

FCC- TEST REPORT

Report Number	: 68.910.19.0025.01	Date of Issue: <u>August 30, 2019</u>
Model	: A7, X780, X785	
Product Type	: Robotic Vacuum Cleaner	
Applicant	: Shenzhen ZhiYi Technology Co., Ltd.	
Address	: 3rd Floor, Bld B, Hytera Technology Park, No.3, 4th of	
	Baolong Road, Long-gang, 518100 Shenzhen,	
	PEOPLE'S REPUBLIC OF CHINA	
Production Facility	: Shenzhen ZhiYi Technology Co., Ltd.	
	:	
Address	3rd Floor, Bld B, Hytera Technology Park, No.3, 4th of	
	Baolong Road, Long-gang, 518100 Shenzhen,	
	PEOPLE'S REPUBLIC OF CHINA	
Test Result	: n Positive o Negative	
Total pages including Appendices	: 61	

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1 Table of Contents

1	Table of Contents.....	2
2	Details about the Test Laboratory	3
3	Description of the Equipment under Test.....	4
4	Summary of Test Standards	5
5	Summary of Test Results	6
6	General Remarks.....	7
7	Test Setups	8
8	Systems test configuration	9
9	Technical Requirement	10
9.1	Conducted Emission	10
9.2	Conducted peak output power.....	15
9.3	6dB and 99% bandwidth.....	17
9.4	Power spectral density	24
9.5	Spurious RF conducted emissions.....	32
9.6	Band edge	45
9.7	Spurious radiated emissions for transmitter	50
10	Test Equipment List.....	58
11	System Measurement Uncertainty	60
12	General product information	61



2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12&13, Zhiheng Wisdomland Business Park,
Nantou Checkpoint Road 2, Nanshan District,
Shenzhen City, 518052,
P. R. China

FCC Registration Number: 514049

Telephone: 86 755 8828 6998
Fax: 86 755 8828 5299

3 Description of the Equipment under Test

Description of the Equipment Under Test

Product:	Robotic Vacuum Cleaner
Model no.:	X780, A7, X785
FCC ID:	2AO2M-A582
Options and accessories:	NIL
Ratings:	100-240VAC, 50/60Hz, Max. 0.5A (for adapter) 19Vdc , 600mA (for robotic vacuum cleaner DC input); 14.4VDC-14.8VDC for internal battery
RF Transmission Frequency:	2412-2462MHz
No. of Operated Channel:	11
Modulation:	CCK, DQPSK, DBPSK for 802.11b QPSK, BPSK for 802.11g/n
Duty Cycle:	100%
Antenna Type:	Integral Antenna
Antenna Gain:	1.5dBi
Description of the EUT:	Tested with external approved adaptor Model: GSCU0600S019V12E (by Hu Nan Giantsun Power Electronics Co., Ltd): Input:100-240V~; 50/60Hz; 0.5A Max; Output: DC19V; 600mA

4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2018 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB558074 D01 v05r02 DTS Measurement Guidance and ANSI C63.10 (2013).

5 Summary of Test Results

Technical Requirements				
FCC Part 15 Subpart C				
Test Condition		Pages	Test Result	Test Site
§15.207	Conducted emission AC power port	10	Pass	Site 1
§15.247(b)(1)	Conducted peak output power	15	Pass	Site 1
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	17	Pass	Site 1
§15.247(e)	Power spectral density*	24	Pass	Site 1
§15.247(a)(1)	Carrier frequency separation	--	N/A	--
§15.247(a)(1)(iii)	Number of hopping frequencies	--	N/A	--
§15.247(a)(1)(iii)	Dwell Time	--	N/A	--
§15.247(d)	Spurious RF conducted emissions	32	Pass	Site 1
§15.247(d)	Band edge	45	Pass	Site 1
§15.247(d) & §15.209 & §15.203	Spurious radiated emissions for transmitter	50	Pass	Site 1
	Antenna requirement	See note 1	Pass	--

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses a permanently integral antenna, which gain is 1.5dBi. According to §15.203, it is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AO2M-A582, complies with Section 15.207, 15.209, 15.205, 15.247 of the FCC Part 15, Subpart C rules.

The EUT has multiple work modes, the worst test results are listed in the report.

SUMMARY:

All tests according to the regulations cited on page 5 were

n - Performed

o - **Not** Performed

The Equipment under Test

n - **Fulfills** the general approval requirements.

o - **Does not** fulfill the general approval requirements.

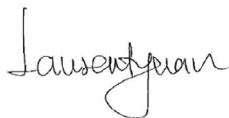
Sample Received Date: April 04, 2019

Testing Start Date: April 04, 2019

Testing End Date: June 26, 2019

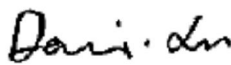
- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

Reviewed by:



Laurent Yuan
EMC Project Manager

Prepared by:



Dawi Xu
EMC Project Engineer

Tested by:

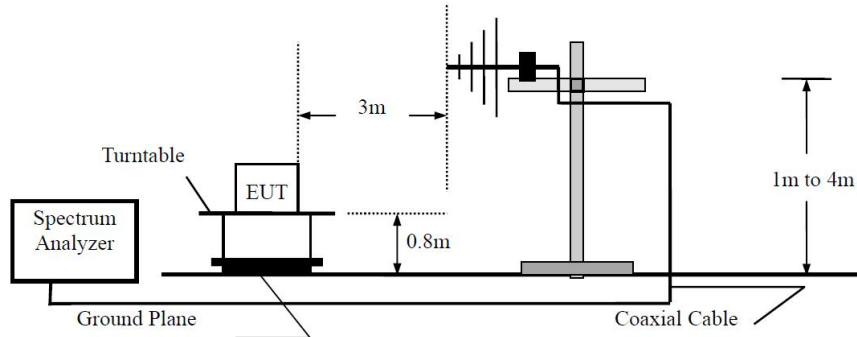


Tree Zhan
EMC Test Engineer

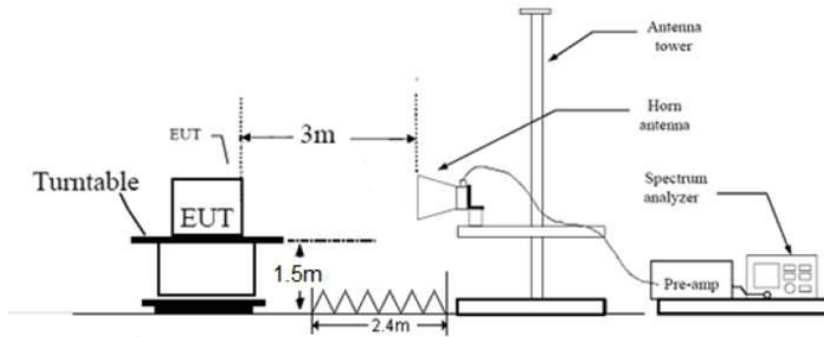
7 Test Setups

7.1 Radiated test setups

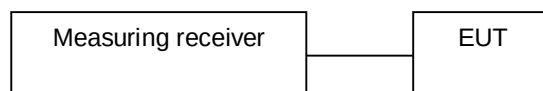
Below 1GHz



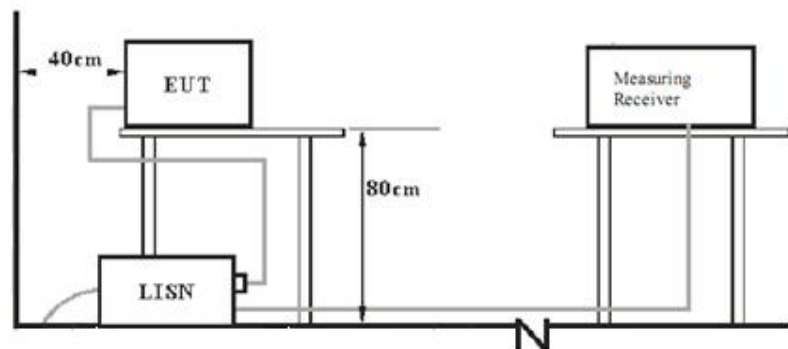
Above 1GHz



7.2 Conducted RF test setups



7.3 AC Power Line Conducted Emission test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Mobile Phone	Huawei	P9	---

Test software: RF test tool

The system was configured to channel 1, 6 and 11 for the test.

9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

According to §15.207, conducted emissions limit as below:

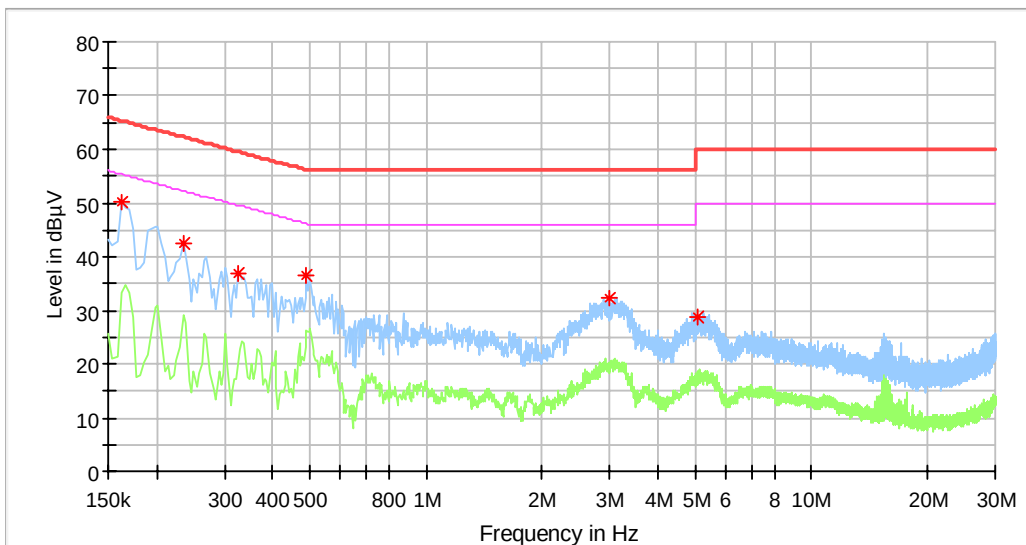
Frequency MHz	QP Limit dB μ V	AV Limit dB μ V
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Remark: “*” Decreasing linearly with logarithm of the frequency

Conducted Emission Test 150kHz – 30MHz

M/N: X780
 Op Cond.: Charging
 Test Spec.: Power Line, Live
 Comment: AC 120V/60Hz

Temperature (°C): 22.5 Relative Humidity (%): 46.7 Atmospheric Pressure(mbar) : 1012



Critical Freqs

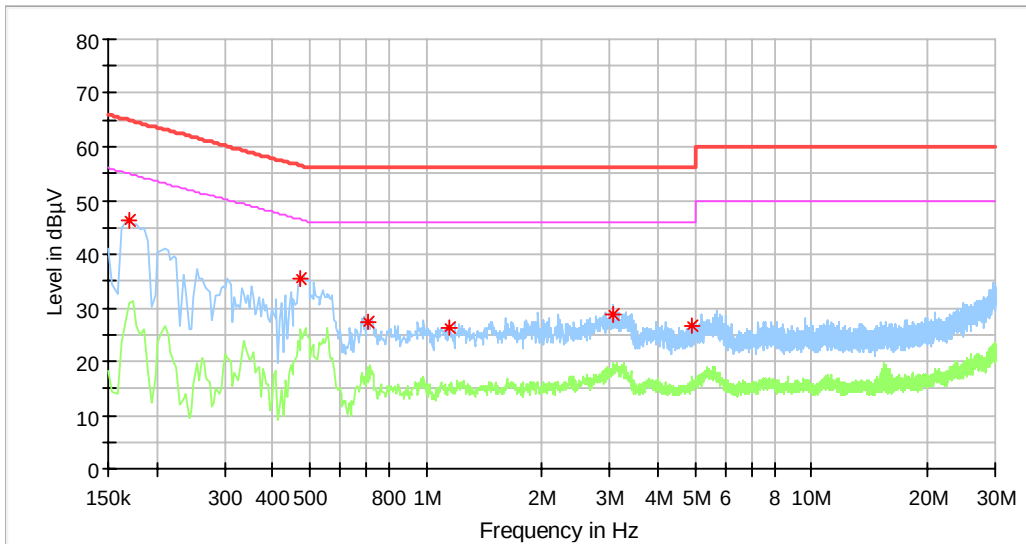
Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.162000	50.11	---	65.36	15.25	L1	10.2
0.234000	42.62	---	62.31	19.68	L1	10.2
0.326000	36.90	---	59.55	22.66	L1	10.2
0.490000	36.50	---	56.17	19.67	L1	10.4
2.978000	32.27	---	56.00	23.73	L1	10.3
5.066000	28.72	---	60.00	31.28	L1	10.4

Remark : Correct factor=cable loss + LISN factor

Conducted Emission Test 150kHz – 30MHz

M/N: X780
 Op Cond.: Charging
 Test Spec.: Power Line, Neutral
 Comment: AC 120V/60Hz

Temperature (°C): 22.5 Relative Humidity (%): 46.7 Atmospheric Pressure(mbar) : 1012



Critical Freqs

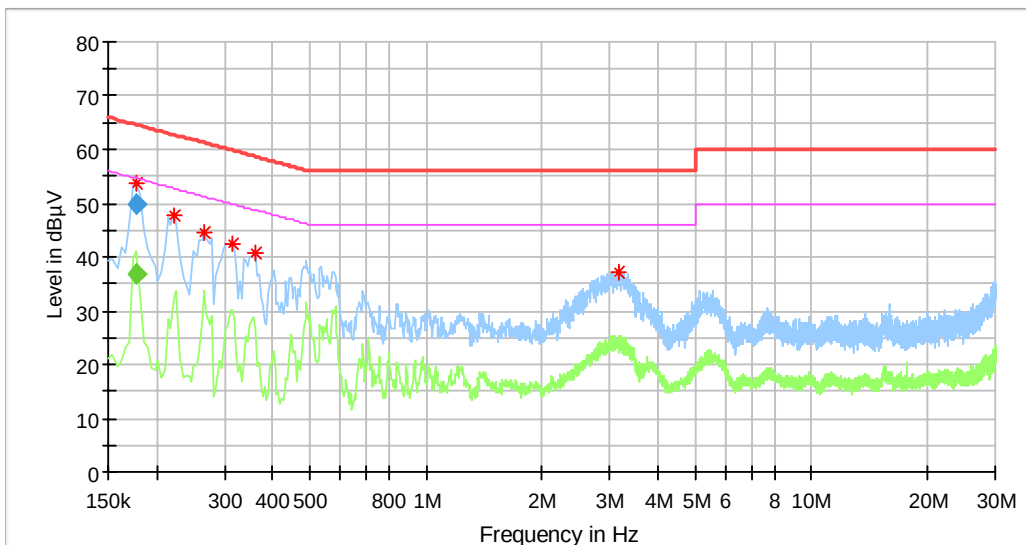
Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.170000	46.16	---	64.96	18.80	N	10.3
0.474000	35.60	---	56.44	20.84	N	10.3
0.710000	27.31	---	56.00	28.69	N	10.4
1.154000	26.47	---	56.00	29.53	N	10.4
3.074000	28.63	---	56.00	27.37	N	10.5
4.898000	26.73	---	56.00	29.27	N	10.6

Remark : Correct factor=cable loss + LISN factor

Conducted Emission Test 150kHz – 30MHz

M/N: X785
 Op Cond.: Charging
 Test Spec.: Power Line, Live
 Comment: AC 120V/60Hz

Temperature (°C): 22.5 Relative Humidity (%): 46.7 Atmospheric Pressure(mbar) : 1012



Critical Freqs

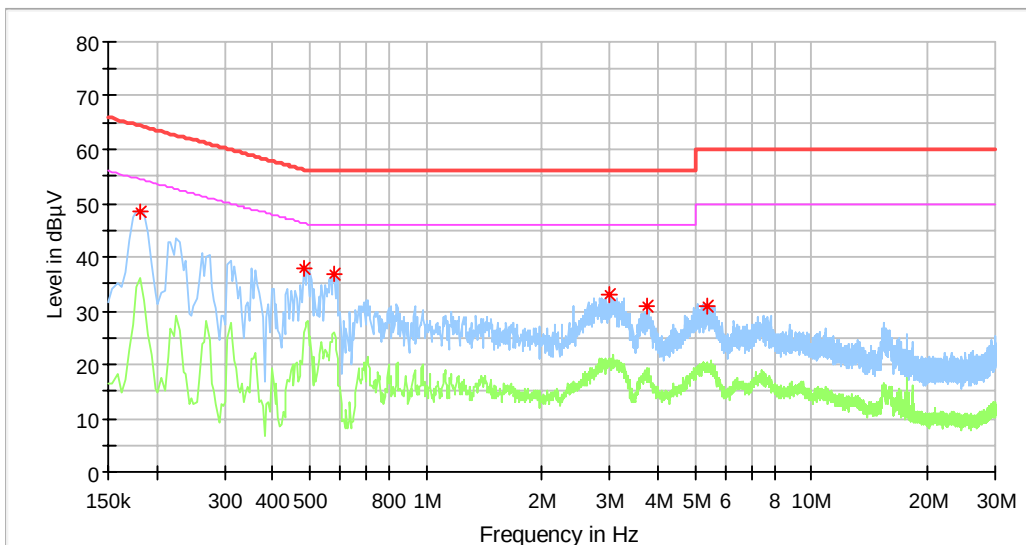
Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.177500	53.65	---	64.58	10.93	L1	10.2
0.222000	47.59	---	62.74	15.15	L1	10.2
0.266000	44.49	---	61.24	16.76	L1	10.2
0.314000	42.34	---	59.86	17.52	L1	10.2
0.362000	40.81	---	58.68	17.88	L1	10.3
3.174000	37.34	---	56.00	18.66	L1	10.4
Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.177500	---	36.68	54.60	17.92	L1	10.2
0.177500	49.70	---	64.60	14.90	L1	10.2

Remark : Correct factor=cable loss + LISN factor

Conducted Emission Test 150kHz – 30MHz

M/N: X785
 Op Cond.: Charging
 Test Spec.: Power Line, Neutral
 Comment: AC 120V/60Hz

Temperature (°C): 22.5 Relative Humidity (%): 46.7 Atmospheric Pressure(mbar) : 1012



Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.182000	48.32	---	64.39	16.07	N	10.2
0.482000	37.99	---	56.30	18.32	N	10.3
0.578000	36.96	---	56.00	19.04	N	10.3
2.982000	32.94	---	56.00	23.06	N	10.4
3.754000	30.82	---	56.00	25.18	N	10.4
5.362000	30.89	---	60.00	29.11	N	10.5

Remark : Correct factor=cable loss + LISN factor

9.2 Conducted peak output power

Test Method

1. Connect the power meter to the EUT
 - a) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
 - b) At all times the EUT is transmitting at its maximum power control level.
 - c) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. Adjust the measurement in dBm by adding $10\log(1/x)$, where x is the duty cycle to the measurement result.

Limits

According to §15.247 (b) (1), conducted peak output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤ 1	≤ 30

Test result as below table

802.11b

Frequency MHz	Conducted Peak Output Power dBm	Result
Top channel 2412MHz	15.5	Pass
Middle channel 2437MHz	16.6	Pass
Bottom channel 2462MHz	17.0	Pass

802.11g

Frequency MHz	Conducted Peak Output Power dBm	Result
Top channel 2412MHz	11.0	Pass
Middle channel 2437MHz	12.2	Pass
Bottom channel 2462MHz	12.7	Pass

802.11nHT20

Frequency MHz	Conducted Peak Output Power dBm	Result
Top channel 2412MHz	10.9	Pass
Middle channel 2437MHz	12.0	Pass
Bottom channel 2462MHz	12.5	Pass

802.11nHT40

Frequency MHz	Conducted Peak Output Power dBm	Result
Top channel 2412MHz	10.9	Pass
Middle channel 2437MHz	11.5	Pass
Bottom channel 2452MHz	11.9	Pass

9.3 6dB and 99% bandwidth

Test Method

1. Connect EUT test port to spectrum analyzer.
2. Use the following spectrum analyzer settings:
Set RBW ³ 1% of the 99% bandwidth, VBW ³ RBW.
Sweep = auto, Detector function = peak, Trace = max hold
3. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
4. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]

≥ 500

Test result

802.11b

Frequency MHz	6dB bandwidth KHz	99 bandwidth KHz	Result
Bottom channel 2412MHz	9640	12987	Pass
Middle channel 2437MHz	10120	12987	Pass
Top channel 2462MHz	10120	13027	Pass

802.11g

Frequency MHz	6dB bandwidth KHz	99 bandwidth KHz	Result
Bottom channel 2412MHz	16400	18142	Pass
Middle channel 2437MHz	16400	18062	Pass
Top channel 2462MHz	16400	18022	Pass

802.11nHT20

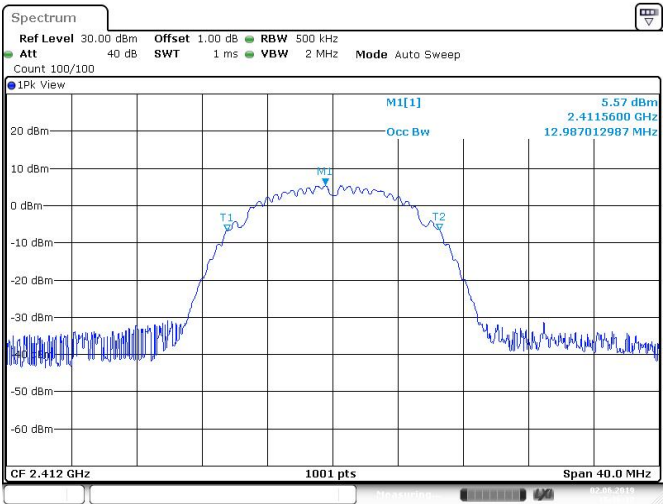
Frequency MHz	6dB bandwidth KHz	99 bandwidth KHz	Result
Bottom channel 2412MHz	17600	19021	Pass
Middle channel 2437MHz	17600	19061	Pass
Top channel 2462MHz	17650	19021	Pass

802.11nHT40

Frequency MHz	6dB bandwidth KHz	99 bandwidth KHz	Result
Bottom channel 2412MHz	36444	36443	Pass
Middle channel 2437MHz	36523	36523	Pass
Top channel 2452MHz	36523	36523	Pass

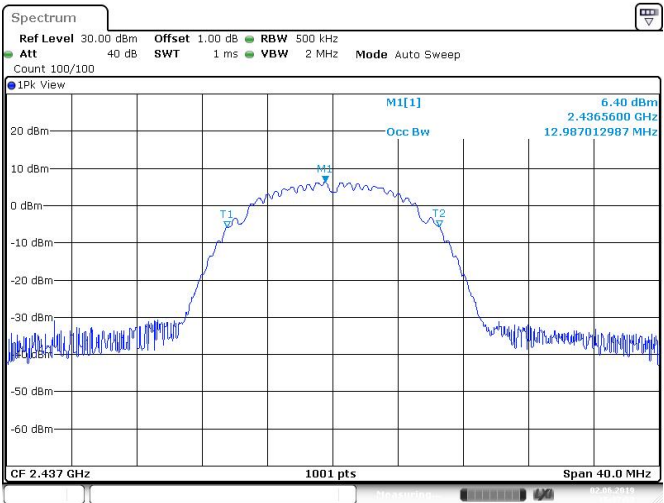


802.11b



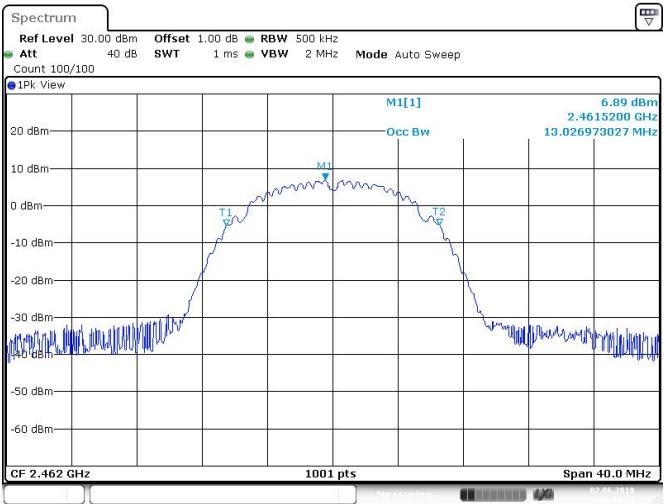
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2412MHz



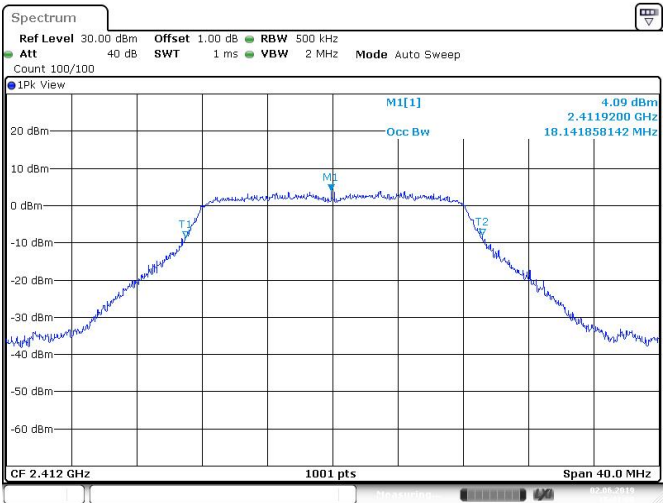
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2437MHz

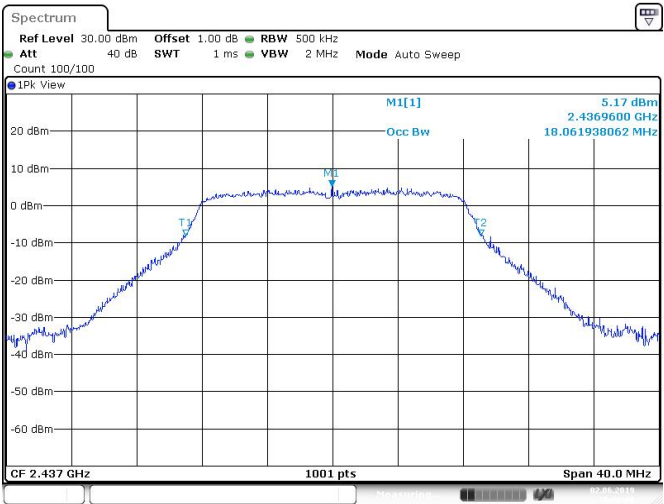


2462MHz

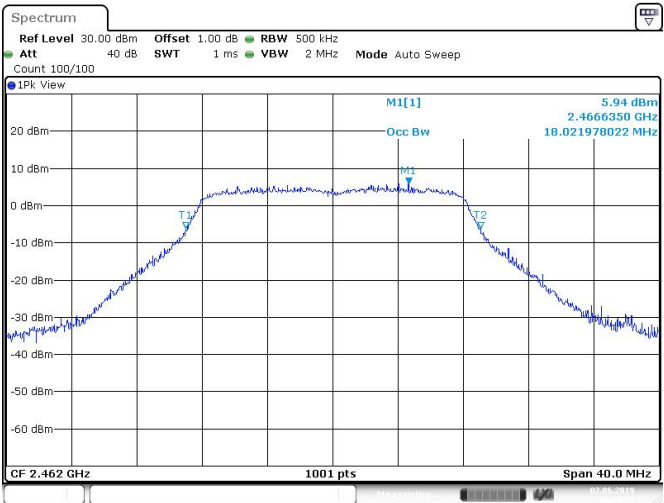
802.11g



2412MHz



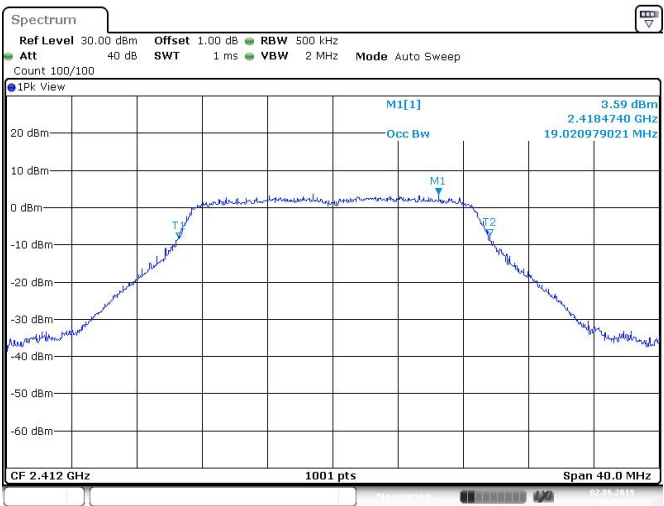
2437MHz



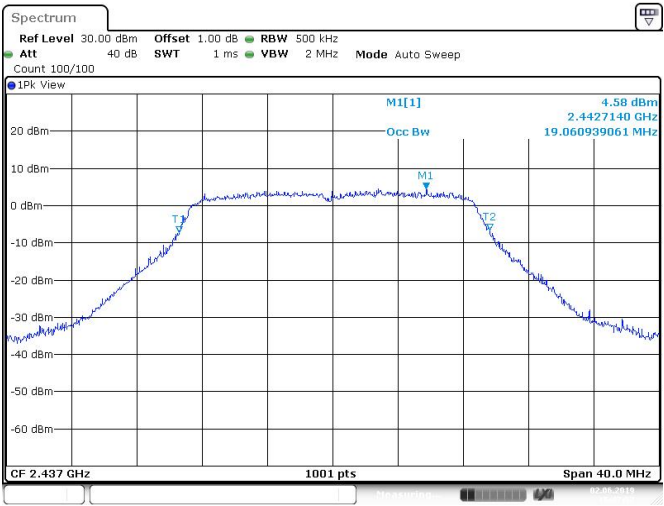
2462MHz



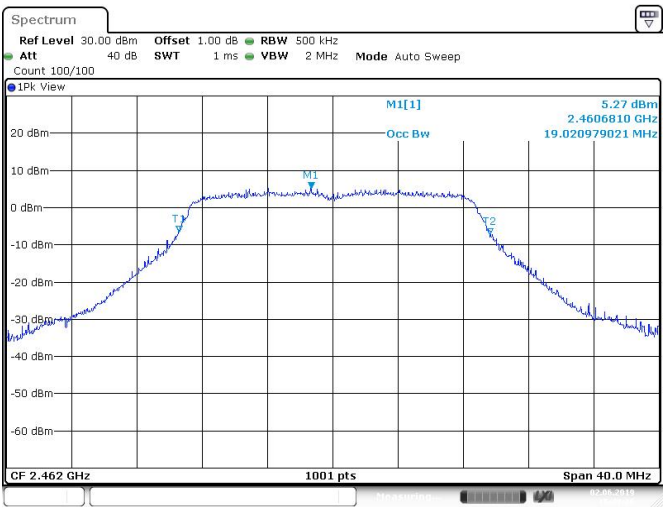
802.11nHT20



2412MHz

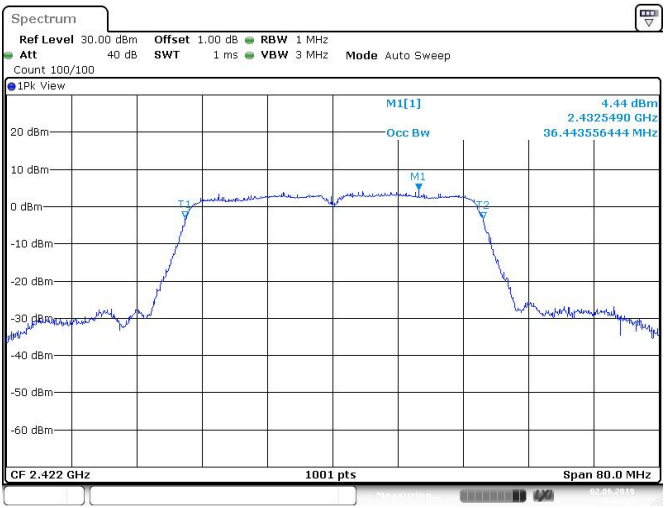


2437MHz

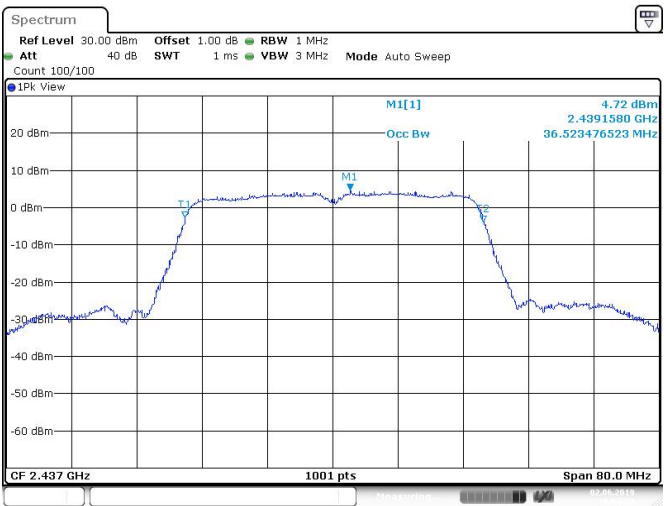


2462MHz

802.11nHT40

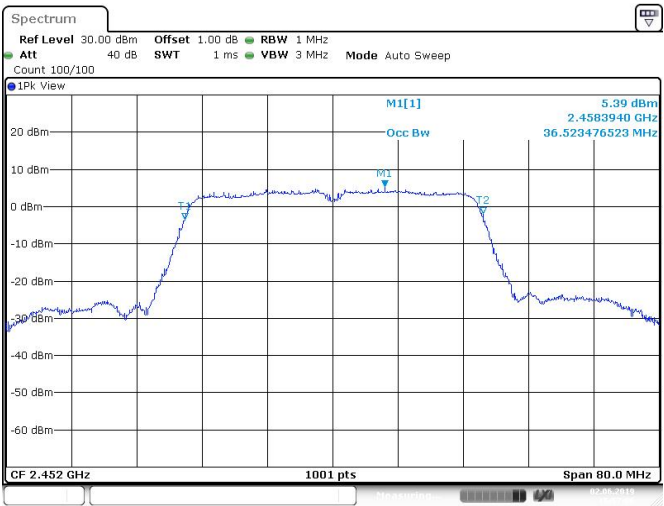


2412MHz



Date: 2 JUN 2019 15:54:01

2437MHz



Date: 2 JUN 2019 15:57:06

2462MHz

9.4 Power spectral density

Test Method

1. Connect EUT test port to spectrum analyzer.
2. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW $\geq$ 3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
3. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
4. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm]

$\leq 8/3\text{KHz}$

Test result

802.11b

Frequency MHz	Power spectral density dBm/3KHz	Result
Top channel 2412MHz	-8.5	Pass
Middle channel 2437MHz	-7.44	Pass
Bottom channel 2462MHz	-6.2	Pass

802.11g

Frequency MHz	Power spectral density dBm/3KHz	Result
Top channel 2412MHz	-15.78	Pass
Middle channel 2437MHz	-14.24	Pass
Bottom channel 2462MHz	-14.28	Pass

802.11nHT20

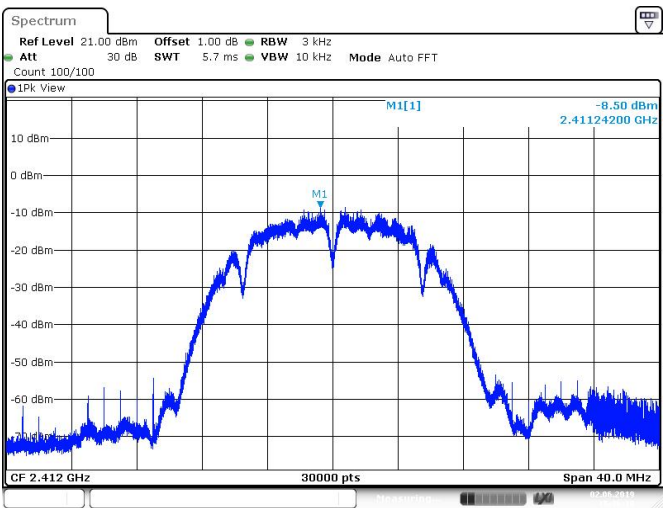
Frequency MHz	Power spectral density dBm/3KHz	Result
Top channel 2412MHz	-15.96	Pass
Middle channel 2437MHz	-14.58	Pass
Bottom channel 2462MHz	-13.51	Pass



802.11nHT40

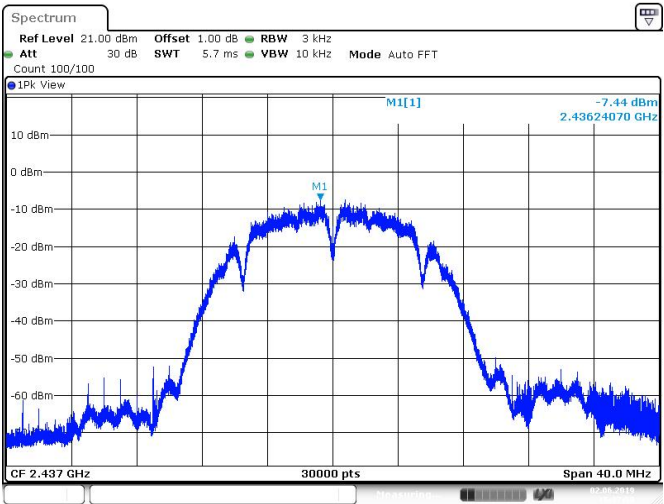
Frequency MHz	Power spectral density dBm/3KHz	Result
Top channel 2412MHz	-18.13	Pass
Middle channel 2437MHz	-17.80	Pass
Bottom channel 2462MHz	-17.49	Pass

802.11b



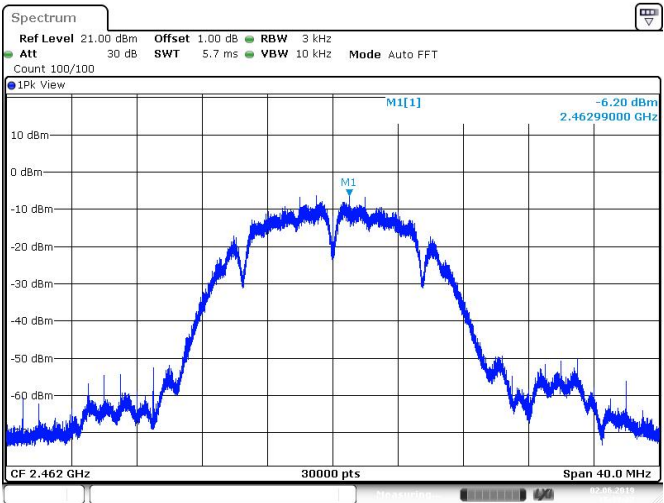
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2412MHz



Date: 2 JUN 2019 15:37:59

2437MHz

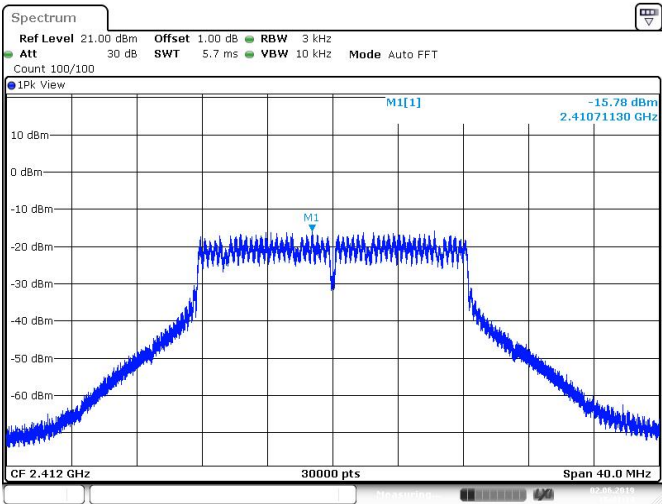


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2462MHz

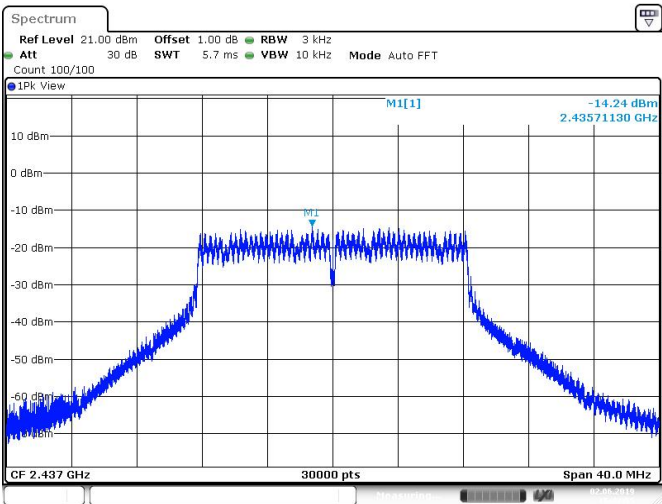


802.11g



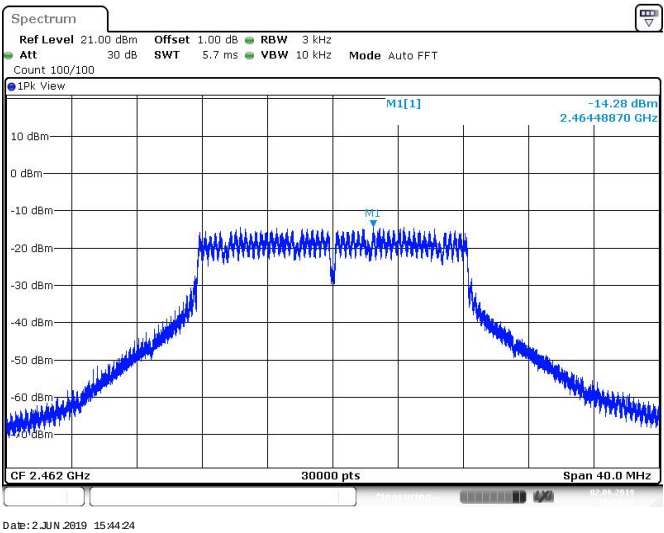
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2412MHz



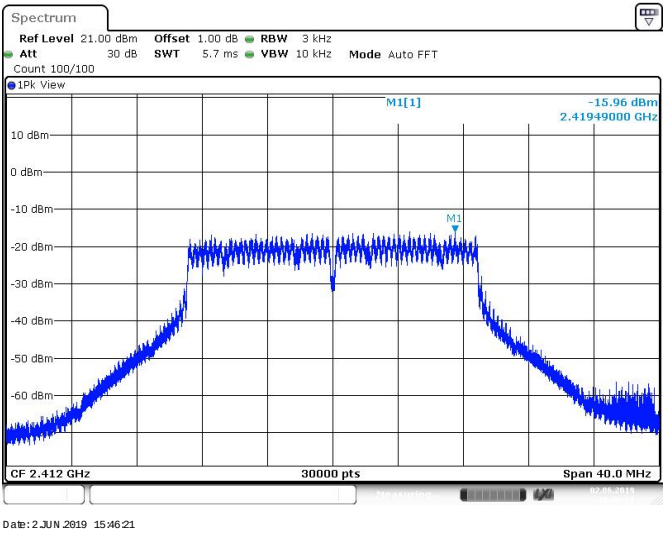
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2437MHz

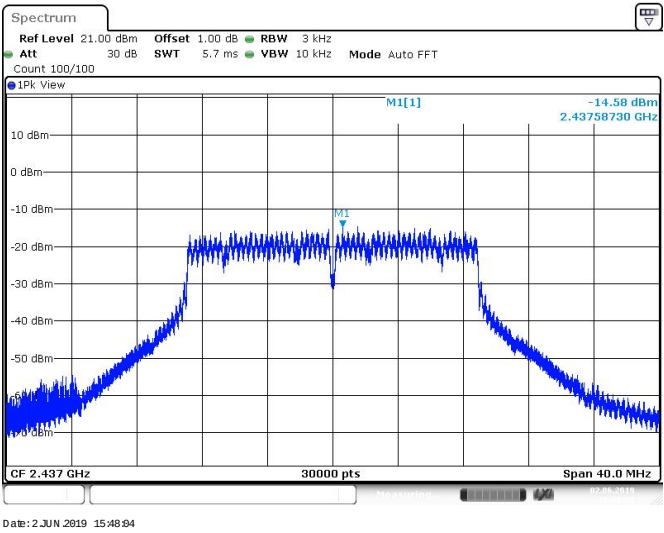


2462MHz

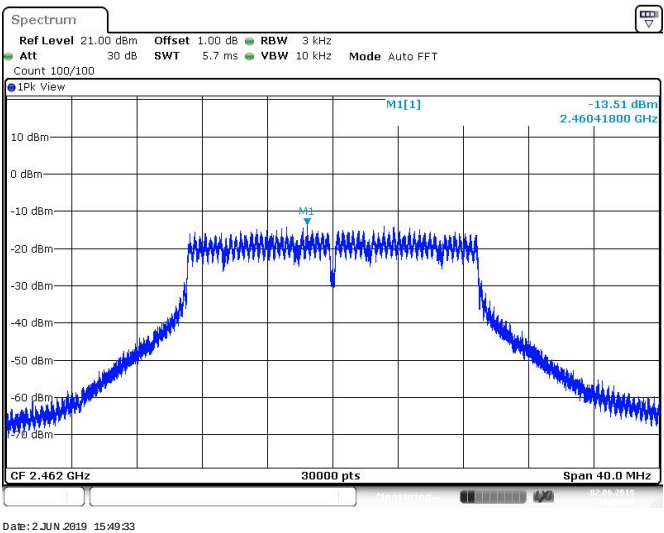
802.11nHT20



2412MHz



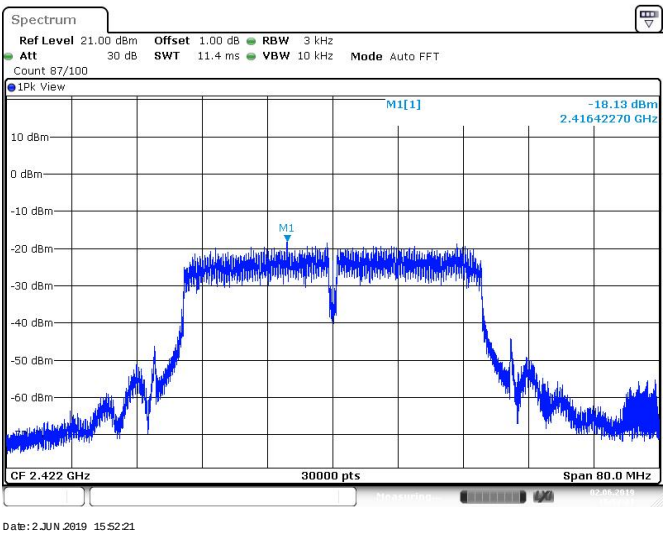
2437MHz



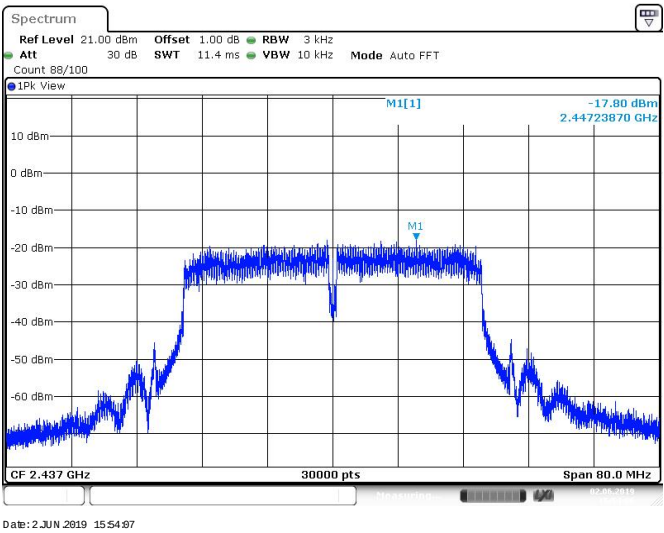
2462MHz



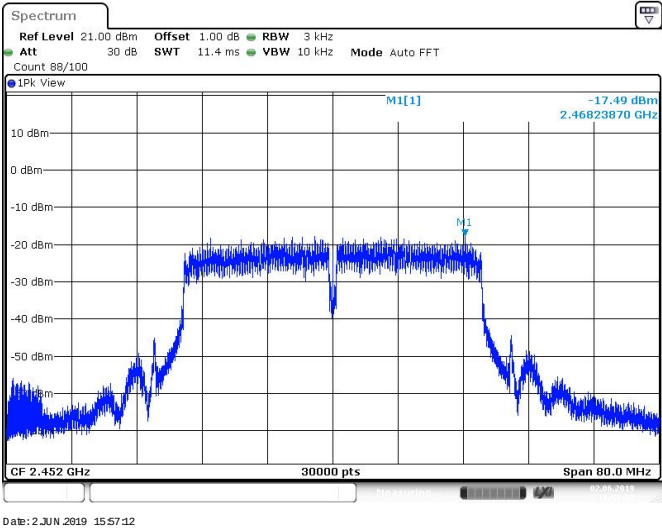
802.11nHT40



2412MHz



2437MHz



2462MHz

9.5 Spurious RF conducted emissions

Test Method

1. Connect EUT test port to spectrum analyzer.
2. Establish a reference level by using the following procedure:
 - a. Set RBW=100 kHz. VBW $\geq$ 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
 - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
3. Use the maximum PSD level to establish the reference level.
 - a. Set the center frequency and span to encompass frequency range to be measured.
 - b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
4. Repeat above procedures until other frequencies measured were completed.

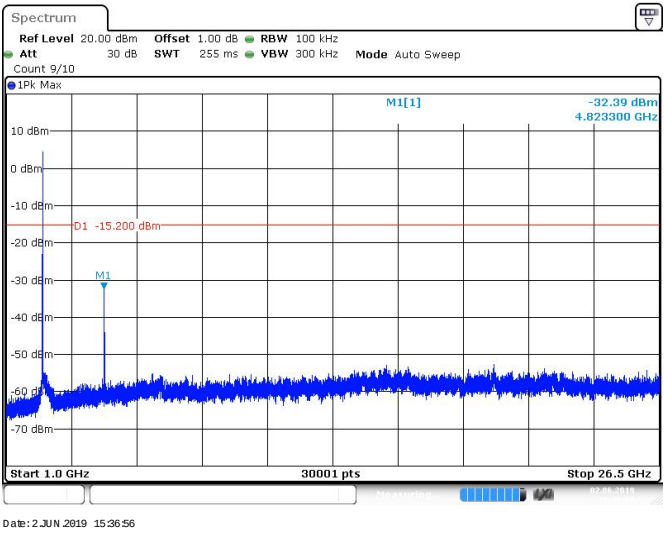
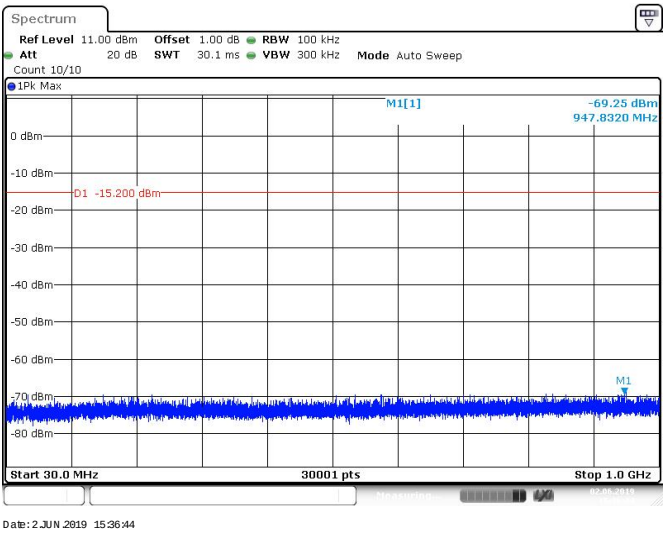
Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

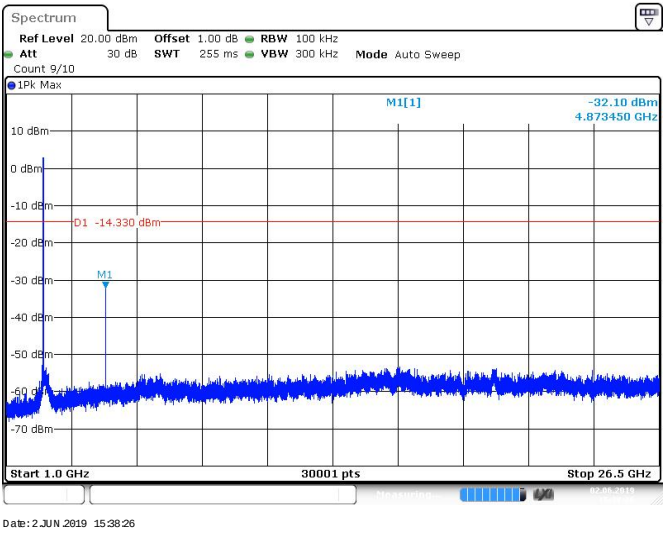
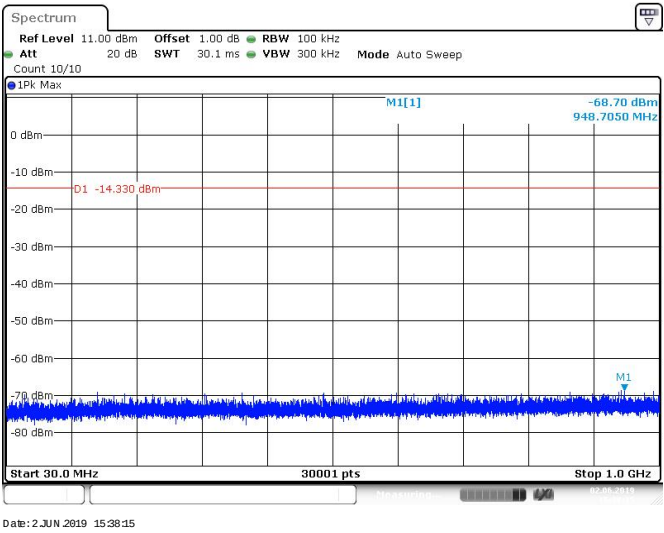


Spurious RF conducted emissions

802.11b

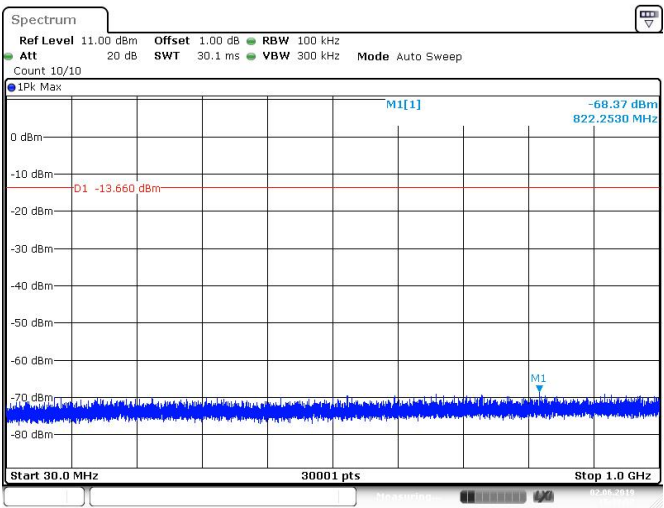


2412MHz

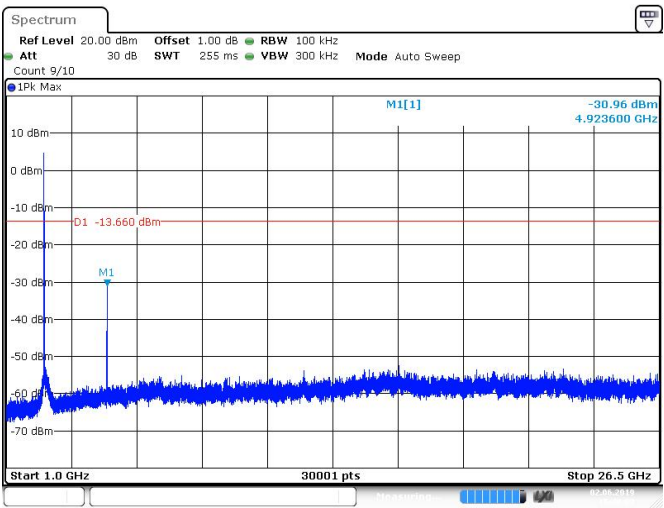


2437MHz

Spurious RF conducted emissions



Date: 2 JUN 2019 15:39:52

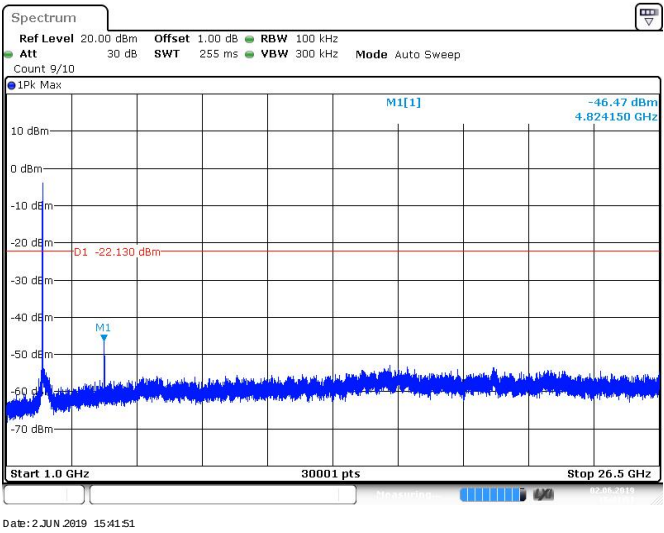
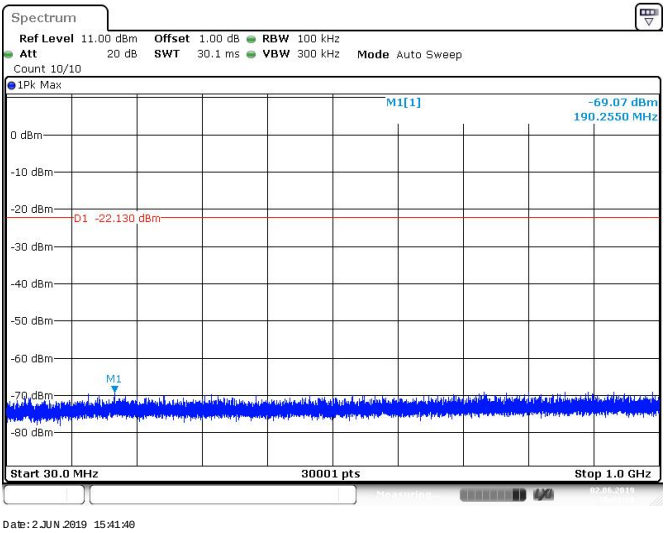


Date: 2 JUN 2019 15:40:04

2462MHz

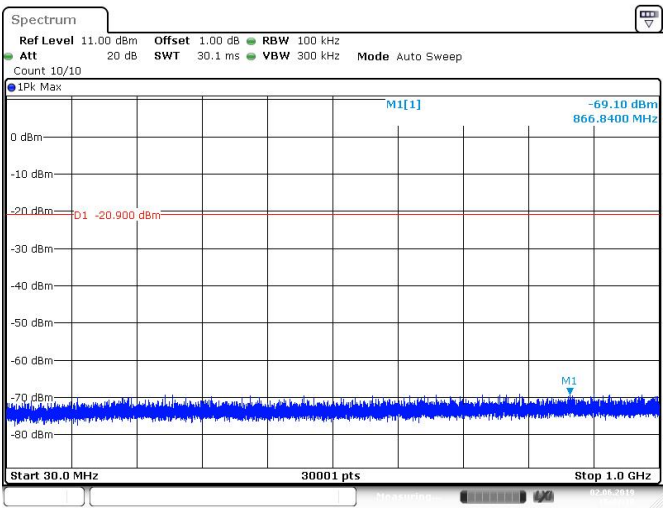


802.11g

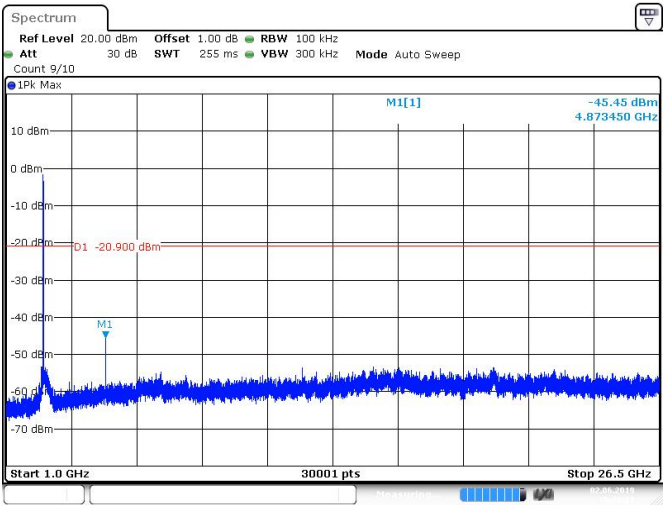


2412MHz

Spurious RF conducted emissions

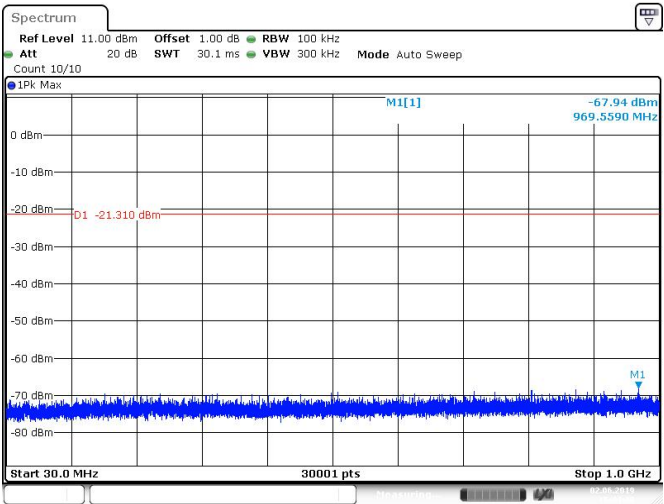


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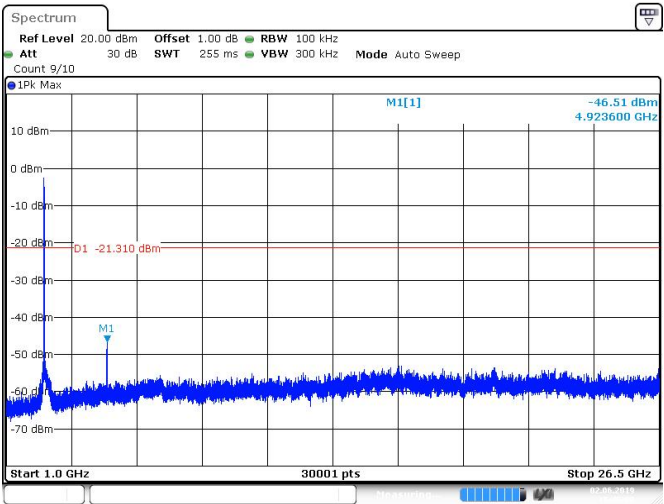


Date: 2 JUN 2019 15:43:22

2437MHz



Date: 2 JUN 2019 15:44:49



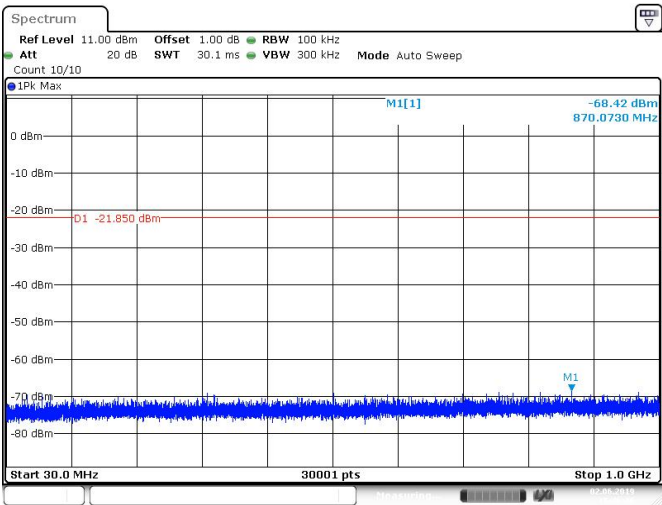
Date: 2 JUN 2019 15:45:00

2462MHz

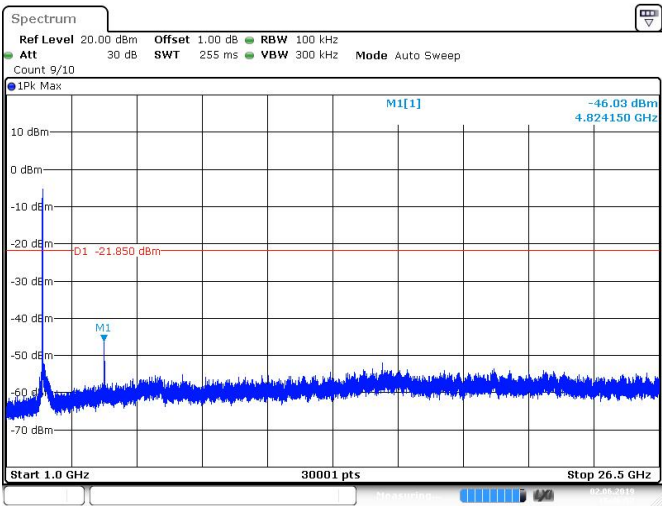


Spurious RF conducted emissions

802.11nHT20

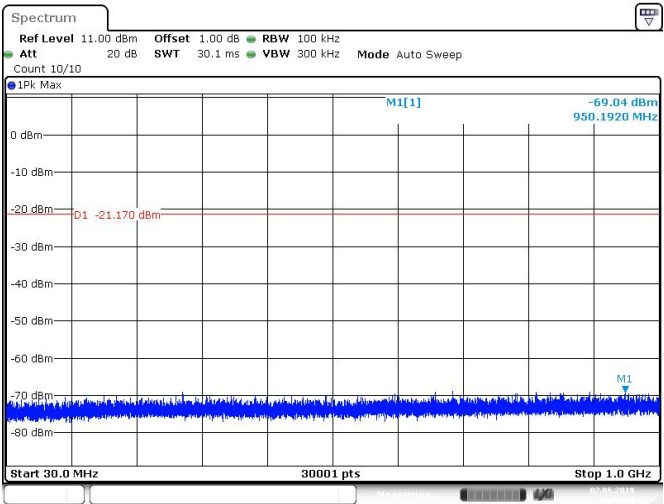


Date: 2 JUN 2019 15:46:46

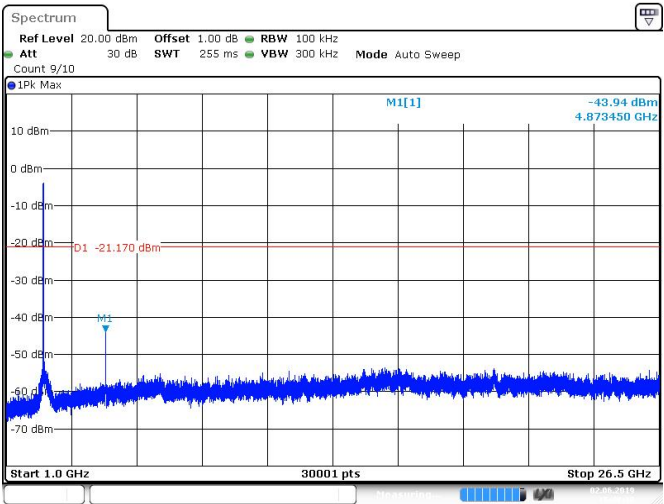


Date: 2 JUN 2019 15:46:57

2412MHz



Date: 2 JUN 2019 15:48:19

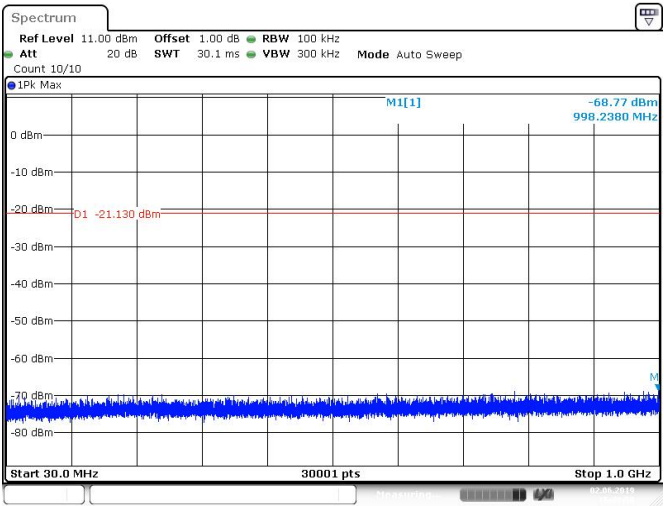


Date: 2 JUN 2019 15:48:31

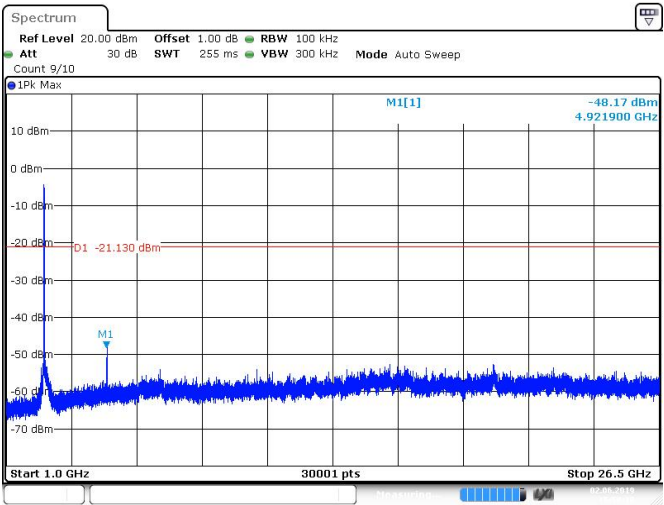
2437MHz



Spurious RF conducted emissions



Date: 2 JUN 2019 15:49:58



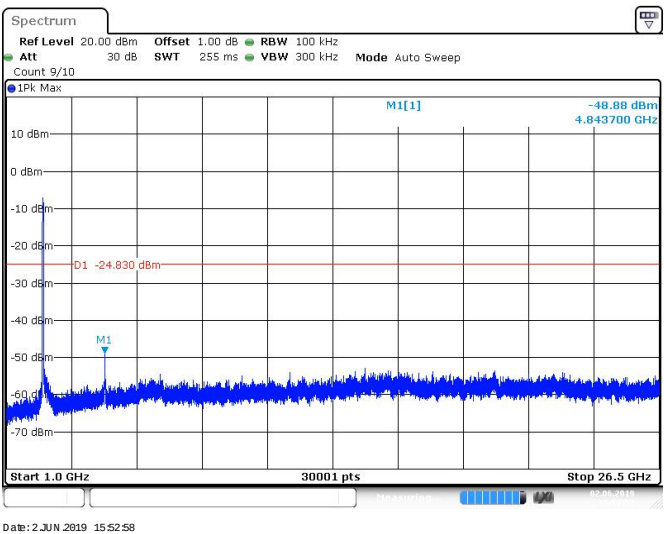
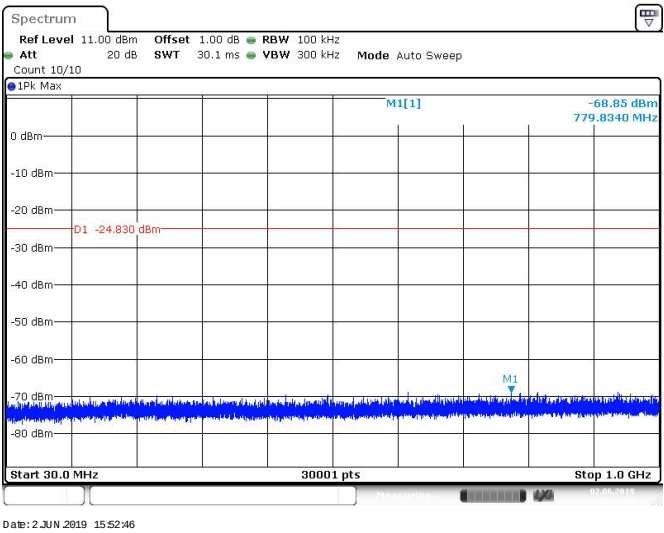
Date: 2 JUN 2019 15:50:10

2462MHz

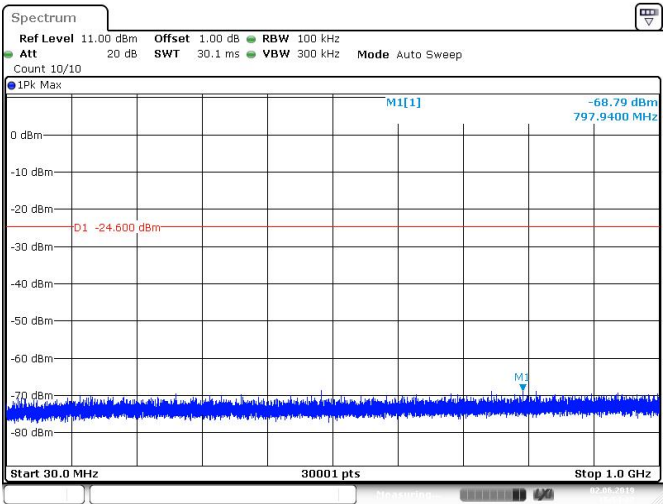


Spurious RF conducted emissions

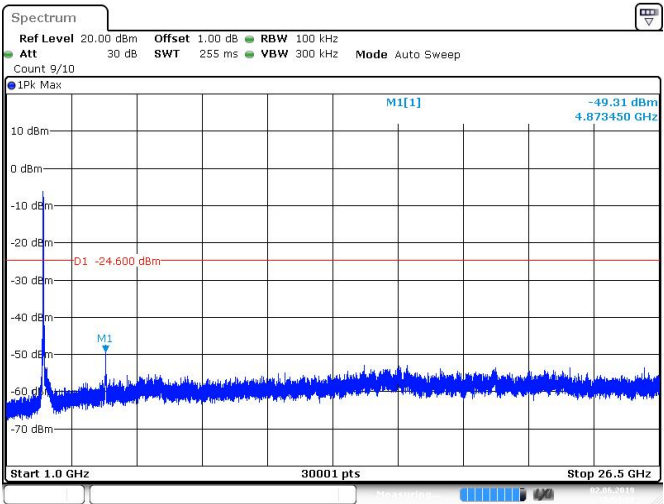
802.11nHT40



2412MHz



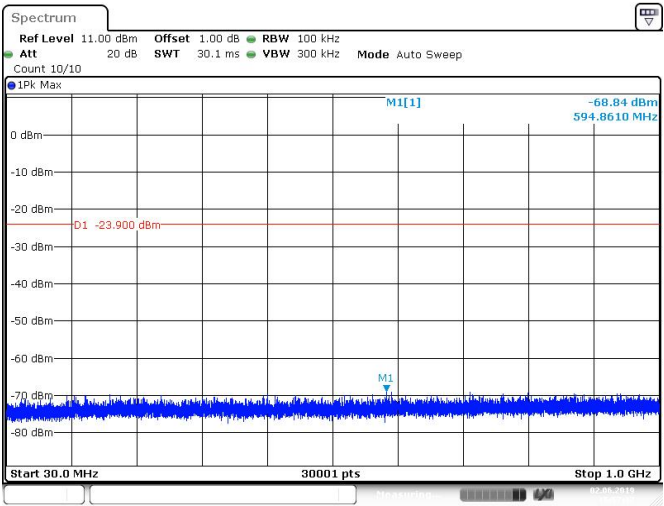
Date: 2 JUN 2019 15:54:22



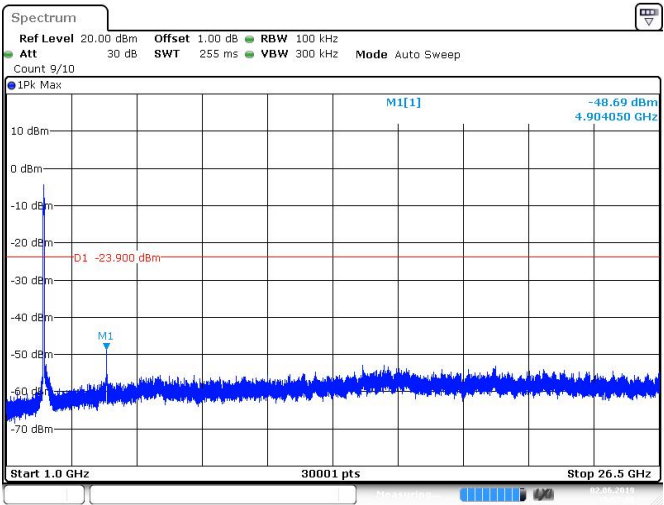
Date: 2 JUN 2019 15:54:34

2437MHz

Spurious RF conducted emissions



Date: 2 JUN 2019 15:57:37



Date: 2 JUN 2019 15:57:48

2452MHz

9.6 Band edge

Test Method

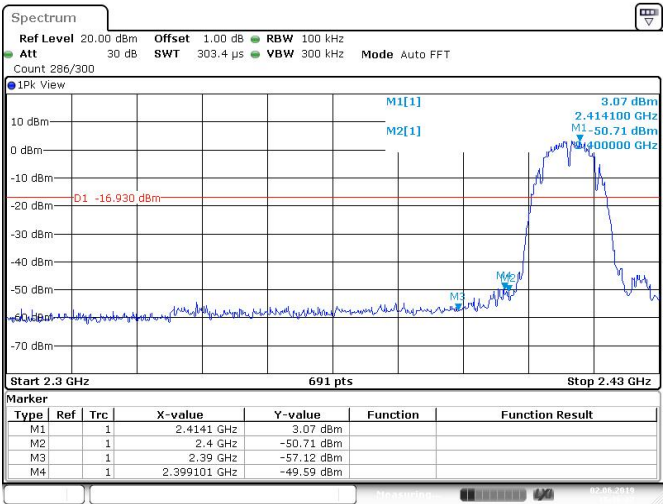
- 1. Connect EUT test port to spectrum analyzer.
- 2. Set spectrum analyzer setting as below:
Set RBW ³ 1% of the span, VBW ³ RBW.
Set Sweep = auto. Set Detector function = peak. Allow the trace to stabilize.
Set Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
- 3. Repeat above procedures until all frequencies measured were complete.

Limit

Frequency Range	Limit (dBc)
MHz	
30-25000	-20

Test result

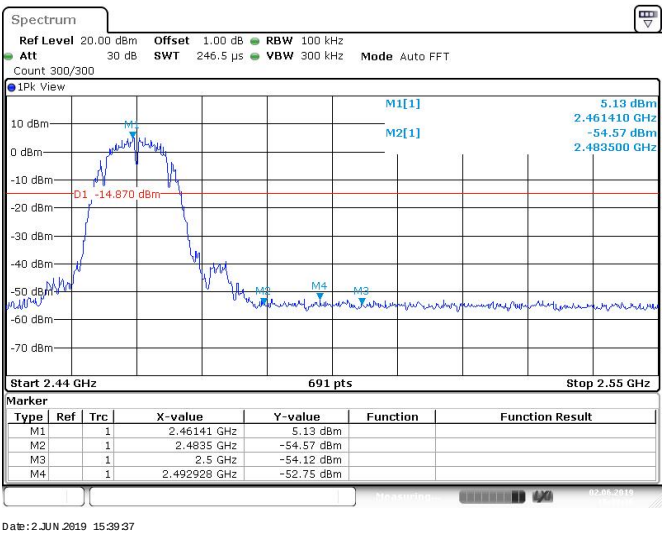
802.11b



Date: 2 JUN 2019 15:36:28

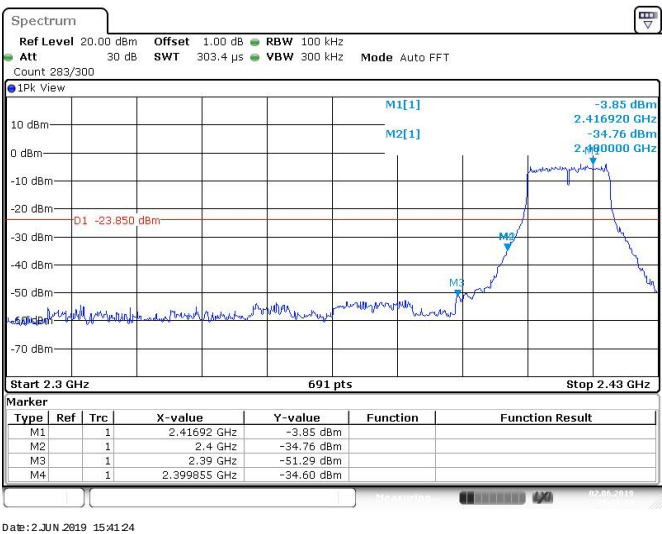
2412MHz

Band edge



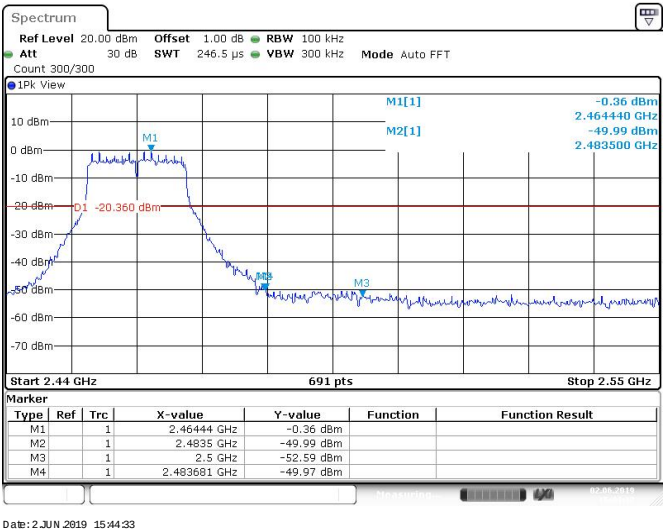
2462MHz

802.11g



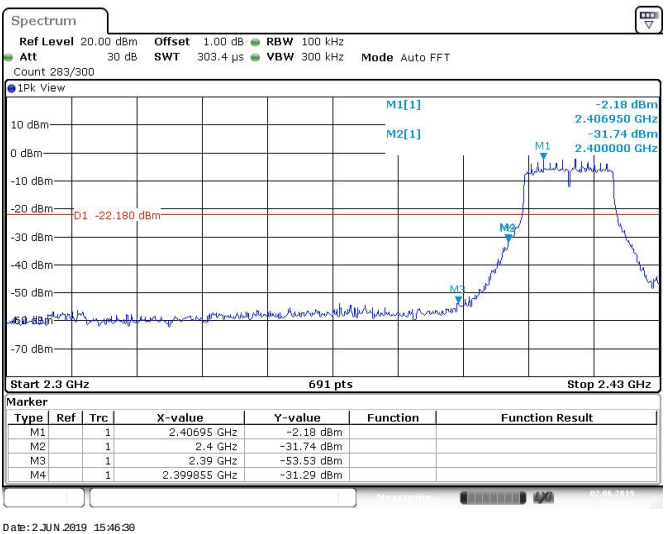
2412MHz

Band edge



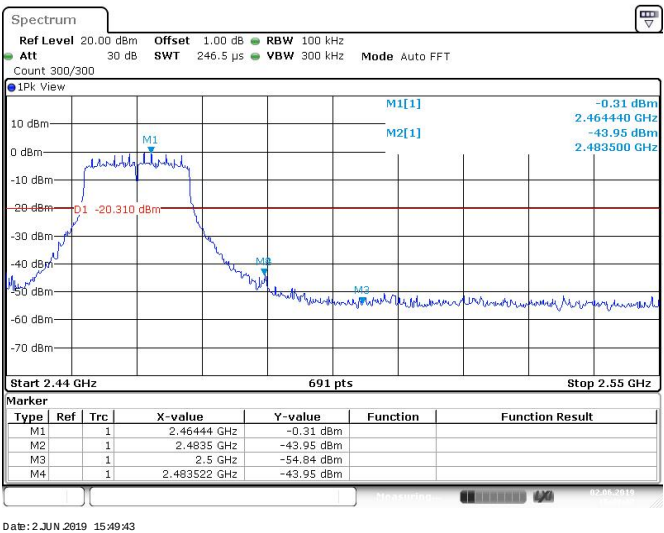
2462MHz

802.11nHT20



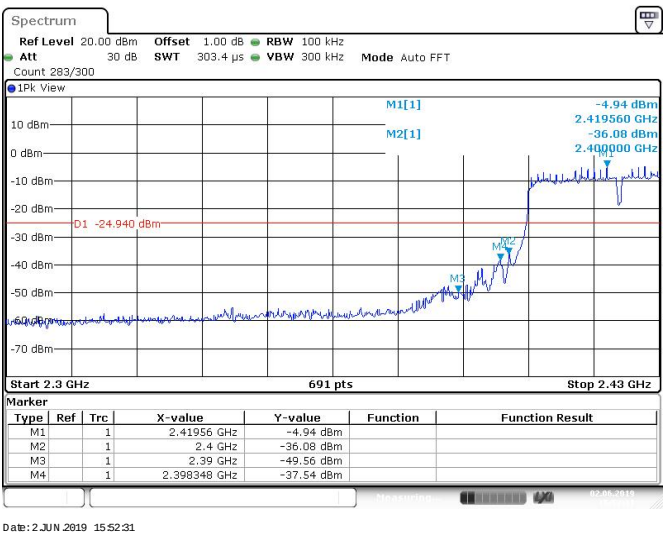
2412MHz

Band edge



2462MHz

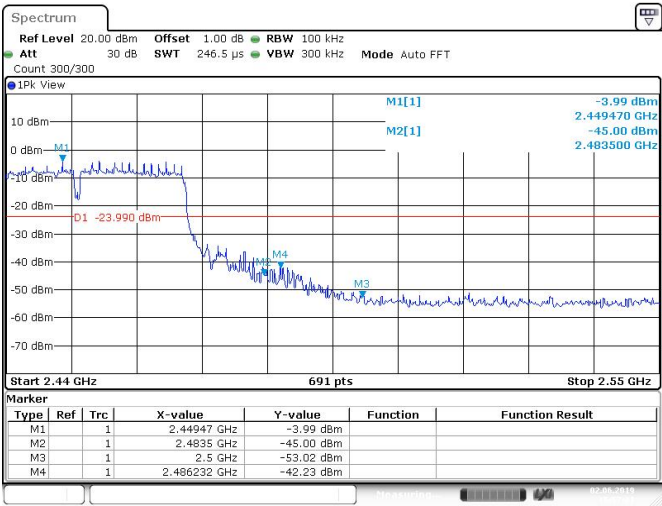
802.11nHT40



2412MHz



Band edge



Date: 2 JUN 2019 15:57:21

2462MHz

9.7 Spurious radiated emissions for transmitter

Test Method

- 1: The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
- 3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5: Use the following spectrum analyzer settings According to C63.10:

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
 RBW = 100 KHz to 120KHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
 RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz

- a) RBW = 1 MHz.
- b) VBW = $[3 \times \text{RBW}]$.
- c) Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq \text{RBW} / 2$.
 Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
- d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
- e) Sweep time = auto.
- f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of $1 / D$, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
- g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (rms) mode was used in the preceding step e), then the correction

factor is $[10 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is $[20 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section 15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBμV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Transmitting spurious emission test result as below:

802.11b

2412MHz (30MHz – 1GHz) for X780

Frequency	Emission Level	Polarization	Limit	Detector	Result	Corr. (dB)
MHz	dBuV/m		dBμV/m			
168.00	30.65	Horizontal	43.50	QP	Pass	-31.2
944.92	36.58	Vertical	46.00	QP	Pass	-14.4

802.11b

2412MHz (30MHz – 1GHz) for X785

Frequency	Emission Level	Polarization	Limit	Detector	Result	Corr. (dB)
MHz	dBuV/m		dBμV/m			
58.28	23.13	Horizontal	40.00	QP	Pass	-26.9
58.77	33.7	Vertical	46.00	QP	Pass	-15.9

2412MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Detector	Result	Corr. (dB)
MHz	dBuV/m		dBμV/m			
1536.12*	38.57	Horizontal	74.00	PK	Pass	-11.1
1536.12*	32.36	Vertical	74.00	PK	Pass	-11.1

Remark:

- (1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Level=Reading Level + Correction Factor
 Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
 Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
 (The Reading Level is recorded by software which is not shown in the sheet)

2437MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2437MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
4923.75*	50.53	Horizontal	74.00	PK	Pass	3.1
4923.75*	52.98	Vertical	74.00	PK	Pass	3.1

2462MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2462MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
1536.18*	47.48	Horizontal	74.00	PK	Pass	-11.1
1536.18*	48.31	Vertical	74.00	PK	Pass	-11.1

Remark:

- (1) “*” means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown “--” in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Level=Reading Level + Correction Factor
 Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
 Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
 (The Reading Level is recorded by software which is not shown in the sheet)

802.11g

2412MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
		Horizontal		QP	Pass
		Vertical		QP	Pass

2412MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
1536.18*	48.06	Horizontal	74.00	PK	Pass	-11.1
1536.18*	48.02	Vertical	74.00	PK	Pass	-11.1

2437MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2437MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
1536.18*	48.00	Horizontal	74.00	PK	Pass	-11.1
1536.18*	48.15	Vertical	74.00	PK	Pass	-11.1

Remark:

- (1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Level=Reading Level + Correction Factor
Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

2462MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2462MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
4924.68*	46.82	Horizontal	74.00	PK	Pass	3.1
4934.06*	50.02	Vertical	74.00	PK	Pass	3.1

802.11nHT20

2412MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2412MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
2338.25*	39.62	Horizontal	74.00	PK	Pass	-6.5
2322.12*	37.76	Vertical	74.00	PK	Pass	-6.6

Remark:

- (1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Level=Reading Level + Correction Factor
 Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
 Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
 (The Reading Level is recorded by software which is not shown in the sheet)

2437MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2437MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
4872.18*	42.45	Horizontal	74.00	PK	Pass	2.9
4871.25*	43.18	Vertical	74.00	PK	Pass	2.9

2462MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2462MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
4918.59*	44.68	Horizontal	74.00	PK	Pass	2.9
4925.15*	43.69	Vertical	74.00	PK	Pass	2.9

Remark:

- (1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Level=Reading Level + Correction Factor
 Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
 Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
 (The Reading Level is recorded by software which is not shown in the sheet)

802.11nHT40

2412MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2412MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
2377.87*	42.27	Horizontal	74.00	PK	Pass	-6.1
2614.06*	39.01	Vertical	74.00	PK	Pass	-4.9

2437MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2437MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
2504.75	38.37	Horizontal	74.00	PK	Pass	-5.1
2501.75	39.56	Vertical	74.00	PK	Pass	-5.1

2462MHz (30MHz – 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result
--	--	Horizontal	--	QP	Pass
--	--	Vertical	--	QP	Pass

2462MHz (Above 1GHz)

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Result	Corr. (dB)
4927.50*	44.17	Horizontal	74.00	PK	Pass	3.1
7325.15*	45.12	Vertical	74.00	PK	Pass	3.1

Remark:

- (1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Level=Reading Level + Correction Factor
Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
(The Reading Level is recorded by software which is not shown in the sheet)

10 Test Equipment List

List of Test Instruments

Conducted Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2019-7-6
LISN	Rohde & Schwarz	ENV4200	100249	2019-7-6
LISN	Rohde & Schwarz	ENV432	101318	2019-7-6
LISN	Rohde & Schwarz	ENV216	100326	2019-7-6
ISN	Rohde & Schwarz	ENY81	100177	2019-7-6
ISN	Rohde & Schwarz	ENY81-CA6	101664	2019-7-6
High Voltage Probe	Rohde & Schwarz	TK9420(VT9 420)	9420-584	2019-6-30
RF Current Probe	Rohde & Schwarz	EZ-17	100816	2019-6-30
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2019-7-6
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A

TS8997 Test System

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Generator	Rohde & Schwarz	SMB100A	108272	2019-7-6
Vector Signal Generator	Rohde & Schwarz	SMBV100A	262825	2019-7-6
Communication Synthetical Test Instrument	Rohde & Schwarz	CMW 270	101251	2019-5-31
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2019-7-6
Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2019-7-6
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2019-7-6
Power Splitter	Weinschel	1580	SC319	2019-7-5
10dB Attenuator	Weinschel	4M-10	43152	2019-7-14
10dB Attenuator	R&S	DNF	DNF-001	2019-7-6
10dB Attenuator	R&S	DNF	DNF-002	2019-7-6
10dB Attenuator	R&S	DNF	DNF-003	2019-7-6
10dB Attenuator	R&S	DNF	DNF-004	2019-7-6
Test software	Rohde & Schwarz	EMC32	Version 10.38.00	N/A
Test software	Tonscend	System for BT/WIFI	Version 2.5.77.0418	N/A

Radiated Spurious Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	101031	2019-7-6
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	708	2019-7-4
Horn Antenna	Rohde & Schwarz	HF907	102295	2019-6-28
Wideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	12827	2019-7-12
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100398	2019-7-6
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2019-7-6
Pre-amplifier	Rohde & Schwarz	SCU 40A	100432	2019-7-6
Fully Anechoic Chamber	TDK	8X4X4	--	2022-7-14
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.80dB; Vertical: 4.87dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.59dB; Vertical: 4.58dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6×10 ⁻⁷ or 1%
Uncertainty Evaluation for Power Spectral Density Conducted measurement	1.17dB
Uncertainty Evaluation for Spurious emissions Conducted measurement	1.43dB

12 General product information

1. Rechargeable battery-powered robotic vacuum cleaner with docking station.

2. Model differences as below:

Model	Main PCB	control PCB		Charger base PCB		Remark
	A/B	C	D	E	F	
X780	√	√		√		Models A7 is the same as model X780 except model name. All models have the similar constructions except the model name, colour of product appearance, main PCB, charger base PCB and control PCB. Air pump is optional in all models. The differences of X785 and X780, A7 lie in the control board and charger base board difference, others are same.
A7						
X785			√		√	

Main PCB: A/B



Control PCB, C



Control PCB, D



Charger base PCB, E



Charger base PCB, F



Unless otherwise specified, the model X785 was chosen as the representative model to perform all the tests. selected test item of Conducted Emission and Radiated Spurious Emission Test (30M-1GHz) was applied on X780, other models are deemed to fulfill relevant EMC requirement without further test.