

FCC Test Report

Product Name	MOXA IEEE 802.11a/n/ac 4*4 module
Model No	WAPC002
FCC ID.	SLE-WAPC002

Applicant	MOXA Inc.
Address	FL.4, NO. 135. LANE 235, BAOQIAO RD. XINDIAN DIST.,NEW TAIPEI CITY, TAIWAN

Date of Receipt	Mar. 29, 2018
Issue Date	Sep. 25, 2019
Report No.	1870151R-RFUSP33V00
Report Version	V1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.

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Test Report

Issue Date: Sep. 25, 2019

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Applicant	MOXA Inc.
Address	FL.4, NO. 135. LANE 235, BAOQIAO RD. XINDIAN DIST.,NEW TAIPEI CITY, TAIWAN
Manufacturer	MOXA Inc.
Model No.	WAPC002
EUT Rated Voltage	DC 24~110V
EUT Test Voltage	DC 24V
Trade Name	MOXA
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2017 ANSI C63.4: 2014, ANSI C63.10: 2013
Test Result	Complied

Documented By

:



(Senior Adm. Specialist / Genie Chang)

Tested By

:



(Engineer / Sam Hsu)

Approved By

:



(Director / Vincent Lin)

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1. GENERAL INFORMATION

1.1. EUT Description

Product Name	MOXA IEEE 802.11a/n/ac 4*4 module
Trade Name	MOXA
Model No.	WAPC002
FCC ID.	SLE-WAPC002
Frequency Range	802.11b/g/n-20MHz:2412-2462MHz,802.11n-40MHz:2422-2452MHz
Number of Channels	802.11b/g/n-20MHz: 11, n-40MHz: 7
Data Speed	802.11b: 1-11Mbps, 802.11a/g: 6-54Mbps, 802.11n: up to 600Mbps
Type of Modulation	802.11b:DSSS, DBPSK, DQPSK, CCK 802.11g/n: OFDM, BPSK, QPSK, 16QAM, 64QAM
Antenna Type	Panel Antenna, Omni-directional Antenna, Railway Antenna, Sector Antenna, Patch Antenna
Antenna Gain	Refer to the table “Antenna List”
Channel Control	Auto
Contains Module	FCC ID: SLE-WAPC002

802.11b/g/n-20MHz Center Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 01:	2412 MHz	Channel 02:	2417 MHz	Channel 03:	2422 MHz	Channel 04:	2427 MHz
Channel 05:	2432 MHz	Channel 06:	2437 MHz	Channel 07:	2442 MHz	Channel 08:	2447 MHz
Channel 09:	2452 MHz	Channel 10:	2457 MHz	Channel 11:	2462 MHz		

802.11n-40MHz (2.4G Band) Center Working Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 03:	2422 MHz	Channel 04:	2427 MHz	Channel 05:	2432 MHz	Channel 06:	2437 MHz
Channel 07:	2442 MHz	Channel 08:	2447 MHz	Channel 09:	2452 MHz		

Test Condition			Test Item	
			Radiated Emission	
Antenna Type	Part No.	Antenna Gain (dBi)	Radiated Emission	Band Edge
No.1 Panel	MAT-WDB-PA-NF-2-0708	7.63dBi For 2.4GHz 8.77dBi for 5.15~5.25GHz 8.77dBi for 5.25~5.35GHz 8.50dBi for 5.47~5.725GHz 8.18dBi for 5.725~5.825GHz	✓	✓
No.14 Omni	ANT-WDB-ARM-02	2.04dBi For 2.4GHz 0.81dBi for 5GHz	✓	✓
No.20 Railway	MHH-A11-XX110170-X0	9dBi For 2.4GHz 8.0dBi for 5GHz	✓	✓
No.21 Sector	WI25-A1-1215053-X0	12dBi For 2.4GHz 15dBi for 5GHz	✓	✓
No.22 Patch	TOP 200 AMR MF-05-4	8.2dBi For 2.4GHz 8.5dBi for 5GHz	✓	✓

Note: The worst case according to the has both 2.4GHz and 5GHz antenna.

Note:

1. This device is a MOXA IEEE 802.11a/n/ac 4*4 module with a built-in 802.11a/b/g/n/ac WLAN ,this report for 2.4GHz WLAN
2. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.
3. Lowest and highest data rates are tested in each mode. Only worst case is shown in the report. (802.11b is 1Mbps 、802.11g is 6Mbps 、802.11n(20M-BW) is 28.8Mbps and, 802.11n(40M-BW) is 60Mbps).
4. At result of pretests, module supports dual-channel transmission, only the worst case is shown in the report. (802.11b is chain A, 802.11g is chain A)
5. These tests are conducted on a sample for the purpose of demonstrating compliance of 802.11b/g/n transmitter with Part 15 Subpart C Paragraph 15.247 of spread spectrum devices.
6. This device contains the two signal modules certified FCC ID: SLE-WAPC002 and FCC ID: SLE-WAPN010

Test Mode: (Simultaneous Transmit)	Mode 1: Transmit (802.11b 1Mbps)
	Mode 2: Transmit (802.11g 6Mbps)
	Mode 3: Transmit (802.11n-20BW_28.8Mbps)
	Mode 4: Transmit (802.11n-40BW_60Mbps)

Test Condition	Test Item	
	Radiated Emission	
Antenna Type	Radiated Emission	Band Edge
No.1 Panel	2.4G b 2437MHz + 5G a 5745MHz	2.4G n20 2412MHz + 5G ac80 5210MHz 5G n20 5745MHz
No.14 Omni	2.4G b 2437MHz + 5G a 5785MHz	2.4G n20 2462MHz + 5G ac80 5210MHz 5G n40 5670MHz
No.20 Railway	2.4G b 2412MHz + 5G a 5700MHz	2.4G n20 2412MHz + 5G ac80 5290MHz 5G n20 5500MHz
No.21 Sector	2.4G b 2437MHz + 5G a 5240MHz	2.4G g 2412MHz + 5G ac80 5290MHz 5G ac80 5530MHz
No.22 Patch	2.4G b 2412MHz + 5G a 5700MHz	2.4G g 2412MHz + 5G n40 5310MHz 5G ac80 5530MHz

Note: The worst case according to the Original report.

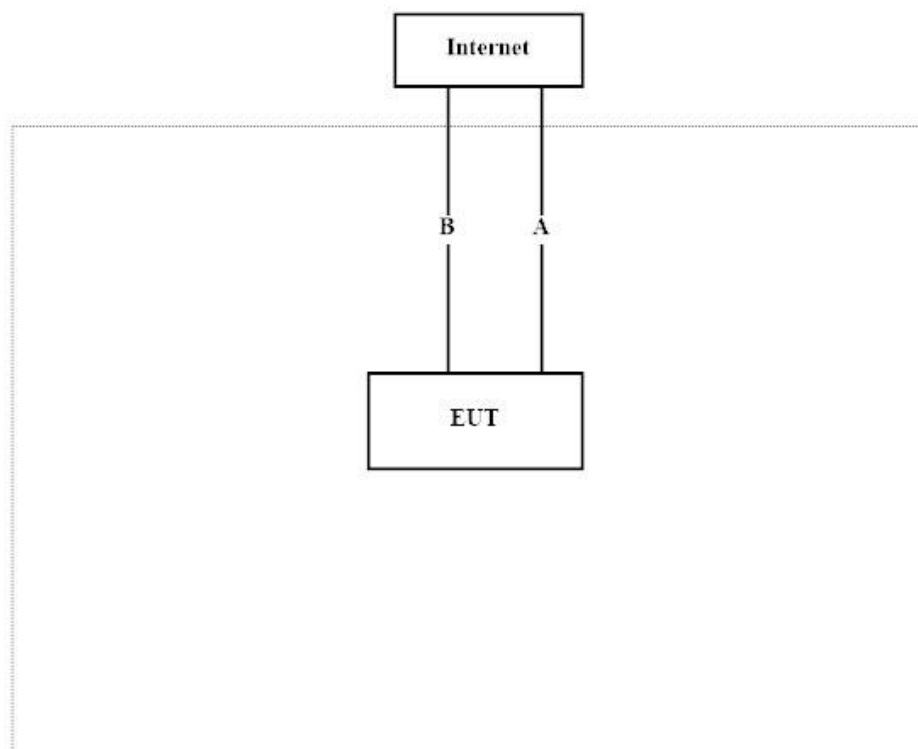
1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Power Cord
N/A				

Signal Cable Type		Signal cable Description
A	LAN Cable	Shielded, 2m
B	RS-232 Cable	Non-shielded, 1.5m

1.4. Configuration of Tested System



1.5. EUT Exercise Software

- (1) Setup the EUT as shown on 1.4
- (2) Execute “QRCT Ver. 3.0.210.0” program on the Notebook PC.
- (3) Configure the test mode, the test channel, and the data rate.
- (4) Start the continuous transmission.
- (5) Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	50-65
Barometric pressure (mbar)	860-1060	950-1000

USA : FCC Registration Number: TW3023

Canada : IC Registration Number: 4075A

Site Description: Accredited by TAF
Accredited Number: 3023

Test Laboratory: DEKRA Testing and Certification Co., Ltd
Address: No.5-22, Ruishukeng, Linkou Dist., New Taipei City 24451,
Taiwan, R.O.C.
Phone number: 886-2-8601-3788
Fax number: 886-2-8601-3789
Email address: info.tw@dekra.com
Website: <http://www.dekra.com.tw>

1.7. List of Test Equipment

For Conducted measurements /CB3/SR8

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Date	Due. Date
	Temperature Chamber	WIT GROUP	TH-1S-B	EQ-201-00146	2019/02/26	2020/02/25
	Spectrum Analyzer	Agilent	N9010A	MY48030495	2018/09/27	2019/09/26
	Peak Power Analyzer	Keysight	8990B	MY51000410	2019/07/30	2020/07/29
	Wideband Power Sensor	Keysight	N1923A	MY56080003	2019/07/30	2020/07/29
	Wideband Power Sensor	Keysight	N1923A	MY56080004	2019/07/30	2020/07/29
	EMI Test Receiver	R&S	ESCS 30	100369	2018/11/19	2019/11/18
	LISN	R&S	ESH3-Z5	836679/017	2019/04/10	2020/04/09
	LISN	R&S	ENV216	100097	2019/04/10	2020/04/09
	Coaxial Cable	DEKRA	RG 400	LC018-RG	2018/06/21	2019/06/20

For Radiated measurements /Site3/CB8

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Date	Due. Date
X	Spectrum Analyzer	R&S	FSP40	100170	2019/03/11	2020/03/10
X	Loop Antenna	Teseq	HLA6121	37133	2017/10/13	2019/10/12
X	Bilog Antenna	Schaffner Chase	CBL6112B	2707	2019/06/23	2020/06/22
X	Coaxial Cable	DEKRA	RG 214	LC003-RG	2019/06/13	2020/06/12
X	Pre-Amplifier	Jet-Power	JPA-10M1G33	170101000330010	2019/06/13	2020/06/12
X	Horn Antenna	ETS-Lindgren	3117	00135205	2019/04/30	2020/04/29
X	Pre-Amplifier	EMCI	EMC012630SE	980210	2018/12/18	2019/12/17
X	Coaxial Cable	DEKRA	SF-106	LC035/37/41-SF	2019/04/16	2020/04/15
X	Amplifier + Cable	EMCI	EMC184045SE	980370	2019/01/19	2020/01/18
X	Horn Antenna	Com-Power	AH-840	101043	2019/03/27	2020/03/26
X	Filter	MicroTRON	BRM50701	019	2019/08/08	2020/08/07
X	Filter	Microwave Circuits	N0257881	36681	2019/08/08	2020/08/07

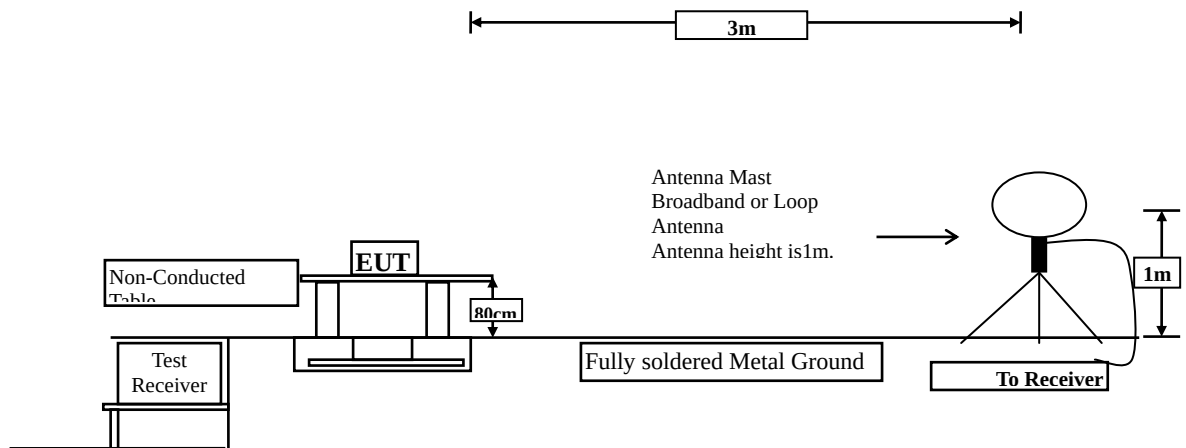
Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version :QuieTek EMI 2.0 V2.1.113.

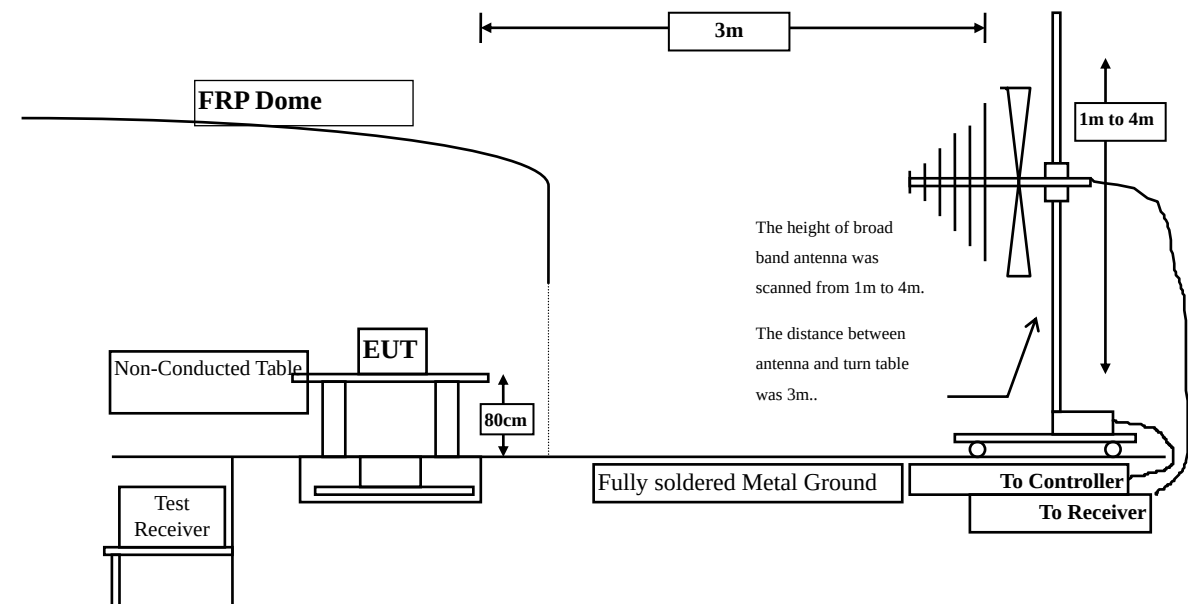
2. Radiated Emission

2.1. Test Setup

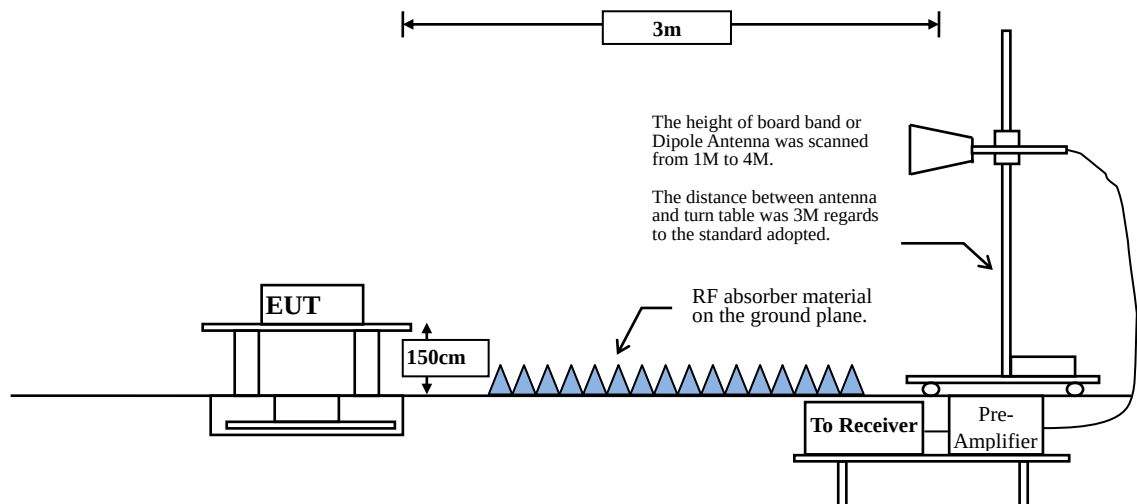
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



2.2. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dBuV/m) = 20 log E field strength (uV/m)

2.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground, when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The worst radiated emission is measured in the Open Area Test Site on the Final Measurement.

The measurement frequency range from 9kHz - 10th Harmonic of fundamental was investigated.

RBW and VBW Parameter setting:

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

$VBW \geq 3 \times RBW$.

Table 1 —RBW as a function of frequency

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

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle $\geq 98\%$

$VBW \geq 1/T$, when duty cycle $< 98\%$

(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
802.11 b	99.31	--	--	10
802.11 g	95.30	2.0580	486	500
802.11 n20	98.28	4.9855	201	10
802.11 n40	96.51	2.4058	416	500

Note: Duty Cycle Refer to Section 9

2.4. Uncertainty

± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

2.5. Test Result of Radiated Emission

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Harmonic Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/18
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437 MHz) (Antenna No.1)

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
Horizontal					
Peak Detector:					
4874.000	-14.467	55.350	40.883	-33.117	74.000
7311.000	-12.418	66.690	54.272	-19.728	74.000
9748.000	-10.653	63.370	52.717	-21.283	74.000
Average Detector:					
7311.000	-12.418	60.280	47.862	-6.138	54.000
Vertical					
Peak Detector:					
4874.000	-14.467	55.560	41.093	-32.907	74.000
7311.000	-12.418	67.000	54.582	-19.418	74.000
9748.000	-10.653	63.680	53.027	-20.973	74.000
Average Detector:					
7311.000	-12.418	61.360	48.942	-5.058	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Harmonic Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/18
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2462 MHz) (Antenna No.14)

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
Horizontal					
Peak Detector:					
4874.000	-14.467	57.340	42.873	-31.127	74.000
7311.000	-12.418	65.900	53.482	-20.518	74.000
9748.000	-10.653	66.530	55.877	-18.123	74.000
Average Detector:					
9748.000	-10.653	58.340	47.687	-6.313	54.000
Vertical					
Peak Detector:					
4874.000	-14.467	57.720	43.253	-30.747	74.000
7311.000	-12.418	65.950	53.532	-20.468	74.000
9748.000	-10.653	63.660	53.007	-20.993	74.000
Average Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Harmonic Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2412 MHz) (Antenna No.20)

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
Horizontal					
Peak Detector:					
4824.000	-15.017	56.230	41.213	-32.787	74.000
7236.000	-11.893	64.530	52.637	-21.363	74.000
9648.000	-11.454	62.330	50.876	-23.124	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4824.000	-15.017	56.550	41.533	-32.467	74.000
7236.000	-11.893	65.080	53.187	-20.813	74.000
9648.000	-11.454	60.540	49.086	-24.914	74.000
Average Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Harmonic Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437 MHz) (Antenna No.21)

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
Horizontal					
Peak Detector:					
4874.000	-14.467	55.600	41.133	-32.867	74.000
7311.000	-12.418	67.920	55.502	-18.498	74.000
9748.000	-10.653	64.630	53.977	-20.023	74.000
Average Detector:					
7311.000	-12.418	62.520	50.102	-3.898	54.000
Vertical					
Peak Detector:					
4874.000	-14.467	56.460	41.993	-32.007	74.000
7311.000	-12.418	70.780	58.362	-15.638	74.000
9748.000	-10.653	64.450	53.797	-20.203	74.000
Average Detector:					
7311.000	-12.418	65.930	53.512	-0.488	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Harmonic Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2412MHz) (Antenna No.22)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
Peak Detector:					
4824.000	-15.017	56.300	41.283	-32.717	74.000
7236.000	-11.893	64.500	52.607	-21.393	74.000
9648.000	-11.454	61.330	49.876	-24.124	74.000
Average Detector:					
--					
Vertical					
Peak Detector:					
4824.000	-15.017	56.240	41.223	-32.777	74.000
7236.000	-11.893	65.600	53.707	-20.293	74.000
9648.000	-11.454	60.000	48.546	-25.454	74.000
Average Detector:					
--					

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : General Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437 MHz) (Antenna No.1)

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV/m	Margin dB	Limit dBuV/m
Horizontal					
179.014	-19.386	54.185	34.799	-8.701	43.500
371.609	-12.315	43.497	31.182	-14.818	46.000
499.536	-10.867	43.538	32.672	-13.328	46.000
600.754	-6.657	42.499	35.843	-10.157	46.000
700.565	-9.152	45.860	36.708	-9.292	46.000
839.739	-8.377	37.631	29.254	-16.746	46.000
Vertical					
124.188	-16.558	51.363	34.805	-8.695	43.500
249.304	-17.969	46.209	28.240	-17.760	46.000
326.623	-14.018	42.294	28.277	-17.723	46.000
586.696	-7.204	37.158	29.954	-16.046	46.000
800.377	-8.930	39.308	30.378	-15.622	46.000
942.362	-8.762	37.087	28.325	-17.675	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : General Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437 MHz) (Antenna No.14)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
170.580	-20.172	56.475	36.302	-7.198	43.500
249.304	-17.969	49.684	31.715	-14.285	46.000
499.536	-10.867	42.815	31.949	-14.051	46.000
600.754	-6.657	42.572	35.916	-10.084	46.000
700.565	-9.152	46.854	37.702	-8.298	46.000
900.188	-9.837	39.344	29.507	-16.493	46.000
Vertical					
127.000	-16.313	52.015	35.702	-7.798	43.500
302.725	-14.612	50.111	35.499	-10.501	46.000
439.087	-9.871	35.845	25.974	-20.026	46.000
592.319	-6.946	36.352	29.405	-16.595	46.000
700.565	-9.152	39.392	30.240	-15.760	46.000
874.884	-8.407	36.756	28.349	-17.651	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : General Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2412 MHz) (Antenna No.20)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
187.449	-18.895	50.805	31.910	-11.590	43.500
250.710	-17.940	50.348	32.407	-13.593	46.000
371.609	-12.315	44.160	31.845	-14.155	46.000
600.754	-6.657	42.515	35.859	-10.141	46.000
700.565	-9.152	46.193	37.041	-8.959	46.000
800.377	-8.930	41.468	32.538	-13.462	46.000
Vertical					
166.362	-20.416	49.666	29.250	-14.250	43.500
326.623	-14.018	43.397	29.380	-16.620	46.000
440.493	-9.775	36.192	26.418	-19.582	46.000
599.348	-6.631	36.341	29.710	-16.290	46.000
751.174	-6.727	36.744	30.017	-15.983	46.000
815.841	-9.010	36.900	27.890	-18.110	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : General Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2437 MHz) (Antenna No.21)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
174.797	-19.781	55.267	35.486	-8.014	43.500
247.899	-18.059	50.101	32.041	-13.959	46.000
373.014	-12.268	42.942	30.675	-15.325	46.000
600.754	-6.657	42.030	35.374	-10.626	46.000
700.565	-9.152	47.017	37.865	-8.135	46.000
800.377	-8.930	41.267	32.337	-13.663	46.000
Vertical					
146.681	-19.104	51.639	32.535	-10.965	43.500
302.725	-14.612	50.033	35.421	-10.579	46.000
458.768	-10.460	36.572	26.112	-19.888	46.000
606.377	-7.066	36.808	29.742	-16.258	46.000
749.768	-6.569	37.954	31.385	-14.615	46.000
859.420	-8.409	37.081	28.672	-17.328	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : General Radiated Emission Data
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 1: Transmit (802.11b 1Mbps) (2412 MHz) (Antenna No.22)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
Horizontal					
164.957	-20.490	55.734	35.245	-8.255	43.500
373.014	-12.268	44.732	32.465	-13.535	46.000
499.536	-10.867	43.494	32.628	-13.372	46.000
600.754	-6.657	42.810	36.154	-9.846	46.000
700.565	-9.152	46.689	37.537	-8.463	46.000
845.362	-8.301	37.991	29.690	-16.310	46.000
Vertical					
142.464	-18.164	52.420	34.255	-9.245	43.500
250.710	-17.940	45.217	27.276	-18.724	46.000
453.145	-10.262	36.645	26.384	-19.616	46.000
595.130	-6.823	36.779	29.956	-16.044	46.000
749.768	-6.569	37.128	30.559	-15.441	46.000
870.667	-8.416	36.522	28.106	-17.894	46.000

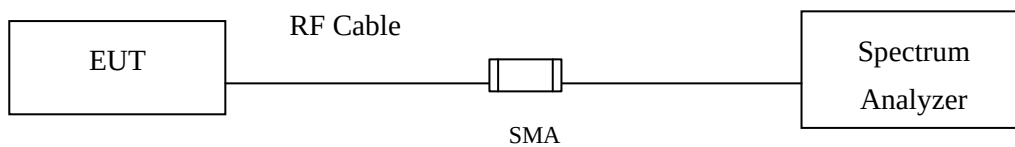
Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

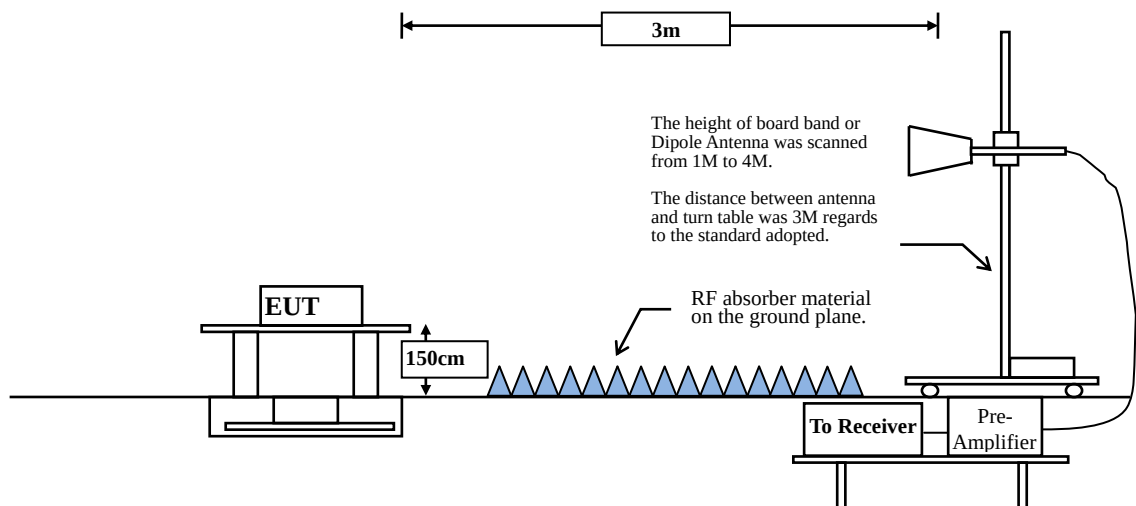
3. Band Edge

3.1. Test Setup

RF Conducted Measurement



RF Radiated Measurement:



3.2. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

3.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

RBW and VBW Parameter setting:

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

VBW $\geq 3 \times$ RBW.

Table 1 —RBW as a function of frequency

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

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle $\geq 98 \%$

VBW $\geq 1/T$, when duty cycle $< 98 \%$

(T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
802.11 b	99.31	--	--	10
802.11 g	95.30	2.0580	486	500
802.11 n20	98.28	4.9855	201	500
802.11 n40	96.51	2.4058	416	500

Note: Duty Cycle Refer to Section 9

3.4. Uncertainty

± 4.08 dB above 1GHz

± 4.22 dB below 1GHz

3.5. Test Result of Band Edge

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/18
 Test Mode : Mode 3: Transmit (802.11n-20BW_28.8Mbps) (2412MHz) (Antenna No.1)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
01 (Peak)	2390.000	8.763	51.222	59.985	74.00	54.00	Pass
01 (Peak)	2400.000	8.799	70.020	78.819	--	--	--
01 (Peak)	2411.159	8.839	96.058	104.897	--	--	--
01 (Average)	2390.000	8.763	32.247	41.010	74.00	54.00	Pass
01 (Average)	2400.000	8.799	41.650	50.449	--	--	--
01 (Average)	2414.203	8.850	82.725	91.574	--	--	--

Figure Channel 01: Horizontal (Peak)

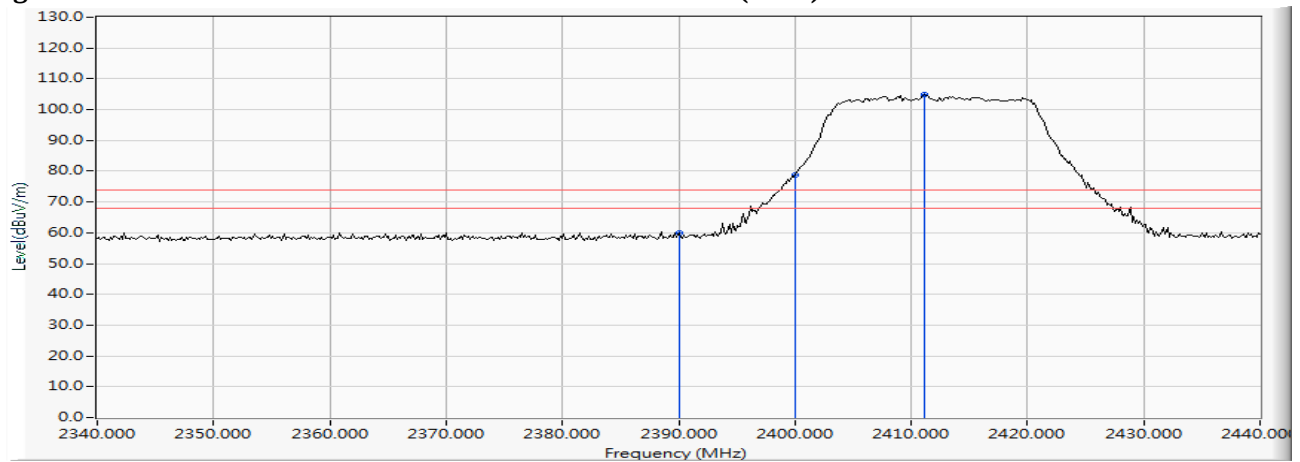
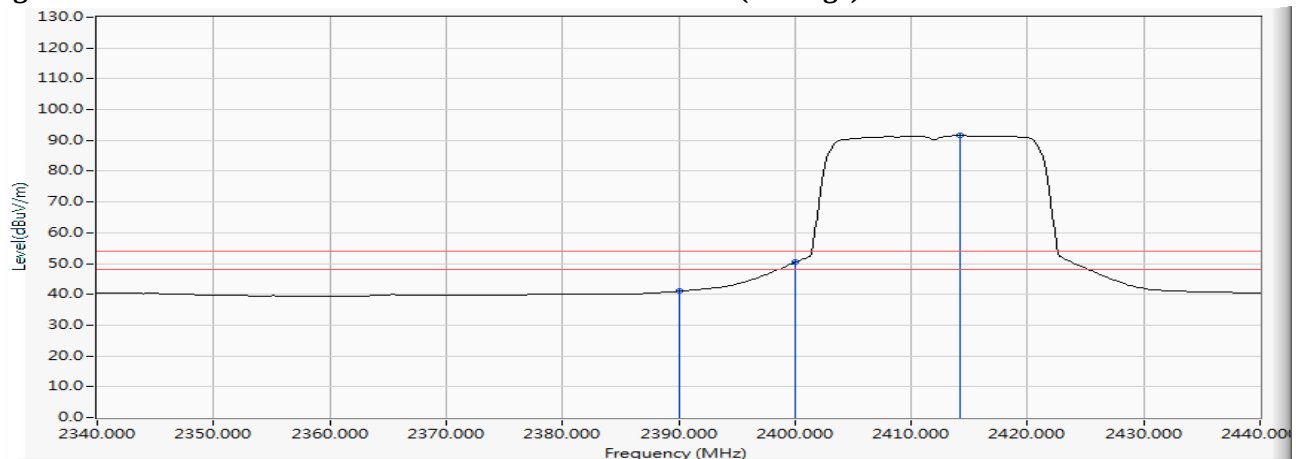


Figure Channel 01: Horizontal (Average)



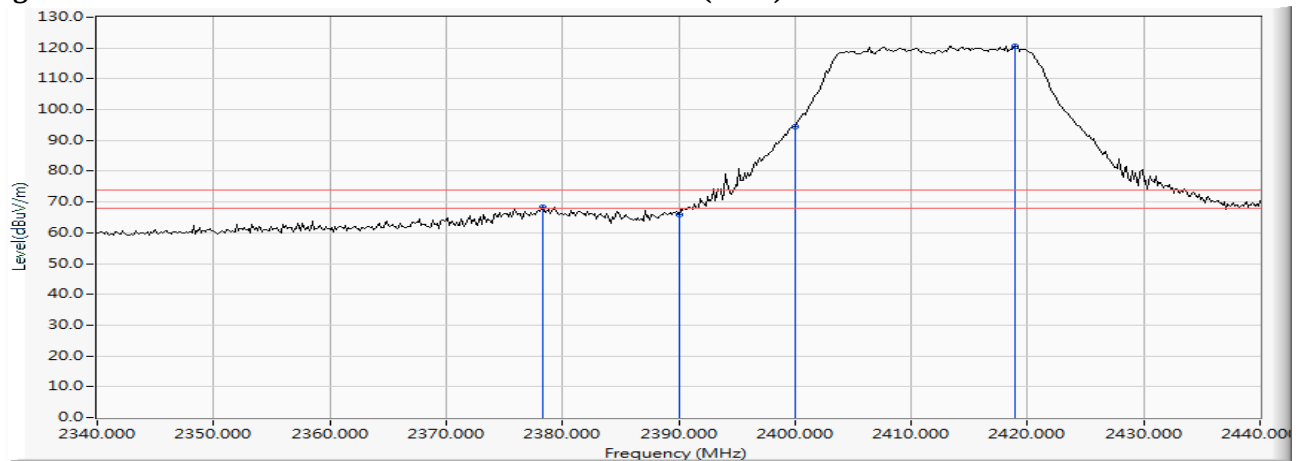
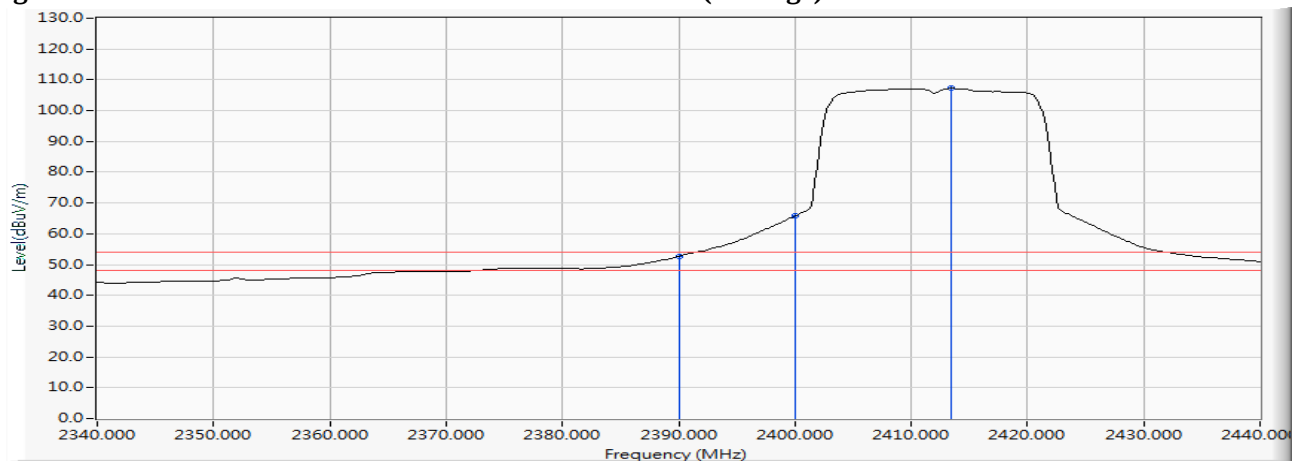
Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/18
 Test Mode : Mode 3: Transmit (802.11n-20BW_28.8Mbps) (2412MHz) (Antenna No.1)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
01 (Peak)	2378.261	8.721	59.477	68.198	74.00	54.00	Pass
01 (Peak)	2390.000	8.763	57.141	65.904	74.00	54.00	Pass
01 (Peak)	2400.000	8.799	85.758	94.557	--	--	--
01 (Peak)	2418.986	8.867	111.796	120.663	--	--	--
01 (Average)	2390.000	8.763	43.983	52.746	74.00	54.00	Pass
01 (Average)	2400.000	8.799	56.962	65.761	--	--	--
01 (Average)	2413.478	8.847	98.351	107.198	--	--	--

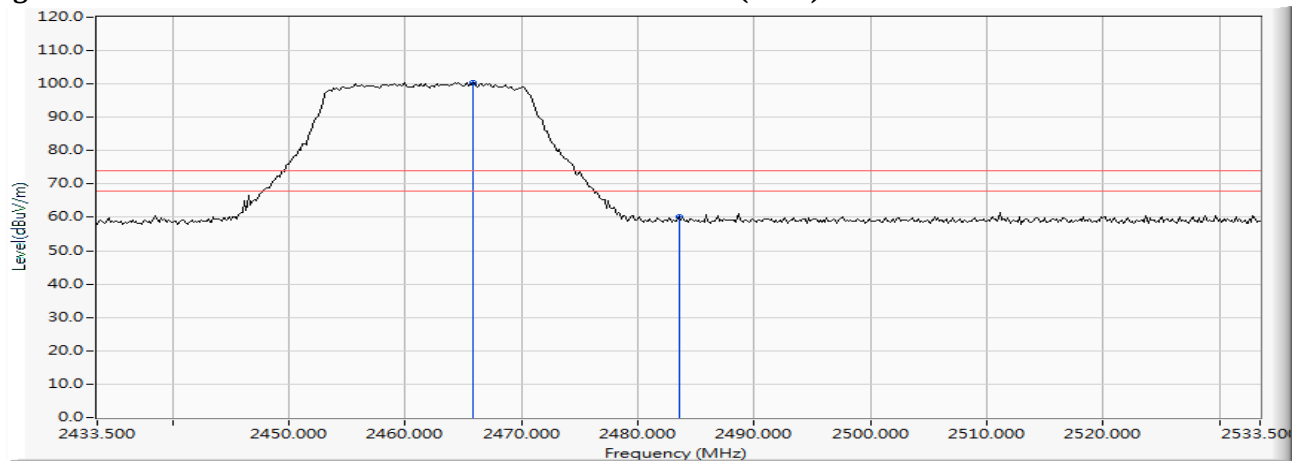
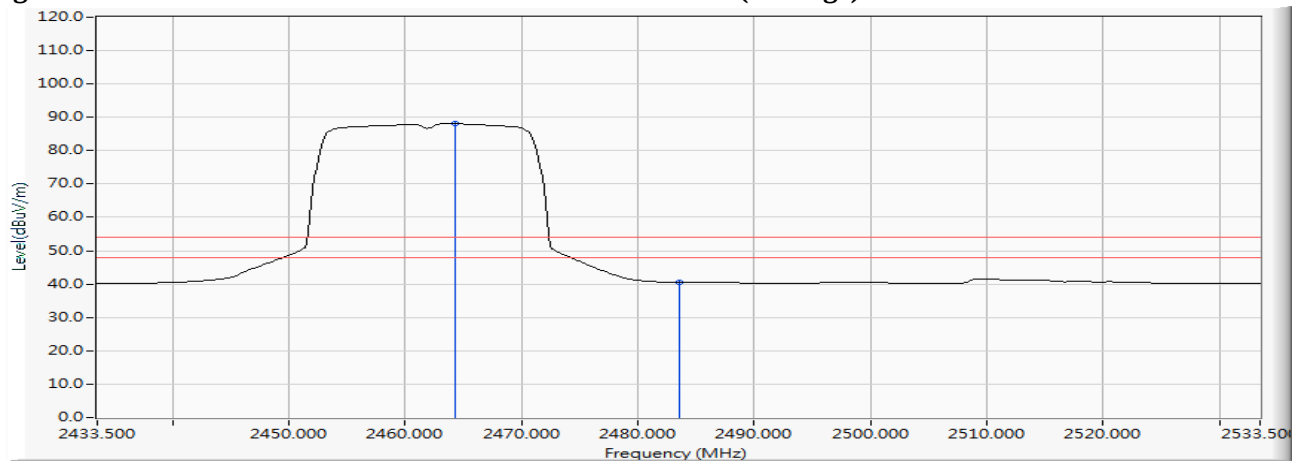
Figure Channel 01: Vertical (Peak)**Figure Channel 01: Vertical (Average)****Note:**

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/18
 Test Mode : Mode 3: Transmit (802.11n-20BW_28.8Mbps) (2462MHz) (Antenna No.14)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
01 (Peak)	2465.819	9.035	91.408	100.444	--	--	--
01 (Peak)	2483.500	9.100	50.903	60.002	74.00	54.00	Pass
01 (Average)	2464.225	9.031	79.060	88.090	--	--	--
01 (Average)	2483.500	9.100	31.461	40.560	74.00	54.00	Pass

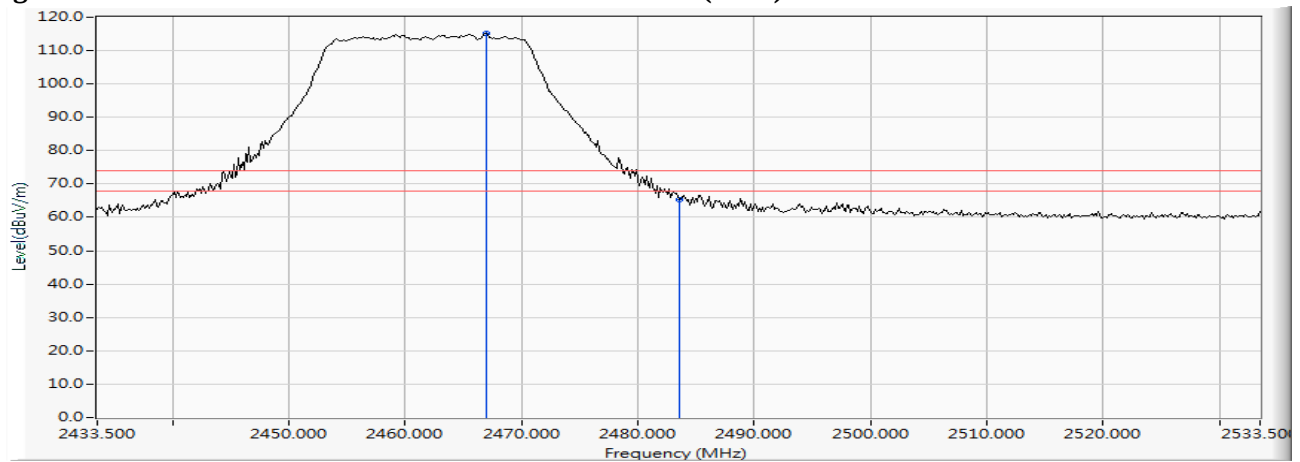
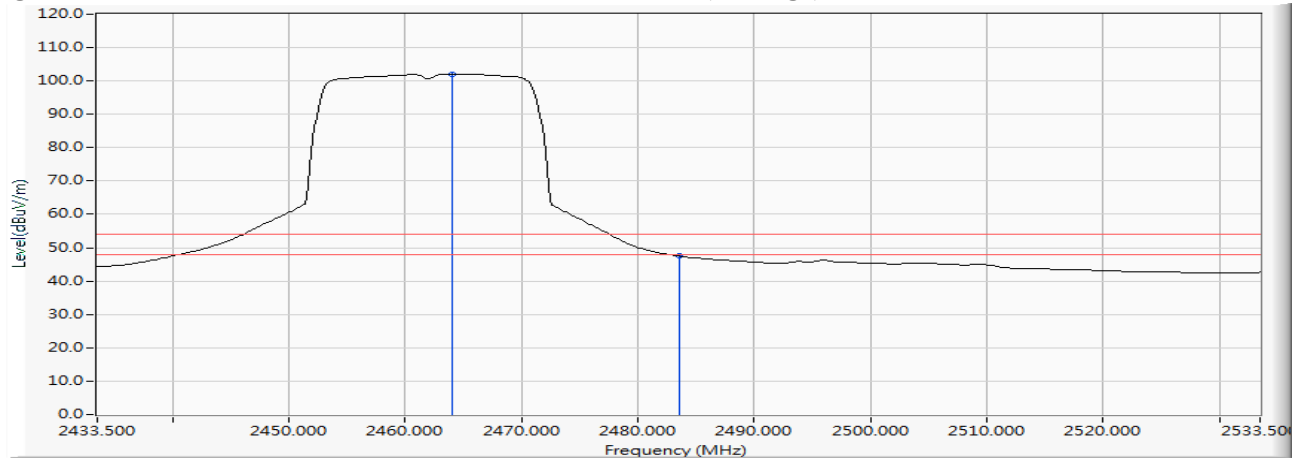
Figure Channel 01: Horizontal (Peak)**Figure Channel 01: Horizontal (Average)****Note:**

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/18
 Test Mode : Mode 3: Transmit (802.11n-20BW_28.8Mbps) (2462MHz) (Antenna No.14)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
01 (Peak)	2466.978	9.040	106.072	115.112	--	--	--
01 (Peak)	2483.500	9.100	56.099	65.198	74.00	54.00	Pass
01 (Average)	2464.080	9.029	93.056	102.085	--	--	--
01 (Average)	2483.500	9.100	38.377	47.476	74.00	54.00	Pass

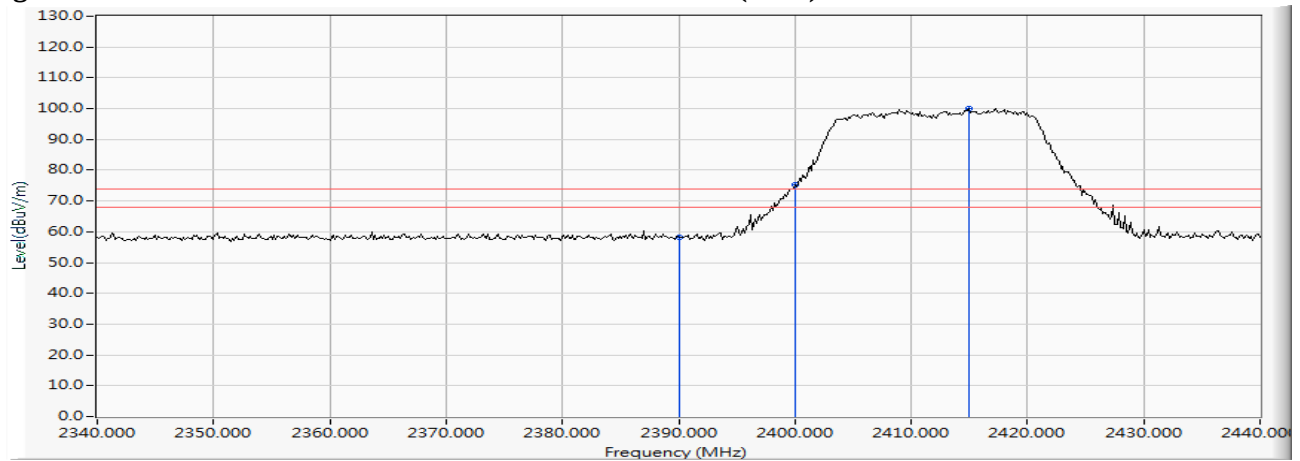
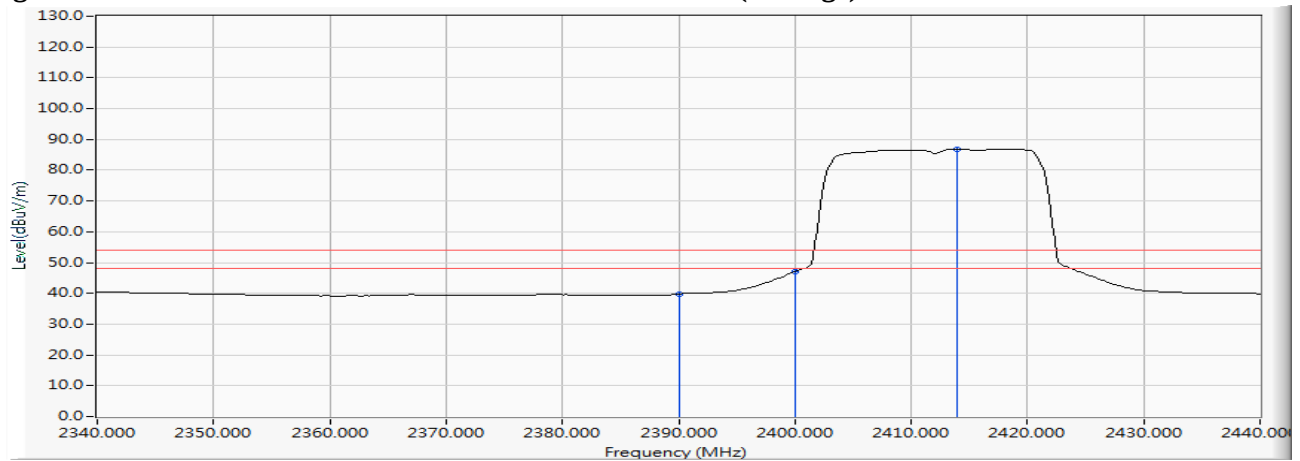
Figure Channel 01:**Vertical (Peak)****Figure Channel 01:****Vertical (Average)****Note:**

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 3: Transmit (802.11n-20BW_28.8Mbps) (2412MHz) (Antenna No.20)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
11 (Peak)	2390.000	8.763	49.481	58.244	74.00	54.00	Pass
11 (Peak)	2400.000	8.799	66.554	75.353	--	--	--
11 (Peak)	2414.927	8.852	91.100	99.952	--	--	--
11 (Average)	2390.000	8.763	31.035	39.798	74.00	54.00	Pass
11 (Average)	2400.000	8.799	38.314	47.113	--	--	--
11 (Average)	2413.913	8.848	78.030	86.878	--	--	--

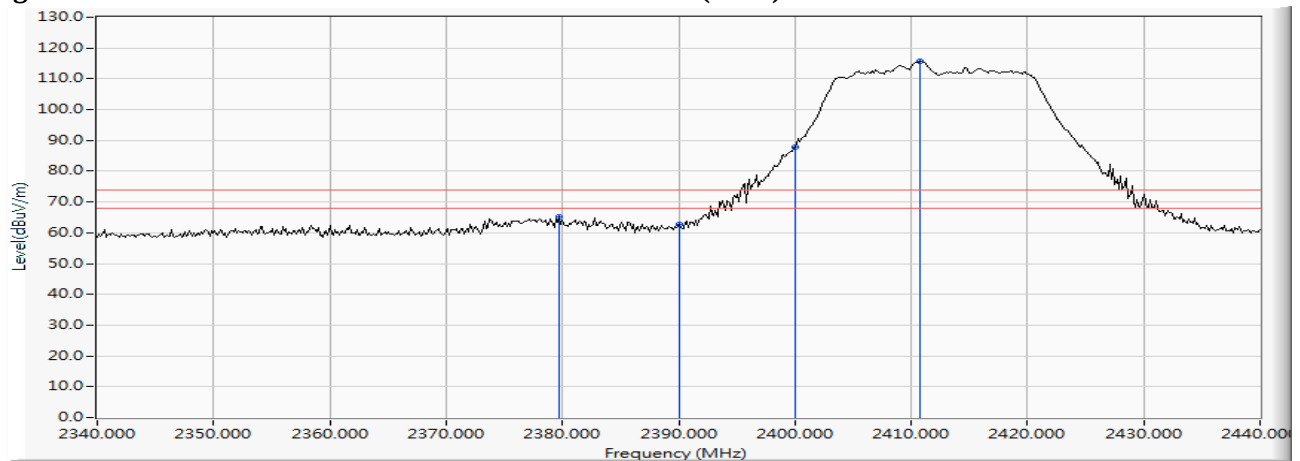
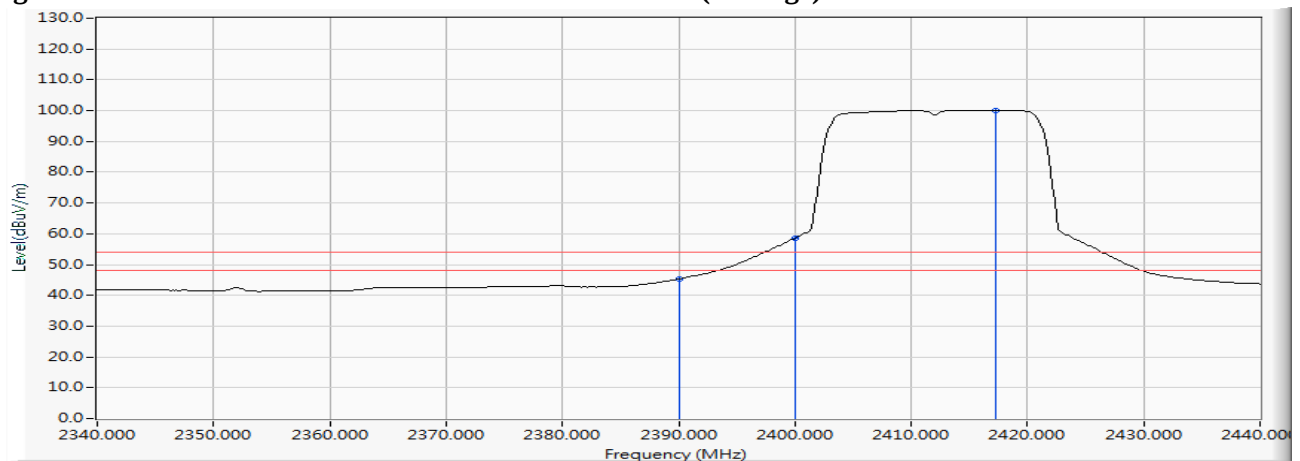
Figure Channel 11: Horizontal (Peak)**Figure Channel 11: Horizontal (Average)****Note:**

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 3: Transmit (802.11n-20BW_28.8Mbps) (2412MHz) (Antenna No.20)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
11 (Peak)	2379.710	8.726	56.296	65.022	74.00	54.00	Pass
11 (Peak)	2390.000	8.763	54.025	62.788	74.00	54.00	Pass
11 (Peak)	2400.000	8.799	78.935	87.734	--	--	--
11 (Peak)	2410.725	8.838	106.746	115.583	--	--	--
11 (Average)	2390.000	8.763	36.553	45.316	74.00	54.00	Pass
11 (Average)	2400.000	8.799	49.816	58.615	--	--	--
11 (Average)	2417.246	8.861	91.290	100.151	--	--	--

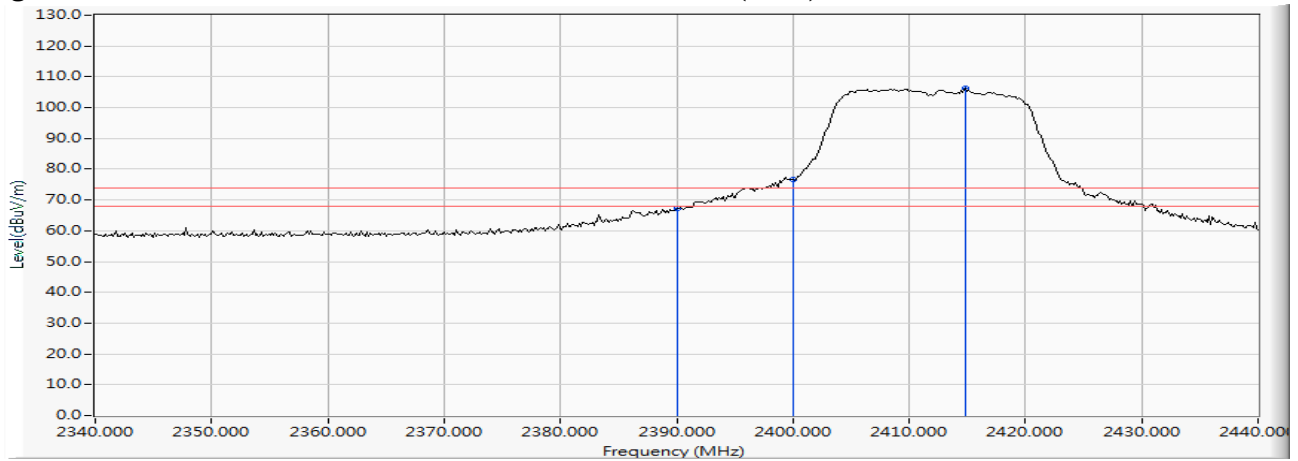
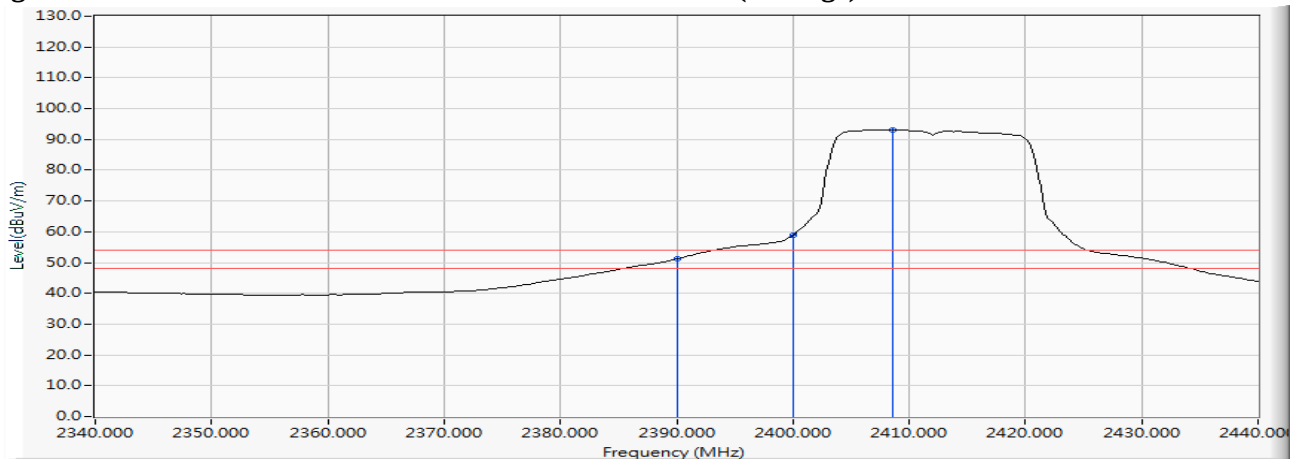
Figure Channel 11: Vertical (Peak)**Figure Channel 11: Vertical (Average)****Note:**

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2412MHz) (Antenna No.21)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
01 (Peak)	2390.000	8.763	58.470	67.233	74.00	54.00	Pass
01 (Peak)	2400.000	8.799	67.790	76.589	--	--	--
01 (Peak)	2414.783	8.851	97.446	106.298	--	--	--
01(Average)	2390.000	8.763	42.375	51.138	74.00	54.00	Pass
01(Average)	2400.000	8.799	50.116	58.915	--	--	--
01(Average)	2408.551	8.829	84.254	93.084	--	--	--

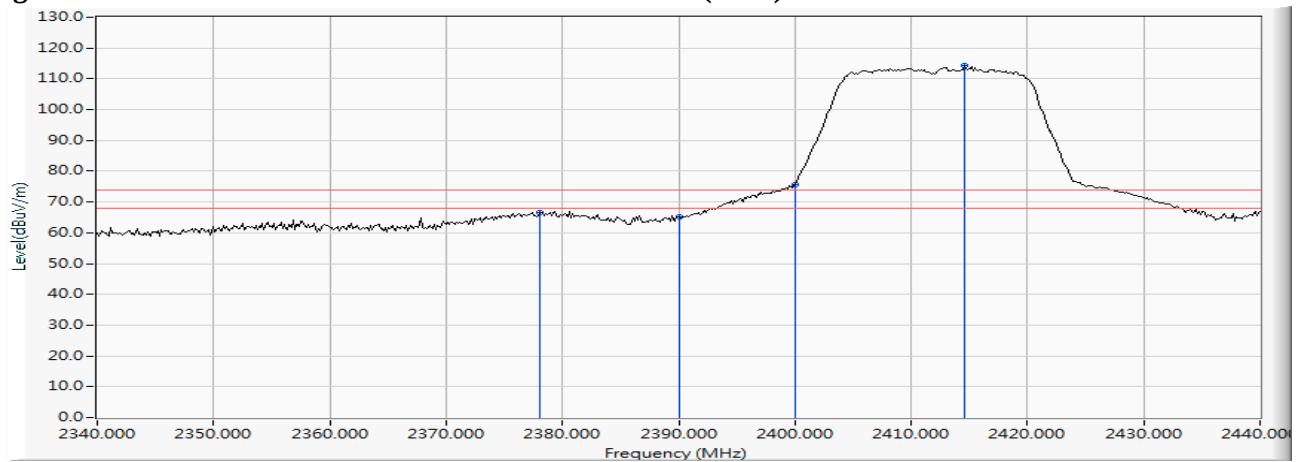
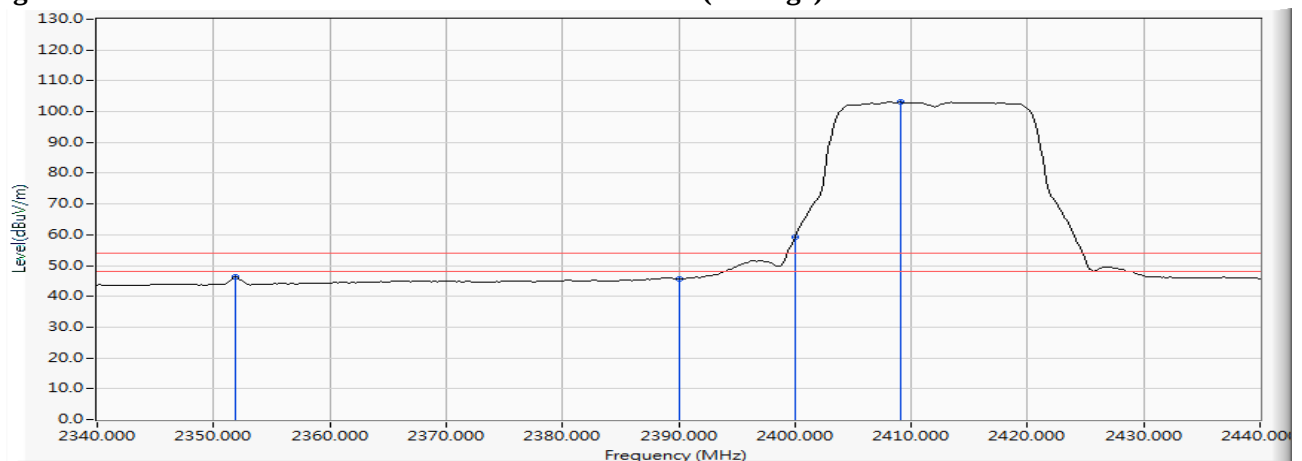
Figure Channel 01:**Horizontal (Peak)****Figure Channel 01:****Horizontal (Average)****Note:**

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2412MHz) (Antenna No.21)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
01 (Peak)	2378.116	8.721	57.916	66.636	74.00	54.00	Pass
01 (Peak)	2390.000	8.763	56.354	65.117	74.00	54.00	Pass
01 (Peak)	2400.000	8.799	66.849	75.648	--	--	--
01 (Peak)	2414.638	8.851	105.328	114.179	--	--	--
01 (Average)	2351.884	8.625	37.690	46.315	74.00	54.00	Pass
01 (Average)	2390.000	8.763	36.820	45.583	74.00	54.00	Pass
01 (Average)	2400.000	8.799	50.532	59.331	--	--	--
01 (Average)	2409.130	8.832	94.228	103.060	--	--	--

Figure Channel 01: Vertical (Peak)**Figure Channel 01: Vertical (Average)**

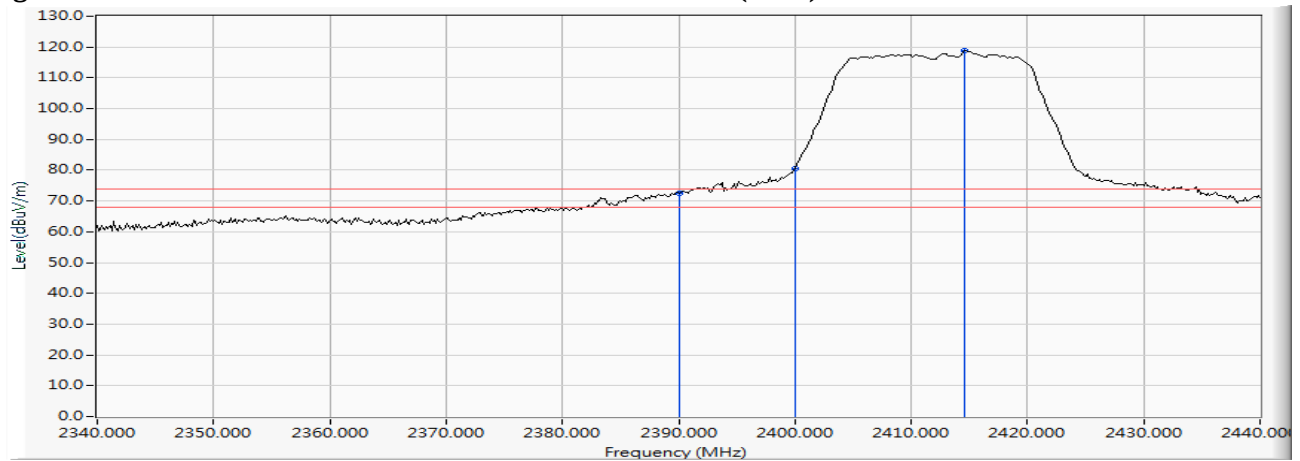
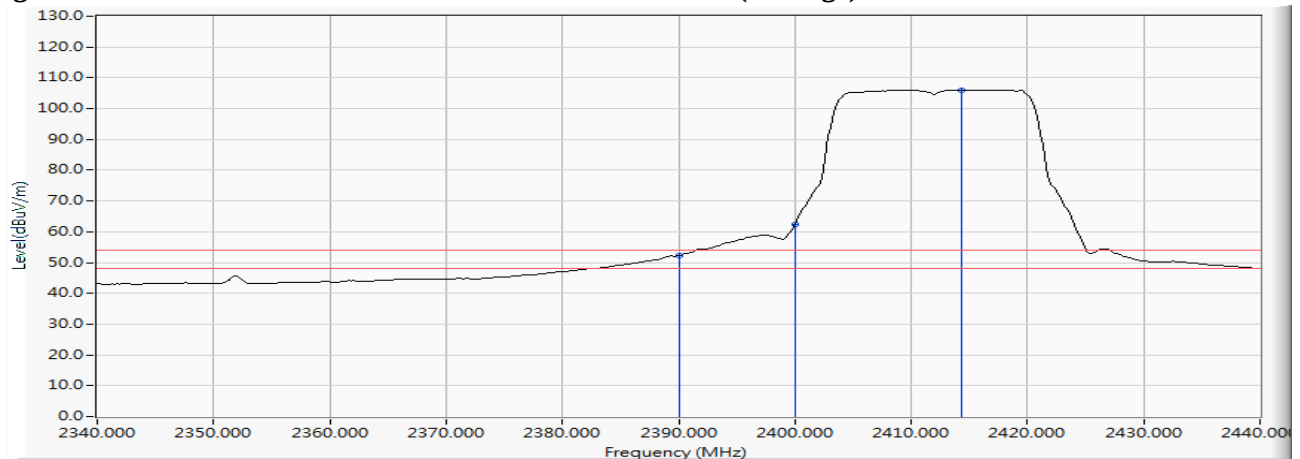
Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2412MHz) (Antenna No.22)

RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
11 (Peak)	2390.000	8.763	63.557	72.320	74.00	54.00	Pass
11 (Peak)	2400.000	8.799	71.600	80.399	--	--	--
11 (Peak)	2414.638	8.851	109.834	118.685	--	--	--
11 (Average)	2390.000	8.763	43.498	52.261	74.00	54.00	Pass
11 (Average)	2400.000	8.799	53.760	62.559	--	--	--
11 (Average)	2414.348	8.850	97.228	106.078	--	--	--

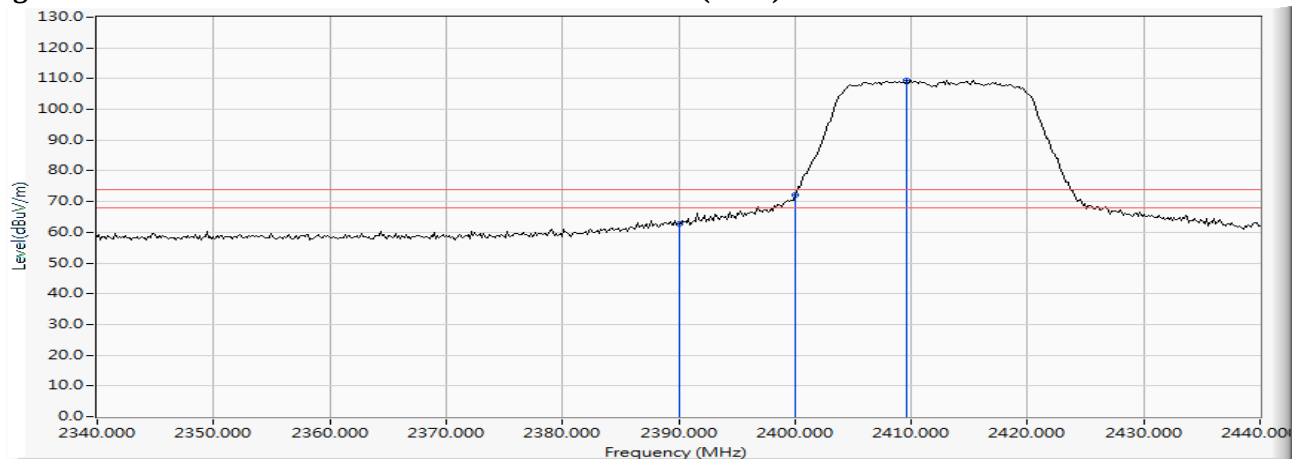
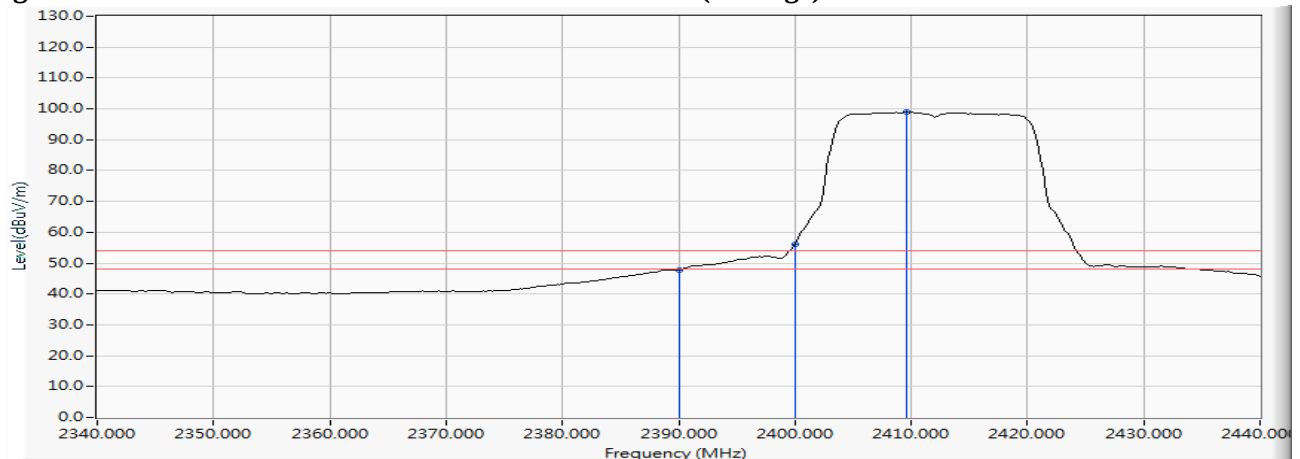
Figure Channel 11:
Horizontal (Peak)

Figure Channel 11:
Horizontal (Average)

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : MOXA IEEE 802.11a/n/ac 4*4 module
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Date : 2019/09/19
 Test Mode : Mode 2: Transmit (802.11g 6Mbps) (2412MHz) (Antenna No.22)

RF Radiated Measurement (Vertical):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Emission Level (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Result
11 (Peak)	2390.000	8.763	54.125	62.888	74.00	54.00	Pass
11 (Peak)	2400.000	8.799	63.395	72.194	--	--	--
11 (Peak)	2409.565	8.834	100.710	109.543	--	--	--
11 (Average)	2390.000	8.763	38.872	47.635	74.00	54.00	Pass
11 (Average)	2400.000	8.799	47.397	56.196	--	--	--
11 (Average)	2409.565	8.834	90.134	98.967	--	--	--

Figure Channel 11:**Vertical (Peak)****Figure Channel 11:****Vertical (Average)****Note:**

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

4. EMI Reduction Method During Compliance Testing

No modification was made during testing.