

ETSI EN 303 413 V1.1.1 (2017-06)



HARMONISED EUROPEAN STANDARD

**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
of article 3.2 of Directive 2014/53/EU**

Reference

DEN/SES-00404

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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 June 2017
Date of latest announcement of this EN (doa):	30 September 2017
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 March 2018
Date of withdrawal of any conflicting National Standard (dow):	31 March 2019

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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Executive summary

The present document gives the technical requirements (clause 4) and test methodology (clause 5) for presumption of conformity of GNSS User Equipment with article 3.2 of the Radio Equipment 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 [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 (RNSS) systems in the RNSS frequency bands given in table 1-1.

Table 1-1: 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 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 1.43 of 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 (e.g. Galileo, Global Positioning System (GPS), BeiDou (BDS), Global Navigation Satellite System (GLONASS), Space Based Augmentation Systems (SBAS)).

The present document covers the essential requirements of article 3.2 of Directive 2014/53/EU [i.1] under the conditions identified in annex A.

2 References

2.1 Normative references

References are specific, identified by date of publication and/or edition number or version number. Only the cited version 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 (V2.1.1) (11-2016): "Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

2.2 Informative references

Informative 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); 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): "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".
- [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".
- [i.13] ITU Radio Regulations (edition of 2016).

3 Definitions and abbreviations

3.1 Definitions

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_0 : 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.

$C/(N_0+I)$: 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

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) 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 systems.

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

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 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.

e.i.r.p.	effective isotropically radiated power
e.r.p.	effective radiated power
GPS	Global Positioning System

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

GLONASS GLObalnaya NAVigatsionnaya 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
 GUE GNSS User Equipment
 ITU International Telecommunication Union
 MEO Medium Earth Orbit
 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
 SBAS Space Based Augmentation System

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

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. 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.

4.2 Conformance specifications

4.2.1 GUE adjacent frequency band selectivity performance

4.2.1.1 Definition

GUE adjacent frequency band selectivity is the ability of the GUE to achieve the specified performance in the presence of noise produced by signals 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

The C/N_0 metric reported by the GUE for all GNSS 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 signal is applied. The adjacent frequency 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, GNSS signals and RNSS frequency bands

GNSS	GNSS Signal Designations	RNSS Frequency Band (MHz)
BDS	B1I	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	1 559 to 1 610
	L2	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 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 frequency 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 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 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 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 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 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 signals in table 4-2.

A GUE also utilizing 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 signals in table 4-3.

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

4.2.2 Spurious emissions

4.2.2.1 Definition

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

4.2.2.2 Limit

The 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 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.

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.

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].

5.3 Test methodology for adjacent frequency band selectivity test

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 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 signal.
- A means for recording C/N_0 as reported by the EUT before and after application of the adjacent frequency 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 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.

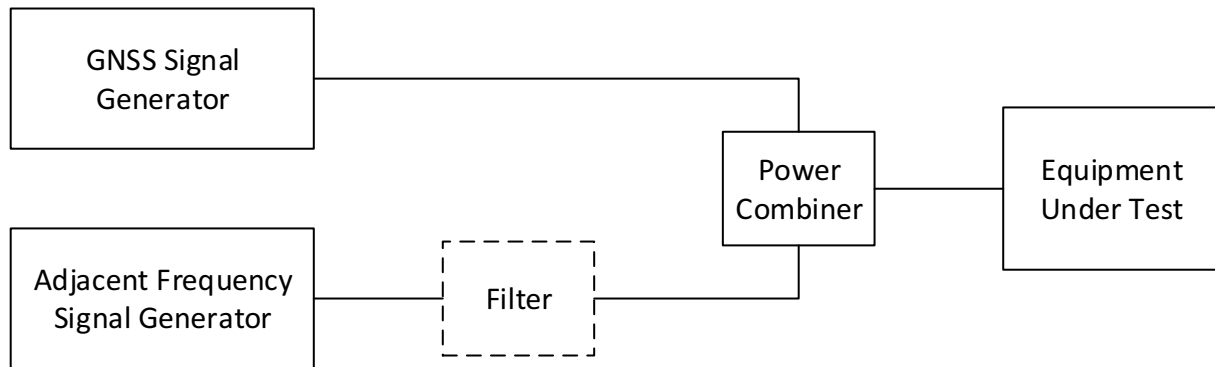


Figure 5-1: Conducted measurement setup for EUT adjacent frequency band selectivity

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 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 signal and adjacent frequency signal.
- A means for establishing and calibrating the RF power of both the GNSS signal and the adjacent frequency 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) [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 signal power levels specified in table 4-2 and, as applicable, table 4-3 are incident upon the antenna of the EUT.

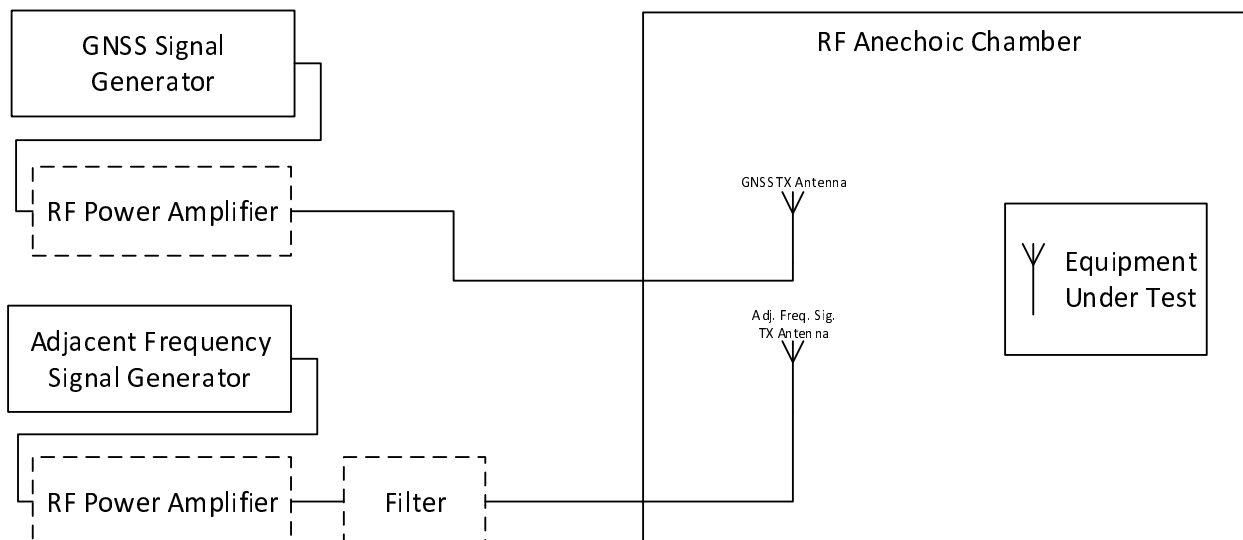


Figure 5-2: Radiated measurement setup for EUT adjacent frequency band selectivity performance

5.4 GUE adjacent frequency band selectivity 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.

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 GNSS 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 signal switched off, the EUT shall be given sufficient time to acquire all simulated satellites from the declared GNSS system(s).
- 3) Record the baseline C/N_0 value(s) reported by the EUT. Sufficient filtering shall be used to obtain a stable value. C/N_0 may be averaged across all the satellites in view for each GNSS constellation. However, C/N_0 shall not be averaged across satellite signals in different GNSS constellations. For a multi-GNSS EUT, there shall be a separate C/N_0 value recorded for each GNSS constellation and each GNSS signal supported.
- 4) The adjacent frequency 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 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 value(s) recorded in step 3).

- 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 and multi-signal EUT, there shall be a separate pass/fail determination for each GNSS and for each GNSS signal supported. If the C/N_0 degradation exceeds the value in equation 4-1 for any supported GNSS 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 bands

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 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 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 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.

5.5.2 Test method

5.5.2.1 Conducted measurement

5.5.2.1.1 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.

The measurement procedure contains 2 parts.

5.5.2.1.2 Pre-scan

The procedure in step 1) to step 4) below shall be used to identify potential unwanted emissions of the EUT:

- 1) 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) 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 5.5.2.1.3 and compared to the limits given in table 4-5.

- 3) 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 5.5.2.1.3 and compared to the limits given in table 4-5.

- 4) In case of conducted measurements on smart antenna systems (equipment with multiple receive chains), step 2) and step 3) shall be repeated for each of the active receive chains, A_{ch} .

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

5.5.2.1.3 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, A_{ch} .

Sum the measured power (within the observed window) for each of the active receive chains.

- 4) The value defined in step 3) shall be compared to the limits defined in table 4-5.

5.5.2.2 Radiated measurement

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

The test procedure is further described in clause 5.5.2.1.

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	Reference: Clause No	U/C	Condition
1	Adjacent signal selectivity	4.2.1	U	
2	Spurious emissions	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.
- 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 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 signal

B.1.1 Definition

The 1 MHz filtered AWGN signal used for interferer simulation shall follow the requirements specified in this clause:

- The 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 ripple shall be less than 3 dB.
- The stopband attenuation shall be at least 62 dB.
- The transition band between the passband and stopband 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 requirements. The filter's gain shall be within the hatched area. The thin line is an example of a filter that fulfils the requirements.

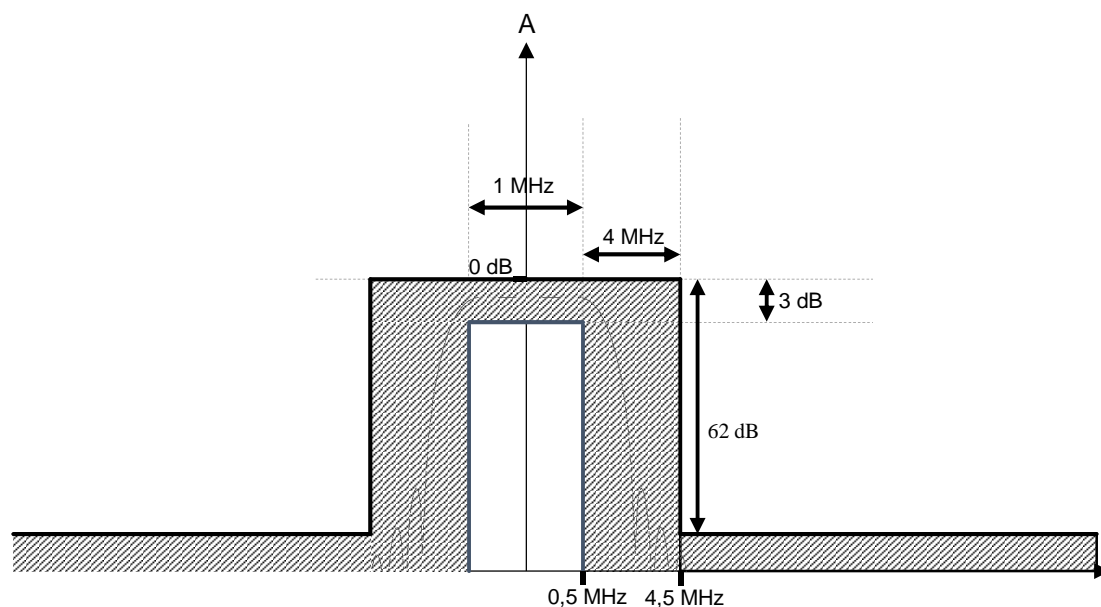


Figure B-1: Adjacent frequency signal

B.1.2 Recommended measurement technique for the adjacent frequency signal settings

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

- Span: ≥ 20 MHz
- Resolution Bandwidth: 10 kHz
- Video Bandwidth: 30 kHz
- Detector: Power average
- Sweep points: $\geq 4\ 001$
- Sweep time: ≥ 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 signal power may be increased for the verification of the interferer 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 signal verification process, no GUE should be connected to the signal generator while the interferer 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) used during the conformance testing to simulate the GNSS satellites supported by the GUE. The signal details of the GNSS constellations are contained in the respective Interface Specifications (see annex E).

B.2.2 GNSS signal details

All GNSS 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

Signal levels relative to reference power levels (see note 1)	Galileo		GPS/Modernized GPS		GLONASS		SBAS		BDS (see note 2)		
	E1	0 dB	L1 C/A	0 dB	G1	0 dB	L1	0 dB	B1I	D1	0 dB
										D2	+5 dB
	E6	+2 dB	L1C	+1,5 dB	G2	-6 dB					
	E5	+2 dB	L2C	-1,5 dB							
			L5	+3,6 dB							

NOTE 1: The signal 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

GNSS	Parameters	Value
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) 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.

Annex C (informative): C/N₀ degradation metric

C.1 General

Measurement of the degradation of C/N₀ 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/N₀ 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/N₀) is the ratio of the received GNSS signal carrier power C, in watts, to the noise power spectral density N₀. The noise power spectral density (N₀, in W/Hz) is given by following expression:

$$N_0 = kT \quad (\text{C-1})$$

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/N₀ with no interference present is:

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

When interference is present, a reduction in C/N₀ 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 δc to the received satellite signal. The resulting carrier to noise-and-interference-density ratio C/(N₀+I), may be expressed as:

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

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:

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

This metric is used in the present document and clause 4 states the maximum allowed degradation of the GUE's reported C/N₀ in equation 4-1 in the presence of the adjacent frequency 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/N₀

The following example calculation provides a 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:

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

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

Parameter	Example	Source
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:

Table D-1: Supported GNSS and GNSS signals

GNSS	GNSS Signals			
BDS	B1I			
Galileo	E1	E5a	E5b	E6
GLONASS	G1	G2		
GPS	L1	L2	L5	
SBAS	L1		L5	

b) Conducted or radiated testing:

Conducted

Radiated

c) Test results for 1 559 MHz to 1 610 MHz RNSS band.

Table D-2: Test results for the 1 559 MHz to 1 610 MHz RNSS band

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent frequency signal power level (dBm)	Measured C/N ₀ (dB-Hz)			
			No interfering signal	With interfering signal	Decrease of C/N ₀	Decrease ≤ 1 dB?
1 518 to 1 525	BDS Pass Fail N/A
			Galileo Pass Fail N/A
			GLONASS Pass Fail N/A
			GPS Pass Fail N/A
			SBAS Pass Fail N/A
1 525 to 1 549	BDS Pass Fail N/A
			Galileo Pass Fail N/A
			GLONASS Pass Fail N/A
			GPS Pass Fail N/A
			SBAS Pass Fail N/A
1 549 to 1 559	BDS Pass Fail N/A
			Galileo Pass Fail N/A
			GLONASS Pass Fail N/A
			GPS Pass Fail N/A
			SBAS Pass Fail N/A
1 610 to 1 626	BDS Pass Fail N/A
			Galileo Pass Fail N/A
			GLONASS Pass Fail N/A
			GPS Pass Fail N/A
			SBAS Pass Fail N/A
1 626 to 1 640	BDS Pass Fail N/A
			Galileo Pass Fail N/A
			GLONASS Pass Fail N/A
			GPS Pass Fail N/A
			SBAS Pass Fail N/A

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

Pass

Fail

e) Test results for 1 164 MHz to 1 300 MHz RNSS band.

Table D-3: Test results for the 1 164 MHz to 1 300 MHz RNSS band

Frequency band (MHz)	Test point centre frequency (MHz)	Adjacent frequency signal power level (dBm)	Measured C/N ₀ (dB-Hz)			
			No interfering signal	With interfering signal	Decrease of C/N ₀	Decrease ≤ 1 dB?
960 to 1 164	BDS Pass Fail N/A
			Galileo Pass Fail N/A
			GLONASS Pass Fail N/A
			GPS Pass Fail N/A
			SBAS Pass Fail N/A
1 300 to 1 350	BDS Pass Fail N/A
			Galileo Pass Fail N/A
			GLONASS Pass Fail N/A
			GPS Pass Fail N/A
			SBAS Pass Fail N/A

f) Final 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) present or absent:

Present

Absent

b) Receiver Spurious Emissions test result:

Pass

Fail

N/A

Annex E (informative): Bibliography

- GPS Interface Specification, IS-GPS-200H, 24 Sept. 2013.

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

- GPS Interface Specification, IS-GPS-705D, 24 Sept. 2013.

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

- GPS Interface Specification, IS-GPS-800D, 24 Sept. 2013.

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

- European GNSS (Galileo) Open Service Signal In Space Interface Control Document, Ref: OS SIS ICD, Issue 1.1.

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

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

NOTE: Available at http://www2.unb.ca/gge/Resources/beidou_icd_english_ver2.0.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.

Annex F (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.

History

Document history		
V1.1.0	March 2017	EN Approval Procedure AP 20170611: 2017-03-13 to 2017-06-12
V1.1.1	June 2017	Publication