

# **ADS-B**

## **Automatic Dependent Surveillance – Broadcast**

### ***Questions and Answers for Owners of Australian General Aviation Aircraft***

Version 2.2  
December 2016

**WARNING:** Information, statements and opinions contained in this document are given in good faith and have been derived from information reasonably believed to be true at the date of this document. The authors of this document disclaim and exclude all liability for any losses, claims, damages, cost and expenses of whatsoever nature arising in any way out of or in connection with the information contained in this document (or any accompanying or subsequent information), its accuracy or completion or by reason of any reliance thereon by any person. The information contained herein is subject to change beyond the control of the authors, who accept no responsibility for its currency. Readers must satisfy themselves from their own inquiries of the currency of all information presented in this document.

<b>1. What is ADS-B?</b> .....	<b>6</b>
<i>What does ADS-B OUT and IN mean?</i> .....	6
<b>2. How does ADS-B work?</b> .....	<b>7</b>
<i>What are the differences between ADS-B in Australia and the USA?</i> .....	7
<i>ADS-B in the USA</i> .....	8
<i>USA Systems - TIS, TIS-B, ADS-R</i> .....	8
<i>Why can't we use UAT in Australia?</i> .....	10
<i>What do the terms ADS-B "Version 1" and "Version 2" mean?</i> .....	10
<i>Is the USA's 1090ES standard more recent than that adopted in Australia?</i> .....	10
<i>Will ADS-B provide weather information in Australia?</i> .....	11
<i>What about national and aircraft operator security?</i> .....	11
<i>Can ADS-B be used to track my aircraft's movements?</i> .....	11
<i>Will I be charged more because I have ADS-B? Are there plans for enroute and terminal charges based on ADS-B data?</i> .....	11
<b>3. Why should I equip my IFR aircraft with ADS-B?</b> .....	<b>12</b>
<i>Do I need ADS-B IN or OUT?</i> .....	12
<i>By what date must I be equipped with ADS-B OUT to comply with the new rules?</i> .....	12
<i>I fly IFR, but almost always in Class G airspace. What use will ADS-B be for me?</i> .....	13
<i>I fly IFR, but almost always in radar coverage. What use will ADS-B be for me?</i> .....	13
<i>I only ever fly VFR. Will I be required to fit ADS-B?</i> .....	13
<i>What use would ADS-B in a VFR aircraft be to me?</i> .....	14
<i>How can we be confident that if we install ADS-B now, we will comply with the legal requirements when mandatory fitment becomes effective?</i> .....	14
<i>What will happen if I do not install ADS-B in our IFR aircraft?</i> .....	14
<i>How can I apply for an exemption from these ADS-B requirements?</i> .....	15
<i>My aircraft is registered with Recreational Aircraft Australia (RAAus). Will it need to be fitted with ADS-B?</i> .....	15
<i>Do the ADS-B rules apply to helicopters?</i> .....	15
<i>My glider or vintage aircraft is exempt from the transponder requirements. Will it need to be fitted with ADS-B?</i> .....	16
<i>When should I equip with ADS-B IN?</i> .....	16
<i>Do TAS and ACAS systems include ADS-B IN?</i> .....	16
<i>This is very complicated. Who can I ask for help, or more information?</i> .....	16
<b>4. What equipment will I need for ADS-B OUT? For ADS-B IN?</b> .....	<b>17</b>
<i>What brands and models of equipment are known to meet the standards and work in Australia?</i> .....	17
<i>Stand-Alone ADS-B Transponders with Inbuilt Position Sources</i> .....	17

<i>Transponders</i> .....	17
<i>GNSS Navigation Systems and Position Sources</i> .....	18
<i>ADS-B IN Products - Portable Devices</i> .....	18
<i>ADS-B IN Products - Installed Devices</i> .....	19
<i>Do other equipment options exist at lower cost for VFR aircraft?</i> .....	19
<i>I already have a Mode S transponder. Isn't that enough?</i> .....	19
<i>I have a recent model or near-new digital Mode C transponder. Can it be upgraded for ADS-B?</i> .....	20
<i>I already have an IFR GPS. Will that work with ADS-B?</i> .....	20
<i>What is the difference between GPS and GNSS?</i> .....	20
<i>What has PBN and RNP got to do with it? Do I need additional equipment for that too?</i>	21
<i>How can I tell that what I'm buying will work?</i> .....	21
<i>What standards or approvals should I look for in the product literature or manual?</i> .....	24
<i>Should I check what revisions of software or firmware are being supplied with my new equipment?</i> .....	24
<i>What's the best way to get my existing equipment upgraded?</i> .....	24
<i>Can I buy an ADS-B transponder and GPS from the USA? Will it work here?</i> .....	24
<i>Is the price of ADS-B equipment expected to change much? Should I wait?</i> .....	25
<i>Will the TSO-C146 GNSS navigator that I am installing for ADS-B do anything more than my existing TSO-C129a unit?</i> .....	25
<i>Why can't I use the GPS in my handheld, or EFB tablet, for ADS-B?</i> .....	26
<i>What's the least cost or most minimal way to install ADS-B?</i> .....	26
<i>I intend to make multiple improvements to my instrument panel at the same time. How can I make sure that what I buy now will last long into the future?</i> .....	26
<i>My transponder is getting old. What should I replace it with?</i> .....	27
<i>I am or will be buying a new IFR aircraft, or importing a used one from overseas. What should I do to ensure that it has ADS-B that will work in Australia?</i> .....	27
<i>I will be buying a new VFR aircraft. Does it need to be equipped with ADS-B?</i> .....	28
<i>My aircraft is in the experimental category and I am the owner-builder. Do I need to use a certified (TSO) GNSS and ADS-B transponder?</i> .....	28
<i>My aircraft is registered with the RAAus. What equipment should I select for ADS-B?.....</i>	29
<i>Can I use the Dynon Transponder as an ADS-B solution in Australia?</i> .....	29
<b>5. How can I get ADS-B installed in my aircraft?</b> .....	<b>30</b>
<i>What are the most common pitfalls and mistakes in ADS-B installations?</i> .....	30
<i>Does ADS-B need another antenna?</i> .....	31
<i>What software and firmware versions are needed for the installation to be successful?..</i>	31
<i>It looks like a pretty simple job. Can I do it myself?</i> .....	31
<i>What installation approvals do I need for ADS-B? Are these the same as the TSOs and DO standards?</i> .....	31
<i>I intend to fit numerous items of new equipment including PFD, MFD, traffic and/or weather systems. These will all be interconnected using ARINC 429. Can I connect the ADS-B transponder that way too?</i> .....	32
<i>My VH-registered aircraft is in the experimental category and I am an owner builder. What should I do to fit ADS-B?</i> .....	32
<i>My aircraft is registered with the RAAus. What should I do to fit ADS-B?</i> .....	32
<i>How can I get more detailed technical help?</i> .....	32
<b>6. Now that I have ADS-B, how can I make use of it?</b> .....	<b>33</b>
<i>What operational approvals do I need?</i> .....	33
<i>What should I enter for Flight ID (FLTID)?</i> .....	33
<i>Are there particular Flight ID requirements for RAAus aircraft?</i> .....	33

<i>How can I tell if the Flight ID is correct? .....</i>	33
<i>Why do I still need a transponder squawk code if I have set the Flight ID? .....</i>	33
<i>Do I need an endorsement or FPA on my instrument rating to use ADS-B?.....</i>	34
<i>How does ATC know that I have ADS-B? .....</i>	34
<i>How and where should ADS-B equipment be shown on flight notifications in NAIPS?.....</i>	34
<i>Should I get formal training to use ADS-B? .....</i>	35
<i>What should I do if ADS-B malfunctions?.....</i>	35
<i>How do I request ADS-B services? .....</i>	35
<i>Will ATC give me priority because I have ADS-B?.....</i>	35
<i>Can air traffic controllers tell whether aircraft position information is being received by radar or ADS-B?.....</i>	36
<i>What prevents the ATC system incorrectly showing two aircraft when my aircraft is being detected by both radar and ADS-B? .....</i>	36
<i>How do I know which routes and altitudes are within ADS-B coverage?.....</i>	36
<i>On a recent VFR flight, ATC did not give me traffic or alert other aircraft to my presence even though I have a working ADS-B installation. Why? .....</i>	36
<i>What transponder code should I use with ADS-B? .....</i>	36
<i>When should I use the ADS-B IDENT function?.....</i>	37
<i>Does ADS-B support emergency declarations? .....</i>	37
<i>When should I turn ADS-B on? Should ADS-B be switched off when leaving the runway after landing? .....</i>	37
<i>Does ADS-B work with TCAS? Can a TCAS equipped airliner see me better, or from further away, if I have ADS-B?.....</i>	37
<i>Can I use information obtained from the Internet for traffic avoidance in flight?.....</i>	38
<i>If I can see my aircraft on those websites after making a flight, doesn't that prove that my ADS-B installation is working correctly?.....</i>	38
<i>When will an ADS-B receiver be installed near my home airport so that we can have surveillance coverage too?.....</i>	38
<b>7. What maintenance must be performed on my ADS-B equipment? .....</b>	<b>39</b>
<i>Can I rely on ATC to tell me if my ADS-B equipment is not working correctly? .....</i>	39
<i>Can I switch ADS-B off in-flight?.....</i>	39

## Change History

Version 1.0	October 2012	Initial issue.
Version 1.02	March 2013	Updated software and equipment sections 4 and 5.
Version 1.04	June 2013	Inserted new table section 5 with updated Garmin software revisions and notes.
Version 1.05	July 2013	Inserted information about Dynon Skyview. Changed flight planning info after 2012 flight plan.
Version 1.06	Nov 2013	Inserted Honeywell products inc KT74 in section 4.
Version 1.07	Nov 2013	Note about Garmin GTX Mode S+ in section 5.
Version 1.08	Apr 2014	Changes regarding Trig, Dynon and Garmin in section 5. Minor revision to other guidance text.
Version 1.11	May 2015	General revision. Updated equipment listings and notes in sections 4 and 5. Removed dated software version information. Added section for ADS-B IN equipment and included diagrams of PBN/ADS-B compliance methods in section 4. Updated text in section 6. Clarified design standard terminology.
Version 2.0	December 2016	General revision. Updated for: time extension for certain private flights; radar changes; new integrated avionics equipment; FAA Version 1 and 2 terminology; flight notifications, equipment software versions; diagrams; and references to AIP and other documents.
Version 2.1	December 2016	CASA & AEA review – CAO change from date of first registration to date of manufacture.
Version 2.2	December 2016	Further CASA & AEA review

## **1. What is ADS-B?**

ADS-B stands for Automatic Dependent Surveillance – Broadcast. It is a system in which aircraft broadcast their position, velocity, identity and other information at a high rate. It is broadcast so that anyone can receive and display the information. Ground stations receive aircraft ADS-B transmissions and forward them for display on Air Traffic Control (ATC) consoles. Typically, ATC can use ADS-B information in the same way as radar.

### **What does ADS-B OUT and IN mean?**

“ADS-B OUT” is the transmission of ADS-B information out from an aircraft to other aircraft or to the ground. ADS-B OUT has been made mandatory for IFR aircraft over an extended transition period. Compliance dates for ADS-B OUT depend on whether the aircraft flies in upper or lower airspace, is newly registered or existing, and whether it operates in areas of intensive air traffic in Western Australia.

“ADS-B IN” is the on-board reception of ADS-B OUT transmissions to allow a Cockpit Display of nearby aircraft to the pilot of the ADS-B IN equipped aircraft. There are no plans in Australia to require mandatory fitment of ADS-B IN.

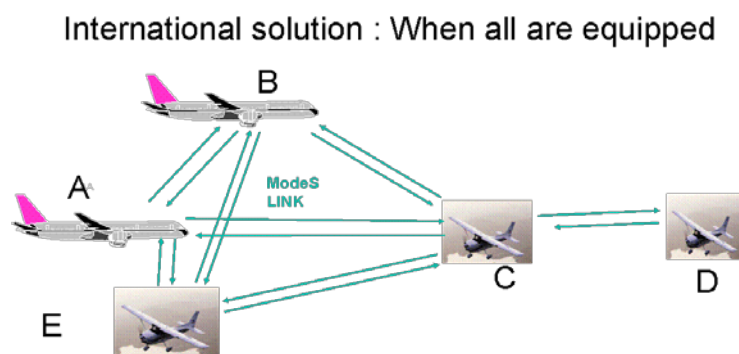
## 2. How does ADS-B work?

### What are the differences between ADS-B in Australia and the USA?

Firstly, let's describe the ADS-B system in Australia.

Australia has implemented ADS-B on 1090 megahertz (MHz). This is the same frequency used by aircraft ATC transponders and hence allows the use of transponders and GPS already installed in many air transport aircraft. The 1090MHz system has been adopted by the International Civil Aviation Organization (ICAO) as the world standard for ADS-B. It is being, or will be used, by Europe, Canada, USA and Australia as well as the Asia – Pacific nations.

The 1090MHz system is a simple one-way transmission of data from the aircraft (ADS-B OUT) to ground stations, which simply listen to transmissions and forward them to ATC systems.



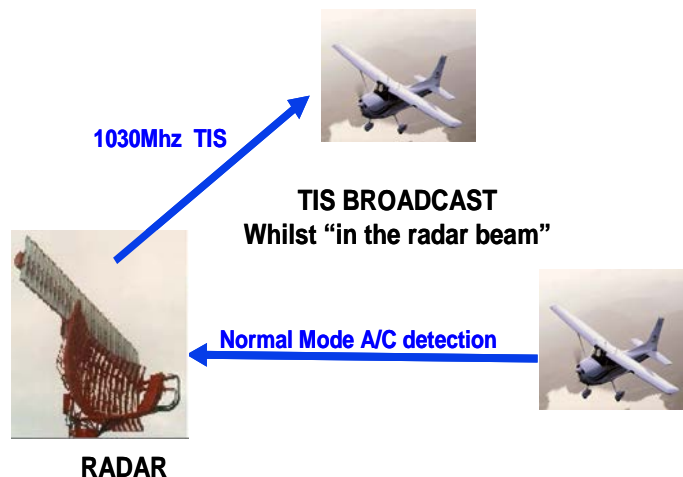
Australia has adopted a single system that allows aircraft with ADS-B IN equipment to receive ADS-B OUT from all equipped aircraft without the need for ground based translator (or "rebroadcast") stations. In our huge country, translator stations, which are necessary to make a dual system work, would be extremely expensive. Further, translator stations on the ground add another point of failure in the relaying of air traffic data.

## ADS-B in the USA

The USA's FAA has adopted a dual system using both 1090MHz and Universal Access Transceiver (UAT). The FAA has adopted 1090MHz for all flight levels, and UAT only for operations below 18,000 feet. UAT supports two-way links, and the FAA provides additional services on the uplink including TIS-B, and ADS-R, which are explained in detail below, as well as FIS-B, for weather and aeronautical information. Dual 1090/UAT systems have not been adopted in Australia or any other country.

## USA Systems - TIS, TIS-B, ADS-R

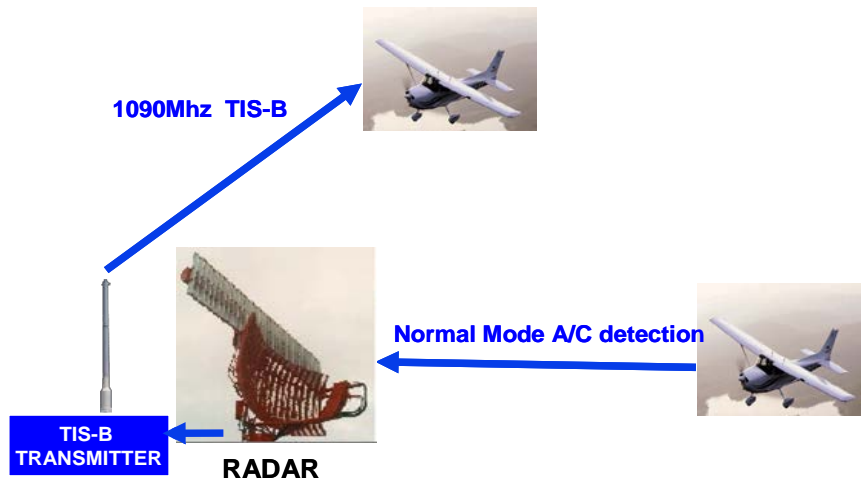
**TIS:** TIS stands for Traffic Information Service. TIS is in the process of being phased out in USA and is not used in Australia. In this system, ATC radar information is collected on the ground, and the ground radar uplinks information to suitably equipped nearby aircraft on 1030MHz. Uplinks can occur only when the radar is pointed at the aircraft, so the amount of information that can be transmitted is necessarily limited.



Some transponder manufacturers still promote TIS as providing traffic for pilot display. You need to be careful that you don't purchase such transponders with the expectation of using the "traffic service" in Australia.

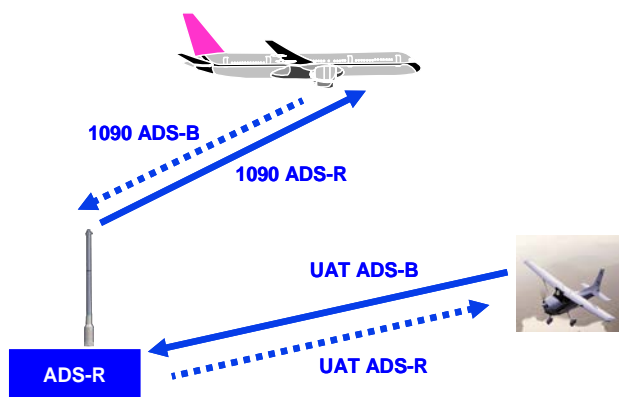
**TIS-B:** This system is a traffic broadcast information service on 1090MHz (and UAT) in USA. It is not used in Australia. The ATC radar collects information and transmits it to ADS-B IN equipped aircraft that are in close proximity.





To reduce congestion on the link, the system only transmits information about aircraft that are within a certain distance or altitude of TIS-B equipped aircraft. The FAA has decided that TIS-B aircraft must be equipped with ADS-B OUT to receive the service. TIS-B is intended as a transition technology until the level of ADS-B equipage is sufficiently high. An ADS-B IN receiver can typically receive TIS-B as if it were received directly from an ADS-B equipped aircraft. Australia does not intend to provide TIS-B for technical and financial reasons.

**ADS-R:** This is a service whereby a ground station receives ADS-B transmissions on one link (UAT or 1090), converts them, and re-transmits them on the other link, so that all ADS-B IN aircraft can see each other, whether they have UAT or 1090 ADS-B equipment. Because Australia uses only the single 1090 link, ADS-R would serve no purpose in Australia and will not be implemented.



### **Why can't we use UAT in Australia?**

In Australia, air traffic infrastructure is funded by the aviation industry, including airlines and general aviation. No stakeholders are willing to fund the high cost of dual-link supporting infrastructure and so there are no UAT based ADS-B ground stations in Australia. UAT equipment may not be used in aircraft in Australia.

### **What do the terms ADS-B “Version 1” and “Version 2” mean?**

The RTCA (Radio Technical Commission for Aeronautics) in the United States defined DO 260, DO 260A and DO 260B standards. When DO 260A was defined, it was necessary to allow receivers to know if the message was DO 260 or DO 260A. A message field was invented defining a “version number” allowing this to occur. DO 260A was designated Version 1, and subsequently DO 260B was designated Version 2. DO 260 does not transmit a version number, and hence receivers always assume Version 0 until a version number is received.

The International Civil Aviation Organisation (ICAO) essentially incorporated the DO 260, DO 260A and DO 260B standards into ICAO documentation as Versions 0, 1 and 2 respectively.

### **Is the USA’s 1090ES standard more recent than that adopted in Australia?**

The United States Federal Aviation Regulations (14CFR 91.227) specify that 1090ES equipment installed in US aircraft must comply with the most recent TSO C166b (DO-260B / Version 2) standard. Australia’s regulations allow greater flexibility, permitting TSO C-166b (DO-260B / Version 2), or TSO-C166a (DO 260A / Version 1), and even most TSO-C166 (DO 260 / Version 0) designs. There are already many successful installations of TSO-C166b equipment in Australian aircraft that are fully operable with the Australian ATC system and also fully compliant with the US rule. Australia designed its systems to operate with a wider range of equipment so that the benefits available to the Australian aviation industry could be achieved with minimal delay. Equally, Australia has less demanding GPS requirements. Some airline TSO C129 GPS systems are acceptable, providing they have the appropriate functionality and output interfaces. Notwithstanding the above, TSO-C166b transponders and TSO C145 and C146 navigation systems are preferred.

### **Will ADS-B provide weather information in Australia?**

There are no plans to uplink weather data on an ADS-B link in Australia. No stakeholders are willing to fund the necessary supporting infrastructure.

### **What about national and aircraft operator security?**

The security of the Australian air traffic management system is being continually monitored and assessed. Various controls and mitigating procedures have been established to manage security risks to levels equivalent to those that already exist under the radar systems that we have today. None of the major Australian aircraft operators have expressed concerns about any increased security risks through the use of modern air traffic surveillance technology.

### **Can ADS-B be used to track my aircraft's movements?**

Yes. ADS-B, like all civil aircraft transmissions, is an open and unencrypted system. It is possible to listen to ADS-B transmissions with an ADS-B receiver. It should be remembered that it has been possible to listen to aircraft radio communications for decades.

### **Will I be charged more because I have ADS-B? Are there plans for enroute and terminal charges based on ADS-B data?**

There are no charges to use ADS-B beyond the existing terminal, en route, meteorological and aviation rescue firefighting charges that already apply. ADS-B lowers the cost of service provision by Airservices compared to extending the radar network or using procedural methods. If anything, future charges should be lower when compared to alternative means of service provision.

### **3. Why should I equip my IFR aircraft with ADS-B?**

#### **Do I need ADS-B IN or OUT?**

Mandatory requirements for ADS-B OUT fitment have been legislated by CASA in the Civil Aviation Orders (CAOs). These mandates have required fitment above FL285 since 12 December 2013, and for other IFR aircraft as described in detail in CAO 20.18. Many operators have chosen to equip sooner with ADS-B OUT to make their aircraft more visible to both ATC and other pilots. Even for some VFR aircraft, there are significant safety benefits to operating under ATC surveillance, including the ability to readily get assistance from ATC.

There are no mandatory requirements currently envisaged for ADS-B IN. However, as more and more aircraft equip with ADS-B OUT, you may want to consider equipping with ADS-B IN avionics on a voluntary basis. Relatively inexpensive products for ADS-B IN are becoming available. ADS-B IN can be integrated with many aircraft multi-function displays (MFD) and other devices.

#### **By what date must I be equipped with ADS-B OUT to comply with the new rules?**

It depends. So far, the regulations have required aircraft to be equipped as follows:

- Dec 2013: All operations at and above FL290.
- Feb 2014: Aircraft operated under the IFR that were manufactured on or after 6 Feb 2014.
- Feb 2016: Aircraft operated under the IFR in Western Australia, within an area of 500NM to the north through to the east of Perth Airport. (This is co-incident with the mandatory requirement to fit GNSS to all IFR aircraft for navigation in Australian airspace.)

Looking ahead, the regulations require all aircraft conducting IFR flight to be equipped by February, 2017, except as follows:

- Australian aircraft, manufactured before 6 February 2014, operating in Australian airspace, but not equipped with ADS-B, will be able to fly IFR for private operations in Class D airspace (subject to ATC clearance), including transiting Class C and E steps when arriving at or departing from a Class D aerodrome (subject to ATC clearance), or in Class G airspace (below 10,000 feet), until 1 January 2020. They will not be able to fly in Class A airspace.

- Foreign registered IFR aircraft, with a secondary surveillance radar (SSR) transponder, may fly in Australian airspace, including oceanic control areas, but must fly under 29,000 feet in continental airspace unless they receive a clearance from ATC. They will need to be equipped with ADS-B when the instrument expires on 6 June 2020.

CAO 20.18, paragraph 9B.12 contains provisions for operations with temporarily unserviceable ADS-B equipment, to permit re-locating the aircraft to an airport where repairs can be made.

**I fly IFR, but almost always in Class G airspace. What use will ADS-B be for me?**

ADS-B will make your aircraft visible to both ATC and other aircraft that have ADS-B IN. ATC provide traffic information on IFR - IFR in Class G and ADS-B will make the traffic information that you receive much more accurate. SAR capabilities are improved with ADS-B, as is the ability to obtain assistance from ATC if required. In time, fitting ADS-B IN to your aircraft is likely to provide further improved safety and efficiency.

**I fly IFR, but almost always in radar coverage. What use will ADS-B be for me?**

Most existing radars can be expected to remain in place till at least 2025, however it is expected that radars at Kalamunda (WA), Mt Boyce (NSW), and Paraburdoo (WA) will be decommissioned by mid-2017; and after that date, enroute SSR only radar coverage can be expected to continue to reduce over time. Significant further extensions of radar coverage are not expected. ADS-B will improve your aircraft's visibility to both ATC and other aircraft that have ADS-B IN.

Over time, ADS-B IN will provide the technology platform for future operational efficiencies, particularly for sequencing and merging procedures.

**I only ever fly VFR. Will I be required to fit ADS-B?**

There are no current mandatory requirements for ADS-B in VFR aircraft, although replacement transponders must be Mode S, ADS-B capable, and any new aircraft is required to have a Mode S Extended Squitter, ADS-B capable transponder if it operates in Class A, B, C or E airspace; or above 10,000 feet in Class G airspace. Nevertheless, many aircraft owners are expected to fit ADS-B for safety and

efficiency reasons, including many VFR operators. CASA has indicated that it will widely consult with industry before regulations are made that would require ADS-B in VFR aircraft, and there are no active proposed regulations in that respect at this time.

### **What use would ADS-B in a VFR aircraft be to me?**

ADS-B out is a little like having taillights on your car. They are used by “the other guy”. In an environment when most aircraft have ADS-B OUT, aircraft with ADS-B IN will have the ability to “see” other aircraft that are nearby. An ADS-B IN system far exceeds the capabilities of the human eye to detect aircraft and alert you to other aircraft that are a risk. The availability of surveillance information and Flight Following services by ATC for VFR aircraft, and the availability of accurate information for SAR purposes are significant advantages too.

There may be other possible benefits for some VFR operators including:

- Performance feedback for student training
- Aircraft tracking, especially in flying clubs and schools for those waiting to use an aircraft
- Co-ordination of arrival support and ground services such as fuel, as savvy vendors use the web to locate inbound aircraft and are ready to offer a range of services. Eventually, these could extend to rental cars and other convenience services for some operations.

The operators of more than 400 VFR aircraft had already equipped with ADS-B by the end of 2016.

### **How can we be confident that if we install ADS-B now, we will comply with the legal requirements when mandatory fitment becomes effective?**

Australia has adopted international technical standards for ADS-B technology including two later version upgrades of those standards. The ADS-B equipment available today that has been certified to the relevant Technical Standard Orders will be satisfactory for use in Australia for at least the next 10 years and probably longer.

### **What will happen if I do not install ADS-B in our IFR aircraft?**

If you do not comply with the applicable fitment requirements, by the prescribed dates, you will not comply with the CASA legislative requirements for flight under the IFR. Operating contrary to the regulations may lead to enforcement action, and Airservices Australia may deny air traffic clearances to non-equipped aircraft.

### **How can I apply for an exemption from these ADS-B requirements?**

The requirements for ADS-B fitment are legal requirements and any exemptions will require a written authorisation from CASA, based on a safety case. Applications for exemptions from the requirements of the Civil Aviation Regulations and Orders must be made to CASA in writing.

Private (and certain foreign) aircraft operators who wish to avail themselves of the time extensions granted by CASA need not separately apply, but they must comply with all the conditions set out in the relevant instruments of authorisation (CASA 113/16 and 114/16). Note that these include restrictions on the category of operation, the classes of airspace and altitudes available, ATC clearances and flight notification requirements.

### **My aircraft is registered with Recreational Aircraft Australia (RAAus). Will it need to be fitted with ADS-B?**

RAAus aircraft are flown only under the VFR and are not permitted to operate under the IFR. There are currently no mandatory requirements for ADS-B fitment for VFR operations. But remember that any aircraft (IFR or VFR) manufactured on or after February 2014 is required to have a Mode S Extended Squitter, ADS-B capable transponder if it operates in Class A, B, C or E airspace; or above 10,000 feet in Class G airspace. This includes aircraft that will be registered with the RAAus.

### **Do the ADS-B rules apply to helicopters?**

Yes, the ADS-B rules apply to all IFR aircraft, including helicopters flown under the IFR.

### **My glider or vintage aircraft is exempt from the transponder requirements. Will it need to be fitted with ADS-B?**

Gliders and vintage aircraft are almost all flown only under the VFR. Owners of these aircraft that choose to voluntarily equip with ADS-B must satisfy the same standards as other VH-registered aircraft.

### **When should I equip with ADS-B IN?**

The benefits of ADS-B IN are clearly more meaningful when other aircraft have ADS-B OUT. Because the majority of IFR aircraft are now equipped with ADS-B, there is value in equipping with ADS-B IN now. If you operate VFR, ADS-B IN will also be of benefit, depending on the locations in which you operate and the type of aircraft that you “mix it” with. A number of vendors of ADS-B OUT products, which optionally include an ADS-B receiver, provide the ability to send such data to a tablet device by WiFi.

### **Do TAS and ACAS systems include ADS-B IN?**

Traffic Advisory Systems (TAS) and Airborne Collision Avoidance Systems (ACAS), including TCAS) in use at this time do not use ADS-B for alerting. A few high-end systems include the display of ADS-B symbols for traffic awareness. It is expected that in the next decade ADS-B will become firmly integrated into TCAS, in ‘hybrid surveillance’ aircraft collision avoidance systems. There are a number of TAS systems available and ADS-B is starting to become an integrated part of some of them. This will accelerate as ADS-B OUT equipage ramps up.

### **This is very complicated. Who can I ask for help, or more information?**

The best source of information for aircraft owners seeking information about ADS-B products is an avionics supplier, based in Australia, which has accreditations from the major manufacturers and employs appropriately licensed and trained personnel that are completely familiar with Australian requirements. For information about modifying a GA aircraft for ADS-B installation, aircraft owners should make contact with a 21.M authorised person, or 21.J approved design organisation.

Caution is recommended in dealing with overseas equipment suppliers who may not be familiar with Australian regulations. Basic information about the requirements and your choices is being made available to members by at least one representative general aviation organisation.



## **4. What equipment will I need for ADS-B OUT? For ADS-B IN?**

*Important Note! This information is intended as a starting point, for guidance only. Always check equipment suitability, compliance and compatibility with an accredited supplier before purchase. A list of applicable international standards is provided at page 24 of this document.*

### **What brands and models of equipment are known to meet the standards and work in Australia?**

CASA AC 21-45(1) lists a number of products already approved and used in Australia for IFR aircraft. The following products are also known to be suitable:

#### **Stand-Alone ADS-B Transponders with Inbuilt Position Sources**

These transponders may be configured to utilise their own inbuilt GNSS position source and do not need interconnection to an external GNSS navigation system:

- Appareo Stratus ESG
- Garmin GTX 335 and 335R, with optional inbuilt GPS position source
- L3 Lynx NGT-9000

#### **Transponders**

These transponders are intended for connection to a separate GNSS ADS-B position source listed under the next heading below:

- ACSS X950 upgrade, NXT 800 replacement, RCZ 852/NXT600 replacements (for business jets and other larger aircraft)
- Avidyne AXP 340
- BendixKing by Honeywell KT 74
- Dynon Skyview
- FreeFlight RANGR FDL-1090-TX
- Garmin GTX 33ES, 330ES and 3000
- Garmin GTX 335 and 335R, without optional inbuilt GPS position source
- Rockwell Collins TDR94/94D
- TRIG TT31, TT22 and TT21

## **GNSS Navigation Systems and Position Sources**

- Accord NexNav
- Avidyne IFD 540/440
- BendixKing by Honeywell KSN 765 and KSN 770
- FreeFlight 1201, 1203C and 1204
- Garmin GPS/GNS 400/500W series
- Garmin GTN 650/750 series
- Garmin G1000 systems with GIA 63W Integrated Avionics Unit\*
- Garmin G2000 and 3000 systems\*
- Trig TN70

*\* Note that many aircraft equipped with Garmin G1000, G2000 and G3000 avionics systems have been delivered with compliant ADS-B OUT for several years.*

## **ADS-B IN Products - Portable Devices**

*Verify with the app vendor that your tablet EFB app is compatible with the hardware product before purchase. Not all products may be suitable for airborne use.*

Non-certified receivers that couple with Tablets (eg iPad) or other EFB units by WiFi or Bluetooth, to provide a traffic display via a suitable moving map app:

- Appareo Stratus 2 ADS-B Receiver for iPad\*
- Dual XGPS 190\*
- Garmin GDL 39\*
- iLevel 2 and 3 SW / AW\*
- NavWorx PADS-B\* PowerFLARM (displays 1090MHz and FLARM [glider] traffic)
- Radenna SkyRadar-D2/Dx\*
- Raspberry Pi kits – various vendors and designs including ADS-Pi, and Stratux (these are low cost, amateur built kits based on a Raspberry Pi computer and Software Defined Radio USB module)
- Sagetech Clarity\*
- SkyGuardTWX 978UAT Dual\*

*\* These devices are dual frequency receivers, able to receive 1090 MHz ADS-B Out (as used in Australia) and 978 MHz ADS-B Out (only used in the USA).*

## **ADS-B IN Products - Installed Devices**

Devices that are designed for permanent installation in an aircraft: The receiver may be combined with other functions (for example, Traffic Awareness Systems [TAS], Traffic and Collision Avoidance Systems [TCAS 1 or TCAS 2] or an ADS-B Out Transponder).

- ACSS TCAS 3000SP (a TCAS 2 system with ADS-B In applications, for large jets)
- Avidyne TAS 6XXA series (some models provide TCAS 1 or TAS functions)
- Funkwerk TM250 (1090 receiver and traffic display to fit in 2 ¼ inch instrument hole)
- Garmin GTS 8XX series (some models provide TCAS 1 or TAS functions)
- L3 Lynx NGT 9000 (ADS-B Out transponder with inbuilt certified GPS receiver, plus ADS-B In receiver, with ADS-B traffic display on the transponder or via WiFi to a Tablet.)

## **Do other equipment options exist at lower cost for VFR aircraft?**

CASA has established a project to consider the potential for approving future products for small VFR aircraft only, including products based on FAA TSO C199, certain non-TSO avionics which have a manufacturer's statement of compliance, lower cost installation processes, and Australian Technical Standards Orders (ATSO). It should be noted that this project is not related to standards for ADS-B installations in IFR aircraft.

Trig avionics has released a GPS position source, which it claims has been certified to FAA TSO C199.

## **I already have a Mode S transponder. Isn't that enough?**

No. Not all Mode S transponders are able to transmit ADS-B – you need a Mode S transponder that has the 'extended squitter' hardware and software to transmit ADS-B data. Secondly, you need a positional source that has RAIM based integrity. Integrity is the ability of the device to detect when it is not being presented with consistent GPS data, so that it can warn the ATC system that the position it is sending may be affected by equipment failure, satellite faults, ranging errors or poor satellite geometry.

**I have a recent model or near-new digital Mode C transponder. Can it be upgraded for ADS-B?**

No, there are no known Mode C transponders that may be upgraded to Mode S Extended Squitter. Some suppliers may offer an attractive commercial trade-in, packaged as an “upgrade”, however.

**I already have an IFR GPS. Will that work with ADS-B?**

Not all IFR GPS units are able to output the required positional data and integrity data to a transponder. The GPS and the transponder need to be interconnected and able to work together in combination. Refer to the information above to determine if your existing GPS is able to provide the required data for ADS-B. If you are buying a new GNSS (GPS), be certain that it complies with TSO C145 or C146, revision a or later, or TSO C196.

**What is the difference between GPS and GNSS?**

Many people use the terms interchangeably, but... GNSS (Global Navigation Satellite System) is the generic ICAO term for satellite constellation providing a positioning service. The GPS is the particular system that is operated by the United States. Other GNSS constellations include COMPASS, GLONAS and Galileo.

### **What has PBN and RNP got to do with it? Do I need additional equipment for that too?**

Performance Based Navigation (PBN) incorporates the concept of Required Navigation Performance (RNP). PBN has been adopted by ICAO as the basis for future IFR navigation worldwide. You can satisfy the Australian PBN requirements (applicable to GA) with either a TSO C129A, or TSO C146 navigation system, but TSO C129A avionics are generally incapable of producing the integrity parameters needed for ADS-B. New TSO C146 navigation systems offer a range of additional features when compared with older systems. You can also choose to retain your existing TSO C129A navigation system and achieve ADS-B compliance with a stand-alone TSO C145 GNSS sensor, connected directly to the transponder, or an ADS-B transponder with inbuilt GNSS sensor. Refer to the diagrams on the following pages, and the equipment lists given earlier in this section, to learn about alternative methods for achieving compliance with PBN and ADS-B at the same time.

### **How can I tell that what I'm buying will work?**

The usual “buyer beware” cautions apply. Buy only from a reputable, accredited supplier with appropriately licensed and rated, qualified installers. Only purchase products that satisfy Australian equipment and installation approval standards. If it sounds too good to be true, it probably is.

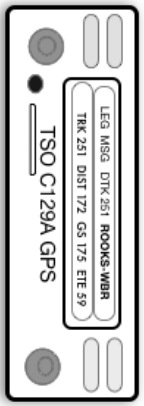
# How to Comply with Australian Requirements for PBN and ADS-B

for Private IFR GA Aircraft registered before February 2014

## Method 1: Utilise Separate Navigation and Surveillance Solutions - Two Alternatives:

Retain existing GPS

CAO 20.18  
Paragraphs:  
9B.3-9B.5  
9B.9-9B.11  
9D.8  
9D.11  
9E.1-9E.2



AND



OR



PBN NAVIGATION Requirement

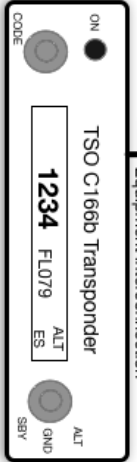
+

ADS-B SURVEILLANCE Requirement

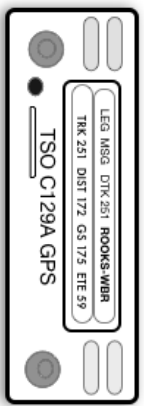
FreeFlight 1201  
or Trig TN70 GNSS



Equipment Interconnection



Transponders: Avidyne AXP340, Dynon SV-XPNDR-261/262, FreeFlight FDL-1090-TX, Garmin GTX 330ES/33ES, Honeywell KTT4, or Trig TT21/22/31.



AND



OR

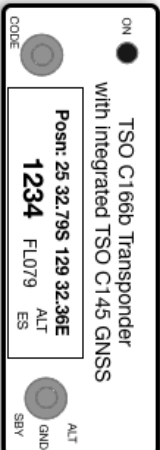


PBN NAVIGATION Requirement

+

ADS-B SURVEILLANCE Requirement

TSO C166b Transponder with Integrated TSO C145 GNSS



Transponders: Garmin GTX335/335FR (with Inbuilt GPS), L3 Lynx NGT-900, Stratus Appareo transponders.

Not all equipment combinations are interoperable in all aircraft. Check with accredited supplier prior to purchase.

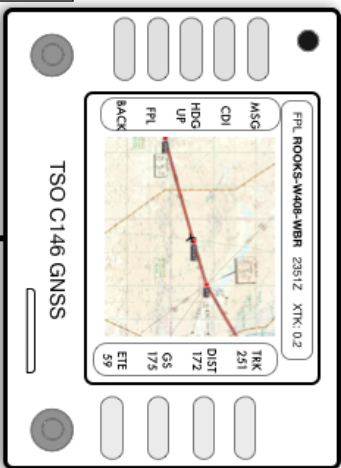
# How to Comply with Australian Requirements for PBN and ADS-B

Private IFR GA Aircraft registered before February 2014

## Method 2: Utilise Integrated Navigation and Surveillance Solutions

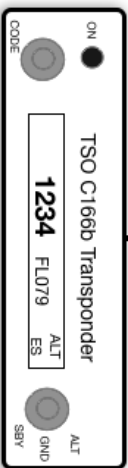
**GNSS Systems:**  
 Avidyne IFD 540  
 Garmin GNS480/CNX80\*  
 Garmin GPS44XXW  
 Garmin GNS4XXW  
 Garmin GPPS5XXW  
 Garmin GNS5XXW  
 Garmin GTNxxx  
 Honeywell KSN 770

**Gain advantage of new GNSS features\*\*  
 Consolidate avionics**



**PBN NAVIGATION and ADS-B SURVEILLANCE Requirements**

Equipment interconnection



**Transponders:**  
 Avidyne AXP340  
 Dynon SV-XPNDR-2611/262  
 FreeFlight FDL-1090-TX  
 Garmin GTX 330ES/33ES 335/335R  
 Honeywell KT74  
 Tig T121/22/31

\*GNS480/CNX80 must be upgraded - refer Garmin SB1519  
 All other systems also have software version dependencies.  
 \*\*TSO C146 GNSS new features vary, but typically include fault detection and exclusion, graphic map display and options for charts, terrain warning, weather detection and traffic display.  
**Not all equipment combinations are interoperable in all aircraft.  
 Check with accredited supplier prior to purchase.**

CAO 20.18  
 paragraphs:  
 9B.3-9B.5  
 9B.9-9B.11  
 9D.8-9D.9  
 9E.1-9E.2

## **What standards or approvals should I look for in the product literature or manual?**

For transponders – a transponder that complies with:

- TSO-C166 (based on the RTCA DO 260 design standard) or
- TSO-C166a or ETSO-C166a (based on the RTCA DO 260A design standard, “Version 1 ADS-B”); or
- TSO-C166b, ETSO-C166b (based on the RTCA DO 260B design standard, “Version 2 ADS-B”).

Models that comply with the later versions have additional features; the *b* versions are preferred.

For GNSS – a GNSS receiver that complies with:

- TSO C145, revision *a* or later, or
- TSO C146, revision *a* or later, or
- TSO C196.

## **Should I check what revisions of software or firmware are being supplied with my new equipment?**

Yes. Some products do not support ADS-B unless you have the correct software version. Some guidance is given in Section 5 of this document. Ask an accredited supplier to verify that your new equipment’s software configuration is correct.

## **What's the best way to get my existing equipment upgraded?**

Contact your accredited avionics supplier or installer and have them obtain the upgrades from the manufacturer for you. Do not allow unlicensed persons to alter, or install software or hardware in certified aircraft equipment.

## **Can I buy an ADS-B transponder and GPS from the USA? Will it work here?**

Yes, provided you buy only Mode S, Extended Squitter (1090ES) equipment that complies with the required FAA Technical Standard Orders (TSOs). Remember that the USA provides TIS, TIS-B, FIS-B, ADS-R, and UAT services, which are not supported in Australia. Operation of UAT equipment is not frequency-licensed in Australia and therefore not permitted; and UAT transmissions cannot be detected by ATC. Do not forget that equipment purchased in the USA must be installed in an Australian aircraft by a licensed and appropriately rated LAME and that CASR 21M



design approval may be required. In many cases, owners find that the expected savings from purchasing overseas are outweighed by the added complexity of purchasing equipment and arranging approvals and installation separately.

### **Is the price of ADS-B equipment expected to change much? Should I wait?**

According to the FAA's Chief Scientist (Surveillance), Doug Arbuckle, waiting until the US mandate applies will not provide a significant reduction in the cost for ADS-B equipment, as some had hoped, due to the demand for the fitment of more than 250 000 aircraft in the US.

*"From our point of view, all the products are that are going to be on the market are now on the market and we don't see any forces that will drive the costs down any further," said Mr Arbuckle. "Pricing is very aggressive. We have talked to several vendors who have said they have made mass buys of hardware to keep the costs as low as they are now, so we really don't see anything that would cause prices to go up or down in the near future."*

According to US-based Aircraft Electronics Association (AEA) Director of Communications, Geoff Hill:

*"The AEA represents the manufacturers of ADS-B equipment and we constantly monitor and discuss with them new products coming to market, as well as any significant future prices—both increases and decreases. All of [the manufacturers] are telling us that the price of equipment for TSO'd certified equipment has reached their lowest price point."*

Furthermore, from a business perspective, operators can currently borrow money at historical low interest rates and at a relatively favourable exchange rate. There would be significant changes in the purchase price of ADS-B equipment if either of those factors change in the future.

If you are buying a new transponder for any aircraft, or a GNSS/GPS for an IFR aircraft, it makes no sense to buy any equipment that does not support ADS-B. Bear in mind that a private IFR aircraft to which the limited CASA time extension applies, must be equipped with ADS-B by 1 January 2020.

### **Will the TSO-C146 GNSS navigator that I am installing for ADS-B do anything more than my existing TSO-C129a unit?**

Yes. It satisfies the IFR navigation requirements for PBN under CAO 20.91. This allows IFR flight without a requirement for any other navigation aid such as ADF or VOR. With TSO-C129 equipment, a ground-based aid is required at any alternate

aerodrome needed. This means the aircraft must carry a serviceable aid (ADF or VOR), the pilot must be qualified and current, and the aid and the approach must be available at the planned alternate. The number of ground nav aids has significantly decreased, and planning options available to the TSO-C129 fitted aircraft are often limited by the availability of a navigation aid that meets the alternate requirements. The algorithms inbuilt in the TSO-C146 navigators can detect and respond to satellite outages much better than the older TSO-C129 units. Most new GNSS equipment has a superior user interface and display capabilities than older equipment. Carriage of TSO-C146 equipment would allow removal of other, older equipment, such as ADF, from the aircraft, if desired. TSO C146 navigation systems would also be able to take advantage of Satellite Based Augmentation System (SBAS), if it were to be introduced in Australia.

### **Why can't I use the GPS in my handheld, or EFB tablet, for ADS-B?**

CASA requires the ADS-B transmissions to include integrity data so that ADS-B receivers can detect when the ADS-B data may be misleading and to prevent erroneous data being processed by ATC or by other pilots. Documented cases exist of GPS providing misleading positional data when integrity algorithms are not included. Systems with integrity algorithms (RAIM) will either flag errors to the pilot, or eliminate the inconsistent satellite from the position solution.

### **What's the least cost or most minimal way to install ADS-B?**

Refer to the diagram on page 22. At this time, the minimal cost solution, assuming that you have no equipment installed today that you can use, is to equip with a low cost ADS-B transponder with inbuilt GNSS. Several examples are listed earlier in this section and shown on the right hand side of the "*Method 1*" diagram.

### **I intend to make multiple improvements to my instrument panel at the same time. How can I make sure that what I buy now will last long into the future?**

Good planning will be the key to your success. Rapid technological advances are always increasing functionality and capability. Look for new equipment that meets the most recent revisions of the standards. Double-check with an accredited supplier about compatibility with other new and existing equipment; don't just assume that the combination of avionics that you have selected will work. Try to integrate the new equipment as far as possible with each other; for example, certain fuel flow sensors can be interconnected with navigation systems and provide valuable information in-

flight. Find out whether the manufacturer has given undertakings to upgrade the equipment over time. Find out if the equipment being ordered now can be supplied in time for your panel refit, as not all avionics that manufacturers have announced are immediately available. When choosing multi-function displays, find out which product choices support all your future expected avionics needs; for example, you may not intend buying a weather detection system now, but by buying a MFD capable of displaying the weather, you could more readily add that in future.

### **My transponder is getting old. What should I replace it with?**

You must purchase a Mode S Extended Squitter transponder with ADS-B capability – even if you don't yet have the GPS to provide an ADS-B solution today. The transition to Mode S in Australia has already begun and is now the most suitable standard for new transponders. Mode S transponders are mandatory in all (IFR & VFR) aircraft manufactured on or after 6 February 2014; and if the transponder installation is replaced after 6 February 2014 for operations in Class A, B, C or E airspace; or above 10,000 feet in Class G airspace. Mode S transponders are mandatory from February 2016 for use at Sydney, Brisbane, Melbourne and Perth airports. Some exemptions apply for VFR operations in Class E and above 10,000 feet in Class G, but only if the aircraft electrical system cannot power a transponder. Note that these transponder replacement rules also continue to apply to private IFR aircraft covered by the limited CASA time extension 114/16.

### **I am or will be buying a new IFR aircraft, or importing a used one from overseas. What should I do to ensure that it has ADS-B that will work in Australia?**

There are two key things, and you need to be certain about both:

1. Make sure that the GNSS supports ADS-B. For almost all general aviation aircraft, that means ensuring that the GNSS/GPS complies with TSO C145, or TSO 146, revision *a* or later.
2. Make sure that the transponder is DO260, DO260A or DO260B compliant.

Whilst all three of these transponder standards are acceptable, DO260B is preferred, because it has been adopted by the FAA in TSO-C166b and EASA (European Aviation Safety Agency) in ETSO-C166b as the minimum standard for their ADS-B mandates for compliance by 2020.

**Caution!** An aircraft seller in the USA could quite honestly and genuinely inform you that an aircraft is “ADS-B equipped” if it has UAT, not 1090MHz ADS-B equipment. UAT equipment is useless in Australia and must not be used. If an aircraft is already equipped with UAT ADS-B equipment, remove the UAT equipment, or disable it, before the aircraft enters Australia.

All newly constructed IFR GA aircraft have standard or optional ADS-B OUT equipment choices. Note that in some cases 1090ES must be specified, and not US-domestic only UAT equipment. UAT equipment is not used in Australia.

**I will be buying a new VFR aircraft. Does it need to be equipped with ADS-B?**

It is not mandatory to equip a new VFR aircraft with ADS-B at this time, although any aircraft (IFR or VFR) manufactured on or after February 2014 that is operated in controlled airspace or above 10,000 feet in Class G airspace must have a Mode S Extended Squitter, ADS-B capable transponder. This will enable you to have ADS-B OUT capability in the future, if you buy a suitable GNSS/GPS and have it connected to the transponder.

Almost all newly constructed VFR GA aircraft have standard or optional ADS-B OUT equipment choices. Note that in some cases 1090ES must be specified, and not US-domestic only UAT equipment. UAT equipment is not used in Australia.

**My aircraft is in the experimental category and I am the owner-builder. Do I need to use a certified (TSO) GNSS and ADS-B transponder?**

The CASA regulations do not allow ADS-B transmissions from other than fully compliant avionics unless the equipment is set to transmit only a value of zero for the NUCp or NIC. When these values are zero, the transponder is effectively transmitting a declaration that receivers should not trust the positional data. The transmission of potentially misleading ADS-B data could be used by ATC or other pilots and is a safety hazard. Further, non-compliant equipment will not satisfy the mandatory ADS-B IFR fitment requirements when they begin to apply for your operations. You should contact an Approved Person for information about the required standards for equipment in sport or experimental aircraft that operate under the IFR.

### **My aircraft is registered with the RAAus. What equipment should I select for ADS-B?**

ADS-B equipment installed in RAAus aircraft must comply with the same technical standards as described above for other aircraft. RAAus aircraft are flown under the VFR and are not permitted to operate under the IFR. There are no current mandatory requirements for ADS-B fitment for VFR operations. But remember that any aircraft (IFR or VFR) manufactured on or after February 2014 is required to have a Mode S Extended Squitter, ADS-B capable transponder if it operates in Class A, B, C or E airspace; or above 10,000 feet in Class G airspace. This includes aircraft that will be registered with the RAAus.

The CASA project (see page 19) to consider the potential for approving future products for small VFR aircraft only, based on FAA TSO C199 (and other potential initiatives), may provide an opportunity for lower cost ADS-B fitment for RAAus aircraft in the future.

### **Can I use the Dynon Transponder as an ADS-B solution in Australia?**

Yes, provided you have a certified GPS in your aircraft. The Dynon transponder model SV-XPNDR-261 has been certified and is ADS-B OUT compliant. However, most Dynon GPS sensor options are not certified, and thus not suitable as a position source for ADS-B in Australia, or compliant with the US 2020 rules. In addition to their own compliant GPS position source, Dynon have made provision for the interconnection of their SkyView or AFS-5000 systems with other compliant GNSS/GPS sensors. Refer to the relevant Dynon installation documentation, or contact Dynon technical support, for more information.

## 5. How can I get ADS-B installed in my aircraft?

*The following technical tips are offered as guidance, for verification with a qualified installer (avionics LAME) and accredited supplier. If there is any doubt, contact should be made with the airframe manufacturer, distributor or authorised support centre to verify current software revisions, service bulletin status, installation data and product availability.*

### What are the most common pitfalls and mistakes in ADS-B installations?

The vast majority of ADS-B installations in Australian aircraft to-date have been smooth and trouble-free; however experience has shown that some common mistakes could be avoided if considered in advance. These include:

- **Incorrect 24 bit Address:** You must get this address from CASA by contacting [aircraftregistrar@casa.gov.au](mailto:aircraftregistrar@casa.gov.au).
  - Do not enter the registration, do not enter all zeros, do not enter all 1's.
  - All Australian registered aircraft 24 bit address codes start with "7C" when expressed in hexadecimal.
  - After installation check that the transmitted address is correct using a transponder ramp test set.
- **Incorrect Flight ID:** Seek guidance on the correct Flight ID to use as explained elsewhere in this document.
- **Incorrect Software or Wiring:** This often results in what appears to be good ADS-B on internet web traffic displays, but does not satisfy the requirements for operational use. Please use the transponder ramp test set to verify that integrity data is correctly transmitted. A separate FAQ is available on the Airservices website on the issue of testing.
- **Set the SIL Value Correctly:** If the GPS is FAA TSO C145, 146 or 196 certified, a SIL value of 3 would normally be expected. If SIL is set to 0, then the ADS-B data will not be presented to ATC.

In summary – please test the installation with the transponder ramp test set, taking particular note of the integrity data. Refer to <http://www.airservicesaustralia.com/wp-content/uploads/Guidance-for-ADS-B-installation-checks.pdf>

CASA has published Airworthiness Bulletins on transponder information in <https://www.casa.gov.au/standard-page/awb-avionics-34-navigation>

### **Does ADS-B need another antenna?**

ADS-B transmissions are normally made by the ATC transponder, using the existing transponder antenna. ADS-B also requires a GPS source and its associated top-mounted antenna. Normally a single GPS antenna is sufficient. A separate antenna may be required for ADS-B IN systems.

### **What software and firmware versions are needed for the installation to be successful?**

It is critical that the software and firmware revisions of ADS-B transponders and GNSS systems are compatible. Listing all possible equipment combinations would be complex and beyond the scope of this document. An accredited supplier of ADS-B transponders and GNSS equipment will have access to manufacturers approved data that identifies which revisions can operate with each other.

### **It looks like a pretty simple job. Can I do it myself?**

Not in a certified aircraft, no. The usual airworthiness rules for aircraft modifications apply. Contact a current rated LAME/approved maintenance organisation and/or authorised person/approved design organisation regarding your installation.

### **What installation approvals do I need for ADS-B? Are these the same as the TSOs and DO standards?**

In addition to equipment design certification standards (TSOs, ETSOs and DOs), the usual airworthiness rules for aircraft modifications apply. Most new ADS-B installations in existing aircraft require a CASR 21M Authorised Person or 21J Approved Design Organisation to prepare an Engineering Order or other similar document. Installation approval requirements should be discussed, prior to order, with your equipment supplier and/or qualified installer, who should be familiar with CASA AC 21-45(1). In most cases, an approved Flight Manual Supplement will be required, which should be retained and maintained in the Aircraft Flight Manual.

**I intend to fit numerous items of new equipment including PFD, MFD, traffic and/or weather systems. These will all be interconnected using ARINC 429. Can I connect the ADS-B transponder that way too?**

ARINC interfaces have been used successfully in large aircraft for many years and ADS-B interconnection can also be implemented using ARINC interfaces on many equipment types. However, some common existing Garmin navigation systems do not output critical integrity data on the ARINC interface, and in these cases, it is necessary to use the serial data interface for interconnection.

**My VH-registered aircraft is in the experimental category and I am an owner builder. What should I do to fit ADS-B?**

A number of experimental owner/builders have already successfully installed ADS-B. In addition to ensuring that any equipment you purchase and install satisfies the required technical standards for GNSS/GPS and Mode S Extended Squitter transponder, you should obtain information about the required standards for equipment in sport or experimental aircraft that operate under the IFR from an Approved Person.

**My aircraft is registered with the RAAus. What should I do to fit ADS-B?**

In addition to ensuring that any equipment you purchase and install satisfies the required technical standards for GNSS/GPS and Mode S Extended Squitter transponder, you should ensure that any modifications made to your aircraft satisfy regulatory and design standard requirements that apply to the aircraft, as well as those contained in the RAAus Technical Manual.

**How can I get more detailed technical help?**

CASA has published AC 21-45 *Airworthiness Approval of Airborne Automatic Dependent Surveillance Broadcast Equipment*, which together with other advisory publications, is intended for technical design and installation personnel.

Assistance is also available from equipment manufacturers' technical support departments, accredited suppliers and through members of the Aircraft Electronics Association (AEA).



## **6. Now that I have ADS-B, how can I make use of it?**

### **What operational approvals do I need?**

No operational approvals are required for ADS-B OUT.

### **What should I enter for Flight ID (FLTID)?**

You should enter EXACTLY the same characters as used in field 7 (callsign) of the Flight Notification. If you have not lodged a flight notification you should enter your registration (without the VH-). Correct use of Flight ID and other important information about transponder use is given in the AIP, Enroute, ENR 1.6 paragraph 7.1.9. Additional information is also available at:

[http://www.airservicesaustralia.com/wp-content/uploads/Correct\\_Entry\\_of\\_FLTID.pdf](http://www.airservicesaustralia.com/wp-content/uploads/Correct_Entry_of_FLTID.pdf)

### **Are there particular Flight ID requirements for RAAus aircraft?**

RAAus aircraft not operating under a flight notification should set their Flight ID to Rxxxx – where xxxx are the last 4 digits of the registration mark. For example, an aircraft registered 24-1234 should set the Flight ID to R1234 (the R standing for “recreational”).

### **How can I tell if the Flight ID is correct?**

There is usually a transponder control capability in the cockpit that allows entry and readout of the Flight ID. Please consult your aircraft’s Flight Manual Supplement, Operations Manual and/or the equipment handbook.

### **Why do I still need a transponder squawk code if I have set the Flight ID?**

Current ATC systems still require the four-digit transponder codes. Even in Europe where Flight ID is mandatory, aircraft squawk a discrete Mode A code in most areas. It is an objective to remove the requirement for a discrete four-digit transponder code, but that cannot be pursued without upgrading existing ground systems and while Mode A/C transponders remain in use.

## **Do I need an endorsement or FPA on my instrument rating to use ADS-B?**

No, but it is important that you know how to correctly operate the ADS-B system in the aircraft you fly and that you observe the ATC surveillance procedures set out in the AIP.

## **How does ATC know that I have ADS-B?**

Two ways!

1. In advance, because you need to include it in your flight notification, refer below.
2. By observation on screen just like radar. The display on screen occurs whether or not you annotate the flight plan.

## **How and where should ADS-B equipment be shown on flight notifications in NAIPS?**

For most general aviation aircraft that are ADS-B equipped, enter (or select) EB1 or LB1, in the surveillance field on the NAIPS flight notification screen. If you also have ADS-B IN, enter EB2 or LB2. (Other flight notification methods, including paper forms, may refer to this as "field 10b").

This indicates:

- E - Mode S transponder with aircraft identification (Flight ID), pressure altitude, and ADS-B capability
- *or* (L indicates a Mode S transponder with the same features as E, as well as optional enhanced surveillance capability)
- B1 - ADS-B OUT on 1090MHz
- *or* (B2 - ADS-B OUT and IN on 1090 MHz)

You can find out whether E or L applies to your aircraft's installation by referring to the aircraft flight manual (AFM) or transponder flight manual supplement, aircraft approved design, or reference to the aircraft manufacturer or installer.

- E is generally applicable to aircraft in which a Mode S transponder and ADS-B has been installed, and in which conventional flight instruments are used
- L applies to many new (and some upgraded) EFIS-equipped IFR aircraft.

### **Should I get formal training to use ADS-B?**

The pilot must be fully familiar with the required operating procedures for proper use of all installed aircraft equipment, including ADS-B. For multi-pilot operations, a short training course, including practical or simulated demonstration of the use of the equipment is recommended. Individual owner-pilots of general aviation aircraft should study the AFM and supplements, and pilot or user guides, and make a self-assessment prior to using the equipment in-flight. Flying instructors should be able to assist with operational questions. It should be expected that correct use of installed ADS-B equipment will be observed during flight reviews and proficiency checks, in the same way that other equipment usage is assessed.

### **What should I do if ADS-B malfunctions?**

1. If in flight, advise ATC immediately.
2. After landing, have the problem rectified as soon as possible.
3. If operating in mandatory ADS-B airspace, you may need to contact ATC, or CASA, before your next flight to obtain approval and a clearance to operate without ADS-B. Refer to paragraph 9B.12 of CAO 20.18 for more information.

### **How do I request ADS-B services?**

ADS-B services will be delivered automatically to IFR aircraft, either following a clearance request or as part of directed traffic information services in Class G airspace. You should indicate ADS-B capability on your flight notification so that ATC know ahead of time that you will be equipped. Please ensure that you include "B1" if you have ADS-B OUT only: refer to page 34.

Pilots of VFR aircraft may request a surveillance information service and/or Flight Following in areas of ADS-B coverage in exactly the same manner as they would when under radar surveillance. Flight Following services are provided subject to controller workload.

### **Will ATC give me priority because I have ADS-B?**

Yes. As described in AIP, in surveillance system coverage, identified aircraft will be given priority over non-identified aircraft. Clearances, deviations around weather, diversions and other requests and situations can be handled more expeditiously by ATC when the aircraft is surveillance-identified.

**Can air traffic controllers tell whether aircraft position information is being received by radar or ADS-B?**

Usually, however ATC will not distinguish between the different forms of surveillance in communicating with pilots in normal circumstances. In some ATC facilities, ADS-B appears just like radar.

**What prevents the ATC system incorrectly showing two aircraft when my aircraft is being detected by both radar and ADS-B?**

Currently, the linkage is provided by the flight plan. When an aircraft has lodged a flight notification, and that flight notification is being processed by ATC (IFR or VFR aircraft in Class C airspace) and the aircraft transmits the correct Flight ID, it will be presented to ATC as one target.

**How do I know which routes and altitudes are within ADS-B coverage?**

As for ATC radar, the exact coverage may not be published. If you are receiving an ATC service, the controller will advise if you are "IDENTIFIED", but won't distinguish if it is by radar or ADS-B.

**On a recent VFR flight, ATC did not give me traffic or alert other aircraft to my presence even though I have a working ADS-B installation. Why?**

As in Class G airspace subject to radar surveillance, you need to request a surveillance information service or Flight Following in order to receive a traffic alerting service. Flight Following is provided subject to controller workload and if the controller is very busy, it may not be possible to provide you with that service. Bear in mind when operating below the ADS-B coverage, which is limited to "line of sight" between aircraft and ADS-B ground receivers, ATC can't see you and will be unable to provide these services.

**What transponder code should I use with ADS-B?**

Set your transponder's four-digit code in exactly the same way as an existing transponder, using the discrete code assigned by ATC. When ATC does not assign a code, use the prescribed codes listed in the AIP for the relevant type of operation or airspace.

### **When should I use the ADS-B IDENT function?**

Under exactly the same conditions as for an ATC transponder – only when requested by ATC.

### **Does ADS-B support emergency declarations?**

Yes, using exactly the same process as for an ATC transponder – check your transponder handbook for details.

### **When should I turn ADS-B on? Should ADS-B be switched off when leaving the runway after landing?**

If your ADS-B solution is based on a Mode S transponder, it should be turned on after start-up and off just before shutdown. Mode S transponders do not garble when on the ground, unlike the older mode A/C transponders. Having the Mode S transponder switched on whilst taxiing makes the aircraft visible to aircraft with ADS-B IN and also to ATC surface movement systems at major airports. If your aircraft does not have a “squat switch” connected to the Mode S transponder, use the “Ground” (GND) setting when taxiing. Switch to ALT on entering the runway for take-off.

### **Does ADS-B work with TCAS? Can a TCAS equipped airliner see me better, or from further away, if I have ADS-B?**

Some more modern TCAS systems provide ADS-B IN capability and can detect your aircraft at ranges far greater than supported by TCAS. Older TCAS systems are not ADS-B capable. In future ADS-B will be incorporated into the TCAS logic. Work is underway to design these systems today.

**Can I use information obtained from the Internet for traffic avoidance in flight?**

No, because the integrity of the positional data cannot be assured. It could be derived from a faulty GPS, or an inertial positional data system, and the delivery method is not error free. Some aircraft transmit ADS-B data, but flag the data as “no integrity”. Additionally, the timing of the display may not be “real time”, so you might be seeing the position of another aircraft some minutes “in the past”. The bottom line is that traffic information from these sources can be, and is sometimes misleading.

**If I can see my aircraft on those websites after making a flight, doesn't that prove that my ADS-B installation is working correctly?**

No. The hobbyist sites do not filter ADS-B data using the required GPS integrity parameters. Aircraft may be displayed on these websites even if they are producing non-compliant or erroneous ADS-B data. Some web sites also use Mode S transponder replies from an aircraft, even if not equipped with ADS-B. If unsure about ADS-B serviceability, an avionics LAME can check your equipment for proper ADS-B operation on the ground.

**When will an ADS-B receiver be installed near my home airport so that we can have surveillance coverage too?**

Airservices plans to improve ADS-B coverage to support Air Traffic control based on good business practices, business cases and safety considerations. Industry input to these decisions is constantly being sought through consultation and industry groups such as ASTRA. Contact your representative aviation organisation to seek their support and present your suggestion.

## **7. What maintenance must be performed on my ADS-B equipment?**

In common with other transponders, an ADS-B Mode S Extended Squitter transponder is subject to AD/RAD 47 every two years, as well as the aircraft's periodic maintenance inspection requirements, particularly as required by CAO 100.5. It should be noted that new ADS-B Mode S Extended Squitter transponder designs do not incorporate electron tube technology, and so are not subject to the pulse width and amplitude tests recently introduced for older transponders. Maintenance of an ADS-B installation in an aircraft must be performed in accordance with approved data by an current rated LAME or approved maintenance organisation.

It can also be noted that the RAAus Technical Manual requires that: *“All transponders must be maintained in accordance with CAO 100.5. Mode S transponders require a 24 bit aircraft address allocated by the CASA Aircraft Register at [aircraftregister@casa.gov.au](mailto:aircraftregister@casa.gov.au).”*

### **Can I rely on ATC to tell me if my ADS-B equipment is not working correctly?**

No, because ATC cannot determine all equipment failure modes. For example, some non-approved GPS equipment can appear to operate correctly under normal situations and only generate misleading data in rare periods of GPS constellation problems. ATC will advise you of significant position errors observed on the controller display, if you are operating IFR, or subject to VFR Flight Following, and are identified by ADS-B. If your ADS-B equipment is simply not working, unless your aircraft is the subject of an equipage mandate, ATC may not consider any non-display of ADS-B information as abnormal, and therefore may not advise you.

### **Can I switch ADS-B off in-flight?**

Except in an emergency, the transponder should not be switched off unless instructed to do so by ATC. Remember that switching off the aircraft transponder will make your aircraft invisible to ATC radar and the traffic detection systems (including TCAS) of other aircraft. Refer to the previous question on page 35 about what to do if ADS-B malfunctions in-flight.