Explanatory Statement

Civil Aviation Act 1988

Civil Aviation Order 20.18 Amendment Instrument 2011 (No. 2)

Purpose
Civil Aviation Order 20.18 Amendment Instrument 2011 (No. 2) does 3 things.

It creates a new standard for aircraft 'Mode Select' (***Mode S***) transponder equipment that operates with ground-based secondary surveillance radars (***SSRs***) used for Air Traffic Control (***ATC***).

It modifies the rules pertaining to aircraft automatic dependent surveillance – broadcast (***ADS-B***) equipment to extend the compliance date by which newly-manufactured aircraft must meet a certain technical standard (GNSS Selective Availability Aware (***SA Aware***) feature) if they are fitted with ADS-B equipment.

Finally, it permits flight with unserviceable ADS-B equipment if certain new conditions are met.

Legislation
Section 98 of the *Civil Aviation Act 1988* (the ***Act***) empowers the Governor-General to make regulations for the Act and the safety of air navigation.

Under subregulation 207 (2) of the *Civil Aviation Regulations 1988* (***CAR 1988***), a person must not use an Australian aircraft in a class of operation if the aircraft is not fitted with the instruments and equipment approved and directed by CASA. In approving or directing, CASA may have regard only to the safety of air navigation.

Under subregulation 5 (1) of CAR 1988, where CASA is empowered to issue certain instruments such as approvals or directions, it may do so in a Civil Aviation Order (***CAO***).

For subregulation 207 (2) of CAR 1988, CASA made Civil Aviation Order 20.18 (***CAO 20.18***) setting out the approval and directions for aircraft instruments and equipment to meet basic operational requirements.

Subsection 9B of CAO 20.18 contains directions relating to the use and carriage of ADS-B equipment by aircraft engaged in private, aerial work, charter or regular public transport operations (paragraph 9B.1, with many technical terms defined in paragraph 9B.2).

ADS-B avionics is a modern aircraft surveillance system for ATC using ground stations to receive radio signals transmitted by ADS-B equipped aircraft. Using ADS-B avionics, an aircraft is able to broadcast its identity, position, altitude, velocity and many other flight parameters with a degree of accuracy, integrity and reliability that is better than SSR.

Under paragraph 9B.3 of CAO 20.18, if an aircraft carries ADS-B transmitting equipment for operational use in Australian territory, the equipment must comply with

the conditions for an approved equipment configuration as set out in Appendix XI or as otherwise approved by CASA.

In particular, Appendix XI contains standards for the GNSS position source equipment used to enable the ADS-B equipment to transmit geographical position. These standards differ depending on whether the relevant aircraft was manufactured before 28 June 2012, or on or after 28 June 2012. Appendix XI also contains *alternative* approved equipment configuration standards — again depending on whether the relevant aircraft was manufactured before 28 June 2012, or on or after 28 June 2012.

Under paragraph 9B.4, the equipment must, depending on the circumstances, transmit exact flight identification, the aircraft's registration mark, or another flight identification directed or approved by ATC.

Under paragraph 9B.5, the equipment must be operated continuously during the flight in all airspace at all altitudes unless the pilot is directed or approved otherwise by ATC. Under paragraph 9B.6, if an aircraft carries ADS-B transmitting equipment which does not comply with an approved equipment configuration, the aircraft must not fly in Australian territory unless the equipment is deactivated, or reset to transmit certain zero values considered equivalent to deactivation. Under paragraph 9B.7, the equipment need not be deactivated for certain flight tests.

Under paragraph 9B.8, on and after 12 December 2013, if an aircraft operates at or above FL 290, it must carry serviceable ADS-B transmitting equipment that complies with an approved equipment configuration, unless the aircraft owner, operator or pilot has written authorisation otherwise from CASA (paragraph 9B.9).

Subsection 9B of CAO 20.18 operates in conjunction with provisions of *CAOs 82.1, 82.3 and 82.5* for foreign aircraft engaged in aerial work, charter and regular public transport (***RPT***) operations. Subsection 9B also operates in conjunction with a direction under regulation 209 of CAR 1988 to foreign aircraft engaged in private operations. In this way, the ADS-B requirements apply (according to their terms) to all Australian and foreign registered aircraft operating in Australia.

Need for amendment — cut-off date

Following a meeting of the ICAO Asia-Pacific ADS-B Study and Implementation Task Force (***APAC ADS-B SITF***), in Singapore in April 2011, CASA decided that it should make a modification to subsection 9B of CAO 20.18.

The amendment is necessary to defer for a period (from 28 June 2012 to 8 December 2016) the requirement for newly manufactured aircraft to be equipped with GNSS position source avionics that have the SA Aware feature incorporated. (The 28 June 2012 date was the target before this CAO amendment and appeared in the standards set out in Appendix XI.)

At the ICAO APAC ADS-B SITF meeting, the International Air Transport Association (IATA) reported that many airlines would be unable to comply with the 28 June 2012 cut-off date because one of the 3 major original equipment manufacturers (OEM) for GNSS receivers could not produce a certificated SA Aware replacement GNSS card for the multi-mode receiver (MMR) by that date. This could mean that airlines would need to purchase another manufacturer's product which

could result in loss of fleet equipage standardisation, maintenance and spares complications, increased costs and economic disadvantage.

Having assessed the safety implications for revised timing, CASA decided to adopt 8 December 2016 as the 'aircraft-manufactured-by' cut-off date for SA Aware forward fit compliance.

Need for further amendment — unserviceable ADS-B equipment
Following discussion with airline representatives at the ASTRA (Australian Strategic Air Traffic Management) Surveillance Technologies Working Group (***STWG***) forum in May 2011, CASA agreed to include specific provisions in the ADS-B rule for certain aircraft operation with ADS-B equipment unserviceability. Therefore, consistent with ICAO guidelines, paragraph 9B.9 is amended to allow limited ADS-B unserviceability for a flight if the flight takes place within 3 days of the discovery of the unserviceability, subparagraph 10.1 (a), (b) or (c) of CAO 20.18 applies for the flight, and ATC clears the flight despite the unserviceability.

Under subsection 10 of CAO 20.18, all instruments and equipment fitted to an aircraft must be serviceable before take-off unless otherwise approved by CASA, or allowed under a permissible unserviceability in the minimum equipment list (PUS under the MEL).

Need for further amendment — Mode S
Airservices Australia (***AA***) is installing Mode S SSRs to replace both the existing Mode A/C SSRs at major Australian aerodromes, and the en route radars on the east coast from Cairns to Adelaide. Modern Mode S radar technology significantly improves SSR performance and accuracy for ATC. It also provides ATC with a display of aircraft transmitted flight identity directly matched to the submitted flight notification. Display of other aircraft flight parameters is also possible via the downlink aircraft parameters (DAPs) feature of the Mode S data-link system.

The Mode S radars operate compatibly with the older Mode A/C transponders currently fitted to the majority of aircraft. However, Mode S transponders are gradually replacing Mode A/C transponders which are now considered to be obsolescent. Most new aircraft have Mode S transponders.

A new subsection 9C is inserted in CAO 20.18, after subsection 9B, to prescribe technical standards for aircraft Mode S transponder equipment. The equipment has been, and is currently being, manufactured to these standards which have been adopted globally by ICAO, the United States Federal Aviation Administration and the European Aviation Safety Agency.

The prescription of Mode S standards does not place any new requirements on industry but simply explicitly states the minimum equipment requirements if a Mode S transponder is fitted. Existing and new aircraft Mode S installations will comply with the standards.

Application
The amendments made to CAO 20.18 operate in conjunction with *CAOs 82.1, 82.3 and 82.5*, and the direction under regulation 209 of CAR 1988, so that the amended rules also apply to foreign aircraft in Australian territory. These instruments have also been amended to reflect the changes made by the CAO amendment. Thus, the

amended ADS-B requirements apply (according to their terms) to all Australian and foreign registered aircraft engaged in private, aerial work, charter or RPT operations in Australia.

CAO amendment
Because of its technical nature, details of the CAO amendment are set out in Attachment 1, with details of relevant ICAO standards that are applied and adopted set out in Attachment 2 (**incorporation by reference**).

Legislative Instruments Act 2003 (*the *LIA)
Under subregulation 5 (1) of CAR 1988, if CAR 1988 empowers CASA to issue instruments such as approvals or directions, CASA may do so in the form of CAOs. Under subsection 98 (5AAA) of the Act, where regulations provide for an instrument to be issued in the form of a CAO, the CAO so made is a legislative instrument. The CAO amendment is, therefore, a legislative instrument subject to registration, and tabling and disallowance in the Parliament, under sections 28, and 38 and 42, of the LIA.

The incorporation by reference of external standards, TSO, ETSO and ICAO, whether as in existence on the date of the instrument (the ICAO Volume IV of Annex 10 standards), or in force from time to time (the TSO and ETSO standards), is permitted under paragraph 14 (1) (b) of the LIA and subsection 98 (5D) of the Act.

Statement of Compatibility with Human Rights
The following Statement is prepared in accordance with Part 3 of the *Human Rights (Parliamentary Scrutiny) Act 2011*.

Civil Aviation Order 20.18 Amendment Instrument 2011 (No. 2), Civil Aviation Order 82.1 Amendment Instrument 2011 (No. 1), Civil Aviation Order 82.3 Amendment Instrument 2011 (No. 2), Civil Aviation Order 82.5 Amendment Instrument 2011 (No. 3) and instrument CASA 498/11 – *Amendment of Direction – use of ADS-B in foreign aircraft engaged in private operations in Australian territory*, being an interrelated package of legislative instruments, are each compatible with the human rights and freedoms recognised or declared in the international instruments listed in section 3 of the *Human Rights (Parliamentary Scrutiny) Act 2011*.

Civil Aviation Order 20.18 Amendment Instrument 2011 (No. 2) creates a new standard for Australian aircraft 'Mode Select' (***Mode S***) transponder equipment that operates with ground-based secondary surveillance radars (***SSR***) used for Air Traffic Control (***ATC***). It modifies the rules pertaining to aircraft ADS-B equipment to extend the compliance date by which newly-manufactured aircraft must meet a certain technical standard (GNSS Selective Availability Aware (***SA Aware***) feature) if they are fitted with ADS-B equipment. Finally, it permits flight with unserviceable ADS-B equipment if certain new conditions are met.

Each of the other interrelated instruments has the effect of applying these new standards to operators of relevant *foreign* aircraft operating in Australian territory. None of the instruments engages any of the applicable rights or freedoms and each of the instruments is compatible with human rights as it does not raise any human rights issues.

Thus, *Civil Aviation Order 20.18 Amendment Instrument 2011 (No. 2)* does not engage any of the applicable rights or freedoms and is compatible with human rights as it does not raise any human rights issues.

Consultation

Industry consultation was undertaken in accordance with the normal processes used by CASA for regulatory developments. Notice of Proposed Rule Making (NPRM) No. 1103AS was published on 6 October 2011 which set out the CAO amendments and invited industry comment. CASA received responses from 8 respondents, including several key industry representative organisations, airlines and equipment manufacturers. A number of changes to the rules as proposed in the NPRM have been made to take account of the comments received. Consultation has also been undertaken with the ASTRA industry representative body on Air Traffic Management.

Regulation Impact Statement (*RIS*)

The amendments will not increase costs for, or impose any additional requirements on, aircraft operators. Therefore, the Office of Best Practice Regulation (***OBPR***) does not require a RIS for the latest CAO amendment because a preliminary assessment of the business compliance costs indicates that the CAO amendment will have only a nil to low impact on business (OBPR Id. No. 13116).

Commencement and making

The CAO amendment takes effect on the day after registration. It has been made by the Director of Aviation Safety, on behalf of CASA, in accordance with subsection 73 (2) of the Act.

[Civil Aviation Order 20.18 Amendment Instrument 2011 (No. 2)]

Details of latest CAO amendment

1 Name of instrument

Under this section, the instrument is the *Civil Aviation Order 20.18 Amendment Instrument 2011 (No. 2).*

2 Commencement

Under this section, the instrument commences on the day after registration.

3 Amendment of Civil Aviation Order 20.18

Under this section, Schedule 1 amends Civil Aviation Order 20.18.

Schedule 1 Amendment

[1] Paragraph 9B.1

Under this amendment, it is made clear that subsection 9B applies to operations in Australian territory.

[2] Paragraph 9B.2, definitions

Under this amendment, it is made clear that the definitions set out in subsection 9B also apply for subsection 9C.

[3] Paragraph 9B.2, definition of *aircraft address*

This amendment modifies the definition of ***aircraft address*** so that it means a unique code of 24 binary bits assigned to an aircraft either by CASA, when the aircraft is registered on the Australian Civil Aircraft Register, or by the relevant recreational aviation administration organisation (RAAO) for the aircraft when the aircraft is placed on its aircraft register.

[4] Paragraph 9B.2, definitions

This amendment inserts new definitions in subsection 9B as follows:

ATC means air traffic control.

EHS DAPs means enhanced surveillance downlink of aircraft parameters.

Mode A is a transponder function that transmits a 4-digit octal identification code for an aircraft when interrogated by an SSR, the code having been dynamically assigned to the aircraft by ATC for the relevant flight sector.

Mode A code is the 4-digit octal identification code transmitted by a Mode A transponder function.

Mode C is a transponder function that transmits a 4-digit octal code for an aircraft's pressure altitude when interrogated by an SSR.

Mode C code is the 4-digit octal identification code transmitted by a Mode C transponder function.

Mode S is a monopulse radar interrogation technique that improves the accuracy of the azimuth and range information of an aircraft, and uses a unique aircraft address to selectively call individual aircraft.

SSR means a secondary surveillance radar system that is used by ATC to detect an aircraft equipped with a radar transponder.

[5] Paragraph 9B.8

This amendment makes paragraph 9B.8 (about when carriage of ADS-B equipment is required) subject to paragraph 9B.9 (setting out certain exceptions).

[6] Paragraph 9B.8, Note

This amendment omits a Note made redundant by amendments changing the aircraft-manufactured-by cut-off date.

[7] Paragraph 9B.9

Under this amendment, certain carriage of serviceable ADS-B equipment is not required if the aircraft owner, operator or pilot has written authorisation from CASA for the aircraft to operate without the ADS-B transmitting equipment, or if the equipment is unserviceable for a flight, and each of 3 conditions are also complied with, namely, that the flight takes place within 3 days of the discovery of the unserviceability; subparagraph 10.1 (a), (b) or (c) of CAO 20.18 applies for the flight (unserviceability permitted with CASA permission); and ATC clears the flight despite the unserviceability.

[8] After subsection 9B

This amendment inserts the new subsection 9C which provides as follows:

9C Standards for Mode S transponder equipment

9C.1 This subsection applies to an aircraft engaged in private, aerial work, charter or regular public transport operations.

9C.2 If the aircraft carries Mode S transponder equipment (the ***equipment***), the equipment must meet the standards set out in this subsection.

9C.3 The equipment must be of a type that is authorised by:

(a) the FAA in accordance with TSO-C112 as in force on 5 February 1986, or a later version as in force from time to time; or

(b) EASA in accordance with ETSO-C112a as in force on 24 October 2003, or a later version as in force from time to time; or

(c) CASA in accordance with an instrument of approval of the type.

A Note explains that CASA Advisory Circular 21-46 provides guidelines on Mode S transponder equipment.

A second Note explains that if Mode S transponder equipment incorporates ADS-B functionality, the standards set out in subsection 9B for ADS-B transmitting equipment will also apply to the Mode S transponder equipment.

9C.4 The aircraft address entered into the equipment must exactly correspond to the aircraft address assigned to the aircraft by CASA or the relevant RAAO.

9C.5 The equipment must transmit each of the following when interrogated on the manoeuvring area of an aerodrome or in flight:

(a) the aircraft address;

(b) the Mode A code;

(c) the Mode C code;

(d) subject to paragraph 9C.7, the aircraft's flight identification in accordance with paragraph 9C.6.

9C.6 The aircraft's flight identification must:

(a) if a flight notification is filed with ATC for the flight — correspond exactly to the aircraft identification mentioned on the flight notification; or

(b) if no flight notification is filed with ATC for the flight — be:

(i) for an aircraft registered on the Australian Civil Aircraft Register — the aircraft's registration mark; or

(ii) for an Australian aircraft registered by an RAAO — be in accordance with the RAAO's operations manual; or

(c) be another flight identification directed or approved for use by ATC.

9C.7 Mode S transponder transmission of the aircraft flight identification is optional for any aircraft that was first registered in Australia before 9 February 2012 (an ***older aircraft***). However, if an older aircraft is equipped to transmit, and transmits, an aircraft flight identification then that aircraft flight identification must be in accordance with paragraph 9C.6.

9C.8 If the equipment transmits any Mode S EHS DAPs, the transmitted DAPs must comply with the standards set out in paragraph 3.1.2.10.5.2.3 and Table 3-10 of Volume IV, Surveillance and Collision Avoidance Systems, of Annex 10 of the Chicago Convention.

A Note explains that paragraph 3.1.2.10.5.2.3 includes 3.1.2.10.5.2.3.1, 3.1.2.10.5.2.3.2 and 3.1.2.10.5.2.3.3. Details of these incorporated standards are set out in Attachment 2 for information.

A second Note explains that Australian Mode S SSR are EHS DAPs-capable, and operational use of EHS DAPS is to be introduced in Australia. However, implementation of Mode S EHS DAPs transmissions that are not in accordance with the ICAO standards may be misleading to ATC. Operators need to ensure that correct parameters are being transmitted.

9C.9 If the equipment is carried in an aircraft first registered in Australia on or after 9 February 2012;

(a) having a certificated maximum take-off weight above 5 700 kg; or

(b) that is capable of normal operation at a maximum cruising true air speed above 250 knots;

the equipment's receiving and transmitting antennae must:

(c) be located in the upper and lower fuselage; and

(d) operate in diversity, as specified in paragraphs 3.1.2.10.4 to 3.1.2.10.4.5 (inclusive) of Volume IV, Surveillance and Collision Avoidance Systems, of Annex 10 of the Chicago Convention.

A Note explains that paragraph 3.1.2.10.4.2.1 is recommendatory only. Details of these incorporated standards are set out in Attachment 2 for information.

[9-16] Appendix XI

These amendments omit mention of 28 June 2012 and insert 8 December 2016 to extend the compliance date by which newly-manufactured aircraft must meet the standard for incorporation of the SA Aware feature in GNSS position source equipment used for ADS-B.

Attachment 2

Details of ICAO standards incorporated by reference

Volume IV, Surveillance and Collision Avoidance Systems,

Annex 10 of the Chicago Convention

For subparagraph 9C.9 (d):

3.1.2.10.4 *Transponder antenna system and diversity operation.* Mode S transponders equipped for diversity operation shall have two RF ports for operation with two antennas, one antenna on the top and the other on the bottom of the aircraft's fuselage. The received signal from one of the antennas shall be selected for acceptance and the reply shall be transmitted from the selected antenna only.

3.1.2.10.4.1 *Radiation pattern.* The radiation pattern of Mode S antennas when installed on an aircraft shall be nominally equivalent to that of a quarter-wave monopole on a ground plane.

Note.— Transponder antennas designed to increase gain at the expense of vertical beamwidth are undesirable because of their poor performance during turns.

3.1.2.10.4.2 *Antenna location.* The top and bottom antennas shall be mounted as near as possible to the centre line of the fuselage. Antennas shall be located so as to minimize obstruction to their fields in the horizontal plane.

3.1.2.10.4.2.1 **Recommendation.—** *The horizontal distance between the top and bottom antennas should not be greater than 7.6 m (25 ft).*

Note.— This recommendation is intended to support the operation of any diversity transponder (including cables) with any diversity antenna installation and still satisfy the requirement of 3.1.2.10.4.5.

3.1.2.10.4.3 *Antenna selection.* Mode S transponders equipped for diversity operation shall have the capability to evaluate a pulse sequence simultaneously received on both antenna channels to determine individually for each channel if the *P*1 pulse and the *P*2 pulse of a Mode S interrogation preamble meet the requirements for a Mode S interrogation as defined in 3.1.2.1 and if the *P*1 pulse and the *P*3 pulse of a Mode A, Mode C or intermode interrogation meet the requirements for Mode A and Mode C interrogations as defined in 3.1.1.

Note.— Transponders equipped for diversity operation may optionally have the capability to evaluate additional characteristics of the received pulses of the interrogations in making a diversity channel selection. The transponder may as an option evaluate a complete Mode S interrogation simultaneously received on both channels to determine individually for each channel if the interrogation meets the requirements for Mode S interrogation acceptance as defined in 3.1.2.4.1.2.3.

3.1.2.10.4.3.1 If the two channels simultaneously receive at least a *P*1 – *P*2 pulse pair that meets the requirements for a Mode S interrogation, or a *P*1 – *P*3 pulse pair that meets the requirements for a Mode A or Mode C interrogation, or if the two channels

simultaneously accept a complete interrogation, the antenna at which the signal strength is greater shall be selected for the reception of the remainder (if any) of the interrogation and for the transmission of the reply.

3.1.2.10.4.3.2 If only one channel receives a pulse pair that meets the requirements for an interrogation, or if only one channel accepts an interrogation, the antenna associated with that channel shall be selected regardless of received signal strength.

3.1.2.10.4.3.3 *Selection threshold.* If antenna selection is based on signal level, it shall be carried out at all signal levels between MTL and –21 dBm.

Note.— Either antenna may be selected if the difference in signal level is less than 3 dB.

3.1.2.10.4.3.4 *Received signal delay tolerance.* If an interrogation is received at one antenna 0.125 microsecond or less in advance of reception at the other antenna, the interrogations shall be considered to be simultaneous interrogations, and the above antenna selection criteria applied. If an accepted interrogation is received at either antenna 0.375 microsecond or more in advance of reception at the other antenna, the antenna selected for the reply shall be that which received the earlier interrogation. If the relative time of receipt is between 0.125 and 0.375 microsecond, the transponder shall select the antenna for reply either on the basis of the simultaneous interrogation criteria or on the basis of the earlier time of arrival.

3.1.2.10.4.4 *Diversity transmission channel isolation.* The peak RF power transmitted from the selected antenna shall exceed the power transmitted from the non-selected antenna by at least 20 dB.

3.1.2.10.4.5 *Reply delay of diversity transponders.* The total two-way transmission difference in mean reply delay between the two antenna channels (including the differential delay caused by transponder-to-antenna cables and the horizontal distance along the aircraft centre line between the two antennas) shall not exceed 0.13 microsecond for interrogations of equal amplitude. This requirement shall hold for interrogation signal strengths between MTL +3 dB and –21 dBm. The jitter requirements on each individual channel shall remain as specified for non-diversity transponders.

Note.— This requirement limits apparent jitter caused by antenna switching and by cable delay differences.

For paragraph 9C.8:

3.1.2.10.5.2.3 *Data formats for standard length transactions and required downlink aircraft parameters (DAPs)*

3.1.2.10.5.2.3.1 All level 2 and above transponders shall support the following registers:

— the capability reports (3.1.2.6.10.2);
— the aircraft identification protocol register 20 {HEX} (3.1.2.9); and
— for ACAS-equipped aircraft, the active resolution advisory register 30 {HEX} (4.3.8.4.2.2).

3.1.2.10.5.2.3.2 Where required, DAPs shall be supported by the registers listed in Table 3-11. The formats and minimum update rates of transponder registers shall be implemented consistently to ensure interoperability.

3.1.2.10.5.2.3.3 The downlink standard length transaction interface shall deliver downlink aircraft parameters (DAPs) to the transponder which makes them available to the ground. Each DAP shall be packed into the Comm-B format (‘MB’ field) and can be extracted using either the ground-initiated Comm-B (GICB) protocol, or using MSP downlink channel 3 via the dataflash application.

Note.— The formats and update rates of each register and the dataflash application are specified in the Technical Provisions for Mode S Services and Extended Squitter *(Doc 9871).*

For 3.1.2.10.5.2.3.2 above:

Table 3-10. DAPs registers

Register	*Name*	*Data content*	*Bits*
40{HEX}	Selected vertical intention	MCP/FCU selected altitude	1-13
		FMS selected altitude	14-26
		Barometric pressure setting minus 800 mb	27-39
		MCP/FCU mode bits	48-51
		Target altitude source bits 54-56	54-56
50{HEX}	Track and turn report	Roll angle	1-11
		True track angle	12-23
		Ground speed	24-34
		Track angle rate	35-45
		True airspeed	46-56
60{HEX}	Heading and speed report	Magnetic heading	1-12
		Indicated airspeed	13-23
		Mach	24-34
		Barometric altitude rate	35-45
		Inertial vertical velocity	46-56