



**BMAA TECHNICAL INFORMATION LEAFLET (TIL)**  
**STANDARD MINOR MODIFICATION**  
**SMM 118 – ADS-B OUT**  
**(CONNECTION OF GPS TO MODE S TRANSPONDER)**  
**ISSUE – 2**  
**APR 2021**

## **Introduction**

This leaflet contains the required information to permit straightforward connection of an approved Mode S Transponder to an approved GPS in a BMAA aircraft. It covers both factory fitted and individually approved transponder and GPS units, and also handheld GPS units.

Notwithstanding the simple approach taken by this TIL, it is the aircraft owner's responsibility to ensure that all materials used in a modification are of adequate quality, that proper aircraft engineering standards are applied, that this modification does not create any safety problem when combined with any other modification to the aircraft, and that no relevant information has been withheld from the BMAA or Inspector. It is the owners responsibility to keep up to date with current regulations regards ADS-B out operation.

## **Description**

ADS-B, or Automatic Dependent Surveillance-Broadcast, uses a combination of a mode-S transponder combined with a GPS to transmit accurate positional information together with aircraft details. ADS-B on a BMAA aircraft is with a non-certified GPS, and therefore the approval is on a no hazard/no credit basis, and the system is not certified to appropriate EASA/National requirements. The transponder must therefore be appropriately configured so that it transmits the information with the correct data regarding the integrity level of the position source (non certified GPS). The ADS-B transponder transmission settings that define this are the Source Integrity Level (SIL) and the System Design Assurance (SDA), and these are set at 0 for a non-certified GPS, or 1 for certified GPS.

Not all transponders can transmit ADS-B out, and there are also some that can transmit ADS-B out but cannot transmit the correct data regarding the GPS source. At the time of writing the Trig TT21 and f.u.n.k.e. TRT800 H/A are both suitable, but only with the correct software as listed below. For specific connection instructions refer to the equipment manufacturer.

For the Trig TT21 the software version must be 2.4 or higher, and the Transponder Controller software version must be 1.7 or higher. You can verify the software version installed when you switch on as this is briefly shown on the controller screen at power up. With the correct software installed, the GPS Certification Level needs to be set as depending on the GPS source being used, in the transponders set up menu. For more information contact Trig Avionics Limited.

For the f.u.n.k.e. TRT800 H/A they require software version 5.3 or higher. For more information contact f.u.n.k.e. Avionics GmbH.

## **GPS Source and Installation**

The GPS source should be BMAA/CAA approved for use on the aircraft, so either a factory fitted unit or fitted at first build for amateur built aircraft or approved as an after-market fit using BMAA TIL 109. It is also possible to use a hand held/portable GPS system that is not permanently installed on the aircraft provided the connections are designed for quick disconnection and reconnection.



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One other option is to use a remote GPS receiver/antenna and this can be approved as part of this standard minor modification.

### **Electrical Interference**

If a radio or intercom is fitted, check that the connection does not cause excessive interference. A small increase in the use of the radio's squelch control to suppress 'noise' is acceptable, but if the squelch cannot completely remove the interference, or the quality of received transmissions is significantly affected by the connection, remedial action is required.

For all other electrical equipment such as an EFIS, check that there is no additional interference and that the displays and instrument accuracy are unaffected.

### What to do once you have connected your transponder to GPS

In conjunction with your Inspector, fill in the form on pages 3 and 4 of this TIL, and print or obtain an electronic copy of the PilotAware screenshot showing your aircraft and return them to the BMAA. The BMAA will return this form to you, with the full modification approval number shown at the bottom of the page. This mod number must then be entered in the aircraft logbook.

It is acceptable to send in the form with your Permit renewal submission.

Aircraft must be wholly owned by BMAA members. A BMAA Ownership Trustee Grid should be submitted with this form for syndicate, group and company owned aircraft.



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**BMAA – STANDARD MINOR MODIFICATION CHECKLIST: TIL 118**

Reg: <b>G-</b> _ _ _ _	Aircraft type:	Serial No:
Owners name <sup>1</sup> :		Owners BMAA No:
<sup>1</sup> BMAA Aircraft Ownership Trustee Grid required for syndicate/group/company owned aircraft		

**Installation Details**

Ensure that the transponder and GPS are already approved installations, if the connection is to be made at the first fit of equipment then the relevant standard minor modifications application should also be included. SMM-104 for Transponder and SMM-109 for GPS

Transponder Make & Model	
<b>Transponder Approval Status</b>	
Factory Fitted/Manufacturer Approved	Yes / No
Fitted when first built (Homebuilt aircraft)	Yes / No
BMAA Minmod TIL104 approval	Mod Number:

GPS Make & Model	
<b>GPS Approval Status</b>	
Factory Fitted/Manufacturer Approved	Yes / No
Fitted when first built (Homebuilt aircraft)	Yes / No
BMAA Minmod TIL109 Approval	Mod Number:
Handheld Unit – No approval required.	Yes / No
Remote GPS receiver/antenna	Yes / No Location:
Certified or Non-certified GPS? <i>e.g. Trig TN-72</i>	Certified / Non-certified



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**APR 2021**

No.	ACTION	COMMENTS	INSPECTOR INITIALS
1	Multi-strand cable used - adequate cable flexibility and current capacity and in accordance with manufacturer's instructions.		
2	All cable terminations properly made - no exposed conductor.		
3	Cables and other components properly secured.		
4	Quick-release fasteners used for de-riggable parts of airframe.		
5	No holes or cuts made in airframe.		
6	Wiring does not interfere with the satisfactory operation of any of the aircrafts controls or systems.		
7	Entry and exit of aircraft not affected.		
8	Remote GPS receiver if fitted mounted securely and clear view to sky.		
9	The data settings for the Transponder are set for "Uncertified GPS" - SIL=0 and SDA=0 or, "Certified GPS" - SIL=1 and SDA=1 correctly displayed on the PilotAware traffic screen. Appendix A.		
10	All aircraft instruments appear to function normally and no radio interference is heard.		
11	ADS-B Output and Transmitted Date checked with PilotAware System in accordance with Appendix A and screen shot obtained. <b>Note:</b> Supply a copy of screenshot with completed forms.	Screen Shot Seen  YES/NO	

**OWNER'S DECLARATION**

I declare that the foregoing information is correct to the best of my knowledge and I will not change the installation design once approved.

Signed:

Name.

Date:

**INSPECTOR'S DECLARATION**

I declare that the foregoing information is correct and the installation is fit to be flown.

Signed:

BMAA Inspector Name:

Date:

BMAA Inspector #:

BMAA Member #:

**This form must be sent with payment as per BMAA Online Shop ([www.bmaa.org](http://www.bmaa.org)), and BMAA Aircraft Ownership Trustee Grid (if applicable) to\*: [technical.office@bmaa.org](mailto:technical.office@bmaa.org)**

BMAA Office Approval:	(signed)	(Name)
Mod No.: G-_____ / TIL118 / 20__ / _____		(Date)

*\*Whilst waiting for this form to be returned by the BMAA the aircraft may be flown for up to one calendar month from the Inspection date above. Once this form is returned to you signed please enter the full modification approval number above in your aircraft logbook and retain this sheet with your aircraft records*



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**APPENDIX A – GROUND TESTING**

In order to verify the ADS-B output, the transmitted data must be checked. The following method uses the PilotAware system to receive the ADS-B data and display it in a useable format. If an alternative method is used, this must be agreed with the BMAA Technical Office beforehand.

**METHOD 1 - PilotAware**

In order to receive the ADS-B data, a PilotAware system is required, running software version 20160307 or later. The PilotAware will require a GPS receiver to be attached so that the correct position, date and time data is displayed. The PilotAware and computer need to be setup in accordance with the instructions provided by PilotAware ([www.pilotaware.com](http://www.pilotaware.com)).

Position the PilotAware and associated computer at a safe distance from the aircraft.

**TEST PROCEDURE**

Ensure that the aircraft is chocked and in a safe area with an appropriate person at the controls.

With the engine running and all electrical services switched on (e.g. strobes, lights, avionics, etc), ensure that the source GPS and transponder are on and transmitting.

Using the computer linked to the PilotAware unit, use a web browser to navigate to the PilotAware data screen (URL: 192.168.1.1). Select the 'traffic' screen, which should show a screen similar to either of the following:

Early PilotAware Screen Shown:

HEX(3)	REG	SQ	DIST-KM	ALT-FT	SIG	Vers	NACp	SDA	NICa	SIL	SILs
404C52	GIBAZ	-	0.002	5	123	2	9	0	1	0	0
4CA9CF	EI-EVG	5510	10.828	18305	11	-	-	-	-	-	-
4010E9	G-EZBU	6347	43.259	34180	6	-	-	-	-	-	-



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**APR 2021**

Later PilotAware Screen Shown:

ADSB status third and fifth figures should read zero.

HEX (10)	REG	MODE	SQ	D(KM)	A(FT)	BR	SIG	ADSB Status	AIRCRAFT, OWNER
4066F6	GXBAL	CSA--	-	0.1	692+00	6	189	2,9,0,1,0,0	-, -
7C4928	VH-OQI	CSA--	3257	26.5	7544:-09	4	9	-, -, -, -, -, -	AIRBUS A380-842, QANTAS
C04BF1	C-GCTS	CSA--	0675	32.1	34994:+00	2	25	2,9,2,0,3,0	AIRBUS A330-342, AIR TRANSAT
300177	I-DISU	CSA--	4021	39.2	32994:+00	12	26	-, -, -, -, -, -	BOEING 777-243, ALITALIA
4CA8E6	EI-ENT	CSA--	3515	46.6	28544:-20	3	11	-, -, -, -, -, -	BOEING 737-8AS, RYANAIR
4008E5	G-MIDT	CSA--	7632	59.7	28444:+44	11	9	-, -, -, -, -, -	AIRBUS A320-232, BRITISH AIRWAYS
49116A	NJE3060	CS---	7511	-	38994:+00	-	36	-, -, -, -, -, -	-, -
400877	G-EUPG	CS---	-	-	11444:+1247	-	9	-, -, -, -, -, -	AIRBUS A319-131, BRITISH AIRWAYS
A1F1A0	N224UA	CS---	0163	-	5694:+00	-	9	-, -, -, -, -, -	BOEING 777-222, UNITED AIRLINES
-	Mode-C	C----	T=05	-	61594:+00	-	18	-, -, -, -, -, -	-, -

- Check that the date, time and position are correct.
- Check that the aircraft being checked is listed (probably at the top) and that it shows the correct Mode S 'hex' code (which can be checked on the CAA's G-INFO database), registration and squawk code and distance. The 'SDA' and 'SIL' fields should show '0' for non-certified and '1' for certified GPS source.

Take a screen print. On Google Chrome for tablets, this can be done by selecting 'print' from the drop-down menu and then saving as a PDF. Otherwise, a photo of the screen can be taken. A copy of the screen shot should be included with the submission, making sure that it is clearly legible.

**METHOD 2: [GETYOURWINGS.CO.UK](http://GETYOURWINGS.CO.UK)**

In order to receive the ADS-B data, you will need a Windows computer equipped with an appropriate antenna (costing around £10) and software provided by [getyourwings.co.uk](http://getyourwings.co.uk). The website describes the equipment needed and how to install and set it up. Position the computer at a safe distance from the aircraft – a nearby clubhouse is ideal!

**TEST PROCEDURE**

Ensure that the aircraft is chocked and in a safe area with an appropriate person at the controls. With the engine running and all electrical services switched on (e.g. strobes, lights, avionics, etc), ensure that the source GPS and transponder are on and transmitting. The software on the computer should show a screen similar to below:



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#### ISSUE – 2

#### APR 2021

GetYourWings.co.uk Transponder Report V1.0.0.6

Main Settings

Selector

Icao	CallSign
4CABC1	
400D9C	
40710E	BEE1SB
4B19D1	SJT941
406B6C	CFE9KJ
400942	
400AB0	

ICAO: Msg DF:0 - Short ACAS  
 ICAO: 1889CF4093C  
 ICAO: 400D9C Msg DF: 4 - Altitude Reply  
 20280290F048FA  
 ICAO: 43C295 Msg DF: 4 - Altitude Reply  
 20005938C346E  
 ICAO: C08B9C Msg DF: 4 - Altitude Reply  
 200013354C2EE4  
 ICAO: 406B6C Msg DF:20 - Comm B Altitude Reply  
 A0001335AAF057FA801069  
 9E565  
 ICAO: AE1171 Msg DF: 4 - Altitude Reply  
 2000C299858FB

Status  
 Aircraft in view 21 Frames/sec  
 0

Aircraft Under Test  
 40710E  
 Auto Refresh

PDF Report Start

Installation Information

Transponder Make  
 GPS Make  
 Aircraft Make

Transponder Model  
 GPS Model  
 Aircraft Type

Owner  
 First Name  
 Last Name  
 Membership Organisation / Number

Aircraft details

ICAO	40710E	SILs	0	NACp	10
Call Sign	BEE1SB	VERS	2	HRD	0 True North
Altitude	16,000ft Q: 1 (25ft Resolution)	NIC	8		
Squawk	7630	Rc	< 0.1 NM (185 m)		
NICsb	0	FS	0 no alert / no SPI - airborne		
NICa	0	Country	United Kingdom		
<b>SDA</b>	2 Major	Speed	280		
<b>SIL</b>	3	Heading	4		
<b>Lat Lon</b>	52.12129,-0.75394	VSI	+4 (Baro)		
Emitter Category	2 Small (15,500 to 75,000 lbs.)				
Surveillance Status	0 No condition information				
CA	DF11 -> Level 2+3+4 (DF0,4,5,11,20,21,24,code7 - is airborne)				
Recorded:	03 October 2019 - 12:00:02		Total Messages: 707		

Map  
 Ravenstone Weston Underwood  
 Stoke Goldington  
 40710E BEE1SB  
 Tyringham  
 Gayhurst  
 Lathbury

- Check that the date, time and position are correct.
- Select the aircraft being checked and check that it shows the correct Mode S 'hex' code (labelled 'ICAO' - this can be checked on the CAA's G-INFO database), registration and squawk code. The 'SDA' and 'SIL' fields should show '0' for non-certified and '1' for certified GPS source.