

FCC Test Report

Product Name : Multi-Service Modular Router

Brand Name : BEC, Billion

Model No. : BEC MX-600

FCC ID : QI3BEC-MX600

Applicant : Billion Electric Co., Ltd.

Address : 8F., No.192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City 231, Taiwan (R.O.C.)

Date of Receipt : Aug. 27, 2021

Issued Date : Nov. 04, 2021

Report No. : 2181152R-RFUSWL2V01

Report Version : V1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

This report must not be used to claim product endorsement by TAF or any agency of the government.

Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

The test report shall not be reproduced except in full without the written approval of DEKRA Testing and Certification Co., Ltd.

Test Report Certification



Product Name : Multi-Service Modular Router
Applicant : Billion Electric Co., Ltd.
Address : 8F., No.192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City
231, Taiwan (R.O.C.)
Manufacturer : Billion Electric Co., Ltd.
Address : 8F., No.192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City
231, Taiwan (R.O.C.)
Brand Name : BEC, Billion
Model No. : BEC MX-600
FCC ID : QI3BEC-MX600
EUT Voltage : DC 12V or DC 15V (adapter)
Testing Voltage : AC 120V/60Hz
Applicable Standard : FCC CFR Title 47 Part 15 Subpart C Section 15.247
ANSI C63.10: 2013
Laboratory Name : Hsin Chu Laboratory
Address : No.372-2, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu
County 310, Taiwan, R.O.C.
TEL: +886-3-582-8001 / FAX: +886-3-582-8958
Test Result : Complied

Documented By : Amelia Wu
(Amelia Wu /Project Specialist)

Approved By : Louis Hsu
(Louis Hsu / Deputy Manager)

The test results relate only to the samples tested.
The test report shall not be reproduced except in full without the written approval of DEKRA Testing and Certification Co., Ltd.

Revision History

Version	Description	Issued Date
V1.0	Initial issue of report	Nov. 04, 2021

TABLE OF CONTENTS

Description	Page
1. General Information.....	6
1.1. EUT Description	6
1.2. Test Mode.....	8
1.3. Comments and Remarks.....	9
1.4. Tested System Details	9
1.5. Configuration of Tested System.....	10
1.6. EUT Operation of during Test	11
1.7. Test Facility	12
1.8. List of Test Equipment	14
1.9. Measurement Uncertainty	15
1.10. Duty Cycle.....	16
2. AC Power Line Conducted Emission.....	18
2.1. Test Setup	18
2.2. Test Limit.....	18
2.3. Test Procedure	18
2.4. Test Specification	18
2.5. Test Result of AC Power Line Conducted Emission.....	19
3. Maximum Conducted Output Power.....	21
3.1. Test Setup	21
3.2. Test Limit.....	21
3.3. Test Procedures	21
3.4. Test Specification	21
3.5. Test Result of Maximum Conducted Output Power.....	22
4. Radiated Emission	23
4.1. Test Setup	23
4.2. Test Limit.....	24
4.3. Test Procedure	24
4.4. Test Specification	24
4.5. Test Result of Radiated Emissions (30 MHz ~ 1 GHz).....	25
4.6. Test Result of Radiated Emissions (1 GHz ~ 10 th Harmonic).....	26
5. Antenna Port Conducted Emission.....	32
5.1. Test Setup	32
5.2. Test Limit.....	32
5.3. Test Procedure	32
5.4. Test Specification	32
5.5. Test Result of Antenna Port Conducted Emission.....	33
6. Radiated Emission Band Edge.....	43
6.1. Test Setup	43
6.2. Test Limit.....	43
6.3. Test Procedure	43
6.4. Test Specification	43
6.5. Test Result of Radiated Emission Band Edge.....	44
7. Occupied Bandwidth & DTS Bandwidth.....	56
7.1. Test Setup	56
7.2. Test Limit.....	56
7.3. Test Procedures	56
7.4. Test Specification	56
7.5. Test Result of Occupied Bandwidth	57

7.6.	Test Result of DTS Bandwidth	59
8.	Maximum Power Spectral Density	61
8.1.	Test Setup	61
8.2.	Test Limit	61
8.3.	Test Procedures	61
8.4.	Test Specification	61
8.5.	Test Result of Maximum Power Spectral Density.....	62
Appendix A.....		64
<input type="checkbox"/>	Test Result of Radiated Emissions Co-location.....	64
Appendix B		65
<input type="checkbox"/>	Test Setup Photograph	65

1. General Information

1.1. EUT Description

Product Name	Multi-Service Modular Router	
Brand Name	BEC, Billion	
Model No.	BEC MX-600	
Frequency Range / Channel Number	IEEE 802.11b/g	2412 ~ 2462 MHz / 11 Channels
	IEEE 802.11n (20 MHz)	2412 ~ 2462 MHz / 11 Channels
	IEEE 802.11n (40 MHz)	2422 ~ 2452 MHz / 7 Channels
Type of Modulation	IEEE 802.11b	DSSS
	IEEE 802.11g/n	OFDM
Data Rate	IEEE 802.11b	1, 2, 5.5, 11 Mbps
	IEEE 802.11g	6, 9, 12, 18, 24, 36, 48, 54 Mbps
	IEEE 802.11n	Support a subset of the combination of GI, MCS 0 ~ MCS 15 and bandwidth defined in 802.11n

Accessories Information				
No.	Equipment Name	Brand Name	Model No.	Rating
1	Adapter	BILLION	BA024-150160AXU	INPUT: AC 100-240V, 0.7A, 50/60Hz OUTPUT: DC 15V, 1.6A
No.	Equipment Name	Description		
2	RJ-45 Cable	Non-Shielded, 1.8m		

The difference for each model is shown as below:

Brand Name	Description
BEC	There is nothing different of two brand names, just for different marketing use.
Billion	

Antenna Information				
Ant.	Brand Name	Model No.	Type	Antenna Gain (dBi)
0	Master	98612PRSX000	Dipole	2.56
1	Master	98612PRSX000	Dipole	2.56

For IEEE 802.11b/g mode: (1TX/1RX)

The EUT supports the antenna with TX and RX diversity functions.

Both Ant. 0 and Ant. 1 support transmit and receive functions, but only one of them will be used at one time.

The Ant. 0 generated the worst case, so it was selected to test and record in the report.

For IEEE 802.11n Mode: (2TX, 2RX)

Both Ant. 0 and Ant. 1 can be used as transmitting/receiving antennas, and them can transmit/receive signal simultaneously.

IEEE 802.11b/g & IEEE 802.11n (20 MHz)

Working Frequency of Each Channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
001	2412 MHz	002	2417 MHz	003	2422 MHz	004	2427 MHz
005	2432 MHz	006	2437 MHz	007	2442 MHz	008	2447 MHz
009	2452 MHz	010	2457 MHz	011	2462 MHz	-	-

IEEE 802.11n (40 MHz)

Working Frequency of Each Channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
003	2422 MHz	004	2427 MHz	005	2432 MHz	006	2437 MHz
007	2442 MHz	008	2447 MHz	009	2452 MHz	-	-

Note:

1. Regards to the frequency band operation; the lowest, middle and highest frequency of channel were selected to perform the test, and then shown on this report.
2. The above EUT information is declared by the manufacturer.

1.2. Test Mode

DEKRA has verified the construction and function in typical operation. The preliminary tests were performed in different data rate, and to find the worst condition, which was shown in this test report. The following table is the final test mode.

Test Mode	Mode 1: Transmit
-----------	------------------

Test Items	Test Mode	Modulation	Channel	Antenna	Result
AC Power Line Conducted Emission	Mode 1	11n (40 MHz)	6	0+1	Pass
Maximum Conducted Output Power	Mode 1	11b	1/6/11	0	Pass
		11g	1/6/11	0	Pass
		11n (20 MHz)	1/6/11	0+1	Pass
		11n (40 MHz)	3/6/9	0+1	Pass
Radiated Emission Below 1 GHz	Mode 1	11n (40 MHz)	6	0+1	Pass
Radiated Emission Above 1 GHz	Mode 1	11b	1/6/11	0	Pass
		11g	1/6/11	0	Pass
		11n (20 MHz)	1/6/11	0+1	Pass
		11n (40 MHz)	3/6/9	0+1	Pass
Antenna Port Conducted Emission	Mode 1	11b	1/6/11	0	Pass
		11g	1/6/11	0	Pass
		11n (20 MHz)	1/6/11	0/1	Pass
		11n (40 MHz)	3/6/9	0/1	Pass
Radiated Emission Band Edge	Mode 1	11b	1/6/11	0	Pass
		11g	1/6/11	0	Pass
		11n (20 MHz)	1/6/11	0+1	Pass
		11n (40 MHz)	3/6/9	0+1	Pass
Occupied Bandwidth & DTS Bandwidth	Mode 1	11b	1/6/11	0	Pass
		11g	1/6/11	0	Pass
		11n (20 MHz)	1/6/11	0/1	Pass
		11n (40 MHz)	3/6/9	0/1	Pass
Maximum Power Spectral Density	Mode 1	11b	1/6/11	0	Pass
		11g	1/6/11	0	Pass
		11n (20 MHz)	1/6/11	0+1	Pass
		11n (40 MHz)	3/6/9	0+1	Pass

Note:

- Determining compliance shall be based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
- The worst case of data rate for 802.11b is 1 Mbps, for 802.11g is 6 Mbps, for 802.11n (20 MHz)/802.11n (40 MHz) are MCS 0, Nss1.

3. For below 1 GHz radiated emission and AC Power Line Conducted Emission have performed all modes of operation were investigated and the worst-case emissions are reported.
4. The EUT was performed at X axis and Z axis position for radiated emission and band edge tests. The worst case was found at Z axis, so the measurement will follow this same test configuration.
5. The EUT could be applied with WLAN 2.4 GHz function, WLAN 5 GHz function and WWAN LTE function; therefore, Co-location Maximum Permissible Exposure (Please refer to DEKRA Report No.: 2181152R-RFUSMPEV02) and Radiated Emission Co-location (Please refer to Appendix A) tests are added for simultaneously transmit between WLAN 2.4 GHz function, WLAN 5 GHz function and WWAN LTE function.

1.3. Comments and Remarks

The product specification and testing instructions for the EUT declared in the report are provided by the manufacturer who will take all responsibilities for the accuracy.

1.4. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

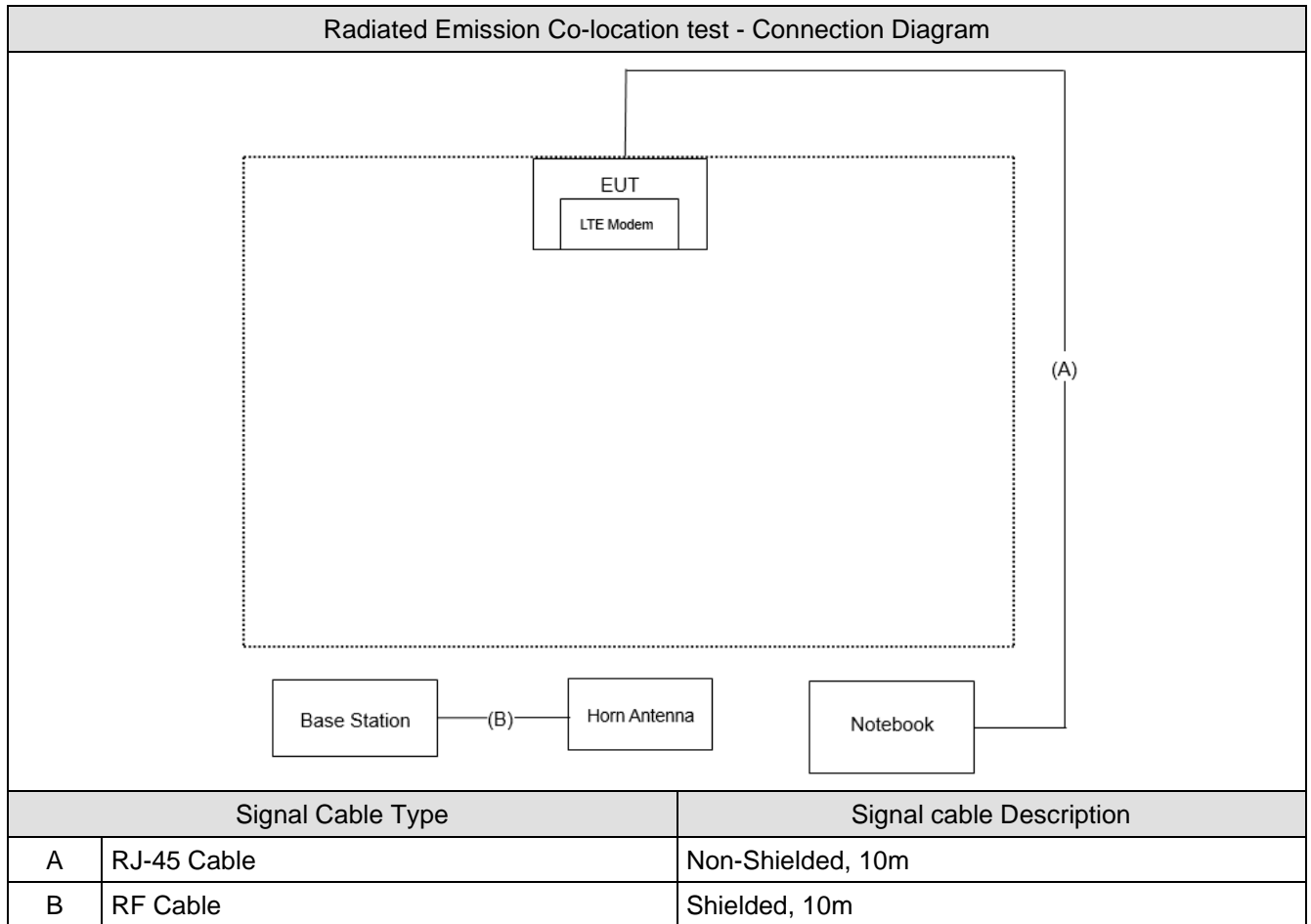
For Radiated Emission Co-location test:

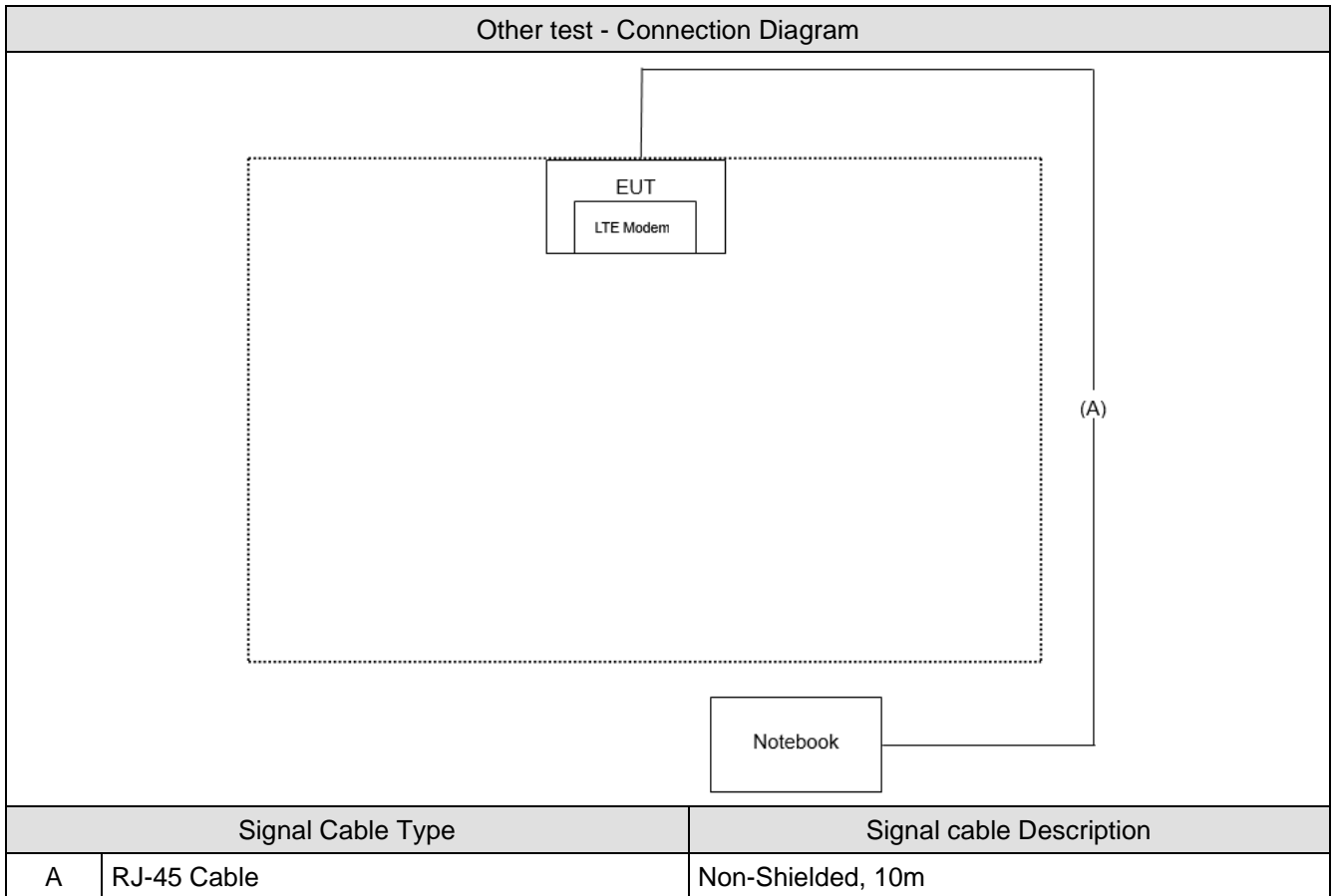
	Product	Manufacturer	Model No.	Serial No.	FCC ID
1	LTE Modem	BEC	MX-100UG	N/A	Contains module FCC ID: RI7LM960
2	Notebook	DELL	Latitude E6320	8611271467	N/A
3	Horn Antenna	Schwarzbeck	BBHA 9120D	1640	N/A
4	Base Station	R&S	CMW500	106071	N/A

For other test:

	Product	Manufacturer	Model No.	Serial No.	FCC ID
1	LTE Modem	BEC	MX-100UG	N/A	Contains module FCC ID: RI7LM960
2	Notebook	DELL	Latitude E6320	8611271467	N/A

1.5. Configuration of Tested System





1.6. EUT Operation of during Test

For Radiated Emission Co-location test:

1	Set the EUT as shown.
2	Execute the control software MT7615 QA 0.0.1.88
3	Configure test mode, test channel and data rate.
4	Let the EUT start sending transmit continuously.
5	EUT is connected through the base station
6	Verify that device is working properly

For other test:

1	Set the EUT as shown.
2	Execute the control software MT7615 QA 0.0.1.88
3	Configure test mode, test channel and data rate.
4	Let the EUT start sending transmit continuously.
5	Verify that device is working properly

1.7. Test Facility

Ambient conditions in the laboratory:

Items	Test Item	Actually	Tested by	Test Date	Test Site
Temperature (°C)	AC Power Line Conducted Emission	24.5	Elwin Lin	2021/9/30	SR2-H
Humidity (%RH)		57			
Temperature (°C)	Maximum Conducted Output Power	24	Clemens Fang	2021/10/14	SR12-H
Humidity (%RH)		70			
Temperature (°C)	Radiated Emission	22 ~ 24.5	Geta Yang Ling Chen	2021/9/17 ~ 2021/10/20	CB2-H
Humidity (%RH)		60 ~ 68			
Temperature (°C)	Antenna Port Conducted Emission	21 ~ 23	Elwin Lin Clemens Fang	2021/9/21 ~ 2121/10/18	SR12-H
Humidity (%RH)		62 ~ 67			
Temperature (°C)	Radiated Emission Band Edge	22 ~ 24.5	Geta Yang Ling Chen	2021/9/17 ~ 2021/10/20	CB2-H
Humidity (%RH)		60 ~ 68			
Temperature (°C)	Occupied Bandwidth & DTS Bandwidth	21 ~ 23	Elwin Lin Clemens Fang	2021/9/21 ~ 2121/10/18	SR12-H
Humidity (%RH)		62 ~ 67			
Temperature (°C)	Maximum Power Spectral Density	23	Clemens Fang	2021/10/18	SR12-H
Humidity (%RH)		67			

Note: Test site information refers to Laboratory Information.

USA : **FCC Registration Number: TW3024**
Canada : **CAB identifier : TW3024**

The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site: <http://www.dekra.com.tw>

If you have any comments, please don't hesitate to contact us. Our test sites as below:

Test Laboratory	DEKRA Testing and Certification Co., Ltd.
Address	1. No.372-2, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C. 2. No.372, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C.
Phone number	1. +886-3-582-8001 2. +886-3-582-8001
Fax number	1. +886-3-582-8958 2. +886-3-582-8958
E mail address	info.tw@dekra.com
Website	http://www.dekra.com.tw
Note: Test site number for address 1 includes SR2-H. Test site number for address 2 includes CB2-H, CB3-H, CB4-H, SR10-H and SR12-H.	

1.8. List of Test Equipment

SR2-H

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Artificial Mains Network	R&S	ENV4200	848411/010	2020/12/24	2021/12/23
Test Receiver	R&S	ESCS 30	836858/022	2021/02/22	2022/02/21
LISN	R&S	ENV216	100092	2021/06/08	2022/06/07

SR12-H

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
High Speed Peak Power Meter Dual Input	Anritsu	ML2496A	1602004	2020/11/30	2021/11/29
Pulse Power Sensor	Anritsu	MA2411B	1531043	2020/11/30	2021/11/29
EXA Signal Analyzer	Keysight	N9010A	MY51440132	2021/01/25	2022/01/24
Pulse Power Sensor	Anritsu	MA2411B	1531044	2020/11/30	2021/11/29
Power Meter	Keysight	8990B	MY51000248	2021/05/21	2022/05/20
Power Sensor	Keysight	N1923A	MY57240005	2021/05/21	2022/05/20
Spectrum Analyzer	Keysight	N9030B	MY57140404	2021/05/14	2022/05/13
Spectrum Analyzer	Keysight	N9010B	MY57110159	2021/03/29	2022/03/28
Spectrum Analyzer	Agilent	N9010A	US47140172	2021/05/28	2022/05/27
Signal & Spectrum Analyzer	R&S	FSV40	101049	2021/03/31	2022/03/30

CB2-H

Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Signal Analyzer	R&S	FSVA40	101455	2020/10/12	2021/10/11
Signal & Spectrum Analyzer	R&S	FSV40	101049	2021/03/31	2022/03/30
Signal Analyzer	R&S	FSVA40	101435	2021/06/04	2022/06/03
EXA Signal Analyzer	Keysight	N9010A	MY51440132	2021/01/25	2022/01/24
Trilog Broadband Antenna	Schwarzbeck	VULB 9168	1272	2021/08/20	2022/08/19
Bilog Antenna	Teseq	CBL6112D	23191	2021/02/26	2022/02/25
Horn Antenna	Schwarzbeck	BBHA 9120D	639	2021/05/17	2022/05/16
Horn Antenna	Schwarzbeck	BBHA 9170	202	2020/12/16	2021/12/15
Pre-Amplifier	EMCI	EMC01820I	980365	2021/05/28	2022/05/27
Pre-Amplifier	EMEC	EM01G18GA	060741	2021/07/02	2022/07/01
Pre-Amplifier	DEKRA	AP-400C	201801231	2020/11/16	2021/11/15
Coaxial Cable(13m)	Huber+Suhner	SF104	CB2-H	2021/08/17	2022/08/16
Radiated Software	AUDIX	e3 V9	CB2-H	N/A	N/A

Note: All equipment upon which need to calibrated are with calibration period of 1 year.

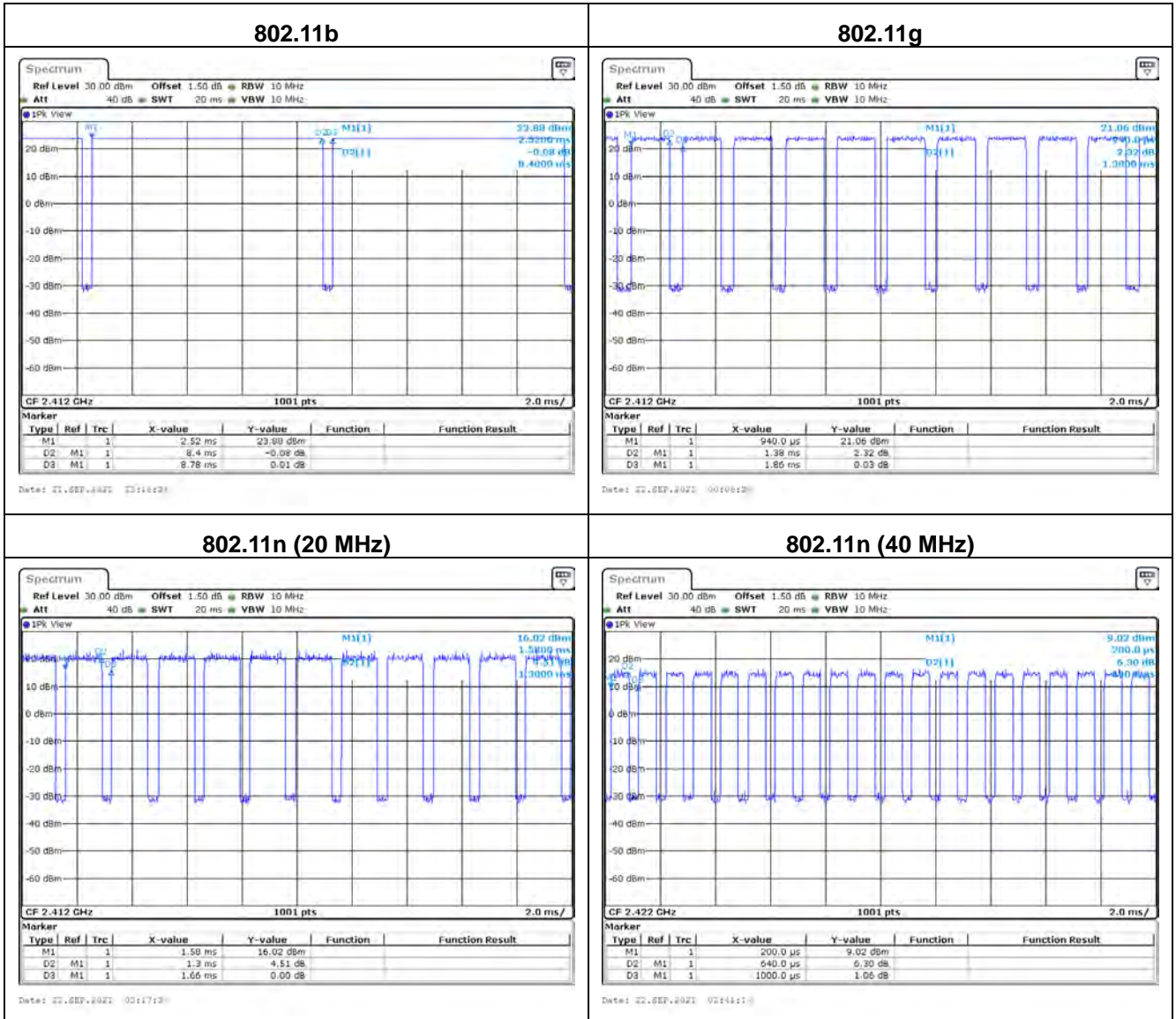
1.9. Measurement Uncertainty

Uncertainties have been calculated according to the DEKRA internal document with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)).

Test Item	Uncertainty
AC Power Line Conducted Emission	± 2.1 dB
Radiated Emission	± 3.40 dB below 1 GHz ± 3.46 dB above 1 GHz
Maximum Conducted Output Power	± 1.16 dB
Antenna Port Conducted Emission	± 1.27 dB
Radiated Emission Band Edge	± 3.46 dB above 1GHz
DTS Bandwidth	± 637 Hz
Occupied Bandwidth	± 637 Hz
Maximum Power Spectral Density	± 2.11 dB

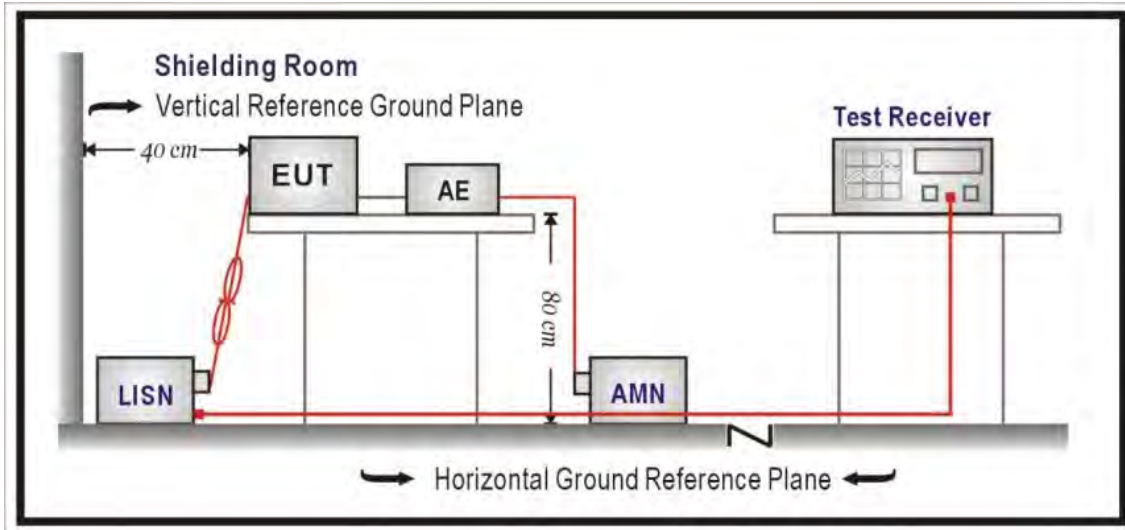
1.10. Duty Cycle

Modulation	On Times (ms)	On+Off Times (ms)	Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)
802.11b	8.400	8.780	95.67	0.192	0.119
802.11g	1.380	1.860	74.19	1.296	0.725
802.11n (20 MHz)	1.300	1.660	78.31	1.062	0.769
802.11n (40 MHz)	0.640	1.000	64.00	1.938	1.563



2. AC Power Line Conducted Emission

2.1. Test Setup



2.2. Test Limit

Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

2.3. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 ohm/50 uH coupling impedance with 50 ohm termination. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.

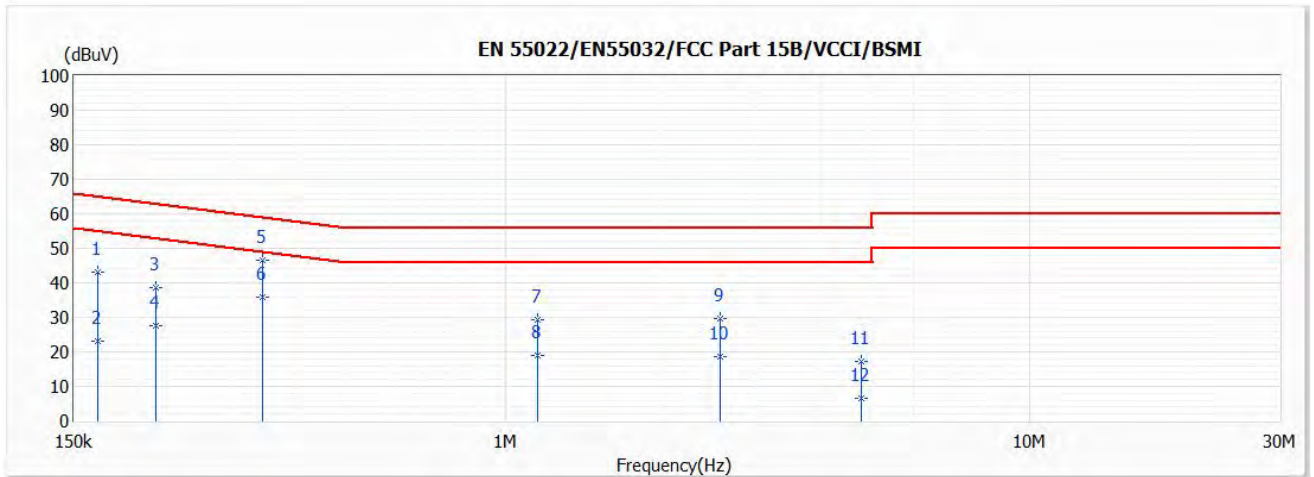
AC Power Line Conducted Emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9 kHz.

2.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

2.5. Test Result of AC Power Line Conducted Emission

Test Mode	Mode 1: Transmit	Phase	Line
Test Condition	802.11n (40MHz) / Ant. 0 + Ant. 1 / 2437 MHz		

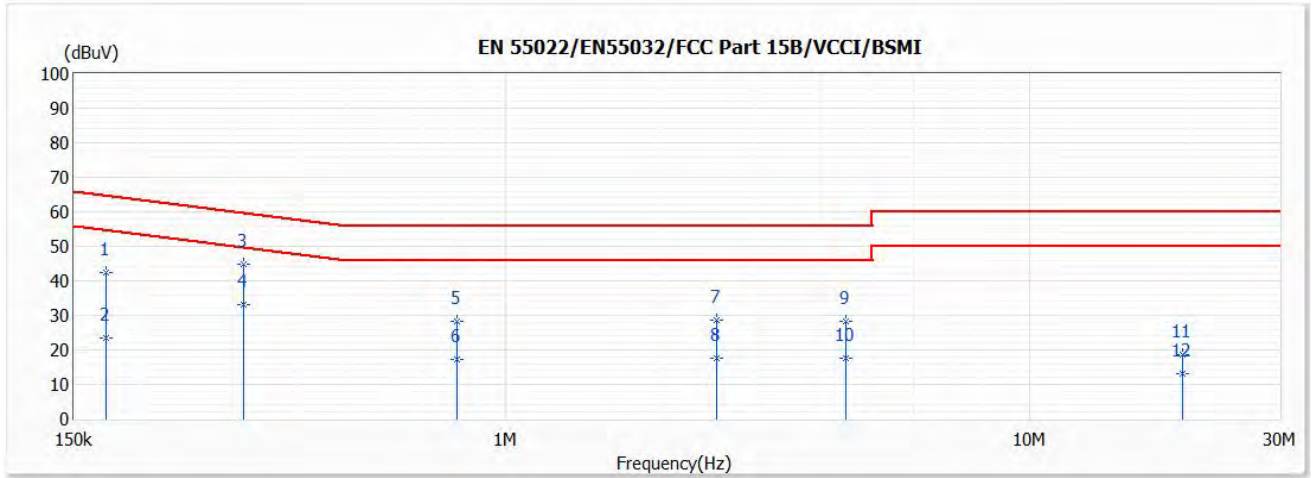


No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.166	43.00	65.15	-22.15	33.37	9.63	QP
2	0.166	23.18	55.15	-31.97	13.55	9.63	AV
3	0.215	38.60	62.99	-24.39	28.96	9.64	QP
4	0.215	27.45	52.99	-25.54	17.81	9.64	AV
*5	0.344	46.41	59.11	-12.70	36.76	9.65	QP
6	0.344	35.83	49.11	-13.28	26.18	9.65	AV
7	1.150	29.39	56.00	-26.61	19.66	9.73	QP
8	1.150	18.87	46.00	-27.13	9.14	9.73	AV
9	2.565	29.49	56.00	-26.51	19.68	9.81	QP
10	2.565	18.76	46.00	-27.24	8.95	9.81	AV
11	4.771	17.13	56.00	-38.87	7.21	9.92	QP
12	4.771	6.47	46.00	-39.53	-3.45	9.92	AV

Remark:

1. "*" means this data is the worst emission level.
2. Emission Level = Reading Level + Correct Factor (Correct Factor = LISN Insertion Loss + Cable Loss).
3. Margin = Emission Level - Limit.

Test Mode	Mode 1: Transmit	Phase	Neutral
Test Condition	802.11n (40MHz) / Ant. 0 + Ant. 1 / 2437 MHz		



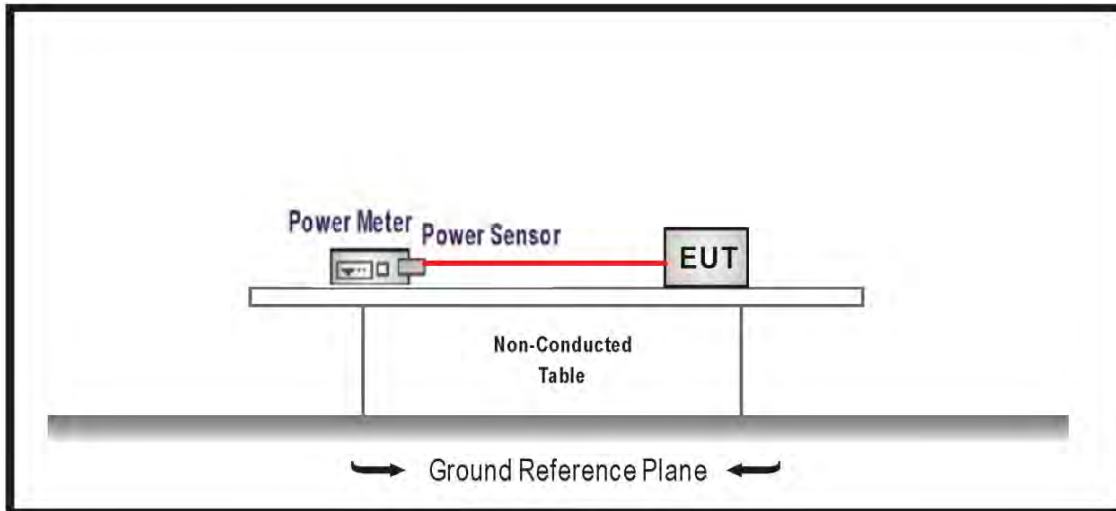
No	Frequency (MHz)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Reading Level (dBuV)	Correct Factor (dB)	Detector Type
1	0.173	42.45	64.83	-22.38	32.81	9.64	QP
2	0.173	23.41	54.83	-31.42	13.77	9.64	AV
*3	0.316	44.85	59.82	-14.97	35.19	9.66	QP
4	0.316	32.97	49.82	-16.85	23.31	9.66	AV
5	0.806	28.33	56.00	-27.67	18.62	9.71	QP
6	0.806	17.10	46.00	-28.90	7.39	9.71	AV
7	2.530	28.55	56.00	-27.45	18.73	9.82	QP
8	2.530	17.69	46.00	-28.31	7.87	9.82	AV
9	4.464	28.34	56.00	-27.66	18.42	9.92	QP
10	4.464	17.65	46.00	-28.35	7.73	9.92	AV
11	19.573	18.74	60.00	-41.26	8.20	10.54	QP
12	19.573	13.23	50.00	-36.77	2.69	10.54	AV

Remark:

1. "*" means this data is the worst emission level.
2. Emission Level = Reading Level + Correct Factor (Correct Factor = LISN Insertion Loss + Cable Loss).
3. Margin = Emission Level - Limit.

3. Maximum Conducted Output Power

3.1. Test Setup



3.2. Test Limit

The maximum conducted output power shall be less 1 Watt.

3.3. Test Procedures

The EUT was setup according to ANSI C63.10: 2013; tested according to DTS test procedure of KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247 requirements.

3.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

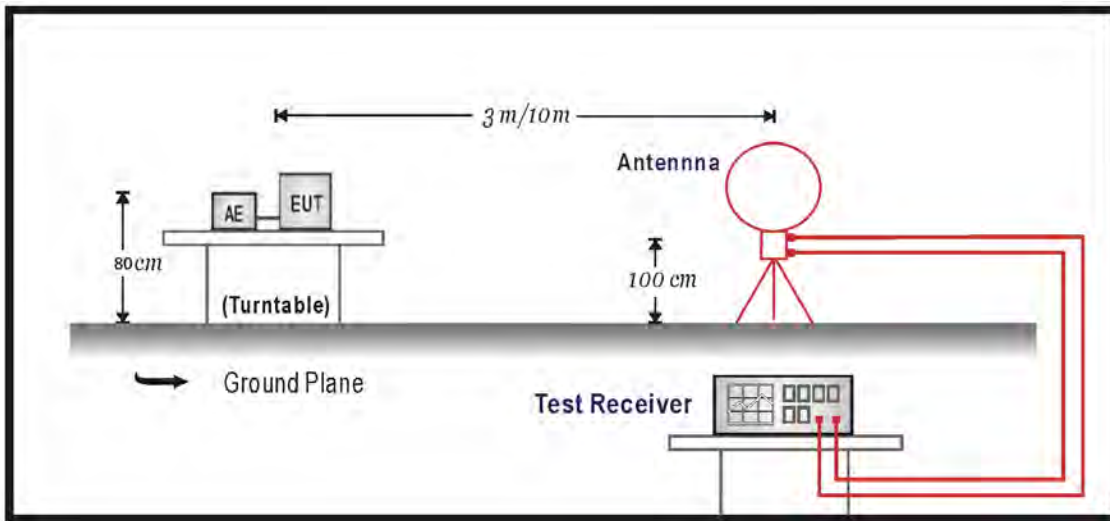
3.5. Test Result of Maximum Conducted Output Power

Modulation	Channel	Frequency (MHz)	Maximum Conducted Output Power (dBm)			Limit (dBm)	Result
			Ant. 0				
802.11b	1	2412	20.920			≤ 30.00	Pass
	6	2437	20.990			≤ 30.00	Pass
	11	2462	21.140			≤ 30.00	Pass
802.11g	1	2412	18.350			≤ 30.00	Pass
	6	2437	18.410			≤ 30.00	Pass
	11	2462	18.590			≤ 30.00	Pass
Modulation	Channel	Frequency (MHz)	Maximum Conducted Output Power (dBm)			Limit (dBm)	Result
			Ant. 0	Ant. 1	Total		
802.11n (20 MHz)	1	2412	15.090	15.440	18.279	≤ 30.00	Pass
	6	2437	15.270	15.420	18.356	≤ 30.00	Pass
	11	2462	15.360	15.410	18.395	≤ 30.00	Pass
802.11n (40 MHz)	3	2422	12.320	12.250	15.295	≤ 30.00	Pass
	6	2437	12.340	12.360	15.360	≤ 30.00	Pass
	9	2452	12.280	12.120	15.211	≤ 30.00	Pass

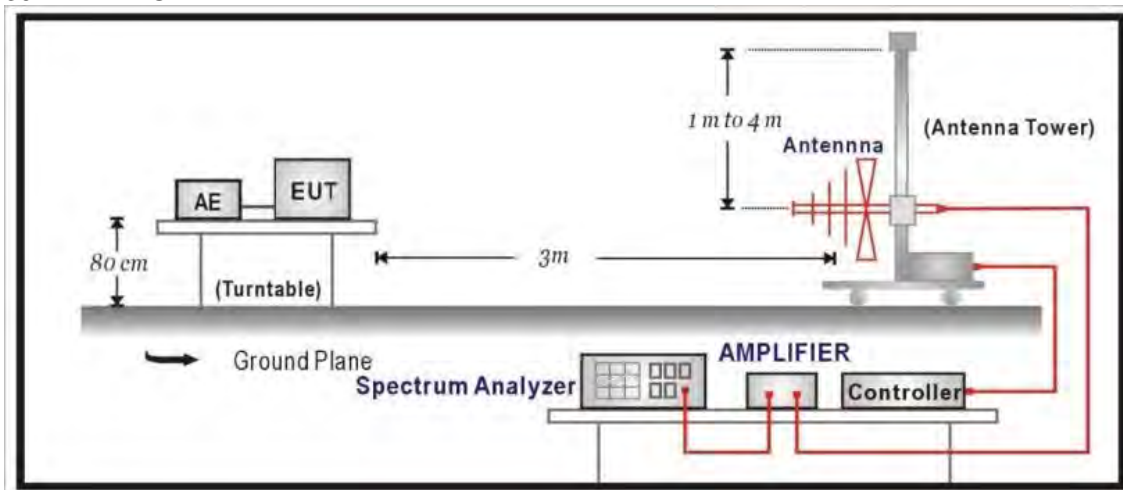
4. Radiated Emission

4.1. Test Setup

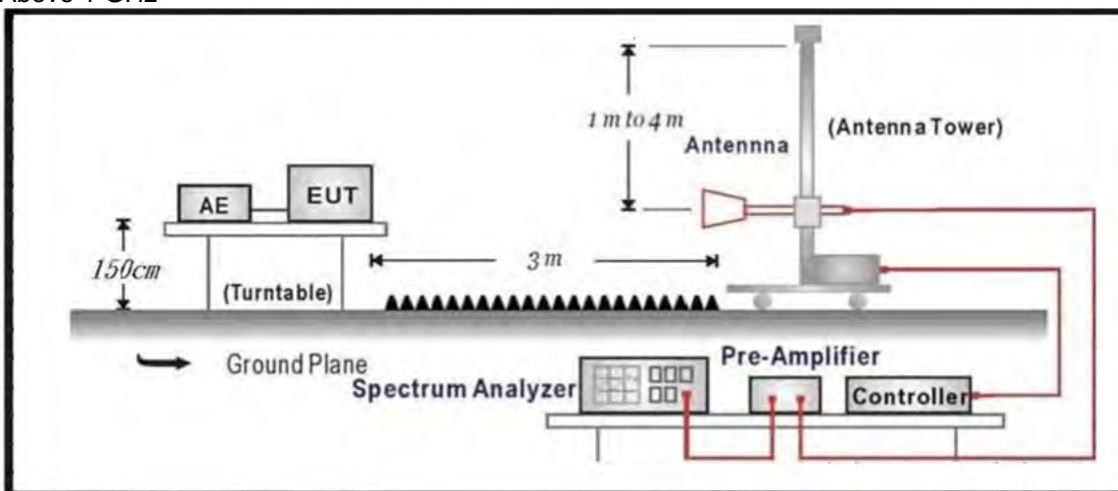
9 kHz ~ 30 MHz



30 MHz ~ 1 GHz



Above 1 GHz



4.2. Test Limit

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 30dB below the level of the fundamental or to the general radiated emission limit in paragraph 15.209, whichever is the lesser attenuation.

Frequency (MHz)	Field strength (uV/m)	Field strength (dBuV/m)	Measurement distance (m)
0.009 – 0.490	2400/F(kHz)	20 log (2400/F(kHz))	300
0.490 – 1.705	24000/F(kHz)	20 log (24000/F(kHz))	30
1.705 - 30	30	29.5	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

Remarks:

1. Field strength (dBuV/m) = 20 log Field strength (uV/m)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

4.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to DTS test procedure of KDB 558074 D01V05r02 for compliance to FCC 47CFR 15.247 requirements.

The EUT and its simulators are placed on a turn table which is 0.8 or 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

On any frequency or frequencies from 9 kHz(include The the lowest oscillator frequency generated within the device up to the 10th harmonic) to 1000 MHz, the limit shown are based on measuring equipment employing a quasi-peak detector function and on any frequency or frequencies above 1000 MHz the radiated limit shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurement are included emission measurement below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.

The bandwidth below 1 GHz setting on the field strength meter is 120 kHz and above 1 GHz is 1 MHz.

4.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

4.5. Test Result of Radiated Emissions (30 MHz ~ 1 GHz)

Site :CB2-H
 Condition :3m Horizontal
 Mode :11n40_TX_2437MHz
 Test By :Cyril

No.	Frequency	Level	Limit	Over	Read	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	48.818	25.49	46.00	-14.51	27.54	-2.05	QP
2	167.255	27.19	43.50	-16.31	29.83	-2.64	QP
3	375.029	27.78	46.00	-18.22	27.57	0.21	QP
4	500.062	35.56	46.00	-10.44	32.34	3.22	QP
5	557.777	36.55	46.00	-9.45	32.06	4.49	QP
6	831.802	31.54	46.00	-14.46	22.00	9.54	QP

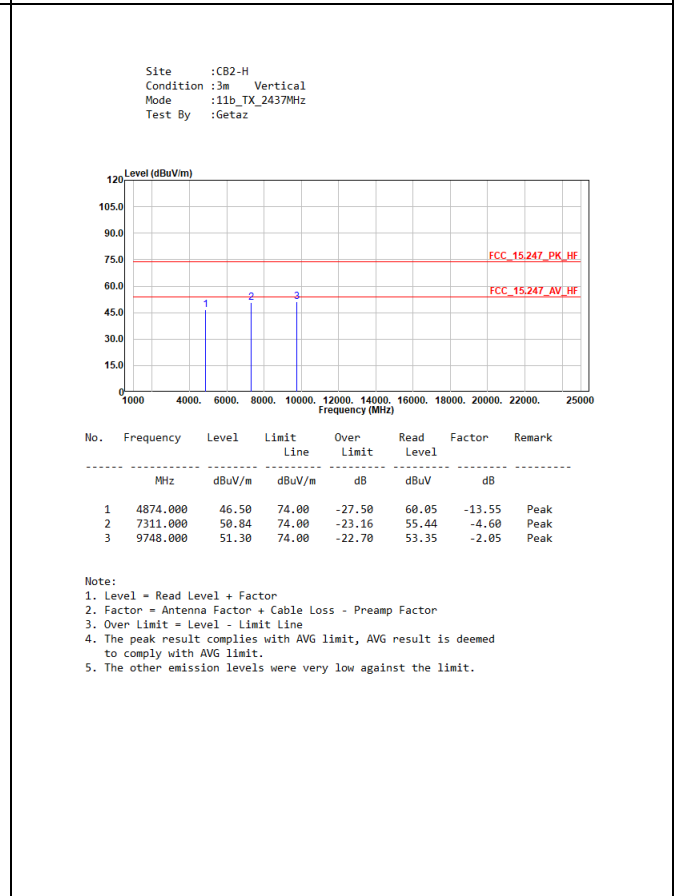
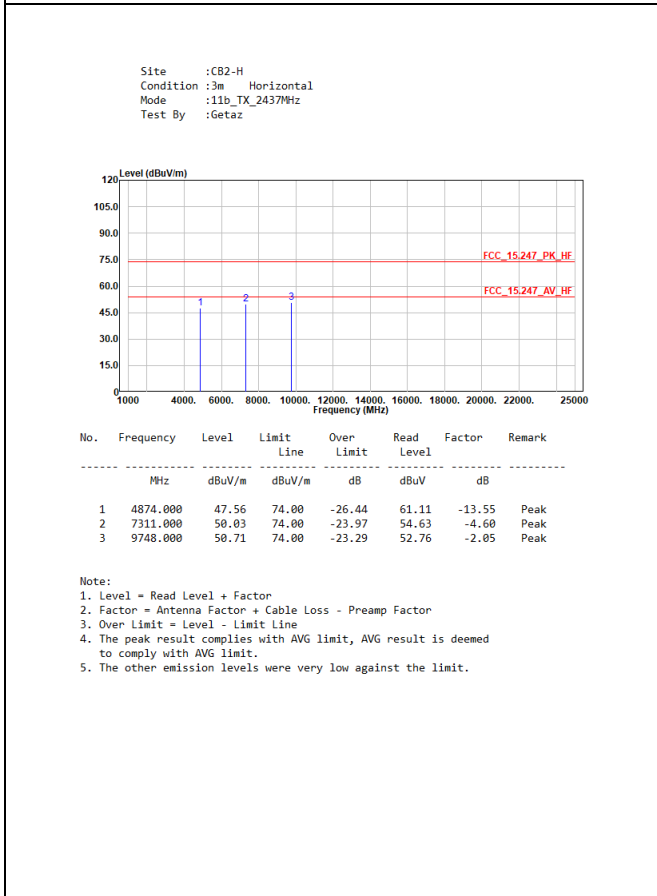
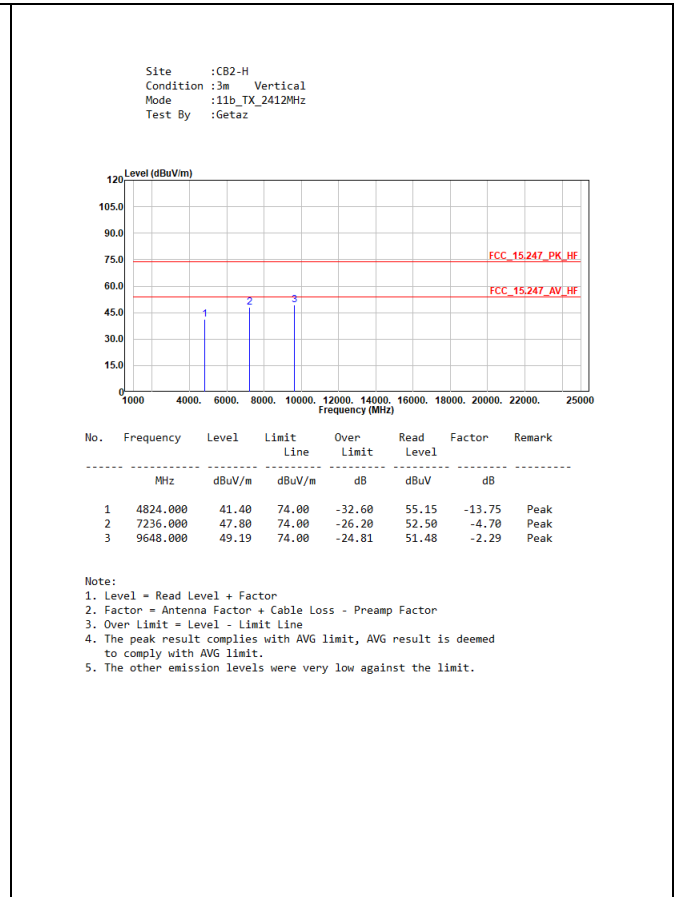
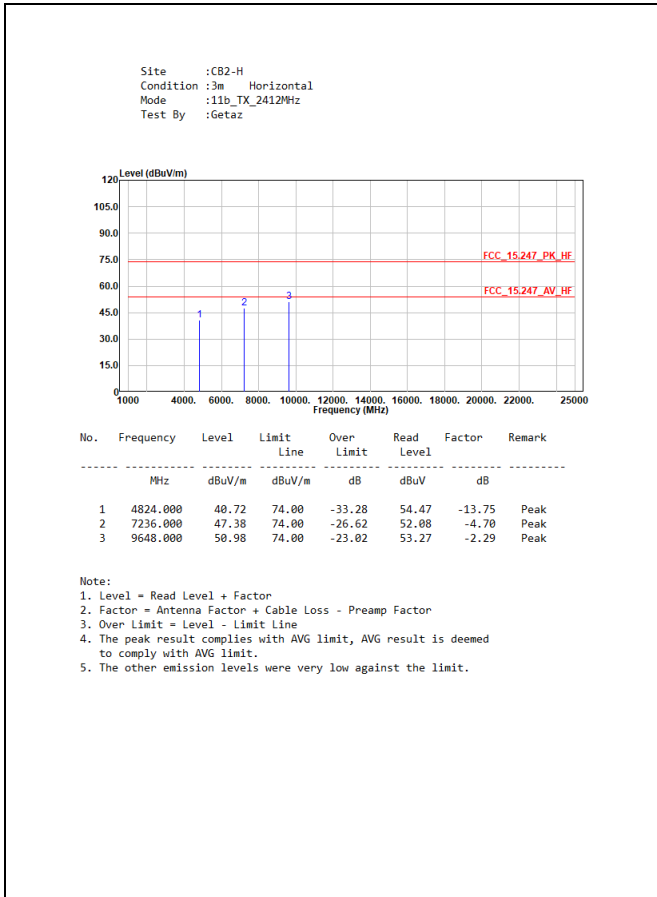
Note:
 1. Level = Read Level + Factor
 2. Factor = Antenna Factor + Cable Loss - Preamp Factor
 3. Over Limit = Level - Limit Line
 4. The emission under 30MHz was not included since the emission levels are very low against the limit.
 5. The other emission levels were very low against the limit.

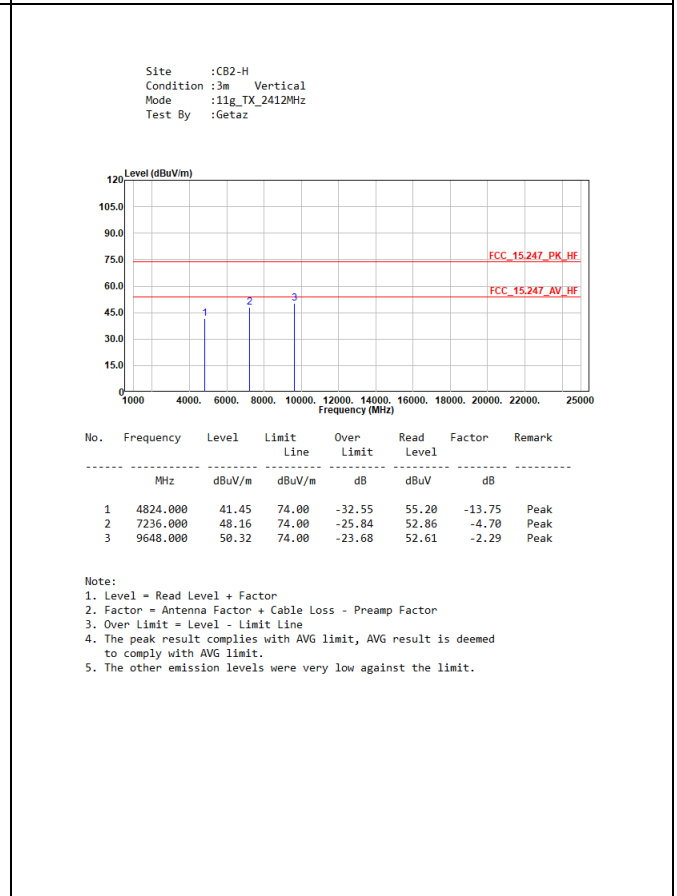
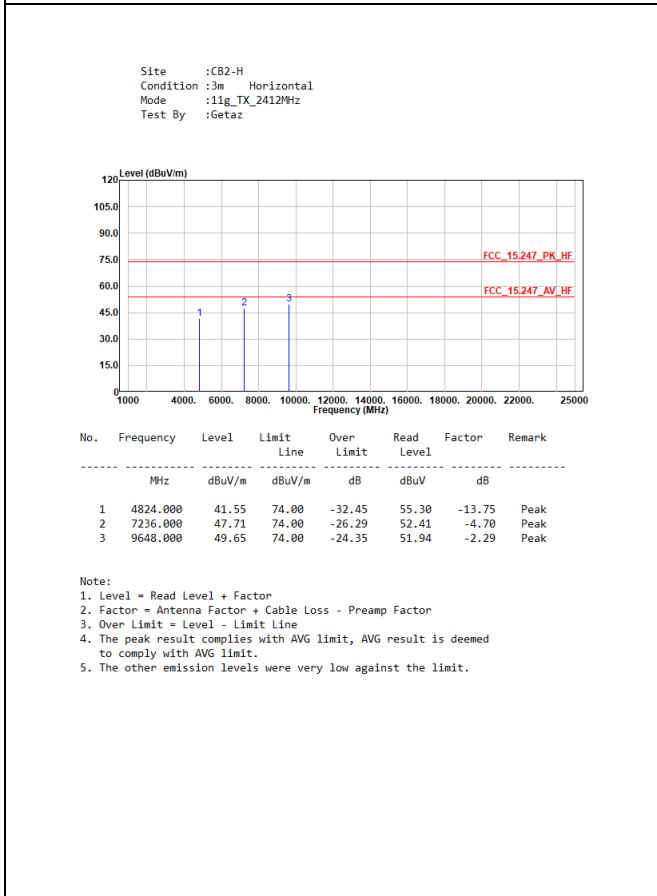
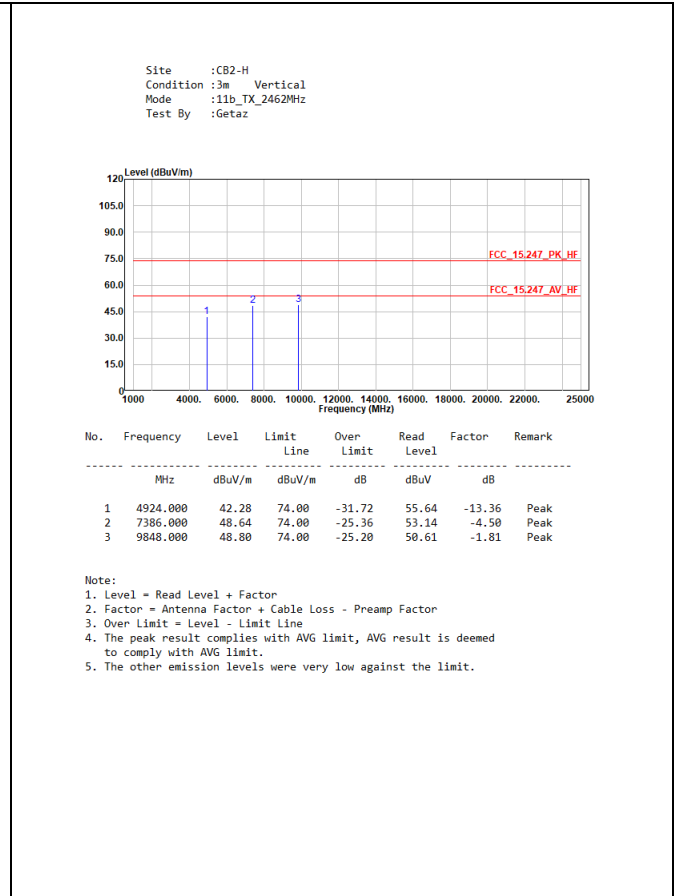
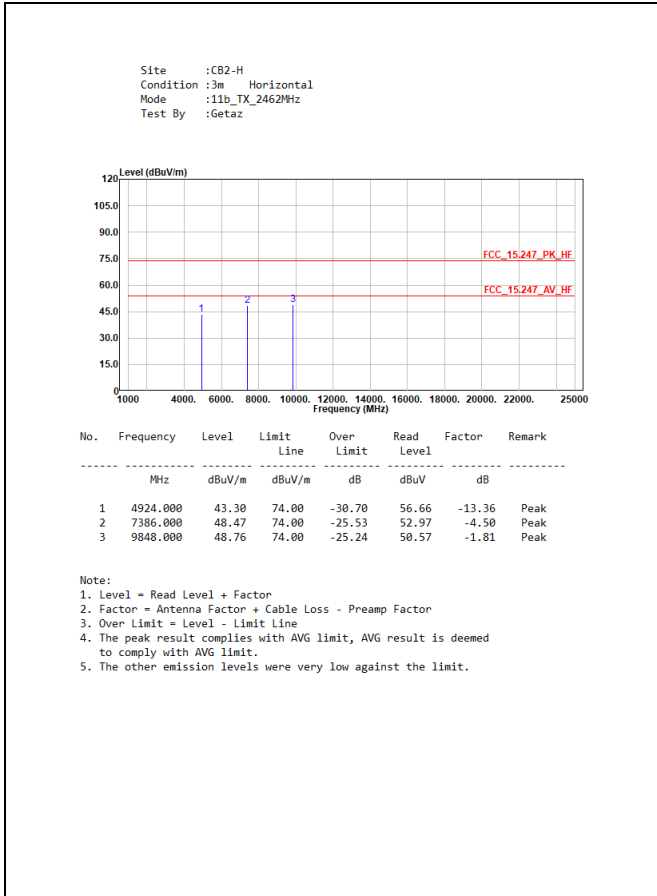
Site :CB2-H
 Condition :3m Vertical
 Mode :11n40_TX_2437MHz
 Test By :Cyril

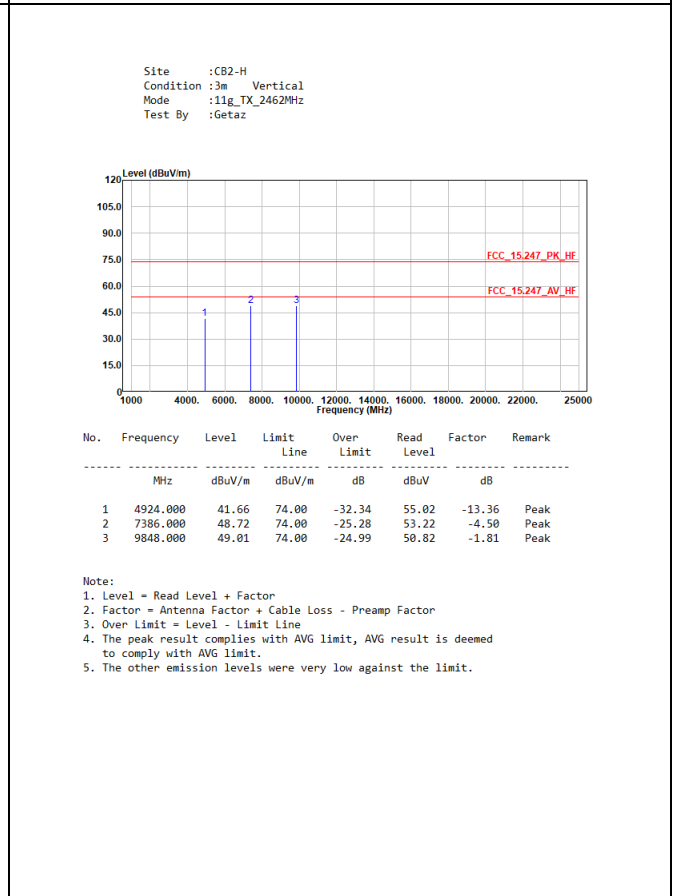
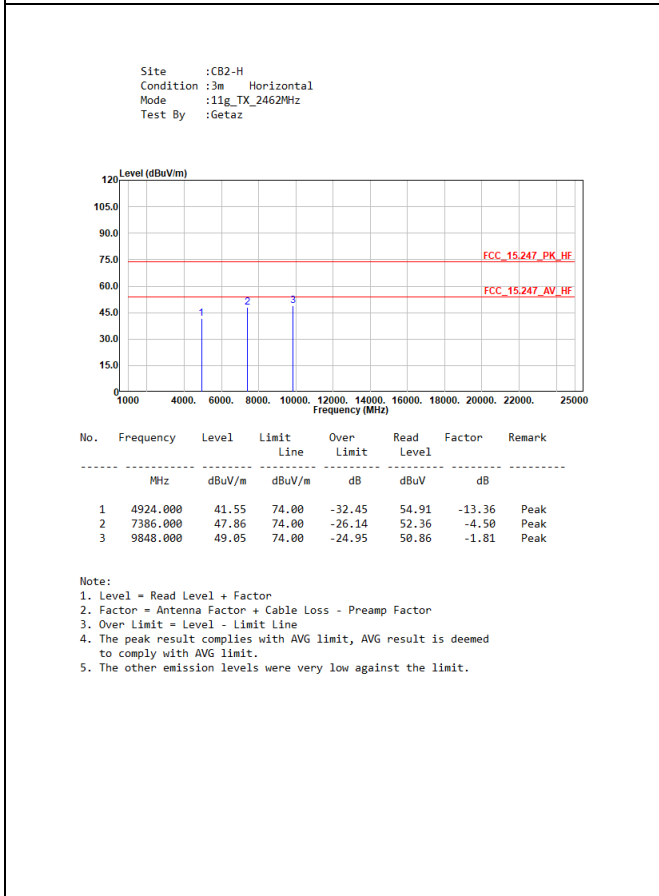
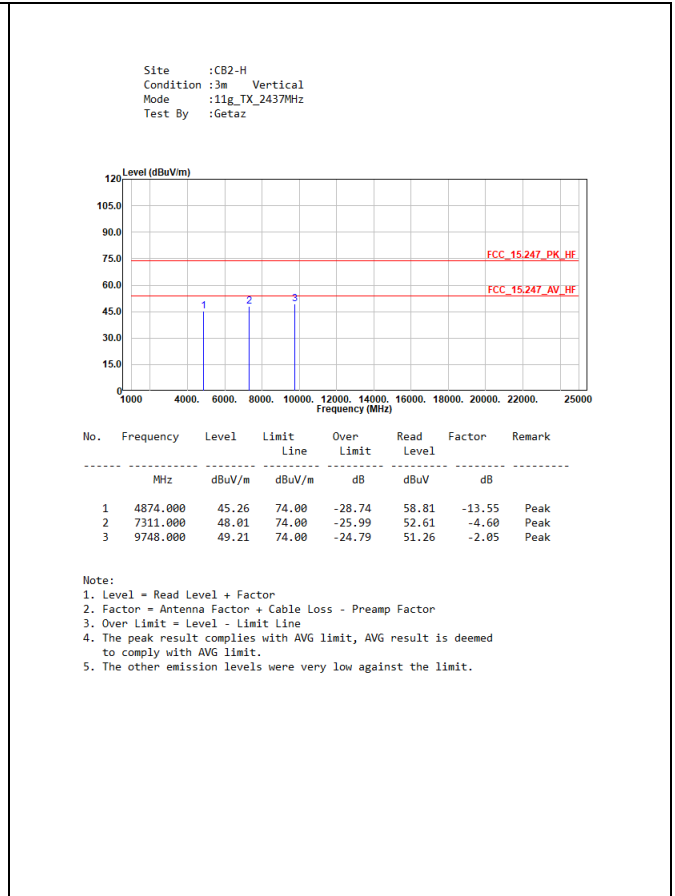
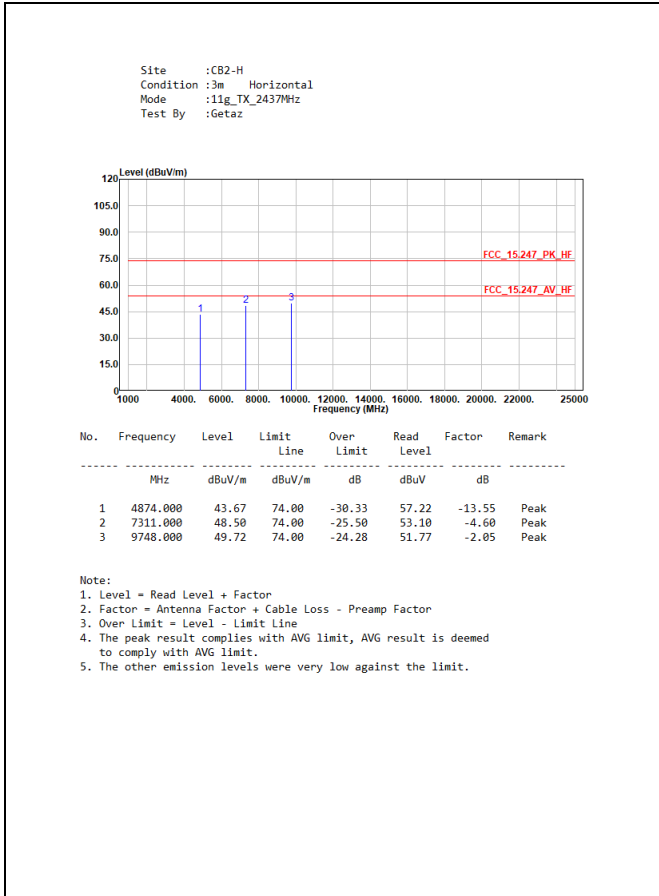
No.	Frequency	Level	Limit	Over	Read	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	94.990	30.47	43.50	-13.03	38.60	-8.13	QP
2	125.060	29.84	43.50	-13.66	34.18	-4.34	QP
3	249.996	30.36	46.00	-15.64	34.07	-3.71	QP
4	375.029	29.56	46.00	-16.44	29.35	0.21	QP
5	500.062	34.27	46.00	-11.73	31.05	3.22	QP
6	590.272	34.96	46.00	-11.04	29.51	5.45	QP

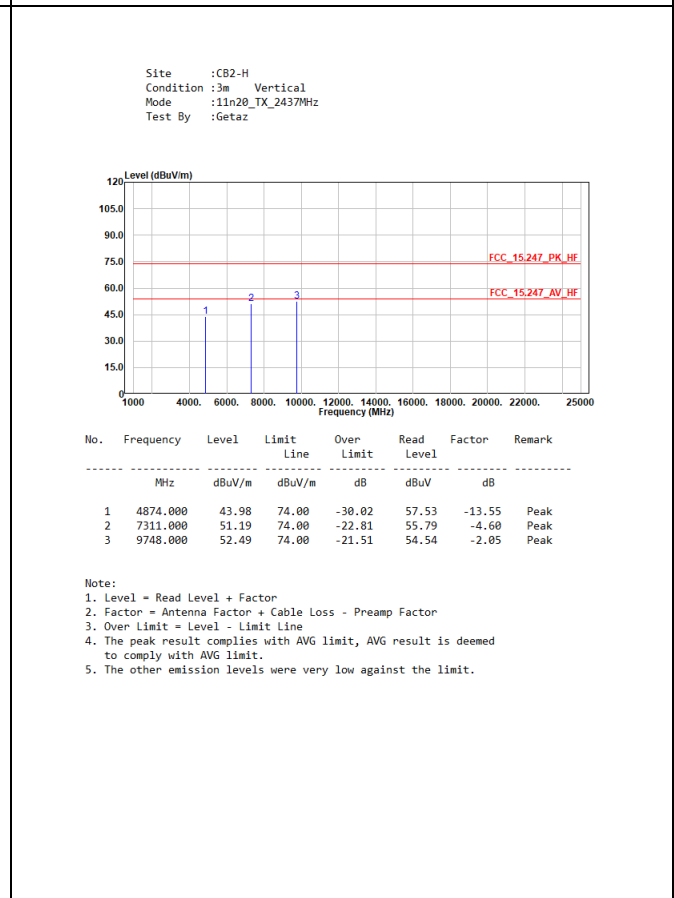
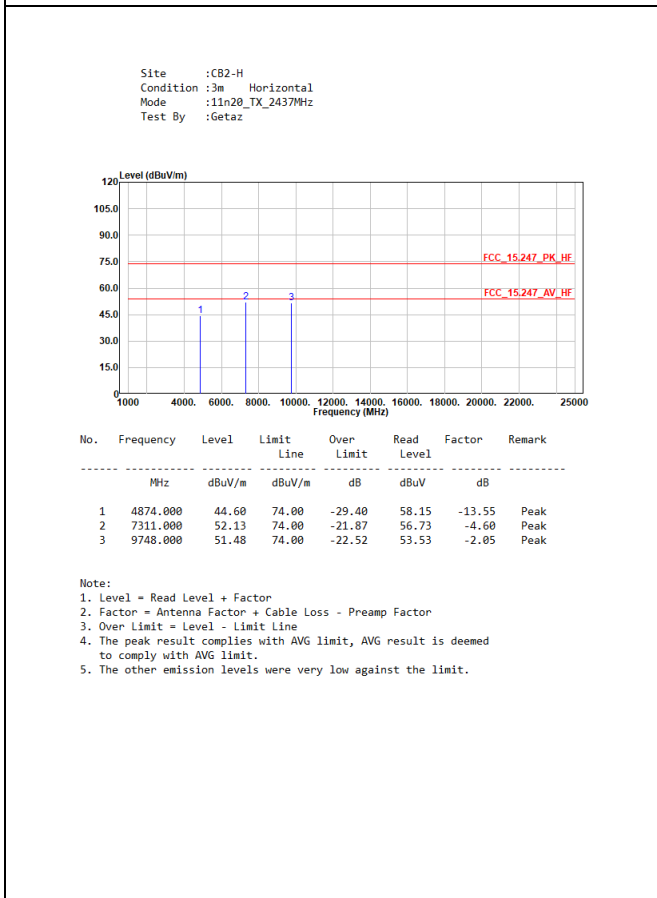
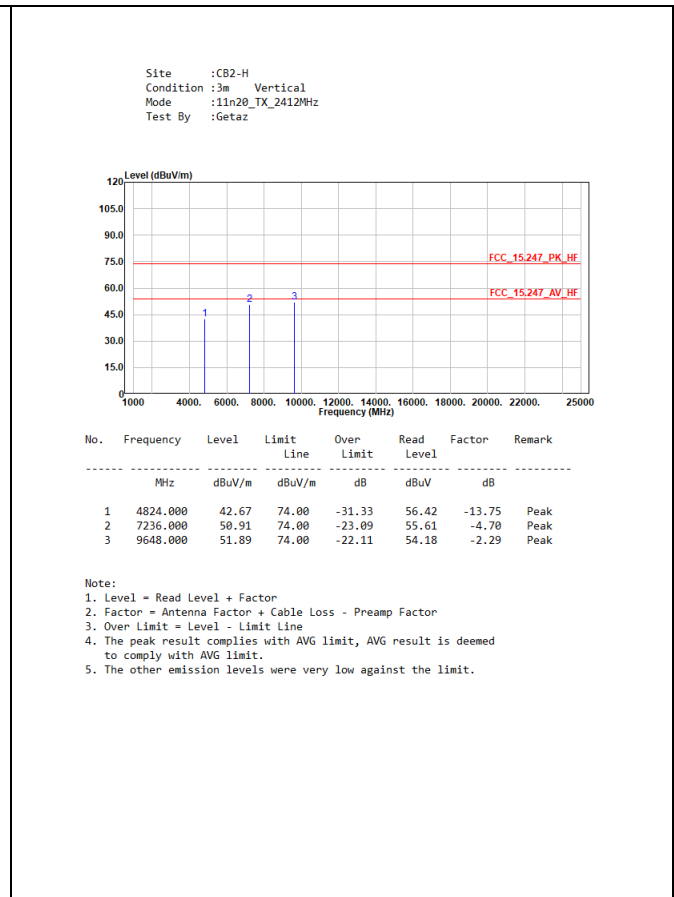
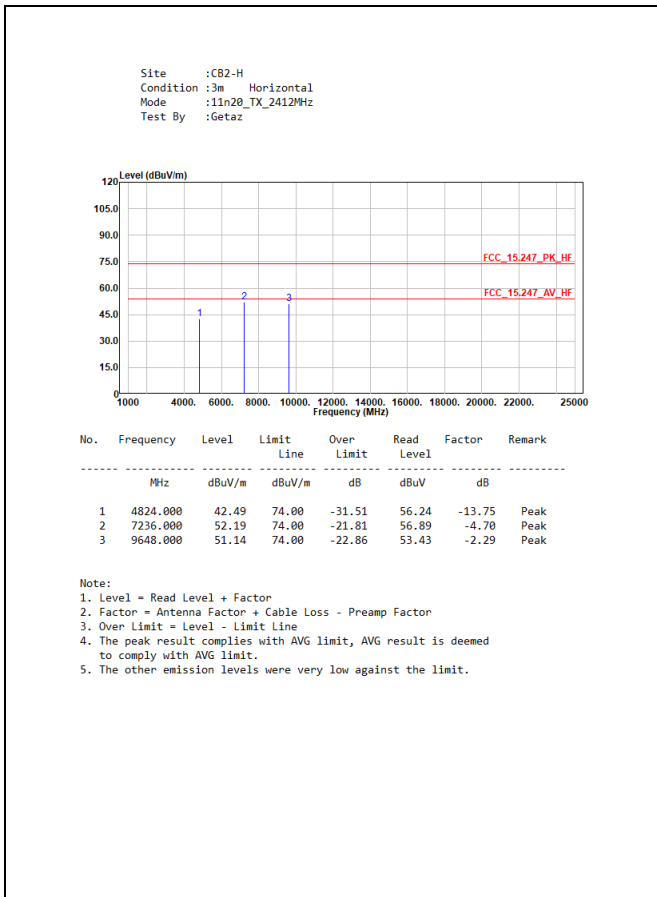
Note:
 1. Level = Read Level + Factor
 2. Factor = Antenna Factor + Cable Loss - Preamp Factor
 3. Over Limit = Level - Limit Line
 4. The emission under 30MHz was not included since the emission levels are very low against the limit.
 5. The other emission levels were very low against the limit.

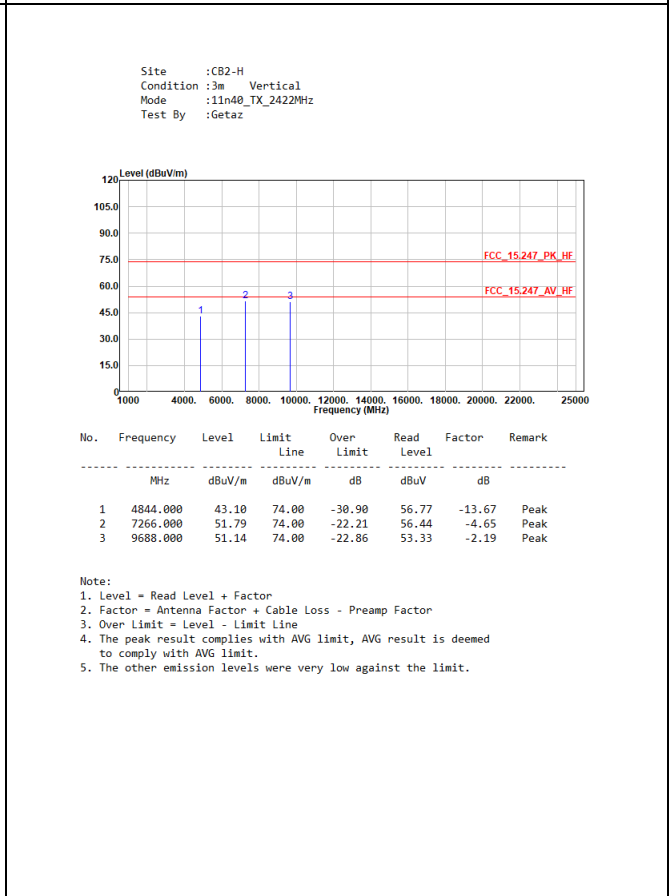
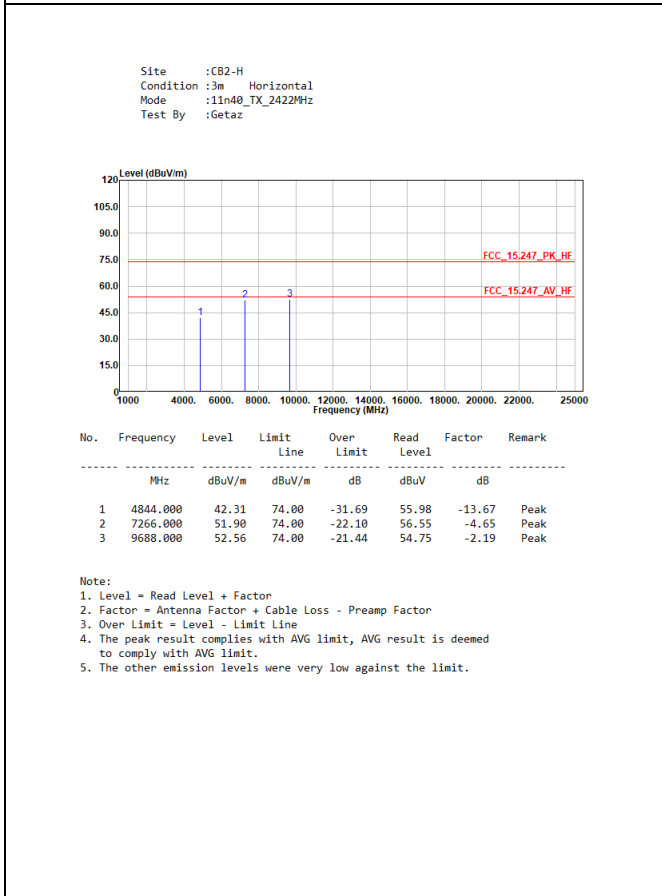
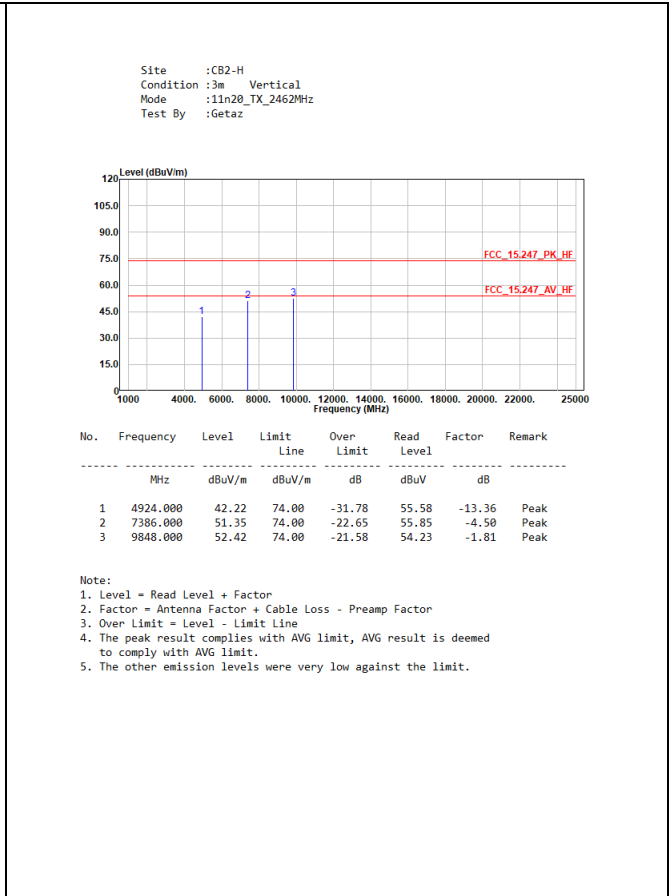
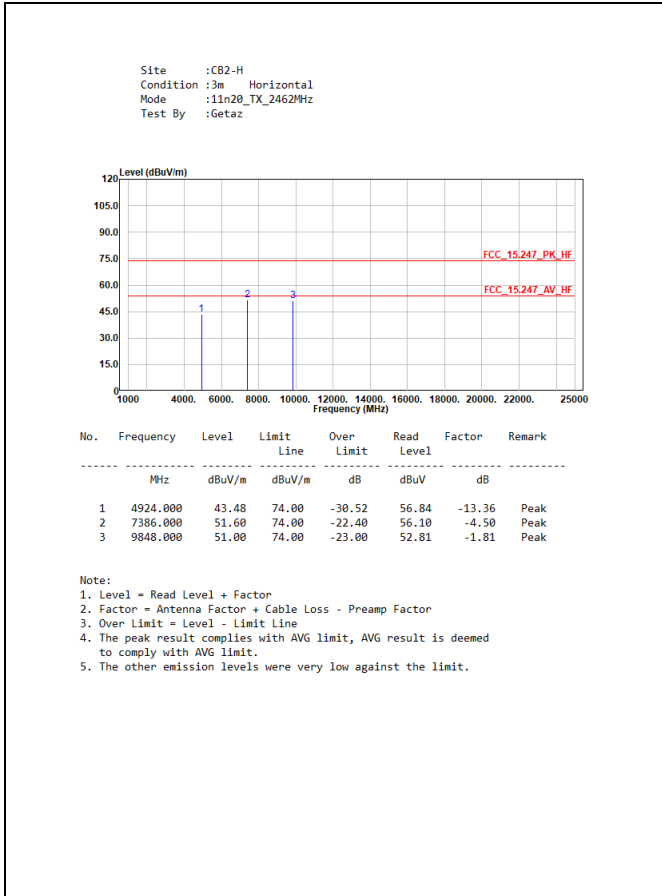
4.6. Test Result of Radiated Emissions (1 GHz ~ 10th Harmonic)

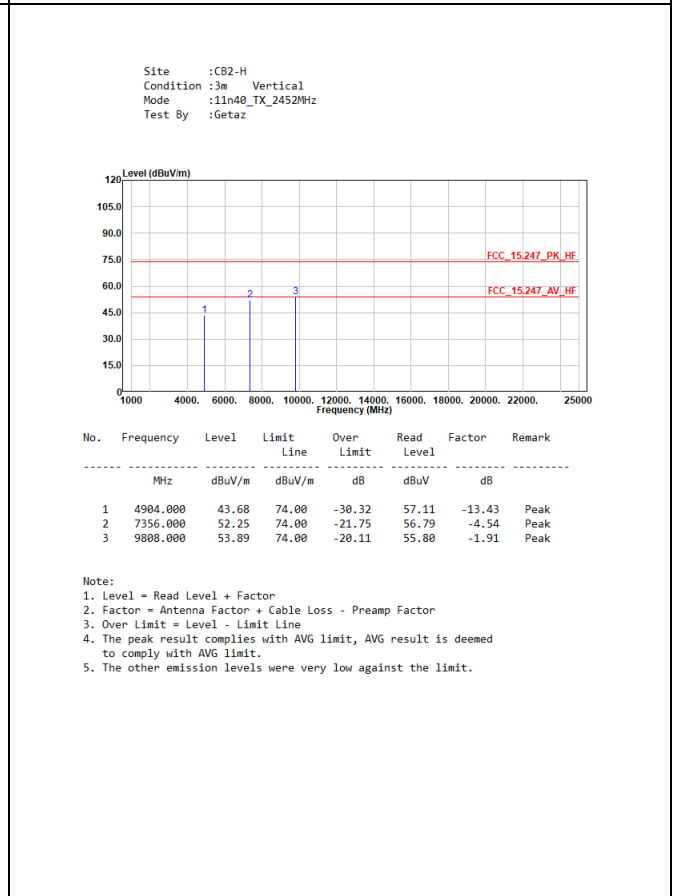
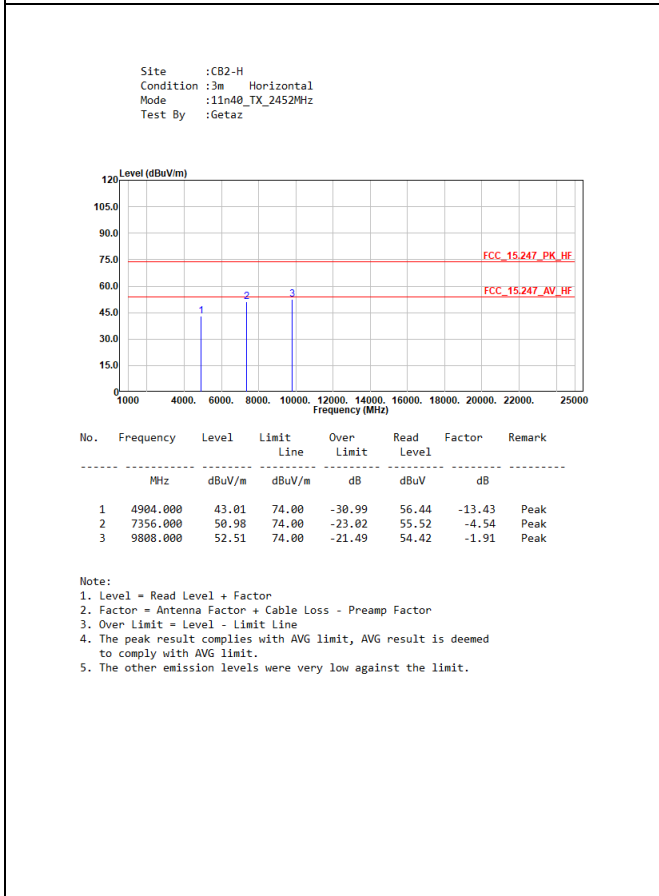
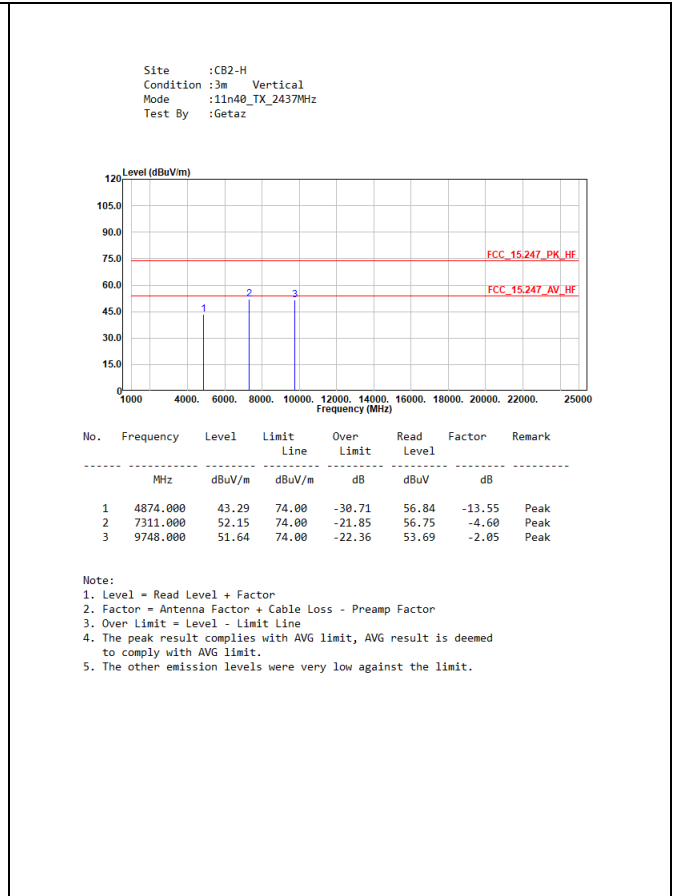
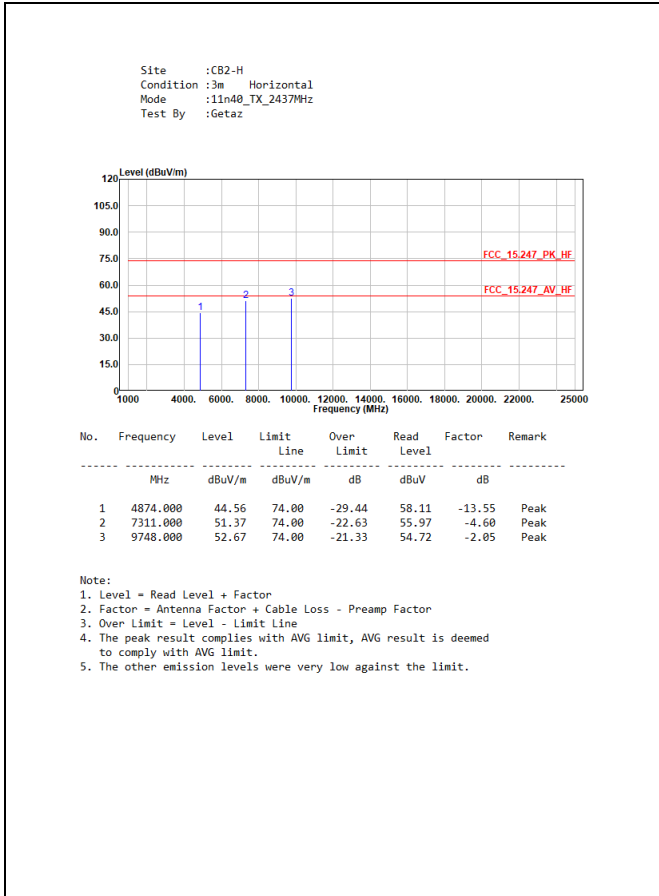






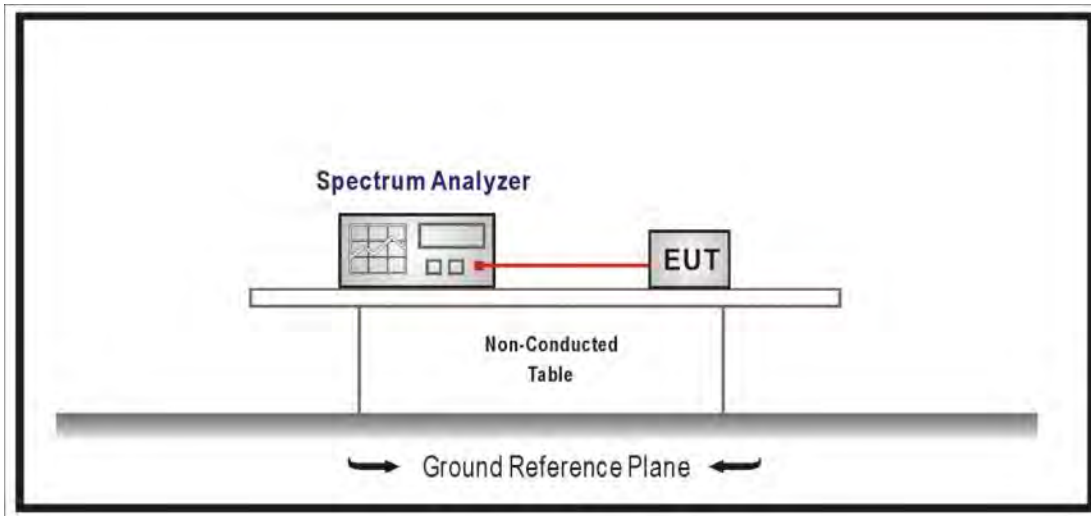






5. Antenna Port Conducted Emission

5.1. Test Setup



5.2. Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limit. If the transmitter complies with the conducted power limit based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limit specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limit specified in §15.209(a) (see §15.205(c)).

5.3. Test Procedure

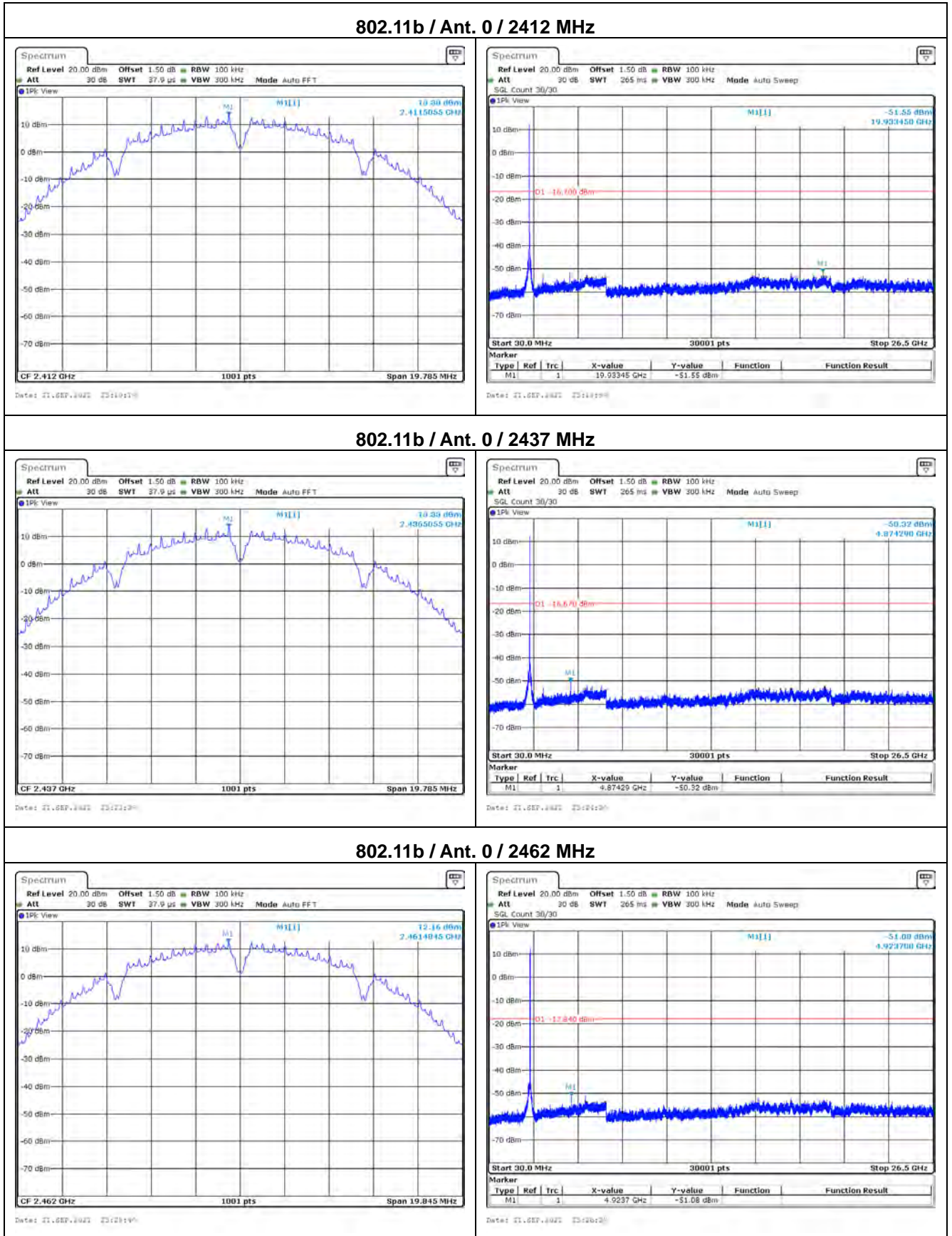
The EUT was setup according to ANSI C63.10: 2013 and tested according to DTS test procedure of KDB 558074 D01 V05r02 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Set VBW > RBW, scan up through 10th harmonic.

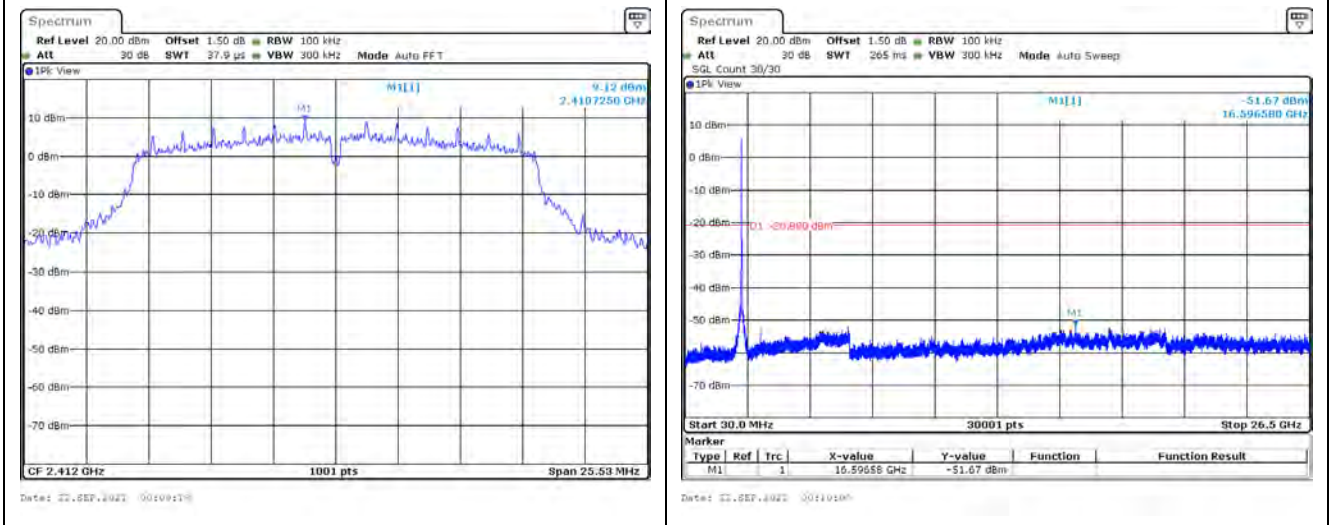
5.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

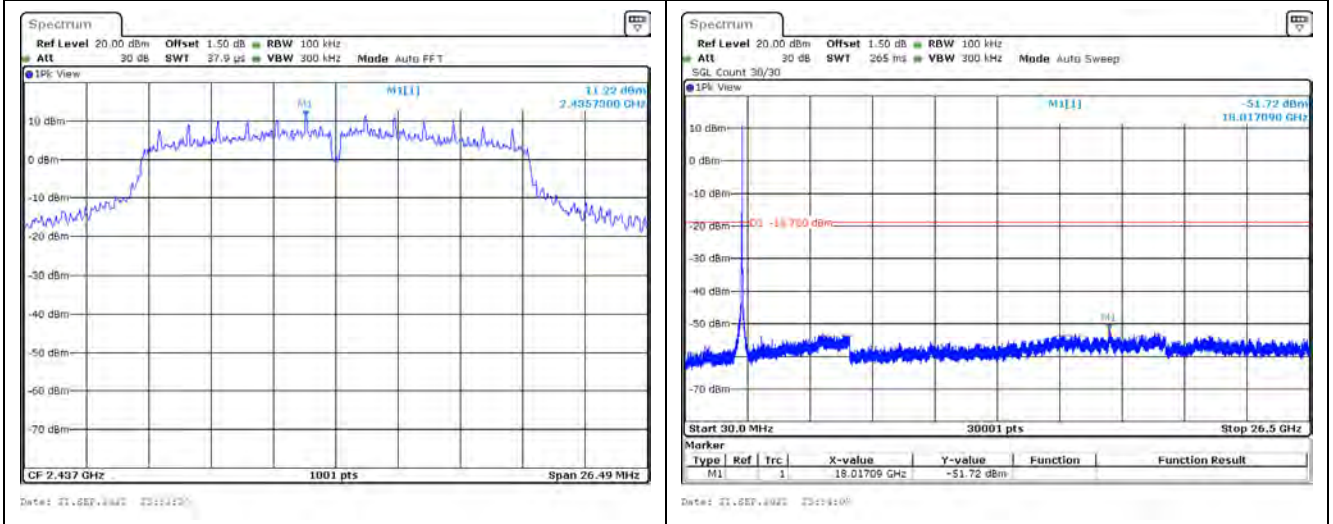
5.5. Test Result of Antenna Port Conducted Emission



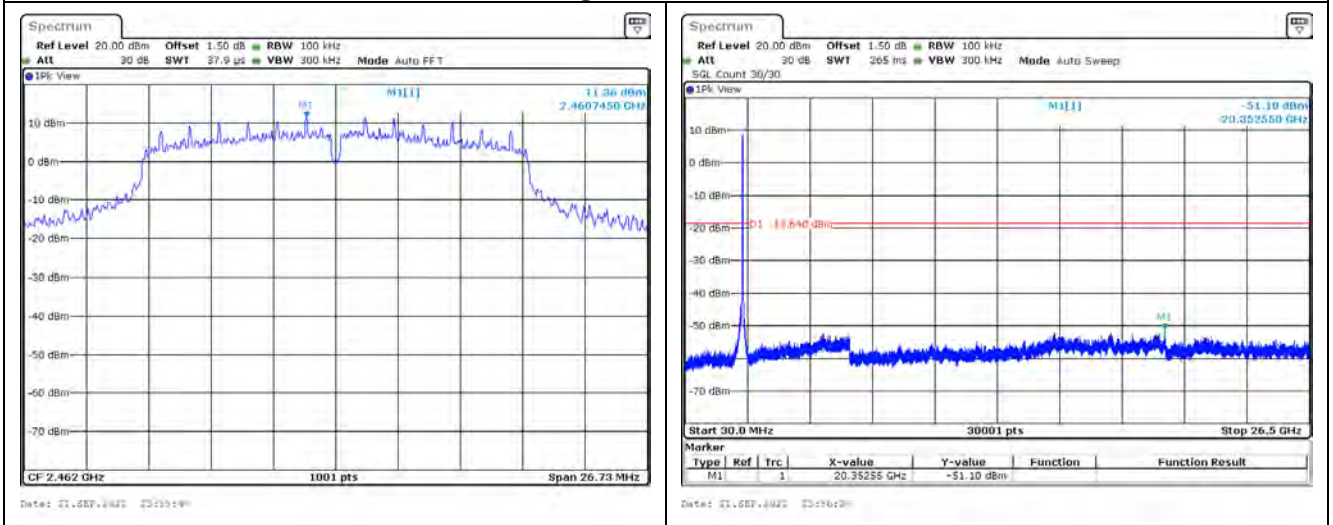
802.11g / Ant. 0 / 2412 MHz



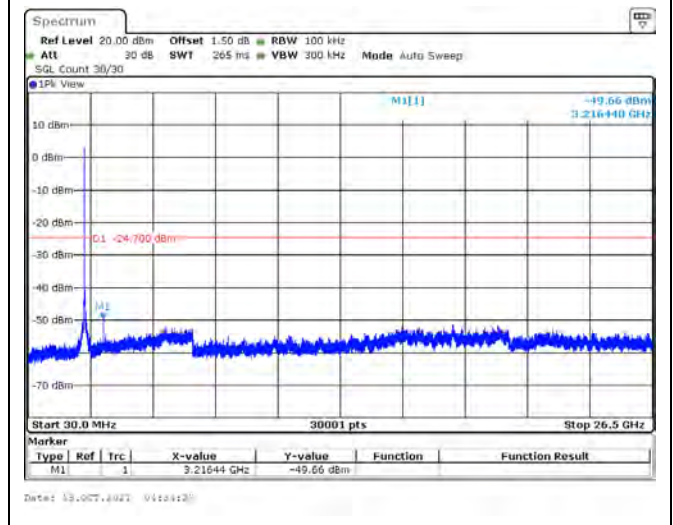
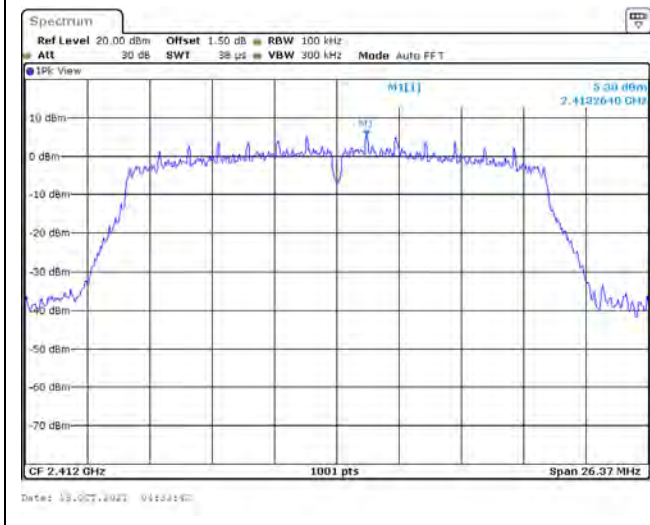
802.11g / Ant. 0 / 2437 MHz



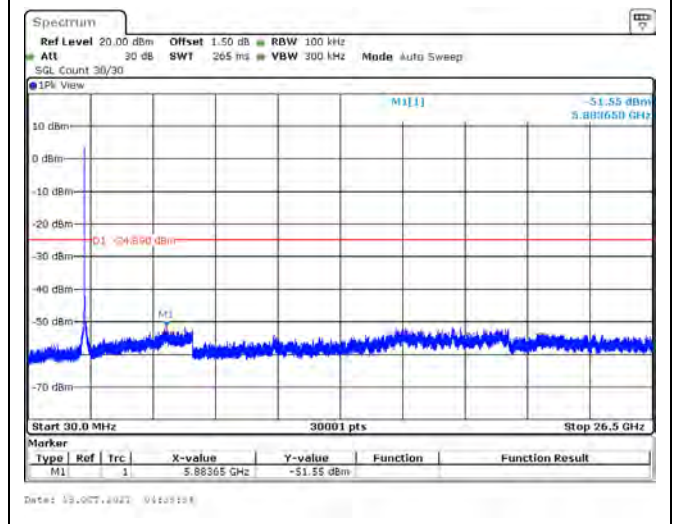
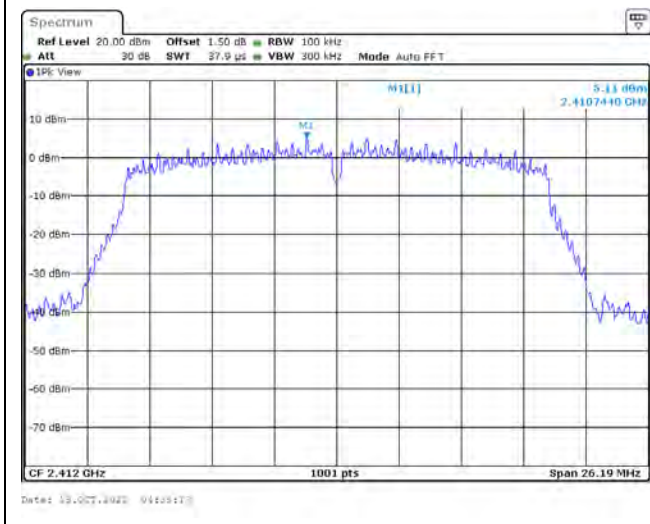
802.11g / Ant. 0 / 2462 MHz



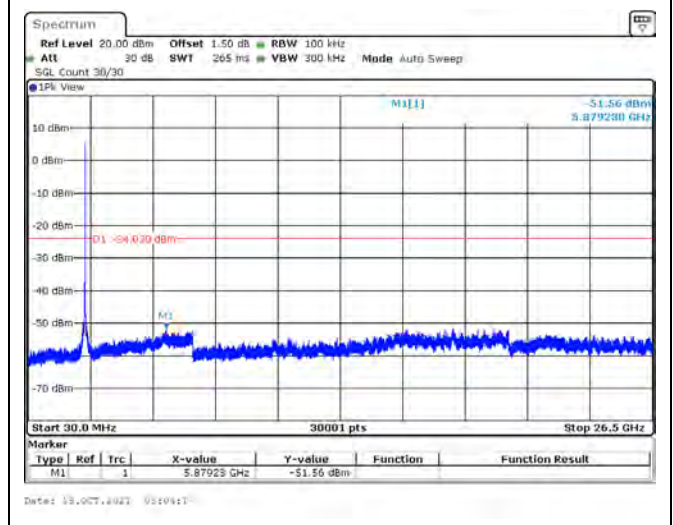
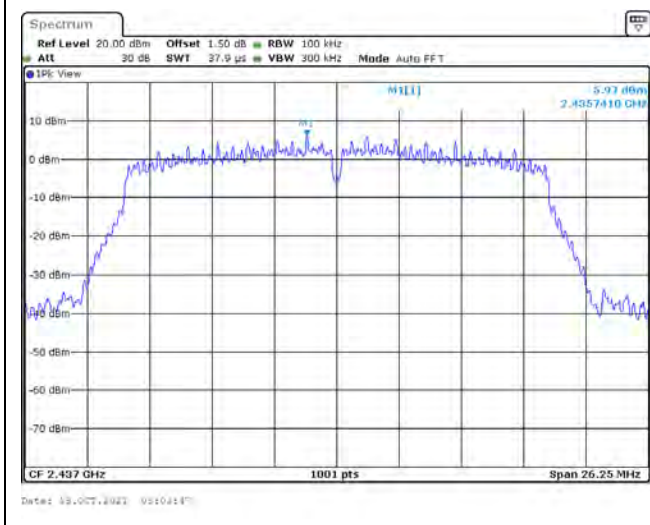
802.11n (20 MHz) / Ant. 0 / 2412 MHz



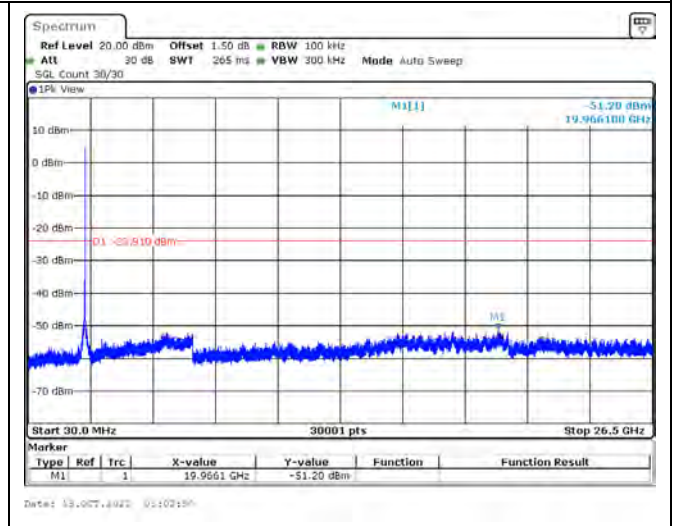
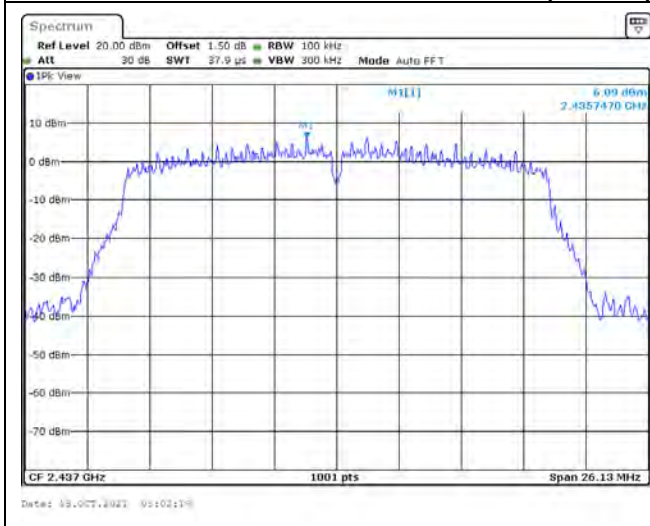
802.11n (20 MHz) / Ant. 1 / 2412 MHz



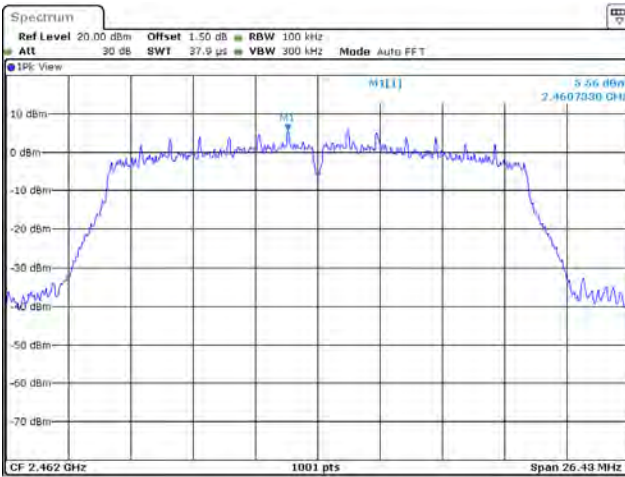
802.11n (20 MHz) / Ant. 0 / 2437 MHz



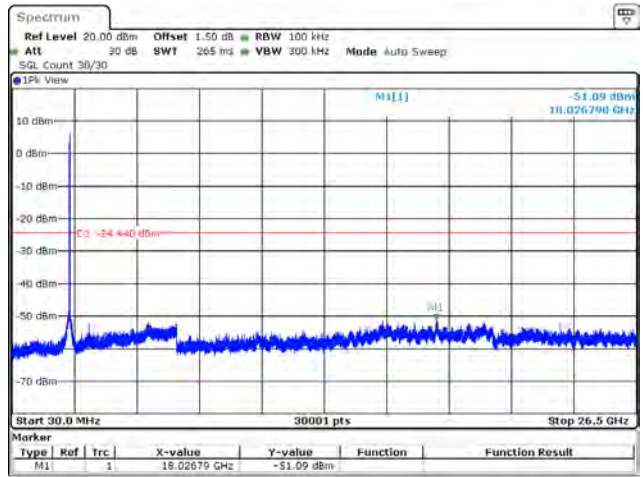
802.11n (20 MHz) / Ant. 1 / 2437 MHz



802.11n (20 MHz) / Ant. 0 / 2462 MHz

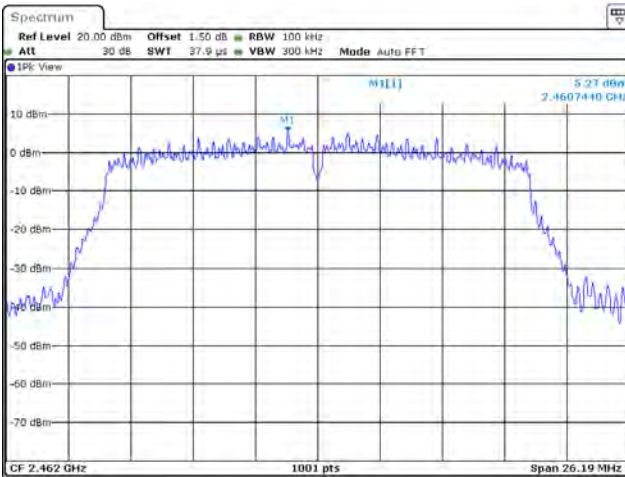


Date: 13-OCT-2021 04:22:11

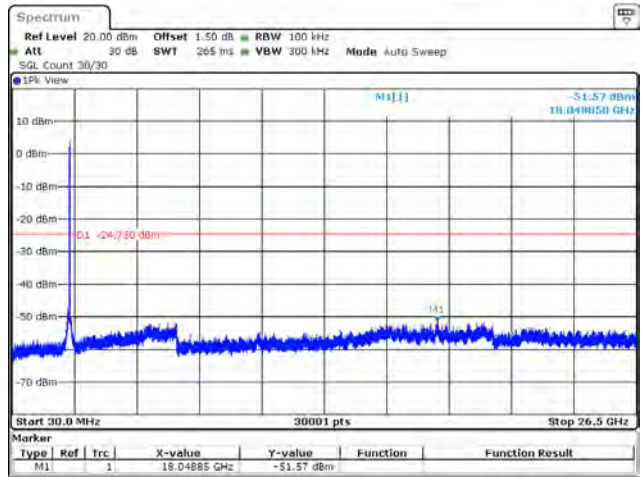


Date: 13-OCT-2021 04:22:10

802.11n (20 MHz) / Ant. 1 / 2462 MHz

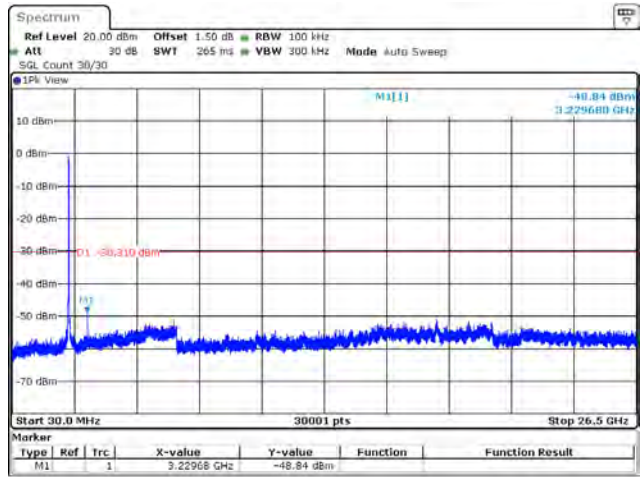
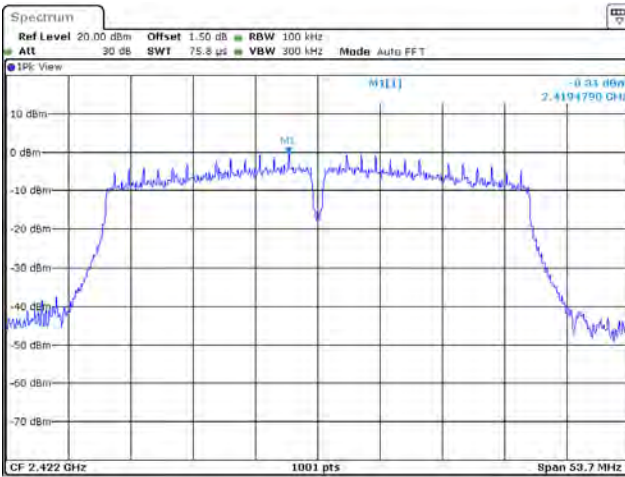


Date: 13-OCT-2021 04:20:20

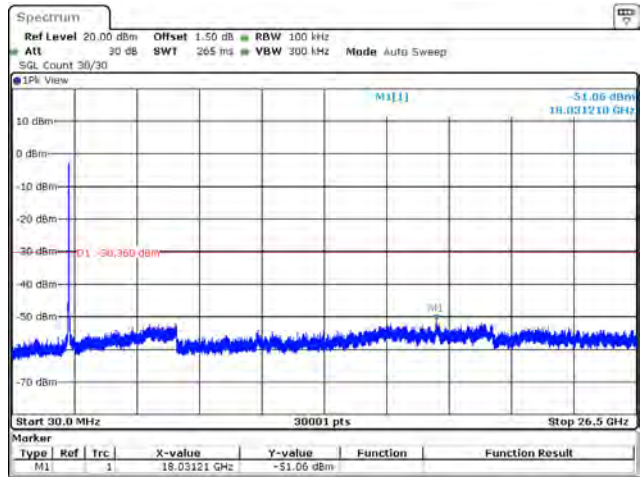
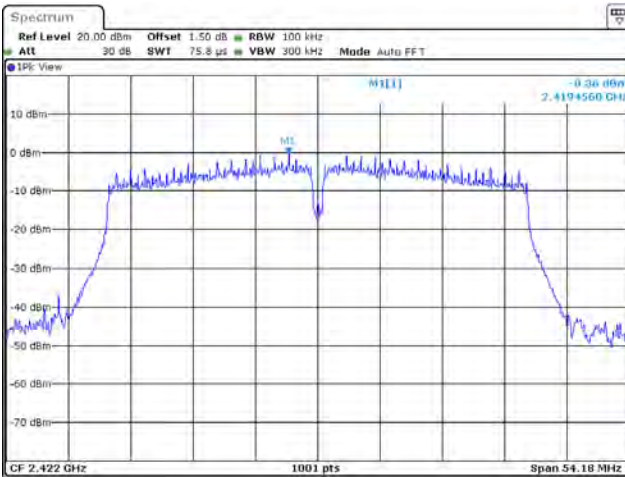


Date: 13-OCT-2021 04:21:09

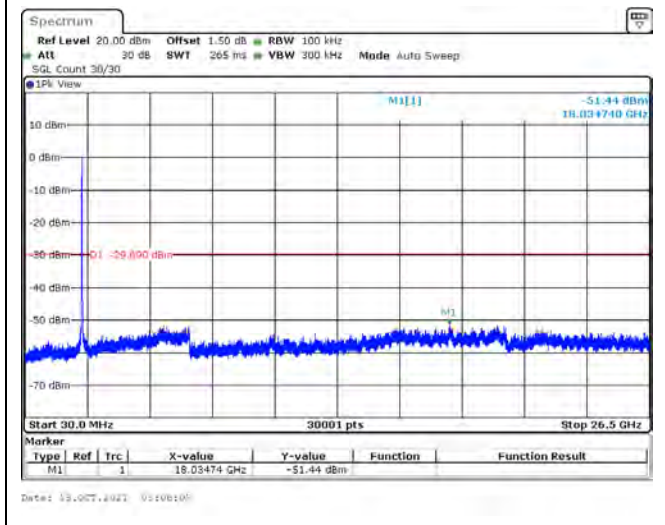
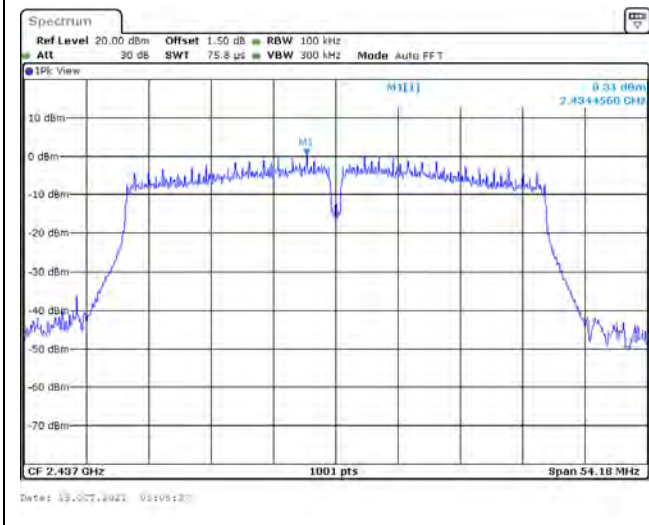
802.11n (40 MHz) / Ant. 0 / 2422 MHz



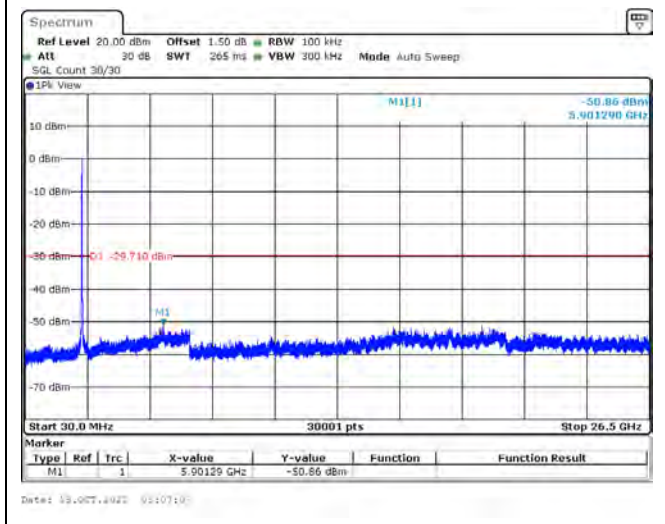
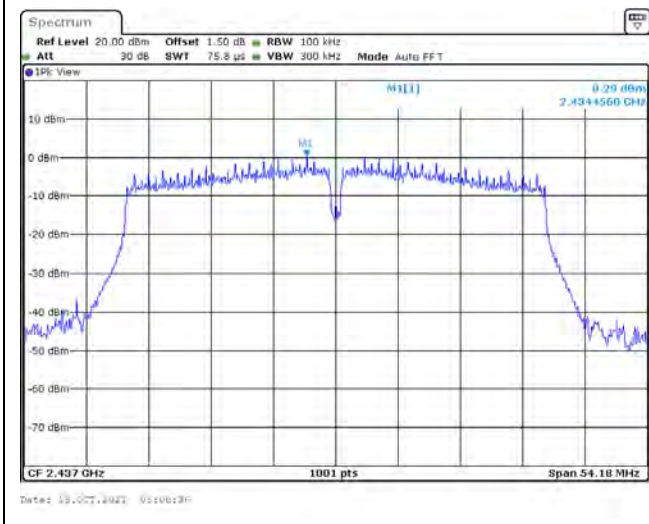
802.11n (40 MHz) / Ant. 1 / 2422 MHz



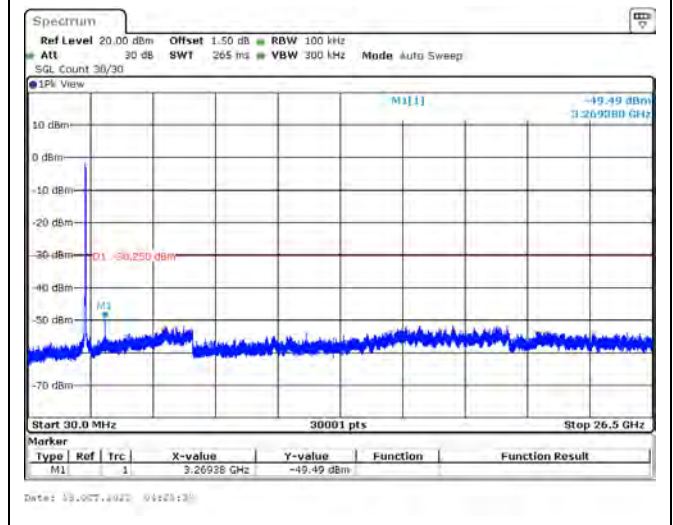
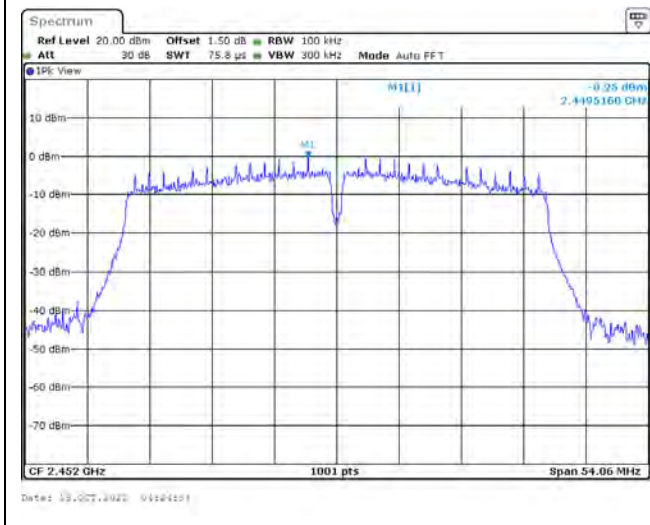
802.11n (40 MHz) / Ant. 0 / 2437 MHz



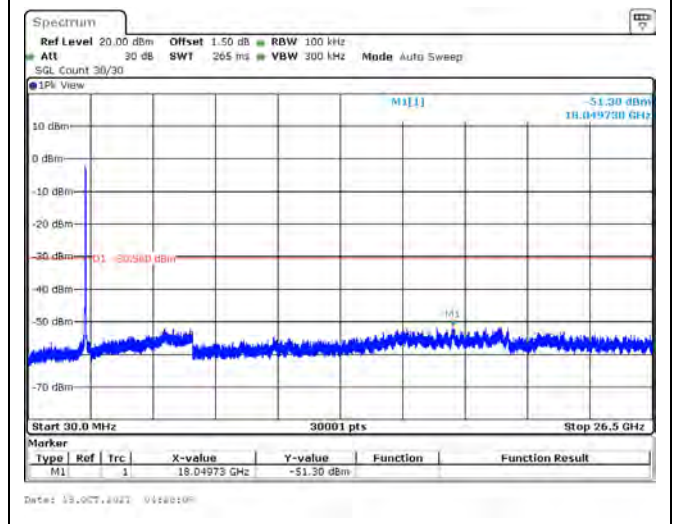
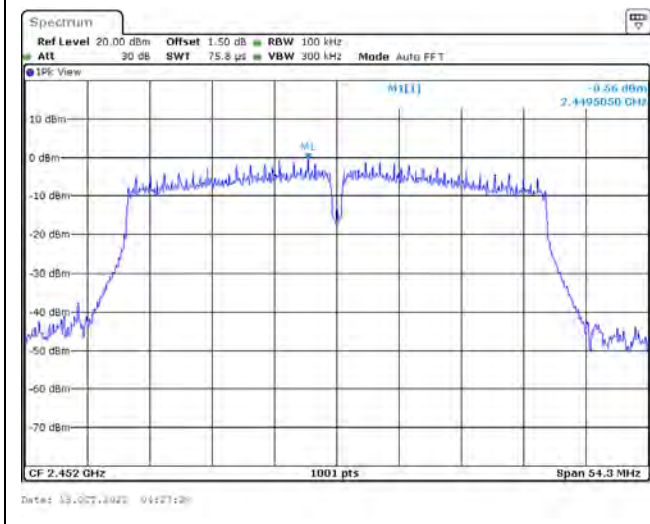
802.11n (40 MHz) / Ant. 1 / 2437 MHz



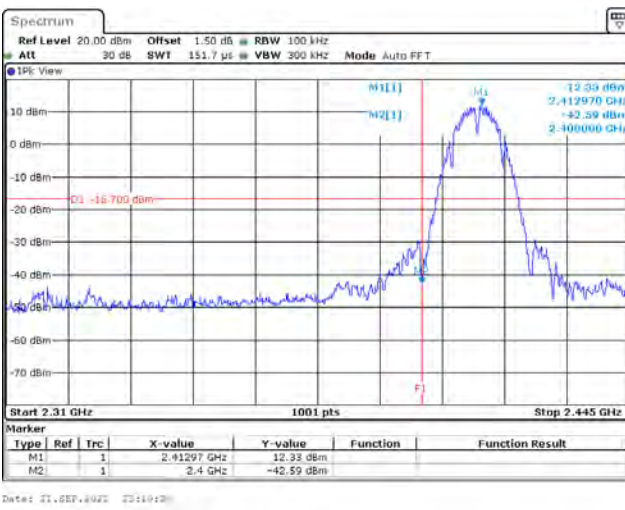
802.11n (40 MHz) / Ant. 0 / 2452 MHz



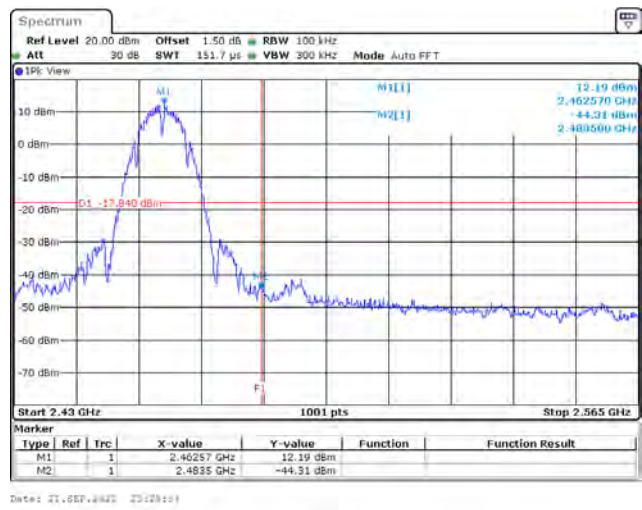
802.11n (40 MHz) / Ant. 1 / 2452 MHz



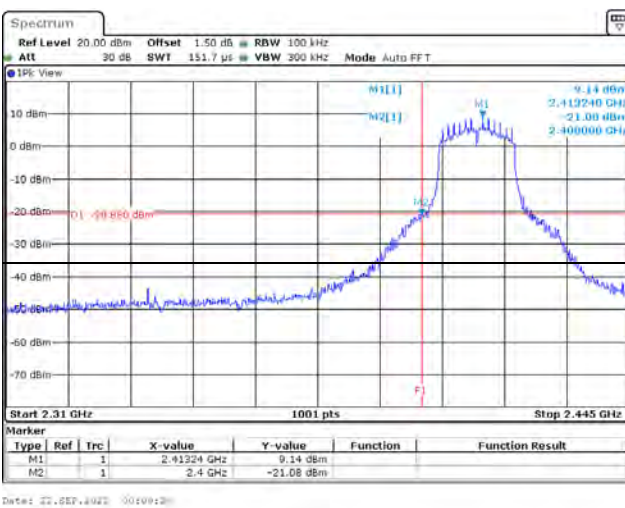
802.11b / Ant. 0 / 2412 MHz (Band Edge)



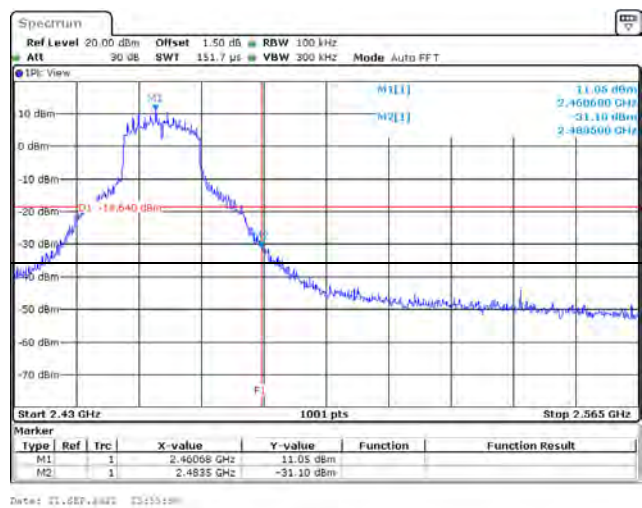
802.11b / Ant. 0 / 2462 MHz (Band Edge)



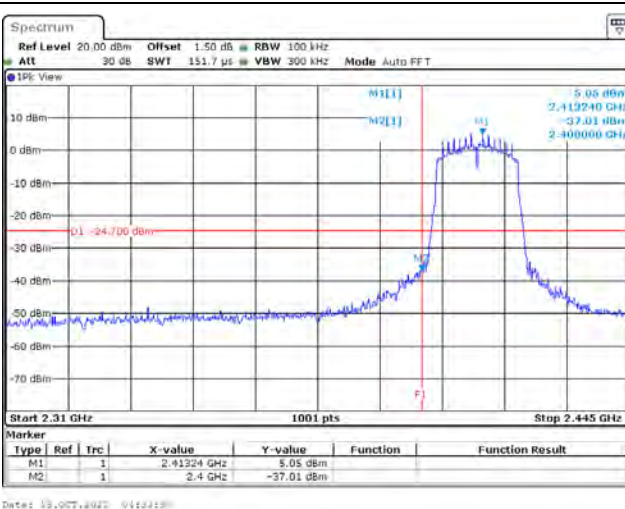
802.11g / Ant. 0 / 2412 MHz (Band Edge)



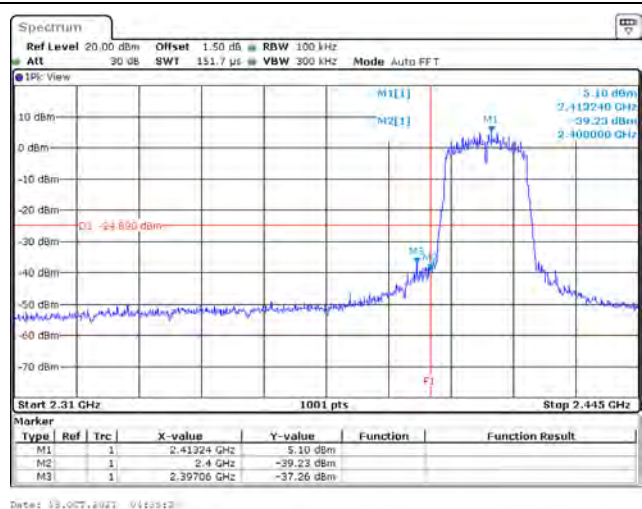
802.11g / Ant. 0 / 2462 MHz (Band Edge)



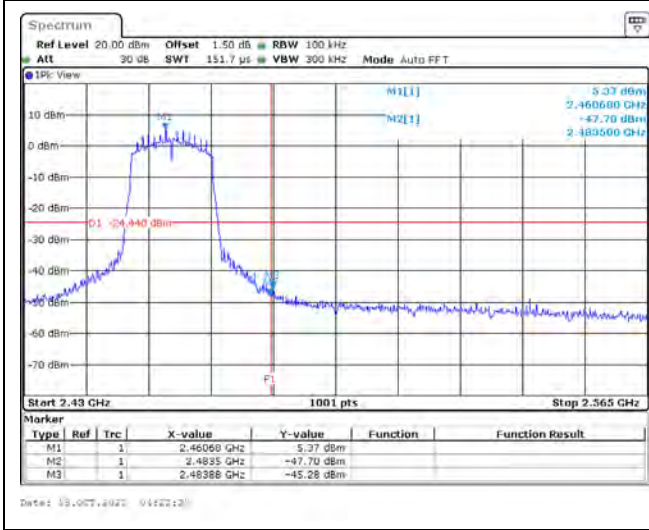
802.11n (20 MHz) / Ant. 0 / 2412 MHz (Band Edge)



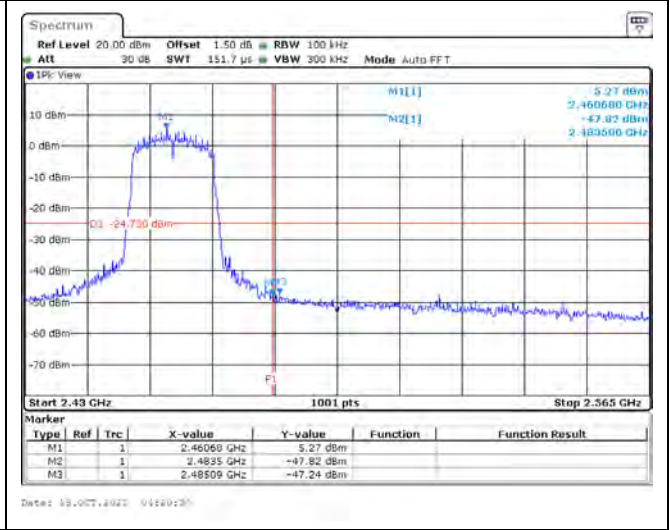
802.11n (20 MHz) / Ant. 1 / 2412 MHz (Band Edge)



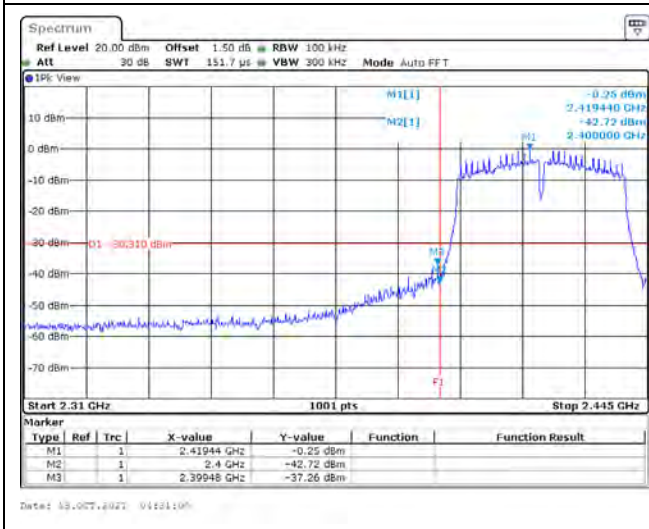
802.11n (20 MHz) / Ant. 0 / 2462 MHz (Band Edge)



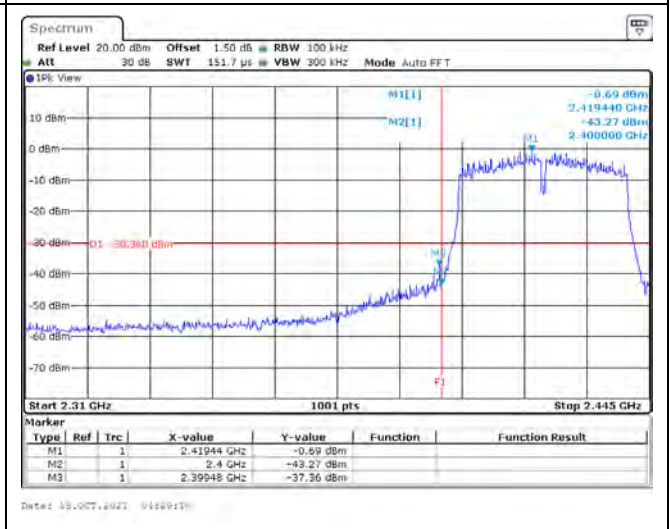
802.11n (20 MHz) / Ant. 1 / 2462 MHz (Band Edge)



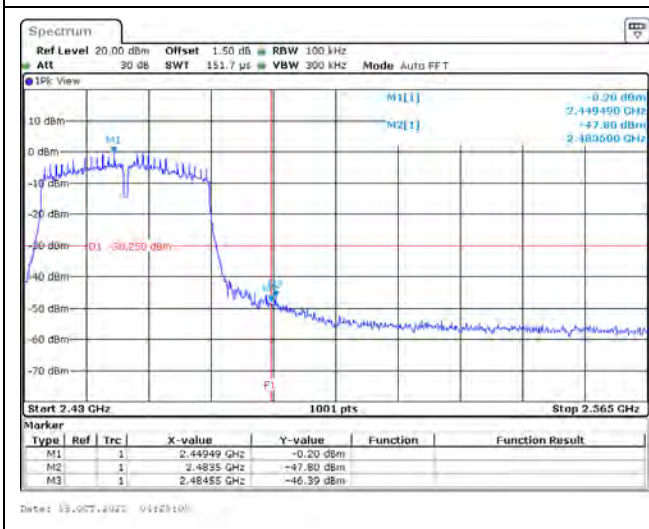
802.11n (40 MHz) / Ant. 0 / 2412 MHz (Band Edge)



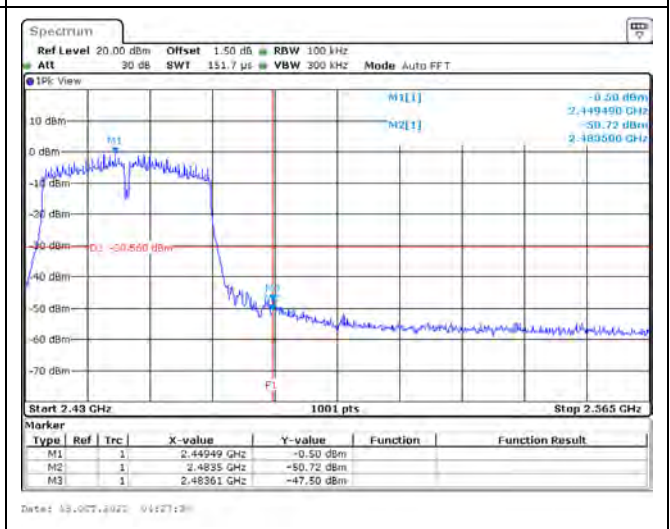
802.11n (40 MHz) / Ant. 1 / 2412 MHz (Band Edge)



802.11n (40 MHz) / Ant. 0 / 2462 MHz (Band Edge)

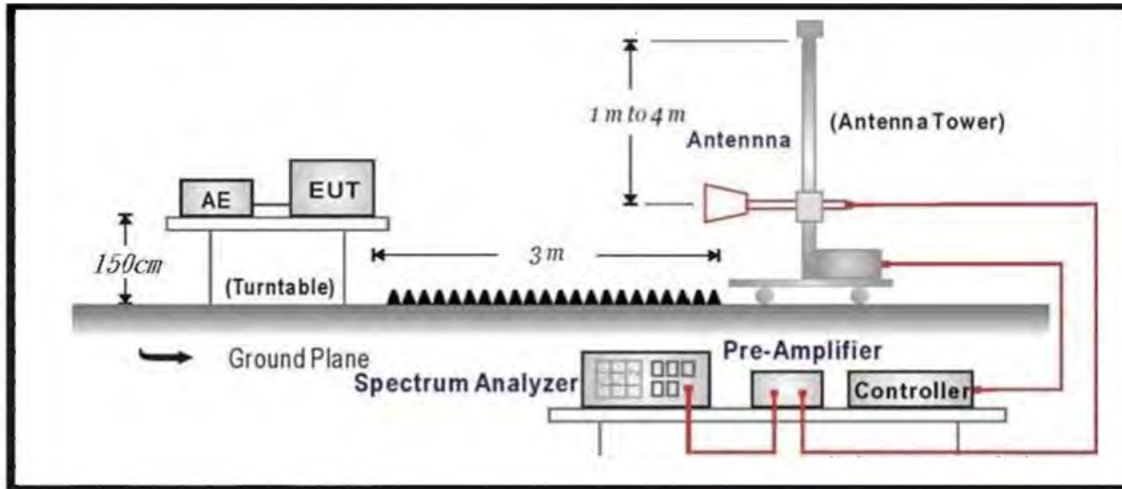


802.11n (40 MHz) / Ant. 1 / 2462 MHz (Band Edge)



6. Radiated Emission Band Edge

6.1. Test Setup



6.2. Test Limit

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 30 dB below the level of the fundamental or to the general radiated emission limit in paragraph 15.209, whichever is the lesser attenuation.

6.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to FHSS test procedure of FCC KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247 requirements.

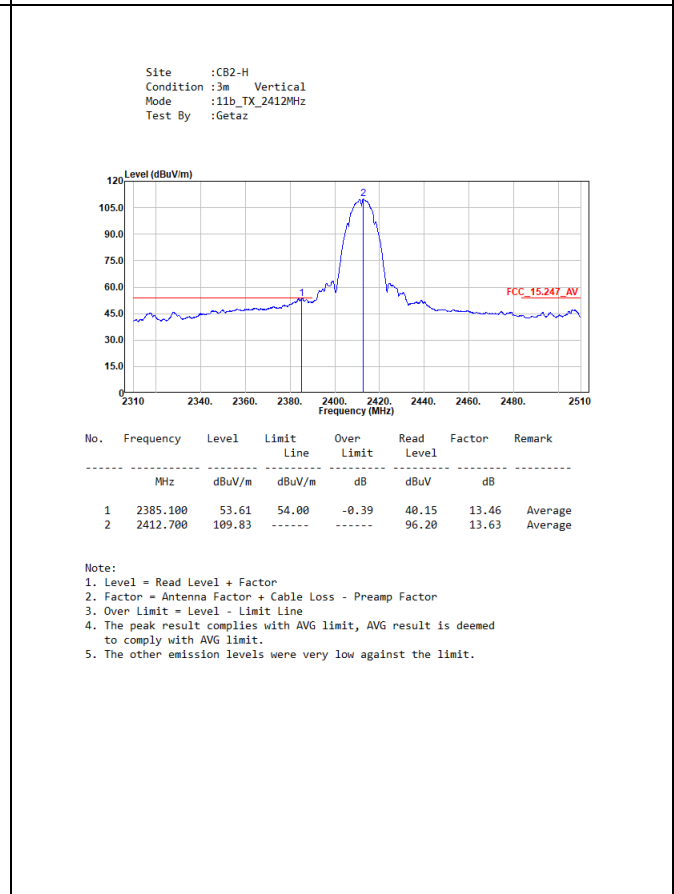
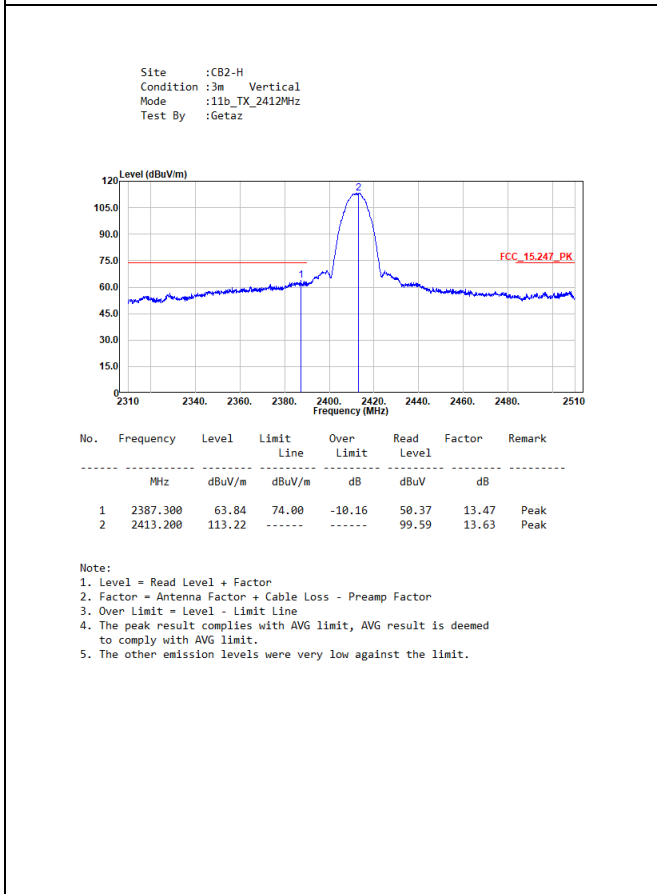
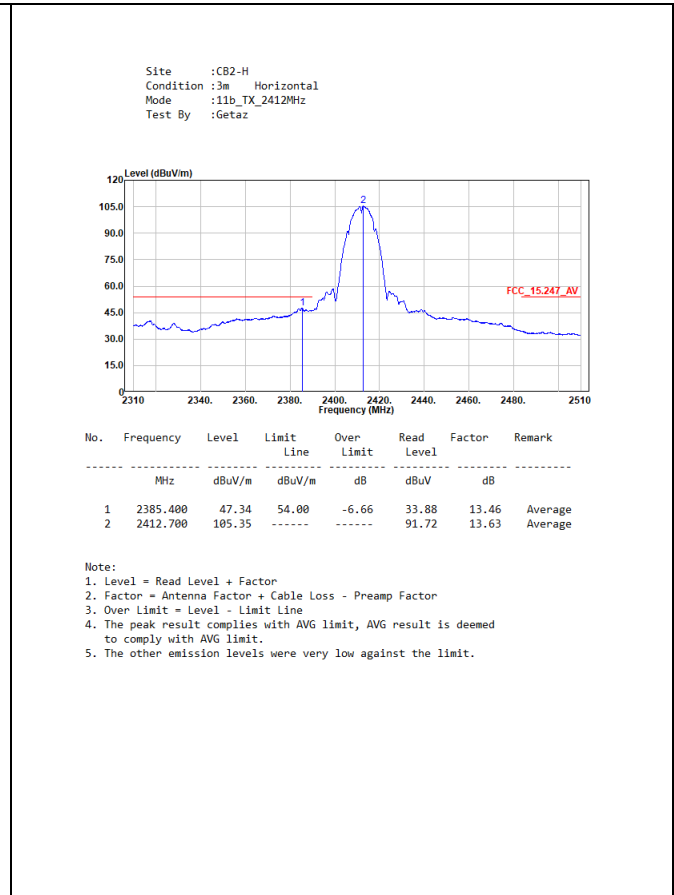
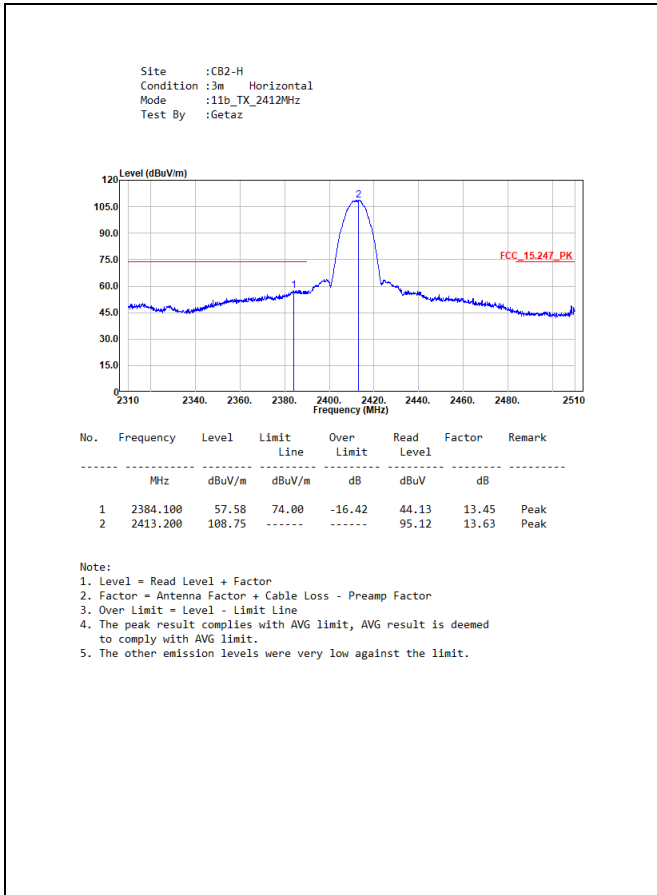
The EUT and its simulators are placed on a turn table which is 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

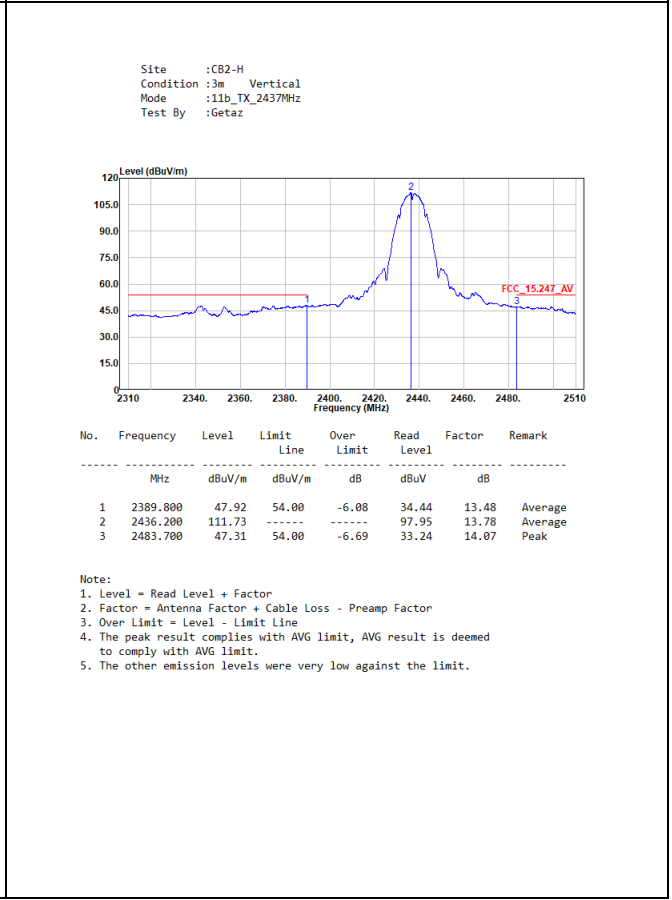
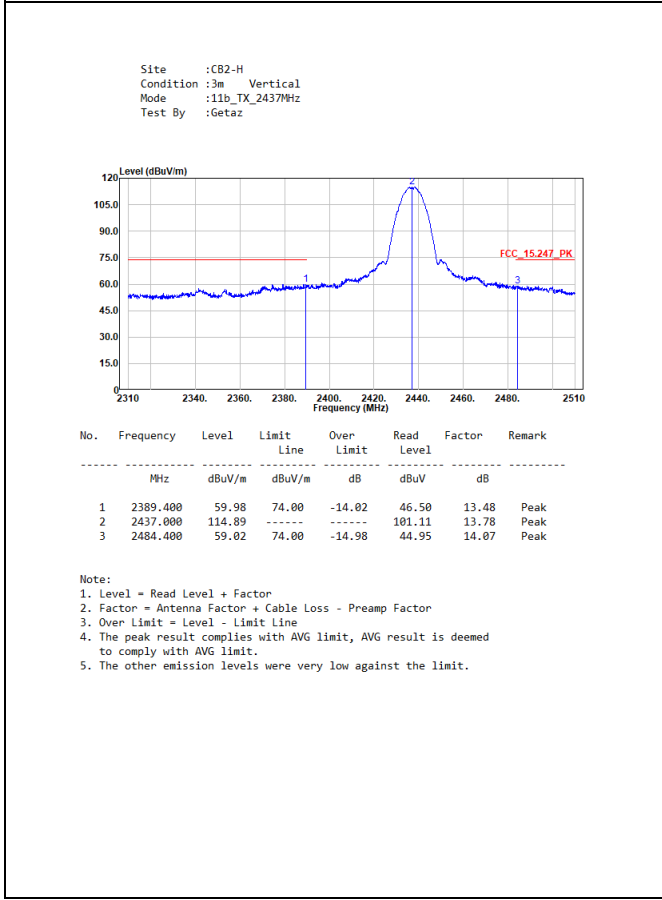
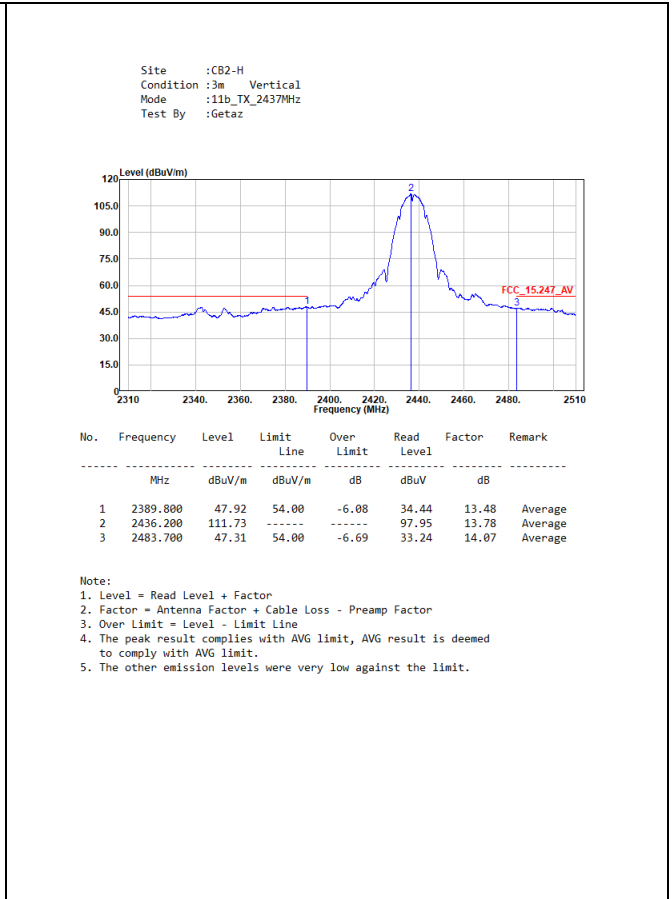
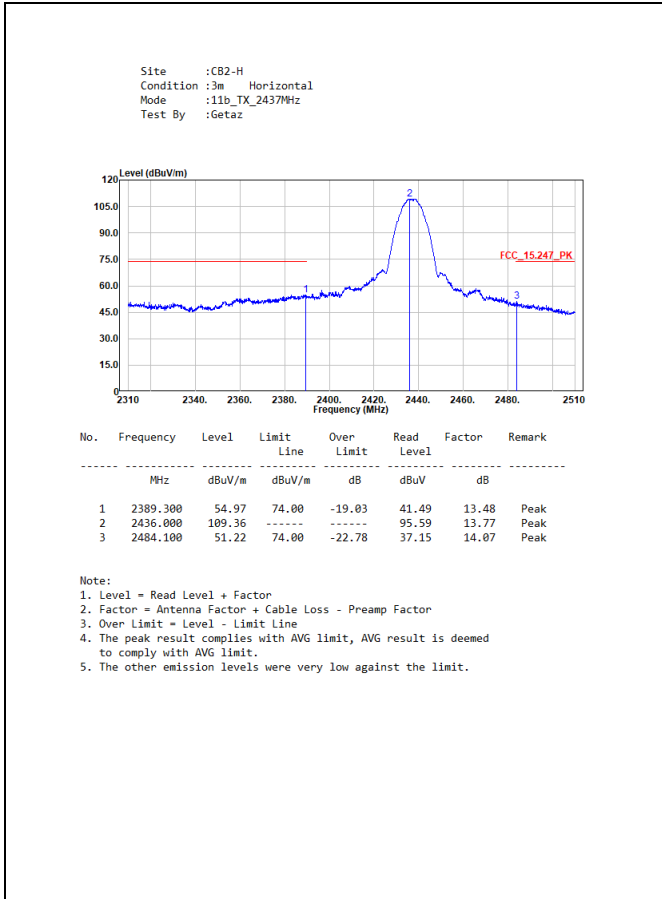
Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

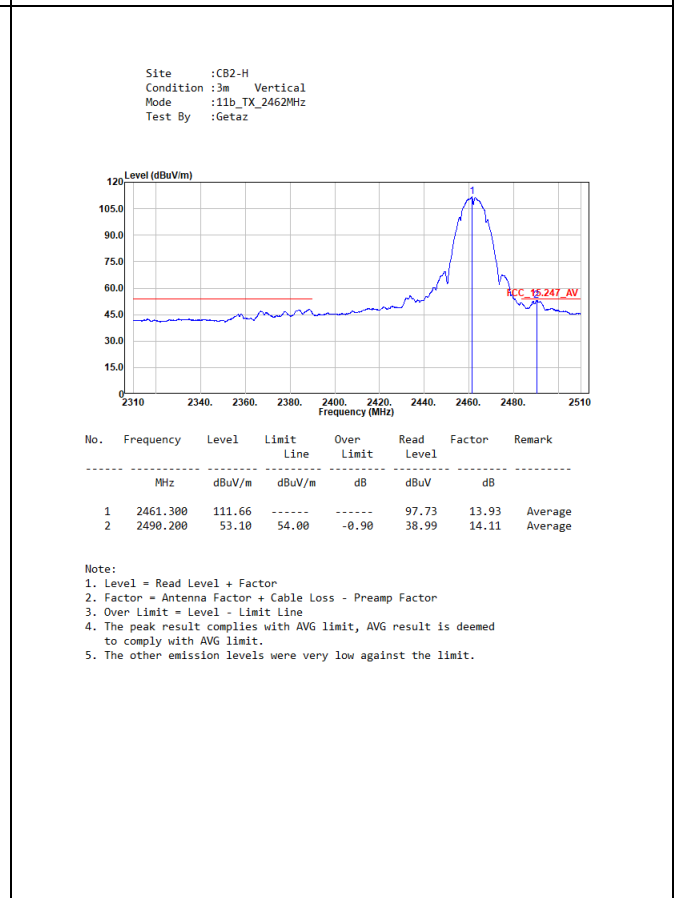
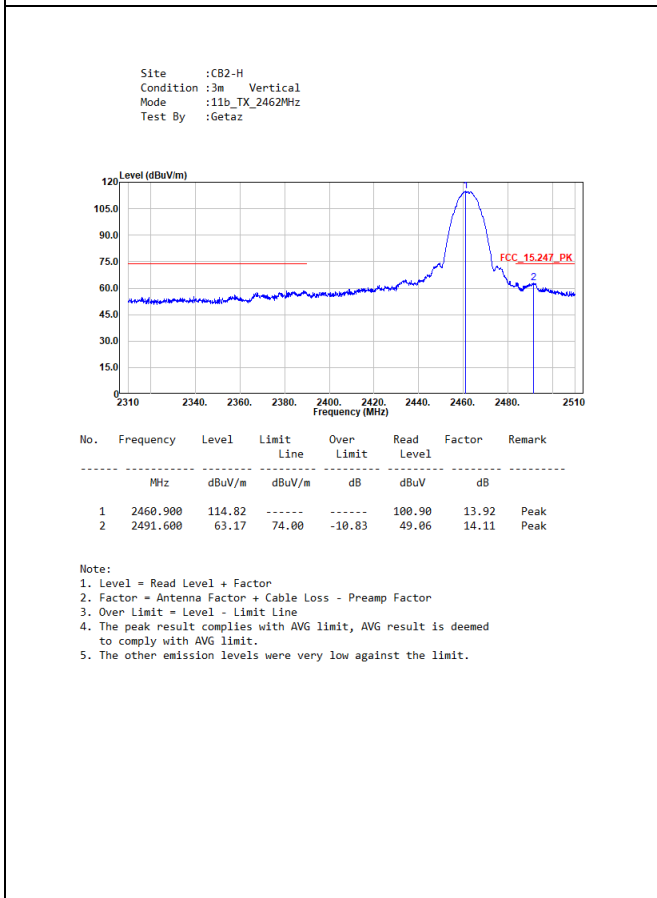
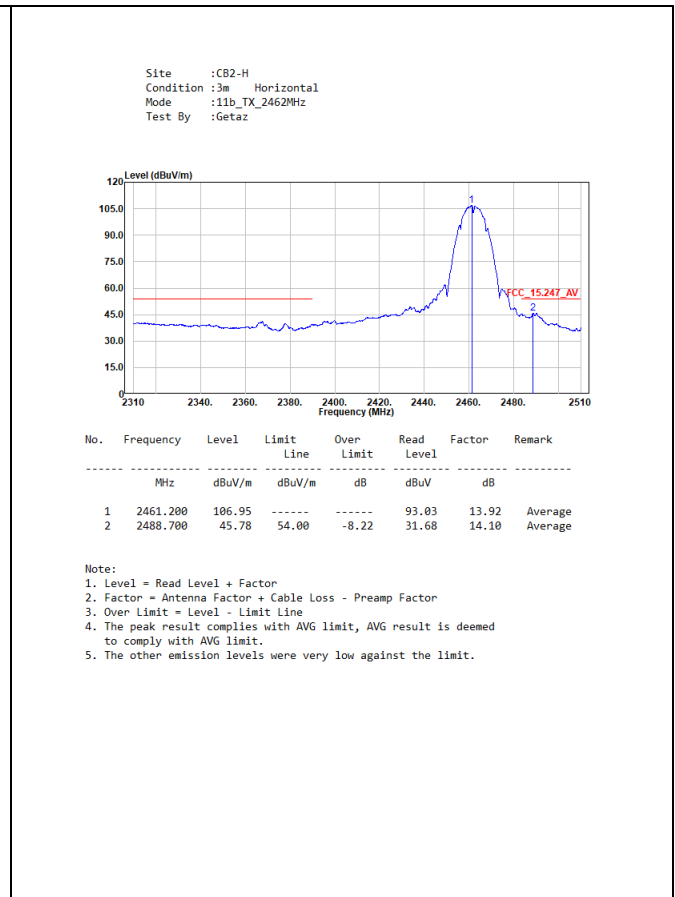
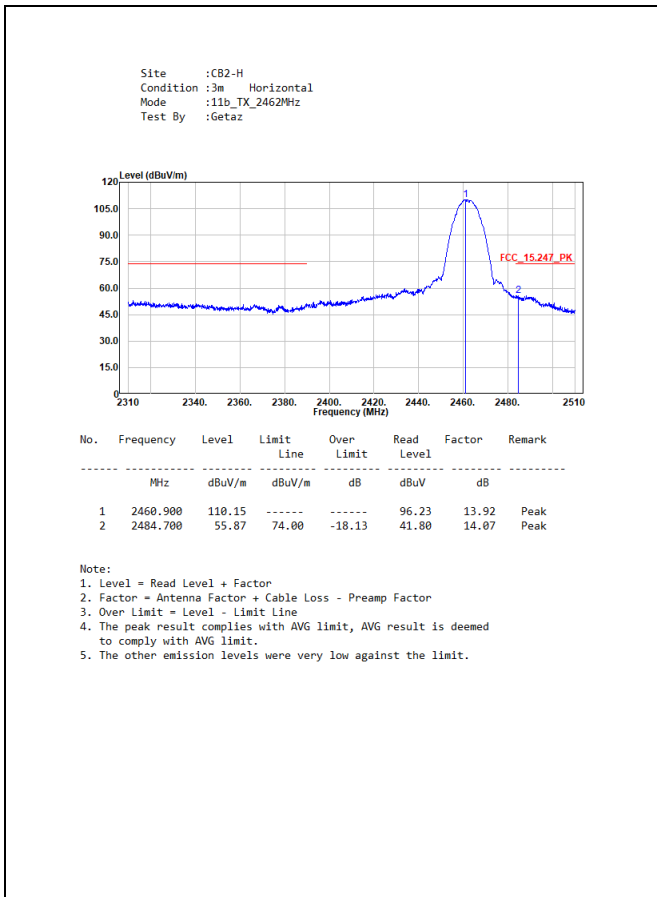
6.4. Test Specification

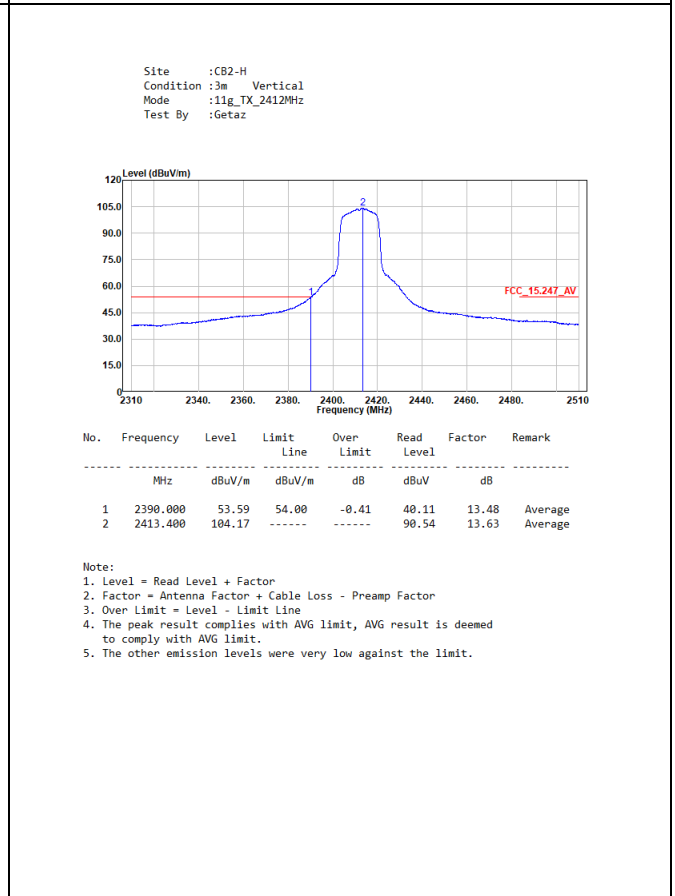
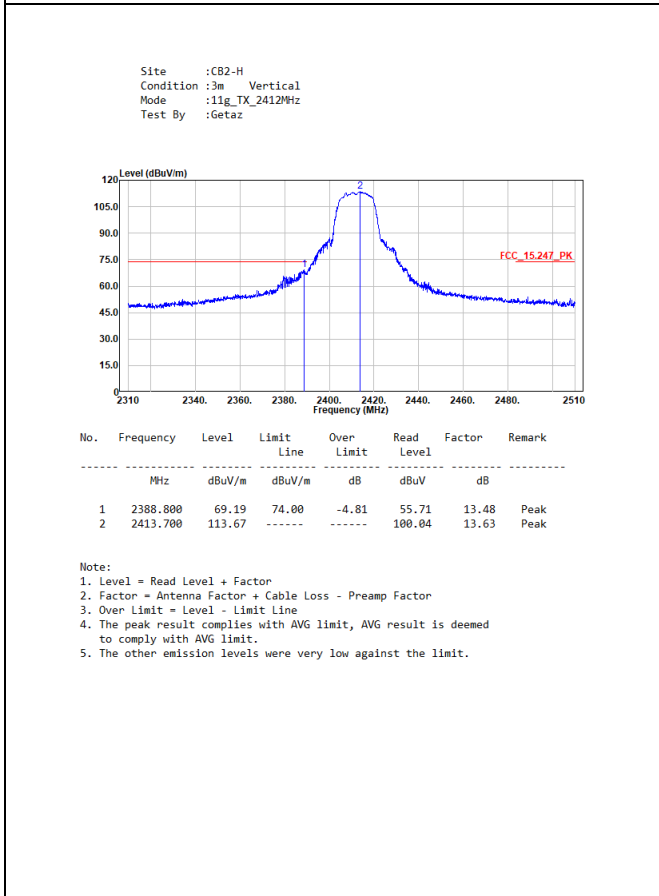
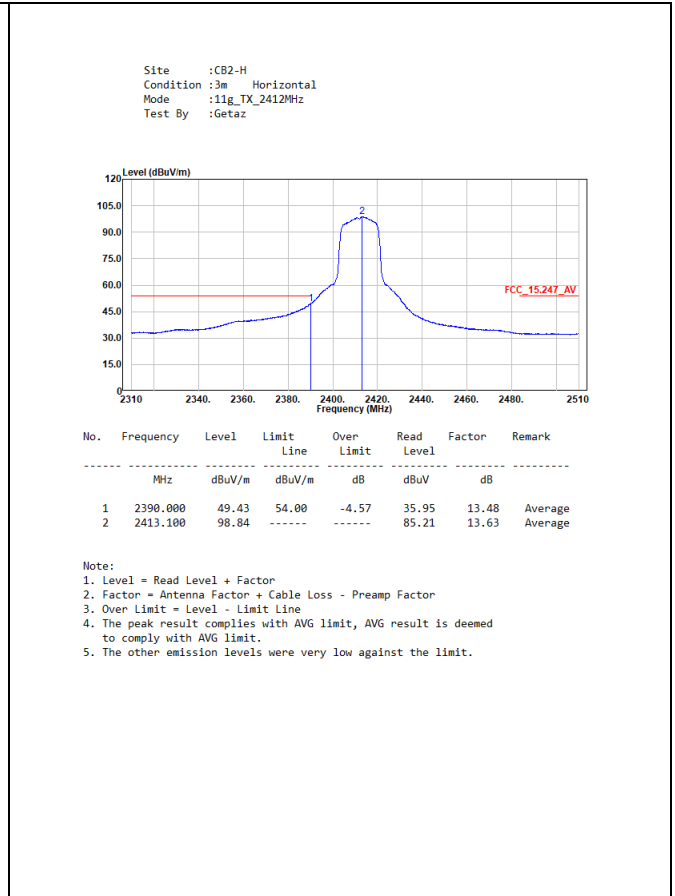
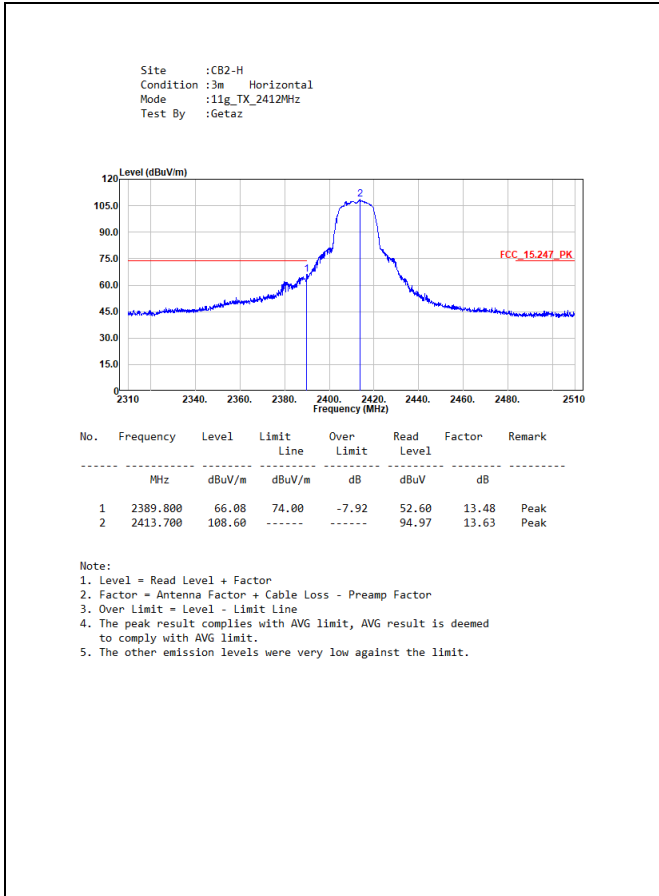
According to FCC Part 15 Subpart C Paragraph 15.247.

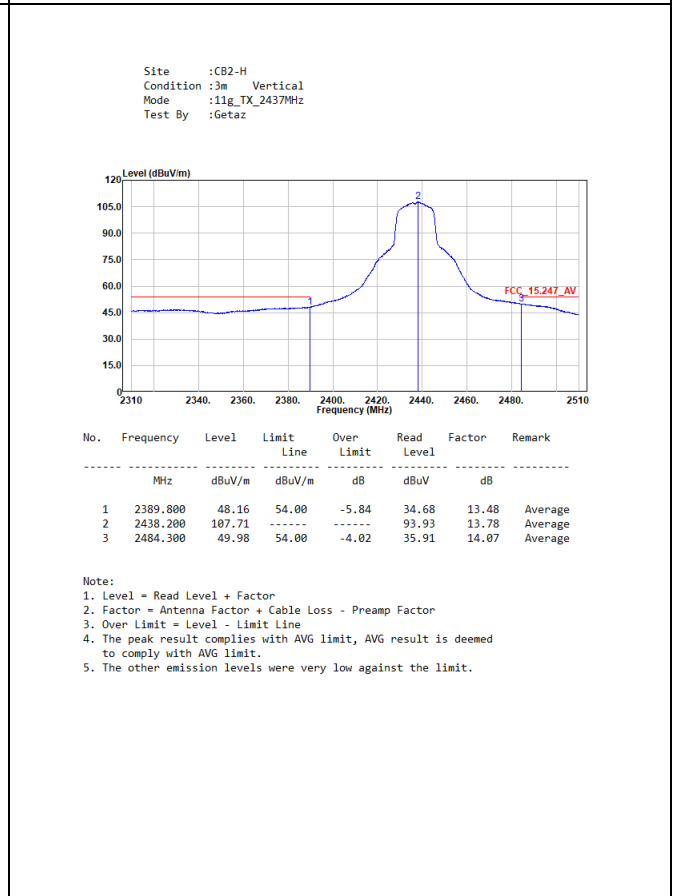
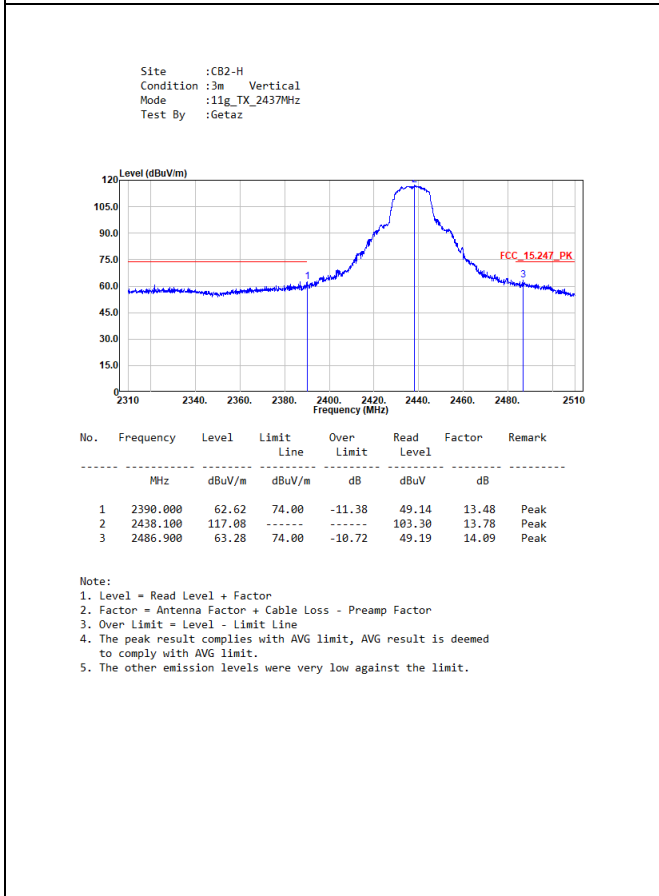
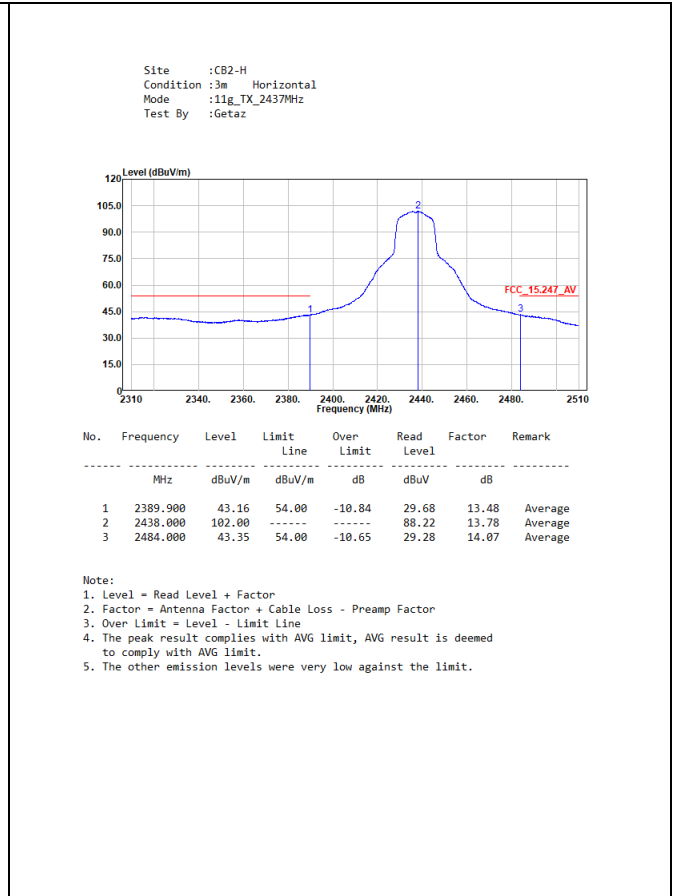
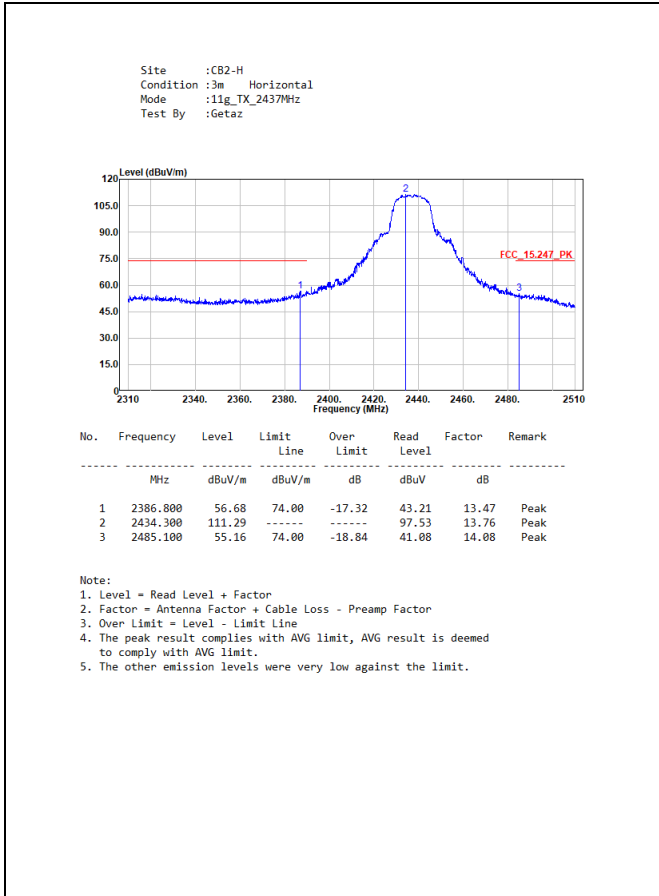
6.5. Test Result of Radiated Emission Band Edge

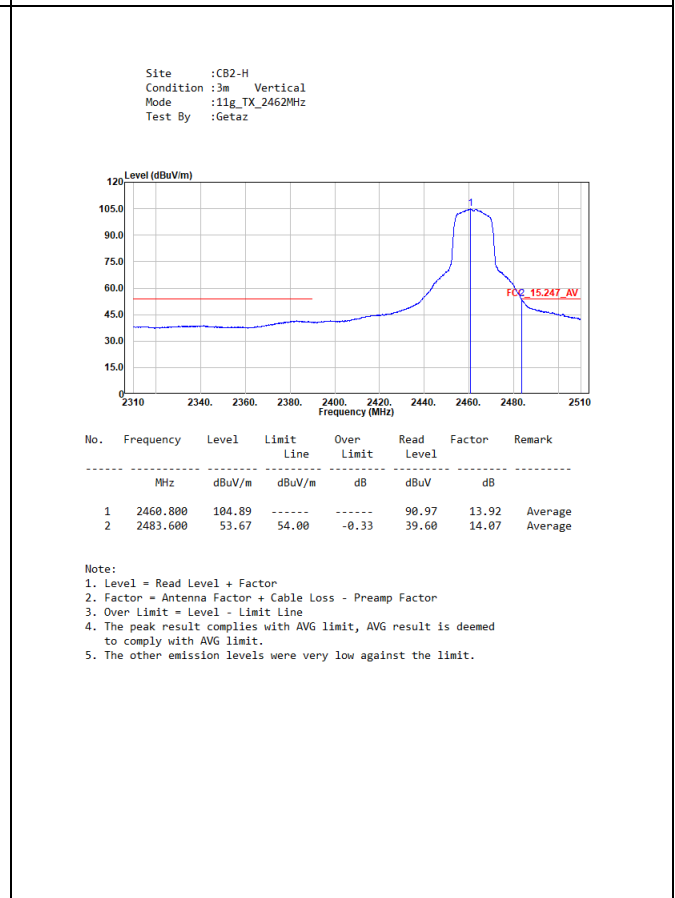
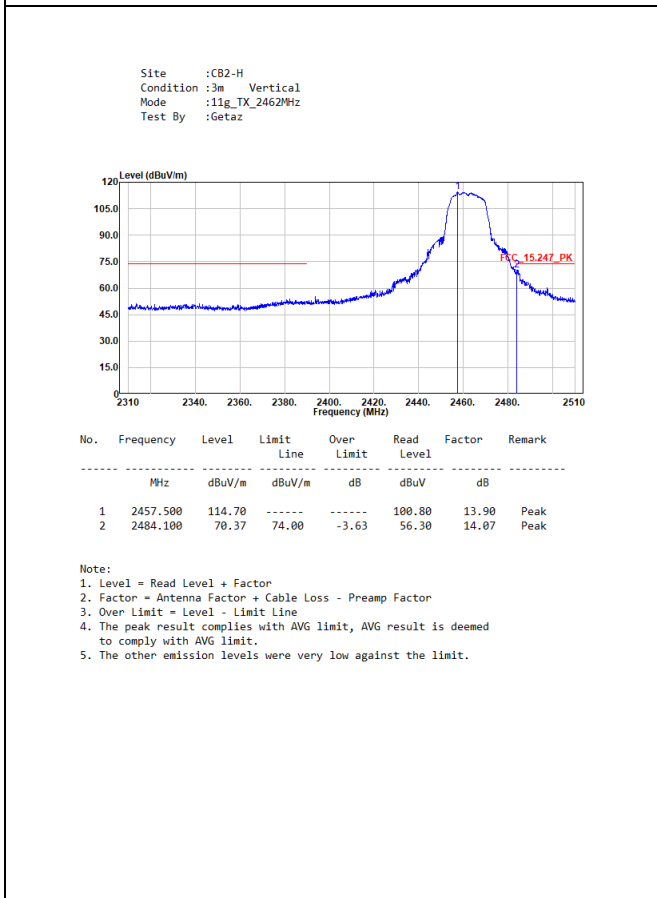
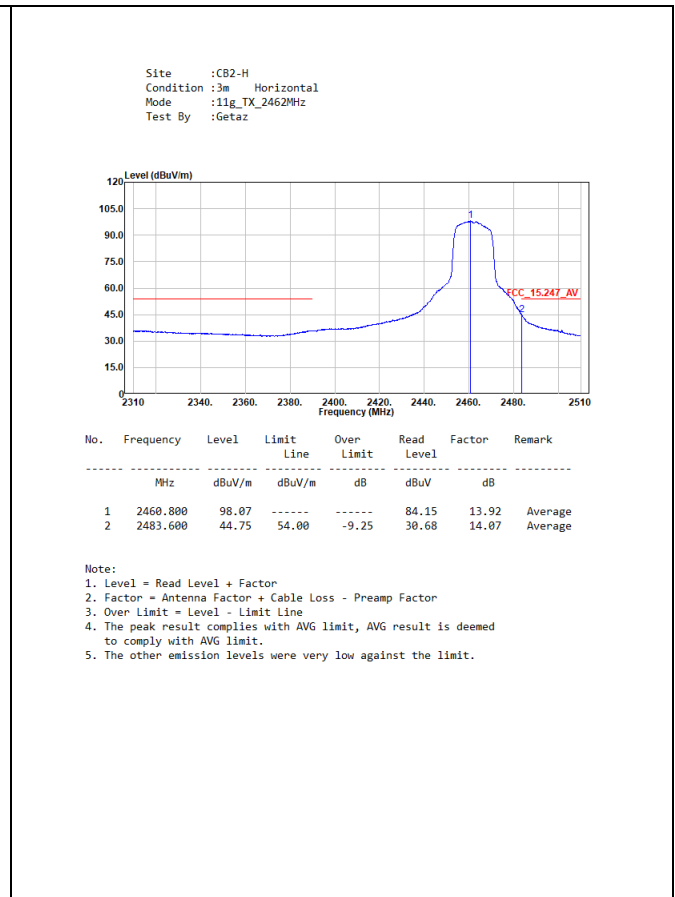
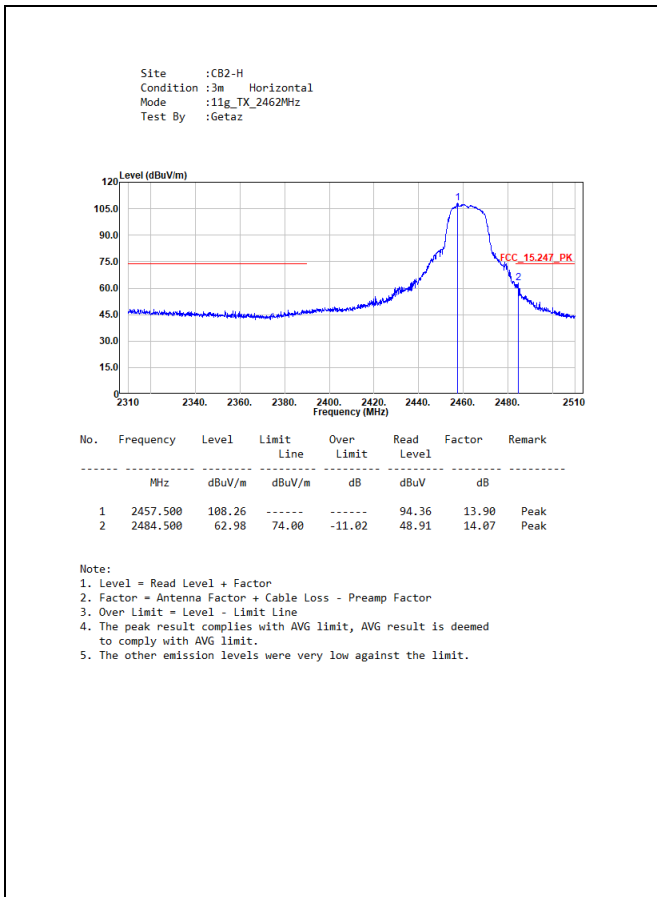


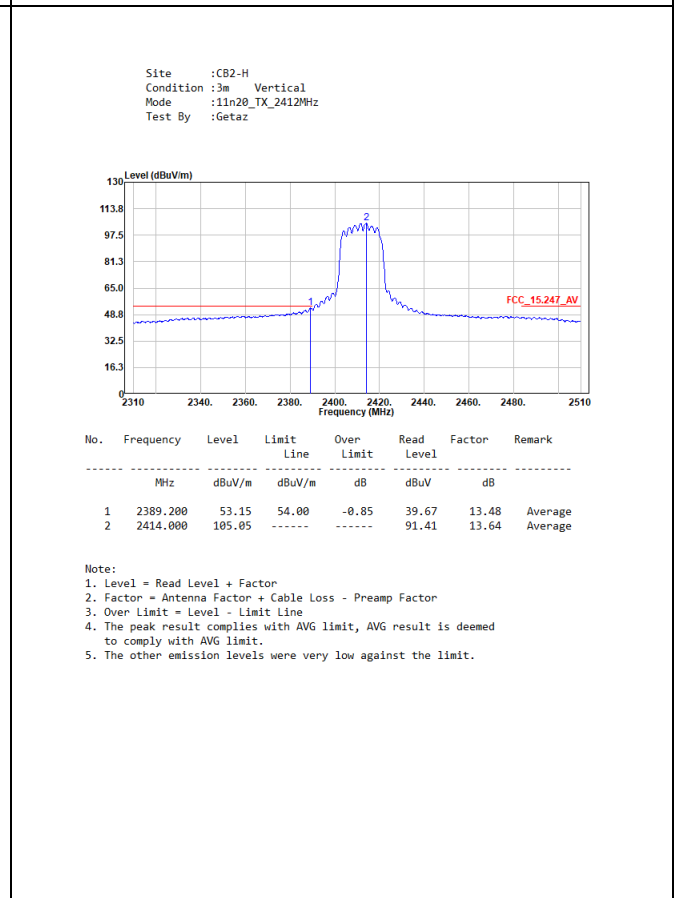
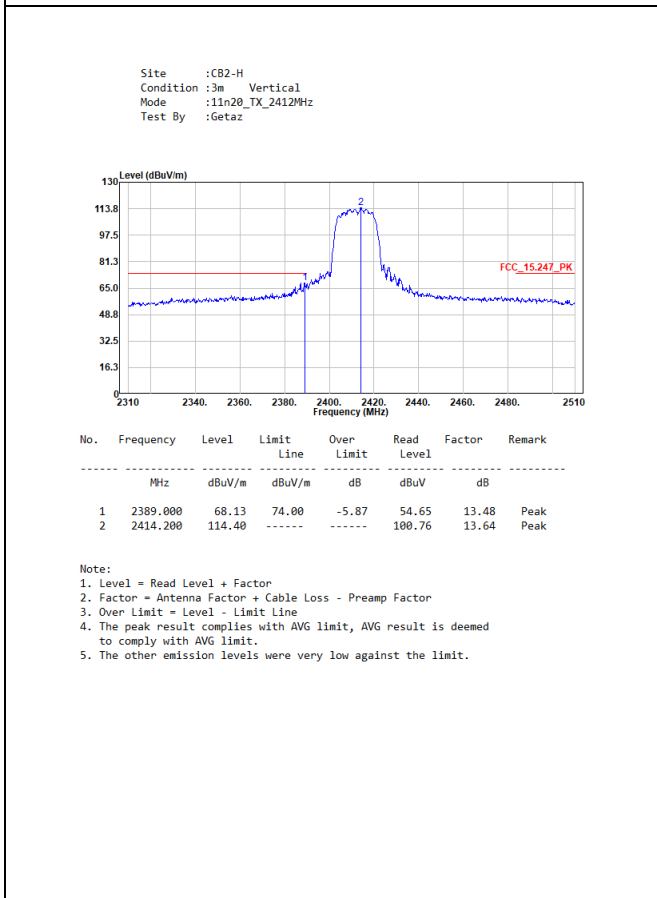
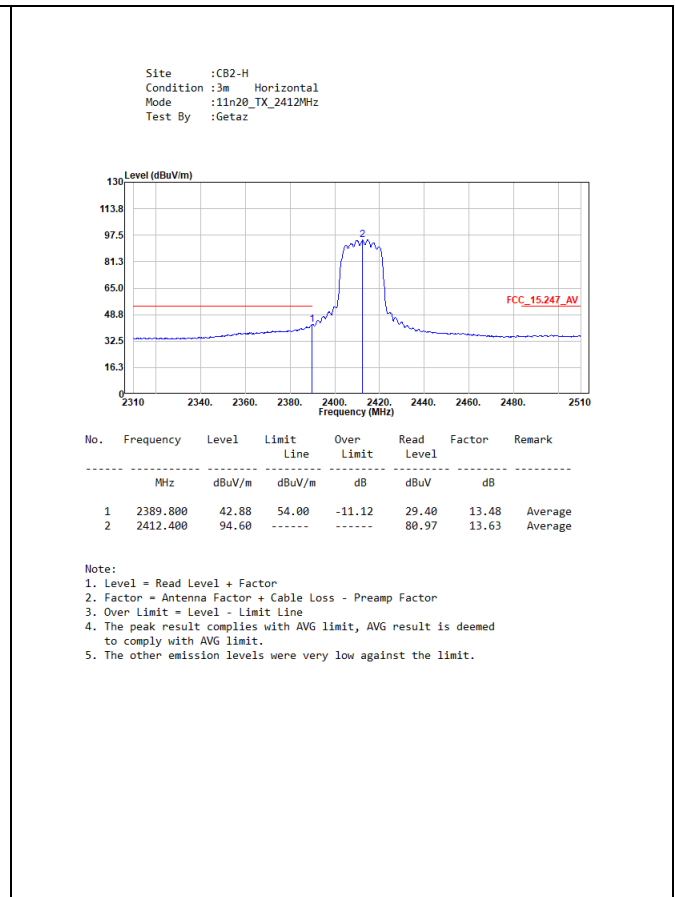
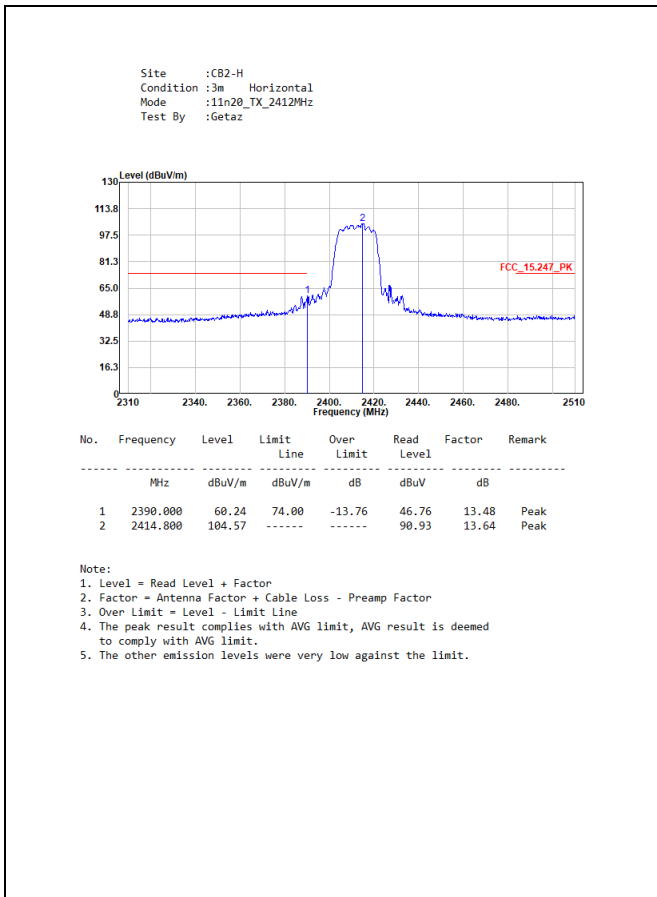


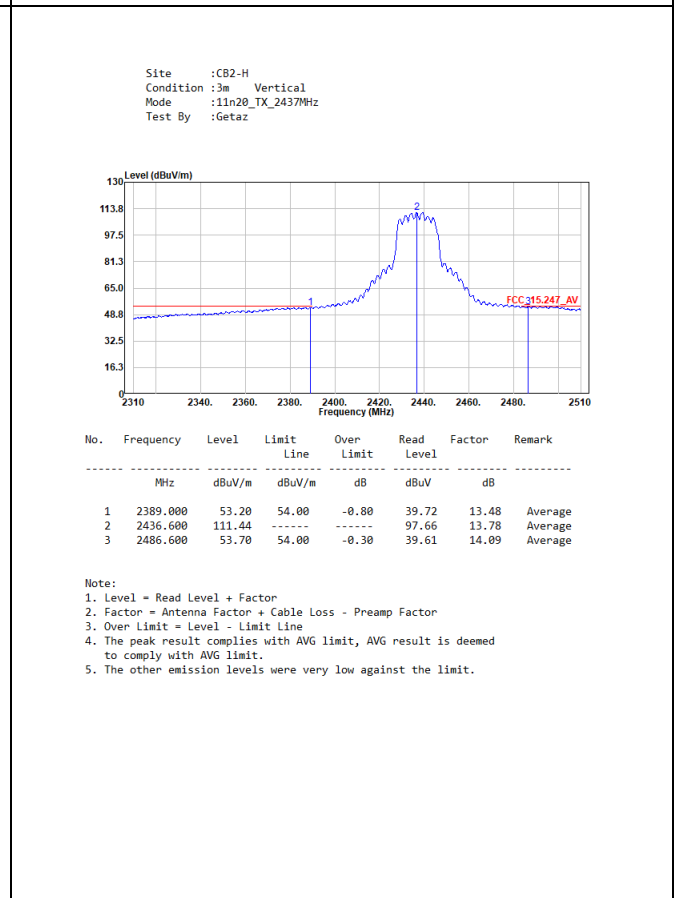
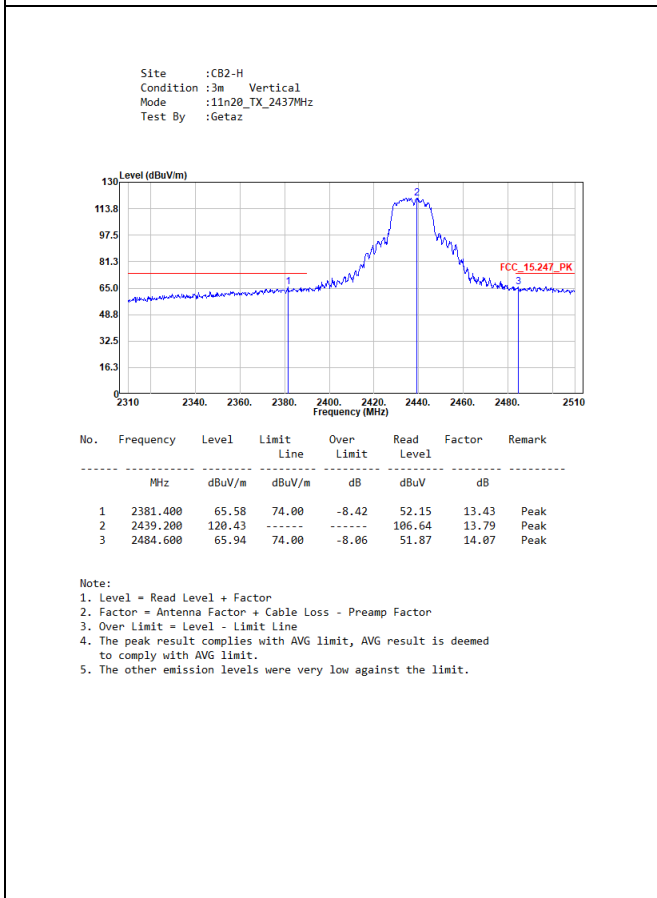
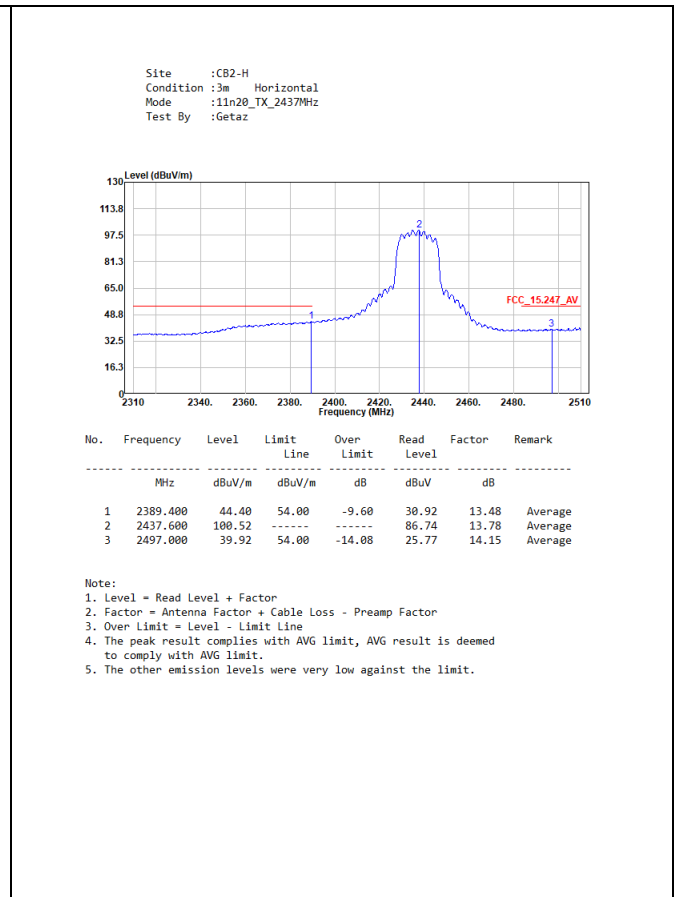
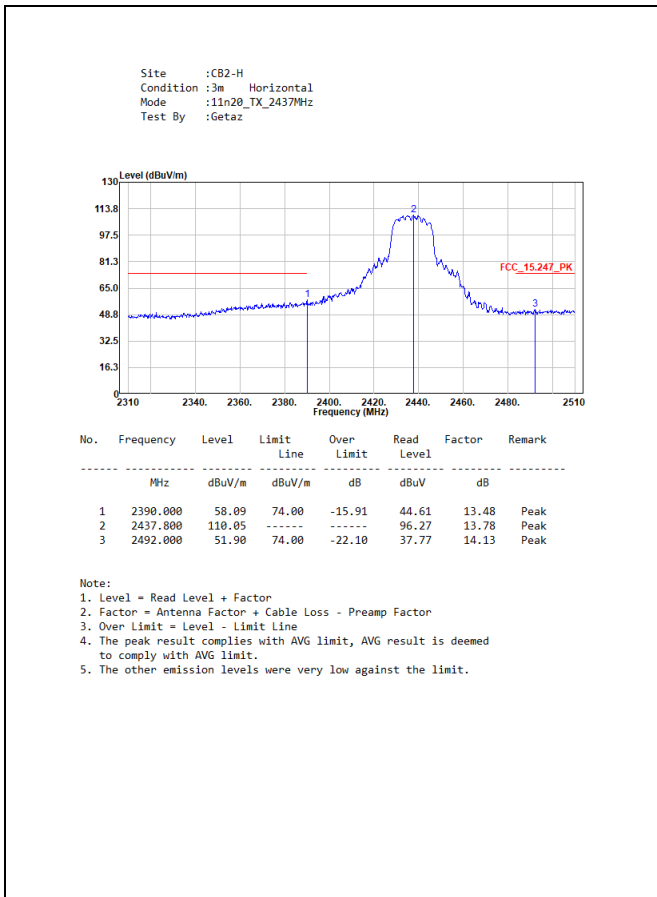


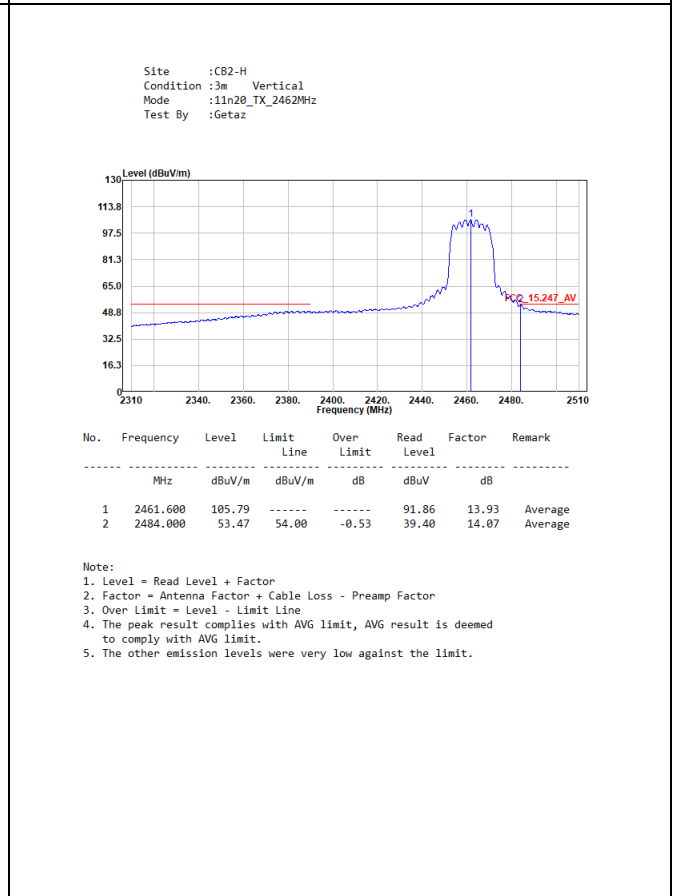
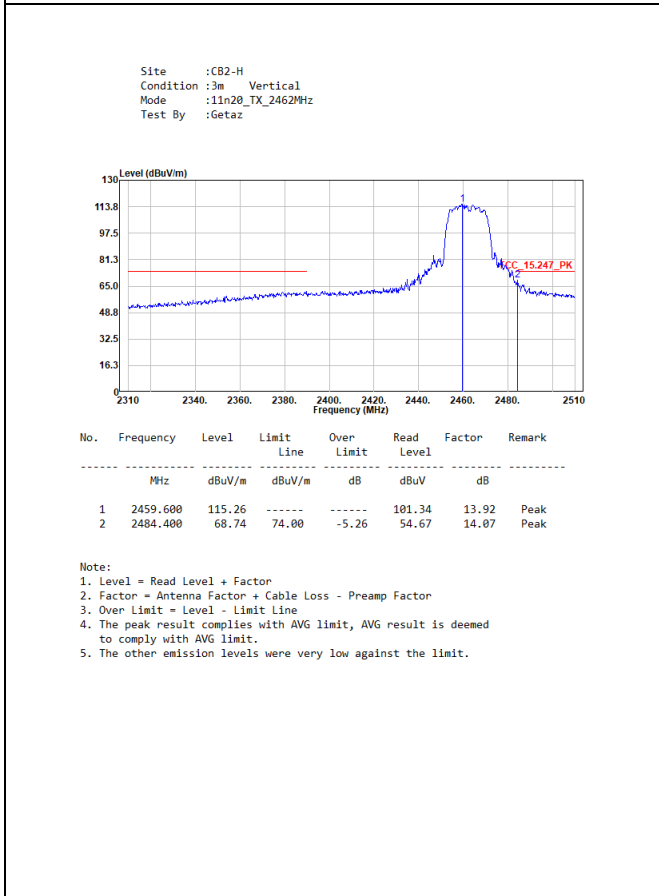
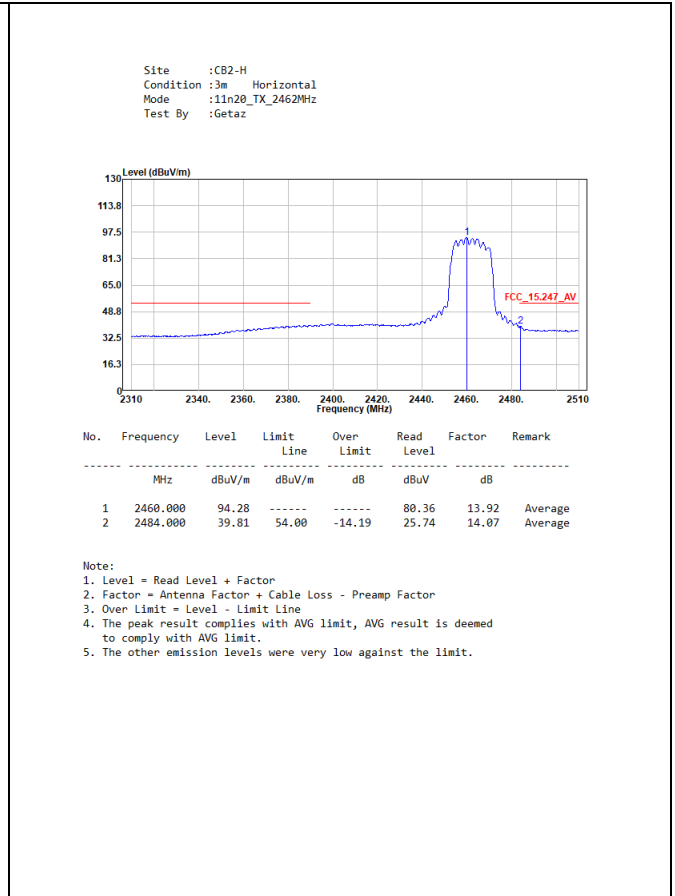
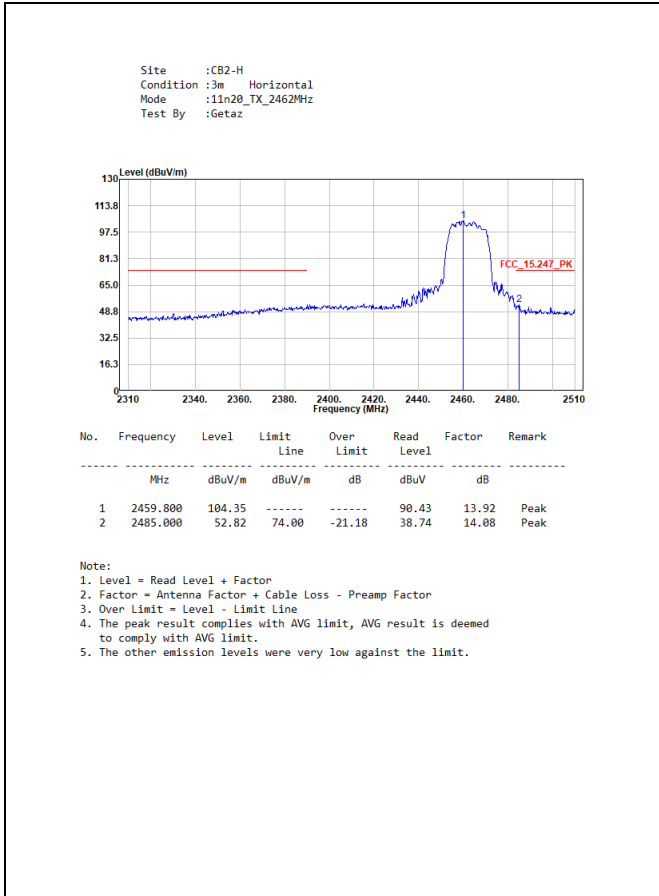


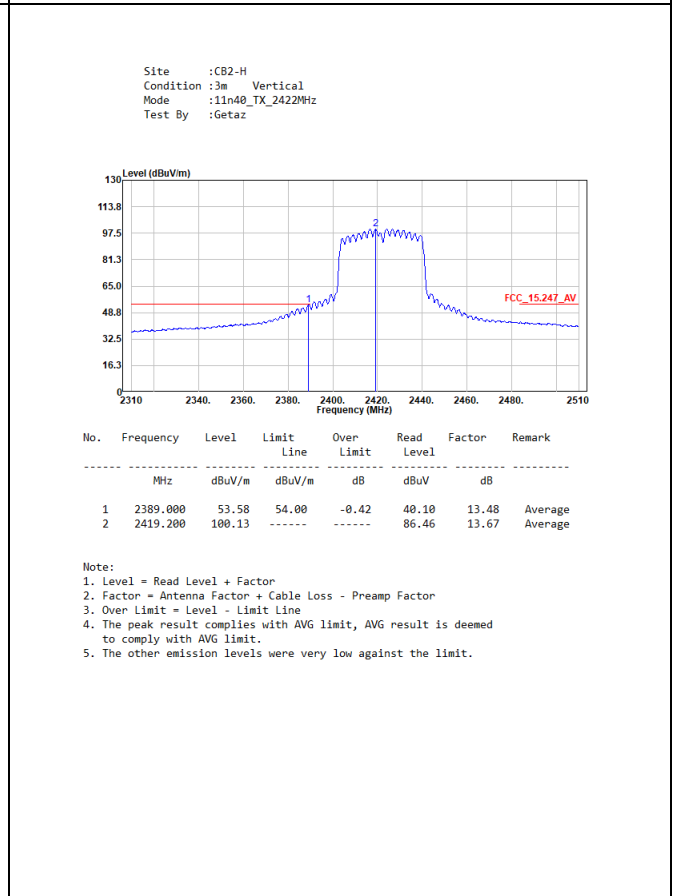
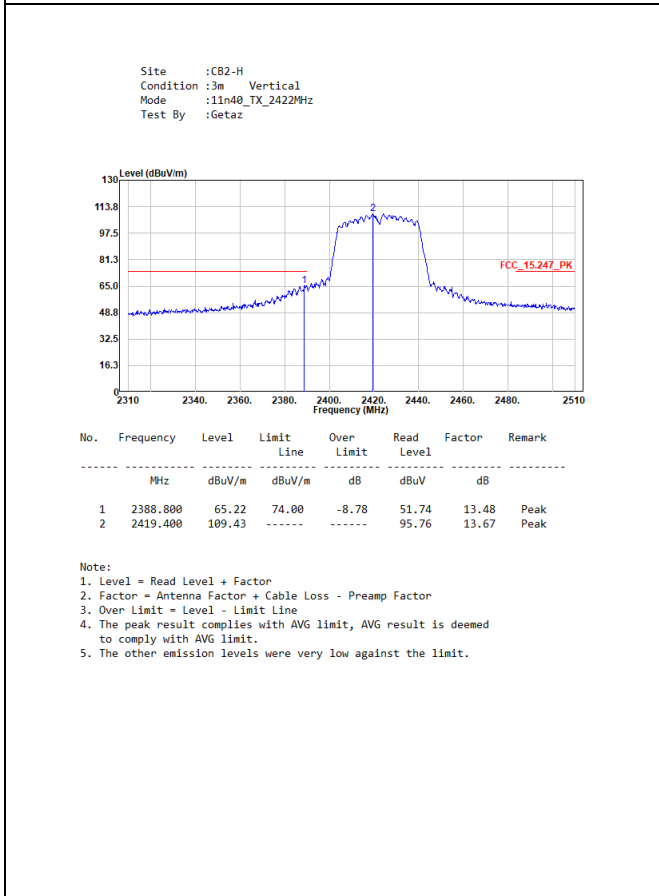
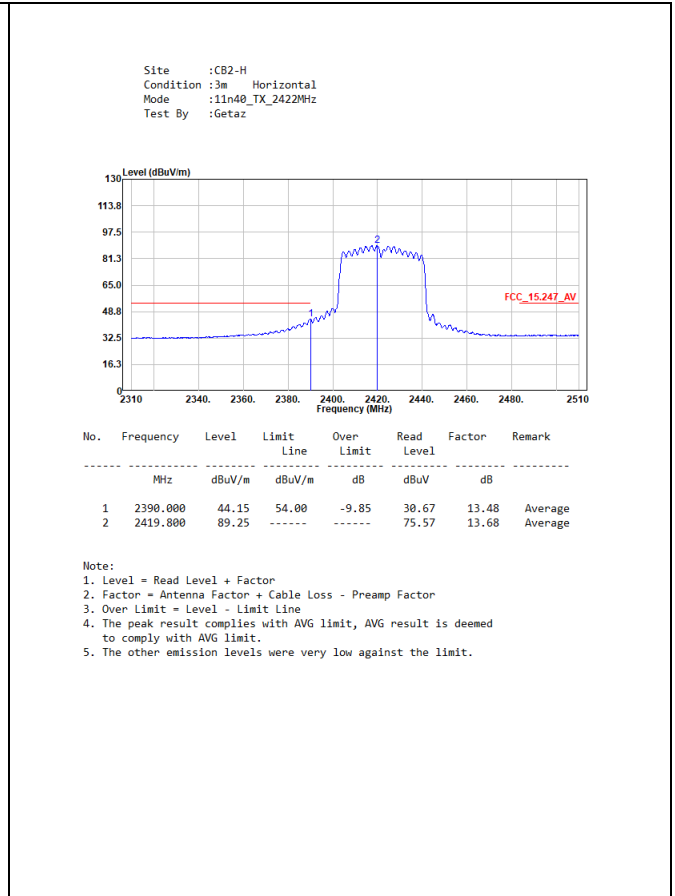
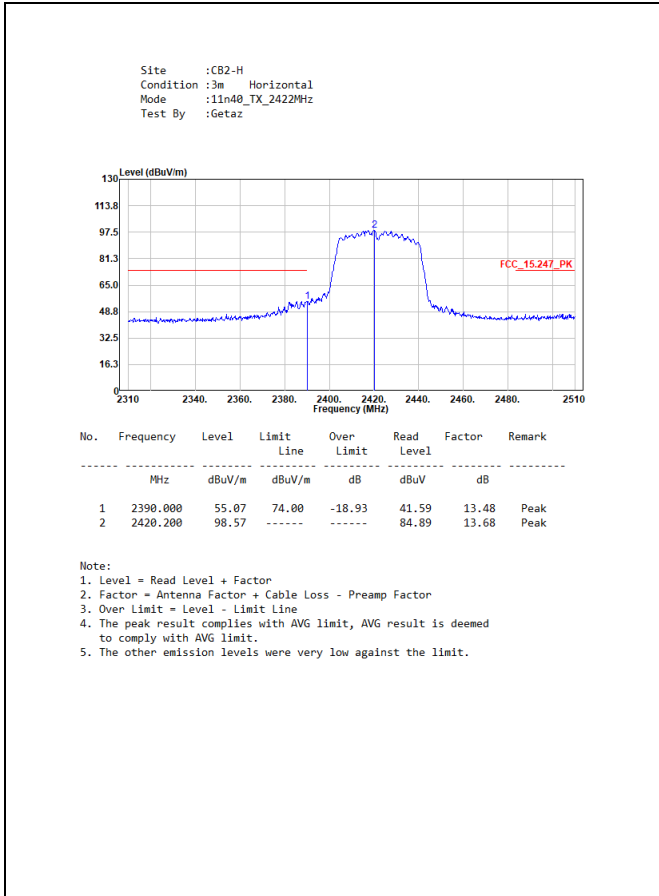


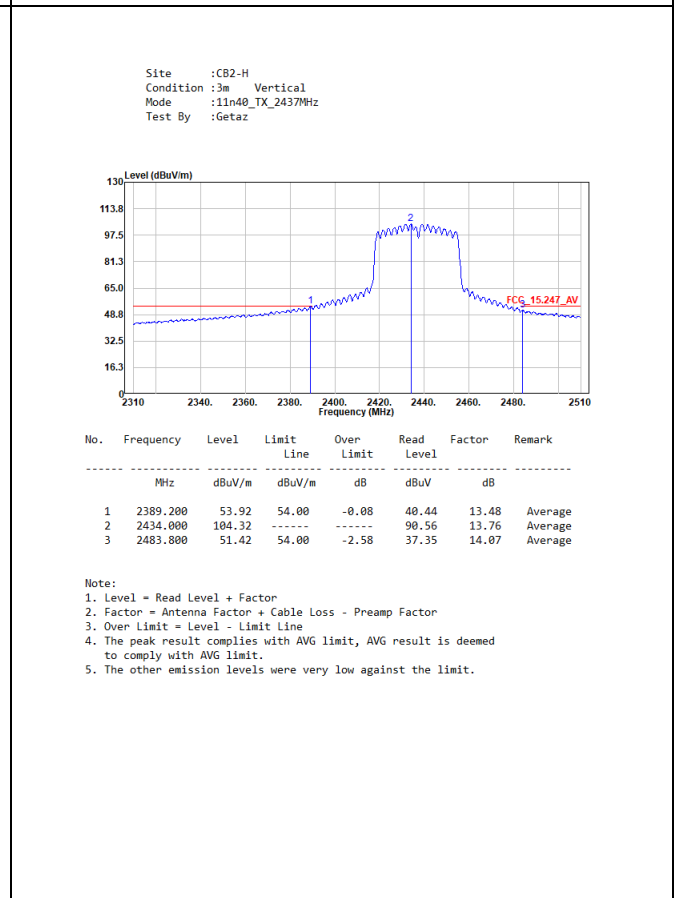
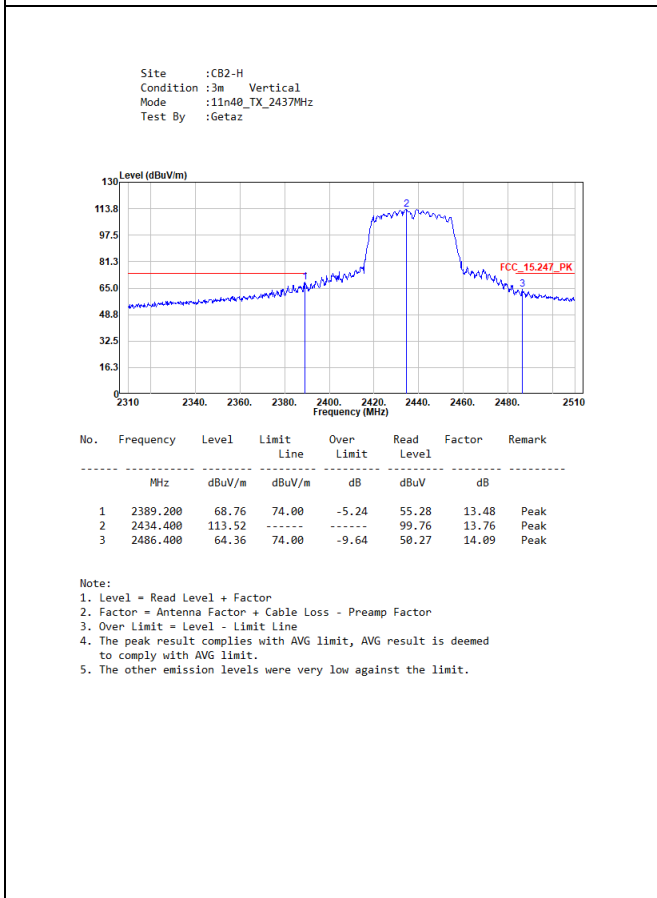
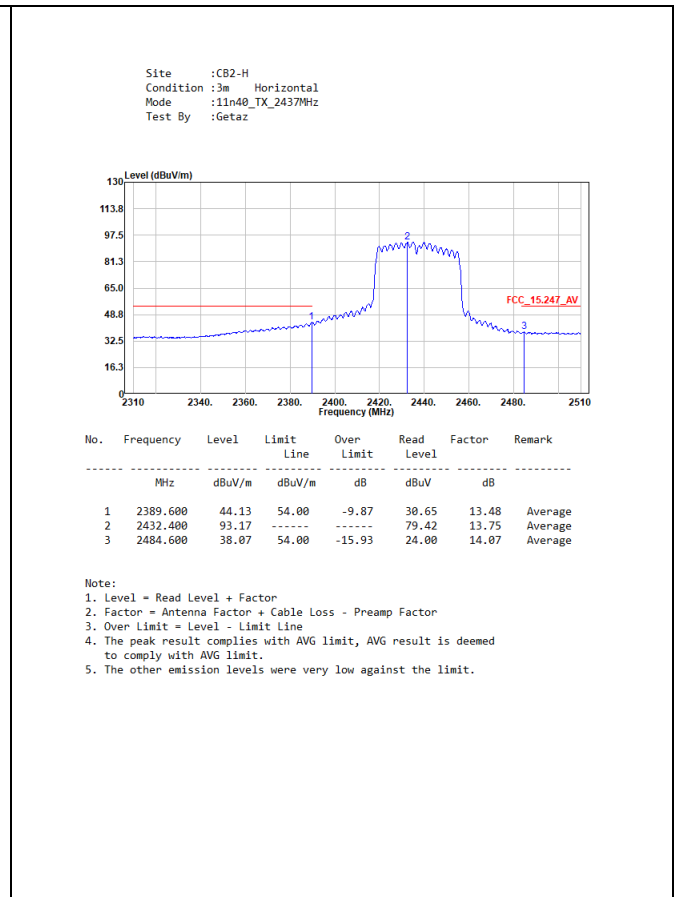
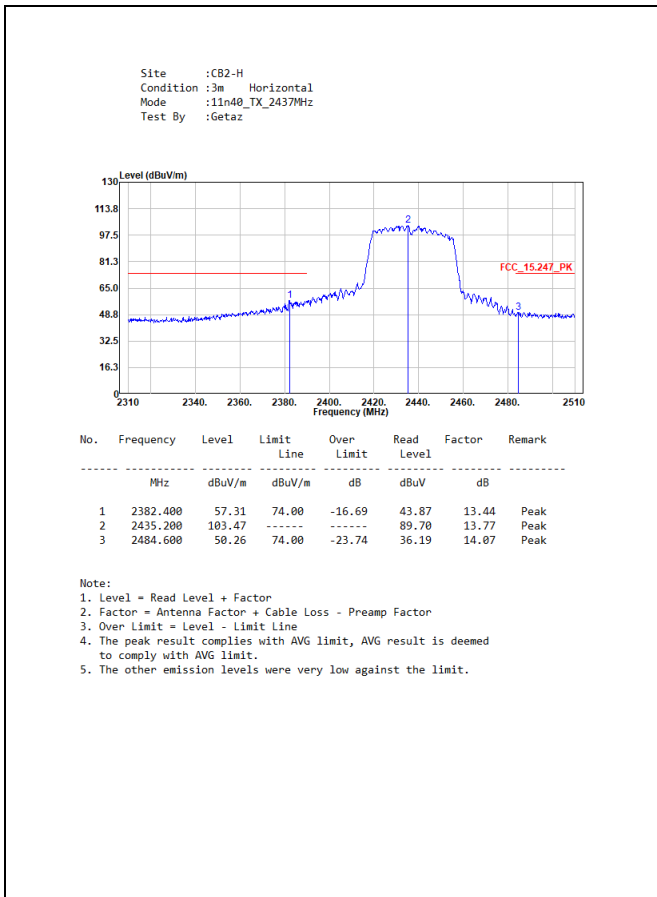


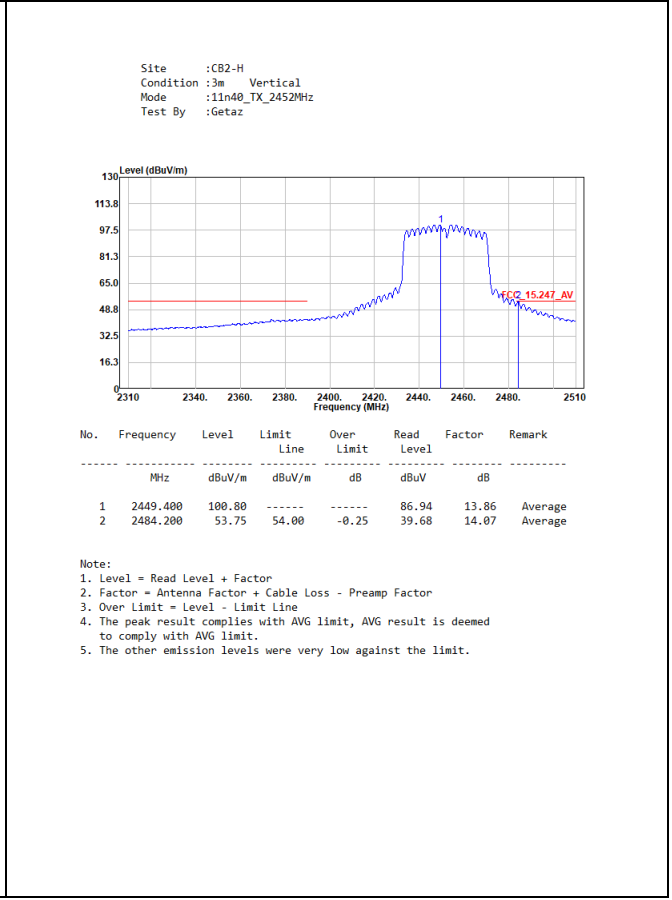
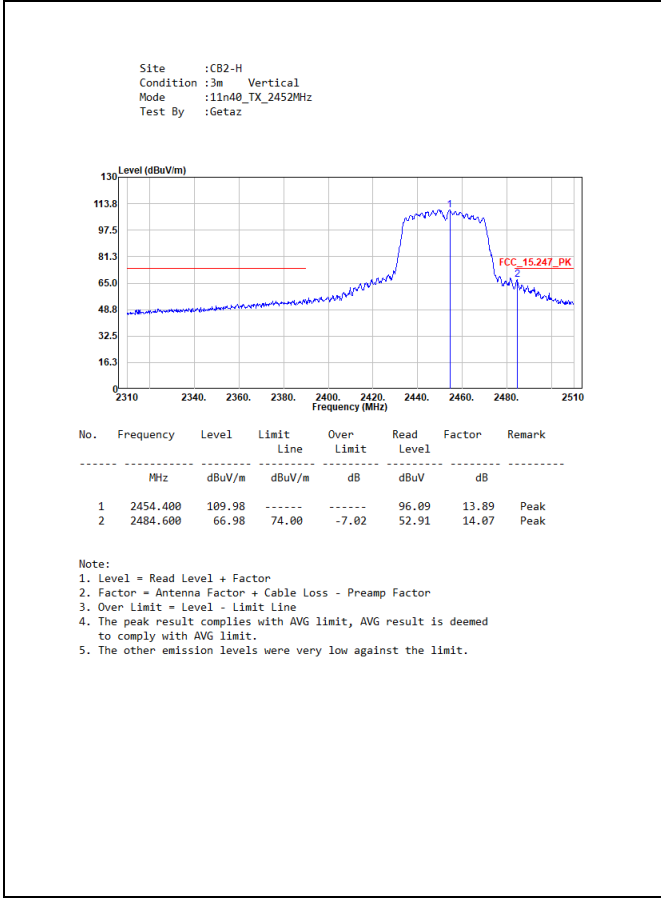
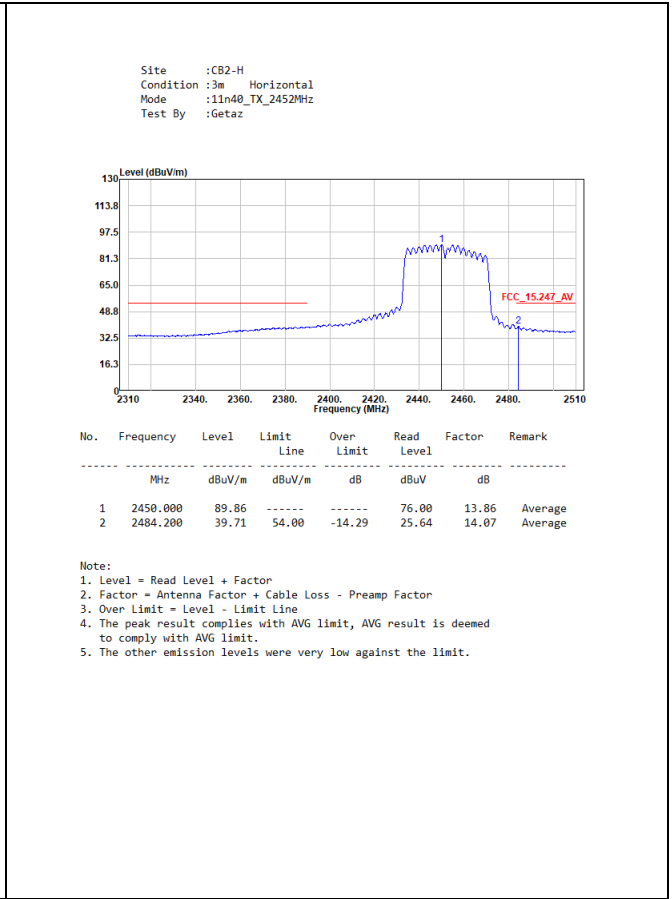
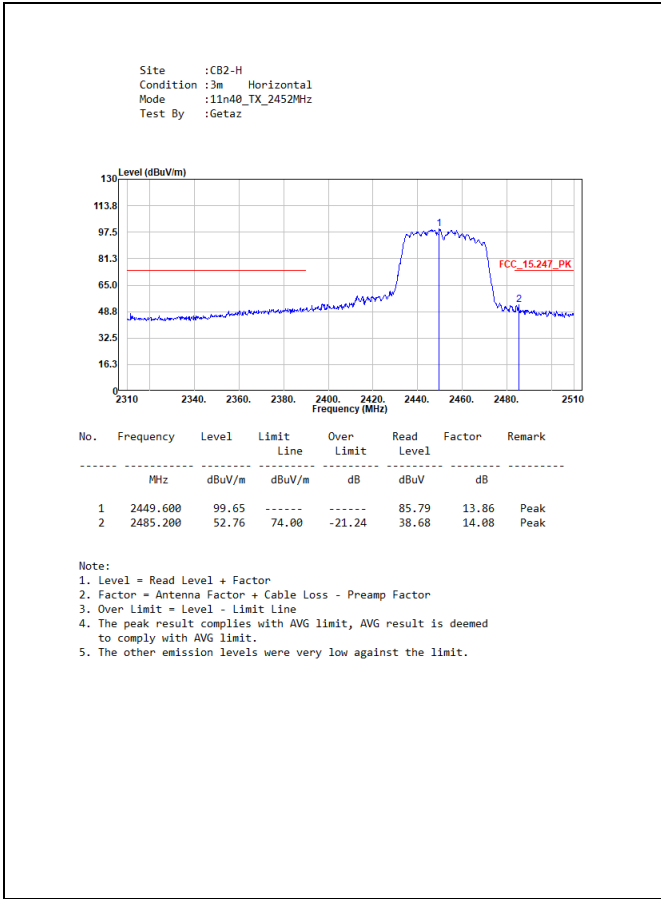






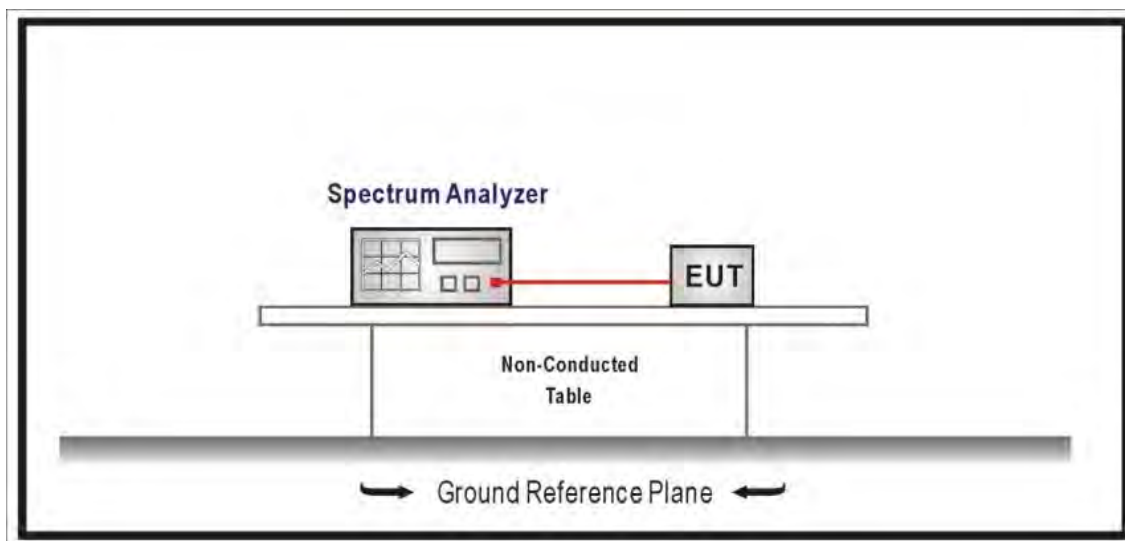






7. Occupied Bandwidth & DTS Bandwidth

7.1. Test Setup



7.2. Test Limit

The 6 dB bandwidth: ≥ 0.50 MHz.

Occupied Bandwidth: NA

7.3. Test Procedures

The EUT was setup according to ANSI C63.10: 2013; tested according to DTS test procedure of KDB 558074 D01 V05r02 for compliance to FCC 47CFR 15.247 requirements.

7.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

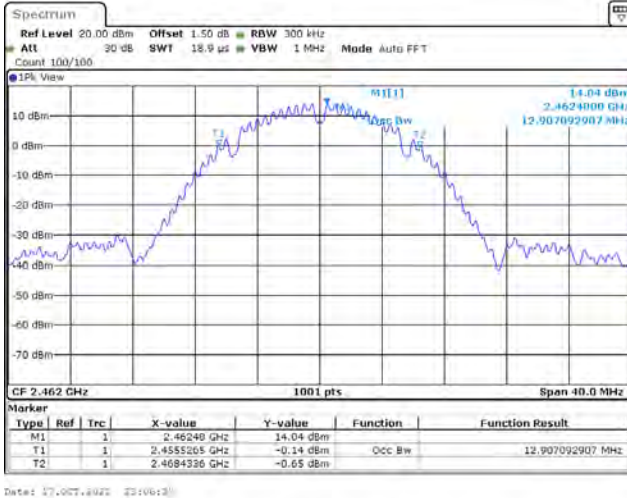
7.5. Test Result of Occupied Bandwidth

Modulation	Channel	Frequency (MHz)	Occupied Bandwidth (MHz)		Limit (MHz)
			Ant. 0	Ant. 1	
802.11b	1	2412	12.827	-	-
	6	2437	12.867	-	-
	11	2462	12.907	-	-
802.11g	1	2412	16.783	-	-
	6	2437	16.863	-	-
	11	2462	16.663	-	-

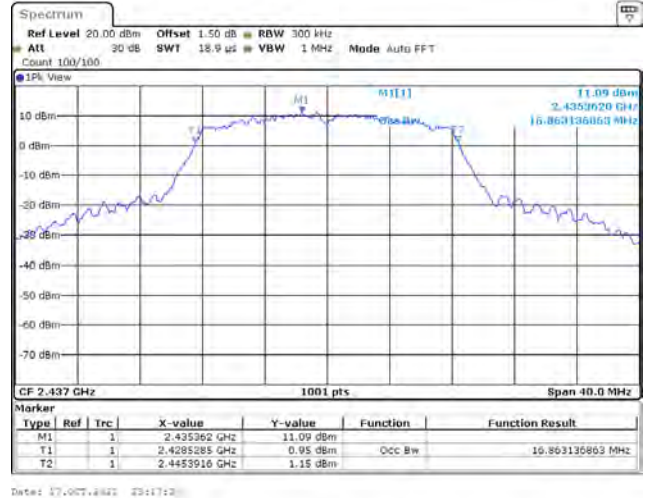
Modulation	Channel	Frequency (MHz)	Occupied Bandwidth (MHz)		Limit (MHz)
			Ant. 0	Ant. 1	
802.11n (20 MHz)	1	2412	17.582	17.462	-
	6	2437	17.502	17.422	-
	11	2462	17.622	17.462	-
802.11n (40 MHz)	3	2422	35.804	36.123	-
	6	2437	36.123	36.123	-
	9	2452	36.043	36.203	-

Spectrum plot of maximum value

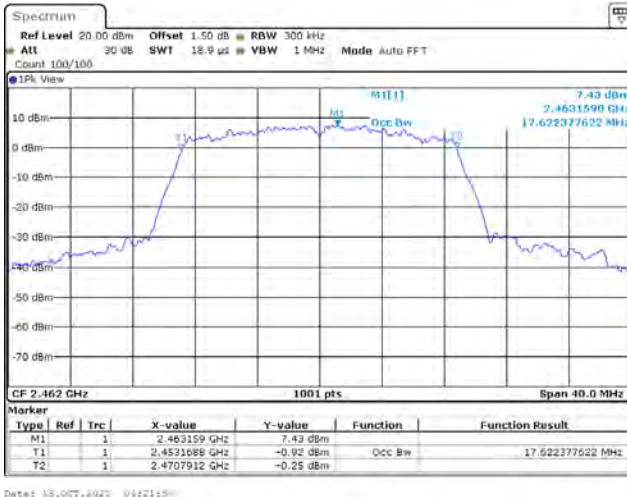
802.11b / Ant. 0 / 2462 MHz



802.11g / Ant. 0 / 2437 MHz



802.11n (20 MHz) / Ant. 0 / 2462 MHz



802.11n (40 MHz) / Ant. 1 / 2452 MHz



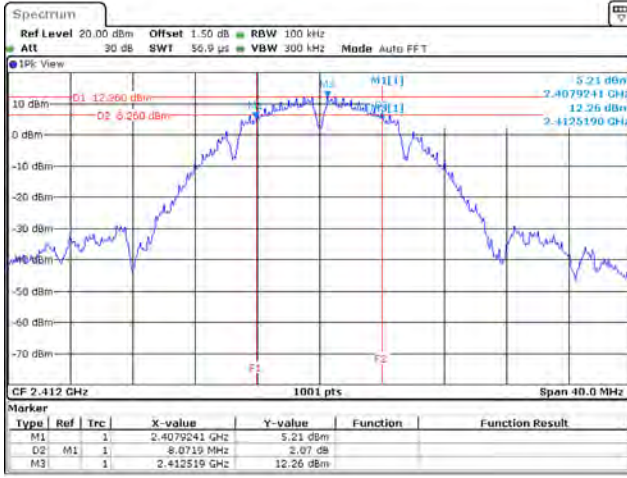
7.6. Test Result of DTS Bandwidth

Modulation	Channel	Frequency (MHz)	DTS Bandwidth (MHz)		Limit (MHz)	Result
			Ant. 0	Ant. 1		
802.11b	1	2412	8.071		≥ 0.50	Pass
	6	2437	8.071		≥ 0.50	Pass
	11	2462	8.551		≥ 0.50	Pass
802.11g	1	2412	15.104		≥ 0.50	Pass
	6	2437	15.104		≥ 0.50	Pass
	11	2462	15.104		≥ 0.50	Pass

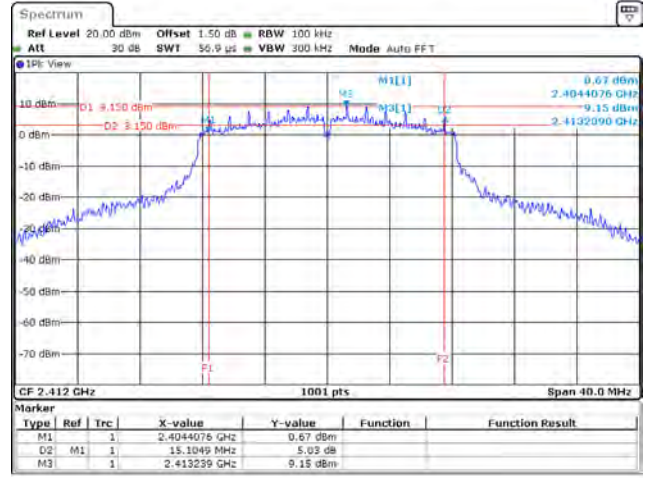
Modulation	Channel	Frequency (MHz)	DTS Bandwidth (MHz)		Limit (MHz)	Result
			Ant. 0	Ant. 1		
802.11n (20 MHz)	1	2412	15.104	16.303	≥ 0.50	Pass
	6	2437	15.104	15.104	≥ 0.50	Pass
	11	2462	15.104	15.704	≥ 0.50	Pass
802.11n (40 MHz)	3	2422	35.005	35.005	≥ 0.50	Pass
	6	2437	35.005	35.005	≥ 0.50	Pass
	9	2452	35.005	35.005	≥ 0.50	Pass

Spectrum plot of worst value

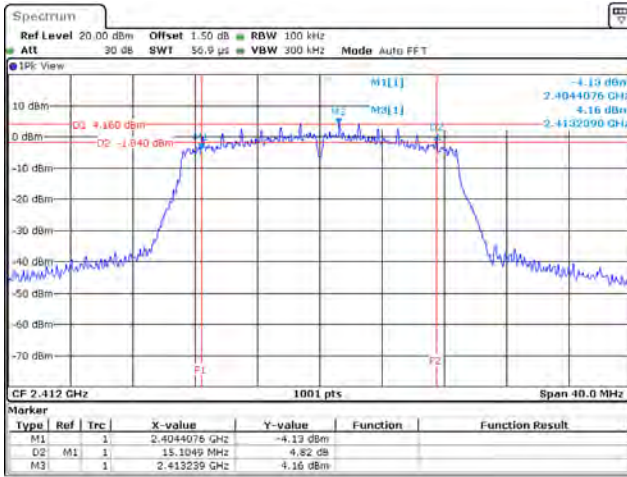
802.11b / Ant. 0 / 2412 MHz



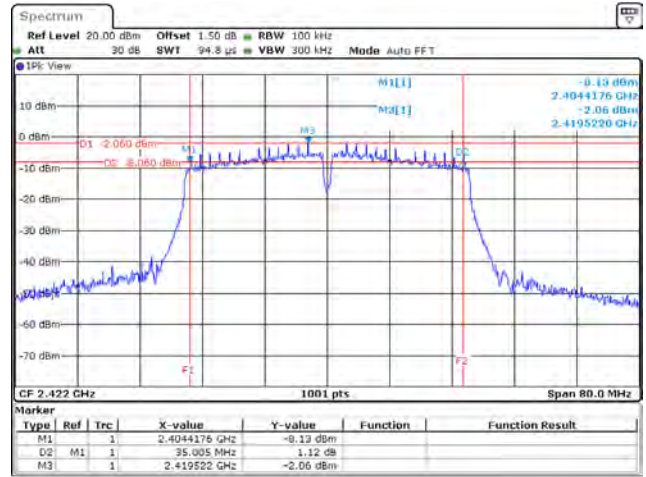
802.11g / Ant. 0 / 2412 MHz



802.11n (20 MHz) / Ant. 0 / 2412 MHz

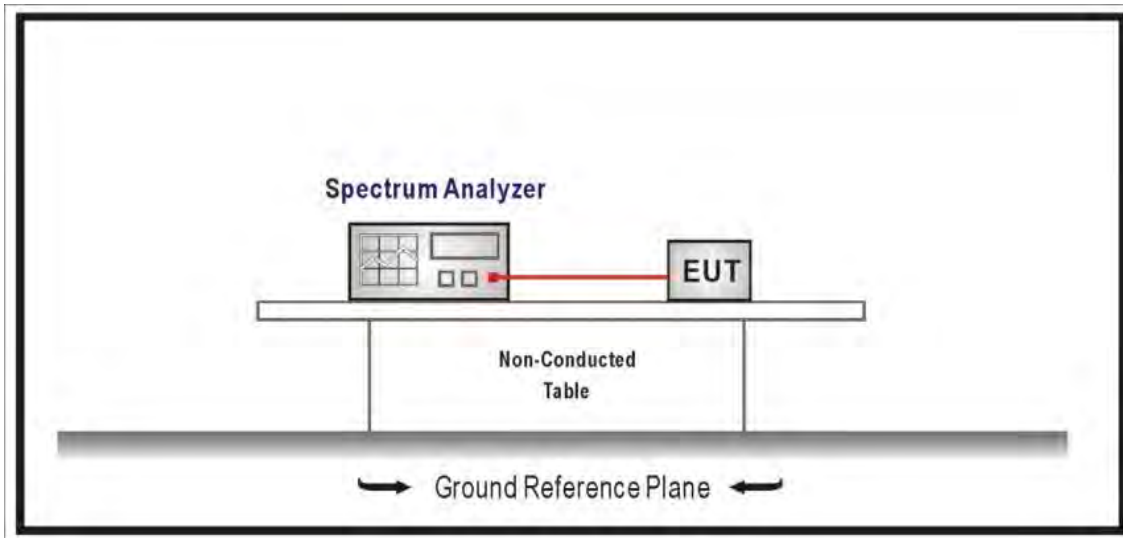


802.11n (40 MHz) / Ant. 0 / 2422 MHz



8. Maximum Power Spectral Density

8.1. Test Setup



8.2. Test Limit

The peak 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.

8.3. Test Procedures

The EUT was setup according to ANSI C63.10: 2013; tested according to DTS test procedure of KDB 558074 D01 V05r02 for compliance to FCC 47CFR 15.247 requirements.

8.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

8.5. Test Result of Maximum Power Spectral Density

Modulation	Channel	Frequency (MHz)	Power Spectral Density (dBm / 3kHz)		Limit (dBm / 3kHz)	Result
			Ant. 0	Total		
802.11b	1	2412	-10.320	-10.128	≤ 8.00	Pass
	6	2437	-9.200	-9.008	≤ 8.00	Pass
	11	2462	-10.120	-9.928	≤ 8.00	Pass
802.11g	1	2412	-15.400	-14.104	≤ 8.00	Pass
	6	2437	-15.200	-13.904	≤ 8.00	Pass
	11	2462	-14.900	-13.604	≤ 8.00	Pass

Modulation	Channel	Frequency (MHz)	Power Spectral Density (dBm / 3kHz)			Limit (dBm / 3kHz)	Result
			Ant. 0	Ant. 1	Total		
802.11n (20 MHz)	1	2412	-18.910	-18.250	-14.496	≤ 8.00	Pass
	6	2437	-17.810	-17.440	-13.549	≤ 8.00	Pass
	11	2462	-18.710	-18.100	-14.322	≤ 8.00	Pass
802.11n (40 MHz)	3	2422	-25.900	-25.350	-20.668	≤ 8.00	Pass
	6	2437	-26.090	-25.370	-20.767	≤ 8.00	Pass
	9	2452	-25.630	-26.680	-21.175	≤ 8.00	Pass

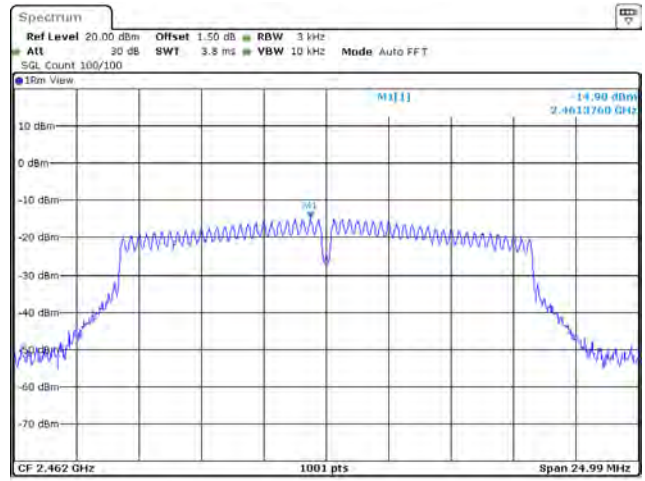
Note: Total power spectral density = power spectral density + duty factor, and the duty factor refer to section 1.10.

Spectrum plot of worst value

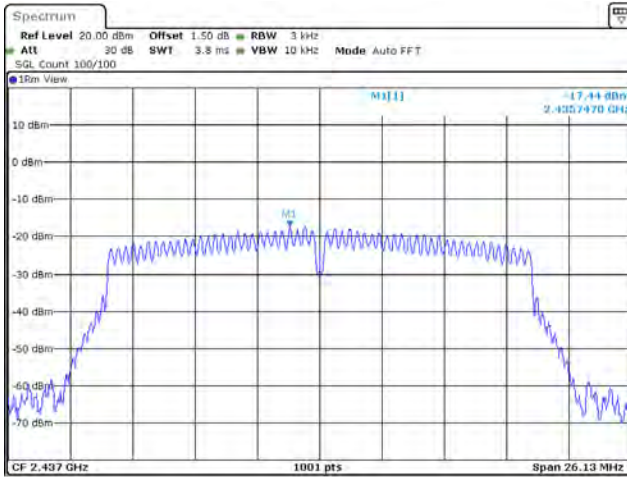
802.11b / Ant. 0 / 2437 MHz



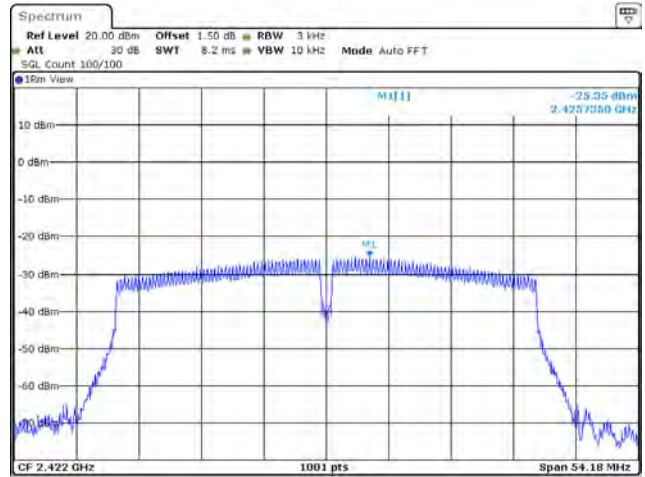
802.11g / Ant. 0 / 2462 MHz



802.11n (20 MHz) / Ant. 1 / 2437 MHz

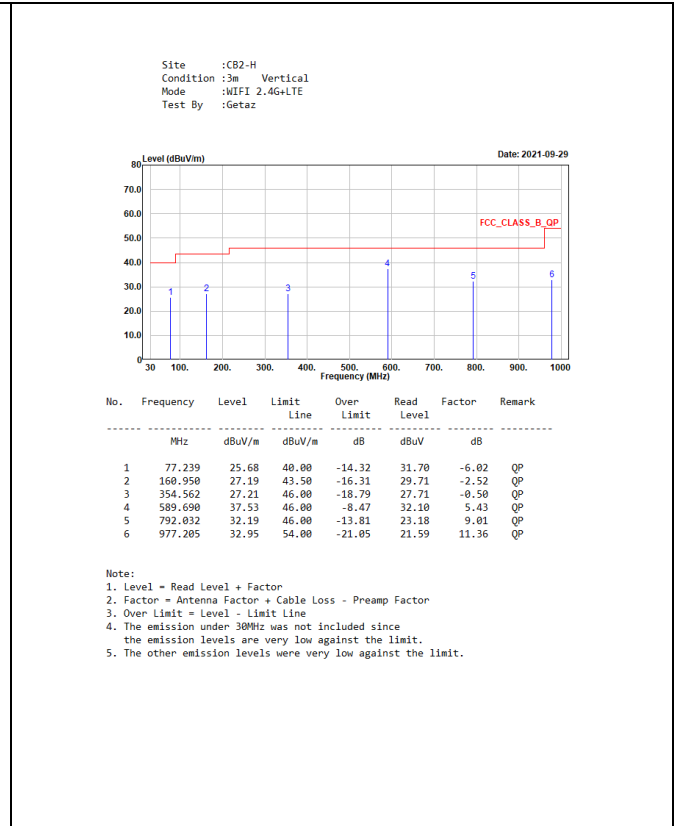
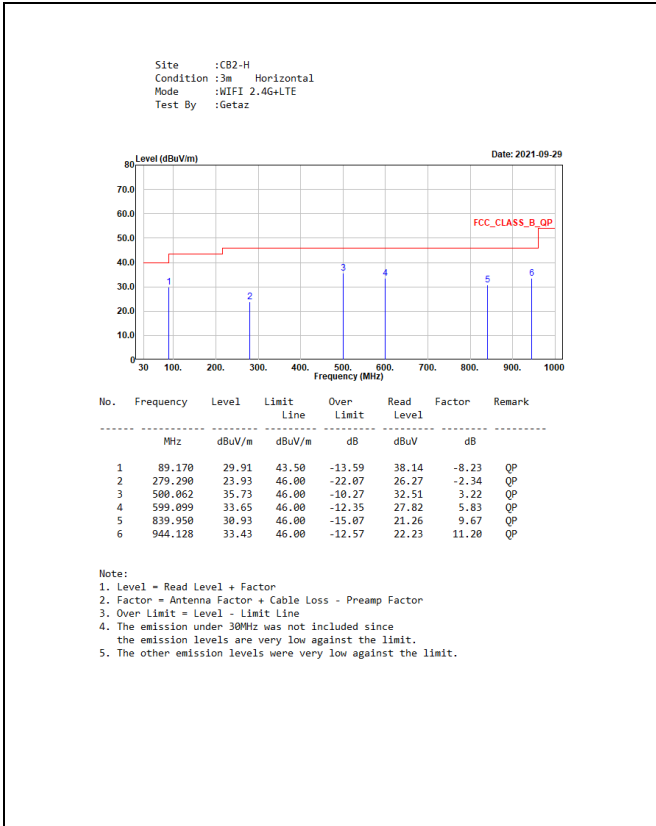


802.11n (40 MHz) / Ant. 1 / 2422 MHz



Appendix A

➤ Test Result of Radiated Emissions Co-location WLAN 2.4 GHz function + WWAN LTE function 30 MHz ~ 1 GHz:



Above 1 GHz:

