



International Civil Aviation Organization

**The Sixth Meeting of the APANPIRG ATM Sub-Group
(ATM/SG/6)**

Hong Kong, China, 30 July – 03 August 2018

Agenda Item 4: ATM Systems (Modernisation, Seamless ATM, CNS, ATFM)

REVIEW OF ADS-B SPECIFIC PHRASEOLOGIES

(Presented by Airways New Zealand)

SUMMARY

This paper presents working paper presents a review of DOC 4444, Chap 12, 12.4.3 ADS-B Phraseologies. The intent of the paper is to highlight that the current ADS-B Phraseologies can, and do generate confusion to both pilots and ATC, therefore, where the functionality for MODE S and ADS-B is derived from the same source the phraseologies used must be the same for both.

1. INTRODUCTION

1.1 In 2014, IATA presented WP/7 to ADS-B SITF/13* on issues identified with ATC ADS-B phraseologies, for which flight crew had no method to comply.

1.2 This paper considers the 2014 IATA paper in conjunction with DOC 4444 *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM), Edition 16, Chapter 12 Phraseologies, para 12.4.3, to identify “IF” and “WHAT” ADS-B phraseologies should be removed.

1.3 The outcome of WP/7 at ADS-B SITF/13 resulted in a review and amendment to the ICAO APAC ADS-B Implementation and Operations Guidance Document (AIGD), Section 9.9 Phraseology (**Attachment A**)

2. DISCUSSION

1090 MHz ADS-B Transmitter

2.1 Existing 1090 MHz ADS-B transmitters commonly rely on two avionics components:

- A high-integrity GPS navigation source, and
- A datalink (ADS-B transmitter unit), the most common one operating at 1090 MHz, and integrated with the Mode S transponder.

2.2 IATA stated in their 2014 paper, “existing commercial aircraft 1090 MHz transponders do not have any specific ADS-B switches, and ADS-B is an integral component of the aircraft MODE S transponder”.

2.3 While the above statements are correct for commercial aircraft, some of the newer and more sophisticated General Aviation (GA) ADS-B transmitters do have the option to transmit either ADS-B or MODE S data independently or both together.

ADS-B Phraseologies

2.4 ICAO DOC 4444, Chapter 12, provides a number of specific ADS-B phraseologies, which some states have adopted. However, controllers are normally unaware of the configuration of on-board ADS-B transmitters and associated Mode S transponders, and usually have limited knowledge of how ADS-B transmitters operate.

- Without knowing the ongoing effect on on-board equipment, such instructions can generate confusion and unwanted RTF congestion, as both pilots and ATC seek clarification.

2.5 A survey was carried out to review Pilot and ATC understanding on the use of the current ADS-B phraseologies (**Attachment B**). The surveyed group included:

- Check instructors from 2 internationally respected ANSPs
- Various General Aviation (GA) IFR pilots, well versed in the benefits of ADS-B
- Technical pilots from 2 internationally respected airlines
- Instructors and trainee pilots from local flying schools operating a mixed fleet of aircraft including a number with ADS-B
- Licenced Aircraft Maintenance Engineer (LAME)

2.6 The survey reinforced the fact that ADS-B instructions from controllers to crew (either commercial or GA) generated confusion as to the exact intent of the instruction and the possible impact to both the aircraft and ATC. For example:

1. “Transmit ADS-B Ident”

- a) A check controller working for ANSP 1 stated that they train and assess controllers on the use of the phraseology “Transmit ADS-B Ident”. During operational audits, they had not heard the phraseology used. Further, they did not realise the ident button was the same, regardless of whether the phraseology used was for ADS-B or SSR.
- b) A technical pilot for Airline 1 asked ‘HOW’ are they supposed to “Transmit ADS-B Ident”. There is no ADS-B Ident button. The response to ATC would be to clarify the instruction, generating necessary but unwanted RTF.
- c) A check controller, who is also an examiner, and a B-CAT instructor, from ANSP 2, did not realise there was no specific ADS-B Ident button. He wondered what the pilot response to such a request would be, saying he would probably just press the Ident button.

- d) GA pilot 2 said the only thing they would know how to do would be Squawk Ident by pushing the ident button on the transponder. They were not sure if this would meet the intent of the ATC request.
 - e) An “A-CAT” Flying School instructor said any such instructions “would have us scratching our heads”.
2. “Stop ADS-B Transmission”
- a) A technical pilot from Airline 1 said:
 - “How”, and what affect would this have in the aircraft, such as loss of TCAS functionality.
 - Turning off the ADS-B transmission will affect ADS-B IN for aircraft appropriately equipped.
 - Do controllers realise the impact of such an action if requested in airspace with either SSR or Multilateration providing additional surveillance but no PSR coverage?
 - b) A “C-Cat” instructor said:
 - When asked he would query ATC if they wanted him to turn off the transponder.
 - The instructor did not realise their aircraft was transmitting ADS-B data, and was unaware if ADS-B could be switched off while leaving the MODE S transponder on.
 - c) An “A-CAT” instructor said that for now we only have ADS-B out capability, which is automatic, so any of the instructions would “have us scratching our heads”.

Issues using current phraseologies

2.7 Most commercial aircraft use a common “transponder control head” for SSR transponder, ACAS and ADS-B functionality.

1. Pilots need to be aware of their aircraft’s equipment limitations.
 - a) When complying with an instruction to stop operations of ADS-B, pilots will need to be aware that this action will potentially stop operation of the MODE S transponder, resulting in a loss of surveillance capability.
 - b) Additionally, pilots must be aware of their company or aircraft operator policy (if any) in regards to transponder operation. These may not be readily evident.
2. ATC need to be aware that an instruction to a pilot to stop operations of one system (e.g. Stop ADS-B Transmission) may result in other functions stopping (e.g. turning off ADS-B turns off the transponder), which may not be the intent or expectation of the controller.

3. The data source used to output the data from MODE S or ADS-B may be the same in both cases. For example, “Transmit ADS-B Altitude”. In this case the data source for ADS-B altitude is the same as the data source for MODE S altitude.

2.8 Some General Aviation aircraft with newer Glass cockpit technology have the ability to use ADS-B independently of the MODE S transponder.

1. The use of the phraseology “Stop ADS-B Transmission” should only apply to appropriately equipped aircraft.
2. However, unless they fly the particular aircraft, it is highly unlikely that a controller will be aware if an aircraft has this facility or not.

2.9 Transponders used for surveillance by SSR, Multilateration and ADS-B are the same, yet for ADS-B ICAO makes a distinction in the phraseologies used.

2.10 The actions by a pilot to comply with ATC instructions are the same in surveillance airspace (such as SSR or Multilateration), as when in ADS-B RAD or ADS-B NRA yet there is a distinction with ADS-B phraseologies.

2.11 Controllers have no indication on the datablock or flight plan to indicate if the aircraft has specific ADS-B capability which is independent from the MODE S transponder.

1. Track fusion, available in newer ATM systems, means the emphasis in track symbols is moving to separation state/capability instead of surveillance types making up the system track.

2.12 The meeting is invited to note the information contained in the Working Paper; specifically, Pilots and ATC do not have a good understanding of ADS-B phraseologies and ADS-B transmitters. This can generate confusion for both Pilots and ATC, which results in unnecessary R/T congestion.

2.13 Where functionality is derived from the same source for both MODE S and ADS-B, a common phraseology must be used because:

1. the intent is already met with the existing SSR phraseologies,
2. to the pilot there is no difference in the transponder function required to action the request
3. the source of the data (e.g. Altitude), is the same.

2.14 Where ICAO elects to retain specific ADS-B phraseologies, there should be clear guidance to Controllers and/or Pilots on the use of the phraseology, given that the ability to determine aircraft ADS-B transmitter functionality is not available to either Controllers or Pilots through current flight planning, aircraft or ATM systems.

3. ACTION BY THE MEETING

3.1 The meeting is invited to note the information contained in this paper.

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Draft Conclusion/Decision ATM/SG/6-X: Amendment to ADS-B Specific Phraseologies	
What: That, considering where system functionality is derived from the same source for both MODE S and ADS-B, the phraseology used between ATC and pilots should be the same, the following phrases be removed from ICAO Doc 4444 PANS-ATM Chapter 12: a) 12.4.3.5 - RE-ENTER ADS-B AIRCRAFT IDENTIFICATION b) 12.4.3.7 - TRANSMIT ADS-B IDENT c) 12.4.3.10 STOP SQUAWK TRANSMIT ADS-B ONLY or STOP ADS-B TRANSMISSION, SQUAWK (CODE) ONLY d) 12.4.3.11 TRANSMIT ADS-B ALTITUDE e) 12.4.3.13 STOP ADS-B ALTITUDE TRANSMISSION [(WRONG INDICATION, or reason)]	Expected impact: ☐ Political / Global ☐ Inter-regional ☐ Economic ☐ Environmental ☐ Ops/Technical
Why: Where functionality is derived from the same source for both MODE S and ADS-B, a common phraseology SHALL be used. Using different phraseologies for the same function generates confusion for both ATC and Pilot, resulting in unnecessary RTF congestion.	Follow-up: ☐ Required from States
When: 30-Nov-15	Status: Draft to be adopted by Subgroup
Who: ☐ Sub groups ☐ APAC States ☐ ICAO APAC RO ☐ ICAO HQ ☐ Other: XXXX	

9.9 PHRASEOLOGY

9.9.1 Phraseology Standard

~~States should note the requirement for ADS-B specific phraseology equivalent to radar specific phraseology as well as the opportunity to use generic phraseology applicable to multiple systems.~~ States should use common phraseology for both ADS-B and radar where possible, and should note the requirement for ADS-B specific phraseology in some instances. States shall refer to PANS ATM Chapter 12 for ADS-B phraseology.

~~States shall refer to PANS ATM Chapter 12 for ADS-B phraseology.~~

ADS-B EQUIPMENT DEGRADATION

ADS-B OUT OF SERVICE (appropriate information as necessary).

TO REQUEST THE CAPABILITY OF THE ADS-B EQUIPMENT

- a) ADVISE ADS-B CAPABILITY;
- *b) ADS-B TRANSMITTER (data link);
- *c) ADS-B RECEIVER (data link);
- *d) NEGATIVE ADS-B.
- * Denotes pilot transmission.

Note: For (b) and (c) – the options are not available for aircraft that are not equipped.

TO REQUEST RESELECTION OF AIRCRAFT IDENTIFICATION
REENTER ~~[ADS-B or MODE S] AIRCRAFT~~ FLIGHT IDENTIFICATION.

Note: For some aircraft, this option is not available in-flight

TERMINATION OF RADAR AND/OR ADS-B SERVICE
IDENTIFICATION LOST [reasons] (instructions).

TO REQUEST THE OPERATION OF THE MODE S OR ADS-B IDENT FEATURE
SQUAWK ~~TRANSMIT ADS-B~~ IDENT.

Note: For some standalone ADS-B equipage affecting General Aviation, the option of “TRANSMIT ADS-B IDENT” may be available

TO REQUEST AIRCRAFT SWITCHING TO OTHER TRANSPONDER OR TERMINATION OF ADS-B TRANSMITTER OPERATION

- a) SWITCH TO OTHER TRANSPONDER
- b) STOP ADS-B TRANSMISSION. SQUAWK (code) ONLY.

Note:

a) In many cases the ADS-B transmitter cannot be operated independently of the SSR transponder and switching off the ADS-B transmission would also switch off the SSR transponder operation

b) “STOP ADS-B TRANSMISSION” applies only to aircraft that have the facility to switch off the ADS-B transmission, while maintaining SSR operation.

~~TO REQUEST TERMINATION OF SSR TRANSPONDER AND/OR ADS-B TRANSMITTER OPERATION~~

~~a) STOP SQUAWK. [TRANSMIT ADS-B ONLY];~~

~~b) STOP ADS-B TRANSMISSION [SQUAWK (code) ONLY].~~

~~Note: In some cases the ADS-B transmitter cannot be operated independently of the SSR transponder and the loss of SSR and ACAS surveillance derived from the operation of the SSR transponder should be considered.~~

9.9.2 Operations of Mode S Transponder and ADS-B

It should be noted that independent operations of Mode S transponder and ADS-B ~~may~~ will not be possible in ~~all~~ many aircraft (e.g. where ADS-B is solely provided by 1090 MHz extended squitter emitted from the transponder). Additionally, some desirable but optional features of ADS-B transmitters may not be fitted in some aircraft. Controller training on this issue, as it relates to the following examples of radio telephony and/or CPDLC phraseology is recommended.

9.9.2.1 STOP ADSB TRANSMISSION or STOP SQUAWK

Issue: In most commercial aircraft, a common “transponder control head” is used for SSR transponder, ACAS and ADS-B functionality. In this case, a pilot who complies with the instruction to stop operation of one system will also need to stop operation of the other systems – resulting in a loss of surveillance not intended or expected by the controller.

ATC need to be aware that an instruction to “Stop ADS-B Transmission” may require the pilot to switch off their transponder that will then stop all other functions associated with the transponder operations (such as ACARs etc). Pilots need to be aware of their aircraft’s equipment limitations, the consequences of complying with this ATC instruction, and be aware of their company policy in regard to this. As with any ATC instruction issued, the pilot should advise ATC if they are unable to comply.

Recommendation: It is recommended that the concatenated phrases STOP ADSB TRANSMISSION, SQUAWK (code) ONLY or STOP SQUAWK, TRANSMIT ADSB ONLY are used. It is recommended that controller training highlights the possible consequences of **issuing** these instructions and that pilot training highlights the consequences of **complying** with this instruction. It is also recommended that aircraft operators have a clearly stated policy on procedures for this situation. Should a pilot respond with UNABLE then the controller should consider alternative solutions to the problem that do not remove the safety defences of the other surveillance technologies. This might include manual changes to flight data, coordination with other controllers and/or change of assigned codes or callsigns.

9.9.2.2 STOP ADSB ALTITUDE TRANSMISSION [WRONG INDICATION or reason] and TRANSMIT ADSB ALTITUDE

Issue: ~~Some~~ Most aircraft ~~may~~ will not have separate control of ADSB altitude transmission. In such cases compliance with the instruction may require the pilot to stop transmission of all ADSB data and/or Mode C altitude – resulting in a loss of surveillance not intended or expected by the controller.

Recommendation: It is recommended that, should the pilot respond with UNABLE, the controller should consider alternative solutions to the problem that do not remove the safety defences of other surveillance data. This might include a procedure that continues the display of incorrect level information but uses pilot reported levels with manual changes to flight data and coordination with other controllers.

ATTACHMENT B – Survey of Pilot and ATC Understanding of ADS-B Specific Phraseologies

Questions put to Airlines Technical Pilots, GA Instructors, experienced ADS-B GA Pilots, and ANSPs.

Respondents asked to comment on the following five phraseologies from DOC 4444, Chapter 12, - Section 12.4.3:

1. WHAT WOULD BE YOUR REPOSENSE IF ASKED TO?
 - a) “RE-ENTER ADS-B AIRCRAFT IDENTIFICATION”
 - b) “TRANSMIT ADS-B IDENT”
 - c) “STOP SQUAWK CODE, TRANSMIT ADS-B ONLY” or “STOP ADS-B TRANSMISSION, SQUAWK CODE (E.G. 1234) ONLY”
 - d) “TRANSMIT ADS-B ALTITUDE”
 - e) “STOP ADS-B ALTITUDE TRANSMISSION (WRONG INDICATION)”
2. WHAT WOULD BE THE AFFECT TO YOU AS THE PIC AND/OR TO ATC IF YOU COMPLIED WITH ANY OF THE ABOVE?-

1

PHRASEOLOGY	12.4.3.5 (To request reselection of aircraft identification) “RE-ENTER ADS-B AIRCRAFT IDENTIFICATION”
RESPONSE	
AIRLINE 1	Ignoring ADS-B, entering ident is easy on most aircraft. Difficult on one manufacturer’s aircraft
AIRLINE 2	Checking and amending the aircraft ident is easy at the pre-flight stage on the B777. Not sure if there are any issues when already airborne if it needs to be re-entered.
ANSP 1	Why is there a difference
ANSP 2	Ask them to change their MODE S address (Flight ID) - only because the ATM system tells me when the transmitted Flight ID does not match the Flight Plan ACID.
GA Instructor 1	Probably recycle the transponder. Alternatively push button to attempt to bring up the aircraft registration which is the Flight ID set on the aircraft.
GA Instructor 2	Re-cycle the transponder.
GA Pilot 1	Able to change via display on my aircraft. I know that on other aircraft this is achievable but may not immediately due to pilot workload. On less sophisticated transponders, there is a need to cycle through a couple of menus whilst continuing to fly the aircraft. Another issue is that some transponders have been installed with the configuration item pilot selectable Flight ID disabled, meaning the pilot cannot change the Flight ID and the data transmitted is whatever the LAME entered which may not be correct. This is not useful for aircraft used with multiple callsigns – e.g. flying school.
GA Pilot 2	Can change Flight ID. Panel is not specific as to if this is MODE S or ADS-B
LAME	Depends on transponder type. In some systems, changing the Flight ID occurs via the transponder front panel. Some systems have fixed Flight ID’s, and others have optional configurable settings. Pilots may be unaware of the setup for the transponder in use.

2

PHRASEOLOGY	12.4.3.7 (To request the operation of the Ident feature) “TRANSMIT ADSB IDENT”
RESPONSE	
AIRLINE 1	How?
AIRLINE 2	There is one ident switch on the transponder for crew to press. It’s the same button as a normal ident. If confused, crew will just push the ident button.

	Most commonly heard in Australia and South China Sea. Seems to becoming rare.
ANSP 1	Check controller stated that they train and assesses controllers on the use of the phraseology “Transmit ADS-B Ident”. During operational audits, they had heard the phraseology used. Further, they did not realise the ident button was the same regardless of whether the phraseology used was for ADS-B or SSR.
ANSP 2	ATC check controller/examiner/B Cat instructor thought there was a specific button for ADS-B IDENT. Did not appreciate that it was a MODE S transponder. Instructs mostly in MODE A/C transponder equipped aircraft.
GA Instructor 1	I guess just push the ident button
GA Instructor 2	No idea.
GA Pilot 1	Press the ident key on the main panel. This will ident both transponder and ADS-B. They cannot be actioned separately.
GA Pilot 2	Probably push the ident button as have no specific ADS-B Ident button. Not sure if this is intent of instruction.
LAME	Single Ident button on transponder

3 AND 4

PHRASEOLOGY	12.4.3.10 (To request termination of transponder and/or ADS-B transmitter operation), “STOP SQUAWK [TRANSMIT ADS-B ONLY]” AND “STOP ADS-B TRANSMISSION [SQUAWK (code) ONLY]”.
RESPONSE	
AIRLINE 1	How
AIRLINE 2	Crew would likely not know what to do
ANSP 1	Check controller stated that they train and assesses controllers on the use of ADS-B
ANSP 2	I guess to turn off the MODE A/C/S and just transmit ADS-B data, but isn't it all one unit so how will a pilot do this?
GA Instructor 1	Stumped, I have no idea what is required for either
GA Instructor 2	Don't know
GA Pilot 1	Select transponder STANDBY button and ensure that I have Enable ES selected. I do not know if this will work. If I had any trouble I would probably have to tell ATC “UNABLE” – note operates advanced GA transponder. To turn off ADS-B I would de-select the Enable ES button, leaving the transponder buttons unchanged. I know this works from ground testing.
GA Pilot 2	Can't turn off MODE S without turning off ADS and vice versa.
LAME	Cannot stop squawk code but could set to anything requested by control. On GA, transponders I am aware of you cannot stop ADS-B transmissions without removing the GPS feed. This is not possible on any installation I have seen.

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PHRASEOLOGY	12.4.3.11 (To request pressure transmission of pressure-altitude) “TRANSMIT ADS-B ALTITUDE”
RESPONSE	
AIRLINE 1	How?
AIRLINE 2	Crew would likely not know what to do
ANSP 1	Check controller stated that they should train and assesses controllers on

	the use of ADS-B
ANSP 2	How, aren't the altitude reports from ADS-B the same as MODE S.
GA Instructor 1	Select ALT on the transponder if it is not already on, but expect it to be on because of MODE S
GA Instructor 2	Don't know
GA Pilot 1	Verify altitude-reporting button on transponder selected. Enables altitude reporting for MODE S and ADS-B. As far as I know, the transponder and ADS-B functions cannot be actioned separately.
GA Pilot 2	Turn off/on the ALT function I guess
LAME	ADS-B altitude is always transmitting in "ALT" mode if ADS-B is transmitting.

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PHRASEOLOGY	12.4.3.13 (To request termination of pressure-altitude transmission) "STOP ADS-B ALTITUDE TRANSMISSION"
RESPONSE	
AIRLINE 1	How, and what affect in the aircraft, such as loss of TCAS functionality. This will also impact on ADS-B IN display for aircraft appropriately equipped
AIRLINE 2	Crew would likely not know what to do
ANSP 1	Check controller stated that they should train and assesses controllers on the use of ADS-B
ANSP 2	How. This will also mean that the MODE S altitude is not available which creates a problem.
GA Instructor 1	Turn ALT back to ON but this would disable my MODE S altitude transmission
GA Instructor 2	Go to standby mode and then switch back to ALT
GA Pilot 1	De-select Altitude Reporting button. This will disable altitude reporting for both the transponder and ADS-B.
GA Pilot 2	Not answered.
LAME	On transponders, I am aware of, selecting "ON" instead of "ALT", will remove the ADS-B altitude, but this will remove baro altitude as well.

PHRASEOLOGY	12.4.3.2 (To advise ADS-B equipment) "ADVISE ADS-B CAPABILITY"
RESPONSE	
AIRLINE 1	This, in most cases would require crew to look up the phraseology table, as pilots are not familiar with the term 1090ES.
AIRLINE 2	Crew will assume they are ADS-B capable unless being positively told by ATC that no ADS-B data is being received. In which case they would likely switch to their other transponder.
ANSP 1	Check controller stated that they train and assesses controllers on the use of ADS-B
ANSP 2	No idea.
GA Instructor 1	MODE S?
GA Instructor 2	B1 –ADS-B OUT only
GA Pilot 1	ADS-B out only.
GA Pilot 2	No idea. Think it is a DO260B
LAME	ADS-B Out DO260B

General comment from survey:

AIRLINE 1:

On all airliner and GA aircraft I have flown, functions such as IDENT, Flight ID and ALTITUDE are part of the MODE S transponder. The practicality of some requests is questionable; therefore, a controller should only use them if they are aware of all the implications, not just the ATC effect.

AIRLINE 2:

I have been curious as to why some of these terms exist, bearing in mind ADS-B squits are automatic and transparent to crew. There is only one button for crew to use to ident, and crew will assume our aircraft are all ADS-B capable, unless there is a transponder MEL or an airborne ADS-B capability failure – in this case crew would expect ATC to advise them of no ADS-B data.

We have not received many ADS-B instructions from ATCOs across our network. There have been cases of crew requested to “Transmit ADS-B Ident,” though the frequency of such requests seems to be decreasing.

ANSP 1:

The vast majority of ATC would not be aware that MODE S and ADS-B use the same transponder. They would use these ADS-B phrases as they are included in the AIP along with quite a number of other ADS-B only phrases. I am unaware of any issues. During operational audits, the phrases are rarely heard or used

ANSP2

If for the majority of aircraft the functionality is from the same source, why have different phraseologies. Both Pilots and Controllers are aware of the current phraseologies for MODE A/C/S transponders. Why add phraseologies, which generate confusion to both? Additionally what are we supposed to do in areas where surveillance coverage is mixed and changes often – e.g. Goes from SSR to ADS-B to Mixed types to ADS-B due to the coverage patterns of each source? Continually swapping phraseologies to meet the surveillance mode would be difficult and confusing.

GA Instructor 1:

Simplify phraseologies and take away terms that are not required or can generate confusion.

GA Instructor 2:

We have a lot of student pilots, especially from overseas countries where English is not their first language. The phraseologies used need to be basic and not cause confusion. Additional phraseologies with the same or similar meaning will only complicate things.

GA Pilot 1:

International GA Pilot with long history in ADS-B. For all the actions above, I would take most of these requests to mean that there is something wrong with the air data system, altitude encoder or transponder. I would probably be inclined to ask ATC exactly what they are seeing to see if I could diagnose the problem. It may not be the answer or any use. It would however generate further RTF.

GA Pilot 2:

Experienced GA IFR pilot with knowledge of ADS-B. There is no way that I would have tried to scroll through the function button to change any settings unless I was on the ground.

Local Flying School:

A-CAT Flying School instructor stated that now we only have ADS-B out capability, which is automatic, so any of the instructions would have us scratching our heads.

LAME:

Cannot stop ADS-B transmission without removing the GPS feed, which is not possibly for any installations I have dealt with.



FIG 1: Example of a Sophisticated GA Panel
– includes ability to transmit ADS-B with MODE S turned off.



FIG 2: Example of a less sophisticated and more common GA Panel
– ADS-B and MODE S in one transponder.