FCC Test Report

Equipment	:	**Air Cleaner**
Model No	:	**ATAKR1601**
Applicant	:	**Brunt. Co., Ltd** 4F, Olympia Bldg, 89 Yangjaecheon-ro, Seocho-gu Seoul South Korea 06748
Date of test	:	**October 11, 2018 to December 6, 2018**
FCC Rule Part(s)	:	**FCC Part 15 Subpart C §15.247**
Report Type	:	**Original Report**

The product was received on December 5, 2018 and testing was completed on March 10, 2018. 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) 12/06/2018

Tested by **Hyeong-Bae, Lee**

(Date) 12/06/2018

Reviewed by **Bang-Hyun, Nam**

BWS TECH INC.

#23, Gokhyeon-ro 480beon-gil, Mohyeon-eup, Cheoin-gu, Yongin-si,
Gyeonggi-do 17031, Republic of Korea
TEL: +82-31-333-5997, FAX: +82-31-333-0017
http://www.bws.co.kr

Report Revision

TEST REPORT NO.	DATE	DESCRIPTION
BWS-18-RF-0005	December 6, 2018	- First Approval Report

TABLE OF CONTENTS

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**	: Brunt. Co., Ltd
● **Company Address**	: 4F, Olympia Bldg, 89 Yangjaecheon-ro, Seocho-gu Seoul South Korea 06748
● **Phone/Fax**	: Tel No. : +82-2-783-5551 Fax No. : +82-2-3452-5551

1.2 Manufacturer

● **Company Name**	: Brunt. Co., Ltd
● **Company Address**	: 4F, Olympia Bldg, 89 Yangjaecheon-ro, Seocho-gu Seoul South Korea 06748
● **Phone/Fax**	: Tel No. : +82-2-783-5551 Fax No. : +82-2-3452-5551

1.3 EUT Description

● **Equipment**	: Air Cleaner
● **Model(s)**	: ATAKR1601
● **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 (Have the same value each modes and ports)
● **Input Voltage**	: AC 220 V
● **Antenna Peak Gain**	: 802.11b/g/n(HT20) :3.09 dBi

1.4 Other Information

● **FCC Rule Part(s)**	: Part 15 Subpart C §15.247
● **FCC ID**	: 2AODVATAKR1601
● **Test Procedure**	: ANSI C63.10-2013 KDB 558074 D01 DTS Meas Guidance v05
● **Date of Test**	: October 11, 2018 to December 3, 2018
● **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. :

Accredited by Industry Canada, February 10, 2015
The Certificate Registration Number is 4963A-2.

Accredited by FCC, July 05, 2017
The Certificate Registration Number is 287786.

Accredited by VCCI, November 20, 2017
The Certificate Registration Number is C-20017

Accredited by RRA(EMC,RF, SAR), August 17, 2018
The Certificate Registration Number is KR0017

Accredited by KOLAS(KS Q ISO/IEC 17025), April 08, 2016
The Certificate Registration 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 v05.

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 0.490-0.510MHz.
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 verification, all tests were carried out with the worst case test modes as shown below, and these were chosen for full testing.

1) 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
The 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)	≤30dBm	Pass
6.3	**Power Spectral Density**	§15.247(e)	≤8dBm/3kHz	Pass
6.4	**6dB Bandwidth**	§15.247(a)(2)	≥500kHz	Pass
6.5	**Conducted Spurious Emission**	§15.247(d)	≥20dBc/100kHz	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 date (yyyy/mm/dd)	Calibration Due date (yyyy/mm/dd)
Bi-Log Antenna	VULB9163	SCHWARZBECK	01063	2017/04/20	2019/04/20
ACTIVE HORN ANTENNA	AHA-118	COM-POWER CORP.	701064	2017/04/20	2019/04/20
Horn Antenna	BBHA9170	SCHWARZBECK	157	2018/04/27	2019/04/27
Loop Antenna	FMZB1519	SCHWARZBECK	00025	2018/01/04	2020/01/04
EMI Test Receiver	ESR	ROHDE & SCHWARZ	101450	2018/01/02	2019/01/02
RF Amplifier (1GHz ~ 26.5GHz)	8449B	Agilient	3947A04710	2018/06/21	2019/06/21
RF Amplifier (1MHz ~ 1GHz)	MPA-10-40	RF Bay	21163921	2018/06/21	2019/06/21
Antenna Master (4m)	AM 4.0	MATURO	AM4.0/225 /17240915	N/A	N/A
Antenna Master (2m)	AM 2.5	MATURO	AM2.5/226 /17240915	N/A	N/A
Positioner Controller	CO2000	MATURO	NCU/459 /17240915	N/A	N/A
PROGRAMMABLE DC POWER SUPPLY	UDP-6015R	UNICORN	1301006	2018/08/29	2019/08/29
SPECTRUM ANALYZER	FSP	ROHDE & SCHWARZ	100631	2018/11/07	2019/11/07
SPECTRUM ANALYZER	FSV30	ROHDE & SCHWARZ	100832	2018/08/29	2019/08/29
SYNTHESIZED SIGNAL GENERATOR	68367C	ANRITSU	#004908	2018/05/23	2019/05/23
USB RF POWER SENSOR	RPR3006W	D.A.R.E!! Instruments	14I000048SNO 09	2018/04/16	2019/04/16
PROGRAMMABLE TEMP. & HUMID. CHAMBER	SJ1013-TH	SeoJin Corp.	9204245	2018/06/08	2019/06/08
RF Cable	RPM 513 1524/71	HUBER SUHNER SUCOFLEX	3612/4FB	N/A	N/A
BANDREJECT FILTER	BRM50701	Micro-Tronics	G236	2018/09/13	2019/09/13

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.

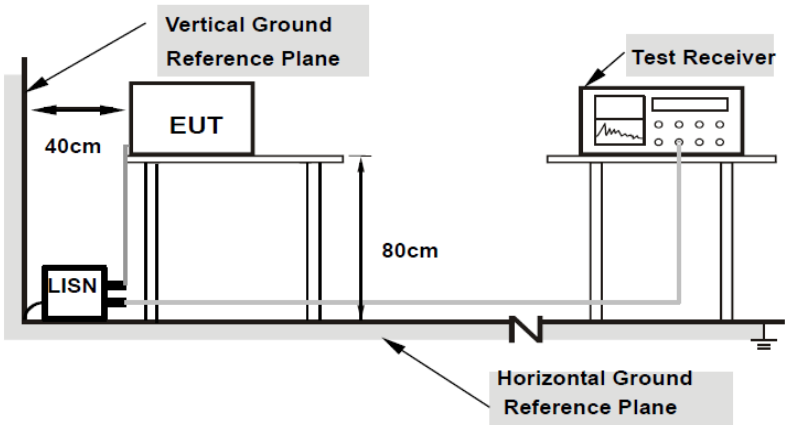
Frequency of emission(MHz)	Conducted limit(dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*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 = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

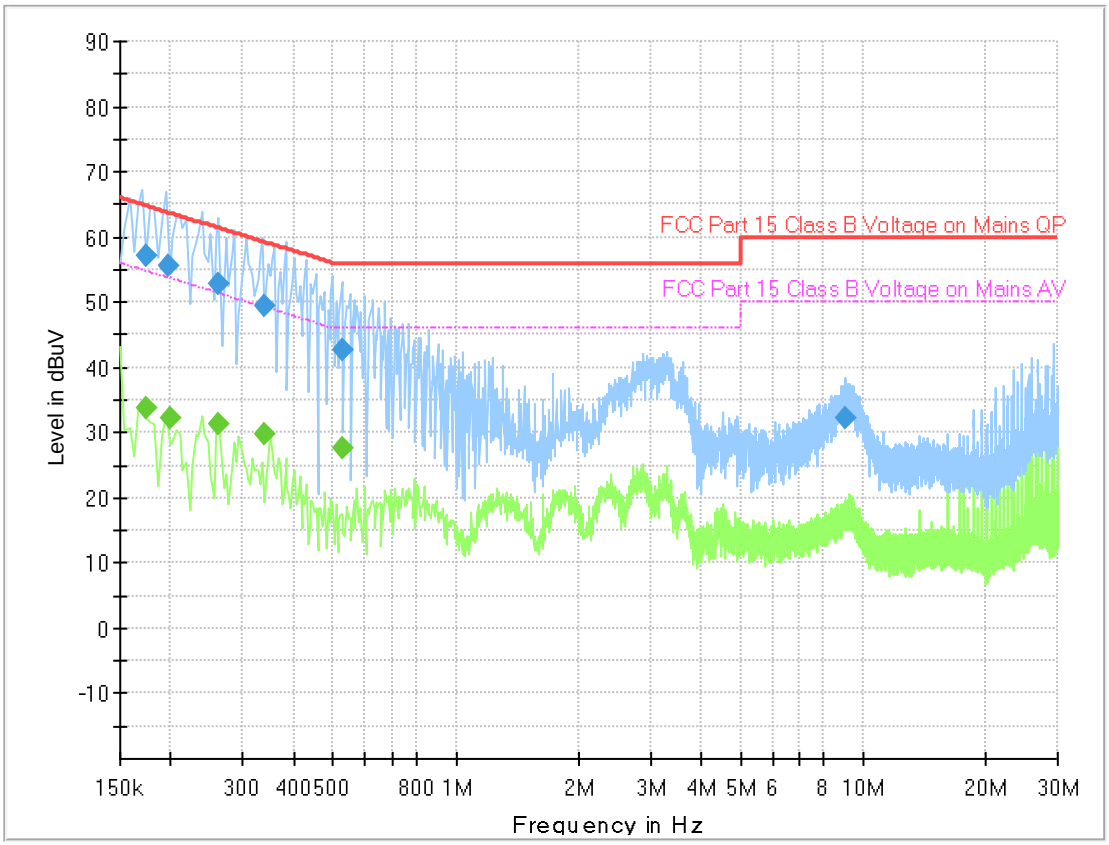
6.1.3 Test SET-UP (Block Diagram of Configuration)



6.1.4 Test Results

Common Information

Test Line: L1
Comment: ATAKR1601

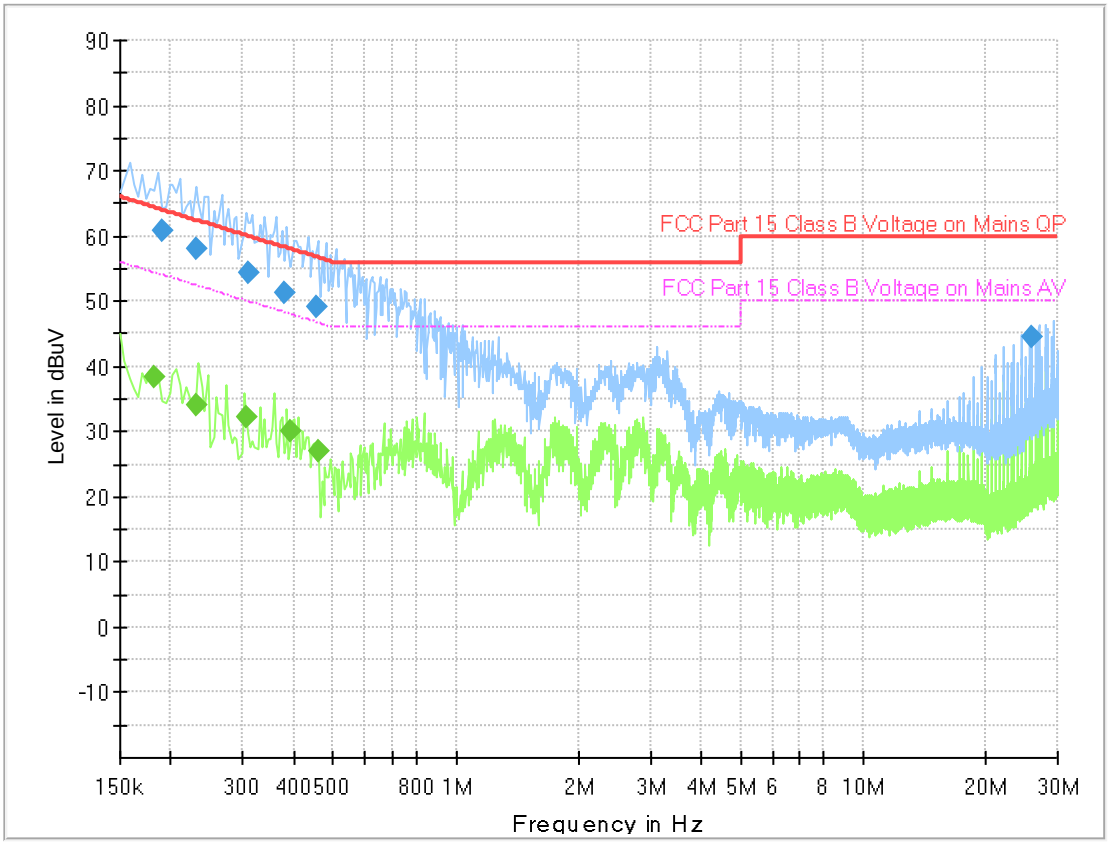


Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.173500	---	33.79	54.79	21.00	3000.0	9.000	L1	FLO	7.8
0.173500	57.22	---	64.79	7.57	3000.0	9.000	L1	FLO	7.8
0.197500	55.73	---	63.72	7.98	3000.0	9.000	L1	FLO	7.8
0.198500	---	32.26	53.67	21.41	3000.0	9.000	L1	FLO	7.8
0.261500	52.74	---	61.38	8.65	3000.0	9.000	L1	FLO	7.9
0.261500	---	31.42	51.38	19.96	3000.0	9.000	L1	FLO	7.9
0.337500	49.30	---	59.27	9.96	3000.0	9.000	L1	FLO	7.9
0.337500	---	29.63	49.27	19.63	3000.0	9.000	L1	FLO	7.9
0.525500	---	27.48	46.00	18.52	3000.0	9.000	L1	FLO	7.9
0.529500	42.70	---	56.00	13.30	3000.0	9.000	L1	FLO	7.9
9.084610	32.32	---	60.00	27.68	3000.0	9.000	L1	FLO	8.2

Common Information

Test Line: N
Comment: ATAKR1601



Final_Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.181500	---	38.31	54.42	16.11	3000.0	9.000	N	GND	7.7
0.189500	60.87	---	64.06	3.19	3000.0	9.000	N	GND	7.7
0.229500	---	34.10	52.47	18.37	3000.0	9.000	N	GND	7.7
0.229500	57.93	---	62.47	4.53	3000.0	9.000	N	GND	7.7
0.305500	---	32.35	50.09	17.74	3000.0	9.000	N	GND	7.7
0.309500	54.29	---	59.98	5.69	3000.0	9.000	N	GND	7.7
0.381499	51.42	---	58.25	6.83	3000.0	9.000	N	GND	7.7
0.390501	---	30.01	48.05	18.04	3000.0	9.000	N	GND	7.7
0.453500	49.01	---	56.81	7.80	3000.0	9.000	N	GND	7.7
0.457500	---	27.01	46.74	19.72	3000.0	9.000	N	GND	7.7
25.964190	44.52	---	60.00	15.48	3000.0	9.000	N	GND	8.4

6.2 Peak Output Power Measurement

6.2.1 Test Limit

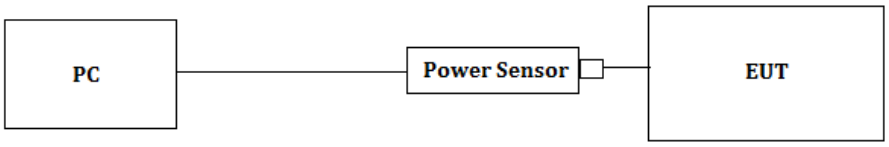
The maximum peak power shall be less than 1 Watt (30dBm).

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 3dB that the directional gain of the antenna exceeds 6dBi.

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)	Transmit Time (s)		Duty Cycle	Duty Cycle Factor (dB)
		T_{on}	T_{off}		
1	2412	1.025	1.028	0.9971	-
6	2437	1.020	1.023	0.9971	-
11	2462	1.025	1.028	0.9971	-

[802.11g]

Channel	Frequency (MHz)	Transmit Time (s)		Duty Cycle	Duty Cycle Factor (dB)
		T_{on}	T_{off}		
1	2412	1.122	1.125	0.9973	-
6	2437	1.223	1.226	0.9976	-
11	2462	1.222	1.225	0.9976	-

[802.11n HT20]

Channel	Frequency (MHz)	Transmit Time (s)		Duty Cycle	Duty Cycle Factor (dB)
		T_{on}	T_{off}		
1	2412	1.224	1.227	0.9976	-
6	2437	1.225	1.227	0.9984	-
11	2462	1.225	1.228	0.9976	-

Notes : 1. Duty Cycle = T_{on} / T_{total}
2. Duty Cycle Factor = 10*log(1/Duty Cycle).

[Peak Output Power Measurement]

[802.11b]

Channel	Frequency (MHz)	Peak Output Power (Conducted) (dBm)	Duty Cycle Factor + Peak Output Power (Conducted) (dBm)	Max. Limit (dBm)	Result
1	2412	12.0	12.0	≤30	Pass
6	2437	12.0	12.0	≤30	Pass
11	2462	12.0	12.0	≤30	Pass

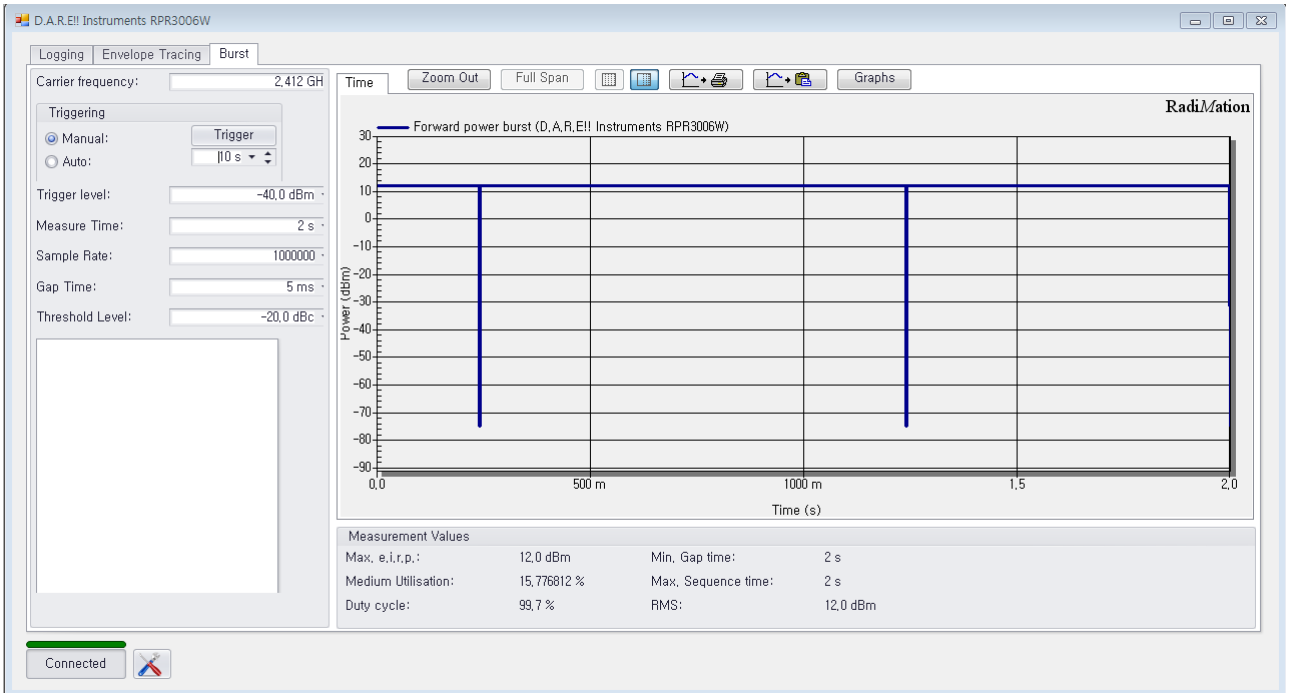
[802.11g]

Channel	Frequency (MHz)	Peak Output Power (Conducted) (dBm)	Duty Cycle Factor + Peak Output Power (Conducted) (dBm)	Max. Limit (dBm)	Result
1	2412	9.5	9.5	≤30	Pass
6	2437	9.7	9.7	≤30	Pass
11	2462	9.4	9.4	≤30	Pass

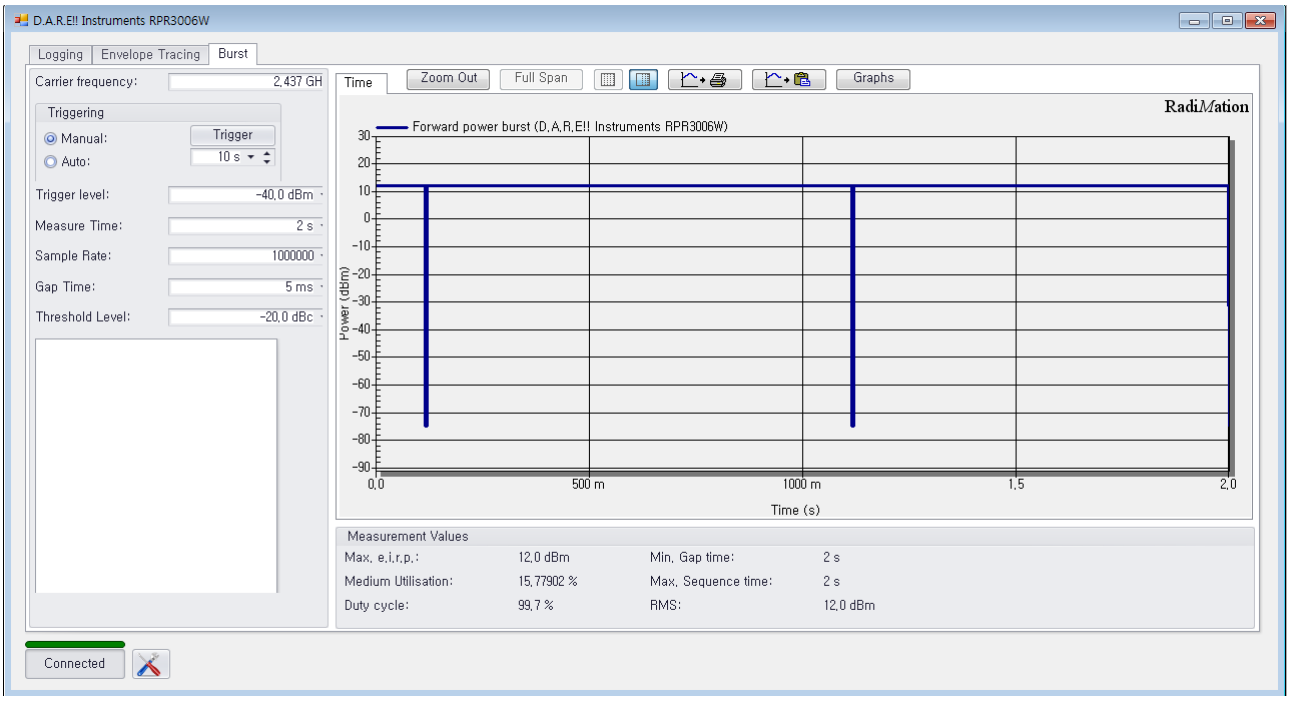
[802.11n HT20]

Channel	Frequency (MHz)	Peak Output Power (Conducted) (dBm)	Duty Cycle Factor + Peak Output Power (Conducted) (dBm)	Max. Limit (dBm)	Result
1	2412	8.9	8.9	≤30	Pass
6	2437	8.9	8.9	≤30	Pass
11	2462	8.6	8.6	≤30	Pass

Test Mode : 802.11b 2412MHz



Test Mode : 802.11b 2437MHz



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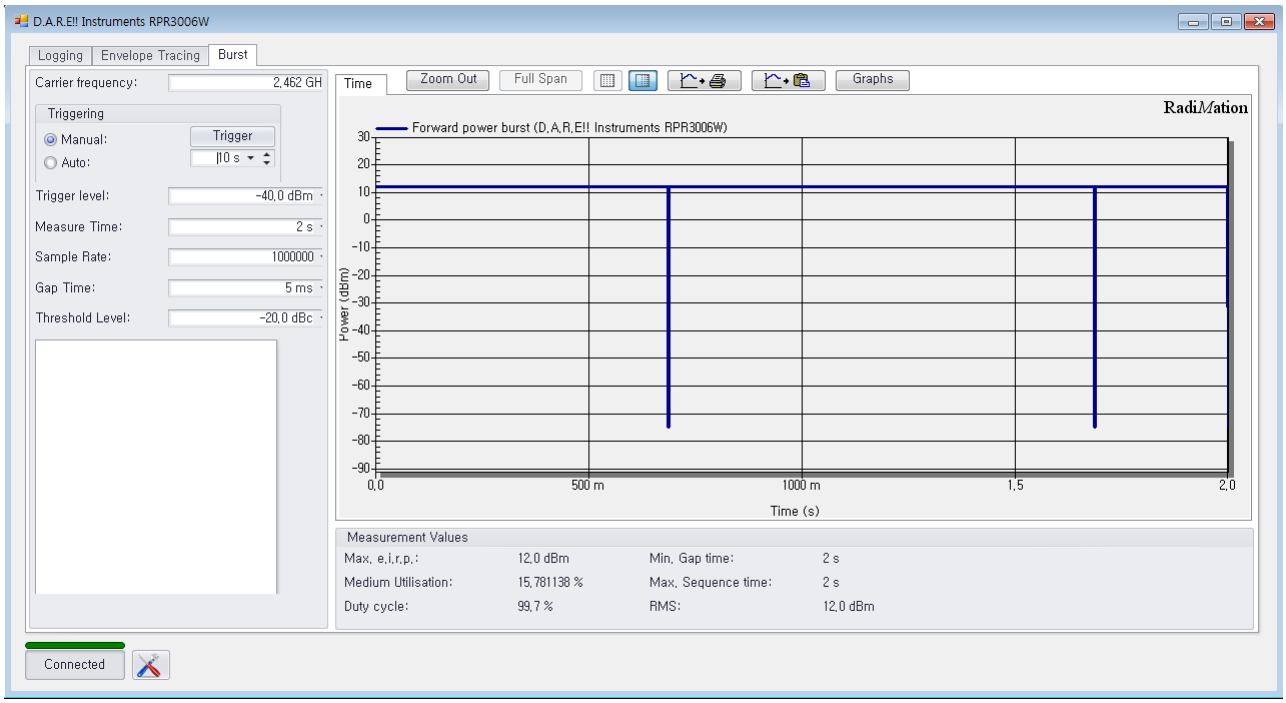

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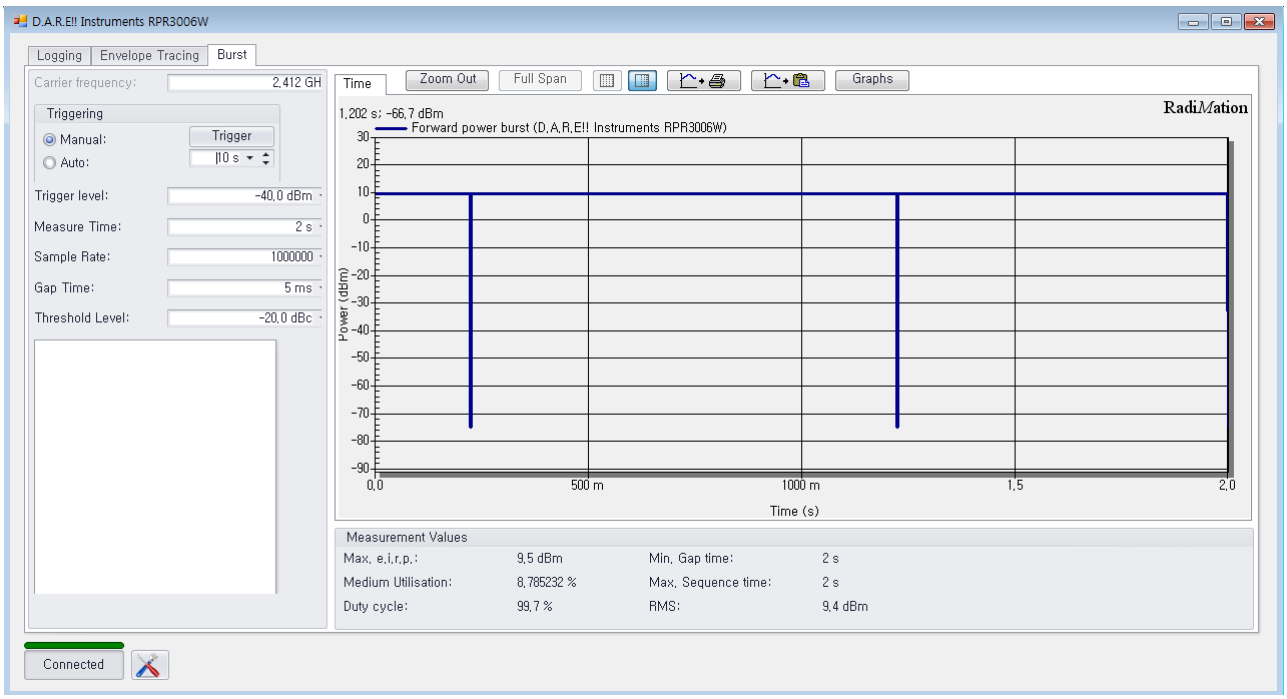
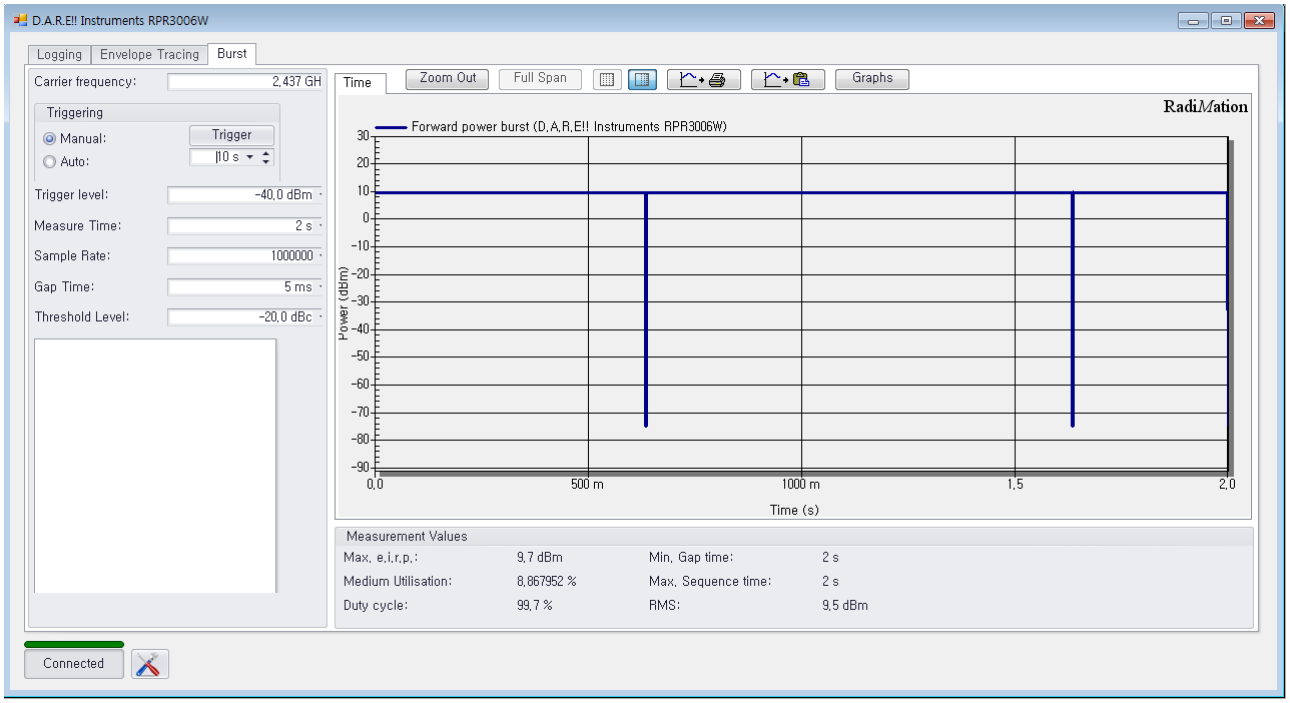
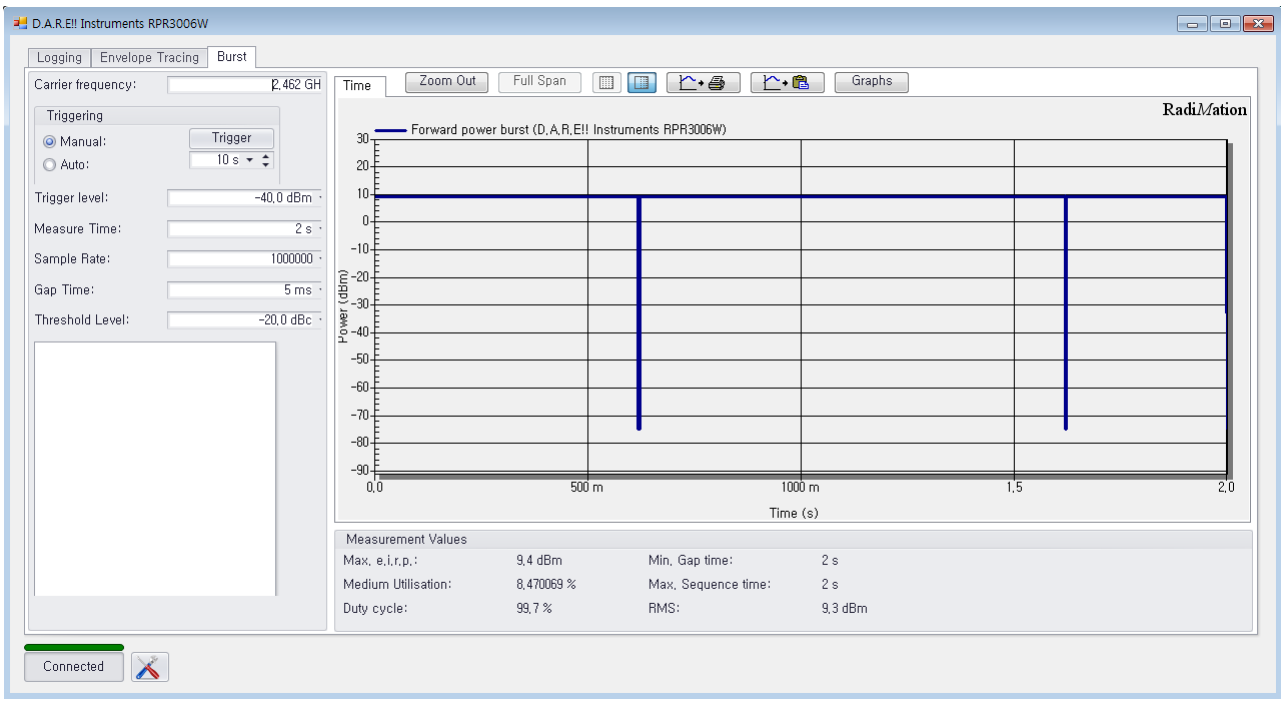


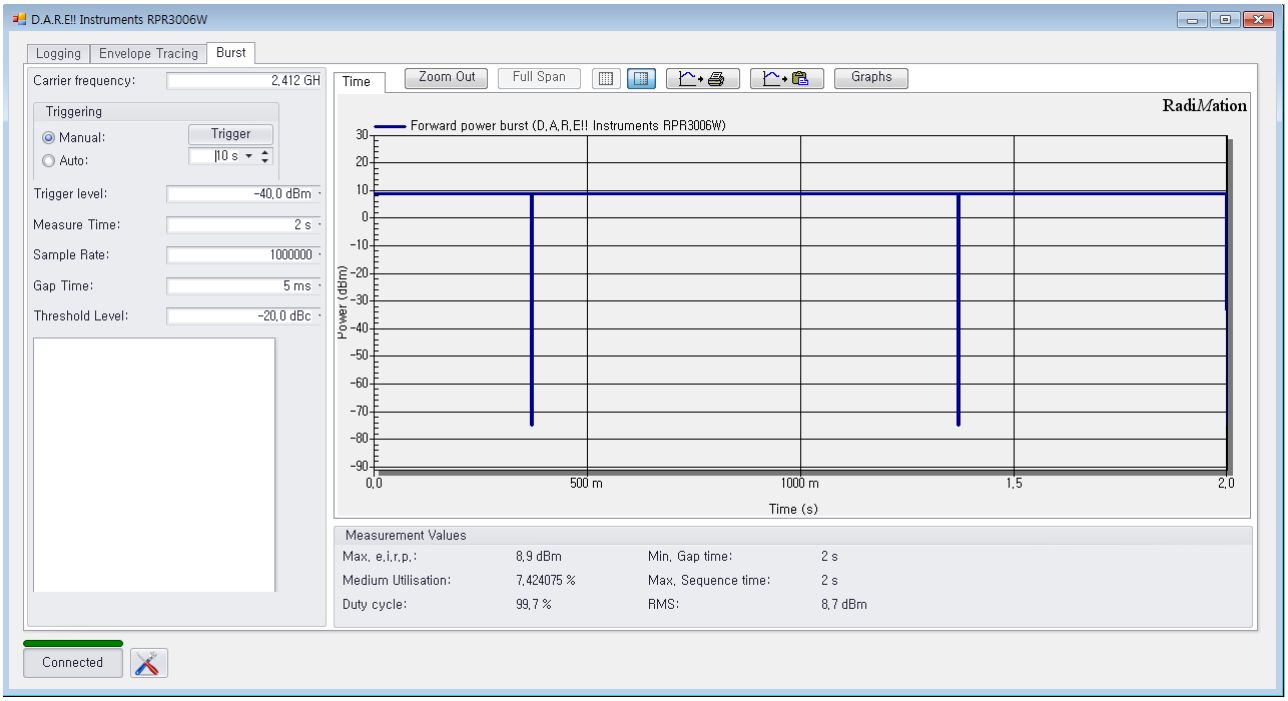
Test Mode : 802.11g 2437MHz



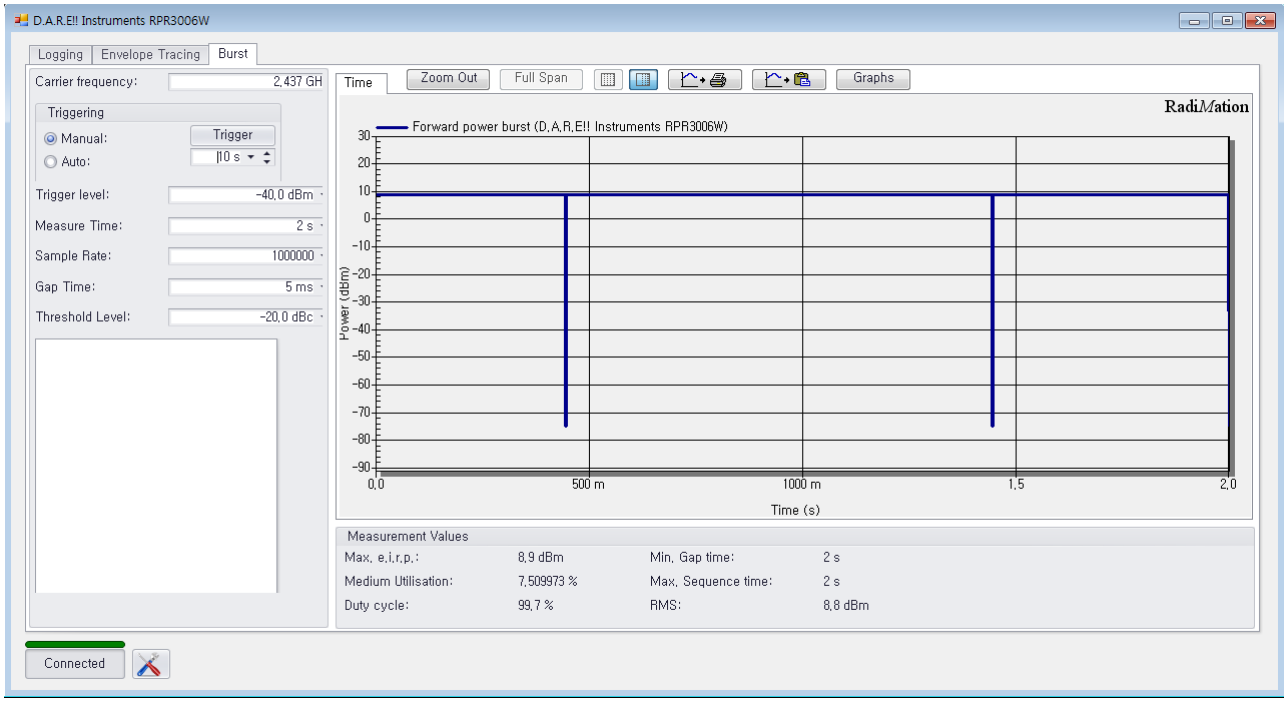
Test Mode : 802.11g 2462MHz



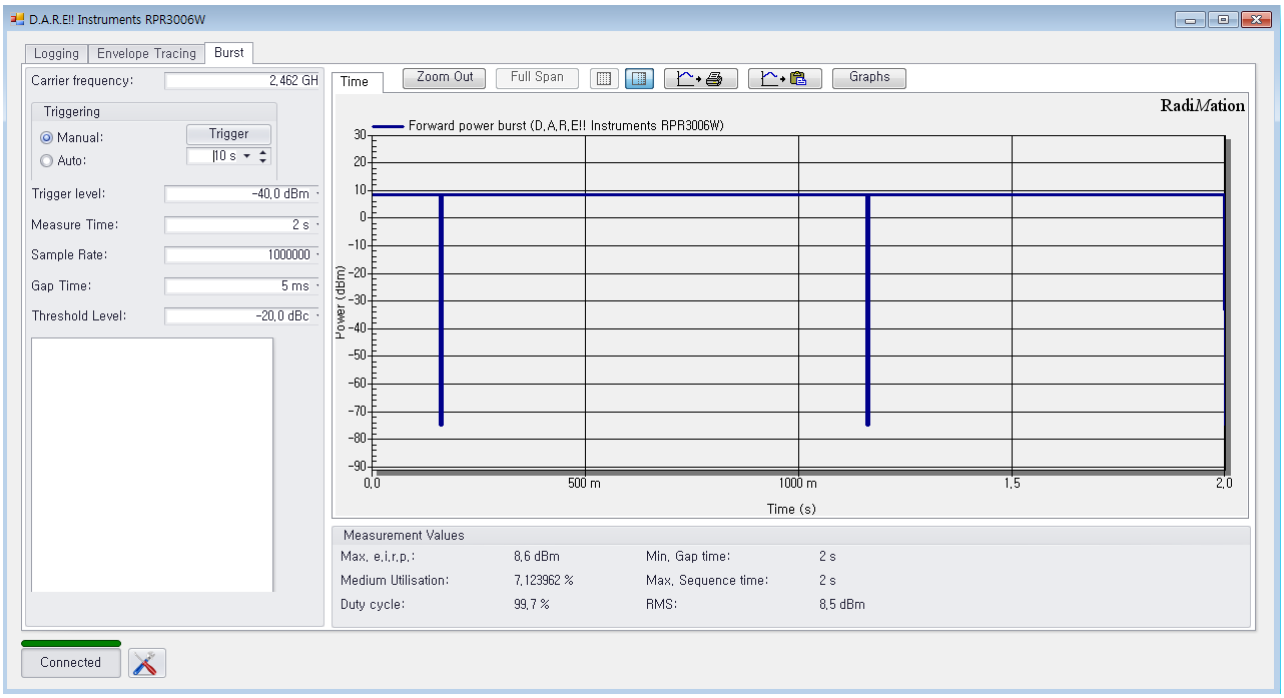
Test Mode : 802.11n20 2412MHz



Test Mode : 802.11n20 2437MHz



Test Mode : 802.11n20 2462MHz



6.3 Power Spectral Density

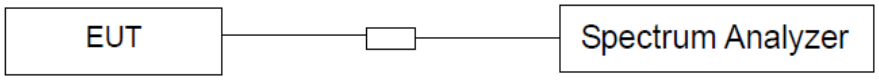
6.3.1 Test Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiated to the Antenna shall not be greater than 8dBm in any 3kHz 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	-8.26	≤ 8.00	Pass
6	2437	-8.79	≤ 8.00	Pass
11	2462	-8.82	≤ 8.00	Pass

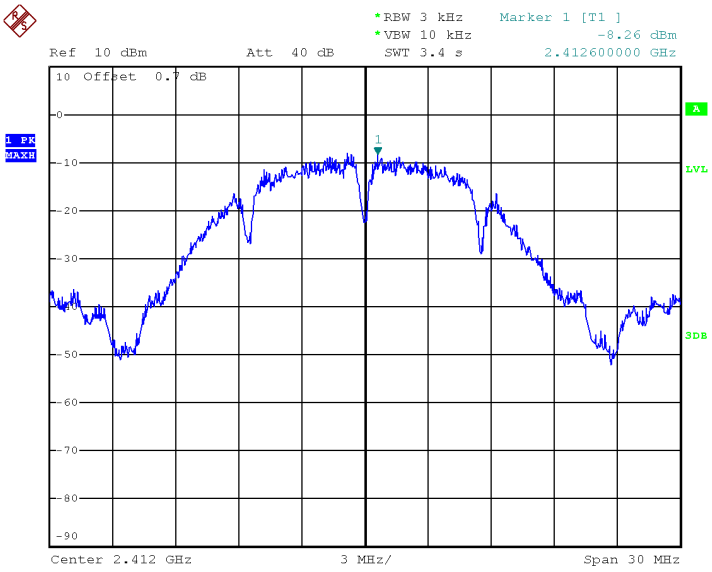
[802.11g]

Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
1	2412	-11.35	≤ 8.00	Pass
6	2437	-12.46	≤ 8.00	Pass
11	2462	-13.01	≤ 8.00	Pass

[802.11n HT20]

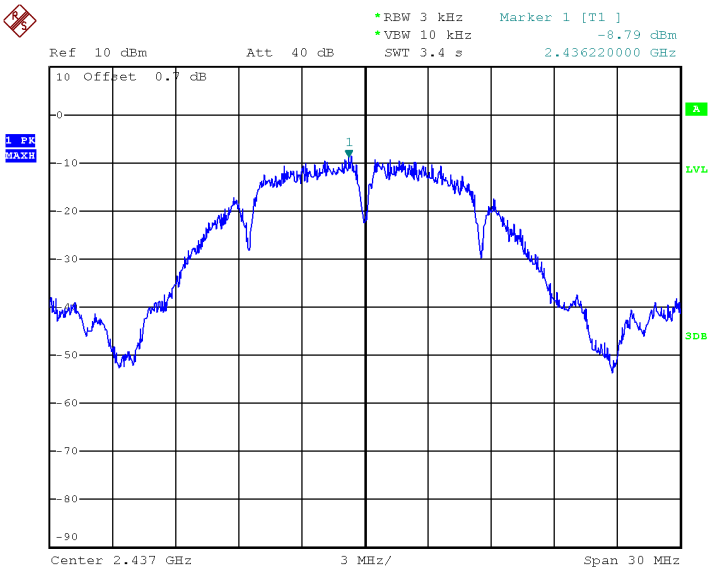
Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
1	2412	-11.98	≤ 8.00	Pass
6	2437	-11.44	≤ 8.00	Pass
11	2462	-11.91	≤ 8.00	Pass

Test Mode : 802.11b 2412MHz



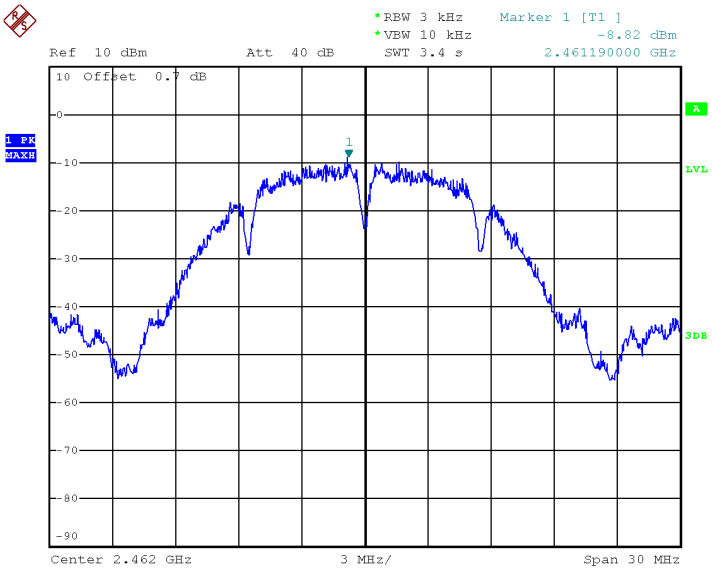
Date: 29.OCT.2018 20:26:51

Test Mode : 802.11b 2437MHz



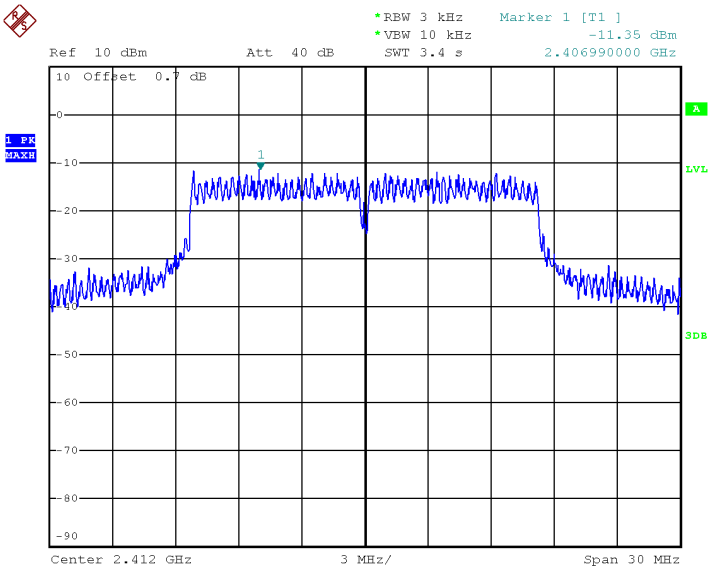
Date: 29.OCT.2018 20:28:08

Test Mode : 802.11b 2462MHz



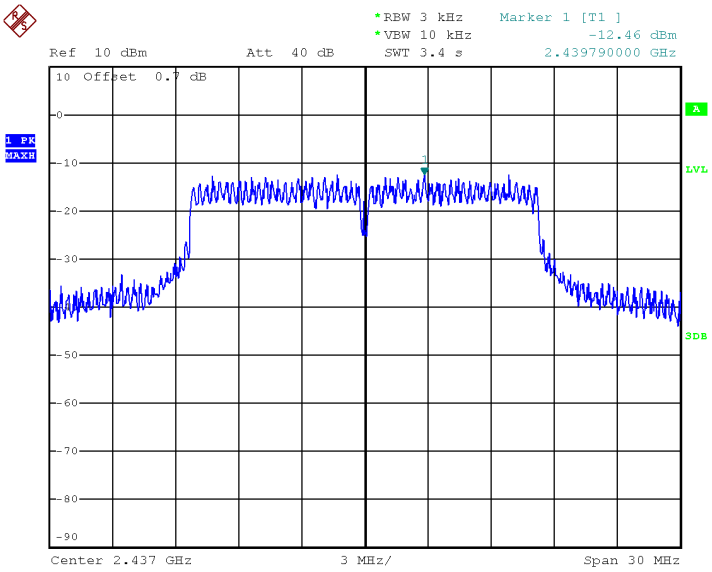
Date: 29.OCT.2018 20:29:26

Test Mode : 802.11g 2412MHz



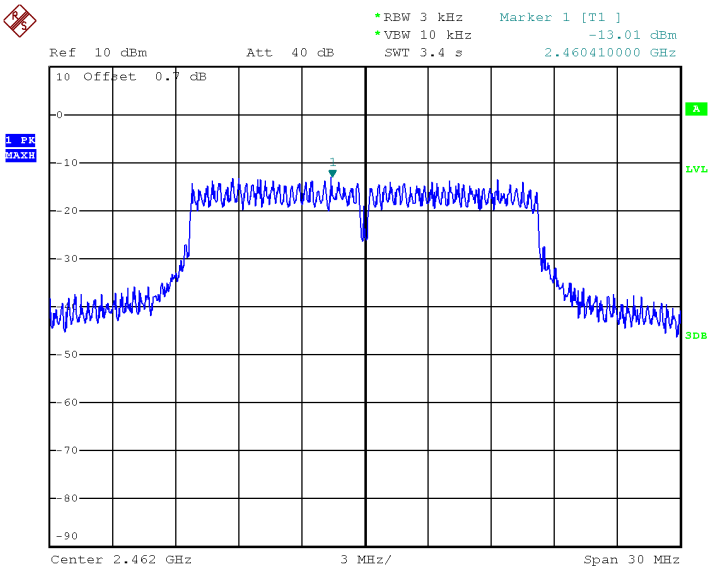
Date: 29.OCT.2018 20:35:10

Test Mode : 802.11g 2437MHz



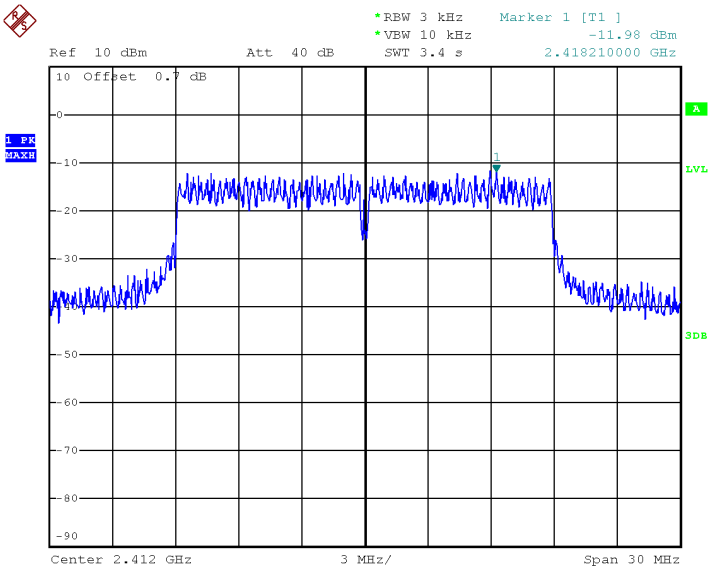
Date: 29.OCT.2018 20:33:09

Test Mode : 802.11g 2462MHz



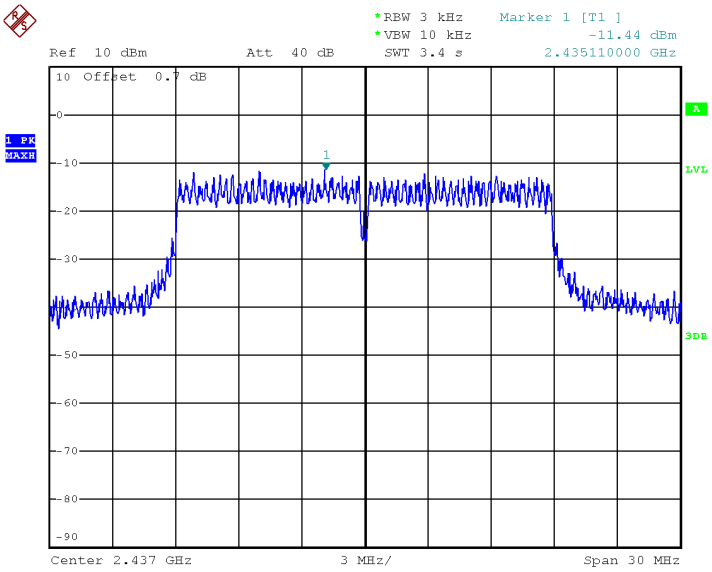
Date: 29.OCT.2018 20:32:08

Test Mode : 802.11n HT20 2412MHz



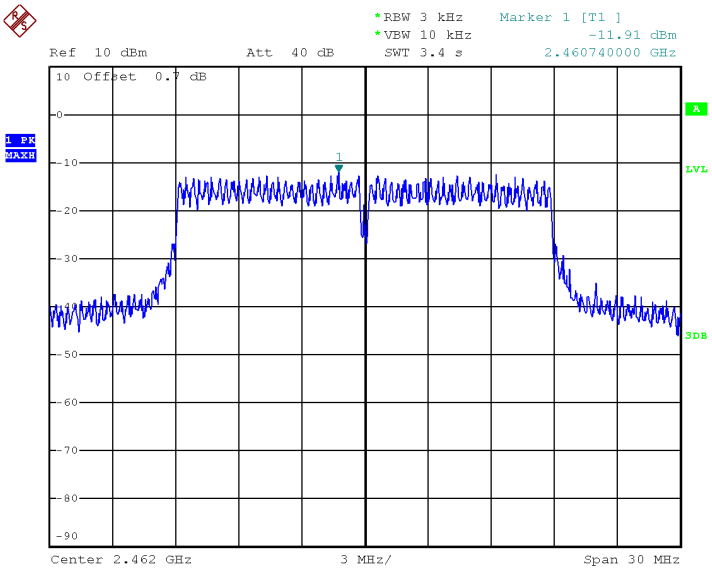
Date: 29.OCT.2018 20:36:24

Test Mode : 802.11n HT20 2437MHz



Date: 29.OCT.2018 20:37:21

Test Mode : 802.11n HT20 2462MHz



Date: 29.OCT.2018 20:38:55

6.4 6dB Bandwidth

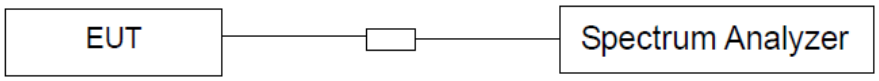
6.4.1 Test Limit

The minimum 6dB 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	10.95	≥ 0.5	Pass
6	2437	10.86	≥ 0.5	Pass
11	2462	10.83	≥ 0.5	Pass

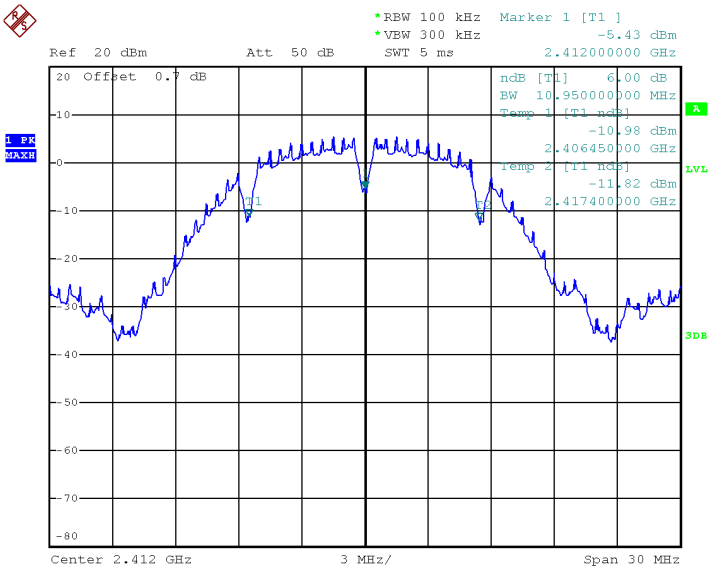
[802.11g]

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
1	2412	17.25	≥ 0.5	Pass
6	2437	17.13	≥ 0.5	Pass
11	2462	17.13	≥ 0.5	Pass

[802.11n HT20]

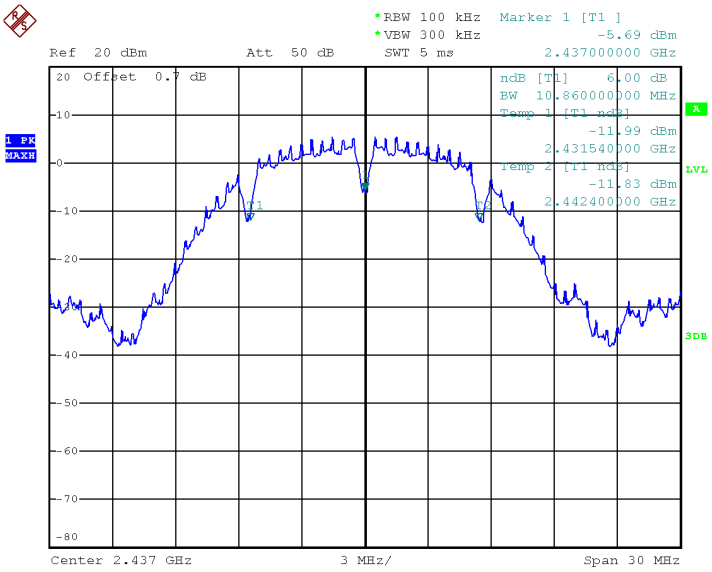
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
1	2412	18.45	≥ 0.5	Pass
6	2437	18.33	≥ 0.5	Pass
11	2462	18.33	≥ 0.5	Pass

Test Mode : 802.11b 2412MHz



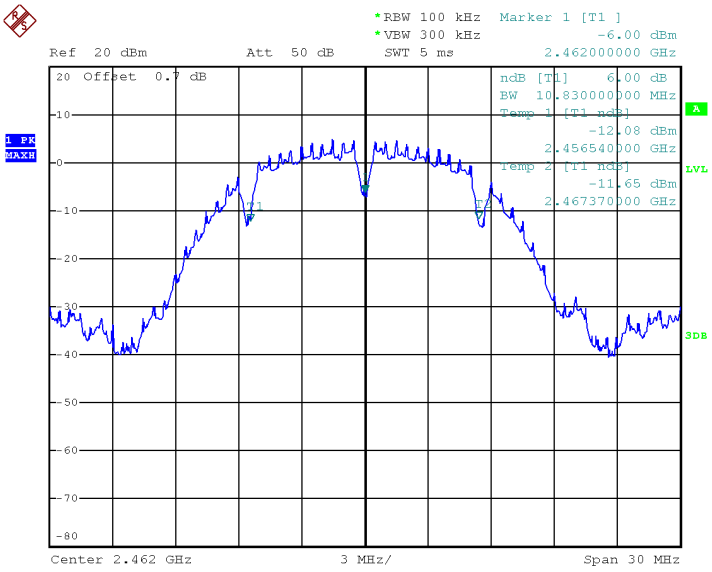
Date: 29.OCT.2018 20:47:37

Test Mode : 802.11b 2437MHz



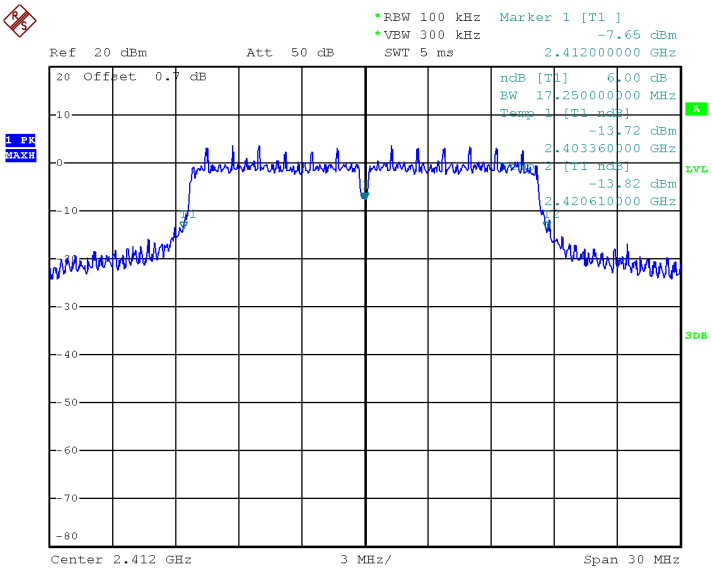
Date: 29.OCT.2018 20:43:39

Test Mode : 802.11b 2462MHz



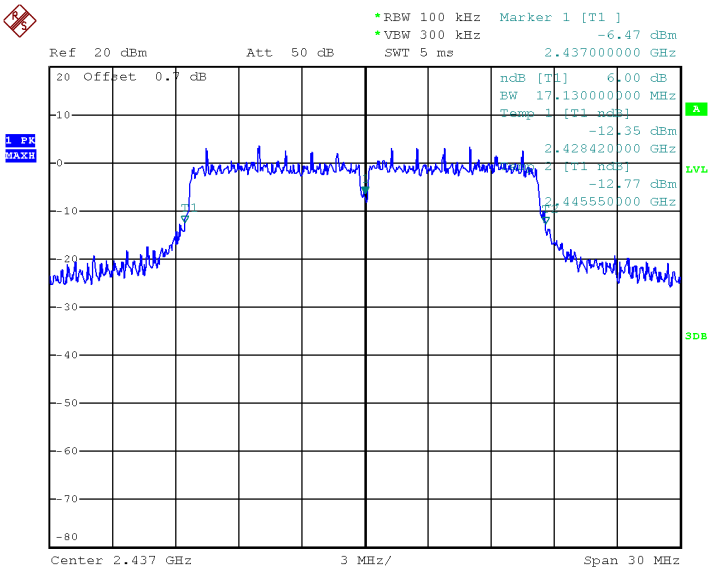
Date: 29.OCT.2018 20:42:37

Test Mode : 802.11g 2412MHz



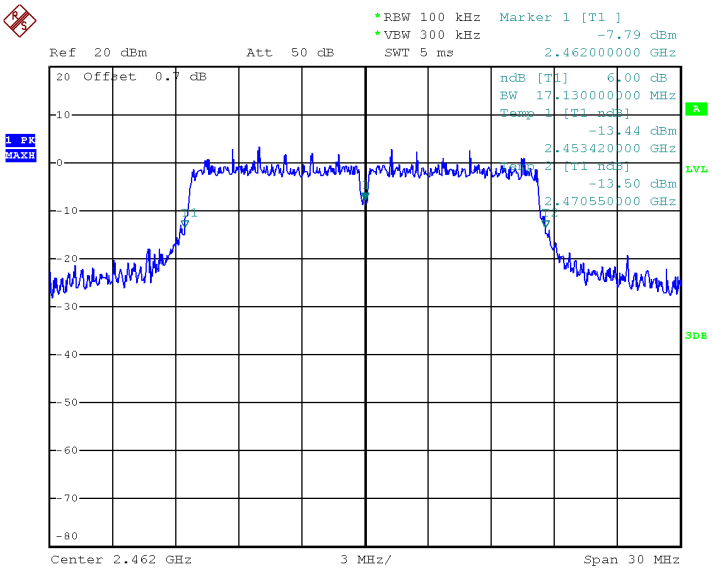
Date: 29.OCT.2018 20:46:48

Test Mode : 802.11g 2437MHz



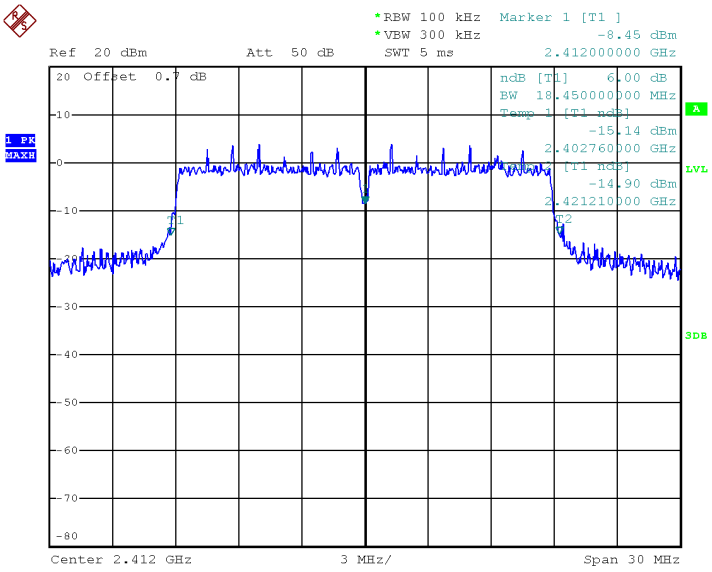
Date: 29.OCT.2018 20:44:26

Test Mode : 802.11g 2462MHz



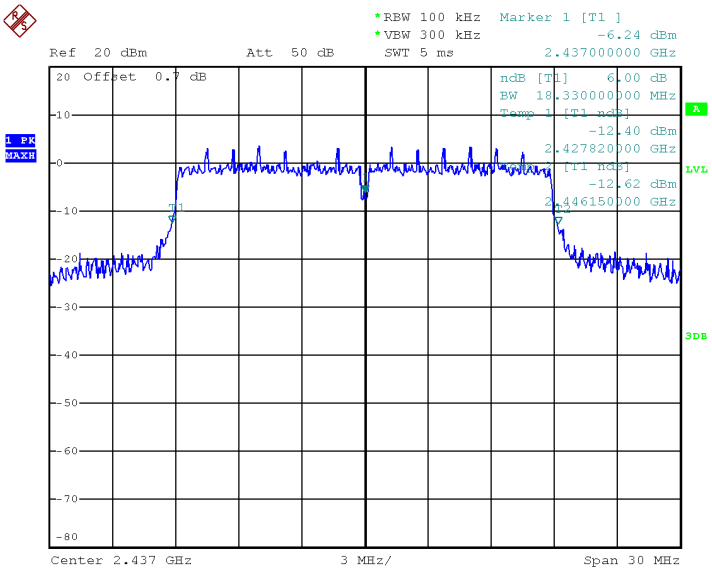
Date: 29.OCT.2018 20:41:52

Test Mode : 802.11n HT20 2412MHz



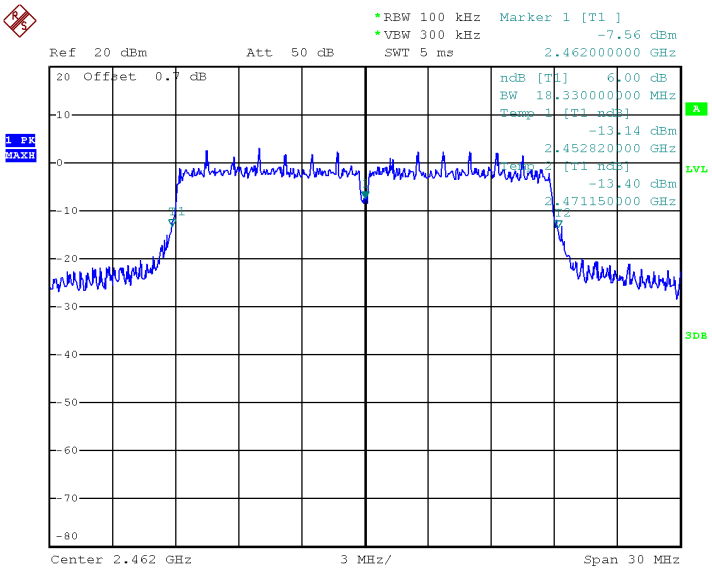
Date: 29.OCT.2018 20:46:02

Test Mode : 802.11n HT20 2437MHz



Date: 29.OCT.2018 20:45:19

Test Mode : 802.11n HT20 2462MHz



Date: 29.OCT.2018 20:40:53

6.5 Conducted Spurious Emission

6.5.1 Test Limit

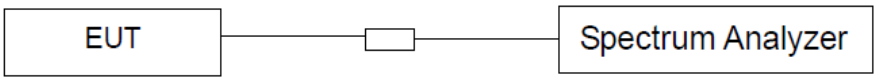
According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains 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 in15.209(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)

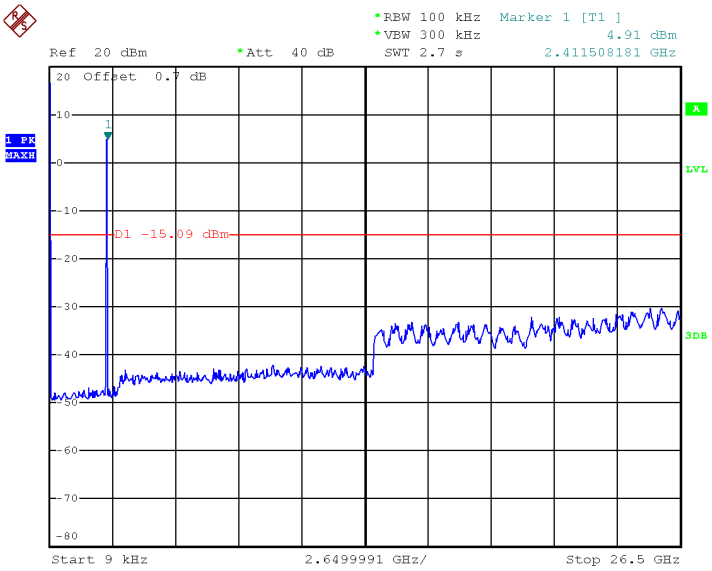
Conducted Emission Test Set-Up, Frequency above 1000MHz



6.5.4 Test Result

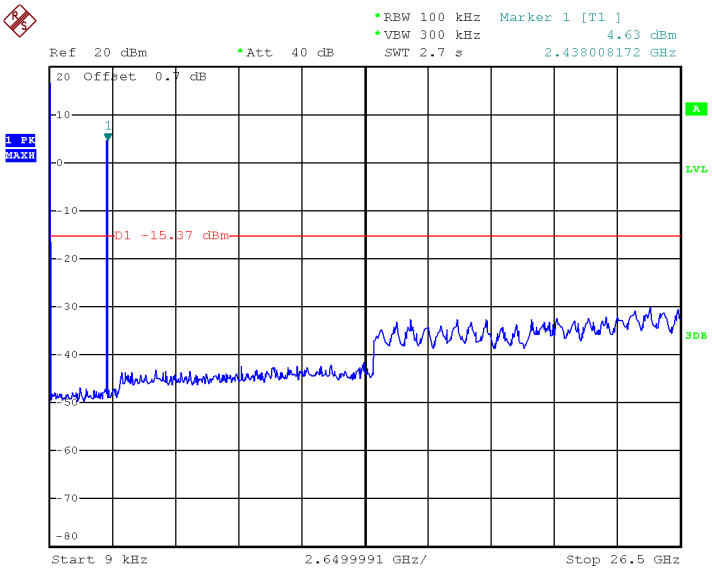
[Conducted Spurious Emission Test]

Test Mode : 802.11b 2412MHz



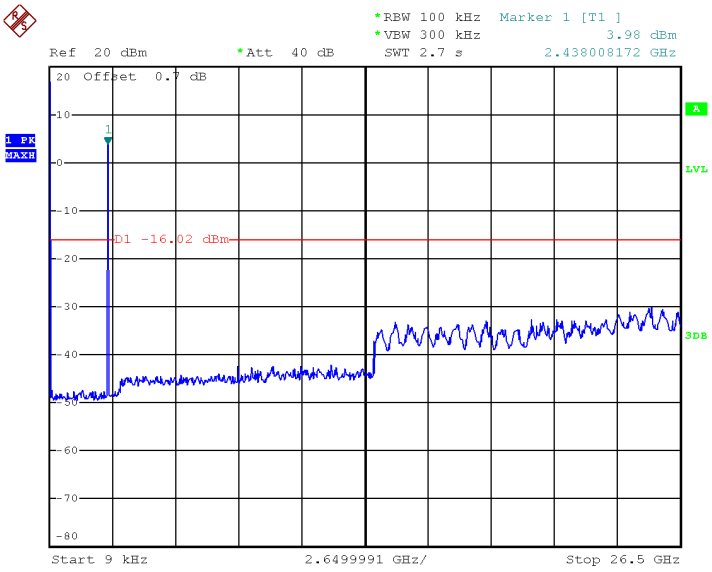
Date: 29.OCT.2018 21:06:25

Test Mode : 802.11b 2437MHz



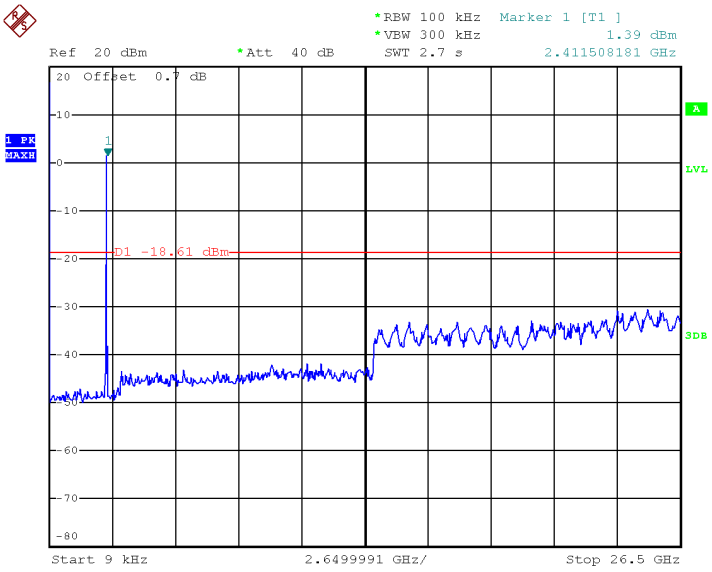
Date: 29.OCT.2018 21:09:02

Test Mode : 802.11b 2462MHz



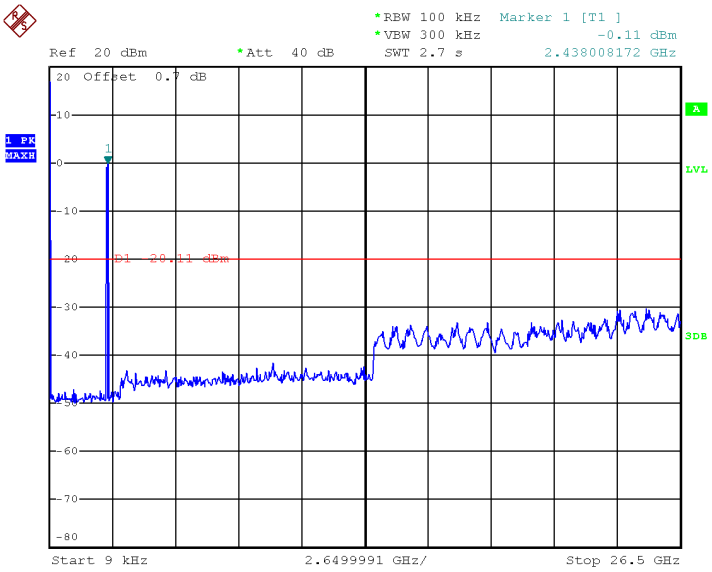
Date: 29.OCT.2018 21:10:28

Test Mode : 802.11g 2412MHz



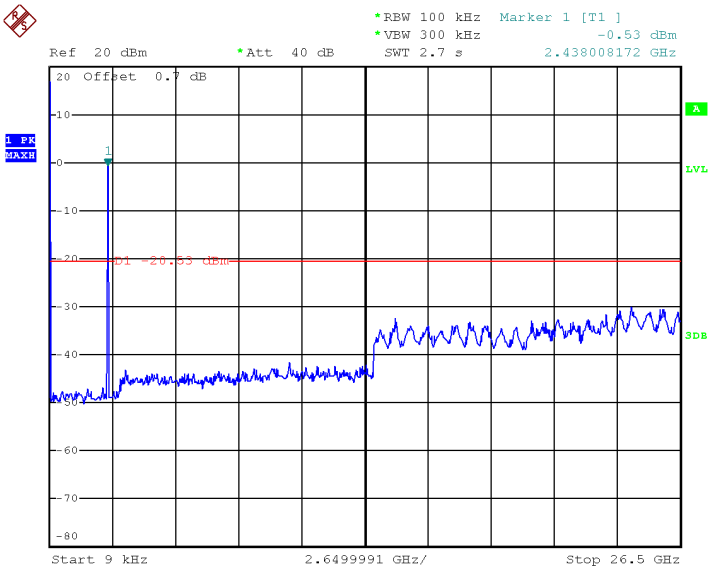
Date: 29.OCT.2018 21:14:06

Test Mode : 802.11g 2437MHz



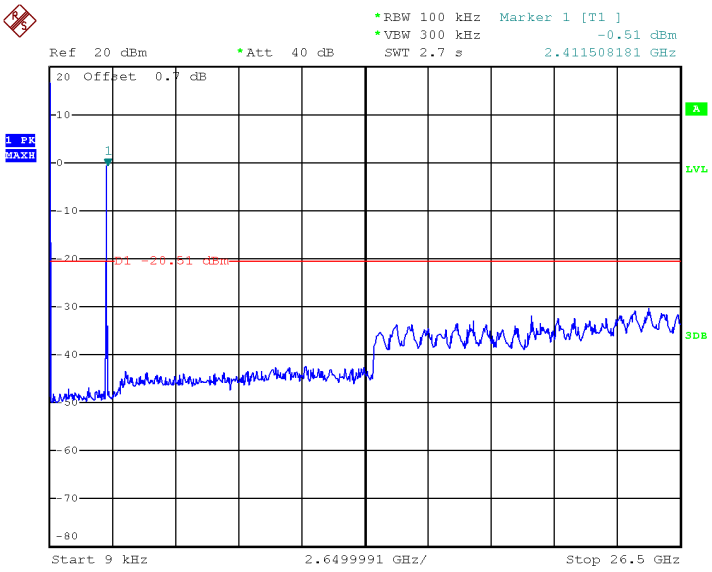
Date: 29.OCT.2018 21:12:54

Test Mode : 802.11g 2462MHz



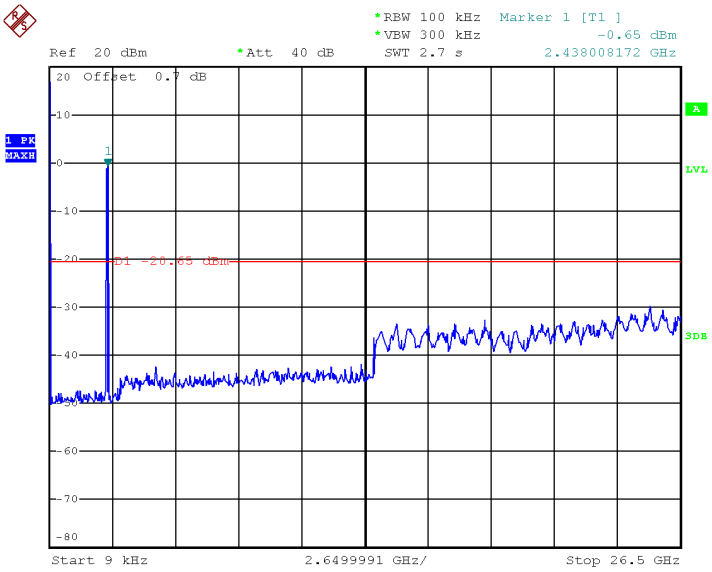
Date: 29.OCT.2018 21:11:55

Test Mode : 802.11n HT20 2412MHz



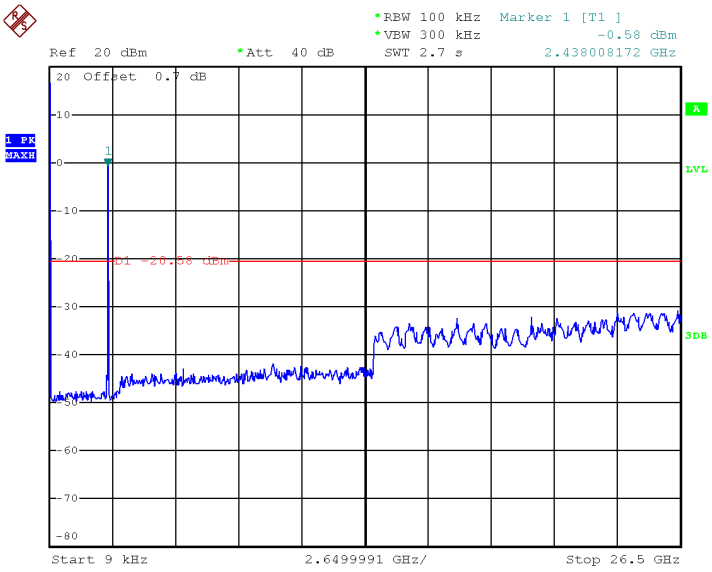
Date: 29.OCT.2018 21:15:19

Test Mode : 802.11n HT20 2437MHz



Date: 29.OCT.2018 21:16:24

Test Mode : 802.11n HT20 2462MHz



Date: 29.OCT.2018 21:18:44

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 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 in15.209(a).

6.6.2 Test Procedure

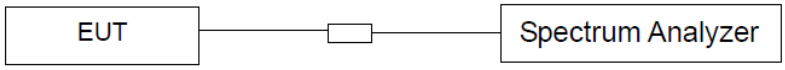
The EUT is placed on a turntable with 1.5 meter above ground.
The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
Set the spectrum analyzer in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

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

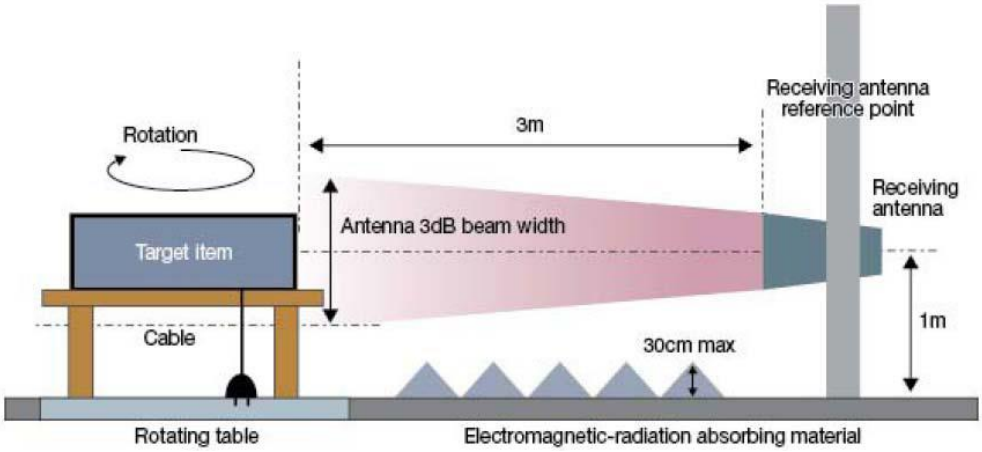
Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

6.6.3 Test SET-UP (Block Diagram of Configuration)

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



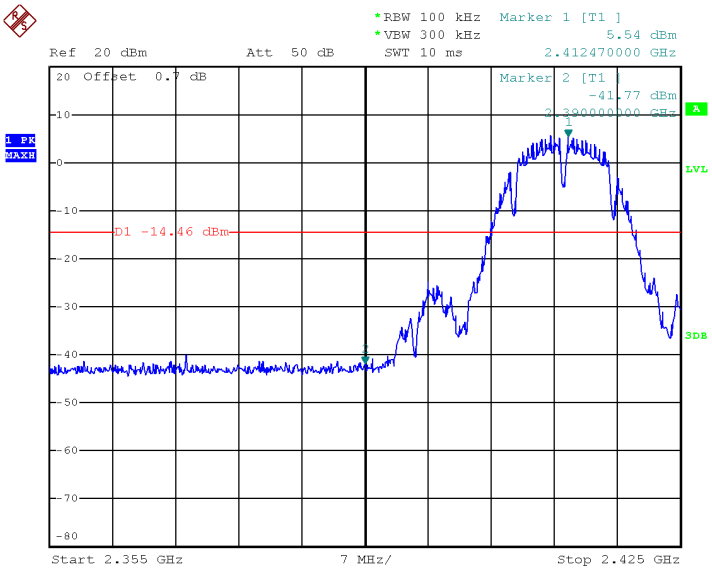
(b)Radiated Emission Test Set-Up, Frequency above 1000MHz



6.6.4 Test Result

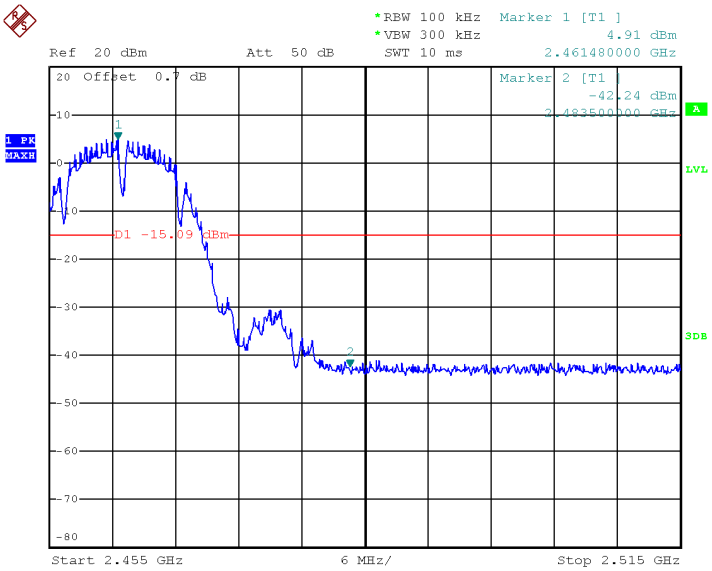
[Conducted Band Edges]

Test Mode : 802.11b 2412MHz Band Edge



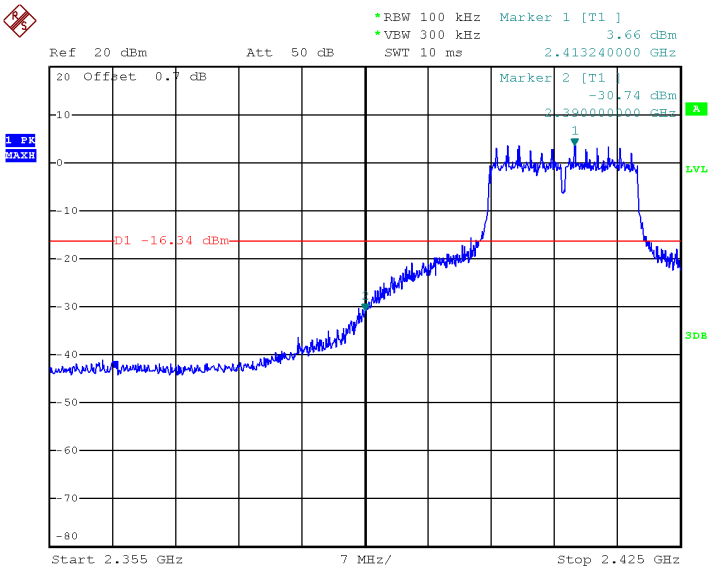
Date: 29.OCT.2018 21:02:08

Test Mode : 802.11b 2462MHz Band Edge



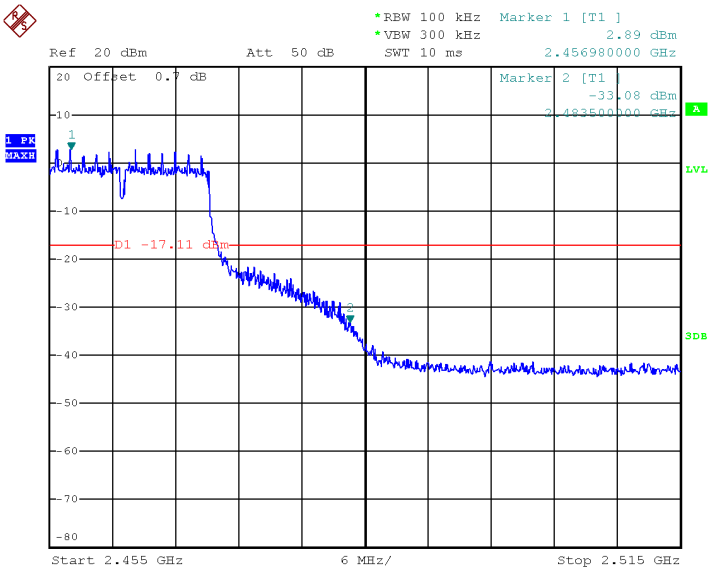
Date: 29.OCT.2018 21:00:43

Test Mode : 802.11g 2412MHz Band Edge



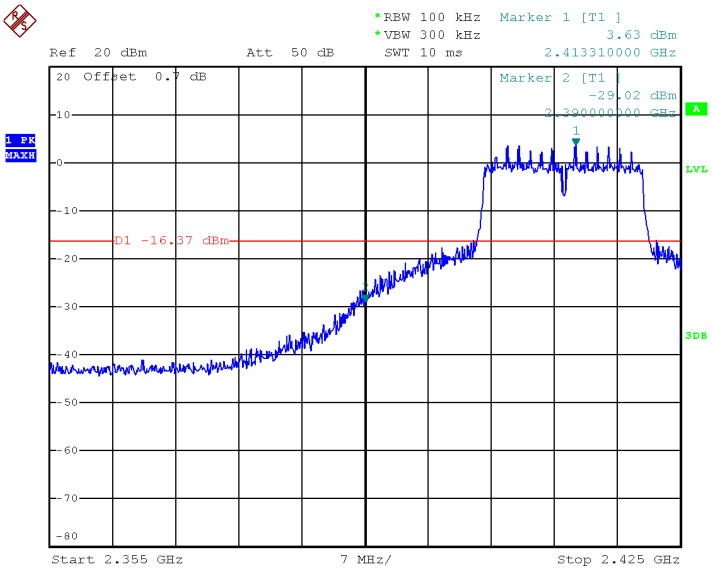
Date: 29.OCT.2018 20:53:04

Test Mode : 802.11g 2462MHz Band Edge



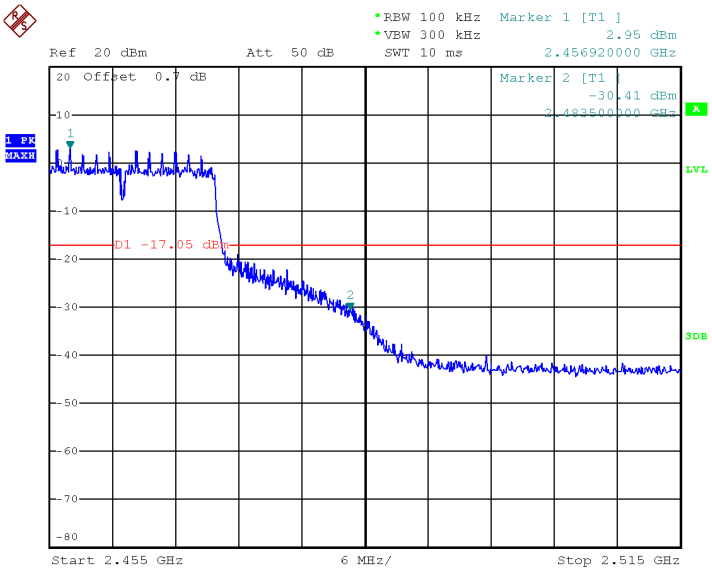
Date: 29.OCT.2018 20:58:33

Test Mode : 802.11n HT20 2412MHz Band Edge



Date: 29.OCT.2018 20:54:09

Test Mode : 802.11n HT20 2462MHz Band Edge



Date: 29.OCT.2018 20:57:08

[Radiated Band Edges Test]

802.11b

Frequency [MHz]	Reading [dB μV]	Detector Mode	Factor [dB]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Pol/Phase
2390	40.77	Peak	-5.0	35.62	74.21	38.36	Hor
2390	40.35	Peak	-5.0	35.47	74.21	38.51	Ver
2483.5	40.14	Peak	-4.8	34.28	74.21	39.70	Hor
2483.5	39.98	Peak	-4.8	35.12	74.21	38.86	Ver

802.11g

Frequency [MHz]	Reading [dB μV]	Detector Mode	Factor [dB]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Pol/Phase
2390	40.64	Peak	-5.0	35.73	74.21	38.25	Hor
2390	40.63	Peak	-5.0	35.59	74.21	38.39	Ver
2483.5	40.32	Peak	-4.8	35.48	74.21	38.50	Hor
2483.5	40.28	Peak	-4.8	35.39	74.21	38.59	Ver

802.11n20

Frequency [MHz]	Reading [dB μV]	Detector Mode	Factor [dB]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Pol/Phase
2390	40.15	Peak	-5.0	34.95	74.21	39.03	Hor
2390	40.05	Peak	-5.0	35.14	74.21	38.84	Ver
2483.5	40.38	Peak	-4.8	35.57	74.21	38.41	Hor
2483.5	39.15	Peak	-4.8	34.29	74.21	39.69	Ver

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

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: Wireless charger configuration was evaluated.

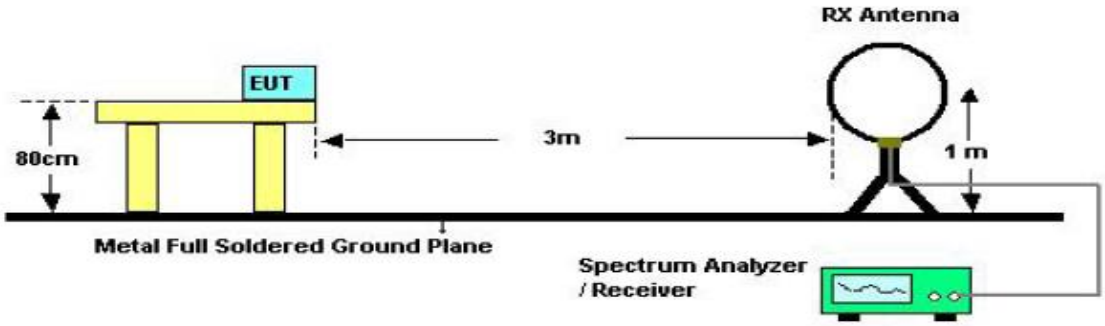
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

6.7.2 Test Procedure

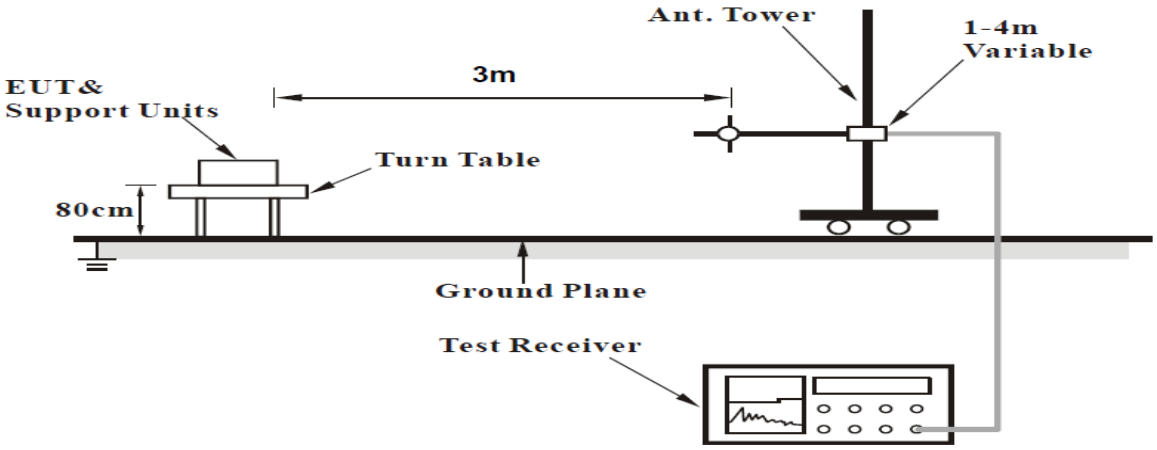
1. The testing follows FCC KDB Publication No. 558074 D01 15.247 Meas. Guidance v05.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. 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.
4. 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.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, 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.
7. Use the following spectrum analyzer settings and peak emission levels are measured :
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW (9-150kHz: 200Hz, 0.15-30MHz: 9kHz, 30-1000MHz: 120kHz, above 1GHz: 1MHz).
   (3) VBW ≥ 3 x 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 ≥ 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.
8. Measure and record the results in the test report.

6.7.3 Test SET-UP (Block Diagram of Configuration)

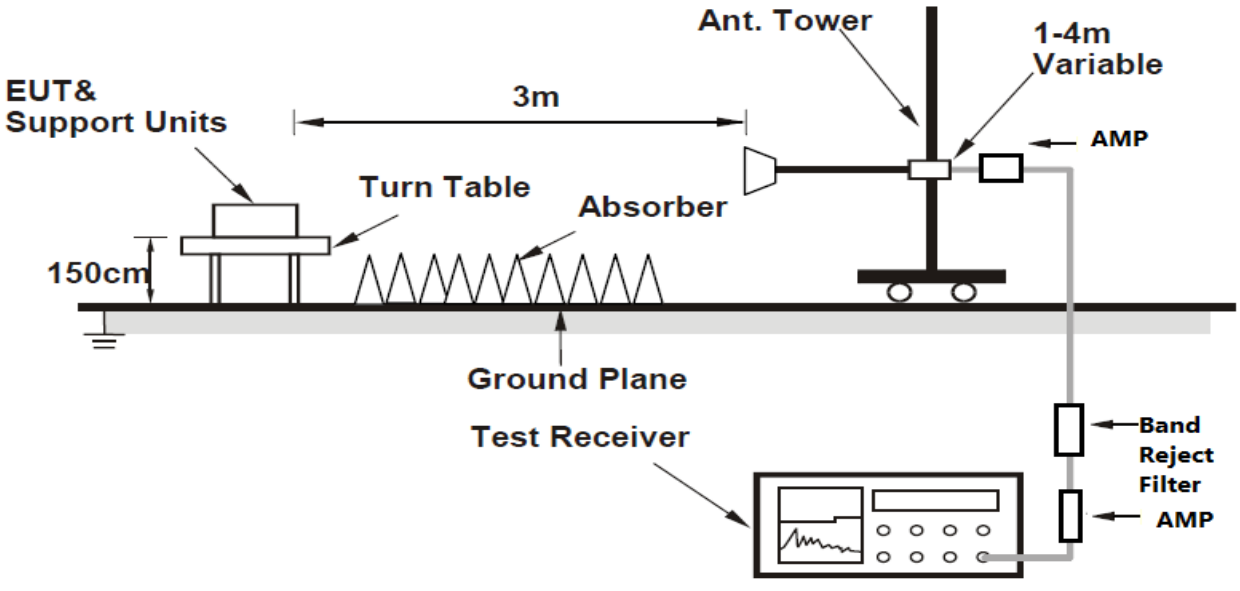
1. Radiated Emission Test Set-Up, Frequency Below 30MHz



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



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



6.7.4 Test Results

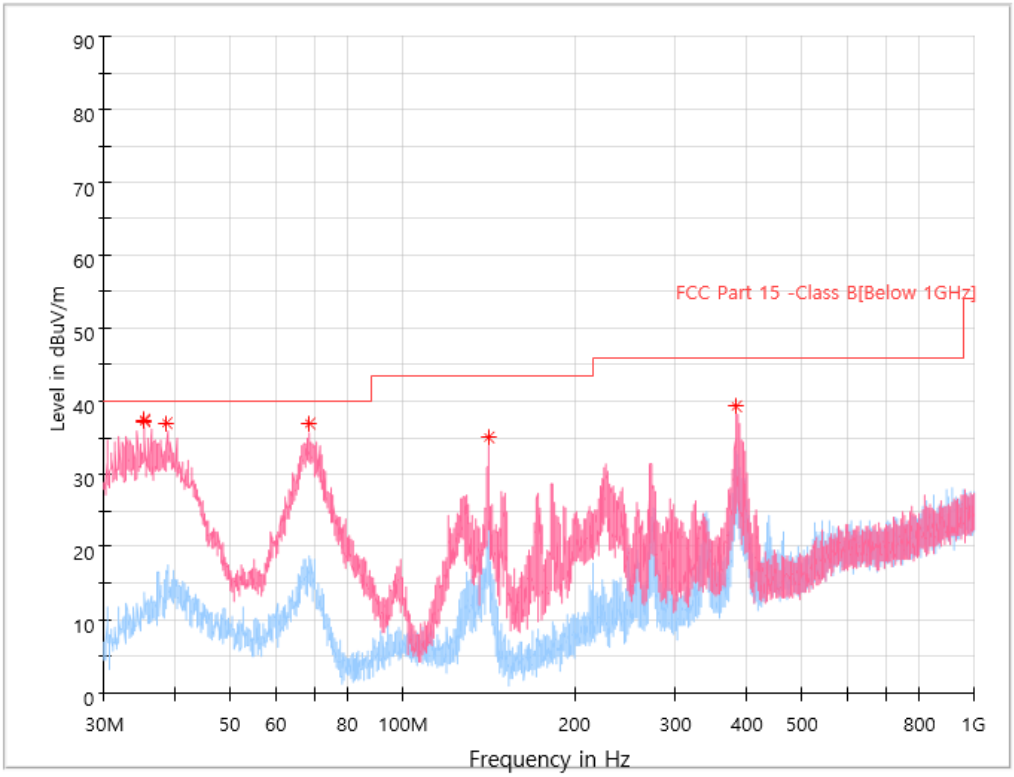
[Below 30MHz]

Frequency [MHz]	Reading [dB μV]	Antenna Factor [dB]	Cable Loss [dB]	Preamp Factor [dB]	Level [dBuV/m]	Pol/Phase
No other emissions were detected at a level greater than 20dB 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 1GHz – 30MHz~1GHz]

Test Mode : 802.11b

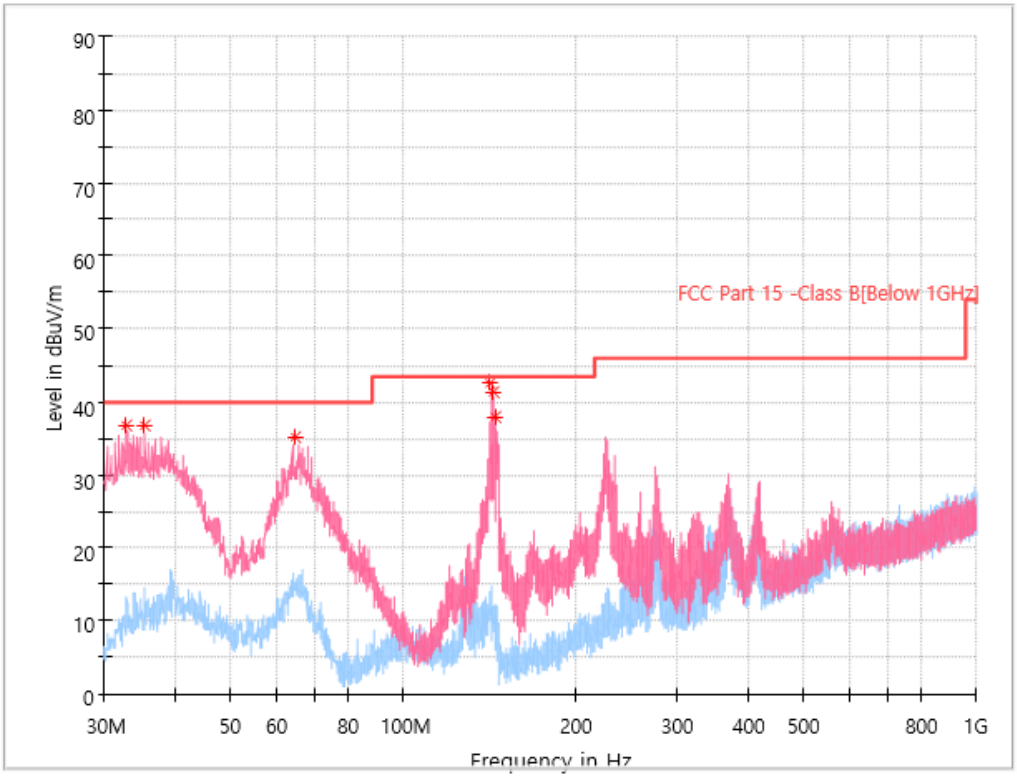


Final_Result

Frequency (MHz)	QuasiPeak (dBuV/m	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.315000	37.53	40.00	2.47	15000.0	120.000	265.0	V	211.0	-27.9
35.335000	37.58	40.00	2.42	15000.0	120.000	250.0	V	0.0	-27.9
38.760000	37.24	40.00	2.76	15000.0	120.000	245.0	V	175.0	-26.7
69.180500	37.13	40.00	2.87	15000.0	120.000	300.0	V	175.0	-28.9
141.718000	35.01	43.52	8.51	15000.0	120.000	275.0	V	345.0	-30.0
384.031500	39.81	46.02	6.21	15000.0	120.000	355.0	V	351.0	-19.6

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

Test Mode : 802.11g

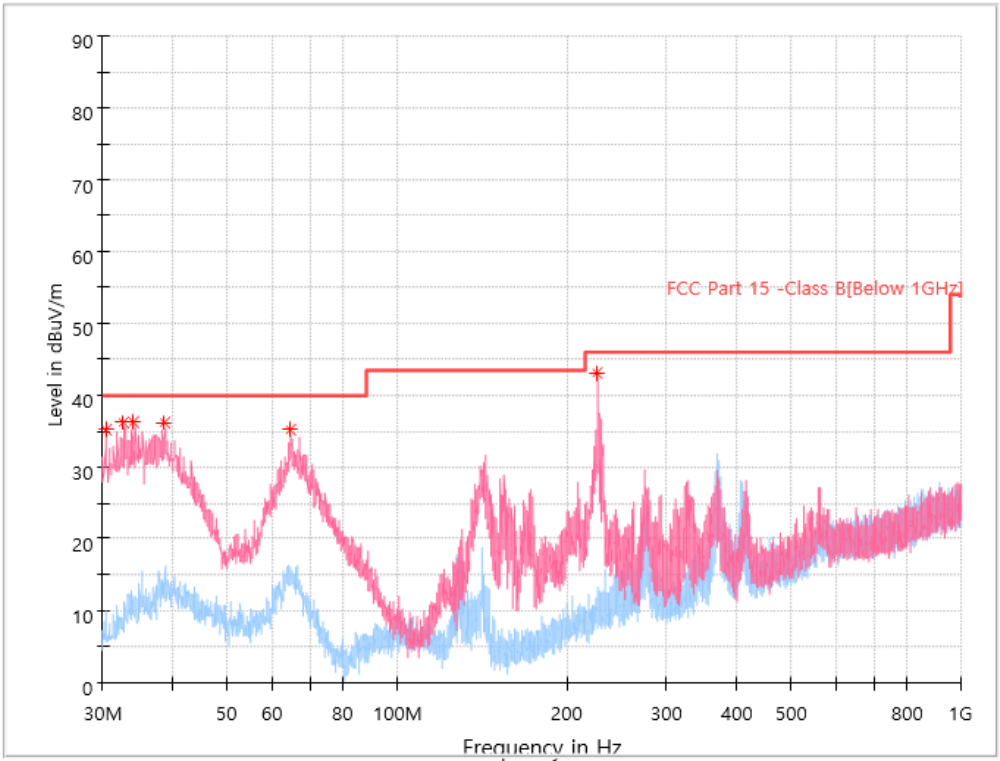


Final_Result

Frequency (MHz)	QuasiPeak (dBuV/m	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
32.861500	36.94	40.00	3.06	15000.0	120.000	213.0	V	280.0	-28.2
35.305000	36.98	40.00	3.02	15000.0	120.000	240.0	V	136.0	-27.9
64.730000	35.02	40.00	4.98	15000.0	120.000	210.0	V	289.0	-27.9
142.739000	42.35	43.52	1.17	15000.0	120.000	257.0	V	38.0	-30.0
142.760500	42.30	43.52	1.22	15000.0	120.000	391.0	V	38.0	-30.0
143.419000	38.13	43.52	5.39	15000.0	120.000	390.0	V	38.0	-29.9

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

Test Mode : 802.11n(HT20)



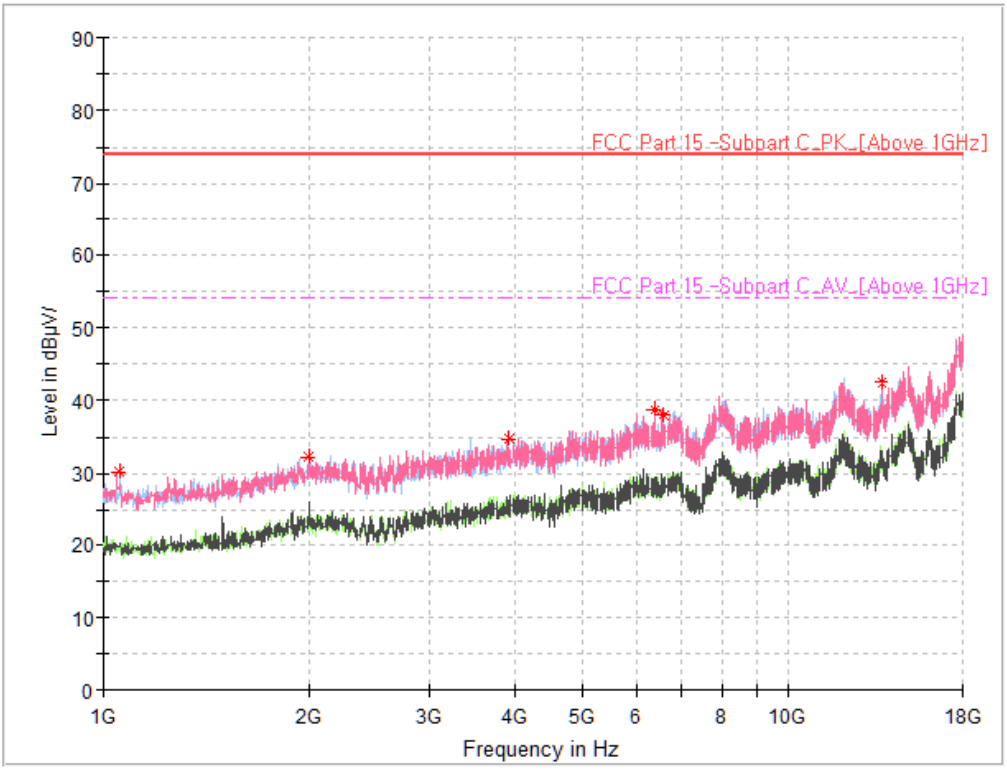
Final_Result

Frequency (MHz)	QuasiPeak (dBuV/m	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.270000	35.03	40.00	4.97	15000.0	120.000	200.0	V	156.0	-28.4
32.831500	36.95	40.00	3.05	15000.0	120.000	210.0	V	119.0	-28.2
35.355000	37.01	40.00	2.99	15000.0	120.000	290.0	V	252.0	-27.9
38.718500	36.88	40.00	3.12	15000.0	120.000	310.0	V	119.0	-26.7
65.884500	35.10	40.00	4.9	15000.0	120.000	400.0	V	0.0	-28.2
224.964000	43.33	46.02	2.69	15000.0	120.000	320.0	V	0.0	-24.9

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

[Above 1GHz - 1GHz~18GHz]

Test Mode : 802.11b

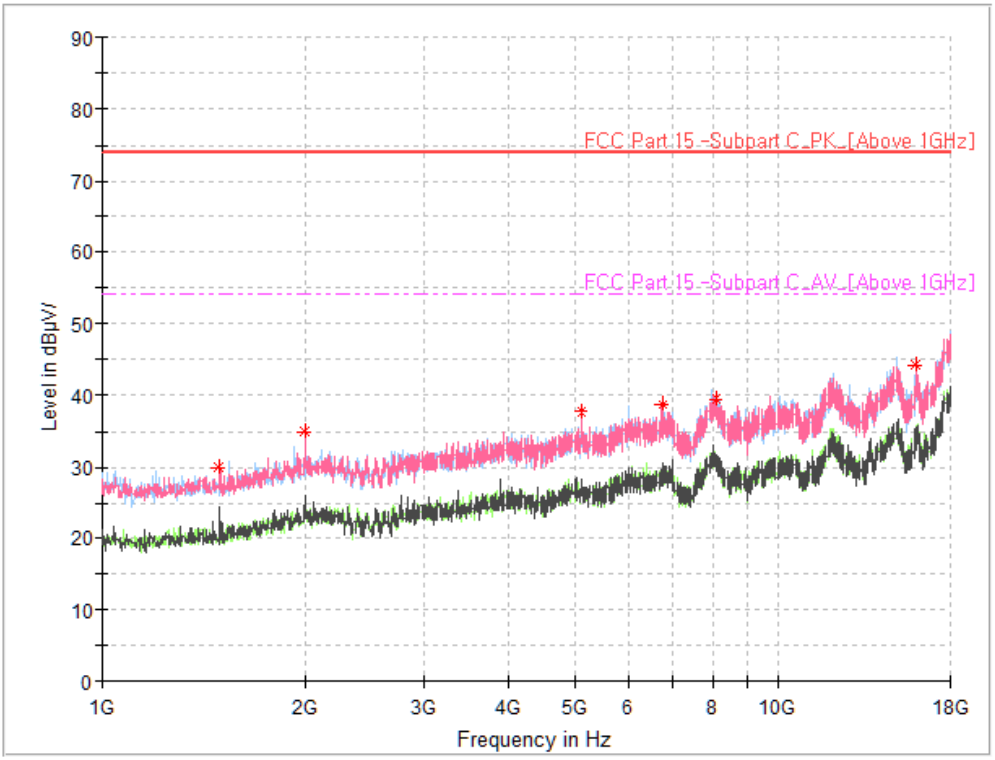


Critical_Freqs

Frequency (MHz)	MaxPeak (dB¥iV/m)	Average (dB¥iV/m)	Limit (dB¥iV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1059.500000	30.18	---	74.00	43.82	5.0	1000.000	100.0	H	318.0
1996.625000	32.25	---	74.00	41.75	5.0	1000.000	100.0	V	316.0
3907.000000	34.71	---	74.00	39.29	5.0	1000.000	100.0	H	155.0
6376.250000	38.71	---	74.00	35.29	5.0	1000.000	100.0	V	43.0
6610.000000	37.90	---	74.00	36.10	5.0	1000.000	100.0	H	51.0
13769.125000	42.45	---	74.00	31.55	5.0	1000.000	100.0	V	0.0

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

Test Mode : 802.11g

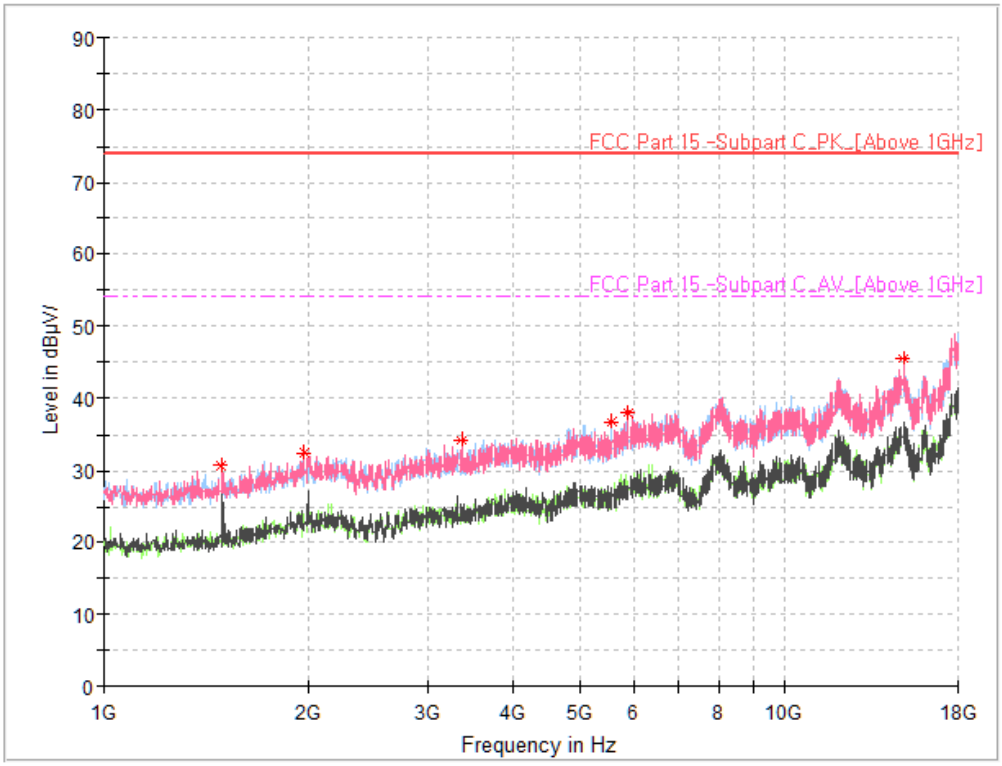


Critical_Freqs

Frequency (MHz)	MaxPeak (dB¥iV/m)	Average (dB¥iV/m)	Limit (dB¥iV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1493.000000	29.94	---	74.00	44.06	5.0	1000.000	100.0	V	0.0
1998.750000	34.98	---	74.00	39.02	5.0	1000.000	100.0	V	70.0
5131.000000	37.72	---	74.00	36.28	5.0	1000.000	100.0	V	145.0
6767.250000	38.68	---	74.00	35.32	5.0	1000.000	100.0	H	108.0
8131.500000	39.56	---	74.00	34.44	5.0	1000.000	100.0	V	204.0
16062.000000	44.16	---	74.00	29.84	5.0	1000.000	100.0	V	221.0

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

Test Mode : 802.11n(HT20)



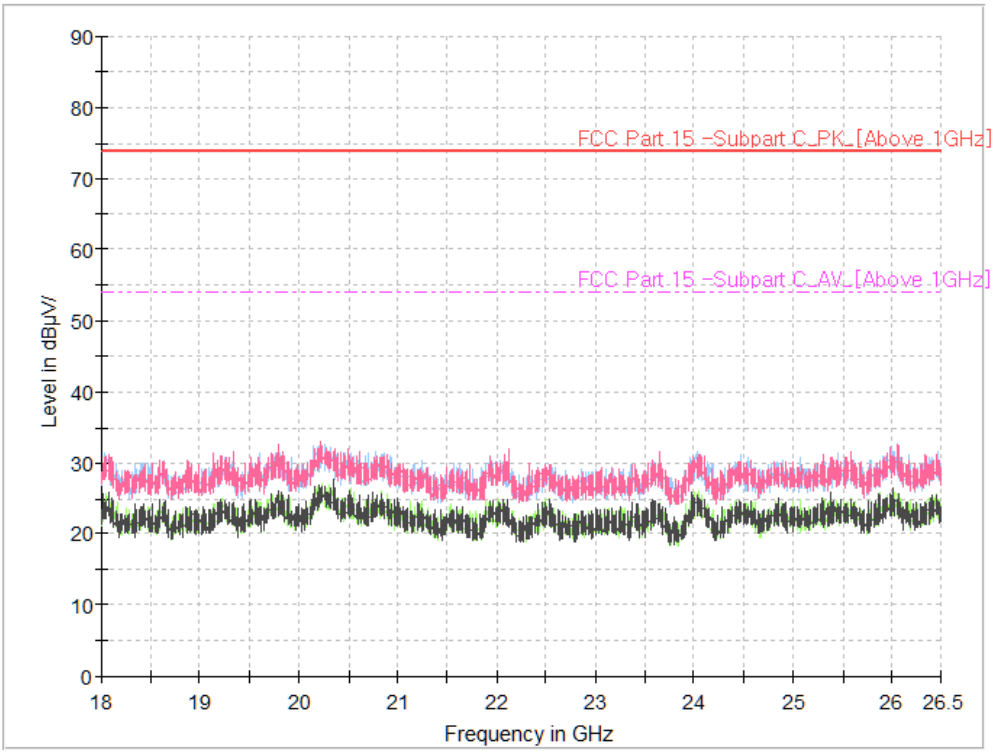
Critical_Freqs

Frequency (MHz)	MaxPeak (dB¥iV/m)	Average (dB¥iV/m)	Limit (dB¥iV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1493.000000	30.60	---	74.00	43.40	5.0	1000.000	100.0	V	136.0
1973.250000	32.55	---	74.00	41.45	5.0	1000.000	100.0	H	243.0
3367.250000	34.13	---	74.00	39.87	5.0	1000.000	100.0	V	0.0
5600.625000	36.76	---	74.00	37.24	5.0	1000.000	100.0	H	0.0
5900.250000	38.05	---	74.00	35.95	5.0	1000.000	100.0	V	59.0
15001.625000	45.42	---	74.00	28.58	5.0	1000.000	100.0	V	18.0

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

[Above 1GHz - 18GHz~26GHz]

Test Mode : 802.11b

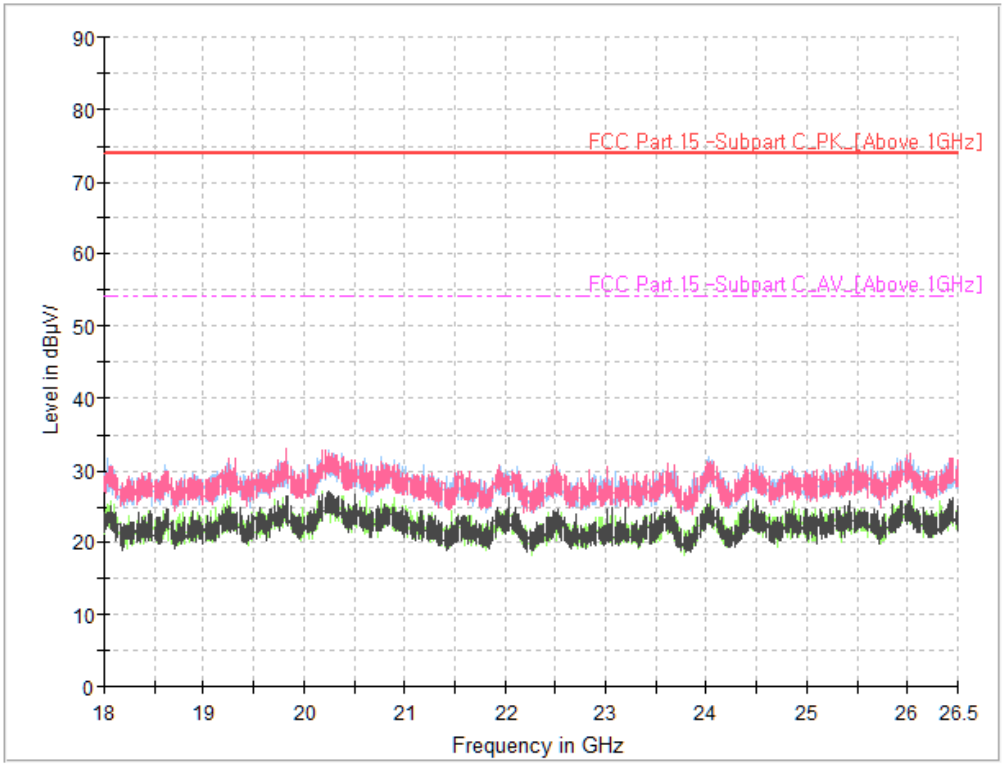


Final_Result

Frequency (MHz)	MaxPeak (dB¥iV/m)	Average (dB¥iV/m)	Limit (dB¥iV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
---	---	---	---	---	---	---	---		---

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

Test Mode : 802.11g

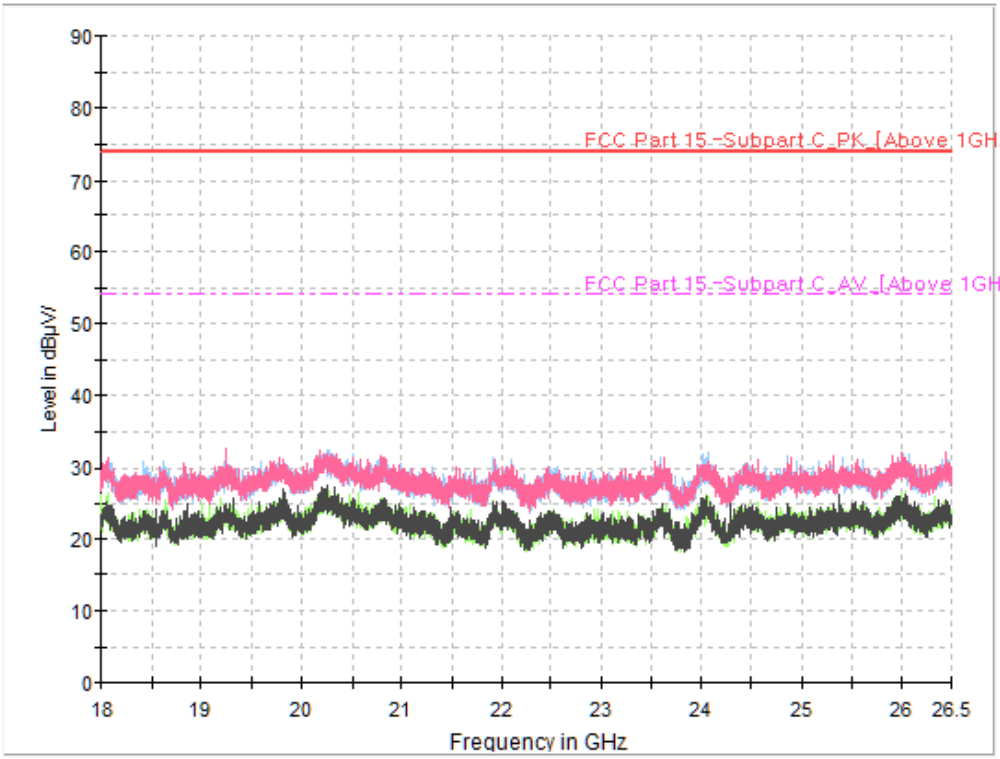


Final_Result

Frequency (MHz)	MaxPeak (dB¥iV/m)	Average (dB¥iV/m)	Limit (dB¥iV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
---	---	---	---	---	---	---	---		---

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

Test Mode : 802.11n(HT20)



Final_Result

Frequency (MHz)	MaxPeak (dB¥iV/m)	Average (dB¥iV/m)	Limit (dB¥iV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
---	---	---	---	---	---	---	---		---

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

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 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

6.8.2 Test Results

Antenna Type	Frequency	Antenna Gain	Limit	Result
PCB Antenna	2.4GHz	3.09 dBi	≤6dBi	Pass