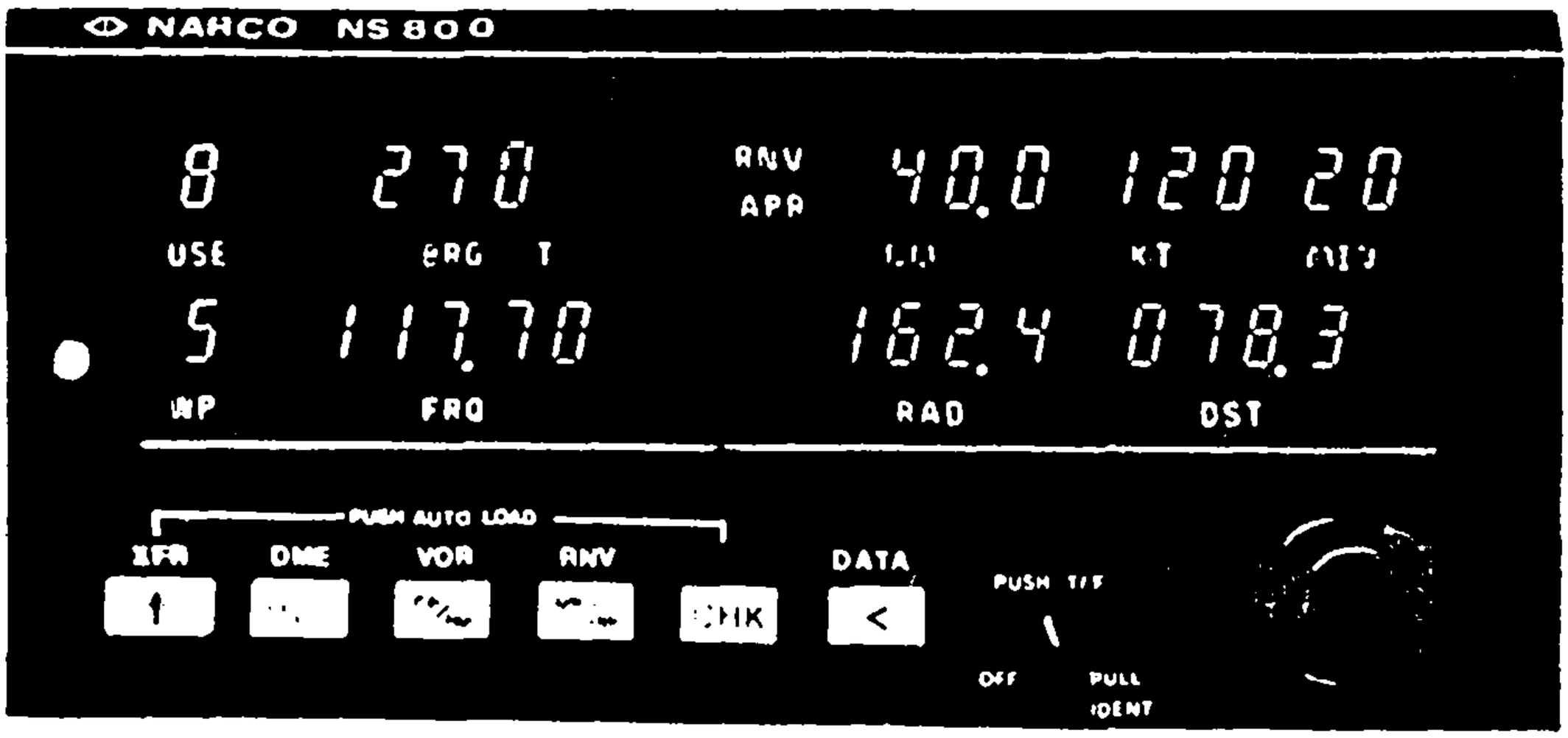
NARCO NS-800

DME/VOR/ILS/RNAV

8-WAYPOINT INTEGRATED NAV SYSTEM



PILOTS GUIDE

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1.1 INTRODUCTION

The Narco NS-800 RNAV panel mounted unit combines a DME, a TSO'd 200 channel VOR/LOC receiver/converter, 40 channel Glideslope receiver/converter and a digital RNAV computer. There are provisions for the preselection, storage and display of 8 NAV frequencies and RNAV waypoint parameters. Data for all 8 waypoints are stored in a nonvolatile memory that requires no batteries of any kind.

The NS-800 must be teamed with a compatible CDI/HSI to complete the RNAV system.

The purpose of this Pilot's Guide is to explain the operation and controls of the NS-800. Extensive use is made of examples as a means of clarifying the use of controls and operational techniques.

2.1 RNAV REVIEW

Area navigation (RNAV) is a method of navigation that permits aircraft operations on ANY desired course (point to point) within the service area of a VORTAC facility without having to fly over the VORTAC. The course is plotted by establishing phantom VORTAC stations, known as waypoints, along the flight path.

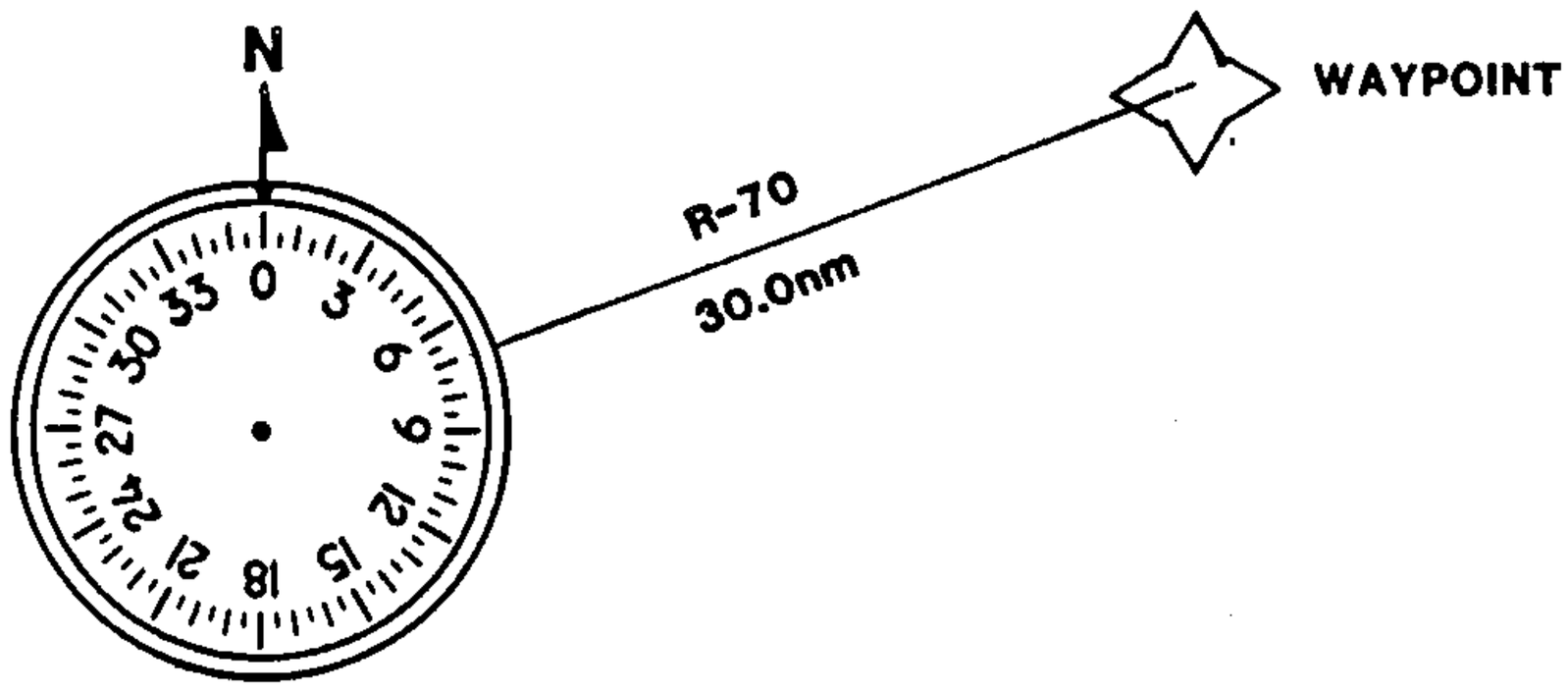
2.1.1 DEFINITION OF A WAYPOINT

A waypoint is predetermined geographical position used for route definition and/or progress reporting purposes that is defined relative to a VORTAC reference facility. A waypoint is described by its radial and distance (parameters) from a selected VORTAC station.

Using the NS-800, a pilot can electronically move the VORTAC station to any point (waypoint) within that station's service coverage area. Hence the name "phantom" station is often used when speaking of a waypoint. Since the waypoint will provide the same information as a real VORTAC, conventional VOR navigation techniques apply when navigating by RNAV.

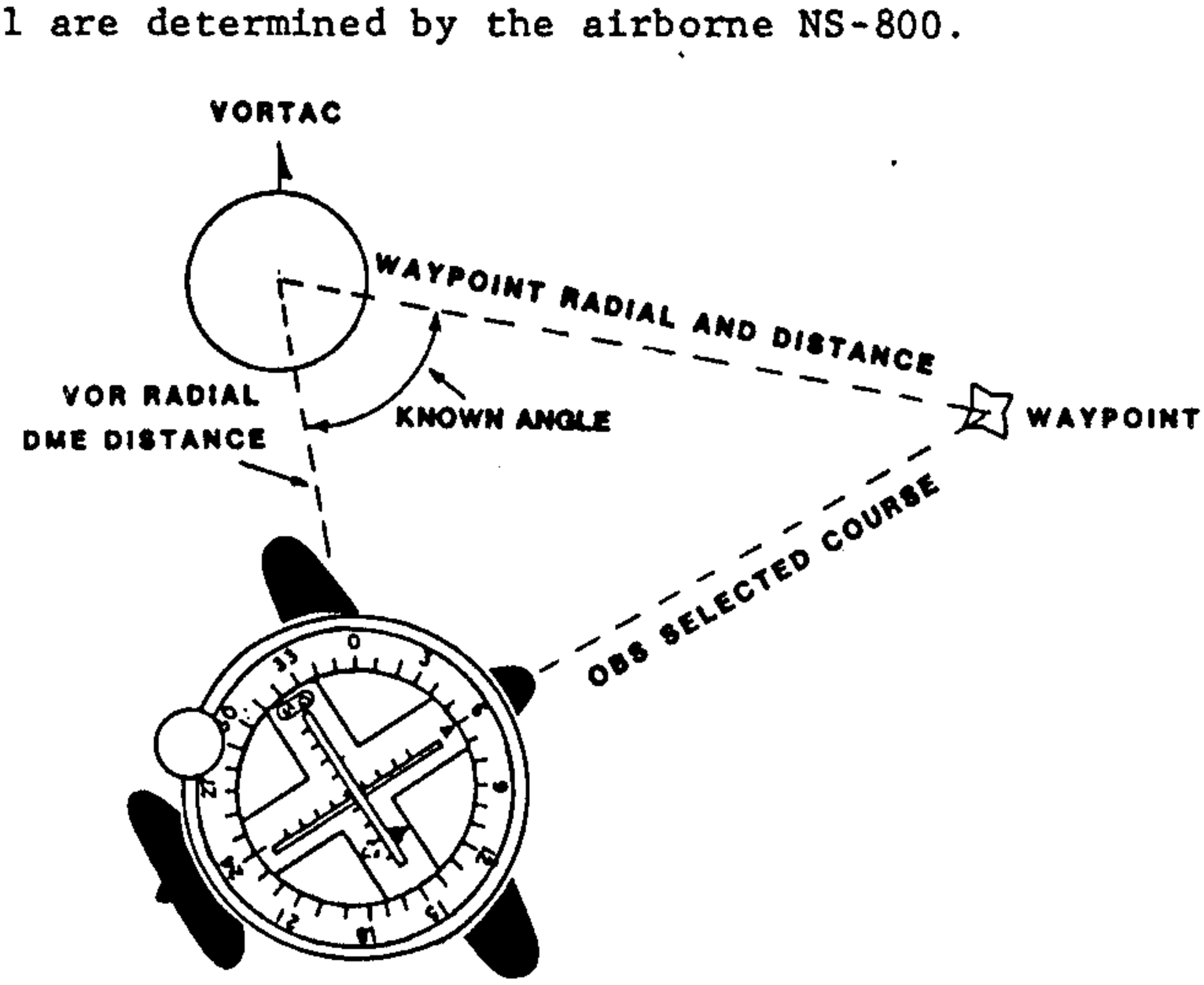
2.1.1 Definition Of A Waypoint (Cont.)

The waypoint shown here is located on the 070.0° radial at a distance of 30.0 nm from the CIBA VORTAC.



2.1.2 RNAV TRIGONOMETRY

As shown here in the figure, the VORTAC, waypoint and aircraft determine 3 points from which a triangle can be constructed. The VORTAC-To-Waypoint distance and radial are extracted from a NAV chart. The VORTAC-To-Aircraft DME distance and VOR radial are determined by the airborne NS-800.



2.1.2 RNAV Trigonometry (Cont.)

When two sides and the included angle of a triangle are known, the third side and angles can be calculated. These known parameters are fed to the NS-800's RNAV computer which solves the third side (distance to waypoint) and steering bearing to the waypoint. As the aircraft moves along the selected course, the VORTAC radial and DME distance information are continuously changing. The RNAV computer processes this information to solve a continuously changing trigonometric problem.

2.1.3 NS-800 DME DISPLAYS (RNAV MODE)

A. NM Display

The computed DME range from the aircraft to the waypoint represents a geographical range. The DME range between the aircraft and the VORTAC station is a slant range. This range is greater than the geographical range because of the altitude of the aircraft. Therefore, when the aircraft reaches the waypoint, the DME should theoretically indicate zero nautical miles and NOT the slant range (altitude) of the aircraft. The distance indicated by the DME when passing over the waypoint represents the "Along-Track" error. The Along-Track error is defined as a fix along the flight track resulting from the total error contributions of the airborne and ground equipment only.

B. KT Display

The DME displays groundspeed (knots) to or from the active waypoint.

C. MIN Display

The DME displays time (minutes) to or from the active waypoint.

2.1.4 CDI/HSI CONTROLS, DISPLAYS (RNAV MODE)

A. OBS Knob

This control selects the desired course to or from the waypoint.

B. Flag Operation

The Indicator will be flagged if the VOR or DME data is invalid.

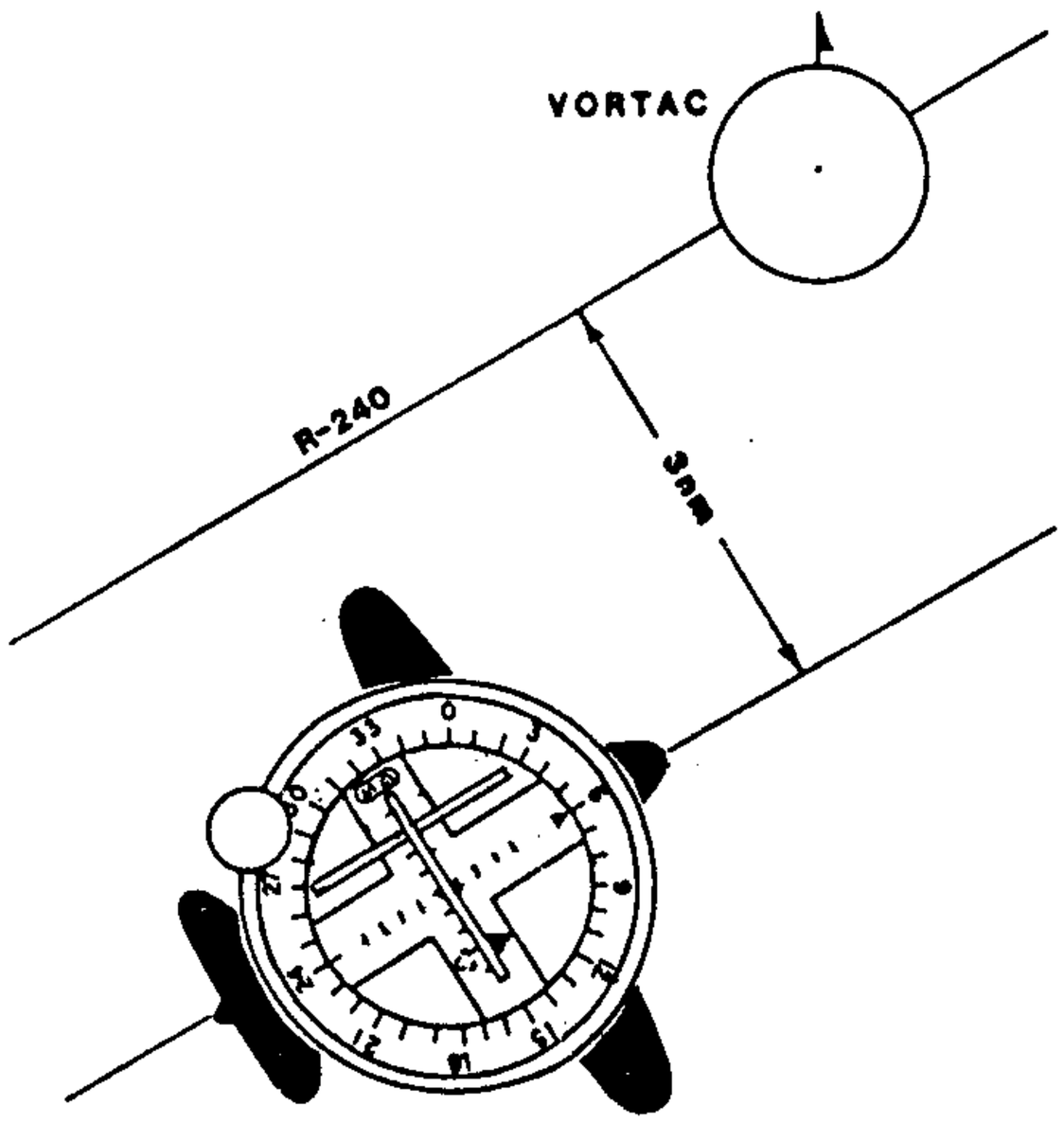
C. Course Deviation

In the RNV Enroute mode, each dot represents 1.0 nm off course (±5 nm full scale deflection).

In the RNV APR mode, each dot represents 0.25 nm off course (±1.25 nm full scale deflection).

2.1.4 CDI/HSI Controls, Displays (RNAV Mode), (Cont.)

As shown in the example, a linear crosstrack deviation on a CDI/HSI permits flying parallel to a selected course by keeping the needle centered on the appropriate dot.



LINEAR CROSSTRACK DEVIATION

When flying a centered needle directly to a waypoint, waypoint passage is indicated when the TO/FROM flag flips from TO to FROM. If the aircraft is either to the left or right of the waypoint at passage, this represents a crosstrack error. Crosstrack error is defined as a fixed error to the left or right from the desired track to the present position, measured perpendicular to the desired track. This error includes airborne equipment, ground equipment and flight technical error.

The NS-800 RNAV system meets the accuracy requirements of FAA Advisory Circular No. 90-45 for Along-Track and Crosstrack errors.

3.1 INTRODUCTION

The purpose of the operation section of this manual is to acquaint the user with the controls and operation of the NS-800 Area Navigation System. Extensive use is made of examples as a means of clarifying use of controls or operational techniques.

3.2 NS-800 FRONT PANEL DESCRIPTION

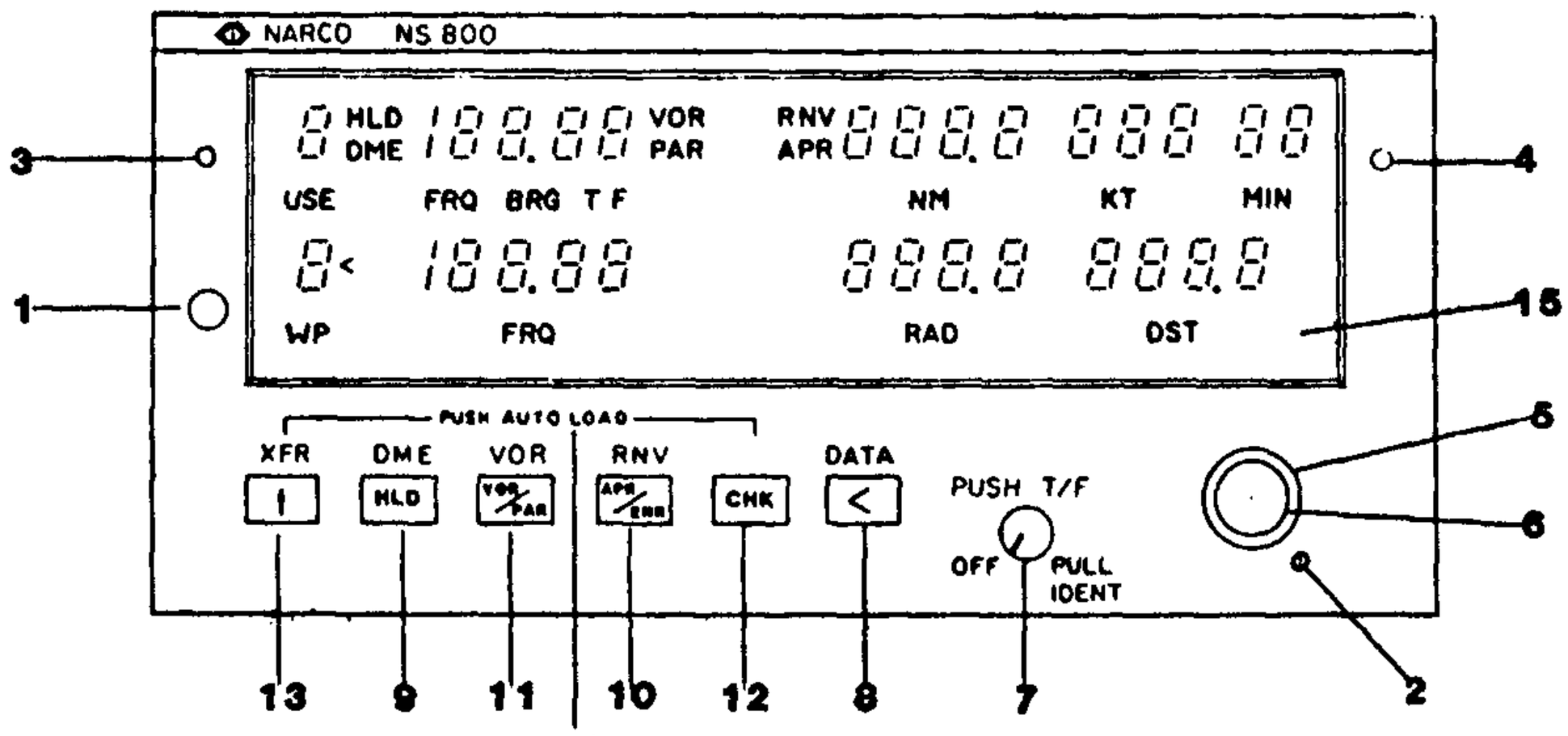


FIGURE 3-1 NS-800 FRONT PANEL

1 PHOTOCELL

The photocell automatically controls the intensity of the gas discharge display.

2 DISPLAY DIMMER ACCESS HOLE

The display's minimum brightness may be adjusted thru this hole.

3,4 LEFTHAND/RIGHTHAND TRAY RELEASE ACCESS HOLES
A special tray release key is inserted in these holes in order to release the NS-800 from its tray.

3.2 NS-800 FRONT PANEL DESCRIPTION (Continued)

5 OUTER DATA SELECT KNOB, 6 INNER DATA SELECT KNOB

These knobs are used to select the following data:

a. Waypoint Number (WP)

When the display Caret (<) is pointing to the WP display digit, rotation of either knob will select waypoint numbers 1 to 8. CW rotation increases and CCW rotation decreases the number.

b. Frequency (FRQ)

When the display Caret (<) is pointing to the FRQ display digits, rotation of the outer knob will control the 10 and 1 Mhz digits in the display in 1 Mhz increments per switch detent.

Rotation of the inner knob controls the 0.1 and 0.05 Mhz digits in the display in 0.05 Mhz increments per switch detent. For both knobs, SW rotation increases and CCW rotation decreases the numbers.

c. Waypoint Radial (RAD)

When the display Caret (<) is pointing to the RAD display digits, rotation of the outer knob will control the 10^{o} and 100^{o} digits in the display in 10^{o} increments per switch detent. Limits are from 00 to 35.

Rotation of the inner knob controls the 0.1^{o} and 1^{o} digits in the display in 0.1^{o} increments per switch detent. Limits are from 0.0 to 9.9.

For both knobs, CW rotation increases and CCW rotation decreases the numbers.

d. Waypoint Distance (DST)

When the display Caret (<) is pointing to the DST display digits, rotation of the outer knob will control the 10 and 100 nm digits in the display in 10 nm increments per switch detent. Limits are from 00 to 19.

Rotation of the inner knob controls the 0.1 and 1 nm digits in the display in 0.1 nm increments per switch detent. Limits are 0.0 to 9.9.

For both knobs, CW rotation increases and CCW rotation decreases the numbers.

3.2 NS-800 FRONT PANEL DESCRIPTION (Continued)

7 POWER ON/OFF, VOLUME CONTROL and PUSH TO/FROM CONTROL

a. Extreme CCW rotation of the knob turns the Unit OFF. Clockwise rotation beyond the switch detent turns the Unit ON and increases audio volume. The knob is pulled out for VOR/LOC IDENT tone.

b. Push T/F Control

The upper left section of the NS-800 display contains a FREQ/BRG TF display. In the VOR or RNV mode of operation, the legend BRG will be annunciated including either a "T" (bearing TO station) or "F" (radial FROM station). When the volume control knob (spring loaded) is pushed IN, the reciprocal of the current indicated bearing (T) or radial (F) will be displayed.

8 DATA BUTTON

This momentary push button controls the display Caret (<) and is used to select any waypoint parameter for data entry. At each push of the button, the display Caret will move left to right from FRQ to RAD to DST to WP and back to FRQ. The Caret indicates which waypoint parameter the data select knobs are addressing. The DATA button is operational in both the VOR and RNV modes with one exception: in the RNV mode, if the standby and active waypoint numbers are the same, the DATA button is inoperative. This prohibits the changing of an active waypoint's parameters.

9 HLD (DME HOLD) BUTTON

The HLD (hold) function allows the DME to continue operating on a selected channel while the NAV receiver is set to a new channel. When the HLD button is pushed, the legends "HLD DME" are annunciated adjacent to the use waypoint number. The DME frequency and "FRQ" legend replaces the displayed bearing and "T/F" legend. If the standby waypoint is the same as the "USE" waypoint, the waypoint RAD and DST parameters will show "bars". All other mode legends are blank. A new NAV frequency may now be selected and transferred into "USE". To release the "HLD" function, press the HLD button. The unit is restored to the VOR mode. NOTE: You cannot go directly from "HLD DME" to the VOR or RNV modes. You must first release the Unit from the "HLD DME" mode.

10 RNV (Area NAV) BUTTON

When the NS-800 is in the VOR mode (VOR legend is annunciated in the display) and this button is pushed, the Unit is placed in the RNAV Enroute mode. The RNV legend is annunciated in the display and the VOR legend is blanked. When flying an

3.2 NS-800 FRONT PANEL DESCRIPTION (Continued)

10 RNV (Area NAV) BUTTON (Cont.)

active waypoint, the "T" or "F" bearing is displayed and the DME display indicates the distance, groundspeed, and Time-to-waypoint. The CDI displays a linear deviation of 1 nm per dot (±5 nm full scale).

If the RNV button is pushed again, the Unit is placed in the APR (approach) mode which is annunciated in the display by the legend "APR". The CDI linear deviation sensitivity is now changed to 1/4 nm per dot (±1¼ nm full scale). Pushing the RNV button alternates the Unit between these modes.

If the active frequency is a LOC/GS channel, then the RNV button is rendered inoperative.

11 VOR BUTTON

Pressing this push button puts the NS-800 into the standard VOR mode. The legend "VOR" is annunciated in the display. The data caret must be shifted to the FRQ display, permitting the VOR channel to be selected and then activated (transferred to USE).

The CDI will display angular deviation (±10° full scale). The DME display indicates distance, groundspeed and Time-to Station (VORTAC). The bearing display indicates the "TO" bearing to the VORTAC.

When the VOR button is pushed again, the Unit is placed in the VOR PAR (parallel) mode. The legend "PAR" is annunciated under the VOR legend in the display. The CDI presentation now becomes linear as in the RNV Enroute mode with a sensitivity of 1 nm per dot (±5 nm full scale). Repetitive pressing of the VOR button alternates the Unit between the VOR and VOR PAR modes.

12 CHK (Check) BUTTON

When the Unit is in the RNV mode and this momentary button is pressed and held in, the upper portion of the display will indicate the aircraft's present position relative to the VORTAC station. The radial (from) and DME distance (nm) from the VORTAC are displayed. The Groundspeed and TTS show dashes.

The lower portion of the display will indicate all the parameters of the active (USE) waypoint.

In the "HLD DME" mode, only the active waypoint parameters are displayed and not the position parameters.

3.2 NS-800 FRONT PANEL DESCRIPTION (Continued)

13 XFR (Transfer) BUTTON

A momentary push button that transfers the standby waypoint (parameters and VOR/LOC frequency) to the USE (active) waypoint. This button is NOT a flip-flop transfer. The transfer is only in one direction, from WP to USE as indicated by the arrow on the button.

14 PUSH AUTO LOAD

This feature makes it possible to automatically load the aircraft's present position (in relation to the VORTAC) into the active waypoint RAD and DST offsets.

Auto Load is accomplished by FIRST pressing in and HOLDING in the "CHK" button with one finger, then pressing in the "XFR" button with another finger and then releasing both buttons. The active RAD and DST displays will be updated to the present position. For example, while the pilot circles his home airport he can use the auto load feature to make his home base the last waypoint for his trip back home.
REMEMBER: The "CHK" button must FIRST be held in before holding in the "XFR" button. If the "XFR" button is pushed first, the Auto Load feature is defeated.

15 DIGITAL GAS DISCHARGE DISPLAY

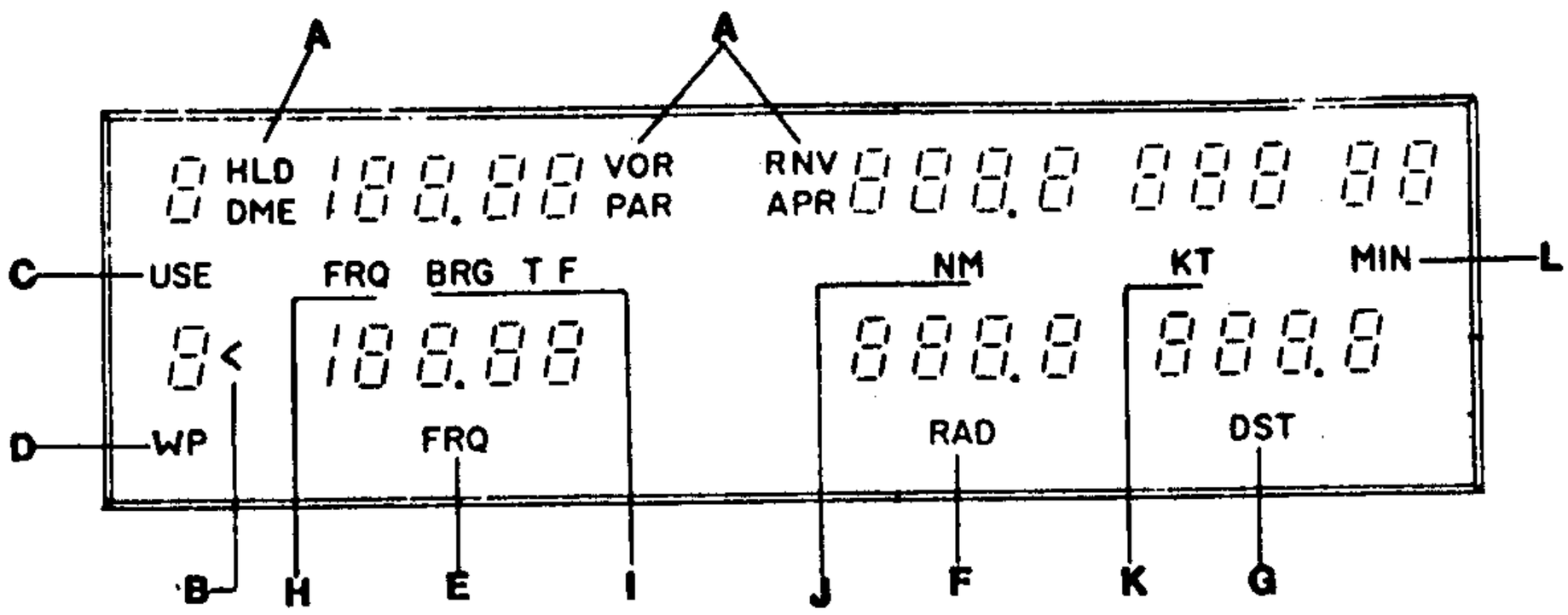


FIGURE 3-2 NS-800 DISPLAY

3.2 NS-800 FRONT PANEL DESCRIPTION (Continued)

15 DIGITAL GAS DISCHARGE DISPLAY (Cont.)

A. System Status Annunciators

These legends annunciate what mode of operation is active:

VOR : Unit operates as a standard VOR/LOC NAV
PAR : CDI presentation is linear (1 nm per dot, ±5 nm full scale)
RNV : Unit operates in the RNAV Enroute mode
RNV : Unit operates in the RNAV Approach mode.
APR : The CDI sensitivity is 1/4 nm per dot (±1¼ nm full scale)
HLD : The Unit operates as an independent DME and
DME : independent NAV

NOTE: When the USE (active) frequency is a LOC/GS channel all system legends go blank. This format is used to annunciate a LOC/GS mode of operation.

B. Caret Display

The Caret is controlled by the DATA button and cycles left to right between the WP, FRQ, RAD and DST displays. The Caret indicates which waypoint parameter the DATA Select knobs are addressing. In Figure 3-2 the Caret is shown pointing to the WP display indicating that the Data Select knobs will control the selection of waypoint numbers 1 to 8.

C. USE Display

This shows the waypoint number that is in active USE.

D. WP (Waypoint) Display

This indicates the number (1 to 8) of the waypoint data storage bin whose data is displayed in the FRQ, RAD and DST displays. When selecting a WP number, the Caret must be pointing to the WP display.

E. FRQ (Frequency) Display

This shows the frequency (VOR, VORTAC, ILS) that is entered into the data storage bin of the displayed waypoint number. When selecting a frequency, the Caret must be pointing to the FRQ display.

3.2 NS-800 FRONT PANEL DESCRIPTION (Continued)

15 DIGITAL GAS DISCHARGE DISPLAY (Cont.)

F. RAD (Radial) Display

This shows the VORTAC station radial (on which the waypoint is located) that is entered into the data storage bin of the displayed waypoint number. The Caret must be pointing to the RAD display in order to select the radial. The display limits are from 000.0 to 359.9 degrees.

G. DST (Distance) Display

This indicates the distance the waypoint is offset from the VORTAC station along the waypoint radial for the waypoint number indicated in the WP display.

The Caret must be pointing to the DST display in order to select a distance. The display limits are from 000.0 to 199.9 nm.

H. FRQ (DME/ILS) Display

In the "HLD DME" mode, this indicates what frequency the DME is locked to. When the active frequency is an ILS frequency, that frequency is displayed here.

I. BRG (bearing) TF Display

In the VOR mode, this indicates the bearing "TO" or the radial (F) from the VORTAC station.

In the RNV mode, this indicates the bearing "TO" or the radial from the waypoint.

When the volume knob is pushed in, this display will indicate the reciprocal of the reading being displayed.

In RNV mode, when the "CHK" button is pressed this display will indicate the position radial from the VORTAC.

J. NM Display

In the VOR mode, this indicates the slant range to the VORTAC.

In the RNV mode, this indicates the actual range to the waypoint.

When the"CHK" button is pressed, this indicates the position distance from the VORTAC.

K. KT (knots) Display

This indicates the aircraft's groundspeed when flying directly to a waypoint or the VORTAC.

3.2 NS-800 FRONT PANEL DESCRIPTION (Continued)

15 DIGITAL GAS DISCHARGE DISPLAY (Cont.)

L. MIN (minutes) Display

This indicates the TTS (time-to-station) when flying directly to a waypoint or the VORTAC.

3.3 NS-800 WAYPOINT PROGRAMMING

The NS-800 is capable of preselecting, storing and displaying 8 NAV frequencies and RNAV waypoint parameters. All data are stored in a non-volatile memory.

A waypoint program consists of the following:

1. Selection of the waypoint number (1 to 8) to be programmed
2. Selection of the VORTAC NAV/DME frequency
3. Selection of the waypoint radial offset
4. Selection of the waypoint distance offset

The programming sequence normally follows that shown above because the display Caret (<), which is used to address each parameter, moves from left to right with each stroke of the DATA button. Therefore, after a WP number has been selected, one stroke of the DATA button moves the Caret one position to the right to the FRQ display.

Waypoint programming is independent of the system operating mode (HLD DME, VOR, VOR PAR, RNV, RNV APR): however, there is one unique condition under which a specific waypoint cannot be programmed:

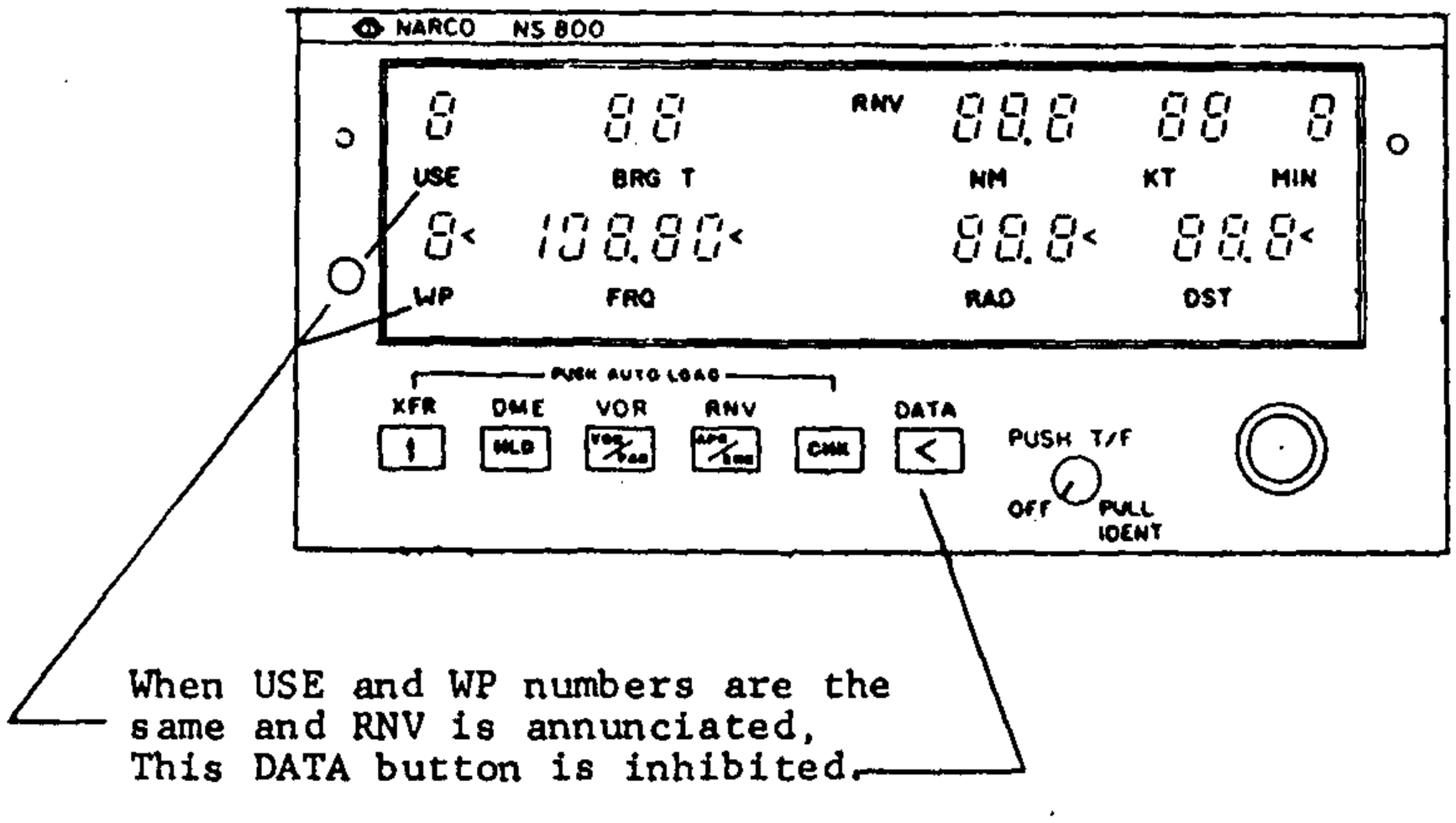
If the NS-800 is operating in the RNV or RNV APR mode, it is NOT possible to change the active (USE) waypoint's frequency, radial or distance offsets. Since it is not normal or desirable to change an active waypoint's parameter(s), this safeguard has been built into the NS-800. Therefore, WHENEVER the RNV or RNV APR modes are annunciated and the displayed USE and WP numbers are the SAME, the DATA button is INHIBITED from addressing the FRQ, RAD or DST displays. The only selection possible under these conditions is the WP number itself, meaning of course, that the 7 remaining waypoints can be programmed.

If the active waypoint's parameter(s) must be changed, then the system mode (in this case RNV or RNV APR) must be changed to "VOR", thereby removing the inhibit restriction on the DATA button.

3.3 NS-800 WAYPOINT PROGRAMMING (Continued)

After reprogramming, push the RNV button to return to that mode. A slower alternate method would be to let the Unit in the RNV mode and transfer to USE another selected waypoint. Then select the previous waypoint and reprogram it and transfer it back to USE.

An example is shown here illustrating the condition under which the DATA button is totally inhibited.



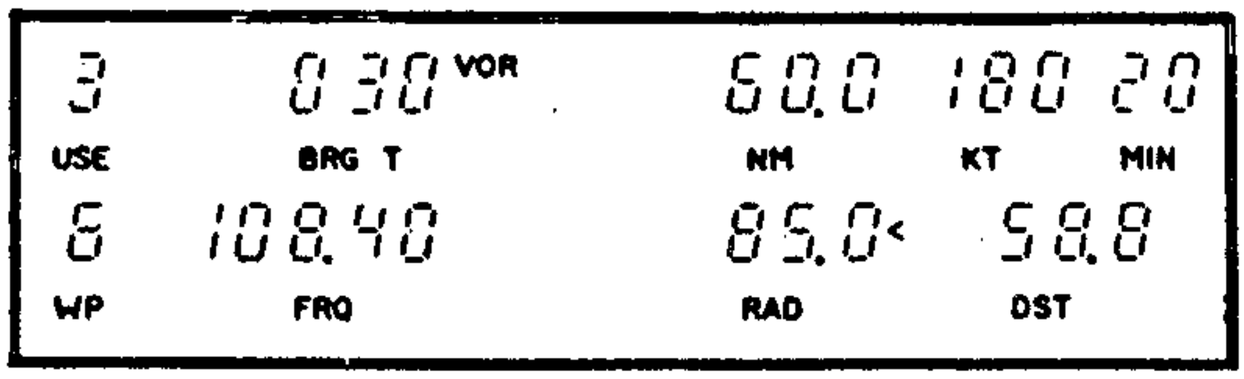
DATA BUTTON INHIBIT EXAMPLE

Keeping in mind the one unique programming restriction, a waypoint programming example will be given. The parameters to be programmed are as follows:

1. WP = 2
2. FRQ = 110.60 Mhz
3. RAD = 045.1°
4. DST = 030.7 nm

3.3 NS-800 WAYPOINT PROGRAMMING (Continued)

We shall assume that the NS-800 is turned on and its display is as shown here in example #1:



DISPLAY EXAMPLE #1: VOR MODE

The display indicates that the system is operating in the VOR mode and the active waypoint is #3. Standby waypoint #6 and its current program is displayed.

3.3.1 Waypoint Programming Procedure

All 8 waypoints may be programmed by the following procedure:

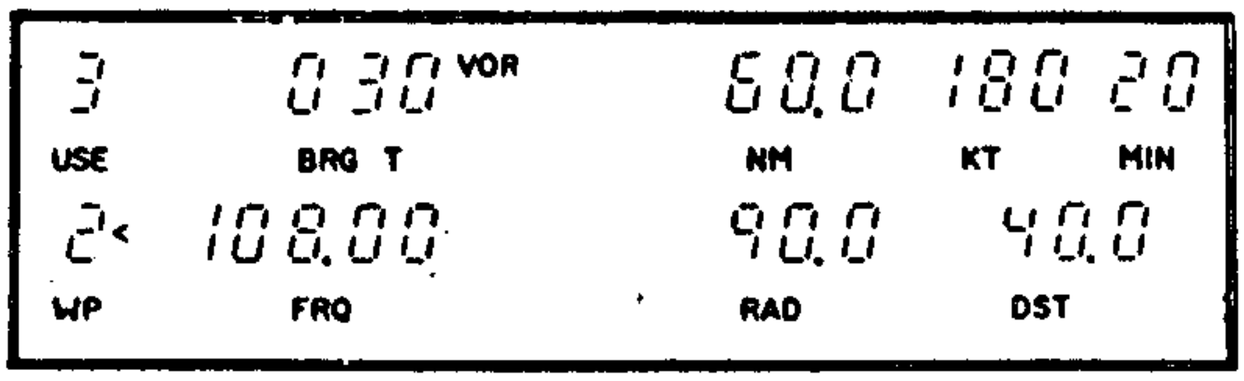
A. WP (waypoint) Number Selection

1. Locate the display Caret (<) and observe which parameter it is addressing (in example #1, it is pointing to the RAD display).

2. Repetitively push the DATA button to shift the Caret to the WP display. The Caret shifts from left to right with each push. The data select knobs will now address the WP display.

3. Rotate either data select knob to select any waypoint number from 1 to 8. In our example this is number 2. This is depicted in example #2 shown here.

NOTE: The display indicates the current program in standby waypoint #2 which we are presently going to change.



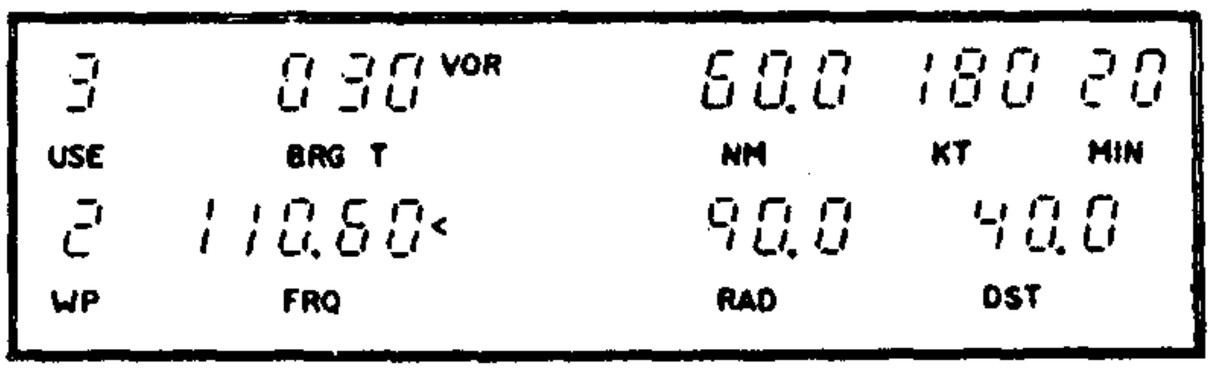
DISPLAY EXAMPLE #2: WP # SELECTION

3.3.1 Waypoint Programming Procedure (Cont.)

B. Waypoint FRQ (frequency) Selection

1. Press the DATA button to shift the Caret (<) to the FRQ display. The data select knobs will now address the FRQ display.

2. Using the outer and inner data select knobs, select the desired VORTAC frequency. (In our example this is 110.60 Mhz). Thefrequency is now stored in data storage bin #2. This is depicted in example #3 shown here.

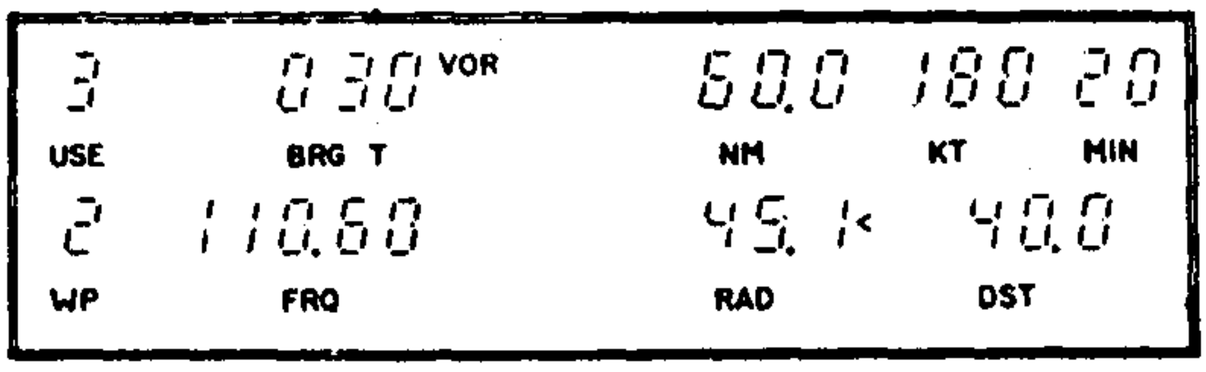


DISPLAY EXAMPLE #3: FREQUENCY SELECTION

C. Waypoint RAD (radial) Selection

1. Press the DATA button to shift the Caret (<) to the RAD display. The data select knobs will now address the RAD display.

2. Using the inner and outer data select knobs, select the desired waypoint radial (limits 000.0 to 359.9°). In our example this is 045.1°. The radial is now stored in data storage bin #2. This is depicted in example #4 shown here.



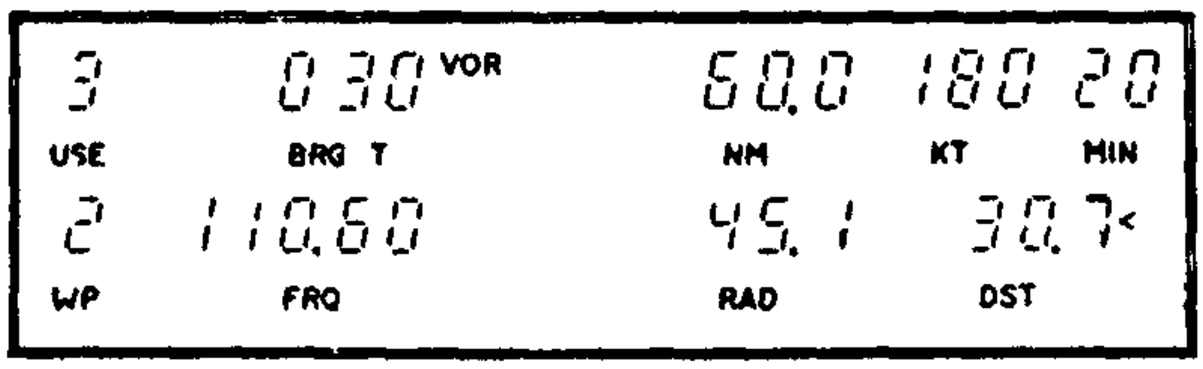
DISPLAY EXAMPLE #4: RADIAL SELECTION

3.3.1 Waypoint Programming Procedure (Cont.)

D. Waypoint DST (distance) Selection

1. Press the DATA button to shift the Caret (<) to the DST display. The data select knobs will now address the DST display.

2. Using the inner and outer data select knobs, select the desired waypoint offset distance (limit 000.0 to 199.9 nm). In our example this is 030.7 nm. The distance is now stored in data storage bin #2 and waypoint 2 has been fully programmed. This is depicted in example #5 shown here.



DISPLAY EXAMPLE #5: WAYPOINT #2 PROGRAM

3. The 7 remaining waypoints are programmed in the fashion just described in steps A, B, C and D.

3.4 AUTO LOAD PROGRAMMING

The NS-800 provides an Auto Load feature in which the aircraft's present position parameters of "VOR radial and DME distance" from a VORTAC station can be automatically loaded into the current USE (active) waypoint. This turns the aircraft's present position into an RNAV waypoint. For example (See Figure 3-3), suppose a pilot's home airport is within the service area of a VORTAC station and he wishes to make his home field a waypoint for his return home trip. Prior to take off he would set the NS-800 to either the VOR or RNV mode, program his selected waypoint with the VORTAC frequency only, and activate the waypoint. After take off the pilot would circle around and make a pass (points A,B,C) across the center of the field, and when over the center (point C), Auto Load his position into the active waypoint.

Auto Loading eliminates system errors because the data loaded into the radial and distance offsets are the actual data as read by the NS-800's NAV receiver and DME. In Figure 3-3, when the aircraft is at position C and the NS-800's "CHK" button is pressed and held, the display would indicate the aircraft's present position as processed by the NS-800. In our example these parameters are a radial of 240° and distance of 22 nm. Since this pilot's NS-800 will

3.4 AUTO LOAD PROGRAMMING (Continued)

indicate these parameters when his plane is at point C, it stands to reason that if these parameters are used as waypoint data, when navigating by RNAV back to the home field and the CDI is centered and waypoint distance shows Zero nautical miles, the planewill be at point C.

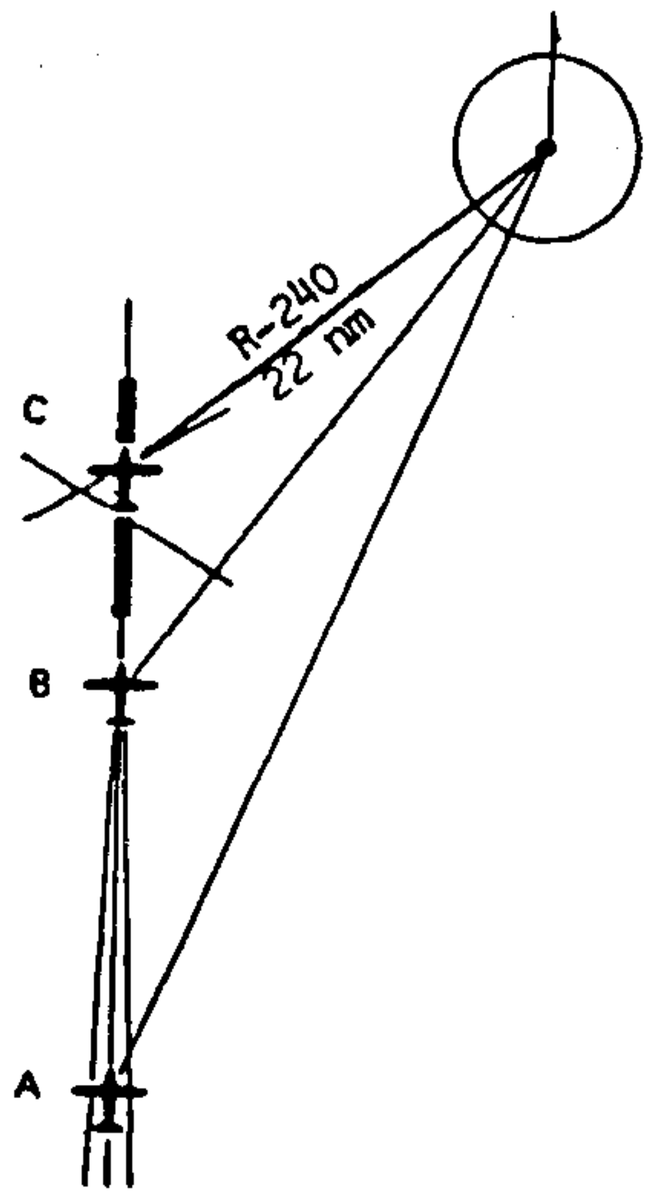


FIGURE 3-3 AUTO LOAD EXAMPLE

3.4.1 Auto Loading Procedure

A. System Mode Selection

The Auto Load feature can be implemented when any of the following modes are selected: VOR, VOR PAR, RNV or RNV APR.

B. Select a waypoint number and enter into the WP display.

C. Select the VORTAC frequency and enter into the FRQ display.

D. Press the XFR button to activate the selected waypoint.

3.4.1 Auto Loading Procedure (Cont.)

E. When the aircraft is over the intended waypoint, FIRST PRESS AND HOLD the CHK button with one finger. While holding the CHK button, press the XFR button with another finger and then release both buttons.

The aircraft's present position parameters of VOR radial and DME distance are immediately loaded and displayed.

CAUTION:

The Auto Load sequence requires that the CHK button be pressed FIRST. If the CHK and XFR buttons are simultaneously pressed, the Auto Load function will NOT transpire.

3.5 SYSTEM MODE SELECTION AND OPERATION

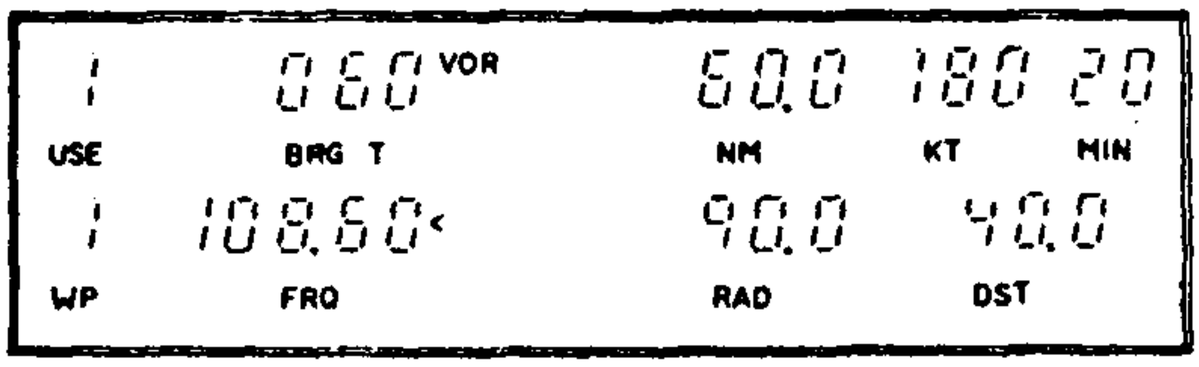
There are five system operational modes available from the NS-800. They include VOR, VOR PAR, RNV, RNV APR, and HLD DME. The following subsections describe their selection and operation.

3.5.1 VOR Mode: Selection and Operation

When the NS-800 is placed in the VOR mode, it may be operated as a standard 200 channel VOR NAV receiver/converter or a 40 channel LOC/GS receiver/converter. Eight NAV channels may be selected and stored in a non volatile memory and recalled and activated. The DME will operate as a standard DME; however, it is frequency slaved to the eight selected NAV channels. Any NAV channel that is NOT a VORTAC channel will cause the DME parameters of DST, KT and MIN to show "bars".

A. VOR Mode Selection

1. If the NS-800 is turned OFF, when it is turned ON it is automatically set to the VOR mode and waypoint #1 is recalled and activated. If the frequency in waypoint #1 is a VOR/VORTAC channel, the mode legend "VOR" will be annunciated and waypoint 1's contents will be displayed as shown here in example #6.

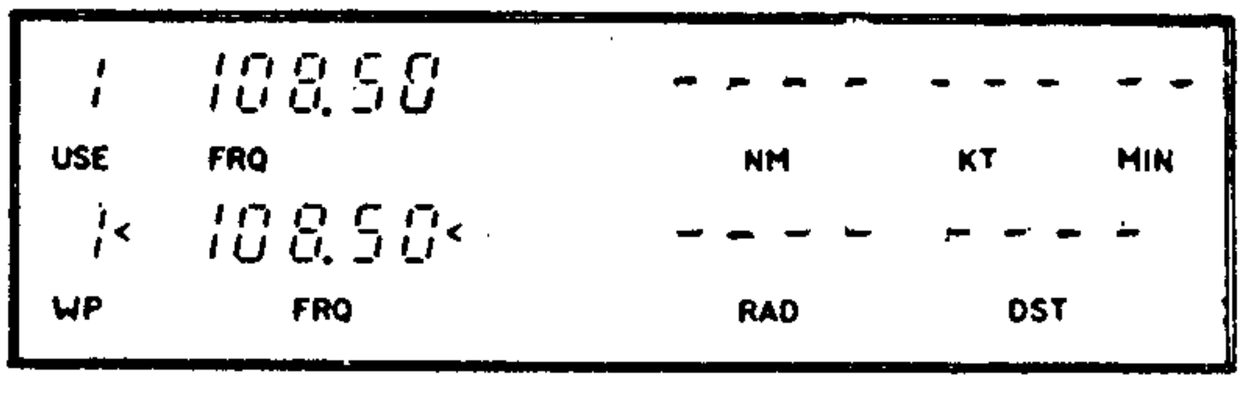


DISPLAY EXAMPLE #6: VOR MODE ANNUNCIATION

3.5.1 VOR Mode: Selection and Operation (Cont.)

A. VOR Mode Selection (Cont.)

If the frequency stored in waypoint #1 happens to be an ILS (LOC/GS) frequency the Unit is still automatically set to the VOR mode and waypoint #1. However, an active (USE) ILS frequency has a special annunciation format, in that ALL the mode legends (VOR, VOR PAR, RNV, RNV APR) are blank. In addition, if the displayed frequency is an ILS frequency, the RAD and DST displays will show dashes eliminating the need for radial and distance data. The DME parameters will show dashes if a DME station is not paired with the ILS channel. Example #7 illustrates these points.



DISPLAY EXAMPLE #7: ILS MODE AND FREQUENCY ANNUNCIATION

2. If the NS-800 is operating in either the RNV, RNV APR or VOR PAR mode, pressing the VOR button will select and annunciate the VOR mode.

B. VOR Mode Operation

The following procedure illustrates how to set up the NS-800 for use as a standard NAV receiver/converter and DME:

1. Select the VOR mode as outlined in step A. Confirm that the legend VOR is annunciated in the display.
2. Locate the display Caret (<) and use the DATA button to shift the Caret to the WP display.
3. Use the data select knobs to select the desired WP number.
4. Press the DATA button to shift the Caret to the FRQ display.
5. Enter the desired VOR/VORTAC or ILS frequency.
6. Press the XFR button to activate the selected waypoint. Confirm that the digit in the USE display is identical to the WP digit.

3.5.1 VOR Mode: Selection and Operation (Cont.)

B. VOR Mode Operation (Cont.)

NOTE: Since both the USE (active) and displayed waypoints are identical and the Caret is addressing the FRQ display, if nothing else is done other than turning the data select knobs, the Unit operates as a standard NAV/DME unit. This is because in the VOR mode it is possible to change the active waypoint's frequency.

If it is desired, additional VOR/ILS frequencies may be stored in any of the 7 remaining waypoints as follows:

7. Use the DATA button to shift the Caret to the WP display.
8. Select another WP number.
9. Press the DATA button to shift the Caret to the FRQ display.
10. Enter the second desired VOR/VORTAC ILS frequency.
11. Repeat steps 7 to 10 to program the remaining waypoints.
12. The next waypoint to be used should now be recalled to act as the standby. When it is required, press the XFR button.

C. CDI/HSI Controls and Displays (VOR Mode)

When the NS-800 is operating in the VOR mode, the companion indicators course deviation is the standard $\pm 10^{o}$ full scale deflection. The OBS control selects the desired course to or from the VOR/VORTAC station.

D. NS-800 DME Displays (VOR Mode)

When the NS-800 is in the VOR mode, the DME portion of the display indicates the slant range distance to the VORTAC station, and the groundspeed and time to or from the VORTAC. If the NAV frequency is not a VORTAC frequency, the DME parameters will show dashes.

E. BRG Display (VOR Mode)

In the VOR mode, the BRG legend is annunciated and will indicate the bearing To or radial From the VOR/VORTAC station. If the NAV frequency is an ILS channel, the bearing information is deleted and the ILS frequency and FRQ legend are annunciated.

3.5.2 VOR PAR Mode: Selection and Operation

A. VOR PAR Mode Selection

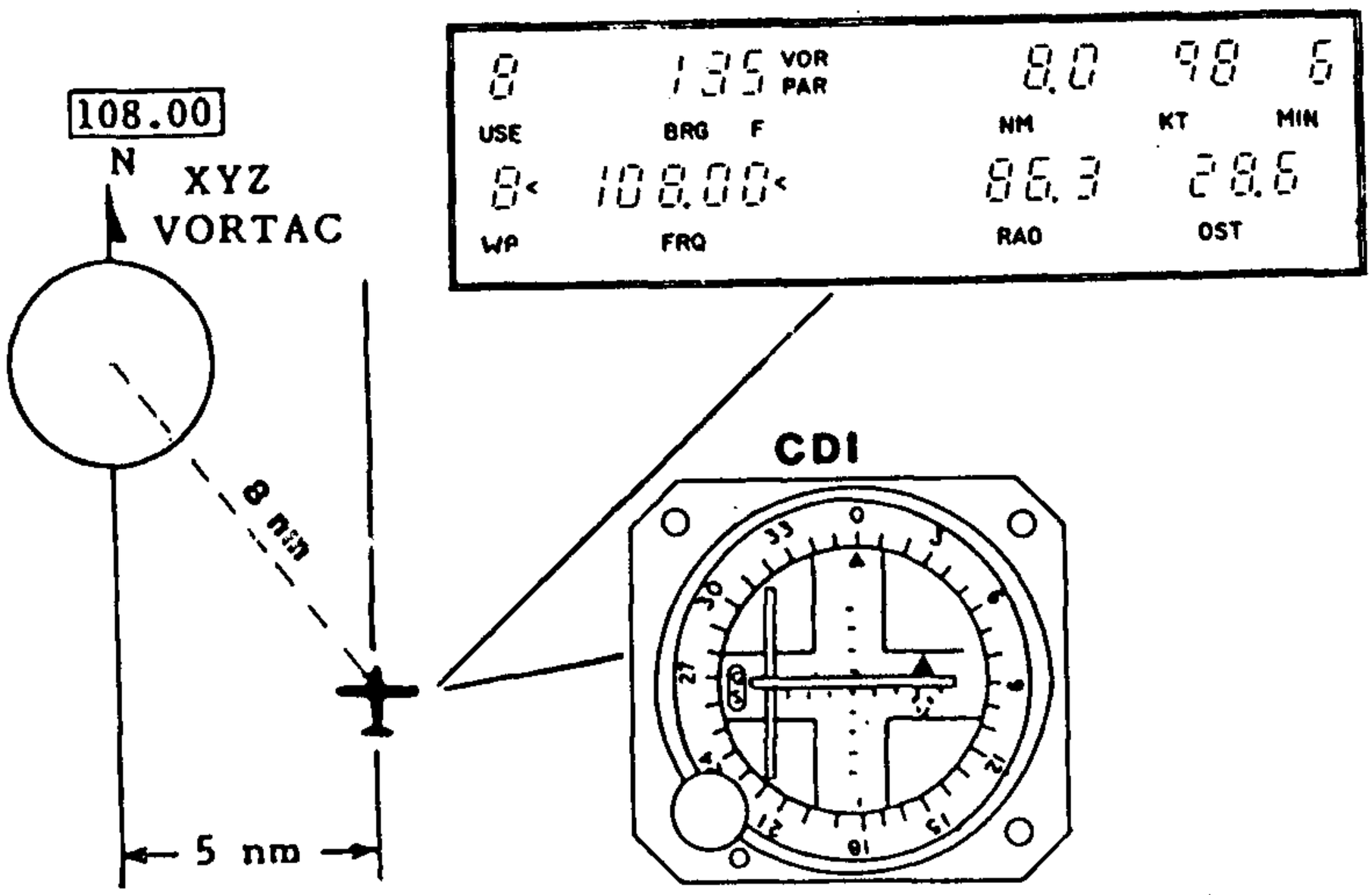
1. Place the NS-800 in the VOR mode as explained in section 3.5.1 step A. Confirm the legend "VOR" is present in the display.

2. Press the VOR button, Confirm the presence of the legend "PAR" under the VOR legend. The Unit is now in the VOR PAR mode.

B. VOR PAR Mode Operation

The VOR PAR mode will permit the aircraft to be navigated parallel to a selected VOR course or Victor airway because the companion CDI/HSI's course deviation is now linear instead of angular. The sensitivity is 1 nm per dot or ±5 nm for a full scale deflection. This is equivalent to the RNV Enroute mode sensitivity. Both VOR and DME information is required, therefore the DME must be operational. Navigating in the VOR PAR mode is restricted to VORTAC stations only.

An example (#9) is shown here in which a pilot is navigating to the XYZ VORTAC while operating the NS-800 in the VOR PAR mode. He is flying a parallel course 5 miles to the right of the VORTAC. Theparallel track is maintained by keeping the CDI needle on the 5th dot.



DISPLAY EXAMPLE #9: VOR PAR MODE OPERATION

3.5.2 VOR PAR Mode: Selection and Operation (Cont.)

B. VOR PAR Mode Operation (Cont.)

The CDI will exhibit a flag condition if either the VOR or DME systems experience a fault and/or failure.

When the NS-800 is operating in the VOR PAR mode, the DME is operating as a standard DME and will indicate the distance to the VORTAC. However, when navigating a parallel track such as shown in the example, the DME's indicated ground-speed and time-to-station are NOT VALID. These parameters are only valid when the aircraft is flying directly to the VORTAC.

3.5.3 RNV Mode: Selection and Operation

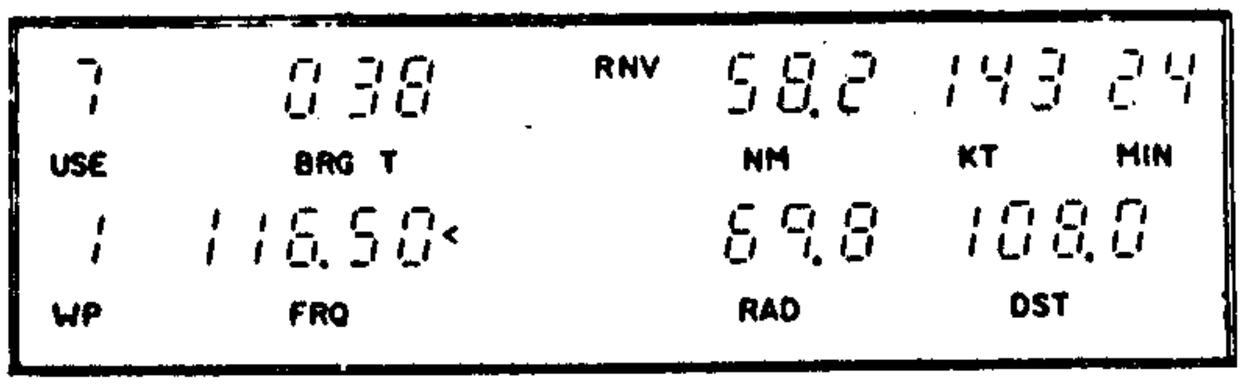
Area navigation is a method of navigation that permits aircraft operations on any desired course within the service area of a VORTAC reference facility. The desired course is established by the use of waypoints. A waypoint is a predetermined geographical position relative to a VORTAC reference facility. The technique used to navigate to or from a waypoint is exactly the same as conventional VOR/DME techniques. Therefore, a waypoint acts as if it is a real VORTAC station but in reality it is only a "phantom" VORTAC.

A. RNV Mode Selection

1. Ensure that the NS-800 is not in the "HLD DME" mode. If it is, press the "HLD" button.

2. Press the RNV button. Confirm the presence of the mode legend RNV in the display. The Unit is now in the RNV Enroute mode of operation.

Display example #10 as shown here indicates that the system is in the RNV mode and the USE (active) waypoint is #7. The standby waypoint is #1 and its frequency and offsets are displayed.



DISPLAY EXAMPLE #10: RNV MODE ANNUNCIATION

3.5.3 RNV Mode: Selection and Operation (Cont.)

B. CDI/HSI Controls and Displays (RNV Mode)

When the NS-800 is operating in theRNV mode, the companion CDI or HSI presents the following information:

1. OBS (Omni Bearing Selector Knob)

This control selects the desired course to or from a waypoint.

2. Course Deviation

Course deviation is linear not angular. The sensitivity is 1 nm per dot, or ±5 nm full scale.

3. Flag Operation

The CDI/HSI will be flagged if the VOR or DME data is not valid.

C. NS-800 DME Displays (RNV Mode)

When the NS-800 is operating in the RNV Mode, the DME displays will present the following information:

1. NM (Nautical Miles) Display

In the RNV mode, the NM display indicates distance to the active waypoint. Dashes are displayed if the DME data is not valid or if the CDI flags.

When the aircraft is passing over the waypoint, the NM display should theoretically indicate zero nm, not the aircraft's range (altitude) as it normally does when a standard mode DME passes over a VORTAC station.

2. KT (Knots) Display

In the RNV mode, groundspeed to or from the active waypoint is displayed.

3. MIN (Minutes) Display

In the RNV mode, time to or from the active waypoint is displayed.

D. NS-800 BRG Display (RNV Mode)

In the RNV mode, the BRG legend is annunciated and indicates the steering bearing "TO" or radial From the waypoint.

3.5.3 RNV Mode: Selection and Operation (Cont.)

E. RNV Mode Operation

When operating the NS-800 in the RNV mode, an aircraft may be navigated directly from the point of origin to destination. This eliminates doglegging, which is frequently associated with flying the Victor airways. RNV mode navigation may be used for the following applications:

1. Location of Airfields

Airfields may be made a waypoint, permitting VFR or RNV Approach (IFR) navigation.

2. Location of a LOM

Establish a waypoint at an LOM and navigate from a holding point directly to the LOM.

3. Location of a Holding Point

Establish a waypoint at a designated ATC HOLD point and navigate directly to it when executing a missed approach.

4. Location of a Weather Break

If Air Traffic Control or a Flight Service Station reports an area weather break, establish a waypoint at that location and navigate directly to it.

5. VORTAC Position Report

In the RNV mode, when theCHK button is pressed the NS-800 will indicate the radial and DME distance from the VORTAC.

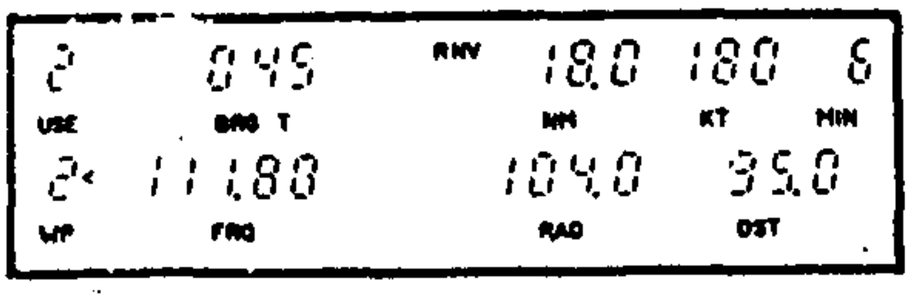
F. USE of CHK Button in RNV Mode

When in the RNV mode and the CHK button is pressed, the BRG display reads the radial (F) from the VORTAC and the nm reads the DME distance to the VORTAC. The Groundspeed (KT) and TTS displays show dashes.

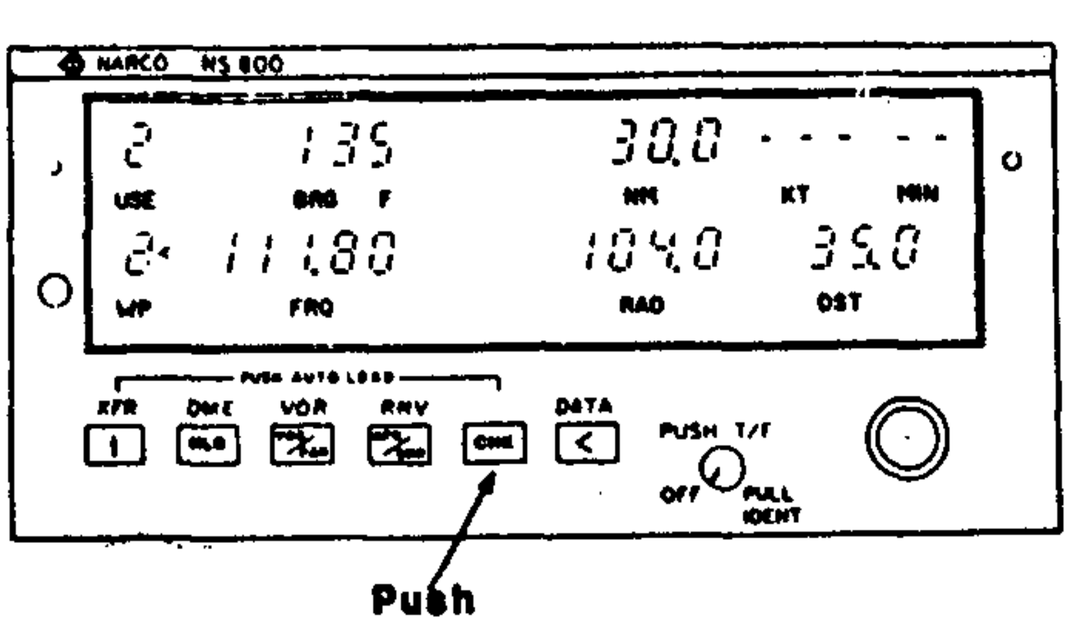
An example (Figure 3-4) illustrating the use of the NS-800 in the RNAV mode will be given.

A pilot wishes to fly from his home field (Titus Airport) to Rico Airport and return. On his navigation chart he draws a straight line between these airports as shown in Figure 3-4. Titus Airport is within the service area of the XYZ VORTAC and Rico Airport is within the service area of the ABC VORTAC. Waypoint #1 is established as an Enroute navigation point, waypoint #2 is the location of Rico Airport (destination) and waypoint #3 is the location of Titus Airport for the return trip.

Prior to the flight, waypoints 1 and 2 are programmed into the NS-800 as outlined in section 3.3. It is the pilot's intention to "AUTOLOAD" waypoint #3 as he passes over the field.

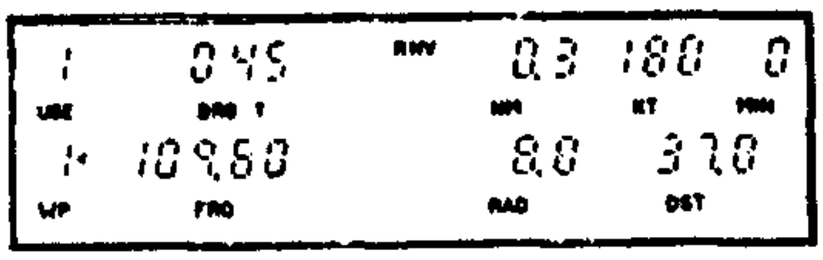


← Bearing,Distance and TTS to WP-2 from point B

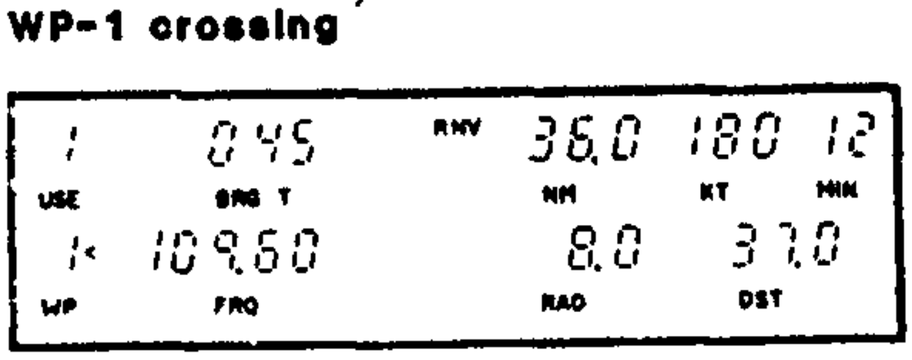


← Point B position relative to ABC VORTAC

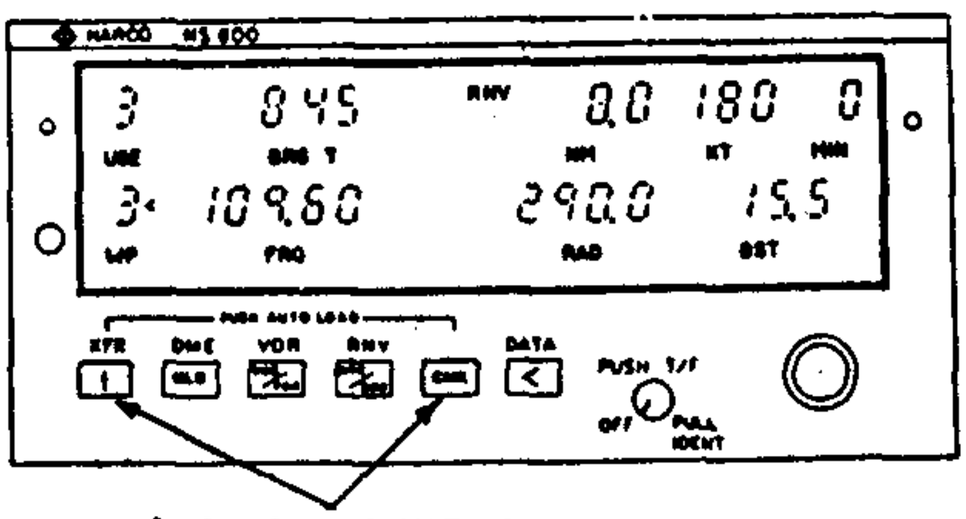
Push



WP-1 crossing



Bearing,Distance and TTS to WP-1 from point A



Auto Load WP-3

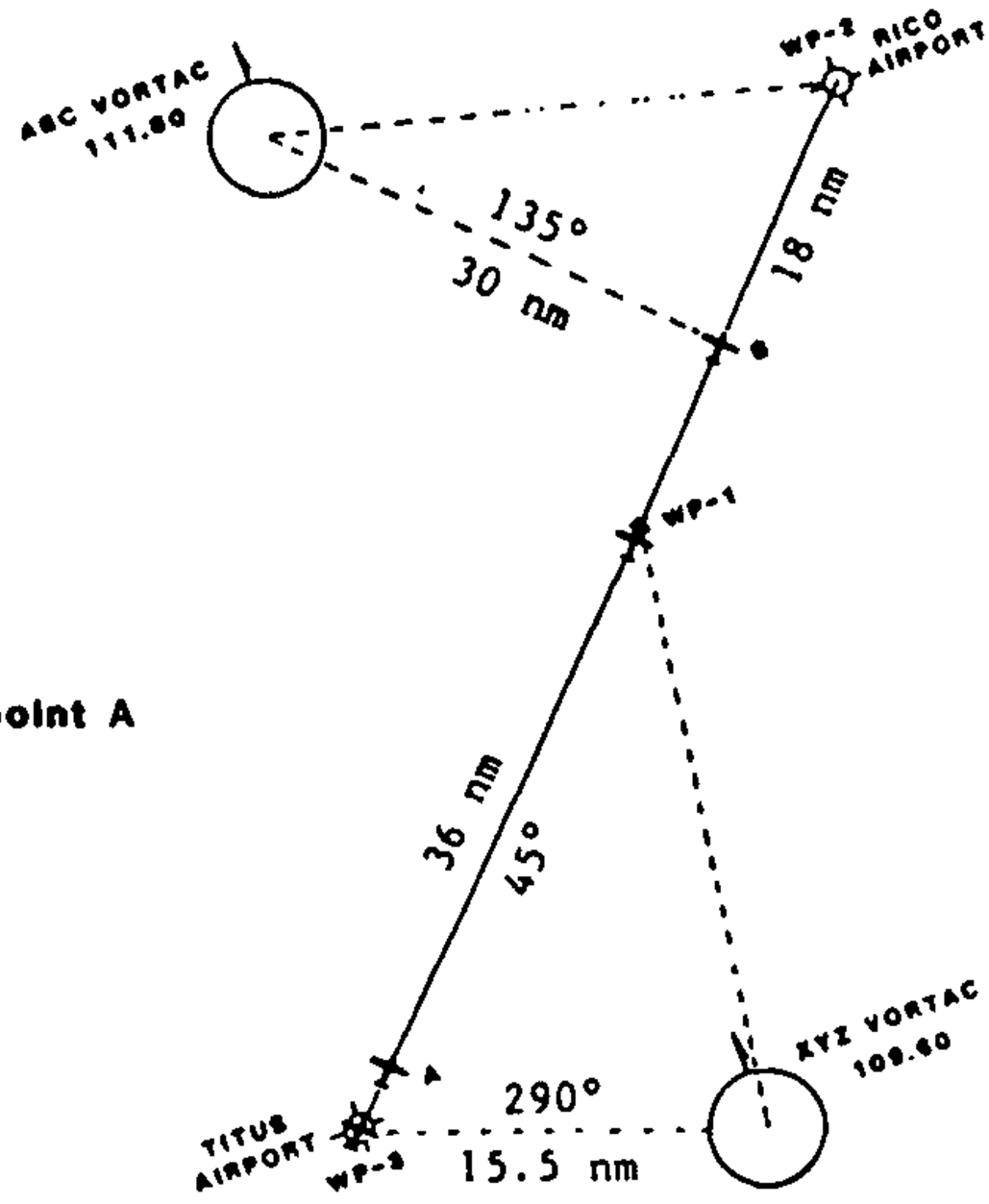


FIGURE 3-4. RNV MODE OPERATION EXAMPLE

3.5.3 RNV MODE: Selection and Operation (Cont.)

F. USE of CHK Button in RNV Mode (Cont.)

The waypoint programs are shown here.

WP#	STATION	FRQ	RAD	DST	APPLICATION
1	XYZ	109.60	008.0°	37 NM	Enroute Navigation
2	ABC	111.80	104.0°	35 NM	Airport Location (destination)
3	XYZ	109.60	290.0*	15.5NM*	Airport Location (return destination)

*AUTOLOADED PARAMETERS

Programming is simple and quick. The NS-800 is turned ON and automatically the first (#1) waypoint is activated and displayed. The Caret is already addressing the FRQ display and the Unit is set to the VOR mode.

1. Enter 109.60 into the FRQ display.
2. Press the DATA button. The Caret shifts to the RAD display.
3. Enter 008.0° into the RAD display.
4. Press the DATA button. The Caret shifts to the DST display.
5. Enter 037.0 NM into the DST display.
6. Press the DATA button. The Caret shifts to the WP display.
7. Enter 2 into the WP display.
8. Press the DATA button. The Caret shifts to the FRQ display.
9. Enter 111.80 into the FRQ display.
10. Press the DATA button.
11. Enter 104.0° into the RAD display.
12. Press the DATA button.
13. Enter 035.0 NM into the DST display.
14. Press the DATA button.
15. Enter 3 into the WP display.
16. Press the DATA button.
17. Enter 109.60 into the FRQ display.
18. Use the DATA button to shift the Caret back to the WP display. Leave the Caret here.
19. Press the XFR button to activate waypoint 3.
20. Press the RNV button to select the RNV mode.

3.5.3 RNV MODE: Selection and Operation (Cont.)

F. USE of CHK Button in RNV Mode (Cont.)

After the pilot takes off, he circles around and passes over Titus field on an estimated heading toward WP #1. When the plane is directly over the field he AUTOLOADS waypoint 3 by first pressing and holding the CHK button, then pressing the XFR button and releasing both. He observes that the RAD display indicates 290.0° and the DST indicated 015.5 NM. These are waypoint 3's parameters as read by his equipment.

The pilot immediately:

a. Selects WP #1
b. Presses the XFR button to activate WP-1.

The pilot now scans the NS-800's DME display and CDI and when both indicate a non-flagged (valid) condition he scans the NS-800's BRG display in order to find his steering bearing TO waypoint #1. The NS-800 indicates that the bearing is 45° and waypoint #1 is 36 nm away (see point A in Figure 3-4). The pilot sets his indicator's OBS to 45° and flys a centered needle to waypoint #1. The pilot now selects waypoint #2 for standby status.

Waypoint 1's passage is annunciated in the same manner as the crossing of a VOR station. The TO/FROM flag changes from TO to OFF to FROM. At waypoint #1 the pilot notes the DME NM indicates a range of 0.3 nm which is his RNAV system error for waypoint #1 (theoretically it should be zero nm).

After passing waypoint #1, the pilot presses the XFR button to activate waypoint #2 and continues to fly a centered needle to his destination.

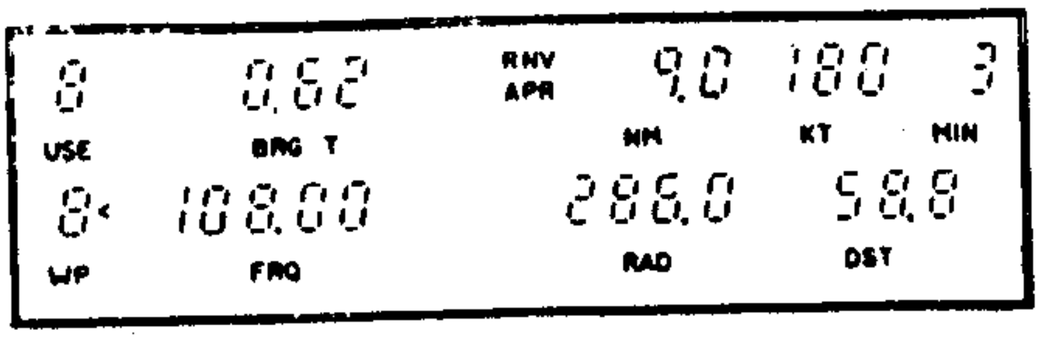
When the controller asks the pilot for a position report (point B in Figure 3-4), the pilot pushes the NS-800's CHK button and replies that he is on the 135° radial and 30 nm from the ABC VORTAC. He releases the CHK button and the NS-800's DME NM display indicates that RICO field is 18 nm away and time-to-waypoint is 6 minutes.

The above example is just one of many applications for the NS-800.

3.5.4 RNV APR (Approach) MODE, Selection and Operation

A. RNV APR Mode Selection

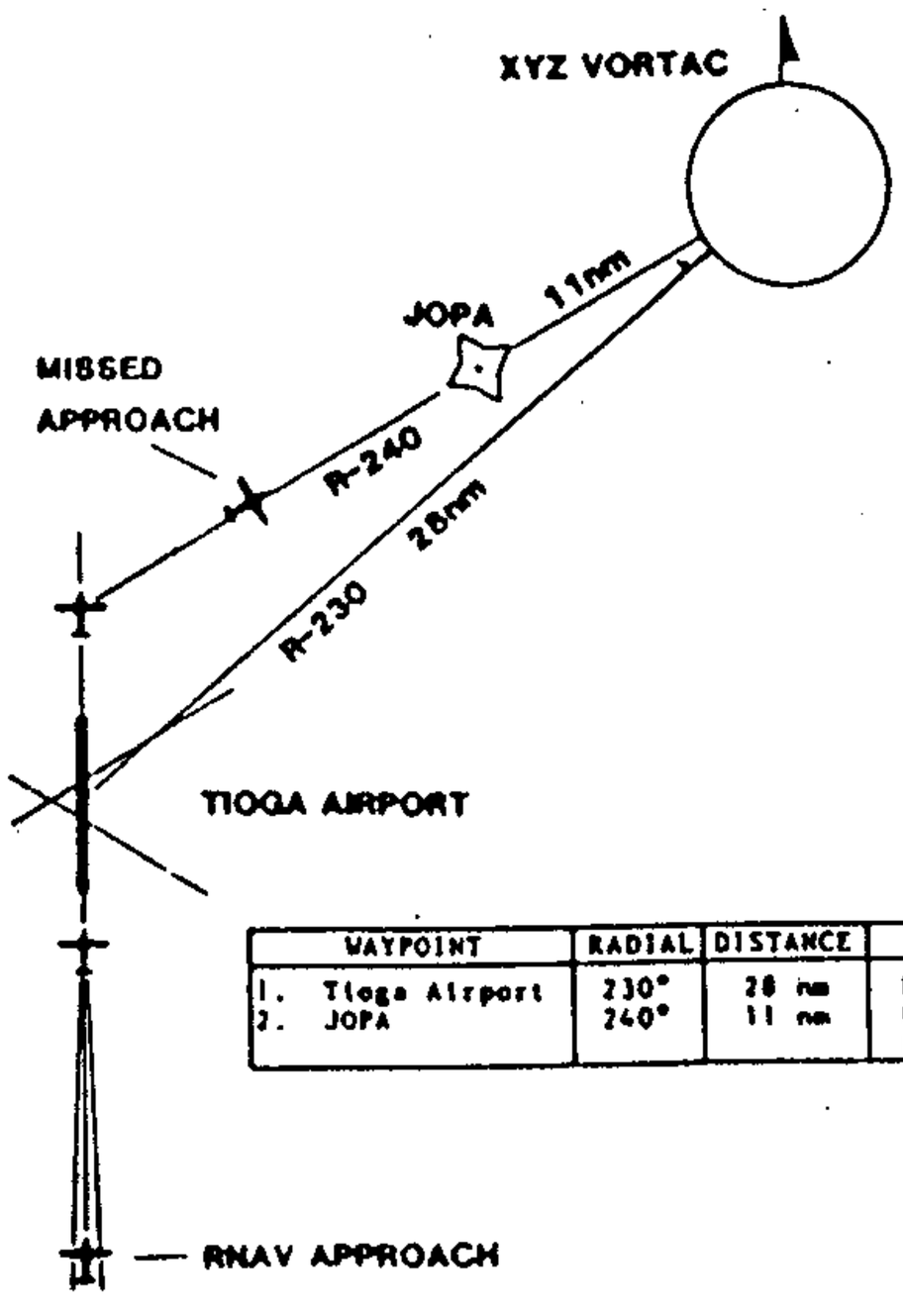
1. Place the NS-800 in the RNV mode as explained in section 3.5.3 step A.
2. Press the RNV button. Confirm that the legend "APR" is annunciated underneath the RNV legend as shown here in display example #11.



DISPLAY EXAMPLE #11: RNV APR ANNUNCIATION

B. RNV APR Operation

When the NS-800 is in the RNV APR mode, the system operation is identical to the RNV Enroute mode; however, the companion CDI/HSI's course deviation changes to a sensitivity of 0.25nm per dot (±1.25nm full scale deflection).



WAYPOINT	RADIAL	DISTANCE	APPLICATION
1. Tioga Airport	230°	28 nm	RNAV Approach
2. JOPA	240°	11 nm	Holding Pattern Entrance

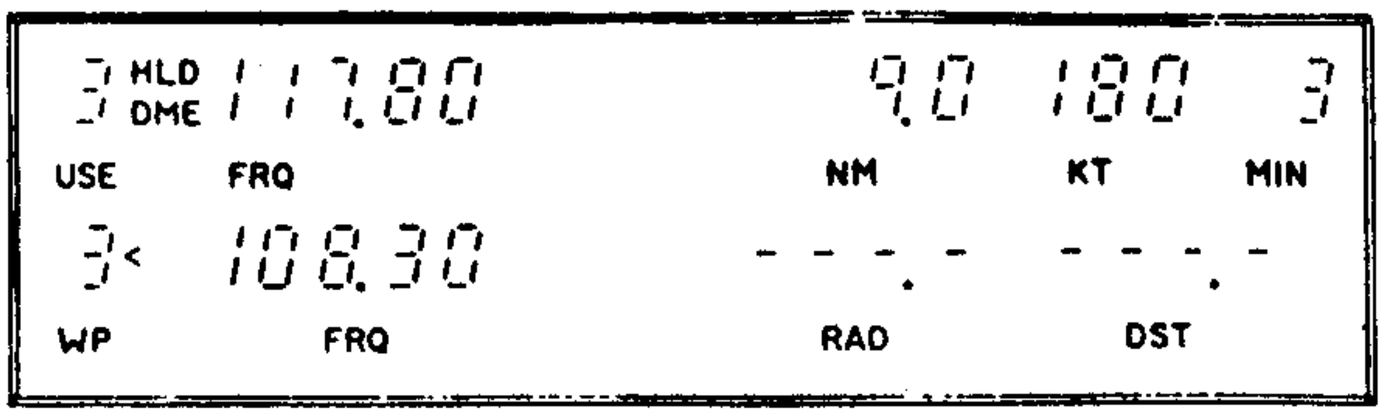
An example of how the RNV APR mode could be used is shown here. An RNAV approach is being made to Tioga Airport. The CDI crosstrack sensitivity is 4 times greater in the Approach mode than it is in the Enroute mode. This permits accurate tracking to the field. The pilot has prepared for a missed approach by making the entrance to the holding pattern (JOPA) his standby waypoint. If a missed approach is declared, the pilot would activate the standby waypoint, set his OBS to 60° (reciprocal of R-240) to intercept the 240° radial, and proceed to JOPA.

FIGURE 3-5 RNV APR MODE OPERATION EXAMPLE

3.5.5 HLD DME (Hold DME) Mode Operation and Selection

When the NS-800 is used to make an ILS landing, the DME section can continue to operate on a chosen VORTAC by placing the DME on "Hold". When the DME is on "hold", the NAV receiver may be set to an ILS channel or another VOR channel.

When the HLD DME feature is activated, the legends "HLD DME" are annunciated adjacent to the USE digit. All other mode legends are blank and the DME "hold frequency" and FRQ legend are annunciated in place of the digital bearing and BRG TF legends. If the USE and standby waypoints are the same, the waypoint RAD and DST parameters will show dashes. A display example is shown here in which the DME is locked to channel 117.80 and the NAV active (and standby) channel is the ILS frequency of 108.30.



DISPLAY EXAMPLE #12: HLD DME ANNUNCIATE

The following procedure illustrates the HLD DME selection:

1. Press the "HLD" button. Confirm the annunciation of HLD DME legends and the active waypoint (hold) frequency in the display.

2. Select a new NAV frequency either by recalling the standby waypoint where it is stored, or by directly entering the required frequency into the waypoint FRQ display.

3. Press the XFR button to activate the new NAV frequency.

   The NAV section of the NS-800 is now operating on the frequency displayed in the lower FRQ display while the DME section is operating on the frequency displayed in the upper FRQ display.

4. To release the "HLD DME" feature, press the HLD button. Confirm the disappearance of the FRQ and HLD DME legends, and the annunciation of the VOR mode and BRG TF legends.

   The Unit is now set to the standard VOR mode.