Civil Aviation Authority of Bangladesh
Flight Standard and Regulations Department
ANS Inspection Division
Headquarters; Kurmitola; Dhaka 1229

No. 30.31.0000.000.117.40.0003.26- 475 Date: 08/10/2026

Subject: **Stakeholders Comments/Opinions for Draft Amendment of ANO 10, Vol: 1 to 5**

1. A draft amendment to ANO 10 , Vol: 1 to 5 has been prepared with a view to incorporating the proposed amendments to the Annex 10, Vol: 1 to 5 and ensuring the continued compliance and effectiveness of the applicable aviation regulatory provisions.

2. In this regard, comments/opinions are hereby invited from aviation stakeholders and/or members of the public on the proposed draft amendment. All concerned are requested to review the draft and provide their comments, observations, and opinions, if any, for consideration during the amendment process. Comments/opinions may be submitted to the undersigned.

3. All comments/opinions received will be duly considered in the process of finalizing the proposed amendment. Your valuable comments and constructive feedback are highly appreciated.

Yours Sincerely,

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Amendment 1 to the Air Navigation Order (ANO), "ANO-10 Vol-4 on Surveillance and Collision Avoidance Systems" in order to incorporate up to Amendment 92 to Annex 10 Volume IV to the Convention on International Civil Aviation:

Civil Aviation Authority of Bangladesh
GAZETTE
Dated: , Dhaka

In exercise of the power conferred by section 47, read with section 14 of the Civil Aviation Act 2017 (Act No 18 of 2017), hereinafter referred as the "act", the Chairman of the Civil Aviation Authority of Bangladesh is pleased to make Amendment 1 to the Air Navigation Order (ANO), "ANO-10 Vol-4 on Surveillance and Collision Avoidance Systems" in the following manner, namely: —

1. **New definitions shall be inserted under regulation 1.3, namely: —**

   "**Lost C2 Link state.** The state of the RPAS in which the C2 Link performance has degraded, as a result of a C2 Link interruption that is longer than the lost C2 Link decision time, to a point where it is not sufficient to allow the remote pilot to actively manage the flight in a safe and timely manner.

   Matching Interrogator Identifier (II) code. II code whose binary format in the interrogator code (IC) field is the same as the binary format in the IC field of the surveillance identifier (SI) code.

   Matching Surveillance Identifier (SI) code. SI code whose binary format in the IC field is the same as the binary format in the IC field of the interrogator identifier (II) code.

   Runway Transition Zone. A zone of a rectangular box exactly enclosing a runway in the horizontal direction and extending to 100 feet altitude above ground level."

2. **The existing text of regulation 2.2.1 shall be replaced by the following new text, namely: —**

   "**2.1.1 General requirement**

   2.1.1.1 When SSR is installed and maintained in operation as an aid to air traffic services, it shall conform with the provisions of 3.1 unless otherwise specified in this 2.1.

   Note.— As referred to in this Annex, Mode A/C transponders are those which conform to the characteristics prescribed in 3.1.1. Mode S transponders are those which conform to the characteristics prescribed in 3.1.1 and 3.1.2. The functional capabilities of Mode A/C transponders are an integral part of Mode S transponders."

3. **The existing text of regulation 2.1.2 shall be replaced by the following new text, namely: —**

   "**2.1.2 Interrogation modes (ground-to-air)**

   2.1.2.1 Interrogation for air traffic services shall be performed on the modes described in 3.1.1.4.3 or 3.1.2. The uses of each mode shall be as follows:

   . . .

   3) *Intermode —*

   Mode A/C-only all-call: to elicit replies for surveillance of Mode A/C transponders. Mode S transponders do not reply.

   . . .

2.1.2.2 Mode A and Mode C interrogations shall be provided.

Note 1.— Requirements for the Mode A and C interrogator are specified in 3.1.

Note 2.— This requirement may be satisfied by intermode interrogations which elicit Mode A and Mode C replies from Mode A/C transponders.

2.1.2.2.1 Interrogators commissioned on or after 1 January 2030 shall also comply with the Mode A and C interrogator requirements specified in 3.1.1.5.2.2 and 3.1.1.8.2.2.

Note. — This requirement may be satisfied by intermode interrogations which elicit Mode A and Mode C replies from Mode A/C transponders.

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2.1.2.4 SIDE-LOBE SUPPRESSION CONTROL INTERROGATION

2.1.2.4.1 Side-lobe suppression shall be provided in accordance with the provisions of 3.1.1.4 and 3.1.1.5 on all Mode A and Mode C interrogations.

2.1.2.4.2 Side-lobe suppression shall be provided in accordance with the provisions of 3.1.2.1.5.1.2.3 on all Mode A/C-only all-call interrogations.

2.1.2.4.3 Side-lobe suppression shall be provided in accordance with the provisions of 3.1.2.1.5.2.1 on all Mode S-only all-call interrogations.

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4. The existing text of regulation 2.1.4 shall be replaced by the following new text, namely: —

“**2.1.4 Mode A reply codes (information pulses)**

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2.1.4.2 The following Mode A codes shall be reserved for special purposes:

2.1.4.2.1 Code 7700 to provide recognition of an aircraft in an emergency.

2.1.4.2.2 Code 7600 to provide recognition of an aircraft with radiocommunication failure.

2.1.4.2.3 Code 7500 to provide recognition of an aircraft which is being subjected to unlawful interference.

2.1.4.2.4 Code 7400 to provide recognition of a remotely piloted aircraft system (RPAS) in a lost C2 Link state.

Note.— Details on a lost C2 Link state can be found in Annex 10 — Aeronautical Telecommunications, Volume VI – Communication Systems and Procedures relating to Remotely Piloted Aircraft Systems C2 Link.

2.1.4.3 Appropriate provisions shall be made in ground decoding equipment to ensure immediate recognition of Mode A codes 7400, 7500, 7600 and 7700.

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5. The existing text of Note of regulation 2.1.5 shall be replaced by the following new text, namely: —

“**2.1.5 Mode S airborne equipment capability**

2.1.5.1 *Transponder levels.* All Mode S transponders shall conform to one of the following five levels:

Note.— The transponder used for a Mode S site monitor may differ from the requirements defined for a normal Mode S transponder. For example, it may be necessary to reply to all-call interrogations when the effective air/ground state is "on-the-ground". For more details see the Aeronautical Surveillance Manual (Doc 9924), Appendix D.

2.1.5.1.1 *Level 1 transponders —*

2.1.5.1.1.1 Level 1 transponders shall have the capabilities prescribed for:

. . .

e) basic data protocols except both data link capability reporting (3.1.2.6.10.2.2) and basic dataflash protocol (3.1.2.6.10.3);

f) air-air service and squitter transactions (3.1.2.8).;

g) system characteristics of the SSR Mode S transponder (3.1.2.10) as applicable to the transponder level.

Note 1.— Level 1 transponders permit SSR surveillance based on pressure-altitude reporting and the Mode A identity code. In an SSR Mode S environment, technical performance relative to a Mode A/C transponder is improved due to Mode S selective aircraft interrogation.

Note 2.— Level 1 transponders are not sufficient to support ADS-B, elementary surveillance and enhanced surveillance. Also, RTCA DO-181F and EUROCAE ED-73F transponder MOPS no longer support Level 1 transponders.

2.1.5.1.2 *Level 2 transponders —*

2.1.5.1.2.1 Level 2 transponders shall have the capabilities of 2.1.5.1.1 and also those prescribed for:

a) standard length communications (Comm-B) (3.1.2.6.6, 3.1.2.6.8, 3.1.2.6.11.2 and 3.1.2.6.11.4);

b) data link capability reporting (3.1.2.6.10.2.2);

c) aircraft identification reporting (3.1.2.9); and

d) SI code capability and operation (3.1.2.3.2.1.4, 3.1.2.5.2.1, 3.1.2.6.1.3, 3.1.2.6.1.4.1, 3.1.2.6.9.1.1 and 3.1.2.6.9.2).

Note.— The aircraft identification reporting capability requires an interface and appropriate input device.

2.1.5.1.2.2 Level 2 transponders with Comm-A capability. Level 2 transponders with Comm-A capability shall have the capabilities of 2.1.5.1.2.1 and those prescribed for Comm-A standard length communication described in 3.1.2.6.2, 3.1.2.6.4 and 3.1.2.6.11.1.

2.1.5.1.2.3 Level 2 transponders with Air-initiated Comm-B capability. Level 2 transponders with Air-initiated Comm-B capability shall have the capabilities of 2.1.5.1.2.1 and those prescribed for Air-initiated Comm-B standard length communication described in 3.1.2.6.11.3.

Note.— Air-initiated Comm-B capability is an optional capability that is not reported to the ground. However, it will be detectable by the existence of applications supporting communication through Air-initiated Comm-B.

2.1.5.1.2.4 Level 2 transponders with basic dataflash capability. Level 2 transponders with basic dataflash capability shall have the capabilities of 2.1.5.1.2.1 and also those prescribed for basic dataflash described in 3.1.2.6.10.3.

2.1.5.1.3 *Level 3 transponders*

2.1.5.1.3.1 Level 3 transponders shall have the capabilities of 2.1.5.1.2.1, 2.1.5.1.2.2, 2.1.5.1.2.3 and those prescribed for ground-to-air extended length message (ELM) communications (3.1.2.7.1 to 3.1.2.7.5).

Note.— Level 3 transponders permit extended length data link communications from ground to air and thus may provide retrieval from ground-based data banks and receipt of other air traffic services which are not available with Level 2 transponders.

2.1.5.1.4 *Level 4 transponders*

2.1.5.1.4.1 Level 4 transponders shall have the capabilities of 2.1.5.1.3 and also those prescribed for air-to-ground extended length message (ELM) communications (3.1.2.7.7 and 3.1.2.7.8).

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2.1.5.1.5 *Level 5 transponders*

2.1.5.1.5.1 Level 5 transponders shall have the capabilities of 2.1.5.1.4 and also those prescribed for enhanced Comm-B and extended length message (ELM) communications (3.1.2.6.11.3.4, 3.1.2.7.6 and 3.1.2.7.9).

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2.1.5.1.6 Extended squitter — Extended squitter transponders shall have the capabilities of 2.1.5.1.2, 2.1.5.1.3, 2.1.5.1.4 or 2.1.5.1.5, the capabilities prescribed for extended squitter operation (3.1.2.8.6) and the capabilities prescribed for ACAS cross-link operation (3.1.2.8.3 and 3.1.2.8.4). Transponders with these capabilities shall be designated with a suffix “e”.

Note.— For example, a Level 2 transponder with extended squitter capability would be designated “Level 2e*”.*

2.1.5.1.7 *Extended squitter non-transponder devices.* Devices that are capable of broadcasting extended squitters that are not part of a Mode S transponder shall conform to all of the 1 090 MHz RF signals in space requirements specified for a Mode S transponder, except for transmit power levels for the identified equipment class as specified in 5.1.1.

2.1.5.2 Mode S transponder minimum capability

2.1.5.2.1 All Mode S transponders used by international civil air traffic shall conform, at least, to the requirements of Level 2 transponders prescribed in 2.1.5.1.2.1.

2.1.5.2.2 *CNS division should ensure that Level 1 transponders are not used in areas where SI codes are used.*

Note .— Level 1 transponders do not report SI code capability. They remain unlocked in areas where SI codes are used; therefore, they affect the usage of 1 090 MHz frequency and contribute to 1 090 MHz RF pollution.

2.1.5.2.3 All Mode S transponders shall maintain the alert condition if the Mode A identity code is changed to one of the Mode A codes of set 1 defined in 3.1.2.6.10.1.1.1, a).

2.1.5.3 Mode S transponders installed on aircraft with gross mass in excess of 5 700 kg or a maximum cruising true airspeed capability in excess of 463 km/h (250 kt) shall operate with antenna diversity as prescribed in 3.1.1.7.18 and 3.1.2.10.4 if:

a) the aircraft individual certificate of airworthiness is first issued on or after 1 January 1990; or

• • •

2.1.5.4 TRANSPONDER CAPABILITY REQUIRED AT SPECIFIC DATES

Note.— The capabilities defined in this section allow a smooth implementation of new features and improvements of SSR Mode S transponders. The requirements on transponders are ensured through the certification process. Requirements on installation are ensured by the State in charge of the aircraft installation approval. Mode S transponder minimum capabilities are listed in 2.1.5.2.

2.1.5.4.1 All Mode S transponders certified on or after 1 January 1999 shall recover sensitivity to within 3 dB of minimum triggering level (MTL) no later than 45 microseconds after receipt of the sync phase reversal following a Mode S interrogation that is not accepted (3.1.2.4.1.2) or that is accepted but requires no reply.

2.1.5.4.2 Transponder designs first certified on or after 1 January 2011 shall have the spurious Mode A/C reply protection capability as specified in 3.1.1.7.8.5.2.

2.1.5.4.3 Mode S Level 2 transponders certified on or after 1 January 2020 shall have data parity with overlay control as specified in 3.1.2.6.11.2.5.

2.1.5.4.4 All Mode S transponders certified on or after 1 January 2020 shall not reply to Mode A/C/S all-call interrogations defined in 3.1.2.1.5.1.1.

Note 1.— If those transponders receive a Mode A/C/S all-call interrogation, it will be recognized as a Mode A/C-only all-call interrogation.

Note 2.— The replies to Mode A/C/S all-call interrogations are no longer supported by equipment certified on or after 1 January 2020 in order to reduce the RF pollution generated by the replies triggered by the false detection of Mode A/C/S all-call interrogations within other types of interrogation.

2.1.5.4.5 Mode S transponders certified on or after 1 January 2030 shall not accept the type control subfield (TCS), rate control subfield (RCS), or surface antenna subfield (SAS) commands received when DI = 2.

Note.— TCS, RCS and SAS were previously defined in 3.1.2.6.1.4.1, DI = 2.

2.1.5.4.6 Mode S transponders certified on or after 1 January 2030 shall maintain the alert condition if the Mode A identity code is changed to one of the codes of set 2 defined in 3.1.2.6.10.1.1.1, b).

Note.— Set 2 allows the reporting of a Mode A code of 7400 to indicate a lost C2 Link state for remotely piloted aircraft systems (RPAS).

2.1.5.4.7 Mode S transponders certified on or after 1 January 2030 shall not set to zero in bit 33 of the data link capability report when aircraft identification cannot be updated within 8 seconds (see 3.1.2.6.10.2.2.3).

Note.— Transponders certified before 1 January 2030 may be set to zero in bit 33 of the data link capability report when losing the aircraft identification input.

2.1.5.4.8 Mode S transponders certified on or after 1 January 2030 shall not set to zero for the aircraft identification upon the loss of the interface providing aircraft identification (see 3.1.2.9.1.4).

2.1.5.4.9 Transponders certified on or after 1 January 2030 shall have their RF output power as specified in 3.1.1.7.17.2 and 3.1.2.10.2.1.2.

2.1.5.4.10 *Transmitters used to replace defective obsolete transmitters in transponders should meet the requirement defined in 3.1.1.7.17.2.1 and 3.1.2.10.2.1.2.1.*

2.1.5.4.11 Transponders certified on or after 1 January 2030 shall have an improved dead time as specified in 3.1.1.7.3.2 and 3.1.2.10.3.2.2.

2.1.5.4.12 Mode S transponders certified on or after 1 January 2030 shall have a Mode S reply rate limiting of type 1 as specified in 3.1.2.10.3.6.1.2.”

6. The existing text of regulation 2.1.5.1.7.1 and 2.1.5.5 shall be deleted.

7. A new regulation 2.1.8 and 2.1.9 shall be inserted namely: —

“2.1.8 1 090 MHz receiver

2.1.8.1 *Decoding of 1 090 MHz messages*

2.1.8.1.1 1 090 MHz receivers produced on or after 1 January 2030 shall be capable of decoding messages transmitted by transponders compliant with the active state transponder output power specified in 3.1.1.7.17.2 and 3.1.2.10.2.1.2.

2.1.8.1.2 *1 090 MHz receivers produced before 1 January 2030 should be capable of decoding messages transmitted by transponders compliant with the active state transponder output power specified in 3.1.1.7.17.2 and 3.1.2.10.2.1.2.*

2.1.9 Mode S interrogator capability

2.1.9.1 Mode S interrogators shall comply with the requirements defined in 3.1.1 and 3.1.2.

2.1.9.2 Mode S interrogators shall not use Mode A/C/S all-call interrogations.

Note.— The use of Mode A/C/S all-call interrogations does not allow the use of stochastic lockout override and therefore might not ensure a sufficient probability of acquisition in areas of high density of flights or when other interrogators lockout transponder on II = 0 for supplementary acquisition.

2.1.9.3 II/SI code operation

2.1.9.3.1 Mode S ground station using an SI code shall:

a) acquire Mode S II-only transponders on the matching II code;

b) selectively interrogate Mode S II-only transponders on the matching II code; and

c) not lockout Mode S II-only transponders when ground stations with overlapping coverage are assigned matching II or SI codes.

Note 1.— A table of matching II/SI codes can be found in Doc 9924, Appendix H.

Note 2.— Mode S II/SI capable transponders support both II and SI codes. Only locking out Mode S II/SI capable transponders means the legacy Mode S II-only transponders are not in a lockout condition and can be acquired by other Mode S ground stations using the matching II code. The suppression of lockout for Mode S II-only transponder is only used when there is overlapping coverage with a ground station using a matching II or SI code, as it is important to use lockout to reduce RF transmissions.

2.1.9.3.2 *Mode S II/SI capable interrogator using an II code should be configurable to only lockout Mode S II/SI capable transponders.*

Note 1.— This mode of operation is used when matching SI codes are used by overlapping interrogators.

Note 2.— A matching SI code is an SI code whose binary format in the IC field is the same as the binary format in the IC field of the II code. Each Mode S II code has four "matching" SI codes. A table of matching II/SI codes can be found in Doc 9924, Appendix H.

Note 3.— This recommendation is to make possible the assignment of matching II codes to Mode S interrogators in areas in which not all transponders are SI code capable and where a matching SI code is assigned.

Note 4.— This recommendation is not necessary if a monitoring programme has demonstrated that all transponders are SI code capable or if SI codes do not need to be used in the ICAO Region. More information on the use of this capability to make possible the assignment of SI codes can be found in Doc 9924, Appendix J."

8. The existing text of Note of regulation 2.2 shall be replaced by the following new text, namely: —

*"***2.2 HUMAN FACTORS CONSIDERATIONS**

. . .

2.2.1.3 The flight crew should have access at all times to the information of the operational state of the transponder.

Note.— Information on the monitoring of the operational state of the transponder is provided in RTCA DO-181 F, Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/ Mode Select (ATCRBS/Mode S) Equipment, and in EUROCAE ED-73F, Minimum Operational Performance Standards (MOPS) for Secondary Surveillance Radar Mode S Transponders."

9. A new regulation 2.3 shall be inserted namely: —

"**2.3 Interference Tolerance Criterion**

2.3.1 Aeronautical surveillance and collision avoidance system receivers defined in this volume utilizing the 1 030 and/or 1 090 MHz channels shall be able to meet their performance requirements under an average interference power to average noise power level ratio of no more than minus 10 dB.

Note 1.— Interference levels above this level may be harmful to the intended operation of the systems in this volume. This would apply to the combination of all non-pulsed interference sources present. Pulsed interference sources or sources with less than 100 per cent operational duty cycle need to be evaluated on a case-by-case basis. Compatibility between standardized systems in this ANO may be evaluated on a case-by-case basis, and interference mitigations may be used which are only available to standardized systems in this ANO.

Note 2.— The interference can be treated as additive noise such that interference 10 dB below a receiver's baseline noise floor generates 0.4 dB of additive noise.

Note 3.— Additional information on application of this interference tolerance criterion and means of compliance can be found in Doc 9924."

10. The existing text of Note of regulation 3.1 shall be replaced by the following new text, namely: —

"**3.1 SECONDARY SURVEILLANCE RADAR (SSR) SYSTEM CHARACTERISTICS**

Note 1.— Section 3.1.1 prescribes the technical characteristics of SSR Mode A and Mode C capabilities. Section 3.1.2 prescribes the characteristics of Mode S capabilities. Table 3-11 provides a summary of the interrogation signal details. Chapter 5 prescribes additional requirements on Mode S extended squitters."

11. The existing text of regulation 3.1.1 shall be replaced by the following new text, namely: —

"**3.1.1 Mode A and Mode C capabilities**

. . .

3.1.1.2.2 The frequency tolerance shall be plus or minus 1 MHz.

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3.1.1.4 INTERROGATION MODES (SIGNALS-IN-SPACE)

Note.— The paragraphs herein describe the signals-in-space at the antenna(s) of the interrogator. Table 3-11 provides a summary of the interrogation signal details.

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3.1.1.4.3 The interval between *P*1 and *P*3 shall determine the mode of interrogation and shall be as follows:

Mode A 8 ± 0.18 microseconds

Mode C 21 ± 0.18 microseconds

3.1.1.4.4 The interval between *P*1 and *P*2 shall be 2.0 plus or minus 0.1 microseconds.

3.1.1.4.5 The duration of pulses *P*1, *P*2 and *P*3 shall be 0.8 plus or minus 0.09 microsecond.

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3.1.1.5 INTERROGATOR AND CONTROL TRANSMISSION CHARACTERISTICS (INTERROGATION SIDE-LOBE SUPPRESSION — SIGNALS-IN-SPACE)

3.1.1.5.1 The radiated amplitude of *P*2 shall be:

a) equal to or greater than the radiated amplitude of *P*1 from the side-lobe transmissions of the antenna radiating *P*1; and

b) at a level lower than 9 dB below the radiated amplitude of *P*1, within the desired arc of interrogation.

3.1.1.5.2 Within the desired beam width of the directional interrogation (main lobe), the radiated amplitude of *P*3 shall comply with 3.1.1.5.2.1 or 3.1.1.5.2.2.

3.1.1.5.2.1 For interrogator commissioned before 1 January 2030, the radiated amplitude of *P*3 shall be within 1 dB of the radiated amplitude of *P*1.

3.1.1.5.2.2 For interrogator commissioned on or after 1 January 2030, the radiated amplitude of *P*3 shall be within 0.5 dB of the radiated amplitude of *P*1.

3.1.1.5.3 One or two control pulses (*P*2 alone, or *P*1 and *P*2) shall be transmitted using a separate antenna pattern to suppress responses from aircraft in the side lobes of the interrogator antenna.

Note.— When using control pulses P*1 and* P*2, separate RF paths are used for the interrogation* P*1 pulse and the control* P*1pulse. The pulse characteristics and timing for both* P*1 pulses are given in 3.1.1.4. Further details on the use of control pulses can be found in Doc 9924.*

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3.1.1.6 REPLY TRANSMISSION CHARACTERISTICS (SIGNALS-IN-SPACE)

Note.—The paragraphs herein describe the signals-in-space at the antenna(s) of the transponder.

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3.1.1.7 TECHNICAL CHARACTERISTICS OF TRANSPONDER MODE A AND MODE C CAPABILITIES

3.1.1.7.1 *Reply*. The transponder shall reply (not less than 90 per cent triggering) when all of the following conditions have been met:

a) the received amplitude of *P*3 is within plus or minus 1 dB of the received amplitude of *P*1;

b) either no pulse is received in the interval 1.3 microseconds to 2.7 microseconds after *P*1 or *P*1 exceeds by more than 9 dB any pulse received in this interval;

c) the received amplitude of a proper interrogation is more than 10 dB above the received amplitude of random pulses where the latter are not recognized by the transponder as *P*1, *P*2 or *P*3;

d) the interval between *P*1 and *P*3 is 8 plus or minus 0.2 microsecond (Mode A), or 21 plus or minus 0.2 microsecond (Mode C); and

e) the duration of *P*1 and *P*3 is 0.8 plus or minus 0.1 microsecond.

. . .

3.1.1.7.3 *DEAD TIME*.

3.1.1.7.3.1 For all transponders, the time interval beginning at the end of a reply transmission and ending when the receiver has regained sensitivity to within 3 dB of MTL (dead time) shall not exceed 125 microseconds.

3.1.1.7.3.2 For transponders with improved dead time, the time interval beginning at the end of a reply transmission and ending when the receiver has regained sensitivity to within 3 dB of MTL (dead time) shall not exceed 20 microseconds.

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3.1.1.7.5 *RECEIVER SENSITIVITY AND DYNAMIC RANGE*

3.1.1.7.5.1 The minimum triggering level of the transponder shall be such that replies are generated to at least 90 per cent of the interrogation signals when:

a) the two pulses *P*1 and *P*3 constituting an interrogation are of equal amplitude and *P*2 is not detected; and

b) the amplitude of these signals is nominally 73 dB below 1 mW, with limits between 69 dB and 77 dB below 1 mW.

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3.1.1.7.6 *Pulse duration discrimination*. Signals of received amplitude between minimum triggering level and 45 dBm, and consisting of *P*1 and/or *P*3 with a duration less than 0.3 microsecond, shall not cause the transponder to initiate reply or suppression action more than 10 per cent of the time. With the exception of single pulses with amplitude variations approximating an interrogation, any single pulse of a duration more than 1.5 microseconds shall not cause the transponder to initiate reply or suppression action more than 10 per cent of the time over the signal amplitude range of minimum triggering level (MTL) to 50 dB above that level.

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3.1.1.7.8 *SPURIOUS EMISSIONS AND SPURIOUS RESPONSES*

3.1.1.7.8.1 *Equipment random triggering rate.* In the absence of valid interrogation signals, transponders shall not generate more than 5 unwanted Mode A or Mode C replies per second as integrated over an interval of at least 30 seconds.

3.1.1.7.8.2 *Installed random triggering rate*. In the absence of valid interrogation signals, transponders shall not generate more than 30 unwanted Mode A or Mode C replies per second as integrated over an interval

of at least 30 seconds. This installed random triggering rate shall not be exceeded when all possible interfering equipment installed in the same aircraft are operating at maximum interference levels.

3.1.1.7.8.3 *Random triggering rate in the presence of low-level in-band continuous wave (CW) interference*. The total random trigger rate on all Mode A and/or Mode C replies shall not be greater than 10 reply pulse groups or suppressions per second, averaged over a period of 30 seconds, when operated in the presence of non-coherent CW interference at a frequency of 1 030 ±0.2 MHz and a signal level of –60 dBm or less.

3.1.1.7.8.4 *SPURIOUS RADIATION*

3.1.1.7.8.4.1 *CW radiation should not exceed 70 dB below 1 W for the transponder.*

3.1.1.7.8.5 *SPURIOUS RESPONSES*

3.1.1.7.8.5.1 *The response to signals not within the receiver pass band should be at least 60 dB below normal sensitivity*.

3.1.1.7.8.5.2 For transponders with spurious Mode A/C reply protection capability, the spurious Mode A/C reply ratio resulting from low-level Mode S interrogations shall be no more than:

a) an average of 1 per cent in the input interrogation signal range between –81 dBm and the Mode S MTL; and

b) a maximum of 3 per cent at any given level in the input interrogation signal range between –81 dBm and the Mode S MTL.

Note 1.— For transponders that reply to Mode A/C/S all-call interrogations, failure to detect a low-level Mode S interrogation can also result in the transponder decoding a three-pulse Mode A/C/S all-call interrogation. This would result in the transponder responding with a Mode S all-call (DF = 11) reply. The above requirement will also control these DF = 11 replies since it places a limit on the probability of failing to correctly detect the Mode S interrogation.

Note 2.— More information about issuing a type certificate for aircraft and separate design approval can be found in the Airworthiness Manual *(Doc 9760).*

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3.1.1.7.9.2 *Reply rate limit control*. To protect the system from the effects of transponder over-interrogation by preventing response to weaker signals when a predetermined reply rate has been reached, a sensitivity reduction type reply limit control shall be incorporated in the equipment. The limit shall be set between 500 and 2 000 Mode A/C replies per second, without regard to the number of pulses in each reply.

3.1.1.7.10 *Reply delay and jitter*. The time delay between the arrival, at the transponder receiver, of the leading edge of *P*3 and the transmission of the leading edge of the first pulse of the reply shall be 3 plus or minus 0.5 microseconds. The total jitter of the reply pulse code group, with respect to *P*3, shall not exceed 0.1 microsecond for receiver input levels between 3 dB and 50 dB above minimum triggering level. Delay variations between Mode A and Mode C shall not exceed 0.2 microseconds.

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3.1.1.7.12.1.1 The Mode A code shall be selected from the 4 096 codes available.

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3.1.1.7.13 *Transmission of the special position identification (SPI) pulse*. When required, this pulse shall be transmitted with Mode A replies, as specified in 3.1.1.6.3, for a period of between 18 plus or minus 1 second.

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3.1.1.7.15 *Simultaneous Signals.* If a *P*1 – *P*2 suppression pair and a Mode A or Mode C interrogation are recognized simultaneously, the transponder shall be suppressed. An interrogation shall not be recognized as Mode A or Mode C if the transponder is in suppression (3.1.1.7.4). If a Mode A and a Mode C interrogation are recognized simultaneously, the transponder shall complete the transaction cycle as if only a Mode C interrogation had been recognized.

3.1.1.7.16 *Reply ratio in the presence of low-level in-band CW interference.* In the presence of non-coherent CW interference at a frequency of 1 030 ±0.2 MHz at signal levels of 20 dB or more below the desired Mode A/C interrogation signal level, the transponder shall reply correctly to at least 90 per cent of the interrogations.

3.1.1.7.17 *Unwanted Output Power*

3.1.1.7.17.1 *Inactive state transponder output power.* When the transponder is in the inactive state, (refer to Figure 3-11), the peak power at 1 090 MHz plus or minus 3 MHz at the antenna end of the transmission line of the transponder, shall not exceed –50 dBm.

Note 1.— Inactive state transponder output power is constrained in this way to ensure that an aircraft, when located as near as 185 m (0.1 NM) to a Mode A/C or Mode S interrogator, does not cause interference to that installation.

Note 2.— Transponders with Mode S capability and installed with an ACAS unit have stricter requirements defined in 3.1.2.10.2.1.1.

3.1.1.7.17.2 *Active state transponder output power.*

3.1.1.7.17.2.1 The RF output power shall be less than or equal to the peak pulse power minus 50 dB for the interval starting 10 microseconds prior to the Mode A/C transmission and for the interval of 10 microseconds following a Mode A/C transmission.

3.1.1.7.17.2.2 For intervals between transmitted pulses that are greater than 0.5 microsecond, the power level at the lowest point within the interval shall be 50 dB or more below the peak pulse power.

Note 1.— These power limitations protect 1 090 MHz receivers from potential missed decodes when signals are received at close range and within desired detection range. In the absence of such limits, signal levels during non-pulse intervals can occur above receiver thresholds and can lead to unintended distortion of pulse positions or false pulse decodes preventing proper detection of transmitted signals. It also makes it more difficult for receivers to decode overlapped replies.

Note 2.— The presence of a signal at a level of 50 dB or more below the peak power may not be measurable within the first 0.5 microsecond following the transmission of a pulse because of the allowed decay time. It is possible that a signal transmitted 50 dB below the peak pulse power can still affect high sensitivity receivers when transmitted in close range. More information is available in Doc 9924.

Note 3.— Information on how to verify unwanted output power can be found in RTCA/DO-181F or EUROCAE/ED-73F.

3.1.1.7.18 *Transponder antenna system and diversity operation.* 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.

3.1.1.7.18.1 *Radiation pattern.* The radiation pattern of 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.

3.1.1.7.18.2 *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.

3.1.1.7.18.2.1 *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.

3.1.1.7.18.3 *Antenna selection.* 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*3 pulse of a Mode A or Mode C interrogation meet the requirements for Mode A and Mode C interrogations as defined in 3.1.1.

3.1.1.7.18.3.1 If the two channels simultaneously receive a *P*1 – *P*3 pulse pair that meets the requirements for a Mode A or Mode C interrogation, the antenna at which the signal strength is greater shall be selected for the transmission of the reply.

3.1.1.7.18.3.2 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.

3.1.1.7.18.3.3 *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.

3.1.1.7.18.3.4 *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.

3.1.1.7.18.4 *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.

3.1.1.7.18.5 *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.

3.1.1.7.19 *Variable direct data.* Variable direct data from the aircraft which can change in flight shall be:

a) the Mode C altitude code (3.1.1.7.12.2);

b) the Mode A identity code (3.1.1.7.12.1); and

c) the SPI condition (3.1.1.6.3).

3.1.1.7.19.1 *Interfaces for variable direct data*

3.1.1.7.19.1.1 A means shall be provided, while on the ground or during flight, for the SPI condition to be inserted by the pilot, without the entry or modification of other flight data.

3.1.1.7.19.1.2 A means shall be provided, while on the ground or during flight, for the Mode A identity code to be displayed to the pilot and modified without the entry or modification of other flight data.

Note.— Implementation of the pilot action for entry of data will be as simple and efficient as possible in order to minimize the time required and reduce the possibility of errors in the data entry.

3.1.1.7.19.1.3 Interfaces shall be included to accept the pressure-altitude.

Note.— A specific interface design for the variable direct data is not prescribed.

3.1.1.8 TECHNICAL CHARACTERISTICS OF GROUND INTERROGATORS MODE A AND MODE C CAPABILITIES

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3.1.1.8.2 *RADIATED POWER*

3.1.1.8.2.1 *In order to minimize system interference the effective radiated power of interrogators should be reduced to the lowest value consistent with the operationally required range of each individual interrogator site.*

3.1.1.8.2.2 *Inactive-state interrogator output power.* For interrogator commissioned on or after 1 January 2030, when the interrogator is not transmitting an interrogation, its output shall not exceed –5 dBm effective radiated power at any frequency between 960 MHz and 1 215 MHz.

Note.— This constraint ensures that aircraft flying near the interrogator (as close as 1.85 km (1 NM)) will not receive interference that would prevent them from being tracked by another interrogator. In certain instances, even smaller interrogator-to-aircraft distances are of significance, for example, if Mode S surveillance on the airport surface is used. In such cases, a further restraint on inactive state interrogator output power may be necessary.

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3.1.1.8.4 *INTERROGATOR RADIATED FIELD PATTERN*

The beam width of the directional interrogator antenna radiating P*3 should not be wider than is operationally required. The side- and back-lobe radiation of the directional antenna should be at least 24 dB below the peak of the main-lobe radiation.*

Note.— This Recommendation is to reduce transponder occupancy. More information can be found in Doc 9924, Appendices D and M.

Editorial Note.— Renumber subsequent paragraphs as follows: 3.1.1.10, 3.1.1.10.1 and 3.1.1.10.2 as 3.1.1.8.5, 3.1.1.8.5.1 and 3.1.1.8.5.2.

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3.1.1.8.6 SPURIOUS EMISSIONS AND SPURIOUS RESPONSES

3.1.1.8.6.1 *SPURIOUS RADIATION*

CW radiation should not exceed 76 dB below 1 W for the interrogator."

12. The existing regulation number shall be renumbered as follows: —

3.1.1.10 to 3.1.1.8.5, 3.1.1.10.1 to 3.1.1.8.5.1 and 3.1.1.10.2 to 3.1.1.8.5.2.

13. The existing text of regulation 3.1.2 shall be replaced by the following new text, namely: —

"**3.1.2 Mode S and intermode capabilities**

3.1.2.1 *Interrogation signals-in-space characteristics*. The paragraphs herein describe the signals-in-space at the antenna(s) of the interrogator.

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3.1.2.1.4.1 *Pulse modulation*. Intermode and Mode S interrogations shall consist of a sequence of pulses as specified in 3.1.2.1.5 and Tables 3-1, 3-3 and 3-4, as summarized in Table 3-11.

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3.1.2.1.5 *Pulse and phase reversal sequences.* Specific sequences of the pulses or phase reversals described in 3.1.2.1.4 shall constitute interrogations.

3.1.2.1.5.1 *Intermode interrogation*

3.1.2.1.5.1.1 *Mode A/C/S all-call interrogation.*
Note.— This interrogation consists of a minimum of three pulses: P1, P3, and the long P4 as shown in Figure 3-3.

3.1.2.1.5.1.2 *Mode A/C-only all-call interrogation.*

Note 1.— This interrogation is defined as P1, P3, and a short P4 as shown in Figure 3-3

Note 2.— The Mode A/C-only all-call interrogation elicits a Mode A or Mode C reply from a Mode A/C transponder. A Mode S transponder recognizes the short P*4 pulse and does not reply to this interrogation.*

3.1.2.1.5.1.2.1 *Pulse intervals.* The pulse intervals between *P*1 and *P*3 shall be as defined in 3.1.1.4.3. The pulse interval between *P*3 and *P*4 shall be 2 plus or minus 0.04 microsecond.

3.1.2.1.5.1.2.2 *Pulse amplitudes.* Relative amplitudes between pulses *P*1 and *P*3 shall be in accordance with 3.1.1.5. The amplitude of *P*4 shall be within –0.5/+2.5 dB of the amplitude of *P*3.

3.1.2.1.5.1.2.3 *Sidelobe suppression*. The pulse interval between *P*1 and *P*2 shall be 2 plus or minus 0.04 microsecond. Amplitude of *P*2 shall be in accordance with 3.1.1.5.

Note 1.— Side-lobe suppression is required for SSR interrogators per 2.1.2.4.1. ACAS and multilateration system interrogations may or may not include the P2 pulse.

Note 2.— When used, P2 is additionally radiated to prevent replies from aircraft in the side and back lobes of the antenna.

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3.1.2.1.5.2 *Mode S interrogation*.

Note 1.— The Mode S interrogation consists of a minimum of three pulses: P1, P2 and P6 as shown in Figure 3-4.

Note 2.— P6 is preceded by a P1 – P2 pair which suppresses replies from Mode A/C transponders to avoid synchronous garble due to random triggering by the Mode S interrogation. The sync phase reversal within P6 is the timing mark for demodulation of a series of time intervals (chips) of 0.25 microsecond duration. This series of chips starts 0.5 microsecond after the sync phase reversal and ends 0.5 microsecond before the trailing edge of P6. A phase reversal may or may not precede each chip to encode its binary information value.

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3.1.2.1.5.2.4 *Intervals*. The pulse interval between *P*1 and *P*2 shall be 2 plus or minus 0.04 microsecond. The interval between the leading edge of *P*2 and the sync phase reversal of *P*6 shall be 2.75 plus or minus 0.04 microsecond. The leading edge of *P*6 shall occur 1.25 plus or minus 0.04 microsecond before the sync phase reversal. *P*5, if transmitted, shall be centred over the sync phase reversal; the leading edge of *P*5 shall occur 0.4 plus or minus 0.04 microsecond before the sync phase reversal.

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3.1.2.2 REPLY SIGNALS-IN-SPACE CHARACTERISTICS

Note.— The paragraphs herein describe the signals-in-space at the antenna(s) of the transponder.

3.1.2.2.1 *Reply carrier frequency*.

3.1.2.2.1.1 *Standard pulse position modulation* (*PPM) reply carrier frequency.* The carrier frequency of all standard Mode S PPM replies (downlink transmissions) be 1 090 plus or minus 1 MHz.

3.1.2.2.1.2 *Phase overlay reply frequency.* The carrier frequency of all phase overlay reply transmissions as defined in 3.1.2.3.1.2.2 shall be 1 090 MHz plus or minus 25 KHz.

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3.1.2.2.6 *Reply phase overlay characteristics*

3.1.2.2.6.1 *Reply phase overlay modulation type*. The phase modulation reply transmission defined in 3.1.2.3.1.2.2 shall use 8 phase-shift keying (PSK) phase states to transmit 3-bits associated with a single -phase state for each PPM data bit and in each of the four preamble pulses.

3.1.2.2.6.2 *Phase error tolerance*. The phase error of transmitted phase information shall be within 3.0 degrees root-mean-square (RMS) and 12.2 degrees peak for the duration of any 0.5 microsecond PPM reply pulse, excluding the leading and trailing edges of the pulse. When a one-microsecond pulse is transmitted as a result of a PPM ZERO data bit in the second half of one PPM bit interval followed by a PPM ONE bit in the first half of the next interval, the phase error for the phase information for each of the 2-phase states shall be within 3.0 degrees RMS and 12.2 degrees peak, except during the phase transition interval when a phase change is required between the 2-phase states, and the leading and trailing edges of the one-microsecond pulse. The phase error tolerance is in addition to the average frequency tolerance specified in 3.1.2.2.1.2, including the phase drift tolerance specified in 3.1.2.2.6.4.

Note.— During transmitter pulse turn-on and turn-off, the phase of the transmitted signal is typically not stable until the final RF output power is reached at the top portion of the pulse. The phase overlay reception algorithm does not rely on a constant phase during the transient portions of the pulse.

3.1.2.2.6.3 *Phase modulation during the phase transition interval*. For a 1.0 microsecond pulse which is formed by a PPM ZERO data bit followed by a PPM ONE data bit, the phase transition interval in which the phase is allowed to change between states shall be less than the 400-nanosecond intervals commencing 200 nanoseconds prior to the PPM bit interval transition at the centre of the 1.0 microsecond pulse.

Note 1.— To meet the pulse-to-pulse amplitude variation requirement in 3.1.2.2.5.2, the RF peak output power of any merged PPM pulses will not vary more than 1 dB due to PO for a receiver bandwidth of 8 MHz when linearly applying phase overlay (PO) across the 400-nanosecond phase transition interval.

Note 2.— The worst case for spectral growth is when the phase overlay frequency shifts are 180 degrees between symbols in 1 microsecond wide PPM data pulses as shown in Figure 3-9. To meet the spectrum requirement in 3.1.2.2.2, one method of reducing spectral growth in this case is to ensure the 180-degree phase transition is linear.

3.1.2.2.6.4 *Phase drift*. The peak phase drift due to transmitter frequency drift shall be within ±43 degrees for the entire message duration. The phase drift tolerance is in addition to the average frequency tolerance specified in 3.1.2.2.1.2.

3.1.2.2.6.5 *Reply spectrum*. The reply spectrum defined in 3.1.2.2.2 shall be met when phase overlay transmissions are active.

3.1.2.3 MODE S DATA STRUCTURE

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3.1.2.3.1.2 *Reply data.*

3.1.2.3.1.2.1 *Standard PPM data*. The reply data block shall consist of 56 or 112 data bits formed by binary pulse position modulation encoding of the reply data as described in 3.1.2.2.5.1.2. A pulse transmitted in the first half of the interval shall represent a binary ONE whereas a pulse transmitted in the second half shall represent a binary ZERO.

3.1.2.3.1.2.2 *Phase overlay modulated data*. For phase overlay modulated signals, the PPM reply data shall additionally contain 8PSK modulated data within the bit interval containing the pulse, either the first half or the second half of the interval as per 3.1.2.3.1.2.1.

3.1.2.3.1.2.2.1 *Phase overlay data definition.* In addition to the binary ONE or binary ZERO represented by PPM, each data interval shall consist of three additional bit values representing the phase modulated reply data as determined by the encoded phase of the pulse in the bit interval as shown in Table 3-7.

3.1.2.3.1.2.2.2 S*ync phase reference pulses.* The reference sync phase shall be encoded in the four preamble pulses and the data pulses of the first four PPM data bits by maintaining constant phase for these pulses.

3.1.2.3.1.2.2.3 *Phase reference*. The reference phase shall represent zero degrees. This reference established by the data pulses in 3.1.2.3.1.2.2.2 is used to establish the phase for subsequent phase state determination.

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3.1.2.3.2.1.4 *PI: Parity/interrogator identifier.* This 24-bit (33-56) or (89-112) downlink field shall have parity overlaid on the interrogator's identity code according to 3.1.2.3.3.2 and shall appear in the Mode S all-call reply, DF = 11 and in the extended squitter, DF = 17 or DF = 18. If the reply is made in response to a Mode S-only all-call with CL field (3.1.2.5.2.1.3) and IC field (3.1.2.5.2.1.2) equal to 0, or is an acquisition or an extended squitter (3.1.2.8.5, 3.1.2.8.6 or 3.1.2.8.7), the II and the SI codes shall be 0.

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3.1.2.3.2.5 *Phase overlay reply data formats.* An overview of the transmitted phase overlay data message structure is shown in Figure 3-10.

3.1.2.3.2.5.1 *Phase overlay message data.* Phase data (PD) message bits shall be contained in bits 1 through 204 of the 324-bit phase data message. If phase overlay is not enabled for the reply or extended squitter, the message data field shall be zero filled.

3.1.2.3.2.5.2 *Phase overlay message type field.* Phase overlay bits 1 through 8 of the 324-bit phase data message shall contain the message type defining the PO message as shown in Table 3-12.

Note.— The data format of the ADS-B State and Status Message, phase overlay Mode S GICB Data Messages and *phase overlay Interrogation/Reply Monitor Messages ADS-R, ADS-SLR and TIS-B are described in the* Technical Provisions for Mode S Services and Extended Squitter *(Doc 9871).*

3.1.2.3.2.5.3 *Phase overlay parity correction data.* Phase overlay bits 205 through 324 of the phase data message shall contain the 120-bit forward error correction (FEC) data encoded in accordance with either 3.1.2.3.2.5.3.1 or 3.1.2.3.2.5.3.2, as specified by the Message Type value in Table 3-12.

3.1.2.3.2.5.3.1 *Reed-Solomon*. When transmitting phase overlay message types 1-6 (RS Message Type Block), the transmitted phase overlay shall use a Reed Solomon RS (54, 34) code with 6-bit symbols where two adjacent phase states (two adjacent PPM pulse data bits) are used as one 6-bit symbol (3 phase bits per 1 PPM bit). The RS (54, 34) code is shortened from a 63 symbol (2N-1) code. The first nine 6-bit symbols of the 63 symbol code that is used for the RS (54, 34) code shall have all bits set to zero. The Reed-Solomon shall use a generator polynomial start value of 1 to compute the parity error correction value. The Reed Solomon shall use a field polynomial of $x^6 + x + 1$.

Note.— Example of Reed-Solomon encodings are shown in Doc 9924.

3.1.2.3.2.5.3.2 *Low Density Parity Code (LDPC)*. When transmitting phase overlay message types 7-12 (LDPC Message Type Block), the transmitted phase overlay parity data shall be established by a cyclic LDPC (54, 34) code with 6 blocks of binary data as shown in Table 3-13, with each block of 54 bits input to the LDPC parity check matrix independently, and after encoding the parity of each block, the message and parity bits are assembled back in order. The LDPC encoder shall
use a field polynomial of $x^{20} + x^{18} + x^{11} + x^9 + x^2 + 1$.

Note.— The parity check matrix is presented in Doc 9924.

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3.1.2.4.1.1.1 *Mode A and Mode C interrogation recognition.* A Mode A or Mode C interrogation shall be recognized when a *P*1 – *P*3 pulse pair meeting the requirements of 3.1.1.4 has been received, and the leading edge of a *P*4 pulse with an amplitude that is greater than a level 6 dB below the amplitude of *P*3 is not received within the interval from 1.3 to 2.7 microseconds following the leading edge of *P*3.

3.1.2.4.1.1.2 *Intermode interrogation recognition.*

3.1.2.4.1.1.2.1 A Mode A/C-only all-call interrogation shall be recognized when the requirements of 3.1.1.7.1 are met with a *P*4 pulse being of any duration greater than 0.7 microsecond and occurring 2 ± 0.1 microsecond from *P3*.

3.1.2.4.1.1.2.2 A Mode A/C-only all-call interrogation shall be recognized if the received power of *P*4 is above *P*3 minus 1 dB at any signal level of *P*1 – *P*3 from MTL+1 dB to –21 dBm.

3.1.2.4.1.1.2.3 An interrogation shall not be recognized as an intermode interrogation if:

a) the received amplitude of the pulse in the *P*4 position is smaller than 6 dB below the amplitude of *P*3; or

b) the pulse interval between *P*3 and *P*4 is larger than 2.37 microseconds or shorter than 1.73 microseconds; or

c) the received amplitude of *P*1 and *P*3 is between MTL and –45 dBm and the pulse duration of *P*1 or *P*3 is less than 0.3 microsecond; or

d) the transponder is in suppression (3.1.2.4.2).; or

e) the pulse interval between *P*1 and *P*3 differs from the nominal spacing by 1.0 microsecond or more; or

f) the pulse duration of *P*4 is less than 0.3 microsecond.

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3.1.2.4.1.2.2 *Intermode interrogation acceptance*

3.1.2.4.1.2.2.1 *Mode A/C/S all-call interrogation acceptance.*

Note.— Mode A/C/S all-call interrogations are no longer useable. If a transponder receives a Mode A/C/S all-call interrogation, it will be recognized as a Mode A/C-only all-call interrogation.

3.1.2.4.1.2.2.2 *Mode A/C-only all-call interrogation acceptance.* A Mode A/C-only all-call interrogation shall not be accepted by a Mode S transponder.

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3.1.2.4.1.3.1 *Replies to intermode interrogations.*

Note 1.— A Mode S reply with downlink format 11 is transmitted in accordance with the provisions of 3.1.2.5.2.2 when a Mode A/C/S all-call interrogation has been accepted by a transponder certified before 1 January 2020.

Note 2.— Since Mode S transponders do not accept Mode A/C-only all-call interrogations, no reply is generated.

3.1.2.4.1.3.2 *Replies to Mode S interrogations*. The information content of a Mode S reply shall reflect the conditions existing in the transponder after completion of all processing of the interrogation eliciting that reply. The correspondence between uplink and downlink formats shall be as summarized in Table 3-5.

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3.1.2.4.1.3.2.1 *Replies to SSR Mode S-only all-call interrogations*. The downlink format of the reply to a Mode S only all-call interrogation (if required) shall be DF = 11. The reply content and rules for determining the requirement to reply shall be as defined in 3.1.2.5.

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3.1.2.4.1.3.2.2 *Replies to surveillance and standard length communications interrogations*. A Mode S reply shall be transmitted when a Mode S interrogation with UF = 4, 5, 20 or 21 and an aircraft address has been accepted. The contents of these interrogations and replies shall be as defined in 3.1.2.6.

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3.1.2.4.1.3.2.3 *Replies to extended length communications interrogations*. A series of Mode S replies ranging in number from 0 to 16 shall be transmitted when a Mode S interrogation with UF = 24 has been accepted. The downlink format of the reply (if any) shall be DF = 24. Protocols defining the number and content of the replies shall be as defined in 3.1.2.7.

3.1.2.4.1.3.2.4 *Replies to air-air surveillance interrogations*. A Mode S reply shall be transmitted when a Mode S interrogation with UF = 0 and an aircraft address has been accepted. The contents of these interrogations and replies shall be as defined in 3.1.2.8.

3.1.2.4.2 *SUPPRESSION*

3.1.2.4.2.1 *Effects of suppression*. A Mode S-capable transponder in suppression (3.1.1.7.4) shall not

recognize Mode A, Mode C or intermode interrogations if either the *P*1 pulse alone or both the *P*1 and *P*3 pulses of the interrogation are received during the suppression interval. Suppression shall not affect the recognition of, acceptance of, or replies to Mode S interrogations.

3.1.2.4.2.2 *Suppression pairs.* The two-pulse Mode A/C suppression pair defined in 3.1.1.7.4.1 shall initiate suppression in a Mode S transponder regardless of the position of the pulse pair in a group of pulses, provided the transponder is not already suppressed or in a transaction cycle.

Note.— The transponder may optionally initiate suppression from a P*3 –* P*4 pulse pair of a Mode A/Conly all-call interrogation according to the criteria of recognition of an intermode interrogation in 3.1.2.4.1.1.2. If the* P*3 –* P*4 pair of the Mode A/C-only all-call interrogation is processed as a suppression, the pulse pair both prevents a reply and initiates suppression. Likewise, the* P*1 –* P*2 preamble of a Mode S interrogation initiates suppression independently of the waveform that follows it.*

3.1.2.4.3 *Declaration of aircraft status*

Note.— Certain fields in downlink format (DF) 4, 5, 11, 17, 20 and 21 messages are based on whether the aircraft is determined, by the transponder, to be on-the-ground or airborne. Transponders determine and express whether the aircraft is on-the-ground or airborne using multiple approaches. Level 2 and above transponders report a declared air/ground status via the capability (CA) field (see 3.1.2.5.2.2.1). All transponders report an effective air/ground state via the vertical status (VS) field (see 3.1.2.8.2.1). The effective air/ground state is also reflected in the flight status (FS) field (see 3.1.2.6.5.1).

3.1.2.4.3.1 *Declared air/ground status determination.* Declared air/ground status shall be restricted to “on-the-ground”, “airborne” or “unknown”.

3.1.2.4.3.1.1 If an automatic means of determining the on-the-ground condition is available and indicates “on-the ground”, the declared air/ground status shall be “on-the-ground”.

3.1.2.4.3.1.2 If an automatic means of determining the on-the-ground condition is available and does not indicate “on-the ground”, the declared air/ground status shall be “airborne”.

3.1.2.4.3.1.3 If an automatic means of determining the on-the-ground condition is unavailable, the declared air/ground status shall be “unknown”.

Note.— The declared air/ground status may be set by air/ground data input (see 3.1.2.10.5.1.3) provided by an automatic means of determining the on-the-ground condition. Automatic means of determining the on-the-ground condition may include, for example, a weight on wheels switch, a strut switch or an airframe-specific air/ground algorithm output.

3.1.2.4.3.2 *Declared air/ground status validation.* Aircraft with an automatic means of determining the on-the-ground condition and whose transponders have access to at least one of ground speed, radio altitude or airspeed, shall perform the following validation check:
3.1.2.4.3.2.1 If an automatic means of determining the on-the-ground condition is available and indicates “on-the-ground”, the declared air/ground status shall be changed to “airborne” if:

Ground Speed > Speed Threshold OR Airspeed > Speed Threshold OR Radio Altitude > 50 feet

Where Speed Threshold is the lesser of 100 knots or the typical rotation speed of the aircraft (if available).

Note 1.— If an automatic means of determining the on-the-ground condition is not available or the declared air/ground status is "airborne", no validation check is required.

Note 2.— Modern aircraft with integrated avionics suites commonly contain sophisticated algorithms for determining the declared air/ground status based on multiple aircraft sensors. These algorithms are customized to the airframe and designed to overcome individual sensor failures. These algorithms are an acceptable means to determine the declared air/ground status and do not require the additional validation in this section.

3.1.2.4.3.3 *Effective air/ground state determination.* Effective air/ground state shall be restricted to "on-the-ground" or "airborne".

3.1.2.4.3.3.1 When the declared air/ground status is "airborne" or "unknown", the effective air/ground state shall be "airborne".

3.1.2.4.3.3.2 When the declared air/ground status is "on-the-ground", the effective air/ground state shall be "on-the-ground".

3.1.2.5 INTERMODE AND MODE S ALL-CALL TRANSACTIONS

3.1.2.5.1 INTERMODE TRANSACTIONS

Note.— The Mode A/C-only all-call interrogation makes it possible to elicit replies only from Mode A/C transponders. In multisite scenarios, the interrogator must transmit its identifier code in the Mode S only all-call interrogation. Thus, a pair of Mode S-only and Mode A/C-only all-call interrogations are used. The intermode interrogations are defined in 3.1.2.1.5.1 and the corresponding interrogation-reply protocols are defined in 3.1.2.4.

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3.1.2.5.2.1.2.3 II: Interrogator identifier. This 4-bit value shall define an interrogator identifier (II) code. These II codes shall be assigned to interrogators in the range from 0 to 15. When multiple II codes are assigned to one interrogator only, one II code shall be used for full data link purposes.

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3.1.2.5.2.1.5 Supplementary acquisition

Note 1.— The acquisition technique defined in 3.1.2.5.2.1.4 provides rapid acquisition for most aircraft. Due to the probabilistic nature of acquiring aircraft with a reduced reply probability (3.1.2.5.2.1.4.1), it may take many interrogations to acquire the last aircraft of a large set of aircraft in the same beam dwell and near the same range (termed a local garble zone). Acquisition performance is greatly improved for the acquisition of these aircraft through the use of limited selective referred to here as supplementary acquisition.

Note 2.— Supplementary acquisition consists of locking out acquired aircraft followed by acquisition by means of the Mode S-only all-call interrogation without lockout override. Only the aircraft not yet acquired and not yet locked-out will reply resulting in an easier acquisition. Additional guidance material can be found in Doc 9924.

Note 3.— Supplementary acquisition used to augment operation based on lockout override (3.1.2.5.2.1.4)

is possible using any assigned IC. If no IC has been assigned, supplementary acquisition uses II equals 0 (3.1.2.5.2.1.5.2.3).

3.1.2.5.2.1.5.1 Lockout within a beam dwell

3.1.2.5.2.1.5.1.1 When lockout is used to supplement the acquisition method described in 3.1.2.5.2.1.4, all aircraft within the beam dwell of the aircraft being acquired should be commanded to lock out to, not just those in the garble zone.

Note.— Lockout of all aircraft in the beam dwell will reduce the amount of all-call fruit replies generated to the all-call interrogations.

3.1.2.5.2.1.5.2 Duration of lockout

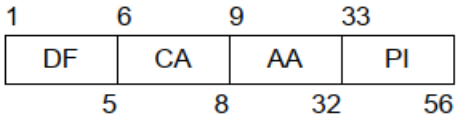
3.1.2.5.2.1.5.2.1 Interrogators performing supplementary acquisition shall perform acquisition by transmitting a lockout command for no more than two consecutive scans to each of the aircraft already acquired in the beam dwell containing the garble zone and shall not repeat it before 48 seconds have elapsed.

Note.— Minimizing the lockout time reduces the probability of conflict with the acquisition activities of a neighbouring interrogator that is also using the same IC.

3.1.2.5.2.1.5.2.2 Mode S-only all-call interrogations for the purpose of supplementary acquisition should take place over a maximum of 18 seconds.

3.1.2.5.2.1.5.2.3 Interrogator without assigned interrogator code (IC). An interrogator authorized to transmit that has not been assigned an IC and is unable to ensure that its lockout region will not overlap with the lockout region of another interrogator using the same IC, shall use II code 0 for supplementary acquisition.

3.1.2.5.2.2 All-call reply, downlink format 11



The reply to the Mode S-only all-call interrogation shall be the Mode S all-call reply, downlink format 11. The format of this reply shall consist of these fields:

Note.— Mode S all-call reply may be transmitted by transponders certified before 1 January 2020 in response to Mode A/C/S all-call interrogation (see 2.1.5.4.4).

. . .

3.1.2.5.2.2.1 *CA: Capability.* This 3-bit (6-8) downlink field shall convey information on the transponder level, the additional information below, and shall be used in formats DF = 11 and DF = 17.

Coding	
0	signifies Level 1 transponder (surveillance only), and no ability to set CA code 7 and either “airborne” or “on-the-ground”
1	reserved
2	reserved
3	reserved
4	signifies Level 2 or above transponder and ability to set CA code 7 and a declared air/ground status of “on-the-ground” (see 3.1.2.8.6.7) on the ground
5	signifies Level 2 or above transponder and ability to set CA code 7 and a declared air/ground status of “airborne” (see 3.1.2.8.6.7) airborne
6	signifies Level 2 or above transponder and ability to set CA code 7 and a declared air/ground status of “unknown” (see 3.1.2.8.6.7) either airborne or on the ground
7	signifies the DR field is not equal to 0 or the FS field equals 2, 3, 4 or 5, and either airborne or on the ground

Note.— Refer to 2.1.5.2.3 for the status of Level 1 transponders.

. . .

3.1.2.5.3 *Lockout protocol*. The all-call lockout protocol defined in 3.1.2.6.9 shall be used by the interrogator with respect to an aircraft once the address of that specific aircraft has been acquired by an interrogator provided that:

— the interrogator is using an IC code different from zero; and

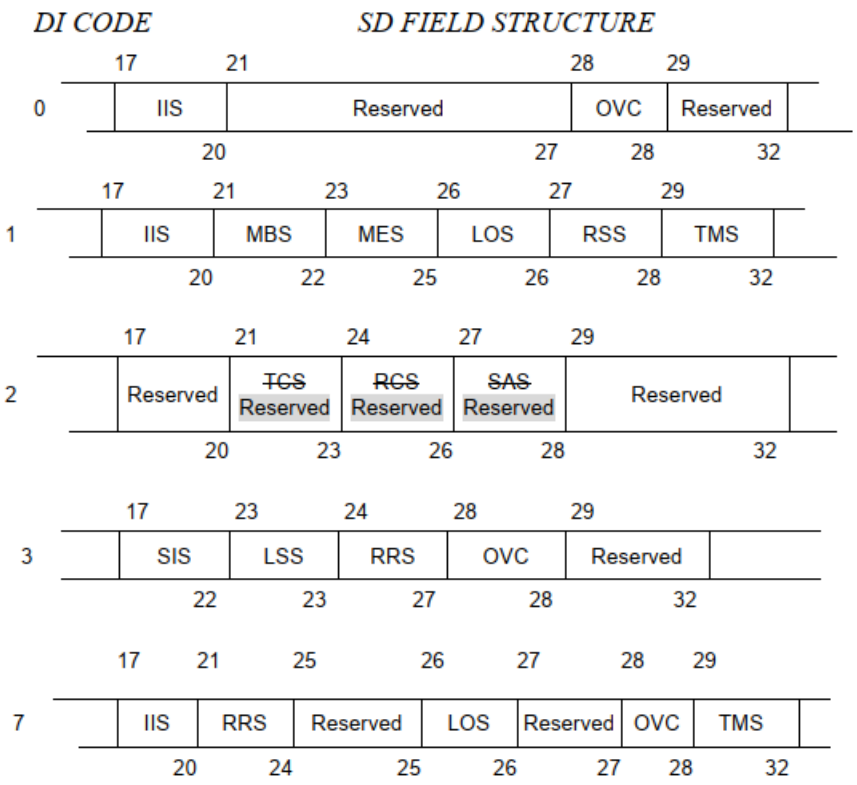
— the aircraft is located in an area where the interrogator is authorized to use lockout.

Note 1.— Following acquisition, a transponder is interrogated by discretely addressed interrogations as prescribed in 3.1.2.6, and 3.1.2.7 and 3.1.2.8 and the all-call lockout protocol is used to inhibit replies to further all-call interrogations.

. . .

3.1.2.6.1.4 *SD: Special designator.* This 16-bit (17-32) uplink field shall contain control codes which depend on the coding in the DI field.

Note.— The special designator (SD) field is provided to accomplish the transfer of multisite, lockout and communications control information from the ground station to the transponder.



3.1.2.6.1.4.1 *Subfields in SD.* The SD field shall contain information as follows:

a) If DI = 0, 1 or 7:

IIS, the 4-bit (17-20) interrogator identifier subfield shall contain an assigned the identifier code of the interrogator (3.1.2.5.2.1.2.3).

Note.— The IIS is intended to match the II code used by the interrogator in the Mode S-only all-call interrogation (3.1.2.5.2.1). Interrogators that do not use Mode S-only all-call interrogations, all-call lockout protocol or multisite data link protocol can use any IC in the IIS fields of their selective interrogations without coordination with neighbouring systems. The use of coordinated values differentiates interrogations transmitted by the different systems operating in the same area and facilitates the understanding of their respective contribution to the 1 090 MHz environment.

. . .

f) If DI = 2:

SD is not assigned. The SD field when DI = 2 was previously used to control the squitter format type and rate reported by the transponder through the deprecated type control subfield (TCS), rate control subfield (RCS), and squitter antenna subfield (SAS) commands.

g) If DI = 3:

SIS, the 6-bit (17-22) surveillance identifier subfield in SD shall contain an assigned the surveillance identifier code of the interrogator (3.1.2.5.2.1.2.4).

Note.— The SIS is intended to match the SI code used by the interrogator in the Mode S-only all-call

interrogation (3.1.2.5.2.1). Interrogators that do not use Mode S-only all-call interrogations, all-call lockout protocol or multisite data link protocol can use any IC in the SIS fields of their selective interrogations without coordination with neighbouring systems. The use of coordinated values differentiates interrogations transmitted by the different systems operating in the same area and facilitates the understanding of their respective contribution to the 1 090 MHz environment.

. . .

3.1.2.6.5.1 *FS: Flight status.* This 3-bit (6-8) downlink field shall contain the following information:

Coding	
0	signifies no alert and no SPI, vertical status (VS) indicates aircraft is “airborne”
1	signifies no alert and no SPI, VS indicates aircraft is “on-the-ground”
2	signifies alert, no SPI, VS indicates aircraft is “airborne”
3	signifies alert, no SPI, VS indicates aircraft is “on-the-ground”
4	signifies alert and SPI, VS indicates aircraft is “airborne” or “on-the-ground”
5	signifies no alert and SPI, VS indicates aircraft is “airborne” or “on-the-ground”
6	reserved
7	not assigned

. . .

3.1.2.6.5.4 *AC: Altitude code.* This 13-bit (20-32) field shall contain altitude coded as follows:

. . .

e) If the M bit equals 1, the 12-bit field represented by bits 20 to 25 and 27 to 32 shall be reserved for encoding altitude in metric units.

. . .

3.1.2.6.9.1.1 The multisite lockout command shall be transmitted in the SD field (3.1.2.6.1.4.1). A lockout command for an II code shall be transmitted in an SD with DI = 1 or DI = 7. An II lockout command shall be indicated by LOS code equals 1 and the presence of a non-zero interrogator identifier in the IIS subfield of SD. A lockout command for an SI code shall be transmitted in an SD with DI = 3. SI lockout shall be indicated by LSS equals 1 and the presence of a non-zero interrogator identifier in the SIS subfield of SD. After a transponder has accepted an interrogation containing a multisite lockout command, that transponder shall commence to lock out (i.e. not accept) any Mode S-only all-call interrogation which includes the identifier of the interrogator that commanded the lockout. The lockout shall persist for an interval *TL* (3.1.2.10.3.9) after the last acceptance of an interrogation containing the multisite lockout command. Multisite lockout shall not prevent acceptance of a Mode S-only all-call interrogation containing PR codes 8 to 12. If a lockout command (LOS = 1) is received together with IIS = 0, it shall be interpreted as a non-selective all-call lockout (3.1.2.6.9.2).

Note 1.— Fifteen interrogators can send independent multisite II lockout commands. In addition, 63 interrogators can send independent SI lockout commands. Each of these lockout commands must be timed separately.

Note 2.— Multisite lockout (which only uses non-zero II codes) does not affect the response of the transponder to Mode S-only all-call interrogations containing II equals 0.

3.1.2.6.9.2 *Non-selective all-call lockout*

Note 1.— In cases where the multisite lockout protocol for II codes is not required (for example, there is no overlapping coverage or there is ground station coordination via ground-to-ground communications) the non-selective lockout protocol may be used.

On acceptance of an interrogation containing code 1 in the PC field, a transponder shall commence to lock out (i.e. not accept)

Mode S-only all-call (UF = 11), with II equals 0.

Note 2.— On acceptance of an interrogation containing code 1 in the PC field transponders certified before 1 January 2020 also do not reply to the Mode A/C/S all-call of 3.1.2.1.5.1.1.

This lockout condition shall persist for an interval *TD* (3.1.2.10.3.9) after the last receipt of the command. Non-selective lockout shall not prevent acceptance of a Mode S-only all-call interrogation containing PR codes 8 to 12.

Note 3.— Non-selective lockout does not affect the response of the transponder to Mode S-only all-call interrogations containing II not equal to 0.

. . .

3.1.2.6.10.1.1.1 *Permanent alert condition.* The alert condition shall be maintained if the Mode A identity code is changed to 7500, 7600 or 7700 any of the codes contained in one of the two Mode A code sets defined as follows:

a) Mode A code set 1 for special purposes shall contain Mode A code 7500, 7600 or 7700.

b) Mode A code set 2 for special purposes shall contain Mode A code 7400, 7500, 7600 or 7700.

. . .

3.1.2.6.10.1.1.3 *Termination of the permanent alert condition.* The permanent alert condition shall be terminated and replaced by a temporary alert condition when the Mode A identity code is set to a value other than those defined in Mode A code set 1 or set 2 listed in 3.1.2.6.10.1.1.1, a) and b).

3.1.2.6.10.1.2 *Special position identification (SPI).* An equivalent of the SPI pulse shall be transmitted by Mode S transponders in the FS field and the surveillance status subfield (SSS) when manually activated. This pulse shall be transmitted for *TI* seconds after initiation (3.1.1.6.3, 3.1.1.7.13 and 3.1.2.8.6.3.1.1).

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3.1.2.6.10.2.2.1.2 *Sources of data link capability*. Data link capability reports shall contain the capabilities provided by the transponder, and the ACAS unit.

3.1.2.6.10.2.2.1.3 The data link capability report shall contain information on the following capabilities as specified in Table 3-6.

Note.— The content of the data link capability report differs between subnetwork versions. See Doc 9871 for further details.

. . .

3.1.2.6.10.2.2.3 *Zeroing of bits in the data link capability report*

If a particular data field within the data link capability report (transponder register 1016) cannot be updated within 8 seconds, the data field shall be set to ZERO.

Note 1.— Bit 33 indicates the availability of aircraft identification data. See Doc 9871 for further details.

Note 2.— Transponders maintaining aircraft identification upon the loss of the interface providing aircraft identification do not reset to zero bit 33 (2.1.5.4.7 and 2.1.5.4.8)

. . .

3.1.2.6.10.3 *Basic dataflash protocol*

Note.— The basic dataflash provides a protocol that allows the Mode S ground stations to be advised of changes that occur infrequently in various transponder registers of interest. The ground stations are advised of changes via Comm-B Broadcast of register 1016 and then extract as needed or desired the register or registers of interest.

3.1.2.6.10.3.1 *Basic dataflash capability report*. Transponders which monitor at least one of the registers subject to basic dataflash protocol and report their changes through the basic dataflash protocol, shall report this capability in the data link capability report (3.1.2.6.10.2.2.2) by setting bit 42 and bit 9 of the MB subfield to 1.

Note 1.— The registers for which changes can be reported using the basic dataflash protocol are defined in Doc 9871.

Note 2.— The setting of bit 9 to 1 indicates that the content of register 1016 continues in register 1116. This is what is expected when the basic dataflash option is implemented even if the basic dataflash state bits report zero because no information is provided to the monitored registers.

3.1.2.6.10.3.2 *Mode S subnetwork version.* Transponders which monitor register changes and report their changes through the basic dataflash protocol shall support a Mode S subnetwork Version 6 or above.

Note.— The basic dataflash protocol uses register formats that have been defined with Mode S Subnetwork Version 6. More information can be found in Doc 9871.

3.1.2.6.10.3.3 Each basic dataflash register that is implemented shall have its contents updated at an interval not to exceed its update interval.

Note.— The register update intervals are defined in Doc 9871.

3.1.2.6.10.3.4 *Register basic dataflash state*

3.1.2.6.10.3.4.1 The basic dataflash state for each of the registers defined in register 1116 shall contain its associated monitoring states as follows:

Coding	
0	Register not monitored or not implemented
1	Register monitored and implemented but no change yet detected

2 Register monitored and change 1 detected

3 Register monitored and change 2 detected

3.1.2.6.10.3.4.2 Each register shall be monitored for a change according to its update period.

Note.— The register update periods are defined in Doc 9871.

3.1.2.6.10.3.4.3 Upon first entry into the monitored state, the transponder shall set the monitoring bits allocated in register 1116 for that basic dataflash register to "1", meaning register monitored and implemented but no change yet detected.

3.1.2.6.10.3.4.4 Once a change has been detected, the basic dataflash state of the corresponding register shall be toggled between 2 and 3 with each change.

Note.— Toggle means if the register basic dataflash state was 2, at the next change it becomes 3 and if it was 3, it becomes 2.

3.1.2.6.10.3.5 *Monitoring change and announcing a change to ground state*

3.1.2.6.10.3.5.1 At intervals not exceeding 1 second, the transponder shall determine if the contents of register 11_{16} have changed since the last update

3.1.2.6.10.3.5.2 If the contents of register 11_{16} have changed, bit 51 of register 10_{16} shall be toggled and the F-timer shall be started (see Table 3-9).

Note.— The toggling (1→ 0 or 0→1) of bit 51 in register 1016 will trigger a Comm-B broadcast of register 10_{16}.

3.1.2.6.10.3.5.3 All basic dataflash monitoring activity (comparison of register contents and setting of bits in register 11_{16}) shall be suspended until the F-timer expires.

Note 1.— The suspension of basic dataflash monitoring avoids the Comm-B broadcast channel saturation.

Note 2.— Dataflash monitoring suspension means that the current content of monitored registers are retained and the detection of a change with the new contents of these registers will re-start after the 30s timer. The monitored registers themselves continue to be updated at their update periodicity.

Note 3.— The use of basic dataflash protocol by ground systems is described in Doc 9924. This allows reduction of periodic GICB extraction of registers.

. . .

3.1.2.6.11 *STANDARD LENGTH COMMUNICATIONS PROTOCOLS,*

. . .

Note 7.— When implemented, the technical provisions for phase overlay capability introduced in this section will provide means for increased data transmission capacity by the 1 090 extended squitters.

. . .

3.1.2.6.11.2 *Ground-initiated Comm-B*

3.1.2.6.11.2.1 *Comm-B data selector, BDS*. The 8-bit BDS code shall determine the register whose contents shall be transferred in the MB field of the Comm-B reply. It shall be expressed in two groups of 4 bits each, BDS1 (most significant 4 bits) and BDS2 (least significant 4 bits).

Note.— The transponder register allocation is specified in Doc 9871.

. . .

3.1.2.6.11.2.6 *Phase overlay ground-initiated Comm-B*. For equipment that support phase overlay on Mode S replies, when the reply contains the contents of the requested ground-initiated Comm-B register, phase data shall be encoded data in accordance with the register requested in the interrogation (that is, requested BDS code) and as defined for that register.

3.1.2.6.11.2.6.1 *PO message type field.* The phase overlay message type field in PD data bits 1–8 shall be set to 2 for phase overlay Mode S GICB data with Reed-Solomon FEC and to 8 to indicate phase overlay Mode S GICB data with LDPC FEC.

3.1.2.6.11.2.6.2 *PO message subtype field.* PD data bits 9–12 shall contain the phase overlay message subtype field and is set to 1. The subfield is defined as shown in Table 3-14.

Note.— Future UF codes may contain commands to force the transmission of other data in the phase overlay data block overlaid on Mode S long replies.

3.1.2.6.11.2.6.3 *PO-BDS field.* PD data bits 13–20 shall contain the BDS register number requested as per 3.1.2.6.11.2.1.

3.1.2.6.11.2.6.4 *PO data-block field.* PD data bits 21–204 shall contain the content of the corresponding phase overlay data associated with the requested BDS register. When there is no phase overlay data defined for the requested BDS register, all bits shall be set to ZERO except the PO message type field is set to 2 or 8, PO message subtype = 1, PO-BDS = BDS number of requested BDS register, and the 24-bit address is contained in the aircraft address (PD bits 181 through 204).

3.1.2.6.11.3 *Air-initiated Comm-B*

3.1.2.6.11.3.1 *General protocol.* The transponder shall announce the presence of an air-initiated Comm-B message with the insertion of code 1 in the DR field. To extract an air-initiated Comm-B message, the interrogator shall transmit a request for a Comm-B message reply in a subsequent interrogation with RR equal to 16 and, if DI equals 7, RRS must be equal to 0 (3.1.2.6.11.3.2.1 and 3.1.2.6.11.3.3.1). Receipt of this request code shall cause the transponder to transmit the air-initiated Comm-B message. If a command to transmit an air-initiated Comm-B message is received while no message is waiting to be transmitted, the reply shall contain all ZEROs in the MB field. For equipment that support phase overlay on Mode S replies, when an air-initiated Comm-B message is transmitted, PD data bits 1–204 shall be set to ZERO.

The reply that delivers the message shall continue to contain code 1 in the DR field. After a Comm-B closeout has been accomplished, the message shall be cancelled and the DR code belonging to this message immediately removed. If another air-initiated Comm-B message is waiting to be transmitted, the transponder shall set the DR code to 1, so that the reply contains the announcement of this next message.

Note.— The announcement and cancellation protocol ensures that an air-initiated message will not be lost due to uplink or downlink failures that occur during the delivery process.

An interrogator that has either not been assigned an IC or cannot ensure that its interrogation region will not overlap with the interrogation region of another interrogator using the same IC, shall not attempt to extract an air-initiated Comm-B message announced by DR equals 1 or 3.

3.1.2.6.11.3.1.1 *Phase overlay data.* When an air-initiated Comm-B message is transmitted, for equipment supporting phase overlay on Mode S replies, PD data bits 1–204 shall be set to ZERO.

. . .

3.1.2.6.11.3.4.1 The transponder shall be capable of storing two or more messages for each of the sixteen II codes: (1) an air-initiated or multisite-directed Comm-B message and (2) the contents of GICB registers 2 through 4.

. . .

3.1.2.6.11.4.2 *Extraction*

3.1.2.6.11.4.2.1 To extract the broadcast message, an interrogator shall transmit RR equals 16 and DI not equal to 3 or 7 or RR equals 16 and DI equals 3 or 7 with RRS equals 0 in a subsequent interrogation.

3.1.2.6.11.4.2.2 For equipment that support phase overlay on Mode S replies, PD message bits 1 through 204 shall contain the data as specified in 3.1.2.6.11.2.6 for the register that is broadcast or all ZEROs for other broadcast channels.

. . .

3.1.2.8.2.1 *VS: Vertical status:* This 1-bit (6) downlink field shall indicate the effective air/ground state (3.1.2.4.3.3).

Coding	
0	signifies that the effective air/ground state aircraft is “airborne”
1	signifies that the effective air/ground state aircraft is “on-the-ground”

. . .

3.1.2.8.5.2 *Acquisition squitter rate.* Acquisition squitter transmissions shall be emitted at random intervals that are uniformly distributed over the range from 0.8 to 1.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous acquisition squitter, with the following exceptions:

a) the scheduled acquisition squitter shall be delayed if the transponder is in a transaction cycle (3.1.2.4.1);

. . .

d) when the effective air/ground state is “on-the-ground”, acquisition squitters shall transmitted only when the surface position extended squitter ADS-B messages are not being transmitted (3.1.2.8.6.3.2).

An acquisition squitter shall not be interrupted by link transactions or mutual suppression activity after the squitter transmission has begun.

Note .— A mutual suppression system may be used to connect onboard equipment operating in the same frequency band in order to prevent mutual interference. Acquisition squitter action resumes as soon as practical after a mutual suppression interval.

3.1.2.8.5.3 *Acquisition squitter antenna selection.* Transponders operating with antenna diversity (3.1.2.10.4) shall transmit acquisition squitters as follows:

a) when the effective air/ground state is "airborne" (3.1.2.4.3.3), the transponder shall transmit acquisition squitters alternately from the two antennas; and

b) when the effective air/ground state is "on-the-ground" (3.1.2.4.3.3), the transponder shall transmit acquisition squitters from the top antenna only.

Note.— Acquisition squitters are not transmitted if the effective air/ground state is "on-the-ground" (3.1.2.4.3.3) and the transponder is transmitting surface position extended squitter ADS-B messages (3.1.2.8.6.4.3).

. . .

3.1.2.8.6.2 *ME: Message, extended squitter.* This 56-bit (33-88) downlink field in DF = 17 shall be used to transmit broadcast messages. Extended squitter shall be supported by registers 05, 06, 07, 08, 09, 0A {HEX} and 61-6F {HEX} and shall conform to either version 0, version 1, version 2 or version 3 message formats as described below:

a) Version 0 ES message formats and related requirements report surveillance quality by navigation uncertainty category (NUC), which can be an indication of either the accuracy or integrity of the navigation data used by ADSB. However, there is no indication- as to which of these, integrity or accuracy, the NUC value is providing an indication of.

b) Version 1 ES message formats and related requirements report surveillance accuracy and integrity separately as navigation accuracy category (NAC), navigation integrity category (NIC) and surveillance integrity level (SIL). Version 1 ES formats also include provisions for enhanced reporting of status information.

c) Version 2 ES message formats and related requirements contain the provisions of version 1 but further enhance integrity and parameter reporting. Version 2 ES formats separately report position source integrity from the integrity of the ADS-B transmitting equipment. Version 2 ES formats also separate vertical accuracy reporting from horizontal position accuracy, remove vertical integrity from position integrity, and provide for the reporting of the SSR Mode A code, GNSS antenna offset and additional horizontal position integrity values. Version 2 ES formats also modify the target state report to include selected altitude, selected heading, and barometric pressure setting.

d) Version 3 ES message formats and related requirements contain the provisions of Version 2 and incorporate additional capabilities. Version 3 ES improves reporting of geometric altitude, supports the broadcast of weather and aircraft parameters in support of air-to-air and air-to-ground weather application as well as improves emitter category classifications. Version 3 also includes support for UAS/RPAS operations as well as position and velocity reporting to accommodate altitude and velocities not supported by previous versions. To enable monitoring of interrogation rates detected and transmitted reply rates by a transponder, Version 3 supports the broadcast of such transponder activity. Version 3 additionally reports transponder antenna offset, an indication of Mode S reply rate limiting status as well as ACAS coordination capability reporting.

Note 1.— The formats and update rates of each register are specified in the (Doc 9871). The formats and update rates for individual squitters are defined by the version number of the extended squitter.

Note 2.— The formats for the four different versions are interoperable. An extended squitter receiver can recognize and decode signals of its own version, as well as lower versions' message formats. The receiver, however, can decode higher version signals according to its own capability.

Note 3.— Guidance material on transponder register formats and data sources is included in the Technical Provisions for Mode S Services and Extended Squitter *(Doc 9871).*

3.1.2.8.6.3 *Extended squitter types*

Note.— Extended squitter types described from 3.1.2.8.6.3.1 to 3.1.2.8.6.3.15 are defined in Doc 9871.

3.1.2.8.6.3.1 *Airborne position squitter.* The airborne position extended squitter type shall use format DF = 17 with the contents of GICB register 05 {HEX} inserted in the ME field.

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3.1.2.8.6.3.1.2 *ACS, altitude code subfield in ME.* The transponder shall report either navigation-derived altitude, or the barometric altitude code in this 12-bit (41-52) subfield of ME when ME contains an airborne position message. When barometric altitude is reported, the contents of the ACS shall be as specified for the 13-bit AC field (3.1.2.6.5.4) except that the M-bit (bit 26) shall be omitted.

3.1.2.8.6.3.2 *Surface position squitter.* The surface position extended squitter type shall use format DF = 17 with the contents of GICB register 06 {HEX} inserted in the ME field.

3.1.2.8.6.3.3 *Aircraft identification squitter.* The aircraft identification extended squitter type shall use format DF = 17 with the contents of GICB register 08 {HEX} inserted in the ME field.

3.1.2.8.6.3.4 *Airborne velocity squitter.* The airborne velocity extended squitter type shall use format DF = 17 with the contents of GICB register 09 {HEX} inserted in the ME field.

3.1.2.8.6.3.5 *Aircraft operational status squitter*. The aircraft operational status extended squitter type shall use format DF = 17 with the contents of GICB register 65 {HEX} inserted in the ME field.

3.1.2.8.6.3.6 *Target state and status squitter*. The target state and status extended squitter type shall use format DF = 17 with the contents of GICB register 62 {HEX} inserted in the ME field.

3.1.2.8.6.3.7 *"Emergency/priority status" squitter*. The "emergency/priority status" extended squitter type shall use format DF = 17 with the contents of GICB register 61 {HEX} inserted in the ME field.

3.1.2.8.6.3.8 *TCAS RA broadcast squitter*. The TCAS RA broadcast extended squitter type shall use format DF = 17 with the contents of GICB register 30 {HEX} inserted in the ME field.

Note.— In ADS-B Version 2, the TCAS RA broadcast extended squitter information was transmitted using the contents in GICB register 61 {HEX} subtype equal to 2.

3.1.2.8.6.3.9 *HVA position squitter*. The HVA position extended squitter type shall use format DF = 17 with the contents of GICB register 6E {HEX} inserted in the ME field.

3.1.2.8.6.3.10 *HVA velocity squitter*. The HVA velocity extended squitter type shall use format DF = 17 with the contents of GICB register 6F {HEX} inserted in the ME field.

3.1.2.8.6.3.11 "*UAS/RPAS contingency" current/next TCP squitters*. The "UAS/RPAS contingency" current/next TCP extended squitter type shall use format DF = 17 with the contents of GICB register 63 {HEX} to 64 {HEX} inserted in the ME field.

3.1.2.8.6.3.12 *ADS-B Wx AIREP squitters*. The ADS-B Wx AIREP extended squitter types shall use the contents of GICB register 68 {HEX} to 6A {HEX}, as applicable, to insert the appropriate aircraft or weather state information in the ME field.

3.1.2.8.6.3.13 *ADS-B Wx PIREP squitters*. The ADS-B Wx PIREP extended squitter types shall use the contents of GICB registers 6B {HEX} to 6D {HEX}, as applicable, to insert the appropriate aircraft or weather state information in the ME field.

3.1.2.8.6.3.14 *Extended Squitter event-driven information*. The event-driven message shall use format DF = 17 with the contents of GICB register 0A {HEX} inserted in the ME field.

Note.— Although labeled as extended squitter, prior to Version 3, this message would only be broadcast once each time the register was loaded with information. ADS-B Version 3 removed the implementation of this register.

3.1.2.8.6.3.15 *Interrogation/reply monitor squitters*. The interrogation/reply monitor squitter types shall use format DF = 17 with the contents of GICB registers 66 {HEX} to 67 {HEX} inserted in the ME field.

3.1.2.8.6.4 *Extended squitter rate*

3.1.2.8.6.4.1 *Initialization*. At power up initialization, the transponder shall commence operation in a mode in which it does not transmit extended squitters. The initialization determination shall be made individually for each squitter type.

3.1.2.8.6.4.2 *Airborne position squitter rate.* Airborne position squitter transmissions shall be emitted when the broadcast message format (see 3.1.2.8.6.7) is "airborne" and the HVA position squitter is not transmitted. Airborne position squitter transmissions shall be emitted at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous airborne position squitter, with the exceptions as specified in 3.1.2.8.6.4.7.

Note.— Selection criteria for the airborne and HVA position squitters are specified in Doc 9871.

3.1.2.8.6.4.3 *Surface position squitter rate.* Surface position squitter transmissions shall be emitted when the broadcast message format (see 3.1.2.8.6.7) is "surface" using one of two rates depending upon whether the high or low squitter rate has been selected (3.1.2.8.6.9). When the high squitter rate has been selected, surface position squitters shall be emitted at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous surface position squitter (termed the high rate). When the low squitter rate has been selected, surface position squitters shall be emitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous surface position squitter (termed the low rate). Exceptions to these transmission rates are specified in 3.1.2.8.6.4.7.

3.1.2.8.6.4.4 *Aircraft identification squitter rate.* Aircraft identification squitter transmissions shall be

emitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous identification squitter when the aircraft is reporting the airborne position squitter type, or when the aircraft is reporting the surface position squitter type and the high rate has been selected. When the surface position squitter type is being reported at the low rate, the aircraft identification squitter shall be emitted at random intervals that are uniformly distributed over the range of 9.8 to 10.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous identification squitter. Exceptions to these transmission rates are specified in 3.1.2.8.6.4.7.

3.1.2.8.6.4.5 *Airborne velocity squitter rate.* Airborne velocity squitter transmissions shall be emitted when the broadcast message format (see 3.1.2.8.6.7) is "airborne" and the HVA velocity squitter is not transmitted. Airborne velocity squitter transmissions shall be emitted at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous airborne velocity squitter, with the exceptions as specified in 3.1.2.8.6.4.7.

3.1.2.8.6.4.6 *Other extended squitter rates*. Other extended squitters shall be emitted at rates consistent with the extended squitter message type and the associated extended squitter version number.

Note.— Other extended squitter rates are specified in (Doc 9871).

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3.1.2.8.6.5 *Extended squitter antenna selection.* Transponders operating with antenna diversity (3.1.2.10.4) shall transmit extended squitters as follows:

a) when the broadcast message format (see 3.1.2.8.6.7) is "airborne", the transponder shall transmit each type of extended squitter alternately from the two antennas; and

b) when the broadcast message format (see 3.1.2.8.6.7) is "on-the-ground", the transponder shall transmit extended squitters from the top antenna only

. . .

3.1.2.8.6.7 *Extended squitter ADS-B message formats*

Note 1.— DF = 17 message fields and formats are based on whether the aircraft is determined, by the transponder, to be on-the-ground or airborne. Level 2 and above transponders report declared air/ground status via the CA field in DF = 17 extended squitter ADS-B messages (see 3.1.2.5.2.2.1).

Note 2.— Extended squitter ADS-B messages are formatted based on the effective air/ground state or the broadcast message format. Effective air/ground state is set based on the declared air/ground status (see 3.1.2.4.3.3). Broadcast message format is set based on the declared air/ground status (see 3.1.2.4.3.3) and in fixed-wing aircraft may also incorporate the output of a broadcast message format algorithm (see 3.1.2.8.6.7.3).

Note 3.— The CA field reports the declared air/ground status (see 3.1.2.5.2.2.1). ACAS II acquires aircraft using squitters that contain the CA field. If an aircraft reports the declared air/ground status as "on-the-ground", that aircraft will not be interrogated by ACAS II in order to reduce unnecessary interrogation activity.

Note 4.— Use of the following technique may result in surface or airborne format extended squitter ADS-

B messages being transmitted when the CA field indicates the declared air/ground status is "unknown" (CA code 6).

3.1.2.8.6.7.1 *Extended squitter ADS-B message format determination for ES version numbers 0 through 2.* Mode S transponders that broadcast Version 0, 1 or 2 ES messages whose formats are not determined as described in 3.1.2.8.6.7.2, shall determine the extended squitter ADS-B message format based on the effective air/ground state (see 3.1.2.4.3.3).

3.1.2.8.6.7.1.1 If the effective air/ground state is "on-the-ground", the extended squitter ADS-B message format shall be "surface".

3.1.2.8.6.7.1.2 If the effective air/ground state is "airborne", the extended squitter ADS-B message format shall be "airborne", except as follows:

a) for aircraft whose emitter category (see Doc 9871) is Set "A" code 2, 3, 4, 5 or 6, or Set "B" code 7, the extended squitter ADS-B message format shall be "surface" if:

   i) if radio altitude and ground speed are available and airspeed is unavailable, and radio altitude indicates < 50 feet and ground speed indicates < 100 knots; or

   ii) if radio altitude and airspeed are available and ground speed is unavailable, and radio altitude indicates < 50 feet and airspeed indicates < 100 knots; or

   iii) if radio altitude, ground speed and airspeed are available and radio altitude indicates <50 feet and both ground speed and airspeed indicate < 100 knots;

b) for aircraft whose emitter category (see Doc 9871) is Set "A" code 2, 3, 4, 5 or 6, or Set "B" code 7, the extended squitter ADS-B message format shall be "surface" if radio altitude is unavailable and available ground speed and airspeed both indicate < 50 knots; or

c) for aircraft whose emitter category (see Doc 9871) is Set "C" code 1 or 2; the extended squitter ADS-B message format shall be "surface".

3.1.2.8.6.7.2 *Extended squitter ADS-B message format determination for ES version numbers 3 and greater.* Mode S transponders shall use the broadcast message format to determine whether to report airborne or surface extended squitter ADS-B messages.

3.1.2.8.6.7.2.1 If subsequent to the validation in 3.1.2.4.3.2 the declared air/ground status is "airborne", the broadcast message format shall be "airborne".

3.1.2.8.6.7.2.2 If subsequent to the validation in 3.1.2.4.3.2 the declared air/ground status is "on-the ground", the broadcast message format shall be "surface".

3.1.2.8.6.7.2.3 If the emitter category (see Doc 9871) is "surface vehicle – emergency vehicle" or "surface vehicle – service vehicle", the broadcast message format shall be "surface".

3.1.2.8.6.7.2.4 If subsequent to the validation in 3.1.2.4.3.2 the declared air/ground status is "unknown" and a broadcast message format algorithm is applicable (see 3.1.2.8.6.7.3), the broadcast message format shall be determined by the broadcast message format algorithm output.

3.1.2.8.6.7.2.5 If subsequent to the validation in 3.1.2.4.3.2 the declared air/ground status is “unknown” and a broadcast message format algorithm is not applicable (see 3.1.2.8.6.7.3), the broadcast message format shall be “airborne”.

3.1.2.8.6.7.3 *Broadcast message format algorithm*

Note.— Broadcast message format algorithm, if implemented, provides a means for fixed-wing aircraft, under certain conditions, to determine the broadcast message format using only sensor data available to the transponder. This is desirable to prevent aircraft without a means of automatically determining the on-the-ground condition from broadcasting an incorrect extended squitter ADS-B message format.

3.1.2.8.6.7.3.1 *If not equipped with an automatic means of determining the on-the-ground condition, aircraft whose emitter category (see Doc 9871) is Set “A” code 1, 2, 3 or 5 should implement a broadcast message format algorithm.*

3.1.2.8.6.7.3.2 If implemented, broadcast message format algorithm requirements shall apply only to aircraft whose emitter category is Set “A” code 1, 2, 3 or 5.

3.1.2.8.6.7.3.3 *Reported broadcast message format.* If implemented, the broadcast message format algorithm shall provide a reported broadcast message format that is limited to “airborne” or “surface”.

3.1.2.8.6.7.3.3.1 After start-up, if the broadcast message format algorithm does not update the reported broadcast message format within 300 seconds, or for more than 10 seconds after last reporting “surface” or “airborne”, the reported broadcast message format shall be set to “airborne”.

3.1.2.8.6.7.3.3.2 During taxi and take-off operations, the broadcast message format algorithm shall determine and update the reported broadcast message format prior to entering or within 5 seconds of exiting the runway transition zone, including while taxiing after landing.

3.1.2.8.6.7.3.3.3 During inflight operations, the broadcast message format algorithm shall maintain a reported broadcast message format of “airborne” while remaining outside of any runway transition zone.

Note.— For additional information regarding broadcast message format algorithm definitions, applicability and performance, refer to RTCA DO-260C/ED-102B §2.2.3.2.2.1.4.

3.1.2.8.6.8 *Squitter status reporting.* Register 07 {HEX} shall be reserved in transponders conforming to ADS-B Version 3 and later.

Note.— Technical provisions for squitter status reporting (Register 07 {HEX}) for ADS-B Version 2 and earlier can be found in Doc 9871.

3.1.2.8.6.9 *Surface squitter rate.* Surface position messages shall be initiated using the low squitter rate. The surface squitter broadcast rate (“high” or “low” as defined in 3.1.2.8.6.4.3) shall be determined as follows:

Note.— Transponders conforming to ADS-B Version 2 and earlier examine the transmission rate subfield (TRS) to determine whether to transmit at the “high” or “low” rate. Relevant detailed technical provisions are specified in Doc 9871.

a) the broadcast rate shall be changed from “high” to “low” when the navigation source position data has not changed more than 10 metres in any 15-minute interval ± 10 seconds;

Note.— It is acceptable to compute the 10-metre distance using either rectangular or polar coordinates.

b) upon selecting the “low” broadcast rate, the transmission device shall save the position data at the time that the “low” rate was selected (including at initialization); and

c) the broadcast rate shall be changed from “low” to “high” when the position of the transmission device has changed by 10 metres or more since the “low” rate was selected.

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3.1.2.8.6.11 *Data insertion.* When the transponder determines that it is time to emit an airborne position squitter, it shall insert the current value of the barometric altitude and surveillance status into the appropriate fields of register 05 {HEX}. The contents of this register shall then be inserted into the ME field of DF = 17 and transmitted.

Note.— Insertion in this manner ensures that (1) the squitter contains the latest altitude and surveillance status, and (2) ground read-out of register 05 {HEX} will yield exactly the same information as the AC field of a Mode S surveillance reply.

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3.1.2.8.7.3.2 *ES/NT squitter types*

Note.— ES/NT squitter types described from 3.1.2.8.7.3.2.1 to 3.1.2.8.7.3.2.13 are defined in Doc 9871.

3.1.2.8.7.3.2.1 *Airborne position squitter.* The airborne position type ES/NT shall use format DF = 18 with the format for register 05 {HEX} inserted in the ME field.

3.1.2.8.7.3.2.2 *Surface position squitter.* The surface position type ES/NT shall use format DF = 18 with the format for register 06 {HEX} inserted in the ME field.

3.1.2.8.7.3.2.3 *Aircraft identification squitter*. The aircraft identification type ES/NT shall use format DF = 18 with the format for register 08 {HEX} inserted in the ME field.

3.1.2.8.7.3.2.4 *Airborne velocity squitter.* The airborne velocity type ES/NT shall use format DF = 18 with the format for register 09 {HEX} as defined in 3.1.2.8.6.2 inserted in the ME field.

3.1.2.8.7.3.2.5 *Aircraft operational status squitter*. The aircraft operational status extended squitter type shall use format DF = 18 with the contents of GICB register 65 {HEX} inserted in the ME field.

3.1.2.8.7.3.2.6 *Target state and status squitter*. The target state and status extended squitter type shall use format DF = 18 with the contents of GICB register 62 {HEX} inserted in the ME field.

3.1.2.8.7.3.2.7 *“Emergency/Priority status” squitter*. The “Emergency/Priority Status” extended squitter type shall use format DF = 18 with the contents of GICB register 61 {HEX} inserted in the ME field.

3.1.2.8.7.3.2.8 *HVA position squitter*. The HVA position extended squitter type shall use format DF = 18 with the contents of GICB register 6E {HEX} inserted in the ME field.

3.1.2.8.7.3.2.9 *HVA velocity squitter*. The HVA velocity extended squitter type shall use format DF = 18 with the contents of GICB register 6F {HEX} inserted in the ME field.

3.1.2.8.7.3.2.10 "*UAS/RPAS Contingency" Current/Next TCP squitter*. The "UAS/RPAS Contingency" Current/Next TCP extended squitter type shall use format DF = 18 with the contents of GICB register 63 {HEX} to 64 {HEX} inserted in the ME field.

3.1.2.8.7.3.2.11 *ADS-B Wx AIREP squitters*. The ADS-B Wx AIREP extended squitter types shall use format DF = 18 with the contents of GICB register 68 {HEX} to 6A {HEX}, as applicable, to insert the appropriate aircraft or weather state information in the ME field.

3.1.2.8.7.3.2.12 *ADS-B Wx PIREP squitters*. The ADS-B Wx PIREP extended squitter types shall use format DF = 18 with the contents of GICB registers 6B {HEX} to 6D {HEX}, as applicable, to insert the appropriate aircraft or weather state information in the ME field.

3.1.2.8.7.3.2.13 *Extended Squitter event-driven information*. The event-driven message shall use format DF = 18 with the contents of GICB register 0A {HEX} inserted in the ME field.

Note.— Although labeled as extended squitter, prior to Version 3 this message would only be broadcast once each time the register was loaded with information. ADS-B Version 3 removed the implementation of this register.

3.1.2.8.7.3.3 *ES/NT squitter rate*

3.1.2.8.7.3.3.1 *Initialization.* At power up initialization, the non-transponder device shall commence operation in a mode in which it does not broadcast any squitters. The non-transponder device shall initiate the broadcast of ES/NT squitters for airborne position, surface position, airborne velocity and aircraft identification when data are available for inclusion in the ME field of these squitter types. This determination shall be made individually for each squitter type. When ES/NT squitters are broadcast, transmission rates shall be as indicated in 3.1.2.8.6.4.2 to 3.1.2.8.6.4.6.

Note 1.— This suppresses the transmission of extended squitters from aircraft that are unable to report position, velocity or identity. If input to the register for the position squitter type stops for 60 seconds, broadcast will cease until data insertion resumes, except for an ES/NT device when the broadcast message format (see 3.1.2.8.6.7) is "surface" (as specified in Doc 9871). Broadcast of airborne position squitters is not discontinued if barometric altitude data is available. Terminating broadcast of other squitter types is described in Doc 9871.

Note 2.— After timeout (3.1.2.8.7.6) this squitter type may contain an ME field of all zeros.

3.1.2.8.7.3.3.2 *Delayed transmission.* ES/NT squitter transmission shall be delayed if the non-transponder device is busy broadcasting one of the other squitter types.

3.1.2.8.7.3.3.2.1 The delayed squitter shall be transmitted as soon as the non-transponder device becomes available.

3.1.2.8.7.3.3.3 *ES/NT antenna selection.* Non-transponder devices operating with antenna diversity (3.1.2.10.4) shall transmit ES/NT squitters as follows:

a) when the broadcast message format (see 3.1.2.8.6.7) is “airborne”, the non-transponder device shall transmit each type of ES/NT squitter alternately from the two antennas; and

b) when the broadcast message format (see 3.1.2.8.6.7) is “surface”, the nontransponder device shall transmit ES/NT squitters from the top antenna only.

3.1.2.8.7.3.3.4 *Register timeout and termination.* The non-transponder device shall clear message fields and terminate broadcast of extended squitter messages as required to prevent the reporting of outdated information.

Note.— The timeout and termination of an extended squitter broadcast is specified in Doc 9871.

3.1.2.8.7.3.3.5 *Airborne/surface message format selection.* Non-transponder devices shall report airborne or surface format extended squitter ADS-B messages as per the requirements in 3.1.2.8.6.7.

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3.1.2.8.8 *MILITARY APPLICATION, DOWNLINK FORMAT 19*

10011	AF:3	

Note.— This format supports military applications. DF = 17 or 18. DF = 19 can be used either as a squitter or as a reply.

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3.1.2.8.8.2 *Application field.* This 3-bit (6-8) downlink field in DF = 19 shall be used to define the format of the 112-bit transmission.

Code 0 to 7 = Reserved for military use

3.1.2.8.9 *EXTENDED SQUITTER MAXIMUM TRANSMISSION RATE*

3.1.2.8.9.1 The maximum total number of full power extended squitters (DF = 17, 18 and 19) emitted by any extended squitter installation shall not exceed 1 or 2 below

1) For a transponder capable of replying to intermode Mode A/C/S all-call interrogations:

   a) 6.2 messages per second averaged over 60 seconds for nominal aircraft operations with no emergency and no ACAS RA activity, while not exceeding 11 messages being transmitted in any 1-second interval; or

   b) 7.4 messages per second averaged over 60 seconds under an emergency and/or ACAS RA condition, while not exceeding 11 messages being transmitted in any 1-second interval.;

2) For a transponder that does not have the capability to reply to intermode Mode A/C/S all-call interrogations or an extended squitter non-transponder device (2.1.5.1.7):

   a) 6.7 messages per second averaged over 60 seconds for nominal aircraft operations with no temporary alert, no permanent alert, no emergency, no ACAS RA and no UAS/RPAS

contingency activity, while not exceeding 15 messages being transmitted in any 1-second interval; or

b) 9.2 messages per second averaged over 60 seconds under a temporary/permanent alert, an emergency, an ACAS RA and/or UAS/RPAS contingency condition, while not exceeding 19 messages being transmitted in any 1-second interval.

Note 1.— It is anticipated that the transmission of any new messages required in addition to the capability specified above will be performed using the capacity provided by phase overlay.

Note 2.— The higher extended squitter rates are associated with transponders not capable of replying to intermode Mode A/C/S all-call interrogations in order to keep an equilibrium on 1 090 MHz link that is subject to overload. States are expected to ensure that this link is maintained through their transponder regulation (for example, TSO). The minimum performance of such a transponder can be found in RTCA DO-181F or EUROCAE ED-73F or later versions.

Note 3.— A higher extended squitter rate (9.2/s) is authorized when there is an emergency, a temporary/permanent alert (Mode A code), an ACAS RA and/or a UAS contingency because such events are rare and are limited to very few platforms at the same time. Therefore, such events have a very limited effect on 1 090 MHz usage.

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3.1.2.9.1.4 *Change of aircraft identification.* If the aircraft identification reported in the AIS subfield is changed in flight, the transponder shall report the new identification to the ground by use of the Comm-B broadcast message protocol of 3.1.2.6.11.4 for BDS1 = 2 (33–36) and BDS2 = 0 (37–40). The transponder shall initiate, generate and announce the revised aircraft identification. The transponder shall ensure that the BDS code is set for the aircraft identification report in all cases, including a loss of the interface.

Note 1.— The setting of the BDS code by the transponder ensures that a broadcast change of aircraft identification will contain the BDS code for all cases of aircraft identification failure (for example, the loss of the interface providing aircraft identification).

Note 2.— In some transponders certified on or prior to 1 January 2030, bits 41–88 in register 20 {HEX} were set to zero upon loss of the interface providing aircraft identification. The transponder also initiated, generated and announced the change in aircraft identification upon loss of the interface.

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3.1.2.10 ESSENTIAL SYSTEM CHARACTERISTICS OF THE SSR MODE S AND INTERMODE TRANSPONDER CAPABILITIES

3.1.2.10.1 *Transponder sensitivity and dynamic range.* Transponder sensitivity shall be defined in terms of a given interrogation signal input level and a given percentage of corresponding replies. Only correct replies containing the required bit pattern for the interrogation received shall be counted. Given an interrogation that requires a reply according to 3.1.2.4, the minimum triggering level, MTL, shall be defined as the minimum input power level for 90 per cent reply-to-interrogation ratio. The MTL shall be –74 dBm ±3 dB for Mode S interrogations (interrogations using *P*6). The reply-to-interrogation ratio of a Mode S transponder shall be:

a) at least 99 per cent for signal input levels between 3 dB above MTL and –21 dBm; and

b) no more than 10 per cent at signal input levels below –81 dBm.

Note.— Transponder sensitivity and output power are described in this section in terms of signal level at the terminals of the antenna. This gives the designer freedom to arrange the installation, optimizing cable length and receiver-transmitter design, and does not exclude receiver and/or transmitter components from becoming an integral part of the antenna subassembly.

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3.1.2.10.1.1.2 *Reply ratio in the presence of pulse pair interference*. Given Mode S interrogation which requires a reply (3.1.2.4), the reply ratio of a transponder shall be at least 90 per cent in the presence of an interfering *P*1 – *P*2 pulse pair if the level of the interfering pulse pair is 9 dB or more below signal level for input signal levels between –68 dBm and –21 dBm and the *P*1 pulse of the interfering pair occurs no earlier than the *P*1 pulse of the Mode S signal.

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3.1.2.10.1.1.4 *Reply ratio in the presence of low-level in-band CW interference*. In the presence of non-coherent CW interference at a frequency of 1 030 ±0.2 MHz at signal levels of 20 dB or more below the desired Mode S interrogation signal level, the transponder shall reply correctly to at least 90 per cent of the interrogations.

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3.1.2.10.2.1 *Unwanted output power*

3.1.2.10.2.1.1 *Inactive state transponder output power.* When the transponder is in the inactive state the peak power at 1 090 MHz plus or minus 3 MHz at the antenna end of the transmission line of the transponder shall not exceed –50 dBm when not installed with an ACAS unit or –70 dBm when installed with an ACAS unit. The inactive state is defined as the entire period between transmissions, less 10-microsecond transition periods preceding the first pulse and plus 10-microsecond transition periods following the last pulse of the transmission (see Figure 3-11).

Note.— Inactive state transponder power is constrained in this way to ensure that an aircraft, when located as near as 185 m (0.1 NM) to a Mode A/C or Mode S interrogator, does not cause interference to that installation. In certain applications of Mode S, airborne collision avoidance for example, where a 1 090 MHz transmitter and receiver are in the same aircraft, it is necessary to further constrain the inactive state transponder power.

3.1.2.10.2.1.2 *Active state transponder output power.*

3.1.2.10.2.1.2.1 The RF output power shall be less than or equal to the peak pulse power minus 50 dB for the interval starting 10 microseconds prior to the Mode S transmission and for the interval of 10 microseconds following a Mode S transmission (see Figure 3-11).

3.1.2.10.2.1.2.2 For intervals between transmitted pulses that are greater than 0.5 microsecond, the power level at the lowest point within the interval shall be 50 dB or more below the peak pulse power.

Note 1.— These power limitations protect 1 090 MHz receivers from potential missed decodes when signals are received at close range and within desired detection range. In the absence of such limits, signal levels during non-pulse intervals can occur above receiver thresholds and can lead to unintended distortion

of pulse positions or false pulse decodes preventing proper detection of transmitted signals. It also makes it more difficult for receivers to decode overlapped replies.

Note 2.— It is possible that a signal transmitted 50 dB below the peak pulse power can still affect high sensitivity receivers when transmitted in close range. More information is available in Doc 9924.

Note 3.— Information on how to verify unwanted output power can be found in RTCA DO-181F and EUROCAE ED-73F.

Note 4.— The presence of a signal at a level of 50 dB or more below the peak power may not be measurable within the first 0.5 microsecond following the transmission of a pulse because of the allowed decay time.

Note 5.— Transmitters compliant with RTCA DO-181F and EUROCAE ED-73F meet the requirements defined in 3.1.2.10.2.1.2.

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3.1.2.10.3.2 *Dead time*

3.1.2.10.3.2.1 For all transponders, the time interval beginning at the end of a reply transmission and ending when the receiver has regained sensitivity to within 3ndB of MTL (dead time). Mode S transponders shall not exceed 125 microseconds.

3.1.2.10.3.2.2 For transponders with improved dead time, the time interval beginning at the end of a reply transmission and ending when the receiver has regained sensitivity to within 3 dB of MTL (dead time) shall not exceed 20 microseconds.

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3.1.2.10.3.6 *Reply rate limiting*

Note.— Reply rate limiting is prescribed separately for Modes A and C and for Mode S.

3.1.2.10.3.6.1 *Mode S reply rate limiting.*

3.1.2.10.3.6.1.1 Mode S reply rate limiting shall permit the minimum reply rates required in 3.1.2.10.3.7.2 and 3.1.2.10.3.7.3.

Note.— Mode S transponders certified before 1 January 2030 have no requirement for Mode S reply rate limiting function and may have a different implementation of this function.

3.1.2.10.3.6.1.2 *Mode S reply rate limiting type 1*

3.1.2.10.3.6.1.2.1 Mode S reply rate limiting shall be separate from Modes A and C reply rate limiting.

3.1.2.10.3.6.1.2.2 The Mode S reply rate limiting shall ensure the transponder does not cease to reply to valid Mode S interrogations for a period greater than 100 milliseconds.

3.1.2.10.3.6.1.2.3 The Mode S reply rate limiting shall limit the Mode S replies to a maximum reply rate of 180 Mode S replies per second or less.

Note.— The maximum reply rate limit can be less than the 180 specified here but is greater than the minimums specified in 3.1.2.10.3.7.3.

3.1.2.10.3.6.1.2.4 The Mode S reply rate limiting shall be accomplished using methods other than sensitivity reduction.

Note.— Sensitivity-reduction rate limiting is prohibited due to the potential impact on ACAS.

3.1.2.10.3.6.1.2.5 The Mode S reply rate limiting function shall exclude the acquisition squitter (see 3.1.2.8.5) and extended squitter (see 3.1.2.8.6) transmissions.

3.1.2.10.3.6.1.2.6 The Mode S reply rate limiting function shall process received interrogations regardless of the received antenna channel.

3.1.2.10.3.6.1.2.7 The Mode S reply rate limiting function shall process received interrogations regardless of uplink format.

Note.— The Mode S reply rate limiting also includes replies to ACAS resolution and coordination messages.

3.1.2.10.3.6.1.2.8 *The Mode S reply rate limiting should be accomplished stochastically.*

3.1.2.10.3.6.2 *Modes A and C reply rate limiting*. Modes A and C prescribed sensitivity reduction (3.1.1.7.9.2) shall not affect the Mode S performance of the transponder.

3.1.2.10.3.7 *Minimum reply rate capability, Mode S*

3.1.2.10.3.7.1 All reply rates specified in 3.1.2.10.3.7 shall be in addition to any squitter transmissions that the transponder is required to make.

3.1.2.10.3.7.2 *Minimum reply rate capability, Mode S*. A transponder capable of transmitting only short Mode S replies shall be able to generate replies at the following rates:

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3.1.2.10.3.7.3 *Minimum Mode S ELM peak reply rate*

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3.1.2.10.3.8 *Reply delay and jitter for Mode S*

3.1.2.10.3.8.1 For all input signal levels between MTL and –21 dBm, the leading edge of the first preamble pulse of the reply (3.1.2.2.5.1.1) shall occur 128 plus or minus 0.25 microsecond after the sync phase reversal (3.1.2.1.5.2.2) of the received *P*6. The jitter of the reply delay shall not be less than or equal to 0.08 microsecond, peak (99.9 percentile).

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3.1.2.10.3.10 *Inhibition of replies.* Replies to Mode S-only all-call interrogations shall always be inhibited when the effective air/ground state is “on-the-ground”. It shall not be possible to inhibit replies to discretely addressed Mode S.

Note.— Transponders certified on or after 1 January 2020 also inhibit replies to the Mode A/C/S all-call when the effective air/ground state is "on-the-ground" (see 2.1.5.4.4).

3.1.2.10.3.10.1 *Aircraft should provide air/ground data to the transponder.*

3.1.2.10.3.10.2 Mode A/C replies from transponders with a Mode S capability shall be inhibited when the effective air/ground state is "on-the-ground" to prevent interference when in close proximity to an interrogator or other aircraft.

Note.— Mode S discretely addressed interrogations do not give rise to such interference and may be required for data link communications with aircraft on the airport surface. Acquisition squitter transmissions may be used for passive surveillance of aircraft on the airport surface.

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

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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.

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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 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.

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3.1.2.10.5 *DATA PROCESSING AND INTERFACES*

3.1.2.10.5.1 *Direct data.* Direct data shall be those which are required for the surveillance protocol of the Mode S system.

3.1.2.10.5.1.1 *Fixed direct data.* Fixed direct data are data from the aircraft which do not change in flight and shall be:

a) the aircraft address (3.1.2.4.1.2.3.1.1 and 3.1.2.5.2.2.2);

b) the maximum airspeed (3.1.2.8.2.2); and

c) the registration marking if used for aircraft identification (3.1.2.9.1.1).

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3.1.2.10.5.1.3 *Variable direct data.* Variable direct data are data from the aircraft which can change in flight and shall be:

a) the Mode C altitude code (3.1.2.6.5.4);

b) the Mode A identity code (3.1.2.6.7.1);

c) air/ground data (3.1.2.5.2.2.1, 3.1.2.6.5.1 and 3.1.2.8.2.1);

d) the aircraft identification if different from the registration marking (3.1.2.9.1.1); and

e) the SPI condition (3.1.2.6.10.1.3).

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3.1.2.10.5.1.4.4 Interfaces shall be included to accept the pressure-altitude and air/ground data.

Note.— A specific interface design for the variable direct data is not prescribed.

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3.1.2.11 ESSENTIAL SYSTEM CHARACTERISTICS OF THE GROUND INTERROGATOR MODE S CAPABILITIES

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3.1.2.11.1.1.1 The interrogation repetition rate for the paired Mode S-only and Mode A/C-only-all-call interrogations used for acquisition in the multisite mode shall be less than 250 per second.

3.1.2.11.1.1.2 *Maximum number of Mode S all-call replies triggered by an interrogator*. For aircraft that are not locked out, a Mode S interrogator shall not trigger, on average, more than 6 Mode S all-call replies per period of 200 ms and no more than 26 Mode S all-call replies counted over a period of 18 seconds.

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3.1.2.11.4 *SPURIOUS RESPONSE*

The response to signals not within the passband should be at least 60 dB below normal sensitivity.

3.1.2.11.5 *Lockout coordination*. A Mode S interrogator shall not be operated using all-call lockout until coordination has been achieved with all other operating Mode S interrogators having any overlapping coverage volume in order to ensure that no interrogator can be denied the acquisition of Mode S-equipped aircraft. If coordination is not possible due to system designs (for example, a mobile interrogator), the interrogator shall either use passive means of acquisition or operate using lockout override (3.1.2.5.2.1.4) with supplementary acquisition (3.1.2.5.2.1.5).

Note 1.— This coordination may be via ground network or by the allocation of interrogator codes and will involve regional agreements where coverage overlaps international boundaries.

Note 2.— Interrogators that do not use Mode S-only all-call interrogations, all-call lockout protocol or multisite data link protocol can use any IC value in the IIS or SIS fields of their selective interrogations without a need for coordination with neighbouring systems.

3.1.2.11.6 *MOBILE INTERROGATORS*

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14. The existing table of Chapter 3 shall be replaced by the following new table, namely: —

"TABLES FOR CHAPTER 3

Table 3-1. Pulse shapes —Interrogation pulse durations

Pulse	*Duration*	*Duration tolerance*	*(Rise time)*		*(Decay time)*	
			Min.	*Max.*	*Min.*	*Max.*
P_1, P_2, P_3, P_5	0.80	±0.09	0.05	0.10	0.05	0.20
P_4 (short)	0.80	±0.09	0.05	0.10	0.05	0.20
P_6 (short)	16.25	±0.20	0.05	0.10	0.05	0.20
P_6 (long)	30.25	±0.20	0.05	0.10	0.05	0.20
S_1	0.80	±0.10	0.05	0.10	0.05	0.20

Table 3-2. Pulse shapes — Mode S replies

Duration	*Duration tolerance*	*(Rise time) Max.*	*(Decay time) Max.*
0.5	±0.05	0.1	0.2
1.0	±0.05	0.1	0.2

. . .

Table 3-4. Subfield definitions

Subfield			
Designator	*Function*	*Field*	*Reference*
ACS	Altitude code subfield	ME	3.1.2.8.6.3.1.2
AIS	Aircraft identification subfield	MB	3.1.2.9.1.1
BDS 1	Comm-B data selector subfield 1	MB	3.1.2.6.11.2.1
BDS 2	Comm-B data selector subfield 2	MB	3.1.2.6.11.2.1
IDS	Identifier designator subfield	UM	3.1.2.6.5.3.1
IIS	Interrogator identifier subfield	SD	3.1.2.6.1.4.1 a)
		UM	3.1.2.6.5.3.1
LOS	Lockout subfield	SD	3.1.2.6.1.4.1 d)
LSS	Lockout surveillance subfield	SD	3.1.2.6.1.4.1 g)
MBS	Multisite Comm-B subfield	SD	3.1.2.6.1.4.1 c)
MES	Multisite ELM subfield	SD	3.1.2.6.1.4.1 c)
OVC	Overlay control	SD	3.1.2.6.1.4.1 i)
RRS	Reply request subfield	SD	3.1.2.6.1.4.1 e) and g)
RSS	Reservation status subfield	SD	3.1.2.6.1.4.1 c)
SCS	Squitter capability subfield	MB	3.1.2.6.10.2.2.1
SIC	Surveillance identifier capability	MB	3.1.2.6.10.2.2.1
SIS	Surveillance identifier subfield	SD	3.1.2.6.1.4.1 g)
SRS	Segment request subfield	MC	3.1.2.7.7.2.1
SSS	Surveillance status subfield	ME	3.1.2.8.6.3.1.1
TAS	Transmission acknowledgement subfield	MD	3.1.2.7.4.2.6

TMS	Tactical message subfield	SD	3.1.2.6.1.4.1 d)

. . .

Table 3-6. Table for the data link capability report (register 10_{16})

Subfields of register 10_{16}	*MB bits*	*Comm-B bits*
Continuation flag	9	41
Operational coordination message (OCM) transmit capability	10	42
Overlay command capability	15	47
ACAS capability	11–14,16 and 37–40	43–46, 48 and 69–72
Mode S subnetwork version number	17–23	49–55
Transponder enhanced protocol indicator	24	56
Specific services capability	25	57
Uplink ELM capability	26–28	58–60
Downlink ELM capability	29–32	61–64
Aircraft identification capability	33	65
Squitter capability subfield (SCS)	34	66
Surveillance identifier code capability (SIC)	35	67
Common usage GICB capability report	36	68
Basic dataflash capability	42	74
Phase overlay (PO) on extended squitter capability	43	75
Phase overlay (PO) on Mode S capability	44	76
Active transponder side indicator	49–50	81–82
Register 1116 data link capability (continuation) change indicator	26–28	58–60

Note.— The "Status of DTE sub address 0 to 15" subfield that was previously defined as MB bits 41– 56 in the data link capability report (register 1016) is now defined as MB bits 41–56 in the data link capability report (extension) (register 1116). Additional information on all bits in the data link capability report can be found in Doc 9871.

Table 3-6. Table for the data link capability report

Phase relative to sync reference (degrees)	Binary value MSB – LSB
0	000
45	001
90	010
135	011
180	100
225	101
270	110
315	111

. . .

Table 3-9. Timer characteristics

Timer				*Duration*	*Tolerance*	*Resettable*
Name	*Number*	*Reference*	*Symbol*	*s*	*s*	
Non-selective lock-out	1	3.1.2.6.9.2	*TD*	18	±1	no
Temporary alert	1	3.1.2.6.10.1.1.2	*TC*	18	±1	no
SPI	1	3.1.2.6.10.1.3	*TI*	18	±1	no
Reservations B, C, D	3*	3.1.2.6.11.3.1	*TR*	18	±1	yes
Multisite lockout	78	3.1.2.6.9.1	*TL*	18	±1	no
Basic dataflash	1	3.1.2.6.10.3.4.2	*TF*	30	±1	no
* As required						

. . .

Table 3-11. Transmitted interrogation signal details

Function	*Value*	*Reference*
Mode A/C		
Carrier frequency	1 030 ±0.20 MHz	3.1.1.1.1 – 3.1.1.1.2
Pulse interval $P_1 – P_3$ (Mode A)	8 ±0.18 microsecond	3.1.1.4.3
Pulse interval $P_1 – P_3$ (Mode C)	21 ±0.18 microsecond	3.1.1.4.3
Pulse interval $P_1 – P_2$	2 ±0.10 microsecond	3.1.1.4.4
Pulse duration P_1, P_2, P_3	0.8 ±0.09 microsecond	3.1.1.4.5
Pulse rise times	0.05 microsecond minimum, 0.10 microsecond maximum	3.1.1.4.6
Pulse decay times	0.05 microsecond minimum, 0.20 microsecond maximum	3.1.1.4.7
Pulse amplitude P_3	P_1 ±0.5 dB	3.1.1.5.2
Intermode		
Carrier frequency	1 030 ±0.01 MHz	3.1.2.1.1
Pulse duration P_1, P_2, P_3, P_4	0.8 ±0.09 microsecond	3.1.2.1.4.1
Pulse rise times	0.05 microsecond minimum, 0.10 microsecond maximum	3.1.2.1.4.1
Pulse decay times	0.05 microsecond minimum, 0.20 microsecond maximum	3.1.2.1.4.1
Pulse interval $P_1 – P_3$ (Mode A-Only All-Call)	8 ±0.18 microsecond	3.1.2.1.5.1.2.1

Pulse interval $P_1 – P_3$ (Mode C-Only All-Call)	21 ±0.18 microsecond	3.1.2.1.5.1.2.1
Pulse interval $P_1 – P_2$	2 ±0.04 microsecond	3.1.2.1.5.1.2.1
Pulse interval $P_3 – P_4$	2 ±0.04 microsecond	3.1.2.1.5.1.2.1
Pulse amplitude P_3	P_1 ±0.5 dB	3.1.2.1.5.1.2.2
Pulse amplitude P_4	P_3 –0.5 dB/+2.5 dB	3.1.2.1.5.1.2.2
Mode S		
Carrier frequency	1 030 ±0.01 MHz	3.1.2.1.1
Pulse duration P_1, P_2, P_3, P_5	0.8 ±0.09 microsecond	3.1.2.1.4.1
Pulse duration P_6 (short)	16.25 ±0.20 microsecond	3.1.2.1.4.1
Pulse duration P_6 (long)	30.25 ±0.20 microsecond	3.1.2.1.4.1
Pulse rise times	0.05 microsecond minimum, 0.10 microsecond maximum	3.1.2.1.4.1
Pulse decay times	0.05 microsecond minimum, 0.20 microsecond maximum	3.1.2.1.4.1
Pulse interval $P_1 – P_2$	2 ±0.04 microsecond	3.1.2.1.5.2.4
Pulse interval P_2 – sync phase reversal	2.75 ±0.04 microsecond	3.1.2.1.5.2.4
Pulse interval P_6 – sync phase reversal	1.25 ±0.04 microsecond	3.1.2.1.5.2.4
Pulse interval P_5 – sync phase reversal	0.4 ±0.04 microsecond	3.1.2.1.5.2.4
Pulse amplitude P_2	Equal to or greater than P_1 – 0.25 dB	3.1.2.1.5.2.5
Pulse amplitude first microsecond P_6	Equal to or greater than P_1 – 0.25 dB	3.1.2.1.5.2.5

Table 3-12. Phase overlay message type field definition

Message type value	Forward error correction	Meaning
0	N/A	No data
1	RS	ADSB state and status message
2		Mode S GICB data
3		Interrogation/reply monitor message
4		Test message
5		DF-18 (ADS-R, ADS-SLR, TISB)
6		Undefined
7		ADSB state and status message
8		Mode S GICB data
9		Interrogation/reply monitor message

10	LDPC	Test message
11		DF-18 (ADS-R, ADS-SLR, TISB)
12		Undefined
13–255	Reserved	

Table 3-13. Phase overlay LDPC data structure

Block #	Phase message data bit (34 bits)	Phase parity correction data bit (20 bits)
1	1–34	205–224
2	35–68	225–244
3	69–102	245–264
4	103–136	265–284
5	137–170	285–304
6	171–204	305–324

Table 3-14. Phase overlay message subtype field definition

Value	Meaning
0	No data
1	The PO data-block contains predefined values as defined for selected GICB registers
2–15	Reserved

FIGURES FOR CHAPTER 3

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NOTES:

Format No.	UF								
0	00000	3	RL:1	4	AQ:1	D5:8	10	AP:24	…Short air-air surveillance (ACAS)
1	00001	27 or 83						AP:24	… Reserved
2	00010	27 or 83						AP:24	…Reserved
3	00011	27 or 83						AP:24	…Reserved
4	00100	PC:3	RR:5	DI:3		SD:16		AP:24	…Surveillance, altitude request
5	00101	PC:3	RR:5	DI:3		SD:16		AP:24	… Surveillance, identify request
6	00110	27 or 83						AP:24	…Reserved
7	00111	27 or 83						AP:24	…Reserved
8	01000	27 or 83						AP:24	…Reserved
9	01001	27 or 83						AP:24	…Reserved
10	01010	27 or 83						AP:24	…Reserved
11	01011	PR:4	IC:4	CL:3		16		AP:24	… Mode S only all-call

12	01100	27 or 83						AP:24	…Reserved
13	01101	27 or 83						AP:24	…Reserved
14	01110	27 or 83						AP:24	…Reserved
15	01111	27 or 83						AP:24	…Reserved
16	10000	3	RL:1	4	AQ:1	18	MU:56	AP:24	… Long air-air surveillance (ACAS)
17	10001	27 or 83						AP:24	…Reserved
18	10010	27 or 83						AP:24	…Reserved
19	10011	107							…Reserved for military use
20	10100	PC:3	RR:5	DI:3	SD:16		MA:56	AP:24	… Comm-A, altitude request
21	10101	PC:3	RR:5	DI:3	SD:16		MA:56	AP:24	… Comm-A, identify request
22	10110	27 or 83						AP:24	…Reserved for military use
23	10111	27 or 83						AP:24	…Reserved
24	11	RC:2		NC:4		MC:80		AP:24	… Comm-C (ELM)

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Figure 3-7. Summary of Mode S interrogation or uplink formats

Format No.	DF										
0	00000	VS:1	CC:1	1	SL:3	2	RI:4	2	AC:13	AP:24	…Short air-air surveillance (ACAS)
1	00001	27 or 83								P:24	… Reserved
2	00010	27 or 83								P:24	…Reserved
3	00011	27 or 83								P:24	…Reserved
4	00100	FS:3		DR:5		UM:3		AC:16		AP:24	…Surveillance, altitude reply
5	00101	FS:3		DR:5		UM:3		ID:16		AP:24	… Surveillance, identify reply
6	00110	27 or 83								P:24	…Reserved
7	00111	27 or 83								P:24	…Reserved
8	01000	27 or 83								P:24	…Reserved
9	01001	27 or 83								P:24	…Reserved
10	01010	27 or 83								P:24	…Reserved
11	01011	CA:3				AA:24				PI:24	… All-call reply
12	01100	27 or 83								P:24	…Reserved
13	01101	27 or 83								P:24	…Reserved
14	01110	27 or 83								P:24	…Reserved
15	01111	27 or 83								P:24	…Reserved
16	10000	VS:1	2	SL:3	2	RI:4	2	AC:13	MV:56	AP:24	… Long air-air surveillance (ACAS)

17	10001	CA:3	AA:24	ME:56	PI:24		…Extended squitter/non transponder
18	10010	CF:3	AA:24	ME:56	PI:24		… Reserved for military use
19	10011	AF:3	10 4				…Comm-B, altitude reply …(see Note 5)
20	10100	FS:3	DR:5	UM:6	AC:13	MB:56	AP:24 DP:24	…Comm-B, identify reply …(see Note 5)
21	10101	FS:3	DR:5	UM:6	ID:13	MB:56	AP:24 DP:24	… Reserved for military use
22	10110	27 or 83					P:24	…Reserved for military use
23	10111	27 or 83					P:24	…Reserved
24	11	1	KE:1	ND:4	MD:80		AP:24	… Comm-D (ELM)

NOTES:

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Figure 3-8. Summary of Mode S reply or downlink formats

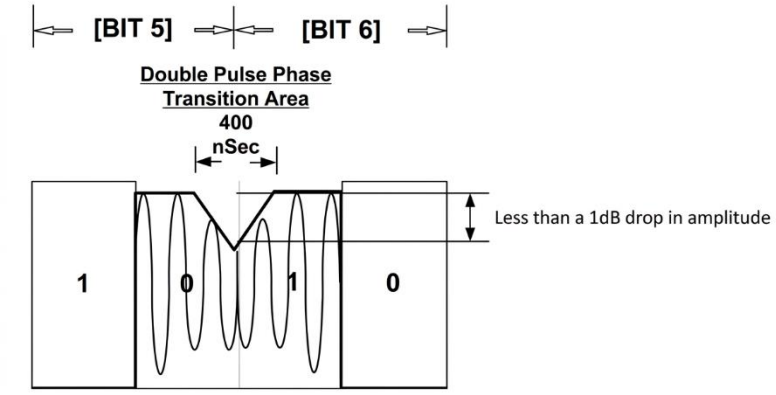


Figure 3-9. Phase overlay one microsecond phase transition

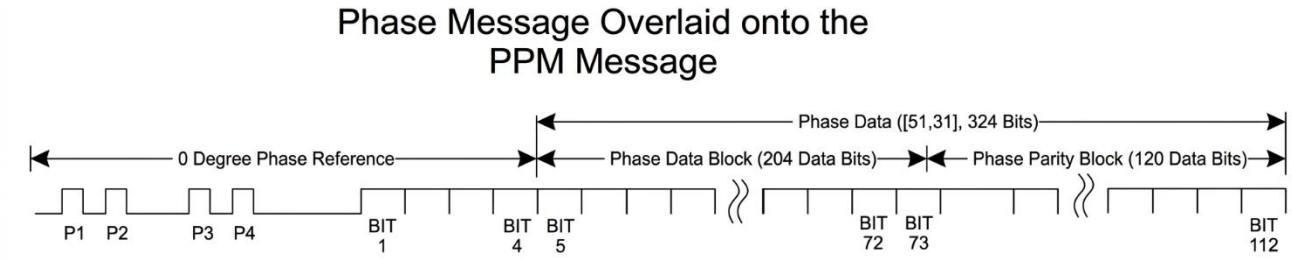


Figure 3-10. Phase overlay message structure

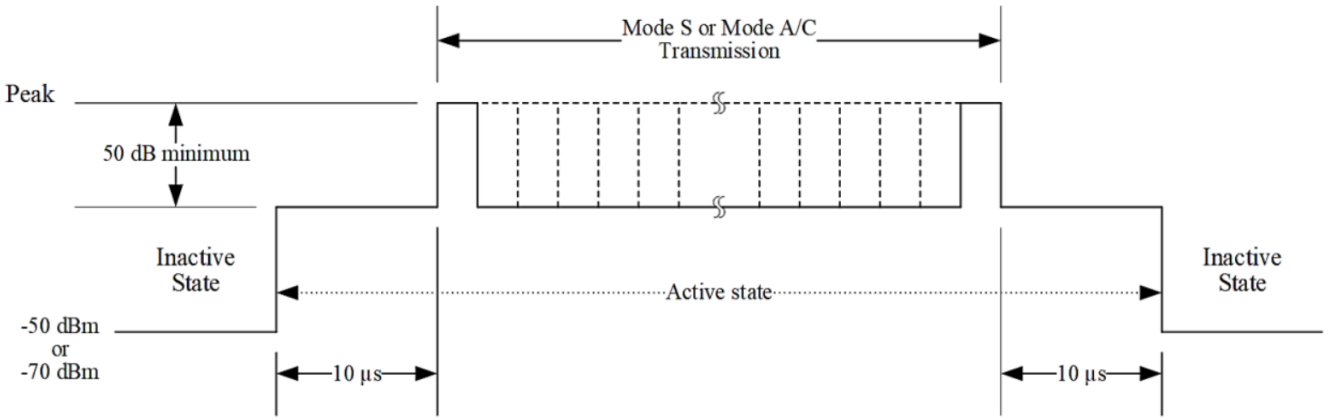


Figure 3-11 Unwanted output power

15. The existing text of regulation 5.1 shall be replaced by the following new text, namely: —

"CHAPTER 5. MODE S EXTENDED SQUITTER

. . .

5.1 MODE S EXTENDED SQUITTER TRANSMITTING SYSTEM CHARACTERISTICS

Note.— Many of the requirements associated with the transmission of Mode S extended squitter are included in Chapters 2 through 5 for Mode S transponder and non-transponder devices using the message formats defined in the Technical Provisions for Mode S Services and Extended Squitter *(Doc 9871). The provisions presented within the following subsections are focused on requirements applicable to specific classes of airborne and ground transmitting systems that are supporting the applications of ADS-B and TIS-B.*

5.1.1 ADS-B out requirements

5.1.1.1 Aircraft, surface vehicles and fixed obstacles supporting an ADS-B capability shall incorporate the ADS-B message generation function and the ADS-B message exchange function (transmit) as depicted in Figure 5-1.

5.1.1.1.1 ADS-B transmissions from aircraft shall be in accordance with 3.1.2.8.6.3 for transponder-based systems or 3.1.2.8.7.3.2 for non-transponder-based systems

5.1.1.1.2 *Extended squitter transmitting equipment should use formats and protocols of the latest version available.*

Note 1.— The data formats and protocols for messages transferred via extended squitter are specified in the Technical Provisions for Mode S Services and Extended Squitter *(Doc 9871).*

Note 2.— Some States and/or regions require extended squitter version 2 or later to be transmitted by specific dates.

5.1.1.2 *Extended squitter ADS-B transmission requirements.* Mode S extended squitter transmitting equipment shall be classified according to the unit's intended range capability and the set of parameters that it is capable of transmitting consistent with the following definition of general equipment classes and the specific equipment classes defined in Tables 5-1 and 5-2:

a) Class A extended squitter airborne systems support an interactive capability incorporating both an extended squitter transmission capability (i.e. ADS-B OUT) with a complementary extended squitter reception capability (i.e. ADS-B IN) in support of onboard ADS-B applications;

b) Class B extended squitter systems provide a transmission only (i.e. ADS-B OUT without an extended squitter reception capability) for use on aircraft, surface vehicles, or fixed obstructions; and

c) Class C extended squitter systems have only a reception capability and thus have no transmission requirements.

. . .

5.1.3 ADS-B OUT requirements for surface vehicles

5.1.3.1 All surface vehicles supporting any versions of extended squitter ADS-B capability shall transmit extended squitter messages as per 5.1.1.2.

5.1.3.2 *Extended squitter version 2 or later required system performance.* The position source and equipment installed in surface vehicles to transmit extended squitter version 2 or later messages shall support the following performance characteristics:

. . .

5.1.3.2.4 The system design assurance parameter shall be equal to 1 or more, which defines the probability of a failure resulting in transmission of false or misleading information to be less than or equal to 1 × 10-3.

Note 1.— These minimum performance requirements for extended squitter version 2 or later transmitted position data from surface vehicles are necessary to support aircraft-based alerting applications.

. . .**"**

16. The existing text of regulation 5.1 shall be replaced by the following new text, namely: —

"5.2 MODE S EXTENDED SQUITTER RECEIVING SYSTEM CHARACTERISTICS (ADS-B IN AND TIS-B IN)

. . .

Note 2.— Detailed technical provisions for Mode S extended squitter receivers can be found within RTCA DO-260C/EUROCAE ED-102B, "Minimum Operational Performance Standards for 1 090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS B)."

. . .

5.2.2.4 *Enhanced reception techniques.* Class A1, A2 and A3 airborne receiving systems shall include the following features to provide improved probability of Mode S extended squitter reception in the presence of multiple overlapping Mode A/C fruit and/or in the presence of an overlapping stronger Mode S fruit, as compared to the performance of the standard reception technique required for Class A0 airborne receiving systems:

a) Improved Mode S extended squitter preamble detection.

. . .

d) Advanced range receiver techniques for Class A3 receivers, which includes optional additional performance enhancements from the use of multiple receivers and antenna sectorization.

Note 1.— The above enhanced reception techniques are as defined in RTCA DO-260C/EUROCAE ED-102B, Appendix I.

Note 2.— The performance provided for each of the above enhanced reception techniques when used in a high fruit environment (i.e. with multiple overlapping Mode A/C fruit) is expected to be at least equivalent to that provided by the use of the techniques described in RTCA DO-260C/EUROCAE ED-102B, Appendix I.

. . .

5.2.3.2 When an extended squitter message is received, the message shall be decoded and the applicable ADS-B report(s) of the types defined in 5.2.3.3 shall be generated within 0.5 seconds.

. . .

Note 2.— Extended squitter ground receiving systems receive ADS-B messages and produce either application-specific subsets or complete ADS-B reports based on the needs of the ground service provider, including the client applications to be supported. Ground receiving systems may also generate ADS-B Wx Pilot Reports (PIREPs) based upon ADS-B Wx PIREP messages. Additional information on ADS-B Wx PIREP messages can be found in Doc 9871.

. . .

5.2.3.3 ADS-B REPORT TYPES

Note 1.— The ADS-B report refers to the restructuring of ADS-B message data received from Mode S extended squitter broadcasts into various reports that can be used directly by a set of client applications. Five ADS-B report types are defined by the following subparagraphs and additional two ADS-B report types (ADS-B Wx Air Report (AIREP)and Aircraft State Report) are defined in Doc 9871 for output to client applications. Additional information on the ADS-B report contents and the applicable mapping from extended squitter messages to ADS-B reports can be found in RTCA DO-260C / EUROCAE ED-102B.

Note 2.— The ADS-B Wx Air Report is an optional report that will be generated when weather information is received in ADS-B Wx subtype 1 and 2 messages along with additional weather information received in aircraft status subtype 1 extended squitter messages. The aircraft state report is an optional report that will be generated when information is received in ADS-B Wx subtype 0 messages. The ADS B Wx subtype 0, 1 and 2 messages are defined in Doc 9871. Specific requirements for the customization of this type of report may vary according to the needs of the client applications of each participant.

5.2.3.3.1 *State vector report.* The state vector report shall contain time of applicability, information about an airborne or vehicle's current kinematic state (e.g. position, velocity), as well as a measure of the integrity of the navigation data, based on information received in airborne or surface position, airborne velocity, identification and category, and aircraft operational status extended squitter messages. Since separate messages are used for position and velocity, the time of applicability shall be reported individually for the position related report parameters and the velocity related report parameters. Also, the state vector report shall include a time of applicability for the estimated position and/or estimated velocity information (i.e. not based on a message with updated position or velocity information) when such estimated position and/or velocity information is included in the state vector report.

. . .

5.2.3.3.2 *Mode status report.* The mode status report shall contain time of applicability and current operational information about the transmitting participant, including airborne/vehicle address, call sign, ADS-B version number, airborne/vehicle length and width information, state vector quality information, and other information based on information received in aircraft operational status, target state and status, aircraft identification and category, airborne velocity and aircraft status extended squitter messages. Each time that a mode status report is generated, the report assembler function shall update the report time of

applicability. Parameters for which valid data is not available shall either be indicated as invalid or omitted from the mode status report.

Note 1.— Specific requirements for the customization of this type of report may vary according to the needs of the client applications of each participant (ground or airborne).

Note 2.— The age of the information being reported within the various data elements of a mode status report may vary as a result of the information having been received within different extended squitter messages at different times. In the absence of item-specific timestamp information, the mode status report includes an optional data update flag that provides applications with the means to establish data age.

5.2.3.3.3 *Air referenced velocity report.* Air referenced velocity reports shall be generated when air referenced velocity information is received in airborne velocity or ADS-B Wx AIREP extended squitter messages. The air referenced velocity report shall contain time of applicability, airspeed and heading information. Only certain classes of extended squitter receiving systems, as defined in 5.2.3.5, are required to generate air referenced velocity reports. Each time that an individual air referenced velocity report is generated, the report assembly function shall update the report time of applicability.

Note 1.— The air referenced velocity report contains velocity information that is received in airborne velocity or ADS-B Wx AIREP messages along with additional information received in airborne identification and category extended squitter messages. Air referenced velocity reports are not generated for surface participants.

Note 2.— Specific requirements for the customization of this type of report may vary according to the needs of the client applications of each participant (ground or airborne).

. . .

5.2.3.4 TIS-B REPORT TYPES

5.2.3.4.1 As TIS-B messages are received by airborne receiving systems, the information shall be reported to client applications. Each time that an individual TIS-B report is generated, the report assembly function shall update the report time of applicability to the current time.

Note 1.— The TIS-B message formats are defined in the Technical Provisions for Mode S Services and Extended Squitter *(Doc 9871).*

. . .

5.2.3.4.2 *TIS-B target report.* All received information elements, other than position, shall be reported directly, including all reserved fields for the TIS-B fine format messages. The reporting format is not specified in detail, except that the information content reported shall be the same as the information content received.

. . .

5.2.3.4.5 *Traffic uplink management report.* The entire message content of any received traffic uplink management message shall be reported directly to the client applications. The information content reported shall be the same as the information content received.

5.2.3.4.5.1 The contents of any received traffic uplink management message shall be reported bit-for-bit to the client applications.

5.2.3.5 REPORT TIME OF APPLICABILITY

The receiving system shall use a local source of reference time as the basis for reporting the time of applicability, as defined for each specific ADS-B and TIS-B report type (see 5.2.3.3 and 5.2.3.4).

5.2.3.5.1 *GNSS UTC measure time reference.* For receiving systems that generate ADS-B and/or TIS-B reports that use GNSS UTC measured time for the purpose of generating the report time applicability, UTC measured time data shall have a minimum range of 300 seconds and a resolution of 0.0078125 (1/128) seconds.

5.2.3.5.2 *ESTABLISHED INSTALLATION RECEIVER TIME REFERENCE*

5.2.3.5.2.1 For receiving systems that generate ADS-B and/or TIS-B reports. that do not use GNSS UTC measure time per 5.2.3.5.1 and for which, there is no appropriate time reference available, the receiving system shall establish an appropriate internal clock or counter having a maximum clock cycle or count time of 20 milliseconds. The established cycle or clock count shall have a minimum range of 300 seconds and a resolution of 0.0078125 (1/128) seconds.

Note.— The use of a time reference as described above is intended to allow the report time of applicability to accurately reflect the time intervals applicable to reports within a sequence. For example, the applicable time interval between state vector reports could be accurately determined by a client application, even though the absolute time would not be indicated by the report.
. . .”

17. The existing table of Chapter 5 shall be replaced by the following new table, namely: —

“TABLES FOR CHAPTER 5
…

Table 5-3. Reception performance for airborne receiving systems

Receiver class	*Intended air-to-air operational range*	*Receiver minimum trigger threshold level (MTL) (see* Note 1*)*	*Reception Technique (see* Note 2*)*	*Required extended squitter ADS-B message support (includes ADS-R and ADS SLR)*	*Required extended squitter TIS-B message support (includes management messages)*
A0 (Basic VFR)	10 NM	–72 dBm	Standard	Airborne position Surface position Airborne velocity Aircraft identification and category Aircraft status Aircraft operational status	Fine airborne position Fine surface position Aircraft identification and category Airborne velocity Management
A1 (Basic IFR)	20 NM	–79 dBm	Enhanced	Airborne position Surface position Airborne velocity Aircraft identification and category Aircraft status Aircraft operational status	Fine airborne position Fine surface position Aircraft identification and category Airborne velocity Management

A2 (Enhanced IFR)	40 NM	–79 dBm	Enhanced	Airborne position Surface position Airborne velocity Aircraft identification and category Aircraft status Aircraft operational status Target state and status	Fine airborne position Fine surface position Aircraft identification and category Airborne velocity Management
A3 (Extended capability)	90 NM	–84 dBm (and –87 dBm at 15% probability of reception)	Enhanced	Airborne position Surface position Airborne velocity Aircraft identification and category Aircraft status Aircraft operational status Target state and status	Fine airborne position Fine surface position Aircraft identification and category Airborne velocity Management

Note 1.— Specific MTL is referenced to the signal level at the output terminal of the antenna, assuming a passive antenna. If electronic amplification is integrated into the antenna assembly, then the MTL is referenced at the input to the amplifier. For Class A3 receivers, a second performance level is defined at a received signal level of –87 dBm where 15 per cent of the messages are to be successfully received. MTL values refer to reception under non- interference conditions.

Note 2.— The extended squitter receiver reception techniques are defined in 5.2.2.4. "Standard" reception techniques refer to the baseline techniques, as required for ACAS 1 090 MHz receivers, that are intended to handle single overlapping Mode A/C fruit. "Enhanced" reception techniques refer to techniques intended to provide improved reception performance in the presence of multiple overlapping Mode A/C fruit and improved decoder re-triggering in the presence of overlapping stronger Mode S fruit. The requirements for the enhanced reception techniques that are applicable to the specific airborne receiver classes are defined in 5.2.2.4.

Note 3.— Management messages include TIS-B, ADS-R and ADS-SLR services. ADS-Rebroadcast (ADS-R) and ADS-Same Link Rebroadcast (ADS- SLR) are defined in Doc 9871.

…

Table 5-4. Mode S extended squitter airborne receiving system reporting requirements

Receiver class	*Minimum ADS-B reporting requirements*	*Minimum TIS-B reporting requirements*
A0 (Basic VFR)	ADS-B state vector report (per 5.2.3.3.1) and ADS-B mode status report (per 5.2.3.3.2)	TIS-B state report and Traffic uplink management report
A1 (Basic IFR)	ADS-B state vector report (per 5.2.3.3.1) and ADS-B mode status report (per 5.2.3.3.2) and ADS-B air referenced velocity report (ARV) (per 5.2.3.3.3)	TIS-B state report and Traffic uplink management report
A2 (Enhanced IFR)	ADS-B state vector report (per 5.2.3.3.1) and ADS-B mode status report (per 5.2.3.3.2) and ADS-B ARV report (per 5.2.3.3.3) and ADS-B target state report (per 5.2.3.3.5)	TIS-B state report and Traffic uplink management report

A3 (Extended capability)	ADS-B state vector report (per 5.2.3.3.1) and ADS-B mode status report (per 5.2.3.3.2) and ADS-B ARV report (per 5.2.3.3.3) and ADS-B target state report (per 5.2.3.3.5)	TIS-B state report and Traffic uplink management report
Note.— Traffic uplink management reports include TIS-B, ADS-R and ADS-SLR service status.		

…"

18. **This Amendment 1 to the Air Navigation Order (ANO), "ANO-10 Vol-4 on Surveillance and Collision Avoidance Systems" shall come into force on the date of publication in the Official Gazette**.

Air Vice Marshal Md. Mostafa Mahmood Siddiq
BSP, GUP, ndc, afwc, acsc, psc
Chairman
Civil Aviation Authority of Bangladesh

Summary of Changes

This table summarizes the changes introduced by Amendment 92 to Annex 10, Volume IV (Surveillance and Collision Avoidance Systems).

Amendment 92 to Annex 10, Volume IV (Surveillance and Collision Avoidance Systems)

Type of changes	Location	Existing Text	Amended Text	Comment
CHAPTER 1. DEFINITIONS				
New text to replace existing text	—	CHAPTER 1. DEFINITIONS Human Factors principles. Principles which apply to design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.	CHAPTER 1. DEFINITIONS Human Factors principles. Principles which apply to design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance. Lost C2 Link state. The state of the RPAS in which the C2 Link performance has degraded, as a result of a C2 Link interruption that is longer than the lost C2 Link decision time, to a point where it is not sufficient to allow the remote pilot to actively manage the flight in a safe and timely manner. Matching Interrogator Identifier (II) code. II code whose binary format in the interrogator code (IC) field is the same as the binary format in the IC field of the surveillance identifier (SI) code. Matching Surveillance Identifier (SI) code. SI code whose binary format in the IC field is the same as the binary format in the IC field of the interrogator identifier (II) code. Runway Transition Zone. A zone of a rectangular box exactly enclosing a runway in the horizontal direction and extending to 100 feet altitude above ground level.	
CHAPTER 2. GENERAL				
New text	**2.1.1**	—	2.1.1 General requirement	
New text to replace existing text	**2.1.1.1**	Note.— As referred to in this Annex, Mode A/C transponders are those which conform to the characteristics prescribed in 3.1.1. Mode S transponders are those which conform to the characteristics prescribed in 3.1.2. The functional capabilities of Mode A/C	Note.— As referred to in this Annex, Mode A/C transponders are those which conform to the characteristics prescribed in 3.1.1. Mode S transponders are those which conform to the characteristics prescribed in 3.1.1 and 3.1.2. The functional capabilities of Mode	

Type of changes	Location	Existing Text	Amended Text	Comment
		transponders are an integral part of those of Mode S transponders.	A/C transponders are an integral part of Mode S transponders.	
Deleted text	**2.1.2.1**	a) Mode A/C/S all-call: to elicit replies for surveillance of Mode A/C transponders and for the acquisition of Mode S transponders.	—	
Deleted text	**2.1.2.1**	b) Mode A/C-only all-call: to elicit replies for surveillance of Mode A/C transponders. Mode S transponders do not reply.	Mode A/C-only all-call: to elicit replies for surveillance of Mode A/C transponders. Mode S transponders do not reply.	
New text	**2.1.2.2**	—	Note 1.— Requirements for the Mode A and C interrogator are specified in 3.1.	
New text	**2.1.2.2.1**	—	2.1.2.2.1 Interrogators commissioned on or after 1 January 2030 shall also comply with the Mode A and C interrogator requirements specified in 3.1.1.5.2.2 and 3.1.1.8.2.2.	
New text to replace existing text	**2.1.2.4.1**	2.1.2.4.1 Side-lobe suppression shall be provided in accordance with the provisions of 3.1.1.4 and 3.1.1.5 on all Mode A, Mode C and intermode interrogations.	2.1.2.4.1 Side-lobe suppression shall be provided in accordance with the provisions of 3.1.1.4 and 3.1.1.5 on all Mode A, and Mode C interrogations.	
New text	**2.1.2.4.2**	—	2.1.2.4.2 Side-lobe suppression shall be provided in accordance with the provisions of 3.1.2.1.5.1.2.3 on all Mode A/C-only all-call interrogations.	
New text	**2.1.4.2.4**	—	2.1.4.2.4 Code 7400 to provide recognition of a remotely piloted aircraft system (RPAS) in a lost C2 state. Link	
New text	**2.1.4.2.4**	—	Note.— Details on a lost C2 Link state can be found in Annex 10 — Aeronautical Telecommunications, Volume VI – Communication Systems and Procedures relating to Remotely Piloted Aircraft Systems C2 Link.	
New text to replace existing text	**2.1.4.3**	2.1.4.3 Appropriate provisions shall be made in ground decoding equipment to ensure immediate recognition of Mode A codes 7500, 7600 and 7700.	2.1.4.3 Appropriate provisions shall be made in ground decoding equipment to ensure immediate recognition of Mode A codes 7400, 7500, 7600 and 7700.	
New text to replace existing text	**2.1.5.1**	2.1.5.1 All Mode S transponders shall conform to one of the following five levels:	2.1.5.1 Transponder levels. All Mode S transponders shall conform to one of the following five levels:	
New text to replace existing text	**2.1.5.1**	Note.— The transponder used for a Mode S site monitor may differ from the requirements defined for a normal Mode S transponder. For example, it may be necessary to reply to all-call interrogations when on the ground For more details see the Aeronautical Surveillance Manual (Doc 9924), Appendix D.	Note.— The transponder used for a Mode S site monitor may differ from the requirements defined for a normal Mode S transponder. For example, it may be necessary to reply to all-call interrogations when the effective air/ground state is “on-the-ground”. For more details see the Aeronautical Surveillance Manual (Doc 9924), Appendix D.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**2.1.5.1.1**	2.1.5.1.1 Level 1 —	2.1.5.1.1 Level 1 transponders	
New text to replace existing text	**2.1.5.1.1.1**	Level 1 transponders shall have the capabilities prescribed for:	2.1.5.1.1.1 Level 1 transponders shall have the capabilities prescribed for:	
New text to replace existing text	**2.1.5.1.1.1**	e) basic data protocols except data link capability reporting (3.1.2.6.10.2.2) and	e) basic data protocols except both data link capability reporting (3.1.2.6.10.2.2) and basic dataflash protocol (3.1.2.6.10.3);	
New text to replace existing text	**2.1.5.1.1.1**	f) air-air service and squitter transactions (3.1.2.8).;	f) air-air service and squitter transactions (3.1.2.8).; and	
New text	**2.1.5.1.1.1**	—	g) system characteristics of the SSR Mode S transponder (3.1.2.10) as applicable to the transponder level.	
New text to replace existing text	**2.1.5.1.1.1**	Note 1.— Level 1 permit SSR surveillance based on pressure-altitude reporting and the Mode A identity code. In an SSR Mode S environment, technical performance relative to a Mode A/C transponder is improved due to Mode S selective aircraft interrogation.	Note 1.— Level 1 transponders permit SSR surveillance based on pressure-altitude reporting and the Mode A identity code. In an SSR Mode S environment, technical performance relative to a Mode A/C transponder is improved due to Mode S selective aircraft interrogation.	
New text	**2.1.5.1.1.1**	—	Note 2.— Level 1 transponders are not sufficient to support ADS-B, elementary surveillance and enhanced surveillance. Also, RTCA DO-181F and EUROCAE ED-73F transponder MOPS no longer support Level 1 transponders.	
New text to replace existing text	**2.1.5.1.2**	2.1.5.1.2 Level 2 —	2.1.5.1.2 Level 2 transponders	
New text to replace existing text	**2.1.5.1.2.1**	Level 2 transponders shall have the capabilities of 2.1.5.1.1 and also those prescribed for:	2.1.5.1.2.1 Level 2 transponders shall have the capabilities of 2.1.5.1.1 and also those prescribed for:	
New text to replace existing text	**2.1.5.1.2.1**	a) standard length communications (Comm-A and Comm-B) (3.1.2.6.2, 3.1.2.6.4, 3.1.2.6.6, 3.1.2.6.8, and 3.1.2.6.11.2	a) standard length communications Comm-B) 3.1.2.6.6, 3.1.2.6.8, 3.1.2.6.11.2 and 3.1.2.6.11.4);	
New text to replace existing text	**2.1.5.1.2.1**	d) data parity with overlay control (3.1.2.6.11.2.5) for equipment certified on or after 1 January 2020.SI	d) code capability and operation (3.1.2.3.2.1.4, 3.1.2.5.2.1, 3.1.2.6.1.3, 3.1.2.6.1.4.1, 3.1.2.6.9.1.1 and 3.1.2.6.9.2).	
Deleted text	**2.1.5.1.2.1**	Note.— Level 2 permits aircraft identification reporting and other standard length data link communications from ground to air and air to ground. The aircraft	Note.— The aircraft identification reporting capability requires an interface and appropriate input device.	

Type of changes	Location	Existing Text	Amended Text	Comment
		identification reporting capability requires an interface and appropriate input device.		
New text	**2.1.5.1.2.2**	—	2.1.5.1.2.2 Level 2 transponders with Comm-A capability. Level 2 transponders with Comm-A capability shall have the capabilities of 2.1.5.1.2.1 and those prescribed for Comm-A standard length communication described in 3.1.2.6.2, 3.1.2.6.4 and 3.1.2.6.11.1.	
New text	**2.1.5.1.2.3**	—	2.1.5.1.2.3 Level 2 transponders with Air-initiated Comm-B capability. Level 2 transponders with Air-initiated Comm-B capability shall have the capabilities of 2.1.5.1.2.1 and those prescribed for Air-initiated Comm-B standard length communication described in 3.1.2.6.11.3.	
New text	**2.1.5.1.2.3**	—	Note.— Air-initiated Comm-B capability is an optional capability that is not reported to the ground. However, it will be detectable by the existence of applications supporting communication through Air-initiated Comm-B.	
New text	**2.1.5.1.2.4**	—	2.1.5.1.2.4 Level 2 transponders with basic dataflash capability. Level 2 transponders with basic dataflash capability shall have the capabilities of 2.1.5.1.2.1 and also those prescribed for basic dataflash described in 3.1.2.6.10.3.	
New text to replace existing text	**2.1.5.1.3**	2.1.5.1.3 Level 3	2.1.5.1.3 Level 3 transponders	
New text to replace existing text	**2.1.5.1.3.1**	Level 3 transponders shall have the capabilities of 2.1.5.1.2.1, and also those prescribed for ground-to-air extended length message (ELM) communications (3.1.2.7.1 to 3.1.2.7.5).	2.1.5.1.3.1 Level 3 transponders shall have the capabilities of 2.1.5.1.2.1, 2.1.5.1.2.2, 2.1.5.1.2.3 and those prescribed for ground-to-air extended length message (ELM) communications (3.1.2.7.1 to 3.1.2.7.5).	
New text to replace existing text	**2.1.5.1.3.1**	Note.— Level 3 permits extended length data link communications from ground to air and thus may provide retrieval from ground-based data banks and receipt of other air traffic services which are not available with Level 2 transponders.	Note.— Level 3 transponders permits extended length data link communications from ground to air and thus may provide retrieval from ground-based data banks and receipt of other air traffic services which are not available with Level 2 transponders.	
New text to replace existing text	**2.1.5.1.4**	2.1.5.1.4 Level 4	2.1.5.1.4 Level 4 transponders	
New text to replace existing text	**2.1.5.1.4.1**	Level 4 transponders shall have the capabilities of 2.1.5.1.3 and also those prescribed for air-to-ground	2.1.5.1.4.1 Level 4 transponders shall have the capabilities of 2.1.5.1.3 and also those prescribed for air-	

Type of changes	Location	Existing Text	Amended Text	Comment
		extended length message (ELM) communications (3.1.2.7.7 and 3.1.2.7.8).	to-ground extended length message (ELM) communications (3.1.2.7.7 and 3.1.2.7.8).	
New text to replace existing text	**2.1.5.1.5**	2.1.5.1.5 Level 5	2.1.5.1.5 Level 5 transponders	
New text to replace existing text	**2.1.5.1.5.1**	Level 5 transponders shall have the capabilities of 2.1.5.1.4 and also those prescribed for enhanced Comm-B and extended length message (ELM) communications (3.1.2.6.11.3.4, 3.1.2.7.6 and 3.1.2.7.9).	2.1.5.1.5.1 Level 5 transponders shall have the capabilities of 2.1.5.1.4 and also those prescribed for enhanced Comm-B and extended length message (ELM) communications (3.1.2.6.11.3.4, 3.1.2.7.6 and 3.1.2.7.9).	
New text to replace existing text	**2.1.5.1.6**	Note.— For example, a l Level 4 transponder with extended squitter capability would be designated “l Level 4 2e”.	Note.— For example, a Level 2 transponder with extended squitter capability would be designated Level 2e”.	
Deleted text	**2.1.5.1.7**	2.1.5.1.7 SI capability — Transponders with the ability to process SI codes shall have the capabilities of 2.1.5.1.1, 2.1.5.1.2, 2.1.5.1.3, 2.1.5.1.4 or 2.1.5.1.5 and also those prescribed for SI code operation (3.1.2.3.2.1.4, 3.1.2.5.2.1, 3.1.2.6.1.3, 3.1.2.6.1.4.1, 3.1.2.6.9.1.1 and 3.1.2.6.9.2). Transponders with this capability shall be designated with a suffix “s”.	—	
Deleted text	**2.1.5.1.7**	Note.— For example, a level 4 transponder with extended squitter capability and SI capability would be designated “level 4es”.	—	
Deleted text	**2.1.5.1.7.1**	2.1.5.1.7.1 SI code capability shall be provided in accordance with the provisions of 2.1.5.1.7 for all Mode S transponders installed on or after 1 January 2003 and by all Mode S transponders by 1 January 2005.	—	
Deleted text	**2.1.5.1.7.1**	Note.— Mandates from certain States may require applicability in advance of these dates.	—	
New text	**2.1.5.2**	—	2.1.5.2 Mode S transponder minimum capability	
New text to replace existing text	**2.1.5.2.1**	2.1.5.2.1 All Mode S transponders used by international civil air traffic shall conform, at least, to the requirements of Level 2 prescribed in 2.1.5.1.2.1.	2.1.5.2.1 All Mode S transponders used by international civil air traffic shall conform, at least, to the requirements of Level 2 transponders prescribed in 2.1.5.1.2.1.	
New text	**2.1.5.2.2**	—	2.1.5.2.2 Recommendation.— States should ensure that Level 1 transponders are not used in areas where SI codes are used.	
New text to replace existing text	**2.1.5.2.2**	Note 1.— Level 1 may be admitted for use within an individual State or within the terms of a regional air navigation agreement. The Mode S Level 1 transponder comprises the minimum set of features for compatible operation of Mode S transponders with SSR Mode S	Note 1.— Level 1 transponders do not report SI code capability. They remain unlocked in areas where SI codes are used; therefore, they affect the usage of 1 090 MHz frequency and contribute to 1 090 MHz RF pollution.	

Type of changes	Location	Existing Text	Amended Text	Comment
		interrogators. It is defined to prevent a proliferation of transponder types below Level 2 which would be incompatible with SSR Mode S interrogators.		
Deleted text	**2.1.5.2.2**	Note 2.— The intent of the requirement for a Level 2 capability is to ensure the widespread use of an ICAO standard transponder capability to allow worldwide planning of Mode S ground facilities and services. The requirement also discourages an initial installation with Level 1 transponders that would be rendered obsolete by later requirements in certain airspace for mandatory carriage of transponders having Level 2 capabilities.	—	
New text	**2.1.5.2.3**	—	2.1.5.2.3 All Mode S transponders shall maintain the alert condition if the Mode A identity code is changed to one of the Mode A codes of set 1 defined in 3.1.2.6.10.1.1.1, a).	
New text to replace existing text	**2.1.5.3**	2.1.5.3 Mode S transponders installed on aircraft with gross mass in excess of 5 700 kg or a maximum cruising true airspeed capability in excess of 463 km/h (250 kt) shall operate with antenna diversity as prescribed in 3.1.2.10.4 if:	2.1.5.3 Mode S transponders installed on aircraft with gross mass in excess of 5 700 kg or a maximum cruising true airspeed capability in excess of 463 km/h (250 kt) shall operate with antenna diversity as prescribed in 3.1.1.7.18 and 3.1.2.10.4 if:	
New text to replace existing text	**2.1.5.4**	2.1.5.4 CAPABILITY REPORTING IN MODE S SQUITTERS	2.1.5.4 TRANSPONDER CAPABILITY REQUIRED AT SPECIFIC DATES	
New text	**2.1.5.4**	—	Note.— The capabilities defined in this section allow a smooth implementation of new features and improvements of SSR Mode S transponders. The requirements on transponders are ensured through the certification process. Requirements on installation are ensured by the State in charge of the aircraft installation approval. Mode S transponder minimum capabilities are listed in 2.1.5.2.	
New text	**2.1.5.4.1**	—	2.1.5.4.1 All Mode S transponders certified on or after 1 January 1999 shall recover sensitivity to within 3 dB of minimum triggering level (MTL) no later than 45 microseconds after receipt of the sync phase reversal following a Mode S interrogation that is not accepted (3.1.2.4.1.2) or that is accepted but requires no reply.	
New text	**2.1.5.4.2**	—	2.1.5.4.2 Transponder designs first certified on or after 1 January 2011 shall have the spurious Mode A/C reply protection capability as specified in 3.1.1.7.8.5.2.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**2.1.5.4.3**	—	2.1.5.4.3 Mode S Level 2 transponders certified on or after 1 January 2020 shall have data parity with overlay control as specified in 3.1.2.6.11.2.5.	
New text	**2.1.5.4.4**	—	2.1.5.4.4 All Mode S transponders certified on or after 1 January 2020 shall not reply to Mode A/C/S all-call interrogations defined in 3.1.2.1.5.1.1.	
New text	**2.1.5.4.4**	—	Note 1.— If those transponders receive a Mode A/C/S all-call interrogation, it will be recognized as a Mode A/C-only all-call interrogation.	
New text	**2.1.5.4.4**	—	Note 2.— The replies to Mode A/C/S all-call interrogations are no longer supported by equipment certified on or after 1 January 2020 in order to reduce the RF pollution generated by the replies triggered by the false detection of Mode A/C/S all-call interrogations within other types of interrogation.	
New text	**2.1.5.4.5**	—	2.1.5.4.5 Mode S transponders certified on or after 1 January 2030 shall not accept the type control subfield (TCS), rate control subfield (RCS), or surface antenna subfield (SAS) commands received when DI = 2.	
New text	**2.1.5.4.5**	—	Note.— TCS, RCS and SAS were previously defined in 3.1.2.6.1.4.1, DI = 2.	
New text	**2.1.5.4.6**	—	2.1.5.4.6 Mode S transponders certified on or after 1 January 2030 shall maintain the alert condition if the Mode A identity code is changed to one of the codes of set 2 defined in 3.1.2.6.10.1.1.1, b).	
New text	**2.1.5.4.6**	—	Note.— Set 2 allows the reporting of a Mode A code of 7400 to indicate a lost C2 Link state for remotely piloted aircraft systems (RPAS).	
New text	**2.1.5.4.7**	—	2.1.5.4.7 Mode S transponders certified on or after 1 January 2030 shall not set to zero in bit 33 of the data link capability report when aircraft identification cannot be updated within 8 seconds (see 3.1.2.6.10.2.2.3).	
New text	**2.1.5.4.7**	—	Note.— Transponders certified before 1 January 2030 may be set to zero in bit 33 of the data link capability report when losing the aircraft identification input.	
New text	**2.1.5.4.8**	—	2.1.5.4.8 Mode S transponders certified on or after 1 January 2030 shall not set to zero for the aircraft identification upon the loss of the interface providing aircraft identification (see 3.1.2.9.1.4).	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**2.1.5.4.9**	—	2.1.5.4.9 Transponders certified on or after 1 January 2030 shall have their RF output power as specified in 3.1.1.7.17.2 and 3.1.2.10.2.1.2.	
New text	**2.1.5.4.10**	—	2.1.5.4.10 Recommendation.— Transmitters used to replace defective obsolete transmitters in transponders should meet the requirement defined in 3.1.1.7.17.2.1 and 3.1.2.10.2.1.2.1.	
New text	**2.1.5.4.11**	—	2.1.5.4.11 Transponders certified on or after 1 January 2030 shall have an improved dead time as specified in 3.1.1.7.3.2 and 3.1.2.10.3.2.2.	
New text	**2.1.5.4.12**	—	2.1.5.4.12 Mode S transponders certified on or after 1 January 2030 shall have a Mode S reply rate limiting of type 1 as specified in 3.1.2.10.3.6.1.2.	
Deleted text	**2.1.5.4.1**	2.1.5.4.1 Capability reporting in Mode S acquisition squitters (unsolicited downlink transmissions) shall be provided in accordance with the provisions of 3.1.2.8.5.1 for all Mode S transponders installed on or after 1 January 1995.	—	
Deleted text	**2.1.5.4.2**	2.1.5.4.2 Recommendation.— Transponders equipped for extended squitter operation should have a means to disable acquisition squitters when extended squitters are being emitted.	—	
Deleted text	**2.1.5.4.2**	Note.— This will facilitate the suppression of acquisition squitters if all ACAS units have been converted to receive the extended squitter.	—	
Deleted text	**2.1.5.5**	2.1.5.5 EXTENDED (ELM) LENGTH MESSAGE TRANSMIT POWER In order to facilitate the conversion of existing Mode S transponders to include full Mode S capability, transponders originally manufactured before 1 January 1999 shall be permitted to transmit a burst of 16 ELM segments at a minimum power level of 20 dBW.	—	
Deleted text	**2.1.5.5**	Note.— This represents a 1 dB relaxation from the power requirement specified in 3.1.2.10.2.	—	
New text	**2.1.8**	—	2.1.8 1 090 MHz receiver	
New text	**2.1.8.1**	—	2.1.8.1 Decoding of 1 090 MHz messages	
New text	**2.1.8.1.1**	—	2.1.8.1.1 1 090 MHz receivers produced on or after 1 January 2030 shall be capable of decoding messages transmitted by transponders compliant with the active state transponder output power specified in 3.1.1.7.17.2 and 3.1.2.10.2.1.2.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**2.1.8.1.2**	—	2.1.8.1.2 Recommendation.— 1 090 MHz receivers produced before 1 January 2030 should be capable of decoding messages transmitted by transponders compliant with the active state transponder output power specified in 3.1.1.7.17.2 and 3.1.2.10.2.1.2.	
New text	**2.1.9**	—	2.1.9 Mode S interrogator capability	
New text	**2.1.9.1**	—	2.1.9.1 Mode S interrogators shall comply with the requirements defined in 3.1.1 and 3.1.2.	
New text	**2.1.9.2**	—	2.1.9.2 Mode S interrogators shall not use Mode A/C/S all-call interrogations.	
New text	**2.1.9.2**	—	Note.— The use of Mode A/C/S all-call interrogations does not allow the use of stochastic lockout override and therefore might not ensure a sufficient probability of acquisition in areas of high density of flights or when other interrogators lockout transponder on II = 0 for supplementary acquisition.	
New text	**2.1.9.3**	—	2.1.9.3 II/SI code operation	
New text	**2.1.9.3.1**	—	2.1.9.3.1 Mode S ground station using an SI code shall:	
New text	**2.1.9.3.1**	—	a) acquire Mode S II-only transponders on the matching II code;	
New text to replace existing text	**2.1.9.3.1**	and	b) selectively interrogate Mode S II-only transponders on the matching II code; and	
New text	**2.1.9.3.1**	—	c) not lockout Mode S II-only transponders when ground stations with overlapping coverage are assigned matching II or SI codes.	
New text	**2.1.9.3.1**	—	Note 1.— A table of matching II/SI codes can be found in Doc 9924, Appendix H.	
New text	**2.1.9.3.1**	—	Note 2.— Mode S II/SI capable transponders support both II and SI codes. Only locking out Mode S II/SI capable transponders means the legacy Mode S II-only transponders are not in a lockout condition and can be acquired by other Mode S ground stations using the matching II code. The suppression of lockout for Mode S II-only transponder is only used when there is overlapping coverage with a ground station using a matching II or SI code, as it is important to use lockout to reduce RF transmissions.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**2.1.9.3.2**	—	2.1.9.3.2 Recommendation.— Mode S II/SI capable interrogator using an II code should be configurable to only lockout Mode S II/SI capable transponders.	
New text	**2.1.9.3.2**	—	Note 1.— This mode of operation is used when matching SI codes are used by overlapping interrogators.	
New text	**2.1.9.3.2**	—	Note 2.— A matching SI code is an SI code whose binary format in the IC field is the same as the binary format in the IC field of the II code. Each Mode S II code has four "matching" SI codes. A table of matching II/SI codes can be found in Doc 9924, Appendix H.	
New text	**2.1.9.3.2**	—	Note 3.— This recommendation is to make possible the assignment of matching II codes to Mode S interrogators in areas in which not all transponders are SI code capable and where a matching SI code is assigned.	
New text	**2.1.9.3.2**	—	Note 4.— This recommendation is not necessary if a monitoring programme has demonstrated that all transponders are SI code capable or if SI codes do not need to be used in the ICAO Region. More information on the use of this capability to make possible the assignment of SI codes can be found in Doc 9924, Appendix J.	
New text to replace existing text	**2.2.1.3**	Note.— Information on the monitoring of the operational state of the transponder is provided in RTCA DO-181 E Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/ Mode Select (ATCRBS/Mode S) Equipment, and in EUROCAE ED-73E Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders.	Note.— Information on the monitoring of the operational state of the transponder is provided in RTCA DO-181 F, Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/ Mode Select (ATCRBS/Mode S) Equipment, and in EUROCAE ED-73E F, Minimum Operational Performance Standards (MOPS) for Secondary Surveillance Radar Mode S Transponders.	
New text	**2.3**	—	2.3 Interference Tolerance Criterion	
New text	**2.3.1**	—	2.3.1 Aeronautical surveillance and collision avoidance system receivers defined in this volume utilizing the 1 030 and/or 1 090 MHz channels shall be able to meet their performance requirements under an average interference power to average noise power level ratio of no more than minus 10 dB.	
New text	**2.3.1**	—	Note 1.— Interference levels above this level may be harmful to the intended operation of the systems in this volume. This would apply to the combination of all non-pulsed interference sources present. Pulsed interference sources or sources with less than 100 per cent operational duty cycle need to be evaluated on a case-by-case basis. Compatibility between standardized systems in this Annex may be evaluated on a case-by-	

Type of changes	Location	Existing Text	Amended Text	Comment
			case basis, and interference mitigations may be used which are only available to standardized systems in this Annex.	
New text	**2.3.1**	—	Note 2.— The interference can be treated as additive noise such that interference 10 dB below a receiver's baseline noise floor generates 0.4 dB of additive noise.	
New text to replace existing text	**2.3.1**	_____	Note 3.— Additional information on application of this interference tolerance criterion and means of compliance can be found in Doc 9924. _____	
CHAPTER 3. SURVEILLANCE SYSTEMS				
New text to replace existing text	**3.1**	Note 1.— Section 3.1.1 prescribes the technical characteristics of SSR systems having only Mode A and Mode C capabilities. Section 3.1.2 prescribes the characteristics of systems with Mode S capabilities. Chapter 5 prescribes additional requirements on Mode S extended squitters.	Note 1.— Section 3.1.1 prescribes the technical characteristics of SSR Mode A and Mode C capabilities. Section 3.1.2 prescribes the characteristics of Mode S capabilities. Table 3-11 provides a summary of the interrogation signal details. Chapter 5 prescribes additional requirements on Mode S extended squitters.	
Deleted text	**3.1.1**	3.1.1 Systems having only Mode A and Mode C capabilities	3.1.1 Mode A and Mode C capabilities	
Deleted text	**3.1.1.2.2**	3.1.1.2.2 The frequency tolerance shall be plus or minus 31 MHz.	3.1.1.2.2 The frequency tolerance shall be plus or minus MHz.	
New text	**3.1.1.4**	—	Note.— The paragraphs herein describe the signals-in-space at the antenna(s) of the interrogator.	
New text	**Table 3-11**	—	Table 3-11 provides a summary of the interrogation signal details.	
Deleted text	**3.1.1.4.3**	3.1.1.4.3 The interval between P and P shall determine the mode of interrogation and shall be as 1 3 follows: Mode A 8 ±0.218 microseconds Mode C 21 ±0.218 microseconds	3.1.1.4.3 The interval between P and P shall determine the mode of interrogation and shall be as 1 3 follows: Mode A 8 microseconds Mode C 21 microseconds	
Deleted text	**3.1.1.4.5**	3.1.1.4.5 The duration of pulses P, P and P shall be 0.8 plus or minus 0.109 microsecond. 1 2 3...	3.1.1.4.5 The duration of pulses P, P and P shall be 0.8 plus or minus microsecond. 1 2 3...	
Deleted text	**3.1.1.5.1**	3.1.1.5.1 The radiated amplitude of P at the antenna of the transponder shall be: 2	3.1.1.5.1 The radiated amplitude of P shall be: 2	
New text to replace existing text	**3.1.1.5.2**	3.1.1.5.2 Within the desired beam width of the directional interrogation (main lobe), the radiated amplitude of P shall be within 1 dB of the radiated amplitude of P. 3 1	3.1.1.5.2 Within the desired beam width of the directional interrogation (main lobe), the radiated amplitude of P shall comply with 3.1.1.5.2.1 or 3.1.1.5.2.2 3	
New text	**3.1.1.5.2.1**	—	3.1.1.5.2.1 For interrogator commissioned before 1 January 2030, the radiated amplitude of P shall 3 be within 1 dB of the radiated amplitude of P. 1	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.1.5.2.2**	—	3.1.1.5.2.2 For interrogator commissioned on or after 1 January 2030, the radiated amplitude of P 3 shall be within 0.5 dB of the radiated amplitude of P. 1	
New text	**3.1.1.5.3**	—	3.1.1.5.3 One or two control pulses (P alone, or P and P) shall be transmitted using a separate 2 1 2 antenna pattern to suppress responses from aircraft in the side lobes of the interrogator antenna.	
New text	**3.1.1.5.3**	—	Note.— When using control pulses P and P, separate RF paths are used for the interrogation P pulse 1 2 1 and the control P pulse. The pulse characteristics and timing for both P pulses are given in 3.1.1.4. Further 1 1 details on the use of control pulses can be found in Doc 9924.	
New text	**3.1.1.6**	—	Note.—The paragraphs herein describe the signals-in-space at the antenna(s) of the transponder.	
Deleted text	**3.1.1.7**	3.1.1.7 TECHNICAL CHARACTERISTICS OF TRANSPONDERS WITH MODE A AND MODE C CAPABILITIES ONLY	3.1.1.7 TECHNICAL CHARACTERISTICS OF TRANSPONDERS MODE A AND MODE C CAPABILITIES	
New text to replace existing text	**3.1.1.7.1**	a) the received amplitude of P is in excess of a level 1 dB below the received 3 amplitude of P but no greater than 3 dB above the received amplitude of P; 1 1	a) the received amplitude of P is within plus or minus 1 dB 3 of the received amplitude of P; 1	
New text	**3.1.1.7.1**	—	d) the interval between P and P is 8 plus or minus 0.2 microsecond (Mode A), or 21 plus or minus 1 3 0.2 microsecond (Mode C); and	
New text	**3.1.1.7.1**	—	e) the duration of P and P is 0.8 plus or minus 0.1 microsecond. 1 3	
Deleted text	**3.1.1.7.3**	3.1.1.7.3 TIME. After recognition of a proper interrogation, the transponder shall not reply to any DEAD other interrogation, at least for the duration of the reply pulse train. This dead time shall end no later than 125 microseconds after the transmission of the last reply pulse of the group.	3.1.1.7.3 TIME. DEAD	
New text	**3.1.1.7.3.1**	—	3.1.1.7.3.1 For all transponders, the time interval beginning at the end of a reply transmission and ending when the receiver has regained sensitivity to within 3 dB of MTL (dead time) shall not exceed 125 microseconds.	
New text	**3.1.1.7.3.2**	—	3.1.1.7.3.2 For transponders with improved dead time, the time interval beginning at the end of a reply transmission and ending when the receiver has regained sensitivity to within 3 dB of MTL (dead time) shall not exceed 20 microseconds.	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.1.7.5.1**	b) the amplitude of these signals is nominally 7173 dB below 1 mW, with limits between 69 dB and 77 dB below 1 mW.	b) the amplitude of these signals is nominally dB below 1 mW, with limits between 69 dB and 77 dB below 1 mW.	
New text to replace existing text	**3.1.1.7.6**	3.1.1.7.6 Pulse duration discrimination. Signals of received amplitude between minimum triggering level and 6 dB above this level, and of a duration less than 0.3 microsecond, shall not cause the transponder to initiate reply or suppression action With the exception of single pulses with amplitude variations approximating an interrogation, any single pulse of a duration more than 1.5 microseconds shall not cause the transponder to initiate reply or suppression action over the signal amplitude range of minimum triggering level (MTL) to 50 dB above that level.	3.1.1.7.6 Pulse duration discrimination. Signals of received amplitude between minimum triggering level and –45 dBm and consisting of P and/or P with a duration less than 0.3 1 3 microsecond, shall not cause the transponder to initiate reply or suppression action more than 10 per cent of the time. With the exception of single pulses with amplitude variations approximating an interrogation, any single pulse of a duration more than 1.5 microseconds shall not cause the transponder to initiate reply or suppression action more than 10 per cent of the time over the signal amplitude range of minimum triggering level (MTL) to 50 dB above that level.	
New text	**3.1.1.7.8**	—	3.1.1.7.8 SPURIOUS EMISSIONS AND SPURIOUS RESPONSES	
New text	**3.1.1.7.8.1**	—	3.1.1.7.8.1 Equipment random triggering rate. In the absence of valid interrogation signals, transponders shall not generate more than 5 unwanted Mode A or Mode C replies per second as integrated over an interval of at least 30 seconds.	
New text to replace existing text	**3.1.1.7.8.2**	3.1.1.7.8.2 Rrandom triggering rate. In the absence of valid interrogation signals, Mode A/C transponders shall not generate more than 30 unwanted Mode A or Mode C replies per second as integrated over an interval equivalent to at least 300 random triggers, or 30 seconds, whichever is less. This random triggering rate shall not be exceeded when all possible interfering equipments installed in the same aircraft are operating at maximum interference levels.	3.1.1.7.8.2 Installed Rrandom triggering rate. In the absence of valid interrogation signals, transponders shall not generate more than 30 unwanted Mode A or Mode C replies per second as integrated over an interval of at least 30 seconds, This installed random triggering rate shall not be exceeded when all possible interfering equipments installed in the same aircraft are operating at maximum interference levels.	
New text	**3.1.1.7.8.4**	—	3.1.1.7.8.4 SPURIOUS RADIATION	
New text	**3.1.1.7.8.4.1**	—	3.1.1.7.8.4.1 Recommendation.— CW radiation should not exceed 70 dB below 1 W for the transponder.	
New text	**3.1.1.7.8.5**	—	3.1.1.7.8.5 SPURIOUS RESPONSES	
New text	**3.1.1.7.8.5.1**	—	3.1.1.7.8.5.1 Recommendation.— The response to signals not within the receiver pass band should be at least 60 dB below normal sensitivity.	
New text	**3.1.1.7.8.5.2**	—	3.1.1.7.8.5.2 For transponders with spurious Mode A/C reply protection capability, the spurious Mode A/C reply	

Type of changes	Location	Existing Text	Amended Text	Comment
			ratio resulting from low-level Mode S interrogations shall be no more than:	
New text	**3.1.1.7.8.5.2**	—	a) an average of 1 per cent in the input interrogation signal range between –81 dBm and the Mode S MTL; and	
New text	**3.1.1.7.8.5.2**	—	b) a maximum of 3 per cent at any given level in the input interrogation signal range between –81 dBm and the Mode S MTL.	
New text	**3.1.1.7.8.5.2**	—	Note 1.— For transponders that reply to Mode A/C/S all-call interrogations, failure to detect a low-level Mode S interrogation can also result in the transponder decoding a three-pulse Mode A/C/S all-call interrogation. This would result in the transponder responding with a Mode S all-call (DF = 11) reply. The above requirement will also control these DF = 11 replies since it places a limit on the probability of failing to correctly detect the Mode S interrogation.	
New text	**3.1.1.7.8.5.2**	—	Note 2.— More information about issuing a type certificate for aircraft and separate design approval can be found in the Airworthiness Manual (Doc 9760).	
New text to replace existing text	**3.1.1.7.9.2**	3.1.1.7.9.2 Reply rate limit control. To protect the system from the effects of transponder over- interrogation by preventing response to weaker signals when a predetermined reply rate has been reached, a sensitivity reduction type reply limit control shall be incorporated in the equipment. The range of this control shall permit adjustment, as a minimum, to any value between 500 and 2 000 replies per second, or to the maximum reply rate capability if less than 2 000 replies per second, without regard to the number of pulses in each reply. Sensitivity reduction in excess of 3 dB shall not take effect until 90 per cent of the selected value is exceeded. Sensitivity reduction shall be at least 30 dB for rates in excess of 150 per cent of the selected value.	3.1.1.7.9.2 Reply rate limit control. To protect the system from the effects of transponder over- interrogation by preventing response to weaker signals when a predetermined reply rate has been reached, a sensitivity reduction type reply limit control shall be incorporated in the equipment. The limit shall be set between 500 and 2 000 Mode A/C replies per second, without regard to the number of pulses in each reply. Sensitivity reduction in excess of 3 dB shall not take effect until 90 per cent of the selected value is exceeded.	
New text to replace existing text	**3.1.1.7.10**	3.1.1.7.10 Reply delay and jitter. The time delay between the arrival, at the transponder receiver, of the leading edge of P and the transmission of the leading edge of the first pulse of the reply shall be 3 plus 3 or minus 0.5 microseconds. The total jitter of the reply pulse code group, with respect to P, shall not exceed 3 0.1 microsecond for receiver input levels between 3 dB and 50 dB above minimum triggering level. Delay variations between modes on which the transponder is capable of replying shall not exceed 0.2 microseconds.	3.1.1.7.10 Reply delay and jitter. The time delay between the arrival, at the transponder receiver, of the leading edge of P and the transmission of the leading edge of the first pulse of the reply shall be 3 plus 3 or minus 0.5 microseconds. The total jitter of the reply pulse code group, with respect to P, shall not exceed 3 0.1 microsecond for receiver input levels between 3 dB and 50 dB above minimum triggering level. Delay variations between Mode A and Mode C shall not exceed 0.2 microseconds.	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.1.7.12.1.1**	3.1.1.7.12.1.1 The Mode A code shall be manually selected from the 4 096 codes available.	3.1.1.7.12.1.1 The Mode A code shall be selected from the 4 096 codes available.	
New text to replace existing text	**3.1.1.7.13**	3.1.1.7.13 Transmission of the special position identification (SPI) pulse. When required, this pulse shall be transmitted with Mode A replies, as specified in 3.1.1.6.3, for a period of between 15 and 30 seconds.	3.1.1.7.13 Transmission of the special position identification (SPI) pulse. When required, this pulse shall be transmitted with Mode A replies, as specified in 3.1.1.6.3, for a period of between 18 plus or minus 1 seconds.	
New text	**3.1.1.7.15**	—	3.1.1.7.15 Simultaneous Signals. If a P – P suppression pair and a Mode A or Mode C interrogation 1 2 are recognized simultaneously, the transponder shall be suppressed. An interrogation shall not be recognized as Mode A or Mode C if the transponder is in suppression (3.1.1.7.4). If a Mode A and a Mode C interrogation are recognized simultaneously, the transponder shall complete the transaction cycle as if only a Mode C interrogation had been recognized.	
New text	**3.1.1.7.16**	—	3.1.1.7.16 Reply ratio in the presence of low-level in-band CW interference. In the presence of non-coherent CW interference at a frequency of 1 030 ±0.2 MHz at signal levels of 20 dB or more below the desired Mode A/C interrogation signal level, the transponder shall reply correctly to at least 90 per cent of the interrogations.	
New text	**3.1.1.7.17**	—	3.1.1.7.17 Unwanted Output Power	
New text	**3.1.1.7.17.1**	—	3.1.1.7.17.1 Inactive state transponder output power. When the transponder is in the inactive state, (refer to Figure 3-11), the peak power at 1 090 MHz plus or minus 3 MHz at the antenna end of the transmission line of the transponder, shall not exceed –50 dBm.	
New text	**3.1.1.7.17.1**	—	Note 1.— Inactive state transponder output power is constrained in this way to ensure that an aircraft, when located as near as 185 m (0.1 NM) to a Mode A/C or Mode S interrogator, does not cause interference to that installation.	
New text	**3.1.1.7.17.1**	—	Note 2.— Transponders with Mode S capability and installed with an ACAS unit have stricter requirements defined in 3.1.2.10.2.1.1.	
New text	**3.1.1.7.17.2**	—	3.1.1.7.17.2 Active state transponder output power.	
New text	**3.1.1.7.17.2.1**	—	3.1.1.7.17.2.1 The RF output power shall be less than or equal to the peak pulse power minus 50 dB for the interval starting 10 microseconds prior to the Mode A/C	

Type of changes	Location	Existing Text	Amended Text	Comment
			transmission and for the interval of 10 microseconds following a Mode A/C transmission.	
New text	**3.1.1.7.17.2.2**	—	3.1.1.7.17.2.2 For intervals between transmitted pulses that are greater than 0.5 microsecond, the power level at the lowest point within the interval shall be 50 dB or more below the peak pulse power.	
New text	**3.1.1.7.17.2.2**	—	Note 1.— These power limitations protect 1 090 MHz receivers from potential missed decodes when signals are received at close range and within desired detection range. In the absence of such limits, signal levels during non-pulse intervals can occur above receiver thresholds and can lead to unintended distortion of pulse positions or false pulse decodes preventing proper detection of transmitted signals. It also makes it more difficult for receivers to decode overlapped replies.	
New text	**3.1.1.7.17.2.2**	—	Note 2.— The presence of a signal at a level of 50 dB or more below the peak power may not be measurable within the first 0.5 microsecond following the transmission of a pulse because of the allowed decay time. It is possible that a signal transmitted 50 dB below the peak pulse power can still affect high sensitivity receivers when transmitted in close range. More information is available in Doc 9924.	
New text	**3.1.1.7.17.2.2**	—	Note 3.— Information on how to verify unwanted output power can be found in RTCA/DO-181F or EUROCAE/ED-73F.	
New text	**3.1.1.7.18**	—	3.1.1.7.18 Transponder antenna system and diversity operation. 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.	
New text	**3.1.1.7.18.1**	—	3.1.1.7.18.1 Radiation pattern. The radiation pattern of antennas when installed on an aircraft shall be nominally equivalent to that of a quarter-wave monopole on a ground plane.	
New text	**3.1.1.7.18.1**	—	Note.— Transponder antennas designed to increase gain at the expense of vertical beamwidth are undesirable because of their poor performance during turns.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.1.7.18.2**	—	3.1.1.7.18.2 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.	
New text	**3.1.1.7.18.2.1**	—	3.1.1.7.18.2.1 Recommendation.— The horizontal distance between the top and bottom antennas should not be greater than 7.6 m (25 ft).	
New text	**3.1.1.7.18.2.1**	—	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.	
New text	**3.1.1.7.18.3**	—	3.1.1.7.18.3 Antenna selection. 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 pulse and the P pulse of a Mode A or Mode C interrogation meet 1 3 the requirements for Mode A and Mode C interrogations as defined in 3.1.1.	
New text	**3.1.1.7.18.3.1**	—	3.1.1.7.18.3.1 If the two channels simultaneously receive a P – P pulse pair that meets the 1 3 requirements for a Mode A or Mode C interrogation, the antenna at which the signal strength is greater shall be selected for the transmission of the reply.	
New text	**3.1.1.7.18.3.2**	—	3.1.1.7.18.3.2 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.	
New text	**3.1.1.7.18.3.3**	—	3.1.1.7.18.3.3 Selection threshold. If antenna selection is based on signal level, it shall be carried out at all signal levels between MTL and –21 dBm.	
New text	**3.1.1.7.18.3.3**	—	Note.— Either antenna may be selected if the difference in signal level is less than 3 dB.	
New text	**3.1.1.7.18.3.4**	—	3.1.1.7.18.3.4 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	

Type of changes	Location	Existing Text	Amended Text	Comment
			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.	
New text	**3.1.1.7.18.4**	—	3.1.1.7.18.4 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.	
New text	**3.1.1.7.18.5**	—	3.1.1.7.18.5 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.	
New text	**3.1.1.7.18.5**	—	Note.— This requirement limits apparent jitter caused by antenna switching and by cable delay differences.	
New text	**3.1.1.7.19**	—	3.1.1.7.19 Variable direct data. Variable direct data from the aircraft which can change in flight shall be:	
New text	**3.1.1.7.19**	—	a) the Mode C altitude code (3.1.1.7.12.2);	
New text	**3.1.1.7.19**	—	b) the Mode A identity code (3.1.1.7.12.1); and	
New text	**3.1.1.7.19**	—	c) the SPI condition (3.1.1.6.3).	
New text	**3.1.1.7.19.1**	—	3.1.1.7.19.1 Interfaces for variable direct data	
New text	**3.1.1.7.19.1.1**	—	3.1.1.7.19.1.1 A means shall be provided, while on the ground or during flight, for the SPI condition to be inserted by the pilot, without the entry or modification of other flight data.	
New text	**3.1.1.7.19.1.2**	—	3.1.1.7.19.1.2 A means shall be provided, while on the ground or during flight, for the Mode A identity code to be displayed to the pilot and modified without the entry or modification of other flight data.	
New text	**3.1.1.7.19.1.2**	—	Note.— Implementation of the pilot action for entry of data will be as simple and efficient as possible in order to	

Type of changes	Location	Existing Text	Amended Text	Comment
			minimize the time required and reduce the possibility of errors in the data entry.	
New text	**3.1.1.7.19.1.3**	—	3.1.1.7.19.1.3 Interfaces shall be included to accept the pressure-altitude.	
New text	**3.1.1.7.19.1.3**	—	Note.— A specific interface design for the variable direct data is not prescribed.	
Deleted text	**3.1.1.8**	3.1.1.8 TECHNICAL CHARACTERISTICS OF GROUND INTERROGATORS WITH MODE A AND MODE C CAPABILITIES ONLY	3.1.1.8 TECHNICAL CHARACTERISTICS OF GROUND INTERROGATORS MODE A AND MODE C CAPABILITIES	
New text to replace existing text	**3.1.1.8.2.1**	Recommendation.— In order to minimize system interference the effective radiated power of interrogators should be reduced to the lowest value consistent with the operationally required range of each individual interrogator site.	3.1.1.8.2.1 Recommendation.— In order to minimize system interference the effective radiated power of interrogators should be reduced to the lowest value consistent with the operationally required range of each individual interrogator site.	
New text	**3.1.1.8.2.2**	—	3.1.1.8.2.2 Inactive-state interrogator output power. For interrogator commissioned on or after 1 January 2030, when the interrogator is not transmitting an interrogation, its output shall not exceed –5 dBm effective radiated power at any frequency between 960 MHz and 1 215 MHz.	
New text	**3.1.1.8.2.2**	—	Note.— This constraint ensures that aircraft flying near the interrogator (as close as 1.85 km (1 NM)) will not receive interference that would prevent them from being tracked by another interrogator. In certain instances, even smaller interrogator-to-aircraft distances are of significance, for example, if Mode S surveillance on the airport surface is used. In such cases, a further restraint on inactive state interrogator output power may be necessary.	
New text	**3.1.1.98.4**	—	Note.— This Recommendation is to reduce transponder occupancy. More information can be found in Doc 9924, Appendices D and M.	
Deleted text	**3.1.1.118.6**	3.1.1.118.6 SPURIOUS EMISSIONS AND SPURIOUS RESPONSES	SPURIOUS EMISSIONS AND SPURIOUS RESPONSES	
Deleted text	**3.1.1.118.6.1**	3.1.1.118.6.1 SPURIOUS RADIATION	SPURIOUS RADIATION	
Deleted text	**3.1.1.118.6.1**	Recommendation.— CW radiation should not exceed 76 dB below 1 W for the interrogator and 70 dB below 1 W for the transponder.	Recommendation.— CW radiation should not exceed 76 dB below 1 W for the interrogator	
Deleted text	**3.1.1.11.2**	3.1.1.11.2 SPURIOUS RESPONSES	—	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.1.11.2**	Recommendation.— The response of both airborne and ground equipment to signals not within the receiver pass band should be at least 60 dB below normal sensitivity.	—	
New text to replace existing text	**3.1.2**	3.1.2 Systems having Mode S capabilities	3.1.2 Mode S and intermode capabilities	
New text to replace existing text	**3.1.2.1**	3.1.2.1 Interrogation signals-in-space characteristics. The paragraphs herein describe the signals-in- space as they can be expected to appear at the antenna(s) of the transponder	3.1.2.1 Interrogation signals-in-space characteristics. The paragraphs herein describe the signals-in- space at the antenna(s) of the interrogator.	
Deleted text	**3.1.2.1**	Note.— Because signals can be corrupted in propagation, certain interrogation pulse duration, pulse spacing and pulse amplitude tolerances are more stringent for interrogators as described in 3.1.2.11.4.	—	
New text to replace existing text	**3.1.2.1.4.1**	3.1.2.1.4.1 Pulse modulation. Intermode and Mode S interrogations shall consist of a sequence of pulses as specified in 3.1.2.1.5 and Tables 3-1, 3-2, 3-3, and 3-4,	3.1.2.1.4.1 Pulse modulation. Intermode and Mode S interrogations shall consist of a sequence of pulses as specified in 3.1.2.1.5 and Tables 3-1, 3-3, and 3-4, as summarized in Table 3-11.	
New text to replace existing text	**3.1.2.1.5.1.1**	This interrogation shall consists of of three pulses: P, P, and the long P as shown 1 3 4 in Figure 3-3. One or two control pulses (P alone, or P and P) shall be transmitted using a separate 2 1 2 antenna pattern to suppress responses from aircraft in the side lobes of the interrogator antenna.	Note.— This interrogation consists of a minimum of three pulses: P, P, and the long P as shown 1 3 4 in Figure 3-3.	
Deleted text	**3.1.2.1.5.1.1**	Note.— The Mode A/C/S all-call interrogation elicits a Mode A or Mode C reply (depending on the P - 1 P pulse spacing) from a Mode A/C transponder because it does not recognize the P pulse. A Mode S 3 4 transponder recognizes the long P pulse and responds with a Mode S reply. This interrogation was 4 originally planned for use by isolated or clustered interrogators. Lockout for this interrogation was based on the use of II equals 0. The development of the Mode S subnetwork now dictates the use of a non-zero II code for communication purposes. For this reason, II equals 0 has been reserved for use in support of a form of Mode S acquisition that uses stochastic/lockout override (3.1.2.5.2.1.4 and 3.1.2.5.2.1.5). The Mode A/C/S all-call cannot be used with full Mode S operation since II equals 0 can only be locked out for short time periods (3.1.2.5.2.1.5.2.1). This interrogation cannot be used with stochastic/lockout override, since probability of reply cannot be specified.	—	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.2.1.5.1.1.1**	3.1.2.1.5.1.1.1 Mode A/C/S all-call interrogations shall not be used on or after 1 January 2020.	—	
Deleted text	**3.1.2.1.5.1.1.1**	Note 1.— The use of Mode A/C/S all-call interrogations does not allow the use of stochastic lockout override and therefore might not ensure a good probability of acquisition in areas of high density of flights or when other interrogators lockout transponder on II=0 for supplementary acquisition.	—	
Deleted text	**3.1.2.1.5.1.1.1**	Note 2.— The replies to Mode A/C/S all-call interrogations will no longer be supported by equipment certified on or after 1 January 2020 in order to reduce the RF pollution generated by the replies triggered by the false detection of Mode A/C/S all-call interrogations within other types of interrogation.	—	
New text to replace existing text	**3.1.2.1.5.1.2**	This interrogation shall be identical to that of the Mode A/C/S all-call interrogation except that the short P pulse shall be used. 4	Note 1.— This interrogation is defined as P, P, and a short P as shown in Figure 3-3 1 3 4	
Deleted text	**3.1.2.1.5.1.32.1**	3.1.2.1.5.1.32.1 Pulse intervals. The pulse intervals between P, P and P shall be as defined in 1 2 3 3.1.1.4.3 and 3.1.1.4.4. The pulse interval between P and P shall be 2 plus or minus 0.054 microsecond. 3 4	3.1.2.1.5.1.32.1 Pulse intervals. The pulse intervals between P and P shall be as defined in 3 3.1.1.4.3 The pulse interval between P and P shall be 2 plus or minus microsecond. 3 4	
Deleted text	**3.1.2.1.5.1.42.2**	3.1.2.1.5.1.42.2 Pulse amplitudes. Relative amplitudes between pulses P, P and P shall be in 1 2 3 accordance with 3.1.1.5. The amplitude of P shall be within –0.51/+2.5 dB of the amplitude of P. 4 3	3.1.2.1.5.1.42.2 Pulse amplitudes. Relative amplitudes between pulses P and P shall be in 3 accordance with 3.1.1.5. The amplitude of P shall be within dB of the amplitude of P. 4 3	
New text	**3.1.2.1.5.1.2.3**	—	3.1.2.1.5.1.2.3 Sidelobe suppression. The pulse interval between P and P shall be 2 plus or minus 1 2 0.04 microsecond. Amplitude of P shall be in accordance with 3.1.1.5. 2	
New text	**3.1.2.1.5.1.2.3**	—	Note 1.— Side-lobe suppression is required for SSR interrogators per 2.1.2.4.1. ACAS and multilateration system interrogations may or may not include the P pulse. 2	
New text	**3.1.2.1.5.1.2.3**	—	Note 2.— When used, P is additionally radiated to prevent replies from aircraft in the side and back 2 lobes of the antenna.	
New text to replace existing text	**3.1.2.1.5.2**	1.—3.1.2.1.5.2 Mode S interrogation. The Mode S interrogation shall consists of three pulses: P, P and P as shown in Figure 3-4. 1 2 6	Note The Mode S interrogation consists of a minimum of three pulses: P, P and P as shown in Figure 3-4. 1 2 6	
Deleted text	**3.1.2.1.5.2.4**	3.1.2.1.5.2.4 Intervals. The pulse interval between P and P shall be 2 plus or minus 0.054 1 2 microsecond. The	3.1.2.1.5.2.4 Intervals. The pulse interval between P and P shall be 2 plus or minus 1 2 microsecond. The interval	

Type of changes	Location	Existing Text	Amended Text	Comment
		interval between the leading edge of P and the sync phase reversal of P shall be 2.75 2 6 plus or minus 0.054 microsecond. The leading edge of P shall occur 1.25 plus or minus 0.054 microsecond 6 before the sync phase reversal. P, if transmitted, shall be centred over the sync phase reversal; the leading 5 edge of P shall occur 0.4 plus or minus 0.054 microsecond before the sync phase reversal. 5	between the leading edge of P and the sync phase reversal of P shall be 2.75 2 6 plus or minus microsecond. The leading edge of P shall occur 1.25 plus or minus microsecond 6 before the sync phase reversal. P, if transmitted, shall be centred over the sync phase reversal; the leading 5 edge of P shall occur 0.4 plus or minus microsecond before the sync phase reversal. 5	
New text	**3.1.2.2**	—	Note.— The paragraphs herein describe the signals-in-space at the antenna(s) of the transponder.	
New text to replace existing text	**3.1.2.2.1.1**	The carrier frequency of all replies (downlink transmissions) from transponders with Mode S capabilities shall be 1 090 plus or minus 1 MHz.	3.1.2.2.1.1 Standard pulse position modulation (PPM) reply carrier frequency. The carrier frequency of all standard Mode S PPM replies (downlink transmissions) shall be 1 090 plus or minus 1 MHz.	
New text	**3.1.2.2.1.2**	—	3.1.2.2.1.2 Phase overlay reply frequency. The carrier frequency of all phase overlay reply transmissions as defined in 3.1.2.3.1.2.2 shall be 1 090 MHz plus or minus 25 KHz.	
New text	**3.1.2.2.6**	—	3.1.2.2.6 Reply phase overlay characteristics	
New text	**3.1.2.2.6.1**	—	3.1.2.2.6.1 Reply phase overlay modulation type. The phase modulation reply transmission defined in 3.1.2.3.1.2.2 shall use 8 phase-shift keying (PSK) phase states to transmit 3-bits associated with a single phase state for each PPM data bit and in each of the four preamble pulses.	
New text	**3.1.2.2.6.2**	—	3.1.2.2.6.2 Phase error tolerance. The phase error of transmitted phase information shall be within 3.0 degrees root-mean-square (RMS) and 12.2 degrees peak for the duration of any 0.5 microsecond PPM reply pulse, excluding the leading and trailing edges of the pulse. When a one-microsecond pulse is transmitted as a result of a PPM ZERO data bit in the second half of one PPM bit interval followed by a PPM ONE bit in the first half of the next interval, the phase error for the phase information for each of the 2-phase states shall be within 3.0 degrees RMS and 12.2 degrees peak, except during the phase transition interval when a phase change is required between the 2-phase states, and the leading and trailing edges of the one-microsecond pulse. The phase error tolerance is in addition to the average frequency tolerance specified in 3.1.2.2.1.2, including the phase drift tolerance specified in 3.1.2.2.6.4.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.2.6.2**	—	Note.— During transmitter pulse turn-on and turn-off, the phase of the transmitted signal is typically not stable until the final RF output power is reached at the top portion of the pulse. The phase overlay reception algorithm does not rely on a constant phase during the transient portions of the pulse.	
New text	**3.1.2.2.6.3**	—	3.1.2.2.6.3 Phase modulation during the phase transition interval. For a 1.0 microsecond pulse which is formed by a PPM ZERO data bit followed by a PPM ONE data bit, the phase transition interval in which the phase is allowed to change between states shall be less than the 400-nanosecond intervals commencing 200 nanoseconds prior to the PPM bit interval transition at the centre of the 1.0 microsecond pulse.	
New text	**3.1.2.2.6.3**	—	Note 1.— To meet the pulse-to-pulse amplitude variation requirement in 3.1.2.2.5.2, the RF peak output power of any merged PPM pulses will not vary more than 1 dB due to PO for a receiver bandwidth of 8 MHz when linearly applying phase overlay (PO) across the 400-nanosecond phase transition interval.	
New text	**3.1.2.2.6.3**	—	Note 2.— The worst case for spectral growth is when the phase overlay frequency shifts are 180 degrees between symbols in 1 microsecond wide PPM data pulses as shown in Figure 3-9. To meet the spectrum requirement in 3.1.2.2.2, one method of reducing spectral growth in this case is to ensure the 180-degree phase transition is linear.	
New text	**3.1.2.2.6.4**	—	3.1.2.2.6.4 Phase drift. The peak phase drift due to transmitter frequency drift shall be within ±43 degrees for the entire message duration. The phase drift tolerance is in addition to the average frequency tolerance specified in 3.1.2.2.1.2.	
New text	**3.1.2.2.6.5**	—	3.1.2.2.6.5 Reply spectrum. The reply spectrum defined in 3.1.2.2.2 shall be met when phase overlay transmissions are active.	
New text to replace existing text	**3.1.2.3.1.2.1**	The reply data block shall consist of 56 or 112 data bits formed by binary pulse position modulation encoding of the reply data as described in 3.1.2.2.5.1.2. A pulse transmitted in the first half of the interval shall represent a binary ONE whereas a pulse transmitted in the second half shall represent a binary ZERO.	3.1.2.3.1.2.1 Standard PPM data. The reply data block shall consist of 56 or 112 data bits formed by binary pulse position modulation encoding of the reply data as described in 3.1.2.2.5.1.2. A pulse transmitted in the first half of the interval shall represent a binary ONE whereas a pulse transmitted in the second half shall represent a binary ZERO.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.3.1.2.2**	—	3.1.2.3.1.2.2 Phase overlay modulated data. For phase overlay modulated signals, the PPM reply data shall additionally contain 8PSK modulated data within the bit interval containing the pulse, either the first half or the second half of the interval as per 3.1.2.3.1.2.1.	
New text	**3.1.2.3.1.2.2.1**	—	3.1.2.3.1.2.2.1 Phase overlay data definition. In addition to the binary ONE or binary ZERO represented by PPM, each data interval shall consist of three additional bit values representing the phase modulated reply data as determined by the encoded phase of the pulse in the bit interval as shown in Table 3-7.	
New text	**3.1.2.3.1.2.2.2**	—	3.1.2.3.1.2.2.2 Sync phase reference pulses. The reference sync phase shall be encoded in the four preamble pulses and the data pulses of the first four PPM data bits by maintaining constant phase for these pulses.	
New text	**3.1.2.3.1.2.2.3**	—	3.1.2.3.1.2.2.3 Phase reference. The reference phase shall represent zero degrees. This reference established by the data pulses in 3.1.2.3.1.2.2.2 is used to establish the phase for subsequent phase state determination.	
Deleted text	**3.1.2.3.2.1.4**	3.1.2.3.2.1.4 PI: Parity/interrogator identifier. This 24-bit (33-56) or (89-112) downlink field shall have parity overlaid on the interrogator's identity code according to 3.1.2.3.3.2 and shall appear in the Mode S all-call reply, DF = 11 and in the extended squitter, DF = 17 or DF = 18. If the reply is made in response to a Mode A/C/S all-call, a Mode S-only all-call with CL field (3.1.2.5.2.1.3) and IC field (3.1.2.5.2.1.2) equal to 0, or is an acquisition or an extended squitter (3.1.2.8.5, 3.1.2.8.6 or 3.1.2.8.7), the II and the SI codes shall be 0.	3.1.2.3.2.1.4 PI: Parity/interrogator identifier. This 24-bit (33-56) or (89-112) downlink field shall have parity overlaid on the interrogator's identity code according to 3.1.2.3.3.2 and shall appear in the Mode S all-call reply, DF = 11 and in the extended squitter, DF = 17 or DF = 18. If the reply is made in response to a Mode S-only all-call with CL field (3.1.2.5.2.1.3) and IC field (3.1.2.5.2.1.2) equal to 0, or is an acquisition or an extended squitter (3.1.2.8.5, 3.1.2.8.6 or 3.1.2.8.7), the II and the SI codes shall be 0.	
New text	**3.1.2.3.2.5**	—	3.1.2.3.2.5 Phase overlay reply data formats. An overview of the transmitted phase overlay data message structure is shown in Figure 3-10.	
New text	**3.1.2.3.2.5.1**	—	3.1.2.3.2.5.1 Phase overlay message data. Phase data (PD) message bits shall be contained in bits 1 through 204 of the 324-bit phase data message. If phase overlay is not enabled for the reply or extended squitter, the message data field shall be zero filled.	
New text	**3.1.2.3.2.5.2**	—	3.1.2.3.2.5.2 Phase overlay message type field. Phase overlay bits 1 through 8 of the 324-bit phase data message shall contain the message type defining the PO message as shown in Table 3-12.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.3.2.5.2**	—	Note.— The data format of the ADS-B State and Status Message, phase overlay Mode S GICB Data Messages and phase overlay Interrogation/Reply Monitor Messages ADS-R, ADS-SLR and TIS-B are described in the Technical Provisions for Mode S Services and Extended Squitter (Doc 9871).	
New text	**3.1.2.3.2.5.3**	—	3.1.2.3.2.5.3 Phase overlay parity correction data. Phase overlay bits 205 through 324 of the phase data message shall contain the 120-bit forward error correction (FEC) data encoded in accordance with either 3.1.2.3.2.5.3.1 or 3.1.2.3.2.5.3.2, as specified by the Message Type value in Table 3-12.	
New text	**3.1.2.3.2.5.3.1**	—	3.1.2.3.2.5.3.1 Reed-Solomon. When transmitting phase overlay message types 1-6 (RS Message Type Block), the transmitted phase overlay shall use a Reed Solomon RS (54, 34) code with 6-bit symbols where two adjacent phase states (two adjacent PPM pulse data bits) are used as one 6-bit symbol (3 phase bits per 1 PPM bit). The RS (54, 34) code is shortened from a 63 symbol (2N-1) code. The first nine 6-bit symbols of the 63 symbol code that is used for the RS (54, 34) code shall have all bits set to zero. The Reed -Solomon shall use a generator polynomial start value of 1 to compute the parity error correction value. x^6 The Reed Solomon shall use a field polynomial of + x + 1.	
New text	**3.1.2.3.2.5.3.1**	—	Note.— Example of Reed-Solomon encodings are shown in Doc 9924.	
New text	**3.1.2.3.2.5.3.2**	—	3.1.2.3.2.5.3.2 Low Density Parity Code (LDPC). When transmitting phase overlay message types 7-12 (LDPC Message Type Block), the transmitted phase overlay parity data shall be established by a cyclic LDPC (54, 34) code with 6 blocks of binary data as shown in Table 3-13, with each block of 54 bits input to the LDPC parity check matrix independently, and after encoding the parity of each block, the message and parity bits are assembled back in order. The LDPC encoder shall use a field polynomial of $x^{20} + x^{18} + x^{11} + x^9 + x^2 + 1$.	
New text	**3.1.2.3.2.5.3.2**	—	Note.— The parity check matrix is presented in Doc 9924.	
Deleted text	**3.1.2.4.1.1.1**	3.1.2.4.1.1.1 Mode A and Mode C interrogation recognition. A Mode A or Mode C interrogation shall be recognized when a P – P pulse pair meeting the requirements of 3.1.1.4 has been received, and 1 3 the leading edge of a P pulse with an amplitude that is	3.1.2.4.1.1.1 Mode A and Mode C interrogation recognition. A Mode A or Mode C interrogation shall be recognized when a P – P pulse pair meeting the requirements of 3.1.1.4 has been received, and 1 3 the leading edge of a P pulse with an amplitude that is	

Type of changes	Location	Existing Text	Amended Text	Comment
		greater than a level 6 dB below the amplitude of P 4 3 is not received within the interval from 1.73 to 2.37 microseconds following the leading edge of P. 3 If a P – P suppression pair and a Mode A or Mode C interrogation are recognized simultaneously, the 1 2 transponder shall be suppressed. An interrogation shall not be recognized as Mode A or Mode C if the transponder is in suppression (3.1.2.4.2). If a Mode A and a Mode C interrogation are recognized simultaneously the transponder shall complete the transaction cycle as if only a Mode C interrogation had been recognized.	greater than a level 6 dB below the amplitude of P 4 3 is not received within the interval from to microseconds following the leading edge of P. 3	
New text to replace existing text	**3.1.2.4.1.1.2.1**	An intermode interrogation shall be recognized when a P – P – P pulse triplet meeting the requirements of 3.1.2.1.5.1 is 1 3 4 received	3.1.2.4.1.1.2.1 A Mode A/C-only all-call interrogation shall be recognized when the requirements of 3.1.1.7.1 are met, with a P pulse being of any duration greater than 0.7 microsecond and occurring 2 ± 0.1 4 microsecond from P. 3	
New text	**3.1.2.4.1.1.2.2**	—	3.1.2.4.1.1.2.2 A Mode A/C-only all-call interrogation shall be recognized if the received power of P is above P minus 1 dB at any signal level of P – P from MTL+1 dB to –21 dBm. 4 3 1 3	
New text to replace existing text	**3.1.2.4.1.1.2.3**	An interrogation shall not be recognized as an intermode interrogation if:	3.1.2.4.1.1.2.3 An interrogation shall not be recognized as an intermode interrogation if:	
Deleted text	**3.1.2.4.1.1.2.3**	b) the pulse interval between P and P is larger than 2.37 microseconds or shorter than 1.73 3 4 microseconds; or	b) the pulse interval between P and P is larger than microseconds or shorter than 3 4 microseconds; or	
New text to replace existing text	**3.1.2.4.1.1.2.3**	d) the transponder is in suppression (3.1.2.4.2).;	d) the transponder is in suppression (3.1.2.4.2).; or	
New text	**3.1.2.4.1.1.2.3**	—	e) the pulse interval between P and P differs from the nominal spacing by 1.0 microsecond or more; 1 3 or	
New text to replace existing text	**3.1.2.4.1.1.2.3**	If a P – P suppression pair and a Mode A or Mode C intermode interrogation are recognized 1 2 simultaneously the transponder shall be suppressed.	f) the pulse duration of P is less than 0.3 microsecond. 4	
Deleted text	**3.1.2.4.1.2.2.1**	3.1.2.4.1.2.2.1 Mode A/C/S all-call interrogation acceptance. A Mode A/C/S all-call interrogation shall be accepted if the trailing edge of P is received within 3.45 to 3.75 microseconds following the leading 4 edge of P and no lockout condition (3.1.2.6.9) prevents acceptance. A Mode A/C/S all-call shall not be 3 accepted if the trailing edge of P is received earlier than 3.3 or later than 4.2 microseconds following the 4 leading edge of P, or if a lockout condition (3.1.2.6.9) prevents acceptance. 3	3.1.2.4.1.2.2.1 Mode A/C/S all-call interrogation acceptance.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.4.1.2.2.1**	—	Note.— Mode A/C/S all-call interrogations are no longer useable. If a transponder receives a Mode A/C/S all-call interrogation, it will be recognized as a Mode A/C-only all-call interrogation.	
Deleted text	**3.1.2.4.1.2.2.2**	Note.— The technical condition for non-acceptance of a Mode A/C-only all-call is given in the preceding paragraph by the requirement for rejecting an intermode interrogation with a P pulse having a 4 trailing edge following the leading edge of P by less than 3.3 microseconds. 3	—	
Deleted text	**3.1.2.4.1.3.1**	3.1.2.4.1.3.1 Mode A and Mode C replies. A Mode A (Mode C) reply shall be transmitted as specified in 3.1.1.6 when a Mode A (Mode C) interrogation has been accepted.	—	
Deleted text	**3.1.2.4.1.3.2**	3.1.2.4.1.3.2 Mode S replies. Replies to other than Mode A and Mode C interrogations shall be Mode S replies.	—	
New text to replace existing text	**3.1.2.4.1.3.2.1**	A Mode S reply with downlink format 11 shall be transmitted in accordance with the provisions of 3.1.2.5.2.2 when a Mode A/C/S all-call interrogation has been accepted. Equipment certified on or after 1 January 2020 shall not reply to Intermode Mode A/C/S all- call interrogations.	Note 1.— A Mode S reply with downlink format 11 is transmitted in accordance with the provisions of 3.1.2.5.2.2 when a Mode A/C/S all-call interrogation has been accepted. by a transponder certified before 1 January 2020	
New text to replace existing text	**3.1.2.4.2.1**	3.1.2.4.2.1 Effects of suppression. A transponder in suppression (3.1.1.7.4) shall not recognize Mode A, Mode C or intermode interrogations if either the P pulse alone or both the P and P 1 1 3 pulses of the interrogation are received during the suppression interval. Suppression shall not affect the recognition of, acceptance of, or replies to Mode S interrogations.	3.1.2.4.2.1 Effects of suppression. A Mode S-capable transponder in suppression (3.1.1.7.4) shall not recognize Mode A, Mode C or intermode interrogations if either the P pulse alone or both the P and P 1 1 3 pulses of the interrogation are received during the suppression interval. Suppression shall not affect the recognition of, acceptance of, or replies to Mode S interrogations.	
New text to replace existing text	**3.1.2.4.2.2**	Note.— P – P pair of the Mode A/C-only all-call interrogation 3 4 both prevents a reply and initiates suppression. Likewise, the P – P preamble of a Mode S 1 2 interrogation initiates suppression independently of the waveform that follows it.	Note.— The transponder may optionally initiate suppression from a P – P pulse pair of a Mode A/C- 3 4 only all-call interrogation according to the criteria of recognition of an intermode interrogation in 3.1.2.4.1.1.2. If Tthe P – P pair of the Mode A/C-only all-call interrogation is processed as a suppression, 3 4 the pulse pair both prevents a reply and initiates suppression. Likewise, the P – P preamble of a Mode S 1 2 interrogation initiates suppression independently of the waveform that follows it.	
Deleted text	**3.1.2.4.2.3**	3.1.2.4.2.3 Suppression in presence of S pulse shall be as defined in 3.1.1.7.4.3. 1	—	
New text	**3.1.2.4.3**	—	3.1.2.4.3 Declaration of aircraft status	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.4.3**	—	Note.— Certain fields in downlink format (DF) 4, 5, 11, 17, 20 and 21 messages are based on whether the aircraft is determined, by the transponder, to be on-the-ground or airborne. Transponders determine and express whether the aircraft is on-the-ground or airborne using multiple approaches. Level 2 and above transponders report a declared air/ground status via the capability (CA) field (see 3.1.2.5.2.2.1). All transponders report an effective air/ground state via the vertical status (VS) field (see 3.1.2.8.2.1). The effective air/ground state is also reflected in the flight status (FS) field (see 3.1.2.6.5.1).	
New text	**3.1.2.4.3.1**	—	3.1.2.4.3.1 Declared air/ground status determination. Declared air/ground status shall be restricted to “on-the-ground”, “airborne” or “unknown”.	
New text	**3.1.2.4.3.1.1**	—	3.1.2.4.3.1.1 If an automatic means of determining the on-the-ground condition is available and indicates “on-the ground”, the declared air/ground status shall be “on-the-ground”.	
New text	**3.1.2.4.3.1.2**	—	3.1.2.4.3.1.2 If an automatic means of determining the on-the-ground condition is available and does not indicate “on-the ground”, the declared air/ground status shall be “airborne”.	
New text	**3.1.2.4.3.1.3**	—	3.1.2.4.3.1.3 If an automatic means of determining the on-the-ground condition is unavailable, the declared air/ground status shall be “unknown”.	
New text	**3.1.2.4.3.1.3**	—	Note.— The declared air/ground status may be set by air/ground data input (see 3.1.2.10.5.1.3) provided by an automatic means of determining the on-the-ground condition. Automatic means of determining the on-the-ground condition may include, for example, a weight on wheels switch, a strut switch or an airframe-specific air/ground algorithm output.	
New text	**3.1.2.4.3.2**	—	3.1.2.4.3.2 Declared air/ground status validation. Aircraft with an automatic means of determining the on-the-ground condition and whose transponders have access to at least one of ground speed, radio altitude or airspeed, shall perform the following validation check:	
New text	**3.1.2.4.3.2.1**	—	3.1.2.4.3.2.1 If an automatic means of determining the on-the-ground condition is available and indicates “on-the-ground”, the declared air/ground status shall be changed to “airborne” if: Ground Speed > Speed Threshold OR Airspeed > Speed Threshold OR Radio	

Type of changes	Location	Existing Text	Amended Text	Comment
			Altitude > 50 feet Where Speed Threshold is the lesser of 100 knots or the typical rotation speed of the aircraft (if available).	
New text	**3.1.2.4.3.2.1**	—	Note 1.— If an automatic means of determining the on-the-ground condition is not available or the declared air/ground status is “airborne”, no validation check is required.	
New text	**3.1.2.4.3.2.1**	—	Note 2.— Modern aircraft with integrated avionics suites commonly contain sophisticated algorithms for determining the declared air/ground status based on multiple aircraft sensors. These algorithms are customized to the airframe and designed to overcome individual sensor failures. These algorithms are an acceptable means to determine the declared air/ground status and do not require the additional validation in this section.	
New text	**3.1.2.4.3.3**	—	3.1.2.4.3.3 Effective air/ground state determination. Effective air/ground state shall be restricted to “on-the-ground” or “airborne”.	
New text	**3.1.2.4.3.3.1**	—	3.1.2.4.3.3.1 When the declared air/ground status is “airborne” or “unknown”, the effective air/ground state shall be “airborne”.	
New text	**3.1.2.4.3.3.2**	—	3.1.2.4.3.3.2 When the declared air/ground status is “on-the-ground”, the effective air/ground state shall be “on-the-ground”.	
Deleted text	**3.1.2.5.1**	Note.— Intermode transactions permit the surveillance of Mode A/C-only aircraft and the acquisition of Mode S aircraft. The Mode A/C/S all-call interrogation allows Mode A/C-only and Mode S transponders to be interrogated by the same transmissions. The Mode A/C-only all-call interrogation makes it possible to elicit replies only from Mode A/C transponders. In multisite scenarios, the interrogator must transmit its identifier code in the Mode S only all-call interrogation. Thus, a pair of Mode S-only and Mode A/C-only all-call interrogations are used. The intermode interrogations are defined in 3.1.2.1.5.1 and the corresponding interrogation-reply protocols are defined in 3.1.2.4.	Note.— The Mode A/C-only all-call interrogation makes it possible to elicit replies only from Mode A/C transponders. In multisite scenarios, the interrogator must transmit its identifier code in the Mode S only all-call interrogation. Thus, a pair of Mode S-only and Mode A/C-only all-call interrogations are used. The intermode interrogations are defined in 3.1.2.1.5.1 and the corresponding interrogation-reply protocols are defined in 3.1.2.4.	
New text to replace existing text	**3.1.2.5.2.1.2.3**	3.1.2.5.2.1.2.3 II: Interrogator identifier. This 4-bit value shall define an interrogator identifier (II) code. These II codes shall be assigned to interrogators in the range from 0 to 15. The II code value of 0 shall only be used for	3.1.2.5.2.1.2.3 II: Interrogator identifier. This 4-bit value shall define an interrogator identifier (II) code. These II codes shall be assigned to interrogators in the range from 0 to 15. When multiple II codes are assigned to one	

Type of changes	Location	Existing Text	Amended Text	Comment
		supplementary acquisition in conjunction with acquisition based on lockout override (3.1.2.5.2.1.4 and 3.1.2.5.2.1.5). When two II codes are assigned to one interrogator only, one II code shall be used for full data link purposes.	interrogator only, one II code shall be used for full data link purposes.	
Deleted text	**3.1.2.5.2.1.4.3**	3.1.2.5.2.1.4.3 Field content for a selectively addressed interrogation used by an interrogator without an assigned interrogator code. An interrogator that has not been assigned with a unique discrete interrogator code and is authorized to transmit shall use the II code 0 to perform the selective interrogations. In this case, selectively addressed interrogations used in connection with acquisition using lockout override shall have interrogation field contents restricted as follows: UF = 4, 5, 20 or 21 PC = 0 DI = 7 IIS = 0 LOS = 0 except as specified in 3.1.2.5.2.1.5 TMS = 0	—	
Deleted text	**3.1.2.5.2.1.4.4**	3.1.2.5.2.1.4.4 An interrogator that has not been assigned with a unique discrete interrogator code and is authorized to transmit using II code 0 shall not attempt to extract an air-initiated Comm-B message announced by DR = 1 or 3.	—	
Deleted text	**3.1.2.5.2.1.4.4**	Note.— These restrictions permit surveillance transaction, GICB transaction and Comm-B broadcast extraction, but prevent the interrogation from making any changes to transponder multisite lockout or communications protocol states.	—	
Deleted text	**3.1.2.5.2.1.5**	3.1.2.5.2.1.5 Supplementary acquisition using II equals 0	3.1.2.5.2.1.5 Supplementary acquisition	
New text to replace existing text	**3.1.2.5.2.1.5**	Note 1.— The acquisition technique defined in 3.1.2.5.2.1.4 provides rapid acquisition for most aircraft. Due to the probabilistic nature of the it may take many interrogations to acquire the last aircraft of a large set of aircraft in the same beam dwell and near the same range (termed a local garble zone). Acquisition performance is greatly improved for the acquisition of these aircraft through the use of limited selective lockout using II equals 0	Note 1.— The acquisition technique defined in 3.1.2.5.2.1.4 provides rapid acquisition for most aircraft. Due to the probabilistic nature of processacquiring aircraft with a reduced reply probability (3.1.2.5.2.1.4.1), it may take many interrogations to acquire the last aircraft of a large set of aircraft in the same beam dwell and near the same range (termed a local garble zone). Acquisition performance is greatly improved for the acquisition of these aircraft through the use of limited selective lockout referred to here as supplementary acquisition.	
New text to replace existing text	**3.1.2.5.2.1.5**	Note 2.— Supplementary acquisition consists of locking out acquired aircraft to II=0 followed by acquisition by means of the Mode S-only all-call interrogation with II=0. Only the aircraft not yet acquired and not yet locked-out will reply resulting in an easier acquisition.	Note 2.— Supplementary acquisition consists of locking out acquired aircraft followed by acquisition by means of the Mode S-only all-call interrogation without lockout override Only the aircraft not yet acquired and not yet	

Type of changes	Location	Existing Text	Amended Text	Comment
			locked-out will reply resulting in an easier acquisition. Additional guidance material can be found in Doc 9924.	
New text	**3.1.2.5.2.1.5**	—	Note 3.— Supplementary acquisition used to augment operation based on lockout override (3.1.2.5.2.1.4) is possible using any assigned IC. If no IC has been assigned, supplementary acquisition uses II equals 0 (3.1.2.5.2.1.5.2.3).	
New text to replace existing text	**3.1.2.5.2.1.5.1.1**	3.1.2.5.2.1.5.1.1 Recommendation.— When II equals 0 lockout is used to supplement acquisition all aircraft within the beam dwell of the aircraft being acquired should be commanded to lock out to II equals 0, not just those in the garble zone.	3.1.2.5.2.1.5.1.1 Recommendation.— When lockout is used to supplement the acquisition method described in 3.1.2.5.2.1.4, all aircraft within the beam dwell of the aircraft being acquired should be commanded to lock out not just those in the garble zone.	
Deleted text	**3.1.2.5.2.1.5.1.1**	Note.— Lockout of all aircraft in the beam dwell will reduce the amount of all-call fruit replies generated to the II equals 0 all-call interrogations.	Note.— Lockout of all aircraft in the beam dwell will reduce the amount of all-call fruit replies generated to the all-call interrogations.	
Deleted text	**3.1.2.5.2.1.5.2.1**	3.1.2.5.2.1.5.2.1 Interrogators performing supplementary acquisition using II equals 0 shall perform acquisition by transmitting a lockout command for no more than two consecutive scans to each of the aircraft already acquired in the beam dwell containing the garble zone and shall not repeat it before 48 seconds have elapsed.	3.1.2.5.2.1.5.2.1 Interrogators performing supplementary acquisition shall perform acquisition by transmitting a lockout command for no more than two consecutive scans to each of the aircraft already acquired in the beam dwell containing the garble zone and shall not repeat it before 48 seconds have elapsed.	
New text to replace existing text	**3.1.2.5.2.1.5.2.1**	Note.— Minimizing the lockout time reduces the probability of conflict with the acquisition activities of a neighbouring interrogator that is also using II equals 0 for supplementary acquisition.	Note.— Minimizing the lockout time reduces the probability of conflict with the acquisition activities of a neighbouring interrogator that is using the same IC	
Deleted text	**3.1.2.5.2.1.5.2.2**	3.1.2.5.2.1.5.2.2 Recommendation.— Mode S-only all-call interrogations with II=0 for the purpose of supplementary acquisition should take place within a garble zone over no more than two consecutive scans or a maximum of 18 seconds.	3.1.2.5.2.1.5.2.2 Recommendation.— Mode S-only all-call interrogations for the purpose of supplementary acquisition should take place over a maximum of 18 seconds.	
New text	**3.1.2.5.2.1.5.2.3**	—	3.1.2.5.2.1.5.2.3 Interrogator without assigned interrogator code (IC). An interrogator authorized to transmit that has not been assigned an IC and is unable to ensure that its lockout region will not overlap with the lockout region of another interrogator using the same IC, shall use II code 0 for supplementary acquisition.	
Deleted text	**3.1.2.5.2.2**	5 8 32 56 The reply to the Mode S-only all-call or the Mode A/C/S all-call interrogation shall be the Mode S all-call reply, downlink format 11. The format of this reply shall consist of these fields:	5 8 32 56 The reply to the Mode S-only all-call interrogation shall be the Mode S all-call reply, downlink format 11. The format of this reply shall consist of these fields:	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.5.2.2**	—	Note.— Mode S all-call reply may be transmitted by transponders certified before 1 January 2020 in response to Mode A/C/S all-call interrogation (see 2.1.5.4.4).	
New text to replace existing text	**3.1.2.5.2.2.1**	3.1.2.5.2.2.1 CA: Capability. This 3-bit (6-8) downlink field shall convey information on the transponder level, the additional information below, and shall be used in formats DF = 11 and DF = 17. Coding 0 signifies Level 1 transponder (surveillance only), and no ability to set CA code 7 and either "airborne" or 1 reserved 2 reserved 3 reserved 4 signifies Level 2 or above transponder and ability to set CA code 7 and on the ground 5 signifies Level 2 or above transponder and ability to set CA code 7 and airborne 6 signifies Level 2 or above transponder and ability to set CA code 7 and either airborne or on the ground 7 signifies the DR field is not equal to 0 or the FS field equals 2, 3, 4 or 5, and either airborne or on the ground	3.1.2.5.2.2.1 CA: Capability. This 3-bit (6-8) downlink field shall convey information on the transponder level, the additional information below, and shall be used in formats DF = 11 and DF = 17. Coding 0 signifies Level 1 transponder (surveillance only), and no ability to set CA code 7 and either "airborne" or "on-the-ground" 1 reserved 2 reserved 3 reserved 4 signifies Level 2 or above transponder and ability to set CA code 7 and a declared air/ground status of "on-the-ground" (see 3.1.2.8.6.7) 5 signifies Level 2 or above transponder and ability to set CA code 7 and a declared air/ground status of "airborne" (see 3.1.2.8.6.7) 6 signifies Level 2 or above transponder and ability to set CA code 7 and a declared air/ground status of "unknown" (see 3.1.2.8.6.7) 7 signifies the DR field is not equal to 0 or the FS field equals 2, 3, 4 or	
New text to replace existing text	**3.1.2.5.2.2.1**	When the conditions for CA code 7 are not satisfied, aircraft with Level 2 or above transponders:	Note.— Refer to 2.1.5.2.3 for the status of Level 1 transponders.	
Deleted text	**3.1.2.5.2.2.1**	a) that do not have automatic means to set the on-the-ground condition shall use CA code 6; and	—	
Deleted text	**3.1.2.5.2.2.1**	b) with automatic on-the-ground determination shall use CA code 4 when on the ground and 5 when airborne.	—	
New text to replace existing text	**3.1.2.5.3**	Note 1.— Following acquisition, a transponder is interrogated by discretely addressed interrogations as prescribed in 3.1.2.6, 3.1.2.7 and 3.1.2.8 and the all-call lockout protocol is used to inhibit replies to further all-call interrogations.	Note 1.— Following acquisition, a transponder is interrogated by discretely addressed interrogations as prescribed in 3.1.2.6, and 3.1.2.7 and the all-call lockout protocol is used to inhibit replies to further all-call interrogations.	
New text to replace existing text	**3.1.2.6.1.4**	1 IIS MBS MES LOS RSS TMS 20 22 25 26 28 32 17 21 24 27 29 TCS RCS SAS 2 Reserved Reserved 20 23 26 28 32 17 23 24 28 29 3 SIS LSS RRS OVC Reserved	1 IIS MBS MES LOS RSS TMS 20 22 25 26 28 32 17 21 24 27 29 2 Reserved Reserved Reserved Reserved Reserved 20 23 26 28 32 17 23 24 28 29 3 SIS LSS RRS OVC Reserved	
New text to replace existing text	**3.1.2.6.1.4.1**	a) If DI = 0, 1 or 7: IIS, the 4-bit (17-20) interrogator identifier subfield shall contain an assigned identifier code of the interrogator (3.1.2.5.2.1.2.3).	a) If DI = 0, 1 or 7: IIS, the 4-bit (17-20) interrogator identifier subfield shall contain the identifier code of the interrogator (3.1.2.5.2.1.2.3).	
New text	**3.1.2.6.1.4.1**	—	Note.— The IIS is intended to match the II code used by the interrogator in the Mode S-only all-call interrogation (3.1.2.5.2.1). Interrogators that do not use Mode S-only all-call interrogations, all-call lockout protocol or	

Type of changes	Location	Existing Text	Amended Text	Comment
			multisite data link protocol can use any IC in the IIS fields of their selective interrogations without coordination with neighbouring systems. The use of coordinated values differentiates interrogations transmitted by the different systems operating in the same area and facilitates the understanding of their respective contribution to the 1 090 MHz environment.	
New text to replace existing text	**3.1.2.6.1.4.1**	f) If DI = 2: TCS, the 3-bit (21-23) type control subfield in SD shall control the extended squitter airborne and surface format types reported by the transponder and its response to Mode A/C, Mode A/C/S all- call and Mode S-only all-call interrogations. The following codes have been assigned: 0 signifies no surface format types or reply inhibit command 1 signifies surface format types for the next 15 seconds (see 3.1.2.6.1.4.2) 2 signifies surface format types for the next 60 seconds (see 3.1.2.6.1.4.3) 3 signifies cancel surface format types and reply inhibit commands 4-7 reserved. The transponder shall be able to accept a new command even though a prior command has not as yet timed out. RCS, the 3-bit (24-26) rate control subfield in SD shall control the squitter rate of the transponder when it is reporting the extended squitter surface type formats. This subfield shall have no effect on the transponder squitter rate when it is reporting the extended squitter airborne type formats. The following codes have been assigned: 0 signifies no surface extended squitter rate command 1 signifies report high surface extended squitter rate for 60 seconds 2 signifies report low surface extended squitter rate for 60 seconds 3-7 reserved.	f) If DI = 2: SD is not assigned. The SD field when DI = 2 was previously used to control the squitter format type and rate reported by the transponder through the deprecated type control subfield (TCS), rate control subfield (RCS), and squitter antenna subfield (SAS) commands.	
Deleted text	**3.1.2.6.1.4.1**	Note 1.— The definition of high and low extended squitter rates is given in 3.1.2.8.6.4 and applies to the surface position, aircraft identification and category, and the operational status messages.	—	
Deleted text	**3.1.2.6.1.4.1**	Note 2.— As stated in 3.1.2.8.5.2 d), acquisition squitters are transmitted when surface type format extended squitters are not being transmitted. SAS, the 2-bit (27-28) surface antenna subfield in SD shall control the selection of the transponder diversity antenna that is used for (1) the extended squitter when the transponder is reporting the surface type formats, and (2) the acquisition squitter when the transponder is reporting the on-the- ground status. This subfield shall have no effect on the transponder diversity antenna selection when it is reporting the airborne status. The following codes have	—	

Type of changes	Location	Existing Text	Amended Text	Comment
		been assigned: 0 signifies no antenna command 1 signifies alternate top and bottom antennas for 120 seconds 2 signifies use bottom antenna for 120 seconds 3 signifies return to the default.		
Deleted text	**3.1.2.6.1.4.1**	Note.— The top antenna is the default condition (3.1.2.8.6.5).	—	
New text to replace existing text	**3.1.2.6.1.4.1**	g) If DI = 3: SIS, the 6-bit (17-22) surveillance identifier subfield in SD shall contain an assigned surveillance identifier code of the interrogator (3.1.2.5.2.1.2.4).	g) If DI = 3: SIS, the 6-bit (17-22) surveillance identifier subfield in SD shall contain the surveillance identifier code of the interrogator (3.1.2.5.2.1.2.4).	
New text	**3.1.2.6.1.4.1**	—	Note.— The SIS is intended to match the SI code used by the interrogator in the Mode S-only all-call interrogation (3.1.2.5.2.1). Interrogators that do not use Mode S-only all-call interrogations, all-call lockout protocol or multisite data link protocol can use any IC in the SIS fields of their selective interrogations without coordination with neighbouring systems. The use of coordinated values differentiates interrogations transmitted by the different systems operating in the same area and facilitates the understanding of their respective contribution to the 1 090 MHz environment.	
Deleted text	**3.1.2.6.1.4.2**	3.1.2.6.1.4.2 TCS subfield equal to one (1) in the SD field for extended squitters. When the TCS subfield in the SD field is set equal to one (1), it shall signify the following:	—	
Deleted text	**3.1.2.6.1.4.2**	a) broadcast of the extended squitter surface formats, including the surface position message (3.1.2.8.6.4.3), the identification and category message (3.1.2.8.6.4.4), the aircraft operational status message (3.1.2.8.6.4.6) and the aircraft status message (3.1.2.8.6.4.6) for the next 15 seconds at the appropriate rates on the top antenna for aircraft systems having the antenna diversity capability, except if otherwise specified by SAS (3.1.2.6.1.4.1 f));	—	
Deleted text	**3.1.2.6.1.4.2**	b) inhibit replies to Mode A/C, Mode A/C/S all-call and Mode S-only all-call interrogations for the next 15 seconds;	—	
Deleted text	**3.1.2.6.1.4.2**	c) broadcast of acquisition squitters as per 3.1.2.8.5 using antenna as specified in 3.1.2.8.5.3 a);	—	
Deleted text	**3.1.2.6.1.4.2**	d) does not impact the air/ground state reported via the CA, FS and VS fields;	—	
Deleted text	**3.1.2.6.1.4.2**	e) discontinue broadcast of the extended squitter airborne message formats; and	—	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.2.6.1.4.2**	f) broadcast of the extended squitter surface formats at the rates according to the TRS subfield unless commanded to transmit at the rates set by the RCS subfield.	—	
Deleted text	**3.1.2.6.1.4.3**	3.1.2.6.1.4.3 TCS subfield equal to two (2) in the SD field for extended squitters. When the TCS subfield in the SD field is set equal to two (2), it shall signify the following:	—	
Deleted text	**3.1.2.6.1.4.3**	a) broadcast of the extended squitter surface formats, including the surface position message (3.1.2.8.6.4.3), the identification and category message (3.1.2.8.6.4.4), the aircraft operational status message (3.1.2.8.6.4.6) and the aircraft status message (3.1.2.8.6.4.6) for the next 60 seconds at the appropriate rates on the top antenna for aircraft systems having the antenna diversity capability, except if otherwise specified by SAS (3.1.2.6.1.4.1 f));	—	
Deleted text	**3.1.2.6.1.4.3**	b) inhibit replies to Mode A/C, Mode A/C/S all-call and Mode S-only all-call interrogations for the next 60 seconds;	—	
Deleted text	**3.1.2.6.1.4.3**	c) broadcast of acquisition squitters as per 3.1.2.8.5 using antenna as specified in 3.1.2.8.5.3 a);	—	
Deleted text	**3.1.2.6.1.4.3**	d) does not impact the air/ground state reported via the CA, FS and VS fields;	—	
Deleted text	**3.1.2.6.1.4.3**	e) discontinue broadcast of the extended squitter airborne message formats; and	—	
Deleted text	**3.1.2.6.1.4.3**	f) broadcast of the extended squitter surface formats at the rates according to the TRS subfield unless commanded to transmit at the rates set by the RCS subfield.	—	
New text to replace existing text	**3.1.2.6.5.1**	3.1.2.6.5.1 FS: Flight status. This 3-bit (6-8) downlink field shall contain the following information: Coding 0 signifies no alert and no SPI, aircraft is “airborne” 1 signifies no alert and no SPI, aircraft is 2 signifies alert, no SPI, aircraft is “airborne” 3 signifies alert, no SPI, aircraft is 4 signifies alert and SPI, aircraft is “airborne” or 5 signifies no alert and SPI, aircraft is “airborne” or 6 reserved 7 not assigned..	3.1.2.6.5.1 FS: Flight status. This 3-bit (6-8) downlink field shall contain the following information: Coding 0 signifies no alert and no SPI, vertical status (VS) indicates “airborne” 1 signifies no alert and no SPI, VS indicates “on-the-ground” 2 signifies alert, no SPI, VS indicates “airborne” 3 signifies alert, no SPI, VS indicates “on-the-ground” 4 signifies alert and SPI, VS indicates “airborne” or “on-the-ground” 5 signifies no alert and SPI, VS indicates “airborne” or “on-the-ground” 6 reserved 7 not assigned..	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.2.6.5.4**	e) If the M bit equals 1, the 12-bit field represented by bits 20 to 25 and 27 to 3132 shall be reserved for encoding altitude in metric units.	e) If the M bit equals 1, the 12-bit field represented by bits 20 to 25 and 27 to shall be reserved for encoding altitude in metric units.	
Deleted text	**3.1.2.6.9.1.1**	Note 2.— Multisite lockout (which only uses non-zero II codes) does not affect the response of the transponder to Mode S-only all-call interrogations containing II equals 0 or to Mode A/C/S all-call interrogations.	Note 2.— Multisite lockout (which only uses non-zero II codes) does not affect the response of the transponder to Mode S-only all-call interrogations containing II equals 0	
Deleted text	**3.1.2.6.9.2**	Note 1.— In cases where the multisite lockout protocol for II codes is not required (for example, there is no overlapping coverage or there is ground station coordination via ground-to-ground communications) the non-selective lockout protocol may be used. On acceptance of an interrogation containing code 1 in the PC field, a transponder shall commence to lock out (i.e. not accept) two types of all-call interrogations:	Note 1.— In cases where the multisite lockout protocol for II codes is not required (for example, there is no overlapping coverage or there is ground station coordination via ground-to-ground communications) the non-selective lockout protocol may be used. On acceptance of an interrogation containing code 1 in the PC field, a transponder shall commence to lock out (i.e. not accept)	
New text to replace existing text	**3.1.2.6.9.2**	a) the Mode S-only all-call (UF = 11), with II equals and	the Mode S-only all-call (UF = 11), with II equals 0.;	
Deleted text	**3.1.2.6.9.2**	b) the Mode A/C/S all-call of 3.1.2.1.5.1.1.	—	
New text to replace existing text	**3.1.2.6.9.2**	This lockout condition shall persist for an interval T (3.1.2.10.3.9) after the last receipt of the command. D Non-selective lockout shall not prevent acceptance of a Mode S-only all-call interrogation containing PR codes 8 to 12.	Note 2.— On acceptance of an interrogation containing code 1 in the PC field transponders certified before 1 January 2020 also do not reply to the Mode A/C/S all-call of 3.1.2.1.5.1.1. This lockout condition shall persist for an interval T (3.1.2.10.3.9) after the last receipt of the command. D Non-selective lockout shall not prevent acceptance of a Mode S-only all-call interrogation containing PR codes 8 to 12.	
New text to replace existing text	**3.1.2.6.9.2**	Note Non-selective lockout does not affect the response of the transponder to Mode S-only all-call interrogations containing II not equal to 0.	Note 23.— Non-selective lockout does not affect the response of the transponder to Mode S-only all-call interrogations containing II not equal to 0.	
New text to replace existing text	**3.1.2.6.10.1.1.1**	3.1.2.6.10.1.1.1 Permanent alert condition. The alert condition shall be maintained if the Mode A identity code is changed to 7500, 7600 or 7700	3.1.2.6.10.1.1.1 Permanent alert condition. The alert condition shall be maintained if the Mode A identity code is changed to any of the codes contained in one of the two Mode A code sets defined as follows:	
New text	**3.1.2.6.10.1.1.1**	—	a) Mode A code set 1 for special purposes shall contain Mode A code 7500, 7600 or 7700.	
New text	**3.1.2.6.10.1.1.1**	—	b) Mode A code set 2 for special purposes shall contain Mode A code 7400, 7500, 7600 or 7700.	
New text to replace existing text	**3.1.2.6.10.1.1.3**	3.1.2.6.10.1.1.3 Termination of the permanent alert condition. The permanent alert condition shall be terminated and replaced by a temporary alert condition	3.1.2.6.10.1.1.3 Termination of the permanent alert condition. The permanent alert condition shall be terminated and replaced by a temporary alert condition	

Type of changes	Location	Existing Text	Amended Text	Comment
		when the Mode A identity code is set to a value other than 7500, 7600 or 7700	when the Mode A identity code is set to a value other than those defined in Mode A code set 1 or set 2 listed in 3.1.2.6.10.1.1.1, a) and b).	
Deleted text	**3.1.2.6.10.1.2**	3.1.2.6.10.1.2 Ground report. The on-the-ground status of the aircraft shall be reported in the CA field (3.1.2.5.2.2.1), the FS field (3.1.2.6.5.1), and the VS field (3.1.2.8.2.1). If an automatic indication of the on-the-ground condition (e.g., from a weight on wheels or strut switch) is available at the transponder data interface, it shall be used as the basis for the reporting of on-the-ground status except as specified in 3.1.2.6.10.3.1. If such indication is not available at the transponder data interface (3.1.2.10.5.1.3), the FS and VS codes shall indicate that the aircraft is airborne and the CA field shall indicate that the aircraft is either airborne or on the ground (CA = 6).	—	
Deleted text	**3.1.2.6.10.2.2.1.2**	3.1.2.6.10.2.2.1.2 Sources of data link capability. Data link capability reports shall contain the capabilities provided by the transponder, the ADLP and the ACAS unit. If external inputs are lost, the transponder shall zero the corresponding bits in the data link report.	3.1.2.6.10.2.2.1.2 Sources of data link capability. Data link capability reports shall contain the capabilities provided by the transponder, and the ACAS unit.	
New text	**3.1.2.6.10.2.2.1.3**	—	Note.— The content of the data link capability report differs between subnetwork versions. See Doc 9871 for further details.	
New text to replace existing text	**3.1.2.6.10.2.2.3**	3.1.2.6.10.2.2.3 Zeroing of bits in the data link capability report If capability information to the transponder fails to provide an update at a rate of at least once every 4 seconds, the transponder shall insert ZERO in bits 41 to 56 of the data link capability report (transponder register 10).If 16	3.1.2.6.10.2.2.3 Zeroing of bits in the data link capability report a particular data field within the data link capability report (transponder register 10) cannot 16 be updated within 8 seconds, the data field shall be set to ZERO.	
New text to replace existing text	**3.1.2.6.10.2.2.3**	Note 1.— Bits 1 to 8 contain the BDS1 and BDS2 codes. Bits 16 and 37 to 40 contain ACAS capability information. Bit 33 indicates the availability of aircraft identification data and is set by the transponder when the data comes from a separate interface and not from the ADLP. Bit 35 is the SI code indication. All of these bits are inserted by the transponder.	Note 1.— Bit 33 indicates the availability of aircraft identification data See Doc 9871 for further details.	
New text	**3.1.2.6.10.2.2.3**	—	Note 2.— Transponders maintaining aircraft identification upon the loss of the interface providing aircraft identification do not reset to zero bit 33 (2.1.5.4.7 and 2.1.5.4.8)	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**3.1.2.6.10.3**	3.1.2.6.10.3 Validation of on-the-ground status declared by an automatic means	3.1.2.6.10.3 Basic dataflash protocol	
New text to replace existing text	**3.1.2.6.10.3**	Note.— For aircraft with an automatic means of determining vertical status, the CA field reports whether the aircraft is airborne or on the ground. ACAS II acquires aircraft using the short or extended squitter, both of which contain the CA field. If an aircraft reports on-the-ground status, that aircraft will not be interrogated by ACAS II in order to reduce unnecessary interrogation activity. If the aircraft is equipped to report extended squitter messages, the function that formats these messages may have information available to validate that an aircraft reporting “on-the-ground” is actually airborne.	Note.— The basic dataflash provides a protocol that allows the Mode S ground stations to be advised of changes that occur infrequently in various transponder registers of interest. The ground stations are advised of changes via Comm-B Broadcast of register 10 and then extract as needed or desired the 16 register or registers of interest.	
Deleted text	**3.1.2.6.10.3.1**	3.1.2.6.10.3.1 Aircraft with an automatic means for determining the on-the-ground state on which transponders have access to at least one of the parameters, ground speed, radio altitude or airspeed, shall perform the following validation check: If the automatically determined air/ground status is not available or is “airborne”, no validation shall be performed. If the automatically determined air/ground status is available and “on-the-ground” condition is being reported, the air/ground status shall be overridden and changed to “airborne” if: Ground Speed > 100 knots OR Airspeed > 100 knots OR Radio Altitude > 50 feet	—	
New text	**3.1.2.6.10.3.1**	—	3.1.2.6.10.3.1 Basic dataflash capability report. Transponders which monitor at least one of the registers subject to basic dataflash protocol and report their changes through the basic dataflash protocol, shall report this capability in the data link capability report (3.1.2.6.10.2.2.2) by setting bit 42 and bit 9 of the MB subfield to 1.	
New text	**3.1.2.6.10.3.1**	—	Note 1.— The registers for which changes can be reported using the basic dataflash protocol are defined in Doc 9871.	
New text	**3.1.2.6.10.3.1**	—	Note 2.— The setting of bit 9 to 1 indicates that the content of register 10 continues in register 11. 16 16 This is what is expected when the basic dataflash option is implemented even if the basic dataflash state bits report zero because no information is provided to the monitored registers.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.6.10.3.2**	—	3.1.2.6.10.3.2 Mode S subnetwork version. Transponders which monitor register changes and report their changes through the basic dataflash protocol shall support a Mode S subnetwork Version 6 or above.	
New text	**3.1.2.6.10.3.2**	—	Note.— The basic dataflash protocol uses register formats that have been defined with Mode S Subnetwork Version 6. More information can be found in Doc 9871.	
New text	**3.1.2.6.10.3.3**	—	3.1.2.6.10.3.3 Each basic dataflash register that is implemented shall have its contents updated at an interval not to exceed its update interval.	
New text	**3.1.2.6.10.3.3**	—	Note.— The register update intervals are defined in Doc 9871.	
New text	**3.1.2.6.10.3.4**	—	3.1.2.6.10.3.4 Register basic dataflash state	
New text	**3.1.2.6.10.3.4.1**	—	3.1.2.6.10.3.4.1 The basic dataflash state for each of the registers defined in register 11 shall contain 16 its associated monitoring states as follows: Coding 0: Register not monitored or not implemented 1: Register monitored and implemented but no change yet detected 2: Register monitored and change 1 detected 3: Register monitored and change 2 detected	
New text	**3.1.2.6.10.3.4.2**	—	3.1.2.6.10.3.4.2 Each register shall be monitored for a change according to its update period.	
New text	**3.1.2.6.10.3.4.2**	—	Note.— The register update periods are defined in Doc 9871.	
New text	**3.1.2.6.10.3.4.3**	—	3.1.2.6.10.3.4.3 Upon first entry into the monitored state, the transponder shall set the monitoring bits allocated in register 11 for that basic dataflash register to “1”, meaning register monitored and 16 implemented but no change yet detected.	
New text	**3.1.2.6.10.3.4.4**	—	3.1.2.6.10.3.4.4 Once a change has been detected, the basic dataflash state of the corresponding register shall be toggled between 2 and 3 with each change.	
New text	**3.1.2.6.10.3.4.4**	—	Note.— Toggle means if the register basic dataflash state was 2, at the next change it becomes 3 and if it was 3, it becomes 2.	
New text	**3.1.2.6.10.3.5**	—	3.1.2.6.10.3.5 Monitoring change and announcing a change to ground state	
New text	**3.1.2.6.10.3.5.1**	—	3.1.2.6.10.3.5.1 At intervals not exceeding 1 second, the transponder shall determine if the contents of register 11 have changed since the last update. 16	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.6.10.3.5.2**	—	3.1.2.6.10.3.5.2 If the contents of register 11 have changed, bit 51 of register 10 shall be toggled 16 16 and the F-timer shall be started (see Table 3-9).	
New text	**3.1.2.6.10.3.5.2**	—	Note.— The toggling (1→ 0 or 0→1) of bit 51 in register 10 will trigger a Comm-B broadcast of 16 register 10. 16	
New text	**3.1.2.6.10.3.5.3**	—	3.1.2.6.10.3.5.3 All basic dataflash monitoring activity (comparison of register contents and setting of bits in register 11) shall be suspended until the F-timer expires. 16	
New text	**3.1.2.6.10.3.5.3**	—	Note 1.— The suspension of basic dataflash monitoring avoids the Comm-B broadcast channel saturation.	
New text	**3.1.2.6.10.3.5.3**	—	Note 2.— Dataflash monitoring suspension means that the current content of monitored registers are retained and the detection of a change with the new contents of these registers will re-start after the 30s timer. The monitored registers themselves continue to be updated at their update periodicity.	
New text	**3.1.2.6.10.3.5.3**	—	Note 3.— The use of basic dataflash protocol by ground systems is described in Doc 9924. This allows reduction of periodic GICB extraction of registers.	
New text	**3.1.2.6.11**	—	Note 7.— When implemented, the technical provisions for phase overlay capability introduced in this section will provide means for increased data transmission capacity by the 1 090 extended squitters.	
New text to replace existing text	**3.1.2.6.11.2.1**	Note.— The transponder register allocation is specified in 9871Annex 10, Volume III, Part I, Chapter 5, Table 5-24.	Note.— The transponder register allocation is specified in Doc	
New text	**3.1.2.6.11.2.6**	—	3.1.2.6.11.2.6 Phase overlay ground-initiated Comm-B. For equipment that support phase overlay on Mode S replies, when the reply contains the contents of the requested ground-initiated Comm-B register, phase data shall be encoded data in accordance with the register requested in the interrogation (that is, requested BDS code) and as defined for that register.	
New text	**3.1.2.6.11.2.6.1**	—	3.1.2.6.11.2.6.1 PO message type field. The phase overlay message type field in PD data bits 1–8 shall be set to 2 for phase overlay Mode S GICB data with Reed-Solomon FEC and to 8 to indicate phase overlay Mode S GICB data with LDPC FEC.	
New text	**3.1.2.6.11.2.6.2**	—	3.1.2.6.11.2.6.2 PO message subtype field. PD data bits 9–12 shall contain the phase overlay message subtype	

Type of changes	Location	Existing Text	Amended Text	Comment
			field and is set to 1. The subfield is defined as shown in Table 3-14.	
New text	**3.1.2.6.11.2.6.2**	—	Note.— Future UF codes may contain commands to force the transmission of other data in the phase overlay data block overlaid on Mode S long replies.	
New text	**3.1.2.6.11.2.6.3**	—	3.1.2.6.11.2.6.3 PO-BDS field. PD data bits 13–20 shall contain the BDS register number requested as per 3.1.2.6.11.2.1.	
New text	**3.1.2.6.11.2.6.4**	—	3.1.2.6.11.2.6.4 PO data-block field. PD data bits 21–204 shall contain the content of the corresponding phase overlay data associated with the requested BDS register. When there is no phase overlay data defined for the requested BDS register, all bits shall be set to ZERO except the PO message type field is set to 2 or 8, PO message subtype = 1, PO-BDS = BDS number of requested BDS register, and the 24-bit address is contained in the aircraft address (PD bits 181 through 204).	
New text to replace existing text	**3.1.2.6.11.3.1**	3.1.2.6.11.3.1 General protocol. The transponder shall announce the presence of an air-initiated Comm-B message with the insertion of code 1 in the DR field. To extract an air-initiated Comm-B message, the interrogator shall transmit a request for a Comm-B message reply in a subsequent interrogation with RR equal to 16 and, if DI equals 7, RRS must be equal to 0 (3.1.2.6.11.3.2.1 and 3.1.2.6.11.3.3.1). Receipt of this request code shall cause the transponder to transmit the air-initiated Comm-B message. If a command to transmit an air-initiated Comm-B message is received while no message is waiting to be transmitted, the reply shall contain all ZEROs in the MB field. The reply that delivers the message shall continue to contain code 1 in the DR field. After a Comm-B closeout has been accomplished, the message shall be cancelled and the DR code belonging to this message immediately removed. If another air-initiated Comm-B message is waiting to be transmitted, the transponder shall set the DR code to 1, so that the reply contains the announcement of this next message.	3.1.2.6.11.3.1 General protocol. The transponder shall announce the presence of an air-initiated Comm-B message with the insertion of code 1 in the DR field. To extract an air-initiated Comm-B message, the interrogator shall transmit a request for a Comm-B message reply in a subsequent interrogation with RR equal to 16 and, if DI equals 7, RRS must be equal to 0 (3.1.2.6.11.3.2.1 and 3.1.2.6.11.3.3.1). Receipt of this request code shall cause the transponder to transmit the air-initiated Comm-B message. If a command to transmit an air-initiated Comm-B message is received while no message is waiting to be transmitted, the reply shall contain all ZEROs in the MB field. For equipment that support phase overlay on Mode S replies, when an air-initiated Comm-B message is transmitted, PD data bits 1–204 shall be set to ZERO. The reply that delivers the message shall continue to contain code 1 in the DR field. After a Comm-B closeout has been accomplished, the message shall be cancelled and the DR code belonging to this message immediately removed. If another air-initiated Comm-B message is waiting to be transmitted, the transponder shall set the DR code to 1, so that the reply contains the announcement of this next message.	
New text to replace existing text	**3.1.2.6.11.3.1**	Note.— The announcement and cancellation protocol ensures that an air-initiated message will not be lost due	Note.— The announcement and cancellation protocol ensures that an air-initiated message will not be lost due to uplink or downlink failures that occur during the	

Type of changes	Location	Existing Text	Amended Text	Comment
		to uplink or downlink failures that occur during the delivery process.	delivery process. An interrogator that has either not been assigned an IC or cannot ensure that its interrogation region will not overlap with the interrogation region of another interrogator using the same IC, shall not attempt to extract an air-initiated Comm-B message announced by DR equals 1 or 3.	
New text	**3.1.2.6.11.3.1.1**	—	3.1.2.6.11.3.1.1 Phase overlay data. When an air-initiated Comm-B message is transmitted, for equipment supporting phase overlay on Mode S replies, PD data bits 1–204 shall be set to ZERO.	
New text to replace existing text	**3.1.2.6.11.3.4.1**	3.1.2.6.11.3.4.1 The transponder shall be capable of storing each of the sixteen II codes: (1) an air-initiated or multisite-directed Comm-B message and (2) the contents of GICB registers 2 through 4.	3.1.2.6.11.3.4.1 The transponder shall be capable of storing two or more messages for each of the sixteen II codes: (1) an air-initiated or multisite-directed Comm-B message and (2) the contents of GICB registers 2 through 4.	
Deleted text	**3.1.2.6.11.3.4.1**	Note.— GICB registers 2 through 4 are used for the Comm-B linking protocol defined in the Mode S subnetwork SARPs (Annex 10, Volume III, Part I, Chapter 5).	—	
New text to replace existing text	**3.1.2.6.11.4.2.1**	To extract the broadcast message, an interrogator shall transmit RR equals 16 and DI not equal to 3 or 7 or RR equals 16 and DI equals 3 or 7 with RRS equals 0 in a subsequent interrogation.	3.1.2.6.11.4.2.1 To extract the broadcast message, an interrogator shall transmit RR equals 16 and DI not equal to 3 or 7 or RR equals 16 and DI equals 3 or 7 with RRS equals 0 in a subsequent interrogation.	
New text	**3.1.2.6.11.4.2.2**	—	3.1.2.6.11.4.2.2 For equipment that support phase overlay on Mode S replies, PD message bits 1 through 204 shall contain the data as specified in 3.1.2.6.11.2.6 for the register that is broadcast or all ZEROs for other broadcast channels.	
New text to replace existing text	**3.1.2.8.2.1**	3.1.2.8.2.1 VS: Vertical status: This 1-bit (6) downlink field shall indicate the status of the aircraft Coding 0 signifies that the aircraft is “airborne” 1 signifies that the aircraft is	3.1.2.8.2.1 VS: Vertical status: This 1-bit (6) downlink field shall indicate the effective air/ground state (3.1.2.4.3.36.10.1.2). Coding 0 signifies that the effective air/ground state is “airborne” 1 signifies that the effective air/ground state is “on-the-ground”	
New text to replace existing text	**3.1.2.8.5.2**	d) acquisition squitters shall only be transmitted on the surface if the transponder is not reporting the surface position type of Mode S extended squitter An acquisition squitter shall not be interrupted by link transactions or mutual suppression activity after the squitter transmission has begun.	d) when the effective air/ground state is “on-the-ground”, acquisition squitters shall be transmitted only when the surface position extended squitter ADS-B messages are not being transmitted (3.1.2.8.6.3.2). An acquisition squitter shall not be interrupted by link transactions or mutual suppression activity after the squitter transmission has begun.	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.2.8.5.2**	Note 2.— The surface report type may be selected automatically by the aircraft or by commands from a squitter ground station (3.1.2.8.6.7).	—	
New text to replace existing text	**3.1.2.8.5.3**	a) when “airborne” the transponder shall transmit acquisition squitters alternately from the two antennas; and	a) when the effective air/ground state is “airborne” (3.1.2.4.3.38.6.7), the transponder shall transmit acquisition squitters alternately from the two antennas; and	
New text to replace existing text	**3.1.2.8.5.3**	b) when on the surface the transponder shall transmit acquisition squitters under control of SAS (3.1.2.6.1.4.1 f)). In the absence of any SAS commands, use of the top antenna only shall be the default.	b) when the effective air/ground state is “on-the-ground” (3.1.2.4.3.38.6.7), the transponder shall transmit acquisition squitters from the top antenna only	
New text to replace existing text	**3.1.2.8.5.3**	Note.— Acquisition squitters are not emitted on the surface if the transponder is reporting the surface type of extended squitter	Note.— Acquisition squitters are not transmitted if the effective air/ground state is “on-the-ground” (3.1.2.4.3.3) and the transponder is transmitting surface position extended squitter ADS-B messages (3.1.2.8.6.4.3).	
New text to replace existing text	**3.1.2.8.6.2**	3.1.2.8.6.2 ME: Message, extended squitter. This 56-bit (33-88) downlink field in DF = 17 shall be used to transmit broadcast messages. Extended squitter shall be supported by registers 05, 06, 07, 08, 09, 0A {HEX} and 61-6F {HEX} and shall conform to either version 0, version 1, or version 2 message formats as described below:	3.1.2.8.6.2 ME: Message, extended squitter. This 56-bit (33-88) downlink field in DF = 17 shall be used to transmit broadcast messages. Extended squitter shall be supported by registers 05, 06, 07, 08, 09, 0A {HEX} and 61-6F {HEX} and shall conform to either version 0, version 1, version 2 or version 3 message formats as described below:	
Deleted text	**3.1.2.8.6.2**	b) Version 1 ES message formats and related requirements report surveillance accuracy and integrity separately as navigation accuracy category (NAC), navigation integrity category (NIC) and surveillance integrity level (SIL). Version 1 ES formats also include provisions for enhanced reporting of status information; and.	b) Version 1 ES message formats and related requirements report surveillance accuracy and integrity separately as navigation accuracy category (NAC), navigation integrity category (NIC) and surveillance integrity level (SIL). Version 1 ES formats also include provisions for enhanced reporting of status information;	
New text	**3.1.2.8.6.2**	—	d) Version 3 ES message formats and related requirements contain the provisions of Version 2 and incorporate additional capabilities. Version 3 ES improves reporting of geometric altitude, supports the broadcast of weather and aircraft parameters in support of air-to-air and air-to-ground weather application as well as improves emitter category classifications. Version 3 also includes support for UAS/RPAS operations as well as position and velocity reporting to accommodate altitude and velocities not supported by previous versions. To enable monitoring of interrogation rates detected and transmitted reply rates by a transponder, Version 3 supports the broadcast of such transponder activity. Version 3 additionally reports transponder antenna	

Type of changes	Location	Existing Text	Amended Text	Comment
			offset, an indication of Mode S reply rate limiting status as well as ACAS coordination capability reporting.	
Deleted text	**3.1.2.8.6.2**	Note 1.— The formats and update rates of each register are specified in the Technical Provisions for Mode S Services and Extended Squitter (Doc 9871). The formats and update rates for individual squitters are defined by the version number of the extended squitter.	Note 1.— The formats and update rates of each register are specified in (Doc 9871). The formats and update rates for individual squitters are defined by the version number of the extended squitter.	
Deleted text	**3.1.2.8.6.2**	Note 2.— The formats for the fourthree different versions are interoperable. An extended squitter receiver can recognize and decode signals of its own version, as well as lower versions' message formats. The receiver, however, can decode higher version signals according to its own capability.	Note 2.— The formats for the different versions are interoperable. An extended squitter receiver can recognize and decode signals of its own version, as well as lower versions' message formats. The receiver, however, can decode higher version signals according to its own capability.	
New text	**3.1.2.8.6.3**	—	Note.— Extended squitter types described from 3.1.2.8.6.3.1 to 3.1.2.8.6.3.15 are defined in Doc 9871.	
Deleted text	**3.1.2.8.6.3.1**	Note.— A GICB request (3.1.2.6.11.2) containing RR equals 16 and DI equals 3 or 7 and RRS equals 5 will cause the resulting reply to contain the airborne position message in its MB field.	—	
New text to replace existing text	**3.1.2.8.6.3.1.2**	3.1.2.8.6.3.1.2 ACS, altitude code subfield in ME. Under control of ATS (3.1.2.8.6.3.1.3), transponder shall report either navigation-derived altitude, or the barometric altitude code in this 12-bit (41- 52) subfield of ME when ME contains an airborne position message. When barometric altitude is reported, the contents of the ACS shall be as specified for the 13-bit AC field (3.1.2.6.5.4) except that the M-bit (bit 26) shall be omitted.	3.1.2.8.6.3.1.2 ACS, altitude code subfield in ME. tThe transponder shall report either navigation-derived altitude, or the barometric altitude code in this 12-bit (41- 52) subfield of ME when ME contains an airborne position message. When barometric altitude is reported, the contents of the ACS shall be as specified for the 13-bit AC field (3.1.2.6.5.4) except that the M-bit (bit 26) shall be omitted.	
Deleted text	**3.1.2.8.6.3.1.3**	3.1.2.8.6.3.1.3 Control of ACS reporting. Transponder reporting of altitude data in ACS shall depend on the altitude type subfield (ATS) as specified in 3.1.2.8.6.8.2. Transponder insertion of barometric altitude data in the ACS subfield shall take place when the ATS subfield has the value of ZERO. Transponder insertion of barometric altitude data in ACS shall be inhibited when ATS has the value 1.	—	
Deleted text	**3.1.2.8.6.3.2**	Note.— A GICB request (3.1.2.6.11.2) containing RR equals 16 and DI equals 3 or 7 and RRS equals 6 will cause the resulting reply to contain the surface position message in its MB field.	—	
Deleted text	**3.1.2.8.6.3.3**	Note.— A GICB request (3.1.2.6.11.2) containing RR equals 16 and DI equals 3 or 7 and RRS equals 8 will	—	

Type of changes	Location	Existing Text	Amended Text	Comment
		cause the resulting reply to contain the aircraft identification message in its MB field.		
Deleted text	**3.1.2.8.6.3.4**	Note.— A GICB request (3.1.2.6.11.2) containing RR equals 16 and DI equals 3 or 7 and RRS equals 9 will cause the resulting reply to contain the airborne velocity message in its MB field.	—	
New text	**3.1.2.8.6.3.5**	—	3.1.2.8.6.3.5 Aircraft operational status squitter. The aircraft operational status extended squitter type shall use format DF = 17 with the contents of GICB register 65 {HEX} inserted in the ME field.	
New text	**3.1.2.8.6.3.6**	—	3.1.2.8.6.3.6 Target state and status squitter. The target state and status extended squitter type shall use format DF = 17 with the contents of GICB register 62 {HEX} inserted in the ME field.	
New text	**3.1.2.8.6.3.7**	—	3.1.2.8.6.3.7 “Emergency/priority status” squitter. The “emergency/priority status” extended squitter type shall use format DF = 17 with the contents of GICB register 61 {HEX} inserted in the ME field.	
New text	**3.1.2.8.6.3.8**	—	3.1.2.8.6.3.8 TCAS RA broadcast squitter. The TCAS RA broadcast extended squitter type shall use format DF = 17 with the contents of GICB register 30 {HEX} inserted in the ME field.	
New text	**3.1.2.8.6.3.8**	—	Note.— In ADS-B Version 2, the TCAS RA broadcast extended squitter information was transmitted using the contents in GICB register 61 {HEX} subtype equal to 2.	
New text	**3.1.2.8.6.3.9**	—	3.1.2.8.6.3.9 HVA position squitter. The HVA position extended squitter type shall use format DF = 17 with the contents of GICB register 6E {HEX} inserted in the ME field.	
New text	**3.1.2.8.6.3.10**	—	3.1.2.8.6.3.10 HVA velocity squitter. The HVA velocity extended squitter type shall use format DF = 17 with the contents of GICB register 6F {HEX} inserted in the ME field.	
New text	**3.1.2.8.6.3.11**	—	3.1.2.8.6.3.11 “UAS/RPAS contingency” current/next TCP squitters. The “UAS/RPAS contingency” current/next TCP extended squitter type shall use format DF = 17 with the contents of GICB register 63 {HEX} to 64 {HEX} inserted in the ME field.	
New text	**3.1.2.8.6.3.12**	—	3.1.2.8.6.3.12 ADS-B Wx AIREP squitters. The ADS-B Wx AIREP extended squitter types shall use the contents of GICB register 68 {HEX} to 6A {HEX}, as applicable, to	

Type of changes	Location	Existing Text	Amended Text	Comment
			insert the appropriate aircraft or weather state information in the ME field.	
New text	**3.1.2.8.6.3.13**	—	3.1.2.8.6.3.13 ADS-B Wx PIREP squitters. The ADS-B Wx PIREP extended squitter types shall use the contents of GICB registers 6B {HEX} to 6D {HEX}, as applicable, to insert the appropriate aircraft or weather state information in the ME field.	
New text	**3.1.2.8.6.3.14**	—	3.1.2.8.6.3.14 Extended Squitter event-driven information. The event-driven message shall use format DF = 17 with the contents of GICB register 0A {HEX} inserted in the ME field.	
New text	**3.1.2.8.6.3.14**	—	Note.— Although labeled as extended squitter, prior to Version 3, this message would only be broadcast once each time the register was loaded with information. ADS-B Version 3 removed the implementation of this register.	
New text	**3.1.2.8.6.3.15**	—	3.1.2.8.6.3.15 Interrogation/reply monitor squitters. The interrogation/reply monitor squitter types shall use format DF = 17 with the contents of GICB registers 66 {HEX} to 67 {HEX} inserted in the ME field.	
Deleted text	**3.1.2.8.6.3.5**	3.1.2.8.6.3.5 Periodic status and event-driven squitters	—	
Deleted text	**3.1.2.8.6.3.5.1**	3.1.2.8.6.3.5.1 Periodic status squitter. The periodic status extended squitter types shall use format DF = 17 to convey aircraft status and other surveillance data. The aircraft operational status extended squitter type shall use the contents of GICB register 65 {HEX} inserted in the ME field. The target state and status extended squitter type shall use the contents of GICB register 62 {HEX} inserted in the ME field.	—	
Deleted text	**3.1.2.8.6.3.5.1**	Note 1.— A GICB request (3.1.2.6.11.2) containing RR equals 22 and DI equals 3 or 7 and RRS equals 5 will cause the resulting reply to contain the aircraft operational status message in its MB field.	—	
Deleted text	**3.1.2.8.6.3.5.1**	Note 2.— A GICB request (3.1.2.6.11.2) containing RR equals 22 and DI equals 3 or 7 and RRS equals 2 will cause the resulting reply to contain the target state and status information in its MB field.	—	
Deleted text	**3.1.2.8.6.3.5.2**	3.1.2.8.6.3.5.2 Event-driven squitter. The event-driven extended squitter type shall use format DF = 17 with the contents of GICB register 0A {HEX} inserted in the ME field.	—	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.2.8.6.3.5.2**	Note.— A GICB request (3.1.2.6.11.2) containing RR equals 16 and DI equals 3 or 7 and RRS equals 10 will cause the resulting reply to contain the event-driven message in its MB field.	—	
New text to replace existing text	**3.1.2.8.6.4.1**	3.1.2.8.6.4.1 Initialization. At power up initialization, the transponder shall commence operation in a mode in which it broadcasts only acquisition squitters (3.1.2.8.5). The transponder shall initiate the broadcast of extended squitters for airborne position, surface position, airborne velocity and aircraft identification when data are inserted into transponder registers 05, 06, 09 and 08 {HEX}, respectively. This determination shall be made individually for each squitter type. When extended squitters are broadcast, transmission rates shall be as indicated in the following paragraphs. Acquisition squitters shall be reported in addition to extended squitters unless the acquisition squitter is inhibited (2.1.5.4). Acquisition squitters shall always be reported if both position and velocity extended squitters are not reportedorted.	3.1.2.8.6.4.1 Initialization. At power up initialization, the transponder shall commence operation in a mode in which it does not transmit extended squitters. The initialization determination shall be made individually for each squitter type.	
New text to replace existing text	**3.1.2.8.6.4.1**	Note 1.— This suppresses the transmission of extended squitters from aircraft that are unable to report position, velocity or identity. If input to the register for the position squitter type stops for 60 seconds, broadcast will be discontinued until data insertion is resumed. Broadcast of airborne position squitters is not discontinued if barometric altitude data is available. Terminating broadcast of other squitter types is described in Technical Provisions for Mode S Services and Extended Squitter (Doc 9871).	Note 1.— Initialization is described in (Doc 9871).	
Deleted text	**3.1.2.8.6.4.1**	Note 2.— After timeout (3.1.2.8.6.6), the position squitter type may contain an ME field of all zeroes.	—	
New text to replace existing text	**3.1.2.8.6.4.2**	3.1.2.8.6.4.2 Airborne position squitter rate. Airborne position squitter transmissions shall be emitted when the aircraft is “airborne” (3.1.2.8.6.7) at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous airborne position squitter, with the exceptions as specified in 3.1.2.8.6.4.7.	3.1.2.8.6.4.2 Airborne position squitter rate. Airborne position squitter transmissions shall be emitted when the broadcast message format (see 3.1.2.8.6.7) is “airborne” and the HVA position squitter is not transmitted. Airborne position squitter transmissions shall be emitted at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous airborne position squitter, with the exceptions as specified in 3.1.2.8.6.4.7.	
New text	**3.1.2.8.6.4.2**	—	Note.— Selection criteria for the airborne and HVA position squitters are specified in Doc 9871.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**3.1.2.8.6.4.3**	3.1.2.8.6.4.3 Surface position squitter rate. Surface position squitter transmissions shall be emitted when the aircraft is on the surface 3.1.2.8.6.7) using one of two rates depending upon whether the high or low squitter rate has been selected (3.1.2.8.6.9). When the high squitter rate has been selected, surface position squitters shall be emitted at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous surface position squitter (termed the high rate). When the low squitter rate has been selected, surface position squitters shall be emitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous surface position squitter (termed the low rate). Exceptions to these transmission rates are specified in 3.1.2.8.6.4.7.	3.1.2.8.6.4.3 Surface position squitter rate. Surface position squitter transmissions shall be emitted when the broadcast message format (see 3.1.2.8.6.7) is “surface” using one of two rates depending upon whether the high or low squitter rate has been selected (3.1.2.8.6.9). When the high squitter rate has been selected, surface position squitters shall be emitted at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous surface position squitter (termed the high rate). When the low squitter rate has been selected, surface position squitters shall be emitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous surface position squitter (termed the low rate). Exceptions to these transmission rates are specified in 3.1.2.8.6.4.7.	
Deleted text	**3.1.2.8.6.4.4**	3.1.2.8.6.4.4 Aircraft identification squitter rate. Aircraft identification squitter transmissions shall be emitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous identification squitter when the aircraft is reporting the airborne position squitter type, or when the aircraft is reporting the surface position squitter type and the high surface squitter rate has been selected. When the surface position squitter type is being reported at the low surface rate, the aircraft identification squitter shall be emitted at random intervals that are uniformly distributed over the range of 9.8 to 10.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous identification squitter. Exceptions to these transmission rates are specified in 3.1.2.8.6.4.7.	3.1.2.8.6.4.4 Aircraft identification squitter rate. Aircraft identification squitter transmissions shall be emitted at random intervals that are uniformly distributed over the range of 4.8 to 5.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous identification squitter when the aircraft is reporting the airborne position squitter type, or when the aircraft is reporting the surface position squitter type and the high rate has been selected. When the surface position squitter type is being reported at the low rate, the aircraft identification squitter shall be emitted at random intervals that are uniformly distributed over the range of 9.8 to 10.2 seconds using a time quantization of no greater than 15 milliseconds relative to the previous identification squitter. Exceptions to these transmission rates are specified in 3.1.2.8.6.4.7.	
New text to replace existing text	**3.1.2.8.6.4.5**	3.1.2.8.6.4.5 Airborne velocity squitter rate. Airborne velocity squitter transmissions shall be emitted when the aircraft is airborne 3.1.2.8.6.7) at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous airborne velocity squitter, with the exceptions as specified in 3.1.2.8.6.4.7.	3.1.2.8.6.4.5 Airborne velocity squitter rate. Airborne velocity squitter transmissions shall be emitted when the broadcast message format (see 3.1.2.8.6.7) is “airborne” and the HVA velocity squitter is not transmitted. Airborne velocity squitter transmissions shall be emitted at random intervals that are uniformly distributed over the range from 0.4 to 0.6 seconds using a time quantization of no greater than 15 milliseconds relative to the previous airborne velocity squitter, with the exceptions as specified in 3.1.2.8.6.4.7.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**3.1.2.8.6.4.6**	3.1.2.8.6.4.6 Periodic status and event-driven squitter rates.	3.1.2.8.6.4.6 Other extended squitter rates. Other extended squitters shall be emitted at rates consistent with the extended squitter message type and the associated extended squitter version number.	
Deleted text	**3.1.2.8.6.4.6.1**	3.1.2.8.6.4.6.1 Periodic status squitter rates. The periodic status squitter types supported by a Mode S extended squitter transmitting system class, as specified in 5.1.1.2, shall be periodically emitted at defined intervals depending on the on-the-ground status and whether their content has changed.	—	
New text to replace existing text	**3.1.2.8.6.4.6.1**	Note.— The aircraft operational status extended squitter type and the target state and status extended squitter type rates are specified in the Technical Provisions for Mode S Services and Extended Squitter (Doc 9871).	Note.— Other extended squitter rates are specified in (Doc 9871).	
Deleted text	**3.1.2.8.6.4.6.2**	3.1.2.8.6.4.6.2 Event-driven squitter rate. The event-driven squitter shall be transmitted once, each time that GICB register 0A {HEX} is loaded, while observing the delay conditions specified in 3.1.2.8.6.4.7. The maximum transmission rate for the event-driven squitter shall be limited by the transponder to twice per second. If a message is inserted in the event-driven register and cannot be transmitted due to rate limiting, it shall be held and transmitted when the rate limiting condition has cleared. If a new message is received before transmission is permitted, it shall overwrite the earlier message.	—	
New text to replace existing text	**3.1.2.8.6.5**	a) when airborne 3.1.2.8.6.7) the transponder shall transmit each type of extended squitter alternately from the two antennas; and	a) when the broadcast message format (see 3.1.2.8.6.7) is “airborne”, the transponder shall transmit each type of extended squitter alternately from the two antennas; and	
New text to replace existing text	**3.1.2.8.6.5**	b) when on the surface 3.1.2.8.6.7) the transponder shall transmit extended squitters under control of SAS (3.1.2.6.1.4.1 f)) In the absence of any SAS commands, use of the top antenna only shall be the default condition.	b) when the broadcast message format (see 3.1.2.8.6.7) is “on-the-ground”, the transponder shall transmit extended squitters from the top antenna only.	
New text to replace existing text	**3.1.2.8.6.7**	3.1.2.8.6.7	3.1.2.8.6.7 Extended squitter ADS-B message formats	
New text	**3.1.2.8.6.7**	—	Note 1.— DF = 17 message fields and formats are based on whether the aircraft is determined, by the transponder, to be on-the-ground or airborne. Level 2 and above transponders report declared air/ground	

Type of changes	Location	Existing Text	Amended Text	Comment
			status via the CA field in DF = 17 extended squitter ADS-B messages (see 3.1.2.5.2.2.1).	
New text	**3.1.2.8.6.7**	—	Note 2.— Extended squitter ADS-B messages are formatted based on the effective air/ground state or the broadcast message format. Effective air/ground state is set based on the declared air/ground status (see 3.1.2.4.3.3). Broadcast message format is set based on the declared air/ground status (see 3.1.2.4.3.3) and in fixed-wing aircraft may also incorporate the output of a broadcast message format algorithm (see 3.1.2.8.6.7.3).	
New text	**3.1.2.8.6.7**	—	Note 3.— The CA field reports the declared air/ground status (see 3.1.2.5.2.2.1). ACAS II acquires aircraft using squitters that contain the CA field. If an aircraft reports the declared air/ground status as “on-the-ground”, that aircraft will not be interrogated by ACAS II in order to reduce unnecessary interrogation activity.	
New text	**3.1.2.8.6.7**	—	Note 4.— Use of the following technique may result in surface or airborne format extended squitter ADS-B messages being transmitted when the CA field indicates the declared air/ground status is “unknown” (CA code 6).	
New text	**3.1.2.8.6.7.1**	—	3.1.2.8.6.7.1 Extended squitter ADS-B message format determination for ES version numbers 0 through 2. Mode S transponders that broadcast Version 0, 1 or 2 ES messages whose formats are not determined as described in 3.1.2.8.6.7.2, shall determine the extended squitter ADS-B message format based on the effective air/ground state (see 3.1.2.4.3.3).	
New text	**3.1.2.8.6.7.1.1**	—	3.1.2.8.6.7.1.1 If the effective air/ground state is “on-the-ground”, the extended squitter ADS-B message format shall be “surface”.	
New text	**3.1.2.8.6.7.1.2**	—	3.1.2.8.6.7.1.2 If the effective air/ground state is “airborne”, the extended squitter ADS-B message format shall be “airborne”, except as follows:	
New text	**3.1.2.8.6.7.1.2**	—	a) for aircraft whose emitter category (see Doc 9871) is Set “A” code 2, 3, 4, 5 or 6, or Set “B” code 7, the extended squitter ADS-B message format shall be “surface” if:	
New text	**3.1.2.8.6.7.1.2**	—	i) if radio altitude and ground speed are available and airspeed is unavailable, and radio altitude indicates < 50 feet and ground speed indicates < 100 knots; or ii) if radio altitude and airspeed are available and ground speed is unavailable, and radio altitude indicates < 50 feet and	

Type of changes	Location	Existing Text	Amended Text	Comment
			airspeed indicates < 100 knots; or iii) if radio altitude, ground speed and airspeed are available and radio altitude indicates <50 feet and both ground speed and airspeed indicate < 100 knots;	
New text	**3.1.2.8.6.7.1.2**	—	b) for aircraft whose emitter category (see Doc 9871) is Set “A” code 2, 3, 4, 5 or 6, or Set “B” code 7, the extended squitter ADS-B message format shall be “surface” if radio altitude is unavailable and available ground speed and airspeed both indicate < 50 knots; or	
New text	**3.1.2.8.6.7.1.2**	—	c) for aircraft whose emitter category (see Doc 9871) is Set “C” code 1 or 2; the extended squitter ADS-B message format shall be “surface”.	
New text	**3.1.2.8.6.7.2**	—	3.1.2.8.6.7.2 Extended squitter ADS-B message format determination for ES version numbers 3 and greater. Mode S transponders shall use the broadcast message format to determine whether to report airborne or surface extended squitter ADS-B messages.	
New text	**3.1.2.8.6.7.2.1**	—	3.1.2.8.6.7.2.1 If subsequent to the validation in 3.1.2.4.3.2 the declared air/ground status is “airborne”, the broadcast message format shall be “airborne”.	
New text	**3.1.2.8.6.7.2.2**	—	3.1.2.8.6.7.2.2 If subsequent to the validation in 3.1.2.4.3.2 the declared air/ground status is “on-the-ground”, the broadcast message format shall be “surface”.	
New text	**3.1.2.8.6.7.2.3**	—	3.1.2.8.6.7.2.3 If the emitter category (see Doc 9871) is “surface vehicle – emergency vehicle” or “surface vehicle – service vehicle”, the broadcast message format shall be “surface”.	
New text	**3.1.2.8.6.7.2.4**	—	3.1.2.8.6.7.2.4 If subsequent to the validation in 3.1.2.4.3.2 the declared air/ground status is “unknown” and a broadcast message format algorithm is applicable (see 3.1.2.8.6.7.3), the broadcast message format shall be determined by the broadcast message format algorithm output.	
New text	**3.1.2.8.6.7.2.5**	—	3.1.2.8.6.7.2.5 If subsequent to the validation in 3.1.2.4.3.2 the declared air/ground status is “unknown” and a broadcast message format algorithm is not applicable (see 3.1.2.8.6.7.3), the broadcast message format shall be “airborne”.	
New text	**3.1.2.8.6.7.3**	—	3.1.2.8.6.7.3 Broadcast message format algorithm	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.8.6.7.3**	—	Note.— Broadcast message format algorithm, if implemented, provides a means for fixed-wing aircraft, under certain conditions, to determine the broadcast message format using only sensor data available to the transponder. This is desirable to prevent aircraft without a means of automatically determining the on- the-ground condition from broadcasting an incorrect extended squitter ADS-B message format.	
New text	**3.1.2.8.6.7.3.1**	—	3.1.2.8.6.7.3.1 Recommendation.— If not equipped with an automatic means of determining the on- the-ground condition, aircraft whose emitter category (see Doc 9871) is Set “A” code 1, 2, 3 or 5 should implement a broadcast message format algorithm.	
New text	**3.1.2.8.6.7.3.2**	—	3.1.2.8.6.7.3.2 If implemented, broadcast message format algorithm requirements shall apply only to aircraft whose emitter category is Set “A” code 1, 2, 3 or 5.	
New text	**3.1.2.8.6.7.3.3**	—	3.1.2.8.6.7.3.3 Reported broadcast message format. If implemented, the broadcast message format algorithm shall provide a reported broadcast message format that is limited to “airborne” or “surface”.	
New text	**3.1.2.8.6.7.3.3.1**	—	3.1.2.8.6.7.3.3.1 After start-up, if the broadcast message format algorithm does not update the reported broadcast message format within 300 seconds, or for more than 10 seconds after last reporting “surface” or “airborne”, the reported broadcast message format shall be set to “airborne”.	
New text	**3.1.2.8.6.7.3.3.2**	—	3.1.2.8.6.7.3.3.2 During taxi and take-off operations, the broadcast message format algorithm shall determine and update the reported broadcast message format prior to entering or within 5 seconds of exiting the runway transition zone, including while taxiing after landing.	
New text	**3.1.2.8.6.7.3.3.3**	—	3.1.2.8.6.7.3.3.3 During inflight operations, the broadcast message format algorithm shall maintain a reported broadcast message format of “airborne” while remaining outside of any runway transition zone.	
New text	**3.1.2.8.6.7.3.3.3**	—	Note.— For additional information regarding broadcast message format algorithm definitions, applicability and performance, refer to RTCA DO-260C/ED-102B §2.2.3.2.2.1.4.	
Deleted text	**3.1.2.8.6.7**	3.1.2.8.6.7 Airborne/surface state determination. Aircraft with an automatic means of determining on-the-ground	—	

Type of changes	Location	Existing Text	Amended Text	Comment
		conditions shall use this input to select whether to report the airborne or surface message types. Aircraft without such means shall report the airborne type messages, except as specified in Table 3-7. Use of this table shall only be applicable to aircraft that are equipped to provide data for radio altitude AND, as a minimum, airspeed OR ground speed. Otherwise, aircraft in the specified categories that are only equipped to provide data for airspeed and ground speed shall broadcast the surface format if: airspeed < 50 knots AND ground speed < 50 knots Aircraft with or without such automatic on-the-ground determination shall use position message types as commanded by control codes in TCS (3.1.2.6.1.4.1 f)). After time-out of the TCS commands, control of airborne/surface determination shall revert to the means described above.		
Deleted text	**3.1.2.8.6.7**	Note 1. — Use of this technique may result in the surface position format being transmitted when the air-ground status in the CA fields indicates “airborne or on the ground”.	—	
Deleted text	**3.1.2.8.6.7**	Note 2.— Extended squitter ground stations determine aircraft airborne or on-the-ground status by monitoring aircraft position, altitude and ground speed. Aircraft determined to be on the ground that are not reporting the surface position message types will be commanded to report the surface formats via TCS (3.1.2.6.1.4.1 f)). The normal return to the airborne position message types is via a ground command to report airborne message types. To guard against loss of communications after take-off, commands to report the surface position message types automatically time-out.	—	
New text to replace existing text	**3.1.2.8.6.8**	3.1.2.8.6.8 Squitter status reporting. A GICB request (3.1.2.6.11.2) containing RR equals 16 and DI equals 3 or 7 and RRS equals 7 shall cause the resulting reply to contain the squitter status report in its MB field.	3.1.2.8.6.8 Squitter status reporting. Register 07 {HEX} shall be reserved in transponders conforming to ADS-B Version 3 and later.	
New text	**3.1.2.8.6.8**	—	Note.— Technical provisions for squitter status reporting (Register 07 {HEX}) for ADS-B Version 2 and earlier can be found in Doc 9871.	
Deleted text	**3.1.2.8.6.8.1**	3.1.2.8.6.8.1 TRS, transmission rate subfield in MB. The transponder shall report the capability of the aircraft to automatically determine its surface squitter rate and its current squitter rate in this 2-bit (33, 34) subfield of MB. Coding 0 signifies no capability to automatically determine surface squitter rate 1 signifies that the high	—	

Type of changes	Location	Existing Text	Amended Text	Comment
		surface squitter rate has been selected 2 signifies that the low surface squitter rate has been selected 3 Unassigned		
Deleted text	**3.1.2.8.6.8.1**	Note 1.— High and low squitter rate is determined on board the aircraft.	—	
Deleted text	**3.1.2.8.6.8.1**	Note 2.— The low rate is used when the aircraft is stationary and the high rate is used when the aircraft is moving. For details of how “moving” is determined, see the data format of register 07 in the Technical 16 Provisions for Mode S Services and Extended Squitter (Doc 9871).	—	
Deleted text	**3.1.2.8.6.8.2**	3.1.2.8.6.8.2 ATS, altitude type subfield in MB. The transponder shall report the type of altitude being provided in the airborne position extended squitter in this 1-bit (35) subfield of MB when the reply contains the contents of transponder register 07 {HEX}. Coding 0 signifies that barometric altitude shall be reported in the ACS (3.1.2.8.6.3.1.2) of transponder register 05 {HEX}. 1 signifies that navigation-derived altitude shall be reported in the ACS (3.1.2.8.6.3.1.2) of transponder register 05 {HEX}.	—	
Deleted text	**3.1.2.8.6.8.2**	Note.— Details of the contents of transponder registers 05 {HEX} and 07 {HEX} are shown in the Technical Provisions for Mode S Services and Extended Squitter (Doc 9871).	—	
New text to replace existing text	**3.1.2.8.6.9**	3.1.2.8.6.9 Surface squitter rate control. Ssurface squitter rate shall be determined as follows:	3.1.2.8.6.9 Surface squitter rate Surface position messages shall be initiated using the low squitter rate. The Ssurface squitter broadcast rate (“high” or “low” as defined in 3.1.2.8.6.4.3) shall be determined as follows:	
New text	**3.1.2.8.6.9**	—	Note.— Transponders conforming to ADS-B Version 2 and earlier examine the transmission rate subfield (TRS) to determine whether to transmit at the “high” or “low” rate. Relevant detailed technical provisions are specified in Doc 9871.	
New text to replace existing text	**3.1.2.8.6.9**	a) once per second the contents of the TRS shall be read. If the value of TRS is 0 or 1, the transponder shall transmit surface squitters at the high rate. If the value of TRS is 2, the transponder shall transmit surface squitters at the low rate	a) the broadcast rate shall be changed from “high” to “low” when the navigation source position data has not changed more than 10 metres in any 15-minute interval ± 10 seconds;	
New text	**3.1.2.8.6.9**	—	Note.— It is acceptable to compute the 10-metre distance using either rectangular or polar coordinates.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**3.1.2.8.6.9**	b) the squitter rate determined via TRS shall be subject to being overridden by commands received via RCS (3.1.2.6.1.4.1 f)). RCS code 1 shall cause the transponder to squitter at the high rate for 60 seconds. RCS code 2 shall cause the transponder to squitter at the low rate for 60 seconds. These commands shall be able to be refreshed for a new 60 second period before time-out of the prior period and	b) upon selecting the “low” broadcast rate, the transmission device shall save the position data at the time that the “low” rate was selected (including at initialization); and	
New text to replace existing text	**3.1.2.8.6.9**	c) after time-out and in the absence of RCS codes 1 and 2, control shall return to TRSthe	c) broadcast rate shall be changed from “low” to “high” when the position of the transmission device has changed by 10 metres or more since the “low” rate was selected.	
Deleted text	**3.1.2.8.6.11**	3.1.2.8.6.11 Data insertion. When the transponder determines that it is time to emit an airborne position squitter, it shall insert the current value of the barometric altitude (unless inhibited by the ATS subfield, 3.1.2.8.6.8.2) and surveillance status into the appropriate fields of register 05 {HEX}. The contents of this register shall then be inserted into the ME field of DF = 17 and transmitted.	3.1.2.8.6.11 Data insertion. When the transponder determines that it is time to emit an airborne position squitter, it shall insert the current value of the barometric altitude and surveillance status into the appropriate fields of register 05 {HEX}. The contents of this register shall then be inserted into the ME field of DF = 17 and transmitted.	
New text	**3.1.2.8.7.3.2**	—	Note.— ES/NT squitter types described from 3.1.2.8.7.3.2.1 to 3.1.2.8.7.3.2.13 are defined in Doc 9871.	
Deleted text	**3.1.2.8.7.3.2.1**	3.1.2.8.7.3.2.1 Airborne position squitter. The airborne position type ES/NT shall use format DF = 18 with the format for register 05 {HEX} as defined in 3.1.2.8.6.2 inserted in the ME field.	3.1.2.8.7.3.2.1 Airborne position squitter. The airborne position type ES/NT shall use format DF = 18 with the format for register 05 {HEX} inserted in the ME field.	
Deleted text	**3.1.2.8.7.3.2.2**	3.1.2.8.7.3.2.2 Surface position squitter. The surface position type ES/NT shall use format DF = 18 with the format for register 06 {HEX} as defined in 3.1.2.8.6.2 inserted in the ME field.	3.1.2.8.7.3.2.2 Surface position squitter. The surface position type ES/NT shall use format DF = 18 with the format for register 06 {HEX} inserted in the ME field.	
Deleted text	**3.1.2.8.7.3.2.3**	3.1.2.8.7.3.2.3 Aircraft identification squitter. The aircraft identification type ES/NT shall use format DF = 18 with the format for register 08 {HEX} as defined in 3.1.2.8.6.2 inserted in the ME field.	3.1.2.8.7.3.2.3 Aircraft identification squitter. The aircraft identification type ES/NT shall use format DF = 18 with the format for register 08 {HEX} inserted in the ME field.	
Deleted text	**3.1.2.8.7.3.2.4**	3.1.2.8.7.3.2.4 Airborne velocity squitter. The airborne velocity type ES/NT shall use format DF = 18 with the format for register 09 {HEX} as defined in 3.1.2.8.6.2 inserted in the ME field.	3.1.2.8.7.3.2.4 Airborne velocity squitter. The airborne velocity type ES/NT shall use format DF = 18 with the format for register 09 {HEX} inserted in the ME field.	
New text	**3.1.2.8.7.3.2.5**	—	3.1.2.8.7.3.2.5 Aircraft operational status squitter. The aircraft operational status extended squitter type shall	

Type of changes	Location	Existing Text	Amended Text	Comment
			use format DF = 18 with the contents of GICB register 65 {HEX} inserted in the ME field.	
New text	**3.1.2.8.7.3.2.6**	—	3.1.2.8.7.3.2.6 Target state and status squitter. The target state and status extended squitter type shall use format DF = 18 with the contents of GICB register 62 {HEX} inserted in the ME field.	
New text	**3.1.2.8.7.3.2.7**	—	3.1.2.8.7.3.2.7 “Emergency/Priority status” squitter. The “Emergency/Priority Status” extended squitter type shall use format DF = 18 with the contents of GICB register 61 {HEX} inserted in the ME field.	
New text	**3.1.2.8.7.3.2.8**	—	3.1.2.8.7.3.2.8 HVA position squitter. The HVA position extended squitter type shall use format DF = 18 with the contents of GICB register 6E {HEX} inserted in the ME field.	
New text	**3.1.2.8.7.3.2.9**	—	3.1.2.8.7.3.2.9 HVA velocity squitter. The HVA velocity extended squitter type shall use format DF = 18 with the contents of GICB register 6F {HEX} inserted in the ME field.	
New text	**3.1.2.8.7.3.2.10**	—	3.1.2.8.7.3.2.10 “UAS/RPAS Contingency” Current/Next TCP squitter. The “UAS/RPAS Contingency” Current/Next TCP extended squitter type shall use format DF = 18 with the contents of GICB register 63 {HEX} to 64 {HEX} inserted in the ME field.	
New text	**3.1.2.8.7.3.2.11**	—	3.1.2.8.7.3.2.11 ADS-B Wx AIREP squitters. The ADS-B Wx AIREP extended squitter types shall use format DF = 18 with the contents of GICB register 68 {HEX} to 6A {HEX}, as applicable, to insert the appropriate aircraft or weather state information in the ME field.	
New text	**3.1.2.8.7.3.2.12**	—	3.1.2.8.7.3.2.12 ADS-B Wx PIREP squitters. The ADS-B Wx PIREP extended squitter types shall use format DF = 18 with the contents of GICB registers 6B {HEX} to 6D {HEX}, as applicable, to insert the appropriate aircraft or weather state information in the ME field.	
New text	**3.1.2.8.7.3.2.13**	—	3.1.2.8.7.3.2.13 Extended Squitter event-driven information. The event-driven message shall use format DF = 18 with the contents of GICB register 0A {HEX} inserted in the ME field.	
New text	**3.1.2.8.7.3.2.13**	—	Note.— Although labeled as extended squitter, prior to Version 3 this message would only be broadcast once each time the register was loaded with information. ADS-B Version 3 removed the implementation of this register.	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.2.8.7.3.2.5**	3.1.2.8.7.3.2.5 Periodic status and event-driven squitters	—	
Deleted text	**3.1.2.8.7.3.2.5.1**	3.1.2.8.7.3.2.5.1 Periodic status squitters. The periodic status extended squitter types shall use format DF = 18 to convey aircraft status and other surveillance data. The aircraft operational status extended squitter type shall use the format of GICB register 65 {HEX} as defined in 3.1.2.8.6.4.6.1 inserted in the ME field. The target state and status extended squitter type shall use the format of GICB register 62 {HEX} as defined in 3.1.2.8.6.4.6.1 inserted in the ME field.	—	
Deleted text	**3.1.2.8.7.3.2.5.2**	3.1.2.8.7.3.2.5.2 Event-driven squitter. The event-driven type ES/NT shall use format DF = 18 with the format for register 0A {HEX} as defined in 3.1.2.8.6.2 inserted in the ME field.	—	
New text to replace existing text	**3.1.2.8.7.3.3.1**	Note 1.— This suppresses the transmission of extended squitters from aircraft that are unable to report position, velocity or identity. If input to the register for the position squitter type stops for 60 seconds, broadcast will cease until data insertion resumes, except for an ES/NT device operating on the surface (as specified in Doc 9871). Broadcast of airborne position squitters is not discontinued if barometric altitude data is available. Terminating broadcast of other squitter types is described in Doc 9871.	Note 1.— This suppresses the transmission of extended squitters from aircraft that are unable to report position, velocity or identity. If input to the register for the position squitter type stops for 60 seconds, broadcast will cease until data insertion resumes, except for an ES/NT device when the broadcast message format (see 3.1.2.8.6.7) is “surface” (as specified in Doc 9871). Broadcast of airborne position squitters is not discontinued if barometric altitude data is available. Terminating broadcast of other squitter types is described in Doc 9871.	
New text to replace existing text	**3.1.2.8.7.3.3.3**	a) when airborne 3.1.2.8.6.7) the non-transponder device shall transmit each type of ES/NT squitter alternately from the two antennas; and	a) when the broadcast message format (see 3.1.2.8.6.7) is “airborne”, the non-transponder device shall transmit each type of ES/NT squitter alternately from the two antennas; and	
New text to replace existing text	**3.1.2.8.7.3.3.3**	b) when on the surfacethe 3.1.2.8.6.7) the non-transponder device shall transmit ES/NT squitters fromusing the top antenna	b) when broadcast message format (see 3.1.2.8.6.7) is “surface”, the non- transponder device shall transmit ES/NT squitters the top antenna only.	
New text to replace existing text	**3.1.2.8.7.3.3.5**	3.1.2.8.7.3.3.5 Airborne/surface state determination. Aircraft with an automatic means of determining the on-the-ground state shall use this input to select whether to report the airborne or surface message types except as specified in 3.1.2.6.10.3.1. Aircraft without such means shall report the airborne type message.	3.1.2.8.7.3.3.5 Airborne/surface message format selection Non-transponder devices shall report airborne or surface format extended squitter ADS-B messages as per the requirements in 3.1.2.8.6.7.	
Deleted text	**3.1.2.8.7.3.3.6**	3.1.2.8.7.3.3.6 Surface squitter rate control. Aircraft motion shall be determined once per second. The surface squitter rate shall be set according to the results of this determination.	—	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.2.8.7.3.3.6**	Note.— The algorithm to determine aircraft motion is specified in the definition of register 07 in the 16 Technical Provisions for Mode S Services and Extended Squitter (Doc 9871).	—	
Deleted text	**3.1.2.8.8**	3.1.2.8.8 EXTENDED APPLICATION, 19 SQUITTER MILITARY DOWNLINK FORMAT 10011 AF:3	3.1.2.8.8 APPLICATION, 19 MILITARY DOWNLINK FORMAT 10011 AF:3	
New text to replace existing text	**3.1.2.8.8**	Note.— This format supports the broadcast of extended squitter ADS-B messages in support of military applications. A separate format is used to distinguish these extended squitters from the standard ADS-B message set broadcast using DF = 17 or 18.	Note.— This format supports military applications. DF = 19 can be used either as a squitter or as a reply.	
New text to replace existing text	**3.1.2.8.8.2**	3.1.2.8.8.2 Application field. This 3-bit (6-8) downlink field in DF = 19 shall be used to define the format of the 112-bit transmission. Code 0 to 7 = Reserved	3.1.2.8.8.2 Application field. This 3-bit (6-8) downlink field in DF = 19 shall be used to define the format of the 112-bit transmission. Code 0 to 7 = Reserved for military use	
New text	**3.1.2.8.9.1**	—	1) For a transponder capable of replying to intermode Mode A/C/S all-call interrogations:	
New text	**3.1.2.8.9.1**	—	2) For a transponder that does not have the capability to reply to intermode Mode A/C/S all-call interrogations or an extended squitter non-transponder device (2.1.5.1.7):	
New text	**3.1.2.8.9.1**	—	a) 6.7 messages per second averaged over 60 seconds for nominal aircraft operations with no temporary alert, no permanent alert, no emergency, no ACAS RA and no UAS/RPAS contingency activity, while not exceeding 15 messages being transmitted in any 1-second interval; or	
New text	**3.1.2.8.9.1**	—	b) 9.2 messages per second averaged over 60 seconds under a temporary/permanent alert, an emergency, an ACAS RA and/or UAS/RPAS contingency condition, while not exceeding 19 messages being transmitted in any 1-second interval.	
New text	**3.1.2.8.9.1**	—	Note 1.— It is anticipated that the transmission of any new messages required in addition to the capability specified above will be performed using the capacity provided by phase overlay.	
New text	**3.1.2.8.9.1**	—	Note 2.— The higher extended squitter rates are associated with transponders not capable of replying to intermode Mode A/C/S all-call interrogations in order to keep an equilibrium on 1 090 MHz link that is subject to overload. States are expected to ensure that this link is maintained through their transponder regulation (for example, TSO). The minimum performance of such a	

Type of changes	Location	Existing Text	Amended Text	Comment
			transponder can be found in RTCA DO-181F or EUROCAE ED-73F or later versions.	
New text	**3.1.2.8.9.1**	—	Note 3.— A higher extended squitter rate (9.2/s) is authorized when there is an emergency, a temporary/permanent alert (Mode A code), an ACAS RA and/or a UAS contingency because such events are rare and are limited to very few platforms at the same time. Therefore, such events have a very limited effect on 1 090 MHz usage.	
New text to replace existing text	**3.1.2.9.1.4**	3.1.2.9.1.4 Change of aircraft identification. If the aircraft identification reported in the AIS subfield is changed in flight, the transponder shall report the new identification to the ground by use of the Comm-B broadcast message protocol of 3.1.2.6.11.4 for BDS1 = 2 and BDS2 = 0 The transponder shall initiate, generate and announce the revised aircraft identification even if the interface providing flight identification is lost. The transponder shall ensure that the BDS code is set for the aircraft identification report in all cases, including a loss of the interface. In this latter case, bits 41 - 88 shall contain all ZEROs.	3.1.2.9.1.4 Change of aircraft identification. If the aircraft identification reported in the AIS subfield is changed in flight, the transponder shall report the new identification to the ground by use of the Comm-B broadcast message protocol of 3.1.2.6.11.4 for BDS1 = 2 (33–36) and BDS2 = 0 (37–40). The transponder shall initiate, generate and announce the revised aircraft identification The transponder shall ensure that the BDS code is set for the aircraft identification report in all cases, including a loss of the interface.	
New text to replace existing text	**3.1.2.9.1.4**	Note 1.— The setting of the BDS code by the transponder ensures that a broadcast change of aircraft identification will contain the BDS code for all cases of identification failure (e.g.for the loss of the interface providing identification).	Note 1.— The setting of the BDS code by the transponder ensures that a broadcast change of aircraft identification will contain the BDS code for all cases of flightaircraft identification failure example, the loss of the interface providing flightaircraft identification).	
New text	**3.1.2.9.1.4**	—	Note 2.— In some transponders certified on or prior to 1 January 2030, bits 41–88 in register 20 {HEX} were set to zero upon loss of the interface providing aircraft identification. The transponder also initiated, generated and announced the change in aircraft identification upon loss of the interface.	
New text to replace existing text	**3.1.2.10**	3.1.2.10 ESSENTIAL SYSTEM CHARACTERISTICS OF THE SSR MODE S TRANSPONDER	3.1.2.10 ESSENTIAL SYSTEM CHARACTERISTICS OF THE SSR MODE S AND INTERMODE TRANSPONDER CAPABILITIES	
Deleted text	**3.1.2.10.1**	3.1.2.10.1 Transponder sensitivity and dynamic range. Transponder sensitivity shall be defined in terms of a given interrogation signal input level and a given percentage of corresponding replies. Only correct replies containing the required bit pattern for the interrogation received shall be counted. Given an interrogation that requires a reply according to 3.1.2.4, the minimum triggering level, MTL, shall be defined as the minimum	3.1.2.10.1 Transponder sensitivity and dynamic range. Transponder sensitivity shall be defined in terms of a given interrogation signal input level and a given percentage of corresponding replies. Only correct replies containing the required bit pattern for the interrogation received shall be counted. Given an interrogation that requires a reply according to 3.1.2.4, the minimum triggering level, MTL, shall be defined as the minimum	

Type of changes	Location	Existing Text	Amended Text	Comment
		input power level for 90 per cent reply-to-interrogation ratio. The MTL shall be –74 dBm ±3 dB for Mode S interrogations (interrogations using P), and as defined in 3.1.1.7.5.1 b) for Mode A and 6 C, and inter-mode interrogations. The reply-to-interrogation ratio of a Mode S transponder shall be:	input power level for 90 per cent reply-to-interrogation ratio. The MTL shall be –74 dBm ±3 dB for Mode S interrogations (interrogations using P 6 The reply-to-interrogation ratio of a Mode S transponder shall be:	
New text to replace existing text	**3.1.2.10.1.1.2**	3.1.2.10.1.1.2 Reply ratio in the presence of pulse pair interference. Given an interrogation which requires a reply (3.1.2.4), the reply ratio of a transponder shall be at least 90 per cent in the presence of an interfering P – P pulse pair if the level of the interfering pulse pair is 9 dB or more below signal 1 2 level for input signal levels between –68 dBm and –21 dBm and the P pulse of the interfering pair occurs 1 no earlier than the P pulse of the Mode S signal. 1...	3.1.2.10.1.1.2 Reply ratio in the presence of pulse pair interference. Given Mode S interrogation which requires a reply (3.1.2.4), the reply ratio of a transponder shall be at least 90 per cent in the presence of an interfering P – P pulse pair if the level of the interfering pulse pair is 9 dB or more below signal 1 2 level for input signal levels between –68 dBm and –21 dBm and the P pulse of the interfering pair occurs 1 no earlier than the P pulse of the Mode S signal. 1...	
Deleted text	**3.1.2.10.1.1.4**	3.1.2.10.1.1.4 Reply ratio in the presence of low-level in-band CW interference. In the presence of non-coherent CW interference at a frequency of 1 030 ±0.2 MHz at signal levels of 20 dB or more below the desired Mode A/C or Mode S interrogation signal level, the transponder shall reply correctly to at least 90 per cent of the interrogations.	3.1.2.10.1.1.4 Reply ratio in the presence of low-level in-band CW interference. In the presence of non-coherent CW interference at a frequency of 1 030 ±0.2 MHz at signal levels of 20 dB or more below the desired Mode S interrogation signal level, the transponder shall reply correctly to at least 90 per cent of the interrogations.	
Deleted text	**3.1.2.10.1.1.5**	3.1.2.10.1.1.5 Spurious response	—	
Deleted text	**3.1.2.10.1.1.5.1**	3.1.2.10.1.1.5.1 Recommendation.— The response to signals not within the receiver pass band should be at least 60 dB below normal sensitivity.	—	
Deleted text	**3.1.2.10.1.1.5.2**	3.1.2.10.1.1.5.2 For transponder designs first certified on or after 1 January 2011, the spurious Mode A/C reply ratio resulting from low level Mode S interrogations shall be no more than:	—	
Deleted text	**3.1.2.10.1.1.5.2**	a) an average of 1 per cent in the input interrogation signal range between –81 dBm and the Mode S MTL; and	—	
Deleted text	**3.1.2.10.1.1.5.2**	b) a maximum of 3 per cent at any given level in the input interrogation signal range between –81 dBm and the Mode S MTL.	—	
Deleted text	**3.1.2.10.1.1.5.2**	Note 1.— Failure to detect a low level Mode S interrogation can also result in the transponder decoding a three-pulse Mode A/C/S all-call interrogation. This would result in the transponder responding with a Mode S all-call (DF = 11) reply. The above requirement will also control these DF = 11 replies since it places a limit on the	—	

Type of changes	Location	Existing Text	Amended Text	Comment
		probability of failing to correctly detect the Mode S interrogation.		
Deleted text	**3.1.2.10.1.1.5.2**	Note 2.— More information about issuing a type certificate for aircraft and separate design approval can be found in the Airworthiness Manual (Doc 9760).	—	
New text to replace existing text	**3.1.2.10.2.1**	3.1.2.10.2.1	3.1.2.10.2.1 Unwanted output power	
New text to replace existing text	**3.1.2.10.2.1.1**	Inactive state transponder output power. When the transponder is in the inactive state the peak pulse power at 1 090 MHz plus or minus 3 MHz shall not exceed –50 dBm The inactive state is defined to include the entire period between transmissions, less 10-microsecond transition periods preceding the first pulse and following the last pulse of the transmission	3.1.2.10.2.1.1 Inactive state transponder output power. When the transponder is in the inactive state the peak power at 1 090 MHz plus or minus 3 MHz at the antenna end of the transmission line of the transponder shall not exceed –50 dBm when not installed with an ACAS unit or –70 dBm when installed with an ACAS unit. The inactive state is defined as the entire period between transmissions, less 10-microsecond transition periods preceding the first pulse and plus 10-microsecond transition periods following the last pulse of the transmission (see Figure 3-11).	
New text to replace existing text	**3.1.2.10.2.1.1**	Note.— Inactive state transponder power is constrained in this way to ensure that an aircraft, when located as near as 185 m (0.1 NM) to a Mode A/C or Mode S interrogator, does not cause interference to that installation. In certain applications of Mode S, airborne collision avoidance for example, where a 1 090 MHz transmitter and receiver are in the same aircraft, it may be necessary to further constrain the inactive state transponder power.	Note.— Inactive state transponder power is constrained in this way to ensure that an aircraft, when located as near as 185 m (0.1 NM) to a Mode A/C or Mode S interrogator, does not cause interference to that installation. In certain applications of Mode S, airborne collision avoidance for example, where a 1 090 MHz transmitter and receiver are in the same aircraft, it is necessary to further constrain the inactive state transponder power.	
New text	**3.1.2.10.2.1.2**	—	3.1.2.10.2.1.2 Active state transponder output power.	
New text	**3.1.2.10.2.1.2.1**	—	3.1.2.10.2.1.2.1 The RF output power shall be less than or equal to the peak pulse power minus 50 dB for the interval starting 10 microseconds prior to the Mode S transmission and for the interval of 10 microseconds following a Mode S transmission (see Figure 3-11).	
New text	**3.1.2.10.2.1.2.2**	—	3.1.2.10.2.1.2.2 For intervals between transmitted pulses that are greater than 0.5 microsecond, the power level at the lowest point within the interval shall be 50 dB or more below the peak pulse power.	
New text	**3.1.2.10.2.1.2.2**	—	Note 1.— These power limitations protect 1 090 MHz receivers from potential missed decodes when signals are received at close range and within desired detection range. In the absence of such limits, signal levels during	

Type of changes	Location	Existing Text	Amended Text	Comment
			non-pulse intervals can occur above receiver thresholds and can lead to unintended distortion of pulse positions or false pulse decodes preventing proper detection of transmitted signals. It also makes it more difficult for receivers to decode overlapped replies.	
New text	**3.1.2.10.2.1.2.2**	—	Note 2.— It is possible that a signal transmitted 50 dB below the peak pulse power can still affect high sensitivity receivers when transmitted in close range. More information is available in Doc 9924.	
New text	**3.1.2.10.2.1.2.2**	—	Note 3.— Information on how to verify unwanted output power can be found in RTCA DO-181F and EUROCAE ED-73F.	
New text	**3.1.2.10.2.1.2.2**	—	Note 4.— The presence of a signal at a level of 50 dB or more below the peak power may not be measurable within the first 0.5 microsecond following the transmission of a pulse because of the allowed decay time.	
New text	**3.1.2.10.2.1.2.2**	—	Note 5.— Transmitters compliant with RTCA DO-181F and EUROCAE ED-73F meet the requirements defined in 3.1.2.10.2.1.2.	
Deleted text	**3.1.2.10.2.2**	3.1.2.10.2.2 Spurious emission radiation	—	
Deleted text	**3.1.2.10.2.2**	Recommendation.— CW radiation should not exceed 70 dB below 1 watt.	—	
Deleted text	**3.1.2.10.3.2**	3.1.2.10.3.2 Mode S dDead time	3.1.2.10.3.2 dDead time	
New text to replace existing text	**3.1.2.10.3.2.1**	Dead time shall be defined as the time interval beginning at the end of a reply transmission and ending when the transponder has regained sensitivity to within 3 dB of MTL Mode S transponders shall not have more than 125 microseconds' dead time.	3.1.2.10.3.2.1 For all transponders, the time interval beginning at the end of a reply transmission and ending when the receiver has regained sensitivity to within 3 dB of MTL (dead time). shall not exceed 125 microseconds'	
New text	**3.1.2.10.3.2.2**	—	3.1.2.10.3.2.2 For transponders with improved dead time, the time interval beginning at the end of a reply transmission and ending when the receiver has regained sensitivity to within 3 dB of MTL (dead time) shall not exceed 20 microseconds.	
Deleted text	**3.1.2.10.3.4.1.3**	3.1.2.10.3.4.1.3 All Mode S transponders installed on or after 1 January 1999 shall recover sensitivity to within 3 dB of MTL no later than 45 microseconds after receipt of the sync phase reversal following a Mode S interrogation that is not accepted (3.1.2.4.1.2) or that is accepted but requires no reply.	—	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**3.1.2.10.3.6.1**	3.1.2.10.3.6.1 Mode S reply rate limiting. Reply rate limiting is not required for the Mode S formats of a transponder. If such limiting is incorporated for circuit protection, it	3.1.2.10.3.6.1 Mode S reply rate limiting.	
New text to replace existing text	**3.1.2.10.3.6.1.1**	shall permit the minimum reply rates required in 3.1.2.10.3.7.2 and 3.1.2.10.3.7.3.	3.1.2.10.3.6.1.1 Mode S reply rate limiting shall permit the minimum reply rates required in 3.1.2.10.3.7.2 and 3.1.2.10.3.7.3.	
New text	**3.1.2.10.3.6.1.1**	—	Note.— Mode S transponders certified before 1 January 2030 have no requirement for Mode S reply rate limiting function and may have a different implementation of this function.	
New text	**3.1.2.10.3.6.1.2**	—	3.1.2.10.3.6.1.2 Mode S reply rate limiting type 1	
New text	**3.1.2.10.3.6.1.2.1**	—	3.1.2.10.3.6.1.2.1 Mode S reply rate limiting shall be separate from Modes A and C reply rate limiting.	
New text	**3.1.2.10.3.6.1.2.2**	—	3.1.2.10.3.6.1.2.2 The Mode S reply rate limiting shall ensure the transponder does not cease to reply to valid Mode S interrogations for a period greater than 100 milliseconds.	
New text	**3.1.2.10.3.6.1.2.3**	—	3.1.2.10.3.6.1.2.3 The Mode S reply rate limiting shall limit the Mode S replies to a maximum reply rate of 180 Mode S replies per second or less.	
New text	**3.1.2.10.3.6.1.2.3**	—	Note.— The maximum reply rate limit can be less than the 180 specified here but is greater than the minimums specified in 3.1.2.10.3.7.3.	
New text	**3.1.2.10.3.6.1.2.4**	—	3.1.2.10.3.6.1.2.4 The Mode S reply rate limiting shall be accomplished using methods other than sensitivity reduction.	
New text	**3.1.2.10.3.6.1.2.4**	—	Note.— Sensitivity-reduction rate limiting is prohibited due to the potential impact on ACAS.	
New text	**3.1.2.10.3.6.1.2.5**	—	3.1.2.10.3.6.1.2.5 The Mode S reply rate limiting function shall exclude the acquisition squitter (see 3.1.2.8.5) and extended squitter (see 3.1.2.8.6) transmissions.	
New text	**3.1.2.10.3.6.1.2.6**	—	3.1.2.10.3.6.1.2.6 The Mode S reply rate limiting function shall process received interrogations regardless of the received antenna channel.	
New text	**3.1.2.10.3.6.1.2.7**	—	3.1.2.10.3.6.1.2.7 The Mode S reply rate limiting function shall process received interrogations regardless of uplink format.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text	**3.1.2.10.3.6.1.2.7**	—	Note.— The Mode S reply rate limiting also includes replies to ACAS resolution and coordination messages.	
New text	**3.1.2.10.3.6.1.2.8**	—	3.1.2.10.3.6.1.2.8 Recommendation.— The Mode S reply rate limiting should be accomplished stochastically.	
New text to replace existing text	**3.1.2.10.3.6.2**	3.1.2.10.3.6.2 Modes A and C reply rate limiting. Reply rate limiting for Modes A and C shall be effected according to 3.1.1.7.9.1. The prescribed sensitivity reduction (3.1.1.7.9.2) shall not affect the Mode S performance of the transponder.	3.1.2.10.3.6.2 Modes A and C reply rate limiting. Modes A and C prescribed sensitivity reduction (3.1.1.7.9.2) shall not affect the Mode S performance of the transponder.	
Deleted text	**3.1.2.10.3.7**	3.1.2.10.3.7 Minimum reply rate capability, Modes A, C and S	3.1.2.10.3.7 Minimum reply rate capability, Modes S	
Deleted text	**3.1.2.10.3.7.2**	3.1.2.10.3.7.2 Minimum reply rate capability, Modes A and C. The minimum reply rate capability for Modes A and C shall be in accordance with 3.1.1.7.9.	—	
New text to replace existing text	**3.1.2.10.3.7.4**	3.1.2.10.3.7.4 Minimum Mode S ELM peak reply rate	3.1.2.10.3.7.4 3 Minimum Mode S ELM peak reply rate	
New text to replace existing text	**3.1.2.10.3.8**	3.1.2.10.3.8 Reply delay and jitter	3.1.2.10.3.8 Reply delay and jitter for Mode S	
Deleted text	**3.1.2.10.3.8**	Note.— After an interrogation has been accepted and if a reply is required, this reply transmission begins after a fixed delay needed to carry out the protocols. Different values for this delay are assigned for Modes A and C, for Mode S and for Modes A/C/S all-call replies.	—	
Deleted text	**3.1.2.10.3.8.1**	3.1.2.10.3.8.1 Reply delay and jitter for Modes A and C. The reply delay and jitter for Modes A and C transactions shall be as prescribed in 3.1.1.7.10.	—	
New text to replace existing text	**3.1.2.10.3.8.21**	3.1.2.10.3.8.21 Reply delay and jitter for Mode S. For all input signal levels between MTL and –21 dBm, the leading edge of the first preamble pulse of the reply (3.1.2.2.5.1.1) shall occur 128 plus or minus 0.25 microsecond after the sync phase reversal (3.1.2.1.5.2.2) of the received P. The jitter of the reply 6 delay shall not exceed 0.08 microsecond, peak (99.9 percentile).	3.1.2.10.3.8.21 For all input signal levels between MTL and –21 dBm, the leading edge of the first preamble pulse of the reply (3.1.2.2.5.1.1) shall occur 128 plus or minus 0.25 microsecond after the sync phase reversal (3.1.2.1.5.2.2) of the received P. The jitter of the reply 6 delay shall be less than or equal to 0.08 microsecond, peak (99.9 percentile).	
Deleted text	**3.1.2.10.3.8.3**	3.1.2.10.3.8.3 Reply delay and jitter for Modes A/C/S all call. For all input signal levels between MTL +3 dB and –21 dBm the leading edge of the first preamble pulse of the reply (3.1.2.2.5.1.1) shall occur 128 plus or minus 0.5 microseconds after the leading edge of the P pulse of the	—	

Type of changes	Location	Existing Text	Amended Text	Comment
		interrogation (3.1.2.1.5.1.1). 4 Jitter shall not exceed 0.1 microsecond, peak (99.9 percentile).		
Deleted text	**3.1.2.10.3.8.3**	Note.— A peak jitter of 0.1 microsecond is consistent with the jitter prescribed in 3.1.1.7.10.	—	
New text to replace existing text	**3.1.2.10.3.10**	3.1.2.10.3.10 Inhibition of replies. Replies to Mode A/C/S all-call and Mode S-only all-call interrogations shall always be inhibited when the aircraft declares the on-the-ground state. It shall not be possible to inhibit replies to discretely addressed Mode S interrogations regardless of whether the aircraft is airborne or on the ground.	3.1.2.10.3.10 Inhibition of replies. Replies to Mode S-only all-call interrogations shall always be inhibited when the effective air/ground state is “on-the-ground” It shall not be possible to inhibit replies to discretely addressed Mode S interrogations	
New text	**3.1.2.10.3.10**	—	Note.— Transponders certified on or after 1 January 2020 also inhibit replies to the Mode A/C/S all-call when the effective air/ground state is “on-the-ground” (see 2.1.5.4.4).	
New text to replace existing text	**3.1.2.10.3.10.1**	3.1.2.10.3.10.1 Recommendation.— Aircraft should provide means to determine the on-the-ground state automatically and provide that information to the transponder.	3.1.2.10.3.10.1 Recommendation.— Aircraft should provide air/ground data to the transponder.	
New text to replace existing text	**3.1.2.10.3.10.2**	3.1.2.10.3.10.2 Recommendation.— Mode A/C replies shallshould be inhibited when the aircraft is on the ground to prevent interference when in close proximity to an interrogator or other aircraft.	3.1.2.10.3.10.2 Mode A/C replies from transponders with a Mode S capability be inhibited when the effective air/ground state is “on-the-ground” to prevent interference when in close proximity to an interrogator or other aircraft.	
Deleted text	**3.1.2.10.4.1**	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.	3.1.2.10.4.1 Radiation pattern. The radiation pattern of antennas when installed on an aircraft shall be nominally equivalent to that of a quarter-wave monopole on a ground plane.	
Deleted text	**3.1.2.10.4.3**	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 pulse and the P pulse of a Mode S interrogation preamble meet the 1 2 requirements for a Mode S interrogation as defined in 3.1.2.1 and if the P pulse and the P pulse of a Mode 1 3 A, Mode C or intermode interrogation meet the requirements for Mode A and Mode C interrogations as defined in 3.1.1.	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 pulse and the P pulse of a Mode S interrogation preamble meet the 1 2 requirements for a Mode S interrogation as defined in 3.1.2.1	
Deleted text	**3.1.2.10.4.3.1**	3.1.2.10.4.3.1 If the two channels simultaneously receive at least a P – P pulse pair that meets the 1 2 requirements for a Mode S interrogation, or a P – P pulse pair that meets the requirements for a Mode A 1 3 or Mode C interrogation, or if the two channels	3.1.2.10.4.3.1 If the two channels simultaneously receive at least a P – P pulse pair that meets the 1 2 requirements for a Mode S interrogation, or if the two channels simultaneously accept a complete interrogation, the antenna at which the signal strength is	

Type of changes	Location	Existing Text	Amended Text	Comment
		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.	greater shall be selected for the reception of the remainder (if any) of the interrogation and for the transmission of the reply.	
New text to replace existing text	**3.1.2.10.5.1.1**	c) the registration marking if used for identification (3.1.2.9.1.1).	c) the registration marking if used for flightaircraft identification (3.1.2.9.1.1).	
New text to replace existing text	**3.1.2.10.5.1.3**	c) the on-the-ground condition (3.1.2.5.2.2.1, 3.1.2.6.5.1 and 3.1.2.8.2.1);	c) air/ground data (3.1.2.5.2.2.1, 3.1.2.6.5.1 and 3.1.2.8.2.1);	
New text to replace existing text	**3.1.2.10.5.1.4.4**	3.1.2.10.5.1.4.4 Interfaces shall be included to accept the pressure-altitude and on-the-ground coding	3.1.2.10.5.1.4.4 Interfaces shall be included to accept the pressure-altitude and air/ground data.	
New text to replace existing text	**3.1.2.11**	3.1.2.11 ESSENTIAL SYSTEM CHARACTERISTICS OF THE GROUND INTERROGATOR	3.1.2.11 ESSENTIAL SYSTEM CHARACTERISTICS OF THE GROUND INTERROGATOR MODE S CAPABILITIES	
Deleted text	**3.1.2.11**	Note.— To ensure that Mode S interrogator action is not detrimental to Mode A/C interrogators, performance limits exist for Mode S interrogators.	—	
New text to replace existing text	**3.1.2.11.1.1.1**	3.1.2.11.1.1.1 The interrogation repetition rate for the Mode A/C/S all-call, used for acquisition, shall be less than 250 per second. This rate shall also apply to the paired Mode S-only and Mode A/C-only all- call interrogations used for acquisition in the multisite mode	3.1.2.11.1.1.1 The interrogation repetition rate for the paired Mode S-only and Mode A/C-only all- call interrogations used for acquisition in the multisite mode shall be less than 250 per second.	
Deleted text	**3.1.2.11.4**	3.1.2.11.4 Tolerances on transmitted signals. In order that the signal-in-space be received by the transponder as described in 3.1.2.1, the tolerances on the transmitted signal shall be as summarized in Table 3-11.	—	
New text to replace existing text	**3.1.2.11.65**	3.1.2.11.65 Lockout coordination. A Mode S interrogator shall not be operated using all-call lockout until coordination has been achieved with all other operating Mode S interrogators having any overlapping coverage volume in order to ensure that no interrogator can be denied the acquisition of Mode S-equipped aircraft.	3.1.2.11.65 Lockout coordination. A Mode S interrogator shall not be operated using all-call lockout until coordination has been achieved with all other operating Mode S interrogators having any overlapping coverage volume in order to ensure that no interrogator can be denied the acquisition of Mode S-equipped aircraft. If coordination is not possible due to system designs (for example, a mobile interrogator), the interrogator shall either use passive means of acquisition or operate using lockout override (3.1.2.5.2.1.4) with supplementary acquisition (3.1.2.5.2.1.5).	
Deleted text	**3.1.2.11.65**	Note 1.— This coordination may be via ground network or by the allocation of interrogator identifier (II) codes	Note 1.— This coordination may be via ground network or by the allocation of interrogator codes and will involve	

Type of changes	Location	Existing Text	Amended Text	Comment
		and will involve regional agreements where coverage overlaps international boundaries.	regional agreements where coverage overlaps international boundaries.	
New text	**3.1.2.11.65**	—	Note 2.— Interrogators that do not use Mode S-only all-call interrogations, all-call lockout protocol or multisite data link protocol can use any IC value in the IIS or SIS fields of their selective interrogations without a need for coordination with neighbouring systems.	
New text to replace existing text	**Table 3-1**	Table 3-1. Pulse shapes — Mode S and intermode interrogations (Rise time) (Decay time) Duration Pulse Duration tolerance Min. Max. Min. Max. P, P, P, P 0.80 ±0.109 0.05 0.10 0.05 0.20 1 2 3 5 P (short) 0.80 ±0.109 0.05 0.10 0.05 0.20 4 P (long) 1.6 ±0.1 0.05 0.1 0.05 0.2 4 P (short) 16.25 ±0.205 0.05 0.10 0.05 0.20 6 P (long) 30.25 ±0.205 0.05 0.10 0.05 0.20 6 S 0.80 ±0.10 0.05 0.10 0.05 0.20 1	Table 3-1. Pulse shapes — Interrogation pulse durations (Rise time) (Decay time) Duration Pulse Duration tolerance Min. Max. Min. Max. P, P, P, P 0.80 0.05 0.10 0.05 0.20 1 2 3 5 P (short) 0.80 0.05 0.10 0.05 0.20 4 P (short) 16.25 ±0.205 0.05 0.10 0.05 0.20 6 P (long) 30.25 ±0.205 0.05 0.10 0.05 0.20 6 S 0.80 ±0.10 0.05 0.10 0.05 0.20 1	
Deleted text	**Table 3-2**	Table 3-2. Pulse shapes — Mode S replies (Rise time) (Decay time) Duration Pulse duration tolerance Min. Max. Min. Max.	Table 3-2. Pulse shapes — Mode S replies (Rise time) (Decay time) Duration Pulse duration tolerance Max. Max.	
Deleted text	**0.5**	0.5 ±0.05 0.05 0.1 0.05 0.2 1.0 ±0.05 0.05 0.1 0.05 0.2	0.5 ±0.05 0.1 0.2 1.0 ±0.05 0.1 0.2	
Deleted text	**Table 3-4**	Table 3-4. Subfield definitions Subfield Designator Function Field Reference ACS Altitude code subfield ME 3.1.2.8.6.3.1.2 AIS Aircraft identification subfield MB 3.1.2.9.1.1 ATS Altitude type subfield MB 3.1.2.8.6.8.2 BDS 1 Comm-B data selector subfield 1 MB 3.1.2.6.11.2.1 BDS 2 Comm-B data selector subfield 2 MB 3.1.2.6.11.2.1 IDS Identifier designator subfield UM 3.1.2.6.5.3.1 IIS Interrogator identifier subfield SD 3.1.2.6.1.4.1 a) UM 3.1.2.6.5.3.1 LOS Lockout subfield SD 3.1.2.6.1.4.1 d) LSS Lockout surveillance subfield SD 3.1.2.6.1.4.1 g) MBS Multisite Comm-B subfield SD 3.1.2.6.1.4.1 c) MES Multisite ELM subfield SD 3.1.2.6.1.4.1 c) OVC Overlay control SD 3.1.2.6.1.4.1 i) RCS Rate control subfield SD 3.1.2.6.1.4.1 f) RRS Reply request subfield SD 3.1.2.6.1.4.1 e) and g) RSS Reservation status subfield SD 3.1.2.6.1.4.1 c) SAS Surface antenna subfield SD 3.1.2.6.1.4.1 f) SCS Squitter capability subfield MB 3.1.2.6.10.2.2.1 SIC Surveillance identifier capability MB 3.1.2.6.10.2.2.1 SIS Surveillance identifier subfield SD 3.1.2.6.1.4.1 g) SRS Segment request subfield MC 3.1.2.7.7.2.1 SSS Surveillance status subfield ME 3.1.2.8.6.3.1.1 TAS Transmission acknowledgement MD 3.1.2.7.4.2.6 subfield TCS Type control subfield SD 3.1.2.6.1.4.1 f) TMS Tactical message subfield SD	Table 3-4. Subfield definitions Subfield Designator Function Field Reference ACS Altitude code subfield ME 3.1.2.8.6.3.1.2 AIS Aircraft identification subfield MB 3.1.2.9.1.1 BDS 1 Comm-B data selector subfield 1 MB 3.1.2.6.11.2.1 BDS 2 Comm-B data selector subfield 2 MB 3.1.2.6.11.2.1 IDS Identifier designator subfield UM 3.1.2.6.5.3.1 IIS Interrogator identifier subfield SD 3.1.2.6.1.4.1 a) UM 3.1.2.6.5.3.1 LOS Lockout subfield SD 3.1.2.6.1.4.1 d) LSS Lockout surveillance subfield SD 3.1.2.6.1.4.1 g) MBS Multisite Comm-B subfield SD 3.1.2.6.1.4.1 c) MES Multisite ELM subfield SD 3.1.2.6.1.4.1 c) OVC Overlay control SD 3.1.2.6.1.4.1 i) RRS Reply request subfield SD 3.1.2.6.1.4.1 e) and g) RSS Reservation status subfield SD 3.1.2.6.1.4.1 c) SCS Squitter capability subfield MB 3.1.2.6.10.2.2.1 SIC Surveillance identifier capability MB 3.1.2.6.10.2.2.1 SIS Surveillance identifier subfield SD 3.1.2.6.1.4.1 g) SRS Segment request subfield MC 3.1.2.7.7.2.1 SSS Surveillance status subfield ME 3.1.2.8.6.3.1.1 TAS Transmission acknowledgement MD 3.1.2.7.4.2.6 subfield TMS Tactical message subfield SD 3.1.2.6.1.4.1 d)	

Type of changes	Location	Existing Text	Amended Text	Comment
		3.1.2.6.1.4.1 d) TRS Transmission rate subfield MB 3.1.2.8.6.8.1		
New text to replace existing text	**Table 3-6**	Table 3-6. Table for (register 10 16 Comm-B Subfields of register 10 MB bits bits 16 Continuation flag 9 41 Overlay command capability 15 47 ACAS capability and 48 and Mode S subnetwork version number Transponder enhanced protocol indicator 24 56 Specific services capability 25 57 Comm-B Subfields of register 10 MB bits bits 16 Uplink ELM capability Downlink ELM capability Aircraft identification capability 33 65 Squitter capability subfield (SCS) 34 66 Surveillance identifier code capability (SIC) 35 67 Common usage GICB capability report 36 68 Status of DTE sub-addresses 0 to 15 41-56 73-88	Table 3-6. Table for the data link capability report (register 10) 16 Comm-B Subfields of register 10 MB bits bits 16 Continuation flag 9 41 Operational coordination message (OCM) transmit 10 42 capability Overlay command capability 15 47 ACAS capability 11–14,16 and 43–46, 48 and 37–40 69–72 Mode S subnetwork version number 17–23 49–55 Transponder enhanced protocol indicator 24 56 Specific services capability 25 57 Comm-B Subfields of register 10 MB bits bits 16 Uplink ELM capability 26–28 58–60 Downlink ELM capability 29–32 61–64 Aircraft identification capability 33 65 Squitter capability subfield (SCS) 34 66 Surveillance identifier code capability (SIC) 35 67 Common usage GICB capability report 36 68 Basic dataflash capability 42 74 Phase overlay (PO) on extended squitter capability 43 75 Phase overlay (PO) on Mode S capability 44 76 Active transponder side indicator 49–50 81–82 Register 11 data link capability (continuation) 51 83 16 change indicator	
New text	**Table 3-6**	—	Note.— The “Status of DTE sub address 0 to 15” subfield that was previously defined as MB bits 41– 56 in the data link capability report (register 10) is now defined as MB bits 41–56 in the data link 16 capability report (extension) (register 11). Additional information on all bits in the data link capability 16 report can be found in Doc 9871.	
Deleted text	**Table 3-7**	Table 3-7. Surface format broadcast without an automatic means of on-the-ground determination ADS-B Emitter Category set “A” Coding Meaning Ground Speed Airspeed Radio Altitude 0 No ADS-B emitter category information Always report airborne position message (3.1.2.8.6.3.1) 1 Light (<15 500 lbs or 7 031 kg) Always report airborne position message (3.1.2.8.6.3.1) 2 Small (15 500 to 75 000 lbs or 7 031 to 34 019 kg) < 100 knots And <100 knots and <50 feet 3 Large (75 000 lbs to 300 000 lbs or 34 019 to 136 078 kg) <100 knots And <100 knots and <50 feet 4 High-vortex aircraft <100 knots And <100 knots and <50 feet 5 Heavy (> 300 000 lbs or 136 078 kg) <100 knots And <100 knots and <50 feet 6 High performance <100 knots And <100 knots and <50 feet (>5g acceleration and >400 knots) 7 Rotorcraft Always report airborne position message (3.1.2.8.6.3.1) ADS-B Emitter Category Set “B” Coding Meaning Ground Speed Airspeed Radio Altitude 0 No ADS-B emitter category	—	

Type of changes	Location	Existing Text	Amended Text	Comment
		information Always report airborne position message (3.1.2.8.6.3.1) 1 Glider/sailplane Always report airborne position message (3.1.2.8.6.3.1) 2 Lighter-than-air Always report airborne position message (3.1.2.8.6.3.1) 3 Parachutist/skydiver Always report airborne position message (3.1.2.8.6.3.1) 4 Ultra-light/hang-glider/paraglider Always report airborne position message (3.1.2.8.6.3.1) 5 Reserved Reserved 6 Unmanned aerial vehicle Always report airborne position message (3.1.2.8.6.3.1) 7 Space/trans-atmospheric vehicle <100 knots And <100 knots and <50 feet ADS-B Emitter Category Set “C” Coding Meaning 0 No ADS-B emitter category information Always report airborne position message (3.1.2.8.6.3.1) 1 Surface vehicle – emergency vehicle Always report surface position message (3.1.2.8.6.3.2) 2 Surface vehicle - service vehicle Always report surface position message (3.1.2.8.6.3.2) 3 Fixed ground or tethered obstruction Always report airborne position message (3.1.2.8.6.3.1) 4 – 7 Reserved Reserved ADS-B Emitter Category Set “D” Coding Meaning 0 No ADS-B emitter category information Always report airborne position message (3.1.2.8.6.3.1) 1 – 7 Reserved Reserved		
New text to replace existing text	**Table 3-7**	0 000 45 001 90 010 135 011 180 100 225 101 270 110	Table 3-7. Phase overlay data definition Phase relative to Binary value sync reference (degrees) MSB – LSB 315 111	
New text to replace existing text	**Table 3-9**	Table 3-9. Timer characteristics Timer Duration Tolerance Name Number Reference Symbol s s Resettable Non-selective lock-out 1 3.1.2.6.9.2 T 18 ±1 no D Temporary alert 1 3.1.2.6.10.1.1.2 T 18 ±1 no C SPI 1 3.1.2.6.10.1.3 T 18 ±1 no I Reservations B, C, D 3* 3.1.2.6.11.3.1 T 18 ±1 yes R Multisite lockout 78 3.1.2.6.9.1 T 18 ±1 no L * As required	Table 3-9. Timer characteristics Timer Duration Tolerance Name Number Reference Symbol s s Resettable Non-selective lock-out 1 3.1.2.6.9.2 T 18 ±1 no D Temporary alert 1 3.1.2.6.10.1.1.2 T 18 ±1 no C SPI 1 3.1.2.6.10.1.3 T 18 ±1 no I Reservations B, C, D 3* 3.1.2.6.11.3.1 T 18 ±1 yes R Multisite lockout 78 3.1.2.6.9.1 T 18 ±1 no L Basic dataflash 1 3.1.2.6.10.3.4.2 T 30 ±1 no F * As required	
New text to replace existing text	**Table 3-11**	Table 3-11. Transmitted signal tolerances Reference Function Tolerance	Table 3-11. Transmitted interrogation signal details	
Deleted text	**3.1.2.1.4.1**	3.1.2.1.4.1 Pulse duration P, P, P, P, P ±0.09 microsecond 1 2 3 4 5 Pulse duration P ±0.20 microsecond 6 3.1.1.4 Pulse duration P – P ±0.18 microsecond 1 3 Pulse duration P – P ±0.10 microsecond 1 2 3.1.2.1.5.1.3 Pulse duration P – P ±0.04 microsecond 3 4 3.1.2.1.5.2.4 Pulse duration P – P ±0.04 microsecond 1 2 Pulse duration P — sync phase reversal ±0.04 microsecond 2 Pulse duration P — sync phase reversal ±0.04 microsecond 6 Pulse	—	

Type of changes	Location	Existing Text	Amended Text	Comment
		duration P — sync phase reversal ±0.05 microsecond 5 3.1.1.5 Pulse amplitude P P ±0.5 dB 3 1 3.1.2.1.5.1.4 Pulse amplitude P P ±0.5 dB 4 3 3.1.2.1.5.2.5 Pulse amplitude P Equal to or greater than P – 0.25 dB 6 2 3.1.2.1.4.1 Pulse rise times 0.05 microsecond minimum, 0.1 microsecond maximum		
New text to replace existing text	**3.1.2.1.4.1**	3.1.2.1.4.1 Pulse decay times 0.05 microsecond minimum, 0.2 microsecond maximum Reference Function Tolerance	Function Value Reference Mode A/C Carrier frequency 1 030 ±0.20 MHz 3.1.1.1.1 – 3.1.1.1.2 Pulse interval P – P (Mode A) 8 ±0.18 microsecond 3.1.1.4.3 1 3 Pulse interval P – P (Mode C) 21 ±0.18 microsecond 3.1.1.4.3 1 3 Pulse interval P – P 2 ±0.10 microsecond 3.1.1.4.4 1 2 Pulse duration P, P, P 0.8 ±0.09 microsecond 3.1.1.4.5 1 2 3 Pulse rise times 0.05 microsecond minimum, 3.1.1.4.6 0.10 microsecond maximum Pulse decay times 0.05 microsecond minimum, 3.1.1.4.7 0.20 microsecond maximum Pulse amplitude P P ±0.5 dB 3.1.1.5.2 3 1 Intermode Carrier frequency 1 030 ±0.01 MHz 3.1.2.1.1 Pulse duration P, P, P, P 0.8 ±0.09 microsecond 3.1.2.1.4.1 1 2 3 4 Pulse rise times 0.05 microsecond minimum, 3.1.2.1.4.1 0.10 microsecond maximum Pulse decay times 0.05 microsecond minimum, 3.1.2.1.4.1 0.20 microsecond maximum Pulse interval P – P 8 ±0.18 microsecond 3.1.2.1.5.1.2.1 1 3 (Mode A-Only All-Call) Pulse interval P – P 21 ±0.18 microsecond 3.1.2.1.5.1.2.1 1 3 (Mode C-Only All-Call) Pulse interval P – P 2 ±0.04 microsecond 3.1.2.1.5.1.2.1 1 2 Pulse interval P – P 2 ±0.04 microsecond 3.1.2.1.5.1.2.1 3 4 Pulse amplitude P P ±0.5 dB 3.1.2.1.5.1.2.2 3 1 Pulse amplitude P P –0.5 dB/+2.5 dB 3.1.2.1.5.1.2.2 4 3 Mode S Carrier frequency 1 030 ±0.01 MHz 3.1.2.1.1 Pulse duration P, P, P, P 0.8 ±0.09 microsecond 3.1.2.1.4.1 1 2 3 5 Pulse duration P (short) 16.25 ±0.20 microsecond 3.1.2.1.4.1 6 Pulse duration P (long) 30.25 ±0.20 microsecond 3.1.2.1.4.1 6 Pulse rise times 0.05 microsecond minimum, 3.1.2.1.4.1 0.10 microsecond maximum Pulse decay times 0.05 microsecond minimum, 3.1.2.1.4.1 0.20 microsecond maximum Pulse interval P – P 2 ±0.04 microsecond 3.1.2.1.5.2.4 1 2 Pulse interval P – sync phase reversal 2.75 ±0.04 microsecond 3.1.2.1.5.2.4 2 Pulse interval P – sync phase reversal 1.25 ±0.04 microsecond 3.1.2.1.5.2.4 6 Pulse interval P – sync phase reversal 0.4 ±0.04 microsecond 3.1.2.1.5.2.4 5 Pulse amplitude P Equal to or greater than P – 0.25 dB 3.1.2.1.5.2.5 2 1 Pulse amplitude first microsecond P Equal to or greater than P – 0.25 dB 3.1.2.1.5.2.5 6 1	

Type of changes	Location	Existing Text	Amended Text	Comment
Deleted text	**Table 3-12**	Table 3-12. Phase overlay message type field definition Message type Forward error Meaning value correction 0 No data N/A 1 ADSB state and status message 2 Mode S GICB data 3 Interrogation/reply monitor message RS 4 Test message 5 DF-18 (ADS-R, ADS-SLR, TISB) 6 Undefined 7 ADSB state and status message 8 Mode S GICB data 9 Interrogation/reply monitor message LDPC 10 Test message 11 DF-18 (ADS-R, ADS-SLR, TISB) 12 Undefined 13–255 Reserved	Table 3-12. Phase overlay message type field definition Message type Forward error Meaning value correction 0 No data N/A 1 ADSB state and status message 2 Mode S GICB data 3 Interrogation/reply monitor message RS 4 Test message 5 DF-18 (ADS-R, ADS-SLR, TISB) 6 Undefined 7 ADSB state and status message 8 Mode S GICB data 9 Interrogation/reply monitor message LDPC 10 Test message 11 DF-18 (ADS-R, ADS-SLR, TISB) 12 Undefined	
Deleted text	**Table 3-14**	Table 3-14. Phase overlay message subtype field definition Value Meaning 0 No data The PO data-block contains predefined values 1 as defined for selected GICB registers 2–15 Reserved End of new text	Table 3-14. Phase overlay message subtype field definition Value Meaning The PO data-block contains predefined values 1 2–15 Reserved End of new text	
New text to replace existing text	**Table 3-14**	FIGURES FOR CHAPTER 3 NOTES: Format No. UF 0 00000 3 RL:1 4 AQ:1 DS:8 10 AP:24.... Short air-air surveillance (ACAS) 1 00001 27 or 83 AP:24 … Reserved 2 00010 27 or 83 AP:24 … Reserved 3 00011 27 or 83 AP:24 … Reserved 4 00100 PC:3 RR:5 DI:3 SD:16 AP:24.... Surveillance, altitude request 5 00101 PC:3 RR:5 DI:3 SD:16 AP:24.... Surveillance, identify request 6 00110 27 or 83 AP:24 … Reserved 7 00111 27 or 83 AP:24 … Reserved 8 01000 27 or 83 AP:24 … Reserved 9 01001 27 or 83 AP:24 … Reserved 10 01010 27 or 83 AP:24 … Reserved 11 01011 PR:4 IC:4 CL:3 16 AP:24.... Mode S only all-call 12 01100 27 or 83 AP:24 … Reserved 13 01101 27 or 83 AP:24 … Reserved 14 01110 27 or 83 AP:24 … Reserved 15 01111 27 or 83 AP:24 … Reserved 16 10000 3 RL:1 4 AQ:1 18 MU:56 AP:24.... Long air-air surveillance (ACAS) 17 10001 27 or 83 AP:24 … Reserved 18 10010 27 or 83 AP:24 … Reserved 19 10011 27 or 83107 AP:24 … Reserved for military use 20 10100 PC:3 RR:5 DI:3 SD:16 MA:56 AP:24.... Comm-A, altitude request 21 10101 PC:3 RR:5 DI:3 SD:16 MA:56 AP:24.... Comm-A, identify request 22 10110 27 or 83 AP:24 … Reserved for military use 23 10111 27 or 83 AP:24 … Reserved 24 11 RC:2 NC:4 MC:80 AP:24.... Comm-C (ELM)... Figure 3-7. Summary of Mode S interrogation or uplink formats Format No. DF 0 00000 VS:1 CC:1 1 SL:3 2 RI:4 2 AC:13 AP:24.... Short air-air surveillance (ACAS) 1 00001 27 or 83 P:24 … Reserved 2 00010 27 or 83 P:24 … Reserved 3 00011 27 or 83 P:24 … Reserved 4 00100 FS:3 DR:5 UM:6 AC:13 AP:24.... Surveillance, altitude reply 5 00101 FS:3 DR:5 UM:6 ID:13 AP:24.... Surveillance, identify reply 6 00110 27 or 83 P:24 … Reserved 7 00111 27 or 83 P:24 … Reserved 8 01000 27 or 83 P:24 … Reserved 9 01001 27 or 83 P:24 …	FIGURES FOR CHAPTER 3 NOTES: Format No. UF 0 00000 3 RL:1 4 AQ:1 DS:8 10 AP:24.... Short air-air surveillance (ACAS) 1 00001 27 or 83 AP:24 … Reserved 2 00010 27 or 83 AP:24 … Reserved 3 00011 27 or 83 AP:24 … Reserved 4 00100 PC:3 RR:5 DI:3 SD:16 AP:24.... Surveillance, altitude request 5 00101 PC:3 RR:5 DI:3 SD:16 AP:24.... Surveillance, identify request 6 00110 27 or 83 AP:24 … Reserved 7 00111 27 or 83 AP:24 … Reserved 8 01000 27 or 83 AP:24 … Reserved 9 01001 27 or 83 AP:24 … Reserved 10 01010 27 or 83 AP:24 … Reserved 11 01011 PR:4 IC:4 CL:3 16 AP:24.... Mode S only all-call 12 01100 27 or 83 AP:24 … Reserved 13 01101 27 or 83 AP:24 … Reserved 14 01110 27 or 83 AP:24 … Reserved 15 01111 27 or 83 AP:24 … Reserved 16 10000 3 RL:1 4 AQ:1 18 MU:56 AP:24.... Long air-air surveillance (ACAS) 17 10001 27 or 83 AP:24 … Reserved 18 10010 27 or 83 AP:24 … Reserved 19 10011 … Reserved for military use 20 10100 PC:3 RR:5 DI:3 SD:16 MA:56 AP:24.... Comm-A, altitude request 21 10101 PC:3 RR:5 DI:3 SD:16 MA:56 AP:24.... Comm-A, identify request 22 10110 27 or 83 AP:24 … Reserved for military use 23 10111 27 or 83 AP:24 … Reserved 24 11 RC:2 NC:4 MC:80 AP:24.... Comm-C (ELM)... Figure 3-7. Summary of Mode S interrogation or uplink formats Format No. DF 0 00000 VS:1 CC:1 1 SL:3 2 RI:4 2 AC:13 AP:24.... Short air-air surveillance (ACAS) 1 00001 27 or 83 P:24 … Reserved 2 00010 27 or 83 P:24 … Reserved 3 00011 27 or 83 P:24 … Reserved 4 00100 FS:3 DR:5 UM:6 AC:13 AP:24.... Surveillance, altitude reply 5 00101 FS:3 DR:5 UM:6 ID:13 AP:24.... Surveillance, identify reply 6 00110 27 or 83 P:24 … Reserved 7 00111 27 or 83 P:24 … Reserved 8 01000 27 or 83 P:24 … Reserved 9 01001 27 or 83 P:24 … Reserved 10 01010 27	

Type of changes	Location	Existing Text	Amended Text	Comment
		Reserved 10 01010 27 or 83 P:24 … Reserved 11 01011 CA:3 AA:24 PI:24.... All-call reply 12 01100 27 or 83 P:24 … Reserved 13 01101 27 or 83 P:24 … Reserved 14 01110 27 or 83 P:24 … Reserved 15 01111 27 or 83 P:24 … Reserved 16 10000 VS:1 2 SL:3 2 RI:4 2 AC:13 MV:56 AP:24.... Long air-air surveillance (ACAS) 17 10001 CA:3 AA:24 ME:56 PI:24 … Extended squitter 18 10010 CF:3 AA:24 ME:56 PI:24... Extended squitter/non transponder 19 10011 AF:3 10... Mmilitary useextended 4 squitter AP:24.... Comm-B, altitude reply 20 10100 FS:3 DR:5 UM:6 AC:13 MB:56.... (see Note 5) DP:24 AP:24.... Comm-B, identify reply 21 10101 FS:3 DR:5 UM:6 ID:13 MB:56.... (see Note 5) DP:24 22 10110 27 or 83 P:24 … Reserved for military use 23 10111 27 or 83 P:24 … Reserved 24 11 1 KE:1 ND:4 MD:80 AP:24.... Comm-D (ELM) NOTES:... Figure 3-8. Summary of Mode S reply or downlink formats	or 83 P:24 … Reserved 11 01011 CA:3 AA:24 PI:24.... All-call reply 12 01100 27 or 83 P:24 … Reserved 13 01101 27 or 83 P:24 … Reserved 14 01110 27 or 83 P:24 … Reserved 15 01111 27 or 83 P:24 … Reserved 16 10000 VS:1 2 SL:3 2 RI:4 2 AC:13 MV:56 AP:24.... Long air-air surveillance (ACAS) 17 10001 CA:3 AA:24 ME:56 PI:24 … Extended squitter 18 10010 CF:3 AA:24 ME:56 PI:24... Extended squitter/non transponder 19 10011 AF:3 10... Reserved for Mmilitary 4 AP:24.... Comm-B, altitude reply 20 10100 FS:3 DR:5 UM:6 AC:13 MB:56.... (see Note 5) DP:24 AP:24.... Comm-B, identify reply 21 10101 FS:3 DR:5 UM:6 ID:13 MB:56.... (see Note 5) DP:24 22 10110 27 or 83 P:24 … Reserved for military use 23 10111 27 or 83 P:24 … Reserved 24 11 1 KE:1 ND:4 MD:80 AP:24.... Comm-D (ELM) NOTES:... Figure 3-8. Summary of Mode S reply or downlink formats	
New text	**Figure 3-9**	—	Figure 3-9. Phase overlay one microsecond phase transition Phase Message Overlaid onto the PPM Message Phase Data ([54,34], 324 Bits) 0 Degree Pha se Reference Phase Data Block (204 Data Bits) Phase Parity Block (120 Data Bits)	
New text	**Figure 3-9**	—	BIT BIT BIT BIT BIT BIT P1 P2 P3 P4 72 73 1 4 5 112	
CHAPTER 5. MODE S EXTENDED SQUITTER				
New text to replace existing text	**5.1**	Note.— Many of the requirements associated with the transmission of Mode S extended squitter are included in Chapters 2 and Chapter 3 for Mode S transponder and non-transponder devices using the message formats defined in the Technical Provisions for Mode S Services and Extended Squitter (Doc 9871). The provisions presented within the following subsections are focused on requirements applicable to specific classes of airborne and ground transmitting systems that are supporting the applications of ADS-B and TIS-B.	Note.— Many of the requirements associated with the transmission of Mode S extended squitter are included in Chapters 2 through 5 for Mode S transponder and non-transponder devices using the message formats defined in the Technical Provisions for Mode S Services and Extended Squitter (Doc 9871). The provisions presented within the following subsections are focused on requirements applicable to specific classes of airborne and ground transmitting systems that are supporting the applications of ADS-B and TIS-B.	
New text to replace existing text	**5.1.1.1.1**	5.1.1.1.1 ADS-B transmissions from aircraft shall include position, aircraft identification and type, airborne velocity, periodic status and event driven messages including emergency/priority information.	5.1.1.1.1 ADS-B transmissions from aircraft shall be in accordance with 3.1.2.8.6.3 for transponder- based systems or 3.1.2.8.7.3.2 for non-transponder-based systems	
New text to replace existing text	**5.1.1.1.2**	Note 2.— Some States and/or regions require extended squitter version 2 to be transmitted by specific dates.	Note 2.— Some States and/or regions require extended squitter version 2 or later to be transmitted by specific dates.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**5.1.1.2**	5.1.1.2 Extended squitter ADS-B transmission requirements. Mode S extended squitter transmitting equipment shall be classified according to the unit's range capability and the set of parameters that it is capable of transmitting consistent with the following definition of general equipment classes and the specific equipment classes defined in Tables 5-1 and 5-2:	5.1.1.2 Extended squitter ADS-B transmission requirements. Mode S extended squitter transmitting equipment shall be classified according to the unit's intended range capability and the set of parameters that it is capable of transmitting consistent with the following definition of general equipment classes and the specific equipment classes defined in Tables 5-1 and 5-2:	
Deleted text	**5.1.1.3**	5.1.1.3 Class A extended squitter system requirements. Class A extended squitter airborne systems shall have transmitting and receiving subsystem characteristics of the same class (i.e. A0, A1, A2, or A3) as specified in 5.1.1.1 and 5.2.1.2.	—	
Deleted text	**5.1.1.3**	Note.— Class A transmitting and receiving subsystems of the same specific class (e.g. Class A2) are designed to complement each other with their functional and performance capabilities. The minimum air- to-air range that extended squitter transmitting and receiving systems of the same class are designed to support are:	—	
Deleted text	**5.1.1.3**	a) A0-to-A0 nominal air-to-air range is 10 NM;	—	
Deleted text	**5.1.1.3**	b) A1-to-A1 nominal air-to-air range is 20 NM;	—	
Deleted text	**5.1.1.3**	c) A2-to-A2 nominal air-to-air range is 40 NM; and	—	
Deleted text	**5.1.1.3**	d) A3-to-A3 nominal air-to-air range is 90 NM. The above ranges are design objectives and the actual effective air-to-air range of the Class A extended squitter systems may be larger in some cases (e.g. in environments with low levels of 1 090 MHz fruit) and shorter in other cases (e.g. in environments with very high levels of 1 090 MHz fruit).	—	
Deleted text	**5.1.1.4**	5.1.1.4 CONTROL ADS-B OUT OF OPERATION	—	
Deleted text	**5.1.1.4.1**	5.1.1.4.1 Recommendation.— Protection against reception of corrupted data from the source providing the position should be satisfied by error detection on the data inputs and the appropriate maintenance of the installation.	—	
Deleted text	**5.1.1.4.2**	5.1.1.4.2 If an independent control of the ADS-B OUT function is provided, then the operational state of the ADS-B OUT function shall be indicated to the flight crew, at all times.	—	
Deleted text	**5.1.1.4.2**	Note.— There is no requirement for an independent control for the ADS-B OUT function.	—	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**5.1.3.2**	5.1.3.2 Extended squitter version 2 required system performance. The position source and equipment installed in surface vehicles to transmit extended squitter version 2 messages shall support the following performance characteristics:	5.1.3.2 Extended squitter version 2 or later required system performance. The position source and equipment installed in surface vehicles to transmit extended squitter version 2 or later messages shall support the following performance characteristics:	
New text to replace existing text	**5.1.3.2.4**	Note 1.— These minimum performance requirements for extended squitter version 2 transmitted position data from surface vehicles are necessary to support aircraft-based alerting applications.	Note 1.— These minimum performance requirements for extended squitter version 2 or later transmitted position data from surface vehicles are necessary to support aircraft-based alerting applications.	
Deleted text	**5.2**	Note 2.— Detailed technical provisions for Mode S extended squitter receivers can be found within RTCA DO-260CB/EUROCAE ED-102BA, "Minimum Operational Performance Standards for 1 090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS B)."	Note 2.— Detailed technical provisions for Mode S extended squitter receivers can be found within RTCA ED-102BA, "Minimum Operational Performance Standards for 1 090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS B)."	
New text	**5.2.2.4**	—	d) Advanced range receiver techniques for Class A3 receivers, which includes optional additional performance enhancements from the use of multiple receivers and antenna sectorization.	
Deleted text	**5.2.2.4**	Note 1.— The above enhanced reception techniques are as defined in RTCA DO-260CB/EUROCAE ED-102BA, Appendix I.	Note 1.— The above enhanced reception techniques are as defined in RTCA ED-102BA, Appendix I.	
New text to replace existing text	**5.2.2.4**	Note 2.— The performance provided for each of the above enhanced reception techniques when used in a high fruit environment (i.e. with multiple overlapping Mode A/C fruit) is expected to be at least equivalent to that provided by the use of the techniques described in RTCA DO-260CB/EUROCAE ED- Appendix I.	Note 2.— The performance provided for each of the above enhanced reception techniques when used in a high fruit environment (i.e. with multiple overlapping Mode A/C fruit) is expected to be at least equivalent to that provided by the use of the techniques described in RTCA ED- 102BA, Appendix I.	
New text to replace existing text	**5.2.3.2**	Note 2.— Extended squitter ground receiving systems receive ADS-B messages and produce either application-specific subsets or complete ADS-B reports based on the needs of the ground service provider, including the client applications to be supported.	Note 2.— Extended squitter ground receiving systems receive ADS-B messages and produce either application-specific subsets or complete ADS-B reports based on the needs of the ground service provider, including the client applications to be supported. Ground receiving systems may also generate ADS-B Wx Pilot Reports (PIREPs) based upon ADS-B Wx PIREP messages. Additional information on ADS-B Wx PIREP messages can be found in Doc 9871.	
New text to replace existing text	**5.2.3.3**	Note 1.— The ADS-B report refers to the restructuring of ADS-B message data received from Mode S extended squitter broadcasts into various reports that can be used directly by a set of client applications. Five ADS-B report types are defined by the following subparagraphs for output to client applications. Additional information on	Note 1.— The ADS-B report refers to the restructuring of ADS-B message data received from Mode S extended squitter broadcasts into various reports that can be used directly by a set of client applications. Five ADS-B report types are defined by the following subparagraphs and additional two ADS-B report types (ADS-B Wx Air Report	

Type of changes	Location	Existing Text	Amended Text	Comment
		the ADS-B report contents and the applicable mapping from extended squitter messages to ADS-B reports can be found in the Technical Provisions for Mode S Services and Extended Squitter (Doc 9871) and RTCA DO-260CB / EUROCAE ED-102BA.	(AIREP)and Aircraft State Report) are defined in Doc 9871 for output to client applications. Additional information on the ADS-B report contents and the applicable mapping from extended squitter messages to ADS-B reports can be found in RTCA DO-260CB / EUROCAE ED-102BA.	
New text to replace existing text	**5.2.3.3**	Note 2.— The use of precision (e.g. GNSS UTC measured time) versus non-precision (e.g. internal receiving system clock) time sources as the basis for the reported time of applicability is described in 5.2.3.5.	Note 2.— The ADS-B Wx Air Report is an optional report that will be generated when weather information is received in ADS-B Wx subtype 1 and 2 messages along with additional weather information received in aircraft status subtype 1 extended squitter messages. The aircraft state report is an optional report that will be generated when information is received in ADS-B Wx subtype 0 messages. The ADS B Wx subtype 0, 1 and 2 messages are defined in Doc 9871. Specific requirements for the customization of this type of report may vary according to the needs of the client applications of each participant.	
New text to replace existing text	**5.2.3.3.1**	5.2.3.3.1 State vector report. The state vector report shall contain time of applicability, information about an airborne or vehicle's current kinematic state (e.g. position, velocity), as well as a measure of the integrity of the navigation data, based on information received in airborne or groundsurface position, airborne velocity, identification and category, aircraft operational status and target state and status extended squitter messages. Since separate messages are used for position and velocity, the time of applicability shall be reported individually for the position related report parameters and the velocity related report parameters. Also, the state vector report shall include a time of applicability for the estimated position and/or estimated velocity information (i.e. not based on a message with updated position or velocity information) when such estimated position and/or velocity information is included in the state vector report.	5.2.3.3.1 State vector report. The state vector report shall contain time of applicability, information about an airborne or vehicle's current kinematic state (e.g. position, velocity), as well as a measure of the integrity of the navigation data, based on information received in airborne or position, airborne velocity, identification and category, and aircraft operational status extended squitter messages. Since separate messages are used for position and velocity, the time of applicability shall be reported individually for the position related report parameters and the velocity related report parameters. Also, the state vector report shall include a time of applicability for the estimated position and/or estimated velocity information (i.e. not based on a message with updated position or velocity information) when such estimated position and/or velocity information is included in the state vector report.	
New text to replace existing text	**5.2.3.3.2**	Note 2.— The age of the information being reported within the various data elements of a mode status report may vary as a result of the information having been received within different extended squitter messages at different times.	Note 2.— The age of the information being reported within the various data elements of a mode status report may vary as a result of the information having been received within different extended squitter messages at different times. In the absence of item-specific timestamp information, the mode status report includes an optional data update flag that provides applications with the means to establish data age.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**5.2.3.3.3**	5.2.3.3.3 Air referenced velocity report. Air referenced velocity reports shall be generated when air referenced velocity information is received in airborne velocity extended squitter messages. The air referenced velocity report shall contain time of applicability, airspeed and heading information. Only certain classes of extended squitter receiving systems, as defined in 5.2.3.5, are required to generate air referenced velocity reports. Each time that an individual mode status report is generated, the report assembly function shall update the report time of applicability.	5.2.3.3.3 Air referenced velocity report. Air referenced velocity reports shall be generated when air referenced velocity information is received in airborne velocity or ADS-B Wx AIREP extended squitter messages. The air referenced velocity report shall contain time of applicability, airspeed and heading information. Only certain classes of extended squitter receiving systems, as defined in 5.2.3.5, are required to generate air referenced velocity reports. Each time that an individual air referenced velocity report is generated, the report assembly function shall update the report time of applicability.	
New text to replace existing text	**5.2.3.3.3**	Note 1.— The air referenced velocity report contains velocity information that is received in airborne velocity messages along with additional information received in airborne identification and category extended squitter messages. Air referenced velocity reports are not generated ground referenced velocity information is being received in the airborne velocity extended squitter messages.	Note 1.— The air referenced velocity report contains velocity information that is received in airborne velocity or ADS-B Wx AIREP messages along with additional information received in airborne identification and category extended squitter messages. Air referenced velocity reports are not generated for surface participantswhen	
Deleted text	**5.2.3.3.3**	Note 2.— Specific requirements for the customization of this type of report may vary according to the needs of the client applications of each participant (ground or airborne).	Note 2.— Specific requirements for the customization of this type of report may vary according to the needs of the client applications of each participant	
Deleted text	**5.2.3.4.1**	Note 3.— The use of precision (e.g. GNSS UTC measured time) versus non-precision (e.g. internal receiving system clock) time sources as the basis for the reported time of applicability is described in 5.2.3.5.	—	
Deleted text	**5.2.3.4.2**	5.2.3.4.2 TIS-B target report. All received information elements, other than position, shall be reported directly, including all reserved fields for the TIS-B fine format messages and the entire message content of any received TIS-B management message. The reporting format is not specified in detail, except that the information content reported shall be the same as the information content received.	5.2.3.4.2 TIS-B target report. All received information elements, other than position, shall be reported directly, including all reserved fields for the TIS-B fine format messages The reporting format is not specified in detail, except that the information content reported shall be the same as the information content received.	
New text to replace existing text	**5.2.3.4.5**	5.2.3.4.5 TIS-B management report. The entire message content of any received uplinkTIS-B management message shall be reported directly to the client applications. The information content reported shall be the same as the information content received.	5.2.3.4.5 Traffic uplink management report. The entire message content of any received traffic management message shall be reported directly to the client applications. The information content reported shall be the same as the information content received.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**5.2.3.4.5.1**	5.2.3.4.5.1 The contents of any received uplinkTIS-B management message shall be reported bit-for-bit to the client applications.	5.2.3.4.5.1 The contents of any received traffic management message shall be reported bit-for-bit to the client applications.	
New text to replace existing text	**5.2.3.5.1**	5.2.3.5.1 Precision time reference. rReceiving systems intended to generate ADS-B and/or TIS-B reports based on the reception of surface position messages, airborne position messages, and/or TIS-B messages shall use GNSS UTC measured time for the purpose of generating the report time applicability, for the following cases of received messages:	5.2.3.5.1 GNSS UTC measure time reference. For rReceiving systems that generate ADS-B and/or TIS-B reports that use GNSS UTC measured time for the purpose of generating the report time applicability,	
Deleted text	**5.2.3.5.1**	a) version zero (0) ADS-B messages, as defined in 3.1.2.8.6.2, when the navigation uncertainty category (NUC) is 8 or 9; or	—	
Deleted text	**5.2.3.5.1**	b) version one (1) or version two (2) ADS-B or TIS-B messages, as defined in 3.1.2.8.6.2 and 3.1.2.8.7 respectively, when the navigation integrity category (NIC) is 10 or 11; UTC measured time data shall have a minimum range of 300 seconds and a resolution of 0.0078125 (1/128) seconds.	UTC measured time data shall have a minimum range of 300 seconds and a resolution of 0.0078125 (1/128) seconds.	
New text to replace existing text	**5.2.3.5.2**	5.2.3.5.2 NON-PRECISION TIME REFERENCE LOCAL	5.2.3.5.2 ESTABLISHED INSTALLATION RECEIVER TIME REFERENCE	
New text to replace existing text	**5.2.3.5.2.1**	5.2.3.5.2.1 For receiving systems not intended to generate ADS-B and/or TIS-B reports based on reception of ADS-B or TIS-B messages meeting the NUC or NIC criteria as indicated in 5.2.3.5.1, a non-precision time source shall be allowed. In such cases, where there is no appropriate precision time source available, the receiving system shall establish an appropriate internal clock or counter having a maximum clock cycle or count time of 20 milliseconds. The established cycle or clock count shall have a minimum range of 300 seconds and a resolution of 0.0078125 (1/128) seconds.	5.2.3.5.2.1 For receiving systems that generate ADS-B and/or TIS-B reports that do not use GNSS UTC measure time per 5.2.3.5.1 and for which there is no appropriate time reference available, the receiving system shall establish an appropriate internal clock or counter having a maximum clock cycle or count time of 20 milliseconds. The established cycle or clock count shall have a minimum range of 300 seconds and a resolution of 0.0078125 (1/128) seconds.	
Deleted text	**5.2.3.5.2.1**	Note.— The use of a non-precision time reference as described above is intended to allow the report time of applicability to accurately reflect the time intervals applicable to reports within a sequence. For example, the applicable time interval between state vector reports could be accurately determined by a client application, even though the absolute time (e.g. UTC measured time) would not be indicated by the report.	Note.— The use of a time reference as described above is intended to allow the report time of applicability to accurately reflect the time intervals applicable to reports within a sequence. For example, the applicable time interval between state vector reports could be accurately determined by a client application, even though the absolute time would not be indicated by the report.	

Type of changes	Location	Existing Text	Amended Text	Comment
New text to replace existing text	**Table 5-3**	Table 5-3. Reception performance for airborne receiving systems Receiver minimum trigger Intended threshold air-to-air level Reception Required extended squitter Required extended squitter Receiver operational (MTL) Technique ADS-B message support TIS-B message support class range (see Note 1) (see Note 2) A0 10 NM –72 dBm Standard Airborne position Fine airborne position (Basic VFR) Surface position Coarse airborne position Airborne velocity Fine surface position Aircraft identification and category Aircraft identification and category Extended squitter airborne Airborne velocity status Management Aircraft operational status A1 20 NM –79 dBm Enhanced Airborne position Fine airborne position Surface position Coarse airborne position (Basic IFR) Airborne velocity Fine surface position Aircraft identification and category Aircraft identification and category Extended squitter airborne Airborne velocity status Management Aircraft operational status A2 40 NM –79 dBm Enhanced Airborne position Fine airborne position (Enhanced Surface position Coarse airborne position IFR) Airborne velocity Fine surface position Aircraft identification and category Aircraft identification and category Extended squitter airborne Airborne velocity status Management Aircraft operational status Target state and status A3 90 NM –84 dBm Enhanced Airborne position Fine airborne position (Extended (and –87 dBm at Surface position Coarse airborne position capability) 15% probability Airborne velocity Fine surface position of reception) Aircraft identification and category Aircraft identification and category Extended squitter airborne Airborne velocity status Management Aircraft operational status Target state and status	Table 5-3. Reception performance for airborne receiving systems Receiver minimum trigger Intended threshold air-to-air level Reception Required extended squitter Required extended squitter Receiver operational (MTL) Technique ADS-B message support TIS-B message support class range (see Note 1) (see Note 2) (includes ADS-R and ADS-SLR) (includes management messages) A0 10 NM –72 dBm Standard Airborne position Fine airborne position (Basic VFR) Surface position Airborne velocity Fine surface position Aircraft identification and category Aircraft identification and category Aircraft Airborne velocity status Management Aircraft operational status A1 20 NM –79 dBm Enhanced Airborne position Fine airborne position Surface position (Basic IFR) Airborne velocity Fine surface position Aircraft identification and category Aircraft identification and category Aircraft Airborne velocity status Management Aircraft operational status A2 40 NM –79 dBm Enhanced Airborne position Fine airborne position (Enhanced Surface position IFR) Airborne velocity Fine surface position Aircraft identification and category Aircraft identification and category Aircraft Airborne velocity status Management Aircraft operational status Target state and status A3 90 NM –84 dBm Enhanced Airborne position Fine airborne position (Extended (and –87 dBm at Surface position capability) 15% probability Airborne velocity Fine surface position of reception) Aircraft identification and category Aircraft identification and category Aircraft Airborne velocity status Management Aircraft operational status Target state and status	
New text	**Table 5-3**	—	Note 3.— Management messages include TIS-B, ADS-R and ADS-SLR services. ADS-Rebroadcast (ADS-R) and ADS-Same Link Rebroadcast (ADS- SLR) are defined in Doc 9871.	
New text to replace existing text	**Table 5-4**	Table 5-4. Mode S extended squitter airborne receiving system reporting requirements Minimum TIS-B reporting Receiver class Minimum ADS-B reporting requirements requirements ADS-B state vector report (per 5.2.3.3.1) TIS-B state report A0 and and (Basic VFR) ADS-B mode status report (per 5.2.3.3.2) TIS-BTraffic management report ADS-B state vector report (per 5.2.3.3.1) TIS-B state report and and A1 ADS-B mode status report (per 5.2.3.3.2) TIS-BTraffic management report (Basic IFR) and	Table 5-4. Mode S extended squitter airborne receiving system reporting requirements Minimum TIS-B reporting Receiver class Minimum ADS-B reporting requirements requirements ADS-B state vector report (per 5.2.3.3.1) TIS-B state report A0 and and (Basic VFR) ADS-B mode status report (per 5.2.3.3.2) uplink management report ADS-B state vector report (per 5.2.3.3.1) TIS-B state report and and A1 ADS-B mode status report (per 5.2.3.3.2) uplink management report (Basic IFR) and ADS-	

Type of changes	Location	Existing Text	Amended Text	Comment
		ADS-B air referenced velocity report (ARV) (per 5.2.3.3.3) ADS-B state vector report (per 5.2.3.3.1) TIS-B state report and and ADS-B mode status report (per 5.2.3.3.2) TIS-BTraffic management report A2 and (Enhanced IFR) ADS-B ARV report (per 5.2.3.3.3) and ADS-B target state report (per 5.2.3.3.5) ADS-B state vector report (per 5.2.3.3.1) TIS-B state report and and A3 ADS-B mode status report (per 5.2.3.3.2) TIS-BTraffic management report and (Extended capability) ADS-B ARV report (per 5.2.3.3.3) and ADS-B target state report (per 5.2.3.3.5)	B air referenced velocity report (ARV) (per 5.2.3.3.3) ADS-B state vector report (per 5.2.3.3.1) TIS-B state report and and ADS-B mode status report (per 5.2.3.3.2) uplink management report A2 and (Enhanced IFR) ADS-B ARV report (per 5.2.3.3.3) and ADS-B target state report (per 5.2.3.3.5) ADS-B state vector report (per 5.2.3.3.1) TIS-B state report and and A3 ADS-B mode status report (per 5.2.3.3.2) uplink management report and (Extended capability) ADS-B ARV report (per 5.2.3.3.3) and ADS-B target state report (per 5.2.3.3.5)	
New text to replace existing text	**Table 5-4**	—	Note.— Traffic uplink management reports include TIS-B, ADS-R and ADS-SLR service status.	