identifier plus a letter of the alphabet. In this example, the leter A was automatically selected to signify that this is the first time that STL had been used to define a Reference Waypoint. If STL were later used in another flight plan to define a Reference Waypoint, the new Reference Waypoint would be named STLB, etc.

   REF NAME :STL
   FREQ :117.40
   RAD :356.3°
   DIS :26.3M
   LAT: N 39° 17.9'
   LON: W 90° 28.1'
   - The waypoint position is automatically defined as the location where the flight plan route comes closest to the reference facility (STL). Another way of stating this is a line from the reference facility which meets the flight plan route at a 90° angle.

4. ENTER key - PRESS to approve the Waypoint page. The Flight Plan # page will be displayed with the reference waypoint automatically inserted in the correct location in the flight plan (Reference Figure 6-13).

   The Reference Waypoint feature can be used as many times as desired to define intermediate waypoints (not to exceed 25 waypoints per flight plan).

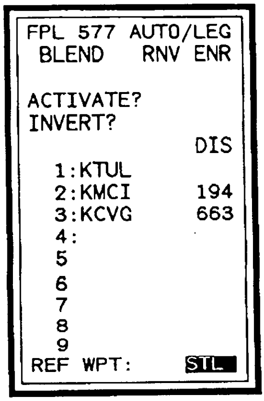


Figure 6-11

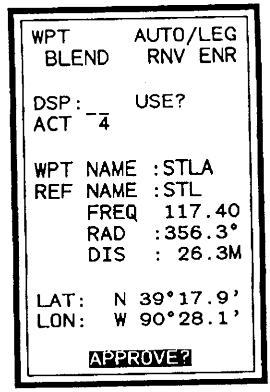


Figure 6-12

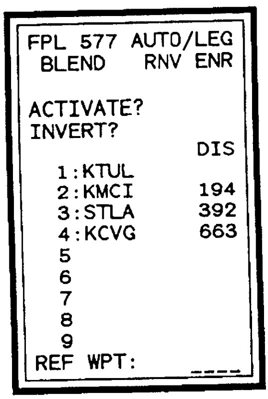


Figure 6-13

DELETING WAYPOINTS FROM A NUMBERED FLIGHT PLAN

The following procedure is used to delete a waypoint from a numbered flight plan.

1. Cursor [↓] or [↑] key - PRESS as necessary to position the cursor over the waypoint identifier to be deleted (Figure 6-14).

2. CLR key - PRESS. The waypoint identifier is replaced by dashes.

3. ENTER key - PRESS. This will cause all the waypoints after the deleted waypoint's position to scroll up and fill the deleted waypoint's position (Figure 6-15). This operation deleted the waypoint from the displayed flight plan, but does not delete the waypoint from the system's waypoint memory.

CLEARING A NUMBERED FLIGHT PLAN

Use the following procedure to clear a numbered flight plan.

1. FPL key - PRESS as necessary to select the desired Flight Plan Menu (FPLS) page.

2. Flight plan number - SELECT the flight plan to be cleared from the menu selection field. When the ENTER key is pressed the selected Flight Plan # page will be displayed.

3. Cursor [↓] or [↑] key - PRESS to position cursor off the page (Figure 6-16).

4. CLR key - PRESS. A flashing DELETE? field will be displayed at the bottom of the Flight Plan # page (Figure 6-17).

5. ENTER key - PRESS to clear the Flight Plan # page (Figure 6-18). If any key other than the ENTER key is pressed the CLEAR operation is cancelled. When a numbered flight plan is cleared it is no longer listed on a Flight Plan Menu page.

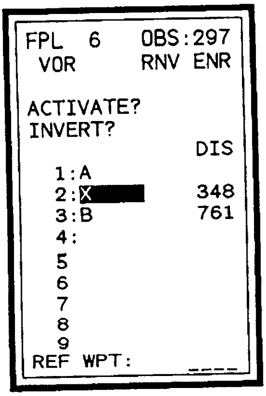


Figure 6-14

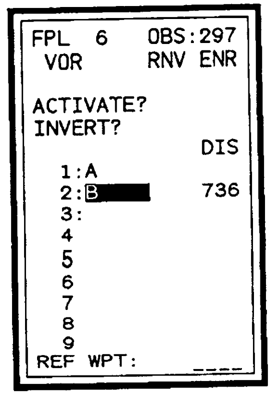


Figure 6-15

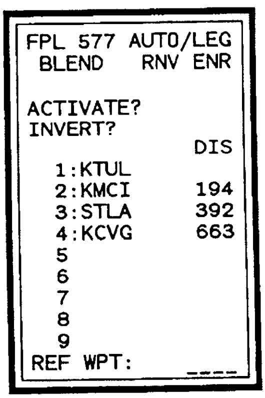


Figure 6-16

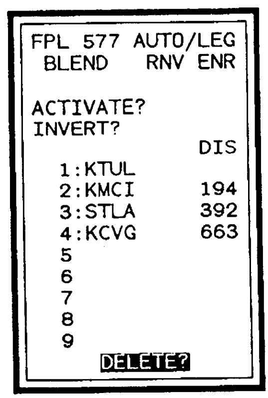


Figure 6-17

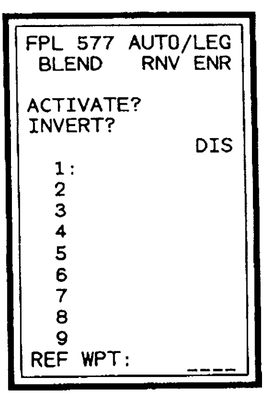


Figure 6-18

REPLACING A WAYPOINT WITH ANOTHER WAYPOINT IN A NUMBERED FLIGHT PLAN

To replace one waypoint with another waypoint in a numbered flight plan, add the replacement waypoint using the procedure "Adding Waypoints To A Numbered Flight Plan" and then delete the original waypoint using the procedure "Deleting Waypoints From A Numbered Flight Plan".

SELECTING AND ACTIVATING A NUMBERED FLIGHT PLAN

A numbered flight plan is made active by putting it into Flight Plan 0. Flight Plan 0 may then be modified without affecting the way the numbered flight plan is stored. Flight plan activation is initiated from the Flight Plan Menu (FPLS) page.

1. FPL key - PRESS as necessary to display the Flight Plan Menu (FPLS) page which lists the desired flight plan (Reference Figure 6-19 and Section IV, Flight Plan Menu page definition). If the flight plan number is known it may be entered on any Flight Plan Menu page, not necessarily the one page listing the numbered flight plan.

2. Desired flight plan - SELECT from the Flight Plan Menu page using the procedure described in Section V, "Menu Selection Field." When the ENTER key is pressed the selected Flight Plan # page will be displayed and the numbered flight plan can be reviewed (Figure 6-20).

   If the displayed flight plan has 9 or fewer waypoints the cursor will be positioned over the ACTIVATE? interrogative field. If the flight plan contains more than 10 waypoints the cursor will be positioned over the NEXT PAGE? field and the ENTER key may be pressed to view the remaining waypoints.

3. Cursor [↓] or [↑] key - PRESS to position the cursor over either the ACTIVATE? (Figure 6-21) or INVERT? interrogative field as desired. ACTIVATE? is used to activate the flight plan in the order the waypoints are displayed. INVERT? is used to activate the flight plan in the inverted order that the waypoints are displayed.

4. ENTER key - PRESS. The numbered flight plan will be copied into Flight Plan 0 which is always the active flight plan (Figure 6-22). The numbered flight plan is still retained in memory and on the Flight Plan Menu page. When a flight plan is copied into Flight Plan 0 in the inverted order, the numbered flight plan is uneffected.

NOTE

DISTANCES WILL NOT BE DISPLAYED ON THE FLIGHT Plan 0 PAGE UNTIL THE SELECTED SENSOR IS PROVIDING VALID POSITION INPUTS TO THE KNS 660.

```
FPLS      AUTO/LEG
 BLEND     RNV ENR

SEL FPL:

   0>KSAT /KCVG
 11 KLAX /KFSO
 14 KLAX /KDAL
 15 KLAX /KSAT
 34 KLAX /KOMA
 43 KIXD /KMEM
 47 KIXD /KTUL
 54 KPHX /KDEN
 55 KPHX /KATL
 99 KPHX /KMKC
  80 FPLS AVAIL
```

Figure 6-19

```
FPL 15    AUTO/LEG
 BLEND     RNV ENR

ACTIVATE?
INVERT?
NEXT PAGE?      DIS
   1:KLAX
   2:PHXB       325
   3:ABQB       575
   4:OKCB      1016
   5:TULA      1105
   6:LITA      1295
   7:MGMA      1614
   8:ATLB      1685
   9:TLHA      1735
REF WPT:       ----
```

Figure 6-20

```
FPL 15    AUTO/LEG
 BLEND     RNV ENR

ACTIVATE?
INVERT?
NEXT PAGE?      DIS
   1:KLAX
   2:PHXB       325
   3:ABQB       575
   4:OKCB      1016
   5:TULA      1105
   6:LITA      1295
   7:MGMA      1614
   8:ATLB      1685
   9:TLHA      1735
REF WPT:       ----
```

Figure 6-21

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



               >DIS
*  1:KLAX         0
*  2:PHXB       325
   3:ABQB       575
   4:OKCB      1016
   5:TULA      1105
   6:LITA      1295
   7:MGMA      1614
  12 KMIA      2162
REF WPT:       ----
```

Figure 6-22

OPERATING FROM THE ACTIVE FLIGHT PLAN

With the exception of DIRECT TO operation as discussed in Level I Operation, normal operation of the KNS 660 is from the active flight plan. The active flight plan is always Flight Plan 0 and is displayed on the Flight Plan 0 (FPL 0) page.

The following subjects were among those covered in Level I Operation and apply directly to operating from the active flight plan.

- System Turn-on
- Self-Test
- Initialization
- Reviewing the Data Base
- Establishing The Correct Operational Status
- Use of NAV 1 and NAV 2 pages
- Defining Waypoints
- DIRECT TO Operation
- Use of NAV Control Function
- Turning System Off
- Predeparture with OMEGA Sensor
- Determining ETA, ETE, Departure Time, and Flight Plan 0 page.

DISPLAYING THE FLIGHT PLAN 0 PAGE

Although many of the KNS 660 pages may be utilized while operating from the active flight plan, the primary page is the Flight Plan 0 page and its definition should be reviewed at this time in Section IV.

The Flight Plan 0 page can be displayed after system initialization in the following ways:

1. Initially, the Flight Plan 0 page is displayed by making a numbered flight plan the active flight plan as previously described in "Selecting And Activating A Numbered Flight Plan".

   Once the desired numbered flight plan has been made active, the Flight Plan 0 page can be recalled into view using one of the methods described in paragraphs 2, 3, and 4 which follow.

2. If the CDU is displaying any page other than a Flight Plan Menu page or the Flight Plan 0 page, pressing the FPL key once will bring the Flight Plan 0 page into view.

3. If the CDU is displaying either a Flight Plan Menu page or the Flight Plan 0 page, pressing the FPL key repeatedly will cycle through all the Flight Plan Menu pages and back to the Flight Plan 0 page.

4. Anytime a Flight Plan Menu page is being displayed, the Flight Plan 0 page can be chosen from the menu selection field and brought into view.

AUTOMATIC SCROLLING OF FLIGHT PLAN 0

The Flight Plan 0 page definition described in Section IV shows how the DIS, ETA, and ETE data as well as the position of the asterisk (or asterisks) can be used to monitor progress along the active flight plan. In addition, as progress is made along a flight plan containing 6 or more waypoints, the waypoints automatically move (scroll) on the Flight Plan 0 page so that the active waypoints are kept in view. This automatic scrolling feature works as follows on the Flight Plan 0 page. Refer to Figure 6-23 through Figure 6-27.

1. The first non-ILS waypoint is always displayed at the top of the list of waypoints.

2. The last non-ILS waypoint is always displayed at the bottom of the list of waypoints.

3. As flight along the active flight plan progresses, the asterisk (OBS operation) or asterisks (AUTO/LEG or AUTO 3D operation) move down the waypoint listing. In OBS operation the pilot must manually make each waypoint active as described later. In AUTO/LEG or AUTO 3D operation the waypoint sequencing is automatic.

4. When the asterisk designating the active TO waypoint (all Methods of Operation) reaches waypoint 6 the TO asterisk remains in the same position and the waypoints scroll to display the next waypoint in the flight plan as shown in Figure 6-26.

5. As further progress is made along the active flight plan, this scrolling action continues (Figure 6-27).

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
* 1:KLAX         0
* 2:PHXB       325
  3:ABQB       575
  4:OKCB      1016
  5:TULA      1105
  6:LITA      1295
  7:MGMA      1614
 12 KMIA      2162
REF WPT:      ----
```

Figure 6-23

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX       350
* 2:PHXB         0
* 3:ABQB       225
  4:OKCB       666
  5:TULA       755
  6:LITA       945
  7:MGMA      1264
 12 KMIA      1812
REF WPT:      ----
```

Figure 6-24

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      1066
  2:PHXB        --
  3:ABQB        --
* 4:OKCB
* 5:TULA        39
  6:LITA       229
  7:MGMA       548
  8:ATLB       619
 12 KMIA      1096
REF WPT:      ----
```

Figure 6-25

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      1200
  3:ABQB        --
  4:OKCB        --
* 5:TULA
* 6:LITA        95
  7:MGMA       414
  8:ATLB       485
  9:TLHA       535
 12 KMIA       962
REF WPT:      ----
```

Figure 6-26

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      2100
  8:ATLB        --
  9:TLHA        --
 10:JAX         --
*11:ORLA
*12 KMIA        62
 13:
 14

REF WPT:      ----
```

Figure 6-27

MANUAL SCROLLING OF FLIGHT PLAN 0

Viewing the complete list of waypoints in the active Flight Plan is different from the "NEXT PAGE?" procedure used to view multiple pages of waypoints of a numbered Flight Plan. As was just described, the waypoints displayed on the Flight Plan 0 page scroll as progress is made along the Flight Plan so that the active waypoint or waypoints are normally automatically kept in view on the Flight Plan 0 page. However, there may be circumstances where it is necessary to manually scroll the waypoints up or down in order to view the waypoints "higher up" or "further down" the list of waypoints comprising the active Flight Plan. For example, this scrolling may be necessary when it is desired to modify the active Flight Plan and the portion to be modified isn't presently being displayed on the Flight Plan 0 page.

The following example will be used to illustrate the procedure for manual scrolling. An aircraft is presently oriented between waypoints 5 and 6 on a flight plan consisting of 12 waypoints (Figure 6-28).

A. Manual Scrolling To Display Waypoints Which Are Further Up The Flight Plan

Figure 6-28 does not presently display the second waypoint. To bring waypoint 2 into view:

1. Cursor [↓] or [↑] key - PRESS to position the cursor over waypoint 1. Waypoint 1 will be replaced by the interrogative field ↑WPT? (Figure 6-29). The ↑WPT? field indicates that there are waypoints which are further up the list than those presently displayed.

2. ENTER key - PRESS once to scroll the waypoints and display waypoint 2 (Figure 6-30). In general, the waypoint list will scroll one position each time the ENTER key is pressed until waypoint 2 is displayed as in Figure 6-30. When the ENTER key is now pressed the ↑WPT? field will be replaced by waypoint 1 as in Figure 6-31.

3. To return the waypoints to their previous position on the Flight Plan 0 page, display another page (other than Message page) and then return to the Flight Plan 0 page. The waypoints can also be scrolled in the opposite direction as previously described.

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR



               >DIS
   1:KLAX      1200
   3:ABQB        --
   4:OKCB        --
 * 5:TULA        --
 * 6:LITA        95
   7:MGMA       414
   8:ATLB       485
   9:TLHA       535
  12 KMIA       962
REF WPT:       ----
```

Figure 6-28

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR



               >DIS
      ↑WPT?
   3:ABQB        --
   4:OKCB        --
 * 5:TULA        --
 * 6:LITA        95
   7:MGMA       414
   8:ATLB       485
   9:TLHA       535
  12 KMIA       962
REF WPT:       ----
```

Figure 6-29

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR



               >DIS
     ↑WPT?
   2:PHXB        --
   3:ABQB        --
   4:OKCB        --
 * 5:TULA        --
 * 6:LITA        95
   7:MGMA       414
   8:ATLB       485
  12 KMIA       962
REF WPT:       ----
```

Figure 6-30

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR



               >DIS
   1:KLAX      1200
   2:PHXB        --
   3:ABQB        --
   4:OKCB        --
 * 5:TULA        --
 * 6:LITA        95
   7:MGMA       414
  12 KMIA       962
REF WPT:       ----
```

Figure 6-31

MANUAL SCROLLING OF FLIGHT PLAN 0 (Cont'd)

B. Manual Scrolling To Display Waypoints Which Are Further Down The Flight Plan

Figure 6-32 does not presently display waypoints 10 and 11. To bring these waypoints into view:

1. Cursor [↓] or [↑] key - PRESS to position the cursor over the last waypoint. The last waypoint will be replaced by the ↓WPT? interrogative field (Figure 6-33). (If the flight plan contains exactly 7 waypoints the cursor is positioned over the blank field below waypoint 7). The ↓WPT? field indicates that there are waypoints which are further down the list than those presently displayed.

2. ENTER key - PRESS once to scroll the waypoints and display waypoint 10 (Figure 6-34). In general, the waypoint list will scroll one position each time the ENTER key is pressed. (Figure 6-35). Continued scrolling will end with a blank waypoint field if the active flight plan contains less than 25 waypoints (Figure 6-36). Note that the active waypoints are no longer displayed.

3. To return the waypoints to their previous position on the Flight Plan 0 page, display another page (other than Message page) and then return to the Flight Plan 0 page. The waypoints can also be scrolled in the opposite direction as previously described.

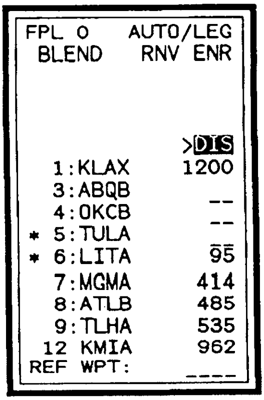


Figure 6-32

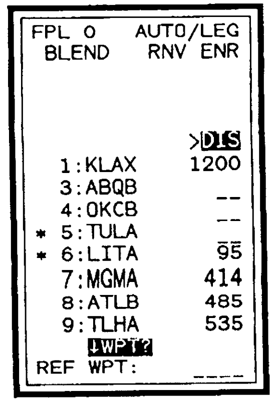


Figure 6-33

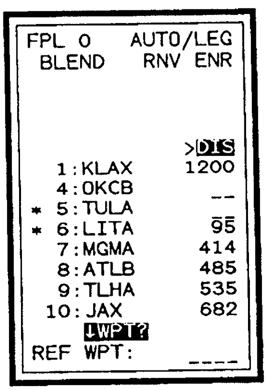


Figure 6-34

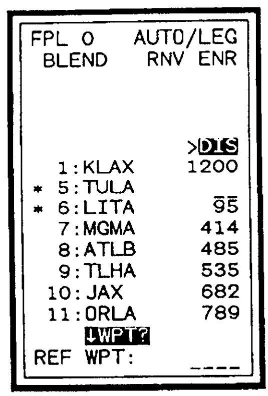


Figure 6-35

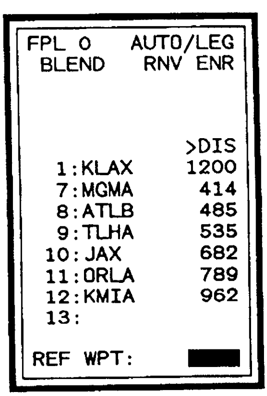


Figure 6-36

DISPLAYING THE DESIRED WAYPOINT PAGE

As you have probably noticed by now, the Waypoint page is automatically displayed whenever the ENTER key is pressed after inputting a waypointer identifier into a data entry field. However, as you learn new KNS 660 operations in this Section there will sometimes be additional requirements to display a desired Waypoint page. A description of the information displayed on the Waypoint page is contained in Section IV.

A. Displaying the Waypoint pages of the Flight Plan 0 waypoints

After initialization, pressing the waypoint (WPT) key once will display the Waypoint page for the active TO waypoint (Figure 6-37) as long as (1) the CDU is displaying a page other than a Waypoint page and (2) the cursor is not positioned over a waypoint identifier. If the system was in DIRECT TO operation when the WPT key was pressed then the Waypoint page associated with the DIRECT TO waypoint will be displayed (Figure 6-38). Otherwise, the Waypoint page for the active TO waypoint from Flight Plan 0 will be displayed.

Once the Waypoint page for the active waypoint is displayed there are two methods of displaying the remaining active flight plan Waypoint pages.

1. Pressing the WPT key repeatedly will cycle through all the Waypoint pages associated with the active flight plan. Each of these Waypoint pages displays the number of the waypoint (as contained in the Flight Plan 0 list) in the DSP: ___ field. For example DSP: 1 (Figure 6-39) indicates that the Waypoint page for the first waypoint in Flight Plan 0 is being displayed. After the Waypoint page associated with the last waypoint in Flight Plan 0 is displayed, a blank Waypoint page is displayed (Figure 6-40). The blank Waypoint page is then followed by the first Waypoint page, etc.

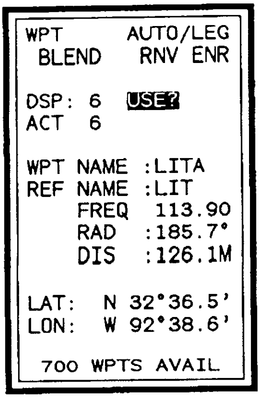


Figure 6-37

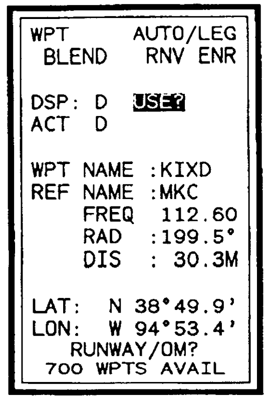


Figure 6-38

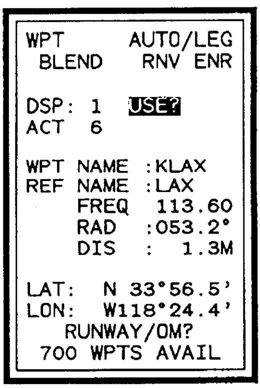


Figure 6-39

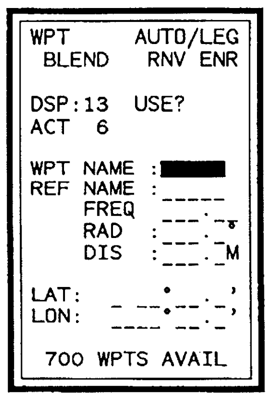


Figure 6-40

DISPLAYING THE DESIRED WAYPOINT PAGE (Cont'd)

2. The desired Waypoint page can be displayed directly by positioning the cursor over the DSP: ___ field (Figure 6-41), and inputting the number of the desired waypoint (Figure 6-42). When the ENTER key is pressed the desired Waypoint page will be displayed (Figure 6-43).

B. Displaying other Waypoint pages

With the exception of the the Waypoint page itself, anytime the cursor is positioned over a waypoint identifier data entry field on any page and the WPT key is pressed, the desired Waypoint page will be displayed. An example is shown in Figures 6-44 and 6-45.

```
WPT        AUTO/LEG
 BLEND     RNV ENR

DSP: 6     USE?
ACT  6

WPT NAME  :LITA
REF NAME  :LIT
    FREQ   113.90
    RAD   :185.7°
    DIS   :126.1M

LAT:   N 32°36.5'
LON:   W 92°38.6'

 700 WPTS AVAIL
```

Figure 6-41

```
WPT        AUTO/LEG
 BLEND     RNV ENR

DSP:12     USE?
ACT  6

WPT NAME  :LITA
REF NAME  :LIT
    FREQ   113.90
    RAD   :185.7°
    DIS   :126.1M

LAT:   N 32°36.5'
LON:   W 92°38.6'

 700 WPTS AVAIL
```

Figure 6-42

```
WPT        AUTO/LEG
 BLEND     RNV ENR

DSP:12    USE?
ACT  6

WPT NAME  :KMIA
REF NAME  :MIA
    FREQ   115.90
    RAD   :137.9°
    DIS   : 13.7M

LAT:   N 25°47.6'
LON:   W 80°17.4'
   RUNWAY/OM?
 700 WPTS AVAIL
```

Figure 6-43

```
NAV 1      AUTO/LEG
 BLEND     RNV ENR

LEG   TULA /LITA

DIS     46.7
ETE    :10

GS 302    TAS:280
WIND    258°t/ 31

DTK  92    TK   93
BRG  92    DA  R03

>POS     RAD  107°
:SHV     DIS  13.6
```

Figure 6-44

```
WPT        AUTO/LEG
 BLEND     RNV ENR

DSP:__     USE?
ACT  6

WPT NAME  :SHV
REF NAME  :SHV
    FREQ   117.40
    RAD   :000.0°
    DIS   :   0.0M

LAT:   N 32°46.2'
LON:   W 93°48.6'

 700 WPTS AVAIL
```

Figure 6-45

ADDING WAYPOINTS TO FLIGHT PLAN 0

Waypoints can be added to an active flight plan which contains fewer than 25 waypoints.

A. To add a waypoint to the end of Flight Plan 0:

1. Cursor [↓] or [↑] key - PRESS to position the cursor over the blank data entry field which follows the last waypoint in the flight plan. If the active flight plan contains 7 or more waypoints it will normally be necessary to first manually scroll the waypoints all the way to the end of the list (↓WPT?) to display the blank data entry field which follows the last waypoint (Figure 6-46).

2. Waypoint identifier - INPUT (Figure 6-47) and PRESS the ENTER key. The Waypoint page (or Waypoint Duplication page) will appear.

3. Waypoint page information - INPUT as required.

4. APPROVE? - PRESS the ENTER key to approve the Waypoint page. The waypoint will be inserted in the desired location in the active flight plan (Figure 6-48).

5. To return the waypoints to their proper position on the Flight Plan 0 page after manual scrolling, display another page (other than Message page) and then return to the Flight Plan 0 page (Figure 6-49). The waypoints can also be scrolled in the opposite direction.

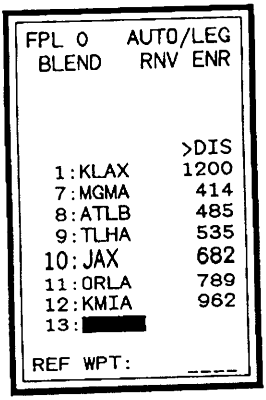


Figure 6-46

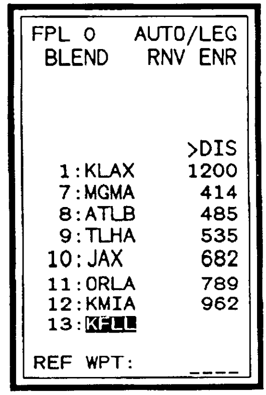


Figure 6-47

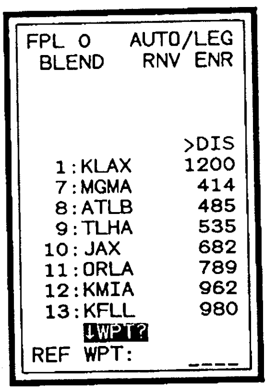


Figure 6-48

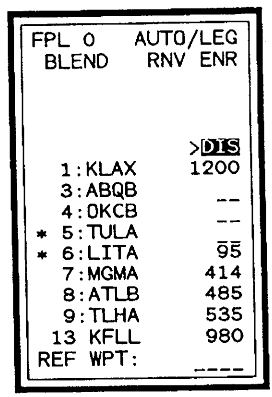


Figure 6-49

ADDING WAYPOINTS TO FLIGHT PLAN 0 (Cont'd)

B. Alternate method to add a waypoint to the end of Flight Plan 0:

1. WPT key - PRESS to display the last waypoint in the flight plan and then PRESS once again to display a blank Waypoint page (Figure 6-50). The cursor will be positioned over the WPT NAME data entry field.

2. Waypoint name identifier - INPUT (Figure 6-51) and PRESS ENTER.

   Enter the rest of the required data for the waypoint on the Waypoint page. Position the cursor over the APPROVE? field.

3. ENTER key - PRESS to approve Waypoint page.

4. FPL key - PRESS to return to Flight Plan 0 page. The new waypoint will be displayed of the bottom of the flight plan list (Figure 6-52).

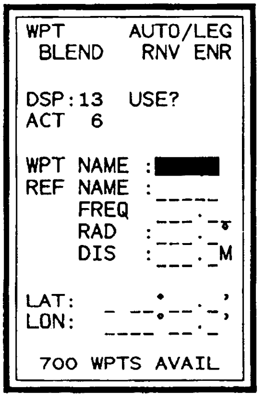


Figure 6-50

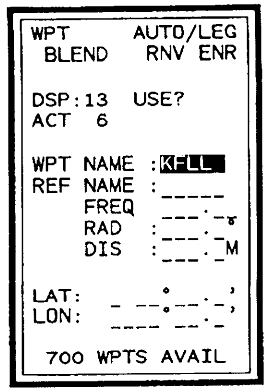


Figure 6-51

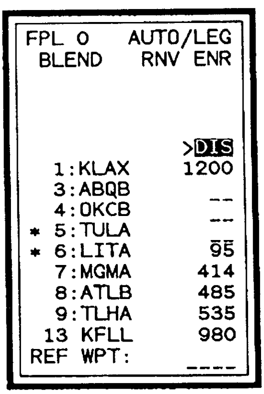


Figure 6-52

ADDING WAYPOINTS TO FLIGHT PLAN 0 (Cont'd)

C. To add a waypoint to the beginning or middle of Flight Plan 0:

1. Cursor [↓] or [↑] key - PRESS to position the cursor over the data entry field of the waypoint identifier which you desire to follow the waypoint being added (Figure 6-53). It may be necessary to first manually scroll the waypoints (↑WPT? or ↓WPT?) to display the desired waypoints.

   If it is desired to add a new waypoint in front of the existing first waypoint and the first waypoint isn't being displayed in a data entry field (i.e., no colon : such as Figure 6-54) it is necessary to scroll the waypoints (↑WPT?) all the way to the beginning to display the existing first waypoint in a data entry field (Figure 6-55).

   If it is desired to add a new waypoint in front of the last waypoint and the last waypoint isn't being displayed in a data entry field (i.e, no colon : such as Figure 6-54) it is necessary to scroll the waypoints (↓WPT?) all the way to the end to display the last waypoint in a data entry field (Figure 6-56).

2. Waypoint identifier - INPUT (Figure 6-57) and PRESS the ENTER key. The Waypoint page (or Waypoint Duplication page) will appear. Information for the Waypoint page should be entered as required.

3. APPROVE? - PRESS the ENTER key to approve the Waypoint page. The waypoint will be inserted in the desired location in the active flight plan (Figure 6-58). To return the waypoints to their proper position on the Flight Plan 0 page after manual scrolling, display another page (other than Message page) and then return to the Flight Plan 0 page. The waypoints can also be scrolled in the opposite direction.

CREATING A REFERENCE WAYPOINT IN FLIGHT PLAN 0

The Reference Waypoint feature described earlier for numbered flight plans (Ref. Page 6-7) may be utilized in exactly the same manner to add a Reference Waypoint to the active flight plan. This feature can not be used for DIRECT TO operation.

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      1200
  3:ABQB        --
  4:OKCB        --
* 5:TULA
* 6:LITA        95
  7:MGMA       414
  8:ATLB       485
  9:TLHA       535
 12 KMIA       962
REF WPT:      ----
```

Figure 6-53

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      1200
  3:ABQB        --
  4:OKCB        --
* 5:TULA
* 6:LITA        95
  7:MGMA       414
  8:ATLB       485
  9:TLHA       535
 12 KMIA       962
REF WPT:      ----
```

Figure 6-54

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      1200
  2:PHXB        --
  3:ABQB        --
  4:OKCB        --
* 5:TULA
* 6:LITA        95
  7:MGMA       414
 12 KMIA       962
REF WPT:      ----
```

Figure 6-55

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      1200
* 6:LITA        95
  7:MGMA       414
  8:ATLB       485
  9:TLHA       535
 10:JAX        682
 11:ORLA       789
 12:KMIA       962

REF WPT:      ----
```

Figure 6-56

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      1200
  3:ABQB        --
  4:OKCB        --
* 5:TULA
* 6:LITA        95
  7:MGMA       414
  8:RRS        485
  9:TLHA       535
 12 KMIA       962
REF WPT:      ----
```

Figure 6-57

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR



              >DIS
  1:KLAX      1200
  3:ABQB        --
  4:OKCB        --
* 5:TULA
* 6:LITA        95
  7:MGMA       414
  8:RRS        472
  9:ATLB       486
 13 KMIA       963
REF WPT:      ----
```

Figure 6-58

DELETING WAYPOINTS FROM FLIGHT PLAN 0

Waypoints which are not currently active (i.e., they aren't currently the TO or FROM waypoints designated by an asterisk) may be easily deleted from the active flight plan using the procedure below. In order to clear a waypoint which is currently active, another waypoint or waypoints must first be made active. One such method for clearing an active waypoint follows these procedures. The system will display a scratch pad error message stating: ILLEGAL - ACT WPT if it is attempted to delete an active waypoint.

To delete a waypoint which is not currently active:

1. Cursor [↓] or [↑] key - PRESS as necessary to position the cursor over the data entry field of the waypoint identifier to be deleted (Figure 6-59). It may be necessary to first manually scroll the waypoints to display the desired waypoint.

   If it is desired to delete the first waypoint and the first waypoint isn't being displayed in a data entry field (i.e., no colon : such as Figure 6-60) is it necessary to scroll the waypoints all the way to the beginning to display the first waypoint in a data entry field (Figure 6-61).

   If it is desired to delete the last waypoint and the last waypoint isn't being displayed in a data entry field (i.e., no colon : such as Figure 6-60) it is necessary to scroll the waypoints all the way to the end to display the last waypoint in a data entry field (Figure 6-62).

2. Clear (CLR) key - PRESS to display dashes (Figure 6-63). The delete procedure can be aborted by pressing the cursor [↓] or [↑] key.

3. ENTER key - PRESS. The waypoint will be deleted and any waypoints following the deleted waypoint will move up one position in the numerical sequence (Figure 6-64).

4. To return the waypoints to their proper position on the Flight Plan 0 page after manual scrolling, display another page (other than Message page) and then return to the Flight Plan 0 page. The waypoints can also be scrolled in the opposite direction.

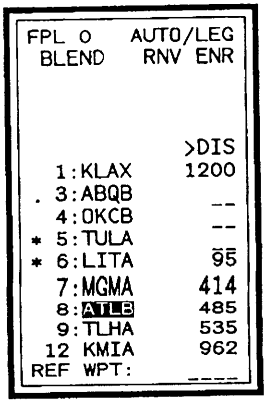


Figure 6-59

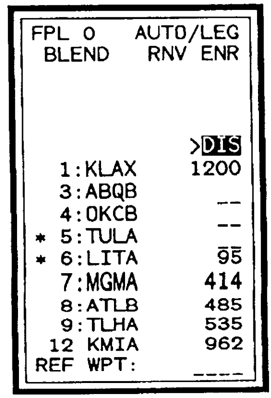


Figure 6-60

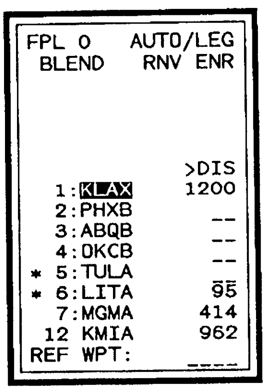


Figure 6-61

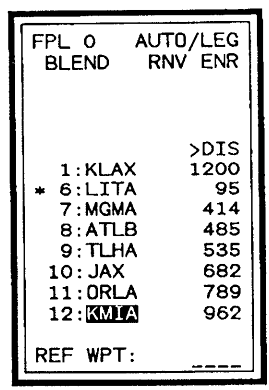


Figure 6-62

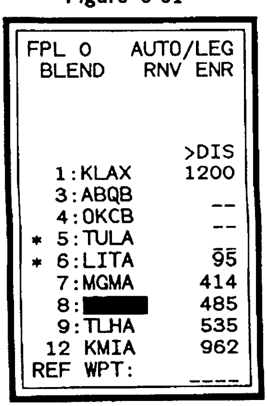


Figure 6-63

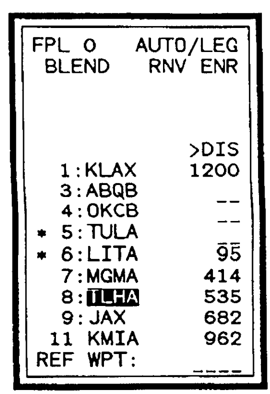


Figure 6-64

DELETING THE ACTIVE WAYPOINT FROM FLIGHT PLAN 0

The system will not allow an active waypoint to be deleted from Flight Plan 0. An active TO or FROM waypoint is designated by an asterisk on the Flight Plan 0 page. Therefore in order to delete a waypoint which is presently active, another waypoint must first be activated. The following procedure presents one method of deleting a waypoint which is presently active.

To delete LITA from Figure 6-65:

1. WPT key - PRESS repeatedly to cycle through the Waypoint pages of the waypoints in the active flight plan until a desired non-active waypoint is displayed (Figure 6-66). The cursor will be positioned over the USE? interrogative field.

2. ENTER key - PRESS to make the displayed waypoint the active waypoint (Figure 6-67).

3. FPL key - PRESS to return to the Flight Plan 0 page.

    a. If the KNS 660 has been in AUTO/LEG or AUTO 3D Method of Operation the system will be providing DIRECT TO operation to the selected waypoint (Figure 6-68).

    b. If the KNS 660 has been in OBS Method of Operation the Flight Plan 0 page will display the desired waypoint as being active (Figure 6-69).

4. Follow the normal procedures for deleting a non-active waypoint (Reference "Deleting Waypoints From Flight Plan 0").

```
FPL 0     AUTO/LEG
 BLEND     RNV  ENR



              >DIS
  1:KLAX     1200
  3:ABQB       --
  4:OKCB       --
* 5:TULA       --
* 6:LITA       95
  7:MGMA      414
  8:ATLB      485
  9:TLHA      535
 12 KMIA      962
REF WPT:     ----
```

Figure 6-65

```
WPT       AUTO/LEG
 BLEND     RNV  ENR

DSP: 7   USE?
ACT  6

WPT NAME  :MGMA
REF NAME  :MGM
    FREQ   112.10
    RAD   :190.8°
    DIS   : 44.9M

LAT:  N 31°29.6'
LON:  W 86°31.7'

 700 WPTS AVAIL
```

Figure 6-66

```
WPT       AUTO/LEG
 BLEND     RNV  ENR

DSP: 7   USE?
ACT  7

WPT NAME  :MGMA
REF NAME  :MGM
    FREQ   112.10
    RAD   :190.8°
    DIS   : 44.9M

LAT:  N 31°29.6'
LON:  W 86°31.7'

 700 WPTS AVAIL
```

Figure 6-67

```
FPL 0     AUTO/LEG
 BLEND     RNV  ENR

DIR:MGMA       414

              >DIS
  1 KLAX     1200
  3:ABQB       --
  4:OKCB       --
  5:TULA       --
  6:LITA       --
* 7:MGMA      414
  8:ATLB      485
  9:TLHA      535
 12 KMIA      962
REF WPT:     ----
```

Figure 6-68

```
FPL 0     OBS:110
 BLEND     RNV  ENR



              >DIS
  1:KLAX     1200
  4:OKCB       --
  5:TULA       --
  6:LITA       --
* 7:MGMA      114
  8:ATLB      185
  9:TLHA      235
 10:JAX       382
 12 KMIA      662
REF WPT:     ----
```

Figure 6-69

DELETING A DIRECT TO WAYPOINT AND CANCELLING DIRECT TO OPERATION

A. To delete a DIRECT TO waypoint when the system is in AUTO/LEG or AUTO 3D Method of Operation:

1. Cursor [↓] or [↑] key - PRESS to position cursor over the DIRECT TO waypoint identifier (Figure 6-70).

2. Clear (CLR) key - PRESS.

3. ENTER key - PRESS to delete the DIRECT TO waypoint and cancel DIRECT TO operation (Figure 6-71). If the DIRECT TO waypoint was also one of the active flight plan waypoints, the waypoint is not deleted from the flight plan. When the DIRECT TO waypoint is deleted and DIRECT TO operation cancelled, the system automatically orients itself along the active flight plan and activates the appropriate waypoint pair.

B. To delete a DIRECT TO waypoint and cancel DIRECT TO operation when the system is in OBS Method of Operation (Figure 6-72), another waypoint must be made active. Attempting to cancel the DIRECT TO waypoint with the Clear (CLR) and ENTER keys will result in the SELECT NEW WPT message being displayed in the scratch pad area. One method of making another waypoint active is as follows:

1. WPT key - PRESS repeatedly to cycle through the Waypoint pages of the waypoints in the active flight plan until a desired non-active waypoint is displayed (Figure 6-73). The cursor will be positioned over the USE? interrogative field.

2. ENTER key - PRESS to make the displayed waypoint the active waypoint and cancel DIRECT TO operation (Figure 6-74).

3. FPL key - PRESS to return to the Flight Plan 0 page (Figure 6-75).

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR

DIR:MGMA    414

              >DIS
   1:KLAX     1200
   3:ABQB       --
   4:OKCB       --
   5:TULA       --
   6:LITA       --
 * 7:MGMA      414
   8:ATLB      485
   9:TLHA      535
  12 KMIA      962
REF WPT:      ----
```

Figure 6-70

```
FPL 0     AUTO/LEG
 BLEND     RNV ENR


              >DIS
   1 KLAX     1200
   3:ABQB       --
   4:OKCB       --
 * 5:TULA       --
 * 6:LITA       95
   7:MGMA      414
   8:ATLB      485
   9:TLHA      535
  12 KMIA      962
REF WPT:      ----
```

Figure 6-71

```
FPL 0      OBS:092
 VOR       RNV ENR

DIR:MGMA       114

              >DIS
   1:KLAX       --
   4:OKCB       --
   5:TULA       --
   6:LITA       --
 * 7:MGMA      114
   8:ATLB      185
   9:TLHA      235
  10:JAX       382
  12 KMIA      662
REF WPT:      ----
```

Figure 6-72

```
WPT        OBS:092
 VOR       RNV ENR

DSP: 8    USE?
ACT  7

WPT NAME  :ATLB
REF NAME  :ATL
    FREQ   116.90
    RAD   :194.7°
    DIS   :150.2M

LAT:   N 31°12.1'
LON:   W 85°10.7'

 700 WPTS AVAIL
```

Figure 6-73

```
WPT        OBS:092
 VOR       RNV ENR

DSP: 8    USE?
ACT  8

WPT NAME  :ATLB
REF NAME  :ATL
    FREQ   116.90
    RAD   :194.7°
    DIS   :150.2M

LAT:   N 31°12.1'
LON:   W 85°10.7'

 700 WPTS AVAIL
```

Figure 6-74

```
FPL 0      OBS:092
 VOR       RNV ENR


              >DIS
   1 KLAX       --
   5:TULA       --
   6:LITA       --
   7:MGMA
 * 8:ATLB      185
   9:TLHA      235
  10:JAX       382
  11:ORLA      489
  12 KMIA      662
REF WPT:      ----
```

Figure 6-75

REPLACING A WAYPOINT WITH ANOTHER WAYPOINT IN FLIGHT PLAN 0

To replace one waypoint with another waypoint in the active flight plan, add the replacement waypoint using the procedure "Adding Waypoints To Flight Plan 0" and then delete the original waypoint using the procedure "Deleting Waypoints from Flight Plan 0".

An alternate method for replacing a waypoint with another waypoint is as follows (Figure 6-76). The new waypoint must already be contained in system memory (main Data Base, supplemental Data Base or user created waypoint) to use this procedure.

1. WPT key - PRESS as required to display the Waypoint page for the waypoint to be replaced (Figure 6-77).
2. Cursor [↓] or [↑] key - PRESS to position cursor over the waypoint name identifier data entry field.
3. New waypoint name identifier - INPUT new identifier over existing identifier (Figure 6-78).
4. ENTER key - PRESS to enter new waypoint name identifier (Figure 6-79).

   The Waypoint page will display the latitude and longitude of the new waypoint. INPUT a REF NAME if required and PRESS the ENTER key. The cursor will be positioned over the APPROVE? field.
5. ENTER key - PRESS to approve the new Waypoint page.
6. FPL key - PRESS to return to the Flight Plan 0 page (Figure 6-80).

```
FPL 0      AUTO/LEG
 BLEND      RNV  ENR



                >DIS
   1 KLAX       1200
   3:ABQB
   4:OKCB         --
*  5:TULA         --
*  6:LITA         95
   7:MGMA        414
   8:ATLB        485
   9:TLHA        535
  12 KMIA        962
REF WPT:        ----
```

Figure 6-76

```
WPT        AUTO/LEG
 BLEND      RNV  ENR

DSP:  6    USE?
ACT   6

WPT  NAME  :LITA
REF  NAME  :LIT
     FREQ   113.90
     RAD   :185.7°
     DIS   :126.1M

LAT:   N 32°36.5'
LON:   W 92°38.6'

 700  WPTS  AVAIL
```

Figure 6-77

```
WPT        AUTO/LEG
 BLEND      RNV  ENR

DSP:  6    USE?
ACT   6

WPT  NAME  :MLU
REF  NAME  :LIT
     FREQ   113.90
     RAD   :185.7°
     DIS   :126.1M

LAT:   N 32°36.5'
LON:   W 92°38.6'

 700  WPTS  AVAIL
```

Figure 6-78

```
WPT        AUTO/LEG
 BLEND      RNV  ENR

DSP:  6    USE?
ACT   6

WPT  NAME  :MLU
REF  NAME  :MLU
     FREQ   117.20
     RAD   :000.0°
     DIS   :   0.0M

LAT:   N 32°31.0'
LON:   W 92°02.1'

     APPROVE?
```

Figure 6-79

```
FPL 0      AUTO/LEG
 BLEND      RNV  ENR



                >DIS
   1:KLAX       1200
   3:ABQB
   4:OKCB         --
*  5:TULA         --
*  6:MLU         100
   7:MGMA        419
   8:ATLB        490
   9:TLHA        540
  12 KMIA        967
REF WPT:        ----
```

Figure 6-80

CLEARING FLIGHT PLAN 0

The active flight plan can be cleared of all waypoints using the following procedure.

1. Cursor [↓] or [↑] key - PRESS one or more times to remove the cursor from the Flight Plan 0 page (Figure 6-81).

2. Clear (CLR) key - PRESS. Note that a flashing DELETE? field appears at the bottom of the page (Figure 6-82).

3. ENTER key - PRESS to clear the Flight Plan 0 waypoints (Figure 6-83). If any key other than ENTER is pressed, the flight plan will not the deleted and the DELETE? field will disappear.

CREATING A FLIGHT PLAN IN FLIGHT PLAN 0

If desired, a flight plan can be created directly on the Flight Plan 0 page. This avoids creating the flight plan on a numbered flight plan page and then having to activate it. The disadvantage is that if a numbered flight plan is subsequently made active, the one programmed directly into Flight Plan 0 will be lost.

To create a flight plan directly on the Flight Plan 0 page begin by clearing the existing Flight Plan 0 page. After positioning the cursor over the waypoint 1 data entry field the procedures previously described for the Flight Plan 0 page can be utilized to create the flight plan.

If more than seven waypoints are contained in the flight plan it will be necessary to manually scroll the waypoints using the ↓WPT? field. To return the waypoints to their proper position after manual scrolling, display another page (other than the Message page) and then return to the Flight Plan 0 page. The waypoints can also to scrolled in the opposite direction.

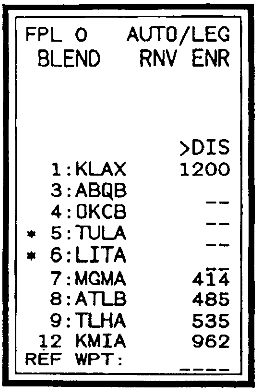


Figure 6-81

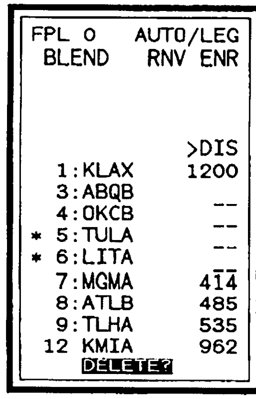


Figure 6-82

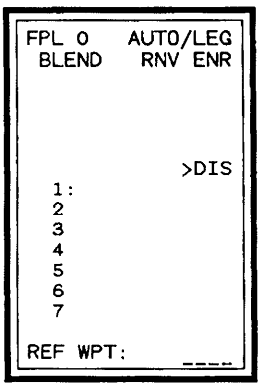


Figure 6-83

STORING FLIGHT PLAN 0 AS A NUMBERED FLIGHT PLAN

The active flight plan (Flight Plan 0) can be loaded into a numbered flight plan so that it can be recalled for later use. This may be desirable, for example, if the active flight plan was originally created on the Flight Plan 0 page and not as a numbered flight plan.

1. Flight Plan (FPL) key - PRESS until any Flight Plan Menu (FPLS) page is displayed. The first flight plan displayed on each Flight Plan Menu page is Flight Plan 0.

2. Cursor [↓] or [↑] key - PRESS until the cursor is over the Flight Plan 0 position (Figure 6-84). Note that the > designates this as a cyclic field.

3. Clear (CLR) key - PRESS. The Flight Plan 0 position will change to 0 STORE IN: ___ (Figure 6-85).

4. Desired Flight Plan Number - INPUT a number which is not used (Figure 6-86). A previously used flight plan number will not be accepted unless that flight plan number is first cleared from the memory.

5. ENTER key - PRESS. Flight Plan 0 will remain the active flight plan and is now stored in the Flight Plan Menu as the flight plan number input in the previous step. (Figure 6-87).

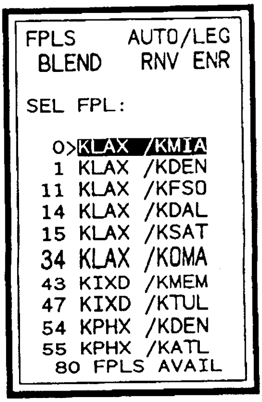


Figure 6-84

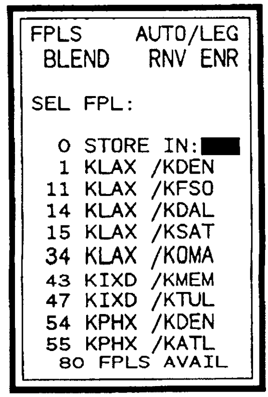


Figure 6-85

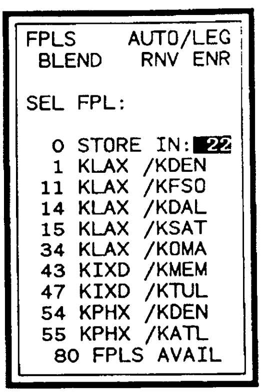


Figure 6-86

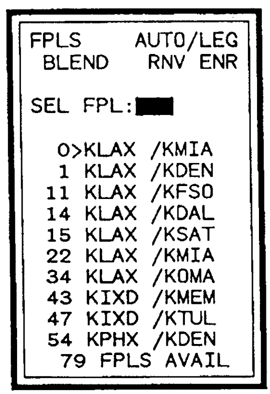


Figure 6-87

PROCEDURES UNIQUE TO OBS METHOD OF OPERATION

In Section II the concepts of both the OBS and AUTO/LEG Methods of Operation were presented. OBS operation requires certain manual procedures such as course selection, waypoint selection and others which are described here.

OBS Manual Course Selection

In OBS operation the pilot must manually select the course TO or FROM the active waypoint. There are four methods of manually selecting the course, not all of which are applicable to every KNS 660 installation.

NOTE

THE AIRCRAFT'S FLIGHT MANUAL SUPPLEMENT SHOULD BE CONSULTED TO DETERMINE WHICH OF THE FOLLOWING METHODS (OR OTHER METHODS) OF COURSE SELECTION ARE APPLICABLE TO THE KNS 660 SYSTEM BEING UTILIZED.

A. If the KNS 660 system is configured with a compatible CDI or with a compatible HSI having a driven course arrow, the course can be selected directly from the CDU.

   1. Cursor [↓] or [↑] key - PRESS to position the cursor over the OBS: ___ field (Figure 6-88).

   2. Desired course - INPUT (Figure 6-89) and PRESS the ENTER key. The desired course will be displayed in the OBS: field (Figure 6-90) and the course arrow on the HSI will be slewed to the proper position.

B. If the KNS 660 system is configured with a compatible CDI or with a compatible HSI having a driven course arrow the DIRECT TO [-D→] key may be pressed as described in Section V to select the course which will center the D-Bar with a TO indication.

C. If the KNS 660 system is configured with a compatible HSI which has a remote course select knob, it can be used to select the desired course. The selected course will be displayed in the OBS: ___ field on the CDU.

PROCEDURES UNIQUE TO OBS METHOD OF OPERATION (Cont'd)

D. If the KNS 660 system is configured with a compatible HSI which has a course select knob on the HSI, it can be turned directly to the desired course. The selected course will be displayed in the OBS: ___ field on the CDU. This method should be used for systems using an HSI which doesn't have a driven course pointer.

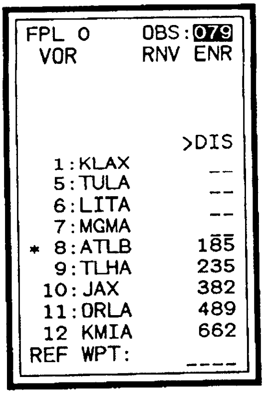


Figure 6-88

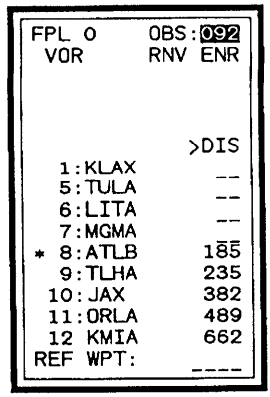


Figure 6-89

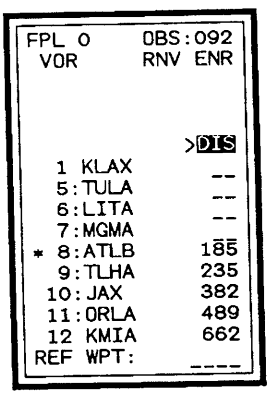


Figure 6-90

OBS Manual Waypoint Selection

The pilot must manually select the active waypoint in OBS operation. There are two methods of selecting the active waypoint.

A. Normal procedure from the active flight plan

To make waypoint 8 active in Figure 6-91:

1. Waypoint page for desired waypoint - DISPLAY as described in "Displaying the Desired Waypoint Page. The cursor will be positioned over the USE? field (Figure 6-92).

2. ENTER key - PRESS to make the displayed waypoint the active waypoint (Figure 6-93).

3. FPL key - PRESS to display the Flight Plan 0 page. The waypoint now has an * to its left to designate the active waypoint (Figure 6-94). The desired course TO or FROM this waypoint can now be selected.

B. DIRECT TO procedure

Any waypoint, whether contained in the active flight plan or not, can be made the active waypoint either by pressing the DIRECT TO [-D→] key and entering a waypoint identifer or by positioning the cursor over a waypoint identifier and then pressing the [-D→] key (Reference "Selecting DIRECT TO Operation" in Section V). In OBS operation once a waypoint has been made active using the DIRECT TO function, a new desired course TO or FROM this waypoint can be manually selected.

Remember also that to delete a DIRECT TO waypoint when the system is in OBS operation, another waypoint must be made active. Attempting to cancel the DIRECT TO waypoint with the CLR and ENTER keys is not permitted in OBS operation.

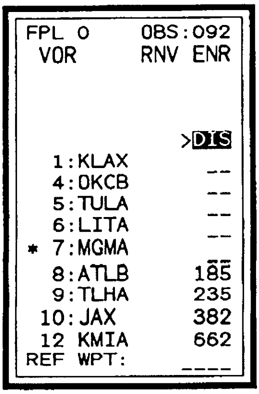


Figure 6-91

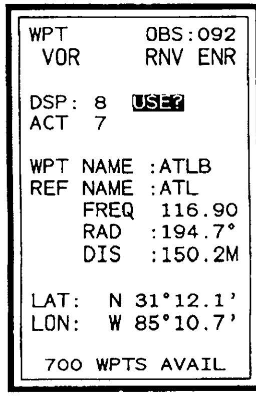


Figure 6-92

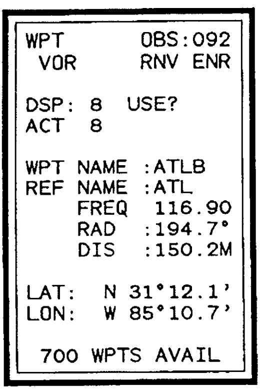


Figure 6-93

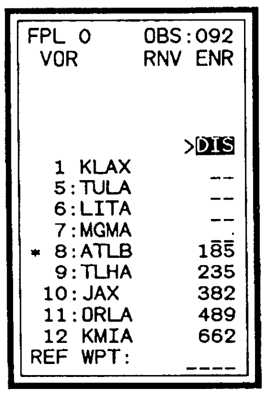


Figure 6-94

PROCEDURES UNIQUE TO OBS METHOD OF OPERATION (Cont'd)

NOTE

IN ORDER TO UTILIZE THE VOR AND DME SENSORS IN THE OBS METHOD OF OPERATION, THE WAYPOINT PAGE FOR THE ACTIVE WAYPOINT MUST CONTAIN THE NAVAID IDENTIFIER IN THE REF NAME: FIELD FOR THE NAVAID WHICH THE VOR NAV RECEIVER AND DME (OR TACAN) WILL ACTUALLY UTILIZE.

Instrument Approaches

The KNS 660 is capable of being used for certain types of instrument approaches when it is configured with compatible Nav and DME sensors. Of course it is also possible to shoot an instrument approach by using the optional NAV control function to transfer tuning of the VOR NAV receiver and DME from the KNS 660 to a conventional frequency selector as described in "Use of the NAV Control Function" in Section V.

To utilize the KNS 660 for ILS, Localizer, VOR, VOR/DME, and RNAV approaches the system must be in the OBS Method of Operation. (See note bottom of page 5-23.)

For the most part, the information required to utilize the KNS 660 system for an instrument approach has already been covered in this and previous sections. Procedures for LORAN approaches are found in Section VII. The most important point to remember is to correctly establish the required Operational Status of the system (i.e. Method of Operation, sensor, and mode. Reference Section V, "Establishing the Correct KNS 660 Operational Status".

A. ILS and Localizer approach guidelines

1. An ILS frequency or frequencies can be included in a numbered flight plan or the active flight plan by entering the frequency without a decimal point as a 5 character waypoint identifier (Figure 6-95). The Waypoint page for an ILS frequency waypoint is displayed in Figure 6-96.

2. An ILS frequency waypoint is made active exactly like any other OBS waypoint (i.e. from the Waypoint page or via DIRECT TO operation as previously described in "OBS Waypoint Selection"). Even if the KNS 660 is in AUTO/LEG or AUTO 3D operation the system will not automatically sequence to an ILS frequency waypoint.

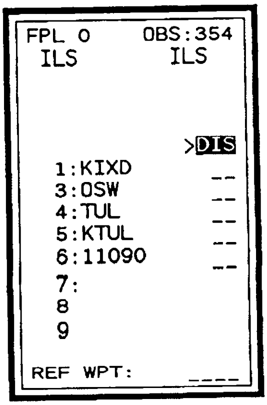


Figure 6-95

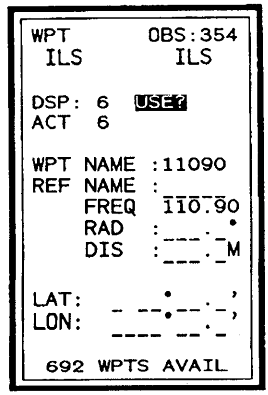


Figure 6-96

3. When an ILS frequency waypoint is made active the Operational Status of the system automatically changes to the following (Figure 6-95):

   Method of Operation: OBS
   Sensor: ILS
   Mode: ILS

4. The course is selected as previously described in "OBS Manual Course Selection".

5. If an ILS frequency waypoint is active and a non-ILS waypoint is manually made the active waypoint, the KNS 660 automatically defaults to the following Operational Status:

   Method of Operation: OBS
   Sensor: VOR
   Mode: RNV ENR

   The desired Operational Status can then be selected.

PROCEDURES UNIQUE TO OBS METHOD OF OPERATION (Cont'd)

6. If an ILS frequency waypoint is active and the OBS/LEG key is pressed to change the Method of Operation to AUTO/LEG or AUTO 3D, the KNS 660 automatically defaults to the following Operational Status:

   Method of Operation: AUTO/LEG or AUTO 3D as selected
   Sensor: VOR
   Mode: RNV ENR

   In addition, the system orients itself along the active flight plan and activates the appropriate pair of waypoints. The desired Operational Status can then be selected.

B. VOR and VOR/DME approach guidelines. For greatest efficiency the following items should be accomplished in the order listed.

1. The navaid (VORTAC, VOR, VOR/DME) specified for the approach must be entered as a waypoint using the station's identifer (Example: OJC, not 11300). The KNS 660 system will not accept a VOR frequency waypoint as was described for ILS approaches. The navaid identifier can be entered as a waypoint in a flight plan or as a waypoint in DIRECT TO operation.

2. The specified navaid waypoint to be used for the approach can be made active either from the Waypoint page or via DIRECT TO operation.

3. Starting with the OBS/LEG key, then the SNS key, and finally the MOD key, the Operational Status of the system should be made the following:

   Method of Operation: OBS
   Sensor: VOR
   Mode: NAV

4. The desired course is selected as previously described in "OBS Manual Course Selection".

PROCEDURES UNIQUE TO OBS METHOD OF OPERATION (Cont'd)

C. RNAV approach guidelines (See note bottom of page 5-23). For greatest efficiency the following items should be accomplished in the order listed.

1. The waypoints utilized for the RNAV approach will normally have to be user created as RNAV waypoints are not included as part of the approach intersections in the Data Base. Since an RNAV approach usually contains several waypoints it will be necessary to include them as part of a flight plan or as an independant flight plan.

2. The user created waypoints to be used in the RNAV approach can be made active one at a time either from the Waypoint page or via DIRECT TO Operation.

3. Starting with the OBS/LEG key, then the SNS key, and finally the MOD key, the Operational Status of the system should be made the following:

   Method of Operation: OBS
   Sensor: VOR
   Mode: RNV APR

4. The desired course is selected as previously described in "OBS Manual Course Selection".

PROCEDURES UNIQUE TO AUTO/LEG (AND AUTO 3D) METHOD OF OPERATION

As described in Section II, the AUTO/LEG Method of Operation is much more automated than OBS operation. Features such as (1) automatic great circle course selection and slewing (2) automatic Navaid selection and tuning and (3) automatic orientation along the flight plan significantly reduce the procedures required when using the KNS 660 in AUTO/LEG operation. These features were explained in Section II and therefore will not be discussed here.

If the KNS 660 system is configured with an HSI which does not have a compatible driven course arrow then the pilot must manually set the course arrow to the correct position. When the KNS 660 is in the AUTO/LEG or AUTO 3D Method of Operation the correct value of where to set the HSI course arrow is displayed in the desired track (DTK) field located on the NAV 1 page. If the pilot fails to position the HSI course arrow to the correct value the CDU will display a message on the Message page stating: ADJUST HSI CRS. During an extended flight in AUTO LEG operation the desired track may change significantly. Whenever the difference between the actual desired track (DTK) and the selected course on the HSI exceeds five degrees the ADJUST HSI CRS Message will be displayed. The pilot should then view the DTK field on the NAV 1 page and reset the HSI course arrow to this value.

Waypoint Selection

A. When operating from a flight plan, the KNS 660 will automatically select and sequence through the waypoints in the flight plan.

B. The DIRECT TO feature can also be used to select a waypoint in AUTO/LEG operation either by pressing the DIRECT TO [-D→] key and entering a waypoint identifer or by positioning the cursor over a waypoint identifer and then pressing the [-D→] key (Ref. "Selecting DIRECT TO Operation" in Section V).

C. Alternate DIRECT TO procedure when operating from the active flight plan (Figure 6-97).

   1. Waypoint page for desired waypoint - DISPLAY as described in "Displaying the Desired Waypoint Page". The cursor will be positioned over the "USE?" field (Figure 6-98).

   2. ENTER key - PRESS to make the displayed waypoint the active waypoint (Figure 6-99).

PROCEDURES UNIQUE TO AUTO/LEG (AND AUTO 3D) METHOD OF OPERATION (Cont'd)

3. FPL key - PRESS to view the Flight Plan 0 page. Note that the system is providing DIRECT TO operation (Figure 6-100).

   Notice that this is exactly the same procedure as the normal procedure for activing waypoints in OBS operation. In AUTO/LEG operation DIRECT TO operation results, while in OBS operation the displayed waypoint is activated but DIRECT TO operation does not result.

```
FPL 0       AUTO/LEG
 BLEND       RNV  ENR



               >DIS
   1 KLAX      1200
   3:ABQB        --
   4:OKCB        --
 * 5:TULA        __
 * 6:LITA        95
   7:MGMA       414
   8:ATLB       485
   9:TLHA       535
  12 KMIA       962
REF WPT:       ----
```

Figure 6-97

```
WPT         AUTO/LEG
 BLEND       RNV  ENR

DSP: 7     USE?
ACT  6

WPT  NAME  :MGMA
REF  NAME  :MGM
     FREQ   112.10
     RAD   :190.8°
     DIS   : 44.9M

LAT:   N 31°29.6'
LON:   W 86°31.7'

  700 WPTS AVAIL
```

Figure 6-98

```
WPT         AUTO/LEG
 BLEND       RNV  ENR

DSP: 7     USE?
ACT  7

WPT  NAME  :MGMA
REF  NAME  :MGM
     FREQ   112.10
     RAD   :190.8°
     DIS   : 44.9M

LAT:   N 31°29.6'
LON:   W 86°31.7'

  700 WPTS AVAIL
```

Figure 6-99

```
FPL 0       AUTO/LEG
 BLEND       RNV  ENR

DIR:MGMA        414

               >DIS
   1 KLAX      1200
   3:ABQB        --
   4:OKCB        --
   5:TULA        --
   6:LITA        __
 * 7:MGMA       414
   8:ATLB       485
   9:TLHA       535
  12 KMIA       962
REF WPT:       ----
```

Figure 6-100

PROCEDURES UNIQUE TO AUTO/LEG (AND AUTO 3D) METHOD OF OPERATION (Cont'd)

Clearing DIRECT TO Operation

In OBS operation the only way to cancel DIRECT TO Operation was to make another waypoint active. However in AUTO/LEG operation the DIRECT TO waypoint can be cleared by positioning the cursor over the DIRECT TO waypoint identifier, pressing the CLR key and then pressing the ENTER key. DIRECT TO Operation is cancelled and the system automatically orients itself along the active flight plan and activates the appropriate pair of waypoints. (Reference "Deleting A DIRECT TO Waypoint And Cancelling DIRECT TO Operation").

ADDITIONAL WAYPOINT OPERATIONS

DELETING WAYPOINTS FROM THE KNS 660 SYSTEM

Earlier in this section the procedures for deleting waypoints from both numbered and active flight plans were discussed. In general, deleting a waypoint from a flight plan does not delete the waypoint from the system's waypoint memory capacity described in Section II (Ref. Section II "Waypoints And Flight PLans"). There are several occasions when it may become necessary to delete waypoints from the KNS 660's waypoint memory. The primary reason for deleting waypoints from the system is to keep the system's waypoint capacity from becoming full. Remember that by pressing the WPT key to view a Waypoint page, the number of empty waypoint slots left is displayed (Ref. Section IV, Waypoint page definition).

The other reason for deleting a waypoint from the system is subtle but important nonetheless. As previously discussed, if a navaid identifier or waypoint in the Data Base has multiple locations, the Waypoint Duplication page is displayed for the pilot to choose the country where the desired navaid or waypoint is located. Once the pilot has made a country choice and the navaid or waypoint becomes one of the system waypoints, the KNS 660 assumes whenever this navaid identifier is entered that the originally chosen country is still desired. If this is not the case then the original waypoint must be deleted from the system memory, the waypoint re-entered, and a new choice made from the Waypoint Duplication page. An example will illustrate this second requirement for clearing waypoints from the system.

DELETING WAYPOINTS FROM THE KNS 660 SYSTEM (Cont'd)

Assume that a KNS 660's Data Base has been configured and loaded with navaids for all 10 geographic regions of the world. A flight plan was originally created which included Nashville VORTAC (BNA). When BNA was originally entered the Waypoint Duplication page offered a choice of USA, Venezuela, and Libya since each of these countries contains a navaid with the BNA identifier (Figure 6-101). USA was chosen from the menu selection field since Nashville is in the USA. At a later time the aircraft is in South America and it is desired to use the BNA VOR/DME located in Venezuela. When BNA is entered in the South American flight plan the BNA Waypoint page (Figure 6-102) for Nashville VORTAC is displayed (the only way to know this is to verify the frequency and location on the Waypoint page). Since the KNS 660 is capable of storing only one waypoint per identifier, it is necessary to clear BNA as a system waypoint and then start from scratch and choose Venezuela from the Waypoint Duplication page.

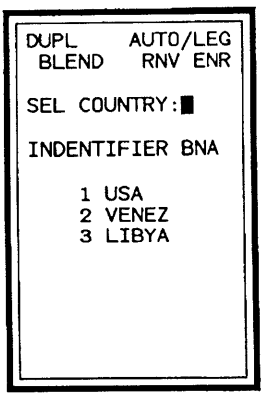


Figure 6-101

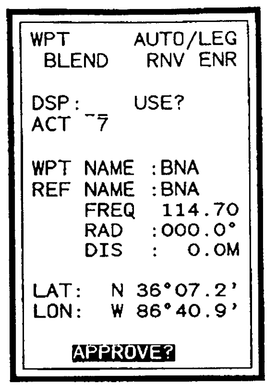


Figure 6-102

DELETING WAYPOINTS FROM THE KNS 660 SYSTEM (Cont'd)

There are three ways in which waypoints are cleared from the system's waypoint memory.

A. Deleting waypoints from the Unused Waypoint page

The Unused Waypoint pages display in alphabetical order the identifiers of user created waypoints that are not contained in an existing flight plan and are not in a protected status (Refer to Section IV).

NOTE

THE UNUSED WAYPOINT PAGES CAN TEMPORARILY DISPLAY WAYPOINTS WHICH ORIGINATED FROM THE MAIN OR SUPPLEMENTAL DATA BASES AND CAN ALSO TEMPORARILY DISPLAY REFERENCE WAYPOINTS; HOWEVER THESE TYPES OF WAYPOINTS ARE DELETED WHEN POWER TO THE KNS 660 IS REMOVED.

The Unused Waypoint pages should be reviewed periodically and waypoints no longer desired should be deleted to allow room for new waypoints. To delete a waypoint from the Unused Waypoint pages:

1. DAT key - PRESS to display the DATA 2 Menu page (Refer to Section IV).
2. UNUSED WPTS page - SELECT from the menu selection field displayed on the DATA 2 Menu page.
3. If additional pages of unused user created waypoints exist, they may be viewed by positioning the Cursor, over either the NEXT PAGE? field (to page forward) or the PREVIOUS PAGE? field (to page backward) and pressing the ENTER key.
4. Cursor [↓] or [↑] key - PRESS to position the cursor over the waypoint to be deleted (Figure 6-103).
5. CLR key - PRESS.
6. ENTER key - PRESS to delete the waypoint. The waypoints below the deleted waypoint will scroll up to fill the blank position (Figure 6-104).

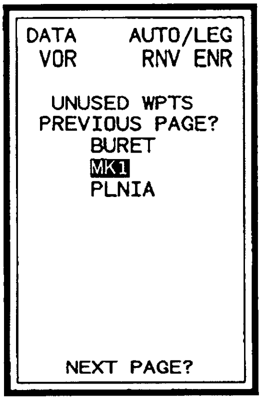


Figure 6-103

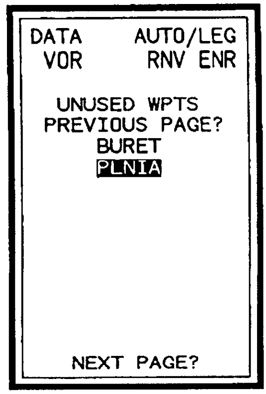


Figure 6-104

B. Deleting waypoints by deleting flight plans

Another method of deleting waypoints is by deleting stored flight plans which are no longer required. The procedures for deleting both numbered flight plans and Flight Plan 0 have been previously presented (Reference "Clearing A Numbered Flight Plan" and "Clearing Flight Plan 0").

When a flight plan is deleted the following rules apply.

1. User created waypoints which were contained only in the deleted flight plan are not deleted from system memory but are now listed on the Unused Waypoint pages. They can be manually deleted from these pages.

2. Waypoints contained in the deleted flight plan which originated from the main or supplemental Data Bases will be deleted from the 800 waypoint memory the next time power is removed from the KNS 660 only if the waypoints aren't contained in another flight plan.

3. No action occurs to waypoints which are contained in both the deleted flight plan and which are also contained in other flight plans.

DELETING WAYPOINT FROM THE KNS 660 SYSTEM (Cont'd)

C. Deleting waypoints from the Waypoint page.

A third method of deleting waypoints from the system's 800 waypoint memory is directly from the Waypoint page. This method could be used to delete the BNA waypoint in the previously mentioned example. To use this method of deleting a waypoint start by displaying the Waypoint page for the waypoint to be deleted.

1. Desired Waypoint page - DISPLAY (Figure 6-105. Ref. Page 6-22, "Displaying the Desired Waypoint Page").

2. Cursor [↓] or [↑] key - PRESS to remove cursor from the Waypoint page.

3. CLR key - PRESS. A flashing DELETE? field will appear at the bottom of the Waypoint page (Figure 6-106). To abort deleting the waypoint PRESS any key on the CDU except the ENTER key.

4. ENTER key - PRESS to display the Waypoint Used- In page (Ref. Figure 6-107 and Section IV). All the flight plans containing the waypoint to be deleted will be displayed. The cursor will be positioned over the flashing DELETE? field at the bottom of the page.

5. ENTER key - PRESS to delete the waypoint from the system's 800 waypoint memory and from all the flight plans which previously contained the waypoint (Figure 6-108).

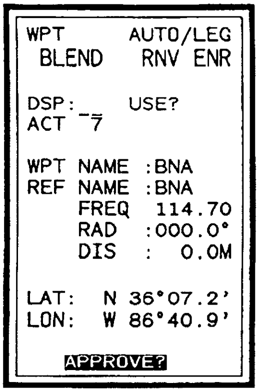


Figure 6-105

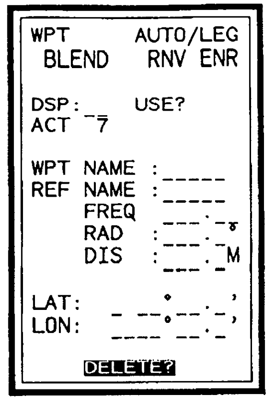


Figure 6-106

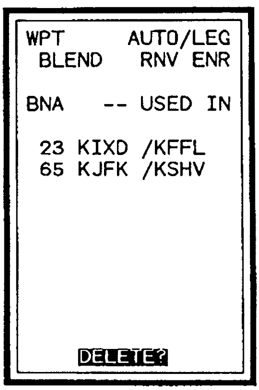


Figure 6-107

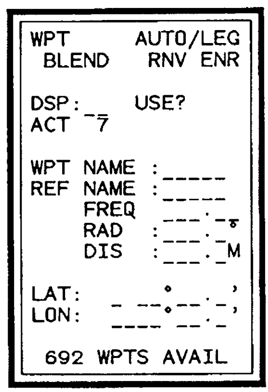


Figure 6-108

EFFECT OF DATA BASE REVISIONS ON STORED WAYPOINTS

If a Waypoint page which previously contained a complete REF NAME identifier, radial, and distance definition (Figure 6-109) ever appears with the REF NAME identifier present but with the RAD and DIS fields dashed out (Figure 6-110), it is an indication that a Data Base revision update changed some parameter (location, elevation, frequency, etc.) of the waypoint itself or some parameter associated with the REF NAME identifer. In either case the displayed latitude and longitude of the waypoint are correct and the dashed RAD and DIS fields are an indication to the pilot that the REF NAME identifier should be re-entered on this Waypoint page.

```
WPT          AUTO/LEG
 BLEND        RNV ENR

DSP: D    USE?
ACT  D

WPT NAME  :KIXD
REF NAME  :MKC
    FREQ   112.60
    RAD   :199.5°
    DIS   : 30.3M

LAT:   N 38°49.9'
LON:   W 94°53.4'
    RUNWAY/OM?
  700 WPTS AVAIL
```

Figure 6-109

```
WPT          AUTO/LEG
 BLEND        RNV ENR

DSP:_        USE?
ACT  6

WPT NAME  :KIXD
REF NAME  :MKC
    FREQ   112.60
    RAD   :___._°
    DIS   :___._M

LAT:   N 38°49.9'
LON:   W 94°53.4'
    RUNWAY/OM?
     APPROVE?
```

Figure 6-110

SAMPLE TRIP #2

The following is a brief example of how the KNS 660 may be utilized on an actual trip. This example demonstrates several of the key points explained in Sections V and VI. Subjects previously covered in Sample Trip #1 will not be covered in as much detail as are new subjects from Section VI. It is assumed in this example that the Data Base has been loaded with appropriate data for the trip and that the pilot has previously reviewed what is loaded in the Data Base.

The trip to be flown is from Memphis, Tennessee International Airport (KMEM) to Big Spring, TX (21XS). The flight plan is filed with the following route: Direct Little Rock (LIT), J66 to Dallas - Ft. Worth (DFW), J4 to Abilene (ABI), Direct Big Spring (BGS), Direct to Big Spring airport (21XS).

The KNS 660 system is installed as the number one NAV in the aircraft. Therefore it will be used for both the enroute and approach phases of flight.

PRE-DEPARTURE

1. Turn the KNS 660 system on and adjust the screen intensity as desired.

2. Verify that the data contained on the Self Test page is correct and approve the Self Test page.

3. Initialize the system at KMEM. Verify that the Initialization page contains the correct date and time. After approving the Initialization page a Flight Plan Menu page (FPLS) will appear.

4. Assume that the flight plan filed to Big Spring hasn't been used before and therefore isn't contained in the KNS 660's menu of flight plans. We will now create the flight plan in the KNS 660.

   Pick a flight plan number which isn't already displayed on the Flight Plan Menu page (say 6 for an example) and input it into the SEL FPL: field. Press the ENTER key to display the blank FPL 6 page.

5. Input Memphis airport as the number one waypoint in the flight plan by keying KMEM into the 1: data entry field. Press the ENTER key to display the Waypoint page for KMEM. Although not required in this case, enter MEM (identifier for Memphis VORTAC) in the REF NAME field and press the ENTER key. With the cursor over the APPROVE? field, press the ENTER key to approve the Waypoint page for KMEM. The FPL 6 page will return with the cursor over the 2: data entry field.

6. Using a procedure similar to step 5 above, enter LIT as waypoint 2, DFW as waypoint 3, ABI as waypoint 4, BGS as waypoint 5, and 21XS as waypoint 6. After approving the Waypoint page for 21XS the FPL 6 page will appear showing all six waypoints.

7. Activate the newly created flight plan by placing the cursor over the ACTIVATE? field and pressing the ENTER key. The flight plan will now be displayed on the FPL 0 page making it the active flight plan.

8. Establish the correct Operational Status for the enroute portion of the trip as follows:

   Method of Operation: AUTO/LEG
   Sensor: BLEND
   Mode: RNV ENR

   A pair of *'s appear next to waypoint 1 (KMEM) and waypoint 2 (LIT) to designate the active leg of the flight plan.

9. The HSI or CDI Nav flag will pull from view and distances along the flight plan will be displayed on the screen when at least one position sensor (VOR, TACAN or OMEGA) is providing valid inputs to the KNS 660. If the KNS 660 system has VOR or TACAN sensors only, line-of-sight altitude with an appropriate navaid must be reached before the system will begin providing navigation data. If the system contains the OMEGA sensor do not take-off until getting the "OMEGA NAV READY" message on the Message page.

ENROUTE

1. After departure from Memphis, clearance is received for "direct Little Rock". Position the cursor over LIT, which is waypoint 2 on the FPL 0 page, and press the [-D→] key. DIR: LIT is displayed near the top of the FPL 0 page. Press the ENTER key once to display the Waypoint page for LIT and a second time to approve the Waypoint page. The KNS 660 will now be providing navigation from the aircraft's present position direct to LIT. A single * appears next to waypoint 2.

2. As the aircraft approaches LIT, the waypoint alert annunciator illuminates to notify the pilot that a leg change is about to occur. About 15 seconds later the KNS 660 begins providing navigation along a transition path to the next leg of the flight plan. After passing abeam LIT the system automatically begins providing navigation along the next leg (LIT to DFW) of the flight plan. A pair of *'s next to LIT and DFW signifies that these waypoints define the active leg of the flight plan.

3. The KNS 660 continues to navigate to DFW, ABI and to BGS. For each leg change the system provides waypoint alerting, turn anticipation, and automatic waypoint sequencing.

APPROACH

1. Approximately 30NM from BGS VORTAC you start to prepare for the VOR 17L approach into Big Spring airport. The VOR 17L approach into Big Spring airport calls for flying outbound on the BGS 180° radial after having transitioned via a holding pattern. The missed approach point is at 9.7NM from BGS.

   If the KNS 660 installation contains the optional NAV control function, it may be selected and the approach made using the VOR navigation receiver and DME in the conventional manner. In this example, however, the NAV control function won't be used so that the procedure using the KNS 660 may be illustrated. An approach can be made using the KNS 660 only if the system contains VOR/DME sensors.

Since BGS is the current active "TO" waypoint and it is also the navaid used to make the approach, a new waypoint doesn't have to be selected for the approach. The correct Operational Status for the approach should be selected as follows:

Method of Operation: OBS
Sensor: VOR
Mode: NAV

2. Upon crossing BGS, manually select 180° as the course. The holding pattern transition and the approach can now be made in the conventional manner.

3. At the missed approach point ground contact isn't made and after following the missed approach procedure you request clearance to your alternate, Midland, Texas Regional Airport. You are cleared direct to Midland VORTAC (MAF) and therefore press the [-D→] key and enter MAF in the DIR: data field. After approving the MAF Waypoint page the system tunes the VOR navigation receiver and DME to 114.80, the frequency for MAF (remember the system is in OBS Method of Operation) and automatically centers the D-Bar with a "TO" indication. (If you are using a CDI or an HSI which doesn't have a driven course arrow, you must manually center the D-Bar.)

4. Just prior to reaching MAF VORTAC you begin receiving vectors for the ILS 10 approach. To prepare, press the [-D→] key and input 11030 directly into the DIR: data field. 11030 is entered since 110.3 is the frequency shown on the approach plate. When the ENTER key is pressed a Waypoint page is displayed showing 11030 in the WPT NAME: field and 110.30 in the FREQ field. Approve the Waypoint page by pressing the ENTER key. The FPL 0 page reappears and indicates that the system has automatically established the following Operational Status:

Method of Operation: OBS
Sensor: ILS
Mode: ILS

5. Manually select the inbound course called for on the approach plate, 103°, and the system is properly configured for the approach.

<u>After Landing</u>

Turn the KNS 660 off in the normal manner.

SECTION VII

NORMAL OPERATION LEVEL III

GENERAL

This section is the last of three sections in a building block type of KNS 660 operational learning process. The objective of this section is to provide information on KNS 660 navigation functions not previously covered and to describe additional features such as Trip Planning, Frequency Management and Fuel Planning.

NOTE

FOR INFORMATION ON ITEMS UNIQUELY APPLICABLE TO A SPECIFIC AIRCRAFT CONSULT THE AIRCRAFT'S KNS 660 AIRPLANE FLIGHT MANUAL SUPPLEMENT.

The sections containing Normal Operation Level I and Level II may be used at any time to supplement the information in this section.

ADDITIONAL NAVIGATION FUNCTIONS AND DISPLAYS

The KNS 660 has a variety of navigation functions and displays in addition to those discussed in Section V and VI.

DETERMINING THE NEAREST AIRPORTS

A separate page is provided which is dedicated to displaying bearing and distance information to the three nearest airports from the aircraft's present position. In addition, the pilot may request bearing and distance to a fourth airport of his own choosing. The three computer selected airports (if three exist) will all be selected from within a 200 NM radius of the aircraft's present position. These airports are chosen from the airports which have been loaded into the main and supplemental Data Base. The system searches the Data Base and selects the three nearest airports approximately every two minutes regardless of whether the pilot calls for the information to be displayed or not. The bearing and distance data displayed, however is real time (continually updated).

The Nearest Airports page is described in Section IV, and is accessible through the DATA 1 Menu page.

1. DAT key - PRESS to obtain DATA 1 Menu page (Figure 7-1).

2. NEAREST APTS menu item - SELECT. REVIEW nearest airports. Note the update time in GMT (Figure 7-2).

3. Cursor - CHECK positioned over the 4: data entry field.

4. ICAO identifier of desired fourth airport - INPUT and PRESS the ENTER key. (The 200 nm restriction does not apply.) Note bearing and distance to fourth airport (Figure 7-3).

   To go "DIRECT TO" one of the displayed airports, such as in an emergency, position the cursor over the identifier of the desired airport (Figure 7-4) and PRESS the key. The Flight Plan 0 page will be displayed with the desired airport identifier already entered in the DIR: field (Figure 7-5). Follow the normal DIRECT TO procedure of pressing the ENTER key to display the Waypoint page and then pressing the ENTER key again to approve the Waypoint page.

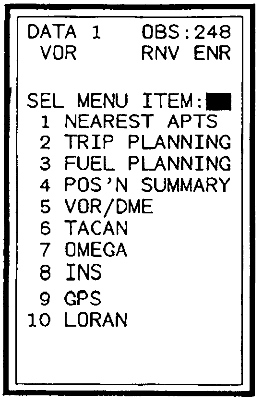


Figure 7-1

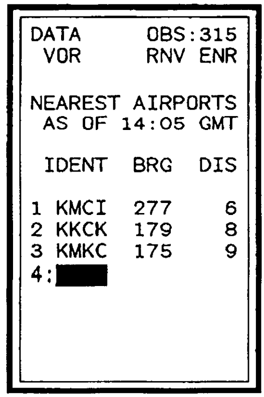


Figure 7-2

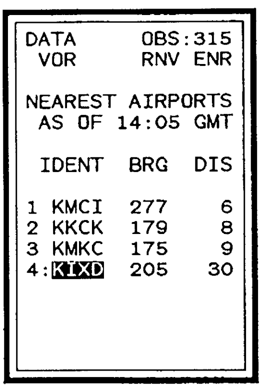


Figure 7-3

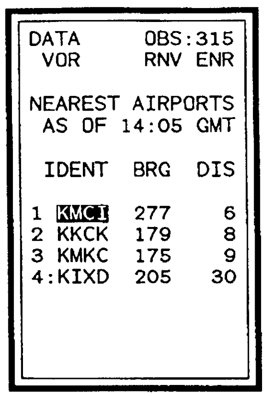


Figure 7-4

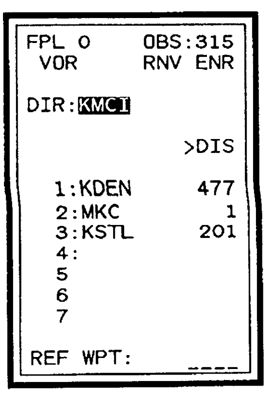


Figure 7-5

SENSOR POSITION SUMMARY

The aircraft's present position in latitude and longitude is presented on a summary page which presents the individually calculated outputs from the following sources (only those sensors actually installed will be displayed):

VOR	(VOR and DME sensors)
DME	(DME sensor used for Rho-Rho updating of the OMEGA/VLF and/or INS sensors. No VOR sensor installed as part of KNS 660 system).
LORAN	(ANI/ONI 7000 LORAN sensor)
TACAN	(Tacan sensor)
OMEGA	(OMEGA/VLF sensor)
INS	(The Inertial Reference Unit sensor)
GPS	(NAVSTAR Global Positioning System Sensor)

The Position Summary page is described in Section IV. The Position Summary page is accessible throught the DATA 1 Menu page.

1. DAT key - PRESS to obtain DATA 1 Menu page.

2. POS'N SUMMARY menu item - SELECT to display the Position Summary page (Figure 7-6). If the KNS 660 installation is configured with more than three navigation sensors, position the cursor over the NEXT PAGE? field and PRESS the ENTER key to display a second Position Summary page.

MONITORING INDIVIDUAL NAVIGATION SENSOR STATUS

Each of the individual navigation sensors configured as part of the KNS 660 system may be monitored through dedicated sensor status pages. The VOR/DME, TACAN, OMEGA/VLF, LORAN, INS, and GPS pages are defined in Section IV, where such questions as: "Which VOR and DME stations are being tuned by the KNS 660 system computer? Are the stations being received? Is Rho-Rho navigation being provided? Which OMEGA/VLF stations are being received and what are the relative signal-to-noise ratios of each?," may be answered. These dedicated sensor status pages are accessible through the DATA 1 Menu page.

1. DAT key - PRESS to view the DATA 1 Menu page.

2. VOR/DME
   TACAN
   OMEGA
   LORAN
   INS
   GPS - SELECT one from the DATA 1 Menu page to display the desired sensor status page (Figures 7-7 through 7-12). Only those sensors actually interfaced with the KNS 660 system will be displayed on the DATA 1 Menu page. If the system has a DME sensor used for Rho-Rho updating of the OMEGA and/or IRU sensors but has no VOR NAV sensor, then the DATA 1 Menu page displays DME instead of VOR.

MONITORING INDIVIDUAL NAVIGATION SENSOR STATUS (Cont'd)

As mentioned on the individual page definitions in Section IV, in addition to monitoring status, certain operational inputs can be made by the pilot on the OMEGA/VLF, LORAN, INS, and GPS Status pages. The VOR/DME Status page and TACAN Status page are used only for monitoring. Reference the following portions of this section for instructions concerning pilot inputs of the OMEGA/VLF, LORAN, INS, and GPS Status pages:

1. Manually Deselecting OMEGA and VLF Stations, Page 7-25.
2. Manually Deselecting Automatic Rho-Rho Updating Of OMEGA/VLF Sensor, Page 7-27.
3. Relaning The OMEGA Sensor, Page 7-29.
4. LORAN sensor operations, Page 7-31.
5. Manual selection/deselection of LORAN stations, Page 7-31.
6. Choosing automatic LORAN chain selection ("AUTO") or dedicated triad ("TRIAD") mode for the LORAN sensor, Page 7-32.
7. Defining a dedicated triad, Page 7-32.
8. Storing dedicated triads, Page 7-34.
9. LORAN approach procedure Page 7-34.
10. Inertial Reference Unit sensor operations, Page 7-15.
11. Rho-Rho updating of the IRU Sensor, Page 7-17.
12. GPS sensor operations, Page 7-35.
13. Restarting the GPS sensor, Page 7-35.

```
DATA        AUTO/LEG
 VOR         RNV ENR

 POS'N SUMMARY
POS     N 38°49.2'
        W 94°53.3'

VOR     N 38°49.2'
        W 94°53.3'

OMEGA   N 38°49.3'
        W 94°53.2'

INS     N 38°49.4'
        W 94°53.4'
     NEXT PAGE?
```

Figure 7-6

```
DATA        AUTO/LEG
 VOR         RNV ENR

     VOR/DME

VOR 1     REC MKC
 182.4°    112.60

DME 1     REC ANX
  36.1NM   114.00

DME 2     REC TOP
  50.6NM   117.80

     RHO-RHO
```

Figure 7-7

```
DATA        AUTO/LEG
 TACAN       RNV ENR

      TACAN
|
TACAN      ____  ___
 ___._          ___

DME 1     REC ANX
  36.1NM   114.00

DME 2     REC TOP
  50.6NM   117.80

     RHO-RHO
```

Figure 7-8

```
DATA        AUTO/LEG
 OMEGA       RNV ENR

  OMEGA STATUS
>AUTO/UPDATE
 SYNC        NAV
   OMEGA/VLF
 OMEGA       VLF
NOR 32     NOR 42
LIB-38*    GBR 44
HAW 98     HAW 86
NDK 99     WAS 93
LRN 26*    MAR 96
ARG 42     MAI 98
AUS 64     AUS-51*
JPN 39     JPN 47
```

Figure 7-9

```
LORAN     RNV ENR

  LORAN STATUS
XXXXX 0105 YYYY
EPE____._ NM

TRIAD SELECT?
 VIEW CHAIN?


GRI        STNS
9980       MVWXYZ
----       ------
----       ------
----       ------
```

Figure 7-10

```
DATA        AUTO/LEG
 INS         RNV ENR

   INS PAGE
  >AUTO/UPDATE
POS    N 38°49.9'
       W 94°53.4'

 GS          405
 TK          275°
 HDG         271°
 OBSERVED    4.1'
    DRIFT    5.3'

 MODE        NAV
 HDG SEL      °m
```

Figure 7-11

```
DATA        AUTO/LEG
 GPS         RNV ENR

  GPS STATUS
STATE         NAV
EPE        XXXXXX
   RESTART?
 SAT SNR ELE HLT
   3  31  46  WK
   6  44  23  GD
   7  39  70  GD
*  17 32   9  BD
*  21 39  35  BD
- --  --  --  --
- --  --  --  --
- --  --  --  --
```

Figure 7-12

MANUALLY UPDATING THE SYSTEM POSITION

Manual position updating of the KNS 660 system may be accomplished using either of the two Hold pages, HOLD 1 or HOLD 2. The sensors which are capable of being updated using manual updating are OMEGA/VLF, VOR/DME, and TACAN. The VOR/DME and TACAN sensors, however, can not be updated unless the updated position is greater than 50 nm from the KNS 660's last calculated position. The Inertial Reference Unit is not manually updatable. Therefore, the primary requirement for manual position updating is to update the OMEGA/VLF Sensor when it is not being provided with Rho-Rho updating. (See "Manually Deselecting Automatic Updating Of OMEGA/VLF Sensor").

Two choices are available for manually updating the system position.

A. To update by first positioning the aircraft over a known reference point and then identifying the point to the system (HOLD 1) page.

1. Aircraft - POSITION over the known reference point. The KNS 660 system may be on any page (after initialization) except the HOLD 1 page.

2. HLD key - PRESS once at the moment the aircraft is over the reference point to display the HOLD 1 page (Figure 7-13).

3. HOLD 1 page - REVIEW the POS field latitude and longitude data captured at the moment the HLD key was pressed.

4. Cursor [↓] or [↑] key - PRESS, if necessary, to positi on the cursor over the IDENT field, or the FIX field.

5. Reference point position - INPUT the identifier contained in system memory into the IDENT: field (Figure 7-14) or the latitude and longitude into the FIX: field of the known reference point. When the ENTER key is pressed the position error will be displayed adjacent to the DIF field and the cursor will be positioned over the flashing UPDATE? field (Figure 7-15).

6. ENTER key - PRESS to update the system. The flashing UPDATE? field will disappear and the DIF field will display 0°00.0' error (Figure 7-16).

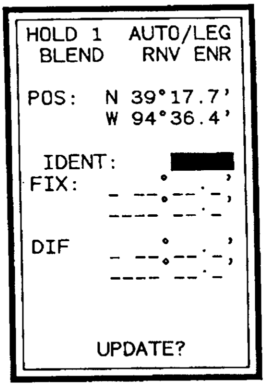


Figure 7-13

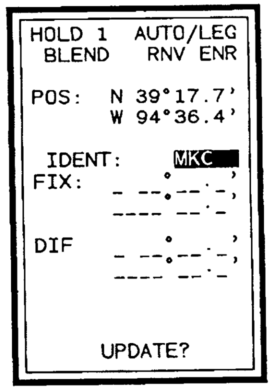


Figure 7-14

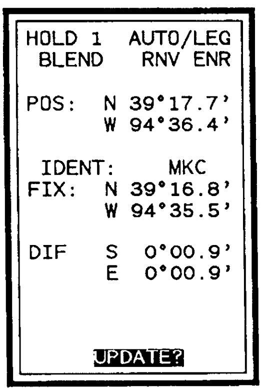


Figure 7-15

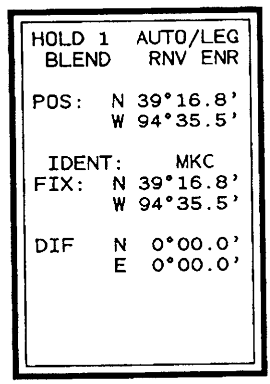


Figure 7-16

MANUALLY UPDATING THE SYSTEM POSITION (Cont'd)

B. To update by first identifying to the system a known reference point and then positioning the aircraft over it. (HOLD 2 page)

1. HDL key - PRESS twice or as required to obtain HOLD 2 page (Figure 7-17).

2. Cursor [↓] or [↑] key - PRESS, if necessary, to position the cursor over the IDENT: or FIX: data entry field.

3. Reference point position - INPUT the identifier contained in system memory into the IDENT field (Figure 7-18) or the latitude and longitude into the FIX field of the known reference point.

   a) If an identifier was entered in the IDENT field.

      (1) ENTER key - PRESS to display the Waypoint page associated with the identifier (Figure 7-19). If the identifier entered was an airport from the Data Base, a runway threshold or outer marker may be selected using the procedure previously discussed in Section V for defining a runway threshold or outer marker as a waypoint.

      (2) Waypoint page - APPROVE by positioning the cursor over the APPROVE? field and pressing the ENTER key. The HOLD 2 page will be displayed with the cursor over the flashing UPDATE? field. (Figure 7-20).

   b) If a latitude and longitude was entered in the FIX field the cursor will advance to the flashing UPDATE? field.

4. Aircraft - POSITION over selected reference point.

5. ENTER key - PRESS to update the system the moment the aircraft is over the reference point. The flashing UPDATE? field will disappear.

The choice of using the HOLD 1 or HOLD 2 page to update the position is really arbitrary and may be swayed somewhat by how much time you have prior to positioning the aircraft over the known reference point. For instance, the first method can be activated spontaneously if during the flight you sight a known reference and do not have enough time to enter in the required identification. A second advantage to the HOLD 1 page is the ability to review the amount of system error present opposite the DIF logo before updating the system. The HOLD 2 page provides a convenient means of accurately initializing the system before take off as the aircraft is positioned over a runway threshold.

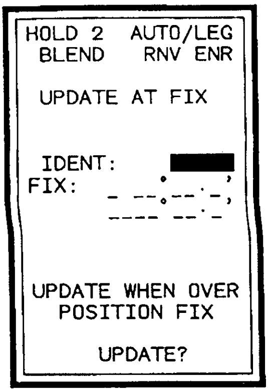


Figure 7-17

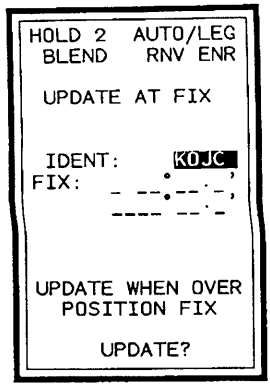


Figure 7-18

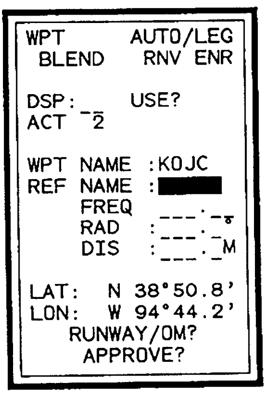


Figure 7-19

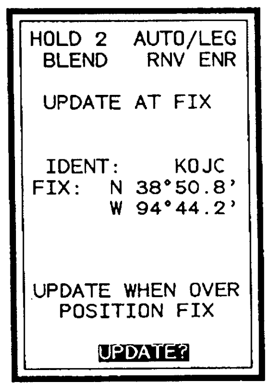


Figure 7-20

CREATING A PRESENT POSITION WAYPOINT

Present position waypoints may be created using the system HOLD 1 page which is described in Section IV.

1. Aircraft - POSITION over the geographic location where you desire to define a waypoint. (The KNS 660 system may be on any page except the HOLD 1 page.)

2. HLD key - PRESS once to display the HOLD 1 page when aircraft is in position. The POS field latitude and longitude data displayed is that which was captured at the moment the HLD key was pressed (Figure 7-21).

3. Waypoint Identifier - INPUT a unique identifier into the IDENT field (Figure 7-22). A unique identifier is one which is not used anywhere else in the system's memory. When the ENTER key is pressed a Waypoint page will be displayed (Figure 7-23). If desired, the cursor can be positioned over the REF NAME field and an identifier entered. The latitude and longitude displayed on the Waypoint page will be that which was captured in Step 2.

NOTE

THE IDENTIFIER ENTERED INTO THE IDENT FIELD IN STEP 3 MUST BE UNIQUE (I.E. NOT ALREADY IN SYSTEM MEMORY). IF THE IDENTIFIER ENTERED IS NOT UNIQUE (I.E. THE IDENTIFIER IS ALREADY CONTAINED IN SYSTEM MEMORY) THE FIX: AND DIF: FIELDS ON THE HOLD 1 PAGE WILL BE FILLED WITH DATA AND A WAYPOINT PAGE WILL NOT BE DISPLAYED. IT IS STILL POSSIBLE TO CREATE A PRESENT POSITION WAYPOINT BY REPOSITIONING THE CURSOR OVER THE WPT NAME: FIELD AND ENTERING A UNIQUE IDENTIFIER. ONLY IF A WAYPOINT PAGE IS DISPLAYED AFTER ENTERING AN IDENTIFIER ON THE HOLD 1 PAGE DO YOU KNOW THAT A UNIQUE IDENTIFIER HAS BEEN ENTERED.

4. ENTER key - PRESS to approve the Waypoint page. The HOLD 1 page will reappear (Figure 7-24). Disregard the flashing UPDATE? field. A waypoint has now been created at the position where the HLD key was pressed in Step 2 having the identifier entered in the IDENT field in Step 3.

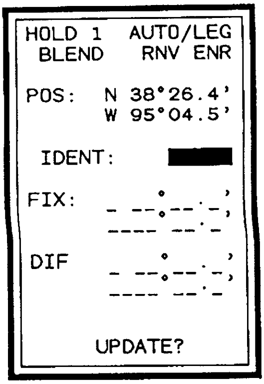


Figure 7-21

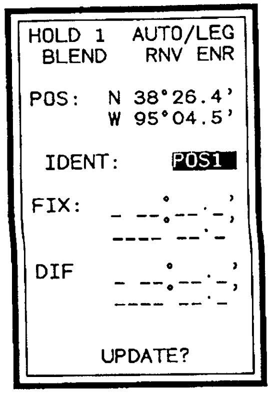


Figure 7-22

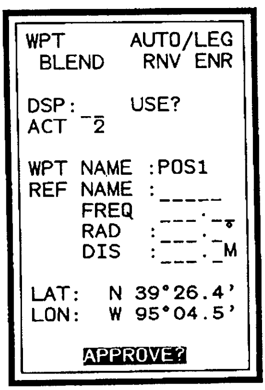


Figure 7-23

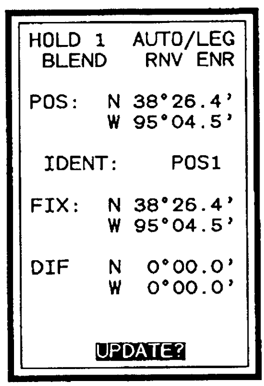


Figure 7-24

PARALLEL TRACK OPERATION

Selection of parallel track operation is possible on the NAV 2 page. Refer to Section IV for a complete NAV 2 page description.

The Parallel Track feature allows the pilot to translate his course up to 99.9 miles left or right of the parent course and fly a parallel track (Figure 7-25).

PARALLEL TRACK

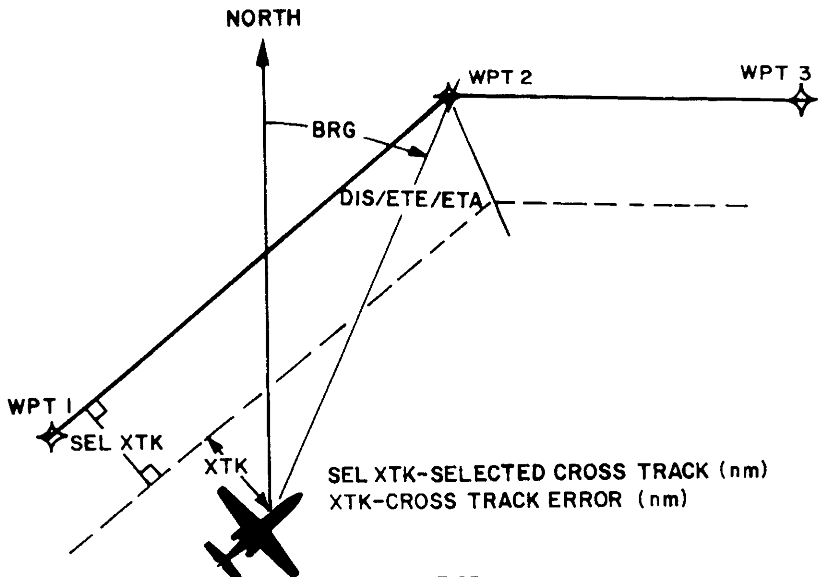


Figure 7-25

In Parallel Track operation the HSI or CDI D-Bar will provide guidance with respect to the selected parallel course. However, the bearing and the distance displayed will be to the parent waypoint. The Parallel Track feature can be used in OBS and AUTO/LEG Methods of Operation. When the system is in AUTO/LEG operation, normal waypoint alerting, turn anticipation, and waypoint sequencing will occur.

To Select Parallel Track Operation:

1. NAV key - PRESS as required to obtain NAV 2 page.
2. Cursor - POSITION over the XTK: data entry field under the SEL logo (Figure 7-26).
3. Data entry - KEY in L or R (located on 1 or 3 key, respectively) followed by the desired nautical mile offset up to 99.9 nm and PRESS the ENTER key (Figure 7-27).

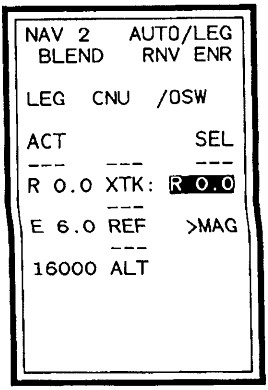


Figure 7-26

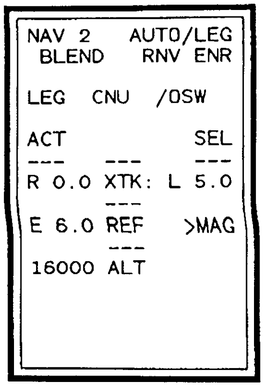


Figure 7-27

To Cancel Parallel Track Operation:

1. NAV key - PRESS as required to obtain NAV 2 page.
2. Cursor - POSITION over XTK: data entry field under SEL logo.
3. CLR key - PRESS.
4. ENTER key - PRESS.

An alternate method of canceling the selected parallel track is to actually select a parallel track of L or R 00.0 nautical miles.

NOTE

PARALLEL TRACK OPERATION IS CANCELLED WHENEVER POWER IS REMOVED FROM THE KNS 660 SYSTEM.

INERTIAL REFERENCE UNIT (IRU) SENSOR OPERATIONS

Operations associated with an IRU sensor are performed on the NAV 2 page and on the dedicated INS Status page. Refer to Section IV for the NAV 2 page description and for the INS Status page description.

When the KNS 660 system is configured with an IRU sensor, two operations unique to the IRU are possible in addition to the normal navigation functions. One, on the NAV 2 page you may select between true and magnetic heading references. For flight outside the area bounded by latitudes North 70° and South 60° the KNS 660 must contain a source of True heading (an IRU sensor) and True heading must be selected on the NAV 2 page. Two, on the dedicated INS Status page, a heading select function is available to reinitialize the IRU in flight as an attitude reference should the IRU experience a power loss after the ground initialization and alignment. The inflight reinitalization will not qualify the IRU as a usable navigation sensor; only as an attitude reference. The pilot should consult the pilot's guide associated with the IRU for further instruction unique to the IRU.

To Select True or Magnetic Heading Reference (Selectable only with IRU sensor installed)

1. NAV key - PRESS to select NAV 2 page.
2. Cursor - POSITION over MAG or TRUE field (Figure 7-28).
3. CLR key - PRESS to change heading reference (Figure 7-29).

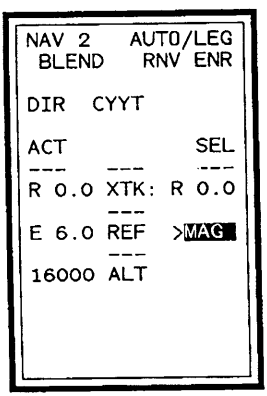


Figure 7-28

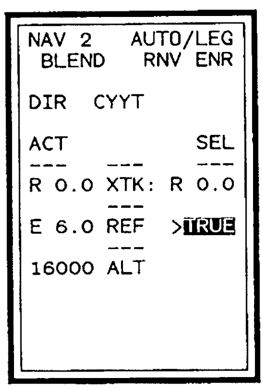


Figure 7-29

INERTIAL REFERENCE UNIT (IRU) SENSOR OPERATIONS (Cont'd)

To Reinitialize IRU Sensor in Flight (As an attitude reference only)

1. DAT key - PRESS to obtain DATA 1 Menu page.
2. INS menu item - SELECT to display the INS Status page (Figure 7-30).
3. IRU mode - SELECT the attitude mode on the IRU mode selector and check that ATT is annunciated on INS Status page. (Other modes are OFF, ALIGN and NAV.)
4. Cursor - POSITION over HDG SEL: data entry field.
5. Data entry - KEY in present magnetic heading and PRESS the ENTER key to reinitialize the IRU as a attitude reference (Figure 7-31).

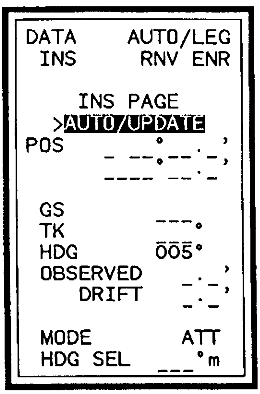


Figure 7-30

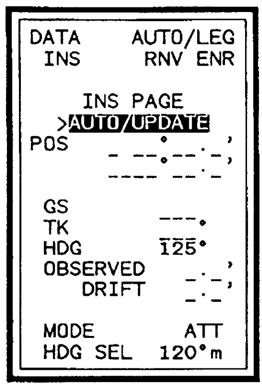


Figure 7-31

AUTOMATIC UPDATING OF THE IRU SENSOR

After one hour of flight time the Inertial Reference Unit's (IRU's) position is normally updated by the VOR/DME or GPS sensor when the KNS 660 system is configured with a compatible GPS sensor or VOR and DME (or TACAN) sensors which are providing Rho-Rho navigation. (Reference AUTO/LEG Method of Operation in Section II and VOR/DME status page in Section IV.) The KNS 660 system can also be configured with a DME sensor (without a VOR sensor) to provide Rho-Rho updating of the IRU sensor. The purpose of automatic updating is to improve the accuracy of the IRU sensor.

NOTE

THE KNS 660 SYSTEM WILL NOT BEGIN RHO-RHO UPDATING OF THE IRU SENSOR UNTIL THE SYSTEM FLIGHT TIME REACHES ONE HOUR.

The position shown on the INS Status page (Figures 7-32 and 7-33) is always the position from the IRU sensor without Rho-Rho updating. If the IRU is being Rho-Rho updated, the updated IRU position is displayed on the Position Summary page (reference Section IV).

It is possible to manually deselect the automatic Rho-Rho updating of the IRU sensor from the INS Status page. The INS Status page is accessible through the DATA 1 Menu page.

1. DAT key - PRESS to obtain DATA 1 Menu page.

2. INS menu item - SELECT to obtain the INS status page.

3. Cursor - POSITION over the AUTO/UPDATE cyclic field (Figure 7-32).

NOTE

THE AUTO/UPDATE FIELD DOES NOT NECESSARILY INDICATE THAT AUTOMATIC UPDATING IS ACTUALLY OCCURING; ONLY THAT THE SYSTEM WILL ALLOW AUTOMATIC UPDATING WHEN THE VOR/DME SENSORS (OR TACAN) ARE PROVIDING RHO-RHO NAVIGATION AND THE FLIGHT TIME IS OVER ONE HOUR. THE PRESENCE OF RHO-RHO NAVIGATION IS DETERMINED ON THE VOR/DME (OR TACAN) STATUS PAGE.

AUTOMATIC UPDATING OFTHE IRU SENSOR (Cont'd)

4. CLR key - PRESS. Note the annunciation change to NO AUTO/UPDATE (Figure 7-33).

   When the IRU has been in the AUTO/UPDATE mode and the pilot selects (NO AUTO/UPDATE the update correction is removed <u>and is irretrievable</u>. The KNS 660 now begins using the raw uncorrected IRU position.

To reselect AUTO/UPDATE:

1. Cursor - Position over the NO AUTO/UPDATE cyclic field.

2. CLR key - PRESS. The annunciation will change to AUTO/UPDATE.

NOTE

THE KNS 660 SYSTEM WILL ALWAYS REVERT THE IRU SENSOR BACK TO THE AUTOMATIC UPDATE MODE WHEN SYSTEM POWER IS CYCLED.

```
DATA       AUTO/LEG
 INS        RNV  ENR

    INS PAGE
>NO AUTO/UPDATE
POS     N 38°49.9'
        W 94°53.4'

 GS         405
 TK         275°
 HDG        271°
 OBSERVED     4.1'
    DRIFT     5.3'

 MODE          NAV
 HDG SEL        °m
```

Figure 7-32

```
DATA       AUTO/LEG
 INS        RNV  ENR

    INS PAGE
  >AUTO/UPDATE
POS     N 38°49.9'
        W 94°53.4'

 GS         405
 TK         275°
 HDG        271°
 OBSERVED     4.1'
    DRIFT     5.3'

 MODE          NAV
 HDG SEL        °m
```

Figure 7-33

REVIEWING THE DATA BASE DEFINITION OF A NAVAID

The information for a navaid (VOR/DME, VORTAC, VOR, DME, ILS/DME, or TACAN) contained in the main or supplemental Data Base can be displayed on the Navaid page for easy review. The Navaid page is described in Section IV and is accessible through the DATA 2 Menu page.

1. DAT key - PRESS as required to obtain DATA 2 Menu page. (Figure 7-34).
2. NAVAID PAGE menu item - SELECT to display a blank Navaid page (Figure 7-35).
3. Desired Data Base navaid identifier - INPUT into the STA IDENT field and PRESS the ENTER key (Figure 7-36). REVIEW data.

```
DATA 2      OBS:248
 VOR        RNV APR

SEL MENU ITEM:█

 1 NAVAID PAGE
 2 AIRPORT PAGE
 3 DATE/TIME
 4 CDU DATA XFR
 5 UPDATE D/BASE
 6 UPDATE FP/WPT
 7 UNUSED WPTS
 8 USER NAVAIDS
 9 USER AIRPORTS
```

Figure 7-34

```
DATA        OBS:248
 VOR        RNV APR

  NAVAID PAGE

STA IDENT:    █████

FREQ:        ___.__
TYPE>       _______
CLASS>     _______
ELEV:       _____FT
MAG VAR:    _ __._°

LAT:    _ __°__._'
LON:    ____°__._'
```

Figure 7-35

```
DATA        OBS:248
 VOR        RNV APR

  NAVAID PAGE

STA IDENT:   JAX

FREQ:        114.50
TYPE>        VORTAC
CLASS>         HIGH
ELEV:          40FT
MAG VAR: W     3.0°

LAT:  N 30°20.3'
LON:  W 81°30.6'
```

Figure 7-36

REVIEWING THE DATA BASE DEFINITION OF AN AIRPORT

The information contained in the main or supplemental Data Base for an airport can be displayed on the Airport page for easy review. The Airport page is described in Section IV and is accessible through the DATA 2 Menu page.

1. DAT key - PRESS as required to obtain DATA 2 Menu page.

2. AIRPORT PAGE menu item - SELECT to display a blank Airport page (Figure 7-37).

3. Desired Data Base ICAO airport identifier - INPUT into the ICAO AIRPORT IDENTIFIER field and PRESS the ENTER key (Figure 7-38). REVIEW data.

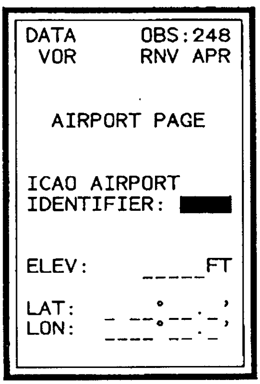


Figure 7-37

Figure 7-38

DISPLAYING DATE, GMT, DEPARTURE TIME, AND FLIGHT TIME

A separate page is provided, dedicated to displaying the current Greenwich date, Greenwich Mean Time (GMT), departure time, and the computed flight time. This page is for information only and there are no alterable data fields on the page.

The Date/Time page is defined in Section IV. The Date/Time page is accessible through the DATA 2 Menu page.

1. DAT key - PRESS to obtain the DATA 2 Menu page.

2. DATE/TIME menu item - SELECT to display the Date/Time page (Figure 7-39).

```
DATA          OBS:248
 VOR          RNV APR

     DATE/TIME

DATE     07 SEP 83

GMT          21:02

DEP TIME     18:00

FLT TIME      3:02
```

Figure 7-39

DISPLAYING REFERENCE NAVAID "FREQUENCIES" VS. TACAN "CHANNELS"

When the KNS 660 system is equipped with the optional TACAN sensor, the operator may choose to display TACAN channel numbers vs. navaid frequencies on the Waypoint page. This choice is made through a cyclic field presentation which is alterable between FREQ> and CHNL> fields using the cursor and the CLR key.

Note that this choice is retained indefinitely through system power down and is alterable only at the operator's direct request through the above process. Note also that the Navaid page presentation of frequencies vs. channels (reference Section IV) will follow in like manner and is a function of the choice made on the Waypoint page.

The Waypoint page is described in Section IV and is accessible through the dedicated WPT key.

DEAD RECKONING

Dead reckoning (DR) refers to the KNS 660's ability to continue to provide navigation capabilities without sensor position inputs. The KNS 660 uses DR as a reversionary status to temporarily allow it to navigate until actual sensor position inputs once again become available. The KNS 660 will provide DR for a limited time whenever the selected sensor (VOR, OMEGA, TACAN, LORAN, GPS, or BLEND) no longer has adequate signals with which to furnish the system valid (unflagged) inputs. If the selected sensor is BLEND, the KNS 660 will not go into DR as long as it is receiving at least one valid VOR, OMEGA, IRU, LORAN, or TACAN sensor position input.

While dead reckoning, the KNS 660 calculates the aircraft's present position from the system's best estimate of ground speed and ground track data. These estimates depend on which "rate aiding" inputs are available to the system. Rate aiding inputs include the standard heading input and the optional True Air Speed (TAS) sensor input to the KNS 660 system. If the KNS 660 system is configured with an IRU, then the IRU provides all rate aiding inputs to the system. Therefore, the KNS 660 can DR (1) utilizing aircraft heading and last computed ground speed (when there is no TAS sensor input), (2) utilizing aircraft heading and True Air Speed (with TAS sensor input) or (3) utilizing the IRU's computed ground speed and ground track output directly.

The amount of time that the KNS 660 will DR is dependent upon four things: (1) the KNS 660 Mode (RNV ENR, RNV APR, or NAV), (2) which rate aiding inputs (heading, true airspeed, inertial sensor) are available, (3) the KNS 660's internal determination of the accuracy of the last valid position sensor prior to DR, and (4) the amount of aircraft maneuvering while the system is dead reckoning. The system will DR substantially longer with the KNS 660 in the RNAV ENR mode than with the KNS 660 in the RNV APR mode. The system will not provide DR in the NAV mode.

The better the rate aiding inputs to the KNS 660 the longer DR can be provided. It will DR longer with both heading and TAS than with just heading. When the system uses an IRU to provide rate aiding inputs it will DR significantly longer than with separate heading and TAS inputs.

The system will provide DR capability for a longer period of time if the last position sensor to provide valid position data prior to DR was VOR/DME rather than OMEGA/VLF. If the VOR/DME sensors were in a rho-rho mode prior to DR the system will DR longer than if they were providing rho-theta operation. In a KNS 660 system utilizing an OMEGA sensor, dead reckoning would be provided for a longer period of time if the OMEGA sensor had been recently rho-rho updated than if the OMEGA sensor had not been recently updated.

DEAD RECKONING (Cont'd)

Depending on the rate aiding inputs used by the KNS 660, changes in altitude and changes in heading will substantially reduce the DR time. Since there is a complex interrelationship among the four variables which affect DR time, it is difficult to predict exactly how long the KNS 660 will be able to provide dead reckoning capability. The three charts below are intended to give you a feel for the magnitude of the range of times DR will be provided.

A message stating SYSTEM DR MODE will appear whenever the system begins dead reckoning. In addition the remote DR annunciator will be illuminated.

KNS 660 SYSTEM WITH HEADING INPUT ONLY (NO TAS OR IRU)			
Aircraft maneuvering which affects DR time	Approximate range of DR times per KNS 660 mode (max. rate of alt. change 4000 ft/min & rate of hdg. change 3°/sec)		
	RVN ENR	RNV APR	NAV
Changes in altitude and changes in heading	1-9 min	0	0

KNS 660 SYSTEM WITH HEADING AND TAS INPUTS (NO IRU)			
Aircraft maneuvering which affects DR time	Approximate range of DR times per KNS 660 mode (max. rate of alt. change 4000 ft/min)		
	RVN ENR	RNV APR	NAV
Changes in altitude	3-12 min.	0	0

KNS 660 SYSTEM WITH IRU			
Aircraft maneuvering which affects DR time	Approximate range of DR times per KNS 660 mode		
	RVN ENR	RNV APR	NAV
None	2.5 - 3.0 Hr.	0	0

ADDITIONAL OMEGA/VLF SENSOR OPERATIONS

When a KNS 660 system includes the OMEGA/VLF sensor option, the pilot should be familiar with the following operations.

MANUALLY DESELECTING OMEGA AND VLF STATIONS

Deselection and reselection of OMEGA and VLF stations by the system occur automatically and are controlled by the system's internal OMEGA signal propagation model. Automatic deselection may occur if a station is too far away, too close, or perhaps due to known poor signal quality in particular areas of the world.

Although seldom required, if a need exists for the pilot to manually deselect a station, this capability is provided on the OMEGA/VLF Status page.

The OMEGA/VLF Status page is completely described in Section IV. The OMEGA/VLF Status page is accessible through the DATA 1 Menu page.

1. DAT key - PRESS to obtain DATA 1 Menu page.
2. OMEGA menu item - SELECT to obtain the OMEGA/VLF Status page.
3. Cursor - POSITION over the space immediately to the right of the three letter station identifier chosen for deselection (Figure 7-40).
4. Minus (9/−) key - PRESS and then PRESS the ENTER key (Figure 7-41). Note the presence of the minus sign signifying manual deselection, and the presence of an asterisk immediately to the right of the signal quality factor signifying deselection (manual or automatic).

To reverse the process:

5. Cursor - POSITION over the minus sign (Figure 7-42).
6. Plus (0/+) key - PRESS and then PRESS the ENTER key (Figure 7-43).

```
DATA       AUTO/LEG
 OMEGA      RNV ENR

  OMEGA STATUS
>AUTO/UPDATE
 SYNC        NAV
   OMEGA/VLF
 OMEGA        VLF
NOR 32     NOR 42
LIB█38     GBR 44
HAW 98     HAW 86
NDK 99     WAS 93
LRN 26*    MAR 96
ARG 42     MAI 98
AUS 64     AUS-51*
JPN 39     JPN 47
```

Figure 7-40

```
DATA       AUTO/LEG
 OMEGA      RNV ENR

  OMEGA STATUS
>AUTO/UPDATE
 SYNC        NAV
   OMEGA/VLF
 OMEGA        VLF
NOR 32     NOR 42
LIB-38*    GBR█44
HAW 98     HAW 86
NDK 99     WAS 93
LRN 26*    MAR 96
ARG 42     MAI 98
AUS 64     AUS-51*
JPN 39     JPN 47
```

Figure 7-41

```
DATA       AUTO/LEG
 OMEGA      RNV ENR

  OMEGA STATUS
>AUTO/UPDATE
 SYNC        NAV
   OMEGA/VLF
 OMEGA        VLF
NOR 32     NOR 42
LIB█38*    GBR 44
HAW 98     HAW 86
NDK 99     WAS 93
LRN 26*    MAR 96
ARG 42     MAI 98
AUS 64     AUS-51*
JPN 39     JPN 47
```

Figure 7-42

```
DATA       AUTO/LEG
 OMEGA      RNV ENR

  OMEGA STATUS
>AUTO/UPDATE
 SYNC        NAV
   OMEGA/VLF
 OMEGA        VLF
NOR 32     NOR 42
LIB 38     GBR█44
HAW 98     HAW 86
NDK 99     WAS 93
LRN 26*    MAR 96
ARG 42     MAI 98
AUS 64     AUS-51*
JPN 39     JPN 47
```

Figure 7-43

AUTOMATIC UPDATING OF THE OMEGA/VLF SENSOR

The OMEGA/VLF sensor position is normally updated by the VOR/DME sensor position whenever the KNS 660 system is configured with compatible VOR and DME (or TACAN) sensors which are providing Rho-Rho navigation. (Reference AUTO/LEG Method of Operation in Section II and VOR/DME Status page in Section IV). The KNS 660 system can also be configured with a DME sensor (without a VOR sensor) to provide Rho-Rho updating of the OMEGA/VLF sensor. Whenever Rho-Rho navigation is not being provided the OMEGA/VLF sensor position is not updated and provides pure OMEGA/VLF position data to the system. The purpose of automatic updating is to improve the accuracy of OMEGA/VLF navigation, although the OMEGA/VLF sensor meets or exceeds the required accuracy limits when it is not being updated.

ORS 06 level KNS 660 systems which include a compatable GPS sensor and OMEGA/VLF sensor will use GPS position data to update the OMEGA position. If both GPS and Rho-Rho data are available, the most accurate data available (normally GPS) will be used to update the OMEGA/VLF sensor.

It is possible to manually deselect the automatic Rho-Rho updating of the OMEGA/VLF from the OMEGA Status page. Reasons for deselecting the automatic updating may include the ability to check pure OMEGA/VLF performance over know terrain prior to a trip where automatic updating would not be possible (over water, etc.). The OMEGA Status page is described in Section IV and is accessible through the DATA 1 Menu page.

1. DAT key - PRESS to obtain DATA 1 Menu page.

2. OMEGA Menu Item - SELECT to obtain the OMEGA/VLF Status page.

3. Cursor - POSITION over the AUTO/UPDATE cyclic field (Figure 7-44).

NOTE

THE AUTO/UPDATE FIELD DOES NOT NECESSARILY INDICATE THAT AUTOMATIC UPDATING IS ACTUALLY OCCURING; ONLY THAT THE SYSTEM WILL ALLOW AUTOMATIC UPDATING WHEN THE VOR/DME SENSORS ARE PROVIDING RHO-RHO NAVIGATION. THE PRESENCE OF RHO-RHO NAVIGATION IS DETERMINED ON THE VOR/DME STATUS PAGE.

4. CLR key - PRESS. Note the annunciator change to NO AUTO/UPDATE (Figure 7-45).

   To reverse the process:

5. Cursor - POSITION over the NO AUTO/UPDATE cyclic field.

6. CLR key - PRESS. The annunciation will change to AUTO/UPDATE.

NOTE

THE KNS 660 SYSTEM WILL ALWAYS REVERT BACK TO THE AUTOMATIC UPDATE MODE WHEN SYSTEM POWER IS CYCLED.

```
DATA          AUTO/LEG
 OMEGA         RNV  ENR

   OMEGA  STATUS
>AUTO/UPDATE
 SYNC          NAV
     OMEGA/VLF
 OMEGA          VLF
NOR  32       NOR  42
LIB  38       GBR  44
HAW  98       HAW  86
NDK  99       WAS  93
LRN  26*      MAR  96
ARG  42       MAI  98
AUS  64       AUS-51*
JPN  39       JPN  47
```

Figure 7-44

```
DATA          AUTO/LEG
 OMEGA         RNV  ENR

   OMEGA  STATUS
>NO AUTO/UPDATE
 SYNC          NAV
     OMEGA/VLF
 OMEGA          VLF
NOR  32       NOR  42
LIB  38       GBR  44
HAW  98       HAW  86
NDK  99       WAS  93
LRN  26*      MAR  96
ARG  42       MAI  98
AUS  64       AUS-51*
JPN  39       JPN  47
```

Figure 7-45

RELANING THE OMEGA

Under certain rare conditions it is possible for the OMEGA/VLF system to detect an uncertainty in its calculated position. Under these specific conditions the system will illuminate the message light and give the pilot a message stating:

OMEGA RE-LANING
SEL OMG DATA PAG

The system at this point is telling the pilot to select the OMEGA Re-lane page and make a choice between two alternative latitude and longitude coordinate positions, both of which are possible in so far as the OMEGA/VLF Sensor is concerned.

1. DAT key - PRESS to obtain the DATA 1 Menu page.
2. OMEGA menu item - SELECT to obtain the OMEGA/VLF Status page (Figure 7-46). Note the presence of the RE-LANE? interrogative field instead of the AUTO UPDATE or NO AUTO UPDATE fields which are normally displayed in this position. (Reference OMEGA/VLF Status page in Section IV).
3. Cursor - POSITION over the RE-LANE? interrogative field and PRESS the ENTER key to obtain the OMEGA Re-lane page (Figure 7-47).

   The OMEGA Re-lane page will display a CURRENT POS? which is the normal OMEGA/VLF derived position coordinates of the aircraft's position. The OMEGA Re-lane page will also display a RE-LANE POS? which is an alternatively derived aircraft position based solely on the received OMEGA stations. The pilot should determine which of the two positions is correct by comparison with other KNS 660 sensor solutions, other navigation equipment on board the aircraft, or by visual reference to known positions on the ground.
4. Cursor - POSITION over the CURRENT POS? field or the RE-LANE POS? field and PRESS the ENTER key to select the correct position data.

```
DATA      AUTO/LEG
 OMEGA     RNV  ENR

  OMEGA  STATUS
    RE-LANE?
 SYNC          NAV
    OMEGA/VLF
 OMEGA         VLF
NOR  32     NOR  42
LIB  38     GBR  44
HAW  98     HAW  86
NDK  99     WAS  93
LRN  26*    MAR  96
ARG  42     MAI  98
AUS  64     AUS-51*
JPN  39     JPN  47
```

Figure 7-46

```
DATA      AUTO/LEG
 OMEGA     RNV  ENR

 RE-LANE  OMEGA
 SELECT  ON  POS

  CURRENT  POS?
     N  38°49.9'
     W  94°53.4'

  RE-LANE  POS?
     N  38°57.0'
     W  94°53.4'
```

Figure 7-47

OMEGA RESTART AFTER POWER INTERRUPTION FOR MORE THAN 7 SECONDS BUT LESS THAN 7 MINUTES

The OMEGA Restart Initialization page (Figure 7-48) is described in Section IV. The OMEGA Restart Initialization page will appear automatically as a substitute for the normal Initialization page during a KNS 660 start up after a power loss to the KNS 660 of at least seven seconds but less than seven minutes (BLEND or OMEGA sensor selected).

KNS 660 system restart after the above described temporary power loss will begin with the normal Self Test page followed by the OMEGA Restart page instead of the normal Initialization page. This page utilizes the systems dead reckoning capability to estimate a new present position upon system re-energization. It is up to the pilot to review this estimated position for accuracy, approve it, or in the data fields provided on either the HOLD 1 or HOLD 2 pages, enter in the correct position.

```
INIT       AUTO/LEG
 OMEGA      RNV ENR

 OMEGA RESTART

LAST GMT     15:17
LAST KNOWN PRES
POS:   N 38°49.9'
       W 94°53.4'

GMT:         15:22
ESTIMATED PRES
POS:   N 38°09.6'
       W 94°57.8'

      APPROVE?
```

Figure 7-48

CHANGES TO NAVY CONTROLLED VLF STATIONS

A significant time and money savings benefit to the KNS 660 operator is the fact that any changes to the Navy controlled chain of VLF stations (i.e. station deletions or additions, frequency changes, etc.) will automatically be accounted for in the routine diskette updating of the Data Base. If however the Data Base and its subscription update service are not being utilized, the operator can still accomplish the necessary updating by taking the system to an authorized service center. The service center can accomplish the necessary updating without any additional parts and without having to remove equipment from the aircraft.

LORAN SENSOR OPERATIONS

General Capabilities

ORS 05 level KNS 660 system are compatible with the ANI/ONI 7000 LORAN Navigational Sensor in two configurations.

For operators desiring only a LORAN sensor input for RNAV Enroute navigation with the KNS 660 system; the ANI/ONI 7000 Control Display Unit is not required. This configuration provides for the KNS 660 system to apply power to the LORAN sensor, and supply it with an initial position. The KNS 660 will use position data from the LORAN sensor. The KNS 660 Control Display Unit can be utilized to view the LORAN chains and stations being used and monitor the status of the LORAN sensor. This configuration also provides the ability to select/deselect LORAN stations and perform dedicated triad mode of operation through the KNS 660 system. This configuration does not provide LORAN APPROACH capability.

The second configuration of KNS 660 system with ANI/ONI 7000 Navigational Sensor requires both the ANI/ONI 7000 LORAN sensor and appropriate ANI/ONI 7000 Control Display Unit. This system configuration provides for the KNS 660 system to supply the LORAN system with an initial position. The KNS 660 system will use position data from the LORAN. The KNS 660 Control Display Unit can be utilized to view the LORAN chains and stations being used and to monitor status of the LORAN system. The ANI/ONI 7000 Control Display Unit is utilized to select/deselect LORAN stations and perform dedicated triad mode of operation. This configuration does provide LORAN approach mode capability.

The following procedures should be utilized in conjunction with the appropriate ANI/ONI 7000 operating information and the aircraft's flight manual supplement.

Manual Selection/Deselection of LORAN Stations

As previously described in Section IV, the LORAN STATUS PAGE may be used to view the LORAN chains and stations in use by the LORAN sensor. By placing the cursor over the VIEW CHAIN ? field (refer to Figure 7-49) and pressing the ENTER key, the VIEW CHAIN page will be displayed. Refer to Section IV for a general description of this page. This page is used to accomplish manual station selection/deselection in systems not containing a LORAN control display unit. LORAN station selection/deselection is accomplished with the ANI/ONI 7000 control display unit when one is included in the system. Refer to Figure 7-50 for the following discussion. First select the GRI or chain in which the station selection/deselection is desired. This may be accomplished by placing the cursor over the GRI: 8990 field, using the keyboard to enter the appropriate GRI and then pressing the ENTER key.

Manual Selection/Deselection of LORAN Stations (Cont'd)

Alternatively, place the cursor over the >N. SAUDI ARABIA field and press the CLR key repeatedly until the name (and corresponding GRI) of the desired chain is displayed. Once the desired GRI has been selected, all available stations within the chain will be displayed. To deselect a particular station, move the cursor up or down the screen until it is immediately to the left of the station to be deselected. See Figure 7-51. Press the 9/— key; a hyphen should appear in the cursor field. To complete the deselection, press the ENTER key. To reverse a manually deselected station, place the cursor over the hyphen immediately to the left of the manually deselected station. Press the 0/+ key followed by the ENTER key. The hyphen should disappear, indicating cancelation of the manual station deselection.

Choosing AUTO or TRIAD Mode

Those systems including an ANI/ONI 7000 control display unit accomplish automatic chain selection (AUTO) or dedicated triad (TRIAD) mode selection with the LORAN control display unit. The following procedure only applies to those systems not containing a LORAN control display unit. Upon each system power up, the AUTO mode will be used for LORAN chain selection. To select TRIAD mode, view the LORAN STATUS page as previously described. Move the cursor over the TRIAD SELECT? field as shown in Figure 7-52. Press the ENTER key to display the TRIAD SELECT page. Refer to Section IV for a description of the information included on the TRIAD SELECT page. Referring to Figure 7-53, move the cursor over the >AUTO field, and press the CLR key. This field will now display >TRIAD, and will flash until a specific dedicated triad is selected (through the KNS 660 system) and then subsequently acquired by the LORAN. To select a specific dedicated triad, move the cursor over the SEL TRIAD: 1 field, use the keyboard to select the appropriate stored dedicated triad by entering a number from 1 to 5, and pressing the ENTER key. An alternative dedicated triad procedure is outlined in the next section. To cancel dedicated triad mode, locate the cursor over the >TRIAD field and press the CLR key. This field will now display >AUTO indicating the LORAN sensor is now operating in its automatic chain selection mode.

Defining a Dedicated Triad

This procedure only applies to those systems not containing a LORAN control display unit. The TRIAD SELECT PAGE, Figure 7-54 can be used to define a dedicated triad. Locate the cursor over either the GRI: 9990 field or >NORTH PACIFIC field to select the desired chain in the same manner as described earlier in the manual station selection/deselection discussion. All stations included in the specific chain are shown alongside the GRI: ___ field (M,X,Y, and Z in this example). After the desired GRI or chain has been selected, press the ENTER key, or the [↓] cursor key. The cursor will move to the location shown in Figure 7-54. Use the keyboard to enter the two desired secondary stations to complete the desired dedicated triad. Note that the master station (M) is automatically selected.

```
DATA      AUTO/LEG
LORAN     RNV  ENR

 LORAN STATUS
AUTO  0105 NAV
EPE____._ NM

TRIAD SELECT?
 VIEW CHAIN?


GRI          STNS
9980         MVWXYZ
```

Figure 7-49

```
DATA      AUTO/LEG
 LORAN     RNV  ENR

  LORAN CHAIN
 AUTO           NAV
GRI:8990
>N.SUDIA ARABIA

STN

 M
 V
 W*
 X*
 Y*
 Z
```

Figure 7-50

```
DATA      AUTO/LEG
 LORAN     RNV  ENR

  LORAN CHAIN
 AUTO           NAV
GRI:8990
>N.SUDIA ARABIA

STN

 M
 V
 W*
 X*
 Y*
 Z
```

Figure 7-51

```
DATA      AUTO/LEG
LORAN     RNV  ENR

  LORAN STATUS
 AUTO  0105 NAV
 EPE____._ NM

 TRIAD SELECT?
  VIEW CHAIN?


 GRI         STNS
 9980        MVWXYZ
```

Figure 7-52

```
DATA      AUTO/LEG
 LORAN     RNV  ENR

  TRIAD SELECT
> AUTO          NAV
SEL TRIAD:
GRI:
>
STA:M

  GRI     STA
1:       :M
2:       :M
3:       :M
4:       :M
5:       :M
```

Figure 7-53

Storing Dedicated Triads

This procedure is only applicable to systems not containing a LORAN control display unit. While viewing the TRIAD SELECT PAGE, move the cursor to the location shown in Figure 7-55. Use the keyboard to enter the desired GRI and press the ENTER key. The cursor will move to the location shown in Figure 7-56 where the keyboard may be used to select the two desired secondary stations (V,W,X,Y, or Z). Pressing the ENTER key complete the storing of this dedicated triad in the KNS 660 non volatile memory. Four additional triads may be stored in an identical fashion.

LORAN APPROACH PROCEDURE

In order to provide LORAN APPROACH capability, the appropriate ANI/ONI 7000 control display unit must be included in the system.

To perform a LORAN approach, use the SENSOR key to select LORAN sensor. Select either AUTO/LEG or OBS Method of Operation. Consult the operating instructions in the ANI/ONI 7000 Operation Manual for approach procedures. Note that the KNS 660 Mode of Operation (RVN ENR or RVN APR) will track the mode selected by the LORAN control display unit.

```
DATA      AUTO/LEG
 LORAN    RNV ENR

  TRIAD SELECT
> TRIAD        NAV
SEL TRIAD:
GRI:9990    MXYZ
>NORTH PACIFIC
STA:M

  GRI    STA
1:       :M
2:       :M
3:       :M
4:       :M
5:       :M
```

Figure 7-54

```
DATA      AUTO/LEG
 LORAN    RNV ENR

  TRIAD SELECT
> TRIAD        NAV
SEL TRIAD:
GRI:
>
STA:M

  GRI    STA
1:       :M
2:       :M
3:       :M
4:       :M
5:       :M
```

Figure 7-55

```
DATA      AUTO/LEG
 LORAN    RNV ENR

  TRIAD SELECT
> TRIAD        NAV
SEL TRIAD:
GRI:
>
STA:M

  GRI    STA
1:       :M
2:       :M
3:       :M
4:       :M
5:       :M
```

Figure 7-56

GPS SENSOR OPERATIONS

General Capabilities

ORS 06 level KNS 660 systems are compatible with BENDIX/KING NAVSTAR Global Positioning System sensors such as the KLN 670 Remote Mount GPS Sensor. The GPS sensor provides present position latitude and longitude, time of day, and "psuedo-altitude" information to the KNS 660 System. The KNS 660 will utilize GPS position information as sensor inputs as described in Section V. Additionally, GPS position data can be used to update the OMEGA position through the AUTO UPDATE feature as described earlier in this section. The "psuedo altitude" information will only be utilized by the KNS 660 as a back up source of altitude data for noncritical calculations.

A GPS Integrity Monitor in the KNS 660 compares GPS position data to position data from other available sensors.

Restarting the GPS Sensor

Operation of the GPS sensor is basically automatic. When the KNS 660 initialization is accomplished via either of the Initialization Procedures outlined in Section V, the GPS sensor is automatically initialized. Whenever the GPS sensor is in either the INIT, STS, ACQ, TRN, FAIL CPU, FAIL MEM, or FAIL REC states as displayed on the GPS STATUS PAGE the RESTART? field will be displayed (Refer to Section IV for description of the GPS STATUS PAGE). Placing the cursor over this field as shown in Figure 7-57 and pressing the ENTER key will cause the GPS RESTART page to be displayed. The GPS RESTART PAGE is described in Section IV and shown again in Figure 7-58. This page is very similar to the INITIALIZATION PAGE described in Section IV. The current date, GMT, WPT ID and present position information known to the KNS 660 will be displayed. If incorrect, this data may be updated via the same procedures used for the INITIALIZATION PAGE (Refer to Section V). To complete the GPS RESTART page, the RESTART MODE must be selected.

Place the cursor over the >MODE NORMAL field and press the CLR key until the appropriate RESTART mode is displayed this field. To determine the proper RESTART mode consult the following table.

DETERMINING PROPER GPS RESTART MODE			
RESTART MODE	GREENWICH MEAN TIME	POSITION	GROUND SPEED
NORMAL	KNOWN WITHIN 5 MIN	KNOWN WITHIN 30NM	KNOWN WITHIN 20KTS
COLD	KNOWN WITHIN 30 MIN	KNOWN WITHIN 1000NM	KNOWN WITHIN 200KTS
SEARCH SKY	NOT KNOWN WITHIN 30 MIN	NOT KNOWN WITHIN 1000NM	NOT KNOWN WITHIN 200KTS

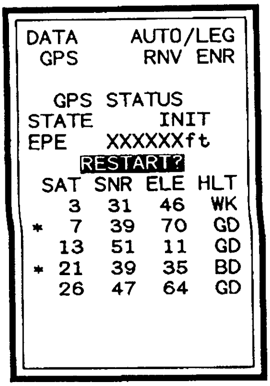


Figure 7-57

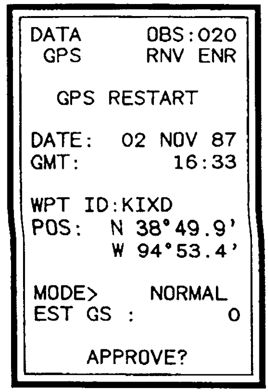


Figure 7-58

Select the NORMAL mode if time, position, and ground speed are known with in the limits shown in the table on page 7-35. If time is known within 5 minutes, groundspeed within 20kts but position is not known within 30nm, the COLD RESTART should be selected.

Once the appropriate RESTART MODE is selected and Estimated Groundspeed [EST GS:] entered, the cursor will appear over the APPROVE? field. Press the ENTER key to initiate the GPS RESTART. The GPS sensor will require approximately 3 minutes to accomplish a NORMAL RESTART, 4 minutes for a COLD RESTART, and 19 minutes for a SEARCH SKY RESTART. No position data is provided by the GPS sensor until it enters NAV or NAV DAT states. As a result of a RESTART request, the GPS sensor will revert to the ACQ state.

If SEARCH SKY is selected and approved, the APPROVE? field will be changed to SEARCH SKY? Press the ENTER key again to initiate the SEARCH SKY restart.

Once any parameter (date, time, position, or groundspeed) has been manually changed on the GPS RESTART page, the GPS sensor must be restarted. Failure to initiate and approve a GPS RESTART will cause the system to remain on the GPS RESTART page.

GPS INTEGRITY MONITOR

Whenever the GPS sensor is in NAV, NAV DAT, or WARN state, the position data furnished by the GPS sensor will be compared with position data from other independent KNS 660 system sensors such as VOR/DME, TACAN, or OMEGA/VLF. Should the position data furnished by the GPS sensor differ beyond certain limits from position data furnished by other KNS 660 system sensors, a message, GPS MONITOR WARN, will be displayed on the MESSAGE PAGE. As long as the GPS MONITOR WARN condition exists, GPS sensor position data will not be used in the BLEND position computation, selection of GPS sensor will by inhibited, and GPS position data will not by used to update INS or OMEGA/VLF sensors. If the GPS sensor was selected when the GPS MONITOR WARN message appears, the KNS 660 system position will become invalid (NAV FLAG in view) until either another sensor is selected or the GPS MONITOR WARN condition no longer exists. When GPS position data again agrees with other position data, the message, GPS NAV READY, will be displayed. Now GPS data will be used in the BLEND position, selection GPS SENSOR will be possible, and GPS data will be available for auto updating OMEGA/VLF and INS sensors.

If appropriate independent sensor inputs are not available to compare GPS position data, the message, GPS MONITOR OFF, will be displayed until such time as adequate independent sensor position data is available. During this time, position data may well be available from the GPS sensor. It is possible for the GPS sensor to be selected when the GPS MONITOR OFF message is displayed. It is recommended that the GPS sensor not be used for IFR navigation when the GPS MONITOR OFF message appears.

NORMAL OPERATION LEVEL III

GPS SENSOR STATES

As described in Section IV, the GPS STATUS page displays one of ten states depending on the signals received by the sensor and the condition of the sensor itself. A more complete description of the various GPS SENSOR STATES is given below.

INIT (Initialization) - The GPS sensor is in the process of initializing itself, collecting information from the KNS 660 system such as present position, date, and GMT. Following the collection of KNS 660 data, the GPS sensor collects data from its own memory to determine which satellites should be visible.

ACQ (acquisition) - After completing the INIT process the sensor begins the ACQ process. During this time, the visible satellites are being acquired and data from them is obtained.

TRN (transition) - This state indicates an adequate number of satellites for navigation have been acquired and are being tracked but no position data can be produced yet. A minimum of three satellites plus altitude data input to the GPS sensor is required for navigation.

NAV - The sensor is providing valid position data.

NAV DATA - The sensor is providing valid position data and additional satellites are being tracked by the sensor. In addition to providing position data, ephemeris and almanac data is collected and stored in the GPS sensor's memory.

WARN - The GPS sensor is providing degraded position data.

STS (Search the Sky) - The GPS sensor is in the process of searching for any satellites which may be visible, where in the ACQ state the sensor is searching for specific satellites. Significantly more time is required to accomplish STS than to accomplish the ACQ. The STS state will be encountered whenever the GPS sensor has not been used for a long enough period of time that all of its stored almanac data is out of date. The almanac data is valid for twenty four weeks from the last revision.

FAIL CPU
FAIL MEM
FAIL REC - These three states indicate the built in test of the GPS sensor has detected a failure condition within various subsections of the sensor.

KNS 660 PLANNING FUNCTIONS

The KNS 660 is capable of a variety of trip planning functions as well as a manual fuel planning function.

TRIP PLANNING

Trip planning provides a means of determining the distance, bearing and estimated time enroute between geographic points while in flight or on the ground without interfering with the on-going navigation functions of the system. The KNS 660 provides three types of trip planning functions:

- Trip planning from the aircraft's present position to another waypoint.
- Trip planning between any two waypoints.
- Trip planning of one of the stored flight plans.

The trip planning functions can be utilized anytime after system initialization. The Trip Planning page definitions are contained in Section IV.

Trip Planning From The Aircraft's Present Position To Another Waypoint

1. DAT key - PRESS to display DATA 1 Menu page.
2. TRIP PLANNING menu item - SELECT to display the Trip Planning Menu page (Figure 7-59).
3. WPT REL TO PRESENT POS menu item - SELECT to display the Waypoint Relative to Present Position Trip Planning page (Figure 7-60).
4. Waypoint Identifier - INPUT into the WPT NAME field (Figure 7-61). When the ENTER key is pressed the Waypoint page will be displayed (Figure 7-62). Complete the Waypoint page as necessary and position the cursor over the APPROVE? field.

   If desired a latitude and longitude may be entered in the LAT: and LON: fields of the Trip Planning page instead of entering a waypoint identifier.
5. ENTER key - PRESS to approve the Waypoint page if a waypoint identifier was entered in step 4. The Trip Planning page will return with the distance (DIS) and bearing (BRG) displayed and the cursor over the ENTER GS field (Figure 7-63). If a ground speed has been previously entered on any Trip Planning page since the KNS 660 has been turned on, this previous ground speed will be displayed. If a new ground speed is desired it may be entered directly over the old one.
6. Estimated ground speed - INPUT into the ENTER GS field. When the ENTER key is pressed the estimated time enroute (ETE) will be displayed (Figure 7-64).

   The system will return to the Trip Planning Menu page when the DAT key is pressed once. Pressing the DAT key a second time will display the DATA 1 Menu page.

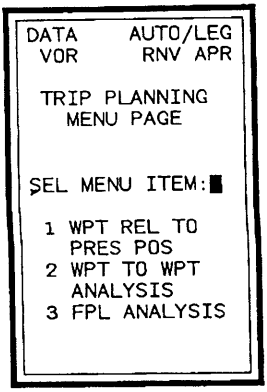


Figure 7-59

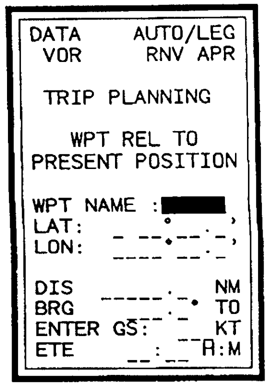


Figure 7-60

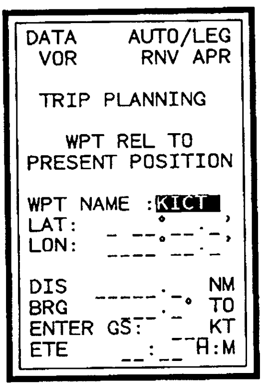


Figure 7-61

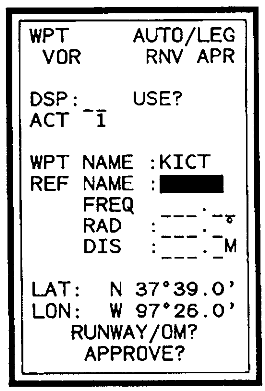


Figure 7-62

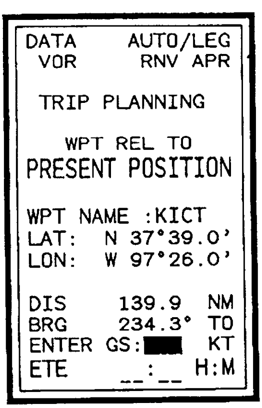


Figure 7-63

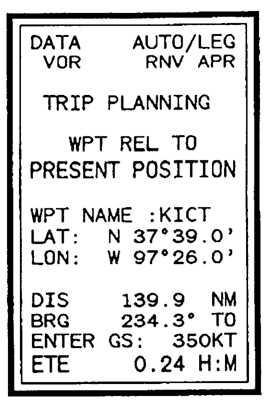


Figure 7-64

Trip Planning Between Two Waypoints

1. DAT key - PRESS to display the DATA 1 Menu page.

2. TRIP PLANNING Menu item - SELECT to display the Trip Planning Menu page.

3. WPT TO WPT ANALYSIS Menu item - SELECT to display the Waypoint To Waypoint Trip Planning page (Figure 7-65).

4. "FROM" waypoint identifier - INPUT into the FROM WPT field (Figure 7-66). When the ENTER key is pressed the Waypoint page will be displayed. Complete the Waypoint page as necessary and position the cursor over the APPROVE? field.

5. ENTER key - PRESS to approve the Waypoint page. The Trip Planning page will return with the cursor over the TO WPT field (Figure 7-67).

6. "TO" waypoint identifier - INPUT into the TO WPT field (Figure 7-68). When the ENTER key is pressed the Waypoint page will be displayed. Complete the Waypoint page as necessary and position the cursor over the APPROVE? field.

7. ENTER key - PRESS to approve the Waypoint page. The Trip Planning page will return with the distance (DIS) and (BRG) displayed and the cursor over the ENTER GS field (Figure 7-69). If a ground speed has been previously entered on any Trip Planning page since the KNS 660 has been turned on, this previous ground speed will be displayed.

8. Estimated ground speed - INPUT into the ENTER GS field. When the ENTER key is pressed the estimated time enroute (ETE) will be displayed (Figure 7-70).

   The system will return to the Trip Planning Menu page when the DAT key is pressed once. Pressing the DAT key a second time will display the DATA 1 Menu page.

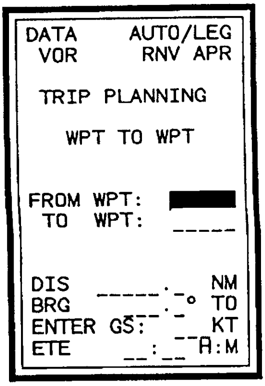


Figure 7-65

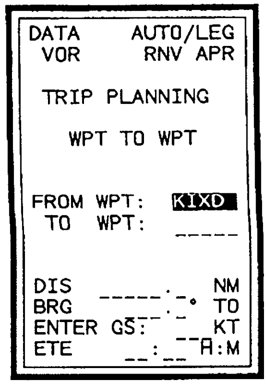


Figure 7-66

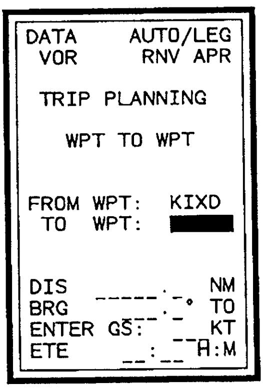


Figure 7-67

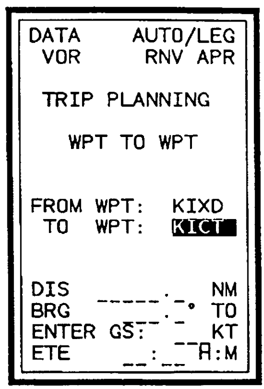


Figure 7-68

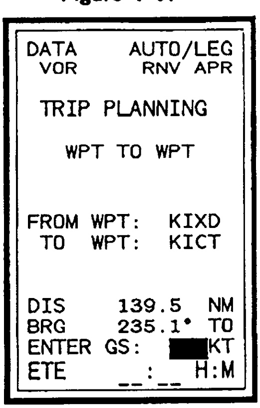


Figure 7-69

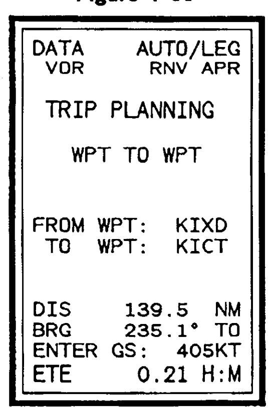


Figure 7-70

Trip Planning Of One Of The Stored Flight Plans

1. DAT key - PRESS to display the DATA 1 Menu page.

2. TRIP PLANNING menu item - SELECT to display the Trip Planning Menu page.

3. FPL ANANLYSIS menu item - SELECT to display the Flight Plan Analysis Trip Planning Page (Figure 7-71).

4. Flight Plan number - INPUT into the ENTER FPL field (Figure 7-72). This is the number of a flight plan listed on one of the Flight Plan Menu pages. When the ENTER key is pressed the first and last waypoint identifiers from the flight plan are displayed as well as the distance along the flight plan route. The cursor will be over the ENTER GS field (Figure 7-73). If a ground speed has been previously entered on any Trip Planning page since the KNS 660 has been turned on, this previous ground speed will be displayed.

5. Estimated ground speed - INPUT into the ENTER GS field. When the ENTER key is pressed the estimated time enroute (ETE) will be displayed (Figure 7-74).

   The system will return to the Trip Planning Menu page when the DAT key is pressed once. Pressing the DAT key a second time will display the DATA 1 Menu page.

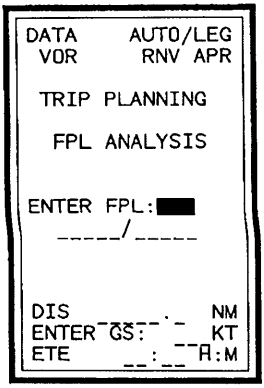


Figure 7-71

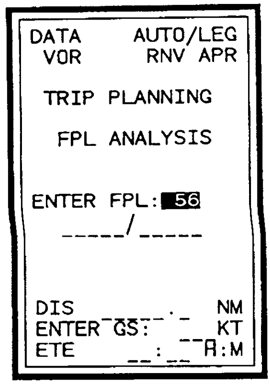


Figure 7-72

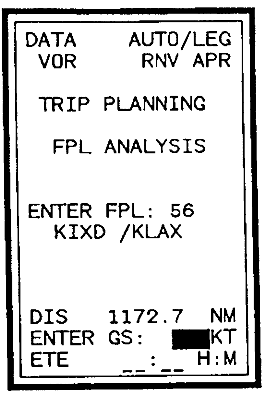


Figure 7-73

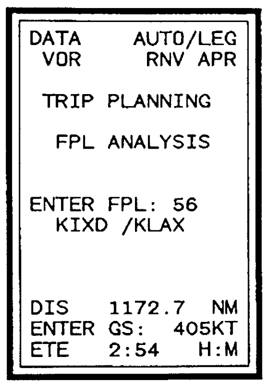


Figure 7-74

FUEL PLANNING

The Fuel Planning page is described in Section IV. The Fuel Planning page is accessible through the DATA 1 Menu page.

The Fuel Planning page provides endurance (HRS), range (NM) and fuel economy (NM/100 LB fuel) data based on pilot inputs of fuel remaining (REM) in lbs, fuel flow (FLOW) in lbs/hrs and desired fuel reserve (RESERVE) in lbs. It also automatically receives an input of the system's present calculated ground speed.

NOTE

THE INFORMATION ON THIS PAGE IS NOT BASED ON INPUTS FROM ACTUAL FUEL FLOW TRANDUCERS.

Since this pilot entered information will require updating (such as a flow change), the LAST UPDATE field annunciates the number of minutes since the last pilot entry has been made. If after 15 minutes no pilot entries have been made, the HRS, RANGE (NM) and NM/100 LB fields will display dashes and an UPDATE INPUTS message will flash on the bottom of the page. If at any time the pilot wishes to reset the LAST UPDATE field to zero he may update any one of the pilot entry fields (i.e. a new fuel flow, fuel remaining, or fuel reserve). If all the data shown is still valid he may simply position the cursor over one of the still valid data entry fields and press the ENTER key.

1. DAT key - PRESS to obtain DATA 1 Menu page.

2. Fuel Planning Menu item - SELECT to display the Fuel Planning page (Figure 7-75).

3. Cursor - POSITION over the REM, FLOW and RESERVE data entry fields and ENTER the fuel remaining, field flow and fuel reserve (desired amount) respectively (Figure 7-76).

4. HRS, RANGE (NM) and NM/100 LB - READ endurance, range and the fuel economy.

   After the initial entries, the system does its own updating in so far that it computes and updates the fuel remaining display (opposite REM) every few seconds based on the fuel flow rate which the pilot entered (Figure 7-77). The system also counts down the endurance (opposite HRS) minute by minute. Ground speed is updated internally based on the system's actual computed ground speed and therefore the range figure opposite RANGE (NM) and fuel economy opposite NM/100LB are dynamic values changing with time and/or variations in ground speed.

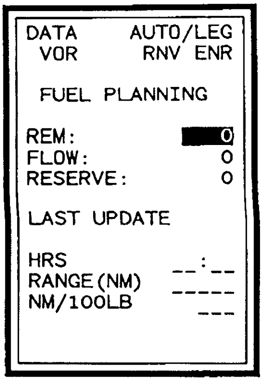


Figure 7-75

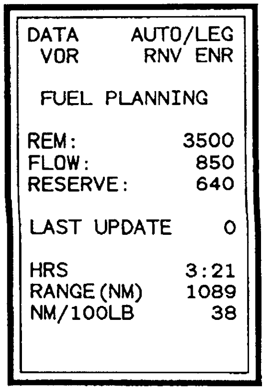


Figure 7-76

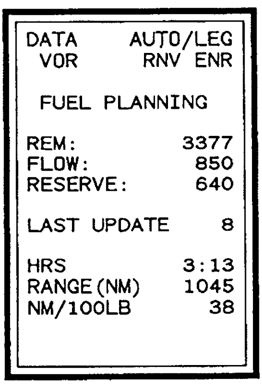


Figure 7-77

USER DEFINED NAVAIDS AND AIRPORTS SUPPLEMENTAL DATA BASE OPERATIONS

As described in Section II, "Waypoints and Flight Plans" (Reference Section IV), the KNS 660 has a block of memory capable of storing any combination of up to 175 navaids and airports which the operator wishes to enter. This is in addition to the main Data Base. Once entered into this supplemental Data Base, the system utilizes these navaids and airports exactly the same as navaids and airports from the main Data Base. If the supplemental Data Base already contains 175 navaids and airports when attempting to enter another navaid or airport, the USER D/BASE FULL message will appear in the scratch pad area. In this case data must be deleted from the supplemental Data Base to make room for new entries. Supplemental Data Base operations are contained on the pages which follow.

ENTERING USER DEFINED NAVAIDS INTO THE SUPPLEMENTAL DATA BASE

Navaid entries into the supplemental Data Base are made on the Navaid page which was defined in Section IV.

1. DAT key - PRESS as required to obtain the DATA 2 Menu page.

2. NAVAID PAGE menu item - SELECT to display a blank Navaid page.

3. Unique navaid identifier - INPUT up to four alpha-numeric characters into the STA IDENT field and PRESS the ENTER key (Figure 7-78). The identifier must be unique (not contained anywhere else in system memory). If the identifier entered already exists for a navaid contained in the Data Base, the Navaid page will display data for the existing navaid. If the identifier entered is identical to a waypoint already contained in memory the message DUPL D/BASE NAME will appear in the scratch pad area.

4. Frequency or TACAN channel of navaid - INPUT into the FREQ or CHNL field and PRESS the ENTER key (Figure 7-79).

5. Type of navaid - SELECT by first pressing the CLR key to cycle through DME, VOR/DME, VORTAC, TACAN, ILS/DME, and VOR until the correct navaid type is displayed (Figure 7-80) and then pressing the ENTER key (Figure 7-81).

6. Class of navaid - SELECT by first pressing the CLR key to cycle through LOW, HIGH, TERMINAL and UNDEFINED until the correct navaid class is displayed (Figure 7-82) and then pressing the ENTER key.

7. Navaid elevation, magnetic variation, latitude and longitude - INPUT and ENTER into the ELEV, MAG VAR, LAT and LON fields, respectively. The elevation entered will only be stored and displayed to the nearest 10 feet. Remember to begin the magnetic variation entry with an E (6 key) or W (4 key) as required. The cursor will now be positioned over the APPROVE? field (Figure 7-82).

8. ENTER key - PRESS to enter the user defined navaid into the supplemental Data Base.

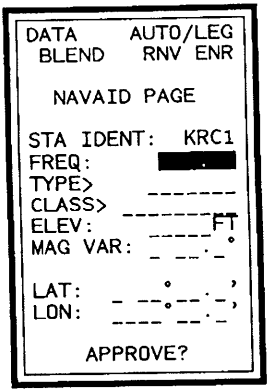


Figure 7-78

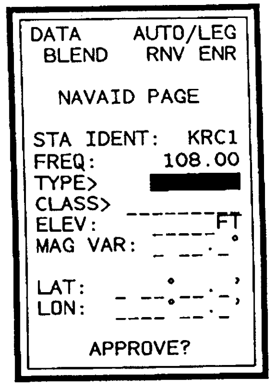


Figure 7-79

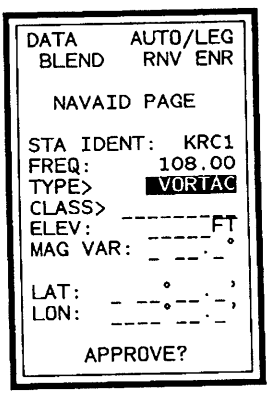


Figure 7-80

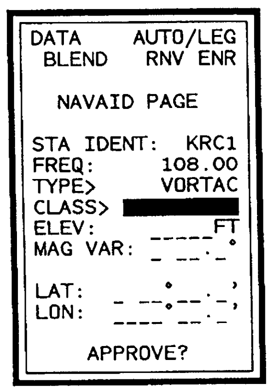


Figure 7-81

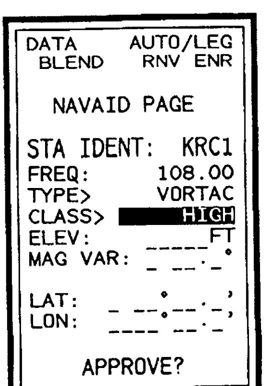


Figure 7-82

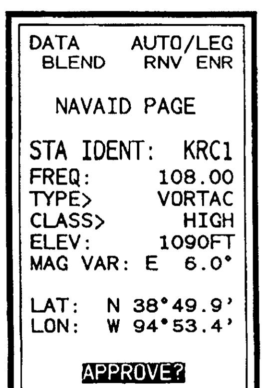


Figure 7-83

ENTERING USER DEFINED AIRPORTS INTO THE SUPPLEMENTAL DATA BASE

Airport entries into the supplemental Data Base are made on the Airport page which was defined in Section IV.

1. DAT key - PRESS as required to obtain the DATA 2 Menu page.

2. AIRPORT PAGE Menu item - SELECT to display a blank Airport page.

3. Unique airport identifier - INPUT up to four alpha-numeric characters into the ICAO AIRPORT IDENTIFIER field and PRESS the ENTER key (Figure 7-84). The identifier must be unique (not contained anywhere else in system memory). If the identifier entered already exists for an airport contained in the Data Base, the Airport page will display data for the existing airport. If the identifier entered is identical to a waypoint already contained in memory (DUPL D/BASE NAME will appear as a scratch pad message.

4. Airport elevation, latitude and longitude - INPUT and ENTER into the ELEV, LAT and LON fields, respectively. The elevation entered will only be stored and displayed to the nearest 10 feet. The cursor will now be positioned over the APPROVE? field (Figure 7-85).

5. ENTER key - PRESS to enter the user defined airport into the supplemental Data Base.

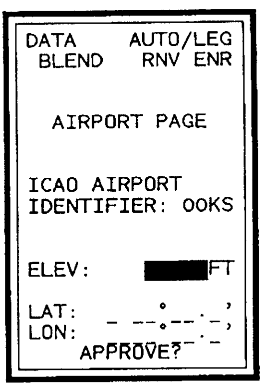


Figure 7-84

Figure 7-85

MODIFYING USER DEFINED NAVAIDS AND AIRPORTS

Modifications to user defined navaids and airports are possible using the same technique employed during initial navaid and airport definition and entry. The modification to the user defined navaid or airport isn't accomplished until the cursor is positioned over the APPROVE? field and the ENTER key is pressed.

REVIEWING THE LISTS OF USER DEFINED NAVAIDS AND AIRPORTS CONTAINED IN THE SUPPLEMENTAL DATA BASE

The User Defined Navaids page (Figure 7-86) and the User Defined Airports page (Figure 7-87) present listings of the identifiers of navaids and airports which have been manually entered into the supplemental Data Base. Note that a description of the navaids and airports does not appear on these pages, only the identifiers. These pages were defined in Section IV. Both pages are accessed from the DATA 2 Menu page. To display the User Defined Navaids page select the USER NAVAID menu item and to select the User Defined Airports page select the USER AIRPORTS menu item.

```
DATA      AUTO/LEG
 VOR       RNV ENR

  USER NAVAIDS
 PREVIOUS PAGE?
      KRC1
      KRC2




   NEXT PAGE?
```

Figure 7-86

```
DATA      AUTO/LEG
 VOR       RNV ENR

 USER AIRPORTS
 PREVIOUS PAGE?
      OOKS
      ID33
      K34



    NEXT PAGE?
```

Figure 7-87

DELETING USER DEFINED NAVAIDS AND AIRPORTS FROM THE SUPPLEMENTAL DATA BASE

User defined navaids may be deleted from the supplemental Data Base from either the User Defined Navaids page or from the Navaid page. Likewise, user defined airports may be deleted from either the User Defined Airports page or from the Airport page. All four of these pages are accessible from the DATA 2 Menu page.

Navaids and airports contained in the main Data Base cannot be deleted. Attempting to clear a non-user defined navaid or airport will result in the message SYSTEM D/BASE being displayed in the scratch pad area.

A. Any effort to delete more than one user defined navaid or airport can be accomplished with greater ease on the User Defined Navaid page or User Defined Airport page, respectively.

1. DAT key - PRESS as required to obtain the DATA 2 Menu page.

2. USER NAVAIDS or USER AIRPORTS menu item - SELECT the appropriate one to display the User Defined Navaids page or User Defined Airports page. (Figure 7-88).

3. Cursor - POSITION over the identifier of the navaid or airport to be deleted (Figure 7-89). If the desired identifier isn't displayed on the page it may be necessary to view other pages by positioning the cursor over the PREVIOUS PAGE? or NEXT PAGE? interrogative field and pressing the ENTER key.

4. CLR key - PRESS and note that the identifier is blanked and dashes appear (Figure 7-90). If at this point the operator does not wish to delete the navaid or airport, pressing any other key besides the ENTER key will abort the delete sequence.

5. ENTER key - PRESS to delete the navaid or airport (Figure 7-91).

B. Deleting user defined navaids and airports from the Navaid page and Airport page.

1. DAT key - PRESS as required to obtain the DATA 2 Menu page.

2. NAVAID PAGE or AIRPORT PAGE menu item - SELECT the appropriate one to display a blank Navaid page or Airport page.

3. Identifier of navaid or airport to be deleted - INPUT into the STA IDENT or ICAO AIRPORT IDENTIFIER field as appropriate. When the ENTER key is pressed the data for the navaid or airport will be displayed (Figure 7-92).

4. Cursor [↓] or [↑] key - PRESS to remove cursor from page.

5. CLR key - PRESS and note the appearance of the DELETE? field (Figure 7-93). If at this point the operator does not wish to delete the navaid or airport, pressing any other key besides the ENTER key will cause the DELETE? field to disappear aborting the delete sequence.

6. ENTER key - PRESS to delete the navaid or airport from the supplemental Data Base.

Figure 7-88

Figure 7-89

Figure 7-90

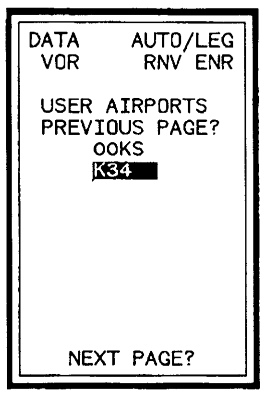


Figure 7-91

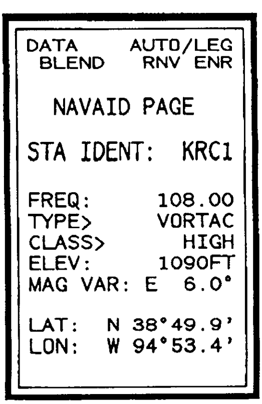


Figure 7-92

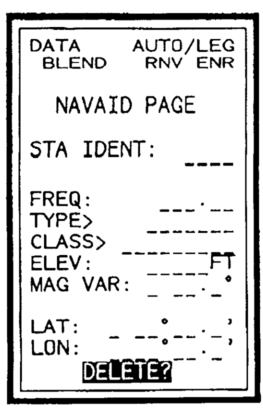


Figure 7-93

FREQUENCY MANAGEMENT

Frequency Managment refers to the ability of using the keyboard of the CDU to select the desired COMM, NAV, ADF, and Transponder frequencies/codes. This feature is in addition to the ability of normal control head tuning with knobs. Frequency management capability is applicable only in those installations using BENDIX/KING Gold Crown III avionics which are compatible with the KNS 660 system. There is no frequency management capability with versions of the KNS 660 which utilize Collins Proline II or BENDIX/KING Series III NAV and DME sensors.

There are several frequency managment methods which may be utilized. The KNS 660 operator should select the technique which is best suited to his particular requirements. Regardless of the method chosen, the frequency or code keyed into the scratch pad area must be acceptable to the intended unit. For example to use the keyboard to enter a COMM frequency, the data keyed into the scratch pad area must be a 5-digit number which is within the allowable COMM frequency range less decimal point (11800-13597). The system will not allow a frequency or code to be transfered to a unit which is outside the unit's usable frequency or code range. Note also that there can be no frequency management capability of the VOR NAV receiver (or TACAN) which is serving as a sensor for the KNS 660 system. If this NAV receiver is removed as a KNS 660 sensor (by activating the optional NAV CTL function), frequency management capabilities are then possible with this NAV receiver.

Frequency management operations are described on the pages which follow.

CONTROL HEAD TRANSFER BUTTON METHOD

This method utilizes the scratch pad area of the CDU and the transfer buttons on the COMM, NAV and ADF Control Heads. It is not applicable for Transponder code selection.

1. Desired frequency - INPUT into scratch pad area (Figure 7-94) and PRESS the ENTER key (Figure 7-95). The scratch pad area of any page except the FREQ 1 page may be utilized. In order to input into the scratch pad area, the cursor must be either off the page or on a non-entereable field.

2. Transfer button on appropriate control head - PRESS to enter the selected freuqency into the standby window of the control head. The scratch pad area of the CDU will be cleared (Figure 7-96).

   When the transfer button is pressed a second time the selected frequency is flip-flopped into the active window (Figure 7-97).

NOTE

A FREQUENCY MANAGEMENT TRANSFER CAN BE ABORTED AND THE SCRATCH PAD CLEARED BY POSITIONING THE cursor OVER THE SCRATCH PAD FIELD AND PRESSING THE CLR KEY. IT CAN ALSO BE ABORTED BY SELECTING A NEW FREQUENCY WITH A FREQUENCY SELECT KNOB OF A CONTROL HEAD CAPABLE OF ACCEPTING THE FREQUENCY ENTERED IN THE SCRATCH PAD.

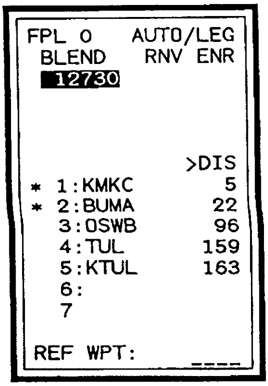


Figure 7-94

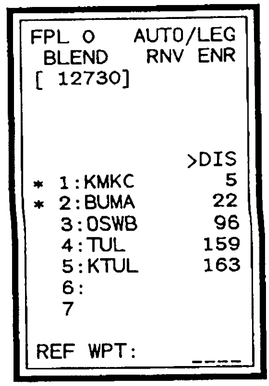
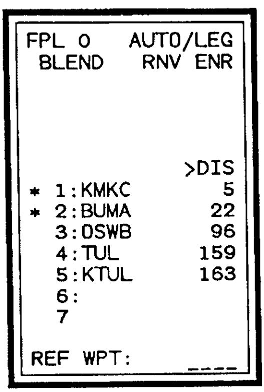


Figure 7-95



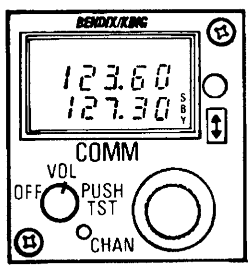


Figure 7-96

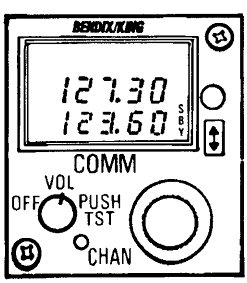


Figure 7-97

FREQ 1 PAGE ENTRY METHOD

This method of frequency management utilizes the scratch pad area and the FREQ 1 page. It may be used for NAV, COMM, ADF and Transponder frequency/code selection. The FREQ 1 page is discussed in Section IV. Steps 1 and 2 of the procedure below may be performed in either order.

1. Desired Frequency or Code - INPUT into scratch pad area and PRESS the ENTER key (Figure 7-98).

2. FRQ key - PRESS once to display the FREQ 1 page. The FREQ 1 page will display a menu selection of only those control head windows capable of utilizing the scratch pad frequency or code (Figure 7-99). If the control head is capable of accepting the frequency in both the active (ACT) and standby (SBY) windows a menu selection item exists for each.

3. Desired menu item - INPUT into the SEL OPTION field (Figure 7-100). When the ENTER key is pressed the selected frequency or code will appear in the appropriate control head window, the scratch pad area will be clear, and the CDU will return to the page which was displayed prior to step 2 (Figure 7-101).

The FREQ 1 page entry method is not available on ORS 05 level KNS 660 systems.

```
FPL 0     AUTO/LEG
 BLEND     RNV  ENR
[  1120]



                >DIS
* 1:KMKC           5
* 2:BUMA          22
  3:OSWB          96
  4:TUL          159
  5:KTUL         163
  6:
  7

REF WPT:        ____
```

Figure 7-98

```
FREQ 1    AUTO/LEG
 BLEND     RNV  ENR
[  1120]

 SEL OPTION:█
STBY             ACT

--1--   ADF1    --2--
        XPDR1     3
        XPDR2     4
```

Figure 7-99

```
FREQ 1    AUTO/LEG
 BLEND     RNV  ENR
[  1120]

 SEL OPTION:3
STBY             ACT

--1--   ADF1    --2--
        XPDR1     3
        XPDR2     4
```

Figure 7-100

```
FPL 0     AUTO/LEG
 BLEND     RNV  ENR




                >DIS
* 1:KMKC           5
* 2:BUMA          22
  3:OSWB          96
  4:TUL          159
  5:KTUL         163
  6:
  7

REF WPT:        ____
```

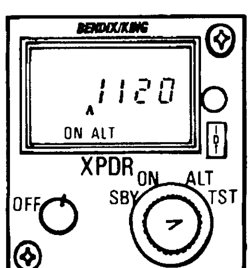


Figure 7-101

FREQ 2 PAGE ENTRY METHODS

There are several variations of using the FREQ 2 page for frequency management. The FREQ 2 page may be used to select NAV, COMM, ADF, and Transponder frequency/codes. Selections made on the FREQ 2 page always change the active window of a control head, never the standby window. The FREQ 2 page is discused in Section IV.

A. FREQ 2 page method using scratch pad. (Steps 1 and 2 may be performed in either order).

1. Desired frequency or code - INPUT into scratch pad area and PRESS the ENTER key (Figure 7-102).

2. FRQ key - PRESS twice or as required to display FREQ 2 page. The FREQ 2 page will display a listing of all control heads connected for frequency management capability and ther respective active frequencies/codes (Figure 7-103).

3. Cursor [↓] or [↑] key - PRESS to position Cursor over the desired control head active frequency field (Figure 7-104).

4. ENTER key - PRESS once to transfer the frequency or code from the scratch pad to the cursor field (Figure 7-105).

5. ENTER key - PRESS again to enter the frequency or code into the active window of the selected control head (Figure 7-106).

B. FREQ 2 page method without using scratch pad.

1. FRQ key - PRESS twice or as required to display FREQ 2 page (Figure 7-107).

2. Cursor [↓] or [↑] key - PRESS to position cursor over the field containing the frequency or code to be changed (Figure 7-108).

3. Desired frequency or code - INPUT (Figure 7-109). When the ENTER key is pressed the frequency or code will be entered into the active window of the selected control head (Figure 7-110).

C. Changing NAV frequency to TACAN channel

When the KNS 660 is configured with a compatible TACAN sensor and NAV/TACAN control head, the format of the FREQ 2 page may be changed to display either a NAV frequency or a TACAN channel. This change is done by positioning the cursor over the desired NAV or TACAN field on the FREQ 2 page and pressing the CLR key twice.

```
FPL 0    AUTO/LEG
 BLEND    RNV ENR
[ 11910]



              >DIS
* 1:KMKC         5
* 2:BUMA        22
  3:OSWB        96
  4:TUL        159
  5:KTUL       163
  6:
  7

REF WPT:      ----
```

Figure 7-102

```
FREQ 2   AUTO/LEG
 BLEND    RNV ENR
[ 11910]
  FREQ SUMMARY

ADF1   :      0368
NAV1   :         .
NAV2   :    112.60
XPDR1  :      1120
XPDR2  :      4353
COMM1  :    127.30
COMM2  :    124.30
```

Figure 7-103

```
FREQ 2   AUTO/LEG
 BLEND    RNV ENR
[ 11910]
  FREQ SUMMARY

ADF1   :      0368
NAV1   :         .
NAV2   :    112.60
XPDR1  :      1120
XPDR2  :      4353
COMM1  :    127.30
COMM2  :    124.30
```

Figure 7-104

```
FREQ 2   AUTO/LEG
 BLEND    RNV ENR

  FREQ SUMMARY

ADF1   :      0368
NAV1   :         .
NAV2   :    112.60
XPDR1  :      1120
XPDR2  :      4353
COMM1  :    127.30
COMM2  :    119.10
```

Figure 7-105

```
FREQ 2   AUTO/LEG
 BLEND    RNV ENR

  FREQ SUMMARY

ADF1   :      0368
NAV1   :         .
NAV2   :    112.60
XPDR1  :      1120
XPDR2  :      4353
COMM1  :    127.30
COMM2  :    119.10
```

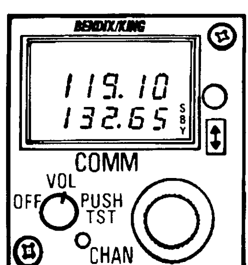


Figure 7-106

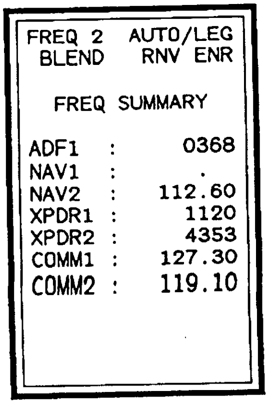


Figure 7-107

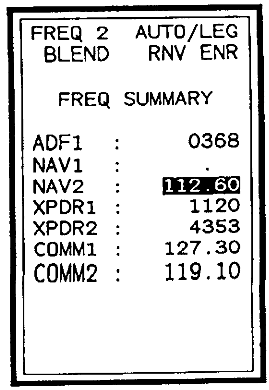


Figure 7-108

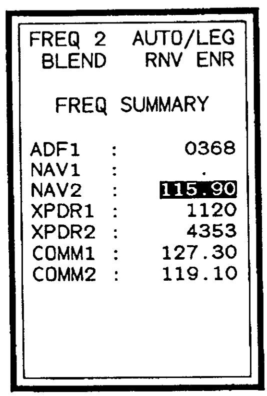


Figure 7-109

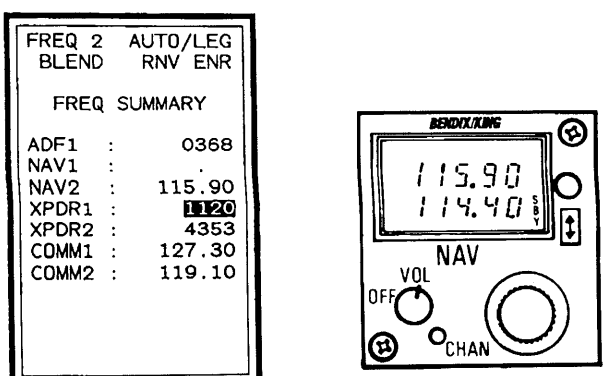


Figure 7-110

BULK LOADING AND SAVING FLIGHT PLANS, WAYPOINTS, AND THE SUPPLEMENTAL DATA BASE

The KDL 569 Data Loader which is used to make routine updates to the Data Base can also be used to bulk load flight plans, waypoints, and user defined navaids and airports (supplemental data base) from a previously prepared floppy diskette to a KNS 660 system. In addition, the Data Loader can be used to store flight plans, waypoints, and user defiend navaids and airports which are contained in a KNS 660 system onto a floppy diskette for later use. These two operations will be especially appreciated by operators managing a fleet of aircraft which all use KNS 660's to fly the same set of structured flight plans.

Before initiating a bulk loading, the floppy diskette must, of course, already contain the desired flight plans and waypoints. This diskette must be loaded from a previous flight plan and waypoint "save" operation. The bulk loading process involves a complete clearing of the existing inventory of up to 100 flight plans, up to 800 waypoints, and up to 175 user defined navaids and airports contained in a KNS 660 prior to the loading of the new data. The operation supersedes the protection afforded "protected" flight plans and waypoints. In other words, protected data is not protected from the bulk loading process, only from normal keyboard entries. Bulk loading does not affect the main Data Base.

Before starting either a bulk loading or saving operation, the KNS 660 must be turned on and initialization must be complete. The KDL 569 Data Loader must be connected to the KNS 660. If the KDL 569 Data Loader is mounted in the aircraft, it is already internally connected to the system. If the Data Loader is mounted in the portable case (KDL 569R) then follow the procedure outlined in Section V for connecting the system.

The bulk loading and saving of flight plans, waypoints, and user defined navaids and airports are accomplished on the Update Flight Plan and Waypoint page which was defined in Section IV. This page is accessible through the DATA 2 Menu page. Loading and saving of flight plans, waypoints, and user defined navaids and airports should be accomplished on the ground prior to flight.

1. Data Loader cover - OPEN

2. Update diskette - INSERT into Data Loader. The end of the diskette having the sliding metal shutter is inserted into the Data Loader first. An arrow is located on the top left side of most diskettes and should be pointed to the back of the Data Loader as the diskette is inserted. Push the diskette into the Data Loader until the diskette locks into place. The diskette will not lock into place if it is positioned incorrectly.

NOTE

THE SYSTEM WILL NOT ALLOW A SUBSCRIPTION DATA BASE UPDATE DISKETTE TO BE USED FOR SAVING FLIGHT PLANS AND WAYPOINTS. ATTEMPTING TO USE IT WILL RESULT IN A SCRATCH PAD MESSAGE STATING "LOADER NOT READY". ANY OTHER GOOD QUALITY 3.5 INCH MICRO-FLOPPY DISKETTE MAY BE USED FOR THIS OPERATION.

BULK LOADING AND SAVING FLIGHT PLANS, WAYPOINTS, AND THE SUPPLEMENTAL DATA BASE (Cont'd)

3. DAT key - PRESS as required to display the DATA 2 Menu page.

4. UPDATE FP/WPT menu item - SELECT to display the Update Flight Plan and Waypoint page.

5. Cursor [↓] or [↑] key - PRESS to position the cursor over the LOAD FP/WPT? field (Figure 7-111) in order to bulk load data from the diskette to the KNS 660. Position the cursor over the SAVE FP/WPT? field (Figure 7-112) in order to load the diskette with the flight plans, waypoints, and user defined navaids and airports contained in the KNS 660.

6. ENTER key - PRESS to initiate the loading or saving operation. When the data transfer is complete a XFER COMPLETED message will be displayed in the scratch pad area.

   If an error should occur during the data transfer, the message **XFER ERROR** will appear. This may be indicative of a hardware malfunction but the operator should try the operation again. If the error message persists, it is quite likely that the system memory dedicated to the storage of flight plans and waypoints will be blank if the error occurred during a "loading" operation. If an error occurred during an attempt to "save" a set of data, the system memory should be uneffected.

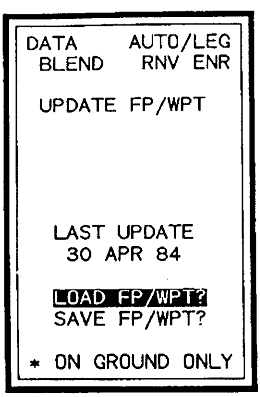


Figure 7-111

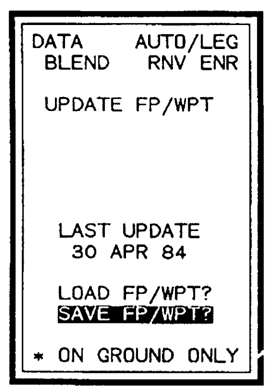


Figure 7-112

DATA TRANSFER BETWEEN SYSTEMS IN DUAL INSTALLATIONS

It is possible to transfer all flight plans, waypoints, user defined navaids, and user defined airports from one KNS 660 system to another in a dual system installation. A partial transfer of data is not possible. Also, all existing flight plans, waypoints, user defined navaids, and user defined airports in the receiving system are erased. In order to accomplish data tranfer, one system must be designated as the RECEIVE system and the other as the TRANSMIT system.

SELECTION OF CDU DATA TRANSFER PAGE (BOTH RECEIVING AND TRANSMITTING SYSTEMS)

1. DAT key - PRESS to obtain DATA 2 Menu page.

2. CDU DATA XFR menu item - SELECT to obtain the CDU Data Transfer page (Figure 7-113).

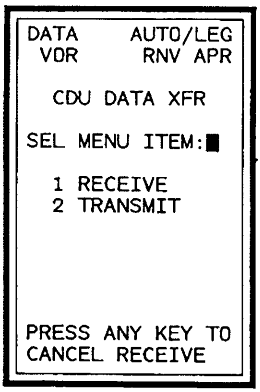


Figure 7-113

RECEIVING SYSTEM (ACCOMPLISH FIRST)

3. RECEIVE menu item - SELECT. Note flashing RECEIVE field.

TRANSMITTING SYSTEM (ACCOMPLISH SECOND)

4. TRANSMIT menu item - SELECT to begin the transfer of data. Note flashing TRANSMIT field.

   At the completion of data transfer, the receiving system will annunciate RECEIVE COMPLETE, NO ERRORS. The transmitting system will annunciate XMIT COMPLETE, NO ERRORS.

DATA TRANSFER BETWEEN SYSTEMS (Cont'd)

If an error should occur during the data transfer, both the receiving and transmitting systems will display the following flashing message: CDU XFR BUS FAIL, ***ERROR***. This may be indicative of a hardware malfunction but the operator should try the operation again. If the error message persists, the transmitting system memory should have remained unchanged while the receiving system memory (the portion effected by the transfer only) will probably have been erased.

Another message is possible and will appear in the transmitting system if it is enabled prior to the receiving system being enabled. The message ENABLE RECEIVER, ***ERROR*** is simply telling the operator to put the receiving system in the RECEIVE mode.

The receiving system RECEIVE mode may be cancelled any time prior to activating the TRANSMIT mode in the transmitting system by pressing any key on the receiving system. The following message will appear: RECEIVE CANCELLED, NO ERRORS.

PROTECTED FLIGHT PLAN AND WAYPOINT OPERATIONS

Protection of flight plans and waypoints from being altered or cleared through the keyboard is possible in the KNS 660 system by assigning protected status to individual flight plans (and thus automatically all of the associated waypoints), or individual waypoints. This protection does not prevent alteration or clearing through bulk loading using the Data Loader or through a CDU data transfer between systems in a dual installation. This ability to protect flight plans and waypoints from keyboard alteration may be especially utilized by those operators wanting to ensure commonality of particular flight plans and waypoints for all aircraft in their fleet. Protection is assigned through activation of the SYSTEM PROTECT mode. Likewise, altering and/or clearing of protected data also involves the activation of the SYSTEM PROTECT mode.

SYSTEM PROTECT mode is a term used to define the mode the system is in when flight plans and waypoints can be assigned protected status or conversely, when protected flight plans or waypoints can be cleared from memory through keyboard entries (as opposed to being cleared through a bulk loading or CDU data transfer process). It is not a mode used during normal operations and does not, as the name might imply, provide protection when it is active. The opposite is true. SYSTEM PROTECT mode is activated to allow changes to the protection status of a flight plan or waypoint. To reemphasize, the SYSTEM PROTECT mode is a limited use mode for assigning protection or clearing protected data.

ENTERING THE SYSTEM PROTECT MODE

The SYSTEM PROTECT mode can be activated from the Self Test page as follows.

1. ON/OFF switch - PRESS ON to display the Self Test page.

2. Cursor [↓] key - PRESS to remove cursor from page.

3. System password - INPUT into the scratch pad area and PRESS the ENTER key (Figure 7-114). "KNC667" is the password entered into memory when KNS 660 systems are shipped from the factory. The password is alterable through the UPDATE FP/WPT page as explained later.

4. Cursor [↓] or [↑] key - PRESS to position cursor back on the TEST OK? field.

5. ENTER key - PRESS to approve the Self Test page. The Initialization page will be displayed with a SYSTEM PROTECT message displayed in the scratch pad area (Figure 7-105). Follow the normal initialization procedures. The SYSTEM PROTECT message will remain displayed while the system is in the SYSTEM PROTECT mode.

CAUTION

ACTIVATING THE SYSTEM PROTECT MODE LEAVES THE SYSTEM VULNERABLE TO INADVERTENT CHANGES TO PROTECTED DATA. NEVER ATTEMPT NAVIGATION IN THIS MODE. CERTAIN SYSTEM FUNCTIONS ARE INHIBITED WHILE IN THIS MODE; THEREFORE PRECLUDING SAFE, FULL SYSTEM USE AND RENDERING THE SYSTEM PROTECT MODE APPROPRIATE FOR GROUND USE ONLY.

PROTECTING FLIGHT PLANS AND WAYPOINTS

If a flight plan is created or a waypoint defined while the system is in the SYSTEM PROTECT mode then the flight plan and waypoint will have protected status when the KNS 660 is turned OFF. Likewise, to protect an existing flight plan or waypoint or alter protected data, the operator must first activate the SYSTEM PROTECT mode, select the appropriate Flight Plan # page or Waypoint page, execute any minor modification (or rewrite) of the flight plan or waypoint definition, and then exit the SYSTEM PROTECT mode by turning the KNS 660 system OFF. Upon system reinitialization, the operator will note the presence of an asterisk in the Flight Plan # page or Waypoint page header signifying protected status.

CLEARING PROTECTED DATA AND REMOVING PROTECTED STATUS

To clear a protected flight plan or waypoint from the system, first activate the SYSTEM PROTECT mode and then clear the flight plan or waypoint in the usual manner.

To remove the protected status from a given flight plan or waypoint the process is more difficult. The operator must activate the SYSTEM PROTECT mode, clear the specific flight plan or waypoint in the normal manner, exit the SYSTEM PROTECT mode (turn the KNS 660 system off), reinitalized the system and then completly recreate the flight plan or redefine the waypoint.

CHANGING THE SYSTEM PASSWORD

To change the system password the system must first be in the SYSTEM PROTECT mode. If the existing password is unknown, the mode can be activated at an authorized King Radio Service Center.

To change the system password:

1. SYSTEM PROTECT mode - ACTIVATE as previously described in "Entering the System Protect Mode".

2. Initialization page - APPROVE.

3. DAT key - PRESS to obtain DATA 2 Menu page.

4. UPDATE FP/WPT Menu item - SELECT to display the Update Flight Plan and Waypoint page.

5. Cursor - POSITION over the PASSWD: data entry field as shown in Figure 7-116. (Visible only when the SYSTEM PROTECT mode is activated.)

6. New system password - INPUT into the PASSWD field (Figure 7-117) and PRESS the ENTER key. Note that a maximum of eight characters may be used and that the password will not be visible on the screen after the ENTER key is pressed (Figure 7-118).

7. ON/OFF switch - OFF.

```
* SELF TEST *

[KNC 667]
SYSTEM         OK
RMI          130°
DIS          34.3NM
SEL CRS      315°
ALT          1100FT
HORZ DEV     RT 3
VNAV DEV     UP 3
CHECK      RMI-DIS
           CDI-CRS
           ALT-ANN
ORS 02
     TEST OK?
©1985/KING RADIO
```

Figure 7-114

```
INIT      AUTO/LEG
 BLEND     RNV ENR
 SYSTEM  PROTECT
DATE:   01 MAY 84
GMT:         16:39

REF STATION ID
            OJC

WPT ID:
POS:   N 38°49.9'
       W 94°53.4'

EST GS:          0

      APPROVE?
```

Figure 7-115

```
DATA      AUTO/LEG
 BLEND     RNV ENR
 SYSTEM  PROTECT
 UPDATE FP/WPT



   LAST UPDATE
    30 APR 84

   LOAD FP/WPT?
   SAVE FP/WPT?
 CLEAR MEMORY?
 PASSWD:
```

Figure 7-116

```
DATA      AUTO/LEG
 BLEND     RNV ENR
 SYSTEM  PROTECT
 UPDATE FP/WPT



   LAST UPDATE
    30 APR 84

   LOAD FP/WPT?
   SAVE FP/WPT?
 CLEAR MEMORY?
 PASSWD:    KING
```

Figure 7-117

```
DATA      AUTO/LEG
 BLEND     RNV ENR
 SYSTEM  PROTECT
 UPDATE FP/WPT



   LAST UPDATE
    30 APR 84

   LOAD FP/WPT?
   SAVE FP/WPT?
 CLEAR MEMORY?
 PASSWD: ______
```

Figure 7-118

BULK CLEARING FLIGHT PLANS, WAYPOINTS, AND THE SUPPLEMENTAL DATA BASE

Bulk clearing through the keyboard of all flight plans and waypoints, protected or not, and of the supplemental Data Base (user defined navaids and airports) is possible from the Update Flight Plan and Waypoint page. Bulk clearing is possible only through activation of the SYSTEM PROTECT mode previously described in this section of the Pilot's Guide.

1. SYSTEM PROTECT mode -- ACTIVATE as previously described in "Entering The System Protect Mode".

2. Initialization page - APPROVE.

3. DAT key - PRESS to obtain DATA 2 Menu page.

4. UPDATE FP/WPT menu item - SELECT to display the Update Flight Plan and Waypoint page.

5. Cursor - POSITION over the CLEAR MEMORY? interrogative field as shown in Figure 7-119 (visible only when the SYSTEM PROTECT mode is activated) and PRESS the ENTER key. All flight plans, waypoints, and user defined airports and navaids will be erased from memory.

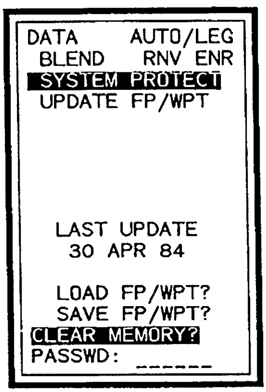


Figure 7-119

VERTICAL NAVIGATION

Vertical navigation (VNAV) refers to the ability of the KNS 660 to compute and display navigational guidance data along a pilot defined vertical path over the ground. The VNAV capabilities of the KNS 660 with ORS 02 operational characteristics have been designed to work in conjunction with the BENDIX/KING KFC 400 Flight Control System. Therefore, the procedures discussed in this portion of the Pilot's Guide relate specifically to operation with the KFC 400. Typically, if a KNS 660 system is installed in an aircraft not having a KFC 400 system certified for VNAV operation then the VNAV functions and displays of the KNS 660 have been disabled at the time of installation.

NOTE

IT IS THE PILOT'S RESPONSIBILITY TO READ THE AIRCRAFT'S KNS 660 FLIGHT MANUAL SUPPLEMENT IN ORDER TO DETERMINE THE SPECIFIC LIMITATIONS AND OPERATING PROCEDURES FOR THAT AIRCRAFT. THIS INCLUDES SYSTEMS IN WHICH THE KNS 660 PROVIDES ONLY ADVISORY VNAV INFORMATION (NOT COUPLED TO THE FLIGHT CONTROL SYSTEM).

There are two types of VNAV operation possible with the KNS 660: manual VNAV and AUTO 3D. At the time of installation, the KNS 660 can be configured in one of three ways: no VNAV, manual VNAV only, or both manual VNAV and AUTO 3D. Manual VNAV allows the pilot to define and fly a vertical path from the aircraft's present position relative to a single waypoint. In AUTO 3D operation the pilot may define and fly a vertical profile for an entire flight plan or a portion of a flight plan.

PILOT INTERFACE WITH VNAV EQUIPMENT

There are several pieces of equipment associated with the use of VNAV operation. Included are the NAV 2 page and the FPL0 page of the control display unit. The NAV 2 page (Figure 7-120) is used by the pilot in making inputs for both manual VNAV and AUTO 3D operation. The FPL0 page (Figure 7-121) is used for making inputs only for AUTO 3D operation.

The KMS 446 flight director mode selector for the KFC 400 (Figure 7-122) is used for selecting the VNAV mode of the flight control system. The KAV 485 altitude/vertical speed indicator (Figure 7-123) is one of the two places where the pilot may select an altitude for a VNAV waypoint.

The vertical deviation indicator used in VNAV operation may be located on the right side of either of two mechanical attitude director indicators, the KCI 310 (Figure 7-125) or the KCI 310A (Figure 7-126). Alternately, in a Bendix EFS-10 installation the vertical deviation indicator is located on the right side of the ED-102 EHSI (Figure 7-127).

A VNAV alert annunciator/switch (Figure 7-124) is normally mounted in the aircraft panel next to the other KNS 660 remote annunciators. It flashes to indicate an upcoming change in the vertical flight path and it must then be pushed by the pilot in order to acknowledge the upcoming change in the vertical path.

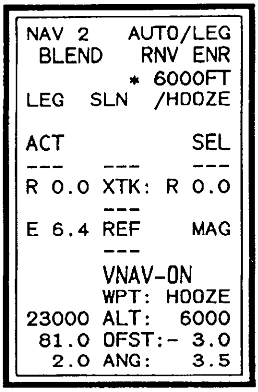


Figure 7-120

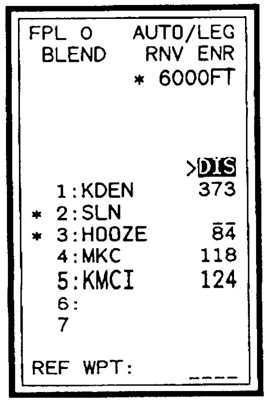
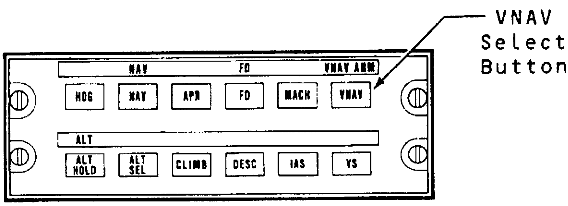
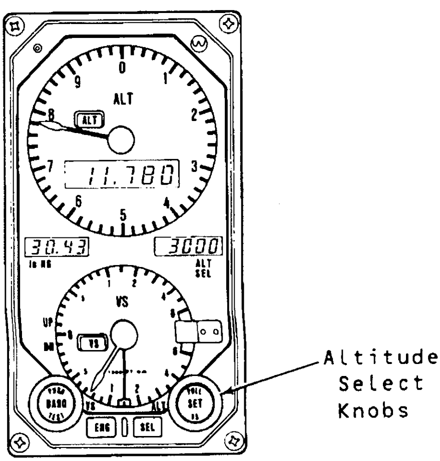


Figure 7-121

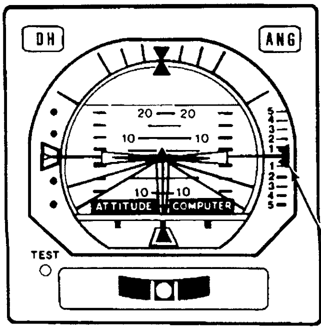


KMS 446 Mode Selector
Figure 7-122

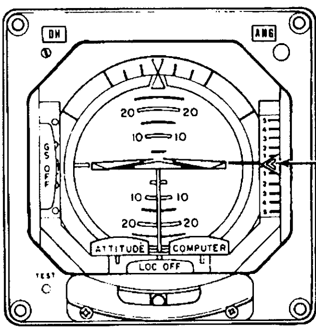


KAV 485
Altitude/Vertical
Speed Indicator
Figure 7-123

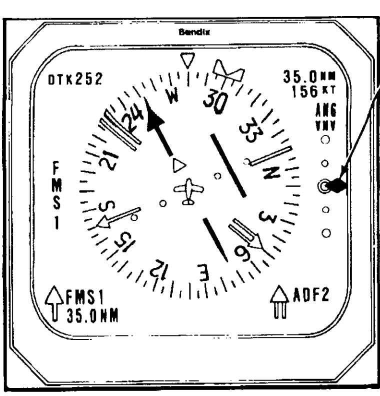
VNAV Alert
Annunciator/Switch
Figure 7-124



KCI 310
Flight Director Indicator
Figure 7-125



KCI 310A
Flight Director Indicator
Figure 7-126



ED 102 EHSI
Figure 7-127

```
FPL 0      AUTO/LEG
 BLEND      RNV ENR
          * 6000FT      ←7



              >DIS
  1:KDEN      373
* 2:SLN
* 3:HOOZE      84
  4:MKC       118
  5:KMCI      124
  6:
  7

REF WPT:     ____
```

Figure 7-128

```
     NAV 2    AUTO/LEG
      BLEND    RNV ENR
             * 6000FT      ←7
     LEG   SLN  /HOOZE

     ACT          SEL
     ---   ---    ---
     R 0.0 XTK: R 0.0
           ---
     E 6.4 REF    MAG
           ---
           VNAV-ON         ←1
           WPT: HOOZE      ←3
6→   23000 ALT:   6000     ←7
10→   81.0 OFST:- 3.0      ←4
8→     2.0 ANG:    3.5     ←9
```

Figure 7-129

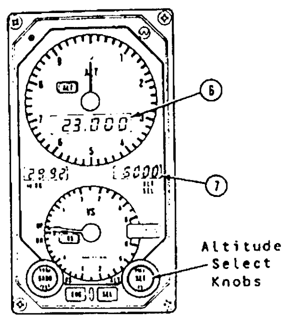


Figure 7-130

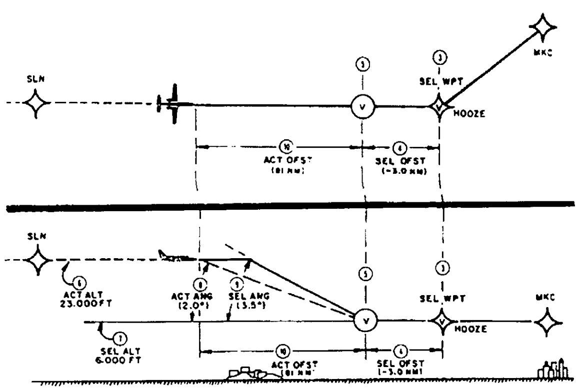


Figure 7-131 (Top)
Figure 7-132 (Bottom)

MANUAL VNAV - AUTO/LEG OPERATION

General

When the KNS 660 is in the AUTO/LEG Method of Operation it is capable of computing vertical navigation guidance to a single waypoint. This single waypoint may be any waypoint in the flight plan which is located ahead of the aircraft or this waypoint may be any current DIRECT TO waypoint. In addition, the pilot can select an along-track offset from this waypoint so as to reach the desired altitude either before or after the waypoint. The basic concept is that the pilot must define the VNAV problem by selecting the desired waypoint, the along-track offset, the desired altitude, and the desired vertical angle the aircraft is to fly in reaching the waypoint (or offset from the waypoint). The KNS 660 then computes the vertical deviation from the defined vertical path and displays this deviation on a vertical deviation indicator. In manual VNAV, guidance is provided so as to transition the aircraft to level flight at the selected altitude and at the selected location over the earth.

Typically, VNAV information is fed to the KFC 400 Flight Control System where the pilot may either hand fly the commands provided by the flight director indicator or the pilot may engage the autopilot and then simply monitor that the autopilot is properly tracking the flight director commands and the vertical deviation indicator.

Although rarely done, VNAV information from the KNS 660 may also be hand flown by following the raw deviation data displayed on the vertical deviation indicator.

Manual VNAV Terminology and Displays

Because the KNS 660 - KFC 400 VNAV capabilities allow so much flexibility it will be helpful to go through the following example in order to understand the terminology associated with manual VNAV. Refer to the figures on the previous page (which folds out) as you go along. In this example the active flight plan is shown in Figure 7-128. The KNS 660 is in AUTO/LEG operation. Figure 7-131 shows a plan view of a portion of the active flight plan while Figure 7-132 shows the corresponding elevation view. The associated VNAV values are shown on the NAV 2 page in Figure 7-129.

MANUAL VNAV - AUTO/LEG OPERATION (Cont'd)

1 VNAV-ON: These words are displayed on the NAV 2 page (Figure 7-129) whenever the pilot has taken action to enable the VNAV function of the KNS 660. The KNS 660 is now calculating deviation from the pilot specified vertical path and this deviation (in feet) is displayed on the vertical deviation indicator. When the VNAV function of the KNS 660 is not enabled, the words VNAV- OFF are displayed. Under these conditions the actual vertical angle to the VNAV waypoint is displayed on the vertical deviation indicator in place of deviation.

There are two means of enabling the KNS 660 VNAV function:

a. Pressing the VNAV select button on the KMS 446 mode selector.

b. Pressing the ENTER key on the KNS 660 CDU while the cursor is on the SEL ANG field of the NAV 2 page.

The actual procedures for using these two methods of enabling the VNAV function are explained a little later in this section of the Pilot's Guide.

If the VNAV function of the KNS 660 has been enabled, the pilot may disable the function by positioning the Cursor over either the SEL WPT field or the SEL ANG field on the NAV 2 page and pressing the CLR key followed by the ENTER key.

2 Vertical Deviation Indicator: This indicator (reference Figures 7-125, 7-126, and 7-127) displays deviation from the pilot specified vertical path when the KNS 660 VNAV is enabled (i.e. VNAV-ON). When the vertical deviation indicator is a KCI 310 or KCI 310A and the KNS 660 is in the RNV ENR mode full scale deflection indicates ±1000 ft. When the KNS 660 is in the RNV APR mode the indicator scale is ±500 ft. WHEN THE VERTICAL DEVIATION INDICATOR IS AN ED-102 EHSI REFER TO THE AIRCRAFT FLIGHT MANUAL SUPPLEMENT TO DETERMINE THE AMOUNT OF DEVIATION REPRESENTED BY FULL SCALE DEFLECTION FOR BOTH THE RNV ENR AND RNV APR MODES. Much like a glideslope indicator, if the pointer is above the center index then the aircraft is below the vertical path. If the pointer is below the center index then the aircraft is above the vertical path.

When the KNS 660 VNAV is not enabled (VNAV-OFF) the vertical deviation indicator displays the actual vertical angle to the vertical waypoint. If the KNS 660 is not computing a vertical angle the vertical deviation indicator is flagged (or sometimes totally removed from display in the case of an EHSI). When the vertical deviation indicator is a KCI 310 or KCI 310A and it is displaying angle it has a range of from -5 to +5 degrees. WHEN THE VERTICAL DEVIATION INDICATOR IS AN ED-102 EHSI, REFER TO THE AIRCRAFT'S FLIGHT MANUAL SUPPLEMENT TO DETERMINE THE ANGLE RANGE WHICH CAN BE DISPLAYED. If the selected altitude is below the aircraft's actual altitude the angle is negative and the pointer is below the center index. If the selected altitude is higher than the aircraft's actual altitude, the angle is positive and the pointer is above the center index.

MANUAL VNAV - AUTO/LEG OPERATION (Cont'd)

When the vertical deviation indicator is displaying angle the ANG display is illuminated on the upper right side of the KCI 310 or KCI 310A Flight Director Indicators. When deviation is being displayed the ANG display is not illuminated. If an ED-102 EHSI is installed instead, the abbreviation ANG VNAV is shown above the VNAV scale when angle is being displayed and VNV is shown when deviation is being displayed.

3 Selected Vertical Waypoint (SEL WPT): A waypoint that has been assigned an altitude. This waypoint must be in the flight plan ahead of the aircraft or a DIRECT TO waypoint. The waypoint named HOOZE is the selected vertical waypoint in this example. When the VNAV function is not enabled (i.e. VNAV-OFF is displayed) the system automatically chooses the active "TO" waypoint as the selected vertical waypoint. The pilot may, however, manually choose another waypoint subject to the limitations above.

4 Selected Offset (SEL OFST): The pilot may enter an along-track offset so that the aircraft reaches the selected altitude a specified distance before or after the selected vertical waypoint. Entering a negative value causes the aircraft to reach the desired altitude prior to reaching the selected vertical waypoint while entering a positive value causes the aircraft to reach the selected altitude on the other side of the selected vertical waypoint along the flight path.

In the example, the selected offset is a −3.0 nautical miles which means the aircraft will reach the selected altitude 3.0 nautical miles prior to HOOZE, the selected vertical waypoint.

5 Offset Vertical Waypoint: When the pilot enters an along-track offset in the SEL OFST field of the NAV 2 page, the point that is defined is referred to as the offset vertical waypoint. All vertical calculations are made to this point but the KNS 660 still provides guidance in the lateral sense (over the ground) to the flight plan or DIRECT TO waypoints. The offset vertical waypoint in Figure 7-132 is designated by the V symbol. Note that if the selected offset had been a +3.0 instead of a −3.0 that the offset vertical waypoint would have been located 3NM from the waypoint named HOOZE along the course line connecting HOOZE and MKC.

6 Actual Altitude (ACT ALT): The aircraft's actual MSL altitude in feet. The aircraft's altitude in the example is 23,000 ft.

7 Selected Altitude (SEL ALT): The pilot can select a desired ending altitude for the aircraft to be at upon reaching the selected vertical waypoint or offset vertical waypoint. This altitude may be entered in the SEL ALT field of the NAV 2 page (Figure 7-129) or using the altitude select knobs and the associated selected altitude display of the KAV 485 altitude/vertical speed indicator (Figure 7-130). The selected altitude in the example is 6000 ft. Whenever the VNAV function is enabled, (VNAV ON), the selected altitude is displayed on the right side of the third line of every page of the CDU (Figure 7-128). The asterisk preceding the altitude indicates that there is a selected offset (SEL OFST) other than 0.

8 Actual Vertical Track Angle (ACT ANG): The actual vertical track angle from the selected vertical waypoint (or offset vertical waypoint if an offset has been entered) to the aircraft's present position. The actual vertical track angle in the example is 2.0°.

MANUAL VNAV - AUTO/LEG OPERATION (Cont'd)

9 Selected Vertical Track Angle (SEL ANG): The pilot may select a vertical track angle to the vertical waypoint or offset vertical waypoint. The selected vertical track angle in the example is 3.5°. This angle can be equal to the actual vertical angle or an angle larger than the actual vertical angle. The maximum angle which can be selected for most aircraft is 6.0°. However, where certification allows in some aircraft the system is programmed to accept up to 9.9°.

NOTE

REFER TO THE AIRCRAFT'S FLIGHT MANUAL SUPPLEMENT TO DETERMINE THE MAXIMUM ALLOWABLE SELECTED VERTICAL TRACK ANGLE.

When the KNS 660 VNAV function is not enabled, the value in the SEL ANG field automatically tracks the value in the ACT ANG field. The act of selecting a vertical track angle is what enables the VNAV function of the KNS 660. This is done by pressing the VNAV select button on the KMS 446 mode selector or by pressing the CDU's ENTER key while the cursor is on the SEL ANG field of the NAV 2 page.

10 Actual Offset (ACT OFST): The along-track distance in nautical miles from the aircraft's present position to the offset vertical waypoint. The actual offset distance in the example is 81 NM.

11 VNAV Alert Annunciator/Switch (Shown in Figure 7-124): This combination annunciator and push button switch is utilized in manual VNAV when the pilot has preselected a vertical track angle. Its use can be illustrated by referring to Figure 7-131 and Figure 7-132. Notice that the aircraft's actual vertical track angle is 2.0° but the pilot has preselected a vertical track angle of 3.5°. The intent being to remain at the existing altitude until intercepting the 3.5° vertical track angle. Approximately 1.5 minutes from intercepting the selected 3.5° vertical track angle the VNAV alert annunciator/switch will begin flashing. This is to alert the pilot of the upcoming change to the aircraft's vertical track. The pilot must press the push button switch while the annunciator is flashing to approve the upcoming vertical track change. If the pilot does not press the push button during the 1.5 minute period, the VNAV function will automatically be disabled.

If the pilot preselects a vertical track angle which will be intercepted in less than 1.5 minutes, the annunciator comes on steadily for five seconds (instead of flashing) along with a scratch pad message stating: VNAV< 1.5 MIN. Under these conditions the pilot need not approve the upcoming vertical track change but may do so to extinguish the lighted annunciator.

Operating Procedures For Manual VNAV-AUTO/LEG Operation

Two examples will be used to illustrate the procedures for using manual VNAV with the KNS 660 in the AUTO/LEG Method of Operation.

Example 1 - The aircraft is operating on the same flight plan as the earlier example (Figure 7-133) and is on the leg between Salina VORTAC (SLN) and HOOZE intersection. The aircraft is at 23,000ft. and is 84nm from HOOZE intersection (Figure 7-134) when it receives a clearance to cross HOOZE intersection at 6000 ft.

1. KNS 660 NAV key - PRESS twice to view the NAV 2 page (Figure 7-135). Verify that HOOZE is displayed in the SEL WPT field. Unless the pilot had previously entered another waypoint into the SEL WPT field, HOOZE should already be displayed since it is the current "TO" waypoint in the flight plan.

2. KAV 485 altitude select knobs - ROTATE to select 6000 ft. in the altitude select display of the KAV 485 (Figure 7-136). 6000 ft. will now also be displayed in the SEL ALT field of the NAV 2 page. (Figure 7-137). Anytime a new altitude is selected on the KAV 485, that same altitude is inserted into the SEL ALT field of the NAV 2 page.

3. Vertical Deviation Indicator - VIEW to determine the actual vertical track angle to HOOZE vertical waypoint. It is indicating a negative 2° vertical track angle (Figure 7-138) which can be verified by viewing the ACT ANG field (Figure 7-137). The ANG annunciator on the KCI 310 or KCI 310A will illuminate to indicate that the vertical deviation indicator is displaying angle. In an EFS 10 installation, ANG VNV will be displayed on the ED-102 EHSI.

4. VNAV Select Button on KMS 446 Mode Selector - PRESS to enable the KNS 660 VNAV function and engage the VNAV mode of the KFC 400 Flight Control System (Figure 7-139). The NAV 2 page will now display VNAV-ON and the selected altitude will now be displayed on the right side of the third line on every page (Figure 7-140). The 2.0° vertical track angle becomes the reference flight path angle and the vertical deviation indicator now displays altitude deviation in feet (±1000 ft. full scale) from this reference flight path. The ANG annunciator is extinguished on the KCI 310 or KCI 310A. If the installation contains an ED-102 EHSI, VNV is displayed above the vertical deviation scale. The command bars of the flight director will deflect up or down (and the aircraft will follow if the autopilot is engaged) to provide guidance to acquire and hold the reference flight path.

   Engagement of the VNAV Coupled mode of the KFC 400 automatically activates the altitude arm (ALT ARM) mode of the flight control system to capture the selected altitude (6000 ft.) As the aircraft reaches 6000 ft. at HOOZE, the VNAV coupled mode of the KFC 400 will automatically disengage and altitude hold (ALT) will automatically engage. The KAV 485 will provide its normal altitude alerting functions during the descent to 6000 ft.

   When the selected vertical waypoint HOOZE is passed, the NAV 2 page once again displays VNAV-OFF, the SEL WPT field displays the current "TO" waypoint, and the vertical deviation indicator reverts to displaying vertical track angle.

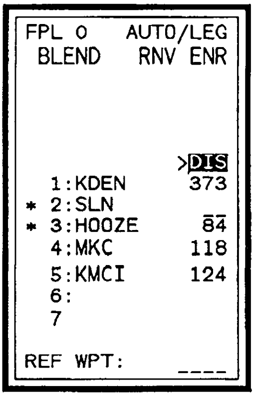


Figure 7-133

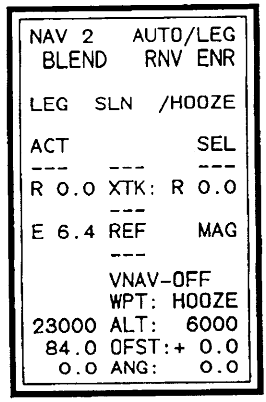


Figure 7-135

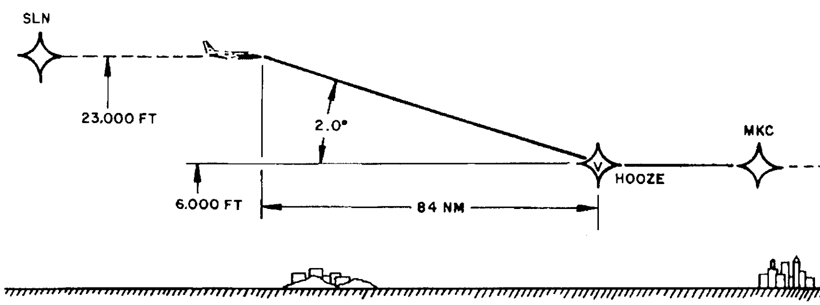


Figure 7-134

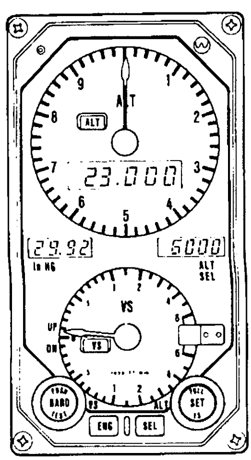


Figure 7-136

MANUAL VNAV - AUTO/LEG OPERATION (Cont'd)

NOTE

TO ENGAGE VNAV AT THE EXISTING VERTICAL TRACK ANGLE ALWAYS USE THE VNAV SELECT BUTTON ON THE KMS 446 MODE SELECTOR AS DISCUSSED IN THIS EXAMPLE. DO NOT PRESS THE ENTER KEY WHILE THE CURSOR RESTS ON THE SEL ANG FIELD TO ENGAGE THE EXISTING ANGLE BECAUSE BY THE TIME THE KFC 400 VNAV MODE IS SELECTED THE ACTUAL VERTICAL TRACK ANGLE MAY BE ENOUGH LARGER THAN THE SELECTED ANGLE THAT THE KFC 400 CAN'T GO INTO THE VNAV COUPLED MODE.

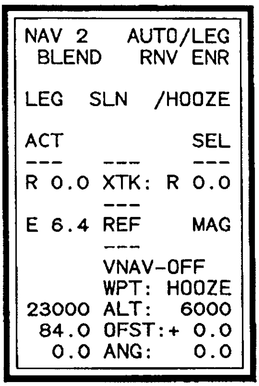


Figure 7-137

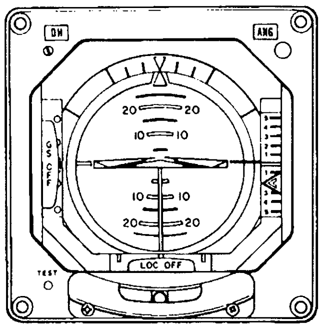


Figure 7-138

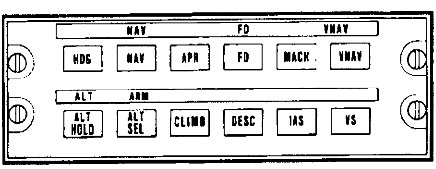


Figure 7-139

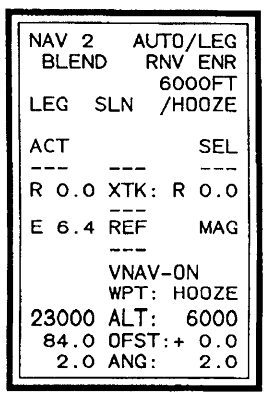


Figure 7-140

Example 2 - In this example the aircraft is operating on the flight plan from Dallas-Ft. Worth (KDFW) to Atlanta Hartsfield (KATL) shown on the FPL0 page in Figure 7-141. The aircraft is presently at 25,000 ft. and 72nm west of La Grange VOR (LGC). At this time a clearance is received to continue the existing route clearance to LGC, and to cross the TIROE intersection at or below 10,000 ft. To comply, the pilot decides to use the VNAV capabilities of the KNS 660 and KFC 400. Figure 7-142 shows the plan view of the current situation while Figure 7-143 shows an elevation view.

1. KNS 660 NAV key - PRESS twice to view the NAV 2 page (Figure 7-144). Notice that LGC is in the SEL WPT field because it is the current "TO" waypoint in the flight plan. Since the vertical navigation will be referenced to TIROE the pilot will have to manually input this identifier.

2. TIROE waypoint - INPUT directly into the SEL WPT field. When the ENTER key is pressed the Waypoint page for the entered waypoint (TIROE) will appear. Approving the Waypoint page will bring back the NAV 2 page with the Cursor over the SEL ALT field (Figure 7-145).

3. 10,000 FT - INPUT directly into the SEL ALT field. When the ENTER key is pressed the Cursor will move to the SEL OFST field (Figure 7-146). The altitude in the selected altitude display of the KAV 485 altitude/vertical speed indicator does not change to 10,000 ft at this time but remains at the last altitude selected by the pilot in order to retain altitude alerting capabilities.

```
FPL 0      AUTO/LEG
 BLEND      RNV  ENR


                >DIS
  1 KDFW         532
  2:BUJ          --
  3:TXK          --
* 4:GRW          --
* 5:LGC          72
  6:TIROE        95
  7:KATL        125
  8:

REF WPT:        ----
```

Figure 7-141

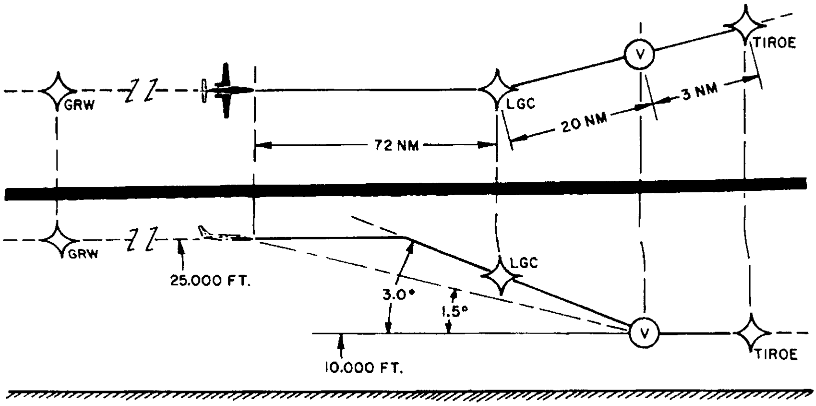


Figure 7-142 (Top)
Figure 7-143 (Bottom)

```
NAV 2      AUTO/LEG
 BLEND     RNV  ENR

LEG   GRW   /LGC

ACT              SEL
---     ---      ---
R 0.0  XTK:  R 0.0
        ---
W 0.1  REF       MAG
        ---
       VNAV-OFF
       WPT:  LGC
25000  ALT:  10000
 72.0  OFST:+  0.0
  0.0  ANG:    0.0
```

Figure 7-144

```
NAV 2      AUTO/LEG
 BLEND     RNV  ENR

LEG   GRW   /LGC

ACT              SEL
---     ---      --
R 0.0  XTK:  R 0.0
        ---
W 0.1  REF       MAG
        ---
       VNAV-OFF
       WPT:  TIROE
25000  ALT:  25000
 95.0  OFST:+  0.0
  0.0  ANG:    0.0
```

Figure 7-145

```
NAV 2      AUTO/LEG
 BLEND     RNV  ENR

LEG   GRW   /LGC

ACT              SEL
---     ---      ---
R 0.0  XTK:  R 0.0
        ---
W 0.1  REF       MAG
        ---
       VNAV-OFF
       WPT:  TIROE
25000  ALT:  10000
 95.0  OFST:+  0.0
  1.4  ANG:    1.4
```

Figure 7-146

MANUAL VNAV - AUTO/LEG OPERATION (Cont'd)

In order to assure that the aircraft is at 10,000 ft. and is slowed sufficiently before reaching TIROE the pilot decides to create an offset vertical waypoint three nautical miles prior to reaching TIROE.

4. −3.0 - INPUT into the SEL OFST field by first pressing the numeric nine key to get the minus sign, followed by the three key and the zero key. When the ENTER key is pressed the cursor will move to the SEL ANG field (Figure 7-147).

At this point the pilot can view the actual vertical track angle to the offset vertical waypoint by viewing the vertical deviation indicator or by viewing the ACT ANG field of the NAV 2 page to see that the existing angle is 1.5°. The pilot could at this time press the VNAV select button on the KMS 446 mode selector to enable the KNS 660 VNAV function and enable the VNAV mode of the KFC 400 Flight Control System. Instead, the pilot decides to keep the aircraft at the present altitude until intercepting a more efficient vertical track angle descent path such as 3.0°.

5. 3.0 - INPUT into the SEL ANG field. When the ENTER key is pressed VNAV-ON is displayed on the NAV 2 page (Figure 7-148) and the vertical deviation indicator displays deviation from the 3.0° vertical track angle. The 10,000 ft VNAV ending altitude will now be displayed on the third line of <u>every</u> CDU page. The asterisk preceding the altitude indicates that an offset has been selected (-3.0 nm in this case).

6. VNAV button on KMS 446 mode selector - PRESS to "arm" the KFC 400 VNAV mode. (Figure 7-149) The KFC 400 will remain in its existing vertical mode (altitude hold, pitch attitude hold, etc.).

Approximately 1.5 minutes from intercepting the 3.0° vertical track angle the VNAV alert annunciator/switch begins flashing and the VNAV-ON annunciation of the NAV 2 page is replaced by the words APPROVE VNAV.

7. VNAV ALERT ANNUNCIATOR/SWITCH - PRESS to acknowledge the upcoming change to the aircraft's vertical flight path. The VNAV alert annunciator/switch will stop flashing and VNAV-ON will once again be displayed on the NAV 2 page. The altitude in the selected altitude display of the KAV 485 altitude/vertical speed indicator will now change to the VNAV ending altitude of 10,000 ft.

   If the pilot fails to press the VNAV alert annunciator/switch during the 1.5 minute period then the VNAV functions of the KNS 660 and KFC 400 are canceled.

   When the aircraft intercepts the selected 3.0° vertical track angle the ARM annunciation on the KMS 446 mode selector will extinguish leaving only the VNAV annunciation and the KFC 400 will then be in the VNAV coupled mode. The command bars of the flight director will provide guidance to acquire and hold the 3.0° vertical track angle to the offset vertical waypoint. Engagement of the VNAV coupled mode automatically activates the altitude arm (ALT ARM) mode of the KFC 400 to capture the selected altitude (10,000ft). While the KNS 660 is providing vertical guidance along the 3.0° vertical track angle it is also providing lateral navigation along the flight plan route (to LGC and then on to TIROE).

MANUAL VNAV - AUTO/LEG OPERATION (Cont'd)

As the aircraft reaches 10,000 ft. three nautical miles from TIROE the VNAV coupled mode of the KFC 400 will automatically disengage and altitude hold (ALT) will engage. The NAV 2 page will display VNAV-OFF and the vertical deviation indicator will revert to displaying vertical track angle.

NOTE

THE VNAV DATA ON THE NAV 2 PAGE SHOULD ALWAYS BE REVIEWED PRIOR TO ENGAGING THE VNAV FUNCTION OF THE KNS 660 AND KFC 400.

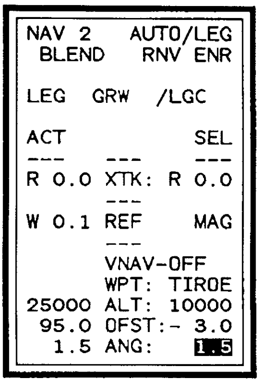


Figure 7-147

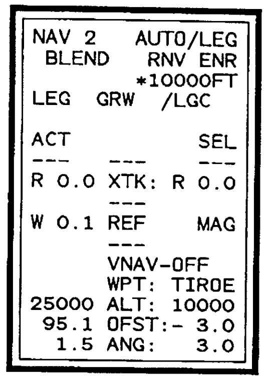


Figure 7-148

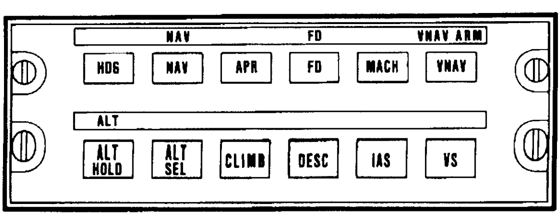


Figure 7-149

MANUAL VNAV - OBS OPERATION

Manual VNAV with the KNS 660 in OBS operation is virtually identical to manual VNAV with the KNS 660 in AUTO/LEG operation. The exception is that before VNAV can be enabled the selected vertical waypoint (SEL WPT) is restricted to being the same as the active lateral waypoint. (In manual VNAV with the KNS 660 in AUTO/LEG operation, recall that any flight plan 0 waypoint that is ahead of the aircraft may be used as the selected vertical waypoint as was done in example 2.) Whereas in AUTO/LEG operation the system always automatically inserts the current "TO" waypoint into the NAV 2 page SEL WPT field when the VNAV is not enabled (VNAV-OFF), in OBS operation the system inserts the current waypoint (whether its "TO" or "FROM") into this field. VNAV cannot be engaged with a "FROM" waypoint in the SEL WPT field.

CANCELING OF MANUAL VNAV

Manual VNAV (AUTO/LEG or OBS operation) and AUTO 3D VNAV are very sensitive to changes that affect vertical navigation calculations. If the pilot changes any parameter which affects the VNAV problem while VNAV is enabled then the KNS 660 VNAV operation and the KFC 400 VNAV mode are automatically canceled. When this occurs a message is displayed on the Message page stating: VNAV CANCELED. Some of the items which may cause VNAV to be canceled are the following:

1. Activating a new flight plan or waypoint or doing anything else that causes the KNS 660 to flag.
2. Changing the Method of Operation of the system (OBS, AUTO/LEG, AUTO 3D).
3. Changing the selected vertical waypoint, selected altitude, selected offset, or selected vertical track angle.
4. Not pressing the flashing VNAV alert annunciator/switch to acknowledge an upcoming vertical track change.
5. Changing the selected parallel offset on the NAV 2 page.
6. Changing the vertical mode of the KFC 400 Flight Control System from a VNAV armed or VNAV coupled mode to an non-VNAV mode.
7. Changing the definition of the vertical flight path such as by adding or deleting waypoints from the current vertical leg.
8. Changing the definition of a waypoint in the current vertical leg of the flight plan.
9. VNAV may be intentionally canceled by positioning the cursor over either the SEL WPT or SEL ANG fields on the NAV 2 page and pressing the CLR key followed by the ENTER key.

NOTE

THE AIRCRAFT HEADING MUST BE WITHIN 80° OF THE SELECTED COURSE TO THE VERTICAL WAYPOINT IN ORDER TO ENABLE THE VNAV FUNCTION. ONCE ENABLED, VNAV WILL BE CANCELED IF THE AIRCRAFT HEADING EXCEEDS 80° FROM THE SELECTED COURSE.

AUTO 3D

General

The AUTO 3D Method of Operation was designed to accommodate unique requirements of certain aircraft operators who have made special arrangements with ATC to obtain "canned" flight plan clearances. These clearances include not only the exact lateral routing between airports but also include altitudes for each leg of the flight from take-off to touchdown. However, other pilots flying aircraft equipped with the KNS 660 navigation system and the KFC 400 Flight Control System may find applications such as profile descents where AUTO 3D operation is useful.

When the KNS 660 is in the AUTO 3D Method of Operation, lateral navigation (two-dimensional navigation over the earth) is identical to that of AUTO/LEG. The primary differences between AUTO 3D and AUTO/LEG are the characteristics of vertical navigation associated with these two Methods of Operation. Where AUTO/LEG allows manual VNAV to a single waypoint, AUTO 3D allows sequential vertical navigation to any or all waypoints in the flight plan.

In AUTO 3D, the pilot may preassign altitudes for as many waypoints in the flight plan, as required. The altitudes are usually assigned on either a Flight Plan # page or directly on the Flight Plan 0 page. The altitudes and distances between waypoints define the vertical path. Before the VNAV function can be enabled in AUTO 3D, the pilot must specify VNAV parameters that indicate how the AUTO 3D path will be initially acquired. This is performed just as in manual VNAV; that is, by specifying the selected offset and selected angle to the waypoint in the flight plan where the vertical flight path is to be acquired. Once the vertical flight path is captured the system automatically sequences to the next leg of the AUTO 3D path every time the aircraft passes a vertical waypoint. All VNAV data on the NAV 2 page tracks the current vertical waypoint. As in manual VNAV, the KNS 660 can feed VNAV information to the KFC 400 Flight Control System where the pilot may hand fly the commands provided by the flight director indicator or the pilot may engage the autopilot and monitor proper tracking.

AUTO 3D Terminology and Displays

Much of the methodology discussed in manual VNAV operation is applicable to AUTO 3D. The fictitious flight plan shown in Figure 7-150 will be used in an example to illustrate the characteristics of AUTO 3D operation. Figure 7-151 shows the Flight Plan # page with the altitudes assigned to the waypoints. A plan view and elevation view representation of the AUTO 3D flight plan are shown in Figures 7-152 and 7-153, respectively.

1 VNAV-ON: Just as in manual VNAV, these words are displayed on the NAV 2 page when the VNAV function of the KNS 660 has been enabled by the pilot. The vertical deviation indicator now displays deviation in feet from the vertical path. When the VNAV function of AUTO 3D is not enabled the NAV 2 page displays VNAV-OFF and the vertical deviation indicator displays the actual vertical angle to the next vertical waypoint (a waypoint which has been assigned an altitude).

2 Vertical Deviation Indicator: Same indications as manual VNAV.

AUTO 3D Terminology and Displays (Cont'd)

3 Vertical Waypoint: Any waypoint in an AUTO 3D flight plan which has been assigned an altitude. In this example, Figures 7-151 and 7-153 illustrate that WPT1, WPT2, WPT3, WPT4, and WPT6 are vertical waypoints because they have been assigned altitudes. The altitudes assigned to vertical waypoints can be displayed on the FPL0 page (Figure 7-154) only for those vertical waypoints which are still ahead of the aircraft in the flight plan. Assigned altitudes for waypoints already passed are dashed.

4 Selected Vertical Waypoint (SEL WPT): The current vertical waypoint (Figure 7-155). It is normally automatically selected as the next vertical waypoint that has not been passed in the flight plan. However, the pilot may also input any waypoint that is ahead of the aircraft in the flight plan. In "DIRECT TO" operation the SEL WPT defaults to the "DIRECT TO" waypoint. WPT4 is the selected vertical waypoint in the example because it is the next vertical waypoint in the flight plan. Had the aircraft instead been located between WPT4 and WPT5, the selected vertical waypoint would be WPT6 since it is the next vertical waypoint in the flight plan.

5 Selected Offset (SEL OFST): In AUTO 3D VNAV operation the pilot may specify a positive or negative along-track offset on the NAV 2 page only in order to acquire the vertical flight path. Once the AUTO 3D flight path is acquired the selected offset to each of the vertical waypoints is 0. If the pilot enters a selected offset, VNAV is canceled and the pilot must again acquire the vertical flight path.

6 Offset Vertical Waypoint: As in the manual VNAV case, when the pilot enters an along-track offset the point that is defined is referred to as the offset vertical waypoint. Figure 7-155 shows the first three waypoints from Figure 7-153. As Figure 7-156 illustrates, when an offset vertical waypoint is used to initially acquire the vertical flight path, the vertical flight path now starts from the offset vertical waypoint. For example, when the offset vertical waypoint was defined by entering a -4.0 selected offset the vertical flight path now starts from this offset vertical waypoint. Notice that the flight path does not include a level segment between the offset vertical waypoint and WPT2.

7 Actual Altitude (ACT ALT): The aircraft's actual MSL altitude in feet. The aircraft's altitude in the example is 29,000 ft.

```
FPL 0        AUTO 3D
 BLEND       RNV ENR
             29000FT


               >DIS
  1 WPT1        195
  2:WPT2         --
* 3:WPT3
* 4:WPT4         31
  5:WPT5         59
  6:WPT6         83
  7:WPT7         95
  8:

 REF WPT:      ____
```

Figure 7-150

```
FPL 21   AUTO/LEG
 BLEND    RNV ENR

ACTIVATE?
INVERT?
                >ALT
  1 WPT1    :  1000
  2:WPT2    :23000
* 3:WPT3    :29000
* 4:WPT4    :29000
  5:WPT5    :
  6:WPT6    :  1500
  7:WPT7    :_____
  8:
  9
 REF WPT:      ____
```

Figure 7-151

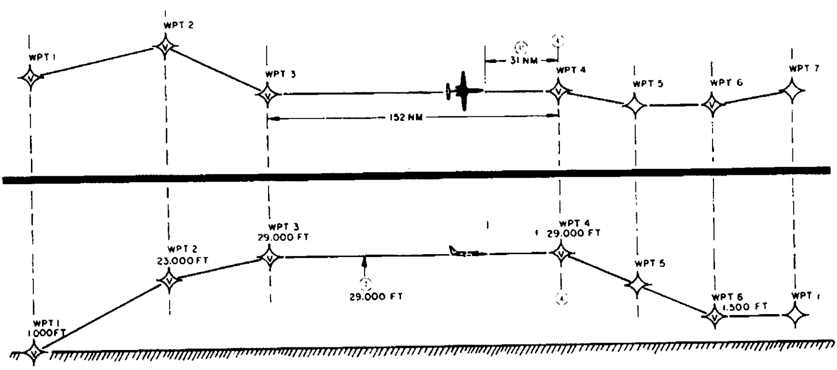


Figure 7-152 (Top)
Figure 7-153 (Bottom)

```
FPL 0        AUTO 3D
 BLEND       RNV ENR
             29000FT


               >ALT
  1 WPT1    :_____
  2:WPT2    :_____
* 3:WPT3    :
* 4:WPT4    :29000      ←8
  5:WPT5    :
  6:WPT6    :  1500
  7:WPT7    :_____
  8:

 REF WPT:      ____
```

Figure 7-154

```
     NAV 2       AUTO 3D
      BLEND      RNV ENR
                 29000FT     ←8
     LEG   WPT3 /WPT4

     ACT             SEL
     ---     ---     ---
     R 0.0  XTK:  R 0.0
             ---
     E 5.3  REF      MAG
             ---
            VNAV-ON          ←1
            WPT:  WPT4       ←4
 7→  23000  ALT:  29000      ←8
11→   31.2  OFST:+ 0.0       ←5
 9→    2.0  ANG:    0.0      ←10
```

Figure 7-155

AUTO 3D (Cont'd)

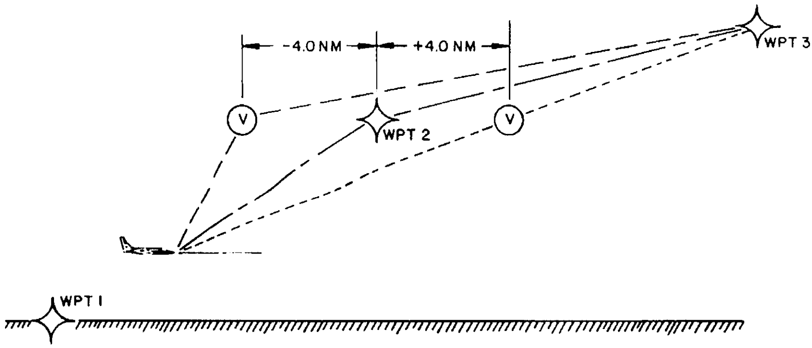


Figure 7-156

8 Selected Altitude (SEL ALT): The selected altitude normally automatically becomes the preassigned altitude of the selected vertical waypoint (SEL WPT). The selected altitude may also be manually selected at any time by the pilot. This altitude may be selected in the appropriate ALT field of the Flight Plan 0 page (Figure 7-154), in the SEL ALT field of the NAV 2 page, or with the altitude select knobs of the KAV 485 altitude/ vertical speed indicator. The selected altitude in the example is 29,000 ft since this is the altitude assigned to the selected vertical waypoint.

9 Actual Vertical Track Angle (ACT ANG): Same as Manual VNAV. The angle defined by the aircaft's actual altitude (ACT ALT), the selected altitude of the selected vertical waypoint, (SEL ALT), and the along-track distance to the selected vertical waypoint (ACT OFST).

10 Selected Vertical Track Angle (SEL ANG): Before AUTO 3D VNAV has been enabled by the pilot the selected vertical track angle tracks the actual vertical track angle. In order to acquire the AUTO 3D vertical flight path the pilot may select this default value or select an angle larger than the ACT ANG.

Once the AUTO 3D vertical flight path has been acquired the SEL ANG is defined by the altitude of the selected vertical waypoint (29,000 ft in this example), the altitude of the "FROM" vertical waypoint (29,000 ft for WPT3), and the along-track distance between these vertical waypoints (152nm). In this example the SEL ANG is 0.0° since there is no change of altitude between these vertical waypoints.

NOTE

THE MAXIMUM ALLOWABLE SELECTED VERTICAL TRACK ANGLE FOR MOST AIRCRAFT IS 6.0°. HOWEVER, WHERE CERTIFICATION ALLOWS IN SOME AIRCRAFT THE SYSTEM WILL ACCEPT UP TO 9.9°. REFER TO THE AIRCRAFT'S FLIGHT MANUAL SUPPLEMENT TO DETERMINE THE MAXIMUM ALLOWABLE SELECTED VERTICAL TRACK ANGLE.

AUTO 3D (Cont'd)

11 Actual Offset (ACT OFST): Same as manual VNAV. The along-track distance in nautical miles from the aircraft's present position to the selected vertical waypoint (or offset vertical waypoint if one exists). The actual offset distance in the example is 31nm.

12 VNAV Alert Annunciator/Switch (Shown in Figure 7-127): The function of this combination annunciator and push button in AUTO 3D is similar to its use in manual VNAV. It is utilized in two situations: (1) when initially acquiring the AUTO 3D vertical flight path with the pilot preselecting a vertical track angle and (2) once the AUTO 3D vertical flight path has been acquired, every time there is a change to the vertical flight path; that is, prior to each vertical waypoint. The first situation is identical to its use in manual VNAV. To illustrate the second situation refer to Figure 7-157 which shows a portion of the vertical flight path of Figure 7-153. The AUTO 3D VNAV is enabled (VNAV-ON displayed on NAV 2 page as shown in Figure 7-155).

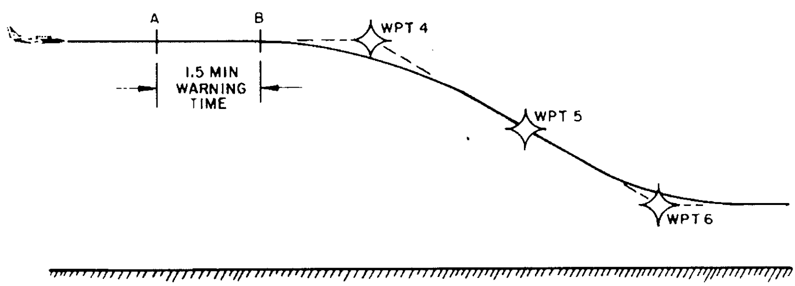


Figure 7-143

The VNAV alert annunciator/switch begins flashing at point "A" which is approximately 1.5 minutes from point "B". Point "B" is the location where the transition to the next vertical flight path begins. When the annunciator flashes, the pilot must press the push button switch to acknowledge the upcoming change to the vertical track. During this 1.5 minute period the words NEXT VNAV WPT flash on the NAV 2 page in place of VNAV-ON. In addition, the value of the altitude displayed on the third line of every page and in the SEL ALT field on the NAV 2 page is the altitude of the next vertical waypoint which is 1500 ft. The SEL WPT field now displays the next vertical waypoint (WPT6) and the SEL ANG field displays the vertical angle between WPT4 and WPT6. Once the pilot acknowledges the upcoming track angle change by pressing the push button, the VNAV displays return to showing information for the current vertical leg. If the pilot fails to acknowledge the track angle change during the 1.5 minute period, VNAV is canceled.

When the aircraft passes the vertical waypoint (WPT4) the VNAV parameters on the NAV 2 page and the altitude on the third line of each page change to those associated with the next vertical waypoint (WPT6 in this case). This is also the time that the selected altitude display of the KAV 485 altitude/vertical speed indicator changes (from 29,000 ft. to 1500 ft. in this example).

Operating Procedures for AUTO 3D VNAV

A sample trip example will be used to illustrate the procedures for utilizing AUTO 3D VNAV. This trip will be along the same ficticious flight plan from WPT1 to WPT7 as in the previous example shown in Figures 7-152 and 7-153. Refer to these figures as you follow through this example. Note that the waypoints in this flight plan are for illustrative purposes only and that in actual use the pilot would create a flight plan using whatever navaids, intersections, etc. are appropriate to define the required routing. The first thing required is to create the vertical flight plan.

Creating An AUTO 3D Flight Plan

1. The pilot uses the normal procedures detailed in Section VI, "CREATING A NUMBERED FLIGHT PLAN ON A FLIGHT PLAN # PAGE", to create a flight plan consisting of WPT1 through WPT7 (Figure 7-158). The KNS 660 can be in any Method of Operation. It does not have to be in AUTO 3D at this time.

2. Cursor [↓] or [↑] key - PRESS as necessary to position the cursor over the DIS field.

3. CLR key - PRESS once to change the DIS field to ALT.

4. Cursor [↓] key - PRESS twice to position the cursor over the dashed altitude field beside WPT1 (Figure 7-159).

5. 1000 - Input into the altitude field beside WPT1. When the ENTER key is pressed the Cursor will be positioned over WPT2 (Figure 7-160).

6. Cursor [↓] key - PRESS once to position the cursor over the altitude field beside WPT2. Input the altitude associated with WPT2 (23000) in this field and press the ENTER key.

7. Using the same procedure, the pilot enters altitudes for WPT3, WPT4, and WPT 6. No altitudes are entered for WPT5 and WPT7 (Figure 7-161).

The altitudes are now stored in memory along with the waypoints as part of the numbered flight plan (flight plan #21 in this example). This flight plan can be selected from the Flight Plan Menu pages and activated in the normal manner (see SELECTING AND ACTIVATING A NUMBERED FLIGHT PLAN in Section VI). To activate the flight plan just created, the pilot positions the cursor over the ACTIVATE? field and presses the ENTER key (Figure 7-162). Distances will be displayed only when the selected position sensor is providing valid data to the KNS 660.

An AUTO 3D flight plan can also be created directly in Flight Plan 0 as the active flight plan. In order to do this the KNS 660 must be in the AUTO 3D Method of Operation. To display the selectable altitude fields associated with each waypoint the Cursor must be positioned over the DIS field on the FPLO page. Pressing the CLR key repeatedly will cycle the field from DIS to ETA to ETE and finally to ALT. The ALT fields cannot be displayed on the FPLO page until the KNS 660 has been put in the AUTO 3D Method of Operation.

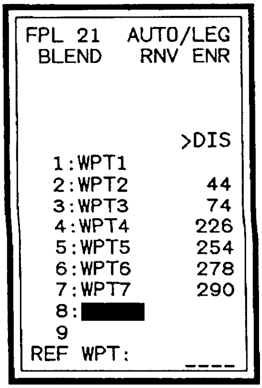


Figure 7-158

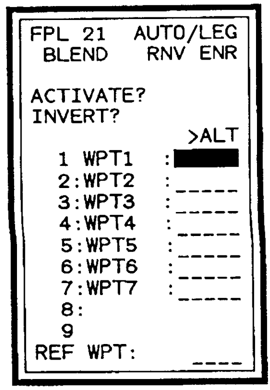


Figure 7-159

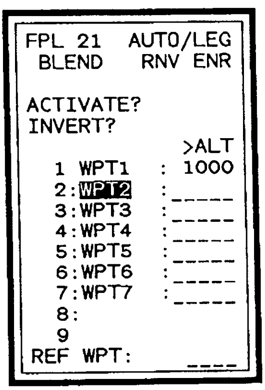


Figure 7-160

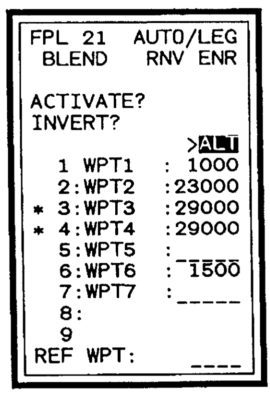


Figure 7-161

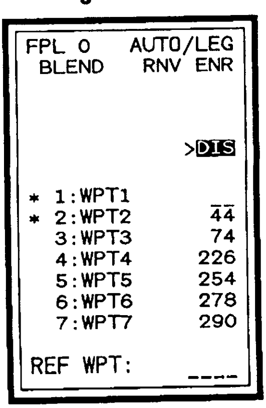


Figure 7-162

Acquiring An AUTO 3D Flight Plan

Prior to takeoff from WPT1 the pilot uses the OBS/LEG key to select the AUTO 3D Method of Operation.

After takeoff the aircraft is given vectors out of the terminal area which takes the aircraft slightly off the desired course. The aircraft is now told to climb and maintain 5000 ft. Finally, the pilot receives clearance "DIRECT TO" WPT2 and to join the vertical flight plan. At this time the aircraft is at the location shown in Figures 7-163 and 7-164. The pilot uses the key to proceed direct to WPT2 (Figure 7-165). In order to acquire the vertical flight plan the pilot uses the following procedure.

1. NAV key - PRESS twice to view the NAV 2 page (Figure 7-166).

2. Altitude select knobs of the KAV 485 altitude/vertical speed indicator - ROTATE to select the desired altitude for WPT2, 23,000 ft. The altitude selected on the KAV 485 is automatically inserted into the SEL ALT field of the NAV 2 page (Figure 7-167).

   Note that if the pilot didn't use the KAV 485 altitude select knobs to select the inital climb restriction altitude of 5000 ft the SEL ALT field would have already had 23,000 ft inserted since it was the preassigned altitude for WPT2. As shown in Figure 7-167 the actual vertical track angle to WPT2 in 2.7° which the pilot decides to use.

3. VNAV button on KMS 446 mode selector - PRESS to enable the KNS 660 AUTO 3D VNAV function and to engage the VNAV mode of the KFC 400 Flight Control System (Figure 7-168). The NAV 2 page is now displaying VNAV-ON and the selected altitude of 23,000 ft will now be displayed on the right side of the third line of every CDU page. The 2.7° vertical track angle becomes the reference flight path angle and the vertical deviation indicator now displays altitude deviation in feet. The command bars of the flight director will deflect up or down (and the aircraft will follow if the autopilot is engaged) to provide guidance to acquire and hold this reference flight path.

Just prior to reaching WPT2 (Approximately 1.5 minutes from beginning the vertical transition to WPT3), the VNAV alert annunciator/switch begins flashing. During this time the pilot can view the VNAV parameters of the next vertical leg of the flight plan by displaying the NAV 2 page (Figure 7-169). The altitude in the SEL ALT field and on the third line of every page is 29,000 ft, the altitude associated with WPT3 which is the next vertical waypoint (SEL WPT). The SEL ANG field displays the vertical angle between WPT2 and WPT3. During the 1.5 minute period that the VNAV alert annunciator/switch is flashing the pilot must press it to acknowledge the upcoming change to the vertical track. (Failure to do so will cause the KNS 660 to cancel VNAV and the KFC 400 to go to the pitch attitude hold mode with the altitude arm mode activated to capture the selected altitude for WPT2 which is 23,000 ft). When the pilot presses the flashing push button to acknowledge the upcoming track angle change the VNAV displays return to showing information for the current vertical leg to WPT2.

When the aircraft passes WPT2 the VNAV parameters on the NAV2 page and of the third line of each page change to those for the next vertical ieg to WPT3 (Figure 7-156). In addition, the selected altitude display of the KAV 485 changes from 23,000 ft to 29,000 ft at this time.

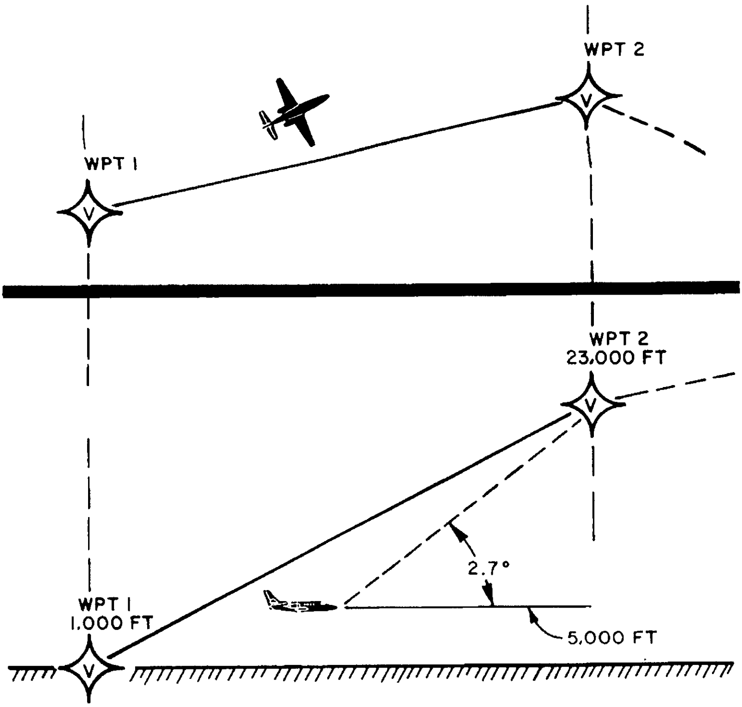


Figure 7-163 (Top)
Figure 7-164 (Bottom)

```
FPL 0        AUTO 3D
 BLEND       RNV ENR

DIR:WPT2          38

               >DIS

   1:WPT1
 * 2:WPT2         38
   3:WPT3         68
   4:WPT4        220
   5:WPT5        248
   6:WPT6        272
   7:WPT7        284

REF WPT:        ----
```

Figure 7-165

```
NAV 2        AUTO 3D
 BLEND       RNV ENR

DIR  WPT2

ACT              SEL
---     ---      ---
R 0.0  XTK:  R 0.0
        ---
E 5.3  REF       MAG
        ---
       VNAV-OFF
       WPT:  WPT2
 5000  ALT:   5000
 38.0  OFST:+  0.0
  0.0  ANG:    0.0
```

Figure 7-166

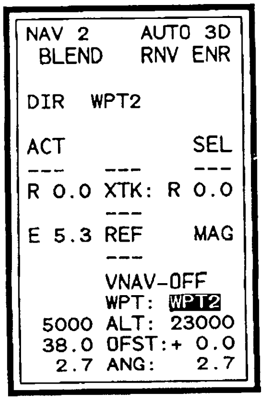
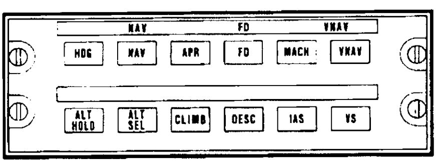


Figure 7-167



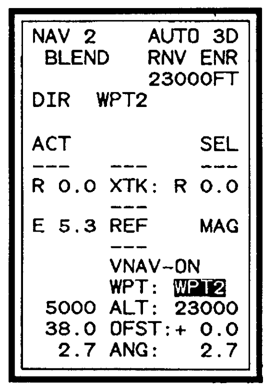


Figure 7-168

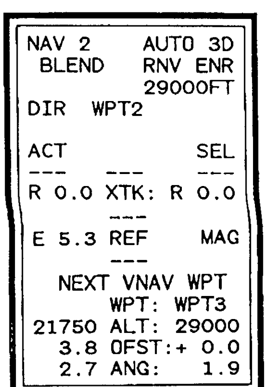


Figure 7-169

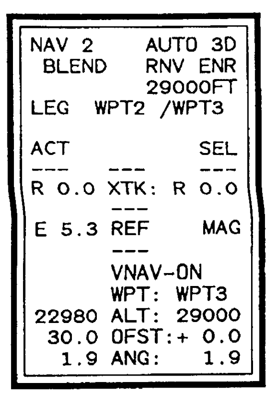


Figure 7-170

Flying the Acquired AUTO 3D Flight Plan

From this point on, the pilot need only press the VNAV alert annunciator/switch at the appropriate times in order to keep the KNS 660 and KFC 400 providing guidance along the defined vertical flight plan. If no deviations are required from the vertical flight plan in this example, the pilot would be required to acknowledge upcoming changes to the vertical track prior to WPT3 and WPT4 just as was done prior to WPT2 since these are vertical waypoints. No pilot acknowledgement is required just prior to WPT6 since it is the last vertical waypoint in the flight plan. After providing guidance to reach WPT3 at 29,000 ft, the KNS 660 and KFC 400 would provide guidance to WPT4 at a 0° vertical track angle since the altitudes associated with WPT3 and WPT4 are both the same. The next vertical leg is defined by WPT4 and WPT6 and guidance would be provided to maintain the vertical track angle between these two vertical waypoints. Lateral navigation is, of course, provided to WPT5. But since the pilot did not assign a specific altitude for WPT5 the aircraft will cross WPT5 at whatever altitude is required to maintain the vertical track angle defined by the altitudes of WPT4 and WPT6 and the along-track distance between WPT4 and WPT6.

WPT6 is the last vertical waypoint in the flight plan. When the aircraft passes WPT6 VNAV remains engaged and the system will automatically assign a 0° vertical track angle. Therefore, since WPT7 has no assigned altitude the system will provide vertical guidance along a 0° vertical track angle between WPT6 and WPT7 and beyond with the result of WPT7 being crossed at 1500 ft. Before continuing with this example we need to review what happens when the pilot changes something that affects the VNAV problem.

Canceling of AUTO 3D VNAV

Just as in manual VNAV, if the pilot changes any parameter that might affect VNAV calculations then the system automatically cancels AUTO 3D VNAV and also the KFC 400 VNAV mode. The Method of Operation remains AUTO 3D but the pilot must manually reacquire the vertical flight path just as was done initially. The same list of items which was given in the manual VNAV section as canceling VNAV applies to AUTO 3D VNAV. In fact AUTO 3D VNAV is more restrictive to change than manual VNAV because changes which affect not only the current vertical leg of the flight plan but also the next vertical leg of the flight plan will cause AUTO 3D to be canceled.

Continuing with a modification to the previous example, let's say that shortly after passing WPT3 at FL 290 on his AUTO 3D flight plan the pilot is told to climb and maintain FL 330. At this point there are a couple actions which the pilot would probably take, each of which would cancel VNAV. If the pilot first used the altitude select knobs of the KAV 485 to select 33,000 ft this would simultaneously change the selected altitude (SEL ALT) of WPT4 on the NAV 2 page and also in the altitude field beside WPT4 on the FPLO page. Changing the selected altitude of the current or next vertical waypoint causes AUTO 3D VNAV to be canceled. If instead the pilot first selected another vertical mode of the KFC 400 such as pitch attitude hold, IAS hold, climb, altitude select, etc., the KNS 660 AUTO 3D VNAV would also cancel since changing the KFC 400 vertical mode while VNAV is enabled causes VNAV to be canceled.

Reacquiring an AUTO 3D Flight Plan (Cont'd)

To comply with the ATC request the pilot climbs to FL 330 and engages the altitude hold mode of the KFC 400 Flight Control System with the NAV mode still engaged. Although the KNS 660 VNAV is no longer enabled, the KNS 660 is still in the AUTO 3D Method of Operation and is still providing lateral navigation to WPT4.

Approximately 53NM from reaching WPT4 the pilot receives a new clearance to rejoin the orignal vertical flight plan, crossing WPT4 at FL 290. The following figures depict the current situation. The aircraft's position is shown in Figure 7-171. The FPL0 page (Figure 7-172) shows the aircraft's position as 53nm from WPT4. If the pilot were to change the cyclic field on the FPL0 page from DIS to ALT the page would be as shown in Figure 7-173. Note that there are no altitudes displayed for the first three waypoints. This is because the system automatically dashes altitudes associated with vertical waypoints that the aircraft has already passed.

Notice also that the altitude associated with WPT4 is now 33,000 ft. instead of the 29,000 ft. which was originally assigned to WPT4. When the pilot was given clearance up to FL 330 he used the KAV 485 altitude select knobs to preselect the new altitude for the KFC 400 to capture. In addition the KAV 485 could now provide its normal altitude alerting capabilities for the assigned altitude of FL 330. Changing the KAV 485 selected altitude to 33,000 ft. also simutaneously changed the selected altitude (SEL ALT) of the current vertical waypoint (WPT 4) to 33,000 ft.

The NAV 2 page for the current situation is shown in Figure 7-174. The pilot decides to remain at FL 330 until intercepting an efficient descent angle such as 3.2° to WPT4.

In order to accomplish this the pilot uses the NAV 2 page to set up the VNAV problem. The selected vertical waypoint SEL WPT is already WPT4 so no action is required for this field. The SEL ALT field is displaying 33000 so the pilot inputs 29000 into this field and presses the ENTER key. The selected altitude displayed on the KAV 485 still remains 33,000 ft. The selected altitude of 29,000 ft. could have also been entered into the ALT field associated with WPT4 on the FPL0 page. The altitude could have also been changed by selecting 29,000 ft on the KAV 485 but this is not a good choice because altitude alerting capability while the aircraft was at FL 330 would have been lost.

The pilot could create an offset vertical waypoint by selecting an along-track offset at this time. The resultant acquistion of the flight path would then be similar to that indicated in Figure 7-156. Since this would be of no benefit in this case the pilot positions the Cursor over the SEL ANG field and enters 3.2°. When the ENTER key is pressed the KNS 660 VNAV is enabled (Figure 7-175). The vertical deviation indicator is now displaying deviation in feet from the selected vertical track angle of 3.2° although at this point the pointer is displaying full scale up.

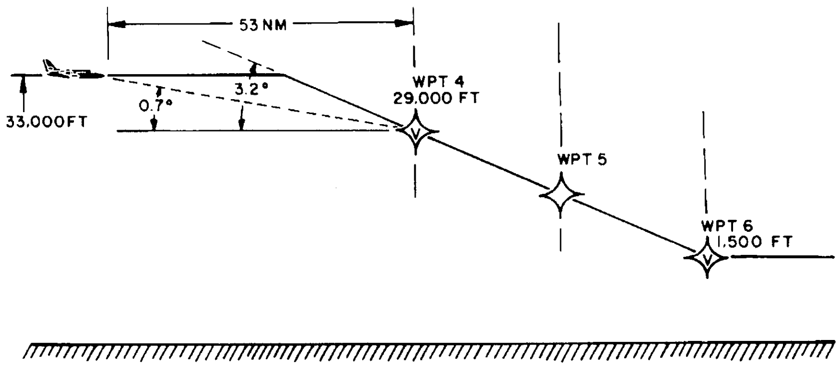


Figure 7-171

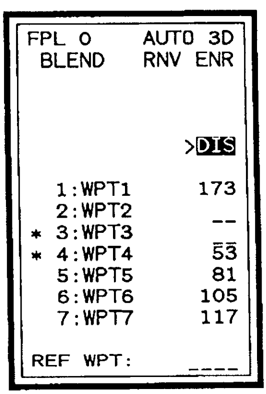


Figure 7-172

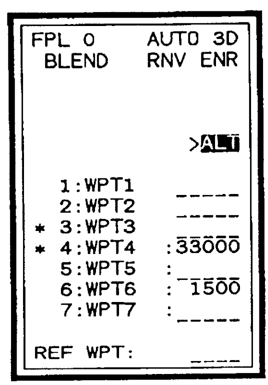


Figure 7-173

AUTO 3D (Cont'd)

Reacquiring An AUTO 3D Flight Plan (Cont'd)

The VNAV select button the KMS 446 mode selector is now pressed to "arm" the VNAV mode of the KFC 400 Flight Control System (Figure 7-176). It will remain in altitude hold mode (ALT) with VNAV ARM displayed until intercepting the 3.2° vertical track angle. When the 3.2° vertical track angle is intercepted the KFC 400 will automatically engage the VNAV coupled mode and the ARM and ALT annunciations on the KMS 446 will be extinguished.

1.5 minutes from intercepting the 3.2° vertical track angle the VNAV alert annunciator/switch begins flashing. As in the previous examples, the pilot must press the push button to acknowledge the upcoming change to the vertical flight path.

The vertical flight path will now be reacquired and vertical as well as lateral guidance will be provided along the rest of the AUTO 3D flight plan as it was orignally created.

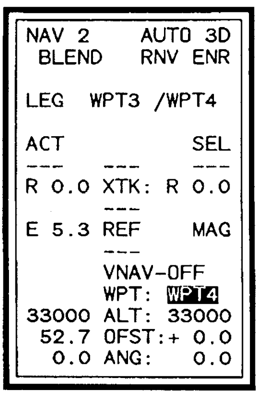


Figure 7-174

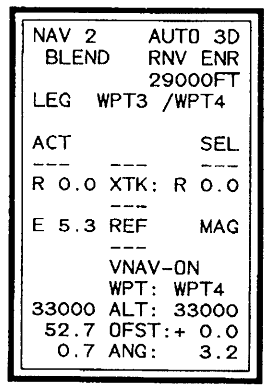


Figure 7-175

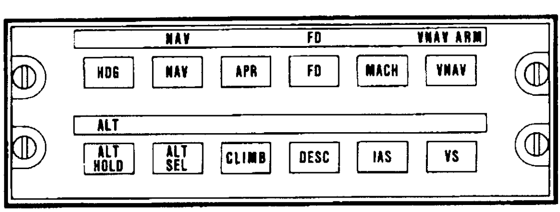


Figure 7-176

VIII Ferry Oper

SECTION VIII

FERRY OPERATION

This section is designed to be used as a stand alone portion of the Pilot's Guide. Its objective is to give the pilot sufficent instruction in order to make the KNS 660 usable for basic VFR navigation in the shortest amount of time and requiring a minumum of training. It is intended strictly for those pilots who have a one time immediate desire to use the KNS 660 as an aid to navigation and who will not be using the KNS 660 on a continuing basis. All others should begin with Section V, Normal Operation Level 1.

WARNING

REFER TO THE AIRCRAFT'S FLIGHT MANUAL FOR SPECIFIC INFORMATION ON HOW THE KNS 660 IS INTERFACED WITH OTHER AVIONICS AND AIRCRAFT SYSTEMS SUCH AS THE AUTOPILOT AND FLIGHT INSTRUMENTS.

KEYBOARD USE

If you are not familiar with the use of KNS 660 keyboard data entry, refer to "Data Keyboards and Data Entry Procedures" found in Section V.

PRE-DEPARTURE (RAMP)

1. ON/OFF Rocker Switch - PRESS ON. SELF TEST page is displayed on screen with cursor (inverse video) over "TEST OK?"

2. BRT/DIM Bright Control Switch - ADJUST as necessary. (Ref. Section III).

3. RMI, DIS, CDI, CRS, ALT, ANN - CHECK actual aircraft displays and instruments for agreement with values listed on screen. If there is disagreement and/or the KNS 660 fails Self Test, the KNS 660 must be turned off with the ON/OFF rocker switch.

4. ENTER key - PRESS to approve the Self Test page. The Initialization page (INIT) will appear.

5. DATE - CHECK. If incorrect, use [↓] or [↑] keys to place cursor over the date field and input the correct date. PRESS ENTER. (Refer to Section IV.)

6. GMT - CHECK. If incorrect, use [↓] or [↑] keys to place cursor over the Greenwich Mean Time field and input the correct time. PRESS ENTER.

7. WPT ID: - INPUT the latitude and longitude of your present location.

   a. Use [↓] or [↑] key to place cursor over first line of POS: field.

   b. Enter latitude. Use either North or South key, located on the 2 or 8 key, prior to entering the latitude in degrees, minutes and tenths of minute. PRESS ENTER.

PRE-DEPARTURE (RAMP) (Cont'd)

c. Enter longitude. Use either East or West key located on the 6 or 4 key prior to entering the degrees, minutes and tenths of minute. PRESS ENTER.

8. Down cursor [↓] key - PRESS repeatedly to position cursor over APPROVE?

9. APPROVE? - PRESS ENTER when all the above items have been correctly entered. The Flight Plan Menu page (FPLS) will appear.

10. Sensor (SNS) key - PRESS repeatedly to determine what sensors are available. The selected sensor is displayed on left side of screen, the second line from top. Select the BLEND sensor.

11. OBS/LEG key - PRESS until AUTO/LEG Method of Operation (upper right hand corner of screen) is displayed.

12. Message (MSG) key - PRESS. Verify that the message "D/BASE OUT DATED" is not being displayed.

NOTE

IF THE DATA BASE NEEDS UPDATING AS INDICATED BY THE MESSAGE "D/BASE OUTDATED", THE DATA BASE WILL HAVE TO BE UPDATED PER THE INSTRUCTIONS IN SECTION V. IF IT IS NOT POSSIBLE TO UPDATE THE DATA BASE, THE KNS 660 SHOULD BE TURNED OFF USING THE ON/OFF ROCKER SWITCH.

13. MSG key - PRESS to return to Flight Plan Menu page.

14. Data (DAT) key - PRESS twice so that DATA 2 Menu page is displayed.

15. Numeral 5 key - PRESS, then PRESS ENTER. The Update Data Base page will be displayed.

16. Numeral 1 key - PRESS, then PRESS ENTER. The Review Data Base page will be displayed.

17. Review Data Base page - CHECK for an asterisk (*) located after the geographic areas which you want to fly. If necessary, refer to Section II for a map showing the parts of the world falling within each of the 10 geographic areas.

18. SEL MENU ITEM: - SELECT a geographic area and INPUT the number associated with the selected geographic area. When the ENTER key is pressed a page showing the navigational elements for the geographic area will be displayed.

PRE-DEPARTURE (RAMP) (Cont'd)

19. Geographic Data - CHECK for an asterisk (*) located after the specific navigation data needed for your area of operation. For example, an asterisk located after APT>3000FT indicates that airports having a hard surface runway of at least 3000 feet for the selected geographic area are located in the Data Base. If navigation is to depend upon the VOR sensor make sure an asterik is located after NAVAID.

    If more than one geographic area needs to be reviewed PRESS the DAT key to return to the Review Data Base page and make another menu selection.

    NOTE

    IF AN ASTERISK IS NOT LOCATED AFTER THE GEOGRAPHIC AREA IN WHICH YOU WANT TO FLY OR THE SPECIFIC NAVIGATION DATA IS NOT SELECTED FOR YOUR AREA OF OPERATIONS, THE DATA BASE WILL HAVE TO BE LOADED PER THE INSTRUCTIONS IN SECTION V. IF IT IS NOT POSSIBLE TO LOAD THE DATA BASE THEN YOU SHOULD NOT ATTEMPT TO USE THE KNS 660 FOR NAVIGATION.

20. Flight Plan (FPL) key - PRESS. The FPL 0 (active flight plan) page will appear. If a flight plan is not already entered (i.e. FPL 0 contains no waypoints) proceed to step 24. If a flight plan is already entered (i.e. FPL 0 contains a list of waypoints) proceed with step 21.

21. Up cursor [↑] key - PRESS once or more so that the cursor field goes off the page (disappears).

22. CLR key - PRESS. Note that the message DELETE? appears at the bottom of the page.

23. ENTER key - PRESS. The FPL 0 waypoints will now disappear.

24. DIRECT TO [-D→] key - PRESS. DIR: will appear near the top of the FPL 0 page.

25. Destination airport ICAO identifier or waypoint identifier - INPUT via the keyboard into the DIR cursor field.

26. ENTER key - PRESS. The Waypoint page will now automatically appear.

    If the Waypoint Duplication (DUPL) page appears:

    a. Numeral for proper country - INPUT via keyboard.

    b. ENTER key - PRESS. The Waypoint page (WPT) will now automatically appear.

PRE-DEPARTURE (RAMP) (Cont'd)

27. Waypoint Page

a. If proper waypoint latitude and longitude displayed:

1) Down cursor [↓] key - PRESS until cursor appears over APPROVE?.

2) ENTER key - PRESS to return to the FPL 0 page.

b. If proper waypoint latitude and longitude not displayed:

1) Cursor [↓] or [↑] key - PRESS until cursor field is adjacen t to LAT:.

2) Waypoint latitude - INPUT via keyboard. North (2 key) or South (8 key) must proceed the numerical input. Use degrees, minutes, and tenths of a minute.

3) ENTER key - PRESS. The cursor field will now appear adjacent to LON:

4) Waypoint longitude - INPUT via keyboard. East (6 key) or West (4 key) must proceed the numerical input. Use degrees, minutes, and tenths of a minute.

5) ENTER key - PRESS. The cursor will now appear over APPROVE?

6) ENTER key - PRESS. The FPL 0 page will return. The KNS 660 Airplane Flight Manual Supplement describes how the KNS 660 interfaces with the aircraft's navigation instruments and autopilot.

BEFORE TAKEOFF

A. If equipped with the optional OMEGA/VLF sensor:

1. Message (MSG) key - PRESS when message light blinks.

2. Messages - CHECK for OMEGA NAV READY. This normally occurs within three minutes after the KNS 660 is initialized.

TAKE-OFF

When not equipped with an OMEGA/VLF sensor, the HSI or CDI NAV flag will be visible and the DME display will be blank until sufficient altitude is gained for initial navigation station acquisition.

The time of departure and an internal flight timer will automatically start whenever the ground speed calculated by the KNS 660 exceeds 50 knots.

ENROUTE

A. NAV 1 page - Information such as distance to destination, estimated time enroute, ground speed, desired track, actual track, bearing, drift angle and present position are available on the NAV 1 page. This page can be displayed by pressing the NAV key once. Refer to Section IV for details of the NAV 1 page.

B. Flight Plan 0 (FPL 0) page - This page provides information as to distance to destination (DIS), the estimated time enroute (ETE), and the estimated time of arrival (ETA).

   This information is obtained by placing the cursor over the DIS field (located on the right hand side of the screen). By pressing the CLR key the field will change from DIS to ETA. When CLR is pressed again the field will change to ETE. When CLR is pressed again the field will change back to DIS. (When the KNS 660 is configured for AUTO 3D operation the sequence will be DIS, ETA, ETE, ALT, DIS).

C. DIRECT TO [-D→] key use - DIRECT TO operation can be used at anytime. The resulting navigation will be direct from present position to the desired waypoint. Use of DIRECT TO operation was described in the Ramp Procedures items 24 thru 27 above. The D-Bar on the HSI or CDI may be recentered at any time by placing the cursor over the DIR waypoint field on the FPL 0 page and pressing the ENTER key.

APPROACH

Use standard VOR/DME systems in aircraft. Do not attempt to use KNS 660 system for approaches prior to learning the procedures discussed in Sections V and VI of this Pilot's Guide.

WARNING

BECAUSE OF THE MULTITUDE OF SWITCHING CONFIGURATIONS WHICH ARE POSSIBLE FOR VOR/DME'S, RMI'S, FLIGHT INSTRUMENTS, AND OTHER AVIONICS, IT IS IMPERATIVE THAT THE PILOT REVIEW THE AIRCRAFT'S KNS 660 FLIGHT MANUAL SUPPLEMENT AND OTHER APPLICABLE FLIGHT MANUAL SUPPLEMENTS PRIOR TO FLYING THE AIRCRAFT.

AFTER LANDING

The KNS 660 can be turned off using the normal Avionics Master shut down procedure or by pressing the OFF side of the ON/OFF rocker switch and holding for approximately 2 seconds.

SECTION IX

INTRODUCTION TO OMEGA/VLF NAVIGATION

Introduction

This section of the Pilot's Guide is included to provide a basic understanding of the principles of OMEGA/VLF navigation. Actual procedures applicable to OMEGA/VLF operation are contained in Sections V, VI, and VII.

Basic Information

OMEGA/VLF navigation equipment uses signals from eight OMEGA transmitting stations and signals from the Navy VLF Communication Network to provide global enroute navigation capabilities. The KNS 660 OMEGA/VLF sensor automatically selects from these stations those which will provide the most accurate navigation.

The OMEGA network of stations was created solely for the purpose of providing long range navigation. Host nation agencies are responsible for maintaining and operating the eight stations comprising the OMEGA navigation system. The U.S. Coast Guard has this responsibility for the United States.

The VLF Communication stations were originally installed only to provide the Navy with fleet communications, but now also serve to provide additional signal capability and redundancy to users of OMEGA navigation. The U.S. Navy operates and maintains most of the VLF Communication stations. The locations of both the OMEGA and VLF Communication stations are shown in Figure 9-1.

Radio signals transmitted from the OMEGA stations and from the VLF Communication stations have a frequency from approximately 10KHz to 24KHz. This frequency range falls within the Very Low Frequency (VLF) range of 3KHz to 30KHz. As can be seen from Figure 9-2, the VLF frequency range is well below the frequencies used for other airborne communication and navigation purposes.

Radio signals in the Very Low Frequency range have characteristics which allow us to utilize them for global radio navigation. These characteristics include the ability to travel long range and "phase stability". These signals are able to travel over and around geographical barriers.

THE OMEGA NETWORK

The eight OMEGA stations transmit the same four common frequencies; 10.2KHz , 11.05KHz, 11-1/3KHz, and 13.6KHz. In addition, OMEGA stations transmit a fifth frequency which is unique for each OMEGA station. These stations transmit in a very precise format and are synchronized with each other using atomic clocks. The nominal radiated power for each of the OMEGA stations is 10,000 watts at 10.2KHz.

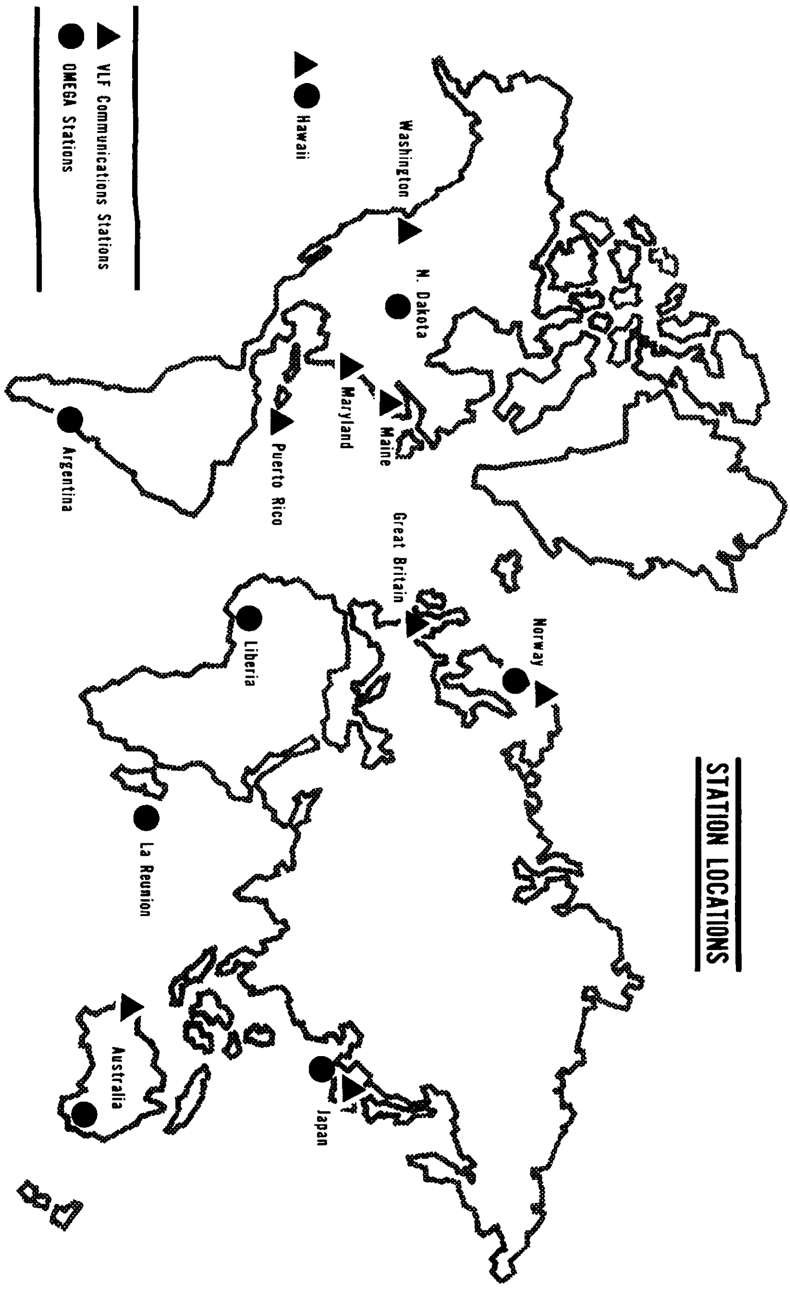

STATION LOCATIONS
VLF Communications Stations
OMEGA Stations
Hawaii
Washington
N. Dakota
Maryland
Maine
Puerto Rico
Argentina
Great Britain
Norway
Liberia
La Reunion
Australia
Japan

Figure 9-1

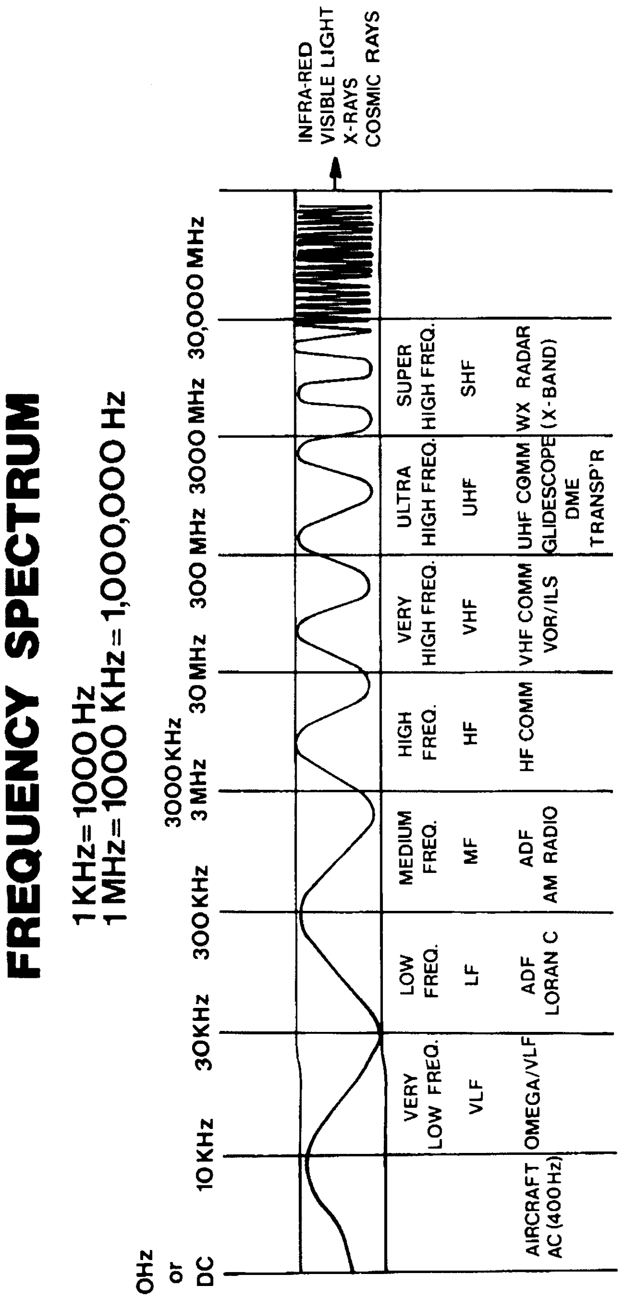

FREQUENCY SPECTRUM
1 KHz = 1000 Hz
1 MHz = 1000 KHz = 1,000,000 Hz
0Hz or DC
10 KHz
30 KHz
300 KHz
3000 KHz 3 MHz
30 MHz
300 MHz
3000 MHz
30,000 MHz
INFRA-RED
VISIBLE LIGHT
X-RAYS
COSMIC RAYS
VERY LOW FREQ.
VLF
LOW FREQ.
LF
MEDIUM FREQ.
MF
HIGH FREQ.
HF
VERY HIGH FREQ.
VHF
ULTRA HIGH FREQ.
UHF
SUPER HIGH FREQ.
SHF
AIRCRAFT AC (400 Hz)
OMEGA/VLF
ADF LORAN C
ADF AM RADIO
HF COMM
VHF COMM VOR/ILS
UHF COMM GLIDESCOPE DME TRANSP'R
WX RADAR (X-BAND)

Figure 9-2

THE OMEGA NETWORK (Cont'd)

Notice in Figure 9-3 that one OMEGA transmission cycle (called an epoch) takes exactly 10 seconds. The epoch contains eight transmission time slots with a 0.2 second gap separating each slot. The sequence is always exactly the same but the duration of the transmission slot varies from 0.9 seconds to 1.2 seconds. Each OMEGA station transmits each of the four common frequencies once and its unique frequency four times in the ten second epoch. The key to the OMEGA format is that during any one of the eight transmission time slots no two stations are transmitting on the same frequency. Three of the four common frequencies (10.2, 11-1/3, and 13.6KHz) are actually used by the KNS 660 OMEGA/VLF sensor for navigation computation from the OMEGA stations. The OMEGA/VLF sensor uses the unique frequencies only as an aid in a process called "synchronization" which the sensor must accomplish before it can use OMEGA signals for navigation. This is the process of sorting out and identifying which station has transmitted each segment in the OMEGA format. Synchronization is automatically accomplished by the system within a few seconds after the KNS 660 has been initialized.

NAVY VLF COMMUNICATION STATIONS

Unlike the OMEGA stations, each Navy VLF Communication station transmits a single unique frequency. These frequencies range from approximately 14KHz to 24KHz. The radiated power from these stations is far greater than from the OMEGA stations. While the lowest power station is about 40,000 watts, the highest power station is over one million watts. The Navy switches between several transmission techniques (types of modulation) but the OMEGA/VLF sensor is able to automatically identify and adapt to the type of modulation being used.

Since these stations are not primarily intended for navigation, the Navy is free to shut down or create new stations with no advance warning. Additionally, the frequencies on which they transmit have been known to change. The KNS 660 system includes the data associated with these VLF Communication stations in the 28 day update information and is able to track these changes at no additional cost or inconvenience to the operator.

OMEGA SIGNAL FORMAT

STATION \ SEGMENT	1	2	3	4	5	6	7	8
NORWAY (A)	10.2	13.6	11 1/3	12.1+	12.1+	11.05	12.1+	12.1+
LIBERIA (B)	12.0+	10.2	13.6	11 1/3	12.0+	12.0+	11.05	12.0+
HAWAII (C)	11.8+	11.8+	10.2	13.6	11 1/3	11.8+	11.8+	11.05
N. DAKOTA (D)	11.05	13.1+	13.1+	10.2	13.6	11 1/3	13.1+	13.1+
LA REUNION (E)	12.3+	11.05	12.3+	12.3+	10.2	13.6	11 1/3	12.3+
ARGENTINA (F)	12.9+	12.9+	11.05	12.9+	12.9+	10.2	13.6	11 1/3
AUSTRALIA (G)	11 1/3	13.0+	13.0+	11.05	13.0+	13.0+	10.2	13.6
JAPAN (H)	13.6	11 1/3	12.8+	12.8+	11.05	12.8+	12.8+	10.2
	0.9	1.0	1.1	1.2	1.1	0.9	1.2	1.0

0.0 1.1 2.3 3.6 5.0 6.3 7.4 8.8 10.0

TIME (SECONDS)

+ IS UNIQUE FREQUENCY AT EACH STATION

Figure 9-3

RADIO WAVE CHARACTERISTICS

Everyone is familiar with what happens when a pebble is dropped into a perfectly calm pond. Waves which consists of a series of equally spaced crests and troughs move outward in concentric circles away from where the pebble entered the water. Radio waves such as from an OMEGA station or VLF Communciation station travel through space in a very similar manner (Figure 9-4).

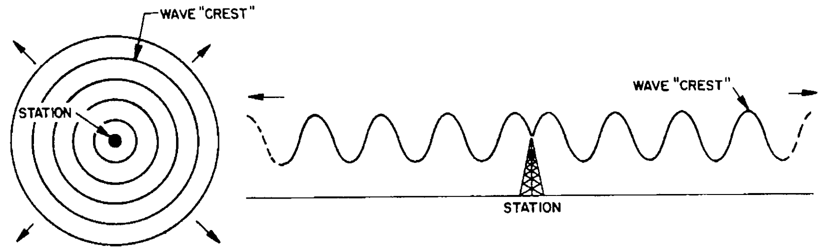


Figure 9-4

In our pond example, the distance between adjacent wave crests is the same. Likewise for a radio wave. The distance between like points on any two adjacent "waves" is the same and is called the wavelength (Reference Figure 9-5).

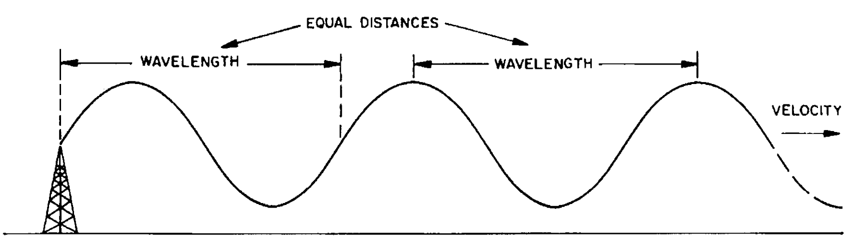


Figure 9-5

The frequency of the radio wave is the number of cycles per second that the wave is producing. All radio waves move through space at the speed of light which is approximately 162,000 nautical miles per second. Fortunately for us, there is a relationship between the wavelength, velocity, and frequency of radio waves.

RADIO WAVE CHARACTERISTICS (Cont'd)

$$\frac{\text{Velocity (NM/second)}}{\text{Frequency (cycles/second)}} = \text{Wavelength (NM/cycle)}$$

For example, a 10.2KHz (10,200 cycles per second) OMEGA signal would have a wavelength of:

$$\frac{\text{162,000 NM/second}}{\text{10,200 cycles/second}} = \text{16 NM/cycle}$$

The wavelengths of the 11-1/3KHz and 13.6KHz OMEGA signals are approximately 14.3 and 12 nautical miles, respectively.
The phase of a radio wave is the position along the radio wave at any given time. Thus the phase of the radio wave in Figure 9-6 that could be measured when an aircraft was in position "A" would be exactly the same phase measured when the aircraft was in position "AA". Likewise, the phase of the radio wave measured when the aircraft was at position "B" would be the same as at position "BB".

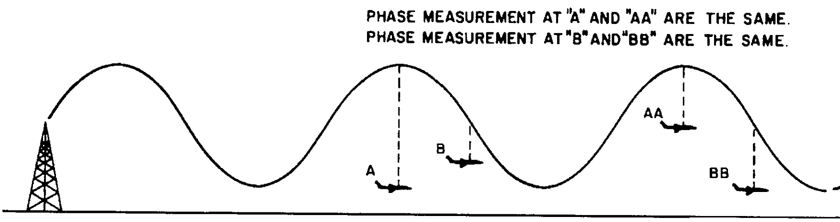


Figure 9-6

In order to have a unit of measurement of phase, OMEGA/VLF engineers divide a cycle up into 100 parts, each called a "centicycle" as shown in Figure 9-7. For our 10.2KHz OMEGA signal, each centicycle would represent approximately 0.16 nautical miles.

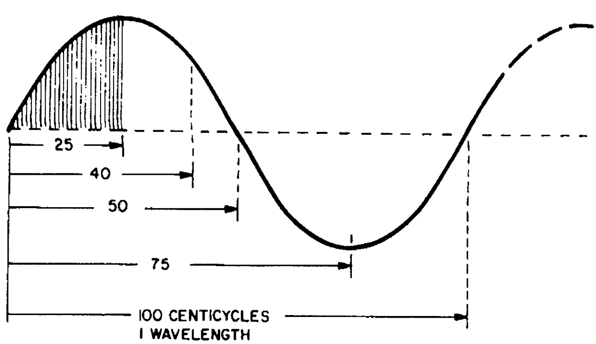


Figure 9-7

DETERMINING POSITION WITH OMEGA/VLF SIGNALS

The "intelligence" obtained by the OMEGA/VLF sensor is the phase of the signals from OMEGA stations and VLF Communication stations that are being received. Therefore, a primary function of the OMEGA/VLF sensor is to precisely and continuously measure the phase of these signals.

After turning the KNS 660 system on and approving the system Self-Test page you must "initialize" the system. Included in this initializaiton is telling the system the correct date, time, and the aircraft's present geographic position. The OMEGA/VLF sensor begins measuring the phases of received OMEGA and VLF Communication stations at this initialization location. As long as the aircaft doesn't move, the phase measured from each station will remain constant. That is, the phase measurement in centicycles from one station will remain at one constant value while the phase measurement from additional stations will be other constant values.

Although Figure 9-8 only depicts one station, when the aircraft takes off and moves over the earth the OMEGA/VLF sensor will begin measuring new phases from each station being received.

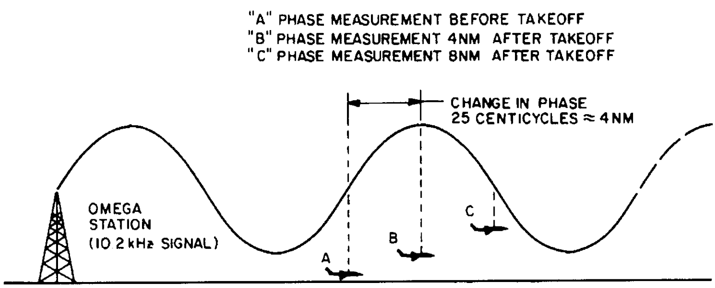


Figure 9-8

The OMEGA/VLF computer solves a continuously changing geometry problem and converts the changes of phase being measured from several stations to a distance and direction that the aircraft has moved since the last phase measurements were taken. These increments of distance and direction are continually combined with previously calculated positions to determine the new aircraft position. Since the phase measurements are taken at very short time intervals, each of the update increments of distance and position is very small.

You can now see the importance of initializing the KNS 660 with the correct geographical position of the aircraft. The system uses the initialization location as a starting point from where changes to position are made. Thus, if you initialized the system six nautical miles east of where the aircraft was actually located, it would carry this six nautical mile error along the flight or until the OMEGA/VLF sensor position was updated - either manually by you or automatically by the VOR/DME sensor. (Reference "Manually Updating The System Position" and "Automatic Rho-Rho Updating Of The OMEGA/VLF Sensor" both contained in Section VII.)

HOW MANY STATIONS ARE REQUIRED TO NAVIGATE?

The number of stations required to provide navigation depends on the accuracy of the "reference oscillator" used by the OMEGA/VLF sensor. Even though you may not be familiar with this term, the concept isn't too difficult to understand.

The frequencies coming from the OMEGA and VLF navigation stations are generated using an atomic clock or "oscillator" and are therefore extremely accurate. Thus the 10.2KHz OMEGA signal being received is in fact exactly 10.2KHz for all practical purposes. In order for the OMEGA/VLF sensor to measure changes in phase of a received signal it must have some sort of a reference frequency to use for comparison. Therefore, for the OMEGA/VLF sensor to measure phase changes of a 10.2KHz OMEGA signal, the OMEGA/VLF sensor must generate 10.2KHz internally. The same is true to measure phase changes for all the OMEGA frequencies and the VLF Communication frequencies. All of these frequencies must be generated internally and then used as a reference for making comparision phase measurements.

If there are any inaccuracies in the sensor generated frequencies being used as references they will show up as errors in the measured phase of the incoming signals. This would totally destroy the accuracy of our navigation if the problem remained uncorrected. There are two ways to solve this dilemma.

The first solution is to calculate the amount of frequency error for each of the OMEGA/VLF sensor generated reference frequencies. Because the frequency error drifts with time, the system must continually determine a correction factor to compensate for the error of each internally generated reference frequency. This solution works very well, but like everything else in life, you don't get something for nothing! In order to have enough information to calculate the correction factors for the sensor generated reference frequencies, signals from <u>three</u> navigation stations must be received by the OMEGA/VLF sensor.

The second approach to solving the problem of the sensor's reference frequency errors is much more straightforward - make the sensor's reference frequencies essentially as accuate as those being generated by the transmission stations themselves. In that case no correction factors would have to be calculated. The solution is to use the optional KA 167 Rubidium Frequency Standard. The KA 167 contains an extremely precise oscillator which is used to generate error-free reference frequencies for the OMEGA/VLF sensor. The OMEGA/VLF sensor is therefore able to determine position using just <u>two</u> stations. The trade-off is higher cost requiring signals from just two stations to navigate versus less cost requiring signals from three stations to navigate.

SOURCES OF POSITION ERROR

The sources of position error associated with OMEGA/VLF navigation can be grouped into two categories; errors due to phase disturbances of the signals while they are traveling from the station to the aircraft, and errors due to poor station/aircraft geometry.

Disturbances To The Phase Of The Signals

It was stated earlier that phase stability was one of the characteristics that allows signals in the Very Low Frequency range to be used for OMEGA/VLF navigation. Despite this fact, there are many factors which can disturb the signals coming from OMEGA and VLF Communciation stations and therefore introduce errors in the calculated position if left uncorrected. Although not all the factors causing disturbances are completely understood, several major factors have been isolated. Since the effects of these factors are usually repeatable, they have been quantified so that they may be stored for further use. The OMEGA/VLF sensor has stored in its memory a "mathematical model" of the world which predicts the effects that various factors will have on incoming OMEGA/VLF siganls, taking into account the aircraft's position and the route the signals took to get to the aircraft. The OMEGA/VLF sensor applies the model's compensation to individually correct the phase measurement of each received signal before computing the aircraft's change in position.

The most important factor to be accounted for in the model's disturbance prediction is the effect of "Diurnal Shift". As shown in Figure 9-9, radio waves travel between the earth's surface and a layer of ionized gases above the earth called the ionosphere.

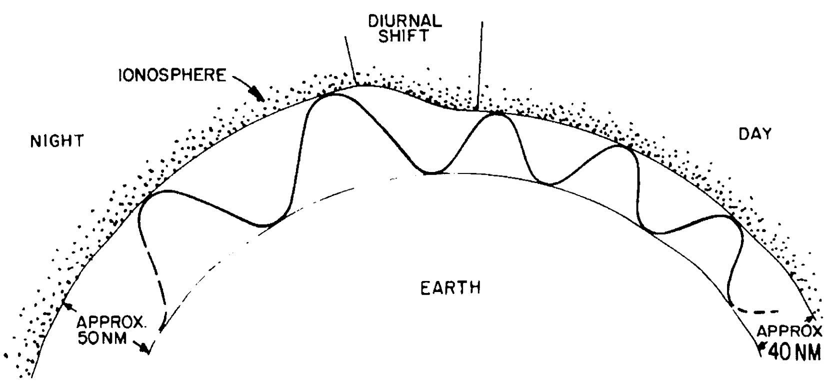


Figure 9-9

The height of the ionoshpere is higher at night than it is during the day. The change in height that occurs during the transition from night to day (and vice-versa) is called Diurnal Shift. In order for the "model" in the OMEGA/VLF sensor to predict the phase shift on a received signal due to Diurnal Shift, it must know the correct time and date. For this reason you are required to verify the time and date of the KNS 660's internal clock each time the KNS 660 is turned on.

Disturbances To The Phase Of The Signals (Cont'd)

In addition to Diurnal Shift this "model" in the OMEGA/VLF sensor predicts the effect on the received signals for differences in ground conductivity, variances of the earth's magnetic field, the non-spherical shape of the earth, and other factors. Since the "model" computes only a prediction of the effects of all of the factors rather than the exact effect, some errors are introduced into the OMEGA/VLF determination of position.

Poor Geometry

In Figure 9-10 the aircraft is located in a position that provides the OMEGA/VLF's computer good station/aircraft geometry, both in the north-south direction and in the east-west direction.

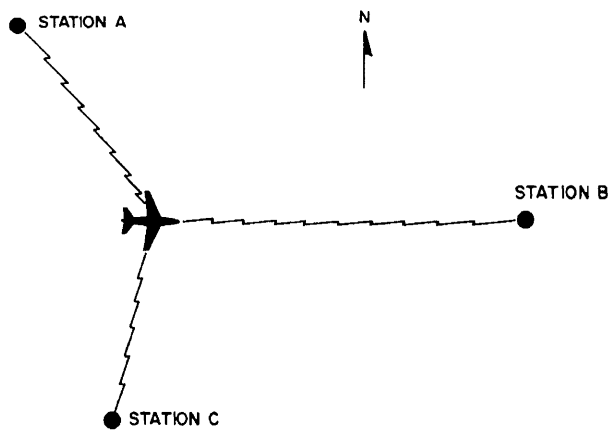


Figure 9-10

In Figure 9-11 the aircraft is located in a position that provides good geometry in the east-west direction but poor geometry in the north-south direction. With the geometry shown in this example, the computer's ability to determine accurate longitude is much better than its ability to determine latitude. In order to minimize this type of error the OMEGA/VLF sensor automatically chooses from the stations being received those which provide the best station/aircraft geometry.

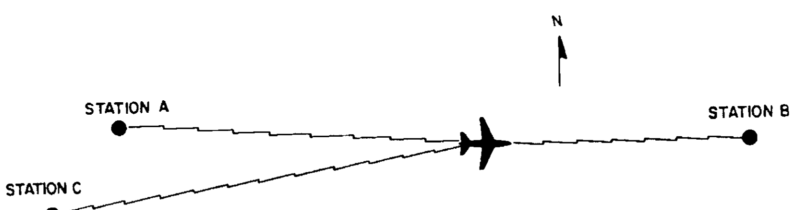


Figure 9-11

Poor Geometry (Cont'd)

Because of the ability of radio waves in the Very Low Freqency range to travel long range it is possible for signals from any one station to reach the aircraft's OMEGA/VLF antenna from two directions (the shorter path around the world and the longer path going around the world in the other direction). Therefore, the OMEGA/VLF sensor automatically deselects any station further than about 8,000 nautical miles away in order to minimize this type of possible interference problem.

In addition, phase errors can develop if the OMEGA/VLF sensor becomes too close to one of the OMEGA or VLF Communication stations. Under these conditions, stray siganls reflected from the ground (groundwave) or from the ionosphere (skywave) in addition to the primary signal may reach the aircraft's OMEGA/VLF antenna. Since these problems are most prevalent close by a transmitting station, the OMEGA/VLF sensor automatically deselects any station less than approximately 300 nautical miles from the aircraft.

OMEGA NAVIGATION STATUS REPORTS

As with other navigational aids, information regarding off-the-air periods and other pertinent data affecting usage of the OMEGA system is available to pilots. Since there is usually redundancy in the number of stations available for use in most parts of the world and since the OMEGA/VLF sensor automatically selects which stations to use, there may be only marginal benefit in knowing the status of the OMEGA stations. However, the information is easily obtainable.

Status information is available on a telephone recording from ONSOD (the U.S. Coast Guard's OMEGA Navigation System Operations Detail) by calling (202) 245-0298. Additional information may be obtained by calling ONSOD at (202) 245-0837 and asking for the Operations Officer.

OMEGA status messages are also broadcast by the National Bureau of Standards on station WWV in Ft. Collins, Colorado and station WWVH in Kauai, Hawaii. Aircraft with HF radios may obtain these messages by listening on WWV at 16 minutes past each hour on 2.5, 5.0, 10.0, 15.0 or 20.0 MHz. The same message is broadcast on WWVH at 47 minutes past each our on 2.5, 5.0, 10.0, and 15.0 MHz.

In addition, major planned off-air maintenance for each OMEGA station is scheduled during one month of the year. At the time of this writing the schedule is as follows:

Month	Station
February	Liberia
March	Argentina
June	Hawaii
July	North Dakota
August	Norway
September	La Reunion
October	Japan
November	Australia

SECTION X

INTRODUCTION TO NAVSTAR GLOBAL POSITIONING SYSTEM

This section of the Pilot's Guide is included to provide a brief, basic understanding of the principals of NAVSTAR Global Positioning System (GPS) navigation. Actual procedures applicable to GPS operation are contained in Sections V, and VII.

The NAVSTAR Global Positioning System is a satellite based system intended to provide worldwide coverage of a precision navigation signal which can be utilized from the earth's surface up to high altitude.

A total of eighteen satellites arranged in constellations, will orbit the earth and transmit precise digitally encoded signals on two frequencies, L1 = 1542.75MHz and L2 = 1227.6MHz. Two types of digitally encoded signals are available on the L1 frequency, P-Code and C/A code. The United States Department of Defense, which is responsible for the satellite portion of the NAVSTAR GPS System has agreed to allow non military users to utilize the C/A code. This will provide a Standard Positioning Service to the general public. Accuracy of position determined from the C/A code Standard Positioning Service will be on the order of 100 meters (332 feet). The exact number of satellites and constellations which will comprise the final NAVSTAR GPS system is not resolved at the writing.

Basic position determination is accomplished by the GPS sensor calculating the distance it is from a minimum of three satellites. Each satellite transmits calibration (ephemeris) data which allows the GPS sensor to calculate the position of the satellite at any point in time. By knowing the distance from three points in space, the GPS sensor can then calculate its position relative to the points in space. Position determination from three satellites is possible provided that altitude information is available to the GPS sensor as it is in KNS 660 system installations.

If four satellites are visible, the GPS sensor can calculate latitude/longitude and "psuedo altitude". The phase "psuedo altitude" is used to distinguish this calculated quantity from the more familiar barometric pressure related altitudes which are used in aviation.

As mentioned previously, each satellite continuously transmits satellite orbital information which is used by the GPS sensor. Two types of information are transmitted by each satellite, Almanac data, and Ephemeris data. Almanac data provides approximate position information and health status for all satellites. Almanac data is used by the sensor to predict which satellites should be visible. Almanac data is stored in the GPS sensor memory and is continuously updated. Stored almanac information is considered outdated when it has not been revised in twenty four weeks. Each satellite transmits unique Ephemeris Data, which consists of more precise satellite orbital data and health status information for that satellite.

INTRODUCTION TO NAVSTAR GLOBAL POSITIONING SYSTEM

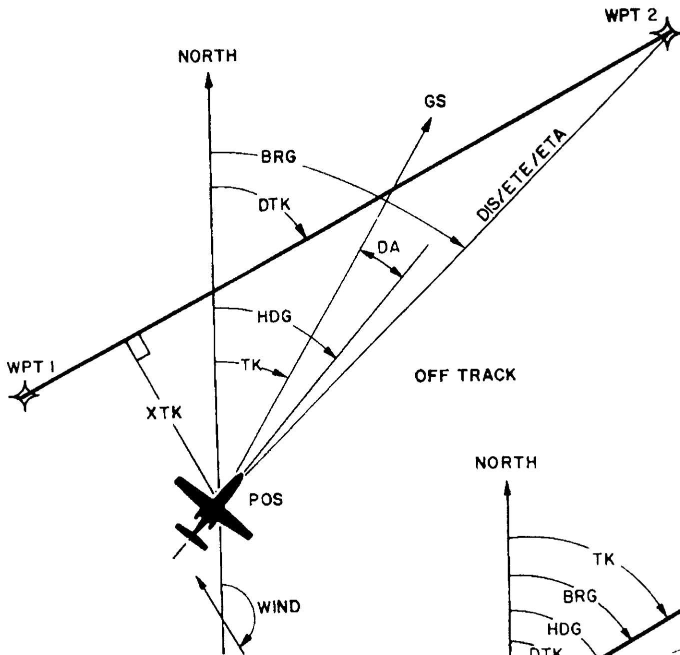
Prior to providing position data, the GPS sensor will have to acquire the Ephemeris data for the satellites being tracked and used for position determination. Ephemeris data is stored in the GPS sensor and is considered outdated if it has not been revised in 3.5 hours.

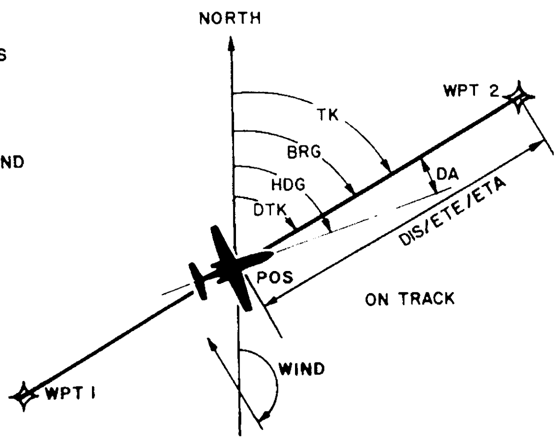
In addition to the satellites in orbit the NAVSTAR Global Positioning System includes a network of ground based receiving stations which monitor the signals transmitted by the satellites. These ground based receiving stations in turn transmit information to receivers aboard each satellite so that the Almanac and Ephemeris data can by revised when necessary.

APPENDIX A

NAVIGATIONAL TERMS USED ON KNS 660 PAGES

BRG	-	Bearing to waypoint (degrees)
DA	-	Drift Angle (degrees)
DIS	-	Distance to waypoint (NM)
DTK	-	Desired Track (degrees)
GS	-	Ground Speed (NM/Hr.)
HDG	-	Heading (degrees)
POS	-	Present position (lat/long)
TK	-	Actual Track (degrees)
WPT	-	Waypoint
XTK	-	Cross Track Error (NM)
ETE	-	Estimated Time Enroute (Hrs./Min.)
ETA	-	Estimated Time of Arrival (GMT)





NOTE:
BRG, DTK, HDG, and TK are normally referenced with respect to magnetic North. If a true heading reference has been chosen on the NAV 2 Page these parameters will be referenced to true North.

B – Page Messages

APPENDIX B

CATALOG OF MESSAGE PAGE MESSAGES

The following is a list of system Message page messages which can be displayed and what is indicated by the message:

AC POWER FAIL - The analog board has detected that the 400 Hz AC power input to the KNS 660 has failed.

ADJUST HSI COURSE - The selected course arrow on the HSI (or CDI) does not display the proper course. If the HSI has a non-driven course arrow the pilot should manually adjust the course arrow to the proper course. If the HSI has a driven course arrow the HSI and/or KNS 660 has a failure.

AIR DATA FAILED - The AIR DATA sensor has failed to communicate with the KNC 667.

ALT FAIL - ENTER
ON HOLD 2 PAGE - All automatic sources of altitude to the system have failed and a manual altitude should be entered on the HOLD 2 page. A new altitude input should be made whenever the aircraft's altitude changes more than 10% when the aircraft is above 5000 ft. or whenever the aircraft's altitude changes more than 500 ft. when the aircraft is below 5000 ft.

ANALOG BD FAILED - The analog input/output board has detected a hardware error and is not operable. The system should be brought in for service.

D/BASE BATT LOW - The battery on the Data Base board is low and needs to be replaced. The system should be brought in for service within approximately a week.

D/BASE BD FAILED - The data base has failed to communicate with the RNAV computer. Either the data base board or the digital I/O board has failed.

D/BASE MEM FAULT - The Data Base has lost its back up memory and should be re-loaded from the data loader.

DB - NO PUB DATA - There is no published data present in the data base memory. Only user defined elements may be accessed.

D/BASE OUT DATED - The current Data Base is out of date and should be updated.

DESELECT DME HOLD - The ARINC 429 input bus has detected that the DME is in the HOLD mode and the operator should deselect this mode from the DME.

DME BIAS FAILURE - The system has detected unusually large DME errors.

DME IDENT FAILED - The system failed to detect an ident for the current DME station.

DME FAILED - The DME sensor has failed to communicate with the KNC 667.

CATALOG OF MESSAGE PAGE MESSAGES

DESELECT FMS CTL - The KNS 660 system has been placed in ILS or NAV mode. The NAV CTL mode should be selected.

DME ONLY REF - The BLEND, VOR or TACAN sensor is selected and the active waypoint's reference (REF NAME entry on Waypoint page) is a DME ONLY station. If the system is in OBS Method of Operation this message will appear in both the RNV ENR and RNV APR modes. If the system is in AUTO/LEG or AUTO 3D Method of Operation this message will appear only in the RNV APR mode.

DUP REF FREQ
SEL REF NEAR ACFT - The system is operating in MAN/OBS method of operation and is receiving data it believes is from a different station than the one tuned.

DO NOT USE FOR
IFR TERM/APR - No position data from rho-theta (VOR/DME) or rho-rho (DME/DME) is available to the system. When this condition exists, navigational accuracy appropriate for terminal or approach phases of flight can not be guaranteed.

ENTER EST POS/GS
ON HOLD 2 PAGE - The OMEGA/VLF receiver requests dead reckoning inputs to begin navigation. The operator should go to the HOLD 2 page and enter an estimated position and groundspeed on that page and update the system using the "UPDATE?" field.

EXT FRQ STD FAIL - The external rubidium frequency standard has failed and needs servicing. This message will appear in conjunction with the message: OMG SERVICE REQD. The OMEGA/VLF sensor may still function without the rubidium frequency standard.

FLT CMPTR FAILED - The Flight computer has failed to communicate with the KNC 667.

FRQ BUS FAILED - A failure has been detected on the Frequency Management bus and should be serviced. The bus may still function but failure is imminent.

FRQ HEAD OFF - A frequency management control head switch was previously on has been turned off or has failed to communicate on the frequency management bus.

FRQ MASTER OFF - The Frequency Management bus master has been turned off or has failed to communicate on the bus.

FRQ SLAVE OFF - The Frequency Management bus slave has been turned off or has failed to communciate on the bus.

GND STA NOT RECV - The system has failed to receive a VOR, DME, or TACAN station.

GPS BAT LOW - The battery in the GPS sensor requires service.

GPS NAV READY - The GPS sensor is ready to provide position data to the KNS 660 system.

GPS FAIL - No data is available from the GPS sensor and the GPS sensor should by examined by an authorized service center.

GPS OSC RQRS ADJ - The GPS sensor requires service.

GPS WARN MODE - Position data provided by the GPS sensor may be inaccurate.

GPS MONITOR OFF - An adequate reference sensor is not available to compare with GPS sensor data, and therefore the KNS 660 GPS Integrity Monitor is inactive.

GPS MONITOR WARN - The KNS 660 GPS Integrity Monitor has detected a difference between GPS position data and position data from independent sensors.

GPS REQUIRES MAN ALT
ON HOLD 2 PAGE - This message indicates the GPS is requesting a manual altitude input.

HDG FAIL - ENTER
ON HOLD 2 PAGE - All automatic sources of heading to the system have failed and a manual heading (true as opposed to magnetic) should be entered on the HOLD 2 page. A new manual heading input should be made each time the aircraft changes heading by approximately 20°.

ILLEGAL NAVAID
IN USE - The system is using a ground station which is out of the station's legal service volume. The pilot should monitor the VOR sensor's position for reasonability until the message no longer appears.

INS FLAGGED - The data from the INS system (IRU sensor) is flagged and is not usable.

INS OFF - The INS system (IRU sensor) is off or is not communicating with the KNC 667.

INVALID VRT PATH - VNAV has been canceled due to two VNAV approvals being required at the same time; the approval of the manually selected vertical track angle and the approval of the next vertical waypoint.

LEG NOT SMOOTHED - The next leg is too short for the transition to provide a smoothed course to the autopilot.

LORAN FAIL - No data is available from the LORAN sensor and it should be examined.

LORAN IN APR - The LORAN sensor is in APPROACH mode, but LORAN is not the selected KNS 660 sensor.

LORAN NAV READY - Valid position data is available from the LORAN sensor.

LORAN NOT READY - The LORAN sensor is operational but is not yet providing position data.

LORAN WARN - Position data provided by the LORAN sensor may be inaccurate.

CATALOG OF MESSAGE PAGE MESSAGES

NEXT VPT REMOVED - AUTO 3D VNAV is engaged and the next AUTO 3D leg was so short that the present flight path curve could not be completed before the next curve had to begin. Therefore, the next vertical waypoint has been removed.

NO EFIS DISPLAY
OF NAV/ILS MODE - The KNS 660 is in NAV or ILS mode and is interfaced to an EFIS system which can not display NAV or ILS data through the Long Range NAV inputs.

NO GPS DATA - The GPS sensor is operational but not providing position data.

NON-NAVAID REF - The BLEND, VOR or TACAN sensor is selected and the active waypoint's reference (REF NAME entry on Waypoint page) is not a navaid. If the system is in OBS Method of Operation this message will appear in both the RNV ENR and RNV APR modes. If the system is in AUTO/LEG or AUTO 3D Method of Operation this message will appear only in the RNV APR mode.

NOT VALID FOR
IFR RANDOM RTS - The system is being operated with VOR or BLEND as the selected sensor but only rho-theta (VOR/DME) position data is available and navigational accuracy can not be guaranteed to the level required for IFR navigation of random routes. This condition is primarily caused by distortion of VOR signals at distances on the order of 90 to 95NM from the VOR station. IFR navigation on random routes is not recommended while this condition exists. Select BLEND sensor if additional position data from OMEGA, INS, or GPS is available to improve navigational accuracy. If no additional position data is available, consider a change in flight plan that remains within 93NM of reference ground stations.

OMEGA FAILED - The OMEGA/VLF receiver has failed to communicate with the KNC 667.

OMEGA NAV READY - The OMEGA/VLF receiver is ready for navigation.

OMEGA NOT READY - The OMEGA/VLF receiver is not ready for navigation.

OMEGA RE-LANING
SEL OMG DATA PAG - The OMEGA/VLF receiver is requesting a re-lane operation. The operator should select the OMEGA Re-lane page from the OMEGA/VLF Status page and re-lane the system to the proper position.

OMEGA WARN MODE - The OMEGA/VLF receiver has transitioned to the WARN Mode of Operation. This means the OMEGA/VLF receiver is still operating but the signal conditions are becoming very poor.

OMG SERVICE REQD - The OMEGA system has had a non-fatal failure and needs servicing at the earliest possible time.

PWR OFF < 7 MIN - The OMEGA/VLF receiver was in the NAV Mode of Operation when the unit lost power and the power to the unit was restored within 7 minutes but not withint 7 seconds.

PWR OFF < 7 SEC - The OMEGA/VLF receiver was in the NAV Mode of Operation when the unit lost power and the power to the unit was restored within 7 seconds.

RESTART GPS ON
GPS RESTART PAGE - The GPS sensor should be restarted.

SEL OBS MODE FOR
IFR J/V ROUTES - The system is being operated in AUTO/LEG Method of Operation with VOR or BLEND as the selected sensor, but only rho-theta (VOR/DME) position data is available and navigational accuracy can not be maintained to the level required for operation on Jet or Victor airways. The OBS Method of Operation should be selected if no OMEGA, INS, LORAN or GPS position data is available through the BLEND sensor.

STEEP TURN AHEAD - The coming leg change involves a large course change. Expect an overshoot in intercepting the next leg.

SYSTEM DR MODE - All selected sensors to the system have flagged and the system is dead reckoning.

TACAN REF - The BLEND or VOR sensor is selected, the system is not configured with a TACAN sensor, and the active waypoint's reference (REF NAME entry on Waypoint page) is a TACAN station. If the system is in OBS Method of Operation this message will appear in the RNV ENR, RNV APR, and NAV modes. If the system is in AUTO/LEG or AUTO 3D Method of Operation this message will appear only in the RNV APR mode.

USING RVSNRY ALT - The system is now using the reversionary source of altitude instead of the primary source of altitude. This disengages VNAV if engaged and inhibits VNAV from engaging.

VNAV CANCELED - VNAV has been disengaged prior to reaching a programmed vertical waypoint or completing the vertical flight plan. This will normally mean that the pilot has altered a parameter (WPT, altitude, offset, or angle) that changes the VNAV problem while VNAV was engaged.

VOR/DME REF - The BLEND or TACAN sensor is selected, the system is not configured with a VOR sensor, and the active waypoint's reference (REF NAME entry on Waypoint page) is a VOR/DME station. If the system is in OBS Method of Operation this message will appear in the RNV ENR, RNV APR, and NAV modes. If the system is in AUTO/LEG or AUTO 3D Method of Operation this message will appear only in the RNV APR mode.

VOR FAILED - The VOR receiver has failed to communicate with the KNC 667.

VOR IDENT FAILED - The system failed to detect an ident for the current VOR station.

VOR ONLY REF - The BLEND, VOR or TACAN sensor is selected and the active waypoint's reference (REF NAME entry on Waypoint page) is a VOR ONLY (no DME) station. If the system is in OBS Method of Operation this message will appear in both the RNV ENR and RNV APR modes. If the system is in AUTO/LEG or AUTO 3D Method of Operation this message will appear only in the RNV APR mode.

WPT >200 NM - The system is in OBS Method of Operation and the distance from the present position to the active waypoint is over 200NM. The MSG light remains solid until the condition is corrected by selecting a closer waypoint or changing to AUTOLEG (or AUTO 3D) operation.

C – Scratch Messages

APPENDIX C

CATALOG OF SCRATCH PAD MESSAGES

The "Scratch Pad" messages are used to display keyboard entry mistakes and the results of other keyboard actions. The following messages appear in the scratch pad area with the indicated situation:

APPROVE PAGE - This message is displayed whenever the "OBS/LEG", "SNS", or "MOD" keys are pressed when the CDU is displaying a page which needs to be approved first.

APT NOT FOUND - This message is displayed whenever an airport is entered on the Nearest Airport page and the airport is not found in the Data Base.

APT NOT SELECTED - This message is displayed when attempting to select a RW THRSHLD field or OUTER MKR field if neither of the airport fields (APT>3000 FT or APT>4000 FT) are selected.

APR MDE CANCELED - The KNS 660 was in APR MDE, LORAN was selected as the sensor and the LORAN was not in APPROACH mode.

AUTO 3D CANCELED - This message is displayed whenever AUTO 3D Method of Operation is canceled.

D/BASE ACCESSED - This message is displayed to tell the pilot that a Data Base access is occuring which will take a long time (more than a couple seconds) to complete.

D/BASE MEM FAULT - This message is displayed whenever a flight plan or waypoint is recalled which has an error in it. The item should be deleted and re-entered.

DIFF TOO LARGE - This message is displayed whenever attempting to update the system on the HOLD 1 page and the difference between the "HOLD" position and the "FIX" position is too large to make a meaningful update.

DME ONLY REF - This message is displayed whenever a Waypoint page is displayed which contains a DME ONLY type navaid as the waypoint's reference, and is configured with a VOR and/or DME sensor.

DUPL D/BASE NAME - This message is displayed whenever an ident is entered on the Navaid or Airport page which is defined as some other type of entity, or when creating a REF WPT: on a Flight Plan page and a unique name cannot be found. It is also displayed when trying to define an outer marker, a runway threshold, or a duplicate intersection as a waypoint and the pilot chooses a waypoint name which is already in the KNS 660's memory. The pilot should choose a unique name; that is, one not presently in memory.

FLIGHTPLAN FULL - This message is displayed whenever attempting to add a waypoint or REF WPT to a flight plan which is full.

FPL0 IS EMPTY - This message is displayed when attempting to store Flight Plan 0 if Flight Plan 0 contains no waypoints.

CATALOG OF SCRATCH PAD MESSAGES

FPL HAS < 2 WPTS - This message is displayed when a REF WPT: is entered on a Flight Plan page, and the flight plan contains less than 2 waypoints.

FPL IS NOT EMPTY - This message is displayed when attempting to store Flight plan 0 in a flight plan which is not blank.

FRQ NOT ACCEPTED - This message is displayed whenever a frequency entered on the FREQ pages is not accepted by the control head.

IDENT NOT FOUND - This message occurs when a Data Base Ident search is performed and the identifier is not found in the Data Base.

ILLEGAL-ACT WPT - This message is displayed whenever attempting to delete the active waypoint, remove it from Flight Plan 0, or to indirectly modify it.

ILLEGAL DATE -This message is displayed whenever the INIT pages are approved and the DATE: is invalid (dashed out).

ILLEGAL ENTRY - This message is displayed whenever an entry is made into a field which is an illegal or out of range value.

ILLEGAL FREQ - This message is displayed whenever attempting to create a user navaid which contains a frequency which is incompatable with the selected navaid type.

ILS REF ILLEGAL - This message is displayed whenever attempting to enter an ILS/DME type navaid into the REF NAME: field on the Waypoint page, or as a REF WPT: on a Flight Plan page.

INCOMPLETE DEF'N - This message is displayed whenever a WPT page, or USER NAVAID page, or USER AIRPORT page is approved and the definition for these items is incomplete.

INVALID GRI - An unknown LORAN GRI has been entered.

INVALID TRIAD - A nonexistant station identifier has been entered.

INVALID VERT ANG - This message is displayed when a vertical angle less than the actual vertical angle or greater than the maximum allowable angle has been entered in the selected angle field of the NAV 2 page.

INVALID VERT WPT - This message is displayed when an invalid vertical waypoint has been entered in the selected waypoint field on the NAV 2 page.

LOADER NOT READY - This message is displayed whenever attempting a D/BASE loader transfer and the loader is not present or ready.

MORE THAN 1 KEY - Indicates that more than one key is being pressed simultaneously. The CDU will only recognize the first of the keys pressed.

NO ACTIVE WPT - This message is displayed when attempting to select NAV mode of operation and no waypoint is active.

NO FPLS AVAIL - This message is displayed whenever attempting to store Flight Plan 0 and no flight plans are available for use.

NO RW/OM FOUND - This message is displayed when selecting the RUNWAY/OM? field on the Waypoint page, and no runways or outer markers are present for that airport.

NON-NAVAID REF - This message is displayed whenever the "NAV" mode of operation is selected with the MOD key and the active waypoint doesn't contain a waypoint reference that is a navaid.

OFFSET IN WPT - This message is displayed when attempting to select NAV mode of operation and the active waypoint contains a distance offset between the navaid waypoint reference and the waypoint. It is also displayed when the system is in the NAV mode and the pilot attempts to select a waypoint containing a distance offset. Change the mode of operation or the active waypoint to resolve the discrepancy.

POS UNDEFINED - This message is displayed on the INIT pages or the HOLD 2 page whenever the page is approved and the lattitude or longitude are not valid numbers.

PROTECTED FPL - This message is displayed whenever attempting to modify or delete a flight plan which has a protected status when the system is not in System Protect mode.

PROTECTED WPT - This message is displayed whenever attempting to modify or delete a waypoint which has a protected status when the system is not in System Protect mode.

REF > 200 NM - This message is displayed whenever a waypoint reference is entered on the Waypoint page or the waypoint's lattitude or longitude is changed so that the waypoint reference is over 200 NM from the waypoint.

SELECT NEW WPT - This message is displayed whenever an ILS freqency waypoint is active and the sensor is changed to something besides ILS (VOR), or if attempting to cancel the "Direct To" mode of the Flight Plan 0 page when the system is in OBS Method of Operation.

SNS/MOD CHANGED - This message is displayed whenever an ILS frequency waypoint is activated and the Method of Operation is not OBS and the selected sensor is not VOR. It is also displayed anytime the pilot changes the Method of Operation by pressing the OBS/LEG key and the system automatically changes the sensor and/or mode to be consistent with the active waypoint.

SPACE NOT AVAIL - This message is displayed any time a Data Base item is selected for inclusion in the Data Base, or a Data Base update is attempted, and not enough space is available in the Data Base to service the request.

CATALOG OF SCRATCH PAD MESSAGES

STUCK KEY - Indicates that a key is constantly engaged. The CDU can not transmit to the computer while a key is stuck.

SYSTEM D/BASE - This message is displayed when attempting to delete a navaid or airport from the Navaid page or Airport page which is a system Data Base entity (i.e. not user defined).

TACAN REF - This message is displayed whenever a Waypoint page is displayed which contains a TACAN type navaid as the waypoint's reference and the system is not configured with a TACAN sensor, but is configured with a VOR sensor.

USER D/BASE FULL - This message is displayed whenever attempting to create a user navaid or airport and no space is available in the supplemental Data Base.

VNAV < 1.5 MIN - This message is displayed when VNAV becomes engaged and the aircraft is less than 1.5 minutes from the predefined vertical track angle change required to reach the selected vertical waypoint.

VOR/DME REF - This message is displayed whenever a Waypoint page is displayed which contains a VOR/DME type navaid as the waypoint's reference and the system is not configured with a VOR sensor, but is configured with a TACAN sensor.

VOR ONLY REF - This message is displayed whenever a Waypoint page is displayed which contains a VOR ONLY type navaid as the waypoint's reference, and is configured with a VOR and/or DME sensor.

WPT NOT IN RANGE - This message is displayed when a REF WPT: is entered on a Flight Plan page, and the waypoint entered is out of the range of the flight plan.

XFER COMPLETED - This message is displayed whenever a D/BASE loader transfer has been completed with no errors.

** XFER ERROR ** - This message is displayed whenever a D/BASE loader transfer has been completed with irrecoverable errors.

VOR NOT PRESENT - This message is displayed when the pilot attempts to activate a waypoint which consists of an ILS frequency and there is no VOR sensor present.

D – Effective Pages

APPENDIX D

LIST OF EFFECTIVE PAGES

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