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Electromagnetic compatibility and Radio spectrum Matters (ERM); 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 (standards.iteh.ai)

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European Standard (Telecommunications series)

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
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**

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

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, EN 301 842 [13] parts 1 to 4, 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 (see bibliography) which are a sub set of EN 302 842-1, 2, 3 and 4. EN 302 842-1, 2, 3 and 4 complies with the requirements of CEC Mandate M/318.

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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 118,000 MHz to 136,975 MHz as defined in ICAO VDL SARPs [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 EN 302 842-1 [4].

NOTE: The present document has been produced with a view to maintaining consistency of numbering with the equivalent standard for ground equipment (see EN 301 842 [13]). 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 EN 301 842 [13]. This has led to a non-standard form of numbering for new requirements in some places.

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1 Scope

The present document provides part 2 of 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 118,000 MHz to 136,975 MHz as defined in ICAO VDL SARPs [2].

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

NOTE: In clause 5.1.4, Tertiary time, as described by the ICAO VDL4 Technical Manual [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 may also cover any 25 kHz channel from 112,000 MHz to 117,975 MHz and the receiver(s) may cover any 25 kHz channel from 108,000 MHz to 117,975 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 EN 301 842 [13].

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 [8]) 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 [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.

EN 302 842-1 [4] 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 EN 302 842-3 [9]. Detailed requirements for point-to-point communication are beyond the scope of the present document, but can be found in EN 302 842-4 [10]. EN 302 842-4 [10] also includes the interface to the Aeronautical Telecommunication Network (ATN) as defined in ICAO ATN SARPs [8].

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:

- references, definitions, abbreviations and symbols are provided in clauses 2 and 3;
- clause 4 describes the VDL Mode 4 mobile station link layer;
- clause 5 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 [1];
- annex B provides a description of the ISO/IEC 9646 [7] 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

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

- [1] ICAO 9816: "Manual on VHF Digital Link (VDL) Mode 4 - Part 2: Detailed Technical Specifications". First Edition 2004.
- [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".
- [3] ISO/IEC 13239 (2002): "Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures".
- [4] ETSI EN 302 842-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); 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".
- [5] ISO/IEC 7498-1 (1994): "Information technology - Open Systems Interconnection - Basic Reference Model: The Basic Model".
- [6] ISO/IEC 10731 (1994): "Information technology - Open Systems Interconnection - Basic Reference Model: Conventions for the definition of OSI services".
- [7] ISO/IEC 9646 (all parts): "Information technology - Open Systems Interconnection - Conformance testing methodology and framework".
- [8] ICAO 9705-CD: "Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN)".
- [9] ETSI EN 302 842-3: "Electromagnetic compatibility and Radio spectrum Matters (ERM); 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".
- [10] ETSI EN 302 842-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); 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".
- [11] EUROCAE ED-14D / RTCA DO-160D: "Environmental Conditions and Test Procedures for Airborne Equipment, July 1997, as amended by Change 1 (December 2000), by Change 2 (June 2001), and by Change 3 (December 2002)".
- [12] Eurocontrol (2003): "VDL Mode 4 Airborne Architecture Study documentation".
- [13] ETSI EN 301 842 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); VHF air-ground Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for ground-based equipment".
- [14] EUROCAE ED-12B / RTCA DO-178B (1993): "Software Considerations in Airborne Systems and Equipment Certification".

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 [5] apply:

- 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 [6] applies for:

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

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3.1.3 General definitions

For the purposes of the present document, the terms and definitions given in EN 302 842-1 [4], 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.

Automatic Dependent Surveillance-Broadcast (ADS-B): surveillance application transmitting parameters, such as position, track, ground speed and time via a broadcast mode data link for use by any air and ground users requiring it

NOTE: ADS-B is a surveillance service based on aircraft self-determination of position/velocity/time and automatic, periodic, broadcast of this information along with auxiliary data such as aircraft identity (ID), intent information and communications control parameters, etc. ADS-B is intended to support multiple high-level applications and associated services such as cockpit display of traffic information, traffic situation awareness functionality, enhanced traffic management in the air and on the ground, search and rescue support and others.