FCC Test Report

Report No.:	RFACXM-WTW-P22040515-1
FCC ID:	2AEUPBHASG001
Test Model:	5F48E9
Received Date:	Apr. 14, 2022
Test Date:	Jun. 19 ~ Jul. 05, 2022
Issued Date:	Sep. 16, 2022
Applicant:	Ring LLC
Address:	12515 Cerise Ave, Hawthorne, CA 90250, 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):	No. 70, Wenming Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)
FCC Registration / Designation Number (1):	788550 / TW0003
FCC Registration / Designation Number (2):	281270 / TW0032

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Release Control Record

Issue No.	Description	Date Issued
RFACXM-WTW-P22040515-1	Original release.	Sep. 16, 2022

1 Certificate of Conformity

Product:	Amazon Sidewalk Bridge Pro by Ring
Brand:	Ring
Test Model:	5F48E9
Sample Status:	Engineering sample
Applicant:	Ring LLC
Test Date:	Jun. 19 ~ Jul. 05, 2022
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 : Polly Chien , **Date:** Sep. 16, 2022

Polly Chien / Specialist

Approved by : Jeremy Lin , **Date:** Sep. 16, 2022

Jeremy Lin / 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 -7.17dB at 0.39238MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -0.2dB at 2390.00MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	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:

1. 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. 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	150kHz ~ 30MHz	2.79 dB
Radiated Emissions up to 1 GHz	9 kHz ~ 30 MHz	3.00 dB
	30MHz ~ 200MHz	2.91 dB
	200MHz ~1000MHz	2.93 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	1.76 dB
	18GHz ~ 40GHz	1.77 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Amazon Sidewalk Bridge Pro by Ring
Brand	Ring
Test Model	5F48E9
Sample Status	Engineering sample
Power Supply Rating	53Vdc (from PoE) 6Vdc (from battery)
Modulation Type	256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM 1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b:11.0/ 5.5/ 2.0/ 1.0Mbps 802.11g: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0Mbps 802.11n: up to 300Mbps VHT: up to 400Mbps
Operating Frequency	2412~2462MHz
Number of Channel	802.11b, 802.11g, 802.11n (HT20), VHT20: 11 802.11n (HT40), VHT40: 7
Output Power	689.530mW
Antenna Type	Refer to note
Antenna Connector	Refer to note
Accessory Device	Refer to note
Cable Supplied	NA

Note:

1. The EUT incorporates a MIMO function. Physically, the EUT provides 2 completed transmitters and 2 receivers.

Modulation Mode	TX Function
802.11b	2TX
802.11g	2TX
802.11n (HT20)	2TX
802.11n (HT40)	2TX
VHT20	2TX
VHT40	2TX

2. The EUT contains following accessory devices.

Product	Brand	Model	Description
PoE	Gospower	G0545-530-060-PSE1000	I/P: 100-240 Vac, 50-60Hz, 0.75 A O/P: 53 Vdc, 0.6 A 1.47m non-shielded cable with 1 core
Battery	WELLTECH ENERGY INC.	5F48E9	Rating: 6Vdc, 3100mAh

3. The EUT contains certified WWAN (LTE) modular which FCC ID: ZMONL668AM00.

4. The EUT uses the following antennas.

RF Chain No.	Type	Connector	Frequency Range	Gain (dBi)	Cable Length (mm)
WiFi 0	Dipole	ipex(MHF)	2.400~2.4835GHz	6.87	145mm
			5.150~5.850GHz	7.89	
WiFi 1	Dipole	ipex(MHF)	2.400~2.4835GHz	7.45	165mm
			5.150~5.850GHz	7.34	
BT	Dipole	ipex(MHF)	2.400~2.4835GHz	5.22	150mm

* Detail antenna specification please refer to antenna datasheet and/or antenna measurement report.

3.2 Description of Test Modes

11 channels are provided for 802.11b, 802.11g, 802.11n (HT20), VHT20:

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

7 channels are provided for 802.11n (HT40), VHT40:

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

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to				Description
	RE≥1G	RE<1G	PLC	APCM	
-	√	√	√	√	-

Where RE≥1G: Radiated Emission above 1GHz & Bandedge Measurement RE<1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission APCM: Antenna Port Conducted Measurement

Note:

1. The EUT is professionally installed.

2. For radiated emission (below 1GHz) and power line conducted emission test items chosen the worst maximum fundamental emission level channel.

Radiated Emission Test (Above 1GHz):

☒ 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
-	VHT20	1 to 11	1, 6, 11	OFDM	BPSK	MCS0
-	VHT40	3 to 9	3, 6, 9	OFDM	BPSK	MCS0

Radiated Emission Test (Below 1GHz):

☒ 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)
-	VHT20	1 to 11	6	OFDM	BPSK	MCS0

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)
-	VHT20	1 to 11	6	OFDM	BPSK	MCS0

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
-	VHT20	1 to 11	1, 6, 11	OFDM	BPSK	MCS0
-	VHT40	3 to 9	3, 6, 9	OFDM	BPSK	MCS0

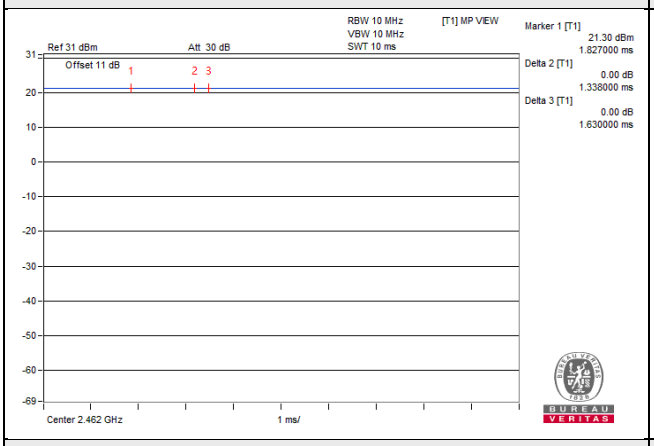
Test Condition:

Applicable to	Environmental Conditions	Input Power	Tested by
RE≥1G	25 deg. C, 65% RH	120Vac, 60Hz	Tim Chen
RE<1G	27 deg. C, 72% RH	120Vac, 60Hz	Randy Wu
PLC	25 deg. C, 75% RH	120Vac, 60Hz	Randy Wu
APCM	25 deg. C, 60% RH	120Vac, 60Hz	Jisyong Wang

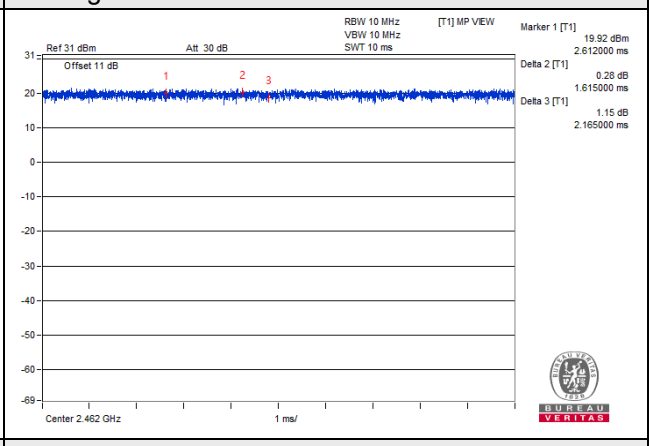
3.3 Duty Cycle of Test Signal

Duty cycle is 100 %, duty factor is not required.

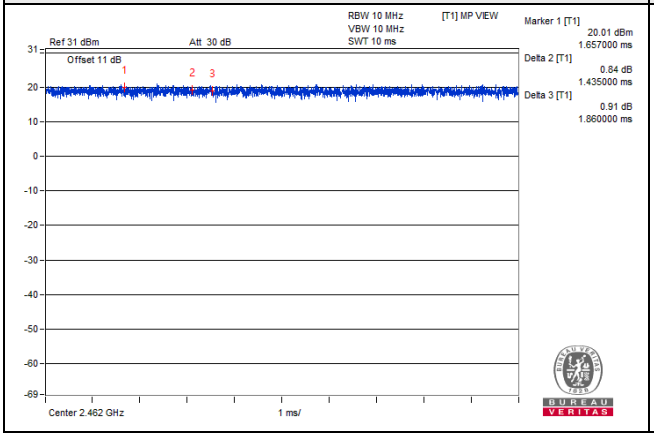
802.11b



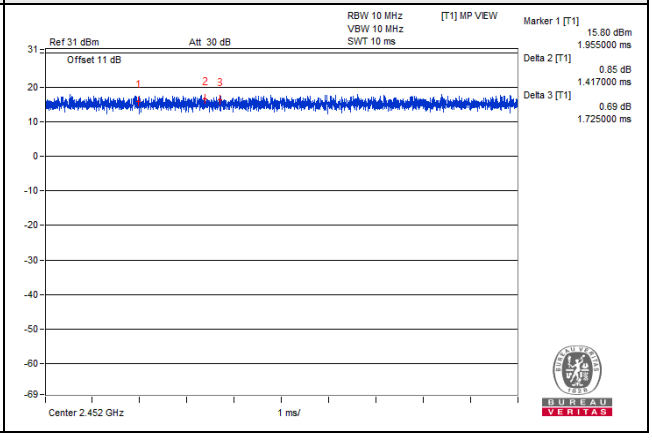
802.11g



VHT20



VHT40



3.4 Description of Support Units

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

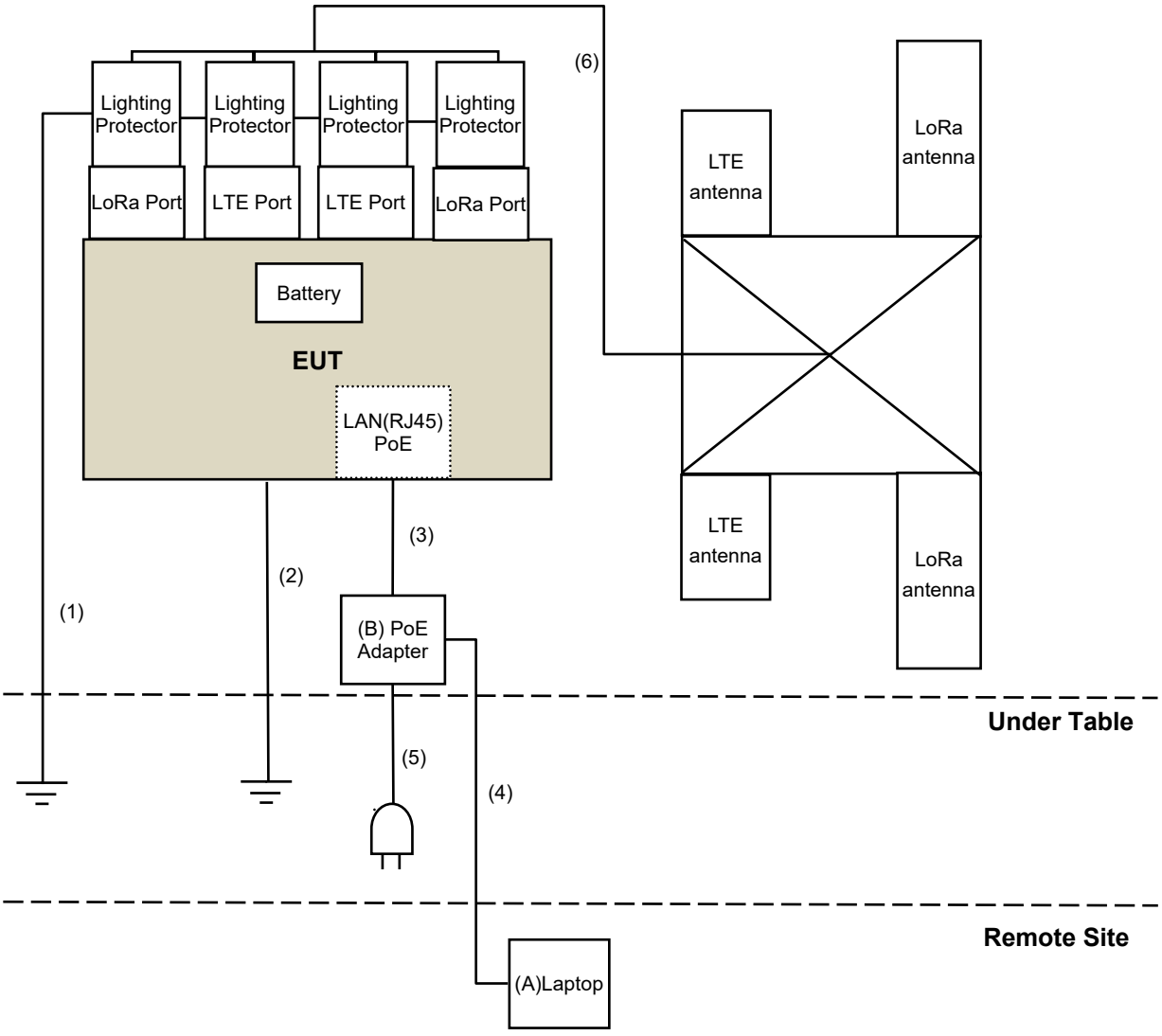
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Lenovo	80Q7	PF0KUGU6	FCC DoC Approved	Provided by Lab
B.	PoE Adapter	Gospower	G0545-530-060-PSE1000	NA	NA	Supplied by client

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

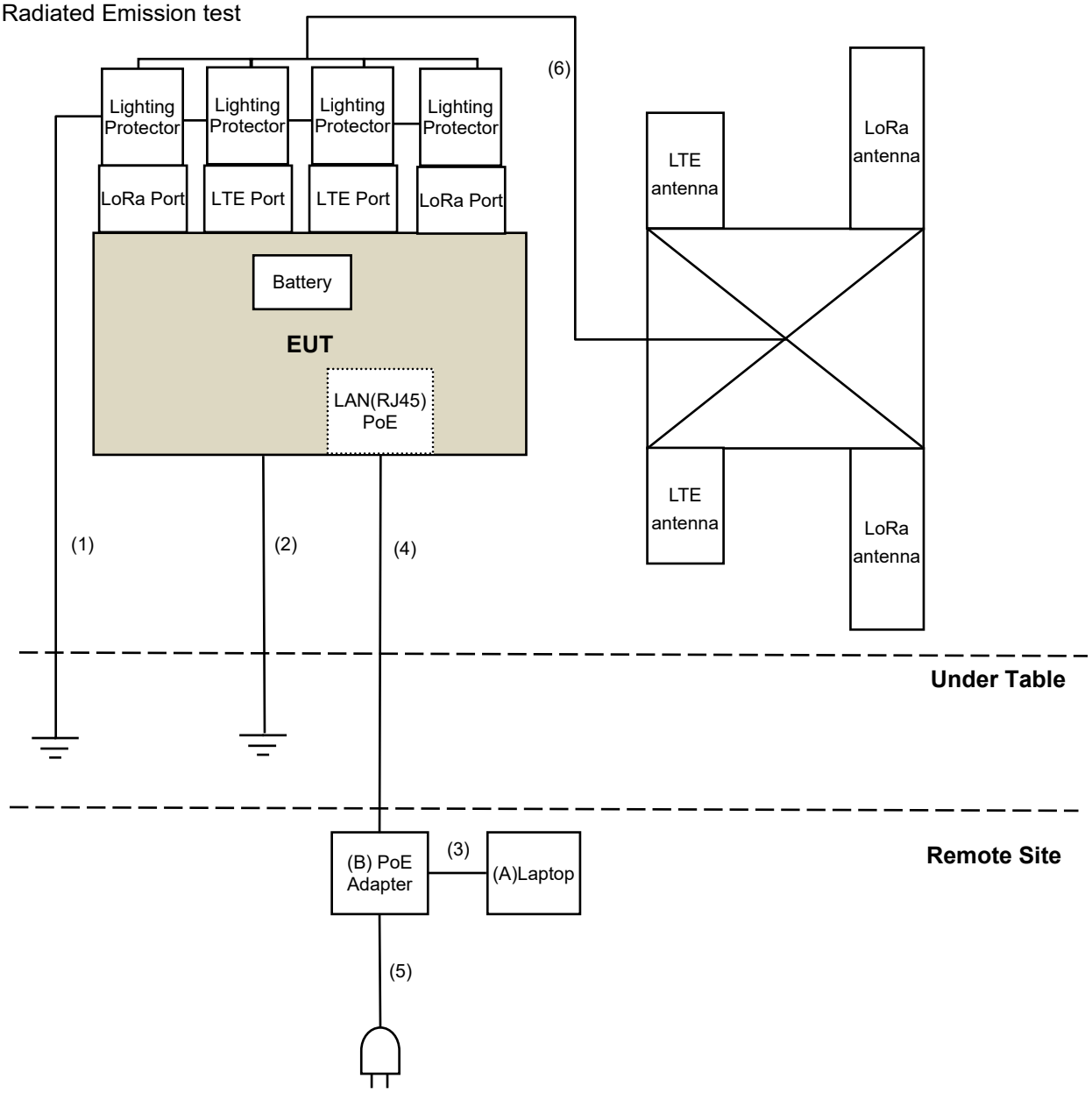
ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	GND Cable	1	3	N	0	Provided by Lab
2.	GND Cable	1	3	N	0	Provided by Lab
3.	RJ-45 Cable	1	1.5	N	0	Provided by Lab
4.	RJ-45 Cable	1	10	N	0	Provided by Lab
5.	AC Cable	1	1	N	0	Supplied by applicant
6.	Antenna Cable	4	1	Y	0	Supplied by applicant

3.4.1 Configuration of System under Test

For AC Power Conducted Emission test



For Radiated Emission 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
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 20dB 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 1000MHz, 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 20dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver Rohde & Schwarz	ESR3	102783	Dec. 21, 2021	Dec. 20, 2022
Spectrum Analyzer KEYSIGHT	N9020B	MY60110513	Dec. 24, 2021	Dec. 23, 2022
BILOG Antenna SCHWARZBECK	VULB9168	9168-1214	Oct. 27, 2021	Oct. 26, 2022
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1170	Nov. 14, 2021	Nov. 13, 2022
HORN Antenna SCHWARZBECK	BBHA 9170	9170-995	Nov. 14, 2021	Nov. 13, 2022
Loop Antenna EMCI	EM-6879	269	Sep. 16, 2021	Sep. 15, 2022
Loop Antenna TESEQ	HLA 6121	45745	Jul. 21, 2021	Jul. 20, 2022
Preamplifier EMCI	EMC330N	980798	Jan. 17, 2022	Jan. 16, 2023
Preamplifier EMCI	EMC118A45SE	980809	Dec. 30, 2021	Dec. 29, 2022
Preamplifier EMCI	EMC184045SE	980786	Jan. 17, 2022	Jan. 16, 2023
RF signal cable EMCI	EMC104-SM-SM-(9000+2000+1000)	201244+ 201232+ 210103	Jan. 17, 2022	Jan. 16, 2023
RF signal cable EMCI	EMCCFD400-NM-NM-(9000+300+500)	201251+ 201249+ 201248	Jan. 17, 2022	Jan. 16, 2023
RF signal cable EMCI	EMC101G-KM-KM-(5000+3000+2000)	201261+201258+201249	Jan. 17, 2022	Jan. 16, 2023
Software BV ADT	ADT_Radiated_V7.6.15.9.5	NA	NA	NA
Antenna Tower Max-Full	MFT-151SS-0.5T	NA	NA	NA
Turn Table Max-Full	MF-7802BS	NA	NA	NA
Turn Table Controller Max-Full	MF-7802BS	MF780208674	NA	NA
Peak Power Analyzer KEYSIGHT	8990B	MY51000485	Jan. 18, 2022	Jan. 17, 2023
Wideband Power Sensor KEYSIGHT	N1923A	MY58190002	May 06, 2022	May 05, 2023

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 WM Chamber 9.

4.1.3 Test Procedures

For Radiated emission below 30MHz

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 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) 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 detect 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 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
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 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.

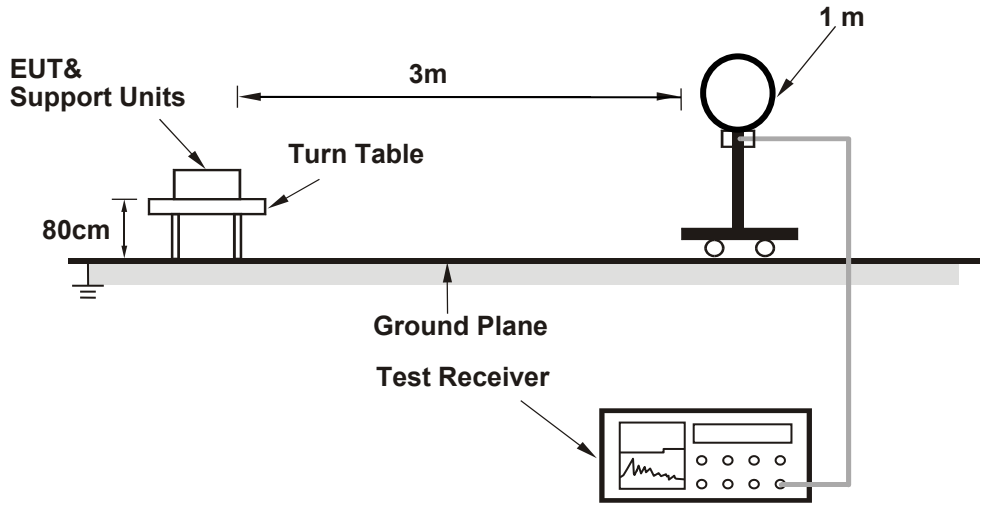
   (RBW = 1MHz, VBW = 10Hz)
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

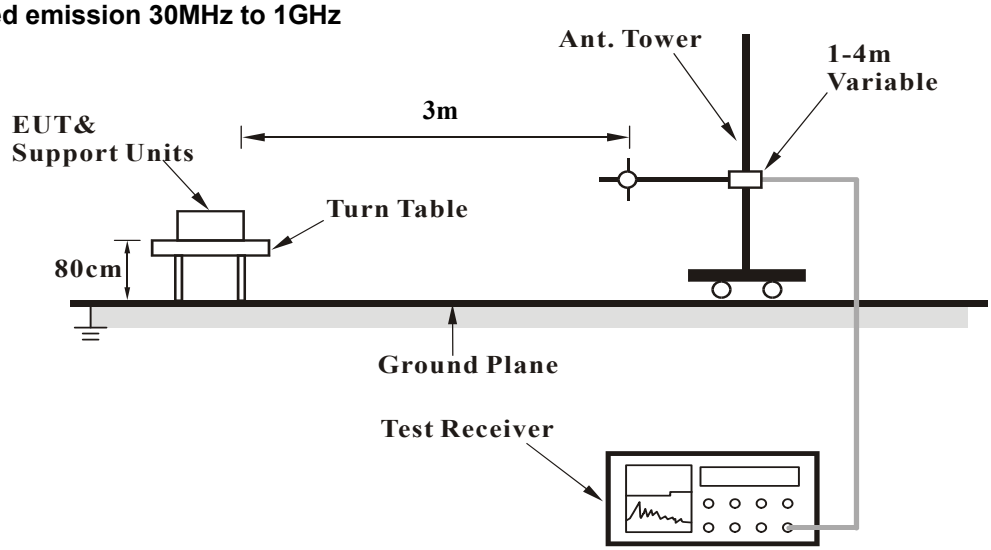
No deviation.

4.1.5 Test Setup

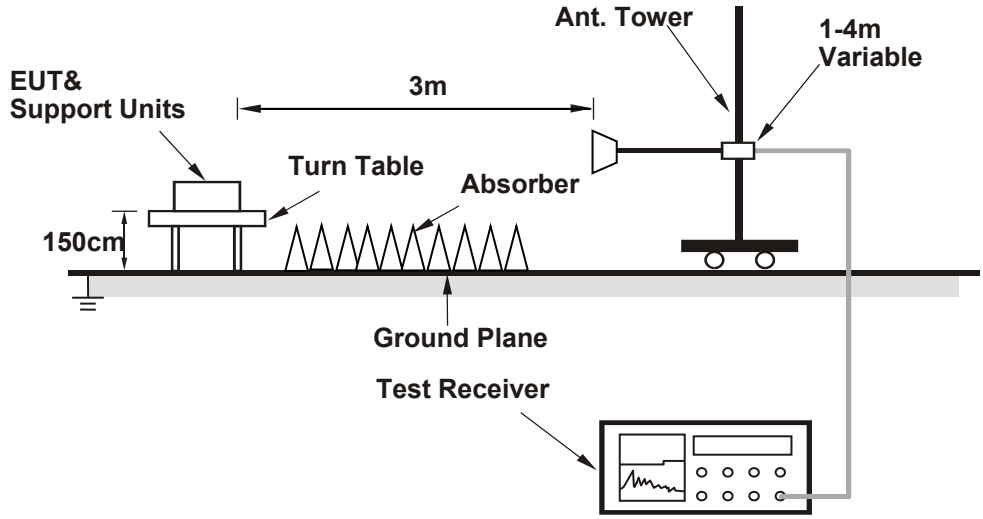
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

4.1.6 EUT Operating Conditions

a. The EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz worst-Case data:

RF Mode	TX 802.11b	Channel	CH 1：2412 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2385.36	62.3 PK	74.0	-11.7	2.17 H	337	30.3	32.0
2	2385.36	53.1 AV	54.0	-0.9	2.17 H	337	21.1	32.0
3	*2412.00	115.5 PK			2.17 H	337	83.4	32.1
4	*2412.00	113.5 AV			2.17 H	337	81.4	32.1
5	4824.00	51.9 PK	74.0	-22.1	2.38 H	352	48.8	3.1
6	4824.00	45.3 AV	54.0	-8.7	2.38 H	352	42.2	3.1
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2387.68	59.9 PK	74.0	-14.1	1.92 V	352	27.9	32.0
2	2387.68	50.1 AV	54.0	-3.9	1.92 V	352	18.1	32.0
3	*2412.00	112.6 PK			1.92 V	352	80.5	32.1
4	*2412.00	110.5 AV			1.92 V	352	78.4	32.1
5	4824.00	52.1 PK	74.0	-21.9	2.29 V	41	49.0	3.1
6	4824.00	45.4 AV	54.0	-8.6	2.29 V	41	42.3	3.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11b	Channel	CH 6：2437 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	117.5 PK			2.14 H	339	85.5	32.0
2	*2437.00	115.3 AV			2.14 H	339	83.3	32.0
3	4874.00	53.6 PK	74.0	-20.4	2.34 H	12	50.4	3.2
4	4874.00	47.7 AV	54.0	-6.3	2.34 H	12	44.5	3.2
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	112.9 PK			1.99 V	360	80.9	32.0
2	*2437.00	110.8 AV			1.99 V	360	78.8	32.0
3	4874.00	54.7 PK	74.0	-19.3	2.31 V	40	51.5	3.2
4	4874.00	47.6 AV	54.0	-6.4	2.31 V	40	44.4	3.2

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11b	Channel	CH 11：2462 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2462.00	114.7 PK			2.39 H	358	82.7	32.0
2	*2462.00	112.6 AV			2.39 H	358	80.6	32.0
3	2486.44	61.6 PK	74.0	-12.4	2.39 H	358	29.6	32.0
4	2486.44	52.5 AV	54.0	-1.5	2.39 H	358	20.5	32.0
5	4924.00	52.4 PK	74.0	-21.6	2.56 H	16	49.1	3.3
6	4924.00	46.4 AV	54.0	-7.6	2.56 H	16	43.1	3.3
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2462.00	113.4 PK			2.03 V	355	81.4	32.0
2	*2462.00	111.3 AV			2.03 V	355	79.3	32.0
3	2487.46	60.7 PK	74.0	-13.3	2.03 V	355	28.7	32.0
4	2487.46	50.3 AV	54.0	-3.7	2.03 V	355	18.3	32.0
5	4924.00	54.6 PK	74.0	-19.4	3.45 V	338	51.3	3.3
6	4924.00	48.4 AV	54.0	-5.6	3.45 V	338	45.1	3.3

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11g	Channel	CH 1：2412 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	65.0 PK	74.0	-9.0	2.16 H	334	33.0	32.0
2	**2390.00**	**53.8 AV**	**54.0**	**-0.2**	**2.16 H**	**334**	**21.8**	**32.0**
3	*2412.00	115.9 PK			2.16 H	334	83.8	32.1
4	*2412.00	108.1 AV			2.16 H	334	76.0	32.1
5	4824.00	50.3 PK	74.0	-23.7	1.42 H	168	47.2	3.1
6	4824.00	38.4 AV	54.0	-15.6	1.42 H	168	35.3	3.1
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	63.2 PK	74.0	-10.8	1.97 V	354	31.2	32.0
2	2390.00	52.1 AV	54.0	-1.9	1.97 V	354	20.1	32.0
3	*2412.00	112.2 PK			1.97 V	354	80.1	32.1
4	*2412.00	104.4 AV			1.97 V	354	72.3	32.1
5	4824.00	50.9 PK	74.0	-23.1	1.01 V	55	47.8	3.1
6	4824.00	39.0 AV	54.0	-15.0	1.01 V	55	35.9	3.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11g	Channel	CH 6：2437 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	121.3 PK			2.22 H	336	89.3	32.0
2	*2437.00	113.5 AV			2.22 H	336	81.5	32.0
3	4874.00	50.7 PK	74.0	-23.3	1.45 H	127	47.5	3.2
4	4874.00	38.6 AV	54.0	-15.4	1.45 H	127	35.4	3.2
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	118.6 PK			1.98 V	355	86.6	32.0
2	*2437.00	110.4 AV			1.98 V	355	78.4	32.0
3	4874.00	51.0 PK	74.0	-23.0	1.21 V	229	47.8	3.2
4	4874.00	39.9 AV	54.0	-14.1	1.21 V	229	36.7	3.2

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11g	Channel	CH 11：2462 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2462.00	117.1 PK			2.10 H	334	85.1	32.0
2	*2462.00	109.7 AV			2.10 H	334	77.7	32.0
3	2483.50	67.5 PK	74.0	-6.5	2.10 H	334	35.5	32.0
4	2483.50	53.0 AV	54.0	-1.0	2.10 H	334	21.0	32.0
5	4924.00	50.6 PK	74.0	-23.4	1.89 H	231	47.3	3.3
6	4924.00	38.9 AV	54.0	-15.1	1.89 H	231	35.6	3.3
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2462.00	114.3 PK			1.93 V	355	82.3	32.0
2	*2462.00	106.6 AV			1.93 V	355	74.6	32.0
3	2483.50	67.1 PK	74.0	-6.9	1.93 V	355	35.1	32.0
4	2483.50	52.8 AV	54.0	-1.2	1.93 V	355	20.8	32.0
5	4924.00	50.5 PK	74.0	-23.5	1.66 V	214	47.2	3.3
6	4924.00	38.6 AV	54.0	-15.4	1.66 V	214	35.3	3.3

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX VHT20	Channel	CH 1：2412 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	67.3 PK	74.0	-6.7	2.15 H	335	35.3	32.0
2	**2390.00**	**53.8 AV**	**54.0**	**-0.2**	**2.15 H**	**335**	**21.8**	**32.0**
3	*2412.00	115.3 PK			2.15 H	335	83.2	32.1
4	*2412.00	107.7 AV			2.15 H	335	75.6	32.1
5	4824.00	50.1 PK	74.0	-23.9	1.42 H	216	47.0	3.1
6	4824.00	38.9 AV	54.0	-15.1	1.42 H	216	35.8	3.1
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	66.4 PK	74.0	-7.6	1.97 V	353	34.4	32.0
2	2390.00	52.8 AV	54.0	-1.2	1.97 V	353	20.8	32.0
3	*2412.00	111.9 PK			1.97 V	353	79.8	32.1
4	*2412.00	104.5 AV			1.97 V	353	72.4	32.1
5	4824.00	49.5 PK	74.0	-24.5	1.83 V	148	46.4	3.1
6	4824.00	38.3 AV	54.0	-15.7	1.83 V	148	35.2	3.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX VHT20	Channel	CH 6：2437 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	121.1 PK			2.20 H	335	89.1	32.0
2	*2437.00	113.3 AV			2.20 H	335	81.3	32.0
3	4874.00	50.4 PK	74.0	-23.6	1.27 H	306	47.2	3.2
4	4874.00	38.3 AV	54.0	-15.7	1.27 H	306	35.1	3.2
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	118.2 PK			1.95 V	359	86.2	32.0
2	*2437.00	110.1 AV			1.95 V	359	78.1	32.0
3	4874.00	49.9 PK	74.0	-24.1	1.00 V	300	46.7	3.2
4	4874.00	39.1 AV	54.0	-14.9	1.00 V	300	35.9	3.2

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX VHT20	Channel	CH 11：2462 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2462.00	116.3 PK			2.18 H	336	84.3	32.0
2	*2462.00	107.5 AV			2.18 H	336	75.5	32.0
3	2483.50	67.8 PK	74.0	-6.2	2.18 H	336	35.8	32.0
4	2483.50	53.4 AV	54.0	-0.6	2.18 H	336	21.4	32.0
5	4924.00	50.9 PK	74.0	-23.1	2.01 H	136	47.6	3.3
6	4924.00	39.1 AV	54.0	-14.9	2.01 H	136	35.8	3.3
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2462.00	113.5 PK			1.94 V	355	81.5	32.0
2	*2462.00	105.2 AV			1.94 V	355	73.2	32.0
3	2483.50	65.3 PK	74.0	-8.7	1.94 V	355	33.3	32.0
4	2483.50	52.3 AV	54.0	-1.7	1.94 V	355	20.3	32.0
5	4924.00	50.5 PK	74.0	-23.5	1.63 V	305	47.2	3.3
6	4924.00	38.8 AV	54.0	-15.2	1.63 V	305	35.5	3.3

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX VHT40	Channel	CH 3：2422 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	64.2 PK	74.0	-9.8	2.13 H	337	32.2	32.0
2	2390.00	52.7 AV	54.0	-1.3	2.13 H	337	20.7	32.0
3	*2422.00	110.3 PK			2.13 H	337	78.3	32.0
4	*2422.00	101.9 AV			2.13 H	337	69.9	32.0
5	4844.00	50.4 PK	74.0	-23.6	1.23 H	167	47.3	3.1
6	4844.00	38.6 AV	54.0	-15.4	1.23 H	167	35.5	3.1
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	63.4 PK	74.0	-10.6	1.95 V	352	31.4	32.0
2	2390.00	52.4 AV	54.0	-1.6	1.95 V	352	20.4	32.0
3	*2422.00	106.3 PK			1.95 V	352	74.3	32.0
4	*2422.00	97.6 AV			1.95 V	352	65.6	32.0
5	4844.00	50.2 PK	74.0	-23.8	1.78 V	216	47.1	3.1
6	4844.00	38.3 AV	54.0	-15.7	1.78 V	216	35.2	3.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX VHT40	Channel	CH 6：2437 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	118.7 PK			2.20 H	335	86.7	32.0
2	*2437.00	110.1 AV			2.20 H	335	78.1	32.0
3	4874.00	50.0 PK	74.0	-24.0	1.07 H	197	46.8	3.2
4	4874.00	39.4 AV	54.0	-14.6	1.07 H	197	36.2	3.2
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	115.1 PK			1.94 V	349	83.1	32.0
2	*2437.00	106.3 AV			1.94 V	349	74.3	32.0
3	4874.00	49.5 PK	74.0	-24.5	1.76 V	249	46.3	3.2
4	4874.00	39.0 AV	54.0	-15.0	1.76 V	249	35.8	3.2

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX VHT40	Channel	CH 9：2452 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2452.00	112.9 PK			2.35 H	334	81.0	31.9
2	*2452.00	103.8 AV			2.35 H	334	71.9	31.9
3	2483.50	63.8 PK	74.0	-10.2	2.35 H	334	31.8	32.0
4	2483.50	52.8 AV	54.0	-1.2	2.35 H	334	20.8	32.0
5	4904.00	50.9 PK	74.0	-23.1	1.65 H	32	47.7	3.2
6	4904.00	39.1 AV	54.0	-14.9	1.65 H	32	35.9	3.2
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2452.00	109.0 PK			1.96 V	322	77.1	31.9
2	*2452.00	100.1 AV			1.96 V	322	68.2	31.9
3	2483.50	63.3 PK	74.0	-10.7	1.96 V	322	31.3	32.0
4	2483.50	52.3 AV	54.0	-1.7	1.96 V	322	20.3	32.0
5	4904.00	50.1 PK	74.0	-23.9	1.68 V	311	46.9	3.2
6	4904.00	38.3 AV	54.0	-15.7	1.68 V	311	35.1	3.2

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

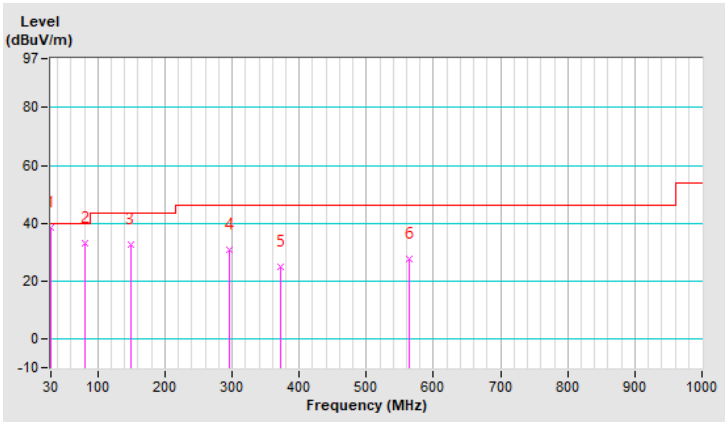
Below 1GHz worst-case data:

RF Mode	TX VHT20	Channel	CH 6：2437 MHz
Frequency Range	9kHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	30.00	38.7 QP	40.0	-1.3	1.01 H	153	53.1	-14.4
2	80.40	33.2 QP	40.0	-6.8	1.01 H	117	51.3	-18.1
3	148.30	32.4 QP	43.5	-11.1	1.01 H	71	45.6	-13.2
4	296.80	30.9 QP	46.0	-15.1	1.01 H	231	43.4	-12.5
5	371.40	25.1 QP	46.0	-20.9	1.01 H	199	35.7	-10.6
6	563.50	27.5 QP	46.0	-18.5	1.51 H	94	34.1	-6.6

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value.
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

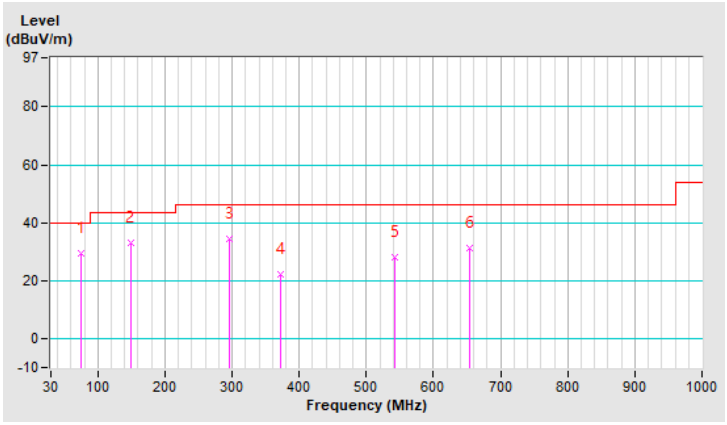


RF Mode	TX VHT20	Channel	CH 6：2437 MHz
Frequency Range	9kHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	75.60	29.7 QP	40.0	-10.3	1.00 V	99	46.5	-16.9
2	148.30	33.3 QP	43.5	-10.2	1.00 V	63	46.4	-13.2
3	296.80	34.4 QP	46.0	-11.6	1.49 V	230	46.9	-12.5
4	371.40	22.2 QP	46.0	-23.8	1.00 V	332	32.8	-10.6
5	542.20	27.9 QP	46.0	-18.1	1.49 V	103	35.0	-7.1
6	654.70	31.1 QP	46.0	-14.9	1.00 V	200	35.7	-4.7

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value.
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



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 0.50MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESR3	102412	Jan. 22, 2022	Jan. 21, 2023
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 04, 2021	Sep. 03, 2022
LISN/AMN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Feb. 17, 2022	Feb. 16, 2023
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Sep. 17, 2021	Sep. 16, 2022
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. Tested date: Jul. 02, 2022

4.2.3 Test Procedures

a. 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/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

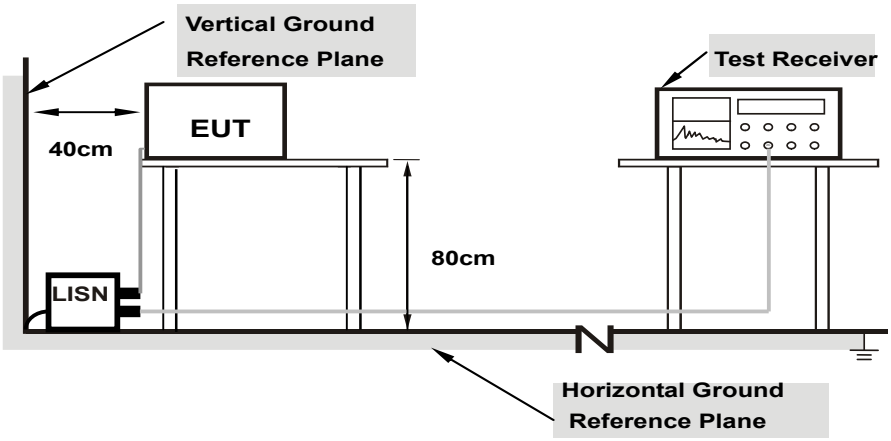
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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

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

Same as 4.1.6.

4.2.7 Test Results

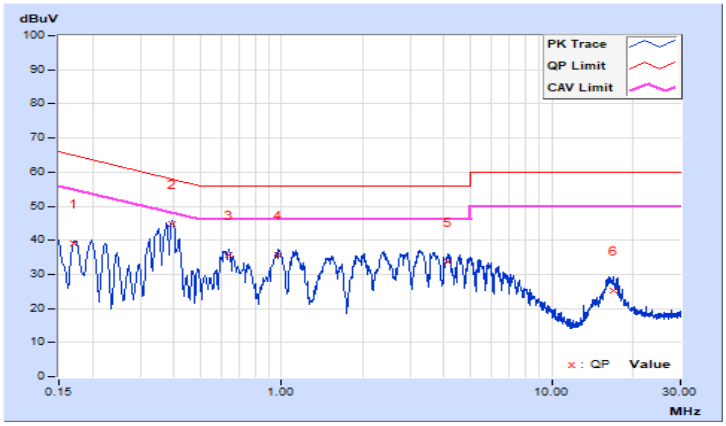
Worst-case data: VHT20

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16977	10.13	28.84	25.03	38.97	35.16	64.97	54.97	-26.00	-19.81
2	**0.39238**	**10.16**	**34.74**	**30.68**	**44.90**	**40.84**	**58.01**	**48.01**	**-13.11**	**-7.17**
3	0.63800	10.17	25.49	18.99	35.66	29.16	56.00	46.00	-20.34	-16.84
4	0.97400	10.19	25.52	18.53	35.71	28.72	56.00	46.00	-20.29	-17.28
5	4.15400	10.25	23.33	14.74	33.58	24.99	56.00	46.00	-22.42	-21.01
6	16.83800	10.36	14.96	9.30	25.32	19.66	60.00	50.00	-34.68	-30.34

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.

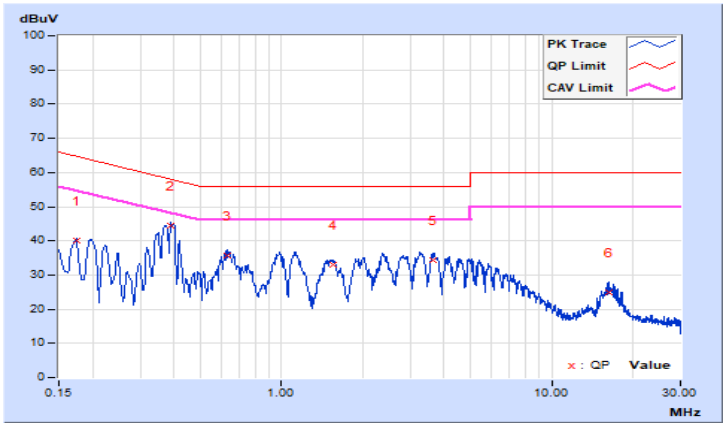


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.17384	10.14	29.76	26.99	39.90	37.13	64.77	54.77	-24.87	-17.64
2	0.39000	10.17	34.36	27.56	44.53	37.73	58.06	48.06	-13.53	-10.33
3	0.63400	10.18	25.42	16.18	35.60	26.36	56.00	46.00	-20.40	-19.64
4	1.55638	10.22	22.76	14.98	32.98	25.20	56.00	46.00	-23.02	-20.80
5	3.65800	10.26	24.12	16.79	34.38	27.05	56.00	46.00	-21.62	-18.95
6	16.22600	10.46	14.45	8.81	24.91	19.27	60.00	50.00	-35.09	-30.73

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.

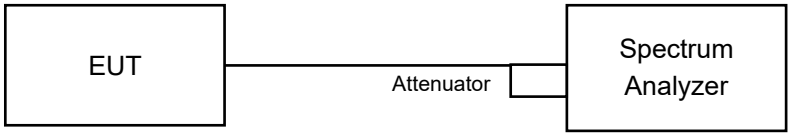


4.3 6dB Bandwidth Measurement

4.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB 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

a. Set resolution bandwidth (RBW) = 100kHz.
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. 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 Result

802.11b

Channel	Frequency (MHz)	6dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	9.08	8.15	0.5	Pass
6	2437	8.08	8.58	0.5	Pass
11	2462	8.58	8.57	0.5	Pass

802.11g

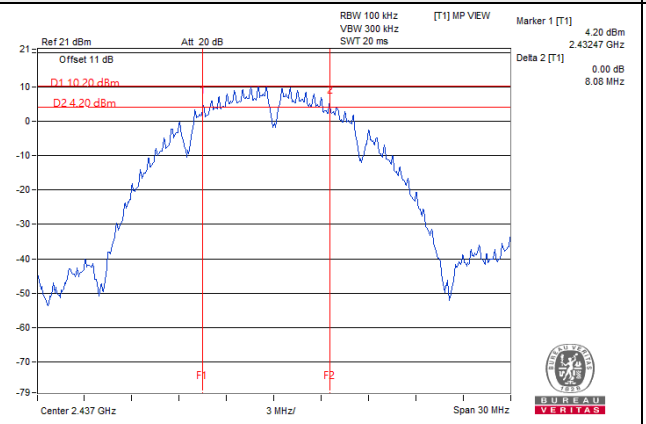
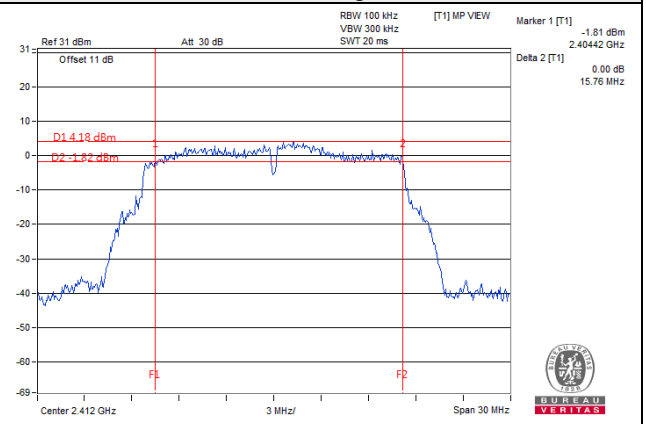
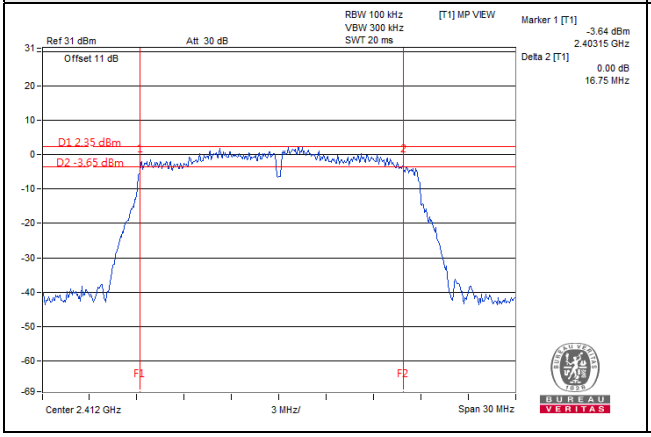
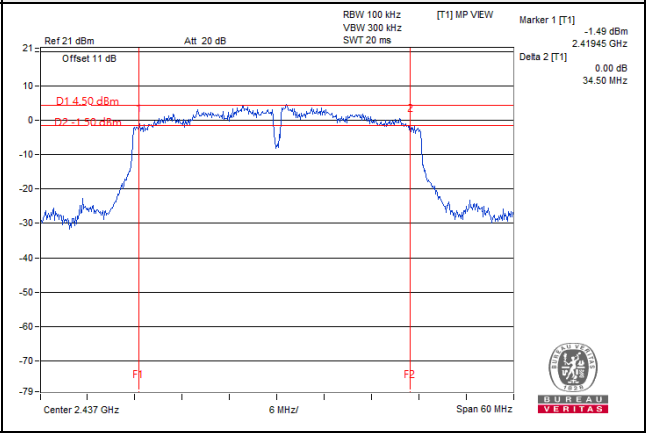
Channel	Frequency (MHz)	6dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	16.12	15.76	0.5	Pass
6	2437	16.36	16.39	0.5	Pass
11	2462	16.36	16.39	0.5	Pass

VHT20

Channel	Frequency (MHz)	6dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	16.75	17.03	0.5	Pass
6	2437	17.66	17.60	0.5	Pass
11	2462	17.60	17.60	0.5	Pass

VHT40

Channel	Frequency (MHz)	6dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
3	2422	35.84	35.85	0.5	Pass
6	2437	36.34	34.50	0.5	Pass
9	2452	35.75	36.17	0.5	Pass

Spectrum Plot of Worst Value	
802.11b	802.11g
	
VHT20	VHT40
	

4.4 Conducted Output Power Measurement

4.4.1 Limits of Conducted Output Power Measurement

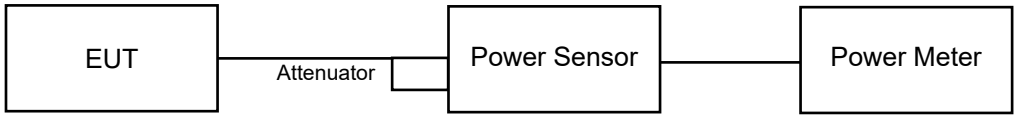
For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

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.

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 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.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Conditions

Same as item 4.3.6.

4.4.7 Test Results

Peak Power

802.11b

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.60	21.05	242.166	23.84	28.55	Pass
6	2437	21.85	22.10	315.290	24.99	28.55	Pass
11	2462	21.76	22.64	333.622	25.23	28.55	Pass

Note: The maximum gain is 7.45 dBi > 6 dBi, so the output power limit shall be reduced to 30-(7.45-6) = 28.55 dBm.

802.11g

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	23.14	23.52	430.968	26.34	28.55	Pass
6	2437	25.31	25.36	683.183	28.35	28.55	Pass
11	2462	23.41	23.52	444.186	26.48	28.55	Pass

Note: The maximum gain is 7.45 dBi > 6 dBi, so the output power limit shall be reduced to 30-(7.45-6) = 28.55 dBm.

VHT20

Channel	Frequency (MHz)	Peak Power (dBm))		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	23.14	23.50	429.935	26.33	28.55	Pass
6	2437	25.33	25.42	**689.530**	28.39	28.55	Pass
11	2462	22.36	23.87	415.968	26.19	28.55	Pass

Note: The maximum gain is 7.45 dBi > 6 dBi, so the output power limit shall be reduced to 30-(7.45-6) = 28.55 dBm.

VHT40

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	21.85	21.99	311.234	24.93	28.55	Pass
6	2437	25.15	25.38	672.484	28.28	28.55	Pass
9	2452	23.10	23.41	423.454	26.27	28.55	Pass

Note: The maximum gain is 7.45 dBi > 6 dBi, so the output power limit shall be reduced to 30-(7.45-6) = 28.55 dBm.

Average Power

802.11b

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	18.76	19.01	154.778	21.90
6	2437	20.03	20.08	202.552	23.07
11	2462	20.08	20.24	207.541	23.17

802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	15.62	15.81	74.582	18.73
6	2437	20.06	20.13	204.430	23.11
11	2462	15.93	16.89	88.039	19.45

VHT20

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	15.43	15.63	71.474	18.54
6	2437	20.02	20.15	203.976	23.10
11	2462	15.21	16.21	74.972	18.75

VHT40

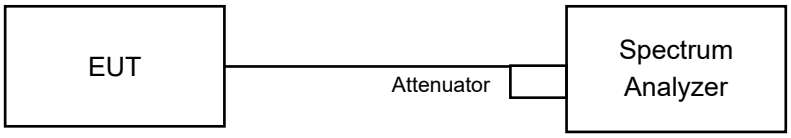
Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	12.11	12.16	32.699	15.15
6	2437	19.79	20.51	207.740	23.18
9	2452	15.42	16.19	76.425	18.83

4.5 Power Spectral Density Measurement

4.5.1 Limits of Power Spectral Density Measurement

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

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 Procedure

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ 3 × RBW.
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Condition

Same as item 4.3.6.

4.5.7 Test Results

802.11b

TX chain	Channel	Frequency (MHz)	PSD (dBm/3kHz)	10 log (N=2) dB	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
0	1	2412	-4.93	3.01	-1.92	3.82	Pass
	6	2437	-3.66	3.01	-0.65	3.82	Pass
	11	2462	-2.90	3.01	0.11	3.82	Pass
1	1	2412	-4.35	3.01	-1.34	3.82	Pass
	6	2437	-3.29	3.01	-0.28	3.82	Pass
	11	2462	-2.68	3.01	0.33	3.82	Pass

Note:
1. Method E) 2) c) of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = Directional gain = 10 log[$(10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20})^2/2$]=10.18dBi > 6dBi, so the power density limit shall be reduced to 8 - (10.18 - 6) = 3.82dBm.

802.11g

TX chain	Channel	Frequency (MHz)	PSD (dBm/3kHz)	10 log (N=2) dB	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
0	1	2412	-8.76	3.01	-5.75	3.82	Pass
	6	2437	-5.54	3.01	-2.53	3.82	Pass
	11	2462	-8.15	3.01	-5.14	3.82	Pass
1	1	2412	-8.31	3.01	-5.30	3.82	Pass
	6	2437	-5.12	3.01	-2.11	3.82	Pass
	11	2462	-7.67	3.01	-4.66	3.82	Pass

Note:
1. Method E) 2) c) of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = Directional gain = 10 log[$(10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20})^2/2$]=10.18dBi > 6dBi, so the power density limit shall be reduced to 8 - (10.18 - 6) = 3.82dBm.

VHT20

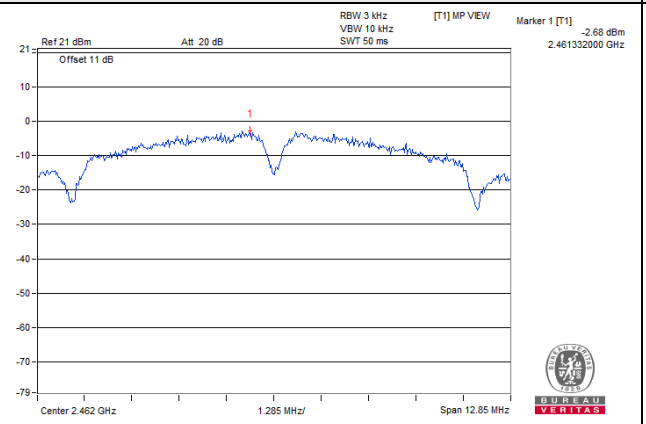
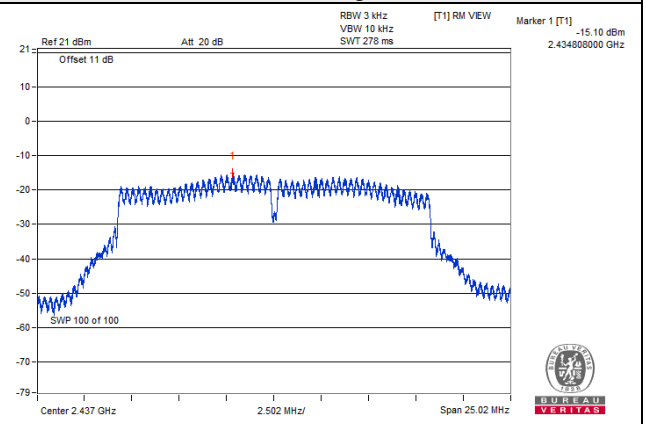
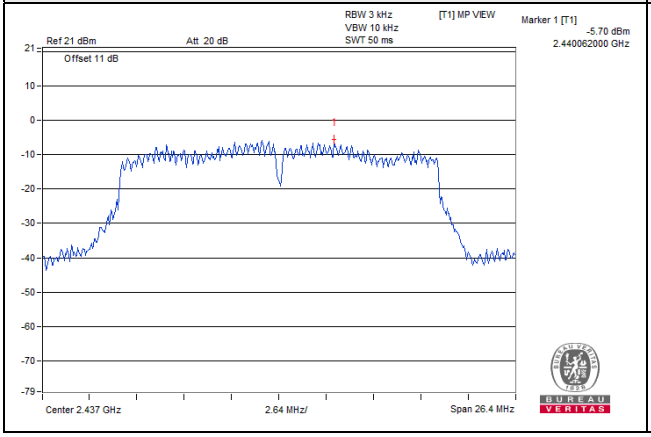
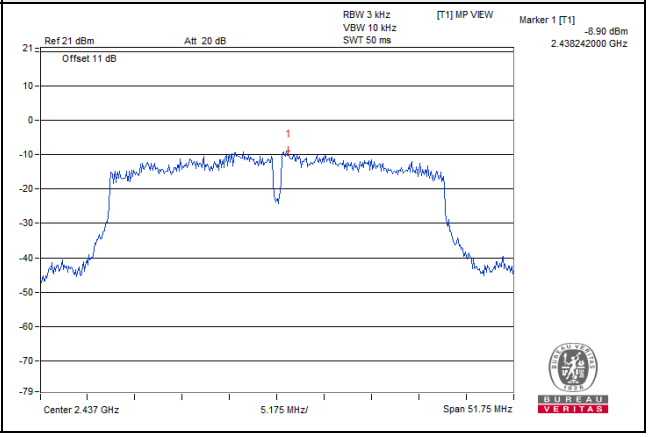
TX chain	Channel	Frequency (MHz)	PSD (dBm/3kHz)	10 log (N=2) dB	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
0	1	2412	-8.49	3.01	-5.48	3.82	Pass
	6	2437	-6.06	3.01	-3.05	3.82	Pass
	11	2462	-8.52	3.01	-5.51	3.82	Pass
1	1	2412	-8.03	3.01	-5.02	3.82	Pass
	6	2437	-5.70	3.01	-2.69	3.82	Pass
	11	2462	-8.04	3.01	-5.03	3.82	Pass

Note:
1. Method E) 2) c) of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = Directional gain = 10 log[$(10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20})^2/2$]=10.18dBi > 6dBi, so the power density limit shall be reduced to 8 - (10.18 - 6) = 3.82dBm.

VHT40

TX chain	Channel	Frequency (MHz)	PSD (dBm/3kHz)	10 log (N=2) dB	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass / Fail
0	3	2422	-15.44	3.01	-12.43	3.82	Pass
	6	2437	-9.21	3.01	-6.20	3.82	Pass
	9	2452	-12.66	3.01	-9.65	3.82	Pass
1	3	2422	-15.32	3.01	-12.31	3.82	Pass
	6	2437	-8.90	3.01	-5.89	3.82	Pass
	9	2452	-12.02	3.01	-9.01	3.82	Pass

Note:
1. Method E) 2) c) of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain = Directional gain = 10 log[$(10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20})^2/2$]=10.18dBi > 6dBi, so the power density limit shall be reduced to 8 - (10.18 - 6) = 3.82dBm.

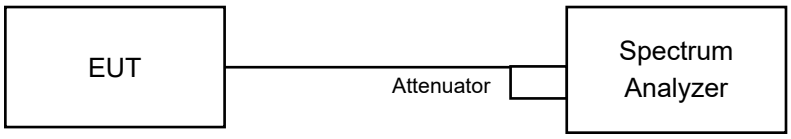
Spectrum Plot of Worst Value	
802.11b	802.11g
	
VHT20	VHT40
	

4.6 Conducted Out of Band Emission Measurement

4.6.1 Limits of Conducted Out of Band Emission Measurement

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

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

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 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 ≥ 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.

4.6.5 Deviation from Test Standard

No deviation.

4.6.6 EUT Operating Condition

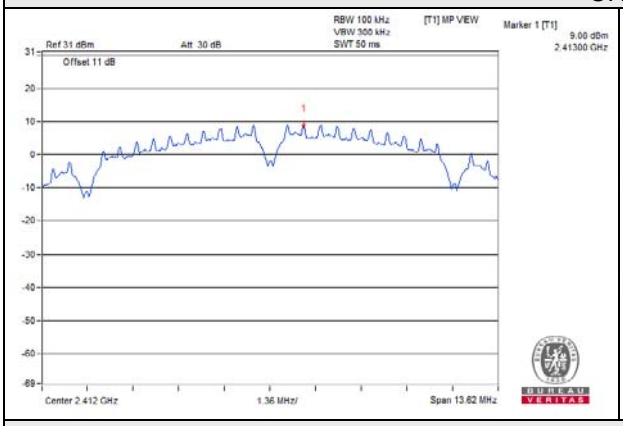
Same as item 4.3.6.

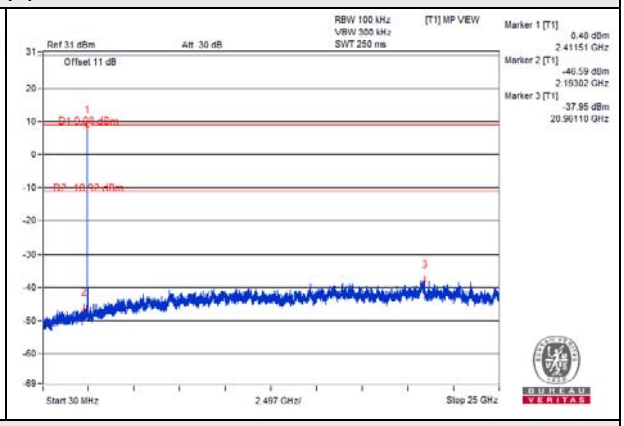
4.6.7 Test Results

The conducted emission test is performed on each TX port of operating mode without summing or adding 10log (N) since the limit is relative emission limit.
The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

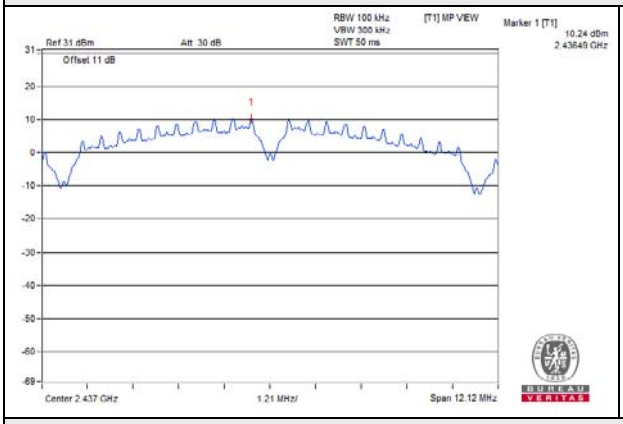
802.11b_Chain 0

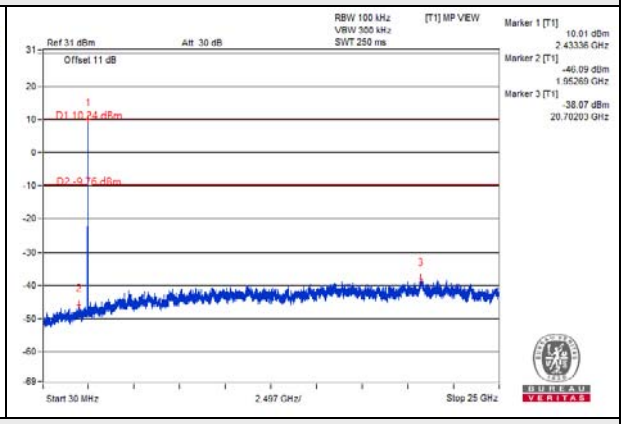
CH 1



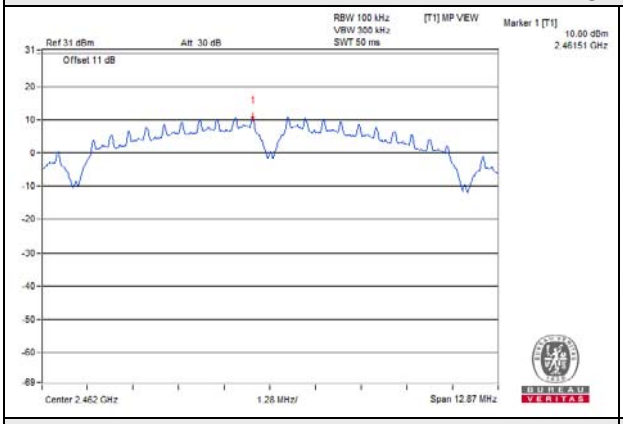


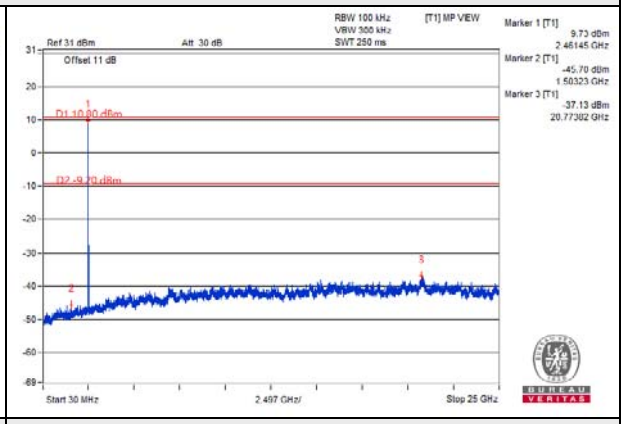
CH 6



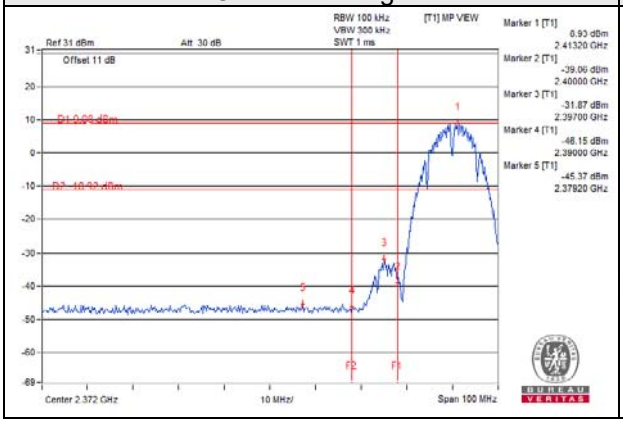


CH 11

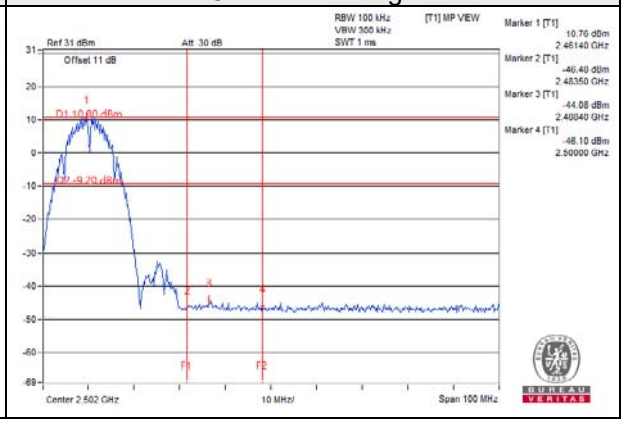




CH 1 Band edge

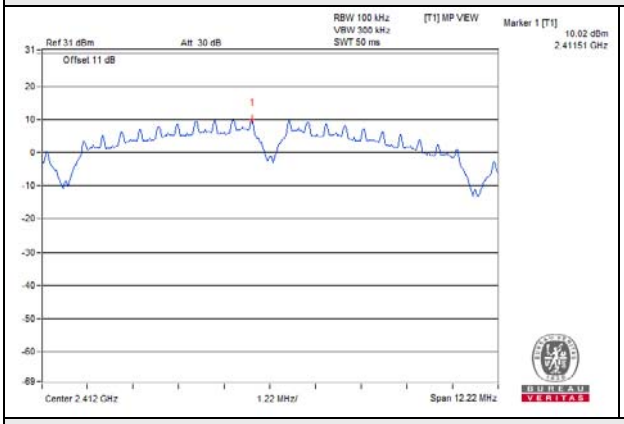


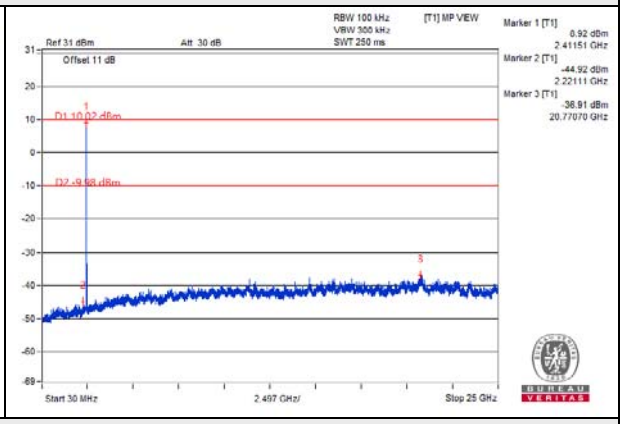
CH 11 Band edge



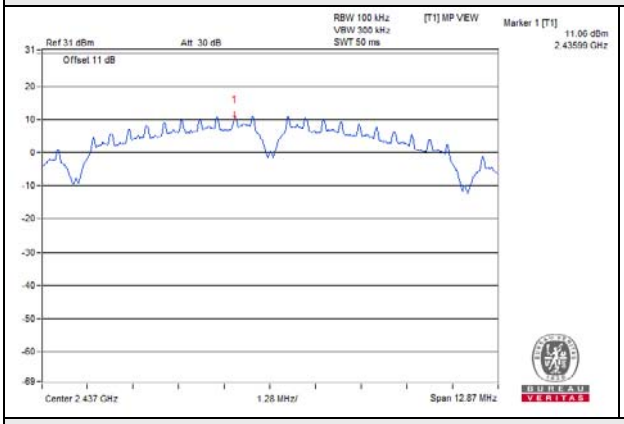
802.11b_Chain 1

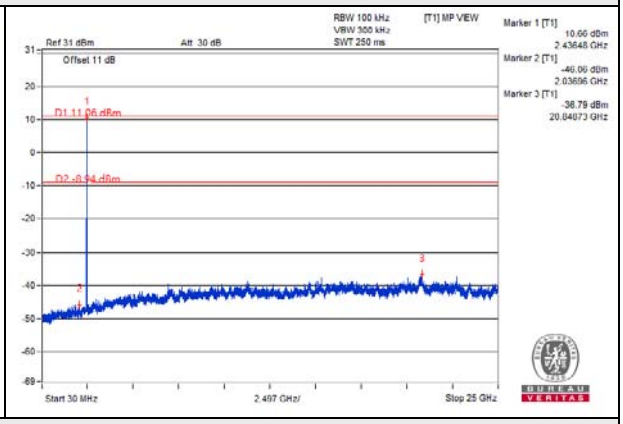
CH 1



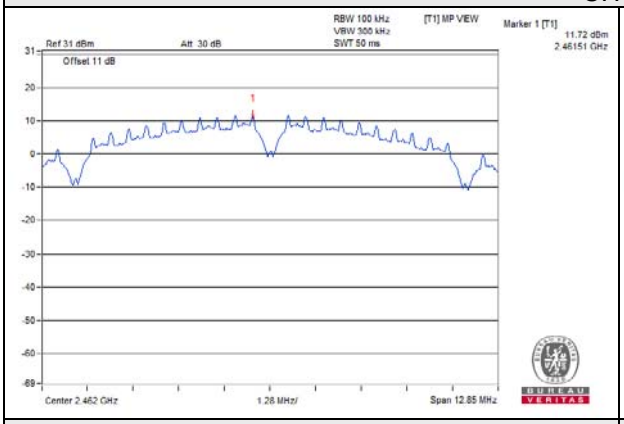


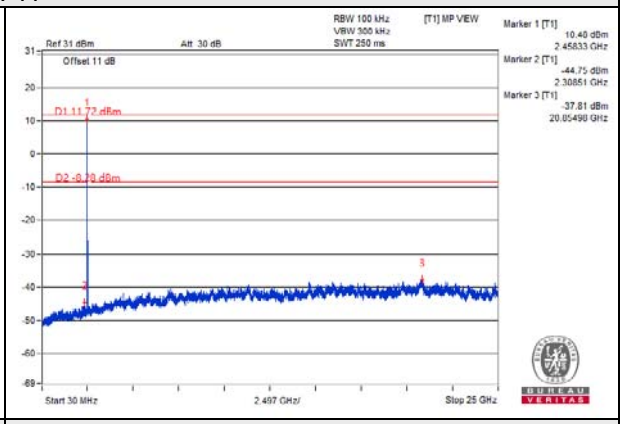
CH 6



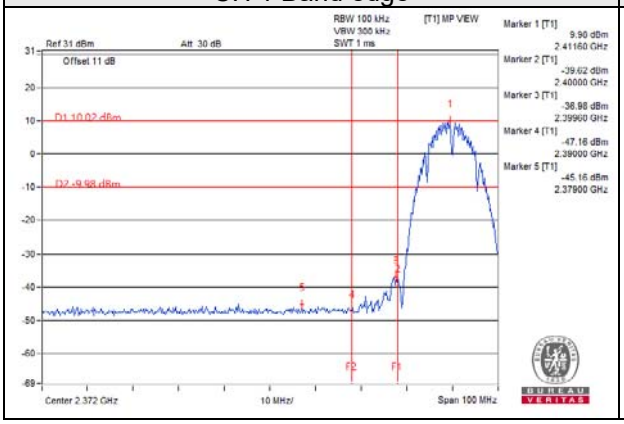


CH 11

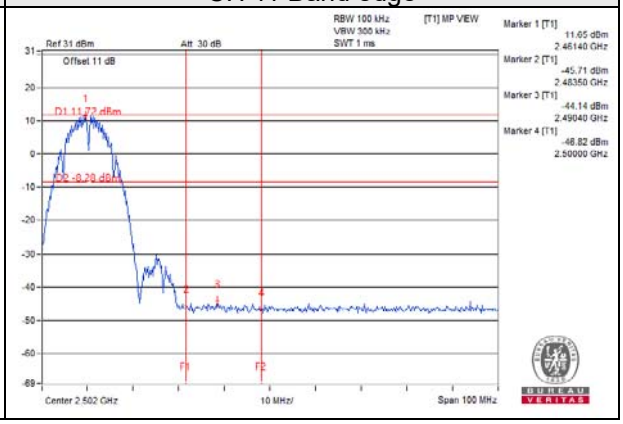




CH 1 Band edge

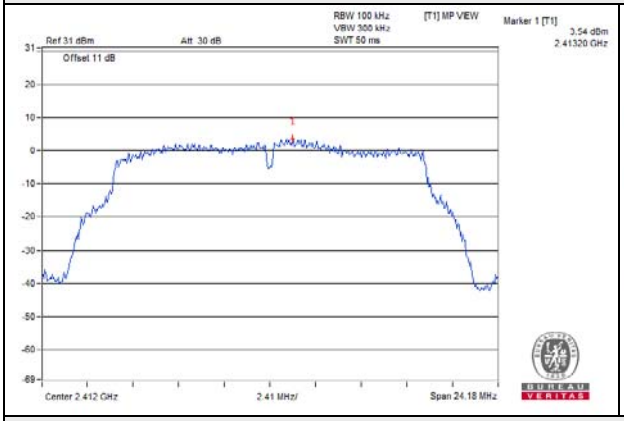


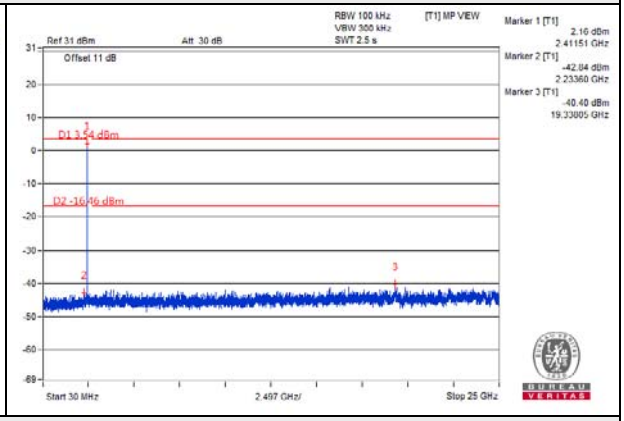
CH 11 Band edge



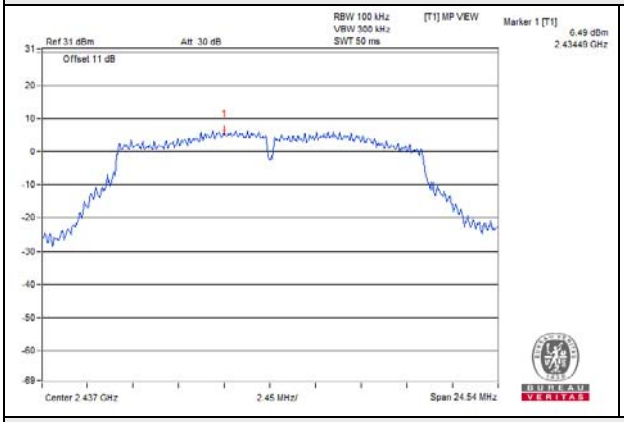
802.11g_Chain 0

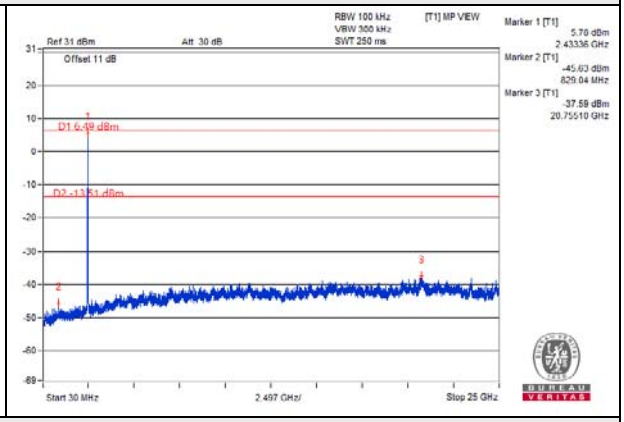
CH 1



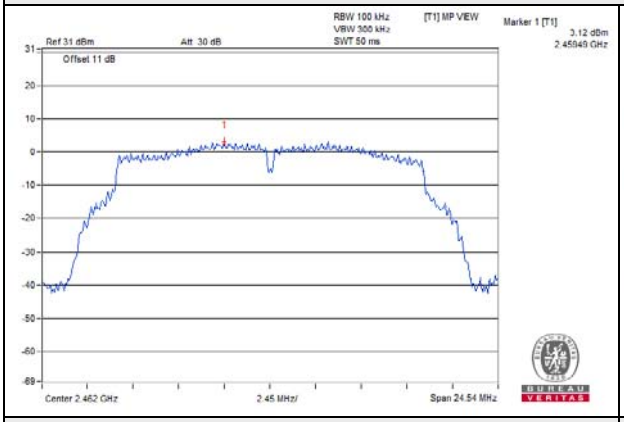


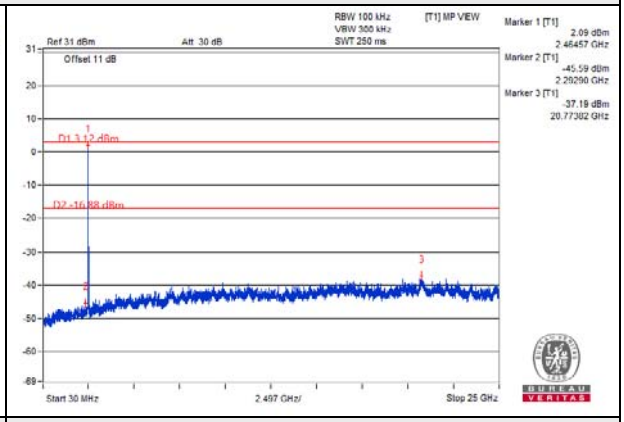
CH 6



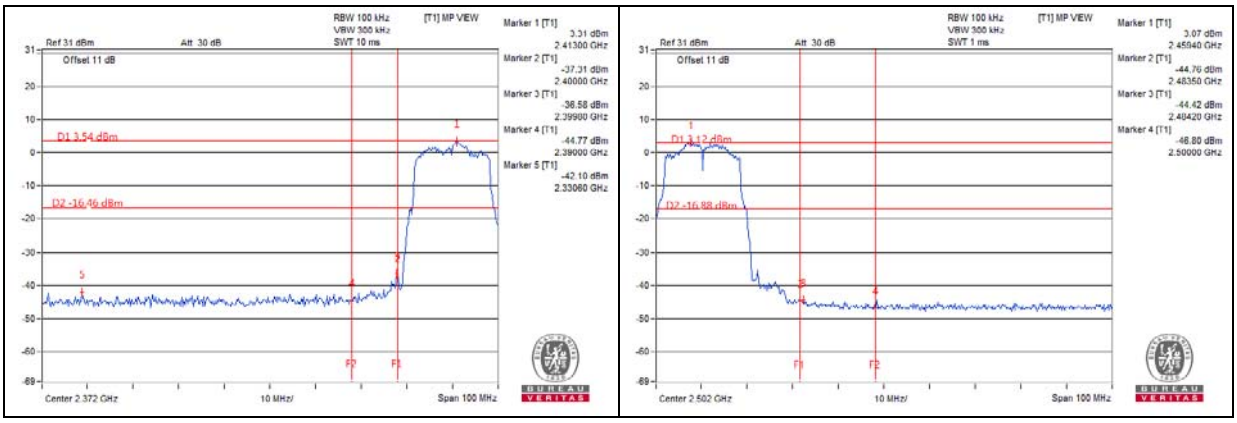


CH 11



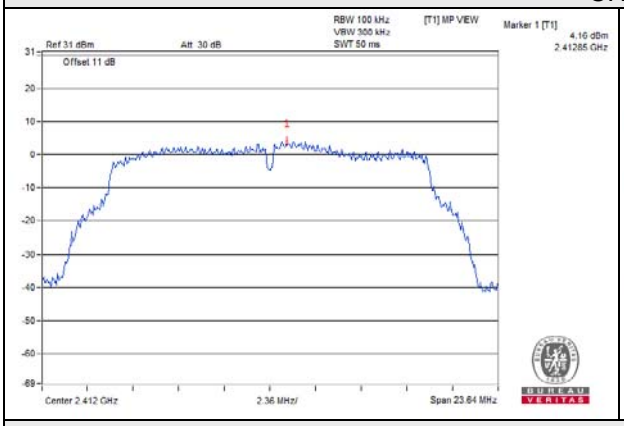


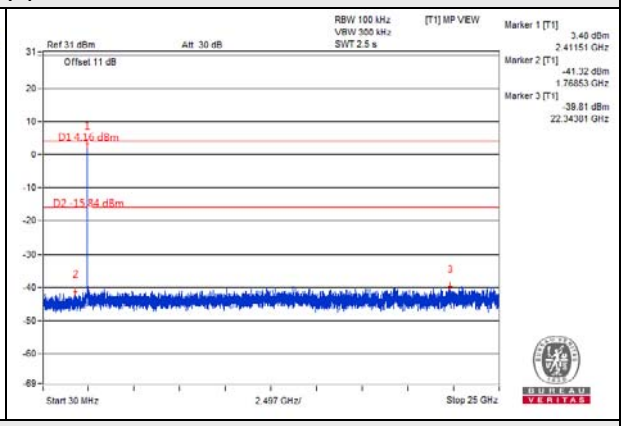
CH 1 Band edge	CH 11 Band edge


RBW 100 kHz
VBW 300 kHz
SWT 10 ms
[T1] MP VIEW
Ref 31 dBm
Att 30 dB
Offset 11 dB
D1 3.54 dBm
D2 -16.46 dBm
Marker 1 [T1]
3.31 dBm
2.41300 GHz
Marker 2 [T1]
-37.31 dBm
2.40000 GHz
Marker 3 [T1]
-36.58 dBm
2.39990 GHz
Marker 4 [T1]
-44.77 dBm
2.39000 GHz
Marker 5 [T1]
-42.10 dBm
2.33060 GHz
Center 2.372 GHz
10 MHz/
Span 100 MHz
RBW 100 kHz
VBW 300 kHz
SWT 1 ms
[T1] MP VIEW
Ref 31 dBm
Att 30 dB
Offset 11 dB
D1 3.12 dBm
D2 -16.88 dBm
Marker 1 [T1]
3.07 dBm
2.45940 GHz
Marker 2 [T1]
-44.76 dBm
2.48350 GHz
Marker 3 [T1]
-44.42 dBm
2.48420 GHz
Marker 4 [T1]
-46.80 dBm
2.50000 GHz
Center 2.502 GHz
10 MHz/
Span 100 MHz

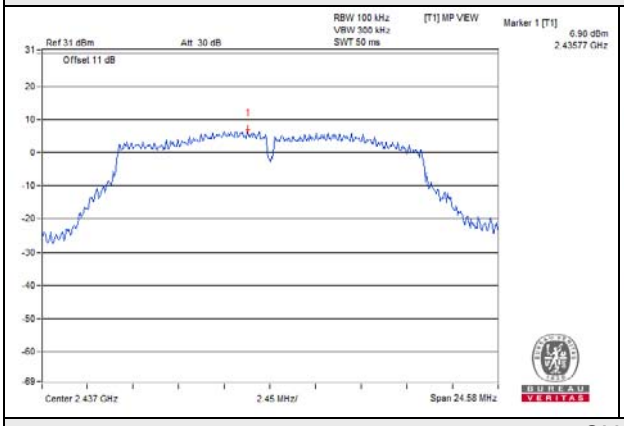
802.11g_Chain 1

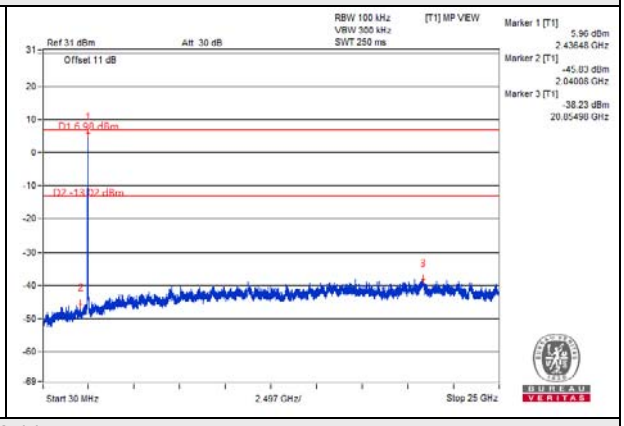
CH 1



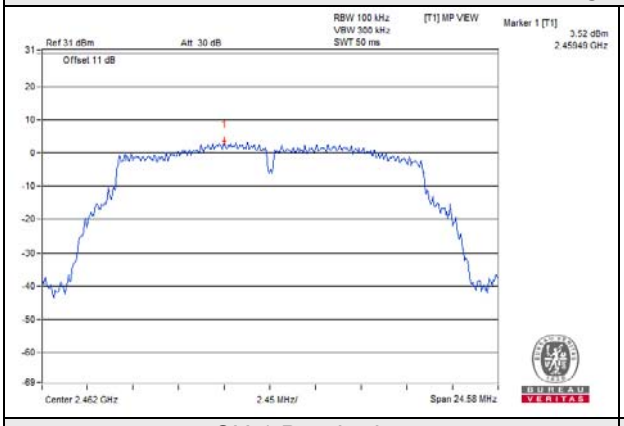


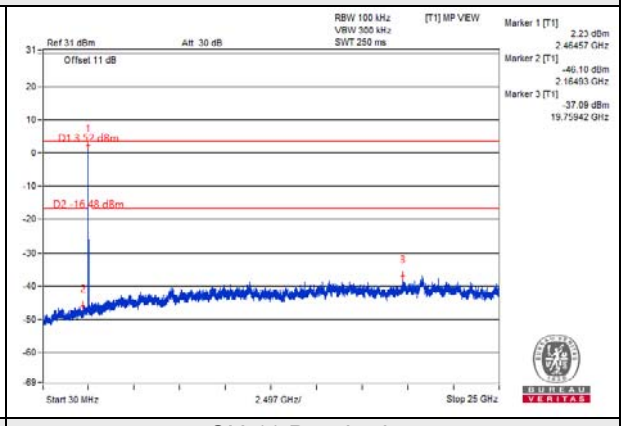
CH 6



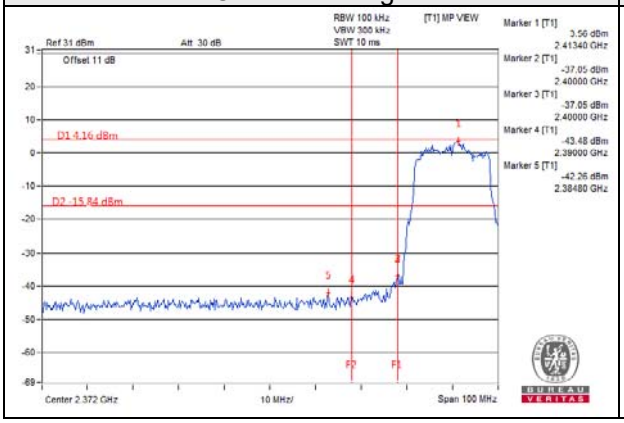


CH 11

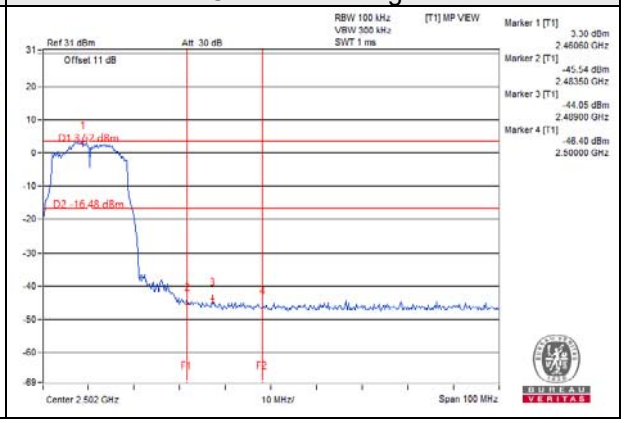




CH 1 Band edge

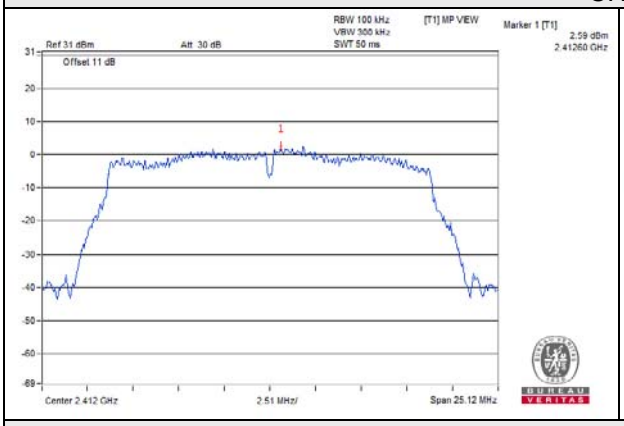


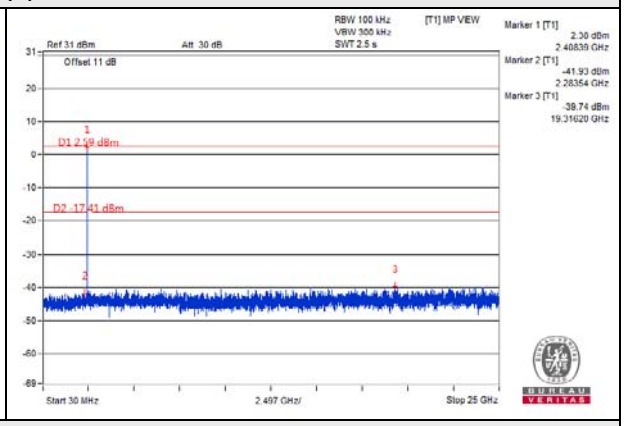
CH 11 Band edge



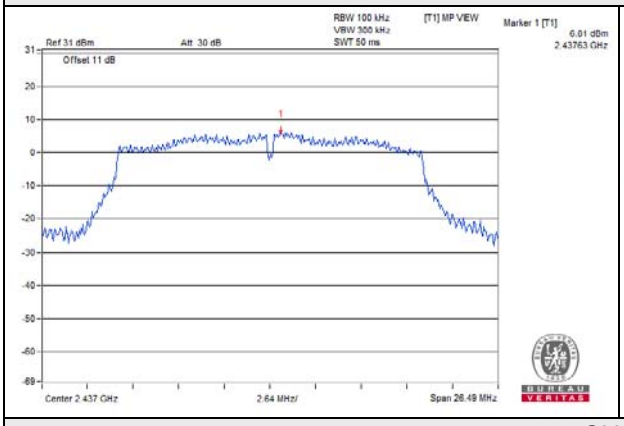
VHT20_Chain 0

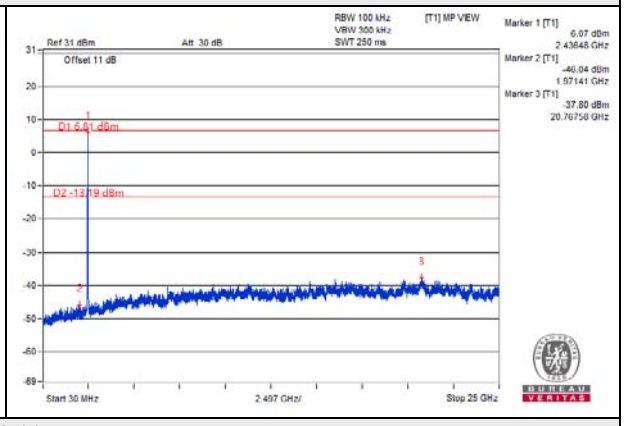
CH 1



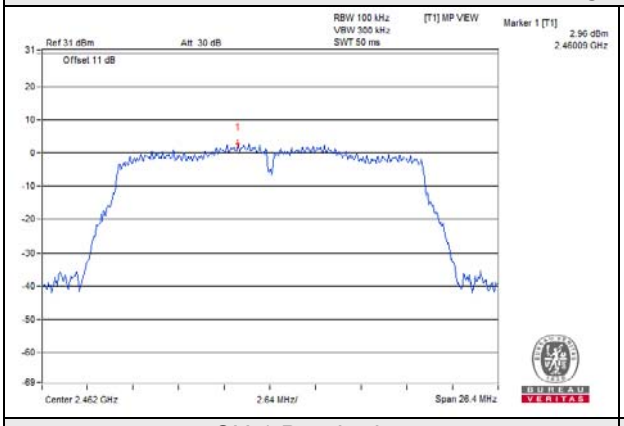


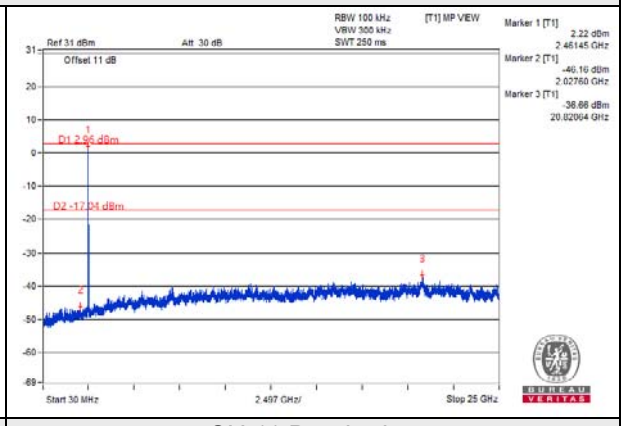
CH 6



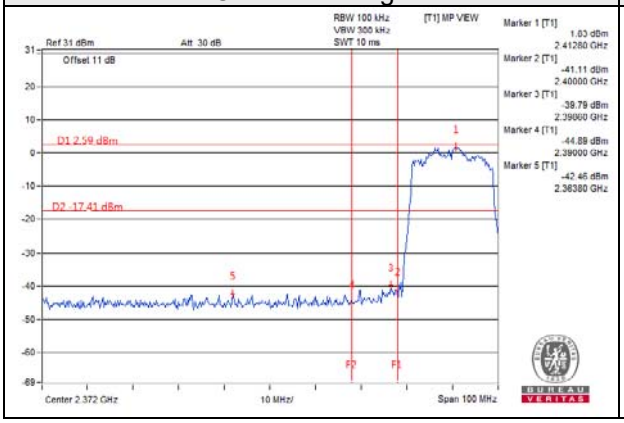


CH 11

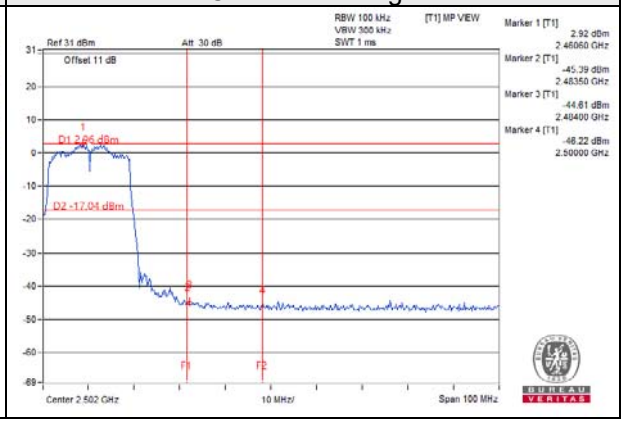




CH 1 Band edge

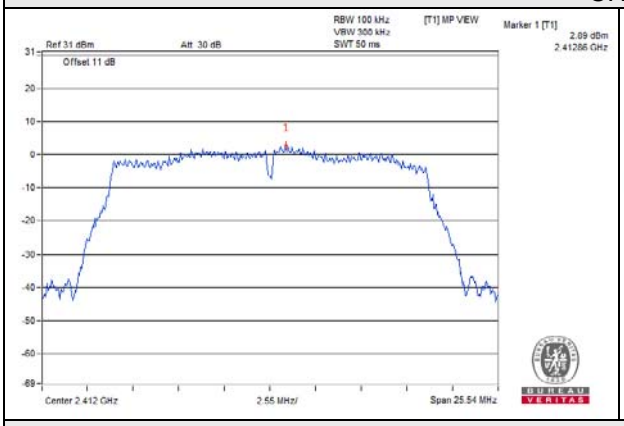


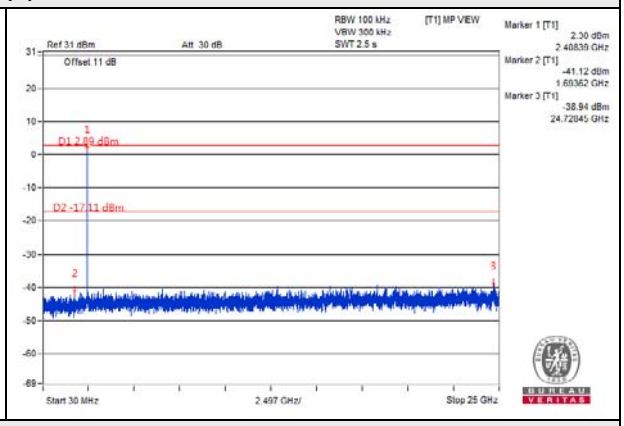
CH 11 Band edge



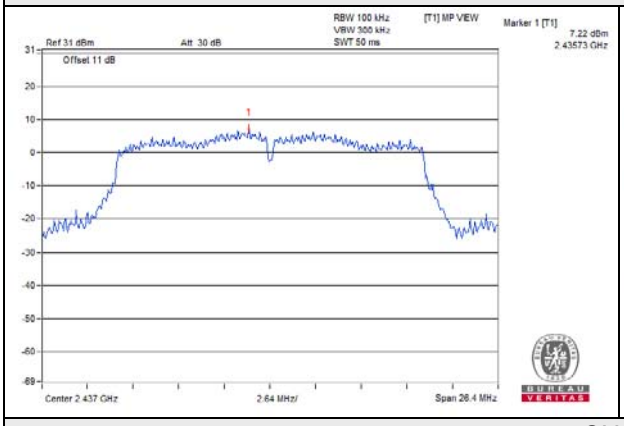
VHT20_Chain 1

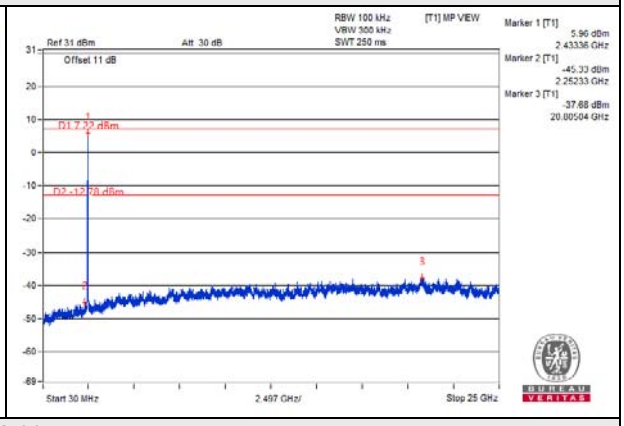
CH 1



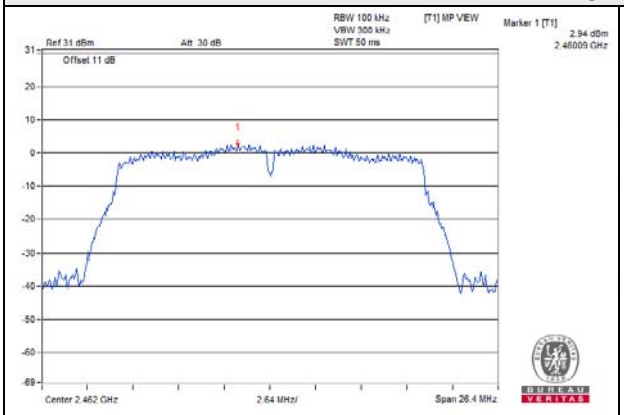


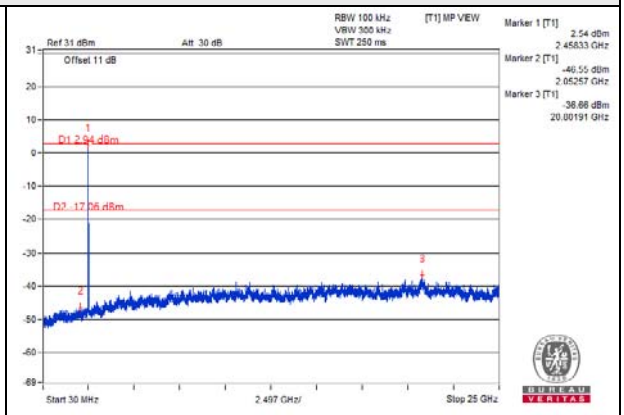
CH 6



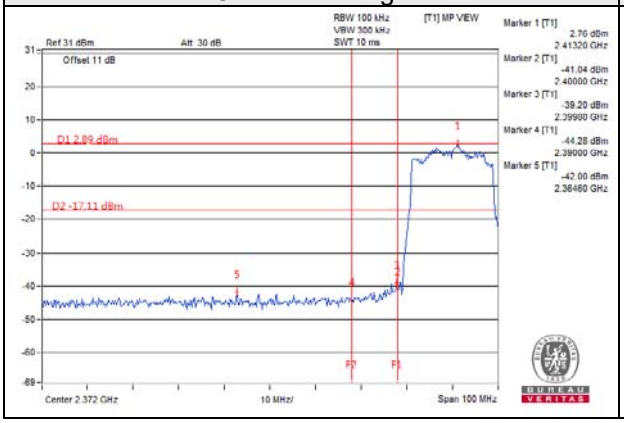


CH 11

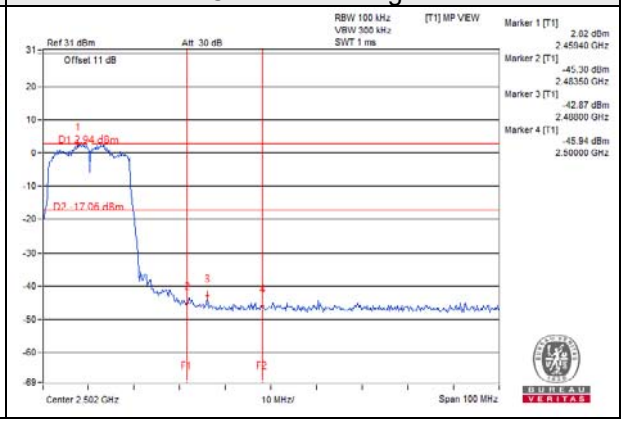




CH 1 Band edge

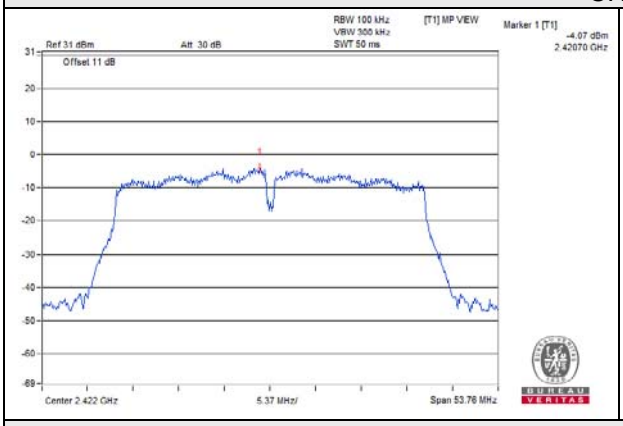


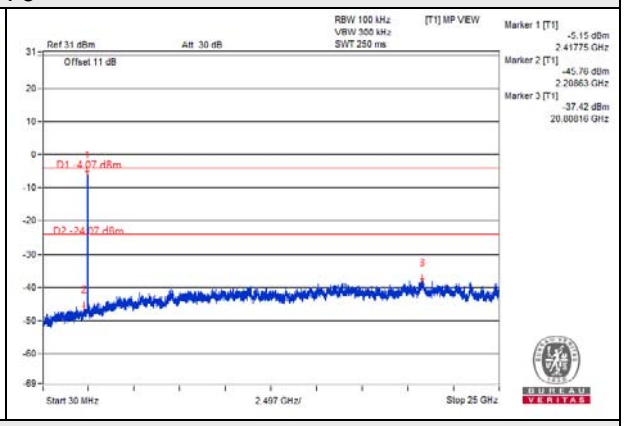
CH 11 Band edge



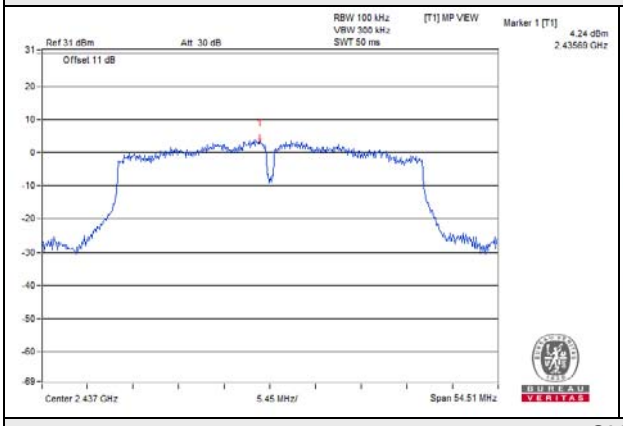
VHT40_Chain 0

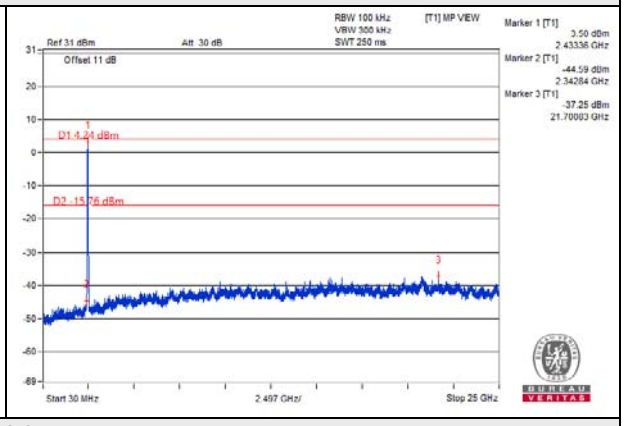
CH 3



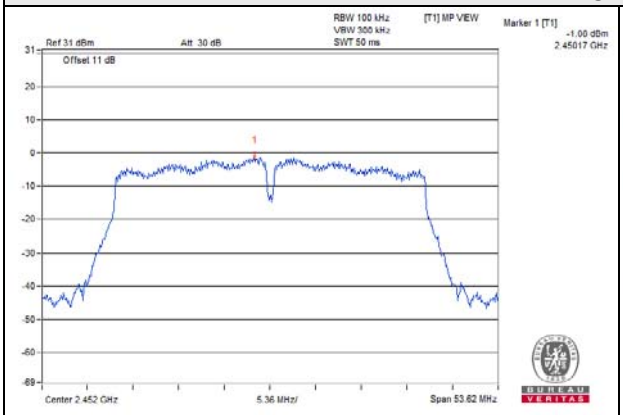


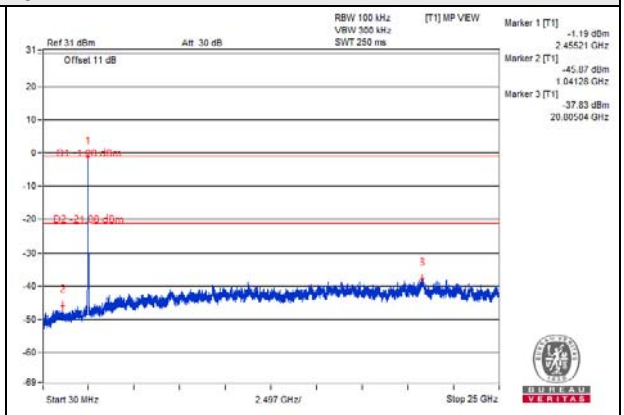
CH 6



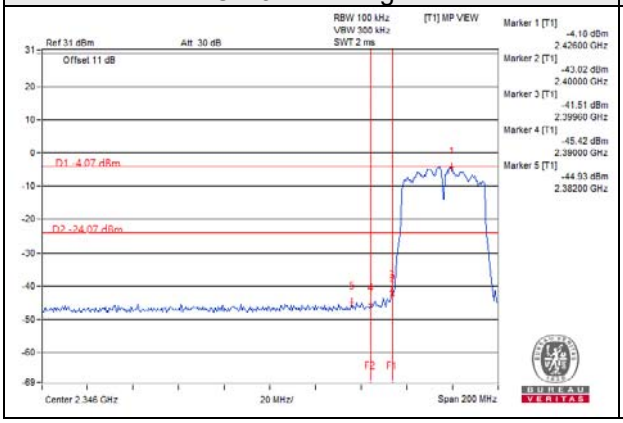


CH 9

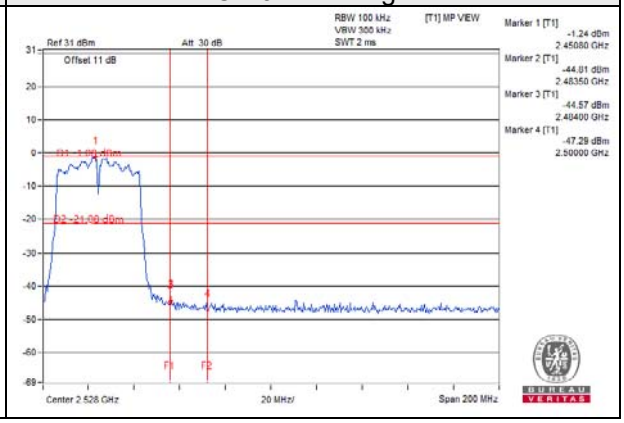




CH 3 Band edge

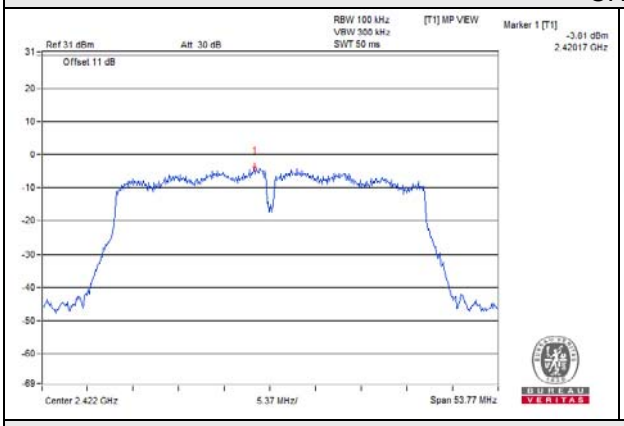


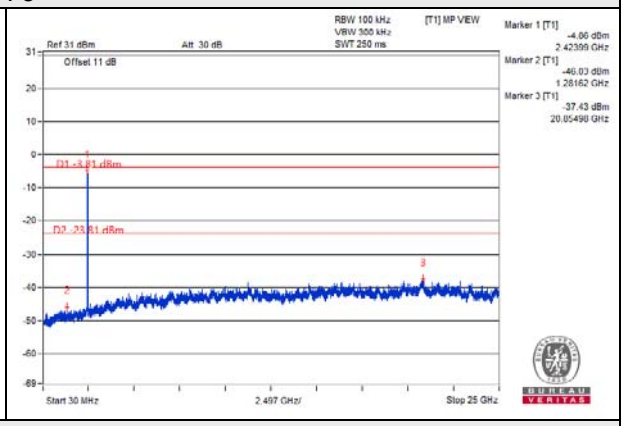
CH 9 Band edge



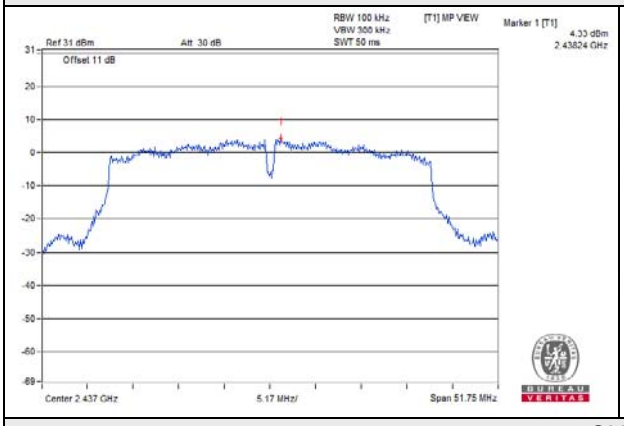
VHT40_Chain 1

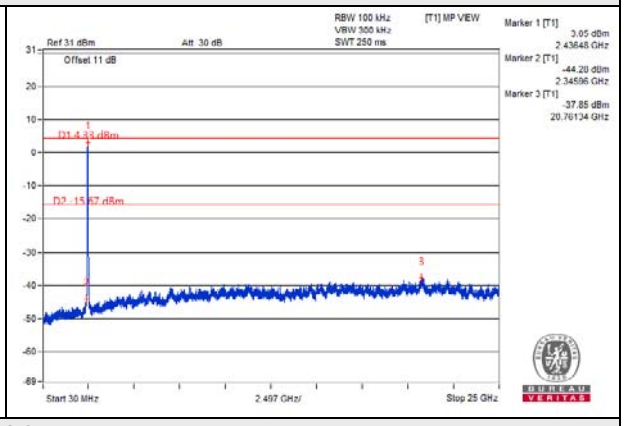
CH 3



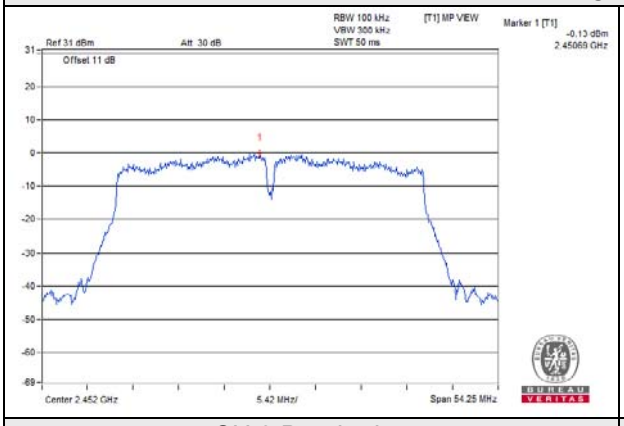


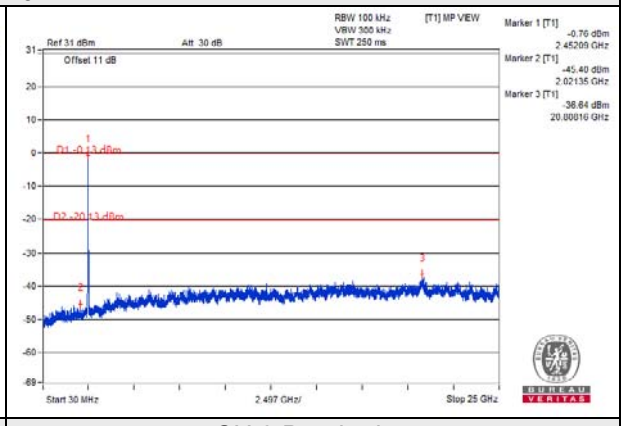
CH 6



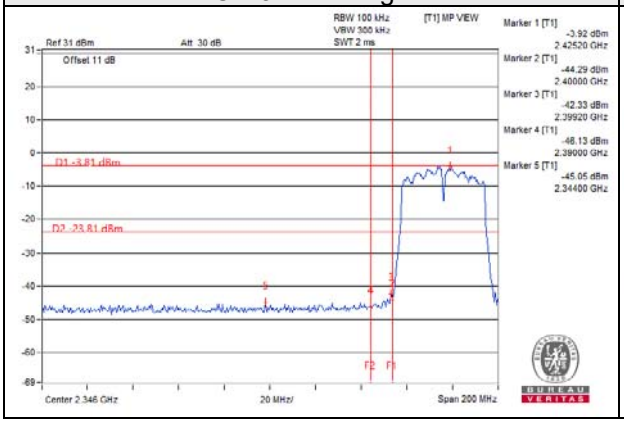


CH 9

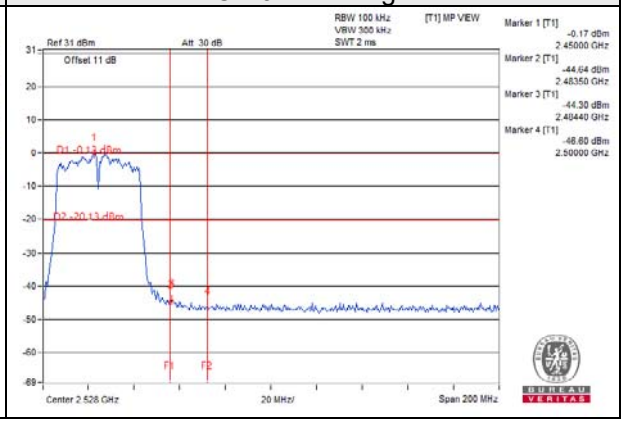




CH 3 Band edge



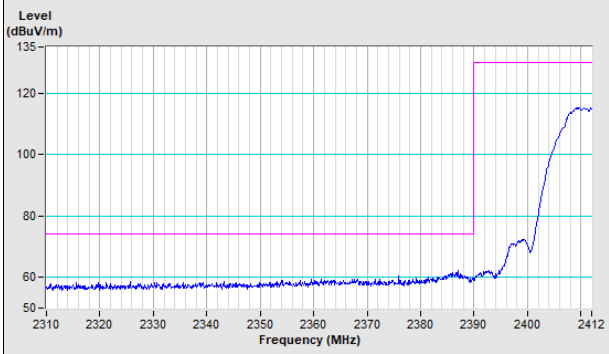
CH 9 Band edge



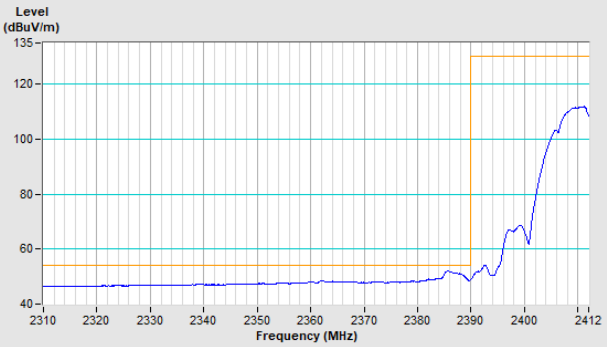
Annex A- Band Edge Measurement

802.11b Channel 1

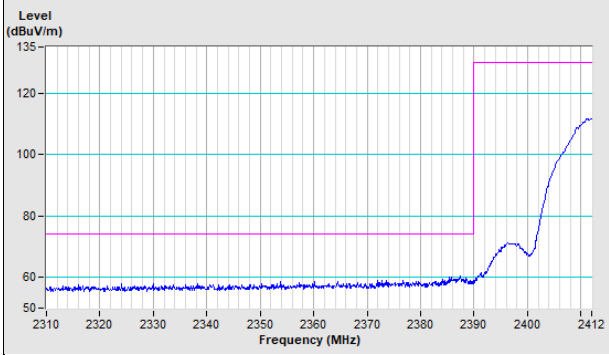
Horizontal (Peak)



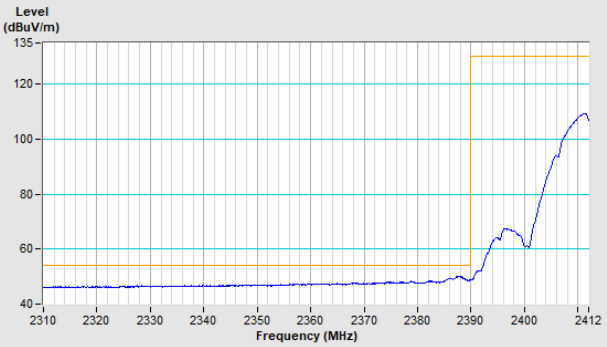
Horizontal (Average)



Vertical (Peak)

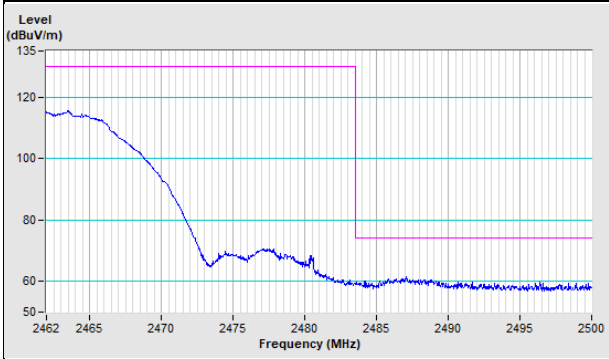


Vertical (Average)

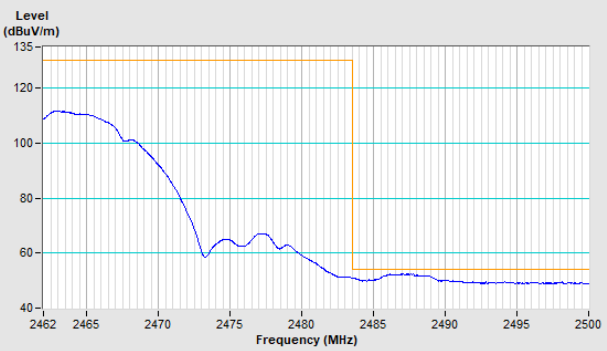


802.11b Channel 11

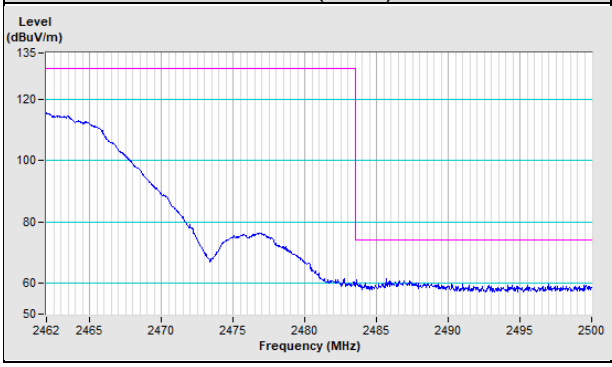
Horizontal (Peak)



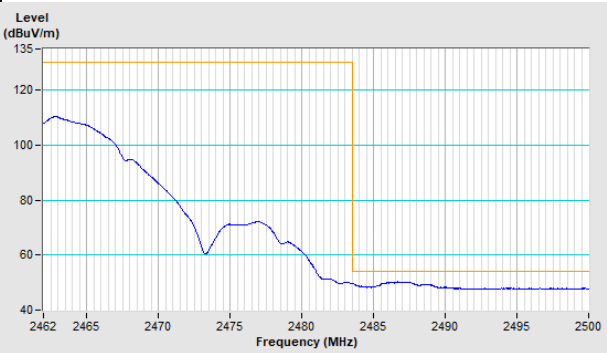
Horizontal (Average)

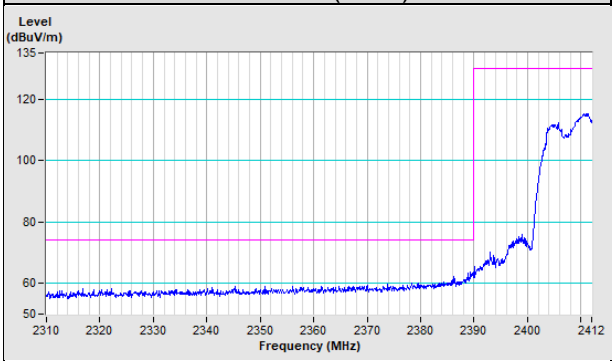
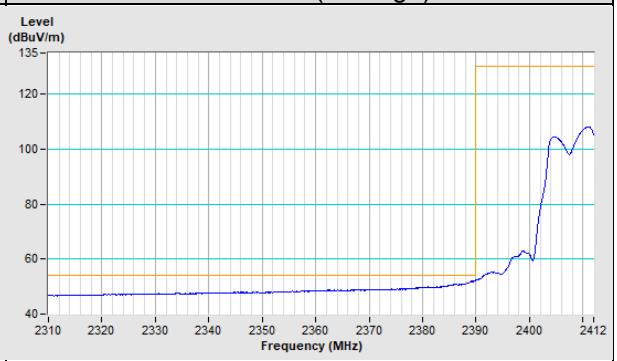
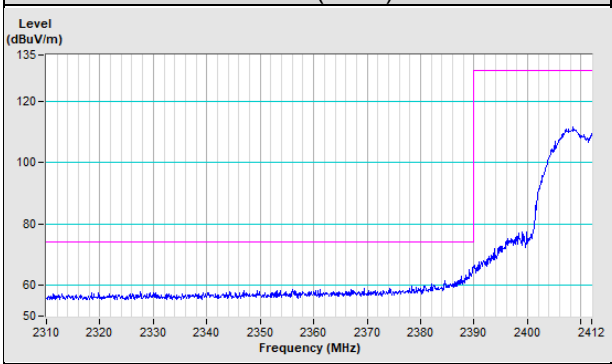
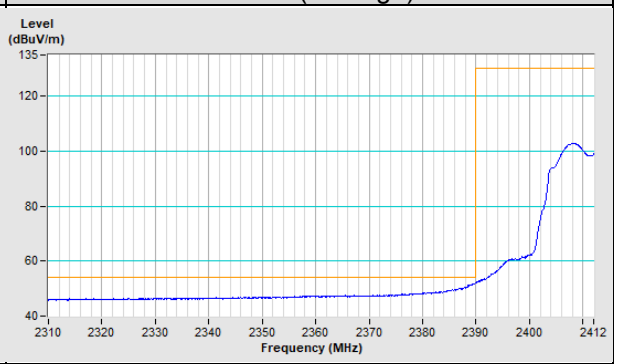
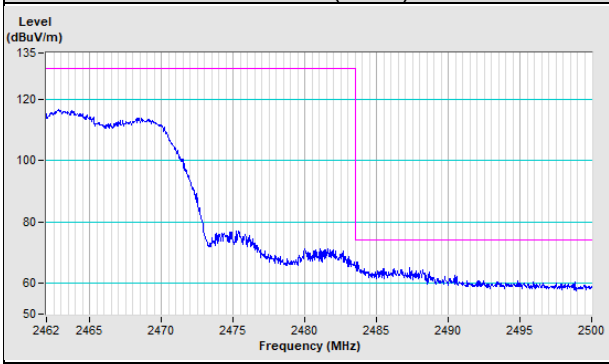
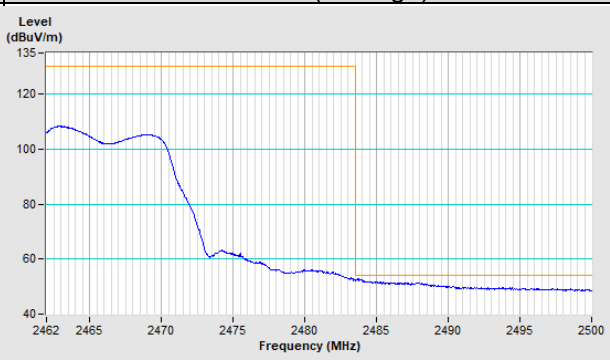
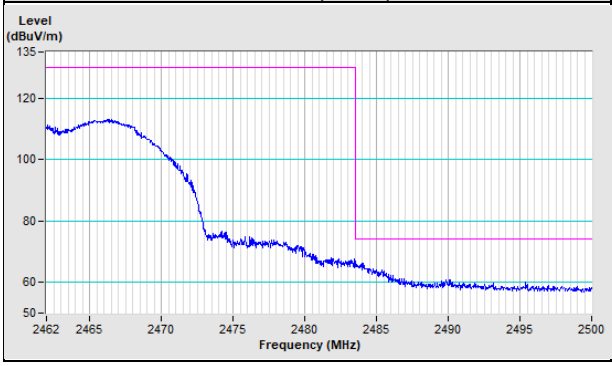
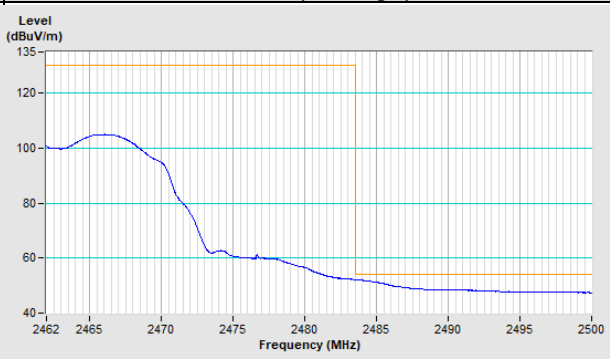


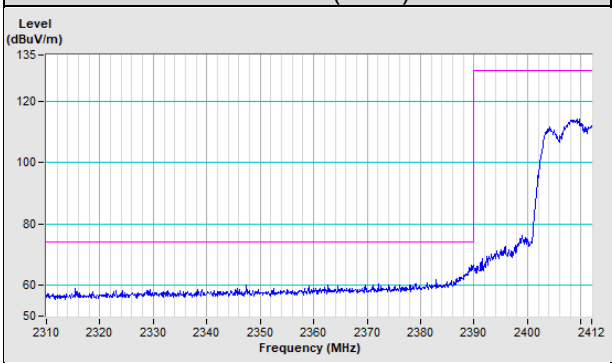
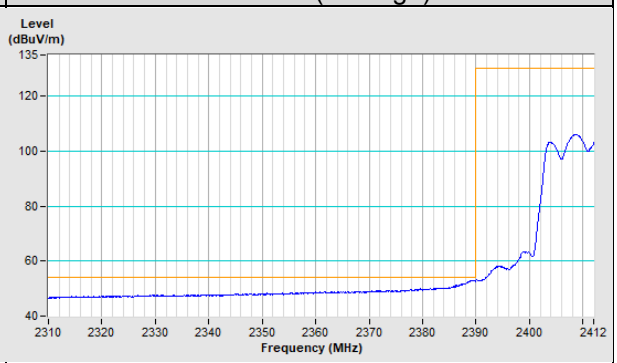
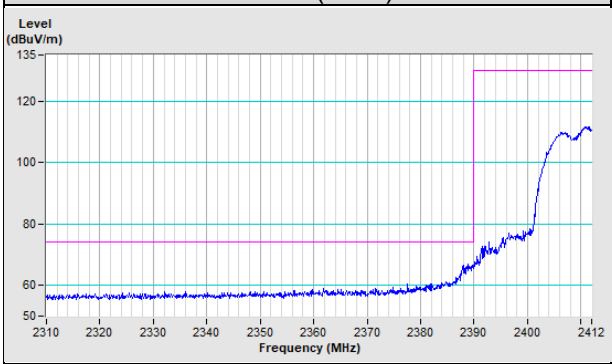
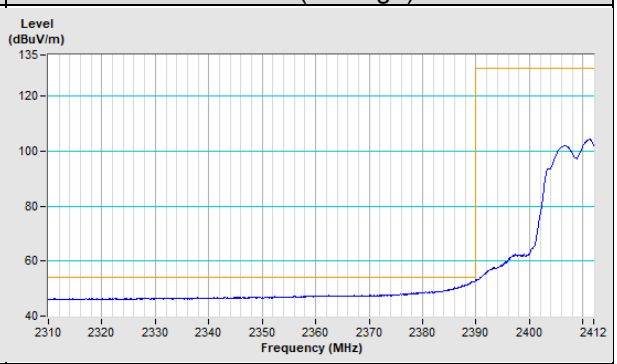
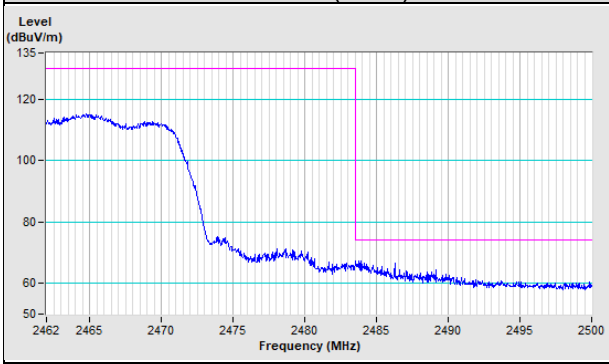
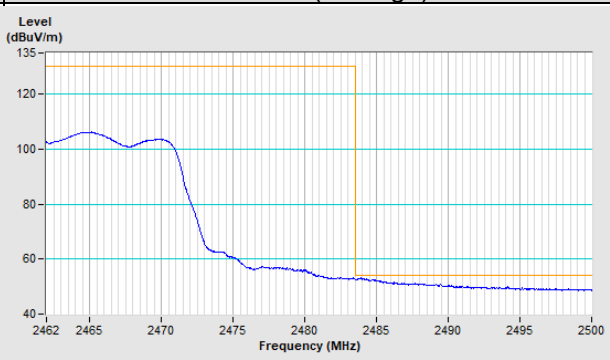
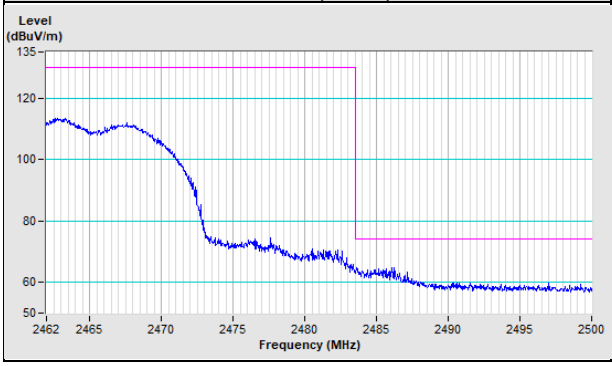
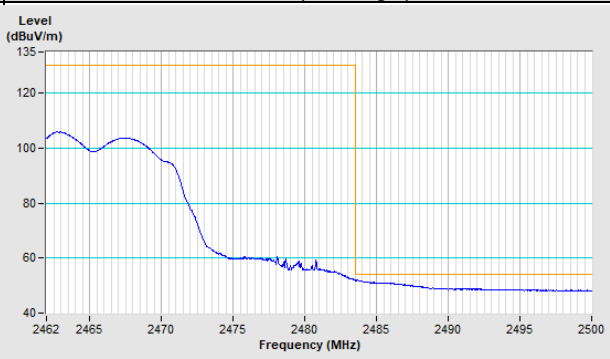
Vertical (Peak)

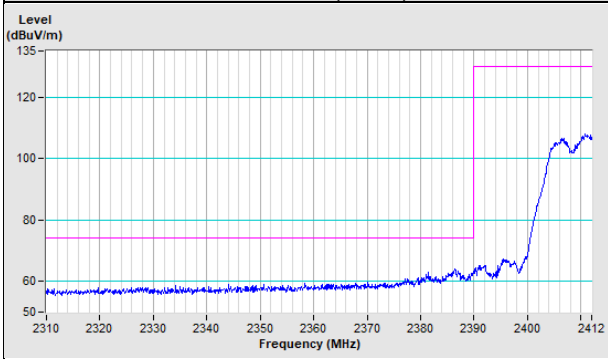
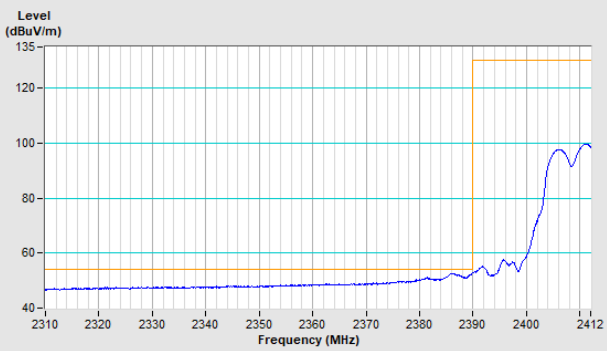
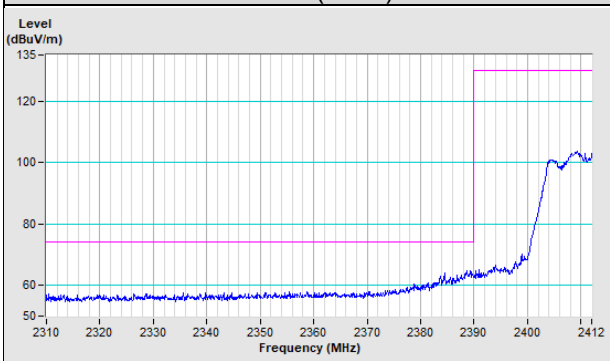
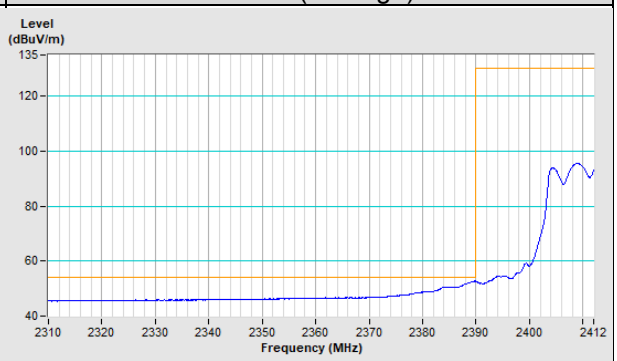


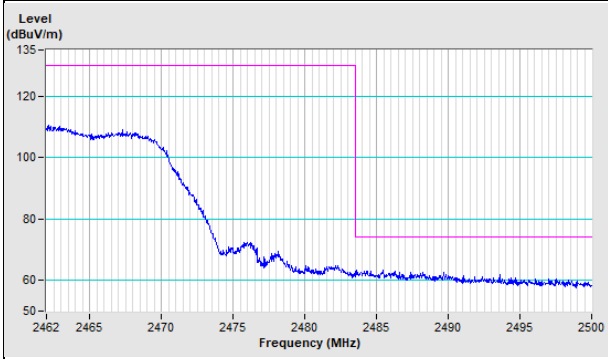
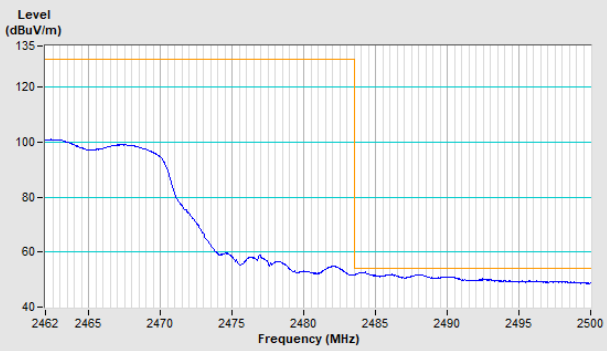
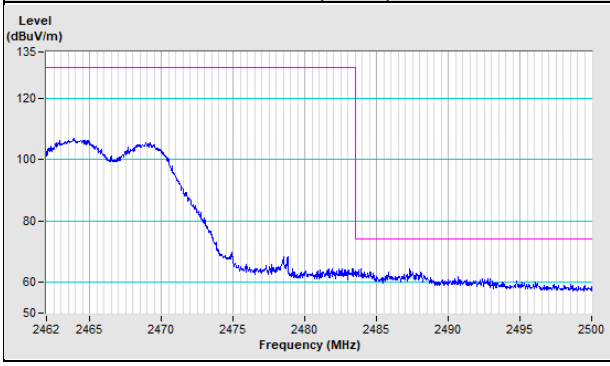
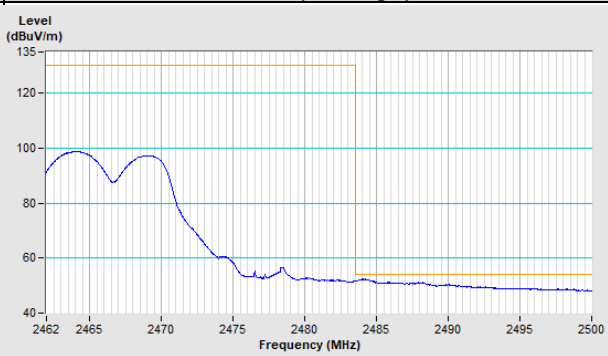
Vertical (Average)



802.11g Channel 1	
Horizontal (Peak)	Horizontal (Average)
	
Vertical (Peak)	Vertical (Average)
	
802.11g Channel 11	
Horizontal (Peak)	Horizontal (Average)
	
Vertical (Peak)	Vertical (Average)
	

VHT20 Channel 1	
Horizontal (Peak)	Horizontal (Average)
	
Vertical (Peak)	Vertical (Average)
	
VHT20 Channel 11	
Horizontal (Peak)	Horizontal (Average)
	
Vertical (Peak)	Vertical (Average)
	

VHT40 Channel 3	
Horizontal (Peak)	Horizontal (Average)
	
Vertical (Peak)	Vertical (Average)
	

VHT40 Channel 9	
Horizontal (Peak)	Horizontal (Average)
	
Vertical (Peak)	Vertical (Average)
	

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 and approved according to ISO/IEC 17025.

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

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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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