TEST REPORT

Reference No.	:	WTX21X12145223W-1
FCC ID	:	2A33F-TC-1
Applicant	:	TrolMaster Agro Instruments Co., Ltd.
Address	:	Room 2520, 25/F., New Tech Plaza, No. 34 Tai Yau Street, Kowloon, Hong Kong , China
Product Name	:	Grow Camera
Test Model	:	TC-1
Standards	:	FCC Part 15.247
Date of Receipt sample	:	Dec. 21, 2021
Date of Test	:	Dec. 21, 2021 to Dec. 27, 2021
Date of Issue	:	Dec. 27, 2021
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 compiler and approver.

Prepared By:

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Tested by:	Reviewed By:	Approved & Authorized By:
Mike Shi / Project Engineer	Jason Su / RF Manager	Silin Chen / Manager

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Report version

Version No.	Date of issue	Description
Rev.00	Dec. 27, 2021	Original
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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	TrolMaster Agro Instruments Co., Ltd.
Address of applicant:	Room 2520, 25/F., New Tech Plaza, No. 34 Tai Yau Street, Kowloon, Hong Kong , China
Manufacturer:	TrolMaster Agro Instruments Co., Ltd.
Address of manufacturer:	Room 2520, 25/F., New Tech Plaza, No. 34 Tai Yau Street, Kowloon, Hong Kong , China

General Description of EUT	
Product Name:	Grow Camera
Trade Name:	/
Model No.:	TC-1
Adding Model(s):	/
Rated Voltage:	DC12V
Power Adapter Model:	MODEL:P12B120100US INPUT:AC100-240V, 50/60Hz, 0.3A OUTPUT:DC12V,1A
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:	16.35dBm (Conducted)
Type of Modulation:	DBPSK,BPSK,DQPSK,QPSK,16QAM,64QAM
Quantity of Channels:	11 for 802.11b/g/n(HT20); 7 for 802.11n(HT40)
Channel Separation:	5MHz
Type of Antenna:	External Antenna
Antenna Gain:	5dBi

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 maintain ed 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.

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
DC Cable	1.18	Unshielded	Without Ferrite

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
RJ45 Cable	1.5	Unshielded	Without Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	E445	EB12648265

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

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
SEMT-1075	Communication Tester	Rohde & Schwarz	CMW500	148650	2021-03-27	2022-03-26
SEMT-1063	GSM Tester	Rohde & Schwarz	CMU200	114403	2021-03-27	2022-03-26
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2021-03-27	2022-03-26
SEMT-1079	Spectrum Analyzer	Agilent	N9020A	US47140102	2021-03-27	2022-03-26
SEMT-1080	Signal Generator	Agilent	83752A	3610A01453	2021-03-27	2022-03-26
SEMT-1081	Vector Signal Generator	Agilent	N5182A	MY47070202	2021-03-27	2022-03-26
SEMT-1028	Power Divider	Weinschel	1506A	PM204	2021-03-27	2022-03-26
SEMT-1082	Power Divider	RF-Lambda	RFLT4W5M18G	14110400027	2021-03-27	2022-03-26
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2021-03-27	2022-03-26
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2021-03-27	2022-03-26
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2021-04-12	2022-04-11
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2021-04-12	2022-04-11
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-19	2023-03-18
SEMT-1068	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2021-03-19	2023-03-18
SEMT-1042	Horn Antenna	ETS	3117	00086197	2021-03-19	2023-03-18
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2021-04-27	2023-04-26
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2021-04-27	2022-04-26
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2021-03-27	2022-03-26
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2021-03-27	2022-03-26
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2021-03-19	2023-03-18
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	/	/
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	/	/
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	/	/
SEMT-C004	Cable	Zheng DI	2M0RFC	/	/	/
SEMT-C005	Cable	Zheng DI	1M0RFC	/	/	/
SEMT-C006	Cable	Zheng DI	1M0RFC	/	/	/

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	Compliant
§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

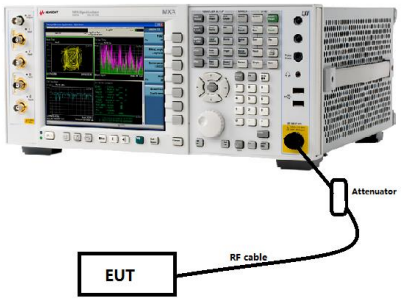
This product has an External antenna, fulfill the requirement of this section.

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

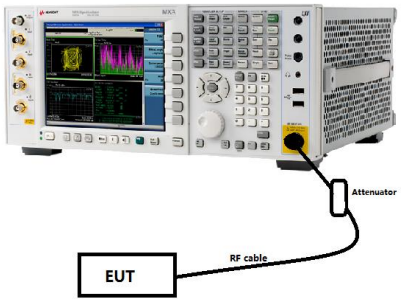
Please refer to Appendix A

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

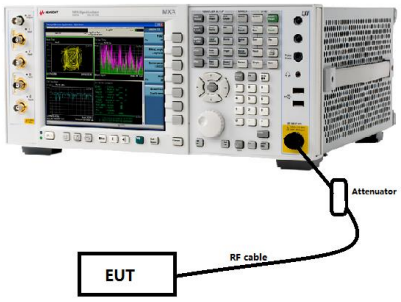
Please refer to Appendix B

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 Subclause 8.3.2.2 and ANSI C63.10-2013 Subclause 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

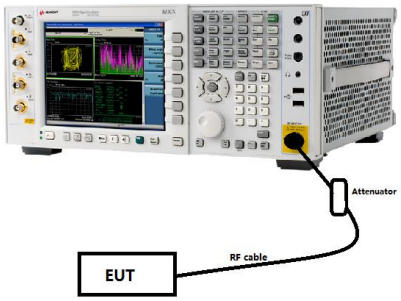
7. Duty Cycle

7.1 Standard Applicable

According to ANSI C63.10-2013 Subclause11.6, Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).

When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this subclause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than ±2%; otherwise, the duty cycle is considered to be nonconstant.

7.2 Test Setup Block Diagram



7.3 Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator; the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
   Span=zero span, Frequency=centered channel, RBW= 1 MHz, VBW ≥ RBW
   Sweep=as necessary to capture the entire dwell time,
   Detector function = peak, Trigger mode
4. Measure and record the duty cycle data

7.4 Summary of Test Results/Plots

Please refer to Appendix D

8. Field Strength of Spurious Emissions

8.1 Standard Applicable

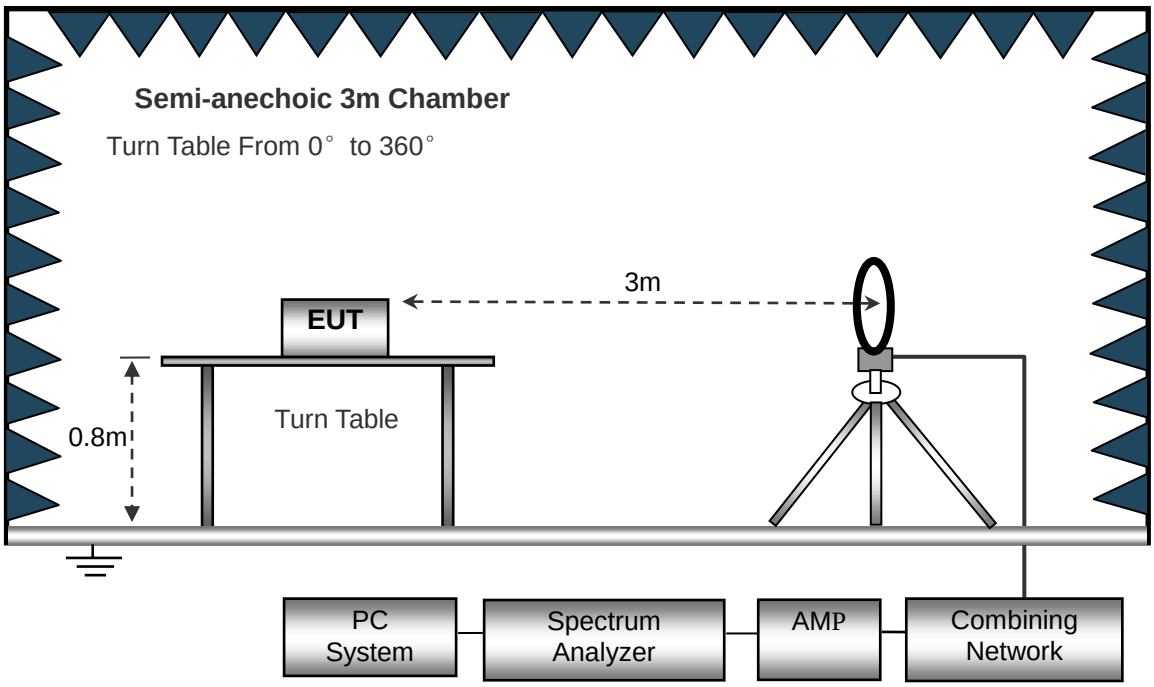
According to §15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the 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).

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.

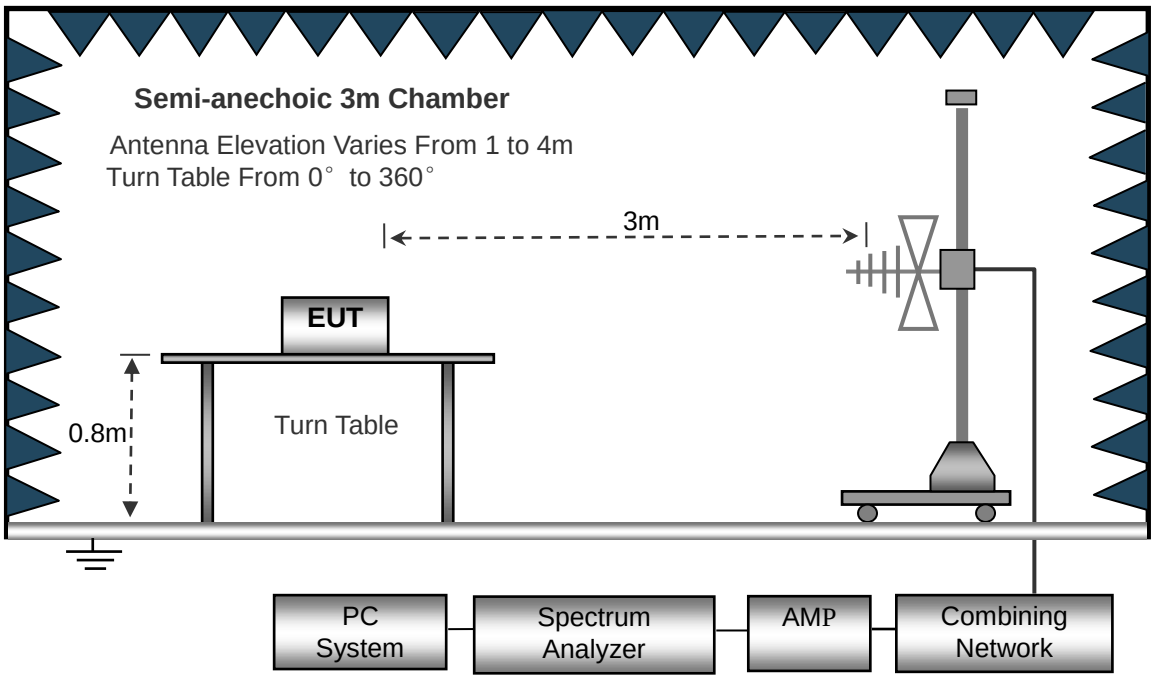
8.2 Test Procedure

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.

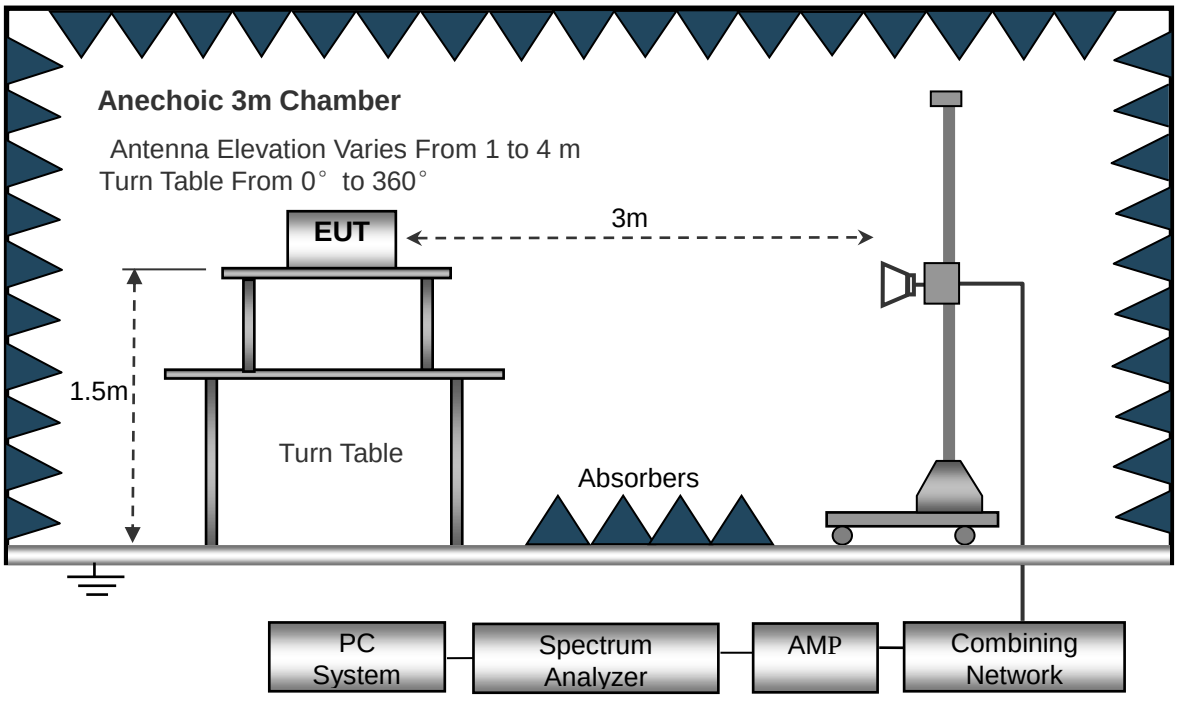
The test setup for emission measurement below 30MHz.



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

8.3 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:

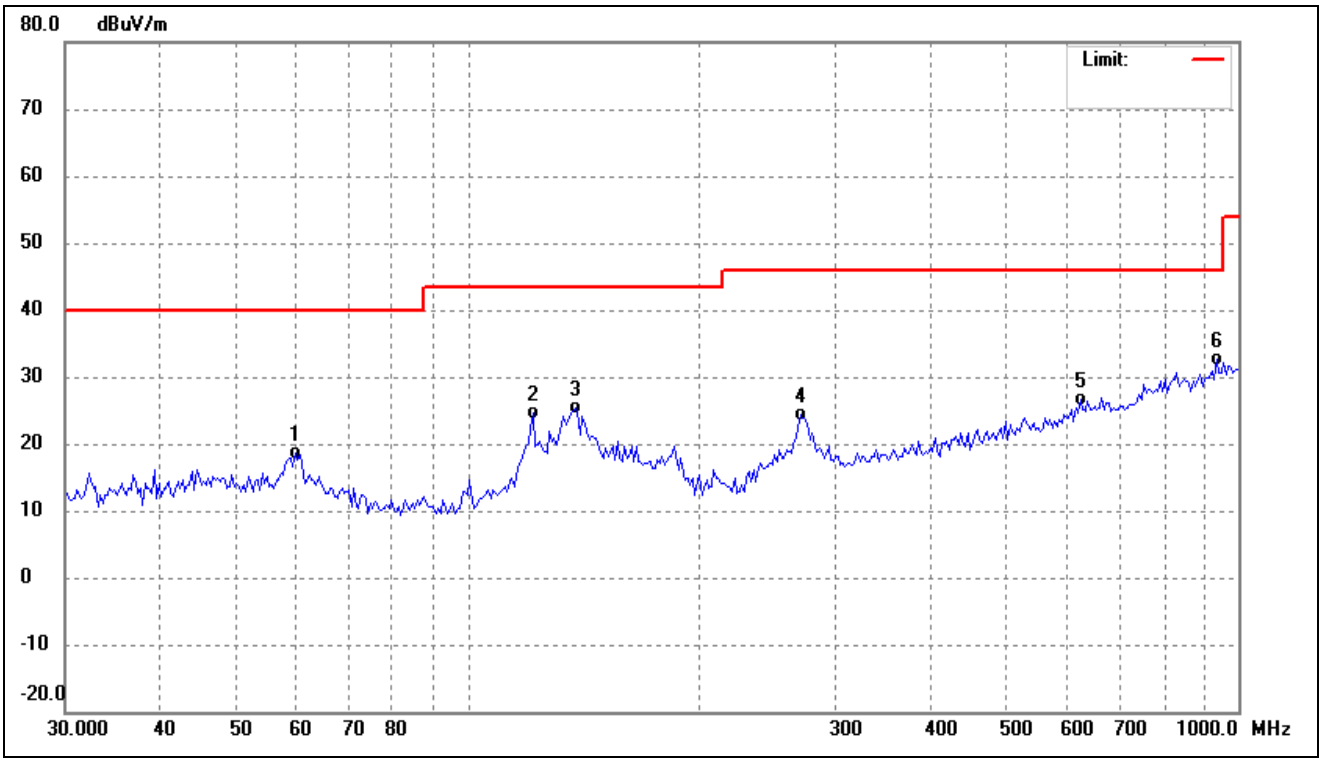
Margin = Corr. Ampl. – FCC Part 15 Limit

8.4 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.

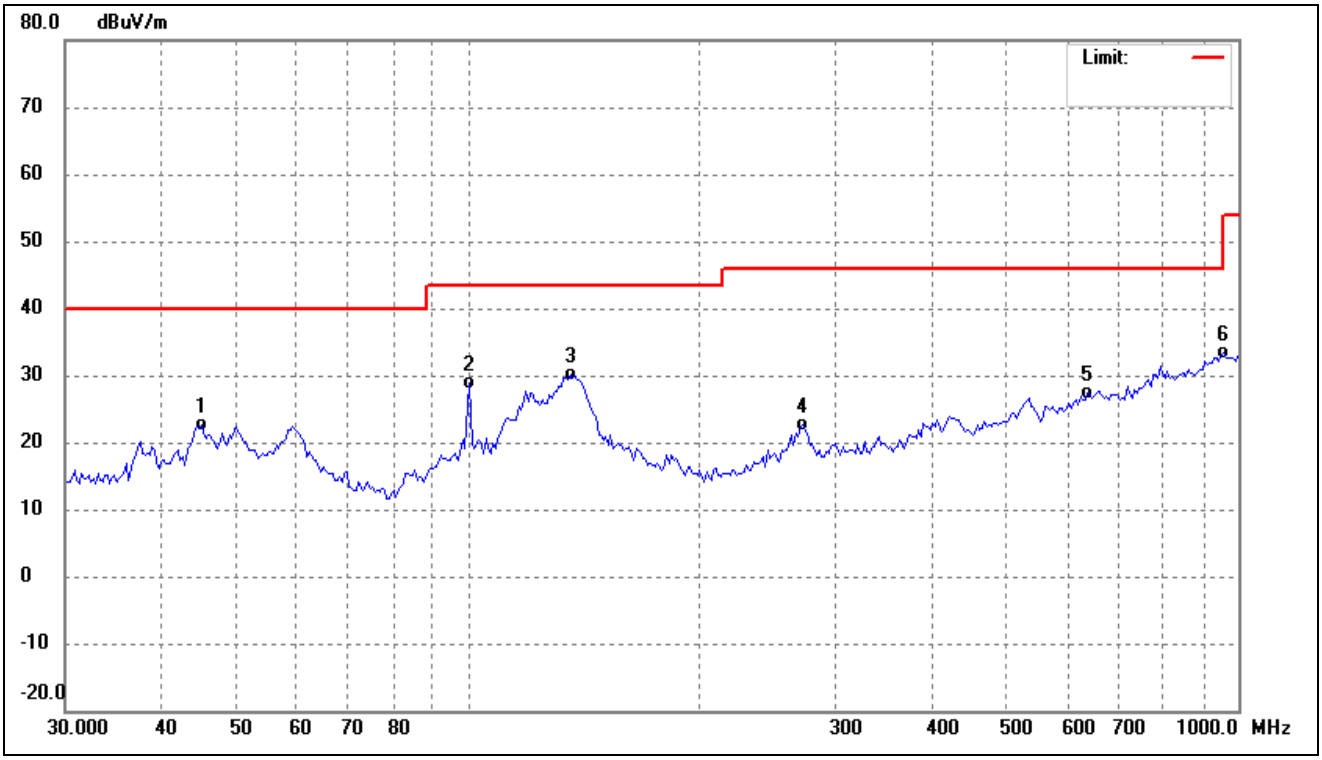
➢ Spurious Emissions Below 1GHz

802.11b_11Mbps			
Test Channel	Low	Polarity:	Horizontal



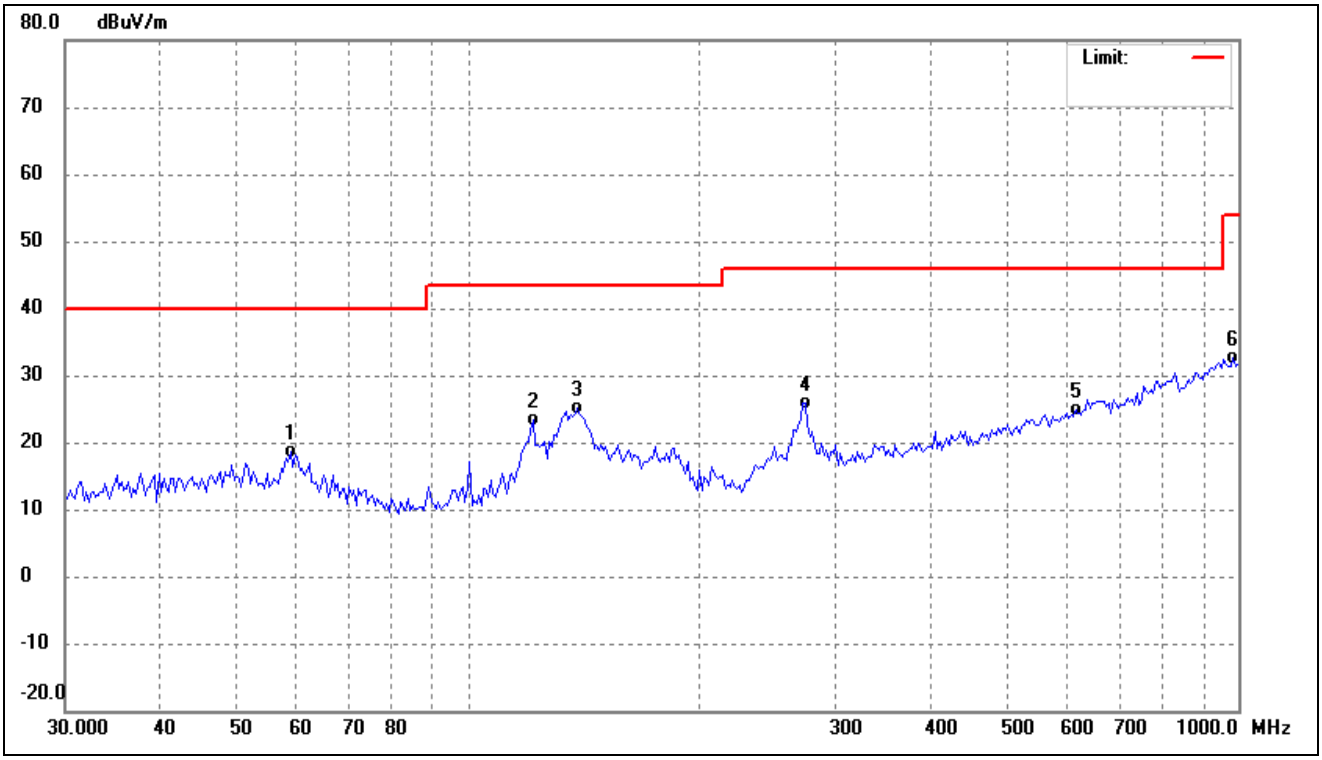
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(deg.)	(cm)	
1	59.7315	33.05	-14.32	18.73	40.00	-21.27	-	-	QP
2	121.4623	40.29	-15.62	24.67	43.50	-18.83	-	-	QP
3	137.8400	40.23	-14.76	25.47	43.50	-18.03	-	-	QP
4	270.6162	38.64	-14.27	24.37	46.00	-21.63	-	-	QP
5	624.4897	33.44	-6.77	26.67	46.00	-19.33	-	-	QP
6	938.7139	35.20	-2.62	32.58	46.00	-13.42	-	-	QP

802.11b_11Mbps			
Test Channel	Low	Polarity:	Vertical



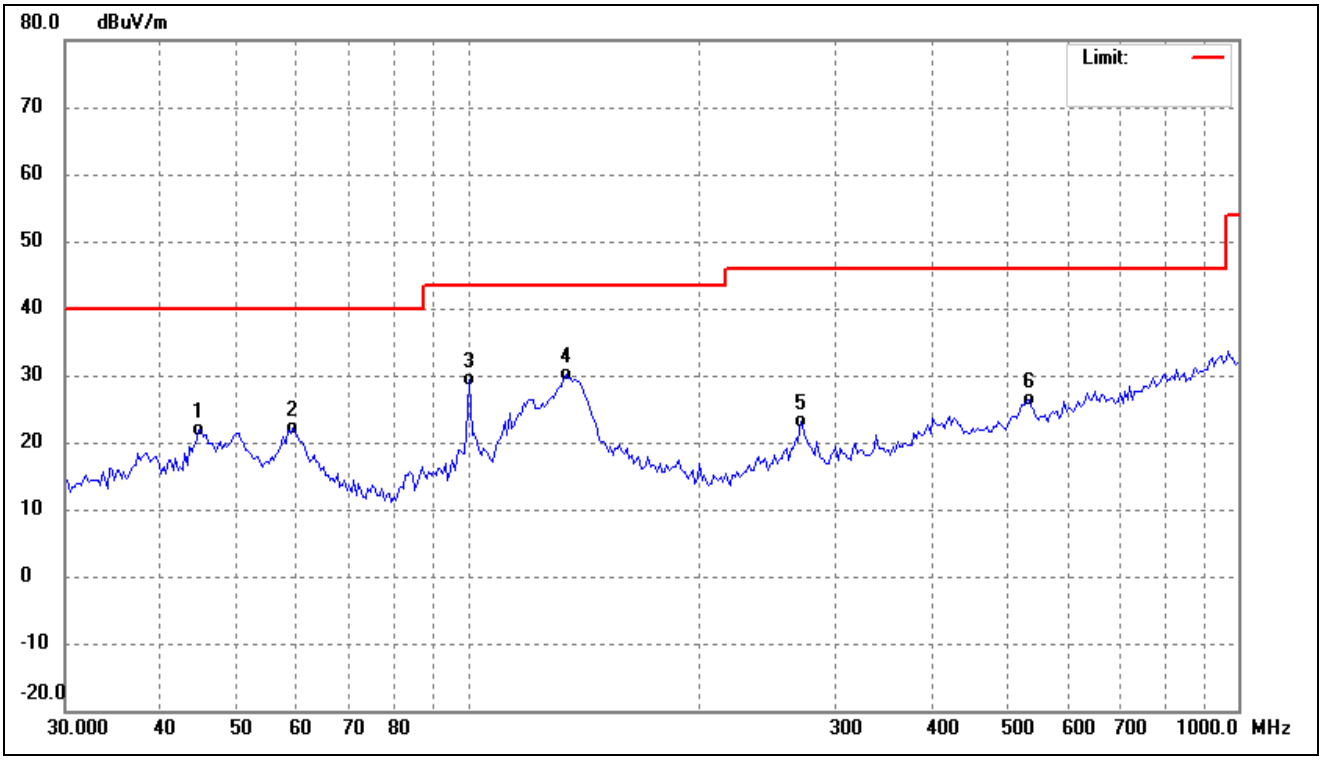
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(deg.)	(cm)	
1	45.0951	36.40	-13.68	22.72	40.00	-17.28	-	-	QP
2	100.4712	46.56	-17.56	29.00	43.50	-14.50	-	-	QP
3	135.9163	45.07	-14.85	30.22	43.50	-13.28	-	-	QP
4	272.5246	36.84	-14.17	22.67	46.00	-23.33	-	-	QP
5	637.7947	34.05	-6.57	27.48	46.00	-18.52	-	-	QP
6	958.7135	35.68	-2.38	33.30	46.00	-12.70	-	-	QP

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Horizontal



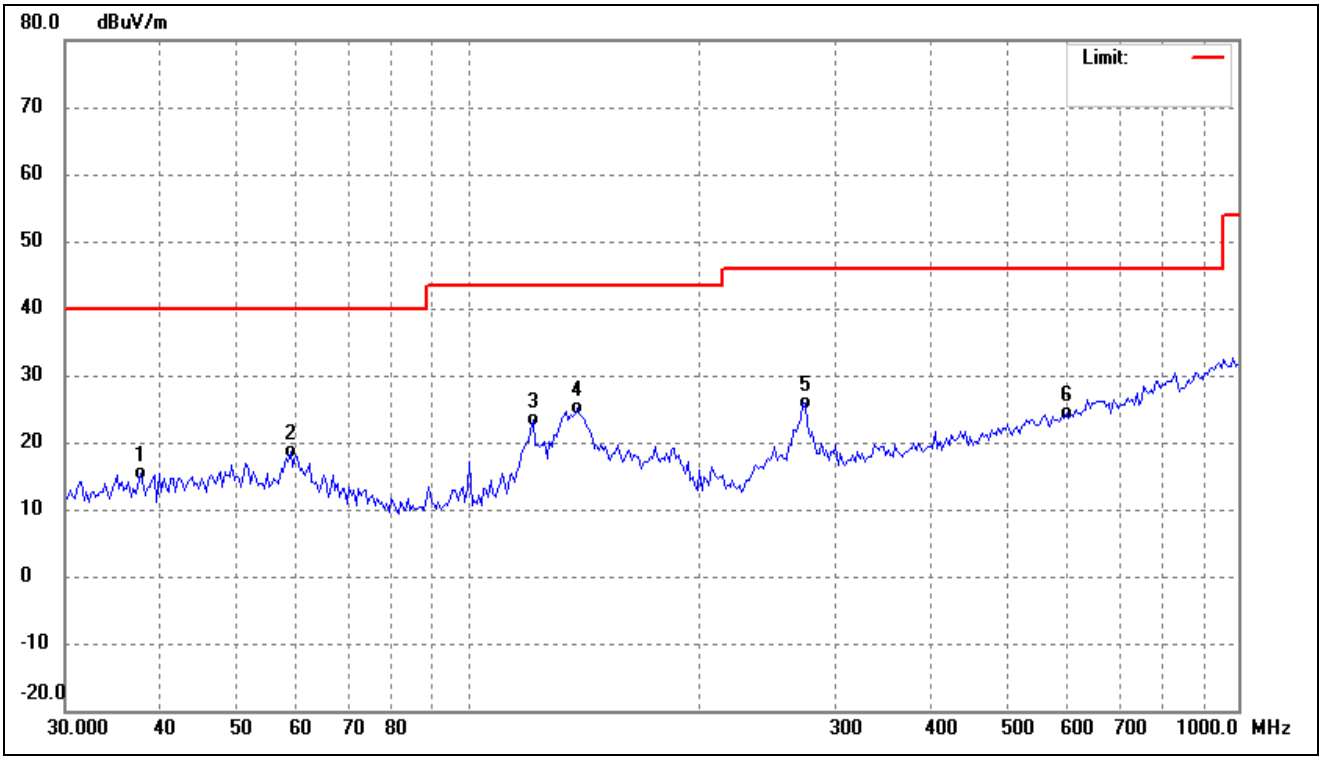
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(deg.)	(cm)	
1	58.8979	33.00	-14.28	18.72	40.00	-21.28	-	-	QP
2	121.4623	39.08	-15.62	23.46	43.50	-20.04	-	-	QP
3	138.8120	39.91	-14.74	25.17	43.50	-18.33	-	-	QP
4	274.4464	39.99	-14.07	25.92	46.00	-20.08	-	-	QP
5	615.7743	31.84	-6.99	24.85	46.00	-21.15	-	-	QP
6	986.0440	34.97	-2.28	32.69	54.00	-21.31	-	-	QP

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Vertical



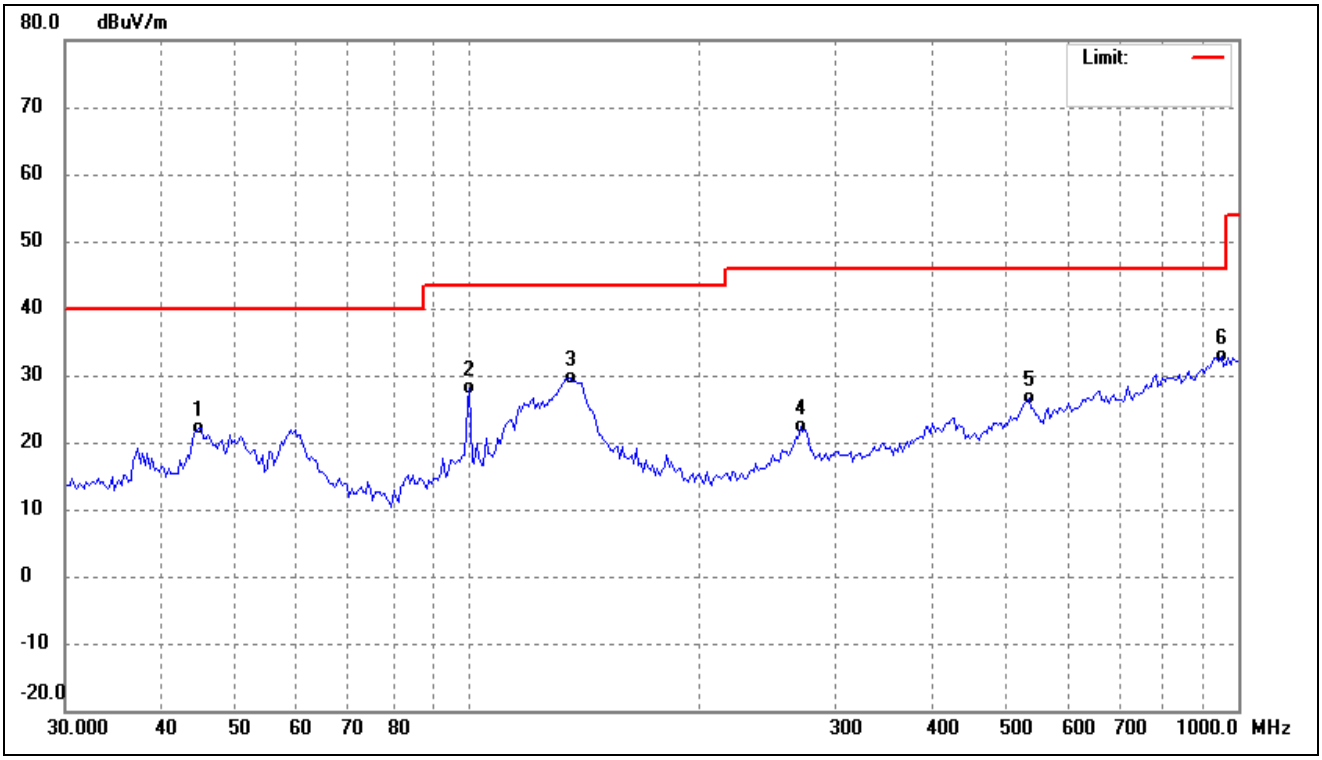
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(deg.)	(cm)	
1	44.7793	35.68	-13.69	21.99	40.00	-18.01	-	-	QP
2	59.3133	36.54	-14.30	22.24	40.00	-17.76	-	-	QP
3	100.4712	46.83	-17.56	29.27	43.50	-14.23	-	-	QP
4	134.0194	44.98	-14.92	30.06	43.50	-13.44	-	-	QP
5	270.6162	37.34	-14.27	23.07	46.00	-22.93	-	-	QP
6	535.0377	35.85	-9.47	26.38	46.00	-19.62	-	-	QP

802.11b_11Mbps			
Test Channel	High	Polarity:	Horizontal



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(deg.)	(cm)	
1	37.5648	29.15	-13.80	15.35	40.00	-24.65	-	-	QP
2	58.8979	33.00	-14.28	18.72	40.00	-21.28	-	-	QP
3	121.4623	39.08	-15.62	23.46	43.50	-20.04	-	-	QP
4	138.8120	39.91	-14.74	25.17	43.50	-18.33	-	-	QP
5	274.4464	39.99	-14.07	25.92	46.00	-20.08	-	-	QP
6	598.7067	31.84	-7.43	24.41	46.00	-21.59	-	-	QP

802.11b_11Mbps			
Test Channel	High	Polarity:	Vertical



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(deg.)	(cm)	
1	44.7793	35.93	-13.69	22.24	40.00	-17.76	-	-	QP
2	100.4712	45.63	-17.56	28.07	43.50	-15.43	-	-	QP
3	135.9163	44.48	-14.85	29.63	43.50	-13.87	-	-	QP
4	270.6162	36.73	-14.27	22.46	46.00	-23.54	-	-	QP
5	535.0377	36.21	-9.47	26.74	46.00	-19.26	-	-	QP
6	952.0001	35.39	-2.41	32.98	46.00	-13.02	-	-	QP

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	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2412MHz							
4824.000	52.95	-3.87	49.08	74	-24.92	H	PK
4824.000	50.05	-3.87	46.18	54	-7.82	H	AV
7236.000	56.08	1.14	57.22	74	-16.78	H	PK
7236.000	36.45	1.19	37.64	54	-16.36	H	AV
4824.000	54.04	-3.86	50.18	74	-23.82	V	PK
4824.000	48.60	-3.86	44.74	54	-9.26	V	AV
7236.000	55.04	1.10	56.14	74	-17.86	V	PK
7236.000	36.86	1.10	37.96	54	-16.04	V	AV
Middle Channel-2437MHz							
4874.000	54.16	-3.74	50.42	74	-23.58	H	PK
4874.000	48.25	-3.74	44.51	54	-9.49	H	AV
7311.000	55.02	1.47	56.49	74	-17.51	H	PK
7311.000	36.75	1.47	38.22	54	-15.78	H	AV
4874.000	54.10	-3.74	50.36	74	-23.64	V	PK
4874.000	49.03	-3.74	45.29	54	-8.71	V	AV
7311.000	54.29	1.47	55.76	74	-18.24	V	PK
7311.000	36.84	1.47	38.31	54	-15.69	V	AV
High Channel-2462MHz							
4924.000	51.57	-3.59	47.98	74	-26.02	H	PK
4924.000	48.15	-3.59	44.56	54	-9.44	H	AV
7386.000	55.09	1.79	56.88	74	-17.12	H	PK
7386.000	36.14	1.79	37.93	54	-16.07	H	AV
4924.000	50.70	-3.59	47.11	74	-26.89	V	PK
4924.000	47.80	-3.59	44.21	54	-9.79	V	AV
7386.000	53.79	1.79	55.58	74	-18.42	V	PK
7386.000	37.64	1.79	39.43	54	-14.57	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.

9. Out of Band Emissions

9.1 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).

9.2 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

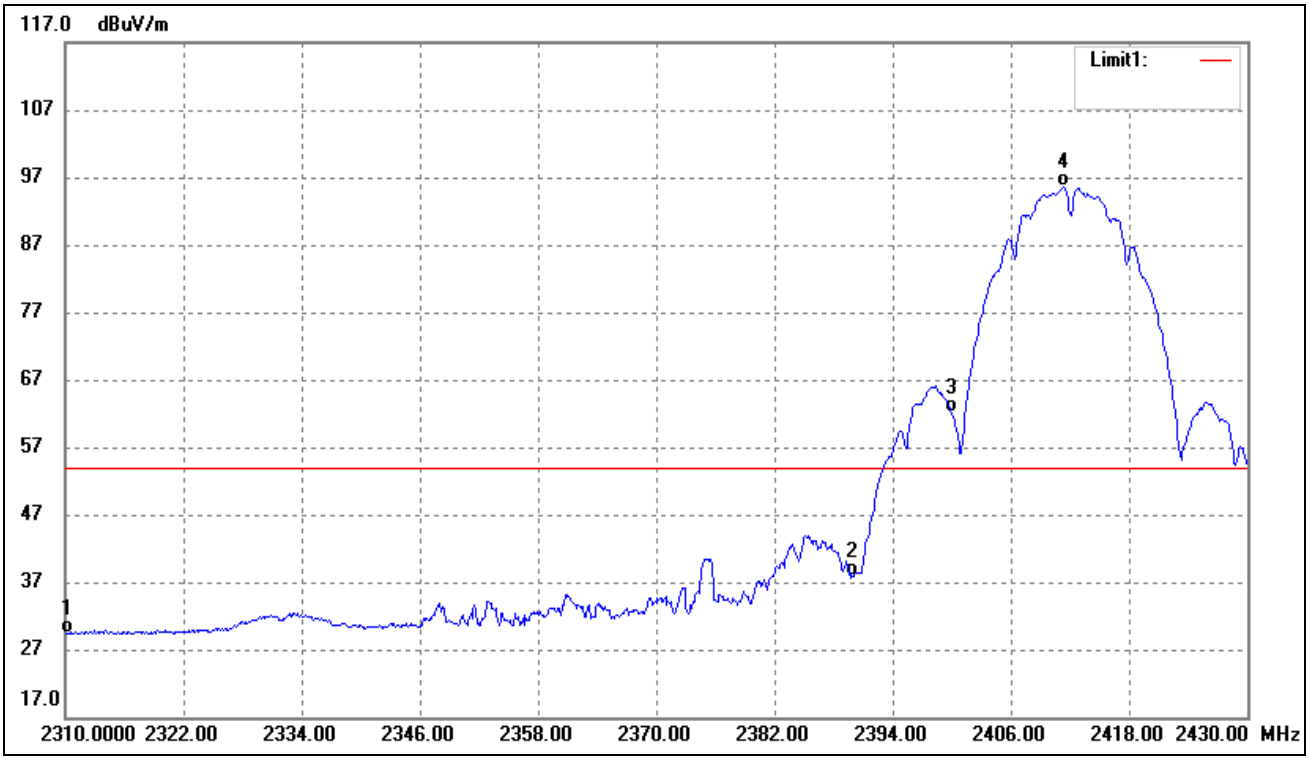
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

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.

9.3 Summary of Test Results/Plots

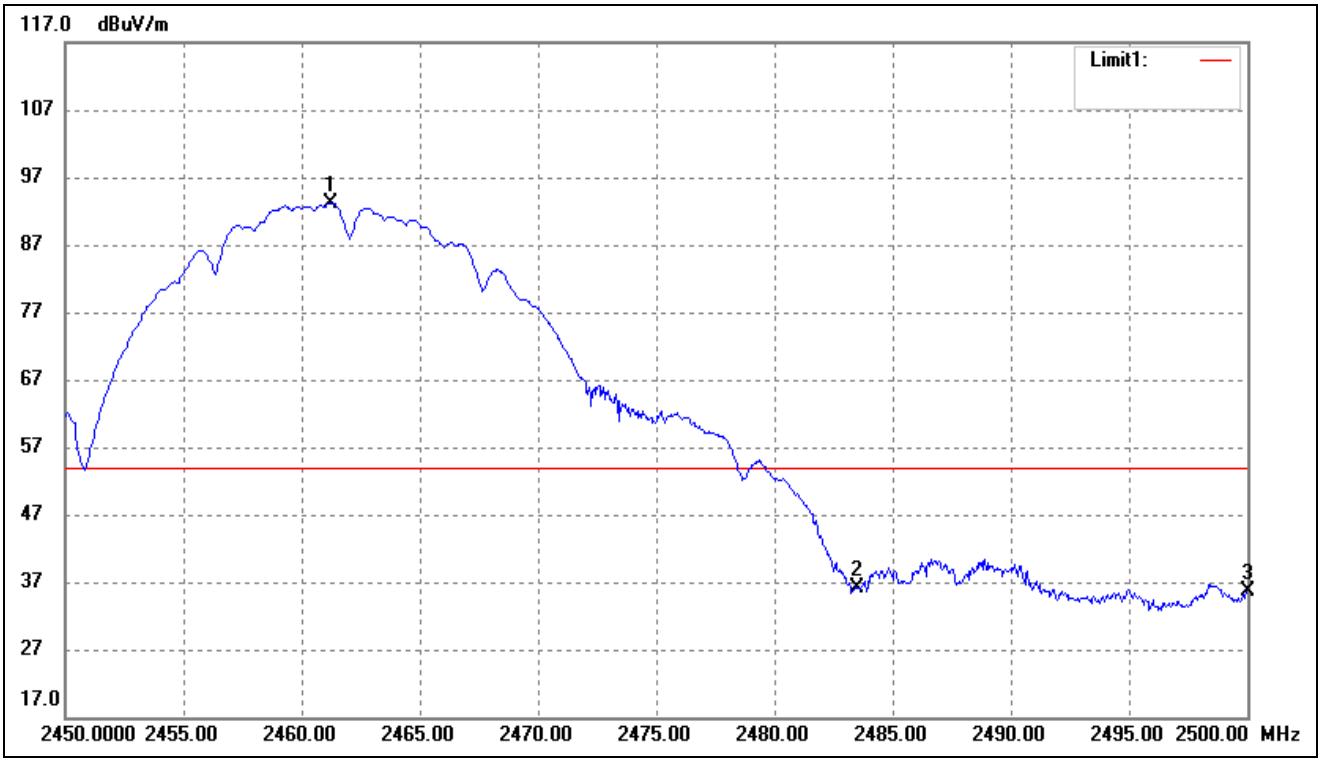
➢ Radiated test

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



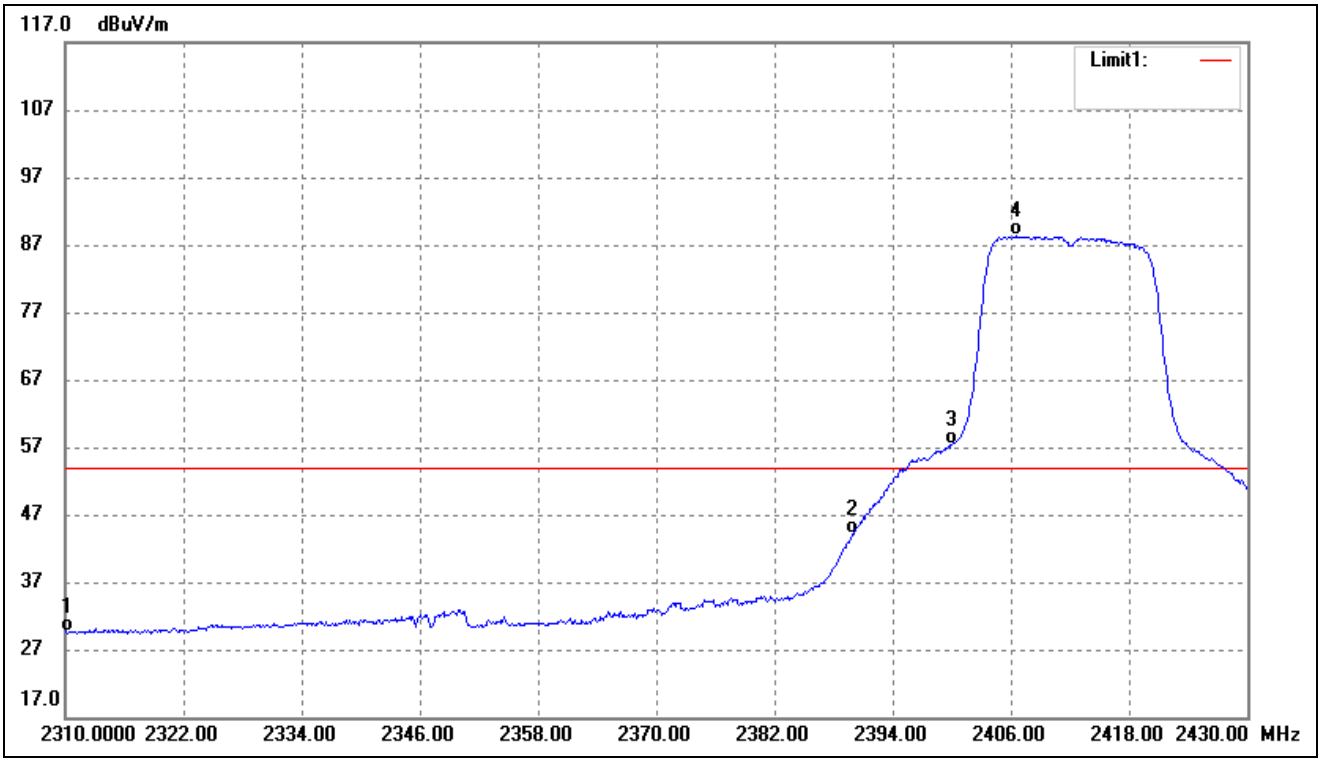
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	40.32	-10.82	29.50	54.00	-24.50	Average Detector
	2310.000	51.96	-10.82	41.14	74.00	-32.86	Peak Detector
2	2390.000	48.46	-10.70	37.76	54.00	-16.24	Average Detector
	2390.000	57.20	-10.70	46.50	74.00	-27.50	Peak Detector
3	2400.000	72.73	-10.69	62.04	Delta=33.5dBc		Average Detector
4	2411.400	106.22	-10.68	95.54			Average Detector

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



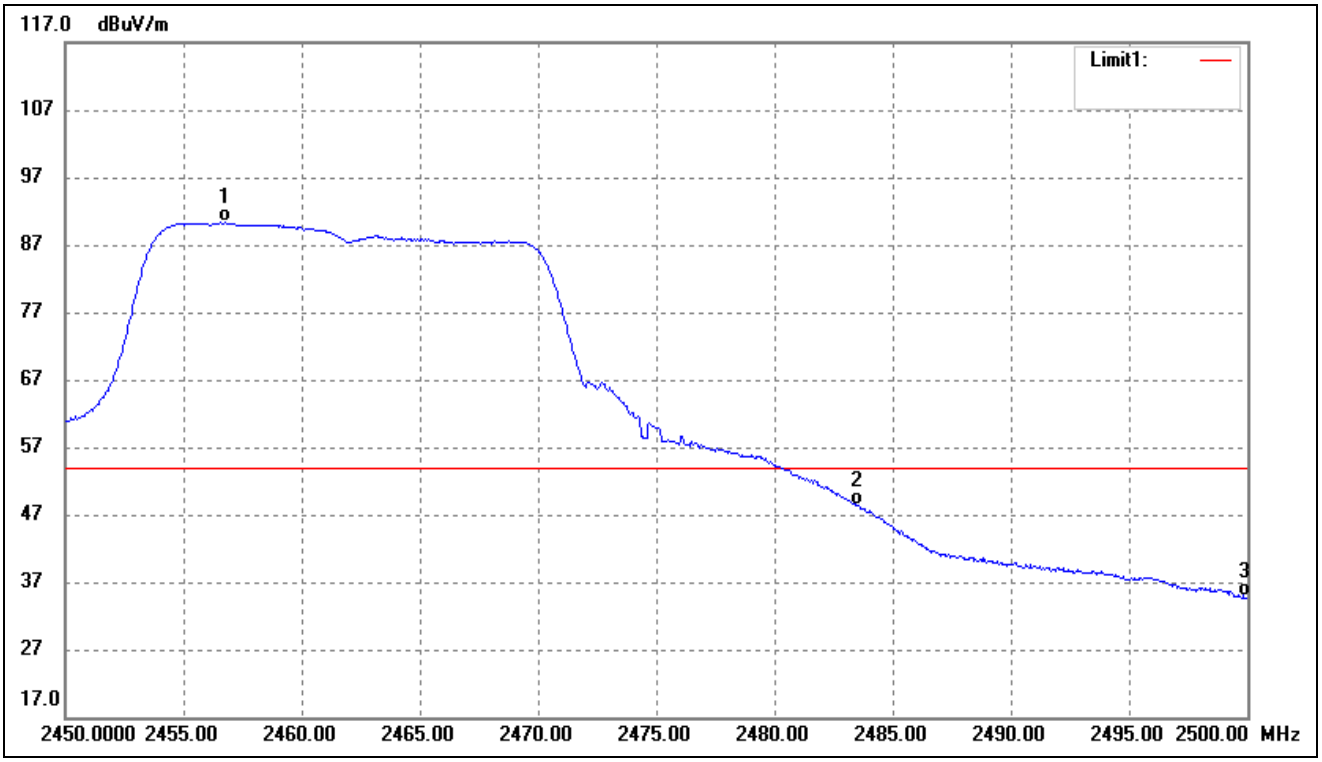
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2461.250	103.82	-10.61	93.21	/	/	Average Detector
	2460.550	108.48	-10.61	97.87	/	/	Peak Detector
2	2483.500	46.77	-10.58	36.19	54.00	-17.81	Average Detector
	2483.500	56.88	-10.58	46.30	74.00	-27.70	Peak Detector
3	2500.000	46.08	-10.55	35.53	54.00	-18.47	Average Detector
	2500.000	55.41	-10.55	44.86	74.00	-29.14	Peak Detector

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



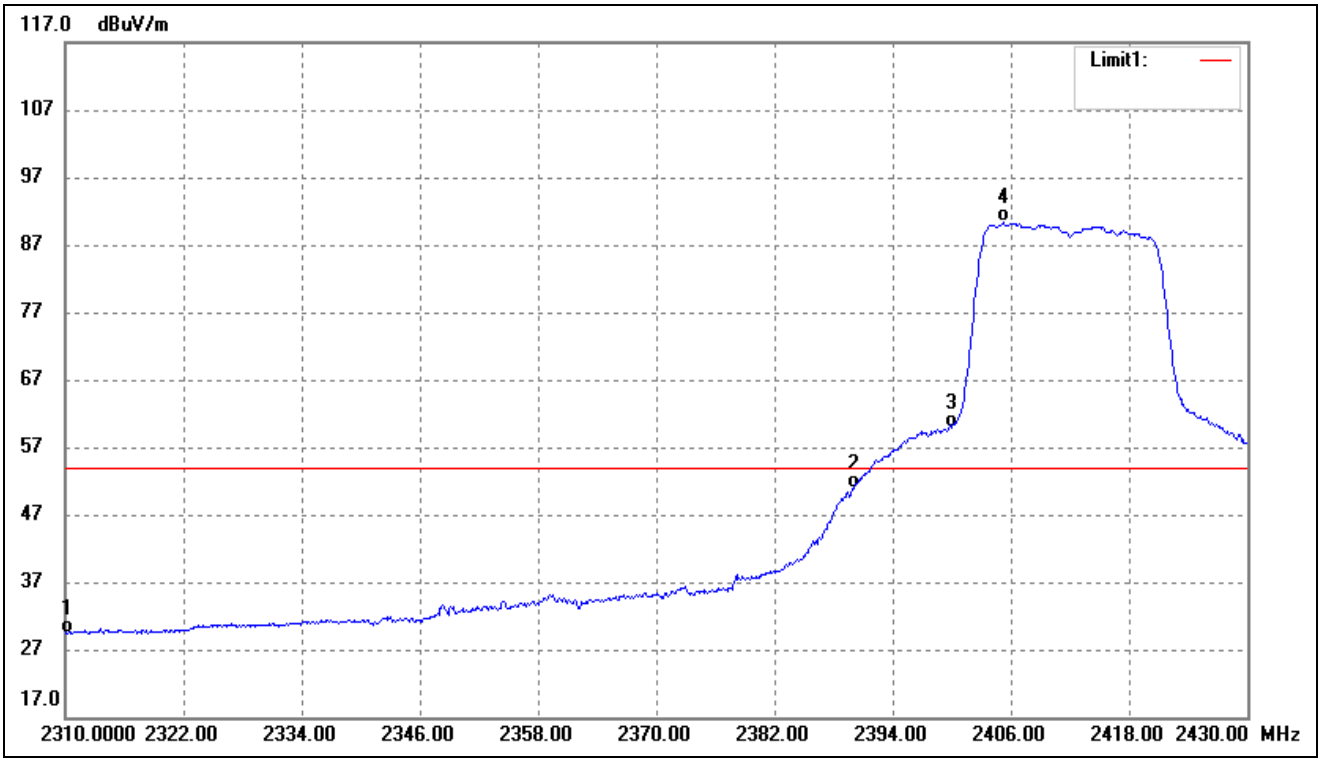
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	40.49	-10.82	29.67	54.00	-24.33	Average Detector
	2310.000	52.66	-10.82	41.84	74.00	-32.16	Peak Detector
2	2390.000	54.75	-10.70	44.05	54.00	-9.95	Average Detector
	2390.000	73.90	-10.70	63.20	74.00	-10.80	Peak Detector
3	2400.000	67.95	-10.69	57.26	Delta=31dBc		Average Detector
4	2406.480	98.94	-10.68	88.26			Average Detector

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



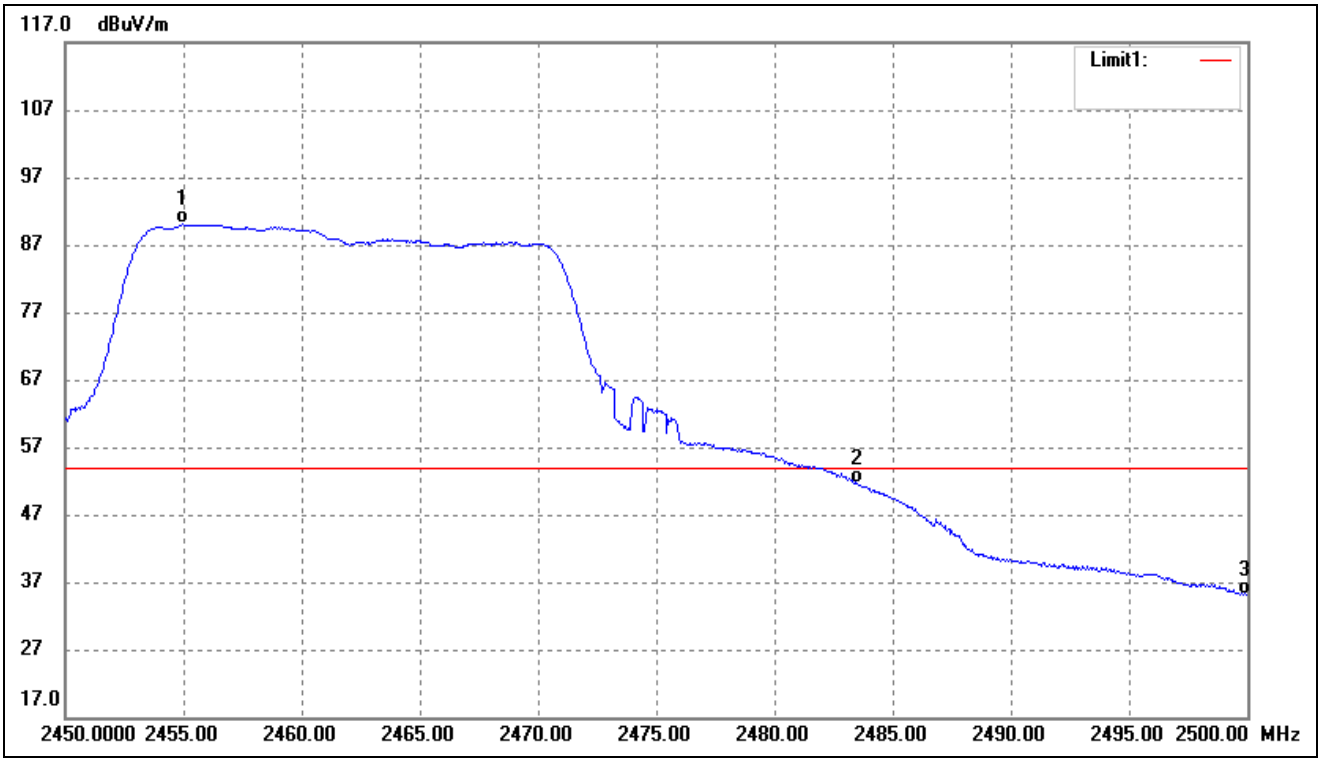
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
2	2456.750	100.93	-10.61	90.32	/	/	Average Detector
	2457.300	112.28	-10.61	101.67	/	/	Peak Detector
1	2483.500	59.04	-10.58	48.46	54.00	-5.54	Average Detector
	2483.500	77.91	-10.58	67.33	74.00	-6.67	Peak Detector
3	2500.000	45.34	-10.55	34.79	54.00	-19.21	Average Detector
	2500.000	64.18	-10.55	53.63	74.00	-20.37	Peak Detector

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



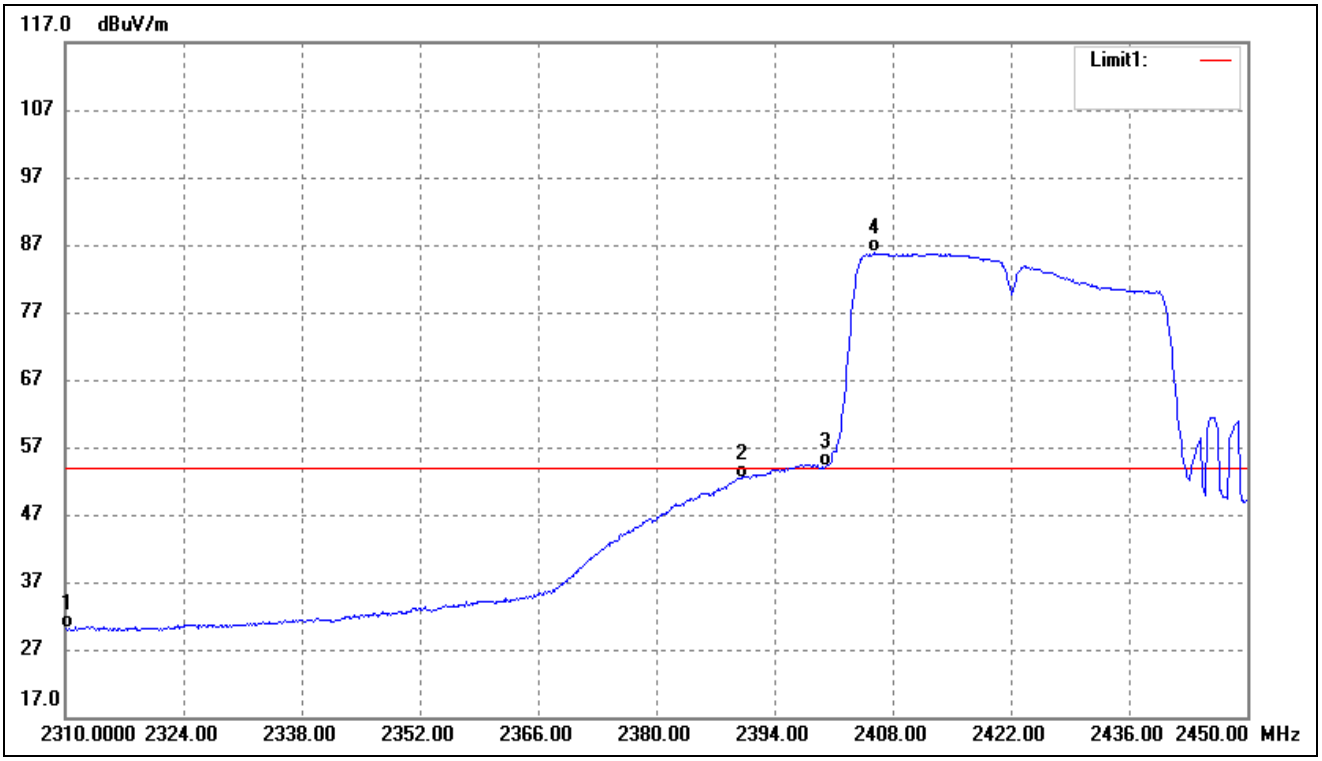
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	40.24	-10.82	29.42	54.00	-24.58	Average Detector
	2310.000	52.18	-10.82	41.36	74.00	-32.64	Peak Detector
2	2390.000	61.65	-10.70	50.95	54.00	-3.05	Average Detector
	2390.000	81.79	-10.70	71.09	74.00	-2.91	Peak Detector
3	2400.000	70.66	-10.69	59.97	Delta=30.3dBc		Average Detector
4	2405.280	100.95	-10.68	90.27			Average Detector

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



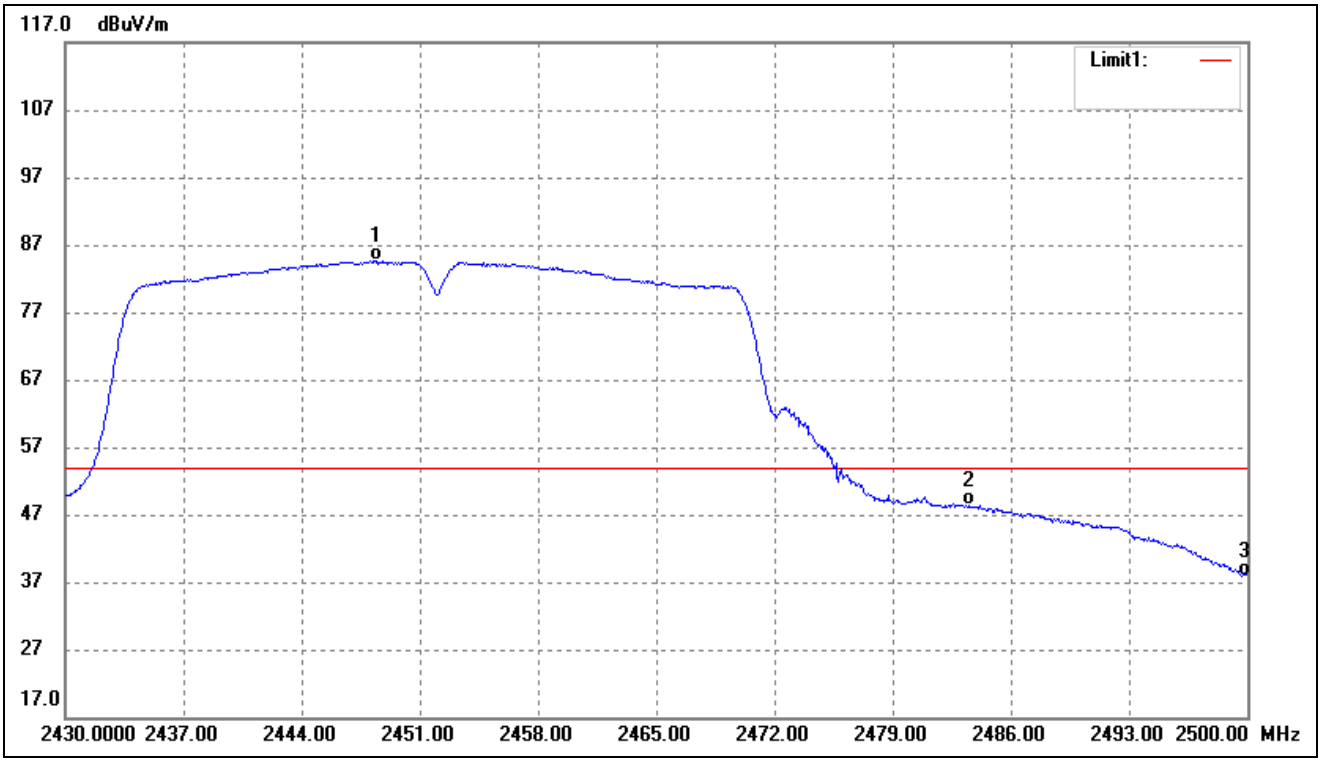
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2454.950	100.70	-10.61	90.09	/	/	Average Detector
	2457.100	111.03	-10.61	100.42	/	/	Peak Detector
2	2483.500	62.31	-10.58	51.73	54.00	-2.27	Average Detector
	2483.500	82.73	-10.58	72.15	74.00	-1.85	Peak Detector
3	2500.000	45.77	-10.55	35.22	54.00	-18.78	Average Detector
	2500.000	65.10	-10.55	54.55	74.00	-19.45	Peak Detector

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



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	40.83	-10.82	30.01	54.00	-23.99	Average Detector
	2310.000	52.71	-10.82	41.89	74.00	-32.11	Peak Detector
2	2390.000	63.11	-10.70	52.41	54.00	-1.59	Average Detector
	2390.000	81.72	-10.70	71.02	74.00	-2.98	Peak Detector
3	2400.000	64.80	-10.69	54.11	Delta=31.68dBc		Average Detector
4	2405.900	96.47	-10.68	85.79			Average Detector

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



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2448.410	95.24	-10.62	84.62	/	/	Average Detector
	2456.040	105.92	-10.61	95.31	/	/	Peak Detector
2	2483.500	59.00	-10.58	48.42	54.00	-5.58	Average Detector
	2483.500	78.20	-10.58	67.62	74.00	-6.38	Peak Detector
3	2500.000	48.52	-10.55	37.97	54.00	-16.03	Average Detector
	2500.000	66.54	-10.55	55.99	74.00	-18.01	Peak Detector

- Conducted test

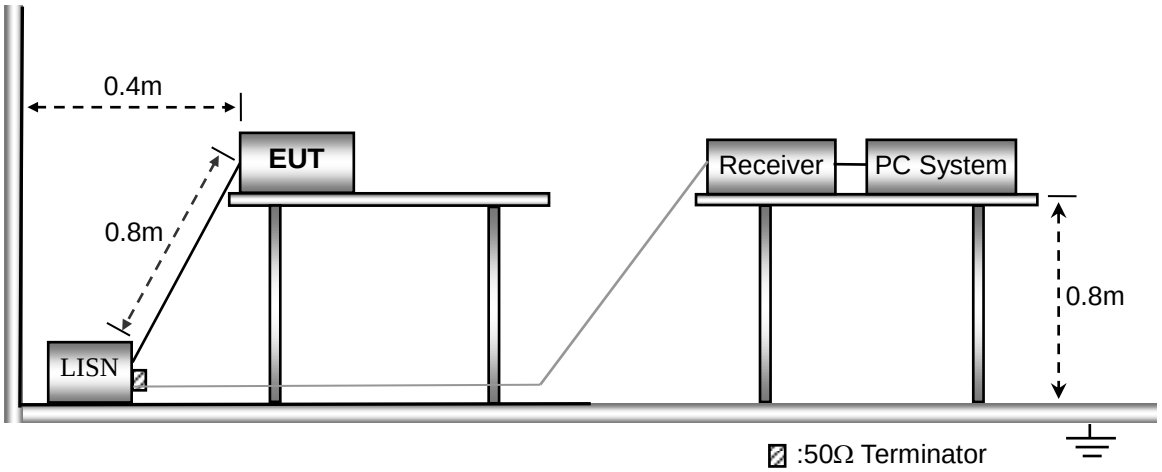
Please refer to Appendix E

10. Conducted Emissions

10.1 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.

10.2 Basic Test Setup Block Diagram



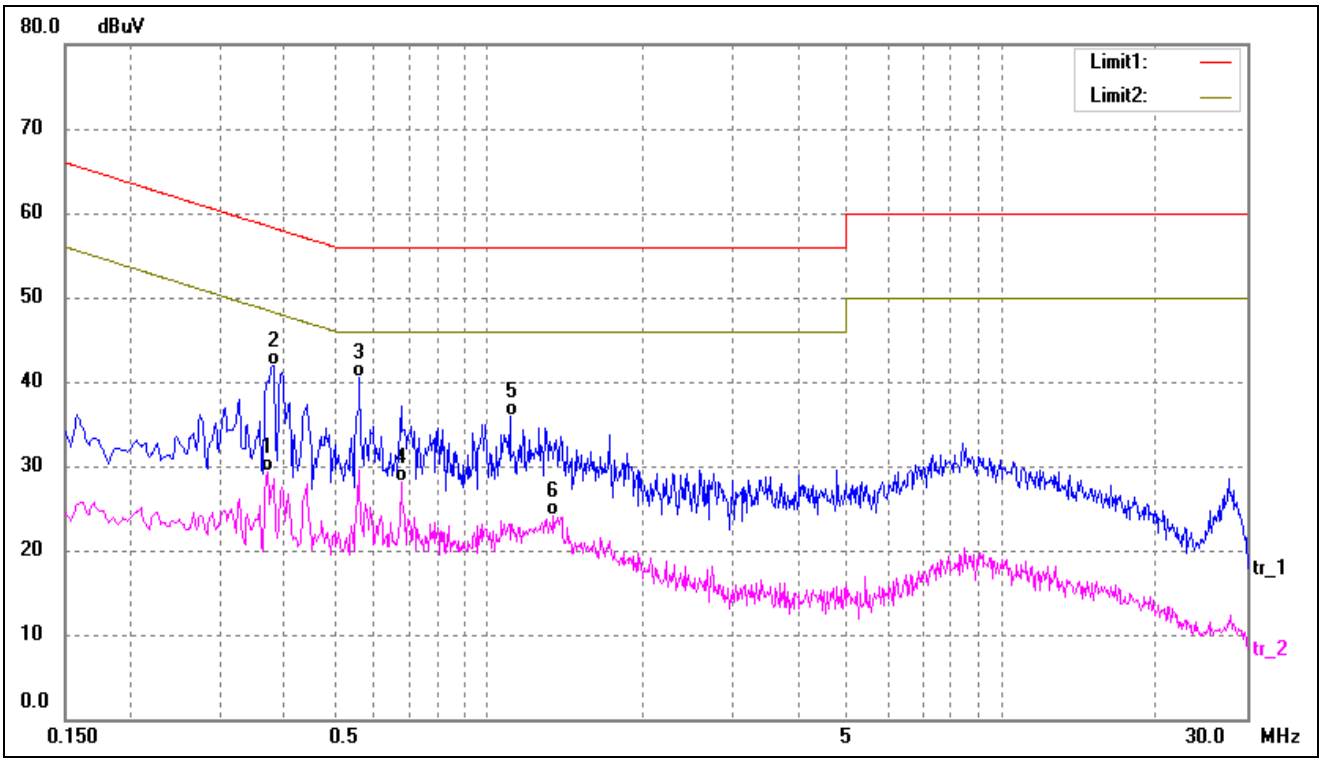
10.3 Test Receiver Setup

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

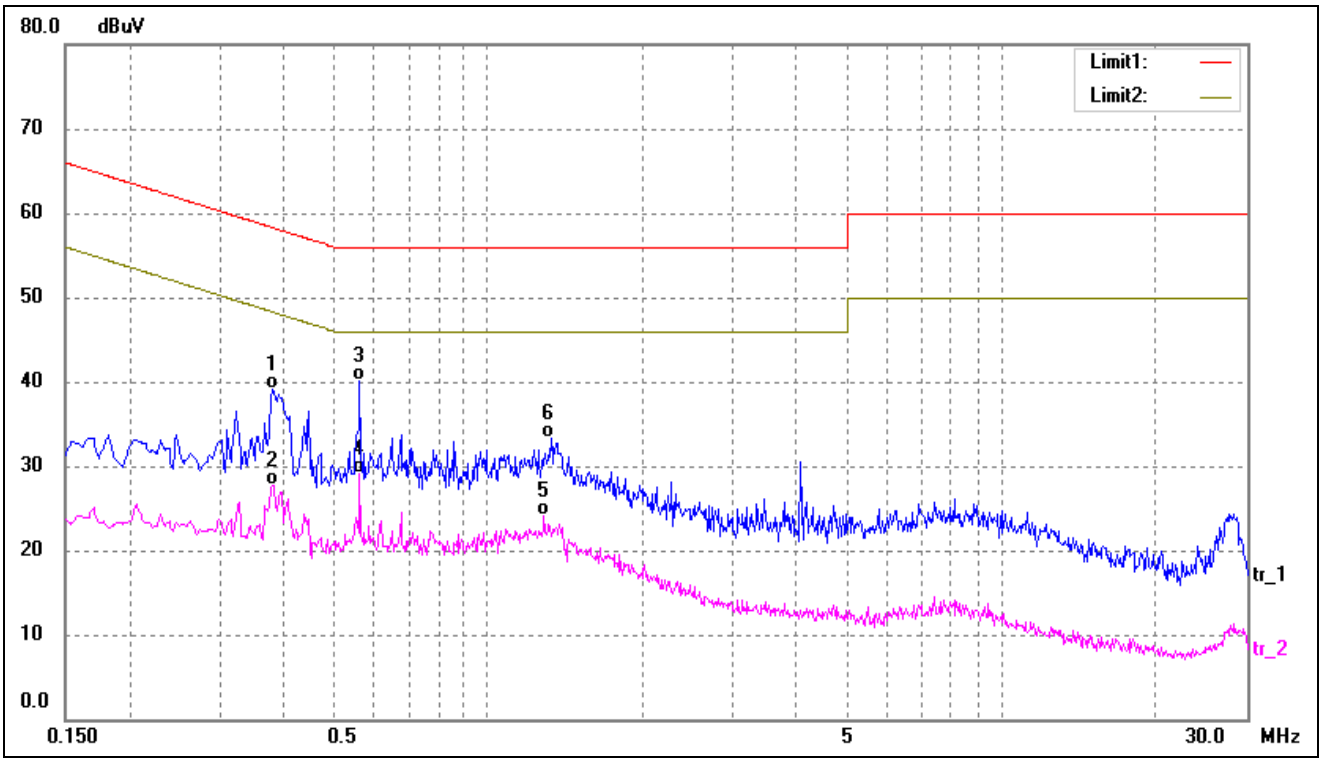
10.4 Summary of Test Results/Plots

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	
1	0.3700	19.00	10.30	29.30	48.50	-19.20	AVG
2	0.3780	31.63	10.30	41.93	58.32	-16.39	QP
3*	0.5620	30.21	10.30	40.51	56.00	-15.49	QP
4	0.6780	17.75	10.37	28.12	46.00	-17.88	AVG
5	1.1020	25.31	10.52	35.83	56.00	-20.17	QP
6	1.3420	13.69	10.41	24.10	46.00	-21.90	AVG

Test Mode	Communication	AC120V 60Hz	Polarity:	Line

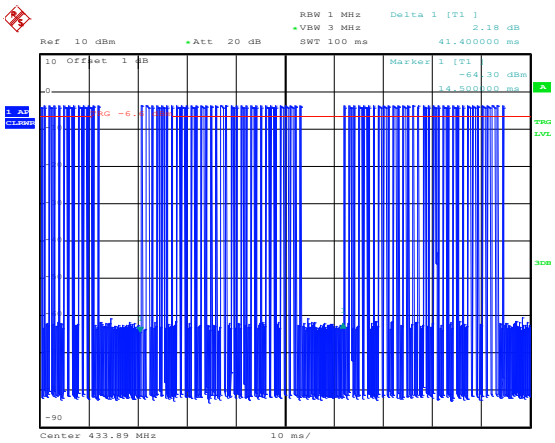
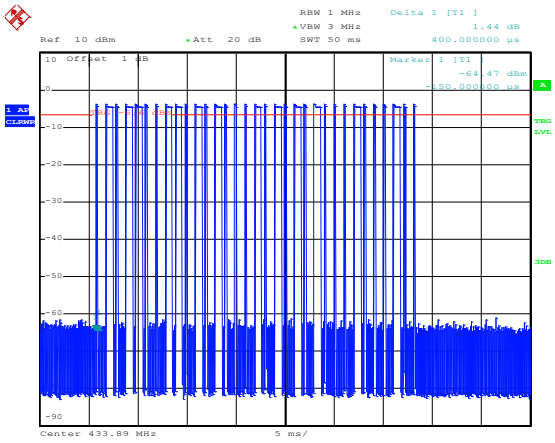


No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	
1	0.3780	28.73	10.30	39.03	58.32	-19.29	QP
2	0.3780	17.50	10.30	27.80	48.32	-20.52	AVG
3*	0.5620	29.75	10.30	40.05	56.00	-15.95	QP
4	0.5620	18.75	10.30	29.05	46.00	-16.95	AVG
5	1.2860	13.69	10.44	24.13	46.00	-21.87	AVG
6	1.3300	22.89	10.42	33.31	56.00	-22.69	QP

	Test Frequency （MHz）	$T_{on\ time}$ (ms)	T_{period} (ms)	Duty cycle
	2444	0.46	5.02	9.1%

Remark: Duty Cycle Factor=20*log(Duty Cycle)

Please refer to the attached test plots:

433.89MHz	
Test Period	
Pulse	

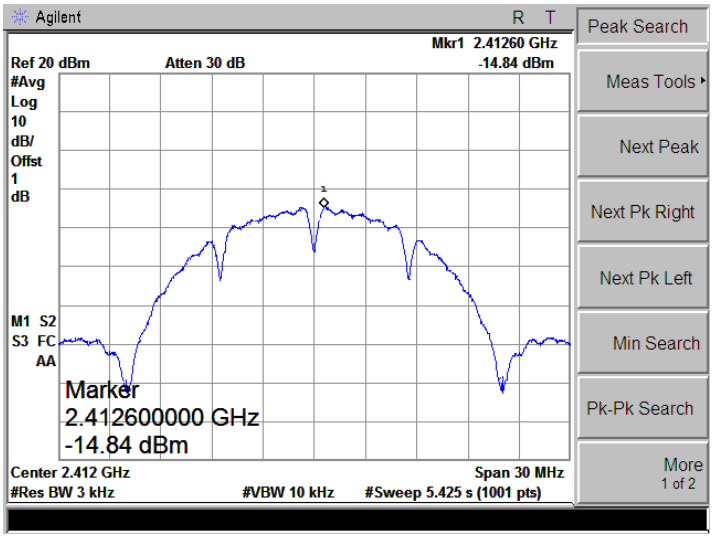
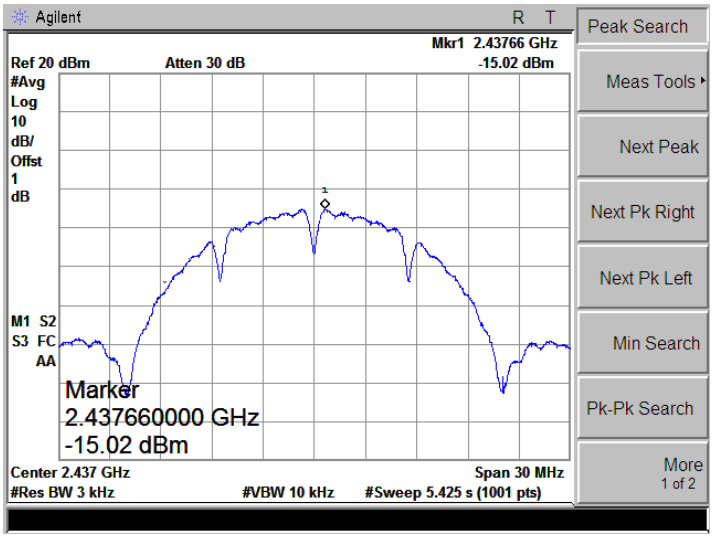
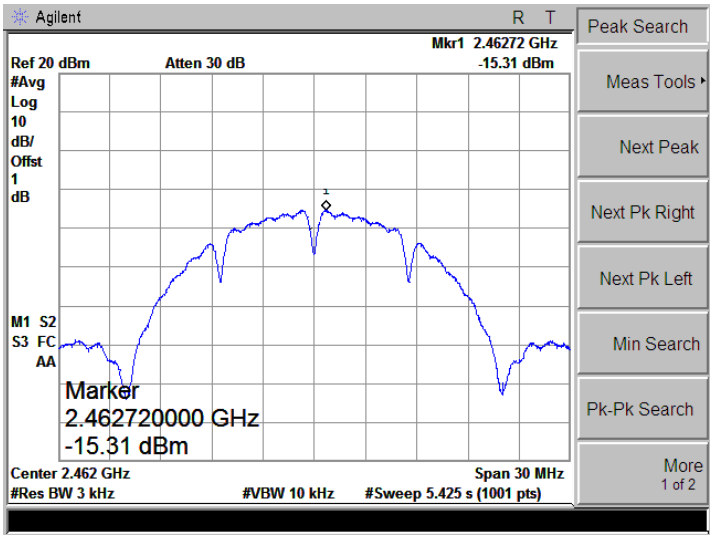
APPENDIX SUMMARY

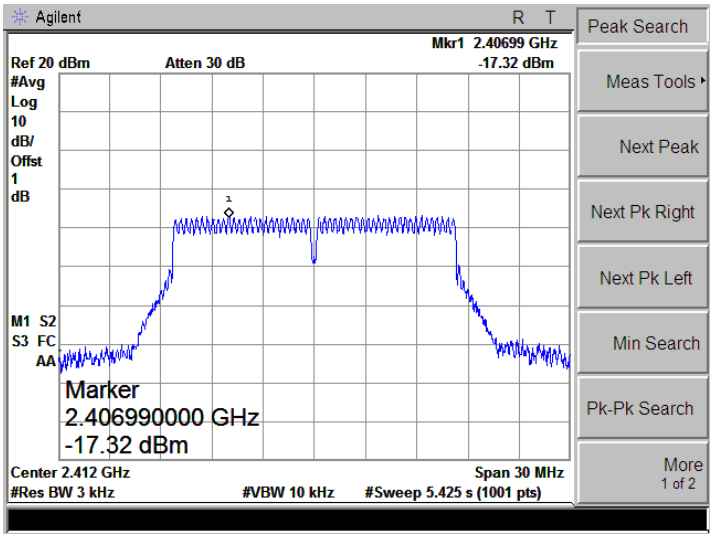
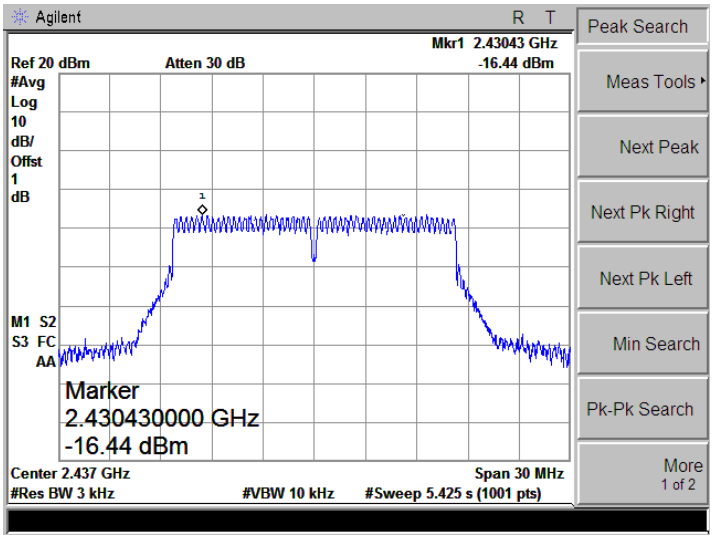
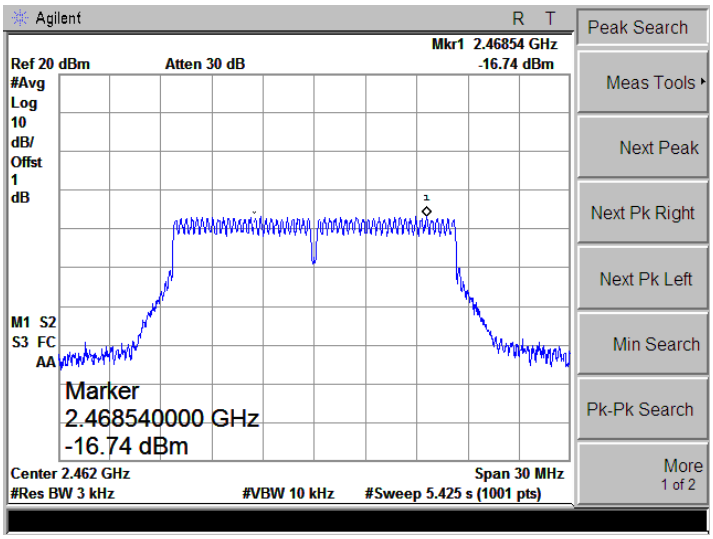
Project No.	WTX21X12145223W	Test Engineer	BAIdi
Start date	2021/12/24	Finish date	2021/12/24
Temperature	23.1℃	Humidity	50%
RF specifications	WIFI-2.4G		

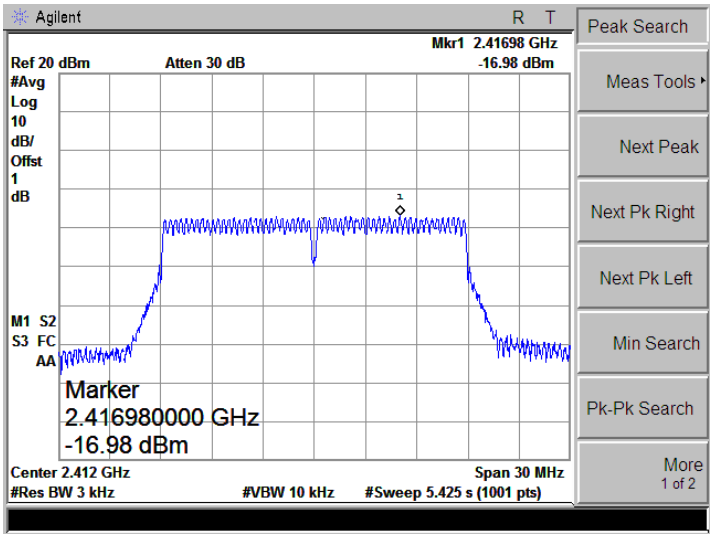
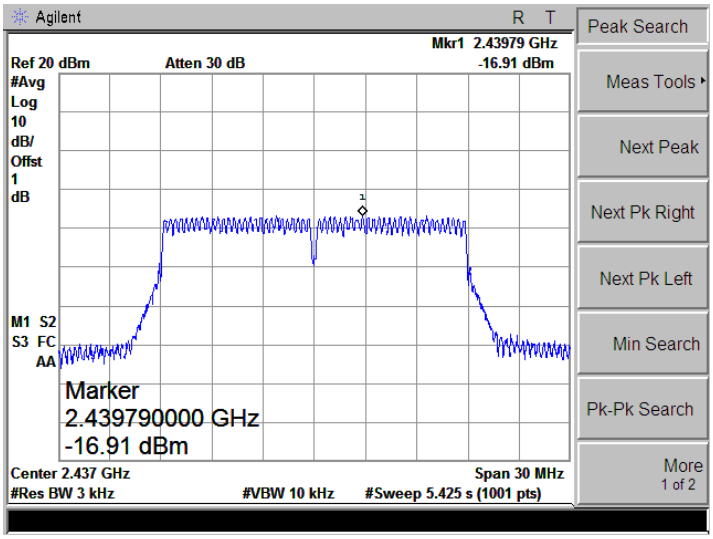
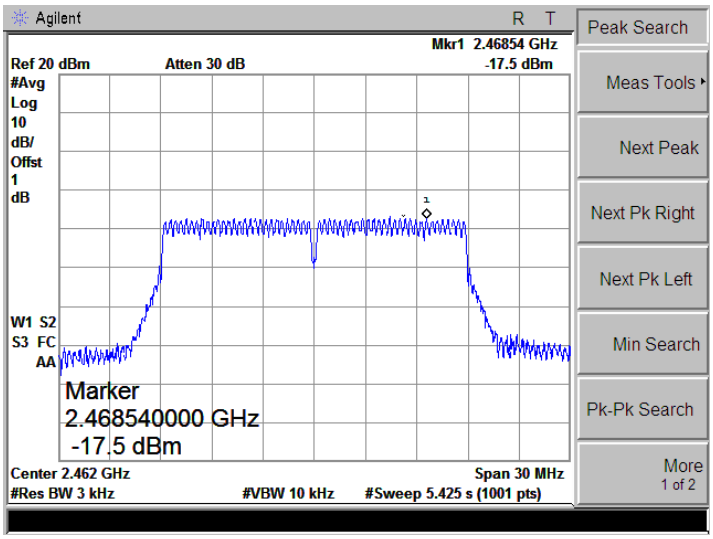
APPENDIX	Description of Test Item	Result
A	Power Spectral Density	Compliant
B	DTS Bandwidth	Compliant
C	RF Output Power	Compliant
D	Conducted Out of Band Emissions	Compliant

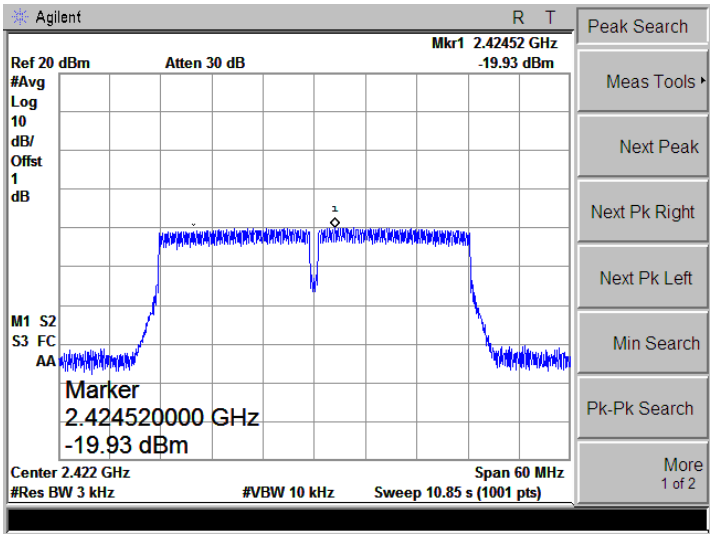
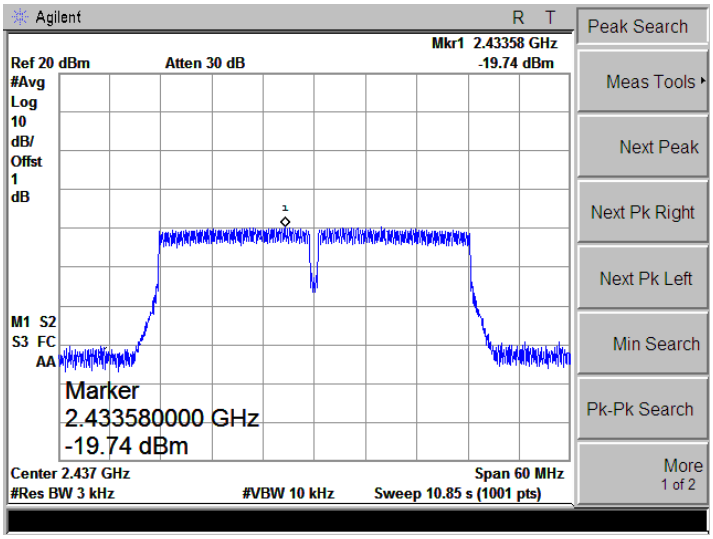
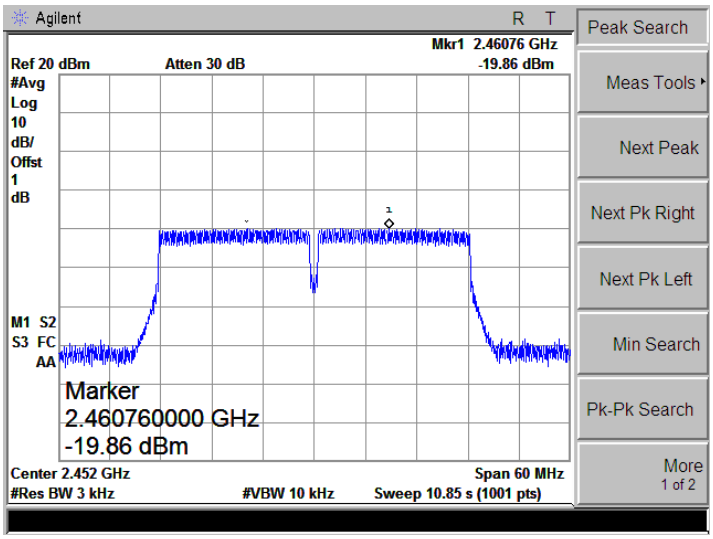
APPENDIX A

Power Spectral Density			
Test Mode	**Test Channel MHz**	**Power Spectral Density dBm/3kHz**	**Limit dBm/3kHz**
802.11b_11Mbps	2412	-14.84	8
	2437	-15.02	8
	2462	-15.31	8
802.11g_54Mbps	2412	-17.32	8
	2437	-16.44	8
	2462	-16.74	8
802.11n-HT20_MCS7	2412	-16.98	8
	2437	-16.91	8
	2462	-17.50	8
802.11n-HT40_MCS7	2422	-19.93	8
	2437	-19.74	8
	2452	-19.86	8

802.11b-Low	
802.11b-Middle	
802.11b-High	

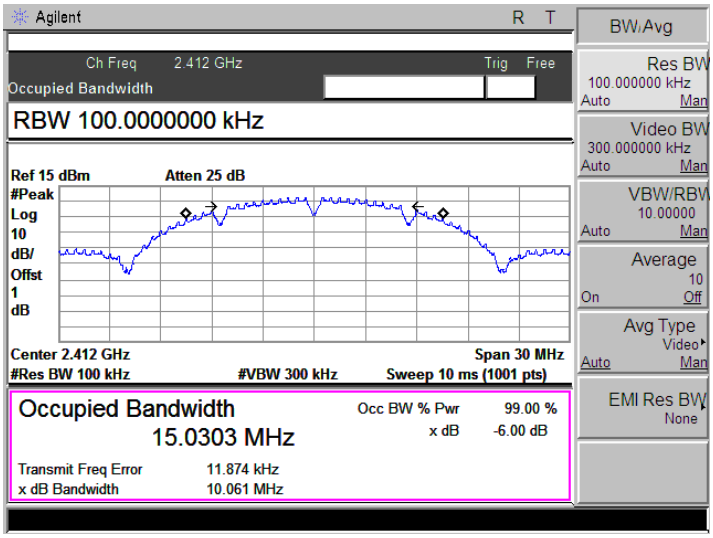
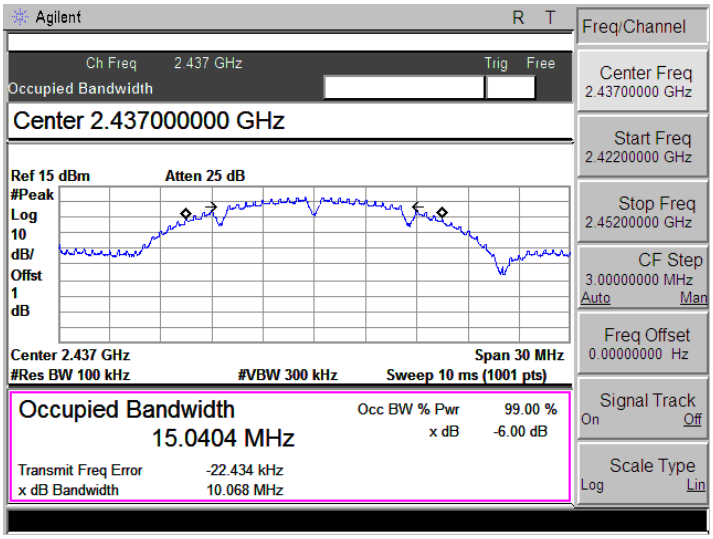
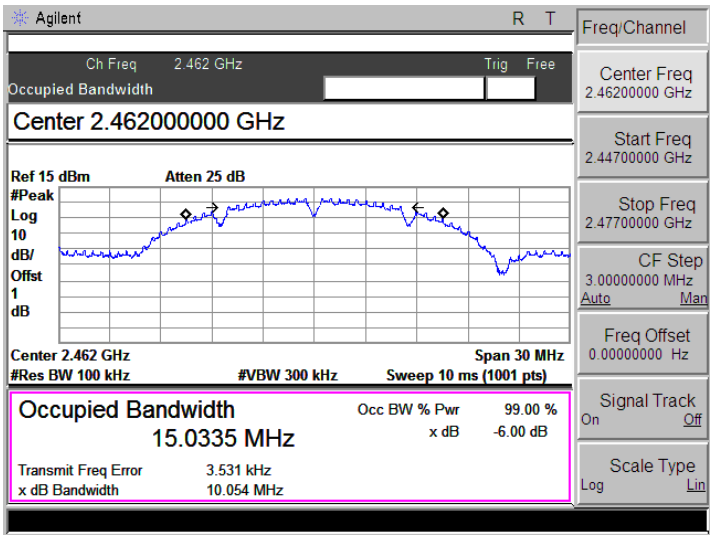
802.11g-Low	
802.11g-Middle	
802.11g-High	

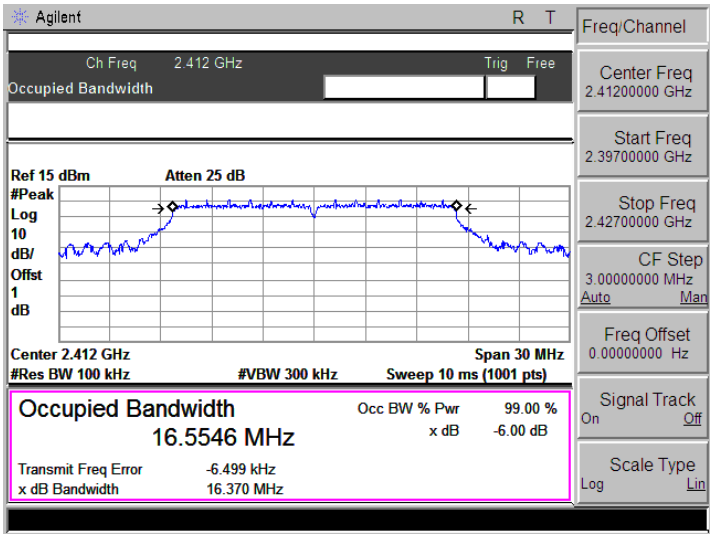
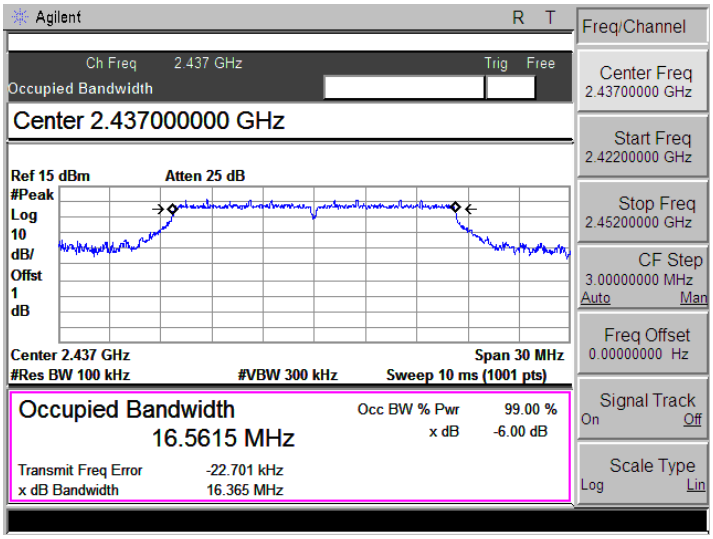
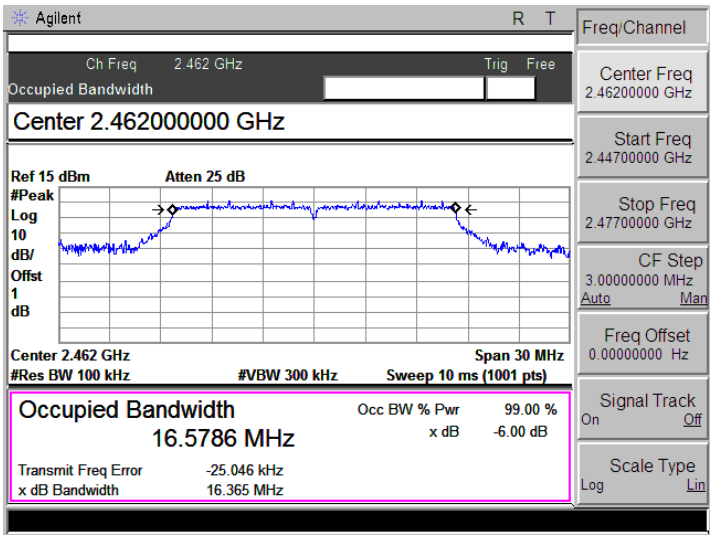
802.11n-HT20-Low	
802.11n-HT20-Middle	
802.11n-HT20-High	

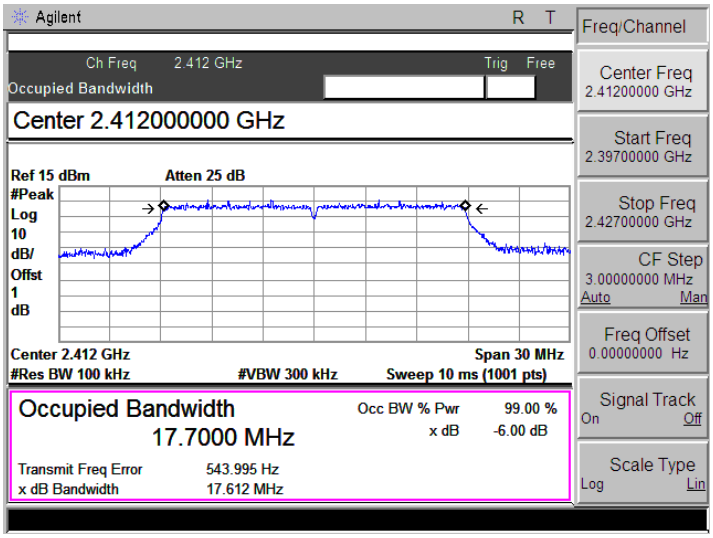
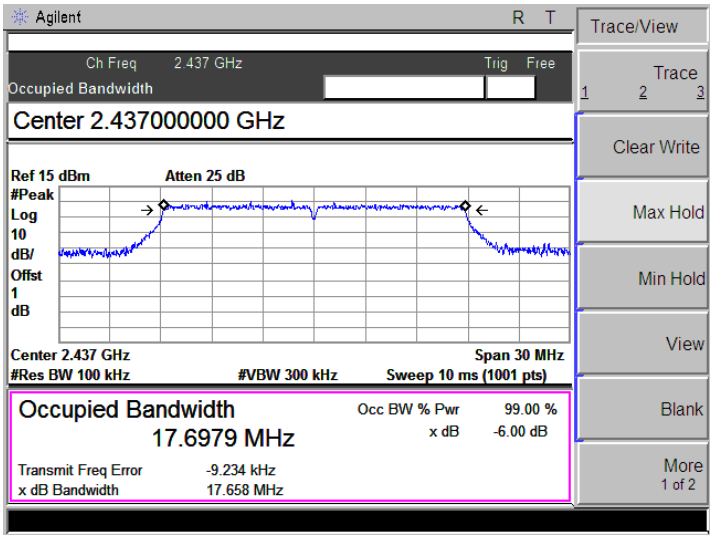
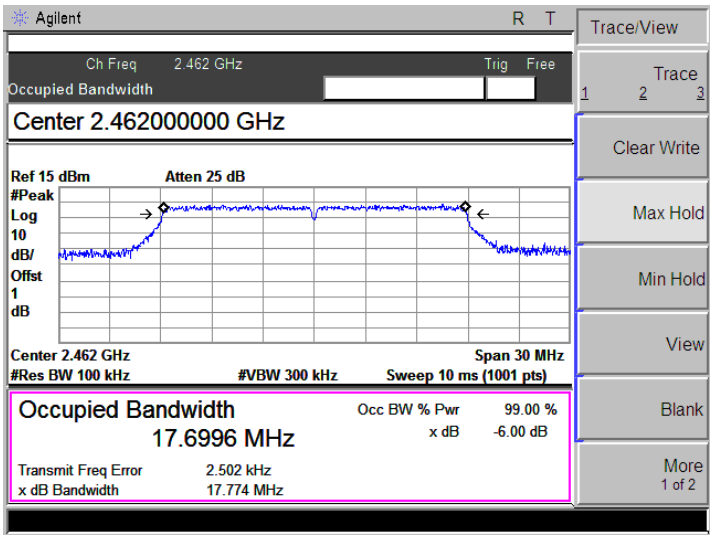
802.11n-HT40-Low	
802.11n-HT40-Middle	
802.11n-HT40-High	

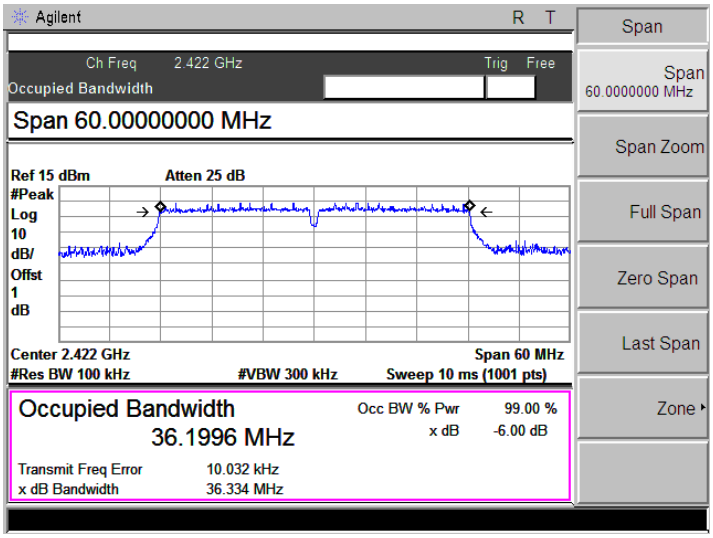
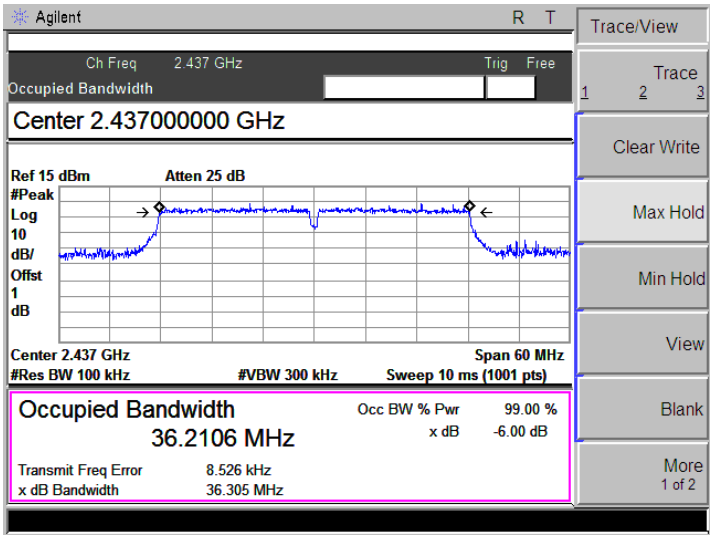
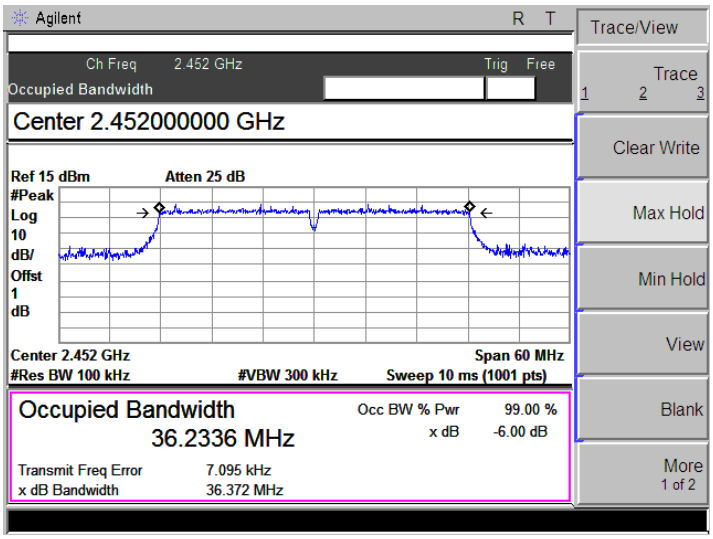
APPENDIX B

DTS Bandwidth			
Test Mode	**Test Channel MHz**	**6 dB Bandwidth MHz**	**Limit kHz**
802.11b_11Mbps	2412	10.061	≥500
	2437	10.068	≥500
	2462	10.054	≥500
802.11g_6Mbps	2412	16.370	≥500
	2437	16.365	≥500
	2462	16.365	≥500
802.11n-HT20_MCS0	2412	17.612	≥500
	2437	17.658	≥500
	2462	17.774	≥500
802.11n-HT40_MCS0	2422	36.334	≥500
	2437	36.305	≥500
	2452	36.372	≥500

802.11b-Low	
802.11b-Middle	
802.11b-High	

802.11g-Low	
802.11g-Middle	
802.11g-High	

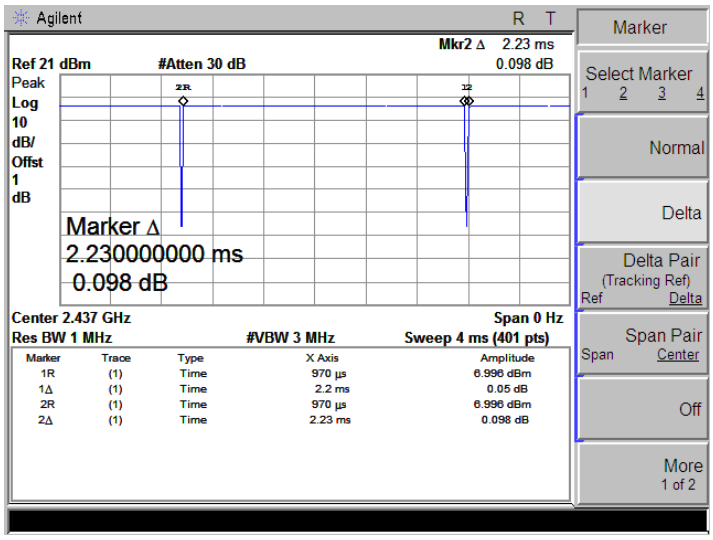
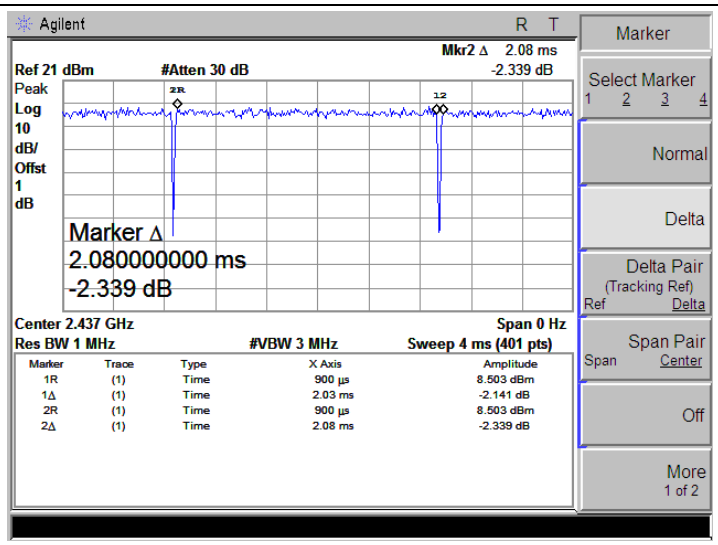
802.11n-HT20-Low	
802.11n-HT20-Middle	
802.11n-HT20-High	

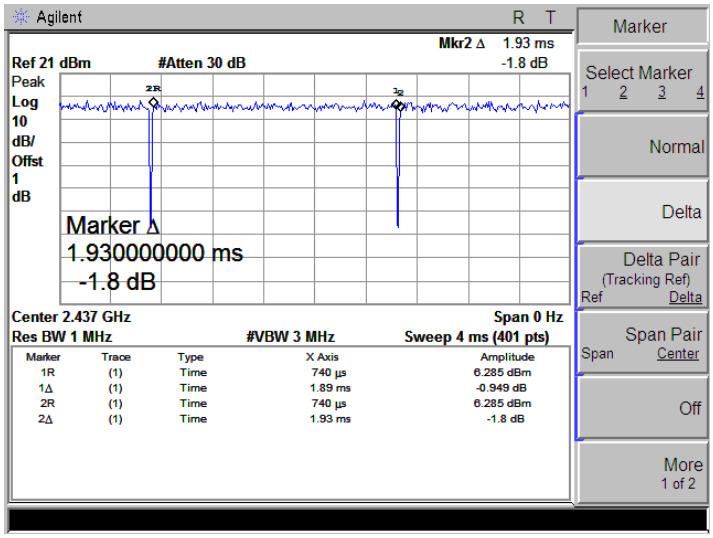
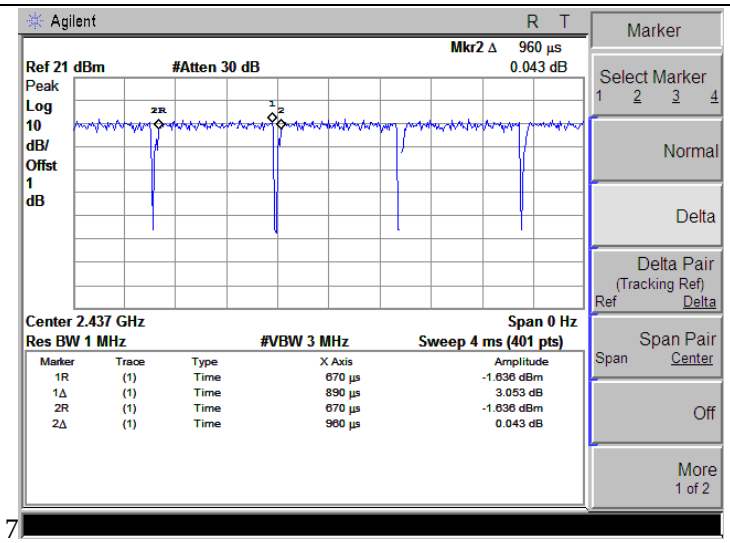
802.11n-HT40-Low	
802.11n-HT40-Middle	
802.11n-HT40-High	

APPENDIX D

Test Mode	Test Frequency (MHz)	$T_{on\ time}$ (ms)	T_{period} (ms)	Duty cycle
802.11b_11Mbps	2437	2.2	2.23	98.65%
802.11g_6Mbps	2437	2.03	2.08	97.60%
802.11n-HT20_MCS0	2437	1.89	1.93	97.93%
802.11n-HT40_MCS0	2437	0.890	0.960	92.71%

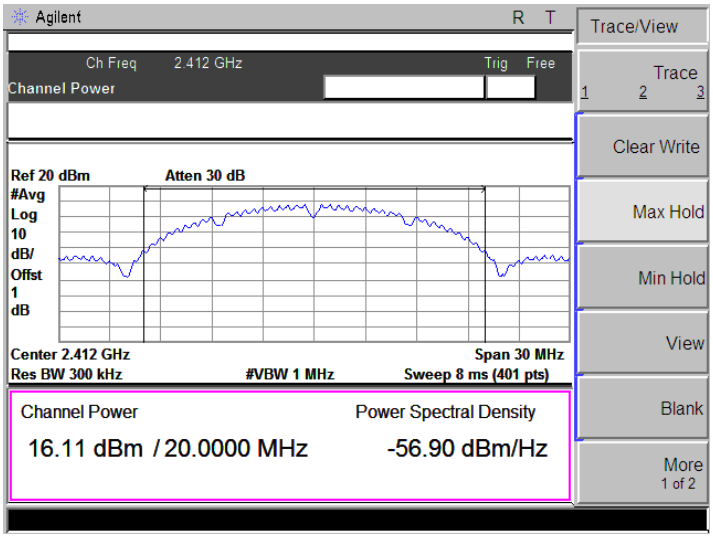
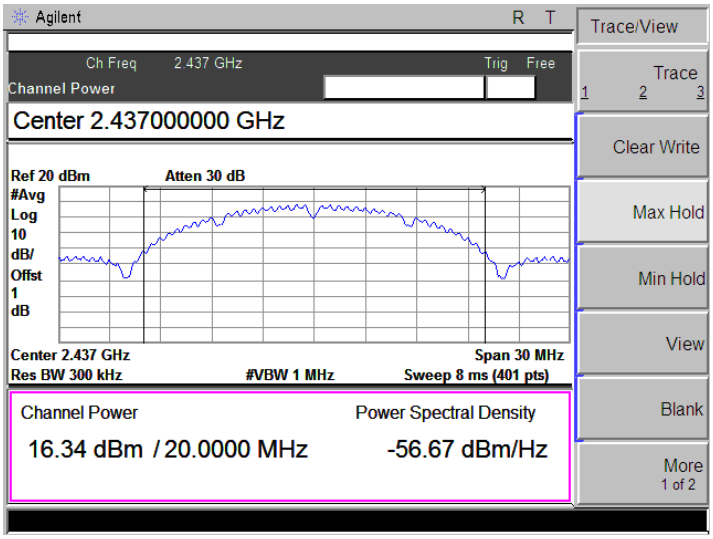
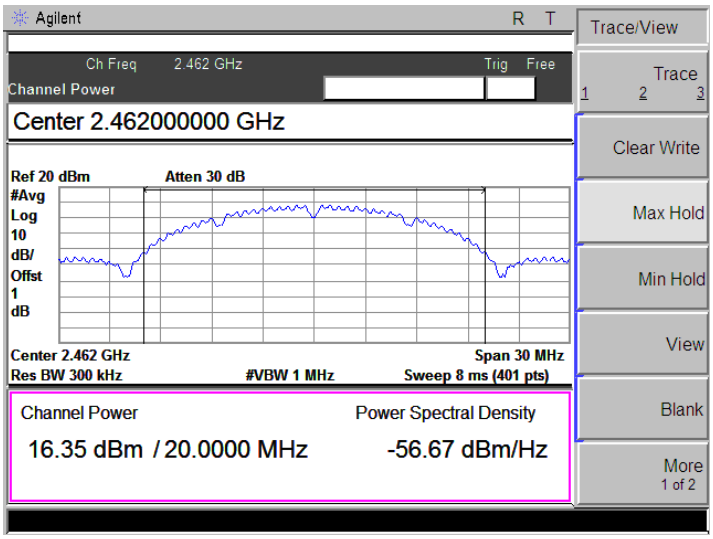
Remark: Duty Cycle Factor=20*log (Duty Cycle)

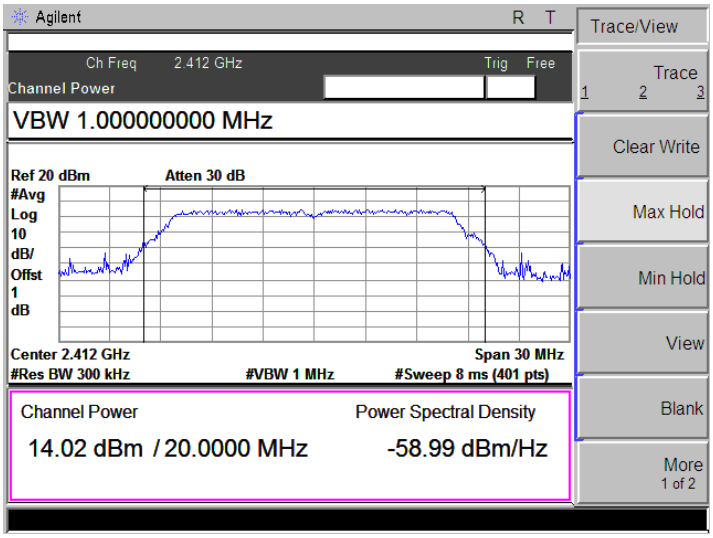
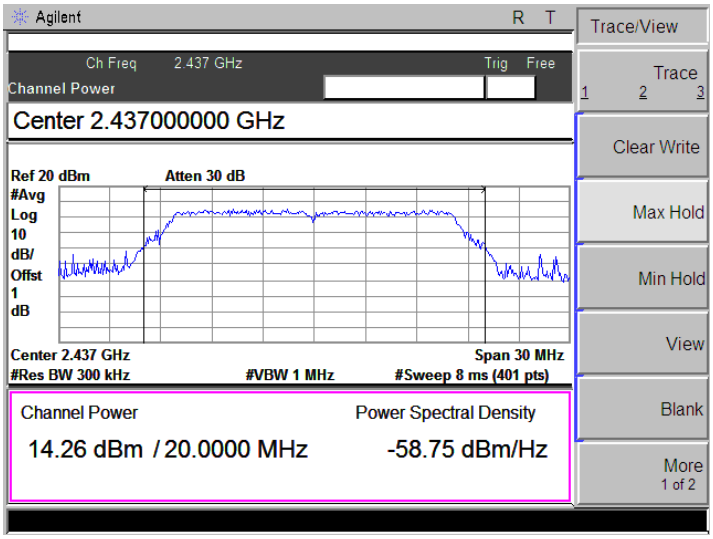
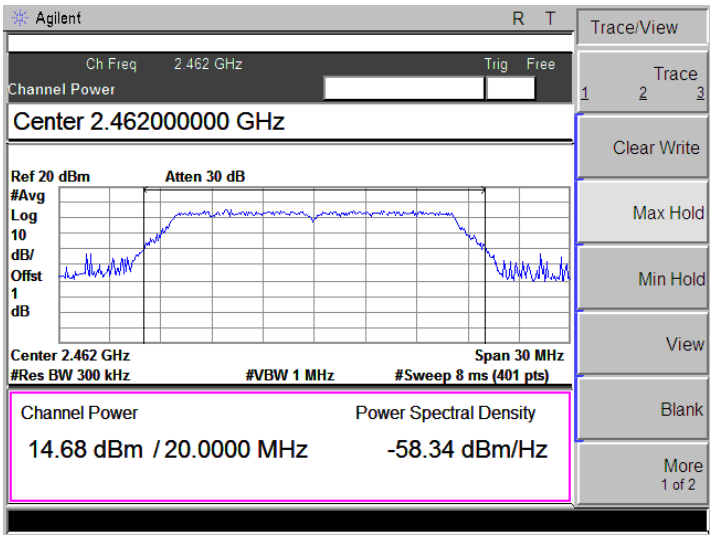
802.11b	
802.11g	

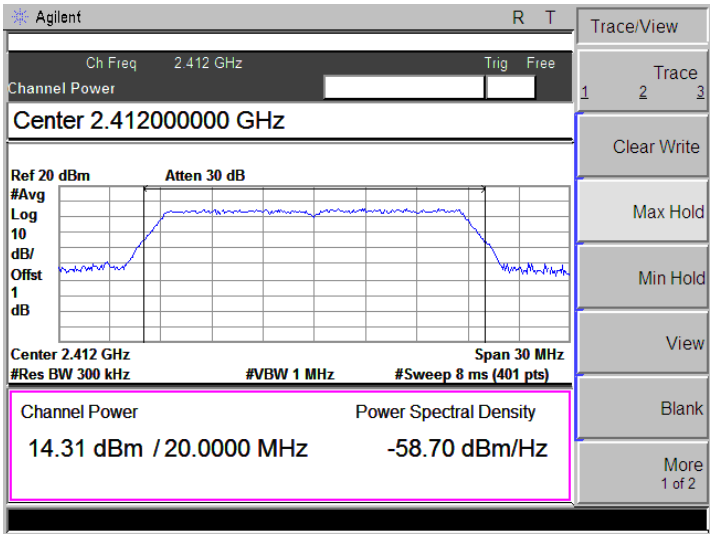
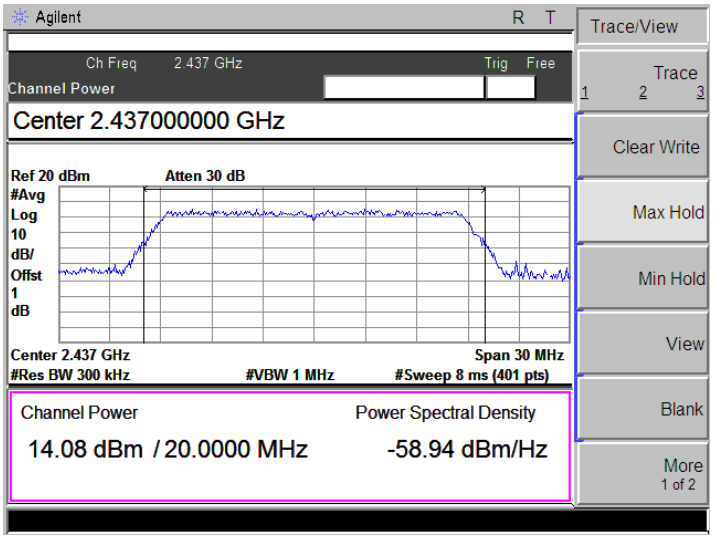
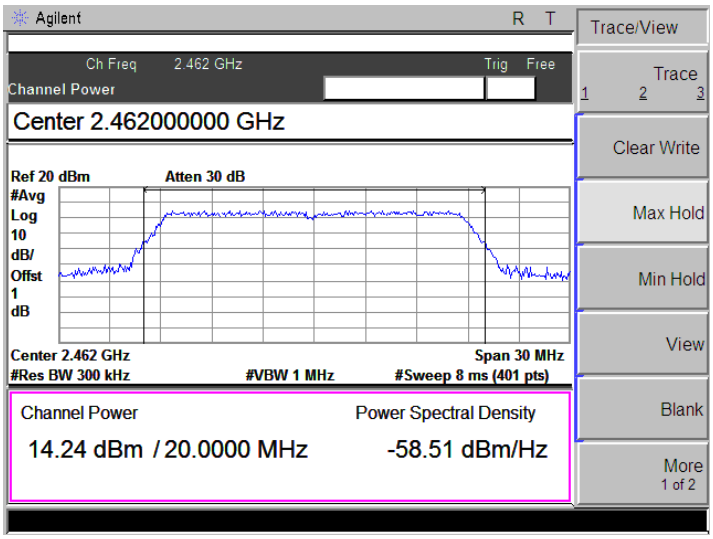
802.11n-HT20	
802.11n-HT40	

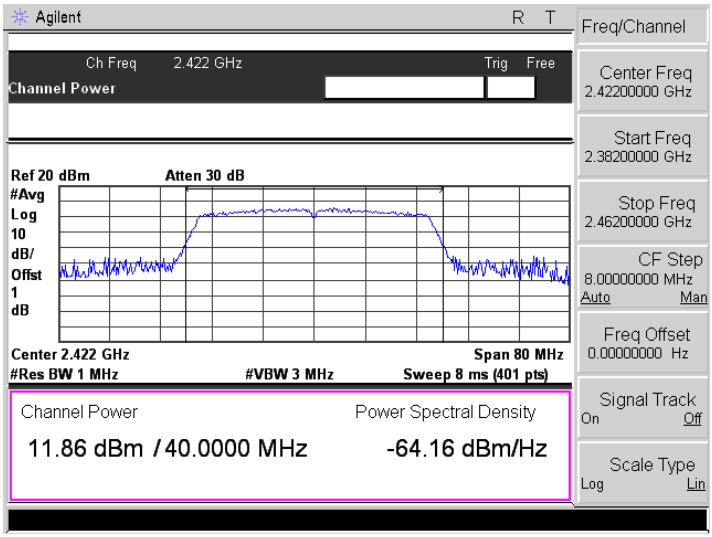
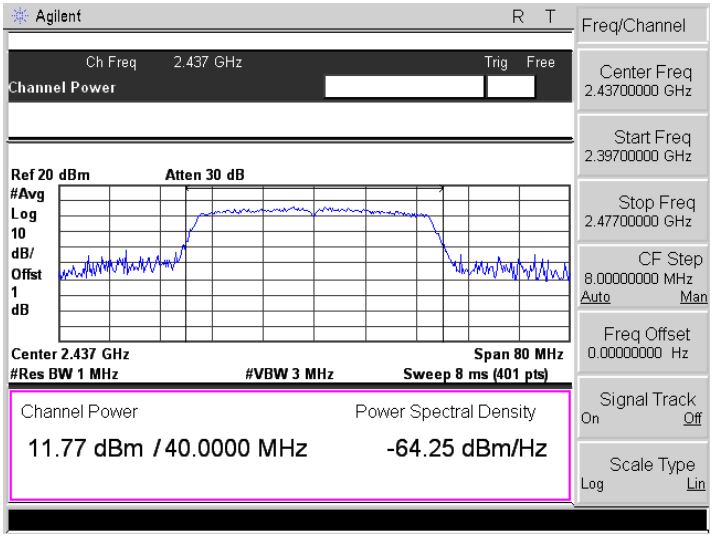
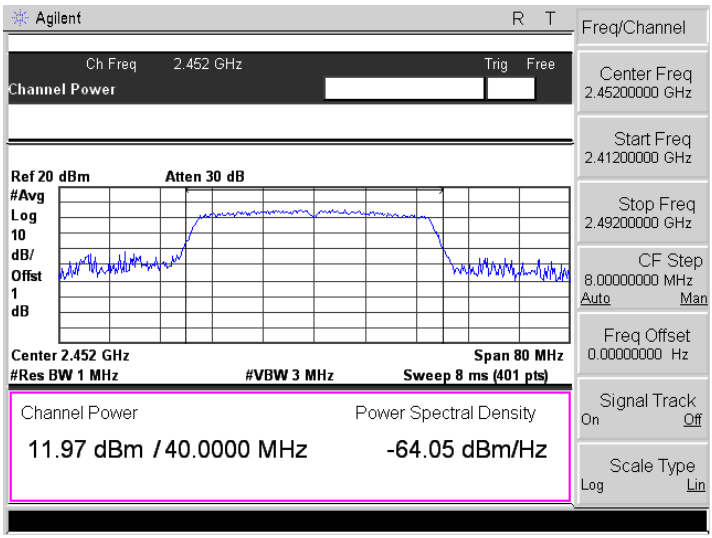
APPENDIX C

Test Mode	Frequency MHz	Reading dBm	Limit dBm
802.11b _ 1Mbps	2412	16.11	30.00
	2437	16.34	30.00
	2462	16.35	30.00
802.11g_6Mbps	2412	14.02	30.00
	2437	14.26	30.00
	2462	14.68	30.00
802.11n HT20_MCS0	2412	14.31	30.00
	2437	14.08	30.00
	2462	14.24	30.00
802.11n HT40_MCS0	2422	11.86	30.00
	2437	11.77	30.00
	2452	11.97	30.00

802.11b-Low	
802.11b-Middle	
802.11b-High	

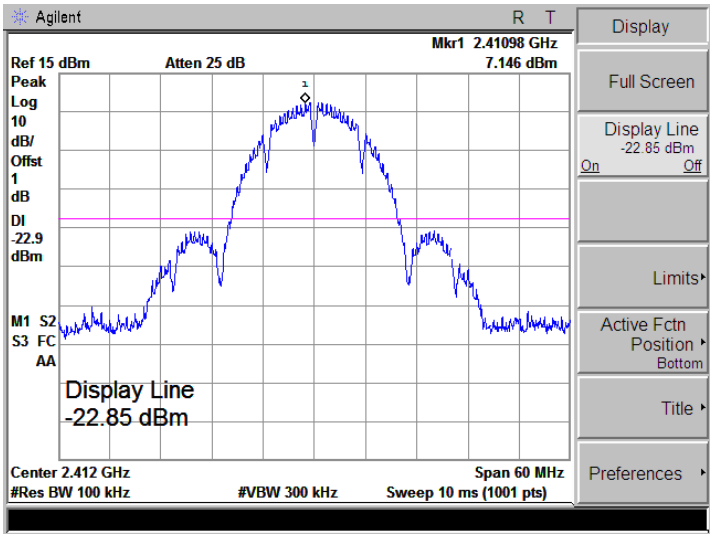
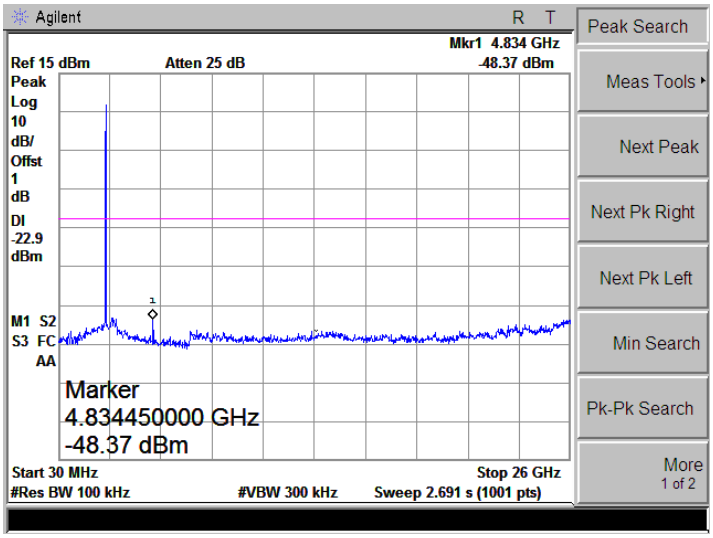
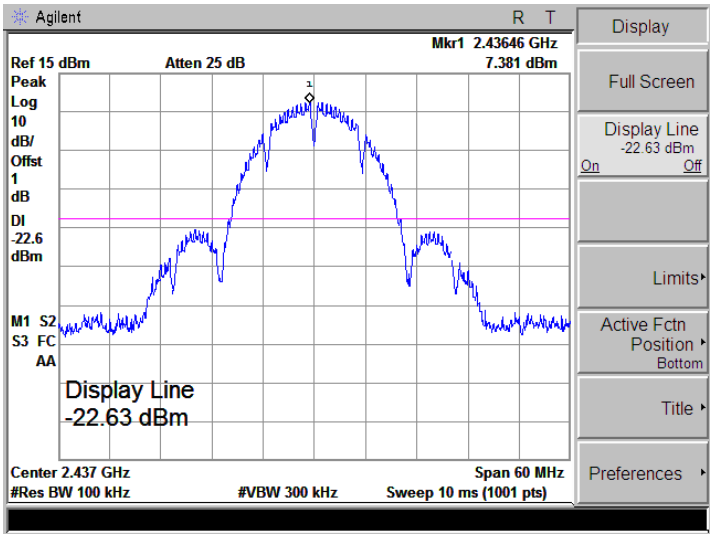
802.11g-Low	
802.11g-Middle	
802.11g-High	

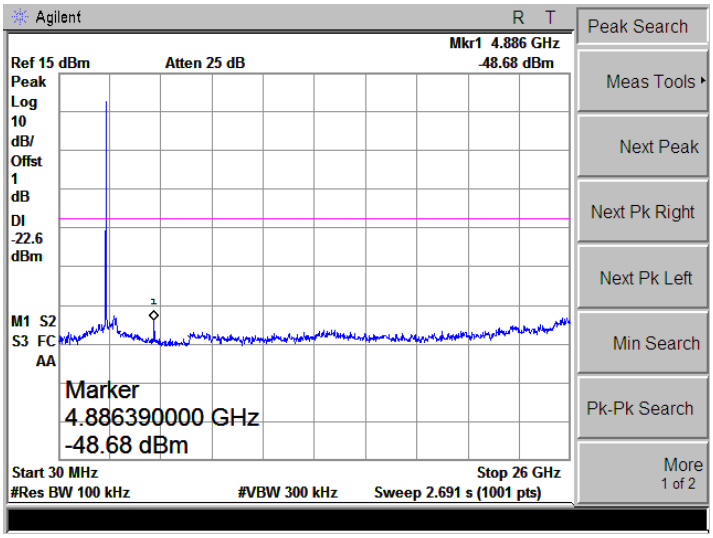
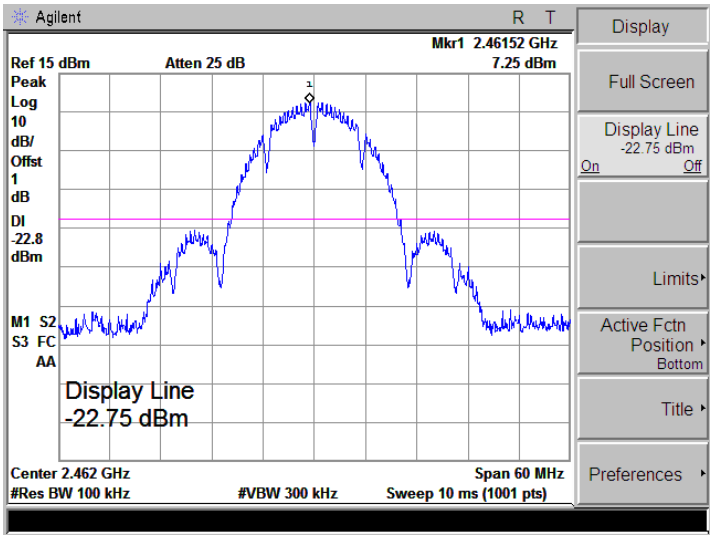
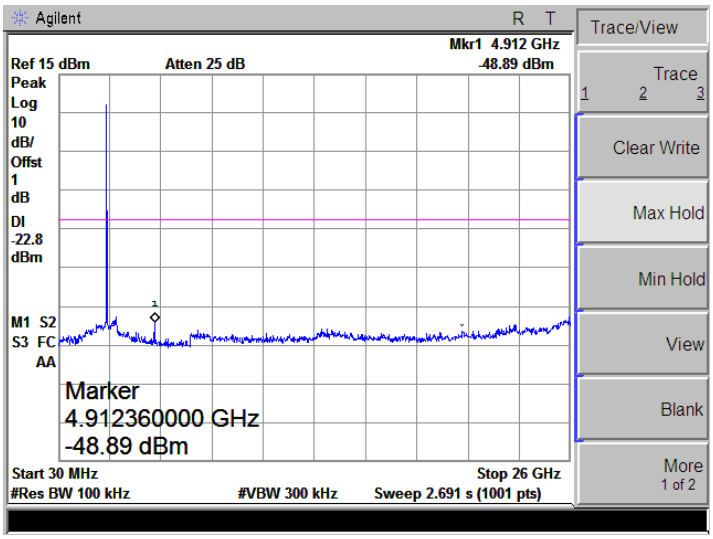
802.11n-HT20-Low	
802.11n-HT20-Middle	
802.11n-HT20-High	

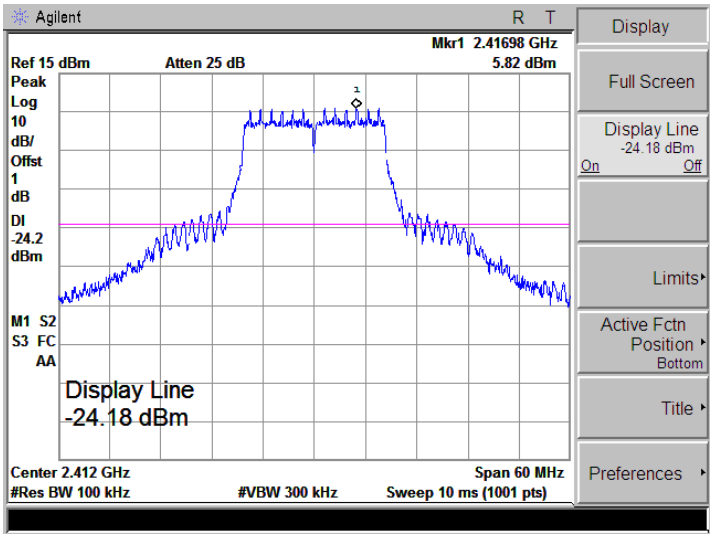
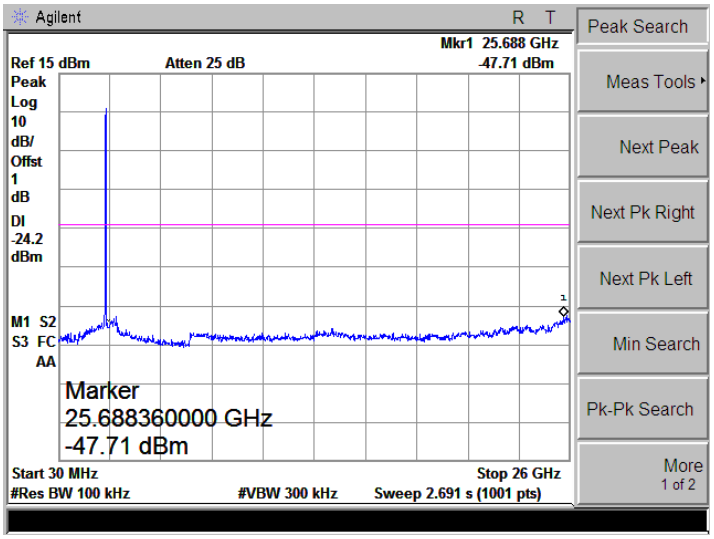
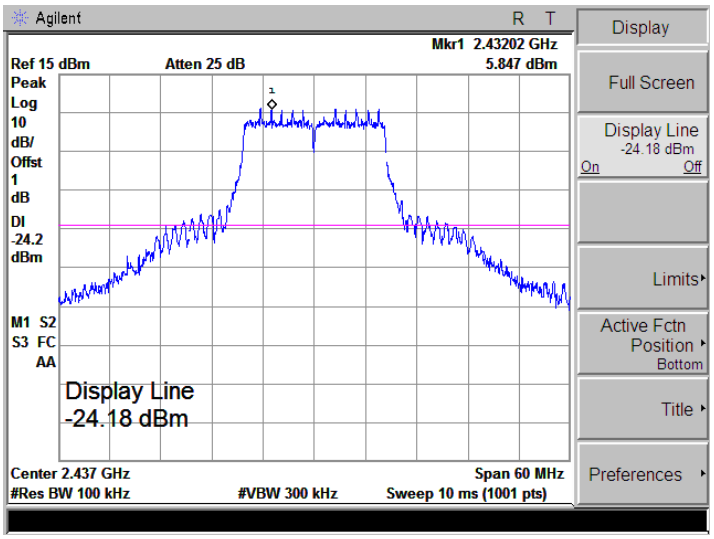
802.11n-HT40-Low	
802.11n-HT40-Middle	
802.11n-HT40-High	

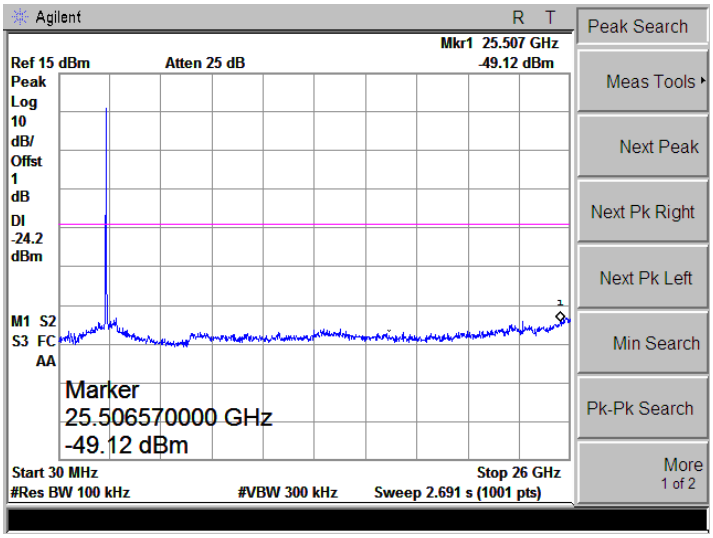
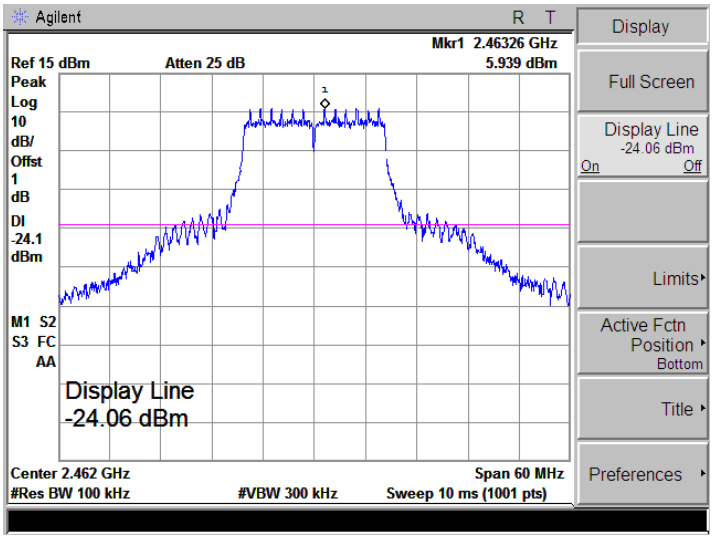
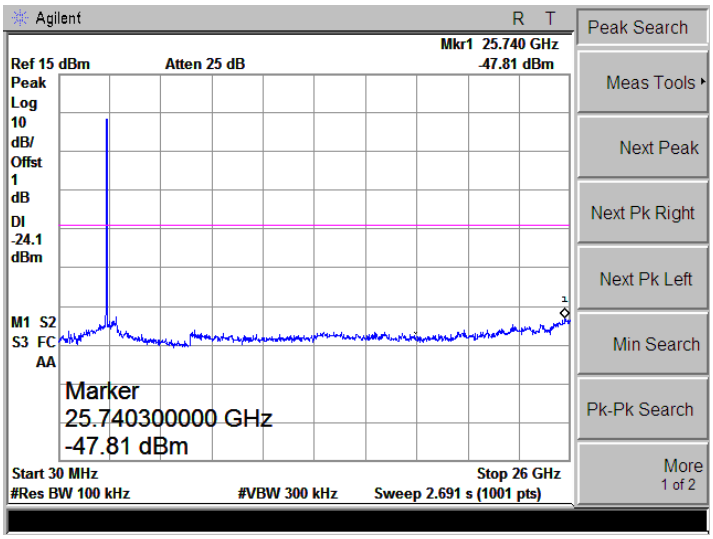
APPENDIX E

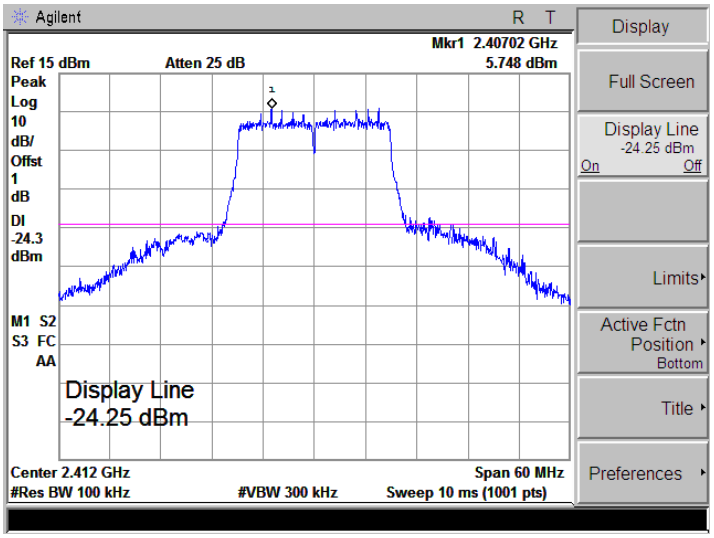
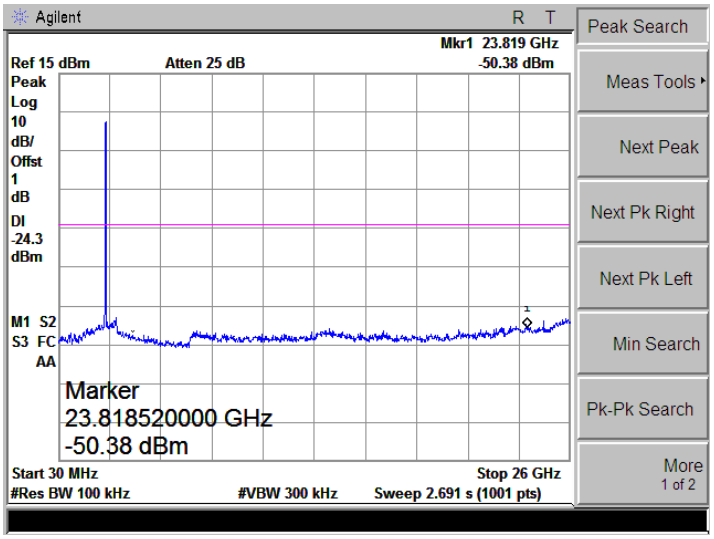
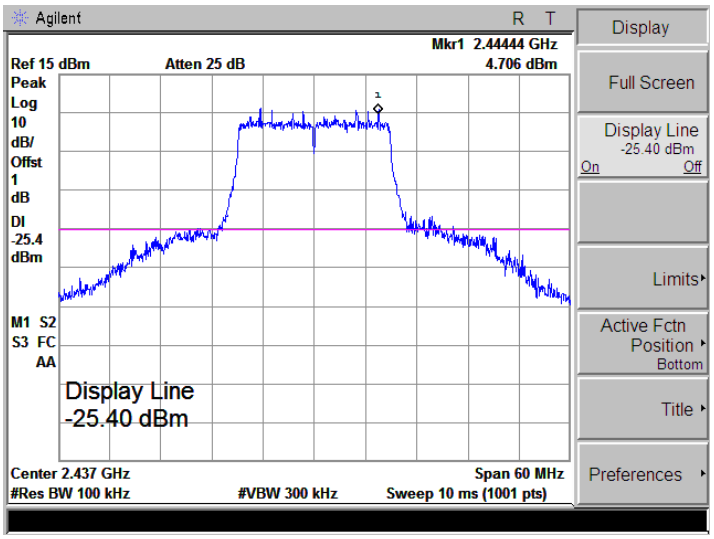
Conducted Out of Band Emissions

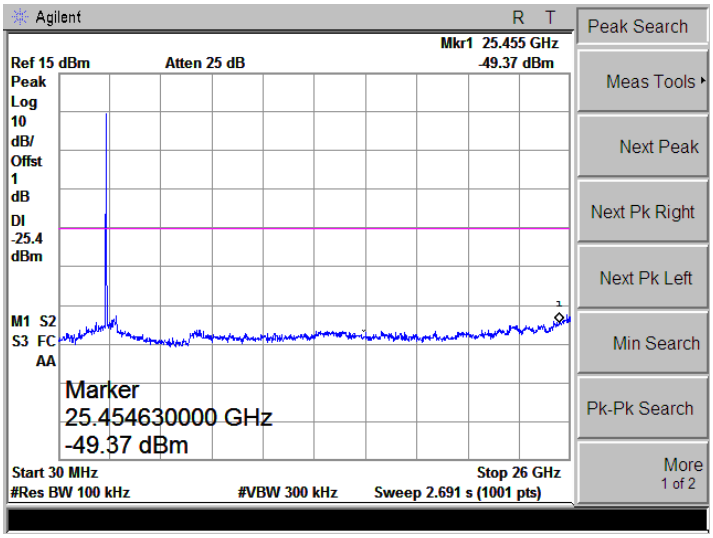
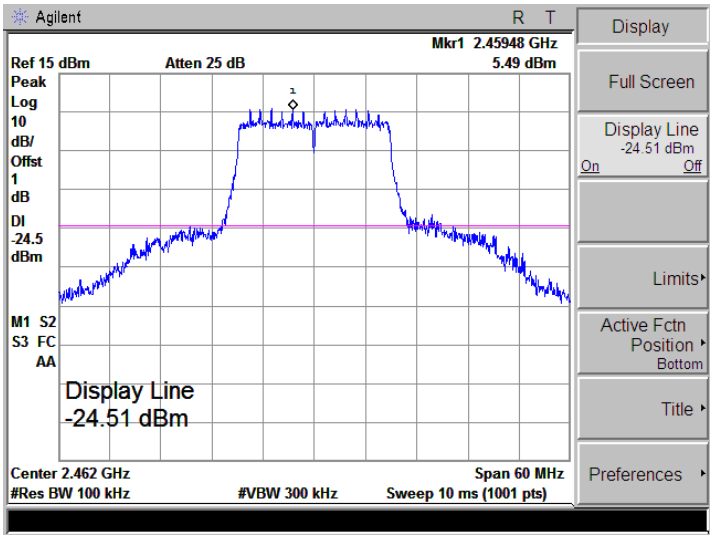
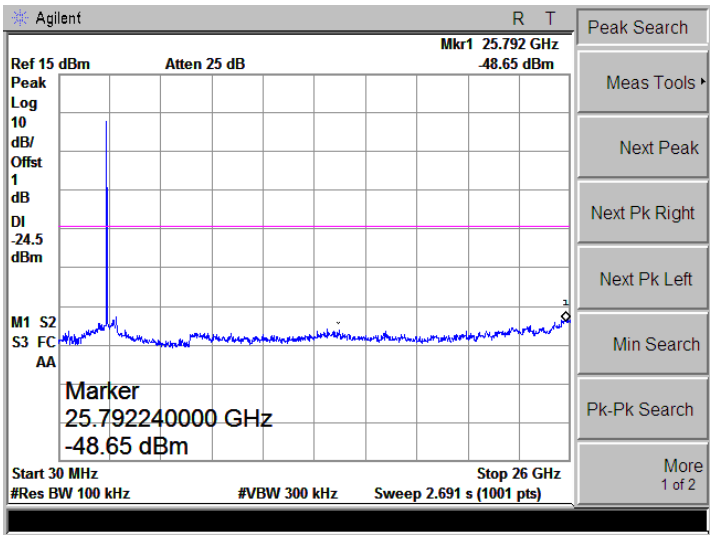
802.11b-Low	
	
802.11b-Middle	

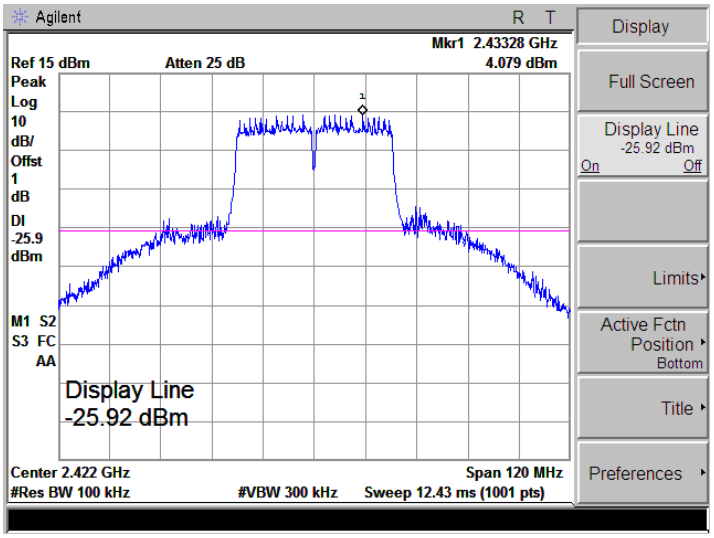
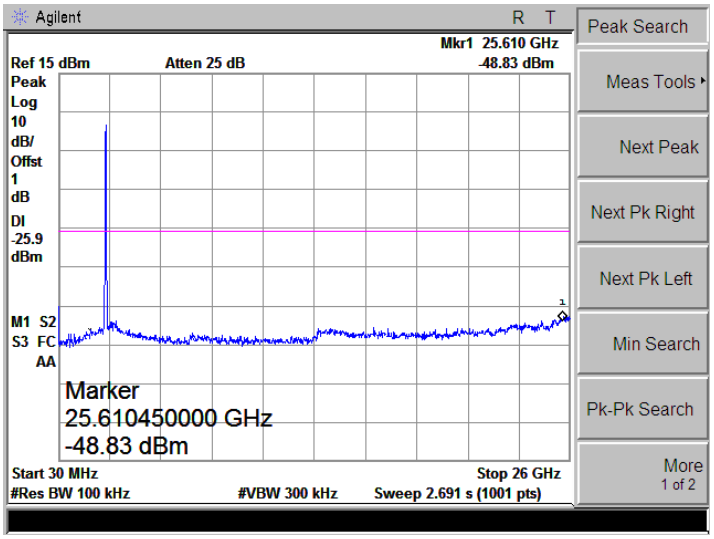
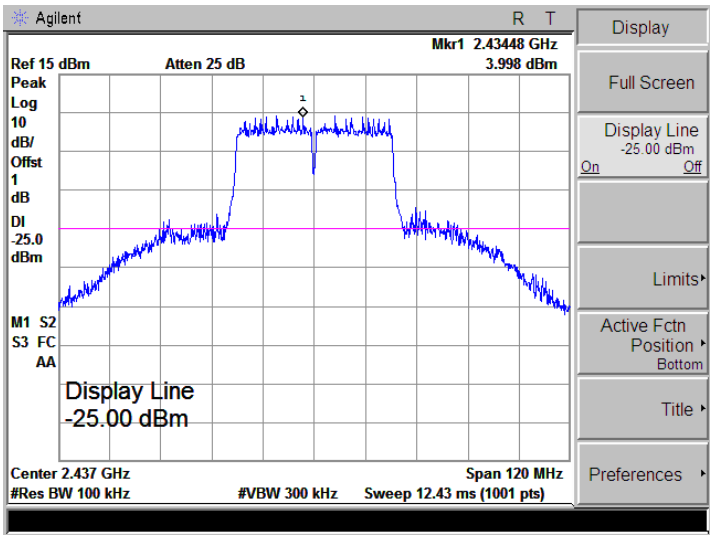
	 Agilent R T Mkr1 4.886 GHz Ref 15 dBm Atten 25 dB -48.68 dBm Peak Log 10 dB/ Offst 1 dB Dl -22.6 dBm M1 S2 S3 FC AA Marker 4.886390000 GHz -48.68 dBm Start 30 MHz #Res BW 100 kHz #VBW 300 kHz Stop 26 GHz Sweep 2.691 s (1001 pts) Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2
802.11b-High	 Agilent R T Mkr1 2.46152 GHz Ref 15 dBm Atten 25 dB 7.25 dBm Peak Log 10 dB/ Offst 1 dB Dl -22.8 dBm M1 S2 S3 FC AA Display Line -22.75 dBm Center 2.462 GHz #Res BW 100 kHz #VBW 300 kHz Span 60 MHz Sweep 10 ms (1001 pts) Display Full Screen Display Line -22.75 dBm On Off Limits Active Fctn Position Bottom Title Preferences
	 Agilent R T Mkr1 4.912 GHz Ref 15 dBm Atten 25 dB -48.89 dBm Peak Log 10 dB/ Offst 1 dB Dl -22.8 dBm M1 S2 S3 FC AA Marker 4.912360000 GHz -48.89 dBm Start 30 MHz #Res BW 100 kHz #VBW 300 kHz Stop 26 GHz Sweep 2.691 s (1001 pts) Trace/View Trace 1 2 3 Clear Write Max Hold Min Hold View Blank More 1 of 2

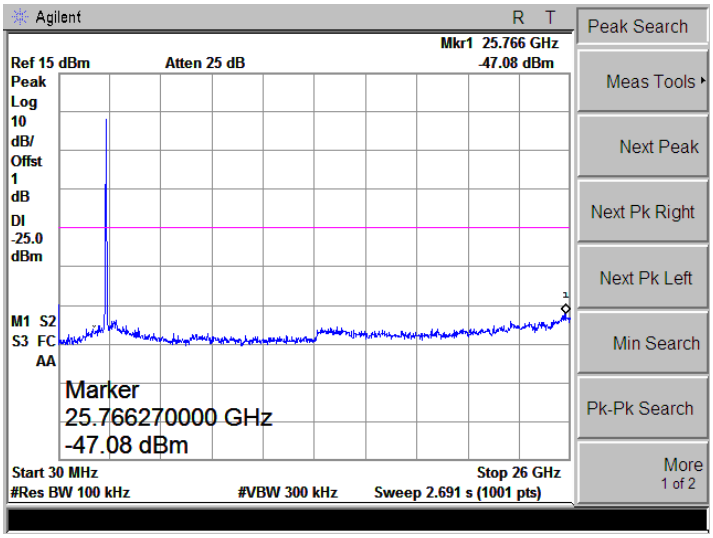
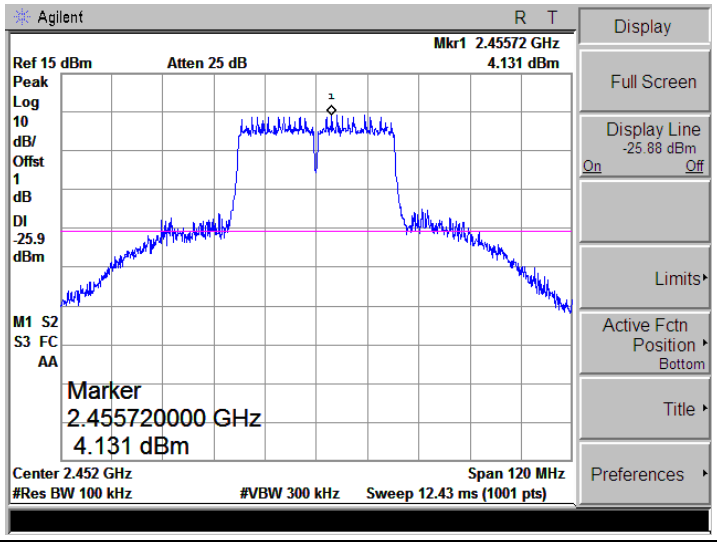
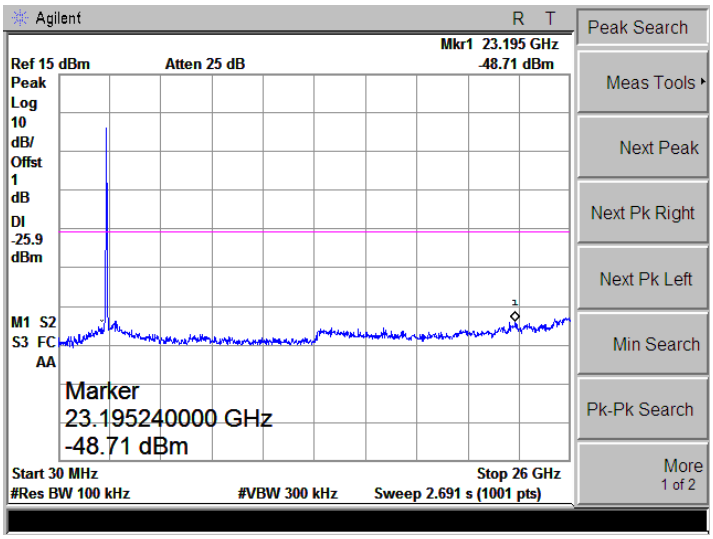
802.11g-Low	 
802.11g-Middle	

	 Agilent R T Mkr1 25.507 GHz Ref 15 dBm Atten 25 dB -49.12 dBm Peak Log 10 dB/ Offst 1 dB Dl -24.2 dBm M1 S2 S3 FC AA Marker 25.506570000 GHz -49.12 dBm Start 30 MHz #Res BW 100 kHz #VBW 300 kHz Stop 26 GHz Sweep 2.691 s (1001 pts) Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2
802.11g-High	 Agilent R T Mkr1 2.46326 GHz Ref 15 dBm Atten 25 dB 5.939 dBm Peak Log 10 dB/ Offst 1 dB Dl -24.1 dBm M1 S2 S3 FC AA Display Line -24.06 dBm Center 2.462 GHz #Res BW 100 kHz #VBW 300 kHz Span 60 MHz Sweep 10 ms (1001 pts) Display Full Screen Display Line -24.06 dBm On Off Limits Active Fctn Position Bottom Title Preferences
	 Agilent R T Mkr1 25.740 GHz Ref 15 dBm Atten 25 dB -47.81 dBm Peak Log 10 dB/ Offst 1 dB Dl -24.1 dBm M1 S2 S3 FC AA Marker 25.740300000 GHz -47.81 dBm Start 30 MHz #Res BW 100 kHz #VBW 300 kHz Stop 26 GHz Sweep 2.691 s (1001 pts) Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2

802.11n-HT20-Low	
	
802.11n-HT20-Middle	

	
802.11n-HT20-High	
	

802.11n-HT40-Low	
	
802.11n-HT40-Middle	

	
802.11n-HT40-High	
	

APPENDIX PHOTOGRAPHS

Please refer to "ANNEX"

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