SLOVENSKI STANDARD
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Elektromagnetna združljivost in zadeve v zvezi z radijskim spektrom (ERM) – Radijska oprema za digitalno povezavo VHF zrak-tla, 4. način – Tehnične karakteristike in merilne metode za talno opremo – 2. del: Splošni opis in plast podatkovnih povezav

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; Part 2: General description and data link layer

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Contents

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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 series covering the VHF air-ground Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for ground-based equipment, as identified below:

Part 1: "EN for ground equipment";

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 airborne standard, EN 302 842 [13] parts 1 to 4, covering the VHF air-ground Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for airborne equipment.

National transposition dates	
Date of adoption of this EN:	15 April 2005
Date of latest announcement of this EN (doa):	31 July 2005
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Date of withdrawal of any conflicting National Standard (dow):	31 January 2006

Introduction

The present document states the technical specifications for Very High Frequency (VHF) Digital Link (VDL) Mode 4 ground-based radio transmitters, transceivers and receivers for air-ground 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 VHF Digital Link (VDL) Standards and Recommended Practices (SARPs) [14].

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 301 489-22 [2] and EN 301 842-1 [4].

1 Scope

The present document provides part 2 of the technical specifications for Very High Frequency (VHF) Digital Link (VDL) Mode 4 ground-based radio transmitters and receivers for air-ground 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 VHF Digital Link (VDL) Standards and Recommended Practices (SARPs) [14].

The present document is designed to ensure that equipment certified to it will be compatible with the relevant ICAO VHF Digital Link (VDL) Standards and Recommended Practices (SARPs) [14] and VDL Mode 4 Technical Manual (TM) [1].

Manufacturers should note that in future the tuning range for the ground transceivers may also cover any 25 kHz channel from 108,000 MHz to 117,975 MHz.

The scope of the present document is limited to ground stations. The equivalent specification for airborne stations is EN 302 842 [13].

The VDL Mode 4 system provides data communication exchanges between aircraft and ground based systems 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) and Flight Information Service - Broadcast (FIS-B) capabilities;
- air-to-air, air-to-ground, ground-to-air and ground mobile services;
- operation without ground infrastructure.

VDL Mode 4 is designed to be an Air/Ground subsystem of the Aeronautical Telecommunication Network (ATN) [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 these have not been focussed on in the present document.

The present document specifies functional specifications of VHF communication ground station equipment intended to be used for air-ground and air-air data communications. The present document is derived from the standards and specifications in:

- VDL Mode 4 standards produced under the auspices of the International Civil Aviation Organization (ICAO) [1].
- 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 301 842-1 [4] deals with tests of the physical layer. The present document defines the core link layer requirements for the VDL Mode 4 ground 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 301 842-3 [9]. Detailed requirements for point-to-point communication are beyond the scope of the present document, but can be found in EN 301 842-4 [10]. EN 301 842-4 [10] also include the interface to the Aeronautical Telecommunication Network (ATN) as defined in 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 ground station link layer;
- clause 5 performance specifications for the VDL Mode 4 ground station and ground station co-ordination;
- clause 6 provides general design requirements;
- clause 7 provides protocol tests for core link layer functions;
- a document history is contained in clause 8;
- clause A provides a detailed cross-reference to the relevant requirements contained in reference [1];
- clause B provides a description of the ISO/IEC 9646 [7] Test Methodology.

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 Manual on VHF Digital Link (VDL) Mode 4, Doc 9816, Part 2, Detailed Technical Specifications, First Edition 2004.

[2] ETSI EN 301 489-22: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 22: Specific conditions for ground based VHF aeronautical mobile and fixed radio equipment".

[3] ISO/IEC 13239 (2002): "Information technology - Telecommunications and information exchange between systems - High-level Data Link Control (HDLC) procedures".

[4] ETSI EN 301 842-1: "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; Part 1: EN for ground equipment".

[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 Doc 9705 - AN/956 (Edition 3 - 2002): "Manual of Technical Provisions for the Aeronautical Telecommunications Network (ATN)".

NOTE: See http://www.icao.int/icao/en/cd_pub_list.htm.

[9] ETSI EN 301 842-3: "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; Part 3: Additional broadcast aspects".

[10] ETSI EN 301 842-4: "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; Part 4: Point-to-point functions".

[11] Eurocontrol ESARR 6 (2003): "Software in ATM Systems".

[12] ETSI EN 300 676: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Ground-based VHF hand-held, mobile and fixed radio transmitters, receivers and transceivers for the VHF aeronautical mobile service using amplitude modulation; Technical characteristics and methods of measurement".

[13] ETSI EN 302 842 (all parts): "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".

[14] ICAO Standards and Recommended Practices, Annex 10, Volume III, Part I, Chapter 6, Edition 2001.

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 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 [6] applies for:

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

3.1.3 General definitions

For the purposes of the present document, the terms and definitions given in EN 301 842-1 [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: unique combination of 24 bits 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 alert and collision avoidance functionality, enhanced traffic management in the air and on the ground, search and rescue support and others.

autotune: procedure by which a VDL Mode 4 ground station may direct a mobile VDL Mode 4 station to transmit on a specified frequency, and with certain characteristics, by sending an uplink burst containing an autotune reservation

burst length: number of slots across which the VDL Mode 4 burst is transmitted

CTRL DLPDU: basic unit of transmission of the LME and VME

current slot: slot in which a received transmission begins

Data Link Entity (DLE): protocol state machine capable of setting up and managing a single data link connection

Data Link Protocol Data Unit (DLPDU): general burst format used by the Data Link Service (DLS) sublayer

Data Link Service (DLS) sublayer: manages the transmit queue, creates and destroys Data Link Entities (DLEs) for connection-oriented communications, provides facilities for the Link Management Entity (LME) to manage the DLS, and provides facilities for connection-less communications

NOTE: The DLS resides above the VDL Mode 4 Specific Services (VSS) and the MAC sublayers.