

Partial FCC Test Report

Report No.: RFBBGM-WTW-P22050652-1

FCC ID: WIYSLM500QA

Test Model: SLM500

Received Date: May 20, 2022

Test Date: Jun. 03 ~ Aug. 03, 2022

Issued Date: Aug. 25, 2022

Applicant: CASTLES TECHNOLOGY CO., LTD.

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

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FCC Registration / 788550 / TW0003

Designation Number: 427177 / TW0011



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Release Control Record

Issue No.	Description	Date Issued
RFBBGM-WTW-P22050652-1	Original Release	Aug. 25, 2022

1 Certificate of Conformity

Product: Smart module

Brand:  **CASTLES**
TECHNOLOGY

Test Model: SLM500

Sample Status: Identical Prototype

Applicant: CASTLES TECHNOLOGY CO., LTD.

Test Date: Jun. 03 ~ Aug. 03, 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 : Lena Wang, **Date:** Aug. 25, 2022
Lena Wang / Specialist

Approved by : Jeremy Lin, **Date:** Aug. 25, 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 -8.63 dB at 0.68200 MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -5.76 dB at 2483.50 MHz.
15.247(d)	Antenna Port Emission	N/A	Refer to note
15.247(a)(2)	6 dB Bandwidth	N/A	Refer to note
---	Occupied Bandwidth Measurement	N/A	Refer to note
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	N/A	Refer to note
15.203	Antenna Requirement	N/A	Refer to note

Note:

1. This report is a partial report, and only test items of AC Power Conducted Emission, Conducted power and Radiated Emissions tests were verified and recorded in this report. Other testing data please refer to SGS report no.: SZCR210300003003.
2. 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.
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	Smart module
Brand	
Test Model	SLM500
Status of EUT	Identical Prototype
Power Supply Rating	5.0 Vdc (host equipment) 3.85 Vdc (Li-ion battery)
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: 11.0 / 5.5 / 2.0 / 1.0 Mbps 802.11g: 54.0 / 48.0 / 36.0 / 24.0 / 18.0 / 12.0 / 9.0 / 6.0 Mbps 802.11n: up to 72.2Mbps
Operating Frequency	2412 ~ 2462 MHz
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20)
Output Power	59.156 mW
Antenna Type	PIFA antenna with 0.08 dBi gain
Antenna Connector	N/A
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

1. This report is prepared for FCC class II permissive change. This report is issued as a supplementary report of SGS report no.: SZCR210300003003. The differences from the original report are adding an End-product (POS Terminal (Brand: Adyen, Model: AMS1)), changing antenna type and disabling 802.11n (HT40). Only AC Power Conducted Emission, Conducted Power and radiated emissions were verified and recorded in this report. Other testing data please refer to the original SGS report no.: SZCR210300003003. And Modular has C2PC the Major change is mainly for GSM power retest. When testing, the modified sample is used for testing.
2. The EUT was installed in POS Terminal (Brand: Adyen, Model: AMS1).
3. The EUT provides 1 completed transmitter and 1 receiver.

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

4. The POS Terminal contains following accessory devices.

Product	Brand	Model	Description
Adapter		1A52-UB52A	I/P: 100-240 Vac, 50/60 Hz, 0.3 A O/P: 5 Vdc, 2 A
Battery	CASTLES TECHNOLOGY	S1AMS1	3.85 Vdc
USB Cable	CHANG YANG ELECTRONICS CO.,LTD	CY-AS-HK0059	0.95 m shielded cable w/o core

5. Detail antenna specification please refer to antenna datasheet and/or antenna measurement report.
6. 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.

7. BT & WWAN & NFC (FCC ID: WIYAMS1001) technology can transmit at same time.
8. WLAN 2.4G & WWAN & NFC (FCC ID: WIYAMS1001) technology can transmit at same time.
9. WLAN 5G & WWAN & NFC (FCC ID: WIYAMS1001) technology can transmit at same time.

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 $\geq$ 1G	RE<1G	PLC	Power	
-	√	√	√	√	-

Where **RE $\geq$ 1G**: Radiated Emission above 1 GHz

RE<1G: Radiated Emission below 1 GHz

PLC: Power Line Conducted Emission

Power: Maximum Output Power

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

NOTE: "-" means no effect.

Radiated Emission Test (Above 1 GHz):

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

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

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)
-	802.11n (HT20)	1 to 11	6	OFDM	BPSK	6.5

Power Line Conducted Emission Test:

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

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11n (HT20)	1 to 11	6	OFDM	BPSK	6.5

Conducted Output Power 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, 60 % RH	120 Vac, 60 Hz	Charles Haaio
RE<1G	25 deg. C, 60 % RH	120 Vac, 60 Hz	Charles Haaio
PLC	25 deg. C, 75 % RH	120 Vac, 60 Hz	Noah Chang
Power	25 deg. C, 60 % RH	120 Vac, 60 Hz	Wayne Lin

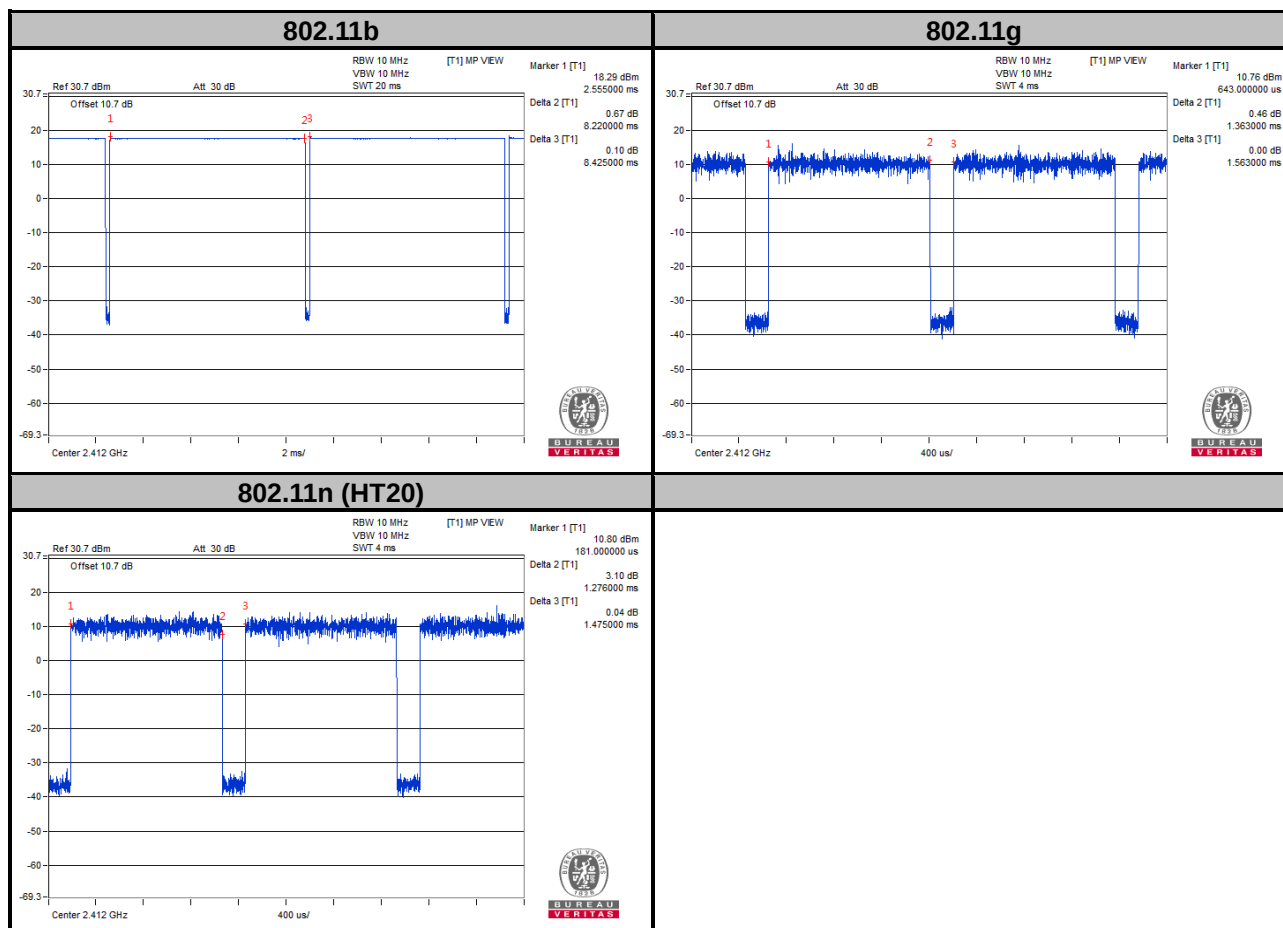
3.3 Duty Cycle of Test Signal

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

802.11b: Duty cycle = $8.22/8.425 = 0.976$, Duty factor = $10 * \log(1/0.976) = 0.11$

802.11g: Duty cycle = $1.363/1.563 = 0.872$, Duty factor = $10 * \log(1/0.872) = 0.59$

802.11n (HT20): Duty cycle = $1.276/1.475 = 0.865$, Duty factor = $10 * \log(1/0.865) = 0.63$



3.4 Description of Support Units

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

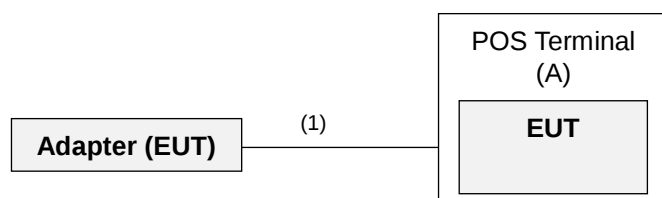
No.	Product	Brand	Model No.	Serial No.	FCC ID
A	POS Terminal	Adyen	AMS1	NA	NA

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB cable	1	0.95	Y	0	Provided by client

Note:

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

3.4.1 Configuration of System under Test



Remote site

3.5 General Description of Applied Standards and References

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

Test Standard:

FCC Part 15, Subpart C (15.247)

ANSI C63.10-2013

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

References Test Guidance:

KDB 558074 D01 Meas Guidance v05r02

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

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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

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

NOTE:

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

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY52260177	Sep. 01, 2021	Aug. 31, 2022
Spectrum Analyzer R&S	FSU43	101261	Apr. 11, 2022	Apr. 10, 2023
Horn Antenna ETS-Lindgren	3117	00143293	Nov. 14, 2021	Nov. 13, 2022
Bi_Log Antenna Schwarzbeck	VULB9168	9168-616	Oct. 27, 2021	Oct. 26, 2022
Horn Antenna Schwarzbeck	BBHA 9170	9170-480	Nov. 14, 2021	Nov. 13, 2022
Attenuator WOKEN	MDCS18N-10	MDCS18N-10-01	Apr. 05, 2022	Apr. 04, 2023
Loop Antenna EMCI	EM-6879	269	Sep. 16, 2021	Sep. 15, 2022
MXG Vector signal generator Agilent	N5182B	MY53050430	Nov. 25, 2021	Nov. 24, 2022
Preamplifier Agilent	310N	187226	Jun. 17, 2021	Jun. 16, 2022
			Jun. 14, 2022	Jun. 13, 2023
Preamplifier Agilent	83017A	MY39501357	Jun. 17, 2021	Jun. 16, 2022
			Jun. 14, 2022	Jun. 13, 2023
Pre-Amplifier 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 Coaxial Cable ETS-Lindgren	EMC104-SM-SM-10000	Cable-CH1-01(RFC-SMS-100-SMS-120+RFC-SMS-100-SMS-4)	Jun. 17, 2021	Jun. 16, 2022
			Jun. 14, 2022	Jun. 13, 2023
RF Coaxial Cable ETS-Lindgren	RFC-SMS-100-SMS-24-IN	Cable-CH1-02(RFC-SMS-100-SMS-24)	Jun. 17, 2021	Jun. 16, 2022
			Jun. 14, 2022	Jun. 13, 2023
Fix tool for Boresight antenna tower BV	BAF-01	10	NA	NA
E3 Software AUDIX	E3	NA	NA	NA
Software BVADT	ADT_Radiated_V8.7.08	NA	NA	NA
Software BVADT	ADT_RF Test Software V6.6.5.4	NA	NA	NA
Antenna Tower MF	NA	NA	NA	NA
Turn Table MF	NA	NA	NA	NA
Controller Max-Full	MF-7802	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. The test was performed in HsinTien 966 chamber 6

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:

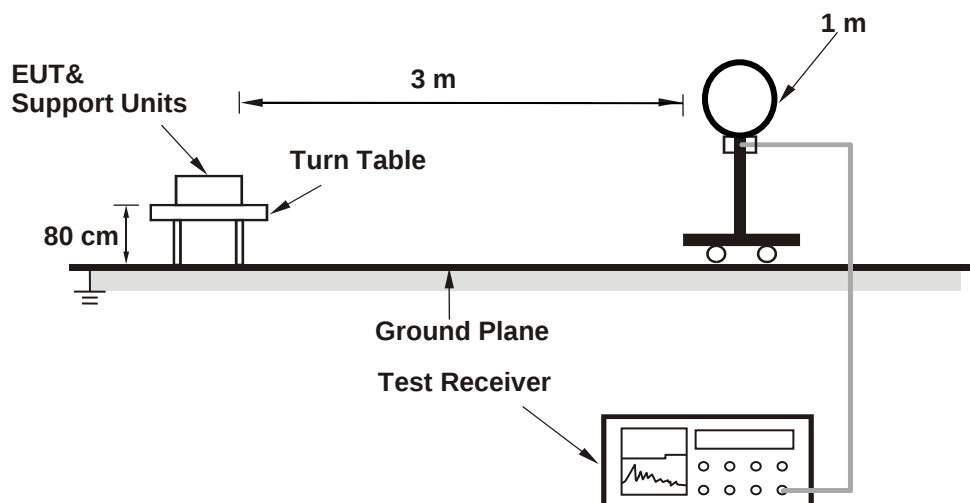
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK)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

4.1.4 Deviation from Test Standard

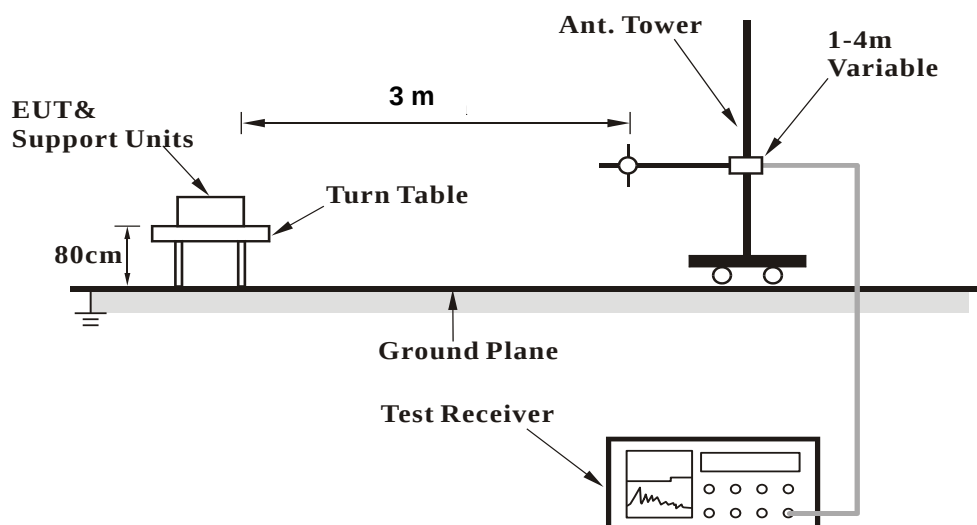
No deviation.

4.1.5 Test Set Up

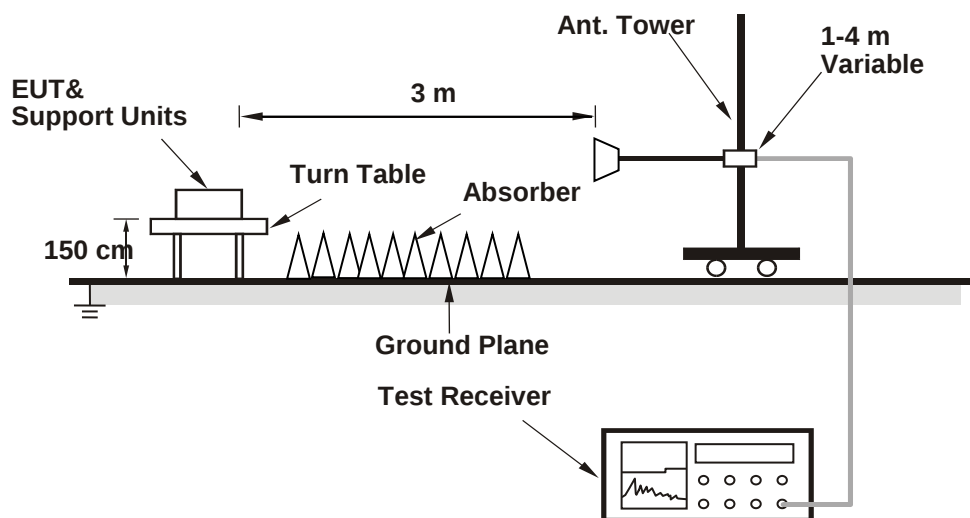
<Radiated Emission below 30 MHz>



<Radiated Emission 30 MHz to 1 GHz>



<Radiated Emission above 1 GHz>



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

4.1.6 EUT Operating Conditions

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

4.1.7 Test Results

Above 1 GHz Data : 802.11b

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	52.94 PK	74.00	-21.06	2.76 H	24	14.94	38.00
2	2390.00	43.51 AV	54.00	-10.49	2.76 H	24	5.51	38.00
3	*2412.00	104.70 PK			2.76 H	24	66.60	38.10
4	*2412.00	102.69 AV			2.76 H	24	64.59	38.10
5	4824.00	51.30 PK	74.00	-22.70	1.56 H	164	39.73	11.57
6	4824.00	43.50 AV	54.00	-10.50	1.56 H	164	31.93	11.57
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	52.87 PK	74.00	-21.13	2.21 V	359	14.87	38.00
2	2390.00	42.80 AV	54.00	-11.20	2.21 V	359	4.80	38.00
3	*2412.00	95.95 PK			2.21 V	359	57.85	38.10
4	*2412.00	93.93 AV			2.21 V	359	55.83	38.10
5	4824.00	51.78 PK	74.00	-22.22	2.63 V	102	40.21	11.57
6	4824.00	44.03 AV	54.00	-9.97	2.63 V	102	32.46	11.57

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	104.38 PK			2.64 H	29	66.42	37.96
2	*2437.00	102.43 AV			2.64 H	29	64.47	37.96
3	4874.00	51.06 PK	74.00	-22.94	1.35 H	205	39.52	11.54
4	4874.00	43.28 AV	54.00	-10.72	1.35 H	205	31.74	11.54
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	*2437.00	95.70 PK			2.21 V	347	57.74	37.96
2	*2437.00	93.58 AV			2.21 V	347	55.62	37.96
3	4874.00	51.57 PK	74.00	-22.43	2.13 V	184	40.03	11.54
4	4874.00	43.72 AV	54.00	-10.28	2.13 V	184	32.18	11.54

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 802.11b	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	104.06 PK			2.10 H	15	66.14	37.92
2	*2462.00	101.17 AV			2.10 H	15	63.25	37.92
3	2483.50	53.14 PK	74.00	-20.86	2.10 H	15	46.57	6.57
4	2483.50	42.73 AV	54.00	-11.27	2.10 H	15	36.16	6.57
5	4924.00	48.60 PK	74.00	-25.40	1.64 H	118	36.98	11.62
6	4924.00	41.45 AV	54.00	-12.55	1.64 H	118	29.83	11.62
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	93.20 PK			2.07 V	360	55.28	37.92
2	*2462.00	90.50 AV			2.07 V	360	52.58	37.92
3	2483.50	52.80 PK	74.00	-21.20	2.07 V	360	14.85	37.95
4	2483.50	42.40 AV	54.00	-11.60	2.07 V	360	4.45	37.95
5	4924.00	48.10 PK	74.00	-25.90	1.64 V	117	36.48	11.62
6	4924.00	41.30 AV	54.00	-12.70	1.64 V	117	29.68	11.62

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.

802.11g

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	58.10 PK	74.00	-15.90	2.76 H	238	20.10	38.00
2	2390.00	45.36 AV	54.00	-8.64	2.76 H	238	7.36	38.00
3	*2412.00	98.28 PK			2.76 H	238	60.18	38.10
4	*2412.00	90.13 AV			2.76 H	238	52.03	38.10
5	4824.00	51.09 PK	74.00	-22.91	2.71 H	76	39.52	11.57
6	4824.00	43.20 AV	54.00	-10.80	2.71 H	76	31.63	11.57
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	53.26 PK	74.00	-20.74	2.21 V	359	15.26	38.00
2	2390.00	42.81 AV	54.00	-11.19	2.21 V	359	4.81	38.00
3	*2412.00	93.48 PK			2.21 V	359	55.38	38.10
4	*2412.00	84.89 AV			2.21 V	359	46.79	38.10
5	4824.00	51.22 PK	74.00	-22.78	1.33 V	149	39.65	11.57
6	4824.00	43.42 AV	54.00	-10.58	1.33 V	149	31.85	11.57

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	98.02 PK			2.64 H	29	60.06	37.96
2	*2437.00	89.85 AV			2.64 H	29	51.89	37.96
3	4874.00	51.25 PK	74.00	-22.75	1.63 H	28	39.71	11.54
4	4874.00	43.49 AV	54.00	-10.51	1.63 H	28	31.95	11.54
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	*2437.00	93.15 PK			2.21 V	347	55.19	37.96
2	*2437.00	84.59 AV			2.21 V	347	46.63	37.96
3	4874.00	50.89 PK	74.00	-23.11	1.26 V	85	39.35	11.54
4	4874.00	43.16 AV	54.00	-10.84	1.26 V	85	31.62	11.54

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 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	100.88 PK			2.10 H	15	62.96	37.92
2	*2462.00	93.61 AV			2.10 H	15	55.69	37.92
3	2483.50	60.53 PK	74.00	-13.47	2.10 H	15	22.58	37.95
4	2483.50	46.87 AV	54.00	-7.13	2.10 H	15	8.92	37.95
5	4924.00	48.01 PK	74.00	-25.99	1.13 H	328	36.39	11.62
6	4924.00	41.38 AV	54.00	-12.62	1.13 H	328	29.76	11.62
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	90.18 PK			2.07 V	360	52.26	37.92
2	*2462.00	83.54 AV			2.07 V	360	45.62	37.92
3	2483.50	53.46 PK	74.00	-20.54	2.07 V	360	15.51	37.95
4	2483.50	42.52 AV	54.00	-11.48	2.07 V	360	4.57	37.95
5	4924.00	47.84 PK	74.00	-26.16	1.34 V	111	36.22	11.62
6	4924.00	41.33 AV	54.00	-12.67	1.34 V	111	29.71	11.62

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.

802.11n (HT20)

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	60.00 PK	74.00	-14.00	2.76 H	238	22.00	38.00
2	2390.00	47.16 AV	54.00	-6.84	2.76 H	238	9.16	38.00
3	*2412.00	97.59 PK			2.76 H	238	59.49	38.10
4	*2412.00	90.00 AV			2.76 H	238	51.90	38.10
5	4824.00	51.69 PK	74.00	-22.31	1.53 H	149	40.12	11.57
6	4824.00	43.91 AV	54.00	-10.09	1.53 H	149	32.34	11.57
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	53.27 PK	74.00	-20.73	2.21 V	359	15.27	38.00
2	2390.00	43.28 AV	54.00	-10.72	2.21 V	359	5.28	38.00
3	*2412.00	93.98 PK			2.21 V	359	55.88	38.10
4	*2412.00	84.78 AV			2.21 V	359	46.68	38.10
5	4824.00	50.77 PK	74.00	-23.23	1.83 V	162	39.20	11.57
6	4824.00	43.02 AV	54.00	-10.98	1.83 V	162	31.45	11.57

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	97.21 PK			2.64 H	29	59.25	37.96
2	*2437.00	89.72 AV			2.64 H	29	51.76	37.96
3	4874.00	51.34 PK	74.00	-22.66	2.10 H	127	39.80	11.54
4	4874.00	43.70 AV	54.00	-10.30	2.10 H	127	32.16	11.54
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	*2437.00	93.63 PK			2.21 V	347	55.67	37.96
2	*2437.00	84.45 AV			2.21 V	347	46.49	37.96
3	4874.00	50.93 PK	74.00	-23.07	2.72 V	54	39.39	11.54
4	4874.00	43.14 AV	54.00	-10.86	2.72 V	54	31.60	11.54

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 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	101.00 PK			2.10 H	15	63.08	37.92
2	*2462.00	94.50 AV			2.10 H	15	56.58	37.92
3	2483.50	63.11 PK	74.00	-10.89	2.10 H	15	25.16	37.95
4	2483.50	48.24 AV	54.00	-5.76	2.10 H	15	10.29	37.95
5	4924.00	48.23 PK	74.00	-25.77	1.15 H	54	36.61	11.62
6	4924.00	41.57 AV	54.00	-12.43	1.15 H	54	29.95	11.62
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	90.39 PK			2.07 V	360	52.47	37.92
2	*2462.00	83.40 AV			2.07 V	360	45.48	37.92
3	2483.50	54.04 PK	74.00	-19.96	2.07 V	360	16.09	37.95
4	2483.50	43.06 AV	54.00	-10.94	2.07 V	360	5.11	37.95
5	4924.00	47.91 PK	74.00	-26.09	1.15 V	174	36.29	11.62
6	4924.00	41.42 AV	54.00	-12.58	1.15 V	174	29.80	11.62

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.

9 kHz ~ 30 MHz Data:

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

30 MHz ~ 1 GHz Worst-Case Data:

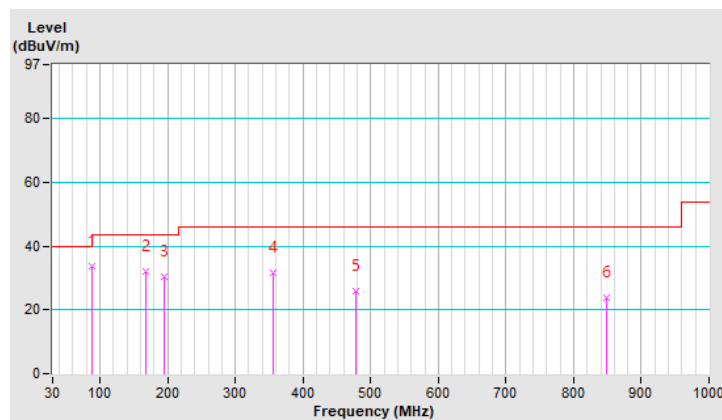
802.11n (HT20)

RF Mode	TX 802.11n (HT20)	Channel	CH 6 : 2437 MHz
Frequency Range	30MHz ~ 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	88.82	33.90 QP	43.50	-9.60	1.28 H	279	56.79	-22.89
2	168.54	32.06 QP	43.50	-11.44	1.16 H	168	49.00	-16.94
3	194.77	30.40 QP	43.50	-13.10	1.15 H	241	50.08	-19.68
4	356.80	31.81 QP	46.00	-14.19	1.14 H	144	46.23	-14.42
5	477.84	26.00 QP	46.00	-20.00	1.64 H	209	37.34	-11.34
6	848.80	23.65 QP	46.00	-22.35	1.15 H	163	28.74	-5.09

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.

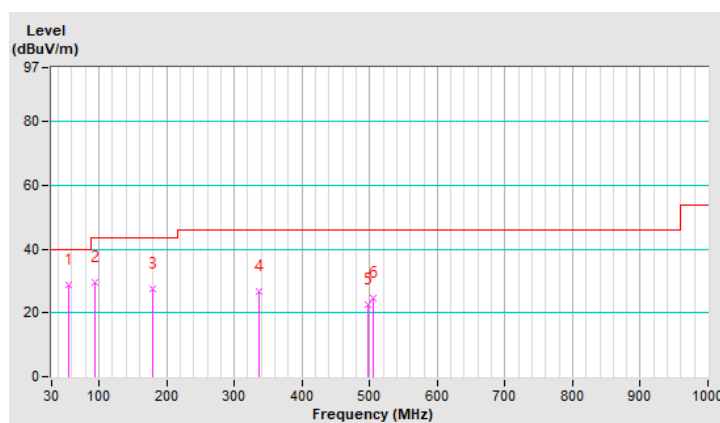


RF Mode	TX 802.11n (HT20)	Channel	CH 6 : 2437 MHz
Frequency Range	30MHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

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	55.38	28.94 QP	40.00	-11.06	1.14 V	241	46.32	-17.38
2	93.41	29.64 QP	43.50	-13.86	1.55 V	228	52.14	-22.50
3	178.80	27.55 QP	43.50	-15.95	1.78 V	163	45.43	-17.88
4	336.64	26.74 QP	46.00	-19.26	1.04 V	336	41.39	-14.65
5	498.50	22.73 QP	46.00	-23.27	1.15 V	207	33.72	-10.99
6	504.40	24.46 QP	46.00	-21.54	1.64 V	2	35.38	-10.92

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	ESCI	100613	Dec. 03, 2021	Dec. 02, 2022
RF signal cable Woken	5D-FB	Cable-cond1-01	Jan. 15, 2022	Jan. 14, 2023
LISN/AMN ROHDE & SCHWARZ (EUT)	ENV216	101826	Mar. 14, 2022	Mar. 13, 2023
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Sep. 07, 2021	Sep. 06, 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 1.
 3. The VCCI Site Registration No. is C-12040.
 4. Test Date: 2022/8/3

4.2.3 Test Procedures

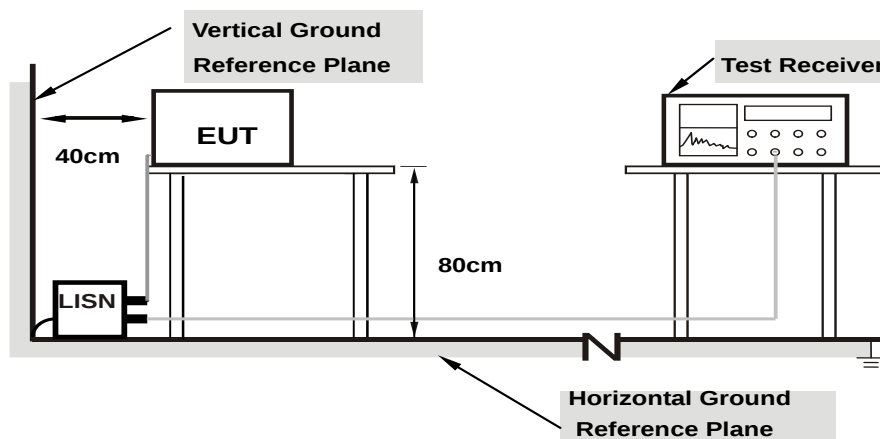
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance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

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

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



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

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

4.2.6 EUT Operating Conditions

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

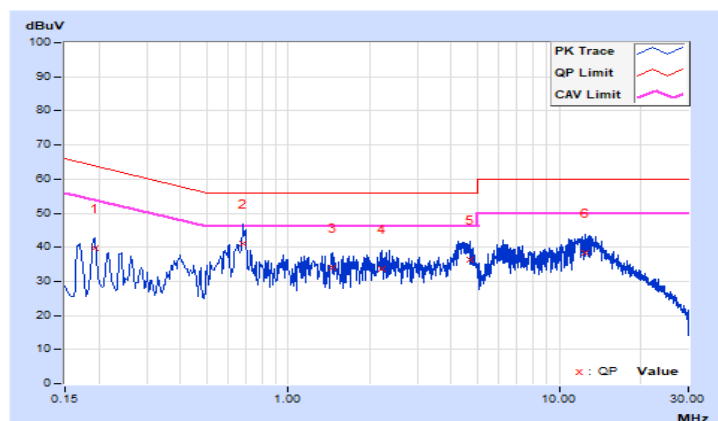
4.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25 °C, 75% RH
Tested by	Noah Chang	Test Date	2022/8/3

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	0.19316	9.71	30.10	19.85	39.81	29.56	63.90	53.90	-24.09	-24.34
2	0.68200	9.82	31.27	27.55	41.09	37.37	56.00	46.00	-14.91	-8.63
3	1.45400	9.87	24.28	18.04	34.15	27.91	56.00	46.00	-21.85	-18.09
4	2.20600	9.91	23.89	17.76	33.80	27.67	56.00	46.00	-22.20	-18.33
5	4.68600	9.96	26.57	20.24	36.53	30.20	56.00	46.00	-19.47	-15.80
6	12.49000	10.09	28.22	16.82	38.31	26.91	60.00	50.00	-21.69	-23.09

Remarks:

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

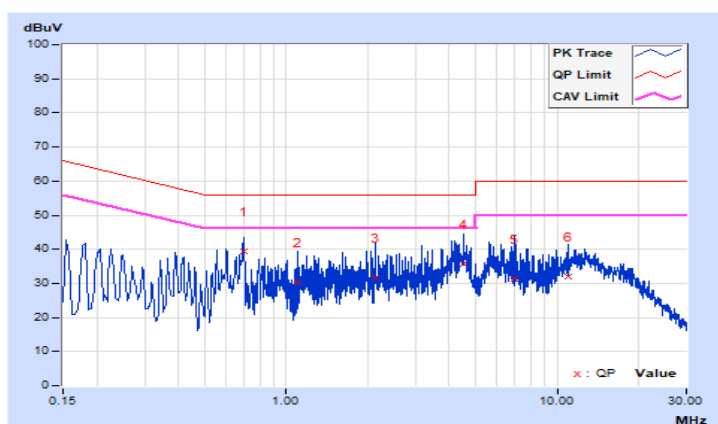


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25 °C, 75% RH
Tested by	Noah Chang	Test Date	2022/8/3

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	0.69800	9.83	29.45	23.73	39.28	33.56	56.00	46.00	-16.72	-12.44
2	1.09800	9.87	20.43	10.63	30.30	20.50	56.00	46.00	-25.70	-25.50
3	2.12600	9.92	21.58	13.20	31.50	23.12	56.00	46.00	-24.50	-22.88
4	4.52200	9.98	25.75	16.38	35.73	26.36	56.00	46.00	-20.27	-19.64
5	7.00200	10.02	21.23	11.73	31.25	21.75	60.00	50.00	-28.75	-28.25
6	10.96200	10.07	21.80	12.65	31.87	22.72	60.00	50.00	-28.13	-27.28

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

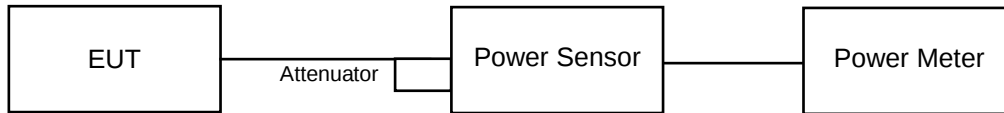


4.3 Conducted Output Power Measurement

4.3.1 Limits of Conducted Output Power Measurement

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

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 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.

4.3.5 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)	Peak Power (mW)	Peak Power (dBm)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	56.494	17.52	31.117	14.93	30	Pass
6	2437	53.703	17.30	29.242	14.66	30	Pass
11	2462	54.954	17.40	30.549	14.85	30	Pass

802.11g

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	54.325	17.35	7.447	8.72	30	Pass
6	2437	57.412	17.59	7.603	8.81	30	Pass
11	2462	55.847	17.47	7.311	8.64	30	Pass

802.11n (HT20)

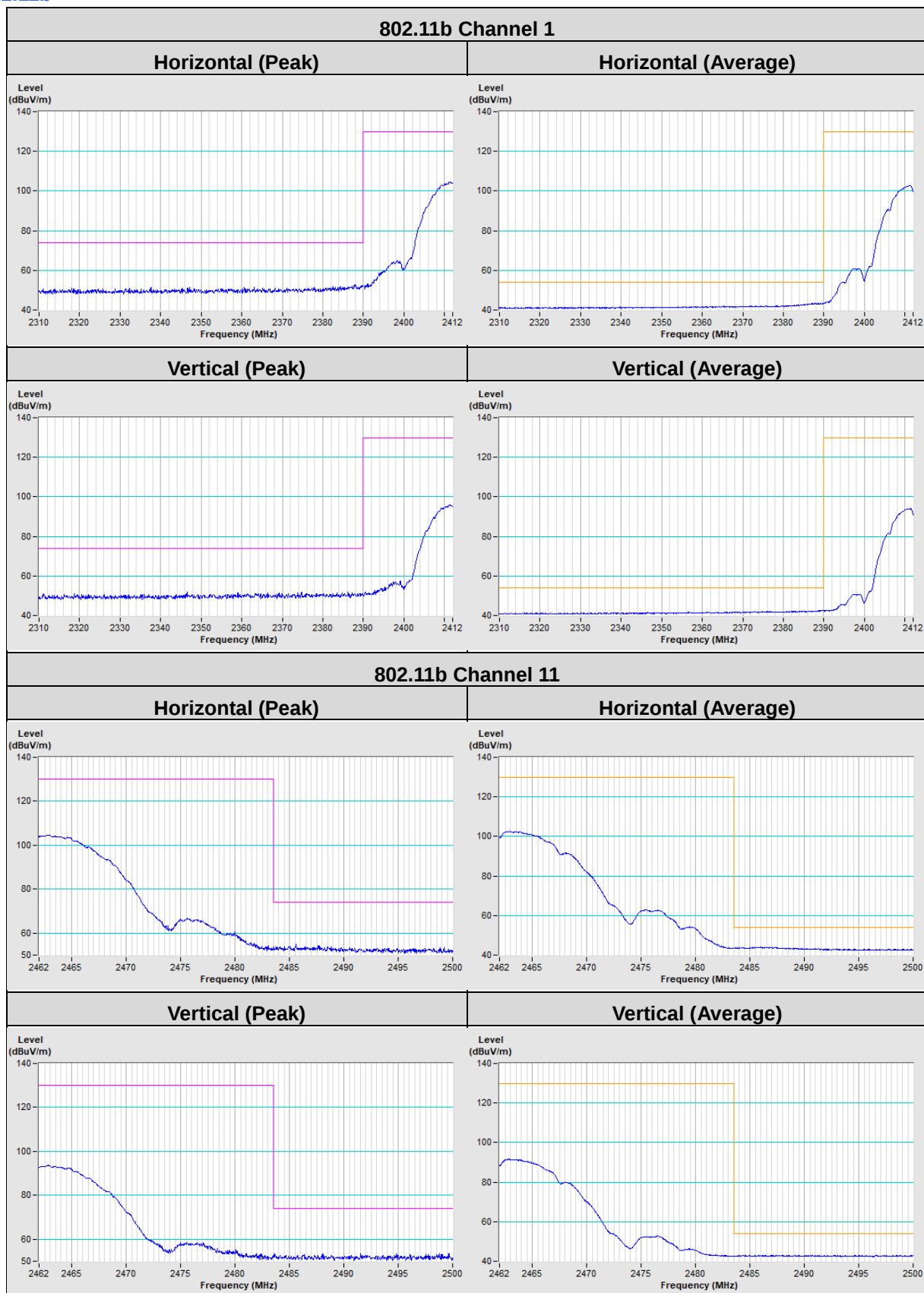
Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	56.364	17.51	6.902	8.39	30	Pass
6	2437	59.156	17.72	7.178	8.56	30	Pass
11	2462	57.677	17.61	6.982	8.44	30	Pass

5 Pictures of Test Arrangements

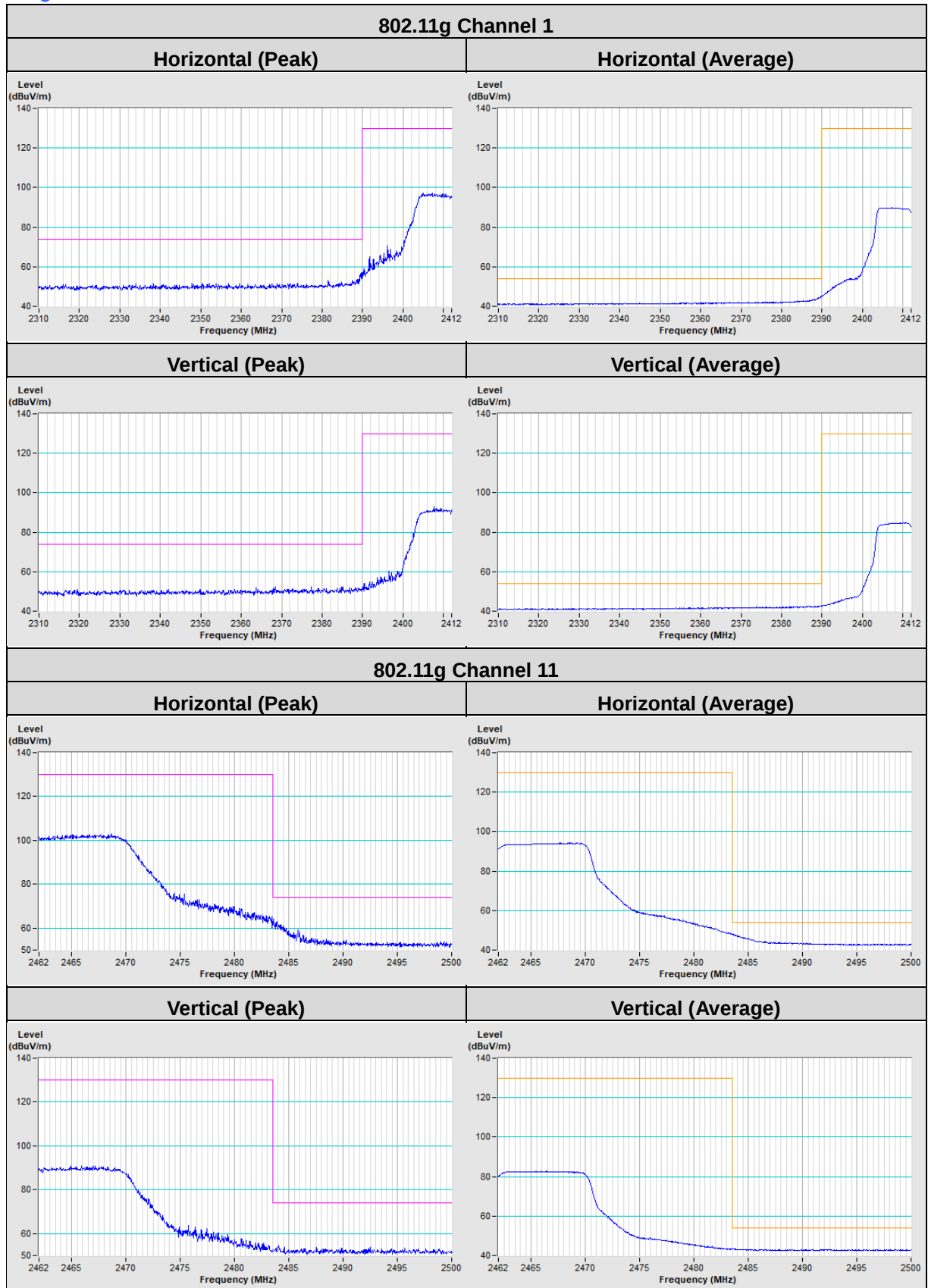
Please refer to the attached file (Test Setup Photo).

Annex A- Band Edge Measurement

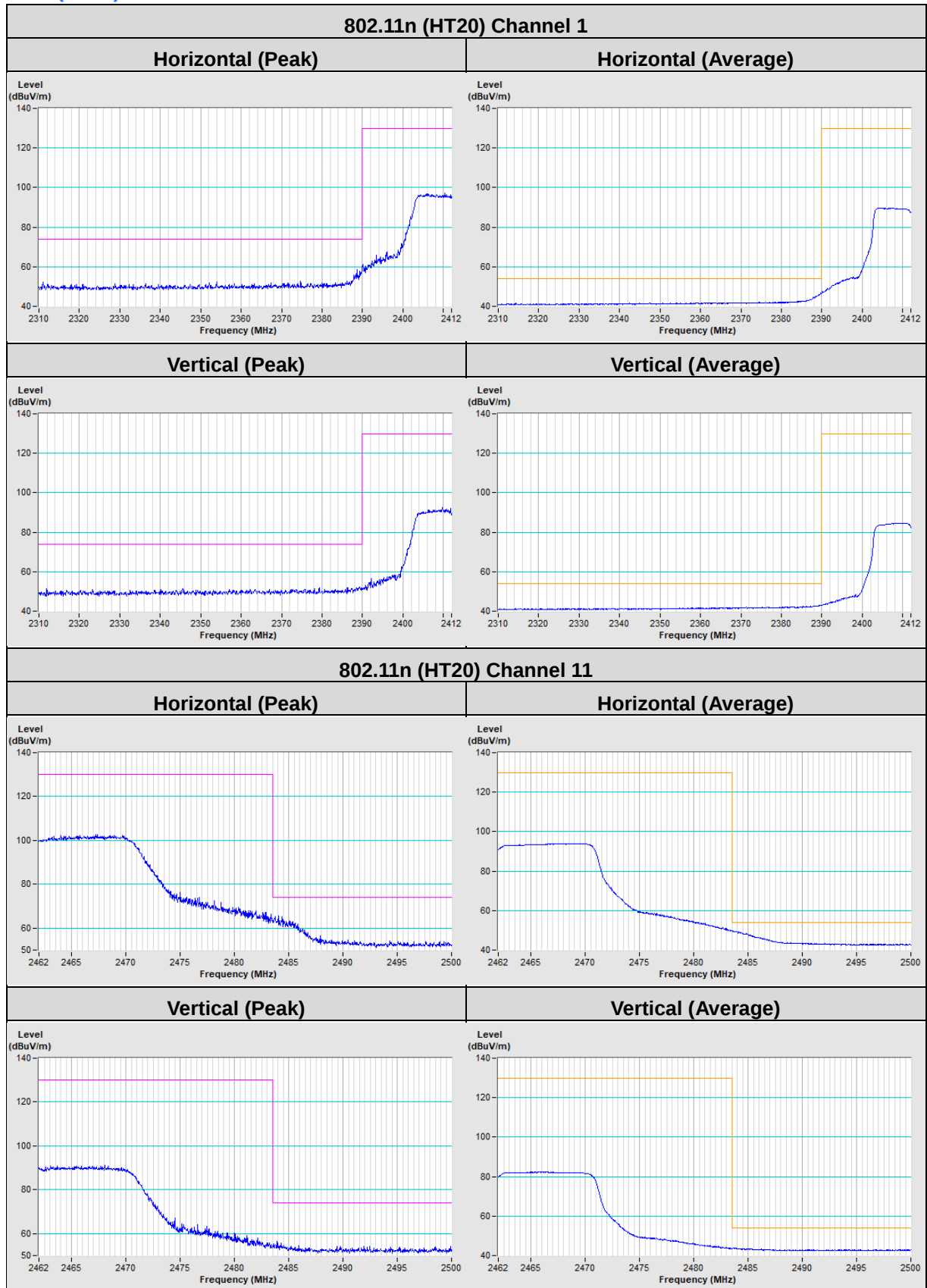
802.11b



802.11g



802.11n (HT20)



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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