Ryan TCAD
AIR TRAFFIC SHIELD

PILOT'S HANDBOOK

model ATS - 8000

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PREFACE

Thank you for becoming an owner of the *Ryan TCAD*. *You* have demonstrated a concern for yourself, those that depend on you for flying safely, and a concern for others that share the airspace around you.

Now you can fly with greater confidence, and greater peace of mind, knowing you are equipped with the best technology available for collision avoidance.

This Operation and Performance Handbook is intended as a guide to the capabilities and operation of the *Ryan TCAD* Air Traffic Shield. By carefully reading this manual, you will become familiar with TCAD, and how to get the best performance from your investment.

WARNING

The TCAD does not detect all aircraft, and is designed as a backup to the See and Avoid concept, and the ATC Radar environment. See TCAD Limits in Appendix 2.

Refer to this handbook for TCAD limits.

CAUTION: This handbook, and the *Ryan TCAD*, are advisory only. Any action recommended in this manual, or made as a result of data supplied by the TCAD, must be in accordance with applicable FARs and common sense. The pilot in command is the final authority as to the operation of the aircraft.

Features of the *Ryan TCAD*

- Provides a shield of airspace above, below, and around your aircraft.
- Detects threats and displays altitude separation, and iNM (indicated nautical miles) between your aircraft and threats.
- Shows trend between your aircraft location and primary threat.
- Will display altitude and ATC assigned code of threat aircraft.
- Features pilot selectable, user programmable shield volumes for Terminal, Standard, and Enroute modes.
- Features Altitude Alert functions for safer, more precise flying.
- Computes and displays Density Altitude by simply setting OAT.
- Provides a digital display of altitude to cross-check and confirm your primary altimeter display.

This Handbook is organized into the following sections:

I Introduction

This section describes the product, operating concept, technology, and components of the Ryan *TCAD*.

II Operator Controls and Basic Displays

Illustrates the controls and display features of the *Ryan TCAD*.

III The Air Traffic Shield

Introduces and describes use of the Air Traffic Shield.

IV Threat Acquisition

Describes recommended procedures when threats are acquired by the TCAD.

V Altitude Displays

Explains display of MSL altitudes and Flight Levels

VI Altitude Alert

Describes operation of the Altitude Alert.

VII Density Altitude

The Density Altitude function is described.

VIII Flying with TCAD

Describes operation of TCAD and illustrates a flight from startup to landing.

IX Operating Tips

Contains useful suggestions to maximize the utility of the *Ryan TCAD.*

X Built-In Test

This built-in test function checks TCAD operation.

Appendix 1 Setup

Describes parameters that can be set by the pilot.

Appendix 2 TCAD Limits

Describes limitations of the TCAD and how those limitations can affect performance of the equipment.

Appendix 3 Excerpts

Excerpts from FAA Advisory Circular 90-48C, Pilots' Role in Collision Avoidance.

Appendix 4

Contains Specifications, Factory Settings, Warranty, Disclaimer, and Customer Support information.

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SECTION I
INTRODUCTION

PRODUCT DESCRIPTION

The Ryan *TCAD* (Traffic and Collision Alert Device) is an on-board air traffic display used to identify potential collision threats. TCAD computes relative altitude and range of threats using transponder replies from nearby Mode C equipped aircraft. Aircraft with non-Mode C transponders can provide range information. The *Ryan TCAD* will not detect aircraft without operating transponders.

TCAD, within defined limits, creates a shield of airspace around the aircraft, whereby detected traffic cannot penetrate without generating an alert. The shield size is selectable for various phases of flight, and is adjustable by the pilot.

The TCAD uses a quickly readable bright character alphanumeric display for threat information. Range is displayed in indicated Nautical Miles (iNM), and relative altitude is displayed in hundreds of feet.

The TCAD will display multiple aircraft threats. TCAD is advisory only, and is a back-up to the See and Avoid Concept, and the ATC radar environment.

Additional functions are provided:

Code and Altitude — TCAD will display the identity code and altitude of detected aircraft.

Indicated Altitude — TCAD provides for MSL corrected altitude (or Flight Level) of the host aircraft, reproducing the ATC altitude display.

Density Altitude — Quickly computes density altitude, for determining runway requirements and cruise performance.

Altitude Alert — Provides tones for approaching a target altitude, and to inform the pilot of inadvertent changes in cruise altitude.

CONCEPT

Transponder reply signals are generated by aircraft as a result of ground interrogations. Reply signals near the host aircraft are sensed by the TCAD antenna, and processed by the computer/display unit. The nominal range of the threat, determined by the arrival amplitude of the threat transponder signal, is displayed as indicated nautical miles. The vertical separation of the host and threat is determined through decoding of Mode C replies. This is important, as effective collision avoidance makes use of the following principle:

"No two aircraft can collide unless they are nearly at the same altitude.

This means that any threat approaching from any angle can be avoided by establishing and maintaining vertical separation. Thus, by decoding Mode C replies and providing altitude, range and trend data, the TCAD supplies essential information to assist the pilot in making an avoidance decision.

Any threat approaching from any angle...

. ..can be avoided by establishing and maintaining vertical separation.

TECHNOLOGY

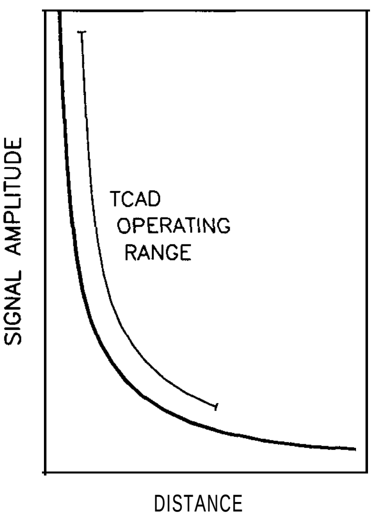
Since the 1950's, researchers have sought methods for alerting pilots of collision threats. The use of reply signals from airborne beacon transponders has emerged as the accepted technological basis for effective collision avoidance.

When transponders are interrogated by secondary surveillance radar (SSR) sites, reply signals are transmitted. The *Ryan TCAD* receives and processes these reply signals from nearby threat aircraft to provide traffic alert information. TCAD displays altitude separation, indicated range, and trend data.

Altitude separation is determined by comparing the Mode C replies from the threat aircraft with data from the onboard altitude encoder. The altitude reply from the threat is referenced to 29.92 inches (pressure altitude), as is the onboard encoder, thus providing meaningful separation information. The difference in altitude is displayed, together with a plus or minus symbol, indicating that the traffic shows above or below your encoded altitude.

TCAD provides altitude trend information by monitoring the altitude difference and displaying a closing symbol when the difference becomes smaller, and a parting symbol when the difference becomes larger. The absence of a trend symbol indicates that the altitude separation is not changing.

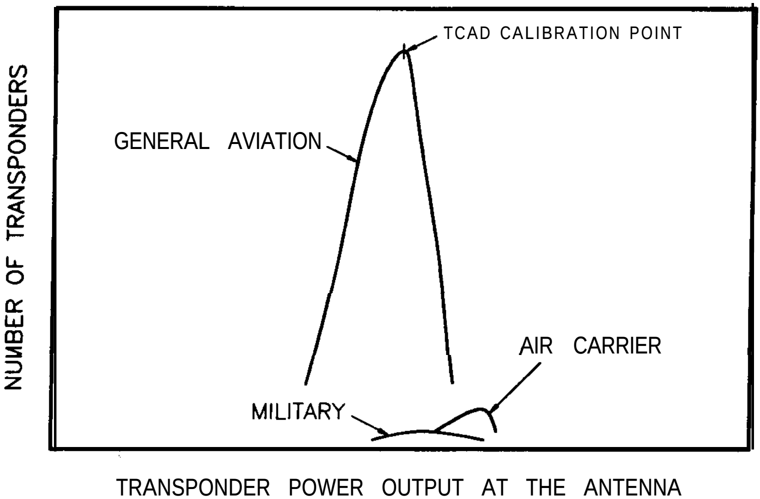
Adequate altitude separation is very important for effective collision avoidance.



The range of a threat aircraft is determined from the arrival amplitude of the digital transponder signal. The amplitude of the signal is independent of code assignment. Amplitude changes with distance, and is used to calculate range and trend data. (See illustration to the left).

Differences in the power output of transponders can cause variation in range. Government investigation in this area has quantified these differences for general aviation, military, and air carrier aircraft. The variation of transponder power output for aircraft in each of these classes is shown in the illustration on the following page.

The *Ryan TCAD* displays range in indicated nautical miles (iNM), based on the typical output from General Aviation transponders. This provides the most accurate range data for the greatest population of airplanes, and gives greater margins for higher speed traffic.



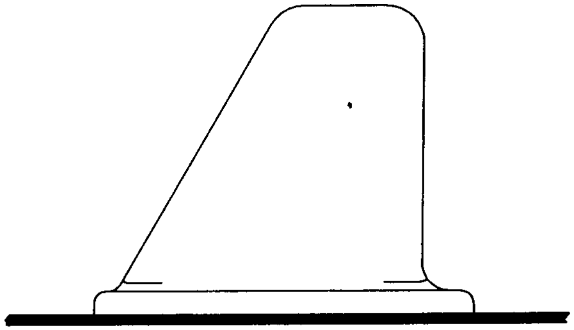
The trend information in range is determined by the increase and decrease of range values. This trend information, particularly in closure situations, is important for effective collision avoidance, and is essentially independent of power variations among transponders.

The TCAD displays threats detected within a predetermined volume of airspace (the Air Traffic Shield). The size of the shield can be selected by the pilot based on anticipated traffic conditions, using the TRML, STD, and ENRT mode buttons. Additionally, the size of the shield in each mode can be programmed by the pilot.

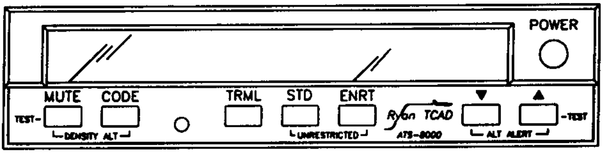
Multiple threats within the shield are prioritized and displayed based on range and altitude. Secondary and third level threats are indicated by symbols and can be displayed at the operator's discretion.

COMPONENTS

The Ryan TCAD Air Traffic Shield consists of two basic components, the Antenna and the Computer/Display unit.



The TCAD antenna is an aerodynamically designed blade antenna normally mounted on top of the aircraft. The above illustration is one-half actual size.



The Computer/Display unit is illustrated above at one-half actual size. This compact unit contains a high performance microwave receiver, an advanced high speed microprocessor based computer, and a bright character alphanumeric display. A Transponder Coupler is included to interface with the onboard transponder.

SECTION II
OPERATOR CONTROLS & BASIC DISPLAYS

The TCAD display uses 16 LED cells to communicate visual information to the pilot. Audible tones are provided for aural communication to the pilot.

A tone is used to call attention to a detected threat that has penetrated the Air Traffic Shield. Additionally, when the Altitude Alert is engaged, a distinctive short tone is generated to call attention to either arrival at a target altitude, or an altitude deviation.

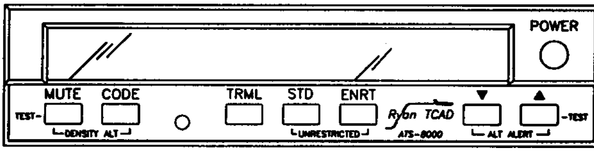
Plus and minus symbols are used to indicate the vertical direction of a threat. Altitude trend information is shown by the use of a closing symbol (two arrows pointing together in an hourglass shape) and by a parting symbol (two arrows pointing apart in a diamond shape).

The mode (TRML, STD, or ENRT) is indicated by a vertical line in the right most cell (the mode cell). The position of the vertical line corresponds to the mode button position on the TCAD. The letter "U" or "G" in the mode cell indicates a special sub-mode has been selected. (See Section III).

One (or two) aircraft symbols to the right of a traffic display indicates that a second (or third) threat has been detected and is available for display. The ▼ button is used to momentarily display the secondary threat, and the ▲ button is used to display the third level threat. When the secondary threat display is selected, the aircraft symbol reverses (i.e. from a light aircraft on a dark background to a dark aircraft on a light background) to clearly indicate which threat is being displayed.

DESCRIPTION OF OPERATOR CONTROLS

Operator controls are illustrated and described as follows:



POWER: This is a push-on, push-off button for supplying power to the unit.

MUTE: When the audible threat warning tone sounds, touching this button disables the tone for a fixed time interval. The time interval is pilot adjustable.

CODE: Used to identify the 4-digit identity code and the altitude of the primary threat.

TRML: Signifies the Terminal Mode, and when touched, sets the range and altitude Shield size to the values previously programmed by the operator.

STD: Signifies the Standard Mode, and when touched, sets the range and altitude Shield size to the values previously programmed by the operator.

ENRT: Signifies the Enroute Mode, and when touched, sets the range and altitude Shield size to the values previously programmed by the operator.

UP ARROW (▲): For data entry and user programming.

DOWN ARROW (▼): For data entry and user programming.

Four functions are accessed by pressing two buttons simultaneously.

UP ARROW (▲) & DOWN ARROW (▼): By pressing these two buttons, the Altitude Alert function (-ALT ALERT-) is engaged or disengaged (See Section VI).

MUTE & CODE: By pressing these two buttons, the Density Altitude function (-DENSITY ALT-) is engaged or disengaged (See Section VII).

ENRT & STD: By pressing these two buttons, the Unrestricted Mode (-UNRESTRICTED-) of operation is engaged (See Section III).

MUTE & UP ARROW (▲): By pressing these two buttons, the Built-in Test function (-TEST-) is initialized (see Section X).

SYMBOLS

Below is an illustration and brief description of the special symbols used on the TCAD display:

- Threat is above
- Threat is below
- Feet
- Threat is closing in altitude
- Threat is parting in altitude
- Altitude Alert activated
- Mute activated
- Indicated Nautical Miles
- TRML (Terminal) mode selected
- STD (Standard) mode selected
- ENRT (Enroute) mode selected
- Ground Mode activated
- Unrestricted Mode selected
- Additional threat
- Additional threat has been selected for display

TONES

Tones are used to alert and communicate information to the pilot. There are four sets of tones used by TCAD:

TONE: ON	A single repetitive tone — available for all modes to indicate shield penetration.
TONE: SGL	A single non-repetitive tone — available for all modes to indicate shield penetration.
TONE: OFF	No tone, available for traffic without altitude data.
IMMINENT ALERT	A repetitive tone to indicate detected traffic is within ±500 feet and 1 iNM, and a faster repetition when within f300 feet and 0.7 iNM. Activated when the single tone option has been selected.

A unique non-repetitive tone is used for the Altitude Alert function.

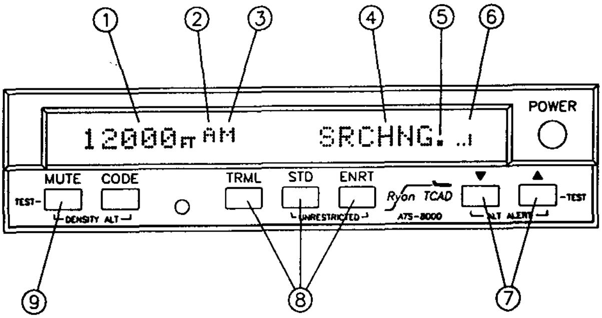
BASIC DISPLAYS

There are two basic displays in the operation of the *Ryan TCAD:*

- When the unit is searching, and
- When a threat is acquired.

The following illustrations show typical displays and associated controls:

Search Configuration



① Aircraft altitude.

② "A" - Altitude Alert engaged.

③ "M" - displayed when tones are muted.

④ TCAD is searching for a threat.

⑤ Self Test cursor

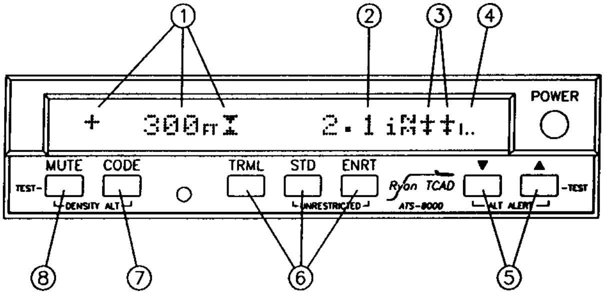
⑥ Mode indicator (shown indicating Mode).

⑦ Used to adjust barometric pressure (altimeter setting); also used to engage/disengage the Altitude Alert.

⑧ Used to select mode.

⑨ Used to mute anticipated audible tones for a specified duration.

Threat Acquisition



① Threat is 300 feet above and converging in altitude.

② Range is 2.1 indicated Nautical Miles.

③ Second and third level threats have been detected. Flashing indicates nearby in altitude (See Section IV).

④ Mode indicator (shown indicating Terminal Mode).

⑤ ▼ Used to display secondary threat.
▲ Used to display third level threat.

⑥ Used to select mode.

⑦ Used to display altitude and code of primary threat.

⑧ Used to mute audible tones for **a** specified duration.

SECTION III
THE AIR TRAFFIC SHIELD

The volume of airspace in which traffic should be detected changes with the traffic density. When traffic is light, and aircraft are at cruising speeds, a large area of airspace should be monitored. In higher density airspace, when the pilot is more alert for traffic and speeds are limited, a smaller surveillance volume is generally appropriate.

The concept of an Air Traffic Shield is used to describe an adjustable volume of airspace, controlled by the pilot to display potential threats, yet prevent extraneous traffic from being displayed.

The Air Traffic Shield is a slice of airspace of specified radius and specified height above and below the aircraft, where a detected threat normally cannot enter without generating an alert.

TERMINAL, STANDARD & ENROUTE MODES

The *Ryan TCAD* provides three quickly selectable and pilot programmable shield volumes, designated as the Enroute (ENRT), Standard (STD) and Terminal (TRML) modes.

When the host aircraft is at cruise, ENRT is selected. A large volume of airspace should be monitored because traffic is usually light, and threats could approach at high speeds and high rates of descent.

STD would typically be selected when the host aircraft transitions from enroute flight. Traffic usually becomes more dense and the speed of potential threats is usually lower. Therefore a smaller shield size would be appropriate.

Similarly, TRML would be selected when in the terminal area, because a smaller volume of airspace is generally best, in order to display threats and prevent extraneous traffic from being displayed.

Each of these shield volumes is easily programmable by the pilot to optimize the shield size according to conditions and pilot preference (see Appendix 1). Once programmed, the TCAD retains the shield volumes in memory for future flights.

The TCAD displays threat data when an intruder is detected near the shield, and a tone is generated when the threat is detected inside the shield. The tone can be suppressed by using the Mute button.

The Shield limits are found in Specifications, Appendix 4.

GROUND MODE

When the host aircraft is on the ground, traffic taxiing or parked nearby can transmit replies. To avoid nuisance indications on the ground, a special feature of the Terminal Mode, called the Ground Mode, can be automatically activated. The airspace monitored in the Ground Mode is about half the size of the programmed Terminal shield. Traffic at and below 100 feet above the host elevation will not be displayed. Alert tones are also muted. Thus data available from aircraft in the air are displayed, and those identified as on the ground are not displayed.

The Ground Mode is activated automatically upon initialization. The display shows the letter "G" in the mode cell, and the small letter "M" is displayed indicating that the alert tones are muted.

Transition from Ground Mode to Terminal Mode *occurs* after takeoff. When the host aircraft climbs more than 200 feet, the alert tones are restored (the "M" disappears from the display). Additionally, as the aircraft climbs, the Ground Mode shield dimensions expand by holding the base of the shield at 200 feet above the departure elevation, and allowing the top of the shield to climb as the aircraft climbs. The monitored airspace expands until the Terminal Mode shield size is reached. Then the "G" in the Mode cell changes to indicate Terminal Mode. A transition symbol of for departure is shown in the Mode cell during the transition from the 200 foot level to the full dimension of the Terminal shield.

Any of the other Modes can be entered by pressing the TRML, STD or ENRT button. The automatic selection of Ground Mode operation is pilot programmable, and can be disabled if desired. Ground mode can be manually accessed by pressing the TRML and STD buttons simultaneously.

Some encoders require a warm-up period before valid data is available. In the Ground Mode, the initialization will automatically halt at the altimeter adjustment until the encoder indicates it is supplying valid data.

Note: Reflected signals from ground objects can cause less reliable ground operation. See Appendix 2.

CAUTION: Do not operate TCAD in the Ground Mode when in flight.

UNRESTRICTED MODE

During the enroute phase of flight, in low traffic densities, a larger volume of airspace may be desired to monitor other traffic. The Unrestricted Mode can be selected by pressing the Enroute and Standard buttons simultaneously (the letter "U" is indicated in the mode cell). This removes all altitude restrictions from the shield and places the horizontal limit at 5 iNM. Aircraft detected within 5 iNM from the surface up to 60,000 feet will be displayed.

If traffic is detected within the ENRT shield, a tone is generated and TCAD automatically returns to the Enroute Mode.

While in the Unrestricted Mode of operation, any of the other modes can be entered by pressing the TRML, STD or ENRT button.

SECTION IV
THREAT ACQUISITION

VISUAL AND NON-VISUAL ACQUISITION

When TCAD detects traffic, and the alert tone sounds, the pilot should view the TCAD display and determine the vertical separation and range between the host and threat. The pilot should then visually scan forward of the aircraft, as the warning time is shortest for head on traffic. If the displayed data does not suggest urgent action, the pilot should continue to scan, giving priority to the region ahead. If the vertical separation is small, and the distance is decreasing, the pilot should take steps to establish the location of the traffic and maintain vertical separation.

More typically, there will be sufficient altitude separation, and sufficient range, so that immediate pilot reaction is not necessary for safety. Knowing the altitude separation, visual scanning can be restricted to the appropriate elevation from the aircraft.

Note: The minimum distance indication on TCAD is **0.3** iNM.

CAUTION: The traffic you see may not be the traffic the TCAD has detected. Continue to monitor the TCAD and visually scan outside even after the traffic is observed.

IMMINENT ALERT

If the single tone option has been selected by the pilot, repetitive warnings are provided when traffic is very close. Traffic detected within ±500 feet and 1 .O iNM will generate a slow repetitive tone. When the traffic is detected within ±300 feet and 0.7 iNM, the tone repetition rate is increased.

MULTIPLE THREATS

TCAD can monitor more than 50 aircraft at one time, and will display up to three. When a second airplane has been detected in the monitored area, a small airplane symbol appears, indicating another threat is available for display. A third threat will generate another aircraft symbol. Data on second and third threats can be momentarily displayed by pressing the ▼ button or ▲ button (See Section IX, Operating Tips).

The significance of the second or third threat is related to their elevations with respect to the primary threat. If the first and second threats are above the host aircraft, both threats can be avoided by descending. Similarly, if both are below the host aircraft, the threats can be avoided by ascending. If the primary threat is above the aircraft and the second threat is below the aircraft (or vice versa), and are within 500 feet of the host, avoiding one could position the other threat closer to the host airplane. If this situation exists, and the detected aircraft are within 1 the small airplane symbol will flash, indicating a need to call up the secondary display before deciding on a course of action.

Generally, the shield size should be reduced when three threats are detected within the monitored area.

MODE A IMAGES

The *Ryan TCAD* processing function decodes and pairs Mode A and C replies from threat aircraft, and sends the data on to be prioritized and displayed. A few ATC assigned Mode A codes are identical to Mode C codes, making it difficult for the processor to determine which of the A/C pair is the Mode A and which is the Mode C. In this case, both combinations are sent on to be prioritized and displayed. If the threat aircraft or Mode A image is within the shield, it will be displayed. In the unlikely event that both the Mode A image and the threat are detected inside the monitored area, the combination is treated as a multiple threat.

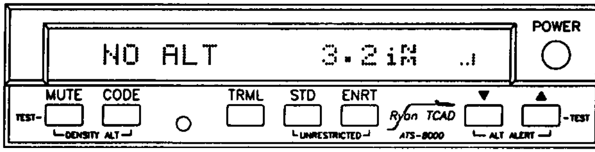
MUTE

The mute button silences and prevents alert tones from sounding for a specified duration. When activated, a small upper case “M” appears on the display (Search configuration). The Altitude Alert tone is not disabled by use of the mute button.

The mute time is pilot adjustable (see Appendix 1). Each press of the mute button restarts the specified mute duration.

NO ALTITUDE THREATS

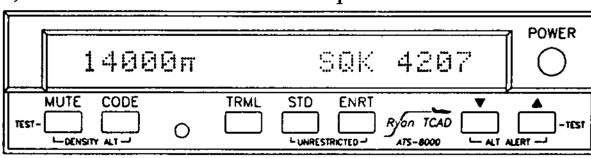
The TCAD can detect aircraft that do not have Mode C altitude reporting capability. Without altitude data, the TCAD provides iNM and horizontal closure information. The TCAD will display NO ALT along with the iNM (See “No ALT” Replies in Section IX).



When the host aircraft is above 12,000 feet pressure altitude, non-Mode C traffic is not displayed.

CODE

Pressing the code button when a threat is shown will display the altitude and identity code of the threat. This can be helpful to determine if the traffic is VFR, VFR handled by ATC, or has an IFR discrete squawk.



The code of the traffic is a secondary function, altitude and iNM are primary. In some situations, especially in high density areas, it may take a moment to acquire the code. If the code is not available, SQK: N/A will be displayed. The code of non-Mode C traffic is also available.

UPDATE RATE

TCAD is updated by transponder replies from threat aircraft. The rate of update varies with the radar environment. The transponder reply light provides an indication of the update rate.

SECTION V
ALTITUDE DISPLAYS

When the current ATC supplied altimeter setting is entered into TCAD, the digital altitude display shown is the same as the altitude shown for your aircraft at the ATC facility. In addition, when a threat has been acquired and the CODE button is pressed, the MSL altitude (or flight level) and ATC assigned code of the threat will be displayed.

Note: The altimeter setting does not need be entered for collision avoidance operation. Since both the host and threat aircraft are transmitting pressure altitude, displayed altitude separation is correct regardless of altimeter setting.

ENTERING ALTIMETER SETTING

The barometric pressure can be adjusted by momentarily pressing any mode button, then the up or down arrow button. Normal operation will resume after releasing the button.

Note: The TCAD is not processing traffic information while the altimeter setting buttons are depressed. TCAD has returned to collision avoidance operation when the "SRCHNG" display appears. If the encoder indicates that it is providing invalid data, the altitude display on TCAD will be replaced by stars (****).

CAUTION: Altitude encoders and altimeters are not always accurate, and could lead to errors in the information provided to TCAD. Be sure that your altimeter and encoder are accurate, and maintain enough separation when traffic is encountered.

HOST ALTITUDE DISPLAY

The MSL altitude or the flight level of the host aircraft is displayed in the search configuration. Below 18,000 feet, the TCAD barometric correction can be adjusted to the local altimeter setting. At 18,000 feet and above, the altimeter automatically adjusts to 29.92 inches, and the display will show Flight Level instead of hundreds of feet.

When the local altimeter is lower than 29.92 inches, FL 180, (and sometimes FL 190) does not exist. TCAD will not display flight levels until the barometric correction in the TCAD indicates that Flight Level display is appropriate.

On descent, the local altimeter setting can be preselected, and when the aircraft descends below the flight levels, the MSL altitude will be displayed.

If the altitude features are not used, a barometric setting of 29.92 inches is recommended for the TCAD.

THREAT ALTITUDE DISPLAY

The altitude of the threat aircraft is displayed when the CODE button is pressed. TCAD will provide the MSL altitude of the traffic (corrected to the barometric pressure setting in the TCAD), or the Flight Level, as appropriate.

See Section VIII, Flying with TCAD.

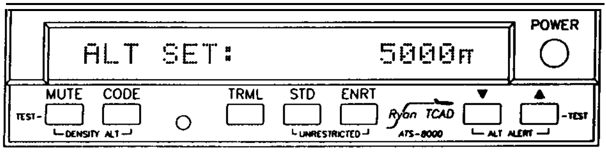
> **CAUTION:** Altitude information provided by the *Ryan TCAD* is advisory only and is not to be used for dispatch purposes.

SECTION VI
ALTITUDE ALERT

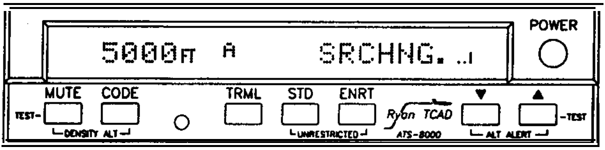
In the Air Traffic Control environment, an unauthorized deviation in assigned altitude can compromise safety. The *Ryan TCAD* provides a means to alert the pilot of arrival at an assigned altitude, or inadvertent changes in cruise altitude.

ENGAGING

The Altitude Alert function is activated by pressing the ▼ and ▲ buttons simultaneously. When this is done, ALT SET: is displayed on the left, with the last entered altitude appearing on the right.



The ▼ and ▲ buttons can be used separately to adjust the displayed altitude to an assigned or desired altitude (or flight level). If no button presses occur for 8 seconds, the Altitude Alert is engaged at the displayed altitude, and TCAD will return to the collision avoidance display. If desired, the Altitude Alert can be manually engaged by pressing the ▼ and ▲ buttons simultaneously while the ALT SET: message is displayed.



In the search configuration, a small upper case "A" appears on the display, indicating the Altitude Alert is engaged.

When the Altitude Alert is set for a target altitude and engaged, a short tone will announce that the aircraft has arrived within 200 feet of the target altitude.

At the selected cruise altitude, changes of 200 feet will generate the tone to indicate an altitude deviation. The aircraft can then return to the cruise altitude.

Note: The altitude encoder provides information in 100 foot increments. Therefore, when the encoder trips the second 100 foot increment, the tone will sound.

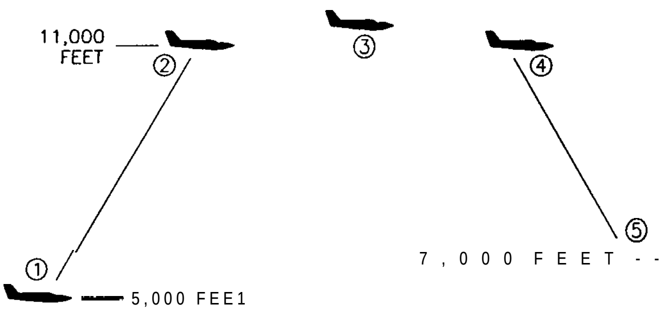
Note: The TCAD continues to operate in the Collision Avoidance configuration when the Altitude Alert is engaged.

CAUTION: TCAD operates in the Collision Avoidance configuration except while the Altitude Alert is being set.

DISENGAGING

The Altitude Alert function is disengaged by pressing the up and down buttons simultaneously. The "A" symbol will disappear from the display. The Altitude Alert will automatically disengage if the aircraft changes 500 feet from a set altitude.

EXAMPLE



① Cleared to climb to and maintain 11,000 feet. The pilot activates the Altitude Alert by pressing the ▼ and ▲ buttons. The ▲ button can be used to set the assigned altitude of 11,000 feet. The display shows ALT SET: 1 1000FT, then engages following a short wait (or manually engaged by pressing both the ▼ and ▲ buttons when ALT SET: 11000FT is displayed).

② As the aircraft passes through 10,800 feet, a tone is issued.

③ If the aircraft deviates from 11,000 feet, a tone sounds.

④ Cleared to descend and maintain 7,000 feet. The Altitude Alert is reset by pressing ▼ and ▲ buttons twice, once to disengage, and again to activate. The pilot uses the ▼ button to set the assigned altitude of 7,000 feet. After 8 seconds, Altitude Alert engages (or manually engaged as before).

⑤ A tone will sound at 7,200 feet as a reminder to level at 7,000 feet.

SECTION VII
DENSITY ALTITUDE

Density Altitude is useful for calculating powerplant performance at cruise, and for calculating runway requirements for high altitude, high temperature departures.

Density Altitude is determined from pressure altitude and temperature. The *Ryan TCAD* receives pressure altitude from the onboard altitude encoder. By manually entering the outside air temperature (OAT), the TCAD can compute and display the Density Altitude.

ENGAGING

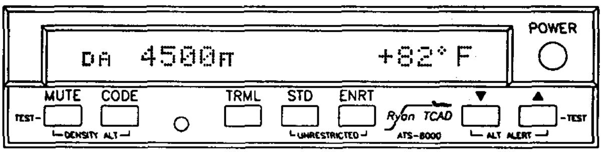
The Density Altitude function is engaged by simultaneously pressing the Mute and the Code buttons. The display will show the previously entered temperature (in degrees F) on the right; and on the left, the Density Altitude corresponding to that temperature and aircraft pressure altitude. The Density Altitude function can be engaged anytime.

Note: Some altitude encoders have a warm-up period of as much as 10 minutes before the correct altitude is reported. Be sure that your encoder is supplying the TCAD with proper pressure

> CAUTION: The TCAD does not operate in the collision avoidance function when computing and displaying Density Altitude.

ENTERING OAT

By depressing the up or down button while engaged in the Density Altitude function, the Outside Air Temperature (OAT) on the TCAD can be adjusted to reflect the OAT as reported, or as shown on the OAT gauge. The Density Altitude corresponding to the displayed temperature and aircraft altitude is computed and displayed.



DISENGAGING

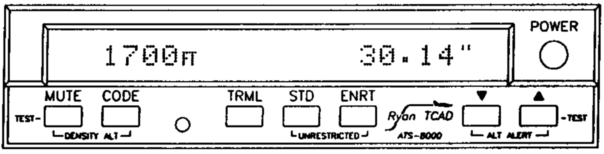
The TCAD can be returned to the collision avoidance function by pressing the Mute or Code button. If no button is pressed for 8 seconds, the TCAD will automatically return to collision avoidance operation.

SECTION VIII
FLYING WITH TCAD

TCAD tracks altitude separation, altitude closure, range and range trend of threat aircraft. The following is a sequence of displays such as might be encountered during typical operation of TCAD. Other sections of this handbook explain set up of pilot programmable functions, use of the Altitude Alert and Density Altitude features, and Built-in Test.

EXAMPLES OF OPERATION

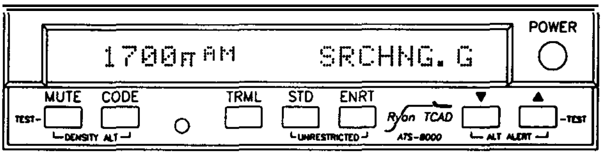
Power has been applied, and TCAD has completed the initialization sequence. The last altimeter setting with the corresponding altitude is now displayed. This display will remain for a period of time, giving the pilot opportunity to enter the current altimeter setting. Use the up and down arrows to do this. If the current altimeter setting has been entered, TCAD should indicate current field elevation ±100 feet.



In the illustration above, current altimeter is 30.14" and the field elevation is 1700 feet MSL. If field elevation is not properly displayed, the altitude encoder is not supplying correct information, and may need additional warm-up time. After a few seconds, TCAD will enter a collision avoidance configuration (Search or Threat Acquisition).

The shield sizes could be reset (see Appendix l), but it is not necessary to adjust them before each flight. For this example, the shield sizes are those set at the factory (see Appendix 3).

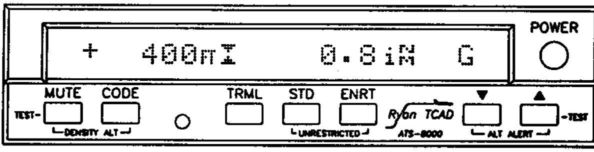
When TCAD is in the search configuration, the altimeter setting can be changed. The altimeter setting does not need to be correct for effective collision avoidance operation, but it can be very helpful (see Section V).



This illustration shows TCAD has automatically entered the Ground Mode, and is operating in the Search Configuration. All tones are muted (hence the “M”) and aircraft at and below 100 feet above the host encoded altitude are not displayed (see Section III for more on Ground Mode).

An ATC clearance is received, providing initial clearance to 4,000 feet. The Altitude Alert can be set for 4,000 feet (see Section VI). When passing through 3,800 feet, a tone will sound as a reminder of arrival at the assigned altitude. When the Altitude Alert is engaged, a small upper case “A” will appear on the display as illustrated above.

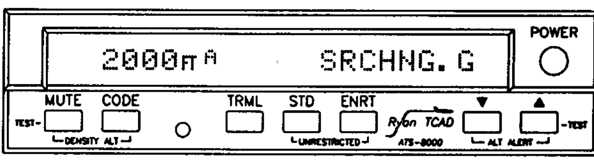
If Density Altitude is of concern for takeoff, this can be provided by depressing the MUTE and CODE buttons, and entering OAT (see Section VII).



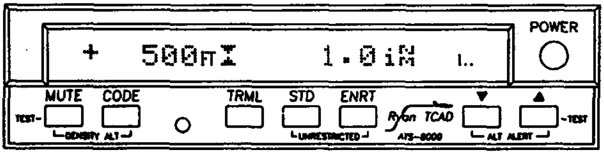
Before takeoff, check the area visually for traffic and check the TCAD. TCAD is indicating traffic 400 feet above, closing in altitude, and 0.8 iNM away. The traffic is then visually acquired on a close in base to final, and lands before your departure. Note the "G" on the right indicating Ground Mode.

WARNING

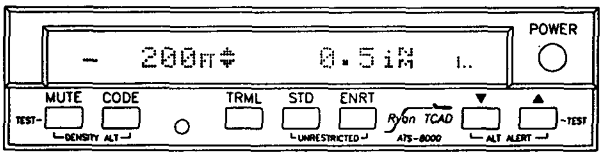
TCAD may not detect all traffic on approach. Always check the area visually before departing.



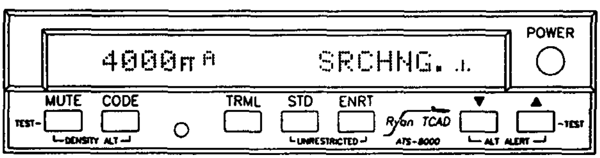
Xfter climbing more than 200 feet, the "M" disappears, indicating that the alert tones are enabled. The mode symbol will indicate the Ground Mode until the aircraft climbs above the programmed base of the Terminal Mode (see Section III). Note the "A" remains, indicating that the Alert is set.



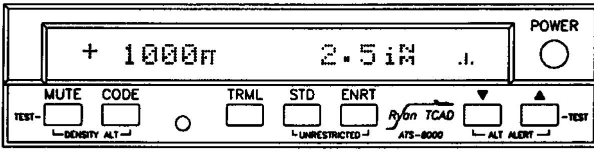
Passing through 2,900 feet, traffic monitored by the TCAD nears the Air Traffic Shield. As shield penetration is detected, a tone sounds. The traffic shows 500 feet above the host aircraft, closing in altitude, 1.0 iNM. The iNM is getting smaller, indicating closure in range. The traffic is acquired visually, crossing from left to right, descending. Climb is momentarily slowed to allow the traffic to pass well clear.



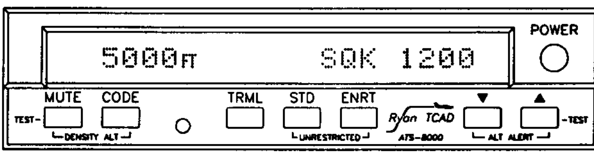
TCAD shows the closest point of approach as 200 feet below and 0.5 iNM. As the traffic departs, the altitude separation and distance increase.



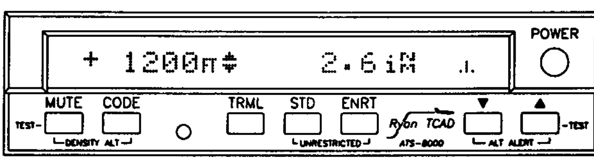
After leaving the airport area, select STD. At 3,800 feet, the Altitude Alert sounds indicating the aircraft is nearing 4,000 feet. The Built-in Test can be operated at any time (see Section X).



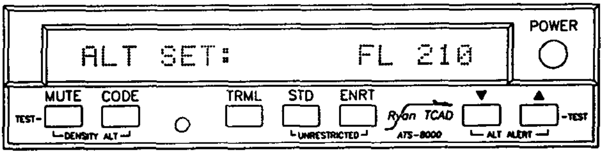
Traffic is acquired 1,000 feet above at 2.5 iNM. No tone is sounded because the traffic is outside the 2.0 iNM shield, even though it is displayed. No closure is indicated, therefore it is most likely not an imminent threat. Continue to monitor the traffic if desired.



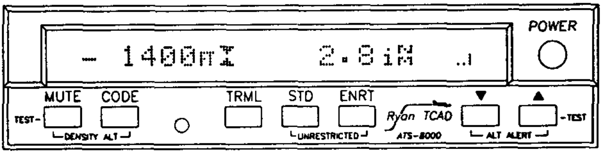
Pressing the code button reveals the traffic to be VFR at 5,000 feet MSL.



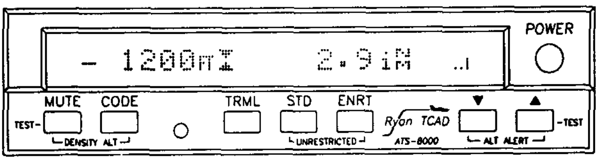
The traffic is now climbing, and will shortly leave the monitored area.



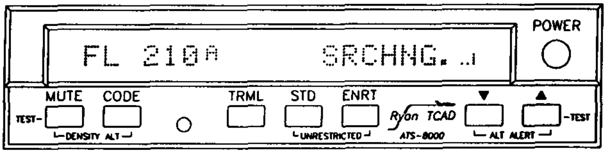
Cleared out of 4,000 feet for Flight Level 210. Reset the Altitude Alert to FL 210.



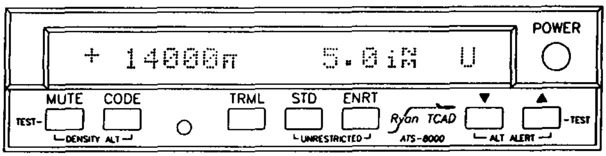
Passing through 10,000 feet, TCAD is placed in the ENRT mode, and a threat is indicated 1,400 feet below, closing in altitude at 2.8 iNM. Since the threat is closing in altitude, it is also climbing. Continue to monitor. You may want to visually acquire the traffic (see Scanning, Section IX, and Appendix 2).



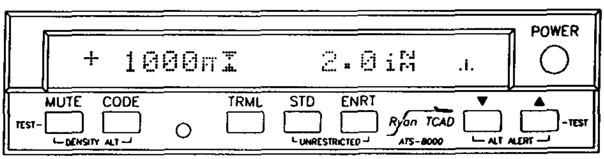
The altitude separation is getting smaller, but the iNM is staying about the same. The traffic is probably flying a parallel course.



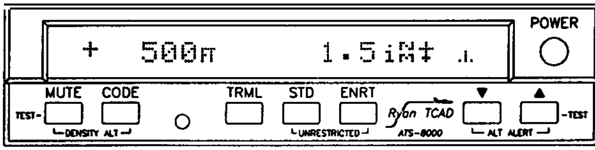
In the clear at FL 208, the Altitude Alert sounds and the aircraft is leveled at FL 2 10. ATC requests and confirms your altitude as Flight Level 210.



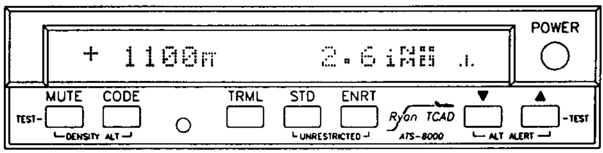
To monitor aircraft well beyond the shield, the Unrestricted Mode is selected (see Section III). Traffic is displayed 14,000 feet above and 5.0 iNM. A jet contrail is observed. Press code for the Mode A squawk and altitude.



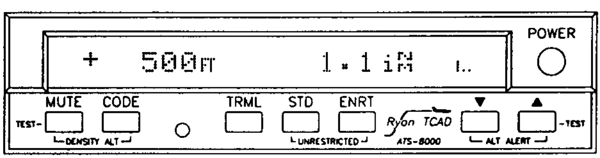
Descending now, ENRT and STD modes are selected as appropriate. The alert tone sounds indicating traffic 1,000 feet above the host airplane, closing and 2.0 iNM. The traffic is then visually acquired. A short time later, ATC reports the traffic.



The traffic is now 500 feet above and 1.5 iNM. A second threat has entered the monitored area.



Pressing the ▼ button, corresponding to the secondary threat, shows additional traffic 1,100 feet above and 2.6 iNM. Note the airplane symbol is reversed (see Threat Acquisition, Section IV and Operating Tips, Section IX).



The TRML mode is selected before arrival. After a few seconds, only the closest of the two threats will be displayed, and the primary threat eventually passes out of the shield. Approach and landing are uneventful.

SECTION IX
OPERATING TIPS

SCANNING

To optimize use of the data provided by TCAD, the pilot should consider where the greatest potential for collision is, and how to best find the traffic.

If the threat aircraft is well above or below your airplane, no action may be necessary on your part to avoid the threat and the traffic can be located if desired.

> CAUTION: Due to encoder variations, any threat within 300 feet of your altitude should be considered at your altitude.

For threats detected at or near your altitude, first scan ahead of the aircraft, then left and right 30 degrees. If traffic is not sighted, expand the scan to 60 degrees left and right. By maintaining adequate vertical separation, traffic can always be avoided.

Most flight hours are flown by Mode C equipped aircraft. Replies received from non-Mode C aircraft will cause NO ALT to be displayed on TCAD, with the iNM. The pilot must analyze this traffic without knowing the altitude difference.

Appendix 3 contains excerpts from AC 90-48C, Pilot's Role in Collision Avoidance, which provides additional tips on visual scanning.

"NO ALT" REPLIES

Many aircraft operate with encoders that require warm up time. Replies received from such aircraft (before encoder warm up) will not contain altitude data. TCAD will indicate NO ALT from these aircraft, until the encoder has warmed up and is providing proper altitude data.

These replies generally come from aircraft interrogated while on the ground. Thus, TCAD can display NO ALT even in locations where altitude reporting is required.

Occasionally a NO ALT indication can be generated from sources other than non-Mode C traffic. These replies come from operations unrelated to civilian air traffic control, and is more likely to occur along the coasts.

There is no difference between these replies and non-Mode C replies and the data is treated as traffic. TCAD priority computations weight nearby Mode C traffic above the non-Mode C, so altitude equipped traffic will be prioritized and displayed appropriately. Good management of shield size will minimize extraneous indications.

RANGE CONSIDERATIONS

Range is displayed in indicated Nautical Miles (iNM). Indicated Nautical Miles (iNM) is equal to actual nautical miles when the threat transponder output power is normal, and the signal is not shadowed. Transponders used aboard General Aviation aircraft typically provide close agreement between iNM and actual range.

Higher speed aircraft, such as airliners, most often transmit stronger transponder signals, usually two times the power of General Aviation transponders. In this case the actual range will be about 40% greater than the displayed iNM, thus offering greater margins for these high speed aircraft. For example, an airliner showing 3.0 iNM may actually be about four miles away. Similarly, an airliner showing .7 iNM is likely to be a mile away. Airframe shadowing can also affect range (see Appendix 2, TCAD Limits).

While iNM is influenced by transponder power output and airframe shadowing, the trend in iNM is essentially independent of these factors. Signals received will increase or decrease as the distance from the traffic changes. Therefore the trend in iNM is important for effective collision avoidance (also see Scalloping in this section).

The display of indicated Nautical Miles increments in 0.1 iNM intervals from 0.3 to 3.0 iNM. From 3.0 iNM to 5.0 iNM, the range increases in 0.2 iNM steps.

DISPLAY PRIORITY

When more than one threat is available for display, TCAD assigns a priority to each threat. There is greater emphasis on threats at or near the host altitude. The primary threat displayed by TCAD is the threat having highest priority.

Note: The priority of a threat is determined by its altitude separation, proximity and closure. As each threat changes position, a secondary threat can become the primary threat.

ALTITUDE AND RANGE BUFFER

Traffic outside the selected shield, but within 200 feet and a short distance from the boundary of the selected shield, will be displayed, but tones will not be issued until the TCAD detects shield penetration. This gives the pilot awareness of traffic that may become a threat.

HIGH DENSITY OPERATION

For best operation in high density areas, make the Air Traffic Shield as small as practicable. When there is a lot of traffic TCAD will constantly show traffic. By reducing the shield size, detected signals will represent real potential threats, not extraneous information.

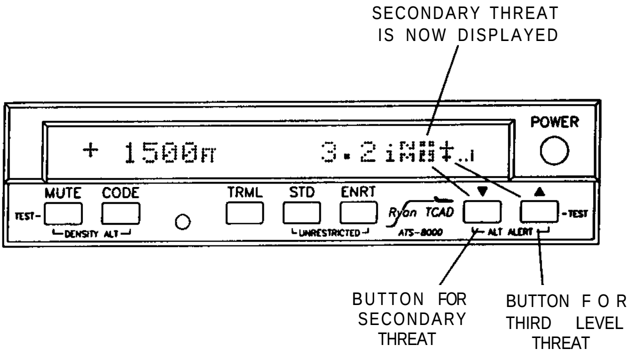
CODE

Pressing the code button when a threat is displayed will cause the threat MSL altitude (or Flight Level) and Mode A squawk to be shown. This is helpful to determine if the traffic is VFR, IFR, or VFR handled by ATC (approach often assigns the same first two digits of the assigned squawk to the VFR traffic they are handling). To get the correct MSL altitude, the altimeter setting in the TCAD must be correct. Code and altitude are available for primary, secondary, and third level threats.

High traffic density can limit Mode A code acquisition. Altitude separation and have the greatest priority. In very dense traffic, code acquisition can become less reliable, and the code of one aircraft could be initially tagged to another airplane. This does not compromise the collision avoidance function. The code of non-Mode C traffic is available by pressing the code button.

MULTIPLE THREATS

When a second target is detected within the selected Air Traffic Shield, a small aircraft symbol is shown. Another aircraft symbol is displayed when a third threat is detected. Generally the shield size should be reduced when three threats are detected within the monitored area.



The secondary and third level threats can be displayed by pressing the ▼ or ▲ button appropriate to the threat. The secondary threat is displayed when the ▼ button is depressed. A third threat is displayed when the ▲ button is depressed.

An indication is provided to confirm which threat is displayed. When the appropriate button is pressed, the corresponding aircraft symbol illuminates to provide a visual indication (see the illustration above). A flashing aircraft symbol indicates the second or third threat is nearby in altitude (see Multiple Threats, Section IV).

MONITORING TRAFFIC

When traffic has been reported by ATC, and is visually acquired, it may be difficult to maintain visual contact. By monitoring TCAD, unexpected changes in altitude or iNM can be observed.

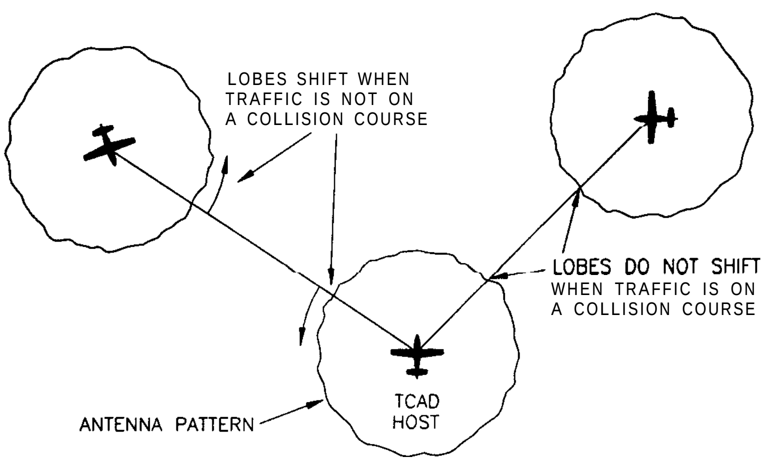
SCALLOPING

Antenna transmission and reception patterns exhibit a property that can be helpful in traffic awareness. The effect, called scalloping or lobing, is a non-uniformity in signal strength at a given radius from the antenna. Scalloping is associated with both the TCAD and transponder antennas, and can be used as an indication that the traffic could be on a collision course.

Traffic closing on a collision course does not move laterally with respect to the host, and the antenna pattern does not cross lobes. This means that received signals will be stable and the iNM indication will step down smoothly. When traffic crosses lobes, there is a fluctuation in the signal and a corresponding variability in the iNM display.

Thus, a smooth decrease in iNM should generally be of greater concern than a fluctuating iNM display.

Note: Aircraft detected inside the shield should never be ignored. The traffic may become a threat by changing course or altitude unexpectedly.



CONSIDERATIONS FOR SETTING SHIELD RADIUS

The setting of shield radius should be optimized (see Setup, Appendix 1). If the shield radius is set to an excessively high value, extraneous alerts will be sounded from aircraft that are no threat. If set to an excessively small value, warning time is compromised.

Minimum values that will provide adequate warning time should be used.

Studies have shown that, given an alert, a minimum of ten seconds warning time is practical. During the ten second warning, the pilot first interprets the displayed data to determine the altitude difference. An immediate reaction is necessary only if this difference is zero or small. Two aircraft converging at 540 knots will cover a distance of 1.5 nm in 10 seconds. Below 10,000 feet, it is unlikely that the converging speed between two aircraft would exceed this value. With the radius set at 1.5 iNM, the warning time for threat aircraft would likely exceed ten seconds. A radius of 1.5 iNM would generally be adequate for standard conditions, with a larger radius for Enroute and a smaller radius for Terminal Mode.

CONSIDERATIONS FOR SETTING SHIELD HEIGHT

Two aircraft converging in altitude at 2400 feet per minute, will change altitude by 400 feet in a ten second period. A ±1,000 foot shield height can be used in standard conditions. In terminal areas where climb and descent rates are usually slower for all aircraft, the limits could be narrowed, and then expanded for enroute flight. When the shield around the host aircraft is thin, extraneous alerts can be practically eliminated, while maintaining good shielding against threats (see Setup, Appendix 1).

SECTION X
BUILT-IN TEST

A TCAD built-in test function and Performance Monitor is provided. For these tests, TCAD receives replies from the host transponder, checking TCAD from the antenna throughout the equipment.

For the Built-in Test to operate, the onboard transponder must be transmitting replies. Before beginning the test, verify that the transponder reply light is illuminating.

The test is initiated by pressing the ▲ and MUTE buttons simultaneously. After a period of processing, the results of the test will be displayed. The following table explains the test and associated displays.

Display	Explanation
TCAD Testing	Testing in process.
A single threat warning tone is sounded.	
Reply rate low	Insufficient replies to complete the test.
REC CHK: OK	Receiver fault check.
SYS CHK: OK	System fault check.

If any check indicates fault, do not use TCAD data.

Note: Interference caused by other traffic and reflections may occasionally disrupt the built-in test and falsely produce a fault indication. This is most likely to occur while on the ground. If necessary, repeat the test for verification.

CAUTION: TCAD does not display traffic information during the Built-in Test procedure.

TCAD also uses the host transponder to continually monitor the equipment performance.

Replies from the host transponder are detected and coarsely measured for proper amplitude. If the amplitude is too low, then a failure is declared.

A receiver failure will allow partial operation of the equipment. "Signal Fail" is momentarily displayed on the TCAD, a tone is generated and TCAD collision alert , functions are deactivated. All other functions are available, including altitude display and altitude alert. After the alert, the equipment will show the altitude on the left display, and "SgnlFAIL" on the right.

TCAD also monitors the interface between TCAD and the transponder. If a malfunction is detected an Interface Failure is declared and a "W" replaces the Mode symbol on the display. An Interface Failure allows full operation of the TCAD, with reduced coverage. All functions are still available.

TCAD uses a cursor on the display to confirm continued operation of the equipment when no traffic is displayed. Two dots in the cell after the G in SRCHNG alternately illuminate, indicating continued operation. If the dots do not alternate, equipment failure is indicated.

APPENDIX 1
SETUP

PROGRAMMING

Several parameters in the TCAD can be set by the user. These parameters are kept in memory, and do not have to be adjusted until desired. This allows flexibility for the pilot, yet requires minimum effort before flight.

To engage a programming function, the appropriate button is pressed twice. The current setting will be displayed. The up and down buttons can be used to adjust the displayed parameter. To select the next parameter, the appropriate button is pressed again. When each parameter has been considered, TCAD returns to collision avoidance operation. In all cases, if no button is pressed for about 8 seconds when in a programming mode, TCAD will step to the next selection until it returns to collision avoidance operation.

SETTING THE SHIELD SIZE

Depress the selected button (TRML, STD, or ENRT) twice. The shield height in hundreds of feet will be displayed. To change the height, press the ▲ or ▼ buttons. Depress the selected button again for shield radius adjustment. Depress the mode button once more to return TCAD to normal operation.

Note: To select TRML, STD, or ENRT mode, the appropriate button must be depressed when TCAD is in a non-programming mode.

Note: For considerations in setting shield size, see Section IX, Operating Tips.

TONE OPTIONS

Depress the Mute button twice. The Tone Volume can be adjusted using the up or down buttons. Depress Mute again to adjust Mute Time Duration. Depress Mute once more for selection of a Single Tone, No Tone, or Continuous Tone for No Altitude alerts. Single or Continuous Tones can similarly be selected for each mode by pressing the appropriate mode button (see below). Depressing the Mute button again allows selection of the Ground Mode. A final press of Mute will return the TCAD to collision avoidance operation.

If no button is pressed for 8 seconds, TCAD will automatically step to the next selection until it returns to collision avoidance operation.

The sequence for tone related set up is as follows:

Press Mute twice:	Volume Set
Press Mute again:	Mute Duration
Press Mute again:	No altitude tones; Single, On, or Off Press TRML: Single, or On Press STD : Single, or On Press ENRT: Single, or On
Press Mute again:	Ground Mode: On or Off
Press Mute again:	Returns to operation

APPENDIX 2
LIMITS

The TCAD only displays intruders equipped with operative Air Traffic Control Radar Beacon System (ATCRBS) transponders. TCAD is a supplement to the pilot, who has the responsibility for avoiding mid-air collisions. TCAD provides no indication of traffic conflicts with aircraft without operative transponders, or where the threat aircraft is outside a radar environment.

AIRFRAME SHADOWING

Microwave energy can be obstructed by the airframes of both the host and threat aircraft. A shadowing occurs when the microwave signals must pass around metal structures.

TCAD is designed to operate optimally when the host TCAD antenna and the threat transponder antenna are in line of sight. With the TCAD antenna top mounted, and with transponder antennas bottom mounted, the optimal condition generally exists when threats are above, to approximately 15 degrees below the host aircraft. When the threat is further below the host aircraft, or during turns, signals can be attenuated, causing display of greater than actual Antenna placement on the threat aircraft and flight maneuvers also have an effect. Whenever a detected threat is below the aircraft, the pilot should consider airframe shadowing when analyzing the data.

For an actual threat to be in the shadowed region, a lengthy and parallel track between host and threat is necessary. Final approach to a runway, with the threat below, offers the most likely occurrence. A minimum shield radius immediately below the host aircraft is imposed in the TCAD design to help ensure display of shadowed threats.

Note: The accuracy of altitude separation information is not influenced by airframe shadowing.

SIGNAL REFLECTIONS

Transponder signals can be reflected by nearby structures. This can result in unreliable altitude and iNM indications, especially near hangars or buildings. This condition occurs primarily when the host aircraft is on the ground, since the top mounted TCAD antenna is less exposed to reflections while in flight.

OVERLAPPED REPLIES

When two aircraft are interrogated at the same instant, the replies received by TCAD can be mixed, degrading the ability to decode the replies. This is more likely to occur in higher density areas, when both aircraft are illuminated at the same moment by the same radar.

By using degarbling techniques, the processor can generally provide data on the closest threat. In some instances, both aircraft will be decoded, and in other instances, accurate decoding is impossible.

By keeping the shield size small in high density areas, the potential for garbled replies is minimized.

CAUTION: Federal Regulations state that "When an ATC clearance has been obtained, no pilot in command may deviate from that clearance, except in an emergency, unless he obtains an amended clearance." Traffic information provided by the Ryan *TCAD* does NOT relieve the pilot in command of this responsibility.

APPENDIX 3
EXCERPTS

Excerpts from AC 90-48C; Pilot's Role in Collision Avoidance.

1. PURPOSE. This advisory circular is issued for the purpose of alerting all pilots to the potential hazards of midair collision and near midair collision, and to emphasize those basic problem areas related to the human causal factors where improvements in pilot education, operating practices, procedures, and improved scanning techniques are needed to reduce midair conflicts.

. . . .

4. ACTION. The following areas warrant special attention and continuing action on the part of all pilots to avoid the possibility of becoming involved in a midair conflict.

a. "See and Avoid" Concept.

(1) The flight rules prescribed in Part 91 of the Federal Aviation Regulations (FAR) set forth the concept of "See and Avoid." This concept requires that vigilance shall be maintained at all times, by each person operating an aircraft, regardless of whether the operation is conducted under Instrument Flight Rules (IFR) or Visual Flight Rules (VFR).

(2) Pilots should also keep in mind their responsibility for continuously maintaining a vigilant lookout regardless of the type of aircraft being flown. Remember that most MAC accidents and reported NMAC incidents occurred during good VFR weather conditions and during the hours of daylight.

b. Visual Scanning.

(1) Pilots should remain constantly alert to all traffic movement within their field of vision, as well as periodically scanning the entire visual field outside of their aircraft to ensure detection of conflicting traffic. Remember that the performance capabilities of many aircraft, in both speed and rates of climb/descent, result in high closure rates limiting the time, available for detection, decision, and evasive action.

(2) The probability of spotting a potential collision threat increases with the time spent looking outside, but certain techniques may be used to increase the effectiveness of the scan time. The human eyes tend to focus somewhere, even in a featureless sky. In order to be most effective, the pilot should shift glances and refocus at intervals. Most pilots do this in the process of scanning the instrument panel, but it is also important to focus outside to set up the visual system for effective target acquisition.

(3) Pilots should also realize that their eyes may require several seconds to refocus when switching views between items in the cockpit and distant objects. Proper scanning requires the constant sharing of attention with other piloting tasks, thus it is easily degraded by such psychophysiological conditions such as fatigue, boredom, illness, anxiety, or preoccupation.

(4) Effective scanning is accomplished with a series of short, regularly-spaced eye movements that bring successive areas of the sky into the central visual field. Each movement should not exceed 10 degrees, and each area should be observed for at least 1 second to enable detection. Although horizontal back-and-forth eye movements seem preferred by most pilots, each pilot should develop a scanning pattern that is most comfortable and then adhere to it to assure optimum scanning.

(5) Peripheral vision can be most useful in spotting collision threats from other aircraft. Each time a scan is stopped and the eyes are refocused, the peripheral vision takes on more importance because it is through this element that movement is detected. Apparent movement is almost always the first perception of a collision threat, and probably the most important, because it is the discovery of a threat that triggers the events leading to proper evasive action. It is essential to remember, however, that if another

aircraft appears to have no relative motion, it is likely to be on a collision course with you. If the other aircraft shows no lateral or vertical motion, but is increasing in size, take immediate evasive action.

(6) Visual search at night depends almost entirely on peripheral vision. In order to perceive a very dim lighted object in a certain direction, the pilot should not look directly at the object, but scan the area adjacent to it. Short stops, of a few seconds, in each scan will help to detect the light and its movement.

(7) Lack of brightness and color contrast in daytime and conflicting ground lights at night increase the difficulty of detecting other aircraft.

(8) Pilots are reminded of the requirement to move one's head in order to search around the physical obstructions, such as door and window posts. The doorpost can cover a considerable amount of sky, but a small head movement uncover an area which might be concealing a threat.

c. Clearing Procedures.

(1) Pilots should:

(i) Prior to taxiing onto a runway or landing area for takeoff, scan the approach areas for possible landing traffic by maneuvering the aircraft to provide a clear view of such areas. It is important that this be accomplished even though a taxi or takeoff clearance has been received.

(ii) During climbs and descents in flight conditions which permit visual detection of other traffic, execute gentle banks left and right at a frequency which permits continuous visual scanning of the airspace about them.

(iii)Execute appropriate clearing procedures before all turns, abnormal maneuvers, or acrobatics.

d. Airspace, Flight Rules, and Operational Environment.

(1) Pilots should be aware of the type of airspace in which they intend to operate in order to comply with the flight rules applicable to that airspace. Aeronautical information concerning the National Airspace System is disseminated by three methods: aeronautical charts (primary); the Airman's Information Manual (AIM); and the Notices to Airmen (NOTAM) system. The general operating and flight rules governing the operation of aircraft within the United States are contained in Part 91 of the FAR.

(2) Pilots should:

(i) Use currently effective aeronautical charts for the route or area in which they intend to operate.

(ii) Note and understand the aeronautical legend and chart symbols related to airspace information depicted on aeronautical charts.

(iii) Develop a working knowledge of the various airspace segments, including the vertical and horizontal boundaries.

(iv) Develop a working knowledge of the specific flight rules (FAR 91) governing operation of aircraft within the various airspace segments.

(v) Use the AIM. The Basic Flight Information and ATC procedures describe the airspace segments and the basic pilot responsibilities for operating in such airspace.

(vi) Contact the nearest FAA Flight Service Station for any pertinent NOTAMS pertaining to their area of operation.

(3) Pilots should also be familiar with, and exercise caution, in those operational environments where they may expect to find a high volume of traffic or special types of aircraft operation. These areas include Terminal Radar Service Areas (TRSA's), airport traffic patterns, particularly at airports without a control tower; airport traffic areas (below 3,000 feet above the surface within five statute miles of an

airport with an operating control tower); terminal control areas; control zones, including any extensions; Federal airways; vicinity of VOR's; restricted areas; warning areas; alert areas; Military Operating Areas (MOA); intensive student jet training areas; military low-level high-speed training routes; instrument approach areas; and areas of high density jet arrival/ departure routings, especially in the vicinity of major terminals and military bases.

e. Use of Communications Equipment and Air Traffic Advisory Services.

(1) One of the major factors contributing to the likelihood of NMAC incidents in terminal areas that have an operating air traffic control (ATC) system has been the mix of known arriving and departing aircraft with unknown traffic. The known aircraft are generally in radio contact with the controlling facility (local, approach, or departure control) and the other aircraft are neither in two-way radio contact nor identified by ATC at the time of the NMAC. This precludes ATC from issuing traffic advisory information to either aircraft.

(2) Although pilots should adhere to the necessary communications requirements when operating VFR, they are also urged to take advantage of the air traffic advisory services available to VFR aircraft.

(3) Pilots should:

(i) Use the AIM.

(A) The basic AIM contains a section dealing with services available to pilots, including information on VFR advisory services, radar traffic information services for VFR pilots, and recommended traffic advisory practices at nontower airports.

(B) The airport/facility directory contains a list of all major airports showing the services available to pilots and the applicable communication frequencies.

(ii) Develop a working knowledge of those facilities providing traffic advisory services and the area in which they give these services.

(iii) Initiate radio contact with the appropriate terminal radar or nonradar facility when operating within the perimeters of the advertised service areas or within 15 miles of the facility when no service area is specified.

(iv) When it is not practical to initiate radio contact for traffic information, at least monitor the appropriate facility communication frequency, particularly when operating in or through arrival/departure routes and instrument approach areas.

(v) Remember that controller observation of aircraft in the terminal area is often limited by distance, depth, perception, aircraft conspicuity, and other normal visual acuity problems. Limitations of radar (when available), traffic volume, controller workload, unknown traffic etc., may prevent the controller from providing timely traffic advisory information. Traffic advisories are secondary to the controllers' primary duties (which are separating aircraft under their control and issuing safety advisories when aware of safety conflicts). Therefore, the pilot is responsible for seeing and avoiding other traffic. Traffic advisories should be requested and used when available to assist the pilot to see and avoid other traffic by assisting, but not substituting in any way, the pilot's own visual scanning. It is important to remember that advisories which air traffic control may provide are not intended to lessen in any manner the pilot's obligation to properly scan to see and avoid traffic.

f. Airport Traffic Patterns.

(1) A significant number of midair collisions, as well as near midair collisions, have occurred within the traffic pattern environment.

(2) Pilots should:

(i) When operating at tower-controlled airports, maintain two-way radio contact with the tower while within the airport traffic area. Make every effort to see and properly avoid any aircraft pointed out by the tower, or any other aircraft which may be in the area and unknown to the tower.

(ii) When entering a known traffic pattern at a nontower airport, keep a sharp lookout for other aircraft in the pattern. Enter the pattern in level flight and allow plenty of spacing to avoid overtaking or cutting any aircraft out of the pattern.

(iii) When approaching an unfamiliar airport fly over or circle the airport at least 500 feet above traffic pattern altitude (usually at 2,000 feet or more above the surface) to observe the airport layout, any local traffic in the area, and the wind and traffic direction indicators. Never descend into the traffic pattern from directly above the airport.

(iv) Be particularly alert before turning to the base leg, final approach course, and during the final approach to landing. At nontower airports, avoid entering the traffic pattern on the base leg or from a straight-in approach to the landing runway.

(v) Compensate for blind spots due to aircraft design and flight-attitude by moving your head or maneuvering the aircraft.

APPENDIX 4

SPECIFICATIONS

General

Weight:	3.8 pounds with antenna and mounting tray
Dimensions:	6.25 inches x 1.5 inches; 11.375 inches deep
Operating Voltage:	11 - 29 Volts DC
Current Requirements:	0.8A @ 14 VDC 0.6A @ 28 VDC
Display dimming:	Automatic

Shield Limits

TRML:	200 FT to 1000 FT 0.5 iNM to 1.5 iNM
STD:	500FTto 1500FT 1 .O iNM to 3.0 iNM
ENRT:	1000 FT to 2000 FT 2.0 iNM to 5.0 iNM (increments of .2 from 3.0 to 5.0)

FACTORY SETTINGS

TCAD is delivered with the following settings:

Mute Volume:	Mid Range
Mute Duration:	30 seconds
No Altitude tones:	Single (SGL)
TRML Mode Tones:	Single (SGL)
STD Mode Tones:	Single (SGL)
ENRT Mode Tones:	Single (SGL)
Ground Mode:	ON

TCAD is factory set to automatically enter Ground Mode when initialized.

ENRT Shield Size:	±2000 feet, 3.0 iNM
STD Shield Size:	±1000 feet, 2.0 iNM
TRML Shield Size:	±500 feet, 1.0 iNM
Altimeter Setting:	29.92 inches
Density Altitude Temperature:	59°F
Altitude Alert:	5,000 feet

PARTS and SERVICE WARRANTY

The Ryan TCAD is warranted against defects in materials and workmanship for 18 months from date of shipment to an authorized dealer, or one year from the date of original installation, whichever occurs first. The obligation of Ryan International Corporation is limited to the repair or replacement, at the option of Ryan International Corporation, of products which prove to be defective during the warranty period. No other warranty is expressed or implied. Proper installation of the *Ryan TCAD* is the responsibility of the installing agency, and is not part of this warranty. Ryan International Corporation is not liable for consequential damages.

Warranty protection is assured only when your *Ryan TCAD* is installed and serviced by an authorized dealer.

CUSTOMER SUPPORT

We appreciate the confidence you have placed in Ryan International Corporation, and in your avionics dealer. We trust that both the *Ryan TCAD* and your dealer have met your expectations. Should you have any questions or comments regarding the *Ryan TCAD*, please contact Customer Service at l-800-877-0048.

DISCLAIMER

As a pilot, you must be relied upon for a certain level of competence and a higher standard of knowledge about the airspace, aerodynamics, regulations, and the Ryan *TCAD*. This includes a knowledge of the limitations as well as the capabilities of the TCAD.

This equipment is designed to increase the pilot's awareness of nearby traffic. It will not detect every aircraft. It is not designed to replace the see and avoid responsibility of the pilot, or the ATC responsibility in the IFR environment.

The information provided by TCAD is not intended to lessen in any manner the pilot's obligation to see and avoid traffic.

The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.

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