



Technical Standard Order

Subject: Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz

1. **PURPOSE.** This Technical Standard Order (TSO) is for manufacturers of Universal Access Transceiver ADS-B equipment or UAT Diplexer seeking a TSO authorization or letter of design approval. In it, we (the Federal Aviation Administration, or FAA) tell you what minimum performance standards (MPS) your Universal Access Transceiver ADS-B equipment or UAT Diplexer must meet for approval and identification with the applicable TSO marking.
2. **APPLICABILITY.** This TSO affects new applications submitted after this TSO's effective date. UAT equipment approved under a previous TSO authorization may continue to be manufactured under the provisions of their original approval, as specified in Title 14 of the Code of Federal Regulations (14 CFR) § 21.603(b). Major design changes to UAT equipment approved under previous versions of this TSO require a new authorization under this TSO; see 14 CFR § 21.611(b). All prior revisions of this TSO are no longer effective. We will not accept applications after the effective date of this TSO.
3. **REQUIREMENTS.** New models of UAT ADS-B equipment or UAT Diplexer identified and manufactured on or after this TSO's effective date must meet the MPS in Section 2 of RTCA Document No. (RTCA/DO-282A, dated July 29, 2004, as amended by appendix 1 of this TSO. The title of RTCA/DO-282A is Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance Broadcast (ADS-B). See Section 2.1.11 of RTCA/DO-282A for UAT equipment classes that apply to this TSO.
 - a. **Functionality.**
 - (1) The standards of this TSO apply to aircraft equipment intended to transmit or receive broadcast messages about an aircraft's position (latitude and longitude), velocity, time, integrity, and other parameters. Similarly equipped operators will share these messages with one another and ground-based facilities, such as air traffic services. These message parameters form the basis for various ADS-B reports.
 - (2) This TSO supports two major classes of UAT ADS-B equipment: Class A equipment, which includes transmit and receive subsystems; and Class B equipment, which includes a transmit subsystem only.

(a) **Class A equipment** includes Classes A0, A1L, A1H, A2, and A3. We require UAT airborne Class A equipment to transmit and receive ADS-B messages, and deliver ADS-B reports to onboard applications. Class A equipment must also support the reception of the Flight Information Services - Broadcast (FIS-B) during the Ground Uplink segment of the UAT message frame. Find data formats for FIS-B uplink services in RTCA/DO-267A, Minimum Aviation System Performance Standards (MASPS) for Flight Information Service Broadcast (FIS-B), dated April 29, 2004.

(b) **Class B equipment** includes Classes B0 and B1. Classes B2 and B3 are not for aircraft use. Classes B0 and B1 have the same transmitter characteristics and payload capability as Classes A0 and A1H, respectively, except they do not have receive subsystems.

(3) The standards of this TSO also support an optional frequency Diplexer. The Diplexer allows the ATCRBS/Mode S Transponder and the UAT equipment developed under this TSO to share antennas.

b. **Use of ADS-B Reports in Airborne Applications.** This TSO addresses only broadcasting messages from transmit subsystems and assembling reports in receiver subsystems. The MPS of this TSO do not address applications that use the information in reports.

(1) If you are a manufacturer of UAT ADS-B equipment, you must seek design approval for applications. You can get design approval by complying with an appropriate TSO for the subject application or, during installation approval, through the type certification or supplemental type certification process. During the certification process, UAT ADS-B equipment approved under this TSO may require installation limitations. These limitations should draw attention to those applications that must be validated as part of the installation approval process.

(2) For industry-recommended practices on how to display ADS-B information, see the guidance in the documents listed below:

- RTCA/DO-243, Guidance for Initial Implementation of Cockpit Display of Traffic Information, dated February 19, 1998;
- RTCA/DO-249, Development and Implementation Planning Guide for Automatic Dependant Surveillance Broadcast (ADS-B) Applications, dated October 6, 1999;
- RTCA/DO-259, Application Descriptions for Initial Cockpit Display of Traffic Information (CDTI) Applications, dated September 13, 2000; and
- SAE Aerospace Recommended Practice (ARP) 5365, Human Interface Criteria for Cockpit Display of Traffic Information, dated January 1999.

c. **Failure Condition Classification.** Failure of the function defined in paragraphs 3 and 3a of this TSO will depend on the equipment's intended use for the ADS-B report information.

For the least demanding uses, the failure condition classifications for the different classes of UAT equipment are as follows:

(1) For Class A0 UAT receiver subsystems, we consider an un-announced failure that provides onboard applications with incorrect reports a minor failure condition. A minor failure condition should occur no more than once per 10^3 flight hours.

(2) For all other classes of UAT receiver subsystems, we consider an un-announced failure that provides onboard applications with incorrect reports a major failure condition. A major failure condition should occur no more than once per 10^5 flight hours.

(3) For all classes of UAT transmitter subsystems, we consider an un-announced failure that broadcasts incorrect ADS-B messages to users a major failure condition. We consider an un-announced failure resulting in loss of function as minor.

NOTE: The above failure condition classifications are driven by airspace considerations. They are independent of the aircraft on which the equipment is to be installed.

(4) To meet at least a design assurance level equal to a minor failure condition, develop software to Level D of RTCA/DO-178B, Software Considerations in Airborne Systems and Equipment Certification, dated December 1, 1992. For a major failure condition, they must develop software to RTCA/DO-178B, Level C.

(5) You may develop equipment to a higher design assurance level in anticipation of more demanding applications. For example, the failure condition could be hazardous/severe-major, if the UAT equipment broadcasts erroneous messages about the status of own-ship Traffic Alert and Collision Avoidance System (TCAS), and other aircraft use this information to make decisions about maneuvering. You should state, and include in the operating instructions and equipment limitations, the hardware and software design assurance levels to which you developed the equipment.

(6) The optional UAT Diplexer is a mechanical device with no active components. If you follow the MPS of this TSO, you should manufacture a device whose probability of undetected failure is the same as that of the aircraft's antenna cable/connectors or a coaxial bulkhead feed-through. However, in the total cable loss budget of the aircraft's antenna system, consider the maximum amplitude attenuation of the UAT Diplexer. Include the following limitation in the installation procedures:

The cable attenuation allowance between the ATCRBS/Mode S transponder output and the antenna input is typically 3.0 dB. It is the responsibility of the installer to ensure that the insertion of the UAT Diplexer does not cause this budget to be exceeded.

(7) You must also state – and include in the operating instructions and equipment limitations – any assumptions about the aircraft installation, software and hardware used in the interface, or procedures required for maintaining the design assurance levels.

d. Functional Qualification. Show the required performance of the equipment defined in paragraphs 3 and 3a of this TSO under the test conditions in RTCA/DO-282A, Section 2.4.

e. Environmental Qualification. Test the equipment to the conditions in RTCA/DO-160D, Environmental Conditions and Test Procedures for Airborne Equipment, dated July 29, 1997. The means for verifying equipment performance must be consistent with the test procedures in RTCA/DO-282A, Section 2.3.

f. Software Qualification. If the equipment includes software, develop the software following the requirements in RTCA/DO-178B.

g. Deviations. We provide for alternative or equivalent means of compliance to the MPS of this TSO. If you use these provisions, show that an equivalent level of safety is maintained and apply for a deviation per 14 CFR § 21.609.

4. MARKING. Under 14 CFR § 21.607(d), mark articles manufactured under this TSO as follows:

a. At least one major component must be permanently and legibly marked with all information listed in 14 CFR § 21.607(d).

b. Besides the requirements of paragraph 4a of this TSO, the following table explains component-specific marking patterns. Find the equipment class in RTCA/DO-282A, Section 2.1.11.

If component:	Mark it with:	Sample marking pattern:
Transmits and receives	Equipment class it supports	Class A0 or Class A3
Transmits, but does not receive	Equipment class it supports	Class B0 or Class B1
Receives, but does not transmit	Equipment class it supports	Class A2 - Receive Only
The optional frequency Diplexer developed under this TSO	<ul style="list-style-type: none"> • The words “UAT Diplexer” • Maximum amplitude attenuation between the antenna port (A) and UAT port (U) of the Diplexer, and • Maximum amplitude attenuation between the antenna port (A) and transponder port (T) of the Diplexer 	UAT Diplexer A/U -0.x dB A/T -0.x dB

c. Also, mark the following permanently and legibly, with at least the name of the manufacturer, manufacturer’s subassembly part number, and the TSO number:

- (1) Each component that is easily removable (without hand tools);
- (2) Each interchangeable element; and

(3) Each subassembly of the article that you determined may be interchangeable.

d. If the component includes software, then the part number must include hardware and software identification. Or, you can use a separate part number for hardware and software. Either way, you must include a means for showing the modification status.

NOTE: Similar software versions, approved to different software levels, must be differentiated by part number.

e. When applicable, identify the component or equipment as a partial system or that the appliance does anything beyond the functions in paragraphs 3 and 3a of this TSO.

5. **APPLICATION DATA REQUIREMENTS.** Under 14 CFR § 21.605(a)(2), you as the manufacturer must send the Aircraft Certification Office (ACO) manager, responsible for your facility, one copy of the following technical data to support the FAA design and production approval:

a. Operating instructions and equipment limitations, sufficient to describe the operational capability of the equipment. In particular, you must describe in detail operational or installation limitations that result from specific deviations granted.

b. Installation procedures and limitations that sufficiently ensure the UAT ADS-B equipment or the UAT Diplexer, when installed per the installation procedures, continues to meet the requirements of this TSO. The limitations must identify any unique aspects of the installation. Finally, the limitations also must include a note with the following statement:

The conditions and tests required for TSO approval of this article are minimum performance standards. Those installing this article on or in a specific type or class of aircraft must determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements.

c. If you build Receive Only class of UAT equipment (see paragraph 4c of this TSO), you must also include the following statement:

Installation of this Receive Only class of equipment is intended only for those aircraft in which a UAT ADS-B transmit class of equipment, or other complementary ADS-B link transmit class of equipment (for example, 1090 MHz ADS-B), is already installed.

d. Schematic drawings, as applicable to the installation procedures.

e. Wiring diagrams, as applicable to the installation procedures.

f. List of the components, by part number, that make up the UAT ADS-B equipment or UAT Diplexer complying with the standards in this TSO. You should include vendor part number cross-references, when applicable.

g. Instructions covering periodic maintenance, calibration, repair, and continued airworthiness of the installed UAT ADS-B equipment or UAT Diplexer. The instructions should also describe details of deviations granted, as noted in paragraph **5a** of this TSO.

h. Material and process specifications list.

i. The quality control system description required by 14 CFR §§ 21.605(a)(3) and 21.143(a), including functional test specifications for testing each production article to ensure compliance with this TSO.

j. Manufacturer's TSO qualification test report on the results of the testing required by paragraph **3d**.

k. Nameplate drawing giving the information required by paragraph **4** of this TSO.

l. A list of all drawings and processes, including revision level, necessary to define the article's design. For minor changes, you only need to provide these revisions to the drawing list on request by the ACO.

m. An environmental qualification form as described in RTCA/DO-160D, Appendix A, for each component developed under this TSO.

n. If the article includes software: Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary. We recommend that you submit the PSAC early in the software development process. Early submittal will allow us to quickly resolve issues, such as partitioning and determining software levels.

6. MANUFACTURER DATA REQUIREMENTS. Besides the data given directly to the FAA, you must have the following technical data available for review by the responsible ACO:

a. The functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Equipment calibration procedures.

c. Corrective maintenance procedures within 12 months after TSO authorization.

d. Schematic drawings.

e. Wiring diagrams.

f. Material and process specifications.

g. The results of the environmental qualification tests conducted per RTCA/DO-160D and RTCA/DO-282A, Section 2.3.

h. If the article includes software, the appropriate documentation as defined in RTCA/DO-178B, including all data supporting the applicable objectives in Annex A of RTCA/DO-178B, Process Objectives and Outputs by Software Level.

7. FURNISHED DATA REQUIREMENTS. If sending one or more articles to one source (such as an operator or repair station), provide the following for each article manufactured under this TSO:

a. One copy of the data in paragraphs **5a** through **5g** and **5m** of this TSO. Add any other data needed for the proper operation, storage, or continued airworthiness of the UAT ADS-B equipment or UAT Diplexer.

b. One copy of the data in paragraphs **5l** and **5n** of this TSO, if the appliance performs functions beyond those described in paragraphs **3** and **3a** of this TSO.

8. HOW TO GET REFERENCED DOCUMENTS.

a. You can buy copies of RTCA documents referenced in this TSO from RTCA, Inc., 1828 L Street, N.W., Suite 805, Washington, D.C. 20036; telephone (202) 833-9339, fax (202) 833-9434. You can also get copies through the RTCA Internet website at www.rtca.org.

b. You can buy copies of SAE documents referenced in this TSO from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001; telephone (724) 776-4970, fax (724) 776-0790. You can also get copies through the SAE Internet website at www.sae.org.

c. You can buy copies of 14 CFR part 21, Subpart O, from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402-9325; telephone (202) 512-1800, fax (202) 512-2250. You can also get copies from the Government Printing Office (GPO), electronic CFR Internet website at www.gpoaccess.gov/ecfr.

d. You can get Advisory Circular (AC) 20-110L (or current revision), "Index of Aviation Technical Standard Orders," from the U.S. Department of Transportation, Subsequent Distribution Office, DOT Warehouse, M30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785. Telephone (301) 322-5377, fax (301) 386-5394. You can also get copies on the Internet from the FAA's Regulatory and Guidance Library (RGL) at www.airweb.faa.gov/rgl. On the RGL website, click on "Advisory Circulars."

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**APPENDIX 1. MINIMUM PERFORMANCE STANDARDS FOR UAT ADS-B
EQUIPMENT OPERATING ON THE FREQUENCY OF 978 MHz**

This appendix gives the minimum performance standards (MPS) for Universal Access Transceiver (UAT) Automatic Dependent Surveillance - Broadcast (ADS-B) Equipment. The applicable standard is RTCA/DO-282A, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance Broadcast (ADS-B), dated July 29, 2004. We at the FAA modified RTCA/DO-282A as follows:

- (1.1) In RTCA/DO-282A, Section 2.4.2.1, replace Table 2-71 with the following Table. Note that there are two (2) lines in the table that must be corrected from their published values, which are highlighted below in gray. As a result of these changes to Table 2-71, there is also a required change to the state file “UAT-DMD.STA” referenced in Step 1 of the test procedure for this paragraph, to automatically set up the HP89441A Vector Signal Analyzer. As of the publication date of this TSO, the revised state file may be obtained from the ADS-B/UAT MOPS web site, which is located at: <http://adsb.tc.faa.gov/WG5.htm> under the link for “Files to Support UAT MOPS Test Procedures.”

APPENDIX 1. MINIMUM PERFORMANCE STANDARDS FOR UAT ADS-B EQUIPMENT OPERATING ON THE FREQUENCY OF 978 MHz, CONTINUED

TABLE 2-71: DIGITAL DEMODULATION MODE CONFIGURATION

VECTOR SIGNAL ANALYZER PARAMETER SETTINGS	
Parameter Item/Function	Parameter Setting Value
Preset	(press to Preset Equipment)
Instrument Mode	Digital Demodulation
Instrument Mode / demodulation setup / demod[ulation] format	[2 FSK]
Instrument Mode / demodulation setup / symbol rate	1.041667 MHz
Instrument Mode / demodulation setup / result [message] length	420 sym[bols]
Instrument Mode / demodulation setup / meas[urement] filter	Low pass
Instrument Mode / demodulation setup / ref[erence] filter	raised cosine
Instrument Mode / demodulation setup / [filter] alpha	0.5
Instrument Mode / demodulation setup / normalize	off
Frequency / center frequency	978 MHz
Frequency / frequency span	[preferably] 3.255 MHz *
Range / ch[annel] 1 [signal] range	-50 dBm
Time / result [message] length	420 sym[bols]
Time / sync search	on
Time / sync pattern	“EACDDA4E2” Hexidecimal (per §2.2.3.1.1)
Time / points/symbol	4
Average / average	on
Average / num[ber of] averages	10
Average / average type	rms expo[nential]
Trigger / trigger type	IF ch[annel]1
Trigger / IF level	0.0001 V[olts]
Trace A – Measurement Data	FSK measured time
Trace A – Data Format	part real (I)
Trace A – RefLvl/Scale / Y per div[ision]	78.125 kHz
Trace C – Measurement Data	FSK measured time
Trace C – Data Format	eye diagram I
Trace C – Data Format / more format setup / eye length	1
Trace C – RefLvl/Scale / Y per div[ision]	70 kHz
Trace D – Measurement Data	symbol table/error summary

NOTE: The “Frequency / frequency span” in Table 2-71, listed as the preferred value for the Vector Signal Analyzer, while it is optimum for the Agilent 89441A, may be changed above or below the value listed [3.255 MHz] in order to produce the cleanest presentation; the one with the largest “EYE” opening. Analyzer equipment other than the Agilent 89441A, or 89600 series, may require a different bandwidth, or frequency span, setting in order to produce the optimum (largest) “EYE” opening.

APPENDIX 1. MINIMUM PERFORMANCE STANDARDS FOR UAT ADS-B EQUIPMENT OPERATING ON THE FREQUENCY OF 978 MHz, CONTINUED

- (1.2) In RTCA/DO-282A, Section 2.4.2.6, replace the entire Step 2, including Table 2-72 with the following:

Step 2: Measure RF Power Output Over Frequency Spectrum

Set up the UAT equipment to transmit a Long ADS-B Message. Measure the peak RF power of the transmitted signal with a 100 kHz bandwidth over the frequency range from 974.75 MHz to 981.25 MHz (± 3.25 MHz). Verify that the levels relative to the power level recorded in Step 1 above are at, or below, the UAT Spectral Mask depicted in Figure 2.2.

- (1.3) In RTCA/DO-282A, Section 2.4.14.3.1.1, renumber Test Procedure Step 6 to Step 7, and insert a new Step 6 with the text as follows:

Step 6: Delay Variation Verification

Set up the Network Analyzer to measure Group Delay Variation. Set the start and stop frequencies to 977 MHz and 979 MHz, respectively. Set the RF power level to 0 dBm. Set the markers at the start, stop and center frequencies. Calibrate the delay measurement by using a through line between the RF IN and OUT ports of the analyzer.

Remove the through line and connect the Diplexer antenna port to the RF IN port of the analyzer and the Diplexer UAT port to the RF OUT port of the analyzer. Terminate the Transponder port of the Diplexer with a 50 ohm load. Measure the absolute Group Delay and verify that the delay is less than 30 nanoseconds. Measure the delay at 978 MHz and read the difference between the delays at 977 MHz and 979 MHz respectively. Verify that the difference is less than 10 nanoseconds.

**APPENDIX 1. MINIMUM PERFORMANCE STANDARDS FOR UAT ADS-B
EQUIPMENT OPERATING ON THE FREQUENCY OF 978 MHz, CONTINUED**

- (1.4) In RTCA/DO-282A, Section 2.4.14.3.1.2, renumber Test Procedure Step 7 to Step 8, and insert a new Step 7 with the text as follows:

Step 7: Delay Variation Verification

Set up the Network Analyzer to measure Group Delay Variation. Set the start and stop frequencies to 1015 MHz and 1105 MHz, respectively. Set the RF power level to 0 dBm. Set the markers at the start and stop frequencies, and at the 1060 MHz center frequency. Calibrate the delay measurement by using a through line between the RF IN and OUT ports of the analyzer.

Remove the through line and connect the Diplexer antenna port to the RF IN port of the analyzer and the Diplexer Transponder port to the RF OUT port of the analyzer. Terminate the UAT port of the Diplexer with a 50 ohm load. Measure the absolute Group Delay and verify that the delay is less than 10 nanoseconds. Measure the delay at 1060 MHz and read the difference between the delays at 1015 MHz and 1130 MHz, respectively. Verify that the difference is less than 5 nanoseconds.

**APPENDIX 1. MINIMUM PERFORMANCE STANDARDS FOR UAT ADS-B
EQUIPMENT OPERATING ON THE FREQUENCY OF 978 MHz, CONTINUED**

(1.5) The following table gives the remaining changes and additions to RTCA/DO-282A:

In RTCA/DO-282A, replace:	With: (new or changed text shown in gray highlights)
Section 2.2.14.3.1.1	<p>The Diplexer shall include a UAT Channel that conveys UAT signals without distortion of the waveform. The UAT Channel shall convey UAT Basic, Long and Ground Uplink Messages while maintaining the modulation accuracy of the input UAT signals as specified in §2.2.2.4 and produce no more than 0.5 dB amplitude attenuation and no more than 30 nanoseconds in propagation delay. Additionally, the variation in delay shall be no more than 10 nanoseconds over the frequency band of 977 MHz to 979 MHz. The UAT Channel shall provide a passband from no greater than 977 MHz to no less than 979 MHz (2.0 MHz minimum) and a maximum attenuation of 0.5 dB. The minimum and maximum attenuation in the passband shall be different by no greater than 0.20 dB. The UAT port of the Diplexer shall be capable of peak power transmissions according to the appropriate aircraft equipage class given by Table 2-1. The VSWR produced by the Diplexer at the UAT port, when the other two ports are terminated in a 50 ohm load, shall not exceed 1.3:1 for frequencies within the passband.</p>
Section 2.2.14.3.1.2	<p>The Diplexer shall include a Transponder Channel that conveys received 1030 MHz interrogation and 1090 MHz reply signals without distortion of the waveform. The Transponder Channel shall convey pulses that are amplitude modulated on either 1030 MHz or 1090 MHz and having rise and fall times of 50 nanoseconds or more and produce no more than 0.5 dB amplitude attenuation and no more than 10 nanoseconds delay while retaining the pulse rise and fall times and pulse width of the input pulses. Additionally, the variation in delay shall be no more than 5 nanoseconds over the frequency band of 1015 MHz to 1105 MHz. The Transponder Channel shall provide a passband from no greater than 1015 MHz to no less than 1105 MHz (90 MHz minimum) and a maximum attenuation of 0.5 dB. The minimum and maximum attenuation in the passband shall be different by no greater than 0.20 dB. The Transponder port shall be capable of handling 1000 Watts instantaneous power. The VSWR produced by the Diplexer at the Transponder port, when the other two ports are terminated in a 50 ohm load, shall not exceed 1.3:1 for frequencies within the passband. If required by the transponder installation, the Diplexer shall support DC coupling from the Transponder port to the antenna port as required by the electrical characteristics of the installed equipment.</p>

**APPENDIX 1. MINIMUM PERFORMANCE STANDARDS FOR UAT ADS-B
EQUIPMENT OPERATING ON THE FREQUENCY OF 978 MHz, CONTINUED**

In RTCA/DO-282A, replace:	With: (new or changed text shown in gray highlights)
Section 2.2.14.3.1.3	The Diplexer shall provide RF isolation between the UAT Channel and the Transponder Channel. The Diplexer shall provide a minimum of 50 dB of isolation between these ports at 1090 MHz. Additionally, the Diplexer shall provide a minimum isolation of 30 dB between the UAT and Transponder ports of the Diplexer at 1030 MHz. The Diplexer shall provide a minimum of 20 dB of isolation between the ports at 978 MHz.
Purpose/Introduction of Section 2.4.14.3.1.1	The Diplexer shall include a UAT Channel that conveys UAT signals without distortion of the waveform. The UAT Channel shall convey UAT Basic, Long and Ground Uplink Messages while maintaining the modulation accuracy of the input UAT signals as specified in §2.2.2.4 and produce no more than 0.5 dB amplitude attenuation and no more than 30 nanoseconds in propagation delay. Additionally, the variation in delay shall be no more than 10 nanoseconds over the frequency band of 977 MHz to 979 MHz. The UAT Channel shall provide a passband from no greater than 977 MHz to no less than 979 MHz (2.0 MHz minimum) and a maximum attenuation of 0.5 dB. The minimum and maximum attenuation in the passband shall be different by no greater than 0.20 dB. The UAT port of the Diplexer shall be capable of peak power transmissions according to the appropriate aircraft equipage class given by Table 2-1. The VSWR produced by the Diplexer at the UAT port, when the other two ports are terminated in a 50 ohm load, shall not exceed 1.3:1 for frequencies within the passband.
“Equipment Required” part of Section 2.4.14.3.1.1	The tests performed in this subparagraph require the Diplexer under test, equipment as described in §2.4.8.2.3.a and §2.4.8.2.3.b, two lengths of 50 ohm cable of known loss and connector adaptors, as necessary, a 50 ohm termination, 20 to 30 dB of power attenuation, and a High Power UAT Message source that meets the maximum RF power requirements of the equipage class under test. Also, provide a means for measurement of VSWR. Additionally, provide a means for measurement of Group Delay variation, an Agilent 8753 Network Analyzer, or the equivalent.

**APPENDIX 1. MINIMUM PERFORMANCE STANDARDS FOR UAT ADS-B
EQUIPMENT OPERATING ON THE FREQUENCY OF 978 MHz, CONTINUED**

In RTCA/DO-282A, replace:	With: (new or changed text shown in gray highlights)
Purpose/Introduction of Section 2.4.14.3.1.2	The Diplexer shall include a Transponder Channel that conveys received 1030 MHz interrogation and 1090 MHz reply signals without distortion of the waveform. The Transponder Channel shall convey pulses that are amplitude modulated on either 1030 MHz or 1090 MHz and having rise and fall times of 50 nanoseconds or more and produce no more than 0.5 dB amplitude attenuation and no more than 10 nanoseconds delay while retaining the pulse rise and fall times and pulse width of the input pulses. Additionally, the variation in delay shall be no more than 5 nanoseconds over the frequency band of 1015 MHz to 1105 MHz. The Transponder Channel shall provide a passband from no greater than 1015 MHz to no less than 1105 MHz (90 MHz minimum) and a maximum attenuation of 0.5 dB. The minimum and maximum attenuation in the passband shall be different by no greater than 0.20 dB. The Transponder port shall be capable of handling 1000 Watts instantaneous power. The VSWR produced by the Diplexer at the Transponder port, when the other two ports are terminated in a 50 ohm load, shall not exceed 1.3:1 for frequencies within the passband. If required by the transponder installation, the Diplexer shall support DC coupling from the Transponder port to the antenna port as required by the electrical characteristics of the installed equipment.
"Equipment Required" part of Section 2.4.14.3.1.2	The tests performed in this subparagraph require the Diplexer under test, equipment as described in § 2.4.8.2.3.a and § 2.4.8.2.3.b, two lengths of 50 ohm cable of known loss and connector adaptors, as necessary, a 50 ohm termination, at least 35 dB of power attenuation, and an RF Signal Source with Pulse Amplitude Modulation at both 1030 MHz and 1090 MHz Carrier Frequencies, and at least 1000 Watts of power output. Also, provide a means for measurement of VSWR. Additionally, provide a means for measurement of Group Delay variation, an Agilent 8753 Network Analyzer, or the equivalent.
Purpose/Introduction of Section 2.4.14.3.1.3	The Diplexer shall provide RF isolation between the UAT Channel and the Transponder Channel. The Diplexer shall provide a minimum of 50 dB of isolation between these ports at 1090 MHz. Additionally, the Diplexer shall provide a minimum isolation of 30 dB between the UAT and Transponder ports of the Diplexer at 1030 MHz. The Diplexer shall provide a minimum of 20 dB of isolation between the ports at 978 MHz.
"Equipment Required" part of Section 2.4.14.3.1.3	The tests performed in this subparagraph require the Diplexer under test, equipment as described in § 2.4.8.2.3.a and § 2.4.8.2.3.b, two lengths of 50 ohm cable of known loss and connector adaptors as necessary, and a 50 ohm termination.

**APPENDIX 1. MINIMUM PERFORMANCE STANDARDS FOR UAT ADS-B
EQUIPMENT OPERATING ON THE FREQUENCY OF 978 MHz, CONTINUED**

In RTCA/DO-282A, replace:	With: (new or changed text shown in gray highlights)
10 nanoseconds in last line of Section 2.4.14.3.1.1, Test Procedure Step 5	30 nanoseconds
existing pattern of bits for Byte #1 in Appendix C, at top of page C-7 in list of Data Bytes Transmitted in the Long Type 1 ADS-B Message	0000 1000
sequence of 34 symbols in Appendix C, middle of page C-7	$\leftarrow [\alpha^3, \alpha^{165}, \alpha^{124}, \alpha^{232}, \alpha^{84}, \alpha^{84}, \alpha^{84}, \alpha^{105}, \underline{0}, \underline{0}, \alpha^{99}, \alpha^{214}, \alpha^{100}, \alpha^{143}, \alpha^{222}, \alpha^{105}, \alpha^{201}, \alpha^{107}, \alpha^{49}, \alpha^{117}, \alpha^{205}, \alpha^{101}, \alpha^{58}, \alpha^2, \alpha^{144}, \alpha^{34}, \underline{0}, \underline{0}, \underline{0}, \alpha^{99}, \alpha^{202}, \underline{0}, \underline{0}, \underline{0}]$
14 symbol parity sequence in Appendix C, middle of page C-7	$\leftarrow [\alpha^{107}, \alpha^{221}, \alpha^{159}, \alpha^{183}, \alpha^{133}, \alpha^{63}, \alpha^{240}, \alpha^{100}, \alpha^{51}, \alpha^{146}, \alpha^{15}, \alpha^{13}, \alpha^{206}, \alpha^{35}]$
word “radius” in Appendix D, Section D.1.1.1.2, at beginning of fifth line of paragraph	diameter
phrase “falls below 9 dB” in Appendix D, Section D.2.3, fifth line of second paragraph	falls below 10 dB