

# NIGHTHAWK FLIGHT SYSTEMS, INC.



## SN4500

### Primary Navigation Display

*with*

*Reversionary Attitude Mode*

*and*

*LNAV Roll Steering*



## Pilot's Guide

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## **Pilot information**

Publication Date: 15-MAR-2022

This guide provides information on the use and operation of the SN4500 Primary Navigation Display.

Information in this manual is current as of publication or revision date. Specifications and operational details are subject to change without notice at the discretion of Nighthawk Flight Systems, Inc.

## **Copyright**

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## **Revision notice**

The “Effectivity, Errata, and Revision History” allow the use of this Pilot Guide with a specific software release. The “Effectivity, Errata, and Revision History” specifically lists the software to which this Pilot’s Guide applies and corrects any errors or omissions in this revision of the Pilot’s Guide. Effectivity, Errata, and Revision History” can be found on page XII of this Pilot’s Guide.

## **Operational and legal issues**

The information displayed on the SN4500 is generated by external equipment. It is the pilot's responsibility to ensure the correct configuration and use of the external equipment. The SN4500 is subject to all legal and operational limitations of the equipment supplying data to it. Always refer to your approved Aircraft Flight Manual Supplement for operation and limitations on the use of installed equipment.

Note: Because aircraft vary in their installed equipment, it is important to note that what is displayed on the SN4500 may vary depending on the presence or absence of equipment.

Please keep in mind that it is required by Federal Aviation Regulations to have on board current charts appropriate to the flight. The moving map on the SN4500 does not fulfill this requirement. A current internal database is not required but is recommended. The internal database supplies supplemental data only (such as nearest airports, nav aids and airspace). Flight plan waypoints and IFR approaches are supplied to the SN4500 by the associated IFR approved GPS receiver. Supplemental data is intended for positional awareness only and should not be used for primary navigation.

## Approvals

The FAA has approved the latest software version of the SN4500 under the following TSOs. Refer to the SN4500 Installation Manual, available on our website at [www.nighthawkfs.com](http://www.nighthawkfs.com), for applicable TSOs by the software and hardware revision level of your unit.

- C3d: Turn and Slip Instrument
- C4c: Bank and Pitch Instruments
- C6d: Direction Instrument, Magnetic (Gyroscopically Stabilized)
- C34e: ILS Glide Slope Receiving Equipment
- C35d: Airborne Radio Marker Receiving Equipment
- C36e: Airborne ILS Localizer Receiving Equipment
- C40c: VOR Receiving Equipment
- C41d: Airborne ADF Equipment
- C113: Airborne Multipurpose Electronic Displays
- C118: Traffic Alert and Collision Avoidance System Airborne Equipment, TCAS I
- C119b: Traffic Alert and Collision Avoidance System Airborne Equipment, TCAS II
- C195b: Avionics Supporting Automatic Dependent Surveillance-Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)

The following RTCA certification levels also apply to this product:

- DO-160E: Environmental (Categories listed in Chapter 13)
- DO-178B: Software Level C
- DO-254: Hardware Level C

Installation of the SN4500 in a type-certificated aircraft must be performed in accordance with the Nighthawk Flight Systems, Inc. SN4500 Installation Manual, document number 82009-IM applicable revision.

## **Conventions Used in This Manual**

The name of a button is placed within square brackets when the button is described in text. For example, "...press the [VUE] selection button to ..."

This manual uses terms, which should be familiar to aviation-minded readers, such as "selected radial" and "magnetic heading". Terms, which are specific to the SN4500, will be placed in the glossary.

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## Effectivity, Revision and Errata History

Date: 09-MAY-2022

Applies to: SN4500 Software A2.09 and later and 2.06 and later  
SN4500 Pilot's Guide 82009-PG, Revision G

With the exception of the superseding information contained in this section, operation of the SN4500 is as described in the SN4500 Pilot's Guide referenced above.

Revision History		
Revision	Date	Comments
G	09-MAY-2022	<p>Updated for software version A2.09 and 2.06</p> <p>Changed company references from Sandel Avionics to Nighthawk Flight Systems, Inc.</p> <ul style="list-style-type: none"> <li>• Page III: Removed address.</li> <li>• Page V: Added TSO C195b.</li> <li>• Chapter 1: Page 1-1 modified description of functions.</li> <li>• Chapter 3: Pages 3-2 and 3-3 added TCN1 and TCN2. Page 3-2 removed WSI. Pages 3-9 and 3-10 added NVIS operation. Added Figures 3-10, 3-11, and 3-12.</li> <li>• Chapter 4: Pages 4-6 through 4-8 added TACAN operation. Added Figures 4-8, 4-9, 4-10, 4-11, and 4-12.</li> <li>• Chapter 8: Removed Page 8-3 removed LTNG SRC menu selection. Added note on discontinuation of WSI service.</li> <li>• Chapter 9: Page 9-1 added ADS-B. Pages 9-6 through 9-8 added description of ADS-B In traffic. Added Figures 9-6, 9-7, 9-8, and 9-9.</li> </ul>

		<ul style="list-style-type: none"> <li>• Chapter 10: Pages 10-6 through 10-8 added information regarding fast slaving for internally slaved heading installations. Added figures 10-2, 10-3, 10-4, and 10-5.</li> <li>• Chapter 11: Page 11-2 removed reference to lamp for COOLING FAN FAIL condition. Page 11-6 removed reference to backlight for OVERTEMP SHTDWN condition.</li> <li>• Chapter 13: Page 13-1 added TSO C195b. Corrected physical dimensions. Page 13-2 corrected nominal voltage value.</li> </ul>
F	05-SEP-2012	<p>Updated for software version 2.05</p> <ul style="list-style-type: none"> <li>• Page V: Updated chapter reference.</li> <li>• Chapter 2: Fig. 2-1 updated. Page 2-4 updated Inner Course and VDI description. Updated Outer Course and VDI description.</li> <li>• Chapter 7: Page 7-12 Clear button operation description updated.</li> <li>• Chapter 8: Updated figure references. Page 8-2 updated formatting. Page 8-4 updated Datalink Weather s/w version.</li> <li>• Chapter 9 updated references.</li> <li>• Chapter 11 new message added for remote OBS configuration.</li> </ul>
E	29-FEB-2012	<p>Updated for software version 2.04</p> <ul style="list-style-type: none"> <li>• Cover: New image.</li> <li>• Chapter 1: Page 1-1 added mention of data recorder.</li> <li>• Chapter 2: Figure 2-1 updated for Roll Steering, page 2-2 added description of readout for LNAV operations. Pages 2-3, 2-6</li> </ul>

		<p>updated for outlined heading bug and optional white heading bug. Page 2-4 added description of GPS track line and note about CDI/VDI pointer shapes.</p> <ul style="list-style-type: none"> <li>• Chapter 3: Page 3-1 updated splash screen brightness information. Figures 3-4, 3-5 updated. Pages 3-6 to 3-9 updated for improved brightness control setting procedures.</li> <li>• Chapter 4: Page 4-2 updated auto-slew operation.</li> <li>• Chapter 5: New chapter for LNAV/Roll Steering operation.</li> <li>• Chapters 6-16: renumbered.</li> <li>• Chapter 6: Page 6-1 updated [BRG] button operation.</li> <li>• Chapter 7: Header title corrected. Figure 7-1 Updated. Page 7-3 updated [MAP] button operation. Page 7-13 removed (blank page).</li> <li>• Chapter 8: Page 8-5 minor formatting change.</li> <li>• Chapter 10: Added No Intercept and AHRS not slaved alerts.</li> <li>• Chapter 11: Added FUNC NOT AVAIL, LNAV CANCELLED, NAV SRC NOT GPS, NO LNAV DATA, PUSH-HOLD-FOR-GPS and SELECT A/P APPR.</li> <li>• Chapter 12: Updated figures 11-1, 11-2, Attitude Display Detail images, and Unusual Attitude images to show improved slip/skid indicator. Figure 11-1: added callout for</li> </ul>
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		VOR TO/FROM arrow.
D1	25-MAR-2010	<p>Updated for software version 2.01</p> <ul style="list-style-type: none"> <li>• Page III: Pub/Copyright date</li> <li>• TOC: updated</li> <li>• Page X1: Effectivity updated.</li> </ul>
D	22-JAN-2009	<p>Updated for software version 2.00</p> <ul style="list-style-type: none"> <li>• Page V: added C3d, c4c</li> <li>• TOC: updated</li> <li>• Page X: Effectivity updated.</li> <li>• Page 2-6: Added REV ATT heading bug color.</li> <li>• Chapter 11: new</li> <li>• Chap. 12 – 15: renumber</li> <li>• Page 12-1: added C3d, c4c</li> </ul>
C	11-NOV-2008	<p>Updated for software version 1.05.</p> <ul style="list-style-type: none"> <li>• Formatting changes made to Effectivity, Revision and Errata History page.</li> <li>• Page 2-1: Added Power On Indicator to Figure 2-1: Physical Features.</li> <li>• Page 2-5: Added GPS approach type annunciators.</li> <li>• Page 3-7: Digits added on brightness adjustment indicator.</li> <li>• Page 4-4 GPS WAAS INTEG annunciations added</li> <li>• Page 4-5 GPS annunciator descriptions added.</li> </ul>

B1	20-DEC-2007	Updated for software version 1.03. <ul style="list-style-type: none"> <li>• Page iii: Patent information updated.</li> <li>• Page XI Errata updated.</li> <li>• Page 2-5: Data color coding tables updated to reflect new data color coding.</li> <li>• Illustrations updated to reflect new data color coding.</li> <li>• Page 9-4: GPS “INTG” annunciator added.</li> </ul>
B	08-NOV-2006	AR 867: Commercial release with software v1.01
A	16-FEB-2006	Initial Release



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## **CHAPTER 1 WELCOME TO THE SN4500**

### **What is the SN4500**

For years, pilots of large commercial aircraft have appreciated the benefits of Electronic Flight Instrumentation Systems, commonly known as EFIS. Full EFIS systems combine data from different sources within the aircraft and provide the pilot with a unified display. This greatly simplifies the instrument scan and improves situational awareness.

The Sandel SN4500 Primary Navigation Display is an enhanced Electronic Horizontal Situation Indicator (EHSI) which packs the essential features of an EFIS NAV display plus enhanced features into a standard four-inch instrument. By combining the functions of an electromechanical HSI, an RMI, a moving map, traffic and a Stormscope® display into one instrument, the SN4500 ties together the critical elements of situational awareness.

The SN4500 uses Nighthawk Flight Systems, Inc.'s proprietary LED backlit rear-projection display technology for brilliant image quality and long operating lifetime.

Internally, the SN4500 uses high-speed digital converters that allow it to receive signals from virtually every type of navigation receiver ever installed in general aviation aircraft. A comprehensive set of maintenance pages allows the installer to simply specify the make and model of the installed equipment, and the SN4500 will configure itself accordingly. In addition, an internal recorder can be enabled that will record up to the last 10 hours of flight data. This data can be used by Nighthawk Flight Systems, Inc. to assist in troubleshooting.

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## CHAPTER 2 DISPLAY OVERVIEW

### SN4500 Physical Features

The SN4500 physical layout consists of a full four inch display, twelve backlit pushbuttons, two knobs with push to select, a power on indicator, and one USB connector.

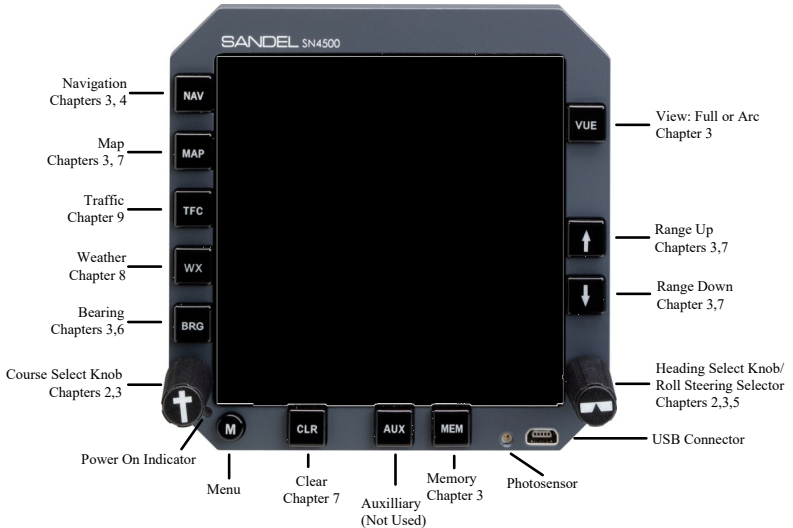


Figure 2-1 SN4500 Physical Features

The following section of the manual describes the appearance of the SN4500 display and identifies each functional element. Detailed descriptions of these elements and a tutorial guide to their use are presented in later sections as noted in Figure 2-1 above.

### Display Areas

The primary display area shows either a 360-degree FULL view or a 70-degree ARC view, as indicated by the white compass ring. The cyan airplane or triangle represents the aircraft's current position. The primary display area may also depict the current GPS flight plan, airports, nav aids, intersections, airspace, traffic, FIS-B datalink weather and/or Stormscope® data if the map feature has been enabled. Several indicators (see below) are also presented within the primary display area.



Figure 2-2 Display Areas

The upper display area presents data from the selected course navigation instrument. The data displayed depends upon the navigation source (VOR/DME or GPS) but it will generally include bearing, distance, and ground speed, if available. The upper display area also includes information on the map status, WX-500 Stormscope® status (if installed), and an annunciation on whether the VOR NAV display is currently receiving either a localizer or a full ILS (localizer/glide slope) signal.

The lower display area presents the numeric data associate with the two bearing pointers. This includes the NAV source, bearing and distance (if available). The right section of this area contains a display of the marker beacon lights if configured and heading data during LNAV operations. The left section includes GPS annunciators, if configured.

### Indicators

Several different symbols, or indicators, are used in each of the display areas. These are described below:



**Lubber line [white]:** Points to the magnetic heading. It is always at the top of the display.



**Heading bug [orange or white]:** This can be set to a desired heading by rotating the Heading Select knob (right knob).

Pressing the Heading Select knob will SYNC the heading bug with the lubber line, allowing the pilot to immediately set the heading bug to the current heading. Software version 2.04 provided a selectable heading bug color. Reference the SN4500 Installation Manual for more information.

**Parked heading bug:** When the display is in the 70-degree ARC mode using the [VUE] button, it is possible for the heading bug to be positioned off of the screen. When this happens, the heading bug “parks” at the side of the screen nearest to its actual position, with the symbol displayed smaller than normal and close to the edge of the screen.



**Heading Bug [Outlined]:** During LNAV operation a HDG bug is not displayed. If the HDG knob is turned more than a single click an outlined heading bug will appear as a visual reference preset only. It does not connect to the SN4500 HDG output until LNAV is cancelled. LNAV operation is detailed in chapter 5.



**Course pointer:** By rotating the Course Select knob (left knob), you can set the course pointer to the desired course to a VOR NAV source. When a long-range NAV source is selected, the course pointer can automatically rotate to the desired track being sent by the NAV source (i.e. “Auto-slew”). A unique course pointer setting is maintained for each NAV source selection.

**Parked course pointer:** When the display is in the 70-degree ARC mode, it is possible for the head of the course pointer to be positioned off of the screen. When this happens, the course pointer “parks” at the side of the screen nearest to its actual position, with the symbol displayed smaller than normal and close to the edge of the screen.



**Bearing pointers 1 and 2:** Two bearing pointers are provided. Bearing pointer 1 (BRG1) is represented by the closed tip arrowhead symbol. Bearing pointer 2 (BRG2) is represented by the open tip arrowhead symbol. Depending on the user-selected settings, these pointers may show the bearing to a VOR, ADF, or GPS waypoint. The numeric information from the instruments assigned to these pointers is displayed in the lower display area. The information is displayed in the same color as the associated bearing pointer. Also note that the tail of each pointer can be used to determine the bearing from the selected NAV source.

**GPS Track:** The white dotted line extending from the “own aircraft” symbol indicates the aircraft GPS ground track. This line is removed when ground track is not available or when the map is off.

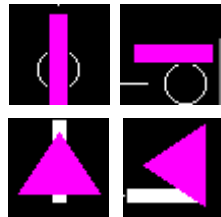


GPS Track

**Inner CDI and VDI:** The course deviation indicator bar (CDI; also known as the lateral deviation bar or “D-bar”) is the movable center section of the course pointer that depicts lateral deviation to the left or right of course. The vertical deviation indicator bar (VDI) is the movable center section that depicts vertical deviation above or below glide slope or GPS final approach path. The VDI is only available when tuned to a glide slope or a vertical deviation from the GPS. Note that the inner CDI and VDI are not visible when the map display is enabled which can be disabled by pressing [CLR]. The inner VDI can be disabled during installation.



**Outer CDI and VDI:** The CDI and VDI are also repeated at the bottom and right side of the display – this is referred to as the outer CDI and outer VDI. There are two shapes of outer CDI and VDI pointers that can be configured during installation – bar or triangle.





**BC** **Back course:** When flying a back course approach, the course pointer should be set to the published front course. The CDI will automatically reverse sense when the course pointer is more than +/- 90 degrees from the lubber line. The label “BC” will appear above the CDI and a yellow “X” will block the outer VDI during a back course approach as a reminder to the pilot as shown in the adjacent figure.







### Data Color Coding

Data displayed on the SN4500 is color coded as follows:

<b>Color</b>	<b>Data displayed</b>
<p>GREEN</p>	<ul style="list-style-type: none"> <li>• Information associated with the primary VHF NAV1 receiver (or NAV2 if in co-pilot configuration)</li> <li>• GPS annunciators: LP, LPV, L NAV, LVNAV ACTV, AUTO and LEG</li> <li>• Class B and C airspace</li> <li>• Stormscope® data older than 30 seconds</li> </ul>
<p>CYAN</p>	<ul style="list-style-type: none"> <li>• Information associated with the LNAV (GPS/FMS) receiver text</li> <li>• GPS annunciators: HLD, PTK and APPR (II Morrow GPS only)</li> <li>• Map status bar icons</li> <li>• Moving map icons</li> <li>• Traffic range ring</li> <li>• Current position symbol, either airplane or triangle</li> <li>• Map range scale</li> </ul>
<p>WHITE</p>	<ul style="list-style-type: none"> <li>•</li> <li>• Compass rose under normal conditions</li> <li>• Magnetic heading and button labels</li> <li>• Non-active legs and waypoints of flight plan</li> <li>• To/From indicator</li> <li>• Inner marker indicator</li> <li>• Traffic targets</li> </ul>

<b>Color</b>	<b>Data displayed</b>
WHITE	<ul style="list-style-type: none"> <li>• New Stormscope® data</li> <li>• GPS Track</li> <li>• ADF bearing pointer / text</li> <li>• Heading bug and associated data (when configured to white during installation).</li> </ul>
RED	<ul style="list-style-type: none"> <li>• Flags indicating failed glide slope, CDI, map, weather or traffic data</li> <li>• Flags indicating abnormal heading condition</li> <li>• Prohibited airspace</li> </ul>
AMBER	<ul style="list-style-type: none"> <li>• GPS annunciators: MSG, WPT, INTEG. Also HOLD (Garmin only)</li> <li>• Compass rose when either gyro or fluxgate has failed</li> <li>• Middle marker indicator</li> </ul>
YELLOW	<ul style="list-style-type: none"> <li>• Information associated with the cross-side NAV receiver (NAV2 if in the pilot configuration, NAV1 if in the co-pilot configuration)</li> <li>• Restricted and warning areas</li> <li>• Flag indicating invalid glide slope</li> <li>• Marker test</li> <li>• Decluttered map status icons</li> </ul>
	<ul style="list-style-type: none"> <li>• LNAV ARMED annunciator</li> </ul>

Color	Data displayed
MAGENTA	<ul style="list-style-type: none"> <li>• Active leg and waypoint of flight plan</li> <li>• LOC1 / LOC2 Indicator</li> <li>• ILS1 / ILS2 Indicator</li> <li>• LNAV annunciator</li> </ul>
	
ORANGE	<ul style="list-style-type: none"> <li>• Heading bug and associated data (when configured to orange during installation).</li> </ul>
	
BLUE	<ul style="list-style-type: none"> <li>• Outer marker indicator</li> </ul>
	
PURPLE	<ul style="list-style-type: none"> <li>• MOA</li> </ul>
	

## CHAPTER 3 BASIC OPERATION

### Overview

The SN4500 is configurable and controllable to provide the information needed at any point in the flight. Configuring the SN4500 refers to selecting the data for a given display. For example, either the VOR or the GPS receiver can drive a bearing pointer. Controlling the SN4500 refers to tailoring the display to suit the immediate situation. For example, the pilot may decide to turn off a bearing pointer completely during the enroute portion of the flight and use it only during an approach.

### Power-up Display

On initial power-up, a short introduction screen will be displayed which includes the software and database (NavData) versions. The brightness level of the introduction screen will be at a level appropriate to the ambient lighting conditions if configured for automatic brightness control or at the level previously set if configured for manual brightness control.



Figure 3-1 Introduction Screen

After a few seconds this display will be removed and the compass card will be shown as below:

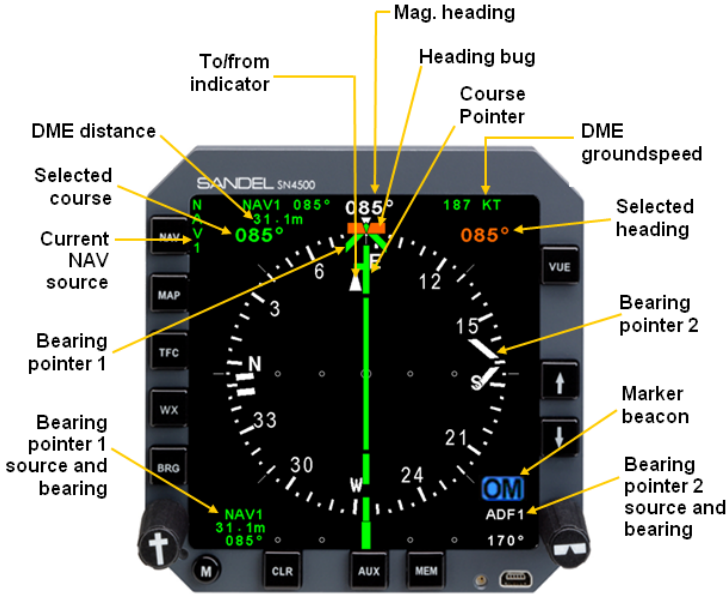


Figure 3-2 SN4500 Display with Compass Card

### Selecting the Data

Sensor data is data that comes from avionic sources within the aircraft. This includes primary navigational instruments as well as sensors. The SN4500 can display data from the following sources:

- Compass system (directional gyro and fluxgate)
- NAV1 and NAV2 receivers
- LNAV1 and LNAV2 receivers (GPS/FMS)
- TCN1 and TCN2 receivers (TACAN)
- DME1 and DME2
- ADF1 and ADF2
- Marker beacon receiver
- Weather detection (WX-500 Stormscope®)

- Traffic

Heading data from the directional gyro and fluxgate compass is always applied directly to the SN4500's compass card display, while other types of sensor data can be displayed in several different ways. You can control these displays by configuring the course pointer, the bearing pointers, the map data and the weather data.

### Selecting the Primary NAV Source

The SN4500's course pointer and CDI can be driven from VOR or GPS data.

In some installations, the [NAV] button on the SN4500 is used to select the primary NAV source. In others, an external switch performs this function and the [NAV] button has no effect. Refer to the Aircraft Flight Manual Supplement for the details of the installation. If external switching is used, this section does not apply.

Pressing the [NAV] button will cycle through the available choices, which are specific to your aircraft and were configured during installation. Selecting a primary navigation source also connects it to the autopilot, if configured.

The current NAV source selection will be annunciated next to the NAV button as shown below.



Figure 3-3 NAV Source Annunciations

Depending on the configuration of the aircraft, the available choices are NAV1, NAV2, GPS1, GPS2, FMS1, FMS2, TCN1, and TCN2. If the selected NAV source is a VOR receiver tuned to a localized frequency, the annunciation will be either LOC1 or LOC2. If a valid glide slope signal is detected then the annunciation will be either ILS1 or ILS2.

Numeric data from the primary NAV source, such as distance, bearing and groundspeed will be displayed in the upper display area if available.

In some installations, the ILS Lockout function may be enabled on the SN4500. This function forces the selection of the NAV receiver when an ILS frequency is selected. Refer to the Aircraft Flight Manual Supplement to see if the ILS Lockout function has been enabled in the aircraft being operated.

While NAV1 is tuned to an ILS frequency and the ILS Lockout is in effect, pressing the [NAV] button will not change sources. Instead, the following message is displayed: “NAV TUNED TO ILS”. To defeat the override and restore the function of the [NAV] button, simply select a non-ILS frequency in the NAV1 receiver.

### Selecting and Displaying Bearing Pointers 1 & 2

To display the bearings pointers, press [BRG] to cycle through available selections. In addition to no bearing pointer display, there are three selections:



- Push [BRG] once: Bearing pointer 1 only
- Push [BRG] twice: Bearing pointer 2 only
- Push [BRG] third time: Bearing pointers 1 and 2

Details about the bearing pointers are in Chapter 6 of this Pilot’s Guide.

### Displaying the Map Data

Map data consists of flight plan waypoints from the LNAV receiver (GPS/FMS), as well as nearby airports, nav aids, intersections and airspace from the SN4500’s internal database. The different categories of map information can be enabled or disabled individually.

To display the map data, press [MAP] to cycle through the available map memory locations. The currently displayed map memory setting is displayed next to the MAP button. In addition to the no map data display, there are three default map memory settings. These settings are shown below with the displayed map status bar icons:

- |   |   |
|---|---|
| Map Memory 1: [no icon]   | GPS/FMS flight plan                         |
| Map Memory 2:  | Airports, Airspace, and GPS/FMS flight plan |
| Map Memory 3:  | VORs and GPS/FMS flight plan                |

When map data is being displayed, press [ ↑ ] or [ ↓ ] to increase or decrease the map range respectively. The currently selected map range is displayed in the upper right display area in cyan. The value of the map range represents the distance from the aircraft symbol to the outer edge of the compass rose.



Map operation is covered in more detail in Chapter 7.

### 360-degree FULL View and 70-degree ARC View

The SN4500 allows the pilot to switch between a traditional 360-degree FULL view of the compass rose and a forward-looking 70-degree ARC view. The ARC view places the airplane symbol at the bottom of the screen and the top 70-degrees of the compass rose is displayed. The ARC view maximizes the display of the ground track ahead of the aircraft and provides the greatest amount of screen area for map data.



Figure 3-4 Full View



Figure 3-5 Arc View

Press [VUE] to switch between the 360-degree and 70-degree ARC views. This action only affects the screen display – all navigation sources, bearing pointers, and other settings remain the same.

### Auto-Slewing the Course Pointer

One unique feature of the SN4500 is its ability to automatically rotate the course pointer to the desired course being sent digitally from the GPS/FMS. This feature is called “auto-slew”, and is especially useful when flying a complex flight plan as it eliminates the burden of manually setting the course pointer for each leg of the flight plan.

When auto-slew is activated and a GPS/FMS is selected as the NAV source, rotating the course select knob will have no effect on the course pointer. The message ‘AUTO – SLEW ACTIVE’ will be displayed in the center display area.

Note that certain GPS receivers such as the KING KLN-90 and Garmin GNS 430/530 support an “OBS” or “HOLD” mode which will override auto-slew when active.

The auto-slew function is enabled/disabled in the NAV menu as described in Chapter 4.

### **Remote Course and Heading Knobs**

The SN4500 supports the use of remote course select and heading select knobs. When using a remote course select knob, the course select knob on the SN4500 will be disabled.

### **Heading Bug Sync**

To rapidly set the heading bug to the aircraft's current heading, press and release the heading select knob.

### **MEM Function**



The SN4500 maintains two different groups of display configuration memories that are toggled by pressing [MEM]. By pressing the [MEM], one can rapidly swap back and forth between the two display configurations. This allows the pilot to set up a particular screen display and easily access the settings for later use. The MEM Function remembers the last settings prior to pressing [MEM].

For example, a preferred “enroute” setup might be 70-degree ARC view with only bearing pointer 1 displayed, connected to a VOR Navaid. The “approach” setup might be 360-degree view with bearing pointer 2 displayed, connected to an ADF. To configure these two screens, first set up the “enroute” screen with the proper settings. Then press [MEM] to toggle to the second screen. The second screen can now be configured with the “approach” settings. Press [MEM] to toggle between the two screens configured for “enroute” and “approach”.

Pressing and holding the [MEM] button will cause the two memories to have the same display settings. “COPY MEM” will be displayed momentarily to confirm this action.

### **Display Brightness (AUTO/MANUAL CONTROL SELECTION)**

The SN4500 display brightness can be configured by the pilot for automatic or manual adjustment. In automatic mode the display brightness and dims based on ambient lighting conditions. The manual brightness setting procedure is determined based on whether the display is configured for internal or external brightness control (during installation).

To select auto or manual brightness control:



Figure 3-6 AUTO/MANUAL Brightness Control Selection

- Press [M] to activate menu mode.
- Press [CLR] to display the brightness menu.
- Rotate the right knob to select either “AUTO” for automatic adjustment or “MAN” for manual adjustment.
- Press [M] to exit the menu and return to normal operation.
- If “AUTO” is selected, the minimum brightness of the display is set by pulling the right knob outwards and rotating the knob to the desired brightness minimum level.

**Display Brightness (INTERNAL BRIGHTNESS CONTROL)**

In manual mode the display brightness is set by pulling the right knob outward and rotating the knob until the desired brightness level is achieved. The label “BRT” and a value ranging from 0-100 (with 100 being the brightest setting) will appear next to the right knob when it is pulled outwards. Press the knob in to return to normal operation. Press and hold [CLR] will steadily ramp up the display brightness without requiring entry into any menus.

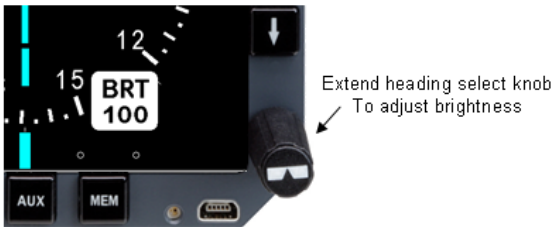


Figure 3-7 Brightness Adjustment

**Display Brightness (EXTERNAL BRIGHTNESS CONTROL)**

- In the manual mode, the aircraft instrument lighting dimmer control is used to adjust the display brightness. If it is desired to balance the display brightness level with other aircraft instruments, pull out and rotate the right knob until the desired brightness level is achieved. The label “TRM” and a value

ranging from -25 to +25 (with +25 being the brightest setting) will appear. Press the knob in to return to normal operation.



Figure 3-8 External Brightness Trim Control

The SN4500 will revert to internal brightness control after detecting a broken connection between the display and the external brightness cockpit lighting control. In this condition Press and hold [CLR] will steadily ramp up the display brightness without requiring entry into any menus.

### Button Brightness

The brightness of the button backlighting can be adjusted to the desired brightness setting from the Pilot Menu as follows:



Figure 3-9 Button Brightness

- Press [M] to activate Pilot Menu mode.
- Press [CLR] to display the brightness menu
- Rotate the left knob to select “BTN”.
- Rotate the left knob to set the button brightness to the desired level ranging from -25 to +25.
- Press [M] to exit the Pilot Menu.

After this setting is made, the button brightness will track the display brightness regardless of how it is configured (Internal - AUTO/MAN or External – AUTO/MAN).

### NIGHT VISION OPTION

Part numbers ending in ‘N’ are certified class B NVIS compliant when NVIS is ‘Active’.

### NVIS Activation/Deactivation

Night Vision (NVIS) mode is activated and deactivated through an externally installed switch.

### NVIS Status Annunciation

When NVIS is active, The NVIS annunciator will display in a shared location with the outer marker annunciator.



Figure 3-10 NVIS Status Annunciator

### Brightness Control

Brightness can be controlled normally while in NVIS mode, however brightness settings above 60 will have no effect.

### Power On Indicator

The Power On Indicator will be turned off while in the NVIS mode.



Figure 3-11 Power On Indicator

### External Brightness Control

For installations connected to an external brightness control, transitioning in and out of NVIS Mode may cause the position of the external control to no longer correspond to the display brightness level. This condition could cause the external control to appear to have no effect on the display brightness level when operating the external control.

The text “SYNC” will be displayed as shown in Figure 3-12 to indicate this condition. To re-sync the control with the display, adjust the external control to a lower level until it affects the display brightness and then re-adjust to the desired brightness level.

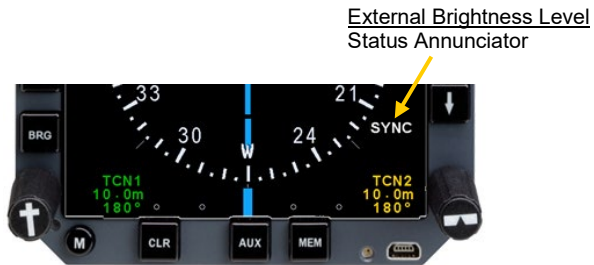


Figure 3-12 Sync Brightness Annunciator





## CHAPTER 4 NAV OPERATION

### NAV Menu

The NAV menu allows the pilot to access GPS Mode and GPS APPR switching along with auto-slew and course pointer settings.



Figure 4-1 NAV Menu

### GPS Mode Selection

GPS/FMS units can be set for automatic or manual sequencing of waypoints in the active flight plan. This can be set on the SN4500 through the NAV Menu or may be available on an external switch. The GPS Mode selection will not be shown if the GPS/FMS interface does not require an external switch for mode selection.



Figure 4-2 GPS Mode

- Press [M] to activate menu mode.
- Press [NAV] to display the NAV menu.

- Rotate the left knob until “GPS MODE” is highlighted in the far left column.
- Press the right knob to toggle the setting between “AUTO” and “HOLD”. (Note: The terminology may differ according to the model of GPS/FMS interfaced to the SN4500.)
- Press [M] to exit the menu and return to normal operation.

### GPS APPR Switch

The GPS APPR selection is used to arm/disarm approach mode on the GPS/FMS. This selection will not be shown if the GPS/FMS interface does not require an external GPS APPR switch.

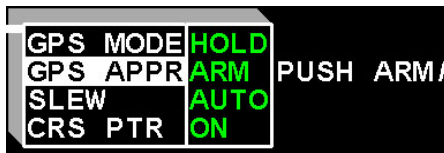


Figure 4-3 GPS APPR

- Press [M] to activate menu mode.
- Press [NAV] to display the NAV menu.
- Press the right knob to arm or disarm GPS Approach mode.
- Press [M] to exit the menu and return to normal operation.

### Auto-Slew Function

Auto-slew function enables the automatic operation of the course pointer when a GPS/FMS is selected as the main NAV source. Options are AUTO and OFF. When set to auto, the course pointer cannot be set manually if the GPS/FMS is navigating on a flight plan or a direct-to course. In some installations the auto-slew function is disabled or set permanently to auto mode and therefore the auto-slew selection will not be shown.

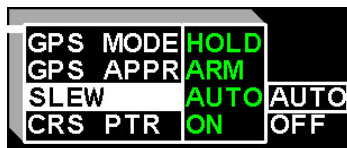


Figure 4-4 Auto-Slew Setup Menu

- Press [M] to activate menu mode.
- Press [NAV] to display the NAV menu.
- Rotate the left knob until “SLEW” is highlighted in the far left column.
- Turn the Right knob to select the desired option on the right.
- Press [M] to exit the menu and return to normal operation.

### Course Pointer Display Function

Controls the display of the course pointer when GPS is selected as the NAV source and the moving map is displayed. Options are AUTO and ON. When set to AUTO, the course pointer is removed when the flight plan waypoints and course lines are displayed. This reduces the on-screen clutter. The course pointer will be displayed momentarily when the course select knob is turned.

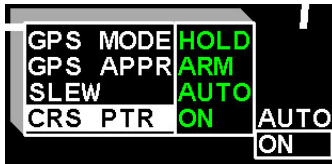


Figure 4-5 Course Pointer Setup Menu

- Press [M] to activate menu mode.
- Press [NAV] to display the NAV menu..
- Rotate the left knob until “CRS PTR” is highlighted in the far left column.
- Rotate the heading bug knob to select the desired option.
- Press [M] to exit the menu and return to normal operation.

### GPS INTEG / WAAS Annunciations

When a properly equipped aircraft has a GPS WAAS approach selected and is on the approach, one of the following GPS WAAS approach annunciators will display: LP, LPV, L NAV, LVNAV.

Any time one of the GPS annunciators changes, it will blink for five seconds.

GPS INTEG & WAAS Approach Type Annunciators



Figure 4-6 Location of INTEG & WAAS Approach Annunciators






ANNUNCIATOR	DESCRIPTION
	<p>When insufficient satellite coverage exists, the “INTEG” annunciator will display in the location of the approach type annunciators. The “INTEG” annunciator will always take priority over the approach type annunciators.</p>
	<p>Lateral Precision Approach</p>
	<p>Lateral Precision Approach with Vertical Guidance</p>
	<p>Lateral Navigation with Vertical Guidance Approach</p>
	<p>Lateral Navigation Approach</p>

Figure 4-7 GPS WAAS Annunciator Descriptions

## TACAN OPTION

Note: Prior to 20 January, 2015 - The TACAN display option software key (p/n 90169-TCN) is subject to the licensing jurisdiction of the Department of State in accordance with the International Traffic in Arms Regulations (ITAR) (22 CFR 120 – 130). It may not be exported (sent, transferred, disclosed or otherwise released to a foreign person) without a license issued by DDTC.

The SN4500 (as an option) supports the use of TACAN as a primary NAV source. The SN4500 supports the use of one or two single channel TACAN receivers or one multi-channel TACAN receiver. The SN4500 also supports a TACAN relay out capability that allows for illumination of an external TCN annunciation (when installed) to indicate when TACAN is the selected NAV source. Operation of the SN4500 utilizing TACAN as a NAV source is done in the same manner as with other NAV sources:

- 1) Upper display area: TACAN displays as NAV source when selected. TCN1 can be selected as the NAV source. TCN2 can be selected as the NAV source if the aircraft is equipped with either: two single channel TACAN receivers or one multi-channel TACAN receiver. The TACAN station ID will be shown if received.



Figure 4-8 TACAN Data in Upper Display Area

- 2) Lower display area: TACAN displays as a bearing pointer NAV source when selected.



Figure 4-9 TACAN Data in Lower Display Area

- 3) Course Pointer: The SN4500 will provide course deviation indications when TACAN is selected as a NAV source.



Figure 4-10 TACAN Course Pointer

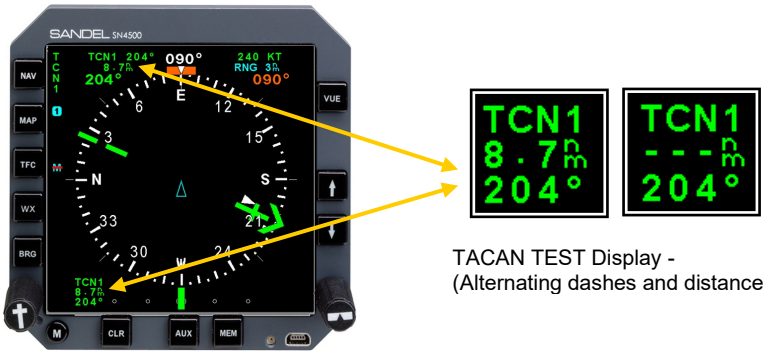
- 4) Bearing Pointers: The pilot configurable bearing pointers will display TACAN bearing information when TACAN is selected as a bearing pointer NAV source. Reference Chapter 6 (Bearing Pointers) of 82009-PG SN4500 Pilot's Guide for details on configuring the bearing pointers.



Figure 4-11 TACAN Bearing Pointers

## TACAN Test

When TACAN information is displayed on the SN4500 and the TACAN TEST function is used on the corresponding TACAN equipment, the associated TACAN DME fields will alternate between “---“ and the distance readout being sent by that TACAN equipment. Refer to the Pilot’s Guide for the TACAN equipment used in your installation for additional information.



TACAN TEST Display -  
(Alternating dashes and distance)

Figure 4-12 TACAN Test



## CHAPTER 5 LNAV / ROLL STEERING

### Overview

NOTE: For LNAV roll steering operations the autopilot is kept in the HDG mode.

An optional Roll Steering function couples the GPS/FMS steering signal to the autopilot HDG mode.

This feature adds the capability for the GPS navigator to more precisely fly a GPS flightplan including high angle course intercepts and holding patterns. This function will exceed the course intercept and tracking capability of the autopilot's typical "NAV" function. When enabled, the LNAV roll steering function is an extension of the of the SN4500 heading bug function.

NOTE: This capability is only available during GPS navigation.

### What is "Roll Steering"?

An autopilot/flight director has a "Nav Tracking" function, activated by its NAV mode control, which banks the aircraft in order to keep the CDI centered on-course. In most autopilots this function relies on two inputs: the course pointer selected course, and the course deviation. This function was designed to track straight-line courses from point to point.

A GPS/FMS, depending on make and model, may contain an output with similar but enhanced capabilities to the "Nav Tracking" function. It is more sophisticated because it knows in advance the course changes, such as radius turns and holding patterns that the aircraft will encounter, and can keep the aircraft on both straight line and radius courses. This output is commonly referred to as "Roll Steering" and is a lateral navigation function inside the GPS/FMS which has the capability of banking the aircraft to keep it on a straight or curved flightplan.

### LNAV and LNAV ARM

The two LNAV roll steering modes are annunciated as "LNAV ARM" or "LNAV" in the upper right of the display where the heading bug digits normally are located.

During LNAV ARM the heading bug will remain operational until "active leg capture" occurs. When capture occurs the heading bug disappears and annunciation changes to LNAV. The 'steering commands' from the GPS are now sent to the autopilot on the HDG output of the SN4500.

### Intercepting an Active Leg (LNAV ARM)

With the autopilot in HDG mode, use the heading bug to turn the aircraft to a track that will intercept the active (magenta) leg of the GPS flight plan. The dotted track line emanates from the airplane present position on the map display and depicts the current ground track. Leg intercept will occur where the track line intersects the GPS active leg.



Press and hold the heading bug knob to select LNAV ARM. Leave the autopilot in HDG mode.

In LNAV ARM a *virtual waypoint* is formed at the intercept where the dotted track line crosses the active leg. This virtual waypoint is used by the SN4500 to calculate the turn anticipation point when LNAV ARM will switch to LNAV. This will provide a turn that smoothly joins the active leg in the direction of the active waypoint. In the case where the aircraft is already within the 2 dots on the CDI, the transition to LNAV will occur immediately. The turn anticipation point will properly calculate up to 135 degree course cut angle at any speed up to and beyond Mach 1.



Figure 5-1 LNAV ARM Roll Steering Mode

## “No Intercept” Message

If LNAV ARM is selected when the current ground track does not converge on the active course leg a “NO INTCPT” message will annunciate. Use the heading bug to change the heading to one that intercepts the active leg.



## LNAV Capture

When Capture occurs the following events take place:

1. Mode changes from LNAV ARM to LNAV.
2. The heading bug disappears.

In LNAV the SN4500 autopilot heading output is driven from the steering information from the GPS Navigator. The GPS navigator will have full control of the final turn on-course and thereafter.



## HDG Preset Function during LNAV

During LNAV operation a HDG bug is not displayed. If the HDG knob is turned more than a single click an outline heading bug will appear as a visual reference preset only. It does not connect to the SN4500 HDG output until LNAV is cancelled. The heading bug digits will be shown at the lower right of the display.



## HDG SYNC during LNAV

The SYNC function (push and release HDG knob) cancels any heading preset and the bug will disappear.

NOTE: An advisory will appear “PRESS-HOLD FOR HDG”. This advisory is to assist the pilot unfamiliar with LNAV operation how to restore use of the heading bug.

## Flying a GPS approach

GPS approach lateral navigation is flown using LNAV in autopilot HDG mode. Before the FAF is reached, to transition to fully coupled autopilot Vertical Guidance, select APPR on the autopilot.

Note: A “SELECT A/P APPR” message will appear on the SN4500 when vertical guidance becomes available as a reminder to switch the autopilot mode to APPR.

### **Flying a GPS transition to LOC/ILS**

A typical LOC or ILS approach uses the GPS to navigate the aircraft towards the final approach course. When the aircraft is on the final approach course the NAV SRC is switched (manually or automatically) from GPS to ILS. The “SELECT A/P APPR” message will appear as a reminder to switch the autopilot mode to APPR. LNAV will cancel automatically within 30 seconds or when on the localizer course, causing the heading bug to reappear at the current heading.

### **Flying a missed approach after an ILS**

If this feature is supported by the GPS/FMS

1. Fly the normal go-around procedure using TOGA if equipped.
2. At a convenient time select GPS as the NAV source.
3. Sequence the navigator to the missed approach procedure
4. When desired activate LNAV by press-hold of the HDG knob. The heading bug will disappear and LNAV mode will select and aircraft guidance will rely on the GPS.

### **Cancelling LNAV Operations**

Press and hold HDG to exit any LNAV mode. The heading bug fill color will be restored and the heading bug will be connected to the HDG output of the SN4500. The heading bug will be at the current heading, or in the case of a preset, it will remain at the preset position. The GPS Steering command is disconnected from the HDG output.

### **Autopilot mode Selection Summary**

- The autopilot HDG mode is used for HDG bug or LNAV roll steering operations.
- The autopilot APPR mode should be activated at or before the final approach fix when navigating ILS or LOC, or when flying a GPS approach that has vertical guidance such as LPV. A “SELECT A/P APPR” message will annunciate on the SN4500 as a reminder to select autopilot APPR mode..
- The autopilot NAV mode should be activated when coupled to a NAV during enroute navigation.

See the autopilot information in the aircraft’s Flight Manual Supplement for specific operation.

## Heading Bug Depiction Summary

The following describe the signal driving the HDG output, which is active when the autopilot is put in HDG mode:

<u>HDG BUG</u>	<u>DESCRIPTION</u>
Color Filled:	Actively driving the HDG output.
Outlined:	Visual Preset. Not driving the heading output.
	GPS Steering drives the HDG output.
Not Displayed:	GPS Steering drives the HDG output.

## ADVISORY MESSAGES ASSOCIATED WITH LNAV

<u>Message</u>	<u>Description</u>
FUNC NOT AVAIL	Attempt to engage LNAV when LNAV function has not been installed. Contact installer.
LNAV CANCELLED	When in LNAV, occurs after approximately 5 seconds if the NAV source is NAV1/2, or within 30 seconds or on-course if the NAV source is LOC/ILS.
NAV SRC NOT GPS	Attempt to engage LNAV when the NAV SRC is not selected to GPS.
NO LNAV DATA	Occurs when in LNAV or LNAV ARM when there is no LNAV data coming from the GPS. LNAV is cancelled. This could occur if there was no active leg or if the installed GPS does not provide this data.
PUSH-HOLD FOR HDG	Occurs when in LNAV and performing a HDG SYNC operation. This will have no effect. Advises to push and hold the HDG knob if you want to restore HDG bug operation.
SELECT A/P APPR	Reminder for Pilot to select the approach mode on the APFD. Occurs when vertical guidance is provided by the GPS in LPV approaches or during LNAV operation when switching to an ILS.

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## CHAPTER 6 BEARING POINTERS

### Bearing Pointers

The SN4500 provides two independent bearing pointers which function in much the same way as a traditional radio magnetic indicator (RMI). The head of each bearing pointer indicates the bearing to the NAV source. The tail of each pointer indicates the bearing from the NAV source. Either pointer can be driven by any navigation source interfaced to the SN4500: VOR, GPS/FMS, or ADF. When a GPS/FMS is selected as the bearing pointer source, the bearing pointer indicates the bearing and distance to the current active waypoint.

To display the bearings pointers, press [BRG] repeatedly to cycle through displaying bearing pointer 1 only, displaying bearing 2 only, displaying both bearing pointers 1 & 2 and disabling both bearing pointers. Pressing and holding [BRG] will also disable both bearing pointers.

The color of each bearing pointer, and its associated numeric display, follow the color-coding when on-side:

ADF: White

GPS: Cyan

VOR: Green (NAV1), Yellow (NAV2)

The cross-side color of the bearing pointer, and its associated numeric display, is yellow when NAV1 is selected and green when NAV2 is selected.

The digital numeric bearing to the navigation source of the bearing pointer is displayed at the bottom of the screen. When the data is invalid, “---“ is displayed and the associated bearing pointer is removed from the screen. The selected bearing pointer name is displayed above the numeric bearing display.

Note. Certain ADF receivers may not supply an “invalid” signal. In these cases, the receiver will “park” the needle, usually 90° to the right of the lubber line, when no signal is being received. See the Pilot’s Guide for your navigation receiver to determine its capability during “No-signal” operation.

## BRG Menu

The NAV sources for the bearing pointers are selected using the BRG menu function.



Figure 6-1 BRG Main Menu

- Press [M] to activate menu mode.
- Press [BRG] to display the BRG menu
- Rotate the left knob to select BRG1 or BRG2 in the left column.
- Rotate the right knob to select the desired option.
- Press [M] to exit the menu and return to normal operation.



## CHAPTER 7 MAP OPERATIONS

### Overview

MAP operations allow you to display navigation information in the form of a “moving map” directly on the SN4500 display. You have extensive control over what kinds of navigation information are displayed on the map:

- Airports and Runways
- Controlled and Special Use Airspace
- VORs
- NDBs
- Intersections
- GPS Flight Plans and Approaches

Within each of these classes of map objects you may fine-tune exactly which items you want displayed. For example, you may choose to exclude military or private airports, or those with unpaved runways or runways shorter than a particular length. Similarly, you may elect not to display terminal VORs or low-powered NDBs, or to display Class B airspace and Restricted Areas but exclude Class C airspace and MOAs. As you will see, the SN4500 offers great flexibility in how you configure your moving map display.

Finally, you may store up to four different map configurations, and then quickly switch from one to another as appropriate to your phase of flight. For instance, when cruising at FL180 or higher, you might want to display only high-altitude VORs, Special Use Airspace and airports with paved runways of 6,000 feet or longer. The SN4500 allows you to save such a map configuration in one of four map memories and then recall it as needed.

All the airports, nav aids and intersections on the moving map, except for the GPS/FMS flight plan waypoints, come from the internal database of the SN4500 and are color-coded cyan. Controlled and Special Use Airspace also comes from the SN4500’s internal database and are color-coded according to its type (Class B and Class C in green, MOAs in purple, Restricted and Warning Areas in yellow, and Prohibited Areas in red.) The GPS/FMS flight plan waypoints and course line come from the database in the GPS/FMS and are color-coded magenta or white.

Note: The SN4500 requires a connection to a GPS/FMS receiver in order to display the moving map. The map display, including the flight plan from the GPS1 receiver, will also be shown when NAV1 or NAV2 is selected as the primary NAV source.

### Internal Database

Non-flight plan data including airspace is referred to as the “internal database” and is stored in the SN4500’s internal memory. The internal database can be periodically updated from a Windows-based PC. The expiration date of the internal database is shown during the power on sequence. Database updates are available directly from Nighthawk Flight Systems, Inc., and may be purchased at [www.nighthawkfs.com](http://www.nighthawkfs.com) by your dealer. As this database is for supplemental use only and not intended for primary navigation, there is no requirement to update it.

The code letter after the NavData expiration date indicates the region of the database currently in the memory of the SN4500:

CODE LETTER	DATABASE REGION
M	All_Americas
N	Asia_Pacific
O	Europe
P	Globe

### Map Controls and Displays

Information associated with control of the map is displayed as follows:

- The map status bar is shown just to the right of the MAP button and shows icons for the currently enabled map items.
- The map memory location currently being displayed is shown at the top of the map status bar as “1”, “2”, “3”, “4” or “S”.



Figure 7-1 Map Operation

Map operations are controlled with the following buttons:

- [MAP] - Press repeatedly to cycle through the map memory locations and no MAP. Press and hold to go to map memory location 1.
- [↑] and [↓] - Press to zoom the map range in or out. Press and hold the [↑] button to auto-range the map to the current waypoint. Press and hold the [↓] to auto-range the map to the final waypoint.

### Map Memories





The [MAP] button cycles from MAP off through a maximum of four possible map memory locations, or memories, plus a scratchpad memory. The map memory that you are currently displaying is shown at the top of the map status bar and will show 1, 2, 3, 4 or S.



Any memory that is empty is skipped during the MAP rotation sequence. In the default setup of the SN4500, memories 1, 2 and 3 contain default settings, and memories S and 4 are empty.

Map memory S has been designated the scratchpad memory and the remaining memories 1-4 are designated as preset memories. All on-screen changes are made to S but can be copied to memories 1-4 as desired. The purpose of having a separate scratchpad is to allow you to quickly add or delete items from your map display to attend to a current flight situation, without changing presets previously made.

The map setup function, described below, shows how to make changes to the map memories. The following table lists the items that can be independently configured for each map memory.

There are a large number of selection items. However, the organization of the SN4500 is intended to make the map setup process as easy as possible. You should experiment with the map settings until you develop the style of operation best suited for your flying.

<b>MAP DATABASE ITEMS</b>			
<b>Status bar icons</b>	<b>Item</b>	<b>Setup Menu Label</b>	<b>Color</b>
Airports 	Civil	CIVIL	Cyan
	Military	MIL	Cyan
	Private	PRIV	Cyan
	Runway Length <sup>1</sup>	MIN LEN	n/a
	Grass Surface	GRASS	n/a
	Other Surface	OTH SFC	n/a
NDBs 	Outer Marker	OM	Cyan
	Low Power	L PWR	Cyan
	High Power	H PWR	Cyan
VORs 	High Level	HI LV	Cyan
	Low Level	LO LV	Cyan
	Terminal	TERM	Cyan
	TACAN	TACAN	Cyan
Intersections 	Enroute	ENRT	Cyan
	SID	SIDS	Cyan

<b>MAP DATABASE ITEMS</b>			
<b>Status bar icons</b>	<b>Item</b>	<b>Setup Menu Label</b>	<b>Color</b>
	STAR	STARS	Cyan
	Approach	APPR	Cyan
GPS/FMS Flight Plan 	Flight Plan Course Line	GPS FPL	Active Leg: Magenta
	Waypoint Symbols <sup>2</sup>	FPL SYM	Other Legs: White
Airspace 	Class B	B	Green (dashed)
	Class C	C	Green (dotted)
	MOA	MOA	Purple (dotted)
	Restricted	RESTR	Yellow (dashed)
	Warning	WARN	Yellow (dotted)
	Prohibited <sup>3</sup>	n/a	Red (Solid)

## Notes:

1. Suppresses display of runways below the specified minimum length
2. Flight plan waypoints can be displayed as facility icons (such as the VOR icon) or to show as the standard waypoint symbol. Most RS-232 GPS receivers are limited to displaying the waypoint symbol only.
3. Prohibited airspace is always displayed when in range and cannot be disabled.

**Getting Started - Example**

The default SN4500 map memories are set up as follows:

S: Empty

1: GPS/FMS flight plan


2: Airports, Airspace, and GPS/FMS flight plan

3: VORs and GPS/FMS flight plan

4: Empty

To get started, it is recommended to try some operations on the ground. Ensure that the GPS/FMS receiver is operating and enter a flight plan or direct-to in order to establish navigation. If the GPS/FMS has a simulator mode then that can be used for practice.

Press [MAP] until “1” shows at the top of the map status bar. You should see the GPS/FMS flight plan on the display. The active leg and waypoint will be shown in magenta and the other waypoints and course lines will be shown in white. Use the [ ↑ ] or [ ↓ ] buttons to adjust the map range.

Set the map range to 30nm, and press [MAP] so that “2” is displayed. The display should show the flight plan as before, but now overlaid with local airports with runways longer than 4,500 feet in length. Note that the airport icon  shows on the map status bar indicating that airports are being displayed and that on-screen airports are shown in cyan. The cyan color indicates that the source of the airport data is coming from the internal database. The flight plan information comes from the GPS/FMS database.

Lower the map range to 15nm. Notice that as the display zooms in, airport displays change from an icon to a runway (or multiple runways). Below 10nm, the runway numbers will also be displayed to assist in verifying orientation with respect to the airport. During flight, the display will rotate and update in real time.

Press [MAP] to change to map memory 3. Notice that the airports are removed and instead, LO and HI VORs are displayed in cyan. On the map status bar the airport icon is removed and replaced with the VOR icon.

Pressing [MAP] again will skip memory 4, because it is empty, and it will jump directly to no map. All the map information will be removed from the screen. To display the map again, repeat the cycle of pressing [MAP] to display map memories 1, 2 and 3.

## Map Setup

After you are familiar with the displaying map information based on the default settings, customize the map display to suit your specific needs. In this example, start by pressing [MAP] until “1” shows at the top of the map status bar.

Press [M] to activate menu mode. Press [MAP] to display the MAP menu. A pop-up window will appear on the display next to the [MAP] button as shown below. All settings in map memory 1 are copied to S (the scratchpad memory), and you can now make non-permanent changes using the knobs. Changes are actually made to the scratchpad memory S. To

save changes into one of the map memory locations 1-4, use the COPY function described later in this chapter.

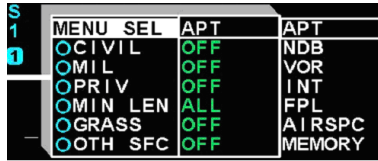


Figure 7-2 Map Setup Menu

The following actions occur every time the Map Setup mode is accessed:

- The currently selected display memory is copied into S.
- S becomes the active memory.
- Map Setup mode is entered and changed can be made to the map display.

Map Setup mode allows you to change the scratchpad memory S by adding or deleting items from the map category by category. While in the map menu, rotate the left knob to highlight an item in the left column and rotate the right knob to select the available options in the right column. The middle column will display the current selection.

As an example, to display Class B airspace the following steps will be used:

- Press [M] to activate menu mode.
- Press [MAP] to display the MAP menu.
- Rotate the left knob until “MENU SEL” in the far left column is highlighted.
- Rotate the right knob until airspace is highlighted as shown below:

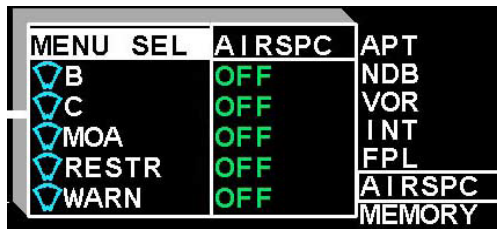


Figure 7-3 Select "AIRSPC"

- Next, rotate the left knob until “B” is highlighted;
- Next, rotate the right knob to toggle Class B airspace to “ON”.

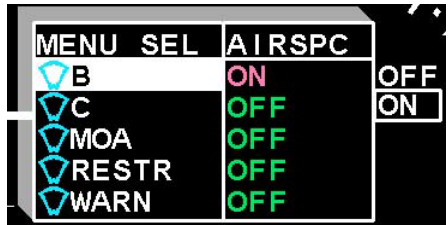


Figure 7-4 Select "ON"

- Press [M] to exit the menu and return to normal operation. Class B airspace will now be shown on the map display and the airspace icon will appear in the Map Status Bar.

### Map Memory Settings

Map settings can be retained for future use by storing them into one of the four memory presets. Individual memory presets can also be cleared, set to defaults, or copied to the scratch memory. These functions are all accessed through the map memory menu.

To access the map memory menu:

- Press [M] to activate menu mode.
- Press [MAP] to display the MAP menu..
- Rotate the left knob until “MENU SEL” in the far left column is highlighted.
- Rotate the right knob until “MEMORY” in the far right column is highlighted.

### Storing Settings into Preset Memories 1-4

- Rotate the left knob until “S COPY TO” in the far left column is highlighted.





Figure 7-5 Storing Settings

- Map memory "S COPY TO"
- Rotate the right knob and select one of the four map memory locations. Press the right knob and the current scratchpad settings will be stored under the specified map memory number, the unit will exit the menu, and return to normal operation.

**Removing a Map Memory from the Rotation Sequence**

Individual map memory settings (including the scratchpad) can be cleared in order to reduce the number of map memories in the MAP button rotation sequence. This is done using the CLEAR function.

To access the "CLEAR" map memory:

- Access the Map Memory menu as described previously.
- Rotate the left knob to highlight "MENU SEL".
- Rotate the right knob until "MEMORY" in the right column is highlighted.
- Rotate the left knob to highlight "CLEAR"

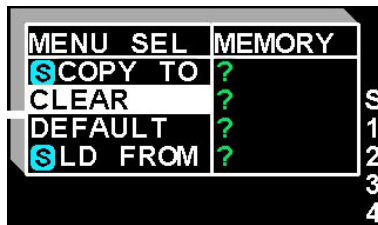


Figure 7-6 Removing Map Memory

- Map memory "CLEAR"
- Rotate the right knob to select the desired map memory location to be cleared.

- Press the right knob to clear the map settings from that memory location. The center column will display the cleared memory location.
- Repeat as necessary to clear additional map memory locations.
- Press [M] to exit the menu and return to normal operation. The memory location(s) that were cleared will be skipped in the rotation sequence.

### Restoring Default Settings

The default settings can be restored at any time. The default settings for individual map memory locations can be restored or all of them can be restored at once. Note that this will erase any previously stored settings. This is done using the “DEFAULT” function.

To access the “DEFAULT” map memory:

- Access the Map Memory menu as described previously.
- Rotate the left knob until “DEFAULT” is highlighted in the far left column. The map memory locations plus “ALL” will be displayed on the right.

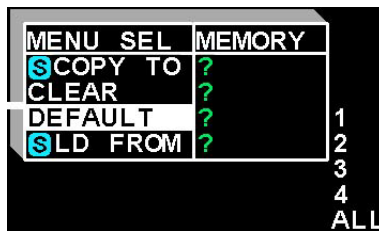


Figure 7-7 Restoring Default Settings

- Map memory "DEFAULT"
- Rotate the right knob until the desired map memory location is selected and then press the right knob to restore the default settings for that memory location. Selecting “ALL” will restore all of the map memory locations to default settings.
- Press [M] to exit the menu and return to normal operation.

## Copying Map Settings into the Scratchpad

It may be desired to copy settings that have been previously stored in a map memory location into the scratchpad. This is done using the “S LD FROM” function.

To access the “S LD FROM” map memory:

- Access the Map Memory menu as described previously.
- Rotate the left knob until “S LD FROM” is highlighted in the far left column. The map memory locations will be displayed on the right.

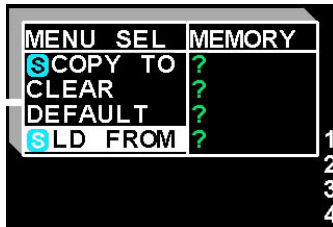
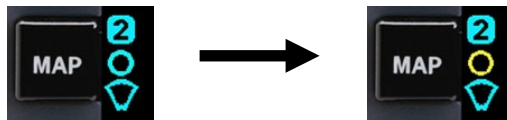


Figure 7-8 Copying Map Settings

- Map memory "S LD FROM"
- Rotate the right knob until the desired map memory location is selected and press the knob to copy the settings in that memory location into the scratchpad memory.
- The scratchpad can now be further modified or press [M] to exit the menu and return to normal operation.

## Automatic Decluttering

Occasionally, the SN4500 map display may become too cluttered to read, such as by turning on several categories of map items. The SN4500 will automatically remove items from the display if the total number of items is too great to display. When this occurs, it is indicated by an icon color change from cyan to yellow on the map status bar as shown following:



Normally the SN4500 will allow up to approximately 50 icons before this action occurs, but this number may be smaller if complex airspace is displayed simultaneously. When automatic decluttering occurs, it occurs first to objects closest to the aircraft. When the display is zoomed-in, these objects will reappear and the associated status bar icon will turn back to cyan.

### **Maximum Range of Internal Map Data**

During normal operation, the SN4500 only displays items from its internal database that are within 200nm of the current aircraft position (400nm for long range VORs and NDBs), even when the selected map range is larger.

### **Clearing the Map Display**

To quickly turn off the map display, press [CLR]. The map display will be removed and a center CDI will be provided. Pressing [CLR] again will return to the most recently displayed map memory location.

## CHAPTER 8 WEATHER DISPLAY INTERFACE

### WX-500 Stormscope® Data

If an L-3 WX-500 Stormscope lightning detection sensor has been installed in the aircraft, it can be configured to display on the SN4500 as shown on Figure 8-1.

Lightning strikes are displayed in the SN4500’s primary display area, and are automatically synchronized with the aircraft’s heading. The status of the WX-500 is displayed in the upper right corner. In normal operation, this represents the current strike rate, preceded by an “S” for strike mode, or “C” for cell mode. Error messages are detailed in the WX-500 User’s Guide.

New cell/strike symbols are shown on the SN4500 in white for 30 seconds after which they are shown in green. Cell/strikes older than 3 minutes are removed from the display.



Figure 8-1 WX-500 Stormscope Display

### WX Menu

The WX menu can only be accessed when a WX-500 Stormscope® is installed.

- To control the various functions of the WX display, press [M] to activate the menu mode, and then press [WX] to display the weather setup menu. See Figure 8-2.



Figure 8-2 WX Setup Menu

- Rotate the left knob to select the desired function in the left column. The following options are available:
- CLEAR: Press the right knob to clear the display of any lightning strikes.
- DISPL: Rotate the right knob to select the display option CELL or STRK.



Figure 8-3 Display Menu

CELL: Enables display of WX-500 strikes in CELL mode, which displays a lightning symbol for each group of strikes.

STRK: Enables display of WX-500 strikes in STRIKE mode, which displays a lightning symbol for each individual strike.

- MODE: Rotate the right knob to highlight the desired MODE option from WX, TEST, or DEMO and push in the knob to select.

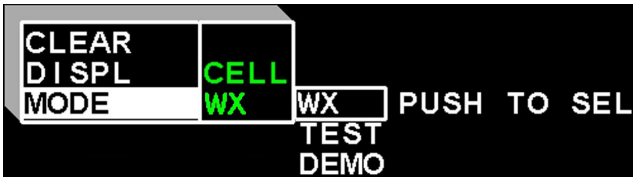


Figure 8-4 WX-500 Mode Menu

WX: Normal WX-500 operation.

TEST: Executes WX-500 self-test.

DEMO: Causes the WX-500 to send a series of simulated lightning strikes to the SN4500 display.

### **FIS-B Datalink Weather**

The SN4500 displays Flight Information Services-Broadcast (FIS-B) weather information when connected to a compatible data link receiver.

Note: With the discontinuation of WSI InFlight service this feature is not currently supported but will be available in a future software release in conjunction with compatible ADS-B In receivers.

The particular FIS-B products (CONUS only) supported in the SN4500 are:

- Precipitation
- Lightning



Figure 8-5 FIS-B Weather Display

## General Operation

Pressing the WX button repeatedly will cycle through the four weather display modes:

1. Precipitation and Lightning [PL]
2. Precipitation only [P]
3. Lightning only [L]
4. Off

The FIS-B display modes are annunciated next to the WX button. A single two digit number appears to the right of the WX annunciations representing time in minutes since the last precipitation update from the data link receiver.

Note: FIS-B lightning may be co-displayed with WX-500 lightning strike information, when a WX-500 is also connected to the SN4500.

## Precipitation Intensity

Precipitation intensity level is represented graphically using the following colors shown in Figure 8-6.



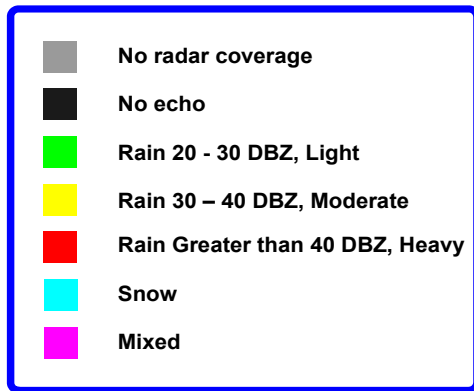


Figure 8-6 Precipitation

### FIS-B Lightning

FIS-B lightning strikes are depicted by small filled circles. Lightning strike age is displayed by the filled color in the circle representing the lightning strike. Three color shades are used to represent strike aging per Figure 8-7

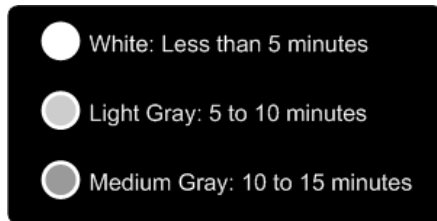


Figure 8-7 FIS-B Lightning Strike Age

After 15 minutes, the strike is removed from the screen.

## **FIS-B Services Backgrounder**

The goal of FIS-B data link systems is to provide weather and other non-control flight advisory information to pilots in a manner that will enhance their awareness of the flight conditions and enable better strategic route planning. The information provided through FIS-B is advisory in nature. This information is provided to be better able to assess the need to consider alternative future route and altitude selections.

This implementation of the FIS-B data link system is not intended to replace existing voice networks, Flight Service Station (FSS) services, preflight briefings, or usurp any joint duties or responsibilities required by part 121 operators. Loss or non-receipt of FIS-B services would not be considered flight critical.

FIS-B products are to be used only for advisory and strategic/planning purposes and not for crew alerting or tactical flying. This is due to the fact that FIS-B products may have significant latency between the observation of a weather phenomenon, the issuance of a forecast or the change in airspace status, and the display of that information in the cockpit.

Because the updates rates are relatively low, FIS-B products should not be used for tactical maneuvering of the aircraft, and should not be the sole basis for immediate corrective action by the pilot. FIS-B products are intended to enable pilots to determine if action should be taken well before it is required, and should be used in conjunction with other information sources to support in-flight decisions.

FIS-B information is to be used as a strategic planning tool for pilot decisions on avoiding areas of inclement weather that are beyond visual range of where poor visibility precludes visual acquisition of inclement weather. FIS-B weather and NAS status information may be used as follows:

- To promote pilot awareness of own ship location with respect to reported weather, including hazardous meteorological conditions, and enhance decision-making during strategic flight planning activities.
- To cue the pilot to communicate with the Air Traffic Control controller, Aircraft Flight Service station specialist, operator, dispatch, or airline operations control center as required.

Figure 8-8 illustrates the FIS-B information flow from the NEXRAD radar sites to the cockpit. The process flow begins with NEXRAD radar observations taken and sent to the processing and uplink facility. Depending on radar sweep rates and configuration, these observations may be aged from 2 – 8 minutes when they enter the processing facility.

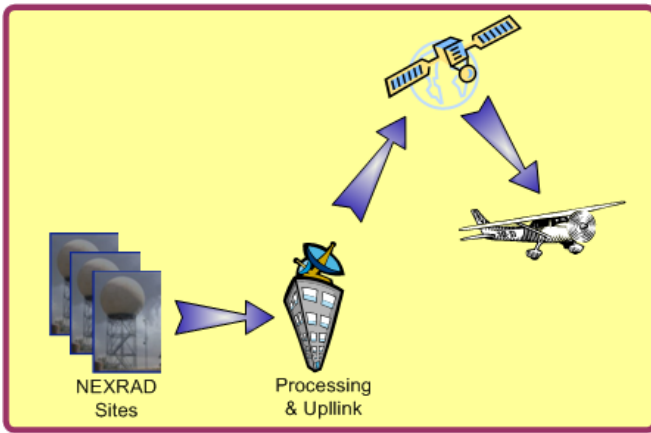


Figure 8-8 FIS-B Information Flow

The processing facility collects the NEXRAD information and builds a set of mosaic tiles representing recent weather conditions. After this information has been processed it is then up-linked to satellites for retransmission to aircraft receivers. This process can take up to 3 minutes depending on the amount of information to be uplinked.

By the time this information is received in the aircraft and displayed on the SN4500, it will be aged from 3 to 11 minutes depending on the amount of data transmitted. This process is repeated at approximately 5 minutes intervals.

Approximately every 5 minutes, a complete set of mosaic weather tiles representing precipitation is transmitted to the aircraft. Flight conditions and aircraft position/attitude may cause errors in the data reception causing loss of 1 or more of the mosaic tiles. When this occurs, the last tile(s) received will be displayed on the screen as long as the reception age of the tile(s) is not older than 30 minutes and the tile(s) is not older than 10 minutes from any other tile. Any tile outside of these aging parameters are

removed from the screen and displayed as no data using a gray background. The reception age uses the time the tile is received from the aircraft receiver by the SN4500. The SN4500 displays to the right of the WX button the time in minutes since any mosaic tiles have been received.

### Examples

FIS-B weather information is provided without any reference to altitude or flight level. Depending upon the current aircraft flight level, it is very possible that the conditions observed visually or from on-board weather radar displays may not correlate to the graphic presentation on the SN4500. Figure 8-9 is a typical example of precipitation displayed on the SN4500.



Figure 8-9 Precipitation Example

Figure 8-9 depicts current aircraft position co-located with precipitation that a pilot would normally associate with visible moisture. However, since the FIS-B information is not referenced to altitude, the actual observed flight conditions may vary. Figure 8-11 illustrates the flight conditions a pilot may reasonably expect to observe while in the area displayed in Figure 8-9.

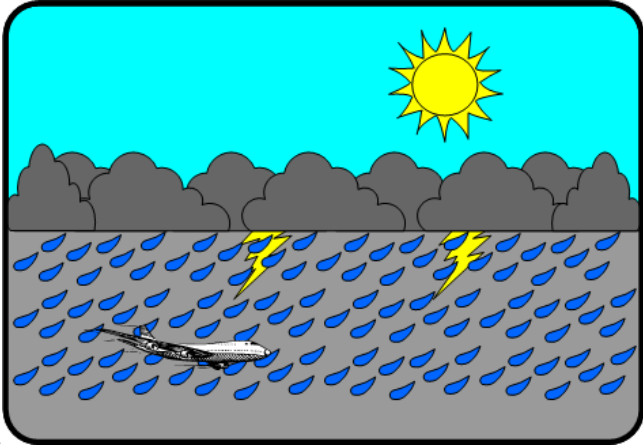


Figure 8-10 Visible Moisture Observed

Figure 8-11 and Figure 8-12 illustrate two other situations where observed flight conditions will not correlate to the display in Figure 8-9.

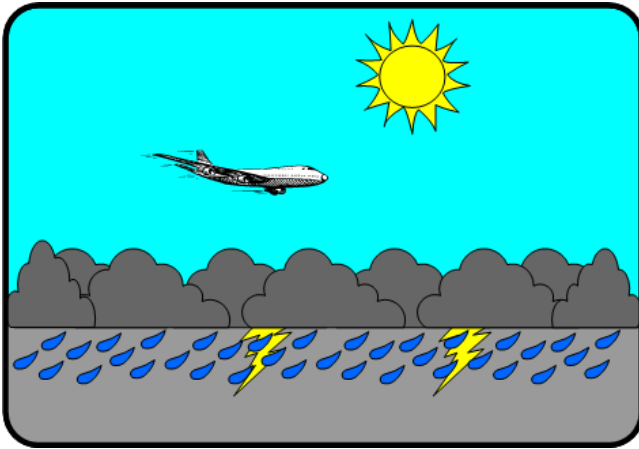


Figure 8-11 No Visible Moisture Observed

Most likely, a flight crew will recognize the cloud deck below and consider that the conditions represented on the SN4500 in Figure 8-9 are well below the aircraft. However, it may not be so apparent when flying between cloud layers as Figure 8-12 illustrates. When flying between layers the flight

crew may consider the FIS-B system has malfunctioned while as the figure shows the serious weather is below the aircraft further illustrating the lack of vertical information provided with the FIS-B weather system.

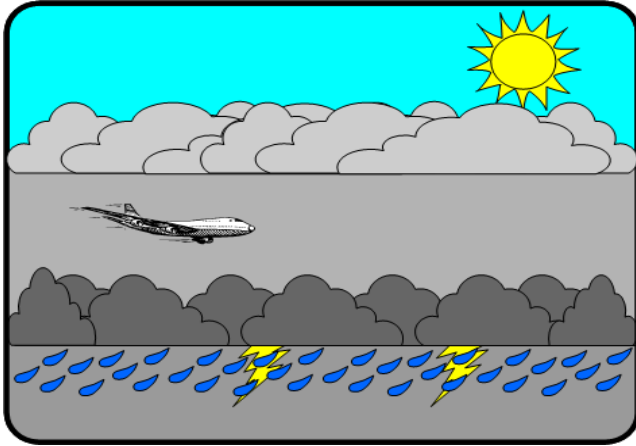


Figure 8-12 Between Layers

## CHAPTER 9 TRAFFIC DISPLAY INTERFACE

The SN4500 can display nearby transponder equipped aircraft when interfaced with a compatible TAS, TCAS or ADS-B processor. Please refer to the Pilot’s Guide for the specific traffic system installed in the aircraft for a complete description of the capabilities.

Note: The SN4500 can be interfaced to a TCAS II processor but will function only as a traffic display as vertical guidance information required for conflict resolution will not be displayed.







Figure 9-1 SN4500 with Traffic

### Traffic Symbolology




The SN4500 uses standard RTCA symbolology to represent traffic.

### Alerting Traffic

DISPLAY	CONDITION	DESCRIPTION
	Resolution Advisory (RA) (Available with TCAS II Only)	Immediate threat that requires evasive action. Note: Vertical guidance information is NOT shown on the SN4500 display.

	Traffic Advisory (TA)	Traffic within 15-30 seconds of closure, or within 0.20 to 0.55nm and +/-600 to +/-800 ft of your aircraft
	Traffic Alert No Bearing / No Altitude	Alerting traffic with no bearing and no altitude information available.
	Traffic Alert No Bearing	Alerting traffic with no bearing information available.



**Non-Alerting Traffic**

DISPLAY	CONDITION	DESCRIPTION
	Proximity Advisory	Traffic within 4nm and +/-1,200 ft of your aircraft
	Other Traffic	Traffic not representing an immediate threat
	Out of Range Traffic	RA and TA targets outside of the currently selected display range will be shown as a half symbol against the compass rose at the corresponding bearing.

**Relative Altitude**

Relative altitude in hundreds of feet and vertical trend information are also given for each target aircraft. **Note:** Values greater than 9900 feet are shown as '99'.



	<p>The '-02' indicates the target is 200 feet below your current aircraft altitude. The up arrow indicates the target is climbing at a vertical rate of greater than 500 fpm.</p>
	<p>The '+05' indicates the target is 500 feet above your current aircraft altitude. The down arrow indicates the target is descending at a vertical rate greater than 500 fpm.</p>

### Absolute Altitude vs. Relative Altitude

The traffic processor may have an option to change the display of altitude from relative to absolute. This is called 'Flight Level' mode by some manufacturers. When activated, the altitude shown for target aircraft will temporarily be shown in hundreds of feet MSL when below 18,000 feet and as a flight level above 18,000 feet. The altitude of your aircraft will be shown in the top right of the SN4500 display.

### Traffic Display Mode

The traffic display mode is annunciated next to the [TFC] button. There are three different modes available which control how the targets are displayed on the SN4500 and are toggled by pressing the [TFC] button.

- ON: Enables display of all targets within the selected map range.
- M: Manual mode. Traffic will be displayed within the selected map range only when alerting traffic is present.
- A: Auto mode. Same as Manual mode except that map range will auto-scale to an appropriate range to show the traffic on-screen.

Selecting the Manual (M) or Auto (A) modes will suppress the display of non-alerting traffic (i.e. traffic other than RAs or TAs). This can be useful in busy terminal areas where the display of all traffic may cause the screen to become too cluttered.

When the traffic display mode is set to ON, pressing the [CLR] button will change the display mode to Auto. This has the effect of removing non-alerting traffic from the display. Pressing [CLR] again will toggle the

traffic display mode back to ON. Note that alerting traffic will always be shown on the display.

### **Altitude Mode**

The currently selected altitude display mode will be displayed next to the [TFC] button.

- <none> Normal altitude display mode. Target aircraft within +/-2,700 ft. of your aircraft are displayed.
- ABV: Above altitude display mode. Target aircraft within -2,700 ft. and +9,000 ft. of your aircraft are displayed.
- BLW: Below altitude display mode. Target aircraft within -9,000 ft. and + 2,700 ft. of your aircraft are displayed.
- XTD: Extended altitude display mode. Target aircraft within +/-9,000 ft. of your aircraft are displayed.

### **TCAS Status**

When traffic is not available, the following annunciations will be displayed next to the [TFC] button. The Traffic Display Mode annunciation will also be lined out in red.

- TEST: TCAS is currently in Test mode
- OFF or STBY: TCAS is currently in Standby mode
- FAIL: TCAS data communication not present

## Traffic Overlay with Moving Map

Traffic targets can be displayed simultaneously with the moving map information described in Chapter 7. Targets will be overlaid on the moving map flight plan and icons as shown in the example below.



Figure 9-2 Traffic with Moving Map

## Traffic Display with Stormscope and Data Link Weather

Traffic targets can be displayed simultaneously with the Stormscope and data link weather information described in Chapter 8. Traffic alerts take precedence over weather information. If an RA or TA target is present, the display of Stormscope and/or data link weather information is suppressed until the target is downgraded to non-alerting traffic status. This will be annunciated by double yellow lines through the Stormscope and/or weather mode icons.

### TFC Menu

Additional traffic options can be accessed by pressing [M] and then [TFC]. The traffic setup menu will be displayed.

The following options are available:

- **ON AUTO:** Enables or disables map auto-ranging when alerting traffic is displayed and the traffic display mode is set to ON.



Figure 9-3 ON AUTO Menu

- **ALT RANGE (Ryan 9900BX/Avidyne 600 Series TAS Only):** Selects the desired altitude mode display. When interfaced with a traffic processor other than the Ryan 9900BX, the altitude mode will be selected by remote switches or by controls on the ‘master display’.

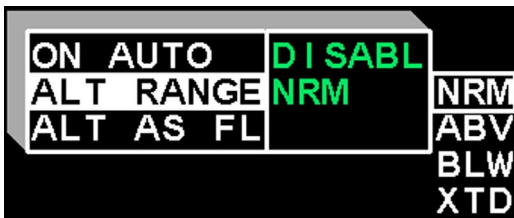


Figure 9-4 Altitude Range Menu

- **ALT AS FL (Ryan 9900BX/Avidyne 600 Series TAS Only):** Changes the altitude of target aircraft to be shown as absolute altitude instead of relative altitude for 30 seconds.



Figure 9-5 Altitude as Flight Level Menu

### ADS-B In Traffic

Optional display of traffic from compatible ADS-B In receivers is supported in software version A2.09 and later and 2.06 and later.

### ADS-B In Traffic Symbolology

New symbology supported by ADS-B In is shown in the table below. Display of Traffic Information File (DTIF) and GDL 88/90 are ADS-B In data formats.

Protocol	Other	Other w/Dir	Prox	Prox w/Dir	TA	TA w/Dir	RA	RA w/Dir
Symbols								
TCAS	YES	--	YES	--	YES	--	YES	--
DTIF	YES	YES	YES	YES	YES	YES	YES	YES
GDL88/90	YES	YES	--	--	YES	YES	--	--

Figure 9-6 New ADS-B In Traffic Symbolology

A velocity vector is displayed, which represents the path of the target for 60 seconds at the current direction and ground speed. The velocity vector is not displayed for targets without direction and ground speed information.



Figure 9-7 Targets with Velocity Vector

**ADS-B In Aircraft Information**

The display of aircraft ID (tail number or airline flight ID) and ground speed is supported. This option is available on the traffic menu accessed by pressing [M] and then [TFC]. When an ADS-B In receiver is interfaced, the option for SHOW INFO is included on the traffic setup menu.



Figure 9-8 Show Info Menu

Rotate the left knob to highlight “SHOW INFO” and press the knob. Then press [M] to exit the menu and return to normal operation.

For the next 30 seconds the relative altitude field will be replaced by alternating aircraft ID and ground speed values for each target for which the data is available.



Figure 9-9 Aircraft ID and Ground Speed Display

## CHAPTER 10 FLAGS AND ABNORMAL CONDITIONS





The SN4500 detects abnormal conditions such as flagged navigation receivers and failed directional gyro or fluxgate. It also monitors its own internal temperature and provides warnings for over temperature or loss of cooling conditions.

In some cases, the flagged displayed will be accompanied with a failed equipment list message. This message can be accessed by holding down the menu button until the message display shows. The list will show both current and prior messages (if applicable). To show just the current messages, exit the message page by pressing the menu button and reenter by holding down the menu button.








Figure 10-1 Messages



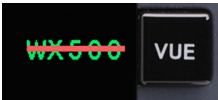

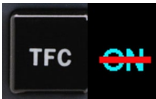
FLAG OR CONDITION	DISPLAY	DESCRIPTION
NAV flag		<p>Large red “X” through the CDI scale, and the deviation bar is not displayed. Numeric information display shows “---“.</p> <p>Note: CDI pointer will be visible under the red “X” for four minutes after power-up to allow testing for certain GPS receivers.</p>

FLAG OR CONDITION	DISPLAY	DESCRIPTION
<p>GS (glideslope) flag</p>		<p>Large red “X” through glide slope scale (VDI), glideslope pointer is not displayed.</p>
<p>GS flag, back course</p>		<p>Large yellow "X" through glideslope scale (VDI) to show that you are on back course approach.</p>
<p>Directional gyro failure</p>		<p>Compass rose color changes from white to amber. Heading data is obtained from fluxgate alone if connected to SN4500. Because fluxgate signals are averaged over time, heading response will lag the aircraft significantly.</p>
<p>Fluxgate failure Loss of gyro &amp; fluxgate or; Loss of gyro without fluxgate installed.</p>		<p>Compass rose color changes from white to amber and the compass heading is redlined. The display can be used to determine relative headings for turns, but the magnetic compass should be used to determine absolute heading.</p>


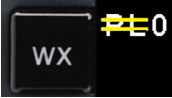



FLAGS AND ABNORMAL CONDITIONS

FLAG OR CONDITION	DISPLAY	DESCRIPTION
Fluxgate excitation lost		Compass rose color changes from white to amber. No numerals are displayed on the compass rose. Heading is flagged.
Fast slave mode		Compass heading is redlined during fast slave correction. Heading has not stabilized.
AHRS not slaved		Compass heading is redlined during fast slave correction. Heading has not stabilized.
GPS/FMS flag		Redlined GPS/FMS at upper left indicates loss of data from the receiver.
Map flag		Redlined map icons indicate that the map cannot be displayed because of loss of LNAV.

FLAG OR CONDITION	DISPLAY	DESCRIPTION
<p>No Intercept</p>		<p>Displayed when in LNAV ARM and the aircraft TRK is not converging on the active leg.</p> <p>NOTE: It is the pilot's responsibility to select an appropriate heading which ensures intercept of the active leg. On the map display the dotted track line will show the expected point at the current aircraft track. Occurs only when in LNAV ARM.</p>
<p>Relay flag</p>		<p>Redlined "NAV2", "GPS1" or "GPS2" next to the NAV button indicates failure of the switching relay for the selected NAV source. The course and vertical deviation indicators must not be used for navigation in this state.</p>
<p>Stormscope® flag</p>		<p>Redlined "WX500" indicates loss of data communication from the WX-500 Stormscope®.</p>
<p>Stormscope® suppressed due to traffic</p>		<p>Double yellow line through the cell or strike count indicates that the Stormscope display has been temporarily suppressed due to the presence of a traffic alert.</p>
<p>Traffic flag</p>		<p>Redlined "ON", "A" or "M" next to TFC button indicates loss of data communication from the traffic processor.</p>

FLAGS AND ABNORMAL CONDITIONS

FLAG OR CONDITION	DISPLAY	DESCRIPTION
Weather flag		<p>Redlined “P” or “L” next to WX button indicates loss of data from the datalink weather receiver.</p>
Weather suppressed due to traffic		<p>Double yellow line through the weather mode annunciation indicates that the data link weather display has been temporarily suppressed due to the presence of a traffic alert.</p>
Integrity / WAAS Approach Type Annunciation		<p>“INTEG” indicates insufficient satellite coverage. Alternate primary means of navigation must be used. When a WAAS approach is selected and “INTEG” is not displayed, the WAAS approach type (LP, LPV, L NAV, LVNAV) will display.</p>

## **Internally Slaved Heading and Fast Slaving Mode**

The following applies when the SN4500 is installed using 'internal slaving'. This is an installation-selected mode and is used with most remote directional gyros (DGs) such as the King KG102 or Mid-Continent DG. In this mode a remote fluxgate is also interfaced to the SN4500.

A fluxgate is an electronic compass sensor, with most of the characteristics of a wet compass. When configured with a remote DG, the fluxgate is the only sensor which provides heading to the SN4500. The remote directional gyro turns the SN4500 compass card directly, but does not know which way is North. The fluxgate supplies North and thereby the SN4500 ensures correct compass card orientation. The SN4500 slowly and continually corrects for gyro drift by using the North input from the fluxgate. This slow correction is imperceptible in flight. The maximum rate for the slow correction is at 3 deg/minute.

The SN4500 has a Fast Slave Mode which turns the card at 25 deg/sec. Any time the compass card is in Fast Slave Mode, the heading is redlined for a minimum of approximately 7 seconds. Fast Slave mode normally occurs only once when systems are powered up and does not occur again unless some unusual condition occurs. However, Fast Slave mode may occur at any time the Compass Card heading differs from the Fluxgate by more than 20 degrees for a period of 2 minutes. This delay is incorporated to ensure that no fast-slaving operation occurs during normal flight maneuvers, including during turns, when the fluxgate (like the compass) is not level.

Fast Slaving is an abnormal condition during flight. It can be caused by a defect or error in either the remote gyro, the remote fluxgate, an undetected fault in the SN4500, or aircraft wiring, or from any cause (including all mechanical fluxgate failures) which would allow the compass card and fluxgate heading to stay diverged. If it occurs during flight the card will realign to the fluxgate signal, even if the fluxgate is incorrect.

Fast Slaving causes the heading to be flagged for approximately 7 seconds. In addition, the software will display a slaving meter when the compass card heading differs from the fluxgate for an extended period of time. The meter will first appear with a green line when the compass Card heading differs from the fluxgate for a period of 30 seconds. As the difference persists over time, the line will extend and change color from green to yellow, and to red. The figures below show the progress of the slaving meter.



Figure 10-2 Slaving Meter Pops Up in Green



Figure 10-3 Slaving Meter Changes to Yellow



Figure 10-4 Slaving Meter Changes to Red



Figure 10-5 Fast Slave With Flagged Heading

Fast Slaving is automatic. If a fast slave occurs in flight or the compass digits redline, cross-compare the SN4500's heading to the magnetic compass (wet compass) with wings level. Pilots normally navigate by flying magnetic track from point to point. Comparing compass heading to actual track (after accounting for wind drift) is also a good way to detect a compass heading error.

Other systems rely on the SN4500's heading output and this could affect functions such as display of traffic, lightning, weather, map items and the flight plan.

## CHAPTER 11 MESSAGES

The Sandel SN4500 displays different messages to alert the pilot. The messages are initiated by the Pilot, the Built in Self Test (BIST), the Power On Self Test (POST), or by the system. Most of the pilot initiated messages are shown for two seconds and are removed automatically. Error messages, which are considered critical, are placed on-screen permanently until acknowledged. The acknowledgment is done using the ACK soft-key which will appear and flash when such a message appears. It also monitors its own internal temperature and provides warnings for over-temperature or loss of cooling conditions.



Figure 11-1 Message and "ACK" Button

Message	Description
400HZ FAILED	Loss of main inverter. Note 1
400HZ HIGH	Problem with main inverter. Note 1
400HZ LOW	Problem with main inverter. Note 1
AIRCRAFT POWER	Main power to unit out of specification.

<b>Message</b>	<b>Description</b>
AUTO-SLEW ACTIVE	Displayed when course knob is turned but course knob setting is over-written by Direct Track from the Long Range NAV Receiver. Auto-slew operation can be disabled by entering the NAV menu and setting auto-slew to OFF. If auto-slew is turned off, you will need to turn the course pointer manually at every waypoint when flying a flight plan.
AUX 400HZ FAILED	Loss of auxiliary inverter. Notes 1, 3
AUX 400HZ HIGH	Problem with auxiliary inverter. Notes 1, 3
AUX 400HZ LOW	Problem with auxiliary inverter. Notes 1, 3
CFG MOD CONFLICT	Configuration module is not installed or the settings in the configuration module does not match the settings in the SN4500 unit
COOLING FAN FAIL	The internal temperature is continuously monitored. An over temperature condition will only occur if the cooling airflow is obstructed. As the temperature rises a warning will be issued prior to shutdown.
COPY MEM	This message appears when [MEM] button is pushed and held. After this COPY MEM is performed, both memories will show the display settings in effect when the COPY MEM was executed.



<b>Message</b>	<b>Description</b>
EXT SW SET TO GPS	This message appears when pressing the “NAV” button on the SN4500 when it is slaved to an external GPS/NAV switch/annunciator panel. Instead of the SN4500 NAV switch use the external GPS/NAV switch.
EXT SW SET TO NAV	This message appears when NAV button pressed while in slave mode and selection is NAV.
FCS FDBCK ERR	In some installations the SN4500 Lateral and Vertical outputs drive the autopilot directly (See your AFMS). These outputs are measured and compared to the expected outputs and the “FCSFDBCK ERR” will appear if there is a miscompare for more than 10 seconds. If this message appears, it may indicate that the autopilot may not be accurately flying the lateral and/or vertical deviation showing on the course deviation indicators due to an internal failure in the SN4500 or a wiring short circuit in the aircraft. Immediately monitor the lateral and vertical deviation indicators, and disable the autopilot (and flight director) NAV or APPR mode for the duration of the flight if the autopilot is not tracking as expected. HDG mode may still be used in this circumstance if verified to be working.
FGATE EXCIT LOST	Fluxgate excitation has failed. Check the gyro circuit breaker. Note 2
FGATE XYZ LOST	Fluxgate XYZ signal voltage too low or not received.

<b>Message</b>	<b>Description</b>
FUNC NOT AVAIL	LNAV roll steering function has not been installed. Contact installer.
GYRO INVALID	Gyro valid flag asserted. Check the gyro circuit breaker. Note 2
GYRO XYZ LOST	Gyro XYZ (synchro) signal voltage too low or not received.
GYRO/FG CFG BAD	The Heading hardware configuration is incorrect. Either a stepper gyro has been configured without a fluxgate (heading steppers must be slaved), or an ARINC-429 heading source has been configured with a fluxgate (ARINC-429 heading inputs may not be slaved).
INTERNAL FAULT	Internal fault on the SN4500 which will require service. UNIT MUST NOT BE USED FOR NAVIGATION IF THIS MESSAGE APPEARS.
LNAV CANCELLED	Occurs after approximately 5 seconds if system is in LNAV roll steering mode and anything other than GPS navigation is selected as the NAV source.
MAP CRC INVALID	Indicates that the upload of the map database to the unit was not completed successfully or the file was corrupted. Repeat the upload procedure. Contact Nighthawk Flight Systems, Inc. technical support if the messages persist. All other functions of the SN4500 continue to operate normally when the map has failed.

<b>Message</b>	<b>Description</b>
MAP INCOMPATIBLE	Indicates a mismatch between the operating software version and the map database. Check the Nighthawk Flight Systems, Inc. website to ensure that you have the latest versions of operating software and database and repeat the upload procedure. All other functions of the SN4500 continue to operate normally when the map has failed.
NAV SRC NOT GPS	Attempt to engage LNAV roll steering mode when the NAV SRC is not selected to GPS.
NAV TUNED TO ILS	This message appears when pressing the “NAV” switch on the SN4500 to select a GPS and this action is overridden because an ILS is tuned on NAV1 or NAV2 and ILS lockout was enabled during installation.
NAV1 TUNED ILS	Appears when VHF NAV1 is tuned to an ILS frequency overriding and changing the SN4500 current NAV selection and ILS lockout was enabled during installation.
NAV2 TUNED ILS	Appears when VHF NAV2 is tuned to an ILS frequency overriding and changing the SN4500 current NAV selection and ILS lockout was enabled during installation.
NO LNAV DATA	Occurs when in LNAV or LNAV ARM roll steering modes when there is no LNAV data coming from the GPS. This could occur if there was no active leg of if the installed GPS does not provide this data.
NOT IMPLEMENTED	<BRG> key pushed with no source of bearing available.

<b>Message</b>	<b>Description</b>
NOT INSTALLED	<TFC> or <WX> key pushed or TFC or WX menu access attempted when supporting equipment is not installed.
OVERTEMP SHTDWN	The internal temperature is continuously monitored. An over temperature condition will only occur if the cooling airflow is obstructed. As the temperature rises a warning will be issued prior to shutdown.
PARAM CRC FAULT	PARAM CRC is not the expected value. The SN4500 installation settings have become invalid. Parameter memory is probably corrupt. This message must not appear on power-up if flight operations are predicated on the use of the SN4500 Navigational Display.
PGM CRC INVALID	Program CRC is not the expected value. This message must not appear on power-up if flight operations are predicated on the use of the SN4500 Navigational Display.
PUSH-HOLD-FOR-GPS	Occurs when in LNAV roll steering mode and performing a HDG SYNC operation. This will have no effect. Advises to push and hold the HDG knob to restore HDG bug operation.
PWR SUPPLY FAIL	Internal power supply out of specification.
RELAY SENSE ERR	This message appears with the selected relay feedback does not match.
REMOTE CRC FAULT	Settings in the configuration module contain an error.

MESSAGES

<b>Message</b>	<b>Description</b>
RMT-COURSE ACTIVE	Course knob on SN4500 disabled due to connection of remote course knob.
USE OBS ON GPS	Adjust OBS on GPS navigator. OBS, including remote CRS knob if equipped, is disabled locally per installation selection. (This option used in tandem training installations).
SELECT A/P APPR	Advisory message for the pilot which appears when flying an LPV or LNAV-V GPS approach. It will appear at the turn to the final approach course or final approach fix intercept, and is a reminder to select the APPR mode on the associated autopilot controller to allow lateral and vertical capture.

Note 1: The inverter failure messages will only appear if a master or auxiliary inverter is installed.

Note 2: Gyro Failures will only be annunciated if the installed Gyro has a valid flag output. If the “Fluxgate Failed” message appears check the Gyro circuit breaker, which is usually the source of Fluxgate power.

Note 3: Loss of the auxiliary 400HZ inverter will only cause the ADF to become invalid if installed.

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## CHAPTER 12 REVERSIONARY ATTITUDE MODE

The SN4500 with software version 2.00 or later includes a Reversionary Attitude Mode capability. This feature, if installed, may be used as backup attitude in the event of loss of the primary attitude display. When activated, the normal HSI presentation is immediately removed from the display and attitude, heading, and certain navigation information is displayed to the pilot in a single integrated format.

NOTE: The SN4500 and associated AHRS are electrically powered and will become inoperative with interruption of their primary electrical power

### Activating Reversionary Attitude Mode

The Reversionary Attitude Mode is activated by operating the externally installed switch labeled “REV” located near the SN4500.

### Pilot Integrity Check

The attitude data source in Reversionary Mode is received from the same AHRS which supplies the HSI heading, typically a Sandel SG102. In order to assure that the reversionary attitude capability is working and available, this feature should be checked each flight prior to takeoff by activating the REV switch and comparing the display against the other aircraft attitude instruments.

During normal flight, if the HSI heading is intermittent erroneous or flagged, it may indicate that Reversionary Mode may be unavailable. Reversionary Mode may be tested at any time by activating the REV switch and comparing against the other aircraft attitude instruments.

Note: Due to the differences in operational characteristics between the AHRS and the other attitude gyros, the Reversionary Mode attitude may differ slightly from the other attitude instruments during or just after maneuvers. This difference should wash out after the aircraft returns to level flight with the slip-skid ball centered. This slight attitude difference during maneuvering should be considered normal.

### Reversionary Mode Display Description

The Reversionary Mode incorporates some of the standard navigation display elements from the SN4500 HSI display overlaid on top of an attitude display with a roll index, sky pointer and slip-skid indicator. Refer to Chapter 2 of this guide for a detailed description of the navigation display elements.

The display elements of Reversionary Attitude Mode are shown in Figure 12-1 below.

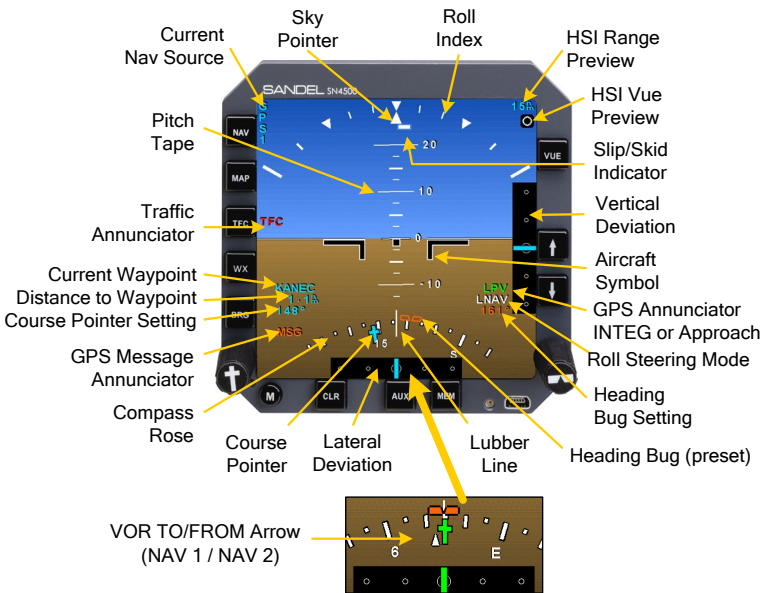


Figure 12-1 Reversionary Mode Display



## Reversionary Mode Controls

In Reversionary Mode the active controls are shown below in Figure 12-2.

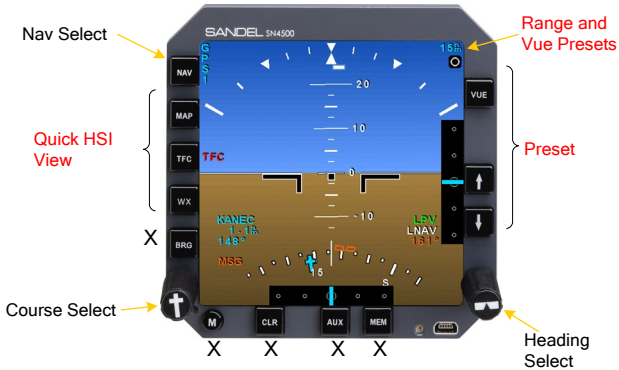


Figure 12-2 Reversionary Display Controls

The items shown above in red have a modified special function, described in the chart below. Controls marked with an 'X' are completely inactive in Reversionary Mode.

### Reversionary Mode Control Description

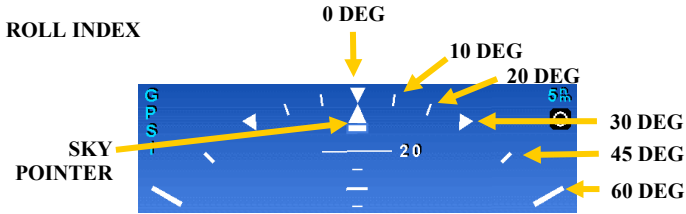
- NAV:** Same as in HSI mode
- MAP:** Momentarily displays HSI showing MAP memory 1 with traffic in Auto.
- TFC:** Momentarily displays HSI showing MAP memory 1 with traffic ON. The display will auto range only if a TA or RA is if active.

WX: Momentarily displays HSI showing MAP memory 1 with traffic in Auto and all available weather information. If a TA or RA becomes active, the traffic will be displayed instead of weather.

Up/Down Arrows: Presets the HSI range

VUE: Presets the HSI view.

### Attitude Display Details



#### FUNCTION

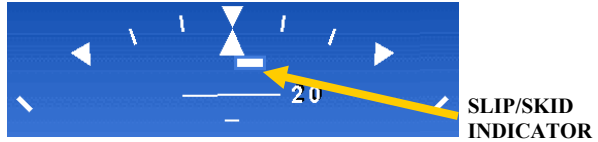
**Roll Index** – Shows roll angle at 10°, 20°, 30°, 45°, and 60°.

**Sky Pointer** – Shows the current roll attitude.

#### OPERATION

Displays the aircraft roll attitude.

NOTE: The sky pointer always points UP, away from the center of the earth.

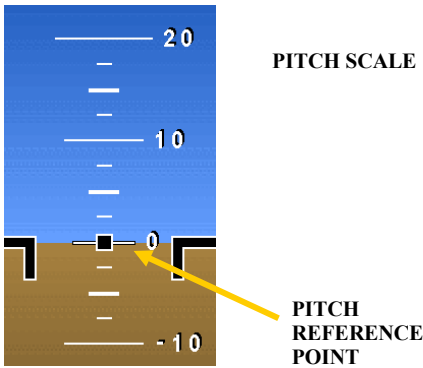


**FUNCTION**

**Slip/Skid Indicator** – Displays the aircraft lateral body acceleration.

**OPERATION**

Identical to a ‘slip/skid ball’ - centered during coordinated flight.



**FUNCTION**

**Pitch Scale** – Displays aircraft pitch attitude in degrees from 0° to 90° relative to the pitch reference point. Scale is marked in increments of 2.5°. Pitch-down attitudes are preceded by a minus sign.

**OPERATION**

Visual indication of the aircraft pitch attitude.

### Unusual Attitudes

When in unusual pitch or roll attitudes, the display will de-clutter by removing all navigation information. In addition to the remaining attitude information, red chevrons will appear pointing in the direction of level pitch attitude.



#### FUNCTION

##### Down Chevrons

Downward pointing red chevrons appear whenever the upward pitch attitude exceeds +30°.

#### OPERATION

Use appropriate unusual attitude recovery techniques to resume normal flight.



**FUNCTION**






**Up Chevrons**

Upward pointing red chevrons appear whenever the downward pitch attitude exceeds  $-20^{\circ}$ .

**OPERATION**

Use appropriate unusual attitude recovery techniques to resume normal flight.

## Reversionary Mode Annunciations

FLAG OR CONDITION	DISPLAY	DESCRIPTION
Attitude Failure Flag		Appears when the attitude is invalid.
Slip/Slid Failure Flag		A red line through the text “SLIP SKID” will appear in the left center of the display in the event that the Slip/Skid indicator is inoperative.
Traffic Alert		Appears when traffic advisory (TA) or resolution advisory (RA) is occurring from the aircraft TCAS system. “TFC” text is displayed in yellow for TA and red for RA. Pressing the TFC pushbutton will momentarily show the traffic display
HSI Vue Preview		HSI will display in FULL mode
		HSI will display in ARC mode
HSI Range Preview		HSI will display at indicated range

## CHAPTER 13 TECHNICAL SPECS AND OPERATING LIMITS

<b>TSO Compliance</b>	
Technical Standard Order (TSO):	C113: Airborne Multipurpose Electronic Displays C3d: Turn and Slip Instruments C4c: Bank and Pitch Instruments C6d: Direction Instrument, Magnetic (Gyroscopically Stabilized) C34e: ILS Glide Slope Receiving Equipment C35d: Airborne Radio Marker Receiving Equipment C36e: Airborne ILS Localizer Receiving Equipment C40c: VOR Receiving Equipment C41d: Airborne ADF Equipment C118: Traffic Alert and Collision Avoidance System Airborne Equipment, TCAS I C119b: Traffic Alert and Collision Avoidance System Airborne Equipment, TCAS II C195: Avionics Supporting Automatic Dependent Surveillance – Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)
Software Certification:	RTCA/DO-178B, Level C
Hardware Certification	RTCA/DO-254, Level C
Environmental Category:	DO-160E [(A2)(F1)Z]BAB[HR]XXXXXXZBABBC[WW]M[XXE 2F2X]XXAX

<b>Physical Dimensions</b>	
Form Factor:	4-ATI (ARINC 408)
Width:	3.975 in. (10.1 cm.)
Height:	3.975 in. (10.1 cm)
Length:	9.45 in. (24.0 cm.) from panel to back of unit
Weight:	3.5 lbs. (1.6 kg.)

<b>Operational Characteristics</b>	
Temperature/Altitude:	-20° C to + 70° C 55,000 ft. maximum altitude
Power Inputs:	22 to 33 VDC 1.4 Amperes nominal @ 28 VDC
400 HZ Reference:	26 volts nominal, less than 1 milliampere load



## CHAPTER 14 INSTALLATION INFORMATION

To be completed by installer.

Date of Installation: \_\_\_\_\_

Installer Company: \_\_\_\_\_

Installer Address:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Installer Phone: \_\_\_\_\_

Work Order #: \_\_\_\_\_

Installer: \_\_\_\_\_

NAV Equipment Inputs: \_\_\_\_\_

Notes: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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**CHAPTER 15 GLOSSARY**

Active Leg	The course line segment between the last waypoint passed and the active waypoint in a flight plan.
Active Waypoint	The next waypoint in a flight plan.
Course Deviation Indicator	The course deviation indicator bar (CDI; also known as the deviation bar or “D-bar”) is the movable center section of the course pointer that depicts deviation to the left or right of course.
Course Segment	A portion of a flight plan between two waypoints.
Cross-Side	Equipment associated with the position opposite the installed pilot or copilot position.
Failure	The inability of the equipment or any sub-part of that equipment to perform within specified limits.
On-Side	Equipment associated with the same position as the installed pilot or copilot position.
Selectable Items	Modifiable values, multiple-choice listings displayed on multiple lines, and requests that an operator may select.
Vertical deviation indicator	The vertical deviation indicator bar (VDI) is the movable center section that depicts vertical deviation above or below glide slope or GPS final approach path.
Waypoint	A position on the GPS/FMS flight plan representing a change in course on-screen by a “star” symbol.
70° ARC View	A forward-looking 70-degree ARC view that maximizes the display of the ground track ahead of the aircraft where the lubber line is centered in the ARC, and the aircraft’s current position, is depicted near the bottom of the display.
360° FULL View	A 360-degree FULL view where the aircraft’s current position is depicted at the center of the display.

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**CHAPTER 16 AVIONICS ACRONYMS**

ACK	Acknowledge
ADF	Automatic Direction Finder
AFM	Airplane Flight Manual
AFMS	Airplane Flight Manual Supplement
AP	Auto Pilot
ASL	Above Sea Level
ATC	Air Traffic Control
BIT	Built-In-Test
C	Celsius
CDI	Course Deviation Indicator
CM	Configuration Module
CONUS	Continental United States
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
DME	Distance Measuring Equipment
EFIS	Electronic Flight Instrument System
EHSI	Electronic Horizontal Situation Indicator
FAA	Federal Aviation Administration
FIS-B	Flight Information Services-Broadcast
FMS	Flight Management System
GA	General Aviation
GPS	Global Positioning System

AVIONICS ACRONYMS

GS	Glide Slope
HDG	Aircraft's magnetic heading
Hz	Hertz (cycles per second)
IFR	Instrument Flight Rules
ILS	Instrument Landing System
KTS	Knots
LNAV	Lateral Navigation; also Long Range Navigation
L NAV	Lateral Navigation Approach
LVNAV	Lateral Navigation with Vertical Guidance Approach
LP	Lateral Precision Approach
LPV	Lateral Precision with Vertical Guidance Approach
MAP	Missed Approach Point
MFD	Multi-function Display
MOA	Military Operations Area
NAV	Navigation Receiver (VOR)
NM	Nautical Miles
OBS	Omni Bearing Selector
POH	Pilot's Operating Handbook
POST	Power-On Self-Test
RMI	Radio Magnetic Indicator
TACAN	Tactical Air Navigation System
TA	Traffic Advisory
TAS	Traffic Advisory System
TFC	Traffic

AVIONICS ACRONYMS

TSO	Technical Standard Order
USB	Universal Serial Bus
Vac	Volts AC (alternating current – in aircraft typically 400Hz)
Vdc	Volts DC (direct current)
VDI	Vertical Deviation Indicator (for glide slope)
VHF	Very High Frequency
VOR	VHF Omnidirectional Radio Range
VORTAC	System with a co-located VOR and a TACAN station

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