



Test report No. : 4788872713-US-R0-V0
Page : 1 of 62
Issued date : May. 23, 2019
FCC ID : S8W-W04A

RADIO TEST REPORT

Product : W04A
Model Name : Whistle GO
Series Model Name : Whistle GO Explore
FCC ID : S8W-W04A
Test Regulation : FCC 47 CFR Part 15 Subpart C (Section 15.247)
Received Date : Mar. 4, 2019
Test Date : Mar. 4, 2019 ~ Mar 29, 2019
Issued Date : May. 23, 2019

Applicant : Whistle Labs, Inc
1355 Market Street Suite 210 San Francisco, CA 94103, USA

Issued By : Underwriters Laboratories Taiwan Co., Ltd.
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd.,
Zhudong Township, Hsinchu County, Taiwan



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Doc No: 17-EM-F0876 / 2.0



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1. Attestation of Test Results

APPLICANT: Whistle Labs, Inc
 1355 Market Street Suite 210 San Francisco, CA 94103, USA

MANUFACTURER Whistle Labs, Inc
 1355 Market Street Suite 210 San Francisco, CA 94103, USA

EUT DESCRIPTION: W04A

BRAND: Whistle

MODEL: Whistle GO
SERIES MODEL: Whistle GO Explore

SAMPLE STAGE: PVT

DATE of TESTED: Mar. 4, 2019 ~ Mar 29, 2019

APPLICABLE STANDARDS	
STANDARD	Test Results
FCC 47 CFR PART 15 Subpart C (Section 15.247)	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Evelyn Lee
 Project Handler

Date : May. 23, 2019

Approved and Authorized By:

Stanley Wu
 Senior Project Engineer

Date : May. 23, 2019

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2. Summary of Test Results

Summary of Test Results		
FCC Clause	Test Items	Result
15.247(a)(2)	6dB Bandwidth	PASS
15.247(b)	Conducted Output Power	PASS
15.247(e)	Power Spectral Density	PASS
15.247(d)	Antenna Port Emission	PASS
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS
15.207	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	PASS

Note:

1. For the Radiated Band Edge test plots were recorded in Appendix I, the Radiated Emissions test plots were recorded in Appendix II.



3. Test Methodology

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB558074 D01 DTS Meas Guidance v05r01, KDB414788 D01 Radiated Test Site v01, ANSI C63.10-2013.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398. The full scope of accreditation can be viewed at http://accreditation.taftw.org.tw/taf/public/basic/viewApplyItems.action?unitNo=3398

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5. Measurement Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Test Item	Measurement Frequency Range	K	U(dB)
Conducted disturbance at mains terminals ports	0.15MHz ~ 30MHz	2	2.6
RF Conducted	9 kHz - 40GHz	2	1.0
Radiated disturbance below 30MHz	9 kHz - 30 MHz	2	2.4
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	2	5.5
Radiated disturbance above 1GHz	1GHz ~ 40GHz	2	5.0

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6. Equipment under Test

6.1. Description of EUT

Product	W04A
Brand Name	Whistle
Model Name	Whistle GO
Series Model Name	Whistle GO Explore
Operating Frequency	2412MHz ~ 2462MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Transfer Rate	802.11b: up to 11 Mbps 802.11g: up to 54 Mbps 802.11n: up to MCS7
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20)
Maximum Output Power	802.11b: 17.71 dBm 802.11g: 22.30 dBm 802.11n (HT20): 22.02 dBm
Normal Voltage	5Vdc (adapter or host equipment) 3.8Vdc for battery
Hardware Version	PVT1
Software Version	0.0.1-d2aa817
Model difference	Whistle GO is with small LED window while Whistle GO Explore is with big LED window

Note:

1. The EUT incorporates a SISO function. Physically, the EUT provides one completed transmitters and one receivers.

Modulation Mode	Tx,Rx Function
802.11b	1TX,1RX
802.11g	1TX,1RX
802.11n (HT20)	1TX,1RX

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2. The EUT contains following accessory devices

Product	Brand	Model	Description
USB Cable	Whistle	N/A	0.77 meter, non-shielded cable, w/o ferrite core
Collar Attachment	Whistle	N/A	N/A

3. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual.

6.2. Channel List

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency	Channel	Frequency
1	2412MHz	7	2442MHz
2	2417MHz	8	2447MHz
3	2422MHz	9	2452MHz
4	2427MHz	10	2457MHz
5	2432MHz	11	2462MHz
6	2437MHz	-	-

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6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	25°C / 62%RH	120Vac / 60 Hz	Mar. 4, 2019 ~ Mar. 29, 2019	Wayne Chen
Radiated Spurious Emission	966-2	24°C / 68%RH	120Vac / 60 Hz	Mar. 8, 2019 ~ Mar. 29, 2019	Will Chen
AC power Line Conducted Emission	SR1	26°C / 60%RH	120Vac / 60 Hz	Mar. 22, 2019	Will Chen

FCC Test Firm Registration Number: 498077

6.4. Description Of Available Antennas

Antenna	Brand Name	Model Name	Antenna Type	Antenna Gain(dBi)
Chain(0)	N/A	N/A	PCB	-4.4

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6.5. Test Mode Applicability and Tested Channel Detail

Test item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions (Above 1GHz)	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1.0
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6.0
	802.11n(HT20)	OFDM	BPSK	1 to 11	1,6,11	MCS0
Radiated Emissions (Below 1GHz)	802.11n(HT20)	OFDM	BPSK	1 to 11	11	MCS0
AC Power Line Conducted Emission	802.11n(HT20)	OFDM	BPSK	1 to 11	11	MCS0
Antenna Port Conducted Measurement	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1.0
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6.0
	802.11n(HT20)	OFDM	BPSK	1 to 11	1,6,11	MCS0

Note:

1. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
2. For below 1 GHz radiated emission and AC power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case.
3. For Antenna Port Conducted Measurement, this item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
4. The EUT have two kinds of the enclosure and six colors, and other circuits design and PCB layout are the same; therefore, there is no more testing need to be verified.
5. The fundamental of the EUT was investigated in three orthogonal axes X/Y/Z, it was determined that Z axis was worst-case . Therefore, all final radiated testing was performed with the EUT in Z axis.

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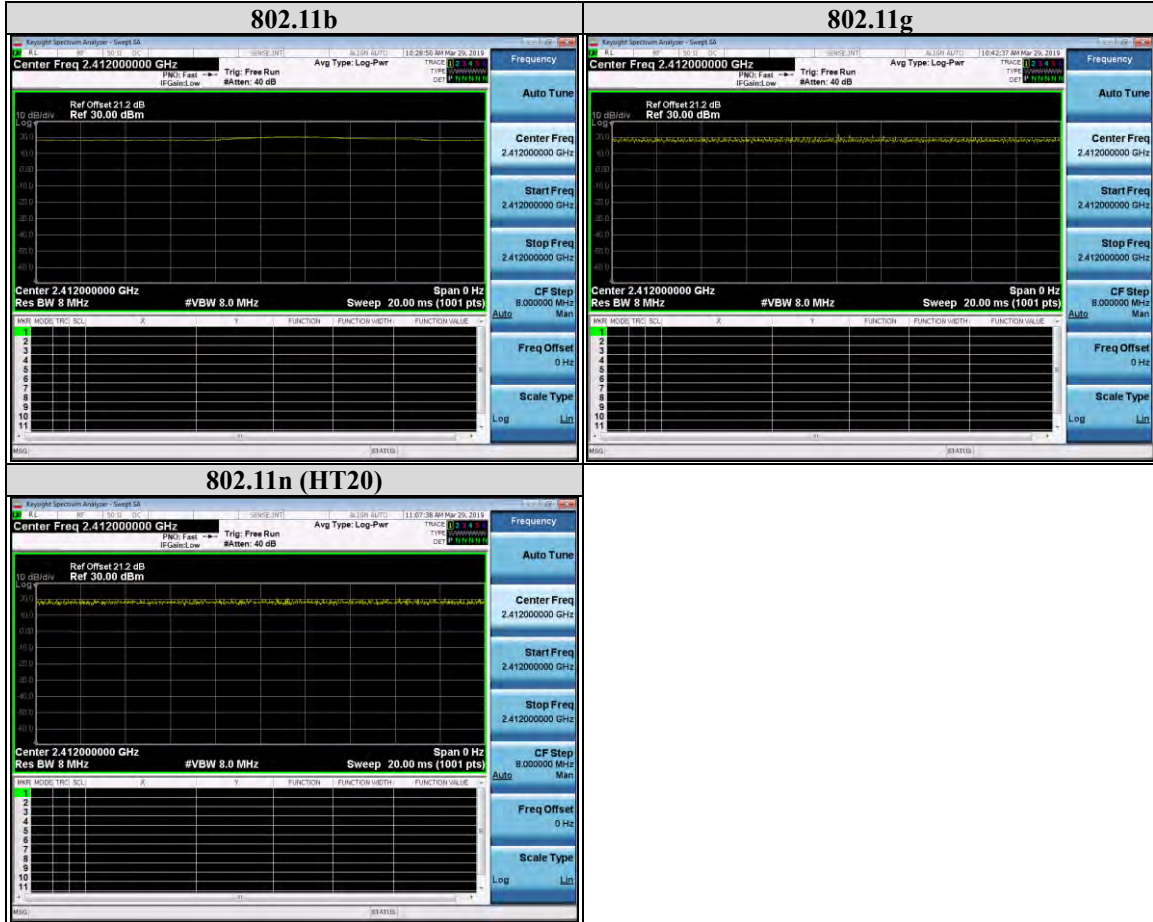


6.6. Duty cycle

802.11b: Duty cycle of test signal is $\geq 98\%$, duty factor is not required.

802.11g: Duty cycle of test signal is $\geq 98\%$, duty factor is not required.

802.11n (HT20): Duty cycle of test signal is $\geq 98\%$, duty factor is not required.



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7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	Nov. 8, 2018	1 year
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	Nov. 8, 2018	1 year
Loop Antenna	ETS lindgren	6502	00213440	Dec. 11, 2018	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	Jan. 14, 2019	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	Jan. 25, 2019	1 year
Horn Antenna(18-40 GHz)	Schwarzbeck	BBHA 9170	781	Jan.16, 2019	1 year
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	Jan. 30, 2019	1 year
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	Jan. 29, 2019	1 year
Preamplifier (18-40GHz)	EMCI	EMC184040SE E	980426	Apr. 26, 2018	1 year
RF Cable (9 KHz~18 GHz)	UltraPhase & EMC Instrument	A1K50-UP0358-A1K50-1500&EMC106-NM-SM-2500/7000	170111-4&170219/170102	Jan. 29, 2019	1 year
RF Cable (18 GHz~40 GHz)	UltraPhase	K1K50-UP0264-K1K50-2500/2500/600	170214-2/170214-6/170111-1	Jan. 29, 2019	1 year

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Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	Nov. 8, 2018	1 year
Pulse Power Sensor	Anrisu	MA2411B	1531202	Dec. 17, 2018	1 year
Power Meter	Anrisu	ML2495A	1645002	Dec. 17, 2018	1 year
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	Nov. 14, 2018	1 year
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	Aug. 5, 2018	1 year
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	Aug. 2, 2018	1 year
Cables	Huber+Suhner	RG 214/U	FCC-BCICF-4 RF	Jan. 29, 2019	1 year

UL Software		
Description	Name	Version
Radiated measurement	EZ_EMC	1.1.4.2
Conducted measurement	Keysight.TestSystem	1.0.0.0
AC power Line Conducted Emission	EZ_EMC	1.1.4.2

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8. Description of Test Setup

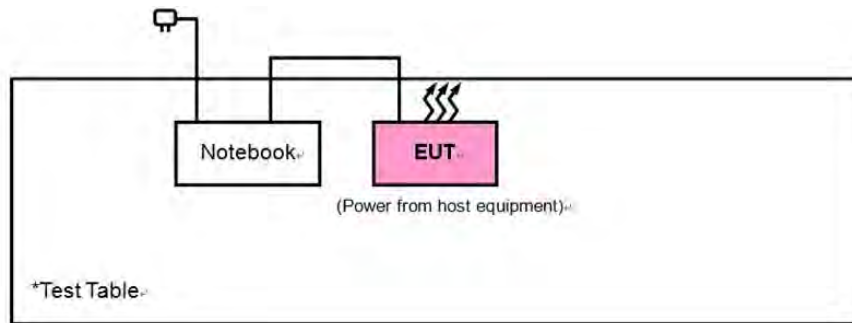
Support Equipment

Item	Equipment	Brand Name	Model Name	S/N
1	Notebook	DELL	Latitude E5470	3JFKWF2

Test Setup

Controlled using a bespoke application (Teraterm469) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

Setup Diagram for Test



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9. Test Results

9.1. 6dB Bandwidth

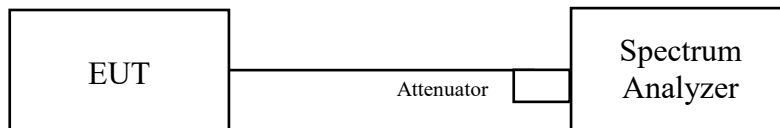
Requirements

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test procedure

- Set resolution bandwidth (RBW) = 100kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

Test Setup



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Test Data

802.11b

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	10.054	0.5	Pass
6	2437	10.046	0.5	Pass
11	2462	10.080	0.5	Pass

802.11g

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	16.523	0.5	Pass
6	2437	16.474	0.5	Pass
11	2462	16.556	0.5	Pass

802.11n (HT20)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	17.719	0.5	Pass
6	2437	17.700	0.5	Pass
11	2462	17.790	0.5	Pass

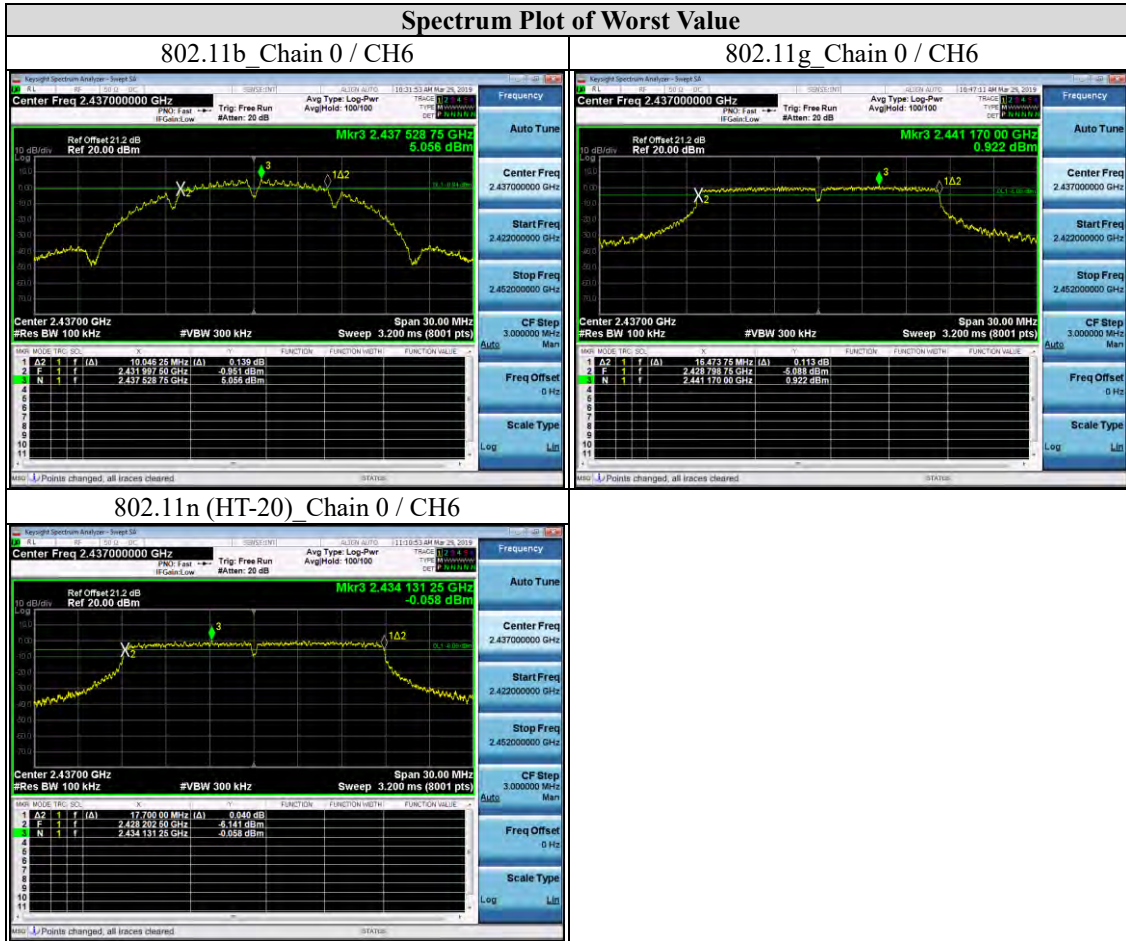
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9.2. Conducted output power

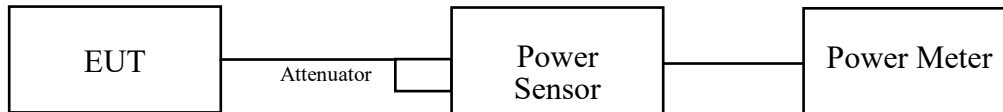
Requirements

For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Test Setup



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Test Data

802.11b

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	57.94	17.63	30	Pass
6	2437	59.02	17.71	30	Pass
11	2462	56.36	17.51	30	Pass

802.11g

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	169.82	22.30	30	Pass
6	2437	143.88	21.58	30	Pass
11	2462	148.94	21.73	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	159.22	22.02	30	Pass
6	2437	143.22	21.56	30	Pass
11	2462	148.25	21.71	30	Pass

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9.3. Power Spectral Density

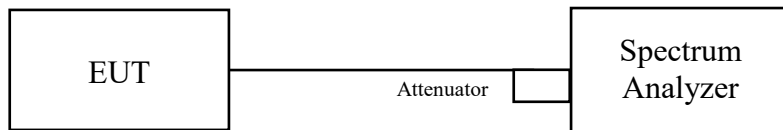
Requirements

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

Test procedure

- a. Set analyzer center frequency to DTS channel center frequency.
- b. Set the span to 1.5 times the DTS bandwidth.
- c. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d. Set the VBW $\geq 3 \times \text{RBW}$.
- e. Detector = peak.
- f. Sweep time = auto couple.
- g. Trace mode = max hold.
- h. Allow trace to fully stabilize.
- i. Use the peak marker function to determine the maximum amplitude level within the RBW.

Test Setup





Test Data

802.11b

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
1	2412	-14.977	8	Pass
6	2437	-14.855	8	Pass
11	2462	-14.771	8	Pass

802.11g

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
1	2412	-14.454	8	Pass
6	2437	-14.312	8	Pass
11	2462	-14.615	8	Pass

802.11n (HT20)

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
1	2412	-13.555	8	Pass
6	2437	-13.912	8	Pass
11	2462	-14.423	8	Pass

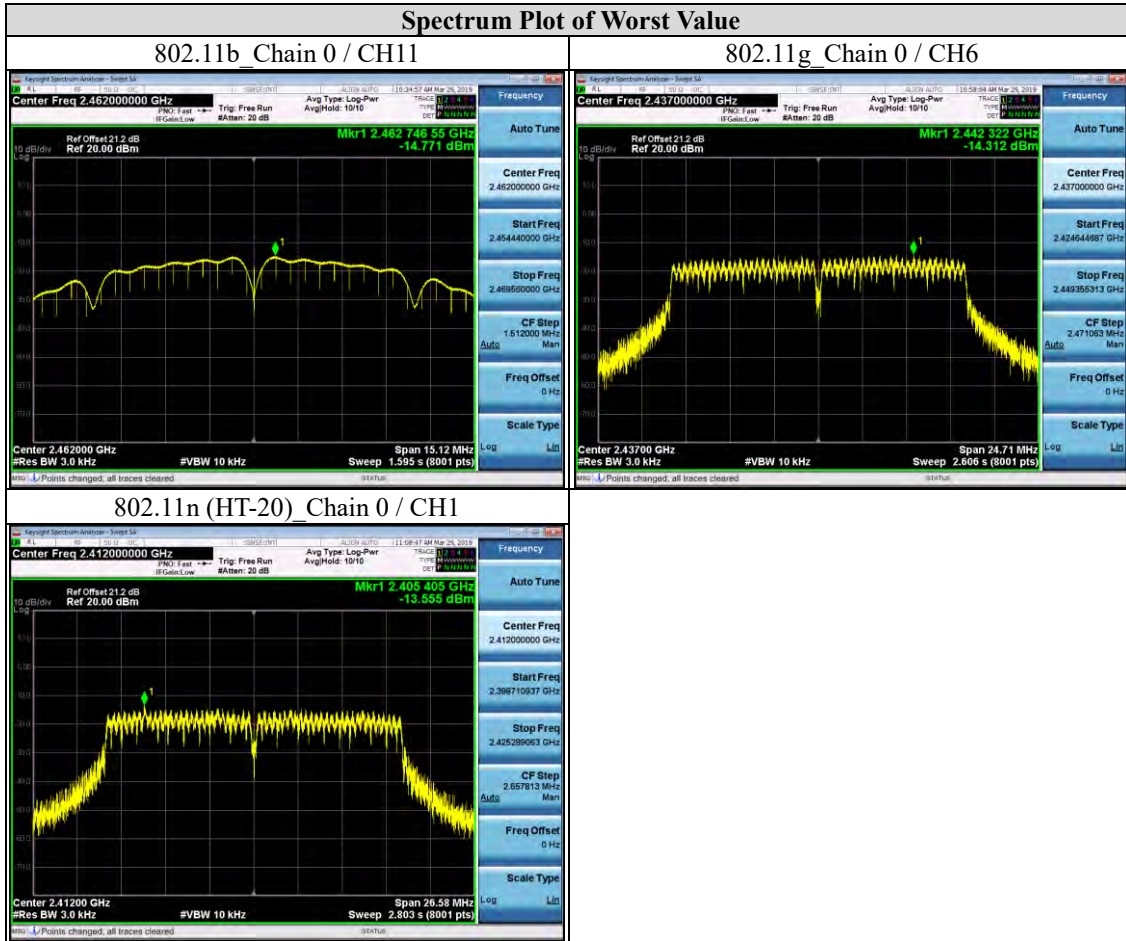
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9.4. Conducted Out of Band Emission

Requirements

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.

Test procedure

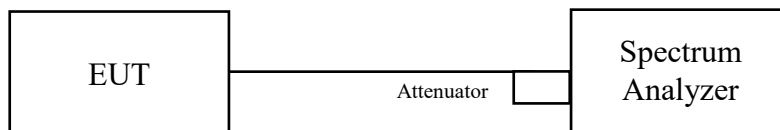
Measurement Procedure REF

1. Set the RBW = 100 kHz.
2. Set the VBW \geq 300 kHz.
3. Set the span to 1.5 times the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement Procedure OOBE

1. Set RBW = 100 kHz.
2. Set VBW \geq 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

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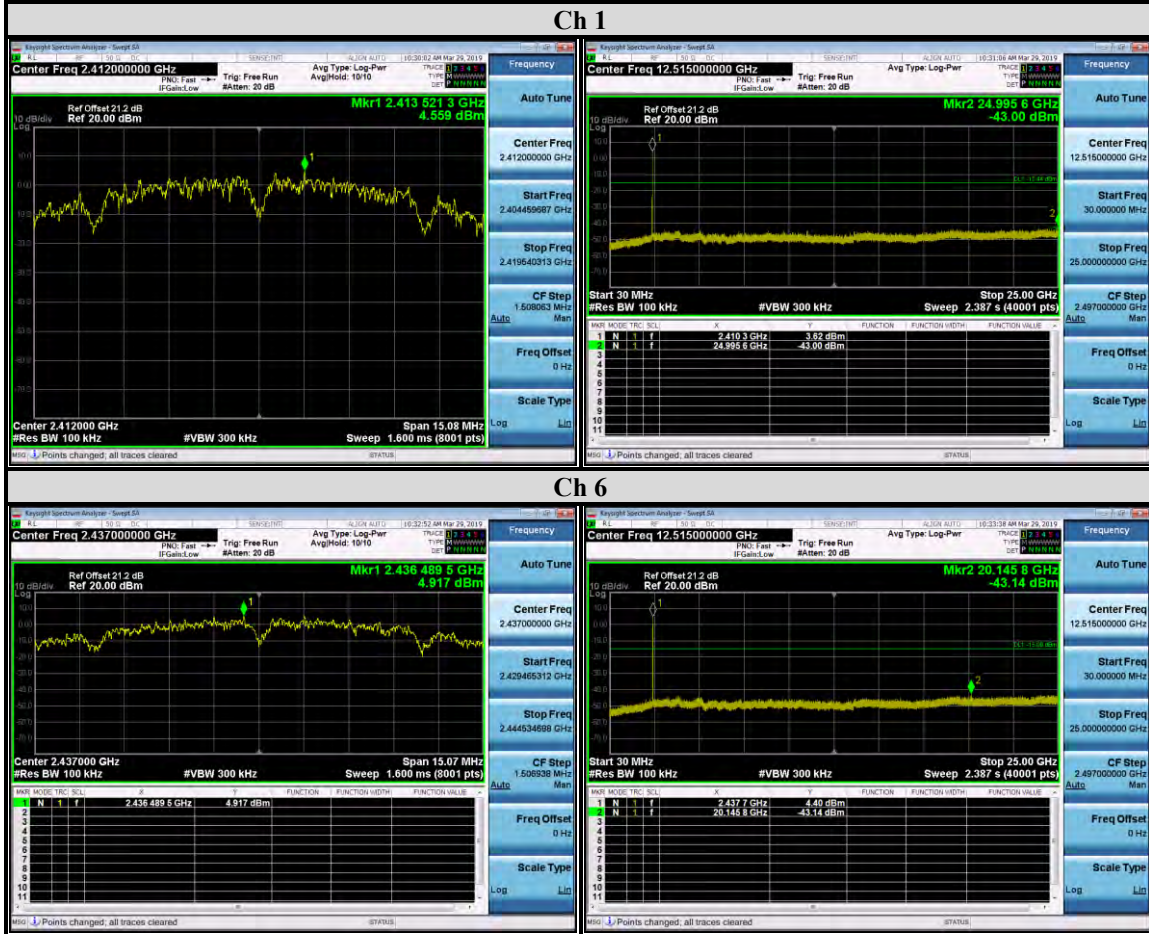
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Test Data

802.11b



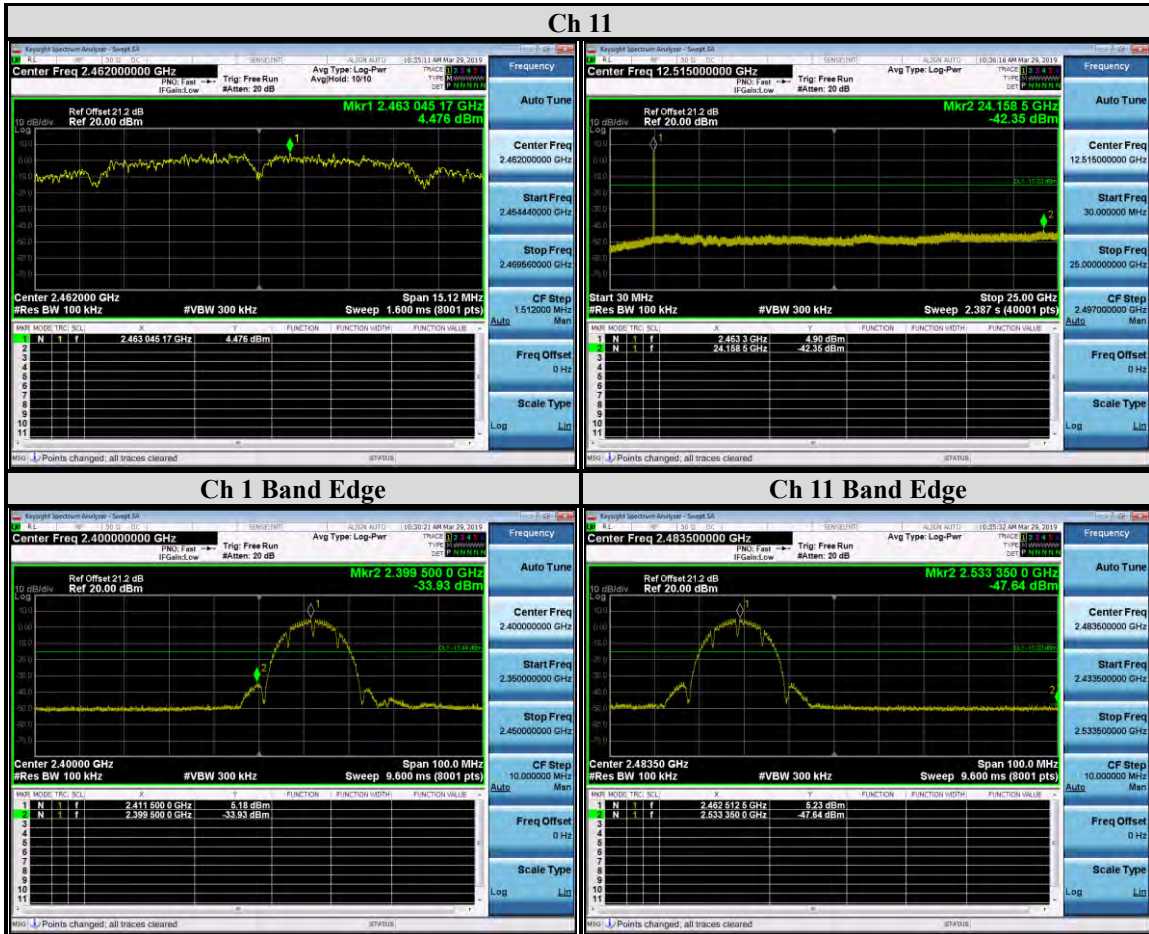
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802.11g

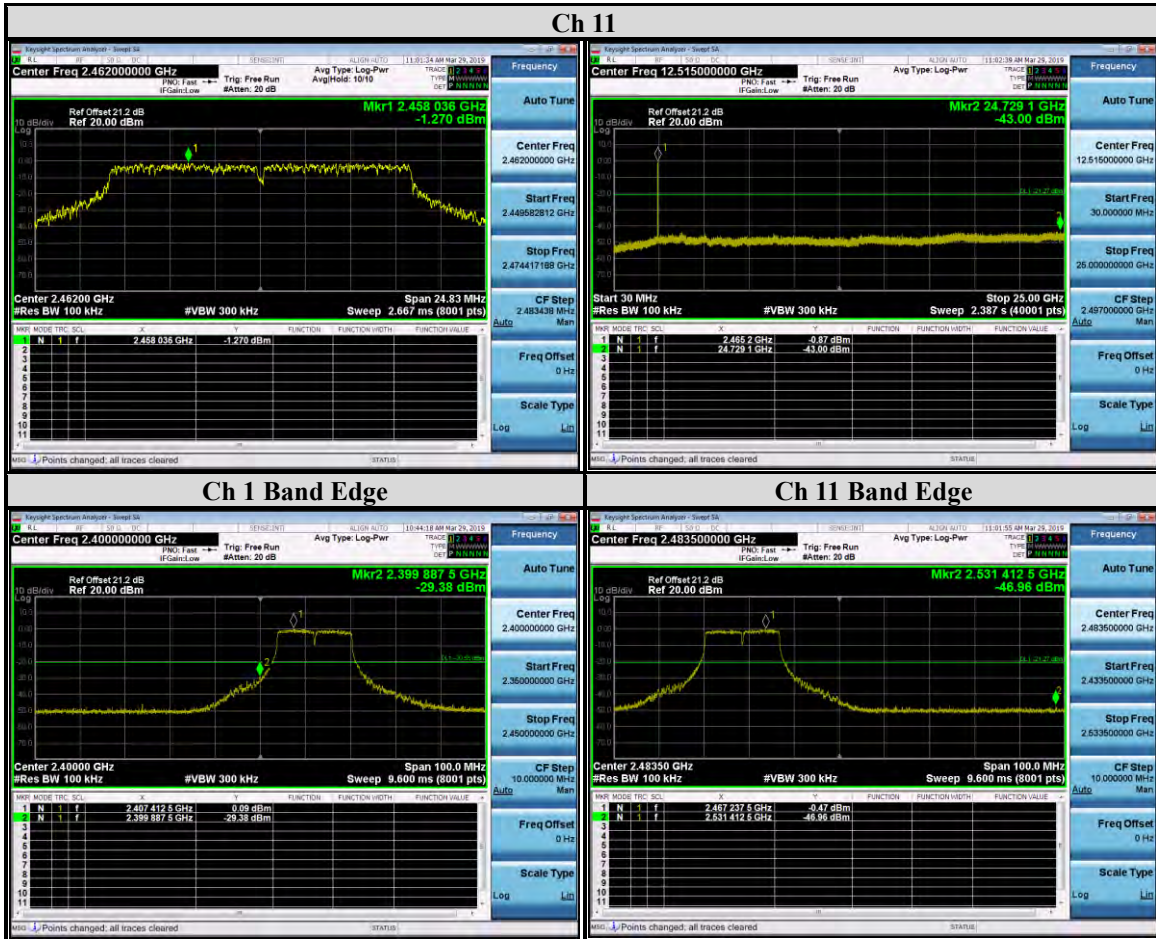


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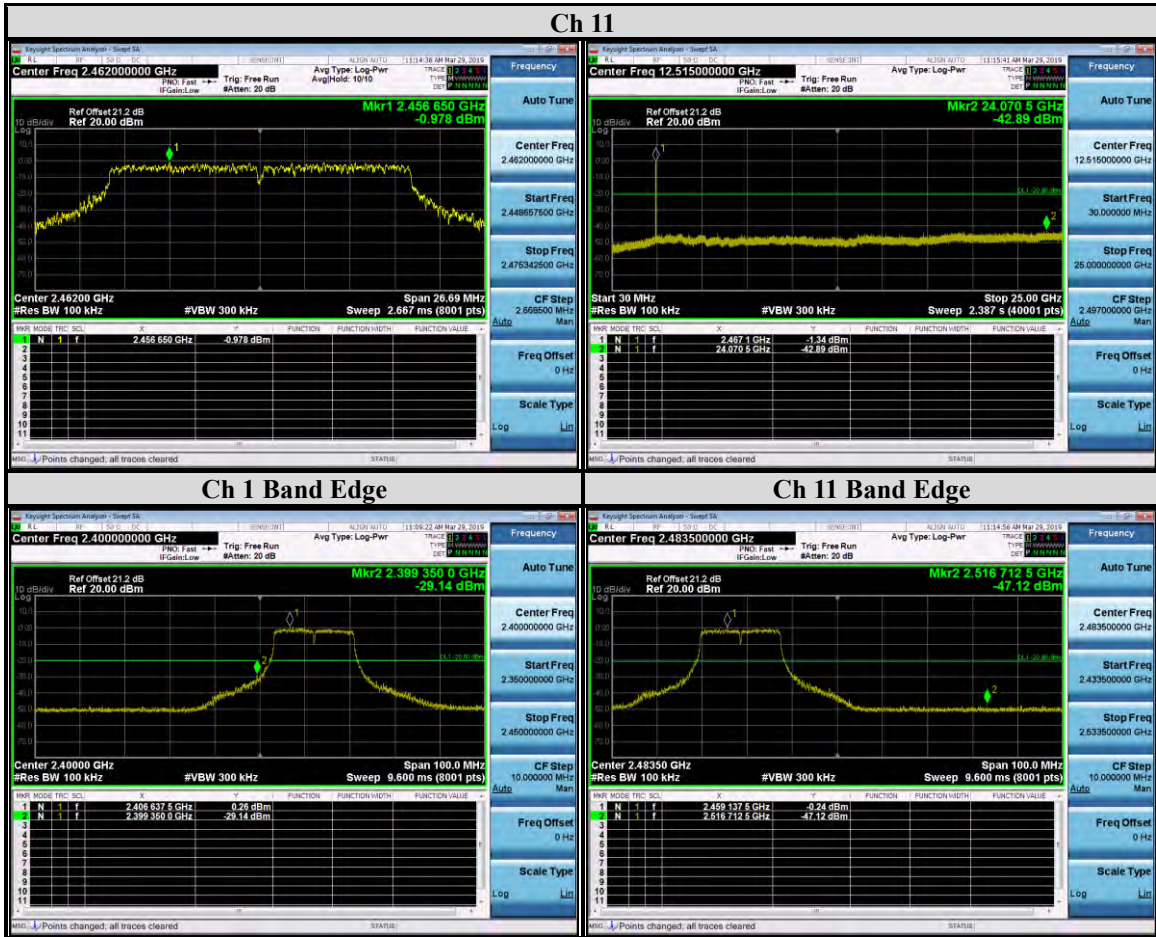
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802.11n (HT20)





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9.5. Radiated Spurious Emission

Requirements

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequency(MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

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Test Procedures

[For 9 kHz ~ 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. For measurement below 30MHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

[For above 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

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Note:

- a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- b. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.

Configuration	Average	
	RBW	VBW
802.11b	1MHz	10 Hz
802.11g		10 Hz
802.11n (HT20)		10 Hz

Note: Refer to section 6.6 for duty cycle.

- d. All modes of operation were investigated and the worst-case emissions are reported.

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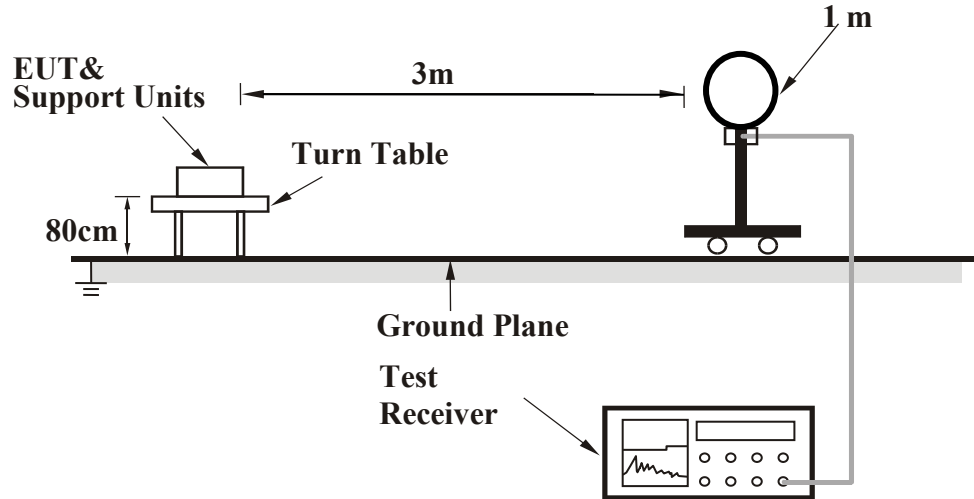
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Facsimile (FAX) :+886-3-583-7948

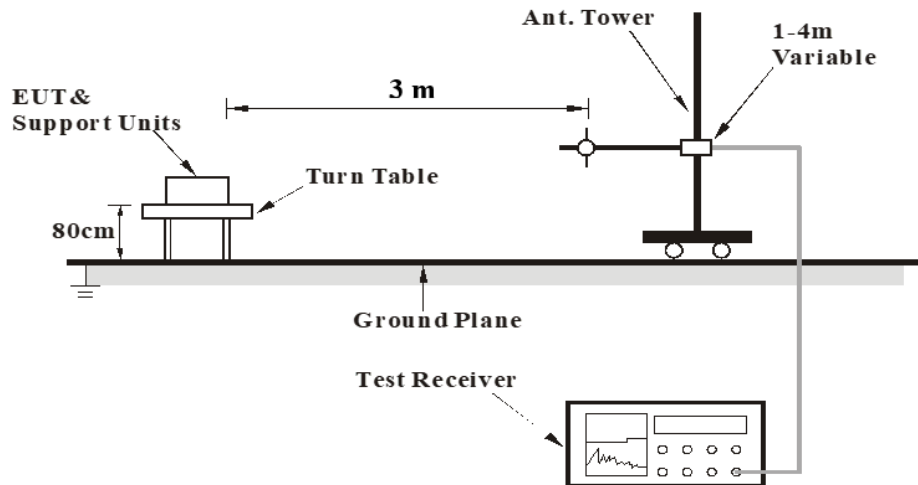
Doc No: 17-EM-F0876 / 2.0

Test Setup

<Frequency Range 9 kHz ~ 30 MHz>

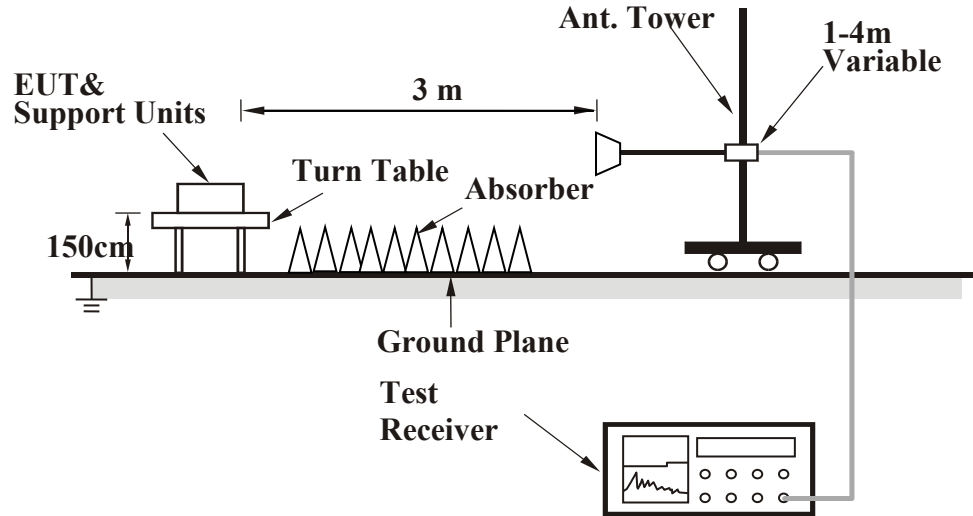


<Frequency Range 30 MHz ~ 1 GHz >





<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations.

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Test Data

Above 1GHz Data 802.11b

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2386.400	55.24	-7.62	47.62	74.00	-26.38	peak
@	2412.000	106.85	-7.61	99.24	-	-	peak
-	2390.000	42.46	-7.60	34.86	54.00	-19.14	AVG
@	2412.000	103.18	-7.61	95.57	-	-	AVG
*	4824.000	49.91	-3.04	46.87	74.00	-27.13	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2390.000	56.95	-7.60	49.35	74.00	-24.65	peak
@	2412.000	112.40	-7.61	104.79	-	-	peak
-	2390.000	45.22	-7.60	37.62	54.00	-16.38	AVG
@	2412.000	108.84	-7.61	101.23	-	-	AVG
*	4824.000	46.02	-3.04	42.98	74.00	-31.02	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "*": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2388.600	53.88	-7.60	46.28	74.00	-27.72	peak
@	2437.000	109.30	-7.69	101.61	-	-	peak
-	2484.000	55.16	-7.63	47.53	74.00	-26.47	peak
-	2390.000	41.84	-7.60	34.24	54.00	-19.76	AVG
@	2437.000	105.47	-7.69	97.78	-	-	AVG
-	2484.400	43.03	-7.63	35.40	54.00	-18.60	AVG
*	4874.000	45.21	-3.02	42.19	74.00	-31.81	peak
*	7311.000	41.65	3.59	45.24	74.00	-28.76	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2388.000	54.79	-7.61	47.18	74.00	-26.82	peak
@	2437.000	113.73	-7.69	106.04	-	-	peak
-	2484.000	57.49	-7.63	49.86	74.00	-24.14	peak
-	2389.600	43.12	-7.60	35.52	54.00	-18.48	AVG
@	2437.000	109.76	-7.69	102.07	-	-	AVG
-	2483.800	45.45	-7.63	37.82	54.00	-16.18	AVG
*	4874.000	44.66	-3.02	41.64	74.00	-32.36	peak
*	7311.000	42.15	3.59	45.74	74.00	-28.26	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "* *": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
@	2462.000	108.33	-7.69	100.64	-	-	peak
-	2484.800	55.80	-7.63	48.17	74.00	-25.83	peak
@	2462.000	104.50	-7.69	96.81	-	-	AVG
-	2484.000	44.06	-7.63	36.43	54.00	-17.57	AVG
*	4924.000	50.65	-3.00	47.65	74.00	-26.35	peak
*	7386.000	43.50	3.94	47.44	74.00	-26.56	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
@	2462.000	112.85	-7.69	105.16	-	-	peak
-	2483.500	59.78	-7.63	52.15	74.00	-21.85	peak
@	2462.000	109.02	-7.69	101.33	-	-	AVG
-	2483.500	47.69	-7.63	40.06	54.00	-13.94	AVG
*	4924.000	44.16	-3.00	41.16	74.00	-32.84	peak
*	7386.000	42.42	3.94	46.36	74.00	-27.64	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "* * ": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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802.11g

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2390.000	59.65	-7.60	52.05	74.00	-21.95	peak
@	2412.000	107.82	-7.61	100.21	-	-	peak
-	2390.000	44.71	-7.60	37.11	54.00	-16.89	AVG
@	2412.000	98.29	-7.61	90.68	-	-	AVG
*	4824.000	46.43	-3.04	43.39	74.00	-30.61	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2390.000	67.08	-7.60	59.48	74.00	-14.52	peak
@	2412.000	112.45	-7.61	104.84	-	-	peak
-	2390.000	49.82	-7.60	42.22	54.00	-11.78	AVG
@	2412.000	103.07	-7.61	95.46	-	-	AVG
*	4824.000	43.58	-3.04	40.54	74.00	-33.46	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "*": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2388.800	54.47	-7.60	46.87	74.00	-27.13	peak
@	2437.000	109.09	-7.69	101.40	-	-	peak
-	2498.800	54.57	-7.58	46.99	74.00	-27.01	peak
-	2390.000	42.01	-7.60	34.41	54.00	-19.59	AVG
@	2437.000	99.73	-7.69	92.04	-	-	AVG
-	2484.600	42.65	-7.63	35.02	54.00	-18.98	AVG
*	4874.000	45.04	-3.02	42.02	74.00	-31.98	peak
*	7311.000	42.53	3.59	46.12	74.00	-27.88	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2390.000	55.62	-7.60	48.02	74.00	-25.98	peak
@	2437.000	113.74	-7.69	106.05	-	-	peak
-	2484.400	57.84	-7.63	50.21	74.00	-23.79	peak
-	2390.000	42.83	-7.60	35.23	54.00	-18.77	AVG
@	2437.000	104.03	-7.69	96.34	-	-	AVG
-	2484.400	44.78	-7.63	37.15	54.00	-16.85	AVG
*	4874.000	43.16	-3.02	40.14	74.00	-33.86	peak
*	7311.000	41.76	3.59	45.35	74.00	-28.65	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "* *": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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Doc No: 17-EM-F0876 / 2.0



EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
@	2462.000	108.88	-7.69	101.19	-	-	peak
-	2483.500	65.71	-7.63	58.08	74.00	-15.92	peak
@	2462.000	99.09	-7.69	91.40	-	-	AVG
-	2483.500	48.86	-7.63	41.23	54.00	-12.77	AVG
*	4924.000	45.69	-3.00	42.69	74.00	-31.31	peak
*	7386.000	41.43	3.94	45.37	74.00	-28.63	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
@	2462.000	113.68	-7.69	105.99	-	-	peak
-	2483.500	75.14	-7.63	67.51	74.00	-6.49	peak
@	2462.000	103.84	-7.69	96.15	-	-	AVG
-	2483.500	56.59	-7.63	48.96	54.00	-5.04	AVG
*	4924.000	43.39	-3.00	40.39	74.00	-33.61	peak
*	7386.000	42.05	3.94	45.99	74.00	-28.01	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "* * ": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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802.11n (HT-20)

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2390.000	66.00	-7.60	58.40	74.00	-15.60	peak
@	2412.000	107.41	-7.61	99.80	-	-	peak
-	2390.000	45.21	-7.60	37.61	54.00	-16.39	AVG
@	2412.000	98.17	-7.61	90.56	-	-	AVG
*	4824.000	45.64	-3.04	42.60	74.00	-31.40	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2390.000	74.81	-7.60	67.21	74.00	-6.79	peak
@	2412.000	112.47	-7.61	104.86	-	-	peak
-	2390.000	51.37	-7.60	43.77	54.00	-10.23	AVG
@	2412.000	103.27	-7.61	95.66	-	-	AVG
*	4824.000	42.72	-3.04	39.68	74.00	-34.32	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "*": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2388.600	54.56	-7.60	46.96	74.00	-27.04	peak
@	2437.000	109.23	-7.69	101.54	-	-	peak
-	2485.200	54.66	-7.63	47.03	74.00	-26.97	peak
-	2389.600	41.50	-7.60	33.90	54.00	-20.10	AVG
@	2437.000	99.10	-7.69	91.41	-	-	AVG
-	2484.000	42.15	-7.63	34.52	54.00	-19.48	AVG
*	4874.000	43.87	-3.02	40.85	74.00	-33.15	peak
*	7311.000	42.03	3.59	45.62	74.00	-28.38	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	2387.800	54.86	-7.61	47.25	74.00	-26.75	peak
@	2437.000	113.51	-7.69	105.82	-	-	peak
-	2484.800	57.85	-7.63	50.22	74.00	-23.78	peak
-	2390.000	42.98	-7.60	35.38	54.00	-18.62	AVG
@	2437.000	103.88	-7.69	96.19	-	-	AVG
-	2484.200	44.93	-7.63	37.30	54.00	-16.70	AVG
*	4874.000	43.41	-3.02	40.39	74.00	-33.61	peak
*	7311.000	42.28	3.59	45.87	74.00	-28.13	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "* *": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 26 GHz

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
@	2462.000	108.62	-7.69	100.93	-	-	peak
-	2483.500	71.14	-7.63	63.51	74.00	-10.49	peak
@	2462.000	99.03	-7.69	91.34	-	-	AVG
-	2483.500	50.28	-7.63	42.65	54.00	-11.35	AVG
*	4924.000	47.84	-3.00	44.84	74.00	-29.16	peak
*	7386.000	42.43	3.94	46.37	74.00	-27.63	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
@	2462.000	113.30	-7.69	105.61	-	-	peak
-	2483.500	80.51	-7.63	72.88	74.00	-1.12	peak
@	2462.000	103.77	-7.69	96.08	-	-	AVG
-	2483.500	59.13	-7.63	51.50	54.00	-2.50	AVG
*	4924.000	43.79	-3.00	40.79	74.00	-33.21	peak
*	7386.000	41.84	3.94	45.78	74.00	-28.22	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@": Fundamental Frequency.
5. "* * ": The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

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Below 1GHz Data

No non-compliance noted:

KDB 414788

- Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

- OFS and chamber correlation testing had been performed and chamber measured test results is the worst case test result.

Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

9 kHz ~ 30 MHz Data

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

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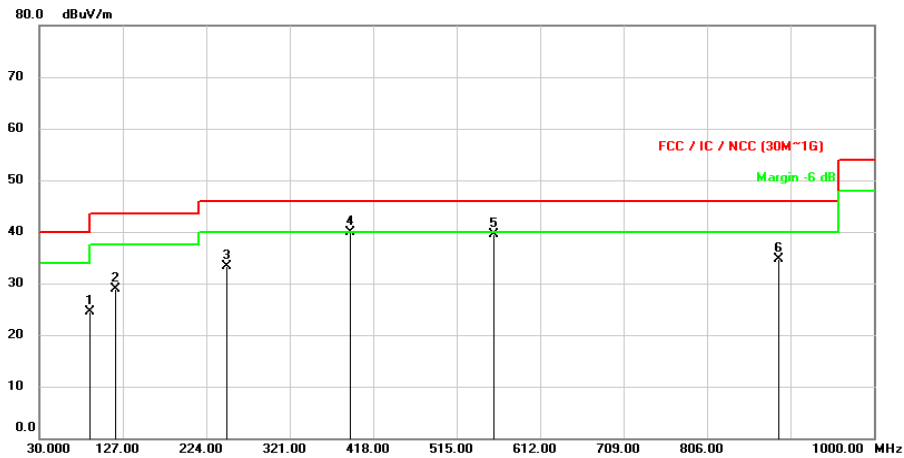


30 MHz ~ 1 GHz Data

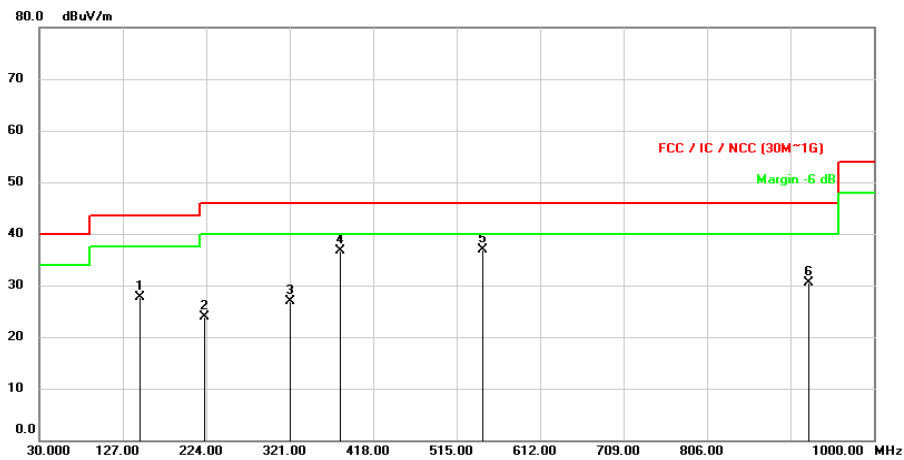
802.11n (HT-20)

EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	30 MHz ~ 1 GHz

Horizontal



Vertical



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Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	88.5233	45.73	-21.15	24.58	43.50	-18.92	peak
-	118.2053	46.83	-17.94	28.89	43.50	-14.61	peak
-	248.3793	49.06	-15.79	33.27	46.00	-12.73	peak
-	390.8400	51.61	-11.72	39.89	46.00	-6.11	peak
-	556.9040	47.70	-8.14	39.56	46.00	-6.44	peak
-	888.8057	37.56	-2.79	34.77	46.00	-11.23	peak
Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	146.6910	43.03	-15.33	27.70	43.50	-15.80	peak
-	221.9307	41.43	-17.48	23.95	46.00	-22.05	peak
-	320.3533	40.36	-13.51	26.85	46.00	-19.15	peak
-	379.4910	48.78	-12.06	36.72	46.00	-9.28	peak
-	544.8760	45.31	-8.45	36.86	46.00	-9.14	peak
-	925.0190	32.43	-2.02	30.41	46.00	-15.59	peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. The other emission levels were very low against the limit.

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9.6. AC Power Line Conducted Emission

Requirements

Frequency (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

Test Procedures

- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

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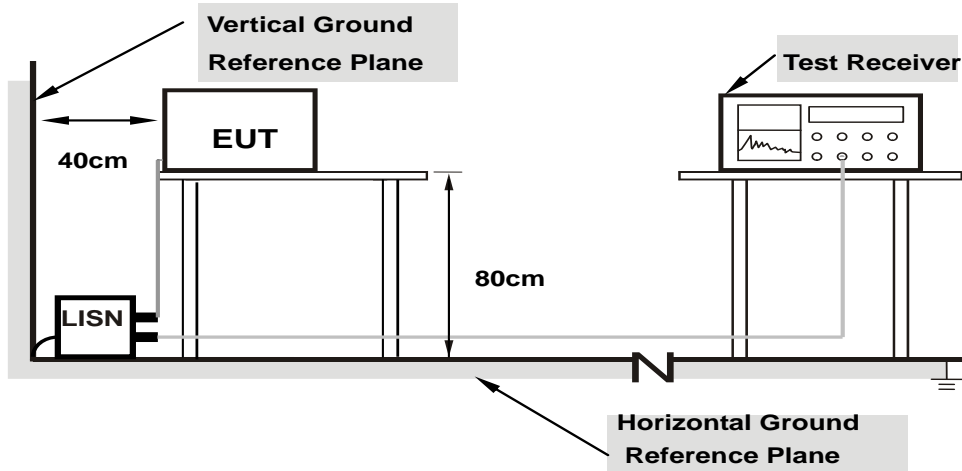
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Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the Setup Configurations.

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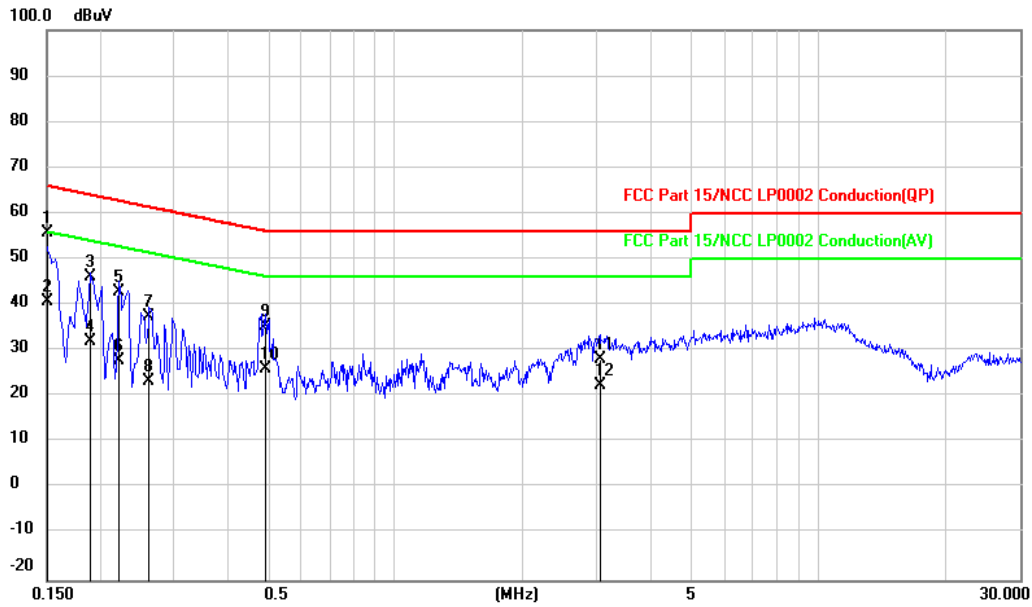


Test Data

802.11n (HT-20)

EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	150 kHz ~ 30 MHz

Phase of Power : Line (L)



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No.	Frequency (MHz)	Reading (dBuV)	Correct dB	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1500	35.97	19.69	55.66	66.00	-10.34	QP
2	0.1500	21.04	19.69	40.73	56.00	-15.27	AVG
3	0.1900	26.57	19.68	46.25	64.04	-17.79	QP
4	0.1900	12.23	19.68	31.91	54.04	-22.13	AVG
5	0.2220	23.18	19.68	42.86	62.74	-19.88	QP
6	0.2220	8.11	19.68	27.79	52.74	-24.95	AVG
7	0.2618	17.78	19.68	37.46	61.37	-23.91	QP
8	0.2618	3.82	19.68	23.50	51.37	-27.87	AVG
9	0.4940	15.81	19.67	35.48	56.10	-20.62	QP
10	0.4940	6.32	19.67	25.99	46.10	-20.11	AVG
11	3.0460	8.37	19.72	28.09	56.00	-27.91	QP
12	3.0460	2.77	19.72	22.49	46.00	-23.51	AVG

Remarks:

1. Result value (dBuV) = Reading value (dBuV) + Correction Factor (dB)
2. Margin(dB) = Result value (dBuV) - Limit value (dBuV)
3. Correction Factor(dB) = Insertion loss(dB) + Cable loss(dB)
4. The other emission levels were very low against the limit.

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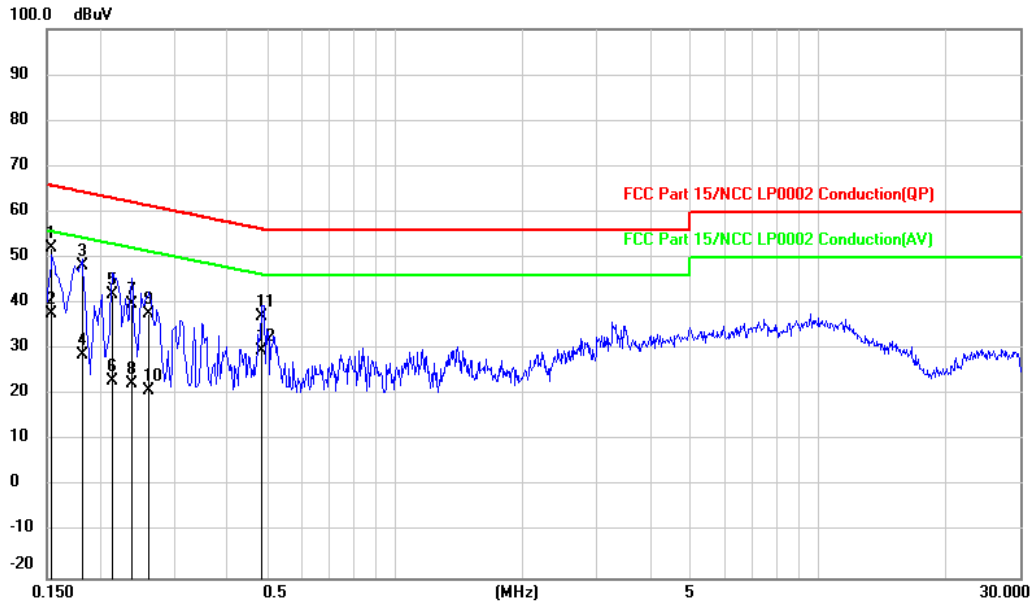
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Phase of Power : Neutral (N)



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No.	Frequency (MHz)	Reading (dBuV)	Correct dB	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1539	32.41	19.68	52.09	65.79	-13.70	QP
2	0.1539	18.05	19.68	37.73	55.79	-18.06	AVG
3	0.1819	28.53	19.68	48.21	64.40	-16.19	QP
4	0.1819	9.07	19.68	28.75	54.40	-25.65	AVG
5	0.2140	22.23	19.68	41.91	63.05	-21.14	QP
6	0.2140	3.43	19.68	23.11	53.05	-29.94	AVG
7	0.2380	20.10	19.68	39.78	62.17	-22.39	QP
8	0.2380	2.78	19.68	22.46	52.17	-29.71	AVG
9	0.2620	18.01	19.68	37.69	61.37	-23.68	QP
10	0.2620	1.40	19.68	21.08	51.37	-30.29	AVG
11	0.4860	17.50	19.67	37.17	56.24	-19.07	QP
12	0.4860	9.97	19.67	29.64	46.24	-16.60	AVG

Remarks:

1. Result value (dBuV) = Reading value (dBuV) + Correction Factor (dB)
2. Margin(dB) = Result value (dBuV) - Limit value (dBuV)
3. Correction Factor(dB) = Insertion loss(dB) + Cable loss(dB)
4. The other emission levels were very low against the limit.

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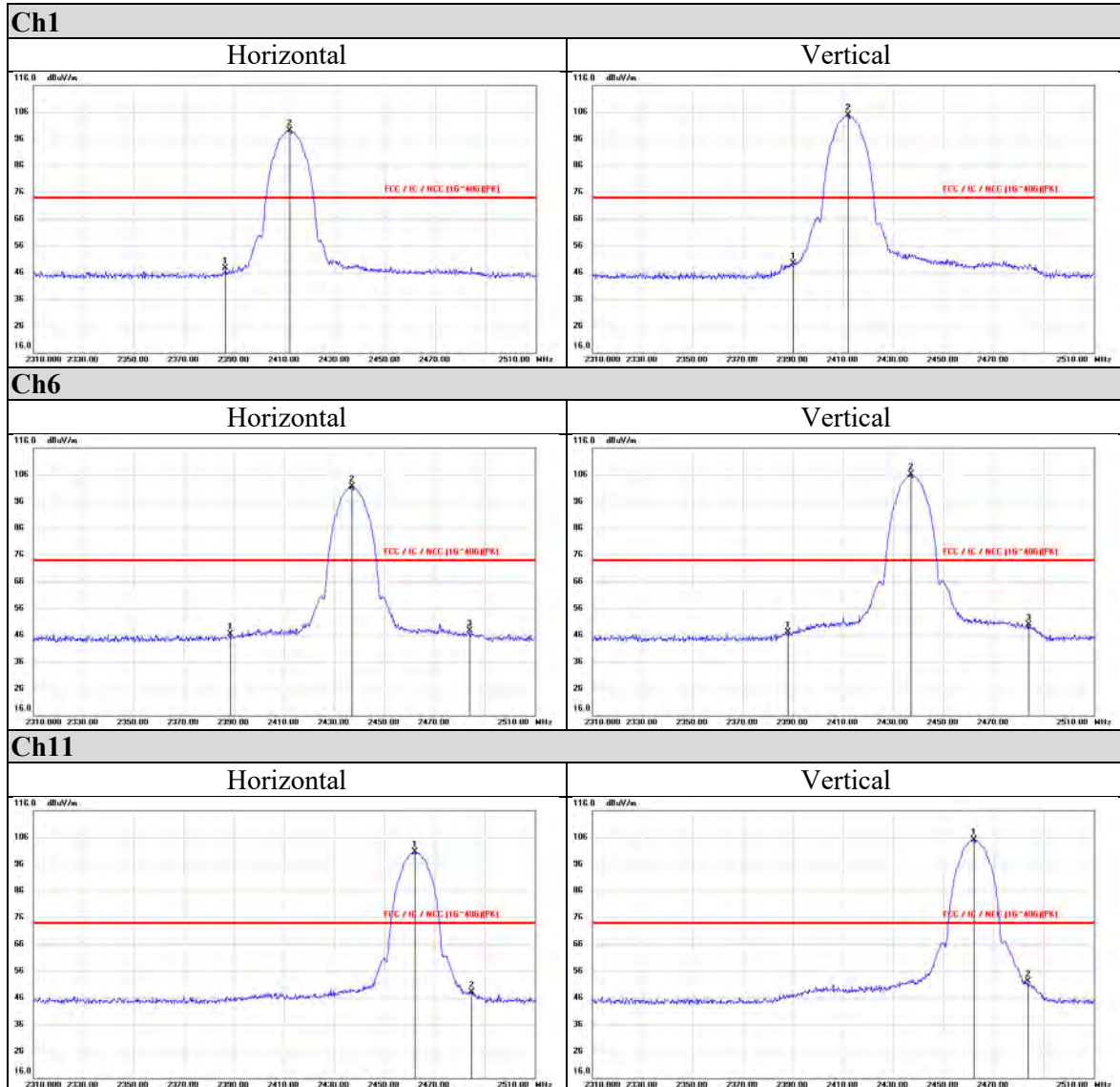
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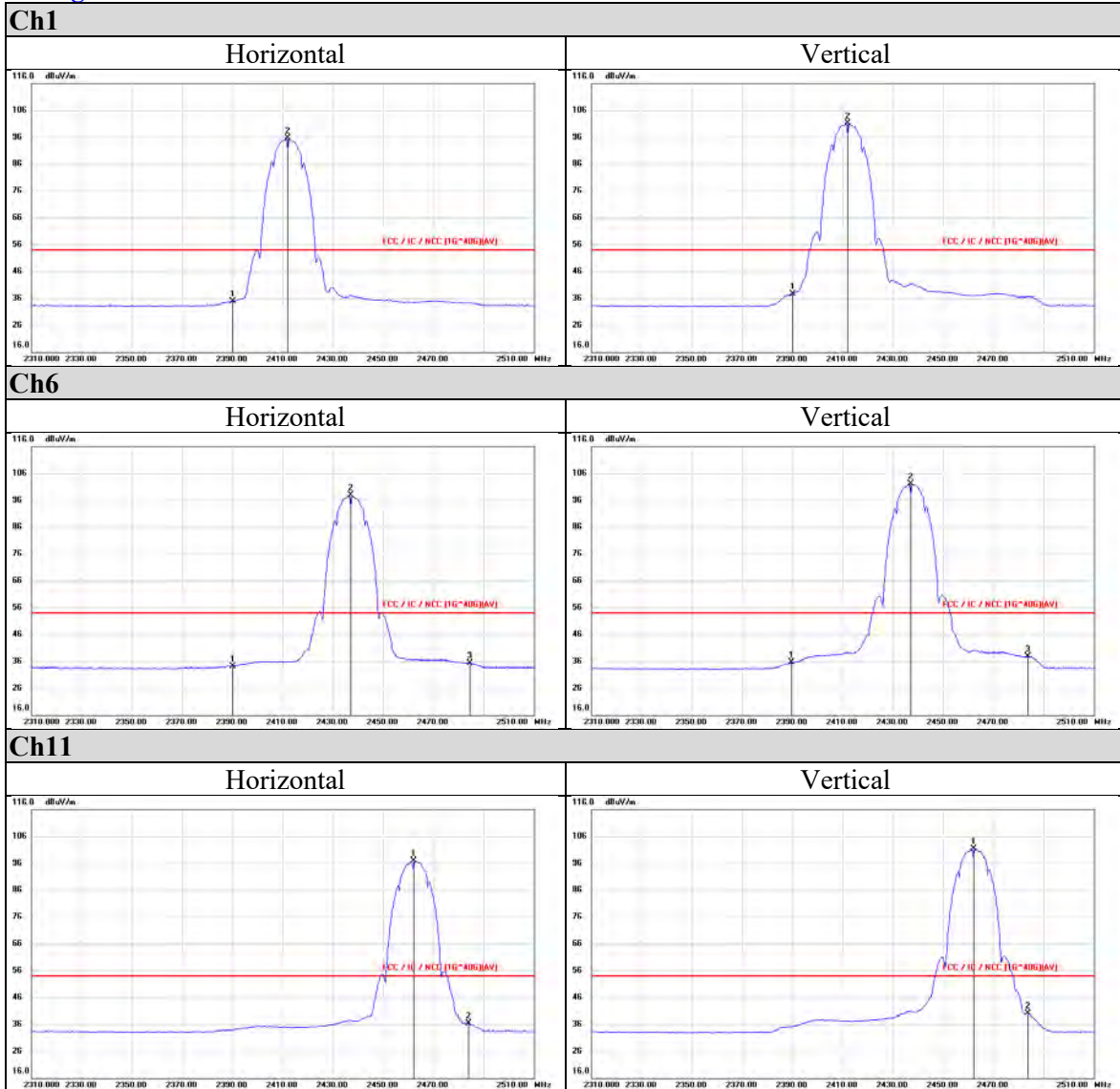
Appendix I Radiated Band Edge Measurement

802.11b Peak





Average



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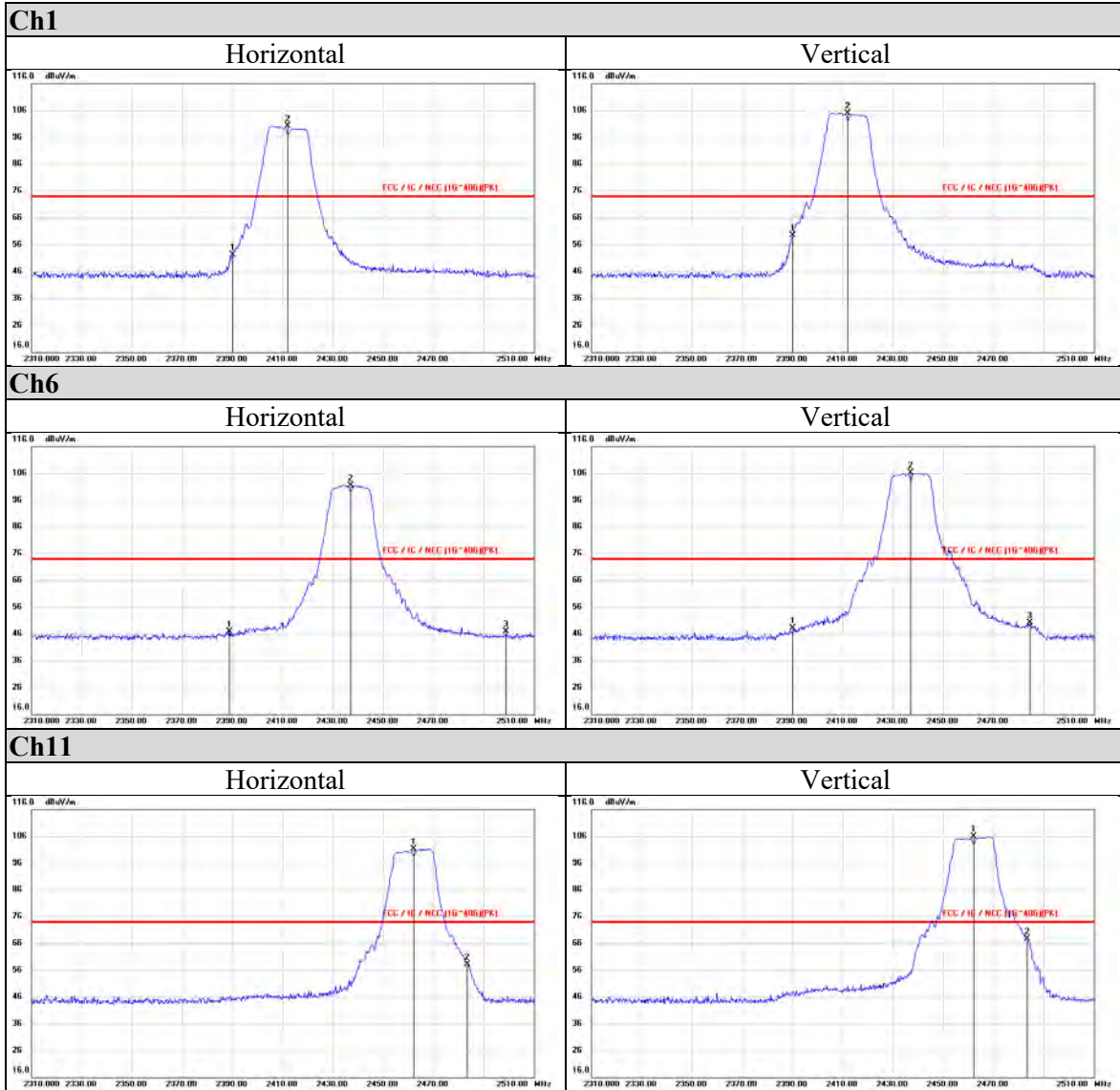
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802.11g
Peak



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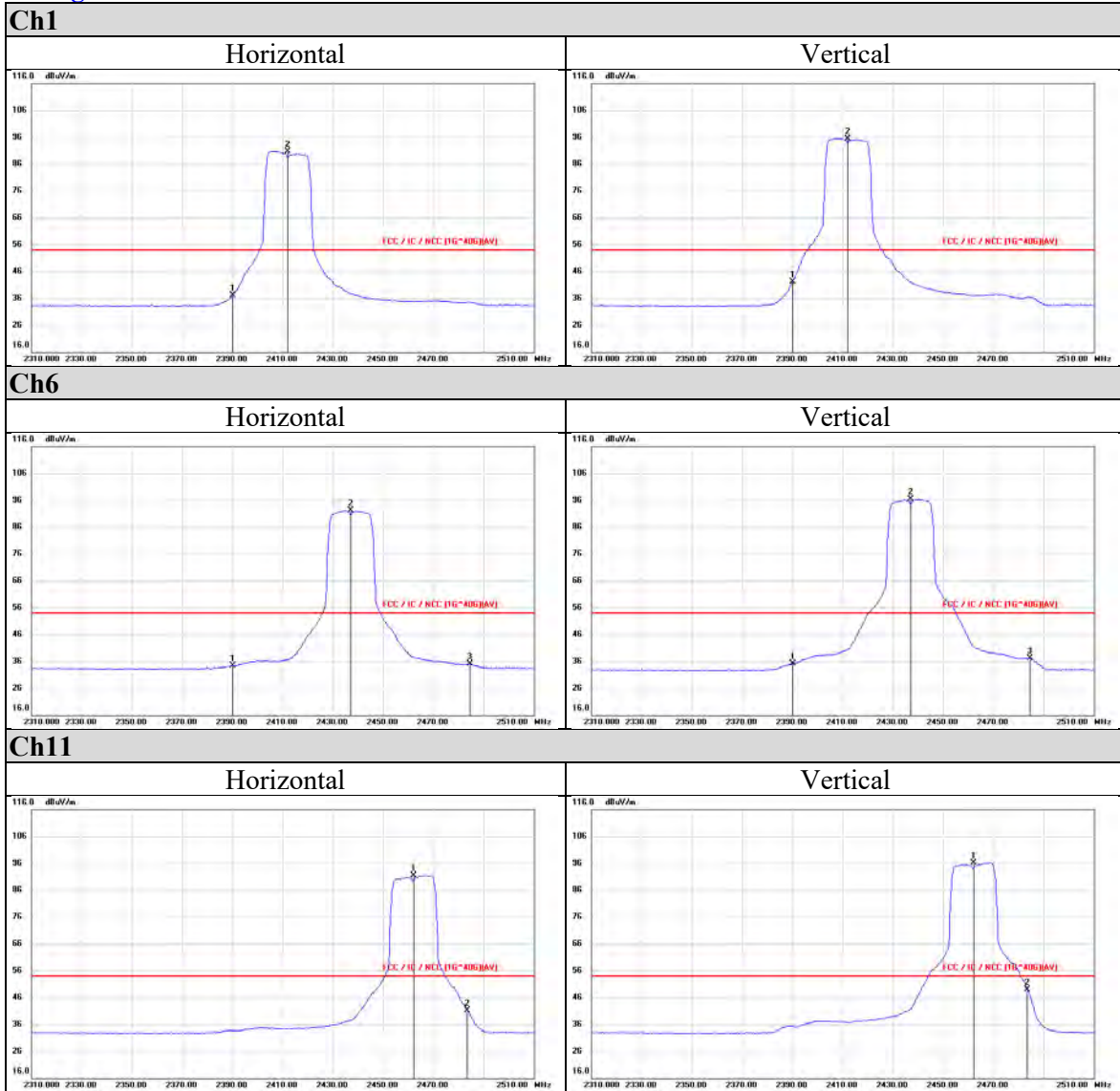
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Average



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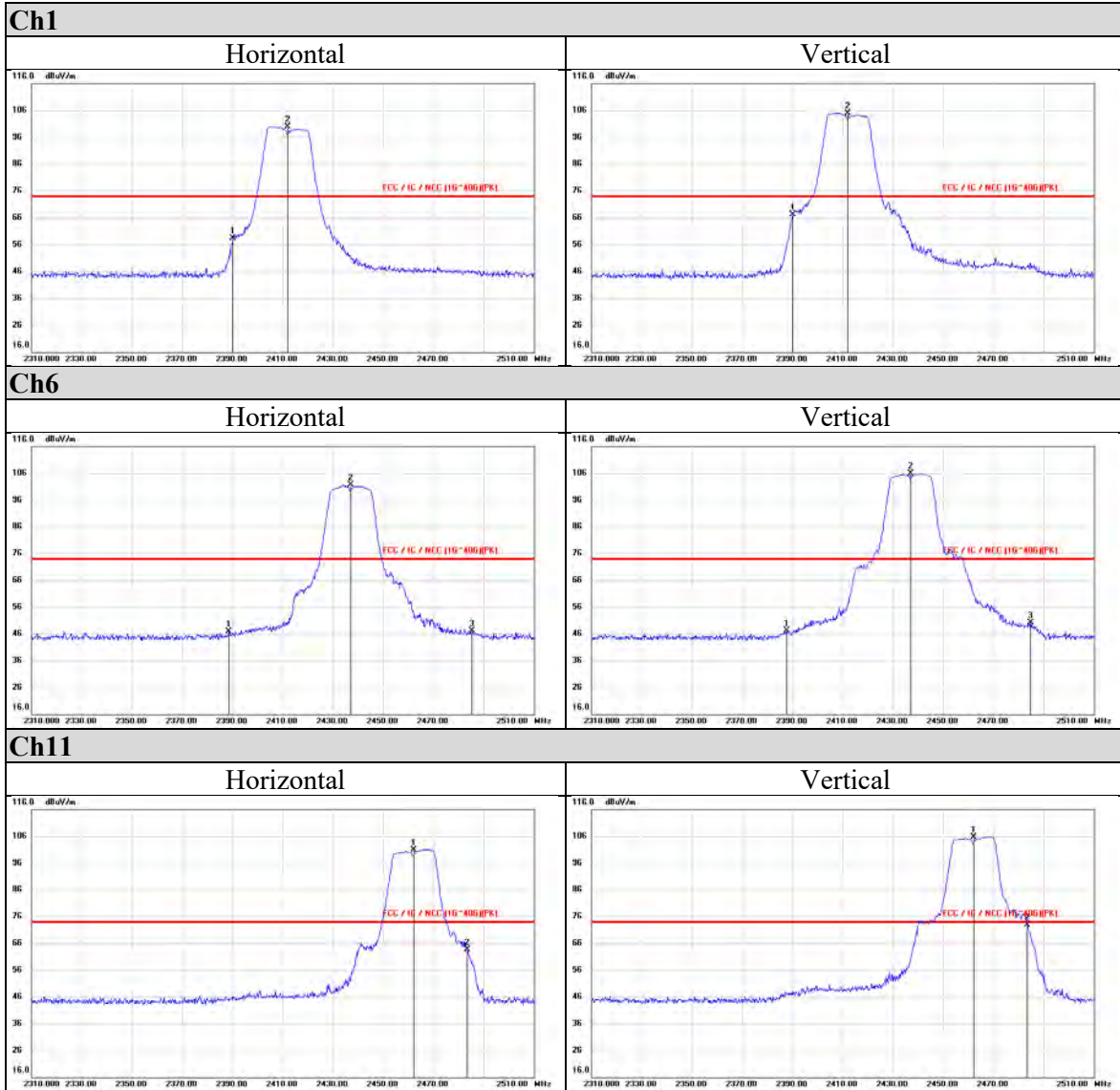
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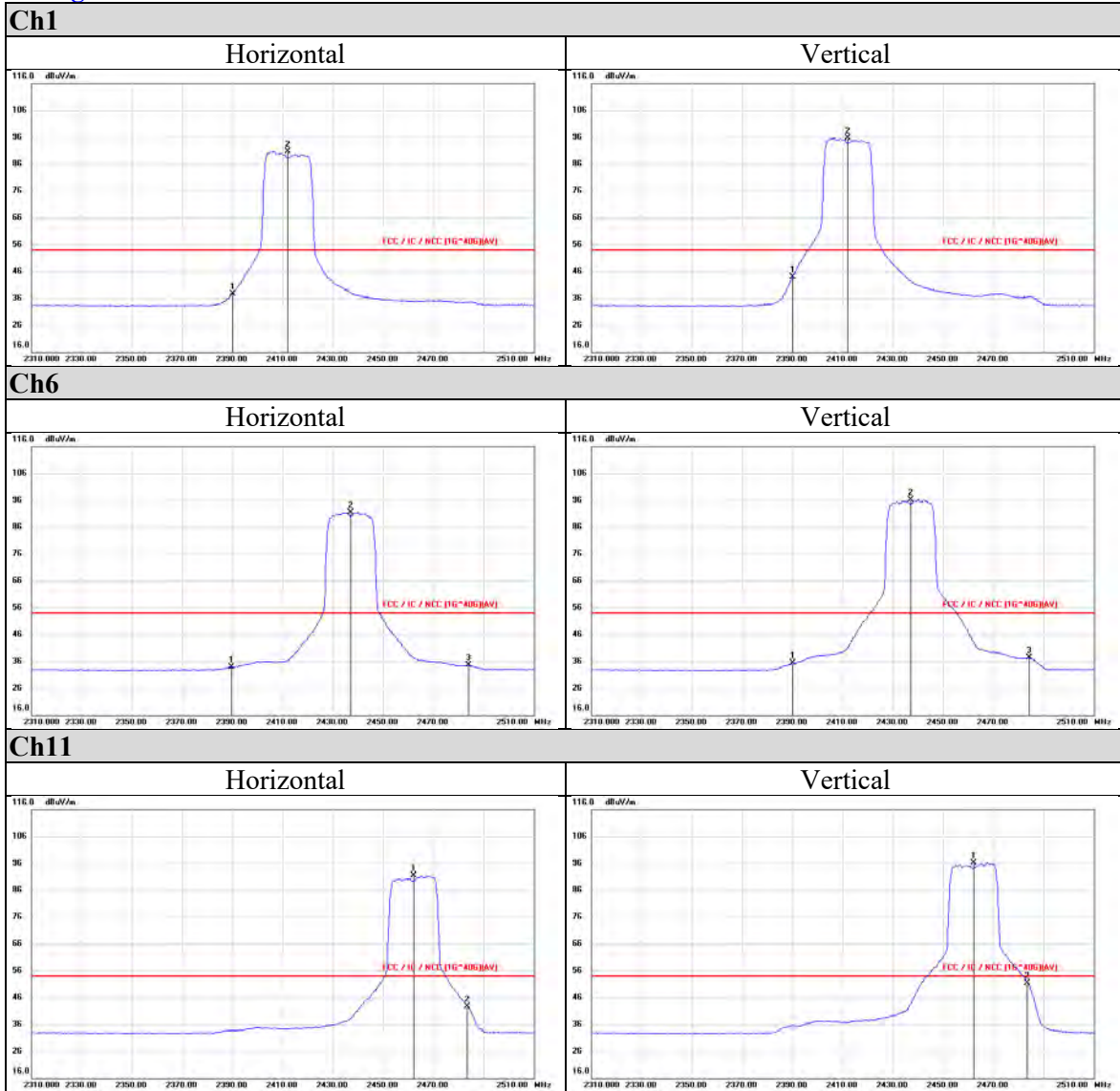
802.11n (HT-20)

Peak





Average



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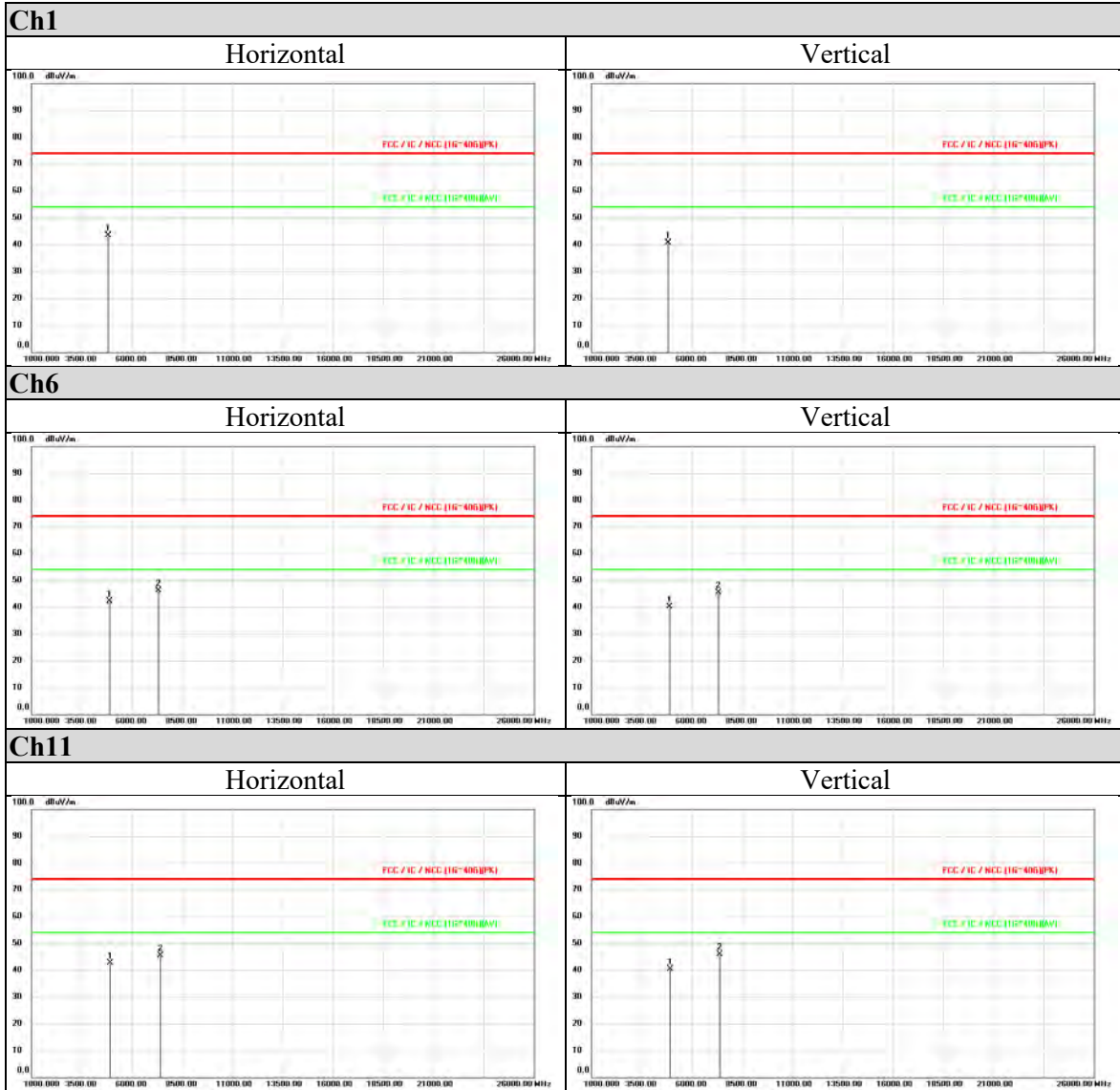
Appendix II Radiated Spurious Emission Measurement

802.11b





802.11g



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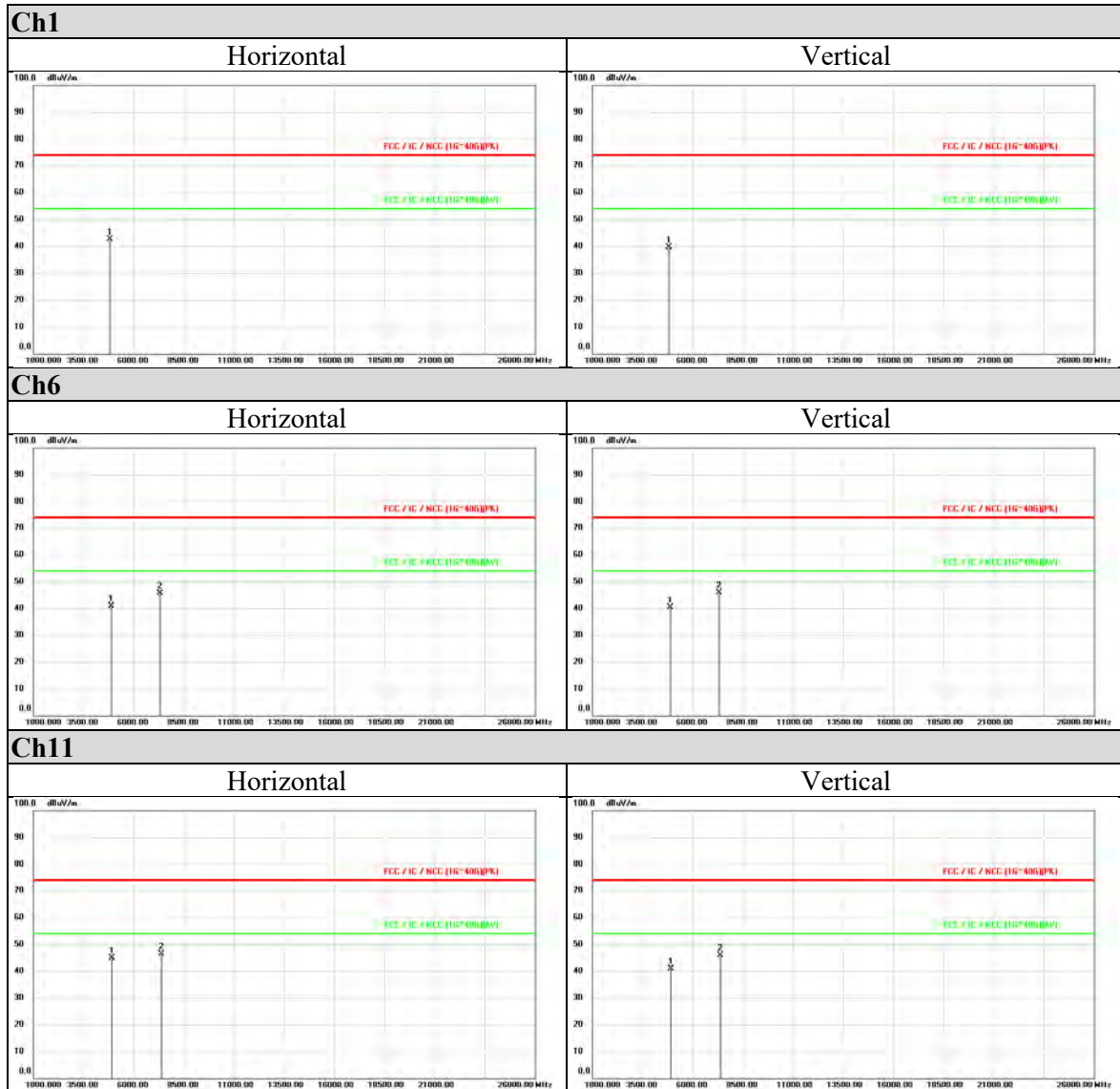
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