Qierling (Beijing) Health Technology Co., Ltd.

TEST REPORT

SCOPE OF WORK
EMC TESTING–SEE PAGE 2

REPORT NUMBER
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EN 300 328 V2.2.2 WIFI-c

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TEST REPORT

Applicant Name & Address	:	Qierling (Beijing) Health Technology Co., Ltd. No 101-42,101-43(Dongsheng district),9th Floor, No 1 Building, No 8th, Heiquan Road, Haidian District, Beijing City.
Manufacturing Site	:	Healthlead Corproation Limited Building A, Digital Silicone Valley Industry Park, No. 89, Hengping Road, Henggang Street, Longgang District, Shenzhen, P.R. China
Intertek Report No:	:	201225119GZU-001

Test standards

ETSI EN 300 328 V2.2.2 (2019-07)

Sample Description

Product	:	Air Purifiering Disinfector
Model No.	:	DS-X400W, DS-P400, DS-S800, DS-X1000W
Electrical Rating	:	100V-240V, 50Hz, 38W for model DS-X400W, DS-P400 220V-240V, 50Hz, 90W for model DS-S800 220V-240V, 50Hz, 120W for model DS-X1000W
Serial No.	:	Not Labeled
Date Received	:	25 December 2020
Date Test Conducted	:	06 January 2021-28 January 2021

Prepared and Checked By

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1.0 TEST RESULT SUMMARY

Radio Spectrum Matter (RSM) Part of Tx				
Test	**Test Requirement**	**Test method**	**Limit/Severity**	**Result**
RF Output Power	EN 300 328: clause 4.3.2.2	EN 300 328: clause 5.4.2	≤20 dBm	PASS
Power Spectral Density	EN 300 328: clause 4.3.2.3	EN 300 328: clause 5.4.3	≤10 dBm/MHz	PASS
Duty cycle, Tx-Sequence, Tx-gap	EN 300 328: clause 4.3.2.4	EN 300 328: clause 5.4.2	EN 300 328: clause 4.3.2.4.3	N/A
Medium Utilisation	EN 300 328: clause 4.3.2.5	EN 300 328: clause 5.4.2	EN 300 328: clause 4.3.2.5.3	N/A
Adaptivity	EN 300 328: clause 4.3.2.6	EN 300 328: clause 5.4.6	EN 300 328: clause 4.3.2.6.3.2	Pass
Occupied Channel Bandwidth	EN 300 328: clause 4.3.2.7	EN 300 328: clause 5.4.7	EN 300 328: clause 4.3.2.7.3	PASS
Transmitter unwanted emissions in the out-of-band domain	EN 300 328: clause 4.3.2.8	EN 300 328: clause 5.4.8	EN 300 328: clause 4.3.2.8.3	PASS
Transmitter unwanted emissions in the spurious domain	EN 300 328: clause 4.3.2.9	EN 300 328: clause 5.4.9	EN 300 328: clause 4.3.2.9.3	PASS
Radio Spectrum Matter (RSM) Part of Rx				
Test	**Test Requirement**	**Test method**	**Limit/Severity**	**Result**
Spurious Emissions (Receiver)	EN 300 328: clause 4.3.2.10	EN 300 328: clause 5.4.10	EN 300 328: 4.3.2.10.3	PASS
Receiver Blocking	EN 300 328: clause 4.3.2.11	EN 300 328: clause 5.4.11	EN 300 328: clause 4.3.2.11.4	PASS

Remark:

N/A: not applicable. Refer to the relevant section for the details.

EN 300 328: the detail version is ETSI EN 300 328 V2.2.2 (2019-07) in the whole report.

Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radio Frequency.

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

TEST REPORT

2.0 Results Conclusion (with Justification)

RE: Radio Testing Pursuant to Radio Equipment Directive 2014/53/EU, standard ETSI EN 300328 V2.2.2 Performed on the Air Purifiering Disinfector, Model: DS-X400W, DS-P400, DS-S800, DS-X1000W.

We tested the Air Purifiering Disinfector, Model: DS-X400W, to determine if it was in compliance with the relevant standard as marked on the Test Results Summary. We found that the unit met the requirement of ETSI EN 300 328 standard when tested as received. The worst case's test data was presented in this test report.

Models difference:

Model	NFC function	WIFI function	Motor /ratings	Ratings
DS-X400W	----	With	DNQ12M84R25F/ DC24 V	100V-240V, 50Hz, 38W
DS-P400	----	With	DNQ12M84R25F/ DC24 V	100V-240V, 50Hz, 38W
DS-S800	With	With	ZWF-75L/ DC310V; 75W; 0,34A	220V-240V, 50Hz, 90W
DS-X1000W	With	With	SIC-58CS-F185-1/ DC310V; 85W, 0,34A;	220V-240V, 50Hz, 120W
Remark: DS-X400W and DS-P400 are identical except model names.				

The four models use the same WiFi module, only one model DS-X400W was tested.

The production units are required to conform to the initial sample as received when the units are placed on the market.

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3.0 LABORATORY MEASUREMENTS

Configuration Information

Operating Frequency:	2412 MHz to 2472 MHz for 802.11b/g/n(HT20) 2422 MHz to 2462 MHz for 802.11b/g/n(HT40)
Type of Modulation:	802.11b: DSSS(CCK/QPSK/BPSK) 802.11g: OFDM(BPSK/QPSK/16QAM/64QAM) 802.11n: OFDM (BPSK/QPSK/16QAM/64QAM)
Transmit Data Rate:	802.11b: 1/2/5.5/11 Mbps 802.11g: 6/9/12/18/24/36/48/54 Mbps 802.11n(HT20): 6.5/13/19.5/26/39/52/58.5/65/72.2Mbps 802.11n(HT40):13.5/27/40.5/54/81/108/121.5/135Mbps
Number of Channels:	13 Channels for 802.11b/g/n(HT20) 11 Channels for 802.11n(HT40)
Channel Separation:	5 MHz
Antenna Type:	PCB_Onboard
Antenna Gain:	1.5 dBi
Function:	Air Purifiering Disinfector with 2.4 GHz WIFI
Power Supply:	DS-X400W & DS-P400:100~240V/50Hz DS-S800, DS-X1000W:200V-240V/50Hz
Support Equipment:	PC: LENOVO, Model: 2344-1S4

EUT channels and frequencies list:

Channel	Frequency (MHz)	**Channel**	Frequency (MHz)
1	**2412**	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	**13**	**2472**
7	**2442**		/

Test frequencies are:

The lowest channel 1: 2412 MHz, middle channel 7: 2442 MHz and the highest channel 13: 2472 MHz for 802.11b/g/n20.

The lowest channel 3: 2422 MHz, middle channel 7: 2442 MHz and the highest channel 11: 2462 MHz for 802.11n40.

Notes:

1. The measurements had been made in the operating mode producing the largest emission in the frequency band being investigated consistent with normal applications. An attempt had been made to maximize the emission by varying the configuration of the EUT.

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2. Test Location:
Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
All tests were performed at:
Room102/104, No 203, KeZhu Road, Science City, GETDD Guangzhou, China

Blocking test was performed at:

Intertek Testing Services Shenzhen Ltd. Longhua Branch

101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, ShenZhen.(for blocking)

Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	RF output power (conducted)	1.1 dB
2	Occupied Channel Bandwidth	2.3%
3	Power Spectral Density	1.5
4	Spurious Emission (TX)-Radiated	4.7 dB (25 MHz-1 GHz)
5	Spurious Emission (TX)-Conducted	4.8 dB (1 GHz-18 GHz)
		1.5 dB
6	Spurious Emission (RX) -Radiated	4.7 dB (25 MHz-1 GHz)
		4.8 dB (1 GHz-18 GHz)
7	Spurious Emission (RX)-Conducted	1.5 dB
8	Temperature	0.5 °C
9	Humidity	0.4 %
10	Time	1.2%

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.
Measurement uncertainty is calculated in accordance with ETSI TR 100 028-1 V1.4.1 (2001-12) and ETSI TR 100 028-2 V1.4.1 (2001-12).
The measurement uncertainty is given with a confidence of 95%, k=2.

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4.0 Test Result of Radio Performance Measurements as Transceiver

4.1 Transmitter Conditions

Item	EUT Type
1	Stand-alone equipment
2	Host connected equipment and plug-in radio equipment
3	Adaptive equipment
4	Non-adaptive equipment

Modulation
Frequency Hopping Spread Spectrum (FHSS) modulation.
DSSS and other forms of modulation

EUT belongs to item 1 & 3 with DSSS modulation.

4.2 Test Conditions

4.2.1 Normal conditions

Ambient:	Temperature:	+15°C to +35°C
	Relative humidity:	20% to 75%
	Press:	1010 mbar

4.2.2 Extreme conditions

Ambient:	Temperature:	Manufacturer's declared operating temperature: -20℃ to +55℃

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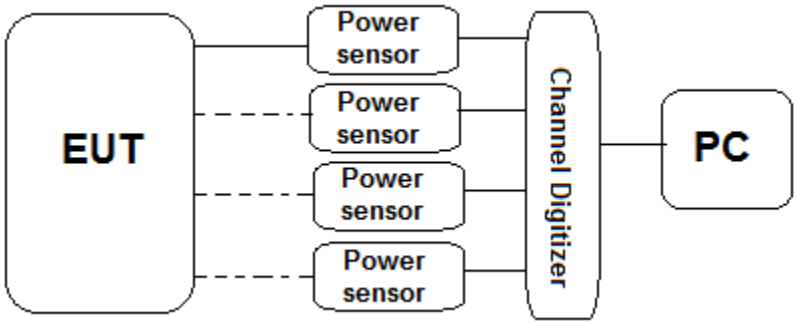
4.3 RF Output Power

Test requirement:	EN 300 328 clause 4.3.2.2 The RF output power for non-FHSS equipment shall be equal to or less than 20 dBm.
Test Method:	EN 300 328 clause 5.4.2.2.1.2
EUT Operation:	
Status:	For systems using wide band modulations other than FHSS, the measurement was performed at the lowest, the middle, and the highest channel on which the equipment could operate. These frequencies were recorded. Entered test mode for the product. Tested in the lowest channel 2412 MHz, middle channel 2442 MHz and the highest channel 2472 MHz for 802.11b/g/n(HT20), lowest channel 2422 MHz, middle channel 2442 MHz and the highest channel 2462 MHz for 802.11n(HT40), kept in continuously transmitting status with normal modulation. Pre-Scan had been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates. Following channel(s) and data rates were selected for the final test as listed below. These tests were performed at normal environmental conditions and repeated at the extremes of the operating temperature range. Conducted measurement for this kind of product which be used for integral antenna equipment connect to the measuring equipment. Refer to the clause 5.4.2 of standard EN 300 328.

Test setup:



Test procedure:

Removed the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the power sensor.
Step 1:
• Used a fast power sensor suitable for 2,4 GHz and capable of minimum 1 MS/s.
• Used the following settings:
- Sample speed 1 MS/s or faster.
- The samples shall represent the RMS power of the signal.
- For adaptive equipment, the measurement duration was long enough to ensure a minimum number of bursts (at least 10) are captured.

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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.
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 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) was calculated using the formula below:
P = A + G + Y
• This value, which shall comply with the limit, was recorded in the test report.

4.3.1 Used Test Equipment

Spectrum Analyzer, Broadband power meter
Refer to Clause 5 Test Equipment List for details.

4.3.2 Test Result and Data

Report the worst case:
802.11b 1Mbps data rate

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm), Limit = -10dBW, i.e.20dBm		
Temperature	Lowest Frequency	Middle Frequency	Highest Frequency

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(°C)	2412 MHz (dBm)	2442 MHz (dBm)	2472 MHz (dBm)
T_{norm} = 25	16.7	16.0	16.8
T_{max} = 55	16.5	15.7	16.6
T_{min} = -20	16.8	16.2	17.1

802.11g 6Mbps data rate

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm), Limit = -10dBW, i.e.20dBm		
Temperature (°C)	Lowest Frequency 2412 MHz (dBm)	Middle Frequency 2442 MHz (dBm)	Highest Frequency 2472 MHz (dBm)
T_{norm} = 25	12.1	12.0	12.2
T_{max} = 55	12.0	11.8	12.0
T_{min} = -20	12.3	12.2	12.3

802.11n(HT20) 6.5Mbps data rate

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm), Limit = -10dBW, i.e.20dBm		
Temperature (°C)	Lowest Frequency 2412 MHz (dBm)	Middle Frequency 2442 MHz (dBm)	Highest Frequency 2472 MHz (dBm)
T_{norm} = 25	12.1	12.4	12.2
T_{max} = 55	12.0	12.2	12.0
T_{min} = -20	12.3	12.5	12.3

802.11n(HT40) 13.5Mbps data rate

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm), Limit = -10dBW, i.e.20dBm		
Temperature (°C)	Lowest Frequency 2422 MHz (dBm)	Middle Frequency 2442 MHz (dBm)	Highest Frequency 2462 MHz (dBm)
T_{norm} = 25	12.1	12.1	12.2
T_{max} = 55	12.0	12.0	12.1
T_{min} = -20	12.3	12.2	12.3

Remark:

1) Test the EIRP in EUT continuously transmitting mode in the lowest frequency, middle frequency and the highest frequency in normal conditions and in extreme conditions.
2) Antenna gain(G): 1.5 dBi
   Cable loss: 0.5dB

P(e.i.r.p)=A(RMS level)+G+Cable loss

TEST RESULTS: The unit does meet the requirements.

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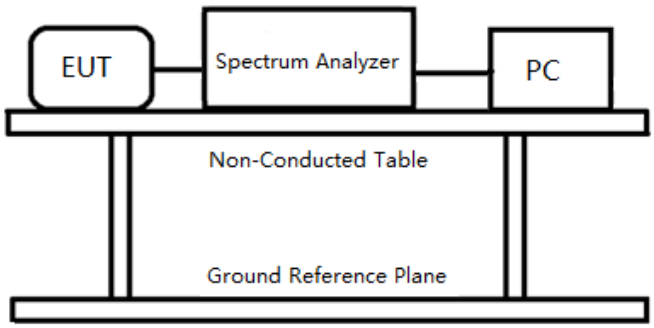
4.4 Power Spectral Density

Test requirement:	EN 300 328 clause 4.3.2.3 The maximum Power Spectral Density for non-FHSS equipment is 10 dBm per MHz.
Test Method:	EN 300 328 clause 5.4.3
EUT Operation:	
Status:	The measurement was repeated for the equipment being configured to operate at the lowest, the middle, and the highest frequency of the stated frequency range. These frequencies were recorded. Entered test mode for the product. Tested in the lowest channel 2412 MHz, middle channel 2442 MHz and the highest channel 2472 MHz for 802.11b/g/n(HT20), lowest channel 2422 MHz, middle channel 2442 MHz and the highest channel 2462 MHz for 802.11n(HT40), kept in continuously transmitting status with normal modulation. Pre-Scan had been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates. Following channel(s) and data rates were selected for the final test as listed below. These tests were performed at normal environmental conditions. Conducted measurement for this kind of products which be used for integral antenna equipment connect to the measuring equipment. Refer to the clause 5.4.3 of standard EN 300 328.

Test setup:



Test procedure:

Removed the antenna from the EUT and then connect a low attenuation RF cable from the antenna port to the spectrum.
Step 1:
• Start Frequency: 2 400 MHz
• Stop Frequency: 2 483,5 MHz
• Resolution BW: 10 kHz

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• Video BW: 30 kHz
• Sweep Points: > 8350; 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 x Channel Occupancy Time x 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 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 3 (multiple antennas, no beamforming or multiple antennas, with beamforming), repeat the measurement for each of the transmit ports. For each frequency 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.

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

with k being the total number of samples and n the actual sample number
Step 4:
Normalize the individual values for amplitude so that the sum was equal to the RF Output Power (e.i.r.p.) measured in clause 5.4.2
Step 5:
Starting from the first sample in the file (lowest frequency), added up the power of the following samples representing a 1 MHz segment and recorded the results for power and position (i.e. sample #1 to #100). This was the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which was recorded.
Step 6:
Shifted 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 #101).
Step 7:
Repeated 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 record results, the highest value was the maximum Power Spectral Density for the EUT. This value, which shall comply with the limit given, was recorded in the test report.

4.4.1 Used Test Equipment

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

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4.4.2 Test Result and Data

Report the worst case:

802.11b 1Mbps data rate

Measurement Conditions (in Normal)	Limit = 10dBm/MHz		
Temperature (°C)	Lowest Frequency 2412 MHz (dBm)	Middle Frequency 2442 MHz (dBm)	Highest Frequency 2472 MHz (dBm)
T_{norm} = 25	7.9	7.4	8.0

802.11g 6Mbps data rate

Measurement Conditions (in Normal)	Limit = 10dBm/MHz		
Temperature (°C)	Lowest Frequency 2412 MHz (dBm)	Middle Frequency 2442 MHz (dBm)	Highest Frequency 2472 MHz (dBm)
T_{norm} = 25	0.4	0.3	1.2

802.11n(HT20) 6.5Mbps data rate

Measurement Conditions (in Normal)	Limit = 10dBm/MHz		
Temperature (°C)	Lowest Frequency 2412 MHz (dBm)	Middle Frequency 2442 MHz (dBm)	Highest Frequency 2472 MHz (dBm)
T_{norm} = 25	0.3	0.4	1.0

802.11n(HT40) 13.5Mbps data rate

Measurement Conditions (in Normal)	Limit = 10dBm/MHz		
Temperature (°C)	Lowest Frequency 2412 MHz (dBm)	Middle Frequency 2442 MHz (dBm)	Highest Frequency 2472 MHz (dBm)
T_{norm} = 25	-2.5	-2.7	-2.5

4.5 Duty cycle, Tx-Sequence, Tx-gap

N/A: not applicable.
These requirements apply to non-adaptive frequency hopping equipment or to adaptive frequency hopping equipment operating in a non-adaptive mode.

These requirements do not apply for equipment with a maximum declared RF Output power 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.

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The EUT belongs to adaptive equipment.

4.6 Medium Utilisation

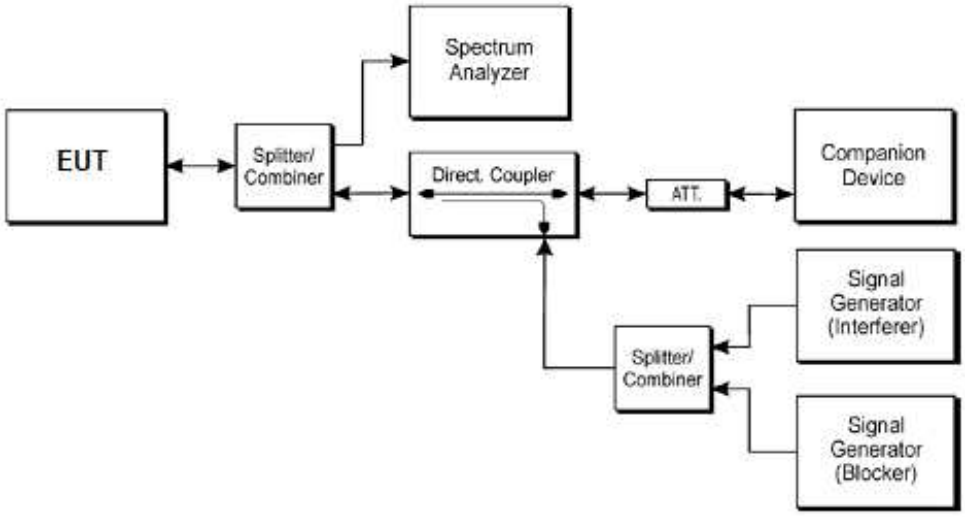
N/A: not applicable.
This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode.

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.

The EUT belongs to adaptive equipment.

4.7 Adaptivity (adaptive equipment using modulations other than FHSS)

Test Requirement:	EN 300 328: clause 4.3.2.6
Test Method:	EN 300 328 clause 5.4.6.2.1.3
EUT Operation:	
Test Status:	Entered test mode for the product. Tested in normal operation on the lowest channel 2412 MHz and the highest channel 2472 MHz for 802.11b/g/n(HT20) mode. lowest channel 2422 MHz and the highest channel 2462 MHz for 802.11n(HT40) mode
Test setup:	These tests were performed at normal environmental conditions.



Test Procedure:	LBT based adaptive equipment using modulations other than FHSS

Step 1:
• The UUT was connected to a companion device during the test. The interference signal

generator, the unwanted signal generator, the spectrum analyzer, the UUT and the companion device were connected using a set-up equivalent to the example given by figure above although the interference and unwanted signal generator did not generate any signals at this point in time. The spectrum analyzer was 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 4.3.2.6.3.2.3).
Testing of Unidirectional equipment does not require a link to be established with a companion device.
• The analyzer was set as follows:
- RBW: ≥ Occupied Channel Bandwidth (if the analyzer does not support this setting, the highest available setting shall be used)
- VBW: 3 × RBW (if the analyzer does not support this setting, the highest available setting shall be used)
- Detector Mode: RMS
- Centre Frequency: Equal to the centre frequency of the operating channel
- Span: 0 Hz
- Sweep time: > maximum Channel Occupancy Time
- Trace Mode: Clear Write
- Trigger Mode: Video

Step 2:

• Configured 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 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.

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 analyzer was used to monitor the transmissions of the EUT on the selected operating channel with the interfering signal injected. This might require the spectrum analyzer sweep to be triggered by the start of the interfering signal.
• it was verified that:
i) The EUT shall stop transmissions on the current operating channel.
ii) Apart from Short Control Signaling 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 EUT may continue to have Short Control Signaling Transmissions on the operating channel while the interfering signal is present. These transmissions shall comply with the limits.
The verification of the Short Control Signaling transmissions may require the analyzer settings to be changed (e.g. sweep time).
iv) Alternatively, the equipment may switch to a non-adaptive mode.

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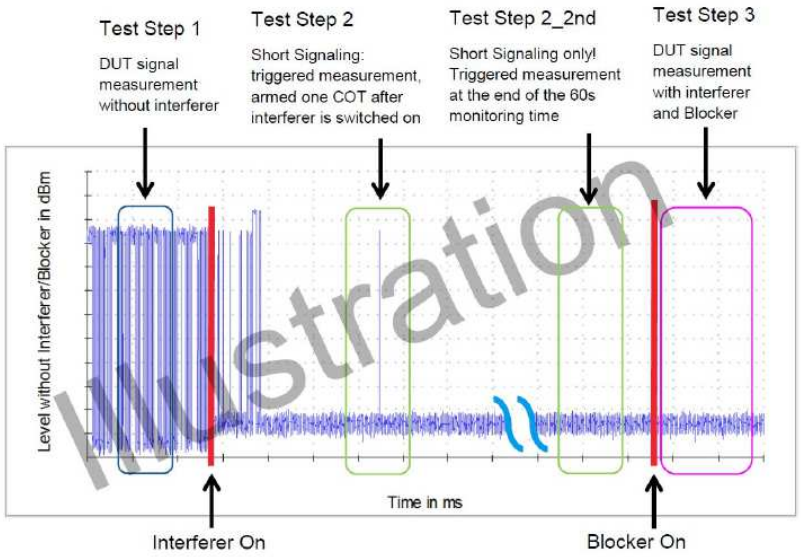
Step 5: Adding the blocking signal
• With the interfering signal present, a 100 % duty cycle CW signal was inserted as the unwanted signal.
• Repeat step 4 to verify that the UUT did not resume any normal transmissions.
i) The UUT shall not resume normal transmissions on the current operating channel 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.
Step 6: Removing the interference and blocking signal
• On removal of the interference and unwanted signal the EUT is allowed to start transmissions again on this channel however this is not a requirement and therefore does not require testing.
Step 7:
• The steps 2 to 6 shall be repeated for each of the frequencies to be tested.

4.7.1 Used Test Equipment List

Spectrum Analyzer, Vector signal generator, Signal Generator.
Refer to Clause 5 Test Equipment List for details.

4.7.2 Test Result and Data

For LBT based Detect and Avoid, Load Based Equipment:



Adaptivity Test schematic graphic

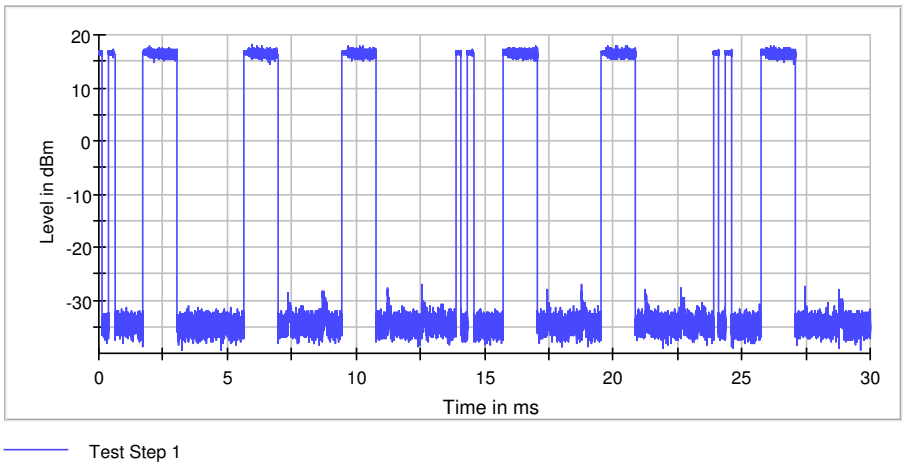
TEST REPORT

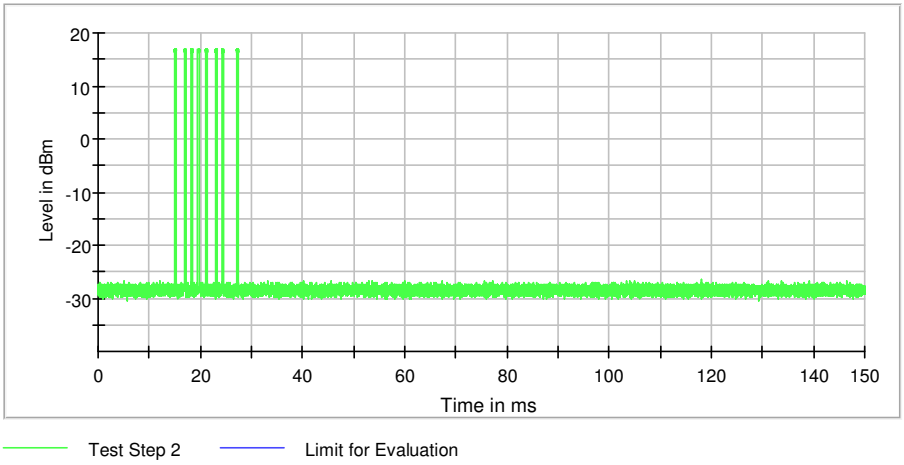
802.11b 1Mbps data rate
1) Test:

Frequency (MHz)	Test Step	No. of Bursts	Max Burst Power (dBm)	COT (ms)	Limit (ms)	CCA Time (µs)	Limit (µs)	Result
2412.000000	Test Step 1	12	16.6	1.326	<13.000	257.000	>18.000	PASS
2472.000000	Test Step 1	14	16.5	1.327	<13.000	139.000	>18.000	PASS

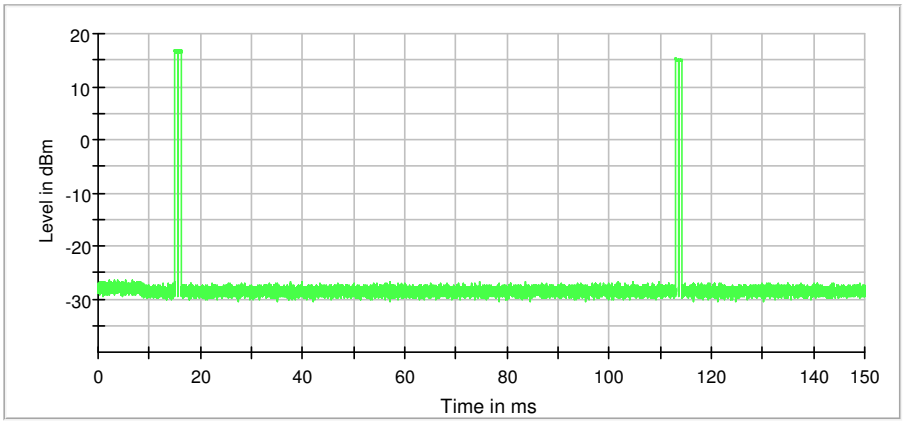
DUT Frequency (MHz)	Test Step	No. of Bursts	Max Burst Power (dBm)	Short Signaling (%)	Limit (%)	Result
2412.000000	Test Step 2	8	16.7	4.8	<10.0	PASS
2412.000000	Test Step 2_2nd	4	16.7	2.5	<10.0	PASS
2412.000000	Test Step 3	0	---	0.0	<10.0	PASS
2412.000000	Test Step 3_2nd	0	---	0.0	<10.0	PASS
2472.000000	Test Step 2	2	15.0	1.3	<10.0	PASS
2472.000000	Test Step 2_2nd	0	---	0.0	<10.0	PASS
2472.000000	Test Step 3	0	---	0.0	<10.0	PASS
2472.000000	Test Step 3_2nd	0	---	0.0	<10.0	PASS

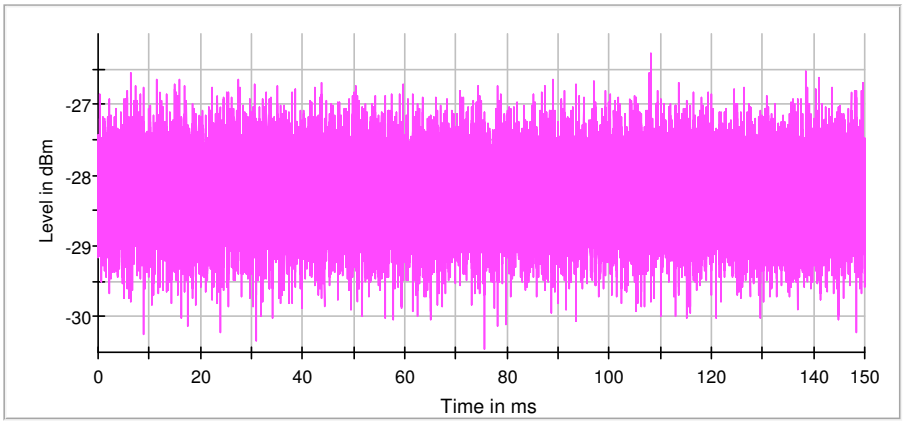
2412 MHz

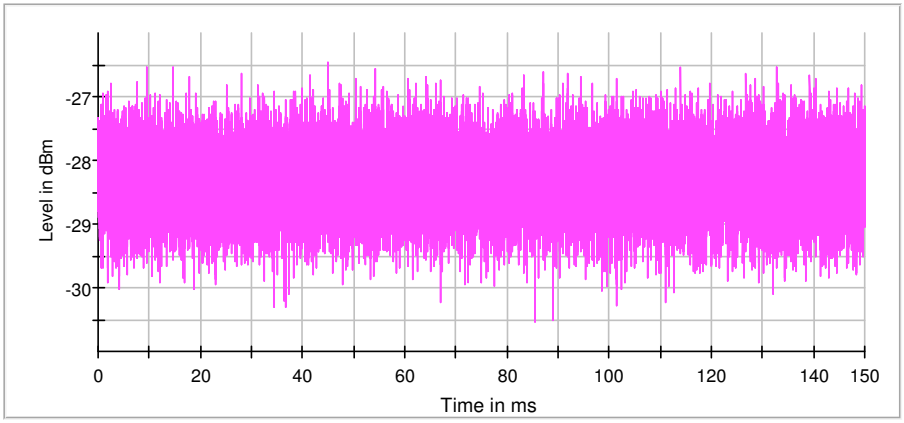




TEST REPORT

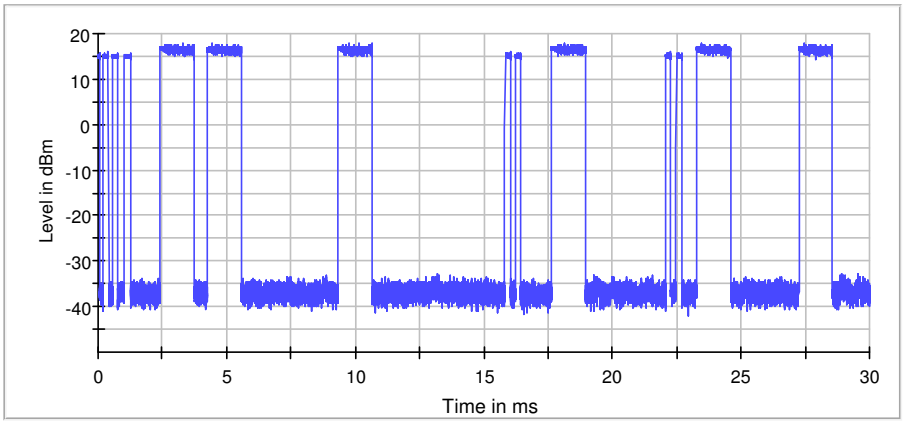

20
10
0
-10
-20
-30
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 2_2
Limit for Evaluation

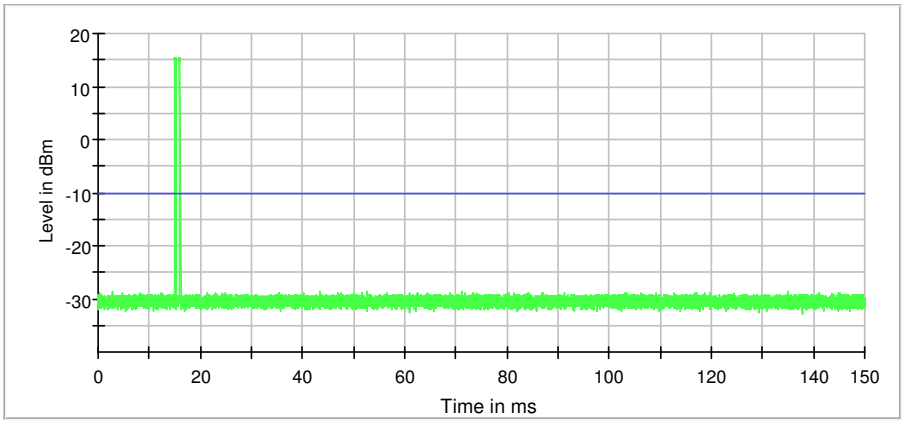

-27
-28
-29
-30
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3
Limit for Evaluation

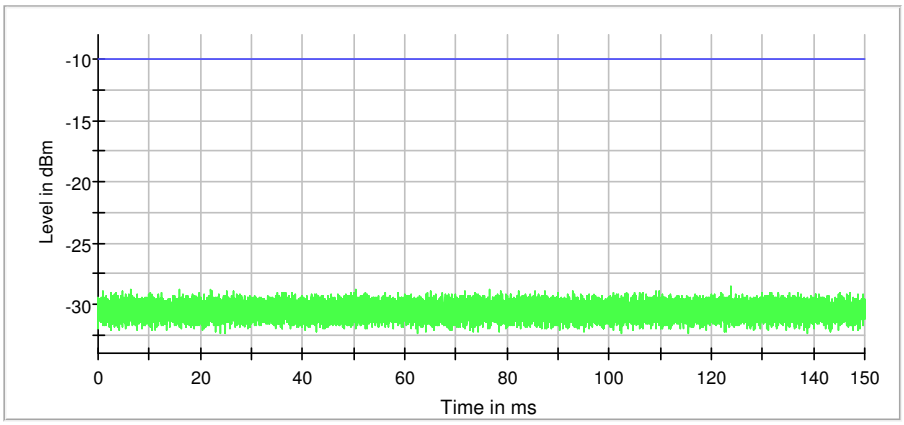

-27
-28
-29
-30
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3_3
Limit for Evaluation

TEST REPORT

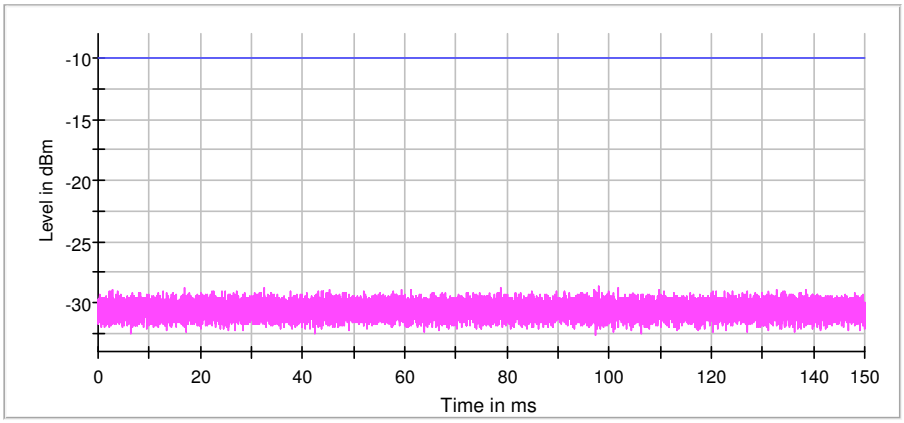
2472MHz:

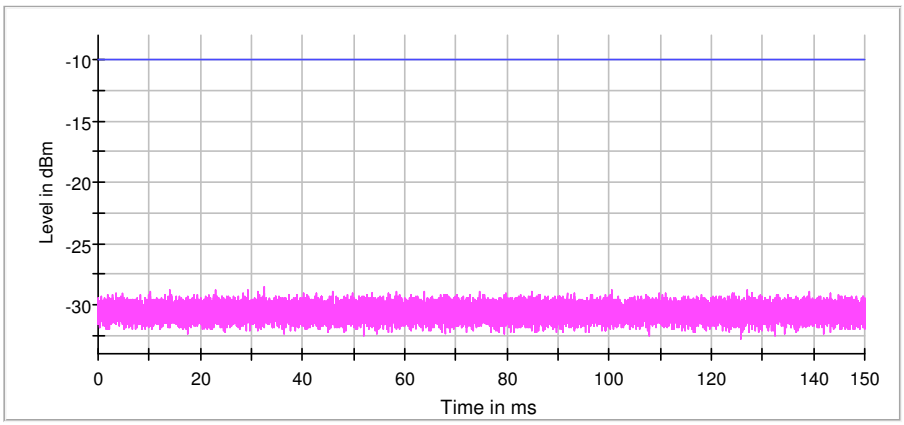






TEST REPORT





802.11g 6Mbps data rate

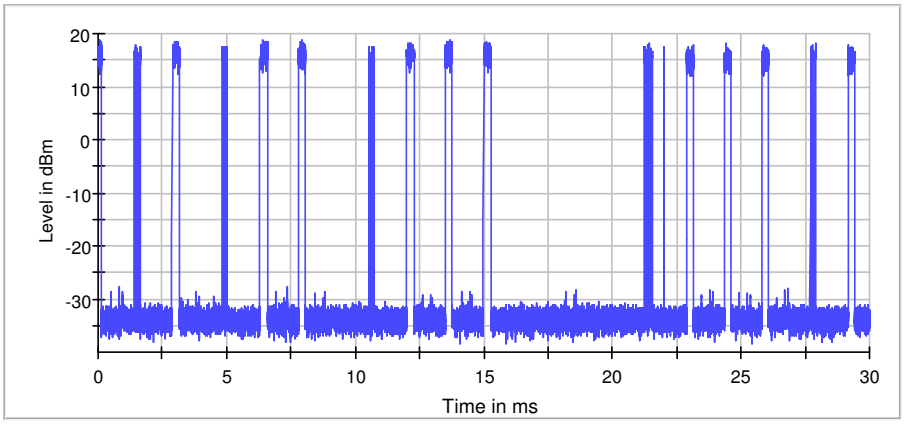
1) Test：

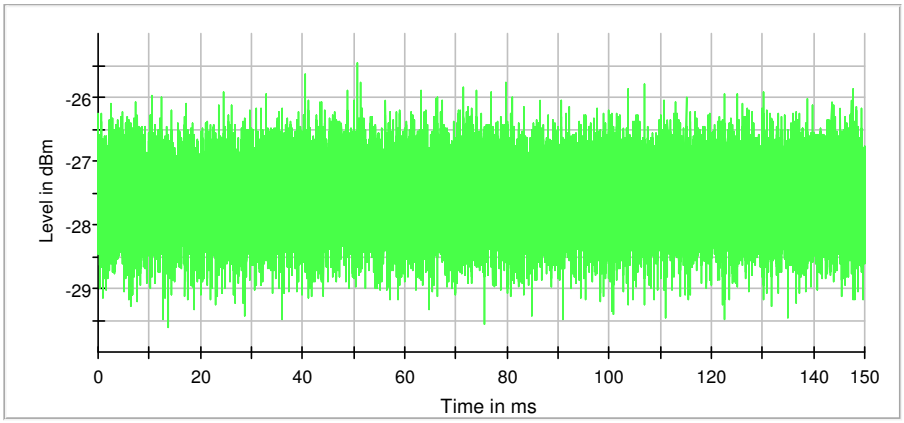
Frequency (MHz)	Test Step	No. of Bursts	Max Burst Power (dBm)	COT (ms)	Limit (ms)	CCA Time (µs)	Limit (µs)	Result
2412.000000	Test Step 1	28	16.2	0.28	<13.000	57.000	>18.000	PASS
2472.000000	Test Step 1	24	15.9	0.25	<13.000	67.000	>18.000	PASS

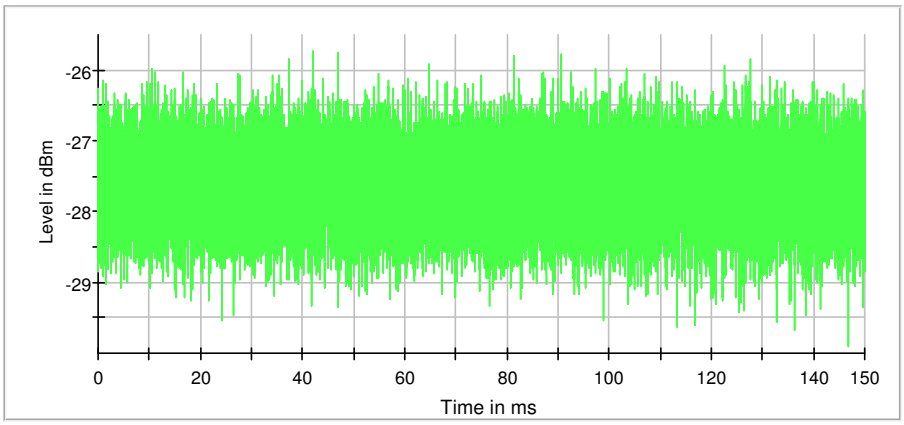
DUT Frequency (MHz)	Test Step	No. of Bursts	Max Burst Power (dBm)	Short Signaling (%)	Limit (%)	Result
2412.000000	Test Step 2	0	---	0.0	<10.0	PASS
2412.000000	Test Step 2_2nd	0	---	0.0	<10.0	PASS
2412.000000	Test Step 3	0	---	0.0	<10.0	PASS
2412.000000	Test Step 3_2nd	0	---	0.0	<10.0	PASS
2472.000000	Test Step 2	1	16.6	0.1	<10.0	PASS
2472.000000	Test Step 2_2nd	0	---	0.0	<10.0	PASS
2472.000000	Test Step 3	1	17.8	0.6	<10.0	PASS
2472.000000	Test Step 3_2nd	0	---	0.0	<10.0	PASS

TEST REPORT

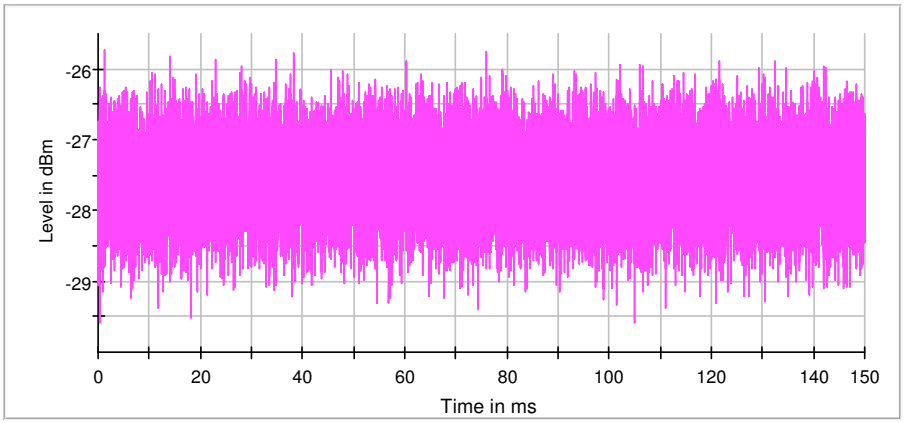
2412MHz:

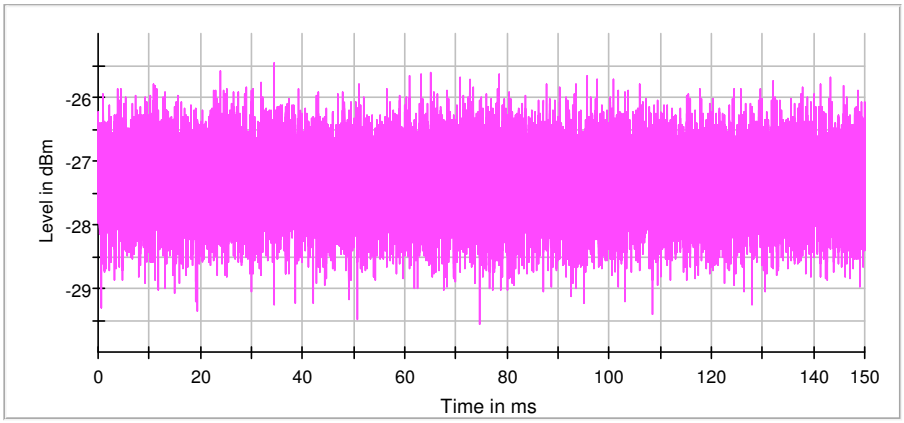




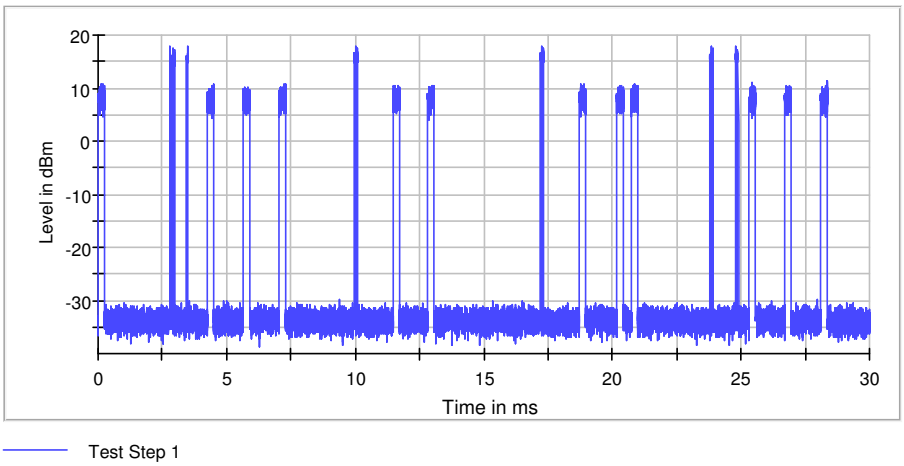


TEST REPORT

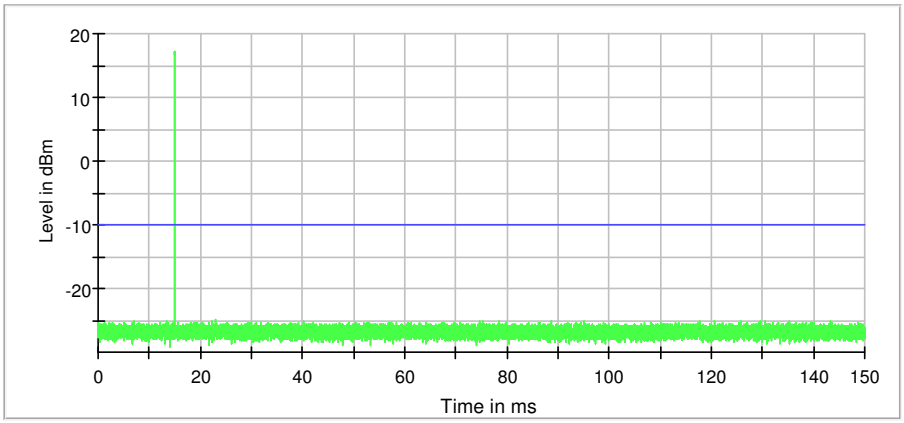


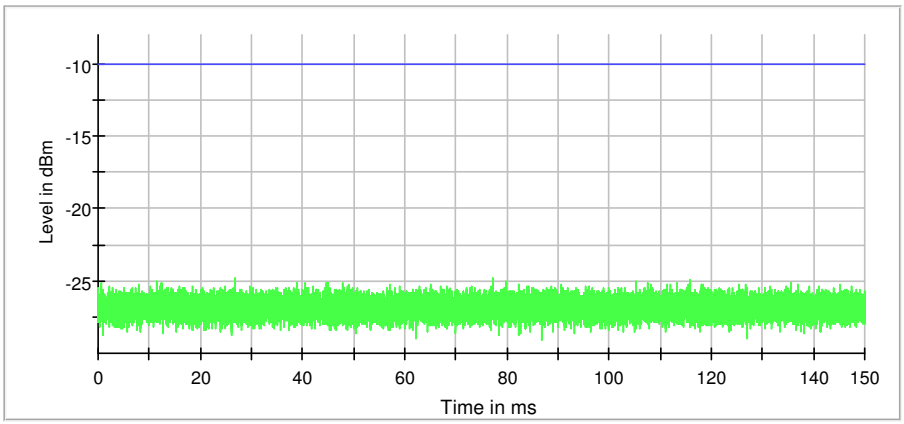


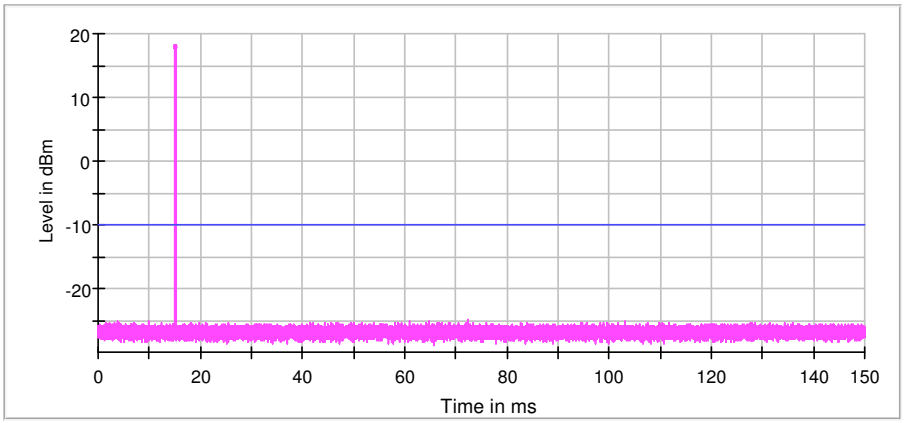
2472MHz:



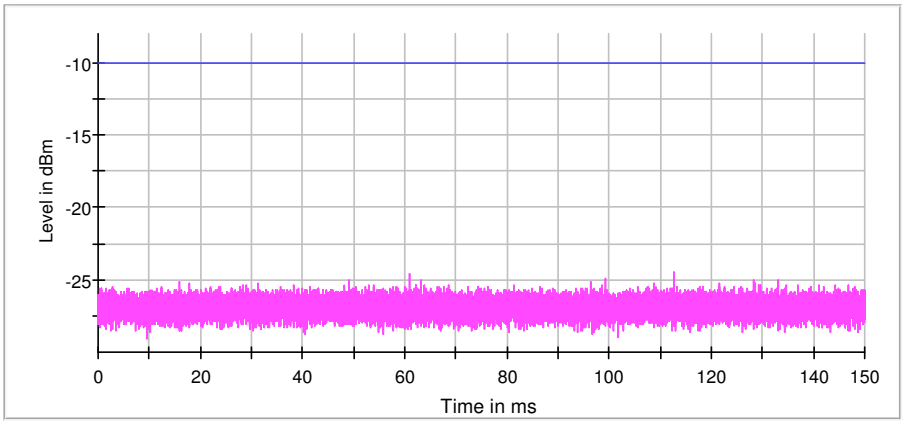
TEST REPORT


20
10
0
-10
-20
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 2
Limit for Evaluation


-10
-15
-20
-25
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 2_2
Limit for Evaluation


20
10
0
-10
-20
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3
Limit for Evaluation

TEST REPORT

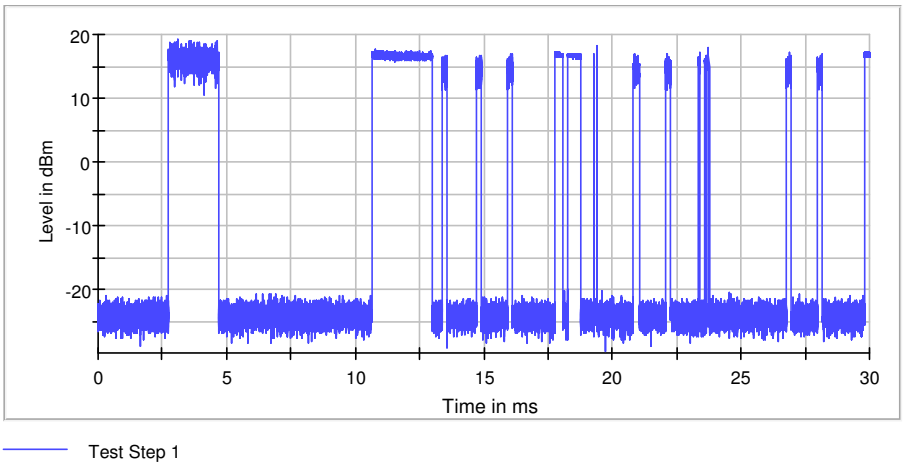


802.11n (HT20) 6.5Mbps data rate:
1) Test:

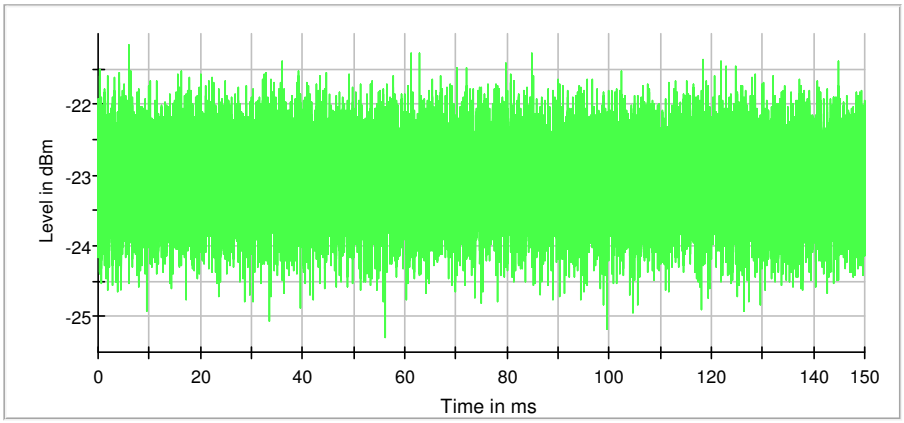
Frequency (MHz)	Test Step	No. of Bursts	Max Burst Power (dBm)	COT (ms)	Limit (ms)	CCA Time (µs)	Limit (µs)	Result
2412.000000	Test Step 1	16	16.7	2.363	<13.000	79.000	>18.000	PASS
2472.000000	Test Step 1	25	18.1	0.359	<13.000	79.000	>18.000	PASS

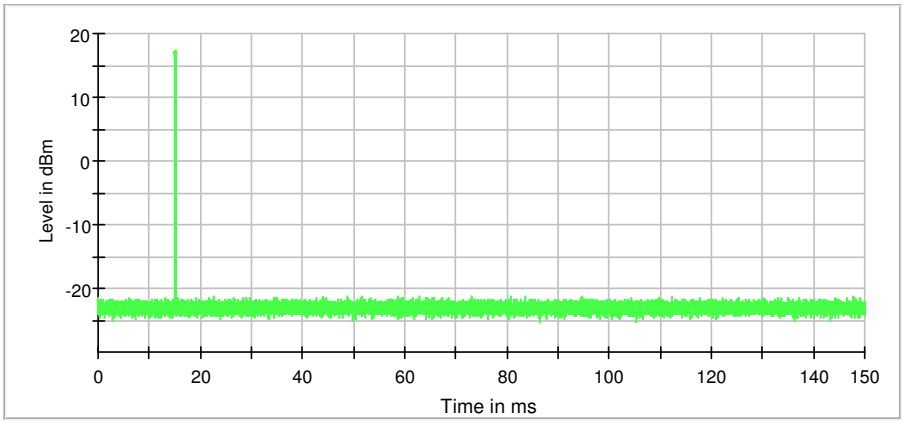
DUT Frequency (MHz)	Test Step	No. of Bursts	Max Burst Power (dBm)	Short Signaling (%)	Limit (%)	Result
2412.000000	Test Step 2	0	---	0.0	<10.0	PASS
2412.000000	Test Step 2_2nd	1	16.9	0.6	<10.0	PASS
2412.000000	Test Step 3	0	---	0.0	<10.0	PASS
2412.000000	Test Step 3_2nd	0	---	0.0	<10.0	PASS
2472.000000	Test Step 2	1	16.6	0.1	<10.0	PASS
2472.000000	Test Step 2_2nd	0	---	0.0	<10.0	PASS
2472.000000	Test Step 3	1	19.2	0.6	<10.0	PASS
2472.000000	Test Step 3_2nd	0	---	0.0	<10.0	PASS

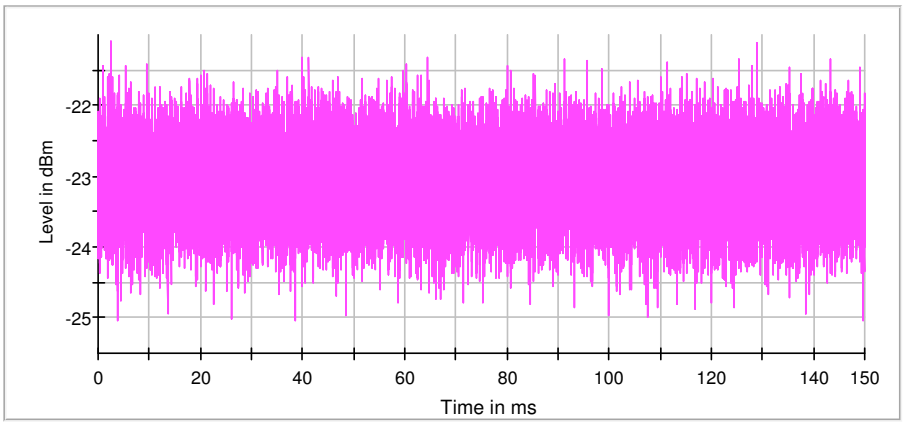
2412MHz

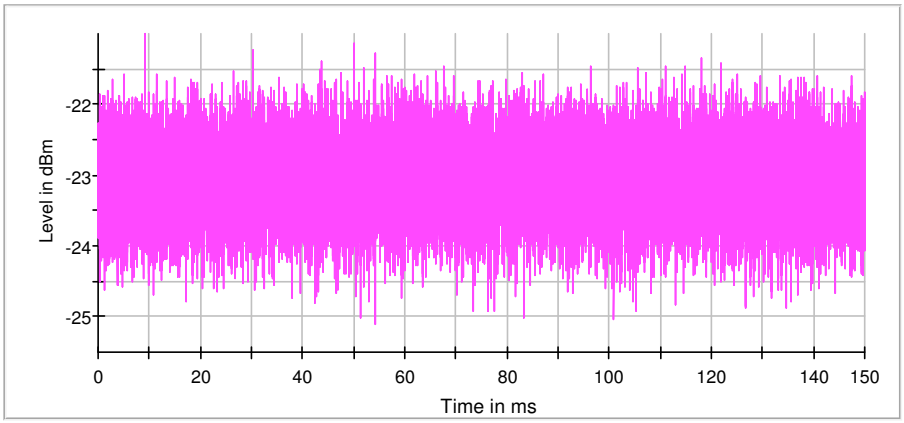


TEST REPORT

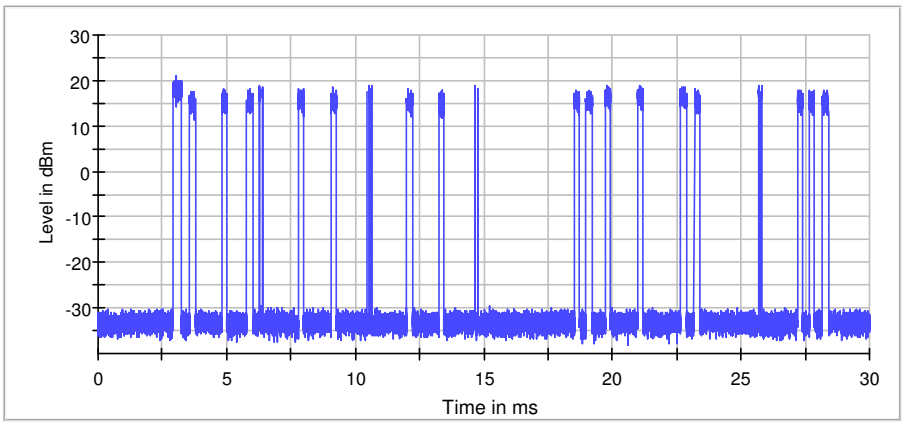

Level in dBm
-22
-23
-24
-25
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 2
Limit for Evaluation

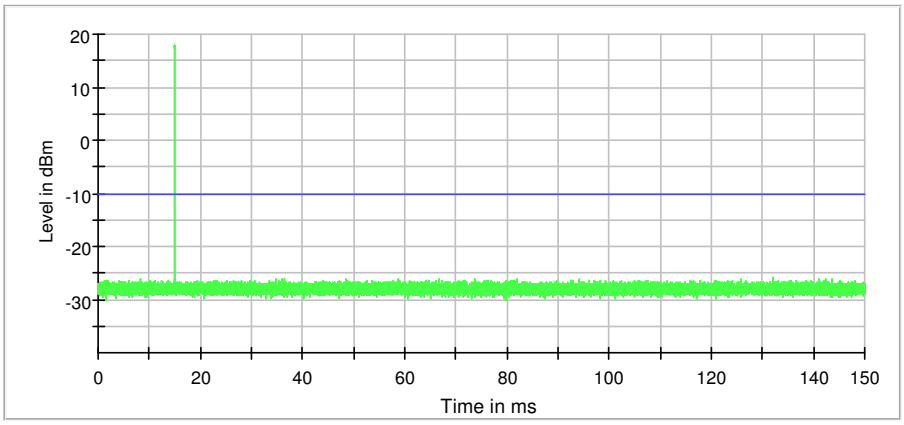

Level in dBm
20
10
0
-10
-20
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 2_2
Limit for Evaluation


Level in dBm
-22
-23
-24
-25
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3
Limit for Evaluation

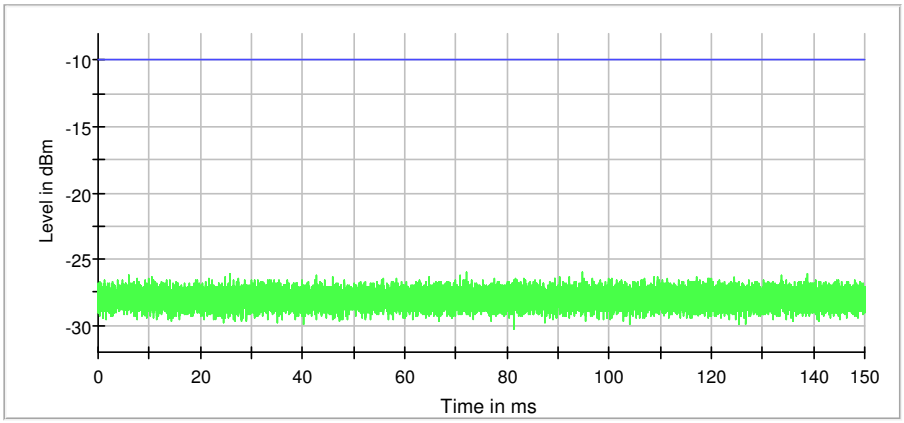

Level in dBm
-22
-23
-24
-25
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3_3
Limit for Evaluation

2472 MHz

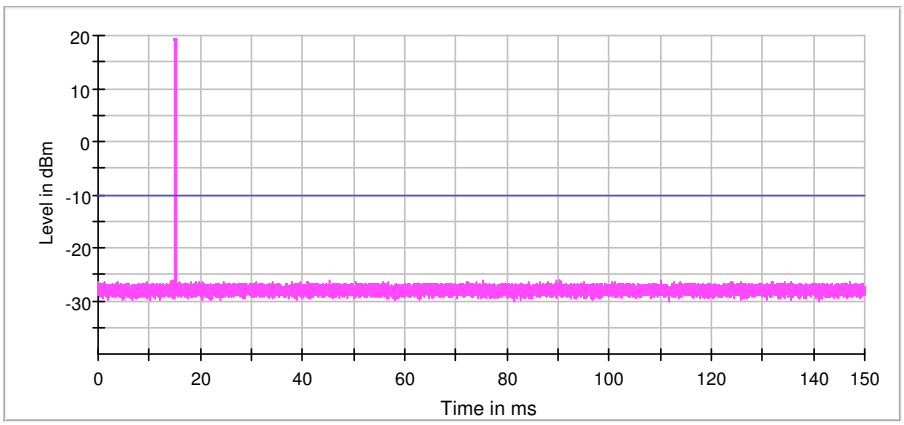

Level in dBm
30
20
10
0
-10
-20
-30
0
5
10
15
20
25
30
Time in ms
Test Step 1


Level in dBm
20
10
0
-10
-20
-30
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 2
Limit for Evaluation

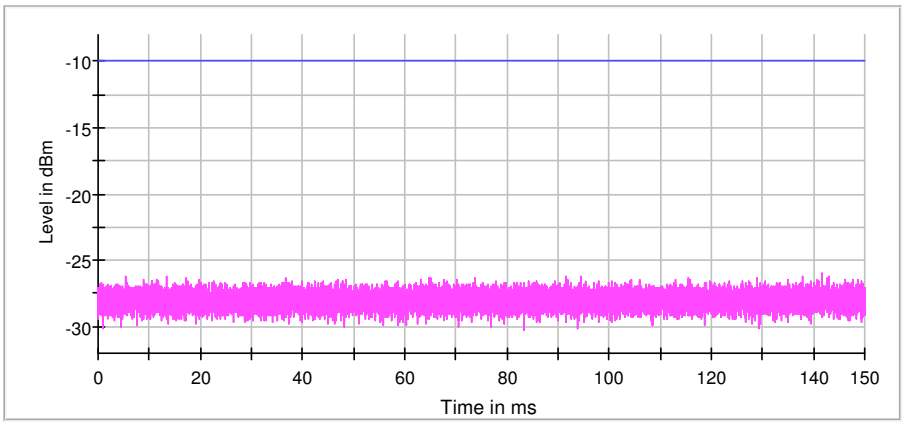
TEST REPORT



Test Step 2_2 Limit for Evaluation



Test Step 3 Limit for Evaluation



Test Step 3_3 Limit for Evaluation

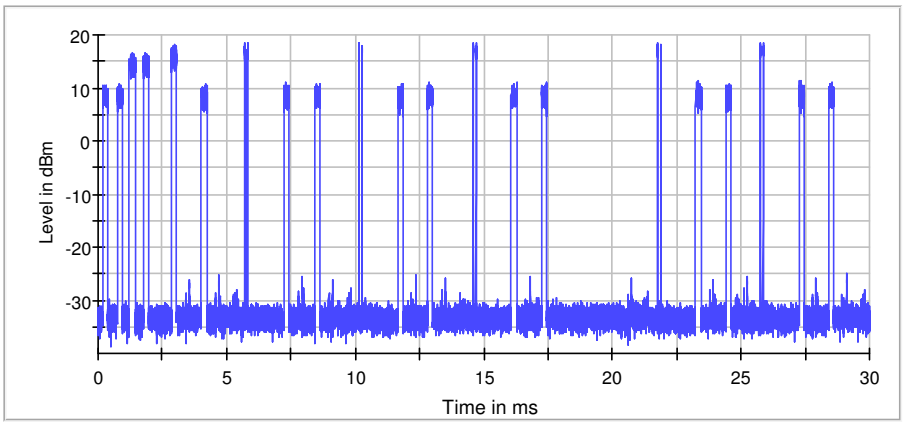
TEST REPORT

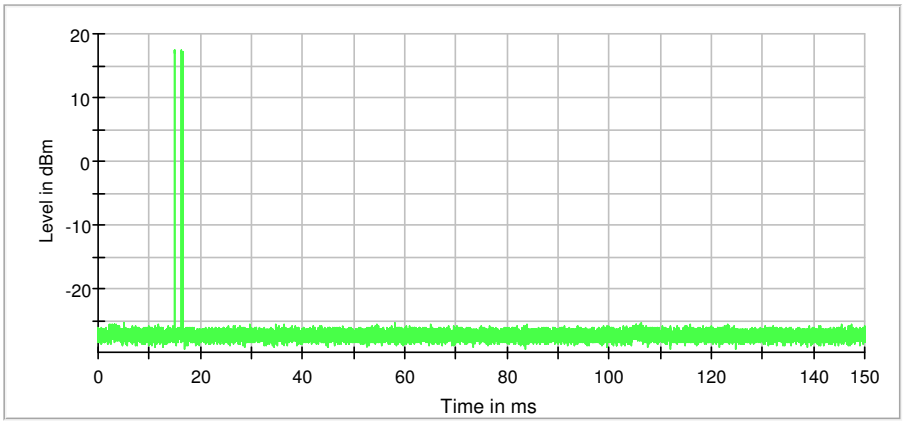
802.11n (HT40) 13.5Mbps data rate
1) Test :

Frequency (MHz)	Test Step	No. of Bursts	Max Burst Power (dBm)	COT (ms)	Limit (ms)	CCA Time (µs)	Limit (µs)	Result
2422.000000	Test Step 1	26	17.0	0.21	<13.000	78.000	>18.000	PASS
2462.000000	Test Step 1	18	17.0	0.99	<13.000	79.000	>18.000	PASS

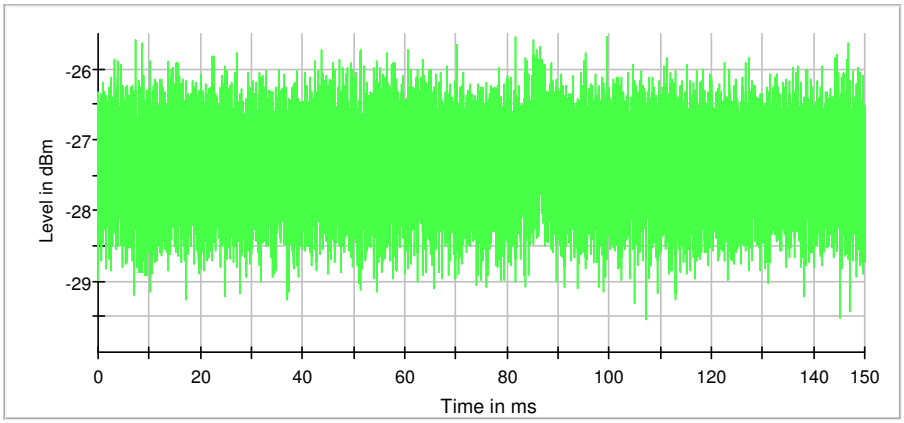
DUT Frequency (MHz)	Test Step	No. of Bursts	Max Burst Power (dBm)	Short Signaling (%)	Limit (%)	Result
2422.000000	Test Step 2	3	16.8	0.2	<10.0	PASS
2422.000000	Test Step 2_2nd	0	---	0.0	<10.0	PASS
2422.000000	Test Step 3	0	---	0.0	<10.0	PASS
2422.000000	Test Step 3_2nd	0	---	0.0	<10.0	PASS
2462.000000	Test Step 2	2	15.9	0.2	<10.0	PASS
2462.000000	Test Step 2_2nd	0	---	0.0	<10.0	PASS
2462.000000	Test Step 3	0	---	0.0	<10.0	PASS
2462.000000	Test Step 3_2nd	0	---	0.0	<10.0	PASS

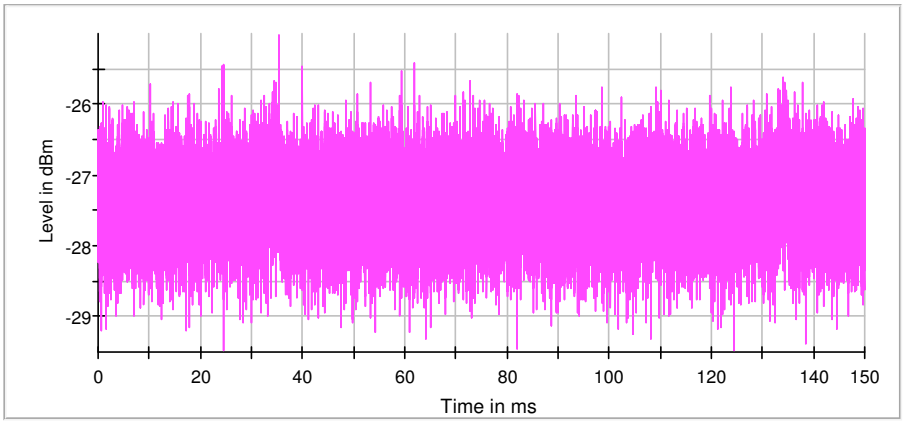
2422MHz

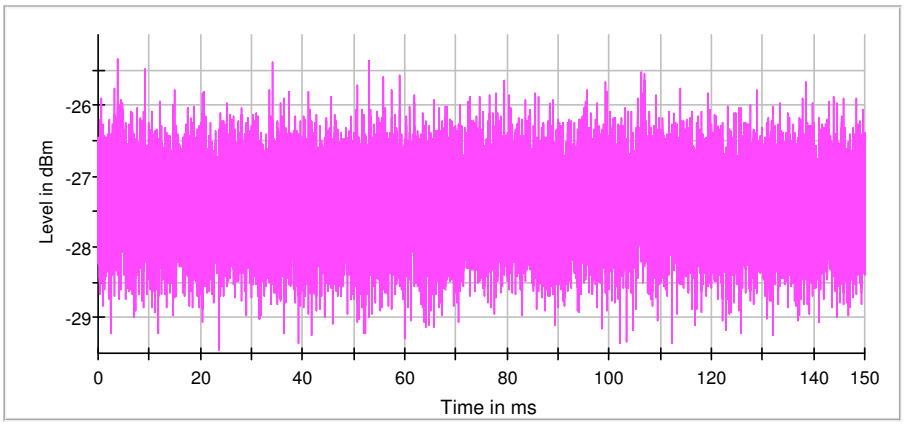




TEST REPORT

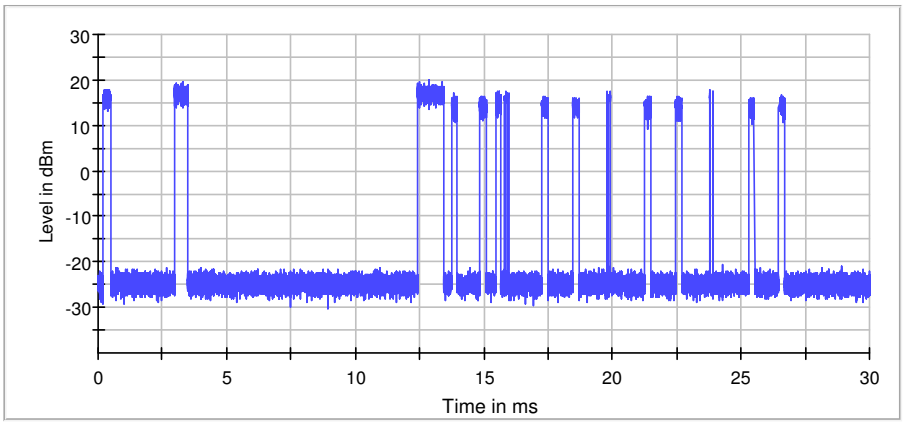

-26
-27
-28
-29
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 2_2
Limit for Evaluation


-26
-27
-28
-29
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3
Limit for Evaluation

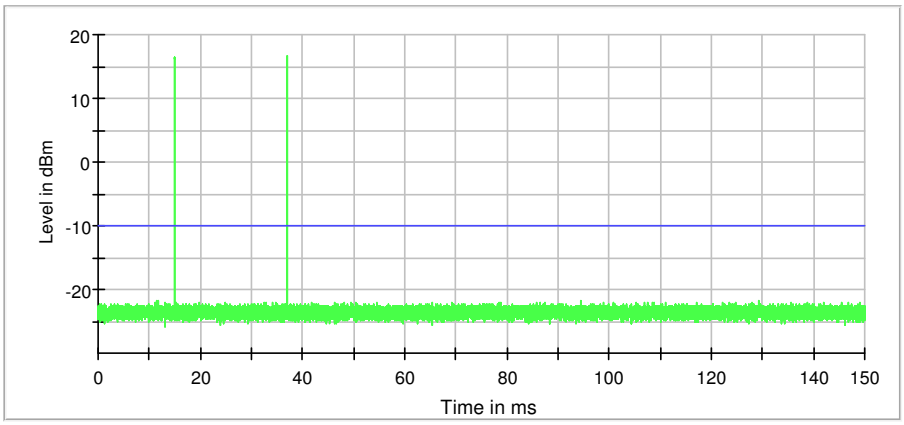

-26
-27
-28
-29
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3_3
Limit for Evaluation

TEST REPORT

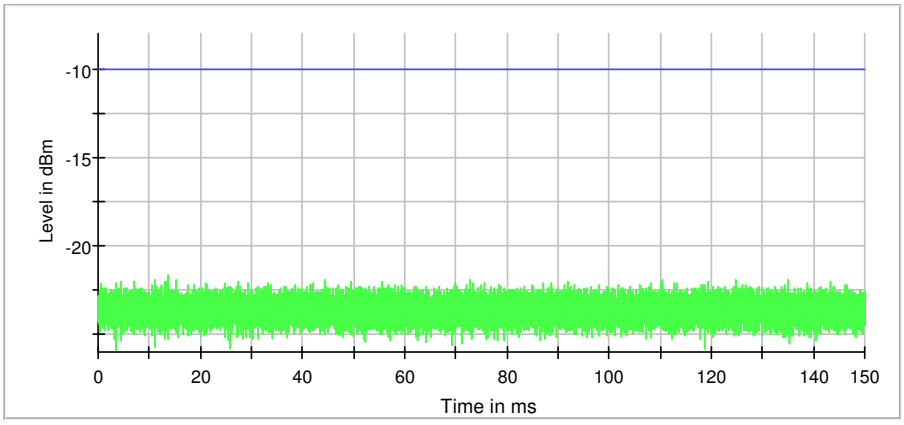
2462 MHz



Test Step 1

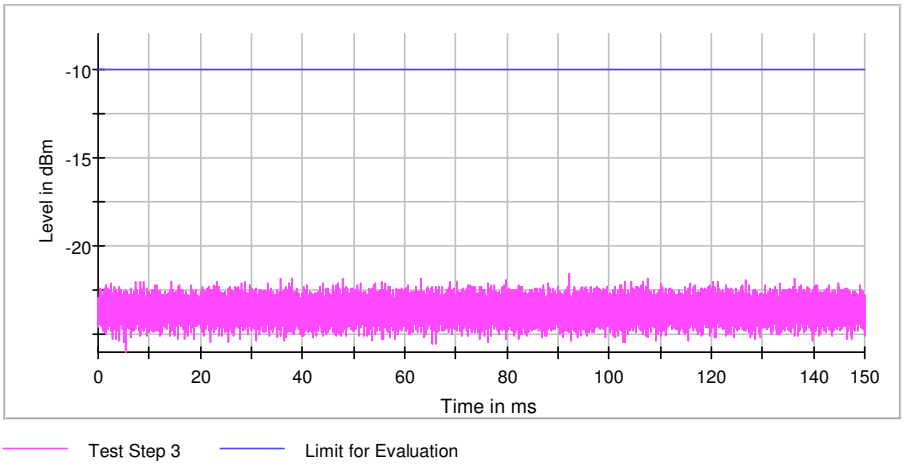


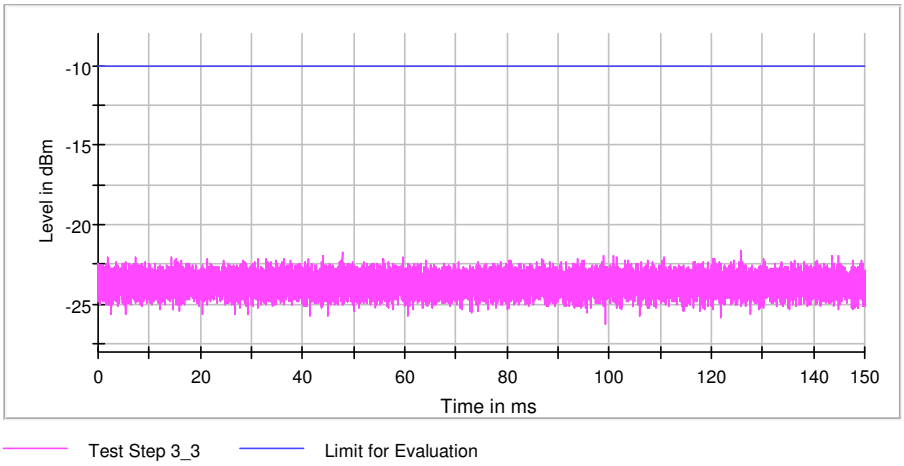
Test Step 2 Limit for Evaluation



Test Step 2_2 Limit for Evaluation

TEST REPORT


-10
-15
-20
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3
Limit for Evaluation

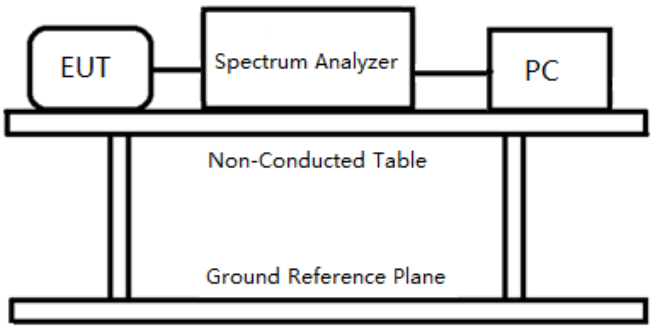

-10
-15
-20
-25
Level in dBm
0
20
40
60
80
100
120
140
150
Time in ms
Test Step 3_3
Limit for Evaluation

TEST REPORT

4.8 Occupied Channel Bandwidth

Test requirement:	EN 300 328 clause 4.3.2.7 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 2,4 GHz to 2,4835 GHz. In addition, for non-adaptive systems 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 Method:	EN 300 328 clause 5.4.7
EUT Operation:	
Status:	The measurement was performed only on the lowest and the highest frequency within the stated frequency range. Entered test mode for the product. Tested in lowest channel 2412 MHz and highest channel 2472 MHz for 802.11b/g/n(HT20), lowest channel 2422 MHz and the highest channel 2462 MHz for 802.11n(HT40) mode. Pre-Scan had been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) and data rates were selected for the final test as listed below. These tests were performed at normal environmental conditions.

Test setup:



Test Procedure:
Step 1:
Connected the EUT 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 × Occupied Channel Bandwidth (e.g. 40 MHz for a 20 MHz channel)
• Detector Mode: RMS
• Trace Mode: Max Hold
• Sweep time: 1s
Step 2:
Waited until the trace was completed.
Found the peak value of the trace and place the analyzer marker on this peak.

TEST REPORT

Step 3:
Used the 99 % bandwidth function of the spectrum analyzer to measure the Occupied Channel Bandwidth of the EUT.
This value was recorded.
Make sure that the power envelope was sufficiently above the noise floor of the analyzer to avoid the noise signals left and right from the power envelope being taken into account by this measurement.

4.8.1 Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

4.8.2 Test result and Data:

Test in 802.11b (1Mbps):

Measurement Conditions (in Normal)	Band edge of 99% Bandwidth (MHz)		Limit (MHz)	
Temperature (°C)	FL	FH	Lower	Higher
T_{norm} = 25	2404.6	2479.5	> 2400.0	< 2483.5
Note: 99% bandwidth of the lowest channel is 14.93 MHz. 99% bandwidth of the highest channel is 15.06 MHz. FL: The Lowest frequency of the power envelope of the lowest channel. FH: The Highest frequency of the power envelope of the highest channel.				

Test in 802.11g (6Mbps):

Measurement Conditions (in Normal)	Band edge of 99% Bandwidth (MHz)		Limit (MHz)	
Temperature (°C)	FL	FH	Lower	Higher
T_{norm} = 25	2402.8	2480.8	> 2400.0	< 2483.5
Note: 99% bandwidth of the lowest channel is 18.26 MHz. 99% bandwidth of the highest channel is 17.64 MHz. FL: The Lowest frequency of the power envelope of the lowest channel. FH: The Highest frequency of the power envelope of the highest channel.				

TEST REPORT

Test in 802.11n(HT20) (6.5Mbps):

Measurement Conditions (in Normal)	Band edge of 99% Bandwidth (MHz)		Limit (MHz)	
Temperature (°C)	FL	FH	Lower	Higher
T_{norm} = 25	2402.7	2481.1	> 2400.0	< 2483.5
Note: 99% bandwidth of the lowest channel is 18.78 MHz. 99% bandwidth of the highest channel is 18.17MHz. FL: The Lowest frequency of the power envelope of the lowest channel. FH: The Highest frequency of the power envelope of the highest channel.				

Test in 802.11n(HT40) (13.5Mbps):

Measurement Conditions (in Normal)	Band edge of 99% Bandwidth (MHz)		Limit (MHz)	
Temperature (°C)	FL	FH	Lower	Higher
T_{norm} = 25	2404.1	2480.0	> 2400.0	< 2483.5
Note: 99% bandwidth of the lowest channel is 35.94 MHz. 99% bandwidth of the highest channel is 35.94 MHz. FL: The Lowest frequency of the power envelope of the lowest channel. FH: The Highest frequency of the power envelope of the highest channel.				

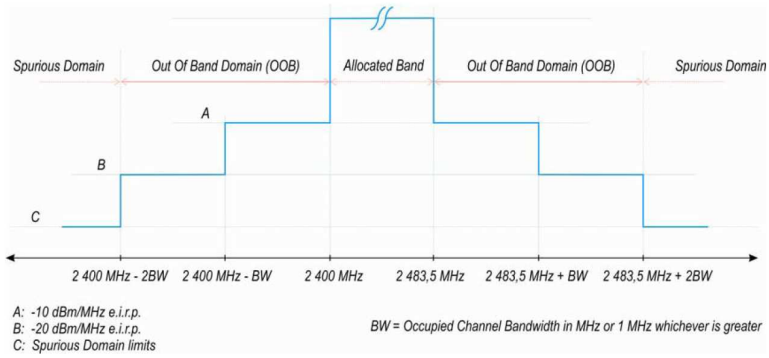
4.9 Transmitter unwanted emissions in the out-of-band domain

Test requirement: EN 300 328 clause 4.3.2.8

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 below.

Note: Within the 2 400 MHz to 2 483.5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement.

TEST REPORT

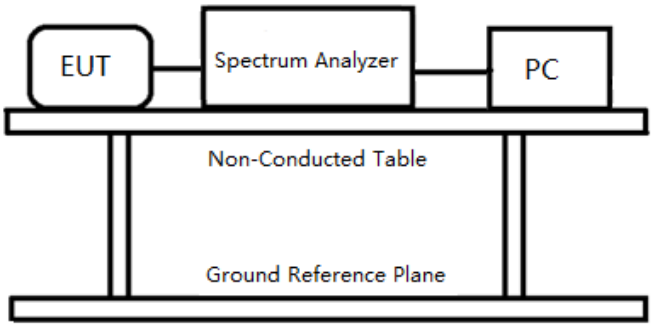


Test Method: EN 300 328 clause 5.4.8

EUT Operation:

Status: Entered test mode for the product. Tested in lowest channel 2412 MHz and highest channel 2472 MHz for 802.11b/g/n(HT20), lowest channel 2422 MHz and highest channel 2462 MHz for 802.11n(HT40) kept in continuously transmitting status with normal modulation.
Pre-Scan had been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) and data rates were selected for the final test as listed below.
These tests were performed at normal environmental conditions and repeated at the extremes of the operating temperature range.
Conducted measurement for this kind of products which be used for integral antenna equipment connect to the measuring equipment.
Refer to the clause 5.3.2 of standard EN 300 328.

Test setup:



Test Procedure:

Step 1:
Connect the UUT to the spectrum analyzer and use the following settings:
- Centre Frequency: 2 484 MHz
- Span: 0 Hz
- Resolution BW: 1 MHz

TEST REPORT

- 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:
Scanned from 2400 MHz-2BW to 2483.5+2BW, found the maximum emission frequency to measure and record.
In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi was added to the results for each of the 1 MHz segments and compared with the limits provided by the mask.
P(e.i.r.p)=A(RMS level)+G+Cable loss

4.9.1 Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details

4.9.2 Test Result and Data

Test in 802.11b (1Mbps) 2412MHz normal mode:

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm/MHz), Limit			
	-20	-10	-10	-20
Temperature (°C)	Segment 2 400 MHz - 2BW to 2 400 MHz - BW	Segment 2 400 MHz - BW to 2 400 MHz	Segment 2 483,5 MHz to 2 483,5 MHz + BW	Segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW
T_{norm} = 25	-55.2	-36.7	-55.3	-55.1

Test in 802.11b (1Mbps) 2472MHz normal mode:

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm/MHz), Limit			
	-20	-10	-10	-20
Temperature (°C)	Segment 2 400 MHz - 2BW to 2 400 MHz - BW	Segment 2 400 MHz - BW to 2 400 MHz	Segment 2 483,5 MHz to 2 483,5 MHz + BW	Segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW
T_{norm} = 25	-56.1	-55.8	-38.6	-53.6

Test in 802.11g (6Mbps) 2412MHz:

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm/MHz), Limit			
	-20	-10	-10	-20
Temperature (°C)	Segment 2 400 MHz - 2BW to 2 400 MHz - BW	Segment 2 400 MHz - BW to 2 400 MHz	Segment 2 483,5 MHz to 2 483,5 MHz + BW	Segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW
T_{norm} = 25	-53.4	-38.2	-53.8	-54.1

Test in 802.11g (6Mbps) 2472MHz:

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm/MHz), Limit			
	-20	-10	-10	-20
Temperature (°C)	Segment 2 400 MHz - 2BW to 2 400 MHz - BW	Segment 2 400 MHz - BW to 2 400 MHz	Segment 2 483,5 MHz to 2 483,5 MHz + BW	Segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW
T_{norm} = 25	-56.9	-56.4	-45.8	-53.7

TEST REPORT

Test in 802.11n (HT20) (6.5Mbps) 2412MHz:

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm/MHz), Limit			
	-20	-10	-10	-20
Temperature (°C)	Segment 2 400 MHz - 2BW to 2 400 MHz - BW	Segment 2 400 MHz - BW to 2 400 MHz	Segment 2 483,5 MHz to 2 483,5 MHz + BW	Segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW
T_{norm} = 25	-53.4	-37.8	-53.9	-54.1

Test in 802.11n (HT20) (6.5Mbps) 2472MHz:

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm/MHz), Limit			
	-20	-10	-10	-20
Temperature (°C)	Segment 2 400 MHz - 2BW to 2 400 MHz - BW	Segment 2 400 MHz - BW to 2 400 MHz	Segment 2 483,5 MHz to 2 483,5 MHz + BW	Segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW
T_{norm} = 25	-56.8	-56.5	-44.9	-53.8

Test in 802.11n (HT40) (13.5Mbps) 2422MHz:

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm/MHz), Limit			
	-20	-10	-10	-20
Temperature (°C)	Segment 2 400 MHz - 2BW to 2 400 MHz - BW	Segment 2 400 MHz - BW to 2 400 MHz	Segment 2 483,5 MHz to 2 483,5 MHz + BW	Segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW
T_{norm} = 25	-53.7	-46.3	-50.8	-53.4

Test in 802.11n (HT40) (13.5Mbps) 2462MHz:

Measurement Conditions (in Normal & Extreme)	Transmitter e.i.r.p.(dBm/MHz), Limit			
	-20	-10	-10	-20
Temperature (°C)	Segment 2 400 MHz - 2BW to 2 400 MHz - BW	Segment 2 400 MHz - BW to 2 400 MHz	Segment 2 483,5 MHz to 2 483,5 MHz + BW	Segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW
T_{norm} = 25	-54.5	-53.2	-45.6	-52.5

Remark:

1) BW= Max. Occupied Channel Bandwidth=1.0519MHz
2) Test the EIRP in EUT continuously transmitting mode in the lowest frequency and highest frequency in normal conditions.
3) Antenna gain(G): 1.5 dBi
   Cable loss: 0.5 dB
   P(e.i.r.p)=A(RMS level)+G+Cable loss

Measurement Uncertainty: ±1.49dB

TEST REPORT

4.10 Transmitter unwanted emissions in the spurious domain

Test requirement: EN 300 328 clause 4.3.2.9

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in below table:

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

(exclude frequency band: 2400-2BW~2483.5+2BW)

Test Method: EN 300 328 clause 5.4.9

EUT Operation:

Status: Entered test mode for the product. Tested in lowest channel 2412 MHz and highest channel 2472 MHz for 802.11b/g/n(HT20), lowest channel 2422 MHz and highest channel 2462 MHz for 802.11n(HT40) kept in continuously transmitting status with normal modulation. Pre-Scan had been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) and data rates were selected for the final test as listed below.

These tests were performed at normal environmental conditions

Test Procedure:

Substitution method was performed to determine the actual spurious emission levels of the EUT.

The following test procedure as below:

1) Below 1GHz test procedure:

1. On the test site as test setup graph below, the EUT was placed at the 1.5m support on the turntable and in the position closest to normal use as declared by the provider.
2. The test antenna was oriented initially for vertical polarization and was chosen to correspond to the test frequency of the transmitter. The output of the test antenna was connected to the measuring receiver.
3. The transmitter was switched on, if possible, without modulation and the measuring receiver was tuned to the test frequency of the transmitter under test.
4. The test antenna was raised and lowered from 1m to 4m until a maximum signal level was detected by the measuring receiver. Then the turntable was rotated through 360° in the horizontal plane, until the maximum signal level was detected by the measuring receiver.
5. Repeated step 4 for test frequency with the test antenna polarized horizontally.
6. Removed the transmitter and replaced it with a substitution antenna (the antenna was

half-wavelength for each frequency involved). The center of the substitution antenna was approximately at the same location as the center of the transmitter. The lower end of the antenna was 0.3 m above the ground when the antenna was polarized vertically.

7. Fed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends vertically polarized, and with the signal generator tuned to a particular test frequency, raised and lowered the test antenna to obtain a maximum reading at the spectrum analyzer. Adjusted the level of the signal generator output until the previously recorded maximum reading for this set of conditions was obtained. This was done carefully repeating the adjustment of the test antenna and generator output.
8. Repeated step 7 with both antennas horizontally polarized for each test frequency.
9. Calculated power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps 7 and 8 by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula:

ERP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd)

where:

Pg is the generator output power into the substitution antenna.

2) Above 1GHz test procedure:

Different between above was the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber, and the test antenna did not need to raise from 1 to 4m, just test at 1.5m height.

Test Setup:

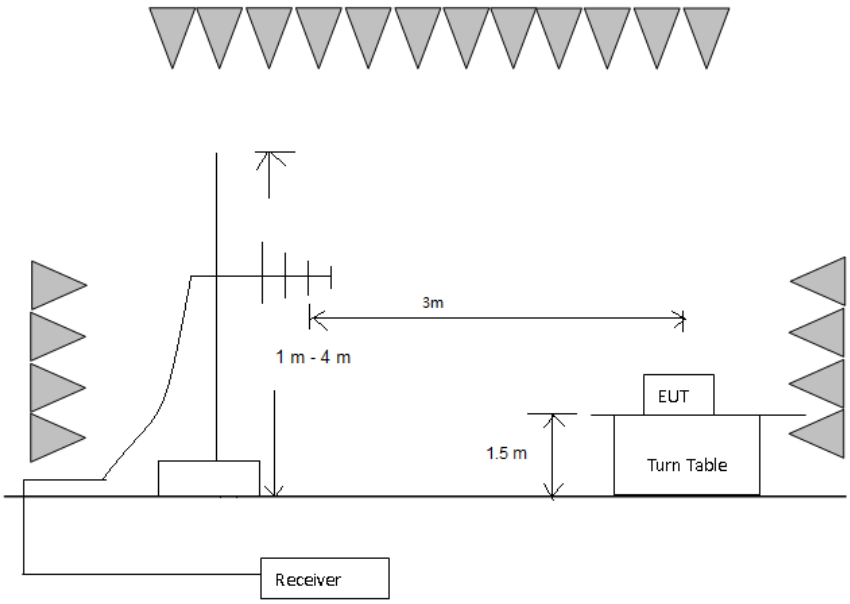


Figure 1. 30 MHz to 1 GHz

TEST REPORT

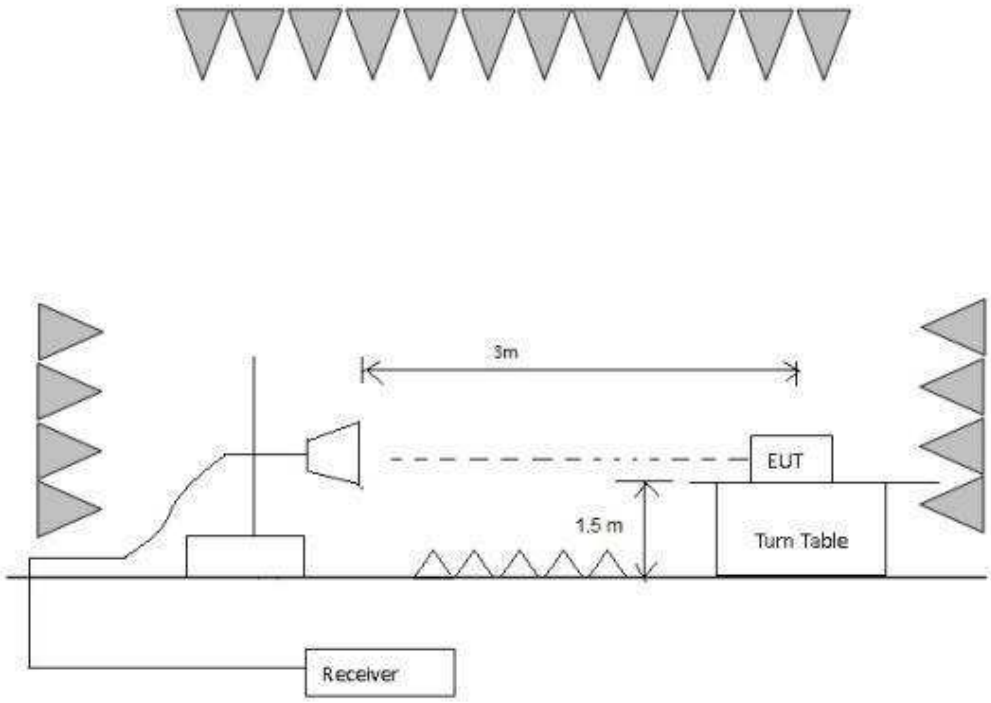


Figure 2. Above 1GHz

4.10.1 Used Test Equipment List

3m Semi-Anechoic Chamber, Super Broadband test Antenna, Bouble-Ridged Waveguide Horn Antenna, EMI Test Receiver, Spectrum Analyzer, Coaxial cable.
Refer to Clause 5 Test Equipment List for details.

4.10.2 Test Result and Data

Test in 802.11b (1Mbps) mode:
Test in lowest Channel (2412 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	191.57	-70.6	-54	-16.6
H	478.88	-69.5	-54	-15.5
H	714.37	-69.6	-36	-33.6
H	2409.94	-51.8	-30	-21.8
H	8054.47	-47.2	-30	-17.2
H	10060.47	-47.1	-30	-17.1
V	191.57	-73.1	-54	-19.1

V	479.95	-73.3	-54	-19.3
V	715.89	-66.5	-36	-30.5
V	5837.03	-49.4	-30	-19.4
V	6919.19	-46.3	-30	-16.3
V	10077.47	-46.6	-30	-16.6

Test in highest Channel (2472 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	191.60	-72.8	-54	-18.8
H	613.52	-71.1	-54	-17.1
H	715.60	-70.3	-36	-34.3
H	2469.97	-52.1	-30	-22.1
H	4944.53	-50.9	-30	-20.9
H	9887.81	-46.8	-30	-16.8
V	184.10	-73.0	-54	-19.0
V	588.43	-69.4	-54	-15.4
V	712.01	-66.3	-36	-30.3
V	4944.00	-49.0	-30	-19.0
V	8021.53	-46.3	-30	-16.3
V	11303.59	-46.1	-30	-16.1

Test in 802.11g (6Mbps) mode:
Test in lowest Channel (2412 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	214.43	-65.7	-54	-11.7
H	638.97	-68.5	-54	-14.5
H	711.91	-66.9	-36	-30.9
H	2414.19	-53.9	-30	-23.9
H	4799.50	-51.7	-30	-21.7
H	9879.84	-47.4	-30	-17.4
V	167.03	-68.5	-36	-32.5
V	479.01	-72.0	-54	-18.0
V	726.43	-69.9	-36	-33.9
V	6059.63	-49.2	-30	-19.2
V	7333.03	-47.3	-30	-17.3
V	11001.31	-46.3	-30	-16.3

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Test in highest Channel (2472 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	191.12	-72.3	-54	-18.3
H	477.82	-72.2	-54	-18.2
H	722.10	-69.9	-36	-33.9
H	1666.19	-53.5	-30	-23.5
H	6900.59	-48.0	-30	-18.0
H	10344.16	-47.5	-30	-17.5
V	188.79	-70.7	-54	-16.7
V	571.87	-70.4	-54	-16.4
V	709.00	-66.9	-36	-30.9
V	6366.69	-47.8	-30	-17.8
V	7967.88	-47.2	-30	-17.2
V	10690.53	-46.2	-30	-16.2

Test in 802.11n(HT20) (6.5Mbps) mode:
Test in lowest Channel (2422 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	191.96	-72.7	-54	-18.7
H	673.60	-70.1	-54	-16.1
H	711.68	-69.7	-36	-33.7
H	1659.81	-54.0	-30	-24.0
H	2406.75	-54.5	-30	-24.5
H	7948.22	-47.4	-30	-17.4
V	179.96	-69.8	-54	-15.8
V	575.24	-70.5	-54	-16.5
V	709.19	-67.1	-36	-31.1
V	5177.22	-50.9	-30	-20.9
V	6969.59	-47.9	-30	-17.9
V	7996.03	-46.7	-30	-16.7

Test in highest Channel (2472 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	192.05	-73.2	-54	-19.2

H	477.85	-71.9	-54	-17.9
H	710.46	-68.8	-36	-32.8
H	1880.81	-55.7	-30	-25.7
H	6769.38	-48.8	-30	-18.8
H	11237.19	-48.2	-30	-18.2
V	177.02	-69.0	-54	-15.0
V	207.03	-70.3	-54	-16.3
V	720.70	-66.6	-36	-30.6
V	4559.38	-52.9	-30	-22.9
V	6633.38	-46.8	-30	-16.8
V	10129.53	-46.3	-30	-16.3

Test in 802.11n(HT40) (13.5Mbps) mode:
Test in lowest Channel (2422 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	191.99	-72.5	-54	-18.5
H	608.22	-71.8	-54	-17.8
H	718.76	-69.4	-36	-33.4
H	1659.81	-52.4	-30	-22.4
H	6523.94	-48.8	-30	-18.8
H	10142.28	-47.8	-30	-17.8
V	192.05	-69.8	-54	-15.8
V	209.45	-70.2	-54	-16.2
V	711.81	-66.9	-36	-30.9
V	5138.44	-51.4	-30	-21.4
V	7960.44	-46.3	-30	-16.3
V	10545.50	-47.0	-30	-17.0

Test in highest Channel (2462 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	191.99	-70.5	-54	-16.5
H	479.08	-71.6	-54	-17.6
H	710.36	-710.4	-36	-674.4
H	1994.50	-54.2	-30	-24.2
H	7180.56	-47.9	-30	-17.9
H	10028.06	-46.8	-30	-16.8
V	192.02	-68.5	-54	-14.5
V	607.47	-68.7	-54	-14.7

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V	710.20	-66.6	-36	-30.6
V	4851.03	-51.8	-30	-21.8
V	8018.34	-47.0	-30	-17.0
V	10153.97	-46.9	-30	-16.9

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.

4.11 Spurious Emissions (Receiver)

Test requirement: EN 300 328 clause 4.3.2.10

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

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

Test Method: EN 300 328 clause 5.4.10

EUT Operation Status: Entered test mode for the product. Tested in lowest channel 2412 MHz and highest channel 2472 MHz for 802.11b/g/n(HT20), lowest channel 2422 MHz and highest channel 2462 MHz for 802.11n(HT40) kept in continuously transmitting status with normal modulation.
Pre-Scan had been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) and data rates were selected for the final test as listed below.
These tests were performed at normal environmental conditions

Test Setup:

TEST REPORT

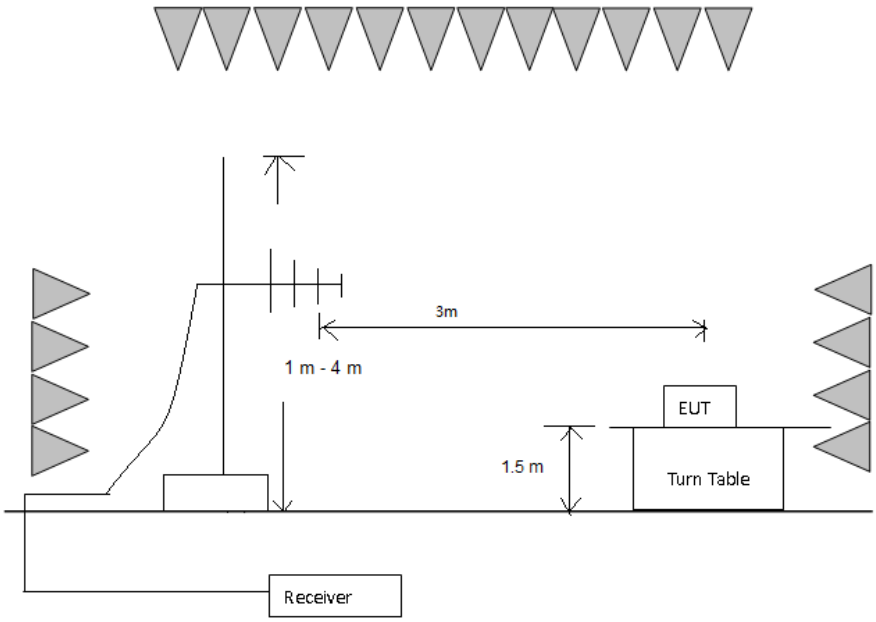

Figure 1. 30 MHz to 1 GHz

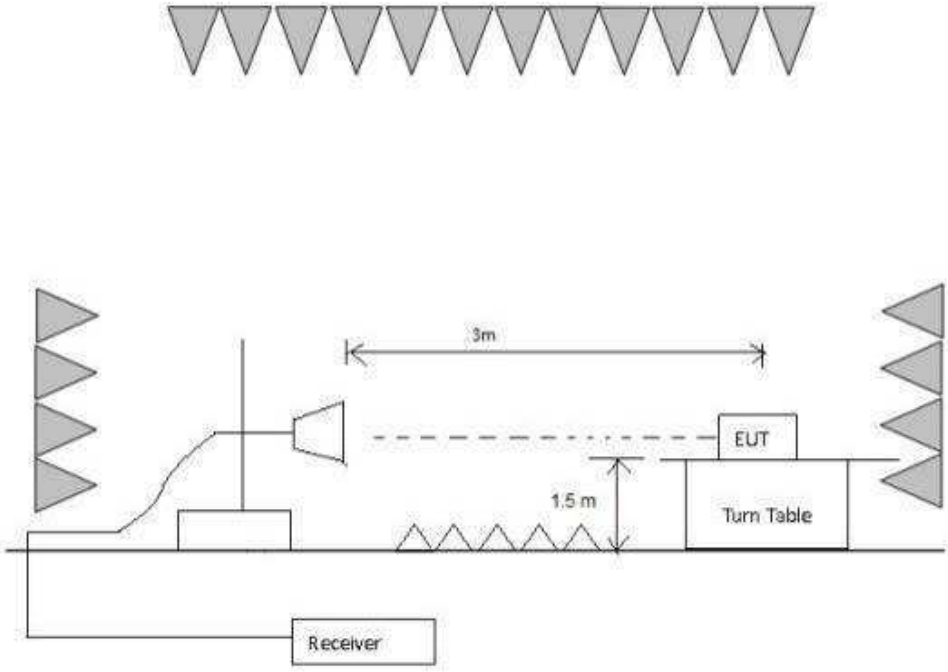

Figure 2. Above 1GHz

TEST REPORT

Test Procedure:
Substitution method was performed to determine the actual spurious emission levels of the EUT.
The following test procedure as below:
1) Below 1GHz test procedure:

1. On the test site as test setup graph below, the EUT was placed at the 1.5m support on the turntable and in the position closest to normal use as declared by the provider.
2. The test antenna was oriented initially for vertical polarization and was chosen to correspond to the test frequency of the transmitter. The output of the test antenna was connected to the measuring receiver.
3. The Receiver was switched on, if possible, without modulation and the measuring receiver was tuned to the test frequency of the transmitter under test.
4. The test antenna was raised and lowered from 1m to 4m until a maximum signal level was detected by the measuring receiver. Then the turntable was rotated through 360° in the horizontal plane, until the maximum signal level was detected by the measuring receiver.
5. Repeated step 4 for test frequency with the test antenna polarized horizontally.
6. Removed the Receiver and replaced it with a substitution antenna (the antenna was half-wavelength for each frequency involved). The center of the substitution antenna was approximately at the same location as the center of the transmitter. The lower end of the antenna was 0.3 m above the ground when the antenna was polarized vertically.
7. Fed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends vertically polarized, and with the signal generator tuned to a particular test frequency, raised and lowered the test antenna to obtain a maximum reading at the spectrum analyzer. Adjusted the level of the signal generator output until the previously recorded maximum reading for this set of conditions was obtained. This was done carefully repeating the adjustment of the test antenna and generator output.
8. Repeated step 7 with both antennas horizontally polarized for each test frequency.
9. Calculated power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps 7 and 8 by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula:
   ERP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd)

where:

Pg is the generator output power into the substitution antenna.

2) Above 1GHz test procedure:

Different between above was the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber, and the test antenna did not need to raise from 1 to 4m, just test at 1.5m height.

4.11.1 Used Test Equipment List

3m Semi-Anechoic Chamber, Super Broadband test Antenna, Bouble-Ridged Waveguide Horn Antenna, EMI Test Receiver, Spectrum Analyzer, Coaxial cable.
Refer to Clause 5 Test Equipment List for details

4.11.2 Test Result and Data

Pre-test in the highest and lowest frequencies with different data rates and modulations, and found the worst case in 802.11b, 1Mbps, 2412MHz and 2472MHz, test data as below:

Test in lowest Channel (2412 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	159.95	-65.4	-57	-8.4
H	383.31	-65.0	-57	-8.0
H	714.63	-69.6	-57	-12.6
H	1660.34	-52.3	-47	-5.3
H	2216.03	-55.8	-47	-8.8
H	4327.75	-54.9	-47	-7.9
V	160.01	-66.0	-57	-9.0
V	633.86	-68.6	-57	-11.6
V	711.00	-66.5	-57	-9.5
V	1950.94	-58.4	-47	-11.4
V	3594.09	-54.7	-47	-7.7
V	4601.88	-53.4	-47	-6.4

Test in the highest Channel (2472 MHz)

Antenna Polarization	Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dBm)
H	159.98	-63.7	-57	-6.7
H	312.08	-66.0	-57	-9.0
H	383.31	-65.0	-57	-8.0
H	1327.78	-52.1	-47	-5.1
H	1658.22	-52.4	-47	-5.4
H	4530.69	-54.7	-47	-7.7
V	159.98	-65.6	-57	-8.6
V	382.34	-71.8	-57	-14.8
V	709.16	-66.6	-57	-9.6
V	2035.41	-57.5	-47	-10.5
V	2147.31	-55.0	-47	-8.0
V	3716.81	-55.1	-47	-8.1

Notes:

1. The test frequency range is 30MHz to 12.75GHz.
2. Other emissions found were at least 10 dB below the limit.

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4.12 Receiver Blocking

Test requirement: EN 300 328 clause 4.3.2.11

The minimum performance criterion shall be a PER less than or equal to 10 %. While maintaining the minimum performance criteria, 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 14, table 15 or table 16 in the standard.

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × $\log_{10}$(OCBW)) or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
(-139 dBm + 10 × $\log_{10}$(OCBW)) or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 584 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 P_{min} + 26 dB where P_{min} 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 P_{min} + 20 dB where P_{min} 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.

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Table 15: Receiver Blocking parameters receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(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 P_{min} + 26 dB where P_{min} 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.			

Table 16: Receiver Blocking parameters receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(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 P_{min} + 30 dB where P_{min} 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.			

As the maximum RF output power of the EUT is greater than 10dBm e.i.r.p., it was considered as receiver category 1 equipment

Test Method: EN 300 328 clause 5.4.11

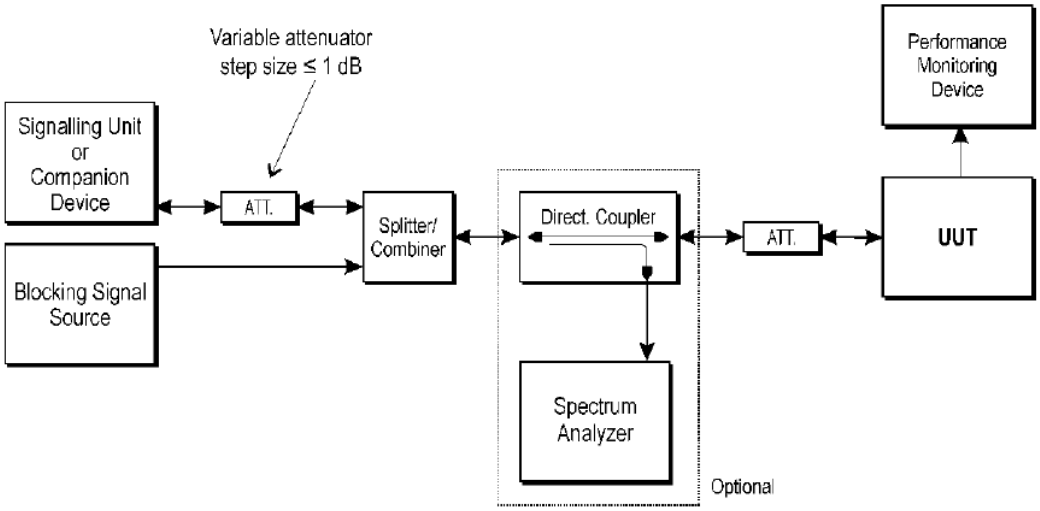
EUT Operation

Status: Tested the EUT in b mode with the lowest data rate as the standard required, at the lowest and highest operation frequency.

These tests were performed at normal environmental.

Test Setup:

TEST REPORT



Test Procedure:

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.

4.12.1 Used Test Equipment List

Refer to Clause 5 Test Equipment List for details.

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4.12.2 Test Result and Data

☑ Receiver Category 1:

2412MHz:

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power(dBm)	PER(%)	Limit(%)
(-133 dBm+10 x $\log_{10}$(OCBW)) or -68dBm whichever is less	2380	-34	3.1	10
(-139 dBm+10 x $\log_{10}$(OCBW)) or -74 dBm whichever is less	2300		1.7	
	2330		2.3	
	2360		2.5	

2472MHz:

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power(dBm)	PER(%)	Limit(%)
(-133 dBm+10 x $\log_{10}$(OCBW)) or -68dBm whichever is less	2504	-34	2.2	10
(-139 dBm+10 x $\log_{10}$(OCBW)) or -74 dBm whichever is less	2524		1.8	
	2584		1.3	
	2674		1.8	

The result is complied with the standard requirement.

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5.0 Test Equipment List

Equipment No.	Equipment	Model	Manufacturer	Cal. Due date (YYYY-MM-DD)	Calibration Interval
EM030-04	3m Semi-Anechoic Chamber	9×6×6 m^3	ETS‧LINDGREN	4/10/2021	1Y
EM080-05	EMI Test Receiver (9 kHz~3 GHz)	ESCI	R&S	7/19/2021	1Y
EM031-02	EMI Test Receiver (9 kHz~7 GHz)	R&S ESR7	R&S	10/16/2021	1Y
EM031-03	Signal and Spectrum Analyzer (10 Hz~40 GHz)	R&S FSV40	R&S	9/6/2021	1Y
EM011-04	Loop antenna (9 kHz-30 MHz)	HFH2-Z2	R&S	6/18/2021	1Y
EM061-03	TRILOG Super Broadband test Antenna (TX)	VULB 9161	SCHWARZBECK	6/18/2021	1Y
EM033-01	TRILOG Super Broadband test Antenna(RX)	VULB 9163	SCHWARZBECK	9/18/2021	1Y
EM033-06	Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(TX)	3115	ETS	9/6/2021	2Y
EM033-02	Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX)	R&S HF907	R&S	6/18/2021	1Y
EM033-05	Pyramidal Horn Antenna (18 GHz-26.5 GHz)(TX)	3160-09	ETS	8/12/2021	2Y
EM033-03	High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX)	R&S SCU-26	R&S	4/24/2021	1Y
EM033-04	High Frequency Antenna & preamplifier (26 GHz-40 GHz)	R&S SCU-40	R&S	4/24/2021	1Y
EM031-02-01	Coaxial cable(9 kHz-1 GHz)	N/A	R&S	4/12/2021	1Y
EM033-02-02	Coaxial cable(1 GHz-18 GHz)	N/A	R&S	4/12/2021	1Y
EM033-04-02	Coaxial cable(18 GHz~40 GHz)	N/A	R&S	4/24/2021	1Y
EM045-01	Broadband power meter	OSP120/OSP-B157	R&S	11/15/2021	1Y
EM082-02	Vector signal generator	SMBV100A	R&S	4/15/2021	1Y
EM031-01	Signal Generator (9 kHz~6 GHz)	SMB100A	R&S	7/22/2021	1Y
EM040-01	Band Reject/Notch Filter	WRHFV	Wainwright	N/A	1Y
EM040-02	Band Reject/Notch Filter	WRCGV	Wainwright	N/A	1Y
EM040-03	Band Reject/Notch Filter	WRCGV	Wainwright	N/A	1Y
EM022-03	2.45 GHz Filter	BRM50702	Micro-Tronics	5/10/2021	1Y
SA016-16	Programmable Temperature & Humidity Test Chamber	MHU-800LJ	TERCHY	10/16/2021	1Y
SA016-22	Climatic Test Chamber	C7-1500	Vötsch	11/12/2021	1Y
SA012-74	Digital Multimeter	FLUKE175	FLUKE	10/16/2021	1Y
EM010-01	Regulated DC Power supply	PAB-3003A	GUANHUA	N/A	1Y
SA040-22	Regulated DC Power supply	IT6721	ITECH	9/6/2021	1Y
EM084-06	Audio Analyzer	8903B	HP	4/15/2021	1Y
EM045-01-01	EMC32 software (RE/RS)	V10.01.00	R&S	N/A	N/A
EM045-01-09	EMC32 software (328/893)	V10.01.00	R&S	N/A	N/A

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Blocking test:

Equip No.	Description	Manufacturer	Model No.	cal. Date	due date
SZ056-05	Spectrum Analyzer	Agilent	E4407B	2020-12-22	2021-12-22
SZ070-05	Directional Coupler	Agilent	87300C	2020-12-22	2021-12-22
SZ070-20	Combiner	Mini-Circuits	ZN2PD-63-S+	2020-05-27	2021-05-27
SZ070-21	Combiner	Mini-Circuits	ZN2PD-63-S+	2020-05-27	2021-05-27
SZ180-13	MXG Vector Signal Generator	Keysight	N5182B	2020-10-27	2021-10-27
SZ062-14	RF cable	BELDEN	RG59-BN	2020-12-12	2021-16-12
SZ065-06	Wideband Radio Communication Tester	R&S	CMW500	2020-05-27	2021-05-27

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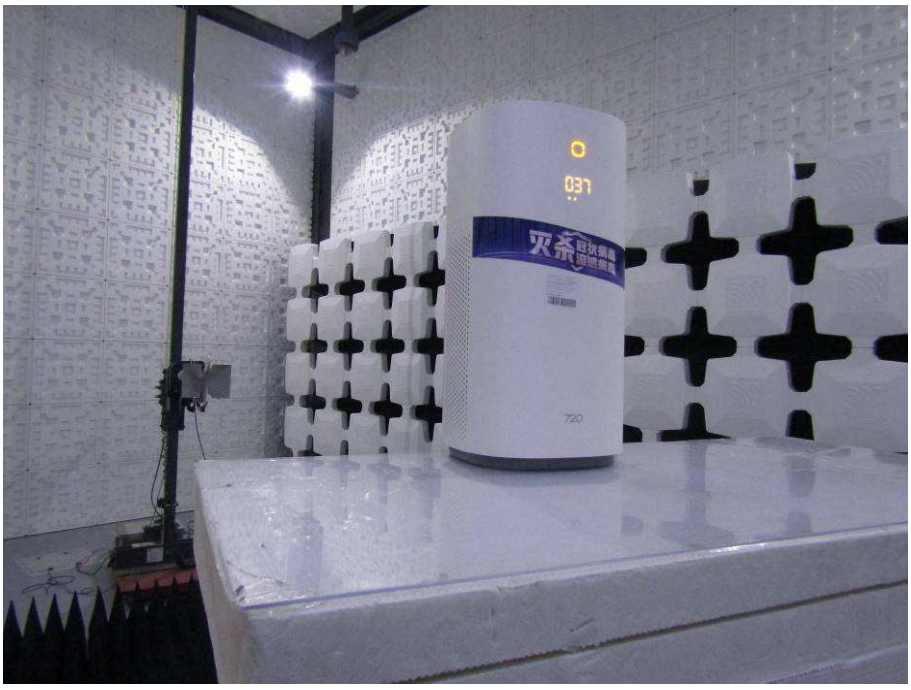
6.0 Appendix I - Photos of test setup

Spurious Emission



7.0 Appendix II - Photos of EUT

Please refer to 201225119GZU-005 test report for more details.

**********End of the test report**********