Advisory Pamphlet

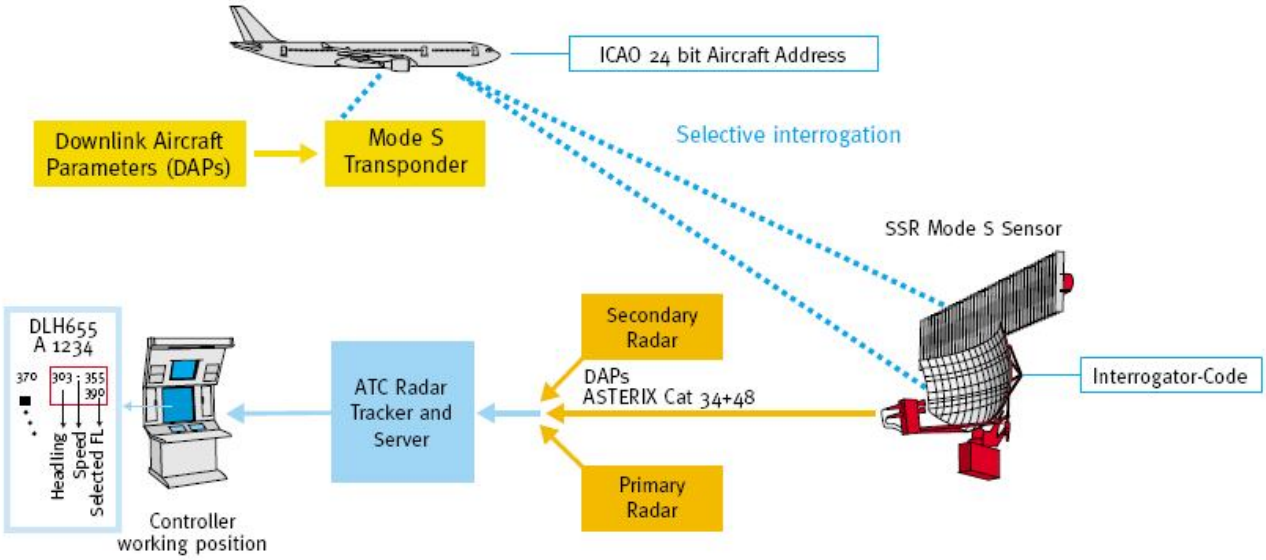
Enhanced Mode S

AP-1.4.309A

AIR OPERATOR
CERTIFICATION

1. Purpose

1.1. In Europe Mode S Transponder is mandated for the airspace classes where today a mode A/C Transponder is mandatory.



1.2. **ELS – SSR Mode S Elementary Surveillance**

1.2.1. The aircraft must comply with the SSR-Mode S Elementary Surveillance (ELS) requirements. A level 2 transponder including SI-code functionality is mandatory supporting the following functions:

1.2.1.1. SSR Mode 3/A

1.2.1.2. Altitude Reporting in 25ft intervals - ref ICAO annex 10 Vol IV Chapter 2 para 2.1.3.

1.2.1.3. 24-Bit Aircraft Address

1.2.1.3.1. All Mode S equipped aircraft engaged in international civil aviation are required to have an aircraft identification feature as prescribed in ICAO Annex 10, Volume IV, Chapter 2, para 2.1.5.2.

1.2.1.3.2. The aircraft address shall be one out of 16777214 twenty-four-bit aircraft addresses allocated by ICAO to the State of Registry or common mark registering authority and assigned as prescribed in the Appendix to ICAO Annex 10, Volume III, Part I, Chapter 9.

1.2.1.3.3. The 24-Bit Aircraft Address (so called Mode S Address) has to be obtained from CAAI

1.2.1.4. Flight Status (airborne or surface) - ref ICAO annex 10 Vol IV Chapter 3 para 3.1.2.8.6.7.

1.2.1.5. BDS 10hex Data Link Capability Report

1.2.1.6. BDS 17hex Common Usage GICB Capability Report

1.2.1.7. BDS 20hex Aircraft Identification

1.2.1.7.1. The Aircraft Identification is the current flight number respectively the aircraft registration marking as shown in item 7 of the flight plan.

1.2.1.7.2. In accordance with ICAO Doc 8168 [PANS-OPS] Vol. I, Part VIII, 1.3, flight crew of aircraft equipped with Mode S having an aircraft identification feature shall set the aircraft identification in the transponder. This setting shall correspond to the aircraft identification specified in item 7 of the ICAO flight plan, or, if no flight plan has been filed, the aircraft registration.

1.2.1.8. BDS 30hex ACAS Active Resolution Advisory

1.2.2. The transponder parameters and data formats for Ground initiated Comm-B (GICB) Protocols as defined in the ICAO Annex 10 Vol III, Attachment A to Chap 5 and the ICAO Manual of Mode S Specific Services (Doc. 9688-AN952).

1.2.3. Mode S equipped aircraft with a maximum take off weight (MTOW) in excess of 5700 kg or a maximum true airspeed in excess of 250 kts (463 km/h) shall be operated with antenna diversity as prescribed in ICAO Annex 10, Vol. IV, Chapter 3, para 3.1.2.10.4.

1.2.4. Mode S equipped aircraft shall be operated with the appropriate transponder peak pulse power as prescribed in ICAO Annex 10, Vol. IV, Chapter 3, para 3.1.2.10.2

1.2.5. The functionality of Mode S transponders shall support the Interrogator Identifier (II) code and Surveillance Identifier (SI) code functionality as prescribed in ICAO Annex 10

1.2.6. To accomplish the mandate it is not sufficient to install the appropriate Mode S transponder on board the aircraft, but it is also required to connect this transponder with the appropriate data sources on board the aircraft (e.g. as described in ARINC 718A).

1.2.7. The granting of exemptions from the requirements for the carriage and operation of Mode S airborne equipment have been coordinated, in accordance with the provisions of ICAO Doc 70301

1.2.8. schedule

1.2.8.1. All new aircraft in production should be equipped by 31 March 2004.

1.2.8.2. All aircraft operating IFR/GAT should be equipped by 31 March 2007.

1.2.8.3. All aircraft operating VFR should be equipped by 31 March 2008.

1.2.8.4. Aircraft operators (private, commercial, or state/military) who are granted exemptions should be advised that it will not be possible to provide the same level of ATM services that applied to aircraft which comply with the Mode S carriage and operation requirements.

1.2.8.5. Exemptions that will be granted on a case-by-case basis, are only temporary in nature and will be reviewed and redefined as necessary.

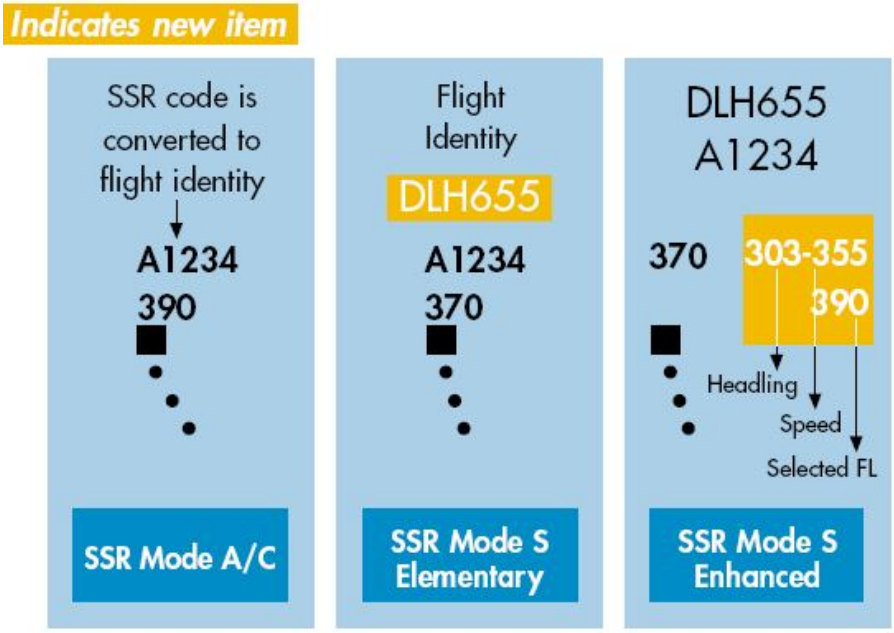
1.2.8.6. Aircraft operators (private, commercial, or state/military) will be required to provide evidence that plans have been made to equip their aircraft with the relevant Mode S functionality as soon as possible.

1.3. **ELS – SSR Mode S Enhanced Surveillance**

1.3.1. SSR-Mode S Enhanced Surveillance (EHS) is required for all IFR flights, as General Air Traffic (GAT) for aircraft with a maximum take-off mass exceeding 5,700kg, or a maximum cruising true airspeed in excess of 250 kts (463 km/h).

1.3.2. SSR-Mode S Enhanced Surveillance (EHS) is required for all IFR flights, as General Air Traffic (GAT) for aircraft with a maximum take-off mass exceeding 5,700kg, or a maximum cruising true airspeed in excess of 250 kts (463 km/h).

1.3.3. Through the automatic extraction of downlink aircraft' parameters, Enhanced Surveillance will lead to a reduction in Radio Telephony (RT) between the air traffic controllers and the pilots. This reduces the workload on a pilot and removes a potential source of error.



1.3.4. In addition to the above ELS requirements the Enhanced Surveillance functionality will need to ensure, through Ground Initiated Comm-B (GICB) protocols as defined in ICAO Annex 10 (Amendment 77), Attachment A to Chapter 5 of Volume III and the Mode S Manual of Specific Services (ICAO Doc 9688-AN/952), the extraction and transmission of information contained in the following standardized transponder registers (designated by BDS x, y and which may be composed of up to 4 different aircraft data):

1.3.4.1. BDS 6,0 Heading and Speed report

1.3.4.1.1. Magnetic heading

1.3.4.1.2. Indicated airspeed

1.3.4.1.3. Mach no.

1.3.4.1.4. Vertical rate (Barometric rate of climb/descend or baro-inertial)

1.3.4.2. BDS 5,0 Track and Turn report

1.3.4.2.1. Track angle rate

1.3.4.2.2. True track angle

1.3.4.2.3. Ground speed

1.3.4.3. BDS 4,0 Selected vertical intention

1.3.4.3.1. Selected altitude (including Barometric Pressure Setting)

For aircraft that require ACAS II, the Resolution Advisory Report will need to be transmitted also by the transponder (ICAO Annex 10, Volume IV)

Minimum Required Characteristics of Aircraft Derived Data for ELS

Parameter	Range	Minimum Resolution	Accuracy Limits	Max Data Age at Transmission	Remarks
Magnetic Heading	-180, +180 degrees	90/512	As installed sensor	1 second	BDS Register 6,0
Indicated Airspeed	As installed sensor	1 kt			
Mach No.	As installed sensor	2.048/512			
Vertical Rate	-4994, +4984 m/min (-16384, +16352 ft/min	8192/256			
Roll Angle	-90, +90 degrees	45/256			BDS Register 5,0
Track Angle Rate (note 1)	-16, +16 degrees/second	8/256			
True Track Angle	-180, +180 degrees	90/512			
Ground Speed	As installed sensor	2 kt			
Selected Altitude	As installed sensor	5m (16ft)	Note 2 & 3		BDS Register 4,0

Notes

(1) If the Track Angle Rate parameter, as defined in the ARINC 429 data bus specification, cannot be readily provided because the aircraft configuration is based on the GAMA 429 specification where data label 335 is assigned to another parameter, then the Track Angle Rate field or fields will need to be ZEROED. No other data parameter shall be used to fill the Track Angle Rate field

(2) The value of Selected Altitude, transmitted by the transponder, will need to correspond within +/-8m (+/- 25ft) to the value displayed to the flight crew or the associated output to the flight control/guidance system.

(3) The Selected Altitude data to be provided by BDS 4,0 is the “MCP/FCU SELECTED ALTITUDE” (bits 2-13), together with bit 1 (STATUS), and bits 48 to 51, set as described in the register definition. In addition, where readily available, Barometric Pressure Setting in bits 28 to 40 of BDS 4,0 should be provided as defined in Annex 10, Table 2-64 BDS 4,0. The transponder subtracts 800 mb from the Barometric Pressure Setting prior to loading into the register

2. Reference Material

2.1. **Regulatory Requirements** - None

2.2. **Reference Material**:

2.2.1. JAA ACJ 20X11 – certification of mode S Transponder System For Enhanced Surveillance

2.2.2. ICAO Annex 10.

2.2.3. JAA LEAFLET NO 13 Rev 1: Certification of Mode S Transponder Systems for Elementary Surveillance

2.3. **Forms** – None

3. Guidance and Procedures

3.1. **Acceptable Means of Airworthiness Compliance**

3.1.1. The criteria for Mode S Elementary Surveillance will need to be satisfied prior to, or concurrently with, the certification tasks for Enhanced Surveillance.

3.1.2. The Mode S Transponder will need to be approved in accordance with EASA Technical Standard Order ETSO-2C112B, or an equivalent standard which is acceptable to the CAAI.

3.1.3. For the processing of data parameters, information may be found in EUROCAE Minimum Operational Performance Specification for Aircraft Data Link Processors, ED-82A, November 1999. This specification is applicable to the processing within a Mark 4 transponder, or, to the processing within an Aircraft Data Link Processor or equivalent when this function is performed separately from the transponder.

3.1.4. When demonstrating compliance with this advisory material, the following specific points should be noted:

3.1.4.1. The applicant will need to submit, to the CAAI, a compliance statement that shows how the criteria of this advisory material have been satisfied, together with evidence resulting from the activities described in the following paragraphs.

3.1.4.2. Compliance with the airworthiness certification specifications for intended function and safety may be demonstrated by equipment qualification, safety analysis of the interface between the transponder and data sources, equipment cooling verification, and ground tests. To support the approval application, design data will need to be submitted showing that the objectives and criteria of Sections1.3.4) of this advisory material have been satisfied.

3.1.5. On the assumption that the transponder installation has been shown to meet the existing criteria for Modes A, and C, Elementary Surveillance, and ACAS II, then the additional functionality introduced for Enhanced Surveillance may be demonstrated by ground testing, using ramp test equipment where appropriate, that verifies:

3.1.5.1. ▪ system operation;

3.1.5.2. the aircraft derived data in the transmitted response, including the 24-bit aircraft address; and functioning of system fault detectors.

3.1.6. To minimize the certification effort for transponder follow-on installations, the applicant may claim from the CAAI, credit for applicable certification and flight test data obtained from equivalent aircraft installations.

3.2. **Flight Manual**

3.2.1. If only Mode S transponder elementary surveillance capability is provided the Flight Manual is not affected.

3.2.2. For Mode S transponder enhanced surveillance capability the Flight Manual (AFM) or the Pilot's Operating Handbook (POH), whichever is applicable, should provide at least the following information.

3.2.2.1. Statement of compliance that the transponder system(s) comply with the criteria of ICAO Doc 7030/4 Regional Supplementary Procedures for operations where Enhanced Surveillance is required.

3.2.2.2. The Limitations Section should identify those parameters that at the time of certification, the transponder is unable to transmit due to the installation configuration.

3.2.2.3. Annex 1 provides a template for an AFM Supplement.

3.3. **Minimum Equipment List**

3.3.1. The MEL will need to be revised to indicate the mandatory carriage of a serviceable system to meet applicable operational requirements for flight in designated airspace. Dispatch with partial un-serviceability of the system, or non-availability of some required aircraft derived data, may be permitted in accordance with the Coordinated Exemptions Policy.

3.4. **Maintenance**

3.4.1. Maintenance testing of altitude reporting transponders should be suitably screened to minimize the risk of nuisance traffic or collision resolution advisories in operating aircraft.

3.4.2. Maintenance tests should include a periodic verification check of aircraft derived data including the ICAO 24 bit aircraft address and the parameters for Enhanced Surveillance using suitable ramp test equipment.

3.4.3. Where possible, maintenance tests should check the correct functioning of system fault detectors.

3.5. **Exemptions**

3.5.1. Coordinated Exemptions Policy is determined by the responsible airspace authorities and managed by EUROCONTROL. Further advice may be obtained by contacting the Mode S Exemptions Coordination Cell at

www.eurocontrol.int/mode_s or modes.reg@eurocontrol.int

Aircraft Type) Flight Manual Reference (**xx**xxx)

(Company Name)

Flight Manual Supplement (1) Issue (1)

Registration Mark: 4X – **xxx** Serial Number: _____

SSR MODE S ENHANCED SURVEILLANCE

Modification Number (**xx**xxx)

ADDITIONAL LIMITATIONS AND INFORMATION FOR CERTIFICATION

The limitations and information contained herein either supplement or, in the case of conflict override those in the flight manual

LIMITATIONS

1. The installed Mode S system satisfies the data requirements of ICAO Doc 7030/4, Regional Supplementary Procedures for SSR Mode S Enhanced Surveillance in designated European airspace. The capability to transmit data parameters is shown in column 2 : (mark as applicable)

Parameter	Available/ Not Available
Magnetic Heading	**Available/ Not Available**
Indicated Airspeed	**Available/ Not Available**
Mach No.	**Available/ Not Available**
Vertical Rate	**Available/ Not Available**
Roll Angle	**Available/ Not Available**
Track Angle Rate	**Available/ Not Available**
True Track Rate	**Available/ Not Available**
Groundspeed	**Available/ Not Available**
Select Altitude	**Available/ Not Available**
Barometric Pressure Setting	**Available/ Not Available**

To be inserted in the flight manual and record sheet amended accordingly.

Page 1 of **(x)** Authority Approval: Date:

Signature: