



**NON-CERTIFIED GPS ADS-B 'QUICK WIN'  
ACTIONS**

**A CWG Action Response by FASVIG**

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Final

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#### **Introduction**

This document provides input requested by the Chairman at the CAA Conspicuity Working Group (CWG) meeting on 12<sup>th</sup> December 2016.

It proposes 'Quick Win' actions that could deliver rapid progress towards CWG objectives which are, in the main, longer term. Early implementation of ADS-B through existing avionic equipment would begin to populate the ADS-B environment generating interest and expectation, leading to increased and earlier adoption of the later bespoke devices.

ADS-B is the global regulatory standard for electronic conspicuity. It will become mandatory for all commercial aviation by 2020. If ADS-B use becomes widespread in UK General Aviation (GA) it is recognised that it would be a beneficial aid to in-flight safety which would reduce the possibility of mid-air collision. However, due to the high cost of certified solutions, take-up of ADS-B so far by UK GA has been very slow. In the absence of affordable ADS-B solutions for UK GA, the use of alternative low cost, often incompatible, systems has grown. This only serves to complicate matters and put at risk the chances of achieving a ubiquitous interoperable electronic conspicuity environment.

The December 2015 report of the NATS ADS-B Trial confirmed that ADS-B systems configured with lower cost non-certified GPS were just as accurate as those with high cost certified GPS. Yet, since that report, only 27 aircraft owners have submitted modification requests to the LAA for approval of non-certified GPS ADS-B systems, of which 24 have so far been approved. Meanwhile ownership of PilotAware devices, which do not broadcast ADS-B, has passed the 1,000 mark.

Actions so far to increase the use of ADS-B in UK GA have had little effect. The proposals in this paper seek to drive actions that would influence stakeholder behaviour and increase UK GA use of ADS-B in calendar year 2017.



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#### **CWG Objective**

From CWG Terms of Reference:

*"The CWG is primarily established to consider how increased conspicuity (visual and electronic) for users of Class G airspace can reduce the likelihood of a mid-air collision through enhanced airborne situational awareness and a more comprehensive ground-based picture for ATS provision. The Working Group will consider all potential means of improving conspicuity, including the utility of existing and emerging technologies, and be mindful of national and international strategies and regulatory requirements. Secondly, the development of improved airborne situational awareness through the carriage and use of moving-map technology will be promoted."*

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#### **Objective of this Paper**

The objective of this paper is to put forward proposals that will encourage and accelerate the voluntary adoption/installation by UK GA of affordable ADS-B Out (and ADS-B In) electronic conspicuity technology so as to enhance situational awareness of pilots and ATC and thus increase safety and reduce the risk of mid-air collisions.

This requires swift actions that will help remove or mitigate obstacles to adoption, simplify the process, increase clarity and understanding, and reduce cost.

The aim is to make a difference within the calendar year 2017.



## Current Situation

### Certified (SIL=2+) GPS Mode S ES ADS-B Out

Connecting a SIL=2+ certified GPS to a Mode S ES transponder in order to enable ADS-B Out is permitted by regulation. It is not known how many GA aircraft are equipped with both these devices and have activated the connection but it is likely to be very few. We are not aware of any campaigns to encourage those already equipped with suitable equipment to enable ADS-B Out.

#### **In EASA aircraft**

There is a Mod Fee to pay to the CAA.

#### **In Annex II aircraft**

There is a Mod Fee to pay the CAA for Annex II aircraft overseen by the CAA. There is no Mod Fee to pay to the LAA or BMAA for the aircraft they oversee. We have no information concerning any Annex II aircraft with such a configuration having been approved.

### Certified (TABS<sup>1</sup> compliant SIL=1) GPS Mode S ES ADS-B Out

There is uncertainty about the status of ADS-B Out based on GPS devices that comply with the FAA TSO-C199 TABS (Traffic Awareness Beacon System) standard (SIL=1).

Those owners who have equipped themselves with Garmin Mode S ES transponders find themselves in a particular bind. Garmin will not support the use of GPS devices with a SIL=0 integrity level. Garmin offer a GPS device that meets the TSO-C199 TABS SIL=1 criteria. Other manufacturers have also announced TSO-C199 compliant GPS devices.

#### **In EASA aircraft**

It is unclear whether SIL=1 configurations are to be accepted as certified.

There would be a Mod Fee to pay to the CAA.

#### **In Annex II aircraft**

It is unclear whether SIL=1 configurations are to be accepted as certified. This configuration is outside the current LAA/BMAA non-certified GPS Mode S ES ADS-B Out modification approval requirements.

Neither the LAA nor BMAA would charge a Mod Fee as it is viewed as an important safety enhancement.

There would be a Mod Fee to pay the CAA for Annex II aircraft overseen by the CAA.

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[http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgTSO.nsf/0/1600df588a6f53ae86257d710070d105/\\$FILE/TSO-C199.pdf](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgTSO.nsf/0/1600df588a6f53ae86257d710070d105/$FILE/TSO-C199.pdf)



### **Non-Certified GPS Mode S ES ADS-B Out**

Certified GPS devices are very expensive and therefore not used by the vast majority of GA pilots (though the new TABS SIL=1 GPS devices coming to market may help reduce the price).

Very many pilots already fly with non-certified GPS devices that are capable of outputting a NMEA feed of position data. Many of these pilots fly aircraft that already have Mode S ES transponders capable of broadcasting ADS-B Out. So, enabling these pilots to wire their existing non-certified GPS to their existing Mode S ES transponder and activating ADS-B Out is a relatively simple and inexpensive solution.

#### **In EASA aircraft**

EASA CS-STAN (see Appendices) allows for Mode S ES ADS-B Out with position and velocity quality indicators report lowest quality subject to a statement by the transponder manufacturer that the device is compatible with the chosen GPS and that the transponder is not compliant with ETSO-C166b<sup>2</sup>.

It is puzzling why ETSO-C166b-compliant transponders should be excluded?

There is a Mod Fee to pay to the CAA.

There is consistent anecdotal evidence that certified avionics engineers are reluctant to install and configure connection to non-certified GPS devices even when the installation meets the above requirements.

#### **In Annex II aircraft**

LAA and BMAA have both announced support for non-certified GPS Mode S ES ADS-B Out (with SIL=0 & SDA=0) and both organisations have published modification procedure. Neither the LAA nor BMAA charge a Mod Fee as it is viewed as an important safety enhancement.

There is a Mod Fee to pay the CAA for Annex II aircraft overseen by the CAA. We have no information concerning any CAA Annex II aircraft with such a configuration having been approved.

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<sup>2</sup> [https://www.easa.europa.eu/download/etso/ETSO-C166b\\_A2\\_CS-ETSO\\_11.pdf](https://www.easa.europa.eu/download/etso/ETSO-C166b_A2_CS-ETSO_11.pdf)



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#### NATS General Aviation: ADS-B /GPS Trial Results

The NATS report, published 21st December 2015, following NATS/CAA sponsored GA Non-Certified GPS ADS-B Trial highlighted the fact that non-certified GPS ADS-B presented just as accurate position information as certified GPS ADS-B. So, policies that prevent/do not encourage the use of non-certified GPS ADS-B do not improve safety; they reduce safety.

#### NATS Conclusions from the ADS-B /GPS Trial Results

“Based on the results of this trial, it can be seen that the quality of non-certified GPS is sufficient for use in enhancing visual acquisition / electronic conspicuity of general aviation. There was no identified impact on the current or planned UK ATC use of 1090MHz / regulated uses of surveillance on 1090MHz, although it makes sense to ensure some form of periodic monitoring of installations to ensure transmission remain of suitable quality.

Therefore, General Aviation should be encouraged forthwith to enable ADS-B from capable transponders to start creating an ADS-B based EC environment to support the introduction of dedicated EC devices, such as NATS LPAT.”

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#### Actions Since the Trial

The LAA<sup>3</sup> and BMAA have acted to deliver modification procedures for the Annex II Permit-to-Fly aircraft they oversee to enable owners to install non-certified GPS Mode S ES ADS-B Out with no fees for the Modification. So far the LAA has approved non-certified GPS Mode S ES ADS-B Out for 24 aircraft (with 3 others in process).

Prospective participants in the trial were advised that following the trial they may be requested to deactivate the connection between the non-certified GPS and the Mode S ES transponder. It is believed that no such requests have been made.

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<sup>3</sup> **LAA TL 3.03:**

<http://www.lightaircraftassociation.co.uk/engineering/TechnicalLeaflets/Mods%20and%20Repairs/TL%203.03%20Avionics%20Installations.pdf>

**LAA MOD 7:** <http://www.lightaircraftassociation.co.uk/engineering/StandardForms/LAA-MOD-7%20%20Avionics%20Installation.pdf>

**LAA MOD 14:**

<http://www.lightaircraftassociation.co.uk/engineering/StandardForms/LAA-MOD-14%20-%20ADS-B.pdf>



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NATS have published a blog<sup>4</sup> where they state:

“Pilots looking to transmit ADS-B from a non-certified GPS source connected to an Extended Squitter capable Mode S transponder, should ensure the modification is conducted by a competent engineer. Visit EASA’s website for more information.”

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Meanwhile, growth in the use of electronic conspicuity solutions that do not broadcast ADS-B will only serve to discourage take-up of ADS-B. There are now more than 1,000 PilotAware devices in use.

CAA has not publicly endorsed the actions of the LAA and BMAA in providing Standard Mods for non-certified GPS ADS-B Out.

Defining policies is not enough. Active encouragement needs to be put into action.

### **CAP1391**

Following the publication of CAP1391 only one device is so far listed as compliant and this has received little publicity. The fact that CAP1391 compliant devices cannot be used simultaneously with a conventional transponder is a significant problem. Owners of aircraft with transponders incapable of ADS-B Out are not likely to look to add ADS-B via CAP1391 devices and we would not want to encourage them to do so while it is a requirement to switch off their transponder in order to use it..

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<sup>4</sup>**NATS Blog**

<http://nats.aero/blog/2016/03/helping-general-aviation-to-see-and-be-seen-in-our-busy-airspace/>



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#### Current Obstacle to Adoption of ADS-B by GA

- Lack of clarity on approval of TABS-compliant SIL-1 GPS as position source for Mode S ES ADS-B Out in all aircraft (CofA and all Annex II aircraft).
- Lack of CAA public support for non-certified SIL=0 GPS as position source for Mode S ES ADS-B Out
- Lack of clarity on approval of non-certified SIL=0 GPS as position source for Mode S ES ADS-B Out in CofA aircraft
- Exclusion, within CS-STAN, of approval for the use of non-certified GPS with the latest ETSO-C166b-compliant transponders.
- Lack of clarity on what is required in a transponder manufacturer's compatibility statements for another manufacturers' non-certified GPS device.
- Disincentive due to cost of Modification fees for CofA aircraft.
- Belief by Avionics Engineers that they are not permitted to connect non-certified GPS devices to Mode S ES transponders to enable ADS-B Out.
- Lack of support by some transponder manufacturers for non-certified GPS as position source for Mode S ES ADS-B Out



## **Proposed Actions**

The following proposals are actions that can be taken relatively quickly. Part of the problem is lack of understanding of what is, and what is not allowed. These actions will address this.

In the following proposed actions the CAA public statement and engagement activities could take the form of a CAA Information Notices which the CAA Conspicuity Working Group would help draft.

### **Confirm Status of TABS-Compliant SIL=1 GPS as position source for Mode S ES ADS-B Out in CofA aircraft**

The CAA should make a public statement setting out the status of TABS-compliant SIL=1 GPS as position source for Mode S ES ADS-B Out in CofA aircraft and in CAA Annex II Permit-to-Fly aircraft.

### **Approval of TABS-Compliant SIL=1 GPS as position source for Mode S ES ADS-B Out in LAA/BMAA Annex II aircraft**

The LAA and BMAA should update their procedures to approve the use of TABS-compliant SIL=1 GPS as position source for Mode S ES ADS-B Out in LAA/BMAA Annex II Permit-to-Fly aircraft. At the same time, for clarity, the procedure should be amended to state explicitly that use of certified SIL=2+ GPS is approved.

### **CAA Public Support for Non-Certified GPS as Position Source for Mode S ES ADS-B Out**

The CAA should make a public statement supporting the use of non-certified GPS as position source for Mode S ES ADS-B Out and make it clear that they endorse the actions taken by the LAA and BMAA in approving such installations.

### **Approval of Non-Certified GPS as position source for Mode S ES ADS-B Out in CofA aircraft**

The CAA should make a public statement clearly stating the circumstance in which it is permitted to use non-certified GPS as position source for Mode S ES ADS-B Out in CofA aircraft and in CAA Annex II Permit-to-Fly aircraft.

### **Permanently Waive CAA Mod Fees for Implementing ADS-B Out in GA Aircraft.**

CAA promised to waive Mod Fees for aircraft under its remit that participated in the NATS GA GPS ADS-B Trial. No CofA aircraft or CAA Annex II Permit-to-Fly aircraft participated in the trial, which of itself is an indication of the hurdles that need to be overcome.

The CAA should announce that it will permanently waive any Mod fees for implementing ADS-B Out on grounds of encouraging safety enhancements.



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#### **Transponder Manufacturer Compatibility with GPS Devices**

In providing a GPS device compatibility statement it should be sufficient for a transponder manufacturer to state that their transponder is compatible with any GPS device that communicates via specified data communications standards (e.g. NMEA). It should not be required for compatibility statements to name individual GPS makes and models.

The CAA should make public the above is an acceptable means of compliance.

#### **CAA Engagement with Transponder Manufacturers**

CAA should engage with transponder manufacturers to ensure manufacturers are aware that use of non-certified GPS and TABS-compliant GPS as position source for Mode S ES ADS-B Out by Certified aircraft and by Annex II Permit-to-Fly aircraft is within regulations and is supported by the CAA.

Furthermore, the CAA should encourage transponder manufacturers, especially those that do not provide Mode S ES support for non-certified GPS, to remove obstacles that prevent implementation, such as providing compliance statements that enable owner to utilise other manufacturers' non-certified GPS devices.

#### **CAA Engagement with Avionics Engineers**

The CAA should engage with avionics engineers to ensure they are aware that use of non-certified GPS and TABS-compliant GPS as position source for Mode S ES ADS-B Out by Certified aircraft and by Annex II Permit-to-Fly aircraft is within regulations and is supported by the CAA.

#### **CAA campaign to encourage GA to adopt ADS-B Out (and In)**

The CAA should fund the Conspicuity Working Group in order to instigate a campaign aimed at:

- Educating GA pilots about ADS-B and its benefits for flight safety.
- Explaining the GPS & Mode S ES ADS-B Out equipment standards that aircraft owners are permitted to install, and confirming the approved process.
- Announce the waiving of Mod Fees for configuring ADS-B Out.

Steve Hutt

FASVIG Ltd



## Appendix

### FAA Advisory Circular AC 20-165A

In FAA Advisory Circular AC 20-165A, the final sentences of paragraphs 3-1 b. (1) and 3-3 c. (3) state respectively:

***“Installations with uncertified equipment must set SDA = 0.”***

***“If integrating with a non-compliant GPS, SIL must be set to 0”.***

Along with ADS-B MASPS (DO-242A) and MOPS (DO-260B and ED102A) this confirms it is permissible to use a non-certified GPS position source provided the SIL and SDA are set to zero.

### CS-STAN

The EASA 'Certification Specifications for Standard Changes and Standard Repairs' (CS-STAN) provides owners of 'non complex' aircraft an alternative certification mechanism. It applies to certified EASA aircraft below 5,700kg and helicopters below 3,175kg.

The full text of CS-STAN is available at:

<https://www.easa.europa.eu/system/files/dfu/Annex%20IV%20to%20EDD%20015-016-R.pdf>

One section of CS-STAN covers:

CS-SC002a – Installation of a Mode S elementary surveillance equipment

Section 2 of CS-SC002a contains the following text, which relates to the use of uncertified GPS position source with SIL and SDA values set to 0:

*“— This SC does not cover 1090 MHz Extended Squitter (ES) ADS-B Out installations compliant to Section 4 of CS-ACNS or AMC 20-24. **However, the voluntary transmission of additional ADS-B data (e.g. GPS position and velocity) can be accepted when the position and velocity quality indicators report lowest quality**, the equipment manufacturer has stated compatibility with the directly connected GPS source, and the transponder is not authorised according to ETSO C166b or equivalent.”*

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The full text of CS-SC002a is reproduced below.



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CS-SC002a – Installation of a Mode S elementary surveillance equipment

CS-STAN ED Decision 2015/016/R (Annex IV) CS-SC002a

## Standard Change CS-SC002a

### INSTALLATION OF MODE S ELEMENTARY SURVEILLANCE EQUIPMENT

#### 1. Purpose

Installation or exchange of Mode S transponder including, optionally, an altitude encoder exchange. This SC does not include installation of antennas.

This SC does not cover 1090 MHz Extended Squitter (ES) ADS-B Out installations compliant to Section 4 of CS-ACNS or AMC 20-24.

#### 2. Applicability/Eligibility

Aeroplanes not being complex motor-powered aircraft with a maximum cruising speed in ISA conditions below 250 kts, rotorcraft not being complex motor-powered aircraft and any ELA2 aircraft.

#### 3. Acceptable methods, techniques and practices

The following standards contain acceptable data:

- FAA Advisory Circular AC 43-13-2B , Chapter 2.

Additionally, the following applies:

- The transponder equipment and its installation are in compliance with paragraph CS ACNS.D.ELS.010 of CS-ACNS and the altitude encoder meets ETSO C-88A or equivalent.
- The elementary surveillance system provides data according to CS ACNS.D.ELS.015.
- This SC does not cover 1090 MHz Extended Squitter (ES) ADS-B Out installations compliant to Section 4 of CS-ACNS or AMC 20-24. However, the voluntary transmission of additional ADS-B data (e.g. GPS position and velocity) can be accepted when the position and velocity quality indicators report lowest quality, the equipment manufacturer has stated compatibility with the directly connected GPS source, and the transponder is not authorised according to ETSO C166b or equivalent.
- If automatic determination of the on-the-ground status is not available, the on-the-ground status is set to 'airborne'.
- The reported pressure altitude is obtained from an approved source connected to the static pressure system providing pressure to the instrument used to control the aircraft.
- Any antenna connected to the transponder has a resulting pattern which is vertically polarised, omnidirectional in the horizontal plane and has sufficient vertical beam width to ensure proper system operation during normal aircraft manoeuvres.
- The equipment is qualified for the environmental conditions to be expected during normal operation.
- Instructions from equipment manufacturer have to be followed.



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— A system ground test verifying all transmitted data according to ACNS.D.ELS.015 has to be performed.

#### **4. Limitations**

Any limitations defined by the equipment manufacturer apply.

In the case of rotorcraft approved for NVIS, if cockpit panels are to be inserted, the change cannot be considered an SC.

#### **5. Manuals**

Amend AFM with AFMS containing or referencing the equipment instructions for operation, as required.

Amend the Instructions for Continuing Airworthiness to establish maintenance actions/inspections and intervals, as required. In particular, include a check every two years to ensure that the data provided according to CS-ACNS ACNS.A.GEN.010 is correct.

#### **6. Release to service**

This SC is not suitable for release to service by the Pilot-owner.