

ADS-B

**Automatic Dependent Surveillance –
Broadcast**

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

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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 1.08a	Apr 2014	Changes regarding Trig, Dynon and Garmin in section 5. Minor revision to other guidance text.

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?

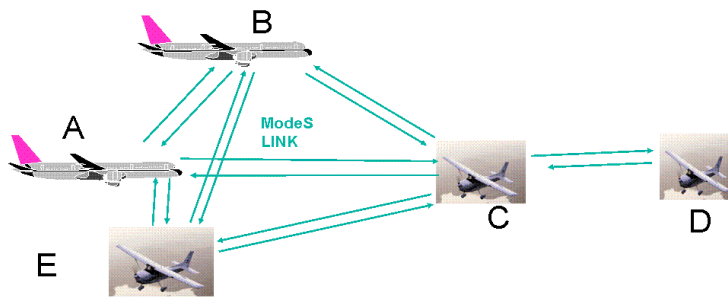
What are the differences between ADS-B in Australia and the USA?

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.

International solution : When all are equipped



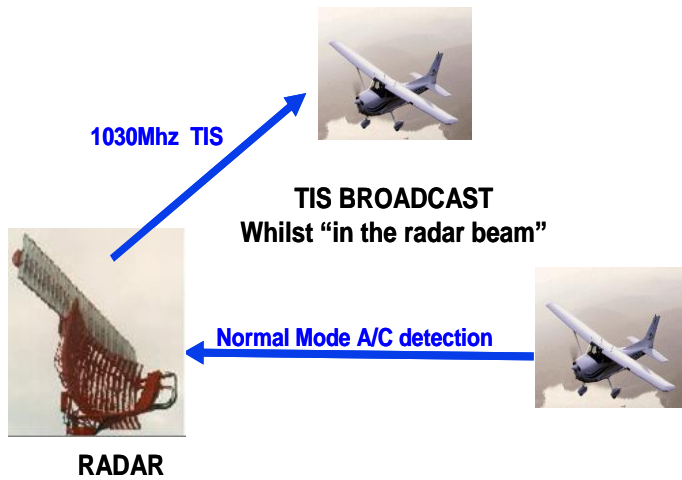
Australia has adopted a single system that allows aircraft with ADS-B IN equipment to receive ADS-B OUT from all equipped aircraft without the need for ground based translator (or “rebroadcast”) stations. In our huge country, translator stations, which are necessary to make a dual system work, would 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.

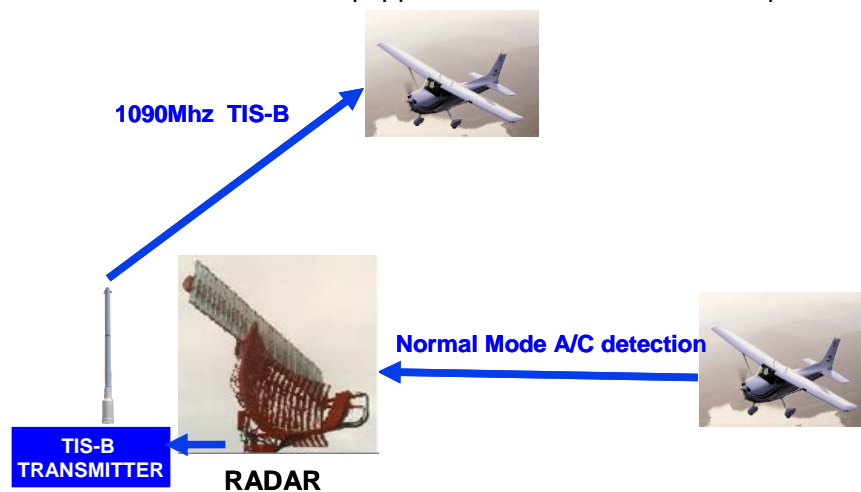
USA Systems - TIS, TIS-B, ADS-R

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.



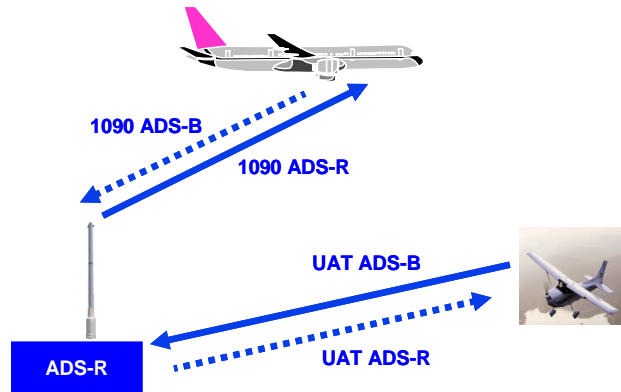
Some transponder manufacturers still promote TIS as providing traffic for pilot display. You need to be careful that you don't purchase such transponders with the expectation of using the "traffic service" in Australia.

TIS-B: This system is a new 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.

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 fire fighting 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 require fitment above FL285 after 12 December 2013, and for IFR aircraft as described in detail in CAO 20.18. Many operators are choosing 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. The current regulations require you to equip as follows:

- Dec 2013: All operations at and above FL290
- Feb 2014: Aircraft operated under the IFR first registered in Australia after 6 Feb 2014.
- Feb 2016: In large parts of Western Australia (Airspace classes A, B, C and E).
(This is co-incident with the mandatory requirement to fit GNSS to all IFR aircraft for navigation in Australian airspace.)
- Feb 2017: All IFR operations at all flight levels

There are some limited provisions for operations with temporarily unserviceable 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? Existing radars can be expected to remain in place till at least 2025, but after that date, radar coverage can be expected 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.

Our club was told by an expert that we would never need ADS-B because all our aircraft fly only below 10,000. Who's right? What's changed?

At one stage, there was discussion about 10,000 feet as a cut-off. However, the latest rules require all IFR aircraft (above and below 10,000 feet) to be ADS-B OUT equipped by February 2017. If you operate under the IFR in Western Australia within an area of 500NM to the north through to the east of Perth Airport, this requirement will commence from February 2016, unless you operate only in Class G airspace.

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 install ADS-B OUT in your IFR aircraft 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 complete justification. Applications for exemptions from the requirements of the Civil Aviation Regulations and Orders must be made to CASA in writing.

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) imported to or manufactured in Australia from 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. Unless covered by the provisions for temporary unserviceability, all IFR operations by non-compliant or non-equipped aircraft require specific exemptions from CASA.

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. If you operate at or above FL290 there is value in equipping now. If you operate above say FL100, you can expect significant benefits by the 2016-2017 timeframe, as other IFR are also required to be equipped with ADS-B OUT. 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.

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 do allow the presentation of ADS-B symbols on the screen for traffic awareness. It is expected that in the next decade ADS-B will become firmly integrated into TCAS, in what is termed ‘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 is a knowledgeable and accredited avionics supplier, based in Australia, with personnel licensed by CASA and completely familiar with Australian requirements. 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?

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 additional products are also known to be suitable:

Transponders

- Garmin GTX 330ES and 33ES
- TRIG TT31, TT22 and TT21
- BendixKing by Honeywell KT 74
- Dynon Skyview

GPS position sources

- FreeFlight 1201, 1203
- Accord NexNav
- Garmin GPS/GNS 400/500W series
- Garmin GTN 650/750 series
- Garmin GIA 63W Integrated Avionics Unit (within G1000 systems)
- BendixKing by Honeywell KSN 765 and KSN 770
- Avidyne IFD 540/440

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 ensure that your general aviation aircraft meets PBN requirements if you choose a stand-alone navigation system that complies with TSO C146a or later, or uses an appropriately certified flight management system and has sensors that comply with TSO C145a or later.

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.

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

For transponders – a transponder that complies with:

- TSO-C166 or
- TSO-C166a or
- TSO-C166b.

Models that comply with the later *a* and *b* versions have additional features.

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 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 CAR 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?

There are indications that the avionics industry in USA is ramping up to support the US market, and this is expected to drive prices down. You should also consider the age of your current transponder and GNSS/GPS as well as the benefits you may derive in the near term from fitting ADS-B. 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.

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

Yes. It will satisfy the IFR navigation requirements for PBN under CAO 20.91. This will allow 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. With the transition to the Back-up Navaid Network (BNN) from February 2016, the number of these ground navaids will decrease markedly thereby reducing the planning options available to the TSO-C129 fitted aircraft.

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-C146a equipment would allow removal of other, older equipment, such as ADF, from the aircraft, if desired.

Why can't I use my handheld Garmin, or similar GPS with ADS-B? It's never been wrong...

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?

At this time, the minimal cost solution, assuming that you have no equipment installed today that you can use, is to use a low cost Mode S Extended Squitter transponder connected to a standalone approved GPS engine (not a navigator). It is beyond the scope of this document to recommend particular products, but purely as an example, the FreeFlight 1201 GPS sensor, combined with a Trig TT31

transponder, has been successfully installed and used by some operators; other product combinations are possible and more are expected in future.

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 very useful 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 became mandatory in all aircraft new to the Australian register (IFR & VFR) from 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 operation in Class E and above 10,000 feet in Class G, but only if the aircraft electrical system cannot power a transponder.

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 and EASA (European Aviation Safety Agency) as the minimum standard for their ADS-B mandates for compliance by 2020 & 2017 respectively.

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. As discussed elsewhere in this document, UAT equipment is useless in Australia and must not be used. If an aircraft is already equipped with UAT ADS-B equipment, it is probably best to have the UAT equipment removed and sold in the United States before the aircraft is imported into Australia.

I am or 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) imported to or manufactured in Australia from 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.

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 a qualified person and/or your sport/experimental association's technical counsellor 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) imported to or manufactured in Australia from 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.

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

Yes, provided you have a certified GPS in your aircraft.

The Dynon Skyview Transponder is a fully certified device and is ADS-B OUT compliant. However no GPS that Dynon sells is certified and thus the Dynon GPS solution is not suitable as a position source for ADS-B in Australia. Dynon have made allowance for the user to connect a compliant GPS such as a Freeflight or a Garmin GPS directly to the transponder. Connection of a certified GPS to the SkyView screen alone is not sufficient. You need Skyview version 5.0 or better and the installer has to tell the Skyview that a directly connected compliant GPS source is being used. In the transponder setup menu, there is a GPS DATA item in the menu. If this is set to "DIRECT (GARMIN ADS-B)" or "DIRECT (FREEFLIGHT)" then they are configured for a direct, TSO'd connection to the GPS. It is easy for a user to verify the system is doing the right thing – if the "GPS STATUS" indicates valid data, then the device is transmitting GPS data from the TSO'd GPS. Refer to the SkyView install manual or contact Dynon technical support for more detail. If no direct connection to a compliant GPS is made, ADS-B messages will still be transmitted, but will be ignored by most receivers because the transmitted "quality" flags will indicate that the data is not trustworthy.

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

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. Sometimes a separate antenna may be required for ADS-B IN systems.

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

The following equipment and software combinations have been found to work successfully, however this table does not imply airworthiness or installation approval, which must be verified or obtained prior to installation from an appropriately licensed/authorised person.

<i>If you have a</i> GPS/GNS System:	<i>With Main Software</i> Version:	<i>and</i> Transponder:	<i>Use</i> Transponder Software Version:
Garmin GPS 400W, GPS 500W, GNC 420W, GNS 430W or 530W	3.20 or later, but not version 5 or later	Garmin GTX 330ES	6.20 (refer Note 1 below)
	5.03 or later and GPS SW v5.00	Garmin GTX 330/33ES	7.00 or later
		Dynon SV-XPNDR- 261 Dynon SV-XPNDR- 262	2.4 or later (refer Note 7 & 8 below)
Garmin GTN 625, GTN 635, GTN 650, GTN 725 or 750	2.00 or later, but not version 3.00 or later	Garmin GTX 330ES	6.20 (refer Note 2 below)
	3.00 or later	Garmin GTX 330ES	7.00 or later
		Dynon SV-XPNDR- 261	2.4 or later (refer Note 7 & 8 below)

<i>If you have a</i> GPS/GNS System:	<i>With Main Software</i> Version:	<i>and</i> Transponder:	<i>Use Transponder</i> Software Version:
		Dynon SV-XPNDR-262	
Garmin GPS, GNS, GNC or GTN	Any of the above versions but you must use "ADSB/OUT settings, NOT "ADS-B + "	Trig TT21	V2.4 or later (refer Note 7 below)
		Trig TT31	V3.4 or later (refer Note 7 below)
Garmin GTN 650 (ARINC 743A output)	GPS SW v5.00 or later	Rockwell TDR94	409 or later
Garmin G1000 integrated avionics	Refer Note 9 below.		
FreeFlight 1201 GPS (serial)	Have installer verify the version required.	Trig TT21	V2.4 or later
		Trig TT31	V3.4 or later
	Any	Dynon SV-XPNDR-261 Dynon SV-XPNDR-262	2.0 or later (refer Note 8 below)
Freeflight GPS (serial)	-0310, release for 1201 GPS/WAAS Sensor	Garmin GTX 330/33ES	7.00 or later

Important Notes:

1. Do **not** use GTX transponder software version 7 or later, (including 7.02) without upgrading the Garmin GPS/GNS main software to version 5.03 or later.
2. Do **not** use GTX transponder software version 7 or later, (including 7.02) without upgrading the Garmin GTN main software to version 3.00 or later.
3. Most installations using Garmin GPS/GNS systems are known to work successfully in Australia utilising the serial (not ARINC) interface. However, some Garmin GPS do output ARINC bus data useable by other products like the Rockwell TDR94.
4. An Australian operator has installed a GTX330ES with software version 7.02,

using another manufacturer's ARINC429 GPS data source (ARINC 743A) interface. All earlier Garmin GTX330ES software versions require the proprietary serial interface to be used.

5. Care should be taken in distinguishing between Garmin GPS/GNS and GTN *Main* software version numbers and *GPS* software version numbers, which differ. Contact Garmin or an authorised dealer for more information.
6. The Garmin GTN series version 3.00 or later serial interface to the GTX 7.00 or later must be set to the '+' version (eg: "GTX Mode S+") ## to ensure that integrity data is passed to the transponder.
7. The Trig (and Dynon) transponders work with the Garmin "ADS-B" protocol. Later Garmin GPS products also implement an "ADS-B+" ## protocol, but that is not yet supported by Trig (and Dynon).
8. A known problem exists for Dynon Skyview shipped before the end of 2012 when the Dynon is connected to Garmin GPS sources. The problem causes misleading positional data to be output . It is corrected by Dynon Skyview Software version 10.00.
9. Contact the airframe manufacturer, distributor or authorised support centre for service bulletin status, installation data and product availability.

The ADS-B+ protocol (RS 232 CH output selection) is used when the GTX transponder is not being controlled by the GTN unit.

The GTX Mode S+ protocol (RS 232 CH output selection) is used when the GTX transponder is being controlled by the GTN uni

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 an appropriately licensed and rated LAME 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 certification standards (TSOs, ETSOs and DOs), the usual airworthiness rules for aircraft modifications apply. Most new ADS-B installations in existing aircraft require a CAR 21M Authorised Person to prepare an Engineering Order. 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 be interconnected using ARINC 429. Can I connect the ADS-B transponder that way too?

ARINC interfaces have been used very successfully in large aircraft for many years. Many existing ADS-B implementations use ARINC429. However, most Garmin GPS systems do NOT output critical integrity data on the ARINC interface. Hence, when using a Garmin GPS system for ADS-B, at this time the serial interface is usually the correct choice for interconnection. As noted above, an Australian operator has installed a GTX330ES with software version 7.02 using another manufacturer's ARINC429 positional data source (ARINC 743A) interface.

According to the manual, the GNSS that I have installed has an ARINC interface for the transponder. Why do I still need to use the serial connection?

Whilst the manual identifies the existence of an ARINC interface, at the time of writing, most Garmin GNSS/GPS products do not provide the required integrity data on the ARINC interface.

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 contact your experimental association's technical counsellor 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 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.

My avionics LAME has technical questions. Who can he contact for help?

Contact the equipment manufacturer's technical support department. Some assistance may also be available to 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?

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, Section 1.6.

Additional information is also available at:

http://www.airservicesaustralia.com/wp-content/uploads/Correct_Entry_of_FLTID.pdf

How can I tell if the FLIGHT ID is correct?

There is normally 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 is still some way off.

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

No, but it is important that you know how the ADS-B system works 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 EB1 in the surveillance field on the NAIPS flight notification screen. If you also have ADS-B IN, enter EB2. (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.
- B1 - ADS-B OUT on 1090MHz.

Should I get formal training to use ADS-B?

In common with all aircraft equipment, it is a requirement that the pilot is fully familiar with the required procedures and proper use of all installed equipment. 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 make a self-assessment prior to using installed ADS-B equipment and seek the assistance of a qualified flying instructor if in any doubt. It should be expected that correct use of installed ADS-B equipment will be observed during flight reviews and rating renewals in the same way that transponder usage is assessed at present.

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 before your next flight to obtain a clearance to operate without ADS-B for the next sector. An AIC will be issued shortly about this procedure.

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.

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?

Yes, however ATC will not distinguish between the different forms of surveillance in communicating with pilots in normal circumstances.

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.

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.

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 will be able to

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.

Is the information on certain Internet websites (such as Flightradar24 and FlightAware) coming from the ATC ADS-B system?

No. It is mainly derived from non-official ADS-B receivers that are connected to the Internet. These receivers are generally operated by radio enthusiasts and hobbyists.

Can I use this for traffic information in flight?

No, because the positional data has no integrity check. It could be derived from a faulty GPS, or an inertial positional data system, and the delivery method is not error free. Some aircraft flying without GPS transmit ADS-B based on inertial reference systems, which become less accurate as the flight progresses. These aircraft transmit ADS-B data, but flag the data as “no integrity”. The hobbyist community do not generally filter these aircraft out. 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 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.

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 appropriately licensed and rated LAME.

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.

If my aircraft's ADS-B system develops a fault, can I continue to fly the aircraft? What if I switch it off?

You can continue to fly the aircraft for three days to a place where repairs can be undertaken. 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.