



**Shenzhen CTA Testing Technology Co., Ltd.**  
Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai  
Street, Bao'an District, Shenzhen, China

## FCC PART 15 SUBPART C TEST REPORT

### FCC PART 15.247

**Report Reference No.**.....: CTA24071501903

**FCC ID.**.....: 2BCRN-SHELLS1

Compiled by

( position+printed name+signature) ..: File administrators Jinghua Xiao

*Jinghua Xiao*

Supervised by

( position+printed name+signature) ..: Test Engineer Lushan Kong

*Lushan Kong*

Approved by

( position+printed name+signature) ..: Manager Eric Wang



Date of issue.....: Aug. 13, 2024

**Representative Laboratory Name** ..: **Shenzhen CTA Testing Technology Co., Ltd.**

Address .....: Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China

**Applicant's name**.....: **Dongguan Aika Electronic Technology Co., Ltd.**

Address .....: Room 201, Building 2, No. 388, Bihu Road, Fenggang Town, Dongguan City, Guangdong Province, China

**Test specification** .....

Standard .....: **FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**

TRF Originator .....: Shenzhen Global Test Service Co.,Ltd.

Master TRF .....: Dated 2014-12

### **Shenzhen CTA Testing Technology Co., Ltd. All rights reserved.**

This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen CTA Testing Technology Co., Ltd. is acknowledged as copyright owner and source of the material. Shenzhen CTA Testing Technology Co., Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

**Test item description** .....: **Smart Karaoke Speaker**

Trade Mark .....: Ikarao

Manufacturer .....: Guangdong Taide Zhilian Technology Co., Ltd

Model/Type reference .....: Shell S1

Listed Models .....: Shell S2

Operation Frequency .....: From 2412MHz to 2462MHz

Hardware Version .....: V1.1

Software Version .....: V2.1

Rating .....: Input: DC 5.0 - 20.0V

Result.....: **PASS**

## TEST REPORT

Test Report No. :	CTA24071501903	Aug. 13, 2024
		Date of issue

Equipment under Test : Smart Karaoke Speaker

Model /Type : Shell S1

Listed model : Shell S2

Applicant : **Dongguan Aika Electronic Technology Co., Ltd.**

Address : Room 201, Building 2, No. 388, Bihu Road, Fenggang Town, Dongguan City, Guangdong Province, China

Manufacturer : **Guangdong Taide Zhilian Technology Co., Ltd**

Address : No. 388, Bihu Road, Fenggang Town, Dongguan City, Guangdong Province, China

<b>Test Result:</b>	<b>PASS</b>
---------------------	-------------

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

## Contents

<b>1. TEST STANDARDS .....</b>	<b>4</b>
<b>2. SUMMARY .....</b>	<b>5</b>
2.1. General Remarks .....	5
2.2. Product Description .....	5
2.3. Equipment Under Test .....	7
2.4. Short description of the Equipment under Test (EUT) .....	7
2.5. EUT operation mode .....	7
2.6. Block Diagram of Test Setup .....	7
2.7. Related Submittal(s) / Grant (s) .....	8
2.8. EUT Exercise Software .....	8
2.9. Special Accessories .....	8
2.10. External I/O Cable .....	8
2.11. Modifications .....	8
<b>3. TEST ENVIRONMENT .....</b>	<b>9</b>
3.1. Address of the test laboratory .....	9
3.2. Test Facility .....	9
3.3. Environmental conditions .....	9
3.4. Statement of the measurement uncertainty .....	9
3.5. Test Description .....	10
3.6. Equipments Used during the Test .....	11
<b>4. TEST CONDITIONS AND RESULTS .....</b>	<b>12</b>
4.1. AC Power Conducted Emission .....	12
4.2. Radiated Emission .....	15
4.3. Maximum Peak Output Power .....	22
4.4. Power Spectral Density .....	23
4.5. 99% and 6dB Bandwidth .....	24
4.6. Conducted Spurious Emissions and Band Edge Compliance of RF Emission .....	25
4.7. Antenna Requirement .....	27
<b>5. TEST SETUP PHOTOS OF THE EUT .....</b>	<b>28</b>
<b>6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT .....</b>	<b>28</b>

## 1. TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15.247](#): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

[ANSI C63.10-2020](#): American National Standard for Testing Unlicensed Wireless Devices

[KDB 558074 D01 DTS Meas Guidance v05r02](#): Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

## 2. SUMMARY

### 2.1. General Remarks

Date of receipt of test sample	:	Jun. 20, 2024
Testing commenced on	:	Jun. 20, 2024
Testing concluded on	:	Aug. 12, 2024

### 2.2. Product Description

Product Name:	Smart Karaoke Speaker
Trade Mark:	Ikarao
Model/Type reference:	Shell S1
List Model:	Shell S2
Model Declaration	PCB board, structure and internal of these model(s) are the same, only the speaker, power amplifier chip, screen size, antenna and appearance are different.
Power supply:	Input: DC 5.0 - 20.0V
Hardware Version	V1.1
Software Version	V2.1
Sample ID	CTA240715019-S0001-1# CTA240715019-1-S0001-2#
<b>Chip1: JL7034A6</b>	
Bluetooth	
Frequency Range	2402MHz ~ 2480MHz
Channel Number	79 channels for Bluetooth (BR/EDR)
Channel Spacing	1MHz for Bluetooth (BR/EDR)
Modulation Type	GFSK, $\pi/4$ -DQPSK for Bluetooth (BR/EDR)
Antenna Description	Internal Antenna 1, 3.87dBi(Max.) for Shell S1 Internal Antenna 1, 7.87dBi(Max.) for Shell S2
<b>Chip2: AC7066D4</b>	
Bluetooth	
Frequency Range	2402MHz ~ 2480MHz
Channel Number	40 channels for Bluetooth (BT LE) 40 channels for Bluetooth (BT 2LE)
Channel Spacing	2MHz for Bluetooth (BT LE) 2MHz for Bluetooth (BT 2LE)
Modulation Type	GFSK for Bluetooth (BT LE) GFSK for Bluetooth (BT 2LE)
Antenna Description	Internal Antenna 3, 3.96dBi(Max.) for Shell S1 Internal Antenna 3, 7.87dBi(Max.) for Shell S2
<b>Chip3: AC7066D4</b>	
Bluetooth	
Frequency Range	2402MHz ~ 2480MHz
Channel Number	40 channels for Bluetooth (BT LE) 40 channels for Bluetooth (BT 2LE)
Channel Spacing	2MHz for Bluetooth (BT LE) 2MHz for Bluetooth (BT 2LE)
Modulation Type	GFSK for Bluetooth (BT LE) GFSK for Bluetooth (BT 2LE)
Antenna Description	Internal Antenna 4, 3.97dBi(Max.) for Shell S1

	Internal Antenna 4, 7.87dBi(Max.) for Shell S2
<b>Module:RTL8821CS</b>	
2.4GWLAN	
WLAN Operation frequency	IEEE 802.11b:2412-2462MHz IEEE 802.11g:2412-2462MHz IEEE 802.11n HT20:2412-2462MHz IEEE 802.11n HT40:2422-2452MHz
WLAN Modulation Type	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)
Channel number:	11 Channel for IEEE 802.11b/g/n (HT20) 7 Channel for IEEE 802.11n (HT40)
Channel separation:	5MHz
WIFI (5.2G/5.3G/5.7G/5.8G Band)	
Frequency Range	5180-5240MHz/ 5260MHz to 5320MHz/ 5500MHz to 5700MHz/ 5745MHz to 5825MHz
Channel Number	4 Channels for 20MHz bandwidth(5180-5240MHz) 4 Channels for 20MHz bandwidth(5260-5320MHz) 11 Channels for 20MHz bandwidth(5500-5700MHz) 5 channels for 20MHz bandwidth(5745-5825MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 2 channels for 40MHz bandwidth(5270~5310MHz) 5 Channels for 40MHz bandwidth(5510-5670MHz) 2 channels for 40MHz bandwidth(5755~5795MHz) 1 channels for 80MHz bandwidth(5210MHz) 1 channels for 80MHz bandwidth(5290MHz) 2 Channels for 80MHz bandwidth(5530-5610MHz) 1 channels for 80MHz bandwidth(5775MHz)
Modulation Type	IEEE 802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT20: OFDM (256QAM,64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT40: OFDM (256QAM,64QAM, 16QAM, QPSK, BPSK) IEEE 802.11ac VHT80: OFDM (256QAM,64QAM, 16QAM, QPSK, BPSK)
Antenna Description	Shell S1: Internal Antenna 2, 4.72 dBi(Max.) for 2.4G Band and 5.26dBi(Max.) for 5G Band Shell S2: Internal Antenna 2, 5.26 dBi(Max.) for 2.4G Band and 5.33 dBi(Max.) for 5G Band
Note: Models Shell S1 and Shell S2 use different antennas of the same type and are tested using maximum antenna gain.	

### 2.3. Equipment Under Test

#### Power supply system utilised

Power supply voltage	:	<input type="radio"/>	230V/ 50 Hz	<input type="radio"/>	120V/60Hz
		<input type="radio"/>	12 V DC	<input type="radio"/>	24 V DC
		<input checked="" type="radio"/>	Other (specified in blank below)		

DC 20.0V

#### 2.4. Short description of the Equipment under Test (EUT)

This is a Smart Karaoke Speaker.

For more details, refer to the user's manual of the EUT.

#### 2.5. EUT operation mode

The application provider specific test software to control sample in continuous TX and RX (Duty Cycle >98%) for testing meet KDI23M0258074 test requirement.

IEEE 802.11b/g/n: Thirteen channels are provided to the EUT.

Antenna	Chain 0		Chain 1		Simultaneously
Bandwidth Mode	20MHz	40MHz	20MHz	40MHz	/
IEEE 802.11b	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IEEE 802.11g	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IEEE 802.11n	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

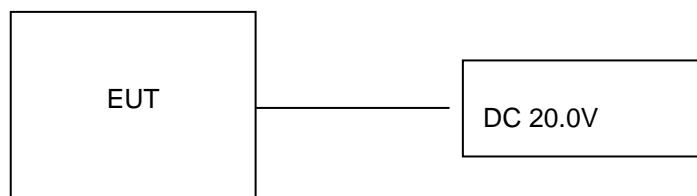
Channel	Frequency(MHz)	Channel	Frequency(MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432		
<b>6</b>	2437		
7	2442		

The EUT has been tested under operating condition.

AC conducted emission pre-test at both at AC 120V/60Hz and AC 240V/50Hz modes, recorded worst case(AC 120V/60Hz);

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position. Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be IEEE 802.11g mode (MCH).

#### 2.6. Block Diagram of Test Setup



## 2.7. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2BCRN-SHELLS1** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

## 2.8. EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by software (setup.exe) provided by application.

## 2.9. Special Accessories

Manufacturer	Description	Model	Serial Number	Certificate
LANTO ELECTRONNIC LIMITED	Adapter	191106C	--	SDOC

Note: The Adapter only used for auxiliary testing.

## 2.10. External I/O Cable

I/O Port Description	Quantity	Cable
DC IN Port	1	1.0M, Unscreened Cable
AV Port	3	N/A
Type-c Port	1	N/A
USB Port	1	N/A
HDMI Port	1	N/A

## 2.11. Modifications

No modifications were implemented to meet testing criteria.

### 3. TEST ENVIRONMENT

#### 3.1. Address of the test laboratory

##### Shenzhen CTA Testing Technology Co., Ltd.

Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China

#### 3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

##### FCC-Registration No.: 517856 Designation Number: CN1318

Shenzhen CTA Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

##### A2LA-Lab Cert. No.: 6534.01

Shenzhen CTA Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

#### 3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 °C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

#### 3.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the Shenzhen CTA Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen CTA Testing Technology Co., Ltd. :

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	9KHz~30MHz	3.02 dB	(1)
Radiated Emission	30~1000MHz	4.06 dB	(1)
Radiated Emission	1~18GHz	5.14 dB	(1)
Radiated Emission	18-40GHz	5.38 dB	(1)
Conducted Disturbance	0.15~30MHz	2.14 dB	(1)
Output Peak power	30MHz~18GHz	0.55 dB	(1)
Power spectral density	/	0.57 dB	(1)
Spectrum bandwidth	/	1.1%	(1)
Radiated spurious emission (30MHz-1GHz)	30~1000MHz	4.10 dB	(1)
Radiated spurious emission (1GHz-18GHz)	1~18GHz	4.32 dB	(1)
Radiated spurious emission (18GHz-40GHz)	18-40GHz	5.54 dB	(1)

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

### 3.5. Test Description

Applied Standard: FCC Part 15 Subpart C				
ISED Rules	Description of Test	Test Sample	Result	Remark
/	On Time and Duty Cycle	CTA240715019-S0001-1#	Compliant	Appendix C
§15.247(b)	Maximum Conducted Output Power	CTA240715019-S0001-1#	Compliant	Appendix C
§15.247(e)	Power Spectral Density	CTA240715019-S0001-1#	Compliant	Appendix C
§15.247(a)(2)	6dB Bandwidth	CTA240715019-S0001-1#	Compliant	Appendix C
§2.1047	99% Occupied Bandwidth	CTA240715019-S0001-1#	Compliant	Appendix C
§15.209, §15.247(d)	Conducted Spurious Emissions and Band Edges Test	CTA240715019-S0001-1#	Compliant	Appendix C
§15.209, §15.247(d)	Radiated Spurious Emissions	CTA240715019-S0001-1# CTA240715019-S0001-2#	Compliant	Note 1
§15.205	Emissions at Restricted Band	CTA240715019-S0001-1#	Compliant	Appendix C
§15.207(a)	AC Conducted Emissions	CTA240715019-S0001-2#	Compliant	Note 1
§15.203 §15.247(c)	Antenna Requirements	CTA240715019-S0001-1#	Compliant	Note 1
§15.247(i)§2.1 091	RF Exposure	/	Compliant	Note 2

Remark:

1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. Note 1 – Test results inside test report;
4. Note 2 – Test results in other test report (MPE Report).
5. We tested all test mode and recorded worst case in report

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel
Maximum Peak Conducted Output Power	11b/DSSS	1 Mbps	1/6/11
Power Spectral Density	11g/OFDM	6 Mbps	1/6/11
6dB Bandwidth	11n(20MHz)/OFDM	6.5Mbps	1/6/11
Spurious RF conducted emission	11n(40MHz)/OFDM	13.5Mbps	3/6/09
Radiated Emission 9kHz~1GHz&			
Radiated Emission 1GHz~10 <sup>th</sup> Harmonic			
Band Edge	11b/DSSS	1 Mbps	1/11
	11g/OFDM	6 Mbps	1/11
	11n(20MHz)/OFDM	6.5Mbps	1/11
	11n(40MHz)/OFDM	13.5Mbps	3/9

### 3.6. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Equipment No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	CTA-308	2024/08/02	2025/08/01
LISN	R&S	ENV216	CTA-314	2024/08/02	2025/08/01
EMI Test Receiver	R&S	ESPI	CTA-307	2024/08/02	2025/08/01
EMI Test Receiver	R&S	ESCI	CTA-306	2024/08/02	2025/08/01
Spectrum Analyzer	Agilent	N9020A	CTA-301	2024/08/02	2025/08/01
Spectrum Analyzer	R&S	FSP	CTA-337	2024/08/02	2025/08/01
Vector Signal generator	Agilent	N5182A	CTA-305	2024/08/02	2025/08/01
Analog Signal Generator	R&S	SML03	CTA-304	2024/08/02	2025/08/01
Universal Radio Communication	CMW500	R&S	CTA-302	2024/08/02	2025/08/01
Temperature and humidity meter	Chigo	ZG-7020	CTA-326	2024/08/02	2025/08/01
Ultra-Broadband Antenna	Schwarzbeck	VULB9163	CTA-310	2023/10/17	2024/10/16
Horn Antenna	Schwarzbeck	BBHA 9120D	CTA-309	2023/10/13	2024/10/12
Loop Antenna	Zhinan	ZN30900C	CTA-311	2023/10/17	2024/10/16
Horn Antenna	Beijing Hangwei Dayang	OBH100400	CTA-336	2024/08/02	2025/08/01
Antenna Tower	Suzhou Keletuo electronic Technology Co., LTD	BK-*AT-BS	N/A	N/A	N/A
Amplifier	Schwarzbeck	BBV 9745	CTA-312	2024/08/02	2025/08/01
Amplifier	Taiwan chengyi	EMC051845B	CTA-313	2024/08/02	2025/08/01
Directional coupler	NARDA	4226-10	CTA-303	2024/08/02	2025/08/01
High-Pass Filter	XingBo	XBLBQ-GTA18	CTA-402	2024/08/02	2025/08/01
High-Pass Filter	XingBo	XBLBQ-GTA27	CTA-403	2024/08/02	2025/08/01
Automated filter bank	Tonscend	JS0806-F	CTA-404	2024/08/02	2025/08/01
Power Sensor	Agilent	U2021XA	CTA-405	2024/08/02	2025/08/01
Amplifier	Schwarzbeck	BBV9719	CTA-406	2024/08/02	2025/08/01

Note:

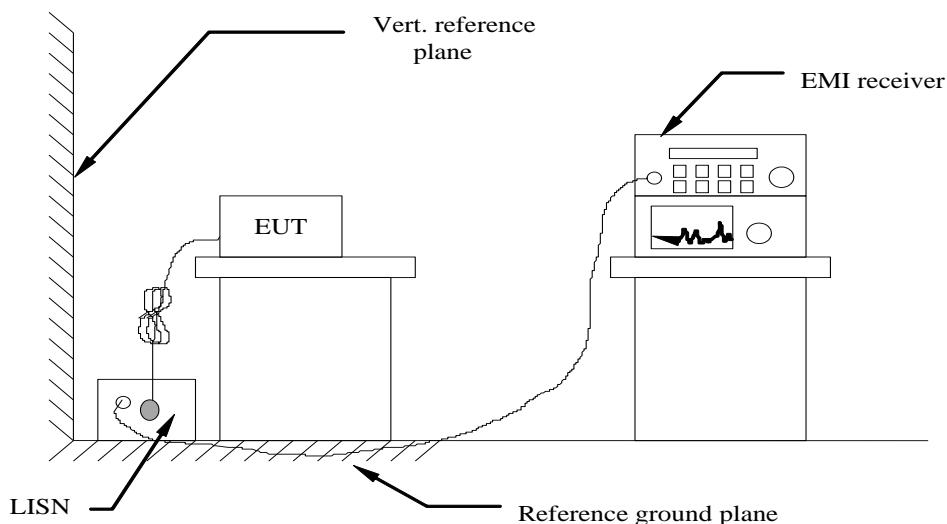
1. The Cal.Interval was one year.

2. All devices whose calibration expired on Aug.02, 2024 were calibrated from Aug.03, 2023 to Aug.02, 2024.

## 4. TEST CONDITIONS AND RESULTS

### 4.1. AC Power Conducted Emission

#### TEST CONFIGURATION



#### TEST PROCEDURE

- 1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2020.
- 2 Support equipment, if needed, was placed as per ANSI C63.10-2020.
- 3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2020.
- 4 The EUT received DC 20V power, the received AC120V/60Hz or AC 240V/50Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5 All support equipments received AC power from a second LISN, if any.
- 6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8 During the above scans, the emissions were maximized by cable manipulation.
- 9 The LISN is greater than 40 cm from the vertical reference plane.

#### AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency.

#### DISTURBANCE Calculation

The AC mains conducted disturbance is calculated by adding the 10dB Pulse Limiter and Cable Factor and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

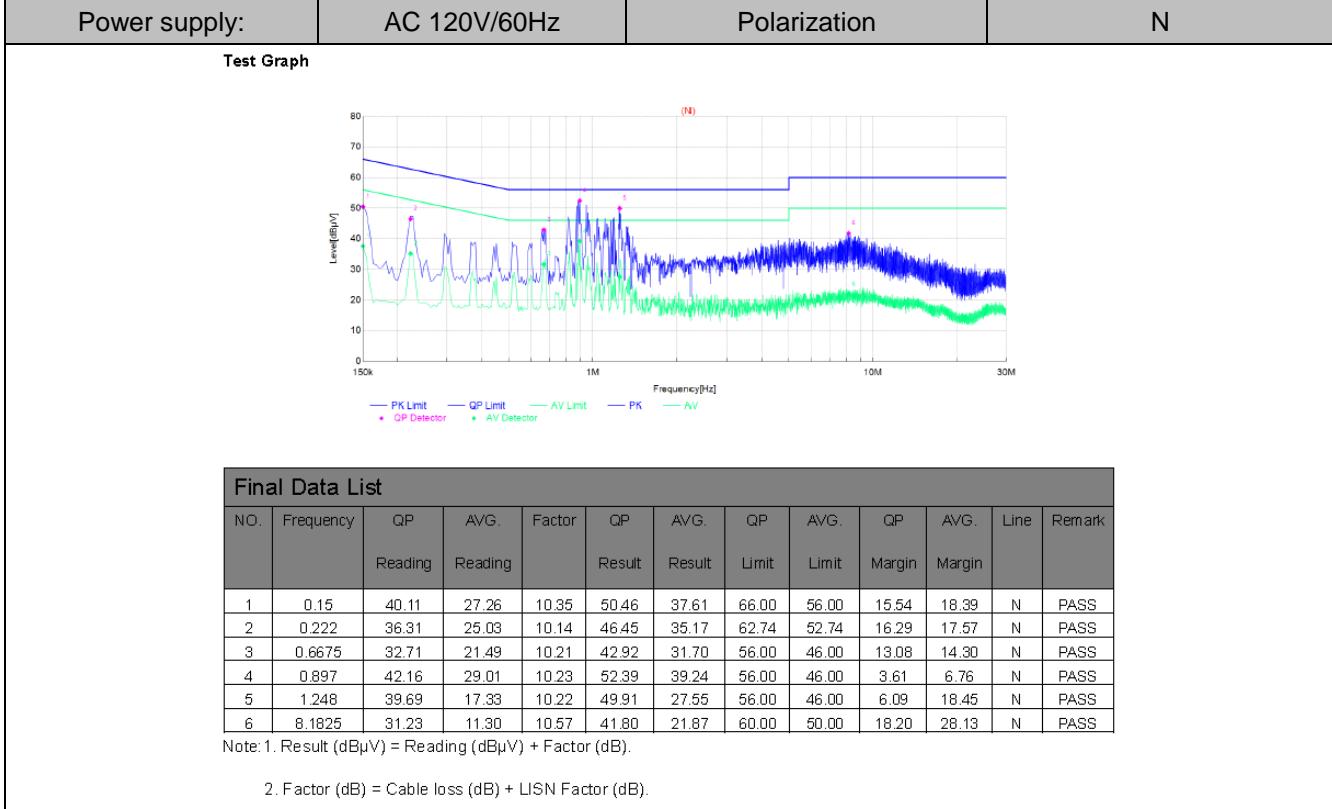
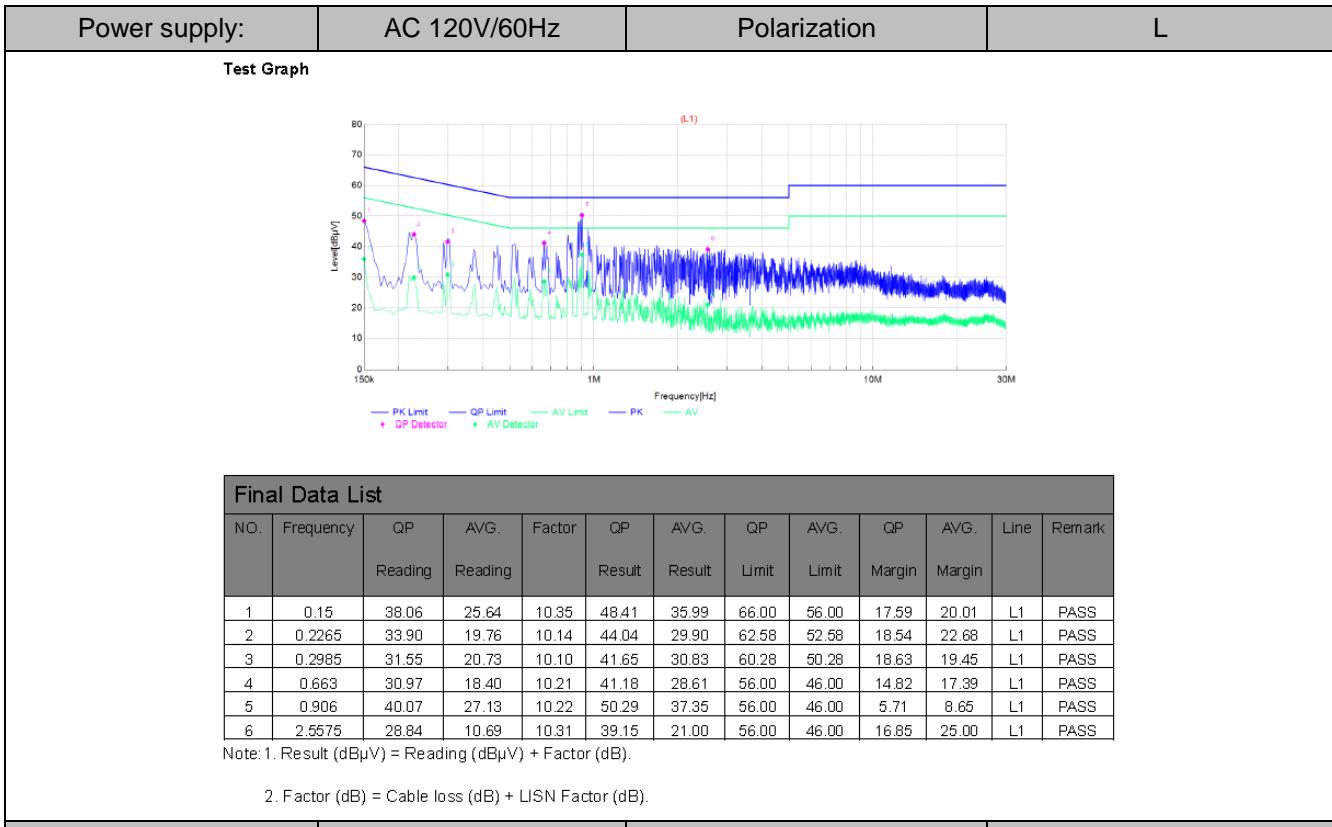
$$CD \text{ (dBuV)} = RA \text{ (dBuV)} + PL \text{ (dB)} + CL \text{ (dB)}$$

Where CD = Conducted Disturbance	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	PL = 10 dB Pulse Limiter Factor

**TEST RESULTS**

Remark: We measured Conducted Emission at 802.11b/802.11g/802.11n HT20/802.11n HT40 mode from 150 KHz to 30MHz in AC120V and the worst case was recorded.

Temperature	25°C	Humidity	60%
Test Engineer	Lushan Kong	Configurations	IEEE 802.11g (MCH)

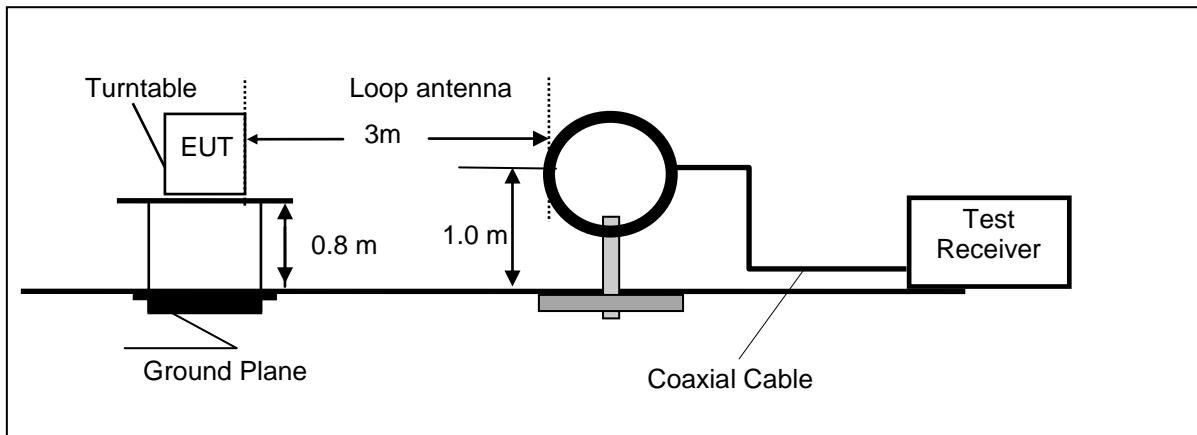
**Model:Shell S1**

## Model:Shell S2

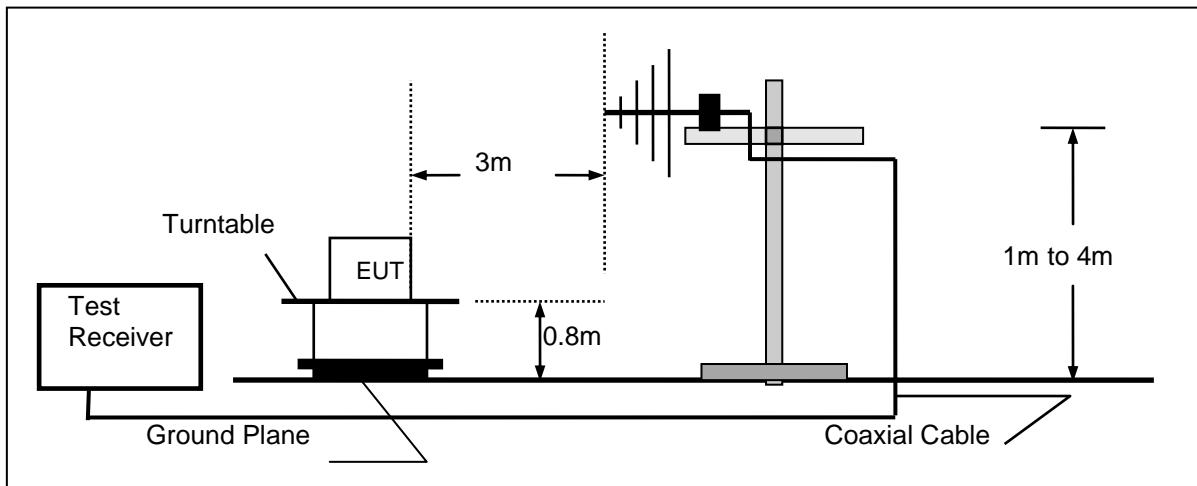
## 4.2. Radiated Emission

### TEST CONFIGURATION

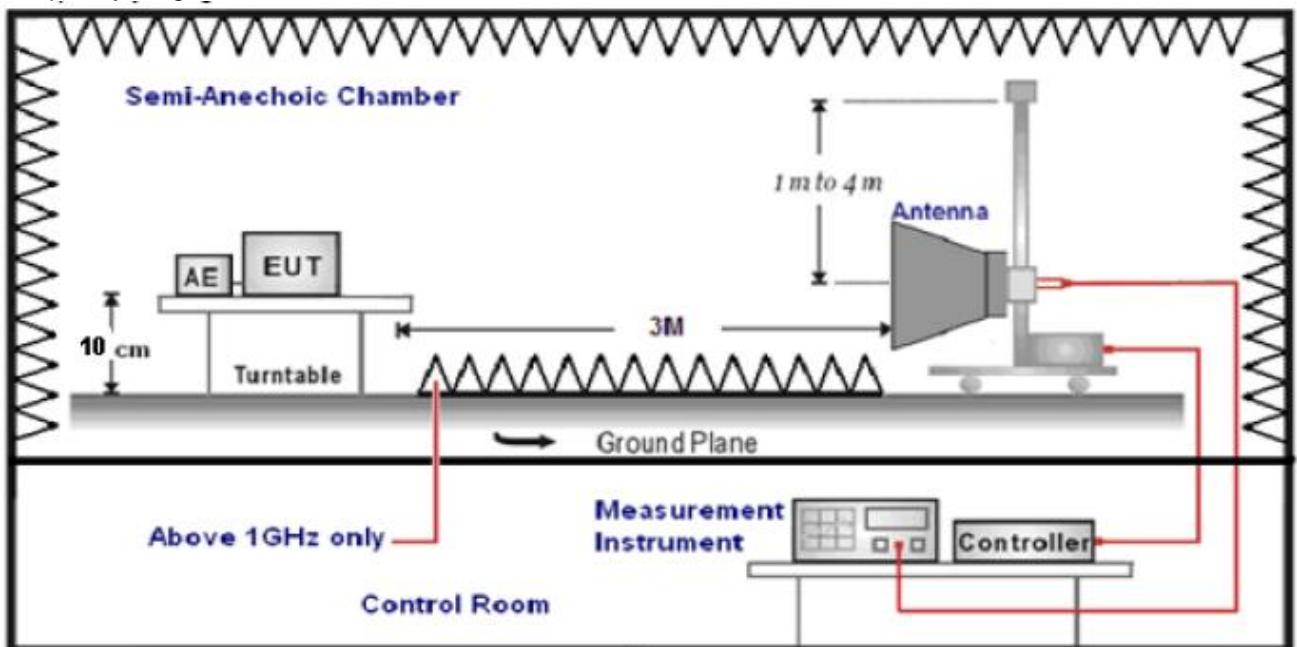
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



**TEST PROCEDURE**

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 30MHz –1GHz; the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. Radiated emission test frequency band from 30MHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Antenna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz, Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz, Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz, Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude		AG = Amplifier Gain
AF = Antenna Factor		

$$Transd = AF + CL - AG$$

**RADIATION LIMIT**

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dB $\mu$ V/m)	Radiated ( $\mu$ V/m)
0.009-0.49	3	$20\log(2400/F(\text{kHz}))+40\log(300/3)$	$2400/F(\text{kHz})$
0.49-1.705	3	$20\log(24000/F(\text{kHz}))+40\log(30/3)$	$24000/F(\text{kHz})$
1.705-30	3	$20\log(30)+40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

**TEST RESULTS**

Remark: We measured Radiated Emission at 802.11b/802.11g/802.11n HT20 mode from 30 MHz to 25GHz in AC120V and the worst case was recorded.

Temperature	25°C	Humidity	60%
Test Engineer	Lushan Kong	Configurations	IEEE 802.11g (MCH)

**For 9 KHz~30MHz**

Freq. (MHz)	Level (dB $\mu$ V)	Over Limit (dB)	Over Limit (dB $\mu$ V)	Remark
-	-	-	-	See Note

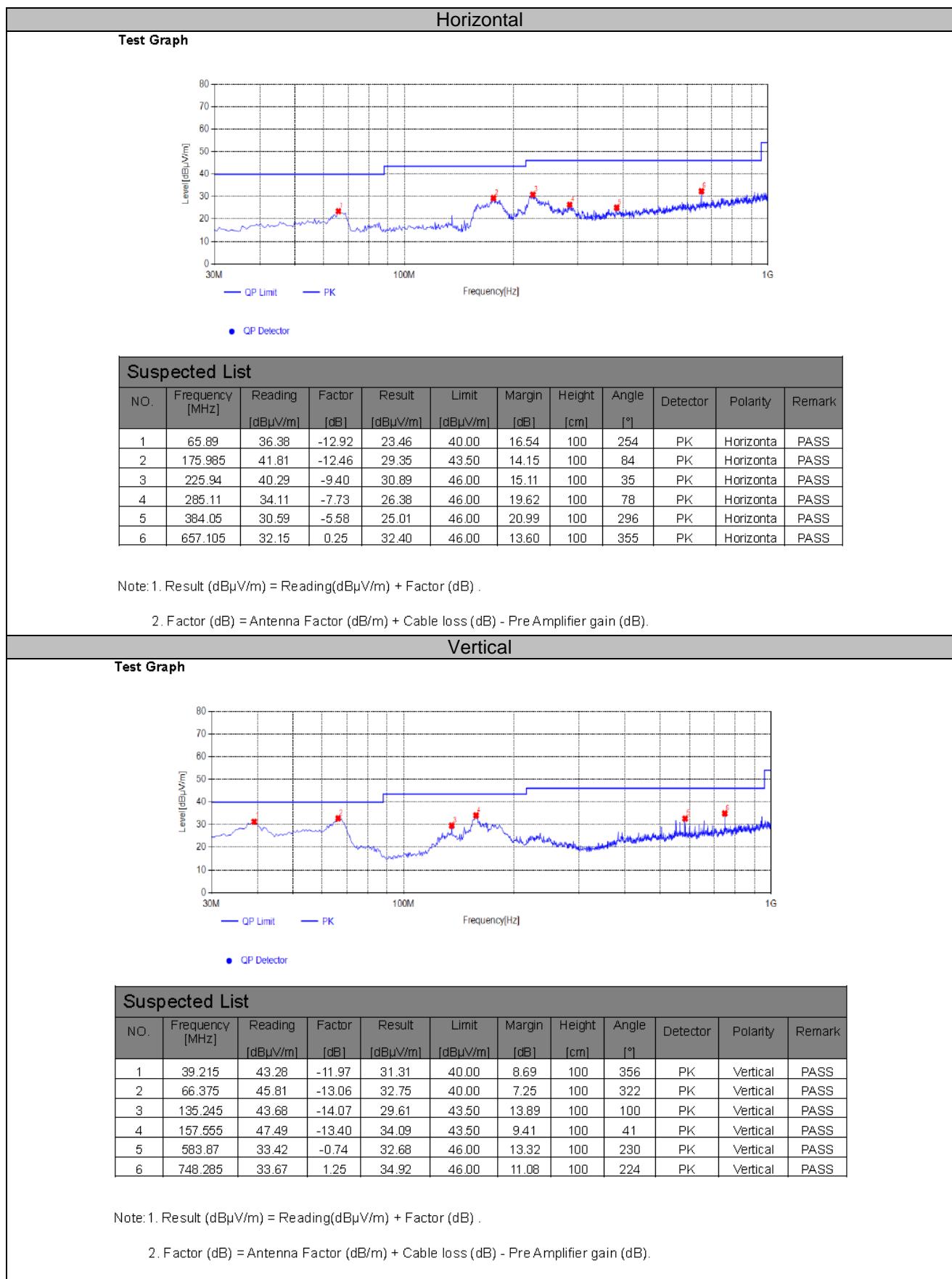
**Note:**

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

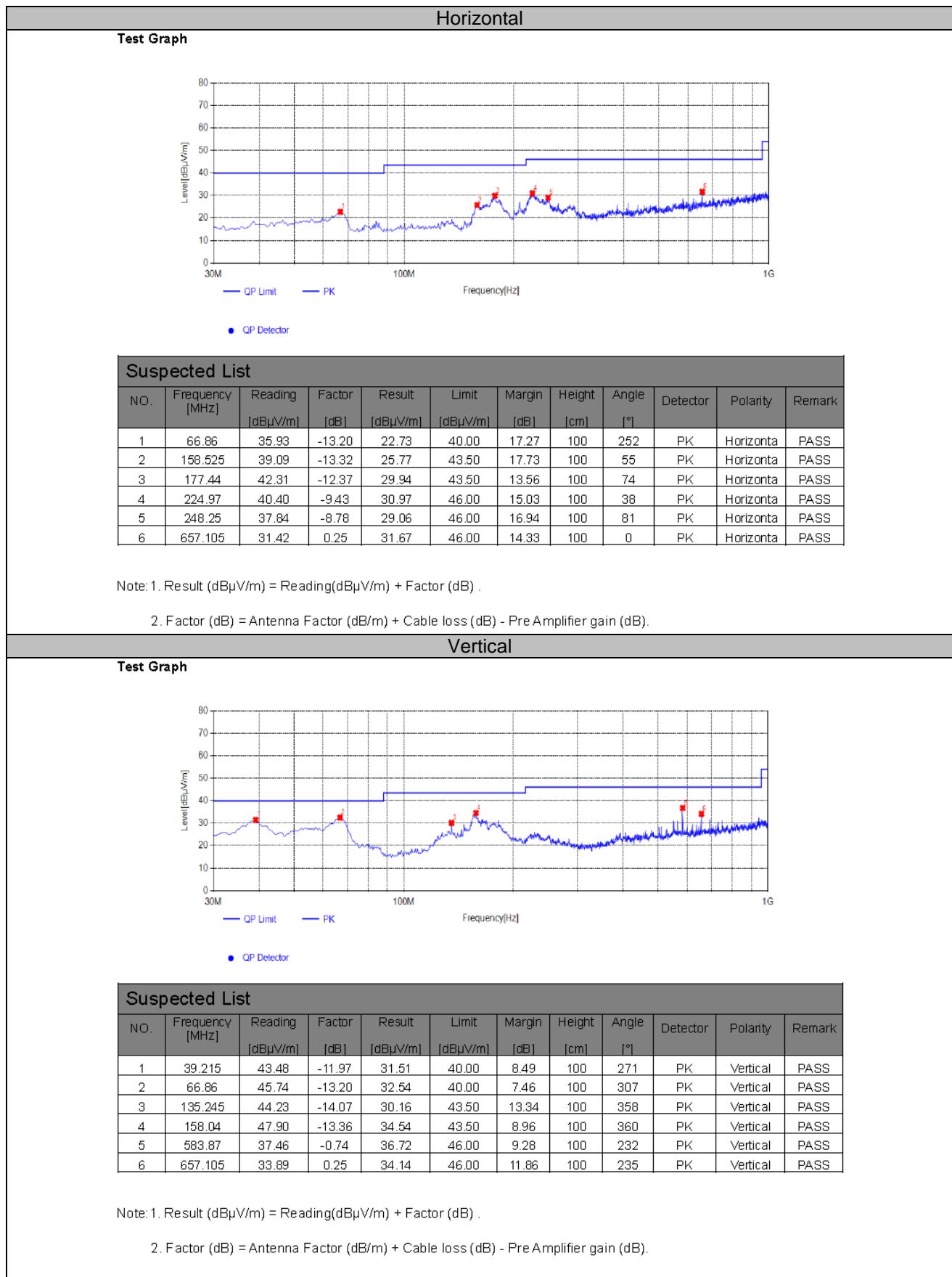
Limit line = specific limits (dB $\mu$ V) + distance extrapolation factor.

**Model:Shell S1**  
**For 30MHz-1GHz**



## Model:Shell S2

For 30MHz-1GHz



For 1GHz to 25GHz

**Model:Shell S1**

IEEE 802.11b(Worst Case)

Channel 1 / 2412 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4824.00	50.41	32.44	30.25	7.95	60.55	74.00	-13.45	Peak	Horizontal
4824.00	35.21	32.44	30.25	7.95	45.35	54.00	-8.65	Average	Horizontal
4824.00	50.93	31.60	36.50	7.00	53.03	74.00	-20.97	Peak	Vertical
4824.00	34.85	31.60	36.50	7.00	36.95	54.00	-17.05	Average	Vertical

Channel 6 / 2437 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4874.00	49.04	32.52	30.31	8.12	59.37	74.00	-14.63	Peak	Horizontal
4874.00	37.18	32.52	30.31	8.12	47.51	54.00	-6.49	Average	Horizontal
4874.00	49.51	31.02	36.50	7.60	51.63	74.00	-22.37	Peak	Vertical
4874.00	35.90	31.02	36.50	7.60	38.02	54.00	-15.98	Average	Vertical

Channel 11 / 2462 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4924.00	50.98	32.68	30.27	7.88	61.27	74.00	-12.73	Peak	Horizontal
4924.00	35.65	32.68	30.27	7.88	45.94	54.00	-8.06	Average	Horizontal
4924.00	51.23	31.58	36.20	7.82	54.43	74.00	-19.57	Peak	Vertical
4924.00	37.78	31.58	36.20	7.82	40.98	54.00	-13.02	Average	Vertical

**Model:Shell S2**

IEEE 802.11b(Worst Case)

Channel 1 / 2412 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4824.00	49.34	32.44	30.25	7.95	59.48	74.00	-14.52	Peak	Horizontal
4824.00	36.16	32.44	30.25	7.95	46.30	54.00	-7.70	Average	Horizontal
4824.00	54.82	32.44	30.25	7.95	64.96	74.00	-9.04	Peak	Vertical
4824.00	36.14	32.44	30.25	7.95	46.28	54.00	-7.72	Average	Vertical

Channel 6 / 2437 MHz

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4874.00	49.81	32.52	30.31	8.12	60.14	74.00	-13.86	Peak	Horizontal
4874.00	37.84	32.52	30.31	8.12	48.17	54.00	-5.83	Average	Horizontal
4874.00	51.14	32.52	30.31	8.12	61.47	74.00	-12.53	Peak	Vertical
4874.00	36.83	32.52	30.31	8.12	47.16	54.00	-6.84	Average	Vertical

Channel 11 / 2462 MHz

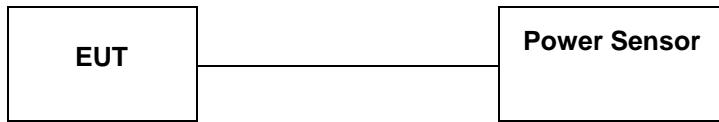
Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4924.00	51.26	32.68	30.27	7.88	61.55	74.00	-12.45	Peak	Horizontal
4924.00	36.35	32.68	30.27	7.88	46.64	54.00	-7.36	Average	Horizontal
4924.00	49.49	32.68	30.27	7.88	59.78	74.00	-14.22	Peak	Vertical
4924.00	32.02	32.68	30.27	7.88	42.31	54.00	-11.69	Average	Vertical

## 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
3. Margin value = Limit value - Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

### 4.3. Maximum Peak Output Power

#### TEST CONFIGURATION



#### TEST PROCEDURE

According to KDB558074 D01 15.247 Measurement Guidance v05r02 Section 8.3.1 Maximum peak conducted output power, 8.3.1.3 The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

#### LIMIT

The Maximum Peak Output Power Measurement is 30dBm.

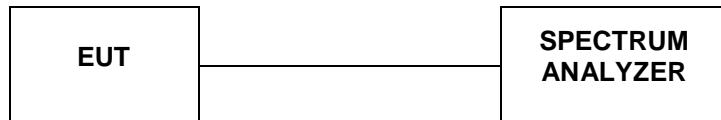
#### TEST RESULTS

For reporting purpose only.

Please refer to Appendix C.3.

#### 4.4. Power Spectral Density

##### TEST CONFIGURATION



##### TEST PROCEDURE

According to KDB 558074 D01 Method PKPSD (peak PSD) This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
4. Set the VBW  $\geq 3 \text{ RBW}$ .
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

##### LIMIT

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

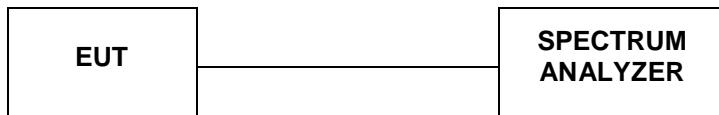
##### TEST RESULTS

For reporting purpose only.

Please refer to Appendix C.4.

## 4.5. 99% and 6dB Bandwidth

### TEST CONFIGURATION



### 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  $RBW=100$  KHz and  $VBW=300$ KHz. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB. According to KDI23M0258074 D01 for one of the following procedures may be used to determine the modulated DTS device signal bandwidth.

1. Set  $RBW = 100$  kHz.
2. Set the video bandwidth ( $VBW$ )  $\geq 3$   $RBW$ .
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### LIMIT

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

### TEST RESULTS

For reporting purpose only.

Please refer to Appendix C.1.

Please refer to Appendix C.2.

## 4.6. Conducted Spurious Emissions and Band Edge Compliance of RF Emission

### TEST REQUIREMENT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### TEST PROCEDURE

According to KDB 558074 D01 for Antenna-port conducted measurement. Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=10Hz for average detector.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.
6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency (see 12.2.2, 12.2.3, and 12.2.4 for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies  $\leq$  30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies  $>$  1000 MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:  

$$E = EIRP - 20\log D + 104.8$$

where:

E = electric field strength in  $\text{dB}\mu\text{V/m}$ ,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

11. Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.
12. Compare the resultant electric field strength level to the applicable regulatory limit.
13. Perform radiated spurious emission test dures until all measured frequencies were complete.

### LIMIT

Below -20dB of the highest emission level in operating band.

Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

## **TEST RESULTS**

### **4.6.1 For Conducted at Restricted Band Measurement**

For reporting purpose only.

Please refer to Appendix C.7.

### **4.6.2 For Conducted Bandedge Measurement**

For reporting purpose only.

Please refer to Appendix C.5.

### **4.6.3 For Conducted Spurious Emissions Measurement**

For reporting purpose only.

Please refer to Appendix C.6.

## 4.7. Antenna Requirement

### Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### **Antenna Information**

The antenna is Internal Aantenna, through the buckle stretched out, The directional gains of antenna used for transmitting is 5.26 dBi.

Reference to the Test Report: **CTA24071501901**.

## **5. TEST SETUP PHOTOS OF THE EUT**

Reference to the Test Report: **CTA24071501901**.

## **6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT**

Reference to the Test Report: **CTA24071501901**.

.....**End of Report**.....