TEST REPORT

No. I19D00119-SRD03

For

Client : Inseego Corp.

Production : Industrial Cellular Gateway with Ethernet,WiFi, Bluetooth,GPS/GLNSS and USB Connectivity

Model Name : SKG1EM7455

Brand Name : SKYUS 160NE

FCC ID : PKRISGSKG1EM7455

IC ID : 3229A-SKG1EM7455

Hardware Version : P2

Software Version : 2.110.1.2

Issued date : 2019-11-13

NOTE

1. The test results in this test report relate only to the devices specified in this report.
2. This report shall not be reproduced except in full without the written approval of East China Institute of Telecommunications.
3. KDB558074 has not been accredited by A2LA.
4. For the test results, the uncertainty of measurement is not taken into account when judging the compliance with specification, and the results of measurement or the average value of measurement results are taken as the criterion of the compliance with specification directly.

Test Laboratory:
East China Institute of Telecommunications
Add: 7-8F, G Area, No.668, Beijing East Road, Huangpu District, Shanghai, P. R. China
Tel: +86 21 63843300
FAX: +86 21 63843301
E-Mail: welcome@ecit.org.cn

Revision Version

Report Number	Revision	Date	Memo
I19D00119-SRD03	00	2019-08-12	Initial creation of test report
I19D00119-SRD03	01	2019-11-07	Second creation of test report
I19D00119-SRD03	02	2019-11-13	Third creation of test report

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1. Test Laboratory

1.1. Testing Location

Company Name	East China Institute of Telecommunications
Address	7-8/F., Area G, No.668, Beijing East Road, Shanghai, China
Postal Code	200001
Telephone	+86 21 63843300
Fax	+86 21 63843301
FCC registration No	CN1177
IC registration No	10766A-1

1.2. Testing Environment

Normal Temperature	15℃-35℃
Relative Humidity	20%-75%

1.3. Project Data

Project Leader	Chen Minfei
Testing Start Date	2019-08-01
Testing End Date	2019-08-03

1.4. Signature

Wang Liang
(Prepared this test report)

Fan Songyan
(Reviewed this test report)

Zheng Zhongbin
(Approved this test report)

2. Client Information

2.1. Applicant Information

Company Name	Inseego Corp.
Address	9605 Scranton Road, Suite 300, San Diego, CA 92121, USA
Telephone	+1 858-812-0606
Postcode	/

2.2. Manufacturer Information

Company Name	Inseego Corp.
Address	9605 Scranton Road, Suite 300, San Diego, CA 92121, USA
Telephone	+1 858-812-0606
Postcode	/

3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1. About EUT

Production	Industrial Cellular Gateway with Ethernet,WiFi,Bluetooth,GPS/GLNSS and USB Connectivity
Model name	SKG1EM7455
WLAN Frequency(2.4G)	2412MHz-2462MHz
WLAN Channel(2.4G)	Channel1-Channel11
WLAN type of modulation	802.11b:DSSS 802.11g/n: OFDM
Additional Communication Function	BT/BLE/2.4G WLAN 802.11 b/g/n20 5G WLAN 802.11 a20/n20/ac20
Extreme Temperature	-30/+60℃
Nominal Voltage	12V
Extreme High Voltage	32V
Extreme Low Voltage	9V
Maximum of Antenna Gain	WIFI2.4Ghz:4dBi

Note:

a. Photographs of EUT are shown in ANNEX A of this test report.

b. The value of the antenna gain is provided by the customer. For specific antenna information, please check the antenna specifications of the customer.

3.2. Internal Identification of EUT used during the test

EUT ID*	SN or IMEI	HW Version	SW Version	Date of receipt
N13	/	2.110.1.2	P2	2019-07-30
N16	/	2.110.1.2	P2	2019-07-30
N20	/	2.110.1.2	P2	2019-07-30

*EUT ID: is used to identify the test sample in the lab internally.

3.3. Internal Identification of AE used during the test

AE ID*	Description	Type	Manufacturer
AE1	RF cable	---	AE1

*AE ID: is used to identify the test sample in the lab internally.

4. Reference Documents

4.1. Documents supplied by applicant

All technical documents are supplied by the client or manufacturer, which is the basis of testing.

4.2. Reference Documents for testing

The following documents listed in this section are referred for testing.

Reference	Title	Version
FCC Part15	FCC CFR 47, Part 15,Subpart C: 15.205 Restricted bands of operation; 15.209 Radiated emission limits, general requirements; 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.	2018-10-1
ANSI 63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013
KDB558074	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247	2018-08-24
RSS-247	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices	2017-02
RSS-Gen	General Requirements for Compliance of Radio Apparatus	2018-04

5. Test Results

5.1. Summary of Test Results

Measurement Items	Sub-clause of Part15C	Sub-clause of IC	Verdict
Maximum Peak Output Power	15.247(a)	RSS-2475.4	P
Peak Power Spectral Density	15.247(e)	RSS-2475.2	P
Occupied 6dB Bandwidth	15.247(d)	RSS-2475.2	P
99% Occupied Bandwidth	/	RSS Gen 6.6	P
Band Edges Compliance	15.247(b)	RSS-2475.5	P
Transmitter Spurious Emission-Conducted	15.247	RSS-2475.5	P
Transmitter Spurious Emission-Radiated	15.247,15.209,	RSS-2475.5	P
AC Powerline Conducted Emission	15.107,15.207	RSS-247 Gen 3.2	P

Note: please refer to Annex A in this test report for the detailed test results.
Please refer to part 5 for detail.
The measurements are according to Public notice KDB558074 and ANSI C63.10.
Terms used in Verdict column

The following terms are used in the above table.

P	Pass, the EUT complies with the essential requirements in the standard.
NP	Not Perform, the test was not performed by ECIT.
NA	Not Applicable, the test was not applicable.
F	Fail, the EUT does not comply with the essential requirements in the standard.

Test Conditions

Tnom	Normal Temperature
Tmin	Low Temperature
Tmax	High Temperature
Vnom	Normal Voltage
Vmin	Low Voltage
Vmax	High Voltage

Hnom	Norm Humidity
Anom	Norm Air Pressure

For this report, all the test case listed above are tested under Normal Temperature and Normal Voltage, and also under norm humidity, the specific conditions as following:

Temperature	Tnom	25℃
Voltage	Vnom	24V
Humidity	Hnom	48%
Air Pressure	Anom	1010hPa

5.2. Statements

The SKG1EM7455 is an initial product for testing.

ECIT only performed test cases which identified with P/NP/NA/F results in Annex A.

ECIT has verified that the compliance of the tested device specified in section 3 of this test report is successfully evaluated according to the procedure and test methods as defined in type certification requirement listed in section 4 of this test report.

6. Test Equipments Utilized

6.1. Conducted Test System

Item	Instrument Name	Type	SN	Manufacturer	Cal. Date	Cal. interval
1	Vector Signal Analyzer	FSQ26	101091	R&S	2019-05-10	1 year
2	DC Power Supply	ZUP60-14	LOC-220Z006-0007	TDL-Lambda	2019-05-10	1 year

6.2. Radiated Emission Test System

Item	Instrument Name	Type	SN	Manufacturer	Cal. Date	Cal. interval
1	Universal Radio Communication Tester	CMU200	123123	R&S	2019-05-10	1 year
2	EMI Test Receiver	ESU40	100307	R&S	2019-05-10	1 year
3	TRILOG Broadband Antenna	VULB9163	VULB9163-515	Schwarzbeck	2017-02-25	3 years
4	Double- ridged Waveguide Antenna	ETS-3117	00135890	ETS	2017-01-11	3 years
5	2-Line V-Network	ENV216	101380	R&S	2019-05-10	1 year

Anechoic chamber

Fully anechoic chamber by ETS.

7. Measurement Uncertainty

Measurement uncertainty for all the testing in this report are within the limit specified in ECIT documents . The detailed measurement uncertainty is defined in ECIT documents.

Measurement Items	Range	Confidence Level	Calculated Uncertainty
Peak Output Power-Conducted	2412MHz-2462MHz	95%	±0.544dB
Peak Power Spectral Density	2412MHz-2462MHz	95%	±0.544dB
Occupied 6dB Bandwidth	2412MHz-2462MHz	95%	±62.04Hz
Frequency Band Edges-Conducted	2412MHz-2462MHz	95%	±0.544dB
Conducted Emission	30MHz-2GHz	95%	±0.90dB
Conducted Emission	2GHz-3.6GHz	95%	±0.88dB
Conducted Emission	3.6GHz-8GHz	95%	±0.96dB
Conducted Emission	8GHz-20GHz	95%	±0.94dB
Conducted Emission	20GHz-22GHz	95%	±0.88dB
Conducted Emission	22GHz-26GHz	95%	±0.86dB
Transmitter Spurious Emission-Radiated	9KHz-30MHz	95%	±5.66dB
Transmitter Spurious Emission-Radiated	30MHz-1000MHz	95%	±4.98dB
Transmitter Spurious Emission-Radiated	1000MHz -18000MHz	95%	±5.06dB
Transmitter Spurious Emission-Radiated	18000MHz -40000MHz	95%	±5.20dB
AC Power line Conducted Emission	0.15MHz-30MHz	95%	±3.66 dB

8. Test Environment

Shielding Room1 (6.0 meters×3.0 meters×2.7 meters) did not exceed following limits along the conducted RF performance testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	> 100 dB
Ground system resistance	< 0.5 Ω

Control room did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. =30 %, Max. = 60 %
Shielding effectiveness	> 100 dB
Electrical insulation	> 10 kΩ
Ground system resistance	< 0.5 Ω

Fully-anechoic chamber1 (6.9 meters×10.9 meters×5.4 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 25 %, Max. = 75 %
Shielding effectiveness	> 100 dB
Electrical insulation	> 10 kΩ
Ground system resistance	< 0.5 Ω
VSWR	Between 0 and 6 dB, from 1GHz to 18GHz
Site Attenuation Deviation	Between -4 and 4 dB,30MHz to 1GHz
Uniformity of field strength	Between 0 and 6 dB, from 80MHz to 3000 MHz

ANNEX A. Detailed Test Results

ANNEX A.1. Output Power-Conducted

A.1.1 Measurement Limit and method:

Standard	Limit(dBm)
FCC CRF 15.247(b)	< 30

A.1.2 Test procedure

The measurement is according to ANSI C63.10 clause 11.2

1. The output power of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Set RBW ⩾ OBW(1MHz), VBW ⩾ 3RBW(3MHz).
4. Span : 80MHz
5. Detector : RMS.
6. Trace mode: Max Hold
7. Spectrum Analyzer setting : Meas—channel PWR ACP—CP/ACP Config—channel bandwidth—20/40MHz

A.1.3 Maximum Peak Output Power-conducted

A.1.4 Maximum Average Output Power-conducted

802.11b/g mode

Mode	Test Level	Test Result(dBm)		
		2412MHz (Ch1)	2437MHz (Ch6)	2462MHz (Ch11)
802.11b	PCL19	17.29	17.70	17.74
802.11g	PCL17	17.00	17.47	17.74
Mode	**Test Level**	**Test Result(dBm)**		
		EIRP 2412MHz(Ch1)	**EIRP 2437MHz(Ch6)**	**EIRP 2462MHz(Ch11)**
802.11b	PCL19	21.29	21.70	21.74
802.11g	PCL17	21.00	21.47	21.74

802.11n mode

Mode	Test Level	Test Result(dBm)		
		2412MHz (Ch1)	2437MHz (Ch6)	2462MHz (Ch11)
802.11n(20MHz)	PCL17	17.30	17.69	17.89
Mode	**Test Level**	**Test Result(dBm)**		
		EIRP 2412MHz(Ch1)	**EIRP 2437MHz(Ch6)**	**EIRP 2462MHz(Ch11)**
802.11n(20MHz)	PCL17	21.30	21.69	21.89

The data rate 11 Mbps and 54 Mbps are selected as worse condition,and The data rate MCS3 for 802.11n(20M) is selected as worse condition, and the following case are performed with this condition.

Conclusion: PASS

ANNEX A.2. Peak Power Spectral Density

A.2.1 Measurement Limit:

Standard	Limit
FCC CFR Part 15.247(e)	< 8dBm/3 KHz

A.2.2 Test procedures

The measurement is according to ANSI C63.10 clause 11.10.

1. The output power of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Set analyzer center frequency to DTS channel center frequency.
4. Set the span to 1.5 times the DTS bandwidth.
5. Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.
6. Set the VBW ≥ [3 × RBW].
7. Detector = peak.
8. Sweep time = auto couple.
9. Trace mode = max hold.
10. Allow trace to fully stabilize.
11. Use the peak marker function to determine the maximum amplitude level within the RBW.
12. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

Measurement Results:

802.11b/g mode（11/54 Mbps）

Mode	Channel	Power Spectral Density(dBm/3kHz)		Conclusion
802.11b	1	Fig 1.	-8.614	P
	6	Fig 2.	-7.920	P
	11	Fig 3.	-8.559	P
802.11g	1	Fig 4.	-7.591	P
	6	Fig 5.	-8.577	P
	11	Fig 6.	-8.780	P

802.11n mode（MCS3）

Mode	Channel	Power Spectral Density(dBm/3kHz)		Conclusion
802.11n(20MH	1	Fig 7.	-7.490	P

z)	6	Fig 8.	-9.443	P
	11	Fig 9.	-7.377	P

Conclusion: PASS

Test graphs as below:

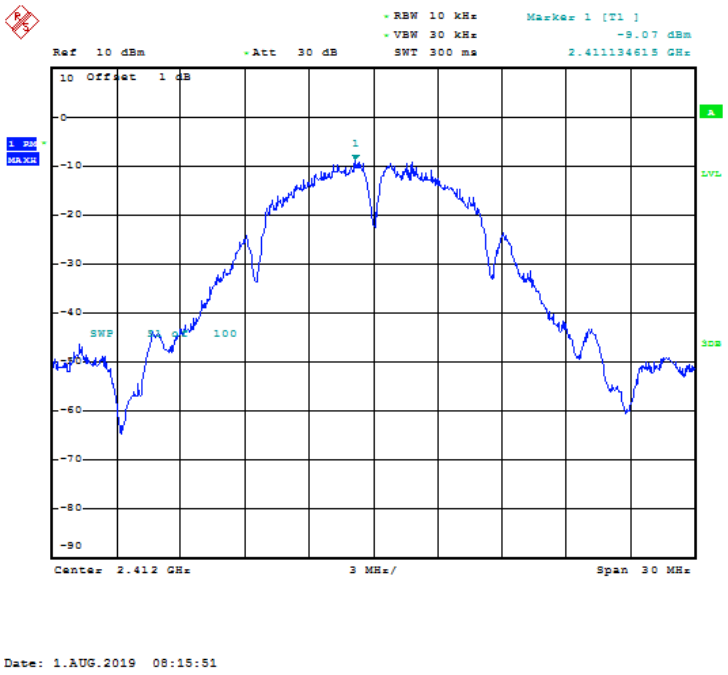


Fig 1. Power Spectral Density (802.11b,Ch1)

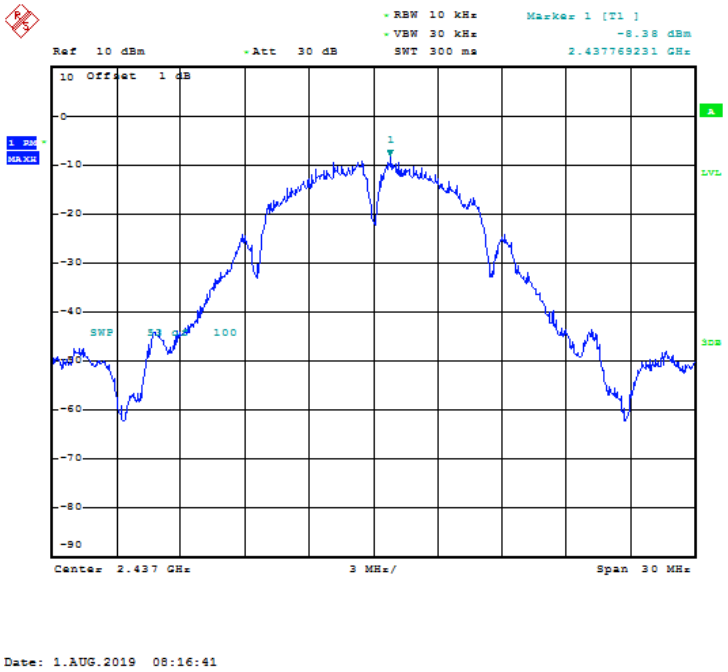


Fig 2. Power Spectral Density (802.11b,Ch6)

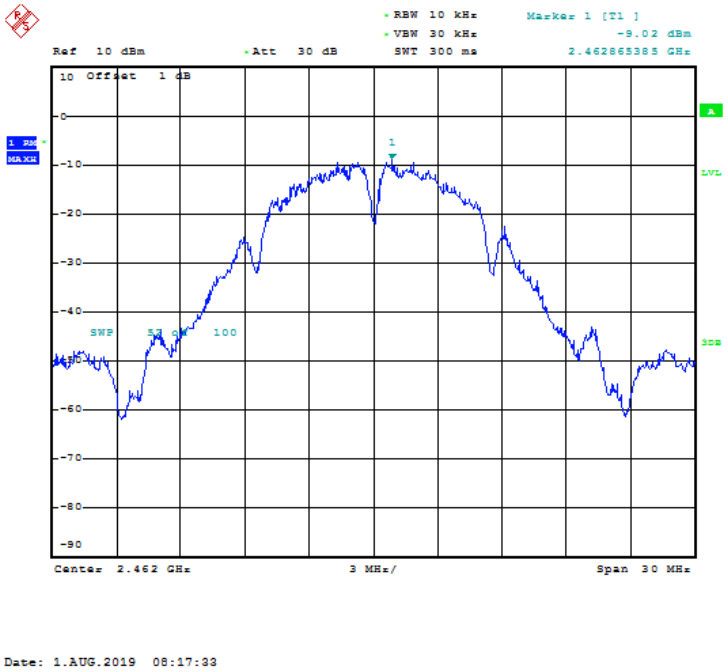


Fig 3. Power Spectral Density (802.11b,Ch11)

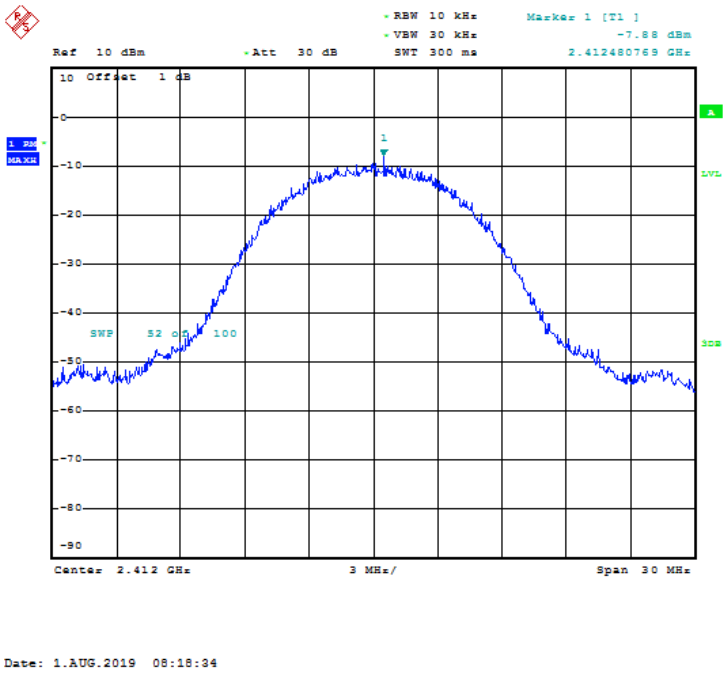


Fig 4. Power Spectral Density (802.11g,Ch1)

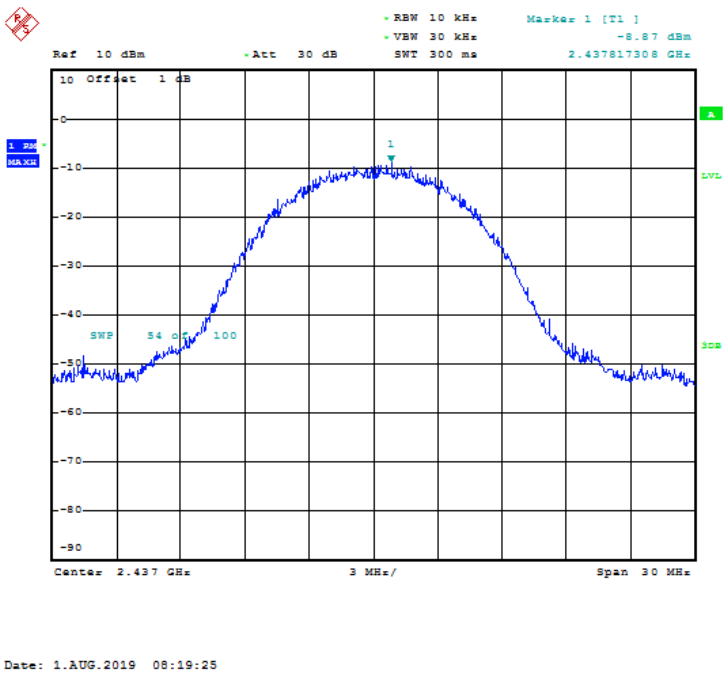


Fig 5. Power Spectral Density (802.11g,Ch6)

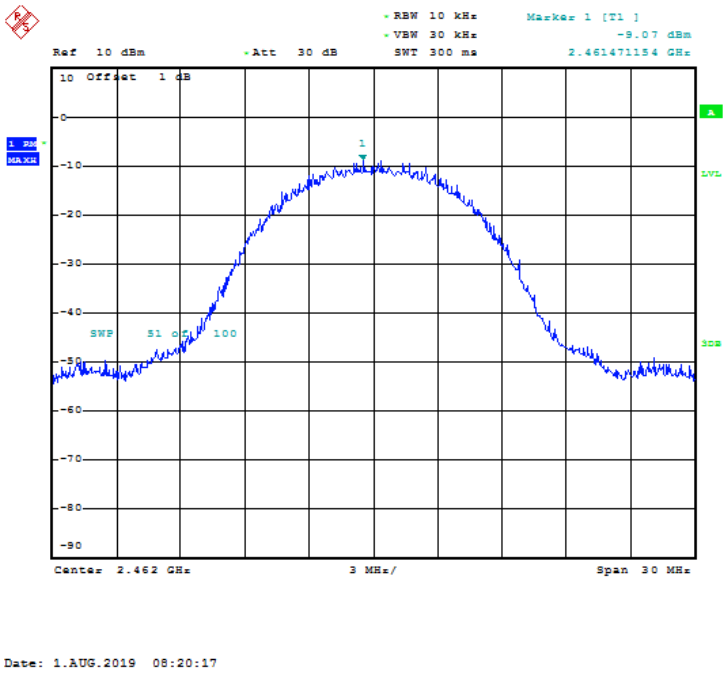


Fig 6. Power Spectral Density (802.11g,Ch11)

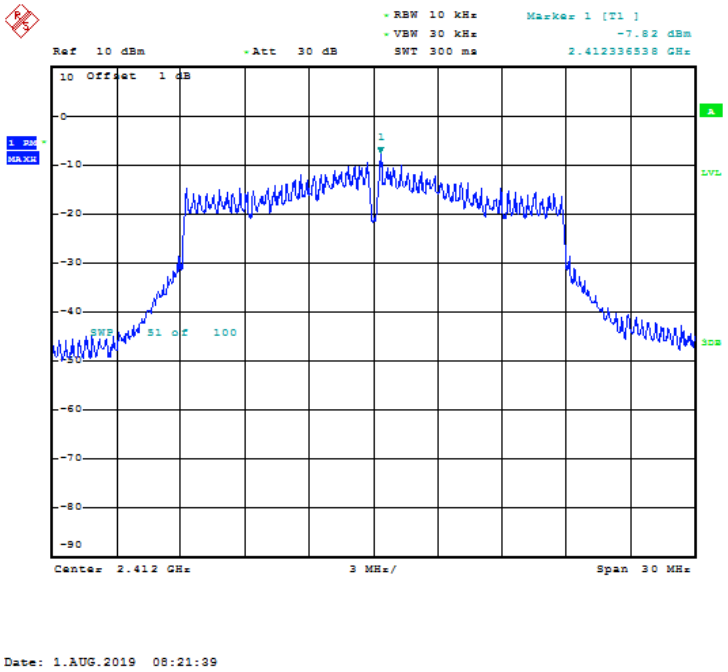


Fig 7. Power Spectral Density (802.11n-20MHz,Ch1)

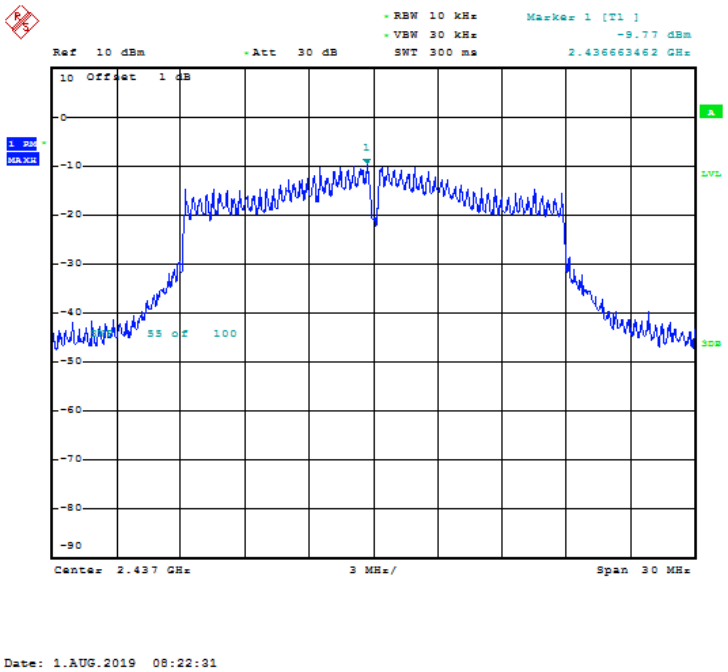


Fig 8. Power Spectral Density (802.11n-20MHz,Ch6)

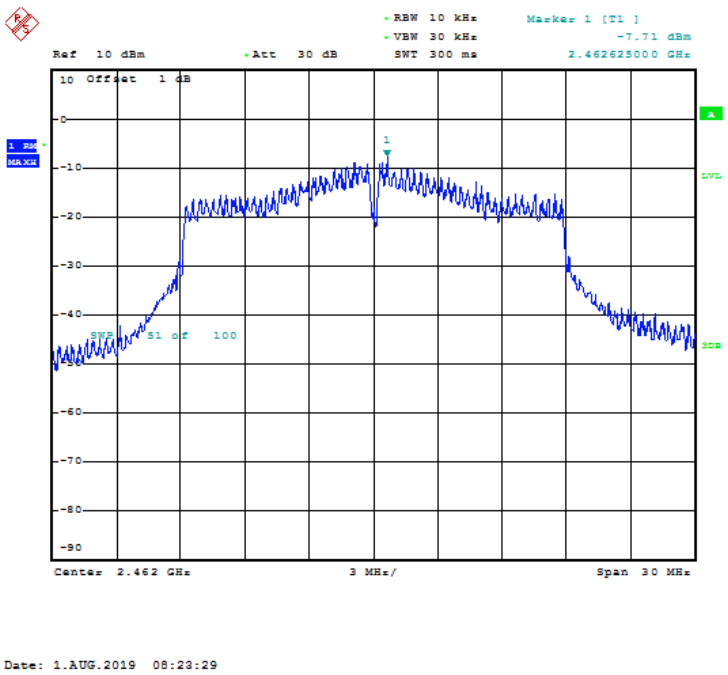


Fig 9. Power Spectral Density (802.11n-20MHz,Ch11)

ANNEX A.3. Occupied 6dB Bandwidth

A.3.1 Measurement Limit:

Standard	Limit(KHz)
FCC 47 CFR Part 15.247(a)	≥500

A.3.2 Test procedure

The measurement is according to ANSI C63.10 clause 11.8.

1. The output power of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Set RBW = 100 kHz.
4. Set the VBW ⩾ [3 × RBW].
5. Detector = peak.
6. Trace mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize.
9. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Measurement Result:

802.11b/g mode（11/54 Mbps）

Mode	Channel	Occupied 6dB Bandwidth(MHz)		Conclusion
802.11b	1	Fig 10.	6.60	P
	6	Fig 11.	6.54	P
	11	Fig 12.	6.60	P
802.11g	1	Fig 13.	15.32	P
	6	Fig 14.	15.45	P
	11	Fig 15.	15.00	P

802.11n mode（MCS3）

Mode	Channel	Occupied 6dB Bandwidth(MHz)		Conclusion
802.11n(20MHz)	1	Fig 16.	15.13	P
	6	Fig 17.	16.86	P
	11	Fig 18.	15.06	P

Conclusion: PASS

Test graphs as below:

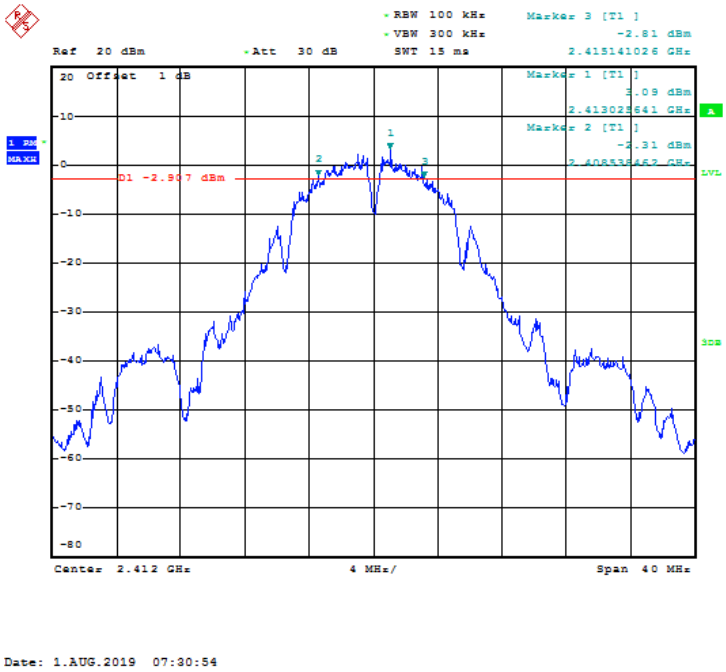


Fig 10. Occupied 6dB Bandwidth (802.11b, Ch1)

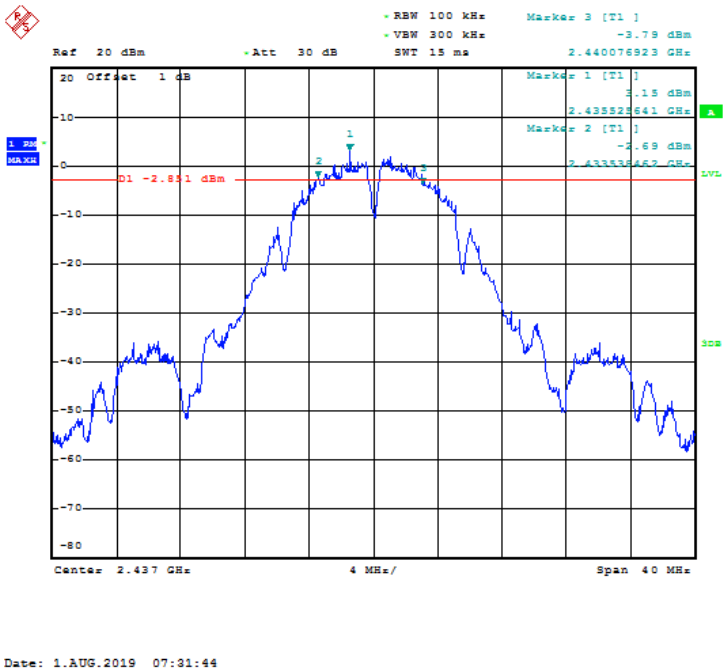


Fig 11. Occupied 6dB Bandwidth (802.11b, Ch6)

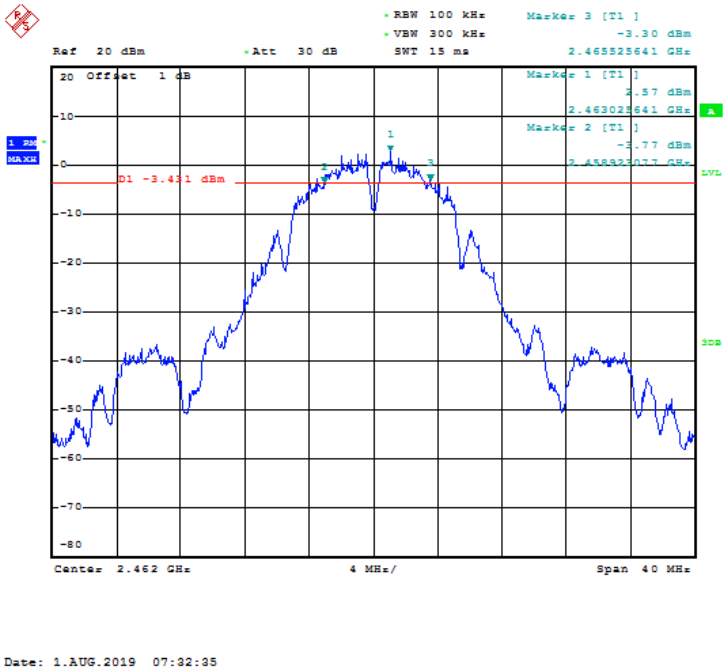


Fig 12. Occupied 6dB Bandwidth (802.11b, Ch11)

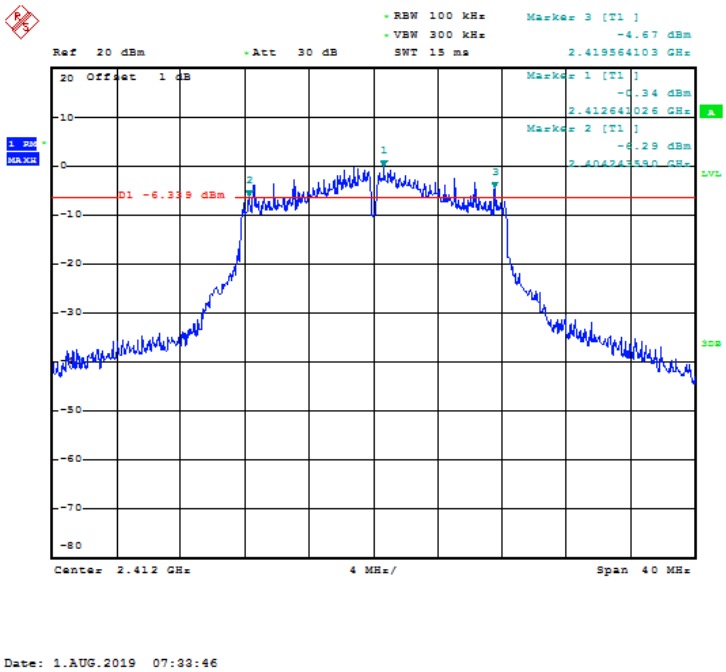


Fig 13. Occupied 6dB Bandwidth (802.11g, Ch1)

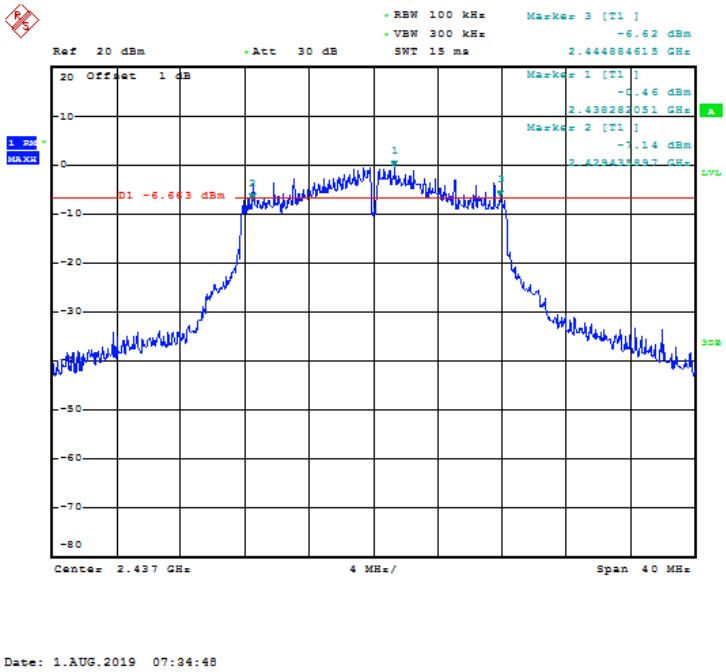


Fig 14. Occupied 6dB Bandwidth (802.11g, Ch6)

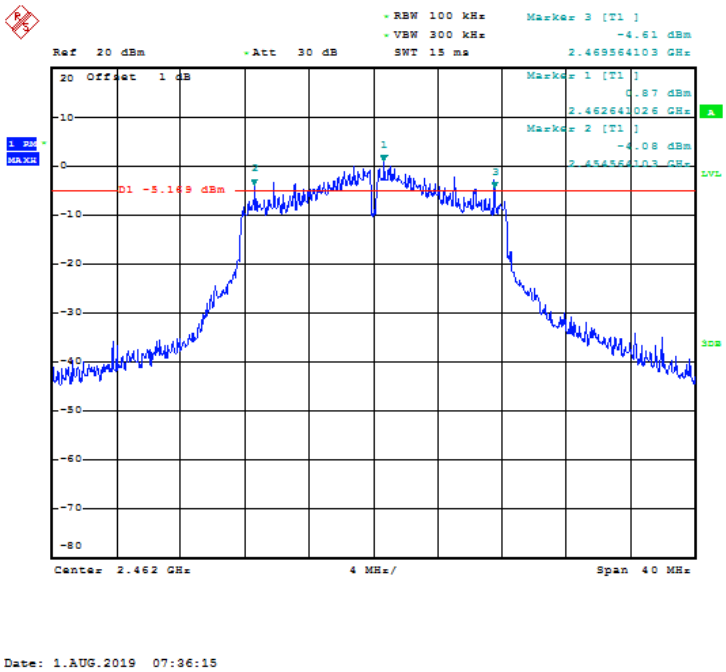


Fig 15. Occupied 6dB Bandwidth (802.11g, Ch11)

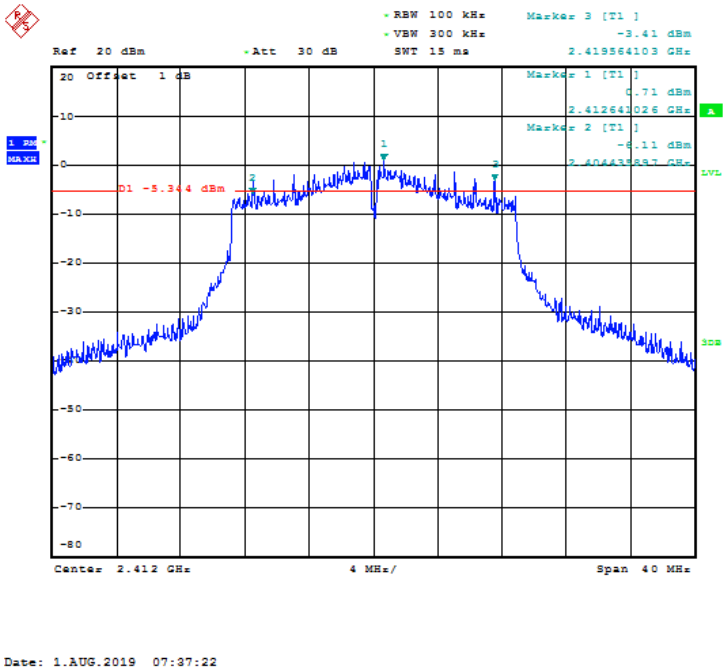


Fig 16. Occupied 6dB Bandwidth (802.11n-20MHz, Ch1)

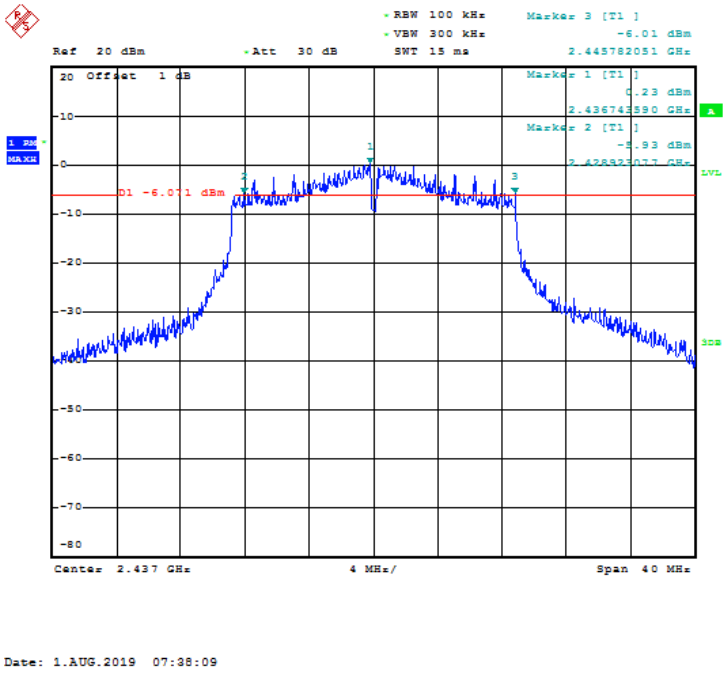


Fig 17. Occupied 6dB Bandwidth (802.11n-20MHz, Ch6)

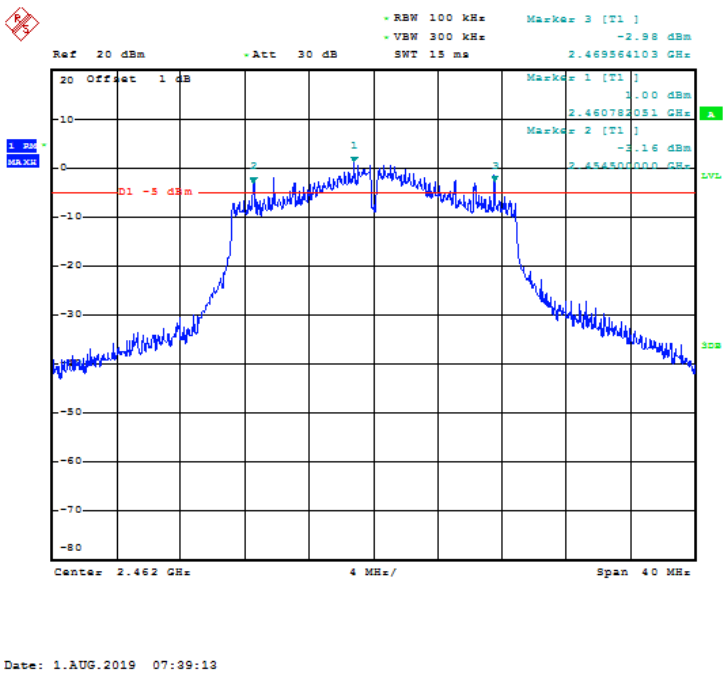


Fig 18. Occupied 6dB Bandwidth (802.11n-20MHz, Ch11)

ANNEX A.4. 99% Occupied Bandwidth

A．4.1 Measurement Limit:

Standard	Limit (MHz)
RSS-GEN	⩾500

A.4.2 Test procedure

1. The EUT output RF connector was connected with a short cable to the spectrum analyzer.
2. Enable EUT transmit in fixed channel as center frequency of spectrum analyzer.
3. Setting spectrum analyzer as below, RBW : ~1% of the span without going below 1%; VBW: >3RBW; SPAN: 2 x Nominal Channel Bandwidth (e.g. 40 MHz for a 20 MHz channel); Detector mode:RMS; Trace mode: MAX Hold; Sweep time: 1 s.

4. Use the 99 % bandwidth function of the spectrum analyzer to measure the Occupied Channel Bandwidth of the EUT.

5. This value shall be recorded.

A．4.3 Measurement Uncertainty:

Measurement Uncertainty	60.80HZ

A．4.4 Measurement Result:

802.11b/g mode（11/54 Mbps）

Mode	Channel	99% Bandwidth(MHz)		Conclusion
802.11b	1	Fig 19.	11.731	P
	6	Fig 20.	11.603	P
	11	Fig 21.	11.667	P
802.11g	1	Fig 22.	16.538	P
	6	Fig 23.	16.538	P
	11	Fig 24.	16.474	P

802.11n mode（MCS3）

Mode	Channel	99% Bandwidth(MHz)		Conclusion
802.11n(20MHz)	1	Fig 25.	17.692	P
	6	Fig 26.	17.756	P
	11	Fig 27.	17.628	P

Conclusion: PASS

Test graphs as below:

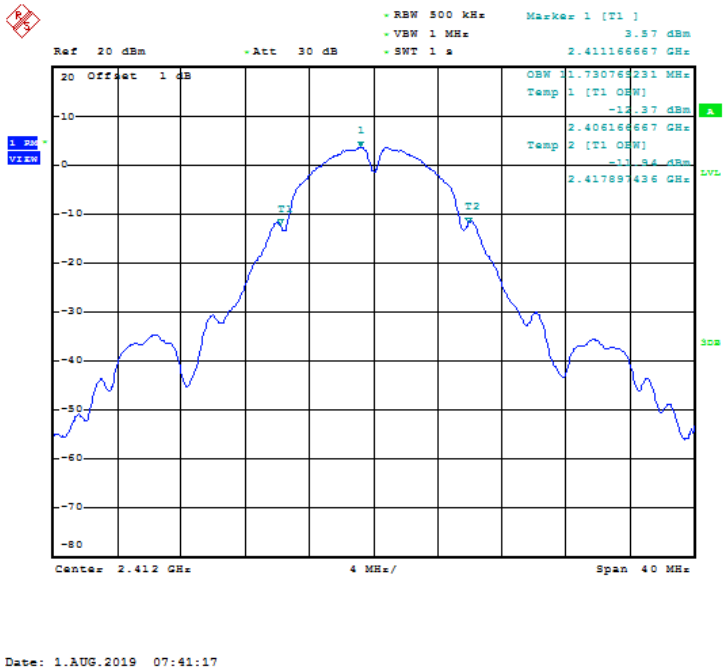


Fig 19. 99% Bandwidth (802.11b, Ch1)

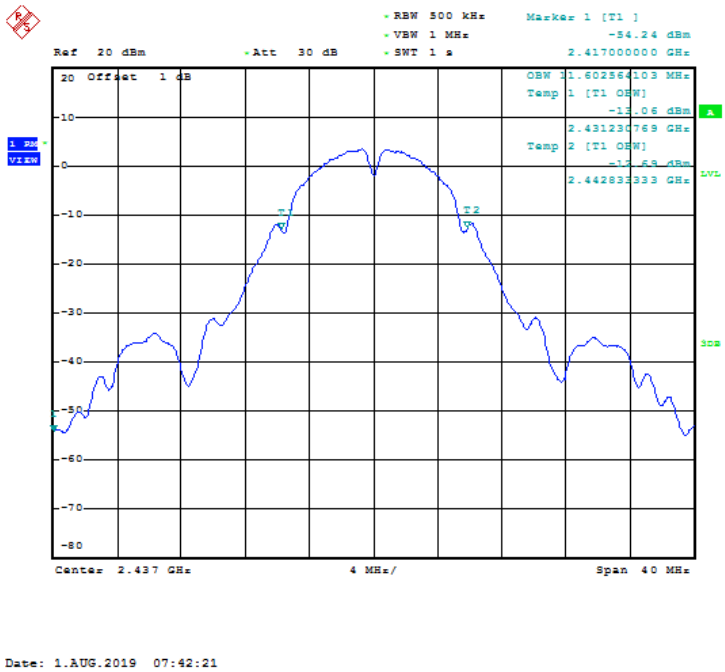


Fig 20. 99% Bandwidth (802.11b, Ch6)

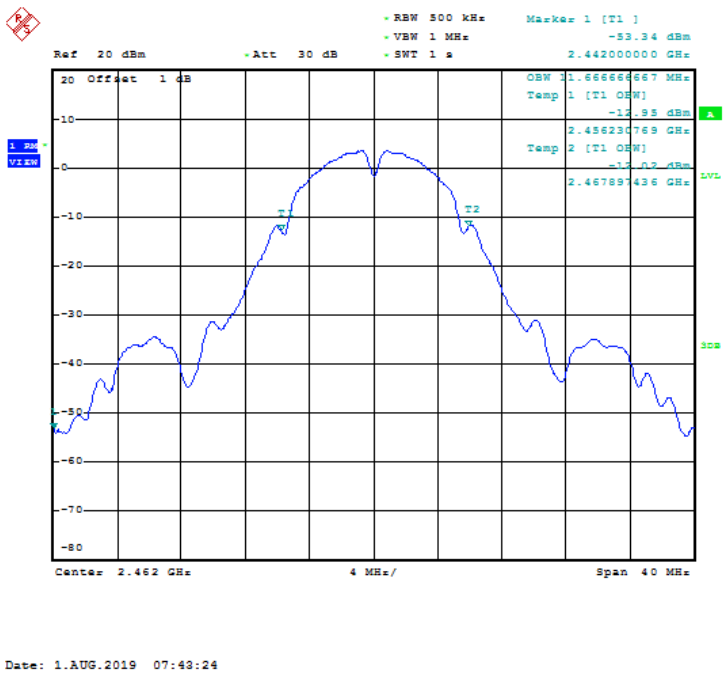


Fig 21. 99% Bandwidth (802.11b, Ch11)

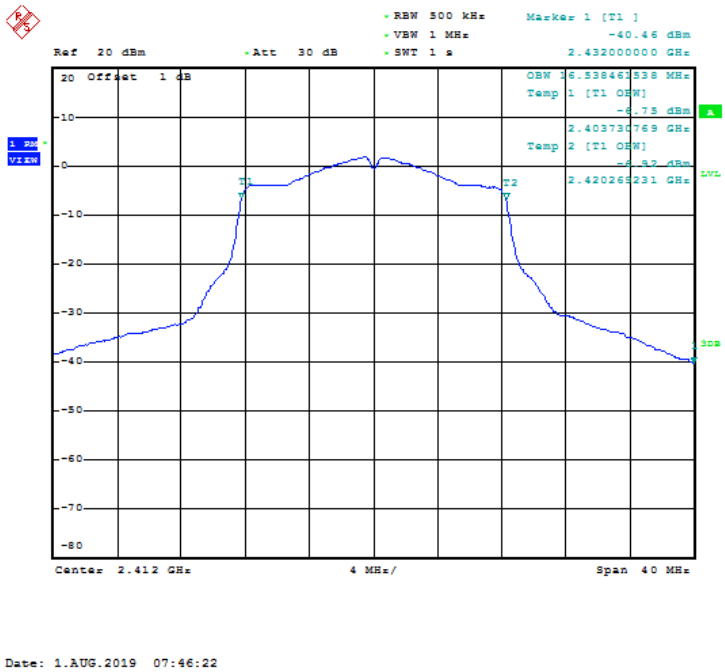


Fig 22. 99% Bandwidth (802.11g, Ch1)

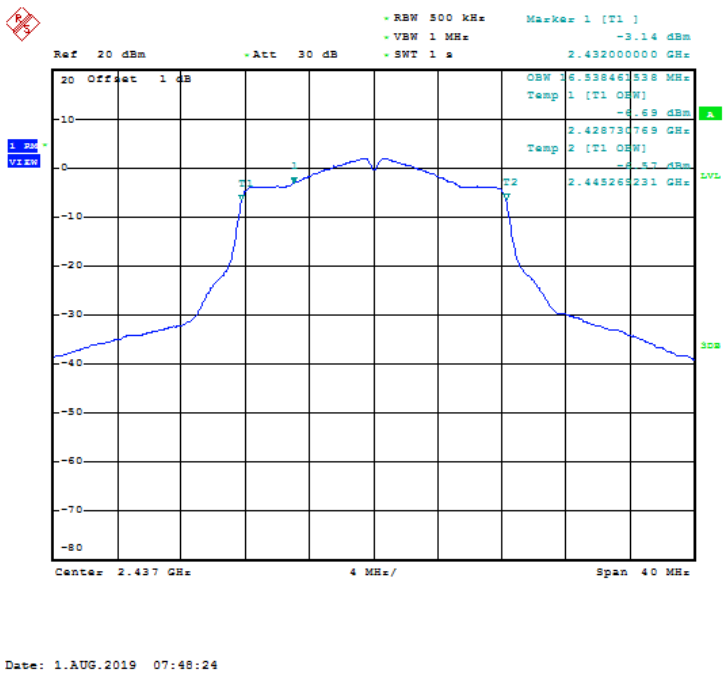


Fig 23. 99% Bandwidth (802.11g, Ch6)

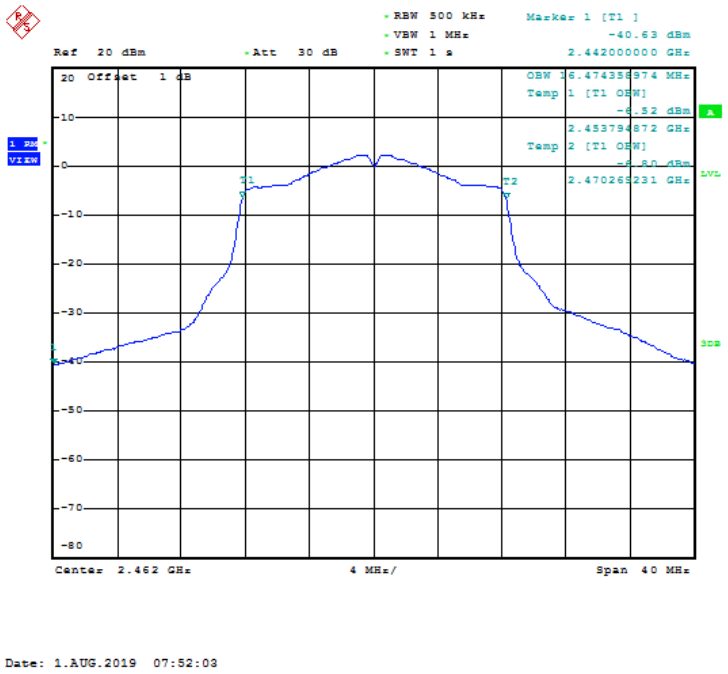


Fig 24. 99% Bandwidth (802.11g, Ch11)

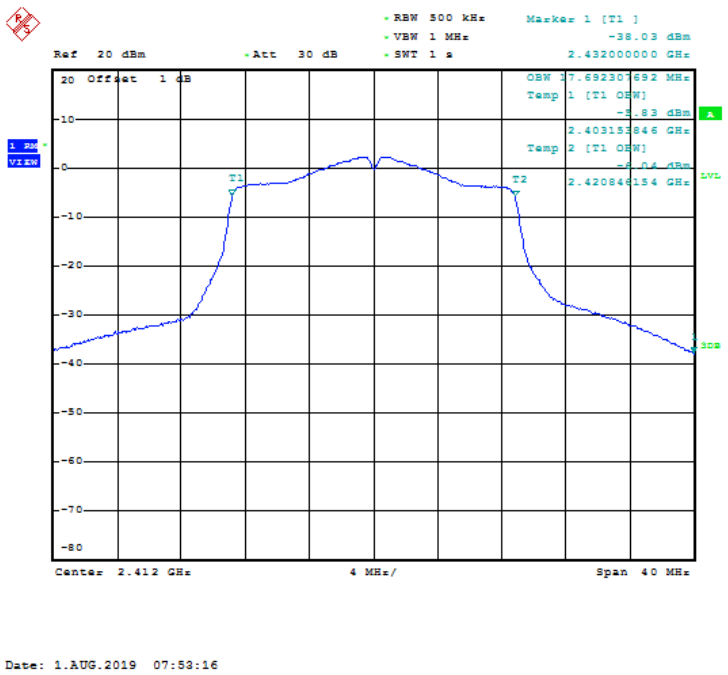


Fig 25. 99% Bandwidth (802.11n-20MHz, Ch1)

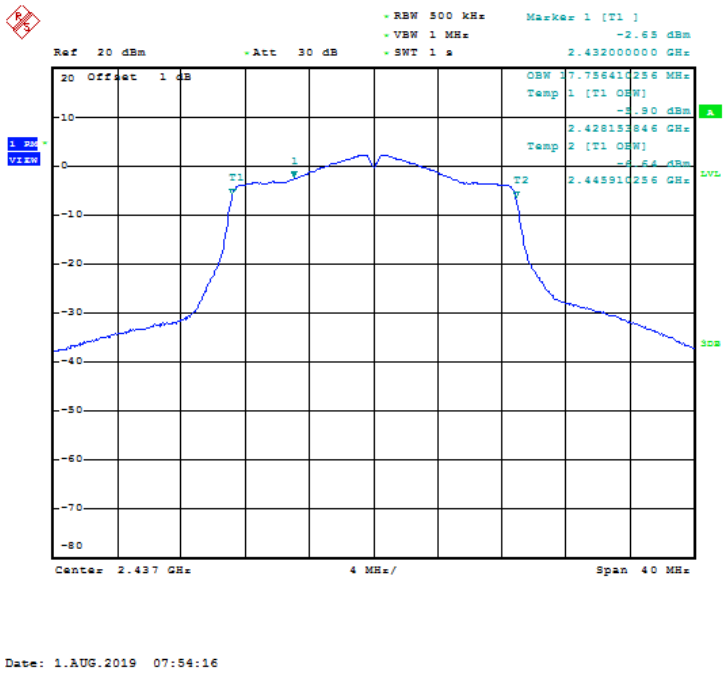


Fig 26. 99% Bandwidth (802.11n-20MHz, Ch6)

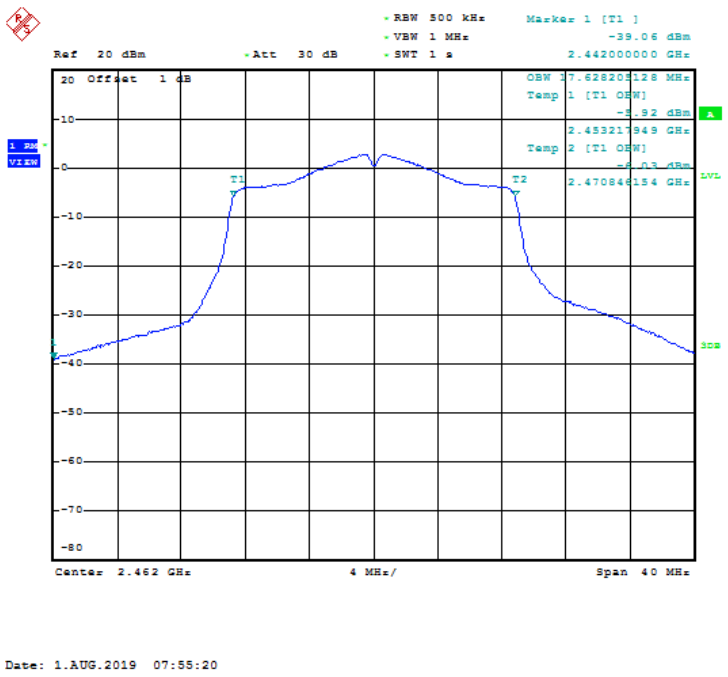


Fig 27. 99% Bandwidth (802.11n-20MHz, Ch11)

ANNEX A.5. Band Edges Compliance

A.5.1 Measurement Limit:

Standard	Limited(dBc)
FCC 47 CFR Part 15.247(d)	>20

A.5.2 Test procedures

The measurement is according to ANSI C63.10 clause11.13.

1. The output power of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.
3. Set instrument center frequency to the frequency of the emission to be measured (must be within 2MHz of the authorized band edge).
4. Set span to 2 MHz.
5. RBW = 100 kHz.
6. VBW ⩾ [3 × RBW].
7. Detector = peak.
8. Sweep time = auto.
9. Trace mode = max hold.
10. Allow sweep to continue until the trace stabilizes

Measurement results

802.11b/g mode

Mode	Channel	Test Results	Conclusion
802.11b	1	Fig 28.	P
	11	Fig 29.	P
802.11g	1	Fig 30.	P
	11	Fig 31.	P

802.11n mode

Mode	Channel	Test Results	Conclusion
802.11n(20MHz)	1	Fig 32.	P
	11	Fig 33.	P

Conclusion: PASS

Test graphs as blew:

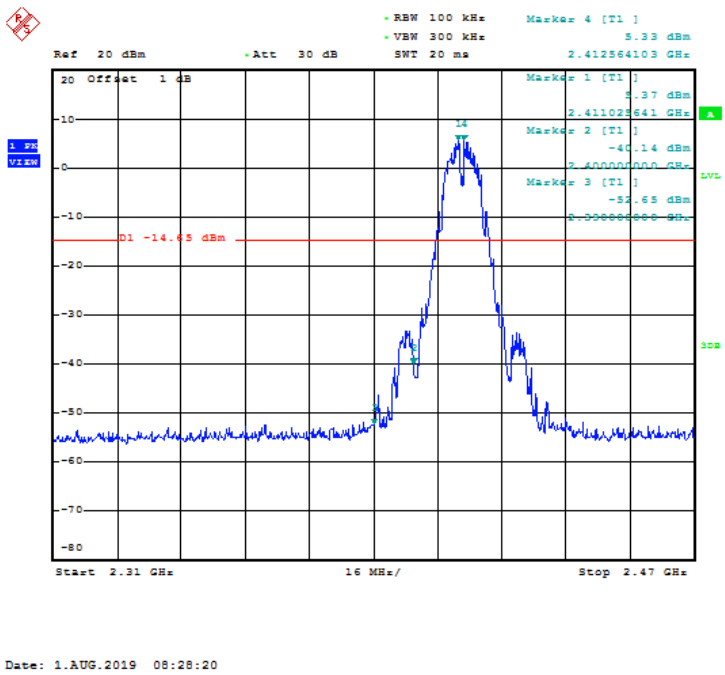


Fig 28. Band Edges (802.11b, Ch1)

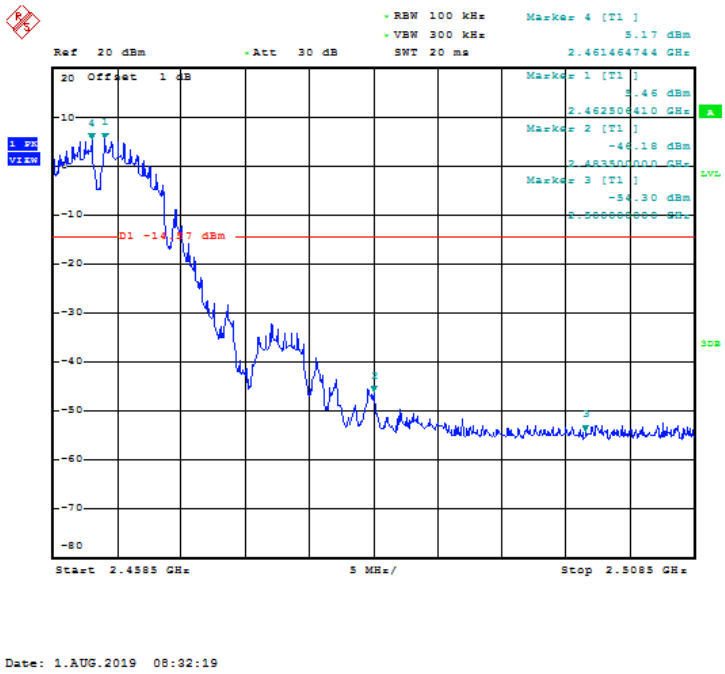


Fig 29. Band Edges (802.11b, Ch11)

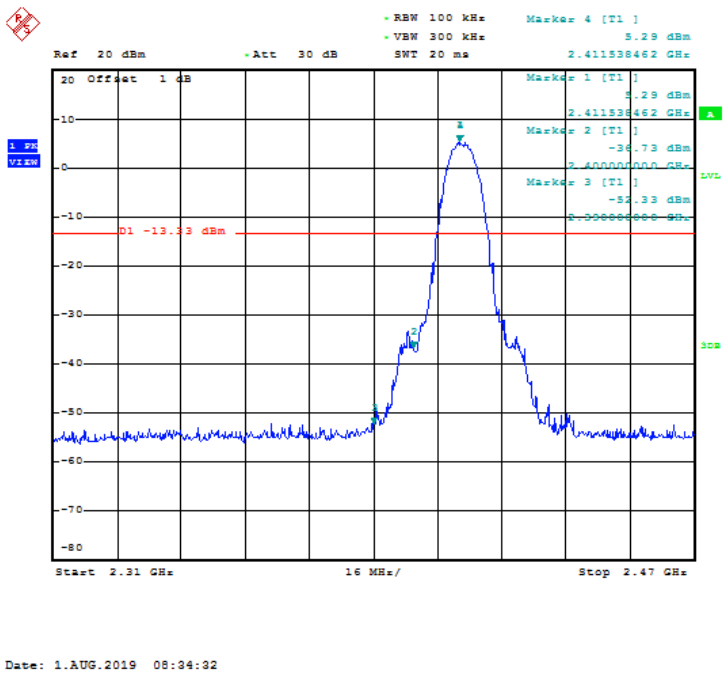


Fig 30. Band Edges (802.11g, Ch1)

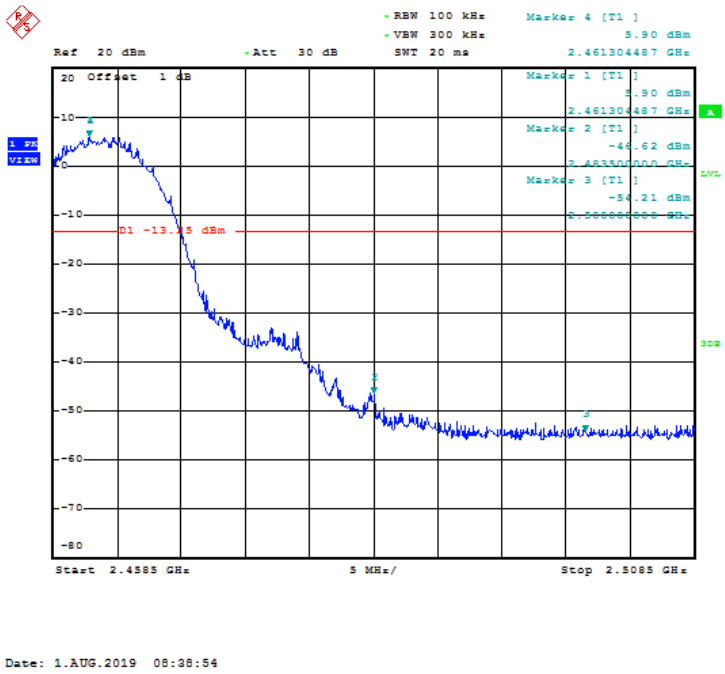


Fig 31. Band Edges (802.11g, Ch11)

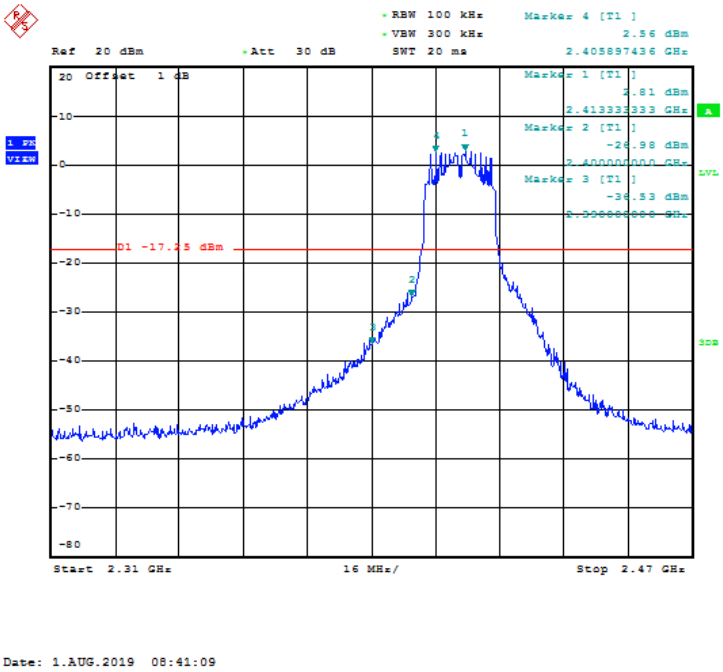


Fig 32. Band Edges (802.11n-20MHz, Ch1)

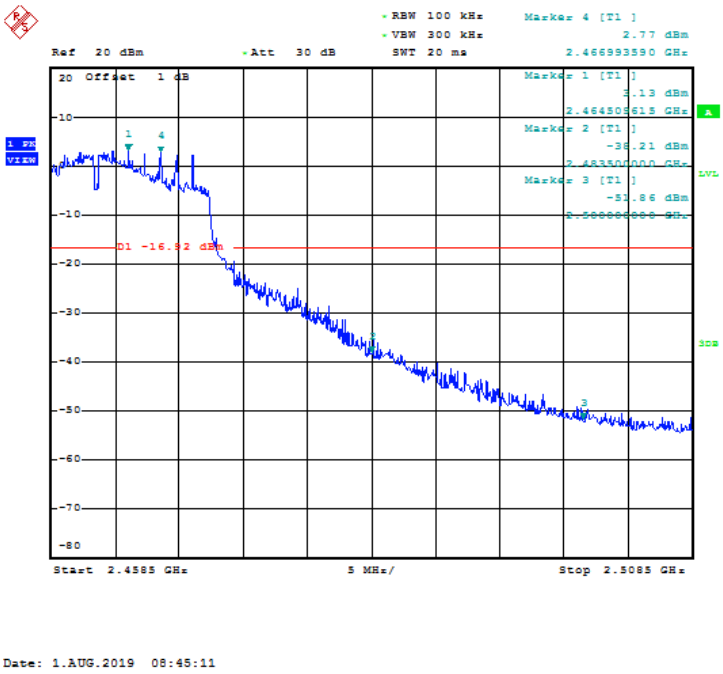


Fig 33. Band Edges (802.11n-20MHz, Ch11)

ANNEX A.6. Transmitter Spurious Emission-conducted

A.6.1 Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247(d)	20dB below peak output power in 100KHz bandwidth

A.6.2 Test procedures

This measurement is according to ANSI C63.10 clause 11.11.

1. The output power of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Enable EUT transmitter maximum power continuously.

Reference level measurement

3. Set instrument center frequency to DTS channel center frequency.
4. Set the span to ≥ 1.5 times the DTS bandwidth.
5. Set the RBW = 100 kHz.
6. Set the VBW ≥ [3 × RBW].
7. Detector = peak.
8. Sweep time = auto couple.
9. Trace mode = max hold.
10. Allow trace to fully stabilize.
11. Use the peak marker function to determine the maximum PSD level.

Emission level measurement

12. Set the center frequency and span to encompass frequency range to be measured.
13. Set the RBW = 100 kHz.
14. Set the VBW ≥ [3 × RBW].
15. Detector = peak.
16. Sweep time = auto couple.
17. Trace mode = max hold.
18. Allow trace to fully stabilize.
19. Use the peak marker function to determine the maximum amplitude level.

Measurement Result:

802.11b/g mode（11/54 Mbps）

Mode	Channel	Frequency Range	Test Results	Conclusion
802.11b	1	2.412GHz	Fig 34.	P
		30MHz~26GHz	Fig 35.	P
	6	2.437GHz	Fig 36.	P
		30MHz~26GHz	Fig 37.	P

	11	2.462GHz	Fig 38.	P
		30MHz~26GHz	Fig 39.	P
802.11g	1	2.412GHz	Fig 40.	P
		30MHz~26GHz	Fig 41.	P
	6	2.437GHz	Fig 42.	P
		30MHz~26GHz	Fig 43.	P
	11	2.462GHz	Fig 44.	P
		30MHz~26GHz	Fig 45.	P

802.11n mode（MCS3）

Mode	Channel	Frequency Range	Test Results	Conclusion
802.11n(20MHz)	1	2.412GHz	Fig 46.	P
		30MHz~26GHz	Fig 47.	P
	6	2.437GHz	Fig 48.	P
		30MHz~26GHz	Fig 49.	P
	11	2.462GHz	Fig 50.	P
		30MHz~26GHz	Fig 51.	P

Conclusion: PASS

Test graphs as below:

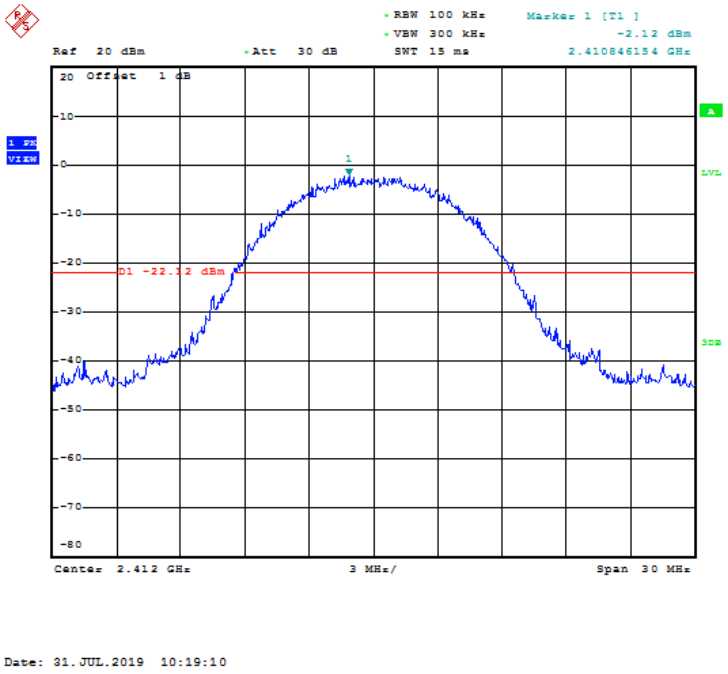


Fig 34. Conducted Spurious Emission (802.11b, Ch1)

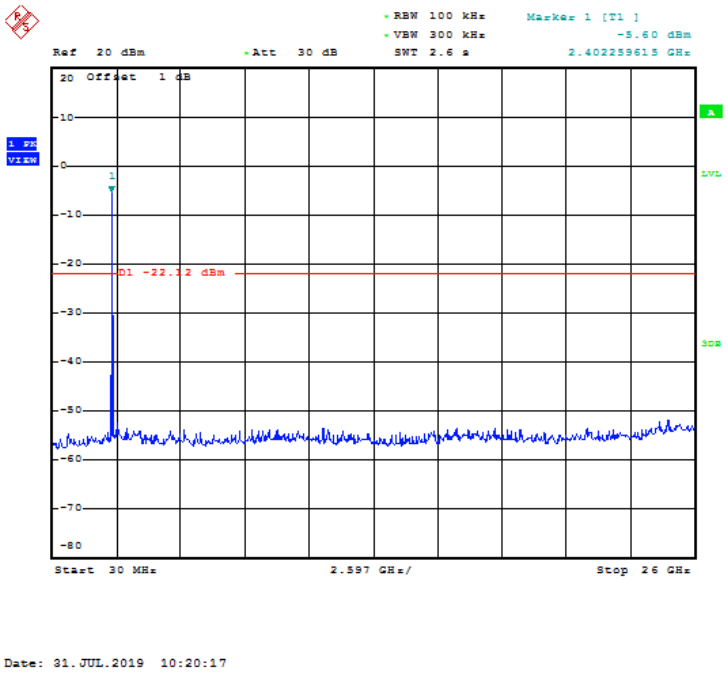


Fig 35. Conducted Spurious Emission (802.11b, Ch1, 30MHz~26GHz)

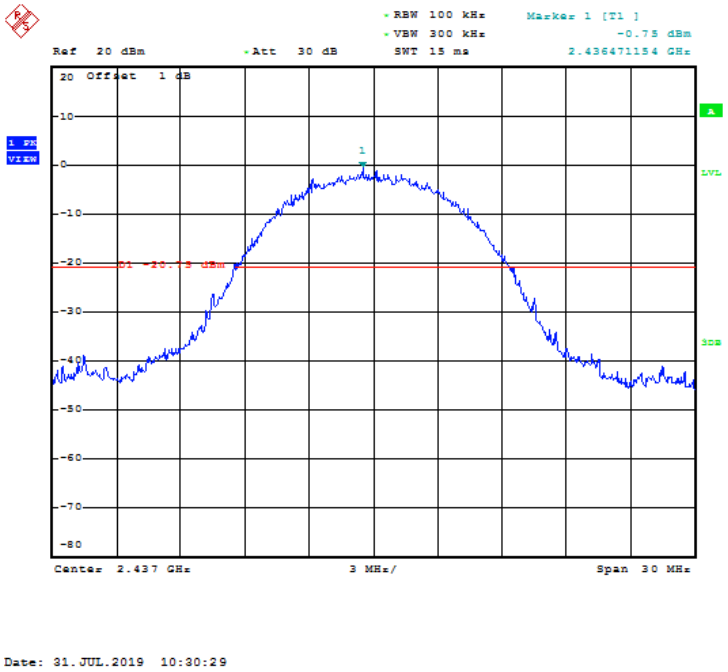


Fig 36. Conducted Spurious Emission (802.11b, Ch6)

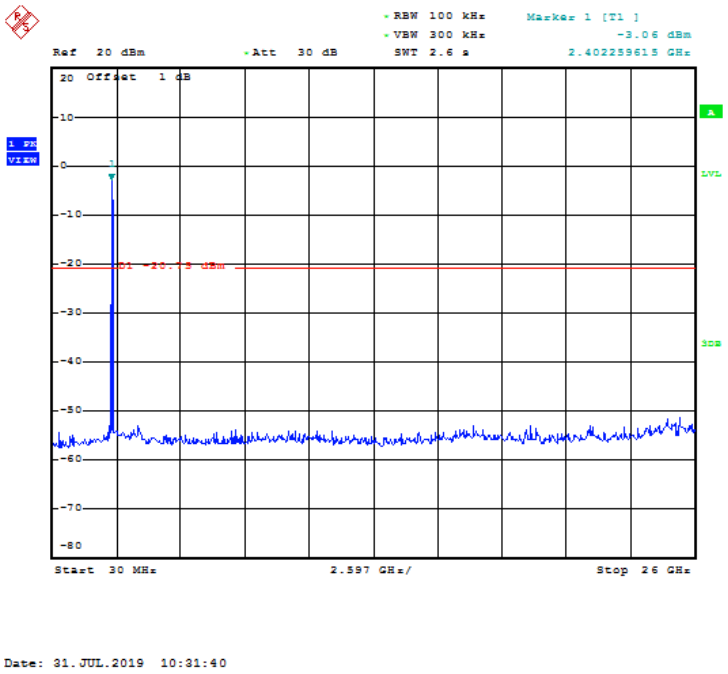


Fig 37. Conducted Spurious Emission (802.11b, Ch6, 30MHz~26GHz)

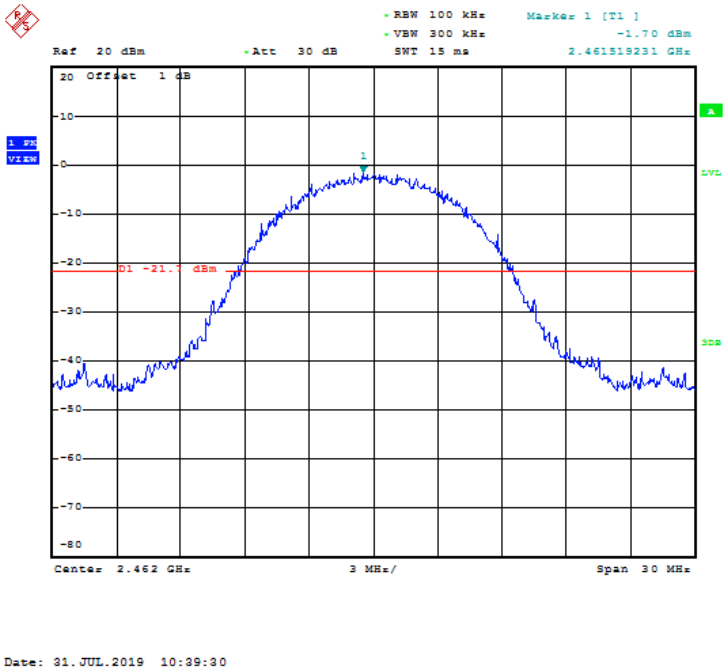


Fig 38. Conducted Spurious Emission (802.11b, Ch11)

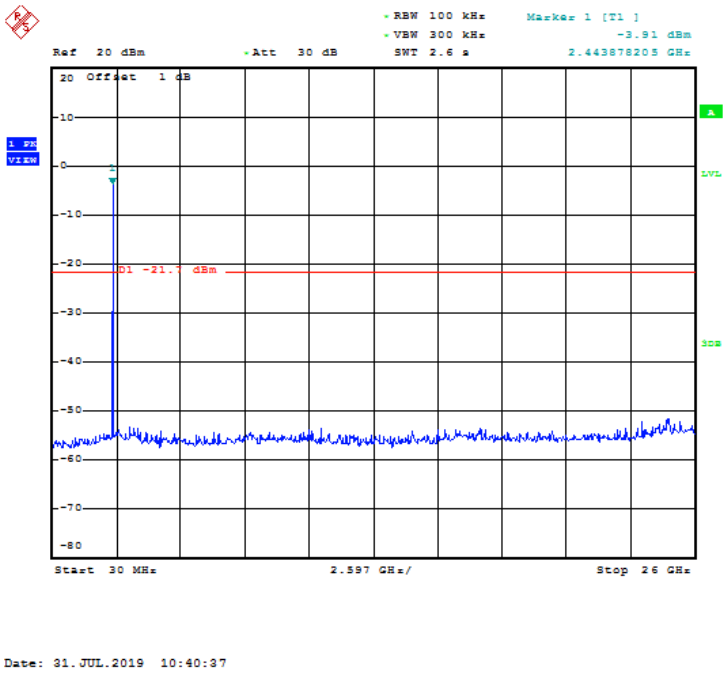


Fig 39. Conducted Spurious Emission (802.11b, Ch11, 30MHz~26GHz)

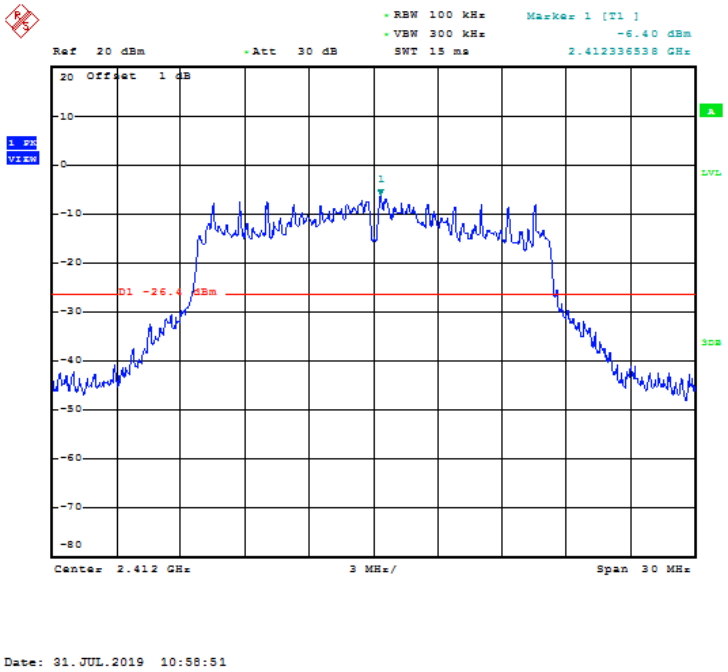


Fig 40. Conducted Spurious Emission (802.11g, Ch1)

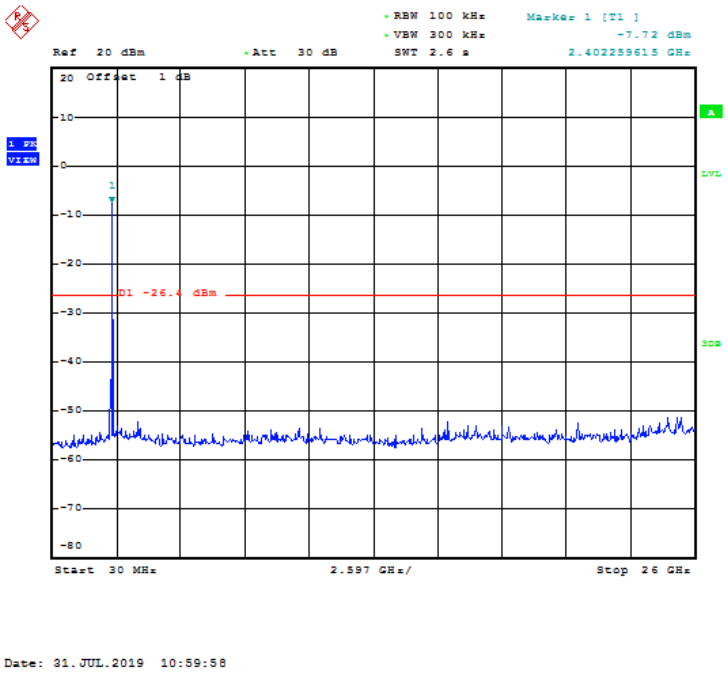


Fig 41. Conducted Spurious Emission (802.11g, Ch1, 30MHz~26GHz)

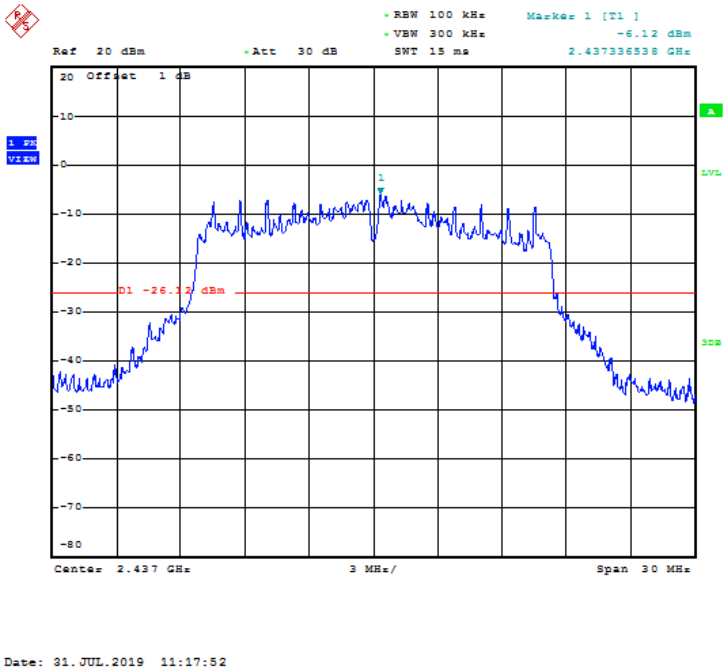


Fig 42. Conducted Spurious Emission (802.11g, Ch6)

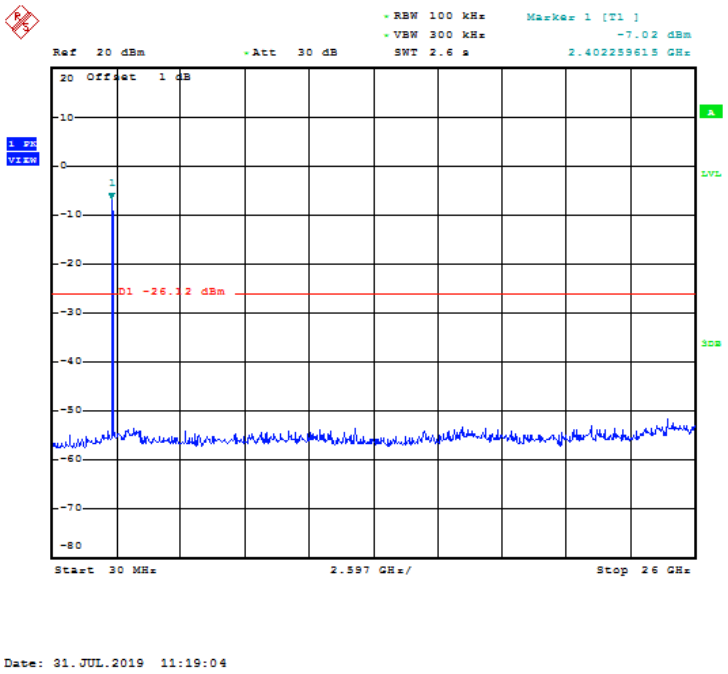


Fig 43. Conducted Spurious Emission (802.11g, Ch6, 30MHz~26GHz)

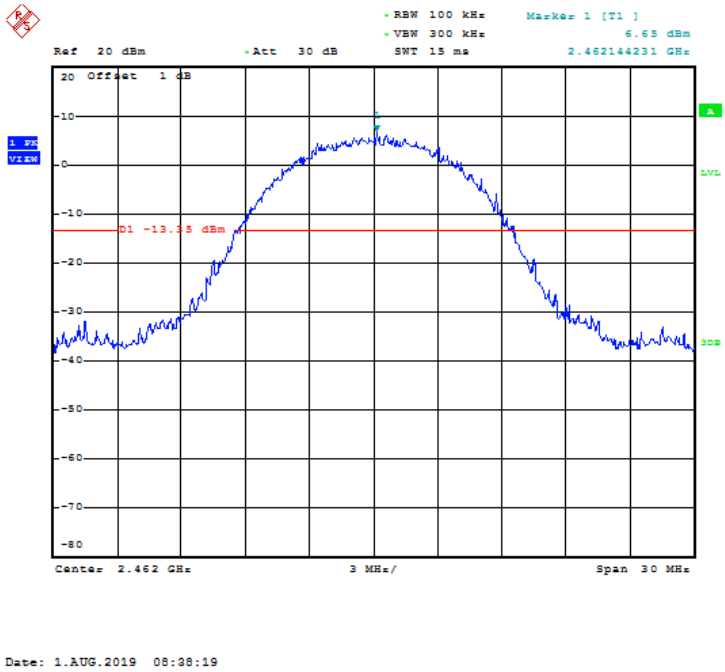


Fig 44. Conducted Spurious Emission (802.11g, Ch11)

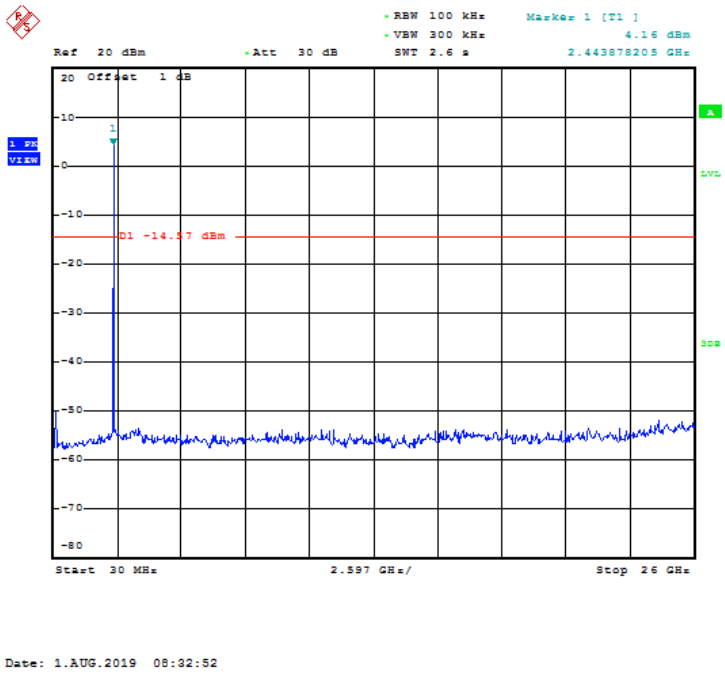


Fig 45. Conducted Spurious Emission (802.11g, Ch11, 30MHz~26GHz)

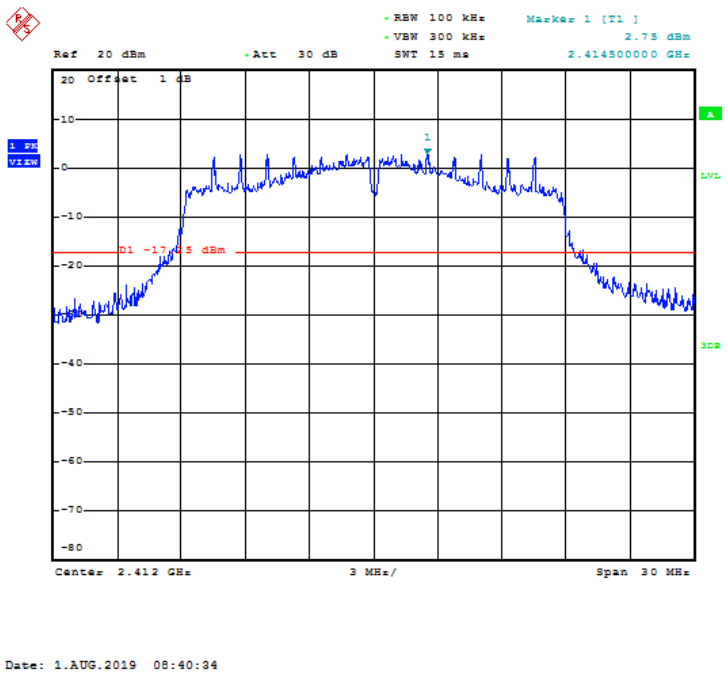


Fig 46. Conducted Spurious Emission (802.11n-20MHz, Ch1)

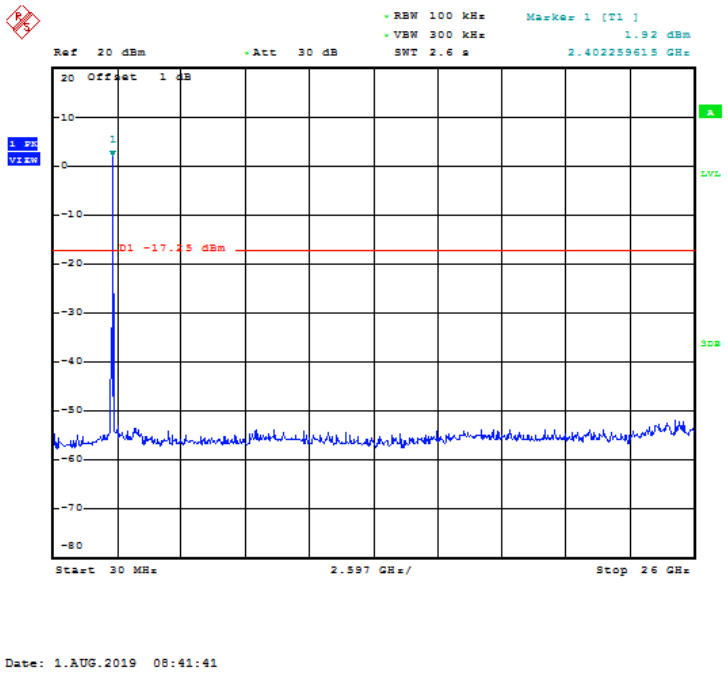


Fig 47. Conducted Spurious Emission (802.11n-20MHz, Ch1, 30MHz~26GHz)

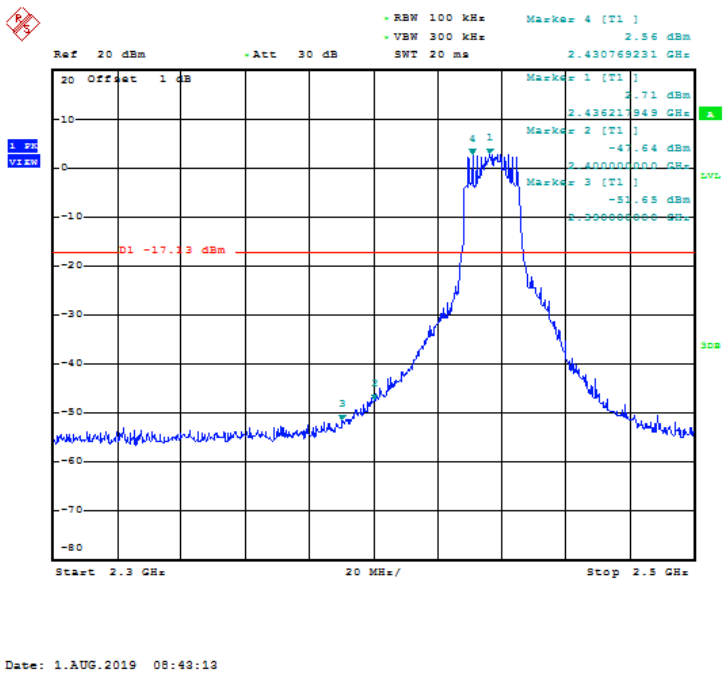


Fig 48. Conducted Spurious Emission (802.11n-20MHz, Ch6)

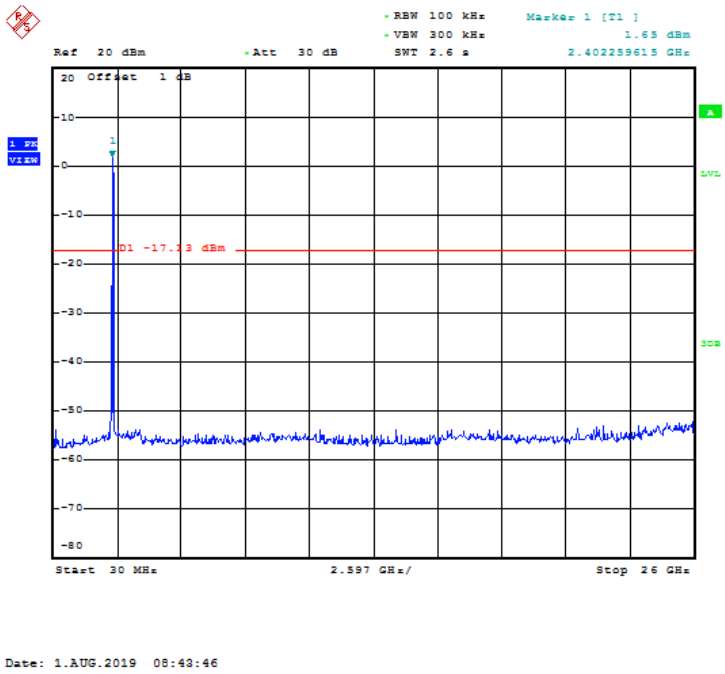


Fig 49. Conducted Spurious Emission (802.11n-20MHz, Ch6, 30MHz~26GHz)

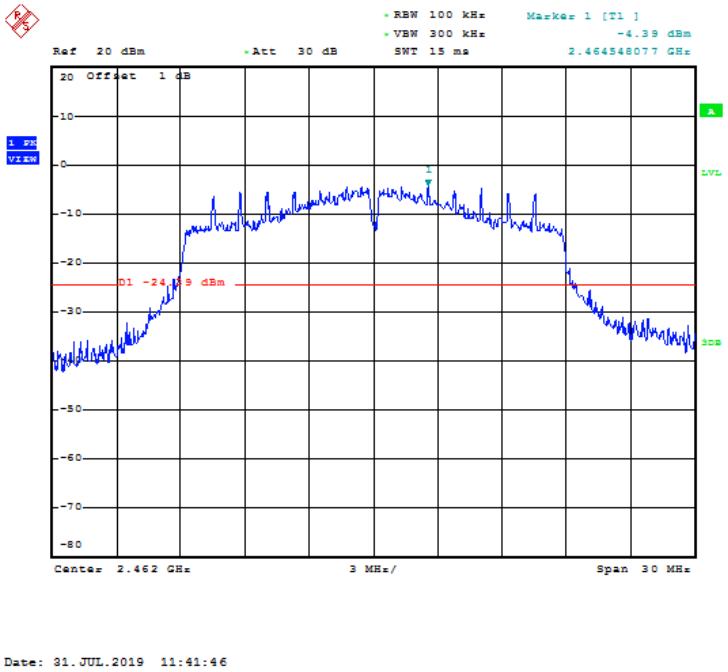


Fig 50. Conducted Spurious Emission (802.11n-20MHz, Ch11)

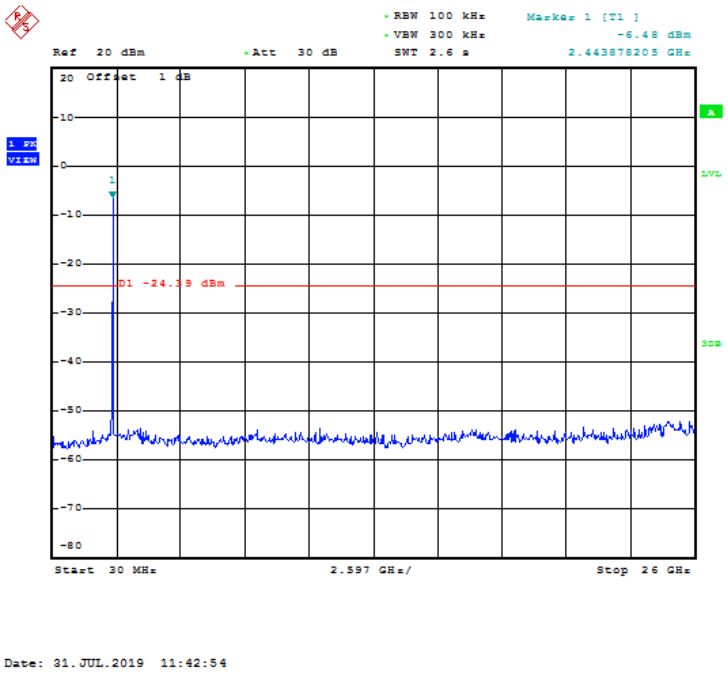


Fig 51. Conducted Spurious Emission (802.11n-20MHz, Ch11, 30MHz~26GHz)

ANNEX A.7. Transmitter Spurious Emission-Radiated

A.7.1 Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.247,15.205,15.209	20dB below peak output power

In addition, radiated emissions which fall in the restricted bands, as defined in 25.205(a), must also comply with the radiated emission limits specified in 15.209(a)(see 15.205(c)).
The measurement is according to ANSI C63.10 clause 11.11 and 11.12.

A.7.2 Limit in restricted band:

Frequency of emission(MHz)	Field strength(uV/m)	Field strength(dBuV/m)
30~88	100	40
88~216	150	43.5
216~960	200	46
Above 960	500	54

A.7.3 Test procedures

Portable, small, lightweight, or modular devices that may be handheld, worn on the body, or placed on a table during operation shall be positioned on a nonconducting platform, the top of which is 80 cm above the reference ground plane. The preferred area occupied by the EUT arrangement is 1 m by 1.5 m, but it may be larger or smaller to accommodate various sized EUTs. For testing purposes, ceiling- and wall-mounted devices also shall be positioned on a tabletop (see also ANSI C63.4-2013 section 6.3.4 and 6.3.5). In making any tests involving handheld, body-worn, or ceiling-mounted equipment, it is essential to recognize that the measured levels may be dependent on the orientation (attitude) of the three orthogonal axes of the EUT. Thus, exploratory tests as specified in 8.3.1 shall be carried out for various axes orientations to determine the attitude having maximum or near-maximum emission level.
The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During testing, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emission from the EUT. This maximization process was repeated with the EUT positioned in each of its three rthogonal orientations.

Frequency of emission (MHz)	RBW/VBW	Sweep Times (s)
30~1000	100KHz/300KHz	5
1000~4000	1MHz/3MHz	15
4000~18000	1MHz/3MHz	40
18000~26500	1MHz/3MHz	20

802.11b mode（11 Mbps）

Mode	Channel	Frequency Range	Test Results	Conclusion
802.11b	Bandedge (low)	2.31GHz~2.5GHz	Fig 52.	P
	Bandedge (high)	2.31GHz~2.5GHz	Fig 53.	P
	11	30MHz~1GHz	Fig 54.	P
		1GHz~3GHz	Fig 55.	P
		3GHz~18GHz	Fig 56.	P

802.11g mode（54 Mbps）

Mode	Channel	Frequency Range	Test Results	Conclusion
802.11g	Bandedge (low)	2.31GHz~2.5GHz	Fig 57.	P
	Bandedge (high)	2.31GHz~2.5GHz	Fig 58.	P
	11	30MHz~1GHz	Fig 59.	P
		1GHz~3GHz	Fig 60.	P
		3GHz~18GHz	Fig 61.	P

802.11n mode（MCS3）

Mode	Channel	Frequency Range	Test Results	Conclusion
802.11n(20MHz)	Bandedge (low)	2.31GHz~2.5GHz	Fig 62.	P
	Bandedge (high)	2.31GHz~2.5GHz	Fig 63.	P
	11	30MHz~1GHz	Fig 64.	P
		1GHz~3GHz	Fig 65.	P
		3GHz~18GHz	Fig 66.	

Conclusion: PASS

Note:

A ”reference path loss” is established and A_{Rpi} is the attenuation of “reference path loss”, and including the gain of receive antenna , the gain of the preamplifier, the cable loss.

P_{Mea} is the field strength recorded from the instrument.

The measurement results are obtained as described below:

ARpi = Cable loss + Antenna Gain-Preamplifier gain

Result = P_{Mea} + Cable loss + Antenna Gain-Preamplifier gain = P_{Mea} + ARpi .

802.11b mode

Ch1 30MHz~1GHz

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
34.0	13.99	-27.5	41.49	V
42.8	27.94	-25.8	53.74	V
175.0	24.79	-29	53.79	H
216.0	20.29	-28.1	48.39	V
314.4	20.16	-25.1	45.26	H
750.0	29.99	-16.9	46.89	H

Ch11 1GHz~3GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl(dB)	PMea(dBuV/m)	Polarity
2553.4	52.96	3.5	49.46	V
2640.2	54.13	4.3	49.83	H
2675.6	54.52	4.5	50.02	V
2733.2	54.89	4.4	50.49	V
2820.0	54.56	4.7	49.86	H
2885.2	55.75	5.6	50.15	H

Ch11 1GHz~3GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2640.2	41.94	4.3	37.64	H
2675.6	42.36	4.5	37.86	V
2733.2	42.2	4.4	37.8	V

2820.0	42.56	4.7	37.86	H
2885.2	43.31	5.6	37.71	H

Ch1 3GHz~18GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
14299.0	55.25	20.8	34.45	V
15371.5	54.81	22.4	32.41	H
16121.8	58.83	24.9	33.93	V
16793.9	60.33	27.1	33.23	V
17242.9	60.54	27.2	33.34	V
17812.2	60.04	28.3	31.74	V

Ch1 3GHz~18GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
14299.0	43.04	20.8	22.24	V
15371.5	43.1	22.4	20.7	H
16121.8	46.13	24.9	21.23	V
16793.9	47.2	27.1	20.1	V
17242.9	47.75	27.2	20.55	V
17812.2	48.39	28.3	20.09	V
14299.0	43.04	20.8	22.24	V

Ch11 30MHz~1GHz

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
34.8	18.68	-27.5	46.18	V
48.5	22.28	-25.2	47.48	V
59.8	22.7	-26.9	49.6	V
175.0	25.63	-29	54.63	H
378.0	30.84	-24	54.84	H

625.0	32.53	-18.7	51.23	H

Ch11 1GHz~3GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2553.4	52.96	3.5	49.46	V
2640.2	54.13	4.3	49.83	H
2675.6	54.52	4.5	50.02	V
2733.2	54.89	4.4	50.49	V
2820.0	54.56	4.7	49.86	H
2885.2	55.75	5.6	50.15	H

Ch11 1GHz~3GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2640.2	41.94	4.3	37.64	H
2675.6	42.36	4.5	37.86	V
2733.2	42.2	4.4	37.8	V
2820.0	42.56	4.7	37.86	H
2885.2	43.31	5.6	37.71	H

Ch11 3GHz~18GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
14299.0	43.04	20.8	22.24	V
15371.5	43.1	22.4	20.7	H
16121.8	46.13	24.9	21.23	V
16793.9	47.2	27.1	20.1	V
17242.9	47.75	27.2	20.55	V
17812.2	48.39	28.3	20.09	V

Ch11 3GHz~18GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity

14299.0	43.04	20.8	22.24	V
15371.5	43.1	22.4	20.7	H
16121.8	46.13	24.9	21.23	V
16793.9	47.2	27.1	20.1	V
17242.9	47.75	27.2	20.55	V
17812.2	48.39	28.3	20.09	V

802.11g

Ch1 30MHz~1GHz

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
35.0	20.04	-27.4	47.44	V
47.6	19.61	-25.3	44.91	V
60.8	21.59	-27.2	48.79	V
124.6	23.82	-29.4	53.22	H
175.0	23.48	-29	52.48	H
378.0	31.64	-24	55.64	H

Ch1 1GHz~3GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2613.6	54.22	3.9	50.32	H
2689.9	54.9	4.6	50.3	H
2786.6	54.71	4.3	50.41	V
2839.7	55.23	4.9	50.33	V
2915.8	54.69	5.7	48.99	V
2997.0	59.31	5.6	53.71	H

Ch1 1GHz~3GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2613.6	41.87	3.9	37.97	H
2689.9	42.32	4.6	37.72	H

2786.6	42.01	4.3	37.71	V
2839.7	42.46	4.9	37.56	V
2915.8	43.31	5.7	37.61	V
2997.0	43.33	5.6	37.73	H

Ch1 3GHz~18GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
13744.5	53.59	18	35.59	V
14325.1	54.06	20.4	33.66	H
15438.2	57.01	22.7	34.31	V
16041.0	58.88	25.2	33.68	H
16830.9	59.3	27.3	32	H
17799.0	60.69	28.4	32.29	H

Ch1 3GHz~18GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
14325.1	42.5	20.4	22.1	H
15438.2	43.87	22.7	21.17	V
16041.0	46.72	25.2	21.52	H
16830.9	47.39	27.3	20.09	H
17799.0	47.83	28.4	19.43	H

Ch11 30MHz~1GHz

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
34.4	20.89	-27.5	48.39	V
60.2	22.12	-27	49.12	V
132.5	22.5	-30.5	53	H
175.0	23.96	-29	52.96	H
378.0	32.39	-24	56.39	V

625.0	32.71	-18.7	51.41	H

Ch11 1GHz~3GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2678.6	54.94	4.5	50.44	V
2729.0	54.21	4.4	49.81	V
2783.5	53.97	4.3	49.67	H
2828.6	54.69	4.8	49.89	H
2888.2	55.71	5.7	50.01	V
2994.2	60.11	5.6	54.51	H

Ch11 1GHz~3GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2678.6	42.45	4.5	37.95	V
2729.0	42.29	4.4	37.89	V
2828.6	42.74	4.8	37.94	H
2888.2	43.41	5.7	37.71	V

Ch11 3GHz~18GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
15658.4	57.39	23.1	34.29	H
15984.7	59.81	25.2	34.61	V
16304.0	58.19	25.8	32.39	H
16751.5	58.47	26.6	31.87	V
17216.1	60.31	27.3	33.01	V
17725.9	59.84	27.5	32.34	H

Ch11 3GHz~18GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
15658.4	44.4	23.1	21.3	H

15984.7	46.75	25.2	21.55	V
16304.0	46.4	25.8	20.6	H
16751.5	46.65	26.6	20.05	V
17216.1	47.85	27.3	20.55	V
17725.9	47.79	27.5	20.29	H

802.11n-20MHz

Ch1 30MHz~1GHz

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
33.7	15.6	-27.5	43.1	V
60.2	21.4	-27	48.4	V
130.5	22.47	-30.3	52.77	H
175.0	23.95	-29	52.95	H
378.0	29.99	-24	53.99	H
399.9	18.17	-23.5	41.67	H

Ch1 1GHz~3GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2616.2	53.24	4	49.24	H
2663.5	55.15	4.5	50.65	H
2713.1	55.11	4.5	50.61	V
2830.5	54.79	4.8	49.99	V
2919.7	55.91	5.6	50.31	H
2989.7	58.28	5.6	52.68	H

Ch1 1GHz~3GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2663.5	42.38	4.5	37.88	H
2713.1	42.3	4.5	37.8	V
2830.5	42.76	4.8	37.96	V

2919.7	43.51	5.6	37.91	H
2989.7	43.1	5.6	37.5	H

Ch1 3GHz~18GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
13746.7	53.81	18	35.81	H
14684.1	55.24	21	34.24	V
15423.8	56.74	22.7	34.04	H
15980.4	59.71	25.2	34.51	V
16780.4	59.84	26.9	32.94	H
17790.2	59.38	28.3	31.08	V

Ch1 3GHz~18GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
14684.1	42.82	21	21.82	V
15423.8	43.95	22.7	21.25	H
15980.4	46.66	25.2	21.46	V
16780.4	47.1	26.9	20.2	H
17790.2	47.75	28.3	19.45	V

Ch11 30MHz~1GHz

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
34.4	16.34	-27.5	43.84	V
61.2	21.9	-27.3	49.2	V
130.5	22.21	-30.3	52.51	H
175.0	24.93	-29	53.93	H
316.5	13.28	-25.1	38.38	V
378.0	28.37	-24	52.37	H

Ch11 1GHz~3GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2567.3	53.92	3.6	50.32	H
2628.9	53.98	4.1	49.88	H
2696.1	54.04	4.6	49.44	H
2746.5	54.22	4.3	49.92	V
2806.7	54.39	4.5	49.89	V
2894.1	56.01	5.8	50.21	V

Ch11 1GHz~3GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
2696.1	42.35	4.6	37.75	H
2746.5	41.96	4.3	37.66	V
2806.7	42.34	4.5	37.84	V
2894.1	43.48	5.8	37.68	V

Ch11 3GHz~18GHz(Peak)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
12790.2	52.17	16.6	35.57	H
13527.0	53.71	17.9	35.81	H
14679.5	55.82	20.9	34.92	V
16303.6	59.69	25.8	33.89	H
17113.7	59.18	27	32.18	H
17806.5	61.05	28.4	32.65	H

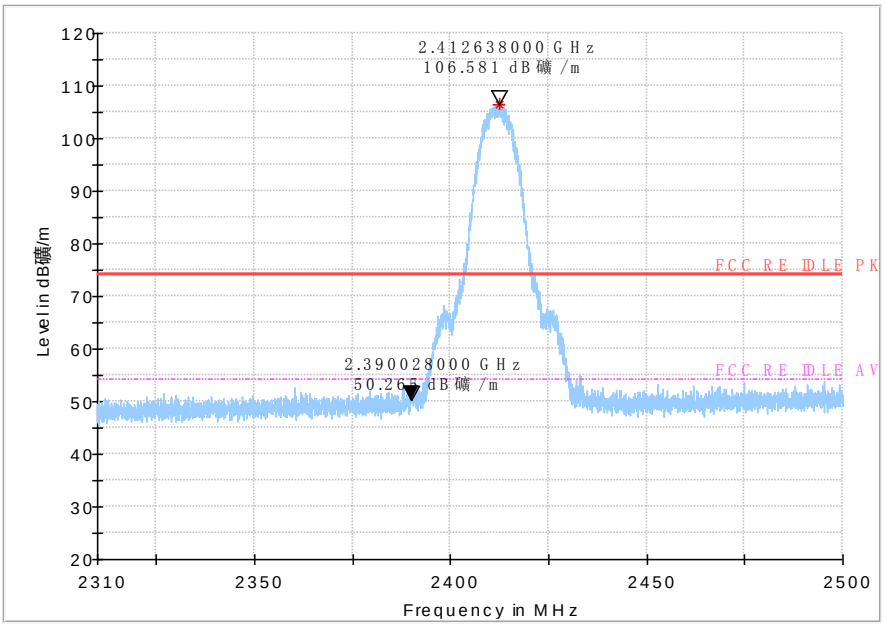
Ch11 3GHz~18GHz(Average)

Frequency(MHz)	Result(dBuV/m)	ARpl (dB)	PMea(dBuV/m)	Polarity
14679.5	42.78	20.9	21.88	V
16303.6	46.49	25.8	20.69	H
17113.7	47.33	27	20.33	H

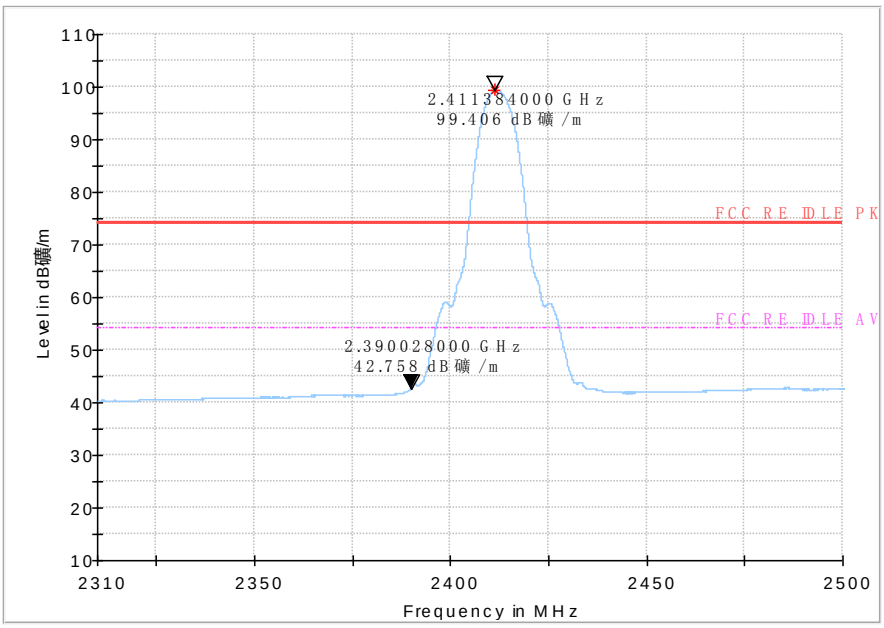
17806.5	47.93	28.4	19.53	H

Note: Only the worst case is written in the report.

Test graphs as below:

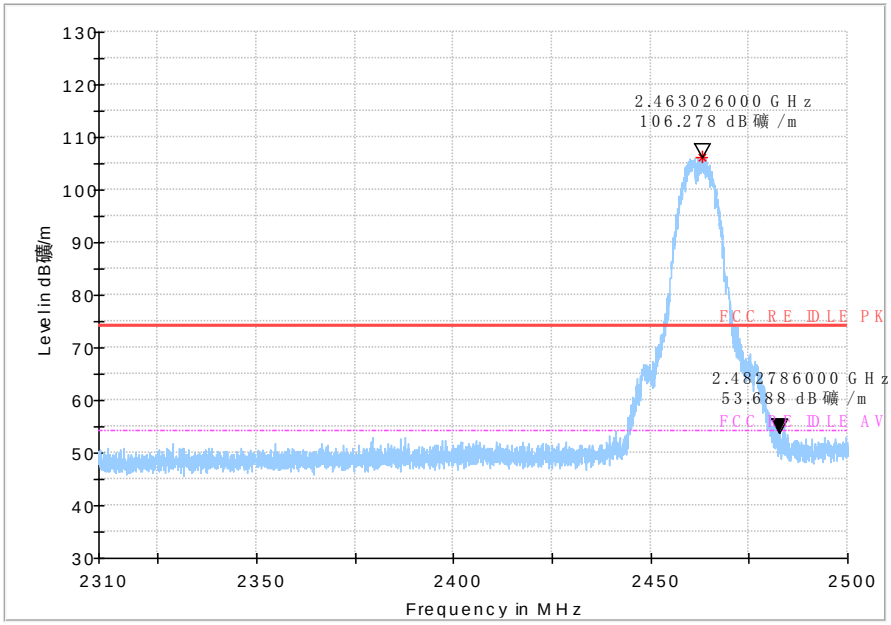


Peak detector

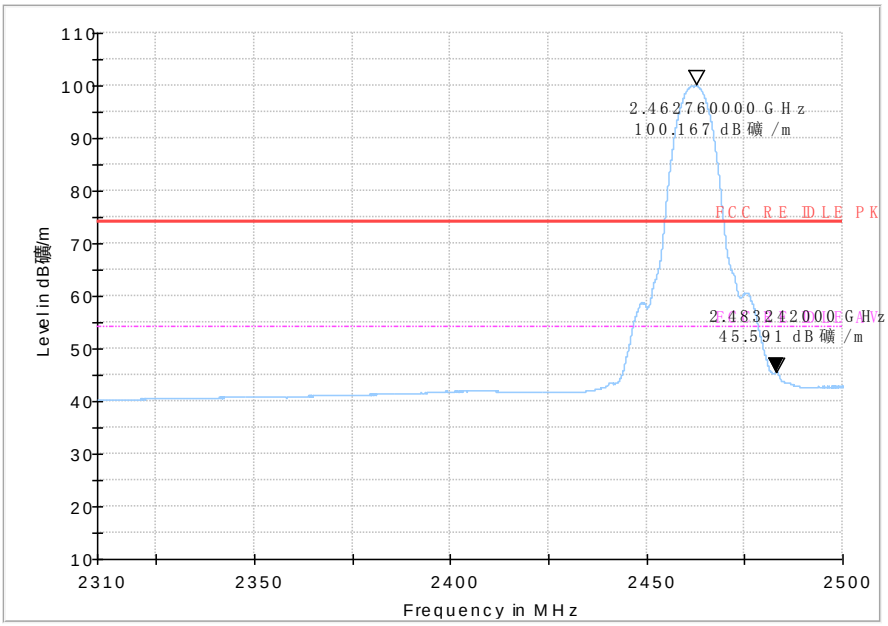


AV detector

Fig 52. Bandedge: 802.11b, low channel



Peak detector



AV detector

Fig 53. Bandedge: 802.11b, high channel

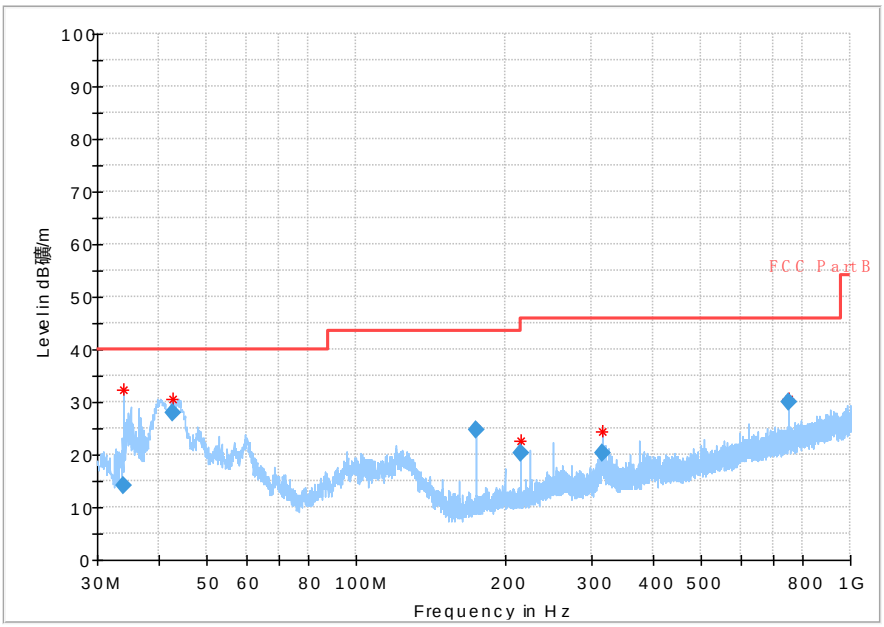


Fig 54. Radiated Spurious Emission (802.11b,Ch1,30MHz~1GHz)

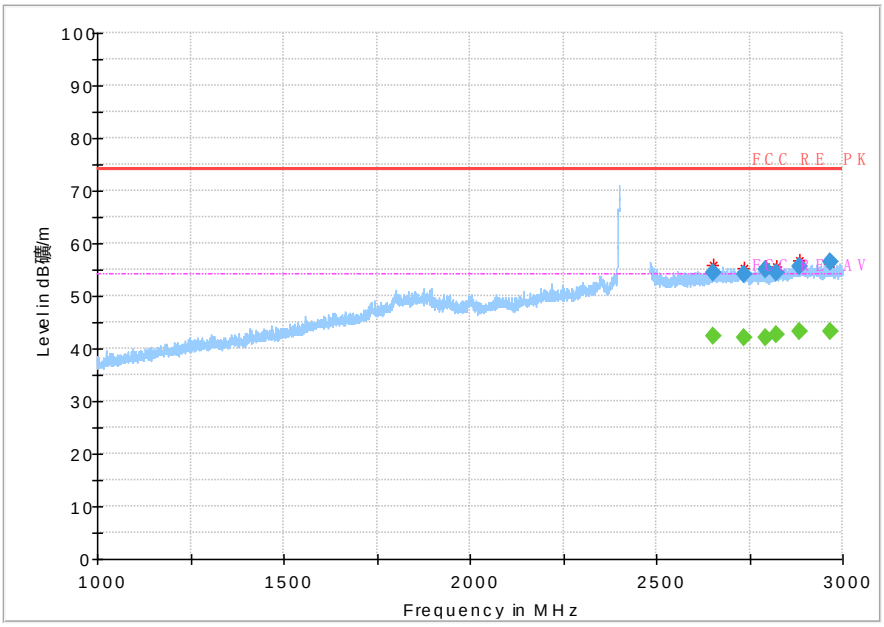


Fig 55. Radiated Spurious Emission (802.11b,Ch1,1GHz~3GHz)

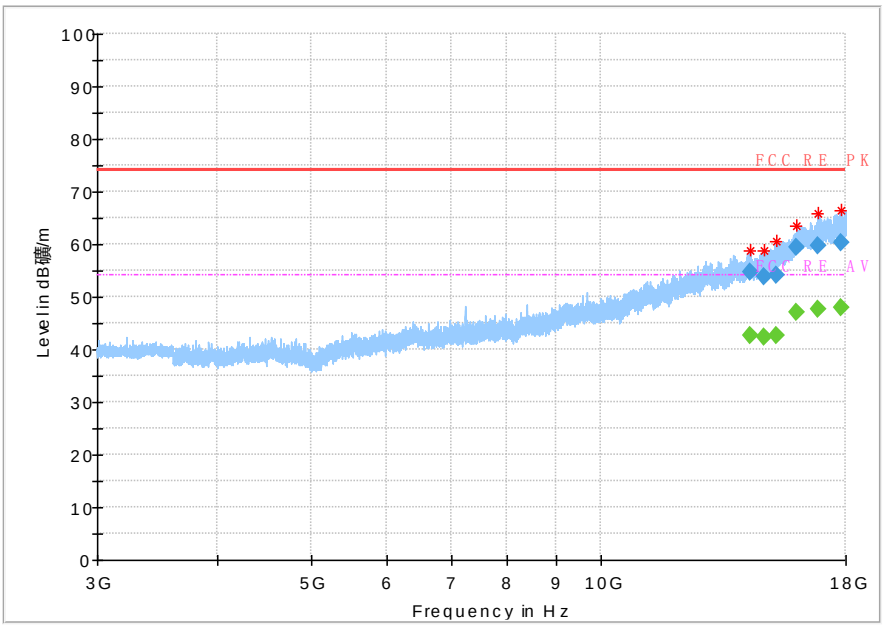


Fig 56. Radiated Spurious Emission (802.11b,Ch1,3GHz~18GHz)

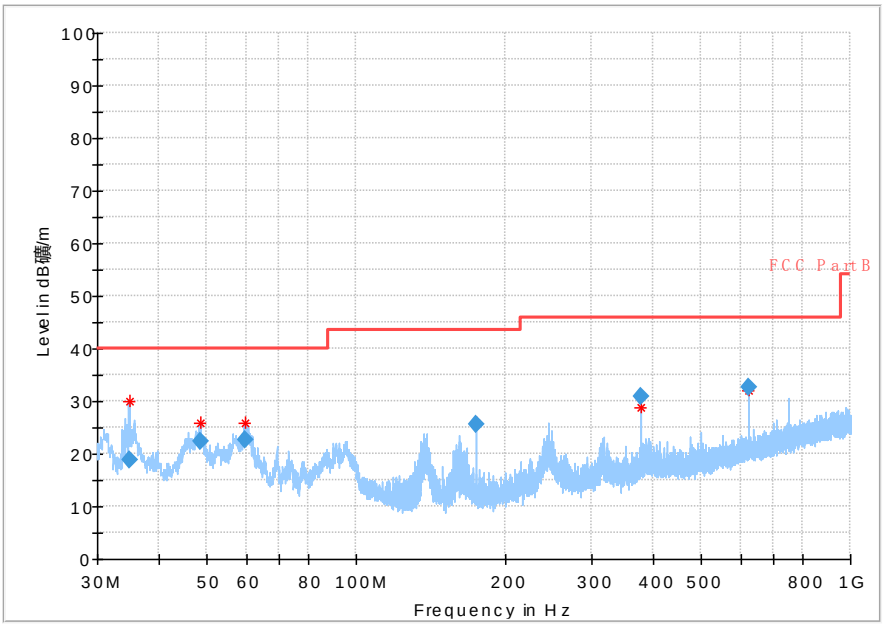


Fig 57. Radiated Spurious Emission (802.11b,Ch11,30MHz~1GHz)

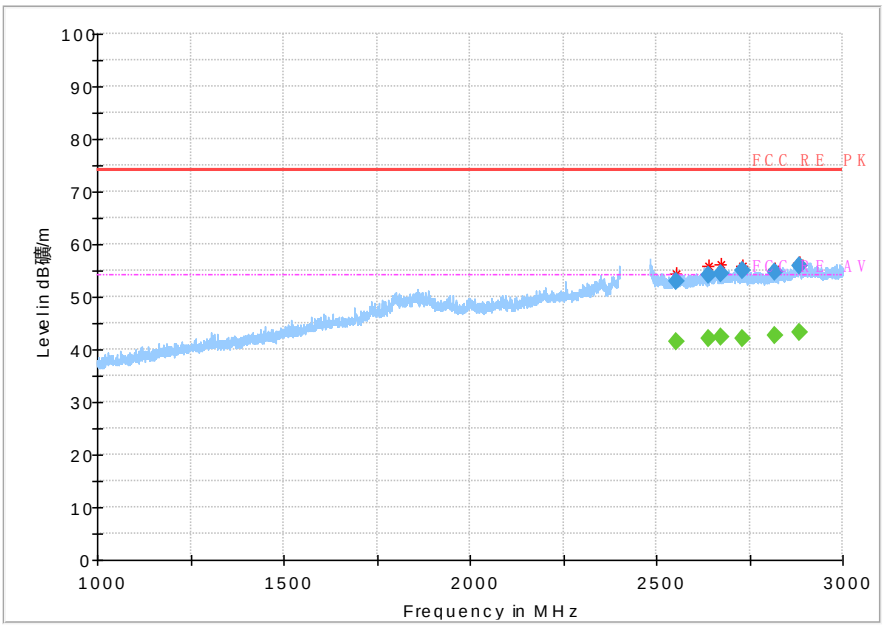


Fig 58. Radiated Spurious Emission (802.11b,Ch11,1GHz~3GHz)

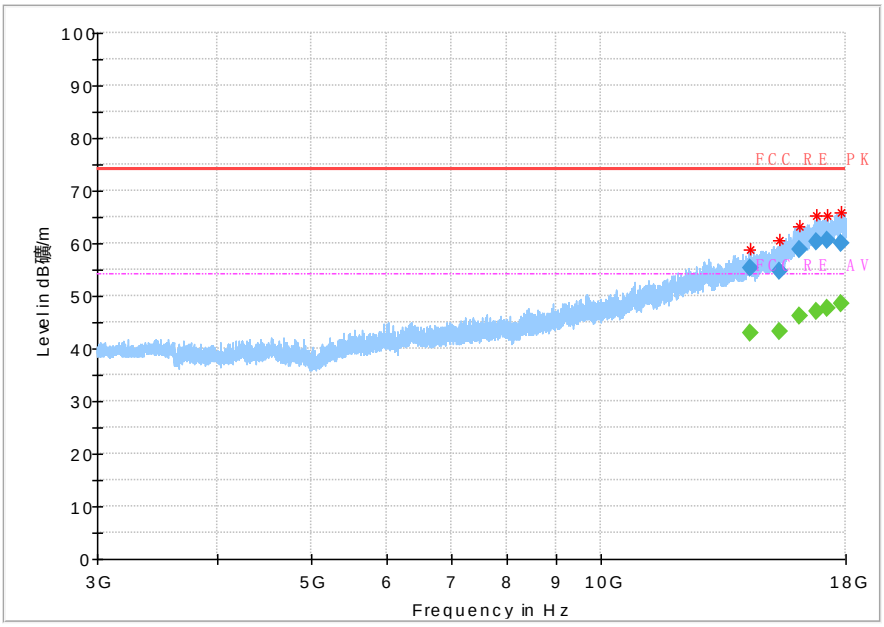
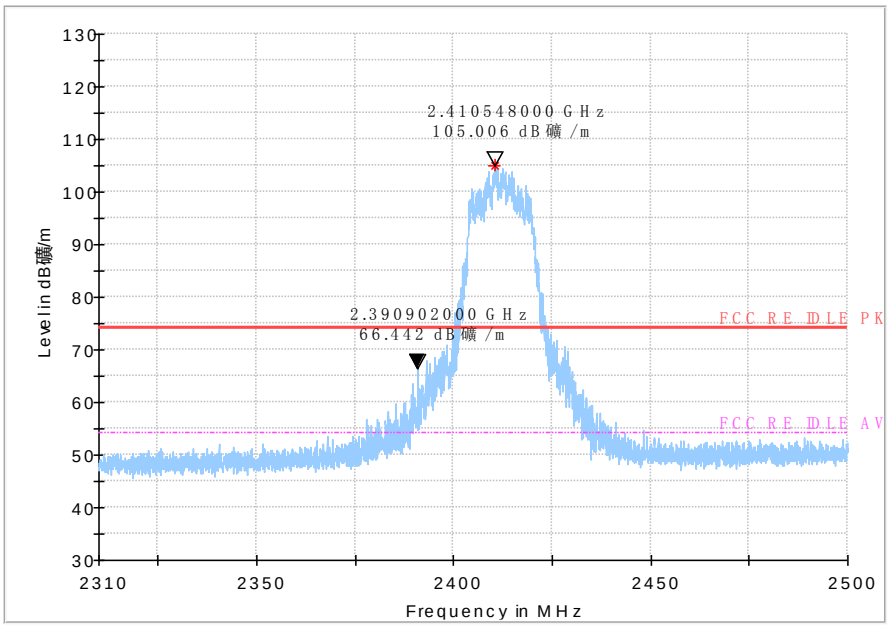
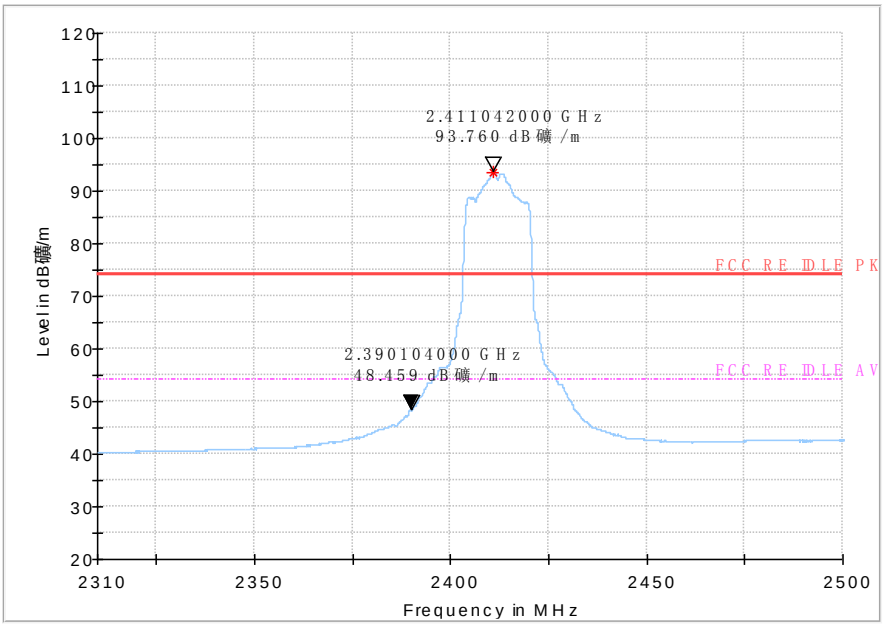


Fig 59. Radiated Spurious Emission (802.11b,Ch11,3GHz~18GHz)

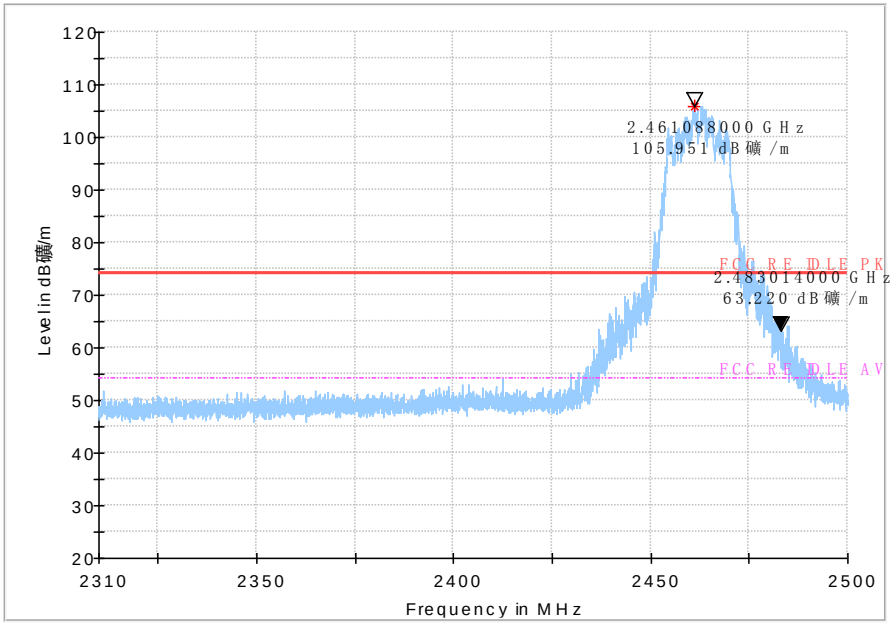


Peak detector

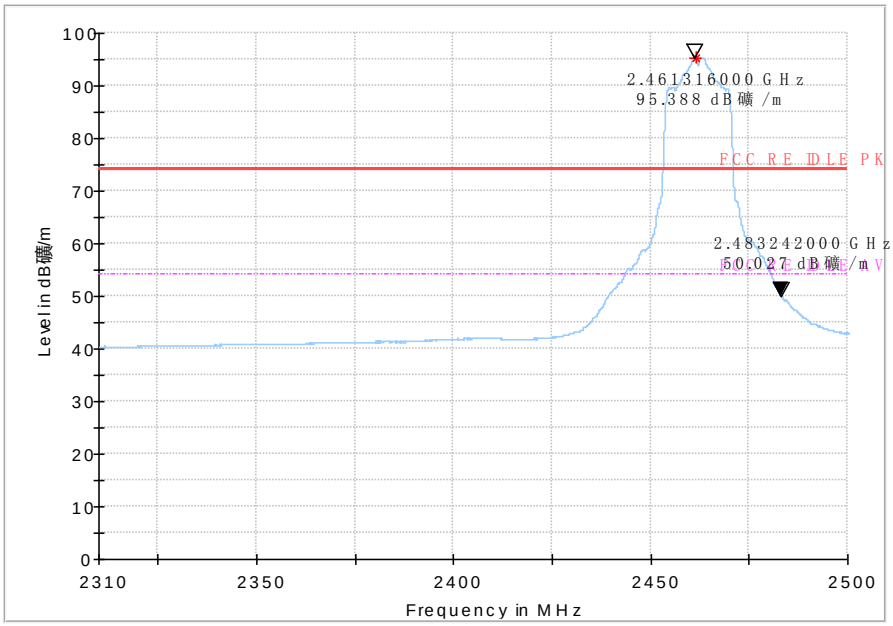


AV detector

Fig 60. Bandedge: 802.11g, low channel



Peak detector



AV detector

Fig 61. Bandedge: 802.11g, high channel

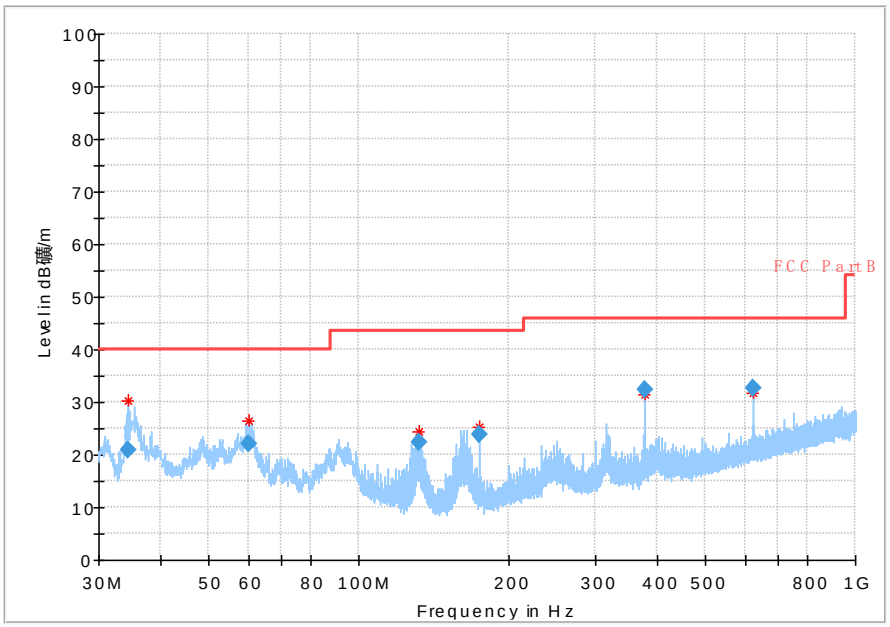


Fig 62. Radiated Spurious Emission (802.11g,Ch11, 30MHz~1GHz)

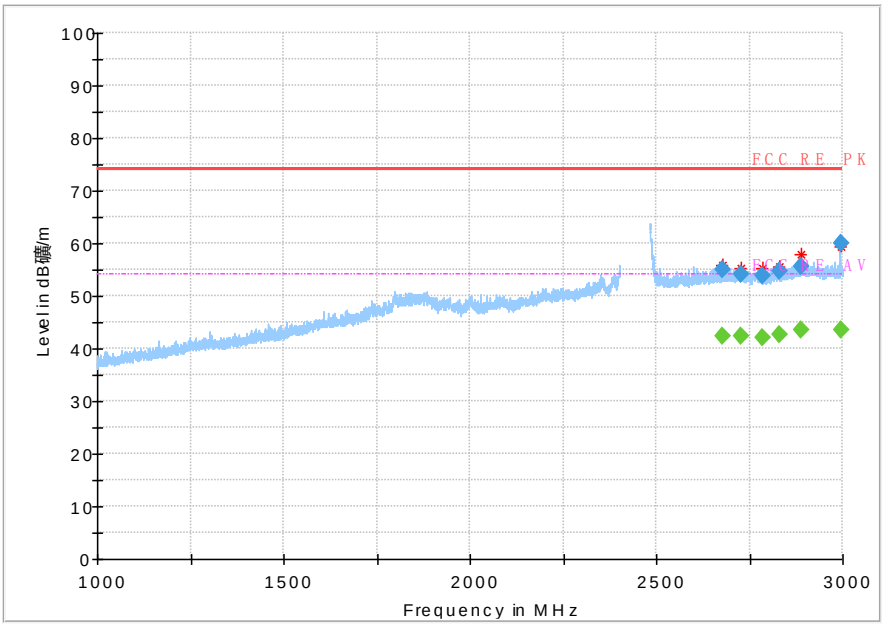


Fig 63. Radiated Spurious Emission (802.11g,Ch11,1GHz~3GHz)

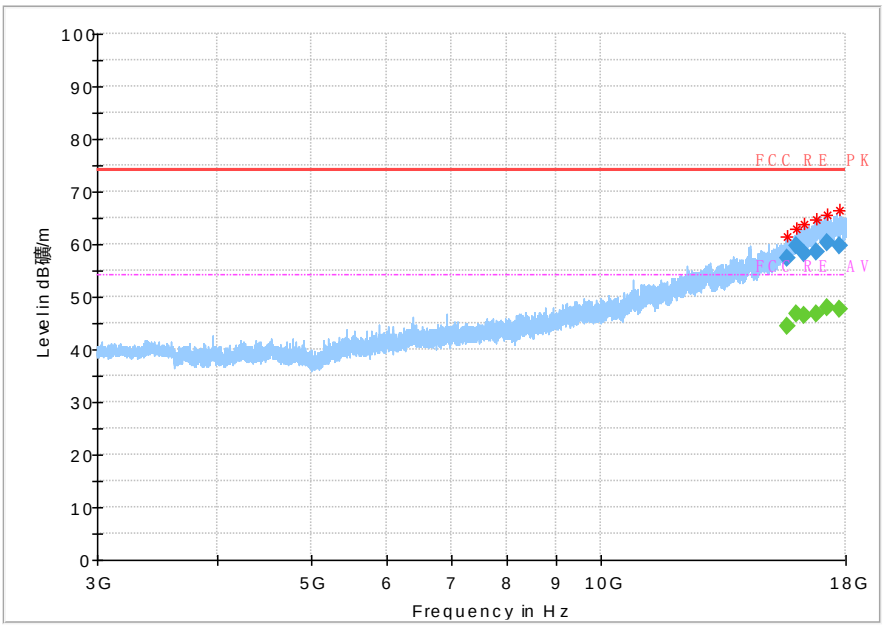
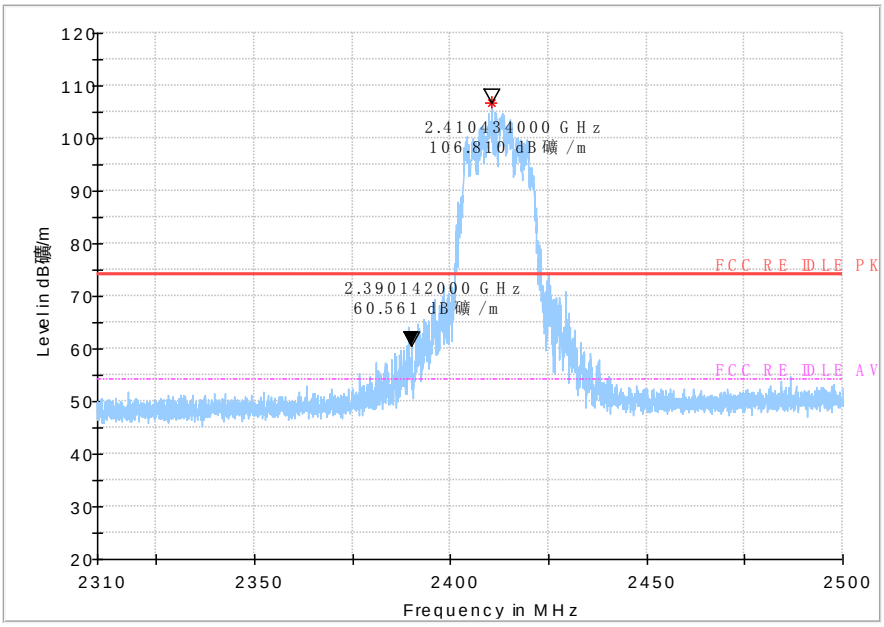
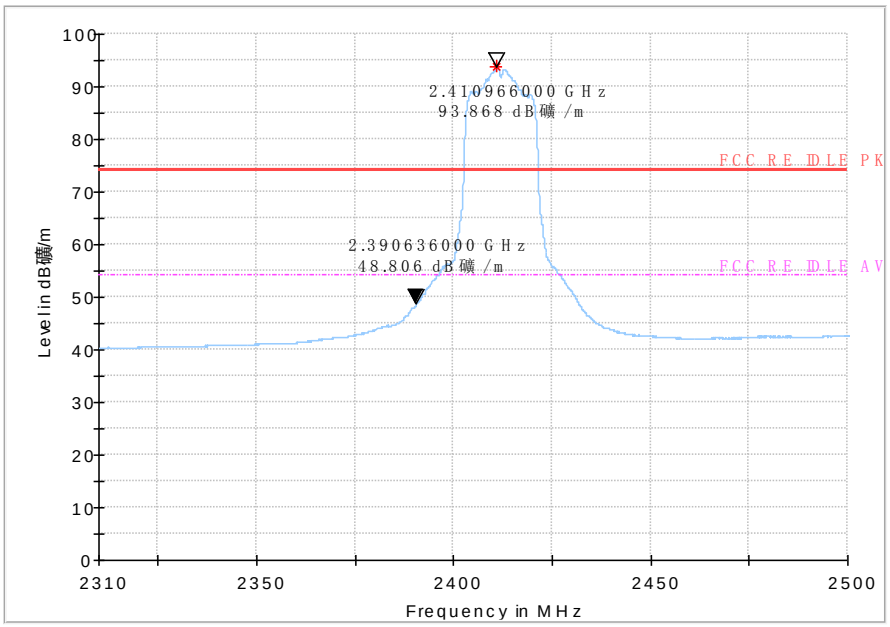


Fig 64. Radiated Spurious Emission (802.11g,Ch11,3GHz~18GHz)

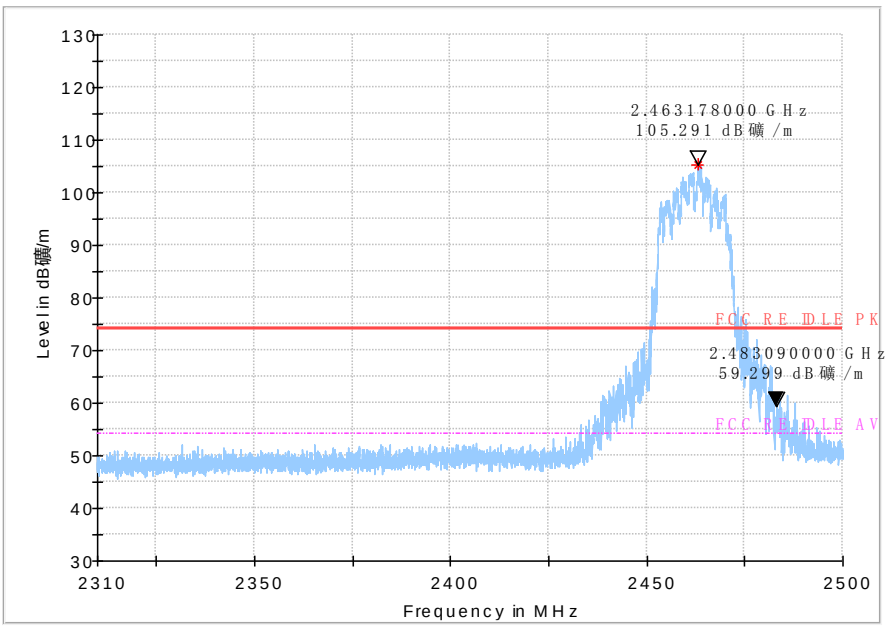


Peak detector

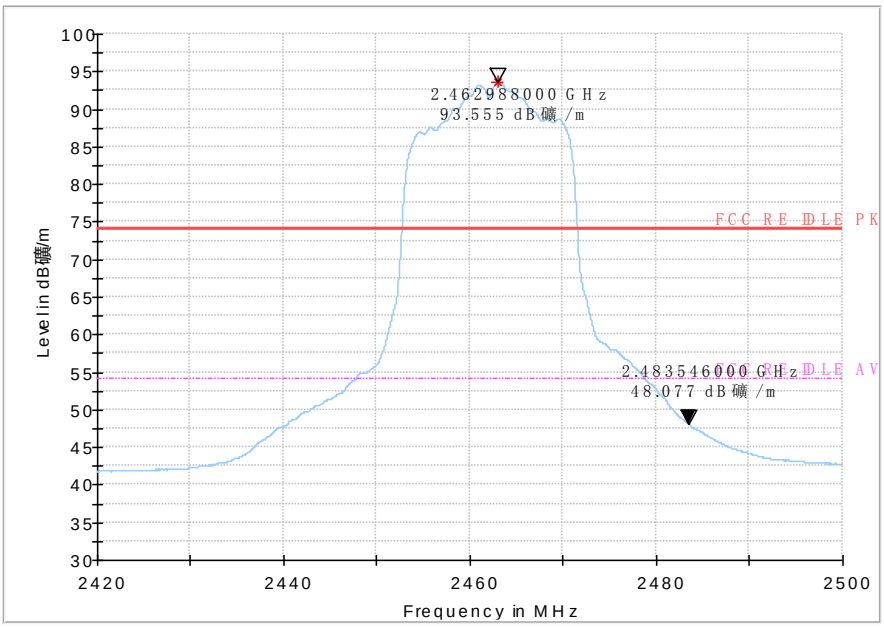


AV detector

Fig 65. Bandedge: 802.11 n-20MHz, low channel



Peak detector



AV detector

Fig 66. Bandedge: 802.11 n-20MHz, high channel

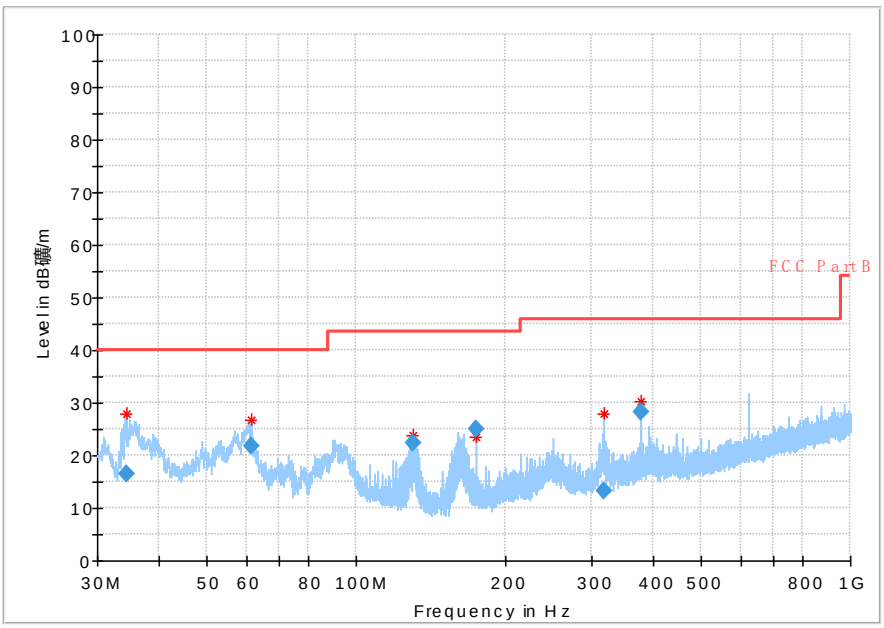


Fig 67. Radiated Spurious Emission (802.11 n-20MHz,Ch11,30MHz~1GHz)

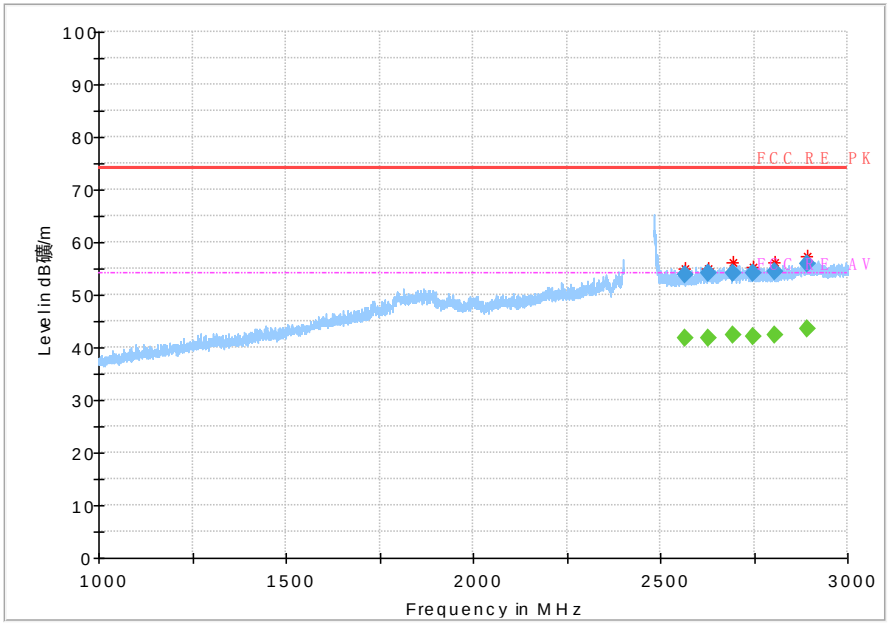


Fig 68. Radiated Spurious Emission (802.11 n-20MHz,Ch11, 1GHz~3GHz)

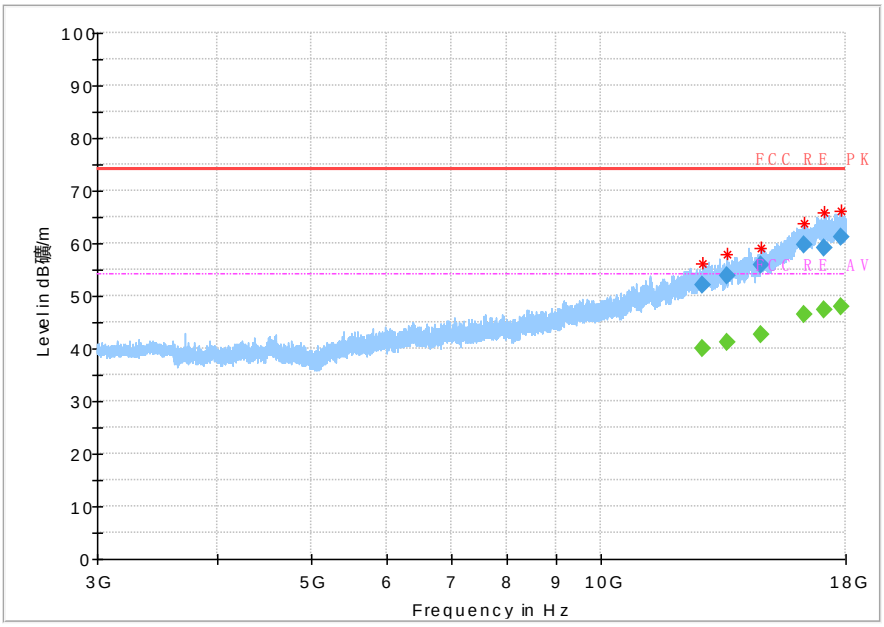
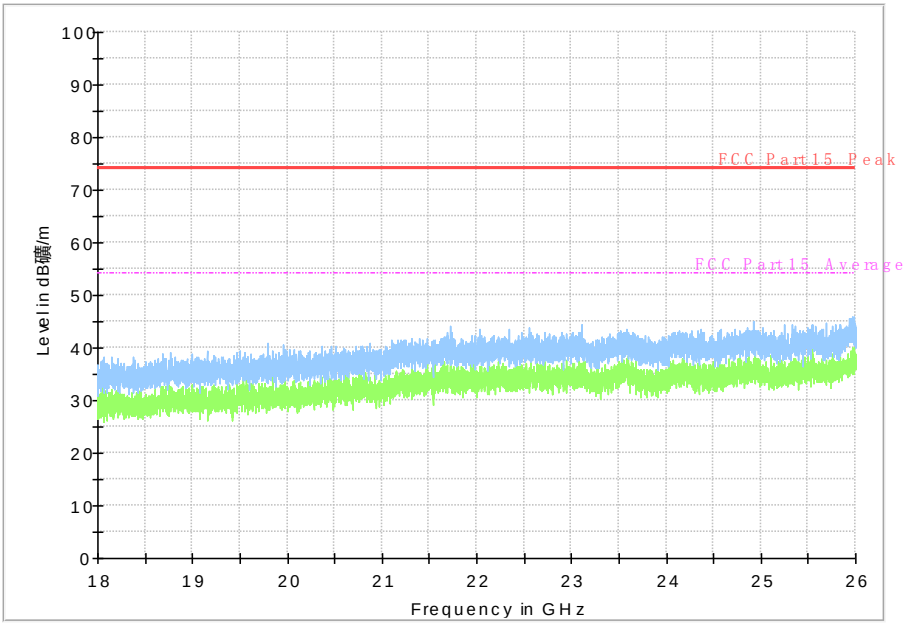


Fig 69. Radiated Spurious Emission (802.11 n-20MHz,Ch11, 3GHz~18GHz)


100
90
80
70
60
50
40
30
20
10
0
Level in dBµV/m
FCC Part15 Peak
FCC Part15 Average
18
19
20
21
22
23
24
25
26
Frequency in GHz

All Channel

ANNEX A.8. AC Powerline Conducted Emission

Method of Measurement: See ANSI C63.10 clause 6.2

1 The one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT.

2 If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed.

3 The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation.

4 If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

5 If the EUT uses a detachable antenna, these measurements shall be made with a suitable dummy load connected to the antenna output terminals; otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended. When measuring the ac conducted emissions from a device that operates between 150 kHz and 30 MHz a non-detachable antenna may be replaced with a dummy load for the measurements within the fundamental emission band of the transmitter, but only for those measurements.36 Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

Test Condition:

Voltage（V）	Frequency（Hz）
120	60

Measurement Result and limit:

(Quasi-peak-average Limit)

Frequency range (MHz)	Quasi-peak Limit (dBμV)	Average Limit (dBμV)	Result (dBμV) With charger 802.11b	Conclusion
0.15 to 0.5	66 to 56	56 to 46	Fig 70.	P
0.5 to 5	56	46		
5 to 30	60	50		
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.				

Conclusion: Pass

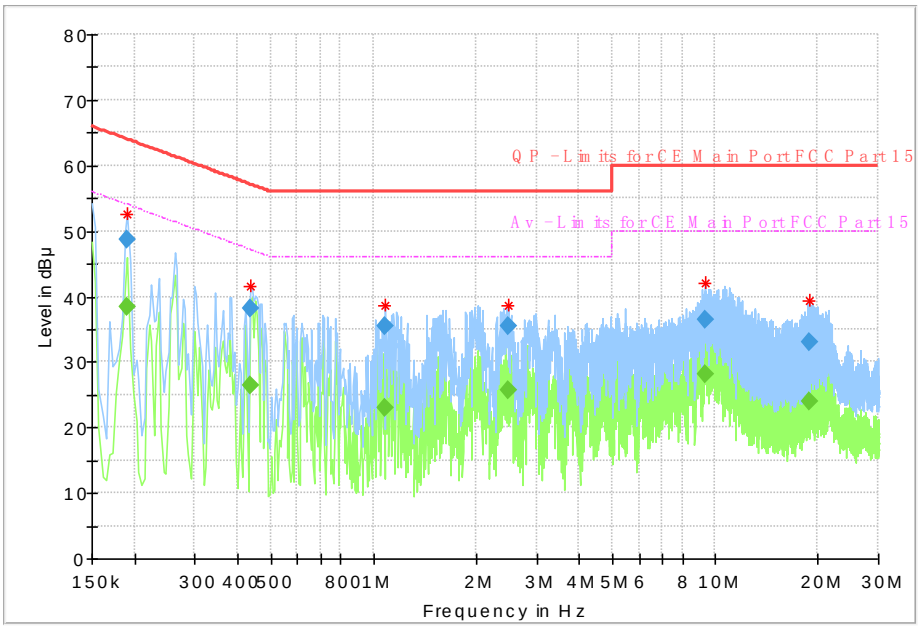


Fig 70. AC Powerline Conducted Emission

Frequency (MHz)	QuasiPeak (dB µ V)	Average (dB µ V)	Limit (dB µ	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.191044	---	38.51	53.99	15.48	15000.0	9.000	L1	ON	9.8
0.191044	48.75	---	63.99	15.24	15000.	9.000	L1	ON	9.8
0.437306	---	26.51	47.11	20.61	15000.	9.000	N	ON	9.8
0.437306	38.07	---	57.11	19.04	15000.0	9.000	N	ON	9.8
1.086544	---	23.02	46.00	22.98	15000.	9.000	N	ON	9.9
1.086544	35.48	---	56.00	20.52	15000.0	9.000	N	ON	9.9
2.485763	---	25.73	46.00	20.27	15000.	9.000	N	ON	10.0
2.485763	35.54	---	56.00	20.46	15000.	9.000	N	ON	10.0
9.306488	36.57	---	60.00	23.43	15000.	9.000	L1	ON	11.2
9.306488	---	28.20	50.00	21.80	15000.	9.000	L1	ON	11.2
18.869681	33.08	---	60.00	26.92	15000.	9.000	L1	ON	13.6
18.869681	---	23.91	50.00	26.09	15000.	9.000	L1	ON	13.6

ANNEX B. Accreditation Certificate

Accredited Laboratory

A2LA has accredited

EAST CHINA INSTITUTE OF TELECOMMUNICATIONS

Shanghai, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 6th day of May 2019.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3682.01
Valid to February 28, 2021

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

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