

FCC Test Report

Report No.: RFBCIB-WTW-P22020171-2

FCC ID: HFS-WAVE1

Test Model: Emerge Wave-1

Received Date: Feb. 11, 2022

Test Date: Feb. 25, 2022 ~ Mar. 21, 2022

Issued Date: Apr. 20, 2022

Applicant: Quanta Computer Inc.

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
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FCC Registration / 788550 / TW0003

Designation Number: 427177 / TW0011



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Release Control Record

Issue No.	Description	Date Issued
RFBCIB-WTW-P22020171-2	Original Release	Apr. 20, 2022

1 Certificate of Conformity

Product: Emerge Wave-1

Brand: Emerge

Test Model: Emerge Wave-1

Sample Status: Engineering Sample

Applicant: Quanta Computer Inc.

Test Date: Feb. 25, 2022 ~ Mar. 21, 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 : Vera Huang, **Date:** Apr. 20, 2022
Vera Huang / Specialist

Approved by : Jeremy Lin, **Date:** Apr. 20, 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 -16.83 dB at 0.34600 MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -1.79 dB at 2390.00 MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.247(a)(2)	6 dB Bandwidth	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	Pass	Reference only
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note:

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

2.1 Measurement Uncertainty

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

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.79 dB
Radiated Emissions up to 1 GHz	9 kHz ~ 30 MHz	3.04 dB
	30 MHz ~ 200 MHz	2.0153 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	Emerge Wave-1
Brand	Emerge
Test Model	Emerge Wave-1
Status of EUT	Engineering Sample
Power Supply Rating	19 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 144.4 Mbps
Operating Frequency	2412 ~ 2462 MHz
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20)
Output Power	54.789 mW
Antenna Type	Refer to Note as below
Antenna Connector	N/A
Accessory Device	Refer to Note as below
Data Cable Supplied	N/A

Note:

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

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

- The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter	FSP Group	FSP120-ABBU3	I/P: 100-240 Vac, 50-60 Hz, 1.4 A O/P: 19 Vdc, 6.32 A, 120W 0.9m AC cable w/o core 1.4m DC cable with 1 core

- The antenna information is listed as below.

Ant. Type	Dipole Antenna					
Frequency (MHz)	2400	2440	2480	5150	5550	5850
Peak Gain (dBi) Main Ant	3.7	3.8	3.8	1.3	2.2	3.7
Peak Gain (dBi) Aux. Ant.	3.2	3.1	2.5	2.5	2.3	2.5

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

3.2 Description of Test Modes

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

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

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 1 GHz **RE<1G**: Radiated Emission below 1 GHz
PLC: Power Line Conducted Emission **APCM**: Antenna Port Conducted Measurement

Note:

1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **X-plane**.
2. For radiated emission (below 1GHz) and power line conducted emission test items chosen the worst maximum power.

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

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)
-	802.11b	1 to 11	6	DSSS	DBPSK	1.0

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)
-	802.11b	1 to 11	6	DSSS	DBPSK	1.0

Bandedge Measurement:

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

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

Antenna Port Conducted Measurement:

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

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	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

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
RE $\geq$ 1G	25 deg. C, 61 % RH	120 Vac, 60 Hz	Charles Hsiao
RE<1G	25 deg. C, 61 % RH	120 Vac, 60 Hz	Karl Lee
PLC	22 deg. C, 60 % RH	120 Vac, 60 Hz	Thomas Cheng
APCM	25 deg. C, 60 % RH	120 Vac, 60 Hz	Gary Lin

3.3 Duty Cycle of Test Signal

Duty cycle of test signal is 100 %, duty factor is not required.

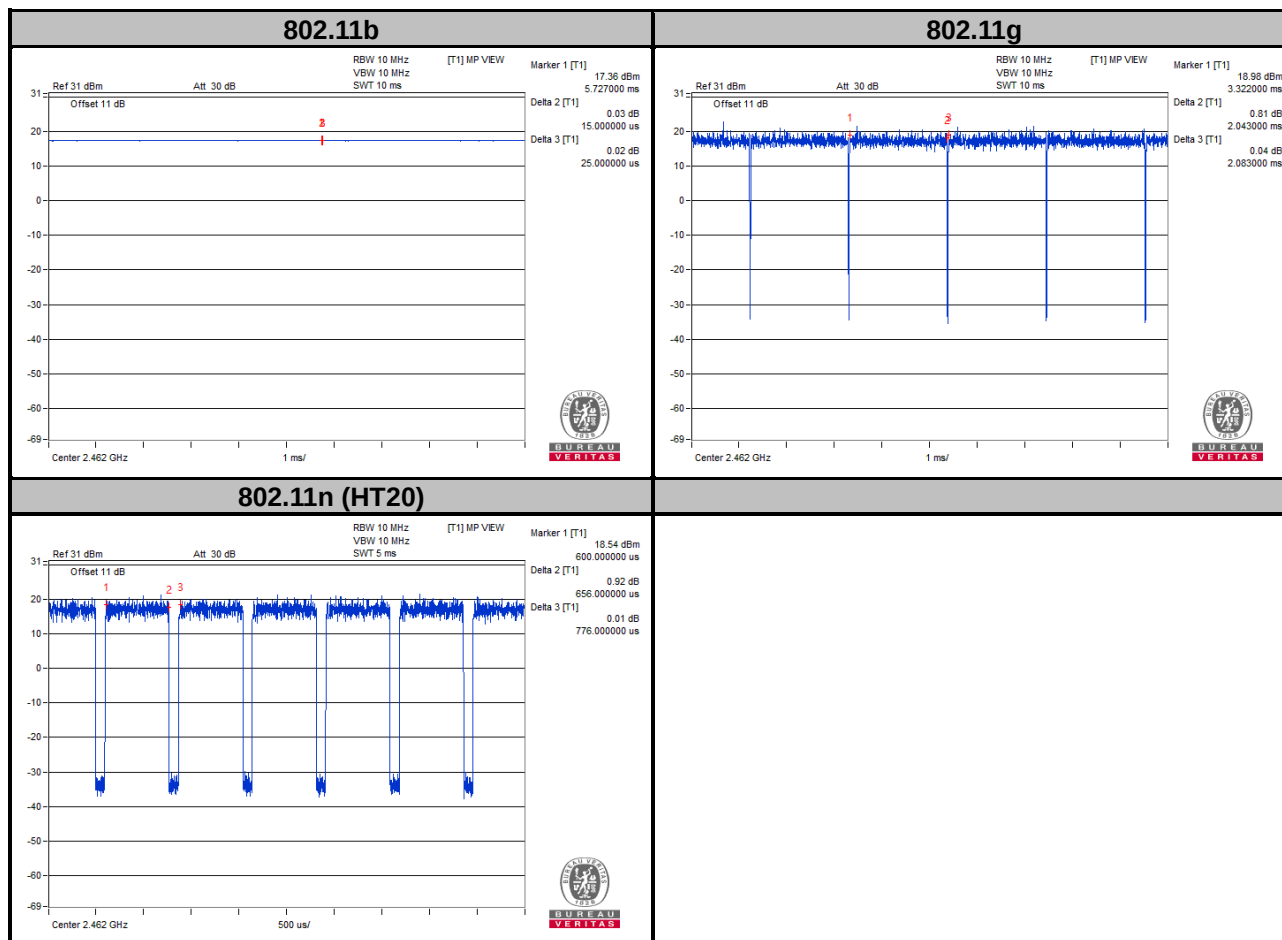
Duty cycle of test signal is ≥ 98 %, duty factor is not required.

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

802.11b: Duty cycle of test signal is 100 %, duty factor is not required.

802.11g: Duty cycle = $2.043/2.083 = 0.981$, Duty cycle of test signal is ≥ 98 %, duty factor is not required.

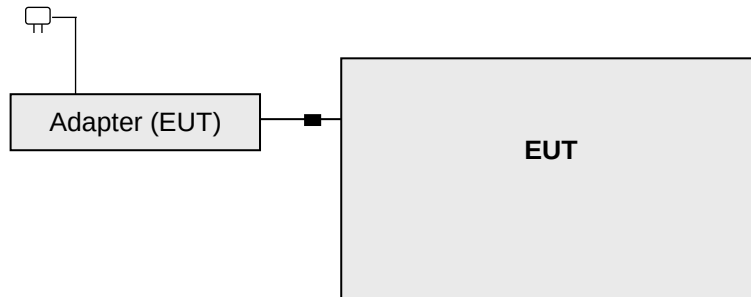
802.11n (HT20): Duty cycle = $0.656/0.776 = 0.845$, Duty factor = $10 * \log(1/0.845) = 0.73$



3.4 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or 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 20 dB below the highest level of the desired power:

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

NOTE:

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

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration	Due Date Of Calibration
Test Receiver Agilent Technologies	N9038A	MY52260177	Sep. 01, 2021	Aug. 31, 2022
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 12, 2021	Apr. 11, 2022
HORN Antenna ETS-Lindgren	3117	00143293	Nov. 14, 2021	Nov. 13, 2022
BILOG Antenna SCHWARZBECK	VULB 9168	9168-616	Oct. 27, 2021	Oct. 26, 2022
HORN Antenna SCHWARZBECK	BBHA 9170	9170-480	Nov. 14, 2021	Nov. 13, 2022
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 13, 2021	Apr. 12, 2022
Loop Antenna	EM-6879	269	Sep. 16, 2021	Sep. 15, 2022
Preamplifier Agilent	310N	187226	Jun. 17, 2021	Jun. 16, 2022
Preamplifier Agilent	83017A	MY39501357	Jun. 17, 2021	Jun. 16, 2022
Preamplifier EMCI	EMC 184045	980116	Oct. 05, 2021	Oct. 04, 2022
Power Meter Anritsu	ML2495A	1012010	Sep. 09, 2021	Sep. 08, 2022
Power Sensor Anritsu	MA2411B	1315050	Sep. 09, 2021	Sep. 08, 2022
RF signal cable ETS-LINDGREN	5D-FB	Cable-CH1-01(RFC-SMS-100-SMS-120+RFC-SMS-100-SMS-400)	Jun. 17, 2021	Jun. 16, 2022
RF signal cable ETS-LINDGREN	8D-FB	Cable-CH1-02(RFC-SMS-100-SMS-24)	Jun. 17, 2021	Jun. 16, 2022
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
Spectrum Analyzer ROHDE & SCHWARZ	FSV40	100979	Mar. 29, 2021	Mar. 28, 2022
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004/ MY55190007/MY55210005	Jul. 12, 2021	Jul. 11, 2022

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:

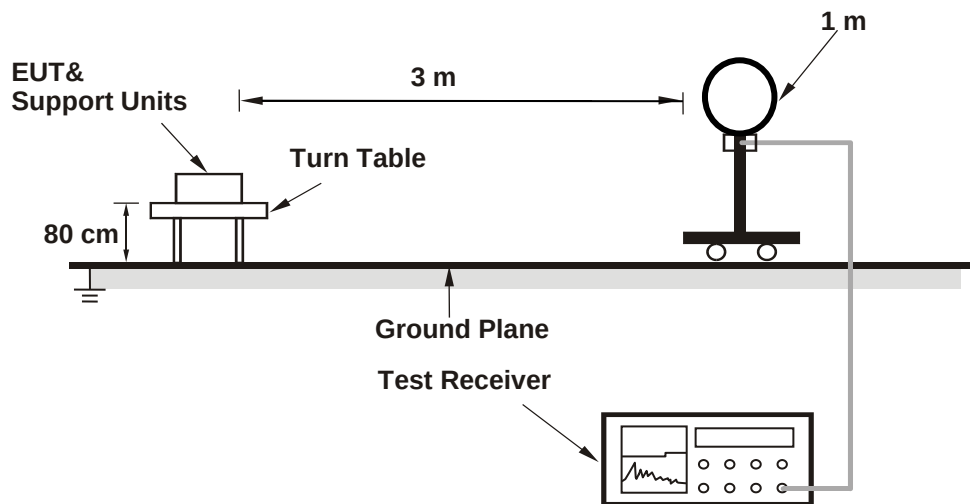
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) 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 = 10 Hz ;
11n (HT20): 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

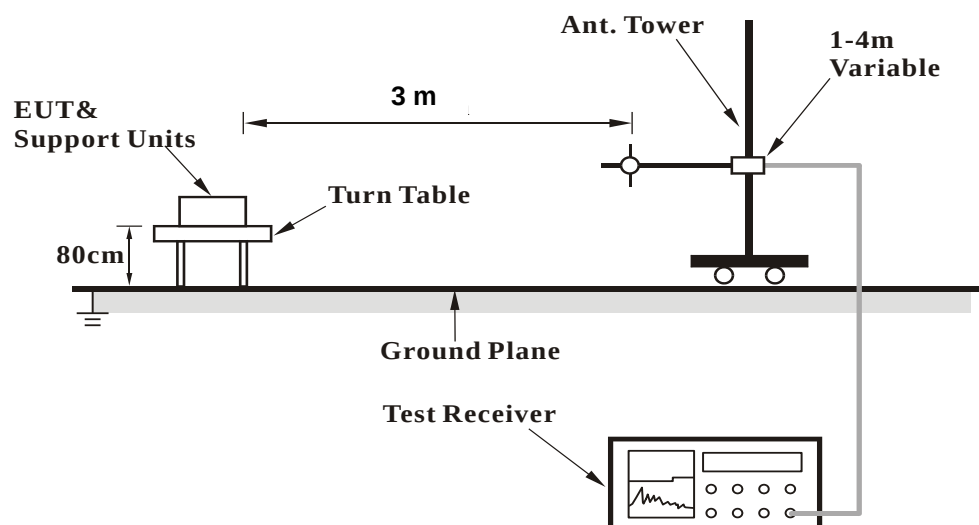
No deviation.

4.1.5 Test Set Up

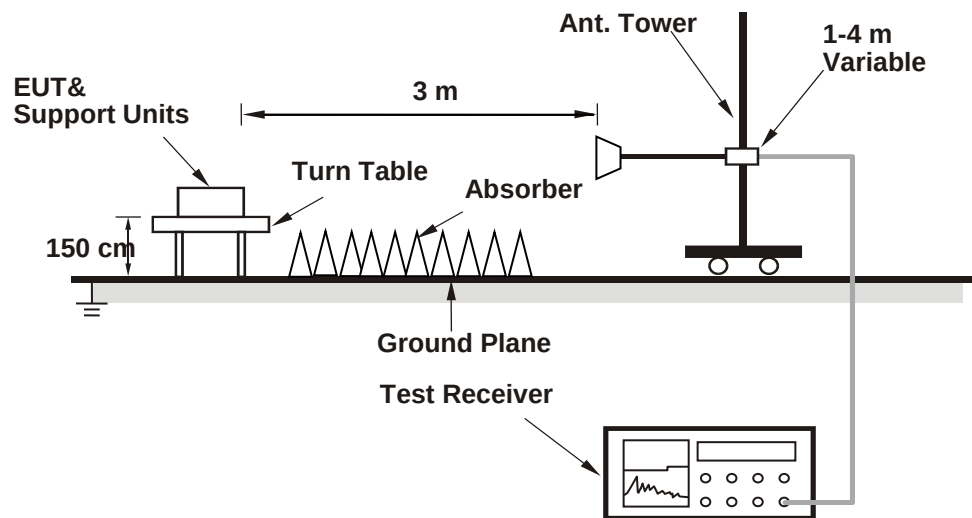
<Radiated Emission below 30 MHz>



<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 :

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	2390.00	68.36 PK	74.00	-5.64	1.07 H	114	31.90	36.46
2	2390.00	43.15 AV	54.00	-10.85	1.07 H	114	6.69	36.46
3	*2412.00	108.02 PK			1.19 H	73	71.43	36.59
4	*2412.00	105.72 AV			1.19 H	73	69.13	36.59
5	4824.00	51.03 PK	74.00	-22.97	1.94 H	23	42.01	9.02
6	4824.00	46.07 AV	54.00	-7.93	1.94 H	23	37.05	9.02
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	61.84 PK	74.00	-12.16	1.14 V	82	25.38	36.46
2	2390.00	45.32 AV	54.00	-8.68	1.14 V	82	8.86	36.46
3	*2412.00	103.00 PK			1.20 V	77	66.41	36.59
4	*2412.00	101.45 AV			1.20 V	77	64.86	36.59
5	4824.00	50.16 PK	74.00	-23.84	1.91 V	342	41.14	9.02
6	4824.00	44.91 AV	54.00	-9.09	1.91 V	342	35.89	9.02

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	106.98 PK			1.29 H	66	70.26	36.72
2	*2437.00	105.19 AV			1.29 H	66	68.47	36.72
3	4874.00	50.75 PK	74.00	-23.25	1.00 H	189	41.26	9.49
4	4874.00	45.10 AV	54.00	-8.90	1.00 H	189	35.61	9.49
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	102.60 PK			1.18 V	106	65.88	36.72
2	*2437.00	100.49 AV			1.18 V	106	63.77	36.72
3	4874.00	49.29 PK	74.00	-24.71	2.04 V	113	39.80	9.49
4	4874.00	44.13 AV	54.00	-9.87	2.04 V	113	34.64	9.49

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	107.60 PK			1.24 H	66	70.80	36.80
2	*2462.00	104.94 AV			1.24 H	66	68.14	36.80
3	2483.50	69.45 PK	74.00	-4.55	1.09 H	61	32.61	36.84
4	2483.50	47.92 AV	54.00	-6.08	1.09 H	61	11.08	36.84
5	4924.00	49.95 PK	74.00	-24.05	1.00 H	187	40.41	9.54
6	4924.00	44.34 AV	54.00	-9.66	1.00 H	187	34.80	9.54
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	102.67 PK			1.02 V	106	65.87	36.80
2	*2462.00	100.72 AV			1.02 V	106	63.92	36.80
3	2483.50	61.52 PK	74.00	-12.48	1.17 V	93	24.68	36.84
4	2483.50	44.43 AV	54.00	-9.57	1.17 V	93	7.59	36.84
5	4924.00	47.69 PK	74.00	-26.31	1.25 V	69	38.15	9.54
6	4924.00	41.40 AV	54.00	-12.60	1.25 V	69	31.86	9.54

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	67.39 PK	74.00	-6.61	1.54 H	71	30.93	36.46
2	2390.00	52.05 AV	54.00	-1.95	1.54 H	71	15.59	36.46
3	*2412.00	109.67 PK			1.19 H	73	73.08	36.59
4	*2412.00	102.36 AV			1.19 H	73	65.77	36.59
5	4824.00	46.62 PK	74.00	-27.38	1.63 H	209	37.60	9.02
6	4824.00	39.51 AV	54.00	-14.49	1.63 H	209	30.49	9.02
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	60.44 PK	74.00	-13.56	1.36 V	59	23.98	36.46
2	2390.00	46.41 AV	54.00	-7.59	1.36 V	59	9.95	36.46
3	*2412.00	104.62 PK			1.20 V	77	68.03	36.59
4	*2412.00	97.69 AV			1.20 V	77	61.10	36.59
5	4824.00	46.48 PK	74.00	-27.52	1.08 V	243	37.46	9.02
6	4824.00	39.23 AV	54.00	-14.77	1.08 V	243	30.21	9.02

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	107.97 PK			1.29 H	66	71.25	36.72
2	*2437.00	100.81 AV			1.29 H	66	64.09	36.72
3	4874.00	47.03 PK	74.00	-26.97	1.87 H	14	37.54	9.49
4	4874.00	39.85 AV	54.00	-14.15	1.87 H	14	30.36	9.49
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	103.46 PK			1.18 V	106	66.74	36.72
2	*2437.00	96.24 AV			1.18 V	106	59.52	36.72
3	4874.00	47.17 PK	74.00	-26.83	2.27 V	184	37.68	9.49
4	4874.00	39.94 AV	54.00	-14.06	2.27 V	184	30.45	9.49

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	108.01 PK			1.24 H	66	71.21	36.80
2	*2462.00	100.94 AV			1.24 H	66	64.14	36.80
3	2483.50	69.28 PK	74.00	-4.72	1.42 H	75	32.44	36.84
4	2483.50	51.87 AV	54.00	-2.13	1.42 H	75	15.03	36.84
5	4924.00	47.28 PK	74.00	-26.72	1.72 H	226	37.74	9.54
6	4924.00	40.14 AV	54.00	-13.86	1.72 H	226	30.60	9.54
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	103.69 PK			1.02 V	106	66.89	36.80
2	*2462.00	96.38 AV			1.02 V	106	59.58	36.80
3	2483.50	59.12 PK	74.00	-14.88	1.09 V	82	22.28	36.84
4	2483.50	45.21 AV	54.00	-8.79	1.09 V	82	8.37	36.84
5	4924.00	47.37 PK	74.00	-26.63	1.51 V	304	37.83	9.54
6	4924.00	40.21 AV	54.00	-13.79	1.51 V	304	30.67	9.54

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 802.11n (HT20)	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	68.23 PK	74.00	-5.77	1.52 H	47	31.77	36.46
2	2390.00	52.21 AV	54.00	-1.79	1.52 H	47	15.75	36.46
3	*2412.00	108.24 PK			1.34 H	60	71.65	36.59
4	*2412.00	100.40 AV			1.34 H	60	63.81	36.59
5	4824.00	46.61 PK	74.00	-27.39	1.94 H	112	37.59	9.02
6	4824.00	39.25 AV	54.00	-14.75	1.94 H	112	30.23	9.02
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	64.37 PK	74.00	-9.63	1.16 V	75	27.91	36.46
2	2390.00	48.61 AV	54.00	-5.39	1.16 V	75	12.15	36.46
3	*2412.00	105.81 PK			1.20 V	91	69.22	36.59
4	*2412.00	97.39 AV			1.20 V	91	60.80	36.59
5	4824.00	46.44 PK	74.00	-27.56	1.10 V	184	37.42	9.02
6	4824.00	39.31 AV	54.00	-14.69	1.10 V	184	30.29	9.02

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 802.11n (HT20)	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	108.45 PK			1.01 H	59	71.73	36.72
2	*2437.00	100.58 AV			1.01 H	59	63.86	36.72
3	4874.00	47.04 PK	74.00	-26.96	1.62 H	47	37.55	9.49
4	4874.00	39.96 AV	54.00	-14.04	1.62 H	47	30.47	9.49
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	106.24 PK			1.16 V	85	69.52	36.72
2	*2437.00	97.65 AV			1.16 V	85	60.93	36.72
3	4874.00	47.09 PK	74.00	-26.91	2.74 V	121	37.60	9.49
4	4874.00	40.00 AV	54.00	-14.00	2.74 V	121	30.51	9.49

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 802.11n (HT20)	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	106.87 PK			1.22 H	67	70.07	36.80
2	*2462.00	98.74 AV			1.22 H	67	61.94	36.80
3	2483.50	67.68 PK	74.00	-6.32	1.36 H	64	30.84	36.84
4	2483.50	51.42 AV	54.00	-2.58	1.36 H	64	14.58	36.84
5	4924.00	47.10 PK	74.00	-26.90	1.47 H	104	37.56	9.54
6	4924.00	39.86 AV	54.00	-14.14	1.47 H	104	30.32	9.54
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	103.73 PK			1.69 V	94	66.93	36.80
2	*2462.00	95.21 AV			1.69 V	94	58.41	36.80
3	2483.50	65.19 PK	74.00	-8.81	1.52 V	84	28.35	36.84
4	2483.50	48.26 AV	54.00	-5.74	1.52 V	84	11.42	36.84
5	4924.00	47.11 PK	74.00	-26.89	1.48 V	174	37.57	9.54
6	4924.00	39.85 AV	54.00	-14.15	1.48 V	174	30.31	9.54

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.

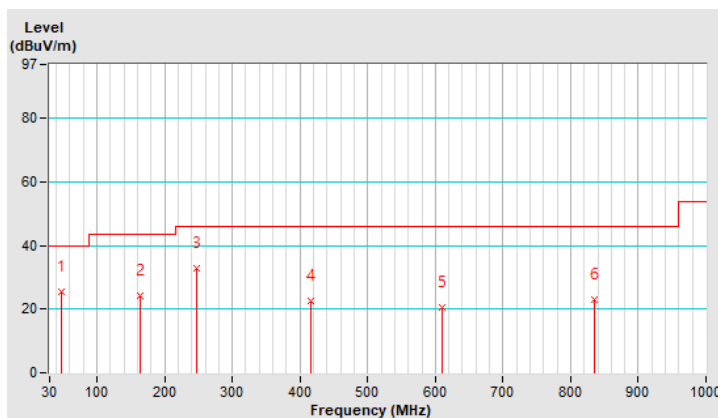
Below 1 GHz Worst-Case Data:

RF Mode	TX 802.11b	Channel	CH 6 : 2437 MHz
Frequency Range	9kHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

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	46.96	25.47 QP	40.00	-14.53	1.25 H	173	42.78	-17.31
2	164.23	24.17 QP	43.50	-19.33	1.33 H	286	41.10	-16.93
3	246.83	32.87 QP	46.00	-13.13	2.51 H	104	50.72	-17.85
4	416.35	22.58 QP	46.00	-23.42	1.58 H	121	35.67	-13.09
5	609.65	20.37 QP	46.00	-25.63	1.32 H	85	29.27	-8.90
6	835.90	22.89 QP	46.00	-23.11	1.15 H	197	28.53	-5.64

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 of frequency range 30MHz~1000MHz.
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.

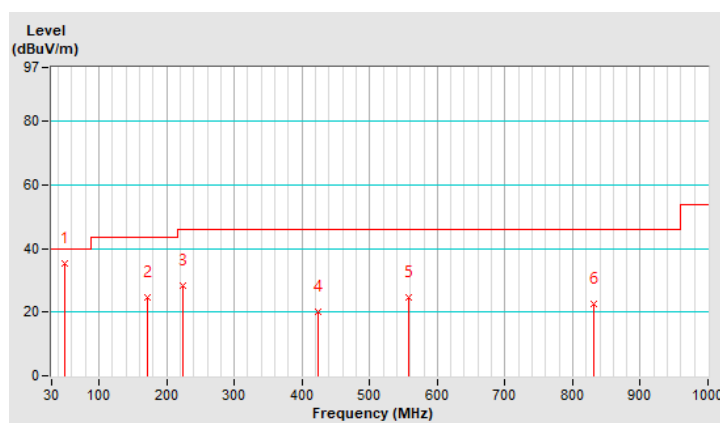


RF Mode	TX 802.11b	Channel	CH 6 : 2437 MHz
Frequency Range	9kHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

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	48.83	35.27 QP	40.00	-4.73	1.84 V	170	52.49	-17.22
2	172.56	24.86 QP	43.50	-18.64	1.18 V	123	42.14	-17.28
3	224.70	28.52 QP	46.00	-17.48	1.31 V	82	48.29	-19.77
4	423.51	20.34 QP	46.00	-25.66	1.49 V	25	33.18	-12.84
5	558.21	24.67 QP	46.00	-21.33	2.16 V	112	35.03	-10.36
6	831.20	22.59 QP	46.00	-23.41	1.26 V	304	28.24	-5.65

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 of frequency range 30MHz~1000MHz.
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 0.50 MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver ROHDE & SCHWARZ	ESR3	102783	Dec. 20, 2021	Dec. 19, 2022
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.
 3. The VCCI Site Registration No. is C-12047.

4.2.3 Test Procedures

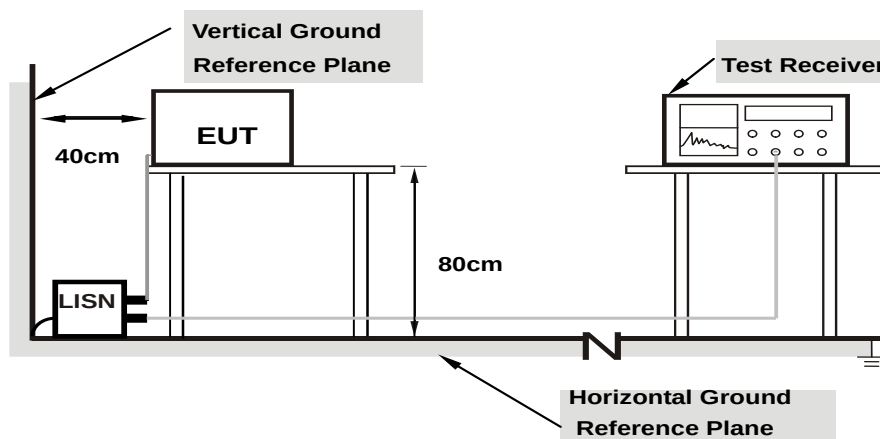
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance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

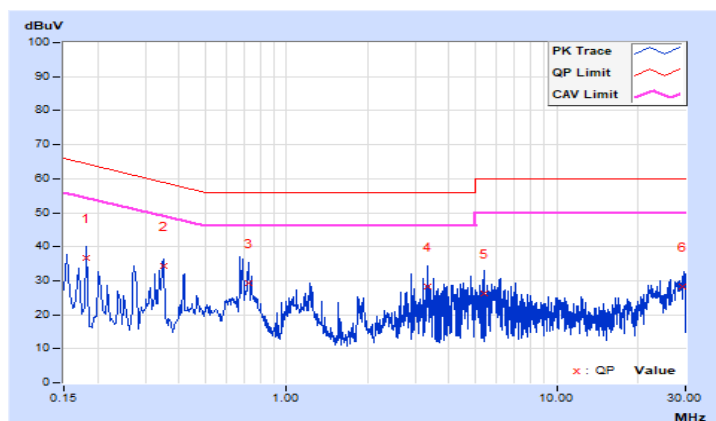
4.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	22 °C, 60% RH
Tested by	Thomas Cheng		

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	0.18200	10.14	26.43	2.74	36.57	12.88	64.39	54.39	-27.82	-41.51
2	0.35000	10.16	24.16	13.17	34.32	23.33	58.96	48.96	-24.64	-25.63
3	0.72200	10.18	19.18	10.00	29.36	20.18	56.00	46.00	-26.64	-25.82
4	3.34200	10.24	17.97	8.89	28.21	19.13	56.00	46.00	-27.79	-26.87
5	5.41800	10.26	16.07	7.89	26.33	18.15	60.00	50.00	-33.67	-31.85
6	29.40600	10.08	18.30	5.61	28.38	15.69	60.00	50.00	-31.62	-34.31

Remarks:

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

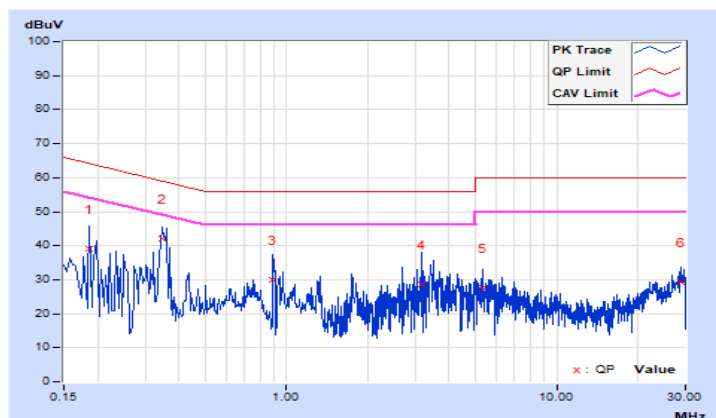


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	22 °C, 60% RH
Tested by	Thomas Cheng		

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	0.18600	10.15	28.80	10.98	38.95	21.13	64.21	54.21	-25.26	-33.08
2	0.34600	10.16	32.07	14.90	42.23	25.06	59.06	49.06	-16.83	-24.00
3	0.89000	10.19	19.74	5.43	29.93	15.62	56.00	46.00	-26.07	-30.38
4	3.15000	10.25	18.35	8.62	28.60	18.87	56.00	46.00	-27.40	-27.13
5	5.31400	10.29	17.16	8.24	27.45	18.53	60.00	50.00	-32.55	-31.47
6	28.70200	10.24	19.00	5.69	29.24	15.93	60.00	50.00	-30.76	-34.07

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

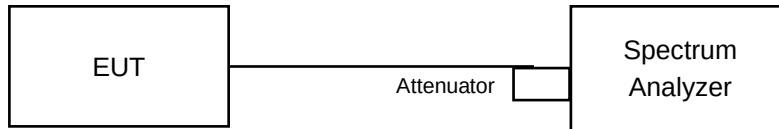


4.3 6 dB Bandwidth Measurement

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
		Chain 0	Chain 1		
1	2412	7.62	8.07	0.5	Pass
6	2437	7.60	7.62	0.5	Pass
11	2462	8.11	8.10	0.5	Pass

802.11g

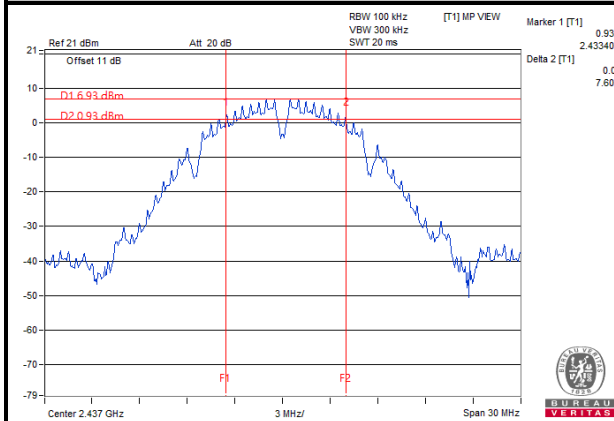
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	16.42	16.42	0.5	Pass
6	2437	16.42	16.44	0.5	Pass
11	2462	16.43	16.42	0.5	Pass

802.11n (HT20)

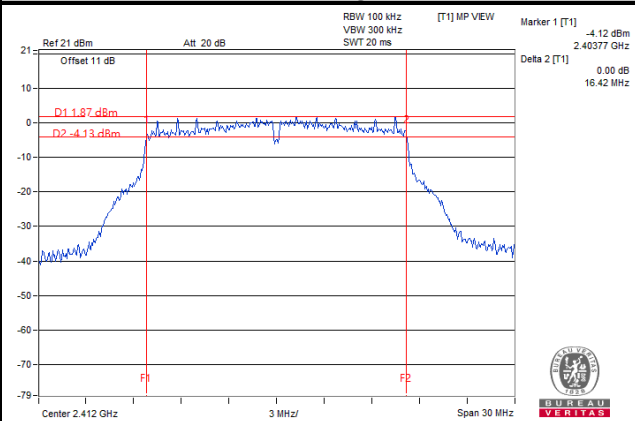
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	17.62	17.64	0.5	Pass
6	2437	17.63	17.64	0.5	Pass
11	2462	17.63	17.64	0.5	Pass

Spectrum Plot of Worst Value

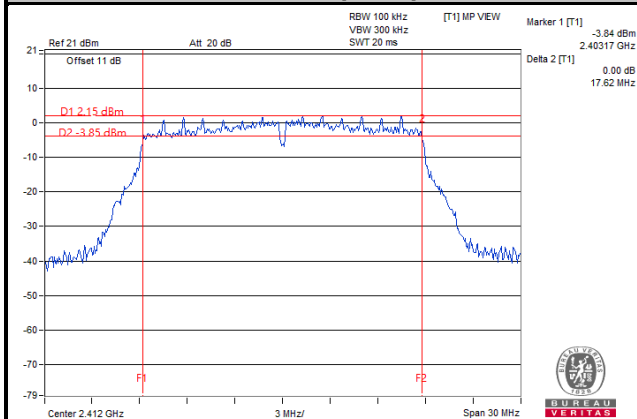
802.11b



802.11g

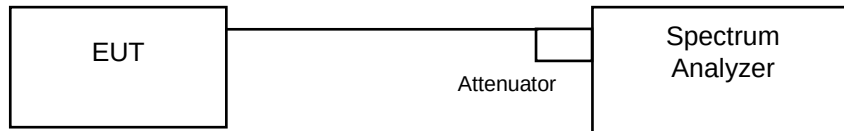


802.11n (HT20)



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
		Chain 0	Chain 1	
1	2412	12.00	12.00	Pass
6	2437	12.00	12.00	Pass
11	2462	12.00	12.00	Pass

802.11g

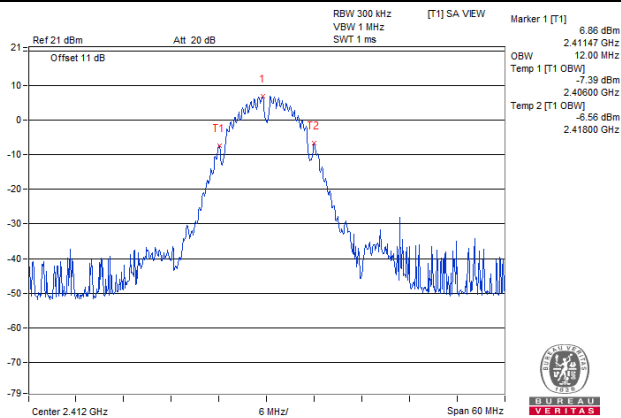
Channel	Frequency (MHz)	Occupied Bandwidth (MHz)		Pass / Fail
		Chain 0	Chain 1	
1	2412	16.95	16.78	Pass
6	2437	16.86	16.80	Pass
11	2462	16.92	16.80	Pass

802.11n (HT20)

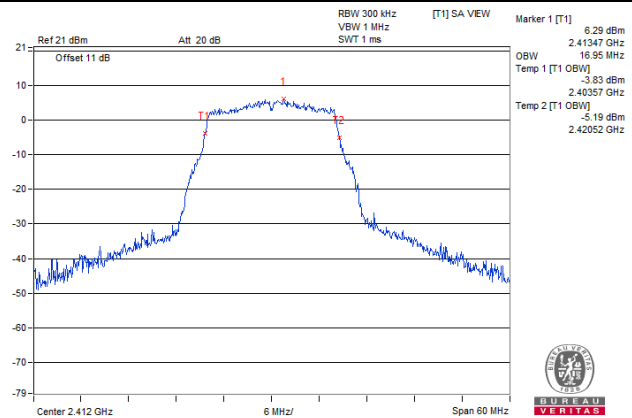
Channel	Frequency (MHz)	Occupied Bandwidth (MHz)		Pass / Fail
		Chain 0	Chain 1	
1	2412	18.00	17.83	Pass
6	2437	18.00	17.88	Pass
11	2462	18.12	17.88	Pass

Spectrum Plot of Worst Value

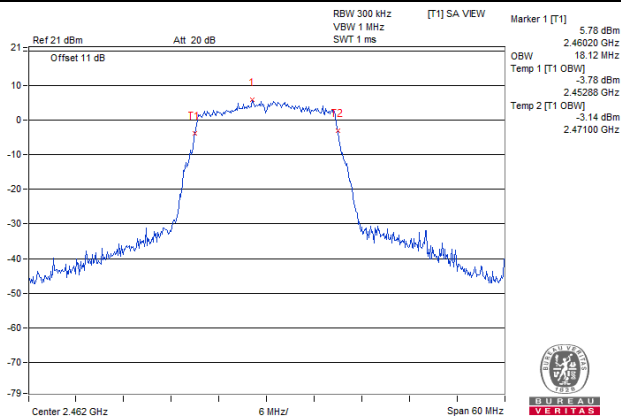
802.11b



802.11g



802.11n (HT20)



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,

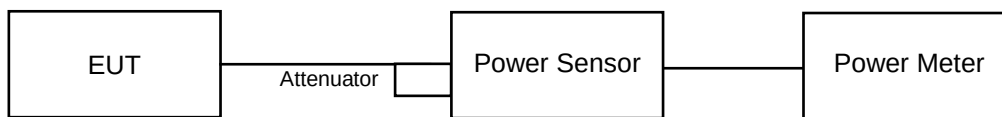
Array Gain = 0 dB (i.e., no array gain) for $NANT \leq 4$;

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

Array Gain = $5 \log(NANT/NSS)$ dB or 3 dB, whichever is less for 20 MHz channel widths with $NANT \geq 5$.

For power measurements on all other devices: Array Gain = $10 \log(NANT/NSS)$ 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

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

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Conditions

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

4.5.7 Test Results

802.11b

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	14.70	13.90	54.059	17.33	30	Pass
6	2437	14.74	13.98	54.789	17.39	30	Pass
11	2462	14.76	13.75	53.636	17.29	30	Pass

802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	13.71	13.21	44.437	16.48	30	Pass
6	2437	13.24	12.76	39.966	16.02	30	Pass
11	2462	13.27	12.81	40.331	16.06	30	Pass

802.11n (HT20)

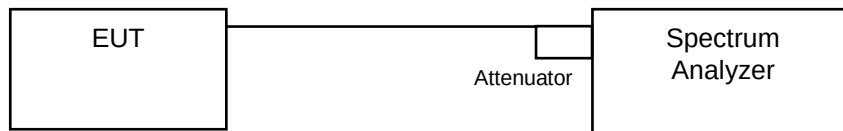
Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	13.41	12.75	40.765	16.10	30	Pass
6	2437	13.36	12.88	41.086	16.14	30	Pass
11	2462	13.15	12.64	39.019	15.91	30	Pass

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

For Average Power (Duty cycle $\geq 98\%$)

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

For Average Power (Duty cycle < 98%)

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

4.6.5 Deviation from Test Standard

No deviation.

4.6.6 EUT Operating Condition

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

4.6.7 Test Results

802.11b

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-17.79	3.01	-14.78	7.48	Pass
	6	2437	-17.16	3.01	-14.15	7.48	Pass
	11	2462	-17.21	3.01	-14.2	7.48	Pass
1	1	2412	-18.55	3.01	-15.54	7.48	Pass
	6	2437	-18.54	3.01	-15.53	7.48	Pass
	11	2462	-18.59	3.01	-15.58	7.48	Pass

NOTE:

1. Directional gain = $10\log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}] = 6.52 \text{ dBi} > 6 \text{ dBi}$, so the power density limit shall be reduced to $8 - (6.52 - 6) = 7.48 \text{ dBm}$.
2. Method 2) C) of power density measurement of KDB 662911 is using for calculating total power density.

802.11g

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-21.57	3.01	-18.56	7.48	Pass
	6	2437	-22.06	3.01	-19.05	7.48	Pass
	11	2462	-22.19	3.01	-19.18	7.48	Pass
1	1	2412	-22.17	3.01	-19.16	7.48	Pass
	6	2437	-22.69	3.01	-19.68	7.48	Pass
	11	2462	-22.46	3.01	-19.45	7.48	Pass

NOTE:

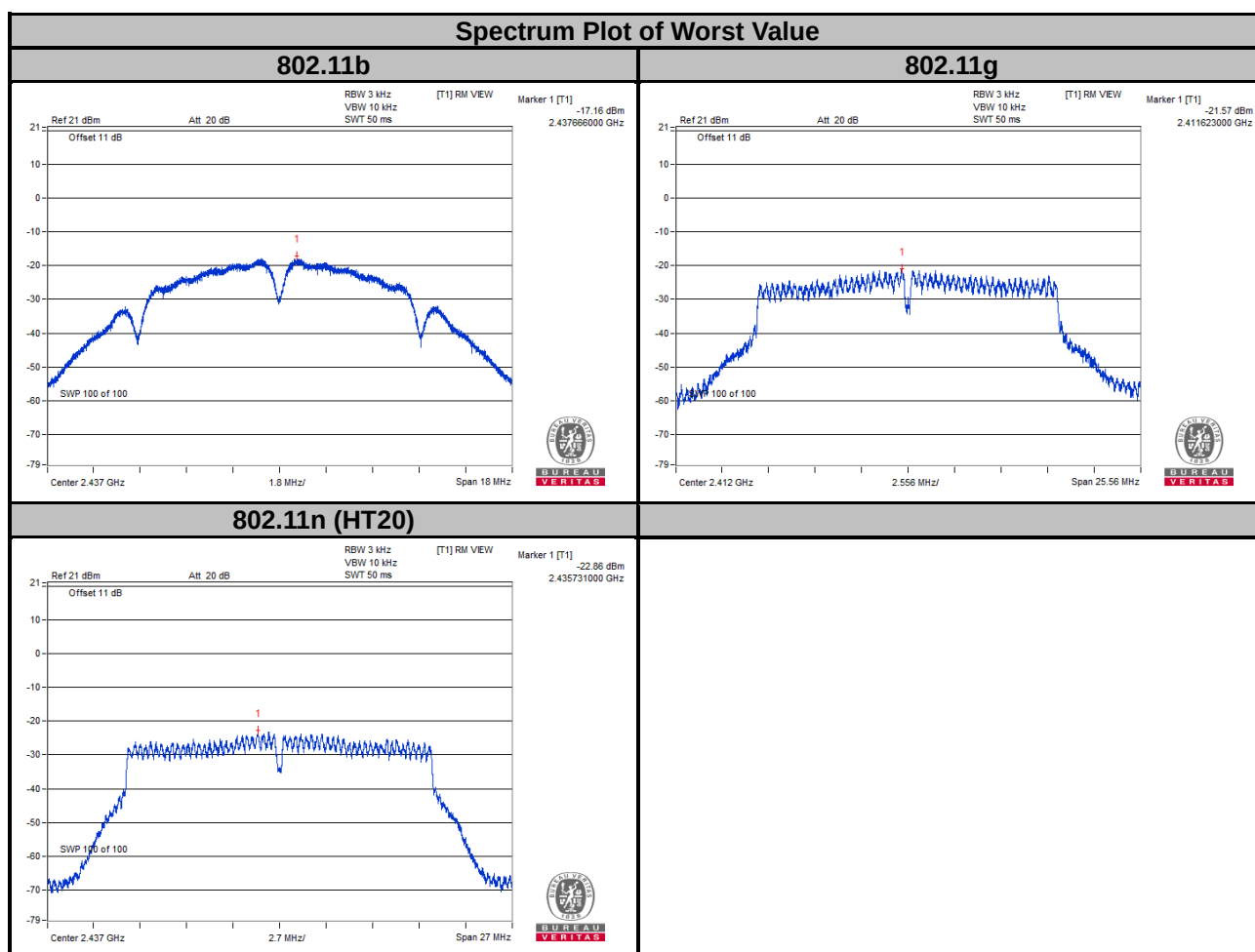
1. Directional gain = $10\log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}] = 6.52 \text{ dBi} > 6 \text{ dBi}$, so the power density limit shall be reduced to $8 - (6.52 - 6) = 7.48 \text{ dBm}$.
2. Method 2) C) of power density measurement of KDB 662911 is using for calculating total power density.

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	-23.01	3.01	0.73	-19.27	7.48	Pass
	6	2437	-22.86	3.01	0.73	-19.12	7.48	Pass
	11	2462	-23.16	3.01	0.73	-19.42	7.48	Pass
1	1	2412	-23.68	3.01	0.73	-19.94	7.48	Pass
	6	2437	-23.74	3.01	0.73	-20	7.48	Pass
	11	2462	-23.92	3.01	0.73	-20.18	7.48	Pass

NOTE:

- Directional gain = $10\log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}] = 6.52 \text{ dBi} > 6 \text{ dBi}$, so the power density limit shall be reduced to $8-(6.52-6) = 7.48 \text{ dBm}$.
- Method 2) C) of power density measurement of KDB 662911 is using for calculating total power density.

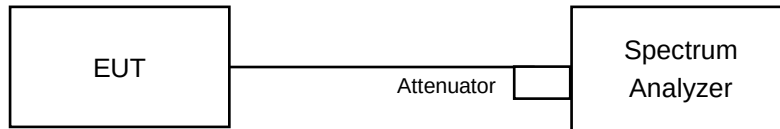


4.7 Conducted Out of Band Emission Measurement

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.

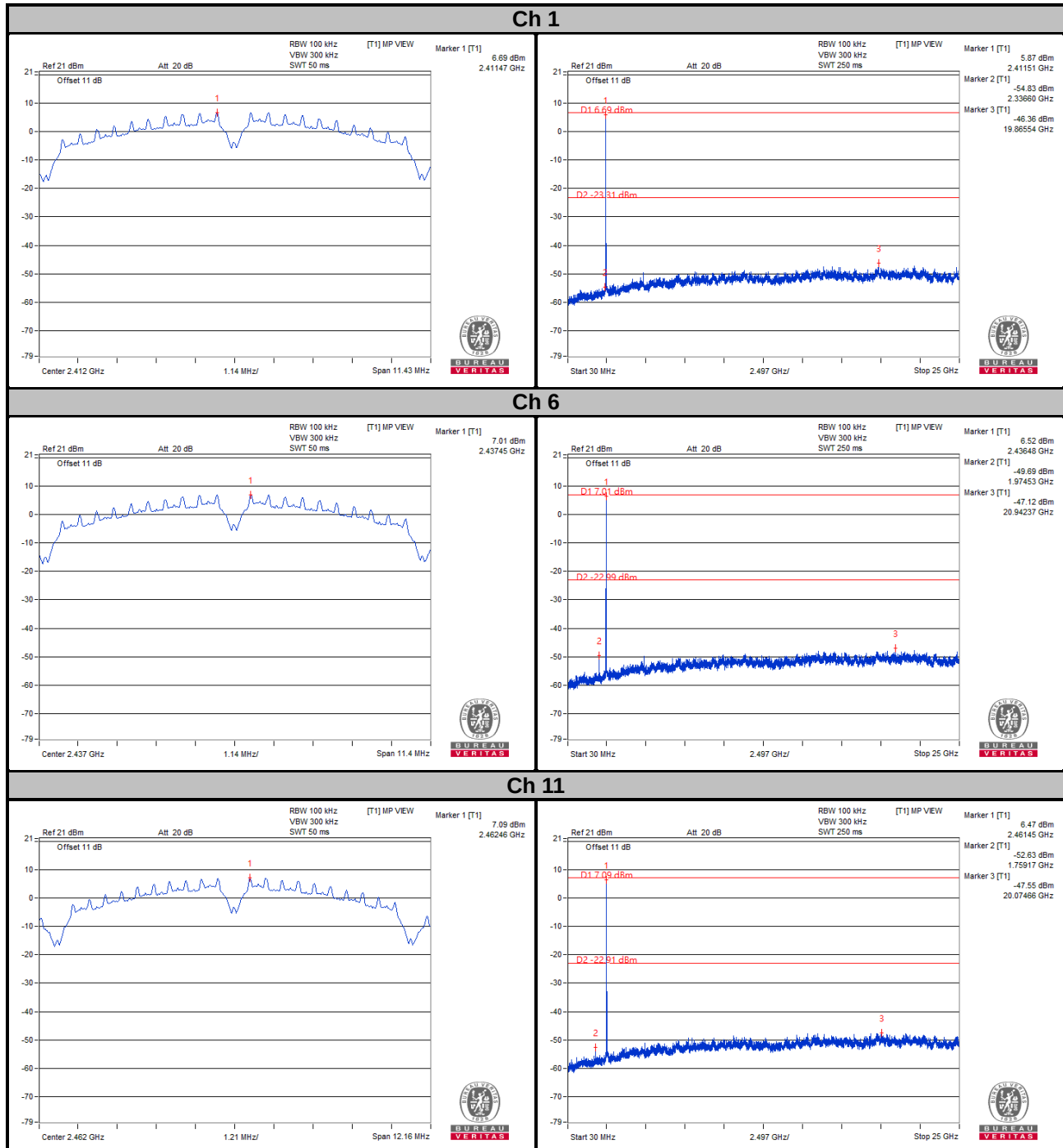
4.7.6 EUT Operating Condition

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

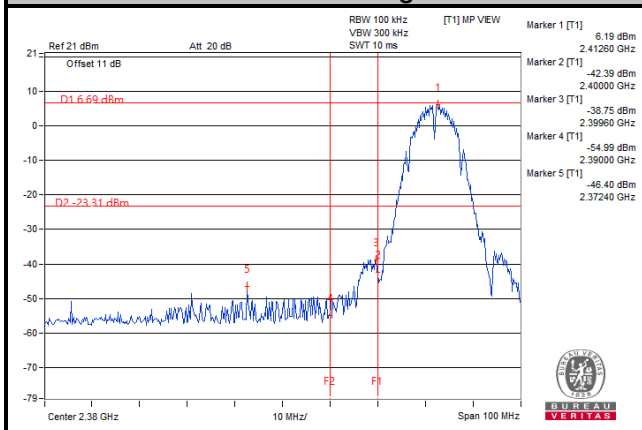
4.7.7 Test Results

The 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.

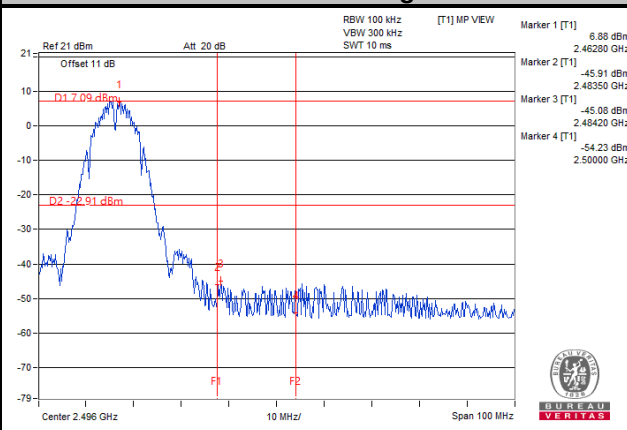
802.11b CHAIN 0



Ch 1 Band Edge

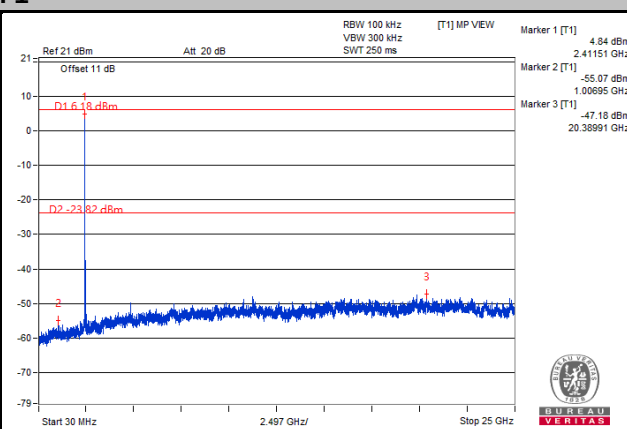
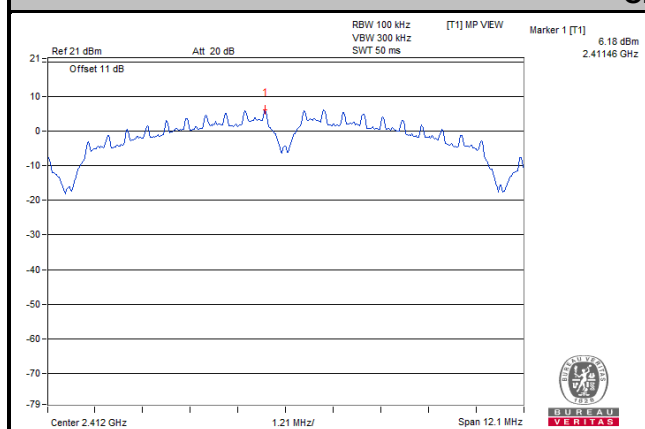


Ch 11 Band Edge

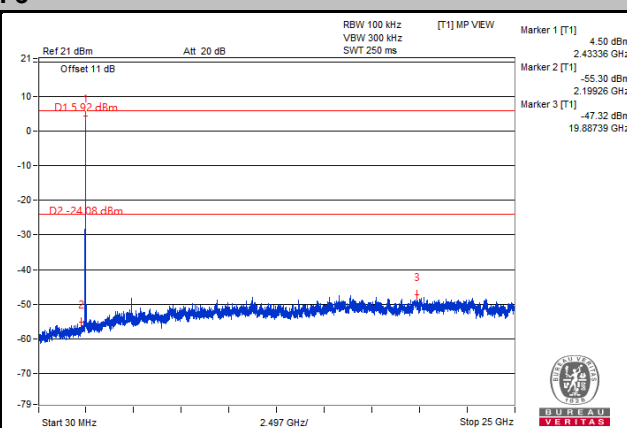
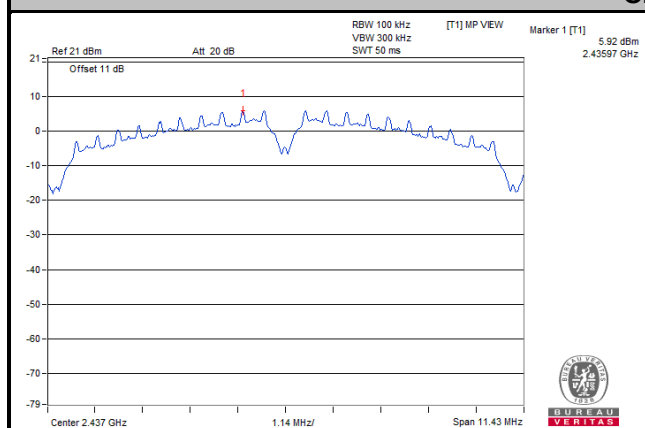


CHAIN 1

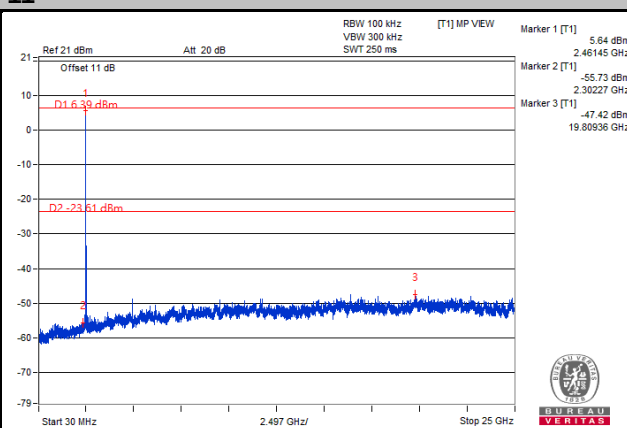
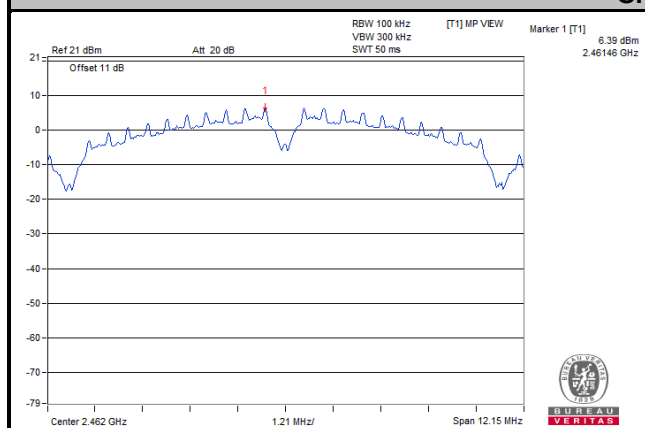
Ch 1

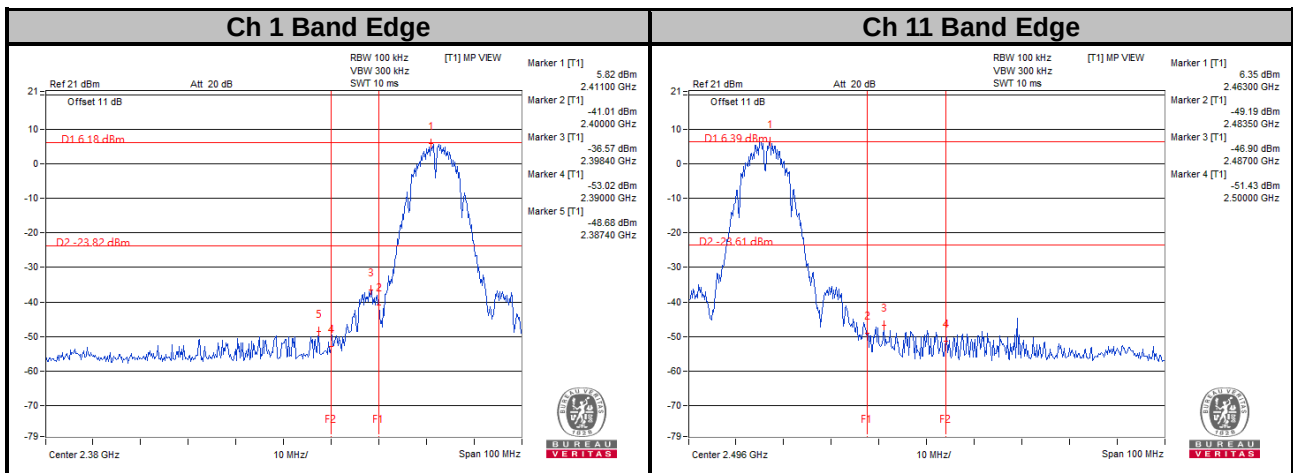


Ch 6



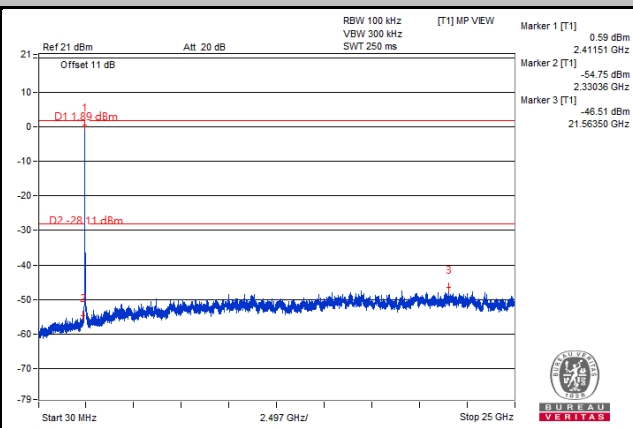
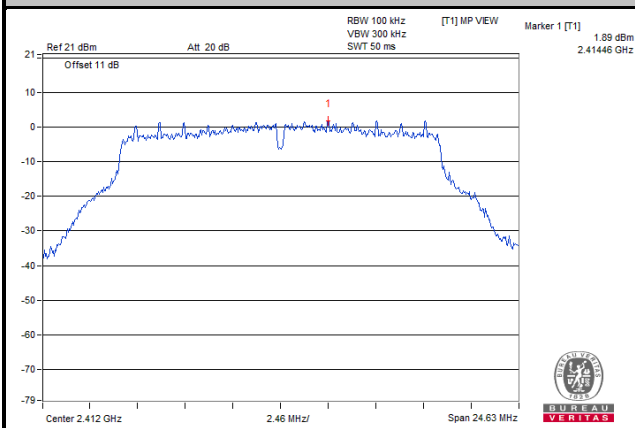
Ch 11



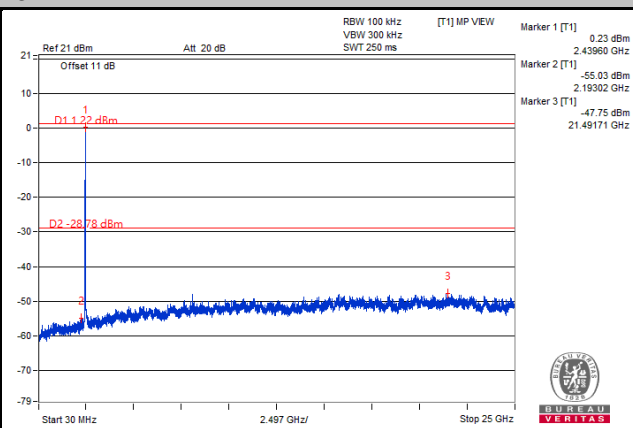
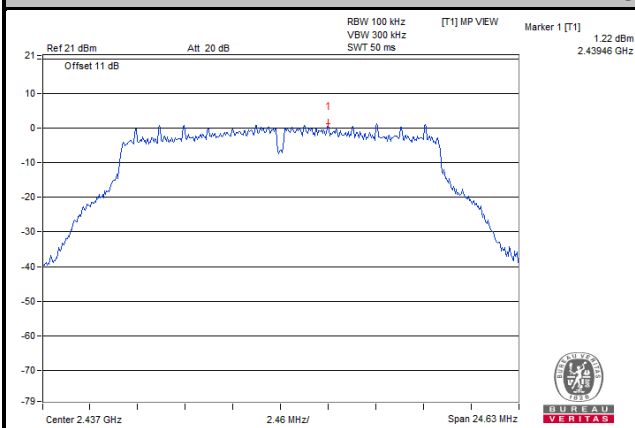


802.11g CHAIN 0

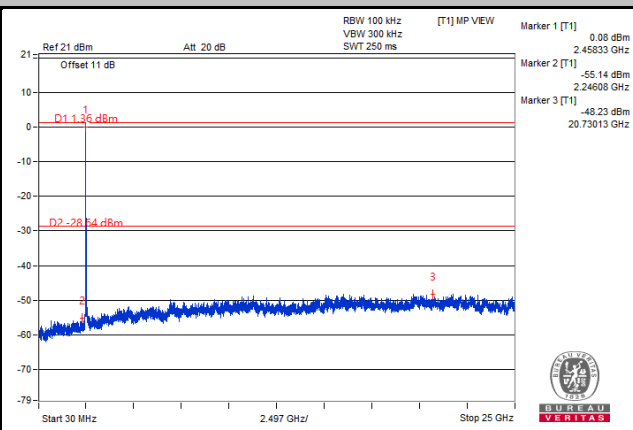
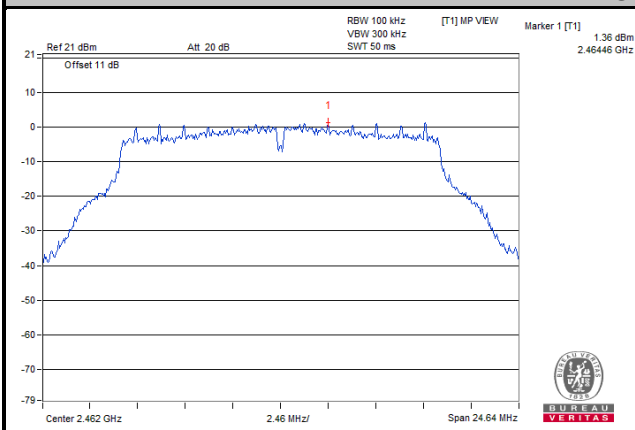
Ch 1

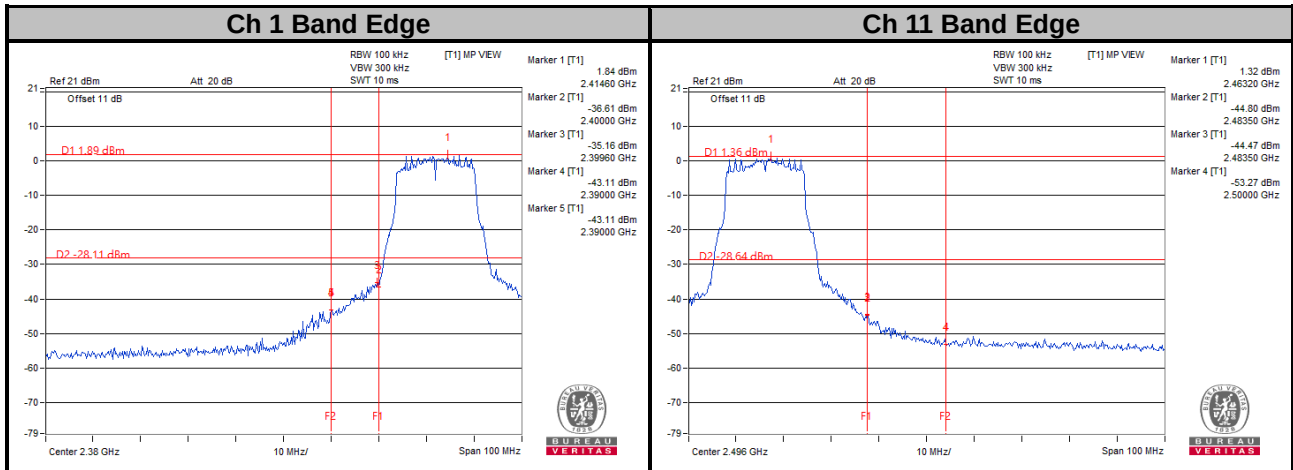


Ch 6



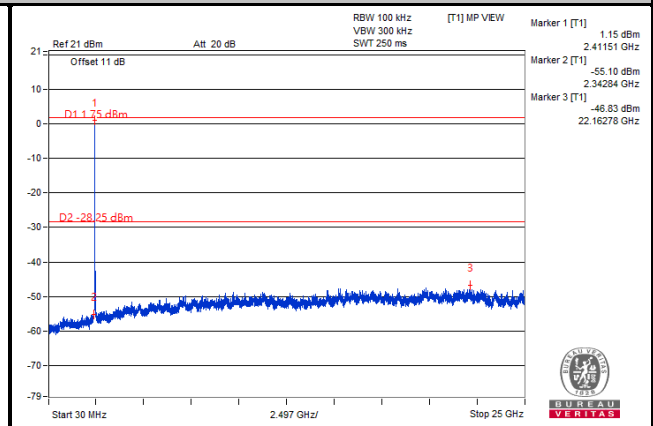
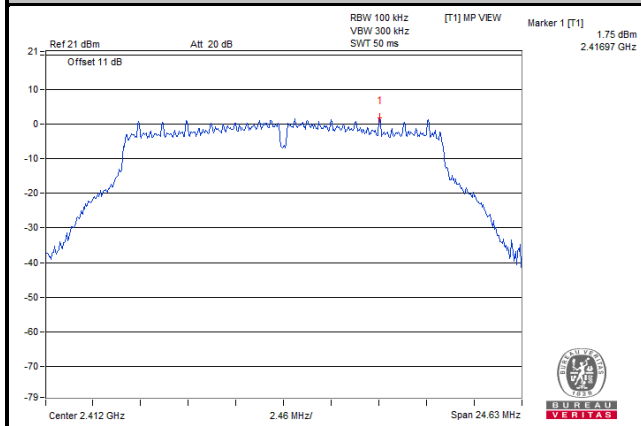
Ch 11



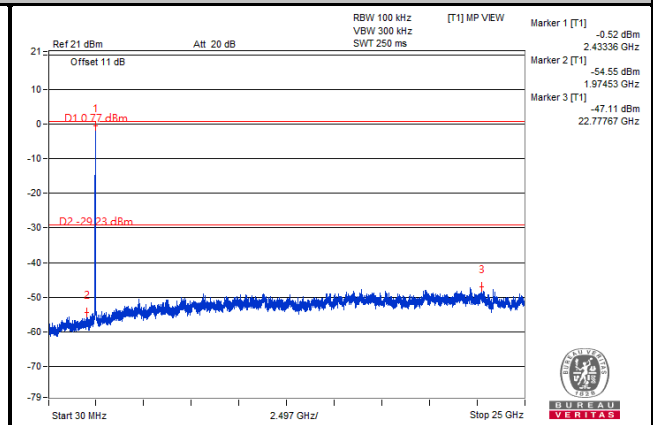
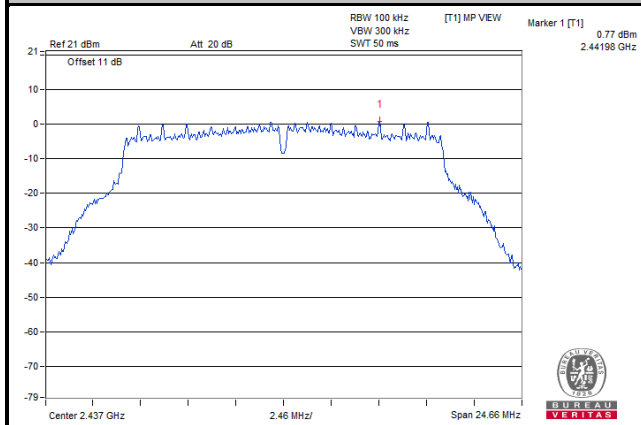


CHAIN 1

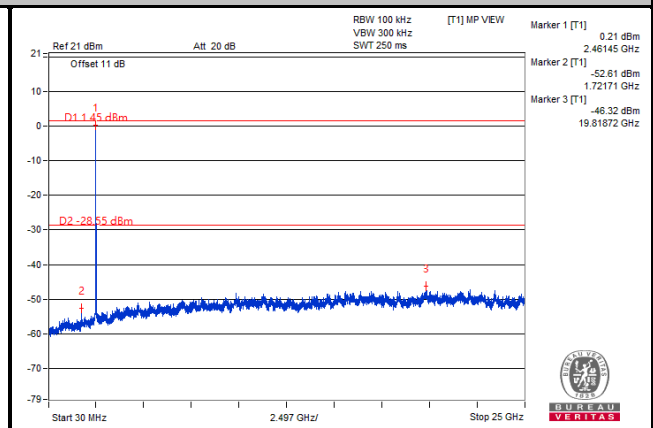
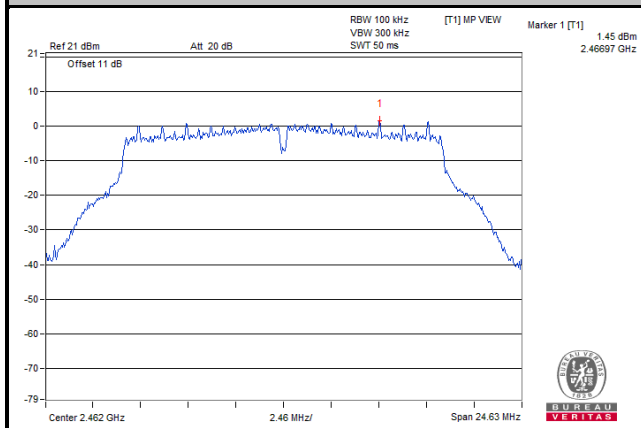
Ch 1



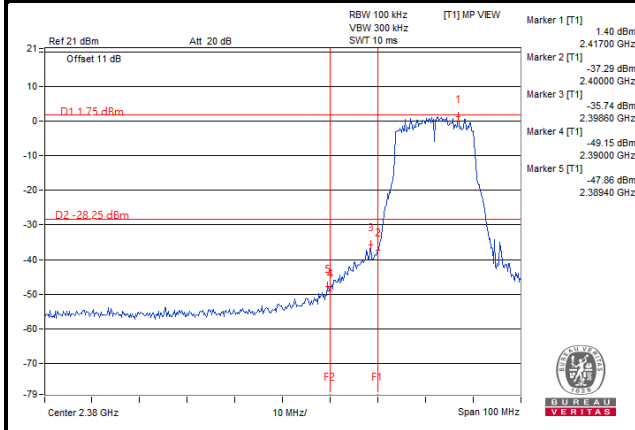
Ch 6



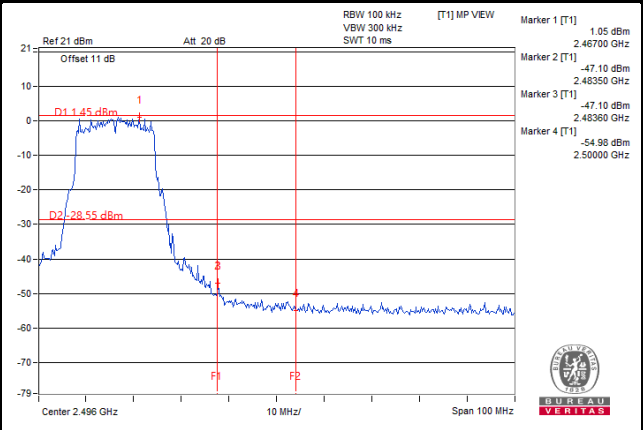
Ch 11



Ch 1 Band Edge

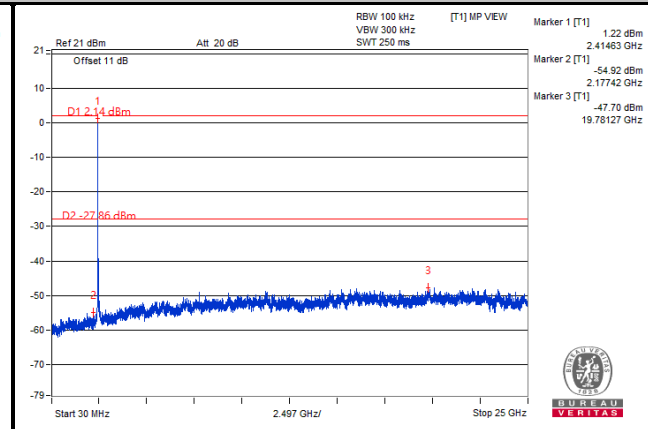
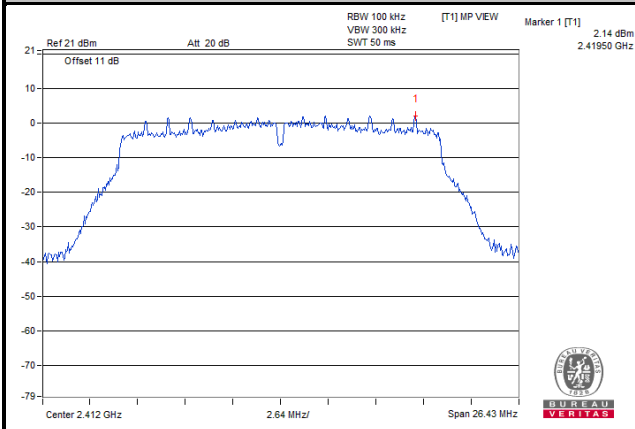


Ch 11 Band Edge

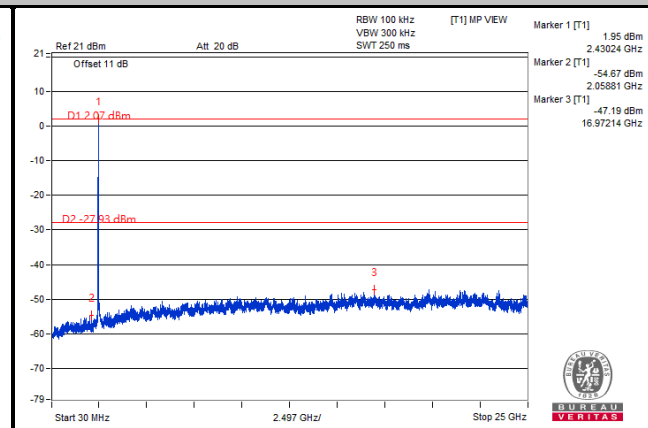
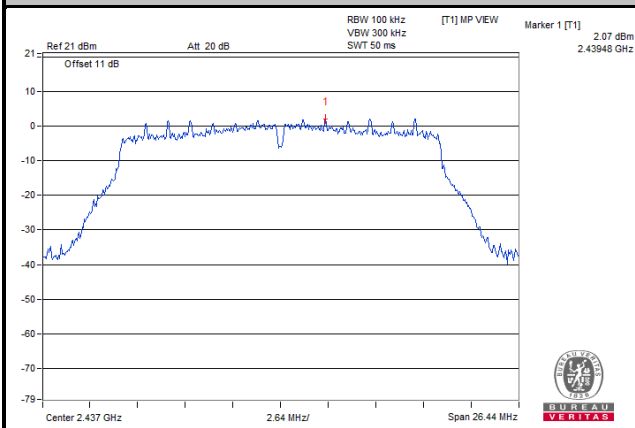


802.11n (HT20) CHAIN 0

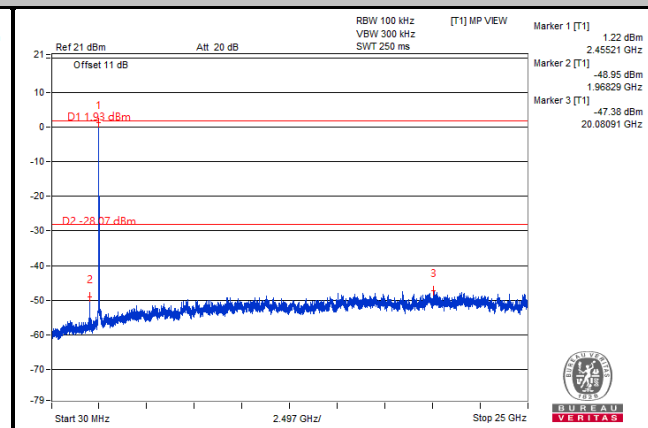
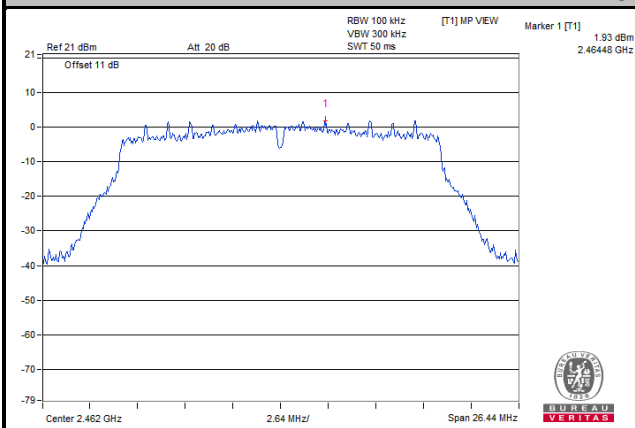
Ch 1

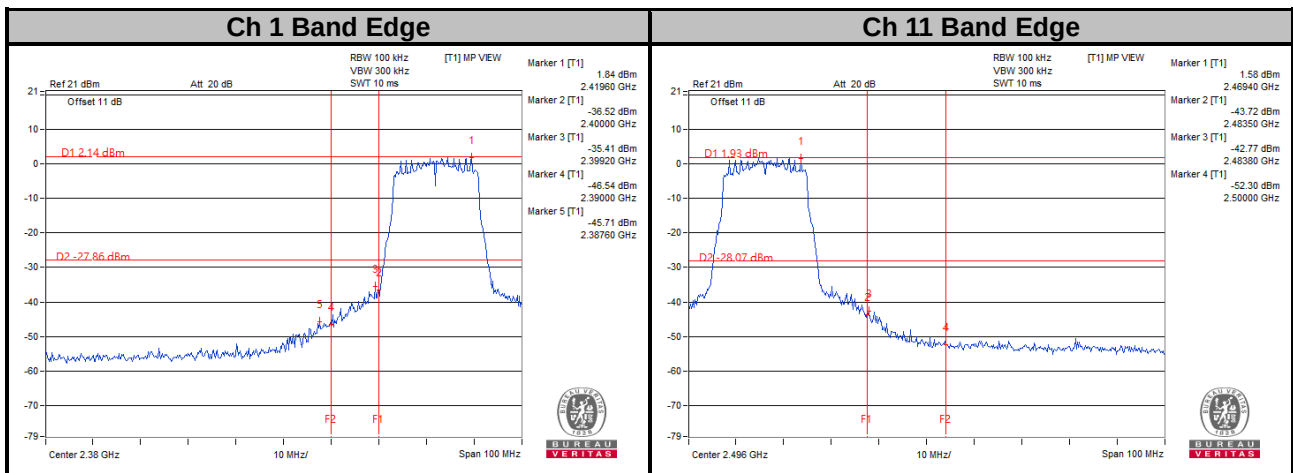


Ch 6



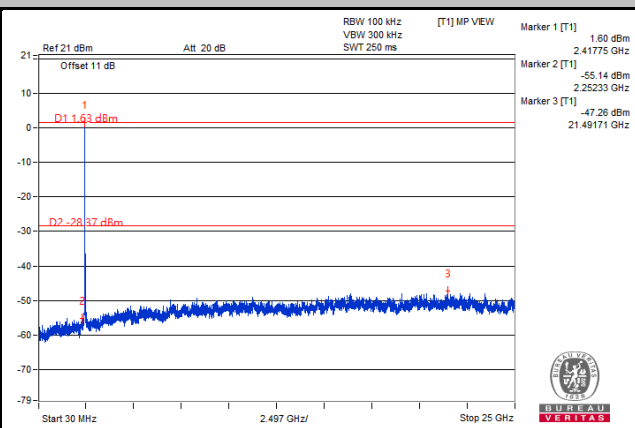
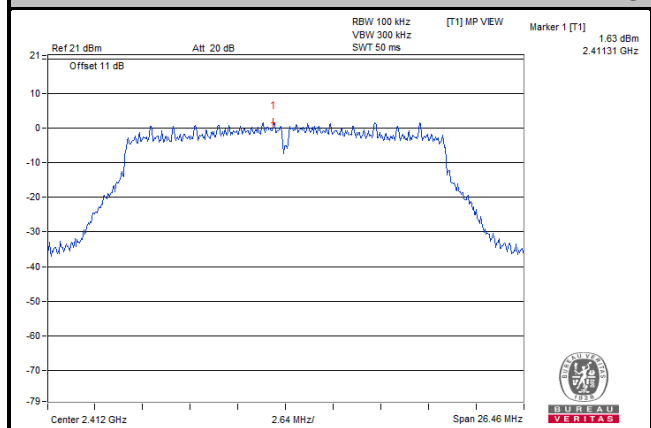
Ch 11



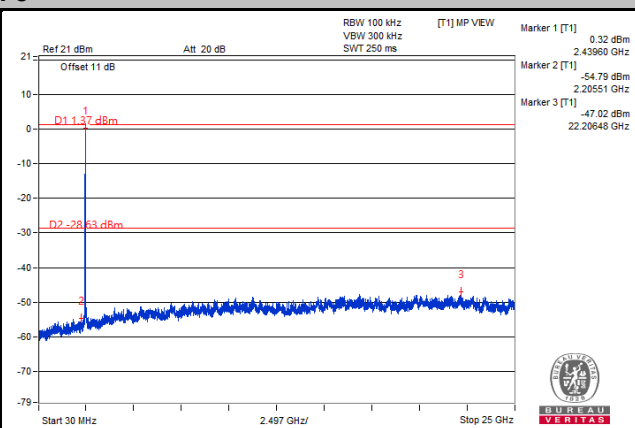
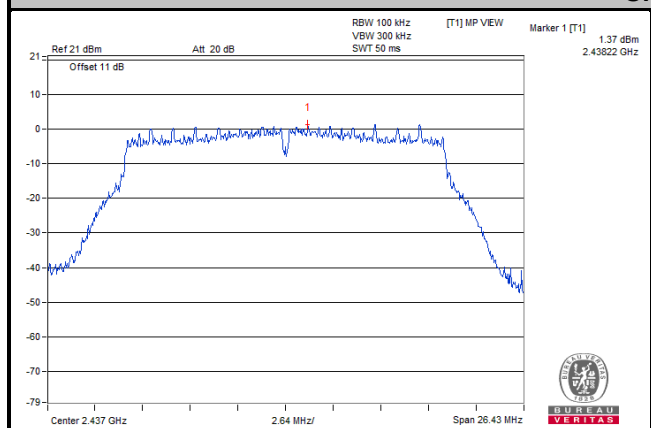


CHAIN 1

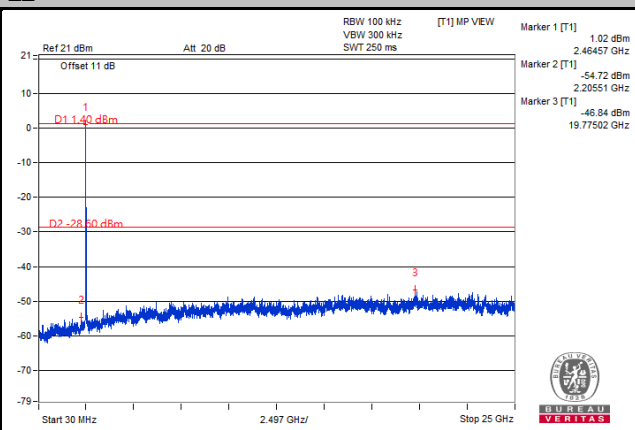
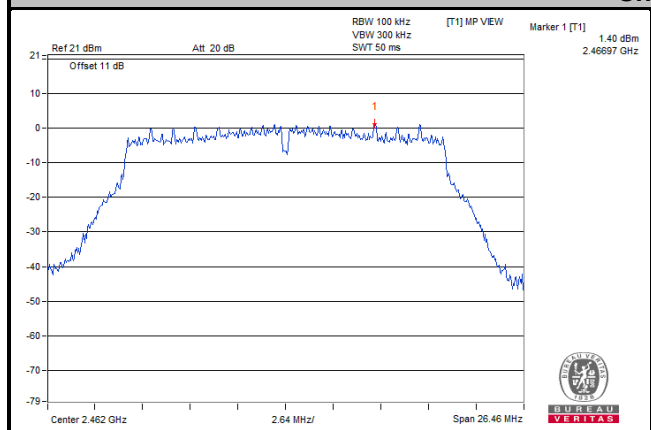
Ch 1



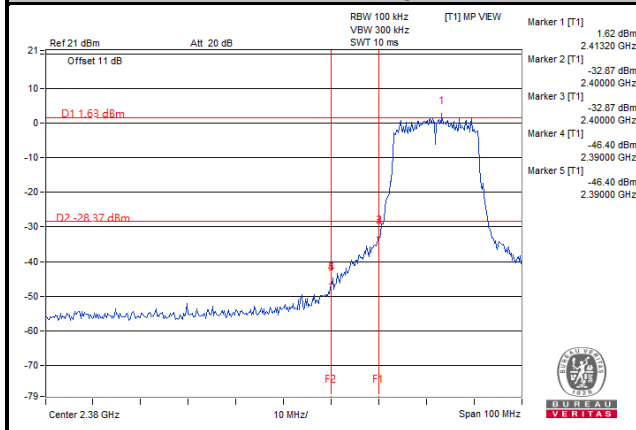
Ch 6



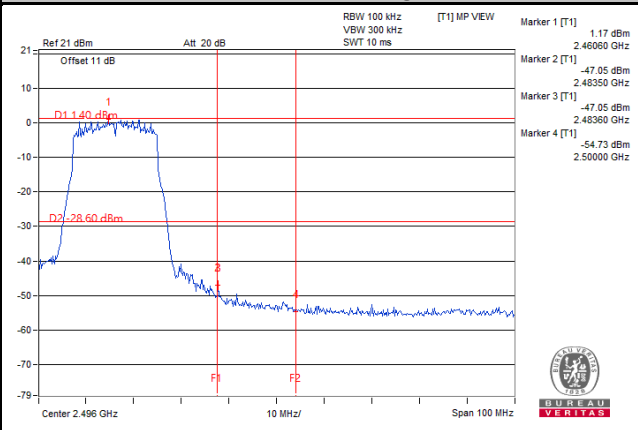
Ch 11



Ch 1 Band Edge



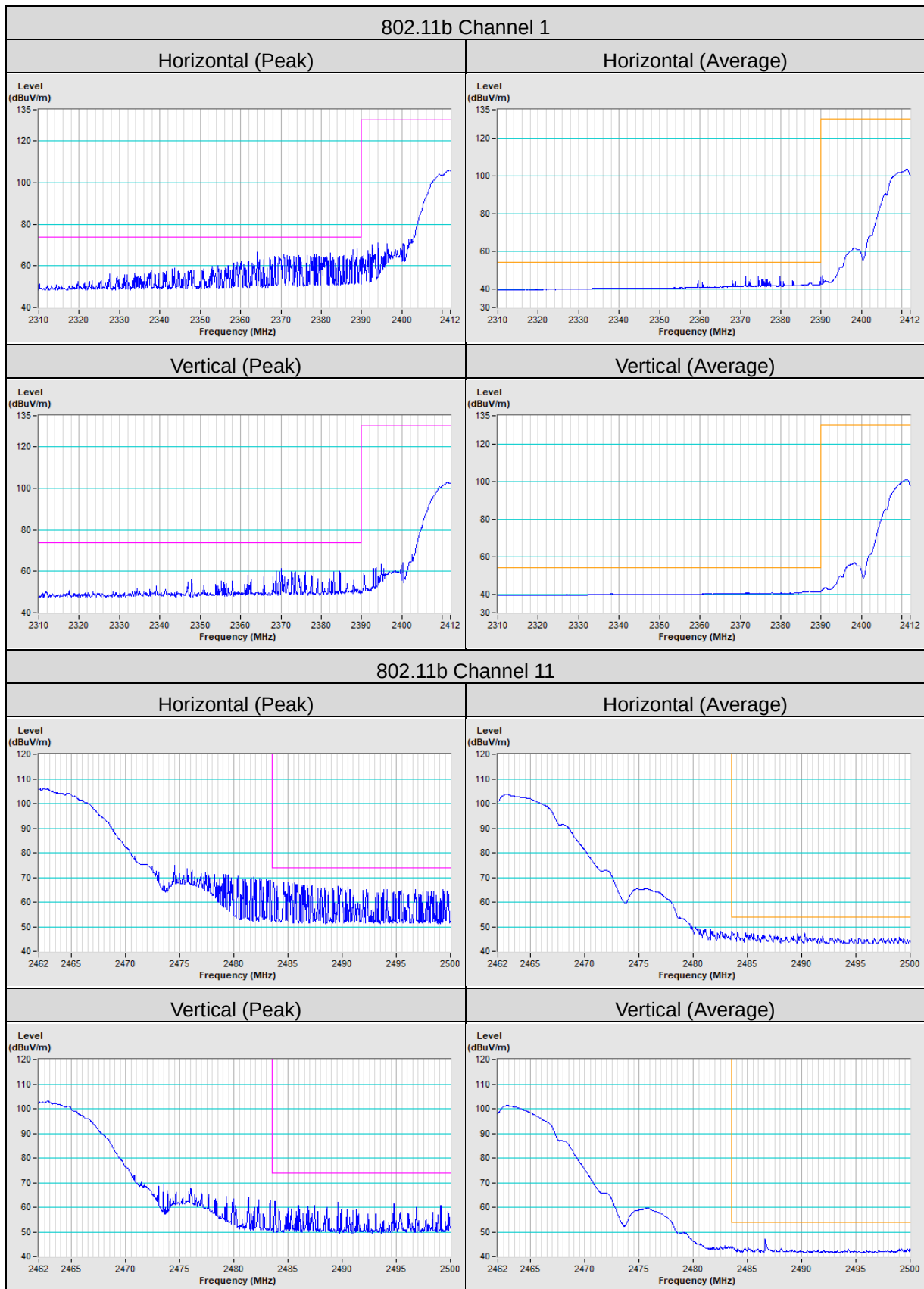
Ch 11 Band Edge

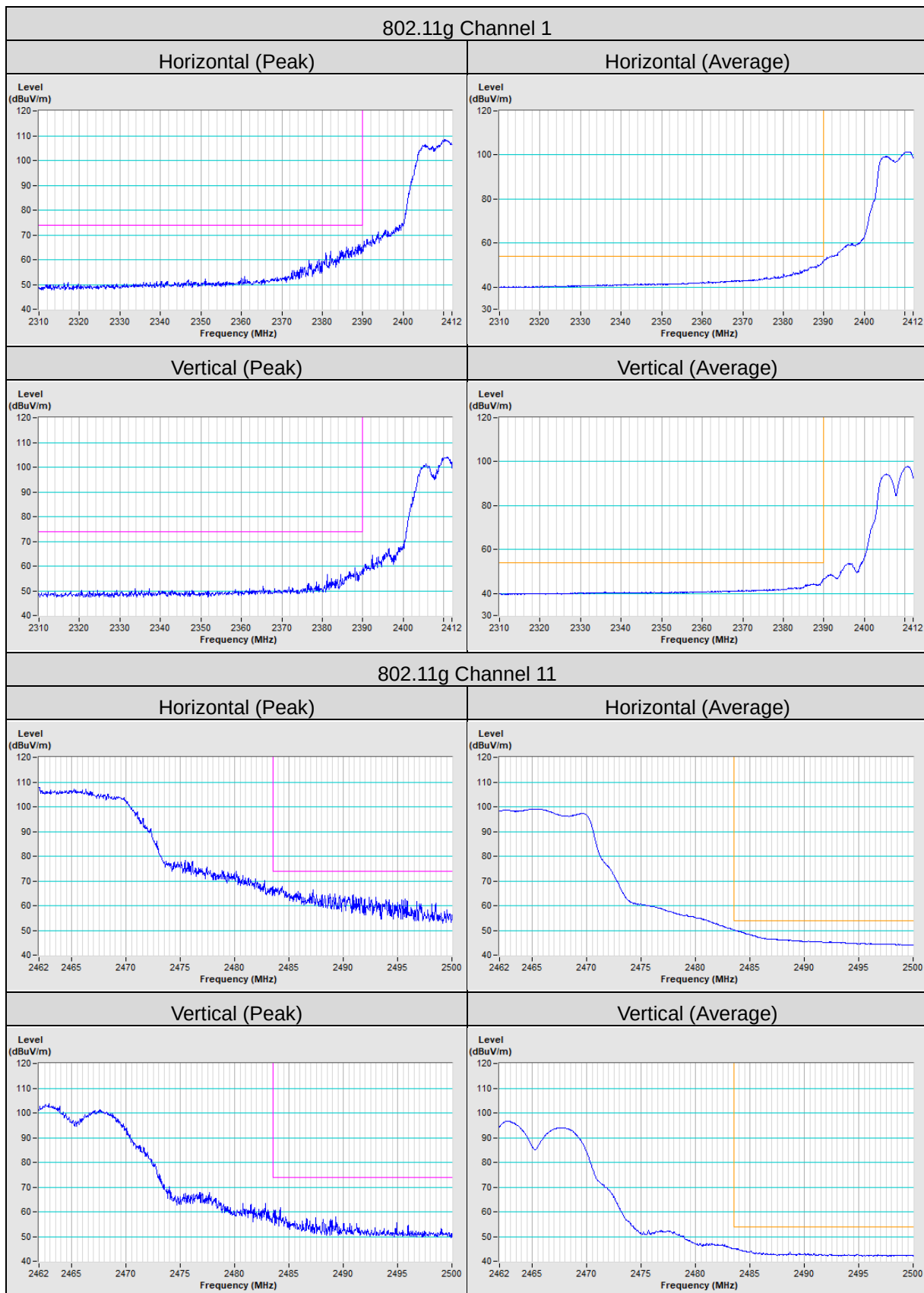


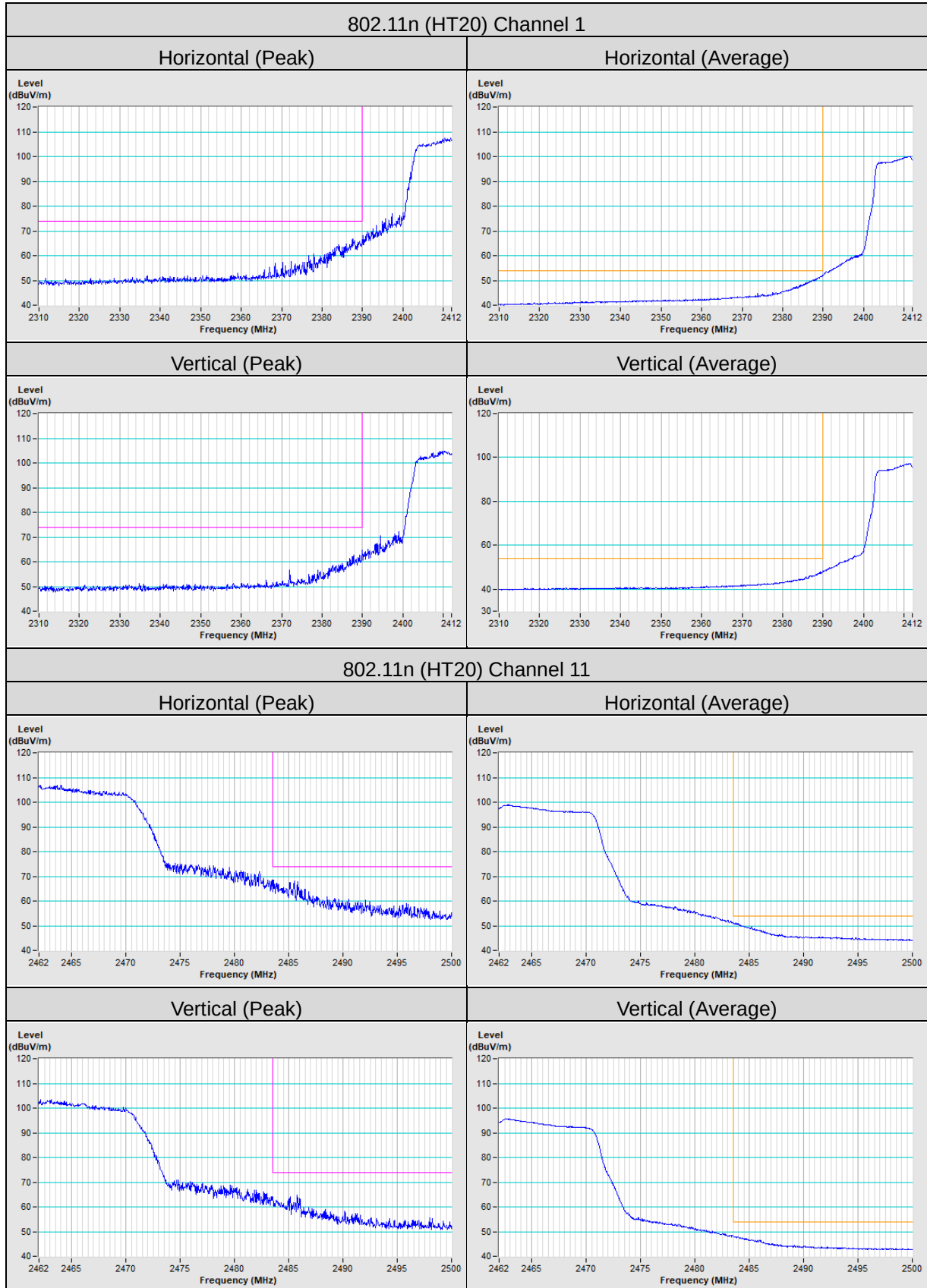
5 Pictures of Test Arrangements

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

Annex A- Band Edge Measurement







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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