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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

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Foreword

This draft Harmonized 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 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.

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

Introduction

The present document states the technical specifications for ground-based equipment implementing Very High Frequency (VHF) Digital 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 Link 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.

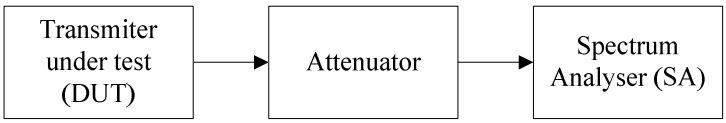

Figure 2: Output power measurement

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).

Step 4: Set the spectrum analyser to capture the transmitted VDB signal including first upper and lower adjacent channel and determine the transmitter for second and higher upper and lower adjacent channel 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]. Record for each of the adjacent channels the highest value of the corresponding upper and lower adjacent channels.

Step 5: Record the higher of the two measured values. Check that the first adjacent channel power is lower than the first adjacent channel power requirement (defined in clause 4.2.1.3.1).

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

NOTE 1: 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.

NOTE 2: The filter may be a cavity filter or a quartz filter.

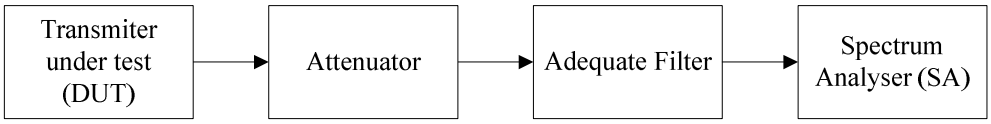

Figure 4: Second and higher adjacent channel power measurement

4.2.1.4 Spurious emissions

4.2.1.4.1 Conducted emissions

4.2.1.4.1.1 Requirement

Unwanted emissions, including spurious and out-of-band emissions, shall be compliant with the levels shown in Table 2. The total power in any VDB harmonic or discrete signal shall not be greater than -53 dBm.

Table 2: GBAS broadcast unwanted emissions

Frequency	Relative Power	Maximum Power
9 kHz to 150 kHz	-93 dBc (see note 3)	-55 dBm / 1 kHz
150 kHz to 30 MHz	-103 dBc (see note 3)	-55 dBm / 10 kHz
30 MHz to 106,125 MHz	-115 dBc	-57 dBm / 100 kHz
106,425 MHz	-113 dBc	-55 dBm / 100 kHz
107,225 MHz	-105 dBc	-47 dBm / 100 kHz
107,625 MHz	-101,5 dBc	-53,5 dBm / 10 kHz
107,825 MHz	-88,5 dBc	-40,5 dBm / 10 kHz
107,925 MHz	-74 dBc	-36 dBm / 1 kHz
107,9625 MHz	-71 dBc	-33 dBm / 1 kHz
107,975 MHz	-65 dBc	-27 dBm / 1 kHz
118,000 MHz	-65 dBc	-27 dBm / 1 kHz
118,0125 MHz	-71 dBc	-33 dBm / 1 kHz
118,050 MHz	-74 dBc	-36 dBm / 1 kHz
118,150 MHz	-88,5 dBc	-40,5 dBm / 10 kHz
118,350 MHz	-101,5 dBc	-53,5 dBm / 10 kHz
118,750 MHz	-105 dBc	-47 dBm / 100 kHz
119,550 MHz	-113 dBc	-55 dBm / 100 kHz
119,850 MHz to 1 GHz	-115 dBc	-57 dBm / 100 kHz
1 GHz to 1,7 GHz	-115 dBc	-47 dBm / 1 MHz

NOTE 1: The maximum unwanted emission level (absolute power) applies if the authorized transmitter power exceeds 150 W.
NOTE 2: The relative unwanted emission level is to be computed using the same bandwidth for desired and unwanted signals. This may require conversion of the measurement for unwanted signals done using the bandwidth indicated in the maximum unwanted emission level column of this table.
NOTE 3: This value is driven by measurement limitations. Actual performance is expected to be better.
NOTE 4: The relationship is linear between single adjacent points designated by the adjacent channels identified above.

4.2.1.4.1.2 Conformance

The following equipment is required:

- Transmitter under test (TUT).
- Spectrum analyser (SA) with power band marker function.
- Suitable attenuator to assure best measurement operation of the SA.
- Adequate filter to assure a dynamic range of the measurement system for the spurious emissions limits in excess of 10 dB more than the required.

The measurement procedure consists in the following steps:

NOTE 1: Testing for unwanted emissions in the 9 kHz to 108 MHz band shall be performed with the VDB transmitter operating at the lowest assignable channel.

NOTE 2: Testing for unwanted emissions in the 117,975 MHz to 1,7 GHz band shall be performed with the VDB transmitter operating at the highest assignable channel.

NOTE 3: The harmonics shall be measured at both the lowest and highest assignable channels.

NOTE 4: This test procedure is also suitable for the measurement of Adjacent.

Channel Power performance above the fourth adjacent channel:

Step 1: Connect the equipment as shown in Figure 5.

Step 2: Tune the transmitter to the first test frequencies given in clause 5.1.

Step 3: Using the filter to reject the on-channel signal in order to increase the dynamic range of the measurement without overloading the spectrum analyser. Measure the frequency response of the filter and take this into account when calculating spurious measurement results.

Step 4: Set the transmission generator to produce continuous maximum length messages and key the transmitter under test "on".

Step 5: Adjust the spectrum analyser reference level to provide the maximum dynamic range for display and set the input attenuator to minimum required to ensure that no signal at the analyser input exceeds the maximum allowable level.

Step 6: Measure the power level at each visible spurious signal up to 107,975 MHz using power band markers appropriate to the bandwidths specified in clause 4.2.1.4.1.1. Use the filter to reject the carrier in order to increase the dynamic range of the measurement without overloading the spectrum analyser.

Step 7: Measure the frequency response of the filter and take this into account when presenting spurious measurement results. If a bandpass filter is used, it will need to be tuned to several measurement frequencies, covering the overall measured frequency range.

Step 8: Tune the transmitter to the third test frequencies given in clause 5.1.

Step 9: Using the filter to reject the on-channel signal in order to increase the dynamic range of the measurement without overloading the spectrum analyser. Measure the frequency response of the filter and take this into account when calculating spurious measurement results.

Step 10: Set the transmission generator to produce continuous maximum length messages and key the transmitter under test "on".

Step 11: Adjust the spectrum analyser reference level to provide the maximum dynamic range for display and set the input attenuator to minimum required to ensure that no signal at the analyser input exceeds the maximum allowable level.

Step 12: Measure the power level at each visible spurious signal above 118,00 MHz using power band markers appropriate to the bandwidths specified in clause 4.2.1.4.1.1. Use the filter to reject the carrier in order to increase the dynamic range of the measurement without overloading the spectrum analyser.

Step 13: Measure the frequency response of the filter and take this into account when presenting spurious measurement results. If a bandpass filter is used, it will need to be tuned to several measurement frequencies, covering the overall measured frequency range.

Step 14: Check that the results do not exceed the limits specified in clause 4.2.1.4.1.1.

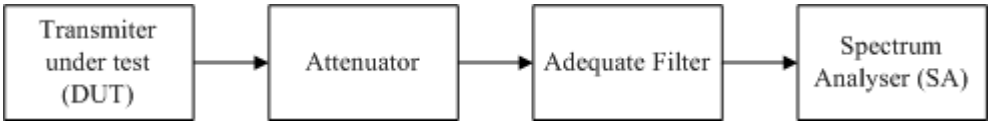

Figure 5: Conducted unwanted measurement

4.2.1.4.2 Radiated emissions - cabinet radiation

4.2.1.4.2.1 Requirement

Requirement for cabinet radiation is specified in EN 300 113-1 [1], clause 7.5.4, Table 5.

4.2.1.4.2.2 Conformance

The test procedure specified in clause 7.5.3 of EN 300 113-1 [1] shall be carried out.

4.2.1.5 Intermodulation attenuation

4.2.1.5.1 Requirements

Requirement for Inter-modulation attenuation is specified in EN 300 113-1 [1], clause 7.6.3.

4.2.1.5.2 Conformance

Conformance tests as defined in EN 300 113-1 [1], clause 7.6.2 shall be carried out.

4.2.1.6 Transient behaviour of the transmitter

4.2.1.6.1 RF power rise time

4.2.1.6.1.1 Requirement

The transmitter shall ramp up to 90 % of the steady state measured output power level (see clause 4.2.1.2) in a time less than 190,5 µs (two symbols) after the beginning of the burst. The transmitter shall stabilize above 90 % of the steady state measured output power level within 476,2 µs (five symbols) after the beginning of the burst.

NOTE: The transmitter power stabilisation segment consists of 5 symbols each representing 000 (2 symbols for the RF power rise time and 3 symbols for the receiver AGC stabilisation).

4.2.1.6.1.2 Conformance

The following equipment is required:

- Transmitter under test (TUT).
- 1 PPS Reference source.
- 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 6.

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

Step 3: Key the transmitter under test "on" and modulate it with a GBAS Standard Test Message in a specific slot.

Step 4: Adjust the attenuator in the analyser to the minimum value which does not overload the input stage of the unit.

Step 5: Use the zero span mode of the signal analyser. Use the analyser video trigger.

Step 6: Adjust the analyser Reference Level in order to have the "steady state" of the envelope at the top of the analyser display.

Step 7: Repeat Steps 2 to 6 at the two remaining test channels.

Step 8: Check that the results do not exceed the limits specified in clause 4.2.1.6.1.1.

NOTE 1: The beginning of the burst corresponds to timeslot start time which is synchronous with the 1PPS signal.

NOTE 2: The following analyser settings can be used: RBW=10 kHz, VBW=20 kHz, SWT=5 ms, attenuation=10 dB.

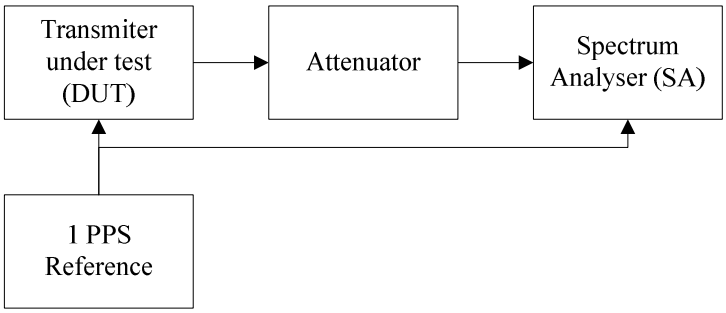

Figure 6: RF power rise and release time measurement (also applicable for RF power release time measurements and emissions in unassigned time slots measurements)

4.2.1.6.2 RF power release time

4.2.1.6.2.1 Requirement

The transmitter output power shall decay at least 30 dB below the steady state declared output power level (see clause 4.2.1.2) within 285,7 µs (three symbols) after transmitting the final information symbol in an assigned time slot.

4.2.1.6.2.2 Conformance

The following equipment is required:

- Transmitter under test (TUT).
- 1 PPS Reference source.
- 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 6.

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

Step 3: Key the transmitter under test "on" and modulate it with a GBAS Standard Test Message in a specific slot.

Step 4: Adjust the attenuator in the analyser to the minimum value which does not overload the input stage of the unit.

Step 5: Use the zero span mode of the signal analyser. Use the analyser video trigger. (typical analyser settings are: RBW=10 kHz, VBW=20 kHz, SWT=5 ms, attenuation=10 dB).

Step 6: Adjust the analyser Reference Level in order to have the "steady state" of the envelope at the top of the analyser display.

Step 7: Repeat Steps 2 to 6 at the two remaining test channels.

Step 8: Check that the results do not exceed the limits specified in clause 4.2.1.6.2.1.

NOTE: The beginning of the burst corresponds to timeslot start time which is synchronous with the 1PPS signal.

4.2.1.7 Modulation Accuracy - Symbol constellation error

4.2.1.7.1 Requirement

The rms Error Vector Magnitude (EVM), shall be less than 6,5 % RMS.

4.2.1.7.2 Conformance

The following equipment is required:

- Transmitter under test (TUT).
- Suitable attenuator to assure best measurement operation of the Vector Signal Analyser VSA.
- Vector Signal Analyser VSA.

The measurement procedure consists of the following steps:

Step 1: Connect the equipment as shown in.

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

Step 3: Key the transmitter under test "on" and modulate it with a GBAS Standard Test Message in a specific slot.

Step 4: Adjust the attenuator in the analyser to the minimum value which does not overload the input stage of the unit.

Step 5: Key the transmitter under test "on" and modulate it with continuous maximum length messages produced by the transmission generator.

Step 6: Record the RMS phase error at the symbol centres.

Step 7: Repeat Steps 2 to 6 at the two remaining test channels.

Step 8: Check that the results do not exceed the limits specified in clause 4.2.1.7.1.

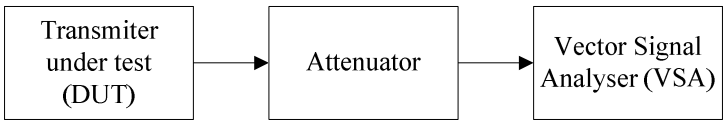

Figure 7: Modulation accuracy measurement

4.2.1.8 Emissions in unassigned time slots

4.2.1.8.1 Requirement

Under all operating conditions, the maximum power over a 25 kHz bandwidth, centred on the assigned frequency, when measured over any unassigned timeslot, shall not exceed -105 dBc referenced to the declared output power.

NOTE: Unlimited emissions in unassigned time slots could interfere the transmission of adjacent GBAS systems and therefore prevent the efficient frequency usage.

4.2.1.8.2 Conformance

The following equipment is required:

- Transmitter under test (TUT).
- 1 PPS Reference source.
- Spectrum analyser (SA).

- Suitable attenuator to assure best measurement operation of the SA.

The measurement procedure shall consist of the following steps:

Step 1: Connect the equipment as shown in Figure 6.

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

Step 3: Key the transmitter under test "on" and modulate it with a GBAS Standard Test Message in a specific slot.

Step 4: Adjust the attenuator in the analyser to the minimum value which does not overload the input stage of the unit.

Step 5: Use the zero span mode of the signal analyser. Use the analyser video trigger. (typical analyser settings are: RBW=10 kHz, VBW=20 kHz, SWT=5 ms, attenuation=10 dB).

Step 6: Adjust the analyser Reference Level in order to have the "steady state" of the envelope at the top of the analyser display.

Step 7: Repeat Steps 2 to 6 at the two remaining test channels.

Step 8: Check that the results do not exceed the limits specified in clause 4.2.1.8.1.

NOTE: The beginning of the burst corresponds to timeslot start time which is synchronous with the 1PPS signal.

4.2.2 Monitor requirements

4.2.2.1 Sensitivity

4.2.2.1.1 Requirements

a) The requirement specified in clause 5.2 shall be met over a dynamic range from -87 dBm to -1 dBm.

b) The message failure rate (MFR) shall be less than or equal to one failed message per 1 000 full length (222 bytes) application data message while operating at -87 dBm.

4.2.2.1.2 Conformance

The following equipment is required:

- VHF Signal Generator.
- External BER test equipment.

The measurement procedure consists of the following steps:

Step 1: Connect the equipment as shown in Figure 10 but notice that the RF combiner is not required for this test. Set the receiver under test into the uncorrected BER mode.

Step 2: Set the desired VDB source (a VHF signal generator A) to generate an input signal to the receiver at one of the test frequencies (see clause 5.1).

Step 3: Modulate the desired signal with the test payload (maximum burst length of symbols) provided by the external BER test equipment. Adjust the level of the signal generator to the maximum signal level (see clause 4.2.2.1.1) at the receiver input terminals.

Step 4: Repeat Steps 2 and 3 at the two remaining test frequencies (see clause 5.1).

Step 5: Using the external BER test equipment, determine the uncorrected BER of the demodulated data at the receiver output. Check the sensitivity requirement (see clause 4.2.2.1.1) is achieved at all three test frequencies.

4.2.2.2 Symbol rate capture range

4.2.2.2.1 Requirements

The requirement specified in clause 5.2 shall be achieved when the reference signal is subject to a symbol rate offset of ±50 parts per million.

4.2.2.2.2 Conformance

The following equipment is required:

- VHF Signal Generator.
- External BER test equipment.

The measurement procedure consists in the following steps:

Step 1: Connect the equipment as shown in Figure 10 - but notice that the RF combiner is not needed for this test. Set the receiver to the uncorrected BER mode.

Step 2: Tune the Desired VDB Source (generator A) to generate an input signal to the receiver at one of the test frequencies (see clause 5.1). Adjust generator A to provide the reference signal level (see clause 4.2.2) at the receiver input terminals.

Step 3: Tune the VHF signal generator to the receiver channel frequency and modulate it with the test payload (maximum burst length of symbols) provided by the external BER test equipment.

Step 4: Adjust the transmitted data clock offset of the external BER test equipment to the maximum offset specified in clause 4.2.2.2.1.

Step 5: Apply the modulated signal to the receiver and determine the uncorrected BER of the demodulated data at the receiver output with the external BER test equipment.

Step 6: Repeat Steps 4 and 5 after adjusting the transmitted data clock offset to the minimum offset specified in clause 4.2.2.2.1.

Step 7: Check that the uncorrected BER requirement (see clause 4.2.2) is achieved in all cases.

4.2.2.3 Co-channel rejection

4.2.2.3.1 Requirements

The requirement specified in clause 5.2 shall be met in the presence of an undesired co-channel VHF data broadcast signal that is either:

- Case a) assigned to the same time slot(s) and 26 dB below the desired VHF data broadcast signal power or lower.
- Case b) assigned to a different time slot(s) and whose power level is up to 15 dBm at the receiver input.

4.2.2.3.2 Conformance

4.2.2.3.2.1 Co-channel rejection assigned to the same time slot(s) (see clause 4.2.2.3.1 case a)

The following equipment is required:

- 2 VHF Signal Generators.
- External BER test equipment.
- RF combiner.

The measurement procedure consists in the following steps:

Step 1: Connect the equipment as shown in Figure 8 and set the receiver to the uncorrected BER mode.

Step 2: Use the Desired VDB Source (named A), to generate a desired input signal to the receiver.

Step 3: Tune the generator A to one of the test frequencies (see clause 5.1) and modulate the carrier with the test payload (maximum burst length of symbols) provided by the external BER test equipment. Adjust generator A to provide the reference signal level (see clause 4.2.2) at the receiver input terminals.

Step 4: Use the second signal generator (named B), to generate a co-channel interfering input signal to the receiver.

Step 5: Tune the signal generator B to the receiver channel frequency and configure it to produce a narrow band FM signal with a maximum peak deviation of ±5,25 kHz. Modulate generator B with a 400 Hz sine wave. Adjust generator B to produce an interfering signal level 20 dB below the reference signal level (see clause 4.2.2) at the receiver input terminals.

Step 6: Apply the desired signal and the co-channel interfering FM modulated signal to the receiver input via the RF combiner and measure the uncorrected BER of the demodulated data at the receiver output with the external BER test equipment.

Step 7: Repeat Steps 2 to 6 at the two remaining test frequencies (see clause 5.1).

Step 8: Check that the uncorrected BER requirement (see clause 4.2.2) is achieved in all cases.

4.2.2.3.2.2 Co-channel rejection assigned to different time slot(s) (see clause 4.2.2.3.1 case b)

The following equipment is required:

- 2 VHF signal generators.
- 1 PPS Reference.
- External BER test fixture (PC with suitable software).
- RF combiner.

The measurement procedure consists in the following steps:

Step 1: Connect the equipment as shown in Figure 8 and set the receiver to the uncorrected BER mode.

Step 2: Adjust the Desired VDB Source (generator A), to produce an input signal to the receiver at the middle test frequency.

Step 3: Modulate generator A on the second assignable time slot with GBAS test messages (max length) provided by the external BER test fixture (PC + Software). Adjust signal generator A to produce the reference signal level (see clause 4.2.2) at the receiver input via the RF combiner.

Step 4: Use the second generator (named B), to generate a co-channel interfering input signal (max length) to the receiver (on the first assignable time slot). Adjust the level of the generator to obtain the interfering signal level (see clause 4.2.2.3.1 case b)) at the receiver input via the RF combiner.

Step 5: Check that the co-channel rejection requirement (defined in clause 4.2.2.3.1 case b)) is achieved.

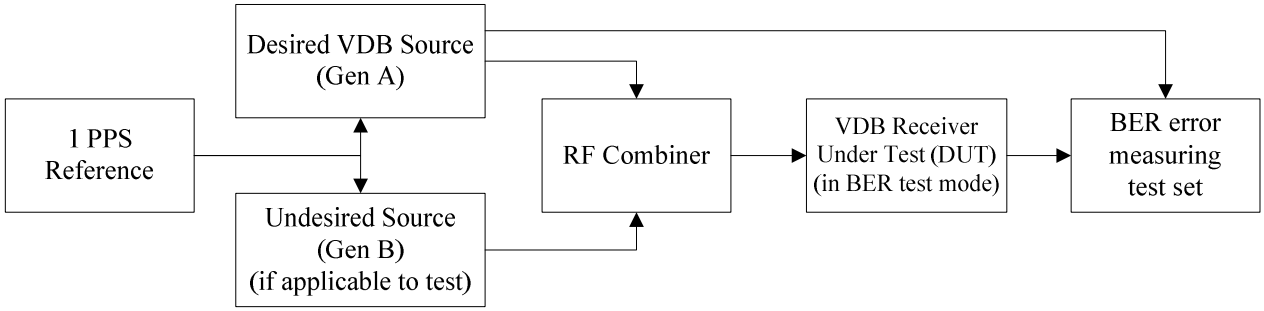

Figure 8: Time slot decoding measurement

4.2.2.4 Adjacent Channel selectivity

4.2.2.4.1 Requirements

4.2.2.4.1.1 First adjacent 25 kHz channel (±25 kHz)

The VHF data broadcast receiver shall meet the requirements specified in clause 5.2 in the presence of transmitted undesired signal offset by 25 kHz on either side of the desired channel that is 18 dB above the desired signal power when the undesired signal is another VHF data broadcast signal assigned to the same time slot(s).

4.2.2.4.1.2 Second adjacent 25 kHz channel (±50 kHz)

The VHF data broadcast receiver shall meet the requirements specified in clause 5.2 in the presence of transmitted undesired signal offset by 50 kHz on either side of the desired channel that is 43 dB above the desired signal power when the undesired signal is another VHF data broadcast source assigned to the same time slot(s).

4.2.2.4.1.3 Third and beyond adjacent 25 kHz channels (±75 kHz or more)

The VHF data broadcast receiver shall meet the requirements specified clause 5.2 in the presence of transmitted undesired signals offset by 75 kHz or more on either side of the desired channel that is 46 dB above the desired signal power when the undesired signal is another VHF data broadcast signal assigned to the same time slot(s).

4.2.2.4.2 Conformance

4.2.2.4.2.1 First adjacent 25 kHz channel (±25 kHz)

The following equipment is required:

- 2 VHF Signal Generators.
- External BER test equipment.
- RF combiner.

The measurement procedure consists in the following steps:

Step 1: Connect the equipment as shown in Figure 8 and set the receiver to the uncorrected BER mode.

Step 2: Adjust the Desired VDB Source, generator A, to produce an input signal to the receiver at one of the test frequencies (see clause 5.1).

Step 3: Modulate generator A with the test payload (maximum burst length of symbols) using the external BER test fixture. Adjust signal generator A to provide the reference signal level see clause 4.2.2) at the receiver input terminals.

Step 4: Use the second VHF signal generator (named B), to generate an adjacent channel interfering input signal to the receiver.

Step 5: Tune generator B to the first upper adjacent channel frequency. Set generator B to produce an interfering source (narrow-band FM signal as defined in clause 5.2.1.4, to simulate a second VDB source). Apply the desired input signal and the adjacent interfering signal to the receiver input via the RF combiner.

Step 6: Adjust the level of signal generator B until the uncorrected BER is reduced to the minimum requirement (see clause 4.2.2). Record the interfering signal level at the receiver input terminals.

Step 7: Repeat Steps 5 and 6 for the lower adjacent channel.

Step 8: Determine the ratio between the Desired and Interfering signal levels for both upper and lower adjacent channels. Record the higher of these two values.

Step 9: Repeat Steps 4 and 8 for the two remaining test frequencies (see clause 5.1).

Step 10: Check that the Adjacent Channel Rejection requirement (defined in clause 4.2.2.4.1.1) is achieved in all cases.

The noise sidebands of the interfering signal shall not to interfere with the desired signal in the receiver passband. The isolation offered by the RF combiner shall be sufficient to prevent intermodulation between the VHF generators.

4.2.2.4.2.2 Second and beyond adjacent 25 kHz channels (±50 kHz or more)

The following equipment is required:

- 2 VHF Signal Generators.
- External BER test equipment.
- RF combiner.

The measurement procedure consists in the following steps:

Step 1: Connect the equipment as shown in Figure 8 and set the receiver to the uncorrected BER mode.

Step 2: Adjust the Desired VDB Source, generator A, to produce an input signal to the receiver at one of the test frequencies (see clause 5.1).

Step 3: Modulate generator A with the test payload (maximum burst length of symbols) using the external BER test fixture. Adjust signal generator A to provide the reference signal level see clause 4.2.2) at the receiver input terminals.

Step 4: Set the second signal generator (named B), to produce an unmodulated interfering signal to the receiver input.

Step 5: Tune generator B to the second upper channel frequency in the range defined in clause 5.1. Adjust the level of the signal generator B to the unmodulated interfering signal power value (also defined in clause 4.2.2.3.2.2) at the receiver input terminals.

Step 6: Apply the wanted input signal and the unmodulated interfering signal to the receiver input via the RF combiner and determine the uncorrected BER of the demodulated data with the external BER test equipment.

Step 7: Repeat Steps 5 and 6 for the lower second adjacent channel and the upper and lower third adjacent channels.

Step 8: Check that the uncorrected BER requirement (see clause 4.2.2) is achieved in all cases.

Step 9: Repeat Steps 8 and 9 for the lower fourth adjacent channel.

Step 10: Repeat Steps 5 to 9 at the two remaining test frequencies (see clause 5.1).

The noise sidebands of the interfering signal shall not to interfere with the desired signal in the receiver passband. The isolation offered by the RF combiner shall be sufficient to prevent intermodulation between the VHF generators.

4.2.2.5 Spurious response rejection

4.2.2.5.1 Requirements

4.2.2.5.1.1 Interference Immunity

The VHF data broadcast receiver shall meet the requirements specified in clause 5.2 in the presence of one or more signals having the frequency and total interference levels specified in Table 3.

Table 3: Interference immunity

Frequency	Maximum level of undesired signals at the receiver input (dBm)
50 kHz up to 88 MHz	-13
88 MHz to 107,900 MHz	(see clause 4.2.2.5.1.2)
108,000 MHz to 117,975 MHz	excluded
118,000 MHz	-44
118,025 MHz	-41
118,050 MHz up to 1 660,5 MHz	-13
NOTE: The relationship is linear between single adjacent points designated by the above frequencies.	

4.2.2.5.1.2 FM Desensitisation

The VHF data broadcast receiver shall meet the requirements specified in clause 5.2 in the presence of VHF FM broadcast signals with signal levels as shown in Table 4.

Table 4: Desensitisation frequency and power requirements that apply for VDB frequencies from 108,025 MHz to 117,975 MHz

Frequency	Maximum level of undesired signals at the receiver input (dBm)
88 MHz ≤ f ≤ 106 MHz	-5
107,9 MHz	-10

4.2.2.5.2 Conformance

The following equipment is required:

- 2 VHF Signal Generators.
- External BER test equipment.
- RF combiner.

NOTE: This test procedure is applicable to basic immunity to interference sources across the frequency range 50 kHz to 1 660,5 MHz but outside the VHF aeronautical band (see clause 4.2.2.5.1) and FM desensitisation (see clause 4.2.2.5.1.2).

The measurement procedure consists in the following steps:

Step 1: Connect the equipment as shown in Figure 10 and set the receiver to the uncorrected BER mode.

Step 2: Use the Desired VDL Source (generator A), to produce an input signal of -87 dBm to the receiver at one of the test frequencies (see clause 5.1).

Step 3: Modulate generator A with the test payload (maximum burst length of symbols) using the external BER test equipment. Adjust signal generator A to provide the reference signal level (see clause 4.2.2) at the receiver input terminals.

Step 4: Use the second signal generator (named B), to generate one of the specified interfering signals at the receiver input.

Step 5: Tune generator B to any frequency defined in clause 4.2.2.5.1. Adjust the level of generator B to provide the interfering signal level also defined in clause 4.2.2, at the receiver input terminals.

Step 6: Apply the desired input signal and the interfering signal to the receiver input via the RF combiner and determine the uncorrected BER with the external BER test equipment.

Step 7: Repeat Steps 5 and 6 for all other frequencies.

Step 8: Repeat Steps 4 to 7 at the two remaining test frequencies (see clause 5.1) - see note 4.

Step 9: Check that the uncorrected BER requirement (see clause 4.2.2) is achieved in all cases.

The noise sidebands of the interfering signal shall not interfere with the desired signal in the receiver passband. The isolation offered by the RF combiner shall be sufficient to prevent intermodulation between the VHF generators.

NOTE 1: Any interfering signal found to reduce the uncorrected BER below the minimum requirement should be investigated using a spectrum analyser connected to the combined output. This should determine whether the RF combiner/test setup is producing an on-channel signal into the receiver under test.

NOTE 2: Alternative procedures or theoretical calculation may be used to reduce the number of discrete frequencies that need to be tested.

NOTE 3: When testing desensitisation to unwanted FM signals at 107,9 MHz, the lowest test frequency to be applied should be 108,075 MHz. The ground subsystem VDB receiver is not required to comply with the -10 dBm desensitisation requirements for FM carriers above 107,7 MHz and VDB channels at 108,025 MHz or 108,050 MHz.

4.2.2.6 Spurious emissions

4.2.2.6.1 Conducted spurious emission

4.2.2.6.1.1 Requirements

When the receiver input is terminated in a resistive load equal to the nominal receiver input impedance, the level of any spurious emission appearing across the load shall not exceed minus 57 dBm over the frequency range of 50 kHz to 1 215 MHz, with the exception of the range of 108 MHz to 137 MHz, where it shall not exceed minus 64 dBm.

4.2.2.6.1.2 Conformance

The following equipment is required:

- Resistive load equal to the nominal input impedance of the receiver.
- Calibrated spectrum analyser to cover the frequency range defined in clause 4.2.2.6.1.1.

The measurement procedure consists in the following steps:

Step 1: Connect the RF output of the equipment under test directly into the RF input of the spectrum analyser. Exercise caution does not allow the transmitter to radiate.

Step 2: Tune the transceiver to one of the test channels (see clause 5.1).

Step 3: Using the calibrated spectrum analyser, measure the power level of any spurious emissions across the matching resistive load at the input of the receiver over the frequency range defined in clause 4.2.2.6.1.1.

Step 4: Record the frequency and power level of all signals which exceed the limit specified in clause 4.2.2.6.1.1.

Step 5: Repeat Steps 2 to 4 at the two remaining test channels (see clause 5.1).

Step 6: Check that the requirements of clause 4.2.2.6.1.1 are achieved.

4.2.2.6.2 Cabinet radiation

4.2.2.6.2.1 Requirement

Requirement for cabinet radiation is specified in EN 300 113-1 [1], clause 8.10.4.

4.2.2.6.2.2 Conformance

The test procedure specified in clause 8.10.3 of EN 300 113-1 [1] shall be carried out.

4.2.2.7 Out-of-band Intermodulation

4.2.2.7.1 Requirements

The aim of the following requirement is to specify the receiver linearity in order to guarantee the third order interception point (IP3) is at least 0 dBm. The requirement specified in clause 4.2.2 shall be achieved in the presence of two interfering signals, displaced in frequency, from the desired signal.

Desired signal (Gen A):

Level: minus 75 dBm

Modulation: VDB

Unwanted signal (Gen B):

Level: minus 32 dBm

Modulation: none

Frequency: test frequency ±1 MHz

Unwanted signal (GenC):

Level: minus 32 dBm

Modulation: VDB (simulated)

Frequency: test frequency ±2 MHz

4.2.2.7.2 Conformance

The following equipment is required:

- 3 VHF Signal Generator.
- External BER test equipment.
- RF combiner.

The measurement procedure consists in the following steps:

Step 1: Connect the equipment as shown in Figure 9.

Step 2: Use a signal generator (named Gen A), to generate the desired VDB signal to the receiver.

Step 3: Tune generator A to one of the test frequencies (see clause 5.1) and modulate the carrier with the test payload (maximum burst length of symbols) provided by the external BER test equipment. Adjust generator A to provide a level of -75 dBm at the receiver input terminals.

Step 4: Tune interfering signal generator B to a frequency 1 MHz above the selected test frequency. Set signal generator B to produce an unmodulated carrier, input to the receiver input terminals at a level of -32 dBm.

Step 5: Tune interfering signal generator C to a frequency 2 MHz above the selected test frequency. Set signal generator C to produce an interfering source (narrow-band FM signal as defined in clause 5.2.1.4, to simulate a second VDB source), input to the receiver input terminals at a level of minus 32 dBm.

Step 6: Apply the desired signal and the two interfering signals to the receiver input via the RF combiner and determine the uncorrected BER of the demodulated data at the receiver output with the external BER test equipment.

Step 7: Repeat Steps 3 to 6 for the remaining frequency combinations by retuning generators B and C.

Step 8: Repeat Steps 2 to 7 at the two remaining test channels (see clause 5.1).

Step 9: Check that the uncorrected BER requirement (see clause 4.2.2) is achieved in every case.

NOTE 1: In the absence of the desired signal (i.e. Generator A switched "off"), it is recommended that the intermodulation products produced by any interaction between the interfering signal generators B and C, have a power level less than -105 dBm at the receiver input. Additional band-pass filters, inserted between each generator and the RF combiner, may be necessary to reduce the intermodulation product.

NOTE 2: In order to avoid intermodulation products stimulated in the desired VDB source by the two undesired sources, attenuators or circulators may be added between the desired VDB source and the RF combiner.

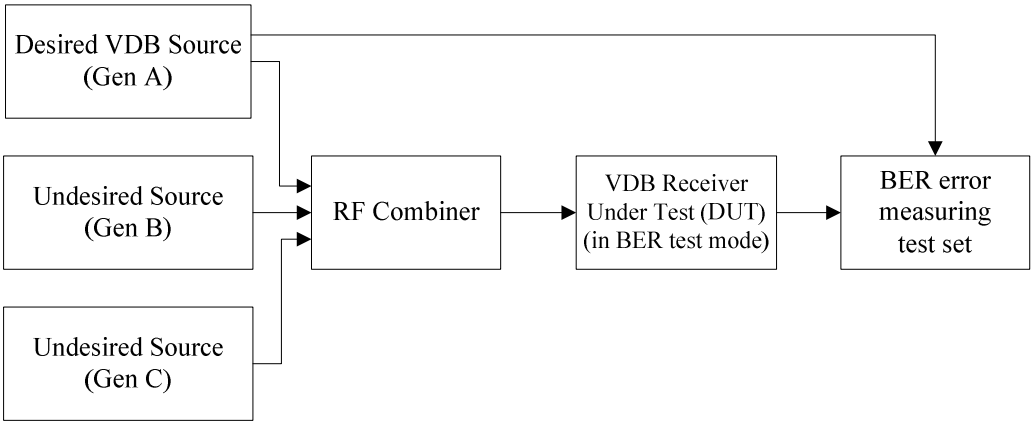

Figure 9: In band Intermodulation measurement

5 General test conditions for compliance with technical requirements

5.1 Test channels

Tests shall be carried out on at least three channels:

- 108,025 MHz.
- 112,00 MHz.
- 117,950 MHz.

5.2 BER test requirements

A BER test shall use a VHF signal generator representing the desired source signal and external BER test equipment (e.g. a computer and test software or Arbitrary Waveform Generator (AWG) interfaced to the VHF signal generator in vector modulation mode) which receives each burst payload from the receiver.

The uncorrected bit error rate (BER) shall be less than or equal to 10^{-4}, while operating over the receiver dynamic range specified in clause 4.2.2.1.1. The reference signal level applied at the receiver input for all receiver requirements, unless otherwise stated is minus 81 dBm.

5.2.1 Uncorrected BER mode

A method for placing the receiver into the uncorrected BER mode shall be provided by manufacturers. The uncorrected BER mode is distinct from the operational mode.

The uncorrected BER mode is used to measure the uncorrected BER requirement:

1) The receiver shall forward each burst payload to the external BER test equipment without error detection or correction procedures.

2) The test payload shall be forwarded to the external BER test equipment only if the burst was successfully detected via the standard 16 symbols synchronization sequence.

5.2.2 VHF signal generators

Receiver test procedures require the use of a high performance VHF signal generator in order to permit high precision measurement. This VHF signal generator shall be capable of the specified modulation format and transmission waveform.

1) The VHF signal generator shall support transmission of VDB test bursts consisting of the ramp up period plus the standard 16 symbols synchronization sequence followed by a variable length test message, up to the maximum length.

2) An external interface to the VHF signal generator shall be provided in order that the test payload can be provided via the external BER test equipment.

5.2.3 External BER test equipment

1) The test payload provided by the external BER test equipment shall be mapped directly into the burst payload in VDB format. The formatting shall include Cyclic Redundancy Check (CRC), scrambling and header.

NOTE: Forward Error Correction (FEC) may be encoded or left null, as this information will not be used when the receiver is configured to output "uncorrected" BER messages.

2) Unless otherwise stated, tests shall be conducted with GBAS standard test messages as defined in clause 5.2.

3) The external BER test equipment generating the test payload for transmission by the VHF signal generator, and receiving/processing the received test payload shall be synchronized either explicitly (via a direct connection) or implicitly (by knowledge of the test payload).

4) Calculation of cumulative BER statistics shall begin once synchronization of the external BER test equipment between the transmitting and receiving burst payload has been accomplished. The receiving external BER test equipment shall detect the loss of an entire burst implicitly by lack of a burst payload message in the given burst period. Each test should include a running count of synchronization failures in addition to the cumulative BER.

5.2.4 Interfering (or undesired) source

Tests for CCI and ACR with the VDB waveform as the interfering signal shall be performed with the interfering signal applied in a continuous (non-pulsed) manner. The waveform shall simulate a VDB signal. Tests have shown that a suitable interfering source is a VHF signal generator configured to produce a narrow-band FM signal modulated with a 400 Hz tone at a peak frequency deviation of 5,25 kHz.

Figure 10 shows the basic test setup for receiver BER tests.

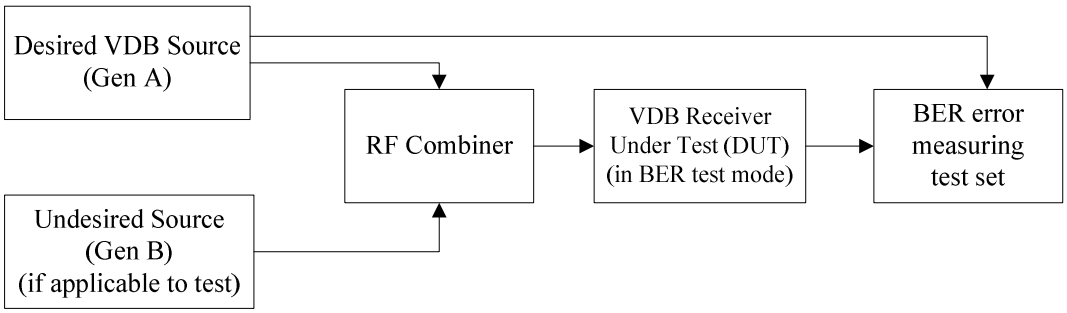

Figure 10: Receiver BER measurement

5.3 GBAS transmission

5.3.1 GBAS VDB transmitter requirements

Unless otherwise stated, any arbitrary signal generator may be used for conformance measurements of the monitor in the clause 4.2.2. In order to prevent falsified measurements of the monitor, the arbitrary signal generator shall fulfil the requirements for transmitters defined in clause 4.2.1.

NOTE: It is recommended, that the arbitrary signal generator fulfils the requirements defined in [i.5].

5.3.2 GBAS Standard VDB test message

Unless otherwise stated, the reference bit sequence is specified as follows:

Each GBAS test message shall transmitted on an assigned time slot and shall be composed of:

- a training sequence
- a data application payload of 222 random bytes scrambled (maximum length random message and bit scrambling)
- the Reed Solomon bytes

5.4 General conditions of measurement

5.4.1 Receiver test signal arrangement

Test signal sources shall be connected to the receiver input in such a way that the impedance presented to the receiver input is 50 Ω ± 5 Ω, irrespective of whether one or more test signals are applied to the receiver simultaneously. This impedance requirement is identical to a return loss of better than 25 dB.

5.4.2 Performance check

Whilst the equipment is being subjected to the normal or extreme test conditions, establish compliance with the requirements of the following clause:

4.2.1.1 Frequency error (Tx).

4.2.1.2 Transmitter power (Tx).

4.2.2.1 Sensitivity (Rx).

5.5 Environmental conditions for testing

Tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile.

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the declared operational environmental profile) to give confidence of compliance for the affected technical requirements.

5.5.1 Normal and extreme test conditions

Measurements shall be made under normal test conditions and also, where stated, under extreme test conditions.

5.5.1.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be a combination of temperature and humidity within the following ranges:

- temperature: +15 °C to +35 °C
- relative humidity: 20 % to 75 %
- atmospheric pressure between 840 to 1 085 hPa

When it is impracticable to carry out the tests under these conditions, a note to this effect, stating the ambient temperature and relative humidity during the tests, shall be added to the test report.

5.5.1.2 Normal power sources

5.5.1.2.1 Mains voltage and frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage.

For the purpose of the present document, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of the test power source shall correspond to the appropriate AC mains.

5.5.1.2.2 Other power sources

For operation from other power sources, the normal test voltage shall be that declared by the equipment manufacturer.

5.5.2 Extreme test conditions

5.5.2.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made at:

- A lower temperature of -10 °C and an upper temperature of +55 °C
- A relative humidity between +20 % to +95 %
- An atmospheric pressure between 840 to 1 085 hPa

This test shall be performed at the nominal supply voltage as defined in clause 5.5.1.2.1.

5.5.2.2 Procedure for tests at extreme temperatures

5.5.2.2.1 General

The equipment shall be switched off during the temperature stabilizing periods.

For tests at the upper temperature on equipment designed for continuous operation, the equipment shall be placed in the test chamber and left until thermal equilibrium is reached. The equipment shall then be switched on for 30 minutes before measurements are made. Transmitters shall be operated in the highest rated power transmit condition in that 30 minutes period before measurements are made.

For tests at the lower temperature, the equipment shall be left in the test chamber until thermal equilibrium is reached. The equipment shall then be switched on for 1 minute in the standby or receive condition before measurements are made.

5.5.2.2.2 High temperature

- Place the equipment in a chamber and heat to 55 ºC (±3 ºC) and allow to stabilize for 1 hour.
- Switch on the equipment (transmitters shall be keyed).
- After 30 minutes carry out a performance check as detailed in clause 5.4.2.
- Switch off the equipment and allow the chamber to cool to room temperature over a 1 hour period.
- Allow time for the equipment to stabilize to normal room temperature and humidity before carrying out the next test.

5.5.2.2.3 Low temperature

- Place the equipment in a chamber and cool to -10 ºC (±3 ºC) for 2 hours.
- Switch on the equipment and maintain the chamber operating temperature at -10 ºC (±3 ºC).
- After 1 minute carry out a performance check as detailed in clause 5.4.2.
- Switch off the equipment and allow the chamber to rise to room temperature over a 1 hour period.
- Allow time for the equipment to stabilize to normal room temperature and for moisture to disperse before carrying out the next test.

5.5.2.3 Extreme values of test power sources

Mains voltage:

- The extreme test voltages shall be ±10 % of the value declared in clause 5.5.1.2.1.
- The frequency of the test voltage shall be the nominal frequency of the supply as declared in clause 5.5.1.2.1.
- This test shall be performed at the normal temperature and humidity as defined in clause 5.5.1.1.

5.5.2.4 Other power sources

For equipment using other power sources, or capable of being operated from a variety of power sources, the extreme test voltages shall be those agreed between the equipment manufacturer and the testing laboratory and shall be recorded in the test report.

5.5.2.5 Performance check

Whilst the equipment is being subjected to the extreme test conditions, establish compliance with the requirements of clause 5.3.2.

5.5.3 Test power source

During testing, the equipment shall be supplied from a test power source capable of producing normal and extreme test voltages as specified in the clauses 5.5.1.2, 5.5.2.3 and 5.5.2.4.

The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of testing the power source voltage shall be measured at the input terminals of the equipment.

During testing, the power source voltages shall be maintained within a tolerance of ±3 % relative to the voltage level at the beginning of each test.

5.6 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in the present document shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in Tables 5 and 6.

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028 [3] and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Tables 5 and 6 are based on such expansion factors.

Table 5: Transmitter measurement uncertainty: maximum values

Measurement uncertainties	Maximum values
Frequency error	±1 x 10^{-7}
Transmitter power (normal and extreme test conditions)	±0,75 dB
Adjacent channel power	±2,5 dB
Conducted spurious emissions: below 1 GHz between 1 GHz and 4 GHz	 ±3 dB ±6 dB
Cabinet radiation	±6 dB
Intermodulation attenuation	±3 dB
Receiver to transmitter turn-around time	±20 % of the limits values
Transmitter to receiver turn-around time	±20 % of the limits values
Modulation Accuracy - Symbol constellation error	±3 dB
Keying transient frequency behaviour	±3 dB
Transient frequency behaviour	±250 Hz

Table 6: Receiver measurement uncertainty: maximum values

Measurement uncertainties	Maximum values
Sensitivity	±3 dB
Co-channel interference	±3 dB
Adjacent channel rejection	±4 dB
Spurious response rejection	4 dB
Intermodulation response rejection	±3 dB
Blocking and desensitization	±4 dB
Conducted spurious emissions: below 1 GHz between 1 GHz and 4 GHz	 ±3 dB ±6 dB
Cabinet radiation	±6 dB

For the test methods according to the present document the uncertainty figures are valid to a confidence level of 95 % calculated according to the methods described in TR 100 028 [3].

Annex A (normative): HS Requirements and conformance Test specifications Table (HS-RTT)

The HS Requirements and conformance Test specifications Table (HS-RTT) in table A.1 serves a number of purposes, as follows:

- it provides a statement of all the requirements in words and by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it provides a statement of all the test procedures corresponding to those requirements by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it qualifies each requirement to be either:
  - Unconditional: meaning that the requirement applies in all circumstances; or
  - Conditional: meaning that the requirement is dependent on the manufacturer having chosen to support optional functionality defined within the schedule.
- in the case of Conditional requirements, it associates the requirement with the particular optional service or functionality;
- it qualifies each test procedure to be either:
  - Essential: meaning that it is included with the Essential Radio Test Suite and therefore the requirement shall be demonstrated to be met in accordance with the referenced procedures;
  - Other: meaning that the test procedure is illustrative but other means of demonstrating compliance with the requirement are permitted.

Table A.1: HS Requirements and conformance Test specifications Table (HS-RTT)

Harmonized Standard EN 303 084 The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive [i.1]						
Requirement			**Requirement Conditionality**		**Test Specification**	
No	**Description**	**Reference: Clause No**	**U/C**	**Condition**	**E/O**	**Reference: Clause No**
1	Frequency error	4.2.1.1.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.1.2
2	Transmitter power	4.2.1.2.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.2.2
3	Adjacent channel power	4.2.1.3.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.3.2
4	Spurious emissions - Conducted emissions	4.2.1.4.1.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.4.1.2
5	Spurious emissions - Radiated emissions - cabinet radiation	4.2.1.4.2.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.4.2.2
6	Intermodulation attenuation	4.2.1.5.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.5.2
7	Transient behaviour of the transmitter - RF power rise time	4.2.1.6.1.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.6.1.2
8	Transient behaviour of the transmitter - RF power release time	4.2.1.6.2.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.6.2.2
9	Modulation Accuracy - Symbol constellation error	4.2.1.7.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.7.2
10	Emissions in unassigned time slots	4.2.1.8.1	C	Only applicable for equipment containing a transmitter	E	4.2.1.8.2
11	Sensitivity	4.2.2.1.1	C	Only applicable for equipment containing a receiver	E	4.2.2.1.2
12	Symbol rate capture range	4.2.2.2.1	C	Only applicable for equipment containing a receiver	E	4.2.2.2.2
13	Co-channel rejection	4.2.2.3.1	C	Only applicable for equipment containing a receiver	E	4.2.2.3.2
14	Adjacent Channel selectivity	4.2.2.4.1	C	Only applicable for equipment containing a receiver	E	4.2.2.4.2
15	Spurious response rejection	4.2.2.5.1	C	Only applicable for equipment containing a receiver	E	4.2.2.5.2
16	Spurious emissions - Conducted spurious emission	4.2.2.6.1.1	C	Only applicable for equipment containing a receiver	E	4.2.2.6.1.2
17	Spurious emissions - Cabinet radiation	4.2.2.6.2.1	C	Only applicable for equipment containing a receiver	E	4.2.2.6.2.2
18	Out-of-band Intermodulation	4.2.2.7.1	C	Only applicable for equipment containing a receiver	E	4.2.2.7.2

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement or its test specification.

Description A textual reference to the requirement.

Clause Number Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is to be *unconditionally* applicable (U) or is *conditional* upon the manufacturers claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement shall or shall not be applicable for a technical requirement which is classified "conditional".

Test Specification:

E/O Indicates whether the test specification forms part of the Essential Radio Test Suite (E) or whether it is one of the Other Test Suite (O).

NOTE: All tests whether "E" or "O" are relevant to the requirements. Rows designated "E" collectively make up the Essential Radio Test Suite; those designated "O" make up the Other Test Suite; for those designated "X" there is no test specified corresponding to the requirement. The completion of all tests classified "E" as specified with satisfactory outcomes is a necessary condition for a presumption of conformity. Compliance with requirements associated with tests classified "O" or "X" is a necessary condition for presumption of conformity, although conformance with the requirement may be claimed by an equivalent test or by manufacturer's assertion supported by appropriate entries in the technical construction file.

Clause Number Identification of clause(s) defining the test specification in the present document unless another document is referenced explicitly. Where no test is specified (that is, where the previous field is "X") this field remains blank.

Annex B (informative): Bibliography

- Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC (EMC Directive).
- Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).

History

Document history			
V0.1.7	January 2013	EN Approval Procedure	AP 20130521: 2013-01-21 to 2013-05-21