WX-8
OWNER'S MANUAL

Operating and interpreting your new "Stormscope" WX-8 system for easy thunderstorm mapping.

3M
((Ryan))))
Stormscope®
Weather Mapping System

Introduction:

With your new "Stormscope" system, you're flying the finest thunderstorm avoidance system available today.

Congratulations! You're now flying with the finest thunderstorm avoidance technology available today—the 3M ((Ryan))))) "Stormscope" Weather Mapping System. You'll soon trust your WX-8 as one of the most valuable instruments in your panel. You'll quickly respect it as a reliable aid in avoiding dangerous turbulence and other hazards of thunderstorms.

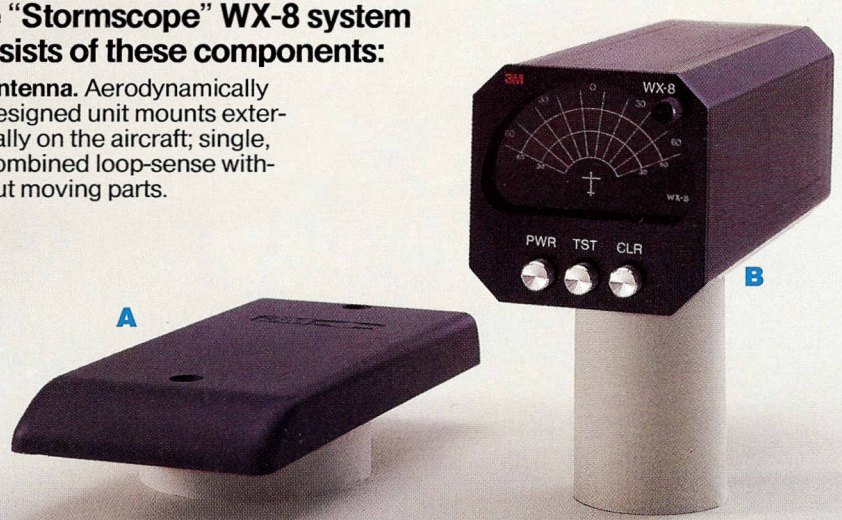
Be sure to use this manual.

This owner's manual will help you make the most of your "Stormscope" system. Read it completely and carefully to understand fully how this important instrument works and how to easily utilize its full capacity.

The product:

The "Stormscope" WX-8 system consists of these components:

A **Antenna.** Aerodynamically designed unit mounts externally on the aircraft; single, combined loop-sense without moving parts.



B **Processor/Display.** Single panel-mounted unit is totally solid state, features 3-color liquid crystal display (LCD), contains all operational controls. Screen is internally edge-lit for night viewing.

Basic benefits of the 3M ((Ryan))))) "Stormscope" Weather Mapping System:

- **You can choose from a series of models, offering a sensible range of capacity and affordability.**
- **Every model of the "Stormscope" system works as well on the ground as it does in the air. This means you can get up-to-the-minute thunderstorm information before takeoff—even before starting the engine(s). You can map the weather first, then map your flight.**
- **Every model can be installed in any single- or multi-engine aircraft; fixed- or rotor-wing; piston, turbo-prop or jet.**
- **Every model has inherently high reliability, because it's a solid-state, low-power, passive system with no moving parts.**
- **Every model is surprisingly lightweight and compact.**
- **Sold through a worldwide network of dealers, each model carries a full one-year warranty.**

WARNING: This "Stormscope" system is not intended for thunderstorm penetration. There is simply no weather mapping instrument available that can safely be used to penetrate thunderstorms. In this manual examples are given of aircraft passing close to thunderstorms. It is very important to note it is not always safe to pass this close to a thunderstorm. Pilot in command is responsible for all decisions regarding flight around thunderstorms.

The display:

Check these convenient control/screen features:

1 **Power/mode switch.** Push "on" to operate.

2 **Test button.** Push to check whether instrument is operating properly, either as a preflight procedure or during in-flight use. (See page 9 for demonstration.)

3 **Clear button.** Push to clear LCD so fresh, new thunderstorm data can be displayed.

4 **Internal-edge lighting.** View display screen comfortably at night, with brightness controlled by panel-light dimmer switch.

5 **Brightness control.** Turn to dial in desired brightness of lit segments on screen (clockwise to brighten, counterclockwise to dim).

6 **Azimuth/range segments.** Azimuth lines indicate 15° segments; range indicated by color: red—5 to 30 nm, yellow—30 to 60 nm, green—60 to 100 nm.

7 **Mapping direction indicator.** Aircraft diagram indicates position of thunderstorm **in relation to aircraft's heading** (not necessarily in terms of degrees off compass north or aircraft course).

Contents:

The concept:

Look at virtually thousands of electrical discharges inside a distant thunderstorm.

There's a good reason to look at electrical discharges. After all, electrical discharges are directly related to convective wind shear. In fact, a thunderstorm by definition must have electrical discharges.

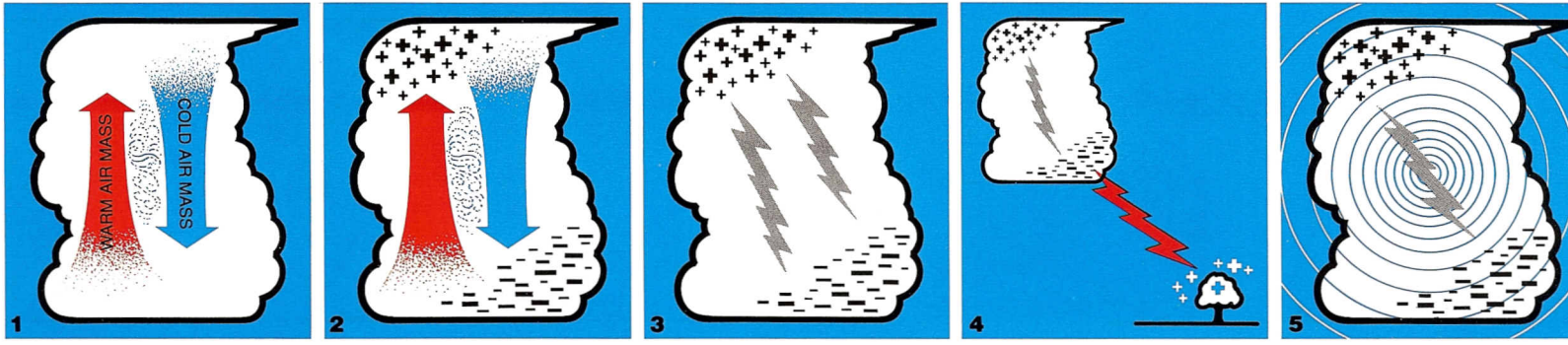
Find the discharges and you've found the wind shear . . . that special kind of turbulence that can mean gust loads strong enough to threaten structural failure. Defined updrafts and downdrafts, opposing each other, produce a separation of positive and negative charges. As these separated charges accumulate, electrical discharges occur. And for every discharge that can be seen by the eye, there may be a hundred more that can't be seen. All electrical discharges send out electromagnetic radio frequency energy—radiating in all directions at the same time at the speed of light. Each discharge has a unique "fingerprint," so to speak.

Therein lies the concept of the "Stormscope" Weather Mapping System: Find the discharges (by receiving the electromagnetic energy radiations) . . . check the "fingerprint" . . . determine azimuth and range . . . then you can **accurately map** thunderstorm activity to **avoid** dangerous wind shears.

Determine the precise heading that will give the smoothest, safest *flight*, while optimizing flight time and fuel efficiency.

That's the name of the game. Get to your destination as directly and as safely as possible. Go around the areas of wind shear. Use this newest, most reliable technology to fly around thunderstorms . . . and save time, save fuel, avoid discomfort at the same time.

Read on through this Owner's Manual to learn more about how to make the underlying concepts of the "Stormscope" Weather Mapping System work effectively for you.



1 The convective flow of air currents associated with thunderstorm development leads to wind shears in the space between the opposing air currents. The closer together these air currents are, the greater the shear activity. The currents oppose each other producing friction.

2 The friction between these convective currents causes electrical charges to separate. As positive and negative electrical charges are separated, they accumulate and congregate in masses of similar charges. **3** Electrical discharges occur as the accumulated masses of segregated positive and negative charges "try to get back together." **4** A few of the discharges are visible, as lightning. For every discharge that can be seen, however, there may be a hundred more that can't be seen. **5** All discharges, whether visible or not, radiate electromagnetic radio frequency energy in all directions at the same time at the speed of light. The electromagnetic signals have unique characteristics and varying rates of occurrence which, along with the strength of the signals, can be monitored to learn about the location

The technology:

Look at *computer-processed display* of the information from the electromagnetic signals received from distant electrical discharges.

Our patented technology is ingeniously simple. Thanks to the marvel of tiny computer chips, plus the fact that there's no need for a transmitter, the "Stormscope" Weather Mapping System is compact, lightweight, and highly reliable.

Here's a brief overview of the technology behind this product: Your WX-8 picks up electromagnetic radio frequency signals from electrical discharges, 135° in front of the aircraft out to 100 nm. This means your WX-8 can help you "see" electrical discharges in over 11,500 square miles of airspace.

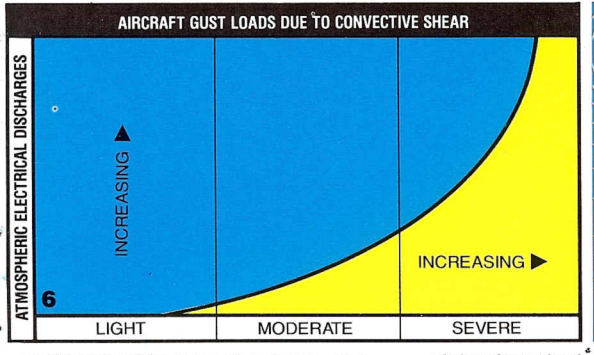
Since the electromagnetic signal from each discharge has a unique "fingerprint," the system can sort out those related to convective shear. The signals are run through a computer-processor to organize and map them, by range and by azimuth.

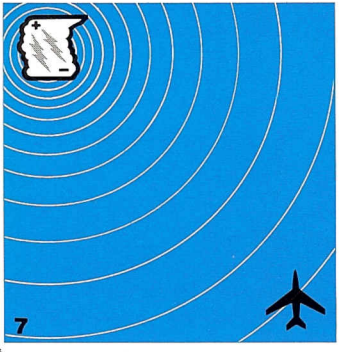
To determine range, the computer looks at each signal's intensity and a relatively narrow frequency bracket; it also analyzes vertical polarizations and the correlation between electrical and magnetic fields of each signal. Azimuth measurement is accomplished in much the same way as an ADF determines direction from an NDB.

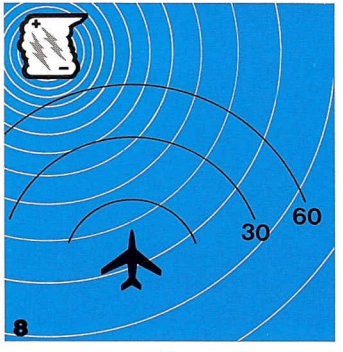
Finally, the computer-processed information is memorized and stored in the order the signals were received; the information is presented in an easy-to-read mapping format on the LCD display screen.

Sounds simple. But actually there are some mighty complicated things going on.

For one thing, it's all happening over and over again. The computer continuously updates the display and presents data accumulated in a very accurate and easy-to-interpret form allowing the pilot to safely navigate around dangerous thunderstorms.







and intensity of the convective shears which preceded the discharges. **6** It's critically important to monitor this complex atmospheric electrical activity accurately and thoroughly. For it's been well established that as electrical discharge activity increases, the potential risk of aircraft gust loads due to convective shear increases at an **accelerating rate.** **7** The radiated electromagnetic signals from electrical discharges are powerful enough to be received and detected at great distances. Your WX-8 has the capability to receive such signals from discharges up to 100 nm away. **8** Since the signals radiate out in all directions at the same time, your aircraft is in a position to receive signals from electrical discharges anywhere in 135° in front of the aircraft out to 100 nm. **9** To effectively map the location of the convective shears, the radiated signals being received at your aircraft must be analyzed for azimuth, (in relation to the **aircraft's heading**), **rate of occurrence** (an indication of intensity of the thunderstorm), and **range**.

Brightly colored segments chart out areas of thunderstorm activity and turbulence.

There's something fascinating about watching your display screen, especially when the instrument is receiving signals from active thunderstorms. The screen literally comes alive, displaying red, yellow and/or green . . . sometimes steady, sometimes flashing slowly, sometimes flashing fast, sometimes all three. Push the clear button and the display recreates itself in just seconds.

The WX-8 has the capacity to display 27 different segments (nine each in three different colored tiers) at once. Colored segments can appear one at a time or in any combination over the entire display. Color indicates range: Green—60 to 100 nm, Yellow—30 to 60 nm, Red—5 to 30 nm. Azimuth lines indicate 15° segments.

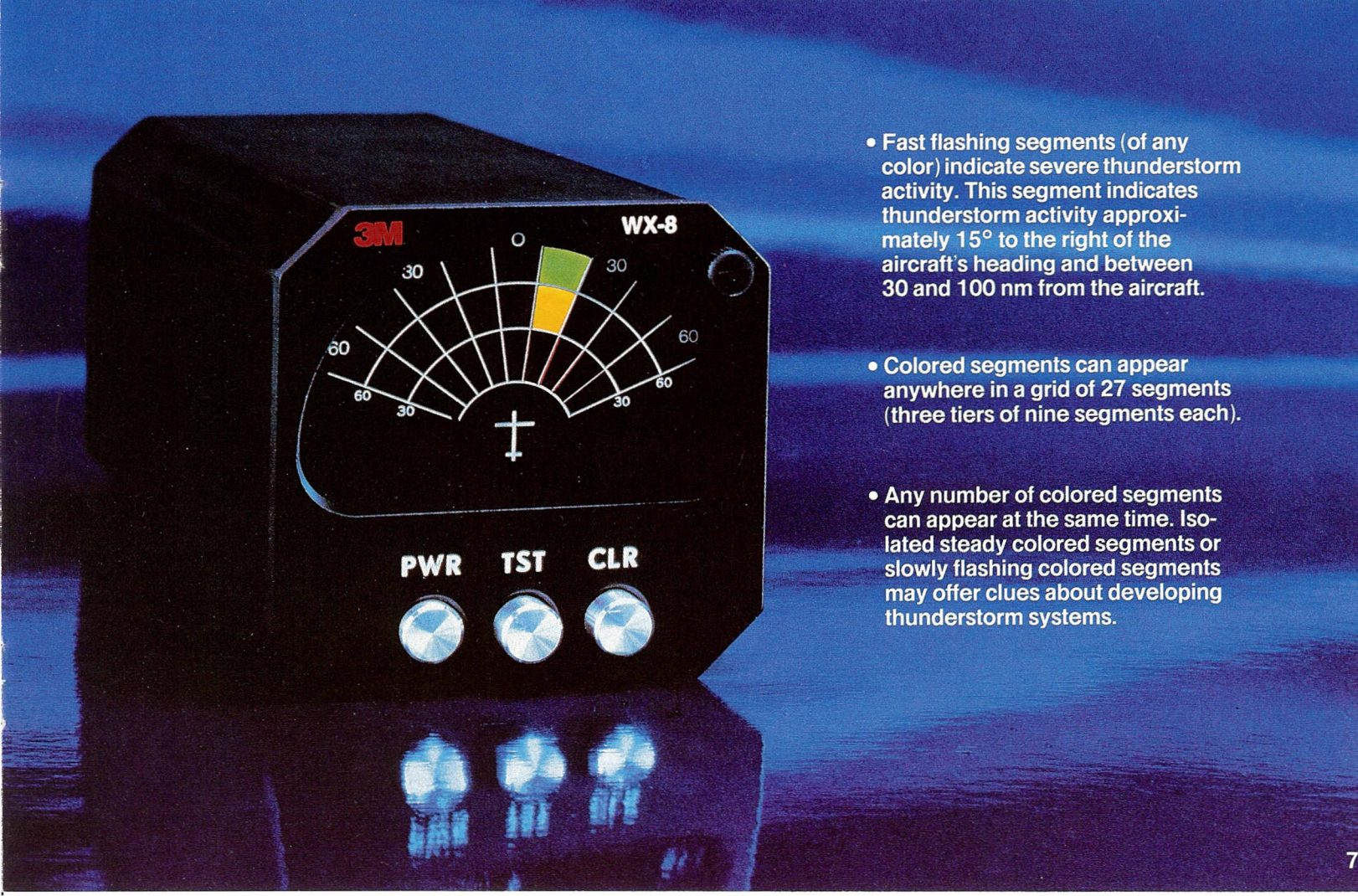
Electrical discharges associated with convective shear send out electromagnetic radio frequency signals. Each signal is received by the antenna of your WX-8 and analyzed by the computer/display. The display lights the segment that most closely corresponds with the range and azimuth of the particular discharge or discharges. The appropriate segment in the proper tier will light when just one electrical discharge occurs. Even though the electrical discharges, and the electromagnetic signals are transitory, the computer stores the information in its memory. The greater the rate of electrical discharge occurrence, the greater the amount of information stored in the computer.

The number of lighted segments that appear on the display and their relative position will give you an idea of the size and location of the thunderstorm and associated electrical discharge activity. The speed with which the color segments flash will indicate the **rate of occurrence** of the electrical discharges and thunderstorm severity. A steady color, for example, indicates weak thunderstorm activity. Watching the display even during periods of low activity can give valuable clues to developing thunderstorm formation.

Thunderstorm activity is continually changing . . . so your "Stormscope" system keeps updating.

Updating means keeping the map of thunderstorm activity always up-to-the-minute. On the WX-8, that means the screen is automatically updated every few seconds and that, at no time, is the information being displayed more than five minutes old. You always know the severity of the thunderstorm activity and its location in relation to your aircraft.

With a typical midwestern-type thunderstorm, the screen may become alive. In severe thunderstorm conditions, it may show steady and slow and fast flashing in a variety of colors, all at the same time. On the other hand, when thunderstorm activity is minimal, the rate of electrical discharge can be relatively slow and less spectacular. But, in any event, it is important to keep an eye on the "Stormscope" system display so that you are always aware of the thunderstorm conditions ahead of you. In addition, it is possible to manually clear the entire screen at any time by pushing the "Clear" button. Then the entire series of instrument responses will begin to unfold again, recreating a new map of thunderstorm activity.



- Fast flashing segments (of any color) indicate severe thunderstorm activity. This segment indicates thunderstorm activity approximately 15° to the right of the aircraft's heading and between 30 and 100 nm from the aircraft.

- Colored segments can appear anywhere in a grid of 27 segments (three tiers of nine segments each).

- Any number of colored segments can appear at the same time. Isolated steady colored segments or slowly flashing colored segments may offer clues about developing thunderstorm systems.

Some terms and concepts worth reviewing before reading on.

The following pages are devoted to explicit examples and explanations of how to read and interpret your WX-8 screen. You'll find it helpful to review the following terminology, conceptual ideas, and illustration/explanation approaches before studying the simulated displays that follow.

Radial spread. This phrase is used to describe a common phenomenon; the lighting of segments immediately inside and outside the segment where the thunderstorm is located. Frequently, for example, the segment that is flashing the fastest will indicate the area where electrical activity is actually taking place while the segments immediately inside and outside it may be flashing slowly or showing steady color. **Regardless of whether the display is showing the actual location of the thunderstorm or radial spread, the pilot should deviate course and avoid the area.**

Rate of occurrence. The "Stormscope" system is receiving electromagnetic frequency signals over and over, repeatedly storing the signals in computer memory, and displaying colors on the screen. The faster the colors flash the more rapidly the electrical discharges are occurring. This is referred to as rate of occurrence. **Rate of occurrence is the best indicator of thunderstorm severity.**

Airspace/weather diagram. Screen examples on the following pages are accompanied by scaled diagrams of a large area of airspace, through which simulated flights are diagrammatically proceeding. These diagrams are used to show the locations of thunderstorm activity in relation to the ever-changing, ever-progressing positions of the aircraft. Each unit in the grid represents an area 50 nm square. The arcs indicate the area being mapped on the screen below. For clarity, thunderstorm areas are indicated in sizes somewhat larger (in square miles of area, for instance) than would normally be the case under actual conditions; and the aircraft, obviously, is indicated considerably oversize in relation to the scale of the grid.

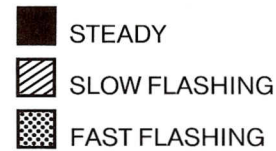
Weak, moderate, severe thunderstorms. Such adjectives are subjective, at best. But in the airspace/weather diagrams on the following pages, three levels of thunderstorm intensity are indicated—by light grey (weak), medium grey (moderate), and black (severe)—in order to somewhat approximate the way various intensities found in actual conditions will affect the screen image.

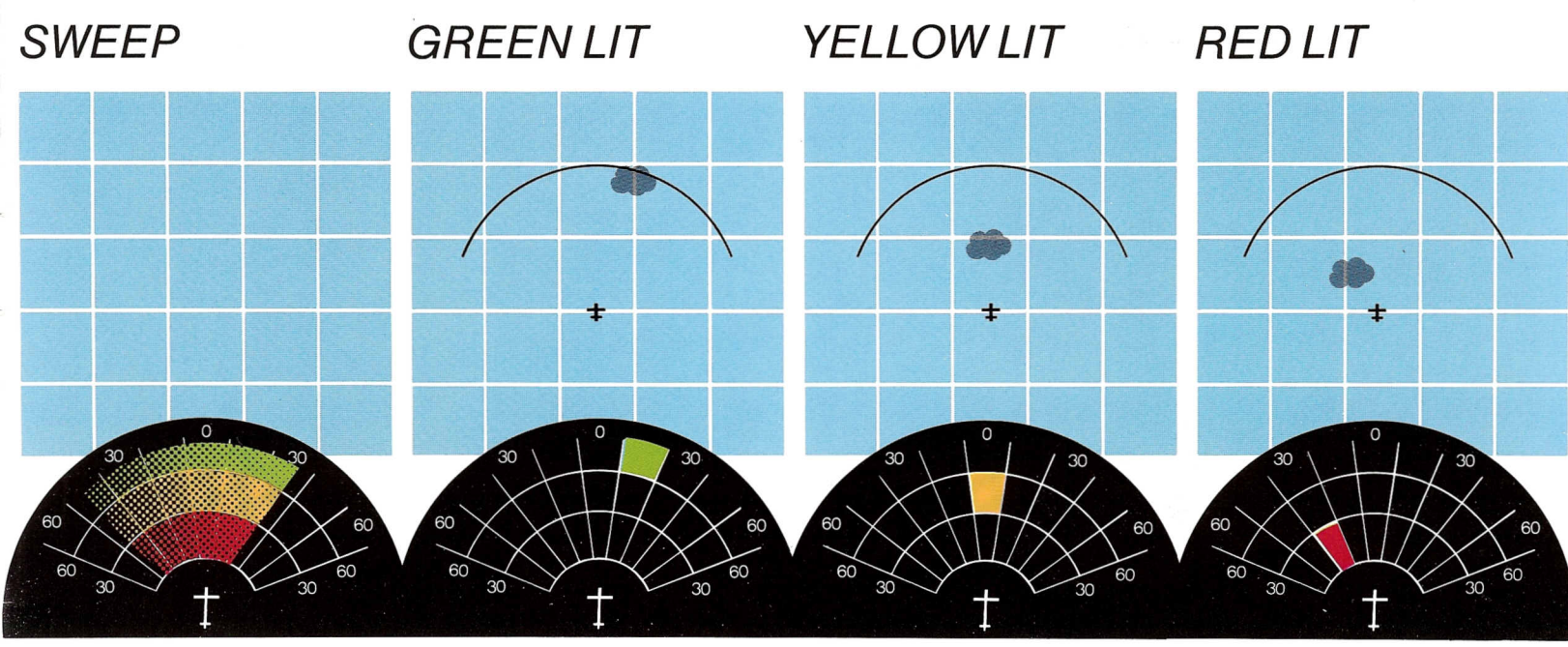
Storm movement. While thunderstorm systems generally are moving (and changing), the usual movement is relatively slow (5 to 45 nmph) when compared to the speed of the aircraft. Therefore, no attempt has been made to accurately indicate storm movement in the airspace/weather diagram.

Aircraft heading. When referring to the screen-image examples and airspace/weather diagrams on the following pages, remember that you're viewing thunderstorm locations in relation to the aircraft's heading (not necessarily in terms of degrees off magnetic north or aircraft course). As an aid to clear understanding, thunderstorm locations are described in captions by positions on a clock.

The WX-8 uses flashing segments to indicate thunderstorm severity. Storms generating a low rate of electrical discharge activity are indicated by steady lit segments. Slow flashing segments indicate moderate electrical activity. Fast flashing segments indicate severe electrical activity.

For the purpose of illustration in this owner's manual, steady, slow and fast flashing segments are indicated as follows:





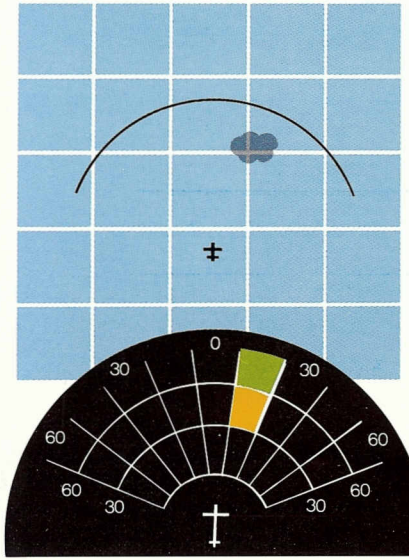
A-1 Example of the test mode. When you push the TST button you will notice that a full color sweep of the total range on the LCD takes place. At the completion of this "sweep," the yellow segment at the 1:30 position will remain lit. (Occasionally the red or green segment may be lit instead of the yellow segment.) When this action is complete, press the CLR button to clear display screen.

B-1 Green segment lit at 12:30. Electrical discharge(s) has occurred 60 to 100 nm from the aircraft approximately 12:30. (Discharges occurring anywhere in the 60 to 100 nm range will appear as a green segment.) It may also indicate a distant developing thunderstorm, not cause for immediate concern but continue monitoring.

B-2 Yellow segment lit at 12:00. Electrical discharge(s) has occurred 30 to 60 nm from and directly ahead of the aircraft. (Discharges occurring anywhere in the 30 to 60 nm range will appear as a yellow segment.) Deviate course either right or left.

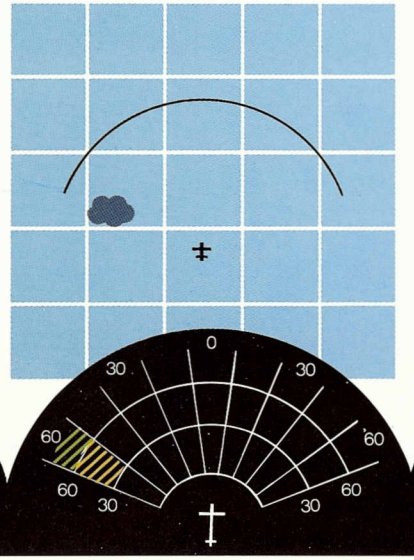
B-3 Red segment lit at 11:00. Electrical discharge(s) has occurred within 30 nm of the aircraft. (Discharges occurring anywhere in the 5 to 30 nm range will appear as a red segment.)

STEADY COLOR



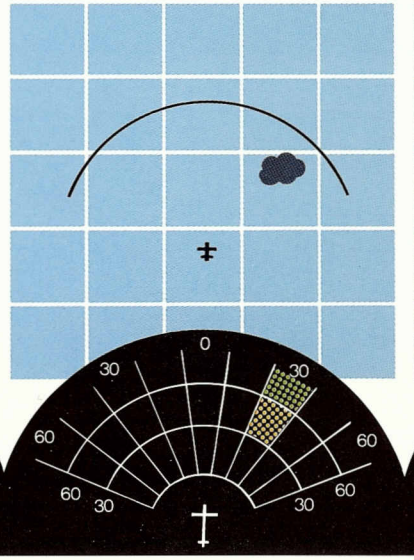
C-1 Steady green and yellow segment at 12:30. Electrical discharges have occurred somewhere between 30 and 100 nm. Deviate course to the left and continue monitoring to watch for thunderstorm development.

SLOW FLASH



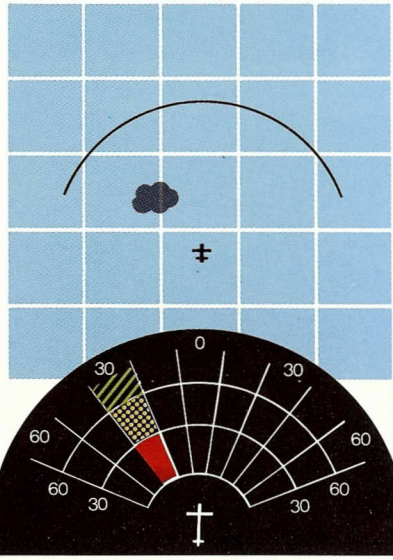
C-2 Green and yellow segments flashing slowly at 10:00. Moderate electrical discharge activity is being detected between 30 and 100 nm. No need for alarm. Continue on course and continue monitoring.

FAST FLASH



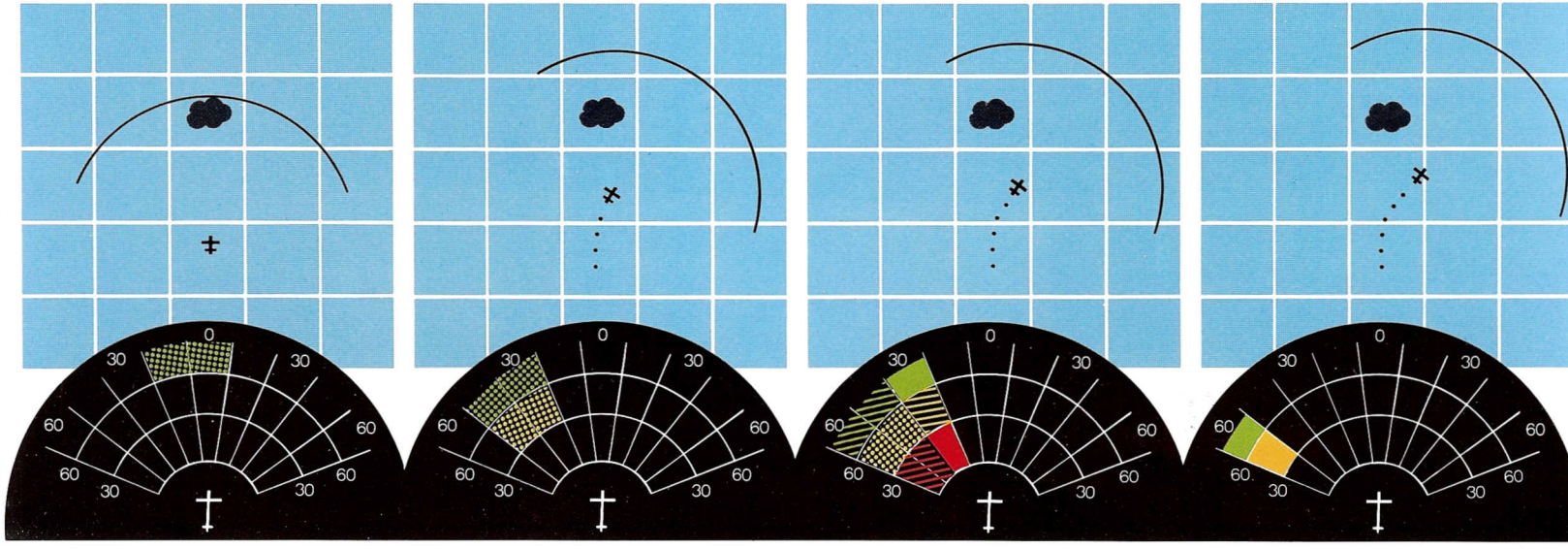
C-3 Green and yellow segments flashing fast at 1:00. Severe electrical discharge activity is occurring between 30 and 100 nm. This is a potentially dangerous situation. Continue on course but continue monitoring.

RADIAL SPREAD



D-1 All three color segments lit at the 11:00 position. Yellow segment is flashing fast. Green segment is flashing slowly. Red segment is steady. This is a probable example of radial spread associated with a thunderstorm between 30 and 60 miles from the aircraft. **NOTE: There may or may not be thunderstorm activity in either the green or the red segments. Don't take chances.** Deviate course to the right and continue monitoring.

CIRCUMNAVIGATING A THUNDERSTORM



E-1 Severe thunderstorm between 60 and 100 nm straight ahead. Segment is showing fast flashing green indicating a high rate of electrical discharge activity. Course deviation to the right is recommended.

E-2 Thunderstorm is now between 30 and 100 nm from the aircraft at 11:00. Two yellow and two green segments flashing fast indicate a high rate of electrical discharge activity. Continue monitoring.

E-3 Thunderstorm is now between 5 and 100 nm from the aircraft and centered at about 10:30. Segments of all three colors are lit. The fast flashing yellow may indicate the center of the thunderstorm. The slow flashing segments on all three tiers indicate the edge of the severe thunderstorm or perhaps radial spread. The steady lit segments indicate further decreased thunderstorm activity.

E-4 Thunderstorm still between 30 and 100 nm from the aircraft but well to the left. Indicates that aircraft is passing to the right of the storm. Continue on deviation course. Once past thunderstorm, proceed on desired course.

WX-8 specifications:

Practical dimensions, lightweight durability, convenient features.

Input voltage	10/16 or 24/32 v (DC nom)
Power requirement	350 ma (input current) 80-160 ma (from instrument dimmer control, max)
LCD display size	2⅝ in wide
Operating range	Max range—100 nm (fixed) Green—60-10 nm Yellow—30-60 nm Red—5-30 nm
Operating azimuth	Forward—135° (segments 15° wide)
Weight	
Display/computer with tray	2 lb. (0.9 kg)
Antenna	2 lb. (0.9 kg)
Total	4 lb. (1.8 kg)
Dimensions	
Display/computer	3.19 in x 3.19 in x 9.22 in
Antenna	.85 in x 4 in x 8.16 in

Parts and service warranty:

We stand behind the materials and workmanship of your "Stormscope" system.

The 3M ((Ryan)))))) "Stormscope" Weather Mapping System is warranted against defects in materials and workmanship for one year from date of installation. 3M's obligation is limited to the repair or replacement, at 3M's option, of products which prove to be defective during the warranty period. No other warranty is expressed or implied. 3M is not liable for consequential damages.

NOTE:

Warranty protection is assured only when installed by an authorized 3M ((Ryan)))))) "Stormscope" dealer.

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