SLOVENSKI STANDARD
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Elektromagnetna združljivost (EMC) in zadeve v zvezi z radijskim spektrom (ERM) - Radijska oprema za podatkovno povezavo VHF zrak-tla, 4. način - Tehnične karakteristike in merilne metode za talno opremo - 1. del: Splošni opis in fizična plast

Electromagnetic compatibility and Radio spectrum Matters (ERM); VHF air-ground Data Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for ground-based equipment; Part 1: General description and physical 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 1 of a multi-part deliverable covering the VHF air-ground Data Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for ground-based equipment, as identified below:

Part 1: "General description and physical layer";

Part 2: "Data link layer".

National transposition dates	
Date of adoption of this EN:	4 January 2002
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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 (118,000 MHz to 136,975 MHz), using Gaussian-filtered Frequency Shift Keying (GFSK) Modulation with 25 kHz channel spacing. Optionally the transmitters, transceivers and receivers may tune between 113,000 MHz to 117,975 MHz.

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 may 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 [5].

1 Scope

The present document states the minimum performance requirements for radio transmitters receivers and transceivers for ground VHF Datalink mode 4 (VDL mode 4) equipment intended to be used for air-ground data communications, operating in the VHF band (118,000 MHz to 137,000 MHz and optionally 113,000 MHz to 117,975 MHz) allocated to the aeronautical mobile service. It is designed to ensure that equipment certified to it will be compatible with the relevant ICAO VHF Digital Link (VDL) mode 4 Standards and Recommended Practices (SARPs) [1].

Manufacturers should note that in the future, all or part of the frequency band 108,000 MHz to 117,975 MHz may become available for aeronautical communications.

The present document applies to Gaussian-filtered Frequency Shift Keying (GFSK) systems, with channel separations of 25 kHz intended for air-ground digital communications. The scope of the present document is limited to ground stations.

The VDL mode 4 system provides data communication exchanges between aircraft and ground systems supporting surveillance applications. The supported modes of communication for VDL mode 4 include:

- broadcast and point-to-point communication,
- air-air and ground-air,
- operation without ground infrastructure.

VDL Mode 4 is designed to be an Air/Ground subsystem of the Aeronautical Telecommunication Network (ATN) using the AM(R)S band and it is organized according to the Open Systems Interconnection (OSI) model (defined by ISO). It provides reliable subnetwork services to the ATN system.

The present document specifications of radio transmitters, receivers and transceivers at ground-based VHF communication equipment intended to be used for air-ground data communications. The present document is derived from the specifications:

- Mode 4 standards produced under the auspices of the International Civil Aviation Organization (ICAO) [1].
- Other relevant standards as defined in clause 2.

The present document includes:

- Clause 2 provides references to relevant documents.
- Clause 3 provides general definitions, abbreviations and symbols used.
- Clause 4 provides a general description and architecture of VDL Mode 4 including reference to the OSI model, communication services, ADS-B and operational scenarios.
- Clause 5 provides functional specifications applicable to the physical layer including transmitter/receiver requirements and the modulation scheme.
- Clause 6 provides general equipment requirements.
- Clause 7 provides general design requirements.
- Clause 8 covers general test conditions, environmental tests and calibration.
- Clause 9 provides detailed test procedures for the physical layer.

The full physical layer tests are provided which correspond closely to the standard set of tests used for other VDL systems.

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.) indicate 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.

[1] Annex 10 to the Convention on International Civil Aviation Aeronautical Telecommunications, International Civil Aviation Organization.

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

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

[4] ETSI EN 300 113-1: "ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and speech) and having an antenna connector; Part 1: Technical characteristics and methods of measurement".

[5] 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".

[6] ISO/IEC 3309: "Information technology - Telecommunications and information exchange between systems - High-level data link control (HDLC) procedures - Frame structure".

[7] ISO/IEC 8208: "Information technology - Data communications - X.25 Packet Layer Protocol for Data Terminal Equipment".

[8] ITU-T Recommendation X.25: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".

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 and makes use of the following terms defined in ISO/IEC 7498-1 [2]:

- layer,
- sublayer,
- entity,
- service,
- service access point,
- service data unit,
- physical layer,
- data link layer.

3.1.2 Service conventions definitions

The present document makes use of the following terms defined in ISO/IEC 10731 [3]:

- service provider,
- service user,
- service primitive,
- request,
- indication,
- confirm.

3.1.3 General definitions

For the purposes of the present document, the following terms and definitions apply:

adjacent channel power: amount of the modulated rf signal power which falls within a given adjacent channel

NOTE: Adjacent channel power includes discrete spurious, signal sidebands, and noise density (including phase noise) at the transmitter output.

Adjacent Channel Rejection: receiver's ability to demodulate the desired signal and meet the BER requirement in the presence of an interfering signal in an adjacent channel

NOTE: The ratio (in dB) between the adjacent interfering signal level and the desired signal level necessary to achieve the specified minimum BER, is the adjacent channel rejection (ACR) ratio.

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

Aeronautical Telecommunications Network: internetwork architecture that allows ground, air/ground, and aircraft data subnetworks 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 and ground speed, via a broadcast mode data link for use by any air and/or ground users requiring it

NOTE: ADS-B is a surveillance service based on aircraft self-determination of position/velocity/time and automatic, periodic or random, broadcast of this information along with auxiliary data such as aircraft identity (ID), 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 function: function, performed by the Link Management Entity, that allows a ground VDL Mode 4 station to command an aircraft to change the operating characteristics of synchronization burst transmissions

Bit Error Rate (BER): expressed as the ratio between the number of erroneous bits received and the total number of bits received

burst: a VHF digital link (VDL) specific services burst is composed of a sequence of source address, burst ID, information, slot reservation, and frame check sequence (FCS) fields, bracketed by opening and closing flag sequences

NOTE: The start of a burst may occur only at quantized time intervals and this constraint allows the propagation delay between the transmission and reception to be derived.

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

Co-Channel Interference (CCI)**:** co-channel interference protection defines the capability of a receiver to demodulate the desired signal and achieve the minimum specified BER performance in the presence of an unwanted signal at the same assigned frequency

NOTE: The ratio (in dB) between the wanted signal level and the unwanted signal level is the co-channel interference ratio. The co-channel interference ratio has a major impact on frequency re-use planning criteria.

conducted measurements: measurements which are made using a direct rf connection to the equipment under test

current slot: slot in which a received transmission begins

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

Data Link Service (DLS) sublayer: sublayer that resides above the VDL Mode 4 Specific Services (VSS) and the MAC sublayers

NOTE: The data link service (DLS) 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.

data rate: Mode 4 nominal data rate is 19 200 bits/s

delayed burst: VDL Mode 4 burst that begins sufficiently after the beginning of a slot so that the transmitting VDL Mode 4 station is confident that no other VDL Mode 4 station that it could receive from and is within the guard range is transmitting in the slot

NOTE: The delayed VDL Mode 4 burst terminates by the end of the slot in which it began (its length is shortened to ensure completion by the nominal time).

DLS system: VDL system that implements the DLS and subnetwork protocols to carry Aeronautical Telecommunications Network (ATN) or other packets