ETSI EN 300 328 V2.1.1 (2016-11)

TEST REPORT

For

Shenzhen Sonoff Technologies Co.,Ltd.

Room 1001, 10F, Building 8, Lianhua Industrial Park, Longyuan Road, Longhua District, Shenzhen, GD, China

Model: Micro

Report Type: Original Report	**Product Type:** USB Smart Adapter
Report Number:	RDG191021006-22
Report Date:	2019-11-22
Reviewed By:	Allen Qiao RF Supervisor
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	USB Smart Adapter
EUT Model:	Micro
Rated Input Voltage:	DC5V
External Dimension:	31*26.5*33（mm)
Serial Number:	RDG191021006-RF-S1
EUT Received Date:	2019/10/22
EUT Received Status:	Good

Objective

This report is prepared on behalf of ***Shenzhen Sonoff Technologies Co.,Ltd.*** in accordance with ETSI EN 300 328 V2.1.1 (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.

The objective is to determine the compliance of EUT with: ETSI EN 300 328 V2.1.1 (2016-11).

Test Methodology

All measurements contained in this report were conducted with ETSI EN 300 328 V2.1.1 (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.

Measurement Uncertainty

Parameter	Flab	Maximum allow uncertainty
Occupied Channel Bandwidth	±5 %	±5 %
RF output power, conducted	±0.61dB	±1,5 dB
Power Spectral Density, conducted	±3 dB	±3 dB
Unwanted Emissions, conducted	±2.47dB	±3 dB
All emissions, radiated	±3.62dB	±6 dB
Temperature	±1℃	±3℃
Supply voltages	±0.4%	±3 %
Time	1%	±5 %

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol "Δ". Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode, which was provided by manufacturer. For 2.4GHz WLAN, 13 channels are provided to testing.
802.11b, 802.11g and 802.11n HT20 modes were tested with Channel 1, 7 and 13.
802.11n HT40 mode was tested with Channel 3, 7 and 11.

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	/	/

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power and PSD across all data rates, bandwidths, and modulations.

The extreme temperature test conditions which were declared by the manufacturer and the normal conditions are as below:
NT: Normal Temperature 25℃
LT: Low Temperature 0℃
HT: High Temperature 45℃

Equipment Modifications

No modification was made to the EUT.

EUT Exercise Software

The software 'SecureCRT' was used and the maximum power was configured as default setting.

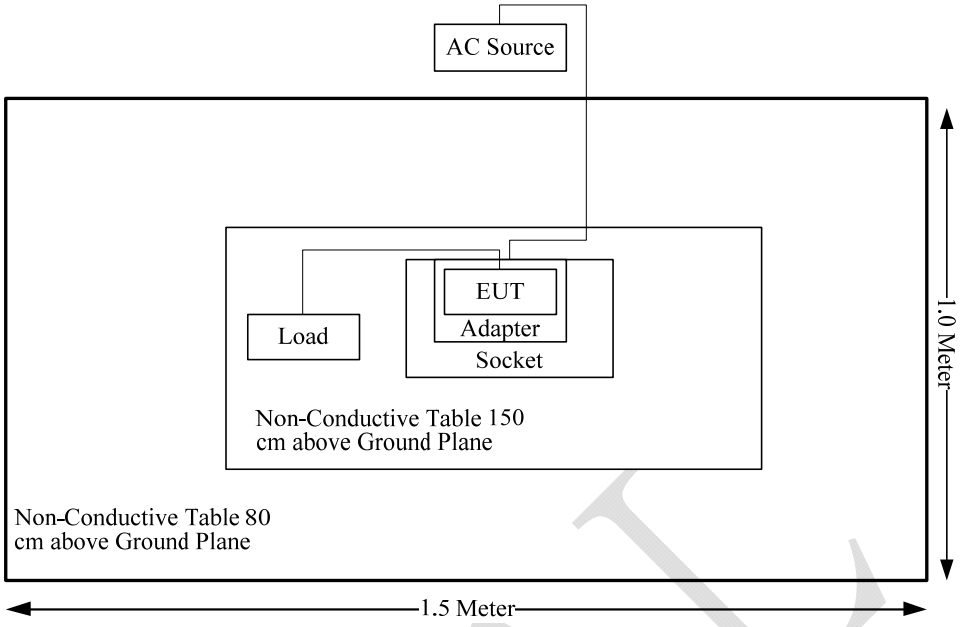
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
unknown	Load	/	/
iHunt	adapter	D8-0502000E	/
Meizu	adapter	U23	/

Support Cable List and Details

Cable Description	Shielding Cable	Ferrite Core	Length (m)	From Port	To
Power Cable	Yes	No	0.5	EUT	Load

Block Diagram of Test Setup



Test Equipment List

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated emissions below 1GHz					
R&S	EMI Test Receiver	ESR3	102453	2019-06-26	2020-06-26
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2019-05-06	2020-05-06
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-02	2019-09-05	2020-09-05
HP	Amplifier	8447D	2727A05902	2019-09-05	2020-09-05
Agilent	Signal Generator	E8247C	MY43321350	2018-12-10	2019-12-10
Radiated emissions above 1GHz					
Agilent	Spectrum Analyzer	E4440A	SG43360054	2019-05-09	2020-05-09
TDK RF	Horn Antenna	HRN-0118	130 084	2018-10-12	2021-10-12
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-02	2019-09-05	2020-09-05
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2019-09-05	2020-09-05
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2019-06-16	2020-06-16
Micro-tronics	High Pass Filter	HPM50111	S/N-G217	2019-06-16	2020-06-16
Agilent	Signal Generator	E8247C	MY43321350	2018-12-10	2019-12-10
RF conducted					
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2019-09-12	2020-09-12
R&S	Spectrum Analyzer	FSU 26	200256	2019-05-09	2020-05-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/04	Each time	N/A
E-Microwave	Blocking Control	EMDCB-00036	OE01203218	2019-05-06	2020-05-06
HP	Step Attenuator	8494B	1510A05007	2019-09-06	2020-09-06
Agilent	Step Attenuator	8496B	2815A10904	2019-09-06	2020-09-06
R&S	Wideband Radio Communication Tester	CMW500	147473	2019-09-12	2020-09-12
Agilent	MXG Vector Signal Generator	N5182B	MY51350142	2019-07-19	2020-07-19
Weinschel	Coaxial Attenuators	53-20-34	LN749	2019-09-06	2020-09-06
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2019-09-23	2020-09-23

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Environmental Conditions

Temperature:	25.4~28.2 °C
Relative Humidity:	48~51%
ATM Pressure:	100.2~ 100.6kPa
Tester:	Neil Liao, Lucy Lu, Chris Mo
Test Date:	2019.10.25~2019.11.20

SUMMARY OF TEST RESULTS

SN	Rule and Clause	Description of Test	Test Result
1	EN 300 328 Clause 4.3.2.2	RF output power	Compliance
2	EN 300 328 Clause 4.3.2.3	Power Spectral Density	Compliance
3	EN 300 328 Clause 4.3.2.4	Duty cycle, Tx-Sequence, Tx-gap	Not applicable*
4	EN 300 328 Clause 4.3.2.5	Medium Utilisation (MU) factor	Not applicable*
5	EN 300 328 Clause 4.3.2.6	Adaptivity	Compliance
6	EN 300 328 Clause 4.3.2.7	Occupied Channel Bandwidth	Compliance
7	EN 300 328 Clause 4.3.2.8	Transmitter unwanted emissions in the out-of-band domain	Compliance
8	EN 300 328 Clause 4.3.2.9	Transmitter unwanted emissions in the spurious domain	Compliance
9	EN 300 328 Clause 4.3.2.10	Receiver spurious emissions	Compliance
10	EN 300 328 Clause 4.3.2.11	Receiver Blocking	Compliance
11	EN 300 328 Clause 4.3.2.12	Geo-location capability	Not applicable**

Note:
The supplier declared that the equipment is adaptive equipment.
Not applicable*: These requirements only apply for non-adaptive equipment.
Not applicable**: The equipment without geo-location capability.

1 – RF OUTPUT POWER

Applicable Standard

This requirement applies to all types of equipment using wide band modulations other than FHSS.

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

Limit

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 supplier 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 supplier.

This limit shall apply for any combination of power level and intended antenna assembly.

Test Procedure

The test procedure shall be as follows:

Step 1:

- Use a fast power sensor suitable for 2,4 GHz and capable of minimum 1 MS/s.
- Use the following settings:
  - Sample speed 1 MS/s or faster.
  - The samples shall represent the RMS power of the signal.
  - Measurement duration: For non-adaptive equipment: equal to the observation period defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) are captured.

  For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used.

Step 2:

- For conducted measurements on devices with one transmit chain:

  - Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. Use these stored samples in all following steps.

- For conducted measurements on devices with multiple transmit chains:

  - Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
  - Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
  - For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples in all following steps.

Step 3:

• Find the start and stop times of each burst in the stored measurement samples.
The start and stop times are defined as the points where the power is at least 30 dB below the highest value

of the stored samples in step 2.
In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.

Step 4:

• Between the start and stop times of each individual burst calculate the RMS power over the burst using the formula below. 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) shall be calculated using the formula below:

P = A + G + Y

• This value, which shall comply with the limit given in clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.

Test Data

Please refer to following table:

Mode	Channel	Result (dBm)			Limit (dBm)
		LT	NT	HT	
802.11b	Low	11.16	11.17	11.19	20
	Middle	11.32	11.34	11.36	
	High	11.41	11.47	11.49	
802.11g	Low	10.34	10.36	10.38	
	Middle	10.55	10.59	10.61	
	High	10.51	10.52	10.57	
802.11n ht20	Low	10.76	10.80	10.82	
	Middle	11.03	11.07	11.09	
	High	10.91	10.96	10.98	
802.11n ht40	Low	11.24	11.26	11.26	
	Middle	11.31	11.32	11.35	
	High	11.37	11.40	11.44	

Note: The antenna gain 2dBi was added into the result.

2 – POWER SPECTRAL DENSITY

Applicable Standard

According to ETSI EN 300 328 V2.1.1 (2016-11) §4.3.2.3.2, this requirement applies to all types of equipment using wide band modulations other than FHSS.

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

Limit

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

Test Procedure

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

The test procedure shall be as follows:

Step 1:

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

- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483.5 MHz
- Resolution BW: 10 kHz
- Video BW: 30 kHz
- Sweep Points: > 8 350; for spectrum analysers not supporting this number of sweep points, the frequency band may be segmented

NOTE: For spectrum analysers not supporting this number of sweep points, the frequency band may be segmented.

- Detector: RMS
- Trace Mode: Max Hold
- Sweep time: For non-continuous transmissions: 2 × Channel Occupancy Time × number of sweep points

  For continuous transmissions: 10 s; the sweep time may be increased further until a value where the sweep time has no impact on the RMS value of the signal.

For non-continuous signals, wait for the trace to stabilize. Save the data (trace data) set to a file.

Step 2:

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

Step 3:

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

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

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

Step 4:

Normalize the individual values for power (in dBm) so that the sum is equal to the RF Output Power (e.i.r.p.) measured in clause 5.3.2 and save the corrected data. The following formulas can be used:

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

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

with 'n' being the actual sample number

Step 5:

Starting from the first sample $P_{Samplecorr}(n)$ (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.

Step 6:

Shift the start point of the samples added up in step 5 by one sample and repeat the procedure in step 5 (i.e. sample #2 to sample #101).

Step 7:

Repeat step 6 until the end of the data set and record the Power Spectral Density values for each of the 1 MHz segments.

From all the recorded results, the highest value is the maximum Power Spectral Density for the UUT. This value, which shall comply with the limit given in clause 4.3.2.3.3, shall be recorded in the test report.

Test Data

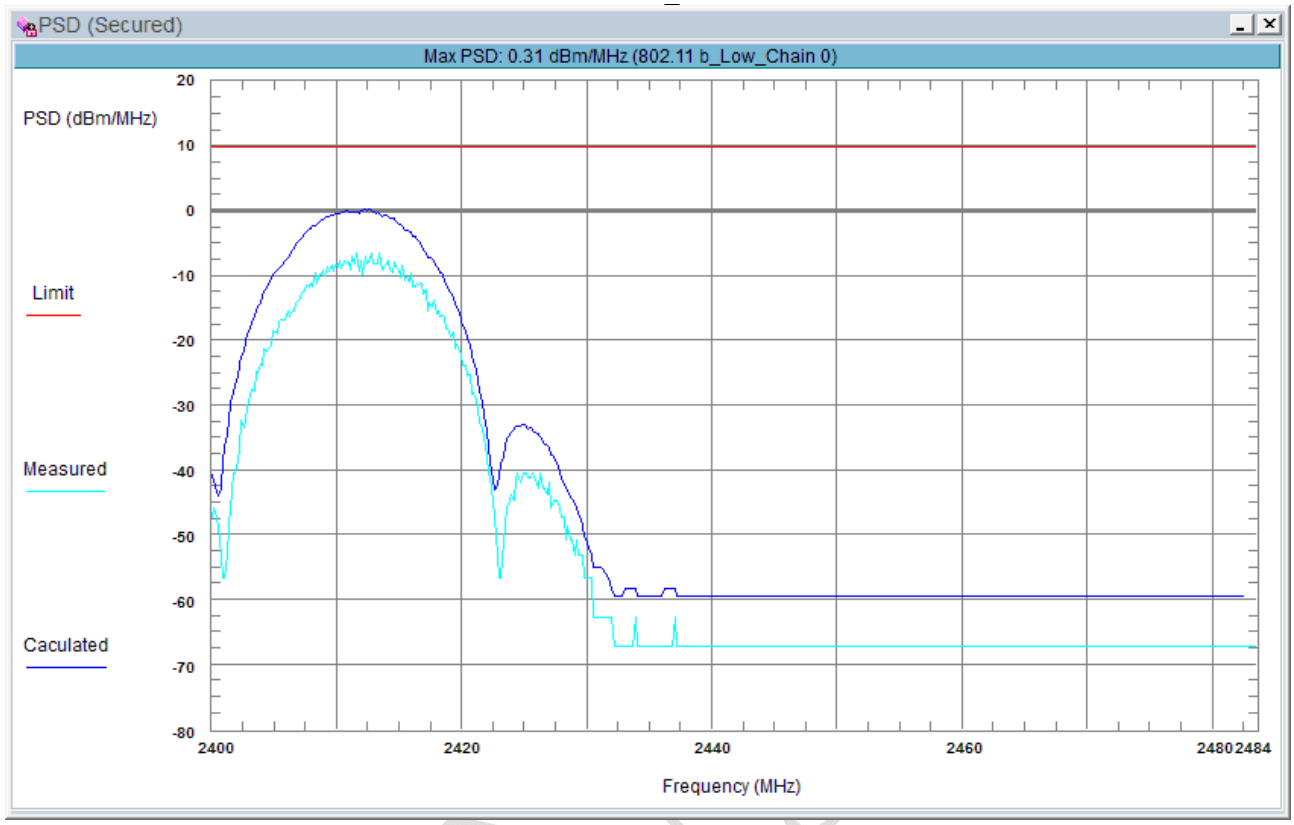
Please refer to following table:

Mode	Channel	Reading (dBm/MHz)	Result (dBm/MHz)	Limit (dBm/MHz)
802.11b	Low	0.31	2.31	10
	Middle	0.44	2.44	
	High	0.65	2.65	
802.11g	Low	-3.30	-1.30	10
	Middle	-3.01	-1.01	
	High	-3.11	-1.11	
802.11n ht20	Low	-3.16	-1.16	10
	Middle	-3.01	-1.01	
	High	-3.03	-1.03	
802.11n ht40	Low	-5.46	-3.46	10
	Middle	-5.59	-3.59	
	High	-5.45	-3.45	

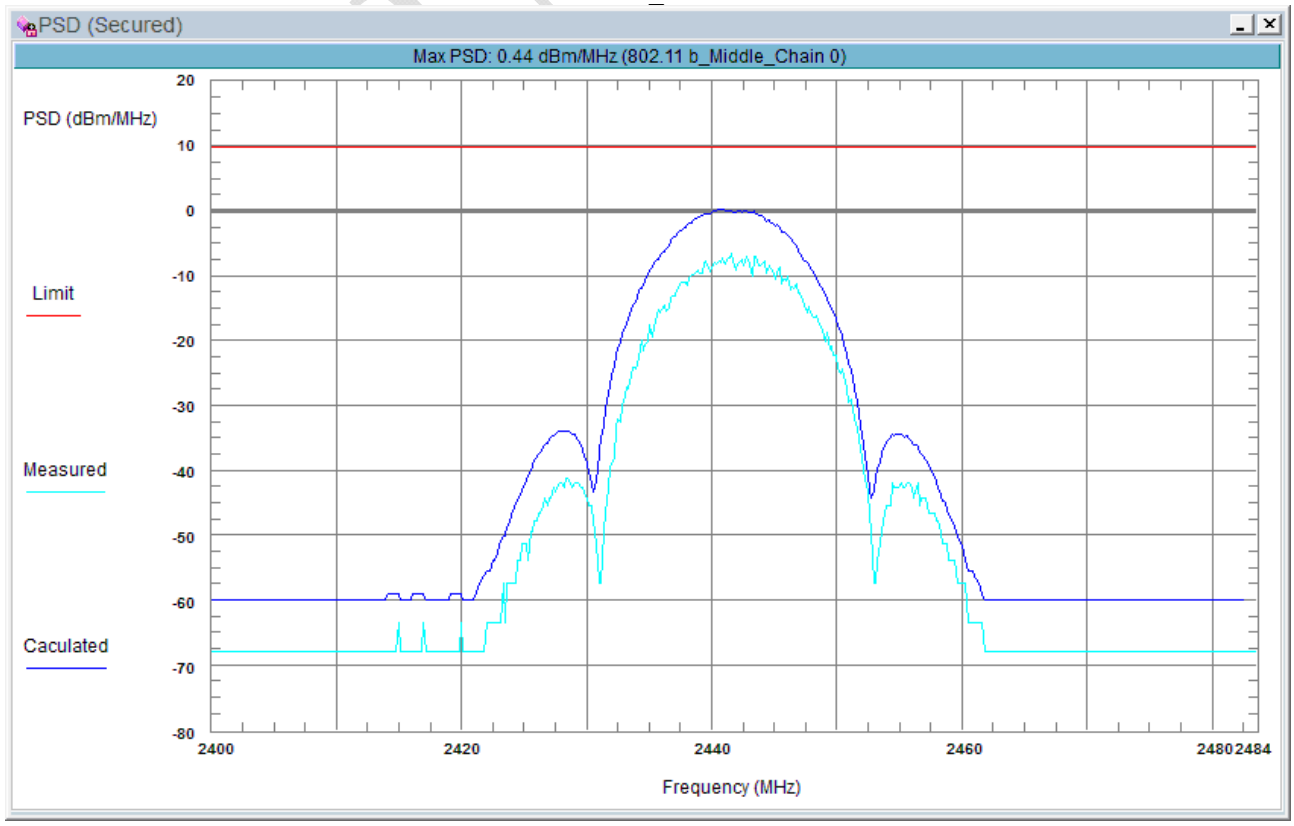
Note: The antenna gain 2dBi was added into the result.

Please refer to following plots:

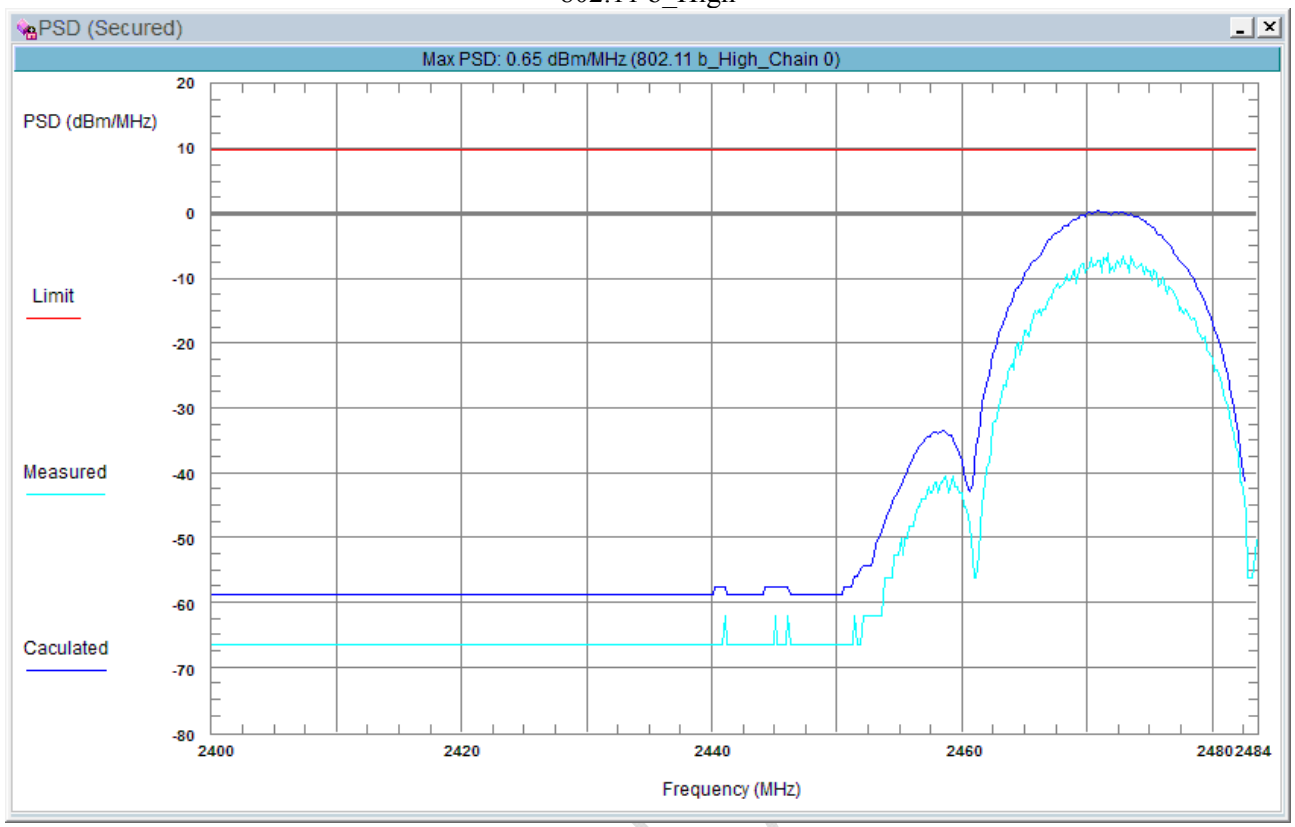
802.11 b_Low



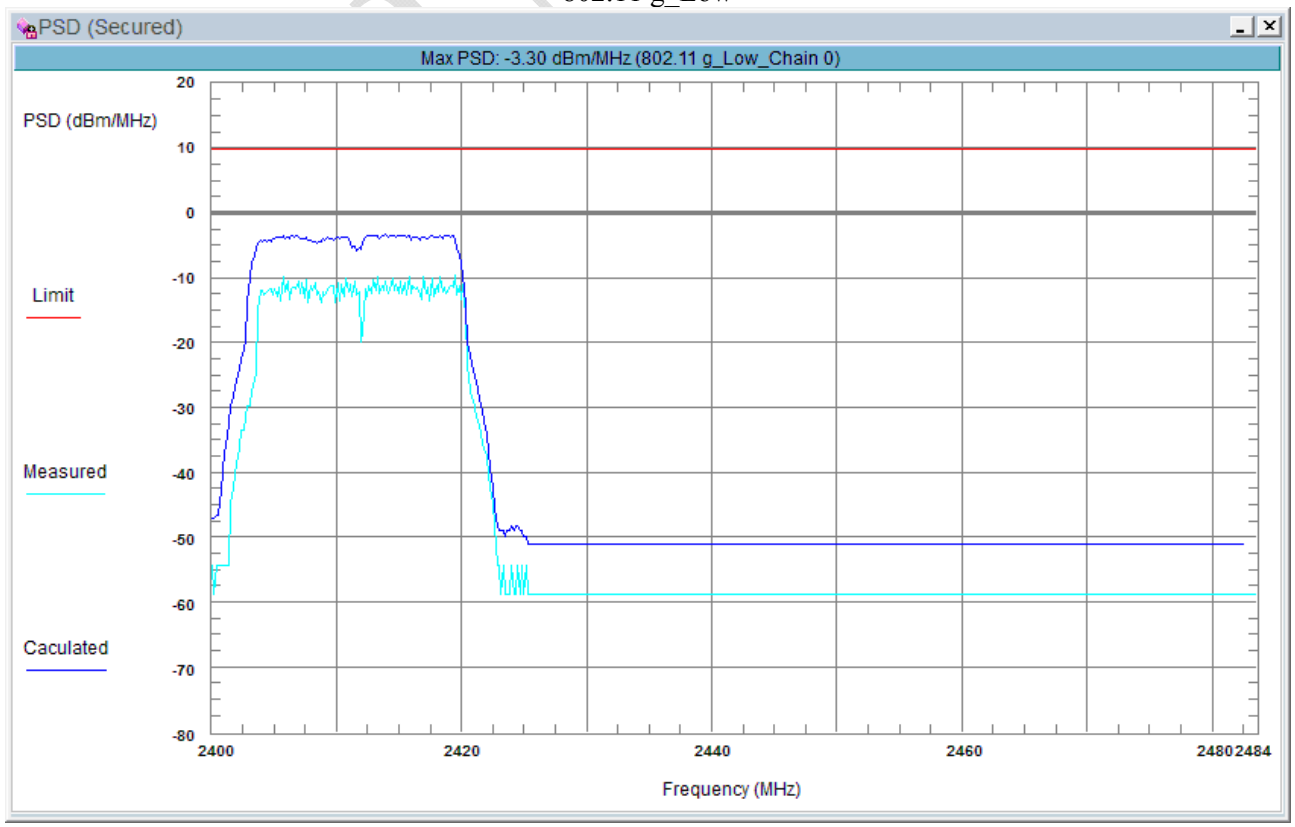
802.11 b_Middle



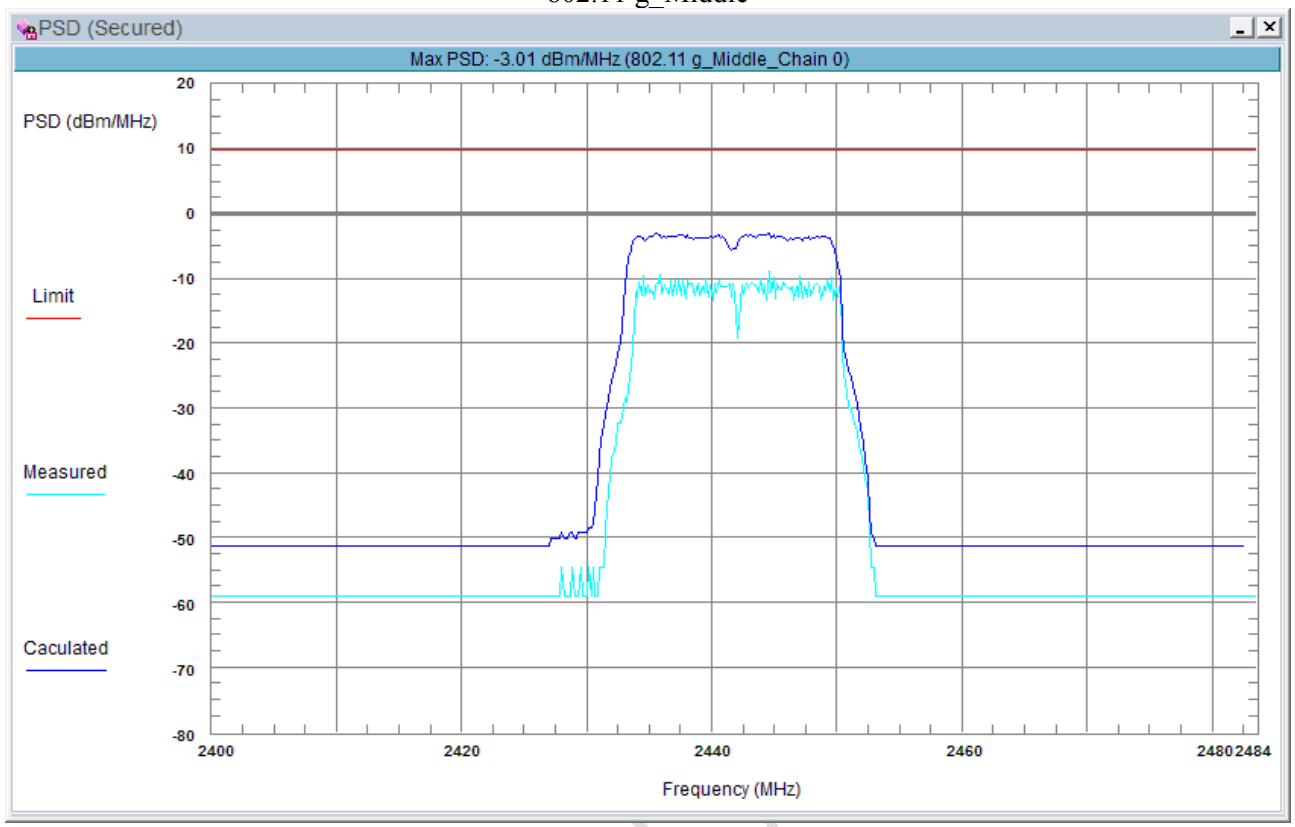
802.11 b_High



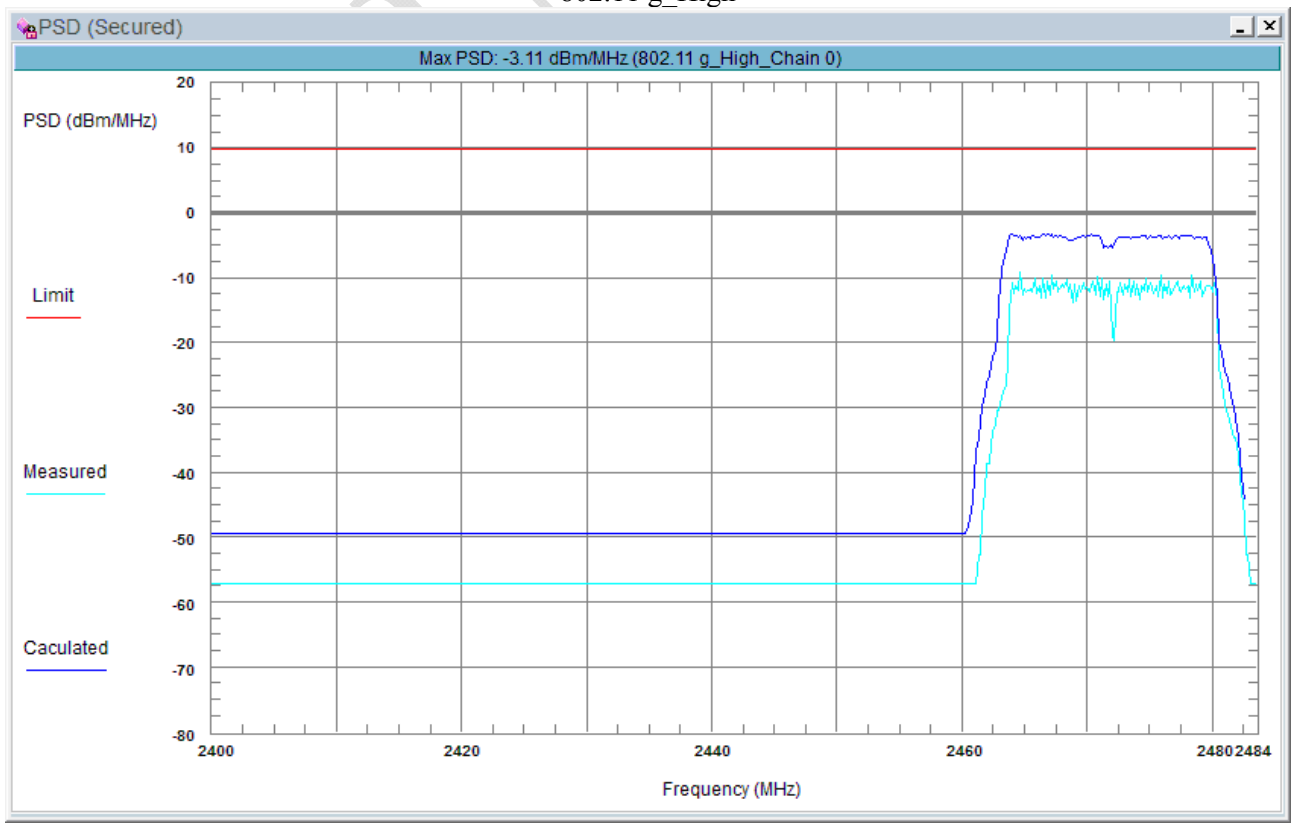
802.11 g_Low



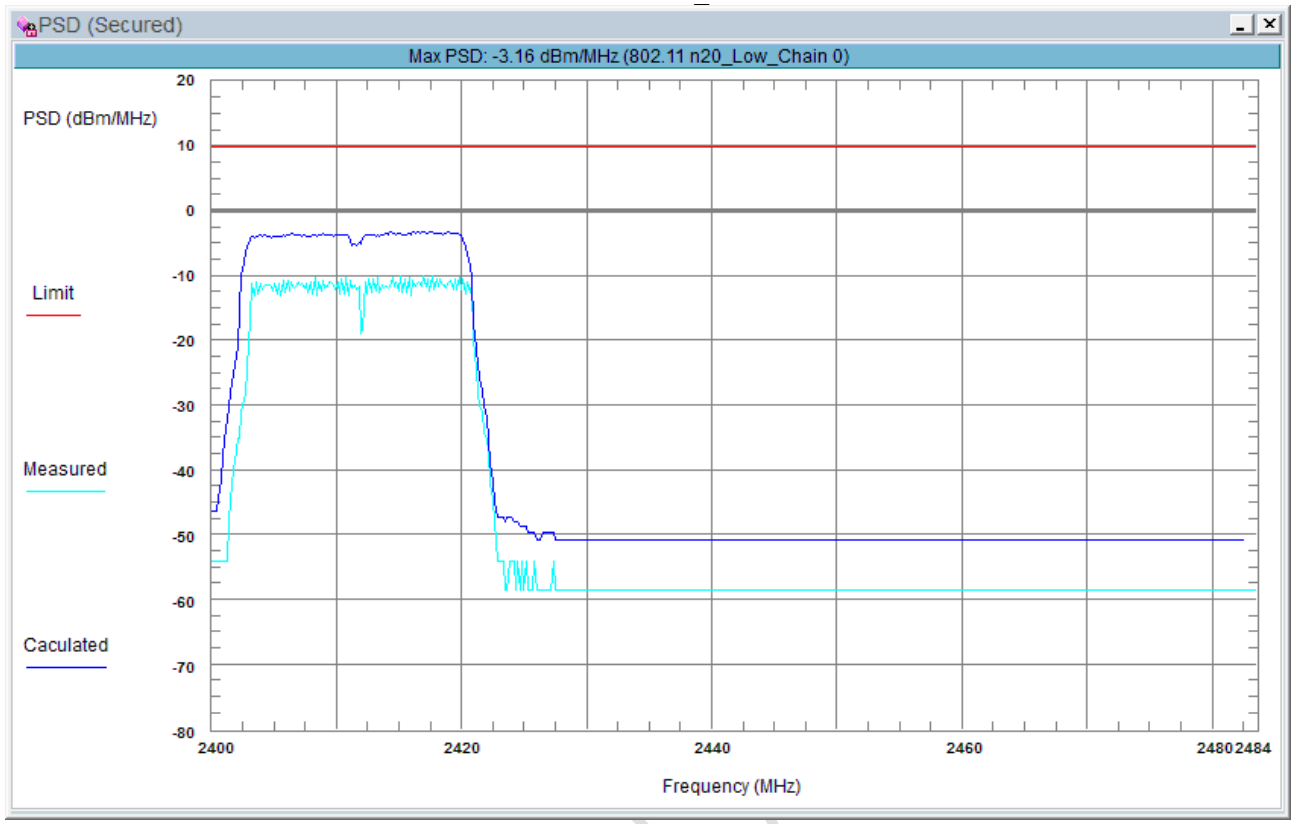
802.11 g_Middle



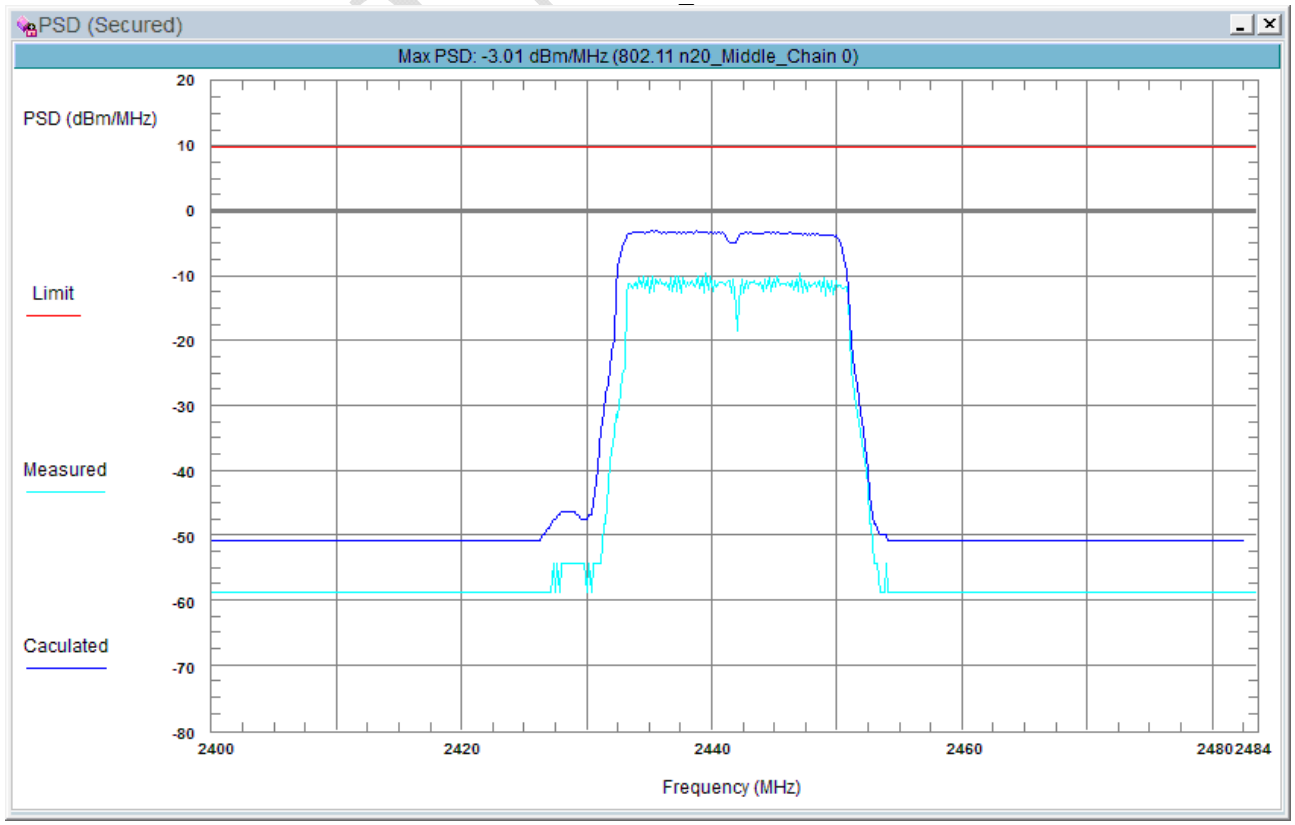
802.11 g_High



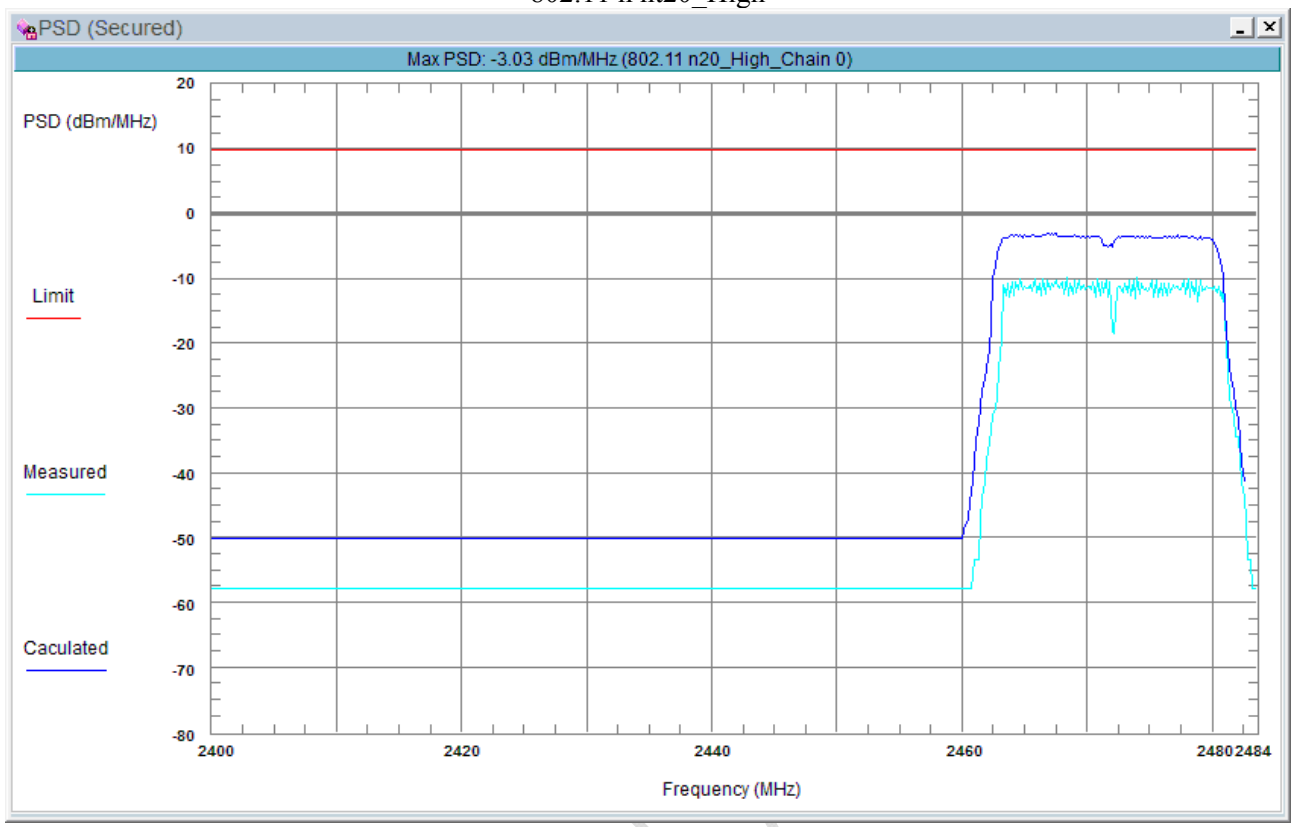
802.11 n ht20_Low



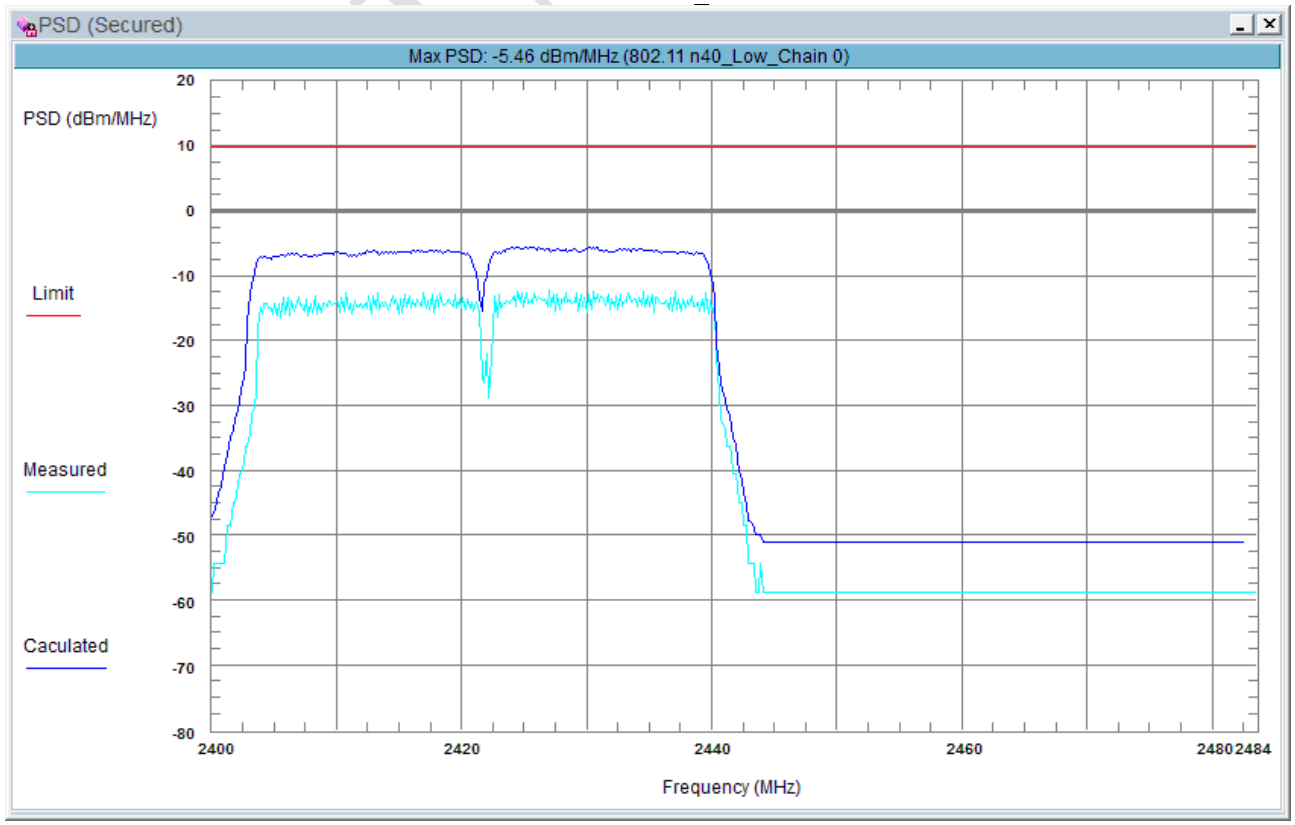
802.11 n ht20_Middle



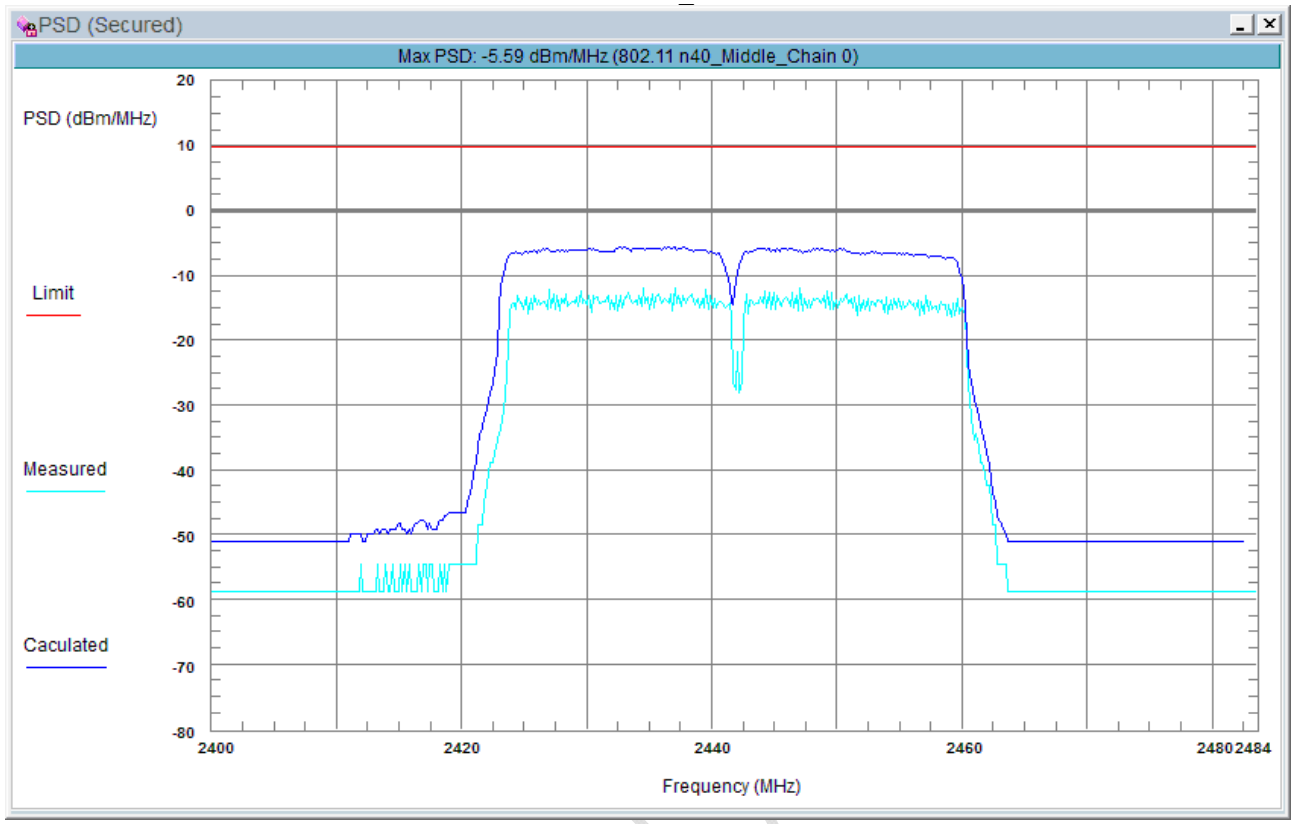
802.11 n ht20_High



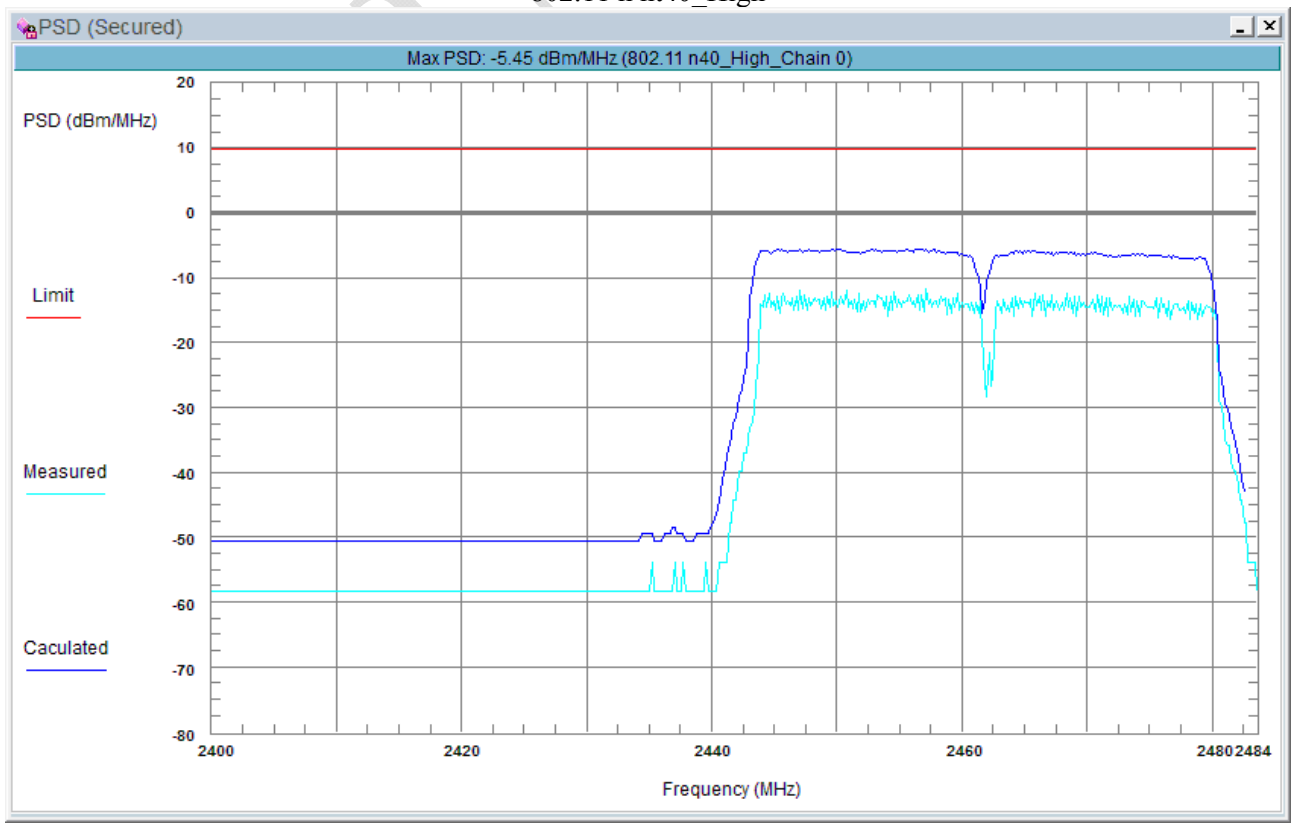
802.11 n ht40_Low



802.11 n ht40_Middle



802.11 n ht40_High



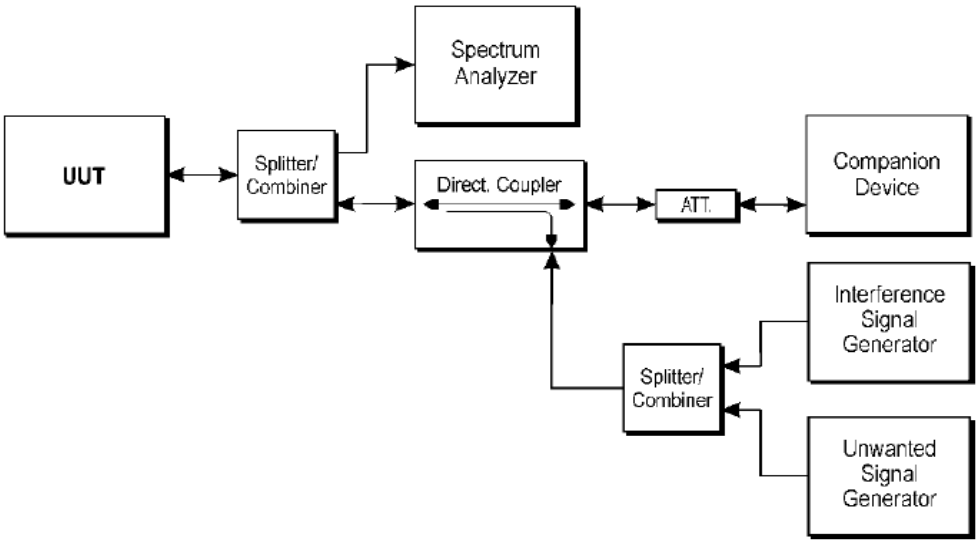
5 – ADAPTIVITY

Applicable Standard

LBT based Detect and Avoid:

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 other transmissions 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.

Test Setup Block Diagram



Test Procedure

The measurement procedure refer to ETSI EN 300 328 V2.1.1 (2016-11) §5.4.6.2

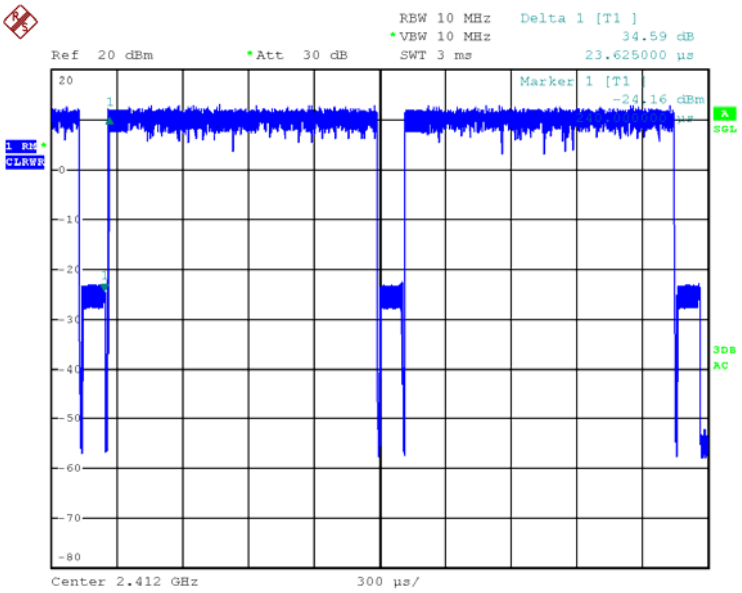
Test Data

Please refer to following table:

Mode	Channel	Frequency (MHz)	COT (ms)	Limit (ms)	CCA (μs)	Limit (μs)	Short Control Signalling Transmission Time (ms)	Limit (ms)
802.11b	Low	2412	1.22	<13	23.63	≥18	0	≤5
	High	2472	1.22		23.63		0	

Please refer to following plots:

2412 CCA



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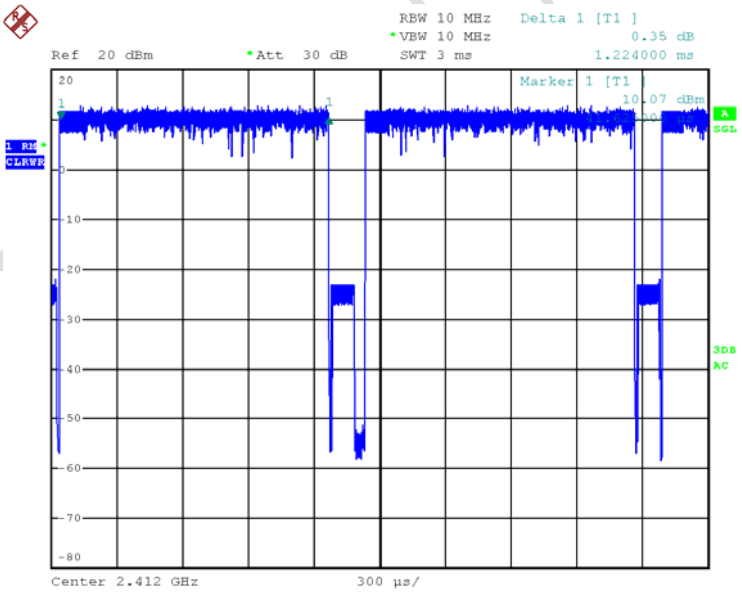
2412 COT



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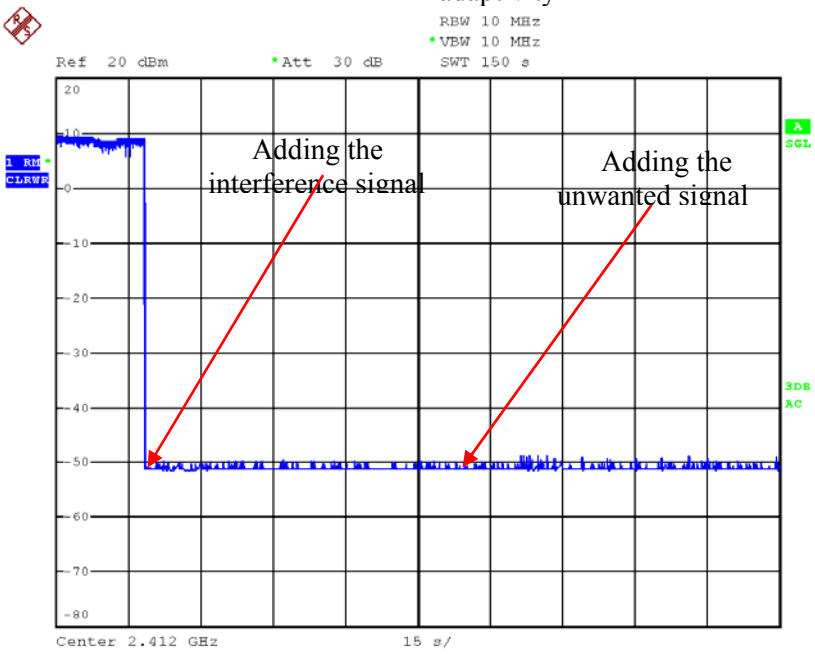
2412 adaptivity



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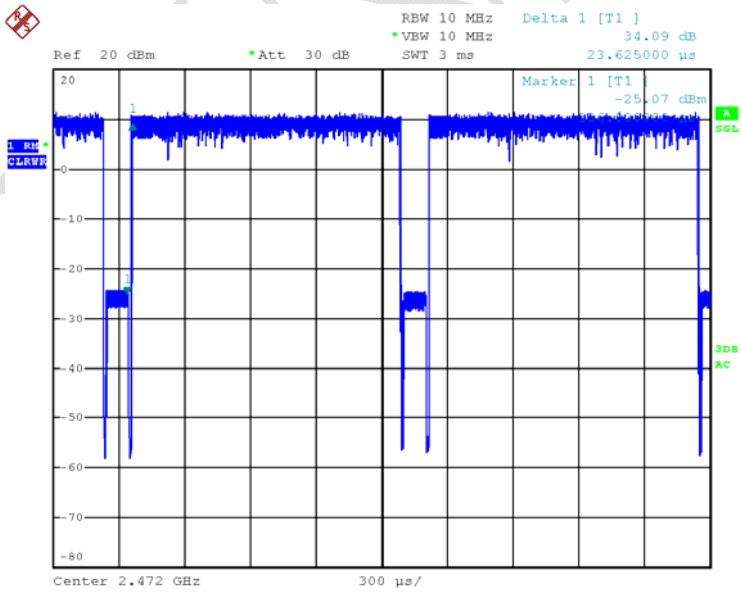
2472 CCA



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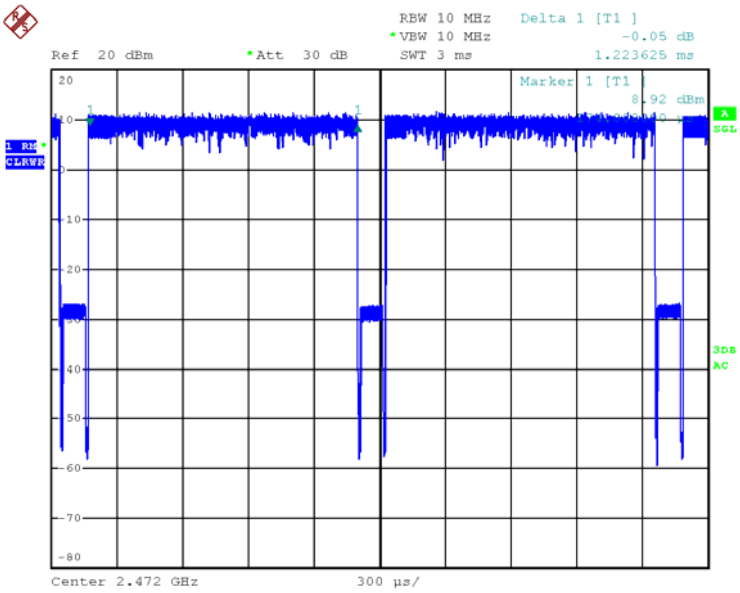
2472 COT



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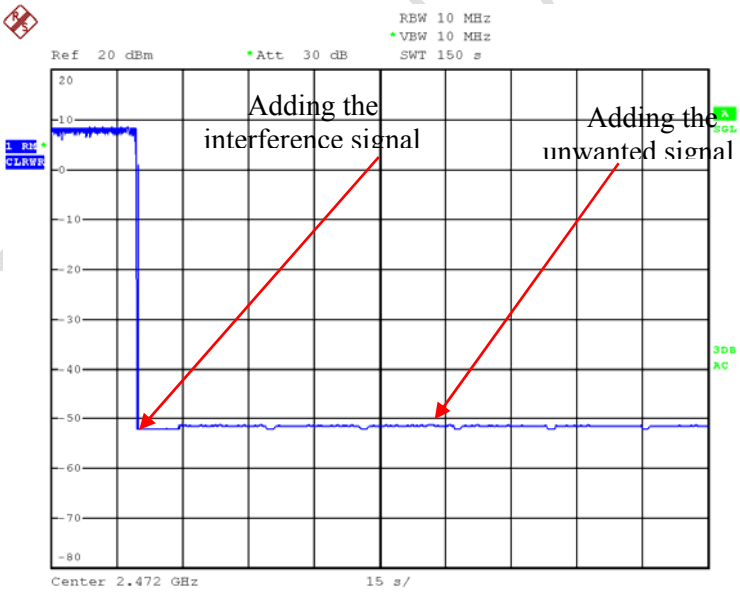
2472 adv



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6 – OCCUPIED CHANNEL BANDWIDTH

Applicable Standard

According to ETSI EN 300 328 V2.1.1 (2016-11)§4.3.2.7.2, the occupied channel bandwidth is the bandwidth that contains 99 % of the power of the signal.

Limit

The Occupied Channel Bandwidth shall fall completely within the band given in clause 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 Procedure

The measurement procedure shall be as follows:

Step 1:

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

- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: ~ 1 % of the span without going below 1 %
- Video BW: 3 × RBW
- Frequency Span for other types of equipment: 2 × Nominal Channel Bandwidth
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep time: 1 s

Step 2:

Wait for the trace to stabilize.
Find the peak value of the trace and place the analyser marker on this peak.

Step 3:

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

NOTE: Make sure that the power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals left and right from the power envelope being taken into account by this measurement.

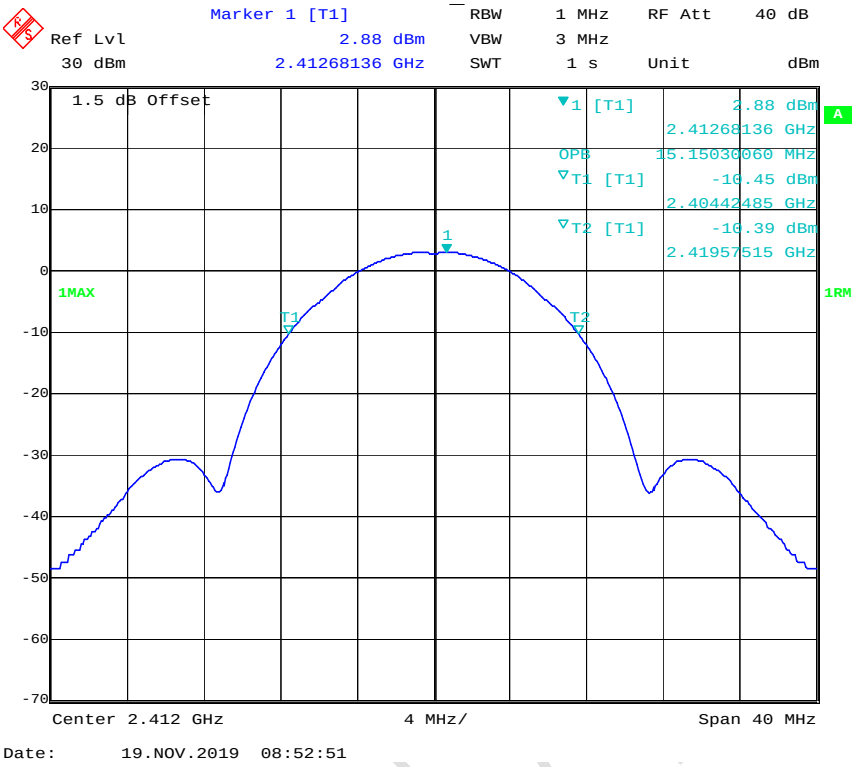
Test Data

Please refer to following table:

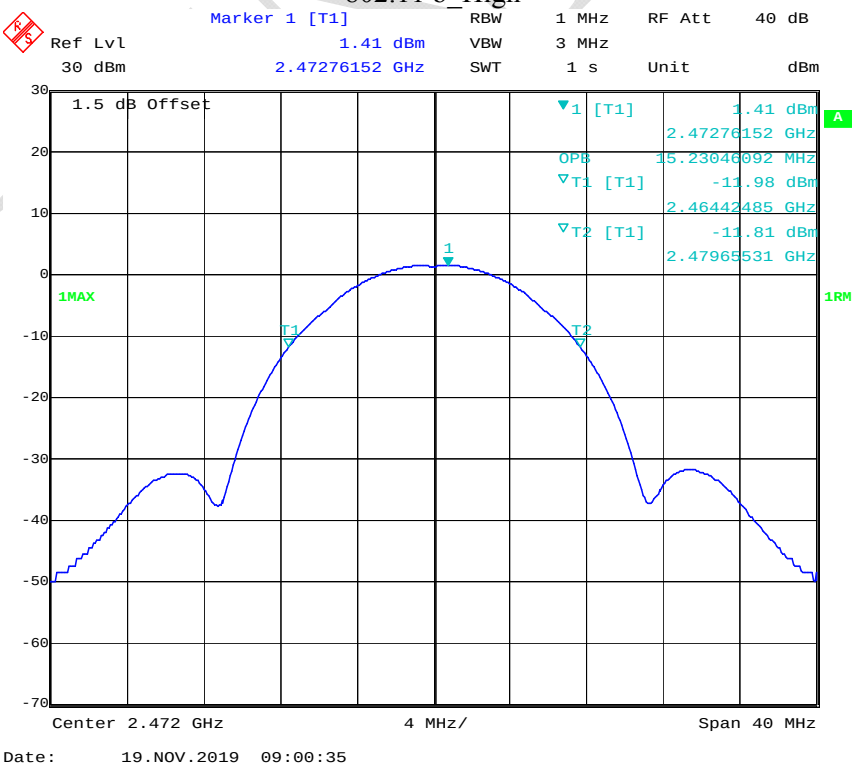
Mode	Channel	Frequency (MHz)	Result (MHz)
802.11b	Low	2412	15.150
	High	2472	15.230
802.11g	Low	2412	17.315
	High	2472	17.315
802.11n ht20	Low	2412	18.437
	High	2472	18.437
802.11n ht40	Low	2422	36.713
	High	2462	36.713

Please refer to following plots:

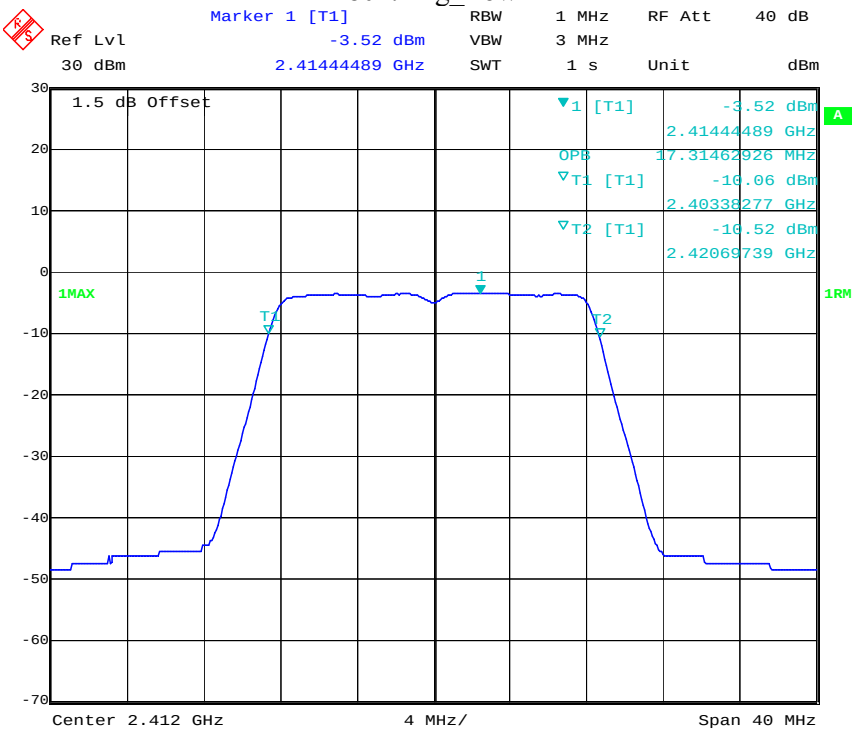
802.11 b_Low



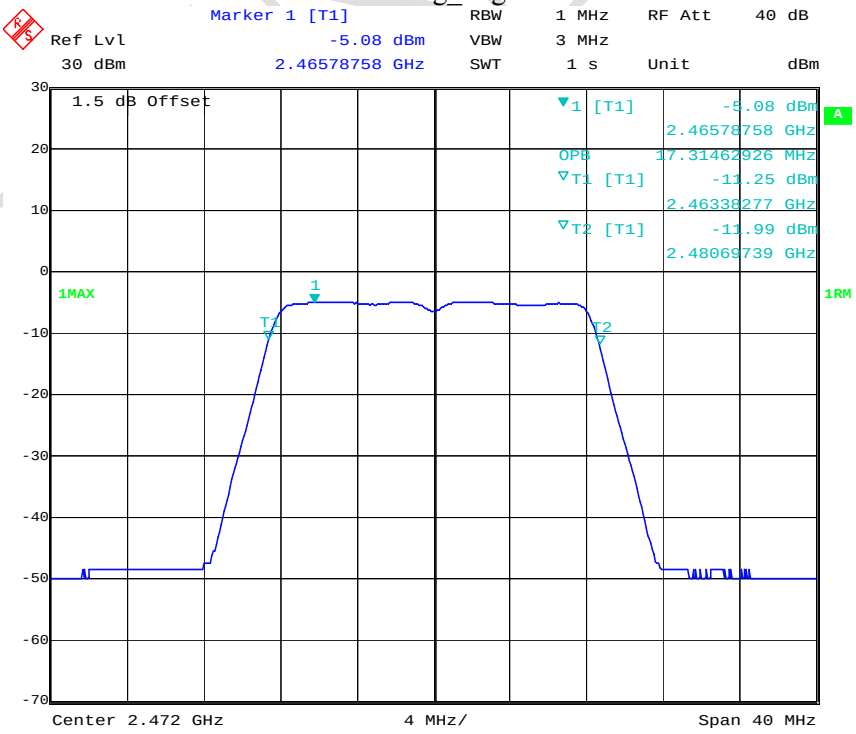
802.11 b_High



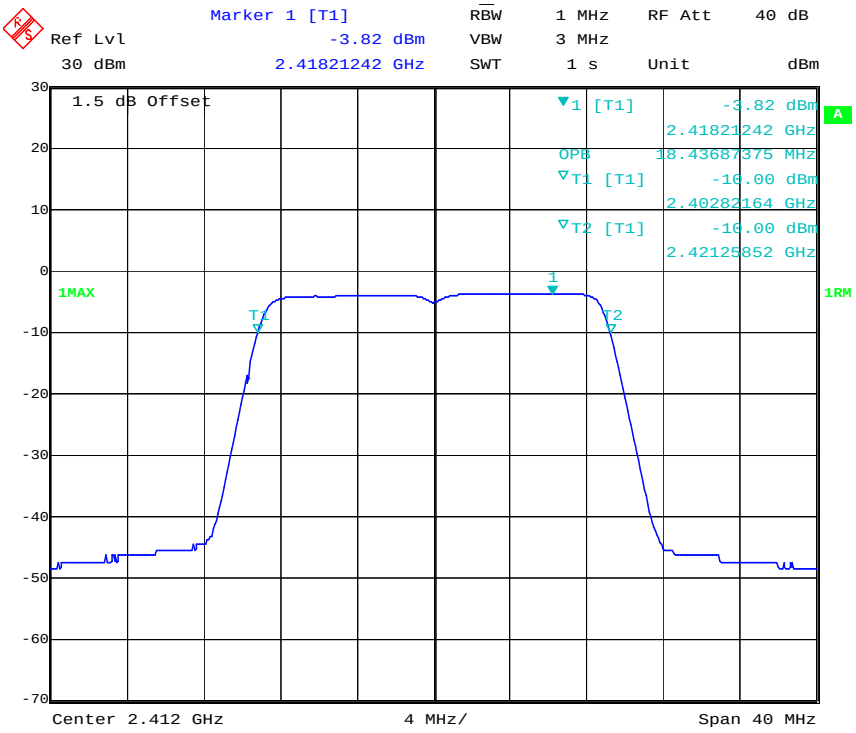
802.11 g_Low



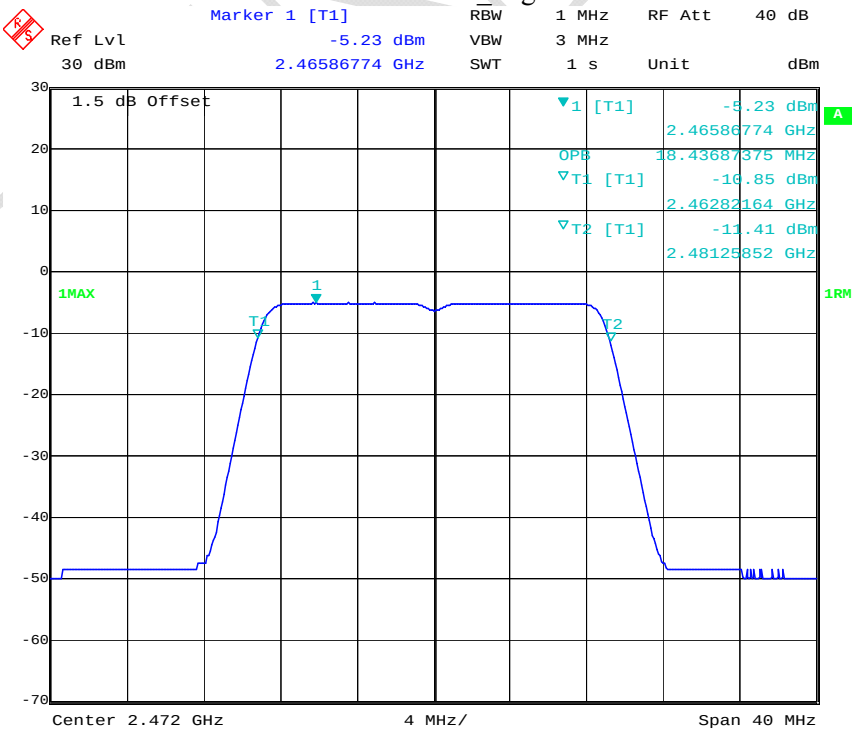
802.11 g_High



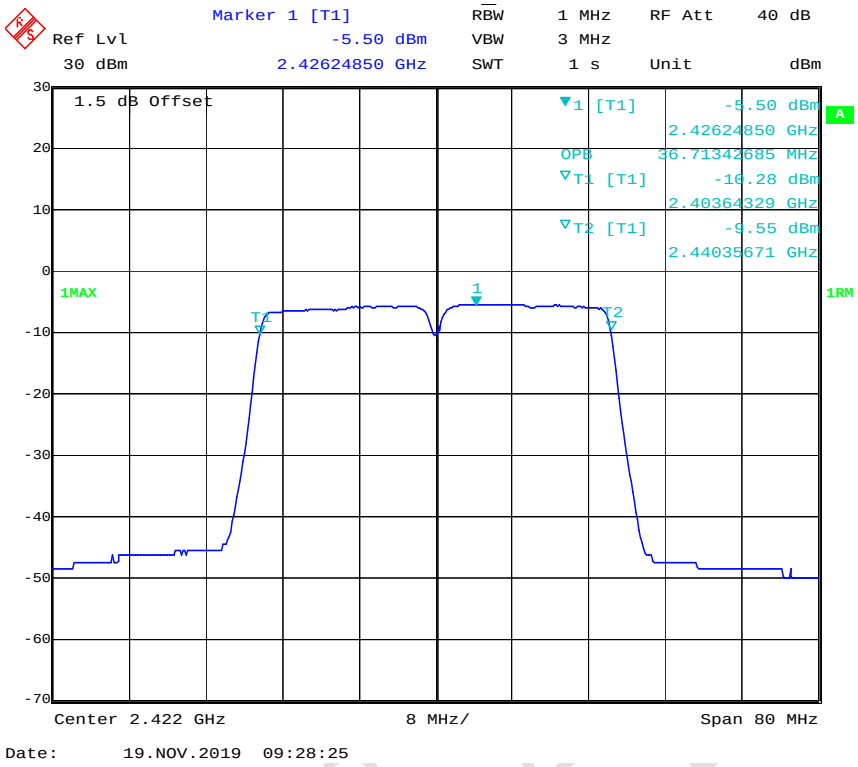
802.11 n ht20_Low



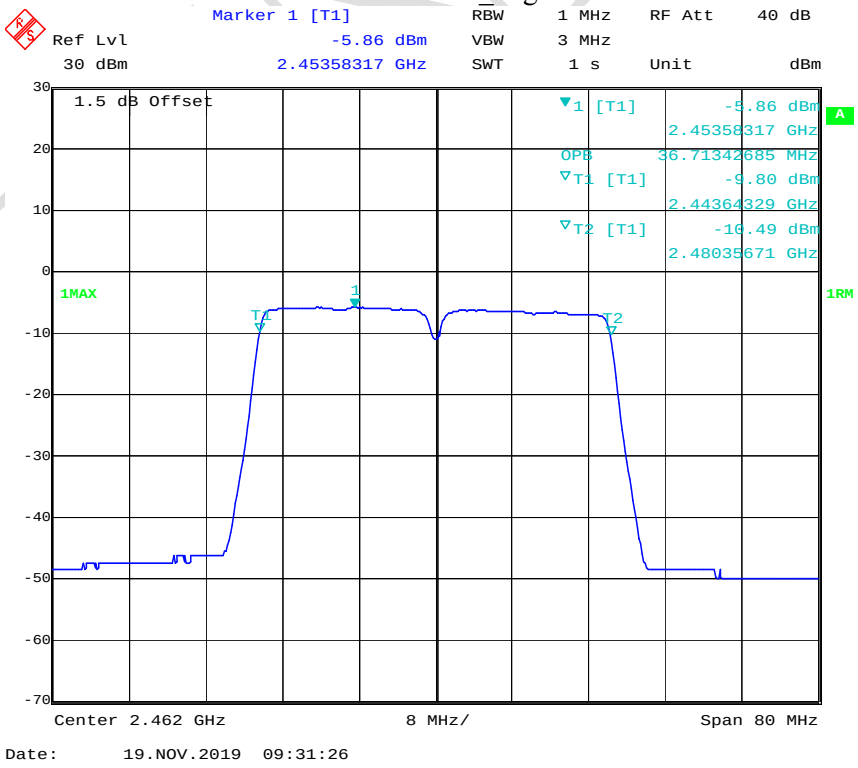
802.11 n ht20_High



802.11 n ht40_Low



802.11 n ht40_High



7 – TRANSMITTER UNWANTED EMISSIONS IN THE OUT-OF-BAND DOMAIN

Applicable Standard

According to ETSI EN 300 328 V2.1.1 (2016-11) §4.3.2.8.2, 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 emissions.

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 2 400 MHz to 2 483,5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.2.7.

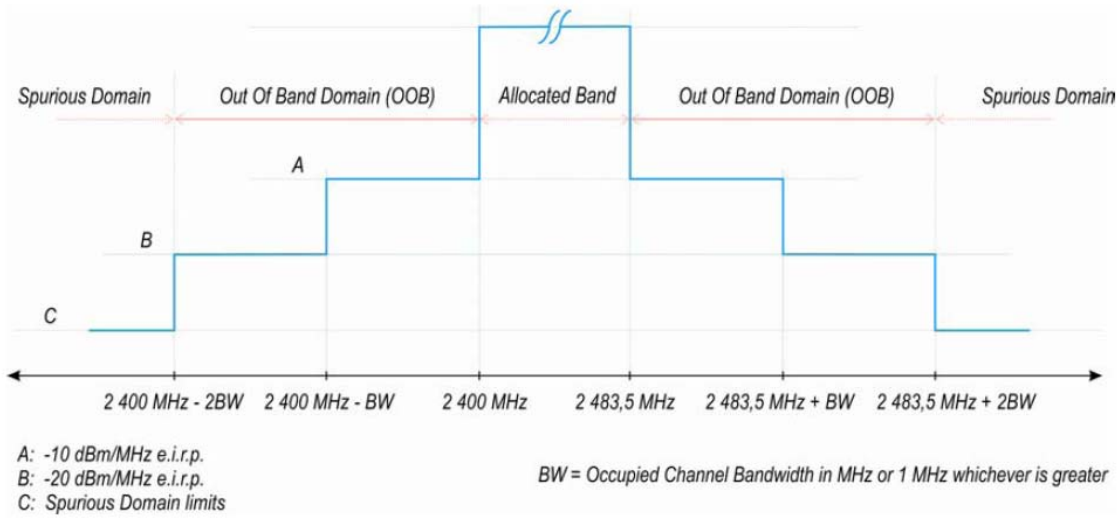


Figure 3: Transmit mask

Test Procedure

According to ETSI EN 300 328 V2.1.1 (2016-11) §5.4.8.2

Test Data

Please refer to following table:

Mode	Channel	Frequency Segment	Result (dBm/MHz)	Limit (dBm/MHz)
802.11b	Low	2400MHz-2BW~2400-BW	-47.92	-20
		2400MHz-BW~2400MHz	-47.22	-10
	High	2483.5MHz~2483.5MHz+BW	-29.57	-10
		2483.5MHz+BW~2483.5MHz+2BW	-47.17	-20
802.11g	Low	2400MHz-2BW~2400-BW	-47.53	-20
		2400MHz-BW~2400MHz	-41.98	-10
	High	2483.5MHz~2483.5MHz+BW	-45.32	-10
		2483.5MHz+BW~2483.5MHz+2BW	-47.15	-20
802.11n ht20	Low	2400MHz-2BW~2400-BW	-47.57	-20
		2400MHz-BW~2400MHz	-41.88	-10
	High	2483.5MHz~2483.5MHz+BW	-44.53	-10
		2483.5MHz+BW~2483.5MHz+2BW	-47.11	-20
802.11n ht40	Low	2400MHz-2BW~2400-BW	-48.44	-20
		2400MHz-BW~2400MHz	-41.84	-10
	High	2483.5MHz~2483.5MHz+BW	-44.67	-10
		2483.5MHz+BW~2483.5MHz+2BW	-47.33	-20

Note: The antenna gain 2dBi was added into the result.

8 – TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

Applicable Standard

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

Transmitter limits for spurious emissions

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 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

Test Procedure

According to ETSI EN 300 328 V2.1.1 (2016-11) §5.4.9.2

Test Data

Pre-scan all modes and worst case as below:

Please refer to following table:

802.11 b_low channel **2412 MHz**

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
4824.00	H	54.92	-52.75	14.20	1.55	-40.10	-30.00	10.10
4824.00	V	55.54	-51.98	14.20	1.55	-39.33	-30.00	9.33
7236.00	H	47.16	-54.07	13.01	1.59	-42.65	-30.00	12.65
7236.00	V	49.55	-51.83	13.01	1.59	-40.41	-30.00	10.41
566.00	H	36.58	-66.26	0.00	0.74	-67.00	-54.00	13.00
635.00	V	36.99	-67.88	0.00	0.82	-68.70	-54.00	14.70

802.11 b_high channel **2472 MHz**

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
4944.00	H	56.87	-50.74	13.94	1.45	-38.25	-30.00	8.25
4944.00	V	58.61	-48.33	13.94	1.45	-35.84	-30.00	5.84
7416.00	H	47.62	-52.98	13.28	1.41	-41.11	-30.00	11.11
7416.00	V	49.35	-51.63	13.28	1.41	-39.76	-30.00	9.76
621.00	H	37.10	-64.88	0.00	0.80	-65.68	-54.00	11.68
711.00	V	36.22	-67.52	0.00	0.94	-68.46	-54.00	14.46

Note 1:The unit of antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.
Note 2:
Absolute Level = Substituted Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

9 – RECEIVER SPURIOUS EMISSIONS

Applicable Standard

According to ETSI EN 300 328 V2.1.1 (2016-11) §4.3.2.10, the 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 the following table. In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or for emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

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

Test Procedure

According to ETSI EN 300 328 V2.1.1 (2016-11) §5.4.10.2

Test Data

Pre-scan all modes and worst case as below:

Please refer to following table:

802.11 b low channel 2412 MHz

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
1570.00	H	48.54	-66.38	9.92	0.88	-57.34	-47.00	10.34
1570.00	V	49.39	-65.98	9.92	0.88	-56.94	-47.00	9.94
485.30	H	36.98	-67.34	0.00	0.70	-68.04	-57.00	11.04
665.20	V	36.66	-67.76	0.00	0.88	-68.64	-57.00	11.64

802.11 b high channel 2472 MHz

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
1810.00	H	47.68	-66.55	11.17	0.71	-56.09	-47.00	9.09
1810.00	V	49.34	-65.46	11.17	0.71	-55.00	-47.00	8.00
477.50	H	37.45	-66.91	0.00	0.69	-67.60	-57.00	10.60
489.50	V	38.11	-69.25	0.00	0.70	-69.95	-57.00	12.95

Note 1:The unit of antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.
Note 2:
Absolute Level = Substituted Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

10 – RECEIVER BLOCKING

Applicable Standard

This requirement applies to all receiver categories as defined in clause 4.2.3.

Limit

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

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, 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 14, table 15 or table 16.

Table 14: 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 the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 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.			

Table 15: 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 4.3.2.11.3 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.			

Table 16: 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 4.3.2.11.3 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 Setup Block Diagram

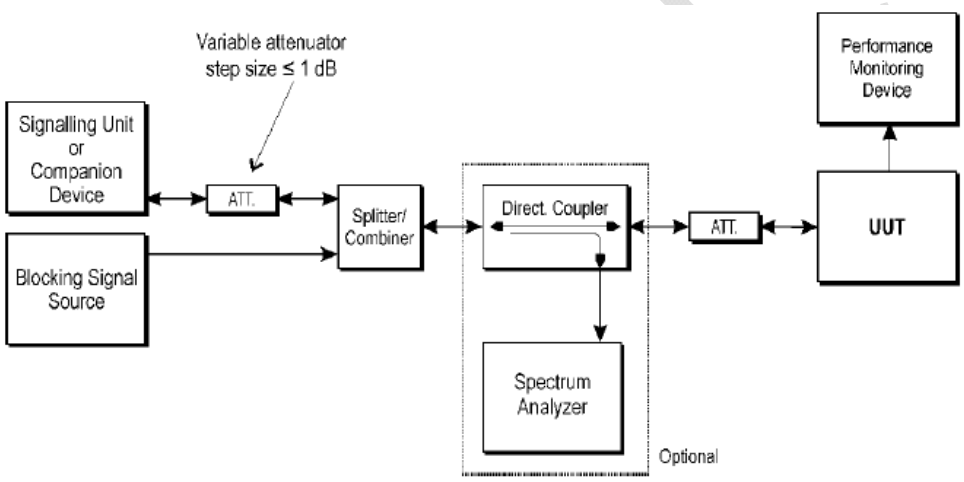


Figure 6: Test Set-up for receiver blocking

Test Procedure

The measurement procedure refer to ETSI EN 300 328 V2.1.1 (2016-11) §5.4.11

Test Data

Please refer to following table:

Category 1

Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Blocking Signal Frequency (MHz)	PER (%)	Limit (%)
802.11 b	Low	2412	1	2380	1.12	≤10
				2503.5	1.13	
				2300	1.12	
				2330	1.12	
				2360	1.13	
				2523.5	1.13	
				2553.5	1.14	
				2583.5	1.12	
				2613.5	1.14	
				2643.5	1.12	
				2673.5	1.13	
	High	2472	1	2380	1.13	≤10
				2503.5	1.12	
				2300	1.14	
				2330	1.14	
				2360	1.13	
				2523.5	1.12	
				2553.5	1.13	
				2583.5	1.14	
				2613.5	1.13	
				2643.5	1.14	
				2673.5	1.12	

Note: EIRP is higher than 10 dBm, and it is adaptive device, so it is belong to category 1.

EXHIBIT A - E.2 INFORMATION AS REQUIRED BY EN 300 328 V2.1.1, CLAUSE 5.4.1

In accordance with EN 300 328, clause 5.4.1, the following information is provided by the supplier.

a) The type of modulation used by the equipment:

☐ FHSS
☒ other forms of modulation

b) In case of FHSS modulation:

In case of non-Adaptive Frequency Hopping equipment:
The number of Hopping Frequencies:_____.

In case of Adaptive Frequency Hopping Equipment:
The maximum number of Hopping Frequencies:_____;
The minimum number of Hopping Frequencies: _____;

The (average) Dwell Time:_____;

c) Adaptive / non-adaptive equipment:

☐ non-adaptive Equipment
☒ adaptive Equipment without the possibility to switch to a non-adaptive mode
☐ adaptive Equipment which can also operate in a non-adaptive mode

d) In case of adaptive equipment:

The Channel Occupancy Time implemented by the equipment: 1.22 ms

☐ The equipment has implemented an LBT based DAA mechanism

In case of equipment using modulation different from FHSS:

☐ The equipment is Frame Based equipment
☒ The equipment is Load Based equipment
☐ The equipment can switch dynamically between Frame Based and Load Based equipment

The CCA time implemented by the equipment: 23.63 µs

☐ The equipment has implemented an non-LBT based DAA mechanism
☐ The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): _____dBm
The maximum (corresponding) Duty Cycle: _____ %

Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared):_____

f) The worst case operational mode for each of the following tests:

RF Output Power: 11.49 dBm;
Power Spectral Density 2.65 dBm/MHz;
Duty cycle, Tx-Sequence, Tx-gap N/A;
Accumulated Transmit Time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment) N/A;
Hopping Frequency Separation (only for FHSS equipment) N/A;
Medium Utilisation N/A;
Adaptivity Pass;
Receiver Blocking Pass;
Nominal Occupied Channel Bandwidth 20 MHz&40 MHz;
Transmitter unwanted emissions in the OOB domain -29.57dBm/MHz;
Transmitter unwanted emissions in the spurious domain -35.84dBm;
Receiver spurious emissions -55.00 dBm;

g) The different transmit operating modes (tick all that apply):

☒ Operating mode 1: Single Antenna Equipment
☒ Equipment with only 1 antenna
☐ Equipment with 2 diversity antennas but only 1 antenna active at any moment in time
☐ Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)

☐ Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming
☐ Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)
☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
Note: Add more lines if more channel bandwidths are supported.

☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming
☐ Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)
☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
Note: Add more lines if more channel bandwidths are supported.

h) In case of Smart Antenna Systems:

The number of Receive chains: ;
The number of Transmit chains: ;

☐ symmetrical power distribution
☐ asymmetrical power distribution

In case of beam forming, the maximum beam forming gain: ;

Note: Beam forming gain does not include the basic gain of a single antenna.

i) Operating Frequency Range(s) of the equipment:

Operating Frequency Range 1: 2412 MHz to 2472 MHz
Operating Frequency Range 2: 2422 MHz to 2462 MHz

Note: Add more lines if more Frequency Ranges are supported.

j) Nominal Channel Bandwidth(s):

Nominal Channel Bandwidth 1:_____20_____MHz
Nominal Channel Bandwidth 2:_____40_____MHz

Note: Add more lines if more channel bandwidths are supported.

k) Type of Equipment (stand-alone, combined, plug-in radio device, etc.):

☒ Stand-alone
☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)
☐ Plug-in radio device (Equipment intended for a variety of host systems)
☐ Other _____;

l) The normal and the extreme operating conditions that apply to the equipment:

Normal operating conditions (if applicable):

Operating temperature range:____+25_____ ° C
Other (please specify if applicable):_____

Extreme operating conditions:

Operating temperature range: Minimum:____0_____ ° C Maximum ____45_____° C
Other (please specify if applicable): _____ Minimum: _____ Maximum _____

Details provided are for the: ☒ stand-alone equipment
☐ combined (or host) equipment
☐ test jig

m) The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:

Antenna Type:

☒ Integral Antenna (information to be provided in case of conducted measurements)

Antenna Gain:_____2.0_____ dBi

If applicable, additional beamforming gain (excluding basic antenna gain):_____ dB

☐ Temporary RF connector provided
☐ No temporary RF connector provided

☐ Dedicated Antennas (equipment with antenna connector)
☐ Single power level with corresponding antenna(s)
☐ Multiple power settings and corresponding antenna(s)

Number of different Power Levels:_____;
Power Level 1:_____ dBm
Power Level 2:_____dBm
Power Level 3:_____.dBm

Note 1: Add more lines in case the equipment has more power levels.
Note 2: These power levels are conducted power levels (at antenna connector).

For each of the Power Levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable

Power Level 1:_____dBm

Number of antenna assemblies provided for this power level:

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

Note 3: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 2:_____dBm

Number of antenna assemblies provided for this power level:

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

Note 4: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 2:_____dBm

Number of antenna assemblies provided for this power level:

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

Note 5: Add more rows in case more antenna assemblies are supported for this power level.

n) The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:

Details provided are for the: ☒stand-alone equipment
☐ combined (or host) equipment
☐ test jig

Supply Voltage ☐ AC mains State AC voltage _____V
☒ DC State DC voltage _____5_____ V

In case of DC, indicate the type of power source
☐ Internal Power Supply
☒ External Power Supply or AC/DC adapter
☐ Battery
☐ Other:_____.

o) Describe the test modes available which can facilitate testing:

The measurements shall be performed during continuously transmitting .

p) The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):

IEEE 802.11™ [i.3] .

q) If applicable, the statistical analysis referred to in clause 5.3.1 q)

(to be provided as separate attachment)

r) If applicable, the statistical analysis referred to in clause 5.3.1 r)

(to be provided as separate attachment)

s) Geo-location capability supported by the equipment:

☐ Yes

☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user.

☒ No

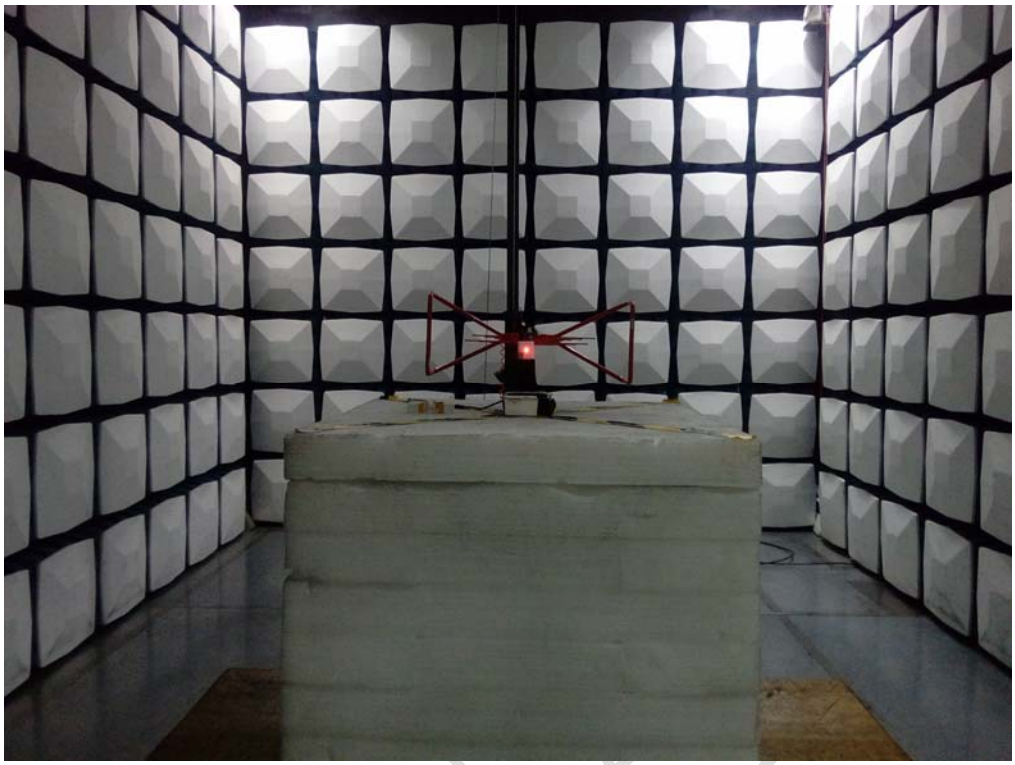
t) Describe the minimum performance criteria that apply to the equipment (see clause 4.3.1.12.3 or clause 4.3.2.11.3): less than 10% .

EXHIBIT B – EUT PHOTOGRAPHS

Please refer to report No.: RDG191021006-02 which was issued by BACL (Dongguan).

EXHIBIT C – TEST SETUP PHOTOGRAPHS

RE Below 1G View



RE Above 1G View

*******END OF REPORT*******