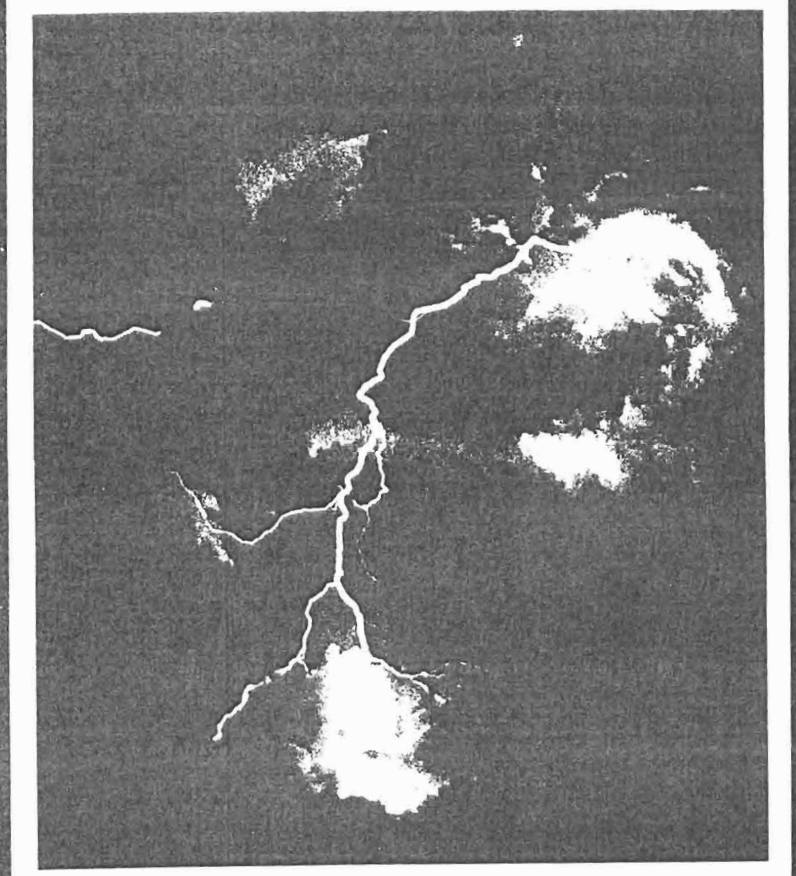


Model WX-10A OWNER'S MANUAL

Operating and interpreting your new "Stormscope" Systems model WX-10A for easy thunderstorm mapping.

3M Stormscope®
Weather Mapping Systems

CONTENTS

INTRODUCTION

You now own the finest thunderstorm avoidance technology available.

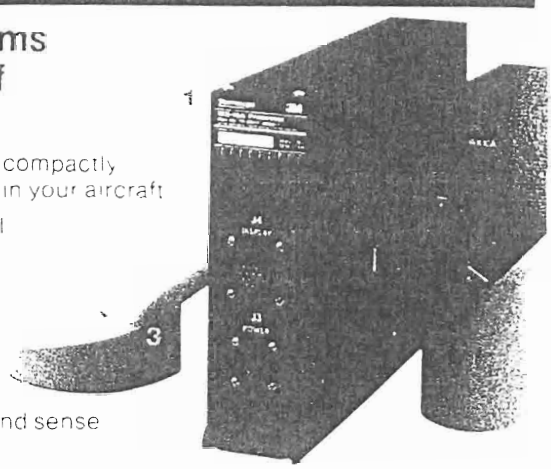
Welcome to the ranks of those who fly with confidence knowing they have the finest thunderstorm avoidance technology available today. As you use your model WX-10A, you will discover how invaluable it is in helping you avoid the dangerous turbulence and other hazards of thunderstorms.

Be sure to use this manual.
It will help you make the most of your Stormscope Systems model WX-10A. Read it carefully and completely, refer to it frequently to understand how this important instrument works and how easily you can utilize its full capability.

WARNING.
Stormscope Weather Mapping Systems are not intended for thunderstorm penetration. There is no weather mapping instrument available that can be used safely to penetrate thunderstorms. This manual gives examples of aircraft passing close to thunderstorms. It is important to note that it is not always safe to pass this close. The pilot in command is responsible for all decisions regarding flight around thunderstorm activity.

THE PRODUCT

Your "Stormscope" Systems model WX-10A consists of these components:



1 **Processor** This totally solid-state unit is compactly designed for easy remote installation in your aircraft.

2 **Display** The single panel-mounted 3ATI cathode-ray-tube unit contains all the operational controls. The screen is internally edge-lit for night viewing.

3 **Antenna** Aerodynamically designed the antenna mounts externally on the aircraft. It is a single combined loop and sense antenna with no moving parts.

THE DISPLAY

Your new model WX-10A has these convenient features:

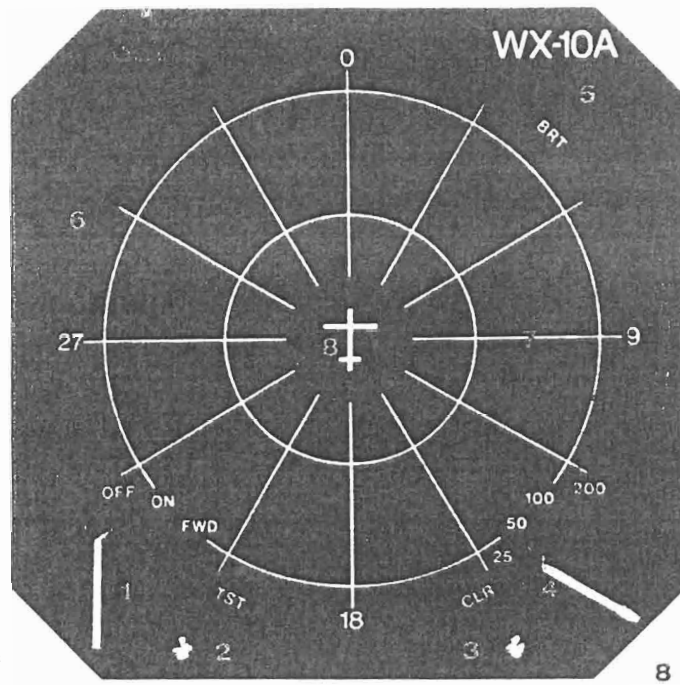
1 **Power/mode switch** Turn switch to ON to operate unit, turn to FWD to concentrate the instrument's memory capacity on the forward 180°.

2 **Test button** Push TST to determine whether instrument is operating properly, either as a pre-flight procedure or during in-flight use.

3 **Clear button** Push CLR to manually clear dots from the display screen.

4 **Range selection switch** Turn switch to desired range (25, 50, 100 or 200 nm). The selected range corresponds to the outer circle on the screen. The inner circle indicates half that range.

5 **Brightness control** Turn the dial to the desired brightness of dots on the screen. (Clockwise to brighten, counter-clockwise to dim.)



6 **Internal edge lighting** Edge lighting is controlled by the panel light-dimmer switch. It enables you to view the display screen comfortably at night.

7 **Mapping lines** The outer circle indicates the range selected with the range selection switch. The inner circle indicates half the selected range. Both circles are divided into 12 arcs of 30° each. Each arc at the outer circle is equal to about half the selected range. For example, if the range is set at 200 nm, each 30° arc on the outer circle indicates about 100 nm. Each 30° arc on the inner circle indicates about 50 nm.

8 **Mapping direction indicator** The aircraft diagram in the center of the display screen indicates the position of the thunderstorm **in relation to aircraft heading, not in terms of degrees off compass north or aircraft course.**

THE CONCEPT

Locating electrical discharge activity is the key to locating thunderstorms.

Thunderstorms by definition contain electrical discharge activity. And it's been well established that as electrical discharge activity increases, the potential risk of severe turbulence due to convective wind shear also increases. Find the electrical discharges and you find the thunderstorms.

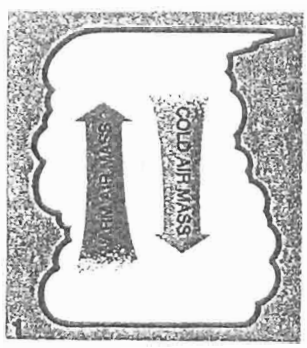
Within the thunderstorm, strong updrafts and downdrafts occurring close together produce a separation of positive and negative charges. When enough of these charges accumulate, electrical discharges occur. Only a few of these discharges are visible; for every discharge that can be seen, there may be a hundred more that can't be seen.

All electrical discharges send out electromagnetic radio frequency energy radiating in all directions. Find those discharges, determine the range and azimuth and you can accurately map thunderstorm locations.

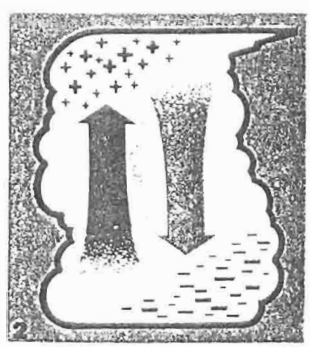
Find the best heading to circumnavigate thunderstorms

You want to save time. You want to save fuel. You want to enjoy the smoothest, most comfortable flight possible. But most important, you want to be safe.

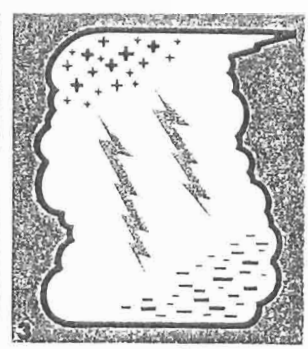
Stormscope® Systems help you circumnavigate thunderstorms to get you to your destination as directly and as safely as possible.



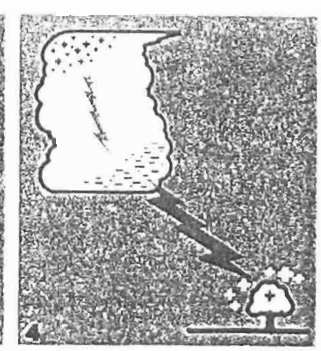
1 [illegible]



2 Friction between opposing air currents causes electrical charges to separate. As positive and negative charges are separated [illegible]



3 Electrical discharges occur as the accumulated masses of segregated positive and negative charges [illegible]



4 A few of the discharges are visible as lightning. For every discharge that can be seen [illegible]

5 [illegible]

THE TECHNOLOGY

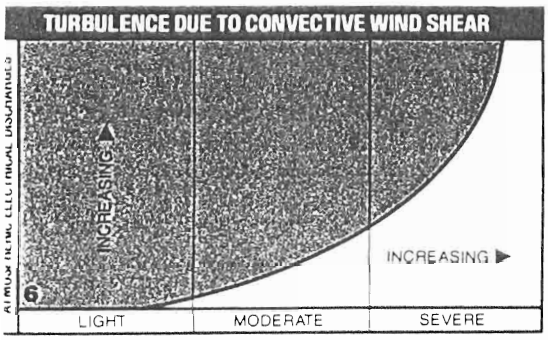
The "Stormscope" Systems model WX-10A lets you see electrical discharge activity.

The model WX-10A picks up electromagnetic radio frequency signals from electrical discharges 360° around the aircraft out to a distance of more than 200 nm (That's a total of more than 150,000 square miles of airspace.)

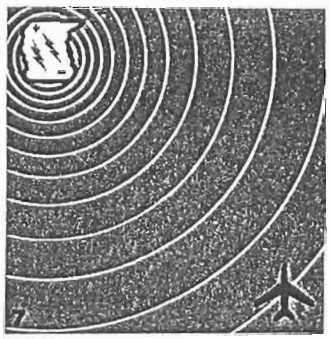
The system sorts out those electromagnetic discharges that are related to convective wind shear and runs them through the computer processor to organize and map them by range and azimuth These discharges have unique characteristics which, along with intensity, can be analyzed by the computer to determine range. Azimuth measurement is determined in much the same way an ADF determines direction to an NDB

Finally, the computer-processed information is memorized and stored in the order the signals were received The information is then presented in an easy-to-read dot pattern on the display screen

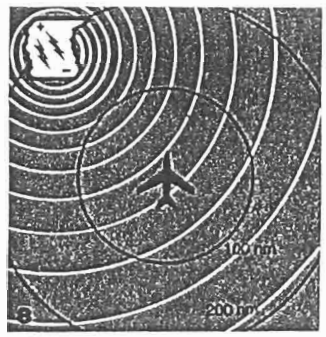
This process goes on continually The computer memorizes the data Obsolete information (more than a few minutes old) is automatically dropped The display screen gives an accurate picture of current thunderstorm activity



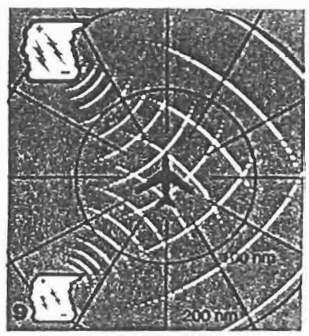
It is critically important to monitor the rapidity with which e discharges occur It is well established that as electrical scharge activity increases the potential risk of severe turbuence due to convective shear increases at an accelerating rate



7 The radiated electromagnetic signals from electrical discharges are powerful enough to be received and detected at great distances Your model WX-10A can receive signals from discharges more than 200 nm away



8 Since the signals radiate out in all directions and your model WX-10A can receive the signals from all directions, thunderstorm activity can be mapped 360° around the aircraft



9 To effectively map the location of the thunderstorms the radiated signals being received must be analyzed for both azimuth direction and range

A CLOSER LOOK

Dynamic, brightly-lit green dots map images of thunderstorm activity.

The model WX-10A has the capacity to show as many as 256 brightly-lit dots at one time each dot representing the approximate location of a single electrical discharge Dot clusters indicate the location of thunderstorm activity These 256 dots can appear anywhere in a grid of more than 12,500 locations over the entire screen Dots can also appear outside the outer circle mapping line (When the range is set to 200 nm the outermost dots can appear 220 nm from the aircraft position)

When the power mode switch is turned to FWD the 256 dot mapping capability is concentrated on the upper half of the screen representing the 180° forward of your position for greater definition of thunderstorm activity

Here's how the model WX-10A works:

Electrical discharges associated with thunderstorms send out electromagnetic radio frequency signals The signals are received by the antenna and analyzed by the processor The processor then instructs the display to place bright green dots on the screen in the positions that map the azimuth and range of the electrical discharges

The processor stores all the information in its memory, so each dot can be shown continuously on the screen A cluster of dots maps an area of thunderstorm activity from dozens, perhaps hundreds, of separate electrical discharges.

The size and shape of the cluster indicates how concentrated or dispersed the electrical discharges are at the thunderstorm location The rapidity with which individual dots occur indicates the rate of occurrence of the electrical discharges and, therefore, thunderstorm severity. Individual dots outside clusters can offer clues to developing thunderstorms and help describe the severity of thunderstorm activity

Thunderstorm activity is continually changing, so your model WX-10A keeps updating.

Updating means keeping the map of thunderstorm activity always up-to-the-second The updating takes place automatically and works like this

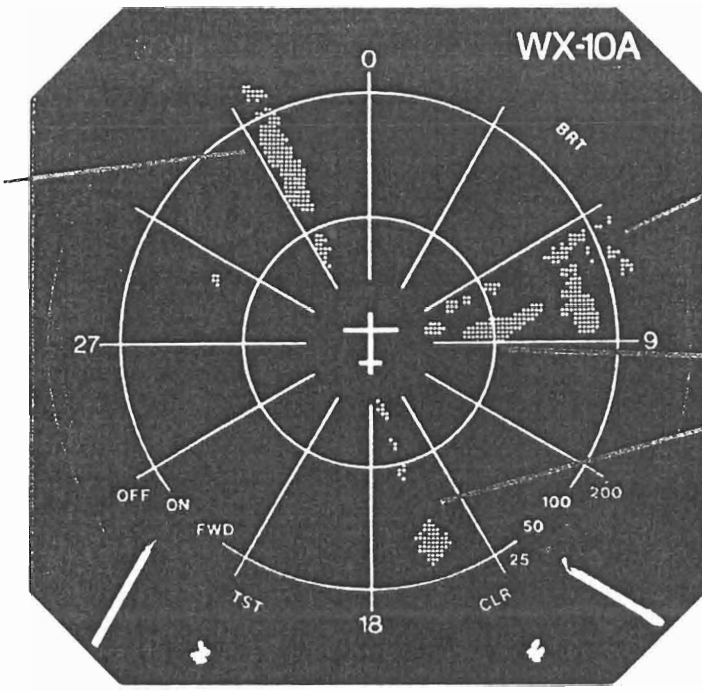
A dot is placed on the screen each time a signal from an electrical discharge is received When a signal is received from the 257th electrical discharge (exceeding the instrument's capacity to store and present 256 dots), the oldest dot in memory is automatically erased and replaced This process goes on continuously At all times the dots represent a recent history of electrical discharges

With a typical thunderstorm the screen may completely change within 25 to 45 seconds In extreme thunderstorm conditions, dot patterns may be completely replaced every 10 to 15 seconds

When thunderstorm activity is minimal the rate of discharge occurrence can be relatively slow and nonspectacular But in any event when a dot has been on the screen about four minutes (two minutes for jets) without being replaced it is automatically cleared from the screen and memory

In addition it is possible to manually clear the screen at any time by pushing the CLR button Then new dots will be displayed as electrical discharges occur creating a fresh new map of thunderstorm activity Use the CLR button often to gain a better understanding of the thunderstorm activity

Clusters of dots map areas of significant thunderstorm activity. This cluster indicates a thunderstorm at the 11:00 position (about 25° off the aircraft heading). The thunderstorm is about 20 nm in diameter with the closest edge about 25 nm from the aircraft at this moment



Individual isolated dots may offer clues about developing thunderstorm systems or the severity of nearby thunderstorms.

Up to 256 dots can appear on the screen at the same time

Dots can appear anywhere in a grid of 12,500 locations over the face of the screen

GLOSSARY

The following pages deal with specific examples of how to read and interpret your model WX-10A Below is a glossary of terms, concepts and illustration explanations that will help you understand these examples

RADIAL SPREAD

This phrase describes a common phenomenon a pie-shaped stream of dots trickling toward the center of the screen Radial spread appears to originate from a larger cluster of dots representing an area of thunderstorm activity (or from a thunderstorm that is beyond the set range of the instrument at that time). Dots in radial spread do not necessarily indicate the location of atmospheric electrical discharges, clusters of dots do

MULTIPLE DISCHARGES

An individual stroke of lightning is frequently made up of more than one electrical discharge These multiple discharges are more prevalent in severe thunderstorms. Your model WX-10A uses image enhancement circuitry to plot multiple discharges in concentrated clusters at the thunderstorm location

RATE OF OCCURRENCE

The "Stormscope" Systems model WX-10A receives electromagnetic radio frequency signals, stores the signals in the processor and displays the dots on the screen The rate at which the dots appear is directly related to the rate at which the electrical discharges occur This is called rate of occurrence and is the best indicator of thunderstorm severity

AIRSPACE/WEATHER DIAGRAM

Dot patterns on the following pages are accompanied by scaled diagrams of a large area of airspace, through which simulated flights are proceeding These diagrams are used to show the location of thunderstorm activity in relation to the changing position of the aircraft Each unit in the grid represents an area 100 nm square The circles indicate the range being mapped on the screen below For clarity, thunderstorm areas are indicated in sizes larger than normal and the aircraft is shown considerably oversize in relation to the scale of the grid

WEAK, MODERATE, SEVERE THUNDERSTORMS

In the airspace/weather diagrams on the following pages, three levels of thunderstorm intensity are indicated: weak—light gray; moderate—medium gray; severe—black. These colors are used to approximate the way various intensities in actual conditions may affect the screen image

STORM MOVEMENT

While thunderstorm systems generally move and change, the usual rate of movement is relatively slow (5 to 45 knots) compared to the speed of the aircraft. Therefore, no attempt has been made to indicate storm movement in the airspace weather diagram

RANGE SWITCHING

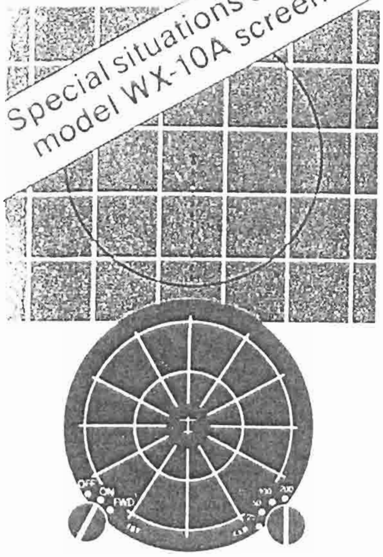
For better definition of thunderstorms, change to the next closer range setting when thunderstorms appear within the inner range circle. For any given thunderstorm intensity, fewer dots will appear on closer ranges. When the range is changed the model WX-10A retains in memory the electrical discharge locations from the previous range until all available dots are used on the newly selected range. (Dots more than four minutes old (two minutes for jets) will disappear from the memory.) For example

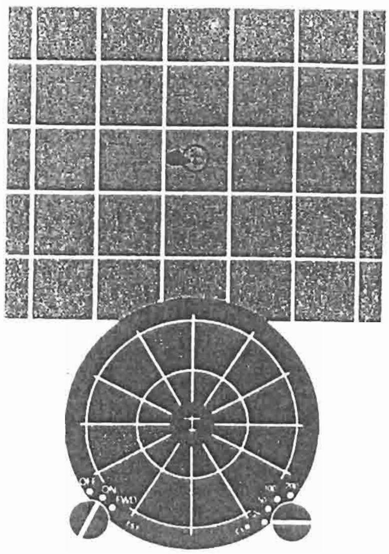
> You have been operating on the 200 nm range with 125 dots appearing on the screen If you change to the 100 nm range the memory could accumulate up to 131 additional signals and related new dot locations without dislodging the 125 dots on the 200 nm range As long as you are within the lifetime of the dots, you can refer back to the 200 nm range to see the same dot pattern still retained in memory

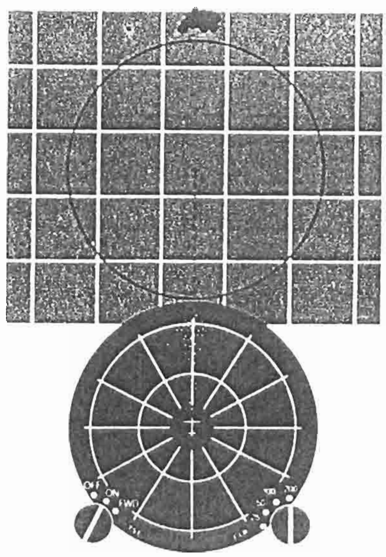
AIRCRAFT HEADING

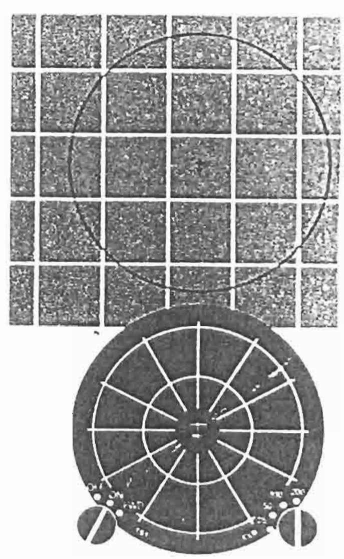
In the following pages, the thunderstorms are always shown in relation to aircraft heading, not in terms of degrees off compass north or aircraft course

Special situations on the model WX-10A screen.









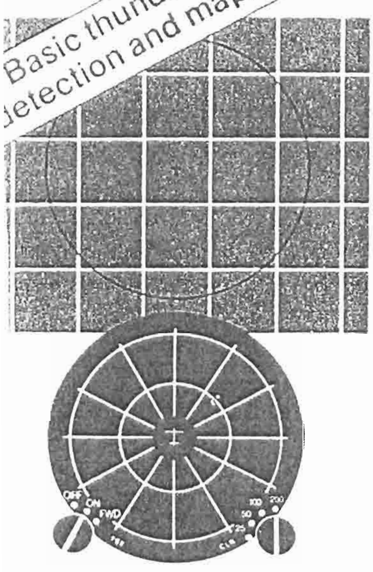
A-1 Randomly scattered dots Possible causes Turning electrical switches on or off atmospheric instability associated with cumulus clouds developing or dissipating thunderstorms etc If screen shows this situation push CLR button Watch screen for developing clusters of dots which indicate thunderstorm activity

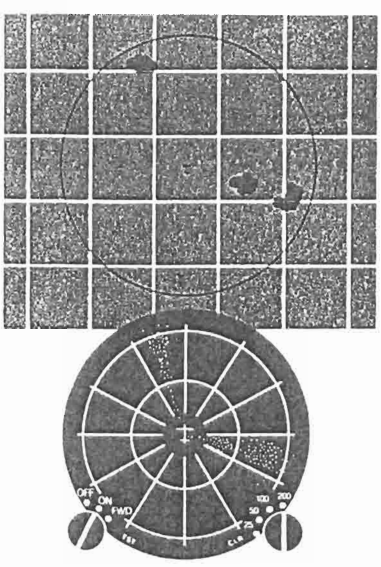
A-2 With range set at 25 nm, dot cluster appears at 8 30, centered about 14 nm from aircraft Electrical discharges close to aircraft, within 3 to 5 nm may cause splattering of dots Cluster is the primary concern Splattering indicates aircraft is too close to the thunderstorm Push CLR button then dots will cluster at thunderstorm location as new discharges occur

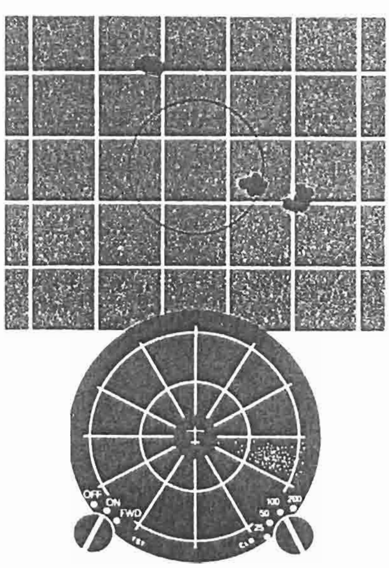
A-3 Dots just off the nose of the aircraft Possible causes Thunderstorm is just beyond the 220 nm range producing radial spread or distant electrical discharges arriving by atmospheric skip from a thunderstorm well beyond the instrument s range No cause for immediate concern Continue monitoring

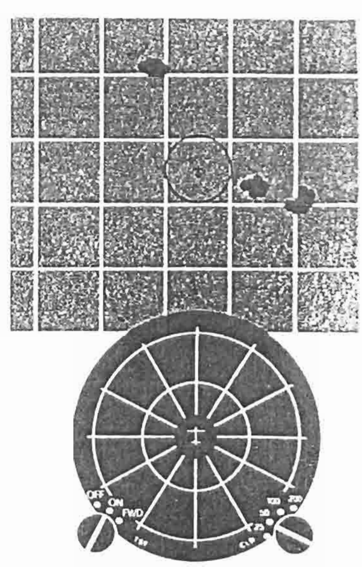
A-4 Concentrated clusters of dots appear across the screen while taxiing Can go all or part way across the screen Cause Underground cable beneath taxiway After aircraft has crossed the cable push CLR button

Basic thunderstorm detection and mapping.







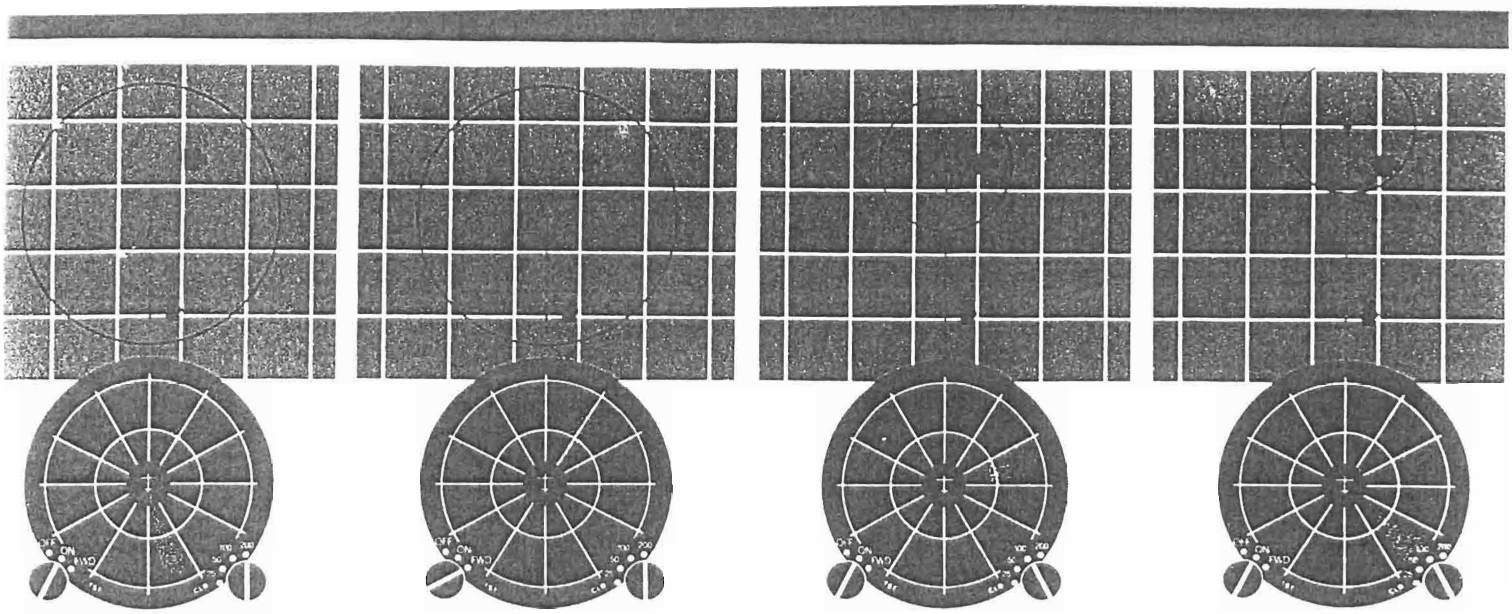


B-1 To test turn power/mode switch ON set range at 100 or 200 nm (test pattern appears at 25 or [illegible] ranges) Allow 30 seconds for warm-up then push TST button If functioning properly, a small cluster of dots appears at 1 30 and 100 nm (inner circle at 200 nm setting outer circle at 100 nm setting) Holding TST button in generates several dots per second Press CLR button after completing test

B-2 Three thunderstorms within 220 nm of aircraft One at 11 30 centered 180 nm two at 3 30, one centered 180 nm, one at 75 nm Each produces some radial spread Multiple discharges appear as concentrated clusters Thunderstorms at 3 30 have more dots than one at 11:30, indicating greater rate of occurrence and a more severe thunderstorm

B-3 Change range to 100 nm (Inner circle now 50 nm) Thunderstorm is mapped at 3 30 centered about 75 nm from aircraft Thunderstorms beyond 110 nm are not visible (Rate of occurrence is less on shorter ranges) Switch back to 200 nm range and view B-2 image if memory capacity permits (See page 8)

B-4 Change range to 50 nm No dots accumulate since no thunderstorms are within 55 nm of the aircraft Use a closer range for better definition of dot clusters within the inner circle Radial spread on long ranges will not necessarily appear on closer range settings



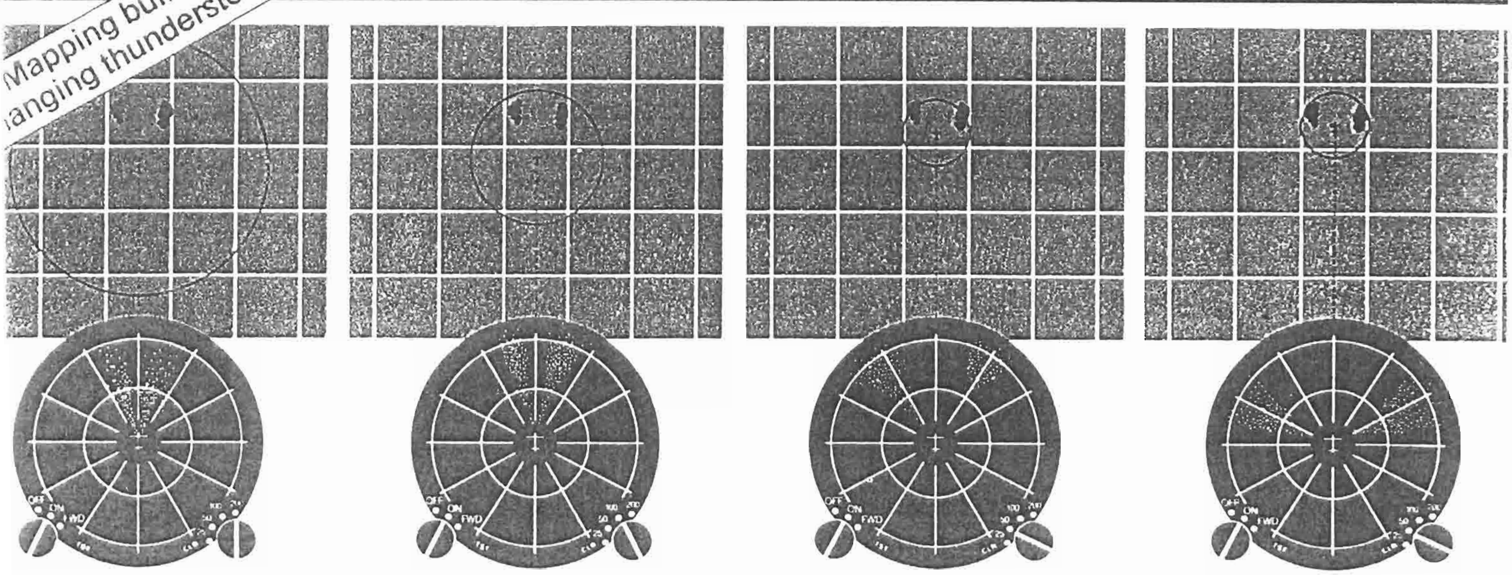
...shows weak thunder... at ...100 nm from ... severe thunderstorm at ... nm away. Fewer dots ... at the location ... thunderstorm indicate a ...

C-2 Turn power/mode switch to FWD. No change in range. Within about four minutes, all dots disappear from the 5:30 thunderstorm since it is now out of range. The weaker thunderstorm at 1:00 is mapped in greater detail since all 256 dots are available for activity in the forward 180°.

C-3 Change range selection switch to 100 nm. Turn power/mode switch back to ON to restore 360° view. Display indicates forward thunderstorm now at 2:30, centered about 55 nm from aircraft. Increased rate of occurrence and radial spread now indicate moderate intensity. (5:30 thunderstorm is beyond 100 nm range and does not appear.)

C-4 Aircraft has flown past ... storm activity. Thunderstorm previously at 2:30 now appears at ... about 90 nm away. The range selector can be changed to a longer range at any time to get an overview ... thunderstorm activity. (See page ...)

Mapping building/ ranging thunderstorms.



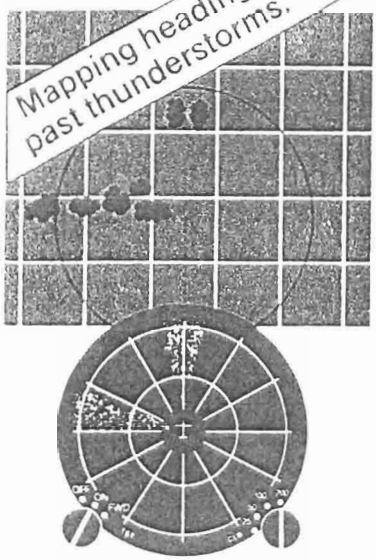
...range set at 200 nm, two ...ate thunderstorms appear at ...and 12:30. Each is approximately 25 to 30 nm wide. Each is ...ed about 90 nm from aircraft ... spread from each indicates ...e of moderate intensity.

D-2 Switch to 100 nm range for better definition of both thunderstorms. Aircraft has not moved significantly from D-1 to D-2. Dot clusters map opening of 40 to 45 nm between the two thunderstorms. (Each segment at the outer circle indicates about one-half the selected range.) (See page 3.)

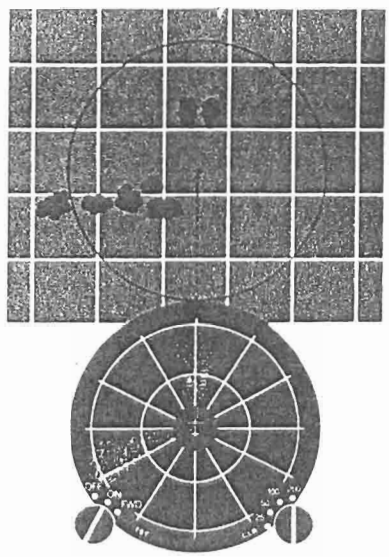
D-3 Range selection switch is turned to 50 nm. Aircraft has traveled about 50 miles since D-2. The thunderstorms display fewer dots on closer ranges. This does not necessarily mean decreased intensity. The thunderstorms are still about 40 to 45 nm apart, each is still 25 to 30 nm wide. Both thunderstorms are centered about 45 nm from the aircraft.

D-4 With range still set at 50 nm the thunderstorms now appear at 9:30 and 2:30, still about 40 to 45 nm apart. The thunderstorm mapping display indicates each thunderstorm is about 25 nm from the aircraft.

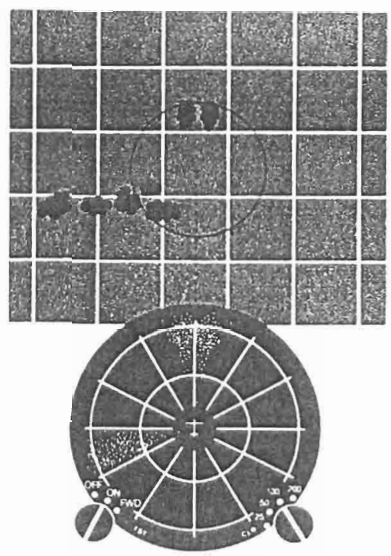
Mapping headings past thunderstorms.



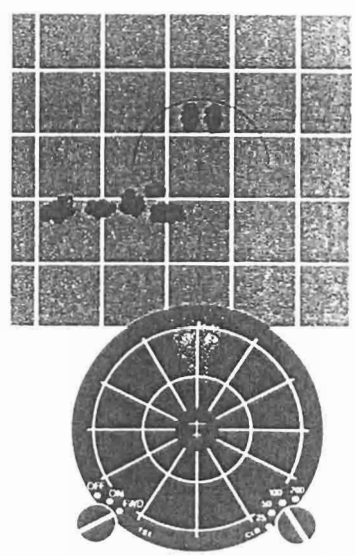
F-1 With range set at 200 nm, two severe thunderstorms appear almost as one cluster of dots off the nose of the aircraft centered about 180 nm away. A second cluster at 9 30 indicates a system which contains several severe thunderstorms. Thunderstorm conditions change rapidly. Avoid premature judgment when thunderstorms are mapped near the outer circle on the 200 nm range.



F-2 With the range still set at 200 nm, the aircraft has maintained its original heading and progressed about 100 nm. The two thunderstorms off the nose of the aircraft appear virtually as one. The line of severe thunderstorms previously at 9 30 now appears at 8 30.

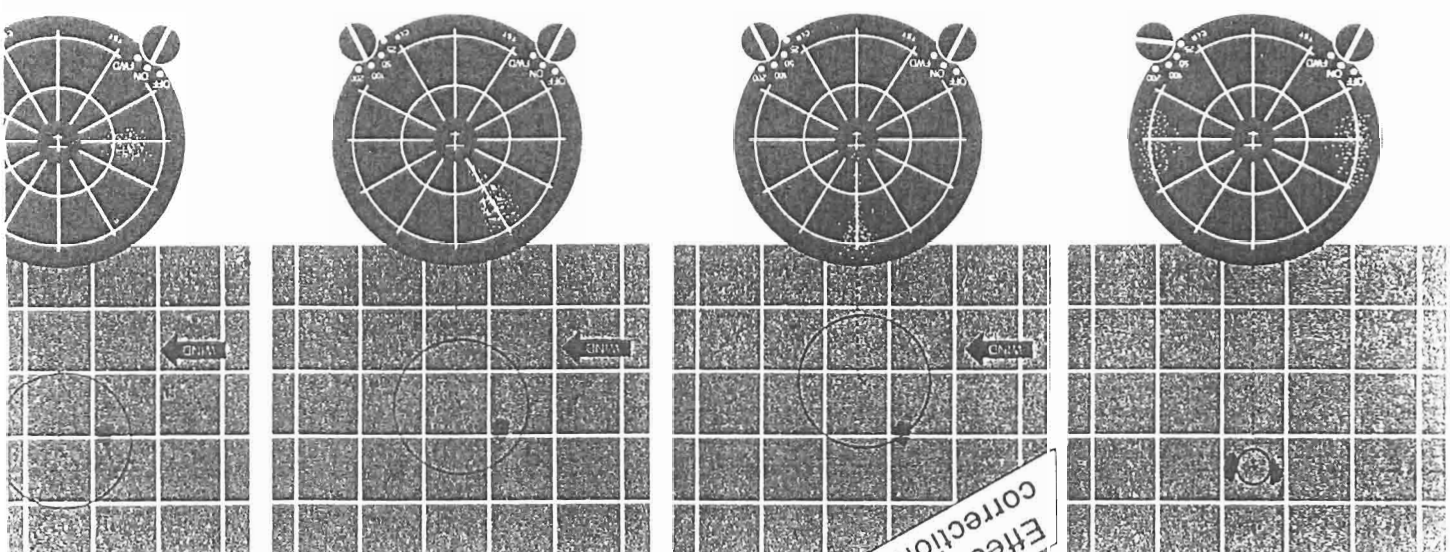


F-3 The range selection switch is turned to the 100 nm range to show greater detail of the thunderstorms. The thunderstorms off the nose of the aircraft now appear as two separate thunderstorms. The line of thunderstorms at 8 30 remains intense.



F-4 The power mode switch is turned to FWD for greater detail. The thunderstorms at 8 30 gradually disappear. The severe thunderstorm at 11 30 is centered about 90 nm from the aircraft. The thunderstorm at 12 15 is also about 90 nm away. Mapping information shows sufficient to choose a route around the thunderstorms. (NOTE: F-2, F-3 & F-4 occur over a short distance.)

Effects of wind-correction angle.



E-1 Range selection switch is set at 100 nm. Moderate thunderstorm is indicated at 12 00, about 90 nm from the aircraft. While the aircraft appears to be flying directly toward the thunderstorm, the airspace diagram indicates that the aircraft has a left crab angle for wind correction. (It is important to be aware of wind-correction angle.)

E-2 The aircraft maintains heading while approaching the thunderstorm. The cluster of dots now appears at 11 00, centered about 75 nm from the aircraft. The thunderstorm continues to be mapped in relation to aircraft heading, not ground track.

E-3 The thunderstorm centered about 60 nm from the aircraft appears at 9 00 on the dial due to wind-correction angle, although the aircraft has already passed the thunderstorm.

D-5 Range selection switch is turned to 25 nm. Thunderstorm activity now appears at 9 00 and 3 00 o'clock, centered about 25 nm from the aircraft. The thunderstorms display greater dots on the shorter range, but the intensity decreased in intensity. It is not always safe to pass this close to thunderstorms.)

MODEL WX-10A SPECIFICATIONS

Proven technology. Improved definition.

Input voltage	10-30 v DC
Power requirement	28 w (max)
CRT screen size	2⅝ in dia
Operating range	Switch-selectable— 25 50 100 200 nm Max range—220 nm
Operating azimuth	Normal—360° Forward mode—180°
Weight	
Computer-processor with tray	5 3 lb (2 4 kg)
Display with tray	3 0 lb (1 4 kg)
Antenna	2 0 lb (0 9 kg)
Total	10 3 lb (4 7 kg)
Dimensions	
Computer-processor	2 25 in x 7 63 in x 12 9 in (5 7 cm x 19 4 cm x 32 8 cm)
Display	3 19 in x 3 19 in x 9.22 in (8.1 cm x 8.1 cm x 23.4 cm)
Antenna	1 30 in x 5 00 in x 9.50 in (3.3 cm x 12.7 cm x 24 1 cm)

PARTS AND SERVICE WARRANTY

We stand behind the materials and workmanship of 3M "Stormscope" Systems.

3M Stormscope Weather Mapping Systems are warranted against defects in materials and workmanship for one year from the date of original 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 Stormscope Systems dealer

LS RSSOM10-A 742 0U O

Litho in USA with 3M offset plates film and proofing systems

3M "Stormscope"
Traffic Control Products
3M UK P.L.C. 3M House
P.O. Box [illegible] Bracknell, Berkshire RG12 [illegible]
Tel: 0344 [illegible]