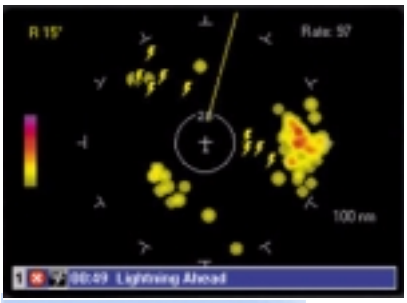
FlightMax™

Flight Situation Display



FlightMax Lightning

Part Number 600-0058 Revision 00

Revision History

Date	Revision	Description
Sep. 7, 2000	00	Production Release

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Introduction

Figure 1: Lighting Icon

This part of the Pilot's Guide explains FlightMax Lightning and its use with the BF Goodrich Avionics Systems WX-500 Weather Mapping System. Topics include:

- *Lightning Overview* - presents an overview of the Lightning function and the Stormscope WX-500 Weather Mapping System.
- *Lightning Pages and Menus* - explains every page and menu used in Lightning.
- *How to Use Lightning* - explains how to perform specific tasks using Lightning.
- *Messages and Error Indications* - provides the meanings of Lightning messages and error indications.
- *Menu Organization* - shows the path to any menu in Lightning.

FlightMax Lightning is verified by the presence of its icon and text label in the Main menu. If Lightning's icon and legend, shown in Figure 1, are not present in the Main menu, contact your installer for assistance.

Before reading this section, you should read and understand your Stormscope WX-500 User's Guide. It contains information essential to the proper use and interpretation of the displays presented by FlightMax Lightning.

Lightning Overview

WARNING

This section is not a guide to weather flying. It should be used in conjunction with your airborne thunderstorm sensor manual, to understand and interpret FlightMax Lightning displays. It is not intended as a guide to the safe use of this data in making route selection decisions in flight.

FlightMax Lightning displays weather avoidance data gathered by an airborne thunderstorm sensor, the BF Goodrich Avionics Systems Stormscope™ WX-500 Weather Mapping System. Proper use of FlightMax Lightning and the WX-500 can improve your ability to maintain a safe distance from thunderstorms by alerting you to their presence under instrument flight conditions and at distances that would preclude avoidance by visual means.

Briefly, airborne thunderstorm sensors detect the electrical discharge associated with lightning. By means of their specialized antennas and electronics and sophisticated processing software, they are able to determine the approximate range and relative bearing of each lightning strike. This information is then sent to the FSD for display.

Since lightning and thunderstorms are always associated with hazardous weather conditions, including extreme turbulence, heavy precipitation and damaging hail, avoidance of areas where lightning is present will increase the likelihood of avoiding these other hazards.

FlightMax Lightning provides access to all of the functions of the WX-500 sensor.

FlightMax Lightning is also available to the FlightMax Map function. The Map function is a terrain and navigation display with overlays of radar, traffic and lightning data. The FlightMax Lightning function provides Lightning data to the Map function for possible overlay display.

Lightning Pages and Menus

Data Page Layout

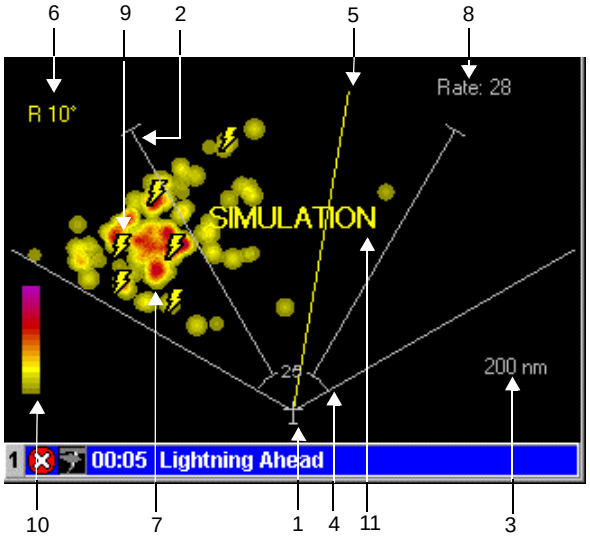

Figure 2: Data Page Layout

NOTE: The storms depicted in the screen graphics do not represent normal storm displays. They were created from actual sensor data, however they were not collected in flight. They are used to illustrate Lightning operation.

1. **Aircraft Symbol** - Shows the position of your aircraft in relation to the thunderstorms depicted on the page.
2. **Azimuth Marks** - Denote relative bearings from your aircraft's heading at 30× intervals.
3. **Display Range** - Shows the total sensing range (from the aircraft symbol to the outer ends of the azimuth marks). The small, inner knob controls the current display range.
4. **25nm ring** - Separates nearby activity from more distant activity.
5. **Bearing Line** - The large, outer knob controls the

angular location of the bearing line. The bearing line and bearing indicator are removed from the screen after 15 seconds of non-use.

6. **Bearing Indicator** - Provides precise bearing information to storm activity. The bearing indicator shows the actual relative bearing (in direction and degrees) at which the bearing line is positioned.
7. **Strikes** - Each strike is shown according to its position and azimuth relative to your aircraft as reported by the lightning sensor. Strikes can be displayed as clusters or as individual strikes.
8. **Strike Rate Indicator** - Displays the number of strikes per minute occurring within the displayed area, based on recent activity.
9. **Strike Flashes** - Depict areas of greatest activity.
10. **Strike Contouring Scale** - The color at the top of the scale indicates the color of the most severe activity.
11. **Mode Annunciator** - Indicates circumstances warranting special interpretation of the displayed data.

Lightning Main Menu

The Lightning main menu provides several options for changing and controlling the Lightning display.

Figure 3: Lightning Main Menu

Forward View

FORWARD VIEW is a toggle function, provides a choice between two views:

FORWARD VIEW is illustrated in Figure 2. Forward view presents storm data in front of your aircraft and is most useful during cruise.

CENTERED VIEW is illustrated in Figure 4. Centered view presents storm data 360°around your aircraft and is most useful during times when high maneuvering is anticipated, such as the terminal area.

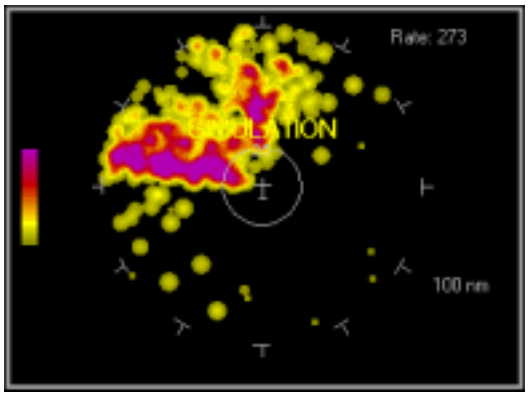

Figure 4: Centered View

Clear Strikes

CLEAR STRIKES, clears the page of lightning strikes and from the WX-500 memory. The most active storms will start to reappear on the screen after a clear strikes.

The WX-500 supports an optional external pushbutton by which strikes may be cleared as well. Use of this pushbutton has the same effect as the menu function.

> **NOTE:** the Lightning Ahead indication is cleared whenever strikes are cleared.

Cell Mode

Cell mode and Strike mode offer two different sensing and display modes for observing storm activity. CELL MODE is a toggle function accessed from the Lightning main menu. A check mark indicates CELL MODE is being used, no check mark indicates strike mode is in use. Both modes may be used with any of the SETTINGS displays, either normal or contoured strike display, with or without strike flashes.

STRIKE MODE is slightly more sensitive and tends to detect storms earlier but it exhibits certain sensing artifacts (“radial spread”) in conditions of high activity. In this mode lightning strikes are depicted as angled crosses (x).

CELL MODE suppresses the sensing artifacts, clumping strikes together to represent thunderstorm cells more

closely. Cell mode offers a more accurate, easier to interpret display in conditions of high activity. However, some capacity for early detection of developing or distant storms is lost. In this mode lightning strikes are depicted as angled crosses (x).

Settings

The LIGHTNING→SETTINGS submenu collects several functions that enable and disable specialized display modes. These functions are described in the following sections. The two history functions: GPS MAP HISTORY and LOOP HISTORY are grouped with the HISTORY function from the Lightning Main Menu for clarity

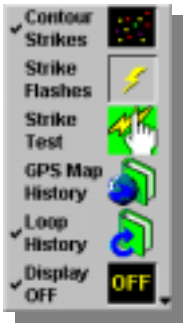

Figure 5: Settings Menu

Contour Strikes

Contour strikes determines how storm activity is depicted visually on the FSD screen. Contour strikes is a toggle function. It depicts strikes in a contour or normal mode.

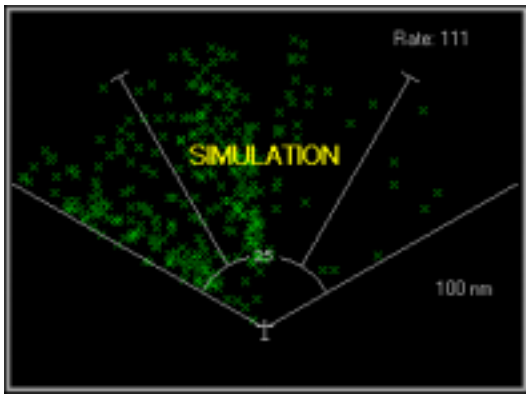

Figure 6: Normal Display Mode

In normal display mode, (Figure 6), strikes are depicted as crosses. Each cross appears on the page when the strike is reported to the FSD by the sensor and is removed three minutes later (or whenever CLEAR STRIKES is selected).

While the strike is displayed its appearance doesn't change but its position may (if track stabilization is enabled). A single cross may indicate the presence of a thunderstorm. A cluster of crosses almost certainly does, and a region of crosses increasing in density should be assumed to indicate a building storm.

CONTOUR MODE (as shown in Figure 2), uses color spots to indicate storm activity.

In contour mode, each isolated strike is initially displayed as a spot, bright yellow in the center and darker yellow at its edges. The size of the spot varies according to the selected display range. As an isolated strike ages, it decreases in intensity and size until, at the end of three minutes, it disappears from the page.

Color is used to indicate a building storm or greater activity. Shades of orange, red and magenta are used to indicate increasing levels of activity. (A color scale representing the full range of color codes is presented on the page, see Figure 2). As the cluster of strikes ages, it is remapped down through the colors and reduced in extent until it fades completely from the page.

WARNING

NEVER fly near or through any thunderstorm, even if it appears to be decreasing in intensity.

Strike Flashes

STRIKE FLASHES causes a lightning stroke symbol to appear for five seconds at the position of each newly painted strike (Figure 2). These figures depict the areas of greatest activity in the immediate past, especially when they cluster.

Strike Test

STRIKE TEST is a test mode of the WX-500. In strike test mode, the WX-500 generates test strikes in a known location every two seconds. Lightning displays a target box on the page and displays all test strikes received, as

shown in Figure 7, clearing each strike one second after reception. On a properly working system, the test strikes should appear and disappear within the test box at regular intervals.

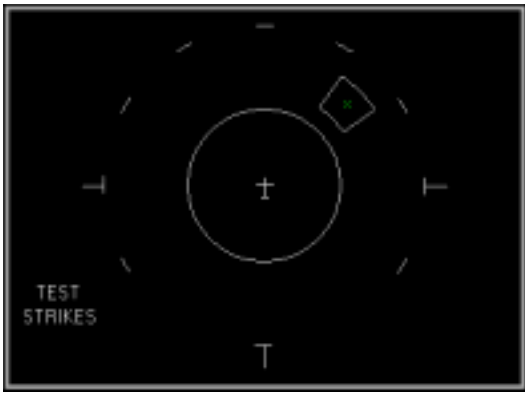

Figure 7: Strike Test

STRIKE TEST can be used as a preflight check or during flight if there is a question about the system's operational integrity.

Display Off

Display Off is a toggle function that enables or disables the display and other operating functions of Lightning. When Display Off is enabled, lightning sensor information is not displayed, error messages are not displayed and lighting information is not available to the "Map" function.

A large screen annunciation saying the lightning display is "Off" appears in the center of the screen. If Display Off is enabled on system power down it will be Off on power up.

History

The HISTORY function is available from the Lightning main menu. It (Figure 8) provides a recent history of storm activity. As you fly, Lightning records all strikes received by the sensor on the hard disk. It can save up to 30 minutes of strikes at the maximum rate they can be delivered from the sensor. This data can then be displayed and reviewed

from the history page. When history is selected a large yellow annunciation that says "HISTORY" is displayed in the center of the screen to indicate that this is not a live display.

> **NOTE:** Selecting History will deactivate the Lightning function in "Map".

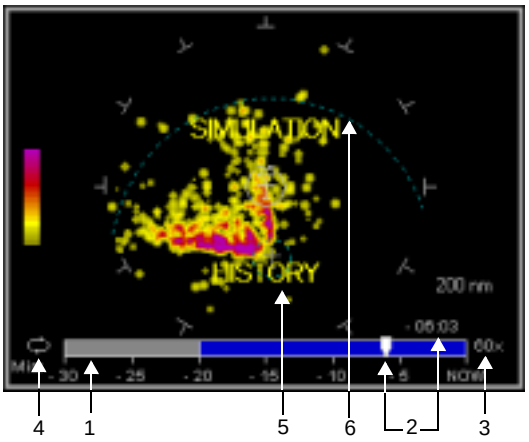

Figure 8: History Display

The history page includes the following features:

1. **Time Scale** - Located at the bottom of the history page shows how much data is available and which portion is selected for display. Gray represents available data and blue represents the portion currently selected for playback. If some of the available recording space has not yet been used, it is represented by a black section.

   The outer cursor knob controls the start point of the history playback (the blue portion of the scale).

   The inner cursor knob controls the playback rate.

2. **Playback Time Indicators** - are indicated graphically by the "slider" on the bar and numerically above the bar. The numerical value is the number of minutes and seconds *in the past* that the currently displayed strikes were recorded.

3. **Playback Rate** - a numeric indicator to the right of the

bar indicates how fast the playback is running. Playback rates range between 10x and 120x, with 10x being the slowest and 120x being the fastest. A playback rate of 120x for the full 30 minute capacity of the recording will go by in 15 seconds.

4. **Loop Indicator** - located to the left of the Time Scale. If it is displayed it indicates that the loop history mode for continuous playback is active.
5. **History Mode** - A large yellow history annunciation in the center of the screen is displayed during history mode.
6. **Sensor Range Circle** - The sensor range circle is a blue circle that marks the bounds of recorded data during replay.

GPS Map History

GPS Map History is selectable from the Lightning Settings menu. GPS Map History will re-reference strikes on playback to your current aircraft position. It creates the appearance that the lightning sensor system had been stationary at the point of playback instead of moving through the air during the period in which the recording was made. A dashed blue sensor range circle marks the bounds of the recorded data during replay. This boundary indicates old strikes outside the sensors range at the time old strikes were recorded. The GPS MAP HISTORY mode can be stopped by deselecting it from the menu.

Loop History

GPS Map History is selectable from the Lightning Settings menu. During normal history once the playback is finished the display returns to the main data page and a live lightning display. To view history data continuously use the LIGHTNING→SETTINGS→LOOP HISTORY function.

Loop History starts at the same time offset in the past and continues suppling data up to the current time. The time scale will keep retuning to the same number of minutes in the past and show lightning data from that point forward, until manually stopped. To stop continuous playback, deselect the function from the menu.

How to Use Lightning

Lightning Startup

FlightMax Lightning starts automatically as part of the normal initialization sequence of the FSD. To use LIGHTNING do the following:

1. Select Lightning from Main Menu.
   Lightning's product identification page will appear.
   Read all of the information on the product identification page and observe any operating limitations it reflects.
2. Press **Enter** to start the Lightning application.
   At startup, Lightning restores all mode selections that were active when it was last used
3. Lightning then displays its data page and main menu (Figure 9).

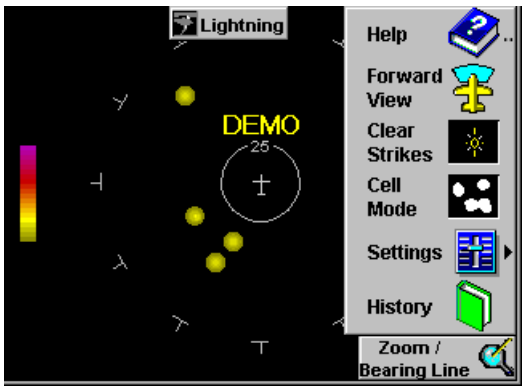

Figure 9: Demo Mode

Lightning Operations

Changing Between Forward and 360° View

Bring up Lightning's main menu, then select FORWARD VIEW. This is a toggle function. A check mark indicates the lightning display is in forward view, no check mark indicates 360° view.

Changing Between Normal and Color Contour Display

Bring up Lightning's main menu and select SETTINGS, this brings up the SETTINGS sub menu. Select CONTOUR STRIKES. This is a toggle function. A check mark indicates the display is in contour strike mode, no check mark indicates normal mode.

Turning Strike Flashes On or Off

In Lightning's main menu, select settings, this brings up the SETTINGS sub menu. Select STRIKE FLASHES. A check mark indicates Strike Flashes is on.

Changing between Cell Mode and Strike Mode

From Lightning's main menu, select CELL MODE. A check mark indicates cell mode is being used.

Clearing Lightning Strikes from the Screen

From Lightning's main menu, select CLEAR STRIKES.

Performing a Strike Test

Strike tests can be performed while on the ground or in flight to check system operation.

1. In Lightning's main menu, select SETTINGS→STRIKE TEST.

   Strikes should appear within the box at regular intervals (2-3 seconds). Occasional strikes outside the box does not constitute a failure.

2. Repeat to return to normal operation.

Cursor Control Functions

Outer Knob - Bearing

The outer knob is used to activate and orient the bearing line. The bearing line and bearing indicator are removed from the screen after 15 seconds of non-use.

Inner Knob - Range

The inner knob is used to select the display range (scale). There are three available range scales, 25, 100, and 200.

Demo Mode

Avidyne provides a demo mode to learn about and simulate Lightning operations while on the ground.

To enable demo operation, use the following procedure:

1. Locate and enter the MAIN→SYSTEM→DEVICES menu.
2. Activate the LIGHTNING configuration page (Figure 10).

   NOTE: while in the configuration page DO NOT change any other settings. Any changes (other than Demo mode) may result in a degradation or loss of lightning sensor data.

3. Select DEMO from the Operation Mode field.
4. Select **Enter** to confirm the changes.
5. To return to normal operation follow the preceding steps, however, select WEATHER for Operation Mode.
   While the WX-500's demo mode is enabled, operation of Lightning will display simulated data along with a DEMO annunciation on Lightning's data page (Figure 9).

   NOTE: Normal operation of Lightning must be restored before flight operations are conducted. You can confirm that the system has returned to normal operation by the removal of the DEMO annunciation from the screen.

How to Run History

To display and run the strike history do the following:

1. Select the desired display range for the history page.
   While on the history page, the cursor control knobs are used to control playback and cannot be used to control display range.
2. Select LIGHTNING→HISTORY or LOOP HISTORY if you wish to run History continuously.
3. The history page is displayed. A color coded time scale runs along the bottom of the display.
   Gray - represents available playback data
   Blue - represents the portion being played back
   Black - represents the recording space not used.

4. Use the large outer knob to set the start point for playback (the blue portion of the scale).
5. Use the small inner knob to set the playback rate.
6. The rate range is from 10x to 120x. 10x will play back a 30 minute recording in 3 minutes and 120x will do it in 15 seconds.

   The playback starts automatically and ends automatically and returns to the main data page with a live display.

Maintenance Functions

Maintenance functions should be performed by qualified service technicians, however there may be situations where access to the maintenance pages is required.

WARNING

Never change any settings in the Lightning configuration pages without consulting with your installer. Some changes may result in a loss of sensor data.

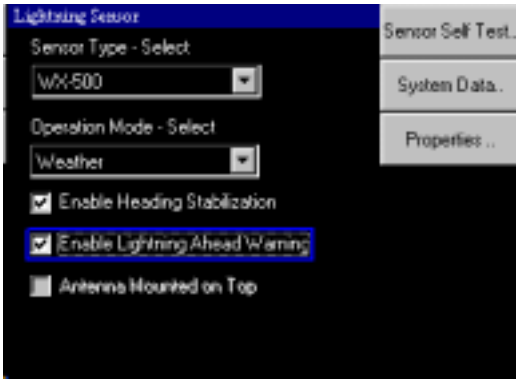

Figure 10: Lightning Configuration Page

Lightning Configuration Page

The LIGHTNING SENSOR configuration page (Figure 10) contains the following features:

Sensor Type

Used to select between the lightning sensor and a simulation program used in conjunction with the Demo mode.

Operation Mode

Normal operating mode is weather. Demo is used to learn Lightning operations. Noise Monitor is used during installation and configuration.

> **NOTE:** Occasionally the Noise Monitor mode will not initialize after selection. If this happens, select Demo mode first and then select Noise Monitor

Heading Stabilization

Enables heading stabilization when checked and disables it when not checked. The heading stabilization source is selected in the PROPERTIES page, described in the Properties Page section.

Lightning Ahead Warning

Enables display of the Lightning Ahead warning message in the message bar when checked and disables it when not checked.

Antenna Mounted on Top

Indicates that the sensor antenna is mounted on top of your aircraft when checked and that it is mounted on the bottom of your aircraft when not checked. This parameter is normally unavailable for change.

Properties Page

The PROPERTIES page provides access to two system configuration parameters. Normally these parameters, would be set by your dealer.

Comm Port - selects which communication port your sensor is connected to. Normally this is port 2.

Heading stabilization Input - defines what type of stabilization is being used if Heading stabilization has been checked on the Lightning configuration page.

The choices are:

None: no stabilization.

Synchro: uses a remote compass system with a synchro motor.

Stepper: uses a remote compass system with a stepper motor.

GPS Ground Track: generates a track stabilized display.

Self Test

Use SELF TEST to manually initiate the self test functions of the WX-500. The responses of the WX-500 are displayed as they are received.

Automatic self tests are performed at power up. Errors discovered during automatic self test are reported to the FSD and are available on the SYSTEM DATA pages.

System Data

Select SYSTEM DATA to gain access to four pages of system data reflecting details of the WX-500's status. These pages provide system information to the dealer. That information may be necessary if the system is experiencing problems.

Heading and Track Stabilization

Heading and track stabilization is available on the FSD if the aircraft is appropriately equipped and configured. Lightning sensors detect the relative bearing and distance of storms. Stabilization is a feature of some sensors which is used to move the storm display when your aircraft changes its heading.

Heading stabilization - uses a remote compass to calculate heading. On an unstabilized display, once a strike is recorded and displayed, it does not move on the display. This will cause storms to be displayed with inaccurate dimensions. Storms may appear elongated or compressed in azimuth, depending on the pattern of strikes recorded during a turn. With an unstabilized display, the screen must be cleared frequently to avoid presentation of confusing data. Because of this confusion a wider berth must be given to all storms. Aircraft properly equipped should use heading stabilization at all times.

CAUTION

Loss of remote compass function accompanied by a flag will cause loss of the heading stabilization function. If the remote compass function is lost or questionable and no flag is present, or if heading stabilization performance appears erratic, you should manually disable heading stabilization.

Track stabilization - has many similarities to heading stabilization, but is based on the ground track measured by the GPS rather than the heading measured by a remote compass. As your ground track angle changes, the change is used to correct the relative bearing of previously recorded strikes. As with heading stabilization, this allows them to be redisplayed at the corrected angle and allows new strikes to be recorded in correct relation to the previously recorded strikes.

Track stabilization is less effective in eliminating turn-related display artifacts in extreme winds, due to the significant changes in crab angle that may result. Strikes are always displayed in correct initial relation to the aircraft, but corrections through turns may not be as precise when winds are strong or gusty.

CAUTION

Track stabilization performance may be erratic when the aircraft is at rest or barely moving due to the inability of the GPS to calculate a reliable ground track angle. Mapping of storms at rest on the ground (after engine start or on the runup pad) may be unreliable and should be disregarded if track stabilization is enabled. Mapping of storms on helicopters in hovering or near-hovering flight may exhibit unpredictable characteristics.

Heading and track stabilization should be set by your installer.

Messages and Error Indications

FlightMax Lightning annunciates the following modes and failures by means of a yellow annunciation message :

Table 1: Mode and Error Annunciations

Message	Meaning
DEMO	Displayed during WX-500 demo mode.
END – STARTING WX	Displayed at end of history playback, prior to returning to normal real-time strike display.
HISTORY	Displayed during history playback.
LOSS OF SENSOR DATA	Communication of strike data from the sensor system to the FSD has been lost.
SENSOR ERROR	The sensor system has reported an error that may mean current data is incomplete or erroneous. The error may clear. One possible error represented by this message is a stuck mike. If this message appears, check your comm transmitters for indication of a stuck mike.
SENSOR FAILURE	The sensor system has reported an error that may mean current data is incomplete or erroneous. The error will not clear until power is removed from and reapplied to the sensor system. You should not generally attempt to fix such an error in flight.
SIMULATION	Reserved for use in non-production configurations.
Verify Antenna Location (run Setup)	There may be an inconsistency between the antenna location jumper setting and the software configuration. This message should only appear during installation. If it appears at a later date, contact your dealer before using Lightning further.

Lightning Ahead Indication

When viewing functions other than Lightning there is a Lightning Ahead alert indication available. The alert is displayed in the message bar. This indication will be given whenever new lightning appears within Lightning's alert area. The alert area extends 75 nm forward of the aircraft and 22° left and right of the nose regardless of display mode and range.

Figure 11 shows a typical display with a Lightning Ahead message in the message bar (note that the red lightning ahead alert area lines are not displayed during normal flight).

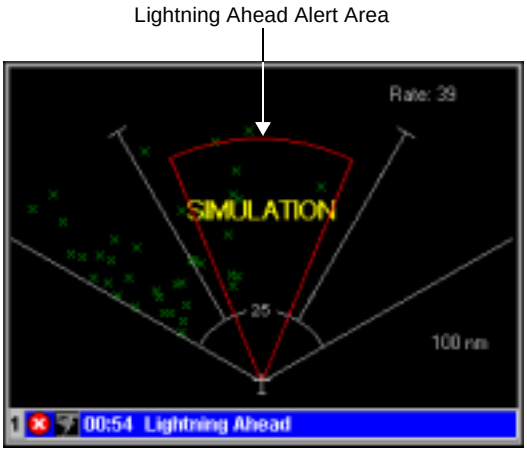

Figure 11: Lightning Ahead

The Lightning Ahead message displays the following characteristics:

- Confirming the Lightning Ahead message, will remove the message bar but the message will remain in the message center as long as lightning remains ahead.
- If lightning persists in the alert area for more than one minute after you confirm the message, the message will be redisplayed.
- When lightning is no longer detected in the alert area, the message is deleted from both the message bar and the message center.
- The Lightning Ahead feature continues to operate based

on current strike data even when you are using the strike history display.

The Lightning Ahead message feature is enabled or disabled from the Lightning configuration page, described in Lightning Configuration Page.

Menu Organization

The following Menu Tree graphically depicts the paths to all Lightning menu functions.