

FCC Test Report

Report No.: RF191211C28 R1

FCC ID: 2AEDS110LTEWIFI

Test Model: SD-WAN 110-LTE-WiFi

Received Date: Dec. 11, 2019

Test Date: Jan. 12 ~ May 10, 2020

Issued Date: May 15, 2020

Applicant: CITRIX SYSTEMS,INC

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FCC Registration / 788550 / TW0003

Designation Number: 427177 / TW0011



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Release Control Record

Issue No.	Description	Date Issued
RF191211C28	Original Release	Feb. 24, 2020
RF191211C28 R1	Revise Applicant information, FCC ID, Product name, Test Model and Brand	May 15, 2020

1 Certificate of Conformity

Product: Networking device

Brand: **CITRIX®**

Test Model: SD-WAN 110-LTE-WiFi

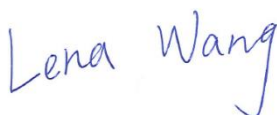
Sample Status: Engineering Sample

Applicant: CITRIX SYSTEMS, INC

Test Date: Jan. 12 ~ May 10, 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:** May 15, 2020
Lena Wang / Specialist


Approved by : _____, **Date:** May 15, 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 -12.68 dB at 0.19725 MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -0.82 dB at 2389.94 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	Meet the requirement of limit.
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	Antenna connector is ipex (MHF) not a standard connector.

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	2.0153 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	Networking device
Brand	CITRIX
Test Model	SD-WAN 110-LTE-WiFi
Status of EUT	Engineering Sample
Power Supply Rating	12 Vdc (adapter)
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 300.0 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	158.125 mW
Antenna Type	Refer to Note as below
Antenna Connector	Refer to Note as below
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

- The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx Function
802.11b	1TX
802.11g	1TX
802.11n (HT20)	2TX
802.11n (HT40)	2TX

- The antenna information is listed as below.

Antenna Type	Manufacturer	Model	Antenna Connector	Antenna Gain	
				WLAN 2.4 GHz	WLAN 5 GHz
Dipole	Taoglas	FXP.830.07.0100C	i-pex(MHF)	2.6	5.0
	Ethertronics	1001932FT	i-pex(MHF)	2.5	4.4

- The WWAN module (Brand: Quectel, Model: EG25-G, EG25-G MINIPCIE) was installed in EUT.
- The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter	AOEM	ADS0248T-U120200	I/P: 100-240 Vac, 50-60 Hz, 0.6 A O/P: 12.0 Vdc, 2.0 A Cable: 1.46m cable w/o core

- 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 $\geq$ 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 **X-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)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5
-	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)
-	802.11g	1 to 11	1	OFDM	BPSK	6.0

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)
-	802.11g	1 to 11	1	OFDM	BPSK	6.0

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)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5
-	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	3.8Vdc	Harry Hsueh
RE<1G	25 deg. C, 65 % RH	3.8Vdc	Karl Lee
PLC	25 deg. C, 65 % RH	3.8Vdc	Jisyong Wang
APCM	25 deg. C, 65 % RH	3.8Vdc	Wayne Lin

3.3 Duty Cycle of Test Signal

Duty cycle of test signal is $\geq 98\%$, duty factor is not required.

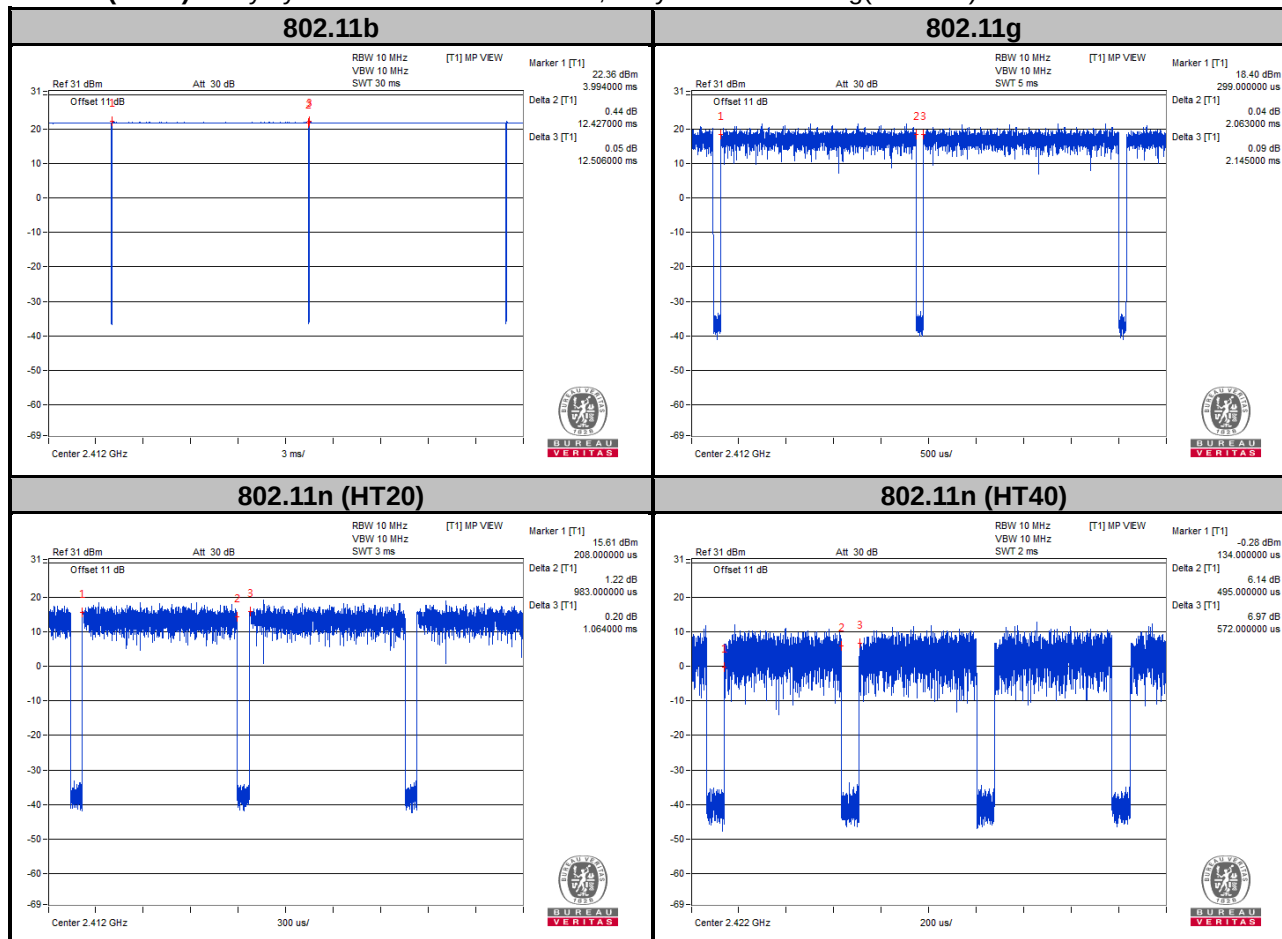
Duty cycle of test signal is $< 98\%$, duty factor shall be considered.

802.11b: Duty cycle = $12.427/12.506 = 0.994$, Duty factor = $10 * \log(1/0.994) = 0.03$

802.11g: Duty cycle = $2.063/2.145 = 0.962$, Duty factor = $10 * \log(1/0.962) = 0.17$

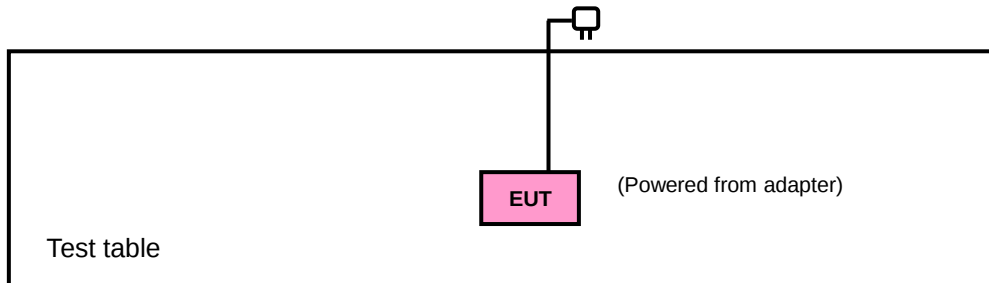
802.11n (HT20): Duty cycle = $0.983/1.064 = 0.924$, Duty factor = $10 * \log(1/0.924) = 0.34$

802.11n (HT40): Duty cycle = $0.495/0.572 = 0.865$, Duty factor = $10 * \log(1/0.865) = 0.63$



3.4 Description of Support Units

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

KDB 662911 D01 Multiple Transmitter Output v02r01

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 30 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 30 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. 15, 2019	Apr. 14, 2020
			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. 15, 2019	Apr. 14, 2020
			Apr. 14, 2020	Apr. 13, 2021
Loop Antenna	EM-6879	269	Sep. 16, 2019	Sep. 15, 2020
Preamplifier Agilent	310N	187226	Jun. 18, 2019	Jun. 17, 2020
Preamplifier Agilent	83017A	MY39501357	Jun. 18, 2019	Jun. 17, 2020
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. 18, 2019	Jun. 17, 2020
RF signal cable ETS-LINDGREN	8D-FB	Cable-CH1-02(RFC-SMS-100-SMS-24)	Jun. 18, 2019	Jun. 17, 2020
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
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:

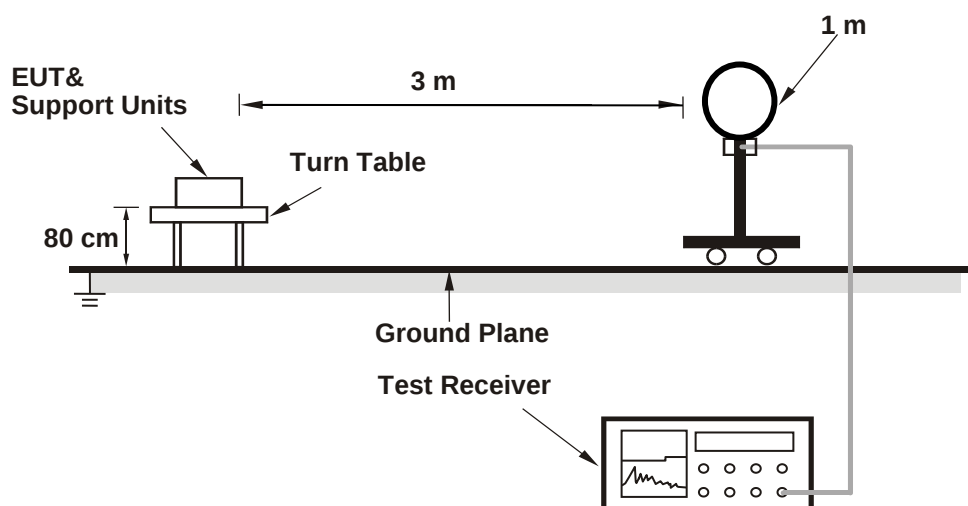
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK)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

4.1.4 Deviation from Test Standard

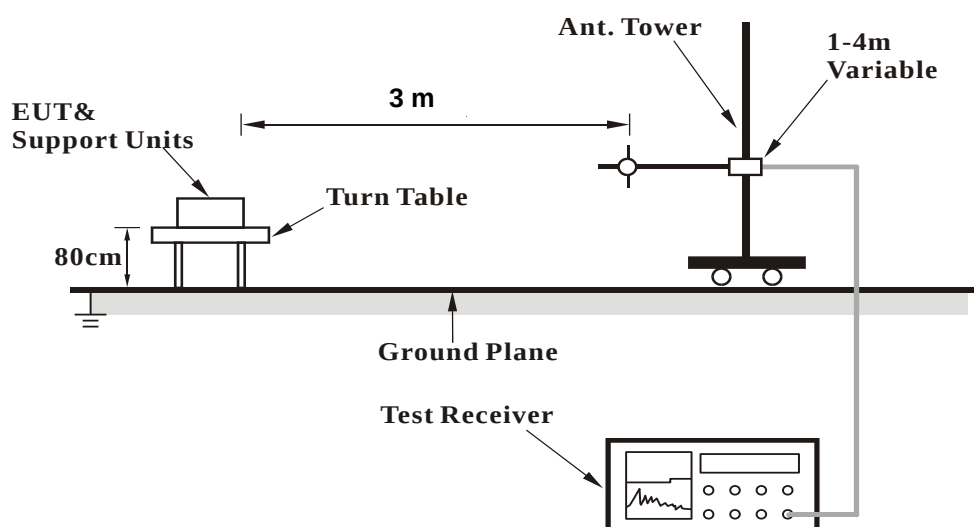
No deviation.

4.1.5 Test Set Up

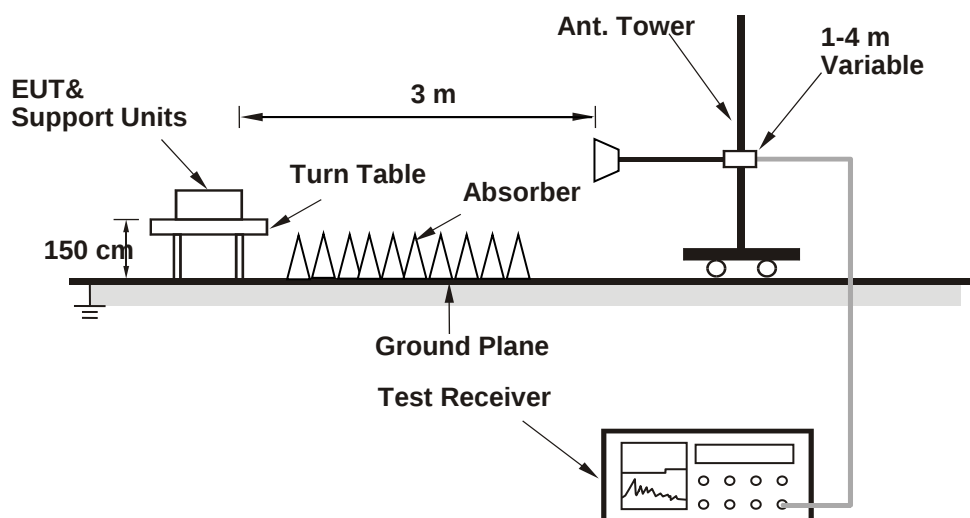
<Radiated Emission below 30 MHz>



<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

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	Harry Hsueh

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
2386.16	52	47	5	54	-2	232	145	Average
2386.16	56.59	51.59	5	74	-17.41	232	145	Peak
2412	105.37	100.31	5.06			232	145	Average
2412	107.72	102.66	5.06			232	145	Peak
4824	51.77	41.48	10.29	54	-2.23	100	76	Average
4824	53.98	43.69	10.29	74	-20.02	100	76	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
2386.16	47.76	42.76	5	54	-6.24	100	225	Average
2386.16	53.48	48.48	5	74	-20.52	100	225	Peak
2412	99	93.94	5.06			100	225	Average
2412	101.76	96.7	5.06			100	225	Peak
4824	51.67	41.38	10.29	54	-2.33	112	14	Average
4824	53.83	43.54	10.29	74	-20.17	112	14	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	Harry Hsueh

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
2347.24	40.17	35.29	4.88	54	-13.83	162	144	Average
2347.24	49.8	44.92	4.88	74	-24.2	162	144	Peak
2437	106.62	101.51	5.11			162	144	Average
2437	108.97	103.86	5.11			162	144	Peak
2483.5	39.45	34.26	5.19	54	-14.55	162	144	Average
2483.5	49.38	44.19	5.19	74	-24.62	162	144	Peak
4874	50.18	39.97	10.21	54	-3.82	100	42	Average
4874	53.08	42.87	10.21	74	-20.92	100	42	Peak
7311	50.45	37.99	12.46	54	-3.55	272	55	Average
7311	55.8	43.34	12.46	74	-18.2	272	55	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
2357.04	37.77	32.87	4.9	54	-16.23	111	226	Average
2357.04	48.08	43.18	4.9	74	-25.92	111	226	Peak
2437	99.61	94.5	5.11			111	226	Average
2437	102.41	97.3	5.11			111	226	Peak
2483.5	36.93	31.74	5.19	54	-17.07	111	226	Average
2483.5	47.22	42.03	5.19	74	-26.78	111	226	Peak
4874	49.12	38.91	10.21	54	-4.88	103	14	Average
4874	52	41.79	10.21	74	-22	103	14	Peak
7311	52.86	40.4	12.46	54	-1.14	110	11	Average
7311	57.2	44.74	12.46	74	-16.8	110	11	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.
- 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	Harry Hsueh

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	102.05	96.91	5.14			186	146	Average
2462	104.21	99.07	5.14			186	146	Peak
2483.5	41.68	36.49	5.19	54	-12.32	186	146	Average
2483.5	50.03	44.84	5.19	74	-23.97	186	146	Peak
4924	52.97	42.72	10.25	54	-1.03	106	84	Average
4924	54.49	44.24	10.25	74	-19.51	106	84	Peak
7386	41.59	29.03	12.56	54	-12.41	104	82	Average
7386	52.21	39.65	12.56	74	-21.79	104	82	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	95.43	90.29	5.14			129	234	Average
2462	98.13	92.99	5.14			129	234	Peak
2483.5	37.79	32.6	5.19	54	-16.21	129	234	Average
2483.5	47.75	42.56	5.19	74	-26.25	129	234	Peak
4924	47.93	37.68	10.25	54	-6.07	130	188	Average
4924	51.7	41.45	10.25	74	-22.3	130	188	Peak
7386	45.66	33.1	12.56	54	-8.34	106	12	Average
7386	52.63	40.07	12.56	74	-21.37	106	12	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2462 MHz: Fundamental frequency.
3. 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	Harry Hsueh

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
2389.94	53.18	48.17	5.01	54	-0.82	165	144	Average
2389.94	66.21	61.2	5.01	74	-7.79	165	144	Peak
2412	99.8	94.74	5.06			165	144	Average
2412	106.66	101.6	5.06			165	144	Peak
4824	40.93	30.64	10.29	54	-13.07	125	76	Average
4824	47.17	36.88	10.29	74	-26.83	125	76	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
2389.94	47.66	42.65	5.01	54	-6.34	102	235	Average
2389.94	57.76	52.75	5.01	74	-16.24	102	235	Peak
2412	94.1	89.04	5.06			102	235	Average
2412	101.43	96.37	5.06			102	235	Peak
4824	36.68	26.39	10.29	54	-17.32	145	82	Average
4824	44.66	34.37	10.29	74	-29.34	145	82	Peak
*6000	48.33	36.21	12.12	64.1	-15.77	100	84	Average
*6000	50.95	38.83	12.12	71.43	-20.48	100	84	Peak
*7236	45.48	33	12.48	64.1	-18.62	101	274	Average
*7236	52.36	39.88	12.48	71.43	-19.07	101	274	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	Harry Hsueh

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
2389.66	51.42	46.42	5	54	-2.58	161	144	Average
2389.66	66.38	61.38	5	74	-7.62	161	144	Peak
2437	104.16	99.05	5.11			161	144	Average
2437	111.39	106.28	5.11			161	144	Peak
2483.52	47.34	42.15	5.19	54	-6.66	161	144	Average
2483.52	61.74	56.55	5.19	74	-12.26	161	144	Peak
4874	48.9	38.69	10.21	54	-5.1	122	76	Average
4874	54.63	44.42	10.21	74	-19.37	122	76	Peak
*5775	54.38	42.73	11.65	74.16	-19.78	126	73	Average
*5775	56.93	45.28	11.65	81.39	-24.46	126	73	Peak
*6000	47.67	35.55	12.12	74.16	-26.49	120	74	Average
*6000	49.42	37.3	12.12	81.39	-31.97	120	74	Peak
7311	48.39	35.93	12.46	54	-5.61	100	82	Average
7311	54.84	42.38	12.46	74	-19.16	100	82	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
2389.94	44.1	39.09	5.01	54	-9.9	100	235	Average
2389.94	57.79	52.78	5.01	74	-16.21	100	235	Peak
2437	97.55	92.44	5.11			100	235	Average
2437	104.61	99.5	5.11			100	235	Peak
2483.56	42.98	37.79	5.19	54	-11.02	100	235	Average
2483.56	56.16	50.97	5.19	74	-17.84	100	235	Peak
4874	45.75	35.54	10.21	54	-8.25	143	85	Average
4874	49.42	39.21	10.21	74	-24.58	143	85	Peak
*5790	54.71	43.11	11.6	67.55	-12.84	133	226	Average
*5790	57.18	45.58	11.6	74.61	-17.43	133	226	Peak
*6000	48.24	36.12	12.12	67.55	-19.31	100	88	Average
*6000	50.94	38.82	12.12	74.61	-23.67	100	88	Peak
7311	51.89	39.43	12.46	54	-2.11	100	280	Average
7311	59.27	46.81	12.46	74	-14.73	100	280	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.
- 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	Harry Hsueh

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	100.19	95.05	5.14			160	145	Average
2462	107.36	102.22	5.14			160	145	Peak
2483.52	52.97	47.78	5.19	54	-1.03	160	145	Average
2483.52	64.57	59.38	5.19	74	-9.43	160	145	Peak
4924	41.11	30.86	10.25	54	-12.89	120	78	Average
4924	47.92	37.67	10.25	74	-26.08	120	78	Peak
*6000	47.91	35.79	12.12	70.19	-22.28	147	62	Average
*6000	49.03	36.91	12.12	77.36	-28.33	147	62	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	93.76	88.62	5.14			100	234	Average
2462	100.74	95.6	5.14			100	234	Peak
2483.52	47.49	42.3	5.19	54	-6.51	100	234	Average
2483.52	59.02	53.83	5.19	74	-14.98	100	234	Peak
4924	32.77	22.52	10.25	54	-21.23	125	88	Average
4924	44.44	34.19	10.25	74	-29.56	125	88	Peak
*6000	50.62	38.5	12.12	63.76	-13.14	148	96	Average
*6000	52.48	40.36	12.12	70.74	-18.26	148	96	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2462 MHz: Fundamental frequency.
3. 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	Harry Hsueh

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	52.53	47.52	5.01	54	-1.47	121	21	Average
2390	65.37	60.36	5.01	74	-8.63	121	21	Peak
2412	101.4	96.34	5.06			126	18	Average
2412	108.68	103.62	5.06			126	18	Peak
4824	39.18	28.89	10.29	54	-14.82	136	221	Average
4824	47.52	37.23	10.29	74	-26.48	136	221	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	45.4	40.39	5.01	54	-8.6	100	305	Average
2390	60.05	55.04	5.01	74	-13.95	100	305	Peak
2412	96.51	91.45	5.06			356	305	Average
2412	103.95	98.89	5.06			356	305	Peak
4824	37.43	27.14	10.29	54	-16.57	119	105	Average
4824	46.84	36.55	10.29	74	-27.16	119	105	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	Harry Hsueh

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	42.15	37.14	5.01	54	-11.85	125	27	Average
2390	53.2	48.19	5.01	74	-20.8	125	27	Peak
2437	105.85	100.74	5.11			122	18	Average
2437	113.78	108.67	5.11			122	18	Peak
2483.5	44.12	38.93	5.19	54	-9.88	125	27	Average
2483.5	56.75	51.56	5.19	74	-17.25	125	27	Peak
4874	42.04	31.83	10.21	54	-11.96	167	1	Average
4874	53.08	42.87	10.21	74	-20.92	167	1	Peak
7311	52.7	40.24	12.46	54	-1.3	100	64	Average
7311	63.58	51.12	12.46	74	-10.42	100	64	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	43.53	38.52	5.01	54	-10.47	400	270	Average
2390	57.44	52.43	5.01	74	-16.56	400	270	Peak
2437	102.95	97.84	5.11			400	264	Average
2437	110.2	105.09	5.11			400	264	Peak
2483.5	42.53	37.34	5.19	54	-11.47	400	270	Average
2483.5	55.15	49.96	5.19	74	-18.85	400	270	Peak
4874	37.6	27.39	10.21	54	-16.4	100	353	Average
4874	47.9	37.69	10.21	74	-26.1	100	353	Peak
7311	45.73	33.27	12.46	54	-8.27	226	9	Average
7311	56.93	44.47	12.46	74	-17.07	226	9	Peak

Remarks:

- Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.
- 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	Harry Hsueh

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	103.11	97.97	5.14			120	18	Average
2462	110.5	105.36	5.14			120	18	Peak
2483.5	50.42	45.23	5.19	54	-3.58	119	19	Average
2483.5	62.38	57.19	5.19	74	-11.62	119	19	Peak
4924	41.21	30.96	10.25	54	-12.79	230	4	Average
4924	51.56	41.31	10.25	74	-22.44	230	4	Peak
7386	42.63	30.07	12.56	54	-11.37	100	7	Average
7386	54.31	41.75	12.56	74	-19.69	100	7	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	95.86	90.72	5.14			112	319	Average
2462	103	97.86	5.14			112	319	Peak
2483.5	49.41	44.22	5.19	54	-4.59	376	264	Average
2483.5	62.18	56.99	5.19	74	-11.82	376	264	Peak
4924	37.44	27.19	10.25	54	-16.56	158	0	Average
4924	47.85	37.6	10.25	74	-26.15	158	0	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2462 MHz: Fundamental frequency.
3. 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	Harry Hsueh

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	52.93	47.92	5.01	54	-1.07	121	331	Average
2390	64.18	59.17	5.01	74	-9.82	121	331	Peak
2422	95.56	90.49	5.07			128	12	Average
2422	103.33	98.26	5.07			128	12	Peak
2483.5	39.92	34.73	5.19	54	-14.08	121	331	Average
2483.5	49.74	44.55	5.19	74	-24.26	121	331	Peak
4844	32.3	22.07	10.23	54	-21.7	167	304	Average
4844	41.87	31.64	10.23	74	-32.13	167	304	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	50.21	45.2	5.01	54	-3.79	400	268	Average
2390	60.54	55.53	5.01	74	-13.46	400	268	Peak
2422	93.5	88.43	5.07			400	262	Average
2422	101.16	96.09	5.07			400	262	Peak
2483.5	38.02	32.83	5.19	54	-15.98	400	268	Average
2483.5	48.43	43.24	5.19	74	-25.57	400	268	Peak
4844	33.69	23.46	10.23	54	-20.31	103	166	Average
4844	42.41	32.18	10.23	74	-31.59	103	166	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	Harry Hsueh

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
2385.32	46.3	41.32	4.98	54	-7.7	121	18	Average
2385.32	61.78	56.8	4.98	74	-12.22	121	18	Peak
2437	99.66	94.55	5.11			118	17	Average
2437	107.12	102.01	5.11			118	17	Peak
2488	46.19	40.98	5.21	54	-7.81	121	18	Average
2488	56.8	51.59	5.21	74	-17.2	121	18	Peak
4874	34.41	24.2	10.21	54	-19.59	162	101	Average
4874	45.86	35.65	10.21	74	-28.14	162	101	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	51.44	46.43	5.01	54	-2.56	355	285	Average
2390	62.84	57.83	5.01	74	-11.16	355	285	Peak
2437	94.6	89.49	5.11			358	306	Average
2437	101.87	96.76	5.11			358	306	Peak
2483.5	46.34	41.15	5.19	54	-7.66	355	285	Average
2483.5	56.57	51.38	5.19	74	-17.43	355	285	Peak
4874	35.26	25.05	10.21	54	-18.74	109	112	Average
4874	45.52	35.31	10.21	74	-28.48	109	112	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	Harry Hsueh

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	38.03	33.02	5.01	54	-15.97	121	17	Average
2390	47.45	42.44	5.01	74	-26.55	121	17	Peak
2452	95.6	90.48	5.12			100	16	Average
2452	103.42	98.3	5.12			100	16	Peak
2483.5	52.5	47.31	5.19	54	-1.5	121	17	Average
2483.5	64.12	58.93	5.19	74	-9.88	121	17	Peak
4904	32.97	22.83	10.14	54	-21.03	177	231	Average
4904	43.31	33.17	10.14	74	-30.69	177	231	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	37.53	32.52	5.01	54	-16.47	400	274	Average
2390	47.37	42.36	5.01	74	-26.63	400	274	Peak
2452	91.97	86.85	5.12			350	265	Average
2452	99.63	94.51	5.12			350	265	Peak
2486.16	43.8	38.61	5.19	54	-10.2	400	274	Average
2486.16	57.87	52.68	5.19	74	-16.13	400	274	Peak
4904	31.36	21.22	10.14	54	-22.64	102	134	Average
4904	43.03	32.89	10.14	74	-30.97	102	134	Peak

Remarks:

1. Emission Level = Read Level + Factor
Margin value = Emission level – Limit value
2. 2452 MHz: Fundamental frequency.
3. 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:

802.11g

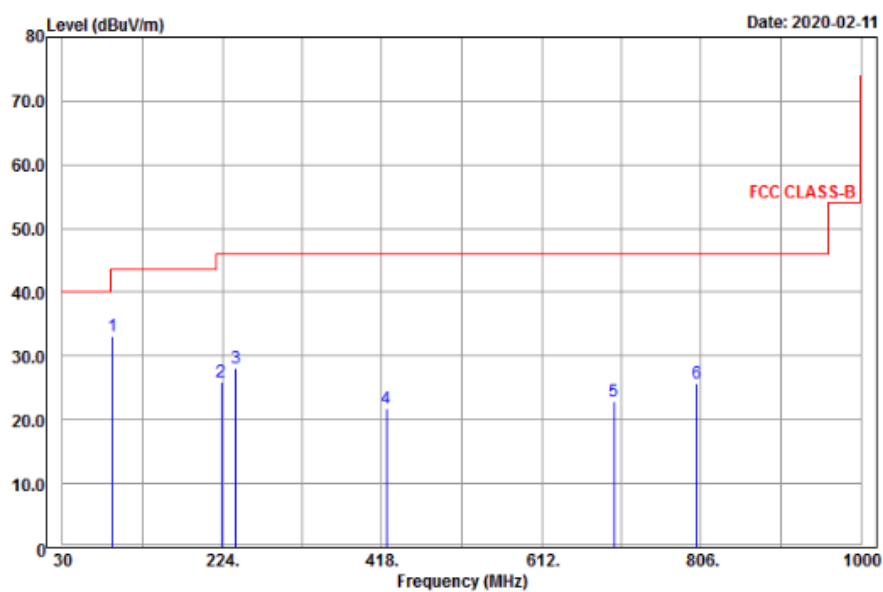
EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Karl Lee

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
90.21	33.19	52.22	-19.03	43.5	-10.31	190	210	Peak
223.05	26.04	43.75	-17.71	46	-19.96	132	225	Peak
240.33	28.12	45.15	-17.03	46	-17.88	180	16	Peak
423.2	21.84	35.37	-13.53	46	-24.16	132	2	Peak
700.4	22.97	32.2	-9.23	46	-23.03	192	315	Peak
800.5	25.77	33.36	-7.59	46	-20.23	154	177	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
89.13	26.46	45.75	-19.29	43.5	-17.04	180	8	Peak
218.73	25.2	43.08	-17.88	46	-20.8	124	111	Peak
251.67	22.11	38.92	-16.81	46	-23.89	165	354	Peak
475	26.47	39.29	-12.82	46	-19.53	147	7	Peak
687.8	25.43	34.77	-9.34	46	-20.57	190	360	Peak
758.5	26.25	34.54	-8.29	46	-19.75	158	285	Peak

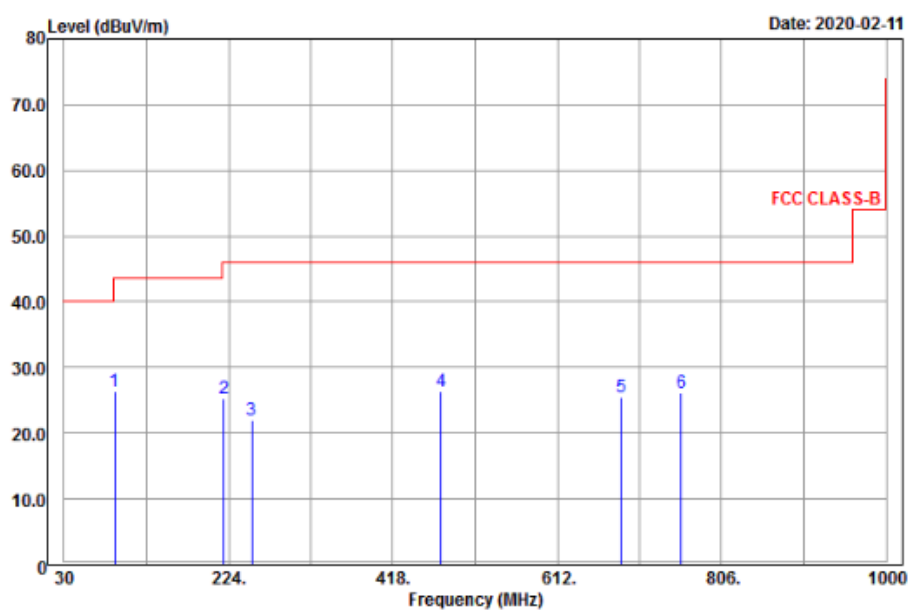
Remarks:

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

Horizontal



Vertical



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. 14, 2019	Feb. 13, 2020
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 05, 2019	Sep. 04, 2020
LISN/AMN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Feb. 11, 2019	Feb. 10, 2020
LISN/AMN 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.
 3. The VCCI Site Registration No. is C-12047.

4.2.3 Test Procedures

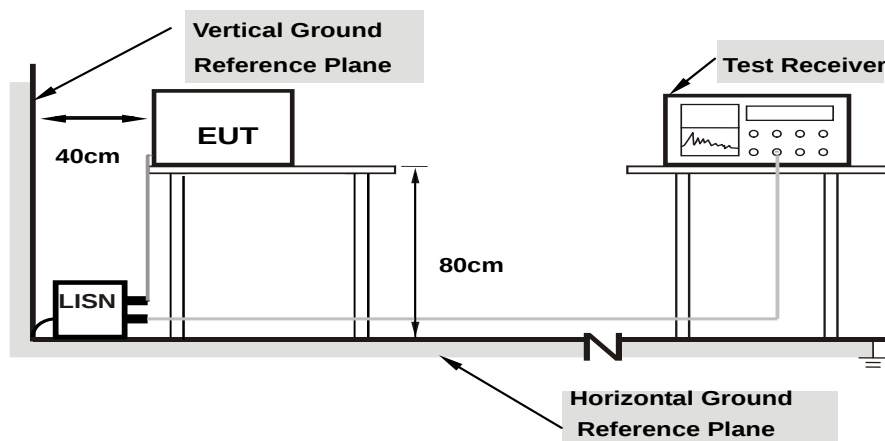
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance 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.

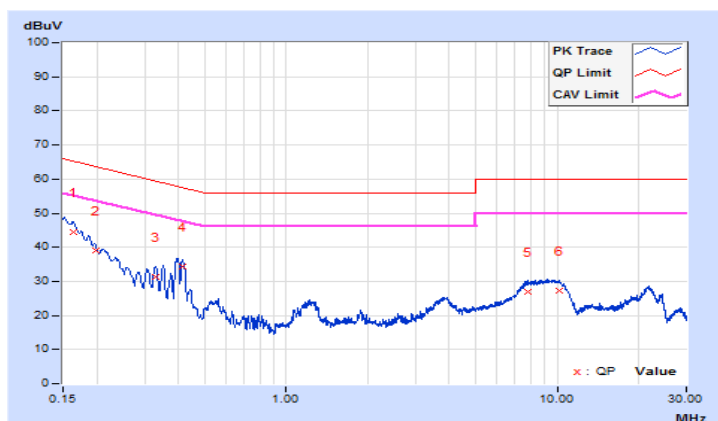
4.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Jisyong Wang	Test Date	2020/1/12

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	0.16307	10.11	34.38	30.75	44.49	40.86	65.31	55.31	-20.82	-14.45
2	0.19725	10.12	28.85	20.38	38.97	30.50	63.73	53.73	-24.76	-23.23
3	0.33000	10.15	21.21	18.87	31.36	29.02	59.45	49.45	-28.09	-20.43
4	0.41305	10.16	24.15	19.44	34.31	29.60	57.59	47.59	-23.28	-17.99
5	7.78875	10.40	16.58	10.46	26.98	20.86	60.00	50.00	-33.02	-29.14
6	10.18275	10.43	16.70	10.90	27.13	21.33	60.00	50.00	-32.87	-28.67

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

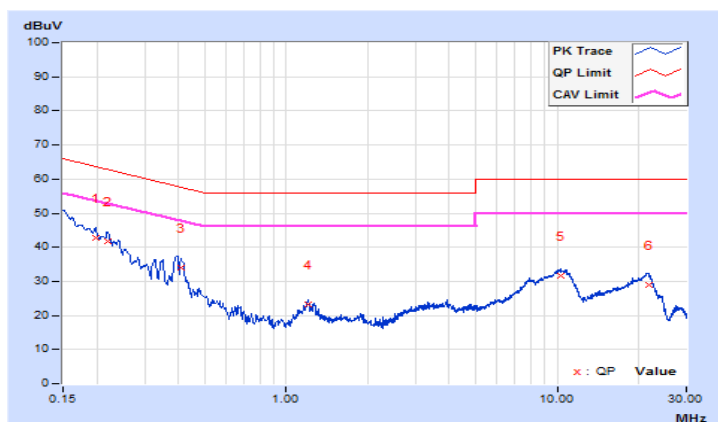


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Jisyong Wang	Test Date	2020/1/12

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	0.19725	10.18	32.71	30.87	42.89	41.05	63.73	53.73	-20.84	-12.68
2	0.21860	10.18	31.50	28.31	41.68	38.49	62.87	52.87	-21.19	-14.38
3	0.40871	10.22	23.79	21.28	34.01	31.50	57.67	47.67	-23.66	-16.17
4	1.20340	10.29	12.89	10.38	23.18	20.67	56.00	46.00	-32.82	-25.33
5	10.25925	10.56	21.12	15.63	31.68	26.19	60.00	50.00	-28.32	-23.81
6	21.70725	10.75	18.25	15.99	29.00	26.74	60.00	50.00	-31.00	-23.26

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

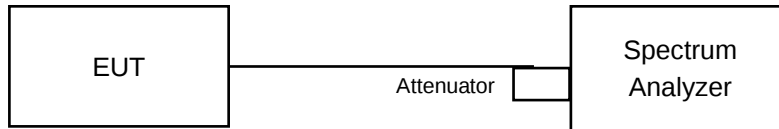


4.3 6 dB Bandwidth Measurement

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	11.14	0.5	Pass
6	2437	9.62	0.5	Pass
11	2462	10.13	0.5	Pass

802.11g

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	16.32	0.5	Pass
6	2437	15.96	0.5	Pass
11	2462	16.33	0.5	Pass

802.11n (HT20)

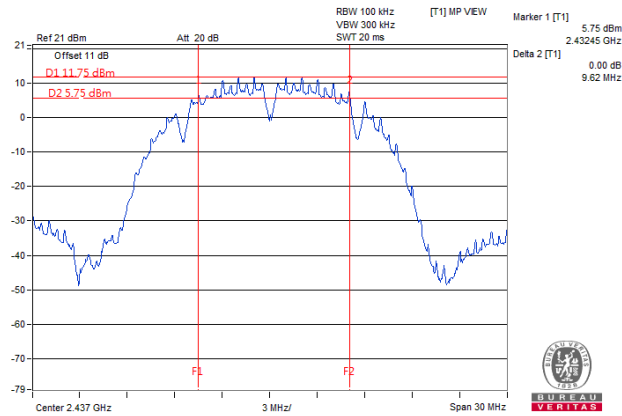
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	16.98	17.00	0.5	Pass
6	2437	16.98	16.62	0.5	Pass
11	2462	17.22	17.00	0.5	Pass

802.11n (HT40)

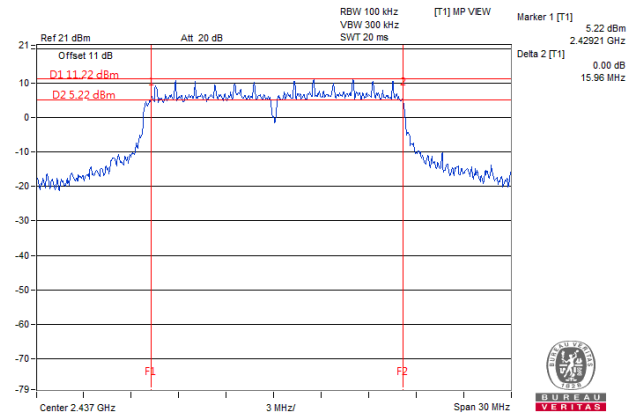
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
3	2422	35.86	35.92	0.5	Pass
6	2437	35.78	35.84	0.5	Pass
9	2452	35.84	35.87	0.5	Pass

Spectrum Plot of Worst Value

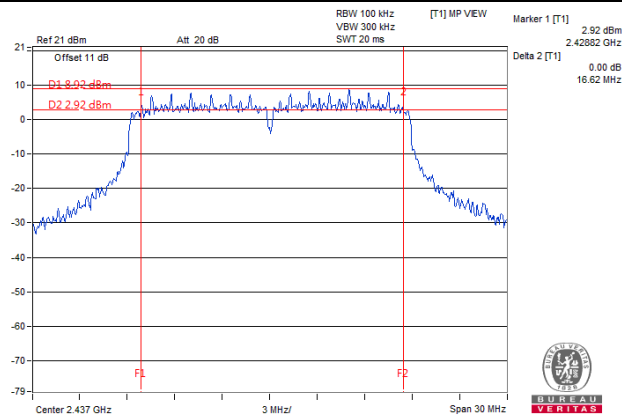
802.11b



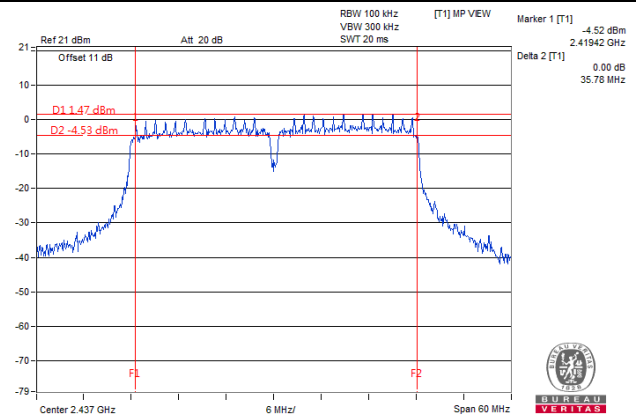
802.11g



802.11n (HT20)

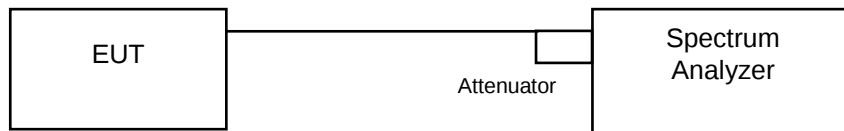


802.11n (HT40)



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	13.85	Pass
6	2437	13.94	Pass
11	2462	13.94	Pass

802.11g

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
1	2412	16.64	Pass
6	2437	17.11	Pass
11	2462	16.64	Pass

802.11n (HT20)

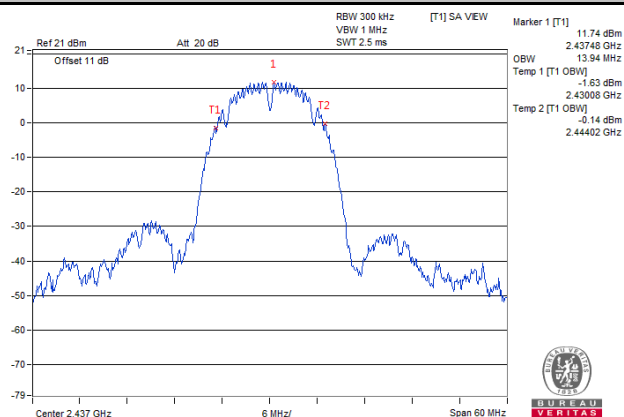
Channel	Frequency (MHz)	Occupied Bandwidth (MHz)		Pass / Fail
		Chain 0	Chain 1	
1	2412	17.88	17.79	Pass
6	2437	17.79	17.79	Pass
11	2462	17.79	17.70	Pass

802.11n (HT40)

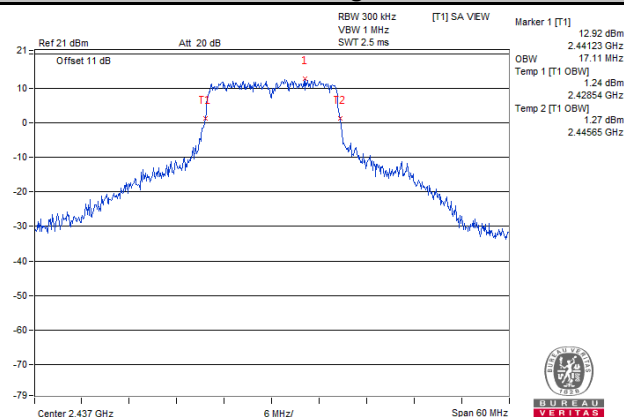
Channel	Frequency (MHz)	Occupied Bandwidth (MHz)		Pass / Fail
		Chain 0	Chain 1	
3	2422	36.54	36.73	Pass
6	2437	36.73	36.54	Pass
9	2452	36.73	36.73	Pass

Spectrum Plot of Worst Value

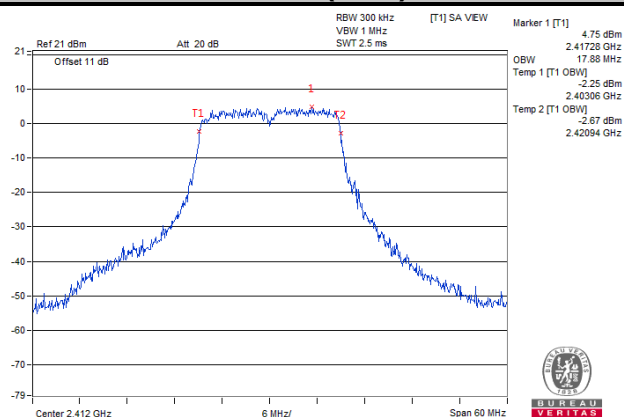
802.11b



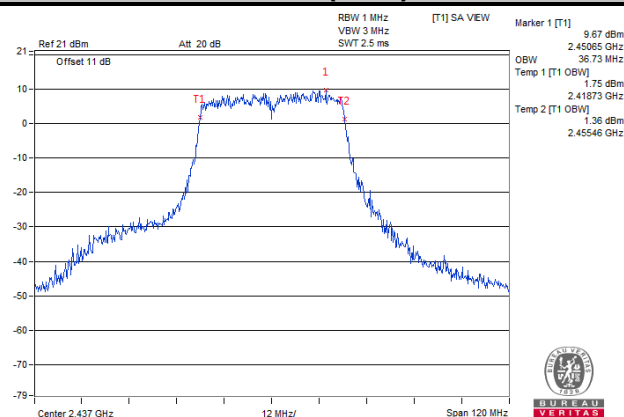
802.11g



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)

Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

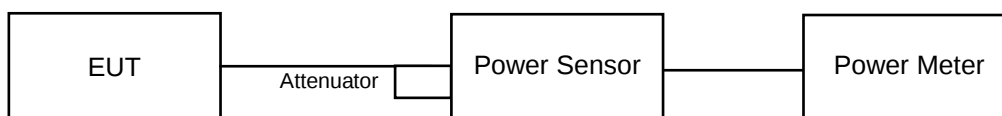
Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;

Array Gain = $5 \log(N_{ANT}/N_{SS})$ dB or 3 dB, whichever is less for 20 MHz channel widths with $N_{ANT} \geq 5$.

For power measurements on all other devices: Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB.

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.

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

Peak Power (For reference)

802.11b

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	157.036	21.96	30	Pass
6	2437	193.642	22.87	30	Pass
11	2462	92.683	19.67	30	Pass

802.11g

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	186.638	22.71	30	Pass
6	2437	363.915	25.61	30	Pass
11	2462	225.944	23.54	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	19.92	19.10	179.473	22.54	30	Pass
6	2437	24.96	24.41	588.844	27.70	30	Pass
11	2462	21.39	21.46	277.971	24.44	30	Pass

802.11n (HT40)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	17.42	16.63	101.158	20.05	30	Pass
6	2437	21.24	20.67	249.459	23.97	30	Pass
9	2452	16.14	15.85	79.616	19.01	30	Pass

Average Power

802.11b

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	90.782	19.58	30	Pass
6	2437	114.025	20.57	30	Pass
11	2462	53.456	17.28	30	Pass

802.11g

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	44.875	16.52	30	Pass
6	2437	132.739	21.23	30	Pass
11	2462	58.210	17.65	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	13.82	12.98	43.954	16.43	30	Pass
6	2437	19.19	18.76	158.125	21.99	30	Pass
11	2462	15.00	15.15	64.417	18.09	30	Pass

802.11n (HT40)

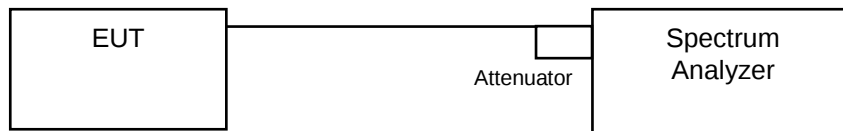
Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	10.00	10.14	20.324	13.08	30	Pass
6	2437	14.00	14.37	52.481	17.20	30	Pass
9	2452	9.00	9.64	17.140	12.34	30	Pass

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 = rms.
- Sweep time = auto couple.
- Trace mode = max hold.
- Add $[10\log(1/D)]$, where D is the duty cycle, to the measured PSD to compute the average PSD during the actual transmission time.
- 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.

802.11b

Channel	Frequency (MHz)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
1	2412	-9.91	8	Pass
6	2437	-8.93	8	Pass
11	2462	-12.21	8	Pass

802.11g

Channel	Frequency (MHz)	PSD (dBm/3 kHz)	Duty Factor (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
1	2412	-15.76	0.17	-15.59	8	Pass
6	2437	-10.93	0.17	-10.76	8	Pass
11	2462	-14.75	0.17	-14.58	8	Pass

802.11n (HT20)

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Duty Factor (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-18.6	3.01	0.34	-15.25	8	Pass
	6	2437	-13.32	3.01	0.34	-9.97	8	Pass
	11	2462	-16.76	3.01	0.34	-13.41	8	Pass
1	1	2412	-19.22	3.01	0.34	-15.87	8	Pass
	6	2437	-13.81	3.01	0.34	-10.46	8	Pass
	11	2462	-16.82	3.01	0.34	-13.47	8	Pass

NOTE:

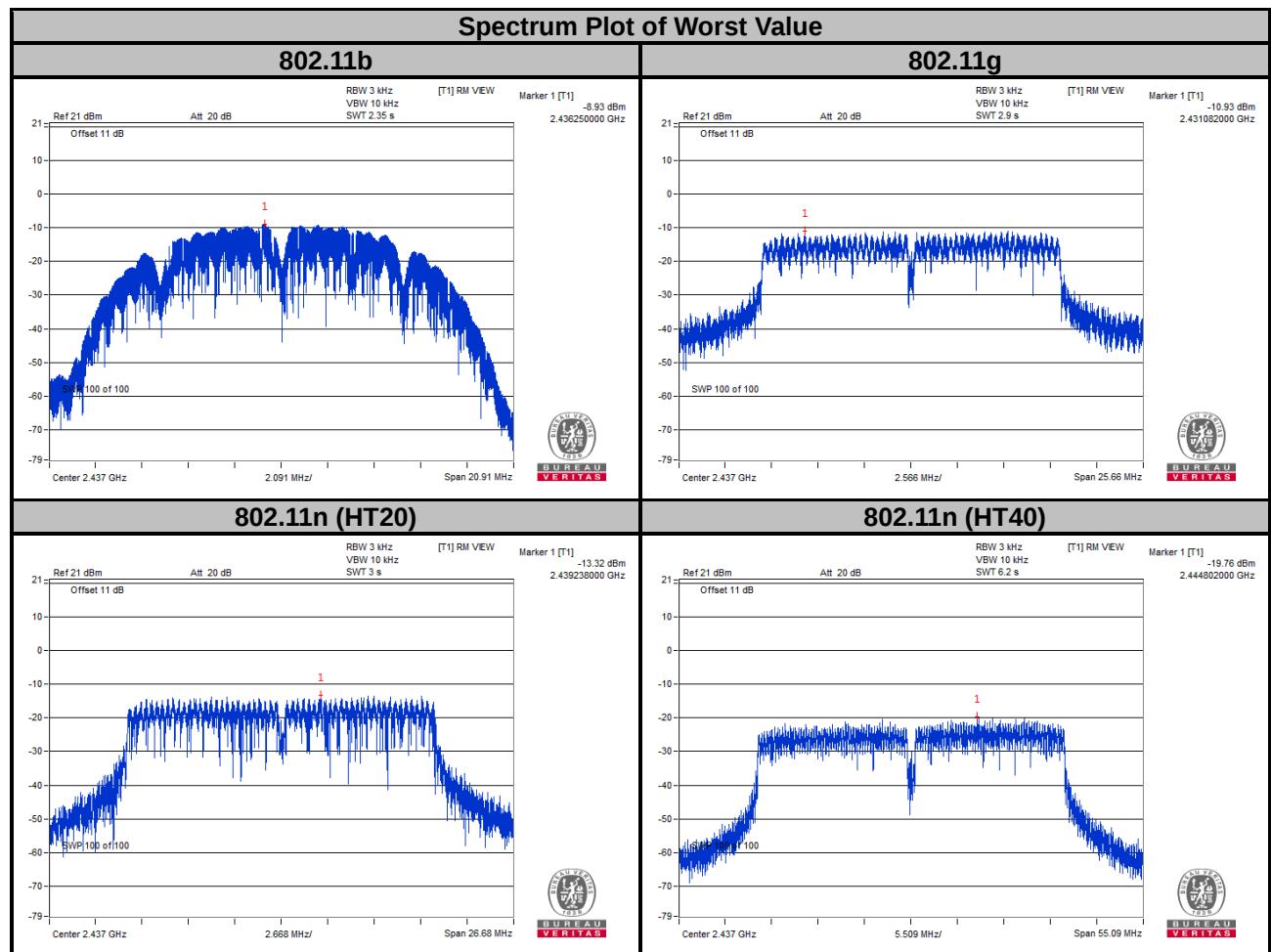
- Directional gain = 2.6 dBi + 10log(2) = 5.61 dBi < 6 dBi, so the limit no need to be reduced.
- Method E) 2) c) of power density measurement of KDB 662911 is using for calculating total power density.

802.11n (HT40)

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Duty Factor (dB)	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	3	2422	-23.4	3.01	0.63	-19.76	8	Pass
	6	2437	-19.76	3.01	0.63	-16.12	8	Pass
	9	2452	-24.89	3.01	0.63	-21.25	8	Pass
1	3	2422	-23.57	3.01	0.63	-19.93	8	Pass
	6	2437	-20.68	3.01	0.63	-17.04	8	Pass
	9	2452	-25.01	3.01	0.63	-21.37	8	Pass

NOTE:

- Directional gain = 2.6 dBi + 10log(2) = 5.61 dBi < 6 dBi, so the limit no need to be reduced.
- Method E) 2) c) of power density measurement of KDB 662911 is using for calculating total power density.

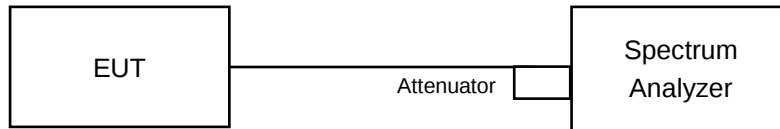


4.7 Conducted Out of Band Emission Measurement

4.7.1 Limits of Conducted Out of Band Emission Measurement

Below -30 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

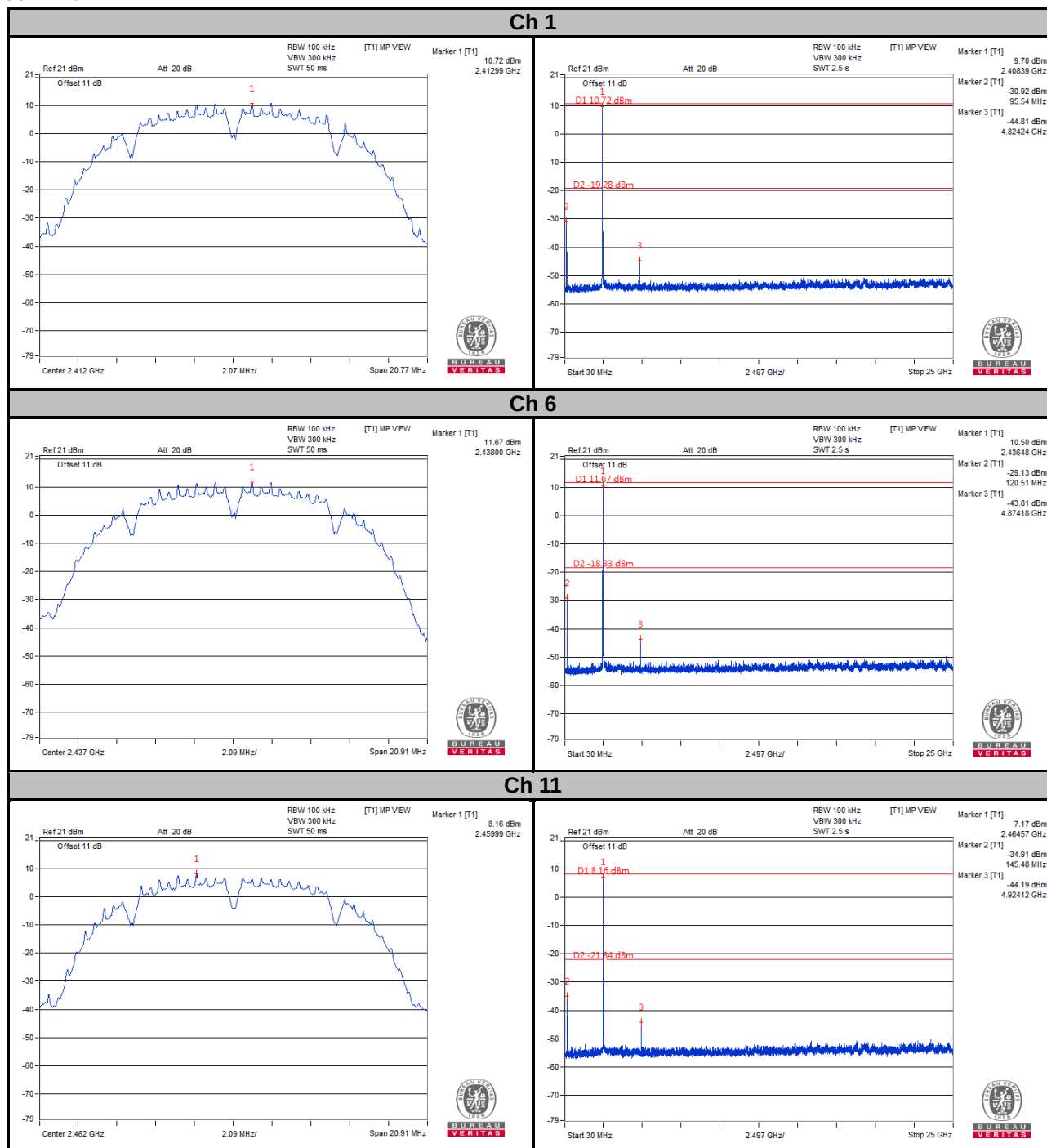
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

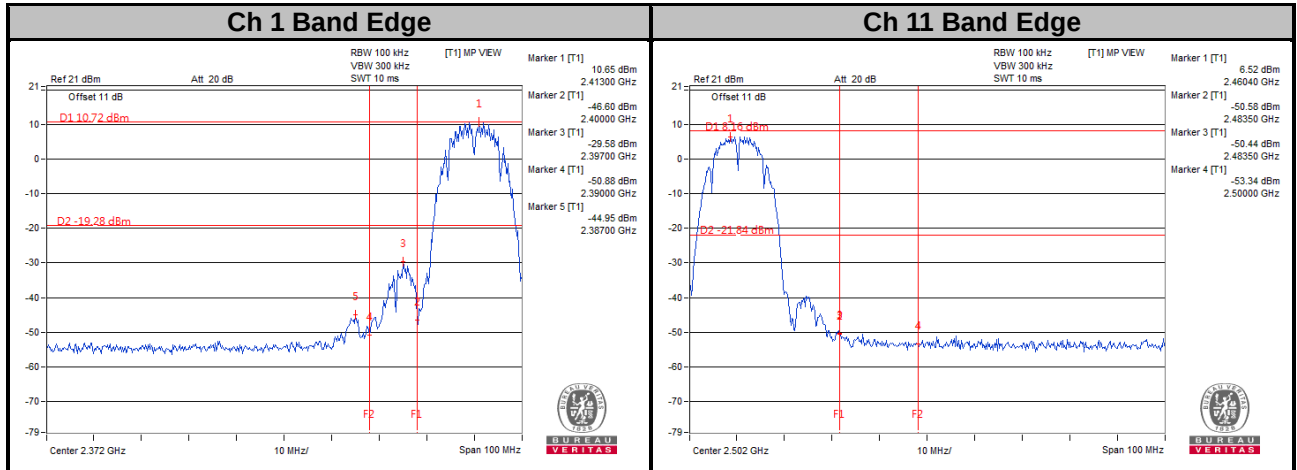
4.7.7 Test Results

The conducted emission test is performed on each TX port of operating mode without summing or adding $10\log(N)$ since the limit is relative emission limit.

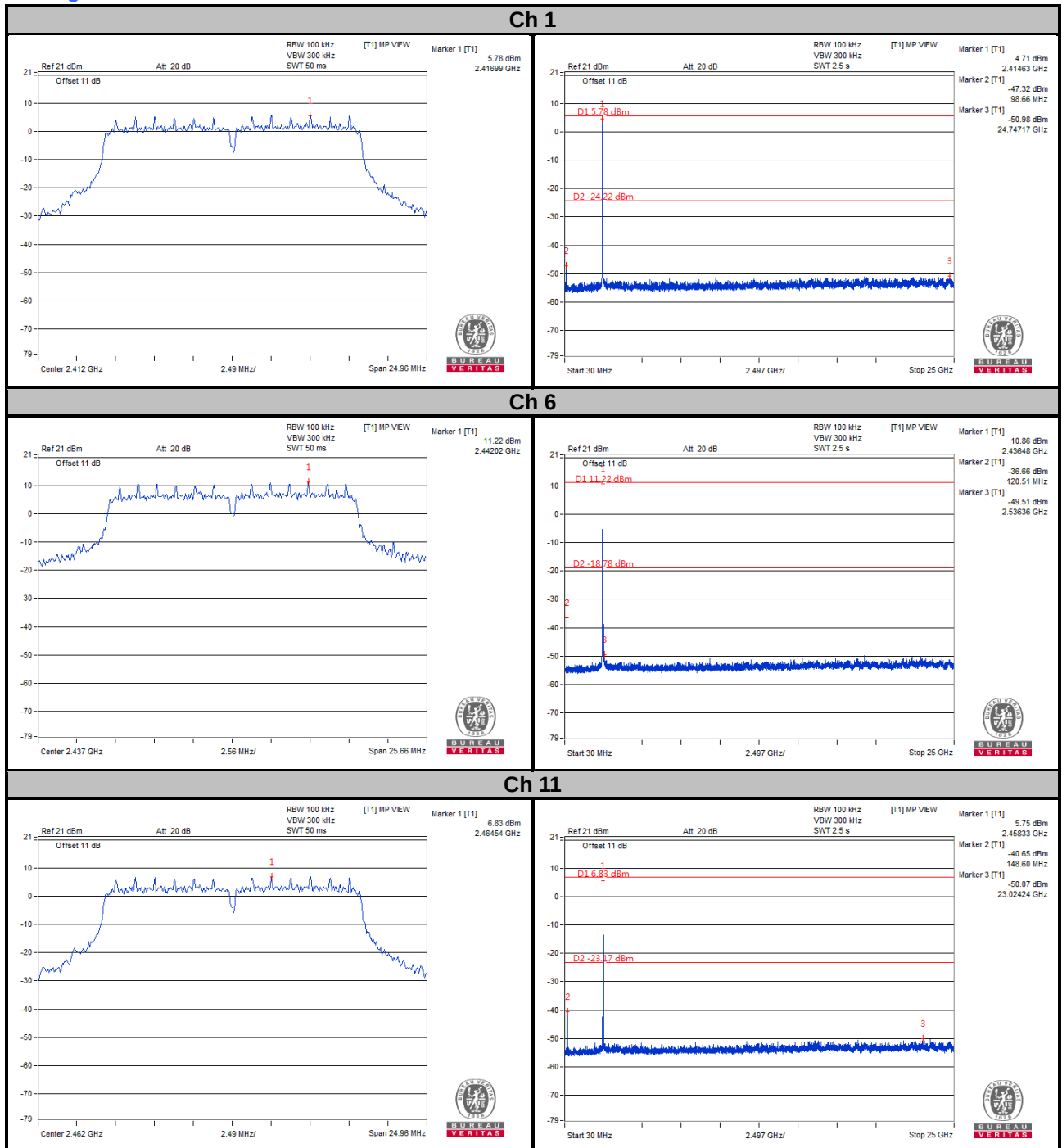
The spectrum plots are attached on the following images. D1 line indicates the highest level, and D2 line indicates the 30 dB offset below D1. It shows compliance with the requirement.

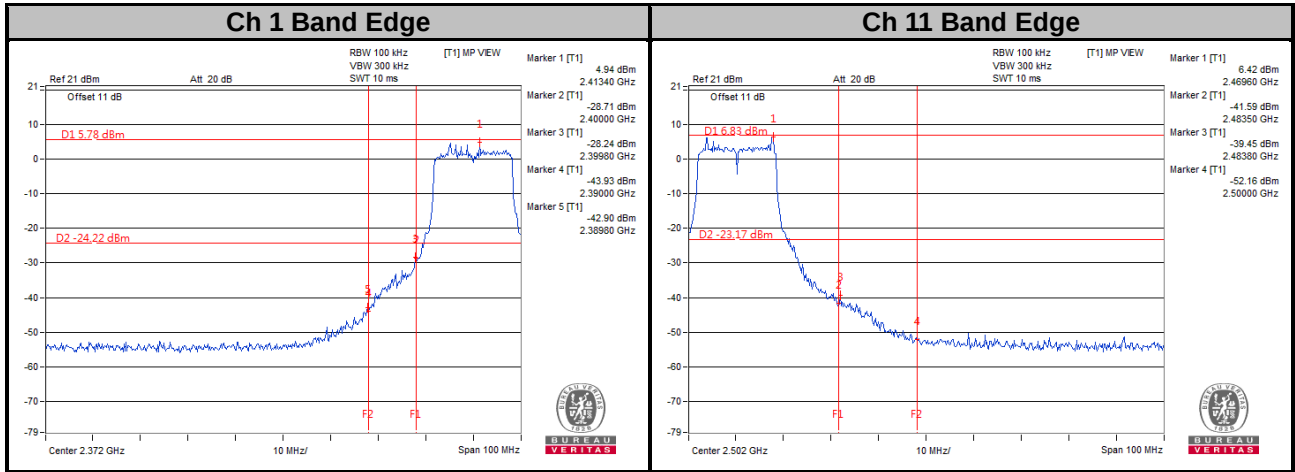
802.11b





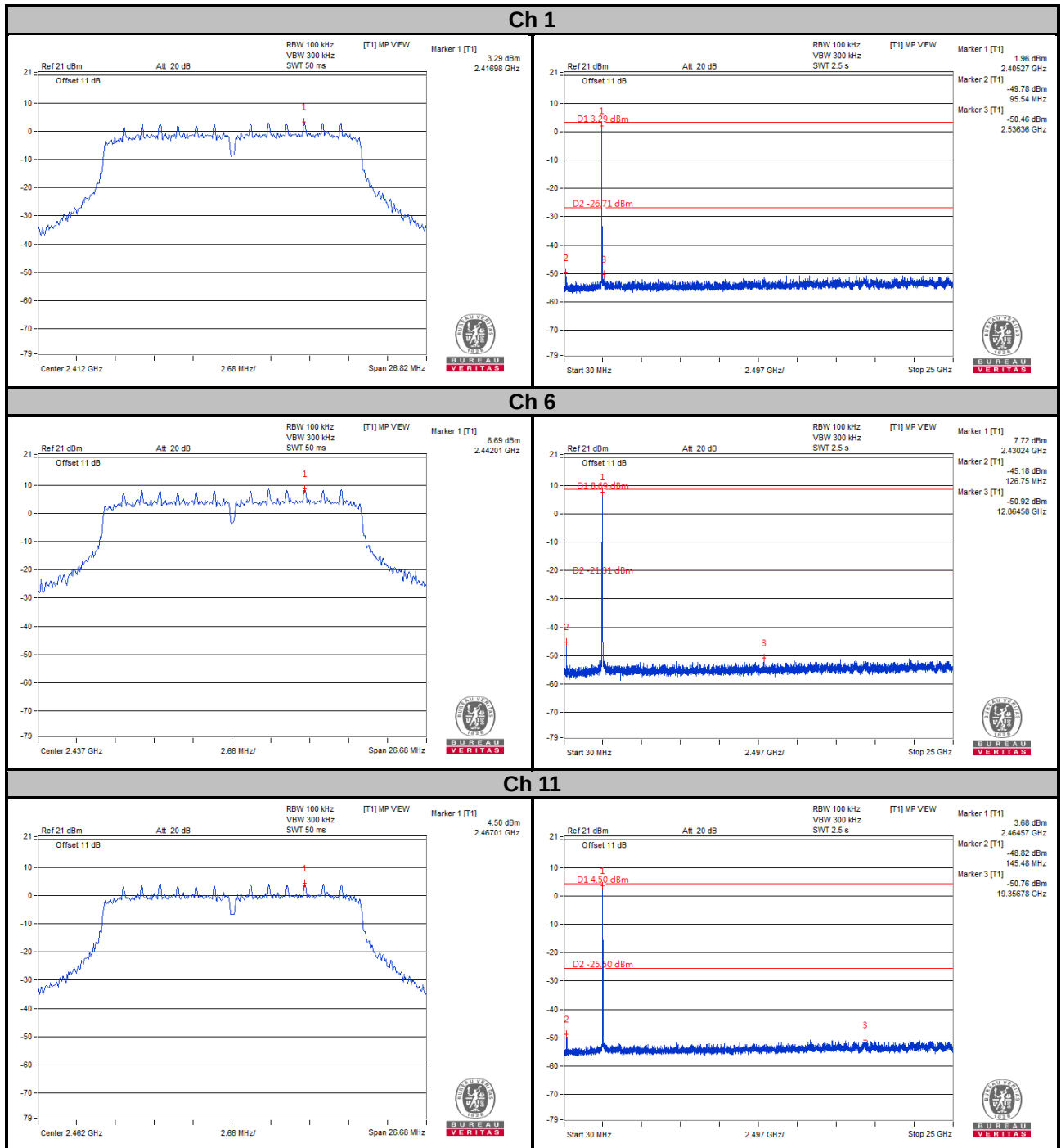
802.11g

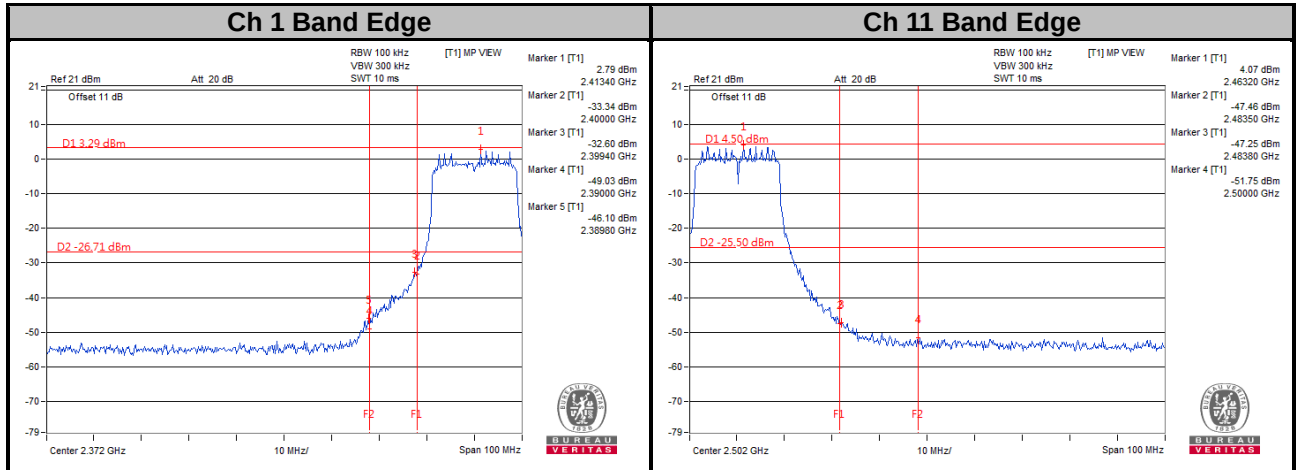




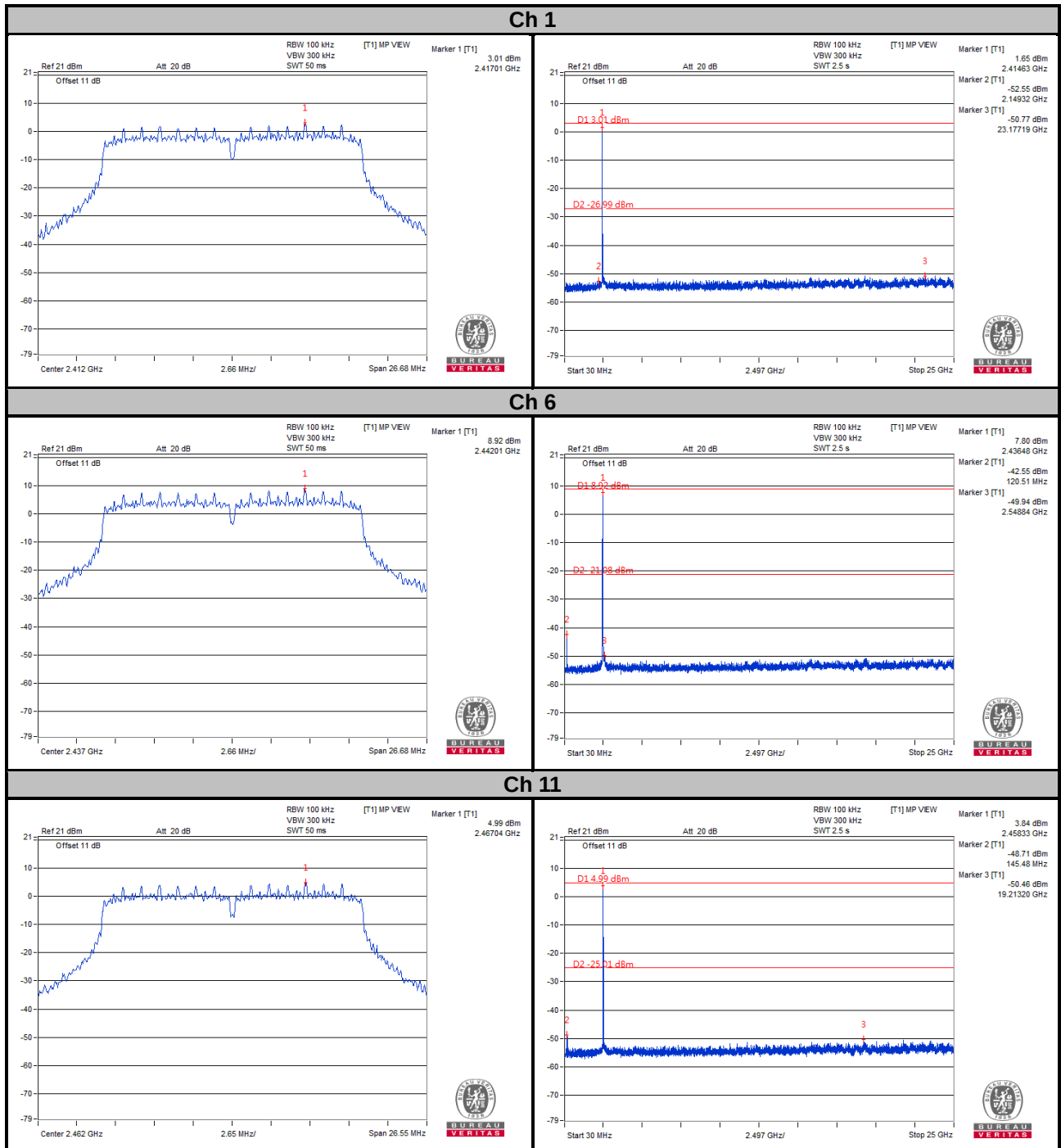
802.11n (HT20)

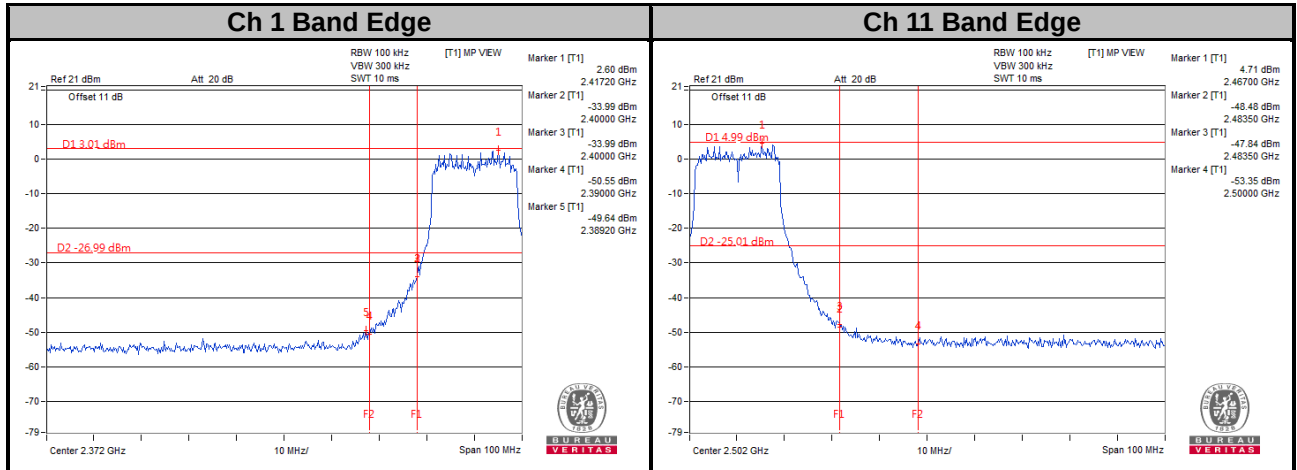
CHAIN 0



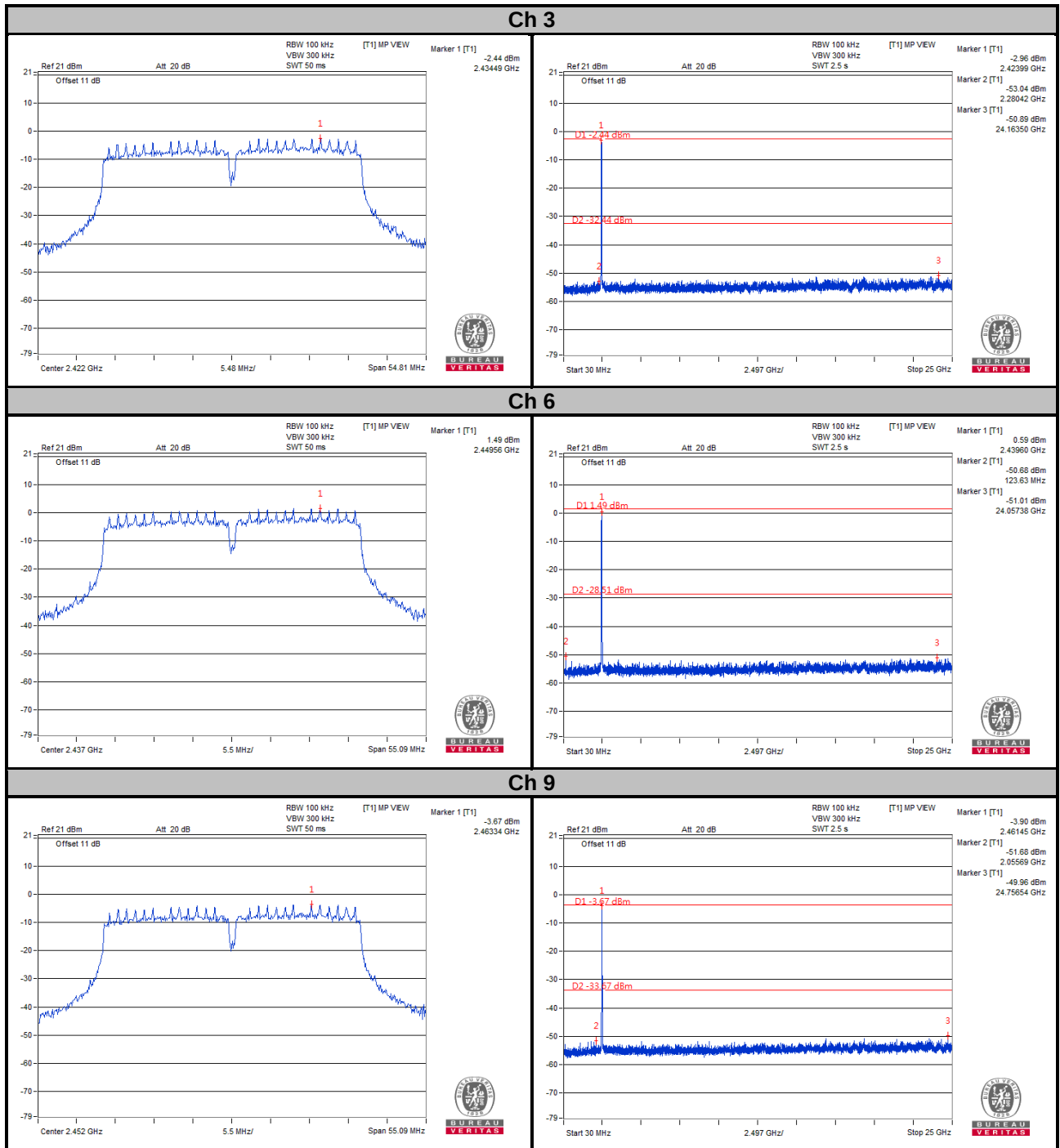


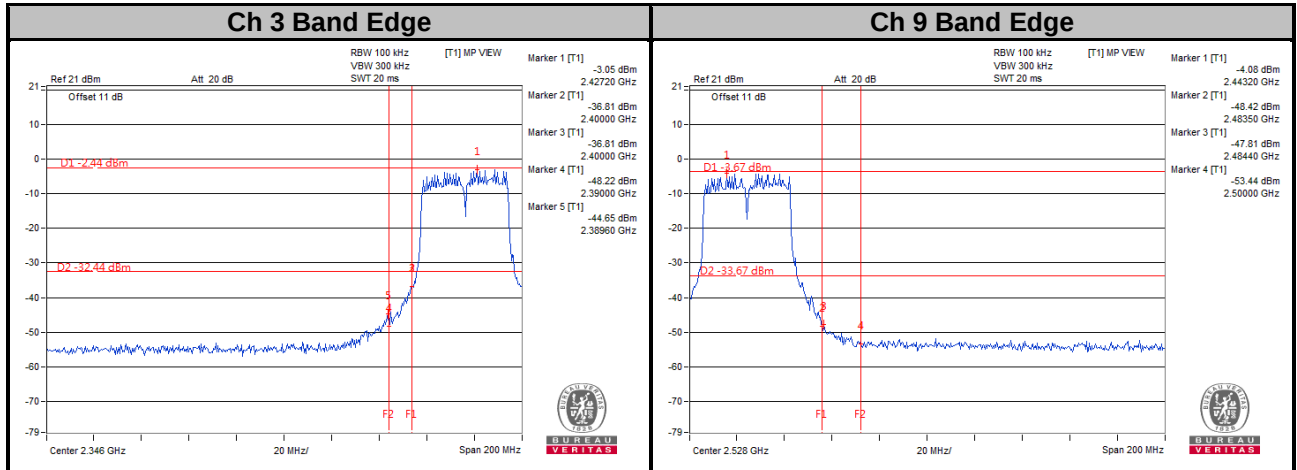
CHAIN 1



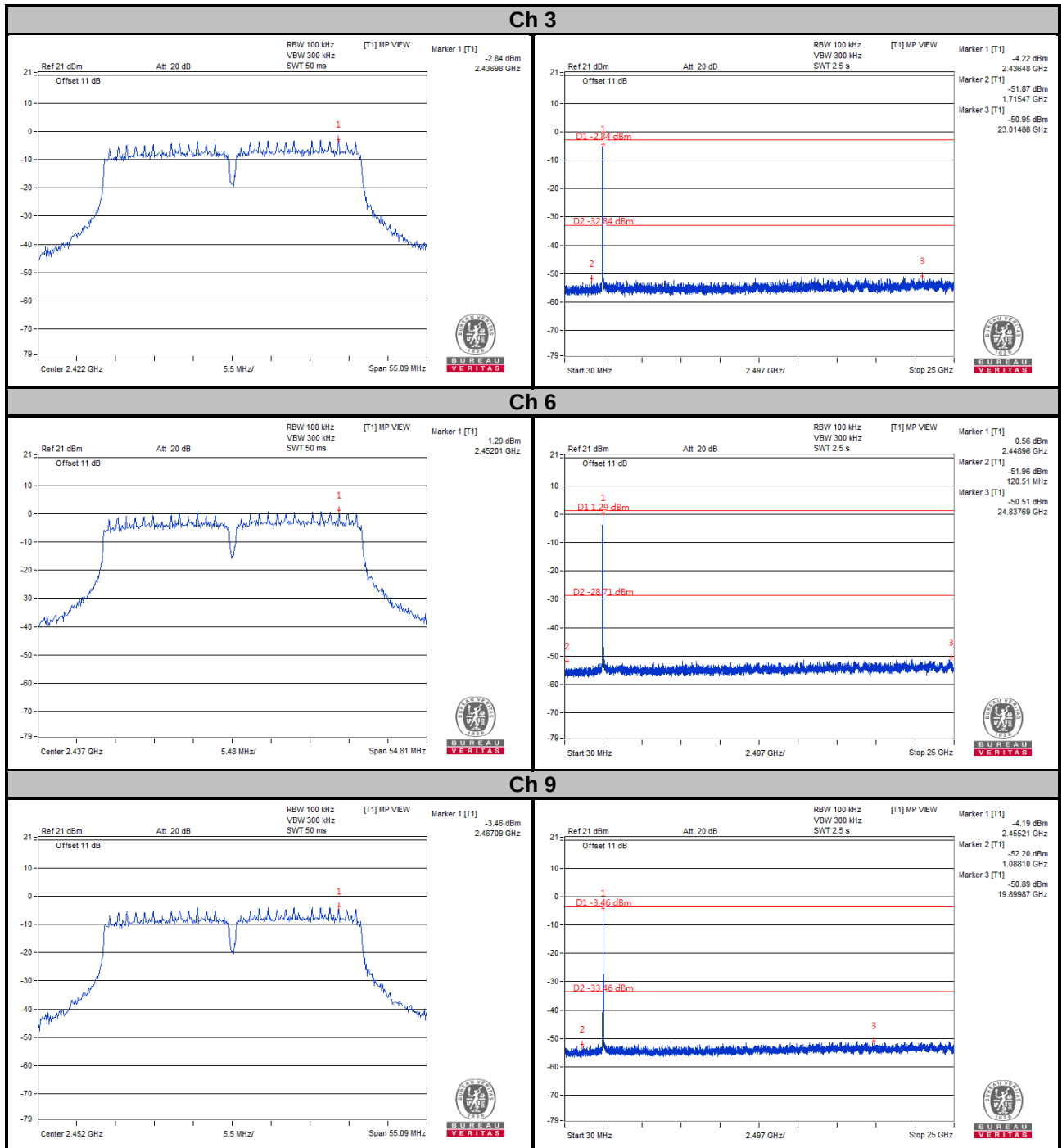


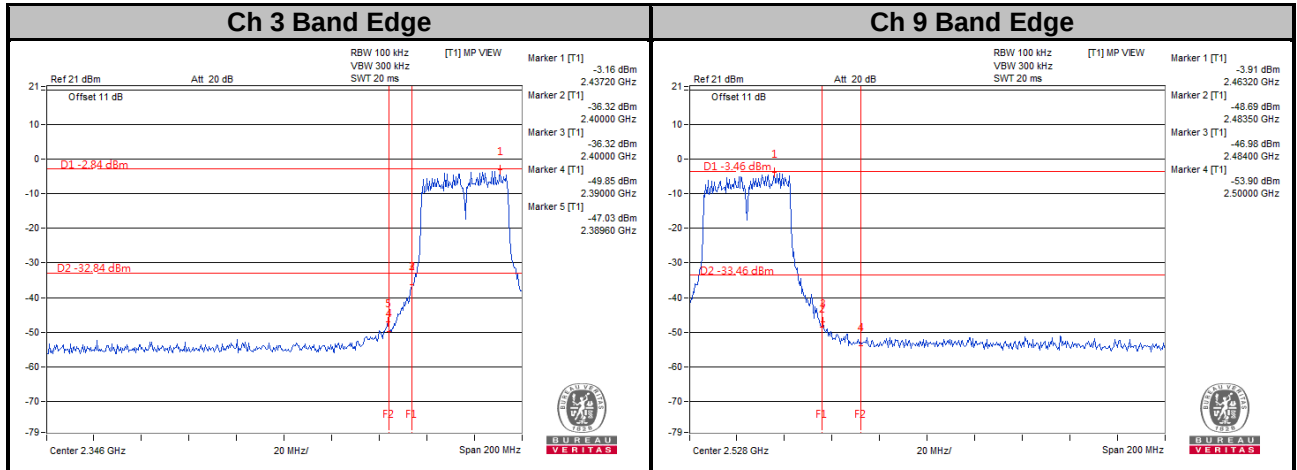
802.11n (HT40) CHAIN 0





CHAIN 1





Annex A- Band-edge measurement

<Radiated Emission above 1 GHz>



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

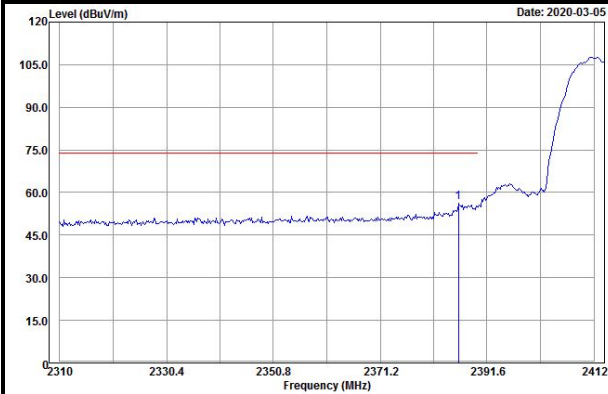
EUT Operating Conditions

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

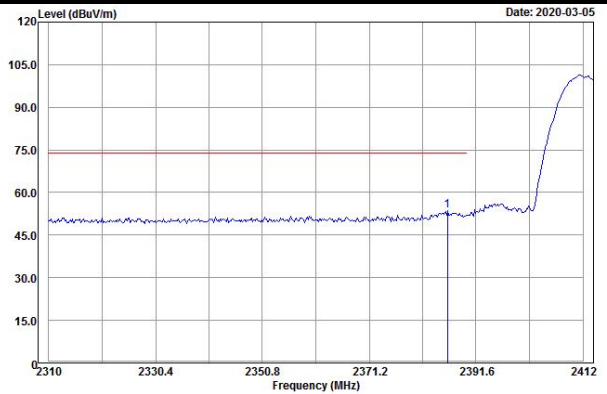
802.11b

Ch 1

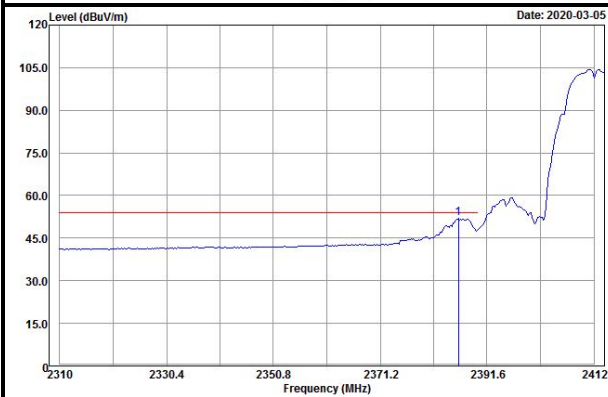
Horizontal



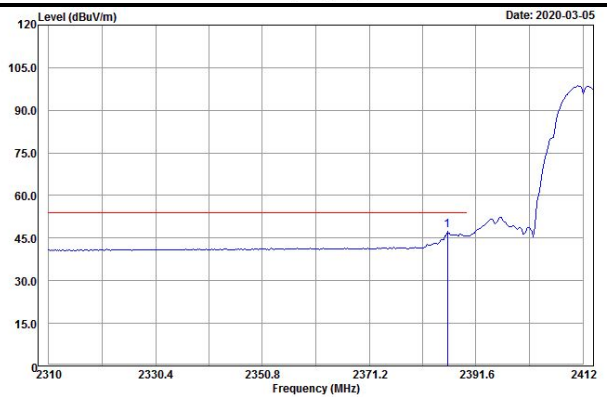
Vertical



Horizontal

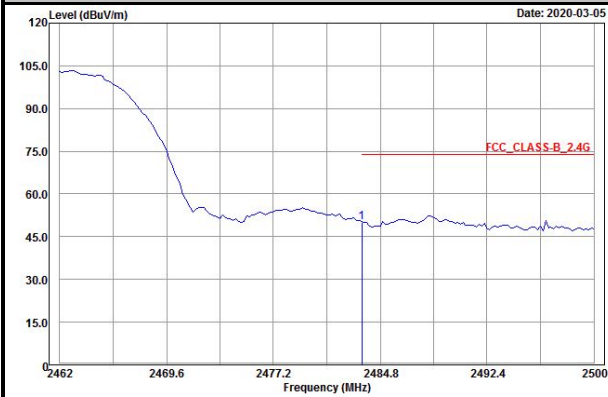


Vertical

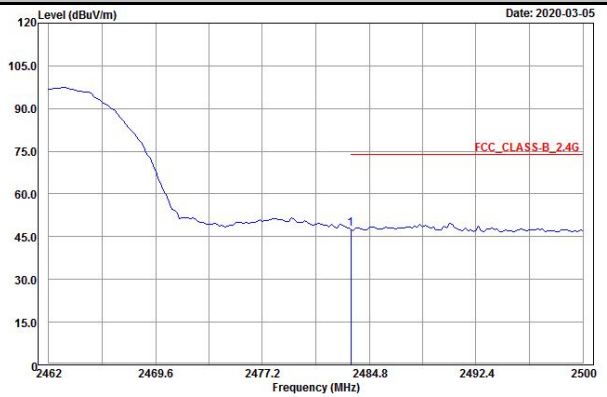


Ch 11

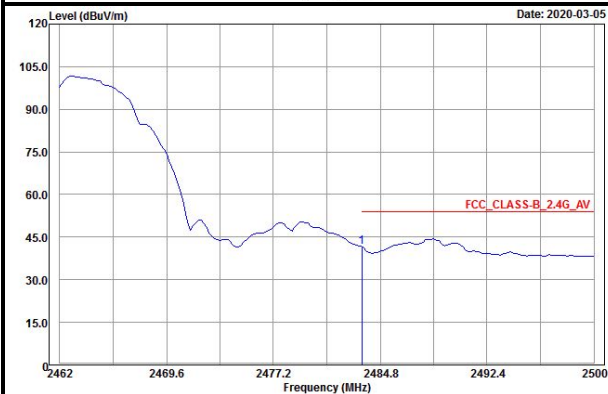
Horizontal



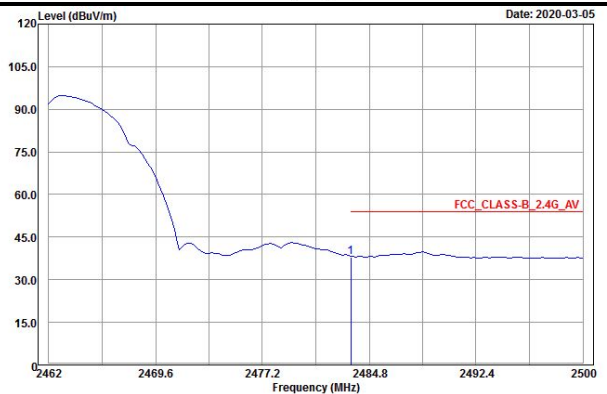
Vertical



Horizontal



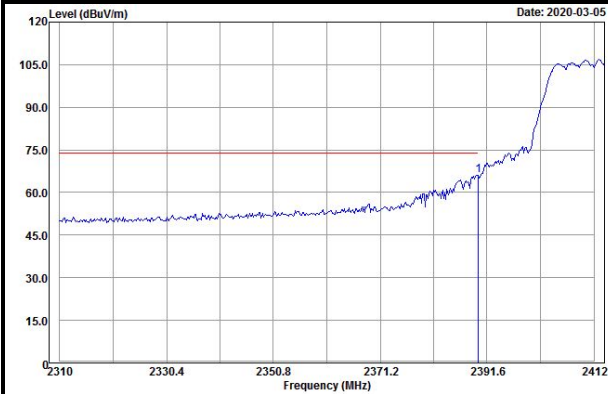
Vertical



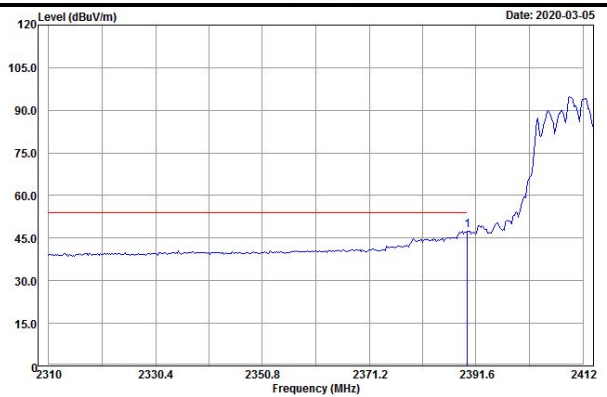
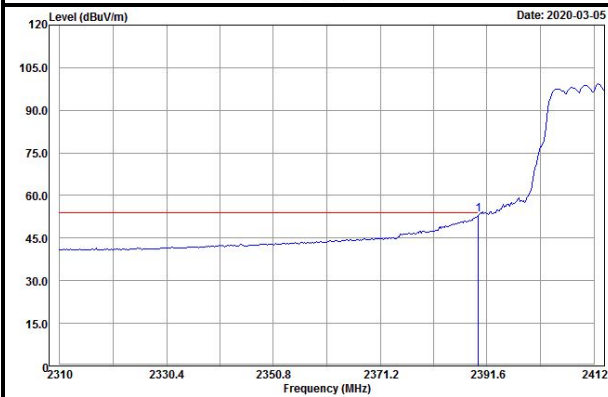
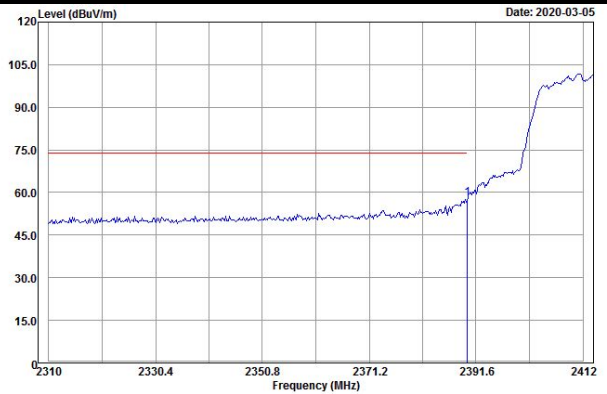
802.11g

Ch 1

Horizontal

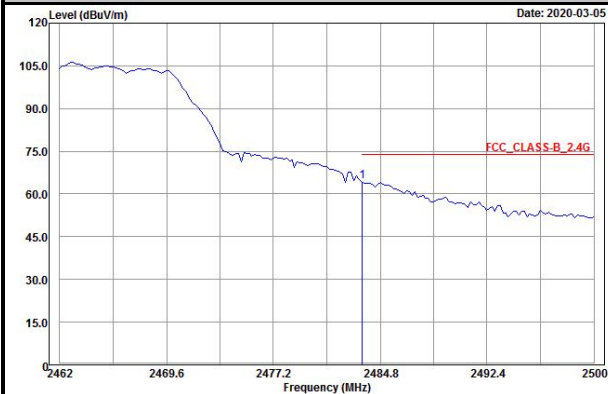


Vertical

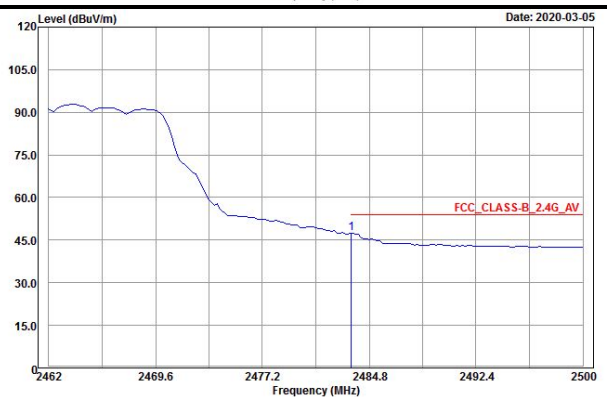
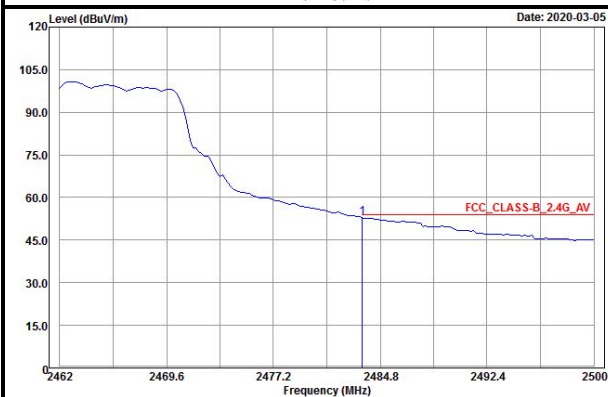
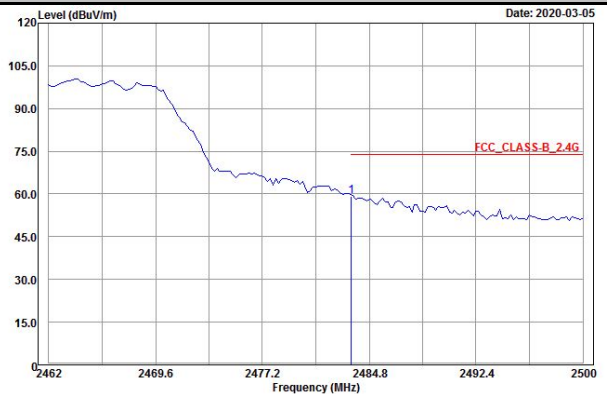


Ch 11

Horizontal



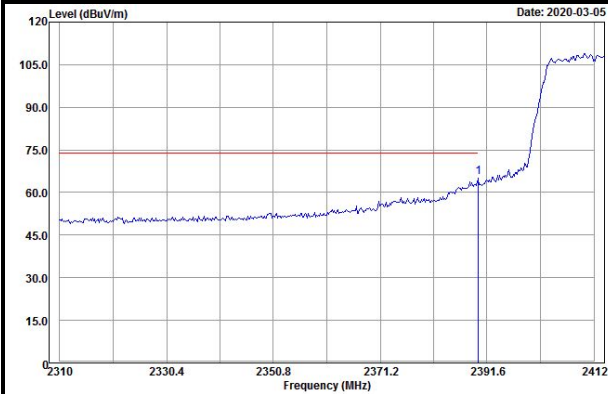
Vertical



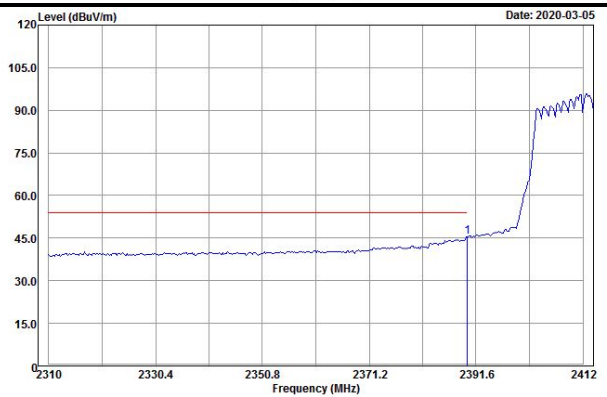
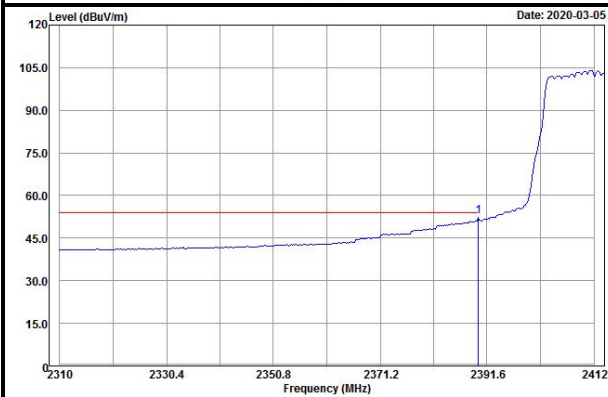
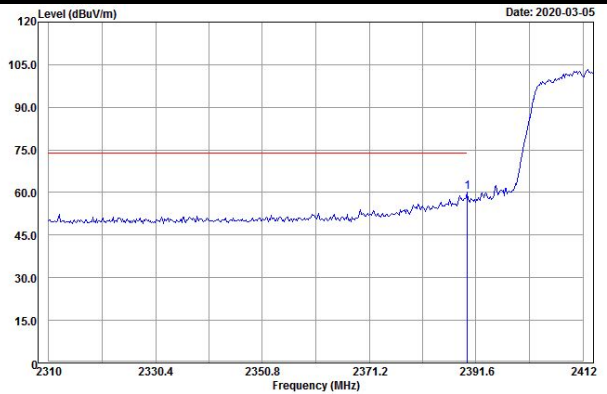
802.11n (HT20)

Ch 1

Horizontal

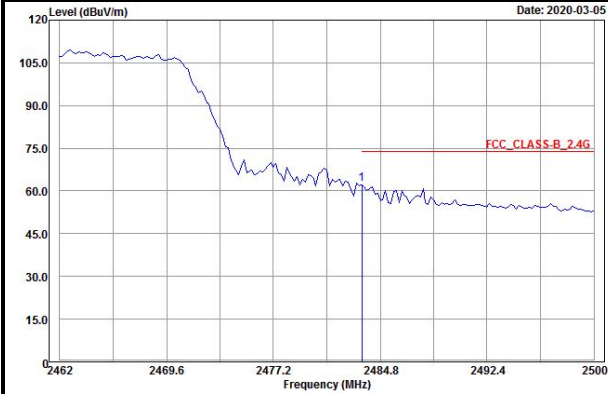


Vertical

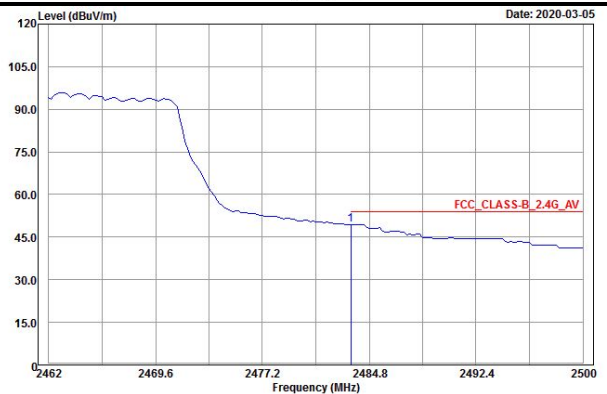
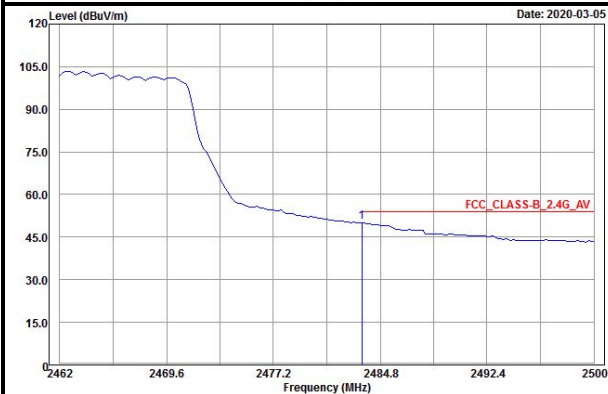
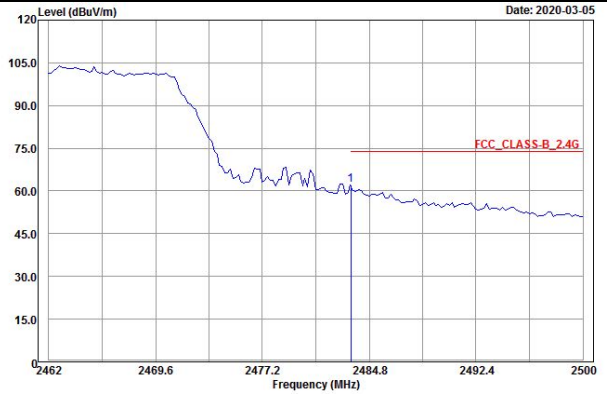


Ch 11

Horizontal



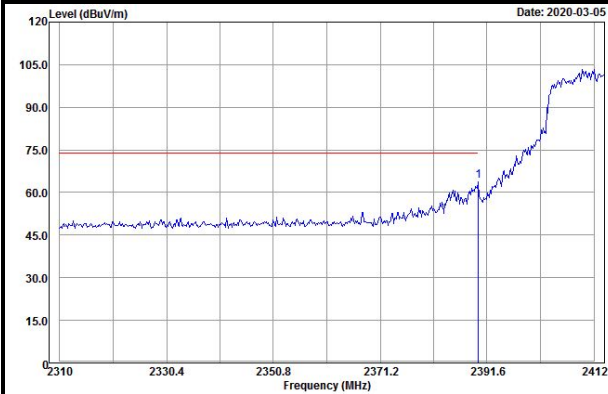
Vertical



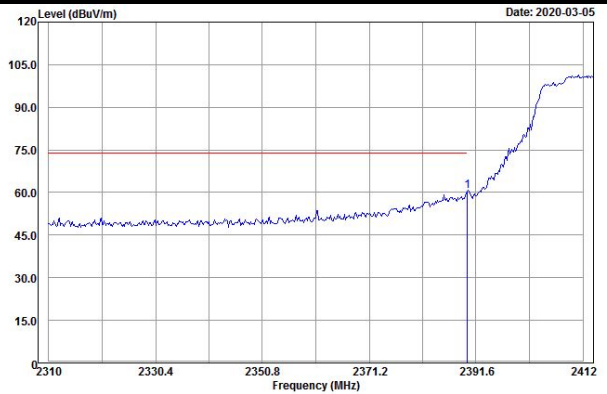
802.11n (HT40)

Ch 3

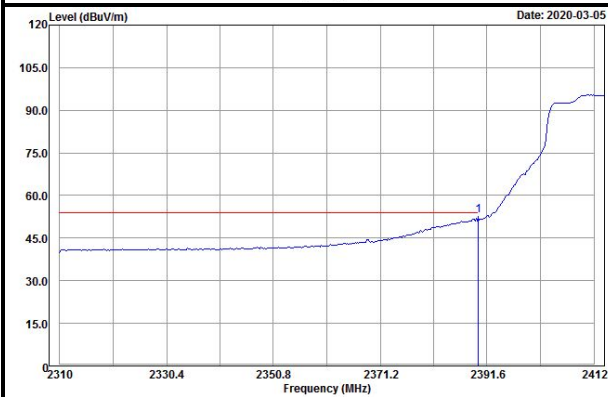
Horizontal



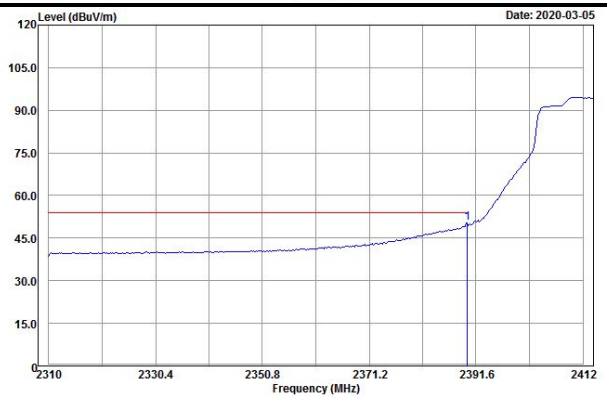
Vertical



Horizontal

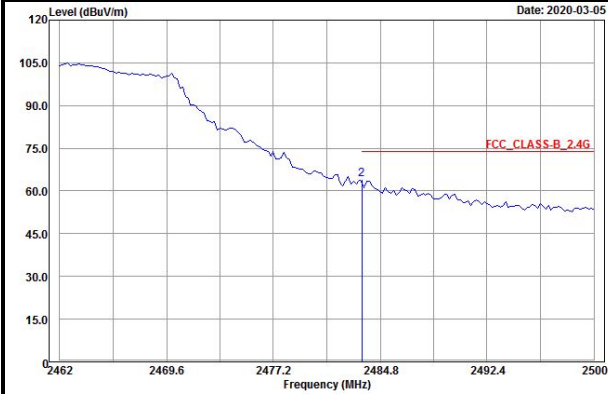


Vertical

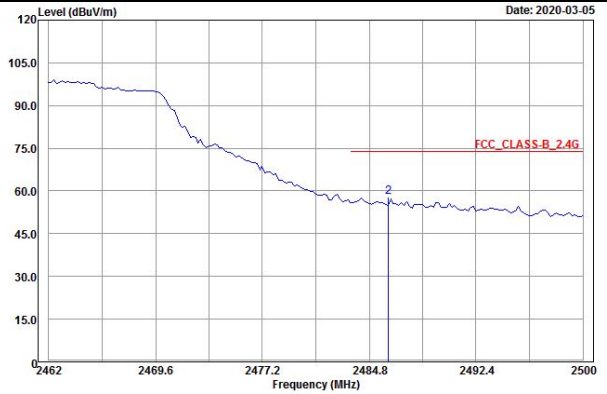


Ch 9

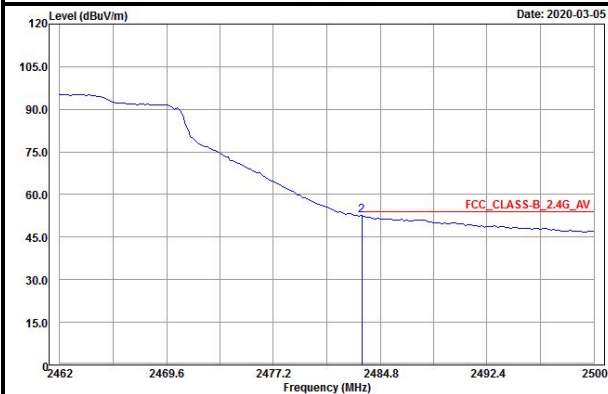
Horizontal



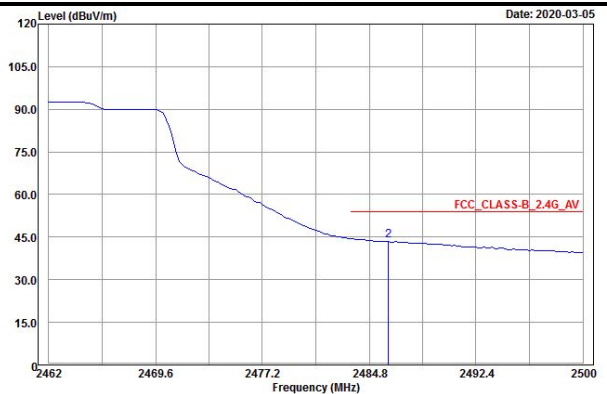
Vertical



Horizontal



Vertical



5 Pictures of Test Arrangements

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

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.

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

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