



T2000ADSB TRANSPONDER



USER MANUAL

Microair Avionics Pty Ltd

ACN 646 664 459
601 Curtin Ave East
Pinkenba QLD 4008
Australia

Phone: +61 7 4160 8200
Email: support@microair.aero
sales@microair.aero
Web: www.microair.aero

About This Document

Microair Avionics has developed the T2000ADS B transponder to provide for aircraft surveillance requirements of ATRBS Mode 3A/C with ADS-B.

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DOCUMENT REVISION STATUS

Revision	Date	Change
1R1	6/02/23	Initial Draft
1R2	24/03/23	Minor corrections, Programming section moved to Installation Manual.

TABLE OF CONTENTS

1.0	INTRODUCTION	4
1.1	ATCRBS CODES	4
1.2	MODE 3A/C	5
1.3	MODE ADSB	6
2.0	T2000ADSB DISPLAY	7
2.1	LAYOUT	7
2.2	DISPLAY FUNCTION.....	8
3.0	CONTROL FUNCTIONS	9
3.1	SELECTMODE KNOB	9
3.2	CODE SELECT KNOB	10
3.3	INFORMATION SELECT KEY	11
3.3.1	PA - PRESSURE ALTITUDE.....	11
3.3.2	UT - TIME UTC	11
3.3.3	TR - TRACK	12
3.3.4	X - LATITUDE (WHERE X = N OR S).....	12
3.3.5	X - LONGITUDE (WHERE X = E OR W)	12
3.3.6	GA - GPS ALTITUDE	12
3.4	MODE KEY.....	13
3.4.1	ASSIGNED (ALTITUDE).....	14
3.4.2	QNH (BAROMETRIC PRESSURE).....	15
3.4.3	BACKLIGHTING	16
3.4.4	FLIGHT ID	16
3.4.5	BUFFER ALT.....	17
3.5	ENTER KEY	18
3.6	TOGGLE KEY	18
3.7	VFR – HOT KEY	19
3.8	ID KEY	19
4.0	ERROR MESSAGES.....	20
5.0	FREQUENTLY ASKED QUESTIONS:.....	21
6.0	LIMITED WARRANTY	23

1.0 INTRODUCTION

The T2000ADSB has been designed to operate seamlessly in two different modes, to satisfy aircraft surveillance requirements:

- ATCRBS Mode 3A/C
- ADS-B

Both mode of operation will operate simultaneously. ADS-B operates at all time power is applied and the data required for a message is available. ATCRBS operates when the aircraft is airborne.

The ADS-B messages are derived from an inbuilt GPS source. The T2000ADSB also has an inbuilt altimeter but is designed to operate with any TSO-c88a compliant altimeter or encoder, depending on user preference.

1.1 ATCRBS Codes

Aircraft operating in controlled airspace will be allocated a unique 4 digit code. Aircraft operating outside but in close proximity to controlled airspace may be allocated a code but would generally squawk that countries VFR code (1200 in most countries).

There are also several special codes, which are used to identify aircraft in special situations. These include:

1200	Civil VFR Flights OCTA not participating in Radar Information Service (RIS). General Aviation Code (US and other countries)
7000	VFR General Aviation Code (Europe)
7500	Unlawful Interference Code
7600	Radio Communications Failure
7700	Emergency Code



IMPORTANT NOTE
ALWAYS check the standby code, BEFORE transferring it to the ACTIVE position.

Code 2100 is a test code that can be used by qualified personnel to test the transponder to ATC.

The user should check the Civil Aviation Rules/Regulations to determine the VFR General Aviation transponder code for their country.

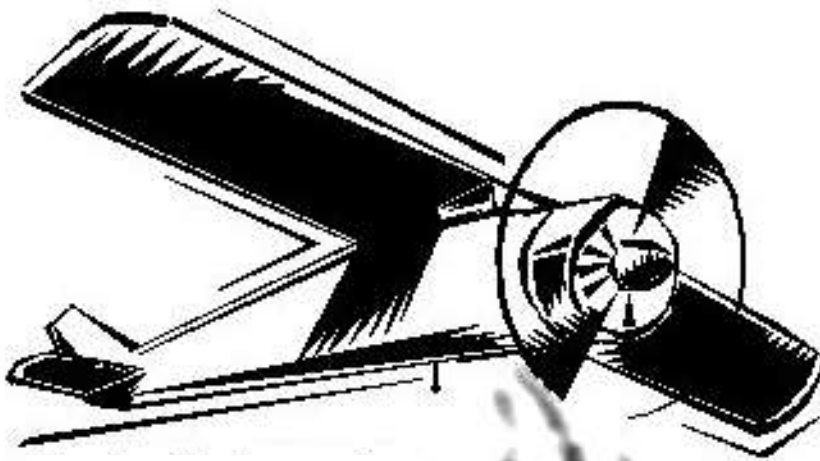
The ADS-B message includes information, which describes the aircraft’s “status”. The aircraft’s status is determined by the currently selected mode A ID code.

Example:	Code 7500 is selected	Aircraft status = UNLAWFUL INTERFERENCE
	Code 7600 is selected	Aircraft status = NO COMMUNICATION
	Code 7700 is selected	Aircraft status = EMERGENCY

For all other mode A codes the aircraft status will be NO EMERGENCY.

1.2 Mode 3A/C

The Microair T2000ADS B Transponder is compliant to RTCA/DO-144, and will operate in the environment of a Radar Beacon System. This system interrogates the transponder, which in turn *replies* with identity code and altitude information. The radar system consists of a network of ground stations, which sweep the horizon like conventional radar. When the transponder in the aircraft detects the radar sweep (is *illuminated*), the transponder *replies* with a burst transmission giving its identity code and altitude.



The aircraft's transponder receives the ground station signal asking it to transmit. The transponder "replies" with the code, and if operating in mode C, the encoder altitude.

Ground stations sweep the sky with a signal, which asks the transponder in the aircraft to transmit its code and altitude.



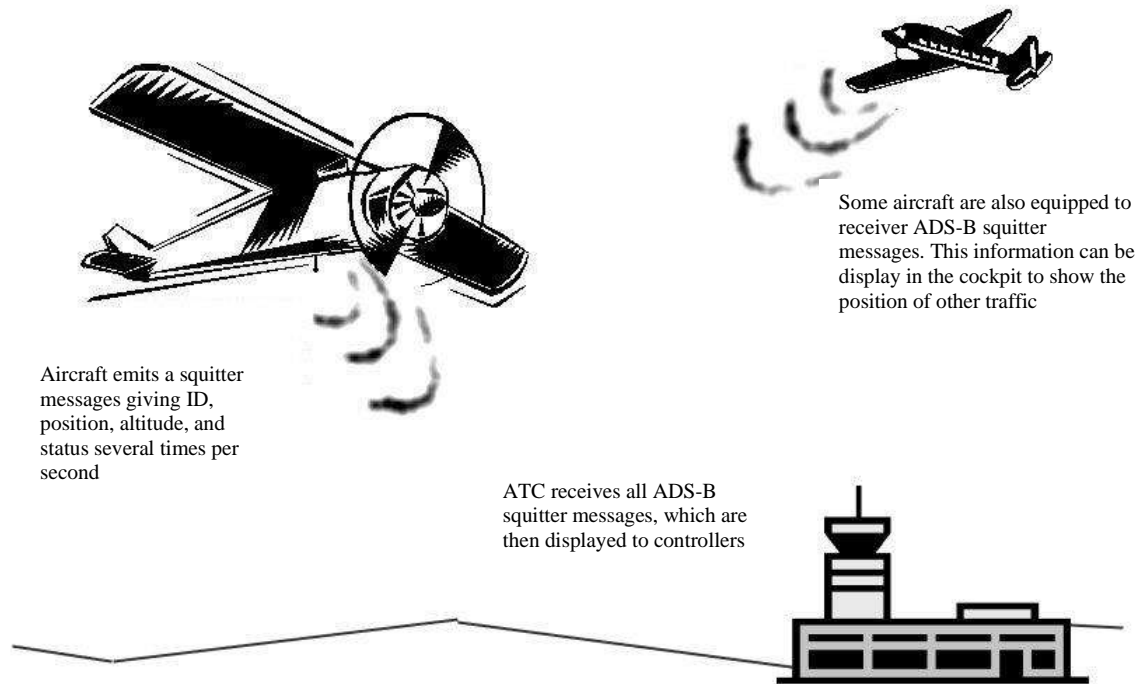
The system presents the *replies* from all transponders in range of the ground stations on a single display screen. This allows ATC to easily locate, identify, and see the altitude of all traffic in their airspace.

A transponder's *reply* is termed a *squawk*. Hence the current code being used by the transponder is termed the *squawk code*. At times of high airspace activity, ATC may wish to uniquely identify an individual aircraft with a request to *squawk ident*. When the pilot uses the *ident* control on the transponder, a distinctive indication appears on the ATC display. The *ident* control should not be used unless ATC requests it.

ATC will issue a code to an aircraft requesting entry into its controlled airspace. This code is normally unique for each aircraft, each time that aircraft passes through the airspace. The code is 4 digits long, and each digit can range from 0-7.

1.3 Mode ADSB

The Microair T200ADS-B is compliant with RTCA/DO-260, and will transmit ADS-B squitter messages containing the aircraft's position (from and GPS source), identity, altitude, and status (eg normal, no comm., emergency, etc).



The feature which makes ADS-B transponders different to Mode A/C or Mode S types is they are not dependent on radar to interrogate them. The ADS-B transponder will issue a series messages called extended squitters. These messages are sent at a rate of approximately 6 messages per second. The position information in these messages is sourced from a compliant GPS receiver that in addition to position and velocity also provides integrity. Integrity is a measure of the quality of the satellite data available to the receiver in that location at that time. The GPS receiver must be capable of calculating the integrity as a value to be sent in the squitter message. If the integrity falls below a certain level the position data cannot be used by ATC.

Other aircraft may be equipped with ADS-B receivers (ADS-B in), which can receiver and decode ADS-B extended squitter messages. This information can then be displayed in the cockpit to give the crew an accurate indication of the traffic situation around them.

The ADS-B message data for the aircraft status is linked to the mode A code. If the pilot selects a mode A code to indicate an abnormal situation (eg 7600 = No Communications), the aircraft status data will change to reflect this.

2.0 T2000ADSB DISPLAY

2.1 Layout

The Microair **T2000ADSB** is a 57mm diameter face version to fit the standard 2 ¼ inch instrument hole. The mounting is by 4 x M4 machine screws, located through the panel and screwed into threaded holes in each corner of the transponder's front face.



IMPORTANT NOTE

Use only the factory supplied screws or M4 x 12mm machine screws. Do NOT oversize the holes, or use over-length screws. These actions may damage internal components of the transponder.



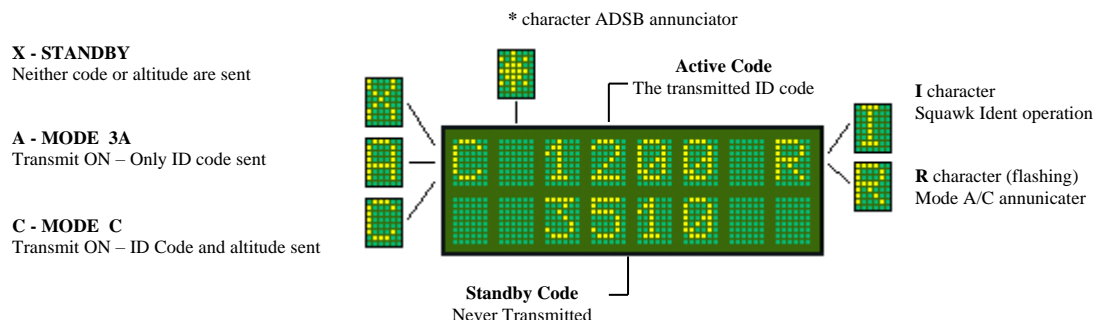
Microair T2000ADSB SFL

Refer to the T2000ADSB Installation manual for full details on how to install your transponder.

2.2 Display Function

The **T2000ADSB** has a dual line display of 8 characters each, with the active code on the top line, and the standby code on the bottom. With the **SELECTMODE** knob set to either the **ON** or **ALT** positions, the active code is displayed on the top line, and the standby code is displayed on the bottom line.

In the top left corner the operational mode character (**X**, **A**, or **C** character) is displayed. Next to it is the ADS-B annunciator (***** character) which remains on when the ADS-B squitter has transmitted. At the top right is the Mode A/C annunciator (**R** character) which flashes with every transponder reply transmitted. If the **ID** key is pressed to activate the ident function, the **R** character is replaced with an **I** character while the ident function is operating.



With the **SELECTMODE** knob in the **ALT DISPLAY** position, the active code is displayed on the top line, and the various position, velocity and time (PVT) information is displayed on the bottom line. Refer section 3.3 below.

3.0 CONTROL FUNCTIONS

This section describes the transponder control keys and their functions. Many of the control keys have more than one function, and some keys access multi-option menus, which can be scrolled.

CONTROL	DESCRIPTION
1	INFO SELECT Key
2	MODE Key
3	ENTER Key
4	IDENT Key
5	TOGGLE Key
6	CODE SELECT Knob
7	SELECTMODE Knob
8	VFR Key



3.1 SELECTMODE KNOB

The **SELECTMODE** knob allows the user to switch the transponder between the 4 operating modes.

Selectmode Knob



STANDBY	In standby the transponder is powered up, but will not transmit in any mode A/C replies. ADSB is active. <i>On the active display line the letter X appears on the left hand side.</i>
ON	The T2000ADS B will reply to Mode A interrogations with the active ID code displayed on the top line. The T2000ADS B will also reply to mode C interrogations, sending framing pulses only, in accordance with mode 3 requirements. <i>On the active display line the letter A appears on the left hand side.</i>
ALT	Will reply to Mode A and C interrogations, with the mode C encoder information. In the absence of a valid encoder input, only the C framing pulse will be sent. <i>On the active display line the letter C appears on the left hand side.</i>
ALT DISPLAY	The standby code is replaced with the data display option selected by pressing the (I) info button. <i>On the active display line the letter C appears on the left hand side.</i>

3.2 CODE SELECT Knob

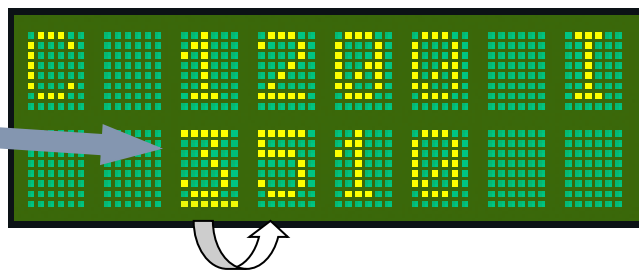
The **CODE SELECT** knob can be rotated clockwise to scroll upwards, and counter-clockwise to scroll downwards. Each digit of the code is adjusted separately. The adjust function starts with the left hand digit, and is moved across to the next digit by pushing the **CODE SELECT** knob inwards. After 10 seconds of inactivity the cursor will revert to the left hand digit.



Code Select

To increase the digit value, rotate the **CODE SELECT** knob clockwise. To reduce the digit value, rotate anticlockwise.

Only values from 0-7 can be selected.



Press the **CODE SELECT** knob inwards to move the cursor to the next digit.

3.3 INFORMATION SELECT KEY

The Information Select key is used to cycle through a number of different T2000ADSB information screens as shown below. Note that the Information Select button only displays data when the Code Select Knob is turned to the ALT DISPLAY setting.



Info Select Key

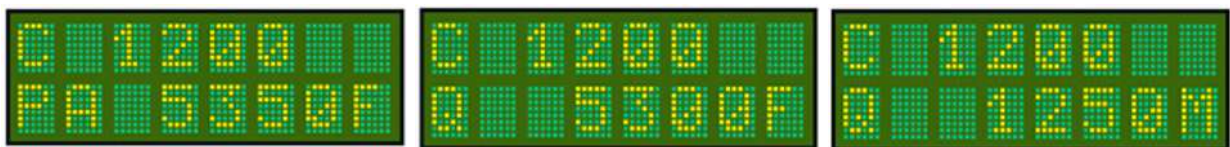
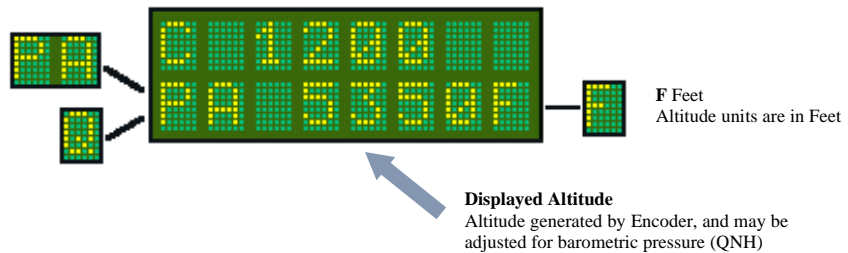
3.3.1 PA - PRESSURE ALTITUDE

Pressure Altitude (altitude with reference to 1013Mb) OR Q - Altitude with reference to the set QNH in either Feet or Meters

If the altitude units are set to feet the altitude is followed by the **F** character. If the altitude units are in metres, the altitude is followed by the **M** character. If no **QNH** or **BARO** value has been entered (default 1013mB or 29.92HG), the raw encoder output is displayed as “pressure altitude”, and the characters **PA** appear at the lower left. If a **QNH / BARO** value has been set, the **Q** character appears at the lower left.

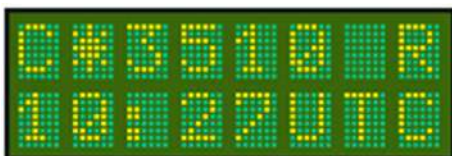
PA Pressure Altitude as sent from the altitude encoder.

Q Altitude is adjusted for QNH or barometric pressure from the mode menu



3.3.2 UT - TIME UTC

Displays UTC time. LT (Local Time) is functionality that will arrive soon.



3.3.3 TR - TRACK.

This screen shows the GPS derived true track and GPS derived ground speed in KTS.



3.3.4 X - LATITUDE (WHERE X = N OR S).

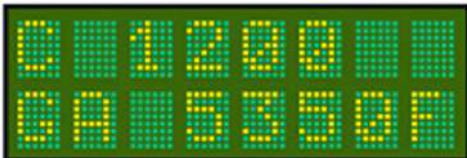
This screen shows the GPS derived latitude as DD.DDD i.e. S27.3250 or N54.2814

3.3.5 X - LONGITUDE (WHERE X = E OR W).

This screen shows the GPS derived longitude DDD.DDD i.e. E153.083 or W007.125

3.3.6 GA - GPS ALTITUDE.

GPS Altitude is derived as the Height above WGS-84 ellipsoid.




3.4 MODE KEY

Press the **MODE** key to access the **MODE MENU**. The first item of the **MODE MENU** is displayed. Step through the **MODE MENU** by pressing the **MODE** key. After the last menu item the **T2000ADSB** returns to the operational display currently in use



Mode Key

The **MODE MENU** is designed to allow the operator fast easy access to functions and parameters, which may need to be adjusted in flight.

MODE MENU		
	Assigned Altitude	 <p>USE MODE KEY TO STEP THROUGH OPTIONS</p>
	QNH	
	Backlighting	
	Flight ID	
	Buffer Altitude	
	back to Operational Mode	<p>OR</p> <p>USE THE <i>Toggle</i> KEY TO RETURN TO THE OPERATIONAL DISPLAY</p>

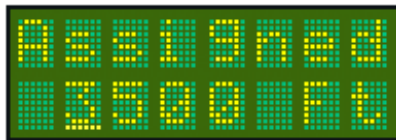
3.4.1 ASSIGNED (ALTITUDE)

The user can input an assigned altitude given by ATC. When used with the altitude buffer value, an audio alert and display indicator advises when the aircraft has climbed or descended, from the assigned altitude.



Press MODE key (1 time)	To select Assigned option
Press CODE SELECT knob	Change increment display value between thousands of feet and hundreds of feet
Rotate CODE SELECT knob	Increment displayed value.
Press ENTER key	To set default value. The default is 0 .
Press ENTER or toggle key	To save and display returns to current operational display

When entering an altitude...



Press the **CODE SELECT** knob to Change increment display value between thousands of feet and hundreds of feet.



Rotate the **CODE SELECT** knob to increase or decrease the height value.

Press the **ENTER** key to return the **ASSIGNED ALTITUDE** to the default value of 0,

OR

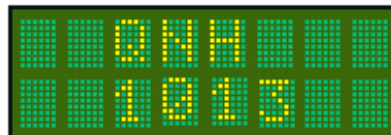
Press the **Toggle** key to save the height value, and return to the operational display.

If **Assigned** is set to **0**, the altitude alert function is disabled. The assigned altitude function is only active when the **SELECTMODE** knob is set to **DISP ALT**.

3.4.2 QNH (BAROMETRIC PRESSURE)

The altitude encoder outputs a pressure altitude relative to a fixed pressure of **1013**mb (29.92inHg) and this is the altitude always reported in the Mode C reply and ADS-B extended squitter messages. The aircraft’s altimeter however is normally adjusted for actual surface pressure before take off and during flight. This means the encoder altitude may not be the same as the altimeter reading.

The **QNH** can be entered here to allow the **T2000ADSB** to compensate the displayed altitude for surface pressure, and hence read the same as the aircraft’s altimeter. The default **QNH** is **1013**mb (or 29.92 if inHg selected, see programming mode below). If the **QNH** is set to **1013**mb, the altitude displayed will default to the unadjusted pressure altitude direct from the encoder. If the **QNH** is set to a discrete value (normally provided by ATC), the displayed encoder pressure altitude will be adjusted for the **QNH** value. The pilot can select any barometric pressure over the range 900 – 1100mB (or 27.00 - 31.99inHg).



Press MODE key (once)	To select QNH option
Rotate CODE SELECT knob	Scroll QNH value up or down to the desired value. The default is 1013
Press ENTER key	To set default value.
Press toggle key	Display returns to current operational display



IMPORTANT NOTE

The T2000ADSB will only transmit the encoder pressure altitude. The adjusted QNH altitude is NEVER transmitted, even when it is selected for display.

3.4.3 BACKLIGHTING

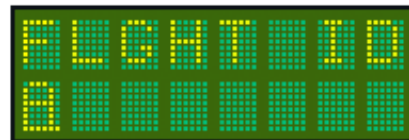
The T2000ADSB LCD display backlight has 11 levels available from 0 – 100%. The level set is remembered and set once the self test is completed during the net power up. Off to its brightest level:

Press MODE key (5 times)	To select BACKLITE option
Rotate CODE SELECT knob	Rotate the code select clockwise to increase the backlight brightness (up to 100%) and counter clockwise to decrease the brightness (down to 0%) in 10% increments.
Press toggle key	Setting is saved & the display returns to current operational display

For battery operators, Microair Avionics recommends that the backlighting be set off to save power.

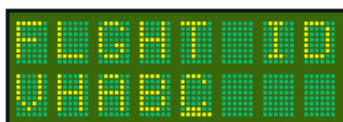
3.4.4 FLIGHT ID

For most sport and general aviation aircraft the Flight ID will be the aircraft’s registration or call sign and is not likely to be changed. Once the flight ID is inputted, it is saved into memory, and will be recalled when the transponder is next turned on. The Flight ID defaults to the A/C ID from the **PROGRAM MODE** menu.



If the Flight ID is not entered, the ADS-B message will transmit “null” values in the Aircraft Identification message.

Press MODE key (6 times)	To select FLT ID option
Rotate CODE SELECT knob	Scroll lower line to select desired character. The default ID is the aircraft ID.
Press CODE SELECT knob	Moves cursor to the next character.
Press ENTER key	To set default value. Default value is blank.
Press toggle key	Display returns to current operational display

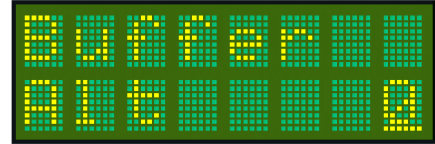


There are rules governing the correct makeup of the flight ID, to ensure the ADS-B message is formatted correctly. In most cases the flight ID will be the aircraft’s registration. The default value of the flight ID is the aircraft ID that is inputted in the **PROGRAM MODE** menu

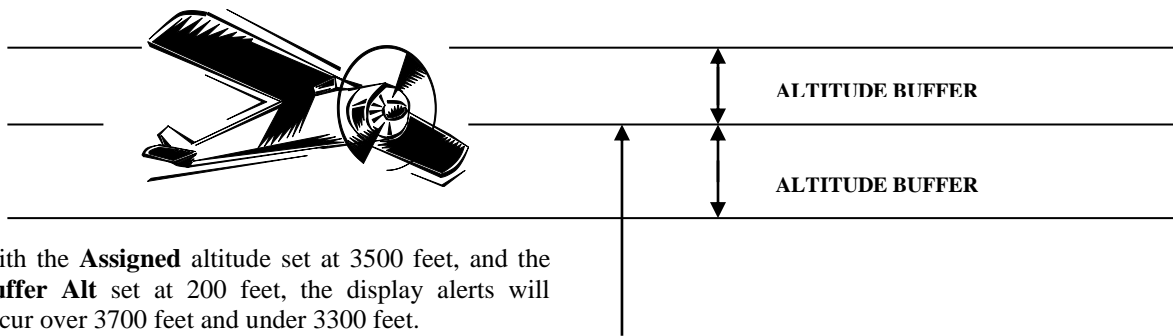
The flight ID can have a maximum of 8 characters and can consists of capital letters A-Z and the numbers 0-9 with spaces in the trailing unused positions (spaces are not allowed in within the Flight or Aircraft IDs).

3.4.5 BUFFER ALT

The user can input a buffer altitude, above and below the assigned altitude, to define a height band in which to fly. When the aircraft exceeds the upper or lower limit, an indicator alert message will be displayed. The alert message advises the pilot of how far, above or below the assigned altitude the aircraft is. If audio output is connected to the aircraft's audio system, an audio tone is heard as well.



Press MODE key (3 times)	To select Buffer Alt option
Rotate CODE SELECT knob	Select the buffer altitude in 50' increments in the range 0 to 2000'
Press ENTER key	Save and move to the next item
Press Toggle key	Save and Display returns to current operational display



With the **Assigned** altitude set at 3500 feet, and the **Buffer Alt** set at 200 feet, the display alerts will occur over 3700 feet and under 3300 feet.

The alert tone is heard as the aircraft passes out of the buffer zone.

No alert will be displayed while the aircraft remains inside the 3700-3300 buffer.



If the aircraft climbs or descends outside the altitude buffer limits, a **Hi / Lo** warning is displayed on the lower line.



T2000ADSB advises the pilot that the aircraft is 500 feet above the **Assigned** altitude. An audio warning tone is heard.



T2000ADSB advises the pilot that the aircraft is 500 feet below the **Assigned** altitude. An audio warning tone is heard.

3.5 ENTER KEY

The **ENTER** key is a confirmation key used to confirm information the user has inputted. After pressing the **ENTER** key, the display will typically give the message **SAVED**, for a short period.

The **ENTER** key is also used to quick-set a parameter to a default value.



The **ENTER** key is also used to acknowledge alerts and error messages. When an alert or error message appears on the lower line of the display, the pilot can press the **ENTER** key to acknowledge the alert / message. The display will then revert to the previous operational display.

Some alerts or error messages, if the alert or error situation continues, will after a preset time display again on the lower line, to remind the pilot that the alert / error still exists.

3.6 TOGGLE KEY

This key acts as a **toggle** switch, exchanging the active and standby codes.



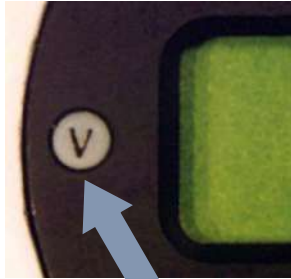
When the transponder is operating in **ALT DISPLAY** the bottom line displays the encoder altitude instead of the standby code. The standby code is stored in memory. To toggle the active and standby codes in this mode, push the **toggle** key once to display the standby code on the bottom line. The standby code is displayed for 10 seconds. Push the **toggle** key again to exchange the active and standby codes. Once the codes have been exchanged, the display will revert back after 10 seconds, to displaying the altitude on the bottom line.



In all modes of operation, only the active code is transmitted.

The **toggle** key is also used to return to the operational screen from the **MODE** and **PROGRAM MODE** menus.

3.7 VFR – HOT KEY



VFR Key

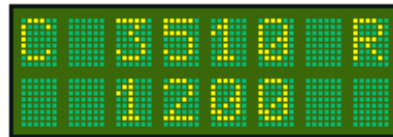
To bring the stored VFR code to the standby line press the **ENTER** key then the **VFR** key.

The **VFR** key will default the standby code immediately to the stored **VFR** code. Typically this code will be **1200** for a General Aviation aircraft. The **VFR** key calls the value set in the **VFR** option of the **PROGRAM MODE** menu.

To transfer the **VFR** code to the active position, press the **toggle** key. If no code is entered, after 10 seconds idle the standby position will revert back to the original **VFR** code.

To make the **VFR** code the **active** code, press the toggle key to bring **VFR** to the top line

Press **VFR** key to bring the stored **VFR** code to the *standby* line. In this case **VFR** = 1200



3.8 ID KEY

To initiate the Ident function press the **ENTER** key then the **ID** key. The ident function will operate for approx 18 seconds.

The **ID** key (Ident) when pressed, adds additional code information to the transmission for **ATC**. The code will flash on the **ATC** display as a means of uniquely identifying the aircraft's code from any other.



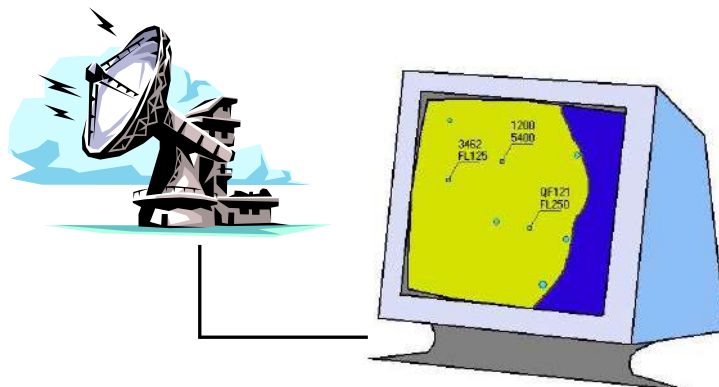
Ident Key

The ID key only needs to be pressed briefly to activate the *ident* function.

Ident data is also added to the ADS-B message to ensure that the ident function is transmitted in all modes.



I character replaces the **R**, while the **IDENT** function is in operation



4.0 ERROR MESSAGES

The T2000ADS B monitors a number of internal and external functions, and will display warnings if potential problems are detected.



This message is displayed if the altitude encoder cannot be detected. The pilot can acknowledge the message by pressing the **ENTER** key. If the fault remains the error message will display again in 5 minutes. The T2000ADS B will remain in mode A.

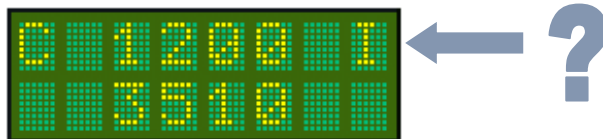


This message is displayed if the GPS cannot be detected.

5.0 FREQUENTLY ASKED QUESTIONS:

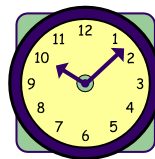
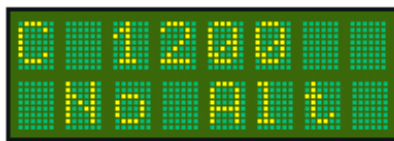
The following questions are common to most users and may help you understand the operation of the T2000ADS B, some of these are explained in the user manual but may have been missed by the reader:

- Q. When I am asked to *Sqwawk Ident* (**ID**) the **I** indicator stays on for a long time. Why ???



- A The **I** or ident character, is used to denote that the transponder reply now includes the ident information, to make the return flash on the ATC display. The ident will stay on for 18 seconds before returning to normal operation.

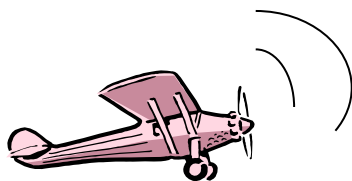
- Q When asked to go to mode C from mode A, the altitude does not appear on the ground station for some time, usually after 8 minutes, is this normal?



**Warm up
time**

- A Yes if the external encoder has a warmup time. The T2000ADS B internal altimeter has no warmup time. We recommend using the internal encoder where power conservation (Gliders etc) is essential.

- Q Whilst flying outside normal radar coverage I have noticed that the reply symbol still flashes from time to time – what causes this?



- A Other aircraft fitted with **TCAS** systems can still interrogate transponder equipped aircraft like yours. This then lets them know where you are, and your contact information is displayed on their TCAS screens. The **TCAS** aircraft could be 100+ miles away and at altitudes +30,000ft!

Q What is the NIC value ?

A ADS-B operation require a very accurate GPS as a source of position data. The GPS must also be very reliable, to be able to provide this data when required. The combination of accuracy and reliability are termed *integrity*. The NIC value is a measure of the GPS integrity.

Q Why does the ground track vary from the aircraft's compass heading and airspeed ?



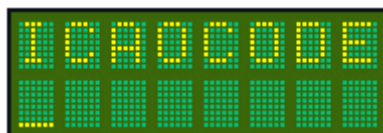
A The ground track represents the path the aircraft is traveling across the ground. This track is influenced by the effect of the wind component. A crosswind component can make the ground track bearing vary considerably from the compass heading. A headwind or tailwind can make the ground track speed vary higher or lower than the indicated airspeed.

Q Why is there a flight ID and an aircraft ID, if they are both the same ?



A For most sport and light GA aircraft the flight ID and the aircraft ID will be set to the aircraft's registration. For IFR and scheduled flight aircraft this will not always be the case. The Flight ID is what is actually transmitted in an ADSB Identification and Category Message, the Aircraft ID is the default value for the Flight ID.

Q What is the ICAO CODE? How do I find out what my aircraft's ICAO CODE is?



A The ICAO CODE is a unique code for every registered aircraft in the world. The code is partly based on the aircraft registration, and is expressed as a 24 digit binary (1's and 0's) number. The ICAO CODE is also expressed as a hex-decimal number, which uses the digits 0-9 and letters A-E.

Aircraft owners or operators can contact their civil aviation authority to be advised of the ICAO CODE for their aircraft's registration.

6.0 LIMITED WARRANTY

The warranty period for any Microair Avionics manufactured article is dependent on Condition of the article at time of sale and the Purchase Date.

For **New Articles** the warranty period commences from Date of Purchase and, unless specified uniquely for the product purchased, is valid for 12 months or the minimum period defined by applicable consumer law, whichever is the longer. In the absence of original Proof of Purchase, the warranty will be valid for 12 months from Date of Factory Shipment as determined by Microair Avionics.

For **Factory Reconditioned Articles** offered for sale, the warranty period commences from Date of Purchase and is valid for 12 months.

For **Factory Exchanged Articles** the warranty period commences from the Date of Purchase of the original article and is valid for the remainder of the original warranty period.

For **Repaired Articles** the warranty period commences from the date of Factory Shipment and is valid for 6 months for the original defect only.

Microair Avionics will, at its sole discretion, repair or replace any components, which fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labour. The customer shall be responsible for any transportation costs for return of this product to Microair Pty Ltd or an approved Microair Service Centre.

This warranty does not cover failures due to abuse, misuse, accident, unauthorised alteration, or repairs carried out by parties other than Microair Avionics or an approved Microair Avionics Service Centre. This warranty does not cover failures where the product has not been installed or operated, in accordance with the provisions of the User and Installation manual(s).

It shall be at Microair Avionics sole discretion to decide if a defect is a result of material or workmanship failure.

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING ANY LIABILITY ARISING UNDER WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, WHICH MAY VARY FROM STATE TO STATE, AND COUNTRY TO COUNTRY.

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Microair Avionics may at its discretion, refer product returns for repair or service, to a service facility closest to you. Microair Avionics reserves the right to repair or replace the product or software or offer a full refund of the purchase price at its sole discretion.

To obtain warranty service, please email or call Microair Avionics in Australia. Domestic or International Return instructions are available on our website. Please follow these instructions carefully.

Phone: +61 7 4160 8200

Email: support@microair.aero

Website: www.microair.aero

