

# ETSI EN 303 413 V1.2.1 (2021-04)



**Satellite Earth Stations and Systems (SES);  
Global Navigation Satellite System (GNSS) receivers;  
Radio equipment operating in the 1 164 MHz to 1 300 MHz  
and 1 559 MHz to 1 610 MHz frequency bands;  
Harmonised Standard covering the essential requirements for  
access to radio spectrum  
of article 3.2 of Directive 2014/53/EU**

---

**Reference****REN/SES-00445**

---

**Keywords**GNSS, harmonised standard, navigation, receiver,  
satellite**ETSI**650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

---

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° w061004871

---

**Important notice**

---

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at [www.etsi.org/deliver](http://www.etsi.org/deliver).

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

---

**Notice of disclaimer & limitation of liability**

---

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

---

**Copyright Notification**

---

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2021.  
All rights reserved.

# Contents

Intellectual Property Rights .....	5
Foreword.....	5
Modal verbs terminology .....	6
Executive summary .....	6
Introduction .....	6
1 Scope .....	7
2 References .....	7
2.1 Normative references .....	7
2.2 Informative references .....	7
3 Definition of terms, symbols and abbreviations.....	9
3.1 Terms .....	9
3.2 Symbols .....	9
3.3 Abbreviations.....	9
4 Technical requirements specifications .....	10
4.1 Environmental profile .....	10
4.2 Conformance specifications.....	11
4.2.1 Receiver blocking.....	11
4.2.1.1 Definition.....	11
4.2.1.2 Specification .....	11
4.2.1.3 Conformance .....	12
4.2.2 Receiver spurious emissions .....	12
4.2.2.1 Definition.....	12
4.2.2.2 Specification .....	12
4.2.2.3 Conformance .....	13
5 Testing for conformance with technical requirements .....	13
5.1 Environmental conditions for testing.....	13
5.2 Void .....	13
5.3 Test methodology for receiver blocking .....	13
5.3.1 General .....	13
5.3.2 Test setup for conducted measurements.....	13
5.3.2.1 Test equipment .....	13
5.3.2.2 EUT configuration.....	14
5.3.3 Test setup for radiated measurements .....	14
5.3.3.1 General .....	14
5.3.3.2 Test equipment .....	15
5.3.3.3 EUT configuration.....	15
5.4 Receiver blocking test.....	16
5.4.1 General .....	16
5.4.2 Test conditions .....	16
5.4.3 Test method for GUE utilizing the 1 559 MHz to 1 610 MHz RNSS band .....	17
5.4.4 Test method for GUE utilizing the 1 164 MHz to 1 300 MHz RNSS band .....	17
5.5 Receiver spurious emissions test .....	17
5.5.1 General .....	17
5.5.2 Test conditions .....	18
5.5.3 Test method.....	18
5.5.3.1 Conducted measurement.....	18
5.5.3.1.1 Introduction.....	18
5.5.3.1.2 Pre-scan.....	18
5.5.3.1.3 Measurement of the emissions identified during the pre-scan .....	19
5.5.3.2 Radiated measurement.....	20

<b>Annex A (informative):</b>	<b>Relationship between the present document and the essential requirements of Directive 2014/53/EU .....</b>	<b>21</b>
<b>Annex B (normative):</b>	<b>Details of parameters used in technical requirements specifications (clause 4) .....</b>	<b>22</b>
B.1	Blocking signal.....	22
B.1.1	Definition.....	22
B.1.2	Measurement technique for validation of the blocking signal settings .....	23
B.2	GNSS signals .....	24
B.2.1	Definition.....	24
B.2.2	GNSS signal details .....	24
B.2.3	GNSS satellite details .....	26
<b>Annex C (informative):</b>	<b>C/N<sub>0</sub> degradation metric .....</b>	<b>27</b>
C.1	General .....	27
C.2	Definition .....	27
C.3	Example calculation of nominal 1 dB degradation of C/N <sub>0</sub> .....	27
<b>Annex D (informative):</b>	<b>Test Report Application Form for ETSI EN 303 413 .....</b>	<b>29</b>
D.1	The right to copy .....	29
D.2	General .....	29
D.3	Information as required by clause 5.4.3 and clause 5.4.4.....	29
D.4	Information as required by clause 5.5 .....	31
<b>Annex E (informative):</b>	<b>GNSS Interface Specifications.....</b>	<b>33</b>
<b>Annex F (informative):</b>	<b>Background to Conformance specifications.....</b>	<b>34</b>
F.1	Introduction .....	34
F.2	Metric used for measurements in GNSS receivers.....	34
F.3	Receiver sensitivity .....	34
F.3.1	Definition.....	34
F.3.2	Justification for non-inclusion .....	34
F.4	Receiver co-channel rejection .....	35
F.4.1	Definition.....	35
F.4.2	Justification for non-inclusion .....	35
F.5	Receiver Selectivity.....	35
F.5.1	Definition.....	35
F.5.2	Justification for non-inclusion .....	35
F.6	Other receiver effects .....	36
F.6.1	Receiver dynamic range.....	36
F.6.1.1	Definition .....	36
F.6.1.2	Justification for non-inclusion.....	36
F.6.2	Reciprocal mixing.....	36
F.6.2.1	Definition .....	36
F.6.2.2	Justification for non-inclusion.....	36
<b>Annex G (informative):</b>	<b>Change history .....</b>	<b>37</b>
History .....		38

# Intellectual Property Rights

## Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, PLUGTESTS™, UMTS™ and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. 3GPP™ and LTE™ are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. oneM2M™ logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

## Foreword

This Harmonised European Standard (EN) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.8] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU 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].

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.

### National transposition dates

Date of adoption of this EN:	12 <u>April 2021</u>
Date of latest announcement of this EN (doa):	31 <u>July 2021</u>
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 <u>January 2022</u>
Date of withdrawal of any conflicting National Standard (dow):	31 <u>January 2023</u>

---

## 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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

---

## Executive summary

The present document gives the technical requirements (clause 4) and test methodology (clause 5) for presumption of conformity of GNSS User Equipment with article 3.2 of Directive 2014/53/EU [i.1].

---

## Introduction

~~ETSI has designed a modular structure for the standards. Each standard is a module in the structure. The modular structure is shown in ETSI EG 203 336 [i.2].~~

The present document defines technical requirements to support the essential requirements of article 3.2 of ~~the Radio Equipment~~ Directive 2014/53/EU [i.1] which states "*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*".

The present document does not contain any requirement, recommendation or information about the installation of the GNSS user equipment.

# 1 Scope

The present document specifies technical characteristics and methods of measurements for Global Navigation Satellite System (GNSS) User Equipment (GUE).

Global Navigation Satellite System (GNSS) User Equipment (GUE) is capable of operating as part of one or more ~~radionavigation-satellite-service~~ RadioNavigation-Satellite Service (RNSS) systems in the RNSS frequency bands given in table 1-1.

**Table 1-1: ~~Radionavigation-satellite-service~~ RadioNavigation-Satellite Service (RNSS) frequency bands**

RNSS frequency bands	Comments
1 164 MHz to 1 300 MHz	space-to-Earth
1 559 MHz to 1 610 MHz	space-to-Earth

A GUE receives radio signals from one or more GNSS constellation for the purpose of radiodetermination of the position, velocity, and/or other characteristics of an object; or the obtaining of information relating to those parameters, by means of the propagation properties of radio waves. RNSS is defined as "A *radiodetermination-satellite service used for the purpose of radionavigation*" (article No. 1.43 of the ITU Radio Regulations [i.13]).

The present document applies to all GUE operating in the bands given in table 1-1 with the ability to receive any GNSS constellation (e.g. BeiDou (BDS), Galileo, Global Positioning System (GPS), ~~BeiDou (BDS)~~, Global Navigation Satellite System (GLONASS), Global Positioning System (GPS), Space Based Augmentation Systems System (SBAS)).

NOTE: The relationship between the present document covers the and essential requirements of article 3.2 of Directive 2014/53/EU [i.1] under the conditions identified is given in annex A.

## 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 <https://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 300 328 (V2.4.1) (~~11 20162.2~~): "Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU for access to radio spectrum".

### 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.

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 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] ~~ETSI EG 203 336 (V1.1.1) (08-2015): "Electromagnetic compatibility and Radio spectrum Matters (ERM); 2.1): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive\_2014/53/EU".~~
- [i.3] Recommendation ITU-R M.1787: "Description of systems and networks in the radionavigation-satellite service (space-to-Earth and space-to-space) and technical characteristics of transmitting space stations operating in the bands 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz".
- [i.4] Recommendation ITU-R M.1901: "Guidance on ITU-R Recommendations related to systems and networks in the radionavigation-satellite service operating in the frequency bands 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz, 5 000-5 010 MHz and 5 010-5 030 MHz".
- [i.5] Recommendation ITU-R M.1902: "Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) operating in the band 1 215-1 300 MHz".
- [i.6] Recommendation ITU-R M.1903: "Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) and receivers in the aeronautical radionavigation service operating in the band 1 559-1 610 MHz".
- [i.7] Recommendation ITU-R M.1905: "Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) operating in the band 1 164-1 215 MHz".
- [i.8] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.
- [i.9] ~~CISPR 16-1-4 Ed. 3.0 (2010): 2019: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements".~~
- [i.10] ETSI TR 102 273 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".
- [i.11] ~~ETSI TR 100 028 1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1".~~  
] \_\_\_\_\_ Void.
- [i.12] ~~ETSI TR 100 028 2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".~~  
] \_\_\_\_\_ Void.
- [i.13] ITU Radio Regulations (edition of 2016).
- [i.14] EN IEC 55016-1-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus" (produced by CENELEC).
- [i.15] EN 55016-2-3: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurements of disturbances and immunity - Radiated disturbance measurements" (produced by CENELEC).



[i.16] EN 55032: "Electromagnetic compatibility of multimedia equipment - Emission requirements"  
(produced by CENELEC).

## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

For the purposes of the present document, the terms ~~and definitions~~ given in Directive 2014/53/EU [i.1] and the following apply:

**C/N<sub>0</sub>**: carrier to noise-density ratio, expressed in dB-Hz

NOTE: The ratio of the received (GNSS) signal carrier power C, in dBW or dBm, to the noise power spectral density, in dBW/Hz or dBm/Hz, in the absence of interference.

**C/(N<sub>0</sub>+I)**: carrier to noise-and-interference-density ratio,  $C/(N_0+I)$ , in dB-Hz

**conducted measurements**: measurements of the performance of the EUT made by direct wired connection to the antenna port

**Equipment Under Test (EUT)**: equipment under test and subject to the performance requirements of the present document

**GNSS User Equipment (GUE)**: radiodetermination equipment capable of receiving signals from one or more GNSS constellation

NOTE: Such a receiver can acquire and then track GNSS signals to determine its location and/or velocity and/or time and/or other related parameters.

**radiated measurements**: measurements of the performance of the EUT made by placing the EUT in a suitable shielded container and radiating the required signals to the EUT

NOTE: I.e. without using a direct wired connection to the antenna port.

**RadioNavigation-Satellite Service (RNSS)**: ~~service(s)~~ services used for the purpose of radionavigation, that is for the determination of the position, velocity, and/or other characteristics of an object

NOTE: Includes the use of GNSS and other RNSS systems.

**RNSS frequency band**: continuous ranges of frequencies detailed in table 1-1, allocated by the ITU Radio Regulations ~~to the RNSS~~ [i.13] to the RNSS

**spurious emissions**: any unintentional GUE emissions, whether inside or outside the receiver bandwidth

NOTE: Since a GNSS receiver is receive-only, any emission is unintentional.

### 3.2 Symbols

Void.

### 3.3 Abbreviations

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

AM(R)S	Aeronautical Mobile (Route) Service
ARNS	Aeronautical RadioNavigation Service
AWGN	Additive White Gaussian Noise
BDS	BeiDou Navigation Satellite System

NOTE: See Recommendation ITU-R M.1787 [i.3], annex 7.

<u>CISPR</u>	<u>Comité International Spécial des Perturbations Radioélectriques</u>
<u>DDC</u>	<u>Digital Down Conversion</u>
e.i.r.p.	effective isotropically radiated power
e.r.p.	effective radiated power
<u>EC</u>	<u>European Commission</u>
<u>EFTA</u>	<u>European Free Trade Association</u>
<u>EGNOS</u>	<u>European Geostationary Navigation Overlay Service</u>
<u>EU</u>	<u>European Union</u>
<u>EUT</u>	<u>Equipment Under Test</u>
<u>GAGAN</u>	<u>GPS-Aided GEO Augmented Navigation System</u>
<u>GHz</u>	<u>Gigahertz</u>
<del>GPS</del>	<del>Global Positioning System</del>

~~NOTE: See Recommendation ITU-R M.1787 [i.3], annex 2.~~

GLONASS      GLObalnaya NAVigationonnaya Sputnikovaya Sistema

NOTE: Latin transliteration of the Cyrillic abbreviation ГЛОНАСС which stands for Глобальная навигационная спутниковая система translating to Global Navigation Satellite System (see Recommendation ITU-R M.1787 [i.3], annex 1).

GNSS            Global Navigation Satellite System

GPS            Global Positioning System

~~NOTE: See Recommendation ITU-R M.1787 [i.3], annex 2.~~

GUE            GNSS User Equipment

Hz             Hertz

IGSO          Inclined Geosynchronous Satellite Orbit

ITU             International Telecommunication Union

kHz            Kilohertz

LO             Local Oscillator

MEO            Medium Earth Orbit

MHz           Megahertz

MSAS          MTSAT Satellite Based Augmentation Navigation System

MSS            Mobile Satellite Service

OOBE          Out-Of-Band Emissions

RF             Radio Frequency

~~RNSS~~         ~~RadioNavigation-Satellite Service~~

~~NOTE: See Recommendations ITU-R 1901 [i.4], 1902 [i.5], 1903 [i.6], 1905 [i.7].~~

RMS            Root Mean Square

RNSS          RadioNavigation-Satellite Service

~~NOTE: See Recommendations ITU-R M.1901 [i.4], M.1902 [i.5], M.1903 [i.6] and M.1905 [i.7].~~

SBAS           Space Based Augmentation System

NOTE: See Recommendation ITU-R M.1787 [i.3], annex 8.

WAAS          Wide Area Augmentation System

## 4 Technical requirements specifications

### 4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the GUE, which shall be ~~declared by the manufacturer~~ in accordance with its intended use. The GUE shall comply with all the technical requirements of the present document ~~which are identified as applicable in annex A~~ at all times when operating within the boundary limits of the ~~declared~~ operational environmental profile defined by its intended use.

## 4.2 Conformance specifications

### 4.2.1 GUE adjacent frequency band selectivity performance

#### 4.2.1 Receiver blocking

##### 4.2.1.1 Definition

~~GUE adjacent frequency band selectivity~~ Receiver blocking is a measure of the ~~ability~~ capability of the GUE to ~~achieve the specified performance in~~ receive a wanted signal without exceeding a given degradation due to the presence of ~~noise produced by signals~~ an unwanted input signal operating in accordance with the allocation table of the ITU Radio Regulations [i.13] in frequency bands adjacent or near-adjacent to the relevant RNSS band.

##### 4.2.1.2 Specifications ~~Specification~~

The  $C/N_0$  metric reported by the GUE for all GNSS ~~constellations~~ and GNSS signals given in table 4-1 and supported by the GUE shall not degrade by more than the value given in equation (4-1) when ~~an adjacent frequency~~ a blocking signal is applied. The ~~adjacent frequency~~ blocking signal is defined in table 4-4, with the frequencies and power levels defined in table 4-2 and/or in table 4-3 depending on the RNSS bands supported by the GUE.

Equation (4-1): Maximum degradation in  $C/N_0$

$$\Delta C/N_0 \leq 1 \text{ dB} \quad (4-1)$$

**Table 4-1: GNSS ~~constellations~~, GNSS signals and RNSS frequency bands**

GNSS Constellation	GNSS Signal Designations	RNSS Frequency Band (MHz)
BDS	<del>B1</del> B1I	1 559 to 1 610
	B1C	1 559 to 1 610
Galileo	E1	1 559 to 1 610
	E5a	1 164 to 1 215
	E5b	1 164 to 1 215
	E6	1 215 to 1 300
GLONASS	G1	1 559 to 1 610
	G2	1 215 to 1 300
GPS	L1 C/A	1 559 to 1 610
	L1C	1 559 to 1 610
	<del>L2</del> L2C	1 215 to 1 300
	L5	1 164 to 1 215
SBAS	L1	1 559 to 1 610
	L5	1 164 to 1 215

**Table 4-2: Frequency bands, ~~adjacent frequency~~ blocking signal test point centre frequencies and power levels for the 1 559 MHz to 1 610 MHz RNSS band**

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent <del>frequency</del> Blocking signal power level (dBm)	Comments
1 518 to 1 525	1 524	-65	MSS (space-to-Earth) band
1 525 to 1 549	1 548	-95	MSS (space-to-Earth) band
1 549 to 1 559	1 554	-105	MSS (space-to-Earth) band
1 559 to 1 610	GUE RNSS band under test		
1 610 to 1 626	1 615	-105	MSS (Earth-to-space) band
1 626 to 1 640	1 627	-85	MSS (Earth-to-space) band

**Table 4-3: Frequency bands, adjacent frequency blocking signal test point centre frequencies and power levels for the 1 164 MHz to 1 300 MHz RNSS band**

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent frequency blocking signal power level (dBm)	Comments
960 to 1 164	1 154	-75	AM(R)S, ARNS band
1 164 to 1 215		GUE RNSS band under test	
1 215 to 1 260		GUE RNSS band under test	
1 260 to 1 300		GUE RNSS band under test	
1 300 to 1 350	1 310	-85	Radiolocation, ARNS, RNSS (Earth-to-space) band

**Table 4-4: Adjacent frequency blocking signal**

Parameter	Value	Comments
Frequency	See table 4-2 and table 4-3	
Power level	See table 4-2 and table 4-3	
Bandwidth	1 MHz	See clause B.1 for details
Format	AWGN	

Annex B contains details of the adjacent frequency blocking signal and the GNSS signals that shall be used in performing the conformance tests. Annex C contains a detailed explanation of the  $C/N_0$  metric. Clause C.3 describes the calculation of the nominal bounding value for the adjacent frequency blocking signal power level at the points closest to the operating band given in table 4-2.

#### 4.2.1.3 Conformance

A GUE utilizing the RNSS band 1 559 MHz to 1 610 MHz shall be presumed to conform to this technical requirements specification if the  $C/N_0$ , as reported by the GUE for each declared GNSS constellation and GNSS signal, does not degrade by more than the value given in equation (4-1) in the presence of the adjacent frequency blocking signals in table 4-2.

A GUE also utilizing any of the RNSS band(s) 1 164 MHz to 1 300 MHz shall be presumed to conform to this technical requirements specification if the  $C/N_0$ , as reported by the GUE for each declared GNSS constellation and GNSS signal, also does not degrade by more than the value given in equation (4-1) in the presence of the adjacent frequency blocking signals in table 4-3.

The testing for conformance with the technical requirements specifications is given in clause 5.4.

## 4.2.2 Spurious Receiver spurious emissions

### 4.2.2.1 Definition

Receiver spurious emissions are emissions at any frequency when the GUE is in receive only operating mode active.

### 4.2.2.2 Limit Specification

The receiver spurious emissions of the GUE shall not exceed the values given in table 4-5.

In case of a GUE with an external antenna connector, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or for emissions radiated by a GUE with an integral antenna (without an antenna connector), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

**Table 4-5: Spurious Receiver spurious emission limits**

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 8,3 GHz	-47 dBm	1 MHz

### 4.2.2.3 Conformance

The conformance tests for this requirement are defined in clause 5.5.

---

## 5 Testing for conformance with technical requirements

### 5.1 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 defined by its intended use.

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 defined by its intended use) to give confidence of compliance for the affected technical requirements.

Unless otherwise declared, the ~~normal~~ temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

- Temperature: +15 °C to +35 °C.
- Relative humidity: 20 % to 75 %.

### ~~5.2 Interpretation of the measurement results~~

~~The interpretation of the results recorded in a test report for the measurements described in the present document should be according to the guidance given in ETSI TR 100 028-1 [i.11] and ETSI TR 100 028-2 [i.12], in particular in annex D of the ETSI TR 100 028-2 [i.12].~~

### 5.2 Void

### 5.3 Test methodology for ~~adjacent frequency band selectivity~~ test receiver blocking

#### 5.3.1 General

For purposes of simplicity, accuracy, and ease of testing, conducted testing is preferred. If this is not feasible then radiated testing may be used.

If special test equipment is used to perform the test, this shall be declared in the test report, for example, custom test fixture, wire harness, or adapter cable.

#### 5.3.2 Test setup for conducted measurements

##### 5.3.2.1 Test equipment

The following test equipment is recommended for performing the tests:

- GNSS signal generator capable of simulating the GNSS constellations and GNSS signals declared as supported by the EUT.
- RF signal generator capable of generating the ~~adjacent frequency~~ blocking signal specified in table 4-4.
- Filter for ensuring the test is not adversely affected by OOB from the RF signal generator into the RNSS band if necessary.

- RF power combiner for combining the GNSS signal(s) and the adjacent frequency blocking signal.
- A means for recording  $C/N_0$  as reported by the EUT before and after application of the adjacent frequency blocking signal.
- A means for establishing the RF power of the test signals at the input to the EUT (this may be accomplished by means of a directional coupler and power meter, or by appropriate calibration prior to the test).

### 5.3.2.2 EUT configuration

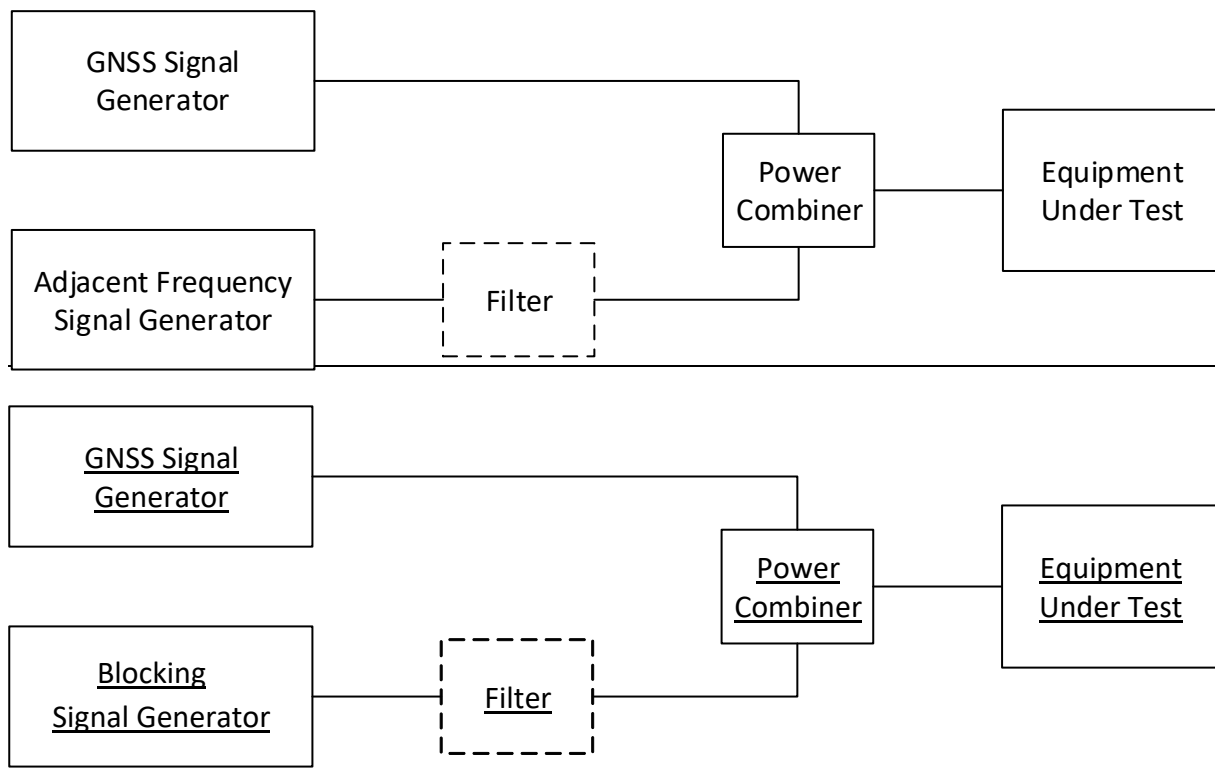
For an EUT with an external, detachable, antenna, the EUT shall be connected to the test bed by means of the antenna port. Alternatively, the EUT may be connected in the same manner as an EUT with an integrated antenna, described below.

For an EUT with an integrated antenna, the antenna element shall be removed and a connection from the antenna to the test bed shall be made in place of the antenna element.

A conceptual block diagram for conducted measurements is shown in figure 5-1.

An equipment list and block diagram shall be provided if the test setup differs from the diagram in figure 5-1.

The test bed shall be calibrated so that the adjacent frequency blocking signal power levels of the test signals specified in table 4-2 and/or, as applicable, table 4-3 are presented to the input of the EUT.



**Figure 5-1: Conducted measurement setup for EUT adjacent frequency band selectivity receiver blocking**

## 5.3.3 Test setup for radiated measurements

### 5.3.3.1 General

Radiated measurements may be performed if conducted measurements are not feasible. In this case the testing should follow the guidance in ETSI TR 102 273 [i.10].

Radiated measurements ~~requires~~require additional test elements and equipment in addition to those specified for conducted measurements. Accordingly, if radiated measurements are performed then the details of the test setup and the calibration details shall be provided in the test report.

### 5.3.3.2 Test equipment

In addition to the test equipment given in clause 5.3.2, the following items are necessary:

- RF anechoic chamber.
- RF amplifiers to overcome cabling losses and path loss in the chamber for the test signals if necessary.
- Transmit antennas for both the GNSS ~~signals~~signals and ~~adjacent frequency blocking~~ signal.
- A means for establishing and calibrating the RF power of both the GNSS ~~signals~~signals and the ~~adjacent frequency blocking~~ signal at the antenna of the EUT (this may be accomplished in real-time by means of an RF field probe, or by calibration (e.g. substitution method, or analytically)). Refer to CISPR 16-1-4 ~~Ed.3.0 (2010);2019~~ [i.9] for further information on appropriate calibration of radiated measurements.

### 5.3.3.3 EUT configuration

A conceptual block diagram for radiated measurements is shown in figure 5-2.

An equipment list and block diagram shall be provided, if the test setup differs from the diagram in figure 5-2.

The orientation of the EUT with respect to the transmitting antennas (normally boresight) shall be declared in the test report.

The test bed shall be calibrated so that the ~~adjacent frequency blocking~~ signal power levels specified in table 4-2 and, as applicable, table ~~4-3~~ are incident upon the antenna of the EUT.

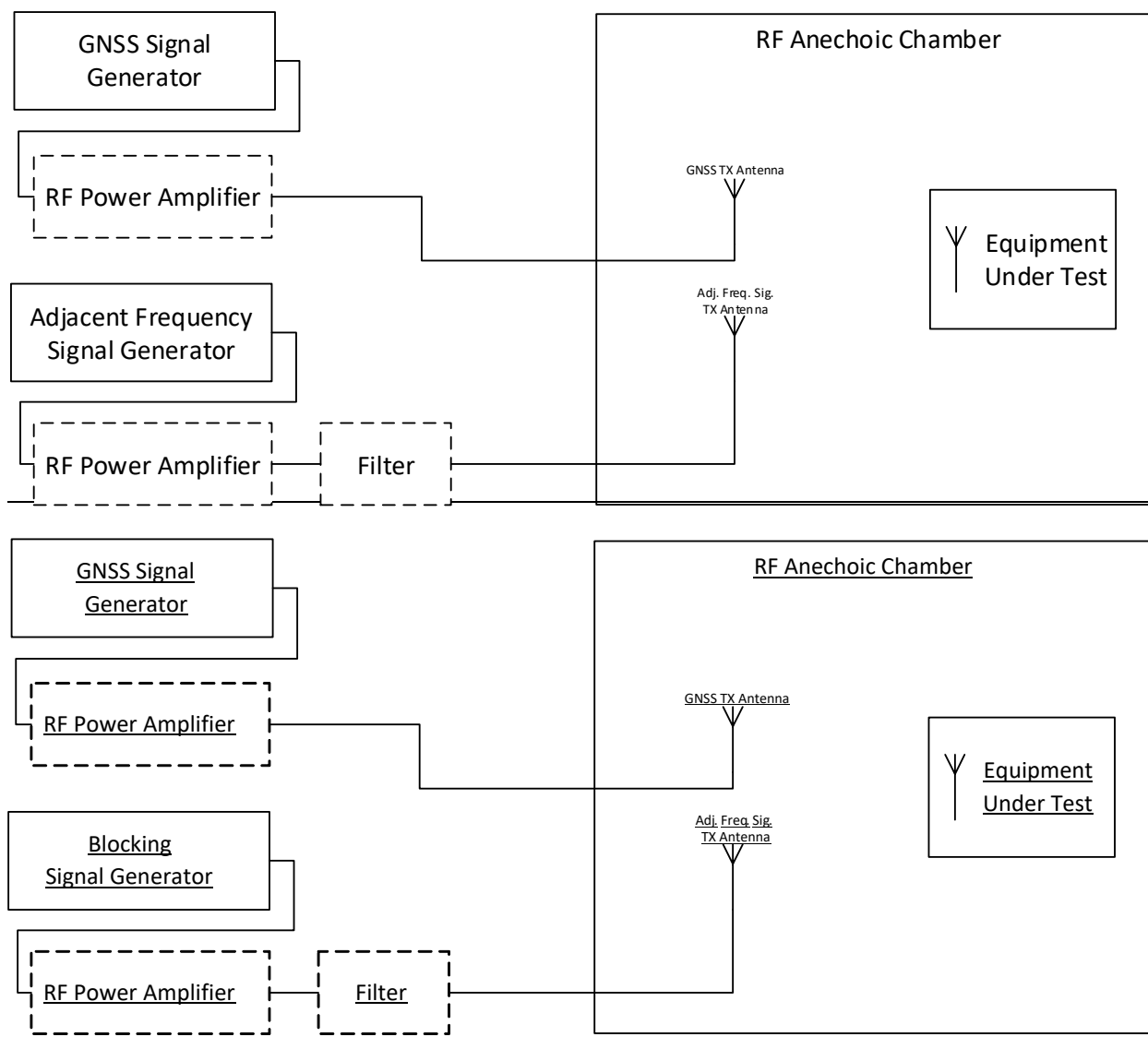


Figure 5-2: Radiated measurement setup for EUT adjacent frequency band selectivity performance receiver blocking

## 5.4 ~~GUE adjacent frequency band selectivity~~ Receiver blocking test

### 5.4.1 General

Clause 5.4 contains the procedure for testing the ~~GUE adjacent frequency band selectivity performance~~.

It is recognized that alternative test methods may exist. If an alternate test method is chosen to demonstrate conformance, then it shall be ensured and declared in the test report that any alternative test method used yields results identical to those described in the present document ~~receiver blocking~~.

### 5.4.2 Test conditions

The test equipment and EUT shall be configured according to figure 5-1 for conducted measurements or figure 5-2 if radiated measurements are to be performed.

The test shall be performed in a clean RF environment, free from other sources of noise or interference that may affect the test results.



### 5.4.3 Test method for GUE utilizing the 1 559 MHz to 1 610 MHz RNSS band

- 1) Configure the GNSS signal generator to simulate ~~those~~ the GNSS constellations and GNSS signals from table-4-1 declared as supported by the GUE, with power levels and other details as specified in clause-B.2.
- 2) With the ~~adjacent frequency~~ blocking signal switched off, the EUT shall be given sufficient time to acquire all simulated satellites from the declared GNSS ~~system(s)-constellations~~.
- 3) Record the ~~baseline~~  $C/N_0$  value(s) reported by the EUT under the condition in step 2). Sufficient filtering shall be used to obtain a ~~stable value-(s)~~  $C/N_0$  may be averaged over time and across all the simulated satellites in view for each a particular GNSS constellation and GNSS signal. However,  $C/N_0$  shall not be averaged across different satellite signals in the same GNSS constellation or across different GNSS constellations. For a multi-GNSS constellation and/or multi-GNSS signal EUT, there shall be a separate  $C/N_0$  value recorded for each GNSS constellation and each GNSS signal supported.
- 4) The ~~adjacent frequency~~ blocking signal generator shall be configured to generate the signal defined in table 4-4, at the first test point centre frequency and signal power level as specified in table 4-2.
- 5) The ~~adjacent frequency~~ blocking signal shall be switched on, and the EUT's  $C/N_0$  value(s) recorded as in step 3) to measure the degradation with respect to the baseline. The difference(s) between this value(s) and the value(s) recorded in step 3) is the  $C/N_0$  degradation caused by the blocking signal for this test point.
- 6) Test point Pass/Fail Criteria: If the  $C/N_0$  degradation from step 5) does not exceed the value in equation-(4-1), then this test point is set to "pass". If the  $C/N_0$  degradation exceeds the value in equation-(4-1), then this test point is set to "fail-". For a multi-GNSS constellation and/or multi-GNSS signal EUT, there shall be a separate pass/fail determination for each GNSS constellation and for each GNSS signal supported. If the  $C/N_0$  degradation exceeds the value in equation (4-1) for any supported GNSS constellation or supported GNSS signal, then this test point is set to "fail".
- 7) Step 1) through step 6) shall be repeated for all test point centre frequencies (and associated signal power level) specified in table 4-2.

If the EUT passes the  $C/N_0$  degradation test for all test points for all GNSS constellations and all GNSS signals declared as supported from table 4-1, the EUT shall be deemed to "pass". If the  $C/N_0$  degradation test fails for any GNSS constellation or GNSS signal at any of the test points, the EUT shall be deemed to "fail".

### 5.4.4 Test method for GUE utilizing the 1 164 MHz to 1 300 MHz RNSS bandsband

For a GUE also utilizing the RNSS bands in the 1 164 MHz to 1 300 MHz range, the test method in clause 5.4.3 (step-1) through step 7), inclusive), shall be repeated using the ~~adjacent frequency~~ blocking test point centre frequencies and associated signal power levels specified in table 4-3.

If the EUT passes the  $C/N_0$  degradation tests as defined in both clause 5.4.3 and clause 5.4.4, the EUT shall be deemed to "pass". If the  $C/N_0$  degradation test fails tests as defined in either or both of clause 5.4.3 or clause-5.4.4, the EUT shall be deemed to "fail".

## 5.5 Receiver spurious emissions test

### 5.5.1 General

Clause 5.5 contains the procedure for testing the receiver spurious emissions.

## 5.5.2 Test conditions

See clause 5.1 for the environmental test conditions. These measurements shall only be performed at the ~~normal~~-test conditions stated in clause 5.1.

Testing shall be performed when the EUT is ~~in receive only operating mode~~ inactive and the manufacturer shall ensure that the receiver remains active for the duration of the test. For this reason, GNSS signals may be required for this test. The manufacturer shall indicate whether GNSS signals were present or not in the test report.

The level of spurious emissions shall be measured as, either:

- a) their power in a specified load (conducted spurious emissions) and their effective radiated power when radiated by the cabinet or structure of the EUT (cabinet radiation); or
- b) the effective radiated power when radiated by cabinet and antenna in case of an EUT with integral antenna and with no temporary antenna connector.

## 5.5.23 Test method

### 5.5.23.1 Conducted measurement

#### 5.5.23.1.1 Introduction

In case of conducted measurements, the EUT shall be connected to the measuring equipment via an attenuator.

If required, the necessary GNSS signals shall be applied to the EUT.

The spectrum in the spurious domain shall be searched for emissions that exceed the limit values given in table 4-5 or that come to within 6 dB below these limits. Each occurrence shall be recorded.

NOTE: Given the unknown characteristics of the EUT's emissions, which may depend on EUT properties (e.g. clock frequency), some spectrum analyser settings like measurement time and number of sweeps are not specified. It is recommended to derive these settings according to the methods described in the following standards: EN IEC 55016-1-1 [i.14], EN 55016-2-3 [i.15] and EN 55032 [i.16].

The measurement procedure contains 2 parts.

#### 5.5.23.1.2 Pre-scan

The procedure in step 1) to step 43) below shall be used to identify potential unwanted emissions of the EUT:

4) The sensitivity of the spectrum analyser should be such that the noise floor is at least 12 dB below the limits given in table 4-5.

2)1) The emissions over the range 30 MHz to 1 000 MHz shall be identified.

Spectrum analyser settings:

- Resolution bandwidth: 100 kHz
- Video bandwidth: 300 kHz
- Filter type: 3 dB (Gaussian)
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points:  $\geq 19\ 400$  (for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented)
- Sweep time: Auto

Wait for the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.5.23.1.3 and compared to the limits given in table 4-5.

3)2) The emissions over the range 1 GHz to 8,3 GHz shall be identified.

Spectrum analyser settings:

- Resolution bandwidth: 1 MHz
- Video bandwidth: 3 MHz
- Filter type: 3 dB (Gaussian)
- Detector mode: Peak
- Trace Mode: Max Hold
- Sweep Points:  $\geq 14\ 600$  (for spectrum analysers not supporting this high number of sweep points, the frequency band may be segmented)
- Sweep time: Auto

Wait for the trace to stabilize. Any emissions identified during the sweeps above that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.5.23.1.3 and compared to the limits given in table 4-5.

4)3) In case of conducted measurements on smart antenna systems (equipment with multiple receive chains), step 2)1) and step 3)2) shall be repeated for each of the active receive chains, Ach. The limits used to identify emissions during this pre-scan shall be reduced by  $10 \times \log_{10}(Ach)$ .

~~The limits used to identify emissions during this pre-scan shall be reduced by  $10 \times \log_{10}(Ach)$ .~~

### 5.5.23.1.3 Measurement of the emissions identified during the pre-scan

The procedure in step 1) to step 4) below shall be used to accurately measure the individual unwanted emissions identified during the pre-scan measurements above. This method assumes the spectrum analyser has a Time Domain Power function.

1) The level of the emissions shall be measured using the following spectrum analyser settings:

- Measurement Mode: Time Domain Power-
- Centre Frequency: Frequency of the emission identified during the pre-scan-
- Resolution Bandwidth: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)-)
- Video Bandwidth:- 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)-)
- Frequency Span: Zero Span-
- Sweep mode: Single Sweep-
- Sweep time: 30 ms-
- Sweep points:  $\geq 30\ 000$ -
- Trigger: Video (for burst signals) or Manual (for continuous signals)-)
- Detector: RMS-

2) Set a window where the start and stop indicators match the start and end of the burst with the highest level and record the RMS value of the power measured within this window. If the spurious emission to be measured is a continuous transmission, the measurement window shall be set to the start and stop times of the sweep.

3) In case of conducted measurements on smart antenna systems (equipment with multiple receive chains), step 2) shall be repeated for each of the active receive chains, Ach.

- 3) Sum the measured power (within the observed window) for each of the active receive chains.
- 4) The value defined in step 2) or step 3) shall be compared to the limits defined in table 4-5.

### 5.5.23.2 Radiated measurement

The test site as described in ETSI EN 300 328 ~~[(V2.2.2) [1]~~, annex B and the applicable measurement procedures as described in ETSI EN 300 328 ~~[(V2.2.2) [1]~~, annex C shall be used.

The test procedure is further described in clause 5.5.23.1.

## Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.8] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU 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].

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.

**Table A-1: Relationship between the present document and the essential requirements of Directive 2014/53/EU**

Harmonised Standard ETSI EN 303 413					
Requirement				Requirement Conditionality	
No	Description	<u>Essential requirements of Directive</u>	<u>Reference: Clause No(s) of the present document</u>	U/C	Condition
1	Adjacent signal selectivity Receiver blocking	3.2	4.2.1	U	
2	Spurious Receiver spurious emissions	3.2	4.2.2	U	

### Key to columns:

#### Requirement:

- No** A unique identifier for one row of the table which may be used to identify a requirement.
- Description** A textual reference to the requirement.

#### Essential requirements of Directive

Identification of article(s) defining the requirement in the Directive.

#### Clause Number(s) of the present document

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 unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).
- Condition** Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

---

## Annex B (normative): Details of parameters used in technical requirements specifications (clause\_4)

### B.1 ~~Adjacent frequency~~Blocking signal

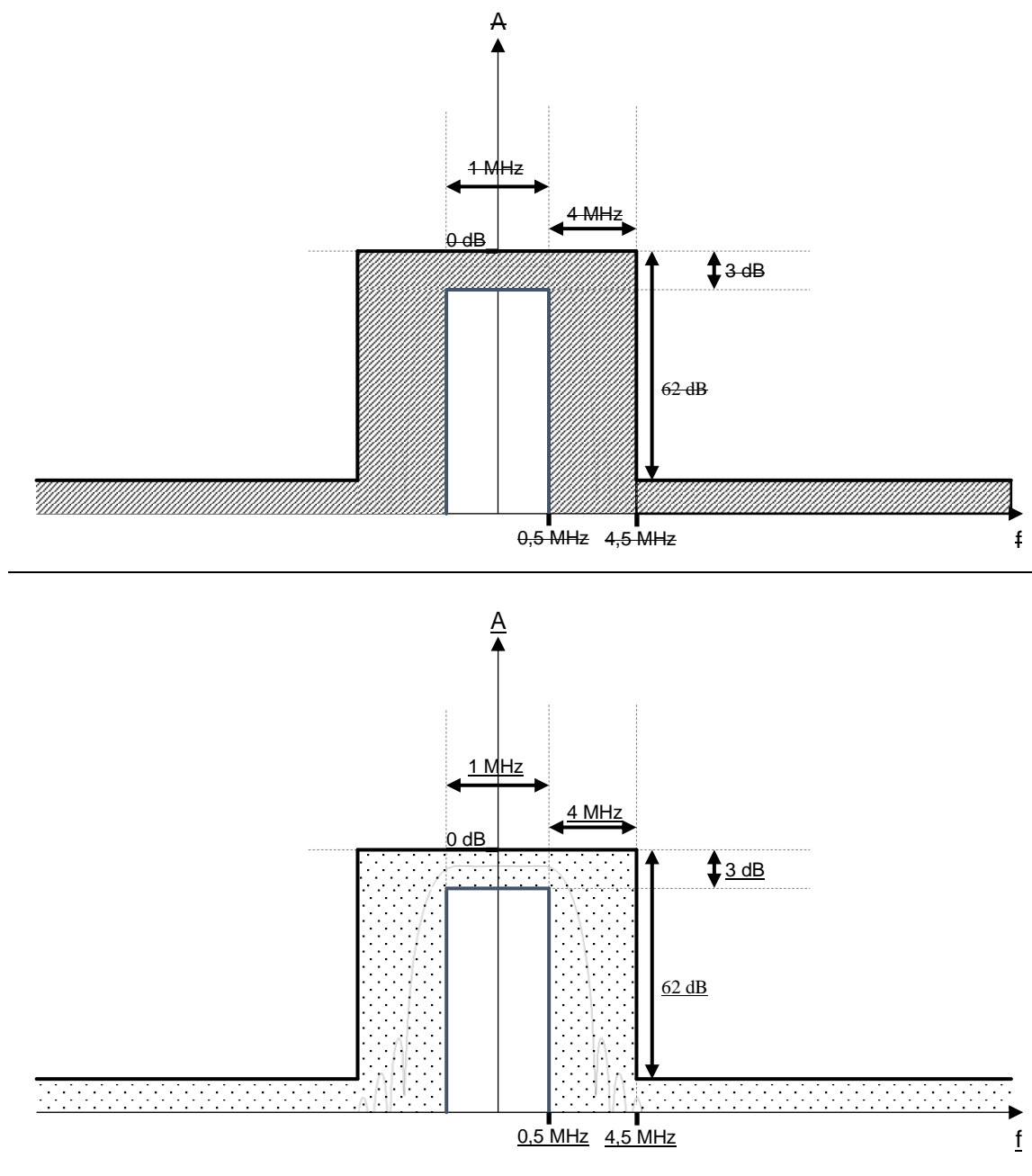
#### B.1.1 Definition

The ~~1 MHz filtered AWGN~~ signal used for ~~interferer~~blocking signal simulation shall be a 1 MHz filtered AWGN signal.

The filter used to generate this signal shall follow the requirements specified in this clause as follows:

- The filter passband shall have a bandwidth of at least 1 MHz. The bandwidth is defined as the frequency range in which the attenuation of the filter is not more than 3 dB.
- Within the 1 MHz bandwidth of the passband, the filter ripple shall be less than 3 dB.
- The stopband attenuation of the filter shall be at least 62 dB.
- The transition band between the passband and stopband of the filter is 4 MHz wide.
- Within the transition band, the filter shall not exceed the maximum passband gain.
- ~~The power level of the interferer signal shall comply with the values defined in table 4-2 and/or table 4-3 when measured over the 1 MHz bandwidth of the passband.~~

Figure B-1 illustrates the filter requirements. The filter's gain shall be within the hatched area. The thin line is an example of a filter that fulfils the requirements.



**Figure B-1: Adjacent frequency Filter used to generate the blocking signal**

The power level of the blocking signal shall comply with the values defined in table 4-2 and/or table 4-3 when measured over the 1 MHz bandwidth of the filter passband.

### B.1.2 ~~Recommended measurement~~ Measurement technique for validation of the adjacent frequency blocking signal settings

To verify that the adjacent frequency blocking signal is consistent with the filter mask described in clause B.1.1, a spectrum analyser with the following settings may be used to validate the blocking signal:

- Span:  $\geq 20$  MHz
- Resolution Bandwidth: 10 kHz
- Video Bandwidth: 30 kHz

- Detector: Power average
- Sweep points:  $\geq 4\,001$
- Sweep time:  $\geq 40$  s

The centre frequencies of the spectrum analyser and the signal generator should be aligned to one or more of the values mentioned in table 4-2 and/or table 4-3.

Since the typical noise floor of a spectrum analyser is higher than the stopband levels, the ~~interferer~~blocking signal power may be increased for the verification of the ~~interferer~~blocking signal before the actual test. For example, at a signal level of -1 dBm/MHz, a regular spectrum analyser can be used to verify the filter characteristics described in clause B.1.1. To avoid damaging the GUE during the blocking signal verification process, no GUE should be connected to the signal generator while the ~~interferer~~blocking signal power is set to higher values than described in table 4-2 and/or table 4-3.

---

## B.2 GNSS signals

### B.2.1 Definition

The GNSS signals are the (wanted) ~~signal(s)~~signals used during the conformance testing to simulate the GNSS satellites for the GNSS constellations and GNSS signals supported by the GUE. The signal details of the GNSS constellations are contained in the respective GNSS Interface Specifications (~~see annex E~~).

### B.2.2 GNSS signal details

All GNSS constellations and GNSS signals declared as supported in the test report shall be simulated during the conformance testing. ~~The relevant GNSS and GNSS signals and the relative signal levels between signal types per GNSS are detailed in table B-1.~~

**~~Table B-1: GNSS, GNSS signals and relative signal levels~~**

The signal power levels for each GNSS signal within each GNSS constellation are defined in table B-1.



**Table B-1: Signal power levels for each GNSS signal within each GNSS constellation supported**

GNSS constellation	GNSS signal	Signal levels relative to reference power levels (see level (note-4))	Galileo		GPS/Modernized GPS				GLONASS		SBAS		BDS (see note 2)						
			E	+dB	L1 C/A	L2	L5	D1	D2	E	+dB	E	+dB	L1	L2	L5	D1	D2	
BDS	B1I																		
	B1C (IGSO)																		
	B1C (MEO)																		
Galileo	E1																		
	E5a																		
	E5b																		
	E6																		
GLONASS	G1																		
	G2																		
GPS	L1 C/A																		
	E6	+2 dB																	
	E5	+2 dB																	
SBAS	L1																		
	L5																		

NOTE-4: The signal power levels represent the total signal power of the satellite per channel, not for example pilot and data channels separately.  
 NOTE 2: For BDS, D1 represents MEO/IGSO satellites B1I signal type and D2 represents GEO satellites B1I signal type.

Where more than one GNSS is supported then the relative signal levels between GNSS to be used during conformance testing are detailed in table B-2.

**Table B-2: Relative signal levels for each GNSS supported**

GNSS	Relative signal level for all satellites (see note)
GPS	0 dB
Galileo	+1,5 dB
GLONASS	-2,5 dB
SBAS	-2,5 dB
BDS	-4,5 dB

NOTE: GPS is used as the reference GNSS. If GPS is not supported then values shall be adjusted and referenced to another supported GNSS.

The signal level(s) for each GNSS shall be as detailed in table B-3 which also gives the maximum signal level that shall be used for each GNSS when the effects of table B-1 and table B-2 are taken into account.

**Table B-3: (Maximum) signal levels for each GNSS supported**

<b>GNSS</b>	<b>Parameters</b>	<b>Value</b>
GPS	(Maximum) signal level	-128,5 dBm
Galileo	(Maximum) signal level	-127 dBm
GLONASS	(Maximum) signal level	-131 dBm
SBAS	(Maximum) signal level	-131 dBm
BDS	(Maximum) signal level	-133 dBm

### B.2.3 GNSS satellite details

The GNSS signal generator shall be configured to maintain constant satellite signal power, independent of elevation angle. Otherwise, the satellite transmit power (and thus the reported  $C/N_0$ ) will change with elevation angle.

One or more satellites can be simulated and used for measurements for each GNSS constellation, there is no requirement to measure multiple satellites although multiple satellites may be used for averaging (within one GNSS constellation and one GNSS signal but not across multiple GNSS constellations or multiple GNSS signals) if desired.

In the case of BDS, at least one MEO satellite shall be used for measurements.

In the case of GLONASS, at a minimum Channel 6 (1 605,375 MHz) shall be used for measurements.

In the case of SBAS, only one system selected from EGNOS, GAGAN, MSAS and WAAS is required to be simulated and tested. The system used shall be declared in the test report.

## Annex C (informative): C/N<sub>0</sub> degradation metric

### C.1 General

Measurement of the degradation of C/N<sub>0</sub> is required to assess the performance of the EUT against the technical requirements in the present document. The information in this annex is intended to inform the manufacturer to assist in completing the tests and making the declaration of conformity.

### C.2 Definition

The C/N<sub>0</sub> degradation metric is used to assess the performance of the GUE against the technical requirements. It is derived as follows.

In the absence of interference, the carrier to noise-density ratio (C/N<sub>0</sub>) is the ratio of the received GNSS signal carrier power C, in watts, to the noise power spectral density N<sub>0</sub>. The noise power spectral density (N<sub>0</sub>, in W/Hz) is given by following expression:

$$N_0 = kT \quad (C-1)$$

where k is Boltzmann's constant,  $1,38 \times 10^{-23}$ , in joules (equivalent to W/Hz) per Kelvin and T is the GUE system noise temperature (in K). Using a decibel scale the baseline C/N<sub>0</sub> with no interference present is:

$$C/N_{0BL} = 10 \times \log_{10}(C/N_0) \text{ dB-Hz} \quad (C-2)$$

When interference is present, a reduction in C/N<sub>0</sub> can occur that is equivalent to an addition of I W/Hz in the in-band noise floor and in some cases a reduction in signal power  $\delta c$  to the received satellite signal. The resulting carrier to noise-and-interference-density ratio C/(N<sub>0</sub>+I), may be expressed as:

$$C/(N_0+I) = 10 \times \log_{10}((C - \delta c) / (N_0 + I)) \text{ dB-Hz} \quad (C-3)$$

Where  $\delta c = 0$  except for the case when the interference power is large enough to drive the GUE front end to a non-linear regime. The difference between these two conditions, that is the interference conditions versus the non-interference condition, is given by:

$$\Delta C/N_0 = C/(N_0+I) - C/N_{0BL} \quad (C-4)$$

This metric is used in the present document and clause 4 states the maximum allowed degradation of the GUE's reported C/N<sub>0</sub> in equation (4-1) in the presence of the adjacent frequency blocking signal compared to nominal, due to linear and/or non-linear effects in the GUE front end.

### C.3 Example calculation of nominal 1 dB degradation of C/N<sub>0</sub>

The following example noise floor calculation provides a was used in defining the nominal bounding value for the test points closest to the 1 559 MHz to 1 610 MHz RNSS operating band (see table 4-2).

In table C-1, the close-in frequency signal power levels denoted as -6 dB I/N has been calculated to achieve -6 dB interference-to-noise ratio with respect to the GUE noise floor. The GUE's pre-correlation noise power is a function of the GUE's noise figure and the system noise temperature, and is calculated by the formula:

$$N_0 = k \times T_0 \times B \times NF \quad (C-5)$$

Where  $k$  is Boltzmann's constant,  $1,38 \times 10^{-23}$ , in joules (equivalent to W/Hz) per Kelvin and  $T$  is the GUE system noise temperature (in K),  $B$  is the GUE's bandwidth (in Hz), and  $NF$  is the GUE's noise figure. Example parameter values and calculation is provided in the table C-1. A manufacturer may use existing sources or declare parameter values used to calculate the -6 dB I/N test power level.

**Table C-1: Close-in frequency signal power levels**

<b>Parameter</b>	<b>Example</b>	<b>Source</b>
System noise temperature $T_0$	290 K	Manufacturer declaration or reference Recommendation ITU-R M.1903 [i.6], table 2, row 4
Thermal noise at $T_0$	-174 dBm/Hz	Calculated
GUE noise figure	2 dB	Manufacturer declaration
GUE RF filter 3 dB bandwidth	20 MHz = 73 dB-Hz	Manufacturer declaration or reference Recommendation ITU-R M.1903 [i.6], table 2, row 6
-6 dB I/N test power level	$P = -174 \text{ dBm/Hz} + 73 \text{ dB-Hz}$ $+2 \text{ dB} -6 \text{ dB} = -105 \text{ dBm}$	Calculated

## Annex D (informative): Test Report Application Form for ETSI EN 303 413

### D.1 The right to copy

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the application form for testing so that it can be used for its intended purposes and may further publish the completed application form.

### D.2 General

The form contained in this annex may be used by the manufacturer to comply with the requirements contained in clause 5.4.3, clause 5.4.4 and clause 5.5 to provide the necessary information about the equipment to the test laboratory prior to the testing. It contains product information as well as other information which might be required to define which configurations are expected to be tested, which tests are expected to be performed as well as the test conditions.

If used, this application form should form an integral part of the test report.

### D.3 Information as required by clause 5.4.3 and clause 5.4.4

a) Supported GNSS constellations and GNSS signals:

**Table D-1: Supported GNSS constellations and GNSS signals**

GNSS Constellations	GNSS Signals			
BDS	<input type="checkbox"/> B1I	<input type="checkbox"/> B1C		
Galileo	<input type="checkbox"/> E1	<input type="checkbox"/> E5a	<input type="checkbox"/> E5b	<input type="checkbox"/> E6
GLONASS	<input type="checkbox"/> G1	<input type="checkbox"/> G2		
GPS	<input type="checkbox"/> L1 C/A	<input type="checkbox"/> L2L1C	<input type="checkbox"/> L5L2C	<input type="checkbox"/> L5
SBAS	<input type="checkbox"/> L1	<input type="checkbox"/> L5	<input type="checkbox"/> L5	

b) Conducted or radiated testing:

- Conducted
- Radiated

c) ~~Test~~ SBAS used for testing (if supported):

- EGNOS
- GAGAN
- MSAS
- WAAS

d) Receiver blocking test results for 1 559 MHz to 1 610 MHz RNSS band.

**Table D-2: TestReceiver blocking test results for the 1 559 MHz to 1 610 MHz RNSS band**

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent frequency Blocking signal power level (dBm)	Measured C/N <sub>0</sub> (dB-Hz)			
			From table 4-2	From table 4-2	No interfering blocking signal	With interfering blocking signal
1 518 to 1 525	.....	.....	.....	.....	.....	BDS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	Galileo <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GLONASS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GPS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	SBAS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
1 525 to 1 549	.....	.....	.....	.....	.....	BDS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	Galileo <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GLONASS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GPS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	SBAS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
1 549 to 1 559	.....	.....	.....	.....	.....	BDS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	Galileo <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GLONASS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GPS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	SBAS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
1 610 to 1 626	.....	.....	.....	.....	.....	BDS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	Galileo <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GLONASS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GPS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	SBAS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
1 626 to 1 640	.....	.....	.....	.....	.....	BDS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	Galileo <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GLONASS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GPS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	SBAS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A

d) Final receiver blocking test results for 1 559 MHz to 1 610 MHz RNSS band:

- Pass
- Fail

e) ~~Test~~ f) Receiver blocking test results for 1 164 MHz to 1 300 MHz RNSS band.

**Table D-3: ~~Test~~Receiver blocking test results for the 1 164 MHz to 1 300 MHz RNSS band**

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent frequency <u>Blocking</u> signal power level (dBm)	Measured $C/N_0$ (dB-Hz)			
			From table 4-3	From table 4-3	No interfering <u>locking</u> signal	With interfering <u>locking</u> signal
960 to 1 164	.....	.....	.....	.....	.....	BDS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	Galileo <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GLONASS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GPS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	SBAS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
1 300 to 1 350	.....	.....	.....	.....	.....	BDS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	Galileo <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GLONASS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	GPS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
			.....	.....	.....	SBAS <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A

f) Final receiver blocking test results for 1 164 MHz to 1 300 MHz RNSS band:

- Pass
- Fail
- N/A

## D.4 Information as required by clause 5.5

a) GNSS ~~signal(s)~~ signals present or absent:

- Present
- Absent

b) Conducted or radiated testing:

- Conducted
- Radiated

c) ~~Receiver Spurious Emissions~~spurious emissions test result:

- Pass
- Fail
- N/A



## Annex E (informative): Bibliography

### • GPSGNSS Interface Specification, IS-GPS-200H, 24 Sept. 2013. Specifications

NOTE: Available at <http://www.gps.gov/technical/icwg/IS-GPS-200H.pdf>.

- GPS Interface Specification, IS-GPS-705D, 24 Sept. 2013 200K: "NAVSTAR GPS Space Segment/Navigation User Segment Interfaces", 6 May 2019.

NOTE: Available at <https://www.gps.gov/technical/icwg/IS-GPS-200K.pdf>.

- GPS Interface Specification, IS-GPS-705F: "NAVSTAR GPS Space Segment/User Segment L5 Interfaces", 6 May 2019.

NOTE: Available at <http://www.gps.gov/technical/icwg/IS-GPS-705D.pdf> and <https://www.gps.gov/technical/icwg/IS-GPS-705F.pdf>.

- GPS Interface Specification, IS-GPS-800D, 24 Sept. 2013 800F: "NAVSTAR GPS Space Segment/User Segment L1C Interfaces", 6 May 2019.

NOTE: Available at <http://www.gps.gov/technical/icwg/IS-GPS-800D.pdf> and <https://www.gps.gov/technical/icwg/IS-GPS-800F.pdf>.

- European GNSS (Galileo) Open Service: "Signal In Space Interface Control Document," Ref: OS SIS ICD V1.3, Issue 1.3.

NOTE: Available at <http://ec.europa.eu/DocsRoom/documents/11870/attachments/1/translations/en/renditions/native>.

NOTE 1: Clause 2.7 of this document includes, inter-alia, specifications of the minimum and maximum received power levels on the ground.

NOTE 2: Available at <https://www.gsc-europa.eu/sites/default/files/sites/all/files/Galileo-OS-SIS-ICD.pdf>.

- BeiDou Navigation Satellite System: "Signal In Space Interface Control Document, Open Service Signal B1I, (Version 2.0)".

NOTE: Available at <http://www2.unb.ca/ggc/Resources/beidou-icd-english-ver2.0.pdf>.

NOTE: Available at <http://en.beidou.gov.cn/SYSTEMS/ICD/201902/P020190227702348791891.pdf>.

- BeiDou Navigation Satellite System: "Signal In Space Interface Control Document, Open Service Signal B1C, (Version 1.0)".

NOTE: Available at <http://en.beidou.gov.cn/SYSTEMS/ICD/201806/P020180608519640359959.pdf>.

- Global Navigation Satellite System GLONASS: "Interface Control Document, Navigational radiosignal In bands L1, L2", (Edition 5.1).

NOTE: Available at [http://russianspacesystems.ru/wp-content/uploads/2016/08/ICD\\_GLONASS\\_eng\\_v5.1.pdf](http://russianspacesystems.ru/wp-content/uploads/2016/08/ICD_GLONASS_eng_v5.1.pdf).

---

## Annex F (informative): Background to Conformance specifications

### F.1 Introduction

This annex details other parameters from "classical" (i.e. channelized, terrestrial communication) radio systems that are mentioned in clause 5.3 of ETSI EG 203 336 (V1.2.1) [i.2], but are not included in clause 4.2 above for one of the following reasons:

- they have been assessed and determined not to contribute to effective use of the radio spectrum by GNSS receivers;
- they are covered by other requirements.

GNSS receivers consist of receive-only equipment that has no feedback loop with GNSS satellite transmitters, which operate with fixed transmit parameters (e.g. power). Therefore, in the case of GNSS, some radio parameters associated with "classical" (i.e. channelized, terrestrial communication) radio systems do not contribute to effective use of the radio spectrum by GNSS receivers or support the efficient use of the radio spectrum in order to avoid harmful interference.

The technical justifications for the non-inclusion of these parameters are provided below.

---

### F.2 Metric used for measurements in GNSS receivers

For all types of GNSS receivers, there is only one metric recognized internationally by GNSS operators and industry for measuring the degradation of the "wanted" signal when interference is added - this is the 1 dB degradation of  $C/N_0$  used in the present document. The 1 dB degradation metric is used for GNSS receivers because the receivers will be able to maintain nominal function at that level, yet an increase beyond 1 dB will materially affect the ability of GNSS receivers to perform their intended functions.

---

### F.3 Receiver sensitivity

#### F.3.1 Definition

Receiver sensitivity is the ability to receive a specified wanted signal at low input signal levels while providing a pre-determined level of performance as described in ETSI EG 203 336 (V1.2.1) [i.2].

#### F.3.2 Justification for non-inclusion

There is no need to specify a requirement for GNSS receiver sensitivity.

GNSS signals (including transmission power and bandwidth) broadcast by each space segment are specified in each GNSS Interface Specification or Interface Control Document (see annex E). GNSS Interface Specifications and Interface Control Documents are authorized and controlled by worldwide international agreements endorsed by EU member states. These GNSS transmission parameters are coordinated among space segment operators and are fixed for the long-term life cycle of each satellite constellation.

Unlike a radiocommunication system providing two-way communication that coordinates the system design of both the transmitting and receiving equipment, GNSS is a "one-way" system and the GNSS space segment broadcasts the GNSS signals totally independently of the design of the receiving equipment. The GNSS Interface Specification and Interface Control Documents do not specify any requirements for receiver sensitivity but instead specify a minimum user-received signal power level on the ground with the understanding that the device manufacturer determines the required GNSS receiver sensitivity depending on the intended application and use cases both existing and in the future. In addition, the minimum user-received signal power level on the ground specified in the Interface Control Documents varies for each of the GNSS signals for which reception capability is included in a GNSS receiver; each signal (including transmission power and bandwidth) is different.

GNSS transmission parameters are thus totally independent of the design of the GNSS receiving equipment in the dedicated and protected RNSS bands. Because GNSS receivers and receiver manufacturers cannot alter or affect the GNSS transmission parameters, efficient use of spectrum for the avoidance of harmful interference, as promoted by article 3.2 of Directive 2014/53/EU [i.1], is determined solely by the established standards that allow transmission of multiple GNSS signals and the interoperability of the different GNSS signals. It is not determined or determinable by the specification of receiver sensitivity.

---

## F.4 Receiver co-channel rejection

### F.4.1 Definition

Receiver co-channel rejection is a measure of the capability of a receiver to receive a wanted signal, without exceeding a given degradation, due to the presence of an unwanted signal, both signals being at the nominal frequency of the receiver as described in ETSI EG 203 336 (V1.2.1) [i.2].

### F.4.2 Justification for non-inclusion

There is no need to specify a requirement for GNSS receiver co-channel rejection.

The RNSS bands are not channelized like "classical" terrestrial communication bands. Therefore, the terrestrial radio communication concept of "co-channel", with wanted and unwanted signals, is not applicable within the RNSS bands. All the authorized GNSS transmissions are continuously transmitted in the applicable bands, and GNSS receivers simply decode the GNSS signals they are interested in while ignoring other GNSS transmissions. There are no additional "co-channel" signals that could form part of any requirement.

---

## F.5 Receiver Selectivity

### F.5.1 Definition

Receiver adjacent channel selectivity (adjacent band selectivity) is a measure of the capability of a receiver to receive a wanted signal, without exceeding a given degradation, due to the presence of an unwanted signal whose frequency is adjacent to the wanted signal as described in ETSI EG 203 336 (V1.2.1) [i.2].

### F.5.2 Justification for non-inclusion

There is no need to specify a separate requirement for GNSS receiver adjacent channel selectivity (adjacent band selectivity).

The RNSS bands are not channelized like "classical" terrestrial communication bands. Therefore, the terrestrial radio communication concept of "adjacent channel" is not applicable within the RNSS bands.

For GNSS receiver adjacent band selectivity, this requirement is contained within the receiver blocking requirements.

The receiver blocking requirement specified in clause 4.2 satisfies all the "classical" receiver requirements of receiver selectivity, including blocking, adjacent signal selectivity (adjacent band selectivity) and reciprocal mixing with a suitable alternative technical requirement for GNSS receivers.

The receiver blocking requirement in clause 4.2 covers at least 30 MHz on either side of each RNSS band. Within this 30 MHz (and more) the power level of the blocking signal is increased as it is moved further away from the "wanted" RNSS band. The blocking signal is specified over the full coverage as a 1 MHz wideband signal and thus it can be considered to be more like an adjacent channel signal rather than the more normal CW blocking signal. It is therefore logical to have only one single requirement for receiver selectivity and not to split it arbitrarily into adjacent band selectivity, blocking and other requirements such as reciprocal mixing.

As described in clause F.2, the 1 dB degradation of  $C/N_0$  metric is the technical means used in the present harmonised standard to measure the GNSS receiver performance in the presence of a blocking signal.

---

## F.6 Other receiver effects

### F.6.1 Receiver dynamic range

#### F.6.1.1 Definition

Receiver dynamic range is defined as the range of the wanted input signal level over which a receiver functions at a specified performance level. The lower end of this range is normally the sensitivity of the receiver. The upper end of a receiver's dynamic range determines how strong a received signal can be before producing degradation due to overloading as described in ETSI EG 203 336 (V1.2.1) [i.2].

#### F.6.1.2 Justification for non-inclusion

There is no need to specify a requirement for GNSS receiver dynamic range as the GNSS satellites transmit with a fixed power and the satellite and receiver geometry of the GNSS system is such that it is impossible to receive a wanted signal that is high enough to produce any overloading effect.

### F.6.2 Reciprocal mixing

#### F.6.2.1 Definition

Reciprocal mixing occurs when noise sidebands of the Local Oscillator (LO) mix with interfering signals at distances from wanted signal comparable to the LO offset range where phase noise is higher than the thermal noise (i.e. from a few hundreds of Hz to a few MHz) converting unwanted noise at the frequency of the receiver which may result in "desensitization" of the receiver additional to that produced by the interference itself. In direct Digital Down Conversion receivers (DDC) a similar effect occurs caused by the phase jitter of the clock associated with the DDC as described in ETSI EG 203 336 (V1.2.1) [i.2].

#### F.6.2.2 Justification for non-inclusion

There is no need to specify a separate requirement for GNSS receiver reciprocal mixing as this requirement is contained within the GNSS receiver blocking requirements (see clause F.5 for more information).

## Annex F~~G~~ (informative): Change history

Version	Information about changes
0.4.0	Stable draft
1.1.0	Implemented Changes: Comments from editHelp implemented
1.1.1	Editorial changes; typo in the ARNS abbreviation corrected and redundant text deleted from the scope.
1.1.2	Annex F added; editorial changes; changes for consistency
1.1.3	Editorial changes; changes for clarification and removal of redundant table in clause B.2.2
1.1.4	Editorial changes; changed name of Adjacent frequency band selectivity to Receiver blocking; clarifications to description of averaging; changes to annex F
1.1.5	Changes to annex F
1.1.6	Changes to annex F to align with latest version of ETSI EG 203 336
1.1.7	Updates to References, Definitions and Abbreviations; addition of BDS B1C signal; changes to clause 4.3; changes to annex F; minor editorial updates, editHelp! updates, updates from SCN#25b
1.1.8	Editorial changes made after comments from HAS consultants

## History

<b>Document history</b>		
<u>V1.1.0</u>	<u>March 2017</u>	<u>EN Approval Procedure</u> <del>AP 20170611: 2017-03-13 to 2017-06-12</del>
<u>V1.1.1</u>	<u>June 2017</u>	<u>Publication</u>
<u>V1.2.0</u>	<u>September 2020</u>	<u>EN Approval Procedure</u> <u>AP 20201229: 2020-09-30 to 2020-12-29</u>
<u>V1.2.1</u>	<u>February 2021</u>	<u>Vote</u> <u>V 20210412: 2021-02-11 to 2021-04-12</u>
<u>V1.2.1</u>	<u>April 2021</u>	<u>Publication</u>