ETSI EN 300 328 V2.2.2: 2019

TEST REPORT

FOR

Base station

Model No.: SID-ESL-19A，SID-ESL-0xA（x=1，2，3，4，6，...，100）

Trademark: N/A

Report No.: E01A23030814R00201

Issue Date: April 13, 2023

Prepared for

Guangdong SID Technology Co., Ltd.

Room 101, Building 5, No. 21, Dongke Road, Dongcheng Street, Dongguan City, Guangdong Province.

Prepared by

Dong Guan Anci Electronic Technology Co., Ltd.

1-2 Floor, Building A, No.11, Headquarters 2 Road, Songshan, Lake Hi-tech Industrial Development Zone, Dongguan City, Guangdong Pr., China

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1. TEST RESULT CERTIFICATION

Applicant	:	Guangdong SID Technology Co., Ltd. Room 101, Building 5, No. 21, Dongke Road, Dongcheng Street, Dongguan City, Guangdong Province.
Manufacturer	:	Guangdong SID Technology Co., Ltd. Room 101, Building 5, No. 21, Dongke Road, Dongcheng Street, Dongguan City, Guangdong Province.
EUT	:	Base station
Model Name	:	SID-ESL-19A, SID-ESL-0xA（x=1，2，3，4，6，...，100）
Input Rating	:	DC 12V, 1A from Adapter

Measurement Procedure Used:

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
ETSI EN 300 328 V2.2.2: 2019	PASS

The device described above is tested by Dong Guan Anci Electronic Technology Co., Ltd. to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Dong Guan Anci Electronic Technology Co., Ltd. is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the ETSI EN 300 328 V2.2.2: 2019 requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Dong Guan Anci Electronic Technology Co., Ltd.

Date of Test : March 29, 2023 to April 08, 2023

Prepared by : Duke Liu / EMC Engineer

Reviewer & Authorized Signer : Tiger Xu / Supervisor

2. EUT DESCRIPTION

Product:	Base station
Model Number:	SID-ESL-19A, SID-ESL-0xA（x=1，2，3，4，6，...，100） (All models are identical except for the model name. We choose SID-ESL-19A for all tests)
Modulation:	GFSK
Frequency Range:	2400MHz-2483.5MHz
Number of Channels:	40 channels
Max Transmit Power:	1.33dBm
Antenna:	External antenna
Test power supply:	DC 12V
Antenna Gain:	0.5 dBi
Temperature Range:	0° C ~ +40° C
Product software version:	V1.0
Product hardware version:	V1.0

Note: for more details, please refer to the User's manual of the EUT.

INFORMATION AS REQUIRED BY EN 300 328 V2.2.2

<table>
<tr><td>EN 300 328</td><td colspan="2">Information Is Provided By The Manufacturer</td></tr>
<tr><td>The Type Of Modulation Used By The Equipment</td><td colspan="2">☒ DSSS
☐ other forms of modulation</td></tr>
<tr><td>In Case Of FHSS

Modulation:</td><td colspan="2">☐ In case of non-Adaptive Frequency Hopping equipment
The number of Hopping Frequencies:

☒ In case of Adaptive Frequency Hopping Equipment
The maximum number of Hopping Frequencies:40
The minimum number of Hopping Frequencies: 40</td></tr>
<tr><td rowspan="12">The Worst Case Operational Mode For Each Of The Following Tests:</td><td>RF Output Power</td><td>1.33dBm</td></tr>
<tr><td>Power Spectral Density</td><td>2.12dBm/MHz</td></tr>
<tr><td>Duty Cycle, Tx-Sequence, Tx-gap.</td><td>N/A</td></tr>
<tr><td>Accumulated Transmit time, Frequency Occupation & Hopping Sequence (only for FHSS equipment)</td><td>N/A</td></tr>
<tr><td>Hopping Frequency Separation (only for FHSS equipment)</td><td>N/A</td></tr>
<tr><td>Medium Utilisation.</td><td>N/A</td></tr>
<tr><td>Adaptivity & Receiver Blocking.</td><td>N/A</td></tr>
<tr><td>Nominal Channel Bandwidth</td><td>1.031MHz</td></tr>
<tr><td>Transmitter Unwanted Emissions in the OOB domain.</td><td>PASS</td></tr>
<tr><td>Transmitter Unwanted Emissions in the spurious domain</td><td>PASS</td></tr>
<tr><td>Receiver spurious emissions</td><td>PASS</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="2">The Different Transmit Operating Modes (Tick All That Apply):</td><td colspan="2">☒ Operating mode 1: Single Antenna Equipment
☒ Equipment with only 1 antenna
☐ Equipment with 2 diversity antennas but only 1 antenna active at any moment in time
☐ Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)</td></tr>
<tr><td colspan="2">☐ Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming

☐ Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)

☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1

☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2</td></tr>
<tr><td></td><td colspan="2">☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam</td></tr>
</table>

	forming ☐ Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode) ☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1 ☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
Operating Frequency Range(S) Of The Equipment:	Operating Frequency Range: 2400 MHz to 2483.5MHz
Nominal Channel Bandwidth(s):	Occupied Channel Bandwidth: 1.031MHz
Type of Equipment (stand-alone, combined, plug-in radio device, etc.):	☒ Stand-alone ☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment) ☐ Plug-in radio device (Equipment intended for a variety of host systems) ☐ Other
Describe the test modes available which can facilitate testing:	Modulation Mode: GFSK Test Frequency: Low Frequency, Middle Frequency, High Frequency
The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):	2.4G RFID
NOTE: N/A means not applicable	

Modified History

Rev.	Summary	Date of Rev.	Report No.
Ver.1.0	Original Report	/	E01A23030814R00201

3. SUMMARY OF TEST RESULT

Clause (EN 300 328)	Test Parameter	Verdict	Remark
4.3.2.2	RF Output Power	PASS	
4.3.2.3	Power Spectral Density	PASS	
4.3.2.4	Duty Cycle and Tx-Sequence and Tx-Gap	N/A (See Note1)	Only applicable for non-adaptive equipment Output Power >10dBm
4.3.2.5	Medium Utilisation Factor	N/A (See Note1)	Only applicable for non-adaptive equipment Output Power >10dBm
4.3.2.6	Adaptivity (adaptive equipment using modulations other than FHSS)	N/A (See Note1)	Only applicable for adaptive equipment Output Power >10dBm
4.3.2.7	Occupied Channel Bandwidth	PASS	
4.3.2.8	Transmitter Unwanted Emission in the Out-of Band	PASS	
4.3.2.9	Transmitter Unwanted Emissions in the Spurious Domain	PASS	
4.3.2.10	Receiver Spurious Emissions	PASS	
4.3.2.11	Receiver Blocking	PASS	
4.3.2.12	Geo-location capability	N/A (See Note1)	Only applicable for have Geo-location function equipment
NOTE1: N/A means not applicable			

4. TEST METHODOLOGY

4.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:

ETSI EN 300 328 –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

4.2 MEASUREMENT EQUIPMENT USED

For Spurious Emissions Test

Equipment Type	Manufacturer	Model No.	Serial Number	Calibrated until
EMI Test Receiver	Rohde & Schwarz	ESPI	100502	2023-11-12
EMI Test Receiver	Rohde & Schwarz	FSV40	102257	2023-11-12
Pre-Amplifier	HP	8447D	2727A06172	2023-05-22
Pre-Amplifier	A-INFO	LA1018N4009	J1013130524001	2023-05-22
Bilog Antenna	Schwarzbeck	VULB9163	VULB9163-588	2023-05-22
Horn Antenna	A-INFO	LB-10180-SF	J2031090612123	2023-05-22
Cable	N/A	N/A	6#	2023-05-22
Cable	N/A	N/A	1-1#	2023-05-22
Cable	N/A	N/A	1-2#	2023-05-22
Cable	N/A	N/A	7#	2023-05-22
3m Semi-anechoic Chamber	chengyu	9m*6m*6m	N/A	2023-05-22
Test Software	Farad	EZ-EMC Ver:ANCI-3A1	N/A	N/A
Band reject Filter(50dB)	WI/DE	WRCGV-2400(2400-2485MHz)	2	2023-11-12

For Other Test Items:

Equipment Type	Manufacturer	Model No.	Serial Number	Calibrated until
Spectrum Analyzer	Rohde & Schwarz	FSV40	102257	2023-11-12
WIDEBAND RADIO COMMUNICATION	Rohde & Schwarz	CMW500	157423	2023-11-12
Vector Signal Generator	Agilent	5182A	MY50140563	2023-11-12
ESG SERIES SIGNAL GENERATOR	Agilent	E4421B	40050971	2023-11-12
USB RF Power sensor	RadiPower	RPR3006W	17I00015SNO88	2023-11-12
RF Test Software	MAIWEI	MTS 8310	N/A	N/A
Humidity Chamber	GAOXIN	GX-3000-150LHT	1801027	2023-05-22
Dc source	RUIYUAN	WYK-6030K	180828026030	2023-11-12

4.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.
The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.
The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

The EUT has been tested under its typical operating condition. so those data rate (GFSK: 1 Mbps;) were used for all test.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Frequency and Channel list for BLE:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	18	2438	…	…
1	2404	19	2440	37	2476
2	2406	20	2440	38	2478
…	…	…	…	39	2480
Note: fc=2402MHz+k×2MHz k=0 to 39					

Test Frequency and channel for BLE:

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2400	19	2440	39	2483.5

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

Dong Guan Anci Electronic Technology Co., Ltd.

1&2/F.,Building 2, Zone A, Zhongda Marine Biotechnology Reserch and Development Base, No.9, Xincheng Avenue, Songshanhu High-technology Industrial Development Zone, Dongguan, Guangdong, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with preselectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

5.3 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description		
Name of Firm	:	Dong Guan Anci Electronic Technology Co., Ltd..
Site Location	:	1-2 Floor, Building A, No.11, Headquarters 2 Road, Songshan, Lake Hi-tech Industrial Development Zone, Dongguan City, Guangdong Pr., China

6. TEST SYSTEM UNCERTAINTY

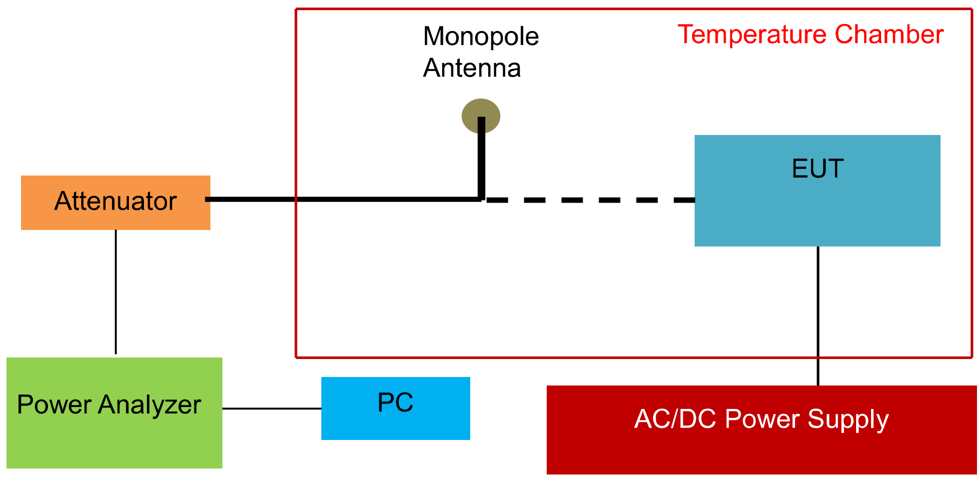
Maximum measurement uncertainty of the test system

Test Parameter	Measurement Uncertainty
RF Output Power	±1.0%
Power Spectral Density	±0.9%
Duty Cycle and Tx-Sequence and Tx-Gap	±1.3%
Medium Utilisation Factor	±1.5%
Occupied Channel Bandwidth	±2.3%
Transmitter Unwanted Emission in the Out-of Band	±1.2%
Transmitter Unwanted Emissions in the Spurious Domain	±2.7%
Receiver Spurious Emissions	±2.7%
Temperature	±3.2%
Humidity	±2.5%

7. SETUP OF EQUIPMENT UNDER TEST

7.1 SETUP CONFIGURATION OF EUT

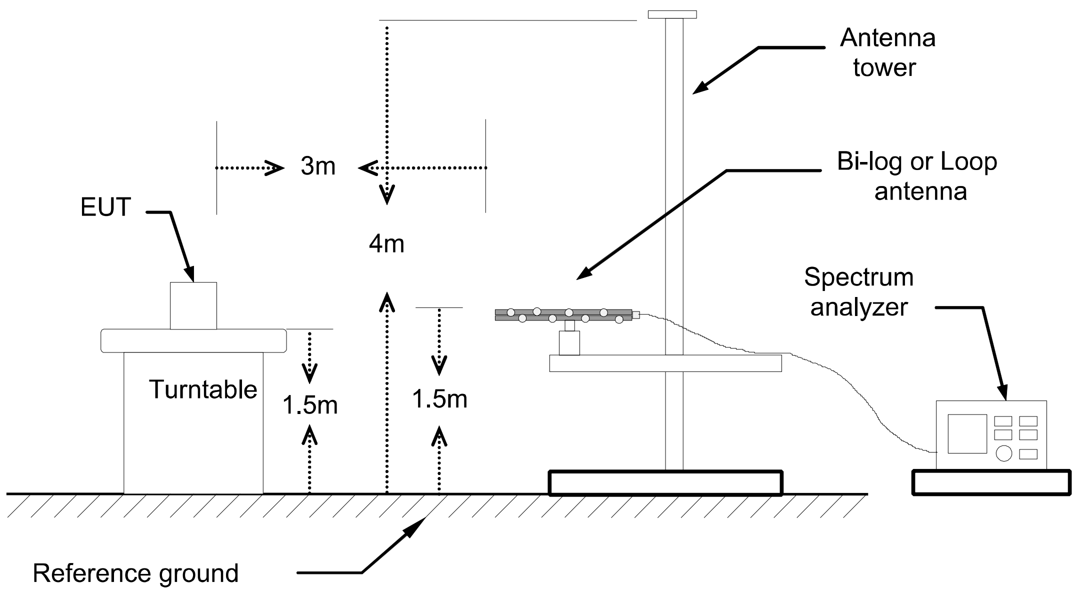
Conducted measurements configuration of EUT shall be as follows:



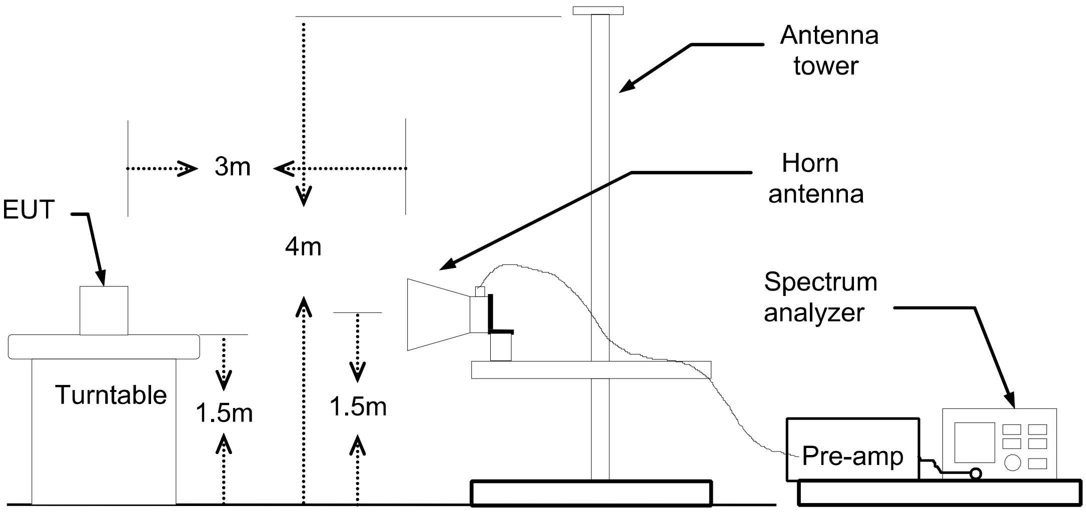
Remarks:
The Signal Analyzer could be connected to a monopole antenna or directly connected to the EUT, if the EUT has already employing an antenna connector.

Radiated measurements configuration of EUT shall be as follows:

Below 1GHz



Above 1GHz



7.2 SUPPORT EQUIPMENT

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
1.	N/A	N/A	N/A	N/A	N/A

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

8. ETSI EN 300 328 REQUIREMENTS

8.1 RF OUTPUT POWER

8.1.1 Applicable standard

EN 300 328 Clause 4.3.2.2

8.1.2 Conformance Limit

The Maximum RF Output Power <= 100 mW (20 dBm) (EIRP) at both Normal and Extreme conditions.

8.1.3 Test Configuration

The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.
Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s)

8.1.4 Test Procedure

1. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.2.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.2.2 for the measurement method.

The test procedure shall be as follows:
■ Conducted measurements
Step 1:
• Use a fast power sensor suitable for 2,4 GHz and capable of minimum 1 MS/s.
• Use the following settings:
- Sample speed 1 MS/s or faster.
- The samples shall represent the RMS power of the signal.
- Measurement duration: For non-adaptive equipment: equal to the observation period defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.
For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used.
Step 2:
• For conducted measurements on devices with one transmit chain:
- Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. Use these stored samples in all following steps.
• For conducted measurements on devices with multiple transmit chains:
- Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
- Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
- For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples in all following steps.
Step 3:
• Find the start and stop times of each burst in the stored measurement samples.
The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2.
In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.
Step 4:
• Between the start and stop times of each individual burst calculate the RMS power over the burst using the formula below. Save these Pburst values, as well as the start and stop times for each burst.

$$P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n)$$

with k being the total number of samples and n the actual sample number.
Step 5:
• The highest of all Pburst values (value "A" in dBm) will be used for maximum e.i.r.p. calculations.

Step 6:

- Add the (stated) antenna assembly gain "G" in dBi of the individual antenna.
- If applicable, add the additional beamforming gain "Y" in dB.
- If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.
- The RF Output Power (P) shall be calculated using the formula below: P = A + G + Y
- This value, which shall comply with the limit given in clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.

■ Radiated measurements

This method shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.

When performing radiated measurements, the UUT shall be configured and antenna(s) positioned (including smart antenna systems and equipment capable of beamforming) for maximum e.i.r.p. towards the measuring antenna. This position shall be recorded.

A test site as described in annex B and applicable measurement procedures as described in annex C shall be used.

Taking into account the calibration factor from the measurement site, the test procedure for RF Output Power is further as described under clause 5.4.2.2.1.2, step 1 to step 5. The RF Output Power P is equal to the value A obtained in step 5. The test procedure for Duty Cycle, Tx-sequence, Tx-gap is further as described in clause 5.4.2.2.1.3 and the test procedure for Medium Utilization is further as described in clause 5.4.2.2.1.4.

8.1.5 Test Results

Temperature:	Refer to the following table	Test Date:	Apr. 07, 2023
Humidity:	53 % RH	Tested by:	KK

Test Conditions			Transmitter Power (dBm)		
			Temp (25)°C	Temp (0)°C	Temp (40)°C
MODES	CHANNEL	VOLT / POWER	Battery 14.4V	Battery 14.4V	Battery 14.4V
GFSK	2402MHz	RMS	0.87	0.85	0.84
	2440 MHz	RMS	1.14	1.12	1.10
	2480 MHz	RMS	1.33	1.31	1.28
Limit			<= 20dBm		
Verdict			PASS	PASS	PASS

All the modulation modes were tested, the data of the worst mode are described in the following table

8.2 POWER SPECTRAL DENSITY

8.2.1 Applicable standard

According to ETSI EN 300 328 clause 4.3.2.3

8.2.2 Conformance Limit

The Maximum Power Spectrum Density <=10 dBm/MHz.

8.2.3 Test Configuration

The measurements for power spectral density shall only be performed at normal test conditions.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.
Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s) provided.

8.2.4 Test Procedure

1. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.3.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.3.2 for the measurement method.

The test procedure shall be as follows:

■Conducted measurement

●Option 1: For equipment with continuous and non-continuous transmissions

The transmitter shall be connected to a spectrum analyser and the Power Spectral Density (PSD) as defined in clause 4.3.2.3 shall be measured and recorded.

Step 1:

Connect the UUT to the spectrum analyser and use the following settings:

• Start Frequency: 2 400 MHz
• Stop Frequency: 2 483,5 MHz
• Resolution BW: 10 kHz
• Video BW: 30 kHz
• Sweep Points: > 8 350; for spectrum analysers not supporting this number of sweep points, the frequency band may be segmented
• Detector: RMS
• Trace Mode: Max Hold
• Sweep time: For non-continuous transmissions: 2 × Channel Occupancy Time × number of sweep points
For continuous transmissions: 10 s; the sweep time may be increased further until a value where the sweep time has no further impact anymore on the RMS value of the signal.

For non-continuous signals, wait for the trace to stabilize.

Save the data (trace data) set to a file.

Step 2:

For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.3.2.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.

Step 3:

Add up the values for power for all the samples in the file using the formula below.

$$P_{burst} = \frac{1}{k}\sum_{n=1}^{k} P_{sample}(n)$$

with k being the total number of samples and n the actual sample number.

Step 4:

Normalize the individual values for power (in dBm) so that the sum is equal to the RF Output Power (e.i.r.p.) measured in clause 5.4.2 and save the corrected data. The following formulas can be used:

$$C_{Corr} = P_{Sum} - P_{e.i.r.p.}$$

$$P_{Samplecorr}(n) = P_{Sample}(n) - C_{Corr}$$

with n being the actual sample number

Step 5:
Starting from the first sample $P_{Samplecorr}(n)$ (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.
Step 6:
Shift the start point of the samples added up in step 5 by one sample and repeat the procedure in step 5 (i.e. sample #2 to sample #101).
Step 7:
Repeat step 6 until the end of the data set and record the Power Spectral Density values for each of the 1 MHz segments.
From all the recorded results, the highest value is the maximum Power Spectral Density (PSD) for the UUT. This value, which shall comply with the limit given in clause 4.3.2.3.3, shall be recorded in the test report.

●Option 2: For equipment with continuous transmission capability or for equipment operating (or with the capability to operate) with a constant duty cycle (e.g. Frame Based equipment)
This option is for equipment that can be configured to operate in a continuous transmit mode (100 % DC) or with a constant Duty Cycle (DC).
Step 1:
• Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: The centre frequency of the channel under test
- RBW: 1 MHz
- VBW: 3 MHz
- Frequency Span: 2 × Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)
- Detector Mode: Peak
- Trace Mode: Max Hold

Step 2:
• When the trace is complete, find the peak value of the power envelope and record the frequency.
Step 3:
• Make the following changes to the settings of the spectrum analyser:
- Centre Frequency: Equal to the frequency recorded in step 2
- Frequency Span: 3 MHz
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep Time: 1 minute
- Detector Mode: RMS
- Trace Mode: Max Hold

Step 4:
• When the trace is complete, the trace shall be captured using the "Hold" or "View" option on the spectrum analyser.
• Find the peak value of the trace and place the analyser marker on this peak. This level is recorded as the highest mean power (power spectral density) D in a 1 MHz band.
• Alternatively, where a spectrum analyser is equipped with a function to measure power spectral density, this function may be used to display the power spectral density D in dBm / MHz.
• In case of conducted measurements on smart antenna systems operating in a mode with multiple transmit chains active simultaneously, the power spectral density of each transmit chain shall be measured separately to calculate the total power spectral density (value D in dBm / MHz) for the UUT.
Step 5:
• The maximum Power Spectral Density (PSD) e.i.r.p. is calculated from the above measured power spectral density D, the observed Duty Cycle (DC) (see clause 5.4.2.2.1.3, step 4), the applicable antenna assembly gain G in dBi and if applicable the beamforming gain Y in dB, according to the formula below. This value shall be recorded in the test report. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the highest gain shall be used.

$$PSD = D + G + Y + 10 \times \log(1 / DC) \text{ (dBm / MHz)}$$

■Radiated measurement

When performing radiated measurements, the UUT shall be configured and antenna(s) positioned (including smart antenna systems and equipment capable of beamforming) for maximum e.i.r.p. towards the measuring antenna. A test site as described in annex B and applicable measurement procedures as described in annex C shall be used.

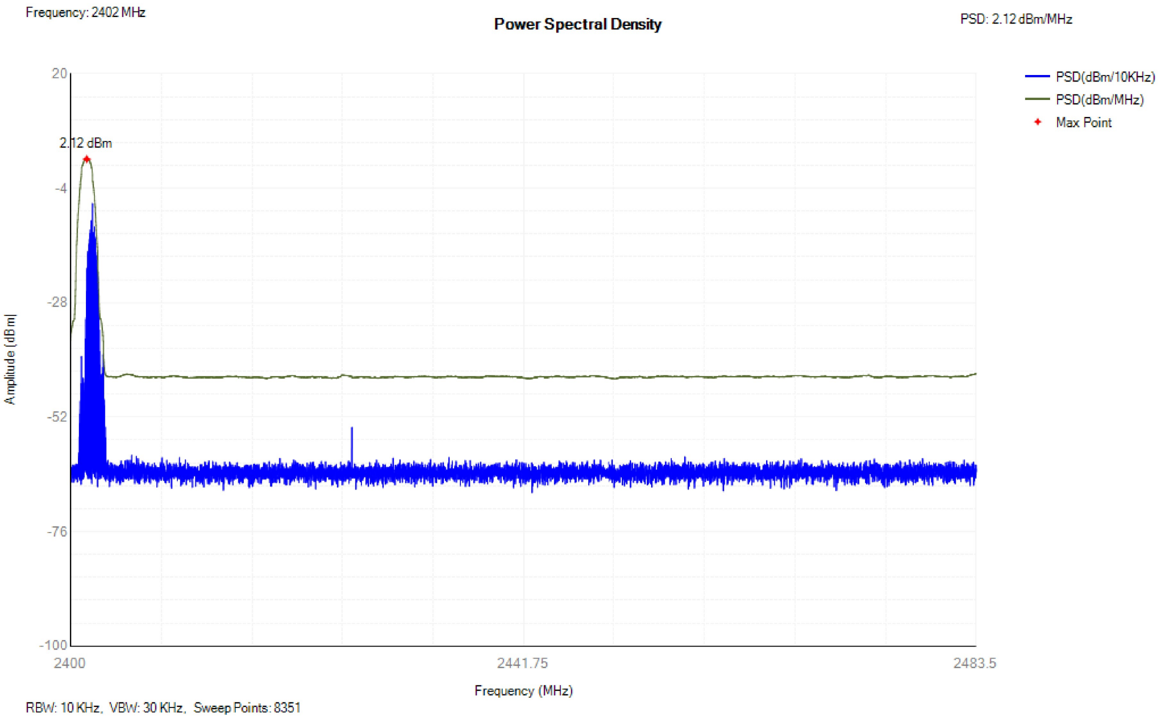
Taking into account the calibration factor from the measurement site, the test procedure is further as described under clause 5.4.3.2.1.

8.2.5 Test Results

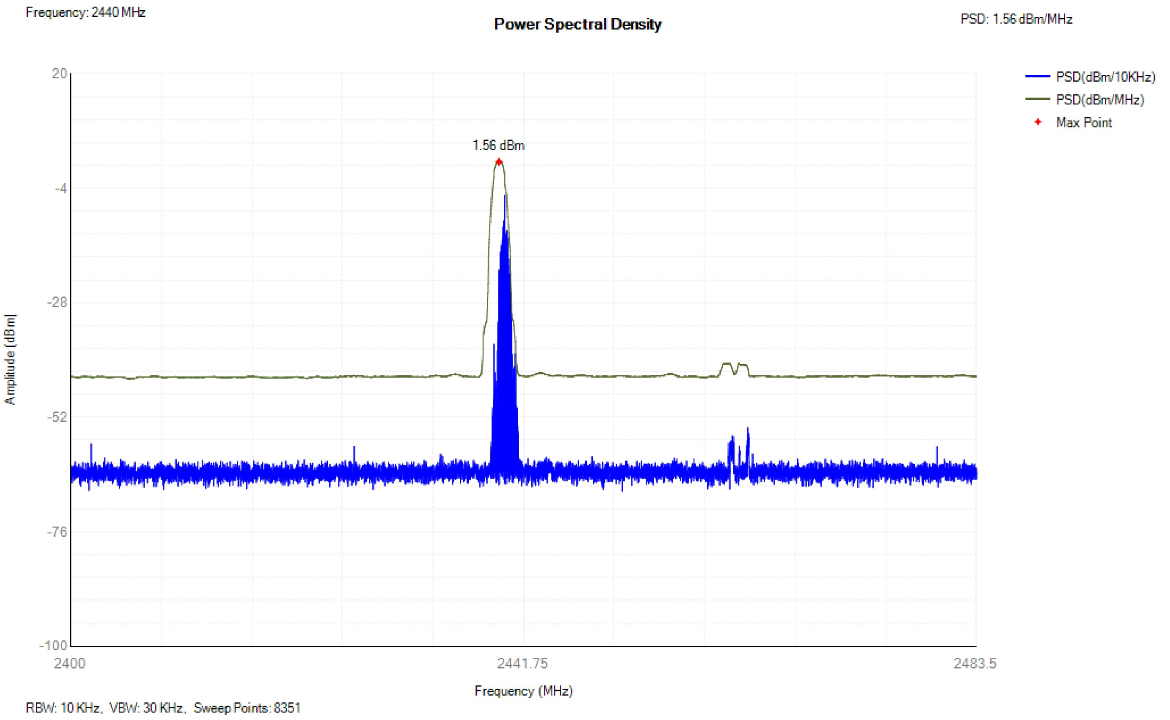
Temperature:	23°C	Test Date:	Apr. 07, 2023
Humidity:	53 % RH	Tested by:	KK

Condition	Mode	Frequency (MHz)	Antenna	Max PSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
NVNT	BLE 1M	2400	Ant1	2.12	10	Pass
NVNT	BLE 1M	2440	Ant1	1.56	10	Pass
NVNT	BLE 1M	2480	Ant1	1.75	10	Pass

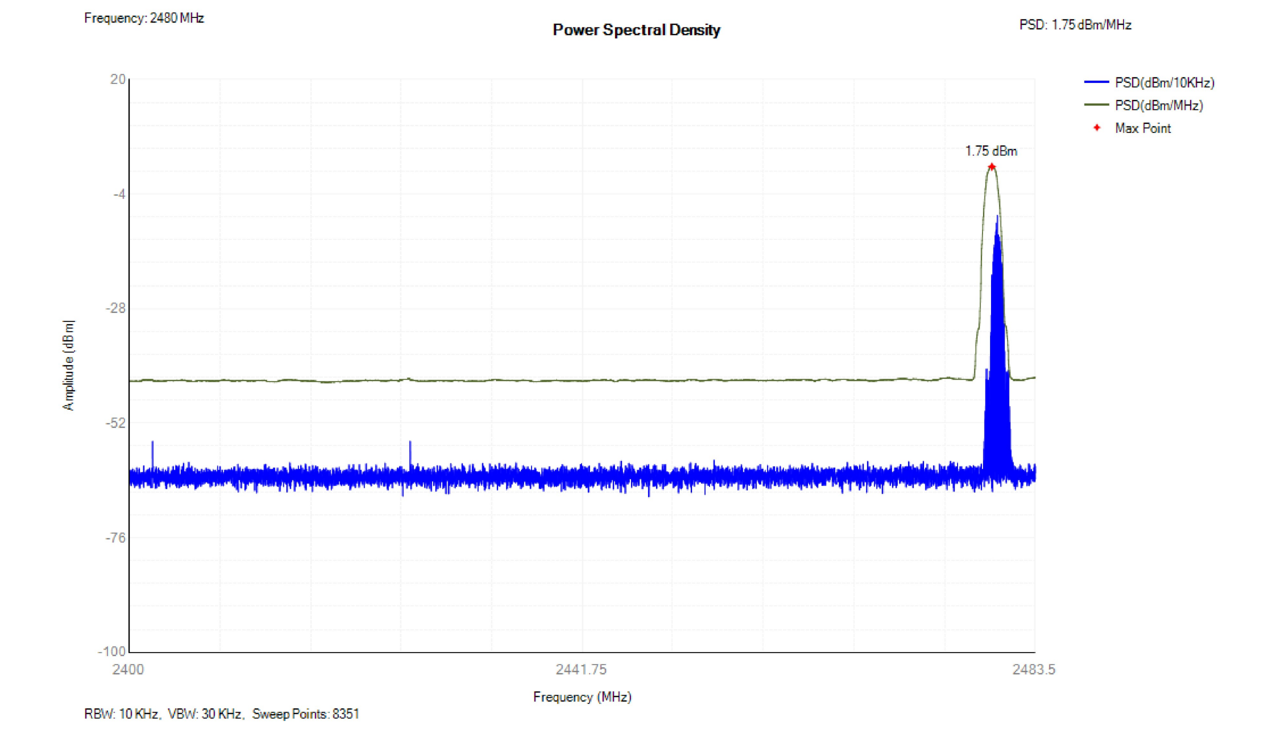
Test Graphs
PSD NVNT BLE 1M 2402MHz Ant1



PSD NVNT BLE 1M 2440MHz Ant1



PSD NVNT BLE 1M 2480MHz Ant1



8.3 OCCUPIED CHANNEL BANDWIDTH

8.3.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.7

8.3.2 Conformance Limit

The requirement applies to all types of equipment using wide band modulation other than FHSS
The occupied channel bandwidth is the bandwidth that contains 99% of the power of the signal
The Occupied Channel Bandwidth shall fall completely within the band 2400-2483.5MHz
In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p. greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.

8.3.3 Test Configuration

The measurements for Occupied Channel Bandwidth shall only be performed at normal test conditions.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.

Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s).

8.3.4 Test Procedure

1. Please refer to ETSI EN 300 328(V2.2.2) clause 5.4.7.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.7.2 for the measurement method.

■Conducted measurement
The measurement procedure shall be as follows:
Step 1:
Connect the UUT to the spectrum analyser and use the following settings:
• Centre Frequency: The centre frequency of the channel under test
• Resolution BW: ~ 1 % of the span without going below 1 %
• Video BW: 3 × RBW
• Frequency Span: 2 × Nominal Channel Bandwidth
• Detector Mode: RMS
• Trace Mode: Max Hold
• Sweep time: 1 s
Step 2:
Wait for the trace to stabilize.
Find the peak value of the trace and place the analyser marker on this peak.
Step 3:
Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT.
This value shall be recorded.
Make sure that the power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals left and right from the power envelope being taken into account by this measurement.
■Radiated measurement
The test set up as described in annex B and the applicable measurement procedures described in annex C shall be used.
Alternatively, a test fixture may be used.
The test procedure is as described under clause 5.4.7.2.1.

8.3.5 Test Results

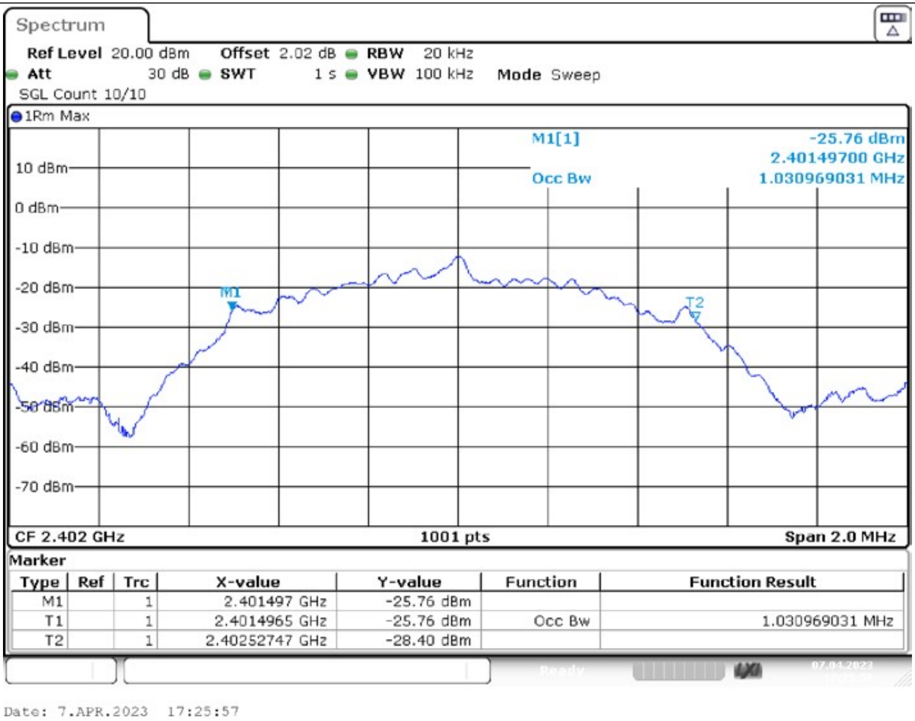
All the modulation modes were tested, the data of the worst mode are described in the following table

Temperature:	22ºC	Test Date:	Apr. 07, 2023
Humidity:	53 % RH	Tested by:	KK

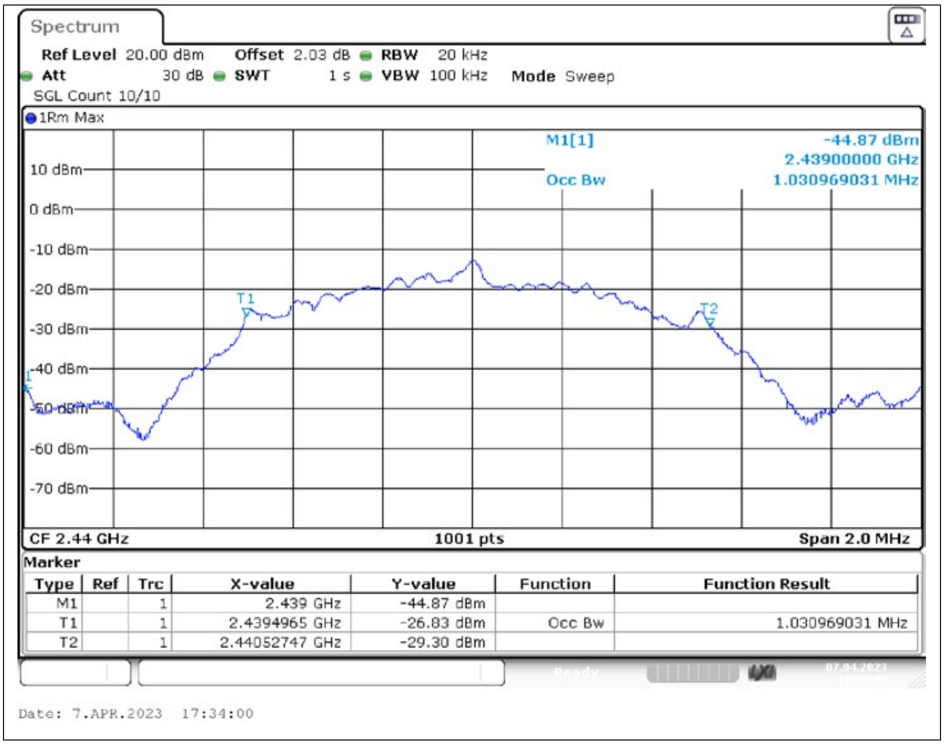
Condition	Mode	Frequency (MHz)	Antenna	Center Frequency (MHz)	OBW (MHz)	Lower Edge (MHz)	Upper Edge (MHz)	Limit OBW (MHz)	Verdict
NVNT	BLE 1M	2400	Ant1	2402.012	1.031	2401.497	2402.527	20	Pass
NVNT	BLE 1M	2440	Ant1	2440.012	1.031	2439.497	2440.527	20	Pass
NVNT	BLE 1M	2480	Ant1	2480.013	1.033	2479.497	2480.529	20	Pass

Test Graphs

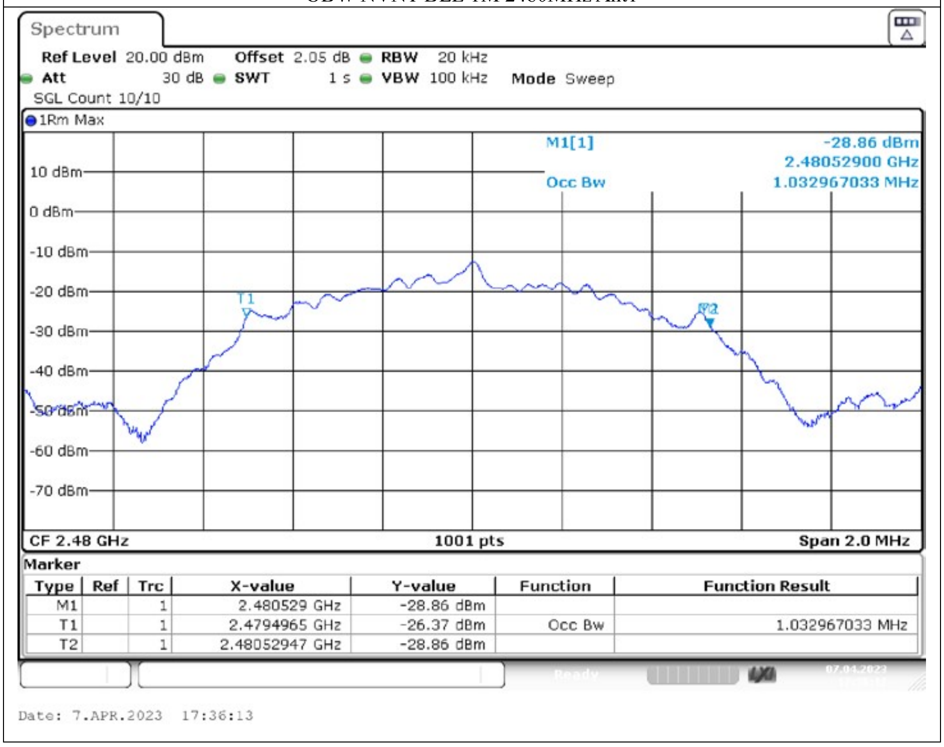
OBW NVNT BLE 1M 2402MHz Ant1



OBW NVNT BLE 1M 2440MHz Ant1



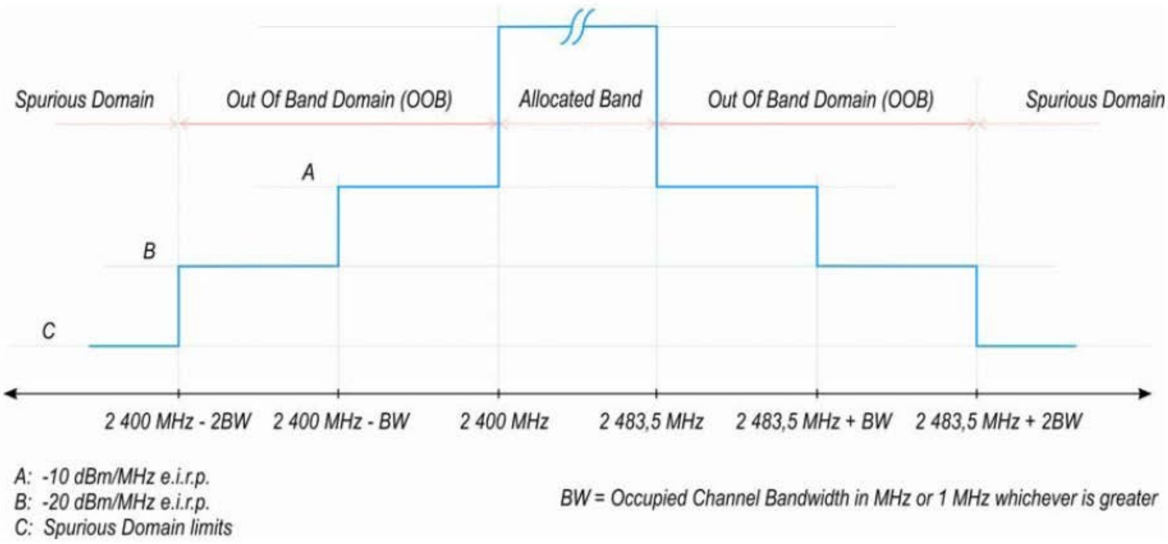
OBW NVNT BLE 1M 2480MHz Ant1



8.4 TRANSMITTER UNWANTED EMISSION IN THE OUT-OF BAND

8.4.1 Applicable standard
ETSI EN 300 328 clause 4.3.2.8

8.4.2 Conformance Limit
The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the limits of the mask given in below figure.



8.4.3 Test Configuration

The measurements for emission in the out-of band shall only be performed at normal test conditions.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.

Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s).

8.4.4 Test Procedure
1. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.8.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.8.2 for the measurement method.

■ Conducted measurement

The applicable mask is defined by the measurement results from the tests performed under clause 5.4.7 (Occupied Channel Bandwidth).
The Out-of-band emissions within the different horizontal segments of the mask provided in figure 1 and figure 3 shall be measured using the procedure in step 1 to step 6 below. This method assumes the spectrum analyser is equipped with the Time Domain Power option.
Step 1:
• Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: 2 484 MHz
- Span: 0 Hz
- Resolution BW: 1 MHz
- Filter mode: Channel filter
- Video BW: 3 MHz
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep Mode: Continuous
- Sweep Points: Sweep Time [s] / (1 μs) or 5 000 whichever is greater

- Trigger Mode: Video trigger; in case video triggering is not possible, an external trigger source may be used
- Sweep Time: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

Step 2 (segment 2 483,5 MHz to 2 483,5 MHz + BW):

• Adjust the trigger level to select the transmissions with the highest power level.
• For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.
• Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.
• Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.
• Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 3 (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW):

• Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 4 (segment 2 400 MHz - BW to 2 400 MHz):

• Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 5 (segment 2 400 MHz - 2BW to 2 400 MHz - BW):

• Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 6:

• In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figure 1 or figure 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.
• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain "G" in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below:

- Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figure 1 or figure 3.
- Option 2: the limits provided by the mask given in figure 1 or figure 3 shall be reduced by 10 × log10(Ach) and the additional beamforming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.

NOTE: Ach refers to the number of active transmit chains.

It shall be recorded whether the equipment complies with the mask provided in figure 1 or figure 3.

■ Radiated measurement

The test set up as described in annex B and the applicable measurement procedures described in annex C shall be used. Alternatively a test fixture may be used.

The test procedure is as described under clause 5.4.8.2.1.

8.4.5 Test Results

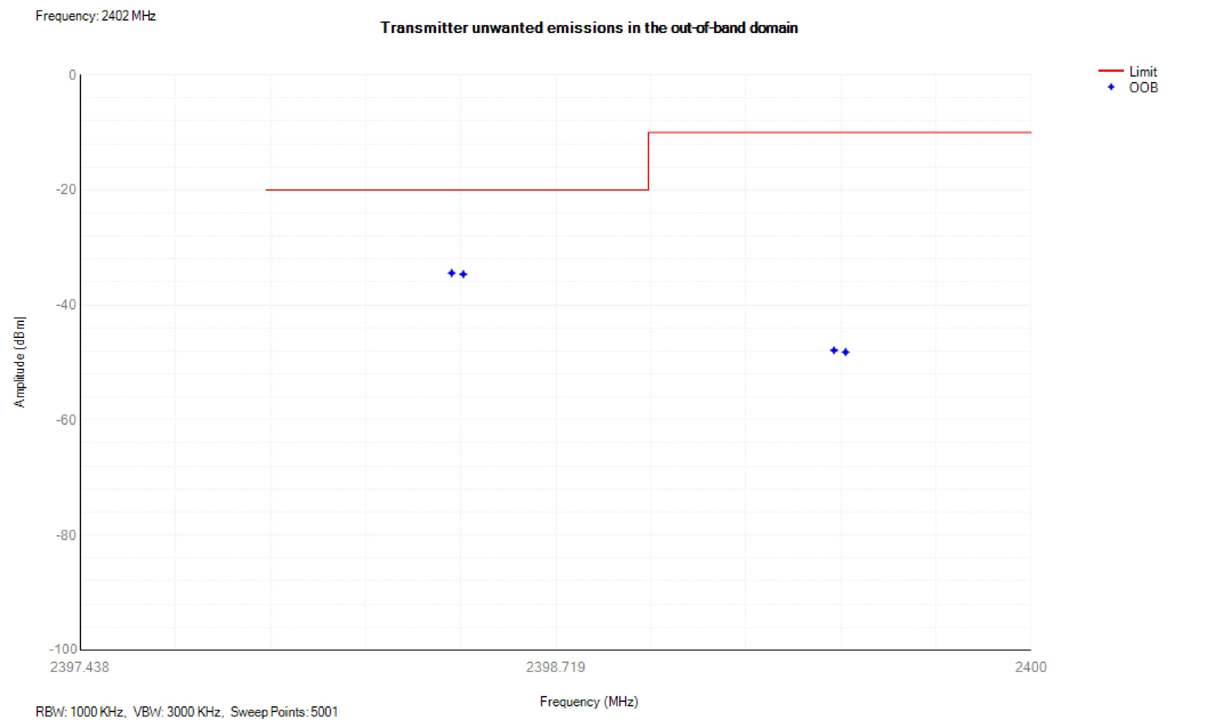
PASS.

All the modulation modes were tested, the data of the worst mode are described in the following pages.

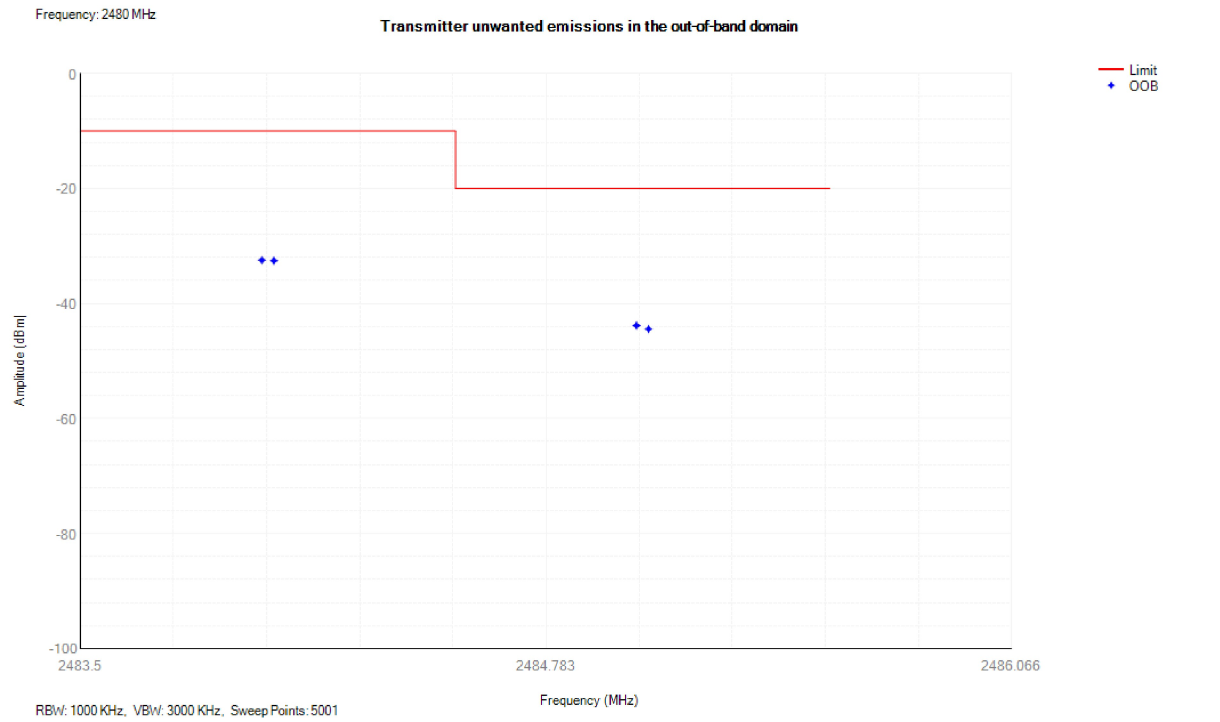
Condition	Mode	Frequency (MHz)	Antenna	OOB Frequency (MHz)	Level (dBm/MHz)	Limit (dBm/MHz)	Verdict
NVNT	BLE 1M	2400	Ant1	2399.5	-48.18	-10	Pass
NVNT	BLE 1M	2402	Ant1	2399.469	-47.87	-10	Pass
NVNT	BLE 1M	2402	Ant1	2398.469	-34.64	-20	Pass
NVNT	BLE 1M	2402	Ant1	2398.438	-34.44	-20	Pass
NVNT	BLE 1M	2480	Ant1	2484	-32.47	-10	Pass
NVNT	BLE 1M	2480	Ant1	2484.033	-32.55	-10	Pass
NVNT	BLE 1M	2480	Ant1	2485.033	-43.82	-20	Pass
NVNT	BLE 1M	2480	Ant1	2485.066	-44.44	-20	Pass

aphs

Tx. Emissions OOB NVNT BLE 1M 2402MHz Ant1



Tx. Emissions OOB NVNT BLE 1M 2480MHz Ant1



8.5 TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

8.5.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.9

8.5.2 Conformance Limit

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in below.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted).
For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

Frequency Range	Maximum power	bandwidth
30 MHz to 47 MHz	-36dBm	100kHz
47 MHz to 74 MHz	-54dBm	100kHz
74 MHz to 87.5 MHz	-36dBm	100kHz
87.5MHz to118 MHz	-54dBm	100kHz
118 MHz to174MHz	-36dBm	100kHz
174MHz to 230MHz	-54dBm	100kHz
230 MHz to 470 MHz	-36dBm	100kHz
470 MHz to 862 MHz	-54dBm	100kHz
862 MHz to1 GHz	-36dBm	100kHz
1GHz to12.75 GHz	-30dBm	1MHz

8.5.3 Test Configuration

The measurements for emissions in the spurious domain shall only be performed at normal test conditions.

Radiated measurements shall be used for equipment.

Conducted measurements shall be used for equipment.

8.5.4 Test Procedure

1. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.9.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.9.2 for the measurement methods.

■ Conducted measurement

● Introduction

The spectrum in the spurious domain (see figure 1 or figure 3) shall be searched for emissions that exceed the limit values given in table 4 or table 12 or that come to within 6 dB below these limits. Each occurrence shall be recorded.
The measurement procedure contains 2 parts.

● Pre-scan

The test procedure below shall be used to identify potential unwanted emissions of the UUT.
Step 1:
The sensitivity of the measurement set-up should be such that the noise floor is at least 12 dB below the limits given in table 4 or table 12.
Step 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: ≥ 19 400; For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.
• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.
For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.
The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used.
Allow 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 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12.

Step 3:
The emissions over the range 1 GHz to 12,75 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: ≥ 23 500; For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.
• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 1 MHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.
For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.
The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used.
Allow 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 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12.
Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.4.9.2.1.3.

Step 4:
• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 and step 3 need to be repeated for each of the active transmit chains (Ach).The limits used to identify emissions during this pre-scan need to be reduced with 10 × log10 (Ach) (number of active transmit chains).

● 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.

Step 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: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power
• Sweep points: Sweep time [μs] / (1 μs) with a maximum of 30 000

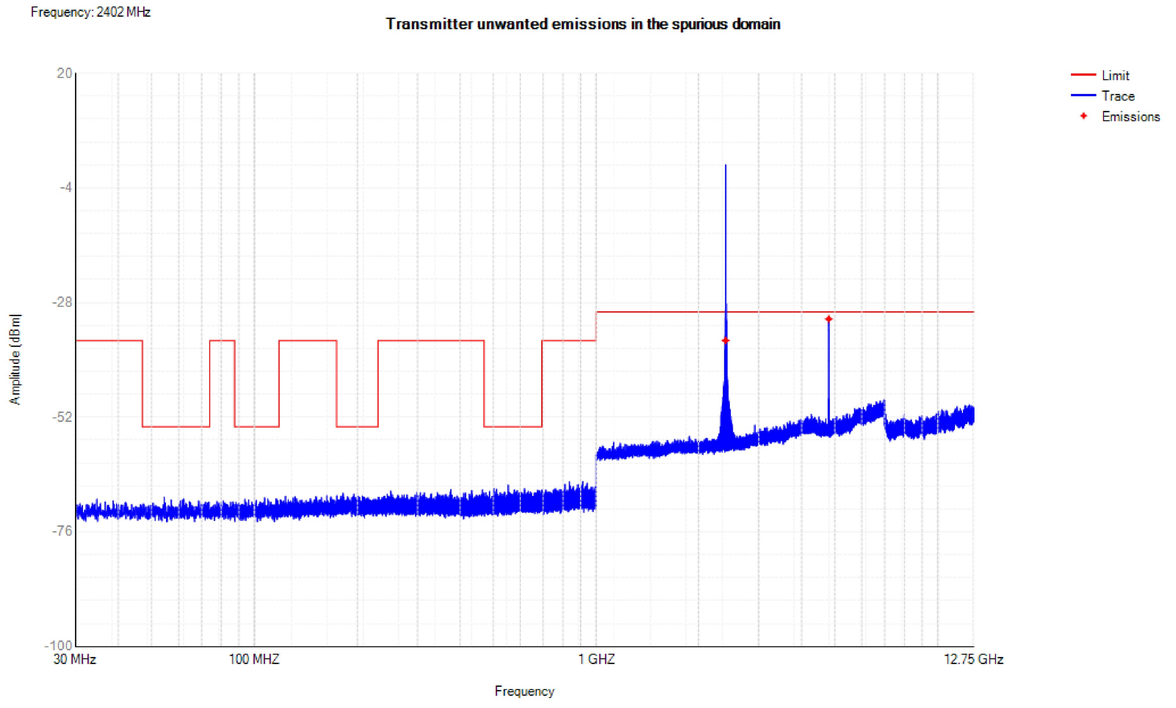
• Trigger: Video (burst signals) or Manual (continuous signals)
• Detector: RMS
Step 2:
• Set a window where the start and stop indicators match the start and end of the burst with the highest level and record the value of the power measured within this window. If the spurious emission to be measured is a continuous transmission, the measurement window shall be set to match the start and stop times of the sweep.
Step 3:
In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 needs to be repeated for each of the active transmit chains (Ach).
Sum the measured power (within the observed window) for each of the active transmit chains.
Step 4:
The value defined in step 3 shall be compared to the limits defined in table 4 or table 12.
■ Radiated measurement
The test site as described in annex B and applicable measurement procedures as described in annex C shall be used.
The test procedure is further as described under clause 5.4.9.2.1.

8.5.5 Test Results

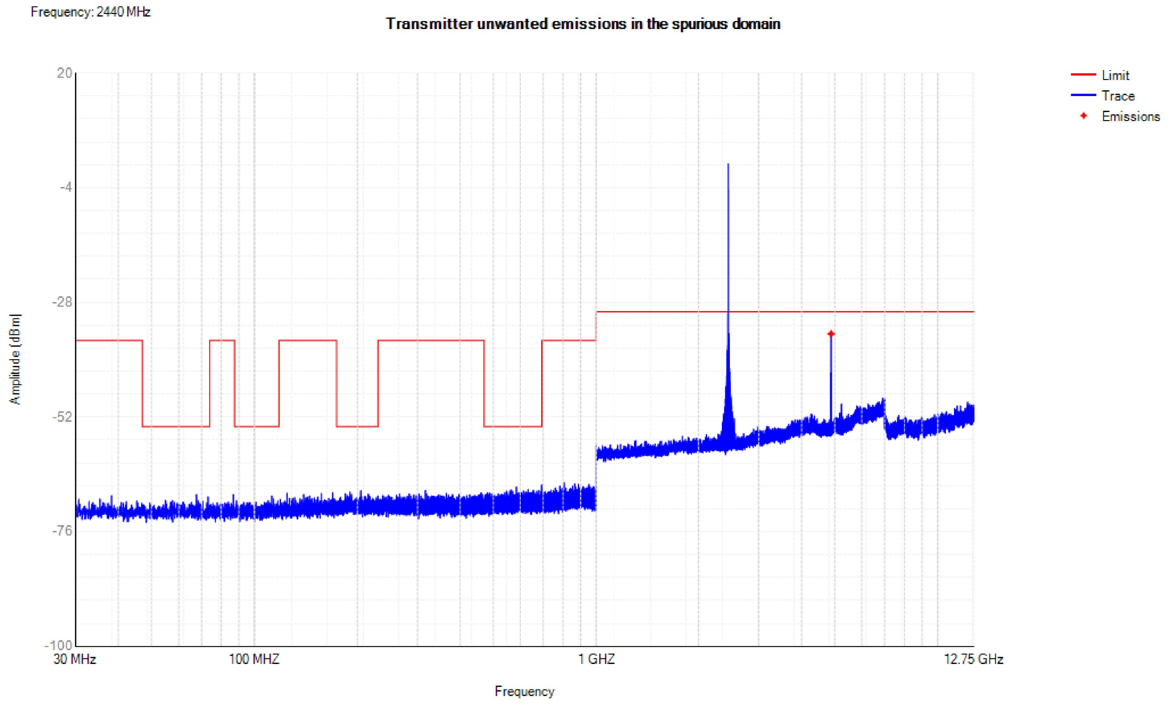
The data of test mode (GFSK) are recorded in the following pages.

Condition	Mode	Frequency (MHz)	Antenna	Range (MHz)	Spur Freq (MHz)	Peak (dBm)	RMS (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	Ant1	30 -47	34.60	-69.14	NA	-36	Pass
NVNT	BLE 1M	2402	Ant1	47 -74	54.50	-68.74	NA	-54	Pass
NVNT	BLE 1M	2402	Ant1	74 -87.5	81.00	-69.55	NA	-36	Pass
NVNT	BLE 1M	2402	Ant1	87.5 -118	107.25	-68.90	NA	-54	Pass
NVNT	BLE 1M	2402	Ant1	118 -174	162.80	-68.44	NA	-36	Pass
NVNT	BLE 1M	2402	Ant1	174 -230	181.80	-67.93	NA	-54	Pass
NVNT	BLE 1M	2402	Ant1	230 -470	375.90	-67.10	NA	-36	Pass
NVNT	BLE 1M	2402	Ant1	470 -694	552.70	-66.22	NA	-54	Pass
NVNT	BLE 1M	2402	Ant1	694 -1000	913.05	-65.45	NA	-36	Pass
NVNT	BLE 1M	2402	Ant1	1000 -2398	2397.50	-29.57	-35.96	-30	Pass
NVNT	BLE 1M	2402	Ant1	2485.5 -12750	4803.50	-31.72	-31.46	-30	Pass
NVNT	BLE 1M	2440	Ant1	30 -47	38.20	-68.46	NA	-36	Pass
NVNT	BLE 1M	2440	Ant1	47 -74	67.70	-68.25	NA	-54	Pass
NVNT	BLE 1M	2440	Ant1	74 -87.5	86.75	-68.24	NA	-36	Pass
NVNT	BLE 1M	2440	Ant1	87.5 -118	112.35	-68.52	NA	-54	Pass
NVNT	BLE 1M	2440	Ant1	118 -174	169.45	-67.87	NA	-36	Pass
NVNT	BLE 1M	2440	Ant1	174 -230	204.75	-67.44	NA	-54	Pass
NVNT	BLE 1M	2440	Ant1	230 -470	316.25	-67.37	NA	-36	Pass
NVNT	BLE 1M	2440	Ant1	470 -694	692.60	-66.26	NA	-54	Pass
NVNT	BLE 1M	2440	Ant1	694 -1000	805.65	-65.77	NA	-36	Pass
NVNT	BLE 1M	2440	Ant1	1000 -2398	2396.50	-48.23	NA	-30	Pass
NVNT	BLE 1M	2440	Ant1	2485.5 -12750	4880.50	-34.89	-34.61	-30	Pass
NVNT	BLE 1M	2480	Ant1	30 -47	31.85	-69.43	NA	-36	Pass
NVNT	BLE 1M	2480	Ant1	47 -74	58.25	-68.93	NA	-54	Pass
NVNT	BLE 1M	2480	Ant1	74 -87.5	79.45	-68.77	NA	-36	Pass
NVNT	BLE 1M	2480	Ant1	87.5 -118	99.00	-68.96	NA	-54	Pass
NVNT	BLE 1M	2480	Ant1	118 -174	171.60	-68.58	NA	-36	Pass
NVNT	BLE 1M	2480	Ant1	174 -230	192.20	-66.80	NA	-54	Pass
NVNT	BLE 1M	2480	Ant1	230 -470	371.65	-67.38	NA	-36	Pass
NVNT	BLE 1M	2480	Ant1	470 -694	660.10	-66.95	NA	-54	Pass
NVNT	BLE 1M	2480	Ant1	694 -1000	975.90	-65.89	NA	-36	Pass
NVNT	BLE 1M	2480	Ant1	1000 -2398	2381.50	-53.25	NA	-30	Pass
NVNT	BLE 1M	2480	Ant1	2485.5 -12750	2487.50	-33.82	-39.85	-30	Pass

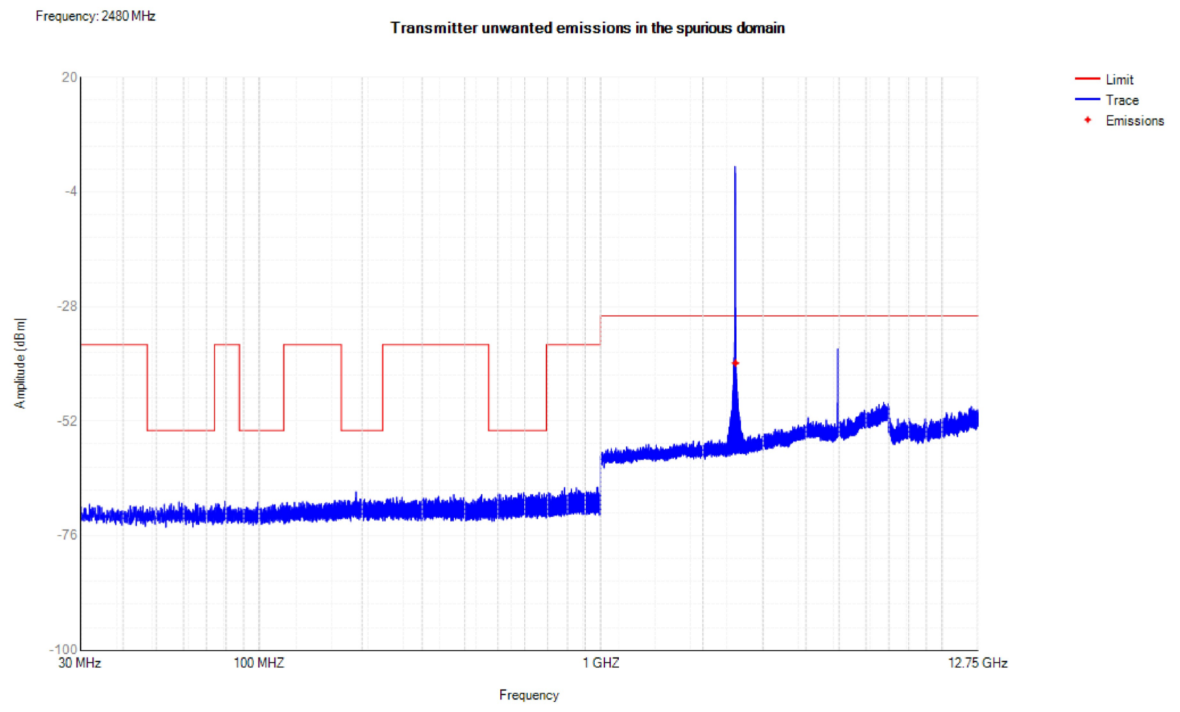
Test Graphs
Tx. Spurious NVNT BLE 1M 2402MHz Ant1



Tx. Spurious NVNT BLE 1M 2440MHz Ant1



Tx. Spurious NVNT BLE 1M 2480MHz Ant1



Notes:
1. Negative sign (-) in the margin column signify levels below the limit.
2. The test frequency range is 30MHz to 12.75GHz.
3. Other emissions found were at least 10 dB below the limit.
4. Measurement Uncertainty: ±5.0dB.
5. Correction value was combined in the calculated result.

8.6 RECEIVER SPURIOUS EMISSIONS

8.6.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.10

8.6.2 Conformance Limit

The spurious emissions of the receiver shall not exceed the values given in below.

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

Frequency Range	Maximum power	Measurement Width
30 MHz to 1 GHz	-57 dBm	100kHz
1 GHz to 12.75 GHz	-47 dBm	1MHz

8.6.3 Test Configuration

The measurements for emissions in the spurious domain shall only be performed at normal test conditions.

Radiated measurements shall be used for equipment.

Conducted measurements shall be used for equipment.

8.6.4 Test Procedure

1. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.11.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.11.2 for the measurement methods.

■ Conducted measurement

● Introduction

The spectrum in the spurious domain (see figure 1 or figure 3) shall be searched for emissions that exceed the limit values given in table 4 or table 12 or that come to within 6 dB below these limits. Each occurrence shall be recorded.

The measurement procedure contains 2 parts.

● Pre-scan

The test procedure below shall be used to identify potential unwanted emissions of the UUT.

Step 1:

The sensitivity of the measurement set-up should be such that the noise floor is at least 12 dB below the limits given in table 4 or table 12.

Step 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: ≥ 19 400; For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.
- Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.
  For Frequency Hopping equipment operating in a normal operating (hopping not disabled)

mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.
The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used.
Allow 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 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12.
Step 3:
The emissions over the range 1 GHz to 12,75 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: ≥ 23 500; For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.
• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 1 MHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.
For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.
The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used.
Allow 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 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12.
Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.4.9.2.1.3.
Step 4:
• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 and step 3 need to be repeated for each of the active transmit chains (Ach).The limits used to identify emissions during this pre-scan need to be reduced with 10 × log10 (Ach) (number of active transmit chains).
● 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.
Step 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: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power
• Sweep points: Sweep time [μs] / (1 μs) with a maximum of 30 000
• Trigger: Video (burst signals) or Manual (continuous signals)
• Detector: RMS
Step 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 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 match the start and stop times of the sweep.
Step 3:
In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains),

step 2 needs to be repeated for each of the active transmit chains (Ach).
Sum the measured power (within the observed window) for each of the active transmit chains.
Step 4:
The value defined in step 3 shall be compared to the limits defined in table 4 or table 12.

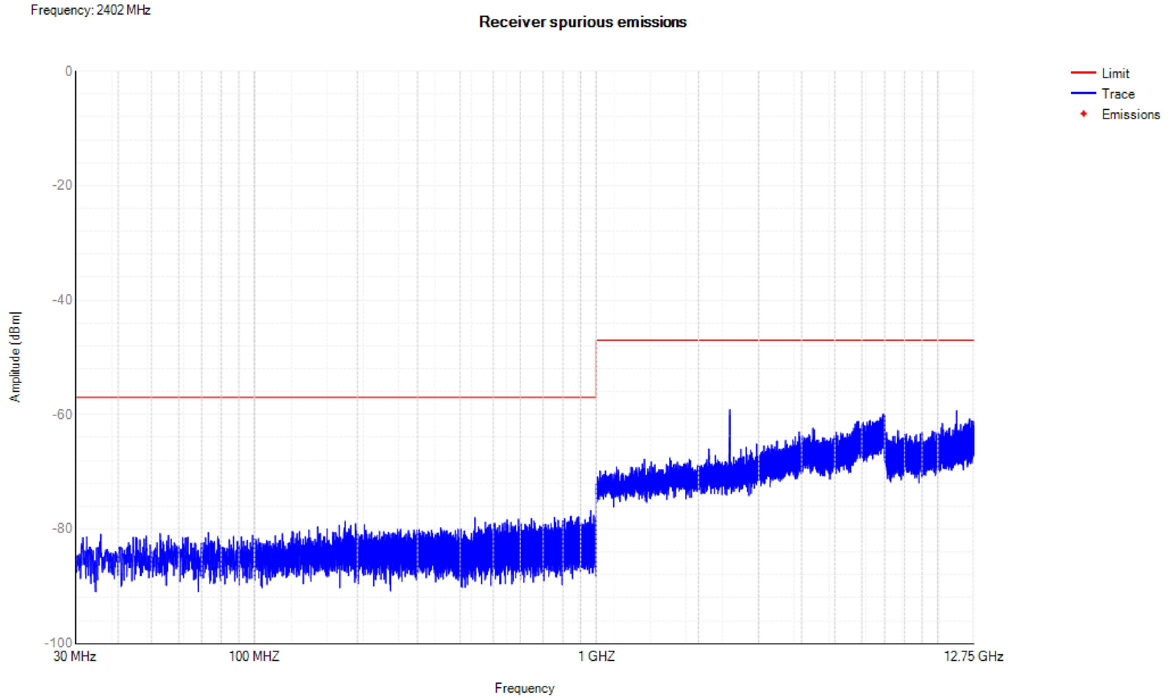
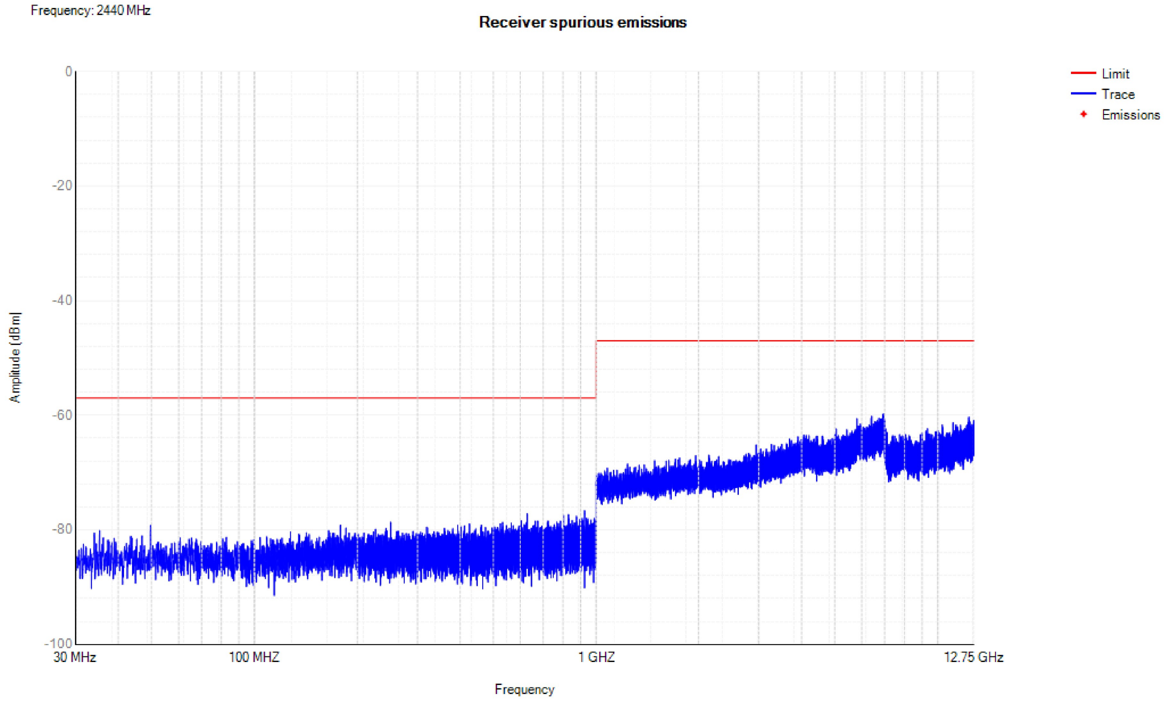
- Radiated measurement

The test site as described in annex B and applicable measurement procedures as described in annex C shall be used.
The test procedure is further as described under clause 5.4.9.2.1.

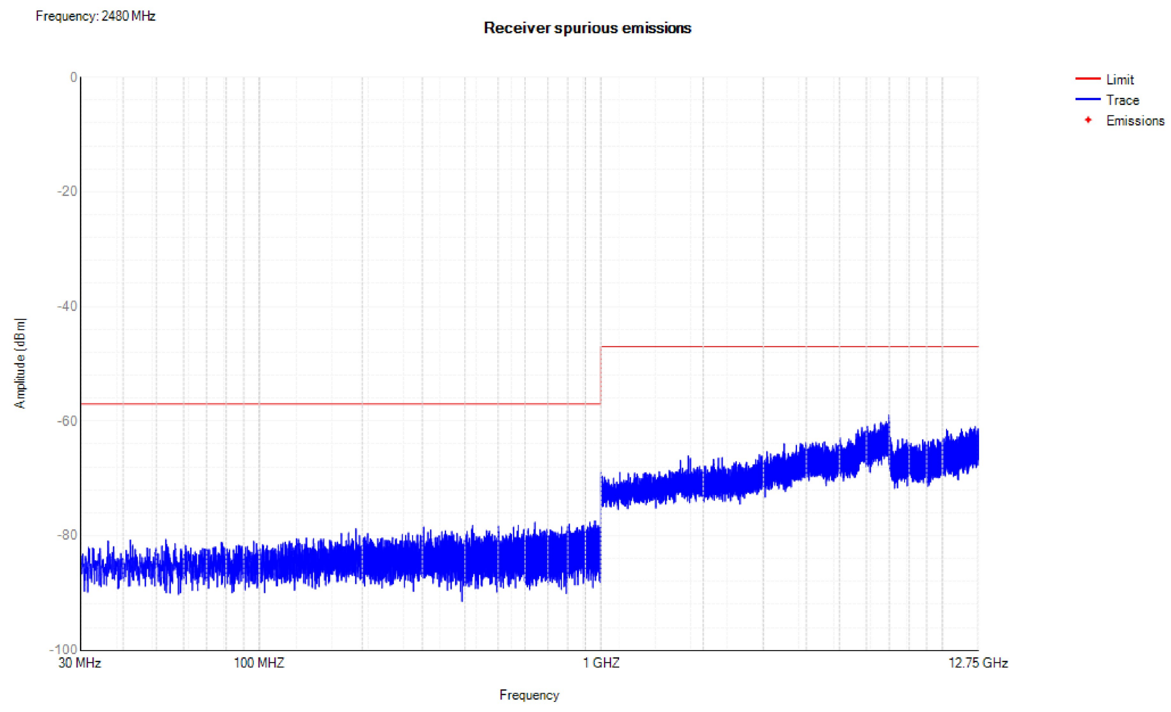
8.6.5 Test Results

The data of test mode (GFSK) are recorded in the following pages.

Condition	Mode	Frequency (MHz)	Antenna	Range (MHz)	Spur Freq (MHz)	Peak (dBm)	RMS (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	Ant1	30 -1000	963.9	-76.77	NA	-57	Pass
NVNT	BLE 1M	2402	Ant1	1000 -12750	2468.5	-59.13	NA	-47	Pass
NVNT	BLE 1M	2440	Ant1	30 -1000	924.65	-76.64	NA	-57	Pass
NVNT	BLE 1M	2440	Ant1	1000 -12750	6961.5	-59.72	NA	-47	Pass
NVNT	BLE 1M	2480	Ant1	30 -1000	960.85	-77.37	NA	-57	Pass
NVNT	BLE 1M	2480	Ant1	1000 -12750	6976	-58.90	NA	-47	Pass

Test Graphs
Rx. Spurious NVNT BLE 1M 2402MHz Ant1

Rx. Spurious NVNT BLE 1M 2440MHz Ant1


Rx. Spurious NVNT BLE 1M 2480MHz Ant1



Notes:
1. Negative sign (-) in the margin column signify levels below the limit.
2. The test frequency range is 30MHz to 12.75GHz.
3. Other emissions found were at least 10 dB below the limit.
4. Measurement Uncertainty: ±5.0dB.
5. Correction value was combined in the calculated result.

8.7 Receiver Blocking

Applicable standard

ETSI EN 300 328 clause 4.3.2.11

8.7.1 Conformance Limit

The minimum performance criterion shall be a PER less than or equal to 10 %. The manufacturer may declare alternative performance criteria as long as that is appropriate for the intended use of the equipment (see clause 5.4.1.t)).

■ General

While maintaining the minimum performance criteria as defined in clause 4.3.1.12.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in below.

●Receiver Category 1

Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × log10(OCBW)) or -68 dBm whichever is less (see note 2)	2 380 2 503,5	-34	CW
(-139 dBm + 10 × log10(OCBW)) or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 484 2 674		
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to Pmin + 26 dB where Pmin is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to Pmin + 20 dB where Pmin is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

●Receiver Category 2

Receiver Blocking parameters receiver category 2 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log10(OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal			

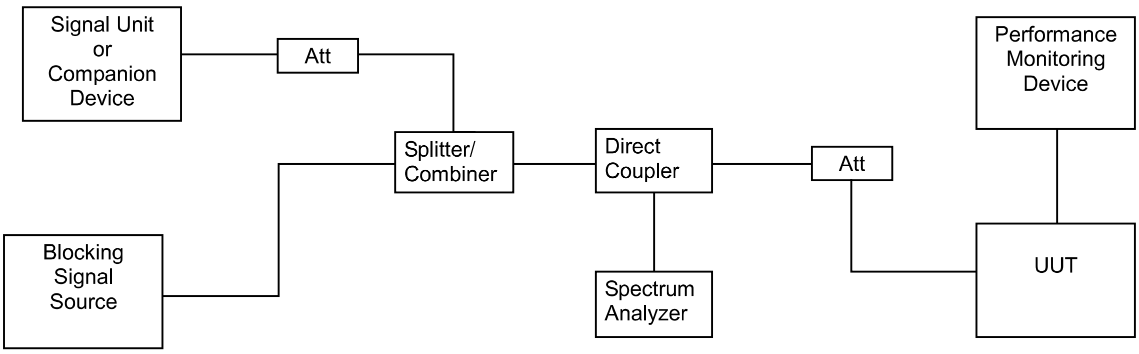
up to Pmin + 26 dB where Pmin is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

●Receiver Category 3

Receiver Blocking parameters receiver category 3 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log10(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1: OCBW is in Hz. NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to Pmin + 30 dB where Pmin is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.			

Test Configuration



Test Procedure

1. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.11.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.2.2) clause 5.4.11.2 for the measurement method.

■ Conducted measurement

Adaptive Frequency Hopping equipment using DAA

Step 1:

• For non-frequency hopping equipment, the UUT shall be set to the lowest operating channel.

Step 2:

• The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.

Step 3:

• With the blocking signal generator switched off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6. The attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is Pmin.

• This signal level (Pmin) is increased by the value provided in the table corresponding to the receiver category and type of equipment.
Step 4:
• The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver category and type of equipment. It shall be verified and recorded in the test report that the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is met.
Step 5:
• Repeat step 4 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.
Step 6:
• For non-frequency hopping equipment, repeat step 2 to step 5 with the UUT operating at the highest operating channel.

■ Radiated measurements

When performing radiated measurements on equipment with dedicated antennas, measurements shall be repeated for each alternative dedicated antenna.
A test site as described in annex B and applicable measurement procedures as described in annex C shall be used.
The test procedure is further as described under clause 5.4.11.2.1.
The level of the blocking signal at the UUT referred to in step 4 is assumed to be the level in front of the UUT antenna(s). The UUT shall be positioned with its main beam pointing towards the antenna radiating the blocking signal. The position recorded in clause 5.4.2.2.2 can be used.

Test Results

Receiver category

☐	Receiver category 1	Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. shall be considered as receiver category 1 equipment.
☐	Receiver category 2	Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p. shall be considered as receiver category 2 equipment.
☒	Receiver category 3	Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. shall be considered as receiver category 3 equipment.
☐	Other Receiver category	Maximum RF Output Power less than 10 dBm e.i.r.p. No need to test Receiver Blocking

Operation Mode:	☒ GFSK		
Test Frequency:	☒2402MHz	☐2480MHz	
Temperature:	22°C	Test Date:	Apr. 07, 2023
Humidity:	53 % RH	Tested by:	Fan

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)	Type of blocking signal	PER(%)	Result
-59	2 380	-34	CW	2.1%	PASS
	2 504	-34	CW	1.3%	PASS
	2 300	-34	CW	0.6%	PASS
	2 584	-34	CW	0.2%	PASS
	OCW=1MHz NOTE: N/A means not applicable				

Operation Mode:	☒ GFSK		
Test Frequency:	☐2402MHz	☒2480MHz	
Temperature:	22°C	Test Date:	Apr. 07, 2023
Humidity:	53 % RH	Tested by:	Fan

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)	Type of blocking signal	PER(%)	Result
-59	2 380	-34	CW	0.8%	PASS
	2 504	-34	CW	1.2%	PASS
	2 300	-34	CW	0.7%	PASS
	2 584	-34	CW	1.3%	PASS
	OCW=1MHz NOTE: N/A means not applicable				

9 APPENDIX PHOTOGRAPHS OF EUT

Please refer to the report :E01A23030814E00201.

END OF REPORT