

FCC Test Report

Report No.: RFBEDW-WTW-P20120331-2

FCC ID: 2AH2Q-DREEM3

Test Model: Dreem3

Series Model: Dreem3SB (refer to item 3.1 for more details)

Received Date: Dec. 09, 2020

Test Date: Dec. 09, 2020 ~ Dec. 29, 2020

Issued Date: Jan. 11, 2021

Applicant: DREEM SAS

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**FCC Registration /
Designation Number:** 788550 / TW0003



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Table of Contents

Release Control Record	4
1 Certificate of Conformity	5
2 Summary of Test Results.....	6
2.1 Measurement Uncertainty.....	6
2.2 Modification Record	6
3 General Information	7
3.1 General Description of EUT	7
3.2 Description of Test Modes.....	8
3.2.1 Test Mode Applicability and Tested Channel Detail.....	9
3.3 Duty Cycle of Test Signal	11
3.4 Description of Support Units	12
3.4.1 Configuration of System under Test	12
3.5 General Description of Applied Standards and References	12
4 Test Types and Results	13
4.1 Radiated Emission and Bandedge Measurement	13
4.1.1 Limits of Radiated Emission and Bandedge Measurement	13
4.1.2 Test Instruments	14
4.1.3 Test Procedures.....	15
4.1.4 Deviation from Test Standard	16
4.1.5 Test Set Up	16
4.1.6 EUT Operating Conditions.....	17
4.1.7 Test Results	18
4.2 Conducted Emission Measurement.....	34
4.2.1 Limits of Conducted Emission Measurement	34
4.2.2 Test Instruments	34
4.2.3 Test Procedures.....	35
4.2.4 Deviation from Test Standard	35
4.2.5 Test Setup.....	35
4.2.6 EUT Operating Conditions.....	35
4.2.7 Test Results	36
4.3 6 dB Bandwidth Measurement.....	40
4.3.1 Limits of 6 dB Bandwidth Measurement.....	40
4.3.2 Test Setup.....	40
4.3.3 Test Instruments	40
4.3.4 Test Procedure	40
4.3.5 Deviation from Test Standard	40
4.3.6 EUT Operating Conditions.....	40
4.3.7 Test Results	41
4.4 Occupied Bandwidth Measurement.....	43
4.4.1 Test Setup.....	43
4.4.2 Test Instruments	43
4.4.3 Test Procedure	43
4.4.4 Deviation from Test Standard	43
4.4.5 EUT Operating Conditions.....	43
4.4.6 Test Results	44
4.5 Conducted Output Power Measurement	46
4.5.1 Limits of Conducted Output Power Measurement.....	46
4.5.2 Test Setup.....	46
4.5.3 Test Instruments	46
4.5.4 Test Procedures.....	46
4.5.5 Deviation from Test Standard	46
4.5.6 EUT Operating Conditions.....	46
4.5.7 Test Results	47

4.6	Power Spectral Density Measurement	48
4.6.1	Limits of Power Spectral Density Measurement.....	48
4.6.2	Test Setup.....	48
4.6.3	Test Instruments	48
4.6.4	Test Procedure	48
4.6.5	Deviation from Test Standard	49
4.6.6	EUT Operating Condition	49
4.6.7	Test Results	50
4.7	Conducted Out of Band Emission Measurement	52
4.7.1	Limits of Conducted Out of Band Emission Measurement.....	52
4.7.2	Test Setup.....	52
4.7.3	Test Instruments	52
4.7.4	Test Procedure	52
4.7.5	Deviation from Test Standard	52
4.7.6	EUT Operating Condition	52
4.7.7	Test Results	53
5	Pictures of Test Arrangements.....	61
	Annex A- Band Edge Measurement	62
	Appendix – Information of the Testing Laboratories	70

Release Control Record

Issue No.	Description	Date Issued
RFBEDW-WTW-P20120331-2	Original Release	Jan. 11, 2021

1 Certificate of Conformity

Product: Neuroband

Brand: DREEM

Test Model: Dreem3

Series Model: Dreem3SB (refer to item 3.1 for more details)

Sample Status: Identical Prototype

Applicant: DREEM SAS

Test Date: Dec. 09, 2020 ~ Dec. 29, 2020

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ANSI C63.10:2013

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

Prepared by : Vera Huang, **Date:** Jan. 11, 2021
Vera Huang / Specialist

Approved by : Dylan Chiou, **Date:** Jan. 11, 2021
Dylan Chiou / Senior Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -22.17 dB at 0.15000 MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -4.01 dB at 2483.5 MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.247(a)(2)	6 dB Bandwidth	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	Pass	Reference only
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note:

- For 2.4G band compliance with rule 15.247(d) of the band-edge items, the test plots were recorded in Annex A. Test Procedures refer to report 4.1.3.
- Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

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

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.79 dB
Radiated Emissions up to 1 GHz	9 kHz ~ 30 MHz	3.04 dB
	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Neuroband
Brand	DREEM
Test Model	Dreem3
Series Model	Dreem3SB
Model Difference	Refer to Note as below
Status of EUT	Identical Prototype
Power Supply Rating	5.0 Vdc (adapter) 3.8 Vdc (battery)
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: 11.0 / 5.5 / 2.0 / 1.0 Mbps 802.11g: 54.0 / 48.0 / 36.0 / 24.0 / 18.0 / 12.0 / 9.0 / 6.0 Mbps 802.11n: up to 150 Mbps
Operating Frequency	2412 ~ 2462 MHz
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
Output Power	211.349 mW
Antenna Type	Chip antenna with -3.55 dBi gain
Antenna Connector	N/A
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

- The EUT provides 1 completed transmitter and 1 receiver.

Modulation Mode	Tx Function
802.11b	1TX
802.11g	1TX
802.11n (HT20)	1TX
802.11n (HT40)	1TX

- The difference between all models are listed as below.

Brand	EUT Configuration	Model	BC (Bone Conduction)	Charging Cable
DREEM	1	Dreem3	w/ BC	USB
	2	Dreem3SB	w/o BC	USB

- The EUT contains following accessory devices.

Product	Brand	Model	Description
Battery	Dreem	YE582730C	Min: 3.0V, Nom: 3.8V, Max: 4.35V 520mAh
USB Cable	Dreem	UE200318TWR1RM	--

- The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.
- The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

7 channels are provided for 802.11n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	7	2442
4	2427	8	2447
5	2432	9	2452
6	2437		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE≥1G	RE<1G	PLC	APCM	
A	√	√	√	√	EUT 1
B	-	√	√	-	EUT 2

Where **RE≥1G**: Radiated Emission above 1 GHz

RE<1G: Radiated Emission below 1 GHz

PLC: Power Line Conducted Emission

APCM: Antenna Port Conducted Measurement

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

NOTE: "-" means no effect.

Radiated Emission Test (Above 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
A	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
A	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5
A	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	13.5

Radiated Emission Test (Below 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A, B	802.11n (HT40)	3 to 9	9	OFDM	BPSK	13.5

Power Line Conducted Emission Test:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A, B	802.11n (HT40)	3 to 9	9	OFDM	BPSK	13.5

Bandedge Measurement:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A	802.11b	1 to 11	1, 11	DSSS	DBPSK	1.0
A	802.11g	1 to 11	1, 11	OFDM	BPSK	6.0
A	802.11n (HT20)	1 to 11	1, 11	OFDM	BPSK	6.5
A	802.11n (HT40)	3 to 9	3, 9	OFDM	BPSK	13.5

Antenna Port Conducted Measurement:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
A	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
A	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5
A	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	13.5

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
RE $\geq$ 1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Tim Chen
RE<1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Tim Chen
PLC	22 deg. C, 66 % RH	120 Vac, 60 Hz	Tim Chen
APCM	25 deg. C, 60 % RH	3.8 Vdc	Jisyong Wang

3.3 Duty Cycle of Test Signal

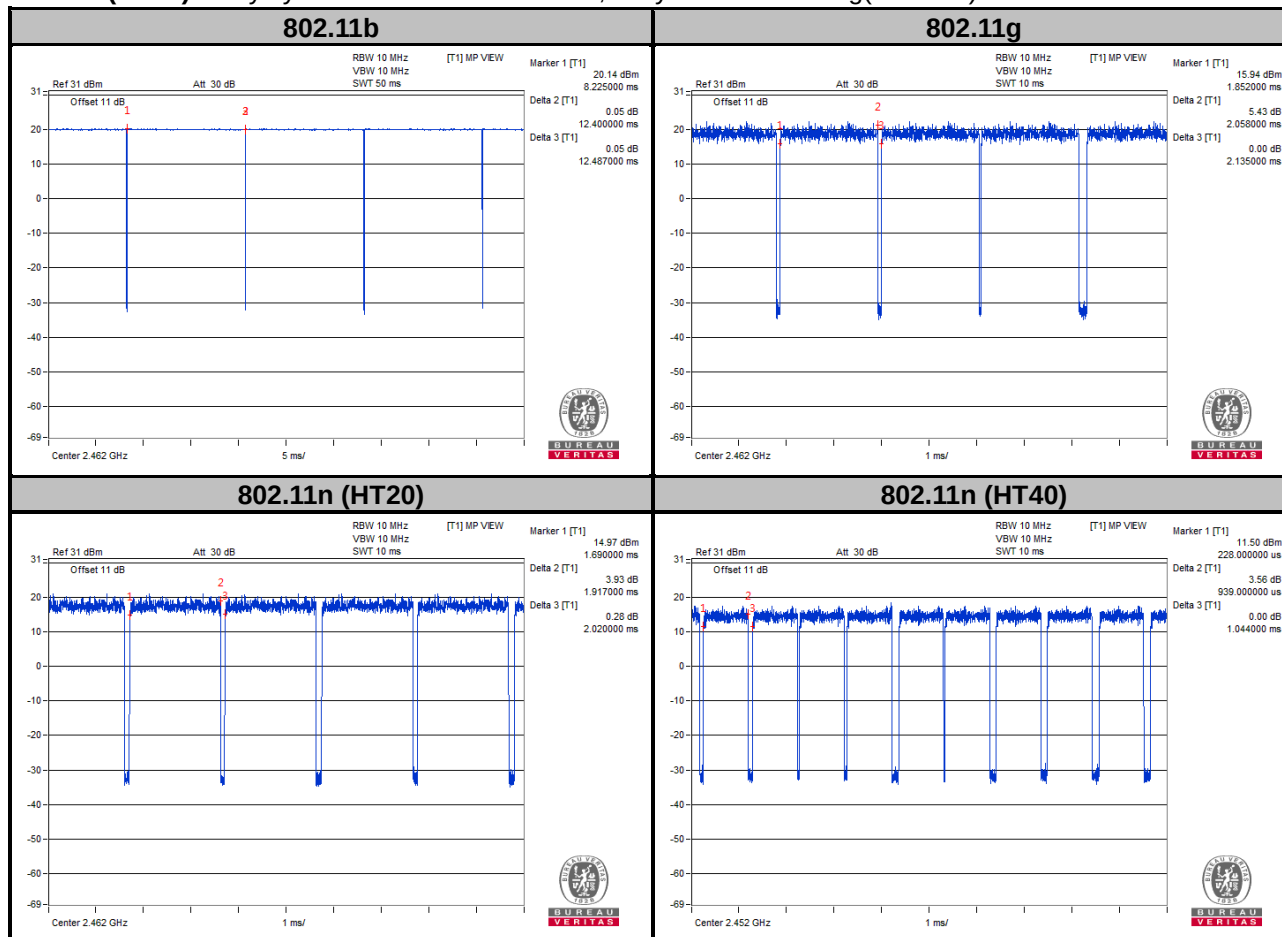
802.11b: Duty cycle = $12.4/12.487 = 0.993$, Duty cycle of test signal is $\geq 98\%$, duty factor is not required.

Duty cycle of test signal is $< 98\%$, duty factor shall be considered.

802.11g: Duty cycle = $2.058/2.135 = 0.964$, Duty factor = $10 * \log(1/0.964) = 0.16$

802.11n (HT20): Duty cycle = $1.917/2.02 = 0.949$, Duty factor = $10 * \log(1/0.949) = 0.23$

802.11n (HT40): Duty cycle = $0.939/1.044 = 0.899$, Duty factor = $10 * \log(1/0.899) = 0.46$



3.4 Description of Support Units

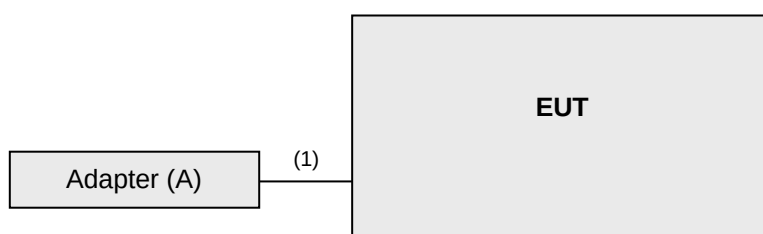
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Adapter	HTC	TC U250	100980	NA	--

Note: All power cords of the above support units are non-shielded (1.8m).

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB Cable	1	0.94	N	0	Provided by client

3.4.1 Configuration of System under Test



3.5 General Description of Applied Standards and References

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

Test Standard:

FCC Part 15, Subpart C (15.247)

ANSI C63.10-2013

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

References Test Guidance:

KDB 558074 D01 Meas Guidance v05r02

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Mar. 18, 2020	Mar. 17, 2021
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 07, 2020	Dec. 06, 2021
Spectrum Analyzer ROHDE & SCHWARZ	FSV40	100980	Apr. 20, 2020	Apr. 19, 2021
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 16, 2020	Apr. 15, 2021
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-969	Nov. 22, 2020	Nov. 21, 2021
BILOG Antenna SCHWARZBECK	VULB 9168	9168-472	Nov. 06, 2020	Nov. 05, 2021
Fixed Attenuator WOKEN	MDCS18N-10	MDCS18N-10-01	Apr. 14, 2020	Apr. 13, 2021
Loop Antenna	EM-6879	269	Sep. 17, 2020	Sep. 16, 2021
Preamplifier EMCI	EMC001340	980201	Oct. 21, 2020	Oct. 20, 2021
Preamplifier EMCI	EMC 012645	980115	Oct. 07, 2020	Oct. 06, 2021
Preamplifier EMCI	EMC 330H	980112	Oct. 07, 2020	Oct. 06, 2021
Power Meter Anritsu	ML2495A	1012010	Sep. 01, 2020	Aug. 31, 2021
Power Sensor Anritsu	MA2411B	1315050	Sep. 01, 2020	Aug. 31, 2021
RF Coaxial Cable EMCI	EMC104-SM-SM-8000	171005	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable HUBER+SUHNNER	SUCOFLEX 104	EMC104-SM-SM-1000(140807)	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Oct. 07, 2020	Oct. 06, 2021
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	NA	NA	NA

- Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 10.

4.1.3 Test Procedures

For Radiated Emission below 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

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

For Radiated Emission above 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

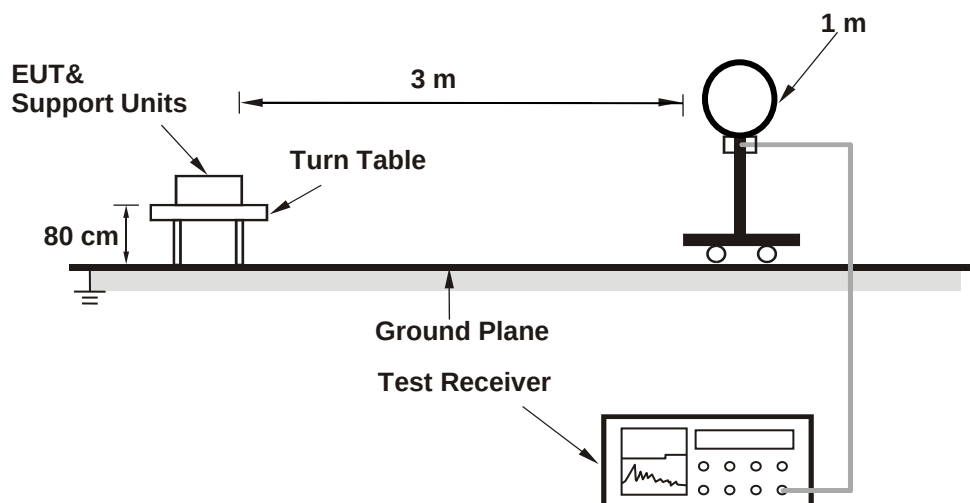
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10 Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1 GHz.
(11b: RBW = 1 MHz, VBW = 10 Hz ; 11g: RBW = 1 MHz, VBW = 510 Hz ;
11n (HT20): RBW = 1 MHz, VBW = 1 kHz ; 11n (HT40): RBW = 1 MHz, VBW = 2 kHz)
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

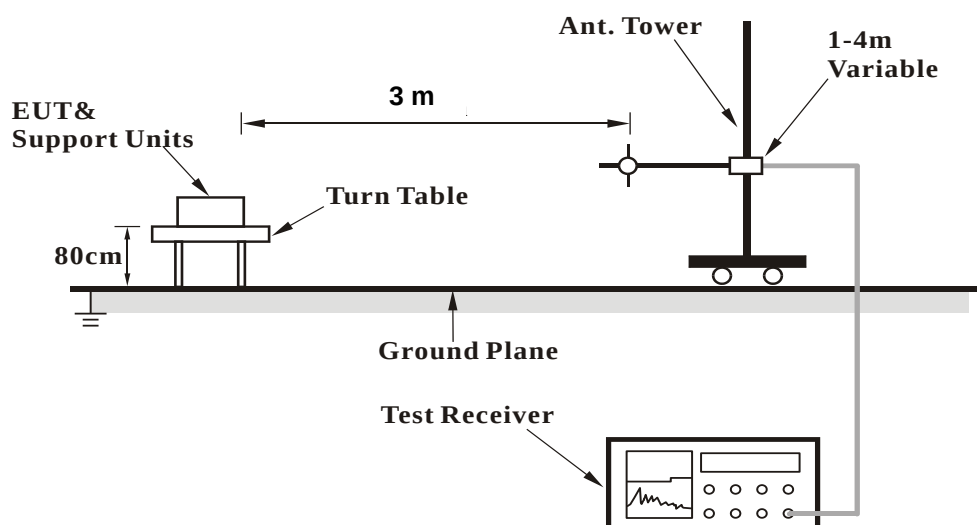
No deviation.

4.1.5 Test Set Up

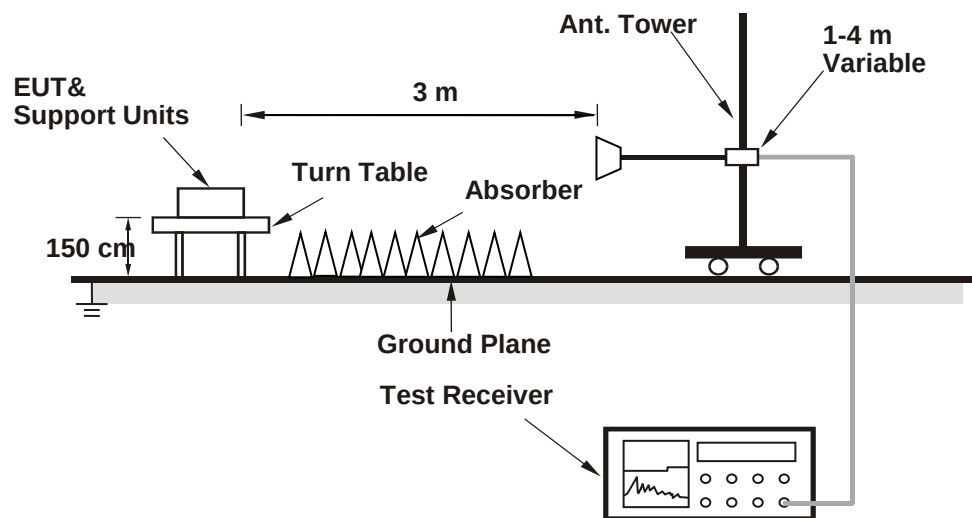
<Radiated Emission below 30 MHz>



<Radiated Emission 30 MHz to 1 GHz>



<Radiated Emission above 1 GHz>



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

4.1.6 EUT Operating Conditions

- Placed the EUT on a testing table.
- Use the software to control the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Mode A

Above 1 GHz Data :

802.11b

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	38.63	44.55	-5.92	54	-15.37	112	159	Average
2390	48.69	54.61	-5.92	74	-25.31	112	159	Peak
2412	93.79	99.74	-5.95	-----	-----	112	159	Average
2412	96.55	102.5	-5.95	-----	-----	112	159	Peak
4824	40.54	56.16	-15.62	54	-13.46	133	144	Average
4824	45.61	61.23	-15.62	74	-28.39	133	144	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	40.15	46.07	-5.92	54	-13.85	312	142	Average
2390	50.45	56.37	-5.92	74	-23.55	312	142	Peak
2412	99.01	104.96	-5.95	-----	-----	312	142	Average
2412	101.93	107.88	-5.95	-----	-----	312	142	Peak
4824	40.48	56.1	-15.62	54	-13.52	269	132	Average
4824	45.72	61.34	-15.62	74	-28.28	269	132	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2412 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	38.65	44.57	-5.92	54	-15.35	147	254	Average
2390	48.43	54.35	-5.92	74	-25.57	147	254	Peak
2437	98.39	104.28	-5.89	-----	-----	147	254	Average
2437	101.16	107.05	-5.89	-----	-----	147	254	Peak
2483.5	39.24	44.94	-5.7	54	-14.76	147	254	Average
2483.5	49.27	54.97	-5.7	74	-24.73	147	254	Peak
4874	41.1	56.66	-15.56	54	-12.9	136	145	Average
4874	46.17	61.73	-15.56	74	-27.83	136	145	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	38.72	44.64	-5.92	54	-15.28	100	230	Average
2390	48.96	54.88	-5.92	74	-25.04	100	230	Peak
2437	98.87	104.76	-5.89	-----	-----	100	230	Average
2437	101.81	107.7	-5.89	-----	-----	100	230	Peak
2483.5	39.96	45.66	-5.7	54	-14.04	100	230	Average
2483.5	50.02	55.72	-5.7	74	-23.98	100	230	Peak
4874	41.13	56.69	-15.56	54	-12.87	271	133	Average
4874	47.27	62.83	-15.56	74	-26.73	271	133	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2437 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	95.57	101.38	-5.81	-----	-----	141	193	Average
2462	98.47	104.28	-5.81	-----	-----	141	193	Peak
2483.5	39.12	44.82	-5.7	54	-14.88	141	193	Average
2483.5	49.07	54.77	-5.7	74	-24.93	141	193	Peak
4924	41.59	57.1	-15.51	54	-12.41	110	147	Average
4924	47.22	62.73	-15.51	74	-26.78	110	147	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	100.3	106.11	-5.81	-----	-----	128	250	Average
2462	103.07	108.88	-5.81	-----	-----	128	250	Peak
2483.5	42.35	48.05	-5.7	54	-11.65	128	250	Average
2483.5	52.01	57.71	-5.7	74	-21.99	128	250	Peak
4924	42.26	57.77	-15.51	54	-11.74	258	60	Average
4924	49.15	64.66	-15.51	74	-24.85	258	60	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

802.11g

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	44.57	50.49	-5.92	54	-9.43	146	253	Average
2390	59.39	65.31	-5.92	74	-14.61	146	253	Peak
2412	90.92	96.87	-5.95	-----	-----	146	253	Average
2412	98.66	104.61	-5.95	-----	-----	146	253	Peak
4824	35.22	50.84	-15.62	54	-18.78	265	131	Average
4824	44.27	59.89	-15.62	74	-29.73	265	131	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	43.95	49.87	-5.92	54	-10.05	100	231	Average
2390	58.81	64.73	-5.92	74	-15.19	100	231	Peak
2412	90.84	96.79	-5.95	-----	-----	100	231	Average
2412	99.45	105.4	-5.95	-----	-----	100	231	Peak
4824	35.81	51.43	-15.62	54	-18.19	131	146	Average
4824	43.75	59.37	-15.62	74	-30.25	131	146	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2412 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	38.52	44.44	-5.92	54	-15.48	148	253	Average
2390	48.13	54.05	-5.92	74	-25.87	148	253	Peak
2437	92.69	98.58	-5.89	-----	-----	148	253	Average
2437	100.22	106.11	-5.89	-----	-----	148	253	Peak
2483.5	39.12	44.82	-5.7	54	-14.88	148	253	Average
2483.5	48.23	53.93	-5.7	74	-25.77	148	253	Peak
4874	34.27	49.83	-15.56	54	-19.73	266	129	Average
4874	41.64	57.2	-15.56	74	-32.36	266	129	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	38.49	44.41	-5.92	54	-15.51	100	231	Average
2390	48.66	54.58	-5.92	74	-25.34	100	231	Peak
2437	92.98	98.87	-5.89	-----	-----	100	231	Average
2437	100.82	106.71	-5.89	-----	-----	100	231	Peak
2483.5	39.97	45.67	-5.7	54	-14.03	100	231	Average
2483.5	51.51	57.21	-5.7	74	-22.49	100	231	Peak
4874	34.47	50.03	-15.56	54	-19.53	136	147	Average
4874	42.56	58.12	-15.56	74	-31.44	136	147	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2437 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	90.81	96.62	-5.81	-----	-----	165	202	Average
2462	99.48	105.29	-5.81	-----	-----	165	202	Peak
2483.5	42.52	48.22	-5.7	54	-11.48	165	202	Average
2483.5	58.49	64.19	-5.7	74	-15.51	165	202	Peak
4924	34.26	49.77	-15.51	54	-19.74	134	147	Average
4924	42.33	57.84	-15.51	74	-31.67	134	147	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	95.1	100.91	-5.81	-----	-----	110	248	Average
2462	103.27	109.08	-5.81	-----	-----	110	248	Peak
2483.5	45.67	51.37	-5.7	54	-8.33	110	248	Average
2483.5	62.4	68.1	-5.7	74	-11.6	110	248	Peak
4924	34.71	50.22	-15.51	54	-19.29	266	134	Average
4924	41.94	57.45	-15.51	74	-32.06	266	134	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

802.11n (HT20)

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	42.05	47.97	-5.92	54	-11.95	134	138	Average
2390	55.78	61.7	-5.92	74	-18.22	134	138	Peak
2412	87.13	93.08	-5.95	-----	-----	134	138	Average
2412	94.52	100.47	-5.95	-----	-----	134	138	Peak
4824	34.42	50.04	-15.62	54	-19.58	135	147	Average
4824	41.76	57.38	-15.62	74	-32.24	135	147	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	42.73	48.65	-5.92	54	-11.27	250	146	Average
2390	57.8	63.72	-5.92	74	-16.2	250	146	Peak
2412	91.46	97.41	-5.95	-----	-----	250	146	Average
2412	98.37	104.32	-5.95	-----	-----	250	146	Peak
4824	34.63	50.25	-15.62	54	-19.37	271	135	Average
4824	41.74	57.36	-15.62	74	-32.26	271	135	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2412 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	38.41	44.33	-5.92	54	-15.59	131	140	Average
2390	48.69	54.61	-5.92	74	-25.31	131	140	Peak
2437	88.2	94.09	-5.89	-----	-----	131	140	Average
2437	94.69	100.58	-5.89	-----	-----	131	140	Peak
2483.5	38.73	44.43	-5.7	54	-15.27	131	140	Average
2483.5	48	53.7	-5.7	74	-26	131	140	Peak
4874	35.3	50.86	-15.56	54	-18.7	130	141	Average
4874	41.28	56.84	-15.56	74	-32.72	130	141	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	38.67	44.59	-5.92	54	-15.33	285	98	Average
2390	48.52	54.44	-5.92	74	-25.48	285	98	Peak
2437	92.73	98.62	-5.89	-----	-----	285	98	Average
2437	99.52	105.41	-5.89	-----	-----	285	98	Peak
2483.5	39.41	45.11	-5.7	54	-14.59	285	98	Average
2483.5	48.82	54.52	-5.7	74	-25.18	285	98	Peak
4874	34.12	49.68	-15.56	54	-19.88	264	134	Average
4874	41.01	56.57	-15.56	74	-32.99	264	134	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2437 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	90.37	96.18	-5.81	-----	-----	167	201	Average
2462	98.3	104.11	-5.81	-----	-----	167	201	Peak
2483.5	42.07	47.77	-5.7	54	-11.93	167	201	Average
2483.5	59.23	64.93	-5.7	74	-14.77	167	201	Peak
4924	34.16	49.67	-15.51	54	-19.84	128	153	Average
4924	42.17	57.68	-15.51	74	-31.83	128	153	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	94.18	99.99	-5.81	-----	-----	110	249	Average
2462	102.52	108.33	-5.81	-----	-----	110	249	Peak
2483.5	45.23	50.93	-5.7	54	-8.77	110	249	Average
2483.5	63.27	68.97	-5.7	74	-10.73	110	249	Peak
4924	33.22	48.73	-15.51	54	-20.78	268	136	Average
4924	42.13	57.64	-15.51	74	-31.87	268	136	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

802.11n (HT40)

EUT Test Condition		Measurement Detail	
Channel	Channel 3	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	42.98	48.9	-5.92	54	-11.02	176	199	Average
2390	55.48	61.4	-5.92	74	-18.52	176	199	Peak
2422	86.79	92.67	-5.88	-----	-----	176	199	Average
2422	93.76	99.64	-5.88	-----	-----	176	199	Peak
2483.5	39.27	44.97	-5.7	54	-14.73	176	199	Average
2483.5	49.42	55.12	-5.7	74	-24.58	176	199	Peak
4844	34.09	49.68	-15.59	54	-19.91	136	151	Average
4844	41.14	56.73	-15.59	74	-32.86	136	151	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	46.11	52.03	-5.92	54	-7.89	132	248	Average
2390	59.76	65.68	-5.92	74	-14.24	132	248	Peak
2422	90.06	95.94	-5.88	-----	-----	132	248	Average
2422	97.93	103.81	-5.88	-----	-----	132	248	Peak
2483.5	40.84	46.54	-5.7	54	-13.16	132	248	Average
2483.5	52.84	58.54	-5.7	74	-21.16	132	248	Peak
4844	34.72	50.31	-15.59	54	-19.28	273	136	Average
4844	42.1	57.69	-15.59	74	-31.9	273	136	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2422 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	39.47	45.39	-5.92	54	-14.53	169	199	Average
2390	51.52	57.44	-5.92	74	-22.48	169	199	Peak
2437	87.56	93.45	-5.89	-----	-----	169	199	Average
2437	96.43	102.32	-5.89	-----	-----	169	199	Peak
2483.5	41.64	47.34	-5.7	54	-12.36	169	199	Average
2483.5	52.49	58.19	-5.7	74	-21.51	169	199	Peak
4874	33.82	49.38	-15.56	54	-20.18	130	141	Average
4874	41.48	57.04	-15.56	74	-32.52	130	141	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	41.82	47.74	-5.92	54	-12.18	112	249	Average
2390	53.6	59.52	-5.92	74	-20.4	112	249	Peak
2437	90.8	96.69	-5.89	-----	-----	112	249	Average
2437	99.57	105.46	-5.89	-----	-----	112	249	Peak
2483.5	44.4	50.1	-5.7	54	-9.6	112	249	Average
2483.5	55.7	61.4	-5.7	74	-18.3	112	249	Peak
4874	33.07	48.63	-15.56	54	-20.93	264	128	Average
4874	41.1	56.66	-15.56	74	-32.9	264	128	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2437 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 9	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	38.46	44.38	-5.92	54	-15.54	176	201	Average
2390	47.82	53.74	-5.92	74	-26.18	176	201	Peak
2452	88	93.82	-5.82	-----	-----	176	201	Average
2452	96.45	102.27	-5.82	-----	-----	176	201	Peak
2483.5	46.65	52.35	-5.7	54	-7.35	176	201	Average
2483.5	60.53	66.23	-5.7	74	-13.47	176	201	Peak
4904	34.07	49.62	-15.55	54	-19.93	138	156	Average
4904	41.96	57.51	-15.55	74	-32.04	138	156	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	39.17	45.09	-5.92	54	-14.83	113	248	Average
2390	49.84	55.76	-5.92	74	-24.16	113	248	Peak
2452	91.42	97.24	-5.82	-----	-----	113	248	Average
2452	100.08	105.9	-5.82	-----	-----	113	248	Peak
2483.5	49.99	55.69	-5.7	54	-4.01	113	248	Average
2483.5	63.53	69.23	-5.7	74	-10.47	113	248	Peak
4904	34.63	50.18	-15.55	54	-19.37	262	124	Average
4904	42.92	58.47	-15.55	74	-31.08	262	124	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2452 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

9 kHz ~ 30 MHz Data:

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

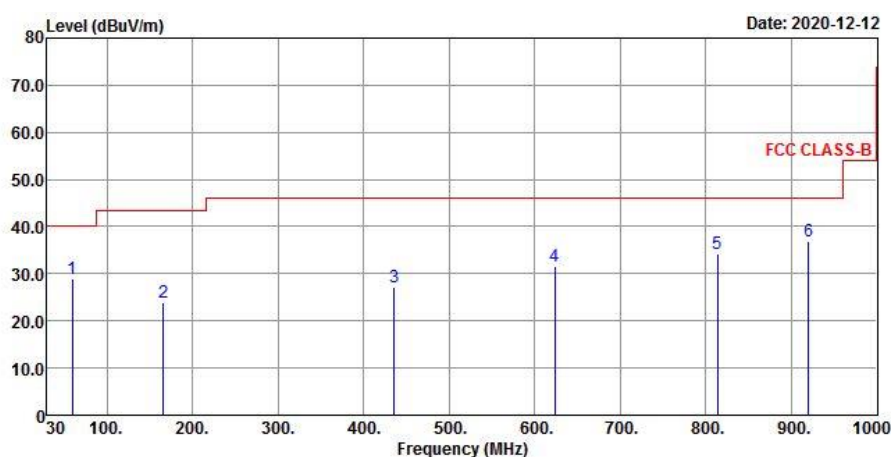
30 MHz ~ 1 GHz Worst-Case Data:

Mode A

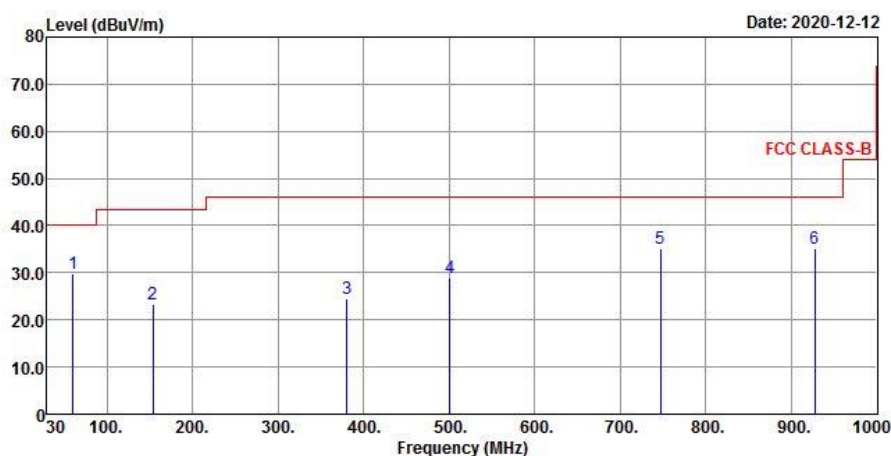
802.11n (HT40)

EUT Test Condition		Measurement Detail	
Channel	Channel 9	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
59.1	28.82	40.96	-12.14	40	-11.18	125	102	QP
165.8	23.93	35.93	-12	43.5	-19.57	148	339	QP
435.46	27.13	33.97	-6.84	46	-18.87	195	135	QP
623.64	31.59	33.53	-1.94	46	-14.41	177	9	QP
813.76	34.25	32.24	2.01	46	-11.75	181	67	QP
920.46	36.8	33.51	3.29	46	-9.2	106	320	QP
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
60.07	29.91	42.47	-12.56	40	-10.09	114	81	QP
154.16	23.22	34.78	-11.56	43.5	-20.28	109	201	QP
380.17	24.64	33.37	-8.73	46	-21.36	133	26	QP
500.45	29.03	34.47	-5.44	46	-16.97	133	211	QP
746.83	35.07	34.12	0.95	46	-10.93	187	187	QP
927.25	35.08	31.69	3.39	46	-10.92	294	133	QP

Remarks:

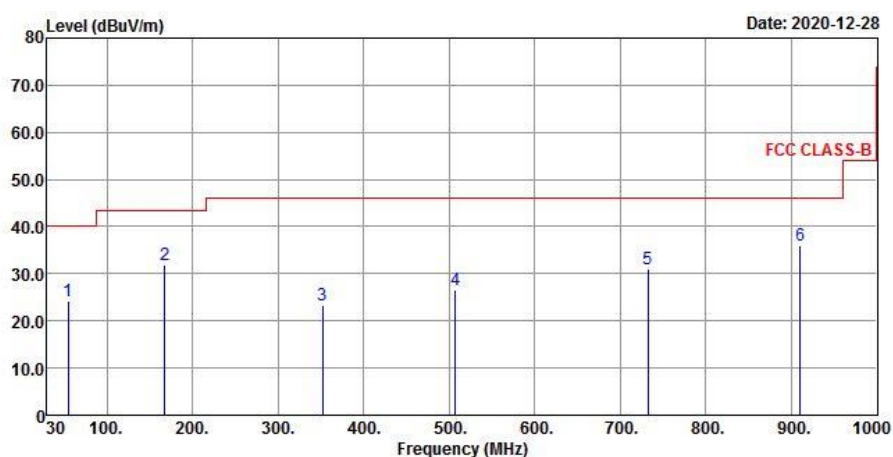
- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value.
- The emission levels of other frequencies were very low against the limit.

Mode B

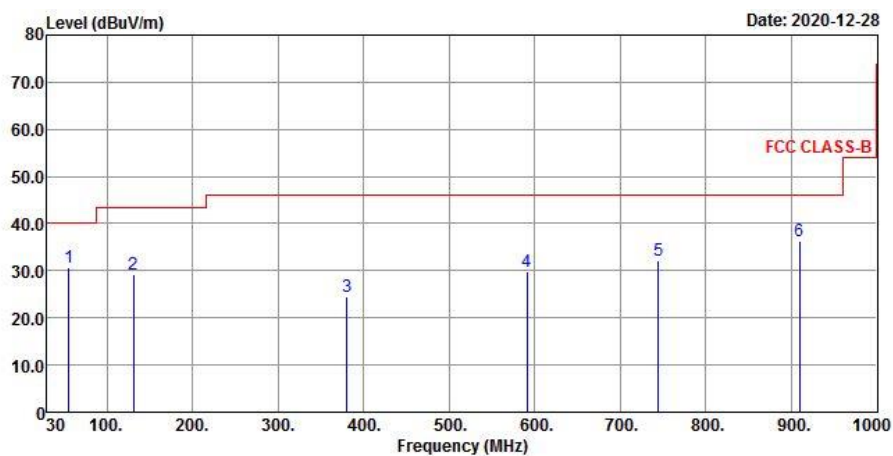
802.11n (HT40)

EUT Test Condition		Measurement Detail	
Channel	Channel 9	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Tim Chen

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
54.25	24.2	36.18	-11.98	40	-15.8	109	234	QP
167.74	31.79	43.95	-12.16	43.5	-11.71	266	210	QP
352.04	23.24	32.94	-9.7	46	-22.76	340	119	QP
507.24	26.55	31.86	-5.31	46	-19.45	168	142	QP
732.28	31.07	30.58	0.49	46	-14.93	204	267	QP
910.76	36.04	32.86	3.18	46	-9.96	316	94	QP
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
55.22	30.82	42.75	-11.93	40	-9.18	151	154	QP
130.88	29.12	41.92	-12.8	43.5	-14.38	216	310	QP
380.17	24.46	33.19	-8.73	46	-21.54	305	121	QP
590.66	29.93	32.95	-3.02	46	-16.07	154	198	QP
744.89	32.18	31.23	0.95	46	-13.82	216	294	QP
909.79	36.23	33.07	3.16	46	-9.77	364	210	QP

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value.
- The emission levels of other frequencies were very low against the limit.

4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver ROHDE & SCHWARZ	ESR3	102412	Feb. 17, 2020	Feb. 16, 2021
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 04, 2020	Sep. 03, 2021
LISN/AMN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Jan. 20, 2020	Jan. 19, 2021
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Aug. 18, 2020	Aug. 17, 2021
Software ADT	BV ADT_Cond_ V7.3.7.4	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in HwaYa Shielded Room 2.
 3. The VCCI Site Registration No. is C-12047.

4.2.3 Test Procedures

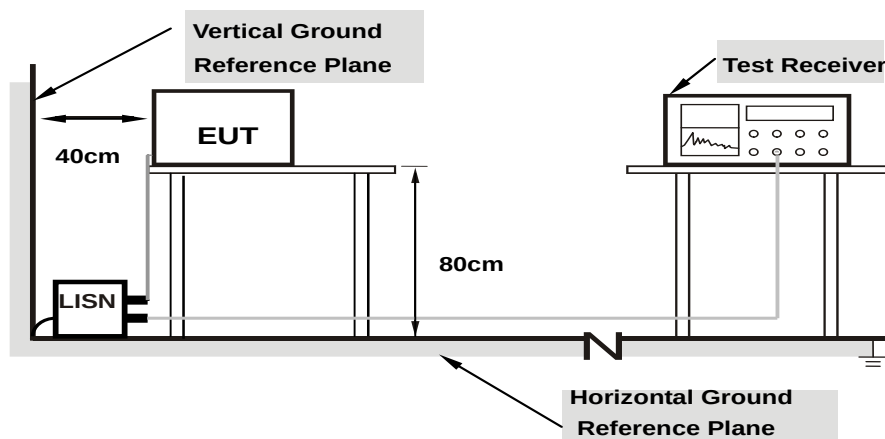
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.

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

4.2.6 EUT Operating Conditions

- Placed the EUT on a testing table.
- Use the software to control the EUT under transmission condition continuously at specific channel frequency.

4.2.7 Test Results

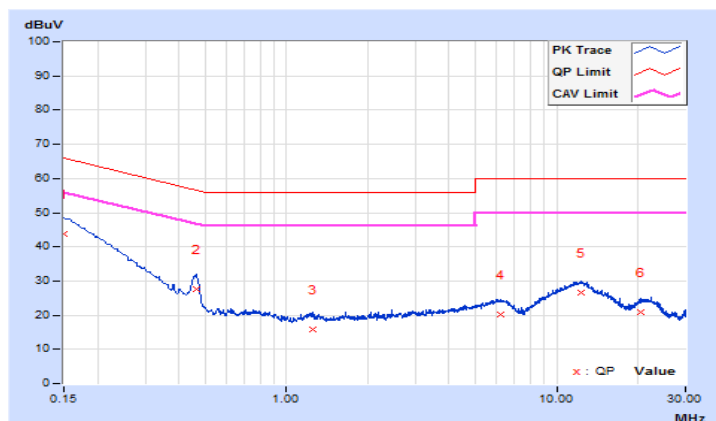
Mode A

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	22°C, 66%RH
Tested by	Tim Chen	Test Date	2020/12/27

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	10.09	33.74	15.17	43.83	25.26	66.00	56.00	-22.17	-30.74
2	0.46271	10.20	17.37	10.58	27.57	20.78	56.64	46.64	-29.07	-25.86
3	1.25250	10.28	5.60	0.07	15.88	10.35	56.00	46.00	-40.12	-35.65
4	6.18225	10.41	9.81	3.04	20.22	13.45	60.00	50.00	-39.78	-36.55
5	12.33150	10.50	16.07	8.32	26.57	18.82	60.00	50.00	-33.43	-31.18
6	20.57550	10.61	10.36	0.77	20.97	11.38	60.00	50.00	-39.03	-38.62

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

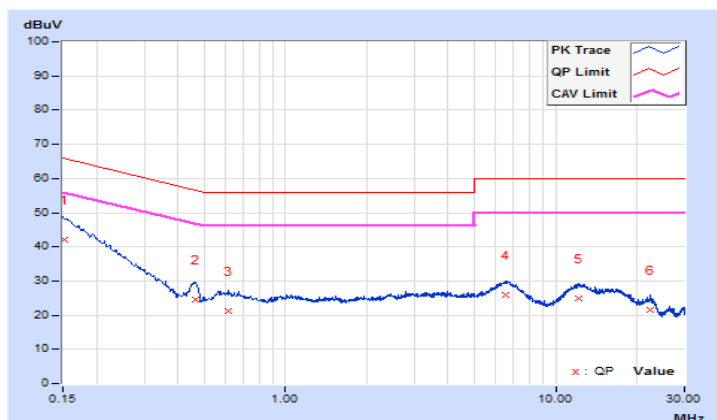


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	22°C, 66%RH
Tested by	Tim Chen	Test Date	2020/12/27

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15200	10.06	32.13	11.86	42.19	21.92	65.89	55.89	-23.70	-33.97
2	0.46271	10.19	14.53	6.35	24.72	16.54	56.64	46.64	-31.92	-30.10
3	0.61350	10.21	10.89	3.68	21.10	13.89	56.00	46.00	-34.90	-32.11
4	6.57150	10.48	15.60	6.15	26.08	16.63	60.00	50.00	-33.92	-33.37
5	12.18075	10.64	14.27	5.12	24.91	15.76	60.00	50.00	-35.09	-34.24
6	22.47900	10.82	10.61	0.22	21.43	11.04	60.00	50.00	-38.57	-38.96

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



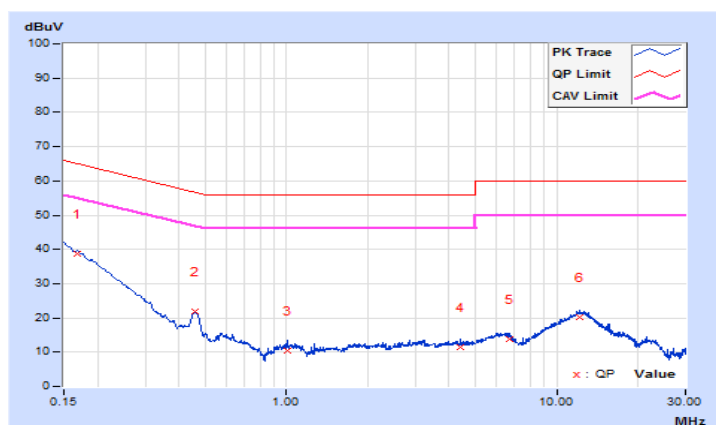
Mode B

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23°C, 66%RH
Tested by	Tim Chen	Test Date	2020/12/29

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16743	0.15	38.56	18.92	38.71	19.07	65.09	55.09	-26.38	-36.02
2	0.45600	0.25	21.63	11.68	21.88	11.93	56.77	46.77	-34.89	-34.84
3	1.00275	0.31	10.13	2.08	10.44	2.39	56.00	46.00	-45.56	-43.61
4	4.39800	0.44	11.10	2.62	11.54	3.06	56.00	46.00	-44.46	-42.94
5	6.72000	0.47	13.20	4.43	13.67	4.90	60.00	50.00	-46.33	-45.10
6	12.19875	0.55	19.58	12.20	20.13	12.75	60.00	50.00	-39.87	-37.25

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

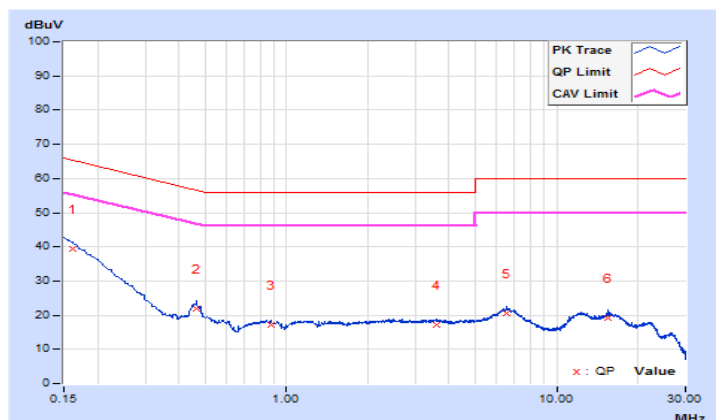


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23°C, 66%RH
Tested by	Tim Chen	Test Date	2020/12/29

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16093	0.11	39.14	19.95	39.25	20.06	65.42	55.42	-26.17	-35.36
2	0.46500	0.24	21.63	11.07	21.87	11.31	56.60	46.60	-34.73	-35.29
3	0.87450	0.29	16.97	9.17	17.26	9.46	56.00	46.00	-38.74	-36.54
4	3.60375	0.43	16.69	8.31	17.12	8.74	56.00	46.00	-38.88	-37.26
5	6.55575	0.52	19.90	11.91	20.42	12.43	60.00	50.00	-39.58	-37.57
6	15.45900	0.78	18.35	10.39	19.13	11.17	60.00	50.00	-40.87	-38.83

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

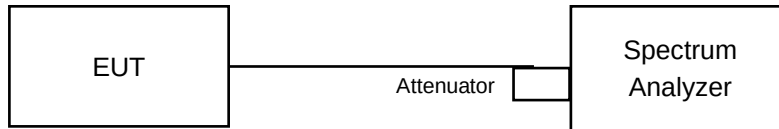


4.3 6 dB Bandwidth Measurement

4.3.1 Limits of 6 dB Bandwidth Measurement

The minimum of 6 dB Bandwidth Measurement is 0.5 MHz.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

- Set resolution bandwidth (RBW) = 100 kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Results

802.11b

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	10.07	0.5	Pass
6	2437	10.06	0.5	Pass
11	2462	10.06	0.5	Pass

802.11g

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	16.40	0.5	Pass
6	2437	16.39	0.5	Pass
11	2462	16.39	0.5	Pass

802.11n (HT20)

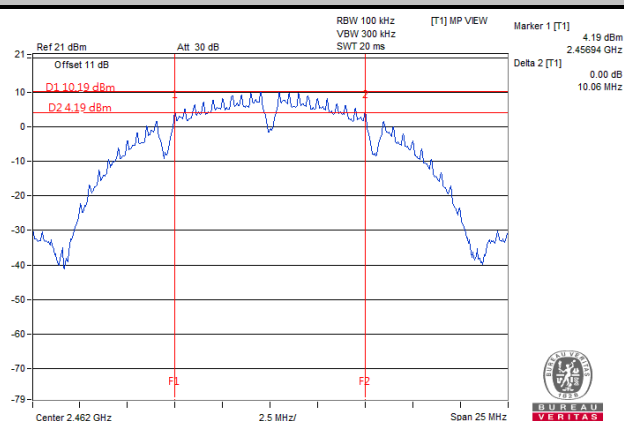
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	17.59	0.5	Pass
6	2437	17.56	0.5	Pass
11	2462	17.58	0.5	Pass

802.11n (HT40)

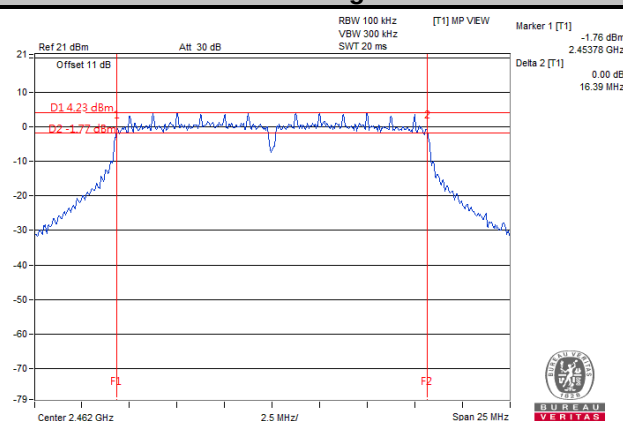
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
3	2422	35.50	0.5	Pass
6	2437	35.50	0.5	Pass
9	2452	35.34	0.5	Pass

Spectrum Plot of Worst Value

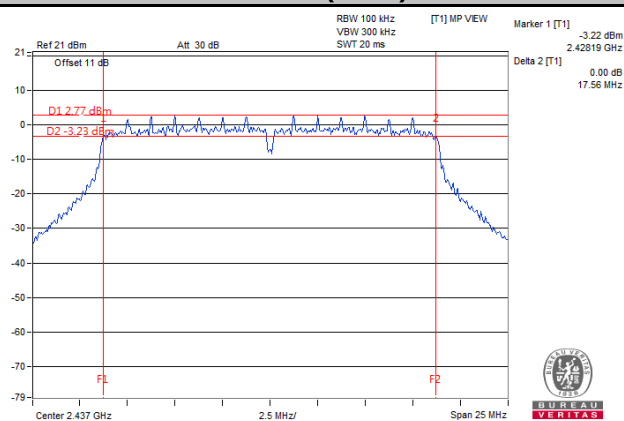
802.11b



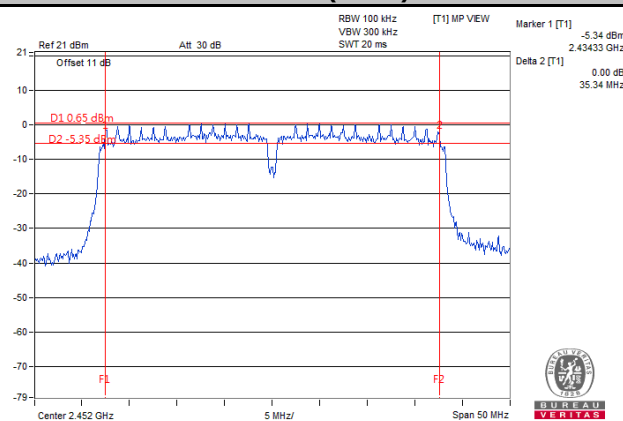
802.11g



802.11n (HT20)



802.11n (HT40)



4.4 Occupied Bandwidth Measurement

4.4.1 Test Setup



4.4.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1 % to 5 % of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to sampling. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

4.4.4 Deviation from Test Standard

No deviation.

4.4.5 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.4.6 Test Results

802.11b

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
1	2412	14.87	Pass
6	2437	15.00	Pass
11	2462	14.87	Pass

802.11g

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
1	2412	17.04	Pass
6	2437	16.92	Pass
11	2462	17.16	Pass

802.11n (HT20)

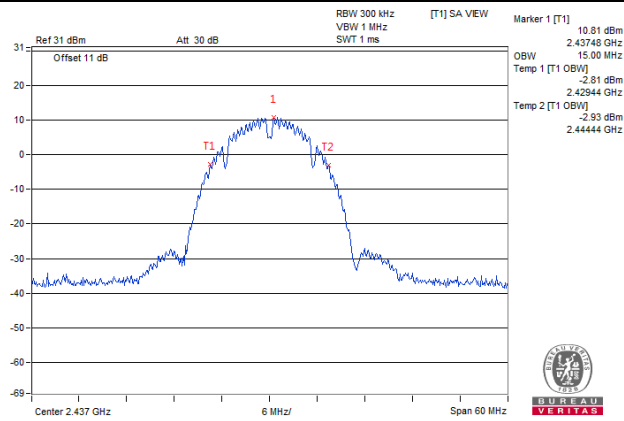
Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
1	2412	18.00	Pass
6	2437	18.12	Pass
11	2462	18.00	Pass

802.11n (HT40)

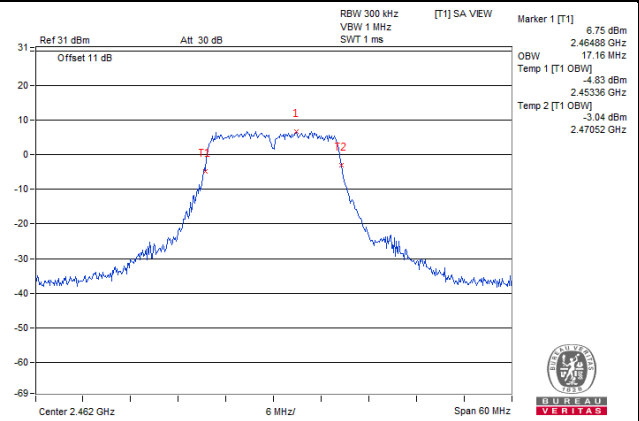
Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
3	2422	36.09	Pass
6	2437	36.00	Pass
9	2452	36.00	Pass

Spectrum Plot of Worst Value

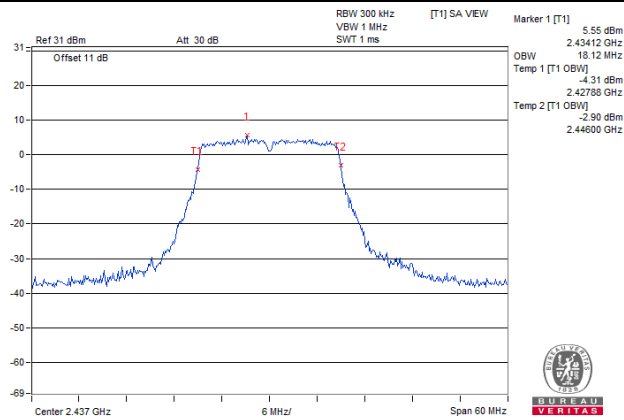
802.11b



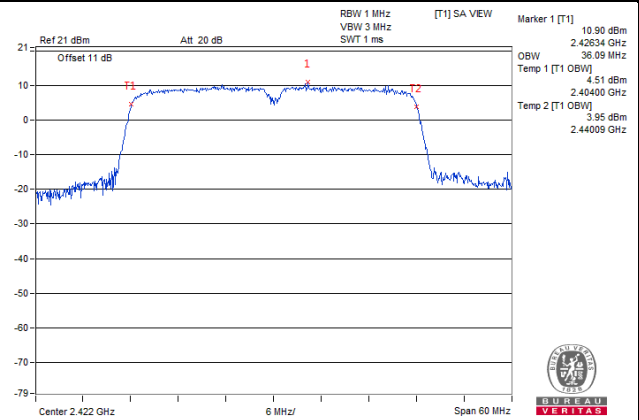
802.11g



802.11n (HT20)



802.11n (HT40)

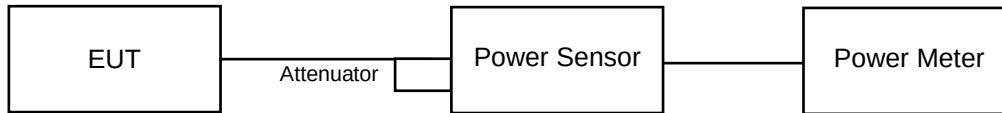


4.5 Conducted Output Power Measurement

4.5.1 Limits of Conducted Output Power Measurement

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

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedures

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.5.7 Test Results

802.11b

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	109.901	20.41	69.024	18.39	30	Pass
6	2437	112.98	20.53	70.632	18.49	30	Pass
11	2462	98.855	19.95	67.92	18.32	30	Pass

802.11g

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	193.642	22.87	31.989	15.05	30	Pass
6	2437	192.752	22.85	32.659	15.14	30	Pass
11	2462	172.187	22.36	31.696	15.01	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	158.489	22.00	27.102	14.33	30	Pass
6	2437	181.97	22.60	27.542	14.40	30	Pass
11	2462	147.571	21.69	26.303	14.20	30	Pass

802.11n (HT40)

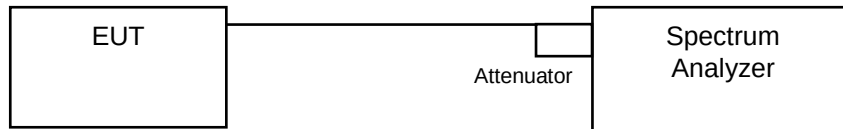
Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
3	2422	211.349	23.25	27.416	14.38	30	Pass
6	2437	197.242	22.95	27.29	14.36	30	Pass
9	2452	190.985	22.81	27.164	14.34	30	Pass

4.6 Power Spectral Density Measurement

4.6.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 Test Procedure

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.

For Average Power

- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 times the OBW.
- Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set VBW $\geq 3 \times \text{RBW}$.
- Detector = power averaging (RMS) or sample detector (when RMS not available).
- Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span/RBW}$.
- Sweep time = auto couple.
- Employ trace averaging (RMS) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level.

For Average Power (Duty cycle < 98%)

- a. Measure the duty cycle (x).
- b. Set instrument center frequency to DTS channel center frequency.
- c. Set span to at least 1.5 times the OBW.
- d. Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- e. Set VBW $\geq 3 \times \text{RBW}$.
- f. Detector = power averaging (RMS) or sample detector (when RMS not available).
- g. Ensure that the number of measurement points in the sweep $\geq 2 \times \text{span/RBW}$.
- h. Sweep time = auto couple.
- i. Do not use sweep triggering. Allow sweep to "free run".
- j. Employ trace averaging (RMS) mode over a minimum of 100 traces.
- k. Use the peak marker function to determine the maximum amplitude level.
- l. Add $10 \log (1/x)$, where x is the duty cycle measured in step (a), to the measured PSD to compute the average PSD during the actual transmission time.

4.6.5 Deviation from Test Standard

No deviation.

4.6.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.6.7 Test Results

802.11b

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
1	2412	-2.56	8	Pass
6	2437	-3.35	8	Pass
11	2462	-3.96	8	Pass

802.11g

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
1	2412	-10.36	8	Pass
6	2437	-9.76	8	Pass
11	2462	-10.57	8	Pass

802.11n (HT20)

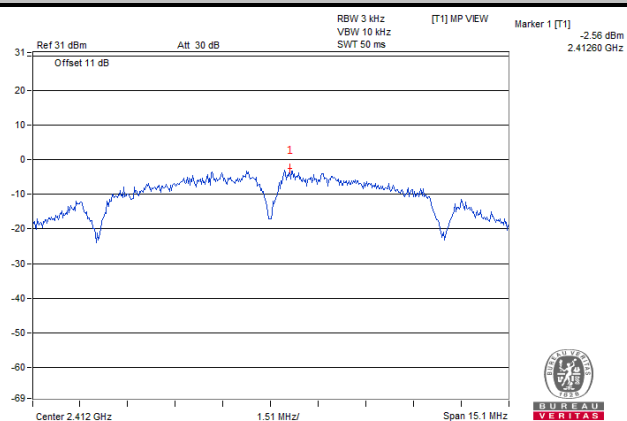
Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
1	2412	-11.34	8	Pass
6	2437	-10.79	8	Pass
11	2462	-10.95	8	Pass

802.11n (HT40)

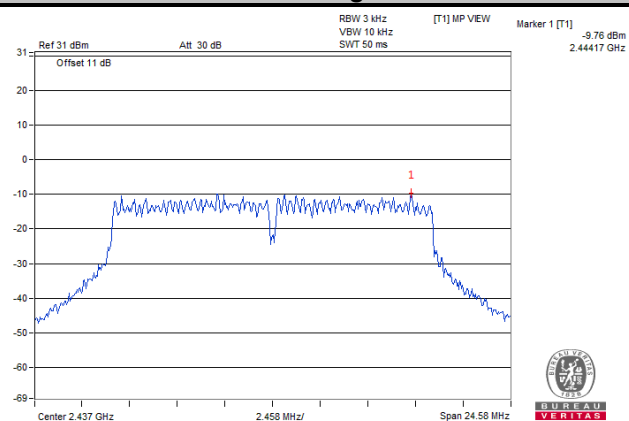
Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
3	2422	-14.07	8	Pass
6	2437	-14.42	8	Pass
9	2452	-14.82	8	Pass

Spectrum Plot of Worst Value

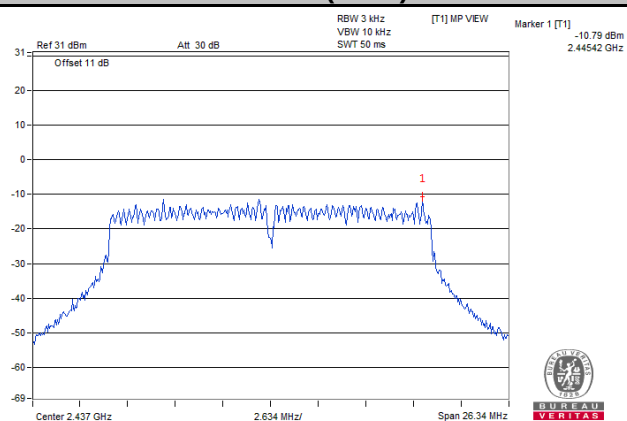
802.11b



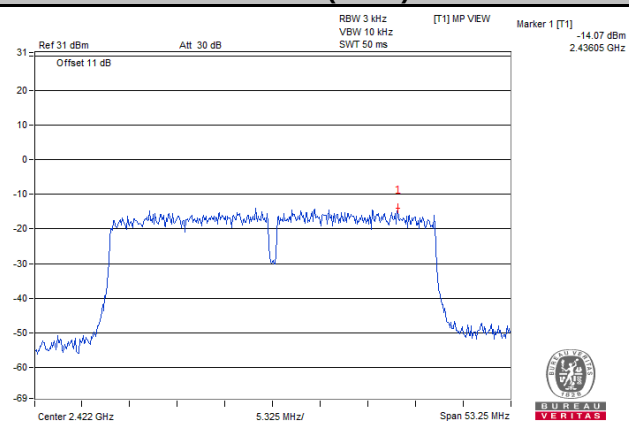
802.11g



802.11n (HT20)



802.11n (HT40)

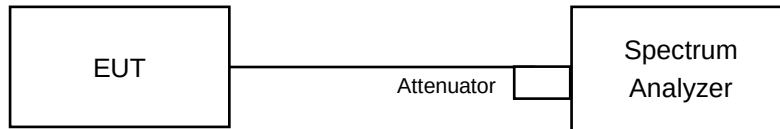


4.7 Conducted Out of Band Emission Measurement

4.7.1 Limits of Conducted Out of Band Emission Measurement

Below -20 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

4.7.2 Test Setup



4.7.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.7.4 Test Procedure

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW $\geq$ 300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

4.7.5 Deviation from Test Standard

No deviation.

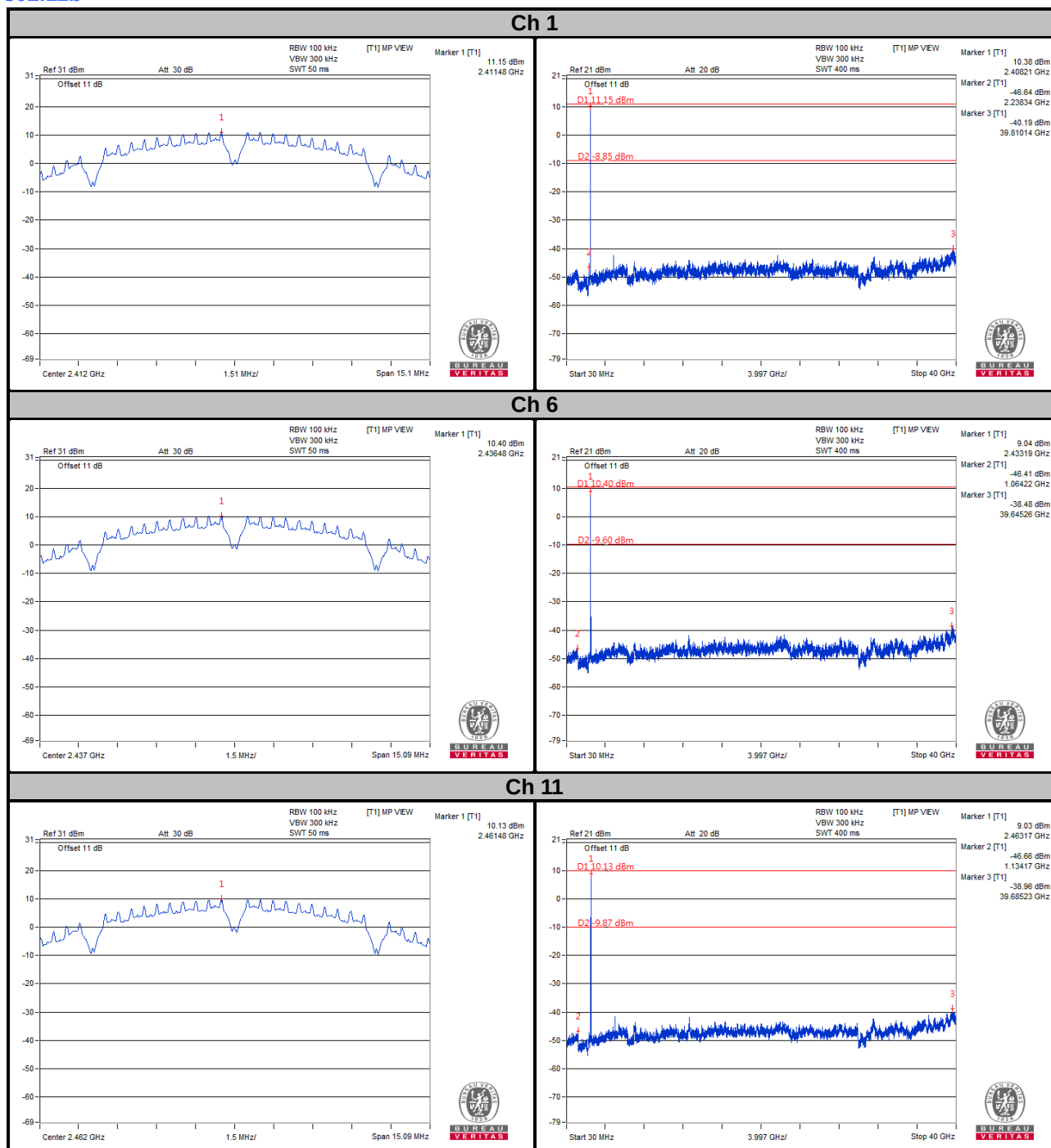
4.7.6 EUT Operating Condition

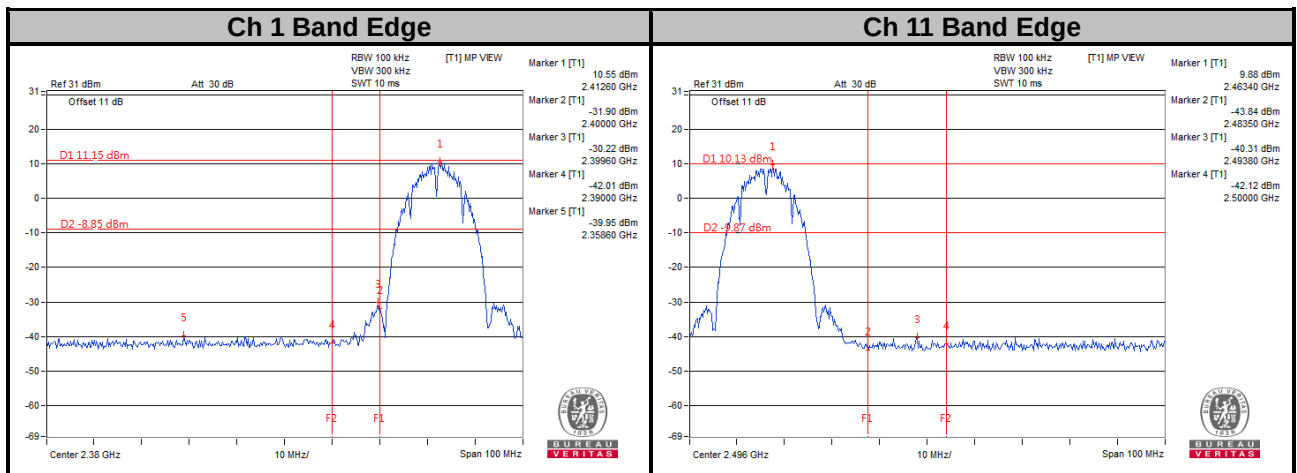
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.7.7 Test Results

The spectrum plots are attached on the following images. D1 line indicates the highest level, and D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement.

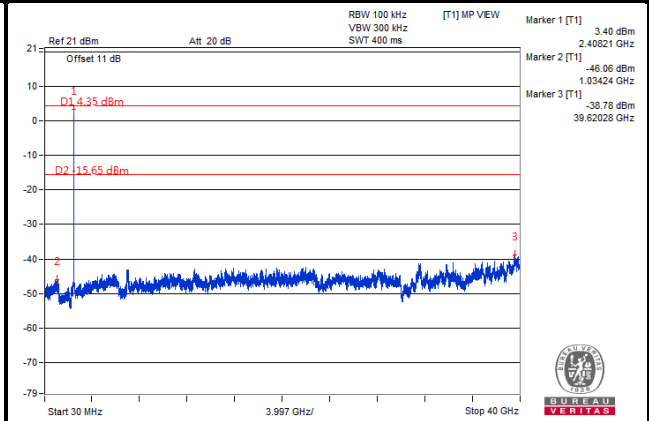
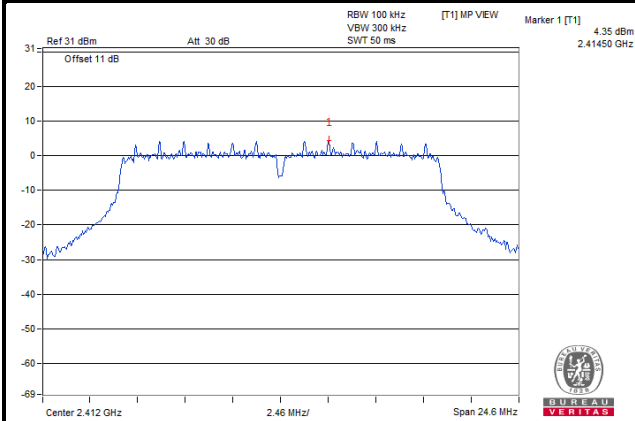
802.11b



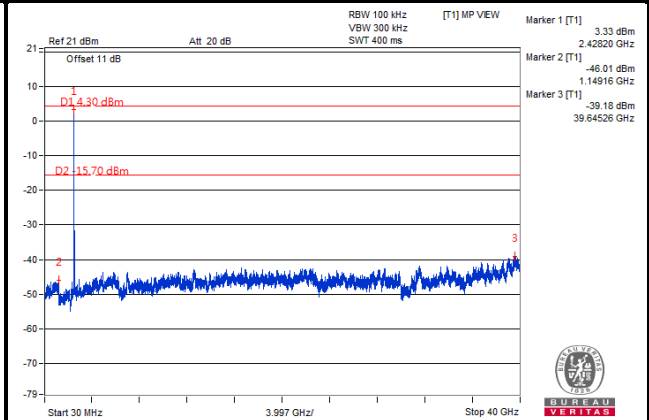
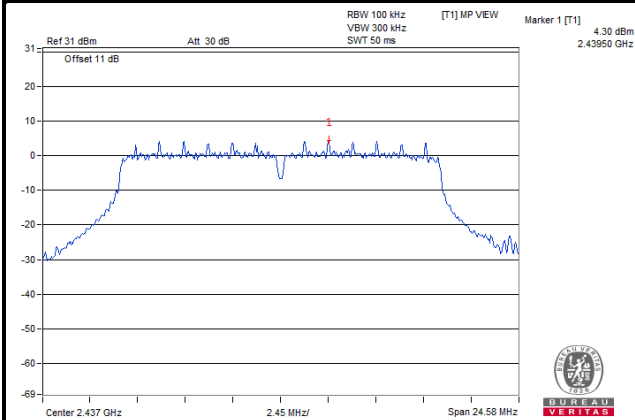


802.11g

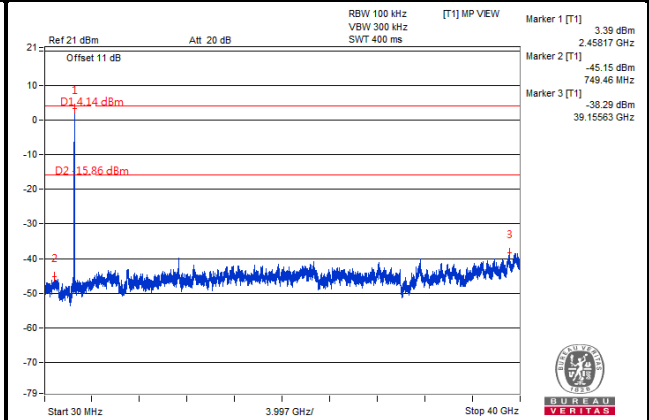
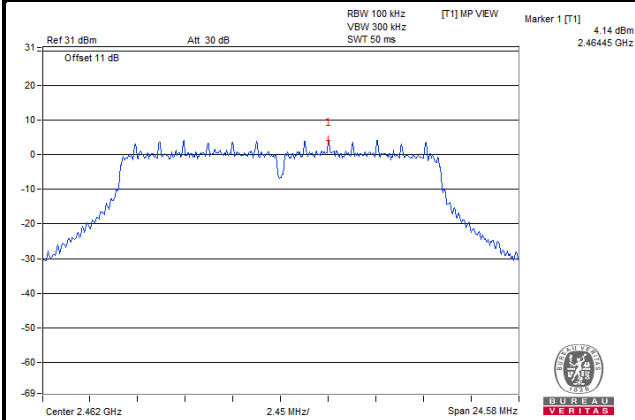
Ch 1

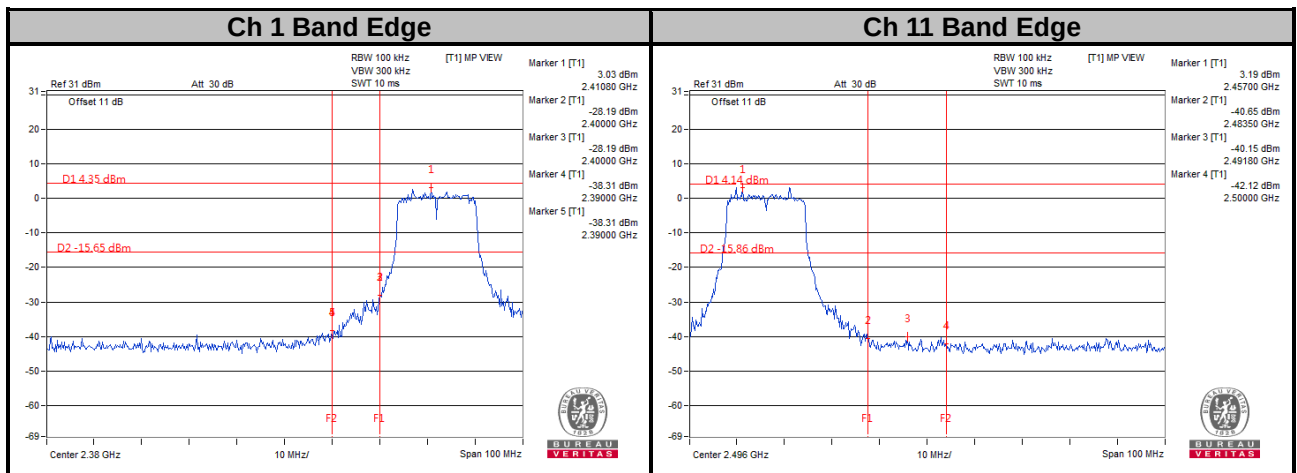


Ch 6



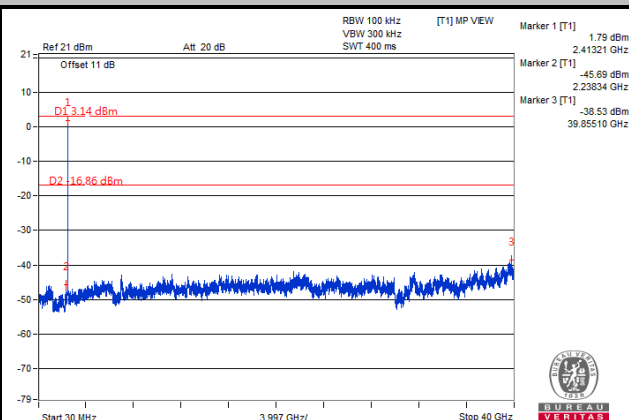
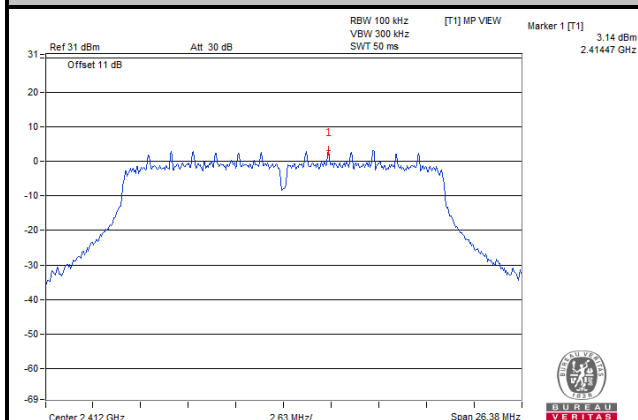
Ch 11



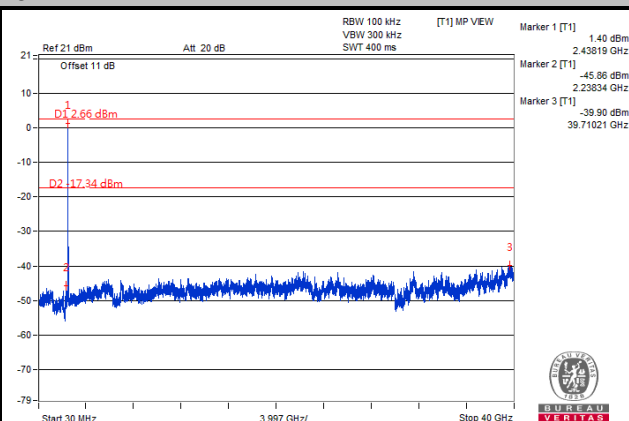
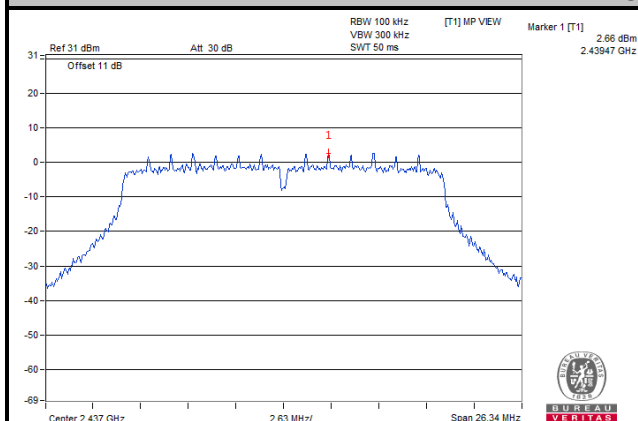


802.11n (HT20)

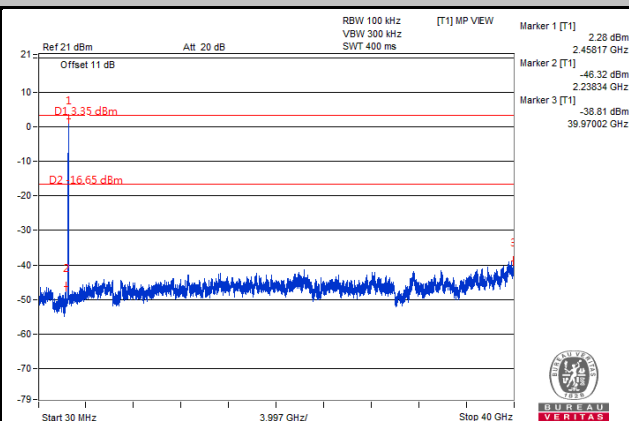
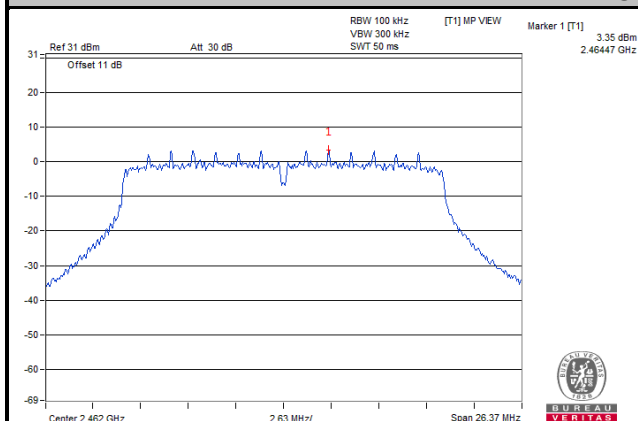
Ch 1

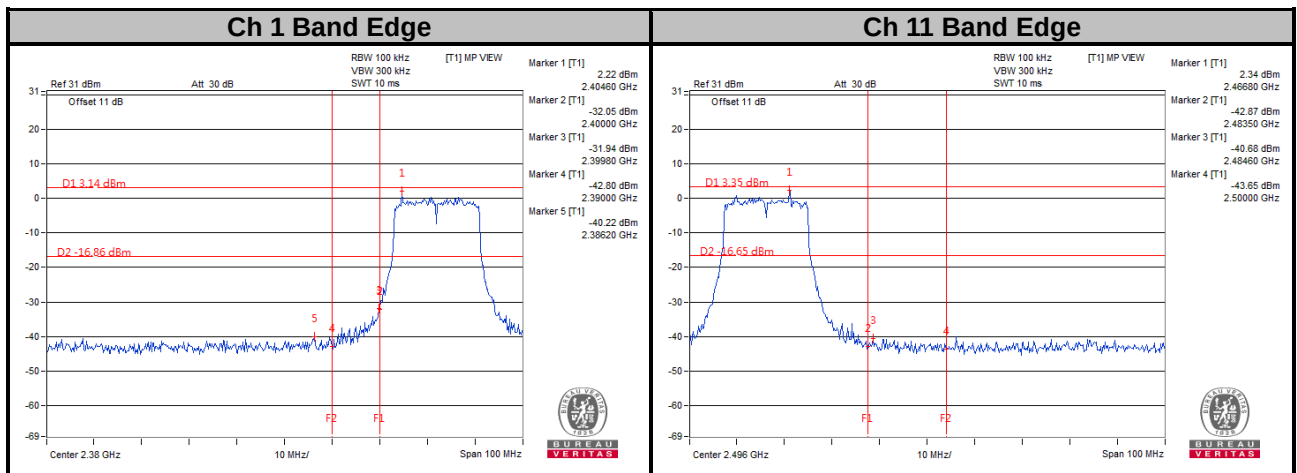


Ch 6



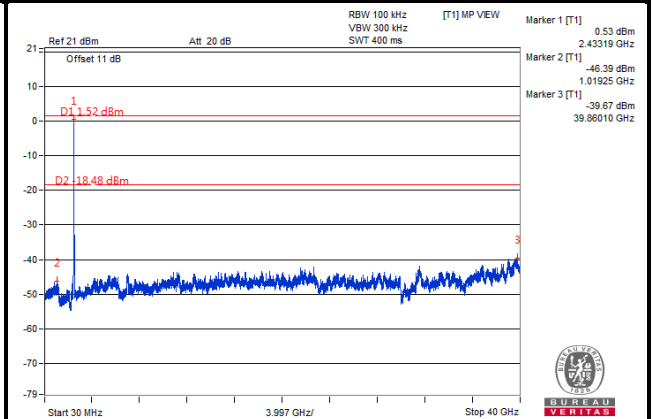
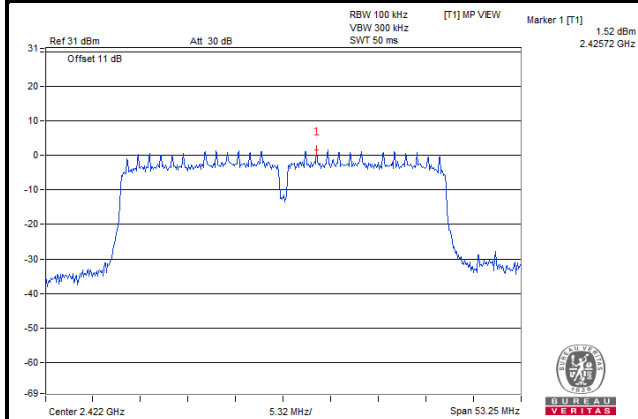
Ch 11



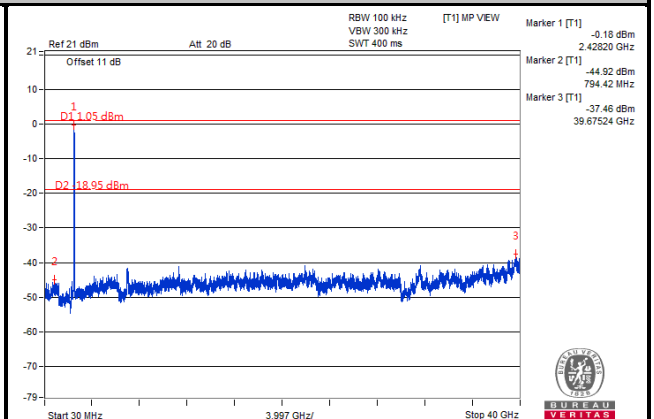
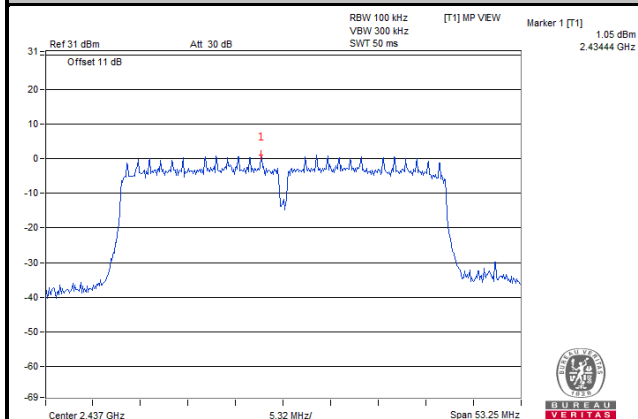


802.11n (HT40)

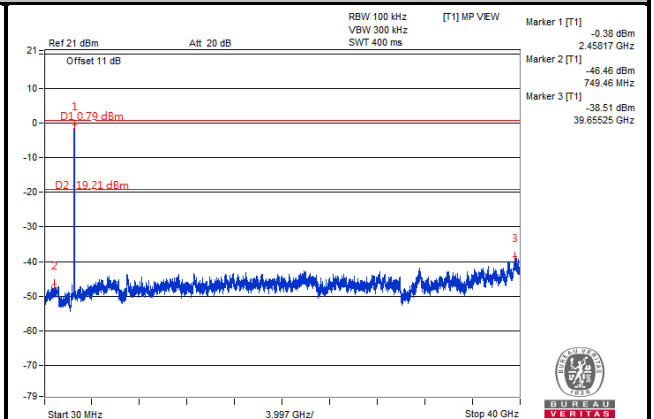
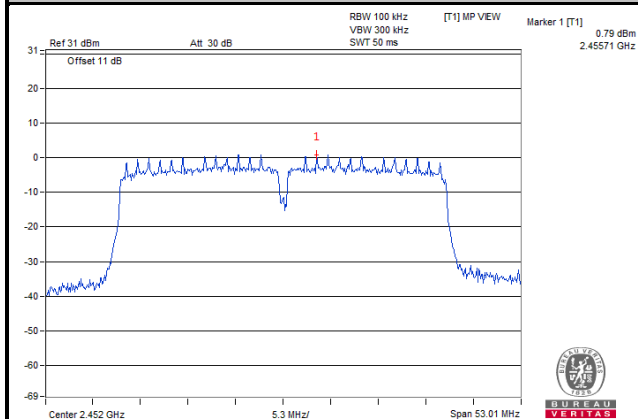
Ch 3

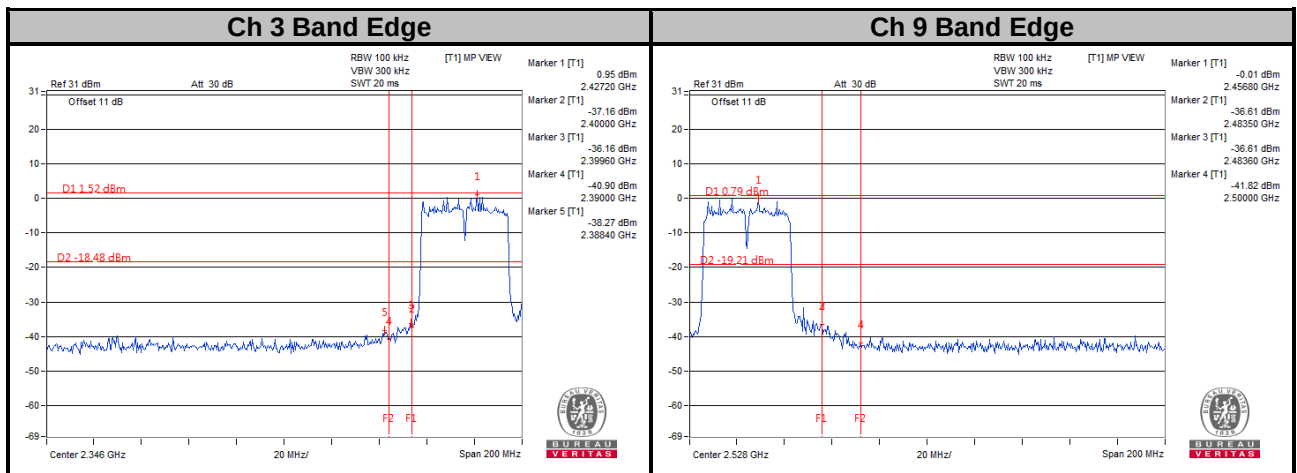


Ch 6



Ch 9



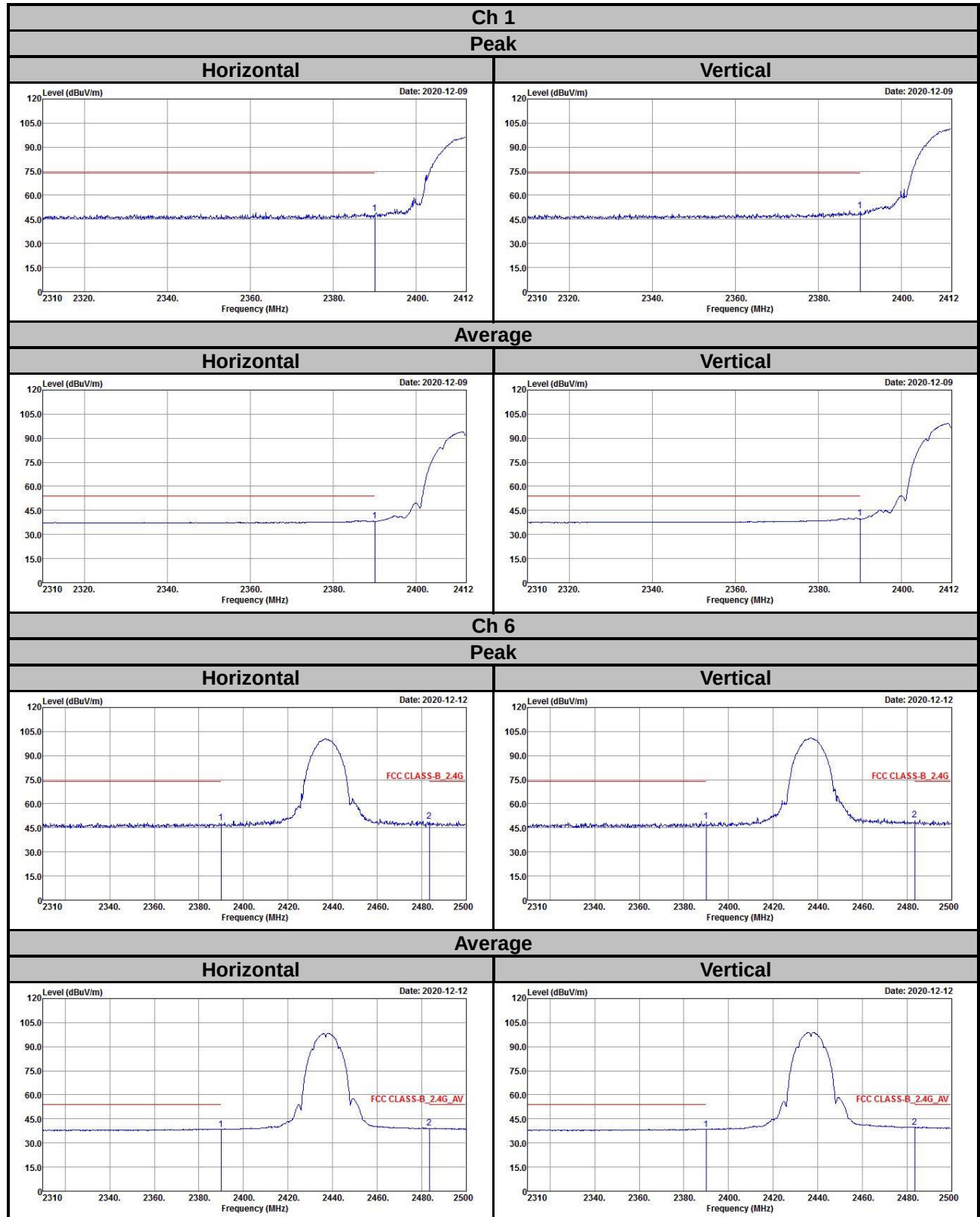


5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Annex A- Band Edge Measurement

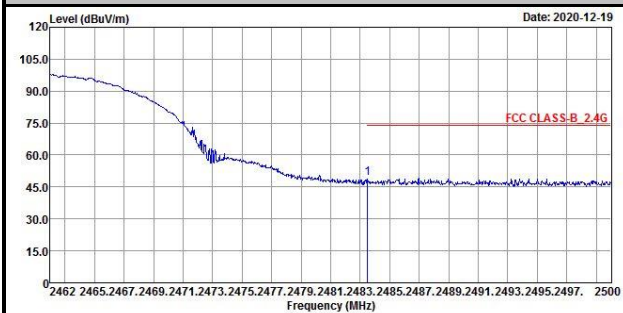
802.11b



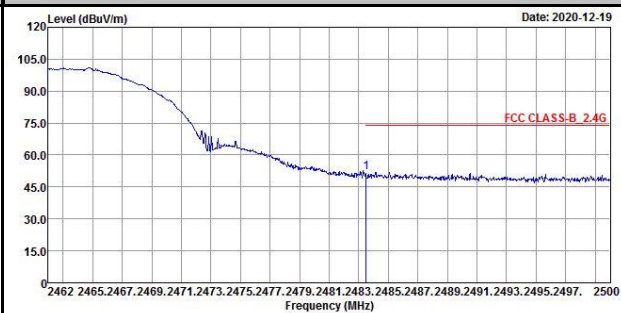
Ch 11

Peak

Horizontal



Vertical



Average

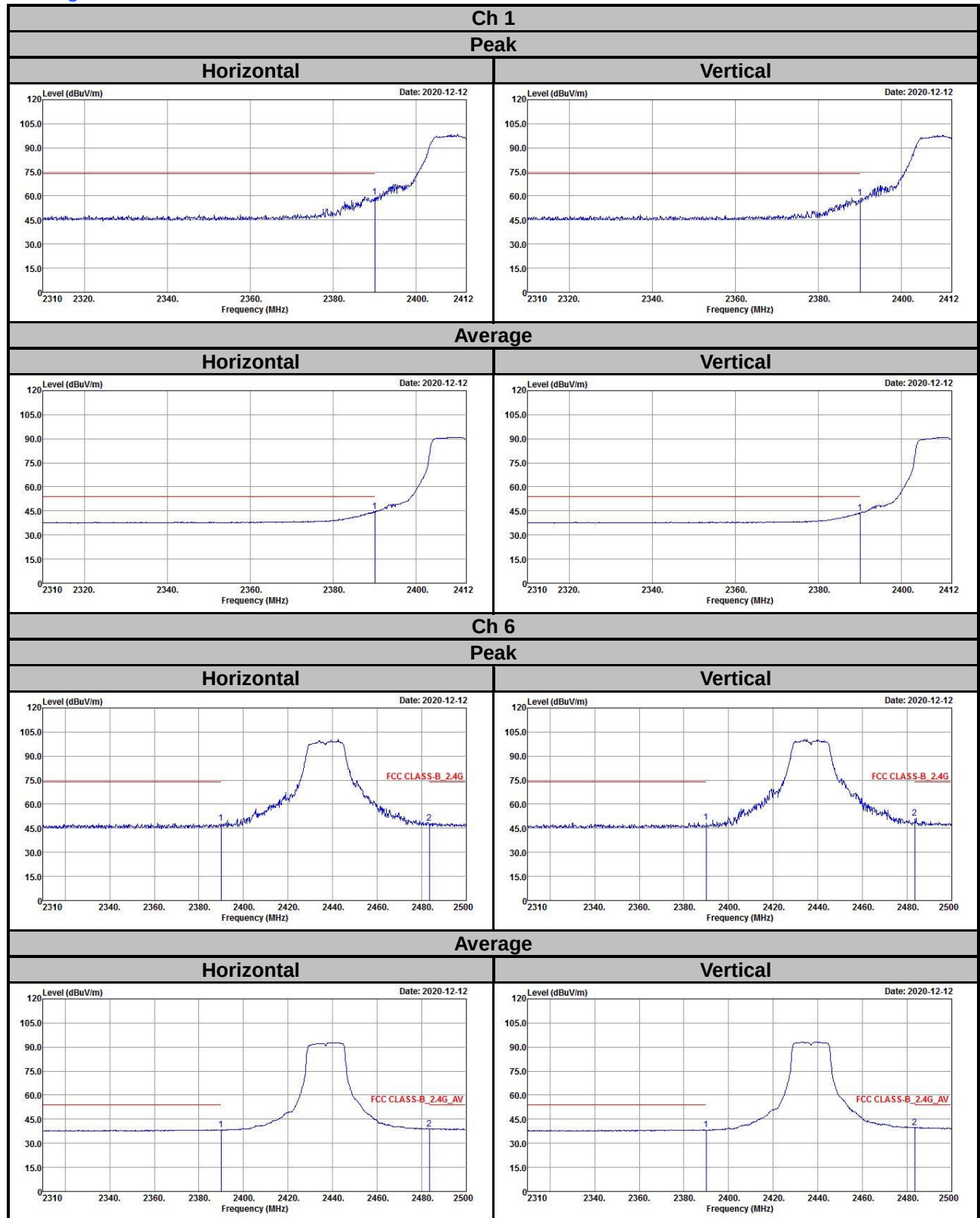
Horizontal



Vertical



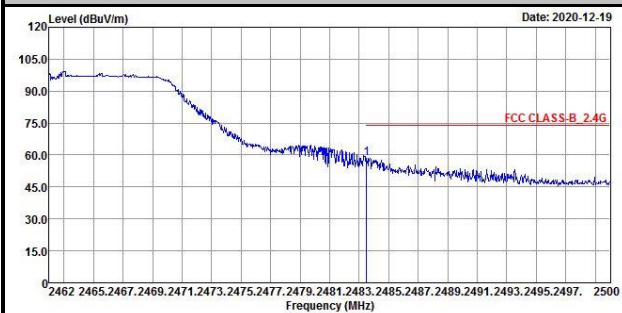
802.11g



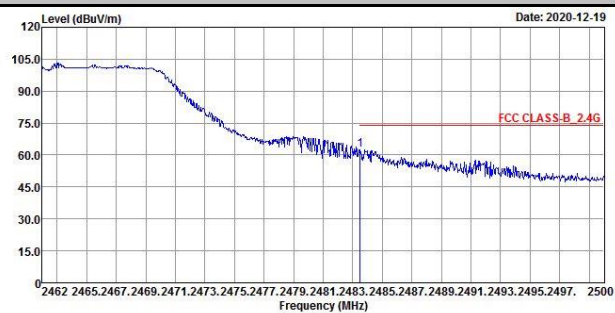
Ch 11

Peak

Horizontal

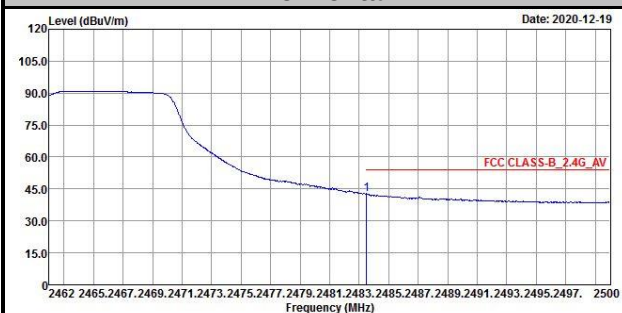


Vertical

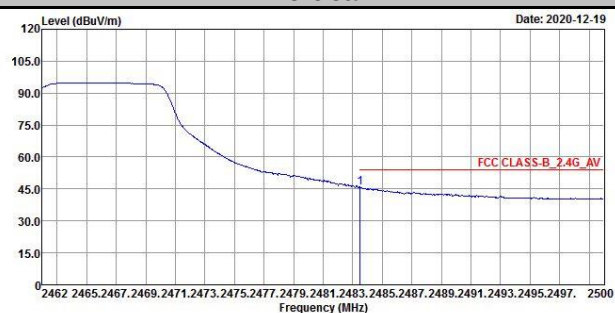


Average

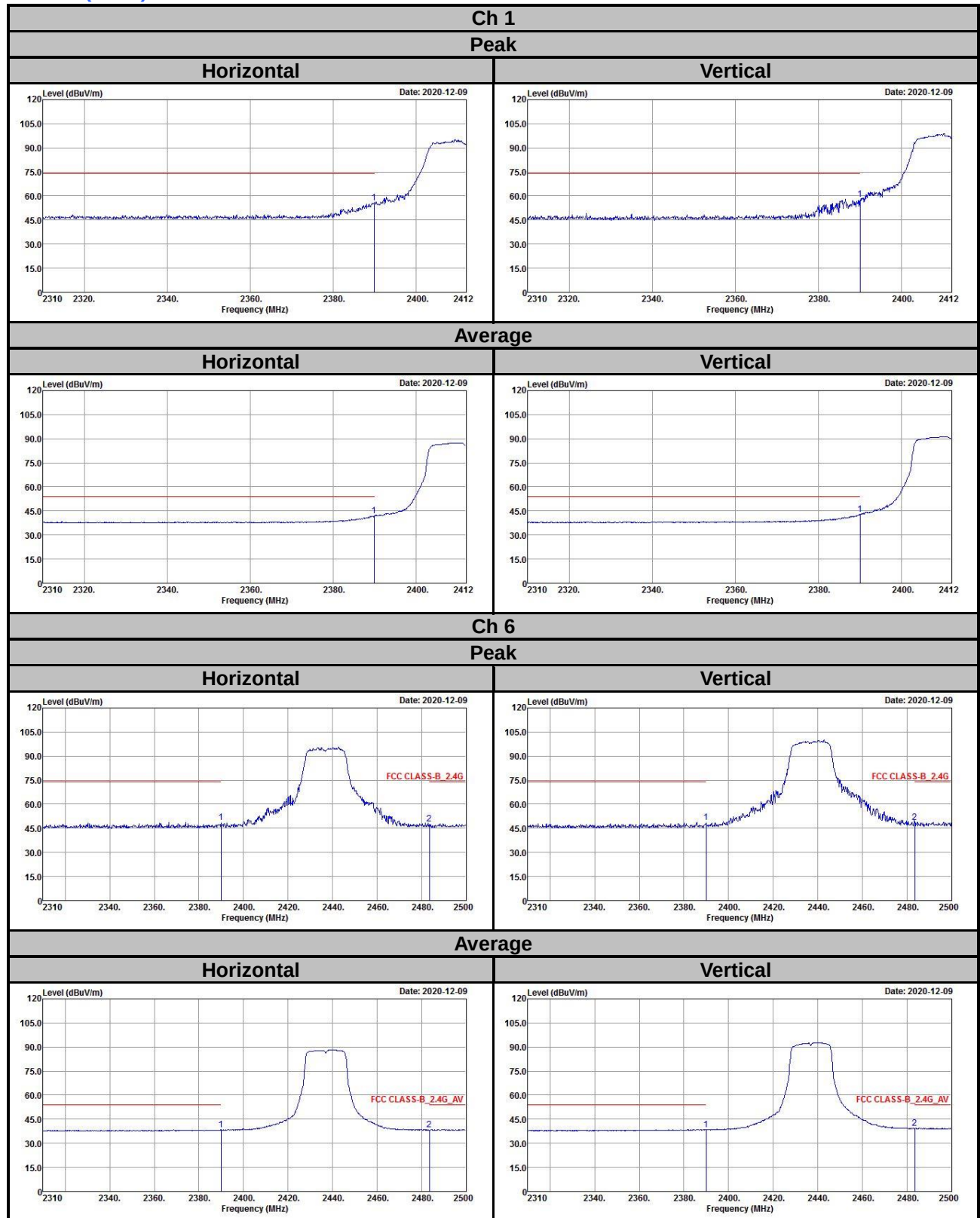
Horizontal



Vertical



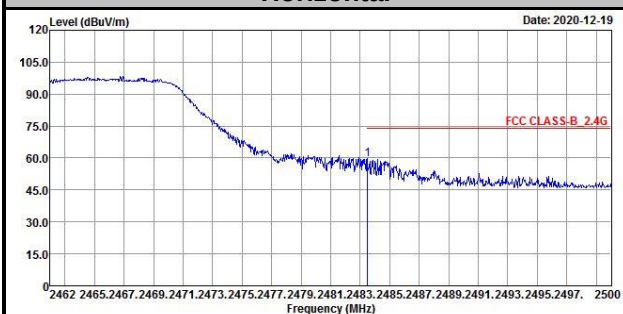
802.11n (HT20)



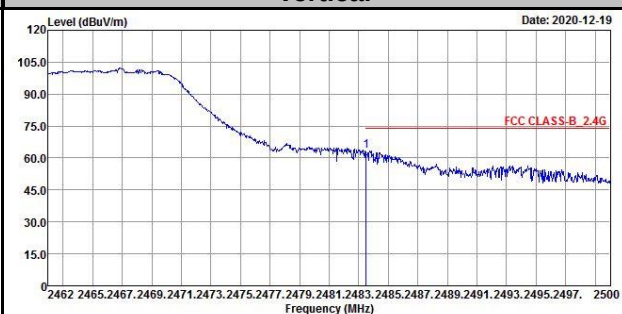
Ch 11

Peak

Horizontal

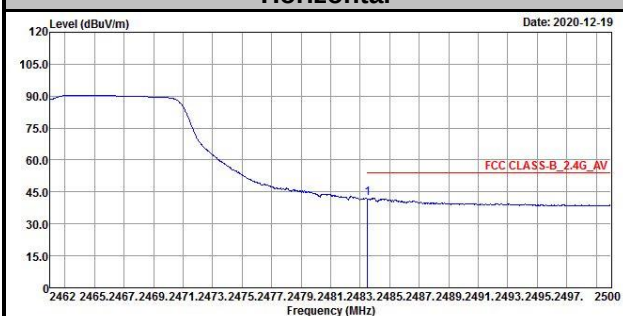


Vertical

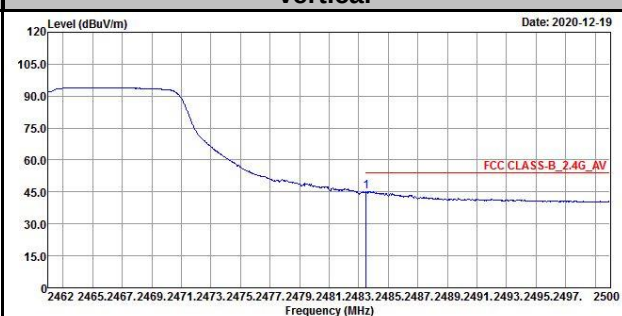


Average

Horizontal



Vertical

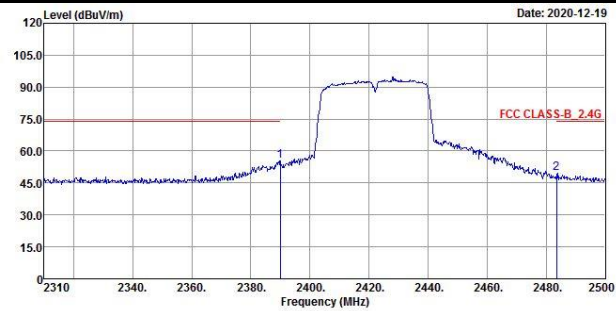


802.11n (HT40)

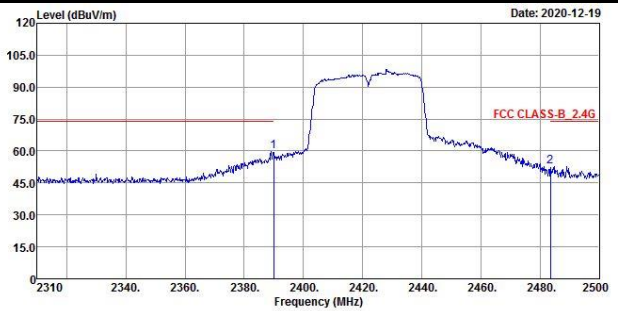
Ch 3

Peak

Horizontal

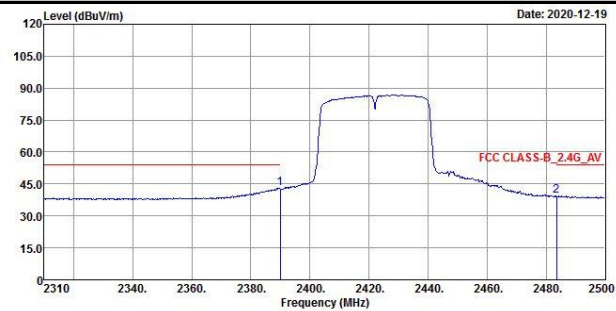


Vertical

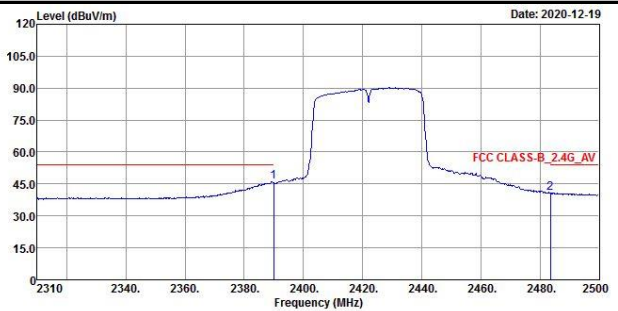


Average

Horizontal



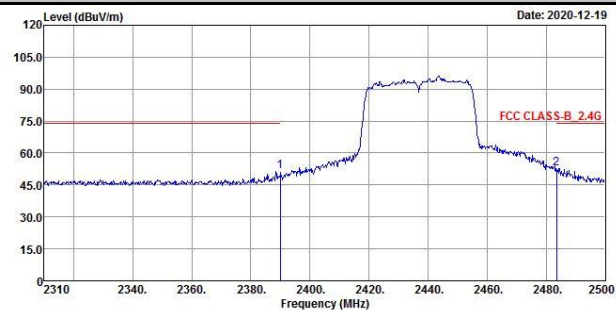
Vertical



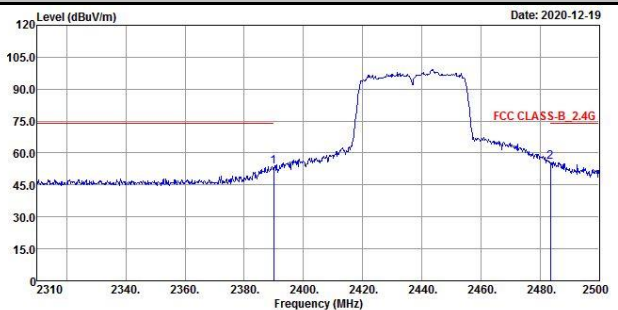
Ch 6

Peak

Horizontal

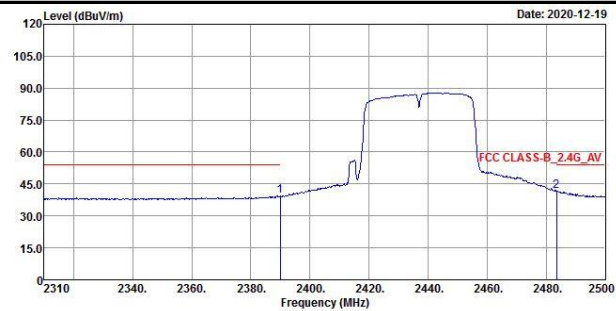


Vertical

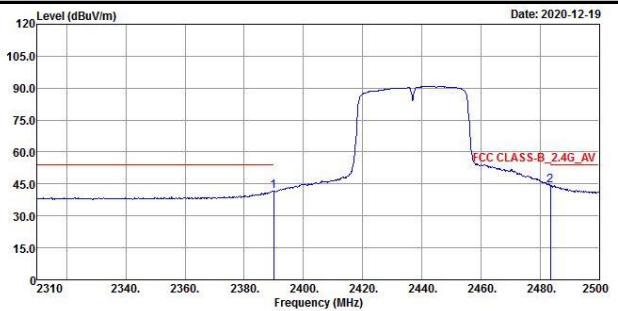


Average

Horizontal



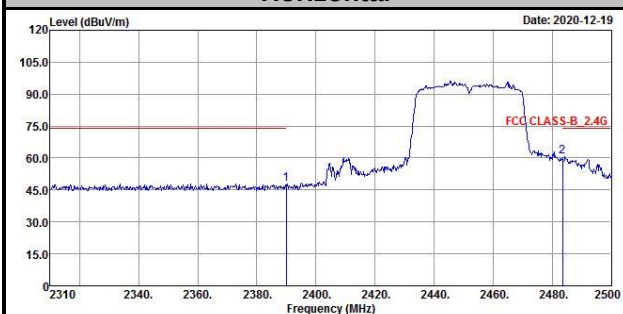
Vertical



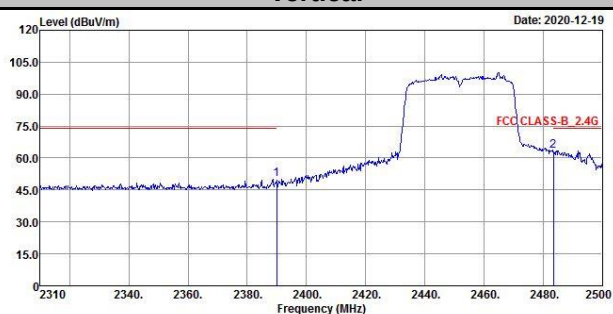
Ch 9

Peak

Horizontal

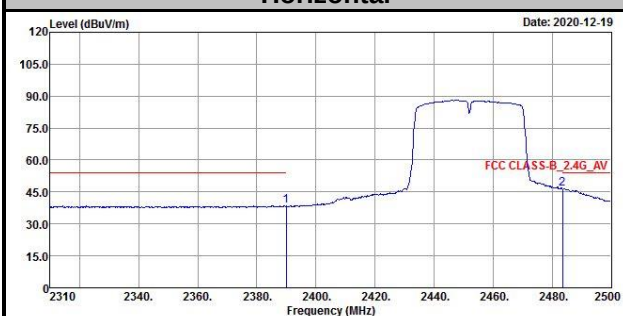


Vertical

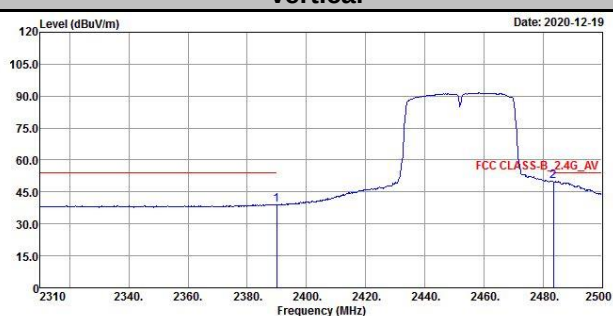


Average

Horizontal



Vertical



Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

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

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Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

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

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