pcas | Portable Collision Avoidance Systems

XRX

Range | Altitude | Bearing

Owner's Manual

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Portable Collision Avoidance System (PCAS)
Model XRX Owner's Manual

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Introduction

Thank You

Congratulations on your purchase of the Zaon XRX. This unit incorporates fourth-generation PCAS™ technology in a compact feature-filled unit. PCAS, or Portable Collision Avoidance System, is the technology developed exclusively by Zaon Flight Systems that makes this unit possible.

XRX offers many other innovative elements, and first-time users may encounter a slight learning curve. Every effort has been afforded to provide a concise manual with clear, comprehensive explanations of all features.

We are pleased to offer you the latest in avionics technology, designed for your personal protection. After reading the manual through, should you have any questions or concerns, we look forward to hearing from you.

Sincerely,

Zaon Flight Systems, Inc.
Avionics Research & Development

Please read through this manual in its entirety and completely familiarize yourself with XRX features before operating the unit.

Cautions & Warnings

As with all collision avoidance devices, XRX may not detect all aircraft within the detection window.

- XRX is not recommended as a substitute for proper traffic scanning procedures as listed in the FAA Airman's Information Manual and under the "See and Avoid" concept presented in FAA AC90-48C. This unit is intended as an additional tool in determining potential traffic threats.

- NEVER operate the unit with a headset, or any other audio components, at high-volume levels. Hearing experts advise against continuous high-volume operation. Should you experience a ringing in your ears, immediately reduce the volume level or discontinue use.

- Until you are familiar with the operations and limitations of this unit, abrupt changes in the control of the aircraft should be avoided unless positive identification with the traffic is made, or you have been ordered to do so by the

Air Traffic Controller. The FAA, their representatives, as well as published airspace regulations, always supersede any indication given by this unit.

- NEVER connect unit to an AC outlet. This may pose a fire hazard or result in an electric shock. NEVER connect the unit to a power source of more than 40V DC. Such a connection will harm the receiver and poses a fire hazard. NEVER connect a non-fused, external power source to the unit. This may result in damage to the unit and may pose a fire hazard. DO NOT connect the unit to any power source using reverse polarity. Doing so may also damage the unit. Follow the guidelines in this manual explicitly when connecting to an external power source.

- NEVER expose the unit to rain, snow or any liquid. Avoid placing the receiver in excessively dusty, hot, or cold environments. DO NOT use or place unit in areas with temperatures below -20°C (-4°F) or above +55°C (130°F).

- AVOID the use of chemical agents such as benzene or alcohol when cleaning, as they damage the unit surfaces.

Manual/Unit Differences

The photos and illustrations in this manual may vary slightly from your unit. These differences are aesthetic only and should not change the functionality of your unit. From time to time, slight modifications are made for any number of reasons, and Zaon reserves the right to make these modifications without prior notification to customers.

The latest manual will be available online at www.zaonflight.com for downloading if revisions are issued. Refer to the version number inside the front cover of this manual.

The information contained in this manual, including numbers and figures, are subject to change without prior notice.

Setup

XRX At-A-Glance

- "3-D" view Quadrant Direction, 45° increments

- Digital range, scalable from 6NM to 1NM

- Relative altitude, scalable from ±2500 ft to ±500 ft, with ascending/descending indicator

- Multiple traffic information

- Menu-driven interface, with selectable aircraft profiles and advanced calibration options

- A built-in altimeter, a built-in compass, and a built-in turn/bank sensor, and internal thermometer provide the highest, real-time accuracy available

- Displays the local squawk code, altitude, bank angle, bearing and temperature

- Audio voice alerts for threats and advisories are included, with both Headset-Direct™ hookup and in-cabin output, as well as RS-232 out for integration with other systems.

- An upgrade path to an installable system will be available
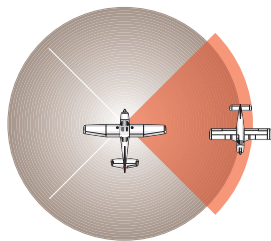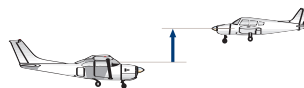
Quadrant Bearing · Relative Altitude + Trend · Digital Range
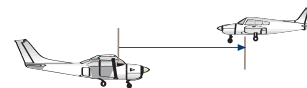
Controls & Functions
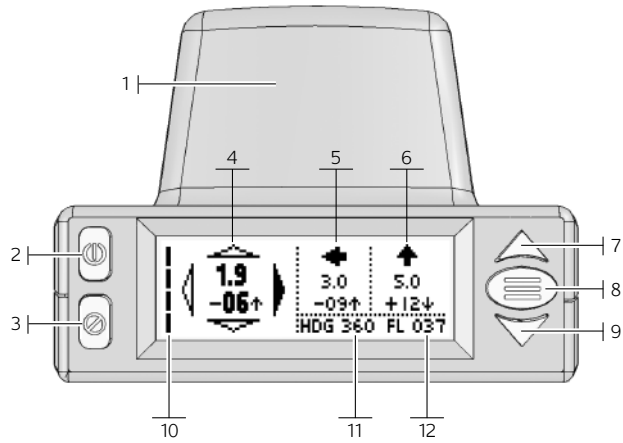
Front View

Rear / Bottom View

Unpacking

Your XRX system contains everything you need for basic operation right out of the box. If any listed items are missing, please contact Zaon directly for replacement (see Appendix: Customer Service).

Placement Considerations
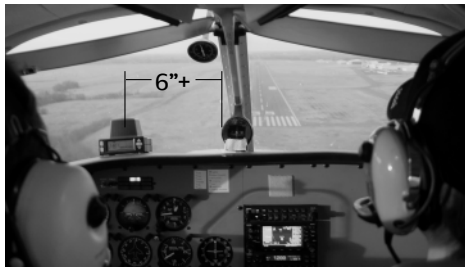
The preferred placement for XRX is on the glareshield, above the instrument panel. This configuration affords XRX the best possible sensitivity and accuracy. Also, position the unit close enough to your power source and to your audio headset connection, if you are going to hook up audio, to allow for proper hookup.

Keeping Clear of Obstructions

XRX needs an approximately 6" "bubble" around the antenna array with no obstructions to ensure the best sensitivity. This includes the magnetic compass, which must be at least 5" away from XRX for mutual calibration. This also includes the windscreen center pillar, GPS antennas, satellite weather antenna (especially those with a magnetic mount), etc. Adhering to this rule will avoid potential magnetic interference and provide the XRX antenna array with adequate reception.
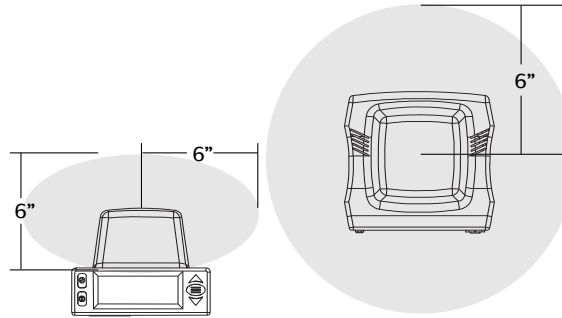
Cable Routing

When routing the cable, place the cable as close to the glareshield as possible. Ensure no cabling is taller than the base of the antenna array. Avoid loops in the wire that may obstruct the XRX antenna array view.

Rubber Feet

The PCAS unit must be set on your glareshield in a stance as close to level as possible. For your convenience, different sized silicone feet are provided in 1/4", 3/8" and 5/8" heights. This setup allows for a stance from level (using all four 1/4" feet) to a maximum of 3/8" differential using 1/4" feet on the front, and 5/8" feet in the back. These feet provide exceptional slip resistance on non-fabric glare-shields. Please ensure the unit is level to the normal cruise attitude of the aircraft. If not, compass accuracy could be affected.
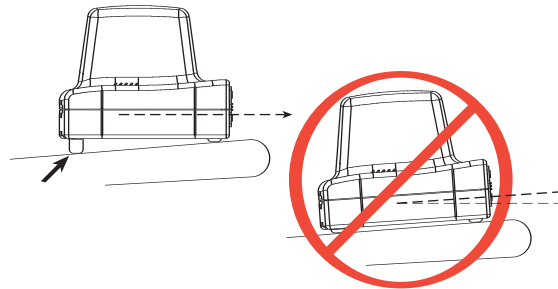
Velcro® Mounting Tabs

If additional slip resistance is required, or you are placing PCAS on a fabric-covered glare shield, use the four Velcro® mounting tabs to secure the unit to your glare shield, allowing for quick removal.

Improper positioning of XRX on the instrument panel can result in errors in bearing.

Connecting the Power

XRX is powered through your aircraft's "cigar-lighter" outlet*, using the included power adapter. The adapter provided with your unit incorporates a built-in replaceable fuse for safety, and can handle between 12-40 volts DC.

The adapter is sensitive to proper polarity, but just in case of improper polarity, XRX is protected against reverse polarity. The connector is tip-positive (+) and outside negative (-) and should only be used in negative-ground systems. Please consult your aircraft manual if you are unsure of your type of aircraft electrical system.

2.35mm Plug

Power Indicator

Fuse (Internal)
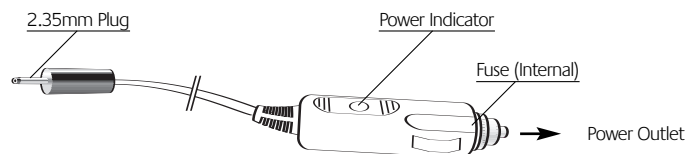
Power Outlet

* Pilots flying newer Cessna models that do not have a cigar lighter outlet should call Zaon for alternative connections.

To replace the internal fuse:

1 | Disconnect both ends of the adapter

2 | Twist off the knurled end cap

3 | Replace the fuse with a 1- to 3-amp rated automobile-style quick-blow fuse

4 | Twist the knurled cap back into place

Connecting to Permanent/Hardwired Power

In some instances, you may wish to power the unit directly from the avionics bus or other power source. Hardwiring the power supply will require a dedicated 1.0 amp minimum, in-line fuse. An internal line filter suppresses any undue transient noise on the power supply. Also, be sure to follow any FAA requirements concerning installation guidelines.

Connecting the Audio

XRX incorporates two different audio methods: In-cabin audio (an internal audible tone generator) and female voice announcements over the Headset-Direct™ connection.

Standard Headset-Direct™ Configuration

Your XRX comes with everything necessary to operate right out of the box, including the audio hookup cabling. To properly integrate the female voice audio alerts with that of your aircraft's system, use the included audio cable assembly. This configuration introduces the XRX voice alerts onto the intercom headset line. With this hookup, the voice alerts do not interfere with intercom transmissions or passenger audio, and maintains the original quality of your intercom system.

Headphone Plug

Microphone Plug

To Your Headset
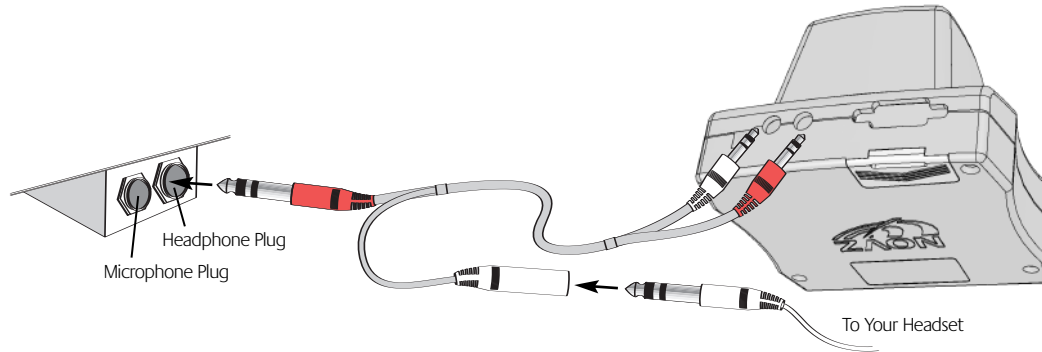
⚠ The red 1/8" connector on the back of the unit is Audio IN; the white 1/8" connector is Audio OUT.

Headset Adapters

The audio cable included with your unit works with GA-style connections with a separate 1/4" headset jack and 1/4" mini microphone jack. If your audio system is different from the standard GA configuration, several optional accessories are available to facilitate audio hookup, including Adapters for Bose® all-in-one connectors and U174 Helicopter-style plugs. To purchase, visit Zaon's website, call us directly, or ask your local avionics shop.

If one or both of the audio connectors becomes partially or fully disconnected, no audio will be heard, including that from the intercom.

In-cabin Audio

XRX incorporates an internal audible tone generator which can alert both the pilot and passengers of traffic threats and advisories. No external hookup is needed to take advantage of these audio cues. To turn this feature on or off, set Switch 6 in group A of the configuration switches to "ON" (see "Configuring the Audio" in the next section).

Rear of unit
Configuration Switches Hatch

To turn In-Cabin audio on or off, set Switch 6, Group A of the config-uration switches.

TIP

To test the audio, go to the 2nd Admin page and press the up arrow.

You will hear the In-Cabin beep, followed by the voice alert "Test" from the audio cable.

Testing the Audio Output

A method has been provided to test the audio output of the XRX system. To test the audio system:

1 | Press and hold the **mute** and **down** buttons at the same time. This will place the unit in admin mode.

2 | Press the **menu/select** button once to advance to the second admin menu, the General Information page.

3 | Press the **up** arrow to initiate the test. You will hear the In-Cabin beep, followed by the voice alert "Test" from the audio cable. You may perform this step as many times as necessary to hear the test audio.

4 | Press the **menu/select** button to navigate through the remaining admin pages and return to the traffic screen.

For more information on the admin mode, see page 54: Additional Menus: Administrative Mode.

Configuring the Audio

Because so many different types of intercoms and audio panels exist, there are many different combinations of audio options. To allow XRX to correctly interface your audio system, you will need to configure your unit. On the bottom rear of the unit, a small hatch reveals two groups of switches. To configure audio, change the settings of the switches in Group A. See "Configuration Switches" in the Appendices for more information.

Rear of unit
Configuration Switches Hatch

Setup

The three options of audio configuration possible with XRX are impedance, mono/stereo selectivity, and ground isolation. If you are unsure of your aircraft's particulars, read the hits below for each category.

Option	Switch 1	Switch 2*	Switch 3*	Switch 4	How to Determine
300 Ω Impedance	ON				Check your intercom or audio panel for the proper impedance.
600 Ω Impedance	**OFF**				
Mono		**ON**	**OFF**		When in doubt, check your headset connector. 3 sections = stereo
Stereo		OFF	ON		
DC Ground Isolation (Stereo 2 wire)				OFF	Symptoms of wrong setting: sound too soft, squeal or hiss, no sound
DC Ground Connection (Stereo 3 wire)				**ON**	

⚠ If the audio level is too low or cannot be heard, try switching the impedance switch to the other setting.

Placing both switches 2 & 3 to ON, or both to OFF may result in NO AUDIO OUTPUT. For in-cabin audio, turn on switch 6 to enable, turn switch 6 off to disable. Switches 5,7, and 8 are not used for audio configuration.

Alternate Wiring

Certain situations may benefit from an alternate audio hookup: wiring XRX directly into the aircraft system through the intercom auxiliary input, using an 1/8" jack (stereo or mono, as compatible) from the XRX audio OUT to the intercom AUX IN. In most cases, this will require hard-wiring and components not included with your XRX system. If your intercom isolates the pilot audio, this configuration will allow the XRX alerts to be heard only through the pilot's headset. If your intercom does not isolate the pilot audio, the XRX alerts may be able to be heard through each headset plugged into the aircraft intercom system. This is a function of the intercom or audio panel and not determined by XRX settings. Please refer to the following wiring schematic if you are hard wiring the unit to your intercom or audio panel.

TIP

SLEEVE

RING

1/8" AUDIO CONNECTOR

IN

150 OHM

150 OHM

GND

INTERNAL COMPONENTS

EXTERNAL COMPONENTS

AUDIO
TRANSFORMER

TIP

SLEEVE

RING

1/8" AUDIO CONNECTOR

OUT

AUDIO SIGNAL

GND

150 OHM

600 OHM
SETTING

300 OHM
SETTING

IMPEDANCE

STEREO SETTING

TIP = SIGNAL (+180°)
RING = SIGNAL (-180°)
SLEEVE = GROUND

GND

MONO SETTING

TIP = SIGNAL
RING = OPEN
SLEEVE = GROUND

GND

MONO/STEREO SWITCH
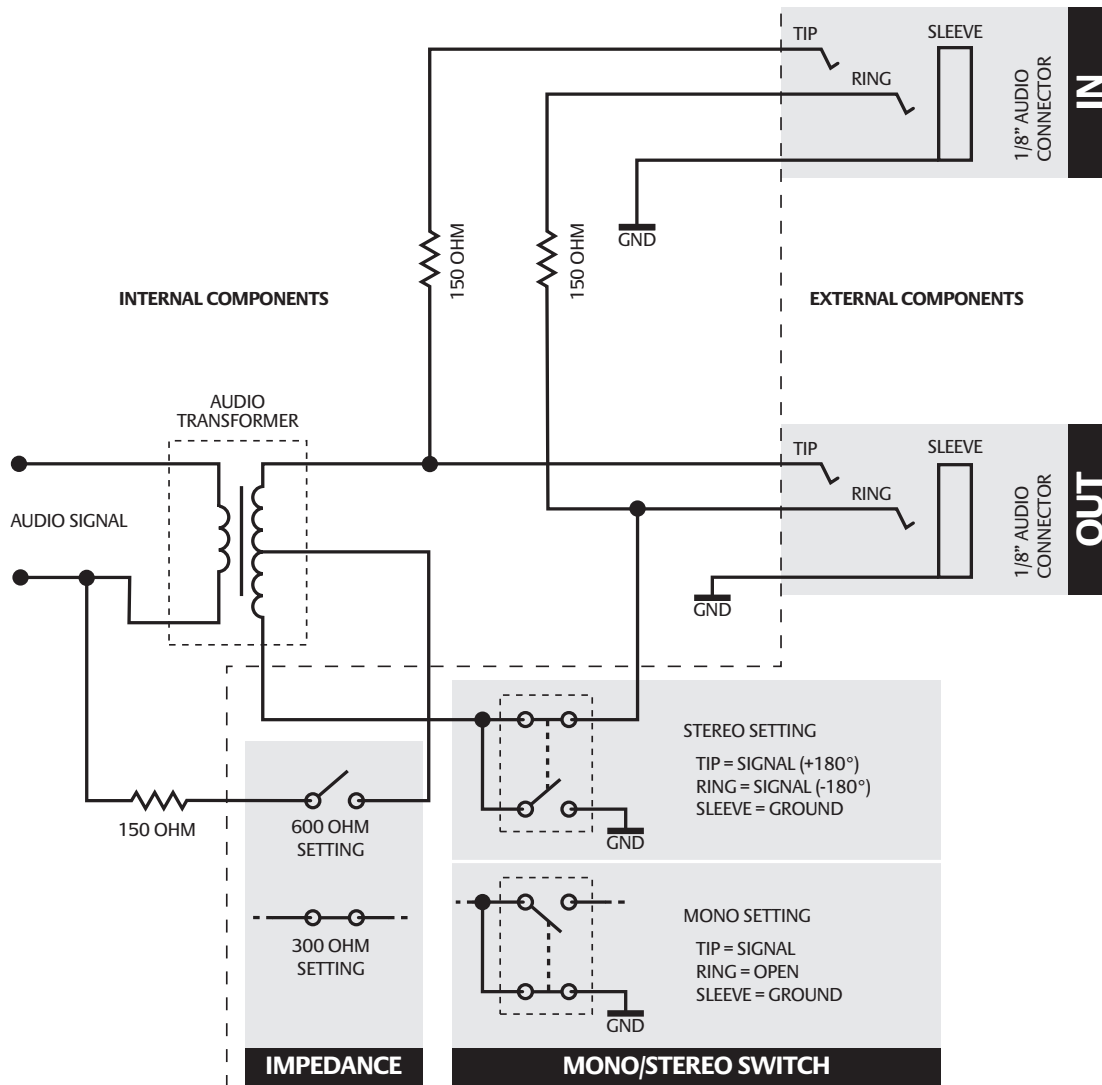
Antenna

XRX incorporates an internal highly-specialized directional antenna. For this reason, the unit should be placed on the glare shield of the aircraft to properly receive signals. Any structure must be at least 6 inches away from antenna such as a compass, portable GPS, etc. Please use common sense when placing your XRX. Metallic objects very near to the unit will affect bearing accuracy, as they would with any compass.

Installation of the unit requires an installation upgrade to your unit to allow for an externally-mounted antenna. Contact Zaon for more information on this installation upgrade.

Initial Calibration

The compass within XRX is calibrated at the factory, and no additional calibrations should be required under normal use. However, if you notice compass errors greater than 20° when compared to your aircraft compass in straight and level flight, you may need to recalibrate the XRX compass. This simple procedure is explained on page 55: Compass Calibration.

Pressurized Aircraft

XRX can be operated in a pressurized aircraft, but because of the internal altimeter, it must be set to pressurized mode. To set the unit to pressurized mode, set Switch 5 in group A of the configuration switches to "ON". For more information, see "Configuration Switches" section in the appendices.

Rear of unit

Configuration Switches Hatch

To turn pressurized aircraft mode on or off, set Switch 5, Group A of the configuration switches.

GROUP A   GROUP B

XRX requires you to have a local transponder with a minimum output of 100 watts and a maximum of 250 watts to use the pressurized mode.
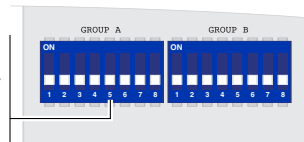
Use of XRX in an automobile will result in inaccurate compass and traffic bearing.

This is caused by the soft iron in the car's frame.

Under normal circumstances, XRX uses the built-in altimeter to determine the local altitude and establish a base reference. The unit then compares the altitude of the target aircraft to this base reference to determine the relative altitude. In a pressurized aircraft, the built-in altimeter is rendered ineffective since it relies on static pressure readings, as found in a non-pressurized aircraft. In pressurized mode, the unit bypasses the built-in altimeter and relies on the transmissions from your own transponder's encoder to establish the base reference. This can be an effective means of determining your own altitude, but you should be aware that a few limitations exist.

If no altitude is received from your transponder, you will see "NO ALT" on the screen and no traffic will be displayed. There are a few reasons why XRX may not always receive the altitude from your transponder, including:
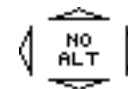
- Your transponder is not turned on, or is on but is not in "ALT" mode, or you do not have a transponder.

- You are below RADAR coverage, a common occurance when on the ground at an airport, or when not in line-of-site of a RADAR station, and no other active system is interrogating your transponder.

- Some squawk codes are coincidental altitude codes. If ATC assigns you a code ending with a "zero", there is a slight chance XRX will not be able to determine which code is an altitude code and which is a squawk code without the aid of an internal altimeter. To alleviate this problem if it happens, simply ask ATC for a code not ending in zero. For example, a squawk code of 0340 is also the same code as 800 feet.

- The output of your transponder is less than 100 watts or greater than 250 watts.

Carry Case

A hard carrying case is included for your XRX. This case is designed to carry all of your accessories and to protect your XRX from damage and the elements.

⚠ The carrying case is not waterproof. Care is needed when leaving the case exposed to the elements.

To clean the carrying case, use a towel and a minor detergent solution or glass cleaner. Do not use harsh abrasives or chemical solutions as this will damage the case.

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Understanding PCAS

What is PCAS?

PCAS, which stands for Portable Collision Avoidance System, is a trademark of Zaon Flight Systems for technology similar in function to TCAS (Traffic and Collision Avoidance System). TCAS is the industry standard for commercial collision avoidance systems. The original PCAS technology was developed by Zaon in 1999. Now, the MRX/XRX line of collision avoidance systems incorporates the fourth generation of PCAS technology. Through this technology, transponder-equipped aircraft are detected and ranged, and the altitude is decoded. PCAS G4 technology has advanced to the point that highly accurate range, relative altitude, and quadrant direction can be accurately detected in a portable, all-in-one cockpit device.

What does XRX show?

Reading your XRX is simple and straightforward if you understand the concepts behind its design and operation. XRX operation can be broken into two areas of thought and use: traffic detection and traffic alerts. It is important to know how to visualize the detection window around you.

The Detection Window

Traffic information takes three forms, or "dimensions". The easiest way to understand this is to think of a target aircraft in three dimensional space.

The first dimension is range, or how far away the aircraft is. Imagine a sphere with your XRX-equipped aircraft in the middle. With only range to go by, the surface area of the sphere represents all of the possible points at which the aircraft could be. The radius, or size, of the sphere is determined by the range, or how far away the target aircraft is.

The second dimension, relative altitude, tells us how far above or below our horizontal plane the aircraft is. Once we know range and relative altitude, the sphere of possible points is reduced to a ring, positioned above us or below us, depending on the relative altitude of the aircraft.

The third dimension is direction. Once we take the ring and add the direction "dimension", we've reduced the possible points where a threat aircraft could be down to a point.

In other words, range, relative altitude, and direction together can tell us the X, Y and Z coordinates of the threat aircraft in three-dimensional space around us, or relative to our position.

The detection window surrounding your aircraft in flight can best be visualized by imagining a "Bubble of Awareness" surrounding your aircraft. XRX will display any aircraft within this detection window. The "bubble of awareness" can be shaped to meet the needs of your current flying situation.

The width of the bubble represents and is defined by range; the height is defined by altitude. Both the altitude limits and range limits can be set independently of each other by the pilot.

RANGE

Ceiling:
22,000 feet (FL220)
Traffic above 22,000 will not be indicated

ALTITUDE

Altitude Setting (Feet)
±2500, ±1500, ±500

Range Setting
(NM Radius)
6.0, 3.0, 1.5

XRX-Equipped
Aircraft

Floor: 0 feet

Illustrations not to scale
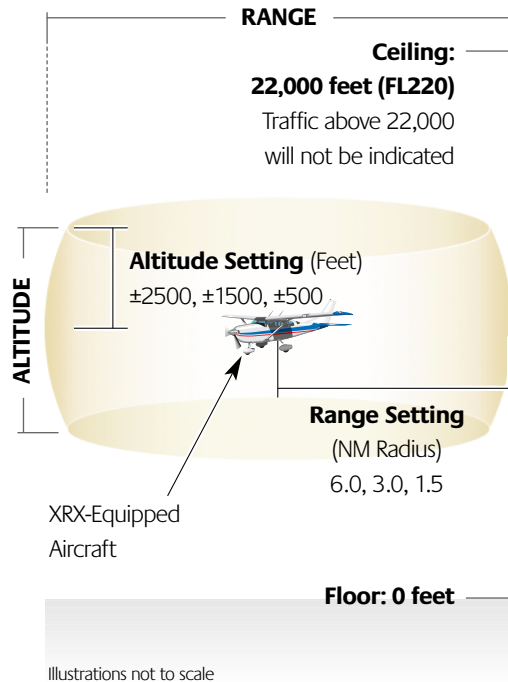
By default, XRX is set to 3 NM and ± 1500 feet at startup .

The Traffic Screen

When XRX detects aircraft within the detection window, the following information is displayed on the traffic screen:
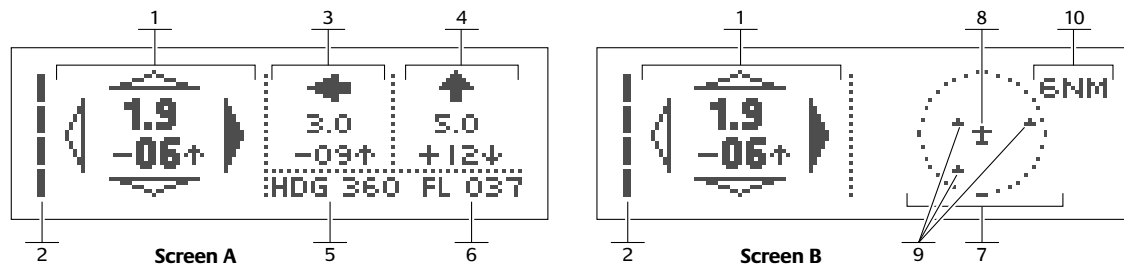
Screen A

Screen B

Target Information

A | Direction relative to your bearing: indicated by the compass rose

B | Range in nautical miles

C | Altitude relative to your local altitude: aircraft is above you (+) or below you (–)

D | Vertical Trend: Ascending (⬆) or descending (⬇)

Primary A/C

Secondary A/C

Screen A & B Information

1 | Primary Aircraft

2 | Volume indicator

Screen A Only

3 | Secondary Aircraft #1

4 | Secondary Aircraft #2

5 | Local heading

6 | Local altitude
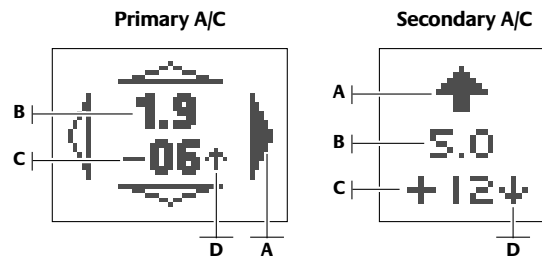
Screen B Only

7 | Overhead traffic view — Range ring is scaled to range setting: 6 NM, 3 NM, 1(1.5) NM

8 | Your aircraft

9 | Target aircraft (maximum of 3)

10 | Range setting

To switch between screens, press **menu/select**, choose **Screen**, then select **Screen A** or **Screen B**. Press **mute** to exit to traffic screen (see page 51 for more details).

Direction is indicated through the compass rose for the primary aircraft, or by an arrow for secondary aircraft (see chart). It is important to note that direction is not cardinal points (N, S, E, W) but is relative to your heading. An arrow up indicates traffic is in front of you. In the example shown, the primary (closest) aircraft is 1.9 NM away, 300 feet above you, and climbing.

Aircraft is...	Primary	Secondary
To your left	1.9 +03↑	◀
In front of you	1.9 +03↑	▲
To your right	1.9 +03↑	▶
Behind you	1.9 +03↑	▼

In additional to the four directions illustrated, 45° angles are also represented for the **primary** aircraft by indicating two adjoining directions. This indicates an aircraft between the front and left of you.

Other important things to know about the traffic screen:

- "No traffic" is indicated by blank areas in both the range and altitude sections of the display, and no directional information. This is true for both the primary traffic and secondary traffic areas.
- Aircraft at the same altitude is indicated by "00" for the relative altitude.
- In the secondary threat positions (1 and 2), traffic bearing is displayed in 90° increments only. Only the primary threat bearing can be shown in 40° increments.

Vertical Trend

In addition to relative altitude of the target aircraft, XRX also displays the vertical trend, or if the aircraft is climbing or ascending. Vertical trend is indicated by ↑ or ↓. Monitoring the vertical trend will assist in deciding if the aircraft is a threat or not. Traffic that is not climbing or descending will not indicate vertical trend.

⚠ Vertical trend is based on the target's actual altitude ascent/descent rate, not the relative altitude change rate.

Local Information

In the lower right corner of the traffic screen, the local heading and local altitude are displayed.

HDG 360 FL 037

Local altitude is displayed in flight levels (indicated by "FL"). The primary source for this information is the unit's own built-in pressure altimeter and is verified when possible by receiving what your transponder encoder is transmitting. It is important to note the local altitude is pressure altitude, not necessarily your actual altitude. This is factory calibrated and should not need adjusting. However, adjustments are possible using the Admin menus, covered later in this chapter.

The magnetic heading you are facing or traveling is also displayed, indicated by "HDG". This information is taken from the on-board compass and is delivered in 10° increments. To calibrate the compass, see "Calibrating the Compass", later in this chapter.

Threat Prioritizing

The primary aircraft is chosen by examining the following criteria:

- Threat aircraft relative altitude (vertical separation)
- Threat aircraft vertical trend (ascending or descending over time)
- Local aircraft vertical trend

Following the rule that "accidents can only occur at your altitude", the aircraft with the least vertical separation, or where the relative altitude is less than any other, is determined to be the primary aircraft. Up to two additional aircraft are displayed in the secondary aircraft positions. However vertical trend is also used to prioritize when two aircraft are on converging paths and both are within ±1000 feet. For example, if you are descending and another aircraft is below (within -1000 feet), it will be the primary threat, even if another aircraft is closer in range and/or relative altitude above you and level.

Should XRX determine that a new aircraft has become a greater threat than the one currently being displayed, it will be displayed in the Primary Threat area. It is not uncommon to see aircraft changing positions on the screen as time passes. See "Example Flight Scenarios" later in this chapter.

> **Traffic may change positions on the screen as time passes and the priority of each intruder changes.**

Resolution & Accuracy

With regard to the **range** of the target aircraft, accuracy increases exponentially the closer the threat gets to your XRX. Range can be determined by examining the amplitude of the received transponder signal and cross checking it against the other aircraft's altitude. For example, an aircraft 5,000 feet above you would not show less than 1.0 NM away. This helps ensure advisories issued are accurate given the true range to the other aircraft. Accuracy and resolution work hand-in-hand. For the XRX, traffic at a range greater than 3.0 miles is displayed in whole mile increments. Between 2.0-3.0 NM, the power output is far enough "up" the logarithmic scale that mileage can be accurately computed in 0.2 mile increments. Under 2.0 miles, traffic is close enough to be computed in 0.1 mile increments.

Altitude is set at 100-ft increments since this is the digital resolution set by transponder encoders.

Bearing accuracy is dependent on the compass and rate of turn. Turns greater than 10° per second can greatly affect the bearing accuracy.

Range Resolution	Altitude Resolution
3-6 NM: Whole mile increments (i.e. 4.0) 2-3 NM: 0.2-mile increments (i.e. 2.4) < 2 NM: 0.1-mile increments (i.e. 1.3) **1.9**	Given in 100-ft. increments, relative to host aircraft altitude (i.e. 600 ft. is shown as 06) **−06**

Traffic Advisories and Alerts

There is a difference between traffic detection, as defined in the previous section, and traffic alerts (threats). XRX will not alert you to traffic that does not fall within your specified threat detection envelope, regardless of whether an indication of traffic appears in the display window.

XRX incorporates a high-volume piezo buzzer to alert you of an impending threat. Two levels of threats are given: traffic advisories and traffic alerts.

The points at which traffic advisories and traffic alerts are given depend on the range setting. The following table shows the various thresholds. Overall, when the detection window is decreased in size by scaling down the range and altitude, the alert thresholds are reduced as well.

Level	Audio	Range Setting	Traffic is within Range...	...and Relative Altitude
Advisory	**Headset**: "Traffic advisory. Monitor Closure Rate" **Beeps**: 2	6 NM	2.0 NM	±700 ft.
		3 NM	1.0 NM	±600 ft.
		1 NM	0.6 NM	±500 ft.
Alert	**Headset**: "Traffic alert. Obtain visual contact." **Beeps**: 4	6 NM	0.7 NM	±700 ft.
		3 NM	0.6 NM	±600 ft.
		1 NM	0.3 NM	±500 ft.

In a case where Altitude is set to ±500 ft and Range is set to 6 or 3 NM, no Traffic Advisories would be given. Because the threshold for these Range settings is greater than 500 ft., the system would "skip over" the Advisory and give an Alert warning.

Each of the top three traffic threats are evaluated independently against the Traffic Advisory and Traffic Threat criteria indicated in the table above. This means that an advisory or alert may be given for an aircraft not in the primary traffic location if it falls within the threshold(s).

How does XRX work?

XRX is a stand-alone, passive system. Passive systems are different from active systems such as TCAS, Skywatch®, etc. Active systems can be found in commercial airliners, corporate jets, and higher-end general aviation aircraft. They actively interrogate aircraft transponders within a specific range. Passive systems like your XRX listen for the replies to these interrogations, as well as ground-based RADAR interrogations.

How is direction obtained?

The key to providing directional information is the antenna design. XRX uses a specially designed antenna which uses a combination of signal amplitude and/or phase cancellation, which is the only way to accurately detect direction from inside the cockpit. Other methods of directional detection do exist, but antenna array installation is required. Difficulties with detection inside the aircraft include airframe echoes, multipath, phase cancellation, and signal path loss due to airframe shadowing. The XRX design overcomes most of these issues. However, direction resolution is limited to 45° increments. Inside your XRX is a highly-specialized antenna array. This array is made up of four precision tuned directional antenna elements which are coupled to four individual super heterodyne RF receivers. Several years of testing and the use of our custom-designed RF anechoic chamber allow the XRX to overcome reception issues and accommodate a wide range of airframe types. The traffic bearing information displayed is directly related to the internal solid-state compass to accommodate changes in heading so that at any given moment the bearing you see is relative to your heading.

This design allows the unit to "hear" which direction the aircraft is approaching and display the information on the screen. Multiple aircraft are tracked at once using this method.

⚠️ Bearing information shown is directly related to the angle at which your XRX system is placed upon your glare shield. Changing the forward angle of the unit greater than 20° to accommodate viewing is not recommended without using the 45° screen option (see page 51: Screen Options).

The Importance of Relative Information

The key to displaying smooth, understandable traffic information is relativity. If the information is always relative to your aircraft, you are your own point of reference. Range is relative to your location, as is the relative altitude (ie +600 above

your altitude) and relative bearing (ie: to your right). For instance, if only the altitude of the other aircraft is known, you would have to find out your own altitude by another glance at your altimeter, then do the math. Likewise, to find out the target's relative bearing, you must glance at your own heading indicator. However, XRX contains these instruments and will do these calculations for you. You will see a live, relative representation that requires no translation, whenever you glance at the XRX screen.

Built-in Compass for Relative Bearing

Target aircraft transponders are not always broadcasting. Therefore, if a target is straight ahead and you initiate a turn, the unit would continue to erroneously indicate the aircraft as straight ahead until the other transponder broadcasts again. Since the XRX incorporates a built-in compass, the unit knows you have changed your heading and can accurately recalculate the relative position of the other aircraft. This is applicable to any aircraft within detection range. It is very important that the compass be calibrated accurately to ensure overall bearing accuracy. (See page 55: Compass Calibration).

TARGET AIRCRAFT

Points at which interrogation reply is received from target aircraft

INCORRECT

XRX
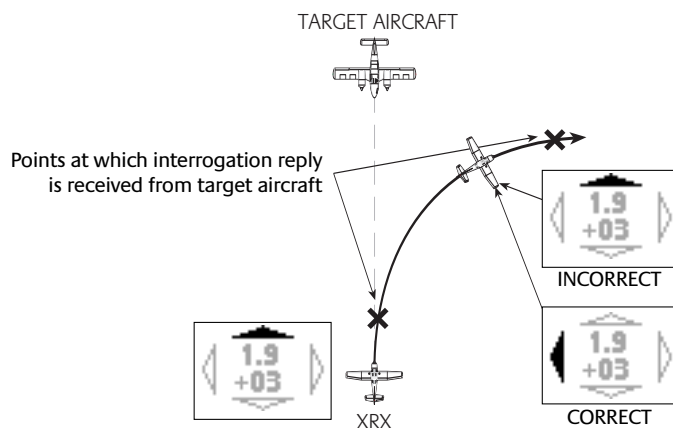
CORRECT

Without the accuracy of an internal compass, the traffic would still show straight ahead until the next reply was received.

With XRX's built-in compass, XRX will correctly and smoothly track traffic by continually updating relative positioning, even between replies. Notice how the target aircraft has descended further (XRX watches the trend) and now shows to the left.

Built-in Altimeter for Relative Altitude

Only XRX incorporates a patent-pending built-in altimeter to establish a base reference. Because XRX displays relative altitude, the unit must know your local altitude at all times. Under normal conditions, the following occurs:

1 | Your transponder's encoder broadcasts your local pressure altitude (set at 29.92").
2 | XRX intercepts and decodes your local altitude.
3 | XRX compares this to the altitude from the built-in pressure altimeter to ensure accuracy.
4 | If acceptable, XRX uses the transponder altitude as a base reference.
5 | XRX accurately presents relative altitude information for traffic.

Many times, the local altitude is not available from your transponder, or cannot be accurately relied on. This is normal for all collision avoidance, and XRX will automatically provide a work-around. In these cases, the following occurs:

1 | XRX uses the built-in pressure altimeter as a base reference.
2 | XRX accurately presents relative altitude information for traffic.

As you can see, the most important thing to note is that your XRX will present you with accurate relative altitude information at all times. It is recommended that the altimeter be checked periodically by setting 29.92 in your altimeter and comparing this to the local altitude the XRX is showing when no transponder is present. Matching these will ensure overall bearing accuracy. (See page 56: Altimeter Calibration).

What does XRX detect exactly?

To explain how the system works, consider the following illustrations:

1 | To start the cycle, an interrogation is sent out from ground-based RADAR stations and/or TCAS or other actively interrogating systems in your area. This signal is sent on 1030 MHz. For TCAS, this interrogation range can have a radius of 40 miles from the interrogation source. The Ground RADAR range can be 200 miles or more.
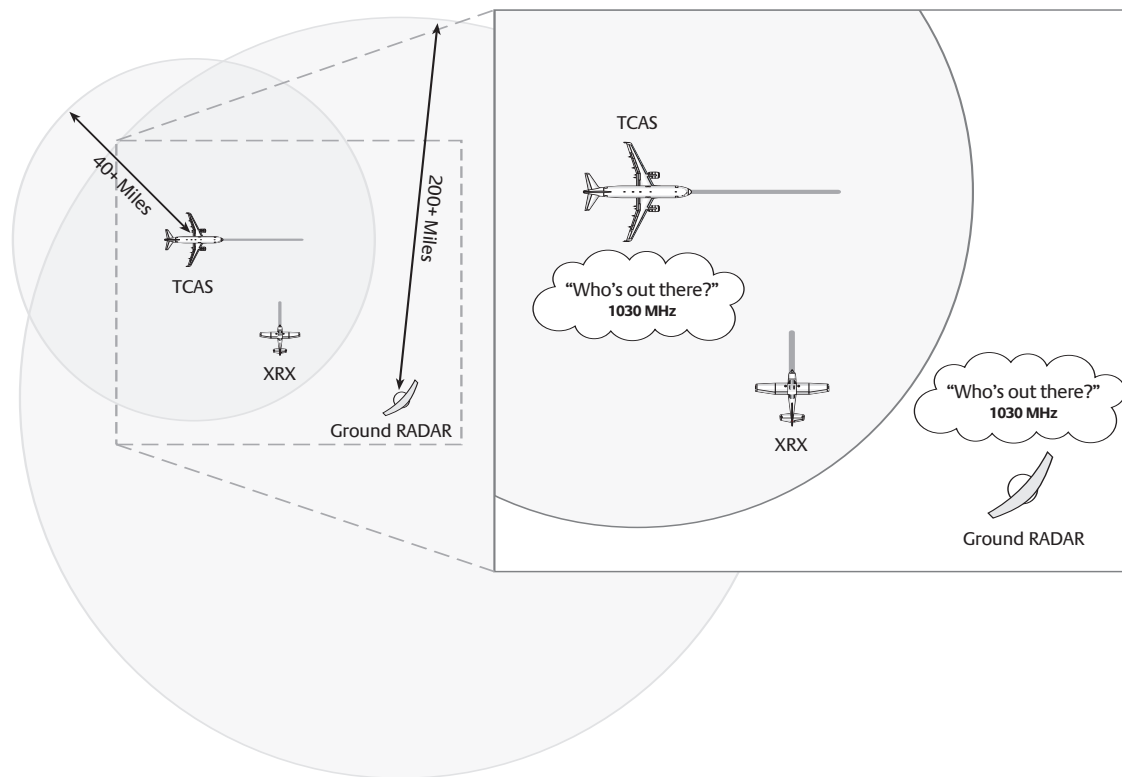
2 | The transponder on any aircraft within range of the interrogation replies on 1090 MHz with their squawk code (known as Mode A) and altitude code (or Mode C). The altitude information is sent in an encoded format.

Mode S transponders also reply on this frequency, and encoded within the Mode S transmission is the Mode A (squawk) and Mode C (altitude) information.

Military aircraft also respond on this frequency but use a different transmission protocol (see Step 3).

Your aircraft's transponder should also reply. However, the XRX unit watches for this signal and will not report it as a threat aircraft. The unit may use this information to establish base altitude for use in step 4.
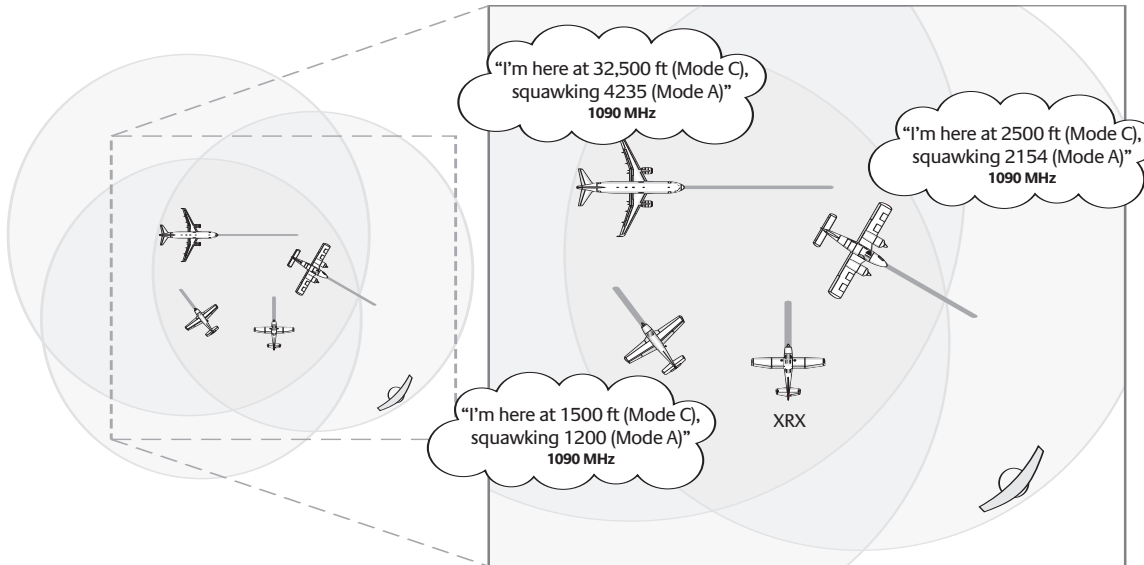
3 | Any aircraft reply within the XRX detection window (maximum 6 miles) will be received. The range is computed, the altitude code is decoded, and the signal angle-of-arrival is determined. XRX will recognize interrogations from TCAS, Skywatch, and any other "active" system, military protocols, and Mode S transmissions.

4 | The altitude of the aircraft (in the example, 2500 ft.) is compared to your local altitude (i.e., 1500 ft.) and the relative altitude is calculated (i.e., 1000 ft. above you). With relative direction, altitude and range determined, XRX displays this information and stores it in memory.

Threat #1

Altitude: 2500 ft
Squawk: 2154
1090 MHz

SIGNAL ANGLE
OF ARRIVAL,
OR RELATIVE
DIRECTION

45°

XRX

Altitude: 1500 ft
Squawk: 1200
1090 MHz

RELATIVE ALTITUDE
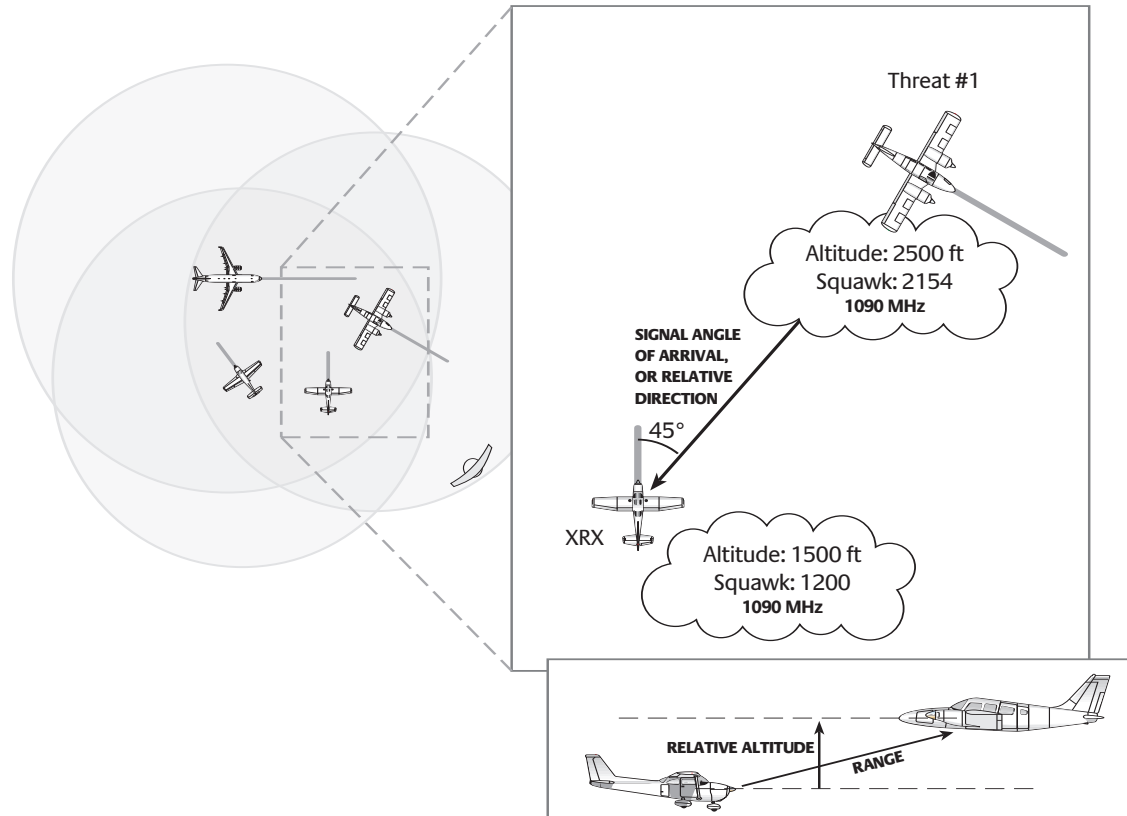
RANGE

5 | If additional aircraft are within detection range, the above process is repeated for each aircraft. The top threat is displayed on the left of the traffic screen, and on Screen A, the second and third threats are displayed on the right.

The greatest threat is determined by looking at aircraft within the detection window you set up and comparing primarily the vertical separation (+/− relative altitude), and secondarily the range to the aircraft currently being displayed. XRX uses patent-pending SmartLogic algorithms to determine which of two or more aircraft is a greater threat. See flight scenarios later in this chapter for more information.

Example Flight Scenarios

Many different flight scenarios exist, of course, but you will find common situations that prevail in everyday flight. The examples on the following pages illustrate what to expect in these common situations and how to visualize the aircraft around you.

Visually Identifying Aircraft

Please be aware of what you can and can't visually identify. Many pilots will experience a situation where the unit will show an aircraft and attempts to visually identify it are unsuccessful. The following is a short list of visual impairments to consider:

- Even to a well-trained eye, general aircraft beyond 1.5 to 2 miles away are too small to see
- Visual effects, such as ground clutter, optical myopia, and haze can obscure aircraft
- Only a relatively small "slice" of the 360° area around the cockpit is within the pilot's scan. Aircraft above, below, and behind may be blocked by your aircraft and much more difficult to see.
- Aircraft at or about your same altitude tend to appear 200 feet lower for every half mile of distance between you and the aircraft. This is an optical illusion which is caused by the curvature of the earth (the horizon) combined with your aircraft angle of attack.

DIRECTION

2.5 NM

TARGET AIRCRAFT

2.0 NM

1.5 NM

RANGE

1.0 NM

0.5 NM

XRX

Example 1:
A Single Aircraft

HDG 360 FL 020
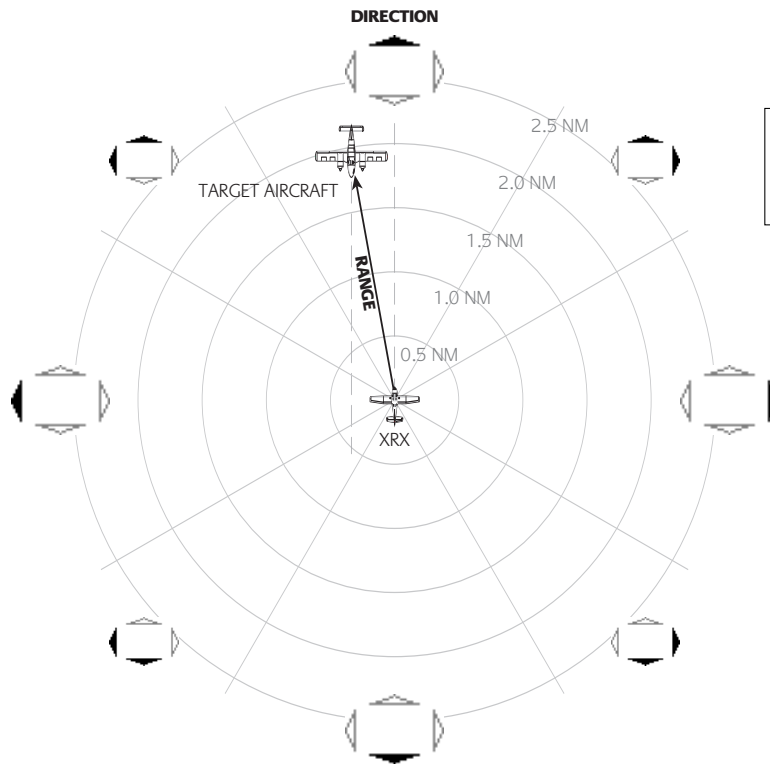
In this example, there is only one aircraft in the detection window. If the aircraft is 1.9 NM away and 300 feet above and descending, this is what the XRX screen will show. This is an alert situation. An attempt should be made to visually identify this aircraft as soon as possible.

Use the information XRX is giving you to alter your course if the situation warrants.
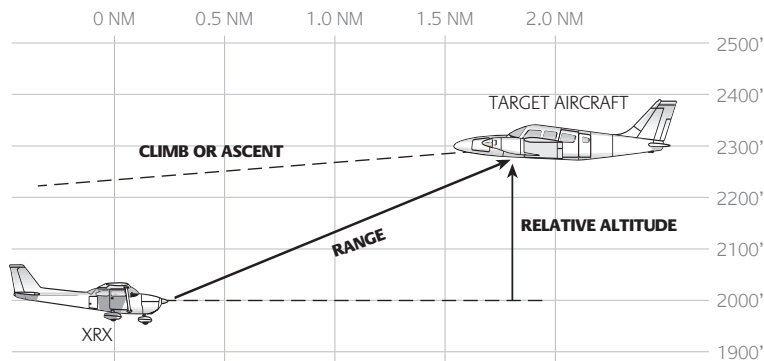
The ascent/descent indicator is based on the target aircraft's actual climb or descend trend, not the relative difference in altitude between you and the target. Because of this, you may see the down arrow, meaning the aircraft is descending, even if you are also descending.

0 NM   0.5 NM   1.0 NM   1.5 NM   2.0 NM

2500'

2400'

TARGET AIRCRAFT

CLIMB OR ASCENT

2300'

2200'

RELATIVE ALTITUDE

RANGE

2100'

2000'

XRX

1900'

DIRECTION

2.5 NM
2.0 NM
1.5 NM
1.0 NM
0.5 NM

PRIMARY AIRCRAFT

RANGE

XRX

RANGE

SECONDARY AIRCRAFT

2.0 NM   1.0 NM   0 NM   1.0 NM   2.0 NM

2600'

PRIMARY AIRCRAFT

2400'

RANGE

2200'

XRX   RELATIVE ALTITUDE

2000'

RELATIVE ALTITUDE

RANGE

1800'

1600'

SECONDARY AIRCRAFT

1400'
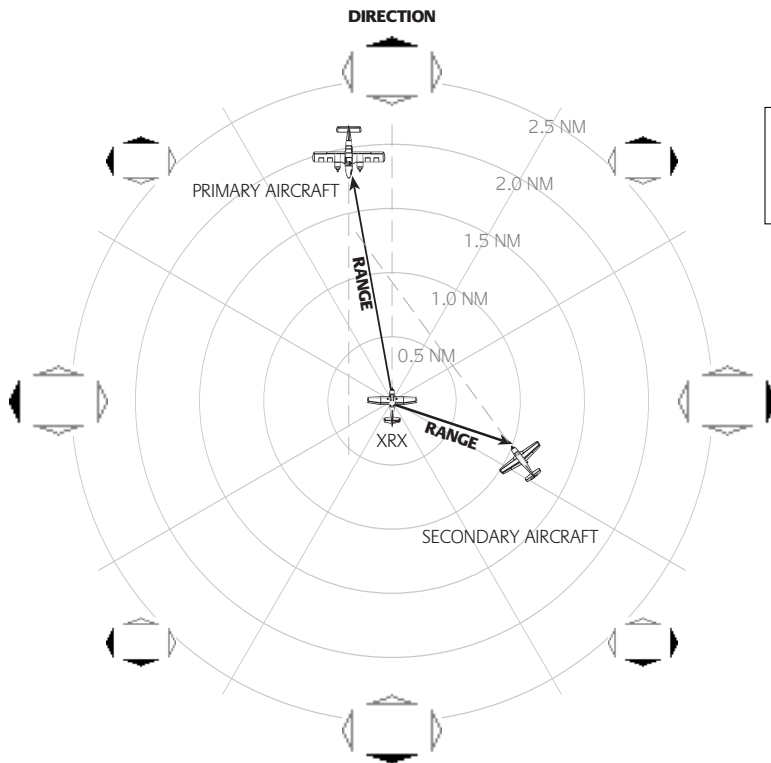
Example 2: Prioritizing

```
1.9      1.0
+03     -05
HDG 360 FL 020
```
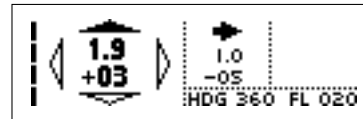
If another aircraft is added to create this scenario, the first thought might be the new, "closer" aircraft might be the greatest threat, and thus be priority 1. But upon further study, notice the aircraft is 500 feet below, whereas the other aircraft is only 300 feet above.

XRX prioritizes based on altitude first, but does take into consideration the ascent/descent rate, as shown in the next scenario, as well as range in certain circumstances. However, the obvious notion that accidents only occur at your altitude holds true, and the aircraft with the least amount of vertical separation will take priority over others.

DIRECTION

2.5 NM

2.0 NM

1.5 NM

1.0 NM

0.5 NM

PRIMARY AIRCRAFT

RANGE

RANGE

XRX

SECONDARY AIRCRAFT
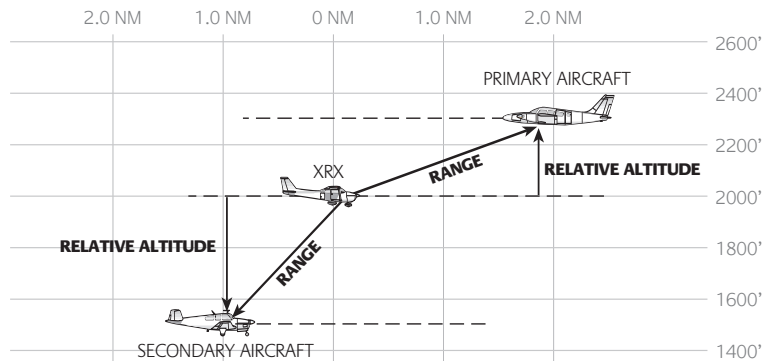
Example 3: Prioritizing Close Altitudes

```
 1.9        1.2
-07        +02↑
        HDG 360 FL 022
```
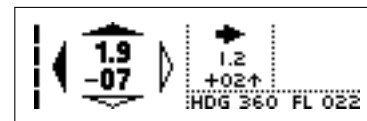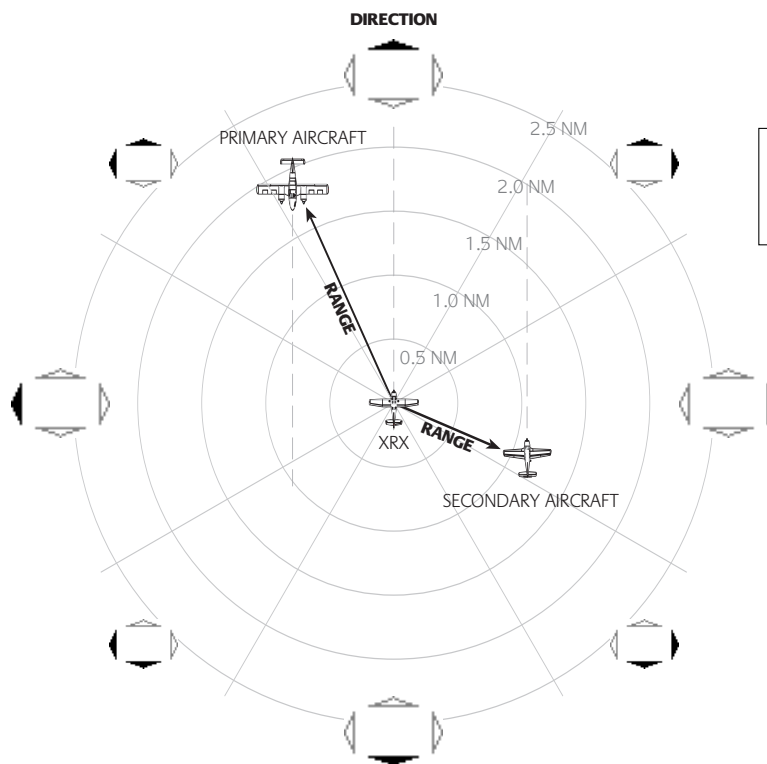
Vertical trend plays a large part in the prioritizing of aircraft threats. In this example, an aircraft is 200 feet above us and climbing, and another is 700 feet below and level. Because we are descending, the aircraft below is a greater threat, even though both the range and the vertical separation are greater than the one above.
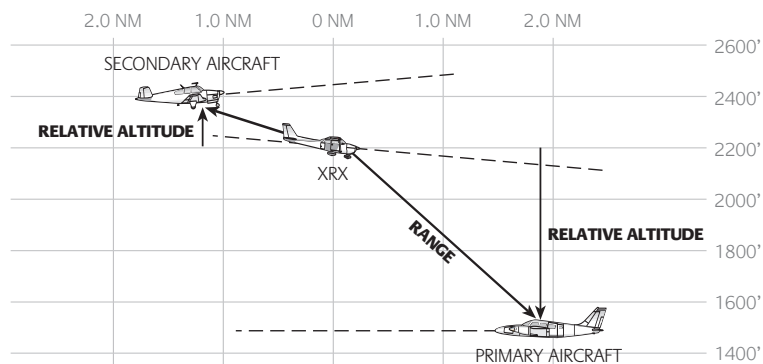
The same would be true if the aircraft below was climbing and we were level or descending.

2.0 NM   1.0 NM   0 NM   1.0 NM   2.0 NM

SECONDARY AIRCRAFT

RELATIVE ALTITUDE

XRX

RANGE

RELATIVE ALTITUDE

PRIMARY AIRCRAFT

2600'

2400'

2200'

2000'

1800'

1600'

1400'

DIRECTION

2.5 NM

2.0 NM

PRIMARY AIRCRAFT

1.5 NM

1.0 NM

0.5 NM

RANGE

XRX

RANGE

SECONDARY AIRCRAFT

2.0 NM   1.0 NM   0 NM   1.0 NM   2.0 NM

2600'

SECONDARY AIRCRAFT   PRIMARY AIRCRAFT

2400'

2200'

RELATIVE ALTITUDE   RANGE   RANGE   RELATIVE ALTITUDE

2000'

1800'

XRX

1600'

1400'

1.7
+05

1.7
+05↑
HDG 360 FL 018
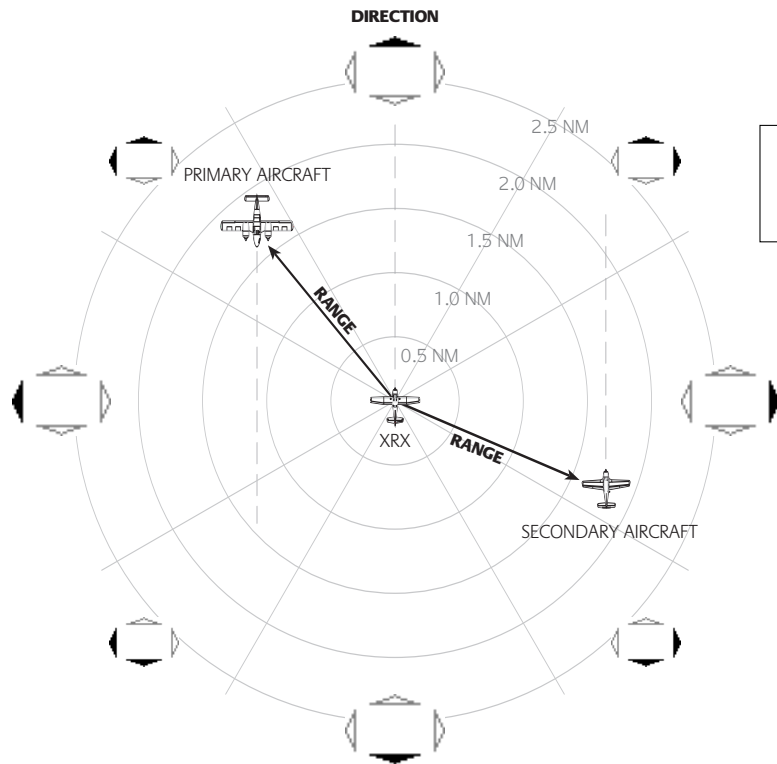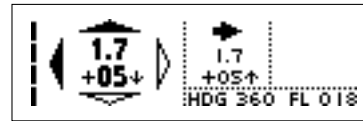
If two aircraft are at the same altitude, range will be used to prioritize. If the range is also the same, the vertical trend will be used to prioritize. Vertical trend is the most important factor when considering an aircraft to be a threat or not. XRX tracks this over time and can use the trend to determine that an aircraft above you and descending is a greater threat than one ascending.
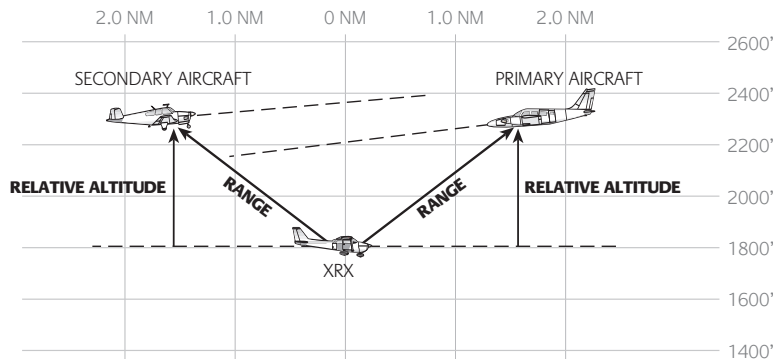
This situation, the aircraft to our left is 500 ft. above us and descending, making it the primary threat. The other aircraft is climbing posing little or no threat. Situations like this commonly occur in heavy traffic environments, like airports, especially when doing pattern work.

Strengths and Limitations

Strengths

Zero False Alerts

XRX boasts the unique ability to filter out any erroneous signals and only display verified transponder-equipped aircraft. Incoming signals must be completely decoded, the Mode A/C must correctly correspond to a valid altitude code, and XRX must be able to do this twice with the same aircraft. This process, among others, virtually guarantees that, if an aircraft information is being displayed, it can only be from a valid transponder-equipped aircraft.

Ground RADAR and TCAS Network Coverage

XRX is a passive system, meaning it listens to replies from other aircraft. Other aircraft are responding to interrogations. There are two types of interrogation networks: Ground RADAR installations and TCAS- or other active system-equipped aircraft.
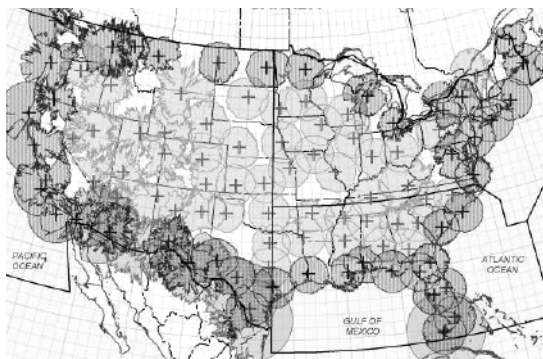
US Ground RADAR installations and approximate surrounding coverage areas at 5000 ft. AGL. (Source: USAF)
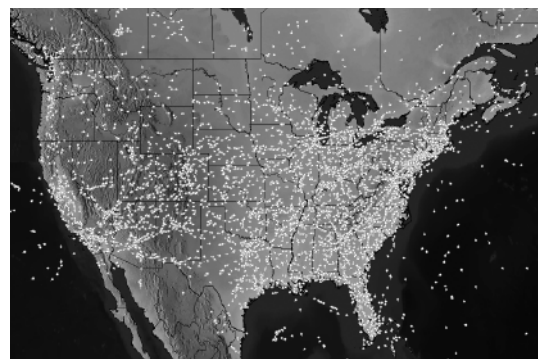
Typical TCAS or other active system network coverage. Each dot represents an airliner with an interrogation range of 100 NM (200 NM diameter). (Source: Flight Explorer)

Ground RADAR installations provide ATC with aircraft data by interrogating outward from the sweeping antenna, pictured here. The range of each installation depends on the type of surrounding terrain and geography, but is usually 100-200 miles in diameter.

Overhead, systems that interrogate, or active systems, exist which make up an even better network of interrogation. Examples of active systems are TCAS, Skywatch, and Ryan/Avidyne active systems. Because these systems are airborne, they are not limited by geographical features and provide an excellent platform for interrogation.

A passive system which does not interrogate, such as XRX, only works if the interrogations are present. However, it is important to note that the combined effect of both overlapping networks provides for a nearly 100% coverage in the United States. The same type of systems exist in countries abroad, especially the same airborne TCAS-based systems. The most important thing to remember is that interrogations happen virtually everywhere you may fly.

Limitations

XRX Cannot Detect All Traffic

XRX, along with all other collision avoidance technologies, cannot detect all aircraft. If another aircraft does not have a transponder, if the transponder is not turned on or to ALT, or in the rare case that no interrogation signal is present, there will be no reply for XRX to detect. XRX is programmed to recognize many shadowing of signals, however some scenarios which can cause signal loss, or degradation are:

- **Target aircraft banking > 30° (top of aircraft visible, bottom turned away):** This can happen because the other aircraft's transponder antenna is on the bottom of the aircraft, however when the target aircraft is < 1.0 NM this is usually not a factor.

- **On the ground, such as the run-up area Target aircraft approaching to land:** You would notice the range be significantly further than actual. The reason is because as the other aircraft approaches, their transponder signal reflects off of the ground and phase cancellation becomes very prominent when they are < 500 feet above ground and coming towards you. When in the run-up, keep this in mind and consider the range to be 50% closer than what it shows. This is not a problem in the air, since XRX antenna reception is not competing with the ground and forward lobes of the target aircraft for signal reception.

⚠

Bearing indication is dependent upon adequate intruder transponder activity.

In areas of reduced activity, bearing may appear to lag.

- **Directional ambiguity conflicts:** Because the primary method of tracking aircraft is based on altitude for GA aircraft squawking 1200, a split in ambiguity is possible when two aircraft are at the same altitude, but in different directions. The display may **briefly** display both opposite directions (see illustration) until a change in their altitudes allows XRX to split the two aircraft into different profiles.
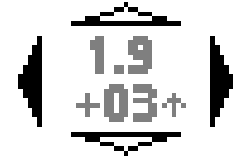
Realistic Detection Window

A common metallic single-engine aircraft exhibits a detection window similar to the diagram here. In metallic aircraft, it is important to note that directly behind your aircraft is a natural shadowing effect due to the vertical tail and empennage mass. However, this region is a very small portion of airspace.

The true effect of this is a limitation in overall detection, not a reduction in bearing quality. An example of this effect is an aircraft at 3.0 NM would indicate 6.0 NM, or an aircraft at 0.5 NM would indicate 1.0 NM. It is a common misconception that multipath propagation that can occur when an RF signal takes different paths around this type of blockage when propagating from the source to the destination. This propagation has no effect on bearing quality, meaning that the tail section of your aircraft will not force an incorrect bearing from the target aircraft.

If your aircraft type is composite, you will not notice this anomaly.
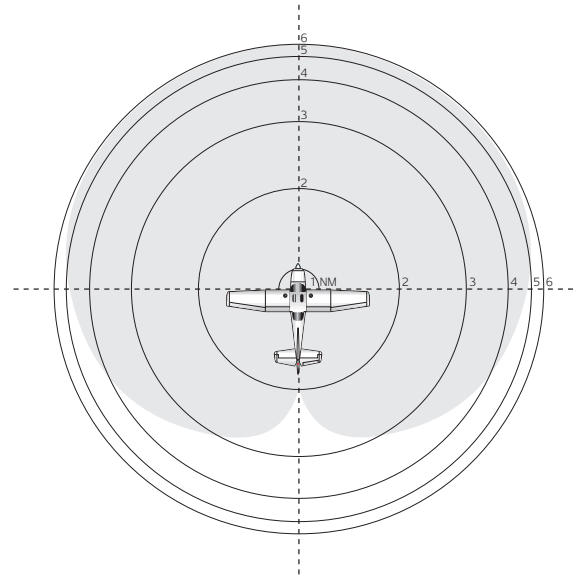
Common Detection Window (High Wing)

North Turning Compass Error

XRX, like all other compasses, can experience a magnetic phenomenon known as turning errors under certain conditions. When a north-bound aircraft banks to turn, the compass momentarily turns in the opposite direction before "catching up" with the correct heading. Please consider these points when turning in an aircraft:

- If on a northerly heading and a turn is made toward east or west, the initial indication of the compass lags or indicates a turn in the opposite direction. The lag diminishes as the turn progresses toward the east or west where there is no turning error. For example, when turning from a heading of 000 to 045, the heading indicator and any associated traffic may indicate a turn to the left (as much as 45°, heading 315 in the example) before "catching up" to heading 045.

- If on a southerly heading and a turn is made toward east or west, the initial indication of the compass will indicate a greater amount of turn than is actually made. This lead also diminishes as the turn progresses toward east or west where there is no turn error. This error has little or no visible effect on XRX.

- The amount of lead or lag is maximum on north / south headings and depends upon the angle of bank used and the latitude of the aircraft.

- When on an east or west heading, no error is apparent while entering a turn to north or south.

TARGET AIRCRAFT

HDG: 040

Actual: 050

Compass indicated track

HDG: 020

Actual aircraft track

Actual: 045

HDG: 330

HDG: 010

XRX
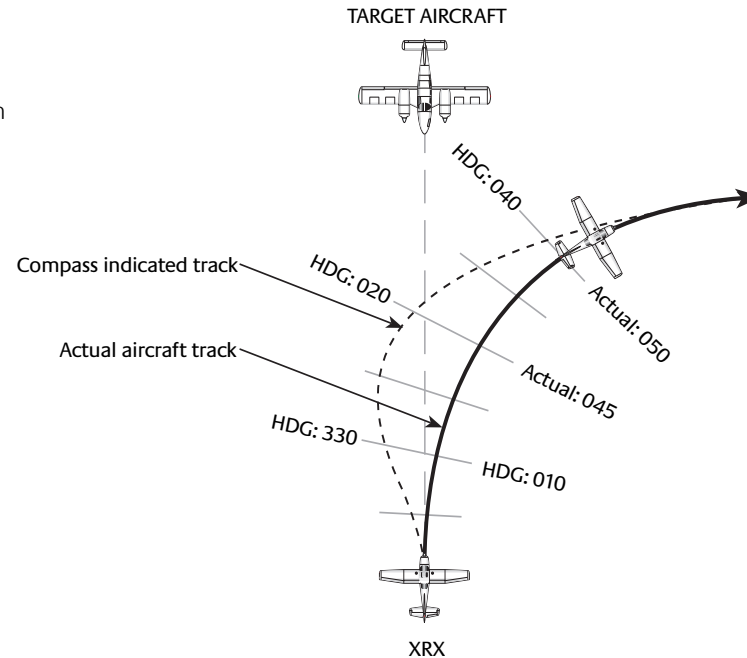
When starting a turn off a northern heading and banking more than 15°, the compass may lag and momentarily show traffic in the opposite direction.

Resetting the Unit in Flight

Like some TCAS systems, XRX assumes you are on the ground when you turn on the unit. As soon as you climb (or descend) 200 feet, it will automatically switch to flight mode. Ground mode reduces ground clutter, or the detection of aircraft at the airport with their transponders turned on. If you turn on or restart the system while in flight, it is important to know that XRX will not show aircraft below you and up to 200 feet above you.

To get out of ground mode when in flight, climb or descend 200 feet above the altitude you were at when you turned on the unit.

Cones of Confusion

At the point where the transmitting signal is either directly above or below your aircraft, cone-shaped areas exist above and below your aircraft in which the directional sensing ability becomes uncertain.

These cones, illustrated here, are similar in appearance and function to the cones of confusion that exist around VORs. These areas of ambiguity become larger the greater the vertical separation. An aircraft entering into these areas of ambiguity may momentarily show up as from more than one direction. In other words, more than one directional arrow may be displayed. As soon as the aircraft passes through, the new direction will be acquired and accurately displayed once again.

The less vertical separation exists between you and the target aircraft, the greater the accuracy of the bearing information. In other words, aircraft close to your altitude are easier to determine their bearing. Aircraft at a high angle to you approach the cone of confusion.

0.7 NM — +2000 ft.
0.5 NM — +1000 ft.
0.2 NM — +500 ft.
0.2 NM — +500 ft.
0.5 NM — +1000 ft.
0.7 NM — +2000 ft.

Strengths and Limitations
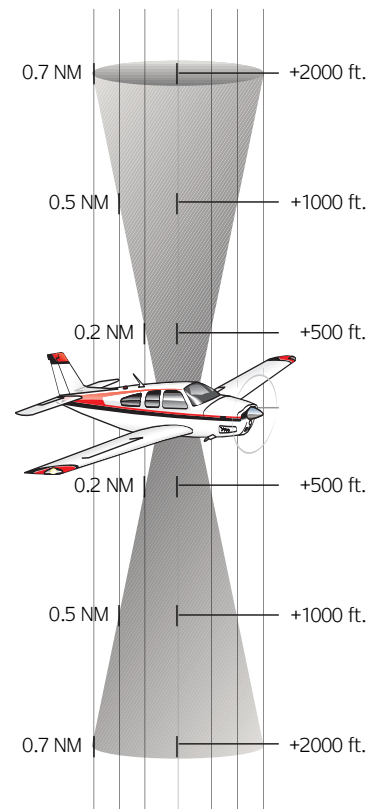
Recognition & Reaction Time

Running time	Action	Seconds
00:00	See object	0.1
00:00	Recognize aircraft	1.0
00:01	Become aware of collision course	5.0
00:06	Decision to turn left or right	4.0
00:10	Muscular reaction	0.4
00:10	Aircraft lag time	2.0
00:12	**TOTAL TIME**	**12.5**

From FAA AC 90-48C.

Time to Closest Approach Point (CAP)

Range	Seconds to Impact	
	600 MPH*	**360 MPH***
10 miles	60 secs.	100 secs.
6 miles	36 secs.	60 secs.
5 miles	30 secs.	50 secs.
4 miles	24 secs.	40 secs.
3 miles	18 secs.	30 secs.
2 miles	**12 secs.**	20 secs.
1 mile	**6 secs.**	**10 secs.**
0.5 mile	**3 secs.**	**5 secs.**

*Combined A/C speeds. **BOLD** times mark the danger zone when insufficient time remains to alter course.

The importance of early warning cannot be stressed enough when it comes to detecting a potential threatening aircraft. These charts indicate how combined aircraft speed and distance play a role in determining your reaction time.

According to the FAA, a typical response time is 12.5 seconds. This translates to a one- to three-mile minimum response distance from an incoming aircraft. PCAS will help you increase awareness and response time.

Buttons & Functions
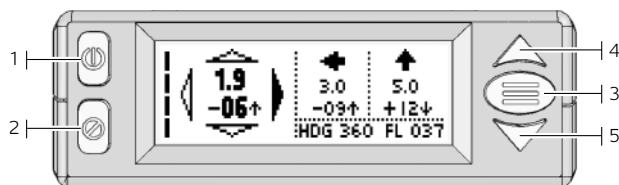
1 | **Power**

Press once to turn unit on. Press again to turn unit off.

2 | **Mute**

Press to mute all audio output; press again to turn mute off and hear audio alerts. Once pressed, the unit will remain in mute until the button is pressed again. Mute will be indicated by replacing the volume bars with the word MUTE.

3 | **Menu** / **Select**

From the traffic screen, press to enter menu mode. Press again to advance through the menus and back to the traffic screen.

4 | **Up**

In traffic screen, turns volume up. In menu mode, moves selector up.

5 | **Down**

In traffic screen, turns volume down. In menu mode, moves selector down.

| **Administrative Mode**

To enter Admin mode, press and hold **mute [2]**, then press **down [5].**

Menus

Hierarchy and Selecting

Highlighted selections are default

AIRCRAFT TYPE

OPEN
HIGH WING
LOW WING

PAGE 47

RANGE WINDOW

6 NM
3 NM
1 NM

PAGE 48

ALTITUDE WINDOW

2500 FT
1500 FT
500 FT

PAGE 49

AIRCRAFT   SCREEN
RANGE
ALTITUDE
COM   EXIT

COMMUNICATION SETUP

ANYWHEREMP
TRUEFLIGHT
NONE

PAGE 50

SCREEN OPTIONS

SCREEN A
SCREEN B
SCREEN A 45
SCREEN B 45

PAGE 51

1.9
−06↑

3.0   5.0
−09↑   +12↓
HDG 360 FL 037
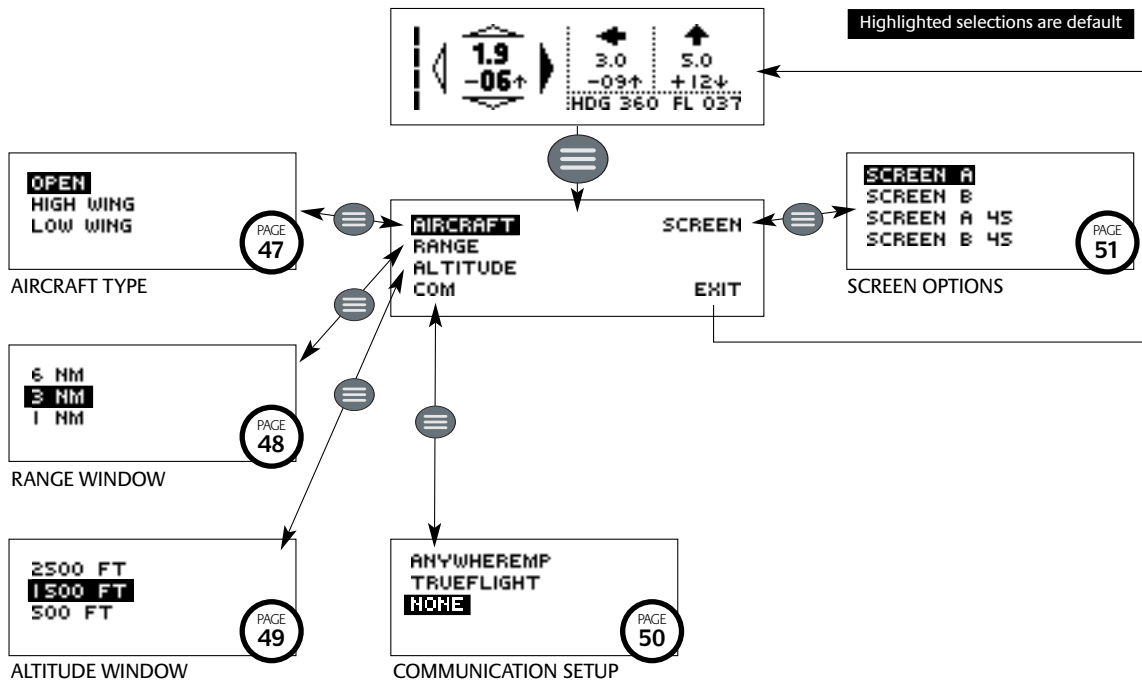
XRX uses simple menus to define the parameters for your flight. From the traffic screen, press the **menu**/**select** button, located to the right of the display, to advance through the menus, and back to the traffic display screen.

To select a highlighted menu parameter and change the setting, press the **up** and **down** buttons until the parameter is highlighted, then press the **menu**/**select** button to display the sub-menu.

In the sub-menu, use the **up** and **down** buttons to highlight the desired setting, then press **menu**/**select** to return to the main menu.

Your selection is temporary and will be saved as long as the unit is on. If the unit is powered off, you will need to reselect your preferences. The only exception is the COM menu selection, which remains even after the unit is turned off).

Pressing the **Mute** button at the main menu will return to the traffic screen.

Menu 1: Aircraft Type

To increase accuracy, different airframe types have different characteristics that effect the antenna reception pattern.

- **Open:** No compensation for airframe, such as a composite aircraft
- **High Wing:** Antenna pattern compensation for a metal high-wing airframe
- **Low Wing:** Antenna pattern compensation for a metal low-wing airframe

To select an aircraft type:

1 | From the Traffic Display Screen, press the **menu**/**select** button once to access the menus.

2 | Press the **menu/select** button to select the Aircraft Type menu.

3 | Use the **up** and **down** buttons to select the desired type

4 | Press **menu**/**select** to return to the main menu.

5 | Press **mute** to return to the traffic screen.

⚠

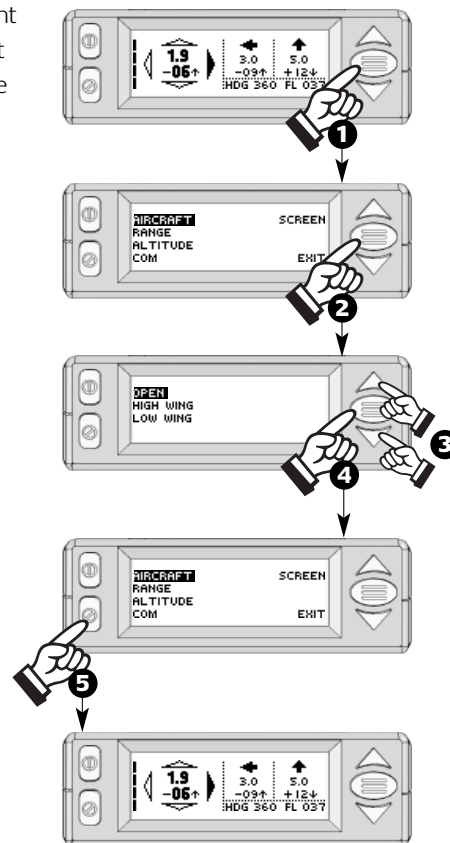Failure to select proper aircraft type can result in bearing errors.

Menu 2: Range

```
6 NM
3 NM
1 NM
```

The range menu allows you to select the horizontal detection window, or range. The available range options are 6 NM radius, 3 NM radius, or 1.5 NM radius (shown as 1 NM in menu).

To select a Range window:

1 | From the Traffic Display Screen, press the **menu**/**select** button once to access the menus.

2 | Press the **down** button once to highlight "RANGE"

3 | Press the **menu/select** button to select the Range menu.

4 | Use the **up** and **down** buttons to select the desired range.

5 | Press **menu**/**select** to return to the main menu.

6 | Press **mute** to return to the traffic screen.

To return to the main menu, press **menu/select** instead of **mute** in step 5.

⚠ Traffic outside the selected range window will not be indicated.

Menu 3: Altitude

```
2500 FT
1500 FT
 500 FT
```
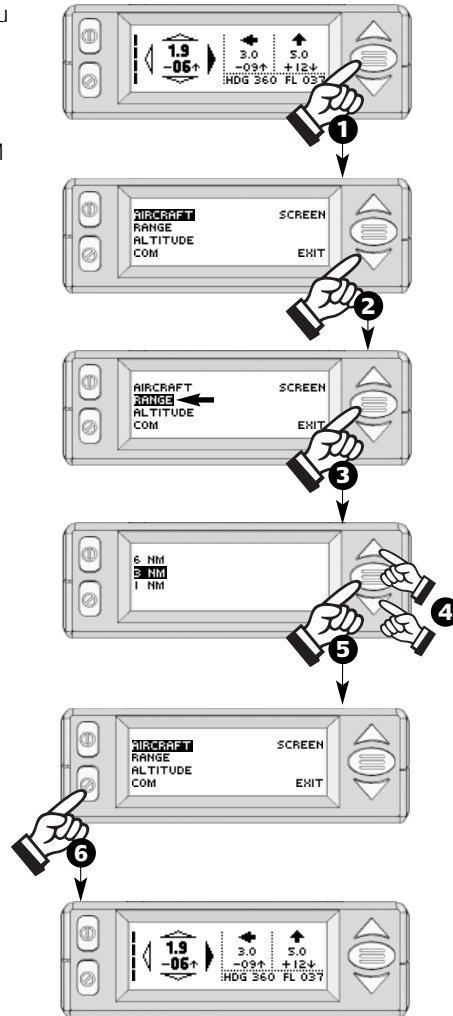
The purpose of the altitude menu is to limit threat indications based on altitude separation from your aircraft, especially when operating in dense traffic environments.

To select an Altitude Limitation:

1 | From the Traffic Display Screen, press the **menu**/**select** button once to access the menus.

2 | Press the **down** button twice to highlight "ALTITUDE"

3 | Press the **menu/select** button to select the Altitude menu.

4 | Use the **up** and **down** buttons to select the desired altitude.

5 | Press **menu**/**select** to return to the main menu.

6 | Press **mute** to return to the traffic screen.

⚠ Traffic outside the selected altitude window will not be indicated.
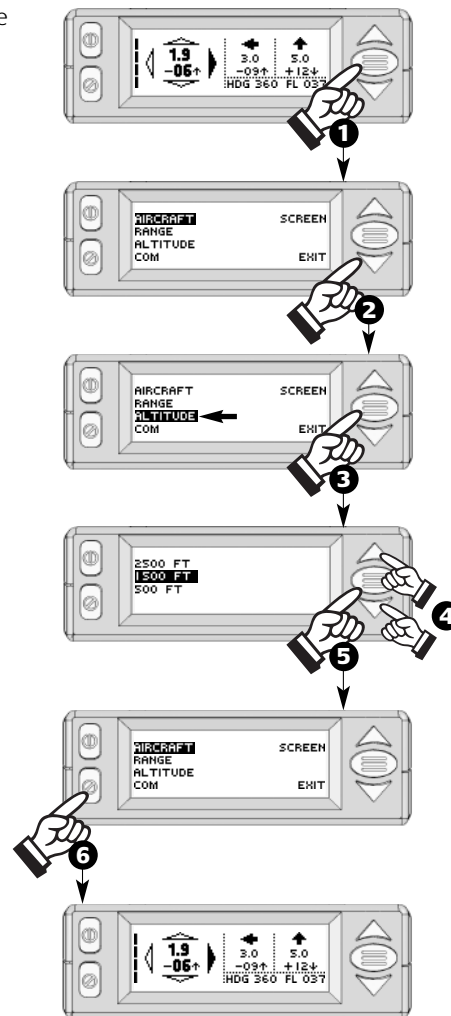
Menu 4: Third-Party Communications Setup (Com)

```
ANYWHEREMP
TRUEFLIGHT
NONE
```

XRX data can be displayed on external and third-party systems through the RS-232 port on the back of the unit. Use this menu to select the appropriate system you wish to connect to. At press time, AnywhereMap and True Flight systems are supported.

To use a different communications setup:
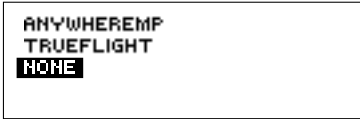
1 | From the Traffic Display Screen, press the **menu**/**select** button once to access the menus.

2 | Press the **down** button three times to highlight "COM"

3 | Press the **menu/select** button to select the Com menu.

4 | Use the **up** and **down** buttons to select the com setting.

5 | Press **menu**/**select** to return to the main menu.

6 | Press **mute** to return to the traffic screen.

When a a com selection other than "none" is made, only the current com mode to indicate the unit is on and functioning (no traffic data will be displayed). All menu configurations can be controlled by the third-party system, but can still be accessed directly on the XRX.

⚠️ When configuring the XRX for third-party output, check the configurations switches to ensure switches A-8 and B-1 are position in the ON position. For more information, see "Configuration Switches" in the Appendices).

Menu 5: Screen Options

```
SCREEN A
SCREEN B
SCREEN A 45
SCREEN B 45
```

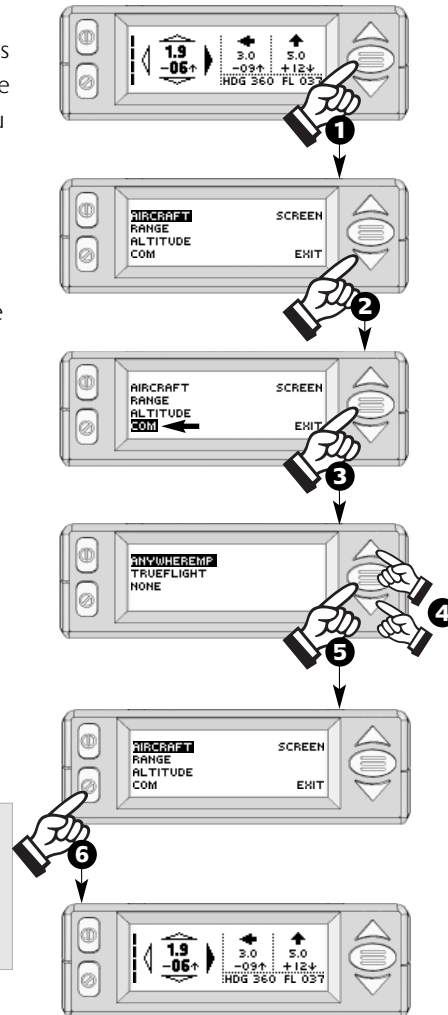The XRX offers the unique ability to display data in different ways, and at different angles.

To use a different screen option:

1 | From the Traffic Display Screen, press the **menu**/**select** button once to access the menus.

2 | Press the **down** button four times to highlight "SCREEN"

3 | Press the **menu/select** button to select the Screen menu.

4 | Use the **up** and **down** buttons to select the desired screen type.

5 | Press **menu**/**select** to return to the main menu.
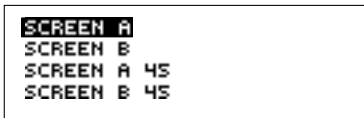
6 | Press **mute** to return to the traffic screen.
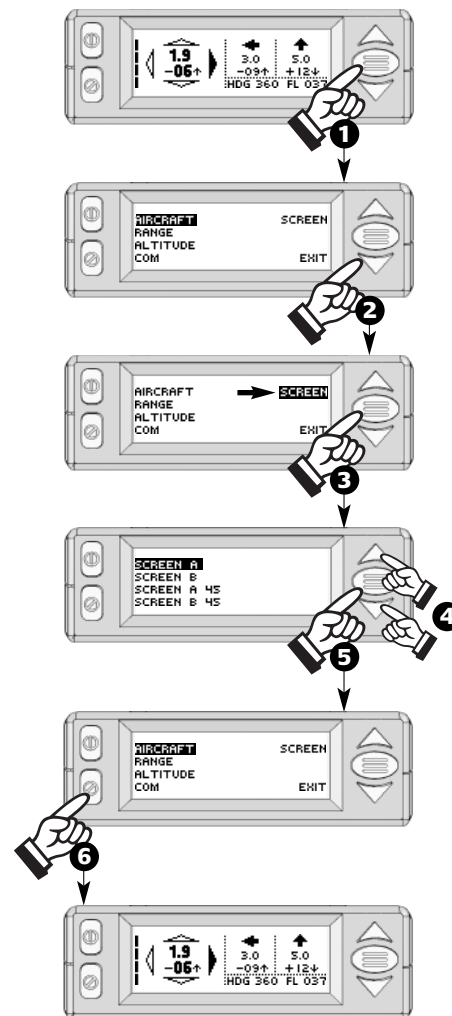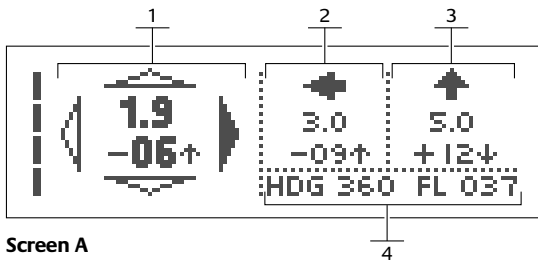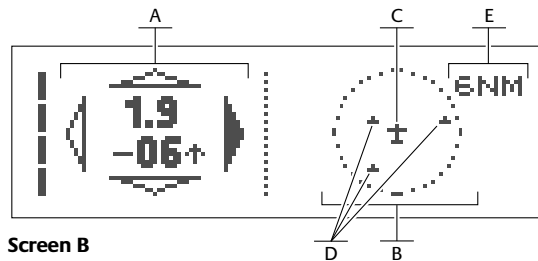
Screen A

Screen B

- **Screen A:** This is the standard traffic screen layout. The primary aircraft is on the left, and two secondary aircraft are on the right, above the local altitude and heading.

  1 | Primary aircraft   3 | Secondary aircraft #2

  2 | Secondary aircraft #1   4 | Local heading and altitude

- **Screen B:** This layout presents you with an alternate overhead view of the top three aircraft with reference to bearing and range only. A range ring representing the maximum detection range surrounds a display of aircraft in relation to your aircraft.

  A | Primary aircraft   D | Target aircraft (maximum of 3)

  B | Overhead view, enclosed by range ring   E | Range setting

  C | Your aircraft

> ⚠ Screen B is designed for quick reference only in composite or wood-and-fabric airframes and does not contain altitude information. Screen B was not intended for use in metallic airframes.

● **Screen A 45:** This setting will adjust the bearing and compass 45 degrees to the left so that XRX can be placed on the right side of the instrument panel and angled towards the pilot. If your glareshield is short, or standard unit placement directly in front of you is not possible or inconvenient, this setup will allow for an alternate placement.
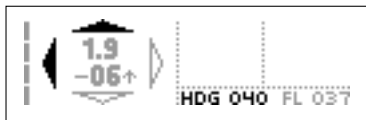
Without the 45° correction, the unit would display the aircraft in the example to the right incorrectly.

With the 45° correction, the unit allows the correct processing of the aircraft in relation to the aircraft.

⚠ If you calibrate the compass with the 45° correction turned on, you must still face XRX due north. Calibration will ignore the 45° correction.

Direction of Travel Heading: 360

45°

Back

LCD

Your Aircraft

● **Screen B 45:** This setting will perform the same angle correction as the above setting, but will display Screen B.
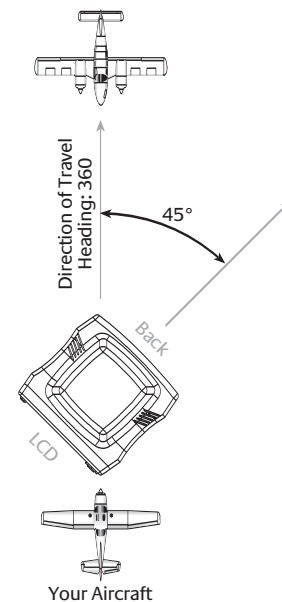
Additional Menus: Administrative Mode

Your XRX unit comes fully calibrated and ready to use. If, however, any of the internal sensors start to drift, adjustments can be made using the admin menu. This menu provides access to compass and altimeter calibration screens, as well as a general information about the environment and the information the on-board sensors are tracking.

To enter Administrative mode:

1 | Press and hold the **mute** button

2 | Press the **down** button within 10 seconds

Admin Mode

Traffic Screen

COMPASS

UP: SET 360
SEL: SKIP

Compass Calibration Page

HDG	360	COMP X	137
TEMP	037	COMP Y	151
SQWK	1200	BANK	150
SEL: NEXT		ALT	007

General Information Page

ALTIMETER
        003

SEL: NEXT

Altimeter Calibration Page

PRESS SEL
TO SAVE

Confirmation Page

Compass Calibration

```
COMPASS

UP: SET 360
SEL: SKIP
```
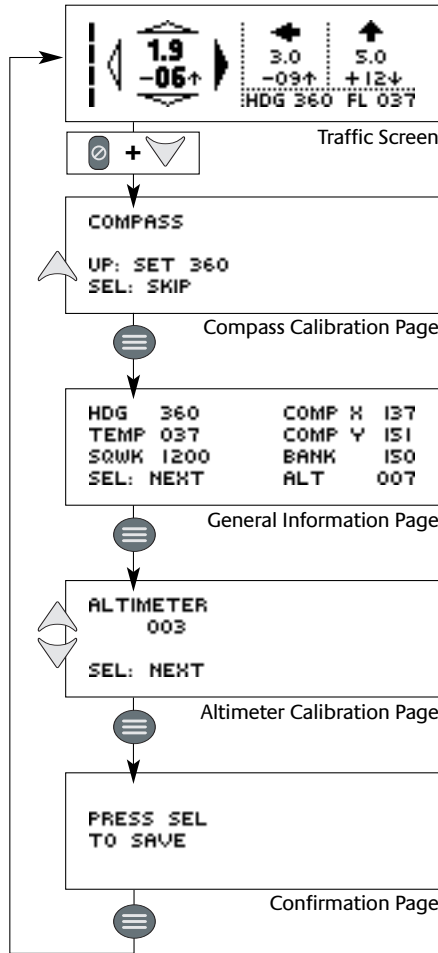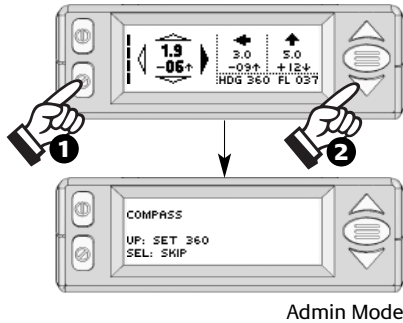
XRX contains a solid-state compass to provide the local heading and smooth traffic transitioning. The compass is factory calibrated and shouldn't need to be re-calibrated in most cases.

If you notice the local heading is in error by more than 20°, you can recalibrate the compass using the following steps:

1 | Make sure XRX is level to the ground (±10°)

2 | Make sure XRX unit is facing directly north using your aircraft's magnetic compass (display faces south)

3 | Press the **mute** and **down** buttons at the same time to enter admin mode.

4 | Wait 30 seconds to allow the compass to stabilize.

5 | Press the **up** button. Wait for the compass to calibrate. The word "wait" will appear in the top right of the screen. When calibration is complete, the screen will advance to the next admin page.

To skip compass calibration press the **menu/select** button to move to the next admin page.

⚠️ Miscalibrating the compass will directly result in bearing errors of all traffic during turns.

❶

< 10°

❷ Magnetic North

❸ ❸

Wait 30 seconds

```
COMPASS

UP: SET 360
SEL: SKIP
```
❺

General Information Page

```
HDG   360      COMP X  137
TEMP  037      COMP Y  151
SQWK 1200      BANK    150
SEL: NEXT      ALT     007
```
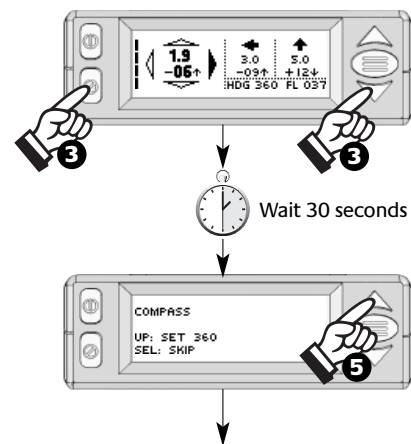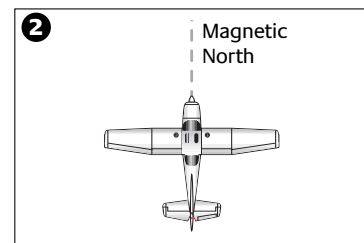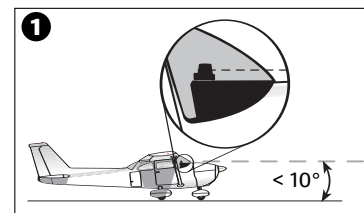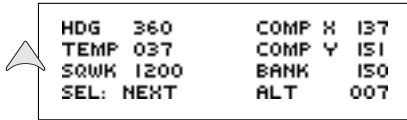
The next admin menu displays general information regarding both your XRX system and your aircraft.

The following information is displayed:

- Your current magnetic heading (HDG)
- XRX system temperature in Celsius (TEMP)
- Your aircraft squawk code (SQWK)
- The local altitude (ALT)
- Coded compass and bank/pitch angles

<Beep> + "Test"

Pressing the **up** button on this page will play the message "test" through the audio system. You can perform this test as many times as needed to properly adjust your audio hookup (see pages 14-17 for more information on hooking up the audio.

To continue to the next menu, press the **menu**/**select** button.

Altimeter Calibration Page

```
ALTIMETER
     003

SEL: NEXT
```
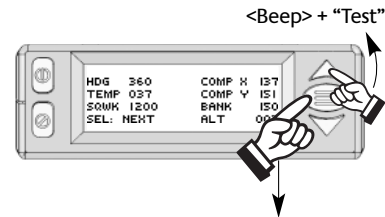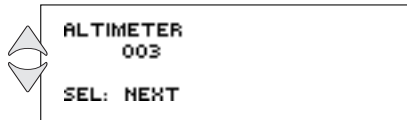
It is recommended that you check your altimeter every 6 months by comparing your aircraft altimeter's pressure altitude (tuned to 29.92) to the XRX pressure altitude shown in the right hand bottom of the traffic screen.

To adjust your altimeter:

1 | In your aircraft, enter 29.92 into the Kollsman window of your altimeter

Set to 29.92

2 | Press the **up** and **down** buttons to match your aircraft's altimeter pressure altitude of 29.92. The altitude XRX shows is in 100 ft. increments, or flight levels. For example, 003 equals 300 feet.

Pressing **up** or **down** will change the altitude shown. However, when you switch from changing altitude down or up, the altitude will reset to the factory default setting. Simply continue from this point to press the **down** or **up** buttons until you achieve the desired altitude.

3 | To continue to the next screen, press the **menu/select** button.
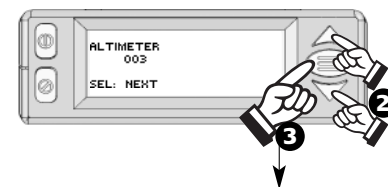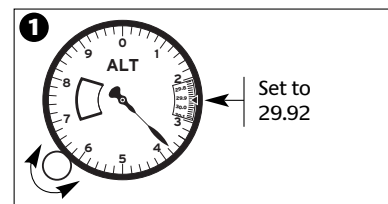
Saving the Settings

The next admin page directs you to press **menu/select** to save changes and return to the traffic screen. The changes you make in the admin pages are saved to flash RAM and will remain even after turning off the unit.
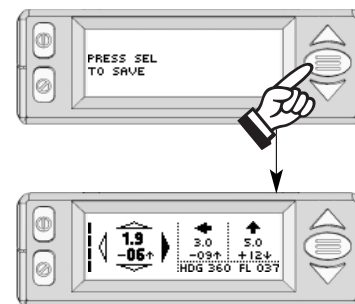
Troubleshooting

Power

Should the XRX unit be turned off when starting up the aircraft?

When using aircraft power it is always a good idea to keep any avionics off during startup. Since the aircraft has only two sources of power, the battery and the alternator, engine starting causes the battery to contribute considerable amperage to the starter which reduces it's output voltage below that of acceptable levels for most avionics. While older, tube-style avionics are not as affected, newer processor-based avionics, such as XRX, may not deal well with this situation, even though most avionics devices turned on during this time period should simply reset itself. A potential power surge does pose some risk, however this is not very likely since the output voltage on most alternators are protected from such.

Occasionally, when the power button is pushed, the unit turns off as soon as the button is released.

This system is turned on through a momentary press of the power button for less than one second. If the power button is held down for too long, the system will shut off when pressure is released. Press the power button for no more than one second, then release.

Unit powers on, the display briefly illuminates, then unit immediately shuts off.

Check all connections for proper installation. Unit will shut off automatically if a short in the system is detected. Unplug all audio connectors and turn on unit. Check to make sure the minimum voltage and current are available through your power connector, both at the aircraft and at the tip of the power adapter (see Appendices: Specifications). If unit never starts up, unit needs to be repaired.

Upon powering up, unit displays a garbled or semi-garbled screen, resets, then operates normally.

This is normal and simply means unit was reset (powered off then back on) too quickly. The unit will sense the improper startup and reset itself.

Traffic Detection

Unit never detects traffic.

If your XRX unit never displays traffic and you suspect or can visually identify aircraft around you, your unit may need to be serviced.

⚠️ While ATC can provide invaluable services to you as a pilot, using them to verify aircraft displayed on the XRX screen may be unreliable. Remember, XRX is an airborne, dual network system capable of detecting aircraft responding to TCAS interrogations, or aircraft that are out of reach of Ground RADAR. A rule of thumb is, if the XRX is displaying traffic, the traffic must exist somewhere. Nothing else can generate the unique squawk and altitude codes used in sensing traffic.

On the ground, during taxiing, or in the run-up, the unit starts showing traffic at erroneous altitudes.

If you pass in close proximity to another aircraft either on the ground or when they are landing or taking off, XRX may momentarily receive their transponder altitude and think it is YOUR altitude. If this occurs, the unit may display traffic below ground altitude or other traffic landing as too low or too high. This situation is self resolved as soon as your transponder transmits again, however it may be confusing until this occurs. To determine if another aircraft has set your altitude with their transponder, you would notice that the local altitude displayed is obviously higher than your ground level pressure altitude, and/or the squawk code may not agree with what your transponder is set to. Reset your XRX by turning it off, waiting at least two (2) seconds, then turning the unit on.

When tracking an aircraft flying overhead, ATC said traffic was less than a mile, but XRX showed the traffic was 2.0 NM. Why the difference in range?

XRX gives range based on true distance in three-dimensional space and is based off of received signal amplitude. Some aircraft such as airliners have twice the power output of most general aviation aircraft and will appear closer than in reality.

When tracking an approaching target, the range appears to decrease rapidly as if it is "catching up".

When transponder antennas are coated with oil, dirt or other materials, the transmission properties can change. We encourage all pilots to make sure their transponder antennas get cleaned as often as possible to reduce this affect of antenna-forward attenuation. This attenuation will cause a distortion in the ability to accurately detect traffic. XRX will be forced to accommodate for this attenuation by updating the range information when it can get a clear signal.

The unit constantly displays < 0.4 NM and "ALT +00".

Instead of ignoring your transponder, the unit is picking up your transponder as a threat. Try the following:

- Make sure your transponder antenna is clean. Even a small amount of grease or dirt build-up can dampen your transponder signal.

- Call Zaon and we can walk you through changing the local host transponder suppression level. This will allow XRX to "dig" a little deeper to lock onto your transponder. If this solution is not effective, you may need to contact a local avionics shop to test the power output of your transponder. The peak power output should be between 100 and 250 watts. Anything less is not acceptable under TSO tolerance, which is what XRX is calibrated to, and may not work with the XRX system.

Clean your transponder antenna often.

Displays constant traffic DETECTION; unit constantly displays > 0.9 NM.

Any traffic displayed can only be from another transponder-equipped aircraft. The only source for traffic detection is from other valid aircraft (unless the unit is detecting your own transponder, see above). In order for traffic to be displayed, XRX must decode a valid Mode C (altitude) signal code. Interference from your aircraft or avionics cannot create this code, and the pilot should trust this indication. It is not uncommon to see a consistent display of traffic within the detection window, especially when it is set to 6.0 NM as this is a large portion of airspace.

Common responses to constant traffic detection:

"I called ATC they said no traffic exists." This is an unreliable way of checking for traffic. ATC doesn't typically indicate traffic which is not a factor. This means there may still be traffic around you which XRX will detect. In addition, ATC may not necessarily be looking at a screen which shows all non-factor traffic. For example, some controllers use a "1200 filter" which blocks all VFR traffic squawking 1200 from being shown.

"I don't see any traffic and it says X.X NM" Traffic is typically not visible beyond 1.5 to 2.0 NM. Just because traffic can't be seen does NOT mean there is no traffic. First-time users may be surprised just how much traffic is nearby that was previously undetected. Again, XRX cannot display traffic unless a valid Mode C transponder code is detected.

"There can't possibly be someone at 5.0 NM for 10 minutes." Actually, this is very common. 5.0 NM may also indicates traffic is GREATER than 5.0 NM. Does the unit show multiple aircraft? If so, several aircraft are within the 5-7 mile range. The only way for XRX to display traffic is to receive a valid code from another transponder.

These responses are typical for many pilots because they simply cannot SEE the traffic they assume it is not real. Pilots must learn to trust the instrument, similar to trusting flight instruments during instrument flying.

The local altitude displayed is different from my altimeter.

XRX displays pressure altitude, not indicated altitude. It is using the same format as your transponder. Indicated altitude will only match when your barometric pressure is 29.92". To test this, set your altimeter to 29.92. It should agree with your XRX within ±100 ft.

While flying, the local altitude displayed is significantly different from the current pressure altitude.

Check to ensure the pressure altitude was incorrectly computed. Check if the pressure has not changed since the calculation. If problem persists, the unit may need to be recalibrated.

Sometimes range information skips, for example, from 5.0 NM to 3.0 NM.

The transponder system on the target aircraft is not always transmitting; therefore this indicates the aircraft moved through 4.0 NM without transmitting for XRX to range it. Also, as an aircraft changes positions, antenna transmission lobes change, leading to signal alterations. This is normal.

When viewing an aircraft on takeoff, the unit did not detect the aircraft until it was airborne or at a certain altitude.

The aircraft was probably below RADAR coverage. Typically, once an aircraft has obtained an altitude of 300-500 feet AGL, it will be in coverage and start transmitting. Also, many pilots initially forget to switch their transponders to altitude. XRX, as with any other collision avoidance system, will not be able to detect an aircraft unless the target transponder is in altitude mode.

When the target aircraft taking off or landing, the unit shows -100 or -200 feet which is not possible.

This is caused by the additive effect of the tolerances involved with the systems. A transponder system has a tolerance of ±100 feet. With two transponders involved (yours and theirs), as much as a ±200 foot variance may occur. These tolerances are FAA specified, and this situation applies for even the most complex TCAS systems.

The unit is alerting me and the aircraft is still 1.5 miles away.

Change modes to decrease threat levels and narrow the scope of what your unit will consider a threat. See the Operations chapter for instructions on how to change the range and/or altitude modes.

The unit did not display any traffic or alerts when an aircraft flew by me.

XRX does not detect ALL aircraft. For example, if the target aircraft is out of RADAR range, does not have transponder on, or the antenna signal is shadowed, among other scenarios, XRX may not be able to display the traffic. Also, check that the altitude mode did not limit the detection window below the target aircraft's position. For example, if an aircraft passed 600 feet below, and the altitude window was set at 500 feet, no traffic would be displayed.

The range of some commercial airliners is displayed as closer than actual distance.

Airliners typically use a higher power transmitter which can affect ranging. While this difference is slight, it can be noticed at greater ranges where the power-to-distance envelope widens. For example, traffic at a true distance of 6 to 10 nm may be displayed as 4 to 6 nm. The closer the traffic is, the more this situation is cleared up. For example, traffic at 1 nm may be displayed as 0.8. This difference should be completely unnoticeable.

Appendix

Specifications

Environmental

Altitude	Min. 0 ft.	Max. 22,000 ft (FL220)
Temperature	Min. 0°C (+32°F)	Max. +65°C (+150°F)
Pressure	Min. 0 kPA (0 PSI)	Max. 100 kPA (14.5 PSI)
Humidity	Tested to 100% humidity	

Mechanical

Dimensions	3.9 (100 mm)	Width
	3.6 (93 mm)	Depth
	2.7 (69 mm)	Height (includes antenna)
Weight	8.2 oz. (232.5 g)	

Electrical

Power	10-48 VDC	Negative ground
Consumption	@ 14V	4.2 watts max.
	@ 24V	2.6 watts max.
Current	300-400 mA	325 mA nominal
Connector Type	2.35mm mini	Tip positive

Receiver

Type	Superheterodyne / PLL x4	
Selectivity	1090 MHz	
Bandwidth	±8.1 MHz	
Signal Modes	X, Y, A, C, S, 2, 3/a, 3/c	
Scan Rate	3.2 kHz	
Data Rate	1000 kbps	
MTL Sensitivity	-78 dBm	
Max Peak Power	+28 dBm	
Max. Detection Range	22.0 NM 7.0 NM	100% Error Rate 10% Error Rate
Receiver Dynamic Range	68 db	

Accuracy

Range Resolution	0-2.0 NM 2.0-3.0 NM 3.0-6.0 NM	±0.1 NM ±0.2 NM ±1.0 NM
Bearing Resolution	30° (45° displayed)	
Altimeter Accuracy	±200 ft.	
Compass Accuracy	±20°	
Bank/Pitch Accuracy	±6°	
Temperature Sense	0.1°C	

Antenna Array

Type	Directional capable, internal, multi-element directional array
Number of Antennas	4
Open Space	±8.2°
Obstruction	±30°
Sense	Amplitude / Phase
Phase Balance	±12°
Amplitude Balance	±0.5°
Phi Range	>65°
Polarization	Cross
Gain	+2.2 dBi

Display

Type	FSTN Liquid Crystal Display, Black/White, Wide Temp
Resolution	122 x 32
Viewing Angle	12:00
Backlight	White Electroeluminesence

Appendix

Audio

Impedance	300 ohms x 2 channels or 600 ohms x 1 channel, selectable
Power	4.0 watts max. @ 2.5 volts peak-to-peak
Compatibility	Stereo / Mono selectable, ground isolation or connection

Storage

Temperature	Min: -40°C (-40°F)	Max: +85°C (185°F)

Upgrading the Firmware

Your XRX unit can be reprogrammed to accept future firmware updates.

The current firmware number will be displayed during the startup screen (i.e. 1.0). For the latest firmware version, or for instructions on how to get your firmware updated, please visit the Zaon website at **http://firmware.zaonflight.com**. Firmware updating may require you to send in your unit to the factory for reprogramming and recalibrating.

Startup screen, showing firmware version installed

Accessories

A complete line of accessories is available from your local avionics or pilot supply store, or through Zaon direct.

Customer Service

Before contacting your place of purchase for a repair or refund, call us directly. In most cases, any concerns can be satisfactorily remedied by one of our technicians or support staff.

Online Support

Web Address	Description
Register Your Unit register.zaonflight.com	Please register your unit with Zaon Flight Systems. This will keep you up-to-date with changes or revisions. Also, no repairs or warranty work will be performed on unregistered units.
Avionics Web Site www.zaonflight.com	All information on Zaon avionics can be accessed from our avionics home page. Start here for most of your questions or information needs.
KnowledgeBase support.zaonflight.com	An extensive database of articles has been established on the internet to assist with a variety of questions and concerns, from installation and operation to detection concerns and expectations. Before contacting us personally, we urge to you search the database for answers to many of your questions.
Firmware Updates firmware.zaonflight.com	This site contains all information concerning the latest firmware releases for all of our products, including information on how to obtain a firmware update.
Accessories accessories.zaonflight.com	Should you need to order or replace any avionics accessories, please visit the XRX accessories page. This page keeps you current with the latest accessories for your XRX.

Personal Support

For personal support or technical questions, please call Zaon Monday through Friday, 8 am to 5 pm Central, at:

Toll-Free	(800) 496-9430
International	+1 (972) 292-1541
or fax	(972) 292-1546
or email	support@zaonflight.com
or visit	www.zaonflight.com

To Return Your Unit For Repair

If you purchased XRX from a Zaon dealer, do not contact the dealer for repair. All repairs must be completed through Zaon directly.

To return your XRX for repair, call us to receive a Returned Merchandise Authorization (RMA) number, return question-naire and shipping instructions. **No repairs or refund will be made without an RMA number.**

To Return Your Unit For A Refund

Units must be returned through the place of purchase. Shipping costs for all returns hereunder shall be at buyer's expense.

The remedies herein shall be cumulative and additional to any other or further remedies provided in law or equity. No waiver of a breach of any provision of this contract resulting from the order shall constitute a waiver of any other breach or of such provision herein.

Warranty Information

Zaon's entire liability and buyer's exclusive remedy for Zaon products that fail to conform to Zaon's limited warranty, which is set forth on the enclosed Warranty & Registration card, shall be, at Zaon's sole option, either repair or replace-ment of the nonconforming products, or, if neither is practicable, a refund of the unit cost paid by buyer to Zaon for such products. The warranty for the repaired or replaced product is limited to the scope and remaining duration of the original warranty for the nonconforming product. This warranty is contingent upon proper use of the Zaon products as they were intended and does not apply to any Zaon Products that are subjected to unusual physical or electrical stress,

misuse, neglect, improper testing or storage, modification or unauthorized repair or upgrade.

Other than as expressly set forth herein, ZAON MAKES NO WARRANTIES, EXPRESS, STATUTORY, IMPLIED OR OTHERWISE. ZAON EXPRESSLY DISCLAIMS THE IMPLIED WARRANTIES AND CONDITIONS OF NON-INFRINGEMENT, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, TO THE MAXIMUM EXTENT PERMITTED BY LAW.

Opening your avionics unit voids the Service Warranty. There are no user-serviceable parts inside your XRX unit. Opening the unit will change the individually-tuned internal circuitry and WILL VOID YOUR WARRANTY COVERAGE.

ZAON'S LIABILITY TO BUYER ARISING OUT OF OR RELATING TO ANY ZAON PRODUCTS SHALL NOT EXCEED THE AGGRE-GATE AMOUNTS PAID BY BUYER TO ZAON FOR SUCH ZAON PRODUCTS. IN NO EVENT WILL ZAON BE LIABLE FOR LOST USE, PROFITS, REVENUE, COST OF PROCUREMENT OF SUBSTITUTE GOODS, OR ANY OTHER SPECIAL, INDIRECT, RELIANCE, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED AND UNDER ANY THEORY OF LIABILITY RELATING HERETO.

Configuration Switches

Your XRX unit has two groups of configuration switches, located inside the hatch on the bottom rear of the unit. Group A configures the audio, and Group B configures the RS-232 output options.

For more on RS-232 output, please refer to a separate document, XRX RS-232 Handbook, available online at www.zaonflight.com.

Bold items are factory default settings.

Rear of Unit

Inside Switch Compartment

RS-232 Connection

Configuration Switches Hatch

A	ON	OFF
1	300 Ω Impedance	**600 Ω Impedance**
2	**Mono***	Stereo**
3	Stereo**	**Mono***
4	**Ground Isolation**	Ground Connect
5	**Non-pressurized**	Pressurized
6	**In-Cabin Audio ON**	In-Cabin Audio OFF
7	**Calibration Mode OFF**	Calibration Mode ON
8	**+5 VDC to RS-232 Pin 9**	OFF / NC
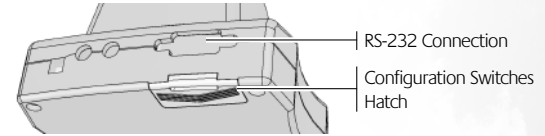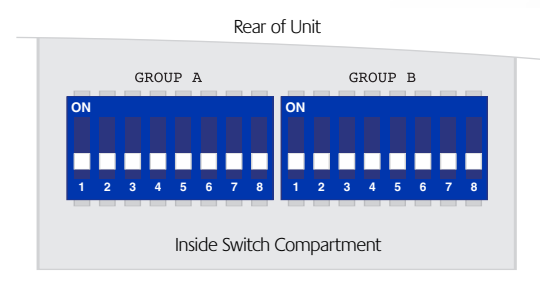
B	ON	OFF
1	**RS-232 Enable**	RS-232 Disable
2	DCD to DSR	OFF / Disconnect
3	RTS to CTS	OFF / Disconnect
4	DTR to DSR	OFF / Disconnect
5	XRX TX to RS-232 TX	OFF / NC
6	**XRX TX to RS-232 RX**	OFF / NC
7	**XRX RX to RS-232 TX**	OFF / NC
8	XRX RX to RS-232 RX	OFF / NC

Installation and FAA

XRX was designed to be placed on the glare shield for optimum use. Installation into any other part of the cockpit is not approved by Zaon for the base XRX unit. The directional antenna is built-in and requires a clear view of the surrounding traffic which can only be achieved by placement in this location. However, an installation upgrade kit will be available which will allow the antenna to be remotely mounted and the base unit to be installed. Contact a Zaon representative for more information.

XRX is a Class 1 EFB device and does not require FAA, AIR or AEG evaluation or certification for normal use. However, if you plan to install XRX into a certificated aircraft, you may need the installation to be approved by your local FAA Flight Standards Field Office (FSDO) field office. The 337 Field Approval Application must be completed for your particular aircraft and approved by the FAA to be in full compliance.

This form, along with the Installation Guide, can be found online at our installation and FAA support site: www.zaonflight.com/avionics/installation.

Appendix

Regulatory Information

FCC Regulations

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed in accordance with the instruction manual, may cause harmful interference to radio communications.

Canadian Regulations

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations. (Cet appareil numérique de la classe B respecte toutes les exigences du Réglement sur le materiel brouilleur du Canada.)

European Economic Community Declaration of Conformity

according to ISO/IEC Guide 22 and EN 45014

CE

Manufacturer's Name: Zaon Flight Systems, Inc.

Manufacturer's Address: 15222 King Road, Suite 403, Frisco, TX 75034 USA

declares that the product

Product Name: PCAS
Model Number: XRX
Product Options: None

conforms to the following product Specifications:

The EMC Directive 89/336/EEC*
Emissions:Harmonized CISPR Standard EN 55022
             Meets or exceeds RTCA DO-138 Category B
Immunity:Harmonized Basic Standard EN 50082-1

The product herewith complies with the requirements of the EMC Directive 89/336/EEC of the European Community and carries the CE marking accordingly.

* The product was tested in a typical installation configuration.

Zaon Flight Systems, Inc.
Office of Quality Manager
Frisco, TX
November 2005

European Contact: Sky Fox GmbH, Pfalzburger Str. 43-44, Berlin, Germany (Fax 49 30 864 746 99)

Appendix

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