

FCC/ ISED RF Test Report

Report No.: FCC_IC_RF_SL20113001-HAR-291_2.4G

FCC ID: 2AHPN-BE2843

IC ID 6434C-BE2843

Model: GM MY20

Received Date: 12/04/2020

Test Date: 12/04/2020 - 12/11/2020

Issued Date: 12/14/2020

Applicant: Harman International Industries Inc.

Address: 30001 Cabot Drive, Novi, MI 48377, USA

Manufacturer: Harman International Industries Inc.

Address: 30001 Cabot Drive, Novi, MI 48377, USA

Issued By: Bureau Veritas Consumer Products Services, Inc.

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**FCC Registration /
Designation Number:** 540430

ISED# / CAB identifier: 4842D



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Release Control Record

Issue No.	Description	Date Issued
FCC_IC_RF_SL20113001-HAR-291_2.4G	Original Release	12/14/2020

1 Certificate of Conformity

Product: Unlicensed National Information Infrastructure Device

Brand: HARMAN

Model: GM MY20

Sample Status: Engineering sample

Applicant: Harman International Industries Inc.

Test Date: 12/04/2020 - 12/11/2020

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)

RSS-247 Issue 2, February 2017

ANSI C63.10: 2013

RSS-Gen Issue 5, March 2019

558074 D01 15.247 Meas Guidance v05r02

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Gary Chou, **Date:** 12/14/2020
Gary Chou / Test Engineer

Approved by : Deon Dai, **Date:** 12/21/2020
Deon Dai / Engineer Review

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247) / ISSED RSS-247				
FCC Clause	RSS Section(s)	Test Item	Result	Remarks
15.207	RSS-Gen [8.8]	AC Power Conducted Emission	N/A	Note1*
15.205 & 15.209 & 15.247(d)	RSS-Gen [8.9] RSS-247 [5.5]	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit.
15.247(d)	RSS-247[5.5]	Antenna Port Emission	PASS	Note1*
15.247(a)(2)	RSS-247[5.2]	6dB Bandwidth & 99% Bandwidth	PASS	Note1*
15.247(b)	RSS-247 [5.4(4)]	Conducted power	PASS	Meet the requirement of limit.
15.247(e)	RSS-247 [5.2]	Power Spectral Density	PASS	Note1*
15.203		Antenna Requirement	PASS	Antenna connector is FAKRA. (The device is professionally installed)

Note: The EUT is DC powered.

Note1*: Please refer to report FCC ID" 2AHPN-BE2843".

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) ($\pm$)
Conducted Emissions at mains ports	150kHz ~ 30MHz	3.51dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.73dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	4.64dB
	6GHz ~ 18GHz	4.82dB
	18GHz ~ 40GHz	4.91dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Unlicensed National Information Infrastructure Device
Brand	HARMAN
Test Model	GM MY20
Status of EUT	Engineering Sample
Power Supply Rating	12Vdc
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: up to 11Mbps 802.11g: up to 54Mbps 802.11n: up to 300Mbps
Operating Frequency	2412~2462MHz
Number of Channel	11 for 802.11b, 802.11g, 802.11n(HT20)
Output Power	16.25mW
Antenna Type	External detachable Antenna, 1.3dBi
Antenna Connector	N/A

3.2 Description of Test Modes

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		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE $\geq$ 1G	RE<1G	PLC	APCM	
-	√	√	N/A	√	-

Where RE $\geq$ 1G: Radiated Emission above 1GHz & Bandedge Measurement
 RE<1G: Radiated Emission below 1GHz
 PLC: Power Line Conducted Emission
 APCM: Antenna Port Conducted Measurement

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane**.

NOTE: "-" means no effect.

Radiated Emission Test (Above 1GHz):

- ☒ 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).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11g	1 to 11	11	DSSS	DBPSK	1

Radiated Emission Test (Below 1GHz):

- ☒ 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).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	11	DSSS	DBPSK	1

Power Line Conducted Emission Test:

- ☐ 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).
- ☐ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11n (HT20)	1 to 11	6	OFDM	BPSK	6.5

Antenna Port Conducted Measurement:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ 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).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE $\geq$ 1G	25deg. C, 65%RH	120Vac, 60Hz	Yao Wei Lee
RE<1G	25deg. C, 65%RH	120Vac, 60Hz	Yao Wei Lee
PLC	25deg. C, 68%RH	120Vac, 60Hz	Yao Wei Lee
APCM	21deg. C, 60%RH	120Vac, 60Hz	Yao Wei Lee

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Dell	Latitude 3550	2MHWY32	N/A	Provided by Lab

Note: The core(s) is (are) originally attached to the cable(s).

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

47 CFR FCC Part 15, Subpart C (Section 15.247)

RSS-247 Issue 2, February 2017

ANSI C63.10: 2013

RSS-Gen Issue 5, March 2019

558074 D01 15.247 Meas Guidance v05r02

All test items have been performed and recorded as per the above standards.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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:

Frequencies (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.

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
EMI Test Receiver	ESW44	1328.4100K44-101662-MH	10/23/2020	10/23/2021
Biconilog Antenna Sunol	JB6	A111717	03/09/2020	03/09/2021
Horn Antenna ETS-Lindgren	3117	218554	12/20/2019	12/20/2020
Pre-Amplifier RF-Lambda	RAMP00M50GA	17032300048	06/18/2020	06/18/2021

4.1.3 Test Procedures

For Radiated emission below 30MHz

- 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. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

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

For Radiated emission above 30MHz

- 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. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- 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.

Note:

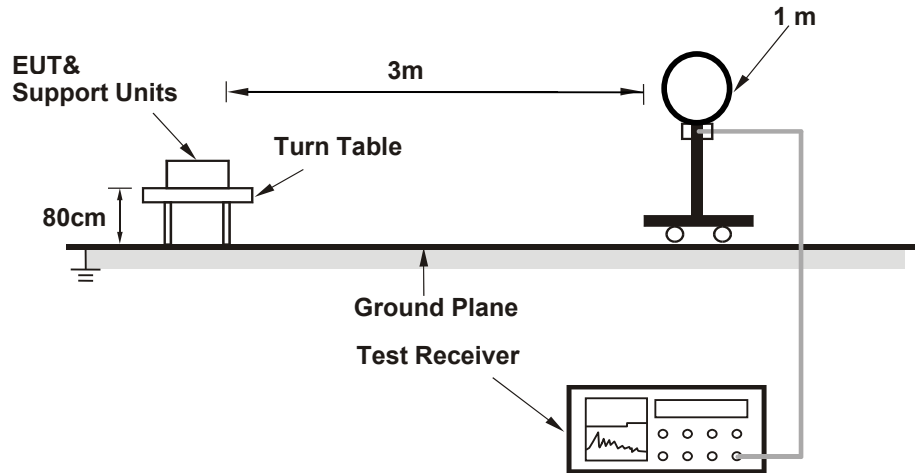
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. 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.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

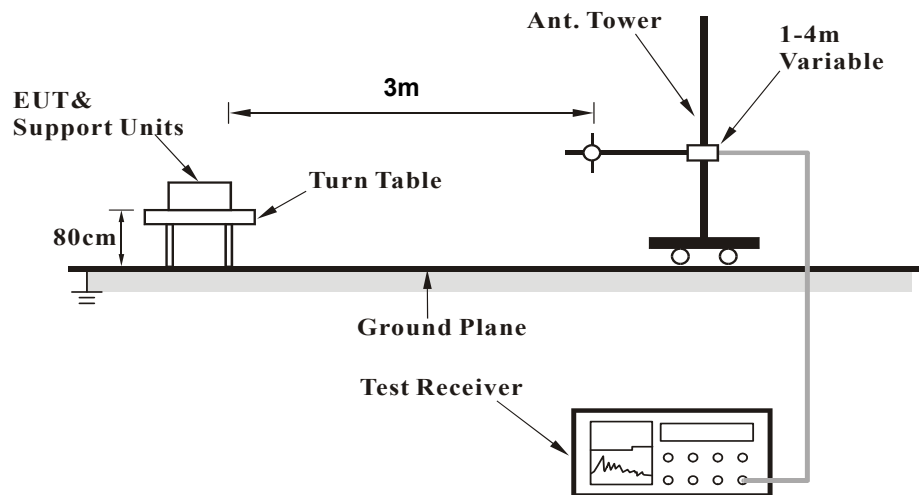
No deviation.

4.1.5 Test Setup

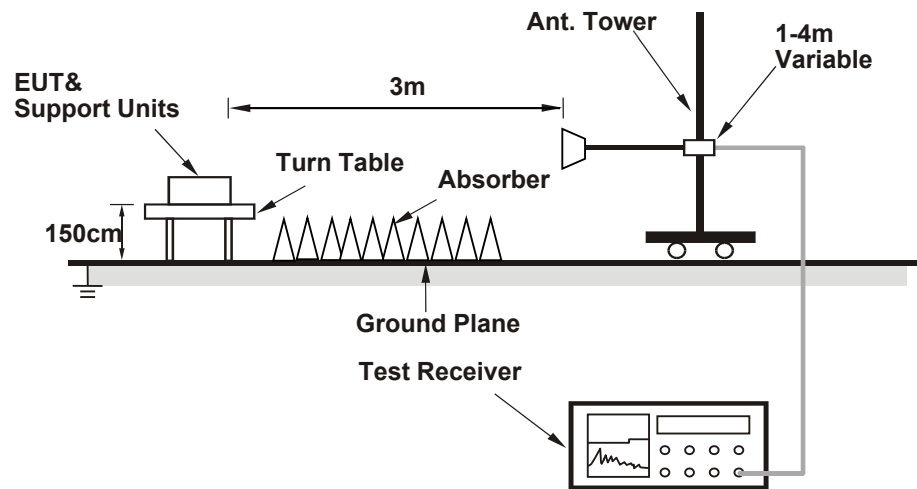
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

- Connected the EUT with the Notebook Computer which is placed on remote site.
- Controlling software has been activated to set the EUT on specific status.

4.1.7 Test Results

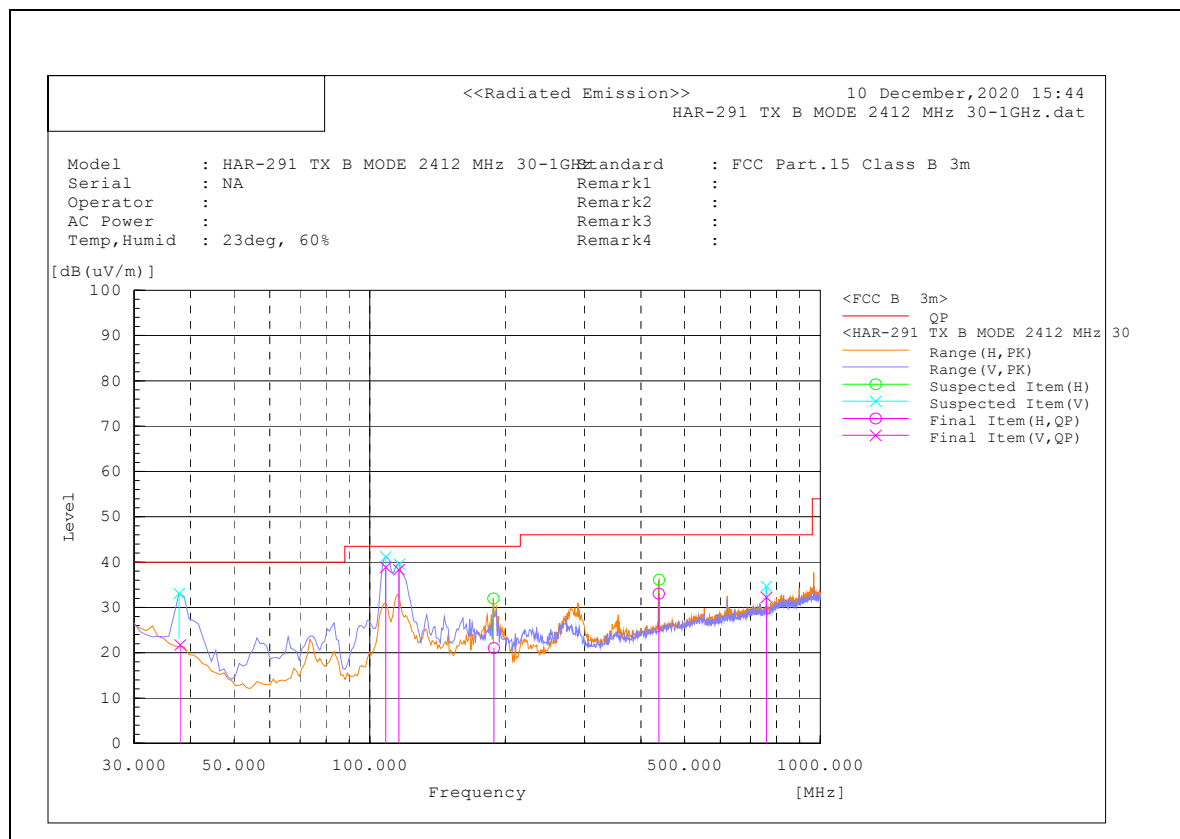
BELOW 1GHz WORST-CASE DATA:

CHANNEL	802.11b Channel 1	DETECTOR FUNCTION	Quasi Peak
FREQUENCY RANGE	30MHz – 1GHz		

Antenna Polarity & Test Distance: Vertical and Horizontal at 3m										
No.	Frequency (MHz)	Polarization (H/V)	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	LimitQP dB(uV/m)	Margin QP [dB]	Height (cm)	Angle (Deg)	Pass/Fail
1	37.968	V	1.8	19.9	21.7	40	-18.3	100	333.4	Pass
2	108.555	V	20.5	18.3	38.8	43.5	-4.7	100	0	Pass
3	115.997	V	19.2	19.1	38.3	43.5	-5.2	100	1.1	Pass
4	188.586	H	3.4	17.6	21	43.5	-22.5	218	316.5	Pass
5	759.557	V	4	28.2	32.2	46	-13.8	152	305.9	Pass
6	438.001	H	9.1	23.9	33	46	-13	143	263.7	Pass

REMARKS:

1. Emission level (dBuV/m) = Reading Value (dBuV) + Factor (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



ABOVE 1GHz WORST-CASE DATA:

WLAN 2.4GHz

802.11g

Above 1GHz-26.5GHz – 802.11g – 2462MHz

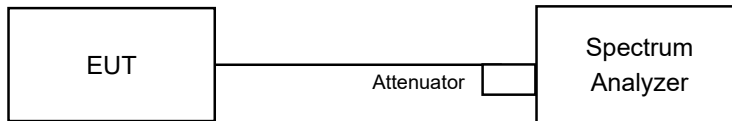
Antenna Polarity & Test Distance: Vertical and Horizontal at 3m														
No.	Frequency (MHz)	Polarization (H/V)	Reading AV [dB(uV)]	Reading PK [dB(uV)]	Factor [dB(1/m)]	Level AV [dB(uV/m)]	Level PK [dB(uV/m)]	Limit\AV [dB(uV/m)]	Limit\PK [dB(uV/m)]	Margin AV [dB]	Margin PK [dB]	Height (cm)	Angle (Deg)	Pass/ Fail
1	4924.468	V	38.5	50.2	-7.1	31.4	43.1	54	74	-22.6	-30.9	269	72.2	Pass
2	4924.468	H	37.2	48.7	-7.1	30.1	41.6	54	74	-23.9	-32.4	248	36.8	Pass
3	7385.503	V	34.9	46.7	-2.1	32.8	44.6	54	74	-21.2	-29.4	147	276.5	Pass
4	7385.503	H	33.6	45.2	-2.1	31.5	43.1	54	74	-22.5	-30.9	129	243	Pass
5	9848.033	V	31.3	43	1.4	32.7	44.4	54	74	-21.3	-29.6	100	53.8	Pass
6	9848.033	H	30	41.5	1.4	31.4	42.9	54	74	-22.6	-31.1	95	46	Pass

4.2 Conducted Output Power Measurement

4.2.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedures

- a. Set the RBW $\geq$ DTS bandwidth.
- b. Set VBW $\geq 3 \times$ RBW.
- c. Set span $\geq 3 \times$ RBW
- d. Sweep time = auto couple.
- e. Detector = peak.
- f. Trace mode = max hold.
- g. Allow trace to fully stabilize.
- h. Use peak marker function to determine the peak amplitude level.

4.2.5 Deviation from Test Standard

No deviation.

4.2.6 EUT Operating Conditions

Same as Item 4.3.6.

4.2.7 Test Results

802.11b

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
1	2412	10.63	30	Pass
6	2437	10.22	30	Pass
11	2462	9.87	30	Pass

802.11g

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
1	2412	12.11	30	Pass
6	2437	11.62	30	Pass
11	2462	11.53	30	Pass

802.11n(HT20)

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Pass/Fail
1	2412	11.03	30	Pass
6	2437	10.23	30	Pass
11	2462	10.22	30	Pass

Appendix – Information on the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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