

FCC Test Report

Report No.: RF200511E13

FCC ID: 2AHBN-AP12

Test Model: AP12

Received Date: May 11, 2020

Test Date: Jul. 08 ~ Aug. 04, 2020

Issued Date: Aug. 04, 2020

Applicant: Juniper Networks, Inc.

Address: 1133 Innovation Way Sunnyvale, CA 94089 USA

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
Lin Kou Laboratories

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test Location (1): No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City
33383, Taiwan

Test Location (2): B2F., No.215, Sec. 3, Beixin Rd., Xindian Dist., New Taipei City 231,
Taiwan

FCC Registration / 788550 / TW0003

Designation Number: 427177 / TW0011



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Release Control Record


Issue No.	Description	Date Issued
RF200511E13	Original Release	Aug. 04, 2020

1 Certificate of Conformity

Product: 802.11ax Wallplate AP
Brand: Mist
Test Model: AP12
Sample Status: Engineering Sample
Applicant: Juniper Networks, Inc.
Test Date: Jul. 08 ~ Aug. 04, 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 :  , Date: Aug. 04, 2020
Lena Wang / Specialist

Approved by :  , Date: Aug. 04, 2020
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 -12.91 dB at 0.58102 MHz.
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -0.64 dB at 2353.86 MHz.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit.
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:

- Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
- 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.

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	2.0153 dB
	200 MHz ~ 1000 MHz	2.0224 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	1.0121 dB
	18 GHz ~ 40 GHz	1.1508 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	802.11ax Wallplate AP
Brand	Mist
Test Model	AP12
Status of EUT	Engineering Sample
Power Supply Rating	55.0 Vdc
Modulation Type	GFSK
Transfer Rate	LE 5.0: 1 Mbps & 2 Mbps
Operating Frequency	2402 ~ 2480 MHz
Number of Channel	40
Output Power	2.193 mW
Antenna Type	PCB antenna with -0.6 dBi gain
Antenna Connector	N/A
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

1. There are three radios for the EUT.

Radio	Function	TX/RX Function
Radio 1(WL0)	WLAN 2.4G	TX/RX
Radio 2(WL1) Scanning	WLAN 2.4G & 5G	TX/RX
Radio 3(WL2)	WLAN 5G	TX/RX
Radio 4	BT5.0	TX/RX

2. The EUT contains following accessory devices. (Support unit only)

Product	Brand	Model	Description
POE	Microsemi	PD-9001GR/AC	I/P: 100-240 Vac, 50/60 Hz, 0.67 A O/P: 55 Vdc, 0.6 A

3. 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.
4. 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

40 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

3.2.1 Test Mode Applicability and Tested Channel Detail

<LE 5.0-1 Mbps>

EUT Configure Mode	Applicable To				Description
	RE \geq 1G	RE<1G	PLC	APCM	
-	√	√	√	√	-

Where **RE \geq 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	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

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	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	39	GFSK	1

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	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	39	GFSK	1

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	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

<LE 5.0-2 Mbps >

EUT Configure Mode	Applicable To				Description
	RE \geq 1G	RE<1G	PLC	APCM	
-	√	√	√	√	-

Where **RE \geq 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	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	2

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	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0	GFSK	2

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	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0	GFSK	2

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	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	2

Test Condition:

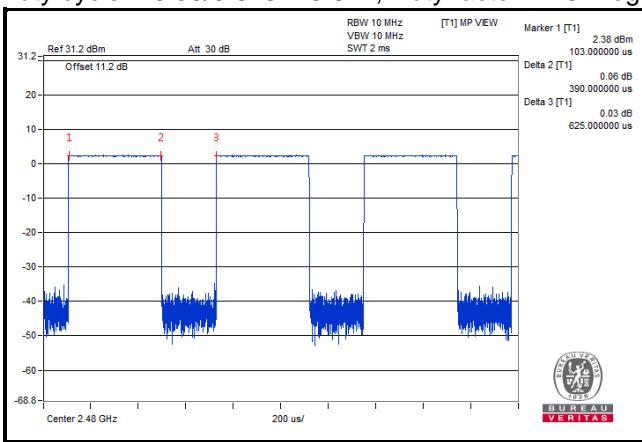
Applicable To	Environmental Conditions	Input Power	Tested by
RE≥1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Karl Lee
RE<1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Karl Lee
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Jisyong Wang
APCM	25 deg. C, 65 % RH	120 Vac, 60 Hz	Gavin Wu

3.3 Duty Cycle of Test Signal

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

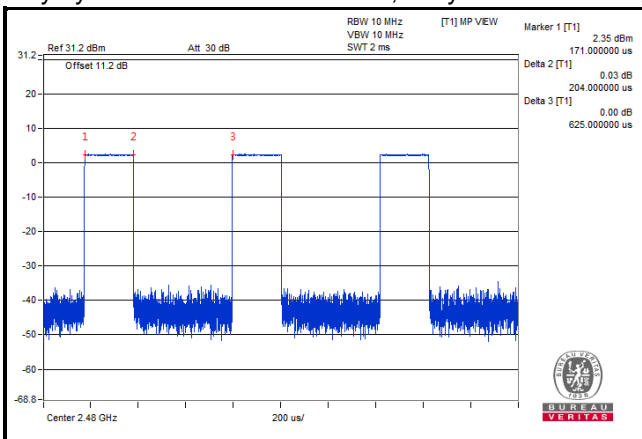
<LE 5.0-1 Mbps >

Duty cycle = 0.39/0.625 = 0.624, Duty factor = 10 * log(1/0.624) = 2.05



<LE 5.0-2 Mbps >

Duty cycle = 0.204/0.625 = 0.326, Duty factor = 10 * log(1/0.326) = 4.86



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.

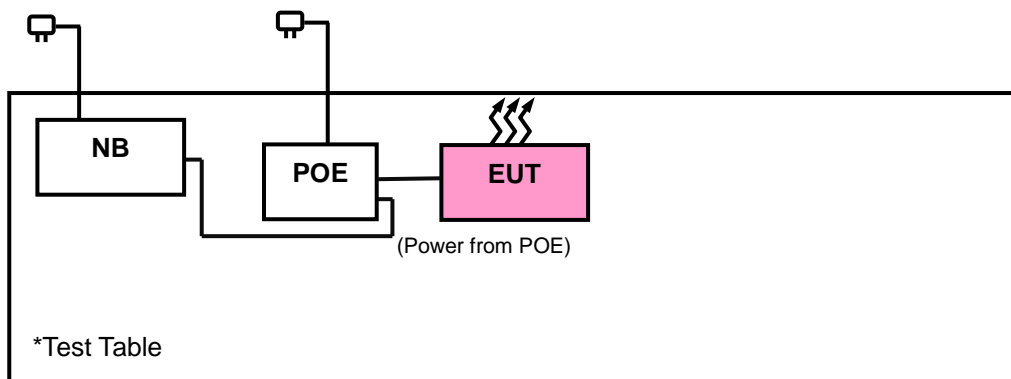
No.	Product	Brand	Model No.	Serial No.	FCC ID
A	Notebook	DELL	E6420	D3T96R1	FCC DoC Approved

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	RJ45 Cable	1	1	N	0	Cat5e
2.	RJ45 Cable	1	1	N	0	Cat5e

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items A acted as communication partners to transfer data.

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 15.247 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 Technologies	N9038A	MY52260177	Aug. 26, 2019	Aug. 25, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 16, 2020	Apr. 15, 2021
BILOG Antenna SCHWARZBECK	VULB 9168	9168-616	Nov. 12, 2019	Nov. 11, 2020
HORN Antenna ETS-Lindgren	3117	00143293	Nov. 24, 2019	Nov. 23, 2020
HORN Antenna SCHWARZBECK	BBHA 9170	9170-480	Nov. 24, 2019	Nov. 23, 2020
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 14, 2020	Apr. 13, 2021
Loop Antenna	HLA 6121	45745	Jul. 06, 2020	Jul. 05, 2021
Preamplifier Agilent	310N	187226	Jun. 17, 2020	Jun. 16, 2021
Preamplifier Agilent	83017A	MY39501357	Jun. 17, 2020	Jun. 16, 2021
Power Meter Anritsu	ML2495A	1012010	Sep. 04, 2019	Sep. 03, 2020
Power Sensor Anritsu	MA2411B	1315050	Sep. 04, 2019	Sep. 03, 2020
RF signal cable ETS-LINDGREN	5D-FB	Cable-CH1-01(RFC-SMS-100-SMS-120+RFC-SMS-100-SMS-400)	Jun. 17, 2020	Jun. 16, 2021
RF signal cable ETS-LINDGREN	8D-FB	Cable-CH1-02(RFC-SMS-100-SMS-24)	Jun. 17, 2020	Jun. 17, 2021
Software BV ADT	E3 8.130425b	NA	NA	NA
Antenna Tower MF	NA	NA	NA	NA
Turn Table MF	NA	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 HsinTien Chamber 1.

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:

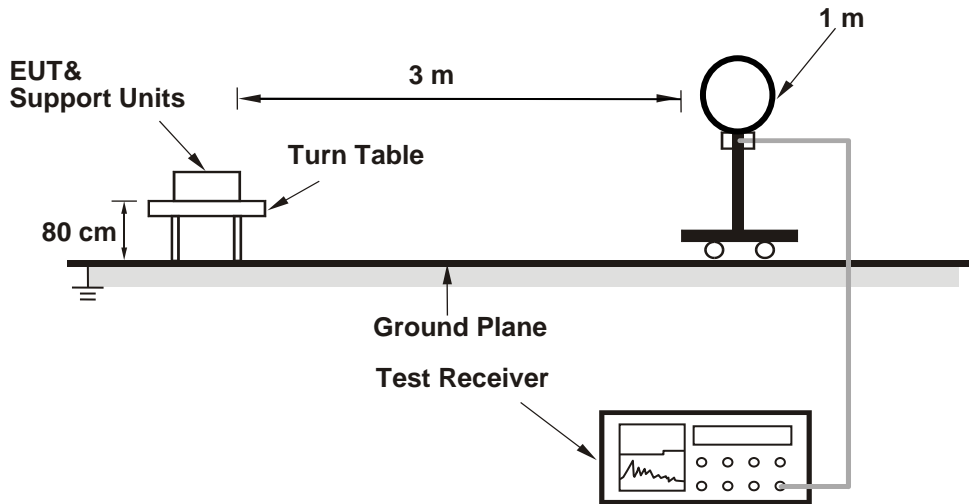
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) 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. (RBW = 1 MHz, VBW = 3 kHz for 1Mbps VBW = 5.1 kHz for 2Mbps)
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

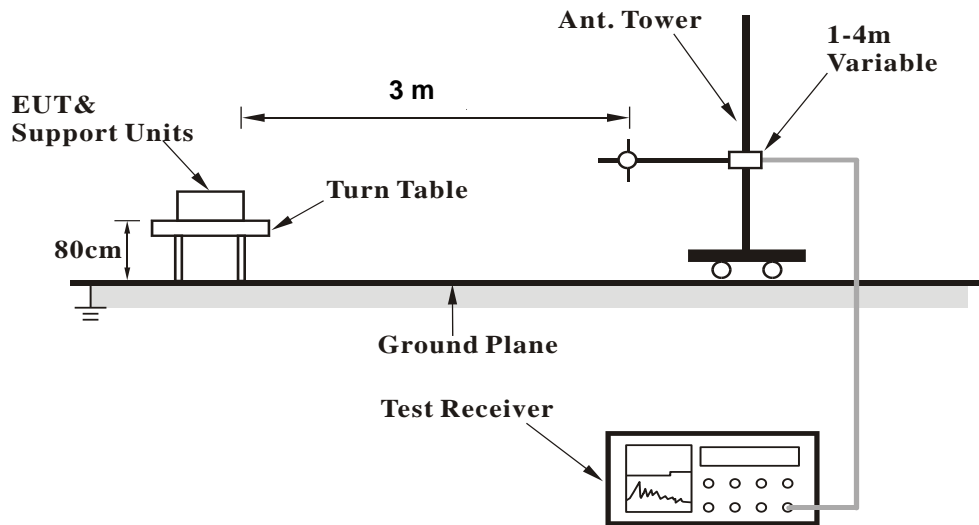
No deviation.

4.1.5 Test Set Up

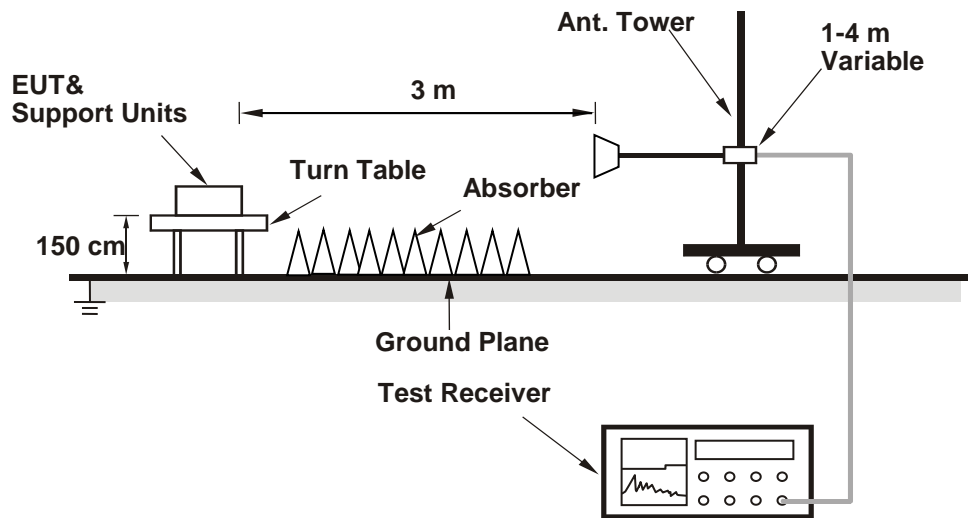
<Radiated Emission below 30 MHz>



<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 the testing table.
- Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1 GHz Data:
<LE 5.0-1Mbps >

EUT Test Condition		Measurement Detail	
Channel	Channel 0	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	Karl Lee

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	42.47	37.97	4.5	54	-11.53	102	107	Average
2390	52.95	48.45	4.5	74	-21.05	102	107	Peak
2402	100.05	95.53	4.52			102	107	Average
2402	100.93	96.41	4.52			102	107	Peak
4804	41.05	30.7	10.35	54	-12.95	195	226	Average
4804	47.25	36.9	10.35	74	-26.75	195	226	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	41.49	36.99	4.5	54	-12.51	196	340	Average
2390	51.92	47.42	4.5	74	-22.08	196	340	Peak
2402	95.22	90.7	4.52			196	340	Average
2402	96.02	91.5	4.52			196	340	Peak
4804	41.78	31.43	10.35	54	-12.22	132	116	Average
4804	47.03	36.68	10.35	74	-26.97	132	116	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2402 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 19	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	Karl Lee

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	41.75	37.25	4.5	54	-12.25	102	107	Average
2390	51.57	47.07	4.5	74	-22.43	102	107	Peak
2440	98.51	93.92	4.59			102	107	Average
2440	99.32	94.73	4.59			102	107	Peak
2483.5	41.94	37.28	4.66	54	-12.06	102	107	Average
2483.5	53.07	48.41	4.66	74	-20.93	102	107	Peak
4880	41.56	31.35	10.21	54	-12.44	136	127	Average
4880	47.81	37.6	10.21	74	-26.19	136	127	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	41.46	36.96	4.5	54	-12.54	196	340	Average
2390	51.68	47.18	4.5	74	-22.32	196	340	Peak
2440	94.68	90.09	4.59			196	340	Average
2440	95.48	90.89	4.59			196	340	Peak
2483.5	40.99	36.33	4.66	54	-13.01	196	340	Average
2483.5	53.36	48.7	4.66	74	-20.64	196	340	Peak
4880	41.94	31.73	10.21	54	-12.06	187	205	Average
4880	48.09	37.88	10.21	74	-25.91	187	205	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2440 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	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	Karl Lee

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
2480	99.02	94.38	4.64			101	109	Average
2480	99.86	95.22	4.64			101	109	Peak
2483.5	43.38	38.72	4.66	54	-10.62	101	109	Average
2483.5	60.81	56.15	4.66	74	-13.19	101	109	Peak
4960	41.89	31.53	10.36	54	-12.11	138	204	Average
4960	48.14	37.78	10.36	74	-25.86	138	204	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
2480	94.23	89.59	4.64			196	323	Average
2480	94.97	90.33	4.64			196	323	Peak
2483.5	42.8	38.14	4.66	54	-11.2	196	323	Average
2483.5	59.42	54.76	4.66	74	-14.58	196	323	Peak
4960	41.27	30.91	10.36	54	-12.73	164	120	Average
4960	47.7	37.34	10.36	74	-26.3	164	120	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2480 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

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EUT Test Condition		Measurement Detail	
Channel	Channel 0	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	Karl Lee

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
2352.74	51.47	47.07	4.4	54	-2.53	302	13	Average
2352.74	57.13	52.73	4.4	74	-16.87	302	13	Peak
2390	41.83	37.33	4.5	54	-12.17	302	13	Average
2390	49.83	45.33	4.5	74	-24.17	302	13	Peak
2402	89.89	85.37	4.52			302	13	Average
2402	92.38	87.86	4.52			302	13	Peak
4804	41.64	31.29	10.35	54	-12.36	180	49	Average
4804	47.86	37.51	10.35	74	-26.14	180	49	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
2353.86	53.36	48.96	4.4	54	-0.64	300	0	Average
2353.86	59.12	54.72	4.4	74	-14.88	300	0	Peak
2390	41.89	37.39	4.5	54	-12.11	300	0	Average
2390	50.73	46.23	4.5	74	-23.27	300	0	Peak
2402	93.93	89.41	4.52			300	0	Average
2402	96.05	91.53	4.52			300	0	Peak
4804	42.22	31.87	10.35	54	-11.78	112	175	Average
4804	48.48	38.13	10.35	74	-25.52	112	175	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2402 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 19	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	Karl Lee

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	43.57	39.07	4.5	54	-10.43	226	13	Average
2390	51.95	47.45	4.5	74	-22.05	226	13	Peak
2440	91.79	87.2	4.59			226	13	Average
2440	93.81	89.22	4.59			226	13	Peak
2483.5	43.27	38.61	4.66	54	-10.73	226	13	Average
2483.5	52.95	48.29	4.66	74	-21.05	226	13	Peak
4880	41.84	31.63	10.21	54	-12.16	159	216	Average
4880	48.03	37.82	10.21	74	-25.97	159	216	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	42.85	38.35	4.5	54	-11.15	274	352	Average
2390	52.58	48.08	4.5	74	-21.42	274	352	Peak
2440	93.13	88.54	4.59			274	352	Average
2440	95.16	90.57	4.59			274	352	Peak
2483.5	43.77	39.11	4.66	54	-10.23	274	352	Average
2483.5	52.9	48.24	4.66	74	-21.1	274	352	Peak
4880	41.08	30.87	10.21	54	-12.92	145	87	Average
4880	47.27	37.06	10.21	74	-26.73	145	87	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2440 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	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	Karl Lee

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
2480	89.65	85.01	4.64			246	13	Average
2480	91.74	87.1	4.64			246	13	Peak
2483.5	44.73	40.07	4.66	54	-9.27	246	13	Average
2483.5	53.89	49.23	4.66	74	-20.11	246	13	Peak
4960	41.64	31.28	10.36	54	-12.36	139	265	Average
4960	47.91	37.55	10.36	74	-26.09	139	265	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
2480	93.62	88.98	4.64			196	357	Average
2480	95.73	91.09	4.64			196	357	Peak
2483.5	46.23	41.57	4.66	54	-7.77	196	357	Average
2483.5	55.89	51.23	4.66	74	-18.11	196	357	Peak
4960	42.16	31.8	10.36	54	-11.84	134	117	Average
4960	48.49	38.13	10.36	74	-25.51	134	117	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2480 MHz: Fundamental frequency.
- The emission levels of other frequencies were very low against the limit.

9 kHz ~ 30 MHz Data:

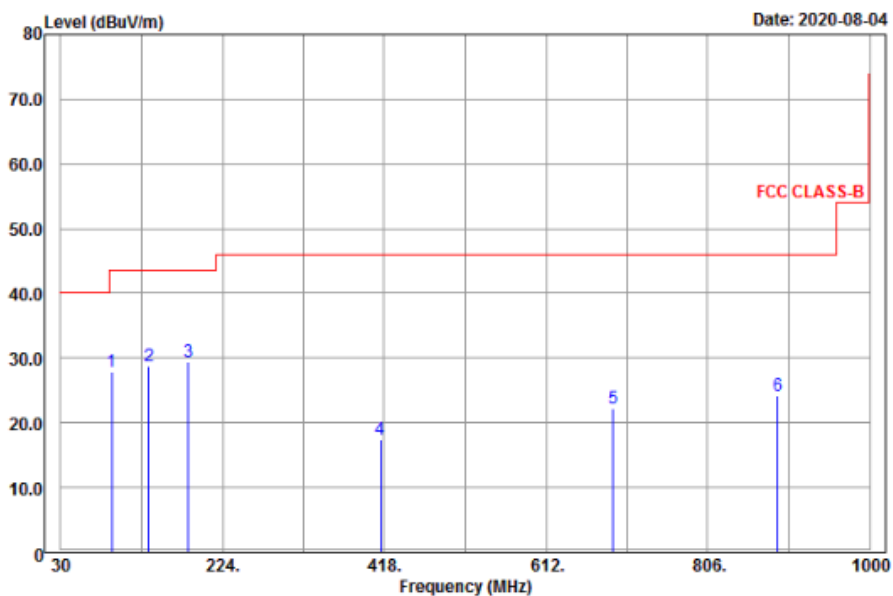
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

30 MHz ~ 1 GHz Worst-Case Data:

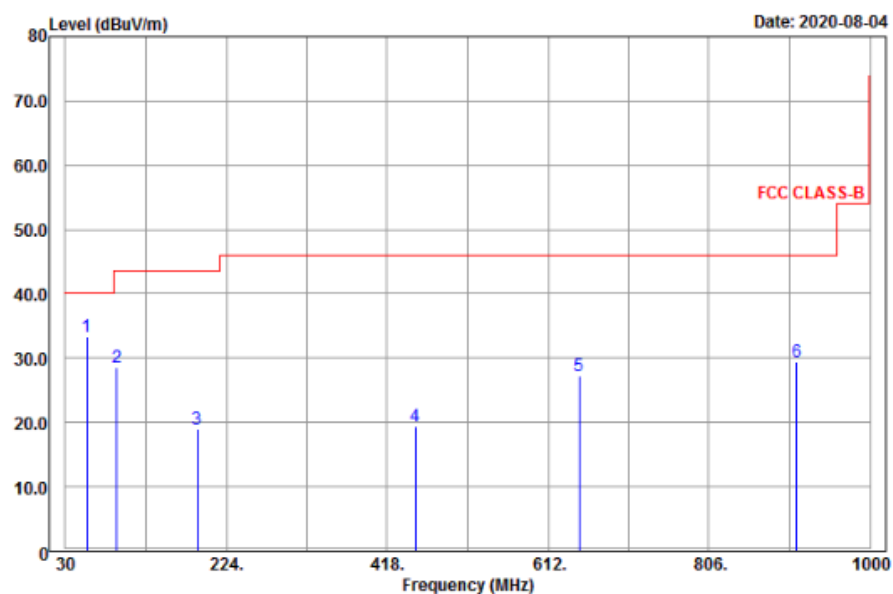
<LE 5.0-1Mbps >

EUT Test Condition		Measurement Detail	
Channel	Channel 39	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	Harry Hsueh

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
91.29	27.97	46.77	43.5	-15.53	-18.8	169	154	Peak
135.57	28.7	49.47	43.5	-14.8	-20.77	144	157	Peak
183.09	29.4	48.74	43.5	-14.1	-19.34	105	132	Peak
413.4	17.37	31.07	46	-28.63	-13.7	106	168	Peak
692.7	22.18	31.47	46	-23.82	-9.29	105	175	Peak
890.1	24.14	30.19	46	-21.86	-6.05	188	157	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
55.65	33.35	48.84	40	-6.65	-15.49	124	132	Peak
91.83	28.54	47.11	43.5	-14.96	-18.57	106	135	Peak
189.03	18.88	37.67	43.5	-24.62	-18.79	142	167	Peak
451.9	19.31	32.57	46	-26.69	-13.26	105	195	Peak
649.3	27.24	37.34	46	-18.76	-10.1	172	184	Peak
911.8	29.51	35.26	46	-16.49	-5.75	162	173	Peak

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. 05, 2019	Sep. 04, 2020
LISN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Jan. 20, 2020	Jan. 19, 2021
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Aug. 13, 2019	Aug. 12, 2020
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 (Conduction 2).
 3. The VCCI Site Registration No. is C-12047.

4.2.3 Test Procedures

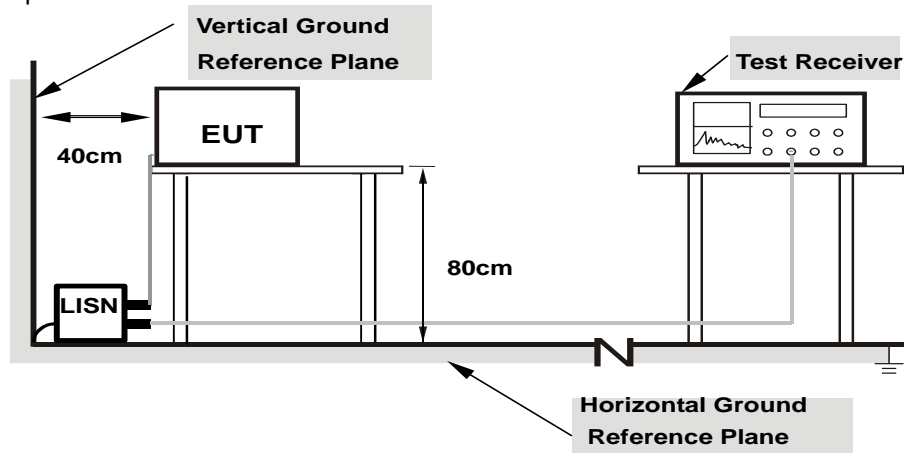
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance 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.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80
from other units and other metal planes**

4.2.6 EUT Operating Conditions

- Placed the EUT on the testing table.
- Set the EUT under transmission condition continuously at specific channel frequency.

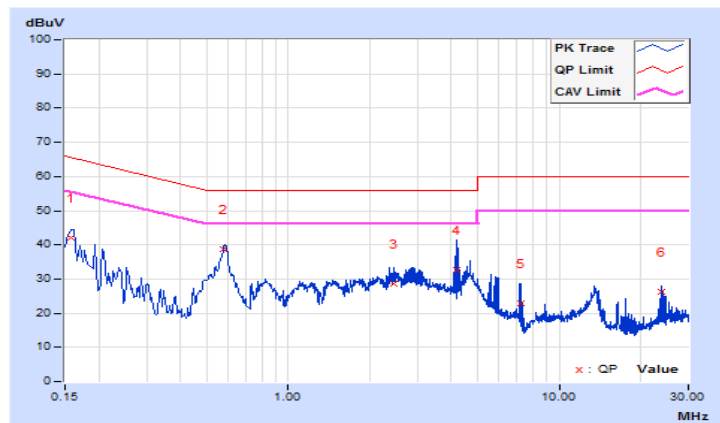
4.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23°C, 69%RH
Tested by	Tim Chen	Test Date	2020/8/3
Test Mode	Mode 1		

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	0.15770	9.63	32.38	21.41	42.01	31.04	65.58	55.58	-23.57	-24.54
2	0.57949	9.66	29.14	22.98	38.80	32.64	56.00	46.00	-17.20	-13.36
3	2.45400	9.74	19.04	13.22	28.78	22.96	56.00	46.00	-27.22	-23.04
4	4.17000	9.79	22.73	8.70	32.52	18.49	56.00	46.00	-23.48	-27.51
5	7.21800	9.83	13.15	7.07	22.98	16.90	60.00	50.00	-37.02	-33.10
6	23.94200	9.91	16.48	14.89	26.39	24.80	60.00	50.00	-33.61	-25.20

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

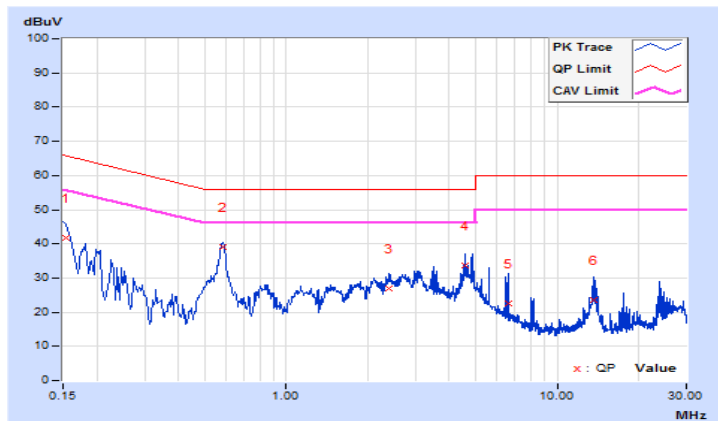


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23°C, 69%RH
Tested by	Tim Chen	Test Date	2020/8/3
Test Mode	Mode 1		

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	0.15400	9.66	32.10	22.22	41.76	31.88	65.78	55.78	-24.02	-23.90
2	0.58102	9.68	29.44	23.41	39.12	33.09	56.00	46.00	-16.88	-12.91
3	2.38600	9.77	17.06	10.84	26.83	20.61	56.00	46.00	-29.17	-25.39
4	4.59400	9.83	23.77	14.99	33.60	24.82	56.00	46.00	-22.40	-21.18
5	6.57800	9.86	12.83	5.82	22.69	15.68	60.00	50.00	-37.31	-34.32
6	13.72200	9.96	13.65	7.36	23.61	17.32	60.00	50.00	-36.39	-32.68

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.

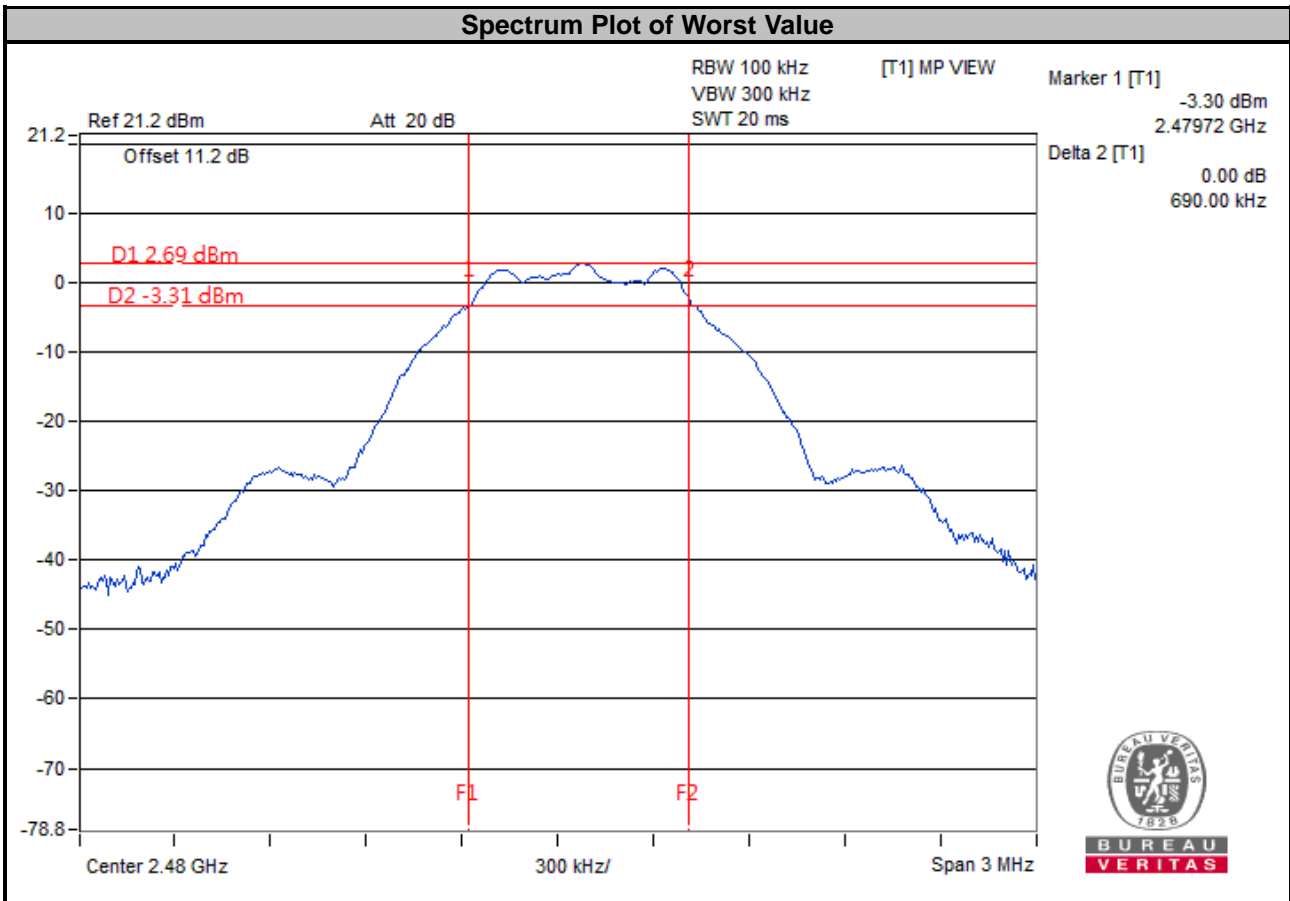
4.3.6 EUT Operating Conditions

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

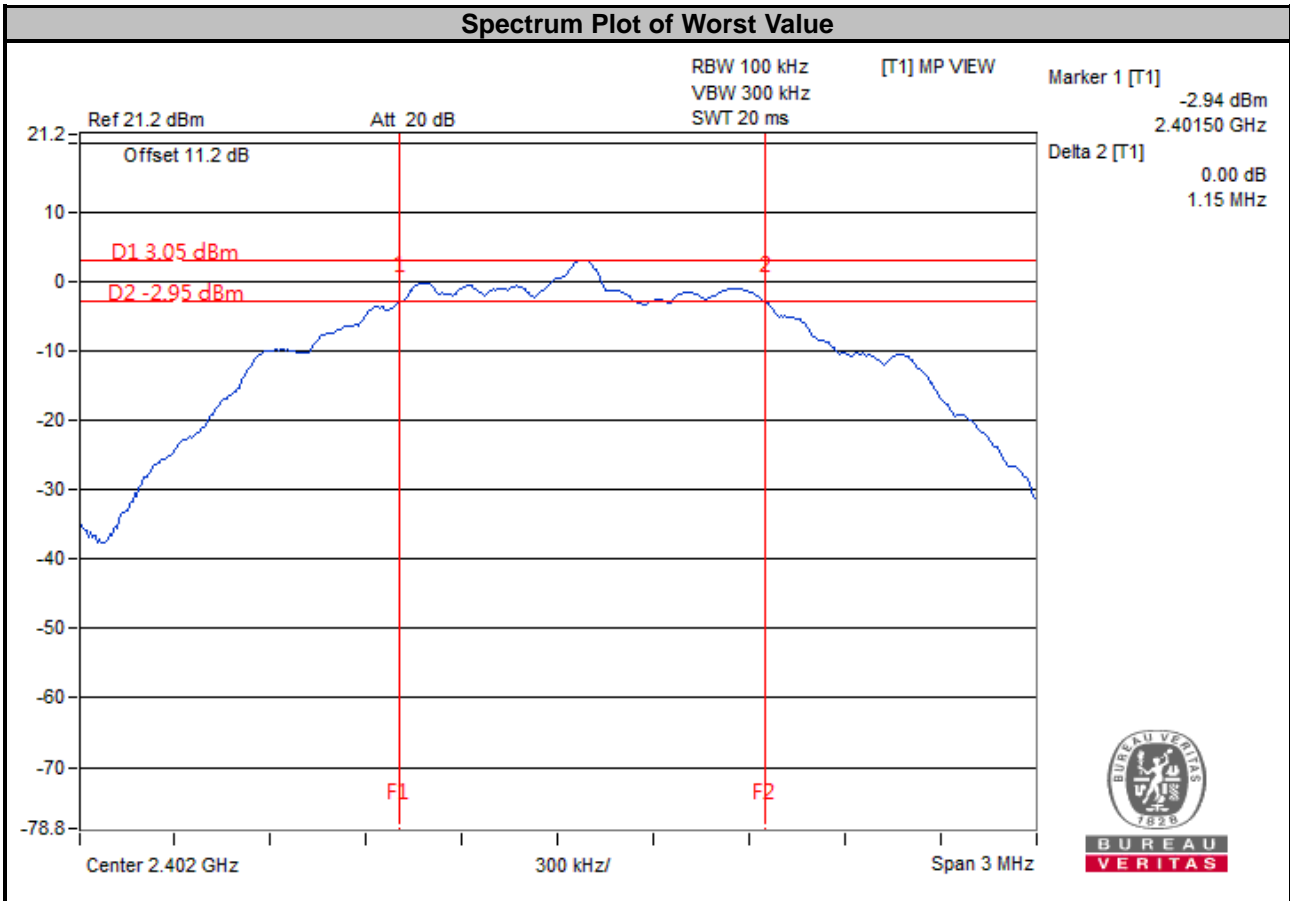
<LE 5.0-1Mbps >

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.72	0.5	Pass
19	2440	0.72	0.5	Pass
39	2480	0.69	0.5	Pass



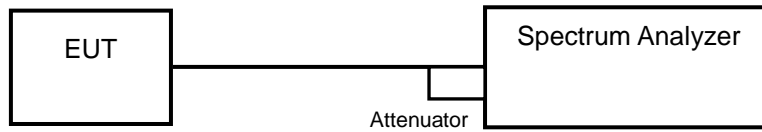
<LE 5.0-2Mbps>

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	1.15	0.5	Pass
19	2440	1.15	0.5	Pass
39	2480	1.15	0.5	Pass



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.

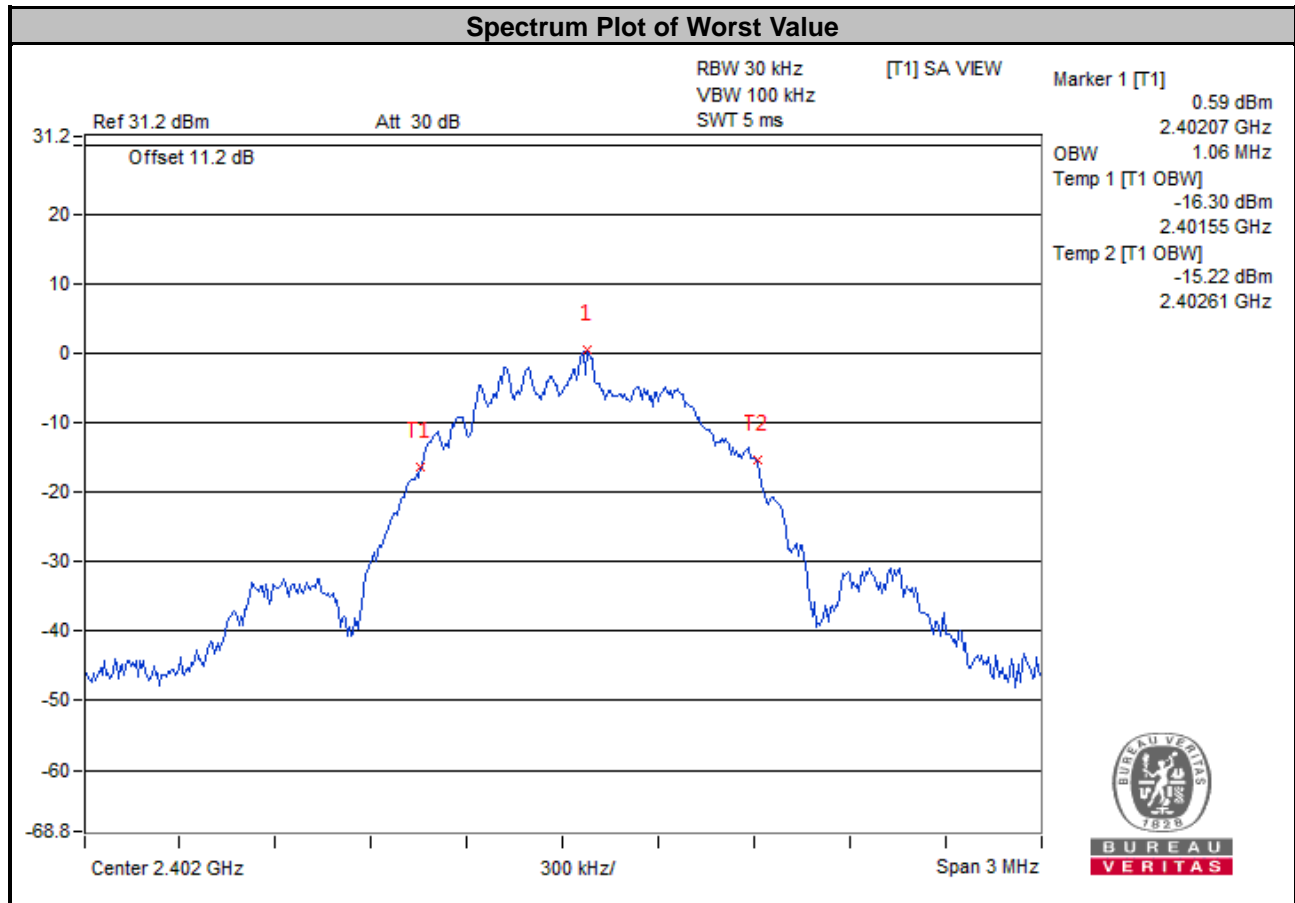
4.4.5 EUT Operating Conditions

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

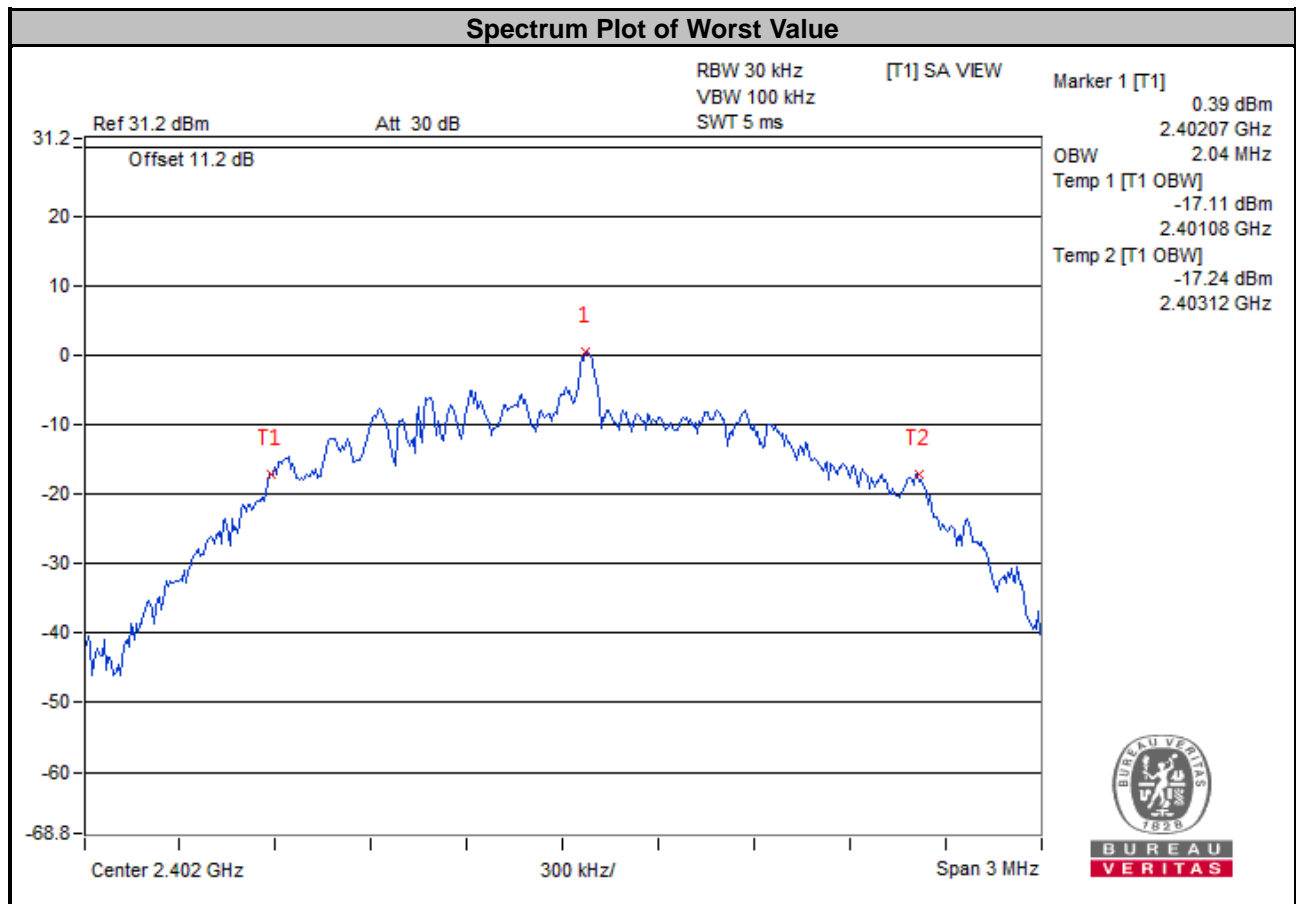
<LE 5.0-1Mbps>

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
0	2402	1.06	Pass
19	2440	1.06	Pass
39	2480	1.05	Pass



<LE 5.0-2Mbps>

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
0	2402	2.04	Pass
19	2440	2.04	Pass
39	2480	2.04	Pass

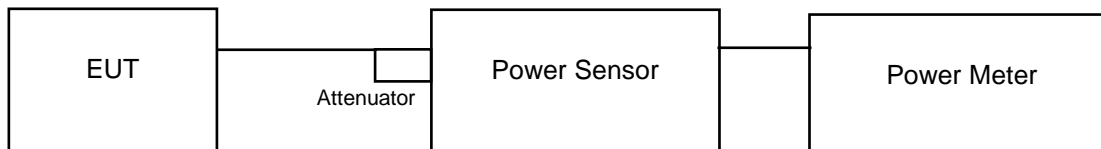


4.5 Conducted Output Power Measurement

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

<LE 5.0-1Mbps>

Channel	Freq. (MHz)	Peak Power		Average Power		Power Limit (mW)	Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)		
0	2402	2.193	3.41	2.113	3.25	1000	Pass
19	2440	2.153	3.33	2.07	3.16	1000	Pass
39	2480	2.065	3.15	1.991	2.99	1000	Pass

<LE 5.0-2Mbps>

Channel	Freq. (MHz)	Peak Power		Average Power		Power Limit (mW)	Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)		
0	2402	2.183	3.39	2.104	3.23	1000	Pass
19	2440	2.148	3.32	2.065	3.15	1000	Pass
39	2480	2.056	3.13	1.982	2.97	1000	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.

4.6.5 Deviation from Test Standard

No deviation.

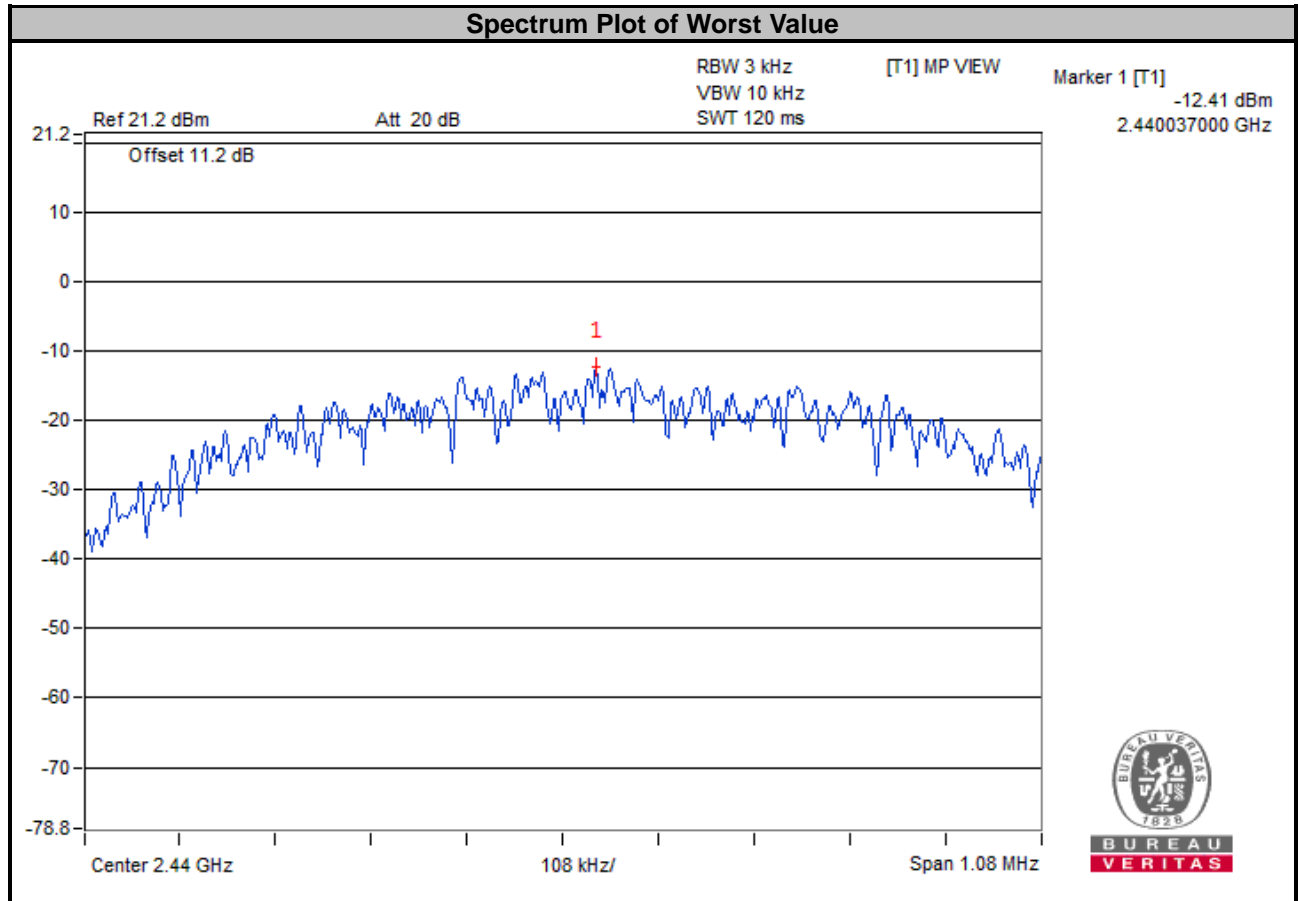
4.6.6 EUT Operating Condition

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

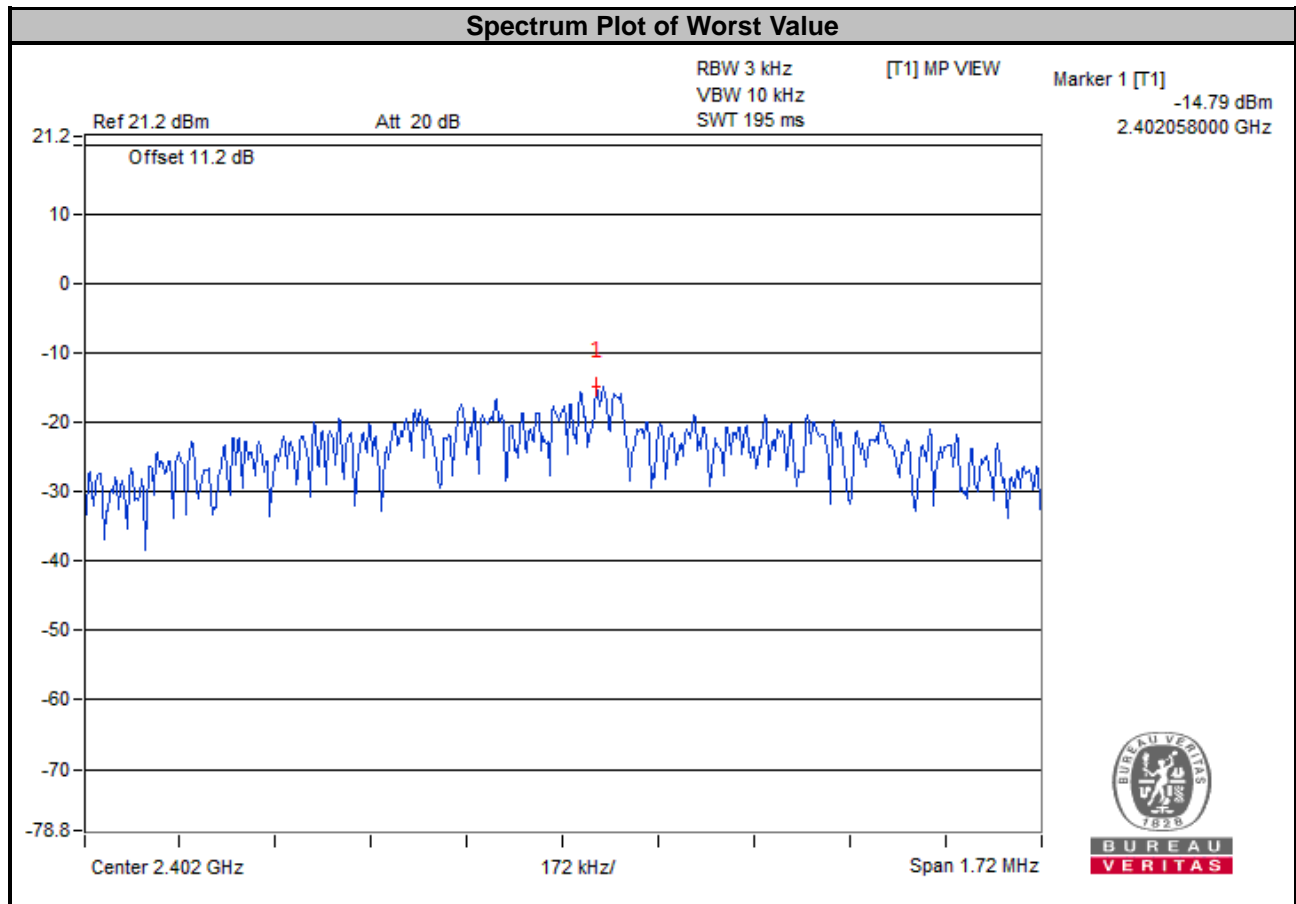
<LE 5.0-1Mbps>

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	2402	-12.45	8	Pass
19	2440	-12.41	8	Pass
39	2480	-12.77	8	Pass



<LE 5.0-2Mbps>

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	2402	-14.79	8	Pass
19	2440	-14.91	8	Pass
39	2480	-15.09	8	Pass



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 OOBE

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.

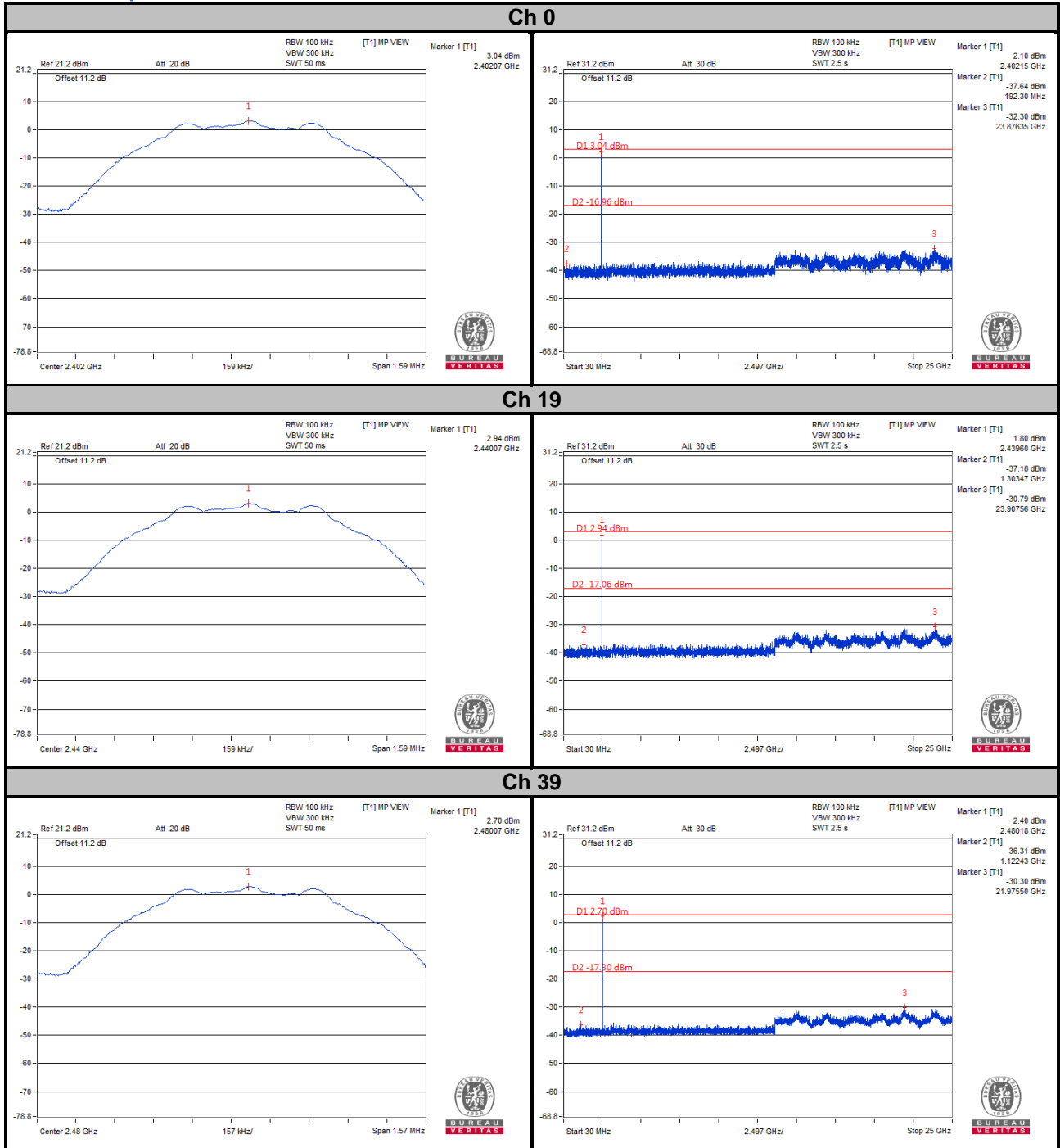
4.7.6 EUT Operating Condition

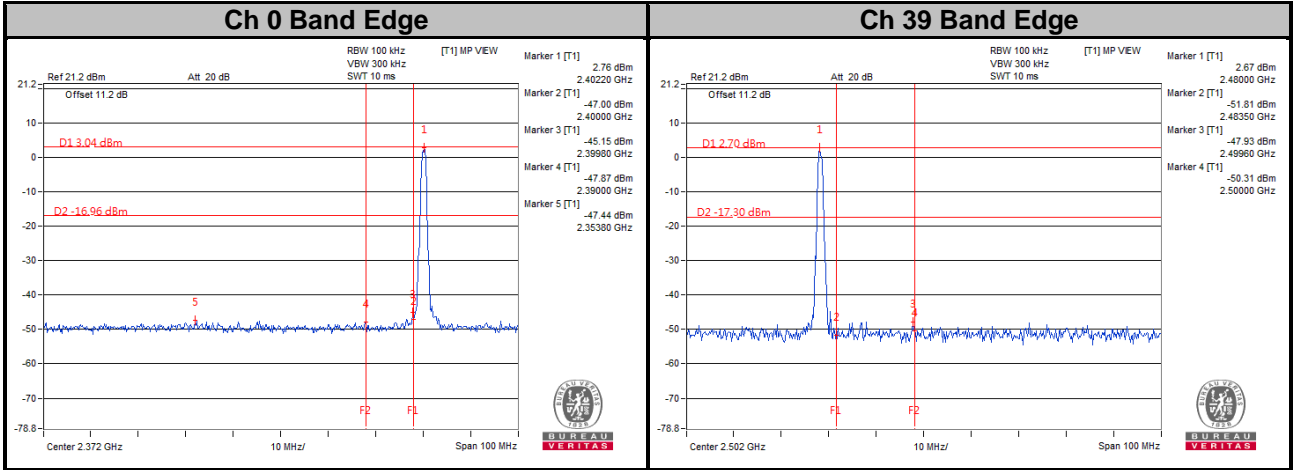
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.7.7 Test Results

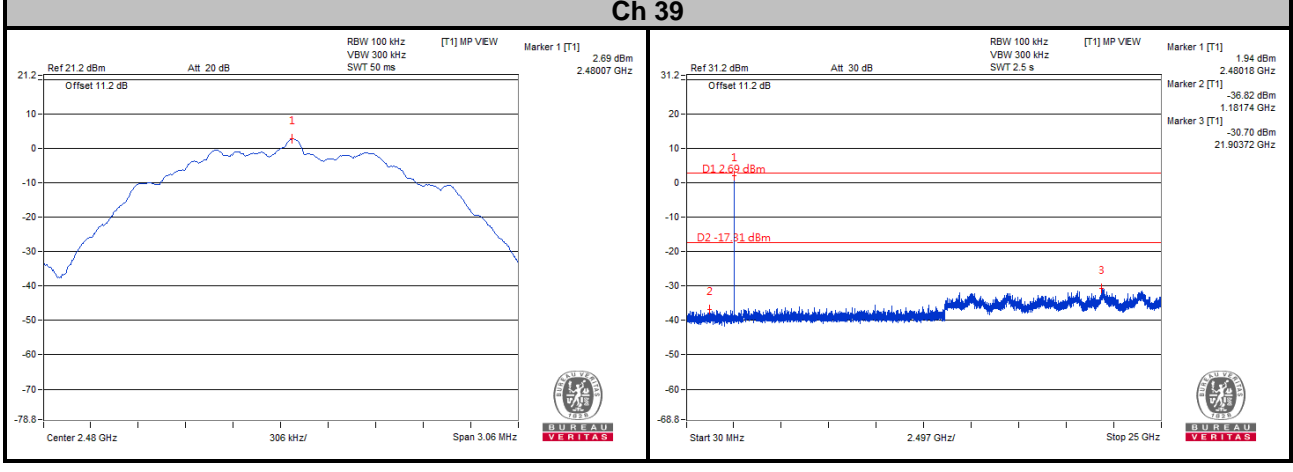
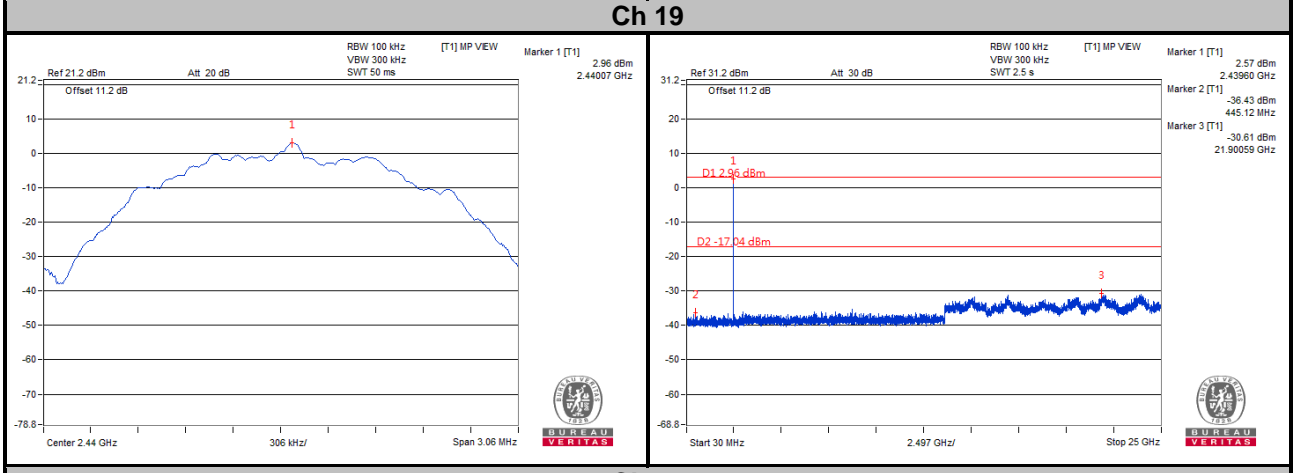
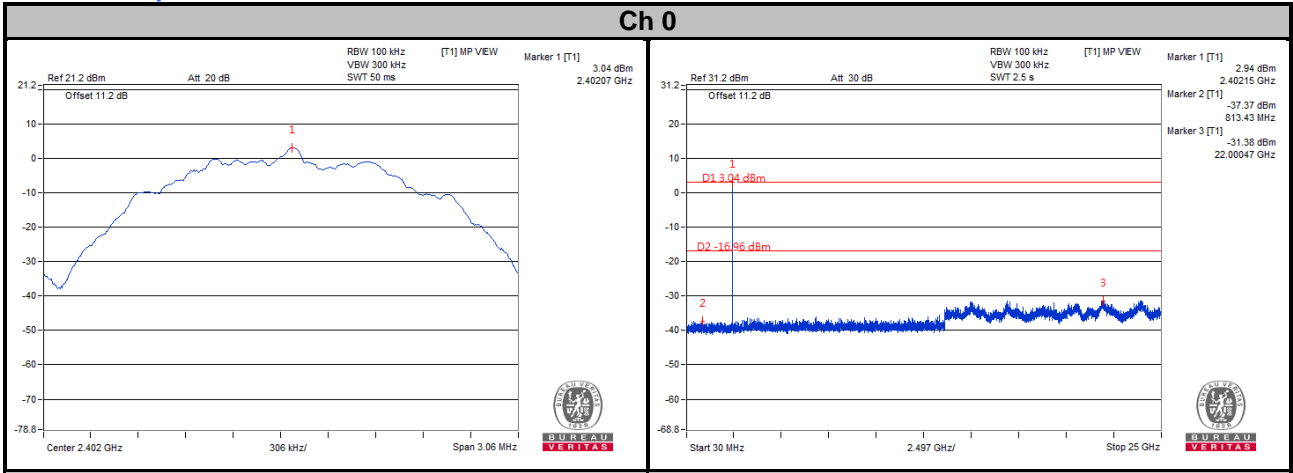
The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement.

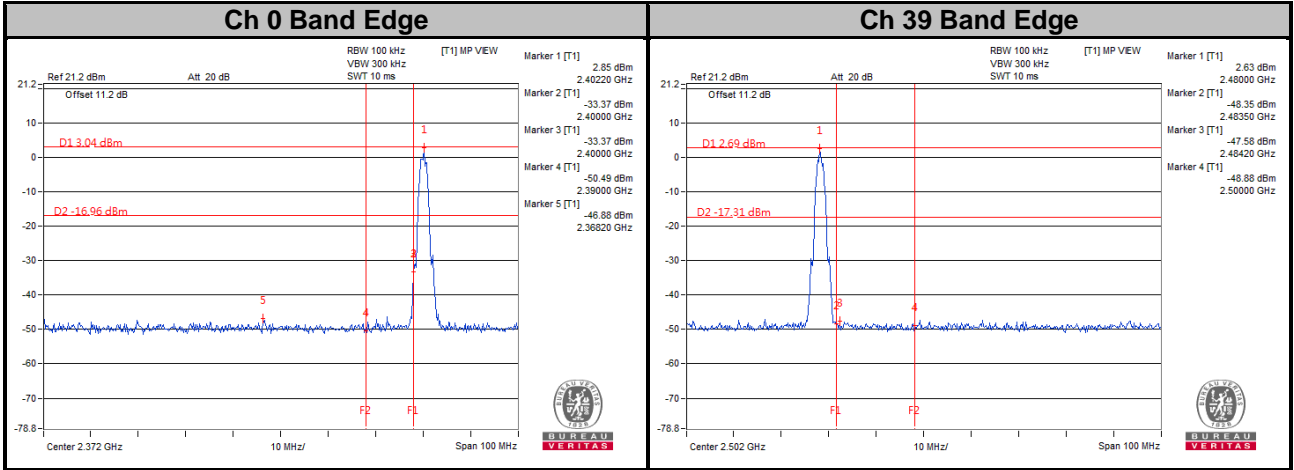
<LE 5.0-1Mbps>





<LE 5.0-2Mbps>



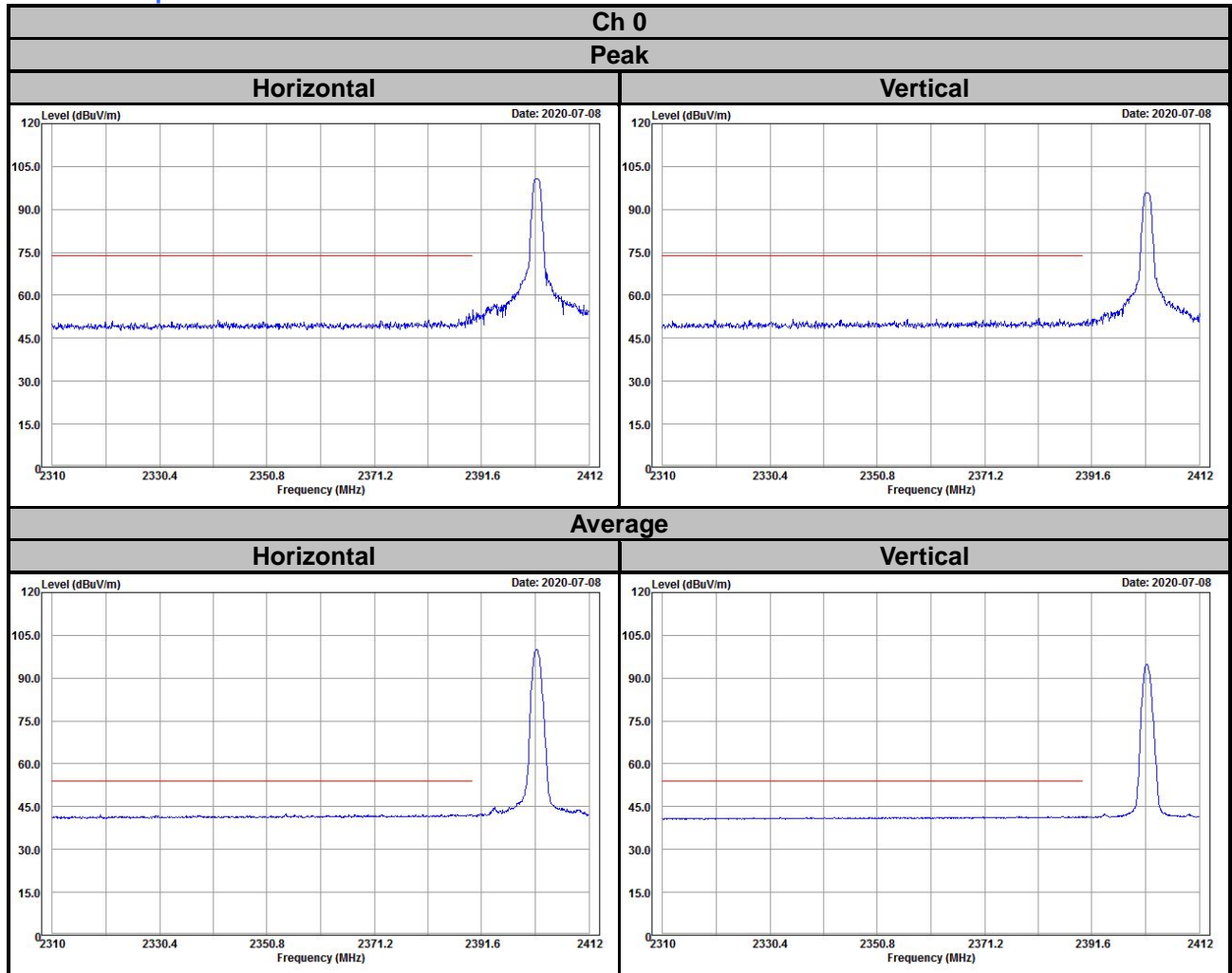


5 Pictures of Test Arrangements

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

Annex A- Band-edge Measurement

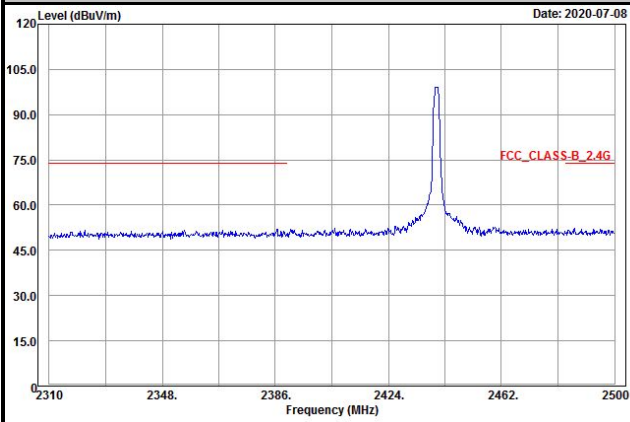
<LE 5.0-1Mbps>



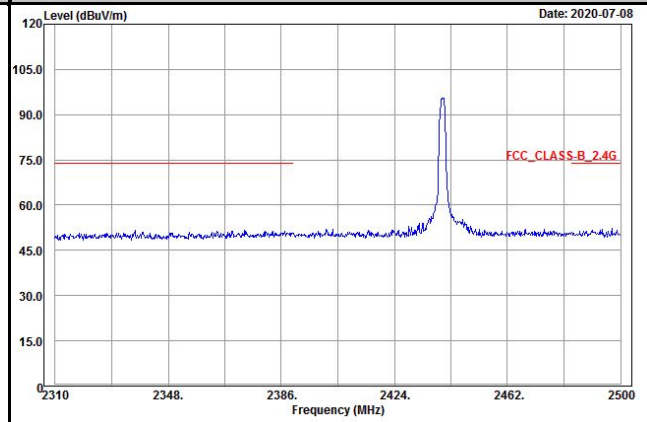
Ch 19

Peak

Horizontal

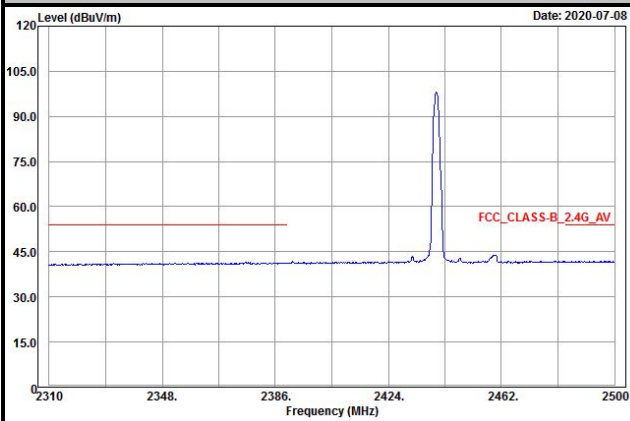


Vertical

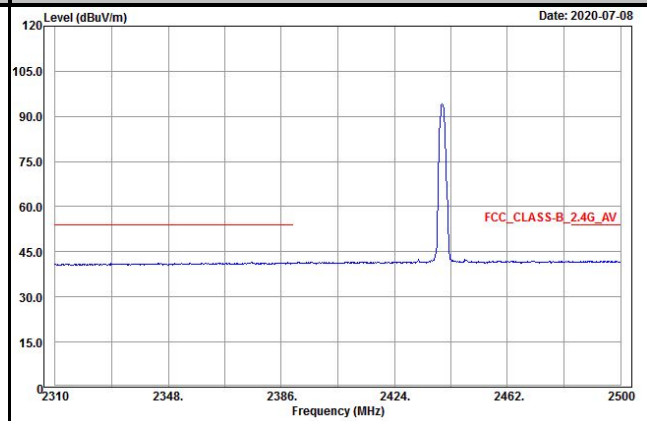


Average

Horizontal

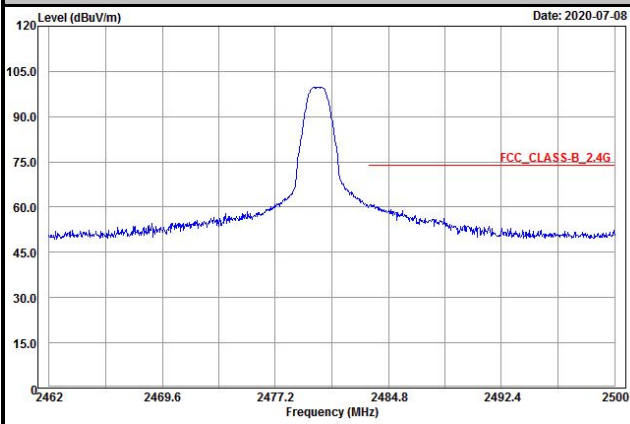


Vertical

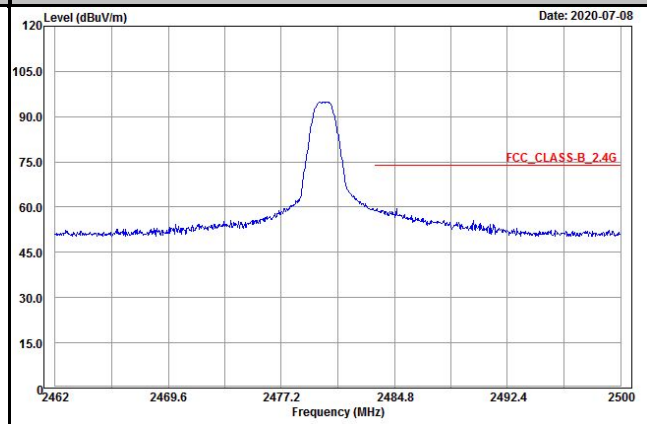


Ch 39
Peak

Horizontal

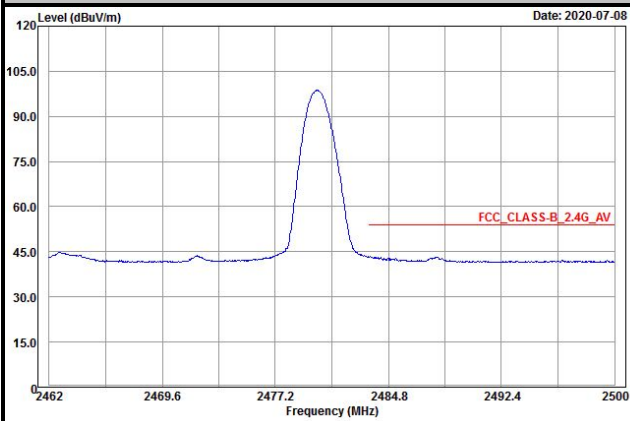


Vertical

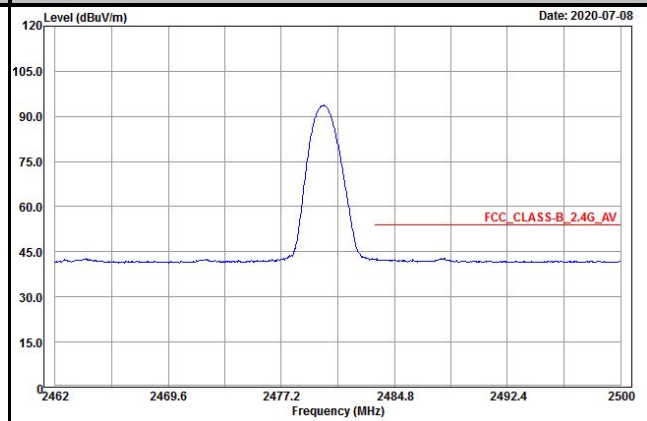


Average

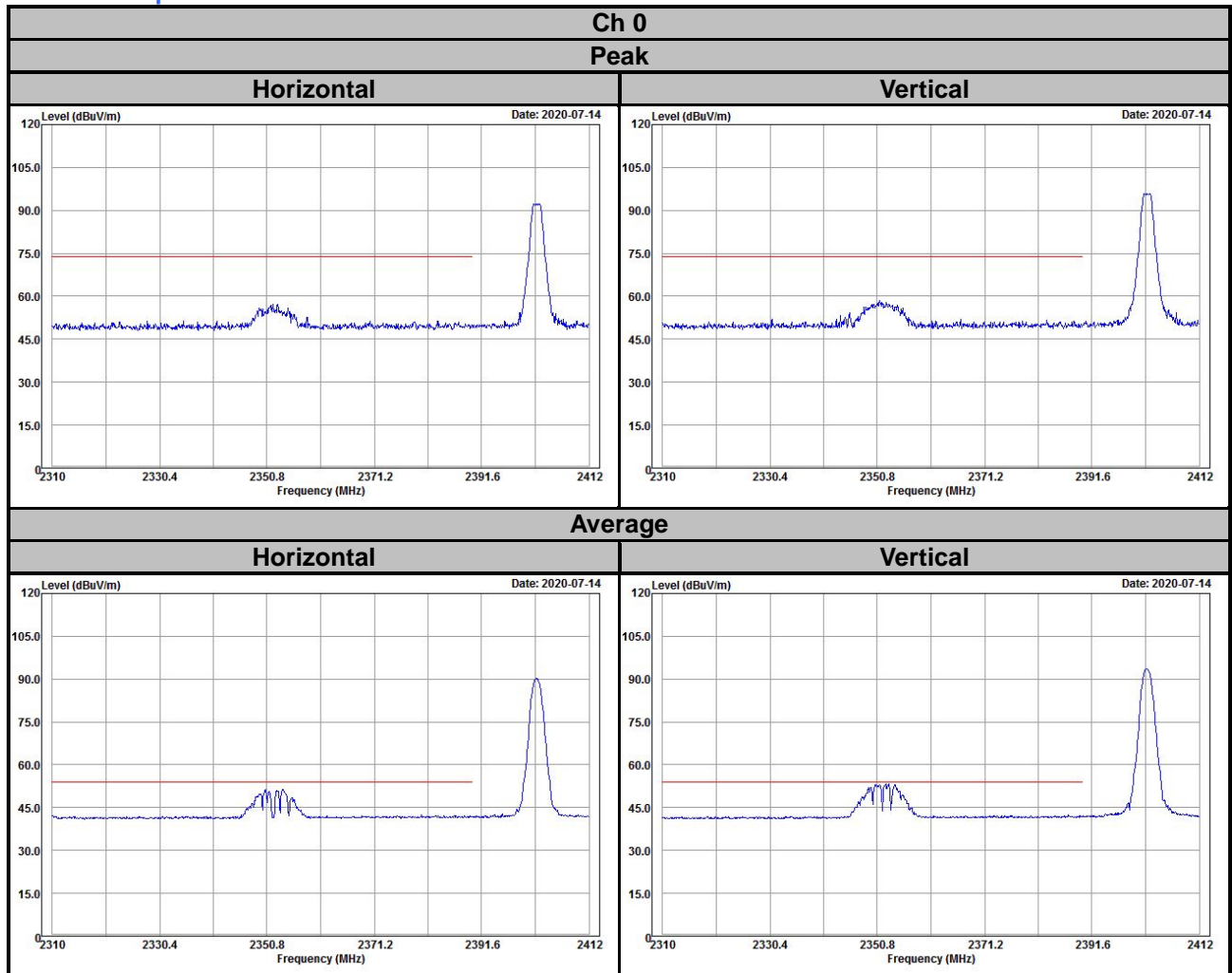
Horizontal



Vertical

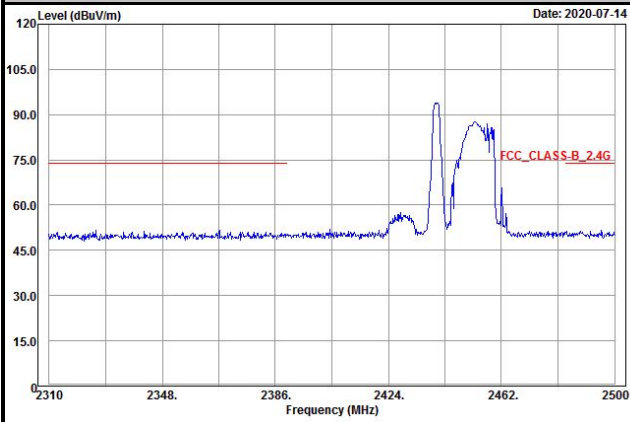


<LE 5.0-2Mbps>

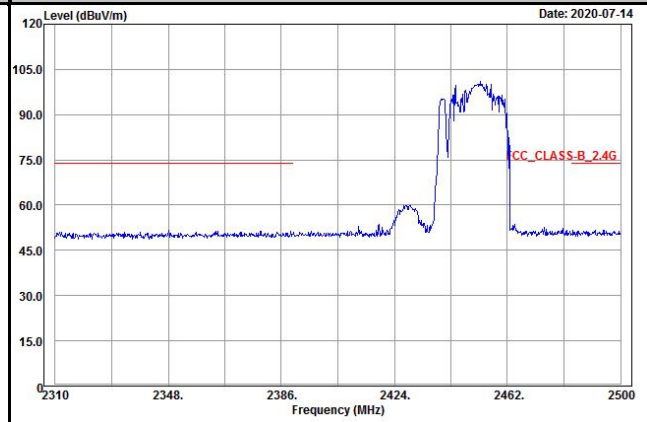


Ch 19
Peak

Horizontal

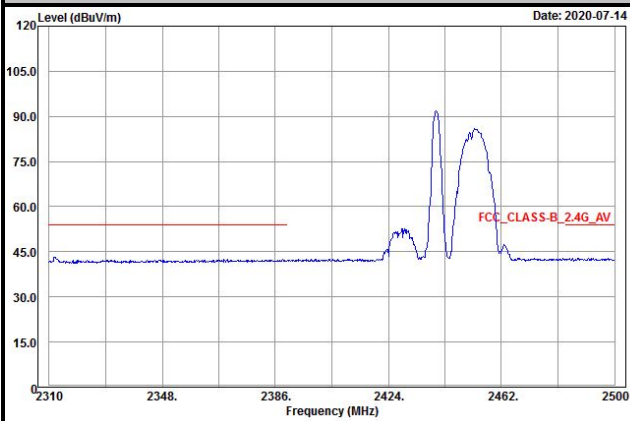


Vertical

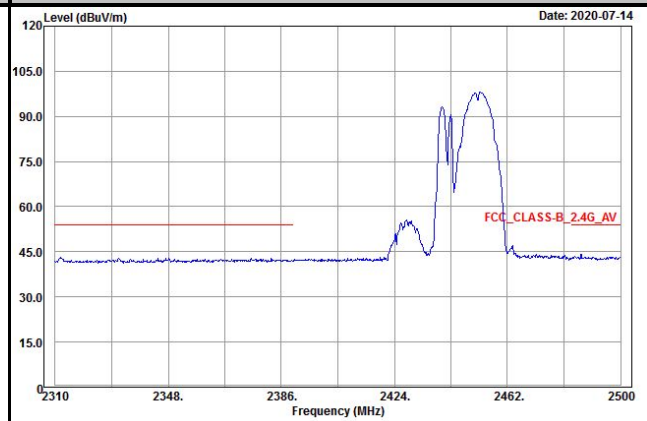


Average

Horizontal



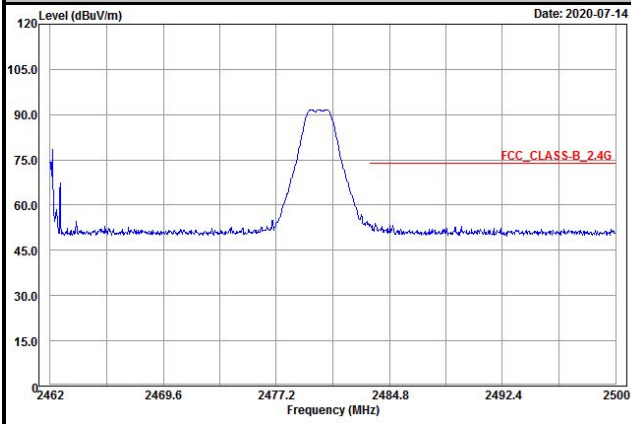
Vertical



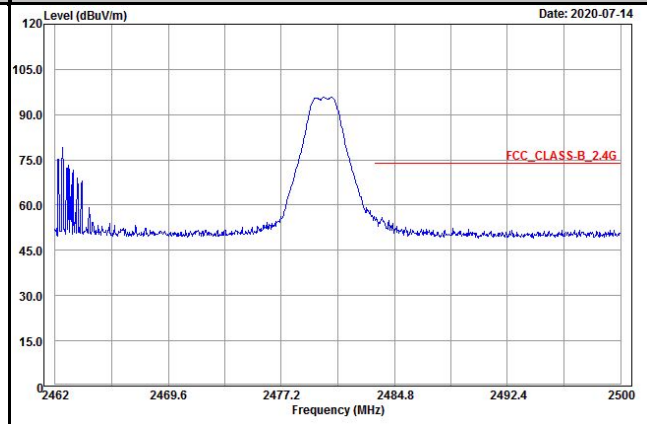
Ch 39

Peak

Horizontal

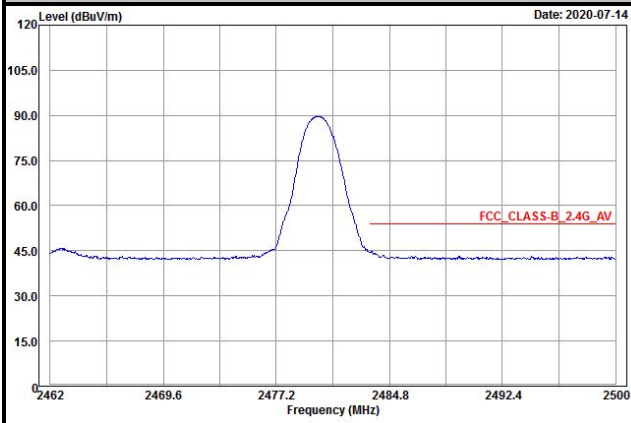


Vertical

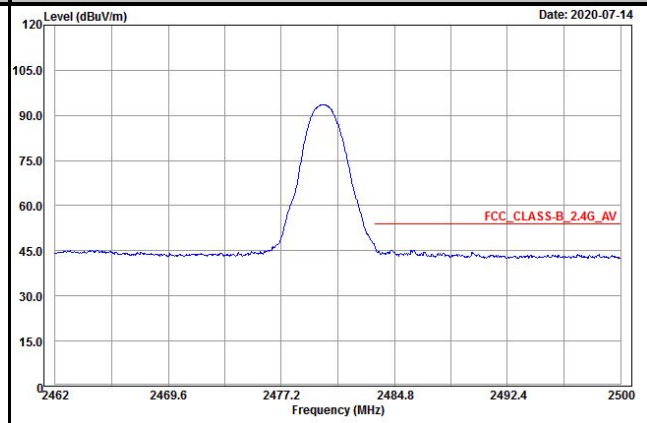


Average

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:

Lin Kou EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

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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