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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;
Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive

Reference
DEN/ERM-JTFEA-015

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Foreword

This Harmonized European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Directive 98/34/EC [i.4] as amended by Directive 98/48/EC [i.6].

The title and reference to the present document are intended to be included in the publication in the Official Journal of the European Union of titles and references of Harmonized Standard under the Directive 1999/5/EC [i.1].

See article 5.1 of Directive 1999/5/EC [i.1] for information on presumption of conformity and Harmonized Standards or parts thereof the references of which have been published in the Official Journal of the European Union.

The requirements relevant to Directive 1999/5/EC [i.1] are summarized in annex A.

National transposition dates	
Date of adoption of this EN:	21 May 2013
Date of latest announcement of this EN (doa):	31 August 2013
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	28 February 2014
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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 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.*"

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the R&TTE Directive [i.1]. The modular structure is shown in EG 201 399 [i.3].

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.

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.

The present document is intended to cover the provisions of Directive 1999/5/EC [i.1] (R&TTE Directive), article 3.2, which states that *"... radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference*".

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 R&TTE Directive [i.1] as well as essential requirements under the Single European Sky Interoperability Regulation [i.2] (as amended) and related implementing rules may apply to equipment within the scope of the present document.

The scope of the present document is restricted to the civil use of GBAS with horizontally polarized signals (GBAS/H).

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 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.

2.1 Normative references

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

[1] ETSI EN 300 113-1 (V1.7.1) (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 to the Convention on International Civil Aviation: "Aeronautical Telecommunications", Vol. I, including Amendments up to 86.

[3] 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".

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] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

NOTE: As amended by Regulation (EC) 1882/2003 of the European Parliament and of the Council of 29 March 2003.

[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).

NOTE: OJEU L96, 31.03.2004, p. 26-42 as amended by Regulation (EC) 1070/2009 of the European Parliament and of the Council of 21 October 2009, OJEU L300/34, 14/11/2009.

[i.3] ETSI EG 201 399: "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of Harmonized Standards for application under the R&TTE Directive".

[i.4] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations and of rules on Information Society services.

[i.5] EUROCAE ED-114: "Minimum operational performance specification for global navigation satellite ground based augmentation system equipment to support category I operations".

[i.6] Directive 98/48/EC of the European Parliament and of the Council of 20 July 1998 amending Directive 98/34/EC laying down a procedure for the provision of information in the field of technical standards and regulations.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in the R&TTE 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
CRC	Cyclic Redundance Check
CW	Continuous Wave
D8PSK	Differential Eight Phase Shift Keying
DSB	Double Side Band
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
R&TTE	Radio and Telecommunications Terminal Equipment (Directive 1999/5/EC [i.1])
RBW	Resolution BandWidth
RF	Radio Frequency
RMS	Root Mean Square
SA	Spectrum Analyser
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

4.2.1.1 Frequency error

4.2.1.1.1 Requirement

The frequency of the RF carrier shall be within ±2 ppm of the selected frequency.

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

4.2.1.1.2 Conformance

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 in the following steps:

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

Step 2: Tune the transmitter under test (TUT) to third of the test frequencies (see clause 5.1).

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 [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 equipment is required:

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

The measurement procedure consists in the following steps:

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

Step 2: Tune the transmitter to one of the test frequencies (see clause 5.1).

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 [2].

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

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.

Table 1: GBAS broadcast power transmitted in adjacent channels

Channel	Relative Power	Maximum Power
1st Adjacent	-40 dBc	12 dBm
2nd Adjacent	-65 dBc	-13 dBm
3rd Adjacent	-74 dBc	-22 dBm
4th Adjacent	-88,5 dBc	-36,5 dBm
8th Adjacent	-101,5 dBc	-49,5 dBm
16th Adjacent	-105 dBc	-53 dBm
32th Adjacent	-113 dBc	-61 dBm
76th Adjacent	-115 dBc	-63 dBm
NOTE 1: The maximum power applies if the authorized transmitter power exceeds 150 W. NOTE 2: The relationship is linear between single adjacent points designated by the adjacent channels identified above.		

4.2.1.3.2 Conformance

4.2.1.3.2.1 Measurement method for the first adjacent channel

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 in the following steps:

Step 1: Connect the equipment as shown in Figure 3.

Step 2: Switch the unit under test on and modulate the carrier with messages from the TUT.

Step 3: Tune the transmitter under test to one of the test frequencies (see clause 5.1).

Step 4: Set the spectrum analyser to capture the transmitted VDB signal including first upper and lower adjacent channel and determine the transmitter first upper and first lower adjacent channel power as an average over the period of the synchronization and ambiguity resolution field of the burst as specified in [2], clause 3.7.3.5.4.4.1.2. Record the highest of the two measured values as first adjacent channel power.

Step 5: Check that the first adjacent channel power is lower than the first adjacent channel power limit (defined in clause 4.2.1.3.1).

Step 6: Repeat Steps 3 to 5 at the remaining 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.

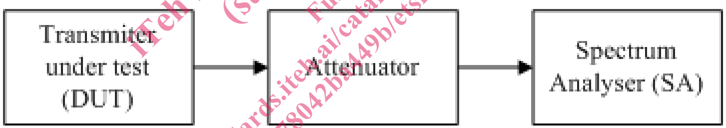

Figure 3: First adjacent channel power measurement (also applicable for symbol constellation error measurements)

4.2.1.3.2.2 Measurement method for the second and higher adjacent channels

The following equipment is required:

- Transmitter under test (TUT).
- Spectrum analyser (SA).
- Adequate filter to assure a dynamic range of the measurement system for the adjacent channel limits in excess of 10 dB more than the requirements given in clause 4.2.1.3.1.

The measurement procedure consists in the following steps:

Step 1: Connect the equipment as shown in Figure 3.

Step 2: Key the transmitter under test "on" and modulate the carrier with messages from the transmission generator.

Step 3: Tune the transmitter to one of the test frequencies (see clause 5.1).