FCC Test Report

(Spot Check)

Report No.:	RF210105C01A
FCC ID:	PZWBHTM70QW
Original FCC ID:	PZWBHTM70QWG
Test Model:	BHT-M70-QW
Received Date:	2021/1/5
Test Date:	2021/3/5 ~ 2021/8/20
Issued Date:	2021/9/30
Applicant:	DENSO WAVE INCORPORATED
Address:	1 Yoshiike Kusagi Agui-cho,Chita-gun Aichi 470-2297, Japan
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan
Test Location:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan
FCC Registration / Designation Number:	723255 / TW2022

This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification.

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Release Control Record

Issue No.	Description	Date Issued
RF210105C01A	Original release.	2021/9/30

1 Certificate of Conformity

Product: 2D Code Handy Terminal

Brand: DENSO

Test Model: BHT-M70-QW

Sample Status: Engineering sample

Applicant: DENSO WAVE INCORPORATED

Test Date: 2021/3/5 ~ 2021/8/20

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 EMC characteristics under the conditions specified in this report.

Prepared by : Vivian Huang , **Date:** 2021/9/30
Vivian Huang / Specialist

Approved by : , **Date:** 2021/9/30
Clark Lin / Technical Manager

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 -13.99 dB at 0.64609 MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -5.5 dB at 4874.00 MHz.
15.247(d)	Antenna Port Emission	NA	Refer to Note 1 below
15.247(a)(2)	6dB bandwidth	NA	Refer to Note 1 below
15.247(b)	Conducted power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	NA	Refer to Note 1 below
15.203	Antenna Requirement	PASS	Antenna connector is Spring not a standard connector.

Note:
1. AC Power Conducted Emission & Output Power & Radiated Emissions & Band Edge Measurement were performed for this addendum. The others testing data refer to original test report.
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

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

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.9 dB
Conducted emissions	-	2.5 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.1 dB
	30MHz ~ 1GHz	5.4 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	5.0 dB
	18GHz ~ 40GHz	5.3 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	2D Code Handy Terminal
Brand	DENSO
Test Model	BHT-M70-QW
Status of EUT	Engineering sample
Power Supply Rating	3.6 Vdc from battery; 5 Vdc from power adapter
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: up to 11 Mbps 802.11g: up to 54 Mbps 802.11n: up to 300 Mbps VHT: up to 400 Mbps
Operating Frequency	2.412 ~ 2.462 GHz
Number of Channel	802.11b, 802.11g, 802.11n (HT20), VHT20: 11 802.11n (HT40), VHT40: 7
Output Power	589.331 mW
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	Battery x 1 Adapter x 1 (Option) Adapter x 1 (for Cradle) QC3.0 charge single Cradle x 1 (Option_Brand: DENSO, Model: CU-M70UQ) USB Cradle with spare battery charge x 1 (Option_Brand: DENSO, Model: CU-M70U) LAN Cradle with Spare battery charge x 1 (Option_Brand: DENSO, Model: CU-M70L)
Data Cable Supplied	USB Cable x 1 (Shielded, 1.45m, Option _Brand: NIEN-YI, Model: NYS3892-0)

Note:

1. Exhibit prepared for Spot Check Verification report, the format, test items and amount of spot–check test data are decided by applicant's engineering judgment, for more details please refer to the declaration letter exhibit. (Original FCC ID: PZWBHTM70QWG, Report No.: RF210105C01)
2. The EUT has below radios as following table:

Radio 1	Radio 2	Radio 3
WLAN 2.4GHz	WLAN 5GHz	Bluetooth

3. WLAN and Bluetooth technology cannot transmit at same time.
4. The EUT must be supplied with a power adapter & battery and following below table:

Item	Brand	Model No.	Spec.
Battery	DENSO	BT3	DC Output: 3.6Vdc, 3050mAh, 10.98Wh
Adapter (Option)	CHANNEL WELL	2ACP0183C	AC Input: 100-240Vac~, 0.5A, 50/60Hz DC Output: 5.0Vdc / 3.0A 15.0W, 9.0Vdc / 2.0A 18.0W, 12.0Vdc / 1.5A 18.0W
For Cradle use			
Item	Brand	Model No.	Spec.
Adapter (Option)	Sunny	SYS1548-5012-T3	AC Input: 100-240Vac~1.5A MAX 50-60Hz AC Cable: Unshielded, 1.71m DC Output: +12.0Vdc / 4.16A DC Cable: Unshielded, 1.16m with one core

5. The antennas provided to the EUT, please refer to the following table:

Antenna No.	RF Chain No	Brand	Model	Antenna gain (dBi)	Frequency Range (MHz)	Antenna Type	Connector Type
1 (WiFi & BT)	Chain0	HONGBO	1415-01R8C00	3.26	2400-2500 (WiFi)	PIFA	Spring
				3.21	2400-2500 (BT)		
				3.63	5150-5250		
				3.65	5250-5350		
				3.45	5470-5725		
				3.52	5725-5850		
2 (WiFi)	Chain1	HONGBO	1415-01R8C00	0.68	2400-2500	PIFA	Spring
				2.63	5150-5250		
				2.6	5250-5350		
				2.93	5470-5725		
				2.4	5725-5850		

6. In the original report, the EUT was pre-tested for conducted emission test under following test modes:

Pre-test Mode	Description
Mode A	**Adapter Mode**
Mode B	Laptop Mode
Mode C	Cradle with Type C port
Mode D	Cradle with RJ45 port
Mode E	QC3.0 charge single Cradle
From the above modes, the worst conducted emission test was found in **Mode A**. Therefore only the test data of the modes were recorded in this report.	

7. In the original report, the EUT was pre-tested for radiated emission test under following test modes:

Pre-test Mode	Description
Mode A	Battery Mode
Mode B	**Adapter Mode**
Mode C	Cradle with Type C port
Mode D	**Cradle with RJ45 port**
Mode E	QC3.0 charge single Cradle
The worst radiated emissions were found in **Mode D** for below 1GHz and found in **Mode B** for above 1GHz. Therefore only the test data of the modes were recorded in this report.	

8. The EUT incorporates a MIMO function.

MODULATION MODE	**TX & RX CONFIGURATION**	
802.11b	2TX	2RX
802.11g	2TX	2RX
802.11n (HT20)	2TX	2RX
802.11n (HT40)	2TX	2RX
VHT20	2TX	2RX
VHT40	2TX	2RX

9. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.
10. 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.

3.2 Description of Test Modes

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

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

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

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

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE≥1G	RE<1G	PLC	APCM	
-	√	√	√	√	-

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

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

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

Radiated Emission Test (Above 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11b	1 to 11	6	DSSS	DBPSK	1

Radiated Emission Test (Below 1GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11b	1 to 11	6	DSSS	DBPSK	1

Power Line Conducted Emission Test:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11b	1 to 11	6	DSSS	DBPSK	1

Antenna Port Conducted 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.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1
802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6
VHT20	1 to 11	1, 6, 11	OFDM	BPSK	6.5
VHT40	3 to 9	3, 6, 9	OFDM	BPSK	13.5

Test Condition:

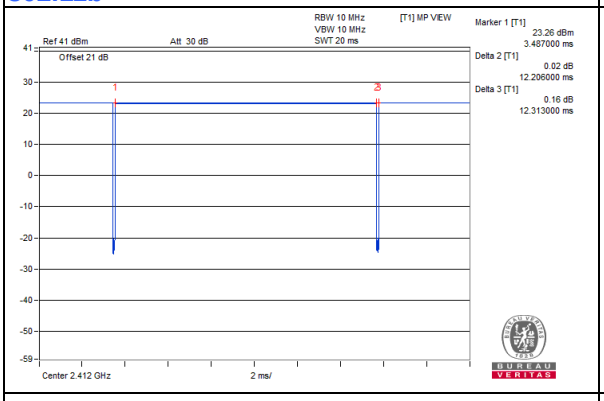
APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE≥1G	25deg. C, 66%RH	120Vac, 60Hz	Tom Yang
RE<1G	25deg. C, 68%RH	120Vac, 60Hz	Tom Yang
PLC	25deg. C, 66%RH	120Vac, 60Hz	Tom Yang
APCM	25deg. C, 60%RH	120Vac, 60Hz	Eric Peng

3.3 Duty Cycle of Test Signal

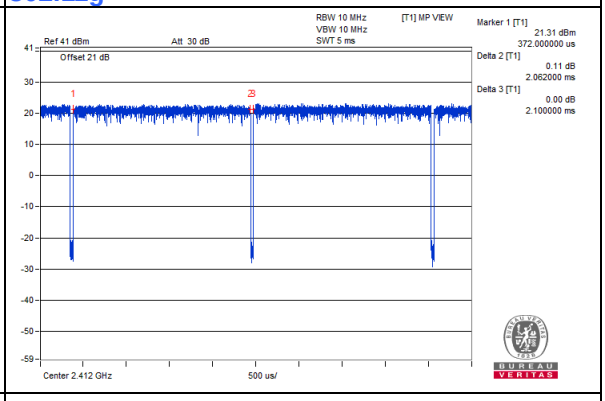
Duty cycle of test signal is ≥ 98 %, duty factor is not required.

802.11b: Duty cycle = 12.206 ms /12.313 ms=0.991
802.11g: Duty cycle = 2.062 ms /2.1ms=0.982
VHT20: Duty cycle = 3.706 ms /3.764 ms=0.985
VHT40: Duty cycle = 4.194 ms /4.263 ms=0.984

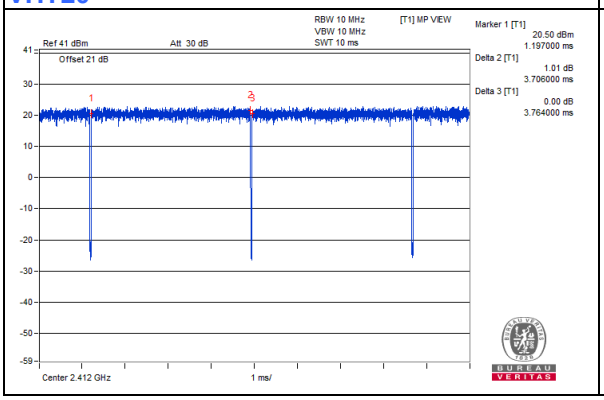
802.11b



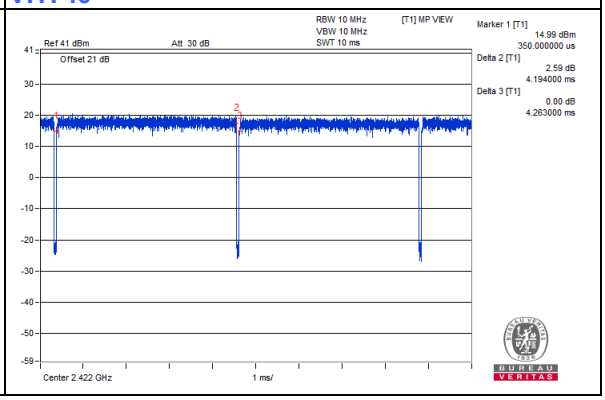
802.11g



VHT20



VHT40



3.4 Description of Support Units

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

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	DELL	E5430	HYV4VY1	FCC DoC	Provided by Lab
B.	Cradle	Denso	CU-M70U	NA	NA	Supplied by client

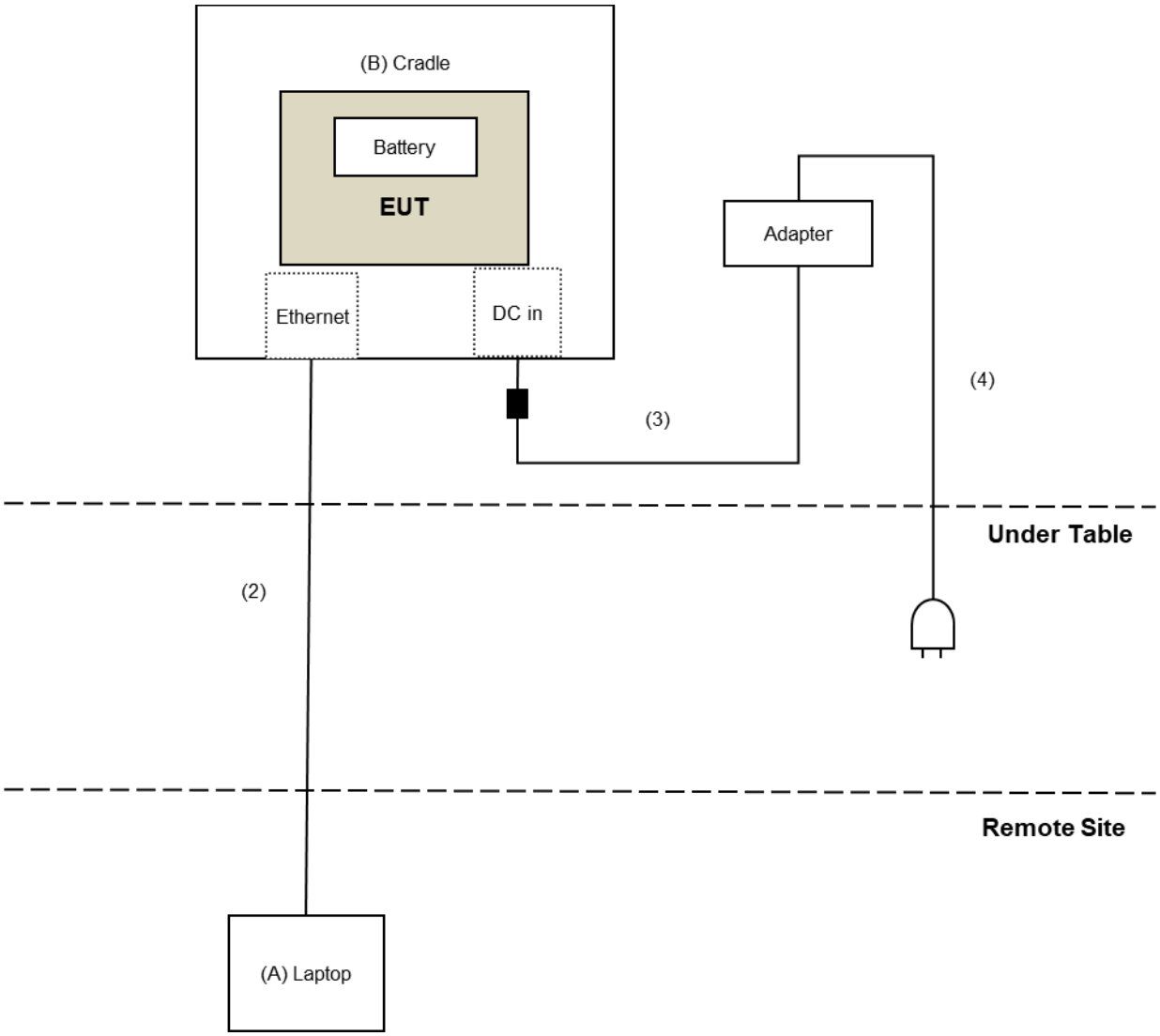
Note:
1. All power cords of the above support units are non-shielded (1.8m).

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB Cable	1	1.45	No	0	Supplied by client
2.	RJ-45 Cable	1	10	Yes	0	Provided by Lab
3.	DC Cable	1	1.16	Yes	1	Supplied by client
4.	AC Cable	1	1.71	Yes	0	Supplied by client

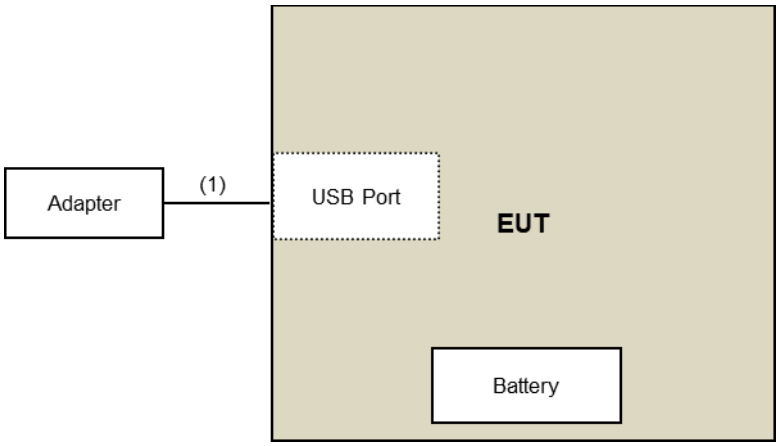
Note: The core(s) is(are) originally attached to the cable(s).

3.4.1 Configuration of System under Test

For radiated emission (below 1GHz):



For conducted emission & radiated emission (above 1GHz):



3.5 General Description of Applied Standards and References

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

Test Standard:

FCC Part 15, Subpart C (15.247)
ANSI C63.10-2013

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

References Test Guidance:

KDB 558074 D01 15.247 Meas Guidance v05r02
KDB 662911 D01 Multiple Transmitter Output v02r01

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

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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

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

Note:

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

4.1.2 Test Instruments

For Radiated Emission and Band-Edge Test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Agilent	N9038A	MY50010156	2020/7/24	2021/7/23
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208406	NA	NA
Pre_Amplifier EMCI	EMC001340	980142	2020/5/25	2021/5/24
LOOP ANTENNA Electro-Metrics	EM-6879	264	2021/3/5	2022/3/4
RF Coaxial Cable JYEBO	5D-FB	LOOPCAB-001	2021/1/7	2022/1/6
RF Coaxial Cable JYEBO	5D-FB	LOOPCAB-002	2021/1/7	2022/1/6
Pre_Amplifier Mini-Circuits	ZFL-1000VH2	QA0838008	2020/10/20	2021/10/19
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	2020/11/5	2021/11/4
RF Coaxial Cable COMMATE/PEWC	8D	966-3-1	2020/3/17	2021/3/16
RF Coaxial Cable COMMATE/PEWC	8D	966-3-2	2020/3/17	2021/3/16
RF Coaxial Cable COMMATE/PEWC	8D	966-3-3	2020/3/17	2021/3/16
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-3-01	2020/9/24	2021/9/23
Horn Antenna Schwarzbeck	BBHA9120-D	9120D-406	2020/11/22	2021/11/21
Pre_Amplifier EMCI	EMC12630SE	980384	2021/1/11	2022/1/10
RF Coaxial Cable EMCI	EMC104-SM-SM-1500	180504	2020/4/29	2021/4/28
RF Coaxial Cable EMCI	EMC104-SM-SM-2000	180601	2020/6/9	2021/6/8
RF Coaxial Cable EMCI	EMC104-SM-SM-6000	210201	2020/6/9	2021/6/8
Fix tool for Boresight antenna tower LIOW GUU	FBA-01	FBA_SIP01	NA	NA
Spectrum Analyzer Keysight	N9030A	MY54490679	2020/7/13	2021/7/12
Pre_Amplifier EMCI	EMC184045SE	980387	2021/1/11	2022/1/10
SHF-EHF Horn Schwarzbeck	BBHA 9170	BBHA9170519	2020/11/22	2021/11/21
RF Cable-Frequency range: 1-40GHz EMCI	EMC102-KM-KM-1200	160924	2021/1/11	2022/1/10
RF cable (40GHz) EMCI	EMC-KM-KM-4000	200214	2020/3/11	2021/3/10

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 966 Chamber No. 3.
3. Tested Date: 2021/3/5 ~ 2021/3/6

For other test items:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Power meter Anritsu	ML2495A	1529002	2021/6/21	2022/6/20
Power sensor Anritsu	MA2411B	1339443	2021/5/31	2022/5/30
10dB Attenuator Woken	MDCS18N-10	MDCS18N-10-01	2021/4/13	2022/4/12
Software	ADT_RF Test Software V6.6.5.4	NA	NA	NA

NOTE:
1. The test was performed in Oven room 2.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Tested Date: 2021/8/20

4.1.3 Test Procedures

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

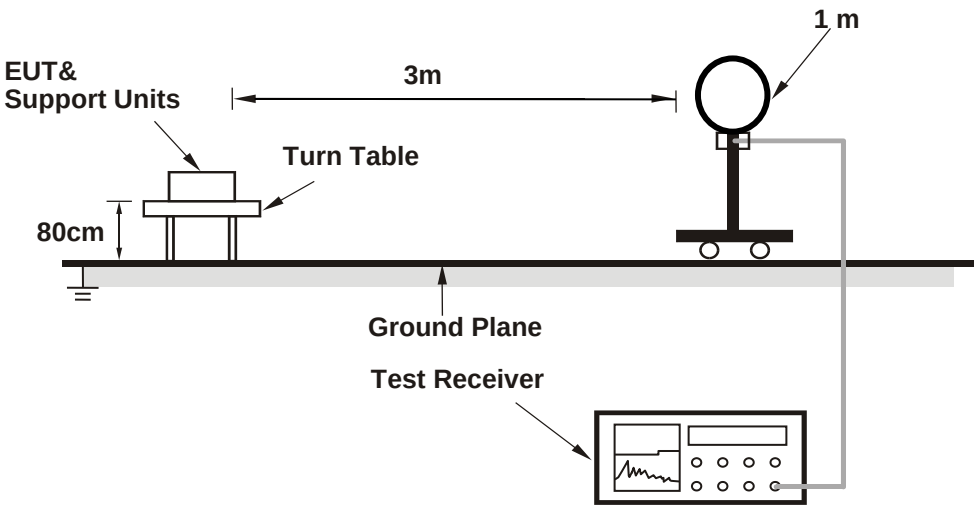
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

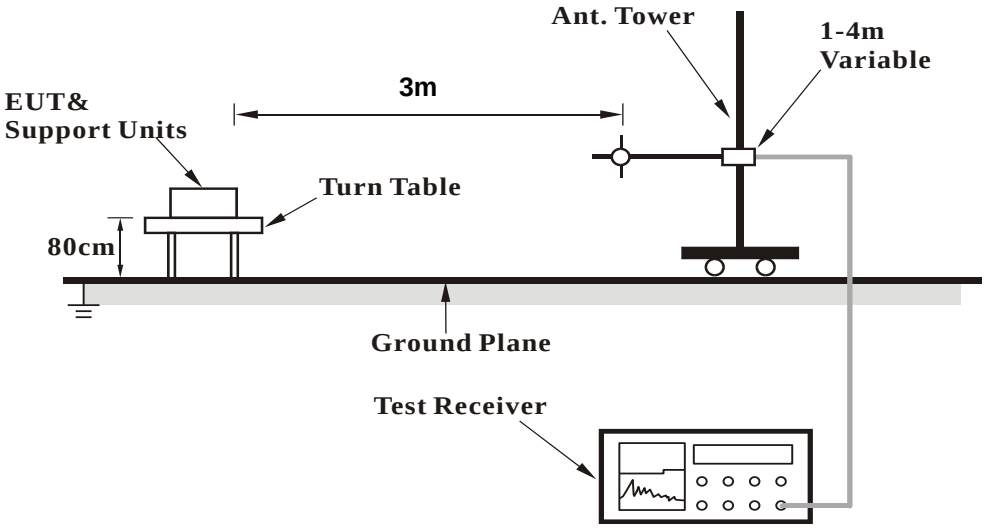
No deviation.

4.1.5 Test Setup

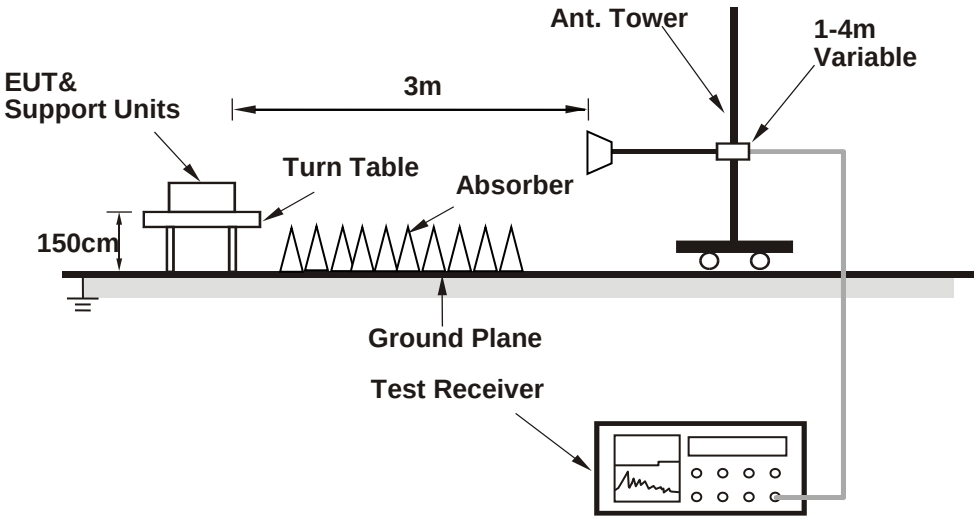
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

4.1.6 EUT Operating Conditions

a. Placed the EUT on the testing table.
b. Controlling software (QRCT4 (v4.0-00067)) has been activated to set the EUT under transmission condition continuously at specific channel frenquency.

4.1.7 Test Results

Above 1GHz Data：

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	2390.00	53.6 PK	74.0	-20.4	1.26 H	355	54.5	-0.9
2	2390.00	40.9 AV	54.0	-13.1	1.26 H	355	41.8	-0.9
3	*2437.00	111.7 PK			1.26 H	355	112.6	-0.9
4	*2437.00	110.0 AV			1.26 H	355	110.9	-0.9
5	2483.50	55.1 PK	74.0	-18.9	1.26 H	355	55.9	-0.8
6	2483.50	43.7 AV	54.0	-10.3	1.26 H	355	44.5	-0.8
7	4874.00	48.9 PK	74.0	-25.1	1.08 H	114	44.7	4.2
8	4874.00	47.0 AV	54.0	-7.0	1.08 H	114	42.8	4.2
9	7311.00	45.9 PK	74.0	-28.1	1.04 H	169	35.7	10.2
10	7311.00	38.6 AV	54.0	-15.4	1.04 H	169	28.4	10.2
Antenna Polarity & Test Distance : Vertical at 3 m								
No	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (m)**	**Table Angle (Degree)**	**Raw Value (dBuV)**	**Correction Factor (dB/m)**
1	2390.00	53.4 PK	74.0	-20.6	1.27 V	112	54.3	-0.9
2	2390.00	40.5 AV	54.0	-13.5	1.27 V	112	41.4	-0.9
3	*2437.00	108.0 PK			1.27 V	112	108.9	-0.9
4	*2437.00	106.7 AV			1.27 V	112	107.6	-0.9
5	2483.50	55.1 PK	74.0	-18.9	1.27 V	112	55.9	-0.8
6	2483.50	43.9 AV	54.0	-10.1	1.27 V	112	44.7	-0.8
7	4874.00	50.0 PK	74.0	-24.0	1.12 V	220	45.8	4.2
8	**4874.00**	**48.5 AV**	**54.0**	**-5.5**	**1.12 V**	**220**	**44.3**	**4.2**
9	7311.00	47.9 PK	74.0	-26.1	1.05 V	108	37.7	10.2
10	7311.00	41.9 AV	54.0	-12.1	1.05 V	108	31.7	10.2

Remarks:

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

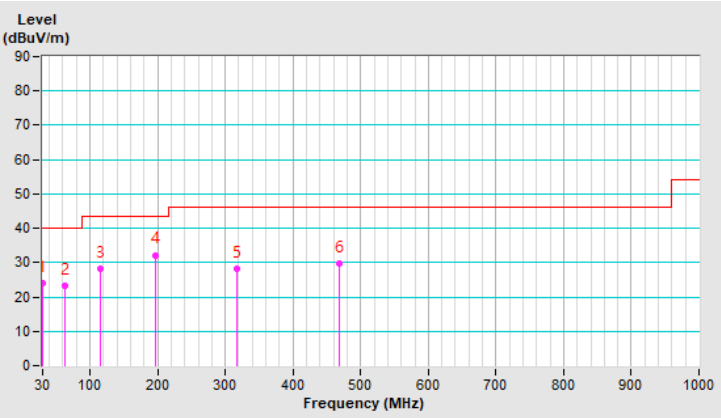
Below 1GHz Data

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	30.00	24.1 QP	40.0	-15.9	1.00 H	274	33.4	-9.3
2	62.88	23.3 QP	40.0	-16.7	1.00 H	146	32.1	-8.8
3	114.51	28.3 QP	43.5	-15.2	1.50 H	88	38.5	-10.2
4	197.76	32.2 QP	43.5	-11.3	2.00 H	278	42.8	-10.6
5	317.58	28.3 QP	46.0	-17.7	1.00 H	38	34.1	-5.8
6	467.86	29.6 QP	46.0	-16.4	2.00 H	116	31.3	-1.7

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. 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.

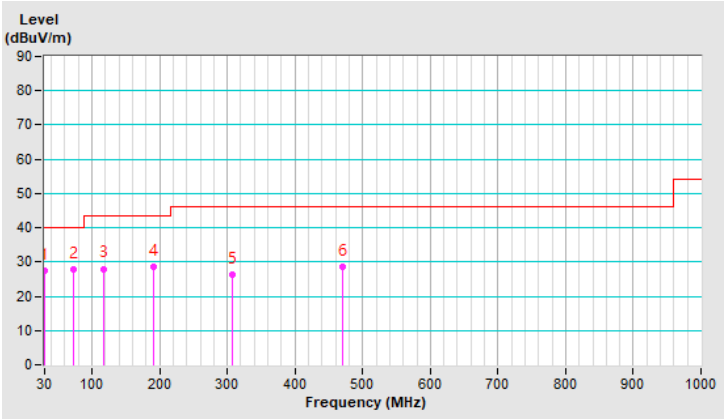


RF Mode	TX 802.11b	Channel	CH 6：2437 MHz
Frequency Range	9kHz ~ 1GHz	Detector Function	Quasi-Peak (QP)

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	30.34	27.4 QP	40.0	-12.6	1.00 V	1	36.8	-9.4
2	73.63	27.7 QP	40.0	-12.3	1.00 V	247	39.1	-11.4
3	117.45	28.0 QP	43.5	-15.5	1.00 V	185	37.9	-9.9
4	190.73	28.7 QP	43.5	-14.8	1.00 V	140	38.9	-10.2
5	308.07	26.2 QP	46.0	-19.8	1.00 V	173	32.4	-6.2
6	469.75	28.7 QP	46.0	-17.3	1.00 V	69	30.4	-1.7

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. 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 0.50MHz.

4.2.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver R&S	ESCS 30	847124/029	2020/10/20	2021/10/19
LISN R&S	ESH3-Z5	848773/004	2020/10/27	2021/10/26
LISN R & S	ESH3-Z5	835239/001	2020/3/19	2021/3/18
50 ohms Terminator	50	3	2020/10/26	2021/10/25
RF Coaxial Cable JYEBO	5D-FB	COCCAB-001	2020/9/26	2021/9/25
Fixed attenuator STI	STI02-2200-10	005	2020/8/29	2021/8/28
Software BVADT	BVADT_Cond_ V7.3.7.4	NA	NA	NA

Note:

1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Conduction 1.
3. Tested Date: 2021/3/6

4.2.3 Test Procedures

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

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

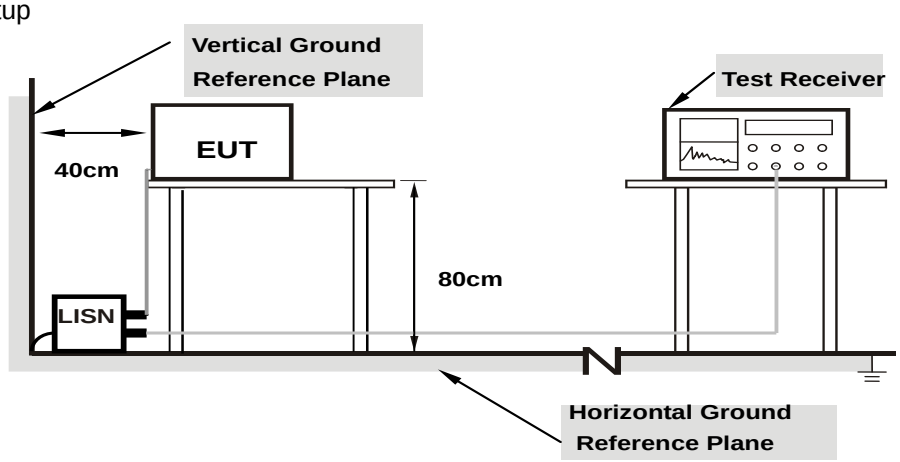
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



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

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

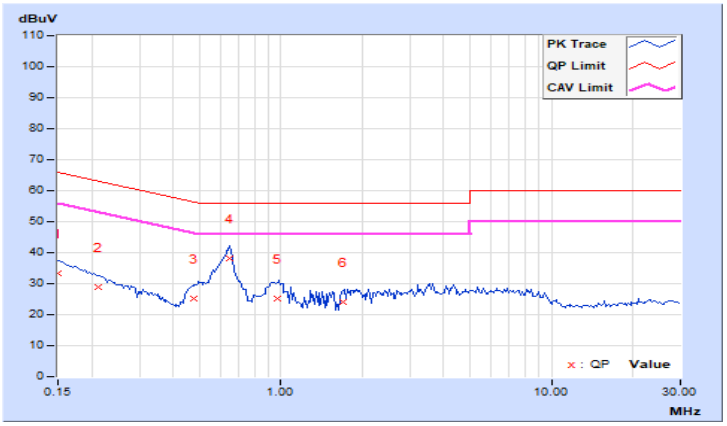
4.2.7 Test Results

RF Mode	TX 802.11b	Channel	CH 6：2437 MHz
Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz

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	0.15000	9.96	23.35	10.14	33.31	20.10	66.00	56.00	-32.69	-35.90
2	0.21250	9.99	18.95	10.41	28.94	20.40	63.11	53.11	-34.17	-32.71
3	0.47422	10.02	15.03	8.36	25.05	18.38	56.44	46.44	-31.39	-28.06
4	**0.64609**	**10.04**	**27.99**	**21.97**	**38.03**	**32.01**	**56.00**	**46.00**	**-17.97**	**-13.99**
5	0.96641	10.06	15.13	8.70	25.19	18.76	56.00	46.00	-30.81	-27.24
6	1.69531	10.12	13.98	5.51	24.10	15.63	56.00	46.00	-31.90	-30.37

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

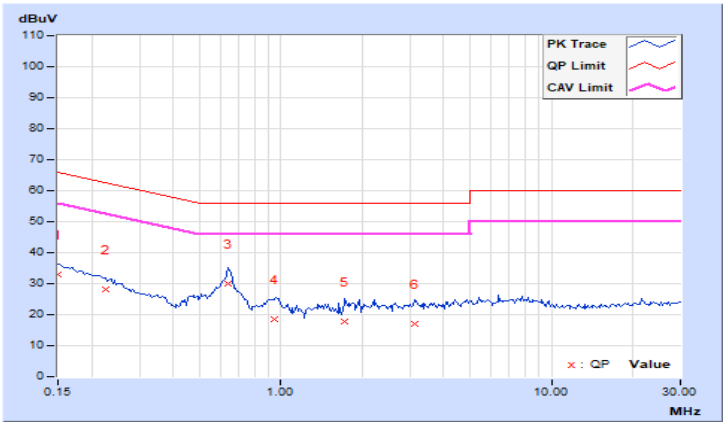


RF Mode	TX 802.11b	Channel	CH 6：2437 MHz
Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz

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	0.15000	9.94	22.90	8.86	32.84	18.80	66.00	56.00	-33.16	-37.20
2	0.22422	9.98	18.35	6.24	28.33	16.22	62.66	52.66	-34.33	-36.44
3	0.64219	10.03	20.05	13.60	30.08	23.63	56.00	46.00	-25.92	-22.37
4	0.94688	10.06	8.43	1.43	18.49	11.49	56.00	46.00	-37.51	-34.51
5	1.71484	10.12	7.63	-0.20	17.75	9.92	56.00	46.00	-38.25	-36.08
6	3.12891	10.20	6.97	-0.79	17.17	9.41	56.00	46.00	-38.83	-36.59

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

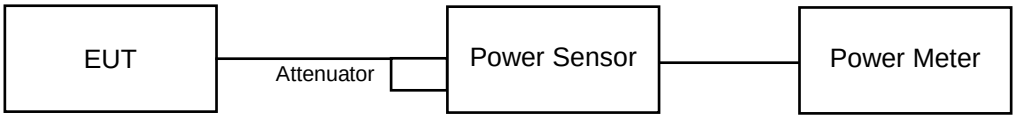
For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

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

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};
Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.

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

4.3.2 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 enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.3.7 Test Results

FOR PEAK POWER

802.11b

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	23.22	23.28	422.708	26.26	30	Pass
6	2437	23.68	23.81	473.782	26.76	30	Pass
11	2462	23.42	23.07	422.554	26.26	30	Pass

Note: The max. gain is 3.26 dBi < 6dBi , so the power limit shall not be reduced.

802.11g

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	23.19	22.89	402.985	26.05	30	Pass
6	2437	25.02	24.34	589.331	27.70	30	Pass
11	2462	22.58	23.19	389.583	25.91	30	Pass

Note: The max. gain is 3.26 dBi < 6dBi , so the power limit shall not be reduced.

VHT20

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	22.60	22.02	341.191	25.33	30	Pass
6	2437	24.84	24.16	565.405	27.52	30	Pass
11	2462	21.95	21.03	283.44	24.52	30	Pass

Note: The max. gain is 3.26 dBi < 6dBi , so the power limit shall not be reduced.

VHT40

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	22.56	22.57	361.019	25.58	30	Pass
6	2437	23.49	22.71	409.995	26.13	30	Pass
9	2452	20.96	20.93	248.618	23.96	30	Pass

Note: The max. gain is 3.26 dBi < 6dBi , so the power limit shall not be reduced.

FOR AVERAGE POWER

802.11b

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Average Power (mW)	Total Average Power (dBm)
		Chain 0	Chain 1		
1	2412	21.33	21.59	280.043	24.47
6	2437	21.77	22.28	319.358	25.04
11	2462	21.63	21.20	277.372	24.43

802.11g

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Average Power (mW)	Total Average Power (dBm)
		Chain 0	Chain 1		
1	2412	19.27	19.23	168.281	22.26
6	2437	21.71	21.91	303.491	24.82
11	2462	18.33	18.53	139.362	21.44

VHT20

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Average Power (mW)	Total Average Power (dBm)
		Chain 0	Chain 1		
1	2412	18.39	18.30	136.632	21.36
6	2437	21.66	22.02	305.776	24.85
11	2462	17.37	17.05	105.275	20.22

VHT40

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Average Power (mW)	Total Average Power (dBm)
		Chain 0	Chain 1		
3	2422	17.65	17.66	116.555	20.67
6	2437	18.72	18.53	145.759	21.64
9	2452	15.71	15.53	72.966	18.63

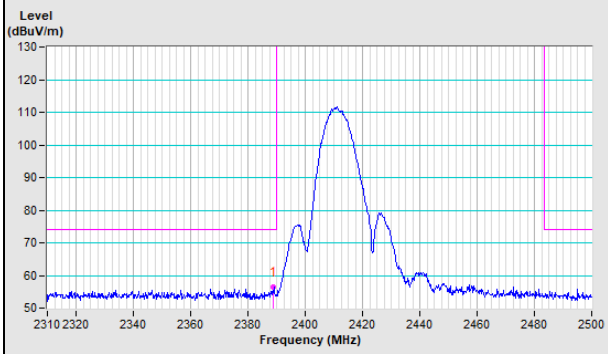
5 Pictures of Test Arrangements

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

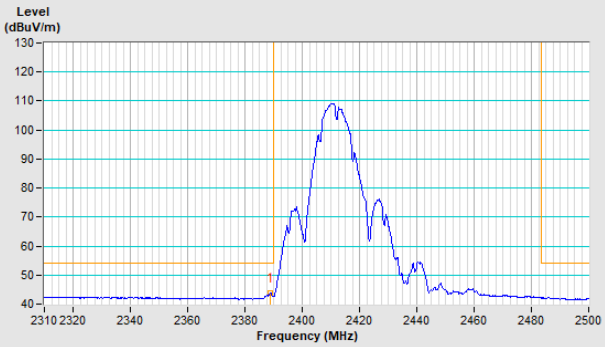
Annex A - Band-Edge Measurement

802.11b Channel 1

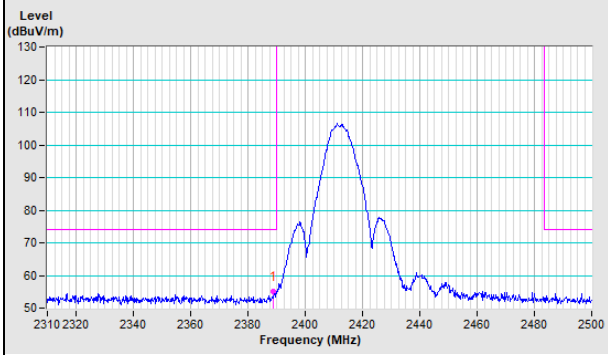
Horizontal (Peak)



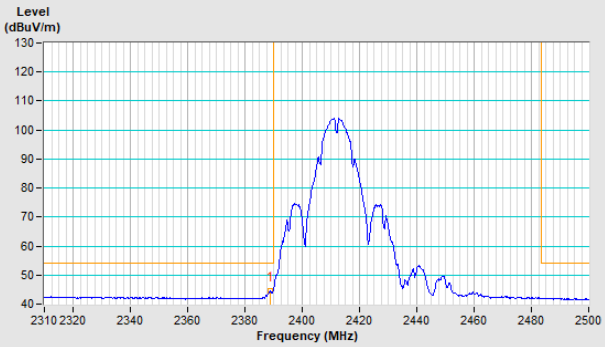
Horizontal (Average)



Vertical (Peak)

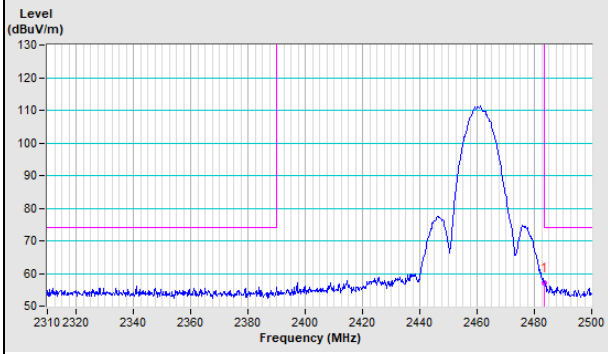


Vertical (Average)

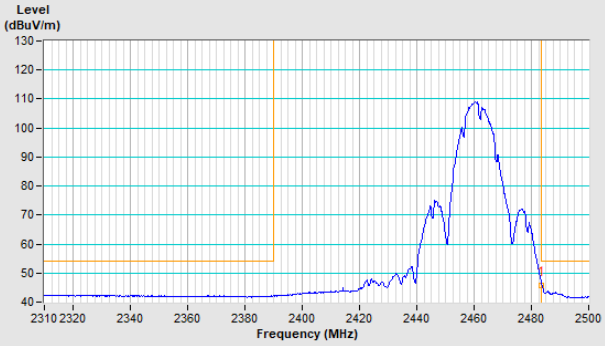


802.11b Channel 11

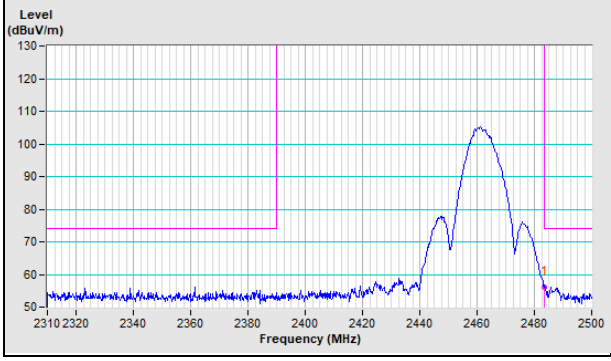
Horizontal (Peak)



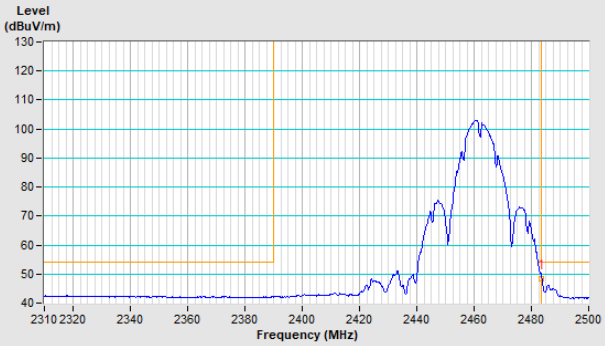
Horizontal (Average)



Vertical (Peak)



Vertical (Average)



Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

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

Lin Kou EMC/RF Lab
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab
Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

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

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