FCC Part 15C
Measurement and Test Report

For

Lumi United Technology Co., Ltd

8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China.

FCC ID: 2AKIT-BR-USH01

FCC Rule(s):	FCC Part 15C
Product Description:	Smart Plug
Tested Model:	BR-USH01
Report No.:	WTX19X12086595W-1
Sample Receipt Date:	2019-12-12
Tested Date:	2019-12-12 to 2019-12-30
Issued Date:	2019-12-30
Tested By:	Jack Huang / Engineer
Reviewed By:	Silin Chen / EMC Manager
Approved & Authorized By:	Jandy So / PSQ Manager

Prepared By:

Shenzhen SEM Test Technology Co., Ltd.
1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road,
Bao'an District, Shenzhen, P.R.C.（518101）
Tel.: +86-755-33663308 Fax.: +86-755-33663309 Website: www.semtest.com.cn

TABLE OF CONTENTS

Report version

Version No.	Date of issue	Description
Rev.00	2019-12-30	Original
/	/	/

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	Lumi United Technology Co., Ltd
Address of applicant:	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China.
Manufacturer:	Lumi United Technology Co., Ltd
Address of manufacturer:	8th Floor, JinQi Wisdom Valley, No.1 Tangling Road, Liuxian Ave, Taoyuan Residential District, Nanshan District, Shenzhen, China.

General Description of EUT	
Product Name:	Smart Plug
Trade Name:	AQara
Model No.:	BR-USH01
Adding Model(s):	/
Rated Voltage:	AC120V/60Hz
Power Adapter Model:	/
Software Version:	1.8D24
Hardware Version:	LM19-GBR-B-T1, LM19-GBR-C-T1, LM19-GBR-A_X3
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:	15.45dBm (Conducted)
Type of Modulation:	DBPSK,BPSK,DQPSK,QPSK,16QAM,64QAM
Data Rate:	1-11Mbps, 6-54Mbps, up to 300Mbps
Quantity of Channels:	11 for 802.11b/g/n(HT20); 7 for 802.11n(HT40)
Channel Separation:	5MHz
Type of Antenna:	Integral Antenna
Antenna Gain:	2.0dBi

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 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
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 Under Section 15.247 Of The Fcc Rules
662911 D01 Multiple Transmitter Output v02r01: Emissions Testing of Transmitters with Multiple Outputs in the Same Band
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, KDB 662911 D01 Multiple Transmitter Output v02r01
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: Shenzhen SEM Test Technology Co., Ltd.
Address: 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C. (518101）

FCC – Registration No.: 125990
Shenzhen SEM Test Technology 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 Shenzhen SEM Test Technology 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:	50~55 %.
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
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Smart Plug	Lumi	BR-USH01	/
Smart Plug	Lumi	BR-USH01	/
Smart Plug	Lumi	BR-USH01	/
TP-LINK-D714	PULIAN	TL-WR842N	/
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
		6-18GHz ±3.92dB

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2019-04-30	2020-04-29
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2019-04-30	2020-04-29
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2019-04-30	2020-04-29
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2019-04-30	2020-04-29
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2019-04-30	2020-04-29
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2019-05-05	2021-05-04
SEMT-1042	Horn Antenna	ETS	3117	00086197	2019-05-05	2021-05-04
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2019-05-05	2021-05-04
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2019-05-05	2021-05-04
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2019-04-30	2020-04-29
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2019-04-30	2020-04-29
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2019-04-30	2020-04-29
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2019-04-30	2020-04-29
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2019-04-30	2020-04-29
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2019-04-30	2020-04-29
SEMT-1170	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2019-05-05	2021-05-04
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2019-04-30	2020-04-29
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2019-04-30	2020-04-29
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2019-04-30	2020-04-29
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	2019-03-18	2020-03-17
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	2019-03-18	2020-03-17
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	2019-03-18	2020-03-17
SEMT-C004	Cable	Zheng DI	2M0RFC	/	2019-03-18	2020-03-17
SEMT-C005	Cable	Zheng DI	1M0RFC	/	2019-03-18	2020-03-17
SEMT-C006	Cable	Zheng DI	1M0RFC	/	2019-03-18	2020-03-17

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
§2.1093	RF Exposure	Compliant
§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. RF Exposure

3.1 Standard Applicable

According to §1.1307 and §2.1091, the mobile transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.

4. Antenna Requirement

4.1 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.

4.2 Evaluation Information

This product has two integral antennas, fulfill the requirement of this section.

5. Power Spectral Density

5.1 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 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2 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:

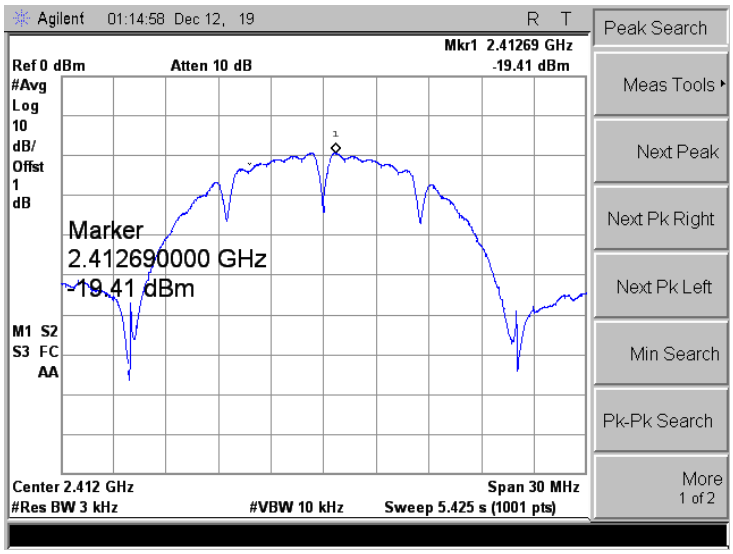
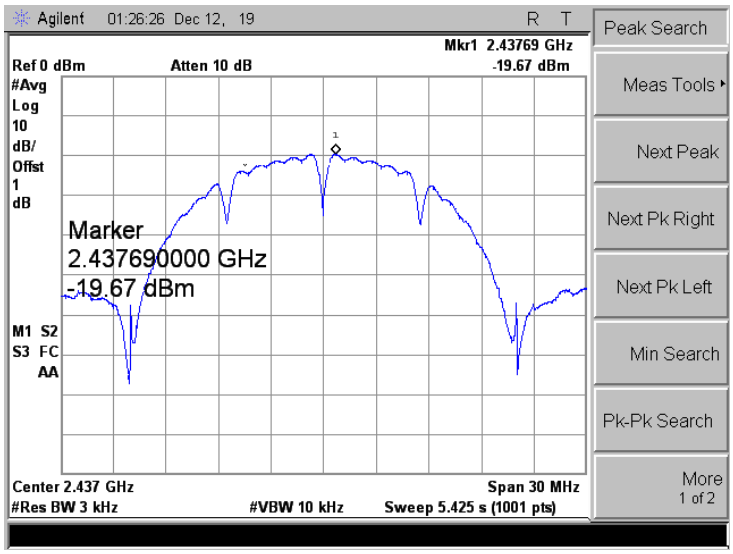
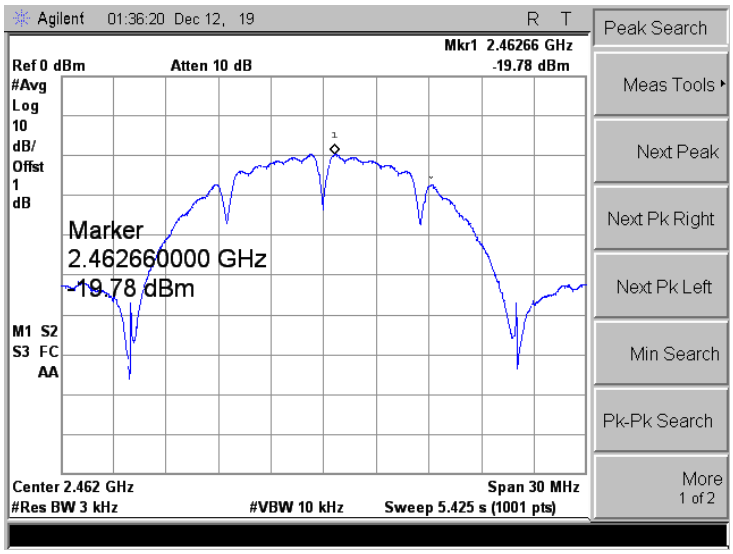
a) Set instrument center frequency to DTS channel center frequency.
b) Set span to at least 1.5 times the OBW.
c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz. .
d) Set VBW ≥3 x RBW.
e) Detector = power averaging (RMS) or sample detector (when RMS not available).
f) Ensure that the number of measurement points 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).

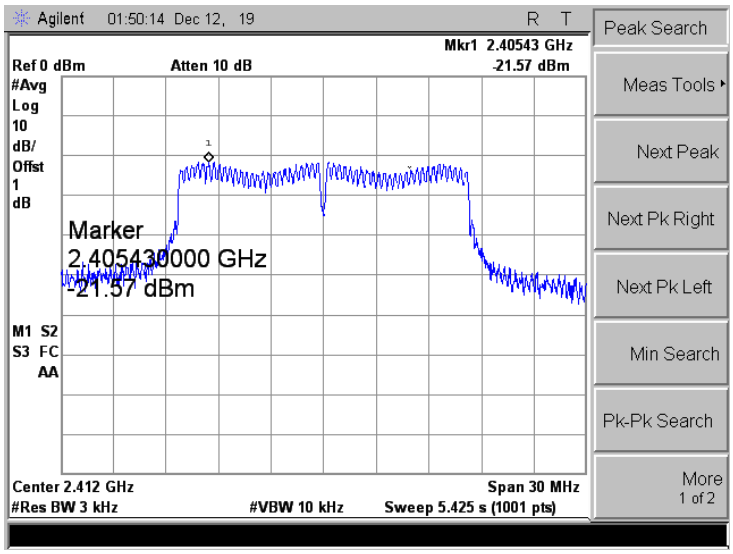
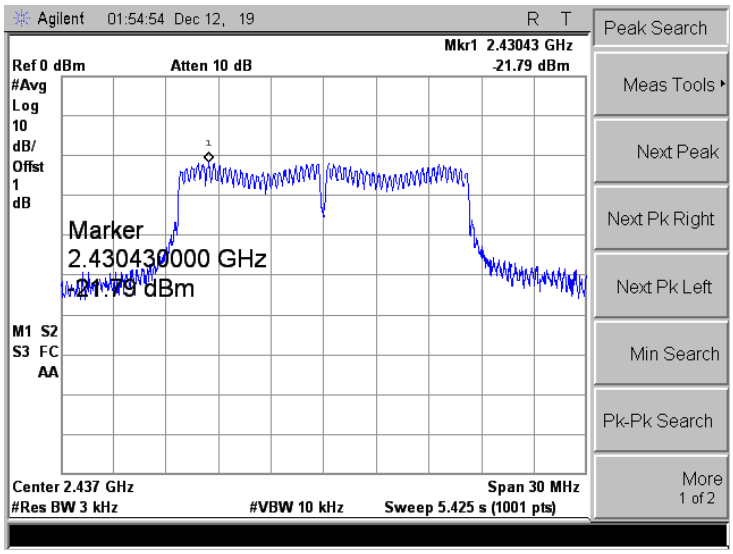
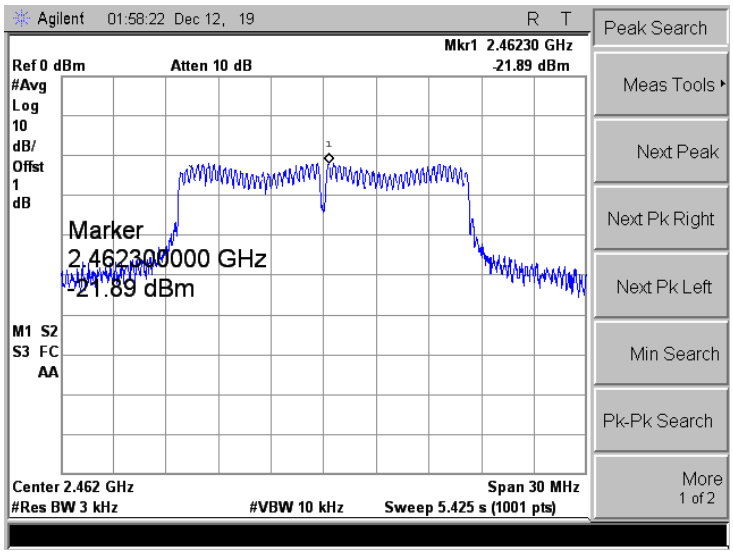
5.3 Summary of Test Results/Plots

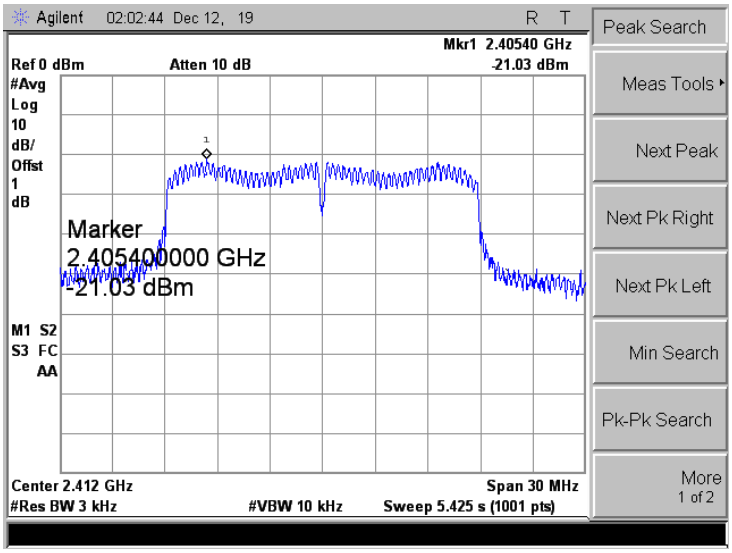
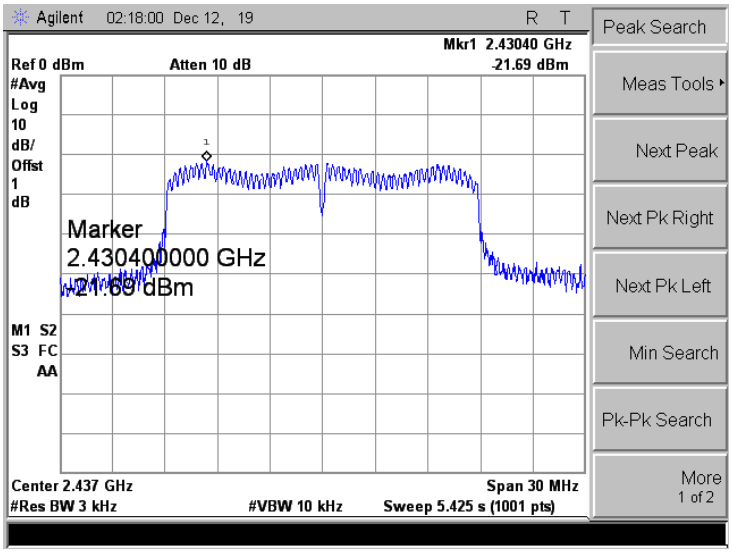
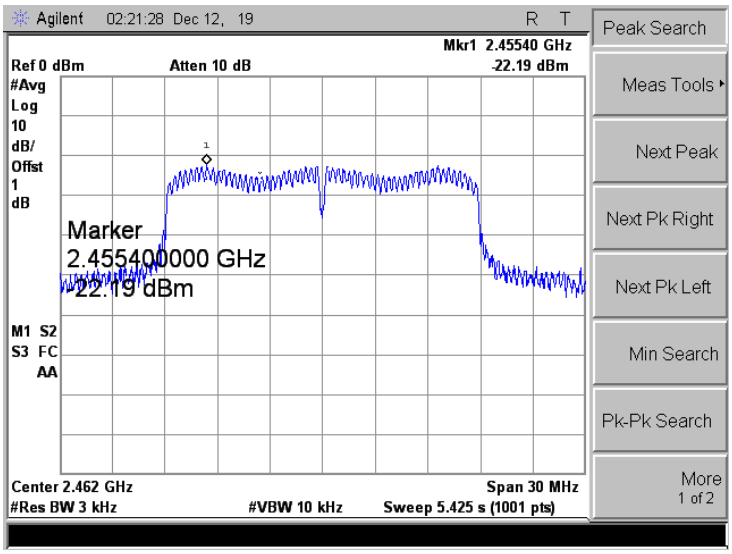
Test Mode	Test Channel MHz	Test Result(dBm/3kHz)		Total dBm	Limit dBm/3kHz
		Antenna 1	Antenna 2		
802.11b_11Mbps	2412	-19.41	-19.82	/	8
	2437	-19.67	-20.53	/	8
	2462	-19.78	-21.64	/	8
802.11g_54Mbps	2412	-21.57	-21.57	/	8
	2437	-21.79	-22.17	/	8
	2462	-21.89	-23.34	/	8
802.11n-HT20_MCS7	2412	-21.03	-22.32	-18.62	8
	2437	-21.69	-21.72	-18.69	8
	2462	-22.19	-23.75	-19.89	8
802.11n-HT40_MCS7	2422	-26.15	-26.88	-23.49	8
	2437	-26.82	-27.38	-24.08	8
	2452	-26.47	-28.08	-24.19	8

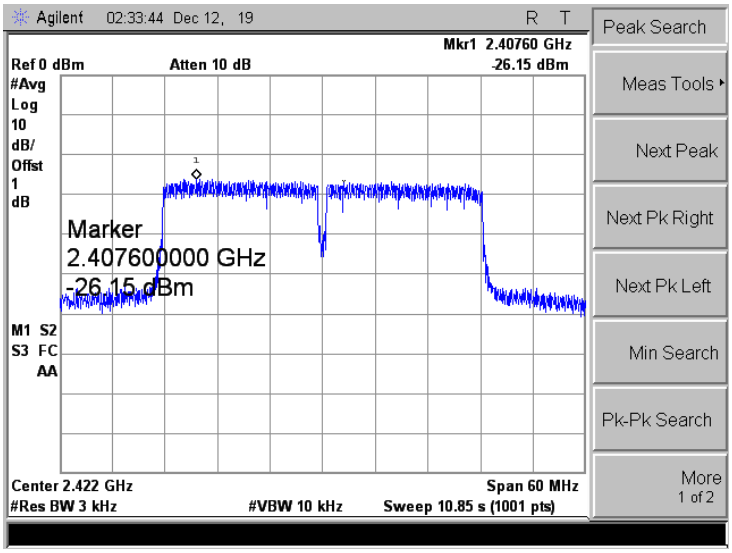
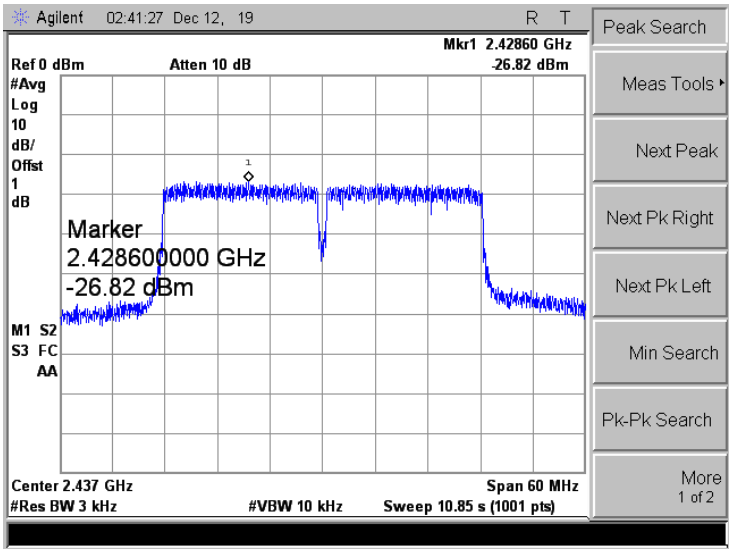
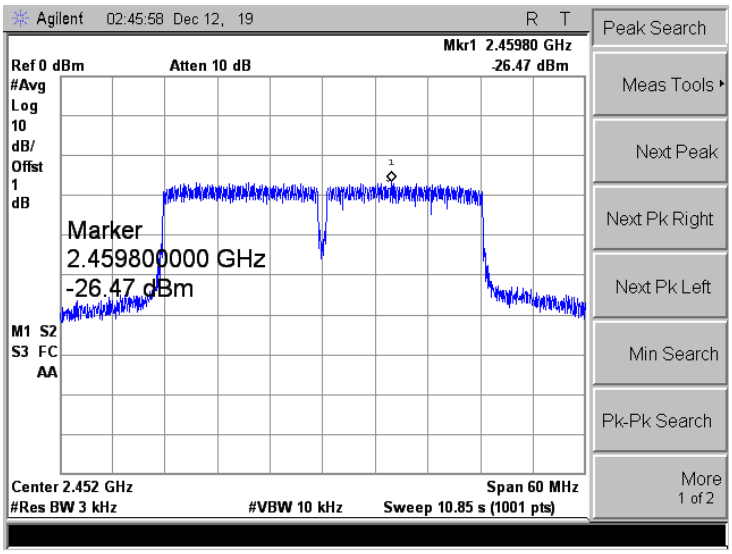
Please refer to the following test plots:

- Antenna 1

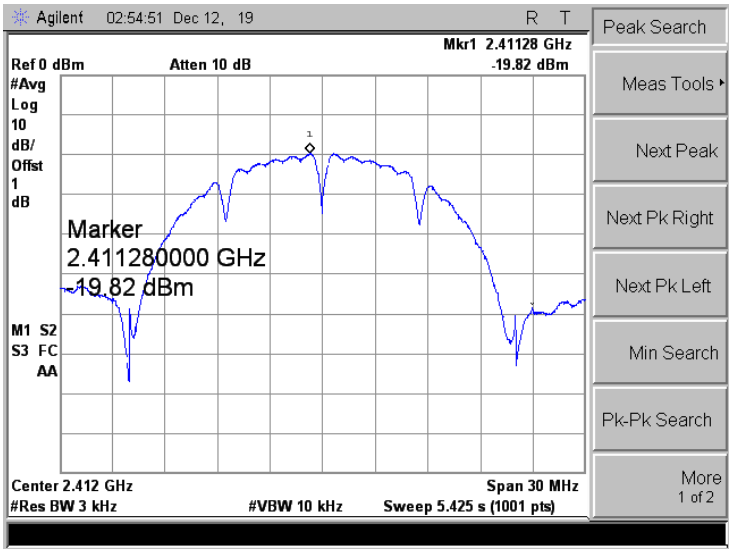
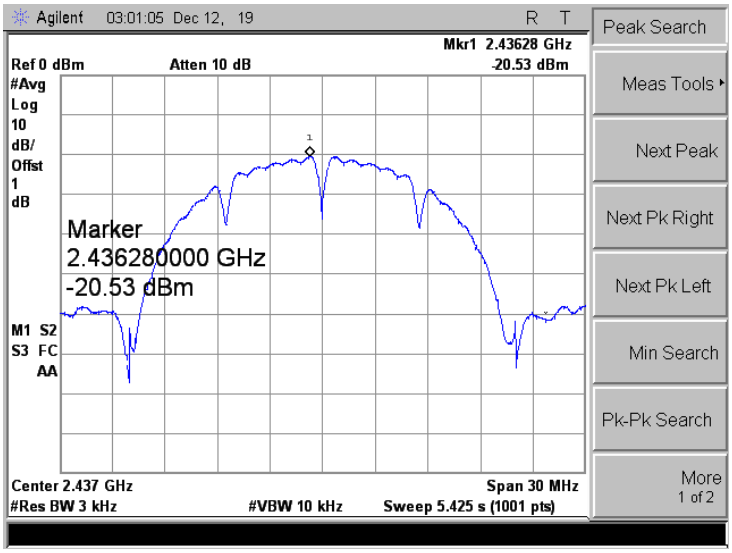
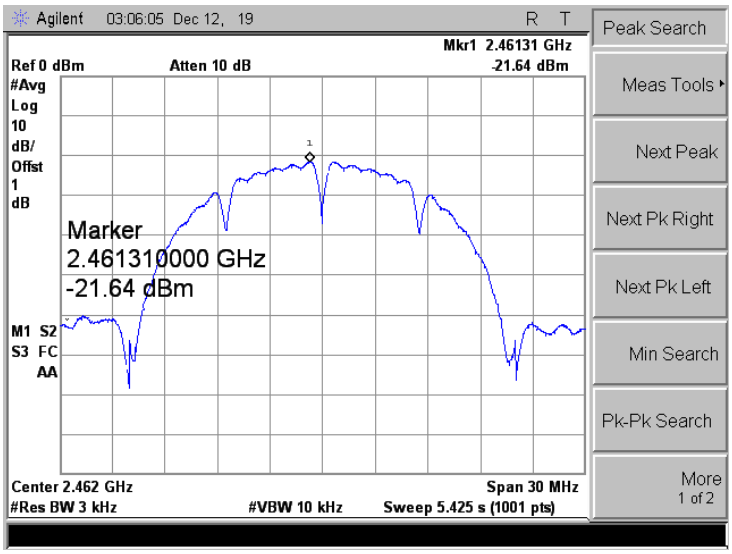
802.11b-Low	
802.11b-Middle	
802.11b-High	

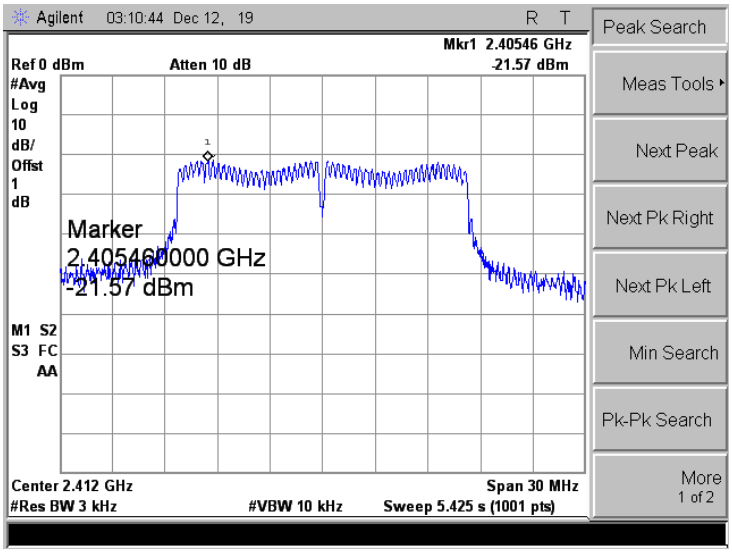
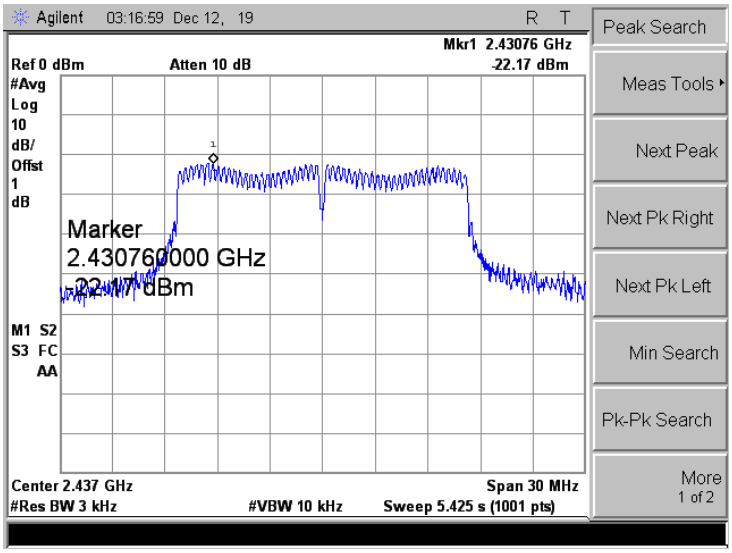
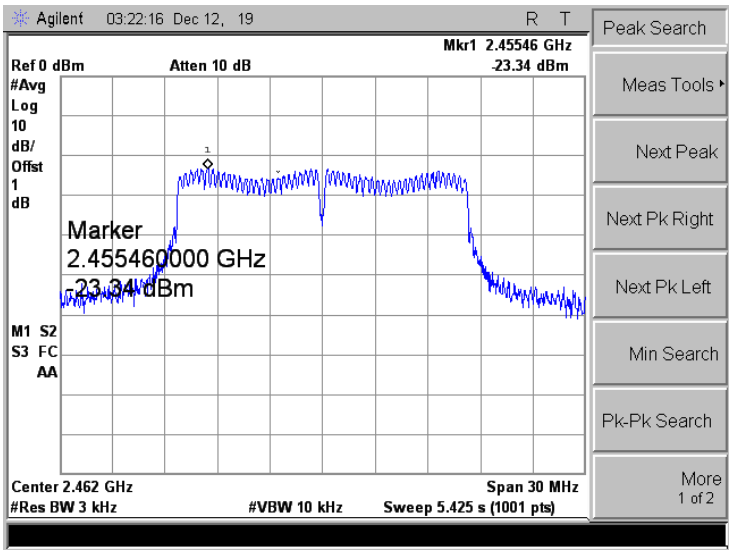
802.11g-Low	
802.11g-Middle	
802.11g-High	

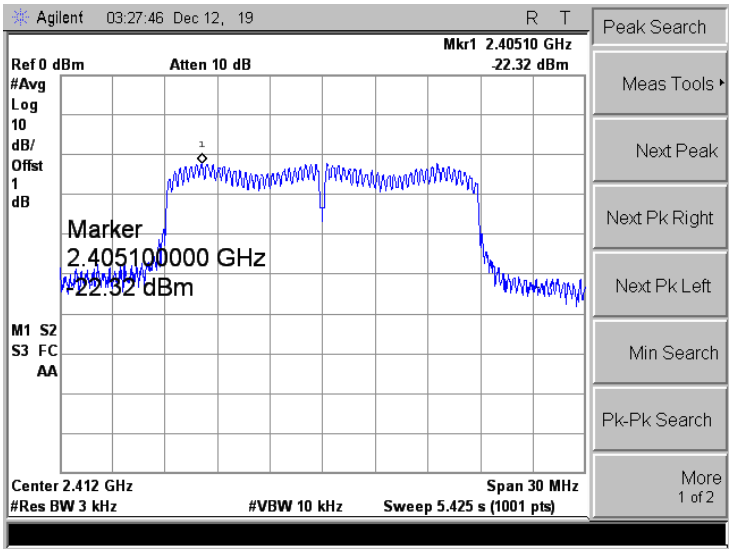
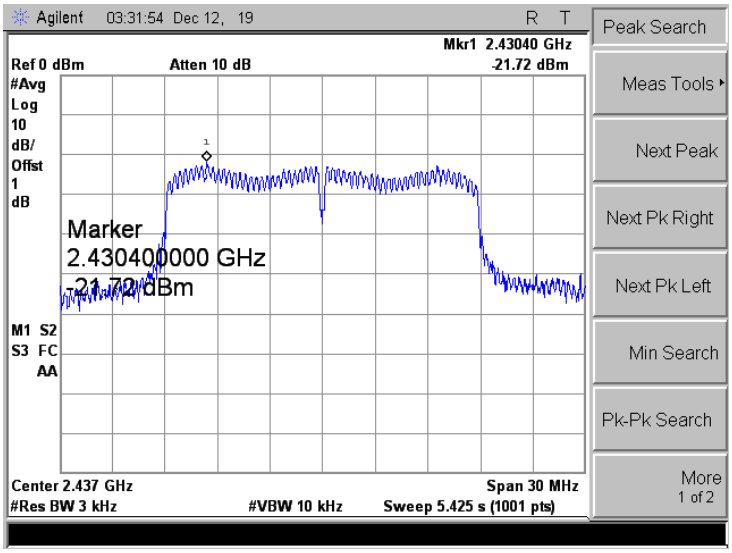
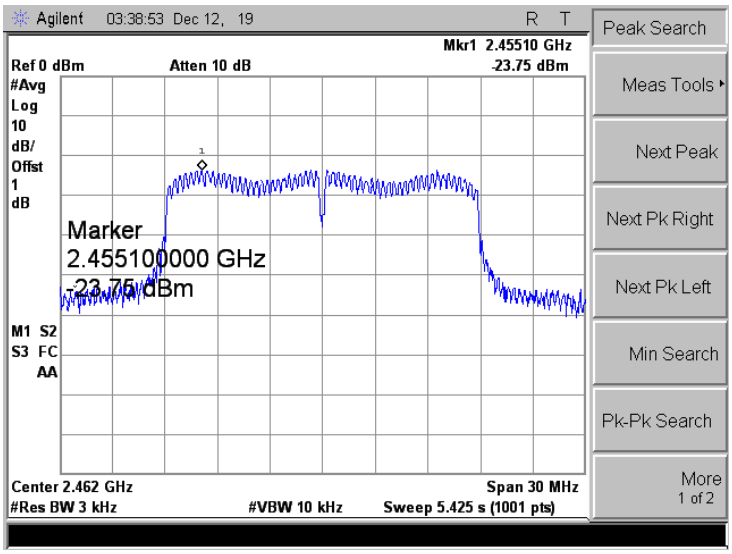
802.11n-HT20-Low	
802.11n-HT20-Middle	
802.11n-HT20-High	

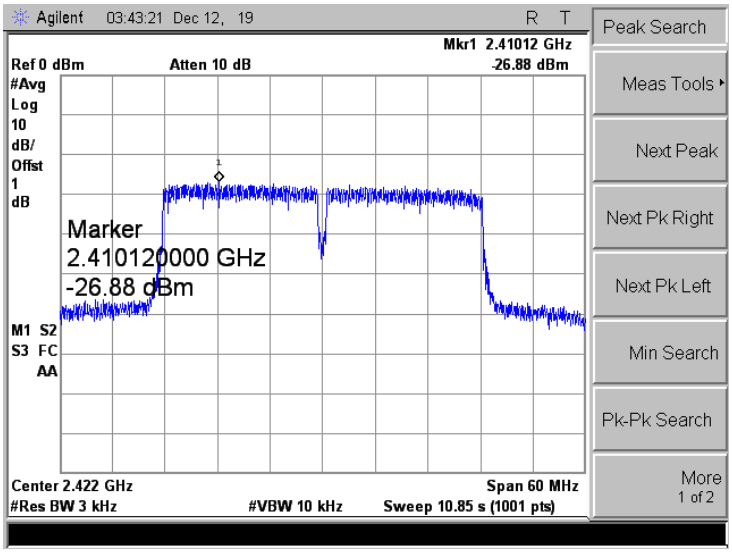
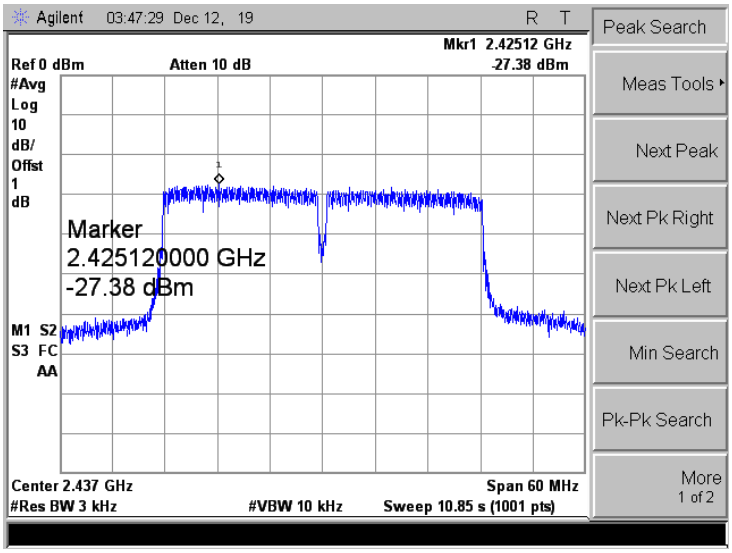
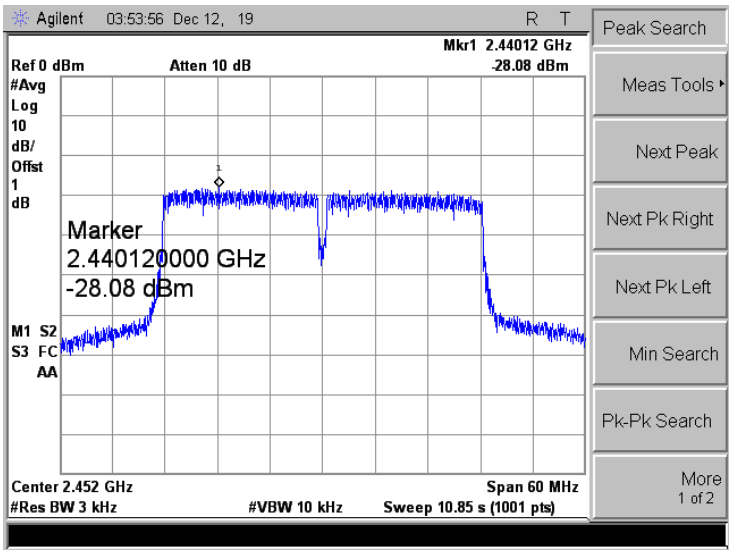
802.11n-HT40-Low	
802.11n-HT40-Middle	
802.11n-HT40-High	

➢ Antenna 2

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	

6. DTS Bandwidth

6.1 Standard Applicable

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

6.2 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:

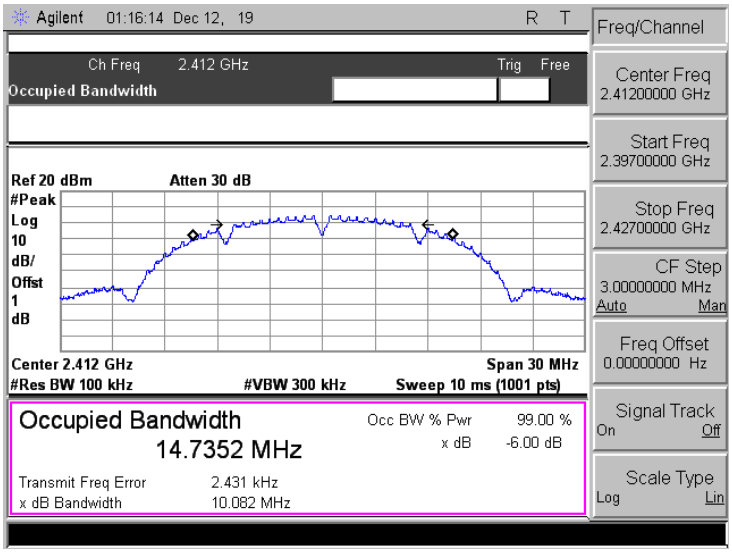
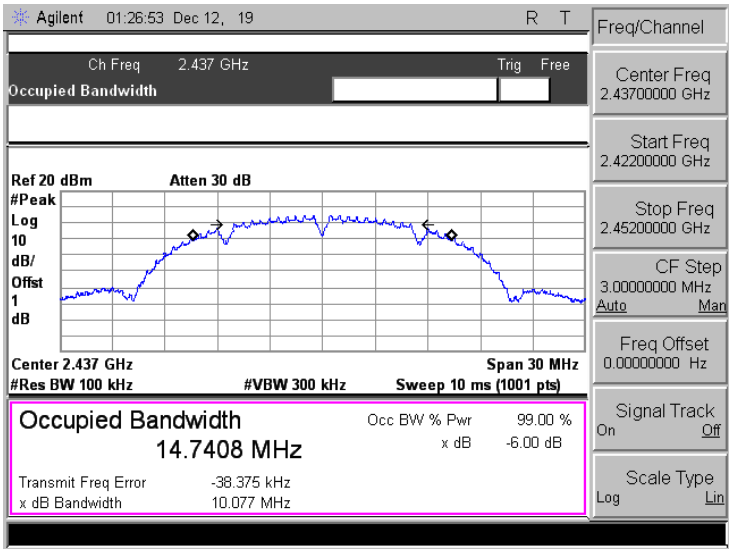
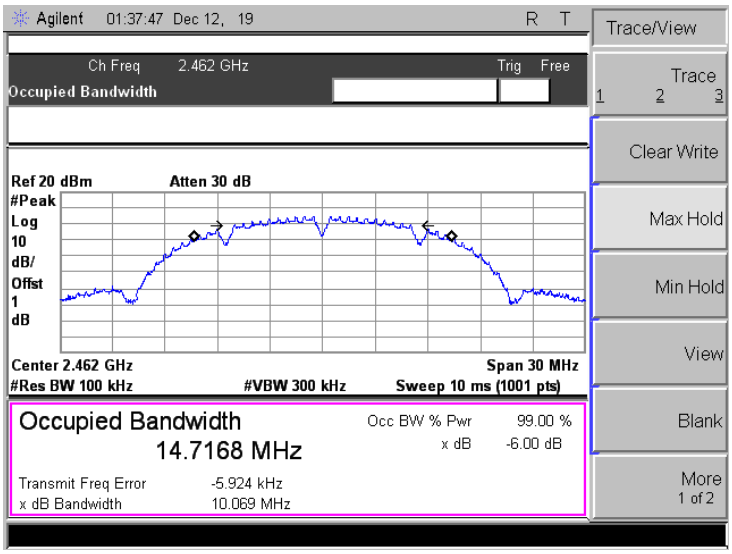
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points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

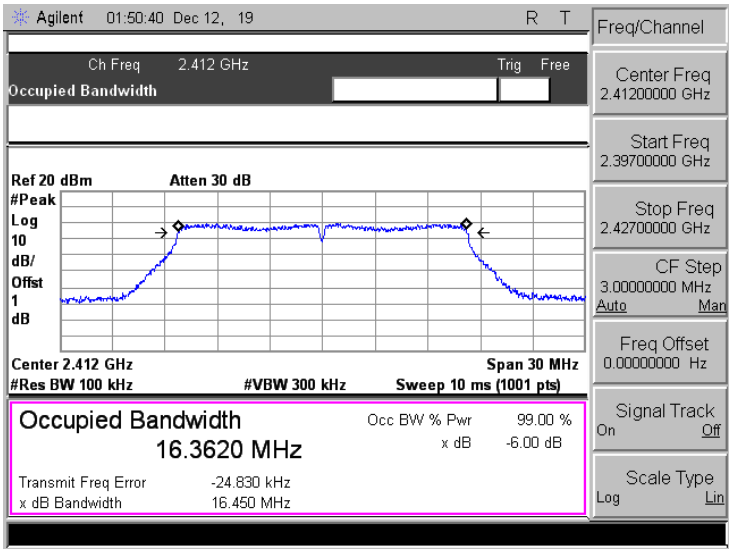
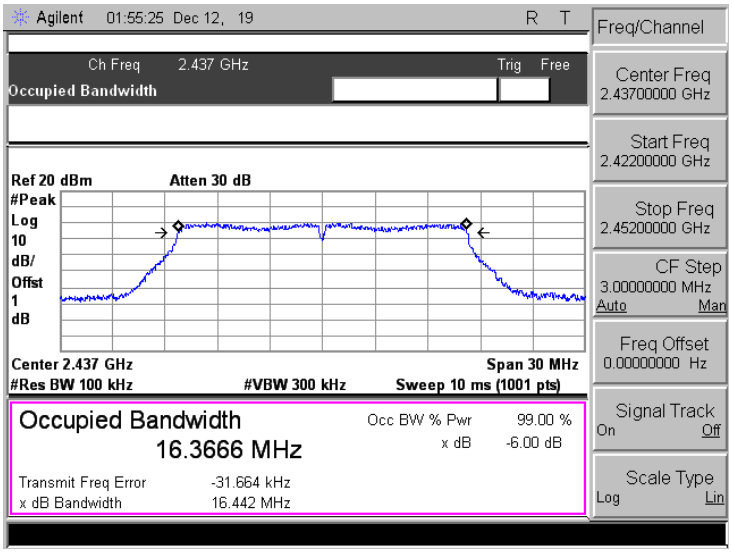
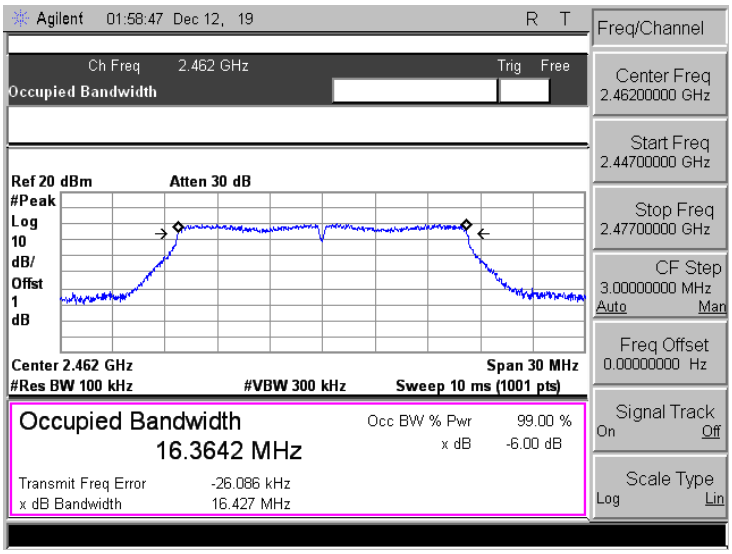
6.3 Summary of Test Results/Plots

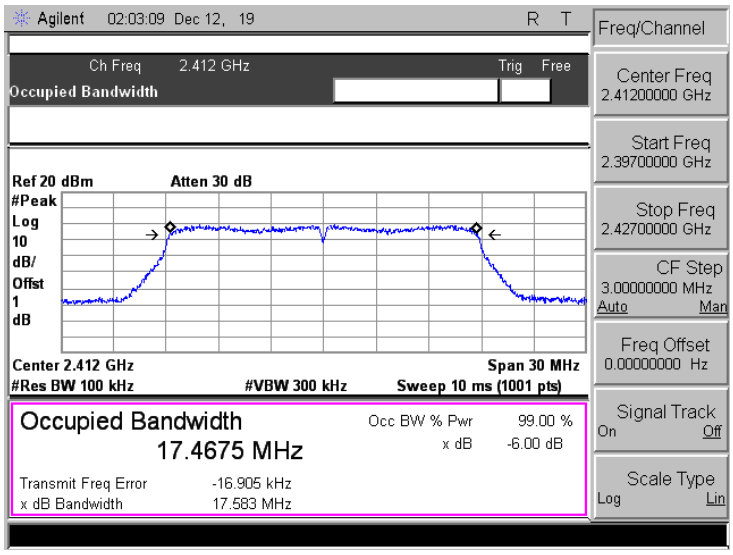
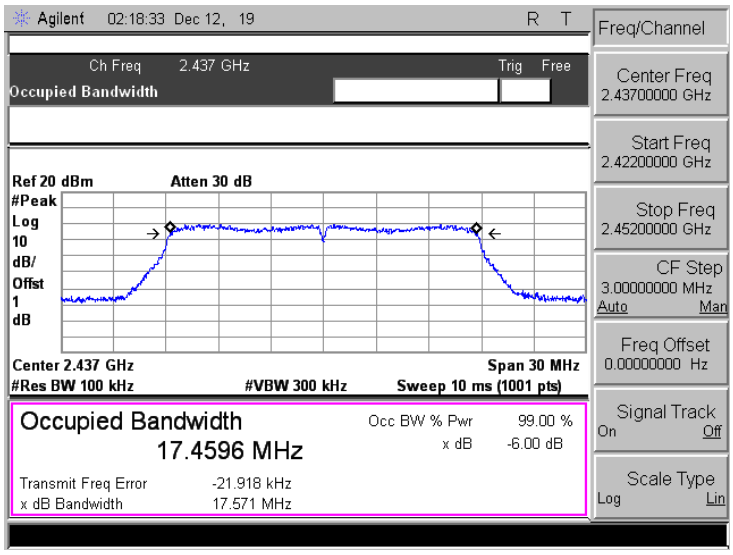
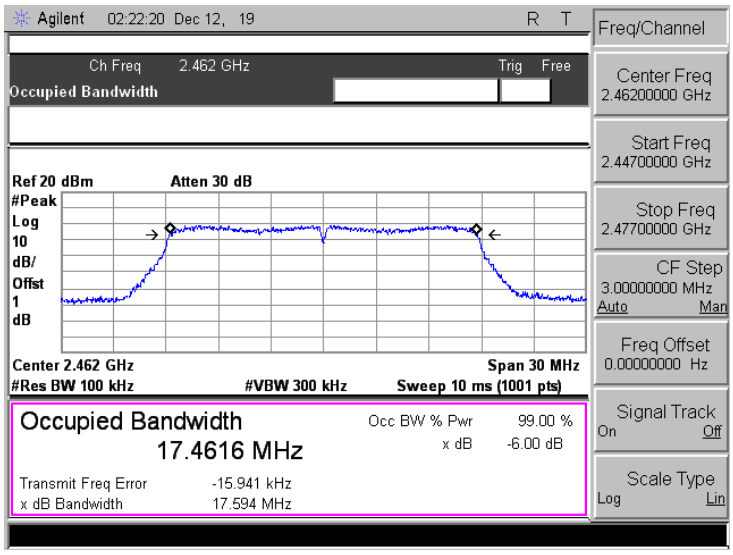
Test Mode	Test Channel MHz	Test Result(MHz)		Limit kHz
		Antenna 1	Antenna 2	
802.11b_11Mbps	2412	10.082	10.085	≥500
	2437	10.077	10.080	≥500
	2462	10.069	10.082	≥500
802.11g_54Mbps	2412	16.450	16.475	≥500
	2437	16.442	16.470	≥500
	2462	16.427	16.475	≥500
802.11n-HT20_MCS7	2412	17.583	17.596	≥500
	2437	17.571	17.579	≥500
	2462	17.594	17.573	≥500
802.11n-HT40_MCS7	2422	36.437	36.408	≥500
	2437	36.418	36.412	≥500
	2452	36.442	36.445	≥500

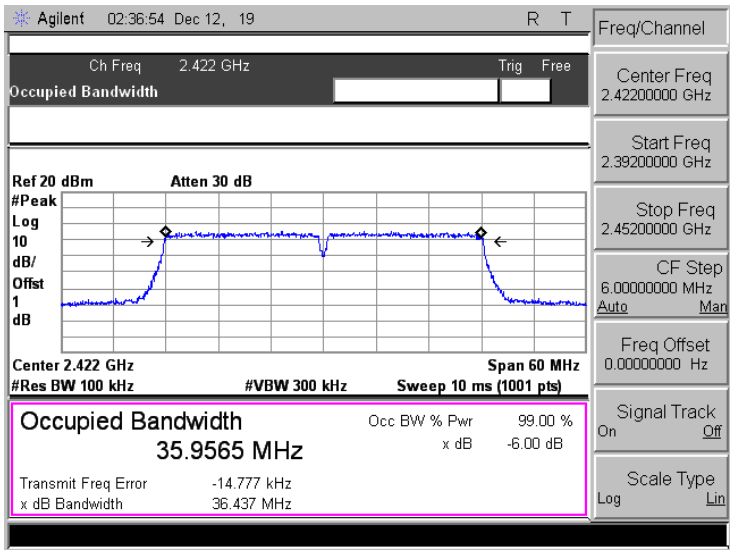
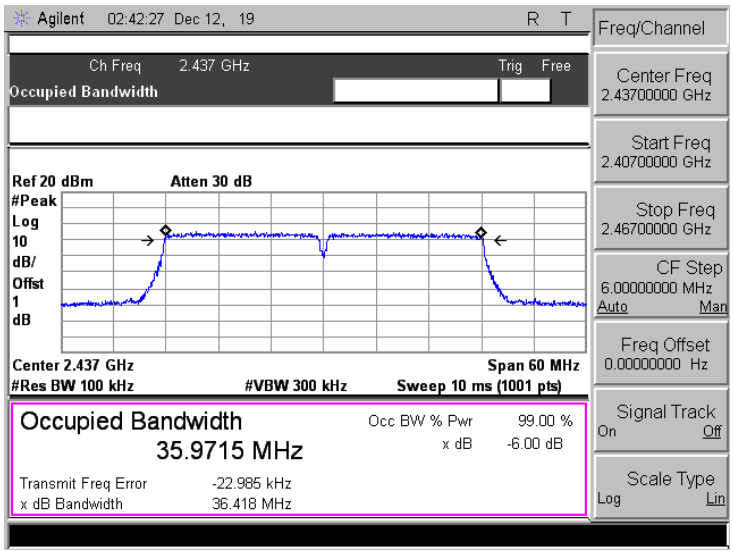
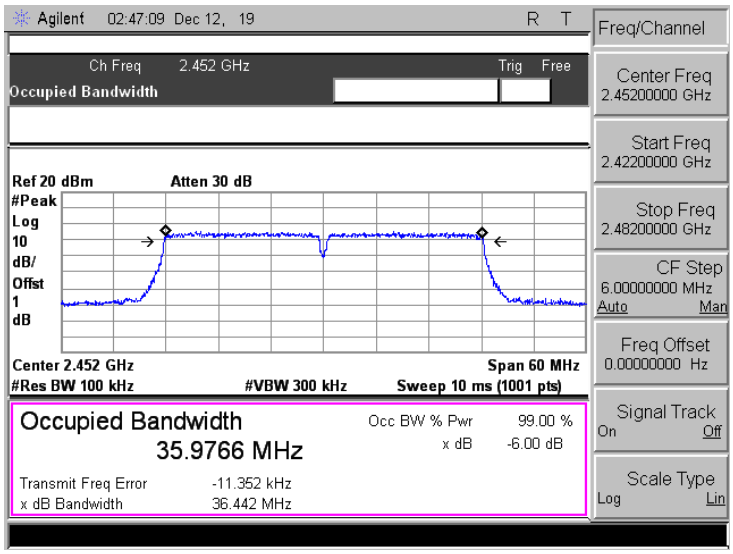
Please refer to the following test plots:

➢ Antenna 1

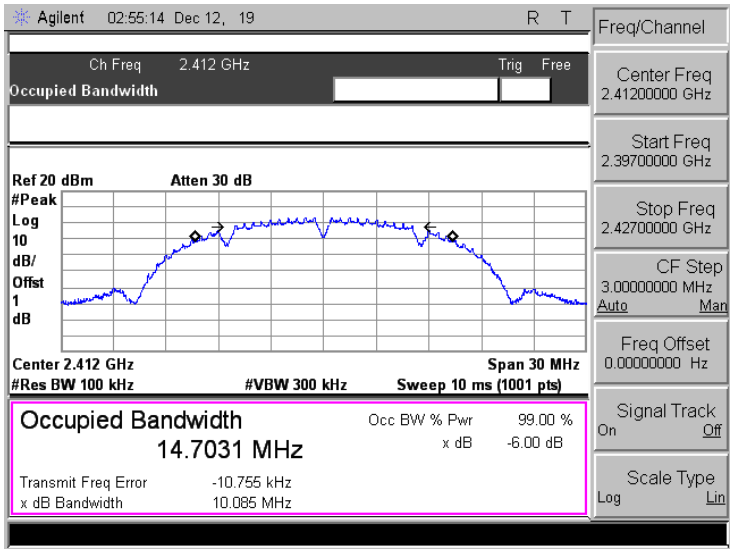
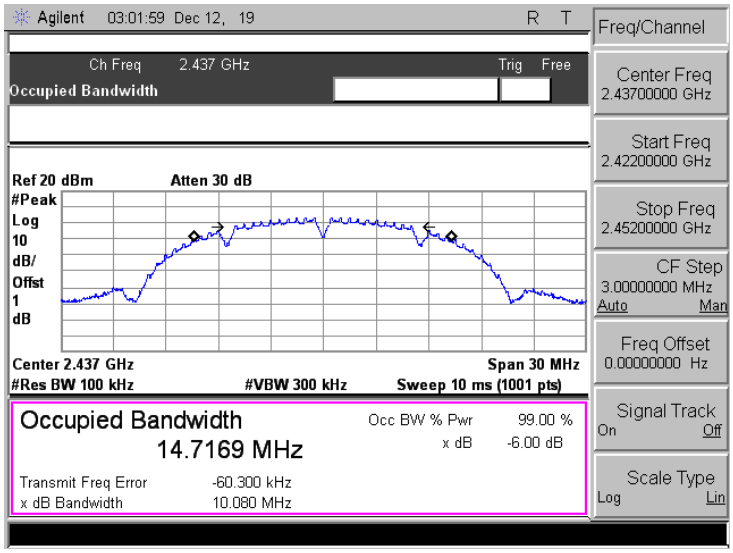
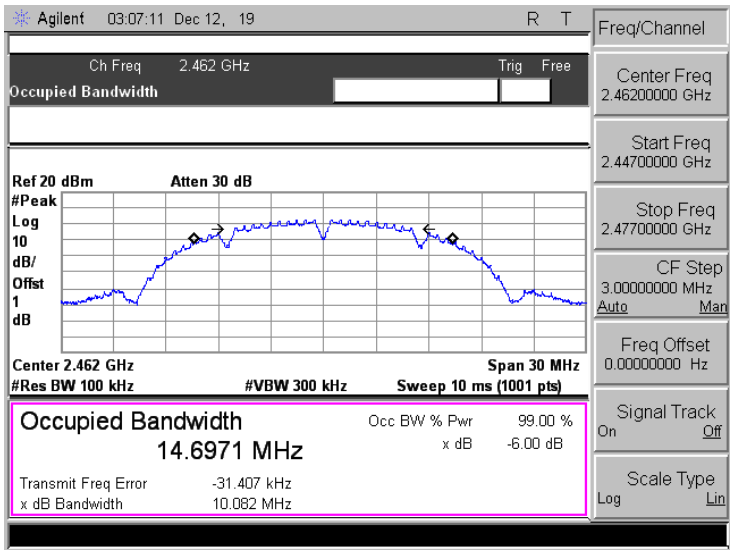
802.11b-Low	
802.11b-Middle	
802.11b-High	

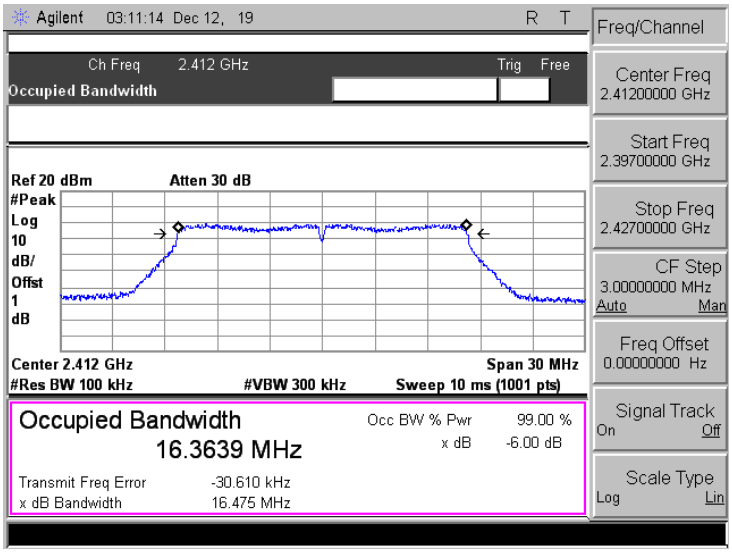
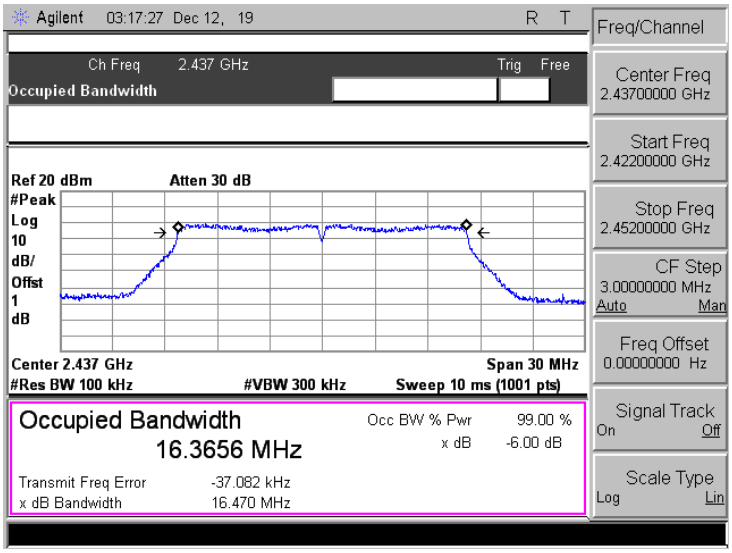
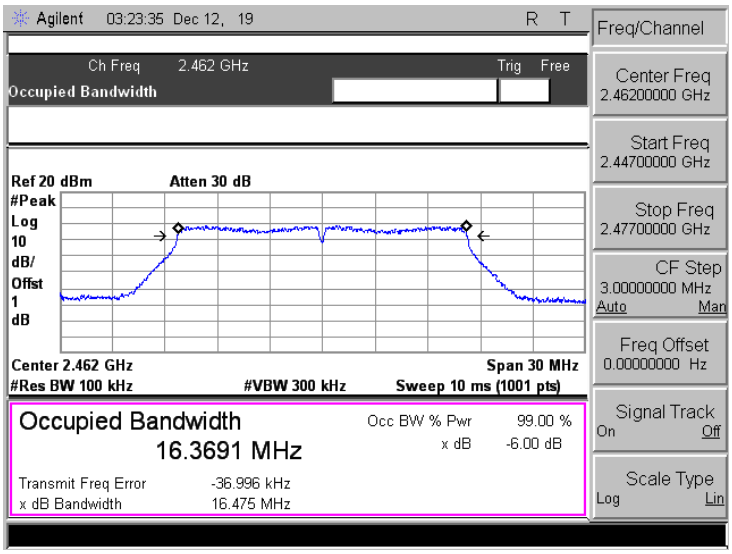
802.11g-Low	
802.11g-Middle	
802.11g-High	

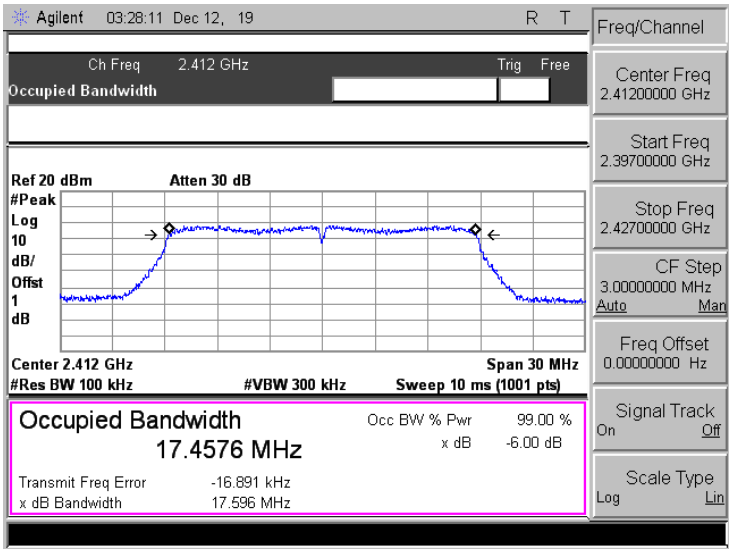
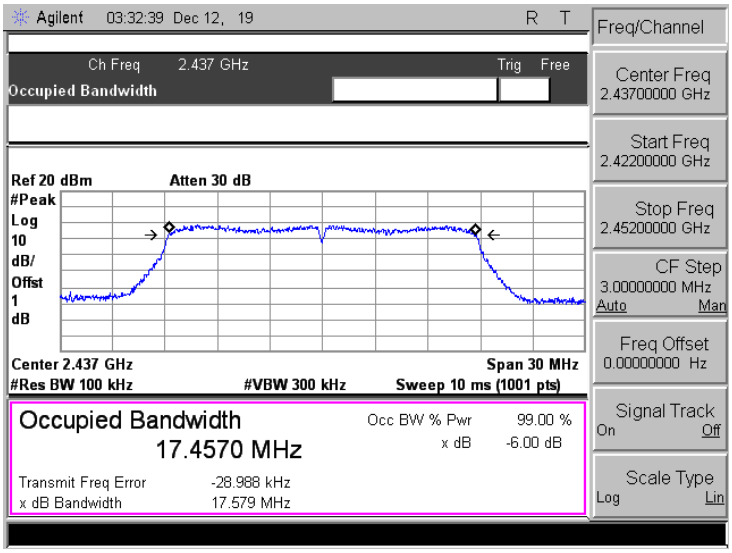
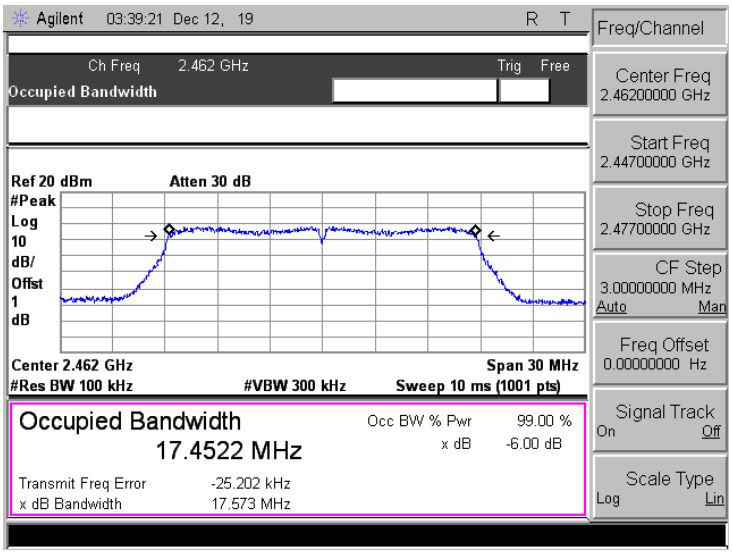
802.11n-HT20-Low	
802.11n-HT20-Middle	
802.11n-HT20-High	

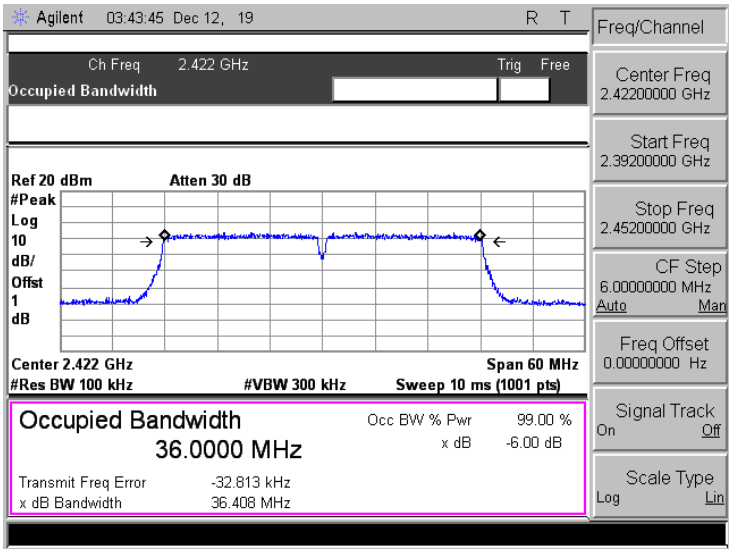
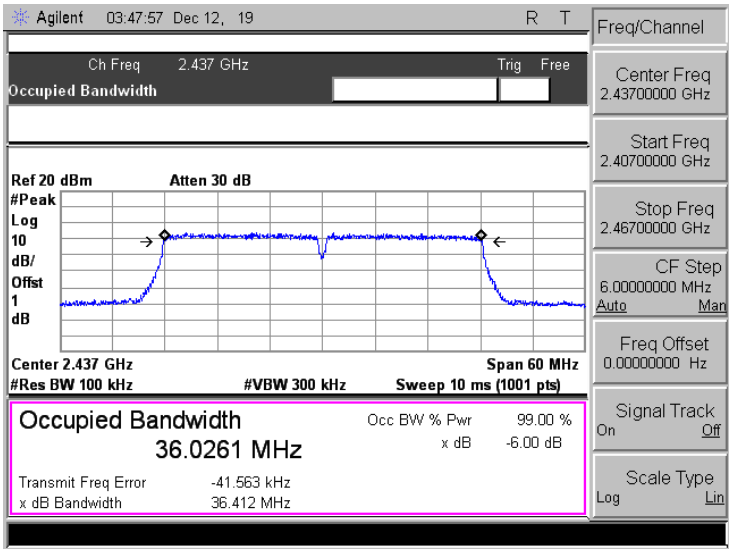
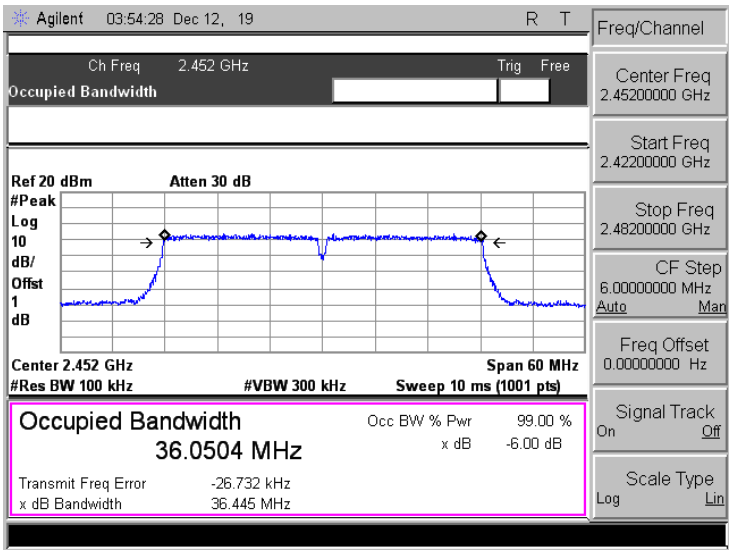
802.11n-HT40-Low	
802.11n-HT40-Middle	
802.11n-HT40-High	

➢ Antenna 2

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	

7. RF Output Power

7.1 Standard Applicable

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

7.2 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

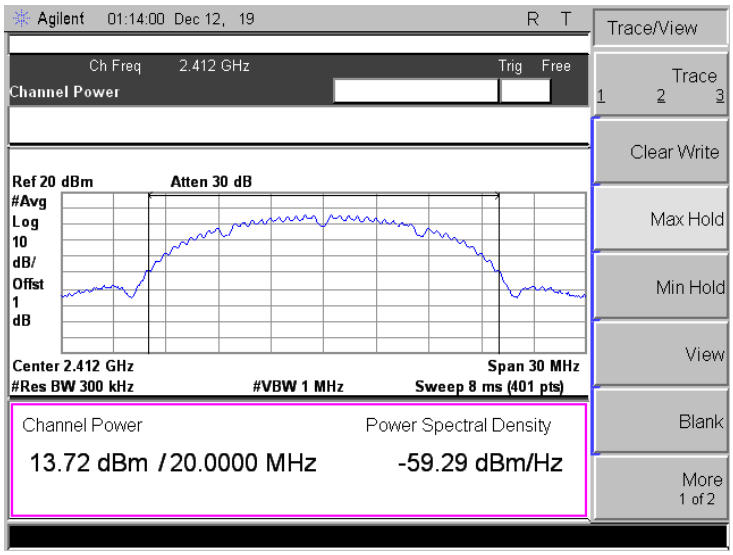
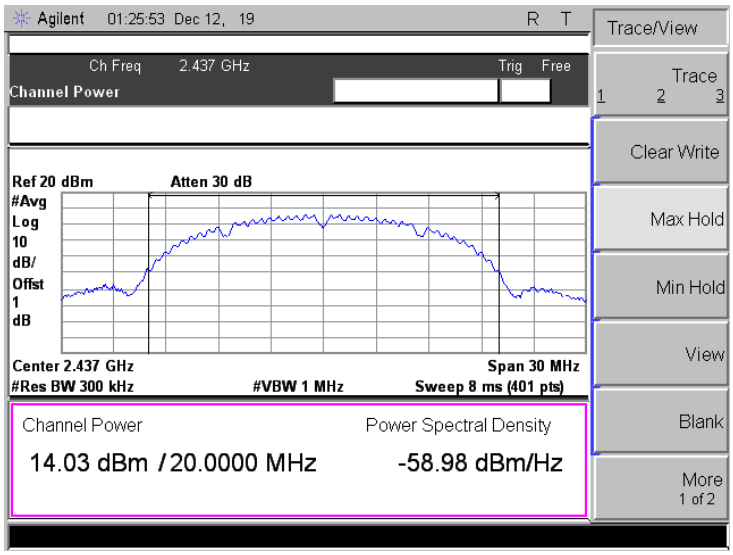
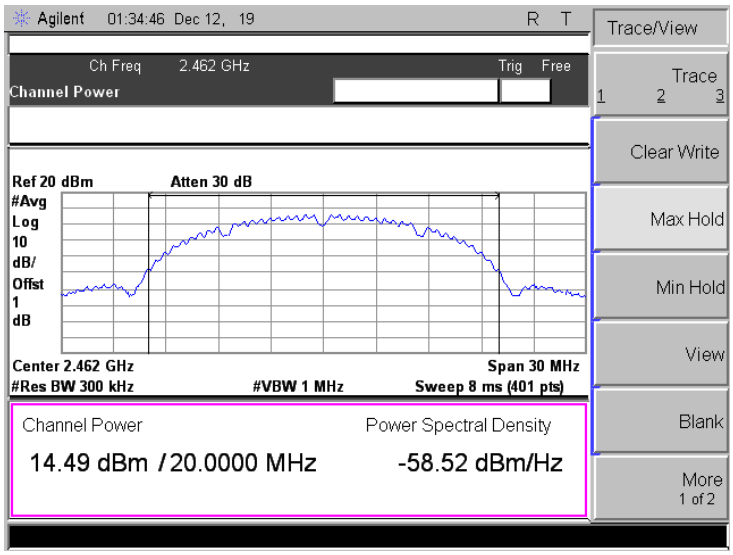
a) Set span to at least 1.5 times the OBW.
b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
c) Set VBW ≥ 3 x RBW.
d) Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
e) Sweep time = auto.
f) Detector = 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.

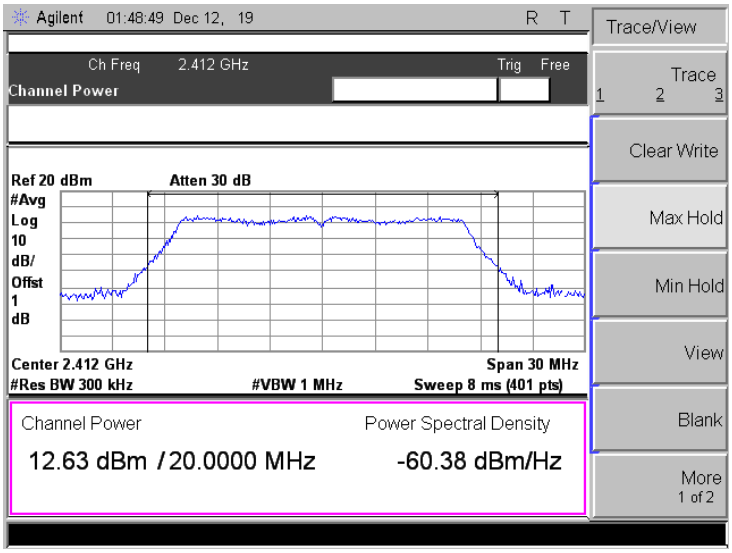
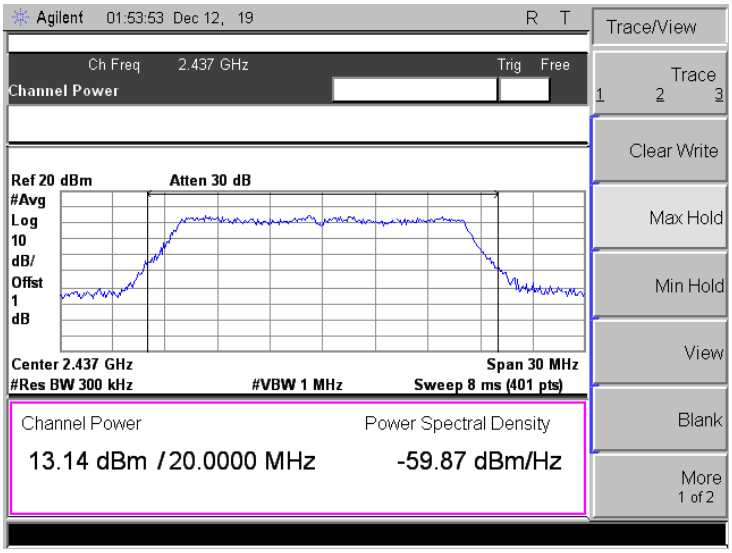
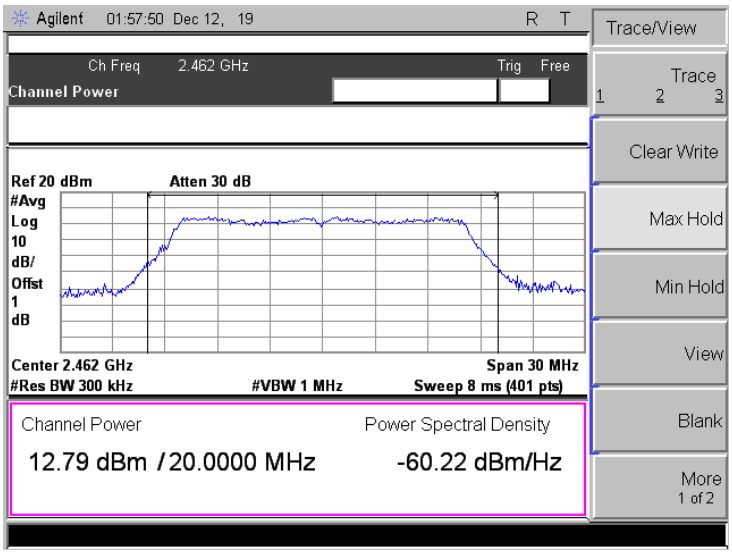
7.3 Summary of Test Results/Plots

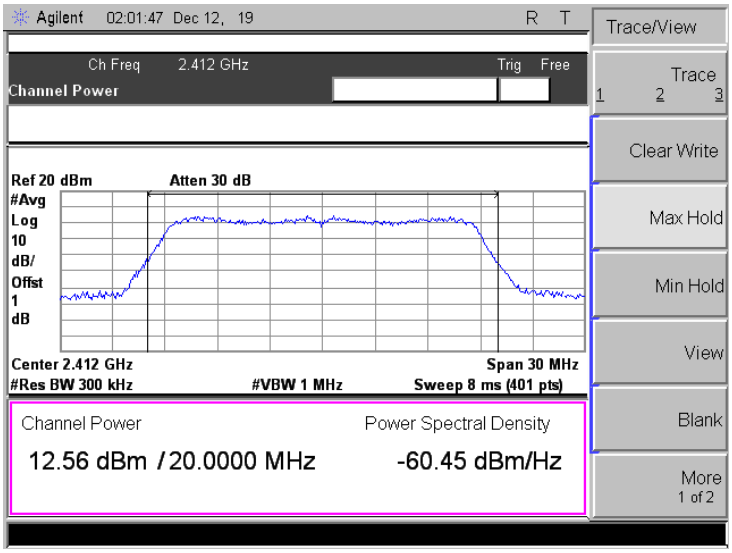
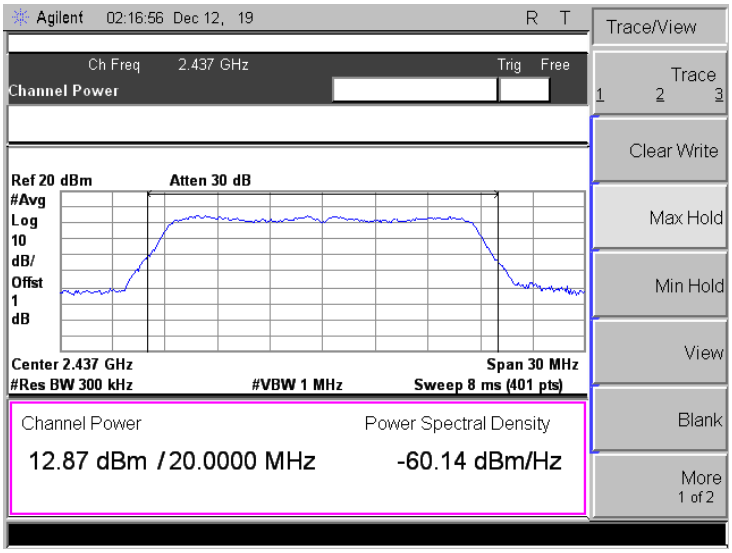
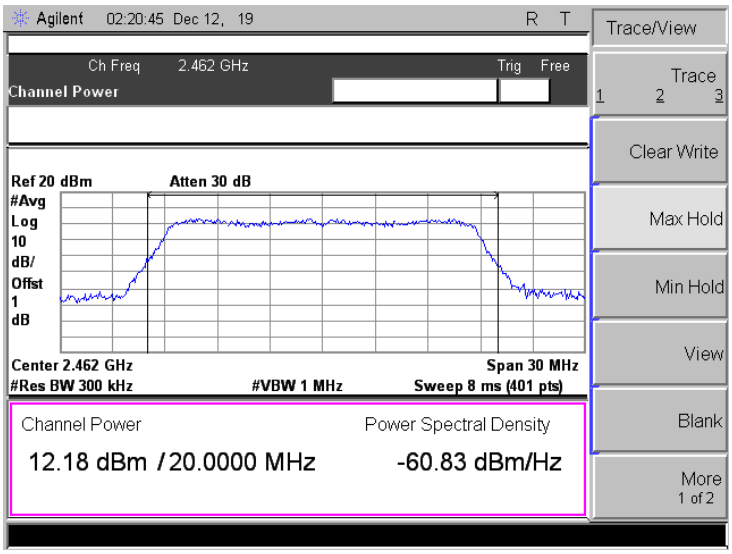
Test Mode	Test Channel MHz	Test Result(dBm)		Output Power (MAX Antenna) mW		Limit mW
		Antenna 1	Antenna 2			
802.11b	2412	13.72	13.07	23.55		1000
	2437	14.03	13.51	25.29		1000
	2462	14.49	13.28	28.12		1000
802.11g	2412	12.63	12.22	18.32		1000
	2437	13.14	12.30	20.61		1000
	2462	12.79	11.43	19.01		1000
Test Mode	**Test Channel MHz**	**Test Result(dBm)**		**Total dBm**	**Output Power mW**	**Limit mW**
		Antenna 1	**Antenna 2**			
802.11n HT20	2412	12.56	12.31	15.45	35.05	1000
	2437	12.87	11.78	15.37	34.43	1000
	2462	12.18	11.14	14.70	29.52	1000
802.11n HT40	2422	10.83	10.21	13.54	22.60	1000
	2437	11.04	10.17	13.64	23.10	1000
	2452	10.56	10.24	13.41	21.94	1000

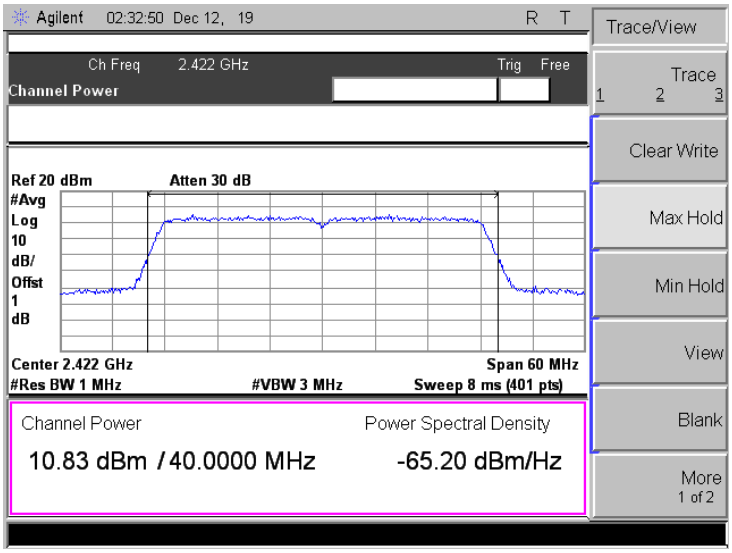
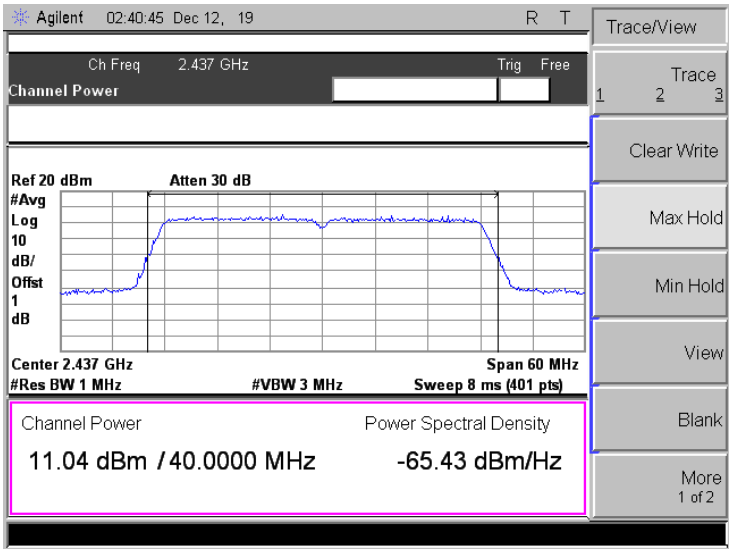
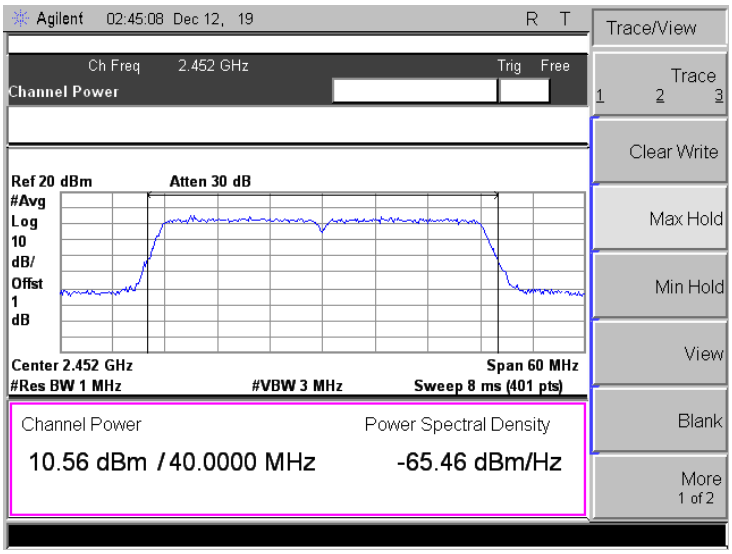
Please refer to the following test plots:

➢ Antenna 1

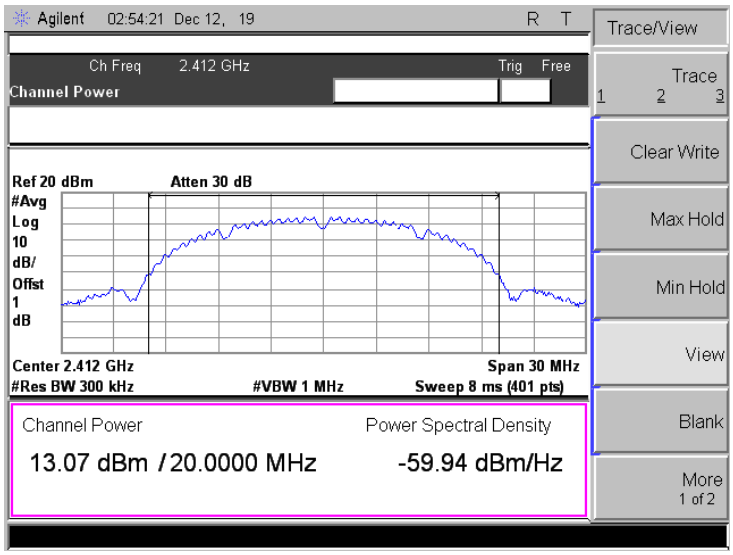
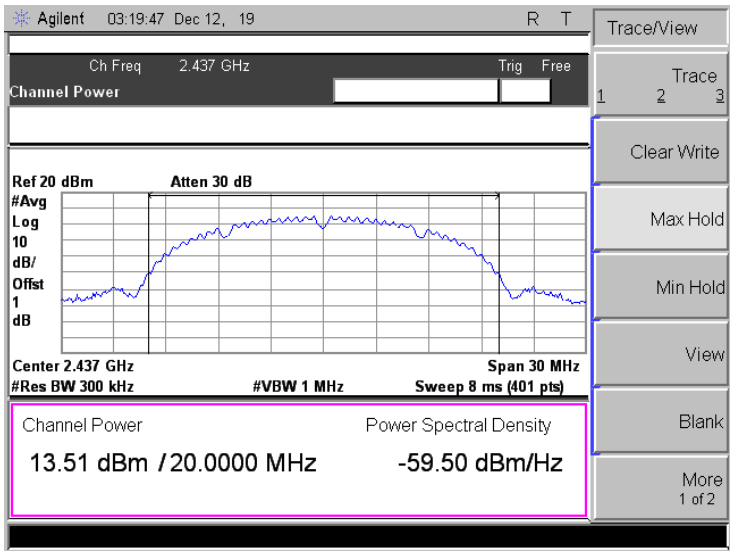
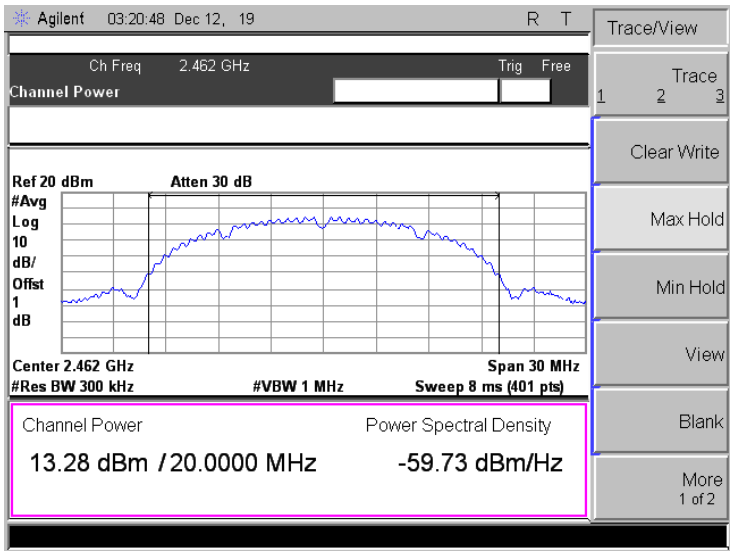
802.11b-Low 11Mbps	
802.11b-Middle 11Mbps	
802.11b-High 11Mbps	

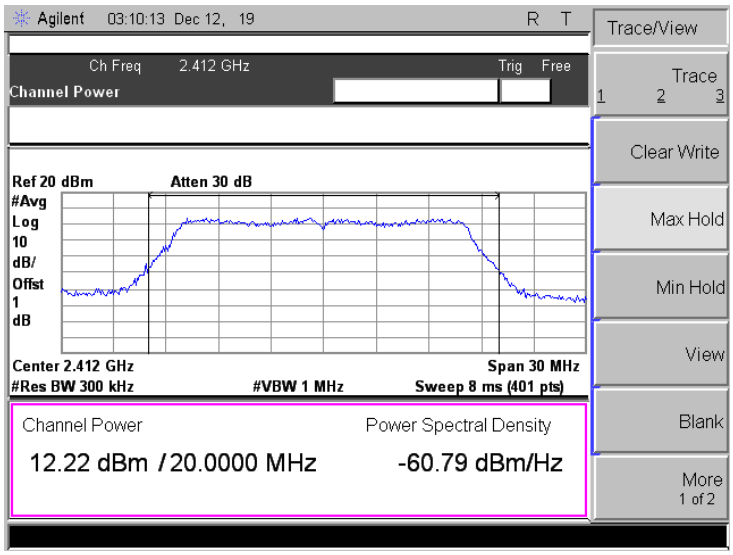
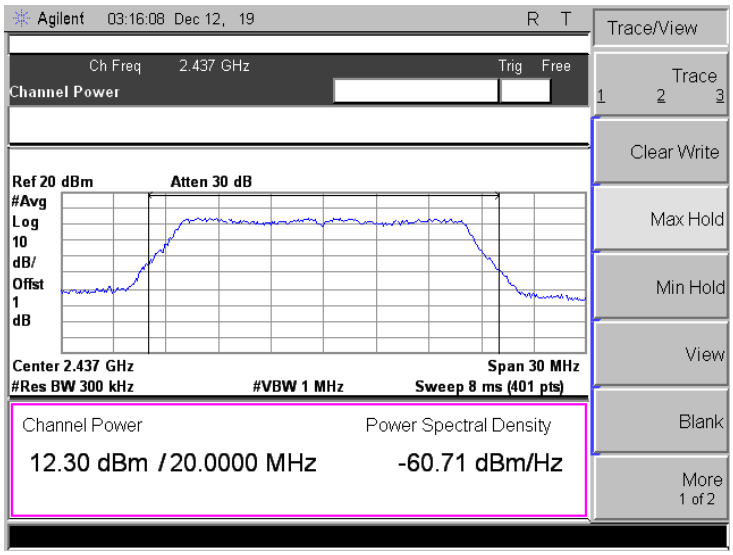
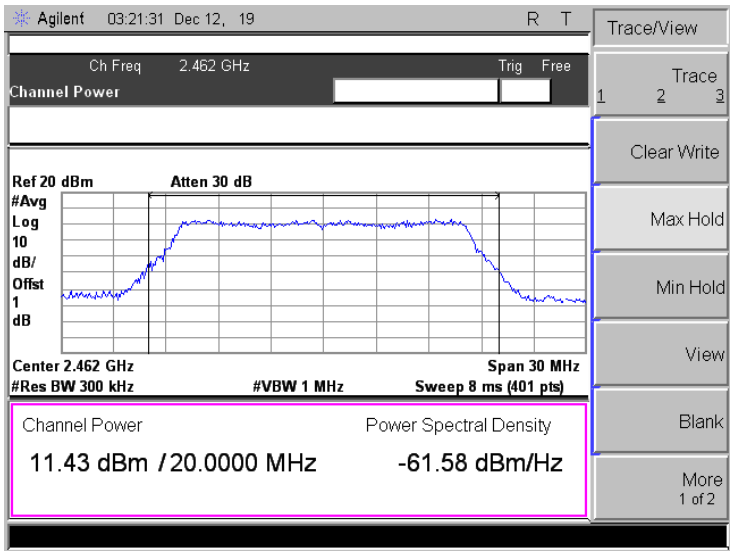
802.11g-Low 54Mbps	
802.11g-Middle 54Mbps	
802.11g-High 54Mbps	

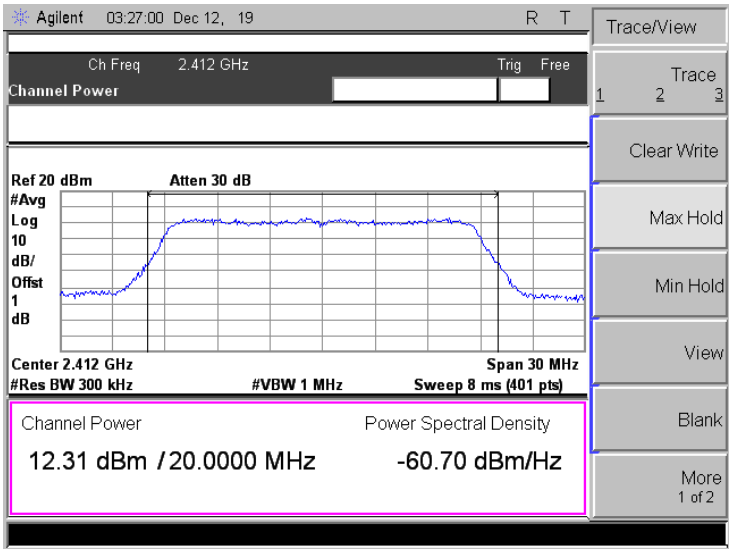
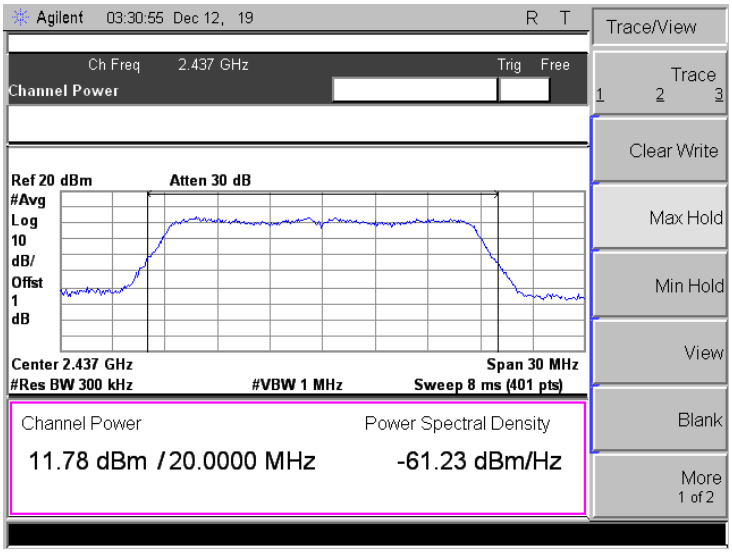
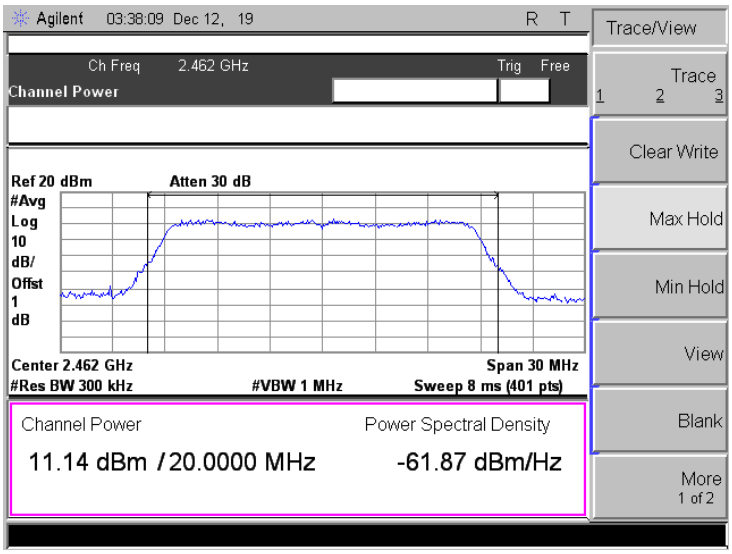
802.11n-HT20-Low MCS7	
802.11n-HT20-Middle MCS7	
802.11n-HT20-High MCS7	

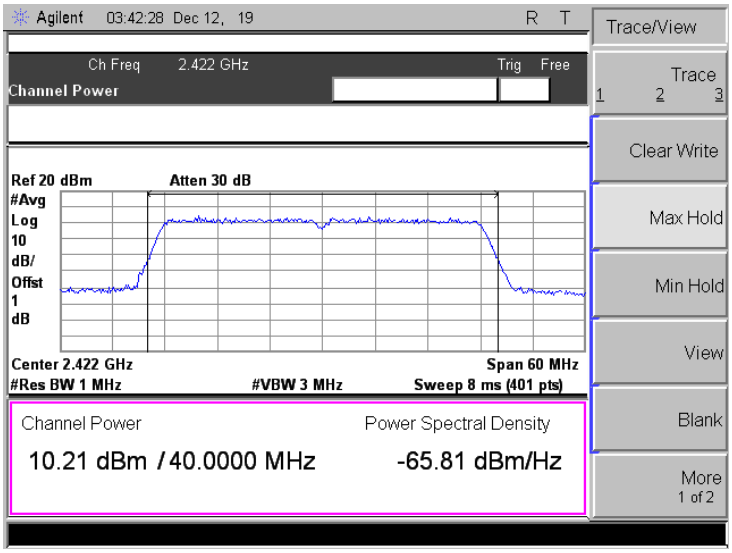
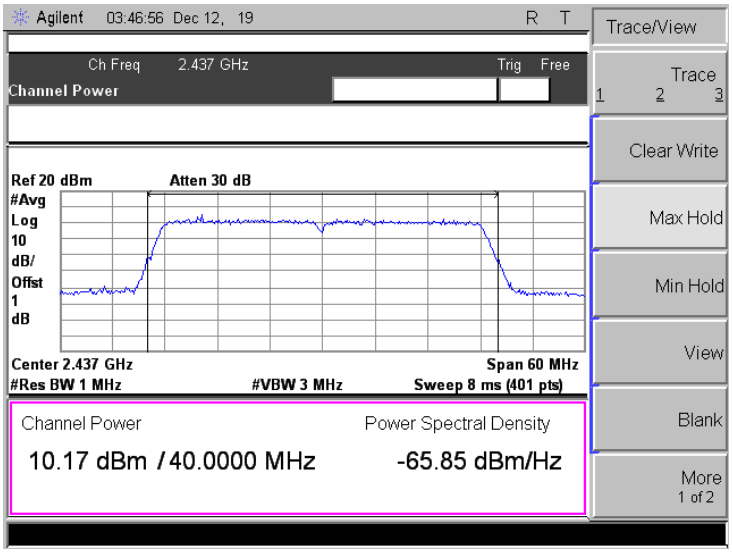
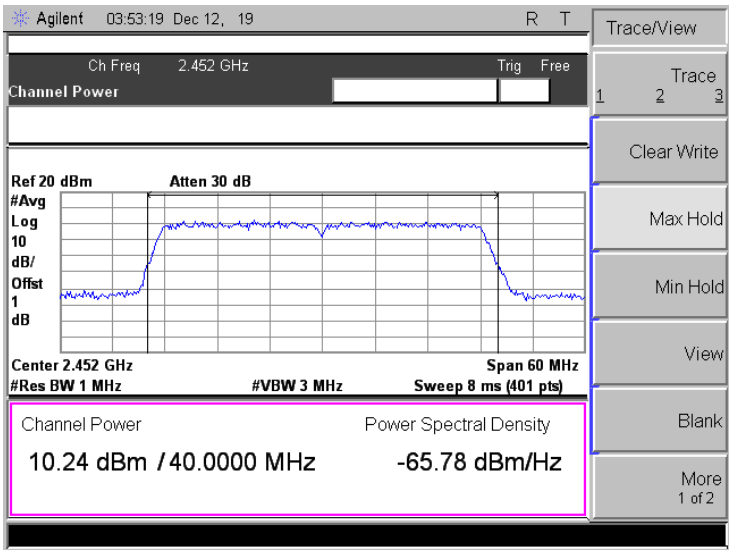
802.11n-HT40-Low MCS7	
802.11n-HT40-Middle MCS7	
802.11n-HT40-High MCS7	

➢ Antenna 2

802.11b-Low 11Mbps	
802.11b-Middle 11Mbps	
802.11b-High 11Mbps	

802.11g-Low 54Mbps	
802.11g-Middle 54Mbps	
802.11g-High 54Mbps	

802.11n-HT20-Low MCS7	
802.11n-HT20-Middle MCS7	
802.11n-HT20-High MCS7	

802.11n-HT40-Low MCS7	
802.11n-HT40-Middle MCS7	
802.11n-HT40-High MCS7	

8. Field Strength of Spurious Emissions

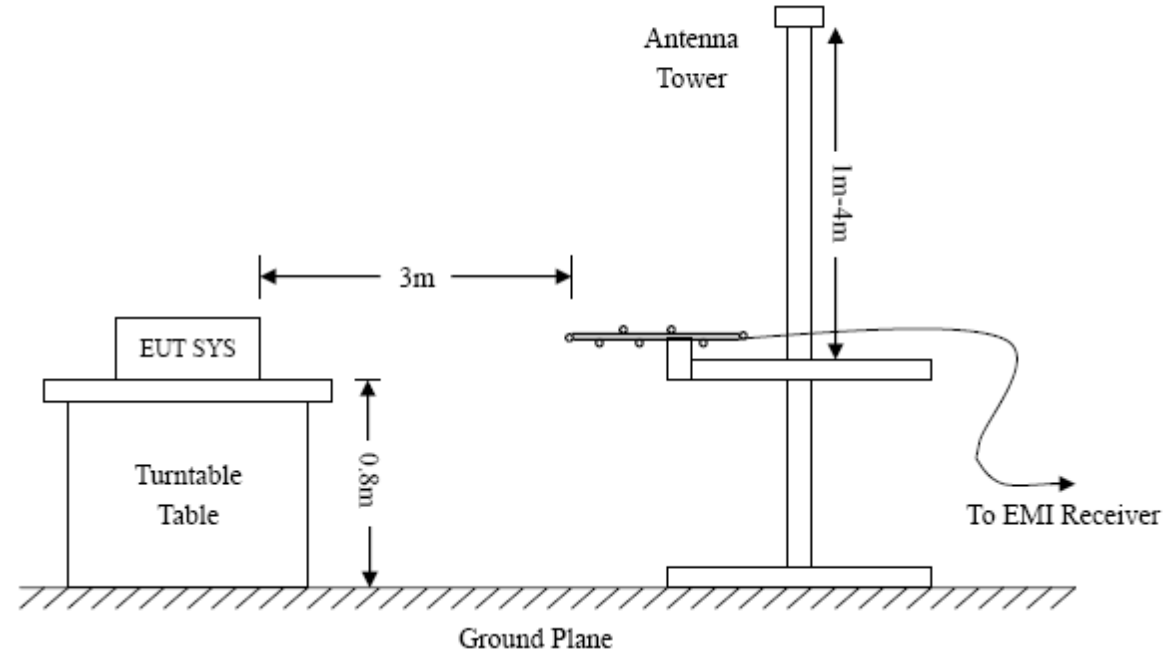
8.1 Standard Applicable

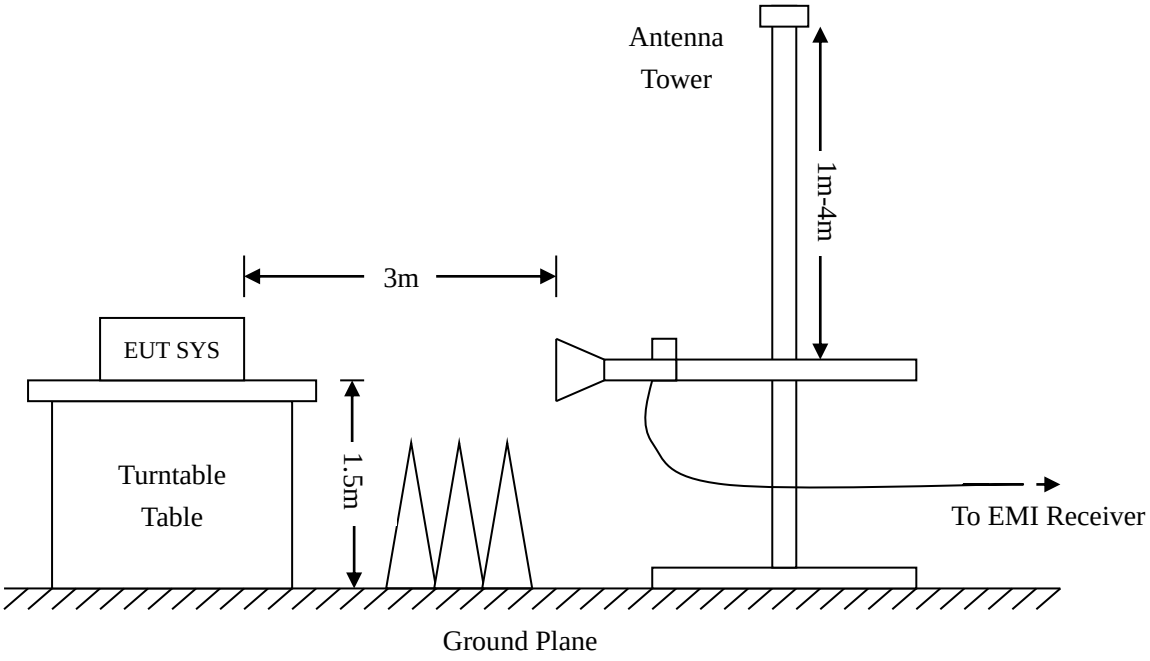
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within 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 30 dB instead of 20 dB. 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 40 cm long in the middle.
The spacing between the peripherals was 10 cm.





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:

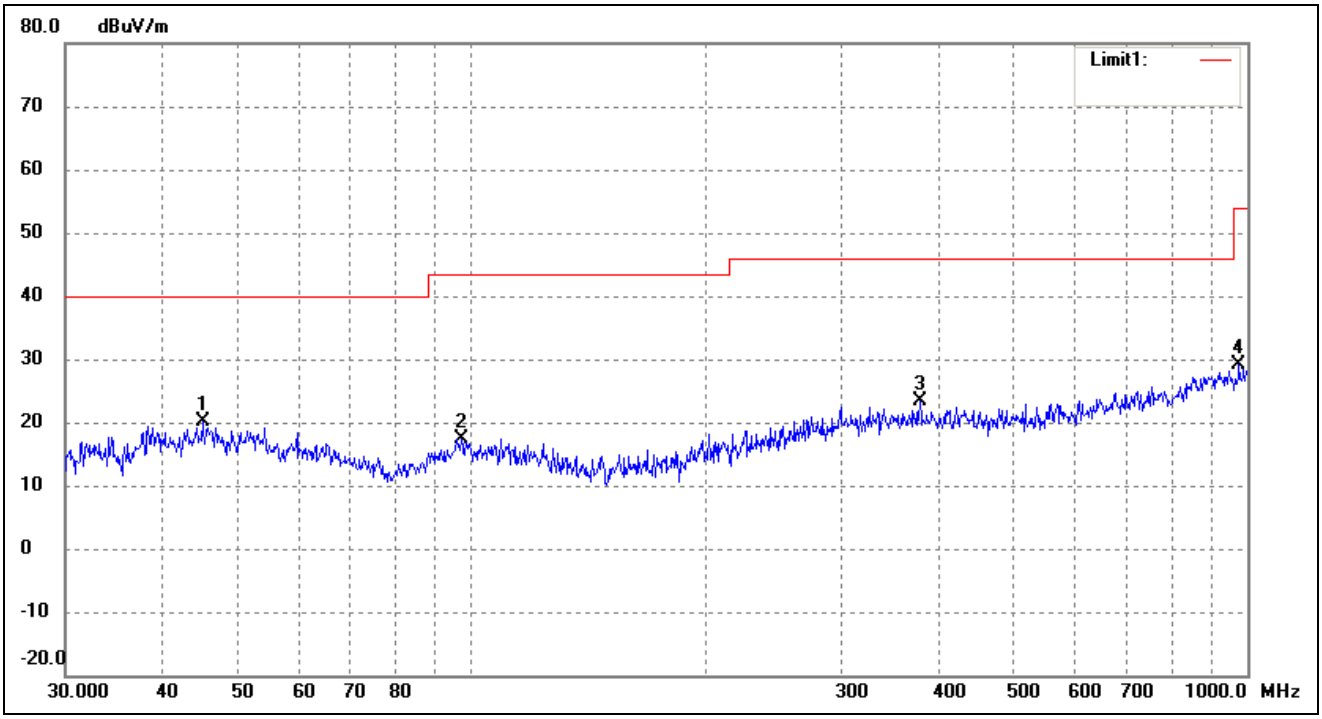
Margin = Corr. Ampl. – FCC Part 15 Limit

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 is recorded in this report.

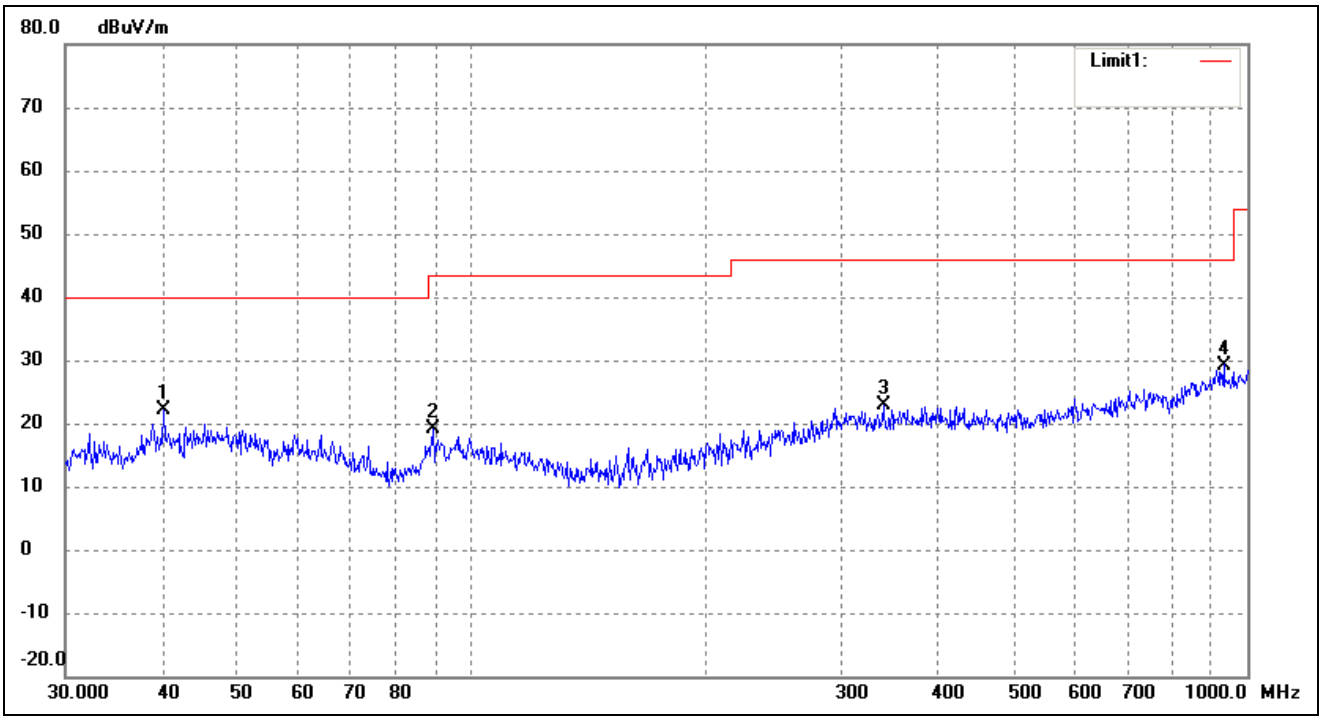
- Spurious Emissions Below 1GHz
- Worst case Antenna 1

802.11b_11Mbps			
Test Channel	Low	Polarity:	Horizontal



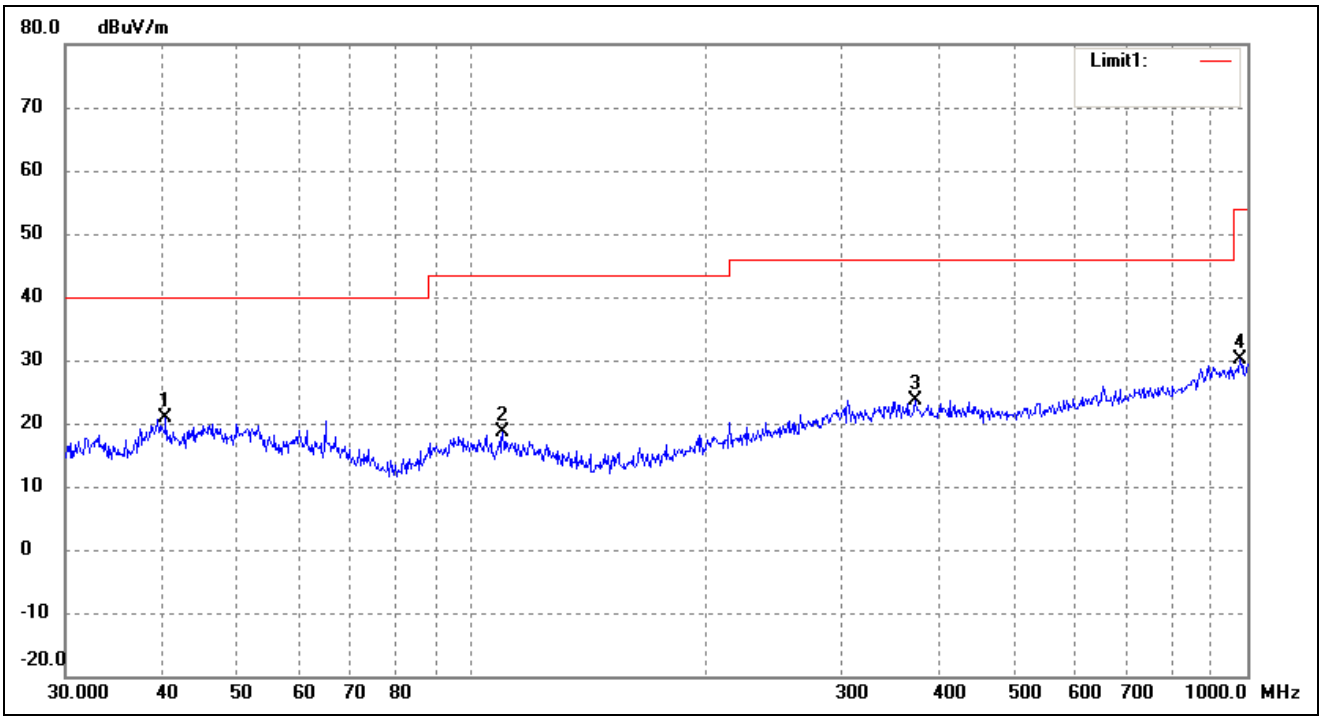
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	45.0583	34.04	-13.93	20.11	40.00	-19.89	219	100	peak
2	97.1148	32.93	-15.50	17.43	43.50	-26.07	92	100	peak
3	378.5843	31.39	-7.95	23.44	46.00	-22.56	112	100	peak
4	975.7529	30.17	-0.92	29.25	54.00	-24.75	93	100	peak

802.11b_11Mbps			
Test Channel	Low	Polarity:	Vertical



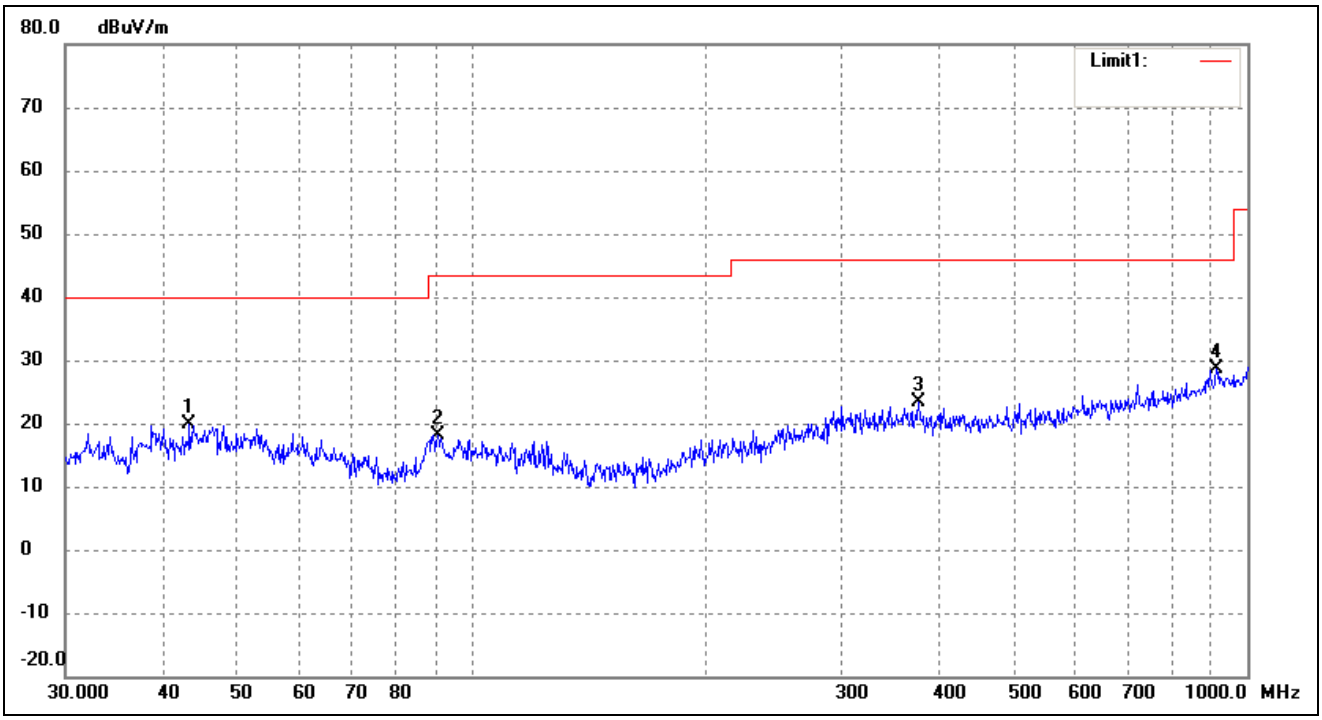
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	40.1347	36.21	-14.15	22.06	40.00	-17.94	331	100	peak
2	89.2764	36.29	-17.09	19.20	43.50	-24.30	339	100	peak
3	339.5888	30.73	-7.95	22.78	46.00	-23.22	77	100	peak
4	932.2715	30.14	-0.89	29.25	46.00	-16.75	213	100	peak

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Horizontal



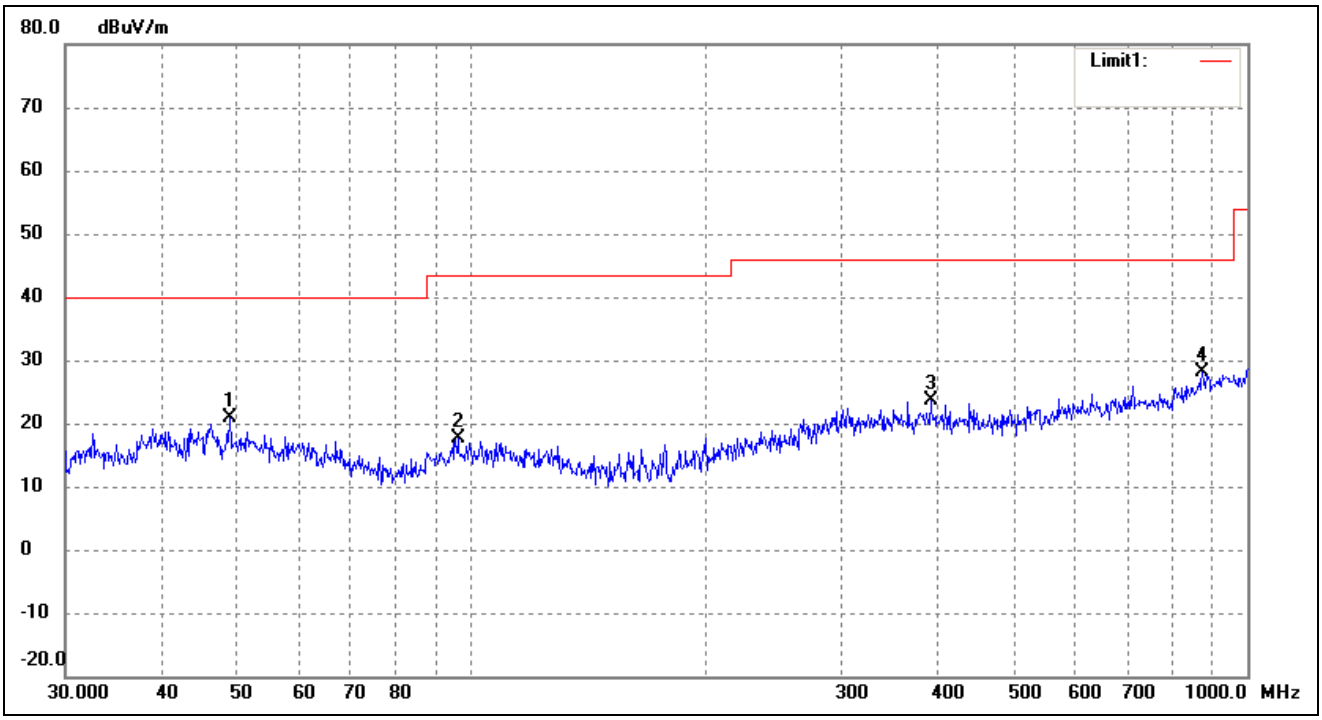
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	40.4172	35.00	-14.14	20.86	40.00	-19.14	312	100	peak
2	109.7960	33.31	-14.78	18.53	43.50	-24.97	192	100	peak
3	373.3112	31.63	-7.94	23.69	46.00	-22.31	98	100	peak
4	979.1804	30.86	-0.85	30.01	54.00	-23.99	125	100	peak

802.11b_11Mbps			
Test Channel	Middle	Polarity:	Vertical



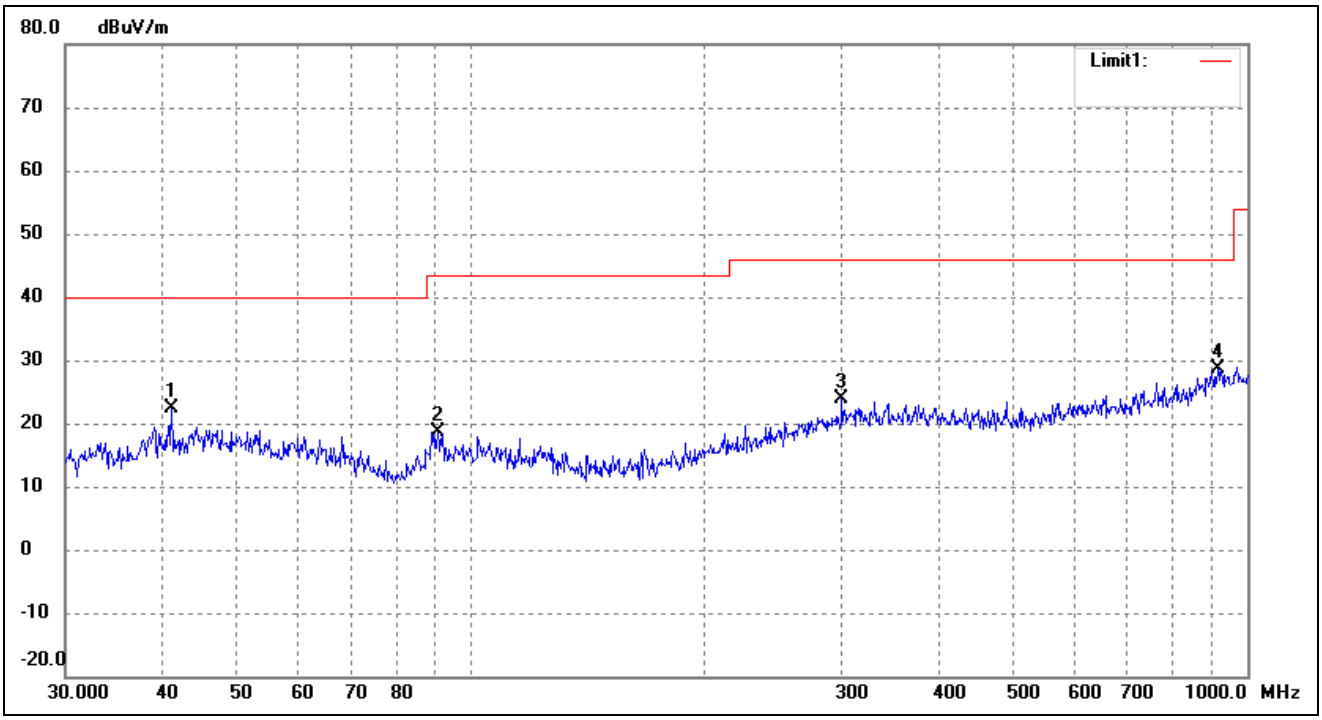
No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	( )	(cm)	
1	43.3534	33.84	-14.01	19.83	40.00	-20.17	315	100	peak
2	90.5374	34.98	-16.79	18.19	43.50	-25.31	90	100	peak
3	377.2591	31.23	-7.95	23.28	46.00	-22.72	140	100	peak
4	912.8620	29.68	-0.99	28.69	46.00	-17.31	94	100	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	48.8429	34.53	-13.71	20.82	40.00	-19.18	335	100	peak
2	96.0986	33.39	-15.70	17.69	43.50	-25.81	347	100	peak
3	390.7226	31.63	-7.90	23.73	46.00	-22.27	51	100	peak
4	875.2470	30.40	-2.31	28.09	46.00	-17.91	318	100	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	41.1320	36.36	-14.10	22.26	40.00	-17.74	99	100	peak
2	90.5374	35.48	-16.79	18.69	43.50	-24.81	124	100	peak
3	300.3673	31.70	-7.83	23.87	46.00	-22.13	120	100	peak
4	916.0687	29.46	-0.93	28.53	46.00	-17.47	142	100	peak

- Spurious Emissions Above 1GHz
- Antenna 1
- *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	60.95	-3.41	57.54	74	-16.46	H	PK
4824.000	41.44	-3.41	38.03	54	-15.97	H	AV
7236.000	60.73	-0.42	60.31	74	-13.69	H	PK
7236.000	42.83	-0.42	42.41	54	-11.59	H	AV
4824.000	62.11	-3.41	58.70	74	-15.30	V	PK
4824.000	40.58	-3.41	37.17	54	-16.83	V	AV
7236.000	57.78	-0.42	57.36	74	-16.64	V	PK
7236.000	38.03	-0.42	37.61	54	-16.39	V	AV
Middle Channel-2437MHz							
4874.000	61.09	-3.41	57.68	74	-16.32	H	PK
4874.000	42.02	-3.41	38.61	54	-15.39	H	AV
7311.000	61.83	-0.42	61.41	74	-12.59	H	PK
7311.000	43.30	-0.42	42.88	54	-11.12	H	AV
4874.000	62.98	-3.41	59.57	74	-14.43	V	PK
4874.000	39.51	-3.41	36.10	54	-17.90	V	AV
7311.000	58.57	-0.42	58.15	74	-15.85	V	PK
7311.000	38.82	-0.42	38.40	54	-15.60	V	AV
High Channel-2462MHz							
4924.000	62.13	-3.41	58.72	74	-15.28	H	PK
4924.000	42.60	-3.41	39.19	54	-14.81	H	AV
7386.000	61.83	-0.42	61.41	74	-12.59	H	PK
7386.000	42.37	-0.42	41.95	54	-12.05	H	AV
4924.000	64.78	-3.41	61.37	74	-12.63	V	PK
4924.000	40.88	-3.41	37.47	54	-16.53	V	AV
7386.000	59.01	-0.42	58.59	74	-15.41	V	PK
7386.000	38.48	-0.42	38.06	54	-15.94	V	AV

- Antenna 2
- *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	62.58	-3.41	59.17	74	-14.83	H	PK
4824.000	41.17	-3.41	37.76	54	-16.24	H	AV
7236.000	60.15	-0.42	59.73	74	-14.27	H	PK
7236.000	43.00	-0.42	42.58	54	-11.42	H	AV
4824.000	64.36	-3.41	60.95	74	-13.05	V	PK
4824.000	41.36	-3.41	37.95	54	-16.05	V	AV
7236.000	58.21	-0.42	57.79	74	-16.21	V	PK
7236.000	39.07	-0.42	38.65	54	-15.35	V	AV
Middle Channel-2437MHz							
4874.000	60.42	-3.41	57.01	74	-16.99	H	PK
4874.000	43.31	-3.41	39.90	54	-14.10	H	AV
7311.000	60.23	-0.42	59.81	74	-14.19	H	PK
7311.000	42.73	-0.42	42.31	54	-11.69	H	AV
4874.000	62.91	-3.41	59.50	74	-14.50	V	PK
4874.000	40.15	-3.41	36.74	54	-17.26	V	AV
7311.000	56.75	-0.42	56.33	74	-17.67	V	PK
7311.000	37.82	-0.42	37.40	54	-16.60	V	AV
High Channel-2462MHz							
4924.000	61.38	-3.41	57.97	74	-16.03	H	PK
4924.000	43.25	-3.41	39.84	54	-14.16	H	AV
7386.000	61.20	-0.42	60.78	74	-13.22	H	PK
7386.000	42.47	-0.42	42.05	54	-11.95	H	AV
4924.000	62.17	-3.41	58.76	74	-15.24	V	PK
4924.000	40.86	-3.41	37.45	54	-16.55	V	AV
7386.000	57.89	-0.42	57.47	74	-16.53	V	PK
7386.000	40.00	-0.42	39.58	54	-14.42	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 100 kHz 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 20 dB below that in the 100 kHz 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 30 dB instead of 20 dB. 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 = 100 kHz.
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
9kHz to 150kHz	200Hz to 300Hz
0.15MHz to 30MHz	9kHz to 10kHz
30MHz to 1000MHz	100kHz to 120kHz
>1000MHz	1MHz

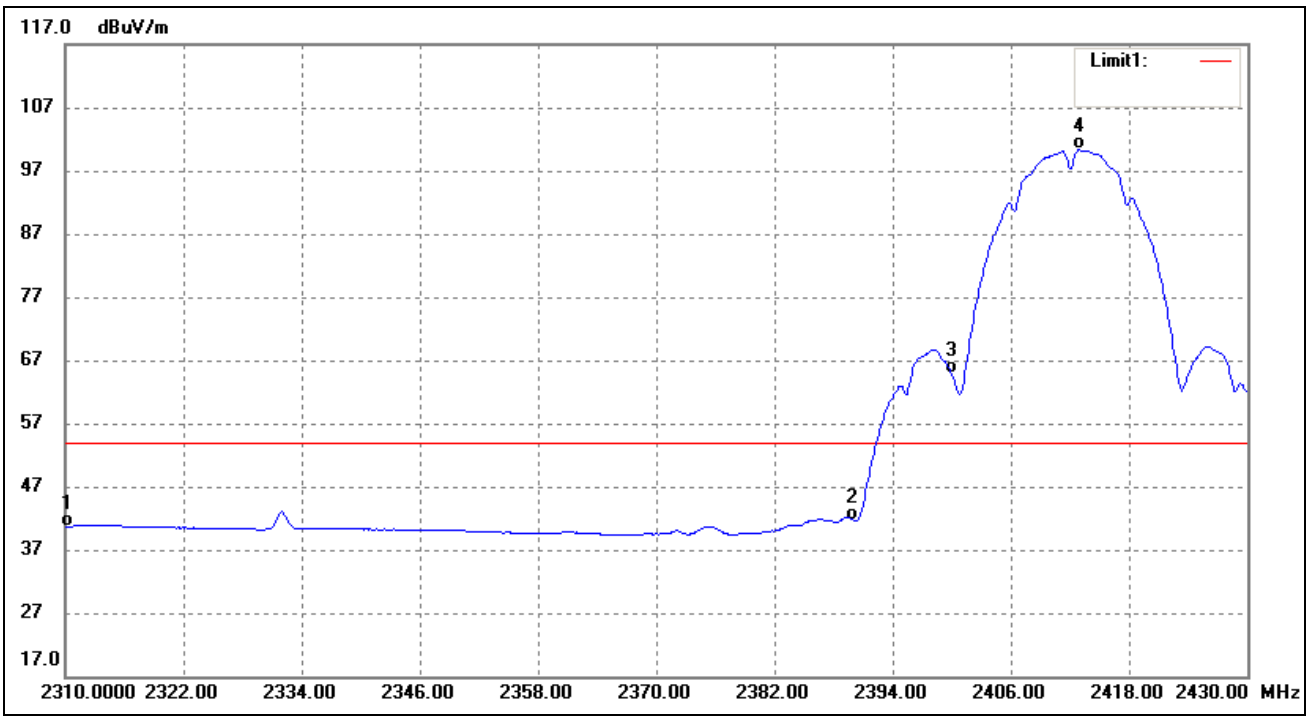
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

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

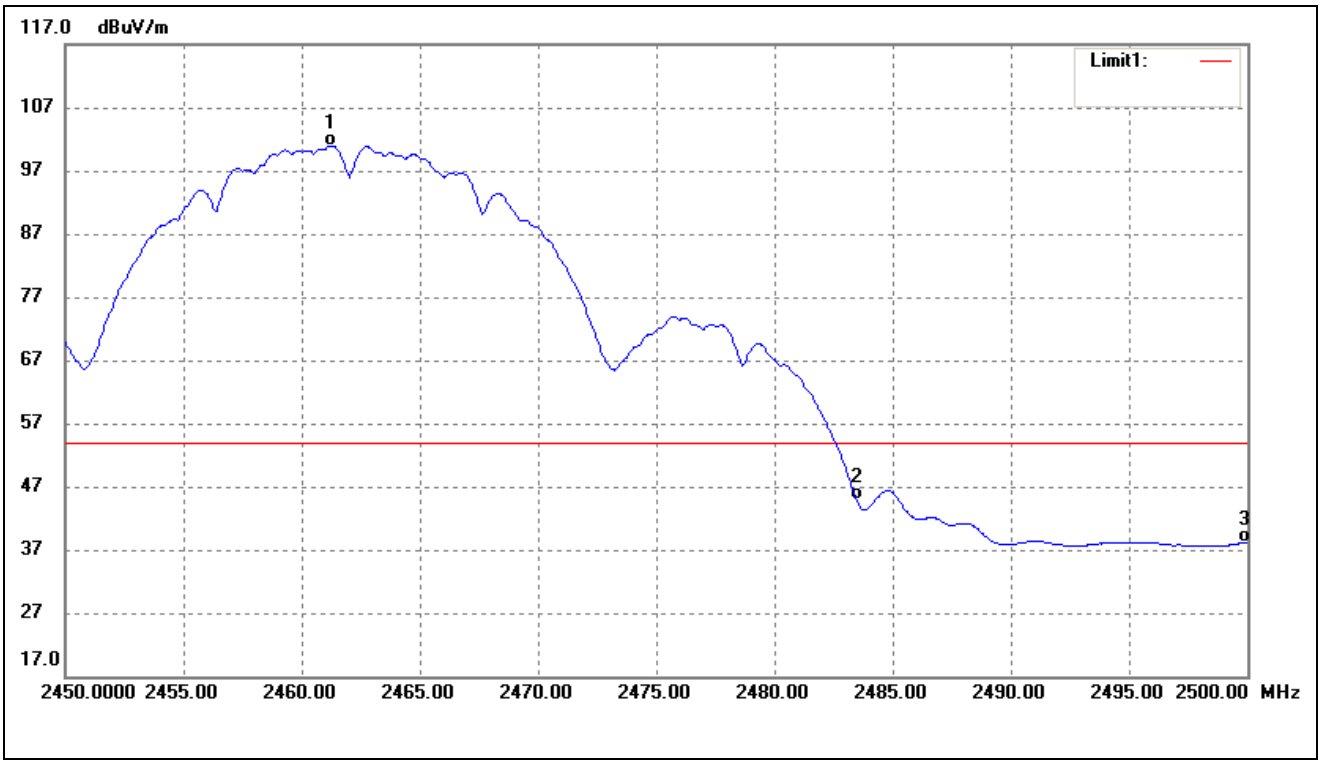
- Radiated test
- Antenna 1(Worst case)

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



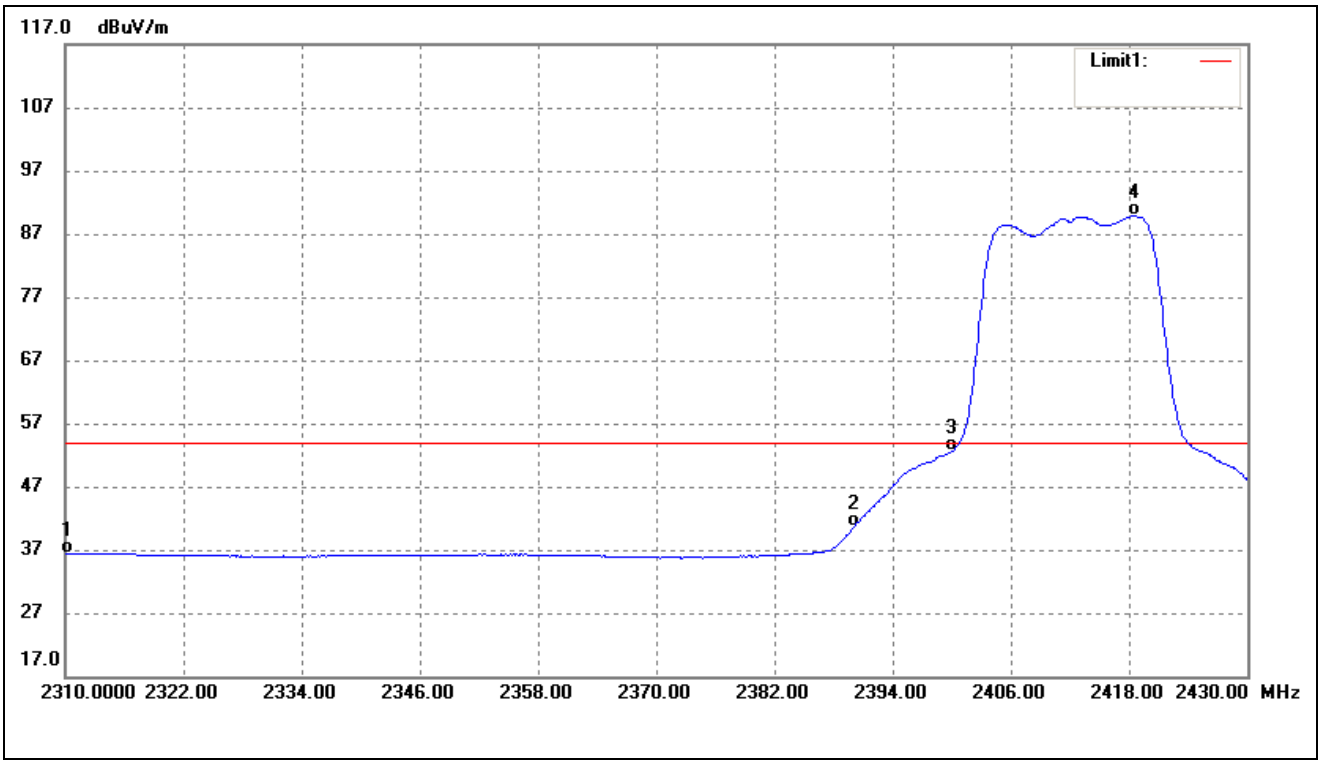
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	50.39	-9.66	40.73	54.00	-13.27	Average Detector
	2310.000	60.84	-9.66	51.18	74.00	-22.82	Peak Detector
2	2390.000	51.18	-9.50	41.68	54.00	-12.32	Average Detector
	2390.000	61.92	-9.50	52.42	74.00	-21.58	Peak Detector
3	2400.000	74.36	-9.48	64.88	Delta=35.4dBc		Average Detector
4	2412.960	109.74	-9.46	100.28			Average Detector

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



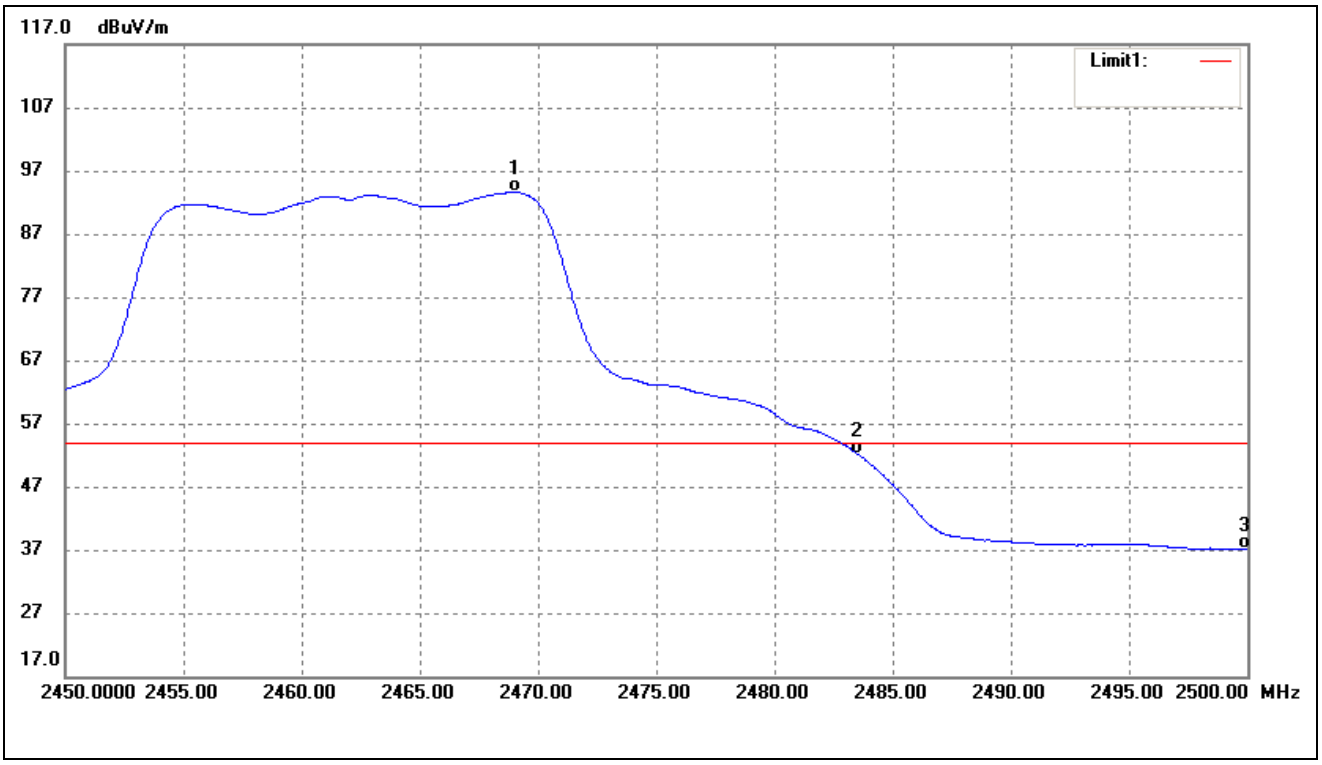
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2461.250	110.36	-9.36	101.00	/	/	Average Detector
	2460.850	114.97	-9.36	105.61	/	/	Peak Detector
2	2483.500	54.07	-9.31	44.76	54.00	-9.24	Average Detector
	2483.500	65.67	-9.31	56.36	74.00	-17.64	Peak Detector
3	2500.000	47.44	-9.28	38.16	54.00	-15.84	Average Detector
	2500.000	59.38	-9.28	50.10	74.00	-23.90	Peak Detector

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



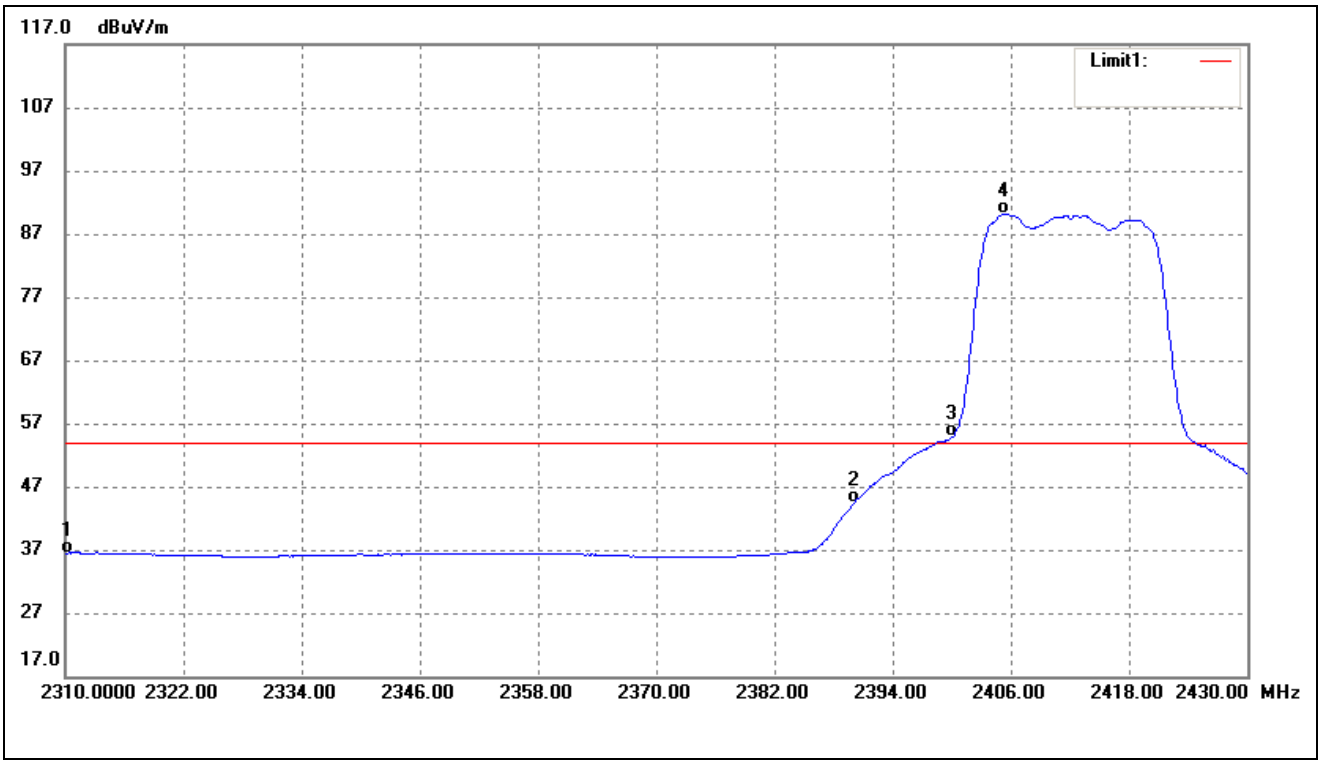
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	46.13	-9.66	36.47	54.00	-17.53	Average Detector
	2310.000	58.12	-9.66	48.46	74.00	-25.54	Peak Detector
2	2390.000	50.12	-9.50	40.62	54.00	-13.38	Average Detector
	2390.000	68.76	-9.50	59.26	74.00	-14.74	Peak Detector
3	2400.000	62.01	-9.48	52.53	Delta=37.28dBc		Average Detector
4	2418.480	99.25	-9.44	89.81			Average Detector

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



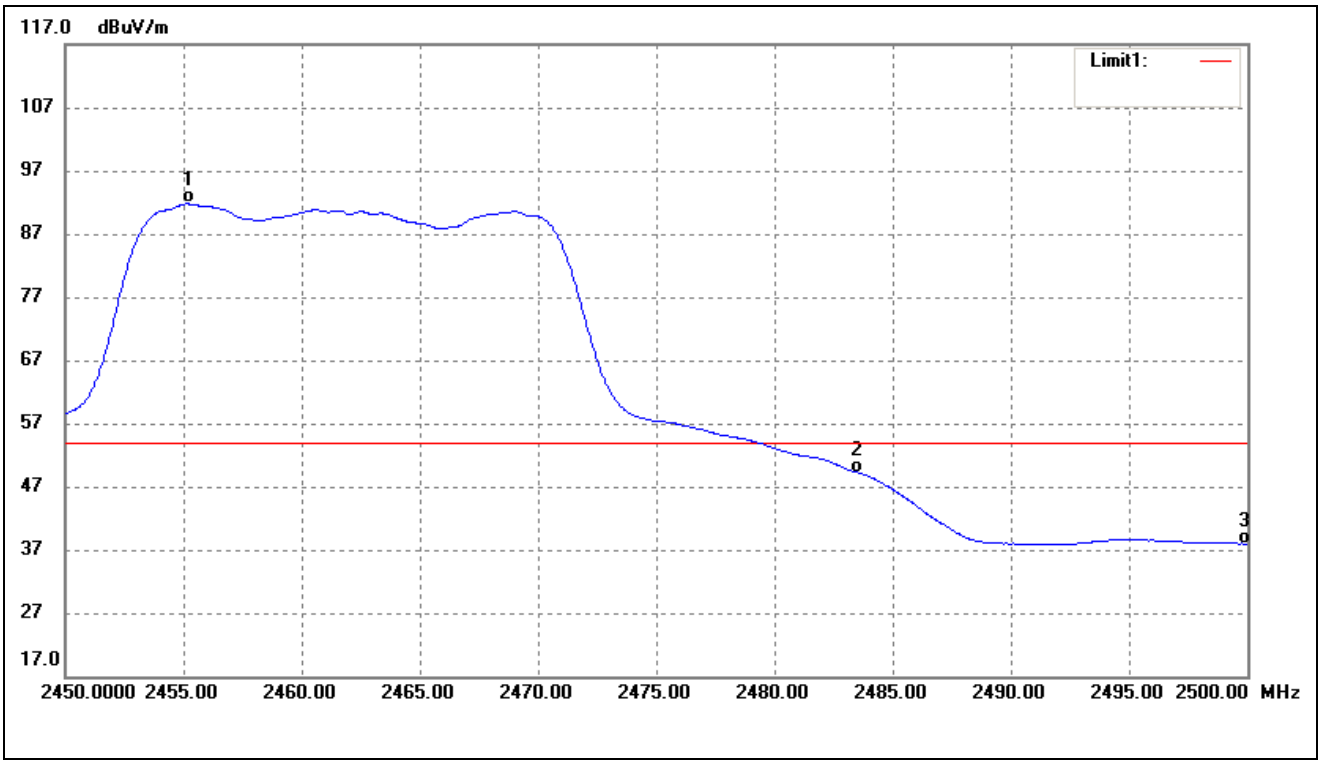
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2469.000	102.90	-9.34	93.56	/	/	Average Detector
	2468.250	113.52	-9.34	104.18	/	/	Peak Detector
2	2483.500	61.52	-9.31	52.21	54.00	-1.79	Average Detector
	2483.500	81.29	-9.31	71.98	74.00	-2.02	Peak Detector
3	2500.000	46.32	-9.28	37.04	54.00	-16.96	Average Detector
	2500.000	58.87	-9.28	49.59	74.00	-24.41	Peak Detector

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



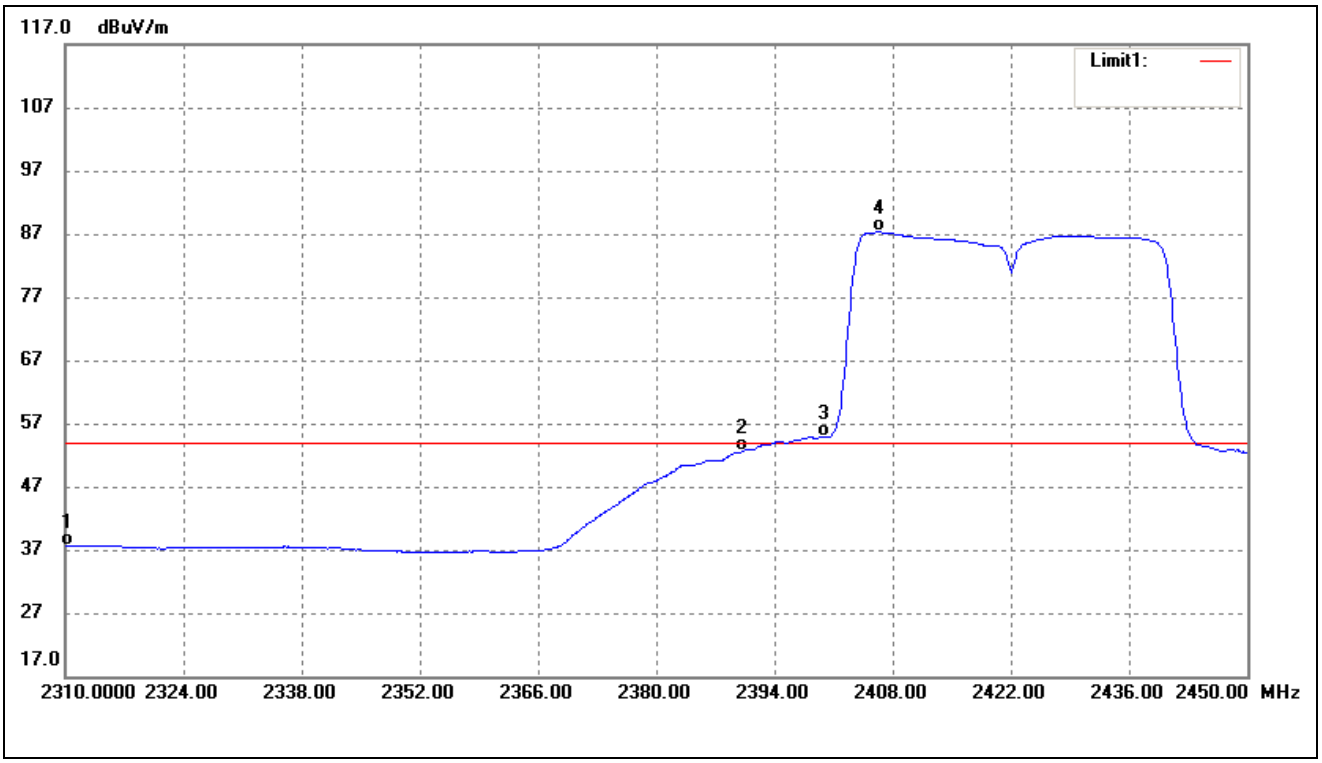
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	46.14	-9.66	36.48	54.00	-17.52	Average Detector
	2310.000	58.39	-9.66	48.73	74.00	-25.27	Peak Detector
2	2390.000	53.90	-9.50	44.40	54.00	-9.60	Average Detector
	2390.000	77.09	-9.50	67.59	74.00	-6.41	Peak Detector
3	2400.000	64.29	-9.48	54.81	Delta=35.38dBc		Average Detector
4	2405.280	99.67	-9.48	90.19			Average Detector

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



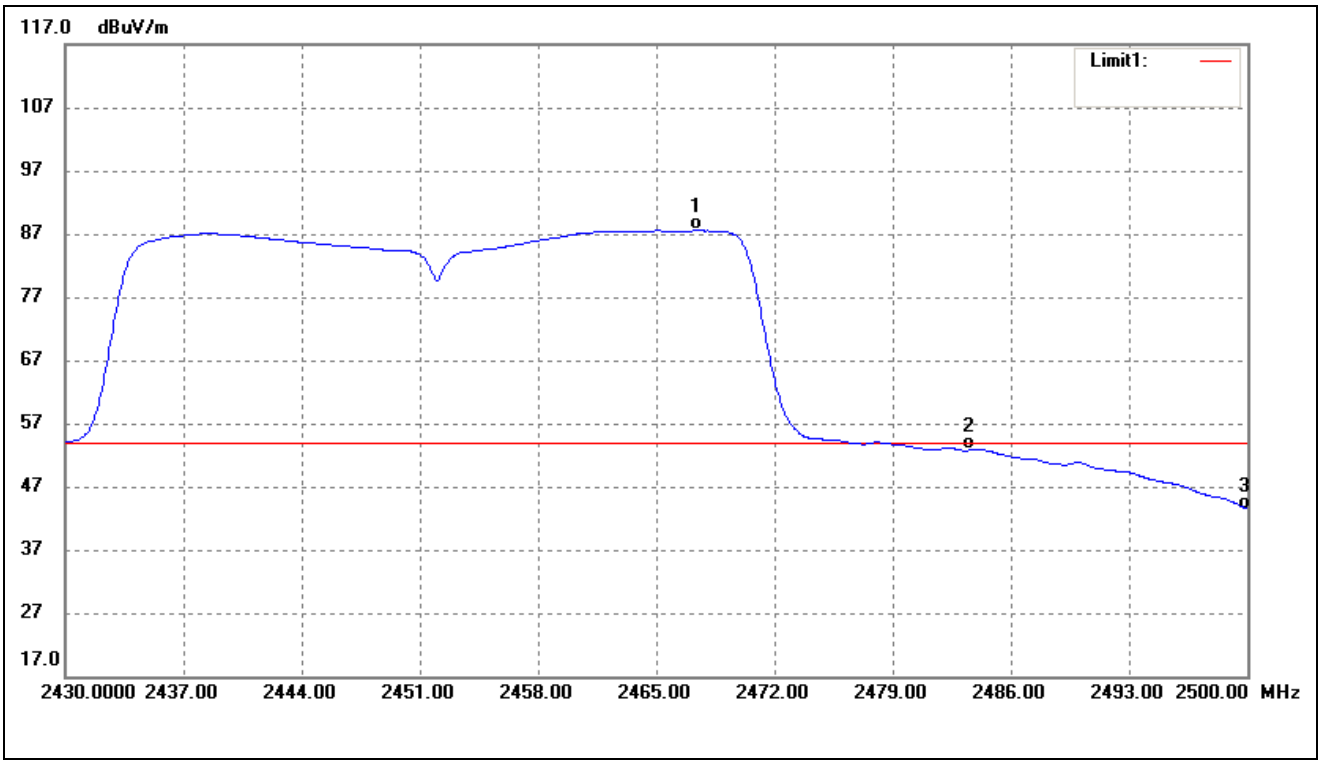
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2455.200	101.14	-9.37	91.77	/	/	Average Detector
	2454.900	111.52	-9.37	102.15	/	/	Peak Detector
2	2483.500	58.56	-9.31	49.25	54.00	-4.75	Average Detector
	2483.500	80.35	-9.31	71.04	74.00	-2.96	Peak Detector
3	2500.000	47.28	-9.28	38.00	54.00	-16.00	Average Detector
	2500.000	59.76	-9.28	50.48	74.00	-23.52	Peak Detector

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



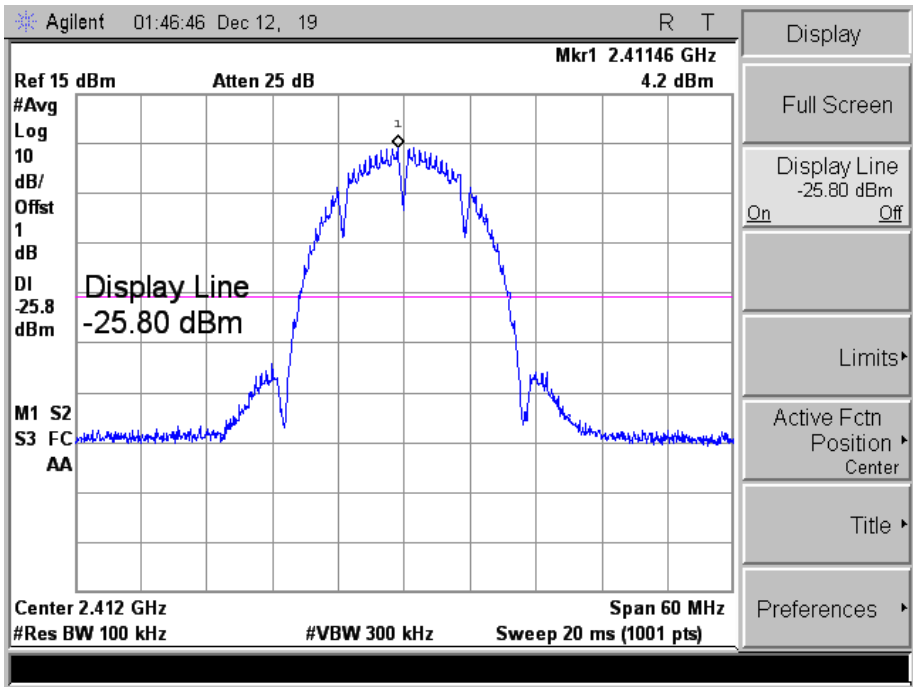
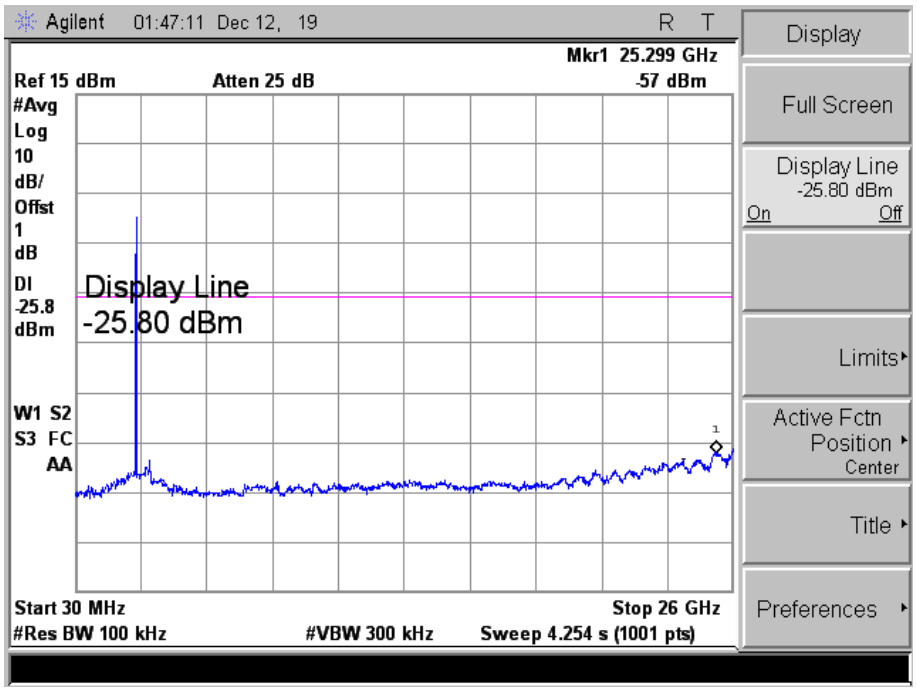
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	47.35	-9.66	37.69	54.00	-16.31	Average Detector
	2310.000	59.23	-9.66	49.57	74.00	-24.43	Peak Detector
2	2390.000	62.07	-9.50	52.57	54.00	-1.43	Average Detector
	2390.000	77.73	-9.50	68.23	74.00	-5.77	Peak Detector
3	2400.000	64.30	-9.48	54.82	Delta=32.46dBc		Average Detector
4	2406.320	96.75	-9.47	87.28			Average Detector

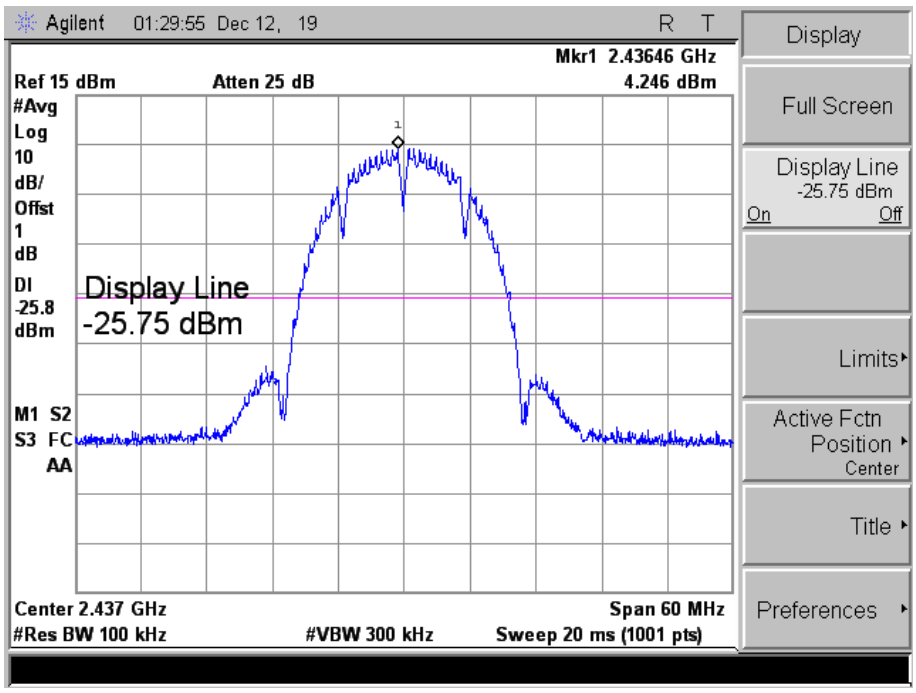
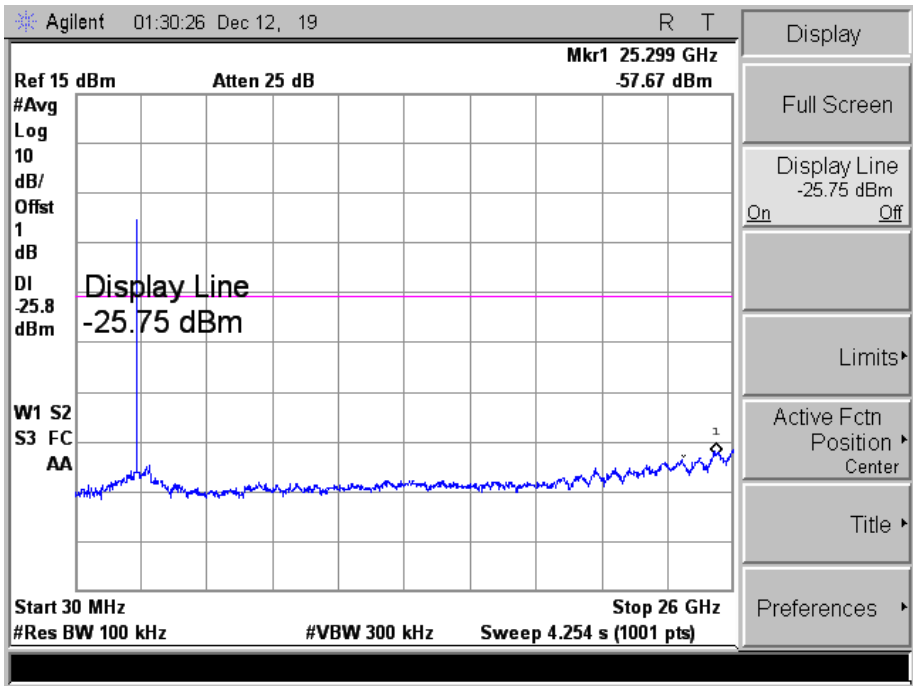
802.11n-HT40_MCS7			
Test Channel	High	Polarity:	Horizontal (worst case)

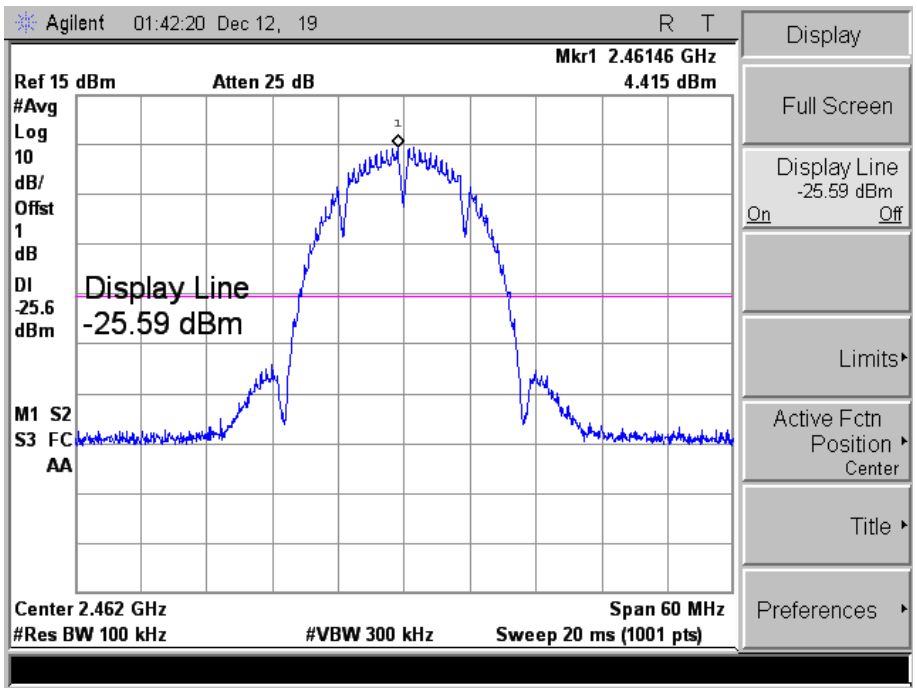
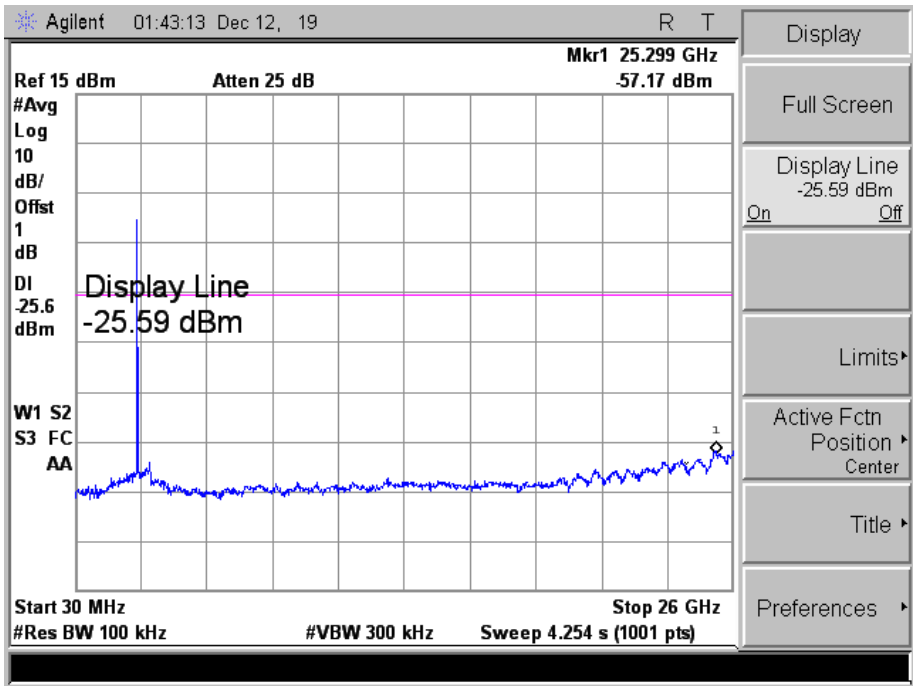


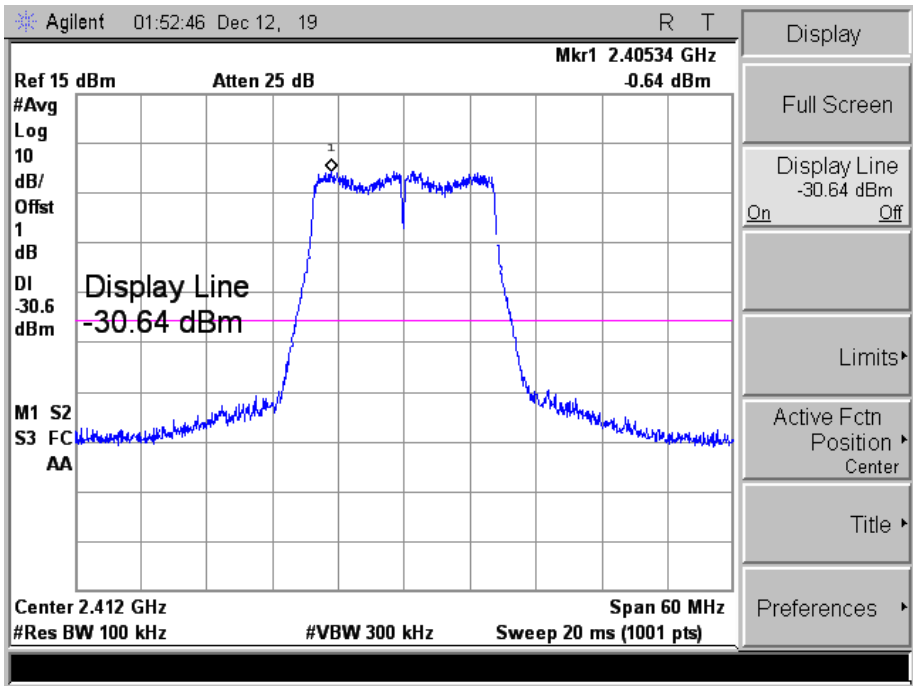
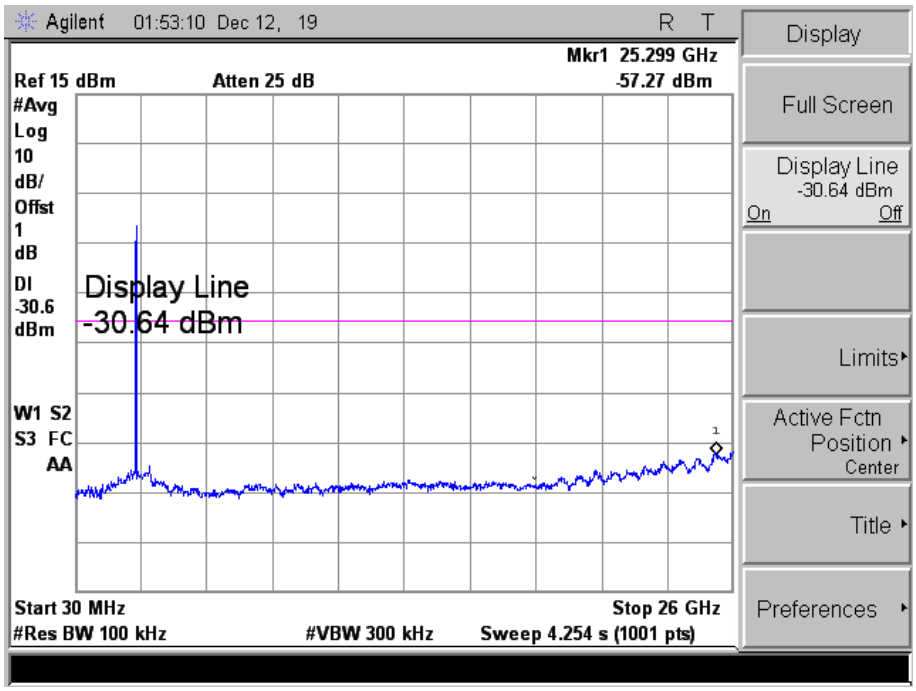
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2467.380	96.87	-9.34	87.53	/	/	Average Detector
	2461.150	107.58	-9.36	98.22	/	/	Peak Detector
2	2483.500	62.11	-9.31	52.80	54.00	-1.20	Average Detector
	2483.500	75.75	-9.31	66.44	74.00	-7.56	Peak Detector
3	2500.000	52.71	-9.28	43.43	54.00	-10.57	Average Detector
	2500.000	68.36	-9.28	59.08	74.00	-14.92	Peak Detector

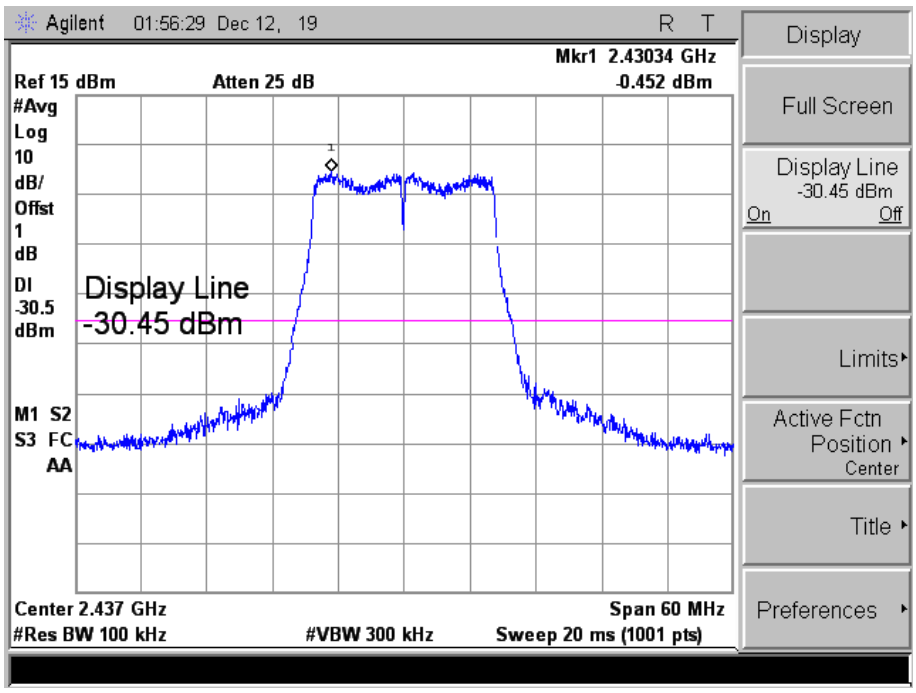
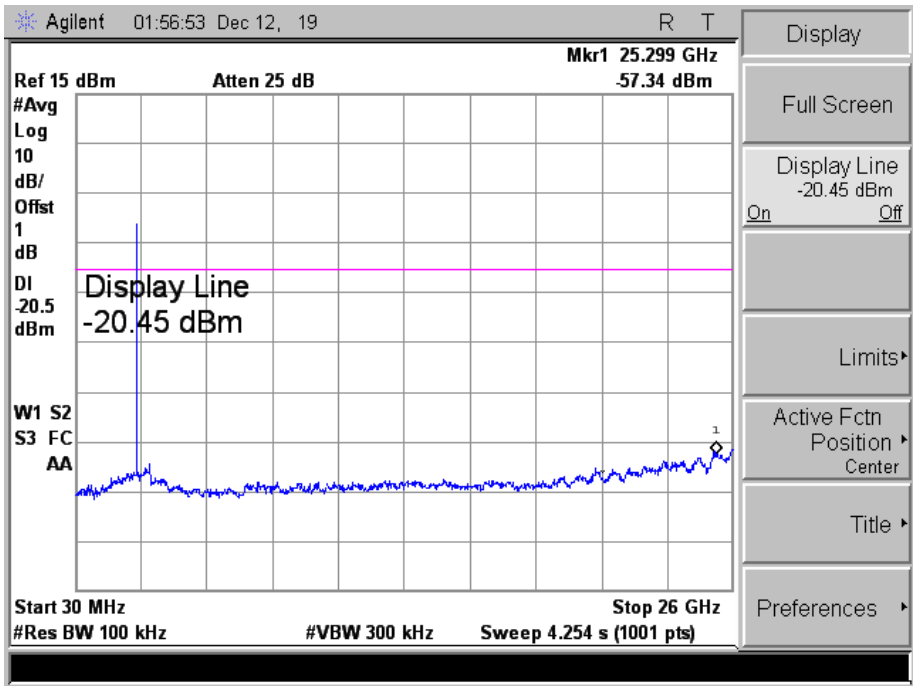
➢ Antenna 1

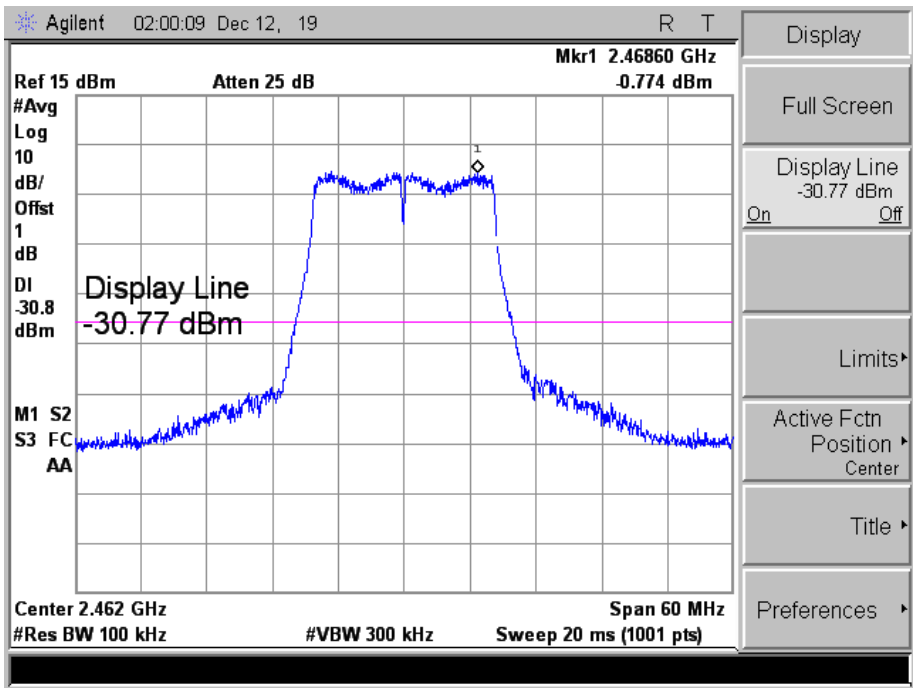
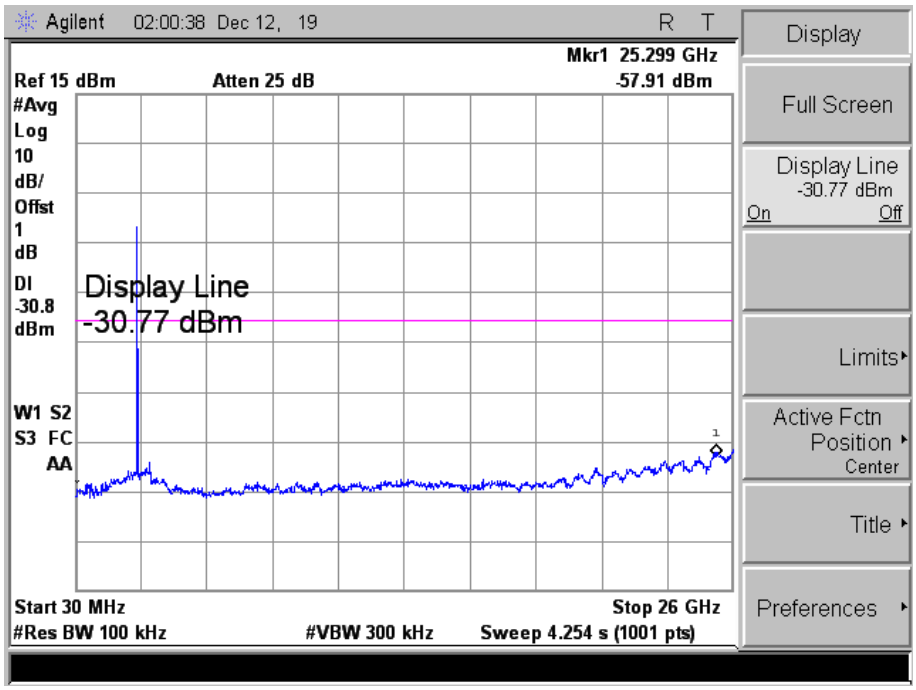
802.11b_11Mbps	
Low	 

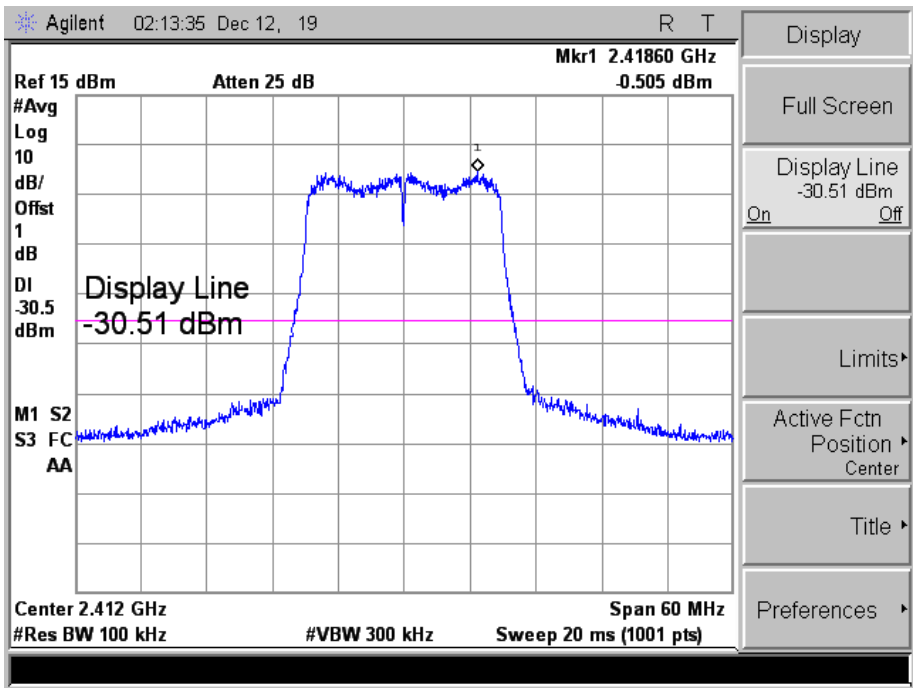
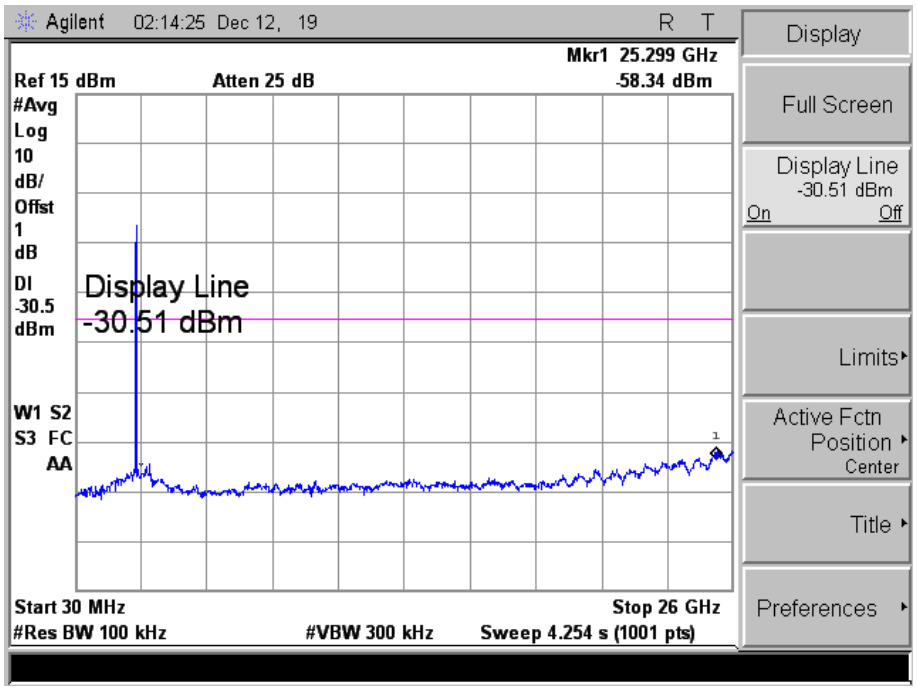
802.11b_11Mbps	
Middle	 

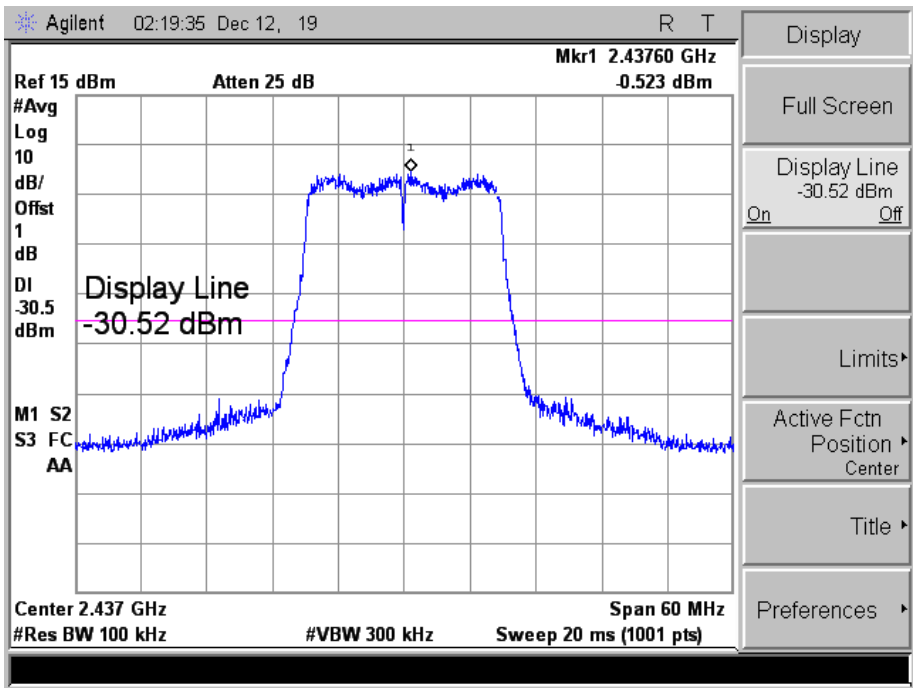
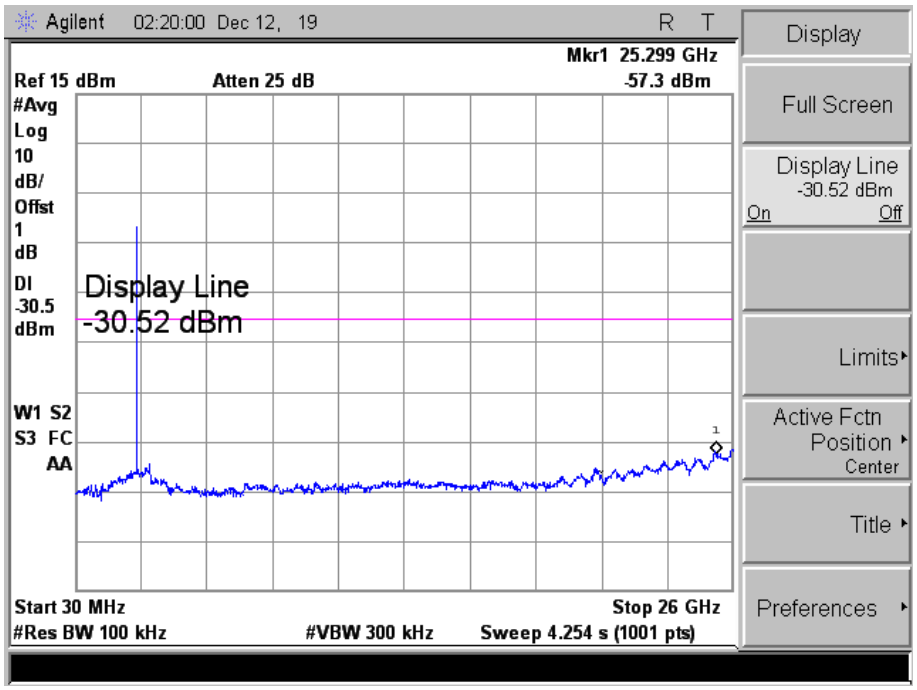
802.11b_11Mbps	
High	
	

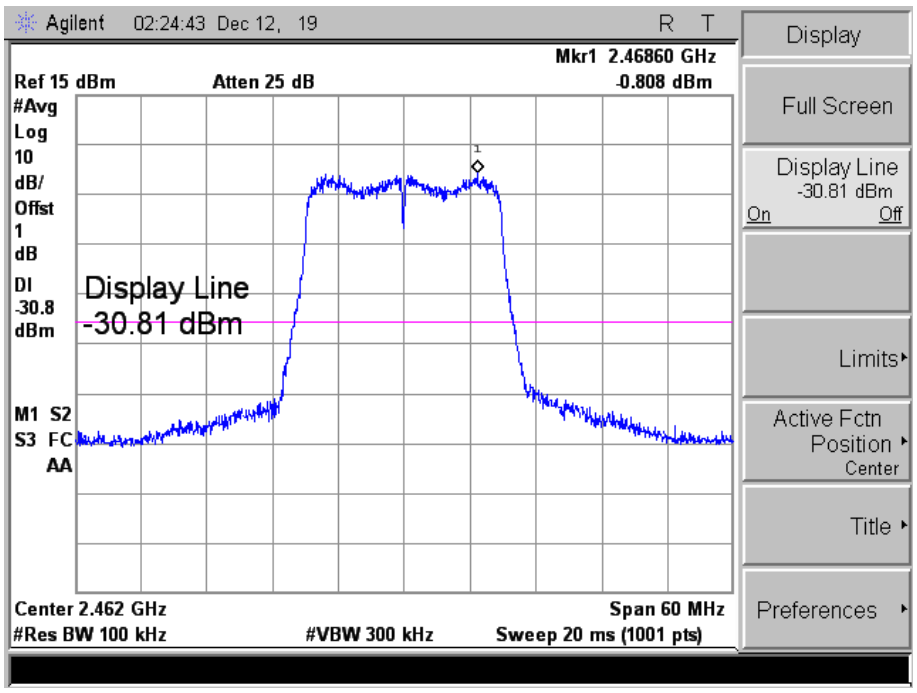
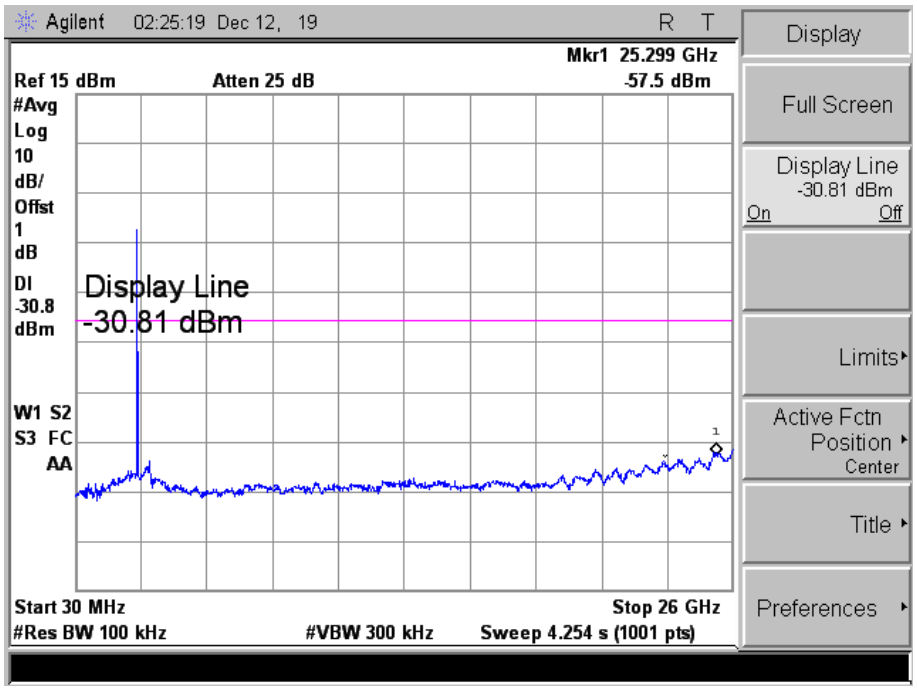
802.11g_54Mbps	
Low	 

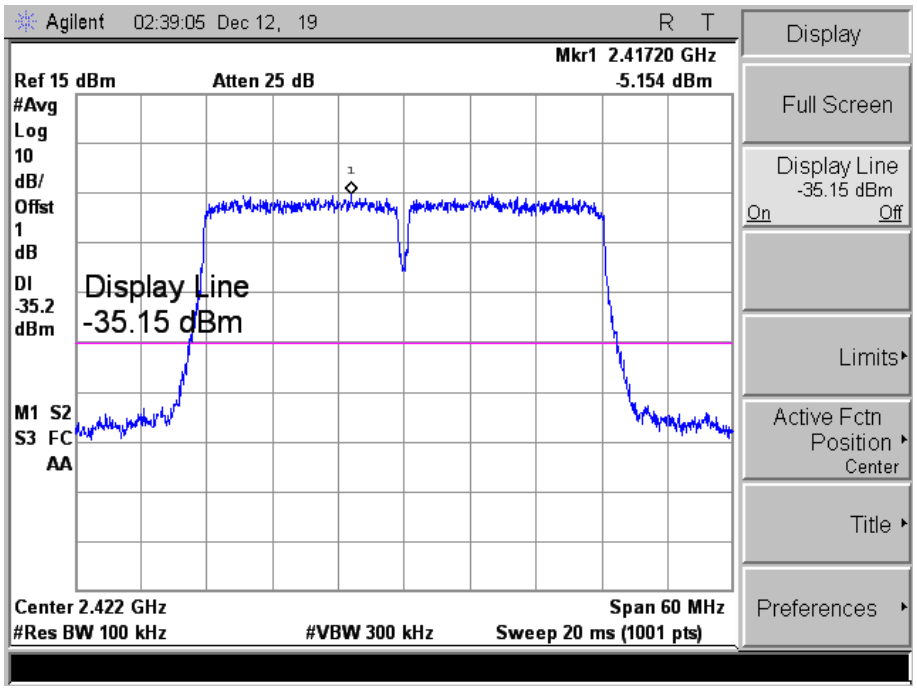
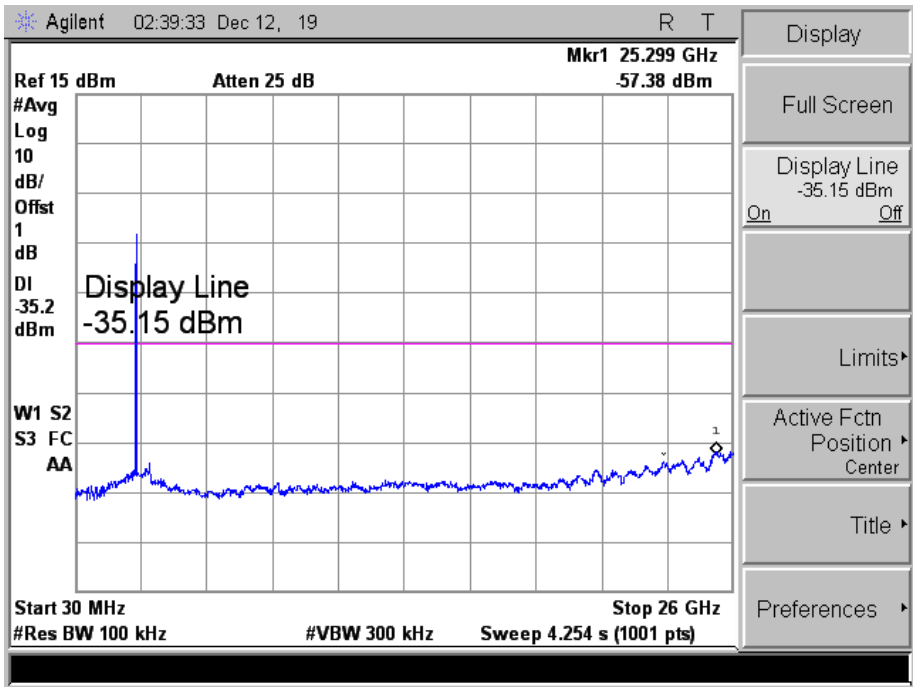
802.11g_54Mbps	
Middle	 

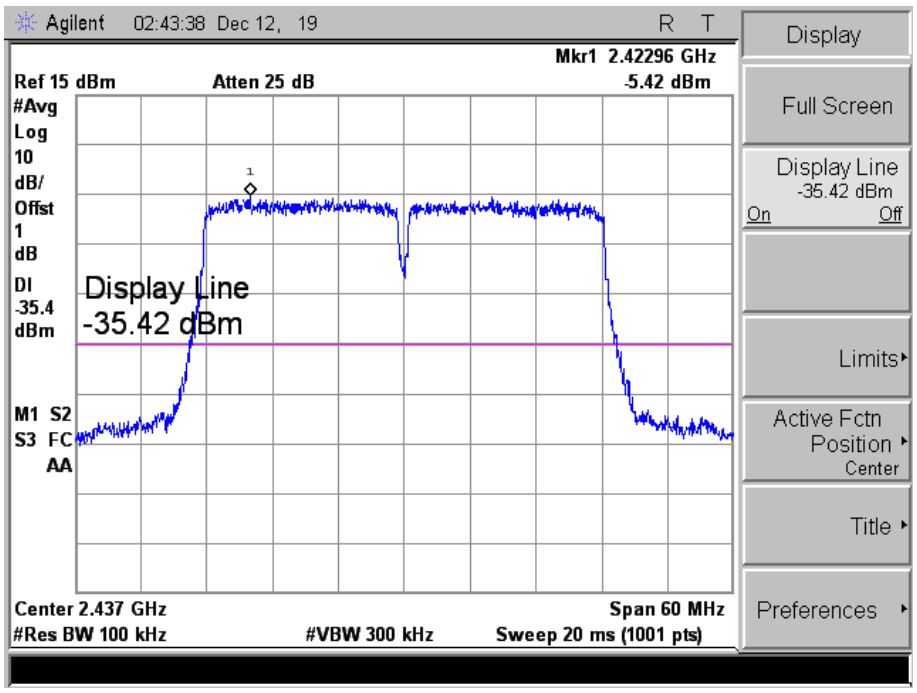
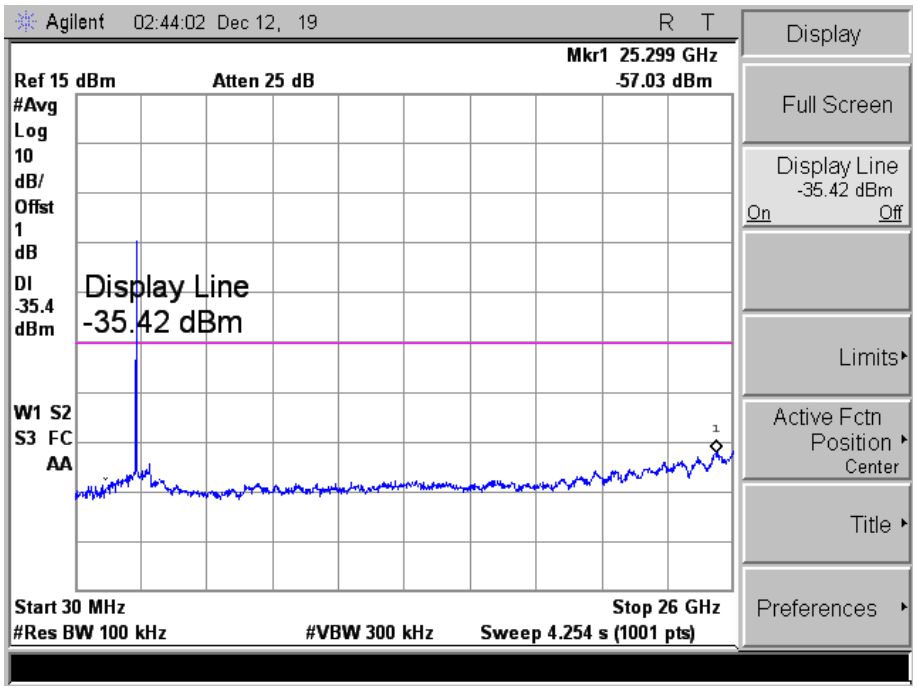
802.11g_54Mbps	
High	 

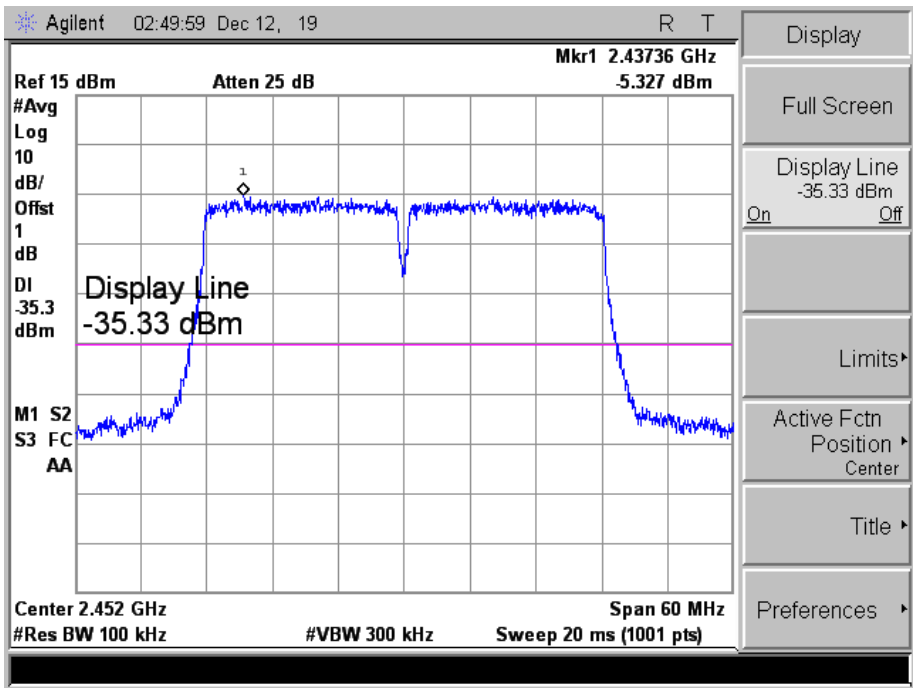
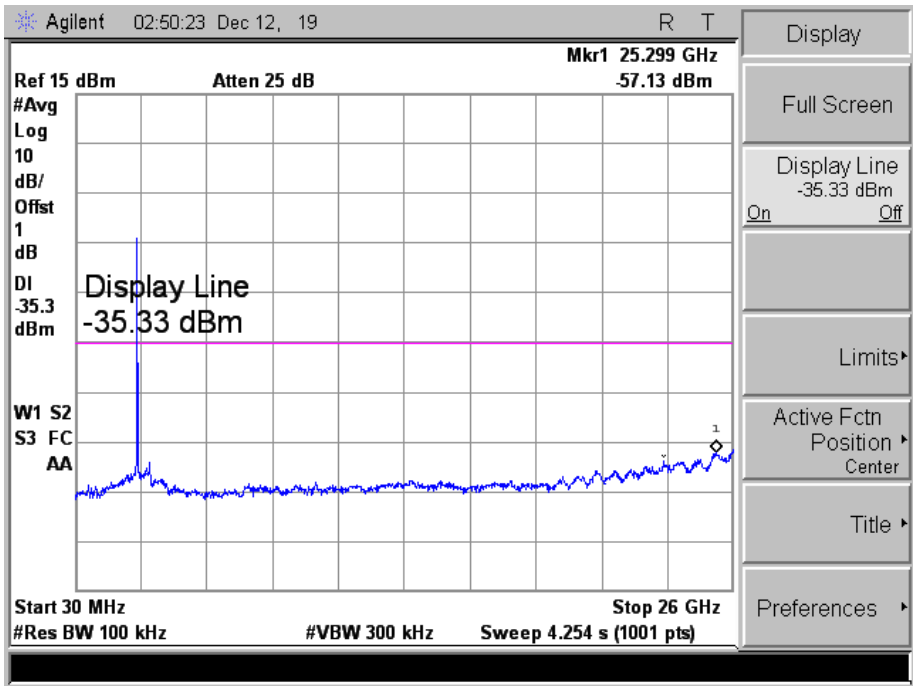
802.11n-HT20_MCS7	
Low	 

802.11n-HT20_MCS7	
Middle	 

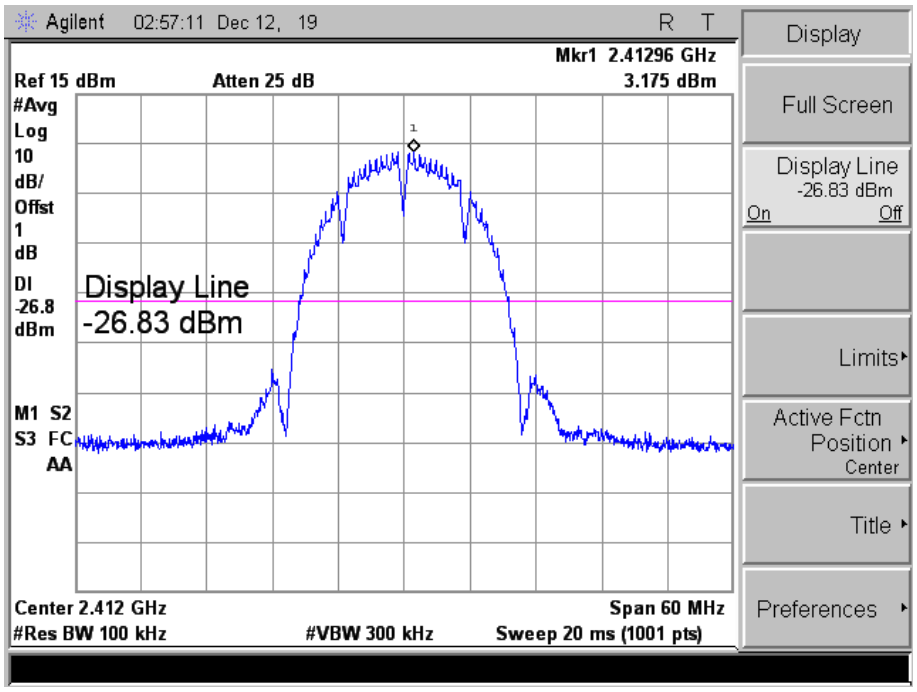
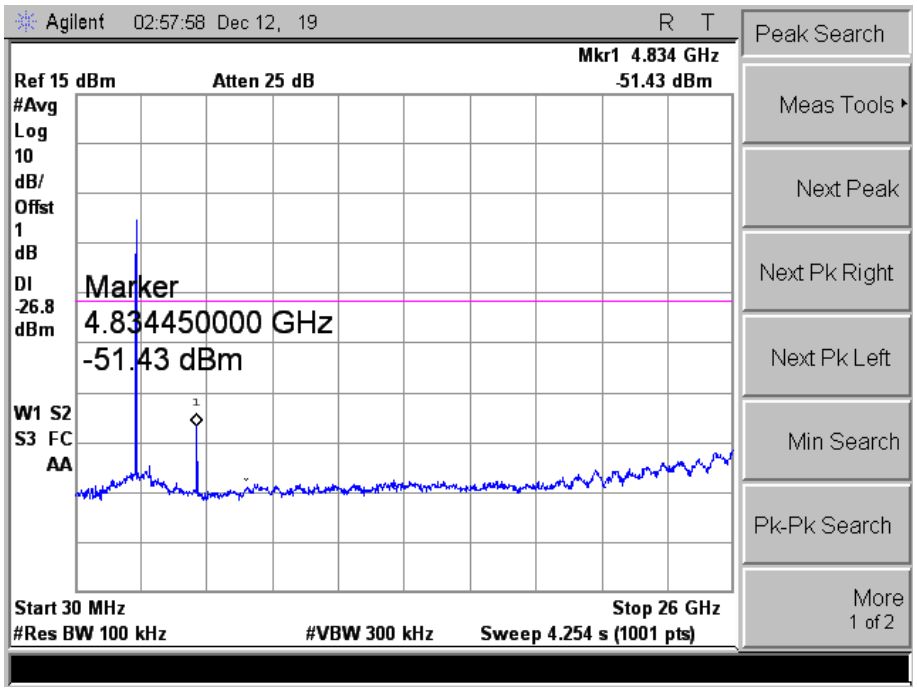
802.11n-HT20_MCS7	
High	 

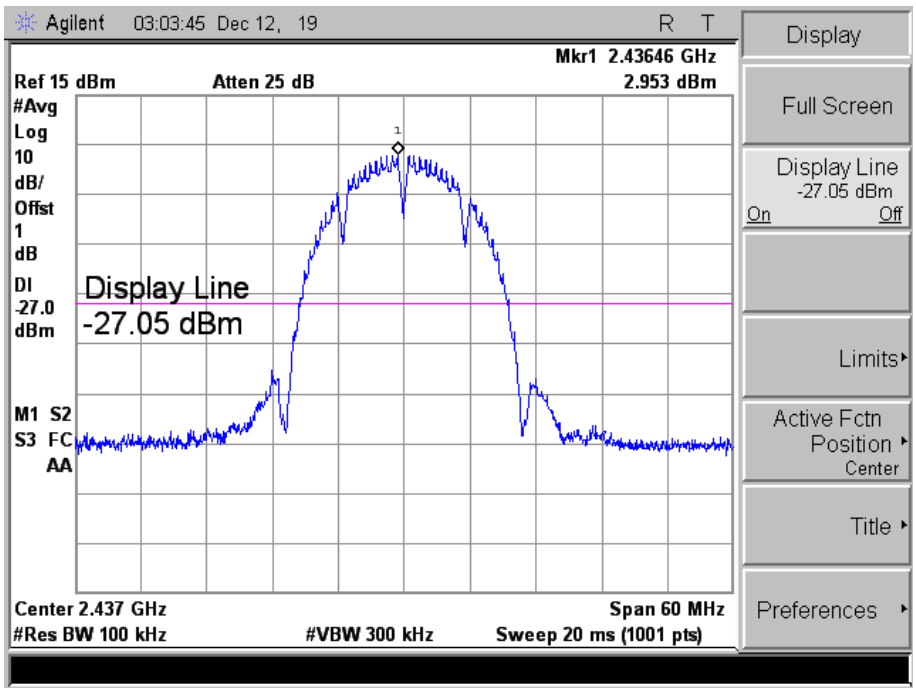
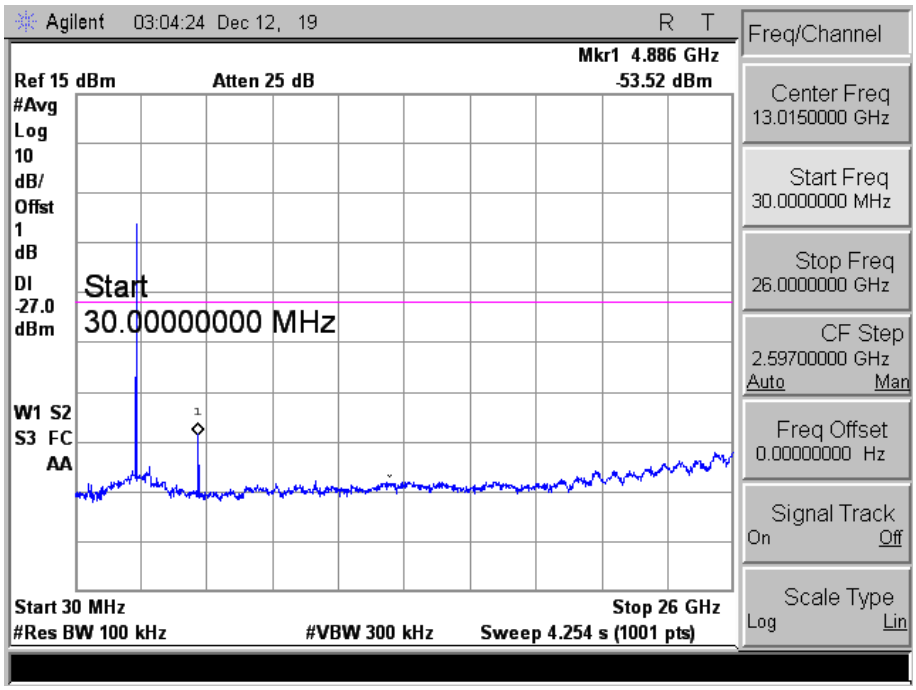
802.11n-HT40_MCS7	
Low	 

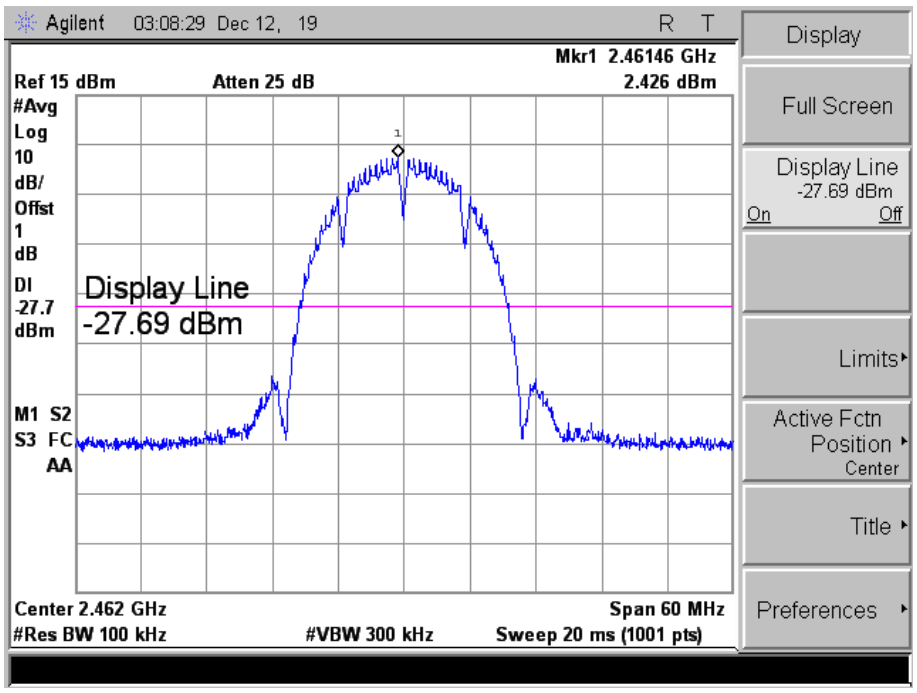
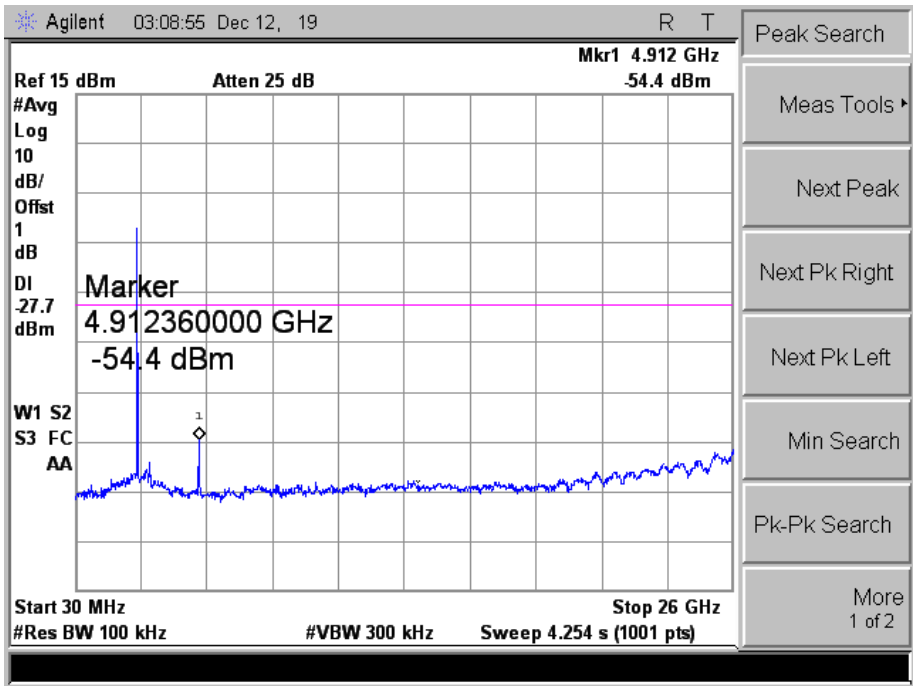
802.11n-HT40_MCS7	
Middle	 

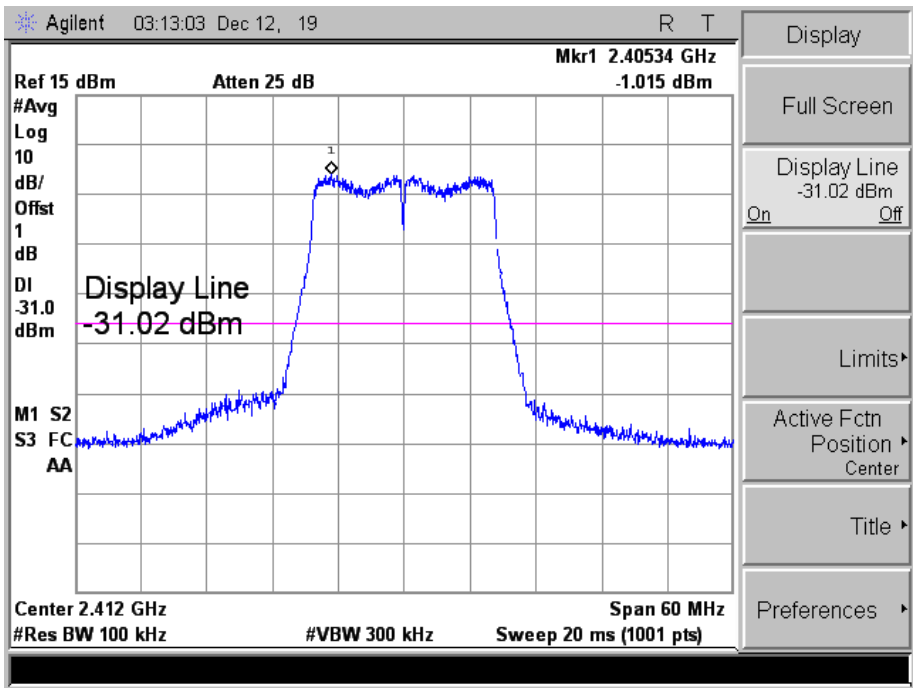
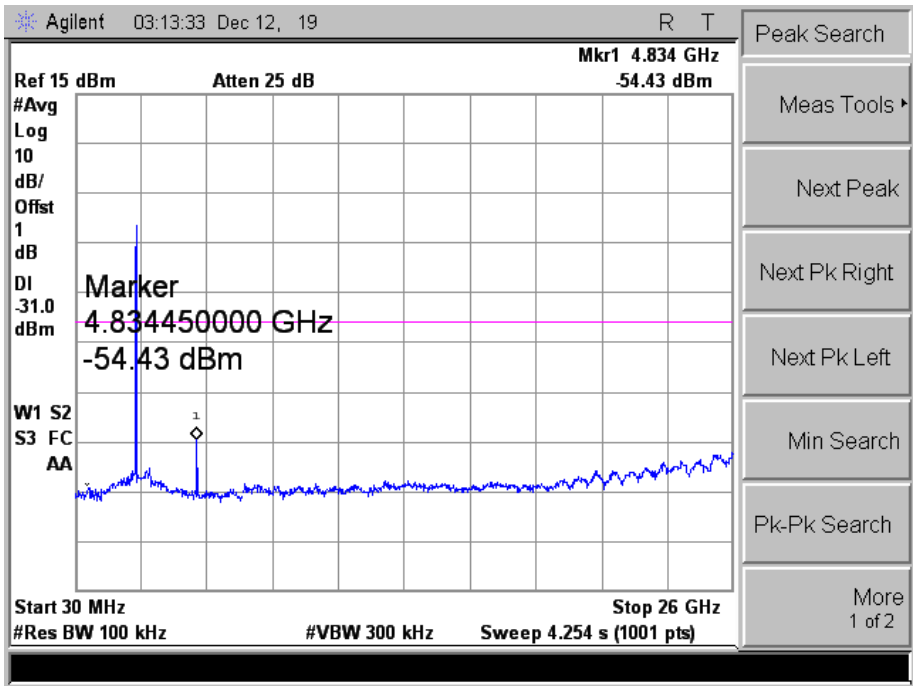
802.11n-HT40_MCS7	
High	 

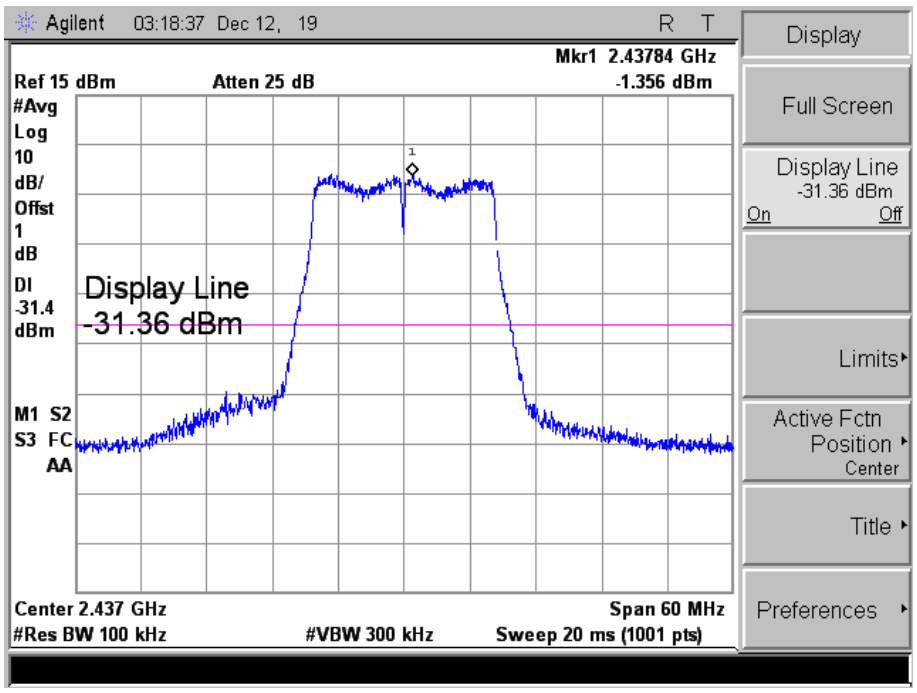
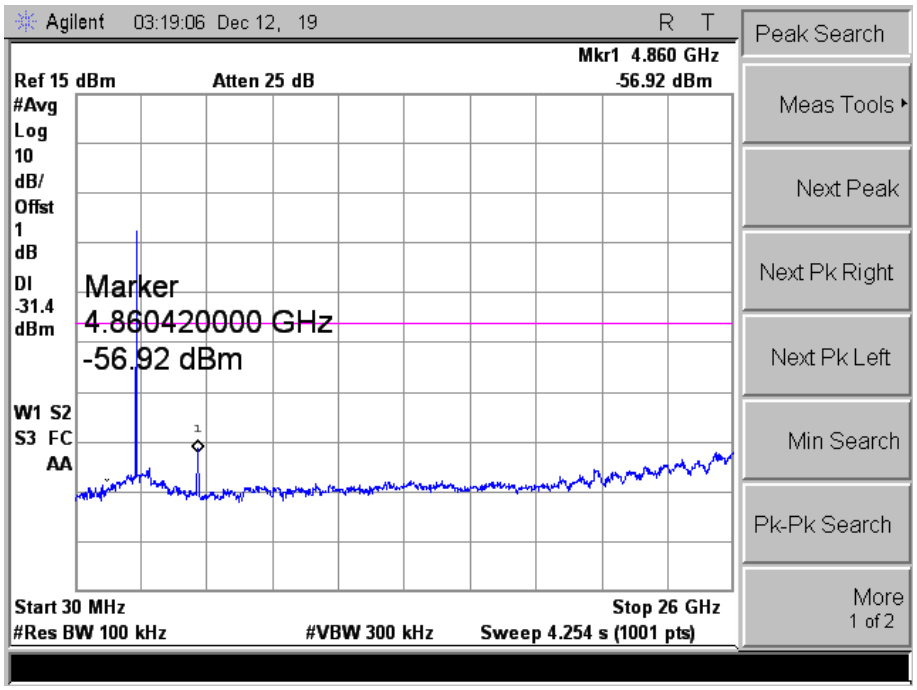
➢ Antenna 2

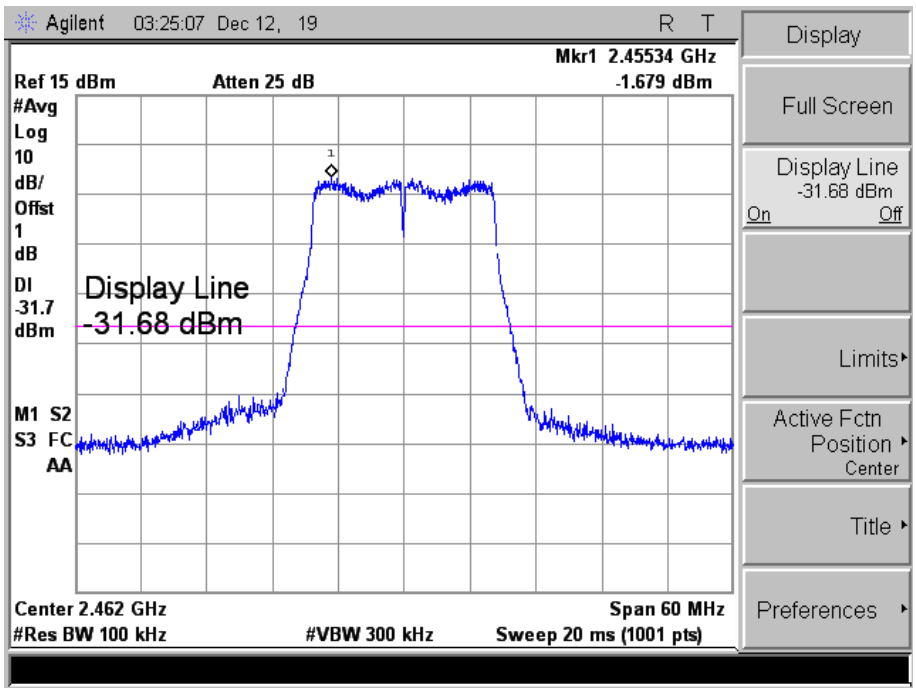
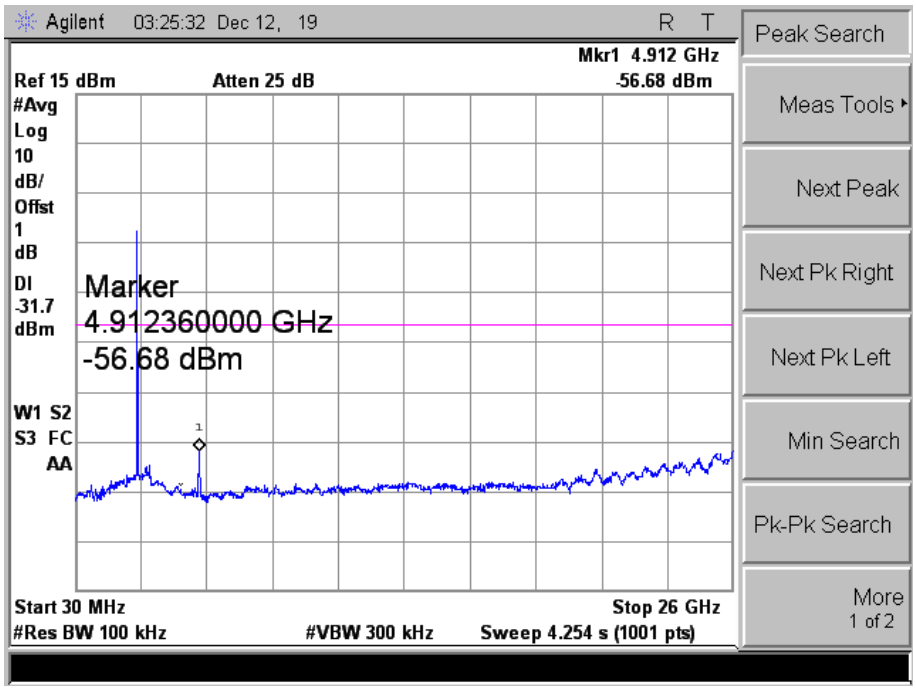
802.11b_11Mbps	
Low	 

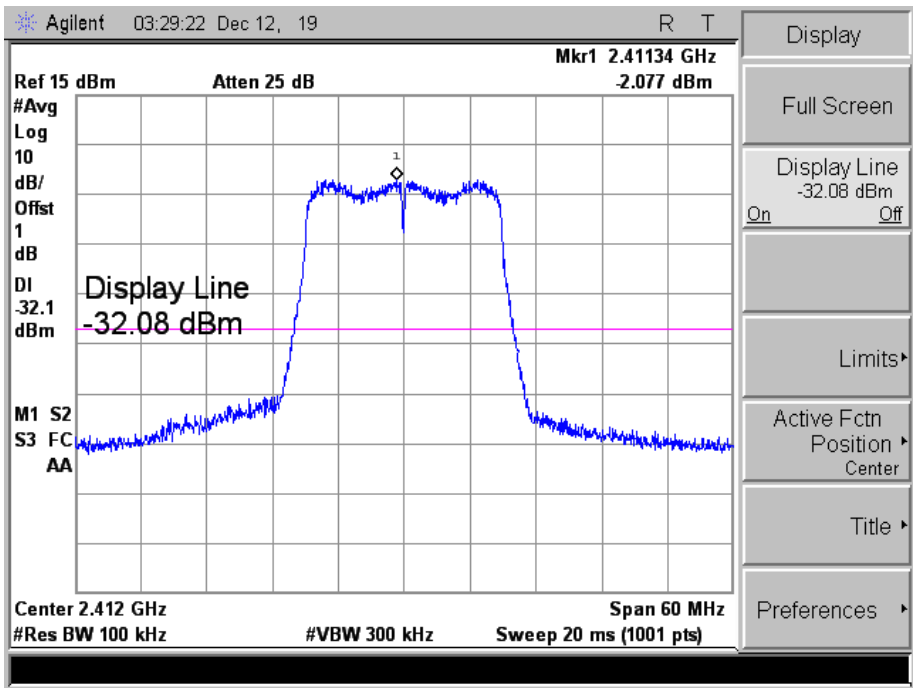
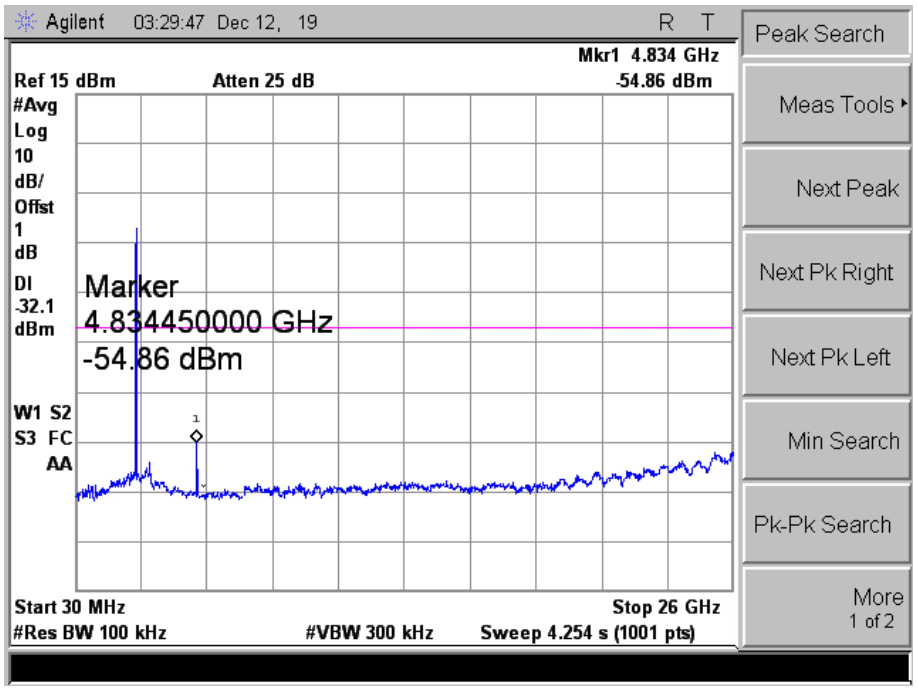
802.11b_11Mbps	
Middle	 

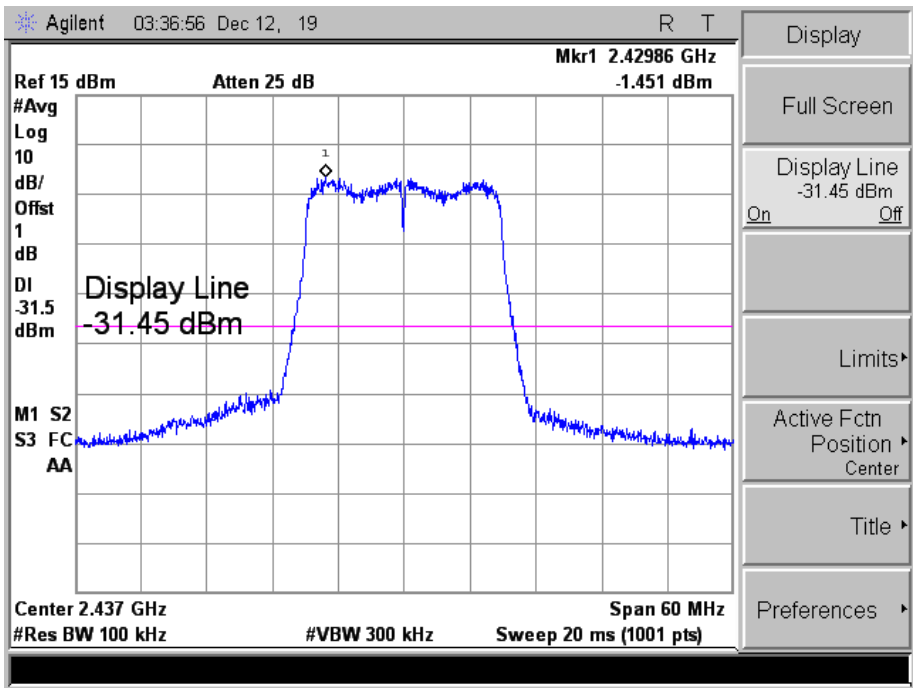
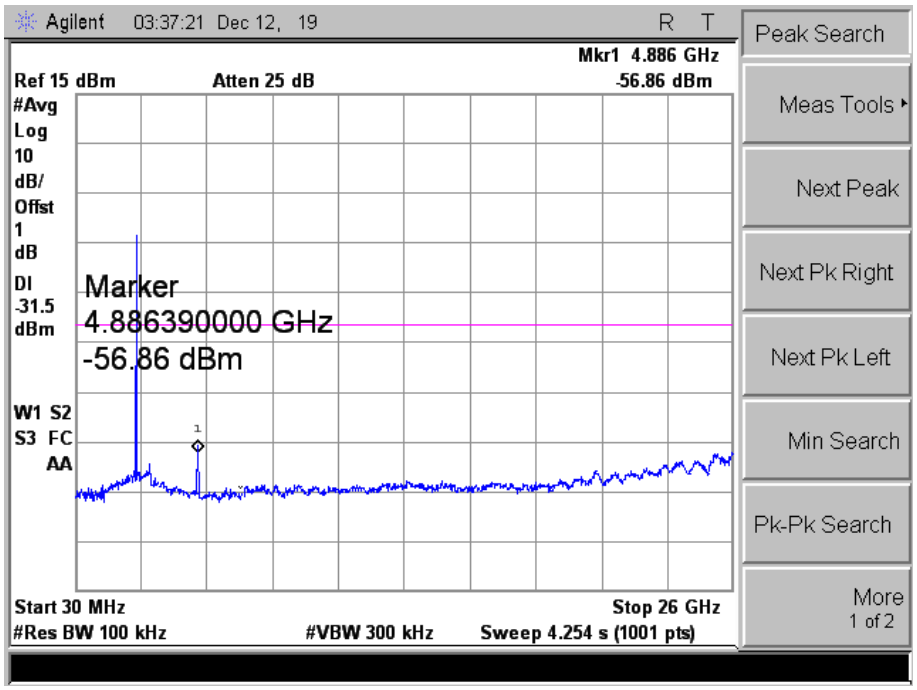
802.11b_11Mbps	
High	 

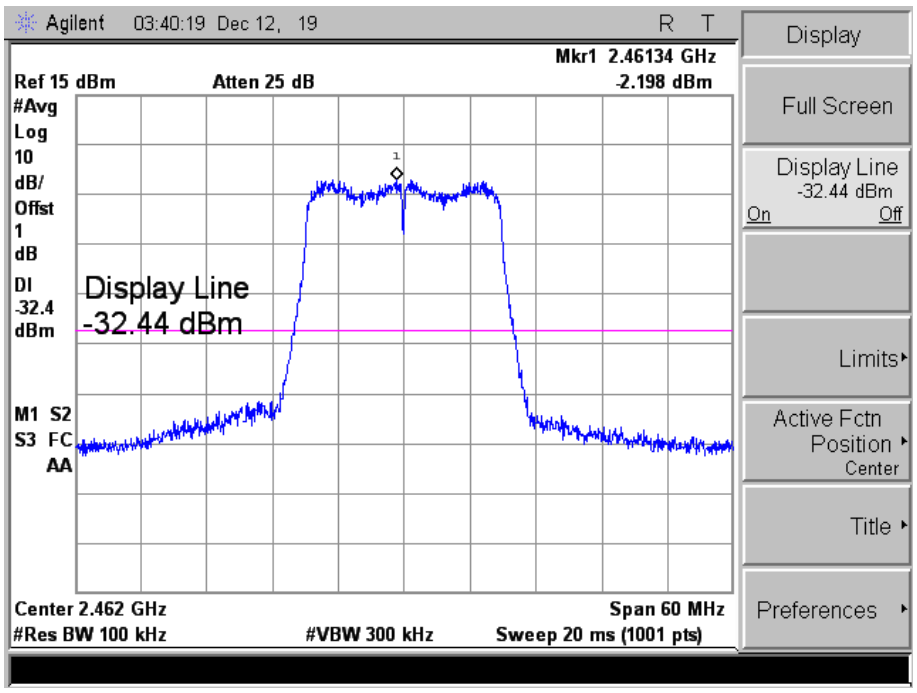
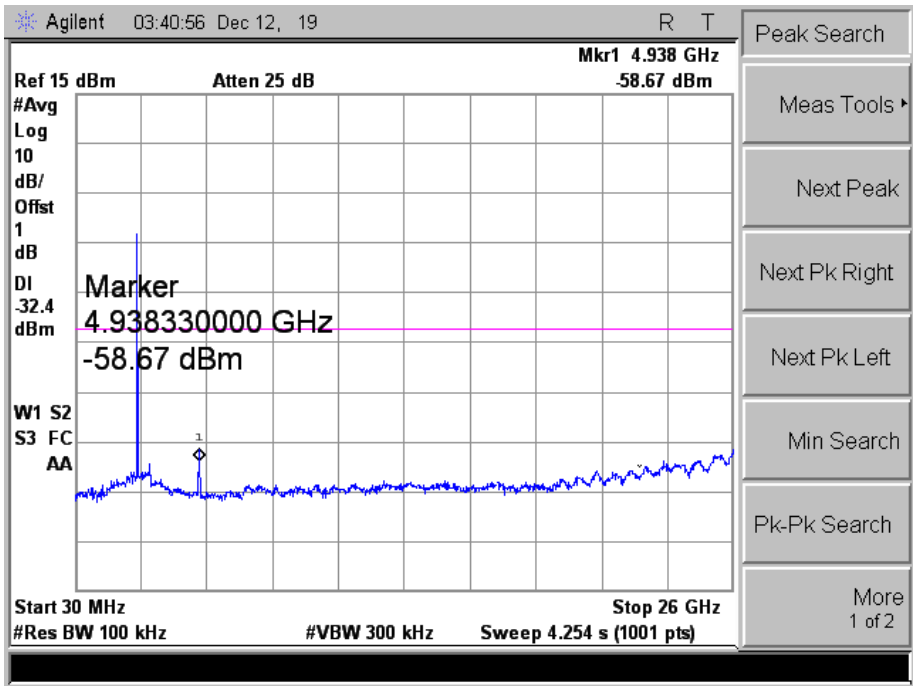
802.11g_54Mbps	
Low	 

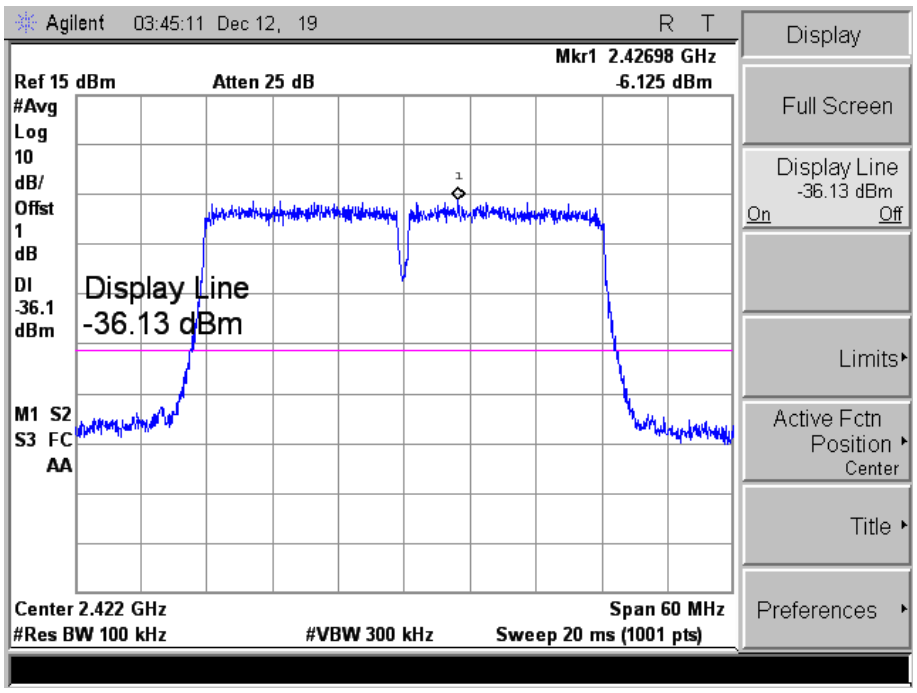
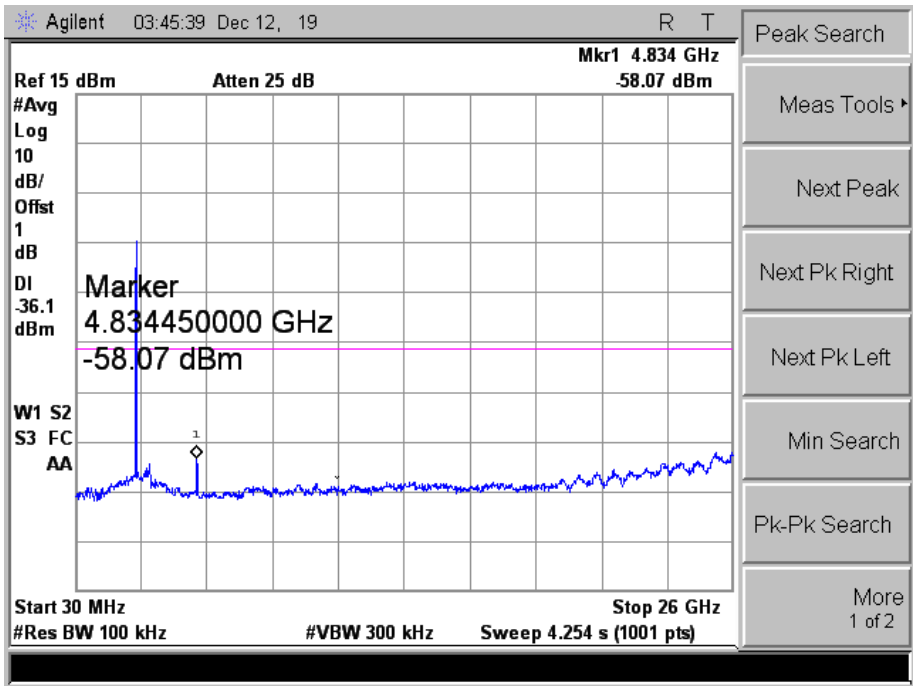
802.11g_54Mbps	
Middle	 

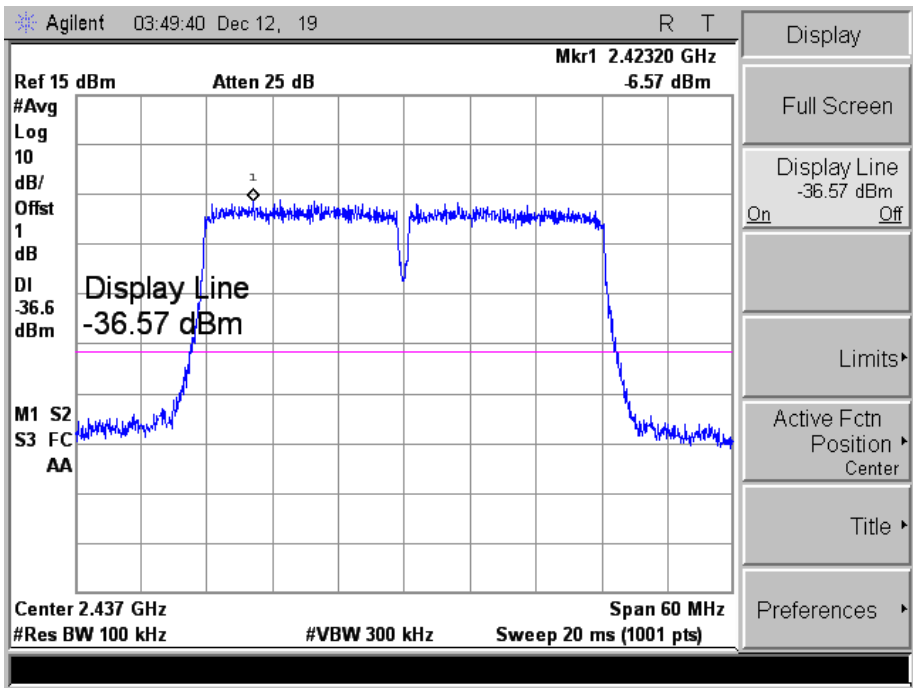
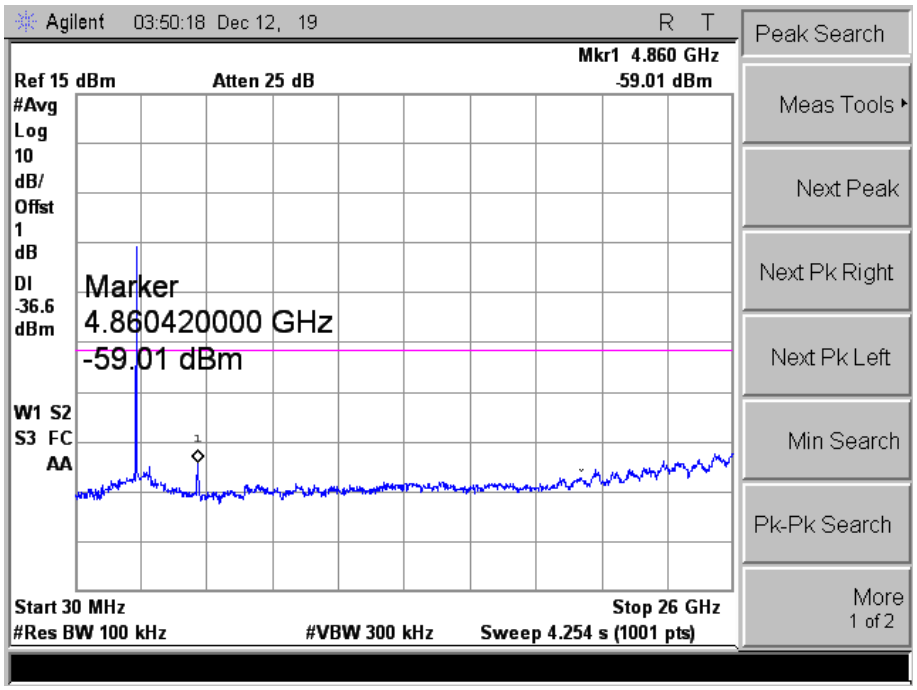
802.11g_54Mbps	
High	 

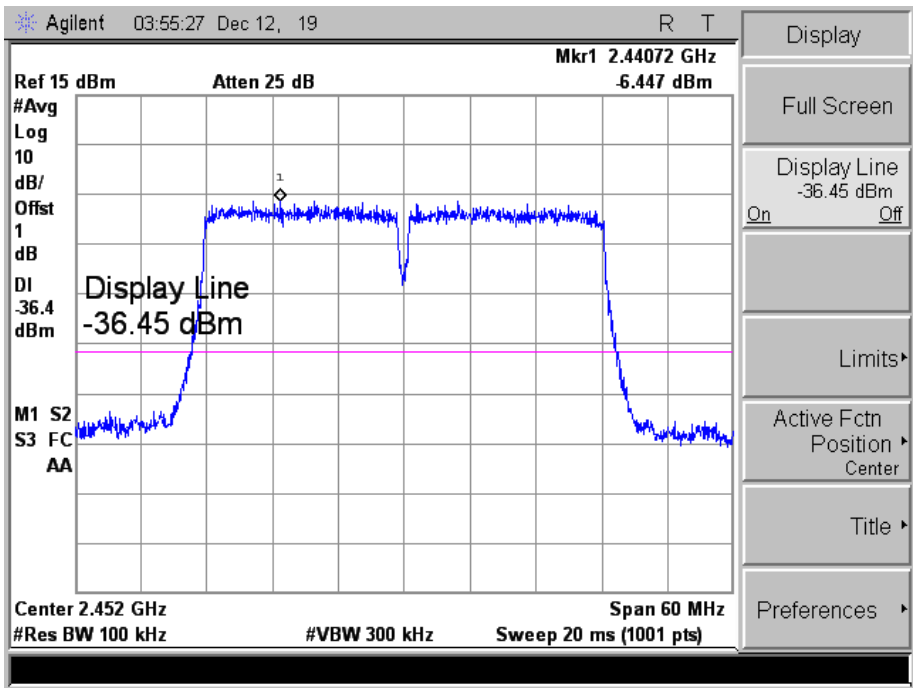
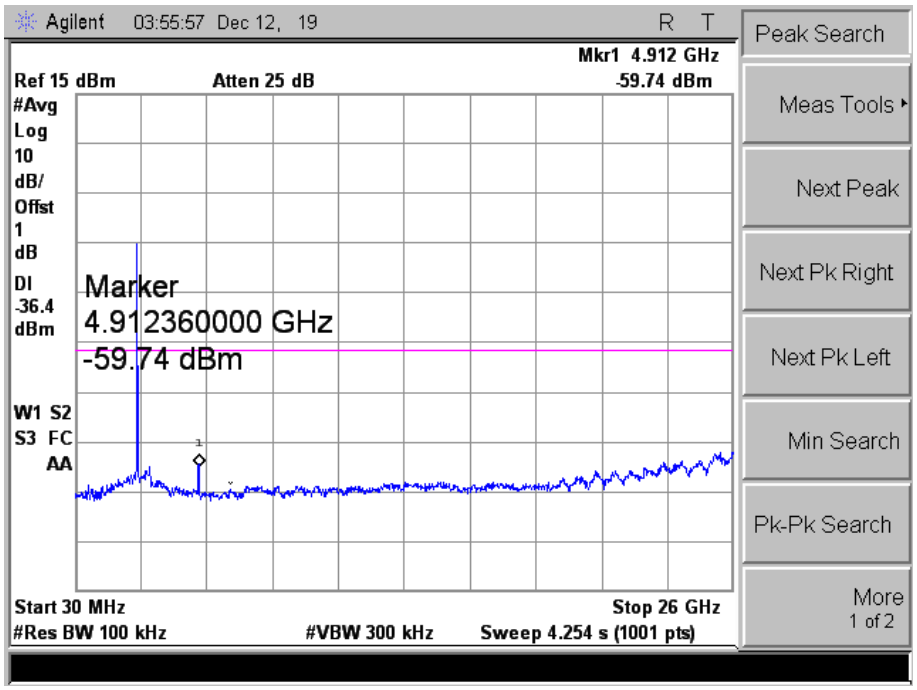
802.11n-HT20_MCS7	
Low	 

802.11n-HT20_MCS7	
Middle	 

802.11n-HT20_MCS7	
High	 

802.11n-HT40_MCS7	
Low	 

802.11n-HT40_MCS7	
Middle	 

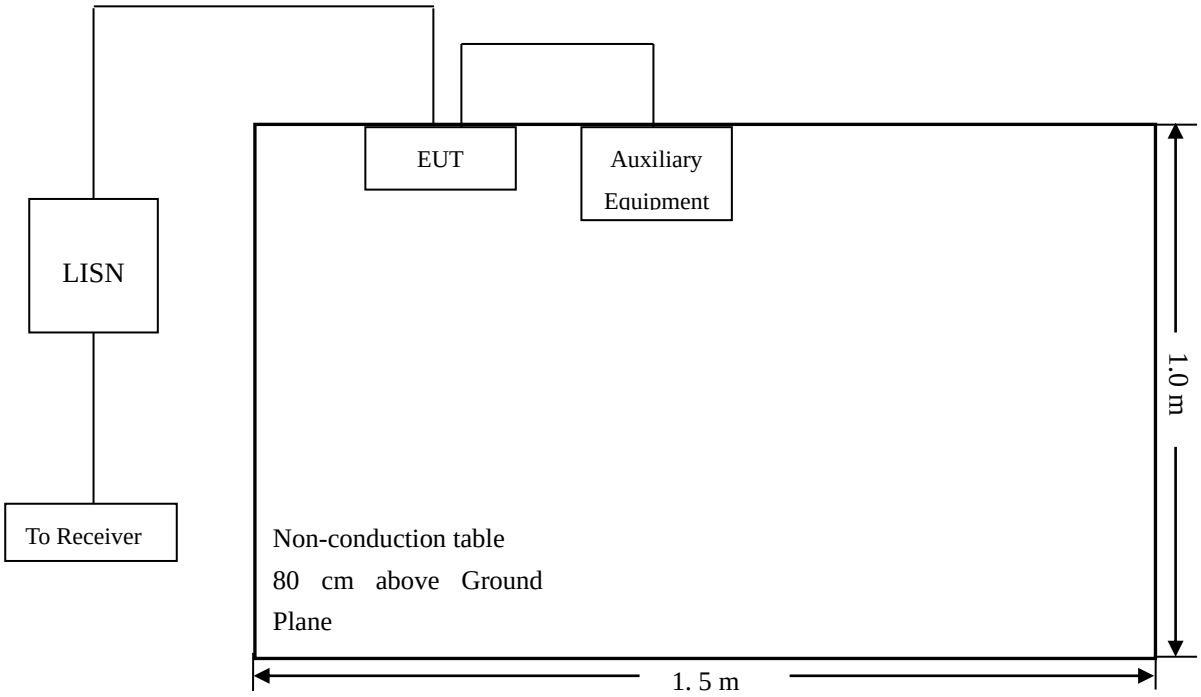
802.11n-HT40_MCS7	
High	 

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 40 cm long in the middle.
The spacing between the peripherals was 10 cm.

10.2 Basic Test Setup Block Diagram



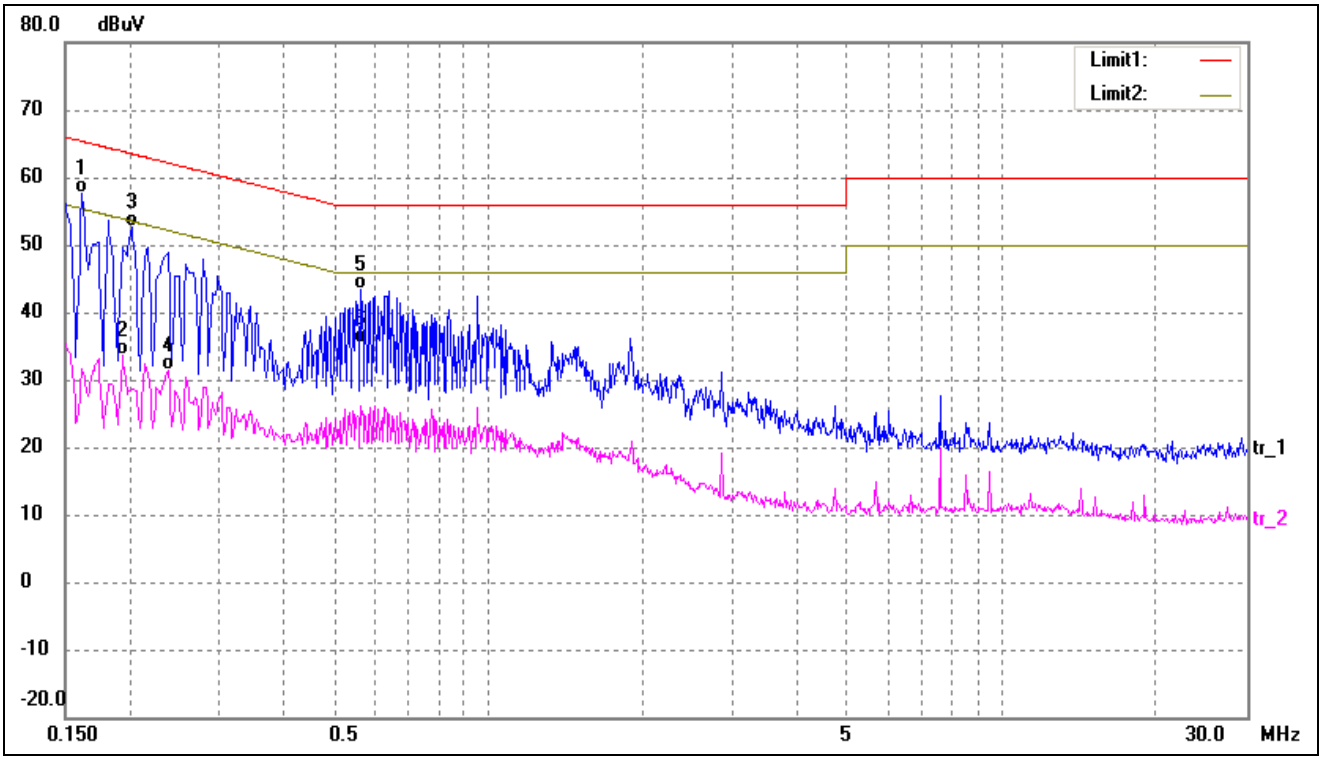
10.3 Test Receiver Setup

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

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

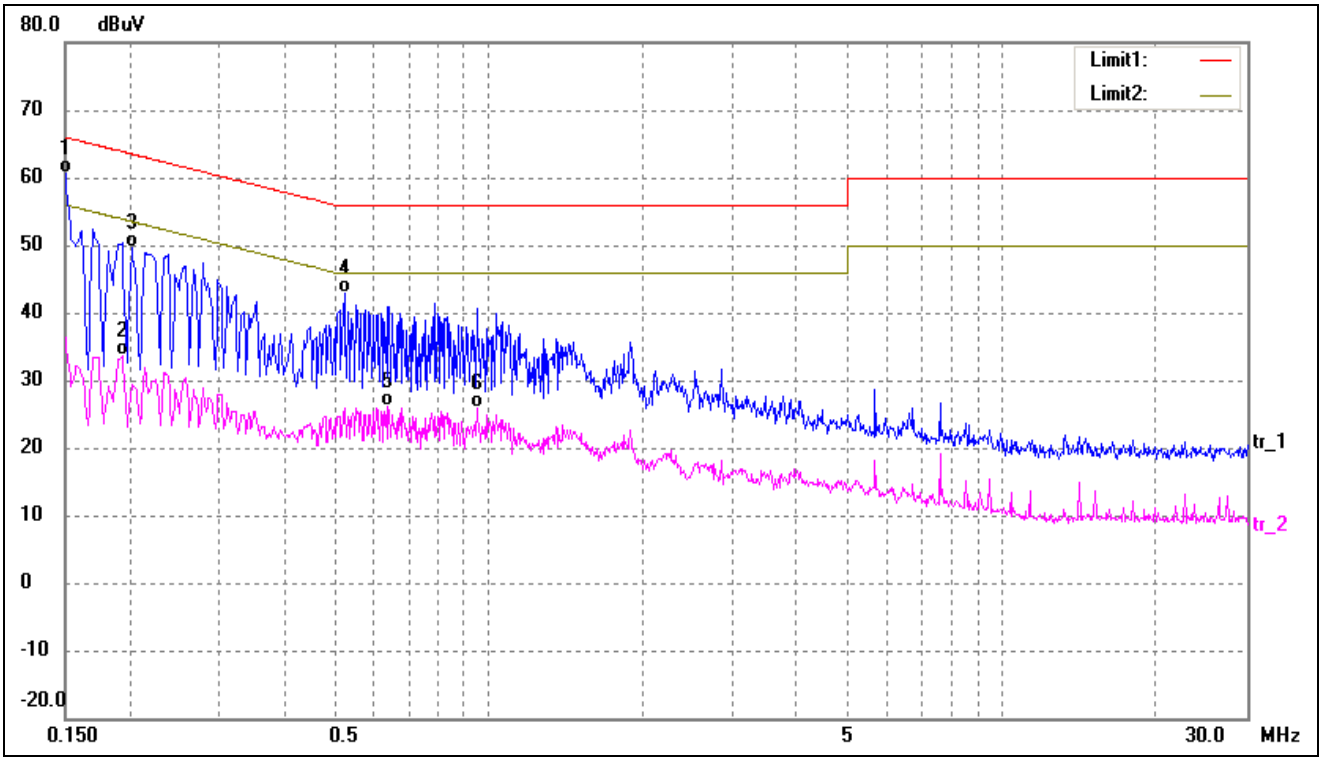
10.4 Summary of Test Results/Plots

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1*	0.1620	47.75	9.95	57.70	65.36	-7.66	QP
2	0.1940	23.56	9.97	33.53	53.86	-20.33	AVG
3	0.2020	42.67	9.97	52.64	63.52	-10.88	QP
4	0.2380	21.41	10.00	31.41	52.16	-20.75	AVG
5	0.5660	33.22	10.04	43.26	56.00	-12.74	QP
6	0.5660	25.34	10.04	35.38	46.00	-10.62	AVG

Test Mode	Communication	AC120V 60Hz	Polarity:	Line



No.	Frequency	Reading	Correct	Result	Limit	Margin	Detector
	(MHz)	(dBuV)	(dB/m)	(dBuV)	(dBuV)	(dB)	
1*	0.1500	50.62	9.95	60.57	65.99	-5.42	QP
2	0.1940	23.61	9.97	33.58	53.86	-20.28	AVG
3	0.2020	39.70	9.97	49.67	63.52	-13.85	QP
4	0.5260	32.88	10.03	42.91	56.00	-13.09	QP
5	0.6380	16.02	10.05	26.07	46.00	-19.93	AVG
6	0.9500	15.62	10.31	25.93	46.00	-20.07	AVG

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