



**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

Intellectual Property Rights	8
Foreword.....	8
Modal verbs terminology.....	8
Introduction	9
1 Scope	10
2 References	12
2.1 Normative references	12
2.2 Informative references.....	12
3 Definitions and abbreviations.....	13
3.1 General definitions	13
3.2 Definition of bit order.....	16
3.3 Abbreviations	16
4 General description of VDL Mode 4 ground station link layer.....	18
4.1 General	18
4.1.1 Overview of VDL Mode 4.....	18
4.1.2 Relationship to OSI reference model	19
4.1.3 VDL Mode 4 services	20
4.1.4 ADS-B Function	20
4.1.5 Operational scenarios.....	21
4.1.6 VDL Mode 4 fundamentals	21
4.1.7 Possible configuration of ground equipment	22
4.1.8 Overall structure of specifications for VDL Mode 4	23
4.1.9 Equipment performance verification	24
4.2 Ground quarantine	25
4.3 System timing.....	25
4.4 Net entry	25
4.5 Autotune capability	25
4.6 Autonomous and fixed access	26
5 Minimum performance specification under standard test conditions.....	26
5.1 MAC sublayer	26
5.1.1 Services.....	26
5.1.2 MAC sublayer services	26
5.1.3 MAC sublayer parameters	26
5.1.3.1 General	26
5.1.3.2 Parameter M1 (number of slots per superframe).....	27
5.1.4 Time synchronization	27
5.1.4.1 Primary.....	27
5.1.4.2 Secondary.....	27
5.1.4.3 Alignment to UTC second	27
5.1.4.4 Data quality level	27
5.1.5 Slot idle/busy notification	28
5.1.5.1 Slot idle detection.....	28
5.1.5.2 Slot busy detection	28
5.1.5.3 Slot occupied detection	28
5.1.5.4 Signal level indication.....	28
5.1.6 Transmission processing	28
5.1.7 Received transmission processing	28
5.2 VSS sublayer	29
5.2.1 Services.....	29
5.2.1.1 Error detection.....	29
5.2.1.2 Channel congestion	29
5.2.2 Burst format	29

5.2.2.1	VSS burst structure	29
5.2.2.2	Version number.....	30
5.2.2.3	Source address.....	30
5.2.2.4	Message ID	30
5.2.2.5	Information field	31
5.2.2.6	Reservation fields.....	31
5.2.2.7	Autonomous/directed flag.....	32
5.2.3	VSS sublayer parameters	32
5.2.3.1	General.....	32
5.2.3.2	Parameter VS1 (number of ground quarantined slots).....	33
5.2.3.3	Parameter VS2 (minimum CCI performance).....	33
5.2.3.4	Parameter VS4 (quarantine slot re-use range).....	33
5.2.3.5	Parameter VS5 (maximum burst length).....	34
5.2.4	VSS quality of service parameters.....	34
5.2.4.1	General.....	34
5.2.4.2	Parameter Q1 (priority)	34
5.2.4.3	Parameters Q2a to Q2d (slot selection range constraint for level n)	35
5.2.4.4	Parameter Q3 (replace queued data)	36
5.2.4.5	Parameter Q4 (number of available slots).....	36
5.2.5	Received transmission processing	37
5.2.6	Reserved access protocol specification.....	37
5.2.6.1	Reservation table.....	37
5.2.6.2	Selecting slots for transmission or reservation.....	38
5.2.6.3	Reserved transmissions	39
5.2.6.4	Reservation conflicts	40
5.2.7	Random access protocol specification	41
5.2.7.1	General.....	41
5.2.7.2	Random access parameters.....	41
5.2.7.3	Random access procedures.....	42
5.2.8	Fixed access protocol specification	42
5.2.8.1	General.....	42
5.2.8.2	Recommendation	43
5.2.9	Null reservation protocol specification	43
5.2.9.1	Null reservation burst format	43
5.2.10	Periodic broadcast protocol specification	43
5.2.10.1	Periodic broadcast reservation burst format	43
5.2.10.2	Periodic broadcast timers	44
5.2.10.3	Periodic broadcast parameters.....	44
5.2.10.4	Periodic broadcast reception procedures	45
5.2.10.5	Periodic broadcast transmission procedures	46
5.2.11	Incremental broadcast protocol specification	48
5.2.11.1	Incremental broadcast reservation burst format	48
5.2.11.2	Incremental broadcast parameters	49
5.2.11.3	Incremental broadcast reception procedures	50
5.2.11.4	Incremental broadcast transmission procedures	50
5.2.12	Combined periodic broadcast and incremental broadcast protocol specification	50
5.2.12.1	Combined periodic broadcast and incremental broadcast reservation burst	50
5.2.13	Big Negative Dither (BND) broadcast protocol specifications	51
5.2.13.1	BND reservation burst format	51
5.2.13.2	BND broadcast parameters.....	51
5.2.13.3	BND broadcast reception procedures	51
5.2.14	Unicast request protocol specification	52
5.2.14.1	Unicast request reservation burst format	52
5.2.14.1a	Unicast request parameters.....	53
5.2.14.2	Unicast request reception procedures	53
5.2.14.3	Unicast request transmission procedures	54
5.2.15	Information transfer request protocol specification	54
5.2.15.1	Information transfer request reservation burst format	54
5.2.15.2	Information transfer request reception procedures	55
5.2.16	Directed request protocol specification.....	56
5.2.16.1	Directed request reservation burst format	56
5.2.16.2	Directed request parameters	59

5.2.16.3	Directed request reception procedures	60
5.2.16.4	Directed request transmission procedures	61
5.2.17	Block reservation protocols specification	62
5.2.17.1	Superframe block reservation burst format	62
5.2.17.2	Second frame block reservation burst format	63
5.2.17.3	Superframe block reservation parameters	64
5.2.17.4	Superframe block reservation reception procedures	64
5.2.17.5	Second frame block reservation parameters	65
5.2.17.6	Second frame block reservation reception procedures	65
5.2.17.7	Superframe block reservation transmission procedures	66
5.2.17.8	Second frame block reservation transmission procedures	66
5.2.18	Response protocol specification	67
5.2.18.1	Response burst format	67
5.2.19	General request protocol specification	67
5.2.19.1	General request burst format	67
5.2.19.2	General request procedures	68
5.2.20	General response protocol specification	68
5.2.20.1	General response burst format	68
5.2.20.2	General response procedures	70
5.2.21	Retransmission procedures	70
5.3	DLS sublayer	71
5.3.1	Services	71
5.3.1.1	General	71
5.3.1.2	Data transfer	71
5.3.1.3	Station address encoding	71
5.3.1.4	DLS burst formats	72
5.3.2	DLS system parameters	73
5.3.2.1	Parameter ND4 (maximum length of a UDATA burst)	74
5.3.3	DLS procedures	74
5.3.3.1	Broadcast	74
5.3.3.2	DLS not supported	74
5.3.3.3	User data packet reception	74
5.4	Link Management Entity sublayer	74
5.4.1	Services	74
5.4.2	Synchronization burst format	75
5.4.2.1	General	75
5.4.2.2	Fixed and variable data fields	75
5.4.2.3	Fixed data field format	75
5.4.2.4	Variable data field format	79
5.4.2.5	Synchronization burst request	79
5.4.2.6	Link management burst	79
5.4.3	Control (CTRL) parameter formats	80
5.4.3.1	Encoding	80
5.4.3.2	VDL Mode 4 parameter identification	80
5.4.3.3	Ground-initiated modification parameters	80
5.4.3.4	Ground-initiated information parameters	83
5.4.3a	LME timers and parameters	86
5.4.3a.1	General	86
5.4.3a.2	Counter L1 (maximum number of missed reservations) and Timer TL3 (inter miss timer)	87
5.4.4	LME procedures	87
5.4.4.1	Synchronization burst procedures	87
5.4.4.2	Peer Entity Contact Table (PECT)	89
5.4.4.3	Network entry protocol specifications	89
5.4.5	Additional material for ADS-B applications	90
5.4.5.1	Information field formats	90
5.4.5.2	ADS-B request format	90
5.5	Additional requirements for ground stations	91
5.5.1	System timing requirements	91
5.5.1.1	Maintenance of Primary time	91
5.5.2	Ground station interface requirements	91
5.5.2.1	Ground station coordination	91
5.5.2.2	Network timing requirements	91

5.5.2.3	Application interface requirements	92
5.5.2.4	Transmission control requirements	92
5.5.2.5	Superframe block reservation rebroadcast procedures.....	92
5.5.2.6	Fixed transmission parameters	92
5.5.2.7	Protection of fixed access protocol transmissions by ground quarantine	93
5.5.2.8	Protection of fixed access protocol transmissions by use of appropriate reservation protocols.....	93
5.5.2.9	Restriction of autotune reservations	93
5.5.2.10	Transmission time for autotune reservations.....	93
5.5.2.11	Reporting of channel usage	94
5.6	Definitions for compact position reporting	94
5.6.1	Introduction.....	94
5.6.2	Parameter symbols, data types, constants and variables	94
5.6.2.1	Parameter symbols	94
5.6.2.2	Data types.....	94
5.6.2.3	Constants.....	94
5.6.2.4	Variables	94
5.6.2.5	Functions.....	95
5.6.2.6	Patch constants.....	95
5.6.3	Fixed data field position encoding	95
5.6.4	Fixed data field position local decoding	95
5.6.5	Fixed data field position global decoding	95
5.6.6	Position report processing.....	95
6	General design requirements	95
6.1	Controls and indicators.....	95
6.2	Operation of controls.....	95
6.3	Warm up.....	95
6.4	Effects of tests	95
6.5	Software management	96
6.6	Recovery from failure	96
6.6.1	Failure of the VDL equipment.....	96
6.7	Monitoring of proper operation	96
7	Protocol test procedures	96
7.1	General	96
7.1.1	Input voltage	96
7.1.2	Power input frequency	96
7.1.3	Adjustment of equipment.....	97
7.1.4	Equipment configuration	97
7.1.5	Test equipment.....	97
7.1.6	Test equipment precautions	97
7.1.7	Ambient conditions.....	97
7.1.8	Connected loads.....	97
7.1.9	Warm-up period.....	97
7.2	Required test rig	98
7.3	Protocol test-suite description methodology	100
7.4	Detailed protocol test procedures	100
7.4.1	Test-suite overview.....	100
7.4.2	Declarations	105
7.4.3	Constraints	105
7.4.3.1	Abbreviations	105
7.4.3.1.1	Subfield mnemonics	105
7.4.3.1.2	Special characters used in the subfield definitions	106
7.4.3.1.3	Station addresses and positions	106
7.4.3.1.4	Tables of values for use in CPR test cases	108
7.4.3.1.5	Tables of values for use in content checking test cases	118
7.4.3.1.6	VDL4 burst formats.....	121
7.4.3.2	Test cases	139
7.4.3.2.1	Test case macros.....	139
7.4.3.2.2	Test case descriptions	141
Annex A (informative):	Cross reference matrix	300

Annex B (informative):	Description of ISO/IEC 9646 Test Methodology.....	316
B.1	Overview of the structure of the ISO/IEC 9646 Test Suites	316
B.2	Test case description	316
B.3	Queue action.....	318
B.4	Repeat construct	318
B.5	Macro definitions	319
B.6	Test case naming	319
Annex C (informative):	Bibliography.....	320
History		325

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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 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";
- Part 5: "Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

The present document is accompanied by an equivalent airborne standard, ETSI EN 302 842 [i.4] 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.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
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 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 112,000 MHz to 136,975 MHz as defined in ICAO VHF Digital Link (VDL) Standards and Recommended Practices (SARPs) [1].

The present document may be used to produce tests for the assessment of the performance of the equipment.

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1 Scope

The present document applies to the following radio equipment types:

- 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 112,000 MHz to 136,975 MHz as defined in ICAO VHF Digital Link (VDL) Standards and Recommended Practices (SARPs) [1].

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 [1] and ICAO VDL4 Technical Manual [i.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 111,975 MHz.

The scope of the present document is limited to ground stations. The equivalent specification for airborne stations is ETSI EN 302 842 [i.4].

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) [i.2] 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) [i.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.

ETSI EN 301 842-1 [3] 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 ETSI EN 301 842-3 [4]. Detailed requirements for point-to-point communication are beyond the scope of the present document, but can be found in ETSI EN 301 842-4 [5]. ETSI EN 301 842-4 [5] also includes the interface to the Aeronautical Telecommunication Network (ATN) as defined in ATN SARPs [i.2].

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 and abbreviations used;
- clause 4 describes the VDL Mode 4 ground station link layer;
- clause 5 provides 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;
- annex A provides a detailed cross-reference to the relevant requirements contained in reference [i.1];
- annex B provides a description of the ISO/IEC 9646 [6] 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] 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).
- [2] ISO/IEC 13239 (2002): "Information technology -- Telecommunications and information exchange between systems -- High-level data link control (HDLC) procedures".
- [3] ETSI EN 301 842-1 (V1.4.0): "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".
- [4] ETSI EN 301 842-3 (V1.4.0): "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".
- [5] ETSI EN 301 842-4 (V1.3.0): "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".
- [6] ISO/IEC 9646 (all parts): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework".

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 AN/448 (First Edition 2004): "Manual on VHF Digital Link (VDL) Mode 4, Part 2: Detailed Technical Specifications".
- [i.2] ICAO Doc 9705 - AN/956 (Edition 3 - 2002): "Manual of Technical Provisions for the Aeronautical Telecommunications Network (ATN)".
- [i.3] EUROCAE ED 109 A: "Software Integrity Assurance Considerations for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems", January 2012.
- [i.4] ETSI EN 302 842 (all parts): "VHF air-ground and air-air Digital Link (VDL) Mode 4 radio equipment; Technical characteristics and methods of measurement for aeronautical mobile (airborne) equipment".
- [i.5] RTCA DO-278A: "Software Integrity Assurance Considerations for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems".

3 Definitions and abbreviations

3.1 General definitions

For the purposes of the present document, the terms and definitions given in ETSI EN 301 842-1 [3], clause 3.1.3 and the following apply:

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.

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.

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.

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).

Global Signalling Channel (GSC): channel available on a world-wide basis for VDL Mode 4 based services

ground base station: aeronautical station equipment, in the aeronautical mobile service, for use with an external antenna and intended for use at a fixed location

link: connects a mobile DLE and a ground DLE and is uniquely specified by the combination of mobile DLS address and the ground DLS address

NOTE: A different sub network entity resides above every link endpoint.