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Ground Based Augmentation System (GBAS)
VHF ground-air Data Broadcast (VDB);
Technical characteristics and methods of measurement for ground-based equipment;
Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

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Foreword

This draft Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document has been prepared to provide a means of conforming to the essential requirements of Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

NOTE: The corresponding Commission's standardisation request is expected shortly.

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

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**", "**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).

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Executive Summary

The present document applies to VDB ground-air digital broadcast using Differential Eight Phase Shift Keying (D8PSK) of Ground-Based Augmentation System GBAS, intended for channel increments of 25 kHz. The VDB system provides data broadcast from ground based to aircraft systems, operating in the VHF band (108,000 MHz to 117,975 MHz). The scope of the present document is limited to ground based stations and is restricted to the civil use of GBAS with horizontally polarized signals (GBAS/H).

Introduction

The present document states the technical specifications for ground-based equipment implementing Very High Frequency (VHF) Data Broadcast (VDB) air interface, operating in the VHF band (108,000 MHz to 117,975 MHz) in increments of 25 kHz.

NOTE: In ICAO Annex 10, Vol. 1 [2], clause 7.2.3 in attachment D it is stated: "...*Until compatibility criteria are developed for GBAS VDB and ILS, VDB cannot be assigned to channels below 112.025 MHz.*"

1 Scope

The present document applies to VDB ground-air digital broadcast using Differential Eight Phase Shift Keying (D8PSK) of Ground-Based Augmentation System GBAS, intended for channel increments of 25 kHz. The VDB system provides data broadcast from ground based to aircraft systems, operating in the VHF band (108,000 MHz to 117,975 MHz). The scope of the present document is limited to ground based stations and is restricted to the civil use of GBAS with horizontally polarized signals (GBAS/H).

The present document contains requirements to demonstrate that "*... Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference* " [i.1].

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the RE Directive [i.1] as well as essential requirements under the SES Interoperability Regulation 552/2004 [i.2] and related implementing rules and/or essential requirements under the EASA basic regulation 216/2008 [i.6] may apply to equipment within the scope of the present document.

2 References

2.1 Normative 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 referenced 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.

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 300 113-1 (V1.7.1) (11-2011): "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".

[2] ICAO Annex 10: "Aeronautical Telecommunications", Vol. I, November 2014.

[3] ICAO DOC 8071 Volume II (fifth edition - 2007): "Manual on Testing of Radio Navigation Aids".

2.2 Informative 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 referenced document (including any amendments) applies.

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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] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

[i.2] Regulation (EC) 552/2004.of the European Parliament and Council of 10 March 2004 on the interoperability of the European Air Traffic Management network (the interoperability Regulation). OJ L96, 31.03.2004, p. 26 as amended by Regulation EC No 1070/2009, OJ L 300, 14/11/2009, p. 34.

[i.3] EUROCAE ED-114A: "Minimum operational performance specification for global navigation satellite ground based augmentation system equipment to support category I operations".

[i.4] ETSI TR 100 028 (all parts) (V1.4.1) (2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[i.5] ETSI TR 100 028-2 (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".

[i.6] Regulation (EU) 1025/2012 of the European Parliament and of the Council of 25 October 2012 on European Standardisation, amending Council Directives 89/686EEC and 93/15/EEC and Directives 94/9/EC, 94/25/EC 95/16/EC, 97/23/EC, 98/34/EC, 2004/22/EC, 2007/23/EC, 2009/23/EC and 2009/105/EC and the European Parliaments and of the Council and repealing Council Decision 87/95/EEC and Decision No 1673/2006/EC of the European Parliament and of the Council.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in the RE Directive [i.1] and the following apply:

adjacent channel power: amount of the modulated RF signal power transmitted outside of the assigned 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 uncorrected 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 uncorrected BER, is the Adjacent Channel Rejection (ACR) ratio.

Aeronautical Mobile Route Service (AM(R)S): mobile service between ground based stations and airborne stations, in which survival craft stations may participate

average transmitter output power: average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long, compared with the lowest frequency encountered in the modulation, taken under normal operating conditions

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

NOTE: The uncorrected BER represents the BER without the benefit of Forward Error Correction (FEC).

Co-Channel Interference (CCI): 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 channel

NOTE: The ratio (in dB) between the wanted signal level and the unwanted signal level is the co-channel interference ratio.

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

data rate: with a nominal data rate of 31 500 bits/s, the VDB symbol rate is expected to be 10 500 symbols/s

environmental profile: range of environmental conditions under which equipment within the scope of the present document is required to comply with the provisions of the present document

ground based station: aeronautical station equipment, in the Aeronautical Mobile Route Service (AM(R)S), for use with an external antenna and intended for use at a fixed location

radiated measurements: measurements which involve the measurement of a radiated field

spurious emissions: conducted RF emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information

NOTE: Spurious emissions include parasitic emissions, intermodulation products and frequency conversion products.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
ACR	Adjacent Channel Rejection
AGC	Automatic Gain Control
AM	Amplitude Modulation
AM(R)S	Aeronautical Mobile (Route) Service
BER	Bit Error Rate
CCI	Co-Channel Interference
CW	Continuous Wave
D8PSK	Differential Eight Phase Shift Keying
DSB	Double Side Band
EASA	European Aviation Safety Agency
EFTA	European Free Trade Association
EVM	Error Vector Magnitude
FC	Frequency Counter
FEC	Forward Error Correction
FM	Frequency Modulation
GBAS	Ground Based Augmentation System
ILS	Instrument Landing System
MFR	Message Failure Rate
PPS	Pulse Per Second
RBW	Resolution BandWidth
RF	Radio Frequency
RMS	Root Mean Square
SA	Spectrum Analyser
SES	Single European Sky
SWT	Sweep Time
TUT	Transmitter Under Test
VBW	Video BandWidth
VDB	VHF Data Broadcast
VHF	Very High Frequency
VSA	Vector Signal Analyser

4 Technical requirements specifications

4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the supplier. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the declared operational environmental profile.

4.2 Conformance requirements

4.2.1 Transmitter requirements

4.2.1.0 Applicability

All the technical requirements in clause 4.2.1 shall only be applicable for equipment containing a transmitter.

4.2.1.1 Frequency error

4.2.1.1.1 Requirement

The frequency of the RF carrier shall be within ±2 ppm of the selected frequency as specified in Table II-4-2B of ICAO DOC 8071 [3].

To facilitate the measurement of the RF carrier frequency, the transmitter shall provide a CW mode.

4.2.1.1.2 Conformance

The following conformance test shall be performed to comply with the technical requirement in clause 4.2.1.1.1.

The following equipment is required:

- Frequency counter (FC) or spectrum analyser (SA), which is suitable for the measurement of the requirements defined in clause 4.2.1.1.1.
- Suitable attenuator to assure best measurement operation of the FC or the SA.

The measurement procedure consists of the following steps:

Step 1: Connect the equipment as shown in Figure 1.

Step 2: Tune the transmitter under test (TUT) to 117,950 MHz.

Step 3: Key the transmitter under test (TUT) "on" and set the Unit under test to transmit an unmodulated RF carrier signal.

Step 4: Set the frequency counter (or SA) to capture transmitted signal and determine its frequency.

Step 5: Check that the measured frequency is consistent with the requirements according to clause 4.2.1.1.1.

NOTE: It is recommended that the output power delivered into a 50 Ω load is measured during signal transmission and is not averaged over the time intervals between signal transmissions.

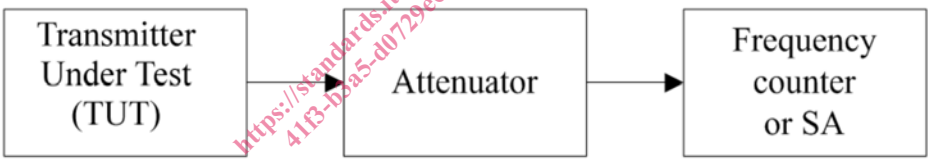

Figure 1: Frequency error measurement

4.2.1.2 Transmitter power

4.2.1.2.1 Requirement

The manufacturers declared output power shall be measured as an average over the period of the synchronization and ambiguity resolution field of the burst as specified in clause 3.7.3.5.4.4.1.2 of ICAO Annex 10 [2]. The measured power shall be ±1 dB of the manufacturer's declared output power.

The requirements of the present document shall also be met for all power output levels at which the transmitter is intended to operate into 50 Ω. For practical reasons measurements shall be performed only at the lowest and the highest power output level at which the transmitter is intended to operate.

4.2.1.2.2 Conformance

The following conformance test shall be performed to comply with the technical requirement in clause 4.2.1.2.1.

The following equipment is required:

- Transmitter under test (TUT).
- Spectrum analyser (SA).
- Suitable attenuator to assure best measurement operation of the SA.

The measurement procedure consists of the following steps:

Step 1: Connect the equipment as shown in Figure 2.

Step 2: Tune the transmitter to the test frequency 108,025 MHz.

Step 3: Key the transmitter under test (TUT) "on" and modulate the carrier with messages from the transmission generator.

Step 4: Set the VSA to capture the transmitted VDB signal and determine the transmitter output power as an average over the period of the synchronization and ambiguity resolution field of the burst as specified in clause 3.7.3.5.4.4.1.2 of ICAO Annex 10 [2].

Step 5: Repeat Steps 2 to 4 at the two remaining test frequencies:

- 112,00 MHz.
- 117,950 MHz.

Step 6: Check that the measured output power is consistent with the manufacturer's declared output power according to clause 4.2.1.2.1, and remains so at all three test channels.

NOTE: It is recommended that the output power delivered into a 50 Ω load is measured during signal transmission and is not averaged over the time intervals between signal transmissions.

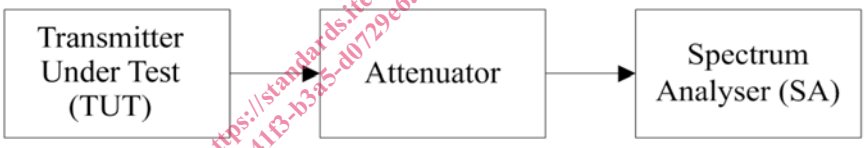

Figure 2: Output power measurement

4.2.1.3 Adjacent channel power

4.2.1.3.1 Requirement

The amount of power during transmission under all operating conditions when measured over a 25 kHz bandwidth centred on the adjacent channel shall not exceed the values shown in Table 1 and specified in Table 3.7.3.5-1 of ICAO Annex 10 [2].