

pcas

Portable Collision
Avoidance Systems

MRX

Range | Relative Altitude

Owner's Manual

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

Written by

Jason Clemens

Contributors

Zane Hovey

Ron Watson

Rachel Ballard

Don Morris

Vince Beasley

Rob Kalberer, True Flight

Greg Yotz, ControlVision

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

Introduction

Thank You

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

The MRX features a 5 NM scan range and a vertical detection window of ± 5000 ft., a built-in altimeter for guaranteed accuracy at all times, and can be powered from 2 AA batteries or aircraft power (12-40 VDC).

MRX 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,
Zoon Flight Systems, Inc.
Avionics Research & Development

Cautions & Warnings

- As with all collision avoidance devices, MRX may not detect all aircraft within the detection window.
- MRX 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 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 $+55^{\circ}\text{C}$ (130°F).

- 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.
- AVOID the use of chemical agents such as benzene or alcohol when cleaning, as they damage the unit surfaces.
- We highly recommend removing batteries from the unit when not in operation for extended periods of time. Even with the unit power OFF, a negligible current still flows through the circuitry. Fully charged batteries may experience a minute power drain that, over time, could deplete the batteries while the unit is powered OFF.

Manual/Unit Differences

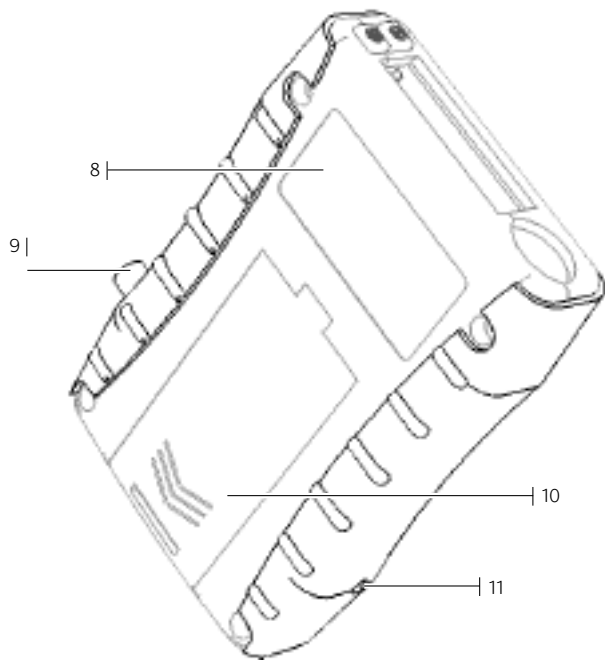
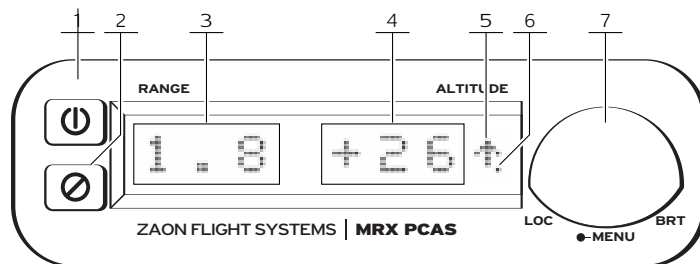
The photos and illustrations in this manual may vary slightly from your unit. These differences are aesthetic only and should not change the functionality of your unit. From time to time, slight modifications are made for any number of reasons, and Zaon reserves the right to make these modifications 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.

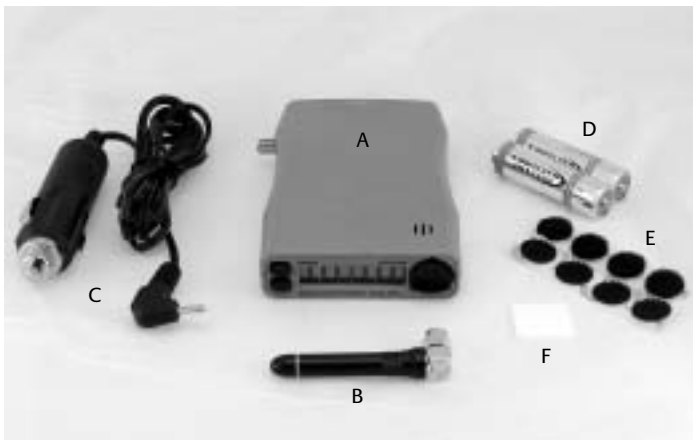
Overview and Setup

Controls & Functions



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Unpacking



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Your MRX 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 on page 43).

Setup

Placement Considerations

The preferred placement for MRX is on the glare shield of your aircraft with the antenna angled vertically. This configuration affords MRX the best possible sensitivity and accuracy. **Position MRX at least 2" away from any magnetic compass** to avoid potential magnetic interference.

You may alternately remotely mount the antenna using an available **antenna extender**, which allows the antenna to be mounted on a side or rear window, and allows the unit to be placed anywhere in the cockpit, such as under the dash. Visit our website for more info.



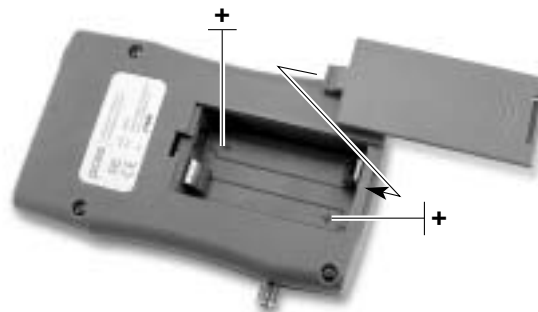
For best performance, we recommend the use of Nickel-Metal-Hydride (NiMH) batteries.

Alkaline batteries may be used, but you may experience a significant reduction in battery life duration.

Power (Batteries)

MRX can be powered from two AA batteries (included). Proper battery insertion must be observed. Improper battery insertion may result in damage to your unit, as well as battery leakage, and may pose a toxicity threat. Also, do not mix battery types (ie: alkalines and rechargeables).

Zaon recommends the use of Nickel-Metal-Hydride (NiMH) rechargeable batteries to achieve the longest battery life. A high mAh rating is recommended (typically 2000 or higher). Alkaline and other types of rechargeable batteries may be used, but you may experience a significant reduction in battery life duration. Setting the display brightness to maximum can reduce battery life by up to 25%.



To install batteries:

- 1 | Open battery bay door by pressing down on the door (use the lines for a better grip) and slide the cover towards the rear of the unit. Remove old batteries (if applicable).
- 2 | Insert two new batteries, observing proper polarity. DO NOT INSERT BATTERIES INCORRECTLY or damage may occur to your unit.
- 3 | Place the battery bay door back on unit and slide it towards the front until it clicks into place.

Low Battery Indications

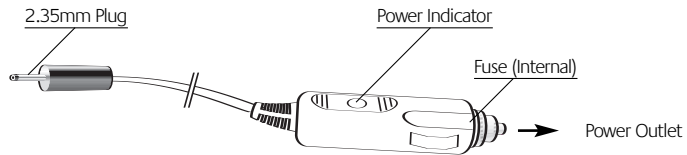
If using batteries, when the battery power drops below an acceptable level, MRX will issue one short beep, accompanied by a "LOW BAT" message for 2 seconds. This alert will continue every minute until the batteries are replaced or recharged.



If there is not enough power left in the batteries for proper operation, MRX will not start up. Replace the batteries to resume operation.

Power (External or Aircraft Power)

MRX may also be 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. 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. **The power adapter does not charge batteries.**

* Pilots flying newer Cessna models that do not have a cigar lighter outlet should call Zoon 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 fuse
- 4 | Twist the knurled cap back into place

Power (Permanent/Hardwired)

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. For more on installation, consult the MRX Installation Guide, available online at www.zaonflight.com



It is imperative that the antenna be positioned vertically to receive the most accurate signal.

Antenna

It is imperative that the antenna be positioned vertically to receive the most accurate signal.

Your MRX antenna is specifically tuned to receive an accurate signal when attached to your unit in the vertical position (either straight up or straight down). Orienting the antenna at any other angle will not accurately detect the signal because the amount of received power would be decreased, which is then translated into an inaccurate distance measure.

No other antennas are acceptable to deliver accurate traffic information.

To install the antenna:

- 1 | Connect the right-angle antenna assembly to the antenna (SMA) connector on the left side of the MRX unit.
- 2 | Once in place, screw on the lock ring to secure the antenna. When the antenna is properly secured, the antenna should not rotate.
- 3 | Rotate the antenna vertically to position properly by unscrewing the antenna slightly. When the antenna is positioned, retighten.
- 4 | **Antenna must be securely fastened to unit.** If antenna is loose, you may notice a constant detection of an aircraft at approximately 2 NM and same relative altitude. The unit is detecting your own transponder. To solve this, tighten the antenna until significant resistance is met.

Basic Operations

What is PCAS?

PCAS, which stands for Portable Collision Avoidance System, is a trademark of Zoon 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 Zoon in 1999. 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 and relative altitude information, and even quadrant direction* can be accurately detected in a portable, all-in-one cockpit device.

* Available on XRX models only (at time of publication)

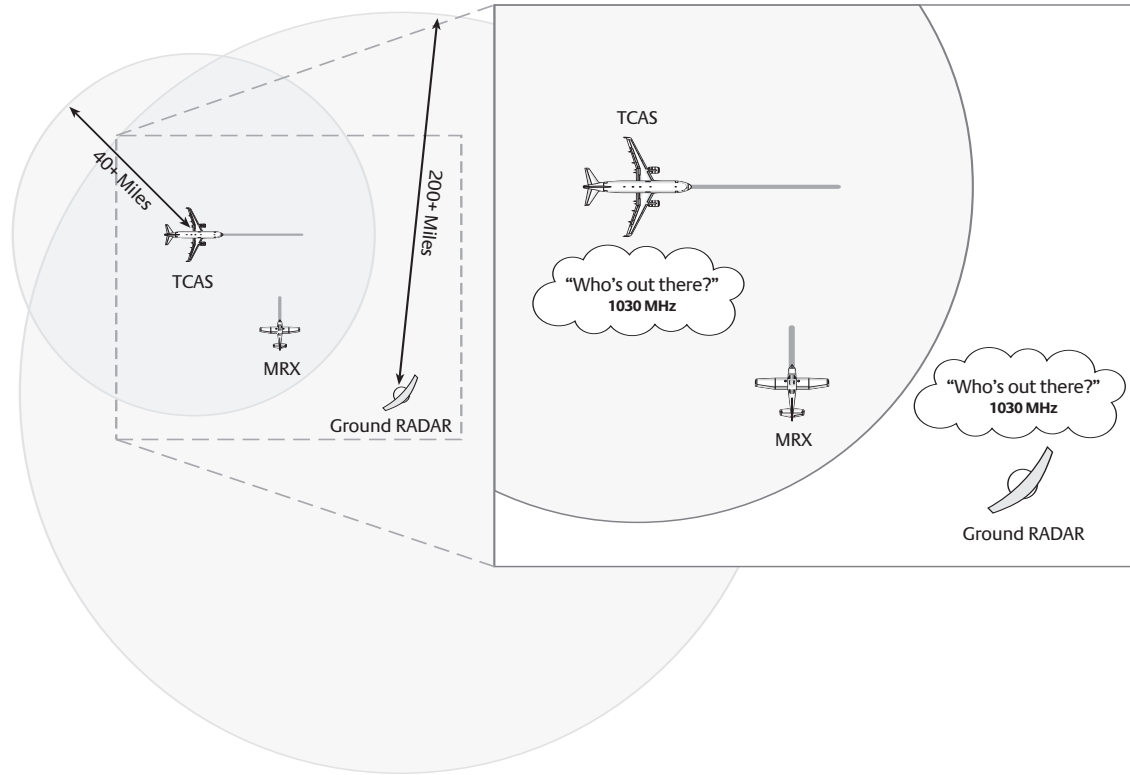
How does MRX work?

MRX 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 MRX listen for the replies to these interrogations.

Traffic Detection

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.

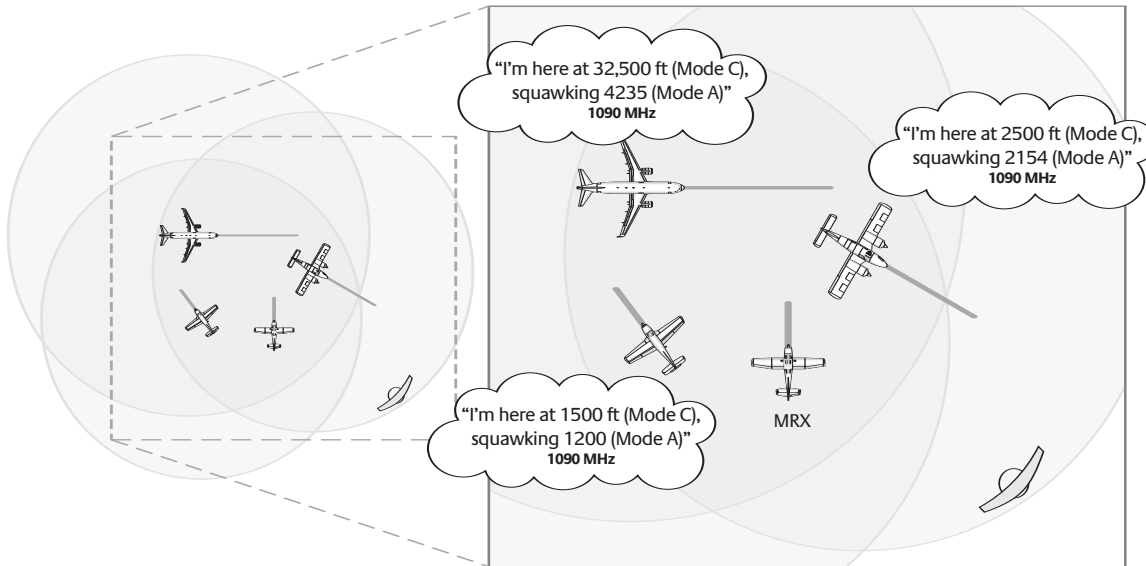


2 | The transponder on any aircraft within range of the interrogation replies on 1090 MHz with their squawk code (known as Mode A) and altitude code (or Mode C). The altitude information is sent in an encoded format.

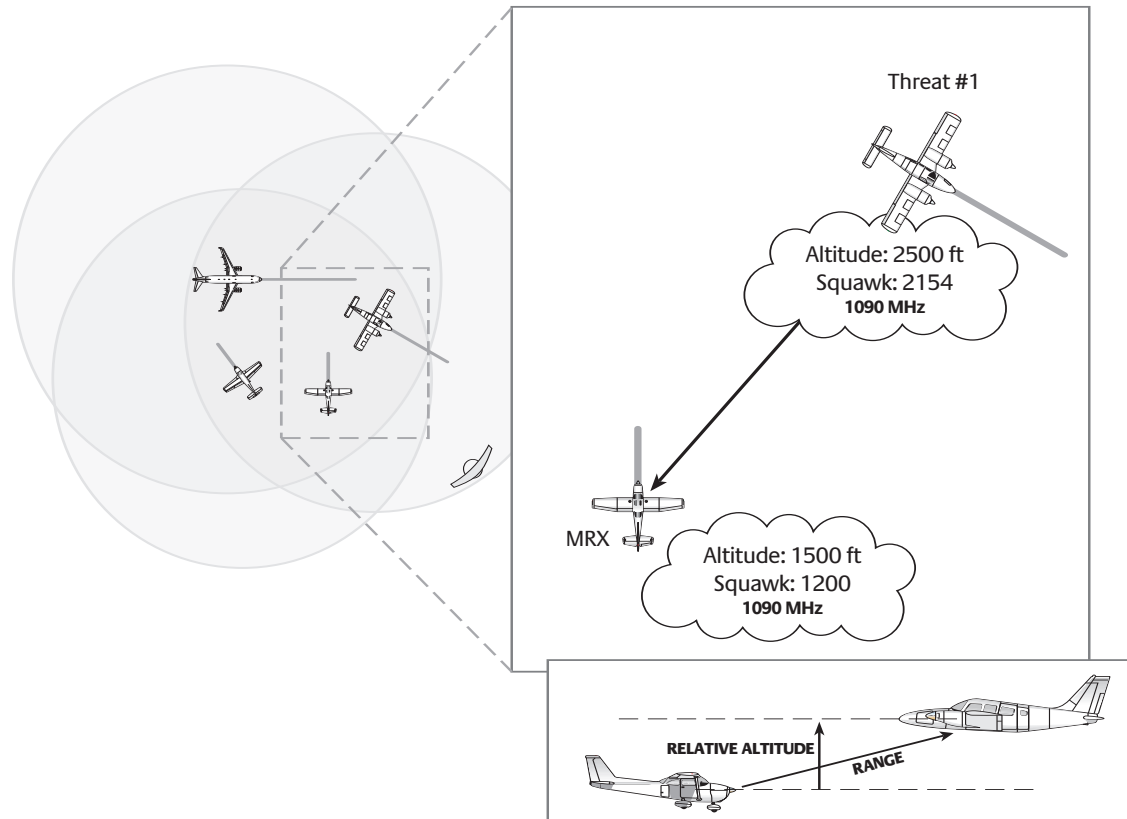
Mode S transponders also reply on this frequency, and encoded within the Mode S transmission is the Mode A (squawk) and Mode C (altitude) information.

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 MRX 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 MRX 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. MRX 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 altitude and range determined, MRX displays this information and stores it in memory.



- 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. MRX 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.

Built-In Altimeter Usage

Only MRX incorporates a patent-pending built-in altimeter to establish a base reference. Because MRX displays relative altitude (in the example illustration above, 2500 feet below your 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 | MRX intercepts and decodes your local altitude.
- 3 | MRX compares this to the altitude from the built-in pressure altimeter to ensure accuracy.
- 4 | If acceptable, MRX uses the transponder altitude as a base reference.
- 5 | MRX 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 MRX will automatically provide a work-around. In these cases, the following occurs:

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

As you can see, the most important thing to note is that your MRX will present you with accurate relative altitude information at all times.

What can and can't MRX do?

✘ **CANNOT:** DETECT ALL TRAFFIC

MRX, 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 MRX to detect.

✔ **CAN:** ZERO FALSE ALERTS

MRX 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 C must correctly correspond to a valid altitude code, and MRX 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.

How to read your MRX

Reading your MRX is simple and straightforward if you understand the concepts behind its design and operation. MRX 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.

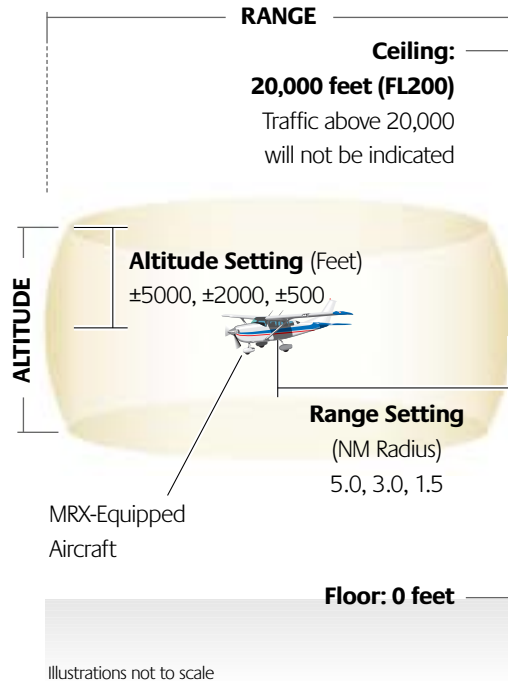
The Detection Window

The detection window surrounding your aircraft in flight can best be visualized by imagining a “Bubble of Awareness” surrounding your aircraft.

The **width** of the bubble represents and is defined by range; the **height** is defined by altitude.

The width and height of the bubble can be reduced on one or both axis (see “Menus” later in this chapter).

In the illustration, the bubble represents the detection window.

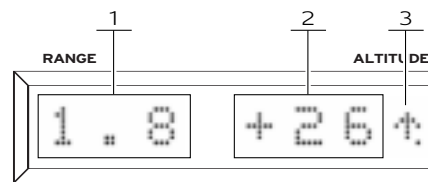


Traffic Detection

The MRX detection window is defined by two dimensions: vertical (altitude) and horizontal (range). Both of these dimensions can be set independently of each other by the pilot. MRX will display any aircraft within this detection window. We call it a “bubble of awareness”, and this bubble can be shaped to meet the needs of your current flying situation (see “Menus” and “MRX Buttons” later in this chapter).

Traffic is displayed in **range** [1] and **altitude** [2] relative to your local altitude (above you or below you, as indicated by + or -).

- Description
- 1 | Range in Nautical Miles
 - 2 | Relative altitude above or below, in 100s of feet (FL)
 - 3 | Vertical trend indicator



Traffic Screen

Altitude Indicators [2]		Vertical Trend Indicators [3]	
	Above		Climbing
	Below		Descending
	Same Altitude (target was climbing)	No Indicator	Level or trend not available
	Same Altitude (target was descending)		

In addition, the **vertical trend** of the aircraft is given [3]. In the example shown, an aircraft is 1.8 NM away, 2600 feet above you, and climbing. Monitoring the vertical trend will assist in deciding if the aircraft is a threat or not. For example, an aircraft 300 feet above and descending is a much greater threat than if the aircraft is ascending.

If **additional aircraft** are in the area, the aircraft displayed will represent the greatest threat. If another aircraft becomes a greater threat, the unit will switch the displayed information to reflect this new threat. See “Threat Switching” later in this section. **No traffic** will be indicated by dashes only on the display.

Threat Switching

MRX tracks the most significant threat to your course of travel. Should MRX determine that a new aircraft has become a greater threat than the one currently being displayed, **- NEW -** will be displayed for two seconds, followed by the new aircraft information.

Threat determination is based on complex algorithms that take into account relative altitude, track rate, and range information. Vertical separation is the primary consideration when considering which of two or more aircraft to display. See “Example Flight Scenarios” later in this chapter.

1 . 8 - 0 3

- N E W -

1 . 6 + 0 5

Resolution & Accuracy

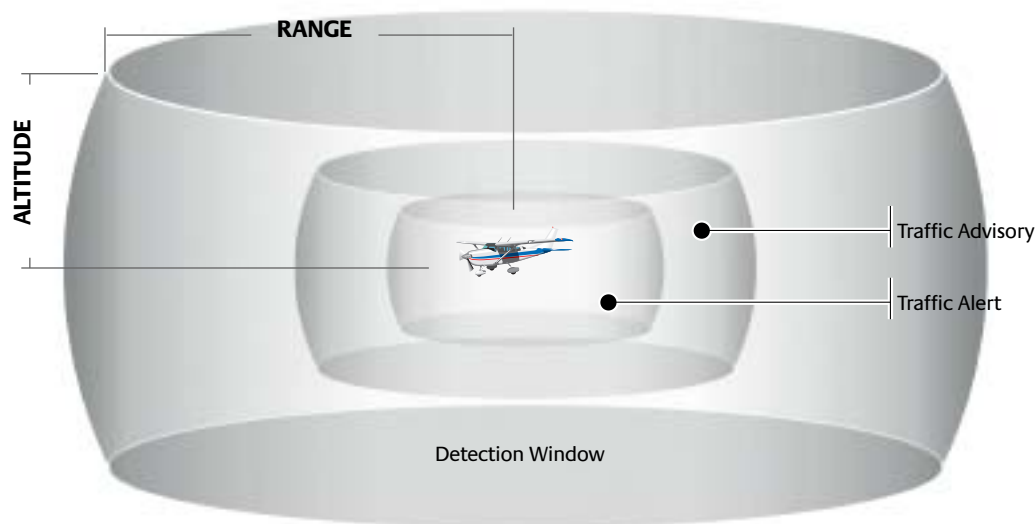
With regard to the range of the target aircraft, accuracy increases exponentially the closer the threat gets to your MRX. Range can be determined by examining the amplitude of the received transponder signal. Accuracy and resolution work hand-in-hand. For the MRX, traffic at a range greater than 2.0 miles is displayed in whole mile increments. Under 2.0 miles, traffic is close enough, and the power output is far enough “up” the logarithmic scale that mileage can be accurately computed in 0.1 mile increments.

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



Range Resolution	Altitude Resolution
<p>2-5 NM: Whole mile increments (i.e. 3.0) < 2 NM: 0.1-mile increments (i.e. 1.3)</p> <div style="text-align: center;"> <p>RANGE</p> <p>1 . 8</p> </div>	<p>Given in 100-ft. increments, relative to host aircraft altitude (i.e. 2600 ft. is shown as 26)</p> <div style="text-align: center;"> <p>ALTITUDE</p> <p>+ 2 6 †</p> </div>

Traffic Advisories and Alerts

There is a difference between **traffic detection**, as defined in the previous section, and **traffic alerts** (threats). MRX 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.



MRX 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 depends 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.

Display	Audio	Range Setting	Traffic is within Range...	...and Altitude
	2 Beeps	5.0 NM	1.0 NM	±1000 ft.
		3.0 NM	0.8 NM	±800 ft.
		1.5 NM	0.5 NM	±600 ft.
	4 Beeps	5.0 NM	1.0 NM	±700 ft.
		3.0 NM	0.8 NM	±500 ft.
		1.5 NM	0.5 NM	±300 ft.

Bold represents the default setting. If you have narrowed the altitude window (as described in “Menus” on page 28), this will supercede the above thresholds. For example, if you have narrowed the altitude to ±500 feet, traffic will not generate an advisory, since the closest altitude threshold is ±600 ft.

Resetting the Unit in Flight

Like some TCAS systems, MRX 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 MRX 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.

Example Flight Scenarios

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

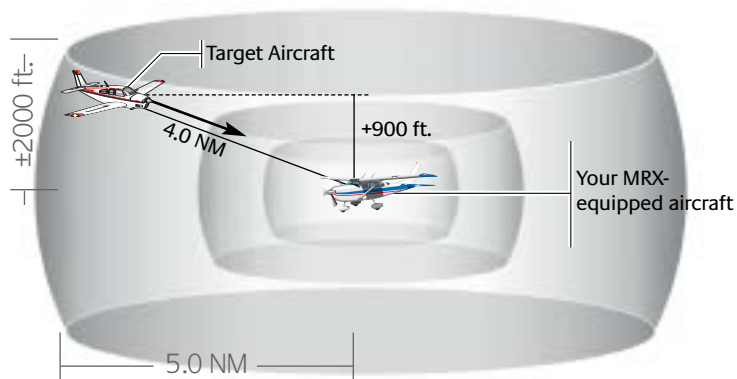


MRX assumes when you turn it on you are on the ground in order to eliminate the detection of aircraft on the ground.

Example One:
Single Aircraft



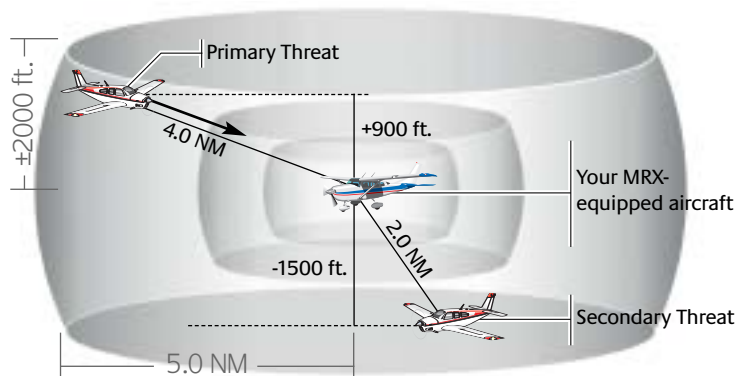
In this example, there is only one aircraft in the detection window you have set (in this case, the default range and altitude). If the aircraft is 4.0 NM away and 900 feet above and descending, this is what the MRX screen will show. **This is NOT an alert situation.** However, an attempt should be made to identify this aircraft if the range gets below two miles. At four miles, it is unlikely you would be able to see the aircraft; however, if the range and altitude continue to count down, this could become a threat.



Example Two:
Multiple Aircraft



MRX prioritizes aircraft based on relative altitude. The aircraft at the closest relative altitude becomes the priority. In this example, the aircraft at +900 feet is a greater threat than the aircraft at -1500 ft, even though the aircraft below is closer in range (2.0 NM vs. 4.0 NM).

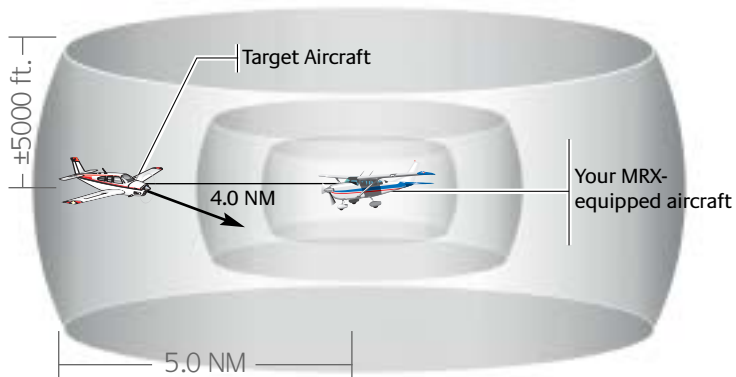


Example Three:

Aircraft at Same Altitude



Aircraft at the same altitude as your aircraft will be represented by 00 . If the aircraft was descending to your altitude, the unit will show $+00$, as in this example. If the aircraft was climbing to your altitude, -00 will be shown. This is not to be confused with the \uparrow or \downarrow arrow, which represents the target aircraft's ascent or descent over time.



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.

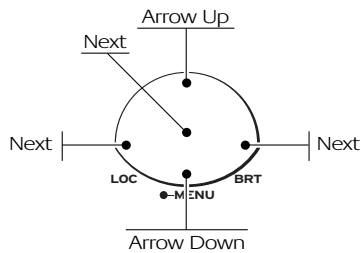
The importance of early warning cannot be stressed enough when it comes to detecting a potential threatening aircraft. These charts indicate how combined aircraft speed and distance play a role in determining your reaction time.

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.

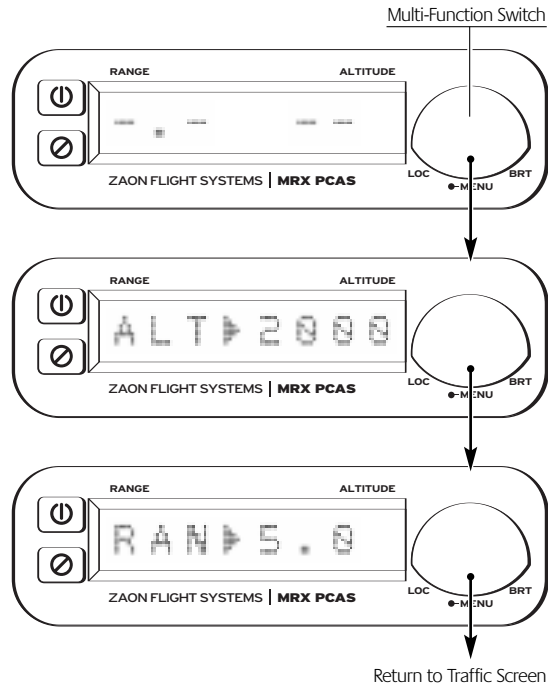
Menus

MRX uses two simple menus to define the parameters for your flight. From the traffic screen, press the multi-function switch, located to the right of the display, to advance through the menus, and back to the Traffic Display Screen. Your selection will be saved as long as the unit is on. If the unit is powered off, you will need to reselect your preferences.

Use the multi-function switch to navigate through the menus as follows:



Multi-function switch functions in menu mode



Menu 1: Altitude

The purpose of the ALT menu is to limit threat indications based on altitude separation from your aircraft, especially when operating in dense traffic environments. ± 2000 feet is the default selection.

To select an Altitude Limitation:

- 1 | From the Traffic Display Screen, press the **multi-function button** once to view the ALT menu.
- 2 | Press the multi-function button **up** and/or **down** until the index pointer designates the altitude you desire.
- 3 | To advance to the altitude screen, press the **multi-function button**.

A rectangular display box with a double-line border containing the text "ALT ▶ 5000".

A rectangular display box with a double-line border containing the text "ALT ▶ 2000".

A rectangular display box with a double-line border containing the text "ALT ▶ 500".

When 5000 ft. is selected, traffic outside of the 5000 ft. altitude window will only be indicated by an up or down arrow, indicating traffic is above or below you, and dashes. When 2000 ft. or 500 ft. is selected, traffic outside these windows will not be indicated.

Menu 2: Range

The RAN menu allows you to select the horizontal detection window, or range. 5.0 NM is the default selection.

To select a Range Limitation:

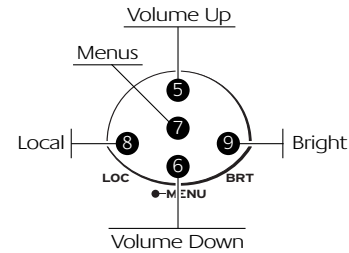
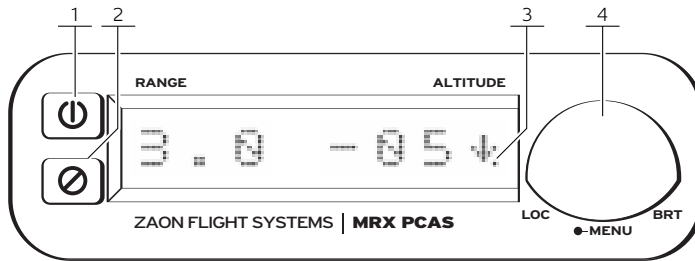
- 1 | From the Traffic Display Screen, press the **multi-function button** once to view the ALT menu.
- 2 | Press the multi-function button **up** and/or **down** until the index pointer designates the altitude you desire.
- 3 | To advance to the altitude screen, press the **multi-function button**.

A rectangular display box with a double-line border containing the text "RAN ▶ 5.0".

A rectangular display box with a double-line border containing the text "RAN ▶ 3.0".

A rectangular display box with a double-line border containing the text "RAN ▶ 1.5".

MRX Buttons & Functions



Multi-function switch functions in traffic screen mode

- 1 | **Power**
Press once to turn unit on. Press again to turn unit off.
- 2 | **Mute**
Press to mute any 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.
 - 3 | Mute will be indicated by a flashing dot in the right corner of the display.
- 4 | **Multi-function Switch**
5-way rocker switch
- 5 | **Volume Up**
Also functions as Menu Selector Up (in menu mode)
- 6 | **Volume Down**
Also functions as Menu Selector Down (in menu mode)
- 7 | **Menu Mode**
Enters menu mode, then advances through menus and back to traffic screen
- 8 | **Local**
Displays local squawk code and altitude information
- 9 | **Bright**
Changes the brightness level of the display

Volume Up/Down

Pressing the multi-function button **up** or **down** while in the traffic screen will change the volume level of the audio alerts. The current volume level will be displayed for 2 seconds after pressing the button up or down.



The volume level is represented by a number of arrows, as indicated here.

Local (LOC) Button

To view local squawk code and altitude, briefly press the multi-function button to the **left** while in the traffic screen. Information in the following sequence will be displayed:

1 | **Mode A (Squawk)**

SQK [Squawk 4-digit code] will be displayed for 2 seconds. If no local transponder is present or detectable, SQK 0000 will be displayed.



2 | **Mode C (Altitude)**

ALT FL[3-digit flight-level altitude] will be displayed for 2 seconds.



Bright (BRT) Button

Pressing the multi-function button to the **right** while in the traffic screen will allow you to change the brightness of the display. The current brightness level will be displayed for 2 seconds after pressing the button right. For night viewing, reduce the brightness to avoid eye strain.



To change the brightness:

- 1 | Press BRT to display the current brightness level
- 2 | Press the multi-function button up or down to change the brightness
- 3 | After you have selected the desired brightness, wait 2 seconds and the screen will revert back to the traffic screen.

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Troubleshooting

Power

Should the MRX 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 its 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 MRX, 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.

If using **battery power**: Once batteries are drained below a level which can sustain proper functioning, the unit will shut itself off upon startup to prevent erroneous operation. Change batteries.

If using **A/C power**: 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. If problem persists, try using batteries. 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.

Unit displays “Low Battery” while powered by an external power source, such as the aircraft.

First, make sure NO batteries are in the unit. Reset power and try again. If low battery condition continues, unit needs to be serviced.

Traffic Detection

Unit never detects traffic.

The antenna supplied with MRX is specifically tuned to be used with the unit. However, if the antenna becomes worn or bent, it will not match well with the tuned input expected. The easiest way to solve this is to use a 50 ohm coax antenna extender to isolate the antenna and the receiver. The antenna extender is available Zaon accessory. This 50 Ohm isolation will allow the system to match better to the unit. If this situation occurs with any isolation between MRX and the antenna, unit may need to be serviced.

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, MRX 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 altitude listed when you press LOC 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 MRX 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 MRX showed the traffic was 2.0 NM. Why the difference in range?

MRX gives range based on true distance in three-dimensional space, where ATC looks at a two-dimensional screen. Traffic may be 5,000 feet above you and 0.5 NM away horizontally, but MRX will show 1.0 NM or greater when taking into consideration the altitude.

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. MRX 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”.

MRX is picking up your transponder as a threat instead of ignoring your transponder. Try the following:

- Make sure your transponder antenna is clean (see above).
- Using an antenna extender (optional accessory), relocate the antenna to a window closest to the location of the aircraft transponder antenna. For example, if transponder antenna is in rear, move MRX antenna to a rear window.
- Contact a local avionics shop to test your transponder for “peak power output” (should be between 150-350 watts). Anything less is not acceptable under TSO tolerance and may not work with our system.
- Consider using an external antenna located three or more feet from your transponder antenna
- If you have access to panel wiring using an antenna extender, route the coax cable of the extender around the transponder coax cable 2-3 times. This will increase the ability of MRX to accurately read the potentially weak transponder signal.



Clean your transponder antenna often.

- Call Zoon 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.

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, MRX 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 5.0 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 MRX will detect. In addition, ATC may not necessarily be looking at a screen which shows all non-factor traffic.

“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, MRX 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 indicate traffic is GREATER than 5.0 NM. Does the unit show multiple aircraft? If so, several aircraft are within the 5-7 mile range. Remember, the only way for MRX to display traffic is to receive a valid Mode C 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 altitude displayed when I press LOC is different from my altimeter.

MRX 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 MRX within ± 100 ft.

While flying, the altitude displayed when I press LOC 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 MRX 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. MRX, 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.

Mrx 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, MRX 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.

Airlines 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 3 to 5 nm may be displayed as 2 to 4 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.

Installation

Can I use a old DME antenna or an old transponder antenna for MRX?

Some antennas are acceptable for use with MRX. Contact Zaon by phone or online for a list of approved antennas.

Can I use 75 Ohm Coax?

No. MRX is a 50 ohm system. 52 ohm cable is acceptable, as long as it is not RG-58.

Appendix

Specifications

Environmental

Altitude	Min. 0 ft.	Max. 20,000 ft (FL200)
Temperature	Min. -20°C (-4°F)	Max. +55°C (+130°F)
Pressure	Min. 0 kPA (0 PSI)	Max. 100 kPA (14.5 PSI)
Humidity	Tested to 100% humidity	

Mechanical

Dimensions	4.2" (107 mm) 0.6" (17 mm) 2.6" (65 mm)	Length Height Width
Weight (without antenna)	3.75 oz. (106 g) 5.75 oz. (163 g)	Without batteries With batteries

Electrical

Power	12-40 VDC	Negative ground
Consumption	Internal battery @ 12V @ 28V	500 mW watt max. 1.2 watts max. 2.8 watts max.
Current	105 mA	
Connector Type	2.35mm mini	Tip positive

Receiver

Selectivity	1090 MHz 8.1 MHz	Receiver A Bandwidth
Signal Modes	X, Y, A, C, S, 2, 3/a	
Scan Rate	22 kHz	
Data Rate	1000 kbps	
MTL Sensitivity	-60 dBm	
Max Peak Power	+21 dBm	
Range Resolution	0-2.0 NM 2.0-5.0 NM	± 0.1 NM ± 1.0 NM
Max. Detection Range	50% Error Rate 10% Error Rate	7.0 NM 6.0 NM
Altimeter Accuracy	± 200 ft.	
Receiver Dynamic Range	42 db	

Antenna

Weight	0.25 oz. (7 g)	
Impedance	50 ohms	
Polarization	Vertical Omnidirectional	
Connector type	SMA RP	

Battery Life

Battery Type	Tested Brand	Capacity (mAh)	Average Tested Duration*
Nickel-Metal Hydride	Rayovac I-C3 15-minute	2000	7.1 hrs.
Lithium	Energizer e2™ Lithium	2900	6.2 hrs.
Alkaline	Energizer™	2850	6.0 hrs.
Alkaline Mang Dioxide	Duracell®	2850	6.0 hrs.
Alkaline Mang (Supplied)	OEM	2850	5.8 hrs.
Carbon/Chloride	Not Recommended	925	N/A

* Average duration over 9 tests. Engineering tests were conducted in a controlled environment (70% humidity, 250 ft. MSL, 22-24°C) and subjected to an average amount of traffic detection. Tests were conducted from 11/15/05 through 12/2/05. Testing conditions will vary greatly and will change the outcome of your own tests. Conditions include amount of traffic, humidity, and temperature range, among many other factors.

Energizer and e2 are trademarks of Eveready Battery Company, Inc. Duracell is a registered trademark of The Gillette Company. Rayovac is a registered trademark of Rayovac Corp. Zaon Flight Systems, Inc. does not endorse any particular brand of batteries and is furnishing these test results on an informational basis only.

Display

Type	8-character super bright red LED graphic module
Maximum Brightness	2300 µcd per character

Storage

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

Your MRX 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:

www.zaonflight.com/firmware. Firmware updating may require you to send in your unit to the factory for reprogramming and recalibrating.

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 MRX from a Zaon dealer, do not contact the dealer for repair. All repairs must be completed through Zaon directly.

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

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 replacement 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 MRX 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.

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.

Installation & The FAA

Installation Kits

Installation kits are available to allow your MRX to be installed into your instrument panel. Contact Zaon directly for installation kit details.

337 Form

MRX 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 MRX, 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. For your convenience, we have a 337 form with all available data to assist you in your application.

This form, along with the Installation Guide, can be found online at our installation and FAA support site:

www.zaonflight.com/installation

FSDO Listings

An up-to-date listing of the FAA Field Service District Offices near you can be obtained on the internet by visiting <http://www2.faa.gov/avr/afs/fsdo/>.

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 Règlement sur le matériel brouilleur du Canada.)

European Economic Community Declaration of Conformity

according to ISO/IEC Guide 22 and EN 45014



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: MRX

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)

Register Online Today! register.zaonflight.com



Designed and manufactured in the U.S.A. by Zaon Flight Systems, Inc. For use in General Aviation Aircraft