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VHF air-ground and air-air Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for aeronautical mobile (airborne) equipment; Part 2: General description and data link layer

Reference
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Foreword

This draft European Standard (EN) has been produced by ETSI Technical Committee Aeronautics (AERO), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document is part 2 of a multi-part deliverable covering the VHF air-ground and air-air Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for aeronautical mobile (airborne) equipment, as identified below:

Part 1: "Physical layer";

Part 2: "General description and data link layer";

Part 3: "Additional broadcast aspects";

Part 4: "Point-to-point functions".

The present document is accompanied by an equivalent ground-based standard, ETSI EN 301 842 [i.5] parts 1 to 5, covering the VHF air-ground Data Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for ground-based equipment.

NOTE: Minimum Operational Performance Specifications (MOPS) are also being developed for VDL Mode 4. EUROCAE have previously published Interim MOPS for VDL Mode 4 [i.6] which are a sub set of ETSI EN 302 842-1 [2], ETSI EN 302 842-2 (the present document) , ETSI EN 302 842-3 [6] and ETSI EN 302 842-4 [7]. ETSI EN 302 842-1 [2], ETSI EN 302 842-2 (the present document), ETSI EN 302 842-3 [6] and ETSI EN 302 842-4 [7] comply with the requirements of EC Mandate M/318 [i.7].

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
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Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document states the technical specifications for Very High Frequency (VHF) Digital Link (VDL) Mode 4 aeronautical mobile (airborne) radio transmitters, transceivers and receivers for air-ground and air-air communications operating in the VHF band, using Gaussian Filtered Frequency Shift Keying (GFSK) modulation with 25 kHz channel spacing and capable of tuning to any of the 25 kHz channels from 112,000 MHz to 136,975 MHz as defined in ICAO VDL SARPs [i.2].

The present document may be used to produce tests for the assessment of the performance of the equipment. The performance of the equipment submitted for type testing should be representative of the performance of the corresponding production model.

The present document has been written on the assumption that:

- the type test measurements will be performed only once, in an accredited test laboratory and the measurements accepted by the various authorities in order to grant type approval;
- if equipment available on the market is required to be checked it will be tested in accordance with the methods of measurement specified in the present document or a documented alternative approved by the certifying authority;
- equipment comply with ETSI EN 302 842-1 [2].

NOTE: The present document has been produced with a view to maintaining consistency of numbering with the equivalent standard for ground equipment (see ETSI EN 301 842 [i.5] parts 1 to 4). Where requirements are the same, they have been given the same number. Some new airborne requirements have been inserted between requirements that were sequential in ETSI EN 301 842 [i.5] parts 1 to 4 . This has led to a non-standard form of numbering for new requirements in some places.

1 Scope

The present document applies to the following radio equipment types:

- Very High Frequency (VHF) Digital Link (VDL) Mode 4 aeronautical mobile (airborne) radio transmitters, transceivers and receivers for air-ground and air-air communications operating in the VHF band, using Gaussian Filtered Frequency Shift Keying (GFSK) modulation with 25 kHz channel spacing and capable of tuning to any of the 25 kHz channels from 112,000 MHz to 136,975 MHz as defined in ICAO VDL SARPs [i.2].

The present document provides part 2 of the technical specifications.

The present document is designed to ensure that equipment certified to it will be compatible with the relevant ICAO VDL SARPs [i.2] and ICAO VDL4 Technical Manual [i.1].

NOTE: In clause 5.1.4, Tertiary time, as described by the ICAO VDL4 Technical Manual [i.1], has not been included as a requirement in the present document due to the opinion of the ETSI Working Group that insufficient evidence was available to be able to verify correct operation of a "floating network" of stations operating on tertiary time.

Manufacturers should note that in future the tuning range for the transmitter and the receiver may cover any 25 kHz channel from 108,000 MHz to 111,975 MHz.

The present document applies to "aeronautical mobile (airborne and in some cases ground vehicles)" equipment which will hereinafter be referred to as "mobile" equipment.

The scope of the present document is limited to mobile stations. The equivalent specification for ground stations is ETSI EN 301 842 [i.5].

The VDL Mode 4 system provides digital communication exchanges between aircraft and ground based systems and other aircraft supporting surveillance and communication applications. The supported modes of communication include:

- broadcast and point-to-point communication;
- broadcast services including Automatic Dependent Surveillance - Broadcast (ADS-B), Traffic Information Service - Broadcast (TIS-B), Flight Information Service - Broadcast (FIS-B) capabilities and GNSS Augmentation Service - Broadcast (GNS-B);
- air-air and ground-air services;
- operation without ground infrastructure.

VDL Mode 4 is designed to be an Air/Ground subsystem of the Aeronautical Telecommunication Network (ATN) (see ICAO ATN SARPs [i.3]) using the AM(R)S band and it is organized according to the Open Systems Interconnection (OSI) model (defined by ISO). It provides reliable sub network services to the ATN system. Other networks can also be supported but have not been the focus of the present document.

The present document is derived from the standards and specifications in:

- ICAO VDL4 Technical Manual [i.1] produced under the auspices of the International Civil Aviation Organization (ICAO).
- Other relevant standards as defined in clause 2.

It is envisaged that manufacturers may provide equipment supporting:

- broadcast services only;
- point-to-point services only;
- both broadcast and point-to-point services.

ETSI EN 302 842-1 [2] deals with tests of the physical layer. The present document defines the core link layer requirements for the VDL Mode 4 mobile station necessary to support all types of equipment. This includes a simple position broadcast functionality.

The present document deals with tests of the link layer sufficient to support core link layer functionality, and it also includes requirements and tests sufficient to recognize and respond to transmissions associated with point-to-point communication. The present document does not address requirements for the full ADS-B message set, or for other broadcast applications that can be supported by the VDL Mode 4 equipment. These are covered by ETSI EN 302 842-3 [6]. Detailed requirements for point-to-point communication are beyond the scope of the present document, but can be found in ETSI EN 302 842-4 [7]. ETSI EN 302 842-4 [7] also includes the interface to the Aeronautical Telecommunication Network (ATN) as defined in ICAO ATN SARPs [i.3].

As the measured values of equipment performance may be a function of the method of measurement, standard test conditions and methods of test are recommended in the present document.

The present document is organized as follows:

- Clause 2 provides references to relevant documents.
- Clause 3 provides general definitions, abbreviations and symbols used.
- Clause 4 describes the VDL Mode 4 mobile station link layer.
- Clause 5 provides performance specifications for the VDL Mode 4 mobile station and any additional mobile functions necessary to support ground station co-ordination.
- Clause 6 provides general design requirements.
- Clause 7 provides protocol tests for core link layer functions.
- Annex A provides a detailed cross-reference to the relevant requirements contained in ICAO VDL4 Technical Manual [i.1].
- Annex B provides a description of the ISO/IEC 9646 [5] test methodology.
- Annex C provides a Bibliography.

Note that the system can support a very wide range of functions. It is not practical to provide specific tests for all aspects of its functionality. The approach used is to provide detailed tests for the core link layer functionality and to provide tests of those remaining requirements which, if wrongly implemented, could cause a deterioration in the service offered by other VDL Mode 4 stations. Therefore:

- a detailed set of protocol tests are provided for the core link layer functionality necessary to support broadcast functions;
- a detailed test of position encoding and decoding is provided because of the importance of position in the management of the VDL Mode 4 link specifically and the need to support ADS-B applications in general.

Mandating and Recommendation Phrases

a) "Shall":

- The use of the word "Shall" indicates a mandated criterion; i.e. compliance with the particular procedure or specification is mandatory and no alternative may be applied.

b) "Should":

- The use of the word "Should" (and phrases such as "It is recommended that...", etc.) indicates that though the procedure or criterion is regarded as the preferred option, alternative procedures, specifications or criteria may be applied, provided that the manufacturer, installer or tester can provide information or data to adequately support and justify the alternative.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] ISO/IEC 13239 (2002): "Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures".

[2] ETSI EN 302 842-1 (V1.3.0): "VHF air-ground and air-air Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for aeronautical mobile (airborne) equipment; Part 1: Physical layer".

[3] ISO/IEC 7498-1 (1994): "Information technology - Open Systems Interconnection - Basic Reference Model: The Basic Model".

[4] ISO/IEC 10731 (1994): "Information technology - Open Systems Interconnection - Basic Reference Model - Conventions for the definition of OSI services".

[5] ISO/IEC 9646 (all parts): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework".

[6] ETSI EN 302 842-3 (V1.4.0): "VHF air-ground and air-air Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for aeronautical mobile (airborne) equipment; Part 3: Additional broadcast aspects".

[7] ETSI EN 302 842-4 (V1.3.0): "VHF air-ground and air-air Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for aeronautical mobile (airborne) equipment; Part 4: Point-to-point functions".

[8] EUROCAE ED-14G/RTCA DO-160G: "Environmental Conditions and Test Procedures for Airborne Equipment", May 2011.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ICAO Doc 9816 (First Edition 2004): "Manual on VHF Digital Link (VDL) Mode 4 - Part 2: Detailed Technical Specifications".

[i.2] ICAO Annex 10 to the Convention on International Civil Aviation: "Aeronautical Telecommunications, Volume III: Communication Systems, Part I: Digital Data Communication Systems, Chapter 6", including Amendment 88 (applicable 14/11/13).

[i.3] ICAO 9705-CD: "Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN)".

[i.4] Eurocontrol (2003): "VDL Mode 4 Airborne Architecture Study documentation".

[i.5] ETSI EN 301 842 (all parts): "VHF air-ground Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for ground-based equipment.

[i.6] EUROCAE ED-108A: "MOPS for VDL Mode 4 Aircraft Transceiver for ADS-B".

[i.7] EC Mandate M/318: "Mandate to CEN/CENELEC/ETSI for standardization in the field of air traffic management systems and Galileo local components".

3 Definitions and abbreviations

3.1 Definitions

3.1.1 Basic reference model definitions

The present document is based on the concepts developed in the open systems interconnect basic reference model. For the purposes of the present document, the terms and definitions given in ISO/IEC 7498-1 [3] apply for:

- layer;
- sublayer;
- entity;
- service;
- physical layer;
- data link layer.

3.1.2 Service conventions definitions

For the purposes of the present document, the terms and definitions given in ISO/IEC 10731 [4] apply for:

- service provider;
- request;
- indication;
- confirm.

3.1.3 General definitions

For the purposes of the present document, the terms and definitions given in ETSI EN 302 842-1 [2], clause 3.1.3 and the following apply:

Aeronautical Mobile Service (AMS): mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate

Aeronautical Telecommunications Network (ATN): internetwork architecture that allows ground, air/ground, and aircraft data sub networks to interoperate by adopting common interface services and protocols based on the International Organization for Standardization Open Systems Interconnection Reference Model

aircraft address: 24-bit address available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance

NOTE: An aircraft may choose not to use this unique address and can use instead a non-unique address.