TECHNICAL REPORT

Report No:	EMC2003020-03
File Reference No:	2020-03-17
Applicant:	
Product:	Bluetooth Speaker
Brand Name:	N/A
Model No:	P329.333, P329.335, P329.336, P329.337
Test Standards:	ETSI EN 300 328 v2.1.1 (2016-11)
Test Result:	The RF Spectrum testing has been performed on the submitted samples and found in compliance with council RE Directive 2014/53/EU

Approved By:

Jack Chung

Jack Chung

EMC Manager

Dated: March 17, 2020

Results appearing herein relate only to the sample tested
The technical reports is issued errors and omissions exempt and is subject to withdrawal at

SHENZHEN TIMEWAY TESTING LABORATORIES

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Special Statement:

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19.

The testing quality system of our laboratory meet with ISO/IEC-17025 requirements, which is approved by CNAS. This approval result is accepted by MRA of APLAC.

Our test facility is recognized, certified, or accredited by the following organizations:

CNAS-LAB Code: L2292

The EMC Laboratory has been assessed and in compliance with CNAS-CL01 accreditation criteria for testing Laboratories (identical to ISO/IEC 17025:2005 General Requirements) for the Competence of testing Laboratories.

FCC-Registration No.: 744189

The EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications commission. The acceptance letter from the FCC is maintained in our files. Registration No.: 744189.

Industry Canada (IC) —Registration No.:5205A

The EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 5205A.

A2LA (Certification Number:5013.01)

The EMC Laboratory has been accredited by the American Association for Laboratory Accreditation (A2LA). Certification Number:5013.01

Test Report Conclusion

Content

1. General Information

1.1 Notes

The test results of this report relate exclusively to the test item specified in 1.5. The TIMEWAY Lab does not assume Responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the TIMEWAY Lab.

1.2 Testing Laboratory

SHENZHEN TIMEWAY TESTING LABORATORIES.

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Site on File With the Federal Communications and Commission – United States
Registration Number: 744189
For 3m Anechoic Chamber

Site Listed with Industry Canada of Ottawa, Canada
Registration Number: IC: 5205A
For 3m Anechoic Chamber

1.3 Test Data

Date of Receipt of Application: March 05, 2020
Date of Receipt of Test Item: March 05, 2020
Date of Test: March 05, 2020 ~ March 17, 2020

1.4 Description of EUT

EUT Type……………………………….:	Bluetooth Speaker	
Applicant……………………………….:		
Manufacturer…………………………..:		
Equipment type……………………....:	Bluetooth 2.4G	
Modulation Type (Technology)…….:	GFSK	
Operating Frequency Range……..:	2.402GHz - 2.480GHz	
Modulation used by the equipment:	Other than FHSS	
Maximum e.r.i.p……………..............:	1.27 dBm	
Maximum OCB ……………….........:	GFSK	1018kHz
Adaptive Mode………………………..:	Adaptive/non-adaptive equipment:	Adaptive Equipment without the possibility to switch to a non-adaptive mode
	LBT Base DAA:	Yes
	Non-LBT Base DAA:	No
	Number of transmit chain:	1
	Number of receive chain:	1
Antenna Gain…………………………:	Antenna Type:	PCB Antenna
	Antenna Gain:	0.58dBi
Operating voltage…….………..…….:	Normal：	DC3.7V
	Lowest：	DC3.3V
	Highest：	DC4.2V
Operating temperature……………...:	Normal：	25℃
	Lowest：	-20℃
	Highest：	40℃

1.5 Setting of test system

Setting	Value	
EUT type:	Bluetooth 2.4G	
	Mode	Modulation Type
	BLE	GFSK
EUT frequency configurable:	Yes	
Test channel-Low:	2402MHz	
Test channel-Middle:	2440MHz	
Test channel-High:	2480MHz	
Adaptive:	Yes	
With TPC function:	No	
Number of the antenna:	1	
Number of transmission chains:	1	
Beam forming:	No	
Operating frequency range:	2400MHz~2483.5MHz	
Maximum beam forming gain:	N.A	
Antenna gain:	0.58dBi	

1.6 Test Standards

ETSI EN 300 328 v 2.1.1 (2016-11)

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

Note: All radiated measurements were made in all three orthogonal planes. The values reported are the maximum values.

1.7 Configuration of The EUT

The EUT was configured according to **CISPR16.** All interface ports were connected to the appropriate peripherals. All peripherals and cables are listed below.

A. EUT

Device	Manufacturer	Model
Bluetooth Speaker	**Richen Industrial Co., Ltd.**	**S156S, P329.333, P329.335, P329.336, P329.337**

B. Internal Devices

Device	Manufacturer	Model
N/A		

C. Peripherals

Device	Manufacturer	Model	Cable
N/A			

D. EUT Exercise

The EUT (Transmitter) was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

1.8 EUT Modifications

No modification by SHENZHEN TIMEWAY TESTING LABORATORIES.

1.9 Tests or Witness Test Engineering

Test By: ____________________

Printing Name: Terry Tang

2. Technical Test

2.1 Summary of Test Results

No deviations from the technical specification(s) were ascertained in the course of the tests Performed	
Final Verdict: (Only "Passed" if all Measurements are "Passed")	**Pass**

2.2 Test Report

Test Report Reference

List of Measurements	
Parameter to be measured	**Clause**
Transmitter Parameters	
Maximum Transmit Power	Clause 4.3.2.2
Power spectral density	Clause 4.3.2.3
Duty Cycle, Tx-sequence, Tx-gap	Clause 4.3.2.4
Medium Utilisation (MU) factor	Clause 4.3.2.5
Adaptivity	Clause 4.3.2.6
Occupied Channel Bandwidth	Clause 4.3.2.7
Transmitter unwanted emissions in the out-of-band domain	Clause 4.3.2.8
Transmitter unwanted emissions in the spurious domain	Clause 4.3.2.9
Receiver Parameters	
Receiver spurious emissions	Clause 4.3.2.10
Receiving Blocking	Clause 4.3.2.11
Geo-location capability	Clause 4.3.2.12

Note: The clause numbers are referenced to ETSI EN 300 328 v2.1.1 (2016-11)

Transmitter Parameters

Clause 4.3.2.2 RF Output Power

Definition

The RF output power is defined as the mean equivalent isotropic radiated power (e.i.r.p.) of the equipment during a transmission burst.

Limits

For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.
The maximum RF output power for non-adaptive equipment shall be declared by the manufacturer and shall not exceed 20 dBm. See clause 5.4.1 m). For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the manufacturer.
This limit shall apply for any combination of power level and intended antenna assembly.

Test condition

See EN300328 v2.1.1 clause 5.1 for the test conditions. Apart from the RF output power, these measurements need only to be performed at normal environmental conditions. The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range.
In the case of equipment intended for use with an integral antenna and where no external (temporary) antenna connectors are provided, a test fixture as described in clause B.4 may be used to perform relative measurements at the extremes of the operating temperature range.
The equipment shall be operated under its worse case configuration (modulation, bandwidth, power, etc.)
with respect to the requirement being tested. Measurement of multiple data sets may be required.
For systems using FHSS modulation, the measurements shall be performed during normal operation (hopping).
For systems using wide band modulations other than FHSS, the measurement shall be performed at the lowest, the middle, and the highest channel on which the equipment can operate. These frequencies shall be recorded.

Test procedures

The test procedure shall be as follows:

Step 1:

Use a fast power sensor suitable for 2,4 GHz and capable of 1 MS/s. Use the following settings:

- Sample speed 1 MS/s or faster.
- The samples must represent the RMS power of the signal.
- Measurement duration: For non-adaptive equipment: equal to the observation period defined in clauses 4.3.1.3.2 or 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.

NOTE 1: 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 half the time between two samples.
- For each instant in time, sum the power of the individual samples of all ports and store them. Use these stored 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. The start and stop points shall be included. Save these P_{burst} 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 P_{burst} 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 clauses 4.3.1.2.3 or 4.3.2.2.3, shall be recorded in the test report.

Test Result:

Test Condition		EIRP (dBm)			Result
		Channel 1 2402MHz	Channel 20 2440MHz	Channel 40 2480MHz	
25°C	DC3.7V	1.15	0.93	0.60	Pass
-20°C	DC3.3V	1.11	0.95	0.66	Pass
	DC4.2V	1.27	0.89	0.58	Pass
40°C	DC3.3V	1.09	0.91	0.62	Pass
	DC4.2V	1.18	0.85	0.57	Pass

Notes:

(1) Conducted measurement method was used.

(2) The path loss as the factor is calibrated to correct the reading.

Clause 4.3.2.3 Power Spectral Density

Definition

The Power Spectral Density (PSD) is the mean equivalent isotropically radiated power (e.i.r.p.) spectral density in a 1 MHz bandwidth during a transmission burst.

Limits

For equipment using wide band modulations other than FHSS, the maximum Power Spectral Density is limited to 10 dBm per MHz.

Test condition

See EN300328 v2.1.1 clause 5.1 for the test conditions. These measurements shall only be performed at normal test conditions.

The measurement shall be repeated for the equipment being configured to operate at the lowest, the middle, and the highest frequency of the stated frequency range. These frequencies shall be recorded.

Test procedures (Option2 used)

Step 1:

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

• Centre Frequency: The centre frequency of the channel under test
• Resolution BW: 1MHz
• Video BW: 3MHz
• Frequency Span: 2 × Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)
• Detector: 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
• Resolution BW: 1MHz
• Video BW: 3MHz
• Sweep Time: 60s
• Frequency Span: 3MHz
• Detector: 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.

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

Test Result:

Test Mode	EIRP (dBm)			Result
	Channel 1 2402MHz	Channel 20 2440MHz	Channel 40 2480MHz	
BLE	-7.85	-8.07	-8.38	Pass

Clause 4.3.2.4 Duty Cycle, Tx-Sequence, Tx-gap

Applicability

These requirements apply to non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode. The equipment is using wide band modulations other than FHSS.

These requirements do not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

Definition

Duty Cycle is defined as the ratio of the total transmitter 'on'-time to a 1 second observation period.

Tx-sequence is defined as a period in time during which a single or multiple transmissions may occur and which shall be followed by a Tx-gap.

Tx-gap is defined as a period in time during which no transmissions occur.

The maximum Duty Cycle at which the equipment can operate, is declared by the manufacturer.

Limits

The Duty Cycle shall be equal to or less than the maximum value declared by the supplier.

The Tx-sequence time shall be equal to or less than 10 ms. The minimum Tx-gap time following a Tx-sequence shall be equal to the duration of that proceeding Tx-sequence with a minimum of 3.5 ms.

Test condition and test procedures

Refer chapters §5.4.2.1 and §5.4.2.2.1.3 of ETSI EN300328 v2.1.1

Result

This test case does not apply this kind of EUT

Clause 4.3.2.5 Medium Utilisation (MU) factor

Applicability

This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode.

In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

Definition

The Medium Utilization (MU) factor is a measure to quantify the amount of resources (Power and Time) used by non-adaptive equipment. The Medium Utilization factor is defined by the formula:

$$MU = (P/100\ mW) \times DC$$

where: MU is Medium Utilization.

P is the RF output power as defined in clause 4.3.2.2.2 expressed in mW.

DC is the Duty Cycle as defined in clause 4.3.2.4.2 expressed in %.

Limits

For non-adaptive equipment using wide band modulations other than FHSS, the maximum Medium Utilization factor shall be 10 %.

Test condition and test procedures

Refer chapters§ 5.4.2.1 and §5.4.2.2.1.4 of ETSI EN300328 v2.1.1

Result

This test case does not apply this kind of EUT.

Clause 4.3.2.6 Adaptivity

Applicability

This requirement does not apply to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode providing the equipment complies with the requirements and/or restrictions applicable to non-adaptive equipment.

In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

Adaptive equipment using modulations other than FHSS is allowed to operate in a non-adaptive mode providing it complies with the requirements applicable to non-adaptive equipment.

An adaptive equipment using modulations other than FHSS is equipment that uses a mechanism by which it can adapt to its radio environment by identifying other transmissions present within its Occupied Channel Bandwidth.

Adaptive equipment using modulations other than FHSS shall implement either of the Detect and Avoid mechanisms provided in clause 4.3.2.6.2 or clause 4.3.2.6.3.

Adaptive equipment is allowed to switch dynamically between different adaptive modes.

Limit

Non-LBT based Detect and Avoid

Definition

Non-LBT based Detect and Avoid is a mechanism for equipment using wide band modulations other than FHSS and by which a given channel is made 'unavailable' because an interfering signal was reported after the transmission in that channel. This mechanism shall operate as intended in the presence of an unwanted signal on frequencies other than those of the operating band.

Requirements & Limits

Equipment using a modulation other than FHSS and using the non-LBT based Detect and Avoid mechanism, shall comply with the following minimum set of requirements:

1) During normal operation, the equipment shall evaluate the presence of a signal on its current operating channel. If it is determined that a signal is present with a level above the detection threshold defined in step 5). the channel shall be marked as 'unavailable'.

2) The channel shall remain unavailable for a minimum time equal to 1 s after which the channel may be considered again as an 'available' channel.

3) The total time during which an equipment has transmissions on a given channel without re-evaluating the availability of that channel, is defined as the Channel Occupancy Time.

4) The Channel Occupancy Time shall be less than 40 ms. Each such transmission sequence shall be followed with an Idle Period (no transmissions) of minimum 5 % of the Channel Occupancy Time with a minimum of 100 μs. After this, the procedure as in step 1 needs to be repeated.

5) The detection threshold shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G); however, beamforming gain (Y) shall not be taken into account. For power levels less than 20 dBm e.i.r.p., the detection threshold level may be relaxed to:

$$TL = -70\ \text{dBm/MHz} + 10 \times \log10\ (100\ \text{mW} / P_{out})\ (P_{out}\ \text{in mW e.i.r.p.})$$

6) The equipment shall comply with the requirements defined in step 1 to step 4 of the present clause in the presence of an unwanted CW signal as defined in table 9.

Table 9: Unwanted Signal parameters

Wanted signal mean power from companion device (dBm)	Unwanted signal frequency (MHz)	Unwanted CW signal power (dBm)
-30	2 395 or 2 488,5 (see note 1)	-35 (see note 2)
NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1. NOTE 2: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

Conformance

The conformance tests for this requirement are defined in clause 5.4.6 and specifically in clause 5.4.6.2.1.3.

LBT based Detect and Avoid

Definition

LBT based Detect and Avoid is a mechanism by which equipment using wide band modulations other than FHSS, avoids transmissions in a channel in the presence of an interfering signal in that channel. This mechanism shall operate as intended in the presence of an unwanted signal on frequencies other than those of the operating band.

Requirements & Limits

The present document defines 2 types of adaptive equipment using wide band modulations other than FHSS and that uses an LBT based Detect and Avoid mechanism: Frame Based Equipment and Load Based Equipment.
Adaptive equipment which is capable of operating as either Load Based Equipment or as Frame Based Equipment is allowed to switch dynamically between these types of operation.

Frame Based Equipment

Frame Based Equipment shall comply with the following requirements:

1) Before transmission, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The equipment shall observe the operating channel for the duration of the CCA observation time which

shall be not less than 18 μs. The channel shall be considered occupied if the energy level in the channel exceeds the threshold given in step 5 below. If the equipment finds the channel to be clear, it may transmit immediately. See figure 2 below.

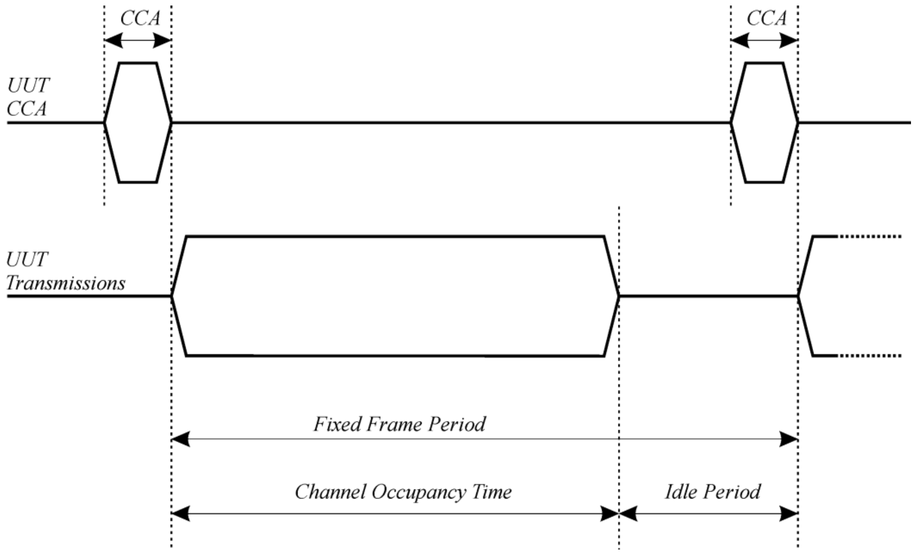


Figure 2: Example of timing for Frame Based Equipment

2) If the equipment finds the channel occupied, it shall not transmit on this channel during the next Fixed Frame Period.

The equipment is allowed to switch to a non-adaptive mode and to continue transmissions on this channel providing it complies with the requirements applicable to non-adaptive equipment. See clause 4.3.2.6.1. Alternatively, the equipment is also allowed to continue Short Control Signalling Transmissions on this channel providing it complies with the requirements given in clause 4.3.2.6.4.

3) The total time during which an equipment has transmissions on a given channel without re-evaluating the availability of that channel, is defined as the Channel Occupancy Time.

The Channel Occupancy Time shall be in the range 1 ms to 10 ms followed by an Idle Period of at least 5 % of the Channel Occupancy Time used in the equipment for the current Fixed Frame Period. See figure 2 below.

4) An equipment, upon correct reception of a packet which was intended for this equipment can skip CCA and immediately (see also next paragraph) proceed with the transmission of management and control frames (e.g. ACK and Block ACK frames are allowed but data frames are not allowed). A consecutive sequence of such transmissions by the equipment without a new CCA shall not exceed the maximum Channel Occupancy Time.

For the purpose of multi-cast, the ACK transmissions (associated with the same data packet) of the individual devices are allowed to take place in a sequence.

5) The energy detection threshold for the CCA shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the CCA threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G); however, beamforming gain (Y) shall not be taken into account. For power

levels less than 20 dBm e.i.r.p. the CCA threshold level may be relaxed to:

$$TL = -70\ \text{dBm/MHz} + 10 \times \log10\ (100\ \text{mW} / P_{out}) \quad (P_{out}\ \text{in mW e.i.r.p.})$$

6) The equipment shall comply with the requirements defined in step 1 to step 4 in the present clause in the presence of an unwanted CW signal as defined in table 10.

Table 10: Unwanted Signal parameters

Wanted signal mean power from companion device	Unwanted signal frequency (MHz)	Unwanted signal power (dBm)
sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)
NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1. NOTE 2: A typical value which can be used in most cases is -50 dBm/MHz. NOTE 3: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

Load Based Equipment

Load Based Equipment may implement an LBT based spectrum sharing mechanism based on the Clear Channel Assessment (CCA) mode using energy detect as described in IEEE 802.11™-2012 [i.3], clause 9, clause 10, clause 16, clause 17, clause 19 and clause 20, or in IEEE 802.15.4™-2011 [i.4], clause 4, clause 5 and clause 8 providing the equipment complies with the conformance requirements referred to in clause 4.3.2.6.3.4. Load Based Equipment not using any of the mechanisms referenced above shall comply with the following minimum set of requirements:

1) Before a transmission or a burst of transmissions, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The equipment shall observe the operating channel for the duration of the CCA observation time which shall be not less than 18 µs. The channel shall be considered occupied if the energy level in the channel exceeds the threshold given in step 5 below. If the equipment finds the channel to be clear, it may transmit immediately.

2) If the equipment finds the channel occupied, it shall not transmit on this channel (see also the next paragraph). The equipment shall perform an Extended CCA check in which the channel is observed for a random duration in the range between 18 µs and at least 160 µs. If the extended CCA check has determined the channel to be no longer occupied, the equipment may resume transmissions on this channel. If the Extended CCA time has determined the channel still to be occupied, it shall perform new Extended CCA checks until the channel is no longer occupied.

NOTE: The Idle Period in between transmissions is considered to be the CCA or the Extended CCA check as there are no transmissions during this period.

The equipment is allowed to switch to a non-adaptive mode and to continue transmissions on this channel providing it complies with the requirements applicable to non-adaptive equipment. Alternatively, the equipment is also allowed to continue Short Control Signalling Transmissions on this channel providing it complies with the requirements given in clause 4.3.2.6.4.

3) The total time that an equipment makes use of a RF channel is defined as the Channel Occupancy Time. This Channel Occupancy Time shall be less than 13 ms, after which the device shall perform a new CCA as described in step 1 above.

4) The equipment, upon correct reception of a packet which was intended for this equipment can skip CCA and immediately (see also next paragraph) proceed with the transmission of management and control frames (e.g. ACK and Block ACK frames are allowed but data frames are not allowed). A consecutive sequence of transmissions by the equipment without a new CCA shall not exceed the maximum channel occupancy time as defined in step 3 above.

For the purpose of multi-cast, the ACK transmissions (associated with the same data packet) of the individual devices are allowed to take place in a sequence.

5) The energy detection threshold for the CCA shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the CCA threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G); however, beamforming gain (Y) shall not be taken into account. For power levels less than 20 dBm e.i.r.p., the CCA threshold level may be relaxed to:

$$TL = -70 \text{ dBm/MHz} + 10 \times \log10 (100 \text{ mW} / P_{out}) \ (P_{out} \text{ in mW e.i.r.p.})$$

6) The equipment shall comply with the requirements defined in step 1 to step 4 of the present clause in the presence of an unwanted CW signal as defined in table 11.

Table 11: Unwanted Signal parameters

Wanted signal mean power from companion device	Unwanted signal frequency (MHz)	Unwanted signal power (dBm)
sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)
NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1. NOTE 2: A typical value which can be used in most cases is -50 dBm/MHz. NOTE 3: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.		

Test condition

See clause 5.1 for the test conditions. These measurements shall only be performed at normal test conditions.
This test shall be performed on the lowest and the highest operating (hopping) frequency. For adaptive frequency hopping equipment, the equipment shall be in a normal operating (hopping) mode.
For equipment which can operate in an adaptive and a non-adaptive mode, it shall be verified that prior to the test, the equipment is operating in the adaptive mode.

Test procedures

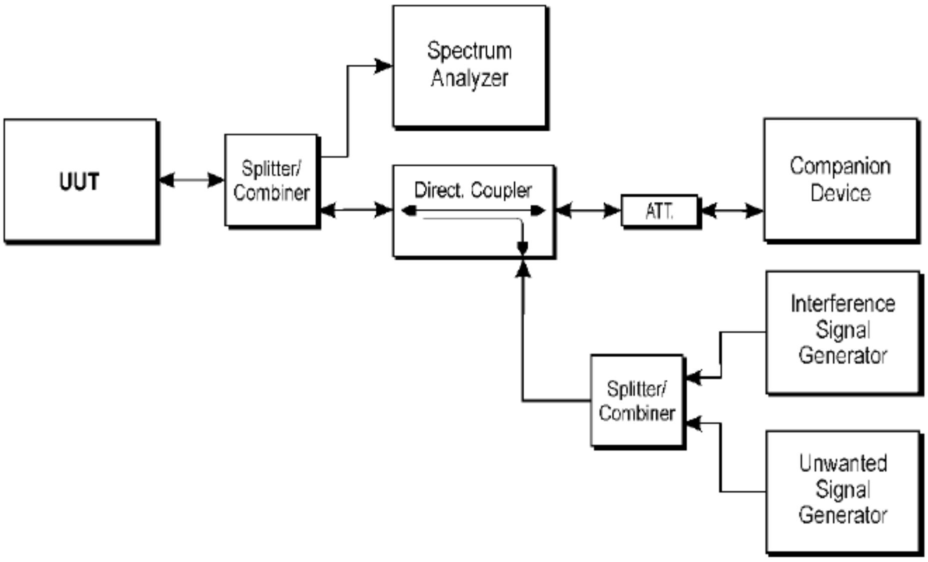


Figure 5: Test set-up for verifying the adaptivity of an equipment

Non-LBT based adaptive equipment using modulations other than FHSS

The different steps below define the procedure to verify the efficiency of the non-LBT based DAA adaptive mechanism of equipment using wide band modulations other than FHSS.
For systems using multiple receive chains only one chain (antenna port) need to be tested. All other receiver inputs shall be terminated.

Step 1:

• The UUT shall connect to a companion device during the test. The interference signal generator, the unwanted signal generator, the spectrum analyser, the UUT and the companion device are connected using a set-up equivalent to the example given by figure 5 although the interference and unwanted signal generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of both the UUT and the companion device and it should be possible to distinguish between either transmission. In addition, the spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the unwanted signals.

- Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 9 (clause 4.3.2.6.2.2).
- The analyser shall be set as follows:

-RBW	⩾ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used)
-VBW	3 × RBW (if the analyser does not support this setting, the highest available setting shall be used)
-Detector	RMS
-Centre Frequency	Equal to the centre frequency of the operating channel
-Span	0Hz
-Sweep Time	> Channel Occupancy Time of the UUT
-Trace mode	Clear/Write
-Trigger Mode	Video

Step 2:

- Configure the UUT for normal transmissions with a sufficiently high payload resulting in a minimum transmitter activity ratio (TxOn / (TxOn + TxOff)) of 0,3. Where this is not possible, the UUT shall be configured to the maximum payload possible.
- Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.2.2. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

Step 3: Adding the interference signal

- An interference signal as defined in clause B.7 is injected on the current operating channel of the UUT. The power spectral density level (at the input of the UUT) of this interference signal shall be equal to the detection threshold defined in clause 4.3.2.6.2.2, step 5.

Step 4: Verification of reaction to the interference signal

- The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel with the interfering signal injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.
- Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall stop transmissions on the current operating channel being tested.
The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time defined in clause 4.3.2.6.2.2, step 4.

ii) Apart from Short Control Signalling Transmissions (see iii) below), there shall be no subsequent transmissions on this operating channel for a (silent) period defined in clause 4.3.2.6.2.2, step 2. After that, the UUT may have normal transmissions again for the duration of a single Channel Occupancy Time period. Because the interference signal is still present, another silent period as defined in clause 4.3.2.6.2.2, step 2 needs to be included. This sequence is repeated as long as the interfering signal is present.

To verify that the UUT is not resuming normal transmissions as long as the interference signal is present, the monitoring time may need to be 60 s or more.

iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interference signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.
The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).
iv) Alternatively, the equipment may switch to a non-adaptive mode.

Step 5: Adding the unwanted signal

• With the interfering signal present, a 100 % duty cycle CW signal is inserted as the unwanted signal. The frequency and the level are provided in table 9 of clause 4.3.2.6.2.2.

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel. This may require the spectrum analyser sweep to be triggered by the start of the unwanted signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall not resume normal transmissions on the current operating channel as long as both the interference and unwanted signals remain present.
To verify that the UUT is not resuming normal transmissions as long as the interference and unwanted signals are present, the monitoring time may need to be 60 s or more.
ii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interference and unwanted signals are present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.
The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

Step 6: Removing the interference and unwanted signal

• On removal of the interference and unwanted signal the UUT is allowed to start normal transmissions again on this channel however, it shall be verified that this shall only be done after the period defined in clause 4.3.2.6.2.2, step 2.

Step 7:

• Step 2 to step 6 shall be repeated for each of the frequencies to be tested.

BT based adaptive equipment using modulations other than FHSS

Step 1 to step 7 below define the procedure to verify the efficiency of the LBT based adaptive mechanism of equipment using wide band modulations other than FHSS. This method can be applied on Load Based Equipment and Frame Based Equipment.

Step 1:

• The UUT shall connect to a companion device during the test. The interference signal generator, the unwanted signal generator, the spectrum analyser, the UUT and the companion device are connected using a set-up equivalent to the example given by figure 5 although the interference and unwanted signal generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of both the UUT and the companion device and it should be possible to distinguish between either transmission. In addition, the spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the unwanted signals.

• Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 10 (clause 4.3.2.6.3.2.2) for Frame Based Equipment or in table 11 (clause 4.3.2.6.3.2.3) for Load Based Equipment.

Testing of Unidirectional equipment does not require a link to be established with a companion device.

• The analyser shall be set as follows:

-RBW	≥ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used)
-VBW	3 × RBW (if the analyser does not support this setting, the highest available setting shall be used)
-Detector	RMS
-Centre Frequency	Equal to the centre frequency of the operating channel
-Span	0Hz
-Sweep Time	> Channel Occupancy Time of the UUT
-Trace mode	Clear/Write
-Trigger Mode	Video

Step 2:

• Configure the UUT for normal transmissions with a sufficiently high payload resulting in a minimum transmitter activity ratio (TxOn / (TxOn + TxOff)) of 0,3. Where this is not possible, the UUT shall be configured to the maximum payload possible.

• For Frame Based Equipment, using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.3.2.2, step 3. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

• For Load Based equipment, using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in clause 4.3.2.6.3.2.3, step 2 and step 3. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

For the purpose of testing Load Based Equipment referred to in the first paragraph of clause 4.3.2.6.3.2.3 (IEEE 802.11™ [i.3] or IEEE 802.15.4™ [i.4] equipment), the limits to be applied for the minimum Idle Period and the maximum Channel Occupancy Time are the same as defined for other types of Load Based Equipment (see clause 4.3.2.6.3.2.3, step 2 and step 3). The Idle Period is considered to be equal to the CCA or Extended CCA time defined in clause 4.3.2.6.3.2.3, step 1 and step 2.

Step 3: Adding the interference signal

• An interference signal as defined in clause B.7 is injected on the current operating channel of the UUT. The power spectral density level (at the input of the UUT) of this interference signal shall be equal to the detection threshold defined in clause 4.3.2.6.3.2.2, step 5 (frame based equipment) or clause 4.3.2.6.3.2.3, step 5 (load based equipment).

Step 4: Verification of reaction to the interference signal

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel with the interfering signal injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall stop transmissions on the current operating channel.

The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy Time defined in clause 4.3.2.6.3.2.2 (frame based equipment) or clause 4.3.2.6.3.2.3 (load based equipment).

ii) Apart from Short Control Signalling Transmissions, there shall be no subsequent transmissions while the interfering signal is present.

To verify that the UUT is not resuming normal transmissions as long as the interference signal is present, the monitoring time may need to be 60 s or more.

iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.

The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

iv) Alternatively, the equipment may switch to a non-adaptive mode.

Step 5: Adding the unwanted signal

• With the interfering signal present, a 100 % duty cycle CW signal is inserted as the unwanted signal. The frequency and the level are provided in table 10 (clause 4.3.2.6.3.2.2) for Frame Based Equipment or in table 11 (clause 4.3.2.6.3.2.3) for Load Based Equipment.

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating channel. This may require the spectrum analyser sweep to be triggered by the start of the unwanted signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall not resume normal transmissions on the current operating channel as long as both the interference and unwanted signals remain present.

To verify that the UUT is not resuming normal transmissions as long as the interference and unwanted signals are present, the monitoring time may need to be 60 s or more.

ii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while the interfering and unwanted signals are present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.

The verification of the Short Control Signalling transmissions may require the analyser settings to be changed (e.g. sweep time).

Step 6: Removing the interference and unwanted signal

• On removal of the interference and unwanted signals the UUT is allowed to start transmissions again on this channel; however, this is not a requirement and, therefore, does not require testing.

Step 7:

• Step 2 to step 6 shall be repeated for each of the frequencies to be tested.

Result

This test case does not apply this kind of EUT. Because the EIRP less than 10dBm.

Clause 4.3.2.7 Occupied Channel Bandwidth

Definition

The Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal.

For non-adaptive Frequency Hopping equipment, the Occupied Channel Bandwidth is declared by the supplier.

Limit

The Occupied Channel Bandwidth shall fall completely within the band given in table 1.

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.

Test condition

See clause 5.1 for the test conditions. These measurements shall only be performed at normal test conditions.

In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains)

Measurements need only to be performed on one of the active transmit chains (antenna outputs).

For systems using FHSS modulation and which have overlapping channels, special software might be required to force the UUT to hop or transmit on a single Hopping Frequency.

The measurement shall be performed only on the lowest and the highest frequency within the stated frequency range.

The frequencies on which the test was performed shall be recorded.

If the equipment can operate with different Occupied Channel Bandwidths (e.g. 20 MHz and 40 MHz), than each channel bandwidth shall be tested separately.

Test procedures

Step 1

The measurement procedure shall be as follows::

Connect the UUT to the spectrum analyzer 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 until the trace is completed.

Find the peak value of the trace and place the analyzer marker on this peak.

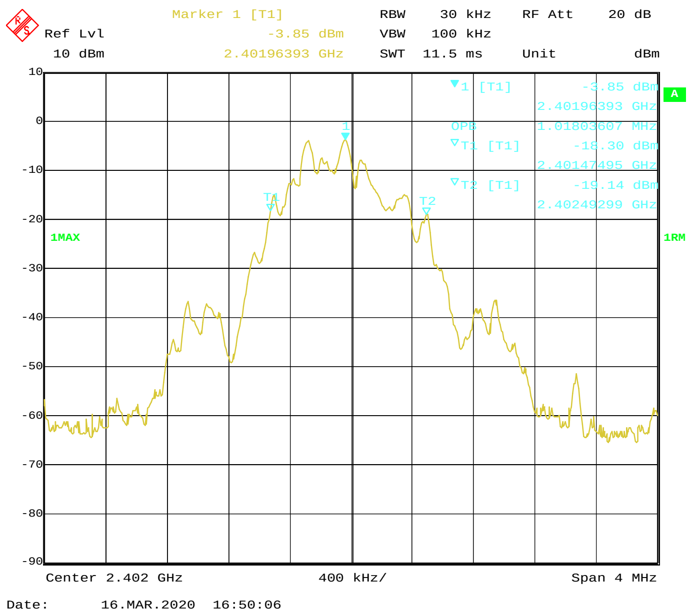
Step 3:

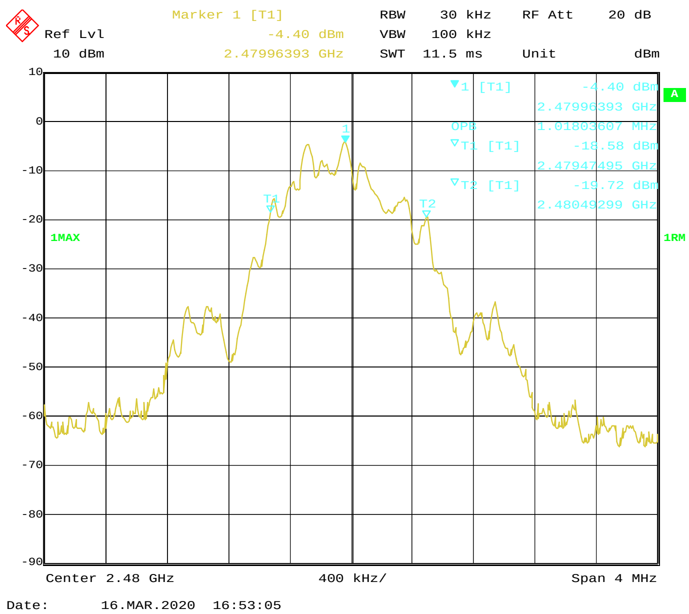
Use the 99 % bandwidth function of the spectrum analyzer to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded.

Test Result:

Channel	Frequency (MHz)	Bandwidth	Measure Frequency(MHz)	Limit	Result
1	2402	1.018MHz	2401.47	≥2400	Pass
40	2480	1.018MHz	2480.49	≤2483.5	Pass

Test Plots:





Clause 4.3.2.8 Transmitter unwanted emissions in the OOB domain

Definition

Transmitter unwanted emissions in the out-of-band domain are emissions when the equipment is in Transmit mode, on frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious.

Limit

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 3

Within the band specified in table 1, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.2.7.

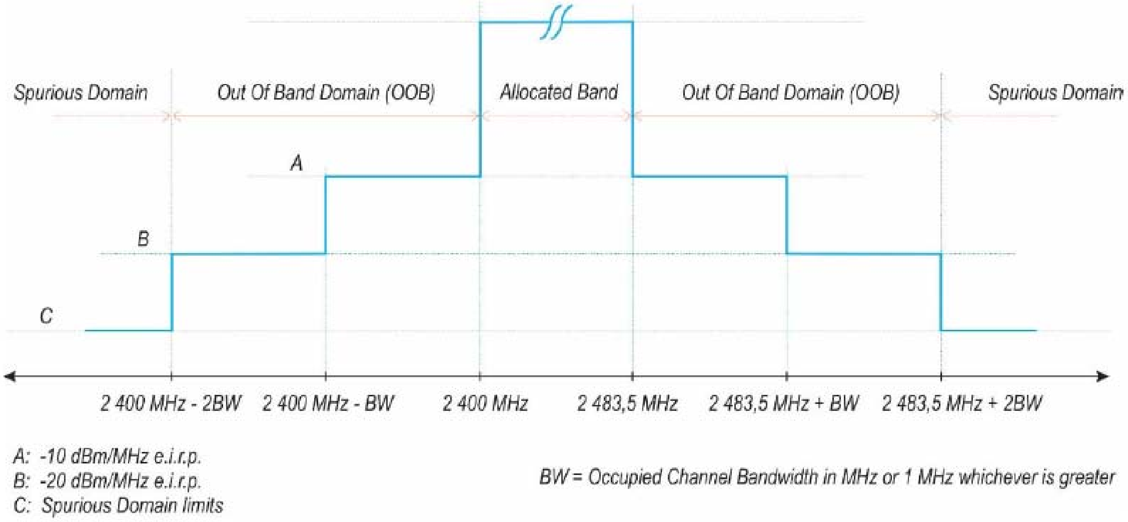


Figure 3: Transmit mask

Test condition

See clause 5.1 for the test conditions.

These measurements shall only be performed at normal test conditions.

For equipment using FHSS modulation, the measurements shall be performed during normal operation (hopping).

For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These operating channels shall be recorded.

The equipment shall be configured to operate under its worst case situation with respect to output power.
If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then each channel bandwidth shall be tested separately.

Test procedures

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: Clear / Write
- 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 2483.5 MHz to 2483.5 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 (2483.5 MHz to 2484.5 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 2483.5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2483.5 MHz + BW – 0.5 MHz (which means this may partly overlap with the previous 1MHz segment).

Step 3: (segment 2483.5 MHz + BW to 2483.5 MHz + 2BW)

• Change the centre frequency of the analyser to 2484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2483.5 MHz + BW to 2483.5 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 2483.5 MHz + 2 BW – 0.5 MHz.

Step 4: (segment 2400 MHz - BW to 2400 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 - 2BW + 0.5 MHz.

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

• Change the centre frequency of the analyser to 2399.5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2400 MHz - 2BW to 2400 MHz - BW. Reduce the centre frequency in 1MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1MHz segment shall be set to 2400 MHz - 2BW + 0.5 MHz.

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 figures 1 or 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 figures 1 or 3.

- Option 2: the limits provided by the mask given in figures 1 or 3 shall be reduced by 10 x $\log_{10}$(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.

Test Result

Test Condition		2402MHz (OCB: 1.018MHz)				2480 MHz (OCB: 1.018MHz)			
		Out-of-band domain (MHz)				Out-of-band domain (MHz)			
		2398.982	2400.00	2397.964	2398.982	2483.50	2484.518	2484.518	2485.536
25°C	DC3.7V	-45.39		-49.23		-48.16		-52.61	
-20°C	DC3.3V	-45.51		-49.21		-48.15		-52.55	
-20°C	DC4.2V	-45.35		-49.28		-48.19		-52.63	
40°C	DC3.3V	-45.46		-49.39		-48.08		-52.48	
40°C	DC4.2V	-45.33		-49.27		-48.29		-52.68	
Limit (dBm/MHz)		-10		-20		-10		-20	
Result		Pass		Pass		Pass		Pass	

Clause 4.3.2.9 Transmitter unwanted emissions in the spurious domain

Definition

Transmitter unwanted emissions in the spurious domain are emissions outside the allocated band and outside the Out-of-band Domain as indicated in figure 3 when the equipment is in Transmit mode.

Limit

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 12.

Table 12: Transmitter limits for spurious emissions

Frequency Range	Maximum Power e.i.r.p(≤1GHz); e.i.r.p(＞1GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100kHz
47 MHz to 74 MHz	-54 dBm	100kHz
74 MHz to 87,5 MHz	-36 dBm	100kHz
87,5 MHz to 118 MHz	-54 dBm	100kHz
118 MHz to 174 MHz	-36 dBm	100kHz
174 MHz to 230 MHz	-54 dBm	100kHz
230 MHz to 470 MHz	-36 dBm	100kHz
470 MHz to 862 MHz	-54 dBm	100kHz
862 MHz to 1 GHz	-36 dBm	100kHz
1 GHz to 12,75 GHz	-30 dBm	1MHz

Test condition

See clause 5.1 for the test conditions. These measurements have to be performed at normal environmental conditions

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 equipment (cabinet radiation); or
b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no antenna connectors.

For equipment using FHSS modulation, the measurements may be performed when normal hopping is disabled. In this case measurements need to be performed when operating at the lowest and the highest hopping frequency. When this is not possible, the measurement shall be performed during normal operation (hopping).

For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These operating channels shall be recorded.

The equipment shall be configured to operate under its worst case situation with respect to output power.
If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then the equipment shall be configured to operate under its worst case situation with respect to spurious emissions.

Test procedures

Pre-scan

Step 1:
The sensitivity of the spectrum analyser should be such that the noise floor is at least 12 dB below the limits given in tables 4 or 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: ≥ 19400
NOTE 1: 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.
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 the same hopping frequency in different hopping sequences.
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 5.3.10.2.1.2 and compared to the limits given in tables 4 or 12.
Step 3:
The emissions over the range 1 GHz to 12.75 GHz shall be identified. Spectrum analyzer settings:
• Resolution bandwidth: 1 MHz
• Video bandwidth: 3 MHz
•Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 23500
NOTE 2: For spectrum analyzers 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.
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 the same hopping frequency in different hopping sequences.
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 may 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), the steps 2 and 3 need to be repeated for each of the active transmit chains (A_{ch}).The limits used to identify emissions during this pre-scan need to be reduced with $10 \times \log_{10} (A_{ch})$ (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 (A_{ch}).

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.

Result

Below is the worst case situation test data:

Channel1 (2402MHz)			Channel 40 (2480MHz)		
Frequency	Polarity	Level (dBm)	Frequency	Polarity	Level (dBm)
4804	Vertical	-46.6	4960	Vertical	-47.7
4804	Horizontal	-44.9	4960	Horizontal	-45.6
Test Result		Pass			

Note:

(1) Radiated measurement method was used. For the radiated method, the antenna polarization was set to vertical and horizontal respectively.

(2) The measurement was performed at the lowest and highest operating frequencies.

(3) The test receiver (spectrum analyzer) was set to Peak detector and 100kHz resolution bandwidth. For measuring emissions that exceed the level of 6 dB below the applicable limit the resolution bandwidth shall be switched to 30 kHz. If the level does not change by more than 2 dB, it is a narrowband emission; the observed value shall be recorded. If the level changes by more than 2 dB, the emission is a wideband emission and its level shall be measured and recorded.

Receiver Parameters

§4.3.2.10 - Receiver Spurious Emissions

Definition

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

Limit

The spurious emissions of the receiver shall not exceed the values given in table 13.

Table 13: Spurious emission limits for receivers

Frequency range	Maximum power e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

Test condition

See clause 5.1 for the test conditions. These measurements have to be performed at normal environmental conditions

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 equipment (cabinet radiation); or

b) their effective radiated power when radiated by cabinet and antenna in case of integral antenna equipment with no antenna connectors.

Testing shall be performed when the equipment is in a receive-only mode.

For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. These frequencies shall be recorded.

For equipment using FHSS modulation, the measurements may be performed when normal hopping is disabled. In this case measurements need to be performed when operating at the lowest and the highest hopping frequency. These frequencies shall be recorded. When disabling the normal hopping is not possible, the measurement shall be performed during normal operation (hopping).

Test procedures

Pre-scan

Step 1:

The sensitivity of the spectrum analyser should be such that the noise floor is at least 12 dB below the limits given in tables 5 or 13.

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: ≥ 19400
• Sweep time: Auto

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 5.3.10.2.1.3 and compared to the limits given in tables 5 or 13.

Step 3:

The emissions over the range 1 GHz to 12.75 GHz shall be identified. Spectrum analyzer settings:

• Resolution bandwidth: 1 MHz
• Video bandwidth: 3 MHz
•Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 23500

NOTE 2: For spectrum analyzers not supporting this high number of sweep points, the frequency band may need to be segmented.

Sweep time: Auto

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 5 or table 13.

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 5.4.10.2.1.3.

Step 4:

• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the steps 2 and 3 need to be repeated for each of the active transmit chains (A_{ch}).The limits used to identify emissions during this pre-scan need to be reduced with $10 \times \log_{10} (A_{ch})$ (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: 30ms
- Sweep points: 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 (A_{ch}).

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

Step 4:

The value defined in step 3 shall be compared to the limits defined in table 5 or table 13.

Results (Radiated Method):

Below is the worst case situation test data:

Channel1 (2402MHz)			Channel 40 (2480MHz)		
Frequency	Polarity	Level (dBm)	Frequency	Polarity	Level (dBm)
50.67	Vertical	-70.9	50.67	Vertical	-71.3
50.67	Horizontal	-71.5	50.67	Horizontal	-71.9
Test Result		Pass			

Notes:

(1) Radiated measurement method was used. For the radiated method, the antenna polarization was set to vertical and horizontal respectively.

(2) The measurement was performed at the lowest and highest operating frequencies.

(3) The test receiver (spectrum analyzer) was set to Peak detector and 100 kHz resolution bandwidth. For measuring emissions that exceed the level of 6 dB below the applicable limit the resolution bandwidth shall be switched to 30 kHz. If the level does not change by more than 2 dB, it is a narrowband emission; the observed value shall be recorded. If the level changes by more than 2 dB, the emission is a wideband emission and its level shall be measured and recorded.

Clause 4.3.1.12 Receiver Blocking

Definition

Receiver blocking is a measure of the ability of the equipment to receive a wanted signal on its operating channel without exceeding a given degradation in the presence of an unwanted signal (blocking signal) on frequencies other than those of the operating band provided in table 1.

Performance Criteria

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)).

Limits

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 table 6, table 7 or table 8.

Receiver Category 1

Table 6: 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 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW
NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Receiver Category 2

Table 7: 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 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW

NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

Receiver Category 3

Table 8: 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 2)	Type of blocking signal
P_{min} + 12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2 583,5	-47	CW

NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

Test Configuration

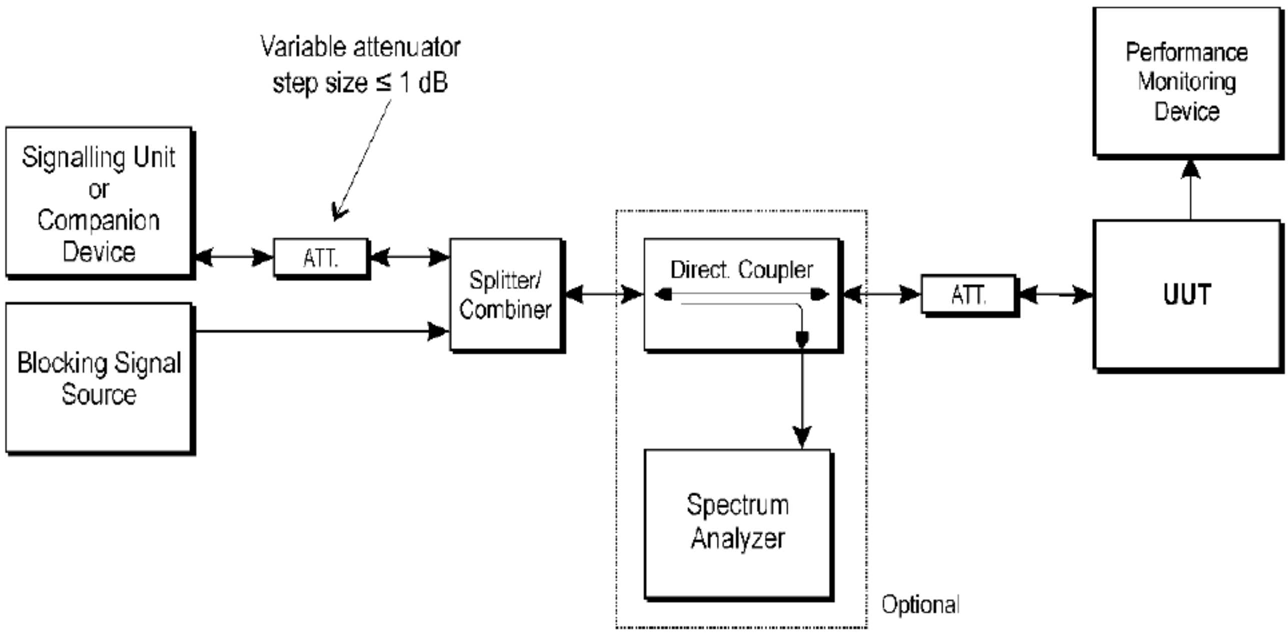


Figure 6: Test Set-up for receiver blocking

Test Method

For systems using multiple receive chains only one chain (antenna port) need to be tested. All other receiver inputs shall be terminated.

The procedure in step 1 to step 6 below shall be used to verify the receiver blocking requirement as described in clause 4.3.1.12 or clause 4.3.2.11.

Table 6, table 7 and table 8 in clause 4.3.1.12.4 contain the applicable blocking frequencies and blocking levels for each of the receiver categories for testing Receiver Blocking on frequency hopping equipment.

Table 14, table 15 and table 16 in clause 4.3.2.11.4 contain the applicable blocking frequencies and blocking levels for each of the receiver categories for testing Receiver Blocking on equipment using wide band modulations other than FHSS.

Step1:

- 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 $P_{min.}$

• This signal level (P_{min}) 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.

Test Result

The EUT is regarded as category 2 Receiver

Low Channel

Wanted signal mean power from companion device(dBm)	Blocking signal frequency(MHz)	Blocking signal power(dBm)	PER	Result
-82.5dBm (Pmin) +6 dB	2380	-57	0.0%	Pass
-82.5dBm (Pmin) +6 dB	2503.5	-57	0.0%	Pass
-82.5dBm (Pmin) +6 dB	2300	-47	0.0%	Pass
-82.5dBm (Pmin) +6 dB	2583.5	-47	0.0%	Pass

High Channel

Wanted signal mean power from companion device(dBm)	Blocking signal frequency(MHz)	Blocking signal power(dBm)	PER	Result
-81.8dBm (Pmin) +6 dB	2380	-57	0.0%	Pass
-81.8dBm (Pmin) +6 dB	2503.5	-57	0.0%	Pass
-81.8dBm (Pmin) +6 dB	2300	-47	0.0%	Pass
-81.8dBm (Pmin) +6 dB	2583.5	-47	0.0%	Pass

§4.3.2.12 Geo-location capability

Geo-location capability is a feature of the equipment to determine its geographical location with the purpose to configure itself according to the regulatory requirements applicable at the geographical location where it operates.

The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographical location during the initial power up of the equipment. The geographical location may also be available in equipment already installed and operating at the same geographical location.

Result: Not applicable. EUT without with geo-location capability

3.0 Product Labelling

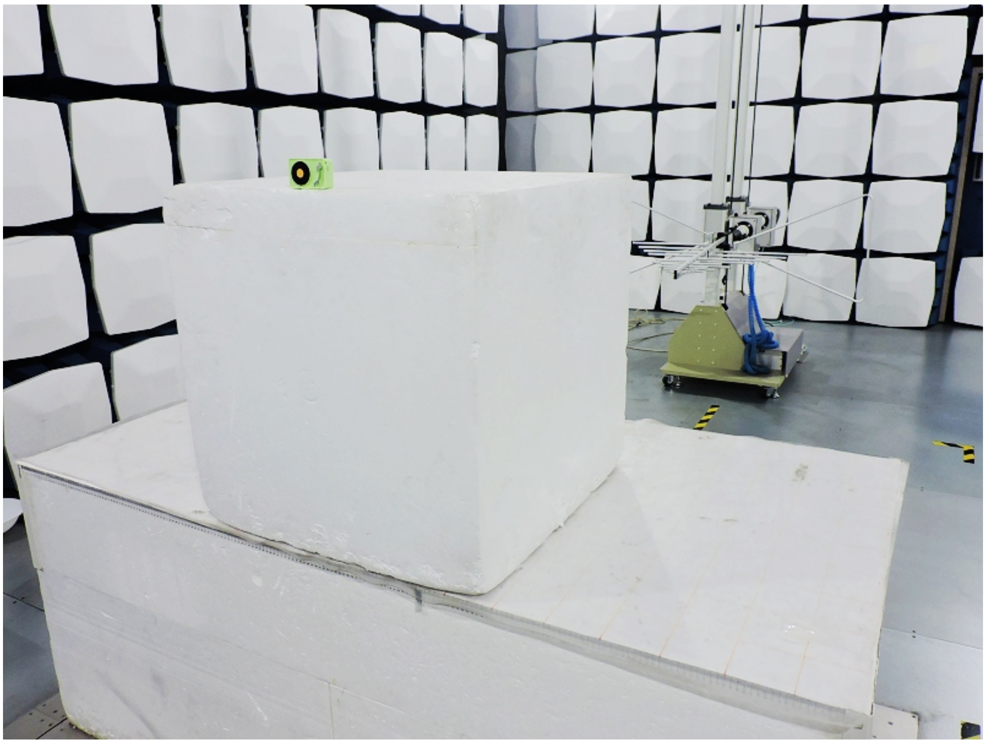
3.1 C-tick Mark label specification

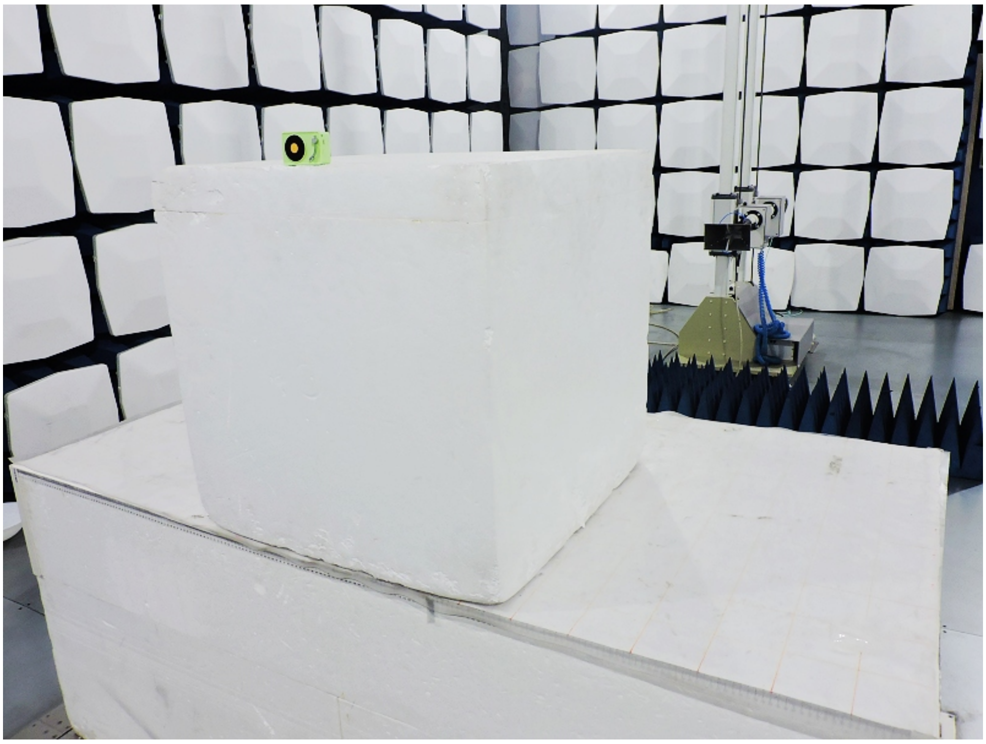
Text of the mark is black or white in color and is left justified. Labels are printed in indelible ink on permanent adhesive backing and shall be affixed at a conspicuous location on the EUT or silk-screened onto the EUT.

3.2 Mark Location: Rear enclosure

4. 0 Photographs – Test Setup

Spurious Radiated emission test view





5.0 Photographs - EUT

Please refer to test report EMC2003020-01

6.0 Test Equipment					
Instrument Type	Manufacturer	Model	Serial No.	Date of Cal.	Due Date
ESPI Test Receiver	ROHDE&SCHWARZ	ESPI 3	100379	2019-06-21	2020-06-20
TWO Line-V-NETW	ROHDE&SCHWARZ	EZH3-Z5	100294	2019-06-21	2020-06-20
TWO Line-V-NETW	ROHDE&SCHWARZ	EZH3-Z5	100253	2019-06-21	2020-06-20
Ultra Broadband ANT	ROHDE&SCHWARZ	HL562	100157	2019-06-21	2020-06-20
ESVB Test Receiver	ROHDE&SCHWARZ	ESVB	826156/011	2019-06-21	2020-06-20
Impuls-Begrenzer	ROHDE&SCHWARZ	ESH3-Z2	100281	2019-06-21	2020-06-20
5K VA AC Power Source	California Instruments	5001iX	56060	2019-06-21	2020-06-20
CDN	EM TEST	CDN M2/M3	-	2019-06-21	2020-06-20
Attenuation	EM TEST	ATT6/75	-	2019-06-21	2020-06-20
Resistance	EM TEST	R100	-	2019-06-21	2020-06-20
Electromagnetic Injection Clamp	LITTHI	EM101	35708	2019-06-21	2020-06-20
Inductive Components	EM TEST	MC2630	-	2019-06-21	2020-06-20
Antenna	EM TEST	MS100	-	2019-06-21	2020-06-20
Signal Generator	ROHDE&SCHWARZ	SMT03	100029	2019-08-22	2020-08-21
Power Amplifier	AR	150W1000	300999	2019-08-22	2020-08-21
Field probe	Holaday	HI-6005	105152	2019-08-22	2020-08-21
Bilog Antenna	Chase	CBL6111C	2576	2019-08-22	2020-08-21
Loop Antenna	EMCO	6507	00078608	2020-06-20	2020-06-20
ESPI Test Receiver	ROHDE&SCHWARZ	ESI26	838786/013	2020-06-20	2020-06-20
966 Chamber	YIHENG	--	N/A	2018-02-07	2021-02-06
Vector Signal Generator	AGILENT	E4438C	MY49070163	2020-01-16	2021-01-15
Splitter	Mini-Circuits	ZAP-50W	NN256400424	2020-01-16	2021-01-15

Directional Coupler	AGILENT	87300C	MY44300299	2020-01-16	2021-01-15
vector Signal Generator	AGILENT	E4438C	US44271917	2020-01-16	2021-01-15
4 Ch.Simultaneous Sampling 14 Bits 2 MS/s	AGILENT	U2531A	TW54063507	2020-01-16	2021-01-15
4 Ch.Simultaneous Sampling 14 Bits 2 MS/s	AGILENT	U2531A	TW54063513	2020-01-16	2021-01-15
Splitter	Mini	PS3-7	4463	2020-01-16	2021-01-15
Spectrum Analyzer	AGILENT	E7405A	US44210471	2020-01-16	2021-01-15
Attenuator	Resnet	20dB	(n.a)	2020-01-16	2021-01-15
Signal Analyzer	AGILENT	N9010A	MY48030494	2020-01-16	2021-01-15
ESD Simulator	NoiseKen	ESS-2002	ESS06Y6394	2019-06-21	2020-06-20
Continuous Wave Simulator	EM TEST	CWS 500N	0704-05	2019-06-21	2020-06-20
Ultra Compact Simulator	EM TEST	UCS 500 M4	0304-42	2019-06-21	2020-06-20
Pre-Amplifier	HP	8447B	--	2019-09-18	2020-09-17
Horn Antenna	SchwarzBeck	BBHA9120D	01919	2018-07-09	2021-07-08
BiConiLog Antenna	SchwarzBeck	9163	1139	2018-07-04	2021-07-03
Pre-Amplifier	SchwarzBeck	BBV 9743	#218	2019-06-21	2020-06-20

7.0 Measurement Uncertainty

Test Item	Uncertainty
Occupied Channel Bandwidth	±5%
RF output power, conducted	±5%
Power Spectral Density, conducted	±3dB
Unwanted Emissions, conducted	±3dB
All emissions, radiated	±6dB
Temperature	±3℃
Humidity	±5%
DC and low frequency voltages	±3%
Time	±5%
Duty Cycle	±5%

End of the Report