



SLOVENSKI STANDARD
SIST EN 301 842-1 V1.2.1:2006
01-marec-2006

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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

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Ta slovenski standard je istoveten z: EN 301 842-1 Version 1.2.1

ICS:

33.060.99	Druga oprema za radijske komunikacije	Other equipment for radiocommunications
33.100.01	Elektromagnetna združljivost na splošno	Electromagnetic compatibility in general

SIST EN 301 842-1 V1.2.1:2006 en

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ETSI EN 301 842-1 V1.2.1 (2005-04)

European Standard (Telecommunications series)

**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**

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Reference

REN/ERM-TG25-026-1

Keywords

aeronautical, digital, radio, testing, VHF

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 Sous-Préfecture de Grasse 06 N° 7303/88

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Contents

Intellectual Property Rights	6
Foreword.....	6
Introduction	6
1 Scope	8
2 References	9
3 Definitions and abbreviations.....	10
3.1 Definitions	10
3.1.1 Basic reference model definitions.....	10
3.1.2 Service conventions definitions	10
3.1.3 General definitions.....	10
3.2 Abbreviations	14
4 General description and architecture of VDL Mode 4	15
4.1 General	15
5 VDL mode 4 physical layer functional specifications	15
5.1 Overview	15
5.1.1 Functions	15
5.1.2 Data reception.....	15
5.1.3 Data transmission.....	16
5.2 Modulation scheme	16
6 VDL Mode 4 equipment requirements (standards.iteh.ai)	16
6.1 Receiver Requirements.....	16
6.1.1 Receiver operating range	16
6.1.2 BER requirement	16
6.1.3 Reference signal level	16
6.1.4 Sensitivity	16
6.1.5 Adjacent channel rejection.....	17
6.1.6 Rejection of signals within the VHF Aeronautical band	17
6.1.7 Rejection of signals outside the VHF Aeronautical band	17
6.1.8 Desired signal dynamic range.....	18
6.1.9 Symbol rate capture range	18
6.1.10 Frequency capture range	18
6.1.11 Co-channel interference.....	18
6.1.12 Conducted spurious emission	18
6.1.13 FM Broadcast Intermodulation.....	18
6.1.13.1 Radio frequencies in the band 117,975 MHz to 137 MHz.....	18
6.1.14 In-band Intermodulation	18
6.1.15 Cabinet radiation.....	19
6.2 Transmitter requirements	19
6.2.1 Transmitter operating range	19
6.2.2 Channel Bit Rate	19
6.2.3 Protection of the transmitter.....	19
6.2.4 Manufacturer's declared output power.....	20
6.2.5 RF power rise time.....	20
6.2.6 RF power release time	20
6.2.7 Conducted Spurious emissions	20
6.2.8 Adjacent channel power.....	20
6.2.9 Wide-band noise	21
6.2.10 Frequency Tolerance.....	21
6.2.11 Load VSWR capability	21
6.2.12 Cabinet radiation.....	21
6.3 Transceiver requirements	21
6.3.1 Start of transmission	21

6.3.2	Automatic transmitter shutdown.....	21
6.3.3	Receiver to transmitter turnaround time	21
6.3.4	Transmitter to receiver turnaround time	21
6.3.5	System timing requirements	22
7	General design requirements	22
7.1	Controls and indicators.....	22
7.2	Class of emission and modulation characteristics	22
7.3	Warm up.....	22
8	Test conditions, power sources and ambient temperatures	22
8.1	Test power source.....	22
8.2	Test channels	22
8.3	General conditions of measurement	23
8.3.1	Receiver test signal arrangement	23
8.3.2	Performance check.....	23
8.4	Normal and extreme test conditions	23
8.4.1	Normal test conditions	23
8.4.1.1	Normal temperature and humidity	23
8.4.1.2	Normal power sources.....	23
8.4.1.2.1	Mains voltage and frequency.....	23
8.4.1.2.2	Other power sources	23
8.4.2	Extreme test conditions.....	23
8.4.2.1	Extreme temperatures.....	23
8.4.2.2	Procedure for tests at extreme temperatures.....	24
8.4.2.2.1	General	24
8.4.2.2.2	High temperature	24
8.4.2.2.3	Low temperature.....	24
8.4.2.3	Extreme values of test power sources	24
8.4.2.3.1	Mains voltage and frequency.....	24
9	Detailed Test Procedures for the physical layer	24
9.1	Receiver.....	25
9.1.1	BER test	25
9.1.2	Sensitivity	26
9.1.3	Adjacent Channel Rejection	27
9.1.4	Rejection of signals within the VHF Aeronautical band.....	27
9.1.5	Rejection of signals outside the VHF Aeronautical band	28
9.1.6	Desired Signal dynamic range	29
9.1.7	Symbol rate capture range	30
9.1.8	Frequency capture range	30
9.1.9	Co-channel interference.....	31
9.1.10	Conducted spurious emission	31
9.1.11	In-band Intermodulation	32
9.2	Transmitter	33
9.2.1	Channel Bit Rate.....	33
9.2.2	Manufacturer's declared output power.....	33
9.2.3	RF power rise time.....	33
9.2.4	RF power release time	34
9.2.5	Spurious emissions	34
9.2.6	Adjacent channel power.....	35
9.2.6.1	Method of measurement for the first adjacent channel	35
9.2.6.2	Method of measurement for the second adjacent channel.....	36
9.2.6.3	Method of measurement for the fourth adjacent channel	37
9.2.6.4	Alternative Measurement Procedure for Adjacent Channel Power (ACP)	37
9.2.7	Wide-band noise	38
9.2.8	Frequency Error	39
9.2.8.1	Definition	39
9.2.8.2	Method of measurement.....	39
9.2.8.3	Limits	39
9.2.9	Load VSWR capability	39
9.3	Physical layer, system parameters	40
9.3.1	Receiver to Transmitter turn-around time.....	40

9.3.2	Transmitter to Receiver turn-around time.....	40
9.3.3	Tuning Time	41
Annex A (informative):	Bibliography.....	42
History		43

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SIST EN 301 842-1 V1.2.1:2006

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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 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".

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The present document is accompanied by an equivalent airborne standard, EN 302 842 [8] 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. <https://standards.itech.ai/catalog/standards/sist-en-301-842-1-v1-2-1-2006-ee4dfa675cb0>

National transposition dates	
Date of adoption of this EN:	15 April 2005
Date of latest announcement of this EN (doa):	31 July 2005
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 January 2006
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) [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 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 [6].

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1 Scope

The present document provides part 1 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) [2].

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) [2] 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 [8].

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) and Flight Information Service - Broadcast (FIS-B) capabilities;
- air-air, air-to-ground, and ground-to-air services;
- operation without ground infrastructure.

The present document is derived from the specifications:

- VDL Mode 4 standards produced under the auspices of the International Civil Aviation Organization (ICAO) [1] and [2].
- 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.

The present document deals with tests of the physical layer necessary to support all types of equipment.

The present document includes:

- Clause 2 provides references to relevant documents.
- Clause 3 provides general definitions, abbreviations and symbols used.
- Clause 4 provides refers to a general description and architecture of VDL Mode 4 contained in EN 301 842-2 [7].
- 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.

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- [1] ICAO Doc 9816 (First Edition 2004): "Manual on VHF Digital Link (VDL) Mode 4, Part 2, Detailed Technical Specifications".
- [2] ICAO Standards and Recommended Practices: "Annex 10 to the Convention of International Civil Aviation", Volume III, Part I, Chapter 6.
- [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] ETSI EN 300 113-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector; Part 1: Technical characteristics and methods of measurement".
- [6] 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".
- [7] ETSI EN 301 842-2: "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".
- [8] 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".

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 [3]:

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

3.1.2 Service conventions definitions *iTeh STANDARD PREVIEW* *(standards.iteh.ai)*

The present document makes use of the following terms defined in ISO/IEC 10731 [4]:

- service provider, [SIST EN 301 842-1 V1.2.1:2006](#)
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- 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 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 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.

SIST EN 301 842-1 V1.2.1:2006

<https://standards.iteh.ai/catalog/standards/sist/816ec7e5-283b-4da8-a6fd>

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

frame: link layer frame is composed of a sequence of address, control, information and FCS fields, bracketed by opening and closing flag sequences

NOTE: A valid frame is at least 11 octets in length and contains an address field (8 octets), a link control field (1 octet) and a frame check sequence (2 octets). A frame may or may not include a variable-length information field.