



FCC RF Test Report

APPLICANT : Hewlett-Packard Company
EQUIPMENT : Slate Tablet
BRAND NAME : hp
MODEL NAME : HSTNN-Q91C
FCC ID : B94HNQ91CHWWRFT
STANDARD : FCC Part 15 Subpart E §15.407
CLASSIFICATION : (NII) Unlicensed National Information Infrastructure

The product was received on Oct. 03, 2014 and testing was completed on Oct. 31, 2014. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Joseph Lin / Supervisor

Approved by: Jones Tsai / Manager



SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR4O0309E	Rev. 01	Initial issue of report	Nov. 11, 2014
FR4O0309E	Rev. 02	Revising the equipment name	Nov. 28, 2014



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.403(i)	6dB Bandwidth	> 500kHz	Pass	-
3.2	15.407(a)	Maximum Conducted Output Power	≤ 30 dBm	Pass	-
3.3	15.407(a)	Power Spectral Density	≤ 30 dBm/500kHz	Pass	-
3.4	15.407(b)	Unwanted Emissions	$\leq -17, -27$ dBm/MHz & 15.209(a)	Pass	Under limit 0.21 dB at 5713.560 MHz
3.5	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 6.40 dB at 3.846 MHz
3.6	15.407(g)	Frequency Stability	Within Operation Band	Pass	-
3.7	15.407(c)	Automatically Discontinue Transmission	Discontinue Transmission	Pass	-
3.8	15.203 & 15.407(a)	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

Hewlett-Packard Company

3000 Hanover Street, Palo Alto, California 94304, USA

1.2 Manufacturer

Quanta Computer Inc.

No. 211, Wen Hwa 2nd Rd., Kuei Shan Hsiang, Tao Yuan Shien, Taiwan, R.O.C.

1.3 Feature of Equipment Under Test

Product Feature	
Equipment	Slate Tablet
Brand Name	hp
Model Name	HSTNN-Q91C
FCC ID	B94HNQ91CHWWRFT
Integrated the WLAN Module	Brand Name : FOXCONN Model Name : T77H462
EUT supports Radios application	GSM/EGPRS/WCDMA/HSPA WLAN 11b/g/n HT20 WLAN 11a/n HT20/HT40 Bluetooth v4.0 EDR/LE
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.



1.4 Product Specification of Equipment Under Test

Product Specification subjective to this standard															
Tx/Rx Channel Frequency Range		5725 MHz ~ 5850 MHz													
Maximum Output Power		<Ant. 1> 802.11a : 14.35 dBm / 0.0272 W <Ant. 2> 802.11a : 14.21 dBm / 0.0264 W SISO <Ant. 1> 802.11n HT20 : 13.42 dBm / 0.0220 W 802.11n HT40 : 13.26 dBm / 0.0212 W SISO <Ant. 2> 802.11n HT20 : 13.45 dBm / 0.0221 W 802.11n HT40 : 13.27 dBm / 0.0212 W <MIMO Ant. 1 + 2> 802.11n HT20 : 13.46 dBm / 0.0222 W 802.11n HT40 : 13.36 dBm / 0.0217 W													
Type of Modulation		OFDM (BPSK / QPSK / 16QAM / 64QAM)													
Antenna Type and Gain		Ant. 1 : PIFA Antenna with gain 1.98 dBi Ant. 2 : PIFA Antenna with gain 0.48 dBi													
Antenna Function Description		<table><tr><td></td><td>Ant. 1</td><td>Ant. 2</td></tr><tr><td>802.11 a</td><td>V</td><td>V</td></tr><tr><td>802.11 n SISO</td><td>V</td><td>V</td></tr><tr><td>802.11 n MIMO</td><td>V</td><td>V</td></tr></table>			Ant. 1	Ant. 2	802.11 a	V	V	802.11 n SISO	V	V	802.11 n MIMO	V	V
	Ant. 1	Ant. 2													
802.11 a	V	V													
802.11 n SISO	V	V													
802.11 n MIMO	V	V													

1.5 Modification of EUT

No modifications are made to the EUT during all test items.



1.6 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1022 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

Test Site	SPORTON INTERNATIONAL INC.		
Test Site Location	No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978		
Test Site No.	Sporton Site No.		
	TH02-HY	CO05-HY	03CH07-HY

1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart E
- ♦ FCC KDB 789033 D02 General UNII Test Procedures New Rules v01
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ ANSI C63.4-2003

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.



2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conducted emission (150 kHz to 30 MHz) and radiated emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.

The final configuration from all the combinations and the worst-case data rates were investigated by measuring the maximum power across all the data rates and modulation modes under section 2.2.

Based on the worst configuration found above, the RF power setting is set individually to meet FCC compliance limit for the final conducted and radiated tests shown in section 2.3.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5725-5850 MHz Band 4 (U-NII-3)	149	5745	157	5785
	151	5755	159	5795
	153	5765	161	5805
	155	5775	165	5825

Note: The above Frequency and Channel in boldface were 802.11n HT40.



2.2 Pre-Scanned RF Power

Preliminary tests were performed in different data rate and data rate associated with the highest power were chosen for full test in the following tables. Final Output Power equals to Measured Output Power adds the duty factor.

<Ant. 1>

5GHz 802.11a mode								
Data Rate (MHz)	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
Average Power (dBm)	14.35	12.13	12.21	12.03	12.20	12.09	12.24	12.33

<Ant. 2>

5GHz 802.11a mode								
Data Rate (MHz)	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
Average Power (dBm)	14.21	14.11	14.10	14.15	14.02	14.05	14.14	14.17

SISO <Ant. 1>

5GHz 802.11n HT20 mode								
Data Rate (MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
Average Power (dBm)	13.42	12.11	12.09	11.89	11.91	11.04	11.04	11.00

5GHz 802.11n HT40 mode								
Data Rate (MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
Average Power (dBm)	13.26	13.15	13.19	13.19	13.24	13.07	13.11	13.17

SISO <Ant. 2>

5GHz 802.11n HT20 mode								
Data Rate (MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
Average Power (dBm)	13.45	13.11	13.14	13.06	13.25	13.42	13.21	13.34

5GHz 802.11n HT40 mode								
Data Rate (MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
Average Power (dBm)	13.27	12.37	12.50	12.29	12.36	12.41	12.49	12.42

**MIMO <Ant. 1+2>**

5GHz 802.11n HT20 mode								
Data Rate (MHz)	MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
Average Power (dBm)	13.46	12.90	10.84	10.98	11.04	11.16	11.18	10.99

5GHz 802.11n HT40 mode								
Data Rate (MHz)	MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
Average Power (dBm)	13.36	12.15	12.68	12.45	12.25	12.55	12.68	12.90

Note: MIMO Ant. 1+2 is a calculated result from sum of the power MIMO Ant. 1 and MIMO Ant. 2.



2.3 Test Mode

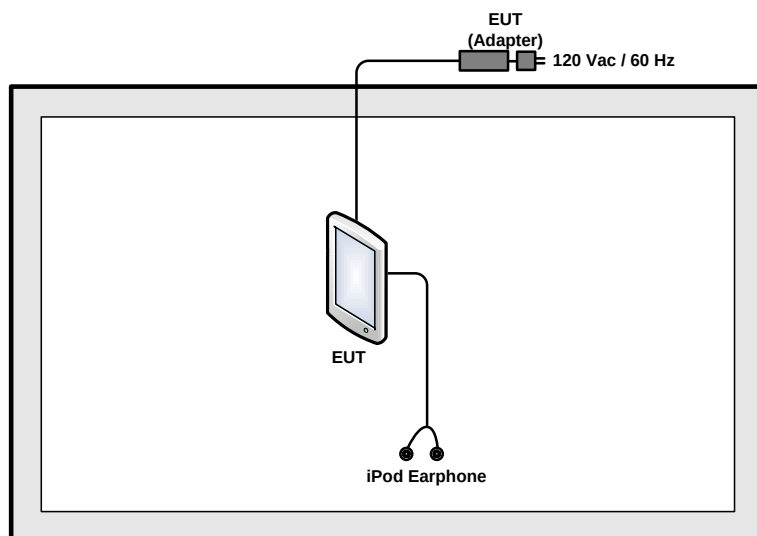
Final results of test modes, data rates and test channels are shown as following table.

Test Cases						
Conducted TCs	Test Items	Mode	Data Rate	Test Channel	Remark	
	6dB Bandwidth Power Spectral Density	802.11a	6 Mbps	L/M/H	-	
		802.11n HT20	MCS0	L/M/H	-	
		802.11n HT40	MCS0	L/H	-	
	Output Power	802.11a	6 Mbps	L/M/H	-	
		802.11n HT20	MCS0	L/M/H	-	
		802.11n HT40	MCS0	L/H	-	
	Frequency Stability	802.11a	6 Mbps	L	-	
Radiated TCs	Radiated Band Edge	802.11a	6 Mbps	L/H	<Ant. 1>	
		802.11n HT20	MCS0	L/H	SISO <Ant. 1> MIMO <Ant. 1+2>	
		802.11n HT40	MCS0	L/H	SISO <Ant. 1> MIMO <Ant. 1+2>	
	Radiated Spurious Emission	802.11a	6 Mbps	L/M/H	<Ant. 1>	
		802.11n HT20	MCS0	L/M/H	SISO <Ant. 1> MIMO <Ant. 1+2>	
		802.11n HT40	MCS0	L/H	SISO <Ant. 1> MIMO <Ant. 1+2>	
	AC Conducted Emission	Mode 1 : WWAN Idle + TC + TF				
	Remark:					
1. TF stands for Test Function, and consists of Bluetooth Link, WLAN (5GHz) Link, H Pattern, GPS Rx, Camera, and MPEG4.						
2. TC stands for Test Configuration, and consists of iPod Earphone, USB HD, LCD Monitor, Adapter, and SD Card.						

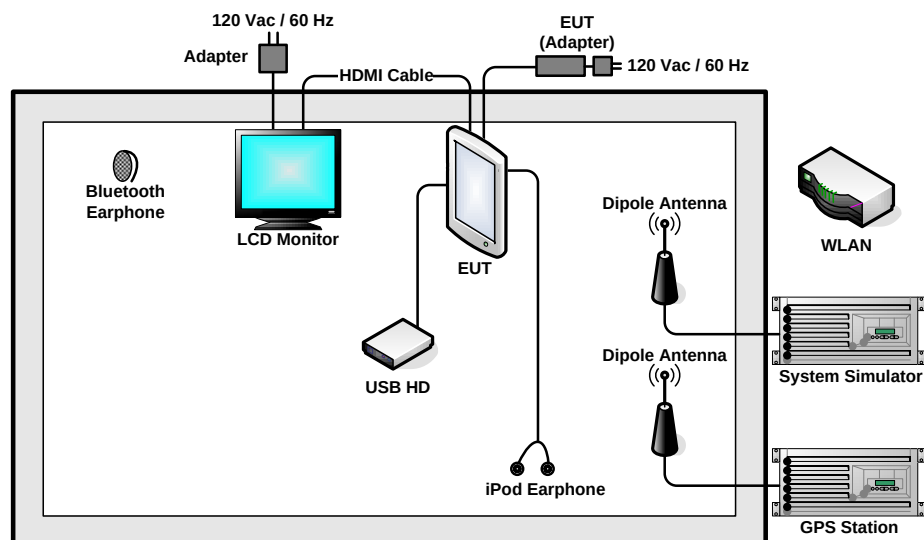
Ch. #		Band IV : 5725-5850 MHz		
		802.11a	802.11n HT20	802.11n HT40
L	Low	149	149	151
M	Middle	157	157	-
H	High	165	165	159

2.4 Connection Diagram of Test System

<WLAN Tx Mode>



<AC Conducted Emission Mode>





2.5 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	R&S	CMU 200	N/A	N/A	Unshielded, 1.8 m
2.	GPS Station	T&E	GS-50	N/A	N/A	Unshielded, 1.8 m
3.	WLAN AP	D-Link	DIR-628	KA2DIR628A2	N/A	Unshielded, 1.8 m
4.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
5.	LCD Monitor	DELL	U2410	FCC DoC	Shielded, 1.6 m	Unshielded, 1.8 m
6.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A
7.	USB HD	WD	WDBAAR3200 ABK-PESN	FCC DoC	Unshielded, 0.5 m	N/A
8.	SD Card	SanDisk	MicroHD HC	FCC DoC	N/A	N/A

2.6 EUT Operation Test Setup

The programmed RF utility “cmd”, is installed in EUT to provide channel selection, power level, data rate and the application type. RF Utility can send transmitting signal for all testing. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

2.7 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 4.2 + 10 = 14.2 \text{ (dB)}\end{aligned}$$

3 Test Result

3.1 6dB Bandwidth Measurement

3.1.1 Description of 6dB Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

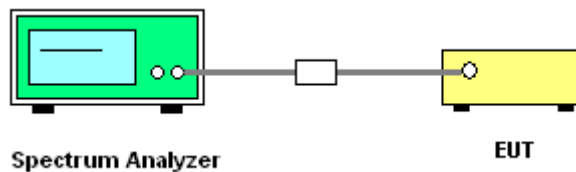
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01.
Section C) Emission bandwidth for the band 5.725-5.85GHz
2. Set RBW = 100kHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Detector = Peak.
5. Trace mode = max hold
6. Measure the maximum width of the emission that is 6 dB down from the peak of the emission.
7. Measure and record the results in the test report.

3.1.4 Test Setup

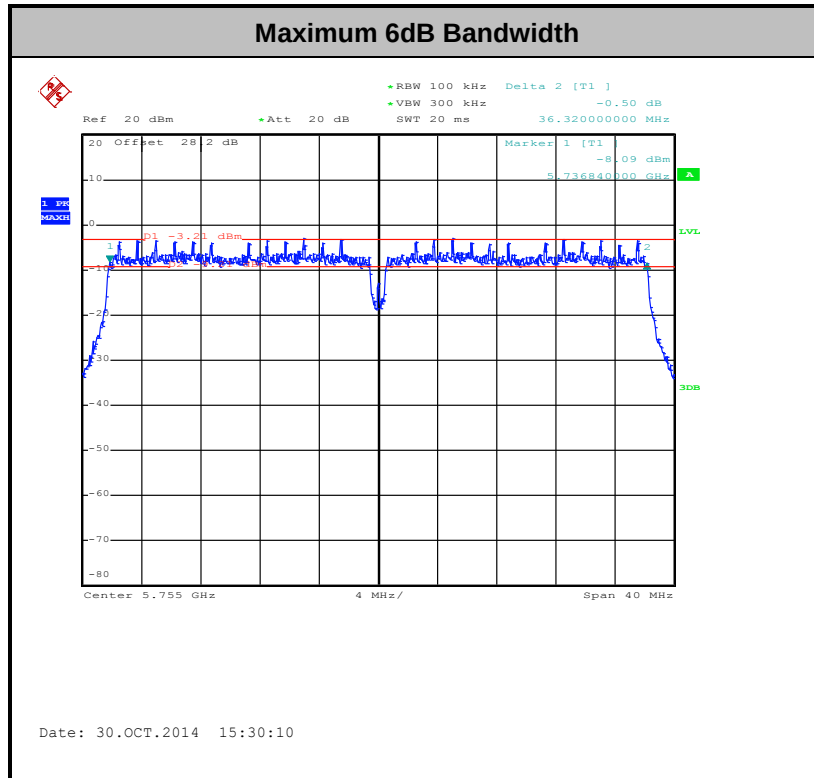




3.1.5 Test Result of 6dB Bandwidth

Test Band :	5GHz band 4	Temperature :	21~26°C
Test Engineer :	Alen Tsui and Lewis He	Relative Humidity :	45~54%

Mod.	Data Rate	N _{TX}	Channel	Freq. (MHz)	6 dB Bandwidth (MHz)		FCC 6 dB Bandwidth Min. Limit (MHz)		Pass/Fail
					Ant. 1	Ant. 2	Ant. 1	Ant. 2	
11a	6Mbps	1	149	5745	15.44	-	0.5	0.5	Pass
11a	6Mbps	1	157	5785	15.78		0.5	0.5	Pass
11a	6Mbps	1	165	5825	15.44		0.5	0.5	Pass
HT20	MCS0	1	149	5745	15.76		0.5	0.5	Pass
HT20	MCS0	1	157	5785	15.76		0.5	0.5	Pass
HT20	MCS0	1	165	5825	15.76		0.5	0.5	Pass
HT40	MCS0	1	151	5755	36.32		0.5	0.5	Pass
HT40	MCS0	1	159	5795	36.32		0.5	0.5	Pass
HT20	MCS0	2	149	5745	15.14	15.74	0.5	0.5	Pass
HT20	MCS0	2	157	5785	15.32	16.32	0.5	0.5	Pass
HT20	MCS0	2	165	5825	15.12	16.28	0.5	0.5	Pass
HT40	MCS0	2	151	5755	36.32	36.32	0.5	0.5	Pass
HT40	MCS0	2	159	5795	36.32	36.32	0.5	0.5	Pass



3.2 Maximum Conducted Output Power Measurement

3.2.1 Limit of Maximum Conducted Output Power

<FCC 14-30 CFR 15.407>

For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

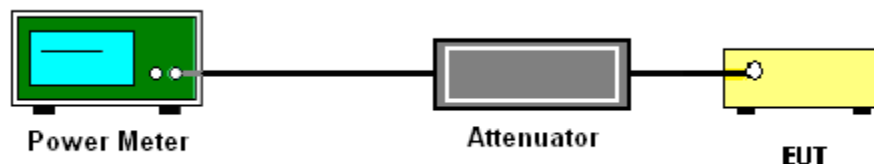
3.2.3 Test Procedures

The testing follows Method PM of FCC KDB 789033 D02 General UNII Test Procedures New Rules v01.

Method PM (Measurement using an RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit continuously with a consistent duty cycle at its maximum power control level.
3. Measure the average power of the transmitter, and the average power is corrected with duty factor, $10 \log(1/x)$, where x is the duty cycle.

3.2.4 Test Setup





3.2.5 Test Result of Maximum Conducted Output Power

Test Band :	5GHz band 4	Temperature :	21~26℃
Test Engineer :	Alen Tsui and Lewis He	Relative Humidity :	45~54%

Mod.	Data Rate	NTX	Ch.	Freq. (MHz)	Duty Factor (dB)		Average Conducted Power (dBm)			FCC Conducted Power Limit (dBm)		DG (dBi)		Pass /Fail
					Ant. 1	Ant. 2	Ant. 1	Ant. 2	SUM	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
11a	6Mbps	1	149	5745	0.20	0.20	12.49	12.29	-	30.00	30.00	1.98	0.48	Pass
11a	6Mbps	1	157	5785	0.20	0.20	14.35	14.21		30.00	30.00	1.98	0.48	Pass
11a	6Mbps	1	165	5825	0.20	0.20	14.18	14.19		30.00	30.00	1.98	0.48	Pass
HT20	MCS0	1	149	5745	0.22	0.22	12.42	12.13		30.00	30.00	1.98	0.48	Pass
HT20	MCS0	1	157	5785	0.22	0.22	13.23	13.34		30.00	30.00	1.98	0.48	Pass
HT20	MCS0	1	165	5825	0.22	0.22	13.42	13.45		30.00	30.00	1.98	0.48	Pass
HT40	MCS0	1	151	5755	0.39	0.43	10.96	10.68		30.00	30.00	1.98	0.48	Pass
HT40	MCS0	1	159	5795	0.39	0.43	13.26	13.27		30.00	30.00	1.98	0.48	Pass
HT20	MCS0	2	149	5745	0.42	0.42	10.14	10.24	13.20	30.00		4.27		Pass
HT20	MCS0	2	157	5785	0.42	0.42	10.34	10.56	13.46	30.00		4.27		Pass
HT20	MCS0	2	165	5825	0.42	0.42	10.28	10.33	13.32	30.00		4.27		Pass
HT40	MCS0	2	151	5755	0.79	0.79	10.32	10.16	13.25	30.00		4.27		Pass
HT40	MCS0	2	159	5795	0.79	0.79	10.41	10.28	13.36	30.00		4.27		Pass



3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

<FCC 14-30 CFR 15.407>

For the band 5.725–5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01.
Section F) Maximum power spectral density.

Method SA-2

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

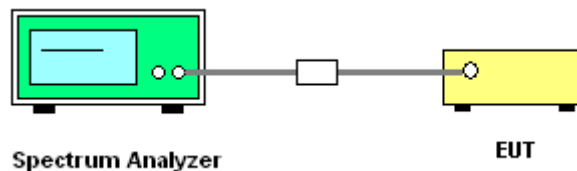
1. The testing follows Method SA-2 of FCC KDB 789033 D01 General UNII Test Procedures v01r03.
 - Measure the duty cycle.
 - Set span to encompass the entire emission bandwidth (EBW) of the signal.
 - Set RBW = 300 kHz.
 - Set VBW $\geq$ 1 MHz.
 - Number of points in sweep $\geq$ 2 Span / RBW.
 - Sweep time = auto.
 - Detector = RMS
 - Trace average at least 100 traces in power averaging mode.
 - Add $10 \log(500\text{kHz}/\text{RBW})$ to the test result.
 - Add $10 \log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add $10 \log(1/0.25) = 6$ dB if the duty cycle is 25 percent.
2. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.

3. Each plot has already offset with cable loss, and attenuator loss. Measure the PSD and record it.
4. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

Method (1): Measure and sum the spectra across the outputs.

The total final Power Spectral Density is from a device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points, the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

3.3.4 Test Setup

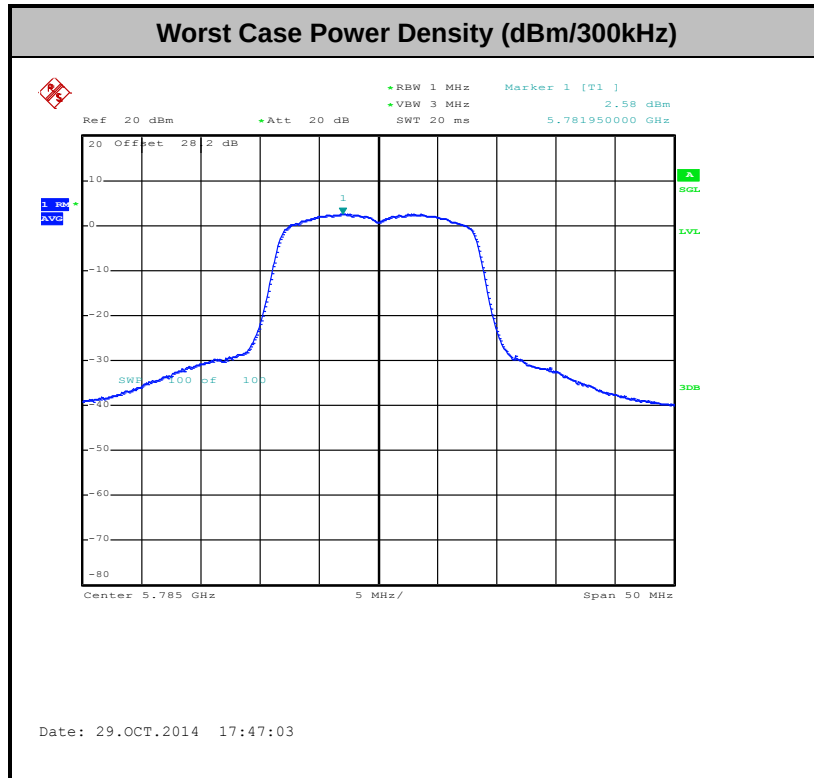




3.3.5 Test Result of Power Spectral Density

Test Band :	5GHz band 4	Temperature :	21~26°C
Test Engineer :	Alen Tsui and Lewis He	Relative Humidity :	45~54%

Mod.	Data Rate	NTX	Channel	Freq. (MHz)	Duty Factor (dB)		10log (500kHz /RBW) Factor (dB)		Average Power Density (dBm/500kHz)			Average PSD Limit (dBm/500kHz)		DG (dBi)		Pass /Fail
					Ant. 1	Ant. 2	Ant. 1	Ant. 2	Ant. 1	Ant. 2	SUM	Ant. 1	Ant. 2	Ant. 1	Ant. 2	
11a	6Mbps	1	149	5745	0.20	0.20	2.22	2.22	3.33			30.00	30.00	1.98	0.48	Pass
11a	6Mbps	1	157	5785	0.20	0.20	2.22	2.22	5.00			30.00	30.00	1.98	0.48	Pass
11a	6Mbps	1	165	5825	0.20	0.20	2.22	2.22	4.96			30.00	30.00	1.98	0.48	Pass
HT20	MCS0	1	149	5745	0.22	0.22	2.22	2.22	3.71			30.00	30.00	1.98	0.48	Pass
HT20	MCS0	1	157	5785	0.22	0.22	2.22	2.22	4.23			30.00	30.00	1.98	0.48	Pass
HT20	MCS0	1	165	5825	0.22	0.22	2.22	2.22	4.44			30.00	30.00	1.98	0.48	Pass
HT40	MCS0	1	151	5755	0.39	0.43	2.22	2.22	-1.45			30.00	30.00	1.98	0.48	Pass
HT40	MCS0	1	159	5795	0.39	0.43	2.22	2.22	1.19			30.00	30.00	1.98	0.48	Pass
HT20	MCS0	2	149	5745	0.42	0.42	2.22				3.77	30.00		4.27		Pass
HT20	MCS0	2	157	5785	0.42	0.42	2.22				4.09	30.00		4.27		Pass
HT20	MCS0	2	165	5825	0.42	0.42	2.22				3.85	30.00		4.27		Pass
HT40	MCS0	2	151	5755	0.79	0.79	2.22				-0.40	30.00		4.27		Pass
HT40	MCS0	2	159	5795	0.79	0.79	2.22				-0.24	30.00		4.27		Pass





3.4 Unwanted Emissions Measurement

This section as specified in FCC Part 15.407(b) is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement. The unwanted emissions shall comply with 15.407(b)(1) to (6), and restricted bands per FCC Part 15.205.

3.4.1 Limit of Unwanted Emissions

- (1) For transmitters operating in the 5725-5850 MHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17 dBm/MHz (78.3dBμV/m); for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of -27 dBm/MHz (68.3dBμV/m).
- (2) Unwanted spurious emissions fallen in restricted bands per FCC Part 15.205 shall comply with the general field strength limits set forth in § 15.209 as below table,

Frequency (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: The following formula is used to convert the EIRP to field strength.

$$E = \frac{1000000\sqrt{30P}}{3} \text{ } \mu\text{V/m, where P is the eirp (Watts)}$$

EIRP (dBm)	Field Strength at 3m (dBμV/m)
-17	78.3
- 27	68.3

- (3) KDB789033 v01r03 H)2)c(i) As specified in 15.407(b), emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of -27 dBm/MHz (or -17 dBm/MHz as specified in 15.407(b)(4)). However, an out-of-band emission that complies with both the average and peak limits of 15.209 is not required to satisfy the -27 dBm/MHz or -17 dBm/MHz peak emission limit.



3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01.

Section G) Unwanted emissions measurement.

(1) Procedure for Unwanted Emissions Measurements Below 1000MHz

- RBW = 120 kHz
- VBW = 300 kHz
- Detector = Peak
- Trace mode = max hold

(2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

- RBW = 1 MHz
- VBW $\geq$ 3 MHz
- Detector = Peak
- Sweep time = auto
- Trace mode = max hold

(3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

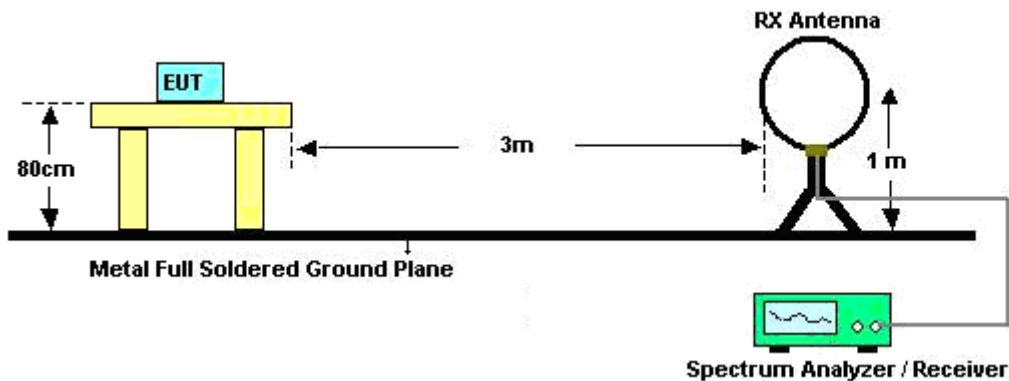
- RBW = 1 MHz
- VBW = 10 Hz, when duty cycle is no less than 98 percent.
- VBW $\geq$ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
1	802.11a	95.39	2070.00	0.48	1kHz
2	802.11a	95.39	2070.00	0.48	1kHz
1	5GHz 802.11n HT20	95.07	1930.00	0.52	1kHz
1	5GHz 802.11n HT20	95.07	1930.00	0.52	1kHz
1	5GHz 802.11n HT40	91.35	498.00	2.01	3kHz
1	5GHz 802.11n HT40	90.48	496.00	2.02	3kHz
1+2	5GHz 802.11n HT20 for Ant 1	90.83	990.00	1.01	3kHz
1+2	5GHz 802.11n HT20 for Ant 2	90.74	980.00	1.02	3kHz
1+2	5GHz 802.11n HT40 for Ant 1	83.33	500.00	2.00	3kHz
1+2	5GHz 802.11n HT40 for Ant 2	83.33	500.00	2.00	3kHz

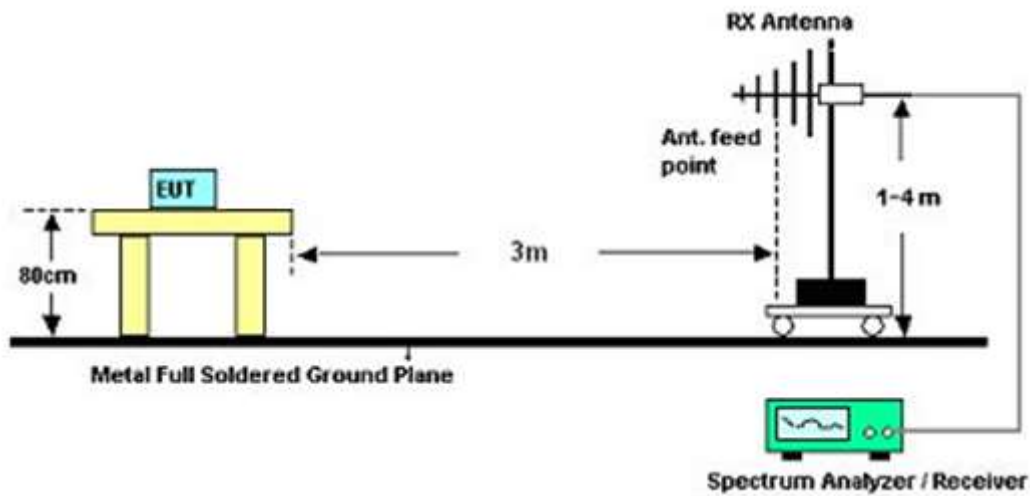
2. The EUT was placed on a rotatable table top 0.8 meter above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

3.4.4 Test Setup

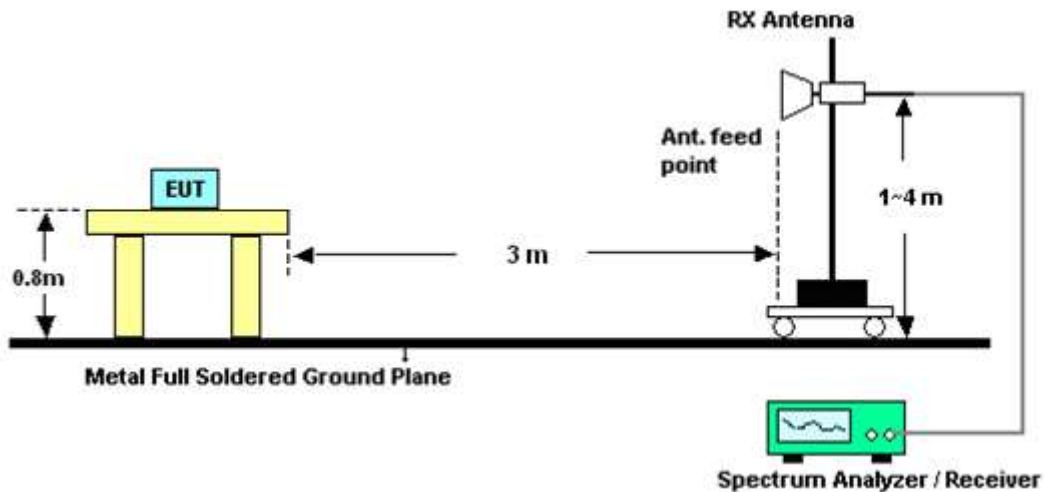
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.4.5 Test Results of Radiated Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

3.4.6 Test Result

The test results please refer appendix A.

3.5 AC Conducted Emission Measurement

3.5.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	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.

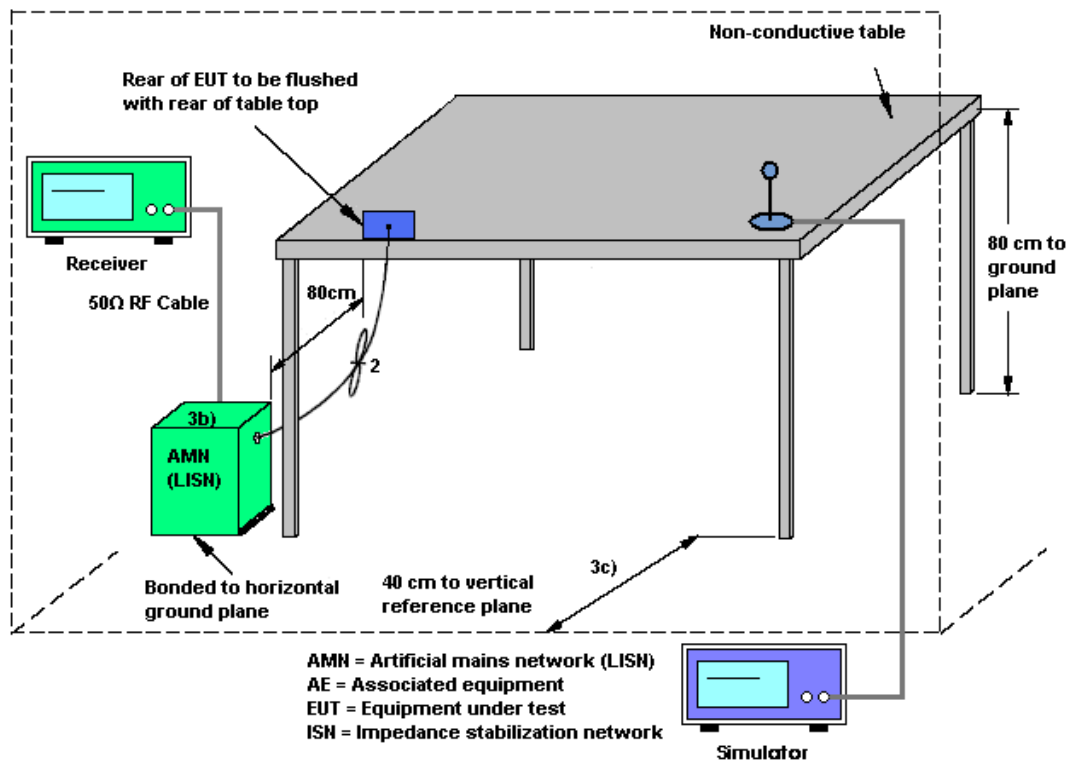
3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

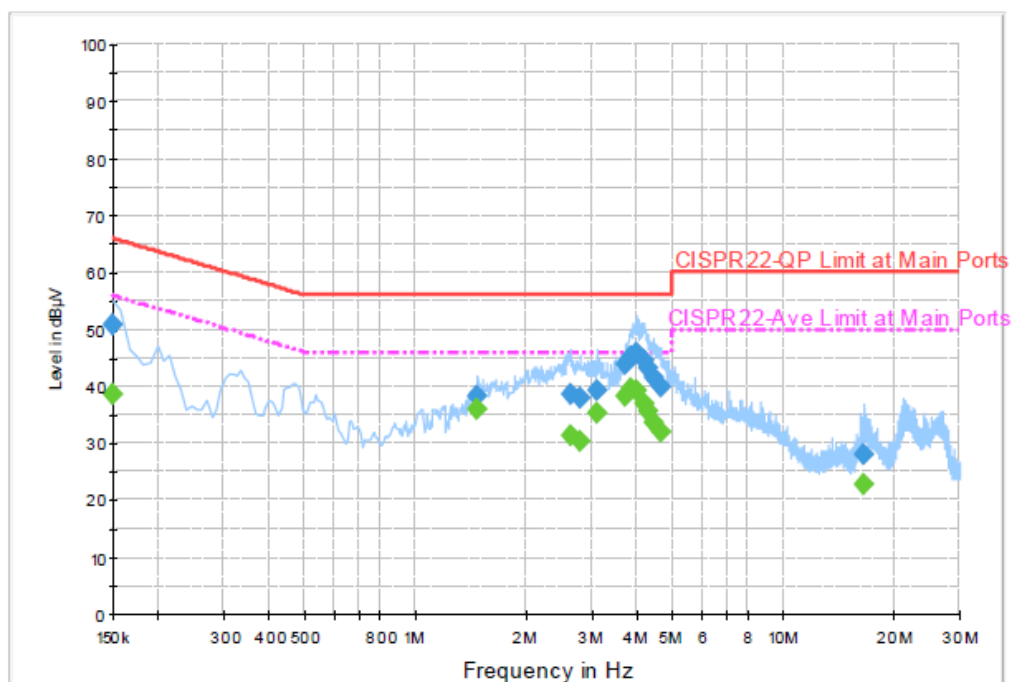
3.5.4 Test Setup





3.5.5 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	20~22℃
Test Engineer :	Cosmo Xu	Relative Humidity :	45~47%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	WWAN Idle + TC + TF		

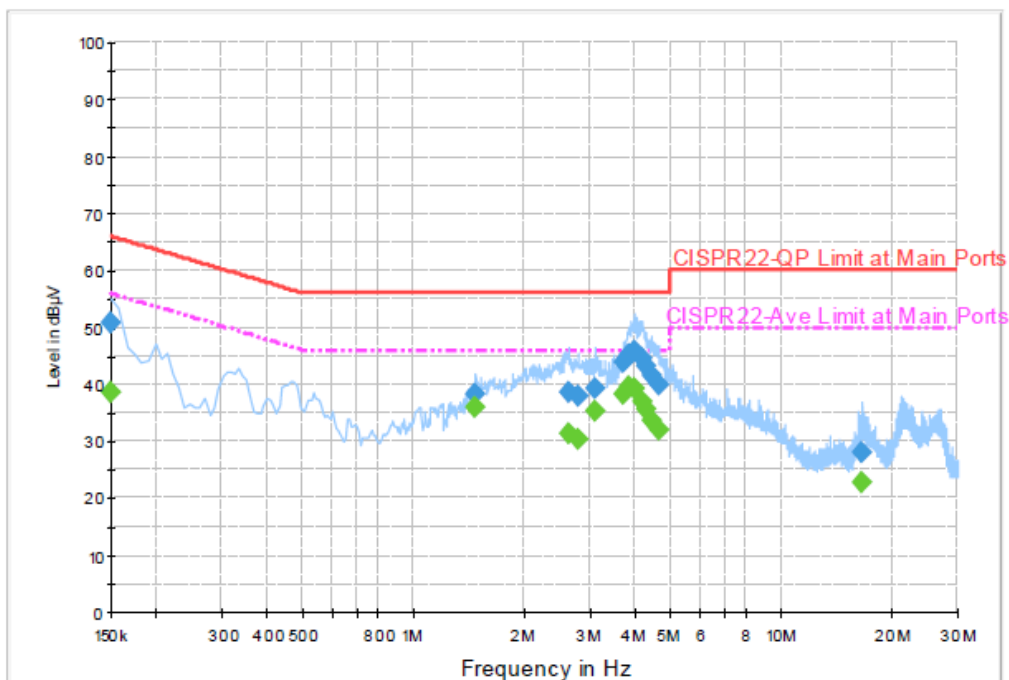


Final Result : QuasiPeak

Frequency (MHz)	QuasiPeak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	50.9	Off	L1	19.4	15.1	66.0
1.470000	38.4	Off	L1	19.5	17.6	56.0
2.638000	38.6	Off	L1	19.5	17.4	56.0
2.798000	38.1	Off	L1	19.5	17.9	56.0
3.110000	39.4	Off	L1	19.6	16.6	56.0
3.702000	43.8	Off	L1	19.6	12.2	56.0
3.846000	45.2	Off	L1	19.6	10.8	56.0
3.958000	46.0	Off	L1	19.6	10.0	56.0
4.174000	44.4	Off	L1	19.6	11.6	56.0
4.270000	43.4	Off	L1	19.6	12.6	56.0
4.438000	41.7	Off	L1	19.6	14.3	56.0
4.622000	40.0	Off	L1	19.6	16.0	56.0
16.574000	28.0	Off	L1	19.9	32.0	60.0



Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Cosmo Xu	Relative Humidity :	45~47%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	WWAN Idle + TC + TF		

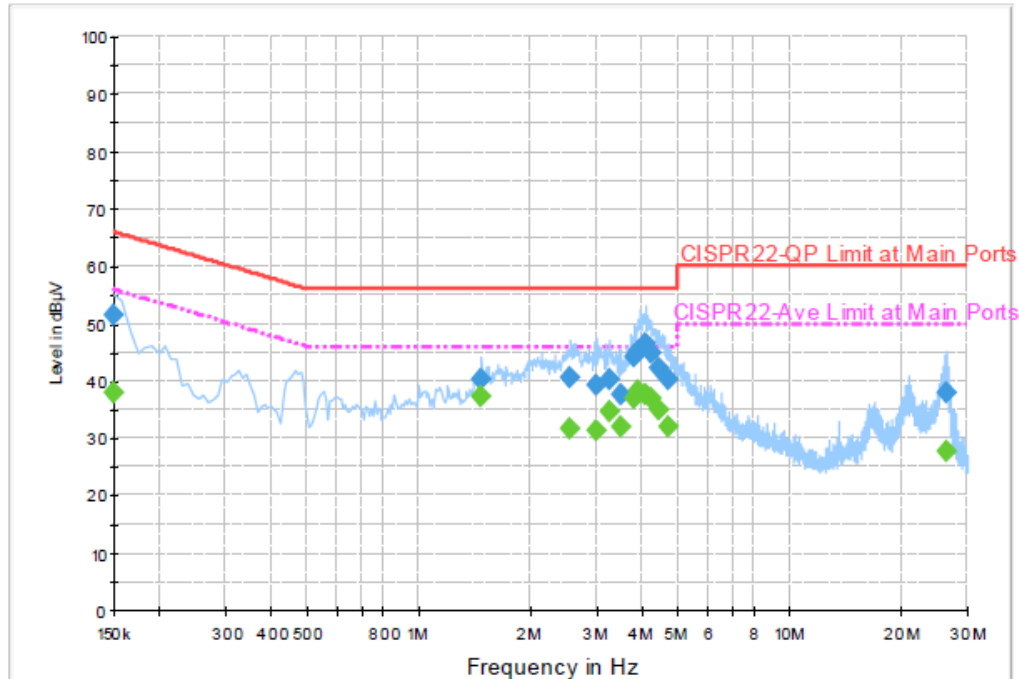


Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	38.5	Off	L1	19.4	17.5	56.0
1.470000	36.1	Off	L1	19.5	9.9	46.0
2.638000	31.2	Off	L1	19.5	14.8	46.0
2.798000	30.4	Off	L1	19.5	15.6	46.0
3.110000	35.4	Off	L1	19.6	10.6	46.0
3.702000	38.2	Off	L1	19.6	7.8	46.0
3.846000	39.6	Off	L1	19.6	6.4	46.0
3.958000	39.2	Off	L1	19.6	6.8	46.0
4.174000	37.0	Off	L1	19.6	9.0	46.0
4.270000	35.5	Off	L1	19.6	10.5	46.0
4.438000	33.7	Off	L1	19.6	12.3	46.0
4.622000	31.9	Off	L1	19.6	14.1	46.0
16.574000	22.6	Off	L1	19.9	27.4	50.0



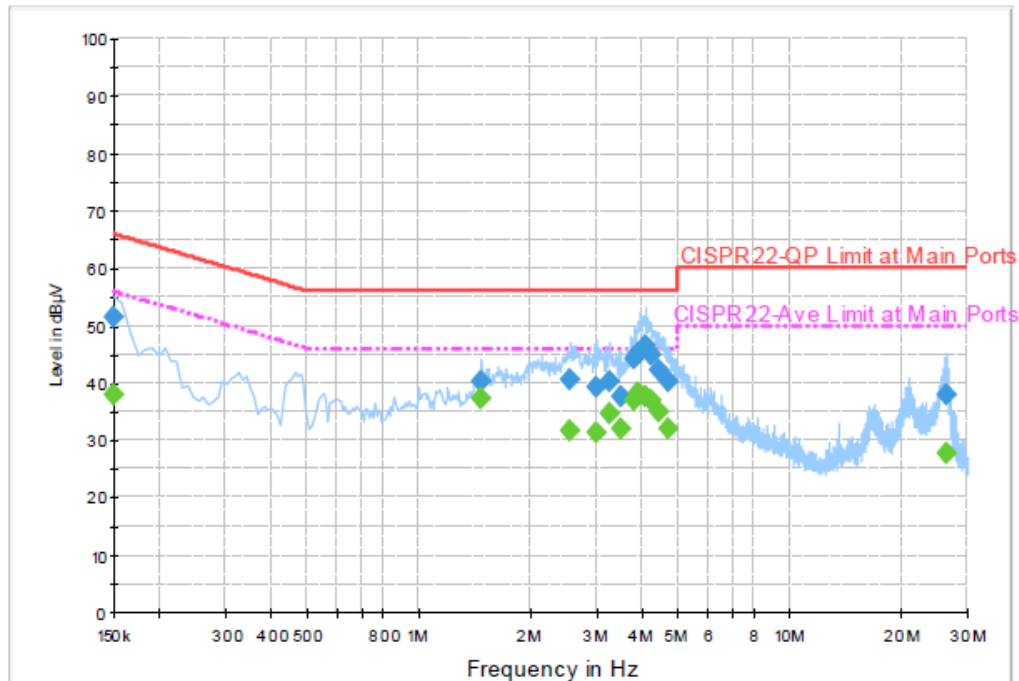
Test Mode :	Mode 1	Temperature :	20~22℃
Test Engineer :	Cosmo Xu	Relative Humidity :	45~47%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	WWAN Idle + TC + TF		

**Final Result : QuasiPeak**

Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	51.6	Off	N	19.5	14.4	66.0
1.470000	40.2	Off	N	19.5	15.8	56.0
2.558000	40.5	Off	N	19.5	15.5	56.0
2.998000	39.1	Off	N	19.6	16.9	56.0
3.246000	40.4	Off	N	19.6	15.6	56.0
3.478000	37.7	Off	N	19.6	18.3	56.0
3.814000	44.2	Off	N	19.6	11.8	56.0
3.886000	45.1	Off	N	19.6	10.9	56.0
4.062000	46.6	Off	N	19.6	9.4	56.0
4.222000	44.9	Off	N	19.6	11.1	56.0
4.398000	42.4	Off	N	19.6	13.6	56.0
4.686000	40.1	Off	N	19.6	15.9	56.0
26.390000	37.9	Off	N	20.1	22.1	60.0



Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Cosmo Xu	Relative Humidity :	45~47%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	WWAN Idle + TC + TF		

**Final Result : Average**

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	37.9	Off	N	19.5	18.1	56.0
1.470000	37.2	Off	N	19.5	8.8	46.0
2.558000	31.5	Off	N	19.5	14.5	46.0
2.998000	31.5	Off	N	19.6	14.5	46.0
3.246000	34.6	Off	N	19.6	11.4	46.0
3.478000	32.2	Off	N	19.6	13.8	46.0
3.814000	37.1	Off	N	19.6	8.9	46.0
3.886000	38.2	Off	N	19.6	7.8	46.0
4.062000	37.5	Off	N	19.6	8.5	46.0
4.222000	36.9	Off	N	19.6	9.1	46.0
4.398000	35.1	Off	N	19.6	10.9	46.0
4.686000	31.9	Off	N	19.6	14.1	46.0
26.390000	27.9	Off	N	20.1	22.1	50.0

3.6 Frequency Stability Measurement

3.6.1 Limit of Frequency Stability

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

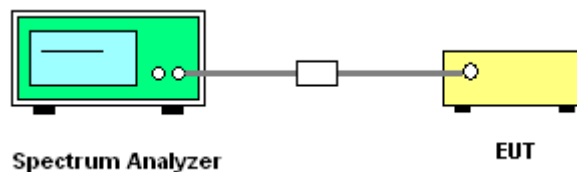
3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.6.3 Test Procedures

1. To ensure emission at the band edge is maintained within the authorized band, those values shall be measured by radiation emissions at upper and lower frequency points, and finally compensated by frequency deviation as procedures below.
2. The EUT was operated at the maximum output power, and connected to the spectrum analyzer, which is set to maximum hold function and peak detector. The peak value of the power envelope was measured and noted. The upper and lower frequency points were respectively measured relatively 10dB lower than the measured peak value.
3. The frequency deviation was calculated by adding the upper frequency point and the lower frequency point divided by two. Those detailed values of frequency deviation are provided in table below.

3.6.4 Test Setup



**3.6.5 Test Result of Frequency Stability**

Test Band :	5GHz band 4	Test Engineer :	Alen Tsui and Lewis He
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Mod.	Data Rate	N _{TX}	Channel	Freq. (MHz)	Center Frequency (MHz)	Frequency Deviation (MHz)	Frequency Stability (ppm)	Temperature (°C)	Voltage (V)
11a	6Mbps	1	149	5745	5745.000	0.000	0.00	20	108
11a	6Mbps	1	149	5745	5745.000	0.000	0.00	20	132
11a	6Mbps	1	149	5745	5745.000	0.000	0.00	20	120
11a	6Mbps	1	149	5745	5745.075	0.075	13.05	-30	120
11a	6Mbps	1	149	5745	5745.050	0.050	8.70	50	120

Note: Center Frequency = (Low Frequency + High Frequency) / 2.



3.7 Automatically Discontinue Transmission

3.7.1 Limit of Automatically Discontinue Transmission

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

3.7.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.7.3 Test Result of Automatically Discontinue Transmission

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.

3.8 Antenna Requirements

3.8.1 Standard Applicable

According to FCC 47 CFR Section 15.407(a)(1)(2) ,if transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.8.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.8.3 Antenna Gain

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

N_{SS} = the number of independent spatial streams of data;

N_{ANT} = the total number of antennas

$g_{j,k} = 10^{G_k / 20}$ if the k th antenna is being fed by spatial stream j , or zero if it is not;
 G_k is the gain in dBi of the k th antenna.

The EUT supports CDD mode.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain "DG" is calculated as following table.



			DG	DG	Power	PSD
			for	for	Limit	Limit
	Ant 1	Ant 2	Power	PSD	Reduction	Reduction
	(dBi)	(dBi)	(dBi)	(dBi)	(dB)	(dB)
Band IV	1.98	0.48	4.27	4.27	0.00	0.00

Power Limit Reduction = DG (Power) – 6dBi, (min = 0)

PSD Limit Reduction = DG (PSD) – 6dBi, (min = 0)



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz~40GHz	Jun. 09, 2014	Oct. 15, 2014 ~ Oct. 31, 2014	Jun. 08, 2015	Conducted (TH02-HY)
Power Meter	Anritsu	ML2495A	1036004	300MHz~40GHz	Aug. 09, 2014	Oct. 15, 2014 ~ Oct. 31, 2014	Aug. 08, 2015	Conducted (TH02-HY)
Power Sensor	Anritsu	MA2411B	1027253	300MHz~40GHz	Aug. 09, 2014	Oct. 15, 2014 ~ Oct. 31, 2014	Aug. 08, 2015	Conducted (TH02-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV30	101749	10Hz ~ 30GHz	Feb. 10, 2014	Oct. 20, 2014 ~ Oct. 25, 2014	Feb. 09, 2015	Radiation (03CH07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9 kHz~7 GHz	Aug. 30, 2014	Oct. 20, 2014 ~ Oct. 25, 2014	Aug. 29, 2015	Radiation (03CH07-HY)
Loop Antenna	TESEQ	HLA 6120	31244	9 kHz~30 MHz	Dec. 02, 2012	Oct. 20, 2014 ~ Oct. 25, 2014	Dec. 03, 2014	Radiation (03CH07-HY)
Bilog Antenna	Schaffner	CBL6111C	2726	30MHz ~ 1GHz	Sep. 27, 2014	Oct. 20, 2014 ~ Oct. 25, 2014	Sep. 26, 2015	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	75962	1GHz~18GHz	Aug. 19, 2014	Oct. 20, 2014 ~ Oct. 25, 2014	Aug. 18, 2015	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz~40GHz	Oct. 02, 2014	Oct. 20, 2014 ~ Oct. 25, 2014	Oct. 01, 2015	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10 MHz ~ 1000MHz	Mar. 17, 2014	Oct. 20, 2014 ~ Oct. 25, 2014	Mar. 16, 2015	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1 GHz~26.5 GHz	Nov. 29, 2013	Oct. 20, 2014 ~ Oct. 25, 2014	Nov. 28, 2014	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	DC~18 GHz	Apr. 21, 2014	Oct. 20, 2014 ~ Oct. 25, 2014	Apr. 20, 2015	Radiation (03CH07-HY)
Turn Table	ChainTek	ChainTek 3000	N/A	0 ~ 360 degree	N/A	Oct. 20, 2014 ~ Oct. 25, 2014	N/A	Radiation (03CH07-HY)
Antenna Mast	ChainTek	ChainTek 3000	N/A	N/A	N/A	Oct. 20, 2014 ~ Oct. 25, 2014	N/A	Radiation (03CH07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100356	9kHz ~ 2.75GHz	Nov. 15, 2013	Oct. 28, 2014	Nov. 14, 2014	Conduction (CO05-HY)
LISN (for auxiliary equipment)	Rohde & Schwarz	ENV216	100081	9kHz ~ 30MHz	Dec. 12, 2013	Oct. 28, 2014	Dec. 11, 2014	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz ~ 30MHz	Dec. 04, 2013	Oct. 28, 2014	Dec. 03, 2014	Conduction (CO05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Oct. 28, 2014	N/A	Conduction (CO05-HY)



5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150kHz ~ 30MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.26
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.50
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