TEST REPORT

Reference No......	:	WTX23X06128782W001
FCC ID.....	:	2BBPK-IOTMOD1
Applicant	:	Phononic, Inc.
Address.....	:	800 Capitola Dr, Suite 7, Durham, NC 27713
Manufacturer.....	:	The same as Applicant
Address.....	:	The same as Applicant
Product Name	:	IoT Board v1
Model No......	:	PCA-019086
Standards	:	FCC Part 15.247
Date of Receipt sample	:	2023-06-14
Date of Test.....	:	2023-06-14 to 2023-06-21
Date of Issue	:	2023-06-21
Test Report Form No.	:	WTX_Part 15_247W
Test Result.....	:	**Pass**

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of approver.

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Report version

Version No.	Date of issue	Description
Rev.00	2023-06-21	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

General Description of EUT	
Product Name:	IoT Board v1
Trade Name:	/
Model No.:	PCA-019086
Adding Model(s):	/
Rated Voltage:	DC5V
Power Adapter Model:	/
Note: The test data is gathered from a production sample provided by the manufacturer.	

Technical Characteristics of EUT	
Support Standards:	802.11b, 802.11g, 802.11n
Frequency Range:	2412-2462MHz for 802.11b/g/n(HT20) 2422-2452MHz for 802.11n(HT40)
RF Output Power:	17.70dBm (Conducted)
Type of Modulation:	CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM
Quantity of Channels:	11 for 802.11b/g/n(HT20); 7 for 802.11n(HT40)
Channel Separation:	5MHz
Type of Antenna:	Dipole Antenna
Antenna Gain:	3.55dBi

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.
558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating undersection 15.247 of the Fcc rules.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02.
The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

Address of the test laboratory
Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.
Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

FCC – Registration No.: 125990
Waltek Testing Group (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is mai ntained in our files. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A
The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A and the CAB identifier is CN0057.

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	802.11b	Low:2412MHz, Middle:2437MHz,High:2462MHz
TM2	802.11g	Low:2412MHz, Middle:2437MHz,High:2462MHz
TM3	802.11n-HT20	Low:2412MHz, Middle:2437MHz,High:2462MHz
TM4	802.11n-HT40	Low:2422MHz, Middle:2437MHz,High:2452MHz

Test Conditions	
Temperature:	22~25 °C
Relative Humidity:	45~55 %.
ATM Pressure:	1019 mbar

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
USB Cable	1.0	Unshielded	Without Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	L13 Yoga	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	±0.42dB
Occupied Bandwidth	Conducted	±1.5%
Power Spectral Density	Conducted	±1.8dB
Conducted Spurious Emission	Conducted	±2.17dB
Conducted Emissions	Conducted	9-150kHz ±3.74dB
		0.15-30MHz ±3.34dB
Transmitter Spurious Emissions	Radiated	30-200MHz ±4.52dB
		0.2-1GHz ±5.56dB
		1-6GHz ±3.84dB
		6-26GHz ±3.92dB

1.7 Test Equipment List and Details

Fixed asset Number	Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
WTXE1041A 1001	Communication Tester	Rohde & Schwarz	CMW500	148650	2023-02-25	2024-02-24
WTXE1005A 1005	Spectrum Analyzer	Agilent	N9020A	US47140102	2023-02-25	2024-02-24
WTXE1084A 1001	Spectrum Analyzer	Agilent	N9020A	MY54320548	2023-02-25	2024-02-24
WTXE1004A 1-001	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2023-02-25	2024-02-24
☐Chamber A: Below 1GHz						
WTXE1005A 1003	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2023-02-25	2024-02-24
WTXE1007A 1001	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2023-02-25	2024-02-24
WTXE1007A 1001	Amplifier	HP	8447F	2805A03475	2023-02-25	2024-02-24
WTXE1010A 1007	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-20	2024-03-19
WTXE1010A 1006	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2023-03-20	2026-03-19
☐Chamber A: Above 1GHz						
WTXE1005A 1003	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2023-02-25	2024-02-24
WTXE1007A 1001	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2023-02-25	2024-02-24
WTXE1065A 1001	Amplifier	C&D	PAP-1G18	14918	2023-02-25	2024-02-24
WTXE1010A 1005	Horn Antenna	ETS	3117	00086197	2021-03-19	2024-03-18
WTXE1010A 1010	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2021-03-19	2024-03-18
WTXE1003A 1001	Pre-amplifier	Schwarzbeck	BBV 9721	9721-031	2023-02-25	2024-02-24
☐Chamber B:Below 1GHz						
WTXE1010A 1006	Trilog Broadband Antenna	Schwarz beck	VULB9163(B)	9163-635	2021-04-09	2024-04-08
WTXE1010A 1007	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-20	2024-03-19

WTXE1038A 1001	Amplifier	Agilent	8447D	2944A101 79	2023-02-25	2024-02-24
WTXE1001A 1002	EMI Test Receiver	Rohde & Schwarz	ESPI	101391	2023-02-25	2024-02-24
☒Chamber C:Below 1GHz						
WTXE1093A 1001	EMI Test Receiver	Rohde & Schwarz	ESIB 26	100401	2023-02-25	2024-02-24
WTXE1010A 1013-1	Trilog Broadband Antenna	Schwarz beck	VULB 9168	1194	2021-05-28	2024-05-27
WTXE1010A 1007	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-20	2024-03-19
WTXE1007A 1002	Amplifier	HP	8447F	2944A038 69	2023-02-25	2024-02-24
☒Chamber C: Above 1GHz						
WTXE1093A 1001	EMI Test Receiver	Rohde & Schwarz	ESIB 26	100401	2023-02-25	2024-02-24
WTXE1103A 1005	Horn Antenna	POAM	RTF-11A	LP228060 221	2023-03-10	2026-03-09
WTXE1103A 1006	Amplifier	Tonscend	TAP01018050	AP22E806 235	2023-02-25	2024-02-24
☒Conducted Room 1#						
WTXE1001A 1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2023-02-25	2024-02-24
WTXE1002A 1001	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2023-02-25	2024-02-24
WTXE1003A 1001	AC LISN	Schwarz beck	NSLK8126	8126-224	2023-02-25	2024-02-24
☐Conducted Room 2#						
WTXE1001A 1004	EMI Test Receiver	Rohde & Schwarz	ESPI	101259	2023-02-25	2024-02-24
WTXE1003A 1003	LISN	Rohde & Schwarz	ENV 216	100097	2023-02-25	2024-02-24

Software List			
Description	**Manufacturer**	**Model**	**Version**
EMI Test Software (Radiated Emission)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission)*	Farad	EZ-EMC	RA-03A1

*Remark: indicates software version used in the compliance certification testing.

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§15.203; §15.247(b)(4)(i)	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§15.207(a)	Conducted Emission	N/A
§15.247(e)	Power Spectral Density	Compliant
§15.247(a)(2)	DTS Bandwidth	Compliant
§15.247(b)(3)	RF Output Power	Compliant
§15.209(a)	Radiated Emission	Compliant
§15.247(d)	Band Edge (Out of Band Emissions)	Compliant

N/A: Not applicable.

3. Antenna Requirement

3.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

3.2 Evaluation Information

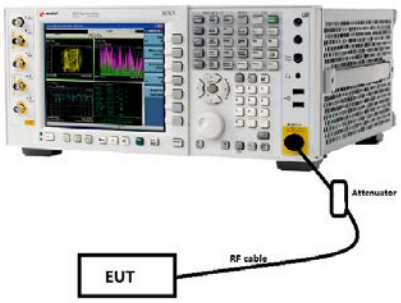
This product has a dipole antenna, fulfill the requirement of this section.

4. Power Spectral Density

4.1 Standard Applicable

According to 15.247(a)(1)(iii), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

4.2 Test Setup Block Diagram



4.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.3, such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density. The test method of power spectral density as below:

a) Set instrument center frequency to DTS channel center frequency.
b) Set span to at least 1.5 times the OBW.
c) Set RBW to: 3kHz ≤ RBW ≤ 100kHz. .
d) Set VBW ≥3 x RBW.
e) Detector = power averaging (RMS) or sample detector (when RMS not available).
f) Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
g) Sweep time = auto couple.
h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
i) Use the peak marker function to determine the maximum amplitude level.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

4.4 Summary of Test Results/Plots

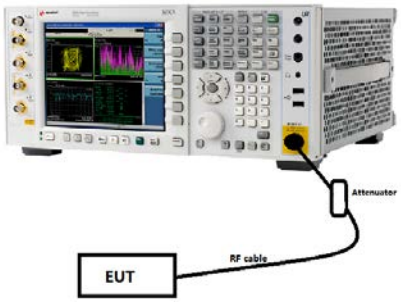
Please refer to Appendix A

5. DTS Bandwidth

5.1 Standard Applicable

According to 15.247(a)(2), systems using digital modulation techniques may operate in the 902–928MHz, 2400–2483.5MHz, and 5725–5850MHz bands. The minimum 6 dB bandwidth shall be at least 500kHz.

5.2 Test Setup Block Diagram



5.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

a) Set RBW = 100kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.4 Summary of Test Results/Plots

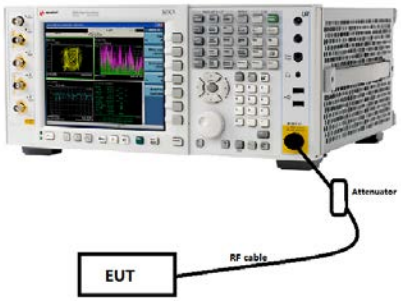
Please refer to Appendix B

6. RF Output Power

6.1 Standard Applicable

According to 15.247(b)(3), for systems using digital modulation in the 902–928MHz, 2400–2483.5MHz, and 5725–5850MHz bands: 1 Watt.

6.2 Test Setup Block Diagram



6.3 Test Procedure

According to the KDB-558074 D01 v05r02 Sub clause 8.3.2.2 and ANSI C63.10-2013 Sub clause 11.9.2.2, when this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth.

a) Set span to at least 1.5 times the OBW.
b) Set RBW = 1-5% of the OBW, not to exceed 1MHz.
c) Set VBW ≥ 3 x RBW.
d) Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
e) Sweep time = auto.
f) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
g) If transmit duty cycle < 98 %, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”.
h) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

6.4 Summary of Test Results/Plots

Please refer to Appendix C

7. Field Strength of Spurious Emissions

7.1 Standard Applicable

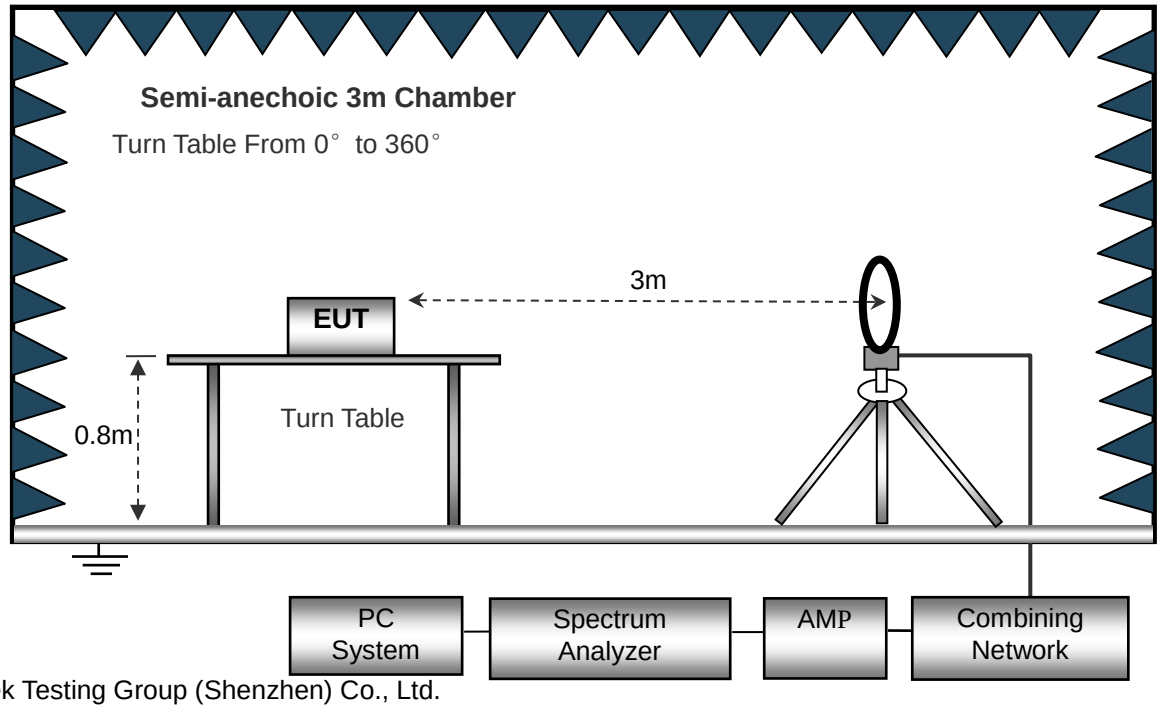
According to §15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

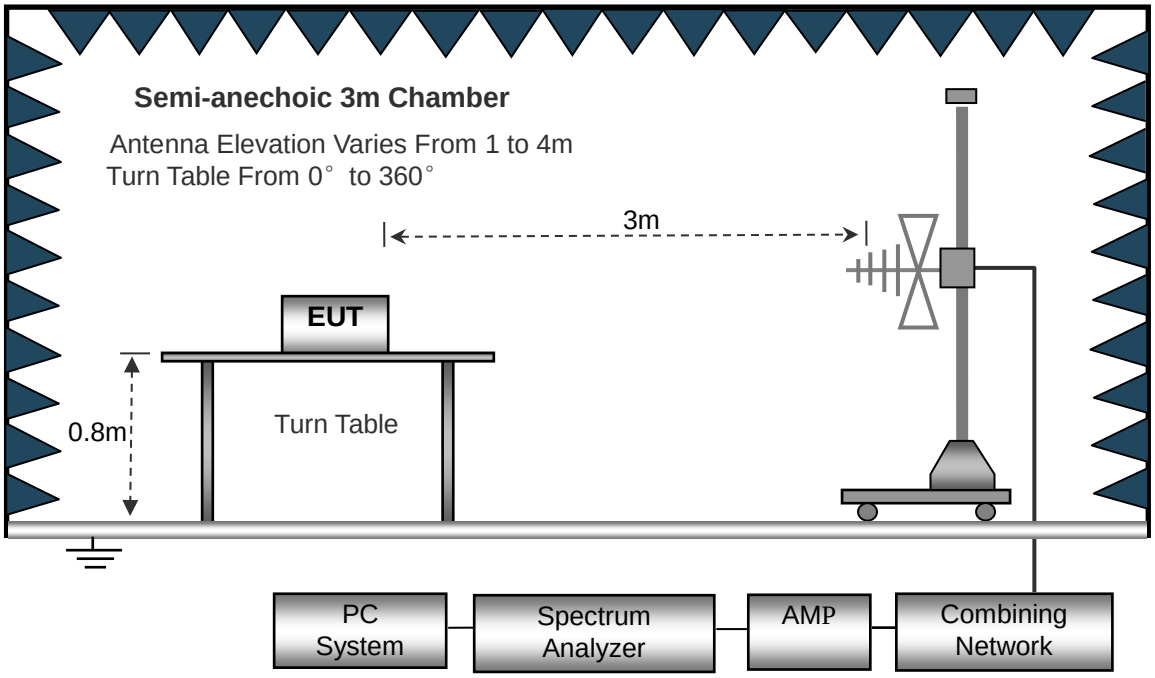
7.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle. The spacing between the peripherals was 10cm.

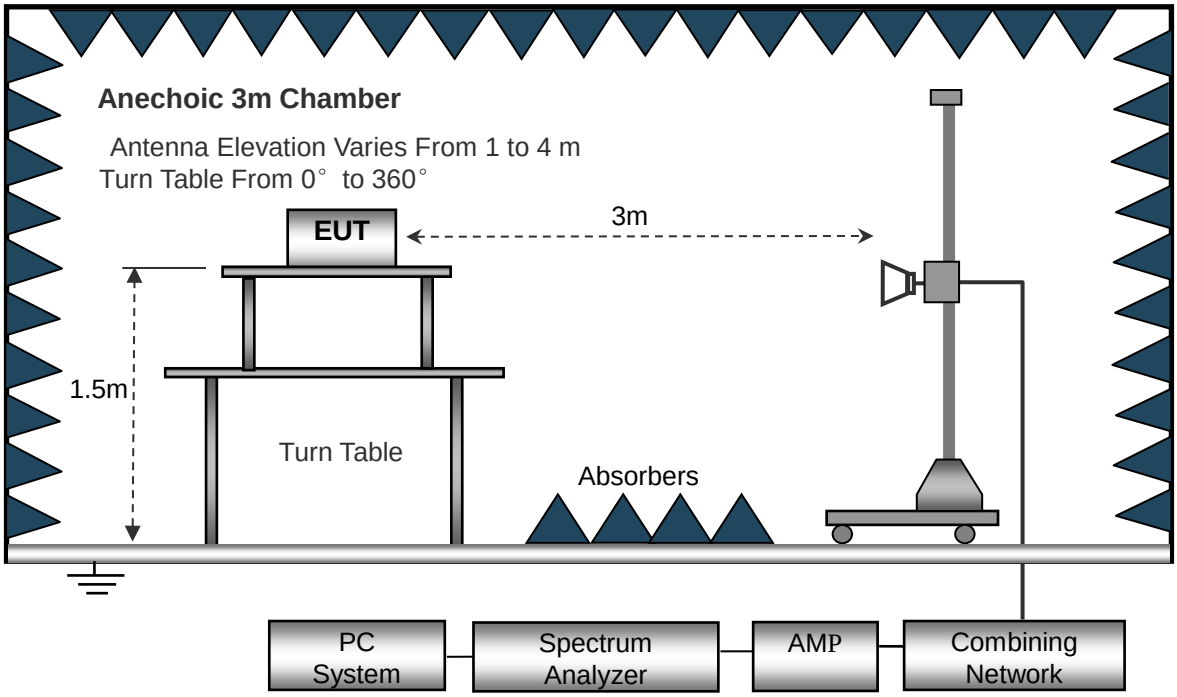
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1GHz.



Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold
Detector function = peak	Detector function = peak, QP	Detector function = peak, AV

7.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

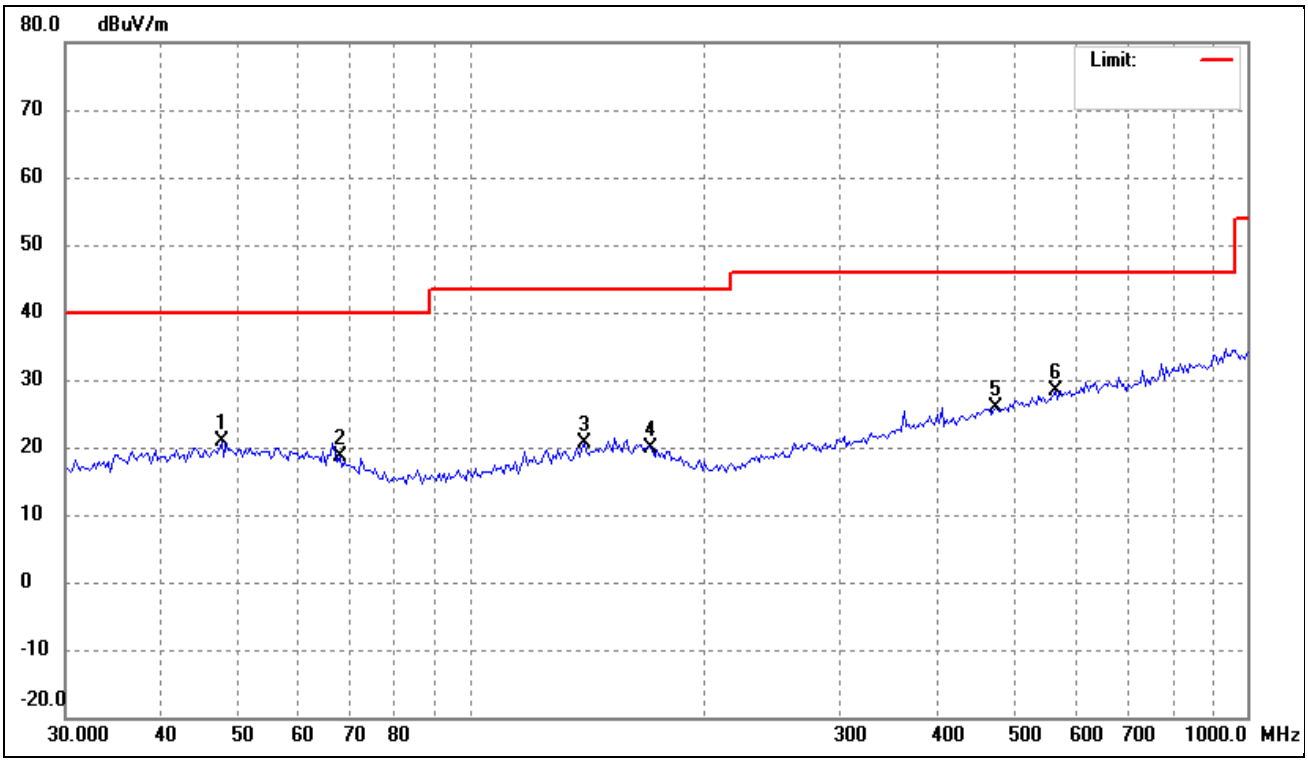
Margin = Corr. Ampl. – FCC Part 15 Limit

7.4 Summary of Test Results/Plots

Note: 1.This EUT was tested in 3 orthogonal positions and the worst case position data was reported.
All test modes (different data rate and different modulation) are performed, but only the worst case(802.11b_ 11Mbps) is recorded in this report.

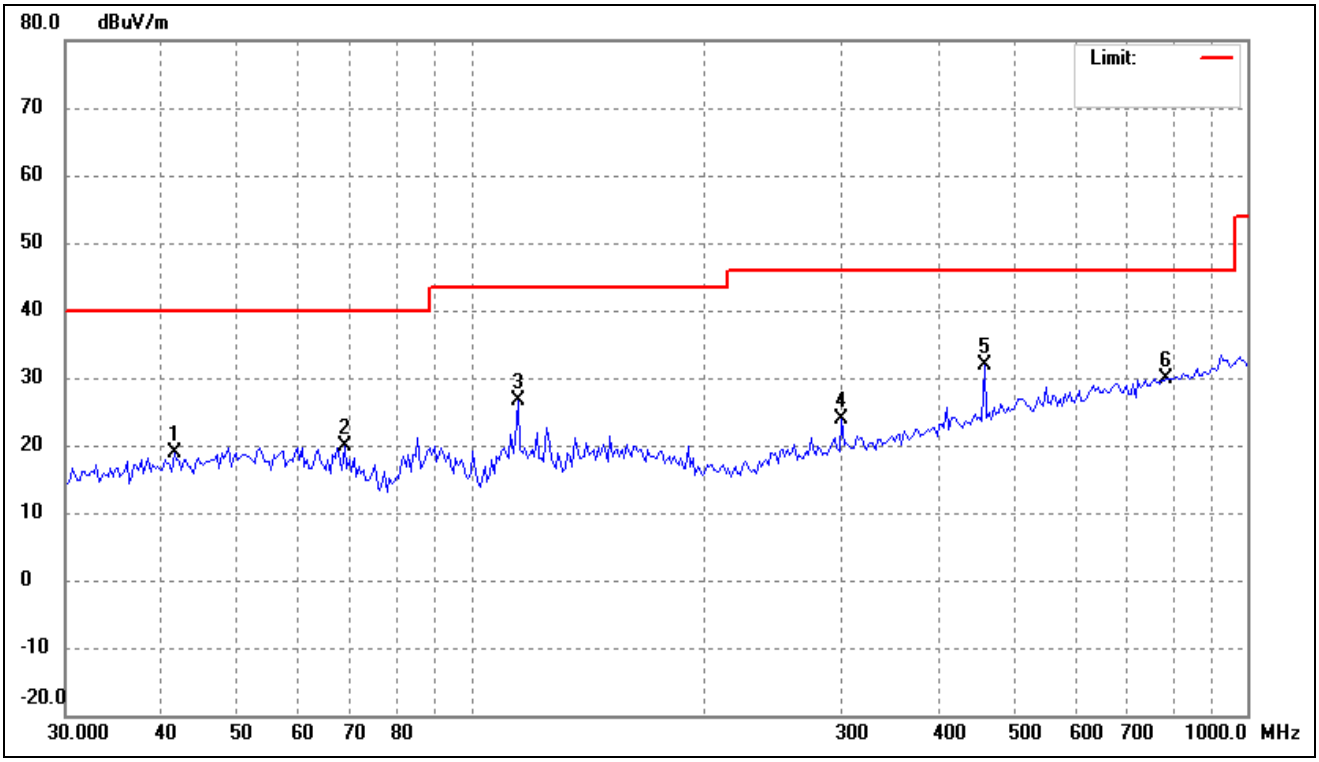
➢ Spurious Emissions Below 1GHz

802.11b_11Mbps			
Test Channel	Low	Polarity:	Horizontal



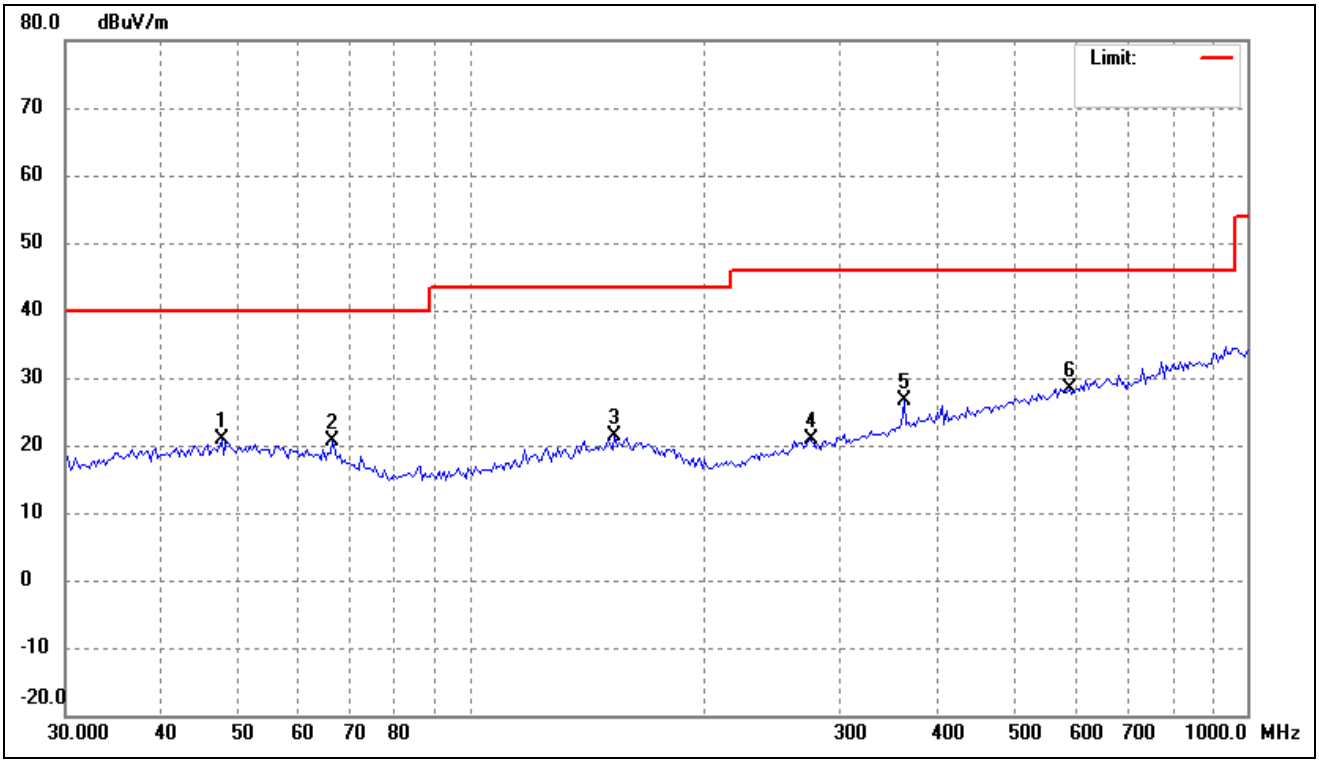
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(·)	(cm)	
1	47.7028	29.13	-8.27	20.86	40.00	-19.14	-	-	peak
2	67.7856	29.00	-10.36	18.64	40.00	-21.36	-	-	peak
3	139.7909	30.05	-9.44	20.61	43.50	-22.89	-	-	peak
4	170.1888	28.83	-8.91	19.92	43.50	-23.58	-	-	peak
5	474.7913	30.13	-4.24	25.89	46.00	-20.11	-	-	peak
6	565.9776	30.76	-2.47	28.29	46.00	-17.71	-	-	peak

802.11b_11Mbps			
Test Channel	Low	Polarity:	Vertical



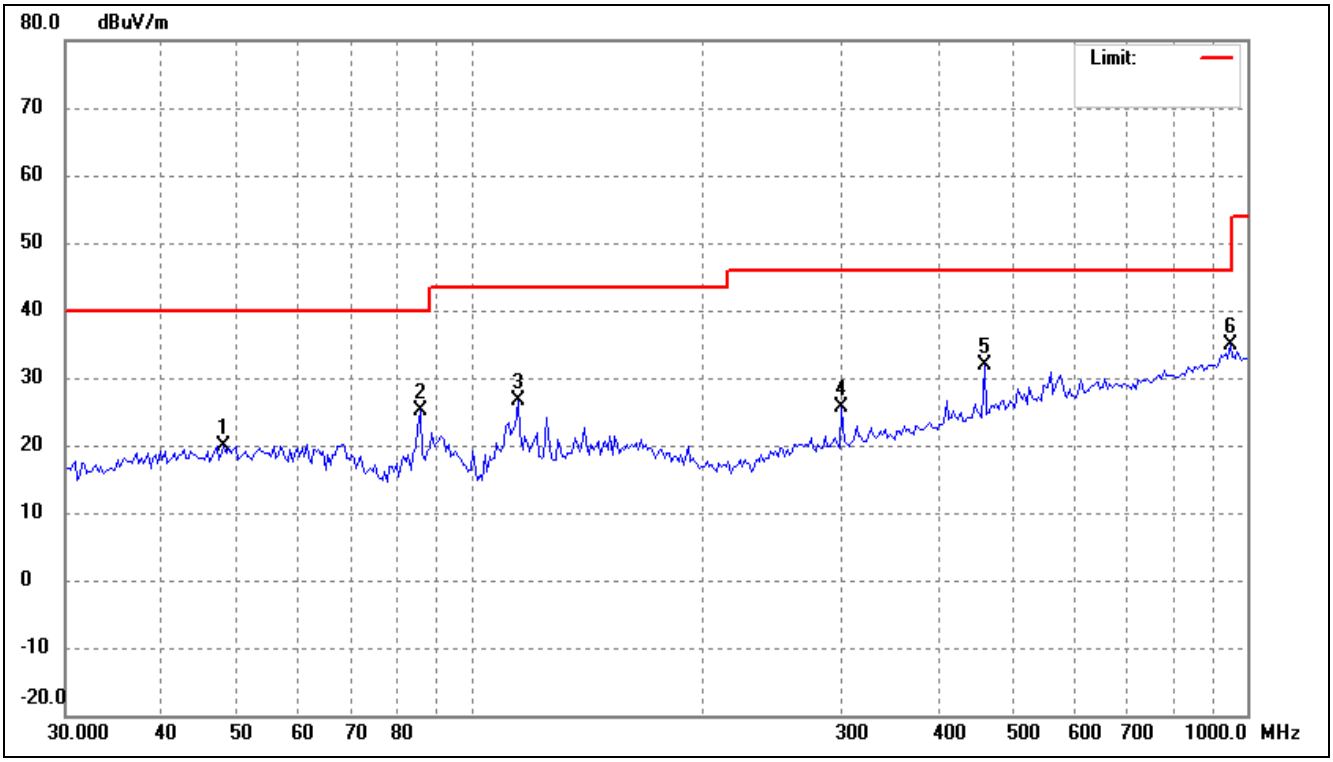
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(·)	(cm)	
1	41.4483	27.48	-8.48	19.00	40.00	-21.00	-	-	peak
2	68.7450	30.41	-10.54	19.87	40.00	-20.13	-	-	peak
3	114.8224	37.62	-11.07	26.55	43.50	-16.95	-	-	peak
4	300.6988	32.19	-8.24	23.95	46.00	-22.05	-	-	peak
5	458.3987	36.27	-4.47	31.80	46.00	-14.20	-	-	peak
6	787.4749	29.75	0.19	29.94	46.00	-16.06	-	-	peak

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Horizontal



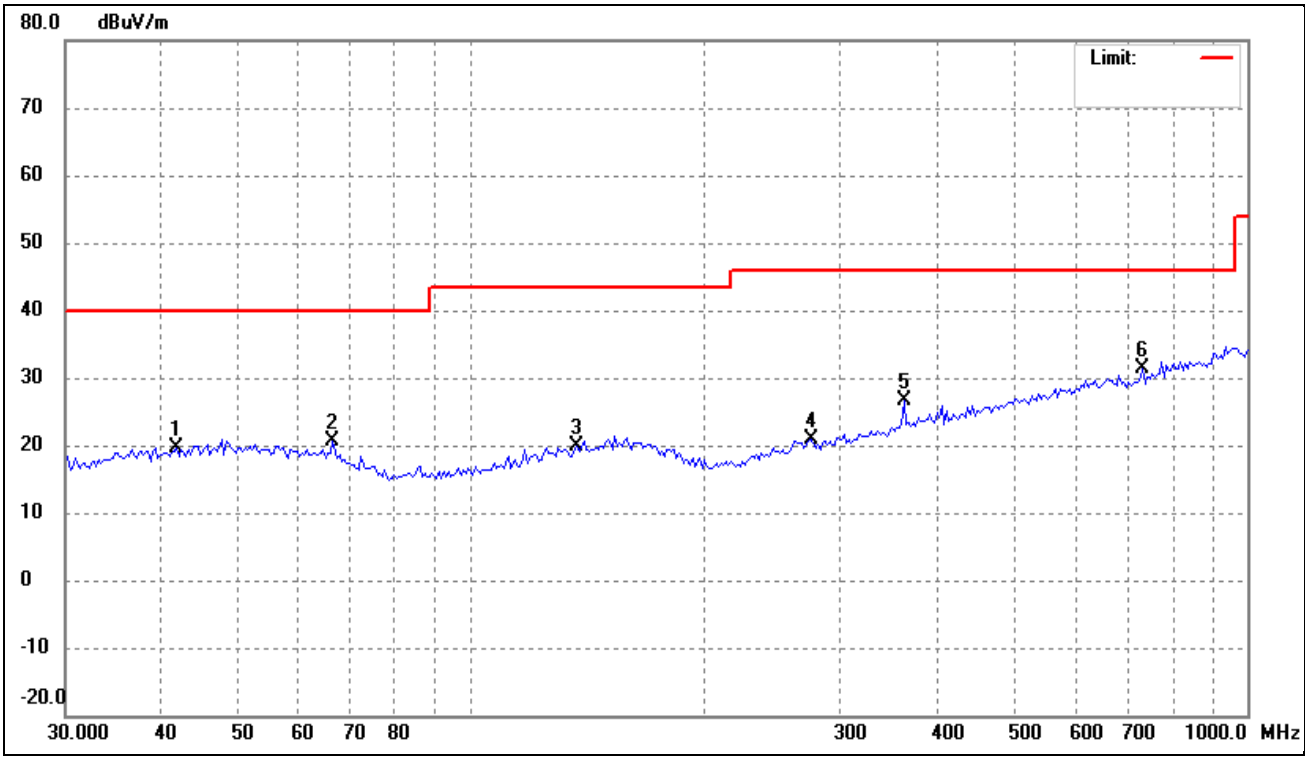
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(·)	(cm)	
1	47.7028	29.13	-8.27	20.86	40.00	-19.14	-	-	peak
2	66.3715	30.63	-10.11	20.52	40.00	-19.48	-	-	peak
3	153.1627	29.89	-8.61	21.28	43.50	-22.22	-	-	peak
4	274.4464	30.05	-9.13	20.92	46.00	-25.08	-	-	peak
5	360.9775	33.34	-6.83	26.51	46.00	-19.49	-	-	peak
6	590.3511	30.38	-1.94	28.44	46.00	-17.56	-	-	peak

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Vertical



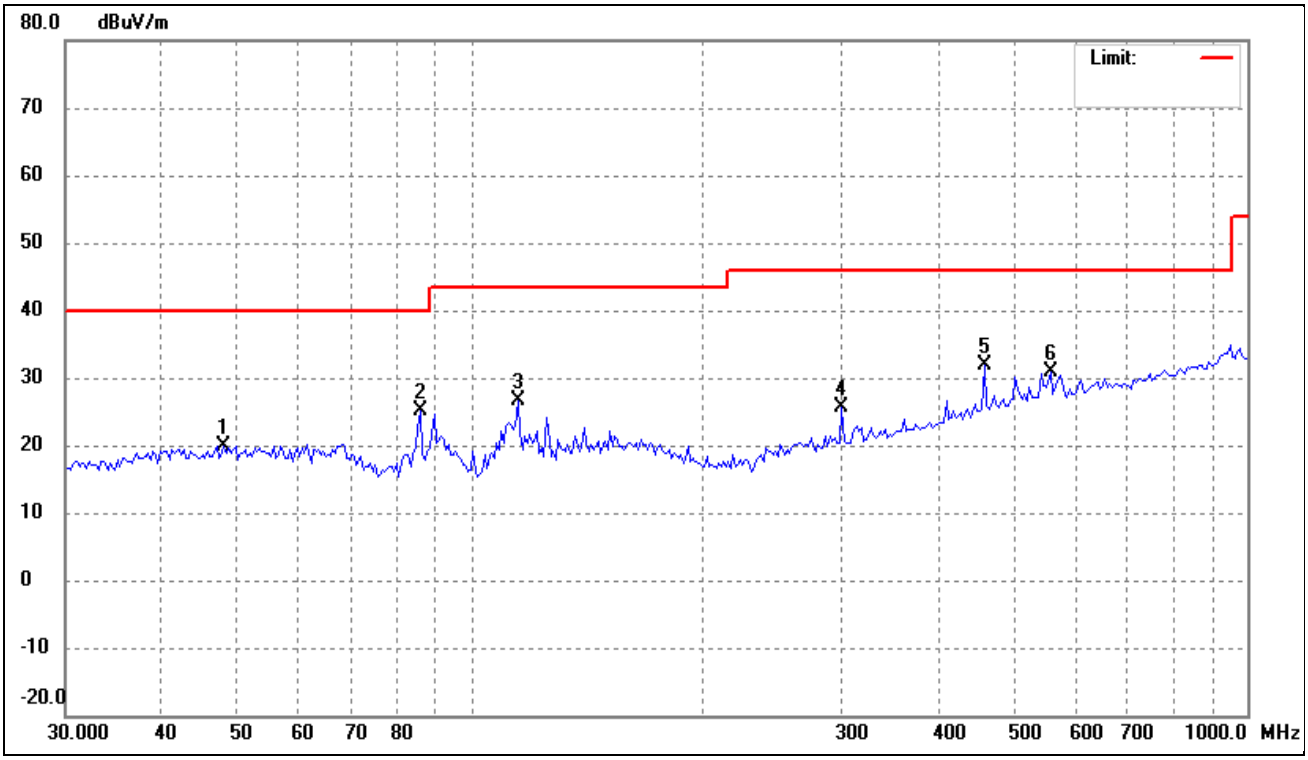
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(·)	(cm)	
1	48.0392	28.23	-8.23	20.00	40.00	-20.00	-	-	peak
2	86.0796	38.11	-13.04	25.07	40.00	-14.93	-	-	peak
3	114.8224	37.62	-11.07	26.55	43.50	-16.95	-	-	peak
4	300.6988	33.80	-8.24	25.56	46.00	-20.44	-	-	peak
5	458.3987	36.27	-4.47	31.80	46.00	-14.20	-	-	peak
6	952.0001	32.62	2.25	34.87	46.00	-11.13	-	-	peak

802.11b_11Mbps			
Test Channel	High	Polarity:	Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(·)	(cm)	
1	41.7406	28.20	-8.47	19.73	40.00	-20.27	-	-	peak
2	66.3715	30.63	-10.11	20.52	40.00	-19.48	-	-	peak
3	136.8747	29.33	-9.56	19.77	43.50	-23.73	-	-	peak
4	274.4464	30.05	-9.13	20.92	46.00	-25.08	-	-	peak
5	360.9775	33.34	-6.83	26.51	46.00	-19.49	-	-	peak
6	734.0373	31.82	-0.46	31.36	46.00	-14.64	-	-	peak

802.11b_11Mbps			
Test Channel	High	Polarity:	Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(·)	(cm)	
1	48.0392	28.23	-8.23	20.00	40.00	-20.00	-	-	peak
2	86.0796	38.11	-13.04	25.07	40.00	-14.93	-	-	peak
3	114.8224	37.62	-11.07	26.55	43.50	-16.95	-	-	peak
4	300.6988	33.80	-8.24	25.56	46.00	-20.44	-	-	peak
5	458.3987	36.27	-4.47	31.80	46.00	-14.20	-	-	peak
6	558.0788	33.43	-2.66	30.77	46.00	-15.23	-	-	peak

Remark: '-'Means' the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

- Spurious Emissions Above 1GHz
- *Test Mode: 802.11b_11Mbps (worst case)*

Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polar H/V	Detector
Low Channel-2412MHz							
4824.00	60.09	-4.50	55.59	74	-18.41	H	PK
4824.00	51.44	-4.50	46.94	54	-7.06	H	AV
7236.00	53.99	1.14	55.13	74	-18.87	H	PK
7236.00	45.79	1.14	46.93	54	-7.07	H	AV
4824.00	58.93	-4.50	54.43	74	-19.57	V	PK
4824.00	50.25	-4.50	45.75	54	-8.25	V	AV
7236.00	51.54	1.14	52.68	74	-21.32	V	PK
7236.00	42.17	1.14	43.31	54	-10.69	V	AV
Middle Channel-2437MHz							
4874.00	60.66	-4.47	56.19	74	-17.81	H	PK
4874.00	50.25	-4.47	45.78	54	-8.22	H	AV
7311.00	55.73	1.47	57.20	74	-16.80	H	PK
7311.00	44.50	1.47	45.97	54	-8.03	H	AV
4874.00	60.62	-4.47	56.15	74	-17.85	V	PK
4874.00	50.49	-4.47	46.02	54	-7.98	V	AV
7311.00	50.87	1.47	52.34	74	-21.66	V	PK
7311.00	43.49	1.47	44.96	54	-9.04	V	AV
High Channel-2462MHz							
4924.00	57.90	-4.44	53.46	74	-20.54	H	PK
4924.00	50.21	-4.44	45.77	54	-8.23	H	AV
7386.00	52.76	1.79	54.55	74	-19.45	H	PK
7386.00	44.56	1.79	46.35	54	-7.65	H	AV
4924.00	59.70	-4.44	55.26	74	-18.74	V	PK
4924.00	53.30	-4.44	48.86	54	-5.14	V	AV
7386.00	50.23	1.79	52.02	74	-21.98	V	PK
7440.00	42.04	1.79	43.83	54	-10.17	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

8. Out of Band Emissions

8.1 Standard Applicable

According to §15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

8.2 Test Procedure

According to the KDB 558074D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.11, the Emissions in nonrestricted frequency bands test method as follows:

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100kHz.
c) Set the VBW ≥ [3 × RBW].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the peak marker function to determine the maximum amplitude level.

According to the KDB 558074 D01 v05r02 Subclause 8.5 and ANSI C63.10-2013 Subclause 11.12, the Emissions in restricted frequency bands test method as follows:

A. Radiated emission measurements:
Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)
RBW = 1MHz, VBW = 1MHz for peak value measured
RBW = 1MHz, VBW = 10Hz for average value measured
Sweep = auto; Detector function = peak/average; Trace = max hold
All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission

must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

B. Antenna-port conducted measurements

Peak emission levels are measured by setting the instrument as follows:

a) RBW = as specified in Table 9.

b) VBW ≥ [3 × RBW].

c) Detector = peak.

d) Sweep time = auto.

e) Trace mode = max hold.

f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

Table 9—RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1000 MHz	100 kHz to 120 kHz
>1000 MHz	1 MHz

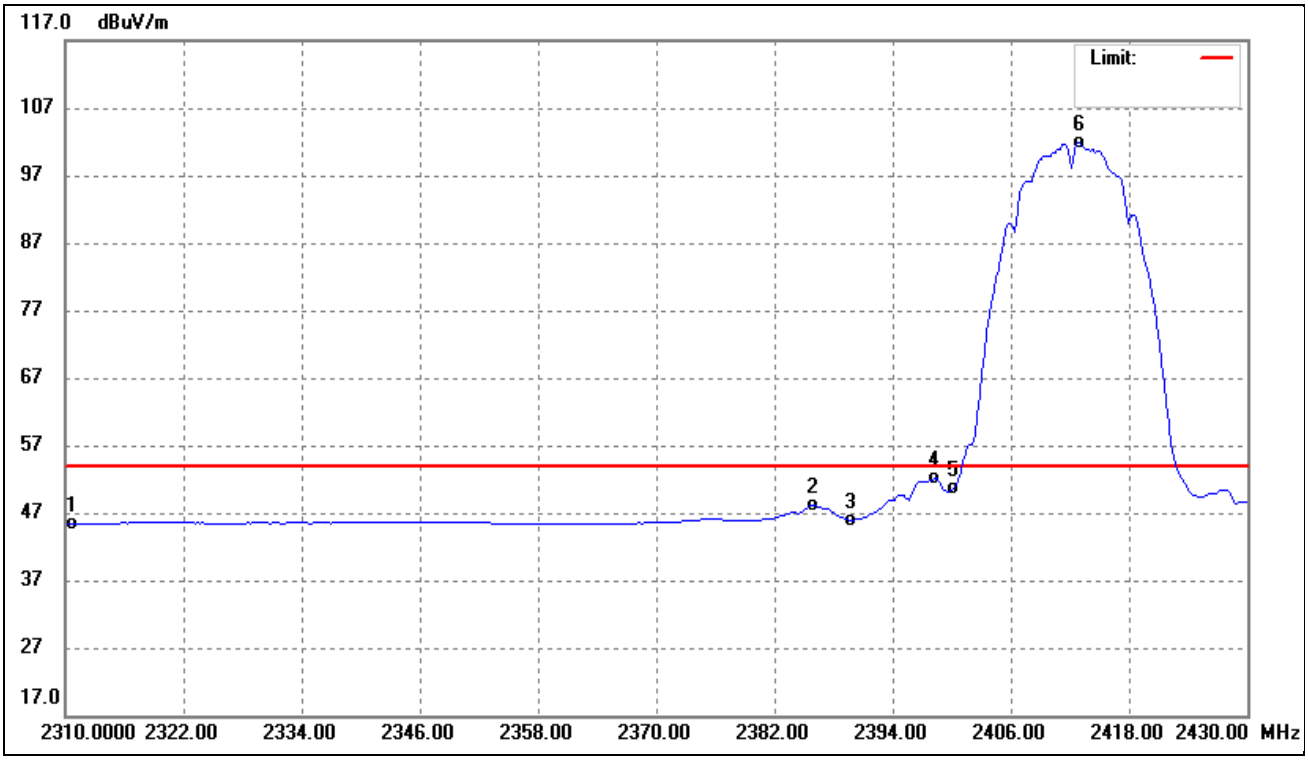
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

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 specified in section 8.1. Report the three highest emissions relative to the limit.

8.3 Summary of Test Results/Plots

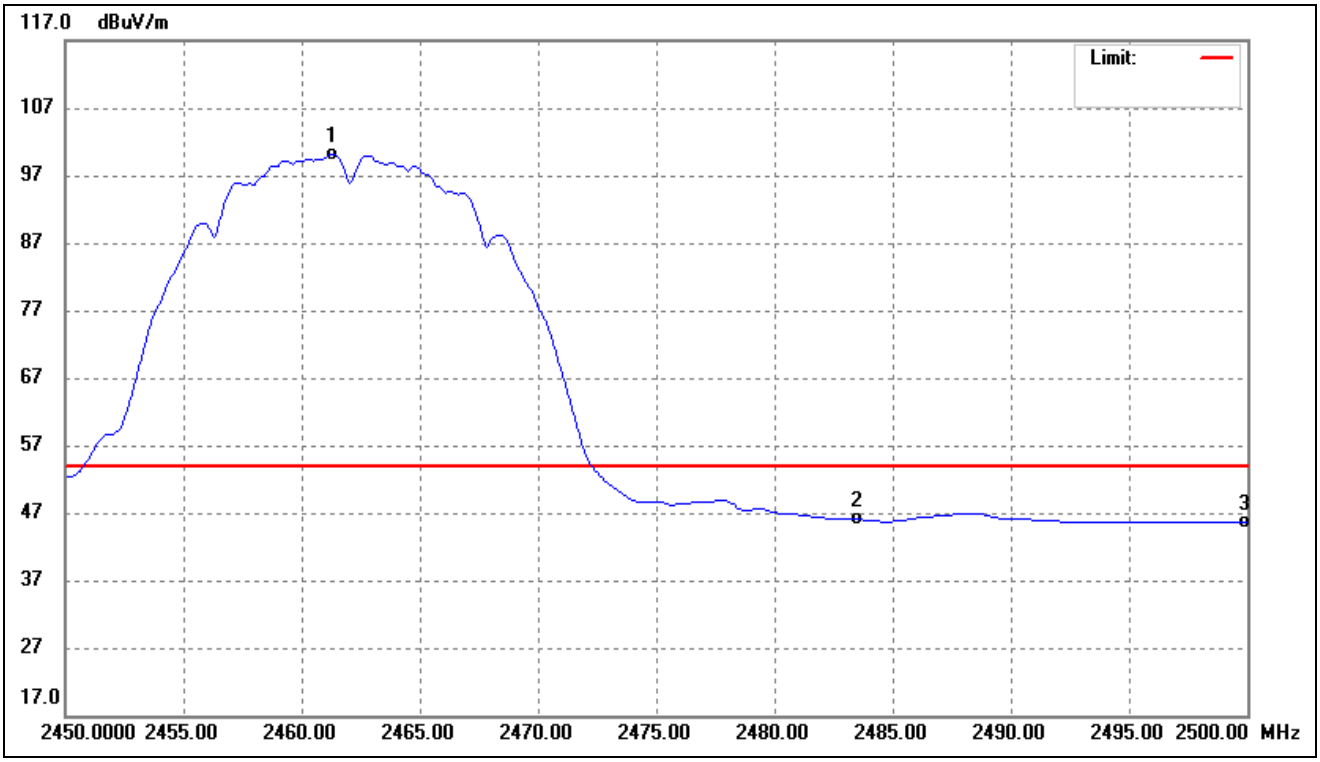
➢ Radiated test

802.11b_11Mbps			
Test Channel	Low	Polarity:	Horizontal(worst case)



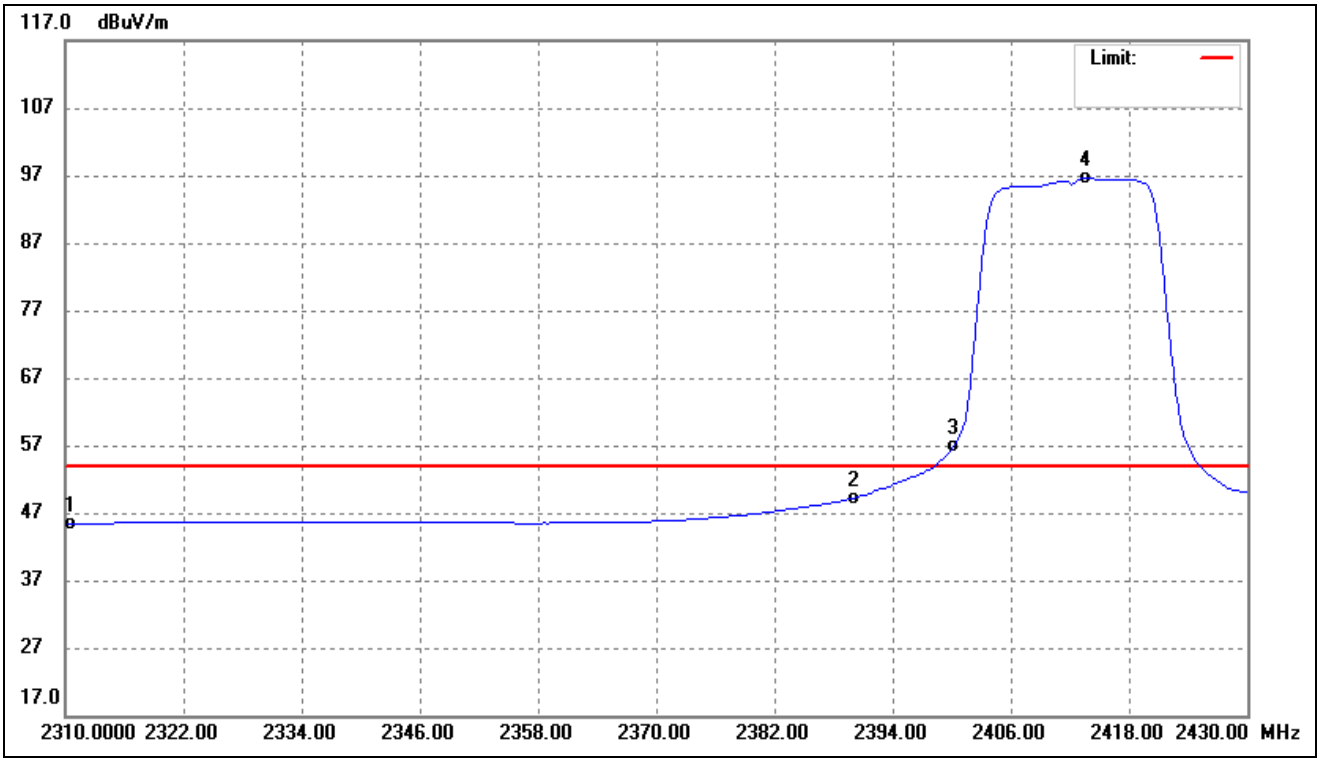
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	44.32	0.98	45.30	54.00	-8.70	Average Detector
	2310.000	56.81	0.98	57.79	74.00	-16.21	Peak Detector
2	2385.992	47.03	1.13	48.16	54.00	-5.84	Average Detector
3	2390.000	44.82	1.13	45.95	54.00	-8.05	Average Detector
	2390.000	57.46	1.13	58.59	74.00	-15.41	Peak Detector
4	2398.257	50.89	1.15	52.04	Delta=49.86dBc		Average Detector
5	2400.000	49.58	1.15	50.73			Average Detector
6	2412.926	100.72	1.18	101.90			Average Detector

802.11b_11Mbps			
Test Channel	High	Polarity:	Horizontal(worst case)



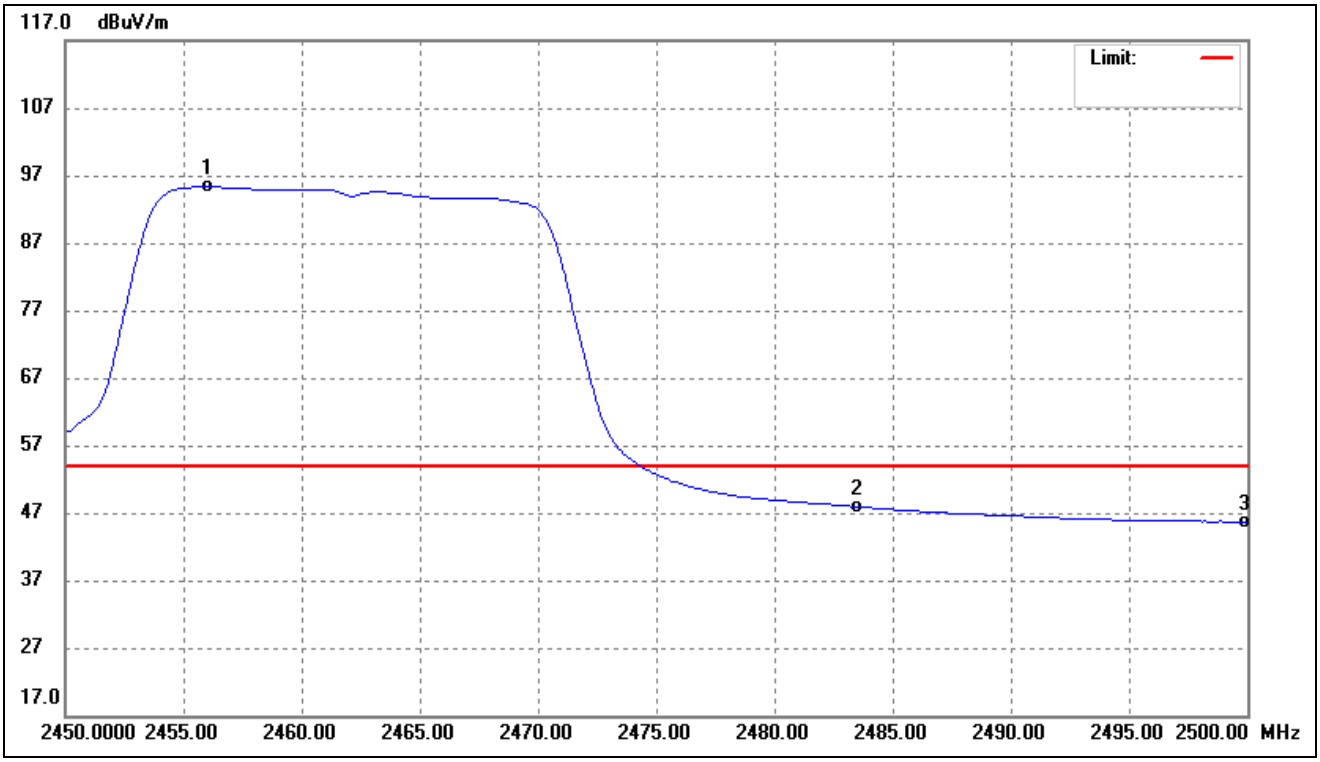
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2461.323	98.98	1.27	100.25	/	/	Average Detector
	2460.521	103.48	1.27	104.75	/	/	Peak Detector
2	2483.500	44.75	1.32	46.07	54.00	-7.93	Average Detector
	2483.500	56.83	1.32	58.15	74.00	-15.85	Peak Detector
3	2500.000	44.28	1.35	45.63	54.00	-8.37	Average Detector
	2500.000	56.40	1.35	57.75	74.00	-16.25	Peak Detector

802.11g_54Mbps			
Test Channel	Low	Polarity:	Horizontal(worst case)



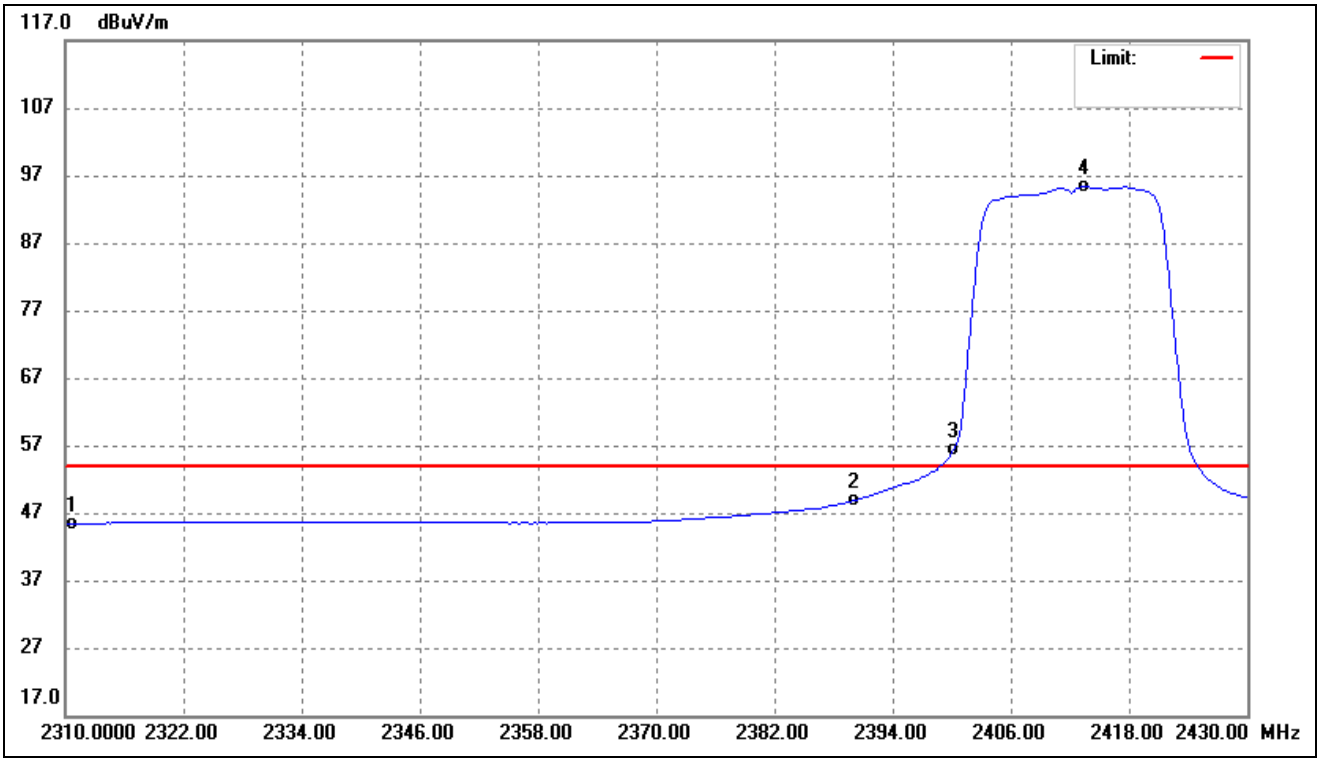
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	44.33	0.98	45.31	54.00	-8.69	Average Detector
	2310.000	56.30	0.98	57.28	74.00	-16.72	Peak Detector
2	2390.000	48.10	1.13	49.23	54.00	-4.77	Average Detector
	2390.000	63.74	1.13	64.87	74.00	-9.13	Peak Detector
3	2400.000	55.62	1.15	56.77	Delta=39.87dBc		Average Detector
4	2413.407	95.46	1.18	96.64			Average Detector

802.11g_54Mbps			
Test Channel	High	Polarity:	Horizontal(worst case)



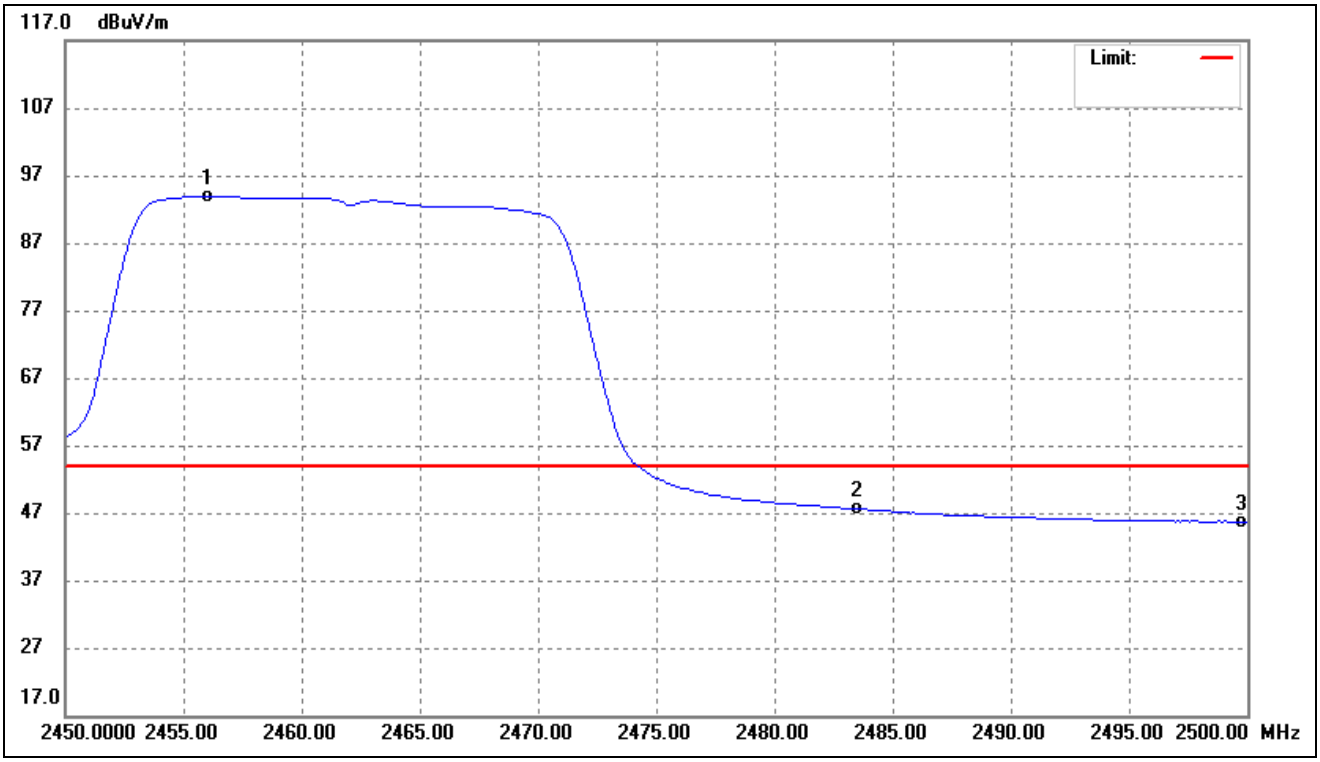
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2456.012	94.11	1.26	95.37	/	/	Average Detector
	2458.617	105.65	1.27	106.92	/	/	Peak Detector
2	2483.500	46.59	1.32	47.91	54.00	-6.09	Average Detector
	2483.500	61.88	1.32	63.20	74.00	-10.80	Peak Detector
3	2500.000	44.34	1.35	45.69	54.00	-8.31	Average Detector
	2500.000	57.10	1.35	58.45	74.00	-15.55	Peak Detector

802.11n-HT20_MCS7			
Test Channel	Low	Polarity:	Horizontal(worst case)



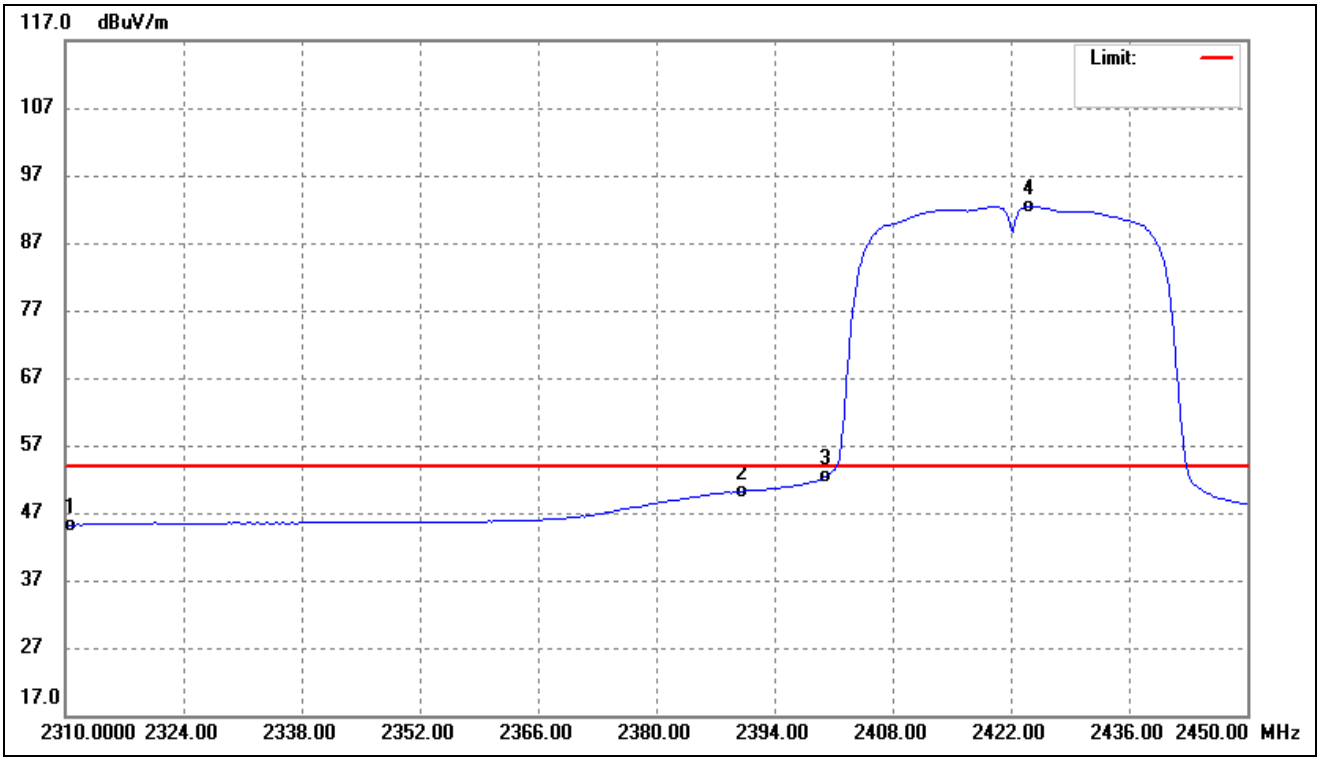
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	44.33	0.98	45.31	54.00	-8.69	Average Detector
	2310.000	57.34	0.98	58.32	74.00	-15.68	Peak Detector
2	2390.000	47.66	1.13	48.79	54.00	-5.21	Average Detector
	2390.000	63.25	1.13	64.38	74.00	-9.62	Peak Detector
3	2400.000	55.26	1.15	56.41	Delta=38.91dBc		Average Detector
4	2413.407	94.14	1.18	95.32			Average Detector

802.11n-HT20_MCS7			
Test Channel	High	Polarity:	Horizontal(worst case)



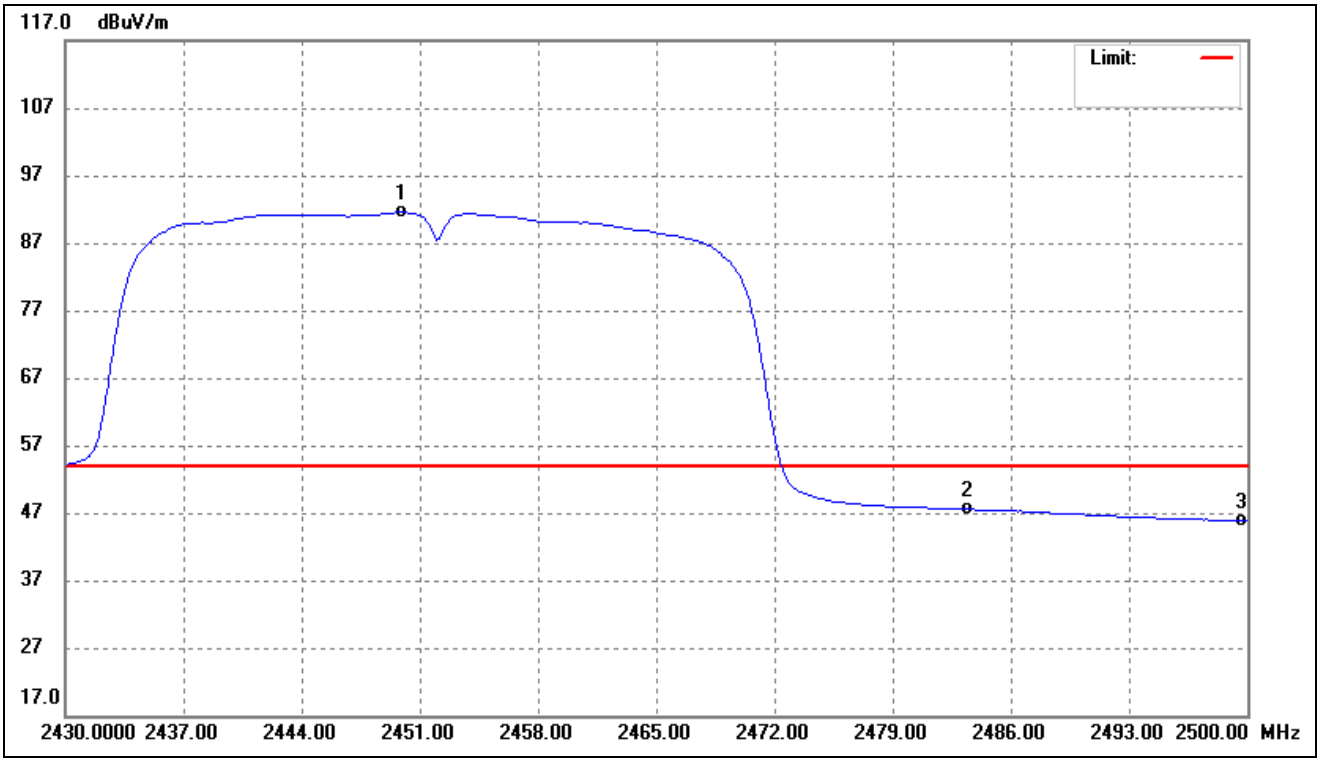
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2455.912	92.67	1.26	93.93	/	/	Average Detector
	2455.511	104.27	1.26	105.53	/	/	Peak Detector
2	2483.500	46.25	1.32	47.57	54.00	-6.43	Average Detector
	2483.500	60.94	1.32	62.26	74.00	-11.74	Peak Detector
3	2500.000	44.35	1.35	45.70	54.00	-8.30	Average Detector
	2500.000	57.00	1.35	58.35	74.00	-15.65	Peak Detector

802.11n-HT40_MCS7			
Test Channel	Low	Polarity:	Horizontal(worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	44.22	0.98	45.20	54.00	-8.80	Average Detector
	2310.000	57.16	0.98	58.14	74.00	-15.86	Peak Detector
2	2390.000	49.08	1.13	50.21	54.00	-3.79	Average Detector
	2390.000	63.27	1.13	64.40	74.00	-9.60	Peak Detector
3	2400.000	51.32	1.15	52.47	Delta=39.92dBc		Average Detector
4	2423.908	91.19	1.20	92.39			Average Detector

802.11n-HT40_MCS7			
Test Channel	High	Polarity:	Horizontal(worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2449.780	90.29	1.25	91.54	/	/	Average Detector
	2448.517	101.97	1.25	103.22	/	/	Peak Detector
2	2483.500	46.25	1.32	47.57	54.00	-6.43	Average Detector
	2483.500	59.74	1.32	61.06	74.00	-12.94	Peak Detector
3	2500.000	44.56	1.35	45.91	54.00	-8.09	Average Detector
	2500.000	58.29	1.35	59.64	74.00	-14.36	Peak Detector

- Conducted test

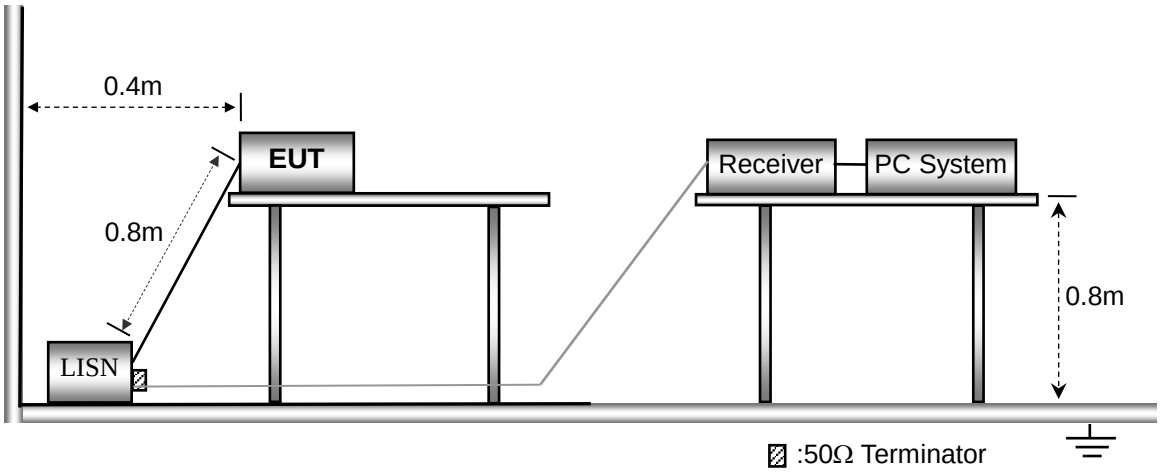
Please refer to Appendix D

9. Conducted Emissions

9.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle. The spacing between the peripherals was 10cm.

9.2 Basic Test Setup Block Diagram



9.3 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency 150kHz
Stop Frequency 30MHz
Sweep Speed ..... Auto
IF Bandwidth..... 10kHz
Quasi-Peak Adapter Bandwidth 9kHz
Quasi-Peak Adapter Mode ..... Normal

9.4 Summary of Test Results/Plots

Not applicable

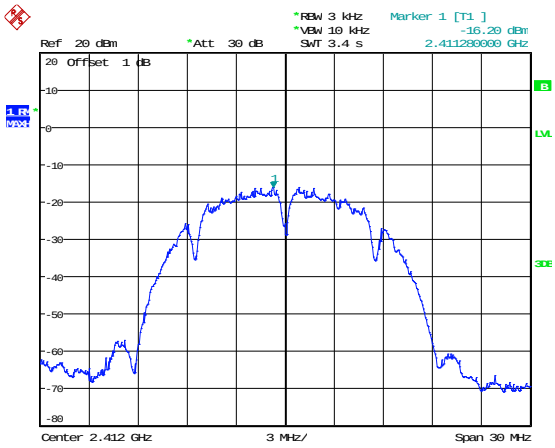
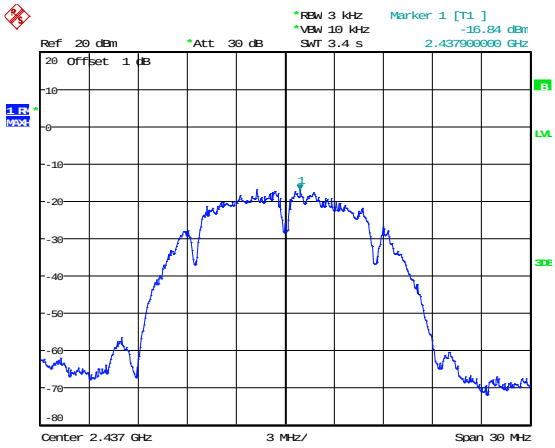
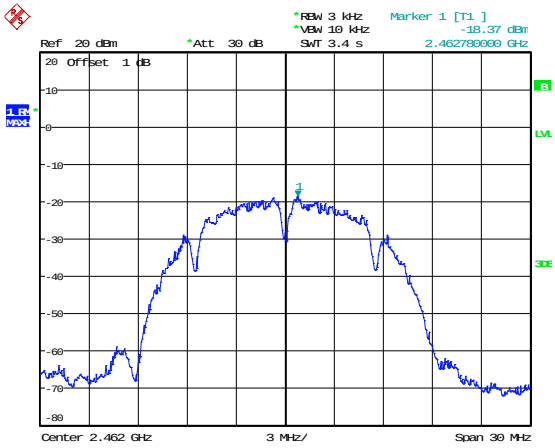
APPENDIX SUMMARY

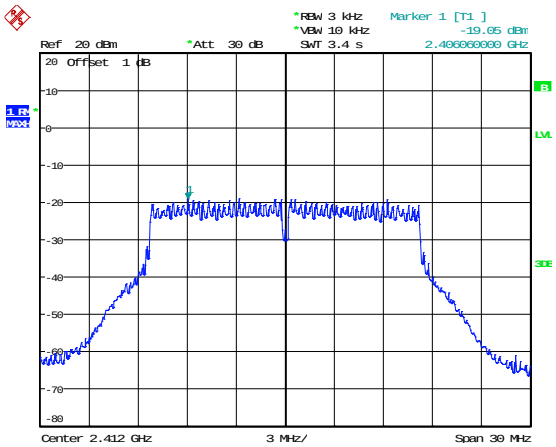
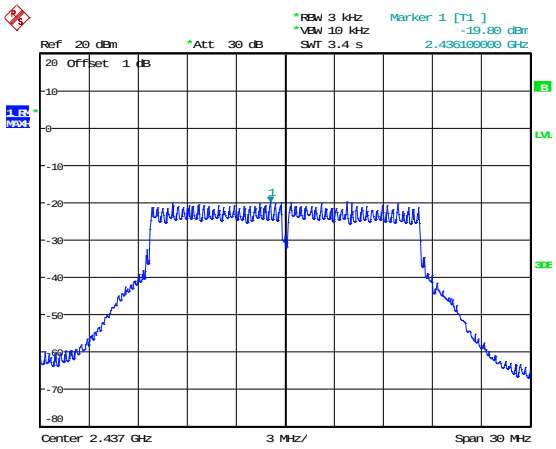
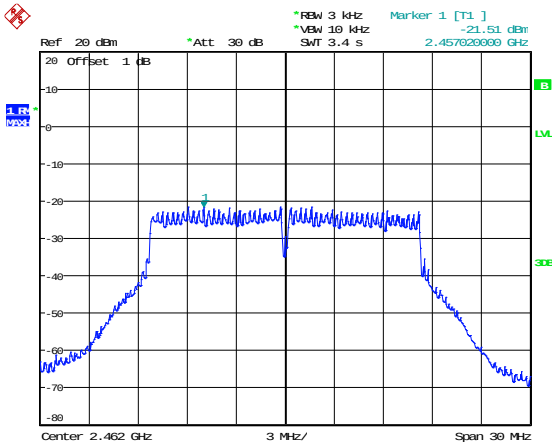
Project No.	WTX23X06128782W	Test Engineer	Timi Huang
Start date	2023/6/19	Finish date	2023/6/19
Temperature	25℃	Humidity	52%
RF specifications	WIFI-2.4G		

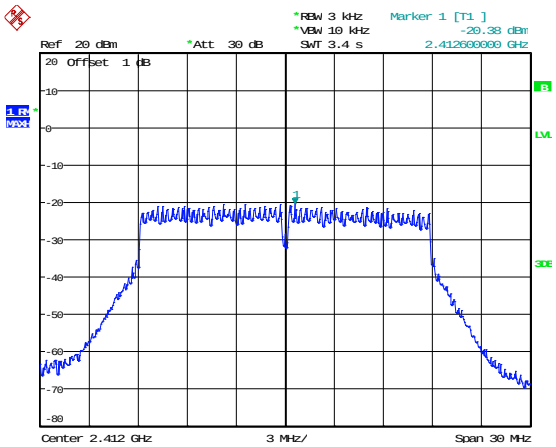
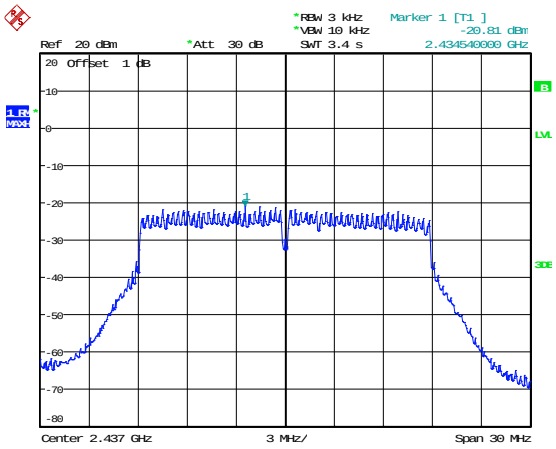
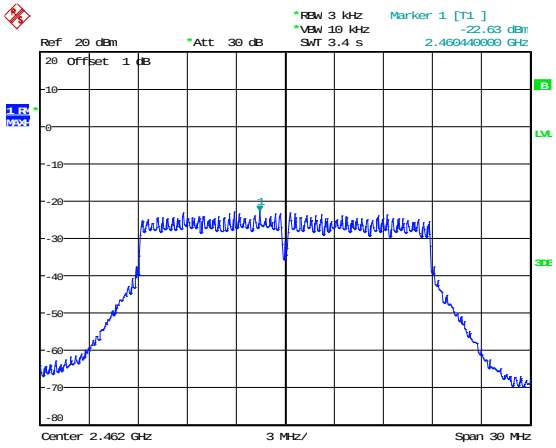
APPENDIX	Description of Test Item	Result
A	Power Spectral Density	Compliant
B	DTS Bandwidth	Compliant
C	RF Output Power	Compliant
D	Conducted Out of Band Emissions	Compliant

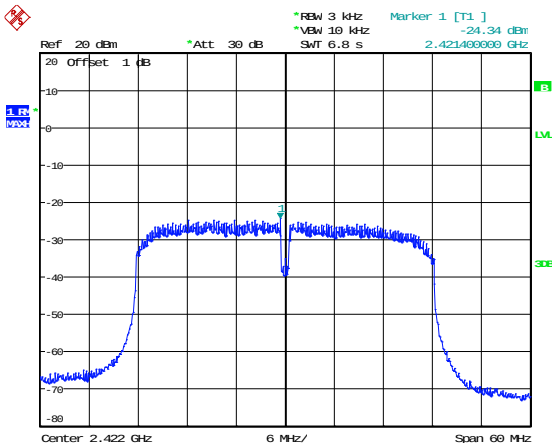
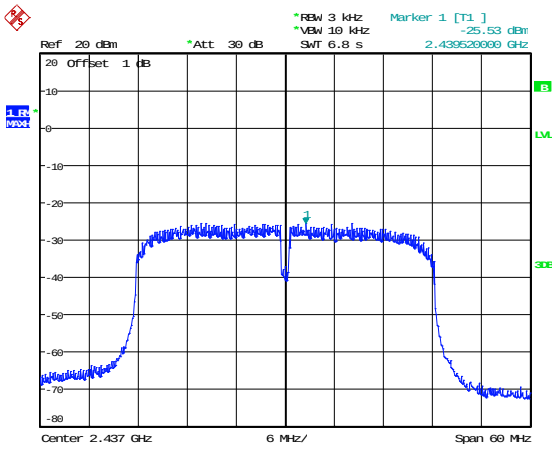
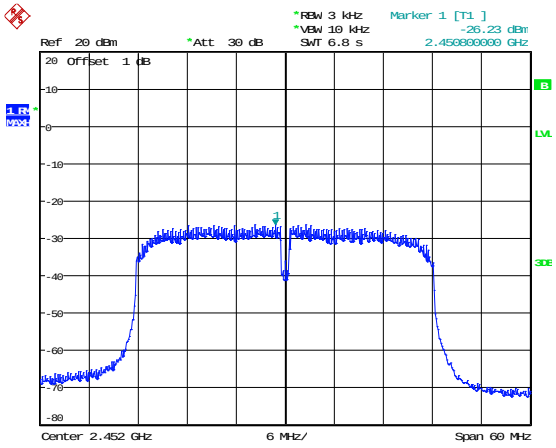
APPENDIX A

Power Spectral Density			
Test Mode	**Test Channel MHz**	**Power Spectral Density dBm/3kHz**	**Limit dBm/3kHz**
802.11b_1Mbps	2412	-16.20	8
	2437	-16.84	8
	2462	-18.37	8
802.11g_6Mbps	2412	-19.05	8
	2437	-19.80	8
	2462	-21.51	8
802.11n-HT20_MCS7	2412	-20.38	8
	2437	-20.81	8
	2462	-22.63	8
802.11n-HT40_MCS7	2422	-24.34	8
	2437	-25.53	8
	2452	-26.23	8

802.11b-Low	 Date: 19.JUN.2023 16:56:08
802.11b-Middle	 Date: 19.JUN.2023 16:56:33
802.11b-High	 Date: 19.JUN.2023 16:56:53

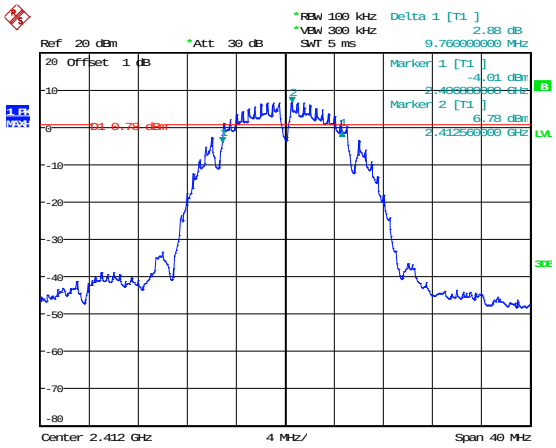
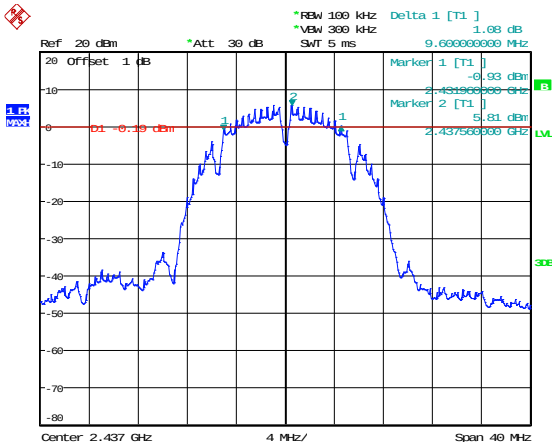
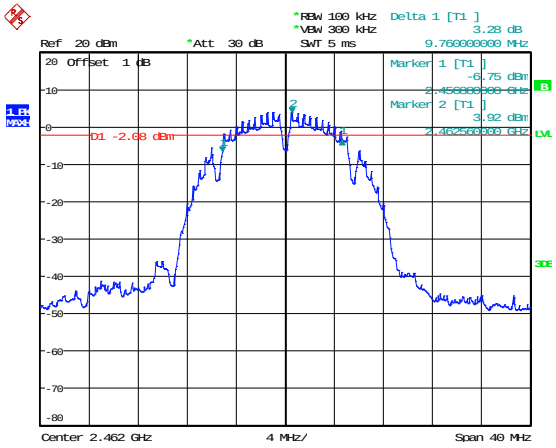
802.11g-Low	 Date: 19.JUN.2023 16:57:18
802.11g-Middle	 Date: 19.JUN.2023 16:57:38
802.11g-High	 Date: 19.JUN.2023 16:58:03

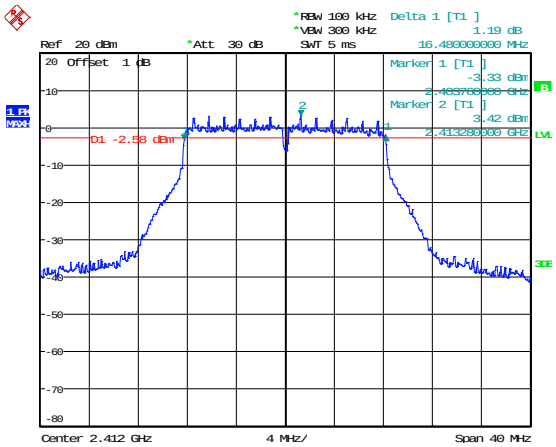
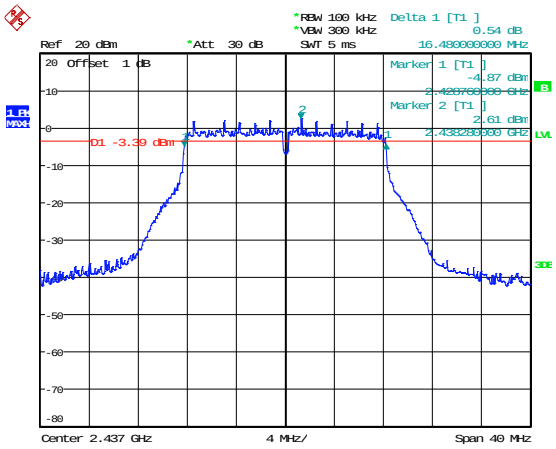
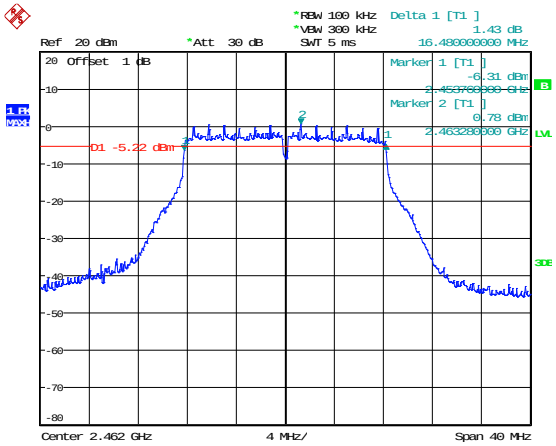
802.11n-HT20-Low	 Date: 19.JUN.2023 16:58:29
802.11n-HT20-Middle	 Date: 19.JUN.2023 16:58:49
802.11n-HT20-High	 Date: 19.JUN.2023 16:59:10

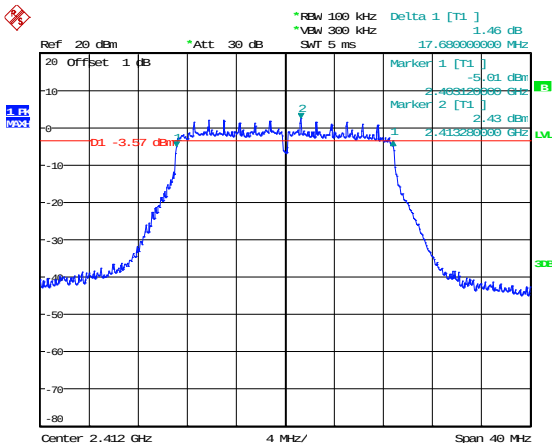
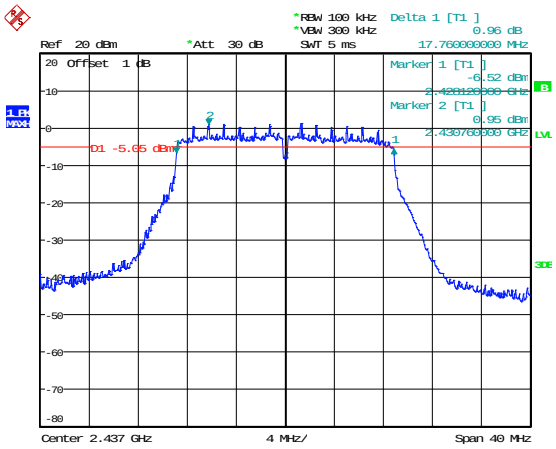
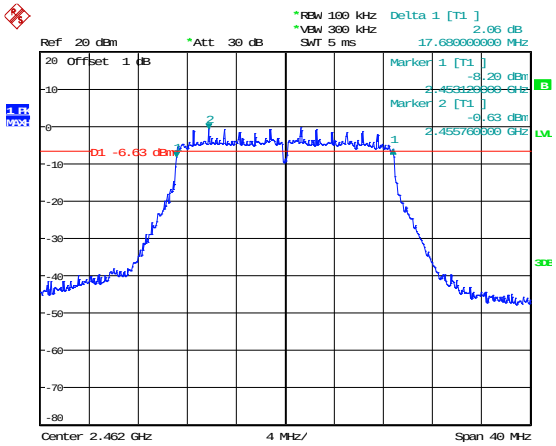
802.11n-HT40-Low	 Date: 19.JUN.2023 16:59:49
802.11n-HT40-Middle	 Date: 19.JUN.2023 17:00:14
802.11n-HT40-High	 Date: 19.JUN.2023 17:00:43

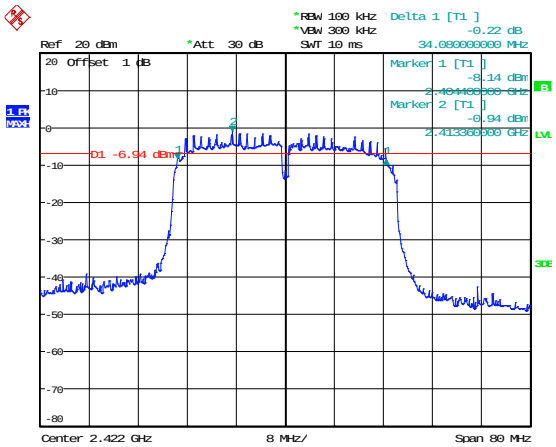
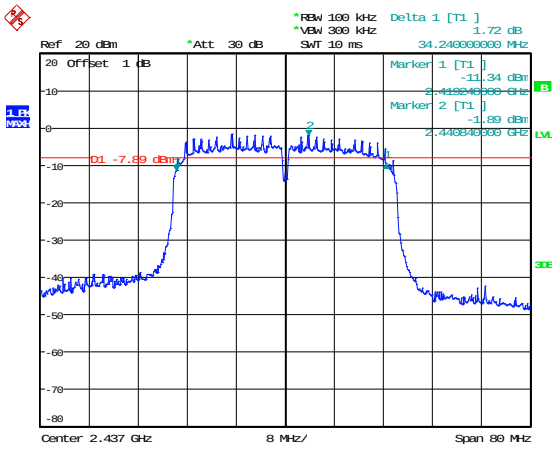
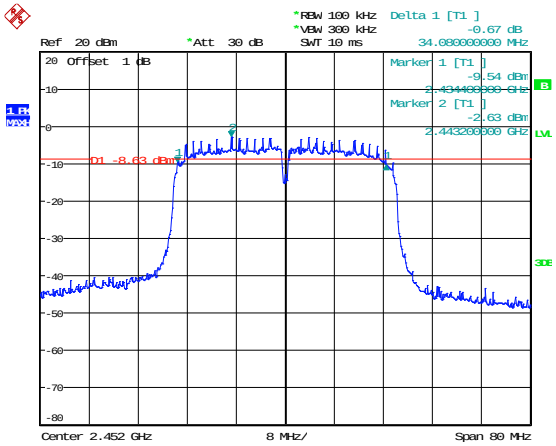
APPENDIX B

DTS Bandwidth			
Test Mode	**Test Channel MHz**	**6 dB Bandwidth MHz**	**Limit kHz**
802.11b_1Mbps	2412	9.76	≥500
	2437	9.60	≥500
	2462	9.76	≥500
802.11g_6Mbps	2412	16.48	≥500
	2437	16.48	≥500
	2462	16.48	≥500
802.11n-HT20_MCS7	2412	17.68	≥500
	2437	17.76	≥500
	2462	17.68	≥500
802.11n-HT40_MCS7	2422	34.08	≥500
	2437	34.24	≥500
	2452	34.08	≥500

802.11b-Low	 Date: 19.JUN.2023 17:04:37
802.11b-Middle	 Date: 19.JUN.2023 17:05:43
802.11b-High	 Date: 19.JUN.2023 17:06:33

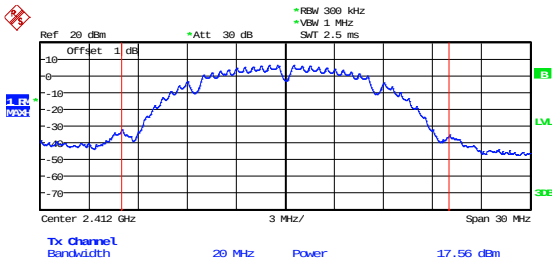
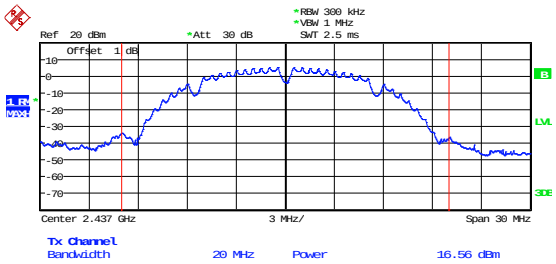
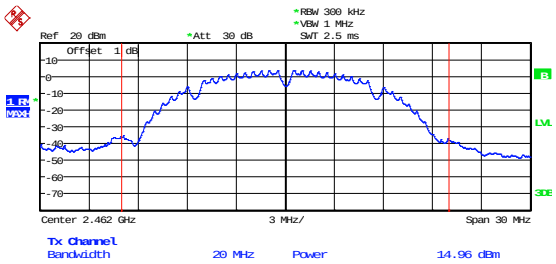
802.11g-Low	 Date: 19.JUN.2023 17:09:03
802.11g-Middle	 Date: 19.JUN.2023 17:09:58
802.11g-High	 Date: 19.JUN.2023 17:11:17

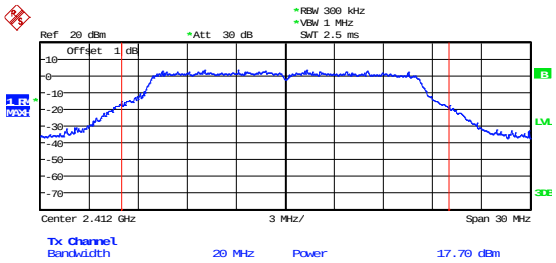
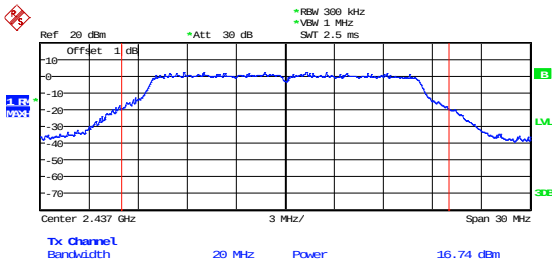
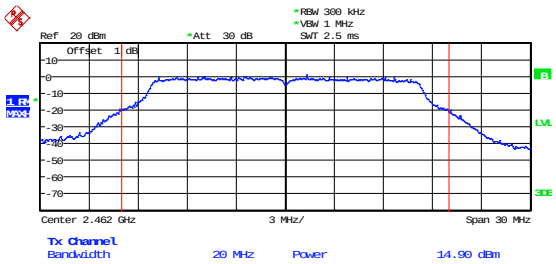
802.11n-HT20-Low	 Date: 19.JUN.2023 17:13:20
802.11n-HT20-Middle	 Date: 19.JUN.2023 17:14:14
802.11n-HT20-High	 Date: 19.JUN.2023 17:14:59

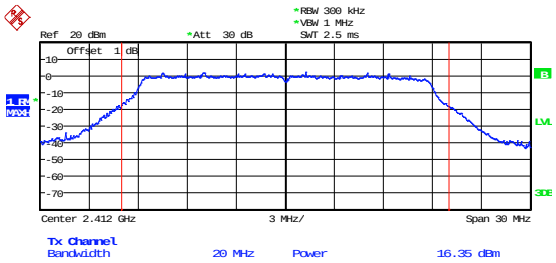
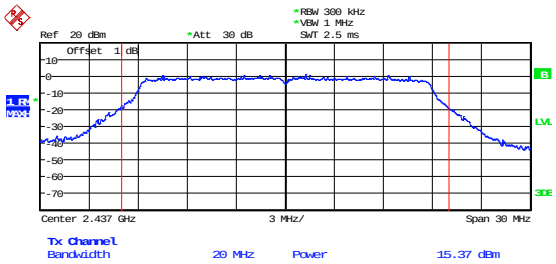
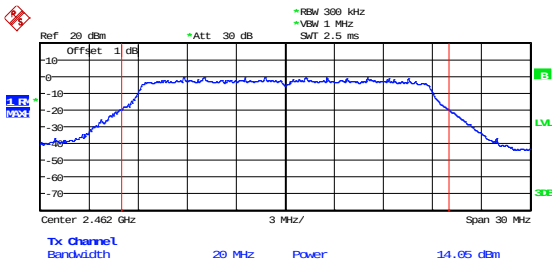
802.11n-HT40-Low	 Date: 19.JUN.2023 17:15:41
802.11n-HT40-Middle	 Date: 19.JUN.2023 17:16:26
802.11n-HT40-High	 Date: 19.JUN.2023 17:17:21

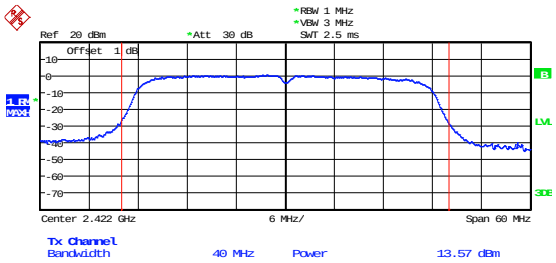
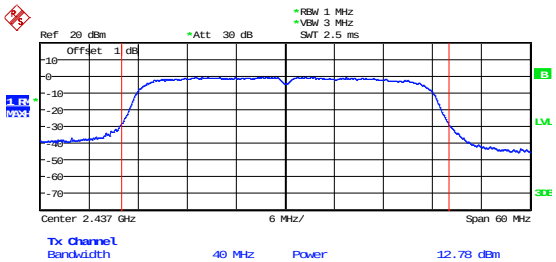
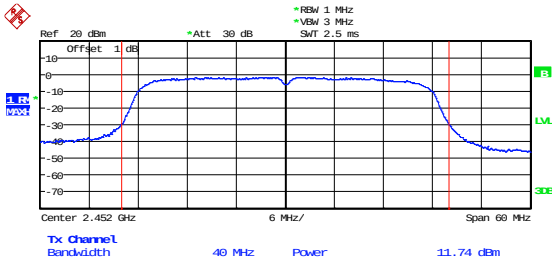
APPENDIX C

Test Mode	Frequency MHz	Reading dBm	Limit dBm
802.11b_1Mbps	2412	17.56	30.00
	2437	16.56	30.00
	2462	14.96	30.00
802.11g_6Mbps	2412	17.70	30.00
	2437	16.74	30.00
	2462	14.90	30.00
802.11n-HT20_MCS7	2412	16.35	30.00
	2437	15.37	30.00
	2462	14.05	30.00
802.11n-HT40_MCS7	2422	13.57	30.00
	2437	12.78	30.00
	2452	11.74	30.00

802.11b-Low	 Date: 19.JUN.2023 16:48:06
802.11b-Middle	 Date: 19.JUN.2023 16:48:51
802.11b-High	 Date: 19.JUN.2023 16:49:30

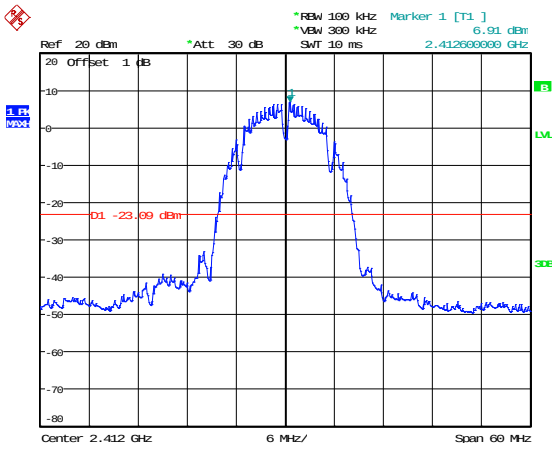
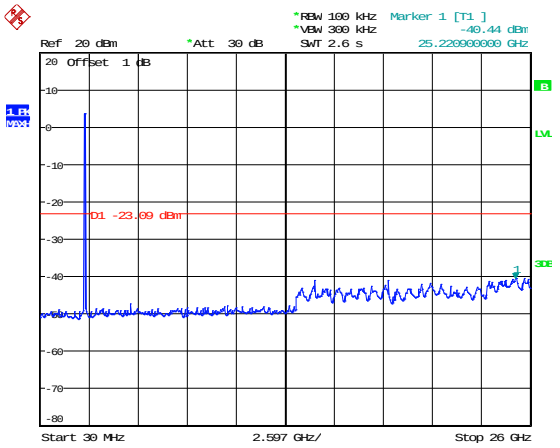
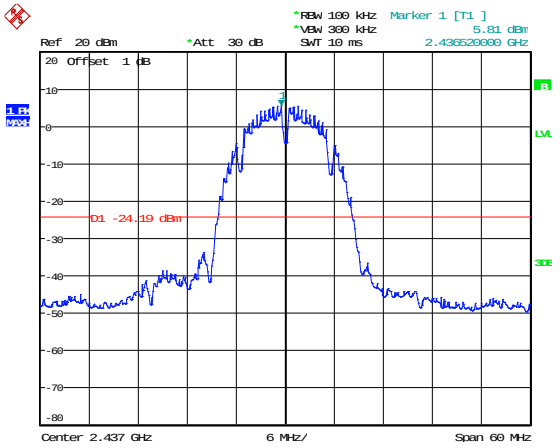
802.11g-Low	 Date: 19.JUN.2023 16:49:59
802.11g-Middle	 Date: 19.JUN.2023 16:50:23
802.11g-High	 Date: 19.JUN.2023 16:50:50

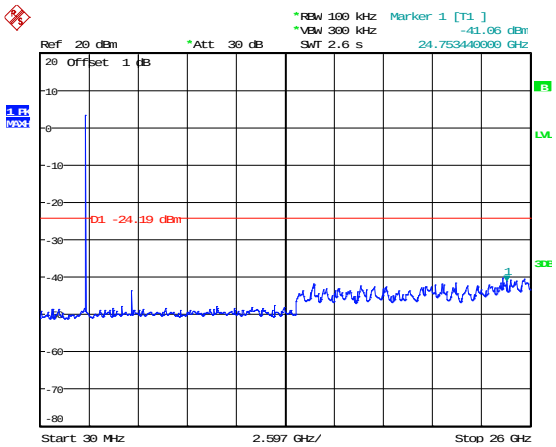
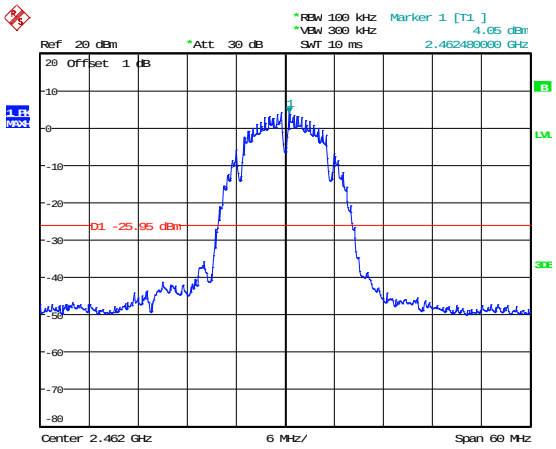
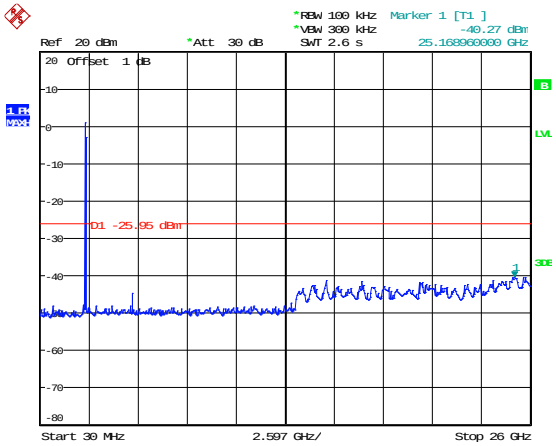
802.11n-HT20-Low	 Date: 19.JUN.2023 16:51:20
802.11n-HT20-Middle	 Date: 19.JUN.2023 16:51:41
802.11n-HT20-High	 Date: 19.JUN.2023 16:52:18

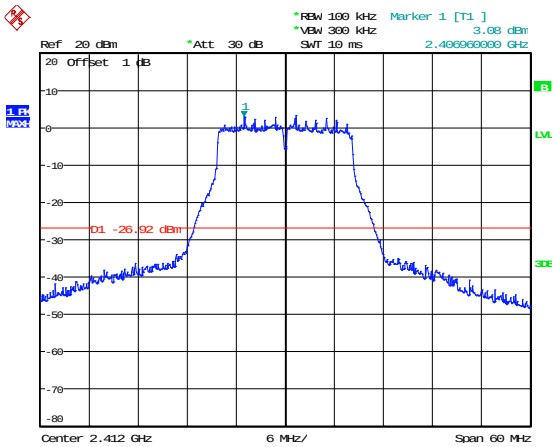
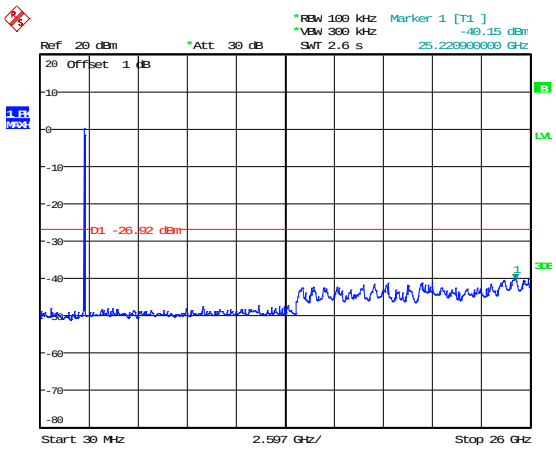
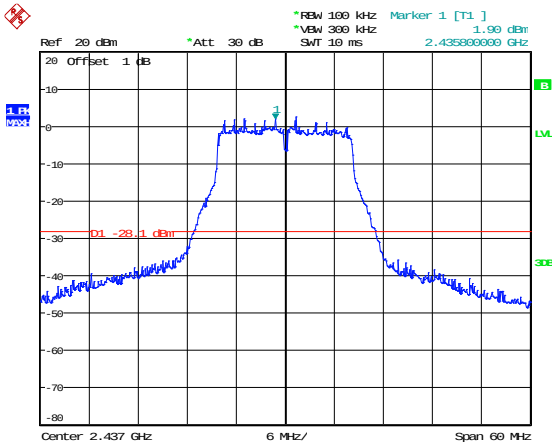
802.11n-HT40-Low	 Date: 19.JUN.2023 16:53:07
802.11n-HT40-Middle	 Date: 19.JUN.2023 16:53:28
802.11n-HT40-High	 Date: 19.JUN.2023 16:53:48

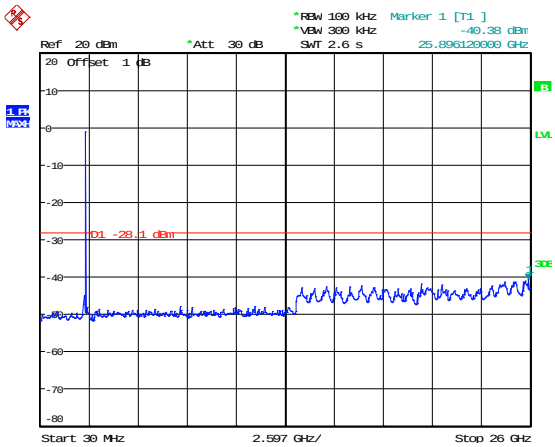
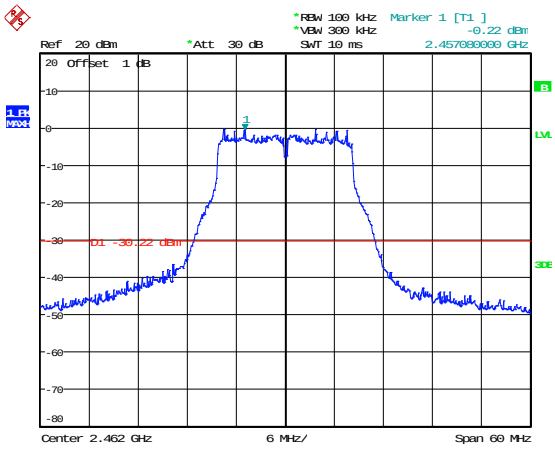
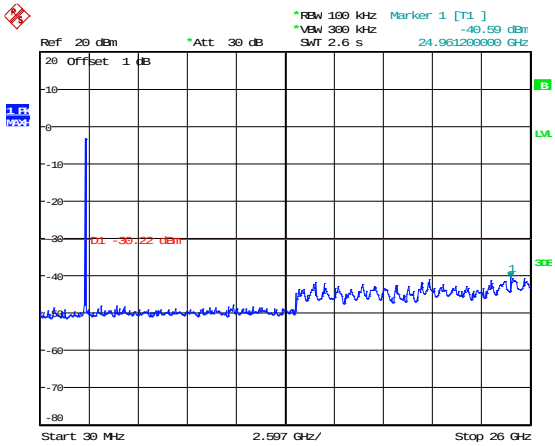
APPENDIX D

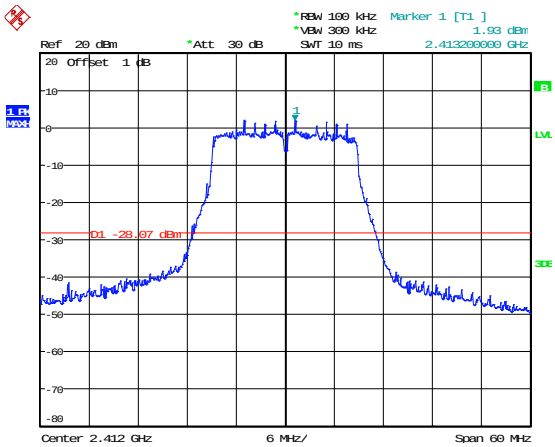
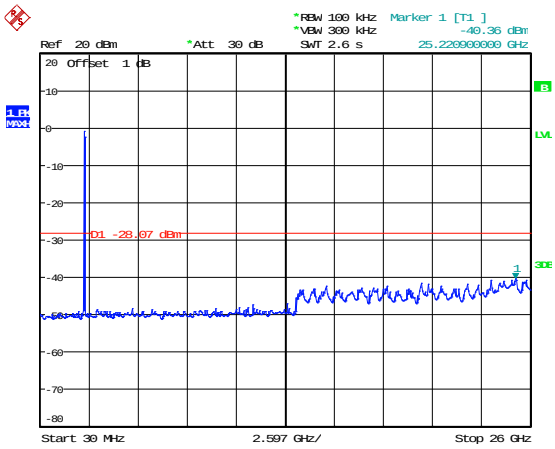
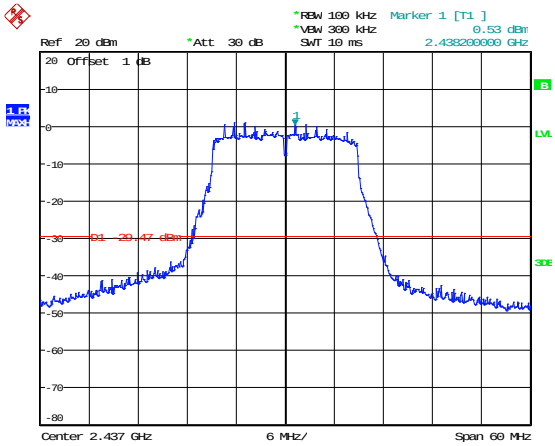
Conducted Out of Band Emissions

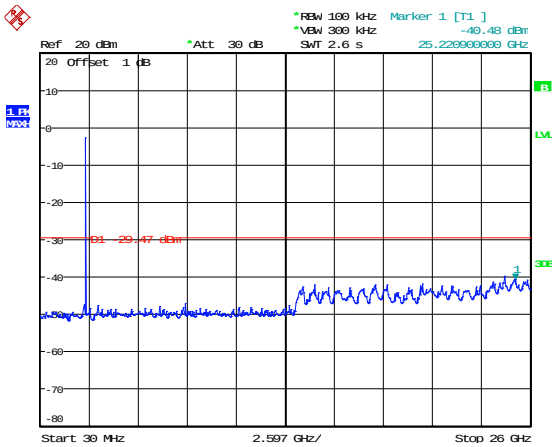
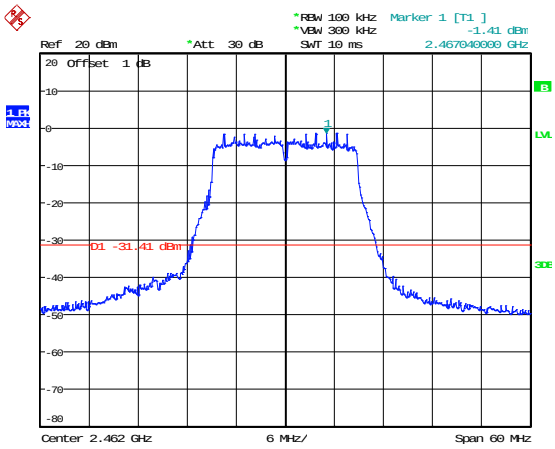
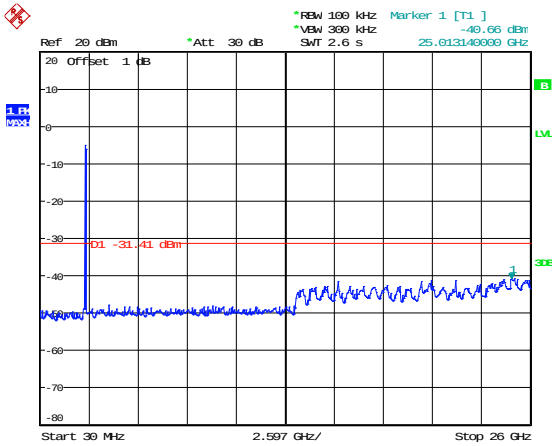
802.11b-Low	 Date: 19.JUN.2023 17:24:33
	 Date: 19.JUN.2023 17:25:05
802.11b-Middle	 Date: 19.JUN.2023 17:25:53

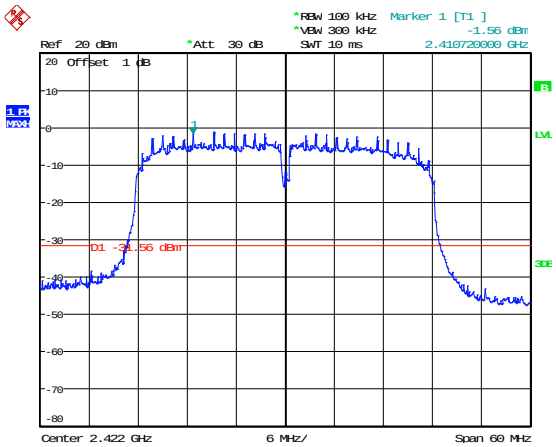
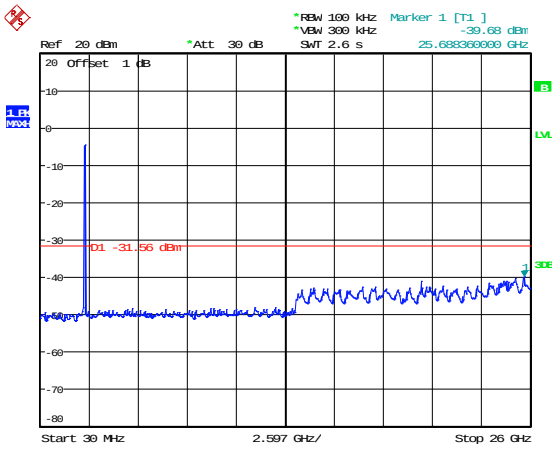
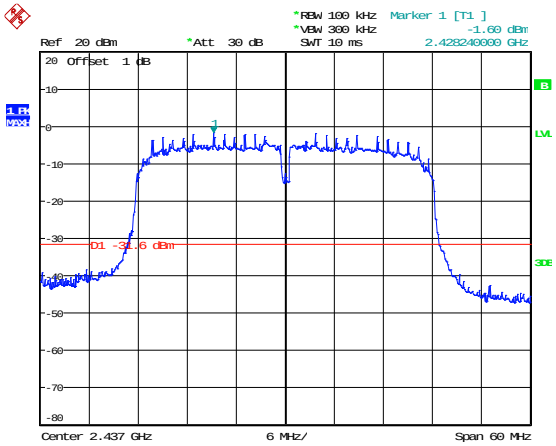
	 Date: 19.JUN.2023 17:26:23
802.11b-High	 Date: 19.JUN.2023 17:26:55
	 Date: 19.JUN.2023 17:27:17

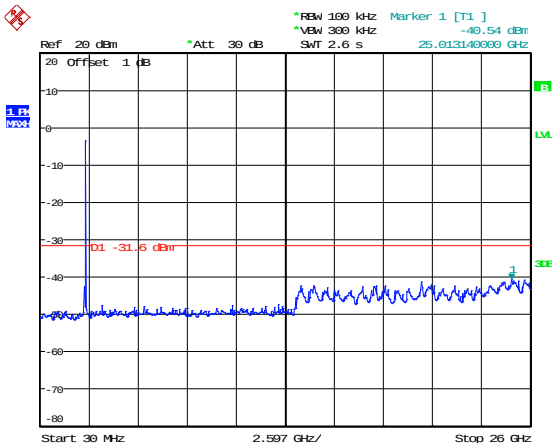
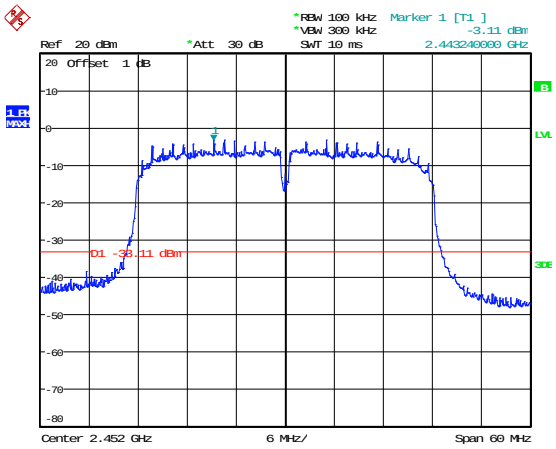
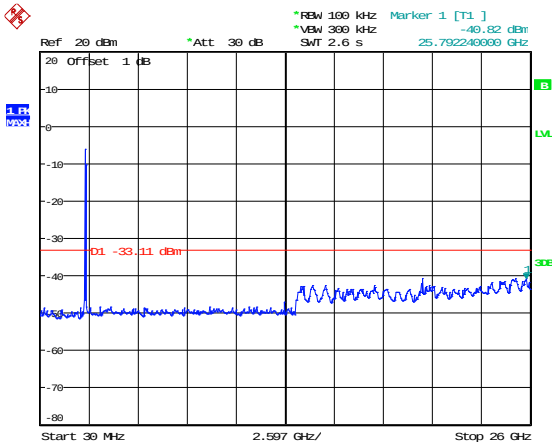
802.11g-Low	 Date: 19.JUN.2023 17:28:01
	 Date: 19.JUN.2023 17:28:35
802.11g-Middle	 Date: 19.JUN.2023 17:29:07

	 Date: 19.JUN.2023 17:29:22
802.11g-High	 Date: 19.JUN.2023 17:29:47
	 Date: 19.JUN.2023 17:30:00

802.11n-HT20-Low	 Date: 19.JUN.2023 17:30:29
	 Date: 19.JUN.2023 17:30:46
802.11n-HT20-Middle	 Date: 19.JUN.2023 17:31:14

	 Date: 19.JUN.2023 17:31:32
802.11n-HT20-High	 Date: 19.JUN.2023 17:32:00
	 Date: 19.JUN.2023 17:32:15

802.11n-HT40-Low	 Date: 19.JUN.2023 17:32:43
	 Date: 19.JUN.2023 17:32:59
802.11n-HT40-Middle	 Date: 19.JUN.2023 17:33:23

	 Date: 19.JUN.2023 17:33:41
802.11n-HT40-High	 Date: 19.JUN.2023 17:34:06
	 Date: 19.JUN.2023 17:34:23

APPENDIX PHOTOGRAPHS

Please refer to “ANNEX”

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