

FCC Part 15C Measurement and Test Report

For

LM Technologies Ltd.

Unit 19, Spectrum House, 32-34, Gordon House Road, London, NW5 1LP,

United Kingdom

FCC ID: VVXLM823

FCC Rule(s):	<u>FCC Part 15C</u>
Product Description:	LM823 Wi-Fi SMT Module 802.11n IPEX_EUS_-20c
Tested Model:	<u>LM823</u>
Report No.:	<u>STR17078231I-1</u>
Tested Date:	<u>2017-06-12 to 2017-10-18</u>
Issued Date:	<u>2017-10-20</u>
Tested By:	<u>Mike Shi / Engineer</u> <i>Mike Shi</i>
Reviewed By:	<u>Silin Chen / EMC Manager</u> <i>Silin Chen</i>
Approved & Authorized By:	<u>Jandy So / PSQ Manager</u> <i>Jandy So</i>
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

Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen SEM.Test Technology Co., Ltd.

TABLE OF CONTENTS

1. GENERAL INFORMATION.....	3
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	3
1.2 TEST STANDARDS.....	4
1.3 TEST METHODOLOGY.....	4
1.4 TEST FACILITY.....	4
1.5 EUT SETUP AND TEST MODE.....	5
1.6 MEASUREMENT UNCERTAINTY.....	5
1.7 TEST EQUIPMENT LIST AND DETAILS.....	6
2. SUMMARY OF TEST RESULTS.....	7
3. RF EXPOSURE.....	8
3.1 STANDARD APPLICABLE.....	8
3.2 TEST RESULT.....	8
4. ANTENNA REQUIREMENT.....	9
4.1 STANDARD APPLICABLE.....	9
4.2 EVALUATION INFORMATION.....	9
5. POWER SPECTRAL DENSITY.....	10
5.1 STANDARD APPLICABLE.....	10
5.2 TEST PROCEDURE.....	10
5.3 ENVIRONMENTAL CONDITIONS.....	10
5.4 SUMMARY OF TEST RESULTS/PLOTS.....	11
6. 6DB BANDWIDTH.....	18
6.1 STANDARD APPLICABLE.....	18
6.2 TEST PROCEDURE.....	18
6.3 ENVIRONMENTAL CONDITIONS.....	18
6.4 SUMMARY OF TEST RESULTS/PLOTS.....	18
7. RF OUTPUT POWER.....	25
7.1 STANDARD APPLICABLE.....	25
7.2 TEST PROCEDURE.....	25
7.3 ENVIRONMENTAL CONDITIONS.....	25
7.4 SUMMARY OF TEST RESULTS/PLOTS.....	26
8. FIELD STRENGTH OF SPURIOUS EMISSIONS.....	33
8.1 STANDARD APPLICABLE.....	33
8.2 TEST PROCEDURE.....	33
8.3 CORRECTED AMPLITUDE & MARGIN CALCULATION.....	34
8.4 ENVIRONMENTAL CONDITIONS.....	34
8.5 SUMMARY OF TEST RESULTS/PLOTS.....	35
9. OUT OF BAND EMISSIONS.....	42
9.1 STANDARD APPLICABLE.....	42
9.2 TEST PROCEDURE.....	42
9.3 ENVIRONMENTAL CONDITIONS.....	43
9.4 SUMMARY OF TEST RESULTS/PLOTS.....	43
10. CONDUCTED EMISSIONS.....	63
10.1 TEST PROCEDURE.....	63
10.2 BASIC TEST SETUP BLOCK DIAGRAM.....	63
10.3 ENVIRONMENTAL CONDITIONS.....	63
10.4 TEST RECEIVER SETUP.....	64
10.5 SUMMARY OF TEST RESULTS/PLOTS.....	64
10.6 CONDUCTED EMISSIONS TEST DATA.....	64

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: LM Technologies Ltd.
Address of applicant: Unit 19, Spectrum House, 32-34, Gordon House Road, London, NW5 1LP, United Kingdom

Manufacturer: LM Technologies Ltd.
Address of manufacturer: Unit 19, Spectrum House, 32-34, Gordon House Road, London, NW5 1LP, United Kingdom

General Description of EUT	
Product Name:	LM823 Wi-Fi SMT Module 802.11n IPEX_EUS_-20c
Trade Name:	LM Technologies
Model No.:	LM823
Adding Model(s):	LM823-1463, LM823-1464, LM823-1465, LM823-1466, LM823-1468
Rated Voltage:	DC 3.3V and DC 5.0V
Power Adapter Model:	/
<i>Note: The test data is gathered from a production sample provided by the manufacturer. The appearance of others models listed in the report is different from main-test model LM822, but the circuit and the electronic construction do not change, only one Resister swap pad, to change 3.3V or 5.0V with the different rated voltage, declared by the manufacturer.</i>	

Technical Characteristics of EUT	
Support Standards:	802.11b, 802.11g, 802.11n
Frequency Range:	2412-2462MHz
RF Output Power:	14.87dBm (Conducted)
Type of Modulation:	CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM
Data Rate:	1-11Mbps, 6-54Mbps, up to 150Mbps
Quantity of Channels:	11
Channel Separation:	5MHz
Type of Antenna:	External Antenna
Antenna Gain:	2.0dBi
Lowest Internal Frequency	40MHz

1.2 Test Standards

The following report is prepared on behalf of the LM Technologies Ltd. in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

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, American National Standard for Testing Unlicensed Wireless Devices, and ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. The measurement guide KDB 558074 D01 v04 for digital transmission systems shall be performed also.

1.4 Test Facility

FCC – Registration No.: 125990

Shenzhen SEM Test Technology Co., Ltd. Laboratory has been recognized to perform compliance testing on equipment subject to the Commissions Declaration Of Conformity (DOC). The Designation Number is CN5010, and Test Firm Registration Number is 125990.

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, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	802.11b	2412MHz, 2437MHz, 2462MHz
TM2	802.11g	2412MHz, 2437MHz, 2462MHz
TM3	802.11n-HT20	2412MHz, 2437MHz, 2462MHz
TM4	802.11n-HT40	2422MHz, 2437MHz, 2452MHz
Note: All test modes (different data rate and different modulation) are performed, but only the worst case is recorded in this report.		

Accessories Equipment List and Details			
Description	Manufacturer	Model No.	Serial Number
Computer	Lenovo	ThinkPad Edge E445	
Accessories Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With Core/Without Core
RF Cable	0.1	Shielded	Without Ferrite
EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With Core/Without Core
/	/	/	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	$\pm 0.42\text{dB}$
Occupied Bandwidth	Conducted	$\pm 1.5\%$
Power Spectral Density	Conducted	$\pm 1.8\text{dB}$
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$
Conducted Emissions	Conducted	$\pm 2.88\text{dB}$
Transmitter Spurious Emissions	Radiated	$\pm 5.1\text{dB}$

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2017-06-12	2018-06-11
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2017-06-12	2018-06-11
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2017-06-12	2018-06-11
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2017-06-12	2018-06-11
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2017-06-12	2018-06-11
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2017-06-08	2018-06-07
SEMT-1042	Horn Antenna	ETS	3117	00086197	2017-06-08	2018-06-07
SEMT-1121	Horn Antenna	Schwarz beck	BBHA 9170	BBHA9170582	2017-06-08	2018-06-07
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2017-06-08	2018-06-07
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2017-06-12	2018-06-11
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2017-06-12	2018-06-11
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2017-06-12	2018-06-11
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2017-08-15	2018-08-14
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2017-08-15	2018-08-14
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2017-06-12	2018-06-11
SEMT-1170	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2017-03-09	2018-03-08

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)	6 dB 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 § 2.1093, the portable 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 an integral antenna, fulfill the requirement of this section.

5. Power Spectral Density

5.1 Standard Applicable

According to 15.247(e), 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 v04, 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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set VBW $\geq 3 \times \text{RBW}$.
- e) Detector = power averaging (RMS) or sample detector (when RMS not available).
- f) Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span/RBW}$.
- 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 Environmental Conditions

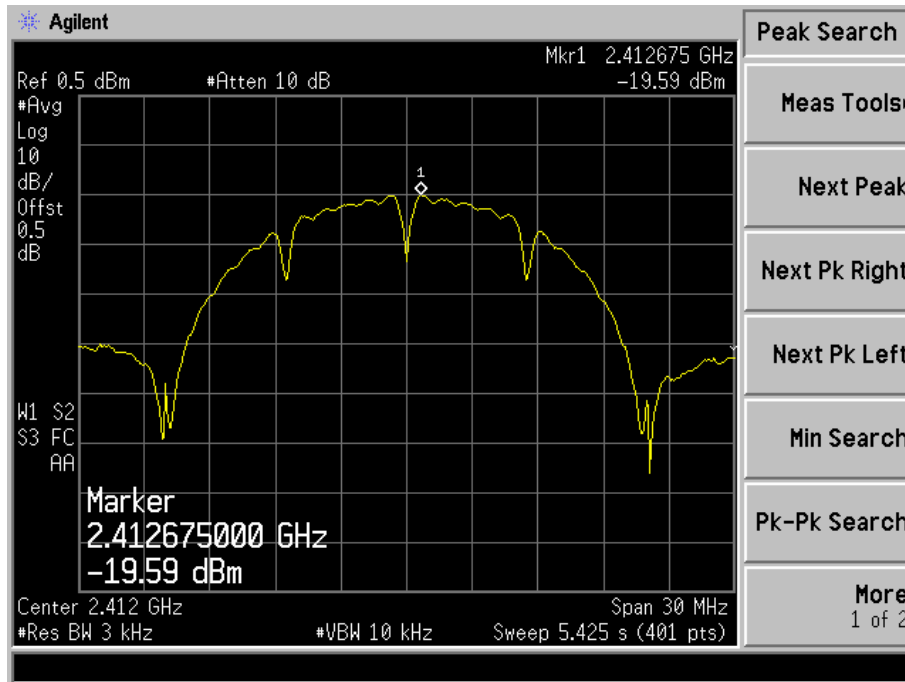
Temperature:	26 C
Relative Humidity:	54
ATM Pressure:	1011 mbar

5.4 Summary of Test Results/Plots

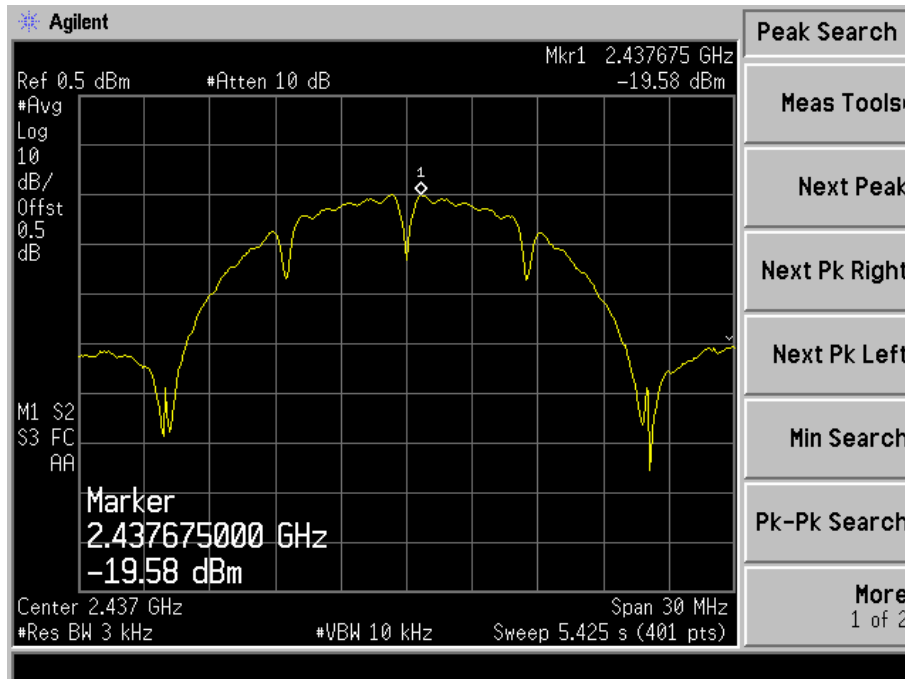
Test Mode	Test Channel MHz	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
802.11b	2412	-19.59	8
	2437	-19.58	8
	2462	-20.35	8
802.11g	2412	-21.48	8
	2437	-21.63	8
	2462	-21.78	8
802.11n HT20	2412	-22.38	8
	2437	-22.42	8
	2462	-22.64	8
802.11n HT40	2422	-25.13	8
	2437	-25.19	8
	2452	-25.42	8

Please refer to the following test plots:

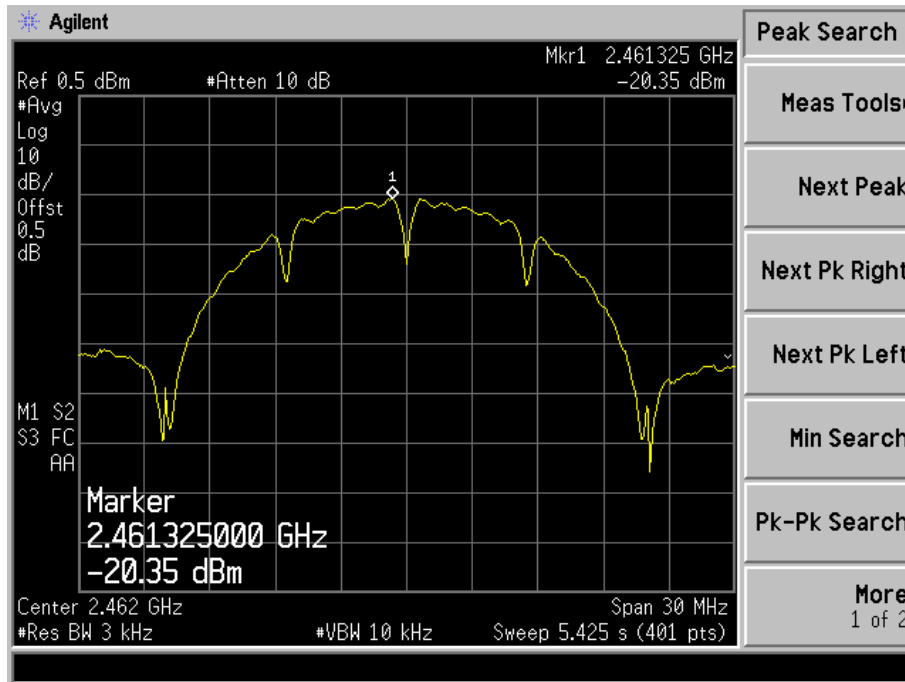
802.11b-Low Channel



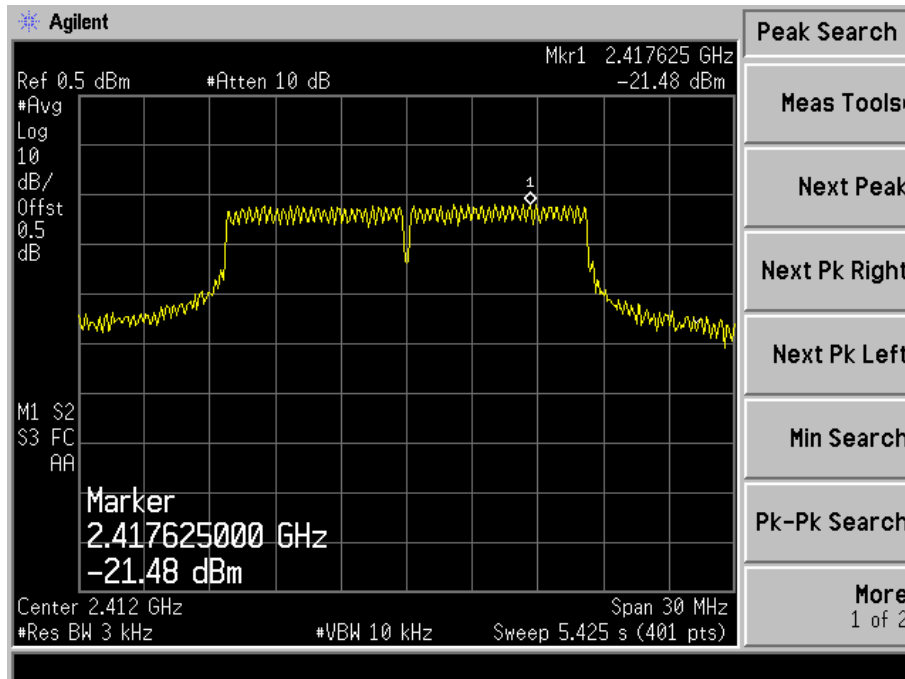
802.11b-Middle Channel



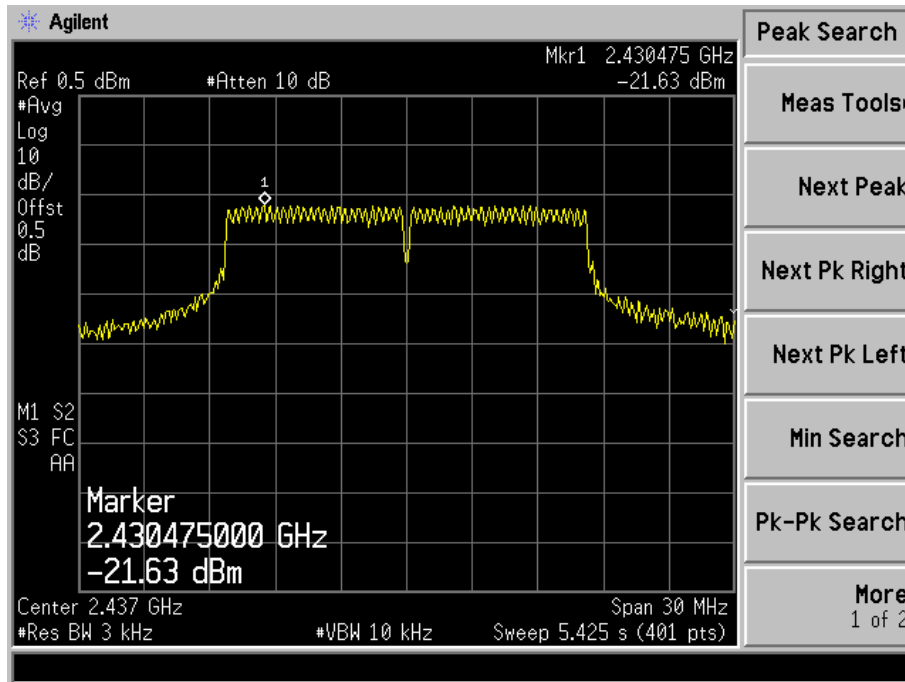
802.11b-High Channel



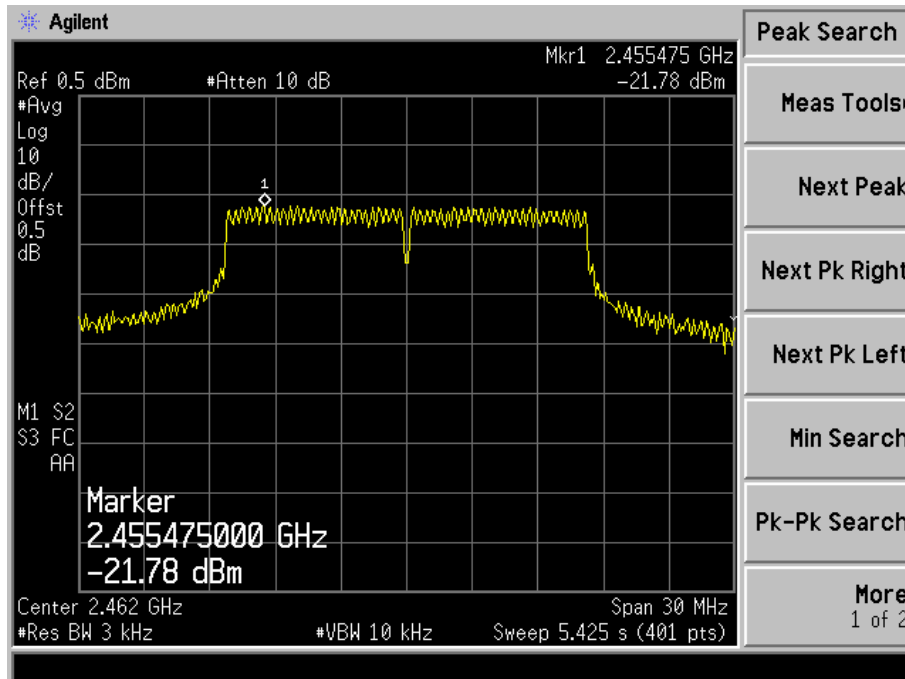
802.11g-Low Channel



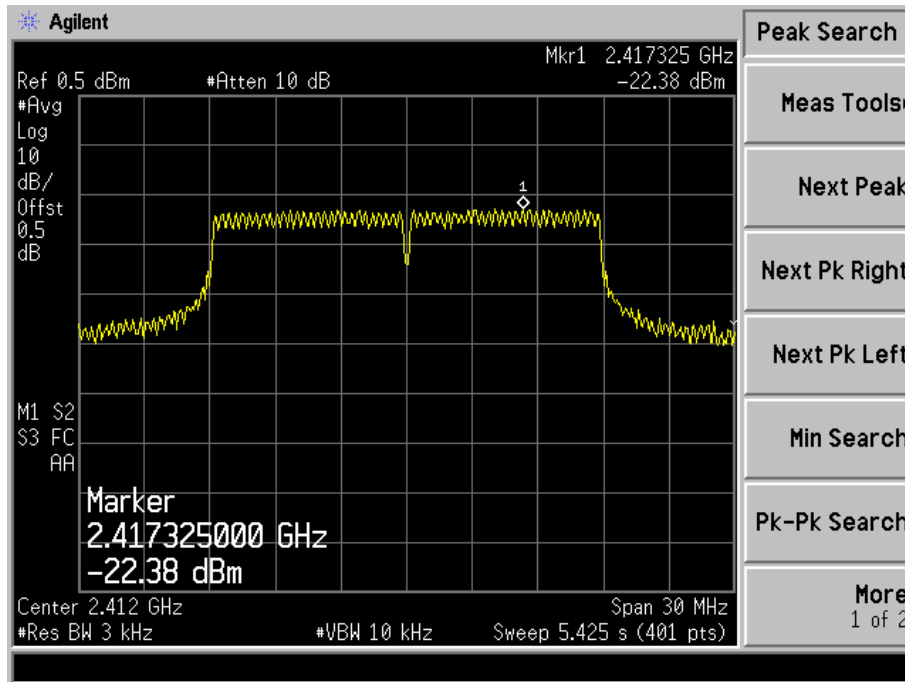
802.11g-Middle Channel



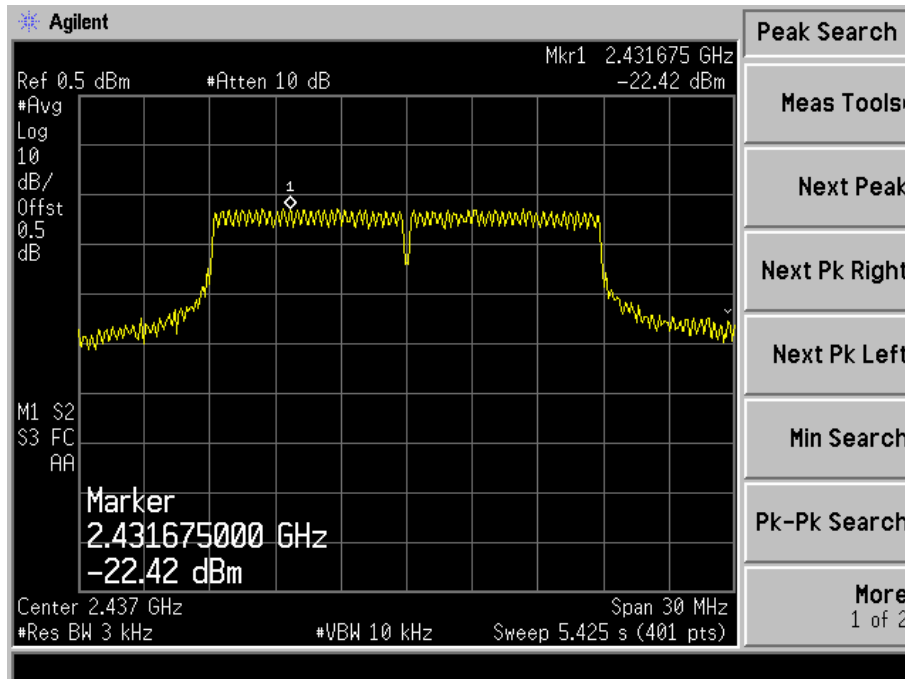
802.11g-High Channel



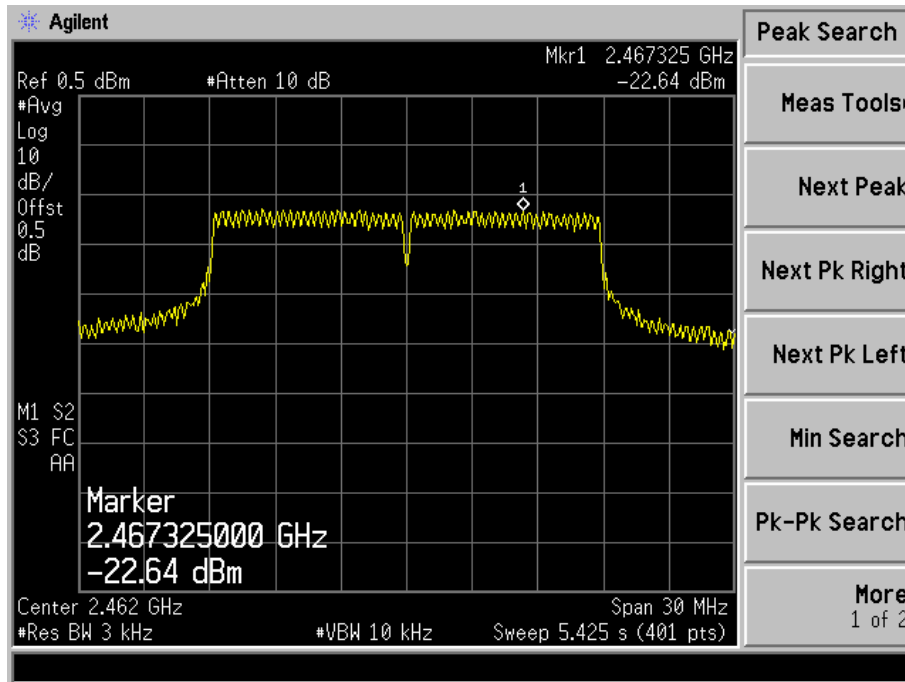
802.11n-HT20-Low Channel



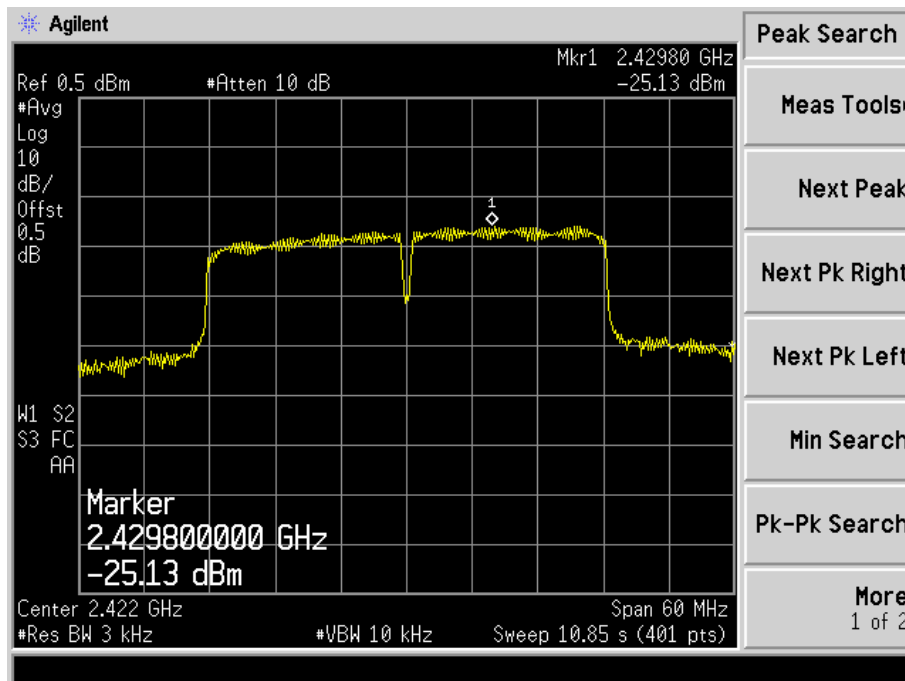
802.11n-HT20-Middle Channel



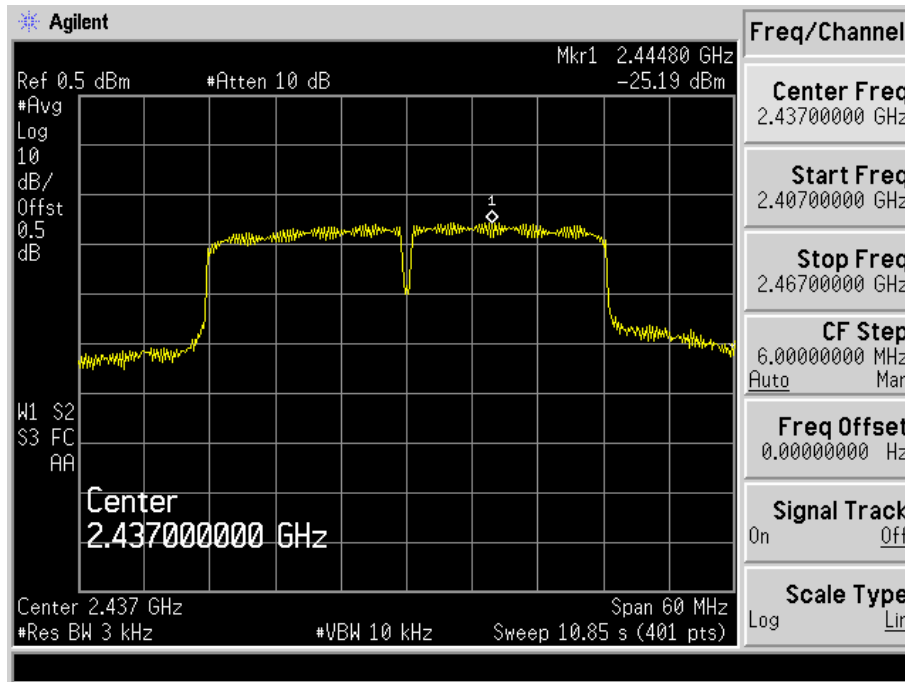
802.11n-HT20-High Channel



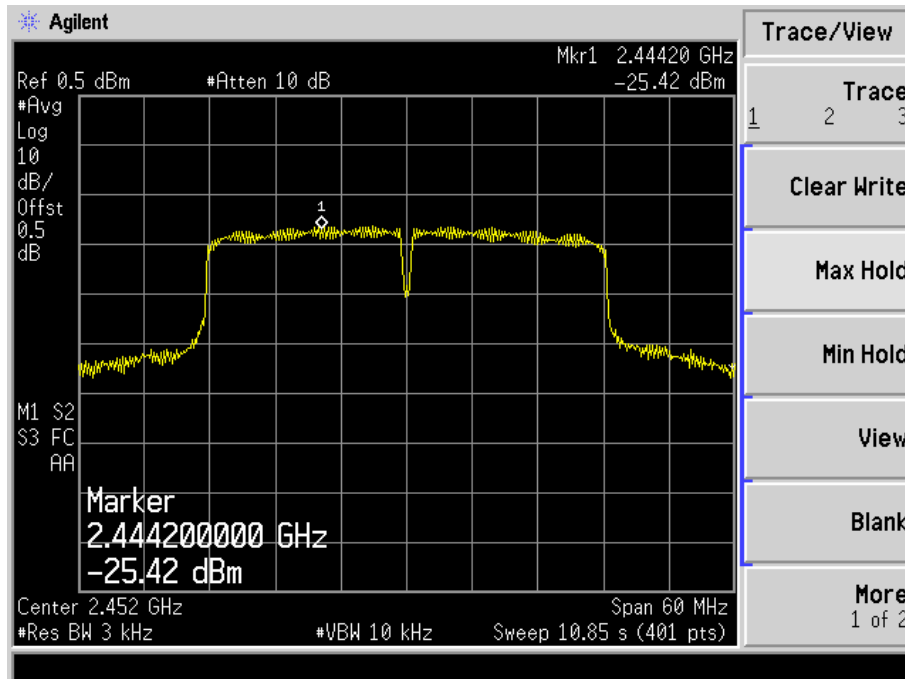
802.11n-HT40-Low Channel



802.11n-HT40-Middle Channel



802.11n-HT40-High Channel



6. 6dB 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

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- 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 Environmental Conditions

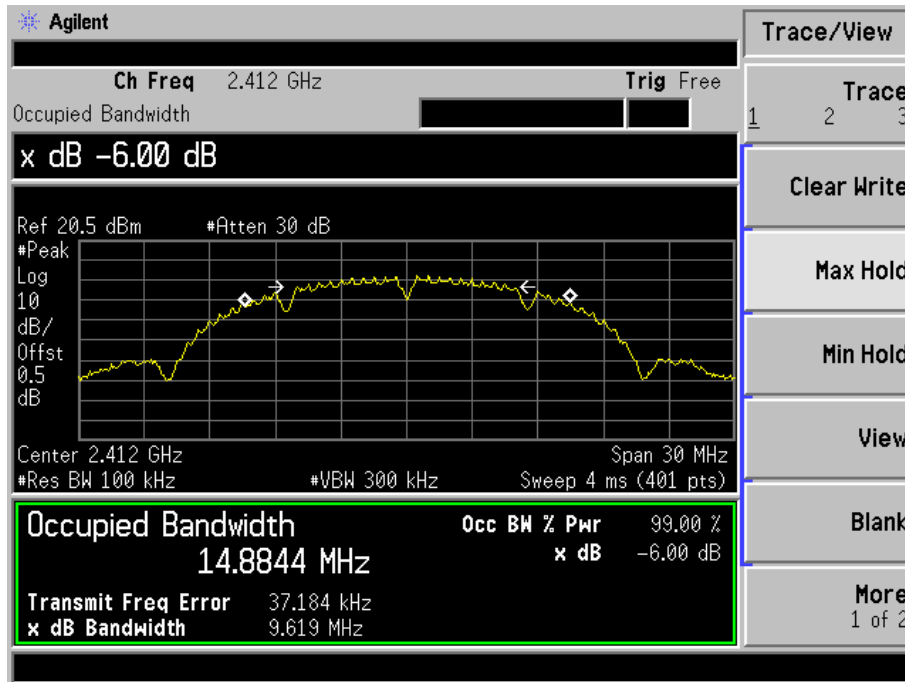
Temperature:	25 C
Relative Humidity:	53
ATM Pressure:	1018 mbar

6.4 Summary of Test Results/Plots

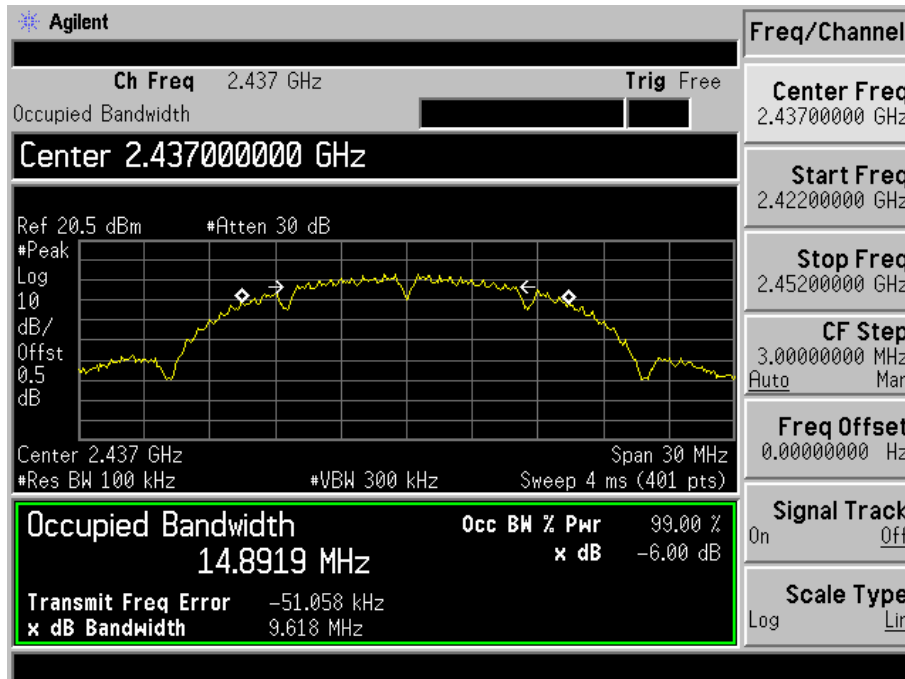
Test Mode	Test Channel MHz	6 dB Bandwidth MHz	99% Bandwidth MHz	Limit kHz
802.11b	2412	9.619	14.8844	≥ 500
	2437	9.618	14.8919	≥ 500
	2462	9.929	14.9256	≥ 500
802.11g	2412	16.515	16.4856	≥ 500
	2437	16.532	16.4878	≥ 500
	2462	16.534	16.5653	≥ 500
802.11n-HT20	2412	17.764	17.6659	≥ 500
	2437	17.819	17.6636	≥ 500
	2462	17.871	17.7668	≥ 500
802.11n-HT40	2422	36.326	35.8312	≥ 500
	2437	36.374	35.8553	≥ 500
	2452	36.451	35.9476	≥ 500

Please refer to the following test plots:

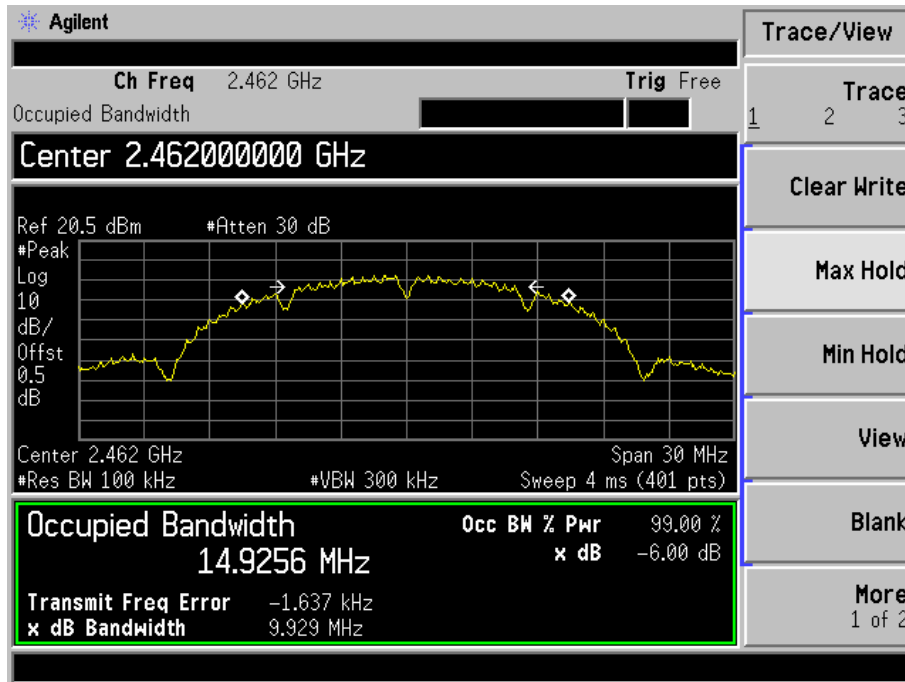
802.11b-Low Channel



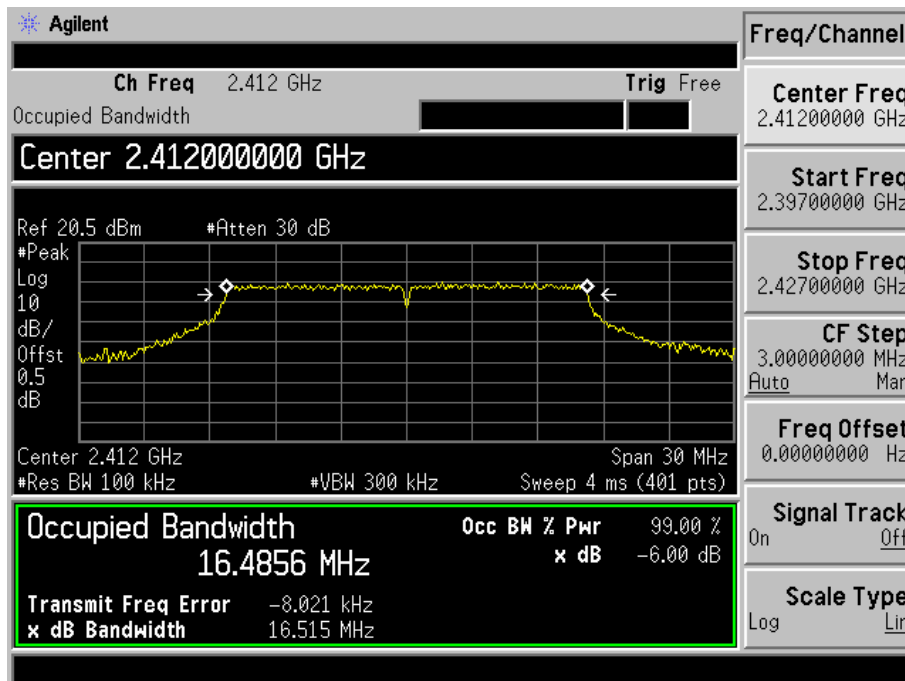
802.11b-Middle Channel



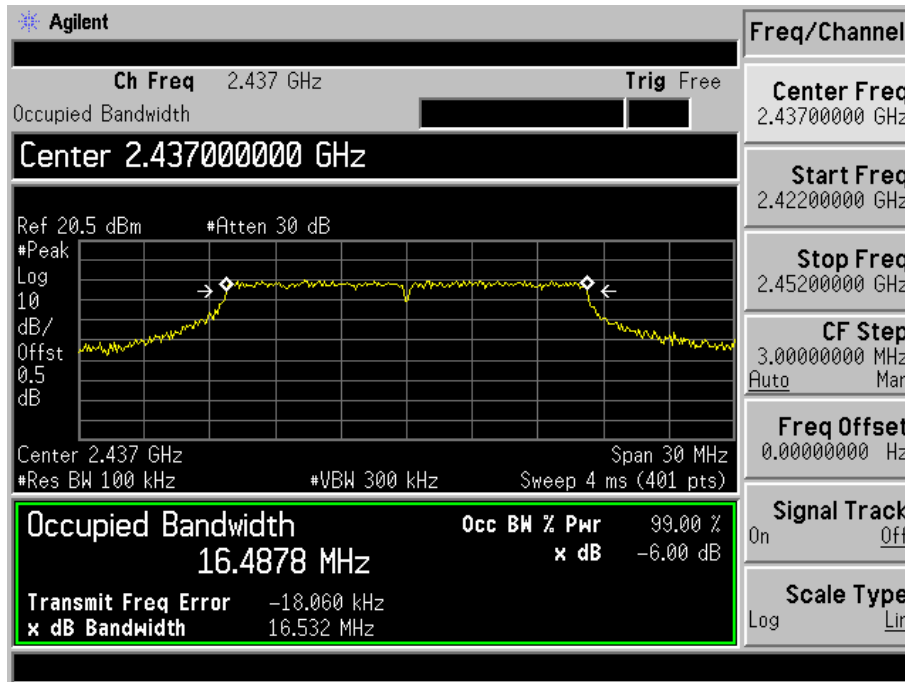
802.11b-High Channel



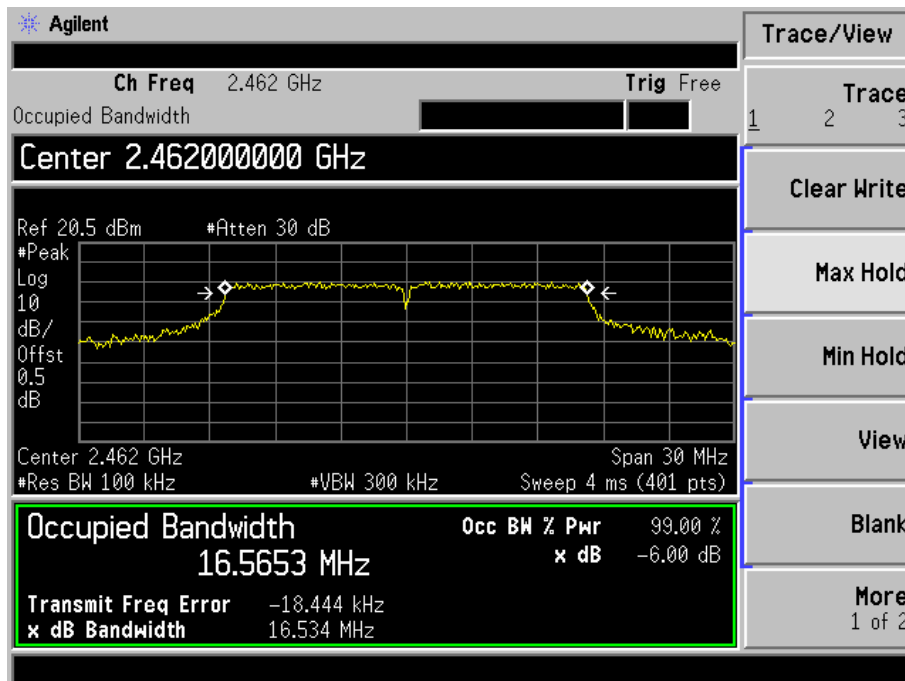
802.11g-Low Channel



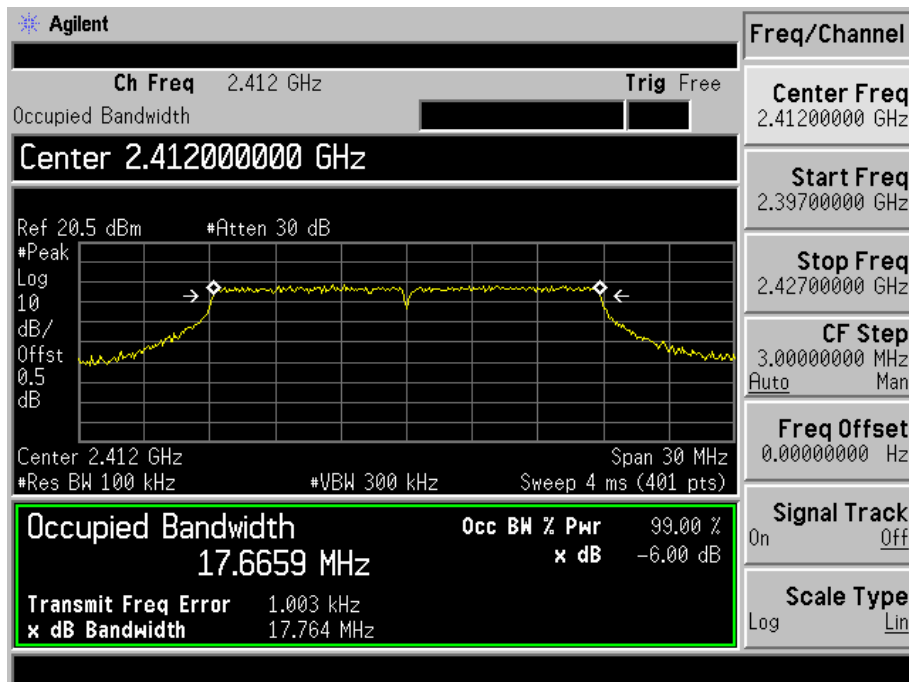
802.11g-Middle Channel



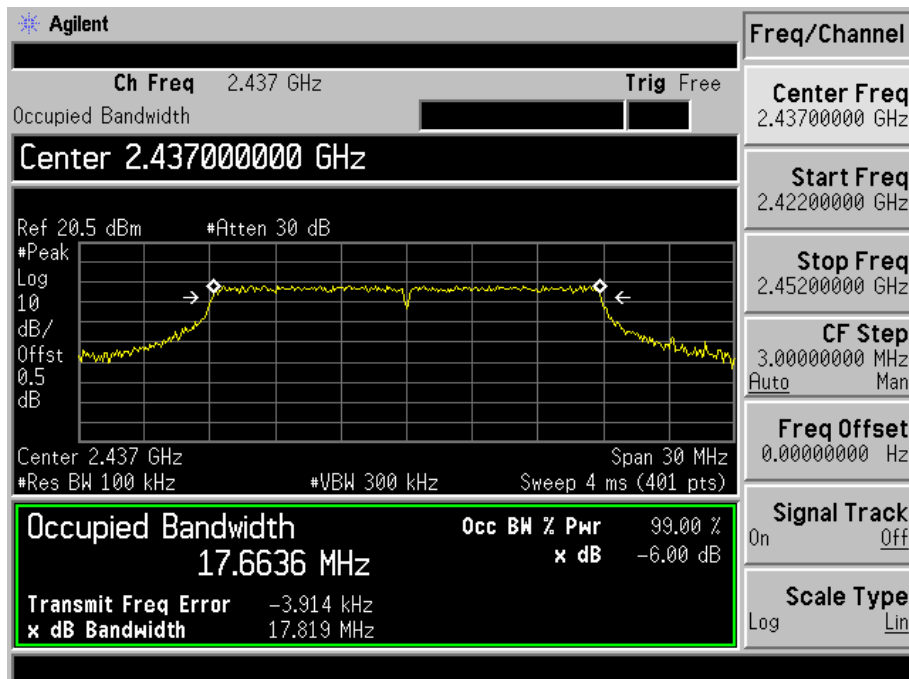
802.11g-High Channel



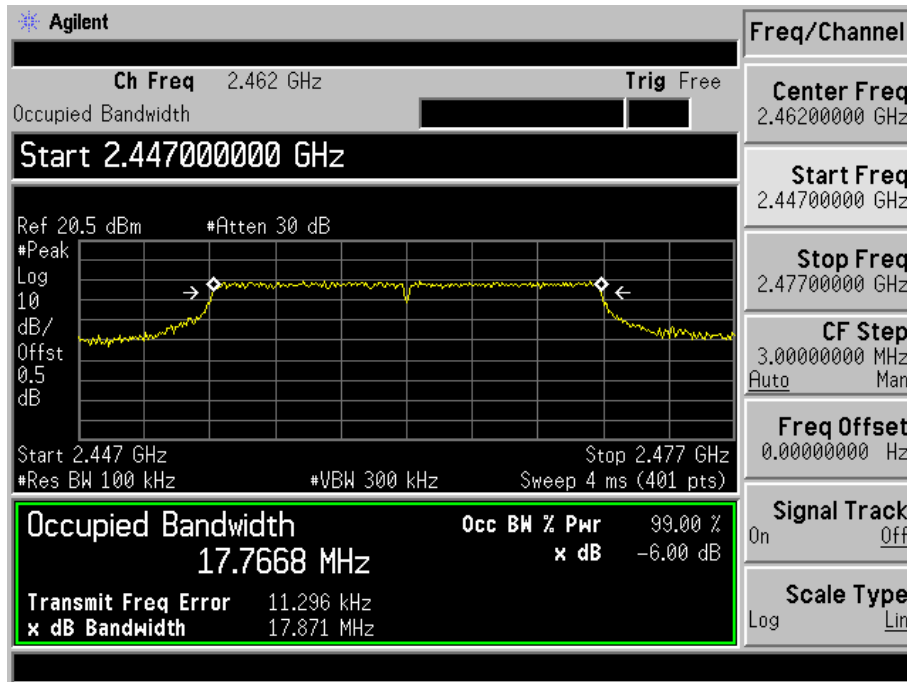
802.11n-HT20-Low Channel



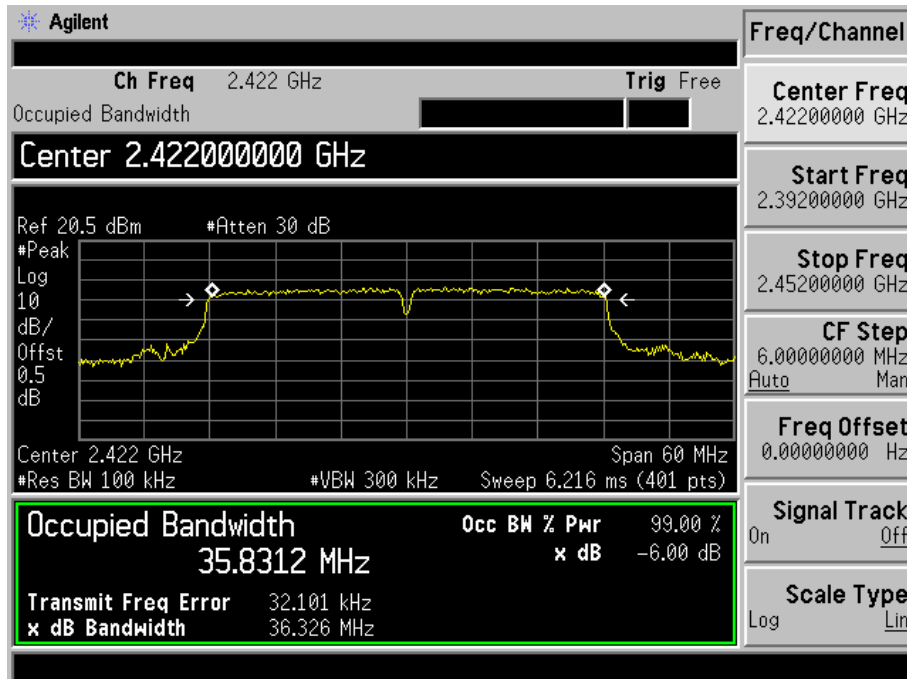
802.11n-HT20-Middle Channel



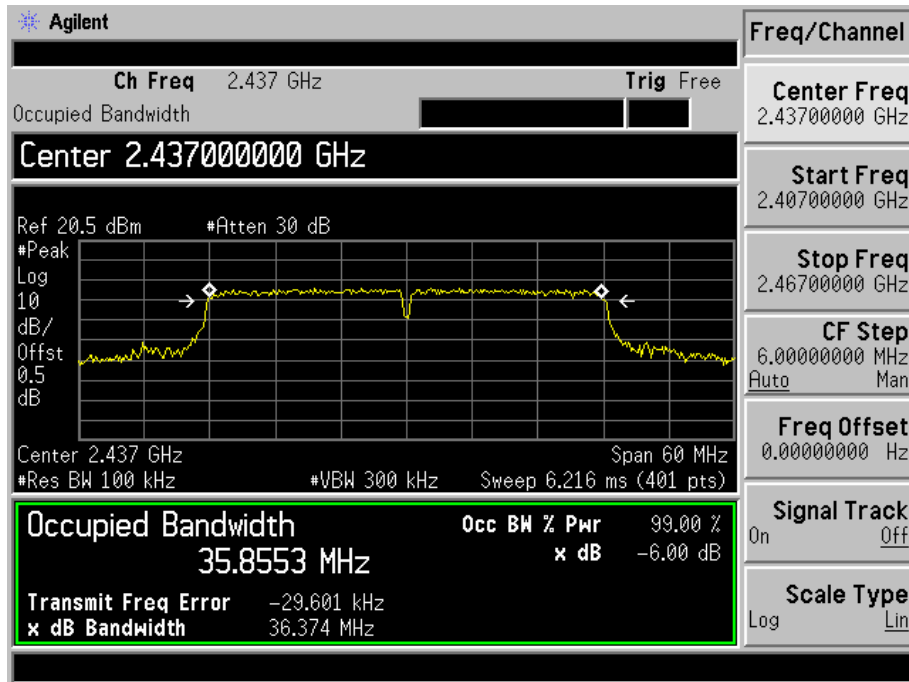
802.11n-HT20-High Channel



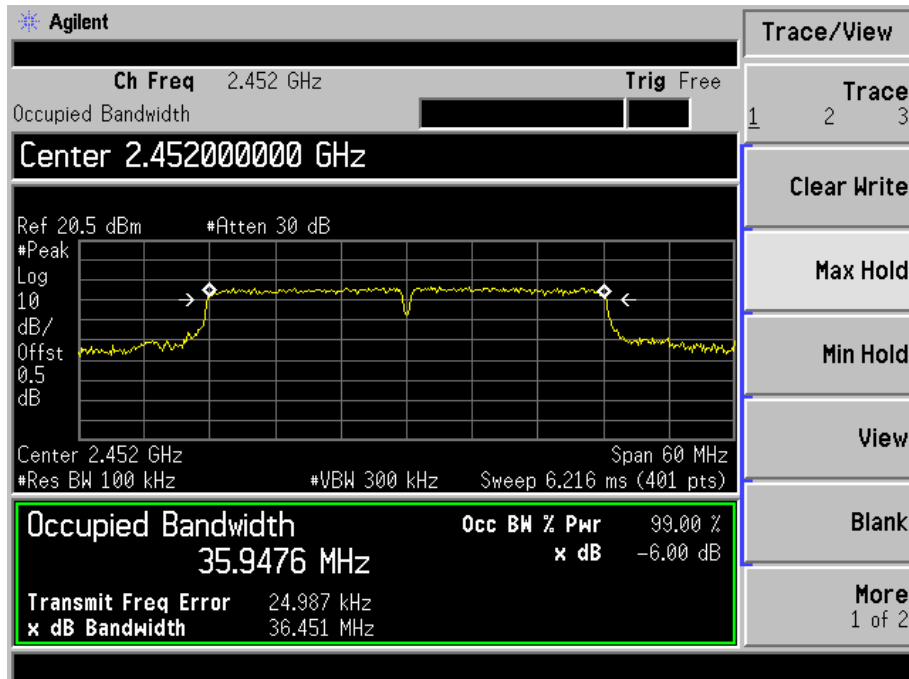
802.11n-HT40-Low Channel



802.11n-HT40-Middle Channel



802.11n-HT40-High Channel



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 v04, 9.2.2.2, 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 $\geq 3 \times$ RBW.
- d) Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$. (This gives bin-to-bin spacing $\leq \text{RBW}/2$, 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 $\geq 98\%$, 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 Environmental Conditions

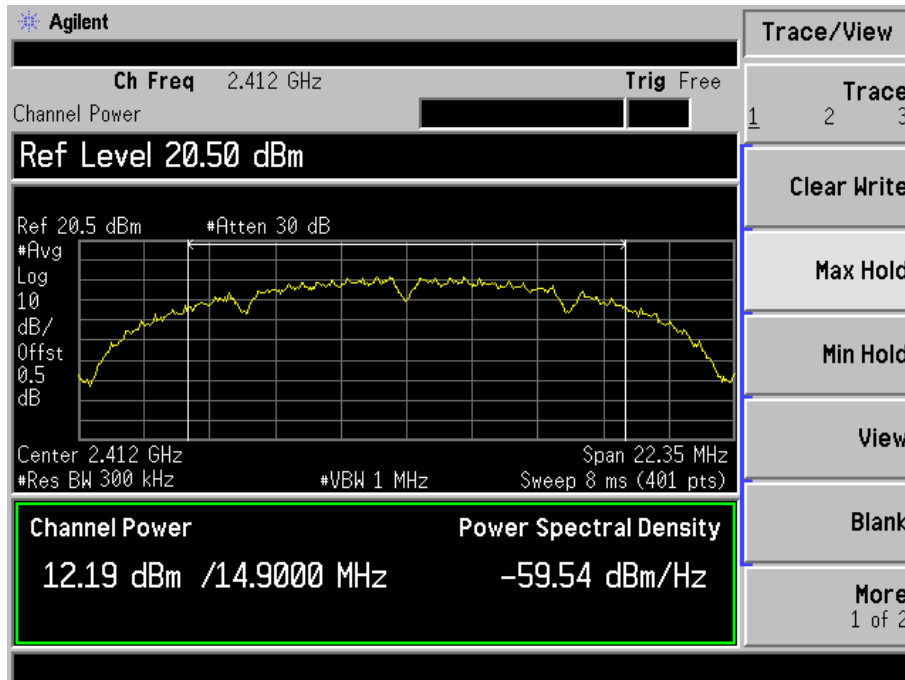
Temperature:	26 C
Relative Humidity:	57
ATM Pressure:	1011 mbar

7.4 Summary of Test Results/Plots

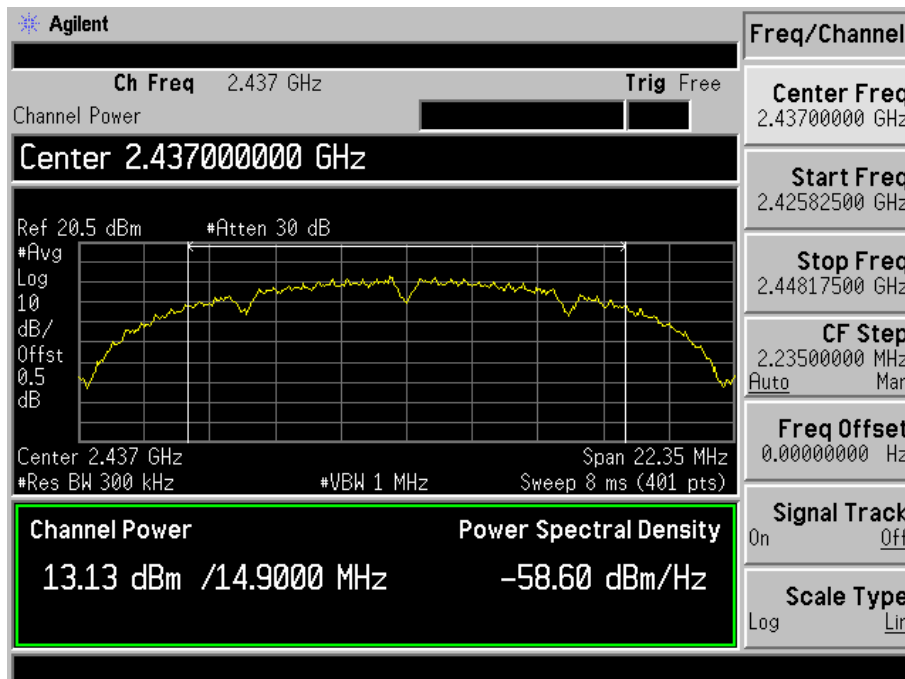
Test Mode	Frequency MHz	Reading dBm	Output Power mW	Limit mW
802.11b_11Mbps	2412	12.19	16.56	1000
	2437	13.13	20.56	1000
	2462	12.44	17.54	1000
802.11g_54Mbps	2412	14.01	25.18	1000
	2437	14.18	26.18	1000
	2462	14.87	30.69	1000
802.11n HT20_MCS7	2412	13.12	20.51	1000
	2437	13.71	23.50	1000
	2462	13.81	24.04	1000
802.11n HT40_MCS7	2422	13.39	21.83	1000
	2437	13.36	21.68	1000
	2452	13.40	21.88	1000

Please refer to the following test plots:

802.11b-11Mbps-Low Channel



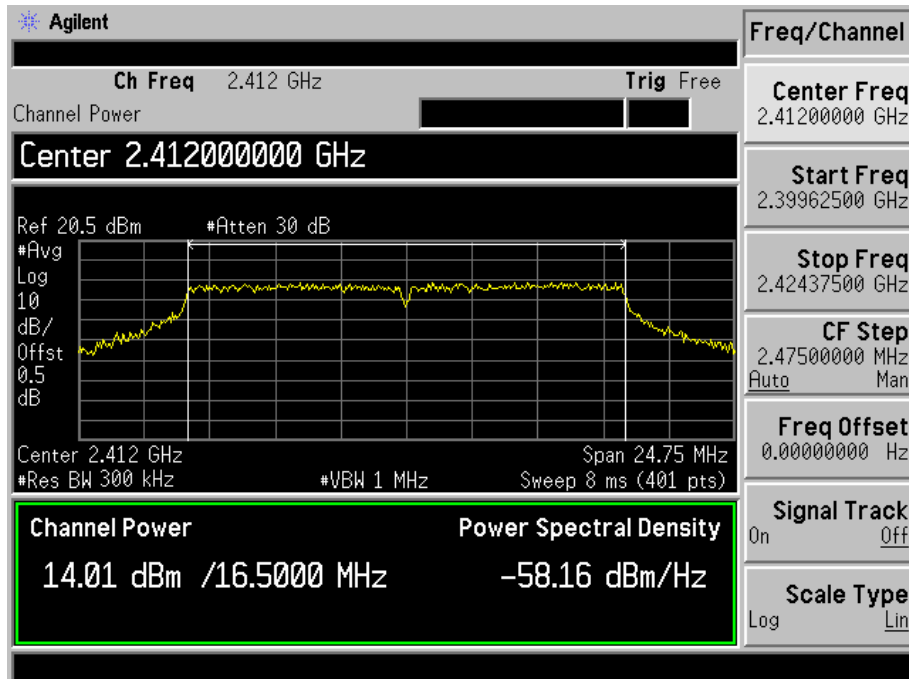
802.11b -11Mbps-Middle Channel



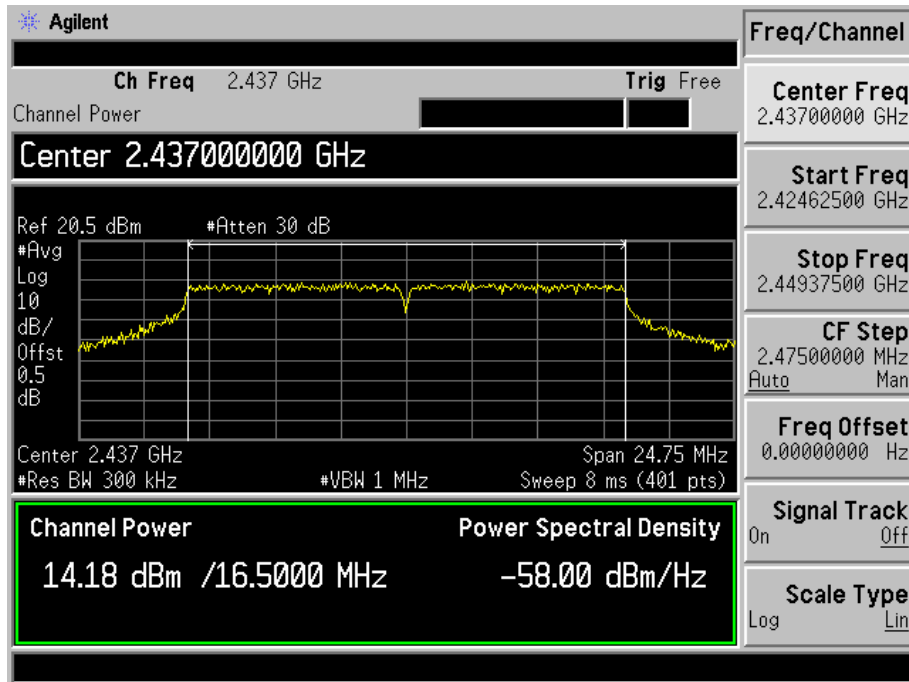
802.11b -11Mbps-High Channel



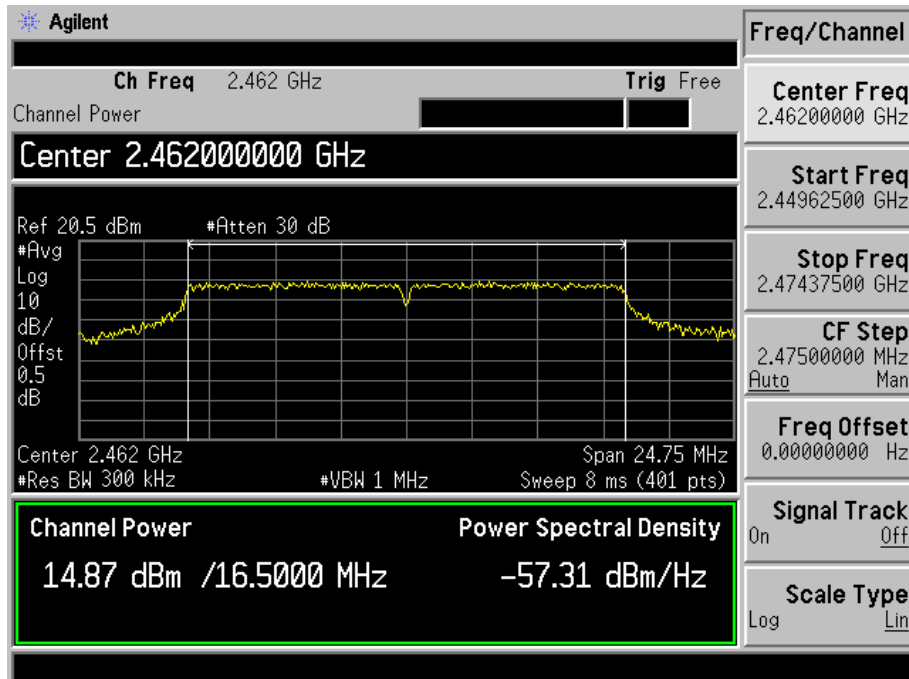
802.11g-54Mbps-Low Channel



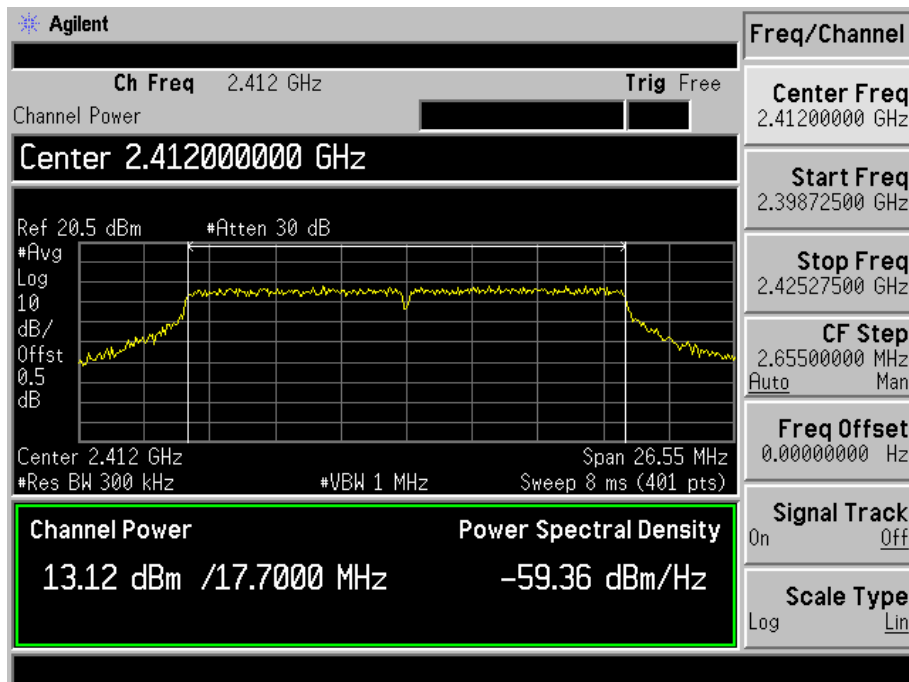
802.11g-54Mbps-Middle Channel



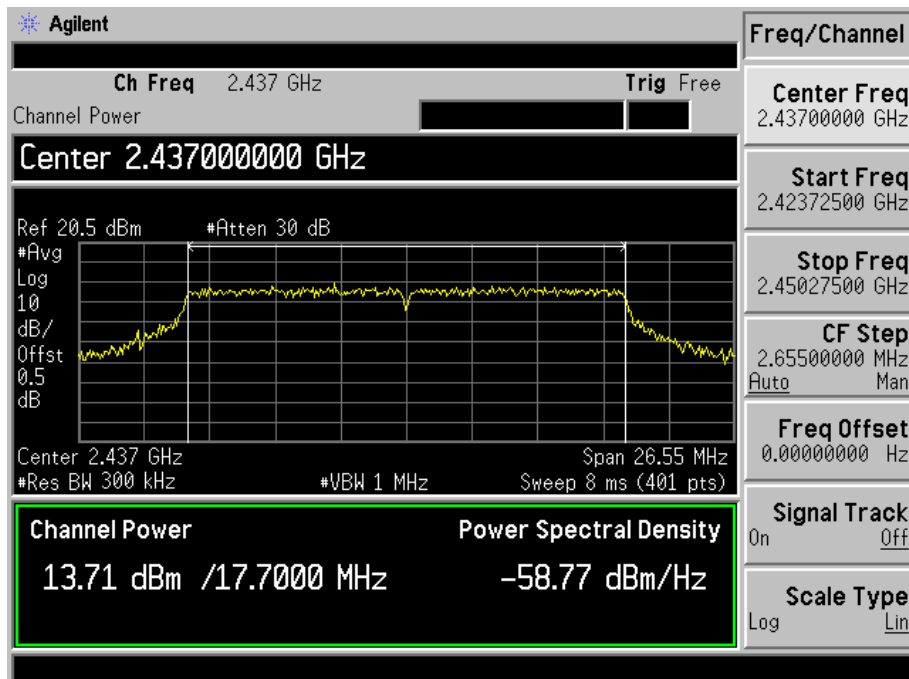
802.11g-54Mbps-High Channel



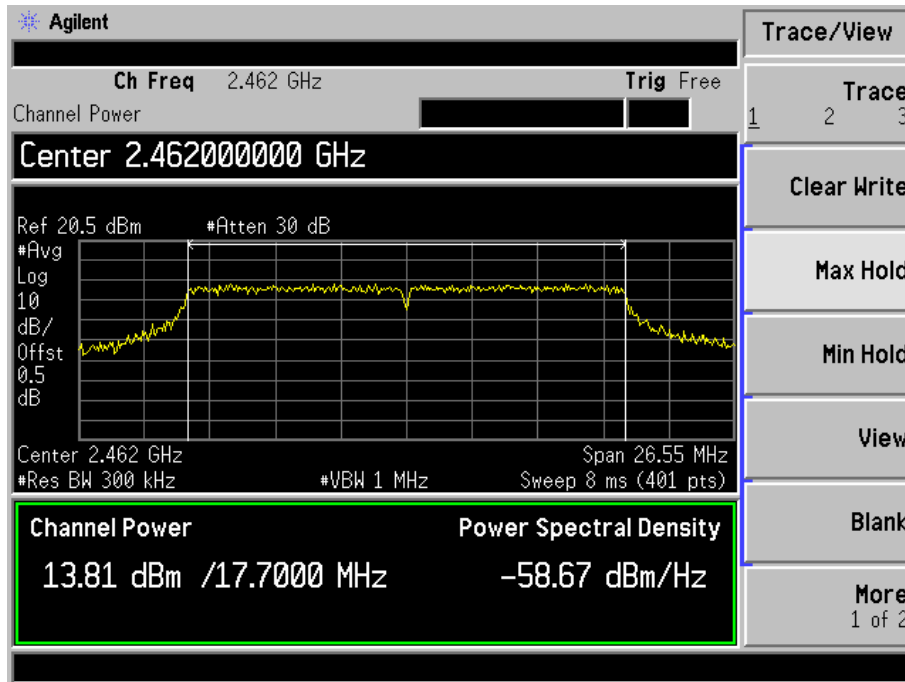
802.11n-HT20-MCS7-Low Channel



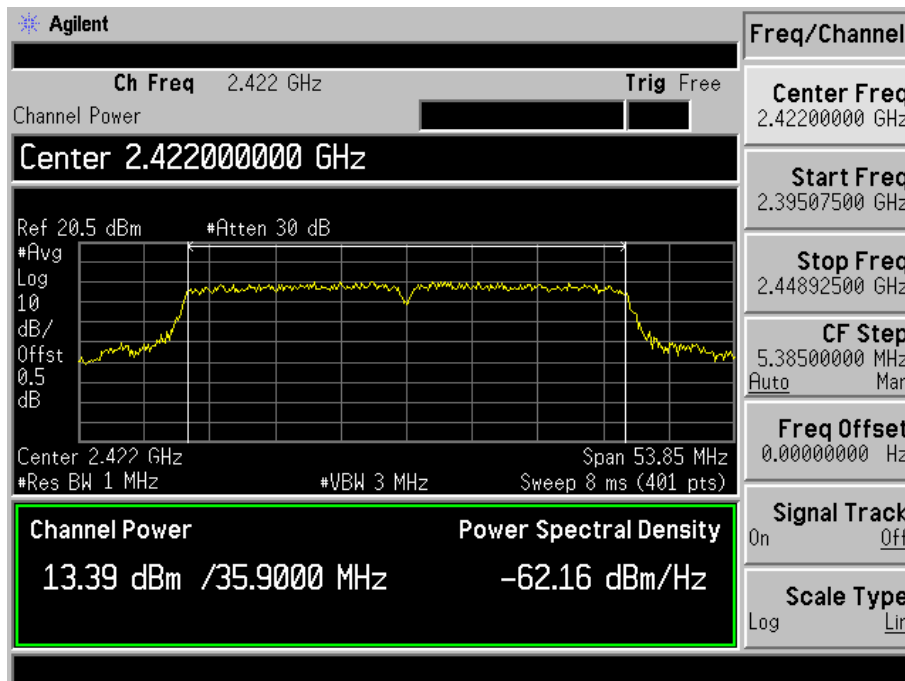
802.11n-HT20-MCS7-Middle Channel



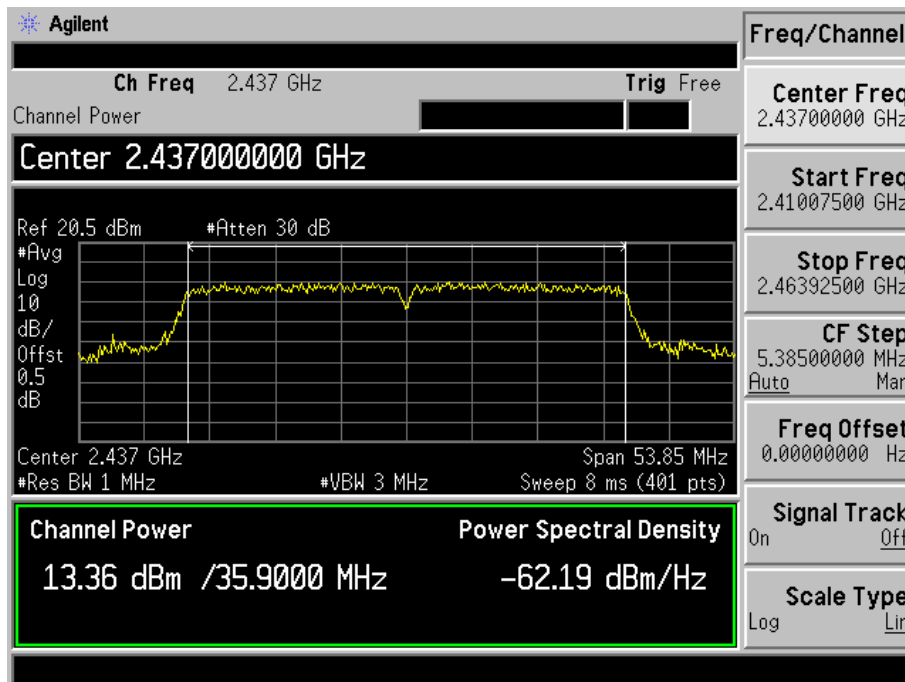
802.11n-HT20-MCS7-High Channel



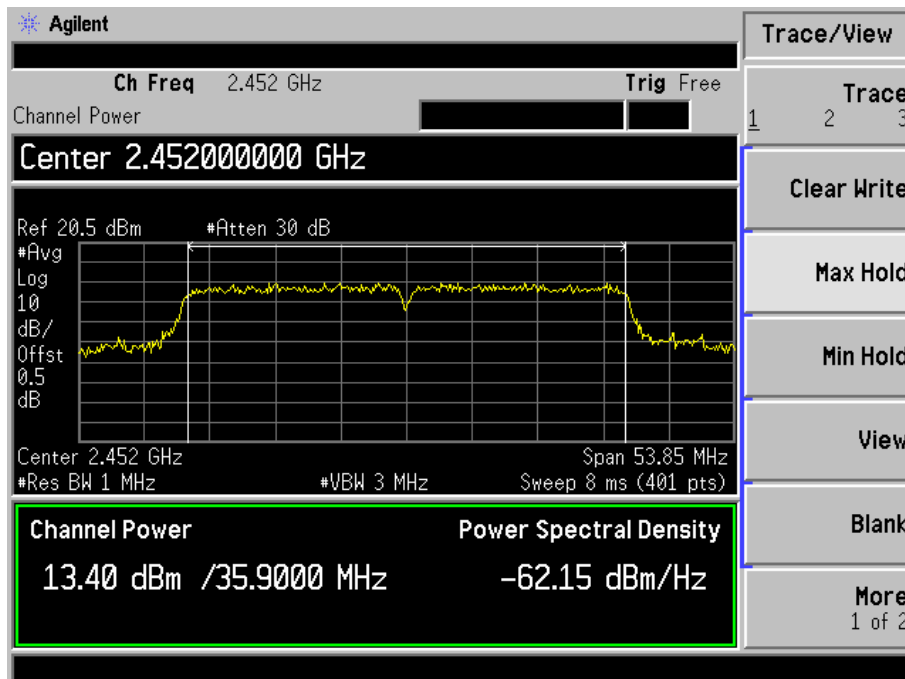
802.11n-HT40-MCS7-Low Channel



802.11n-HT40-MCS7-Middle Channel



802.11n-HT40-MCS7-High Channel



8. Field Strength of Spurious Emissions

8.1 Standard Applicable

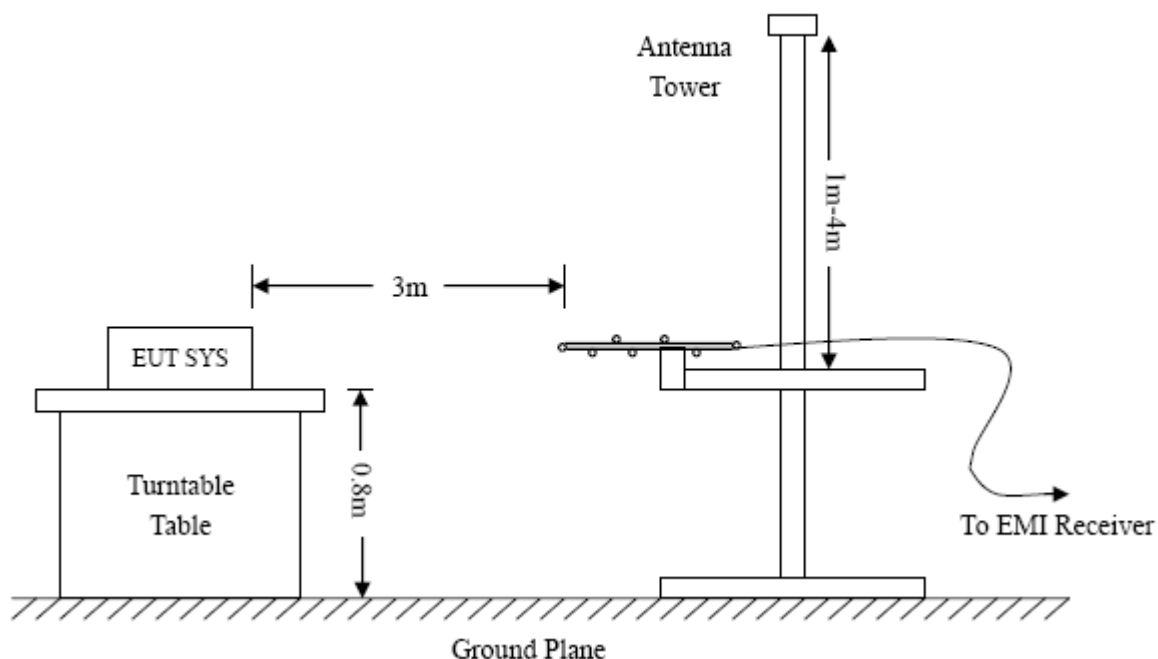
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within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

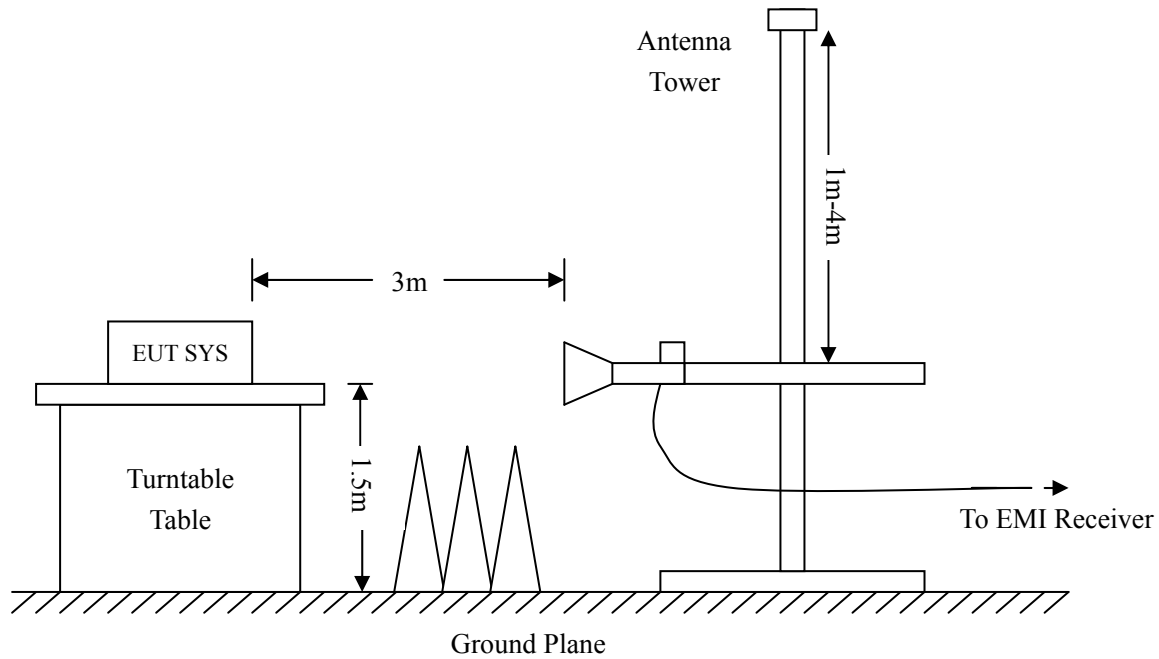
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

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

RBW=10KHz,

VBW =30KHz

Sweep time= Auto

Trace = max hold

Detector function = peak

Frequency :30MHz-1GHz

RBW=120KHz,

VBW=300KHz

Sweep time= Auto

Trace = max hold

Detector function = peak, QP

Frequency :Above 1GHz

RBW=1MHz,

VBW=3MHz(Peak), 10Hz(AV)

Sweep time= Auto

Trace = max hold

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:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

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

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

8.4 Environmental Conditions

Temperature:	25 C
Relative Humidity:	52
ATM Pressure:	1012 mbar

8.5 Summary of Test Results/Plots

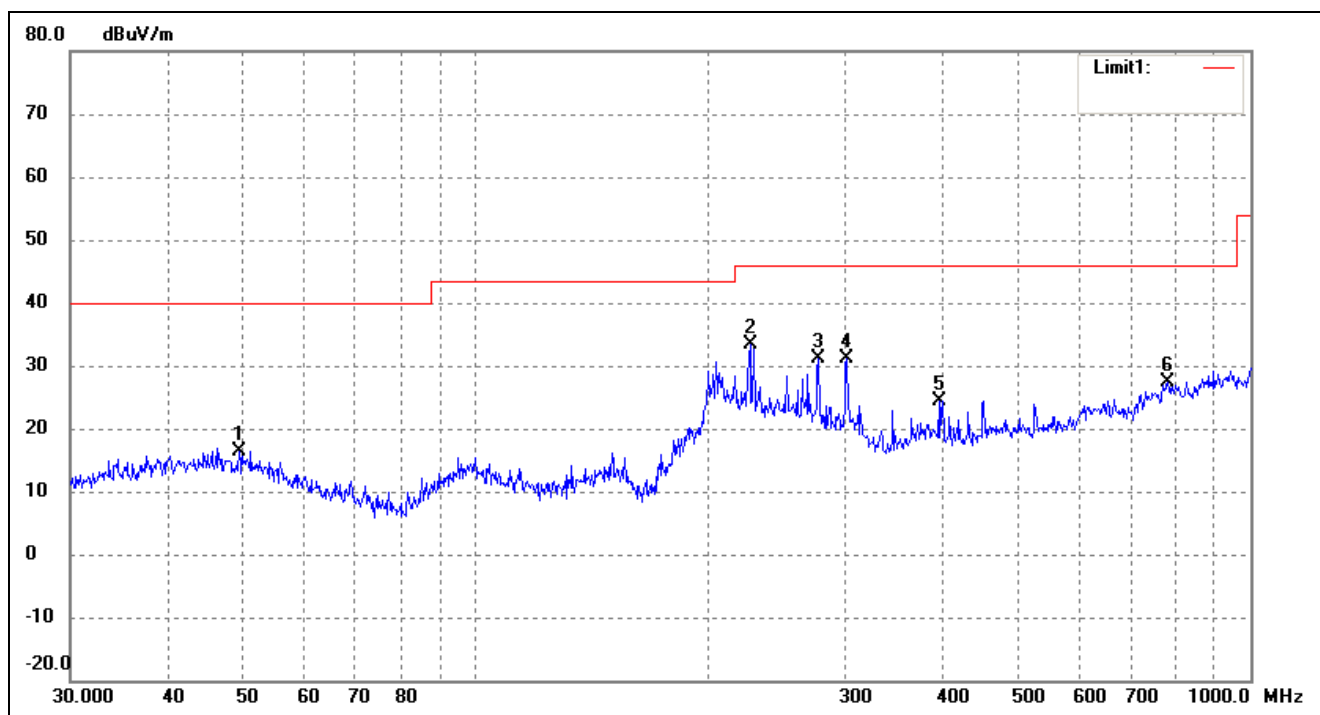
According to the data below, the FCC Part 15.205, 15.209 and 15.247 standards, and had the worst cases:

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Plot of Radiated Emissions Test Data (30MHz to 1GHz)

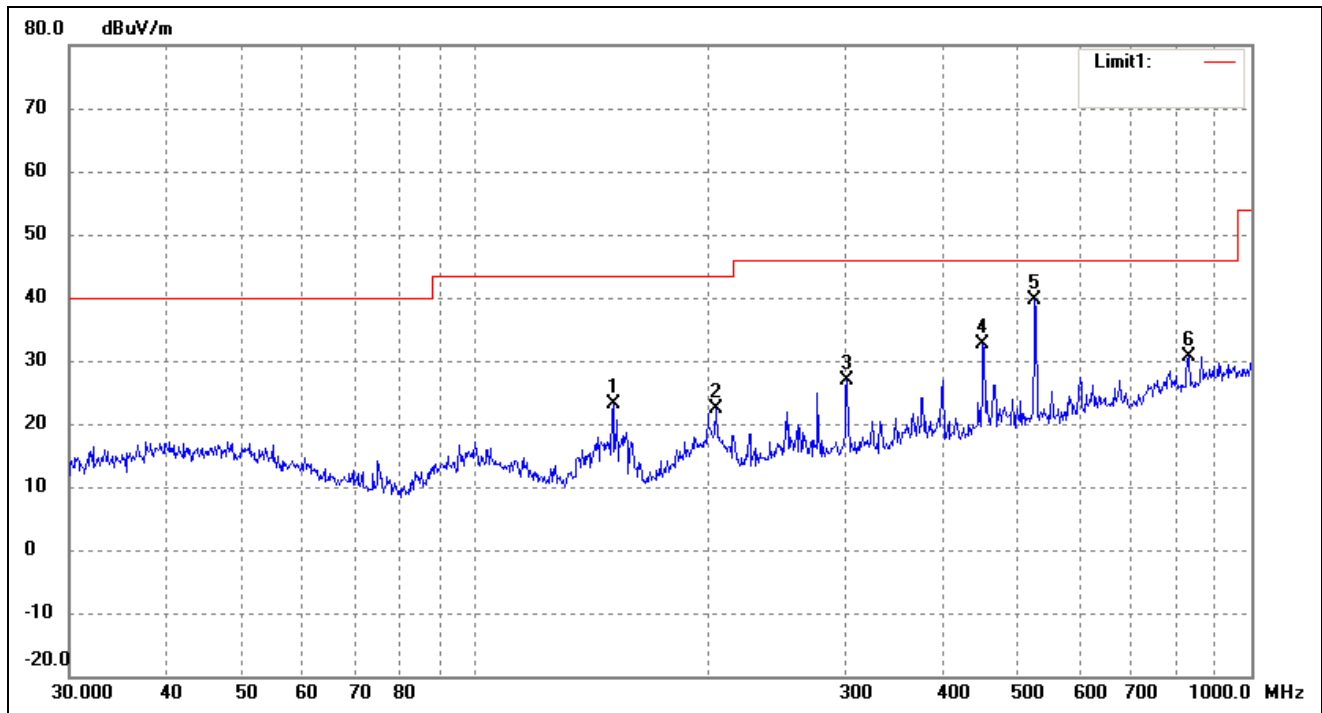
EUT: LM823 Wi-Fi SMT Module 802.11n IPEX_EUS_-20c
 Tested Model: LM823
 Operating Condition: 802.11b Transmitting Low Channel-2412MHz (worst case)
 Comment: DC 3.3V~5V

Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	49.5328	26.98	-10.69	16.29	40.00	-23.71	303	100	peak
2	226.0994	45.33	-12.02	33.31	46.00	-12.69	100	100	peak
3	277.0935	40.69	-9.59	31.10	46.00	-14.90	182	100	peak
4	301.4224	40.85	-9.75	31.10	46.00	-14.90	114	100	peak
5	396.2415	31.88	-7.49	24.39	46.00	-21.61	56	100	peak
6	782.3453	26.84	0.50	27.34	46.00	-18.66	120	100	peak

Test Specification: Vertical

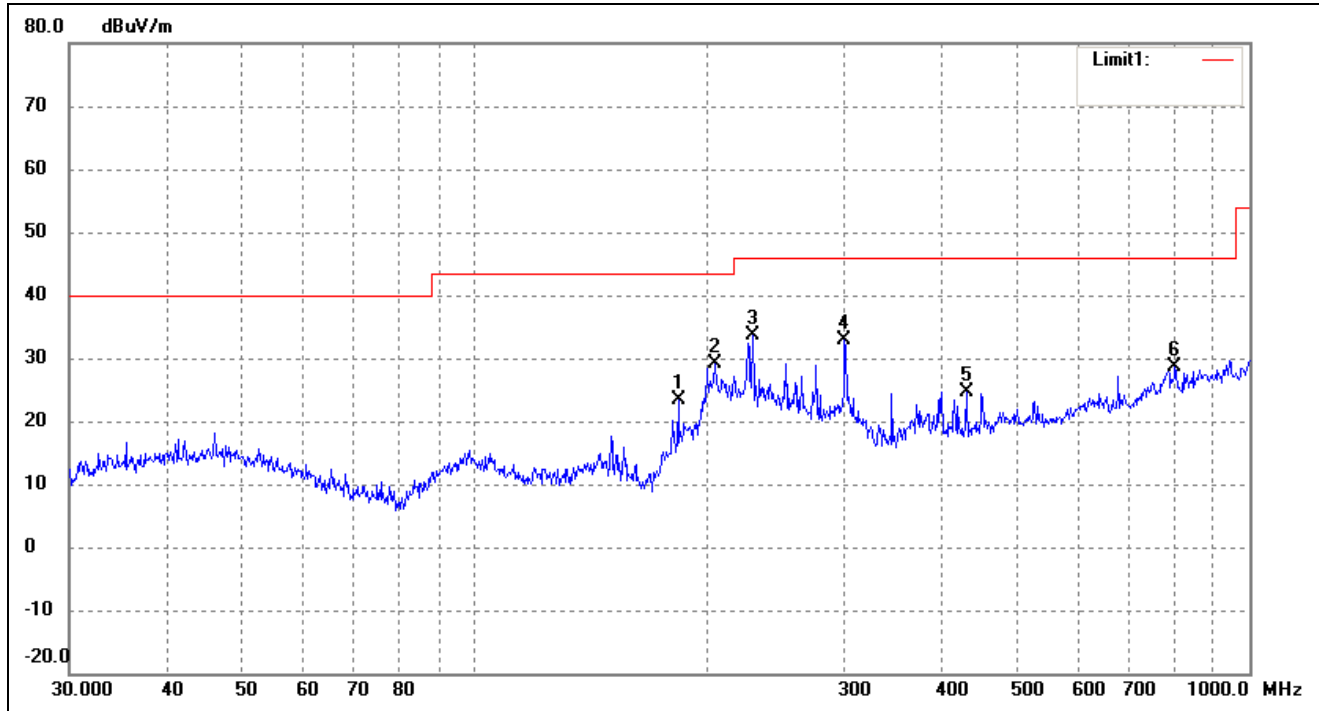


No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	150.5378	37.96	-14.95	23.01	43.50	-20.49	318	100	peak
2	204.2377	34.23	-11.78	22.45	43.50	-21.05	213	100	peak
3	301.4224	36.53	-9.75	26.78	46.00	-19.22	97	100	peak
4	451.1350	39.67	-7.07	32.60	46.00	-13.40	298	100	peak
5	526.3967	45.47	-5.93	39.54	46.00	-6.46	58	100	peak
6	830.4002	30.86	-0.21	30.65	46.00	-15.35	203	100	peak

Operating Condition: 802.11b Transmitting Middle Channel-2437MHz (worst case)

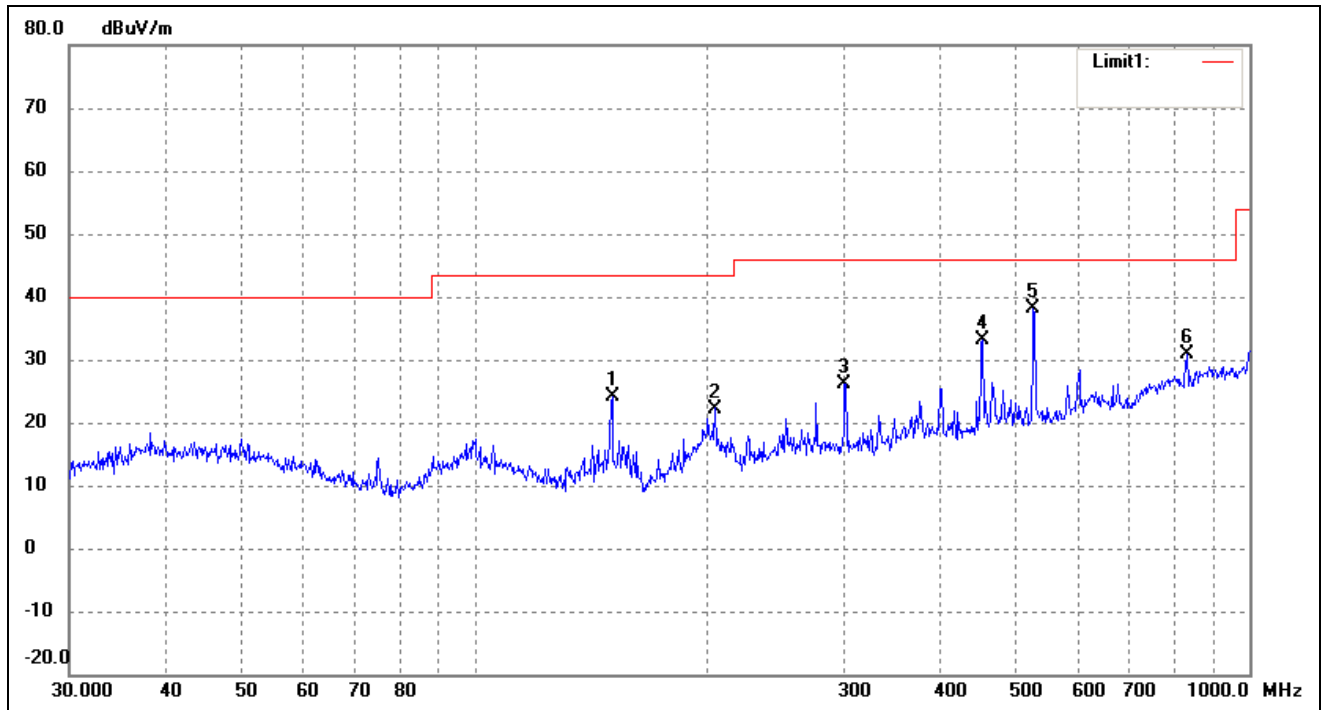
Comment: DC 3.3V~5V

Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	183.2005	37.11	-13.80	23.31	43.50	-20.19	224	100	peak
2	204.2377	40.94	-11.78	29.16	43.50	-14.34	188	100	peak
3	228.4904	45.37	-11.84	33.53	46.00	-12.47	74	100	peak
4	300.3673	42.69	-9.75	32.94	46.00	-13.06	126	100	peak
5	431.0316	32.25	-7.66	24.59	46.00	-21.41	93	100	peak
6	801.7863	28.88	-0.13	28.75	46.00	-17.25	158	100	peak

Test Specification: Vertical

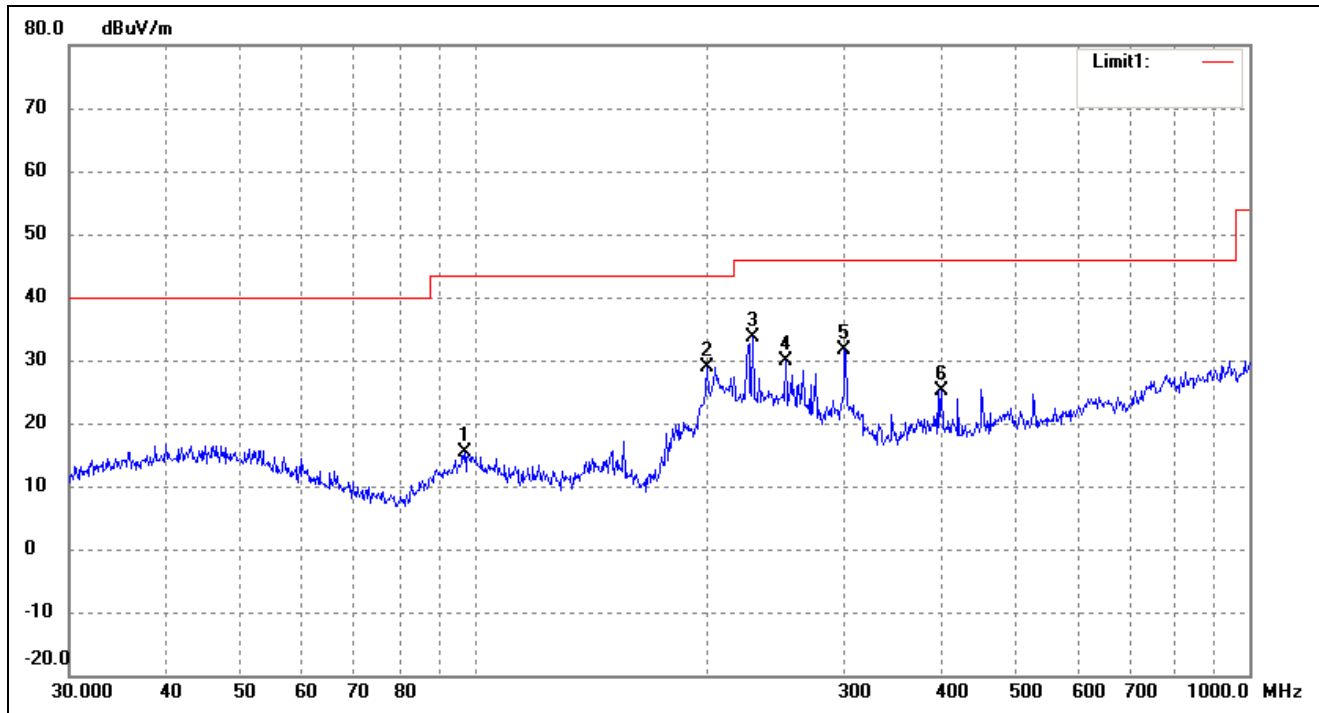


No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	150.5378	39.19	-14.95	24.24	43.50	-19.26	279	100	peak
2	204.2377	34.03	-11.78	22.25	43.50	-21.25	96	100	peak
3	300.3673	35.97	-9.75	26.22	46.00	-19.78	132	100	peak
4	452.7197	40.02	-7.00	33.02	46.00	-12.98	95	100	peak
5	526.3967	43.98	-5.93	38.05	46.00	-7.95	312	100	peak
6	830.4002	30.97	-0.21	30.76	46.00	-15.24	166	100	peak

Operating Condition: 802.11b Transmitting High Channel-2462MHz (worst case)

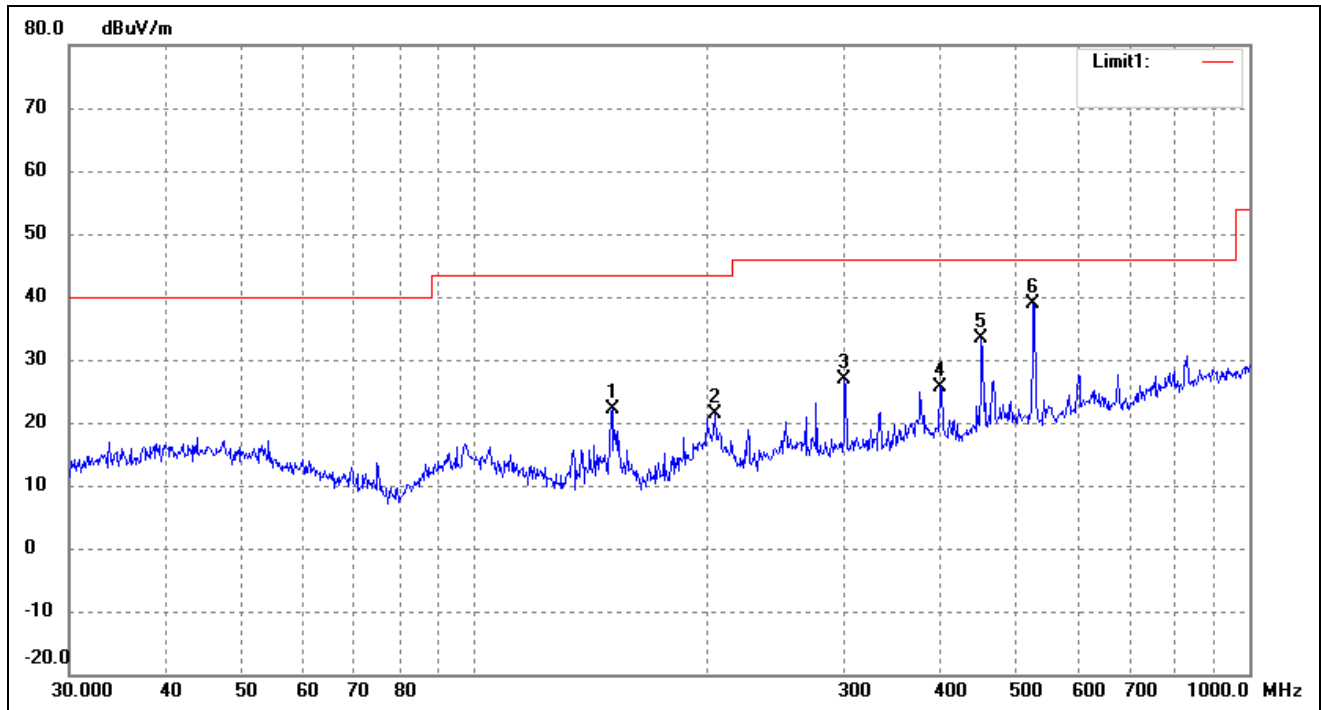
Comment: DC 3.3V~5V

Test Specification: Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	97.1148	27.44	-12.04	15.40	43.50	-28.10	155	100	peak
2	199.2855	40.60	-11.69	28.91	43.50	-14.59	193	100	peak
3	228.4904	45.52	-11.84	33.68	46.00	-12.32	60	100	peak
4	252.0627	40.36	-10.42	29.94	46.00	-16.06	333	100	peak
5	300.3673	41.37	-9.75	31.62	46.00	-14.38	330	100	peak
6	400.4319	32.74	-7.61	25.13	46.00	-20.87	269	100	peak

Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	150.5378	36.97	-14.95	22.02	43.50	-21.48	66	100	peak
2	204.2377	33.19	-11.78	21.41	43.50	-22.09	154	100	peak
3	300.3673	36.51	-9.75	26.76	46.00	-19.24	100	100	peak
4	399.0302	33.17	-7.58	25.59	46.00	-20.41	115	100	peak
5	451.1350	40.35	-7.07	33.28	46.00	-12.72	89	100	peak
6	526.3967	44.83	-5.93	38.90	46.00	-7.10	228	100	peak

Spurious Emissions above 1GHz

Test Mode: 802.11b (worst case)

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2412MHz							
4824.000	65.29	-3.87	61.42	74	-12.58	H	PK
4824.000	49.91	-3.87	46.04	54	-7.96	H	AV
7236.000	66.38	1.14	67.52	74	-6.48	H	PK
7236.000	43.65	1.19	44.84	54	-9.16	H	AV
4824.000	67.19	-3.86	63.33	74	-10.67	V	PK
4824.000	51.35	-3.86	47.49	54	-6.51	V	AV
7236.000	66.77	1.10	67.87	74	-6.13	V	PK
7236.000	44.30	1.10	45.40	54	-8.60	V	AV
Middle Channel-2437MHz							
4874.000	64.30	-3.74	60.56	74	-13.44	H	PK
4874.000	53.22	-3.74	49.48	54	-4.52	H	AV
7311.000	64.61	1.47	66.08	74	-7.92	H	PK
7311.000	46.61	1.47	48.08	54	-5.92	H	AV
4874.000	64.54	-3.74	60.80	74	-13.20	V	PK
4874.000	52.45	-3.74	48.71	54	-5.29	V	AV
7311.000	68.59	1.47	70.06	74	-3.94	V	PK
7311.000	47.22	1.47	48.69	54	-5.31	V	AV
High Channel-2462MHz							
4924.000	64.75	-3.59	61.16	74	-12.84	H	PK
4924.000	47.93	-3.59	44.34	54	-9.66	H	AV
7386.000	64.93	1.79	66.72	74	-7.28	H	PK
7386.000	45.75	1.79	47.54	54	-6.46	H	AV
4924.000	63.98	-3.59	60.39	74	-13.61	V	PK
4924.000	46.86	-3.59	43.27	54	-10.73	V	AV
7386.000	65.76	1.79	67.55	74	-6.45	V	PK
7386.000	45.80	1.79	47.59	54	-6.41	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 v04, the band-edge radiated test method as follows:

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.

According to the KDB 558074 D01 v04, the conducted spurious emissions test method as follows:

1. Set start frequency to DTS channel edge frequency.
2. Set stop frequency so as to encompass the spectrum to be examined.
3. Set RBW = 100 kHz.
4. Set VBW $\geq$ 300 kHz.
5. Detector = peak.
6. Trace Mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize (this may take some time, depending on the extent of the span).
9. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

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.

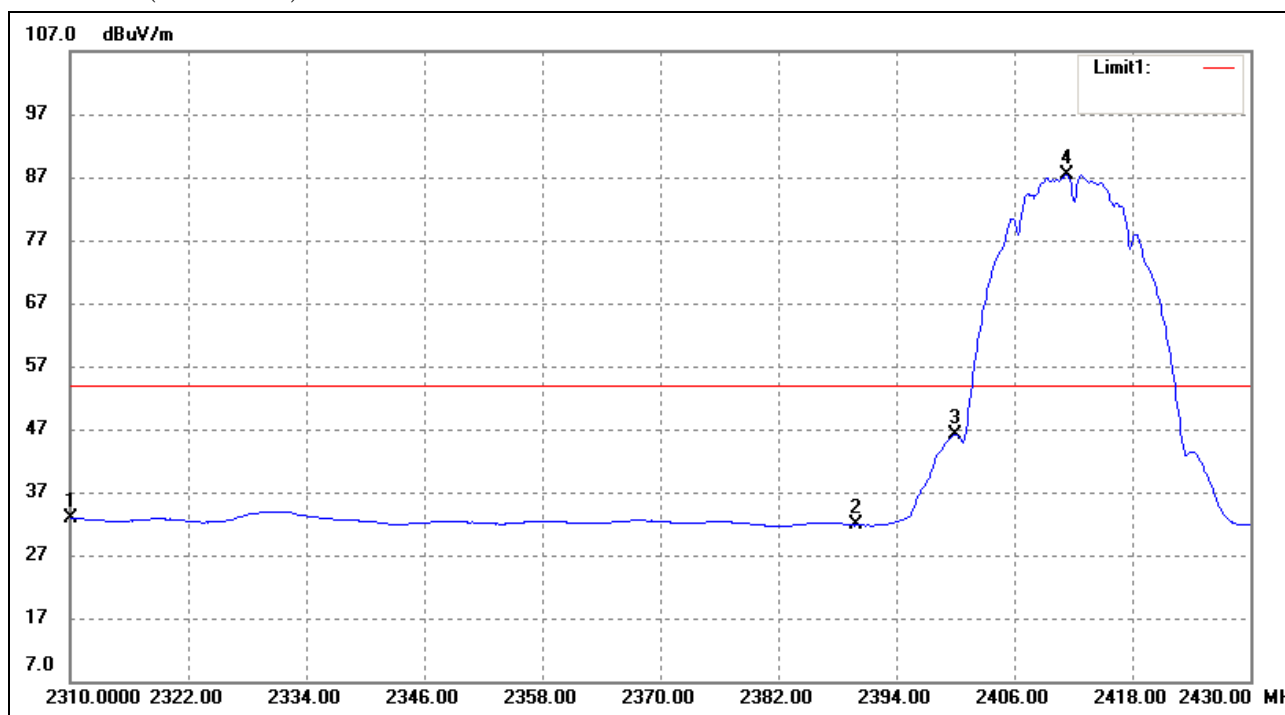
9.3 Environmental Conditions

Temperature:	23 C
Relative Humidity:	54
ATM Pressure:	1011 mbar

9.4 Summary of Test Results/Plots

802.11b-Lowest Bandedge

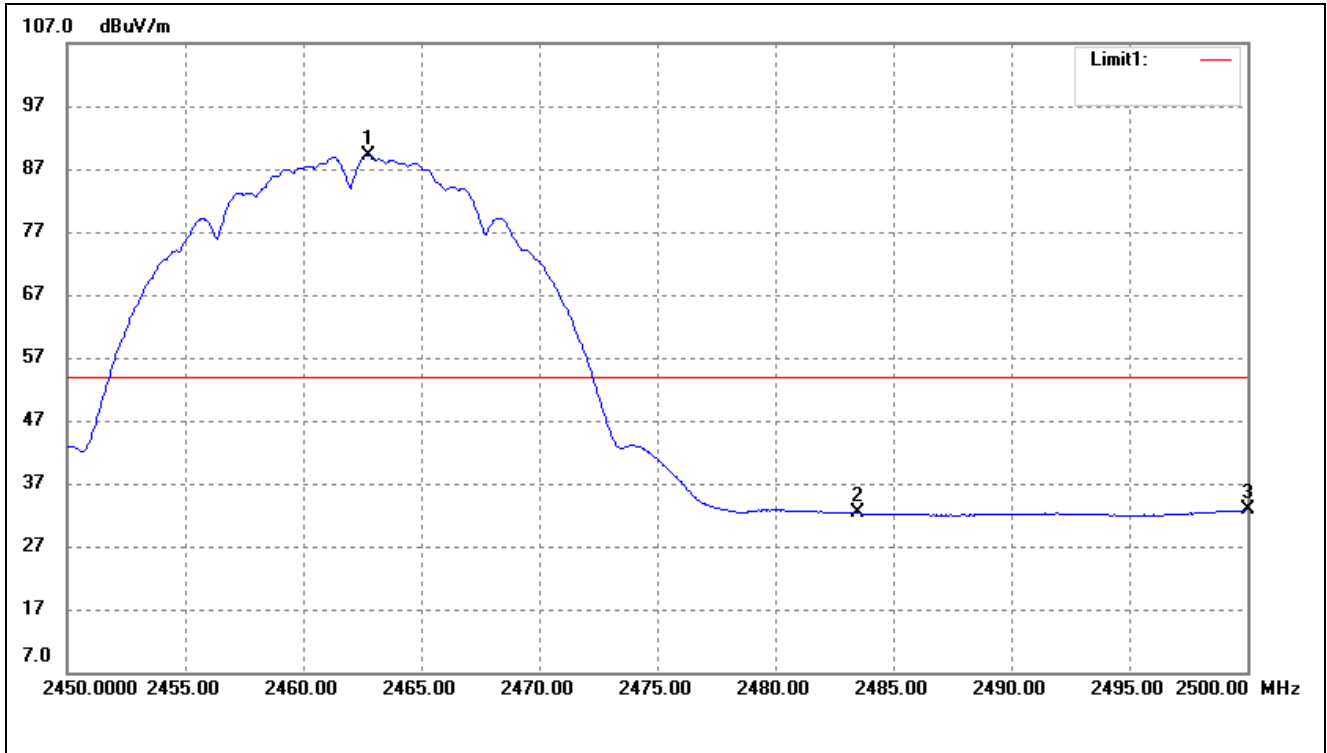
Vertical (Worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	33.23	-0.35	32.88	54.00	-21.12	Average Detector
	2310.000	46.47	-0.35	46.12	74.00	-27.88	Peak Detector
2	2390.000	33.05	-1.29	31.76	54.00	-22.24	Average Detector
	2390.000	47.93	-1.29	46.64	74.00	-27.36	Peak Detector
3	2400.000	47.52	-1.40	46.12	54.00	-7.88	Average Detector
	2400.000	60.09	-1.40	58.69	74.00	-15.31	Peak Detector
4	2411.280	88.91	-1.44	87.47	/	/	Average Detector
	2411.040	97.82	-1.44	96.38	/	/	Peak Detector

802.11b-Highest Bandedge

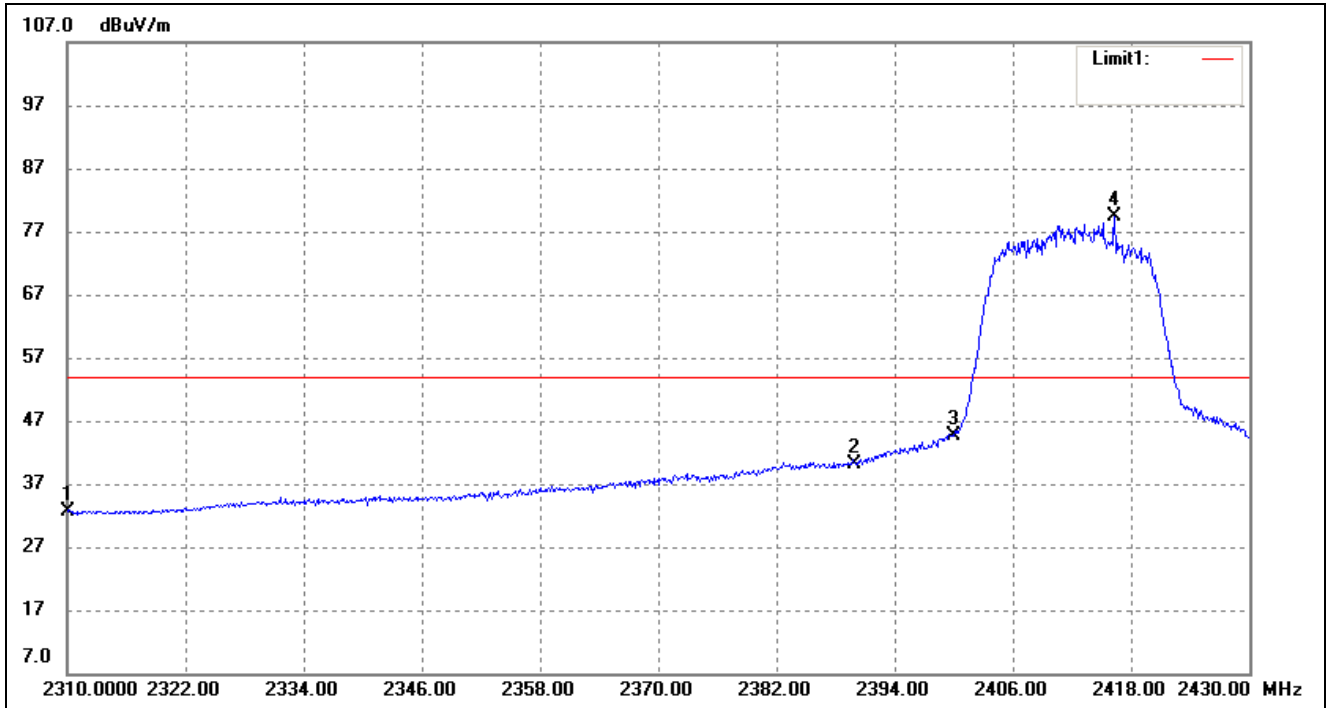
Vertical (Worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2462.750	90.63	-1.38	89.25	/	/	Average Detector
	2463.000	97.33	-1.38	95.95	/	/	Peak Detector
2	2483.500	33.62	-1.36	32.26	54.00	-21.74	Average Detector
	2483.500	47.44	-1.36	46.08	74.00	-27.92	Peak Detector
3	2500.000	34.10	-1.34	32.76	54.00	-21.24	Average Detector
	2500.000	50.10	-1.34	48.76	74.00	-25.24	Peak Detector

802.11g-Lowest Bandedge

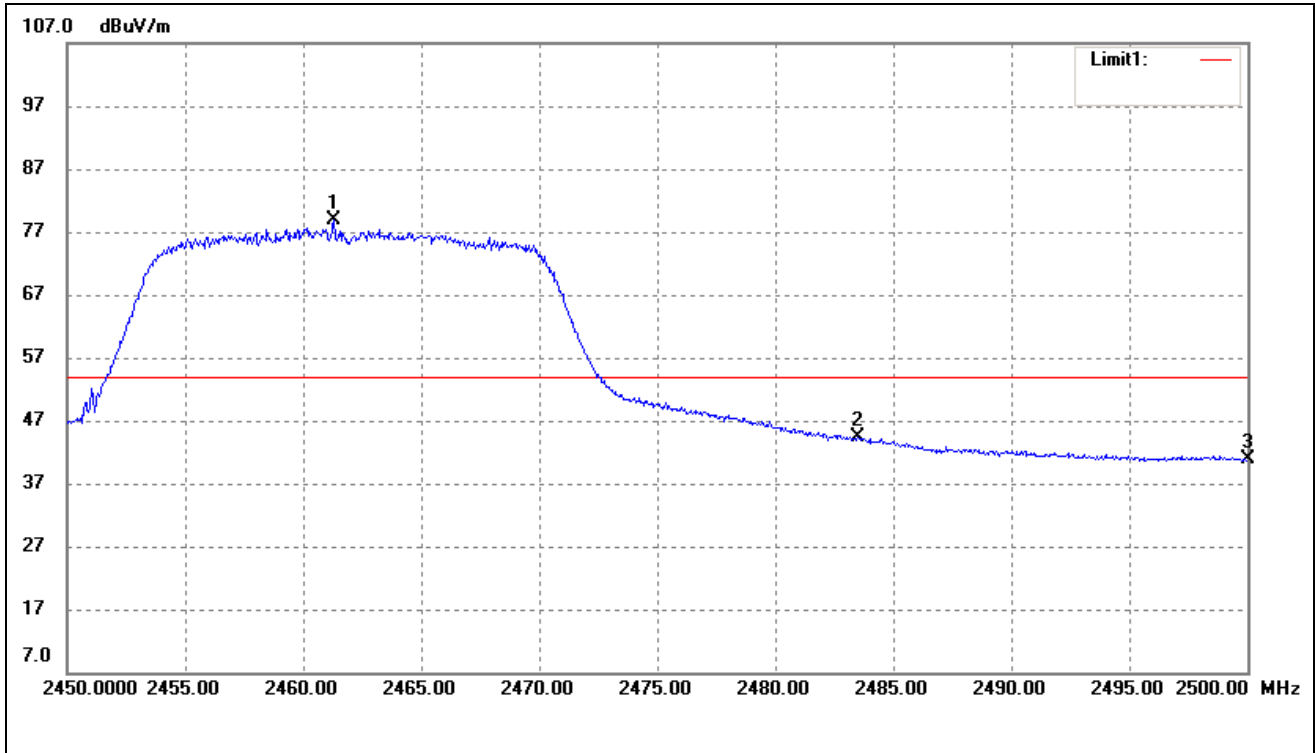
Vertical (Worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	33.59	-1.00	32.59	54.00	-21.41	Average Detector
	2310.000	46.28	-1.00	45.28	74.00	-28.72	Peak Detector
2	2390.000	40.89	-0.88	40.01	54.00	-13.99	Average Detector
	2390.000	59.82	-0.88	58.94	74.00	-15.06	Peak Detector
3	2400.000	45.38	-0.86	44.52	54.00	-9.48	Average Detector
	2400.000	63.97	-0.86	63.11	74.00	-10.89	Peak Detector
4	2416.320	80.09	-0.83	79.26	/	/	Average Detector
	2411.040	99.96	-0.84	99.12	/	/	Peak Detector

802.11g-Highest Bandedge

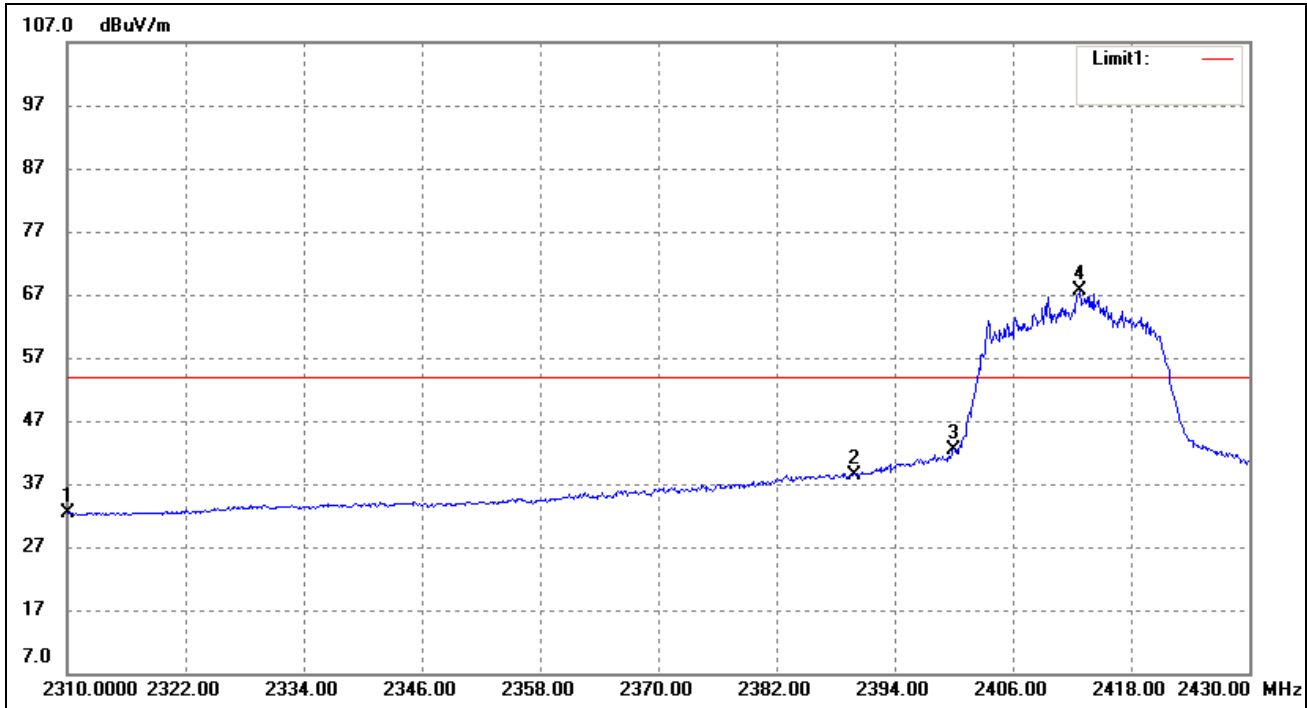
Vertical (Worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2461.300	79.55	-0.76	78.79	/	/	Average Detector
	2459.600	105.00	-0.76	104.24	/	/	Peak Detector
2	2483.500	45.06	-0.73	44.33	54.00	-9.67	Average Detector
	2483.500	67.83	-0.73	67.10	74.00	-6.90	Peak Detector
3	2500.000	41.59	-0.70	40.89	54.00	-13.11	Average Detector
	2500.000	57.85	-0.70	57.15	74.00	-16.85	Peak Detector

802.11n-HT20-Lowest Bandedge

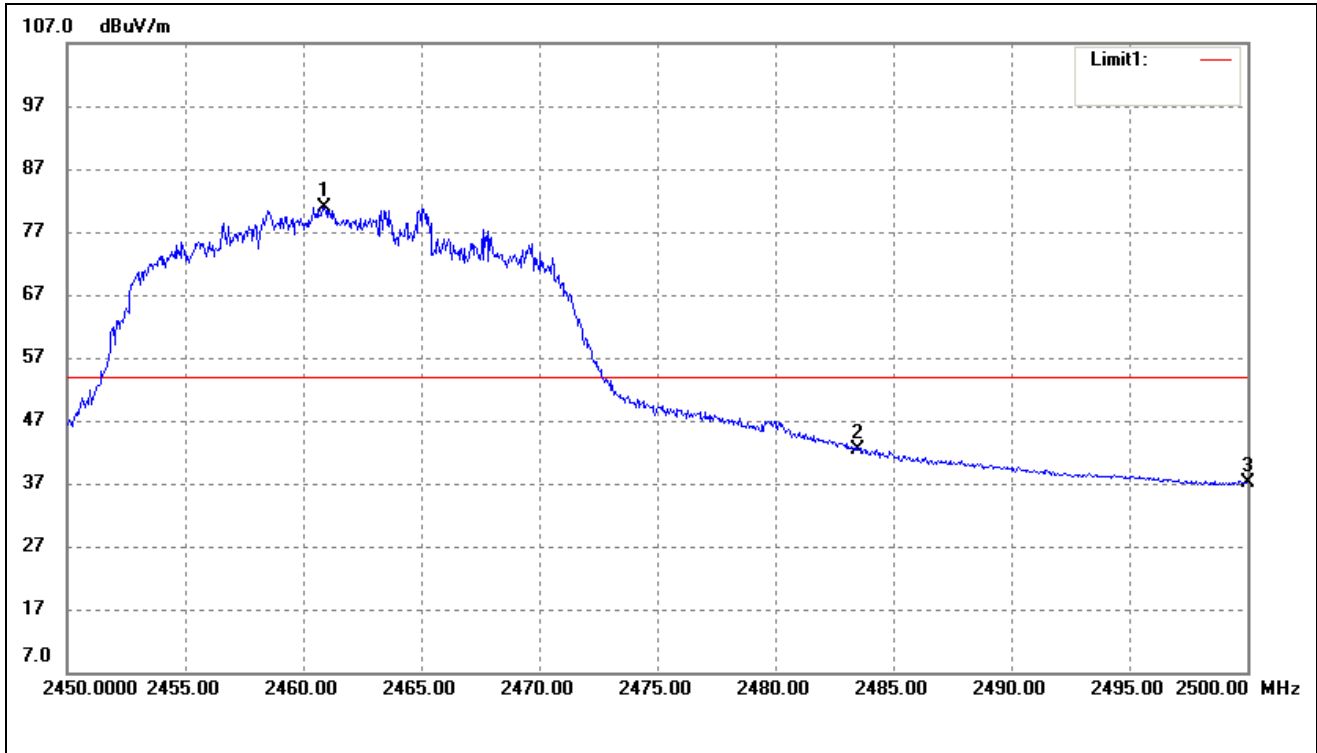
Vertical (Worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2310.000	33.36	-1.00	32.36	54.00	-21.64	Average Detector
	2310.000	46.55	-1.00	45.55	74.00	-28.45	Peak Detector
2	2390.000	39.24	-0.88	38.36	54.00	-15.64	Average Detector
	2390.000	63.39	-0.88	62.51	74.00	-11.49	Peak Detector
3	2400.000	43.36	-0.86	42.50	54.00	-11.5	Average Detector
	2400.000	66.78	-0.86	65.92	74.00	-8.08	Peak Detector
4	2412.840	68.41	-0.84	67.57	/	/	Average Detector
	2413.200	103.49	-0.84	102.65	/	/	Peak Detector

802.11n-HT20-Highest Bandedge

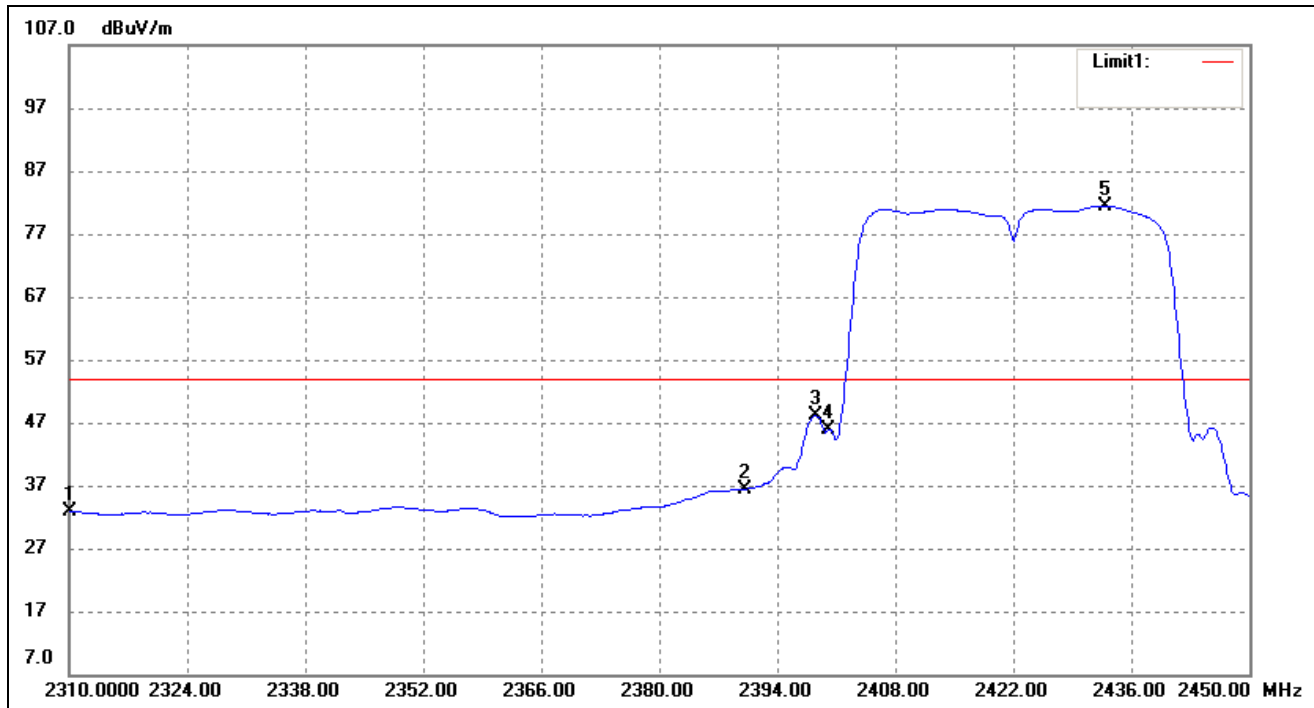
Vertical (Worst case)



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2460.900	81.62	-0.76	80.86	/	/	Average Detector
	2460.950	99.51	-0.76	98.75	/	/	Peak Detector
2	2483.500	43.13	-0.73	42.40	54.00	-11.60	Average Detector
	2483.500	61.51	-0.73	60.78	74.00	-13.22	Peak Detector
3	2500.000	37.79	-0.70	37.09	54.00	-16.91	Average Detector
	2500.000	53.83	-0.70	53.13	74.00	-20.87	Peak Detector

802.11n-HT40-Lowest Bandedge

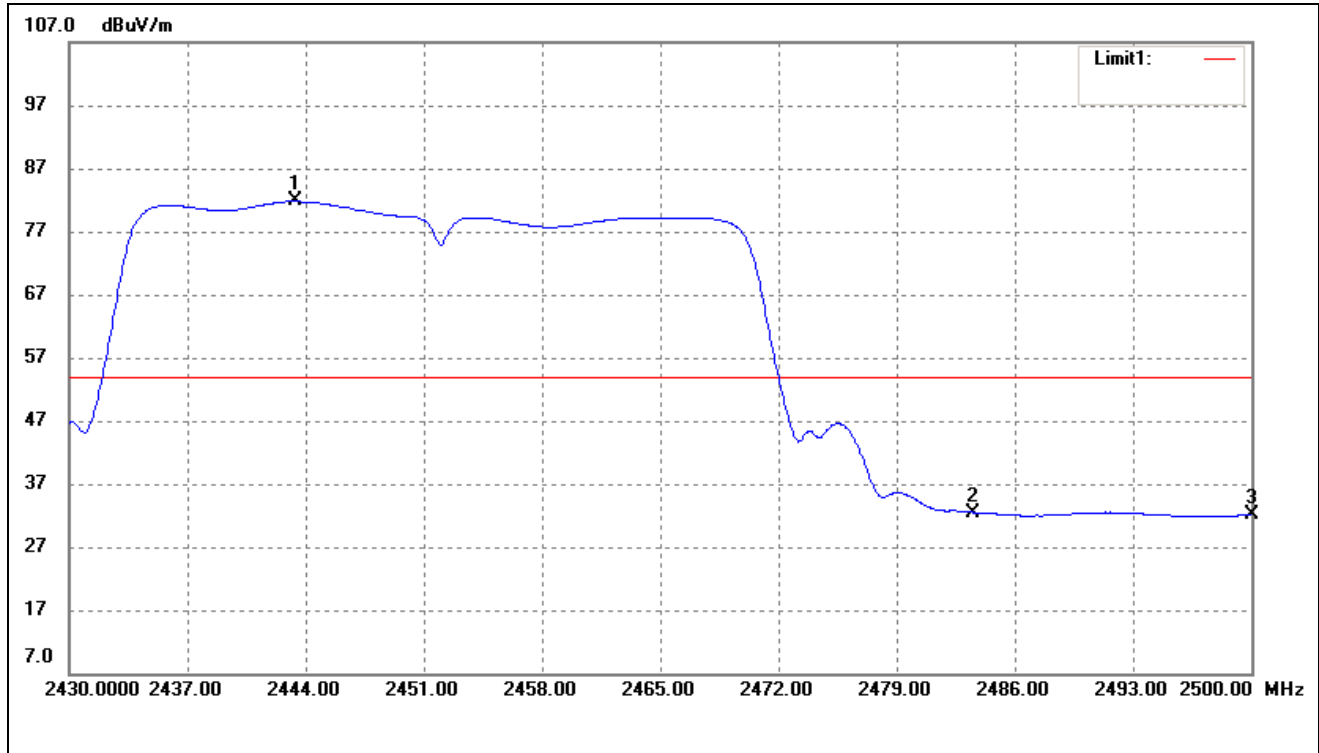
Vertical (Worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	33.22	-0.35	32.87	54.00	-21.13	Average Detector
	2310.000	46.91	-0.35	46.56	74.00	-27.44	Peak Detector
2	2390.000	37.68	-1.29	36.39	54.00	-17.61	Average Detector
	2390.000	54.02	-1.29	52.73	74.00	-21.27	Peak Detector
3	2398.480	49.45	-1.38	48.07	54.00	-5.93	Average Detector
4	2400.000	47.28	-1.40	45.88	54.00	-8.12	Average Detector
	2400.000	62.28	-1.40	60.88	74.00	-13.12	Peak Detector
5	2432.920	82.92	-1.42	81.50	/	/	Average Detector
	2425.360	95.21	-1.43	93.78	/	/	Peak Detector

802.11n-HT40-Highest Bandedge

Vertical (Worst case)

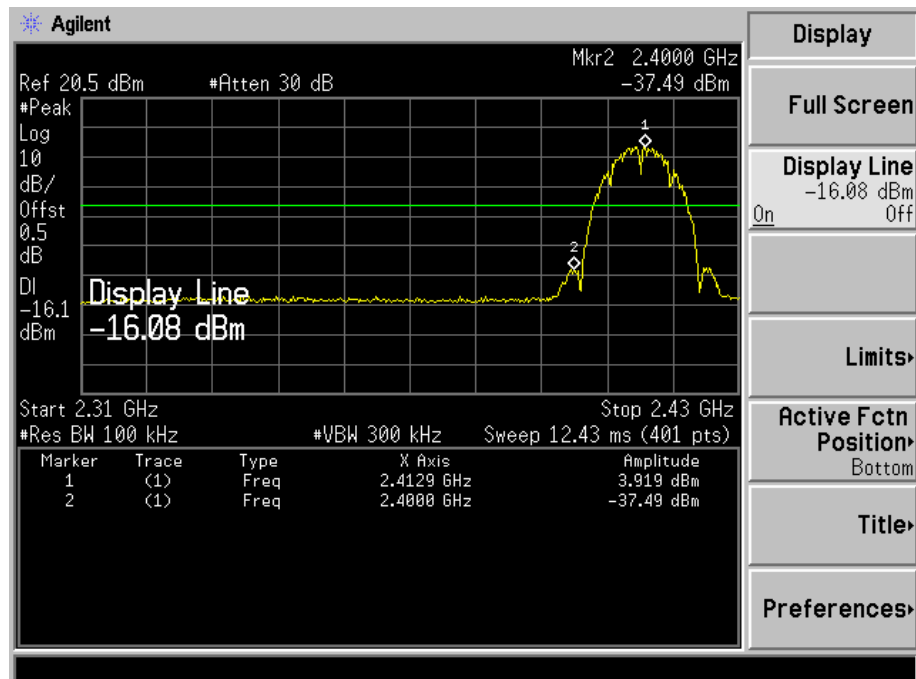
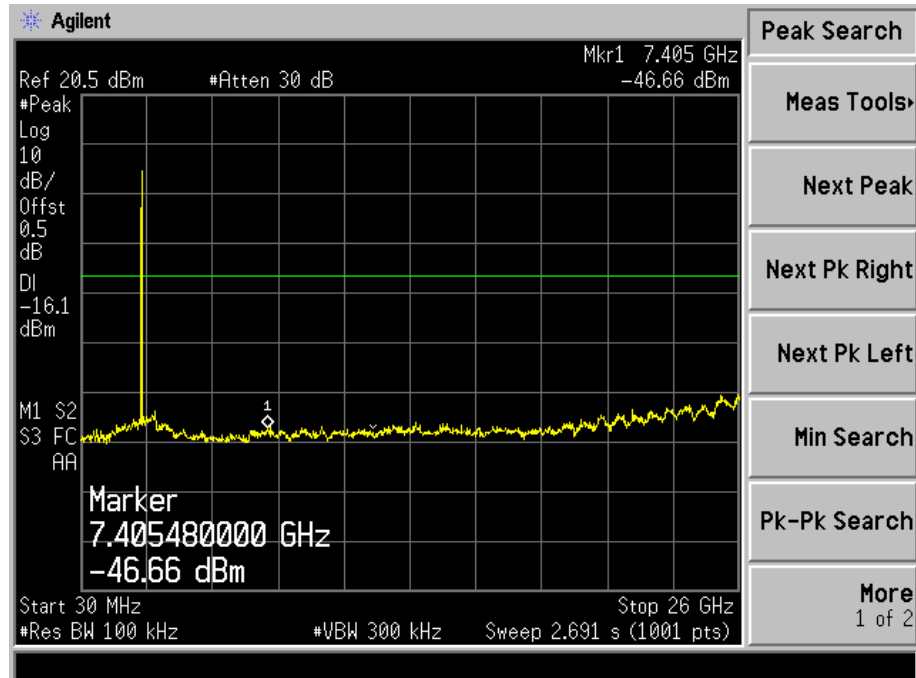


No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2443.370	83.23	-1.41	81.82	/	/	Average Detector
	2454.990	94.76	-1.39	93.37	/	/	Peak Detector
2	2483.500	33.85	-1.36	32.49	54.00	-21.51	Average Detector
	2483.500	47.87	-1.36	46.51	74.00	-27.49	Peak Detector
3	2500.000	33.49	-1.34	32.15	54.00	-21.85	Average Detector
	2500.000	47.34	-1.34	46.00	74.00	-28.00	Peak Detector

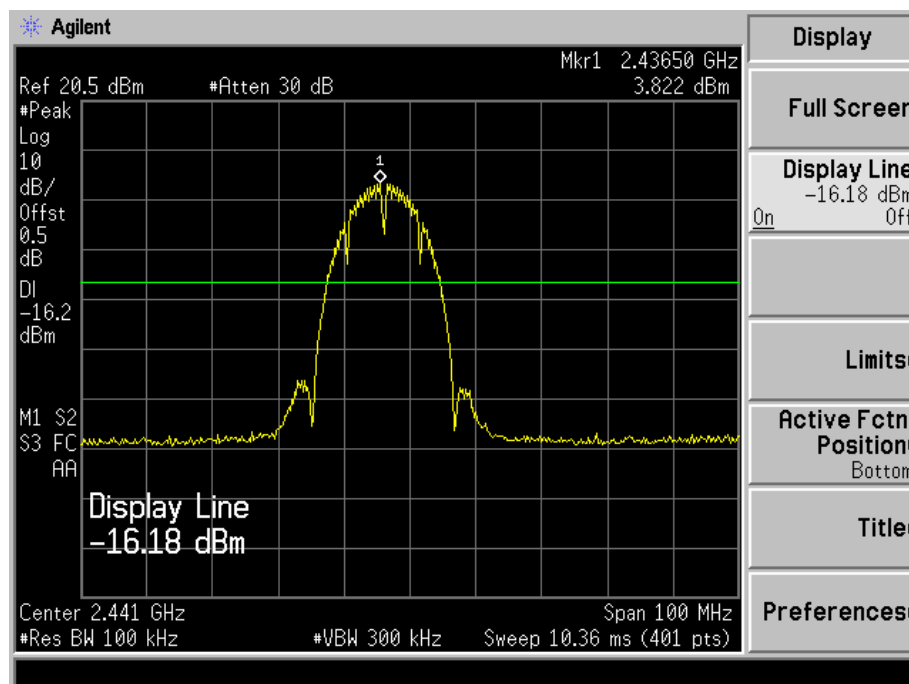
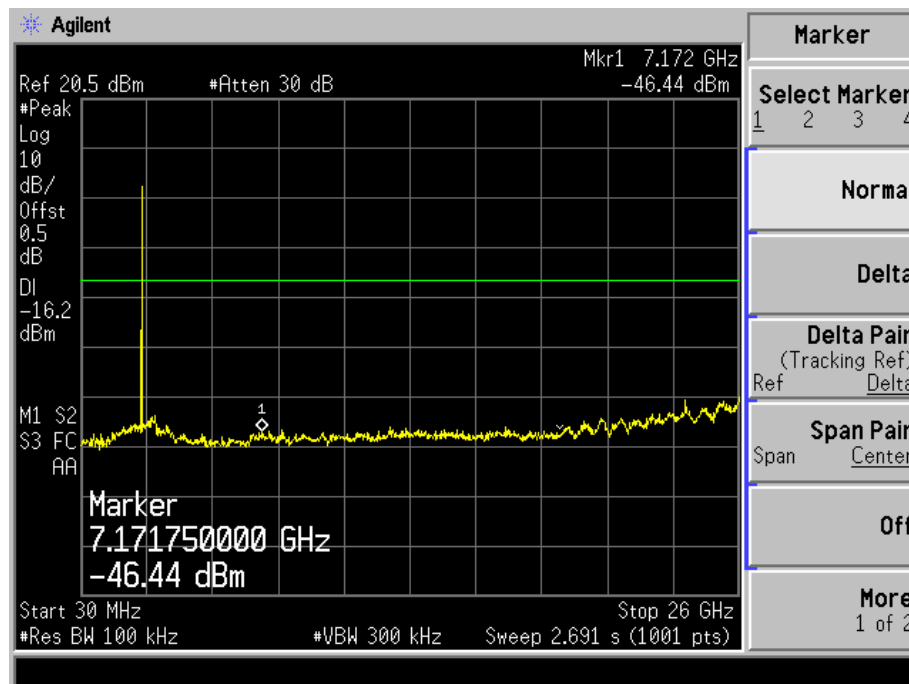
Spurious (Conducted)

802.11b-Lowest

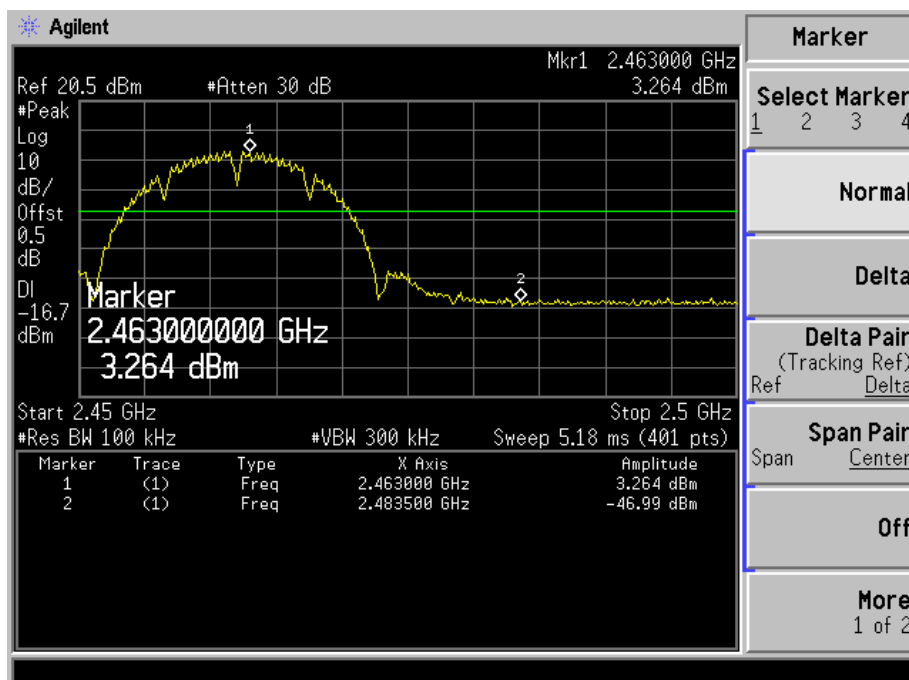
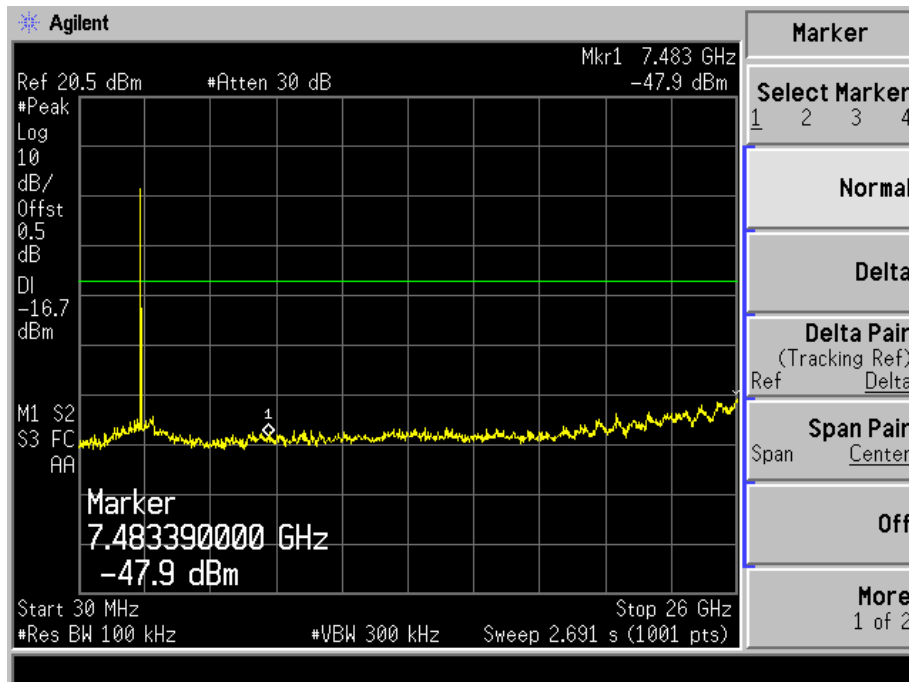
Lowest



Middle



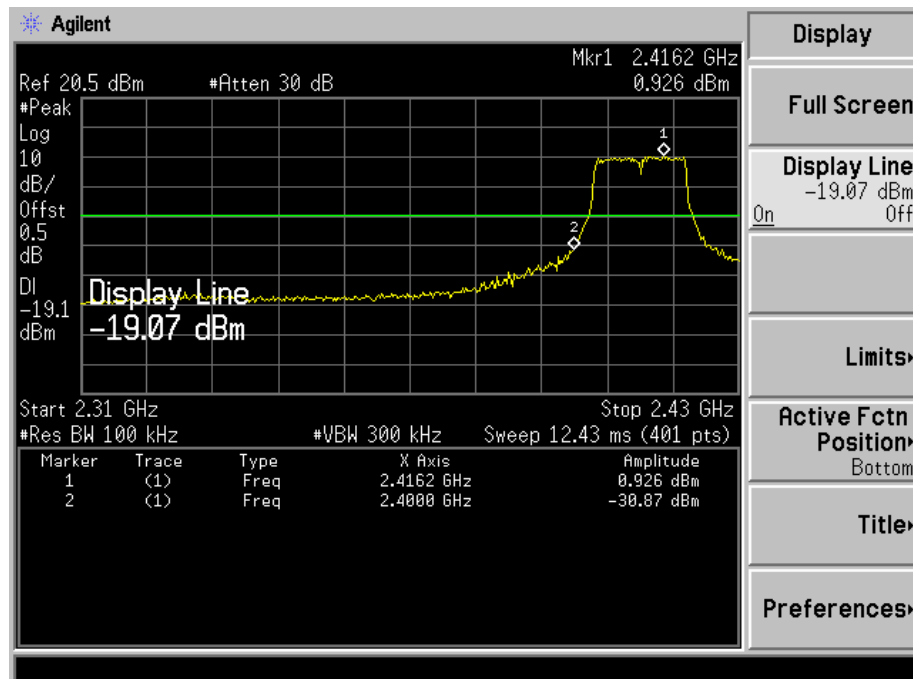
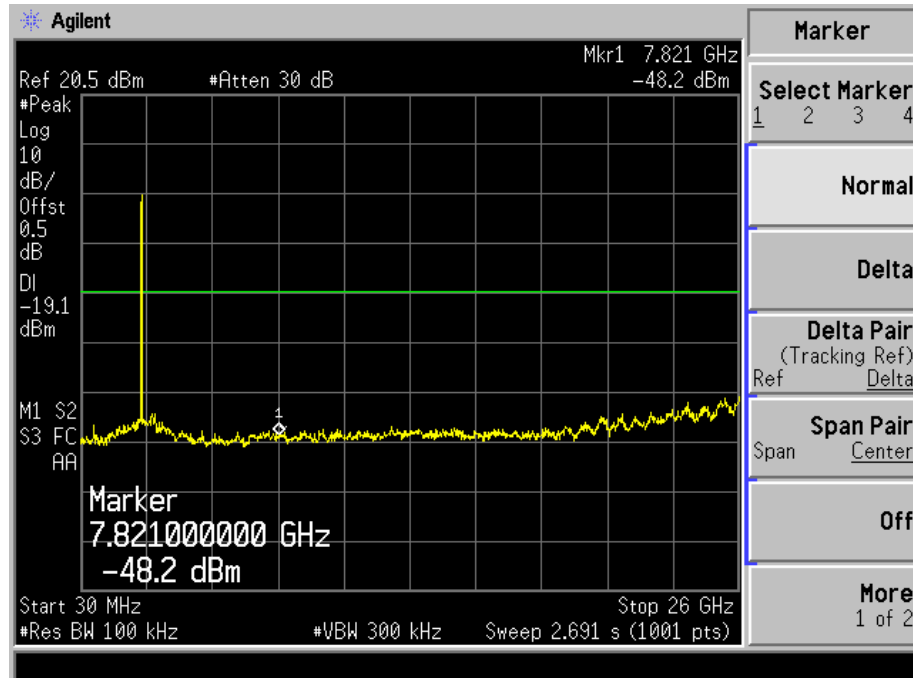
Highest



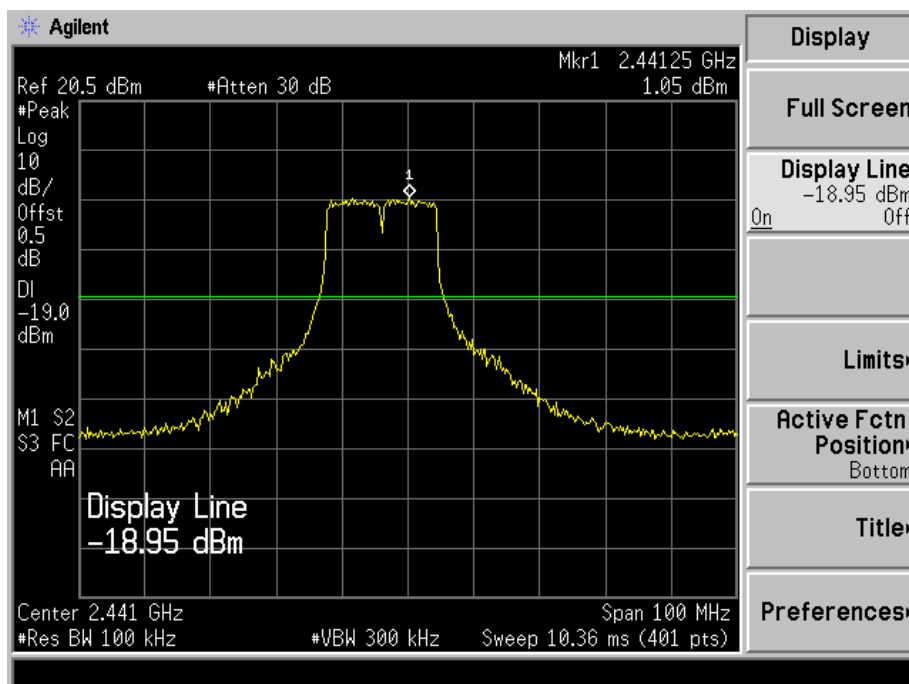
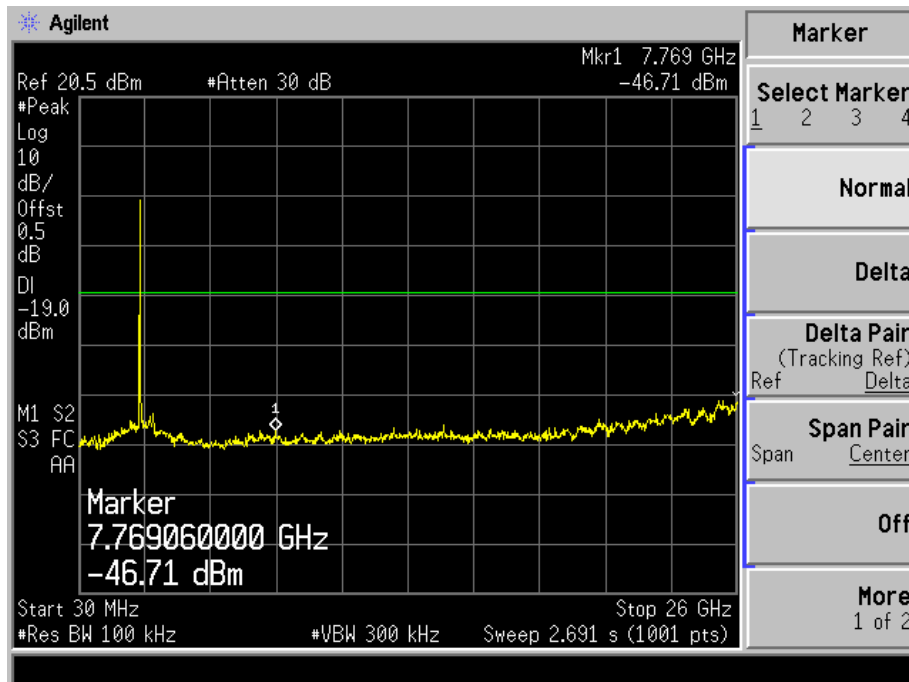
Spurious (Conducted)

802.11g-Lowest

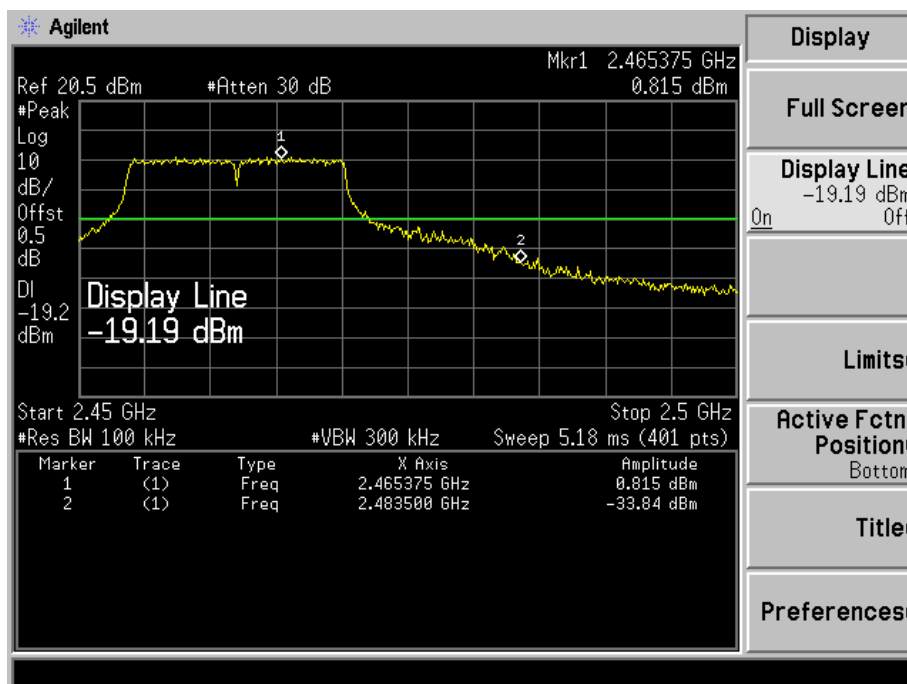
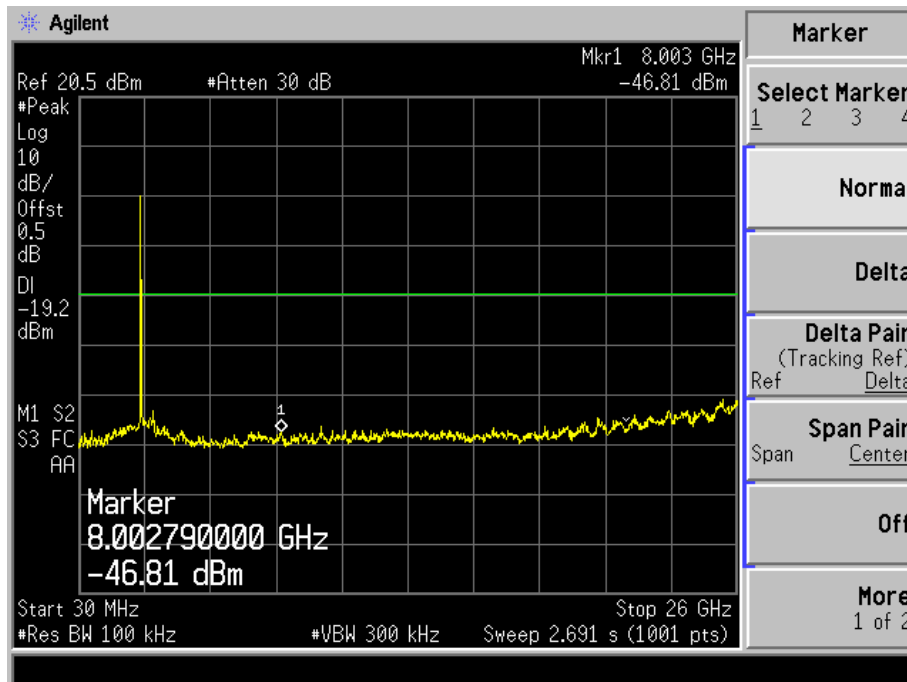
Lowest



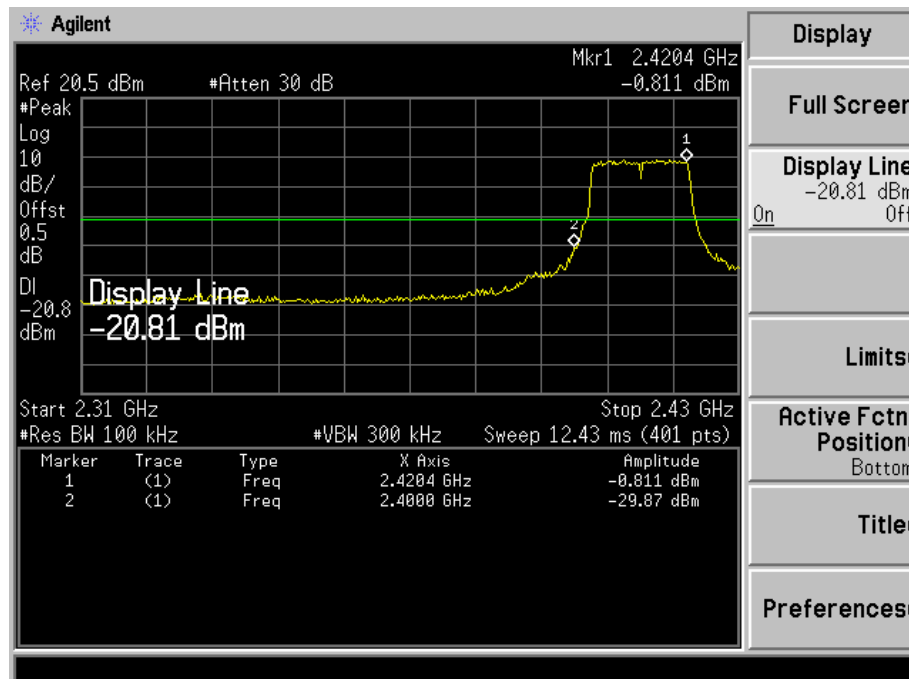
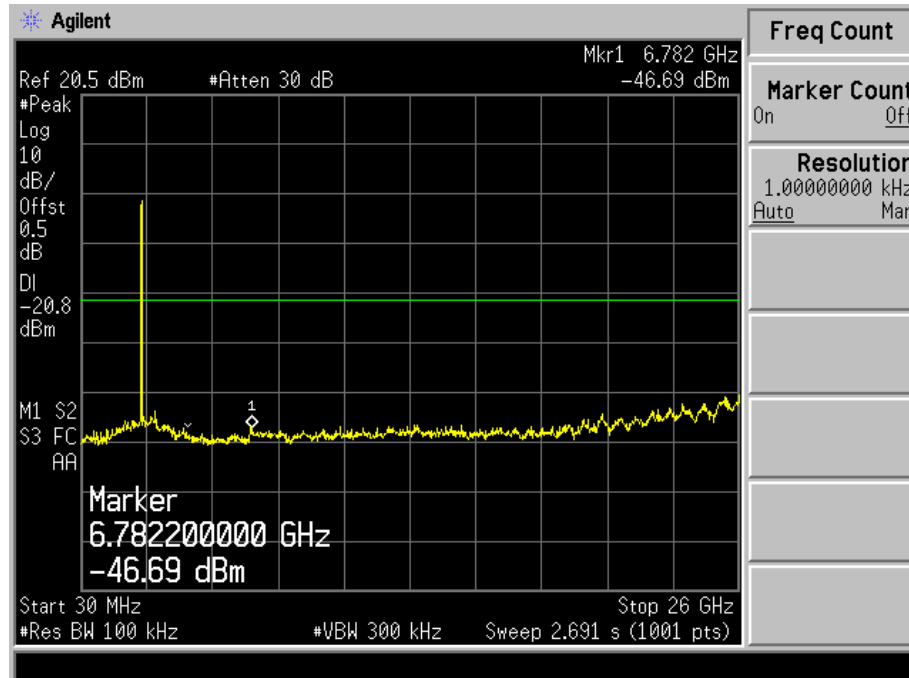
Middle



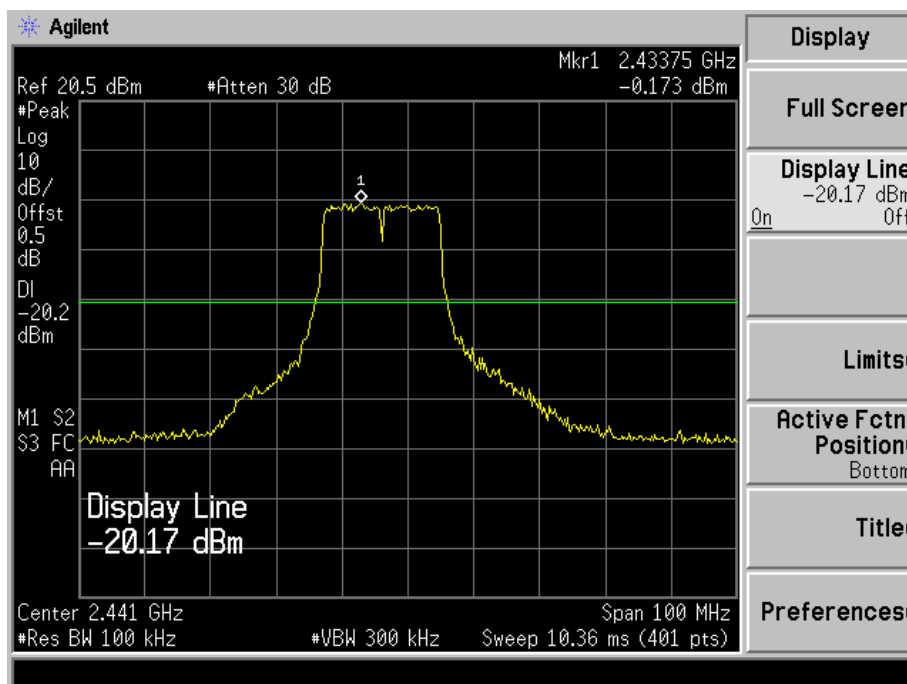
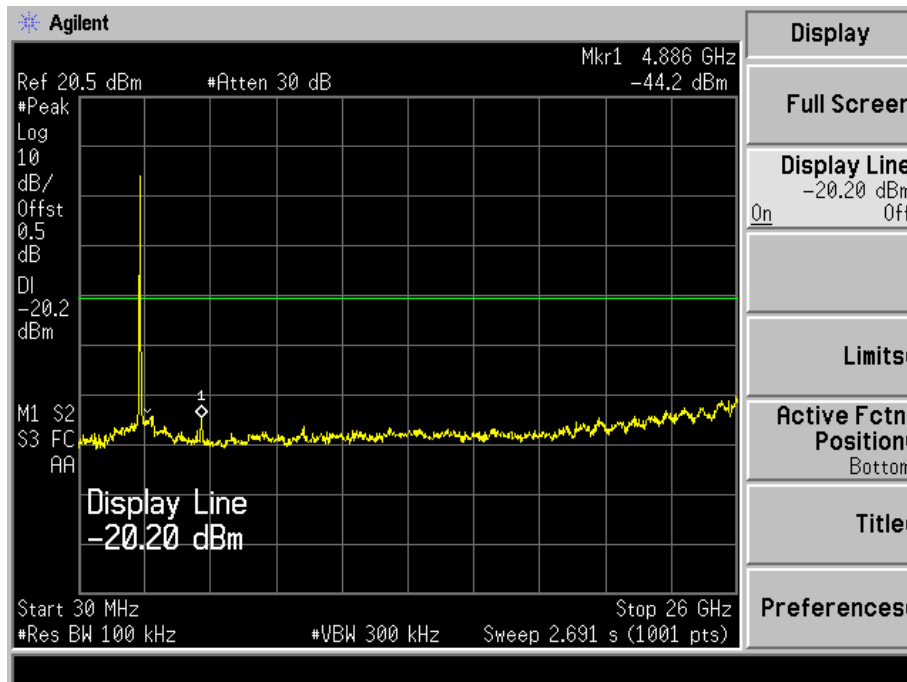
Highest



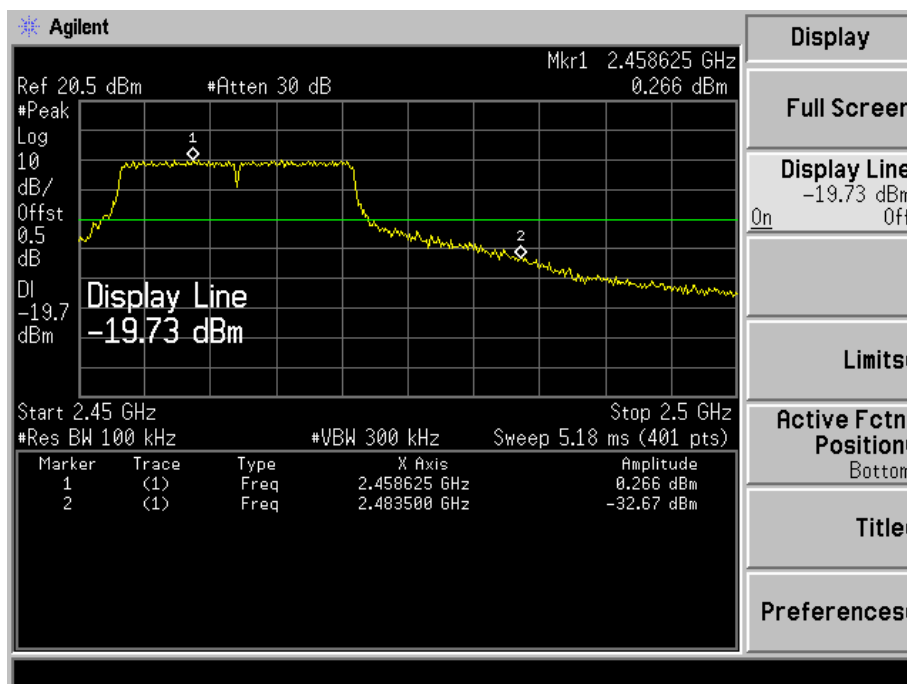
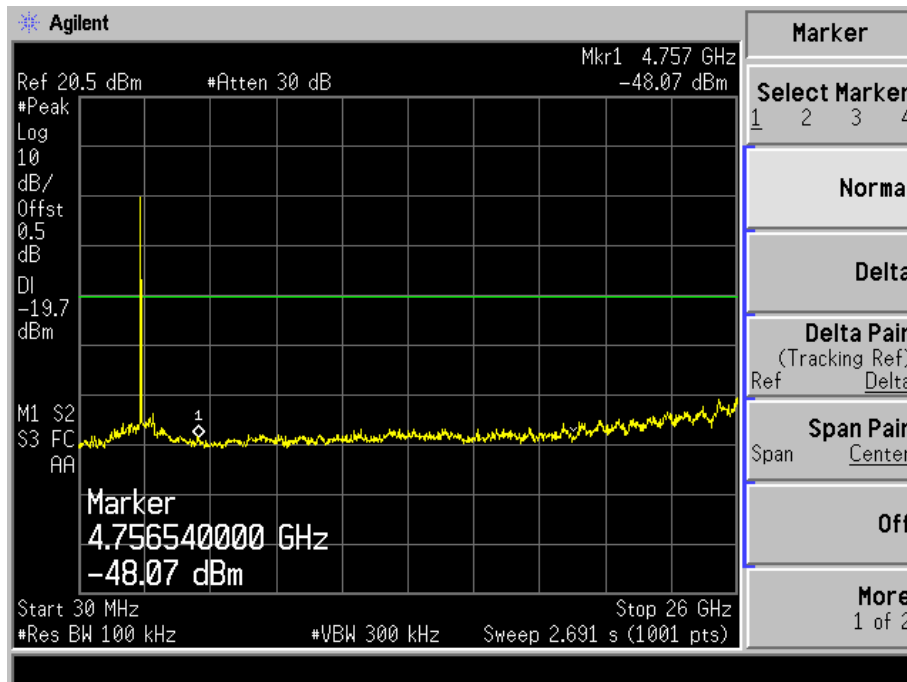
Spurious (Conducted)
802.11n-HT20-Lowest
Lowest



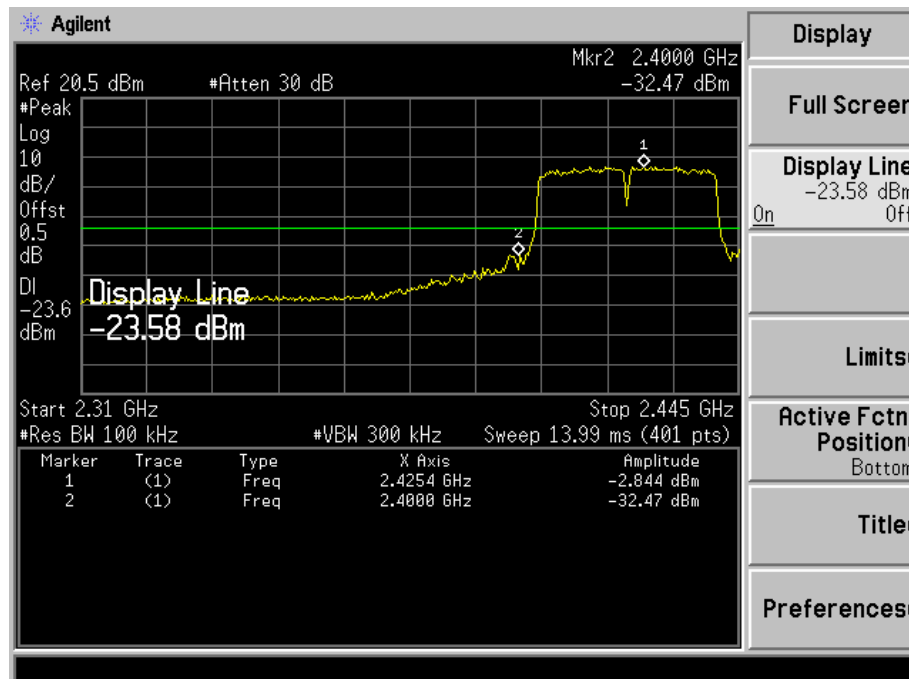
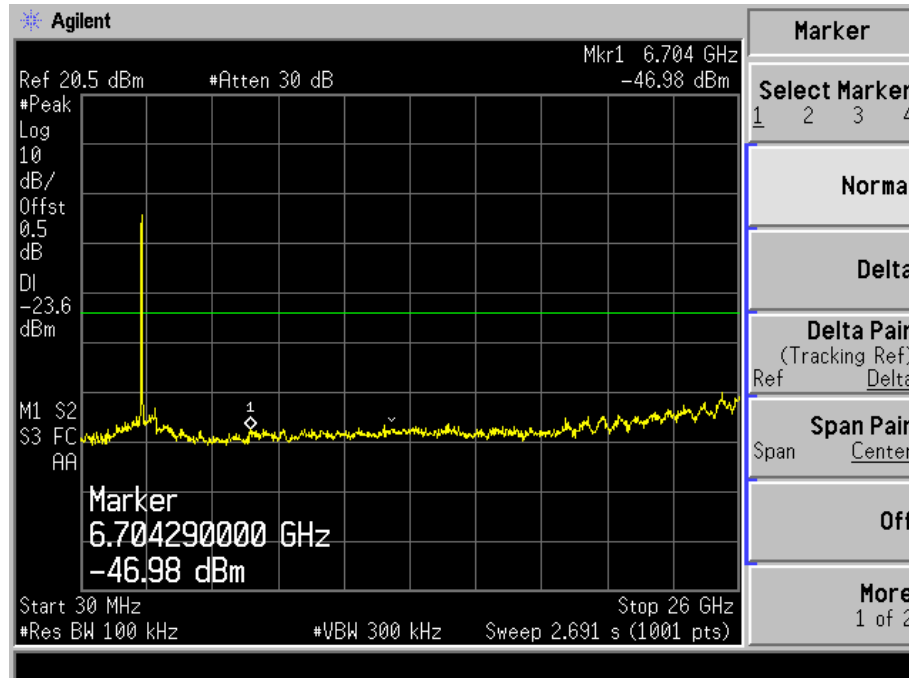
Middle



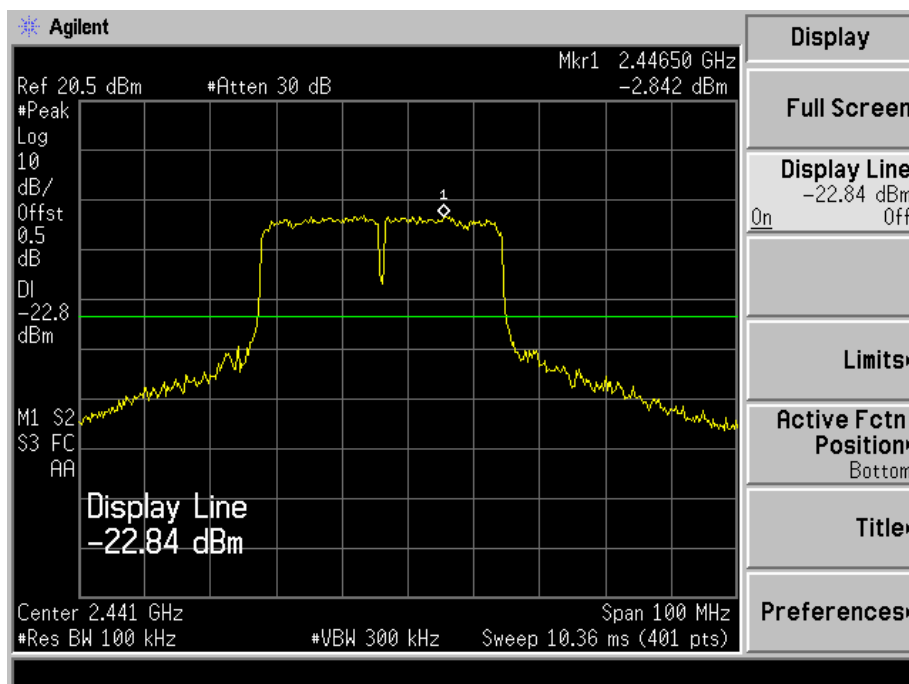
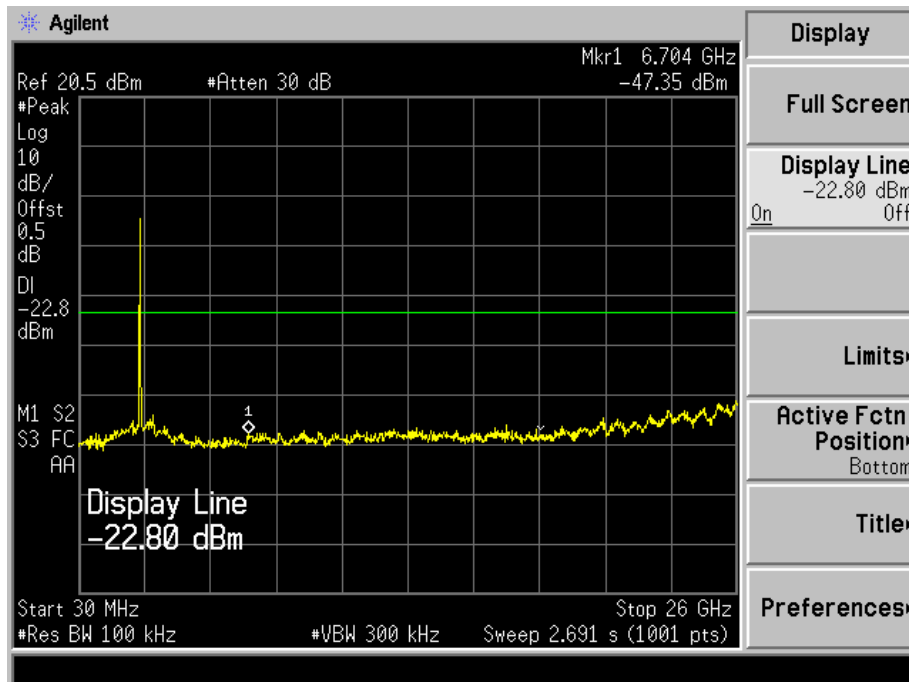
Highest



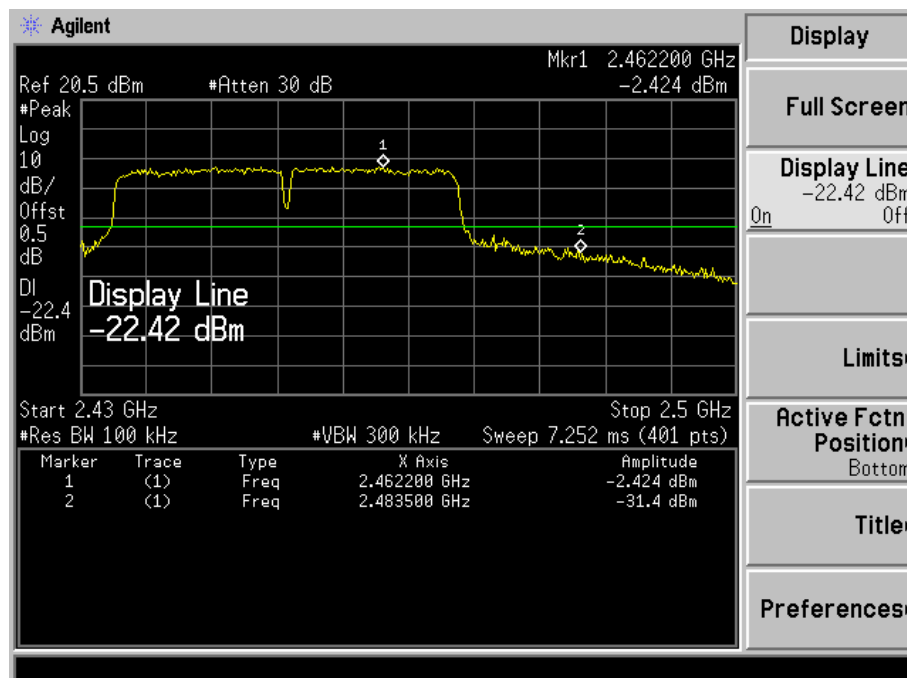
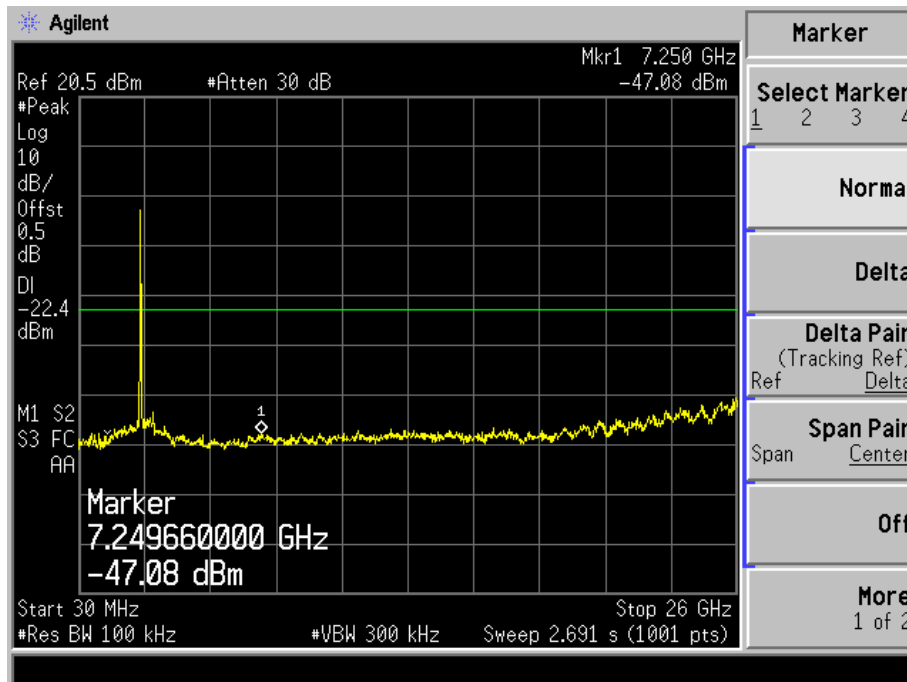
Spurious (Conducted)
802.11n-HT40-Lowest
Lowest



Middle



Highest



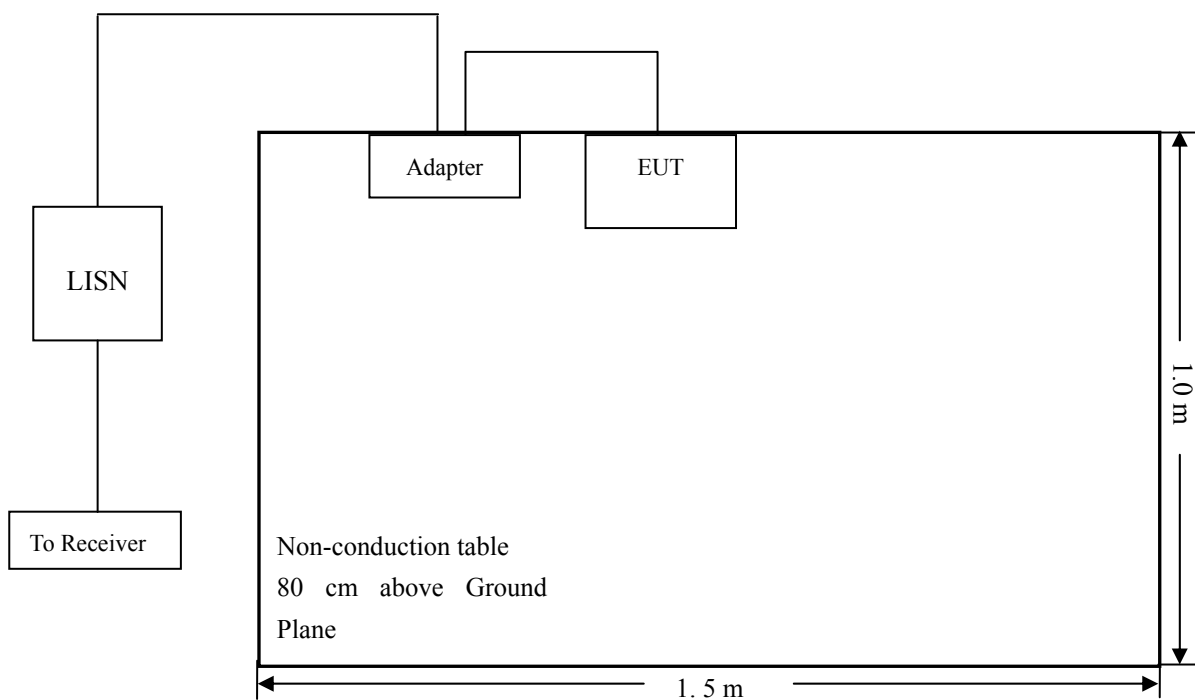
10. Conducted Emissions

10.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 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 Environmental Conditions

Temperature:	25 C
Relative Humidity:	52
ATM Pressure:	1012 mbar

10.4 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

10.5 Summary of Test Results/Plots

According to the data in section 10.6, the EUT complied with the FCC Part 15.207 Conducted margin for this device, with the *worst* margin reading of:

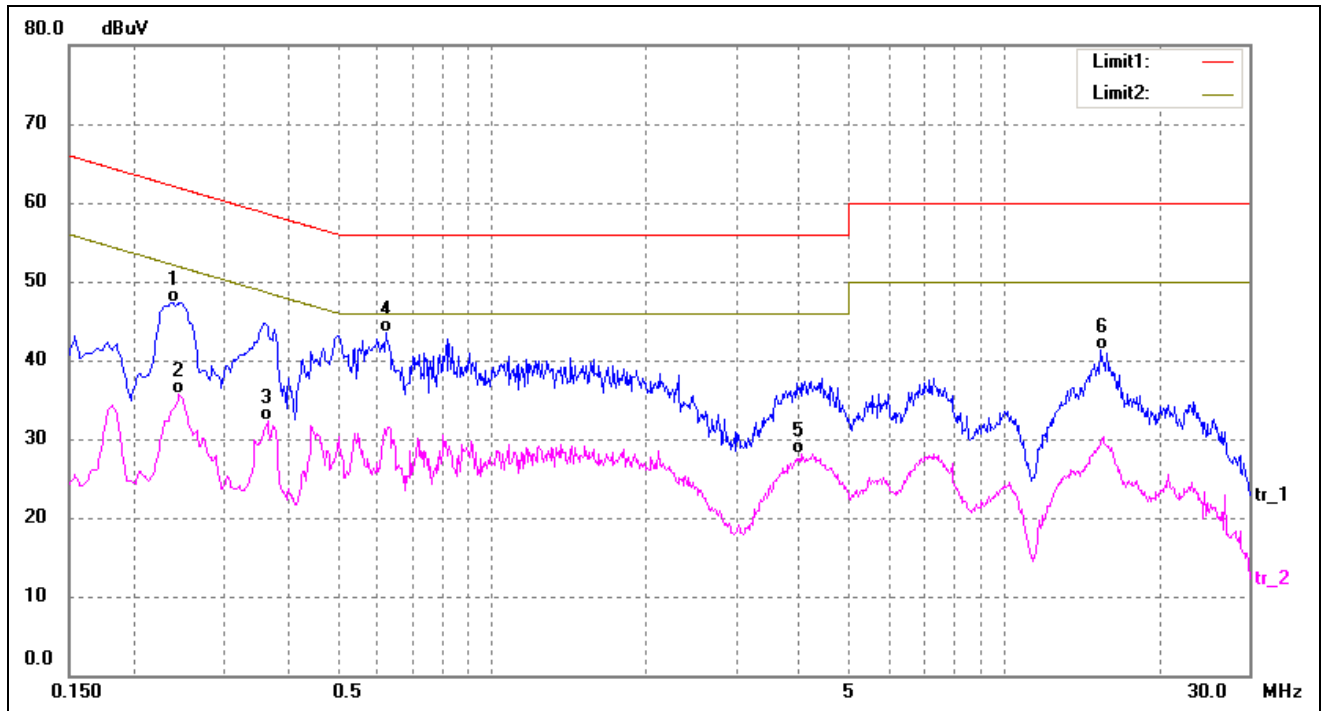
-11.61 dB at 0.5100 MHz in the Line mode, QP detector, 0.15-30MHz

10.6 Conducted Emissions Test Data

Plot of Conducted Emissions Test Data

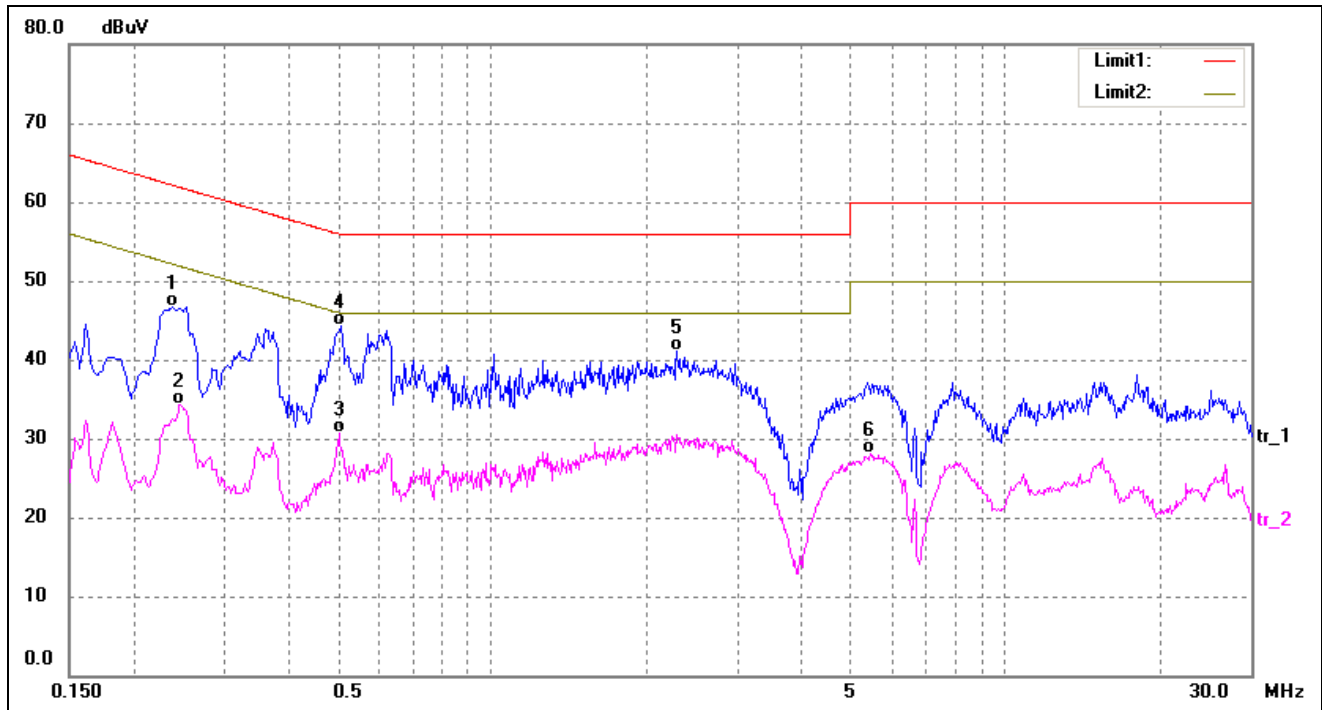
EUT: LM823 Wi-Fi SMT Module 802.11n IPEX_EUS_-20c
Tested Model: LM823
Operating Condition: Transmitting(Wi-Fi)
Comment: DC 3.3V~5V

Test Specification: Neutral



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.2380	37.53	9.80	47.33	62.17	-14.84	QP
2	0.2460	25.83	9.80	35.63	51.89	-16.26	AVG
3	0.3660	22.44	9.80	32.24	48.59	-16.35	AVG
4*	0.6220	33.69	9.79	43.48	56.00	-12.52	QP
5	4.0220	18.44	9.68	28.12	46.00	-17.88	AVG
6	15.4100	31.72	9.62	41.34	60.00	-18.66	QP

Test Specification: Line



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.2380	36.86	9.80	46.66	62.17	-15.51	QP
2	0.2460	24.58	9.80	34.38	51.89	-17.51	AVG
3	0.5020	20.88	9.80	30.68	46.00	-15.32	AVG
4*	0.5100	34.59	9.80	44.39	56.00	-11.61	QP
5	2.2900	31.45	9.73	41.18	56.00	-14.82	QP
6	5.4700	18.54	9.65	28.19	50.00	-21.81	AVG

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