



FCC Test Report

Equipment : Access Control System
Model No : ASP-2000
FCC ID : 2AXQD-ASP-2000
Applicant : AHA INC CO.,LTD
67, Hwanggeum-ro, 109 beon-gil, Yangchon-eup,
Gimpo-si, Geonggi-do, 10048, korea
Date of test : September 11, 2020 to September 30, 2020
FCC Rule Part(s) : FCC Part 15 Subpart C §15.247
Report Type : Original Report

The product was received on September 11, 2020 and testing was completed on September 30, 2020. We, BWS TECH Inc. would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of BWS TECH Inc. the test report shall not be reproduced except in full.

(Date) 07/10/2020

Tested by **Hyeong-Bae Lee**

(Date) 07/10/2020

Reviewed by **Yong-Ki Cho**

BWS TECH INC.

#23, Gokhyeon-ro 480beon-gil, Mohyeon-eup, Cheoin-gu, Yongin-si,
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*This test report is not related to KS Q ISO/IEC 17025 and KOLAS accreditation.

*The authenticity of this test report can be confirmed in the Android app "DOCUQR" or www.docuqr.com

Report Revision

TEST REPORT NO.	DATE	DESCRIPTION
BWS-20-RF-0006	September 29, 2020	- First Approval Report
BWS-20-RF-0006-R1	September 30, 2020	- Added Measurement Uncertatinty and revised 6 dB Bandwidth.
BWS-20-RF-0006-R2	October 7, 2020	- Update the Model name.

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1. General Information

Scope – Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)

1.1 Applicant

● Company Name	: AHA INC CO.,LTD
● Company Address	: 67, Hwanggeum-ro, 109 beon-gil, Yangchon-eup, Gimpo-si, Geonggi-do, 10048, korea
● Phone/Fax	: Tel No. : +82-31-8048-7232 Fax No. : +82-31-997-0911

1.2 Manufacturer

● Company Name	: AHA INC CO.,LTD
● Company Address	: 67, Hwanggeum-ro, 109 beon-gil, Yangchon-eup, Gimpo-si, Geonggi-do, 10048, korea
● Phone/Fax	: Tel No. : +82-31-8048-7232 Fax No. : +82-31-997-0911

1.3 EUT Description

● Equipment	: Access Control System
● Model(s)	: ASP-2000
● Derived Model(s)	: ASP-19, AIC-1000, SZ-1082D, SZ-1081D, SW-1081-D, SW-1080-D, SW-1082D, SW-1081D, SV-1082D, SV-1081D, FPS-1000R, CRS-100, ASP-1000, ASP-19F, ASP-19E, ASP-19D
● Operation Frequency	: 802.11 b/g/n(HT20): 2412MHz-2462MHz
● Number of Channels	: 802.11 b/g/n(HT20): 11
● Modulation Method	: 802.11 b : DSSS 802.11 g/n(HT20) : OFDM
● Power Tolerance	: +/- 2dB
● Input Voltage	: DC 12 V
● Antenna Peak Gain	: 802.11b/g/n(HT20/40) :-1 dBi

1.4 Other Information

● FCC Rule Part(s)	: Part 15 Subpart C §15.247
● FCC ID	: 2AXQD-ASP-2000
● Test Procedure	: ANSI C63.10-2013 KDB 558074 D01 DTS Meas Guidance v05r02
● Date of Test	: September 11, 2020 to September 29, 2020
● Place of Test	: BWS TECH Inc. (FCC Registration Number : 287786) #23, Gokhyeon-ro 480 Beon-gil, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17031, South Korea TEL: +82 31 333 5997 FAX: +82 31 333 0017

2. Description of Test Facility

Site Description

Test Lab. :  NRRA Designation Number is KR0017.
 The Certificate Designation Number is KR0017.
 The Certificate Accreditation Number is KT174.

Name of Firm : BWS TECH Inc.

Site Location : #23, Gokhyeon-ro 480 Beon-gil, Mohyeon-eup, Cheoin-gu, Yongin-si, Gyeonggi-do 17031, South Korea

3. Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.10: 2013 and the requirements of FCC Rules Part 15.207, 15.209 and 15.247.

Radio testing was performed according to KDB 558074 D01 DTS Meas Guidance v05r02.

3.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and is operated in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 FCC Part 15.205 Restricted Bands of Operations

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(²)
13.36-13.41			

1 Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

2 Above 38.6

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

3.4 Description of Test Modes

The EUT has been tested under operating condition.

After output power verification, all tests were carried out with the worst case test modes as shown below.

The worst-case of data rates and antenna configurations are shown as follows.

- Data rates

Band	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS 0
This device supports non-beamforming in 802.11n.	

4. Summary of Test Result

Clause	TEST Description	Standard Section	Requirements	Result
6.1	AC Power Line Conducted Emission	§15.207	§15.207(a)	Pass
6.2	Peak Output Power Measurement	§15.247(b)(3)	≤ 30 dBm	Pass
6.3	Power Spectral Density	§15.247(e)	≤ 8 dBm/3 kHz	Pass
6.4	6 dB Bandwidth	§15.247(a)(2)	≥ 500 kHz	Pass
6.5	Conducted Spurious Emission	§15.247(d)	≥ 20 dBc/100 kHz	Pass
6.6	Band Edges Measurement	§15.247(d)	§15.205(a)	Pass
6.7	Radiated Spurious Emission	§15.247(d), §15.209(a), §15.35(b)	§15.209(a), §15.247(d)	Pass
6.8	Antenna Application	§15.247(b), §15.203	§15.247(b), §15.203	Pass

5. Test Equipment

Equipment	Model	Manufacturer	Serial number	Calibration Due date (year/month/date)
POWER SUPPLY	MEC 1705	Mecha solution	277	2021/06/18
USB RF POWER SENSOR	RPR3006W	D.A.R.E!! Instruments	14I000048SNO09	2021/04/07
ATTENUATOR	F04-B1820-01	SRT	17060803	2021/06/04
SYNTHESIZED SIGNAL GENERATOR	68367C	ANRITSU	#004908	2021/05/15
Signal Analyzer	FSP	Rohde & Schwarz	100631	2020/12/24
EMC ANALYZER	E7405A	Agilent	MY45104194	2021/02/13
Boresight Antenna mast controller	AM-BS-4500E	AUDIX	060908-BS	N/A
Antenna Turntable Controller	JAC-2	Daeli EMC	N/A	N/A
Loop Antenna	FMZB1519	SCHWARZBECK	00025	2022/01/06
TRILOG Broadband Antenna	VULB 9163	SCHWARZBECK	01063	2021/04/30
Active Horn Antenna	AHA-118	COM-POWER CORP.	701064	2021/04/30
Horn Antenna	BBHA9170	Schwartzbek	157	2021/04/27
RF Amplifier	MPA-10-40	RF Bay, Inc.	191246	2021/06/04
Band reject filter	BRM50701	Micro-Tronics	G236	2021/08/28

6. Test Data

6.1 AC Power Line Conducted Emission

6.1.1 Test Limit

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

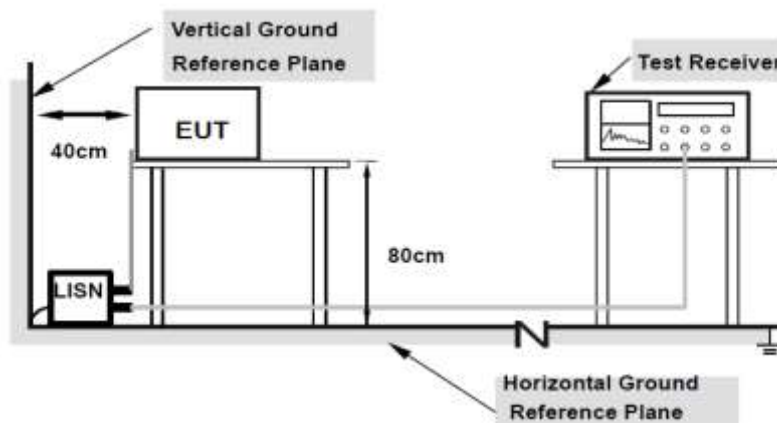
Frequency of emission(MHz)	Conducted limit(dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

6.1.2 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room and was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network(LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 uH LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9 kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

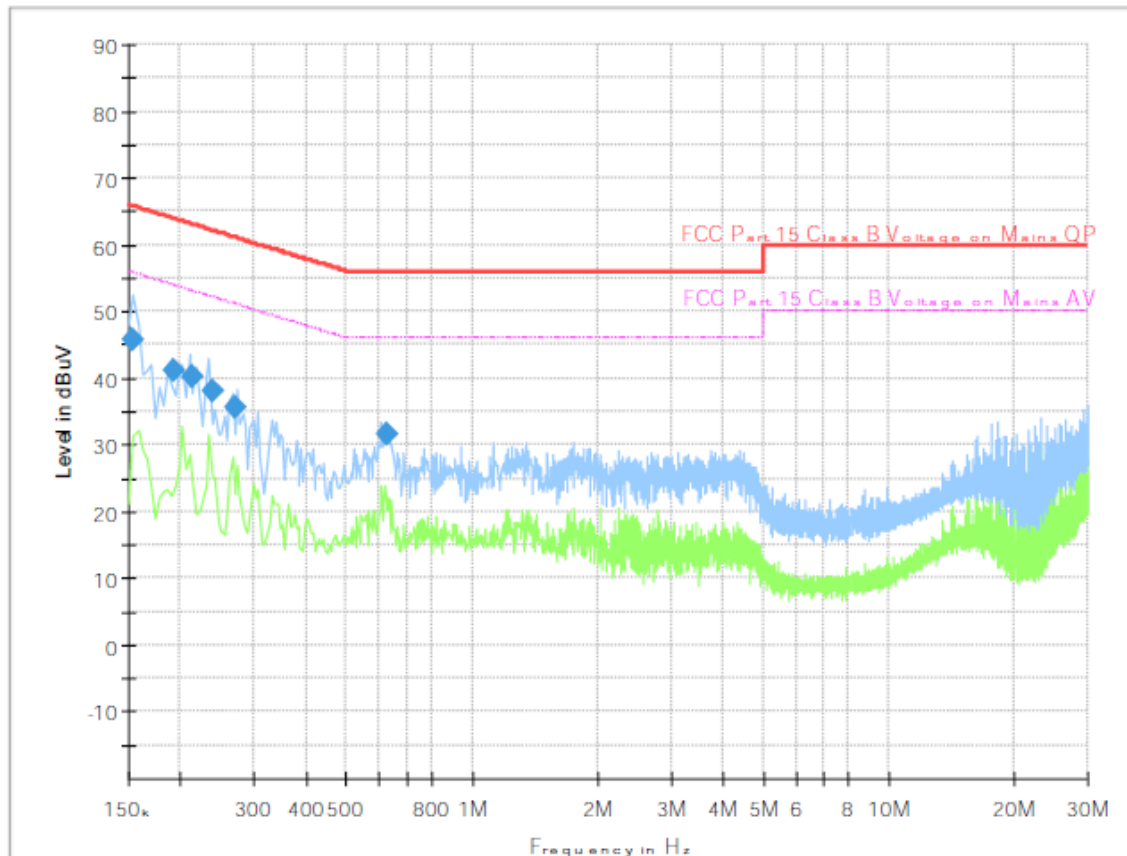
6.1.3 Test SET-UP (Block Diagram of Configuration)



6.1.4 Test Results

Common Information

Test Line: L1
Comment: 802.11b

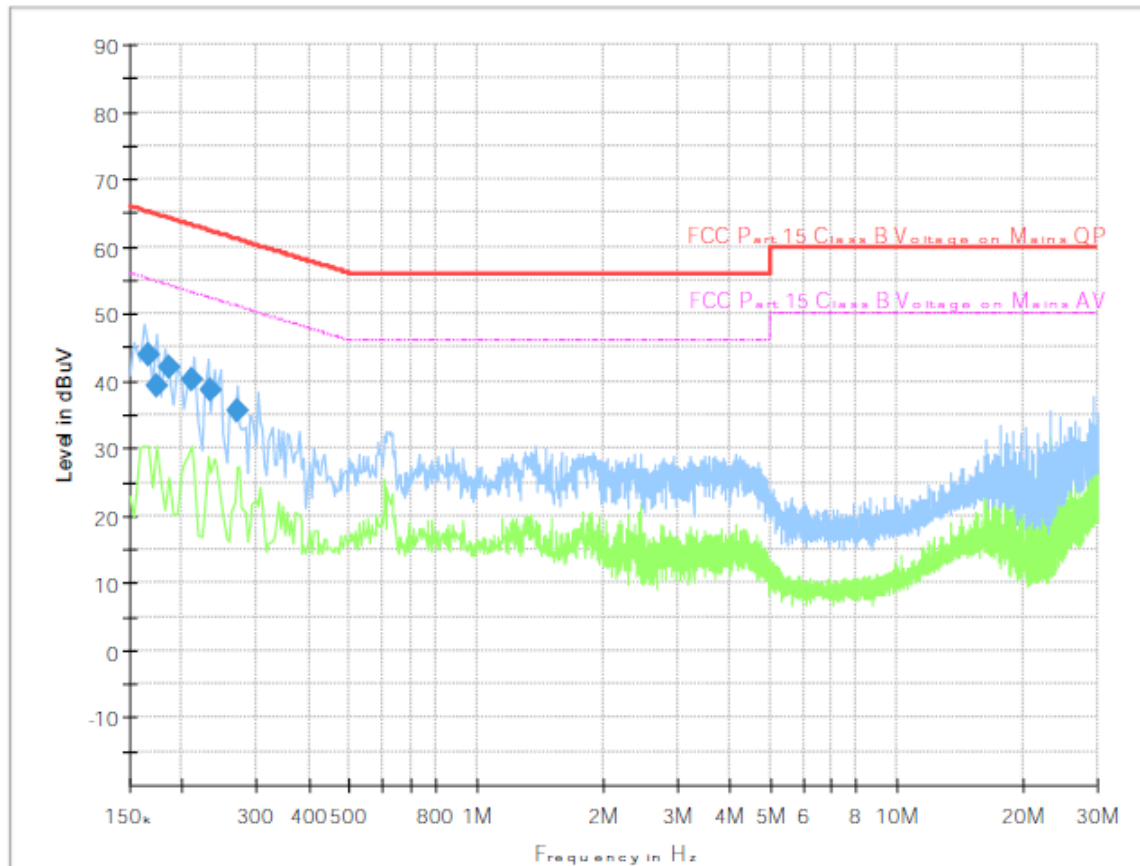


Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.154000	45.67	---	65.78	20.11	3000.0	9.000	L1	GND	7.7
0.193500	41.21	---	63.89	22.68	3000.0	9.000	L1	GND	7.7
0.213500	40.18	---	63.07	22.88	3000.0	9.000	L1	GND	7.7
0.237500	38.22	---	62.18	23.96	3000.0	9.000	L1	GND	7.7
0.269500	35.68	---	61.13	25.45	3000.0	9.000	L1	GND	7.7
0.625499	31.75	---	56.00	24.25	3000.0	9.000	L1	GND	7.6

Common Information

Test Line: N
Comment: 802.11b

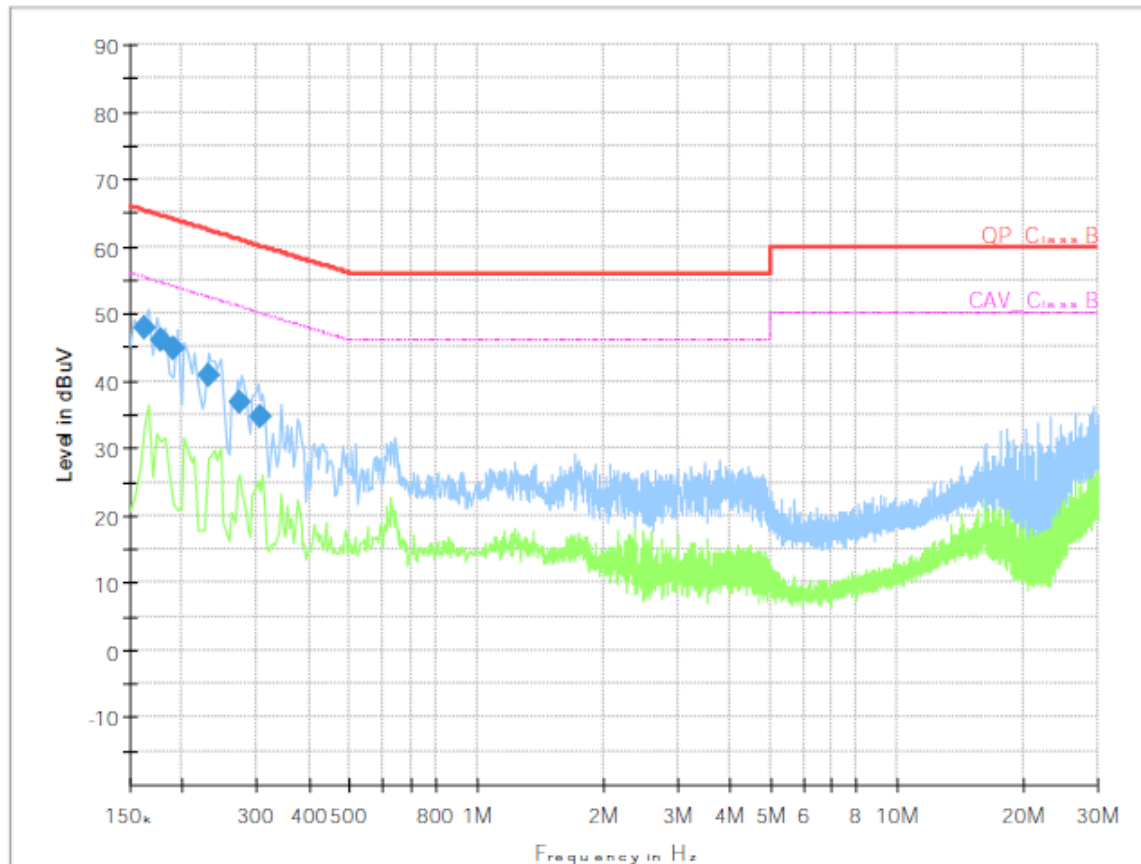


Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.165500	43.90	---	65.18	21.28	3000.0	9.000	N	GND	7.7
0.173500	39.19	---	64.79	25.60	3000.0	9.000	N	GND	7.7
0.186500	42.22	---	64.19	21.97	3000.0	9.000	N	GND	7.7
0.209500	40.18	---	63.23	23.05	3000.0	9.000	N	GND	7.7
0.233500	38.60	---	62.32	23.72	3000.0	9.000	N	GND	7.7
0.269500	35.54	---	61.13	25.59	3000.0	9.000	N	GND	7.7

Common Information

Test Line: L1
Comment: 802.11g

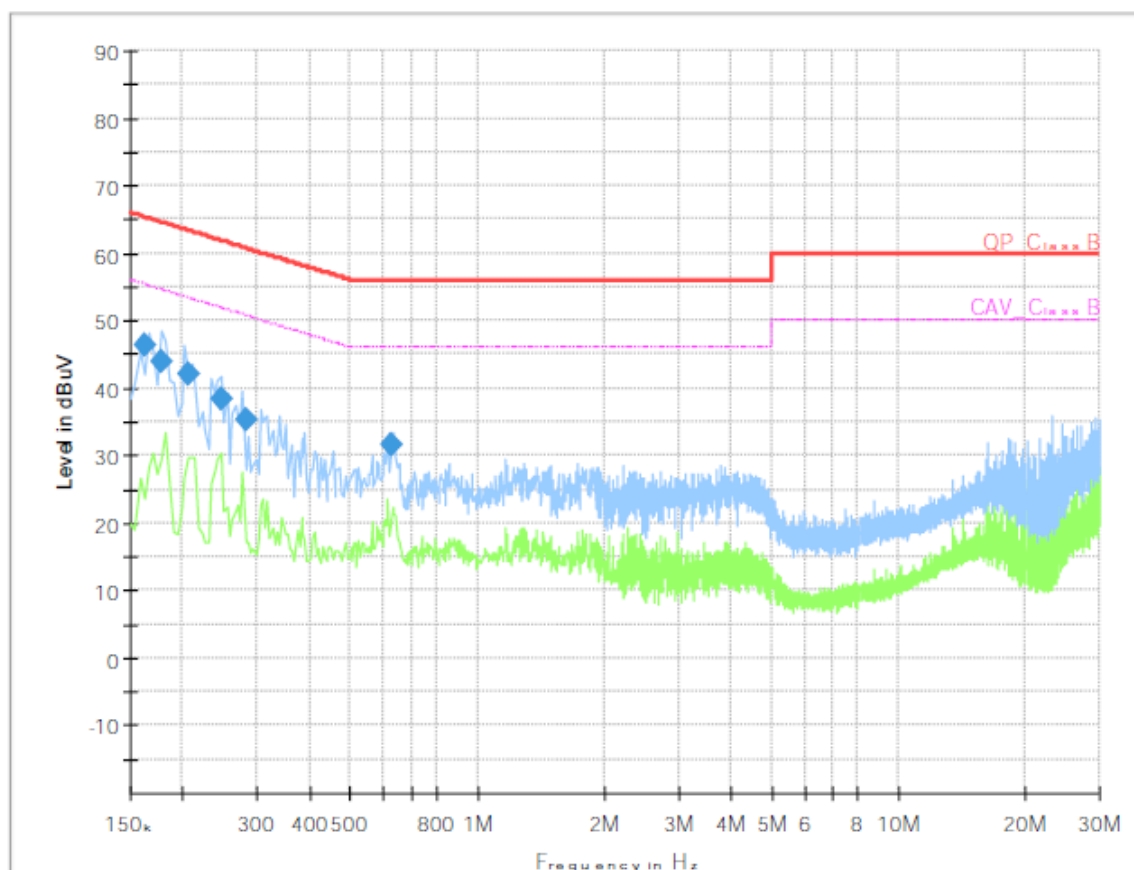


Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.161500	47.95	---	65.39	17.44	3000.0	9.000	L1	GND	7.7
0.177500	46.07	---	64.60	18.53	3000.0	9.000	L1	GND	7.7
0.189500	44.84	---	64.06	19.21	3000.0	9.000	L1	GND	7.7
0.229500	40.88	---	62.47	21.59	3000.0	9.000	L1	GND	7.7
0.273500	37.00	---	61.01	24.01	3000.0	9.000	L1	GND	7.7
0.306500	34.66	---	60.07	25.40	3000.0	9.000	L1	GND	7.7

Common Information

Test Line: N
Comment: 802.11g

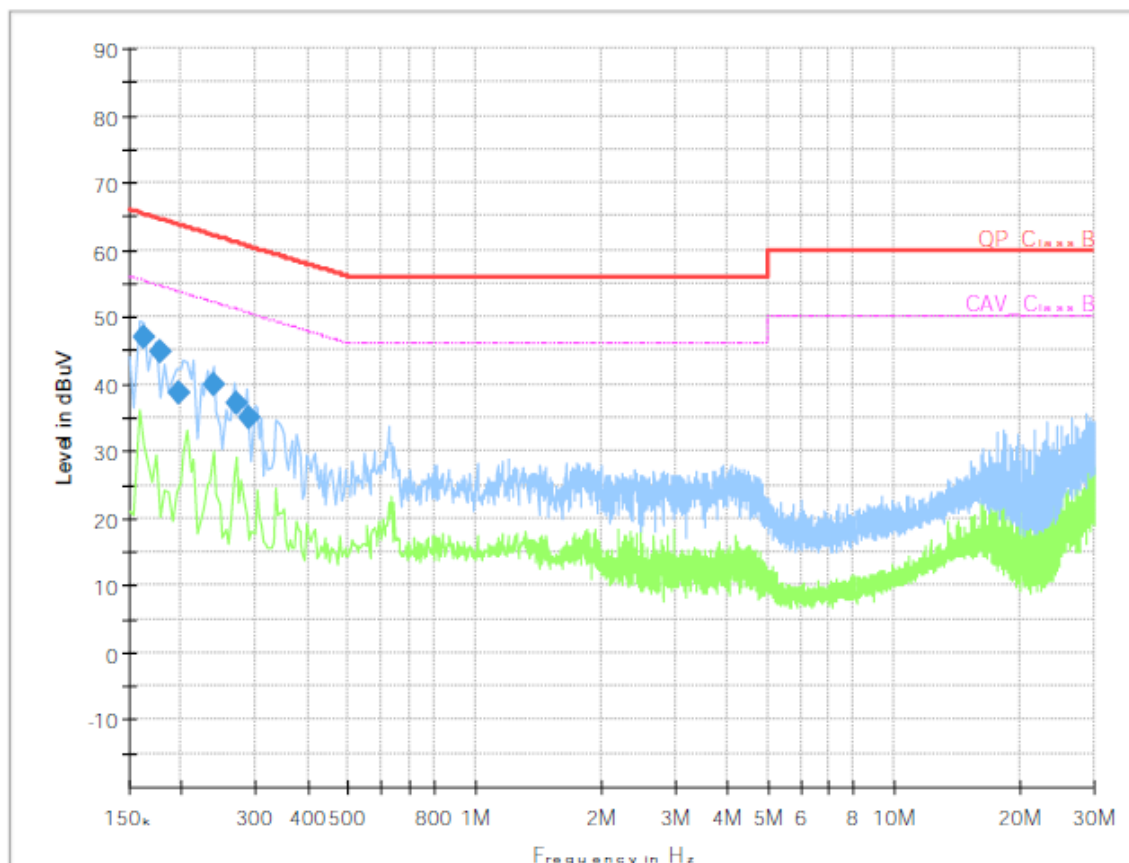


Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.161500	46.38	---	65.39	19.00	3000.0	9.000	N	GND	7.7
0.177500	44.05	---	64.60	20.55	3000.0	9.000	N	GND	7.7
0.206500	41.92	---	63.35	21.43	3000.0	9.000	N	GND	7.7
0.246500	38.48	---	61.87	23.40	3000.0	9.000	N	GND	7.7
0.282500	35.16	---	60.74	25.58	3000.0	9.000	N	GND	7.7
0.625498	31.47	---	56.00	24.53	3000.0	9.000	N	GND	7.7

Common Information

Test Line: L1
Comment: 802.11n HT20

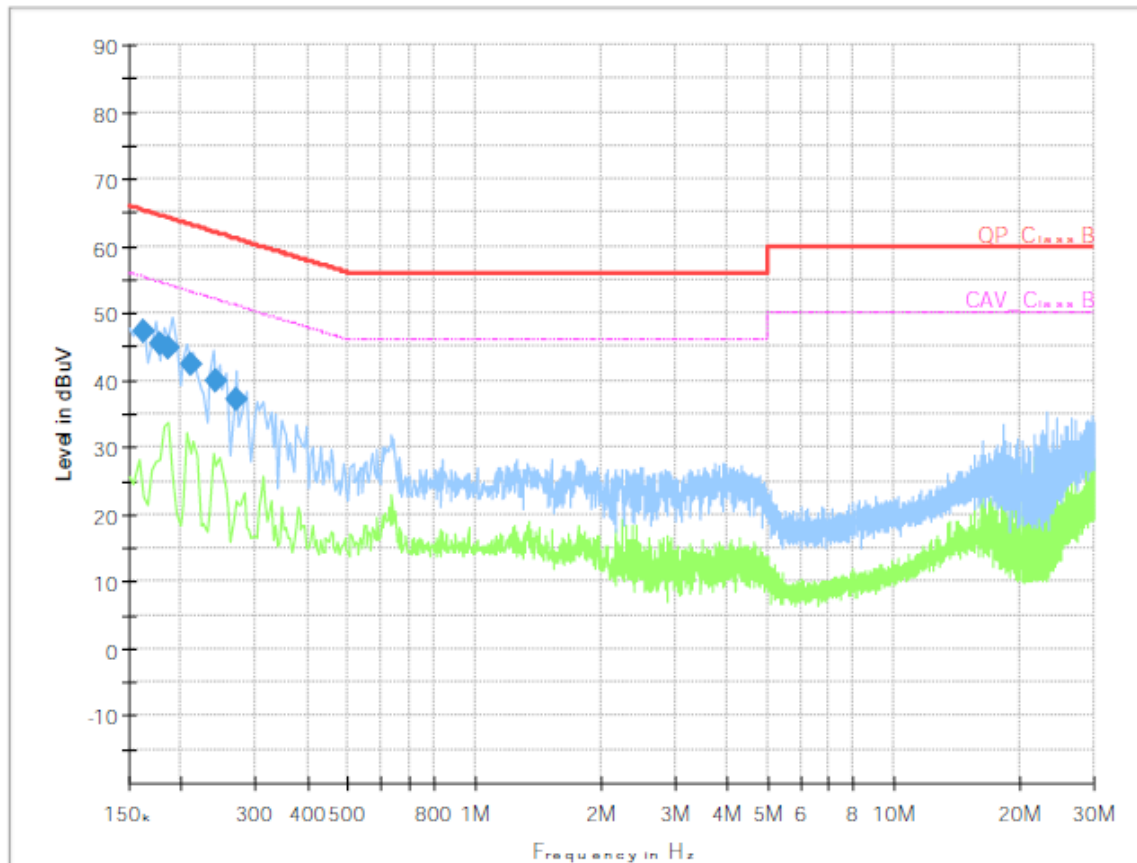


Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.161500	47.00	---	65.39	18.39	3000.0	9.000	L1	GND	7.7
0.178500	44.78	---	64.56	19.78	3000.0	9.000	L1	GND	7.7
0.197500	38.66	---	63.72	25.06	3000.0	9.000	L1	GND	7.7
0.237500	39.91	---	62.18	22.27	3000.0	9.000	L1	GND	7.7
0.269500	37.05	---	61.13	24.08	3000.0	9.000	L1	GND	7.7
0.289500	35.07	---	60.54	25.47	3000.0	9.000	L1	GND	7.7

Common Information

Test Line: N
Comment: 802.11n HT20



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.161500	47.27	---	65.39	18.12	3000.0	9.000	N	GND	7.7
0.178500	45.33	---	64.56	19.22	3000.0	9.000	N	GND	7.7
0.185500	44.79	---	64.24	19.45	3000.0	9.000	N	GND	7.7
0.210500	42.43	---	63.19	20.76	3000.0	9.000	N	GND	7.7
0.241500	39.92	---	62.04	22.12	3000.0	9.000	N	GND	7.7
0.269500	37.25	---	61.13	23.88	3000.0	9.000	N	GND	7.7

6.2 Peak Output Power Measurement

6.2.1 Test Limit

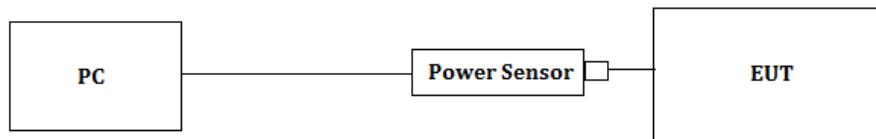
The maximum peak power shall be less than 1 Watt (30 dBm).

Note: If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the direction gain of the antenna exceeds 6dBi, In case of point-to-point operation, the limit has to be reduced by 1dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

6.2.2 Measurement Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 15.247 Meas. Guidance v05.
2. The RF output of EUT was connected to the power meter. The path loss was compensated to the results for each measurement.
3. Set to the maximum output power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.

6.2.3 Test SET-UP (Block Diagram of Configuration)



6.2.4 Test Results

[Duty Cycle]

[802.11b]

Channel	Frequency (MHz)	Duty Cycle	Duty Cycle Factor (dB)
1	2412	0.996	0.017
6	2437	0.996	0.017
11	2462	0.996	0.017

[802.11g]

Channel	Frequency (MHz)	Duty Cycle	Duty Cycle Factor (dB)
1	2412	0.972	0.123
6	2437	0.973	0.119
11	2462	0.972	0.123

[802.11n HT20]

Channel	Frequency (MHz)	Duty Cycle	Duty Cycle Factor (dB)
1	2412	0.970	0.132
6	2437	0.970	0.132
11	2462	0.970	0.132

Notes : 1. Duty Cycle = T_{on} / T_{total}
2. Duty Cycle Factor = $10 \cdot \log(1/\text{Duty Cycle})$.

[Peak Output Power Measurement]

[802.11b]

Channel	Frequency (MHz)	Peak Output Power (dBm)	Antenna Gain (dBi)	Peak Output Power (EIRP) (dBm)	Duty Cycle Factor + Peak Output Power (EIRP) (dBm)	Max. Limit (dBm)	Result
1	2412	12.0	-1.00	11.00	11.02	≤ 30	Pass
6	2437	12.0	-1.00	11.00	11.02	≤ 30	Pass
11	2462	12.0	-1.00	11.00	11.02	≤ 30	Pass

[802.11g]

Channel	Frequency (MHz)	Peak Output Power (dBm)	Antenna Gain (dBi)	Peak Output Power (EIRP) (dBm)	Duty Cycle Factor + Peak Output Power (EIRP) (dBm)	Max. Limit (dBm)	Result
1	2412	11.8	-1.00	10.80	10.92	≤ 30	Pass
6	2437	11.8	-1.00	10.80	10.92	≤ 30	Pass
11	2462	11.7	-1.00	10.70	10.82	≤ 30	Pass

[802.11n HT20]

Channel	Frequency (MHz)	Peak Output Power (dBm)	Antenna Gain (dBi)	Peak Output Power (EIRP) (dBm)	Duty Cycle Factor + Peak Output Power (EIRP) (dBm)	Max. Limit (dBm)	Result
1	2412	11.7	-1.00	10.70	10.83	≤ 30	Pass
6	2437	11.6	-1.00	10.60	10.73	≤ 30	Pass
11	2462	11.5	-1.00	10.50	10.63	≤ 30	Pass

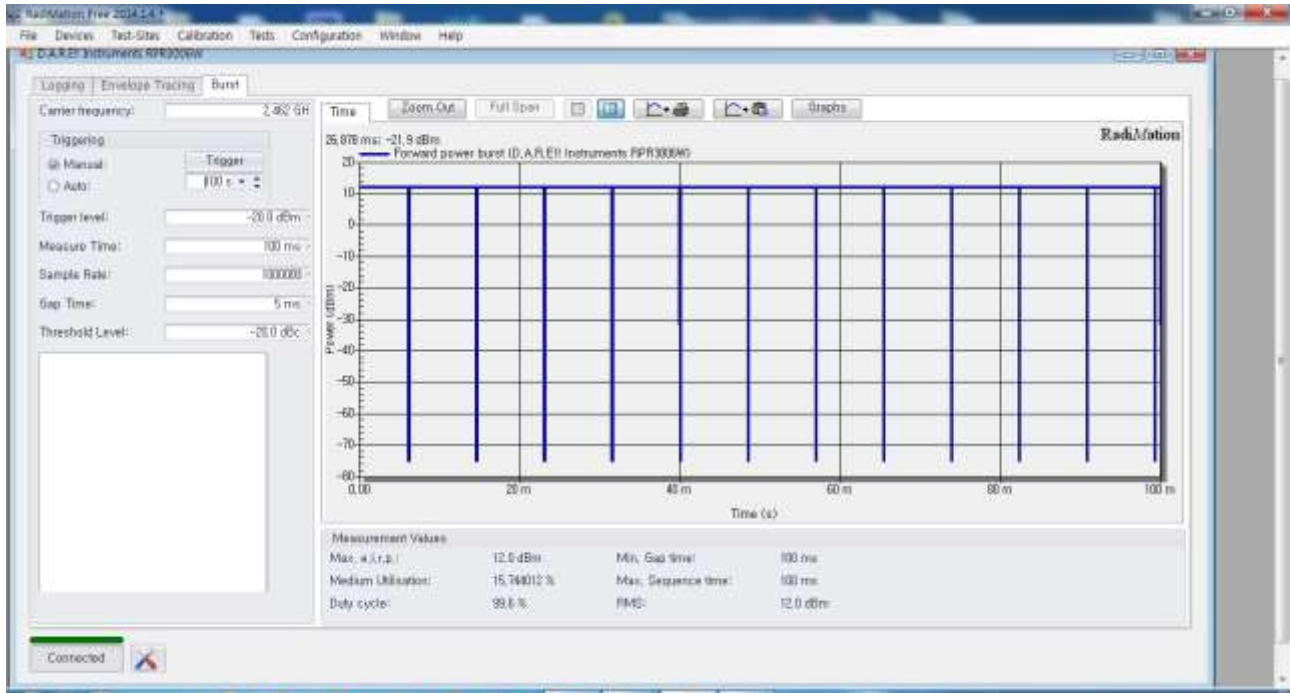
Test Mode : 802.11b 2412MHz



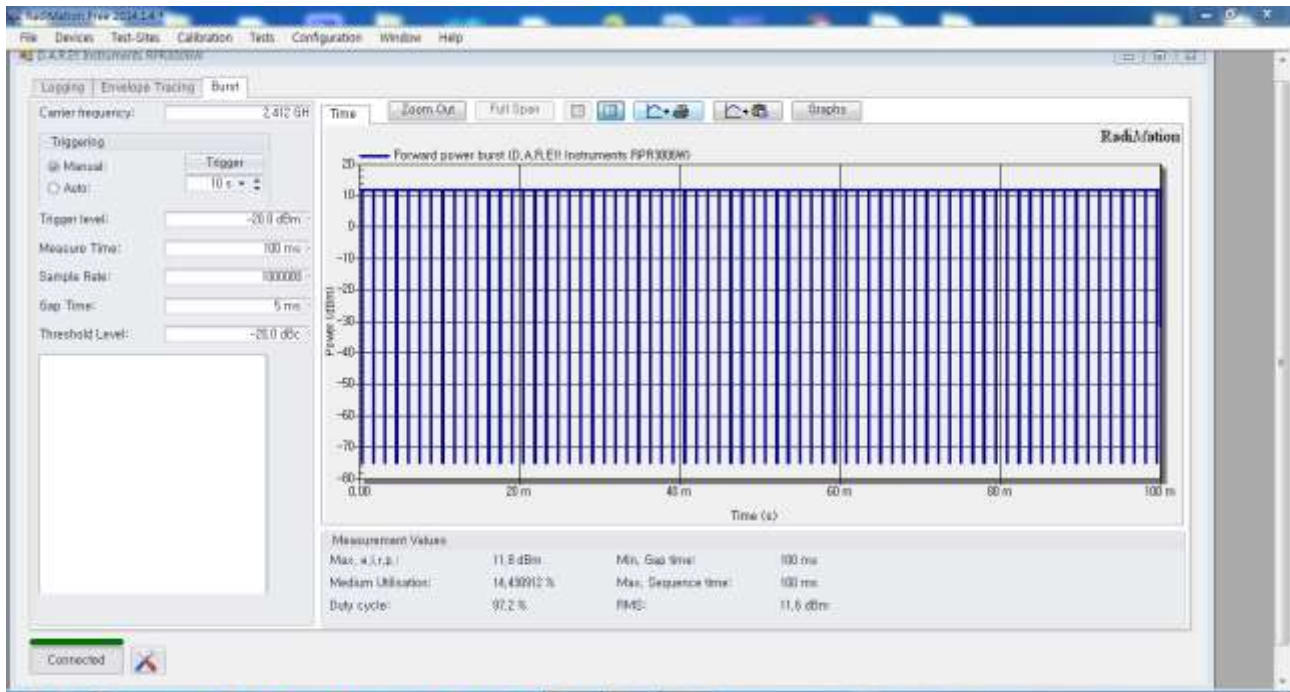
Test Mode : 802.11b 2437MHz



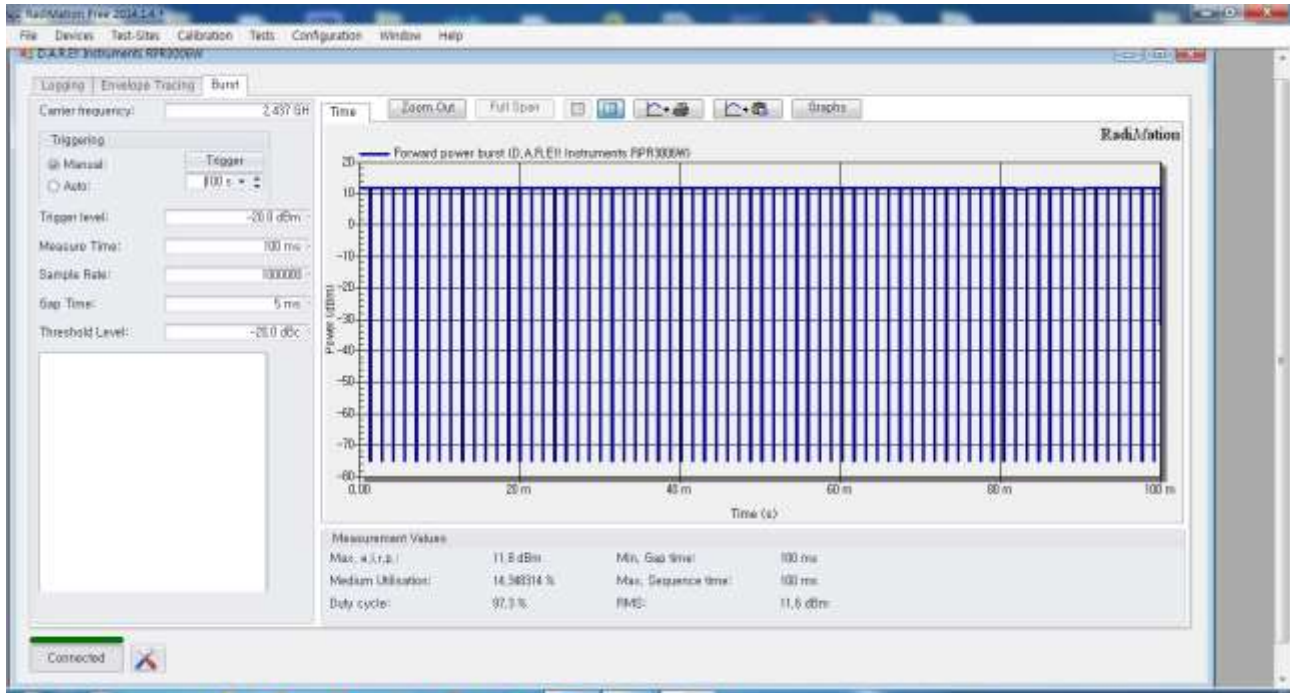
Test Mode : 802.11b 2462MHz



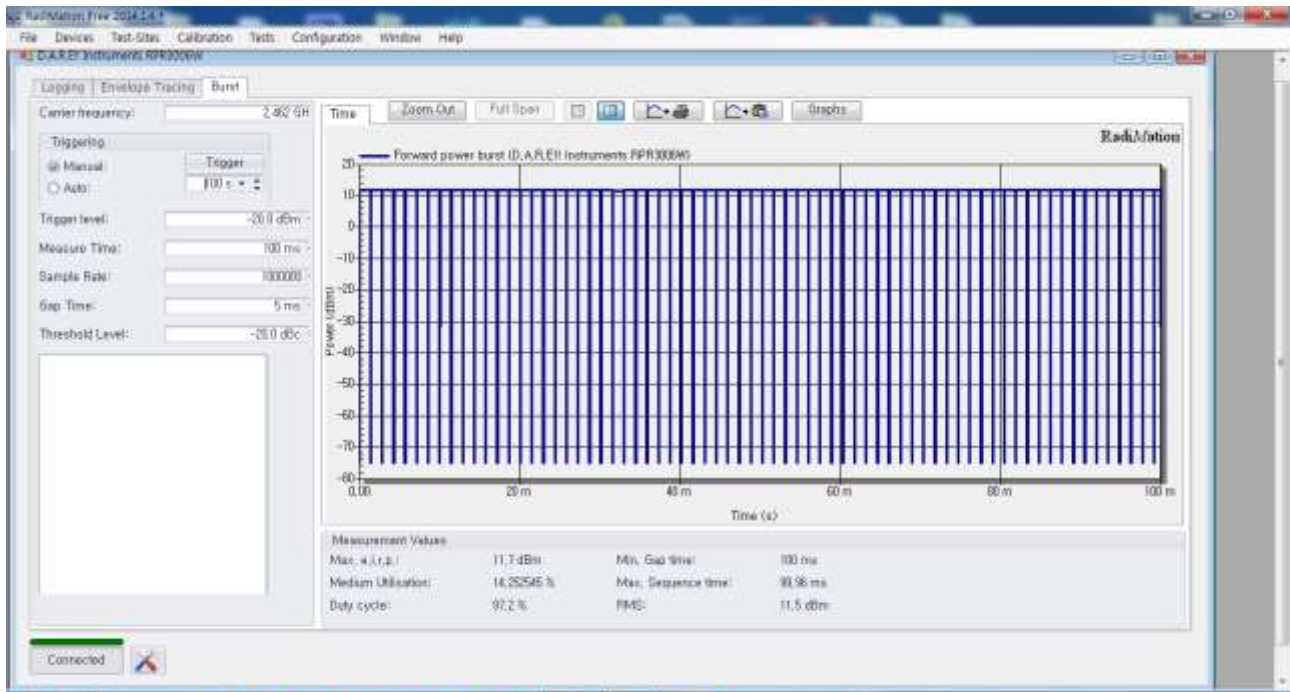
Test Mode : 802.11g 2412MHz



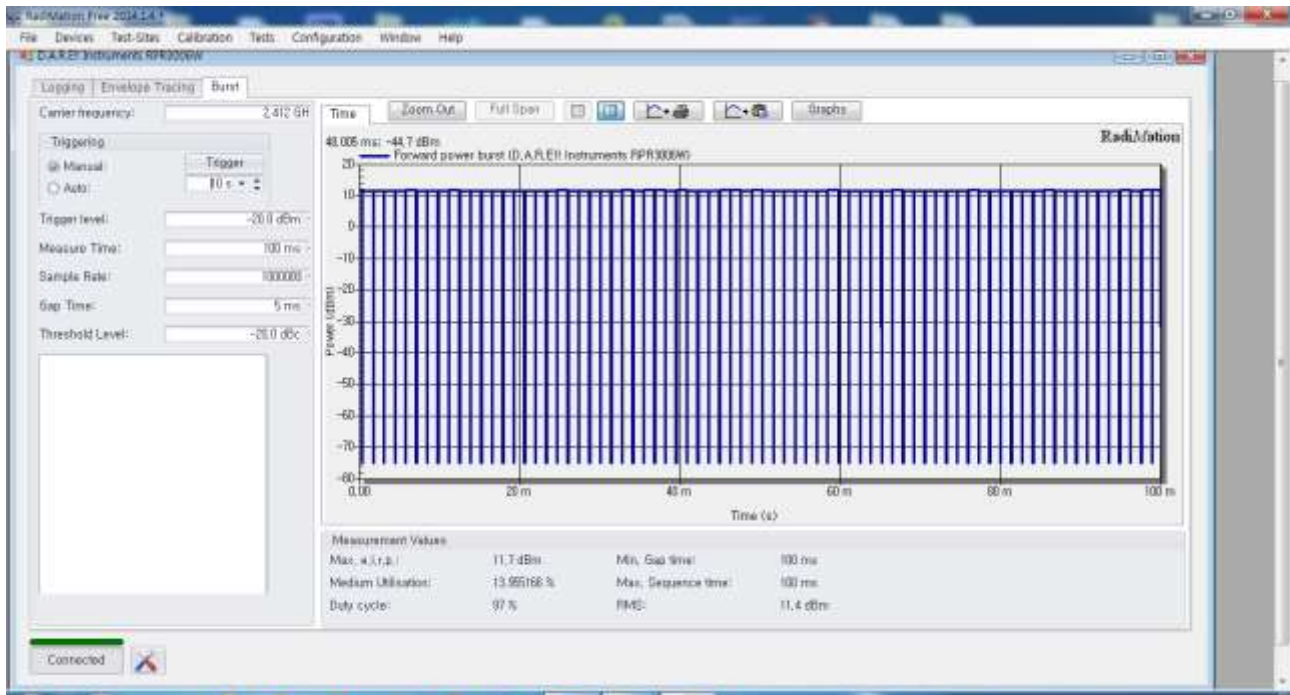
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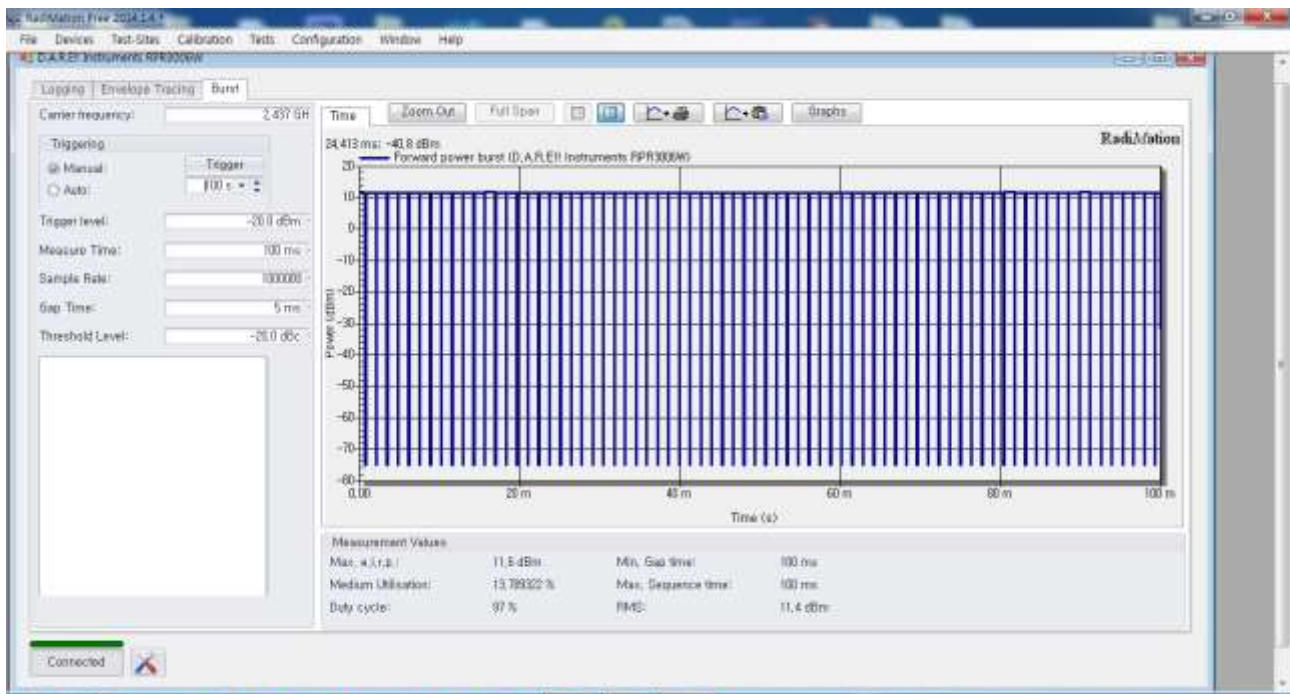
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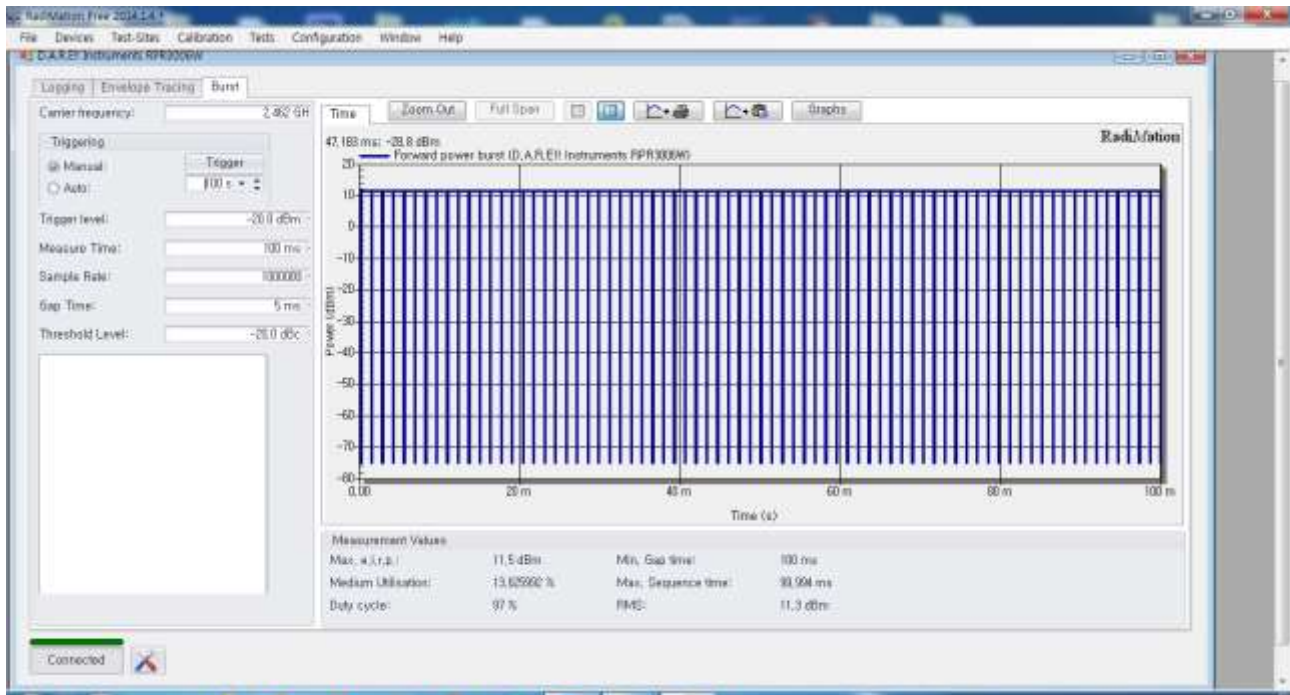
Test Mode : 802.11n20 2412MHz



Test Mode : 802.11n20 2437MHz



Test Mode : 802.11n20 2462MHz



6.2.5 Measurement Uncertainty

→ Uncertainty = ± 1.2 dB (k = 2, 95.45 %)

6.3 Power Spectral Density

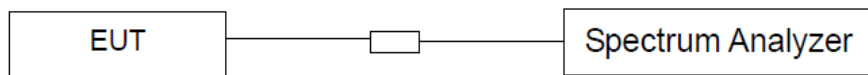
6.3.1 Test Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiated to the Antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

6.3.2 Test Procedures

1. The testing follows FCC KDB Publication No. 558074 D01 15.247 Meas. Guidance v05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set (RBW = 3 kHz, VBW = 10 kHz, Detector = Peak, Span = 1.5 times DTS Channel Bandwidth, Trace mode = Max Hold, Sweep = Auto).
5. Measure and record the results in the test report.

6.3.3 Test SET-UP (Block Diagram of Configuration)



6.3.4 Test Results

[802.11b]

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
1	2412	-6.61	≤ 8.00	Pass
6	2437	-5.93	≤ 8.00	Pass
11	2462	-6.22	≤ 8.00	Pass

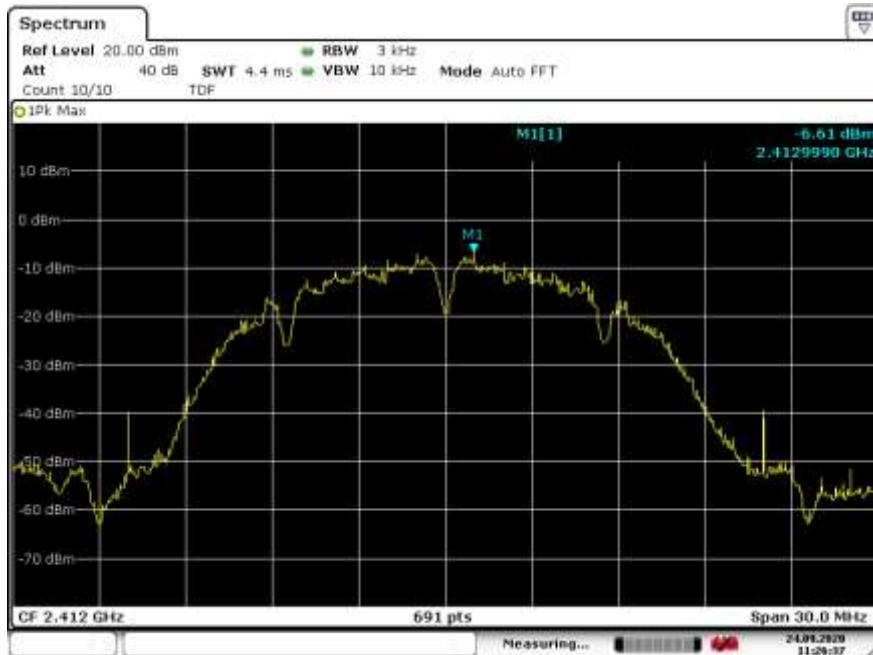
[802.11g]

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
1	2412	-10.29	≤ 8.00	Pass
6	2437	-11.18	≤ 8.00	Pass
11	2462	-10.25	≤ 8.00	Pass

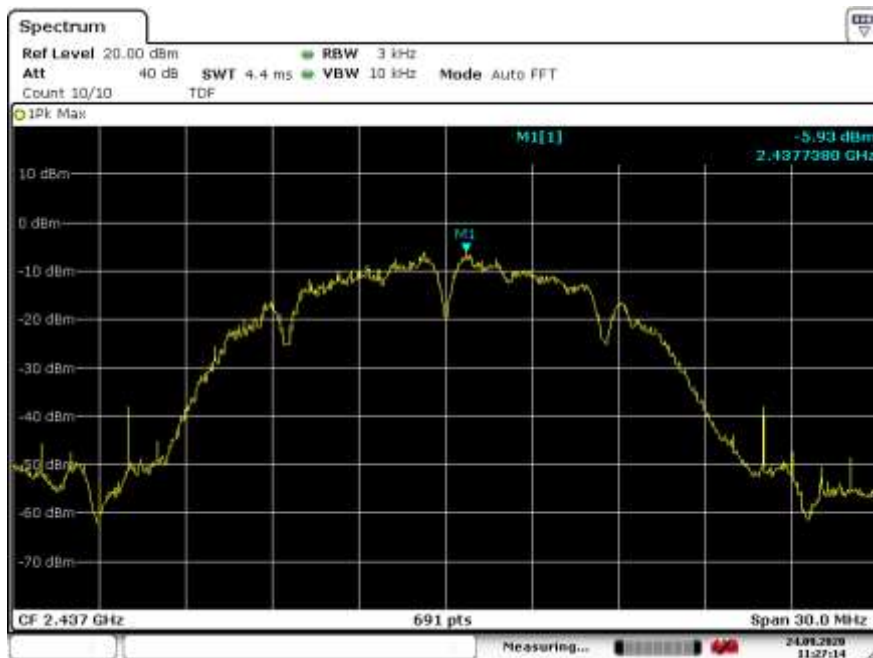
[802.11n HT20]

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
1	2412	-11.33	≤ 8.00	Pass
6	2437	-11.37	≤ 8.00	Pass
11	2462	-11.95	≤ 8.00	Pass

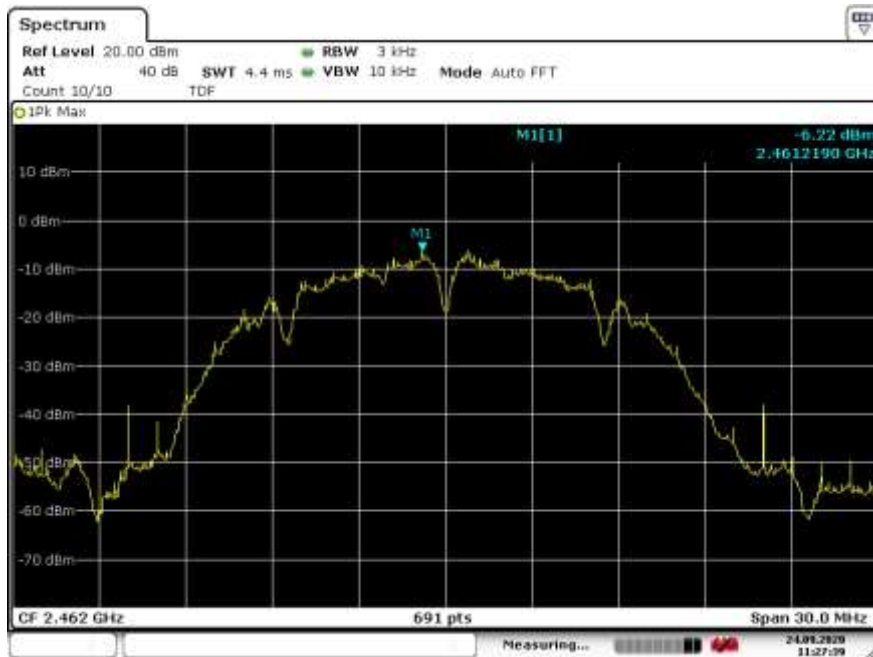
Test Mode : 802.11b 2412MHz



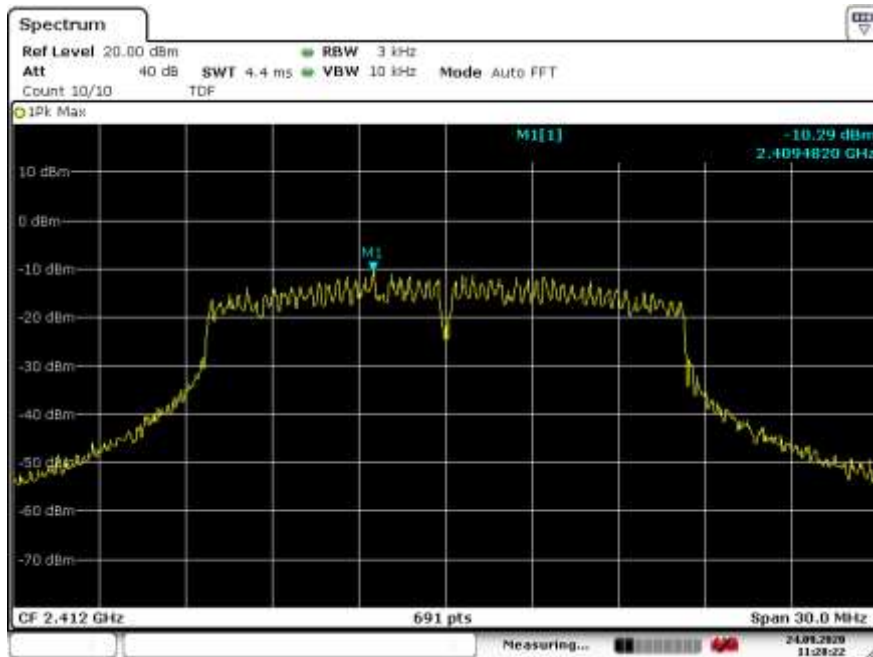
Test Mode : 802.11b 2437MHz



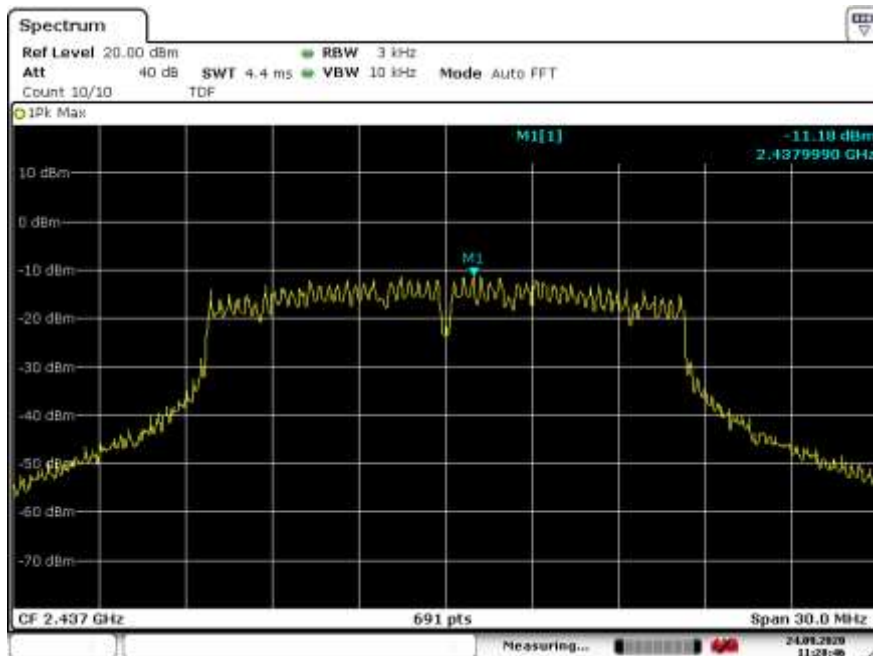
Test Mode : 802.11b 2462MHz



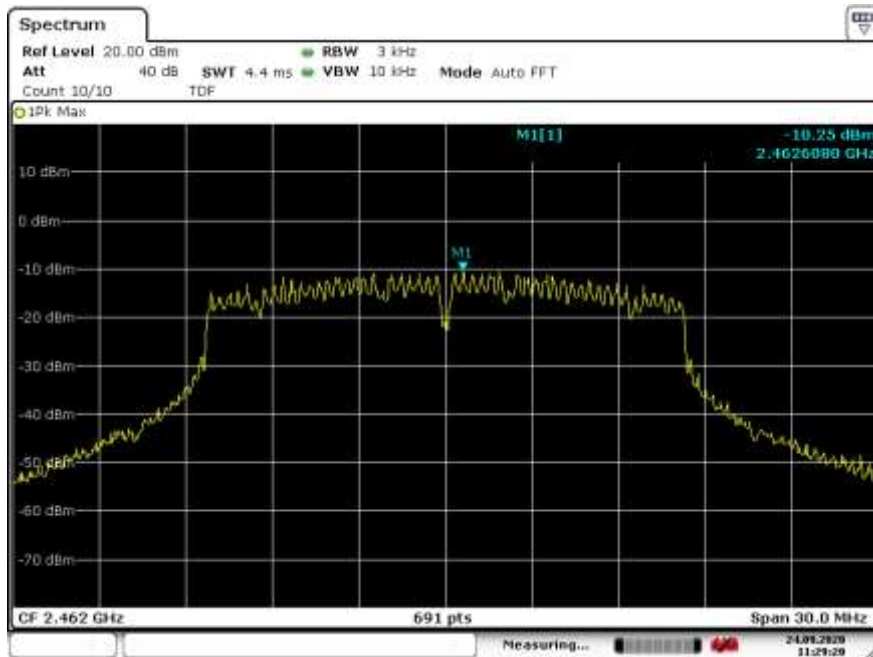
Test Mode : 802.11g 2412MHz



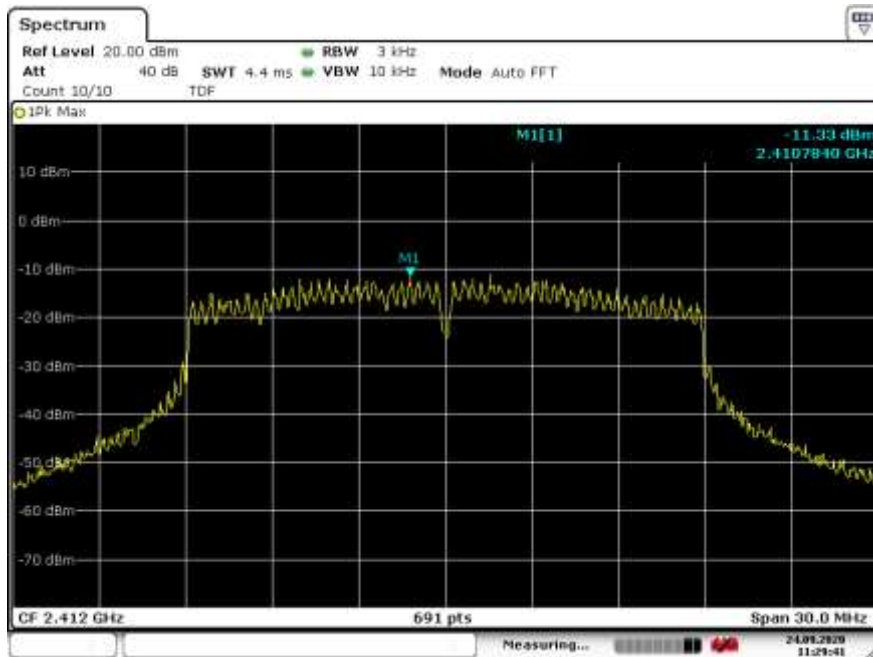
Test Mode : 802.11g 2437MHz



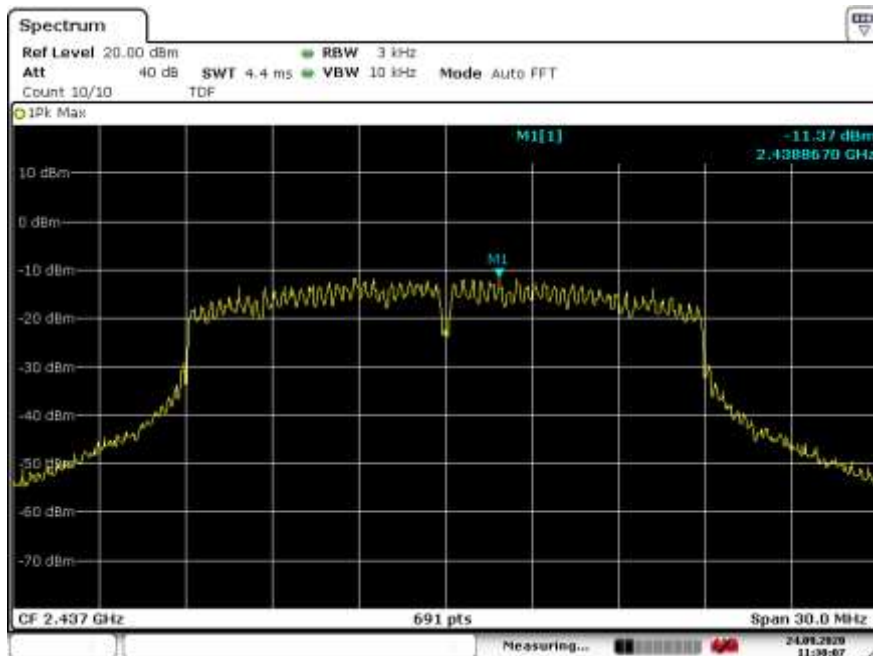
Test Mode : 802.11g 2462MHz



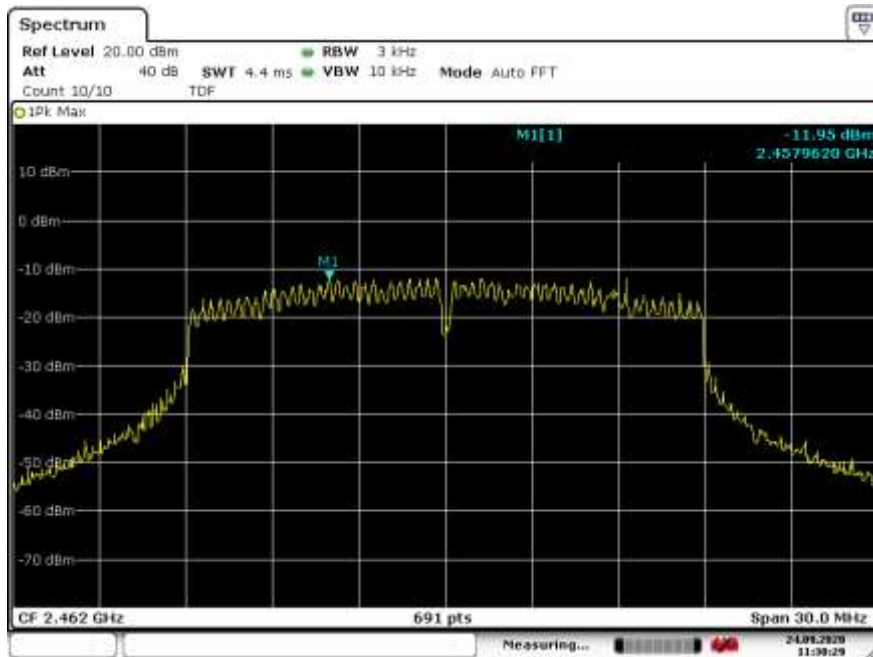
Test Mode : 802.11n HT20 2412MHz



Test Mode : 802.11n HT20 2437MHz



Test Mode : 802.11n HT20 2462MHz



6.3.5 Measurement Uncertainty

→ Uncertainty = ± 1.2 dB (k = 2, 95.45 %)

6.4 6 dB Bandwidth

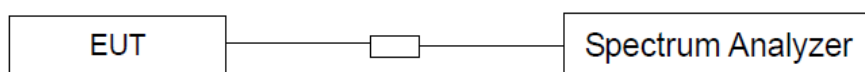
6.4.1 Test Limit

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

6.4.2 Measurement Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 15.247 Meas. Guidance v05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set (RBW = 100 kHz, VBW = 300 kHz, Detector = Peak, Trace mode = Max Hold, Sweep = Auto).
5. Measure and record the results in the test report.

6.4.3 Test SET-UP (Block Diagram of Configuration)



6.4.4 Test Results

[802.11b]

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
1	2412	3.82	≥ 0.5	Pass
6	2437	2.03	≥ 0.5	Pass
11	2462	1.80	≥ 0.5	Pass

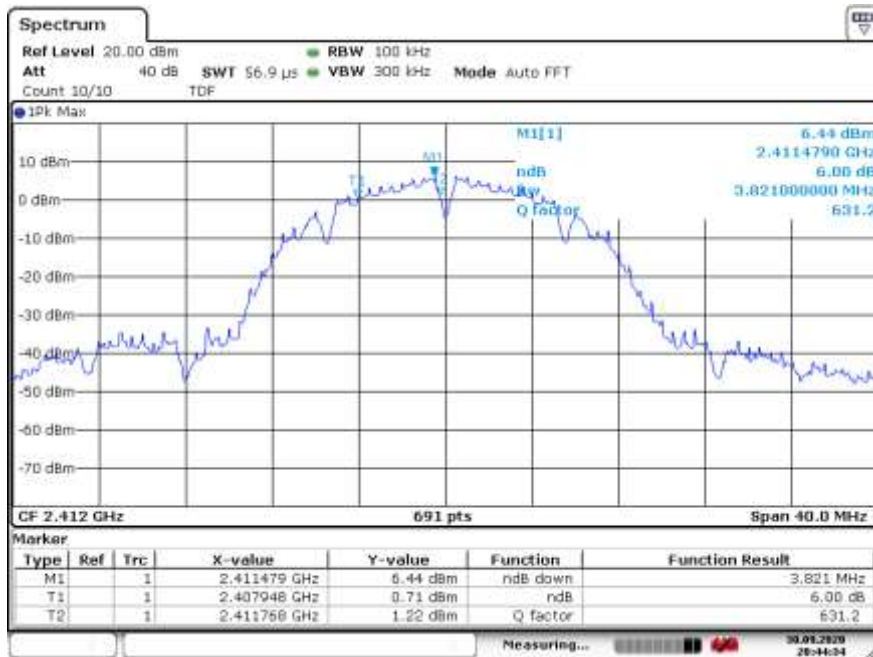
[802.11g]

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
1	2412	4.69	≥ 0.5	Pass
6	2437	3.71	≥ 0.5	Pass
11	2462	5.33	≥ 0.5	Pass

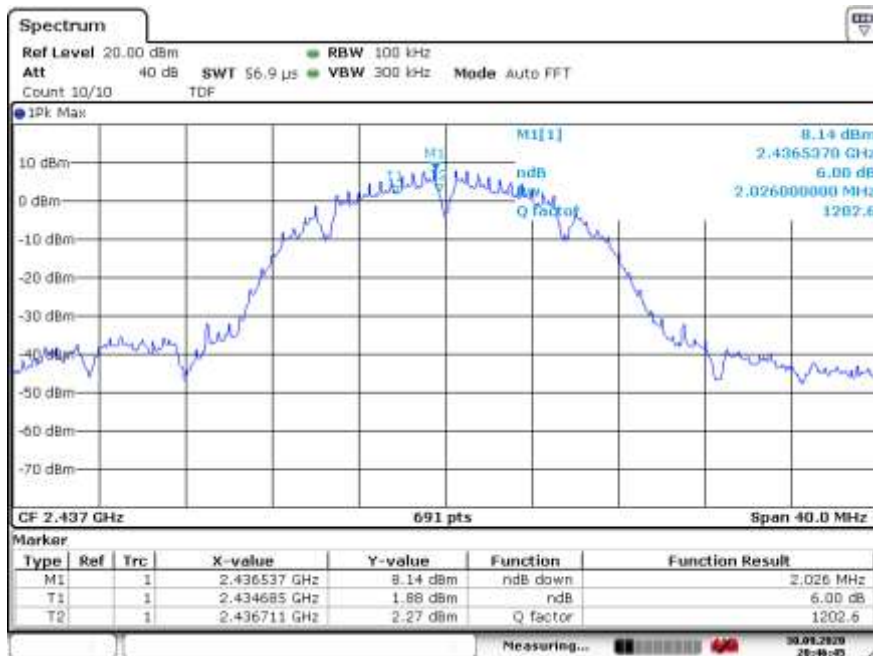
[802.11n HT20]

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
1	2412	6.19	≥ 0.5	Pass
6	2437	5.33	≥ 0.5	Pass
11	2462	4.98	≥ 0.5	Pass

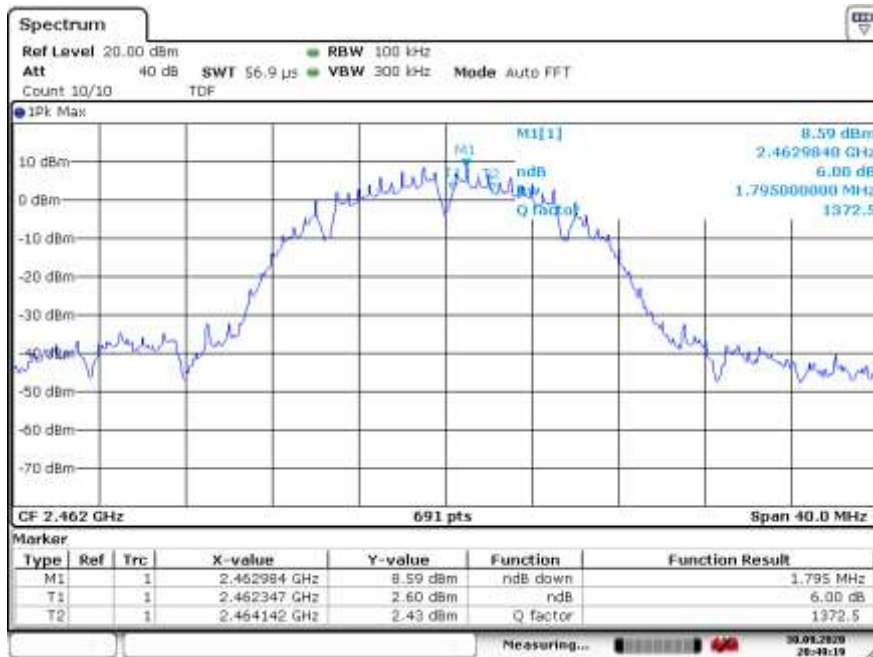
Test Mode : 802.11b 2412MHz



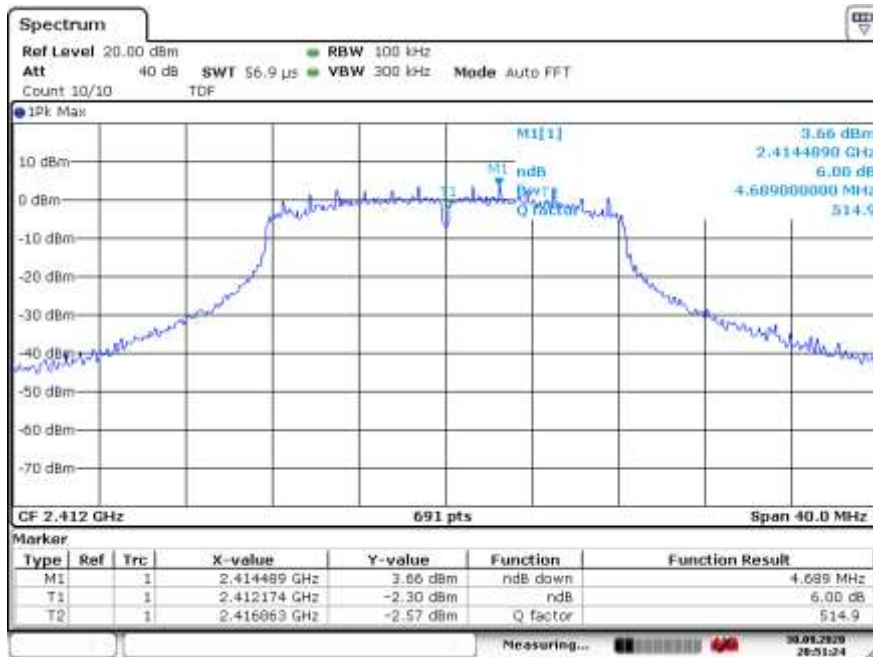
Test Mode : 802.11b 2437MHz



Test Mode : 802.11b 2462MHz



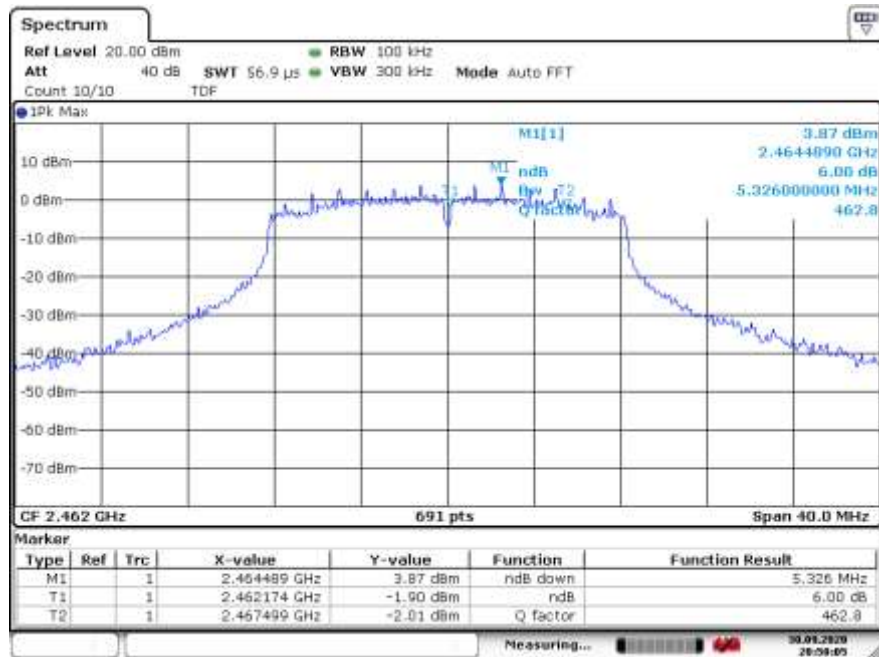
Test Mode : 802.11g 2412MHz



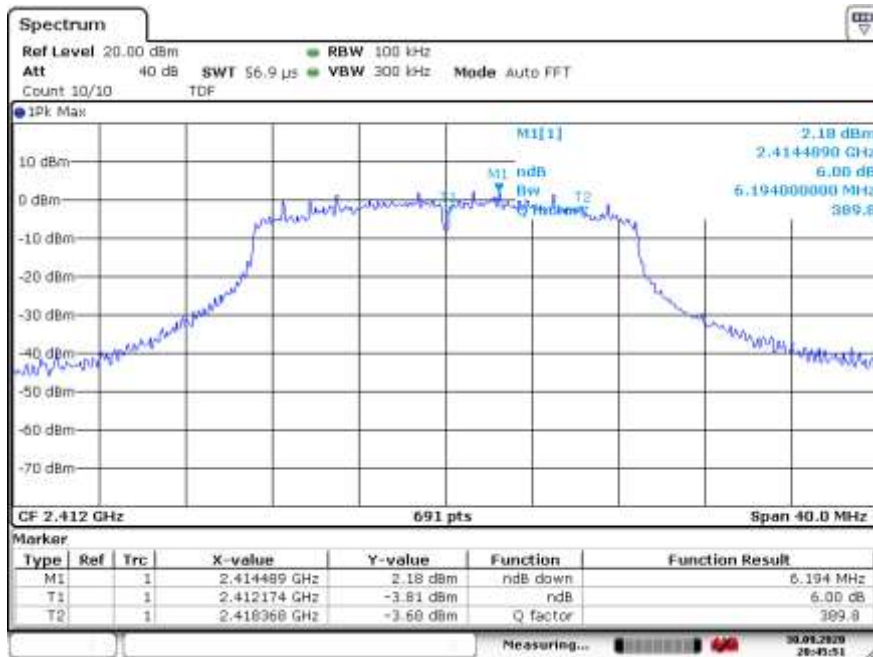
Test Mode : 802.11g 2437MHz



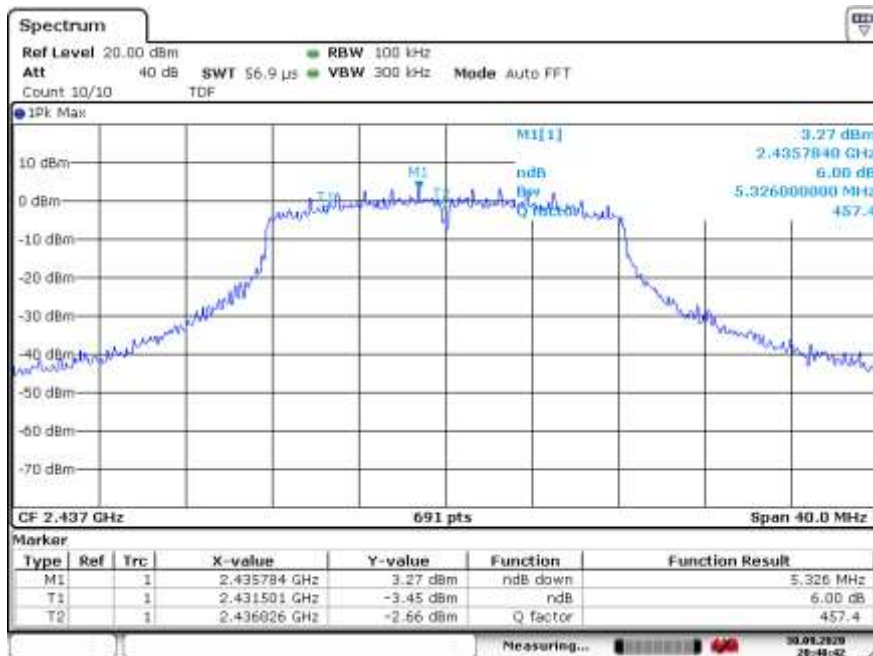
Test Mode : 802.11g 2462MHz



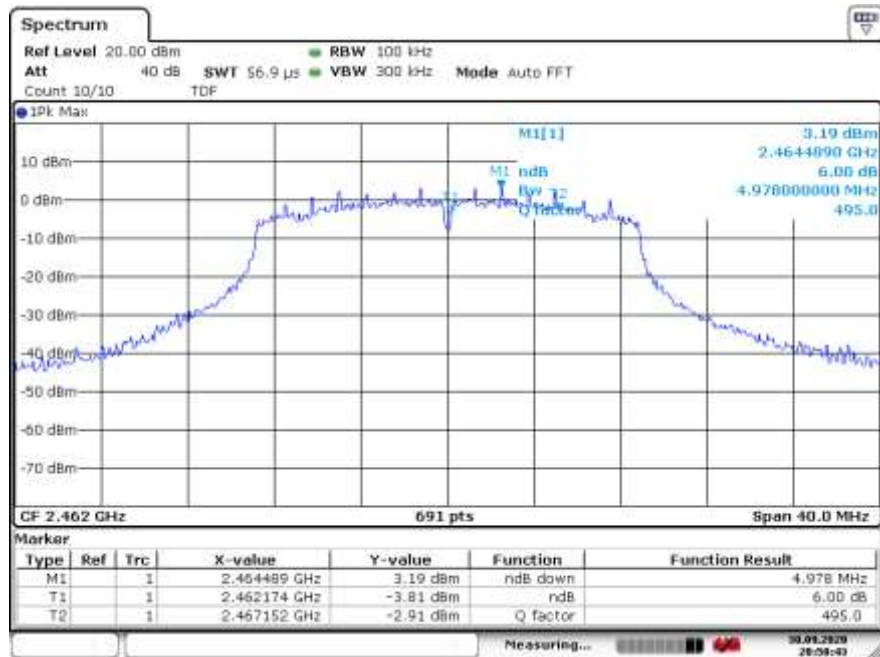
Test Mode : 802.11n HT20 2412MHz



Test Mode : 802.11n HT20 2437MHz



Test Mode : 802.11n HT20 2462MHz



6.4.5 Measurement Uncertainty

→ Uncertainty = $\pm 3.4 \%$

6.5 Conducted Spurious Emission

6.5.1 Test Limit

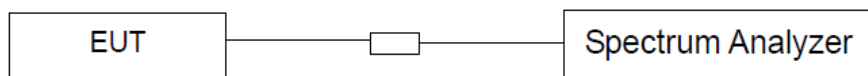
According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

6.5.2 Test Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 15.247 Meas. Guidance v05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.
The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set (RBW = 100 kHz, VBW = 300 kHz, Detector = Peak, Trace mode = Max Hold, Sweep = Auto).
5. Measure and record the results in the test report.

6.5.3 Test SET-UP (Block Diagram of Configuration)

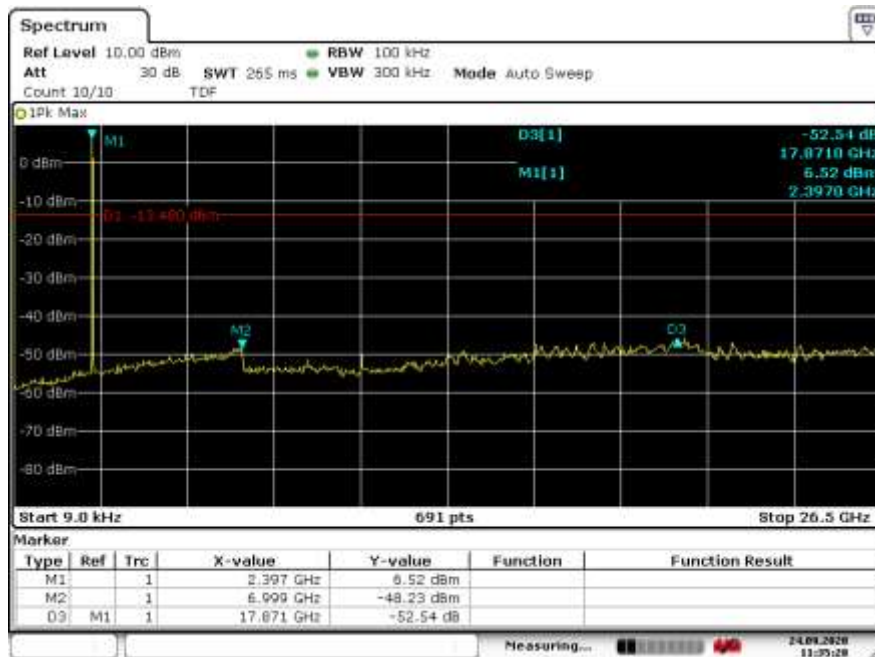
Conducted Emission Test Set-Up, Frequency above 1000 MHz



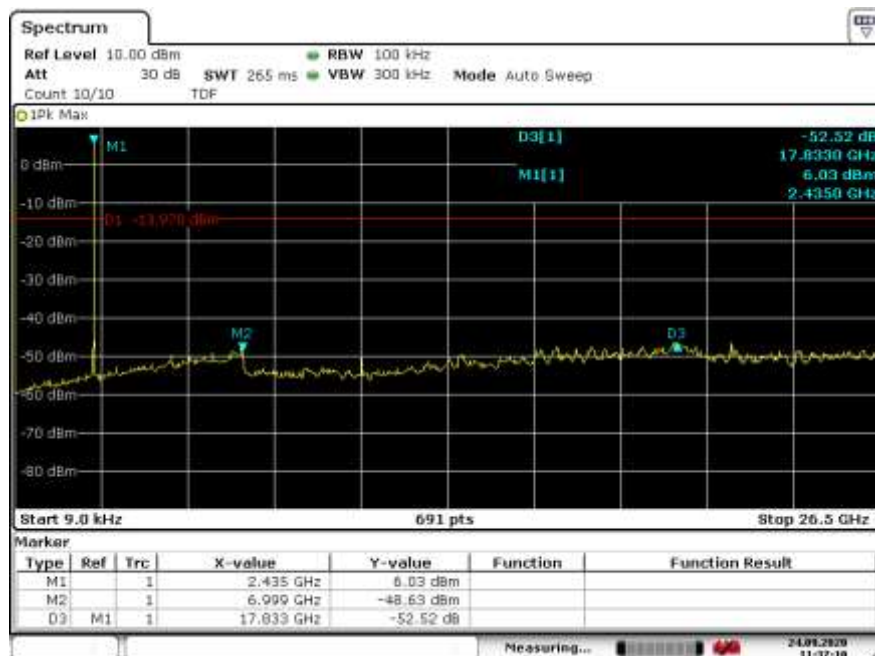
6.5.4 Test Result

[Conducted Spurious Emission Test]

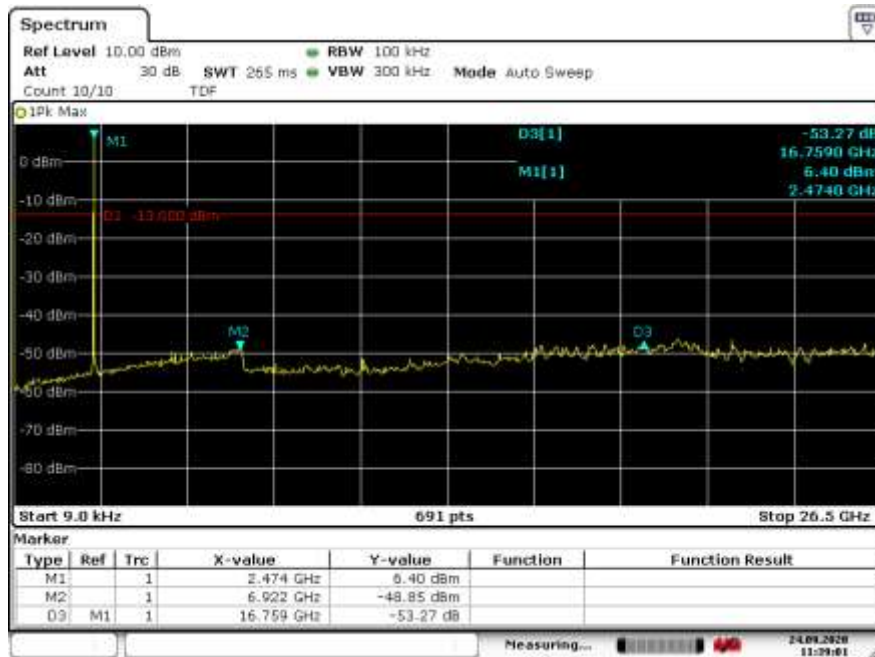
Test Mode : 802.11b 2412MHz



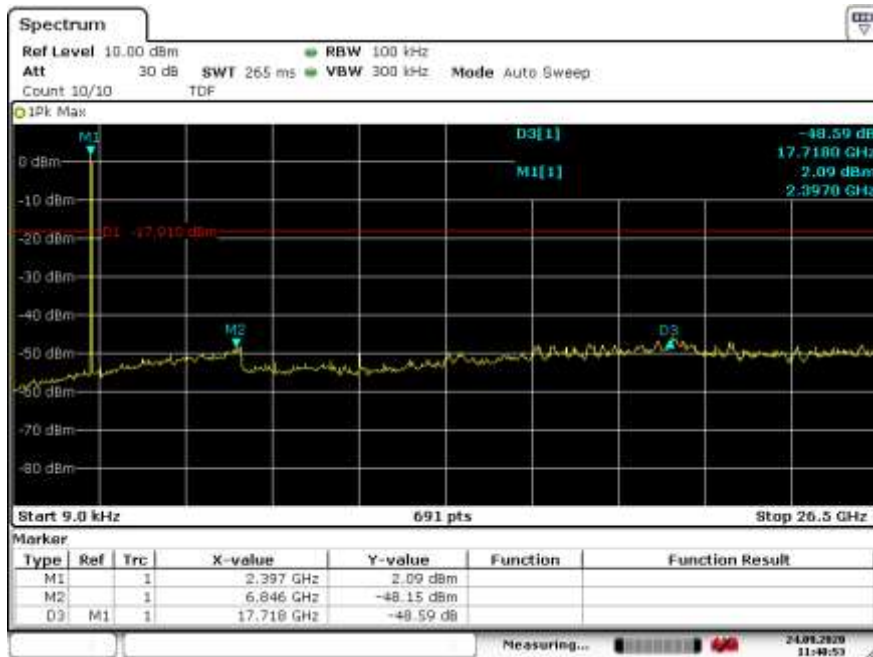
Test Mode : 802.11b 2437MHz



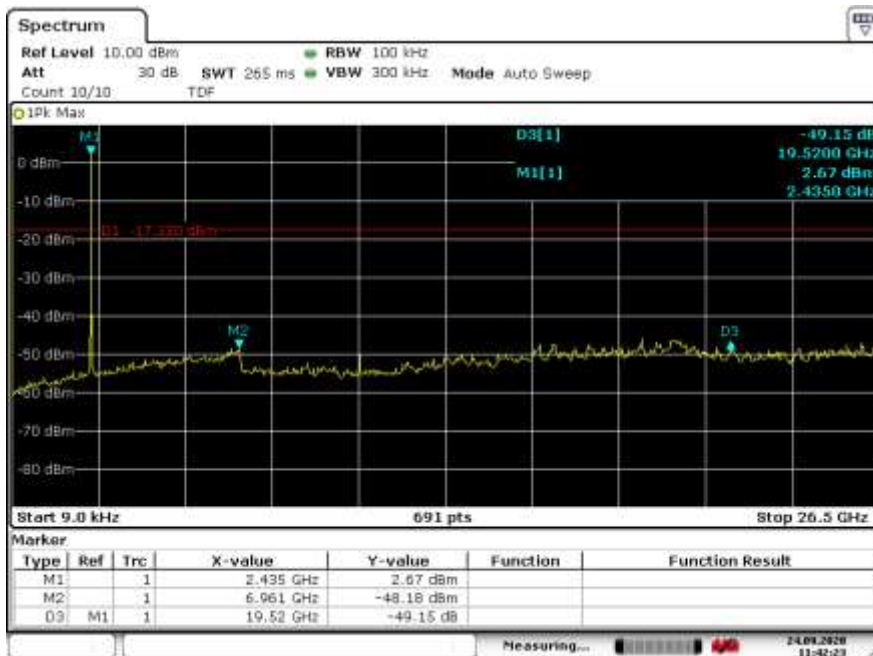
Test Mode : 802.11b 2462MHz



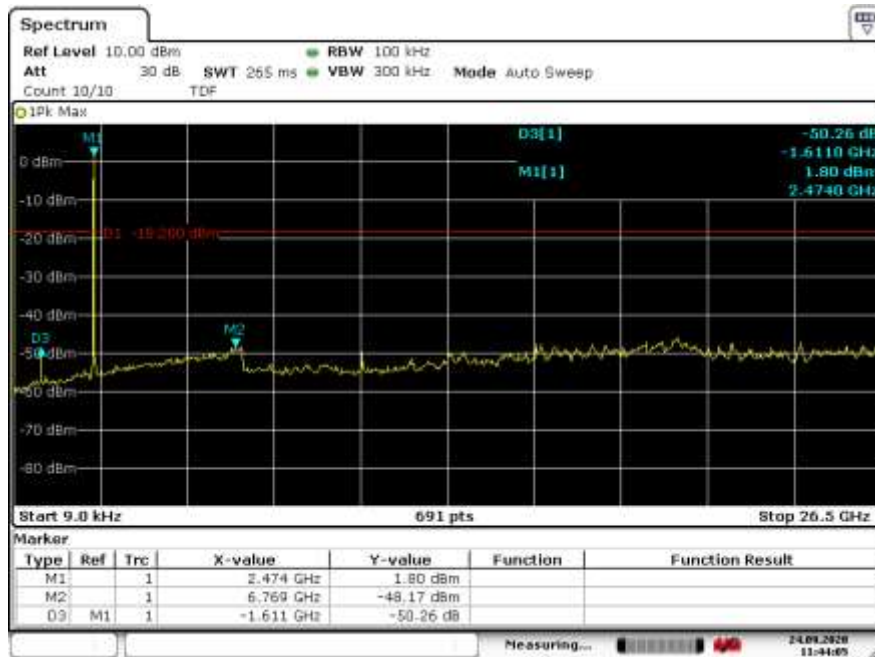
Test Mode : 802.11g 2412MHz



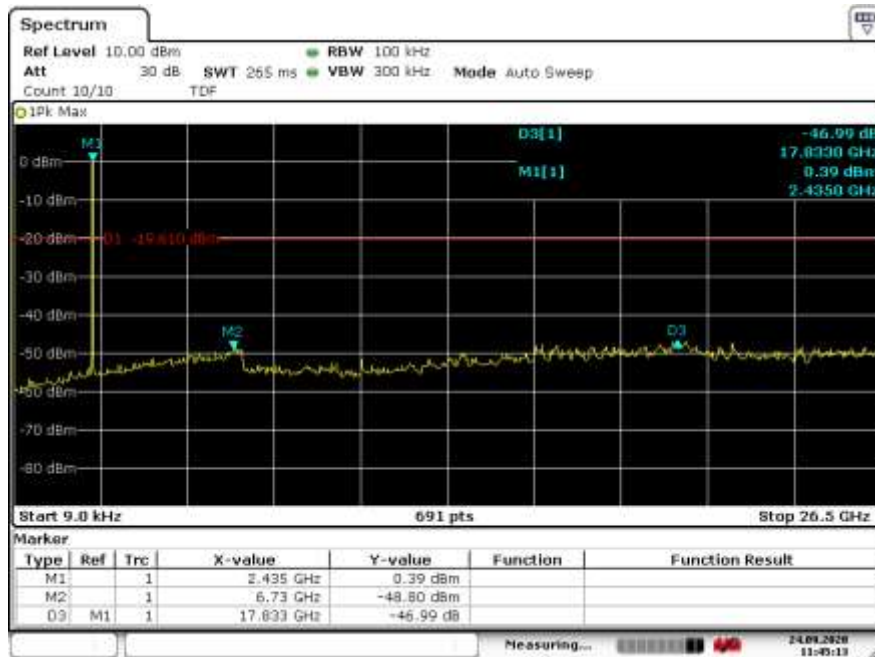
Test Mode : 802.11g 2437MHz



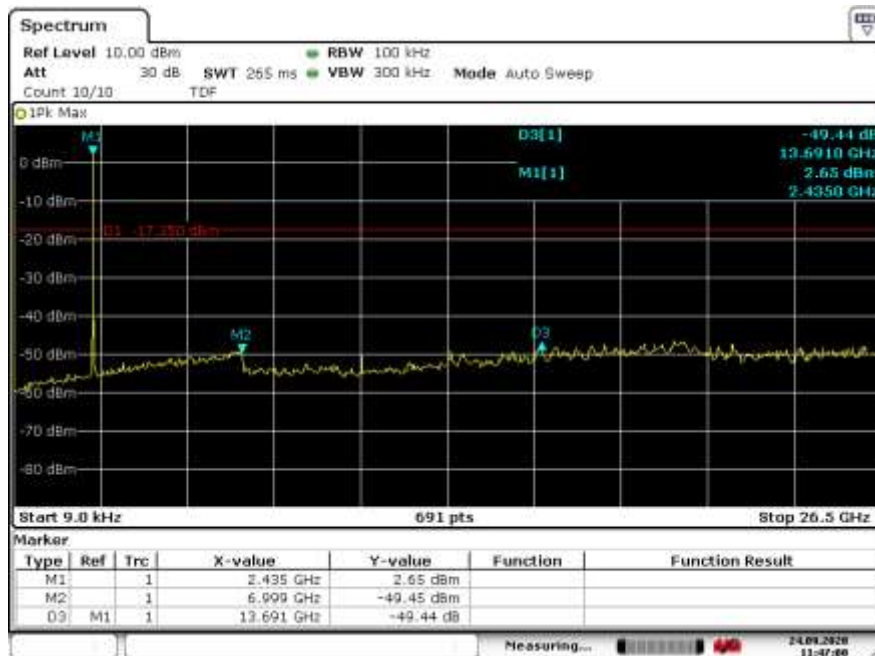
Test Mode : 802.11g 2462MHz



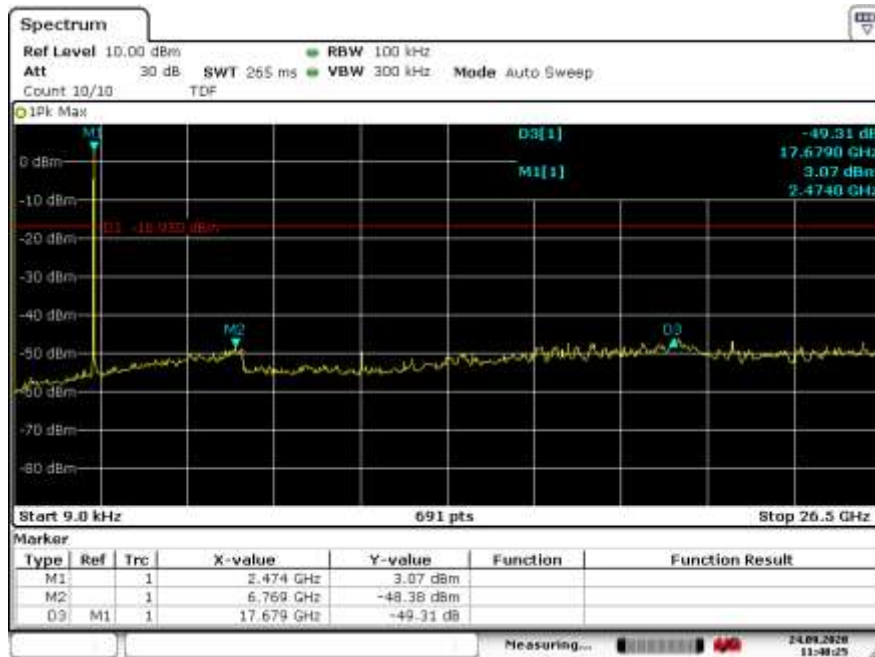
Test Mode : 802.11n HT20 2412MHz



Test Mode : 802.11n HT20 2437MHz



Test Mode : 802.11n HT20 2462MHz



6.5.5 Measurement Uncertainty

→ Uncertainty = ± 1.2 dB (k = 2, 95.45 %)

6.6 Band Edges Measurement

6.6.1 Test Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

6.6.2 Test Procedure

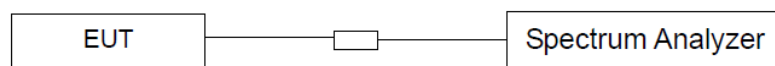
The EUT is placed on a turntable with 1.5 meter above ground.
 The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
 EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
 Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:

PEAK: RBW=VBW=100 kHz / Sweep=AUTO
 AVERAGE: RBW=100 kHz / VBW=10Hz / Sweep=AUTO

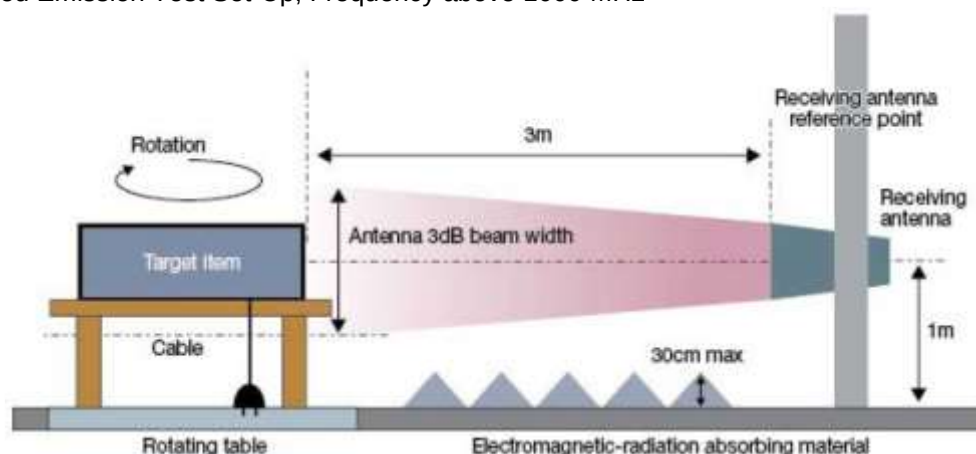
Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

6.6.3 Test SET-UP (Block Diagram of Configuration)

(a) Conducted Emission Test Set-Up, Frequency above 1000 MHz



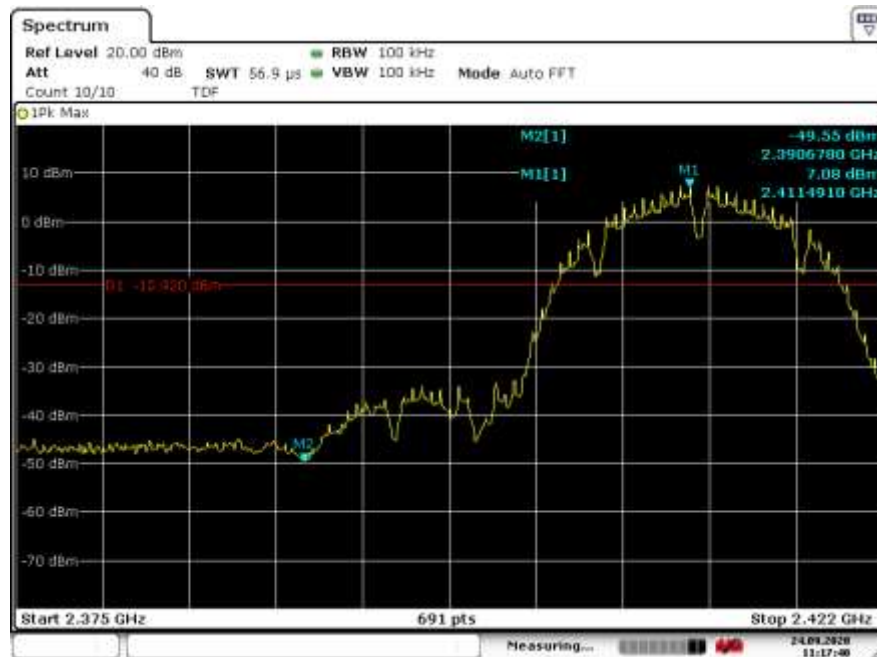
(b) Radiated Emission Test Set-Up, Frequency above 1000 MHz



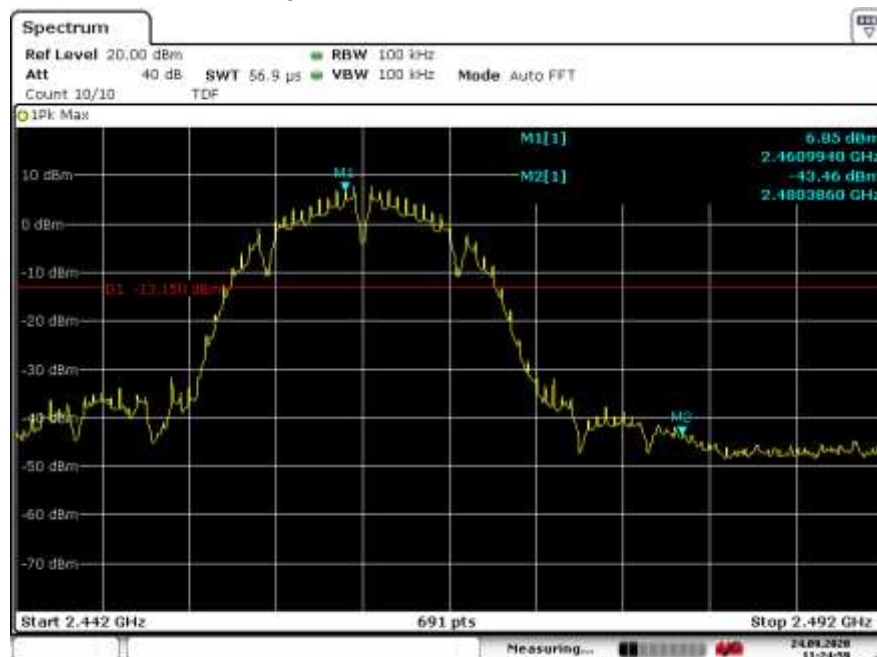
6.6.4 Test Result

[Conducted Band Edges]

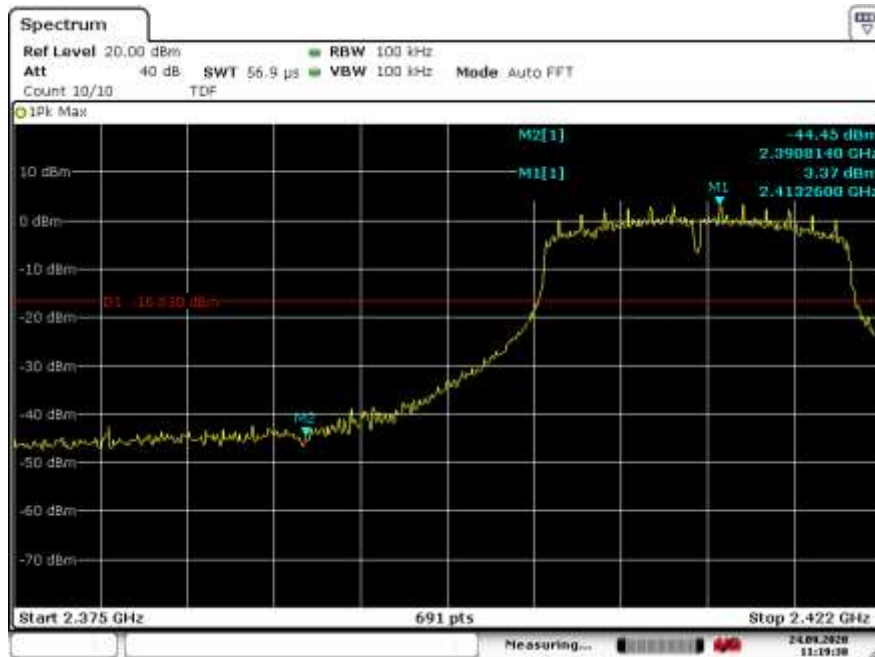
Test Mode : 802.11b 2412MHz Band Edge



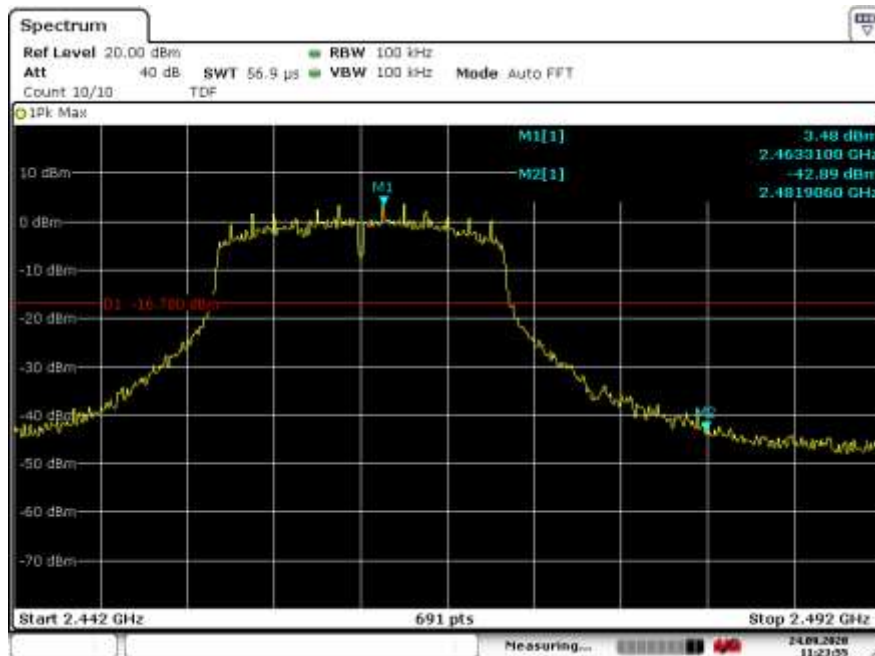
Test Mode : 802.11b 2462MHz Band Edge



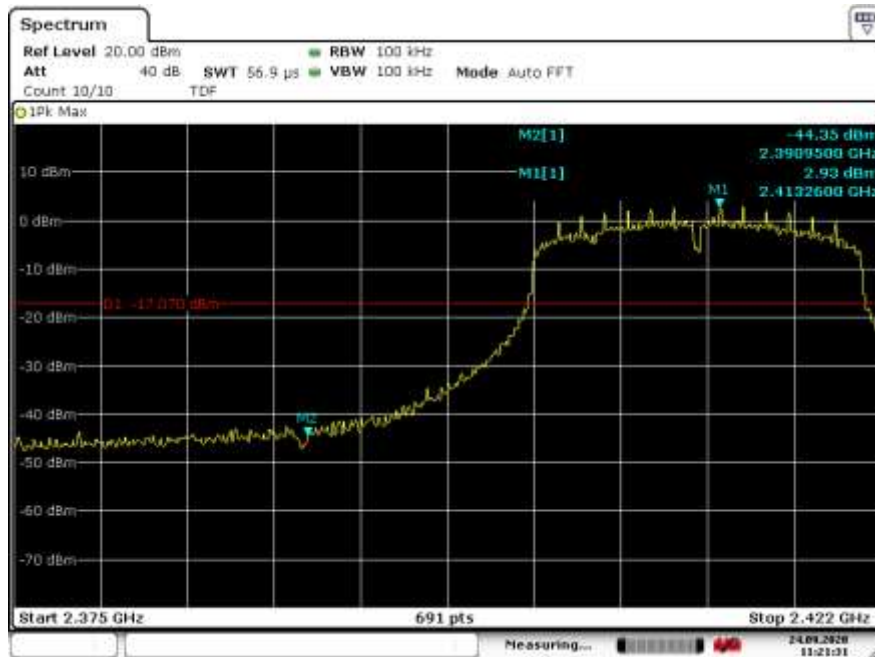
Test Mode : 802.11g 2412MHz Band Edge



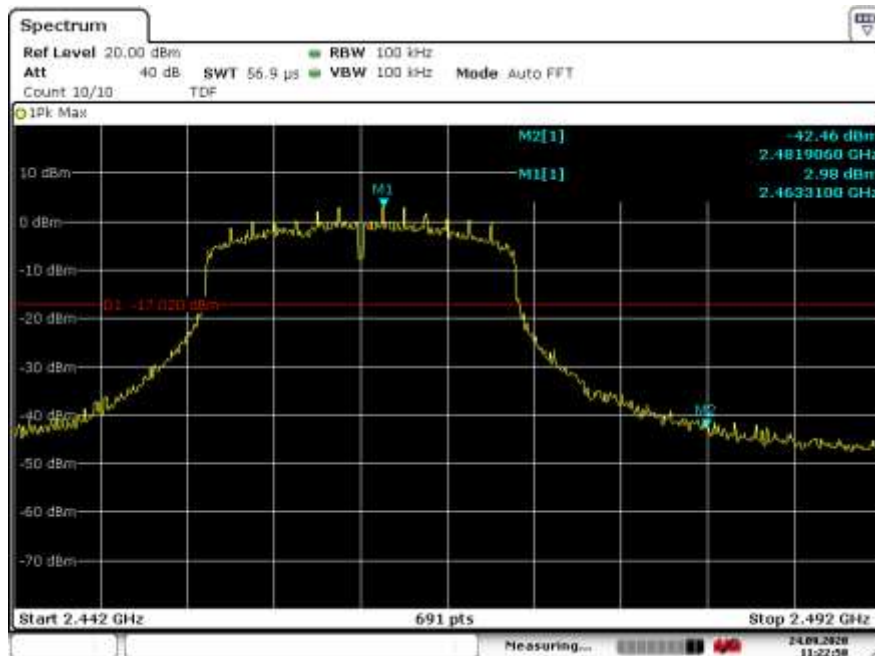
Test Mode : 802.11g 2462MHz Band Edge



Test Mode : 802.11n HT20 2412MHz Band Edge



Test Mode : 802.11n HT20 2462MHz Band Edge



[Radiated Band Edges Test]

[802.11b]

Frequency [MHz]	Reading [dB μ V]	Detector Mode	Factor [dB]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Pol/Phase
2390.04	42.98	Peak	-7.14	35.84	73.98	38.14	Hor
2390.04	47.33	Peak	-7.14	40.19	73.98	33.79	Ver
2483.50	66.72	Peak	-6.94	59.78	73.98	14.20	Hor
2483.50	61.99	Peak	-6.94	55.05	73.98	18.93	Ver

[802.11g]

Frequency [MHz]	Reading [dB μ V]	Detector Mode	Factor [dB]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Pol/Phase
2390.04	63.11	Peak	-7.14	55.97	73.98	18.01	Hor
2390.04	62.01	Peak	-7.14	54.87	73.98	19.11	Ver
2483.48	76.37	Peak	-6.94	69.43	73.98	4.55	Hor
2483.48	74.59	Peak	-6.94	67.65	73.98	6.33	Ver

[802.11n HT20]

Frequency [MHz]	Reading [dB μ V]	Detector Mode	Factor [dB]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Pol/Phase
2390.04	59.15	Peak	-7.14	52.01	73.98	21.97	Hor
2390.04	58.43	Peak	-7.14	51.29	73.98	22.69	Ver
2483.50	75.35	Peak	-6.94	68.41	73.98	5.57	Hor
2483.50	73.13	Peak	-6.94	66.19	73.98	7.79	Ver

Note : Factor = Antenna Gain + Cable loss – Amplifier Gain.

6.6.5 Measurement Uncertainty

- Conducted Uncertainty = ± 1.2 dB (k = 2, 95.45 %)
- Radiated Uncertainty = ± 2.50 dB (k = 2, 95.45 %)

6.7 Radiated Spurious Emission

6.7.1 Test Limit

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Note: Bluetooth module configuration was evaluated.

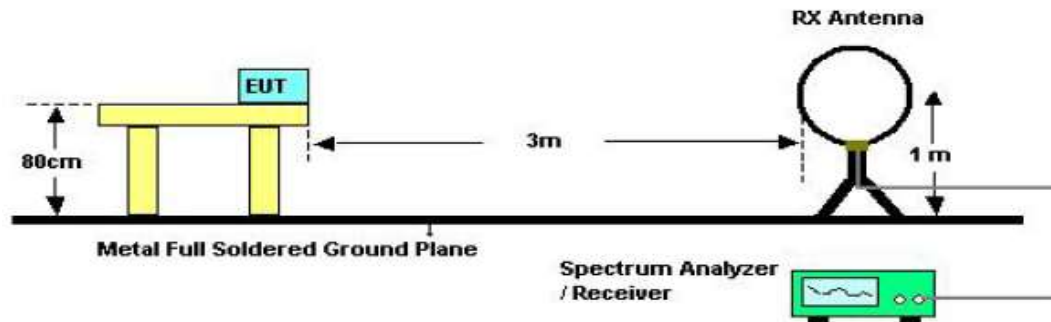
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

6.7.2 Test Procedure

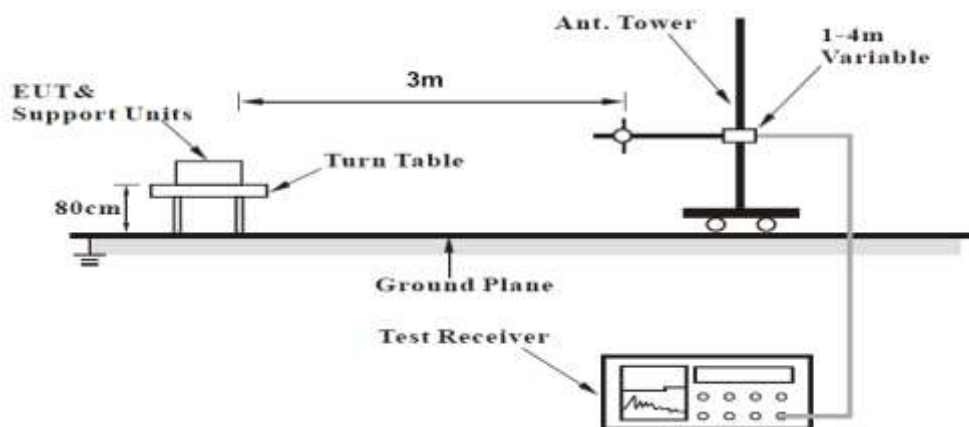
- The testing follows FCC KDB Publication No. 558074 D01 15.247 Meas. Guidance v05.
- The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
- The EUT was placed on a turntable. For emissions testing at or below 1 GHz, the table height was 80cm above the reference ground plane. For emission measurements above 1 GHz, the table height was 1.5m.
- The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.
- Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
- For measurement below 1 GHz, If the emission level of the EUT measured by the peak detector is 3 dB 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.
- Use the following spectrum analyzer settings and peak emission levels are measured :
 - Span shall wide enough to fully capture the emission being measured;
 - Set RBW (9-150 kHz: 200 Hz, 0.15-30MHz: 9kHz, 30-1000 MHz: 120 kHz, above 1GHz: 1 MHz).
 - VBW $\geq 3 \times$ RBW ; Sweep = auto; Detector function = peak; Trace = max hold
 For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
- Measure and record the results in the test report.

6.7.3 Test SET-UP (Block Diagram of Configuration)

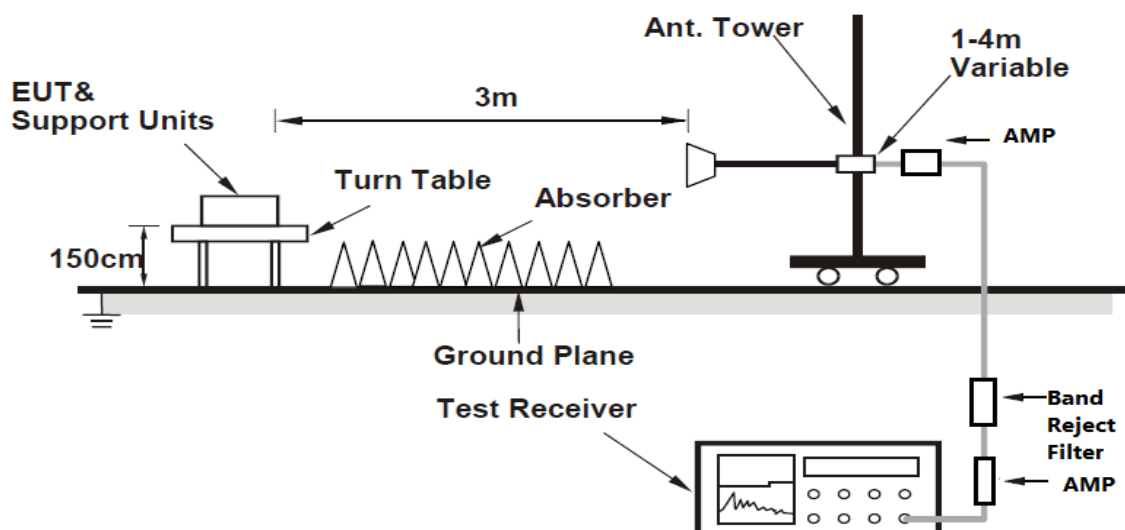
1. Radiated Emission Test Set-Up, Frequency Below 30 MHz



2. Radiated Emission Test Set-Up, Frequency Below 1000 MHz



3. Radiated Emission Test Set-Up, Frequency Above 1000 MHz.



6.7.4 Test Results

[Below 30MHz]

Frequency [MHz]	Reading [dB μ V]	Antenna Factor [dB]	Cable Loss [dB]	Preamp Factor [dB]	Level [dBuV/m]	Pol/Phase
No other emissions were detected at a level greater than 20 dB below limit.						

Remark: §15.31(o)_The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

[Below 1 GHz – 30 MHz ~ 1 GHz]

Test Mode : 802.11b (Worst case : X-H)



BWS TECH
tel:031-333-5997
fax:031-333-0017
www.bws.co.kr

Radiated Emission TEST .test

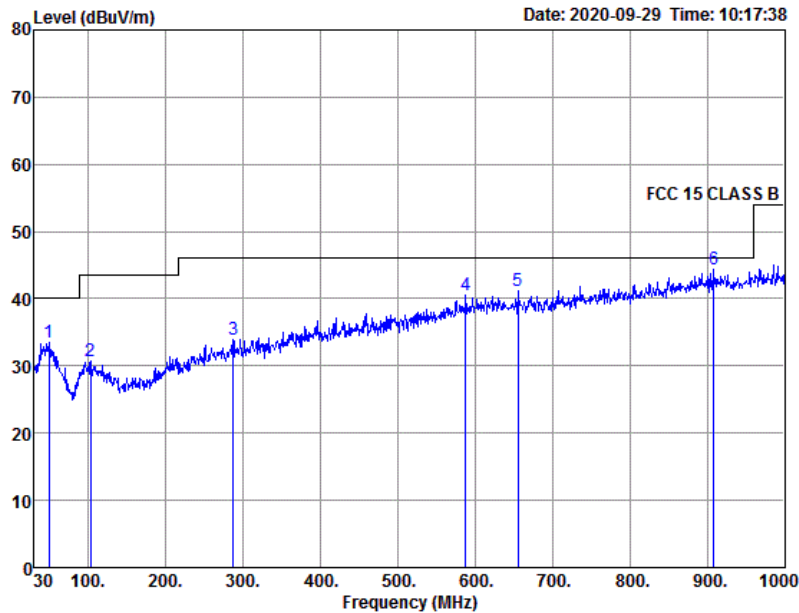
EUT:

Manufacturer: H

Operating Condition:

Data: 1 File: C:\아하정보통신.EM6 (1)

Date: 2020-09-29 Time: 10:17:38



Freq. MHz	AntFac (dB/m)	CabLoss (dB)	Reading (dBuV)	Measured (dBuV/m)	Over (dBuV/m)	Limit (dBuV/m)	Pol/Phase	Remark
49.400	19.86	0.36	13.25	33.47	-6.53	40.00	HORIZONTAL	Peak
102.750	17.35	0.54	12.83	30.72	-12.78	43.50	HORIZONTAL	Peak
287.050	19.36	0.90	13.73	33.99	-12.01	46.00	HORIZONTAL	Peak
587.750	25.31	1.34	13.79	40.44	-5.56	46.00	HORIZONTAL	Peak
655.650	25.70	1.40	14.08	41.18	-4.82	46.00	HORIZONTAL	Peak
908.820	28.52	1.66	14.28	44.46	-1.54	46.00	HORIZONTAL	Peak

Note: 1. Measured Level = Antenna Factor + Cable Loss - Preamp + Reading

Review:

Note : Only the worst case plots for Radiated Spurious Emissions.

Test Mode : 802.11g (Worst case : X-H)

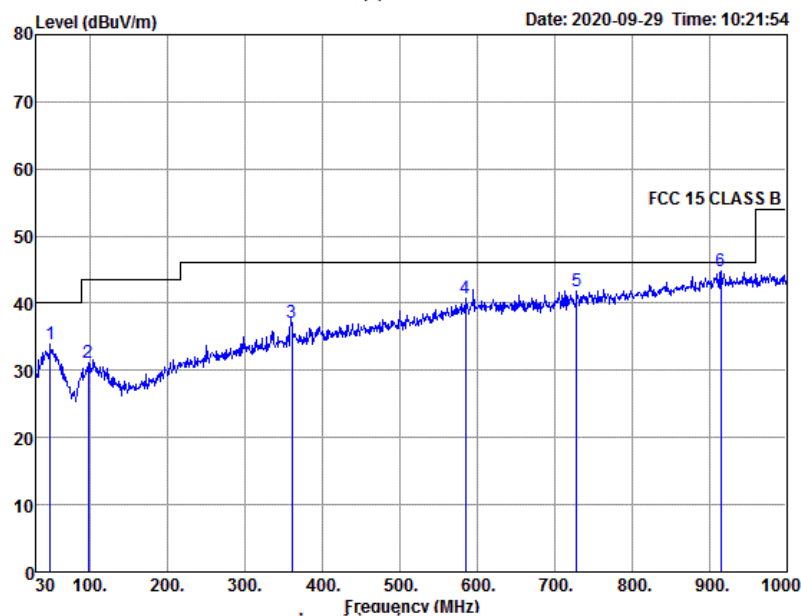


BWS TECH
tel:031-333-5997
fax:031-333-0017
www.bws.co.kr

Radiated Emission TEST .test

EUT:
Manufacturer: H
Operating Condition:

Data: 2 File: C:\아하정보통신.EM6 (2)



Freq. MHz	AntFac (dB/m)	CabLoss (dB)	Reading (dBuV)	Measured (dBuV/m)	Over (dBuV/m)	Limit (dBuV/m)	Pol/Phase	Remark
48.430	19.84	0.35	13.83	34.02	-5.98	40.00	HORIZONTAL	Peak
96.930	17.13	0.59	13.48	31.20	-12.30	43.50	HORIZONTAL	Peak
360.770	20.94	1.03	15.15	37.12	-8.88	46.00	HORIZONTAL	Peak
584.840	25.24	1.34	14.17	40.75	-5.25	46.00	HORIZONTAL	Peak
728.400	26.15	1.47	14.15	41.77	-4.23	46.00	HORIZONTAL	Peak
915.610	28.54	1.68	14.68	44.90	-1.10	46.00	HORIZONTAL	Peak

Note: 1. Measured Level = Antenna Factor + Cable Loss - Preamp + Reading

Review:

Note : Only the worst case plots for Radiated Spurious Emissions.

Test Mode : 802.11n(HT20) (Worst case : X-H)



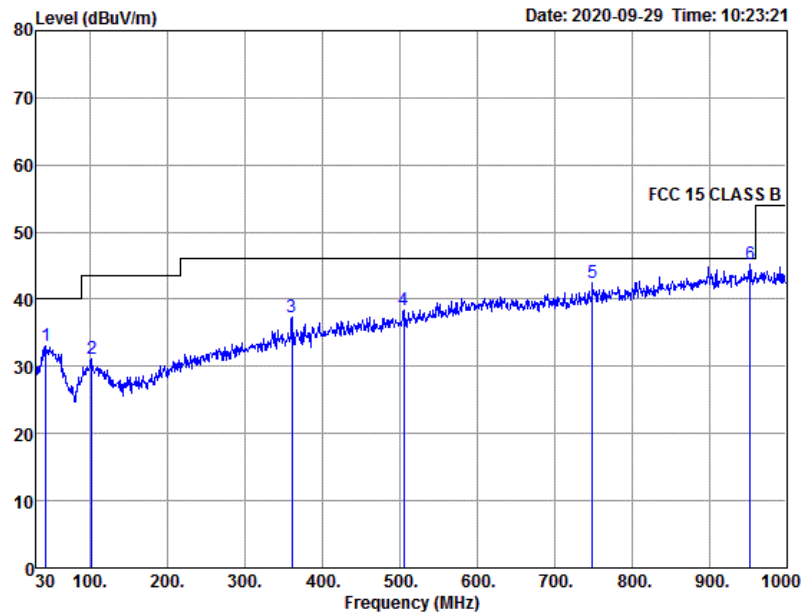
BWS TECH
tel:031-333-5997
fax:031-333-0017
www.bws.co.kr

Radiated Emission TEST ..test

EUT:
Manufacturer: H
Operating Condition:

Data: 3 File: C:\아하정보통신\EM6 (3)

Date: 2020-09-29 Time: 10:23:21



Freq. MHz	AntFac (dB/m)	CabLoss (dB)	Reading (dBuV)	Measured (dBuV/m)	Over (dBuV/m)	Limit (dBuV/m)	Pol/Phase	Remark
42.610	19.40	0.32	13.27	32.99	-7.01	40.00	HORIZONTAL	Peak
101.780	17.42	0.53	13.12	31.07	-12.43	43.50	HORIZONTAL	Peak
360.770	20.94	1.03	15.35	37.32	-8.68	46.00	HORIZONTAL	Peak
505.300	23.40	1.27	13.74	38.41	-7.59	46.00	HORIZONTAL	Peak
748.770	26.41	1.49	14.57	42.47	-3.53	46.00	HORIZONTAL	Peak
953.440	28.62	1.76	14.84	45.22	-0.78	46.00	HORIZONTAL	Peak

Note: 1. Measured Level = Antenna Factor + Cable Loss - Preamp + Reading

Review:

Note : Only the worst case plots for Radiated Spurious Emissions.

[Above 1 GHz – 1 GHz ~ 18 GHz]

Test Mode : 802.11b (Worst case : X-H)



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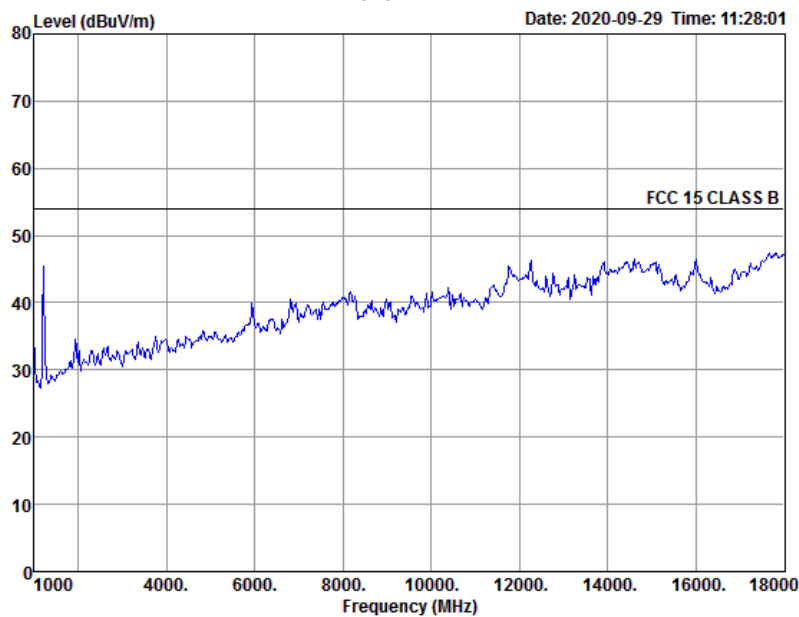
Radiated Emission TEST .test

EUT:

Manufacturer: H

Operating Condition:

Data: 13 File: C:\아하정보통신.EM6 (13)



Review:

Note : 1) Only the worst case plots for Radiated Spurious Emissions.
2) A filter was used for this test.

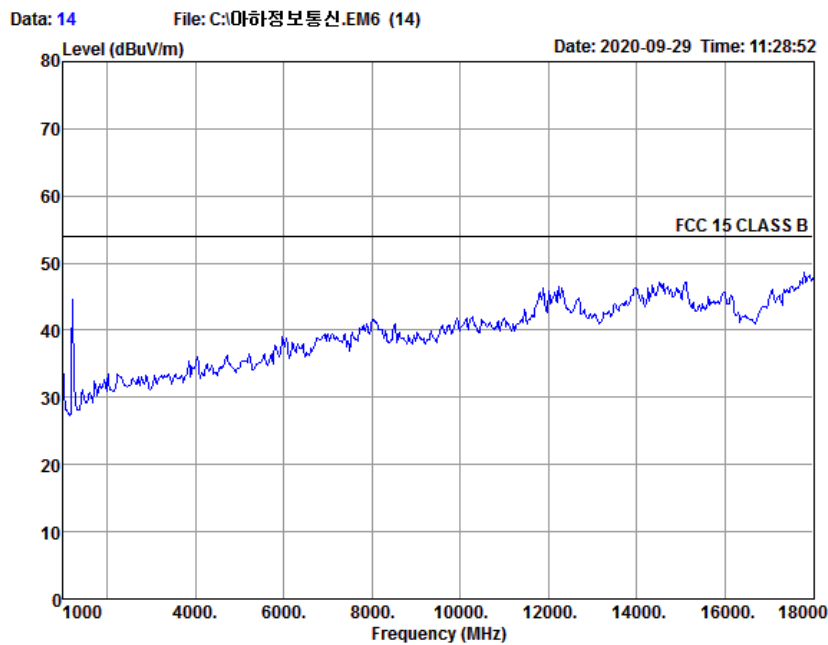
Test Mode : 802.11g (Worst case : X-H)



BWS TECH
tel:031-333-5997
fax:031-333-0017
www.bws.co.kr

Radiated Emission TEST ..test

EUT:
Manufacturer: H
Operating Condition:



Review: _____

Note : 1) Only the worst case plots for Radiated Spurious Emissions.
2) A filter was used for this test.

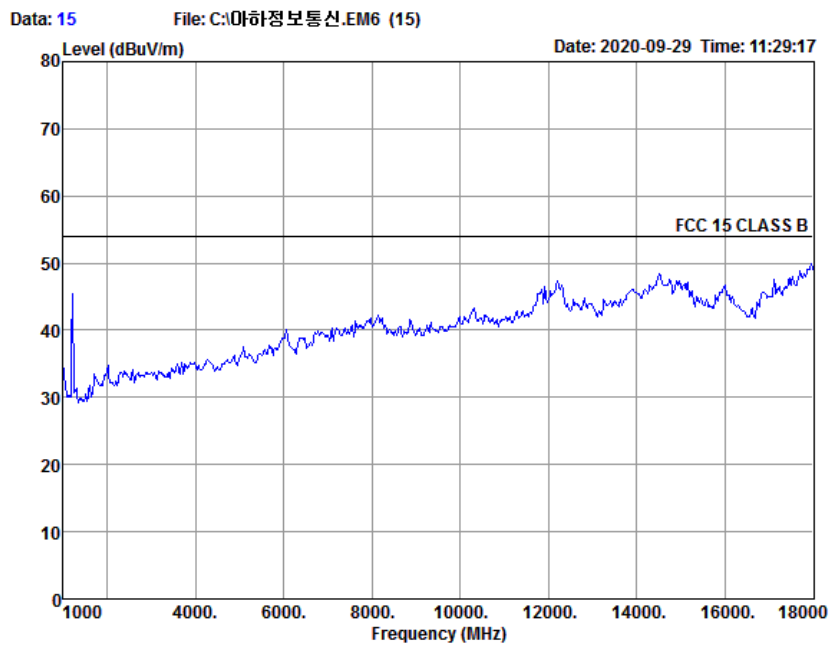
Test Mode : 802.11n(HT20) (Worst case : X-H)



BWS TECH
tel:031-333-5997
fax:031-333-0017
www.bws.co.kr

Radiated Emission TEST ..test

EUT:
Manufacturer: H
Operating Condition:



Review: _____

Note : 1) Only the worst case plots for Radiated Spurious Emissions.
2) A filter was used for this test.

[Above 18 GHz – 18 GHz ~ 30 GHz]

Test Mode : 802.11b (Worst case : X-H)



BWS TECH
 tel:031-333-5997
 fax:031-333-0017
 www.bws.co.kr

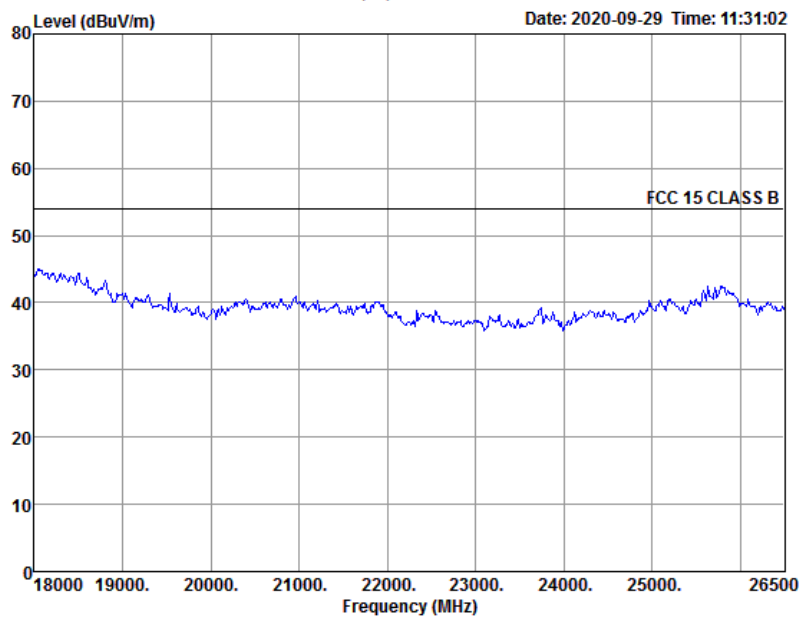
Radiated Emission TEST .test

EUT:

Manufacturer: H

Operating Condition:

Data: 16 File: C:\아하정보통신.EM6 (16)



Review:

Note : Only the worst case plots for Radiated Spurious Emissions.

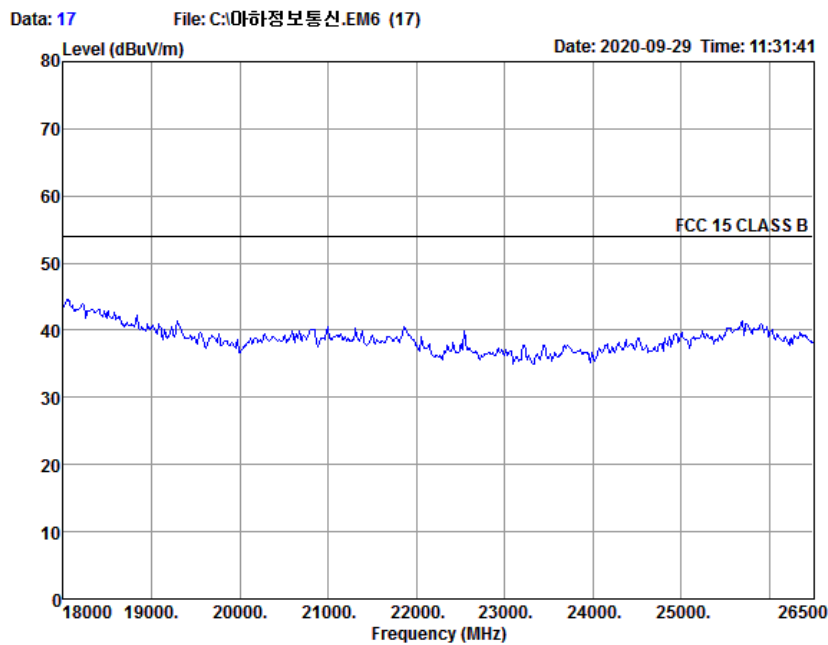
Test Mode : 802.11g (Worst case : X-H)



BWS TECH
tel:031-333-5997
fax:031-333-0017
www.bws.co.kr

Radiated Emission TEST ..test

EUT:
Manufacturer: H
Operating Condition:



Review: _____

Note : Only the worst case plots for Radiated Spurious Emissions.

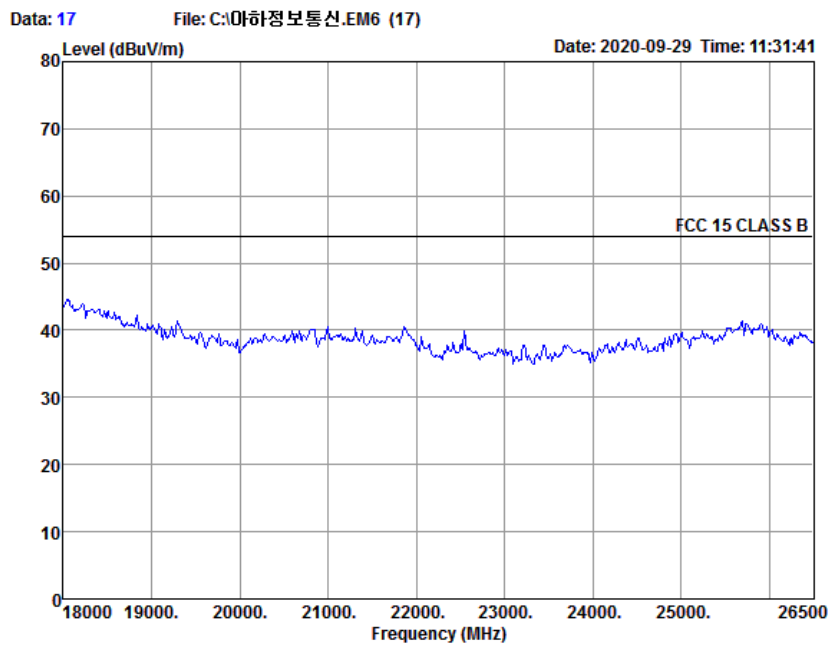
Test Mode : 802.11n(HT20) (Worst case : X-H)



BWS TECH
tel:031-333-5997
fax:031-333-0017
www.bws.co.kr

Radiated Emission TEST ..test

EUT:
Manufacturer: H
Operating Condition:



Review: _____

Note : Only the worst case plots for Radiated Spurious Emissions.

6.7.5 Measurement Uncertainty

→ Uncertainty = ± 2.50 dB (k = 2, 95.45 %)

6.8 Antenna Application

6.8.1 Antenna Requirement

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to §15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

6.8.2 Test Results

Antenna Type	Frequency	Antenna Gain	Limit	Result
PCB Antenna	2.400 GHz	-1.0 dBi	≤ 6 dBi	Pass

<End>