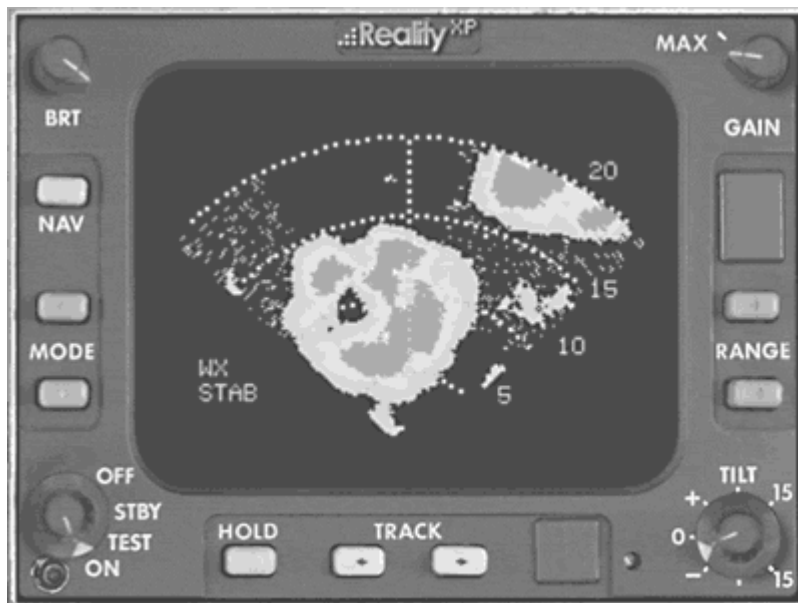


Reality XP Wx500 Radar

User's Manual



This manual is intended for Flight Simulation use only, and may not be used in any real world aviation applications. The authors are not responsible for any errors or omissions. This manual may be printed out by the user or at the user's request by a commercial print shop. This authorization is provided by the publisher of this product.

About this manual

This manual is intended for flight simulation purposes only, and shall not be used for any real world aviation application or reference.

This manual is intentionally written using “gray scale” colored text in many areas, and much of the print is intentionally this medium gray color. This has been done to conserve ink while printing. In some cases “black” type has been used for emphasis. Photographs used in this manual have also been reduced to black and white, and also in contrast in order to conserve ink. Please be sure to double-check your printer’s settings prior to printing in order to achieve the best results. We have tested, and experienced no issues printing this manual on laser printers. If you are experiencing a problem using a laser printer, you should check the printer’s quality settings.

By reading this manual you should become well acquainted with the product, and should be able to obtain the information necessary to “fly” the product within Flight Simulator.

Please take the time to read this manual completely; so that you can become properly acquainted with the product and its operation.

We thank you for having chosen a Reality XP Product and wish you a pleasant and a safe virtual flight with us.

Important information

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Standard Disclaimer

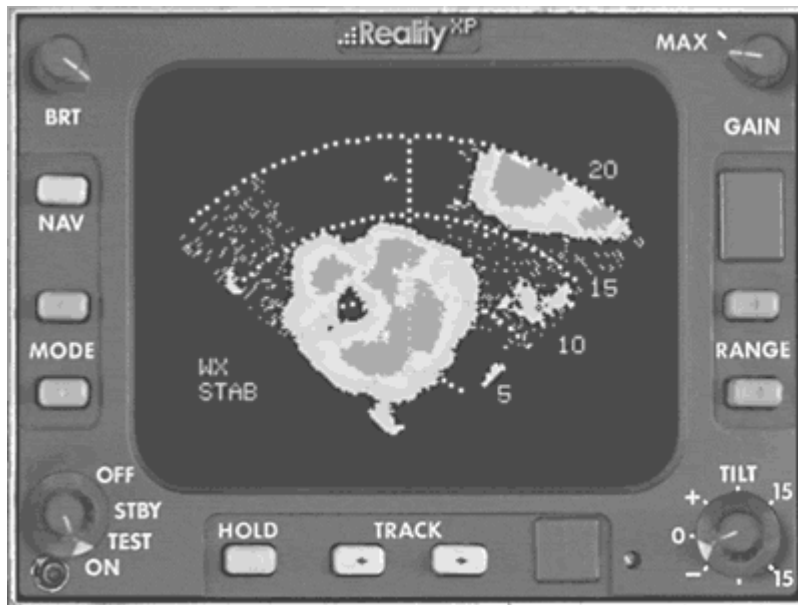
This software is designed **for entertainment only**. Although we have designed the product to resemble and function like the original, it is not designed as a training device. Not all systems have been simulated, and some of those that have been simulated may not be entirely functional.

NOT FOR USE IN REAL FLIGHT OR AIRPLANE OPERATION.

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Flight Line Wx500 overview



For the discriminating pilots, Flight Line Wx500 is a unique and innovative solution brought to you by Reality XP. Modeled after today's real world avionics, it is a modern Onboard Weather Radar based on a state of the art technology. The Flight Line Avionics products are unequalled in providing the features, levels of performance and reliability that flight simulation users require. The Reality XP Flight Line Avionics sets a new higher standard to which all other Avionics Simulations will be compared.

The Flight Line Wx500 is a comprehensive Onboard Weather Radar Simulation accurately modeled from real world radar physics and simulated weather scenarios in Flight Simulator. With its unique real-time rendering technology and true to life graphics, the Flight Line Wx500 offers a solid foundation to understanding and using modern onboard weather radar.

With Flight Line Avionics, you'll be flying a simulated avionics package capable of providing the same features and benefits as the real avionics. The Reality XP Wx500 package is so realistic that pilots can use it as a training tool to familiarize themselves with the workings of the actual equipment. Each button and knob is fully functional and performs identically to its real-world counterpart.

Important information for customers of a previous version

The Flight Line Wx500 2005 is a major upgrade from previous versions. Several configuration settings may work differently.

Prior to installing the Flight Line Wx500 in an aircraft with the Wx500 Config application, it is recommended to remove any previous installations with the EZConfig program. The EZConfig program locates the v2.x installations and is installed in the following folder:

```
[fs9]\RealityXP\Flight Line Wx500\obsolete\
```

Additional information

After installation, a new program group is accessible from your Windows Start Menu \ Reality XP. This program group contains the necessary utilities and documentation. Make sure you review all available documentation.

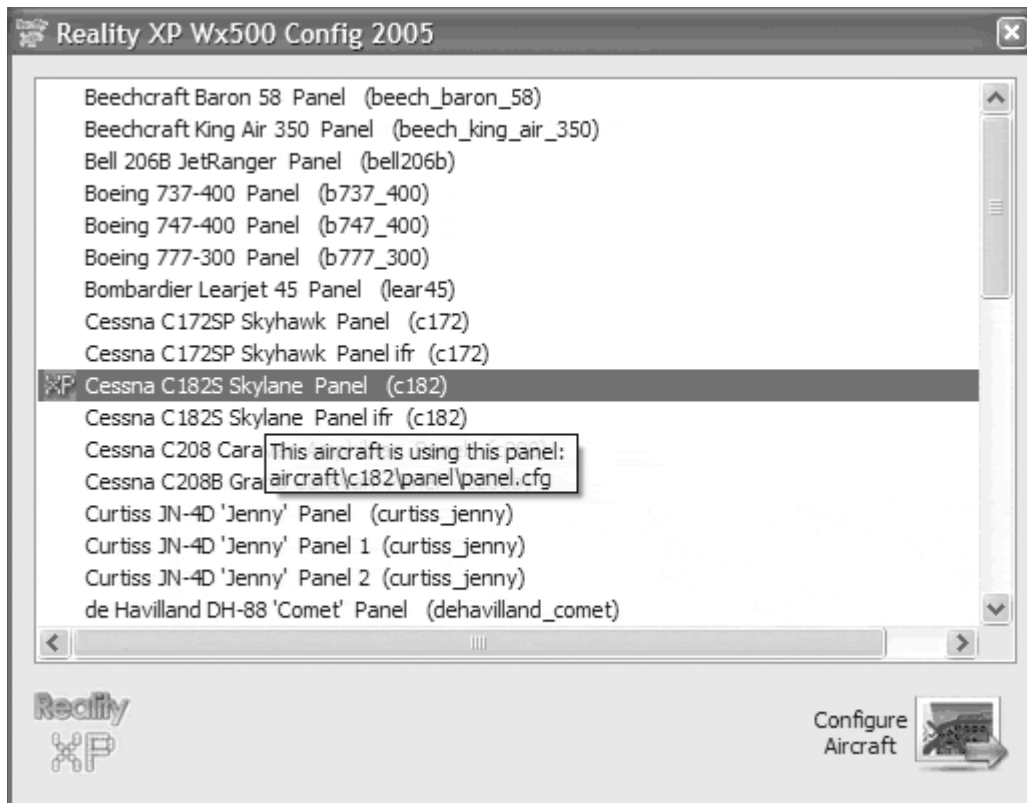
Please take the time to read all manuals completely; so that you can become properly acquainted with the product and its operation.

Getting Started

The Wx500 is a Flight Simulator compatible gauge and can be configured in any Flight Simulator aircraft panel. The software package includes an easy to use configuration program to assist with integration and configuration: Wx500 Config.

When first started, Wx500 Config detects and prompts you with all available aircrafts and panels with the “select an aircraft” panel. Flight Simulator has an open architecture that permits several aircraft to share the same panel, and the selected aircraft can use different panel configurations. Not all available aircraft and panels configurations are listed in the “select an aircraft”: Apollo Config lists only the unique combinations of both aircraft and panels.

NB: Wx500 Config operation, advanced panel integration and Wx500 gauges settings are covered in separate documents. Make sure to review the complete documentation located in your Windows Start Menu / Reality XP program group.



General features

All of the Reality XP gauges and controls utilize a relatively unique implementation of click spots. They work as follows:

1. As your mouse cursor passes over a click spot on the panel it will cause it to turn from an arrow cursor into a “hand” cursor. There are no + or - click spots: the hand cursor will be empty.
2. Whenever a single click spot is used, and depending upon its function a left click will accomplish the same task as a right click. In other cases, a left click will accomplish one task, while a right click will accomplish another.
3. In some cases the click spot will not function as stated above, but instead will feature separate functions for the left and right clicks. Example: For a toggle switch with 3 positions, a left click will move the switch in one direction, while a right click will move it in the opposite direction.
4. Certain click spots will work with left and right clicks, and the mouse wheel, if your mouse is so equipped. This type of click spot is used on gauges that require adjustment, such as the knobs, etc. In this case the left click turns the item “left” and a right click turns it “right”. Forward / back scrolling on your mouse wheel will also do the same.

Tool-tips

By turning on FS “Tool Tips” you will see descriptions of these clicks spots when your mouse cursor is placed over them.

Gauges settings

The gauges can be configured for a variety of panel/aircraft situation. These features are designed to get the most out of Flight Simulator.

Configuration File

Wx500 Config provides a graphical user interface to most of the settings provided for the Flight Line Wx500. These settings are configured with files located in:

[fs9]\RealityXP\Common\Settings\

Refer to the additional Wx500 Service Manual (located in your Windows Start Menu \ Reality XP program group) for additional details and configuration options.

Introduction to Weather Radar

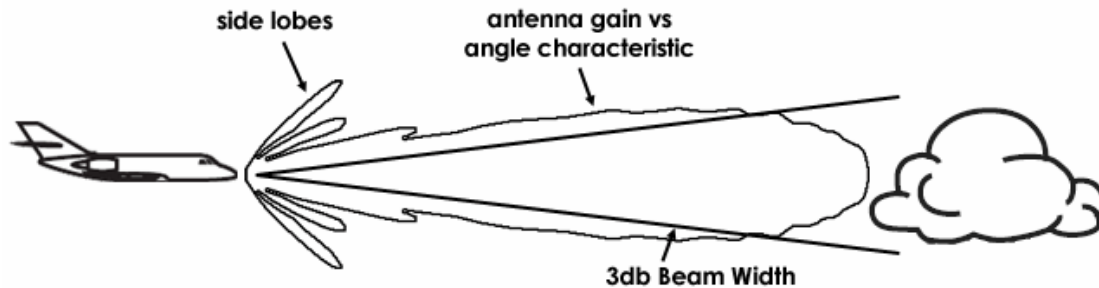
The primary use of this radar is to aid the pilot in avoiding thunderstorms and associated turbulence. Each owner/operator normally develops their own operational procedures for use of weather radar in conjunction with the manufacturer's recommendations. The following information is presented to assist the FS user in getting the most out of this gauge. Operational techniques for the Flight Line Wx500 are similar to earlier generation weather avoidance radars where the proficient operator manages the antenna tilt control and gain to attain the best awareness of the storm threats by analyzing the height, size, and relative direction of movement.

Radar is fundamentally a distance measuring system using the principle of radio echoing. The term RADAR is an acronym for Radio Detecting and Ranging. It is a method for locating targets by using radio waves. The transmitter generates microwave energy in the form of pulses. These pulses are then transferred to the antenna where they are focused into a beam. The radar beam is much like the beam of flashlight: the energy is focused and radiated by the antenna in such a way that it is most intense in the center of the beam and the intensity decreases close to the edge. The same antenna is used for both transmitting and receiving. When a pulse intercepts a target, the energy is reflected as an echo, or return signal, back to the antenna. From the antenna, the returned signal is transferred to the receiver and processing circuits located in the receiver transmitter unit. The echoes, or returned signals, are displayed on an indicator.

Weather Radar Principle

Airborne weather avoidance radar, as its name implies, is for avoiding severe weather, not for penetrating it. Whether to fly into an area of radar echoes depends on echo-intensity, spacing between the echoes, aircraft capabilities and pilot experience. Remember that weather radar detects only precipitation drops; it does not detect minute cloud droplets, nor does it detect turbulence. Therefore, the radar provides no assurance of avoiding instrument weather in clouds and fog. The indicator may be clear between intense echoes; this clear area does not necessarily mean it is safe to fly between the storms and maintain visual sighting of them.

Probably the most important aspect of a weather radar is the antenna beam illumination characteristic. To make a proper interpretation of what you are seeing on the display, you must have an understanding of what the radar beam "is seeing". The following figure is a side view of the radar beam characteristic with a storm depicted at a distance. The size of the storm causes it to just fill the 3 dB beam width. It's important to understand and visualize this situation, in order to enhance your understanding of the content of this manual. First some observations are in order:



Note that the antenna gain versus angle characteristic is a continuous function at all angles. This means that there is a gain value associated with all forward angles relative to the selected tilt angle. In this figure the tilt angle is shown as zero degrees. This means the beam center is along the same angle as the aircraft flight angle. Next, the points on either side of the beam where the antenna gain is down 3 dB relative to the maximum gain defines the 3 dB beam width. The remainder of the manual uses the cone shaped 3 dB beam width extensively to illustrate how the beam spreads with distance, much like a flashlight beam. Note that there are small side lobes characteristically at fairly large angles to the main beam.

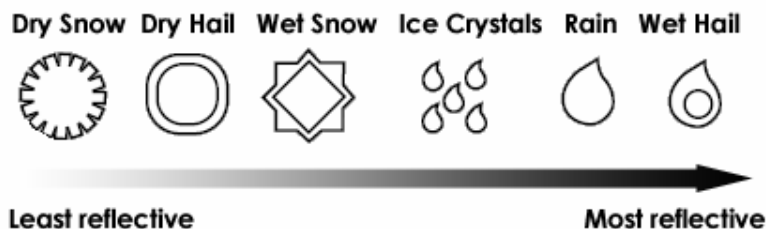
The cone formed by the 3 dB beam width is where most of the radar energy is concentrated, so it is important to realize that at any given time whatever is within this cone (and sometimes other strong targets like clutter outside the cone) is what is being painted on the display. The pilot should be aware of how wide this cone is as a function of range. The primary target of interest is obviously weather cells of significance. The typical cell is considered to be 3 nm in diameter.



Flight Line Wx500 models a simplified antenna gain continuous function with a fairly accurate 3db beam width. It does not model side lobes.

What target will reflect the radar's pulses and thus be displayed on the indicator? Only precipitation (or objects more dense than water such as earth or solid structures) will be detected by an X-band weather radar. Therefore weather radar does not detect clouds, thunderstorms or turbulence directly. Instead, it detects precipitation which may be associated with dangerous thunderstorms and turbulence. The best radar reflectors are raindrops and wet snow or hail. The larger the raindrop the better it reflects. Because large drops in a small concentrated area are characteristic of a severe thunderstorm, the radar displays the storm as a strong echo. Drop size is the most important factor in high radar reflectivity. Generally, ice, dry snow, and dry hail have low reflective levels and often will not be displayed by the radar.

A cloud that contains only small raindrops, such as fog or drizzle, will not produce a measurable radar echo. But if the conditions should change and the cloud begins to produce rain, it will be displayed on radar.



Due to limitations of the Flight Simulator Weather Engine, the Flight Line Wx500 may not display an accurate picture for every possible weather condition. It however is accurate enough for building solid training and understanding foundations of weather radar operation.

Weather Attenuation Compensation

An extremely important aspect that the operator of a weather avoidance radar system must understand is the significance of attenuation. When a radar pulse is transmitted into the atmosphere, it is progressively absorbed and scattered so that it loses its ability to return to the antenna. This attenuation or weakening of the radar pulse is caused by two primary sources, distance and precipitation. The Flight Line Wx500 models Weather Attenuation Compensation as well as radar advanced features which significantly reduce the effects of attenuation. It is therefore up to the operator to understand the radar's limitations in dealing with attenuation.

Attenuation is affected by distance. This is because the radar energy leaving the antenna is inversely proportional to the square of the distance. The displayed effect is that as the storm approaches, it will appear to be gaining in intensity. To compensate for the attenuation caused by distance the Sensitivity Timing Control (STC) and Extended STC circuitry are simulated. The Flight Line Wx500 has an STC range of 0 to approximately 20 nautical miles. The radar unit will electronically compensate for the effects of distance attenuation and the net effect is that targets do not appear to change color as the distance decreases.

Outside the STC range the Extended STC circuitry increases the displayed intensity to more accurately represent storm intensity. Attenuation due to precipitation is far more intense and is less predictable than attenuation due to distance. As the radar pulses pass through moisture, some radar energy is reflected. But much of that energy is absorbed. If this beam has been fully attenuated the radar will display a "radar shadow" which appears as an end to the precipitation when, in fact, the heavy rain may extend for many more miles. In the worst case, precipitation attenuation may cause the area of heaviest precipitation to be displayed as the thinnest area of heavy precipitation. It may cause one cell containing heavy precipitation to totally block or shadow a second heavy cell located behind the first cell and prevent it from being displayed on the radar. Never fly into radar shadows and never believe that the full extent of heavy rain is being seen on radar unless another cell or a ground target can be seen beyond the heavy cell. Proper use of the antenna tilt control can help detect radar shadows.

Introduction to Weather Interpretation

This section contains general information on use of radar for weather interpretation. Review of this information will assist the operator in using radar.

The Flight Line Wx500 can give you a clue to the presence of turbulence. Areas of the display where the colors change rapidly over a short distance represent steep rainfall gradients, which are usually associated with severe turbulence. Turbulence may be divided into two basic types: (1) clear-air turbulence; and (2) turbulence associated with thunderstorms and precipitation. The latter is most common. It is with this type that weather radar is most helpful to the pilot. It is not possible to detect clear air turbulence with this type of radar system. Weather guidance is now available from ground radar stations in some areas. However, this system suffers in comparison with the airborne weather radar where the weather is clearly visible on the pilot's indicator, instantly available for the pilot to act upon, considering his immediate circumstances and future flight planning. The strong up and down drafts in a thunderstorm create very large raindrops which are usually displayed on a radar as level 3. The probability of turbulence in these strong vertical gusts is great. The National Severe Storms Laboratory (NSSL) has found that the intensity level of the precipitation reflection correlates with the degree of turbulence found in a thunderstorm. The most severe turbulence in the storm, however, may not be at the same place that gives the greatest radar reflectivity.

The rate of change in rainfall rate laterally within a storm is called the rain gradient. This change will appear on the indicator as a change from green to yellow to red. Areas of the display where colors change rapidly over a short distance represent steep rainfall gradients. These are usually associated with severe turbulence. Avoid any storm with a steep rain gradient by an extra margin and especially avoid flying near the portion of the storm with the steepest gradient.

Thunderstorm Avoidance

Above all, remember: Never regard any thunderstorm as LIGHT, even when radar observers report the echoes are of light intensity. Avoiding thunderstorms is the best policy:

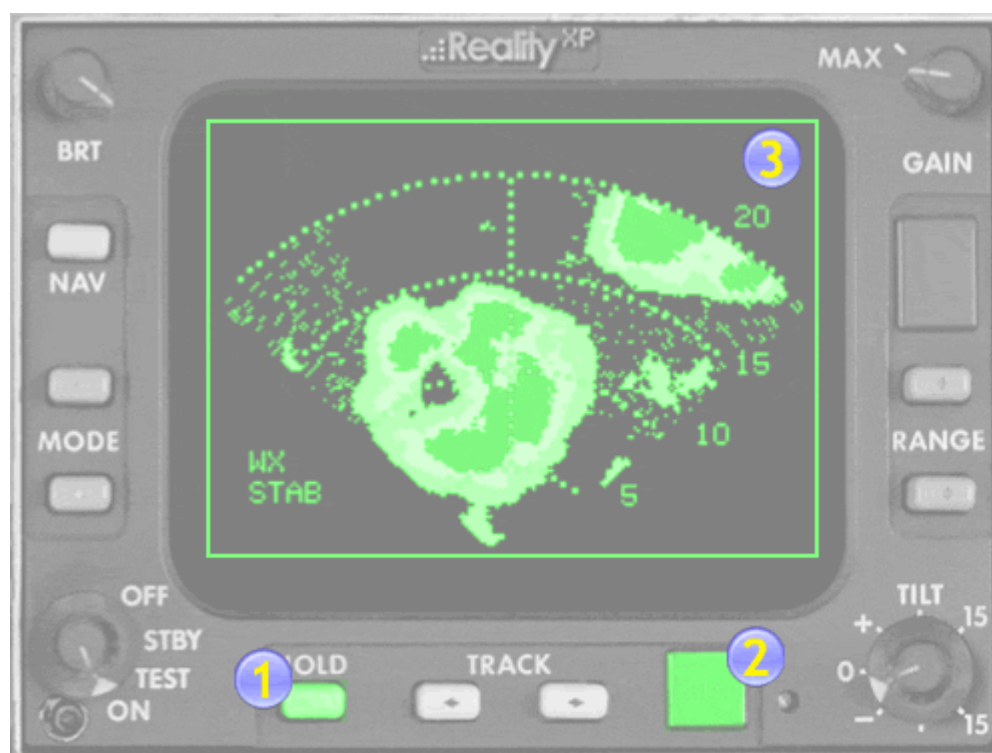
- DON'T attempt to plan a course between closely spaced echoes.
- DON'T land or take off into a thunderstorm. A sudden wind shift or low level turbulence could cause loss of control.
- DON'T attempt to fly under a thunderstorm even if you can see through to the other side. Turbulence under the storm could be severe.
- DON'T try to navigate between thunderstorms that cover 6/10 or more of the display. Fly around the storm system by a wide margin.
- DON'T fly without airborne radar into a cloud mass containing scattered embedded thunderstorms. Scattered thunderstorms not embedded usually can be visually circumnavigated.
- DO avoid by at least 20 nautical miles, any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.
- DO clear the top of a known or suspected severe thunderstorm by at least 10,000 feet altitude. This may exceed the altitude capability of the aircraft.
- DO remember that vivid and frequent lightning indicates a severe thunderstorm.
- DO regard any thunderstorm with tops 35,000 feet or higher as severe whether the top is visually sighted or determined by radar.

Operation with Flight Simulator

This section covers detailed information about the enhanced features that the gauge offers when running with Flight Simulator.

Special Click spots

Special click spots located on the gauge bezel enhance some of the Flight Line Wx500 functions. The following illustration show their locations:



1- Stab Mode toggle: Controls the Tilt 0 degrees reference. When set to On the Tilt 0 degrees is in relation to the horizontal. When set to Off the Tilt 0 degrees is in relation to the aircraft pitch. NB: When stabilized, the radar does not simulate gimbals limits.

2- Easy Mode toggle: When set to On, the radar simulation is based on a simpler model and provides a top-down view of the actual weather conditions, regardless of the Tilt setting. WAC and Radar Shadows are eliminated.

3 - Popup: The click spot toggles the popup window. The Left and Right mouse buttons operate two different popup idents when configured in the RXPWX500.INI file. Wx500 Config automatically configures the click spot for proper operation.

Controls



ON: selects the normal condition of operation for weather detection and/or other modes of operation. The system will transmit after a 5 seconds warm-up time is completed. The radar system initializes the Wx mode at 80nm.

TEST: in this mode the multicolored arc displays a test pattern. The test pattern (typical 3 color) is initialized and sized to fit the display. No radar transmissions occur while TEST is selected.

STBY: fully energizes the system circuitry but no radar transmissions occur.

OFF: removes all power from the radar unit.



BRT: controls brightness of the indicator display (CW rotation for max brightness).



Gain: the gain knob adjusts the radar gain from 0 to -20db (CCW rotation reduces gain).



Wx mode selection: opens a menu screen to select between the Wx (weather), WxA (weather alert) and Map modes of operation. Wx, WxA or Map will appear in the lower left of the display. Colors are Black for no returns, Green for weak returns, Yellow for moderate returns, and Red for heavy returns. When the WxA mode is selected, Red areas of storms flash between red and black. Map mode selects an alternate sensitivity scheme to enhance the ground returns (Flight Line Wx500 does not include an elevated earth surface model and considers the world flat).



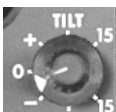
RANGE: clears the display and advances the indicator to the next range. The upper button increases range, the lower button decreases it. The Wx500 display ranges are: 20, 40, 80 nm. The selected range is displayed in the upper right corner of the display with the range ring distance displayed along the right edge.



HOLD: suspend the radar beam in its last position and freezes the display. Pressing Hold again resumes normal operation.



TRACK: provides a yellow track centerline for horizontal profile. With the radar on and a track button pushed, the track line position moves left or right in 1 degree increments. The track line is automatically removed from the display after a 10 seconds interval.



TILT: permits manual adjustments of antenna tilt 15° up or down for best indicator presentation. When the Wx500 is configured in the Vertical Stabilization mode, the tilt angle range is relative to the horizontal. When the Stabilization mode is disabled, the tilt angle range is relative to the aircraft pitch angle.

Flight Simulator Interface and Settings

The Flight Line Wx500 is closely integrated to the Flight Simulator Weather engine simulation. For best results, it is recommended that you understand the following features and limitations:

Radar Range: the Flight Line Wx500 detection range capability is directly affected by the Flight Simulator “cloud draw distance” setting. The greater the Flight Simulator range, the better the detection in the large scales.

Radar Detection: the Flight Line Wx500 detection level is directly affected by the number of 3D clouds simulated and displayed. For best results, it is recommended to set the following parameters in Flight Simulator Option/Display/Weather settings:

- Cloud Draw Distance: from 40 to 80nm
- 3D cloud percentage: 100%
- Cloud detail: detailed clouds
- Cloud coverage density: a minimum of Medium



When 3D cloud percentage setting is *100%*, it forces Flight Simulator to exclusively use 3D shaped volumetric clouds. It greatly enhances the capability of the Wx500 to detect water in the distance.

Set “detailed clouds” to a minimum setting of *medium* as this forces Flight Simulator to display the cloud shapes closer to the actual weather condition it is trying to simulate. This greatly enhances the experience.

Note that the factor affecting the performance the most is the Cloud Draw Distance, which exponentially affects the number of displayed clouds. The other settings do not affect the number of displayed clouds. They only affect the complexity of their displayed shape.

Operation in-flight

The Flight Line Wx500 provides weather avoidance information with greater clarity than any previous generation weather avoidance radars. The purpose of this section is to help you get acquainted with the radar and used to interpreting the display so that you can get the maximum benefit during your flying. Your proficiency will only improve with usage. Hence, we recommended that you become familiar with the operation of the system during fair weather instead of while trying to penetrate a storm front.

In previous sections of this User's Manual we have described the various controls and discussed the features of the radar system. This section gives a more detailed discussion of some of these controls and how to make the most benefit from them. Note: Your radar is a weather-avoidance device. It will help you see the weather ahead and will assist you in planning the best routing to avoid any significant conditions in your path.

Tilt Management

Management of the antenna tilt is the single most important function performed by the pilot to ensure that the radar depicts the weather in front of the aircraft as accurately as is possible in order to assist in making good tactical decisions:

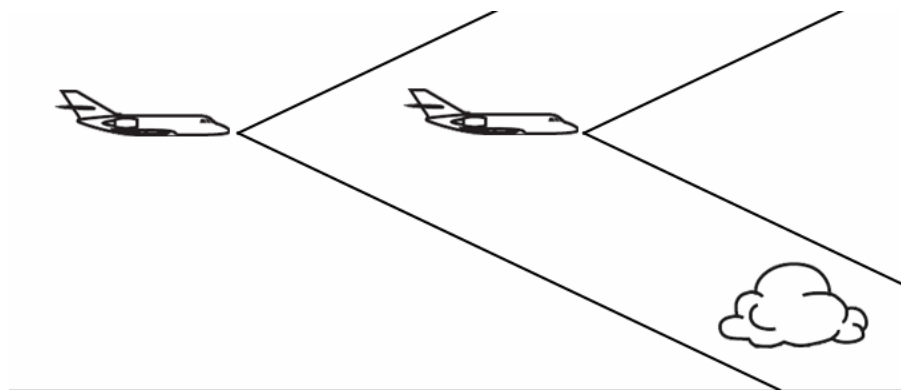
- The earth's curvature must be considered in determining the location of the beam at long distances.
- The center of the radar beam is referenced to the horizon by the aircraft vertical reference system.
- Adjusting the antenna tilt control will cause the center of the radar beam to scan above or below the plane of the attitude reference system.

Simply, a low setting will result in excessive ground or sea returns while too high a setting (although excessive returns are eliminated) can result in the radar beam passing over the top of a weather target.

For detecting weather targets at long ranges and to allow adequate time for planning the proper avoidance path, the tilt angle should be set for a sprinkle of ground target returns on the display. By slowly raising the tilt angle, weather targets will emerge from the ground returns because of their height above the ground. In order to minimize ground returns when closely examining weather targets below the aircraft flight level, select the shortest range that allows full depiction of the area of interest.

Over Scanning and Tilt Management

When flying at high altitudes, the use of proper tilt management ensures observation of weather targets without over scanning. For example, a low altitude storm detected on the long range setting may disappear from the display as it is approached. While it may have dissipated during your approach toward the storm, don't count on it. It may be that you are directing the radiated energy from the antenna above the storm as you get closer. Judicious management of the antenna tilt control will avoid over-scanning a weather target.



General Operation

Follow these steps to adjust the antenna tilt to optimize the radar's capability to identify significant weather:

1. Select the WX (weather) mode of operation and adjust the Brightness control as desired.
2. Select the 40 or 80 nm range.
3. Adjust the antenna tilt control down until the entire display is filled with ground returns.
4. Slowly work the antenna tilt up so that ground returns are painted on or about the outer one third of the indicator area.
5. Watch the strongest returns on the display. If they become weaker and fade out as the returns move to the near limit of the ground return pattern, then they are probably just ground returns or insignificant weather. If, on the other hand, the returns continue strong after moving down into the lower half of the indicator then you are approaching a potential hazardous storm or storms and should take evasive action immediately.
6. Examine the area behind strong targets. If radar shadows are detected you are approaching a hazardous storm or storms and should deviate immediately, regardless of the aircraft's altitude. If weather is being detected, move the antenna tilt control up and down in small increments until the return object is optimized. At that angle, the most active vertical level of the storm is being displayed.

Separation of Weather and Ground Targets

One of the most difficult tasks when using airborne weather radar is separating weather targets from ground targets. This is especially true since the maximum return from a storm cell occurs when the radiation beam is centered on the rainfall shaft. In many cases, this shaft may be no higher than 5,000 feet thus requiring some antenna down tilt to observe it. If you are flying at an altitude considerably above this, the antenna beam will also intersect the ground, thus masking the storm cells with ground targets. Proper adjustment of the antenna tilt will assist you in target separation.



Significant weather will exhibit a stronger return than ground return at shallow angles.

Notice the *Radar Shadow* behind the red cells as shown from no ground returns in the far side of the displayed cell.

Raising the antenna tilt until a weather target emerges from the ground returns.

Shadowed Areas

Extremely heavy rainfall can reduce the ability of the radar energy to penetrate a weather cell and present a complete picture of the weather area. This condition is referred to as “radar attenuation”. Under these conditions ground returns can be helpful in analyzing the weather situation. Tilt the antenna down and observe the ground returns around the displayed cell. If no ground returns are displayed on the far side of the displayed cell (shadowed area), heavy rain may be blocking the radar energy. This could mean that a larger area of precipitation exists than that which is displayed.

WARNING: AVOID AND NEVER PENETRATE A SHADOWED AREA.

Product Support

You should read this manual, and the others included with this product from cover to cover before asking for support or help with this product. We have found that over 95% of all product support questions can be answered by reading the manual.

You can visit the Reality XP General Forum for general customer service issues at:

<http://www.reality-xp.com/community/users.htm>

While anyone may read this support forum, you will need to register in order to post a question or reply with an answer. Support at this forum may be provided by any one of the following individuals:

1. Members of the Development / Publishing Team.
2. Members of the product's beta testing team.
3. Knowledgeable users of the product who know the correct answer.

If you still require help: Product support is available through our online help system. Please visit <http://www.reality-xp.com> for additional support information.

Thank you.