



Variant FCC/IC RF Test Report

APPLICANT : NetComm Wireless Limited
EQUIPMENT : 4G WiFi M2M Router
BRAND NAME : NetComm Wireless
MODEL NAME : NTC-140W-01
FCC ID : XIA-NTC140W
IC : 8847A-NTC140W
STANDARD : FCC Part 15 Subpart C §15.247
IC RSS-210 issue 8
CLASSIFICATION : (DTS) Digital Transmission System

This is a variant report which is only valid together with the original test report. The product was received on Dec. 05, 2014 and testing was completed on Feb. 04, 2015. 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



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FCC ID : XIA-NTC140W

IC : 8847A-NTC140W

Page Number : 1 of 23

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR441109-03	Rev. 01	This is a variant report. Please refer to Product Equality Declaration. All the test cases were performed on original report which can be referred to Sporton Report No. FR441109. Base on original report, the case of conducted emission and radiated emission was verified.	Feb. 10, 2015
FR441109-03	Rev. 02	Revising SW Version in 1.3 section	Feb. 11, 2015



SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(d)	RSS-210 A8.5	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 0.55 dB at 2483.920 MHz
3.2	15.207	RSS-Gen 7.2.4	AC Conducted Emission	15.207(a)	Pass	Under limit 15.60 dB at 0.446 MHz
3.3	15.203 & 15.247(b)	RSS-210 A8.4	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

NetComm Wireless Limited
Level 2, 18-20 Orion Road Lane Cove NSW Australia

1.2 Manufacturer

NetComm Wireless Limited
Level 2, 18-20 Orion Road Lane Cove NSW Australia

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	4G WiFi M2M Router
Brand Name	NetComm Wireless
Model Name	NTC-140W-01
FCC ID	XIA-NTC140W
IC	8847A-NTC140W
EUT supports Radios application	CDMA/EV-DO/GSM/EGPRS/WCDMA/HSPA/LTE WLAN 11b/g/n HT20/HT40
HW Version	V1.1
SW Version	V2.0.20.3
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 subjective to this standard

Product Specification subjective to this standard			
Tx/Rx Channel Frequency Range	802.11b/g/n : 2412 MHz ~ 2462 MHz		
Maximum (Peak) Output Power to antenna	MIMO <Ant. 1+2> 802.11b : 15.07 dBm (0.0321 W) 802.11g : 25.27 dBm (0.3365 W) 802.11n HT20 : 24.83 dBm (0.3041 W) 802.11n HT40 : 24.89 dBm (0.3083 W)		
Antenna Type	802.11b/g/n : Dipole Antenna with gain 2.00 dBi		
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)		
Antenna Function for Transmitter			
		Ant. 1	Ant. 2
	802.11 b MIMO	V	V
	802.11 g MIMO	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 District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978			
Test Site No.	Sporton Site No.			IC Registration No.
	TH02-HY	CO05-HY	03CH07-HY	4086B-1

Note: The test site complies with ANSI C63.4 2009 requirement.

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 C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r02
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ ANSI C63.10-2013
- ♦ IC RSS-210 Issue 8
- ♦ IC RSS-Gen Issue 4
- ♦ NOTICE 2012-DRS0126

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. FCC permits the use of the 1.5 meter table for frequency above 1GHz as an alternative in C63.10-2013 through inquiry tracking number 961829.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.
4. Per the section 2.2.3 of Notice of 2012-DRS0126, " Receivers Excluded from Industry Canada Requirements", only radiocommunication receivers operating in stand-alone mode within the band 30-960 MHz and scanner receivers are subject to Industry Canada requirements.



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).

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 radiated tests shown in section 2.3.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		



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 shown in the following tables.

MIMO <Ant. 1+2>

802.11b				
Data Rate (MHz)	1M bps	2M bps	5.5M bps	11M bps
Peak Power (dBm)	15.07	14.51	14.91	14.92

802.11g								
Data Rate (MHz)	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
Peak Power (dBm)	25.27	25.24	24.98	24.68	24.64	25.17	22.41	22.35

2.4GHz 802.11n HT20								
Data Rate (MHz)	MCS 0	MCS 1	MCS2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
Peak Power (dBm)	24.83	24.48	24.61	24.29	23.30	23.35	22.32	21.39

2.4GHz 802.11n HT40								
Data Rate (MHz)	MCS 0	MCS 1	MCS2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
Peak Power (dBm)	24.89	24.68	24.83	24.62	23.39	24.23	22.53	21.39

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 test mode of radiated spurious emissions are considering the modulation and worse data rates from the power table described in section 2.2.

MIMO Antenna

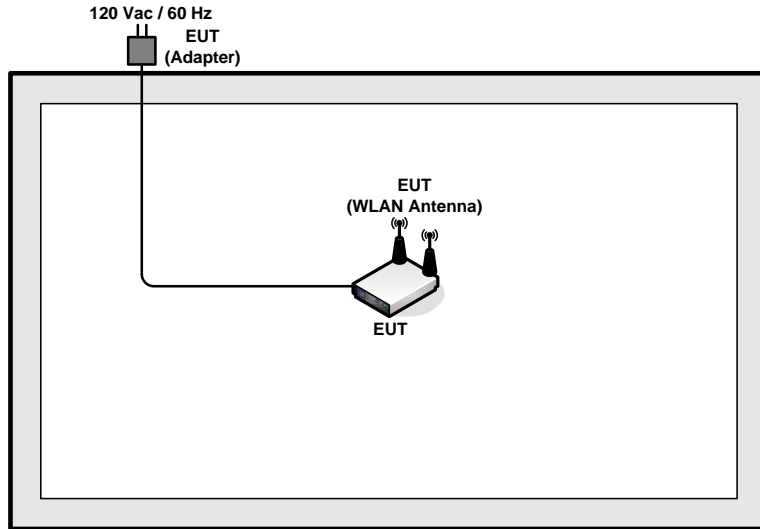
<2.4GHz>

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

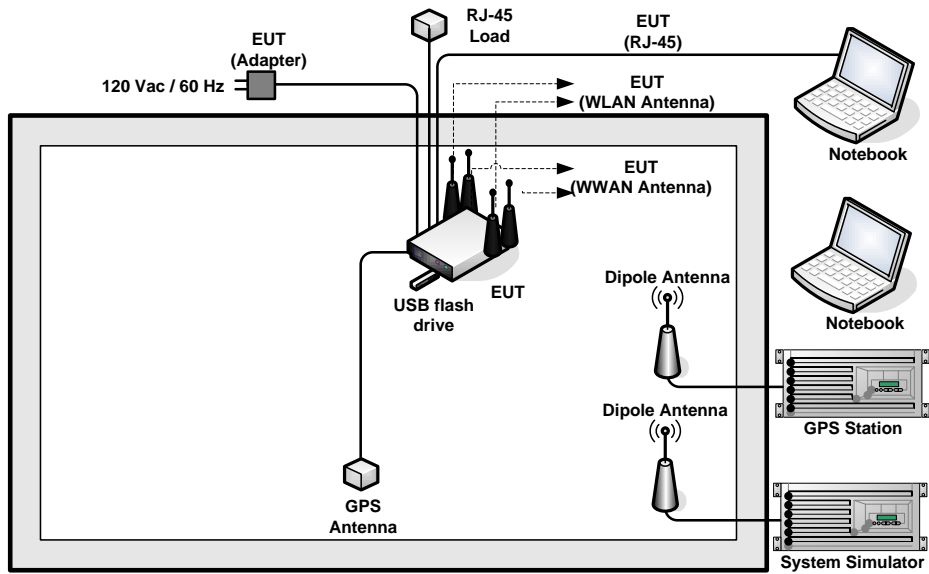
Test Cases	
AC Conducted Emission	Mode 1 : GSM850 (GPRS Class 8) Idle + WLAN Link + Adapter + GPS Rx + LAN Link + USB Flash Drive + SD Card

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	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
2.	GPS Station	Pendulum	GSG-54	N/A	N/A	Unshielded, 1.8 m
3.	Notebook	DELL	Latitude E6320	FCC DoC/ Contains FCC ID: QDS-BRCM1054	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	Notebook	DELL	P20G	FCC DoC/ Contains FCC ID:QDS-BRCM1051	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
5.	Notebook	DELL	Inspiron N4110	N/A	N/A	N/A
6.	USB Flash Drive	Kingston	DataTraveler 100	FCC DoC	N/A	N/A
7.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

2.6 EUT Operation Test Setup

For WLAN function, programmed RF utility, "CMD" installed in the notebook make the EUT provide functions like channel selection and power level for continuous transmitting and receiving signals.



3 Test Result

3.1 Radiated Band Edges and Spurious Emission Measurement

3.1.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

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

3.1.2 Measuring Instruments

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



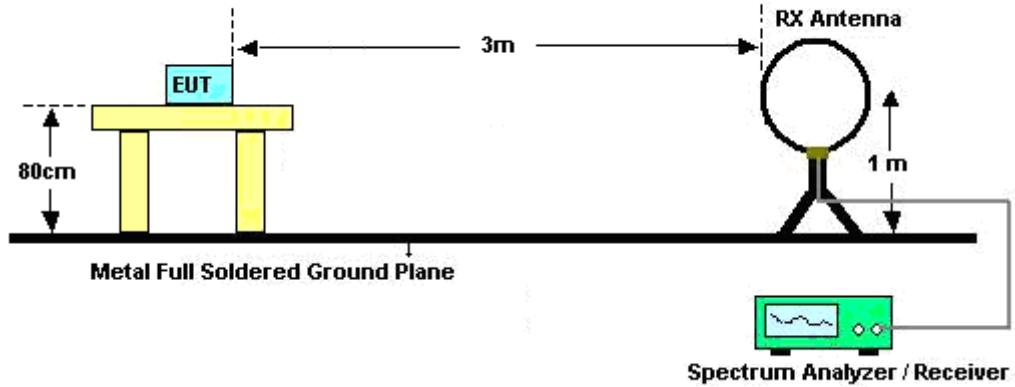
3.1.3 Test Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r02.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1 \text{ GHz}$; $\text{VBW} \geq \text{RBW}$; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1 \text{ GHz}$ for peak measurement.
For average measurement:
 - $\text{VBW} = 10 \text{ Hz}$, when duty cycle is no less than 98 percent.
 - $\text{VBW} \geq 1/T$, 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.

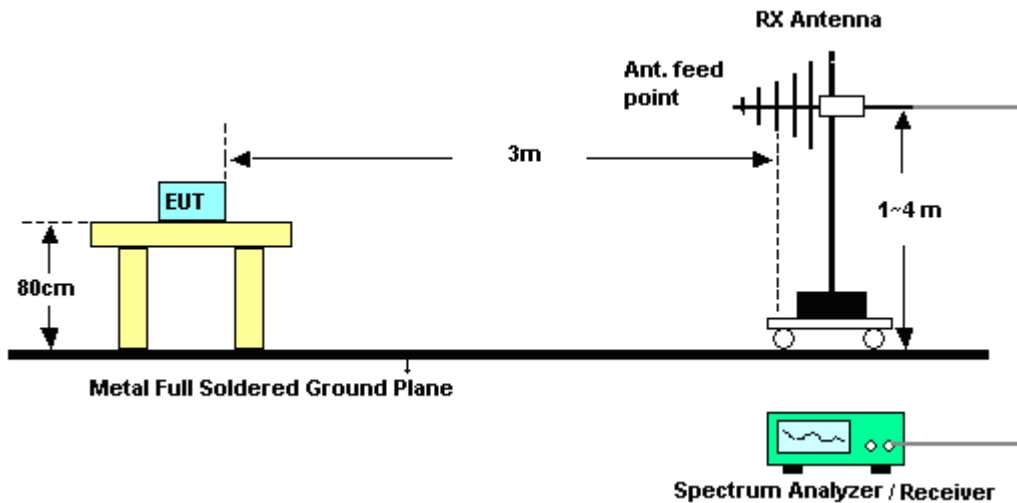
Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
1+2	802.11b	97.68	8430	0.12	300Hz
1+2	802.11g	87.46	1395	0.72	1kHz
1+2	2.4GHz 802.11n HT20	86.33	1295	0.77	1kHz
1+2	2.4GHz 802.11n HT40	72.70	635	1.57	3kHz

3.1.4 Test Setup

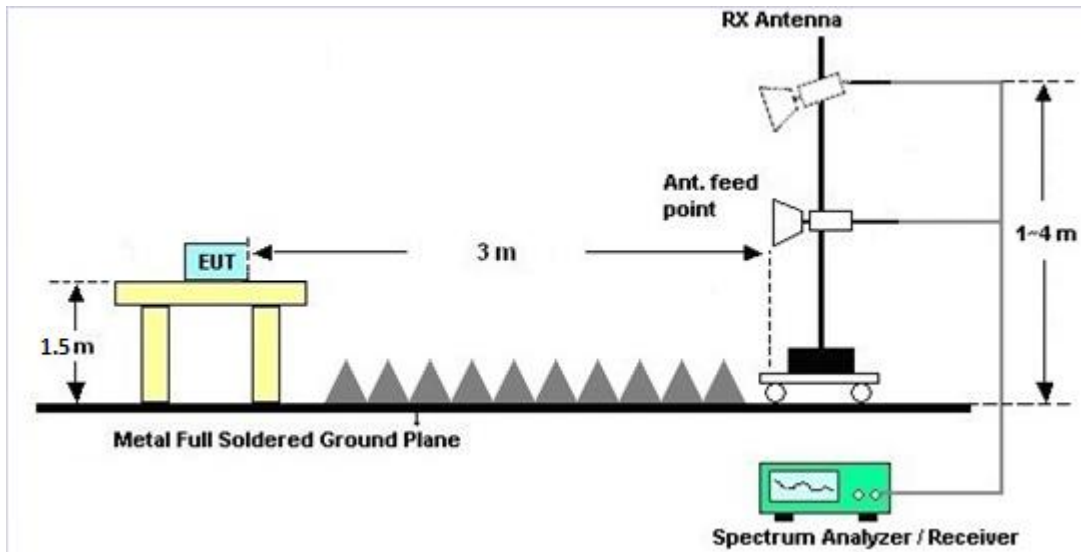
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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

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.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B of this test report.

3.1.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix B of this test report.



3.2 AC Conducted Emission Measurement

3.2.1 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.

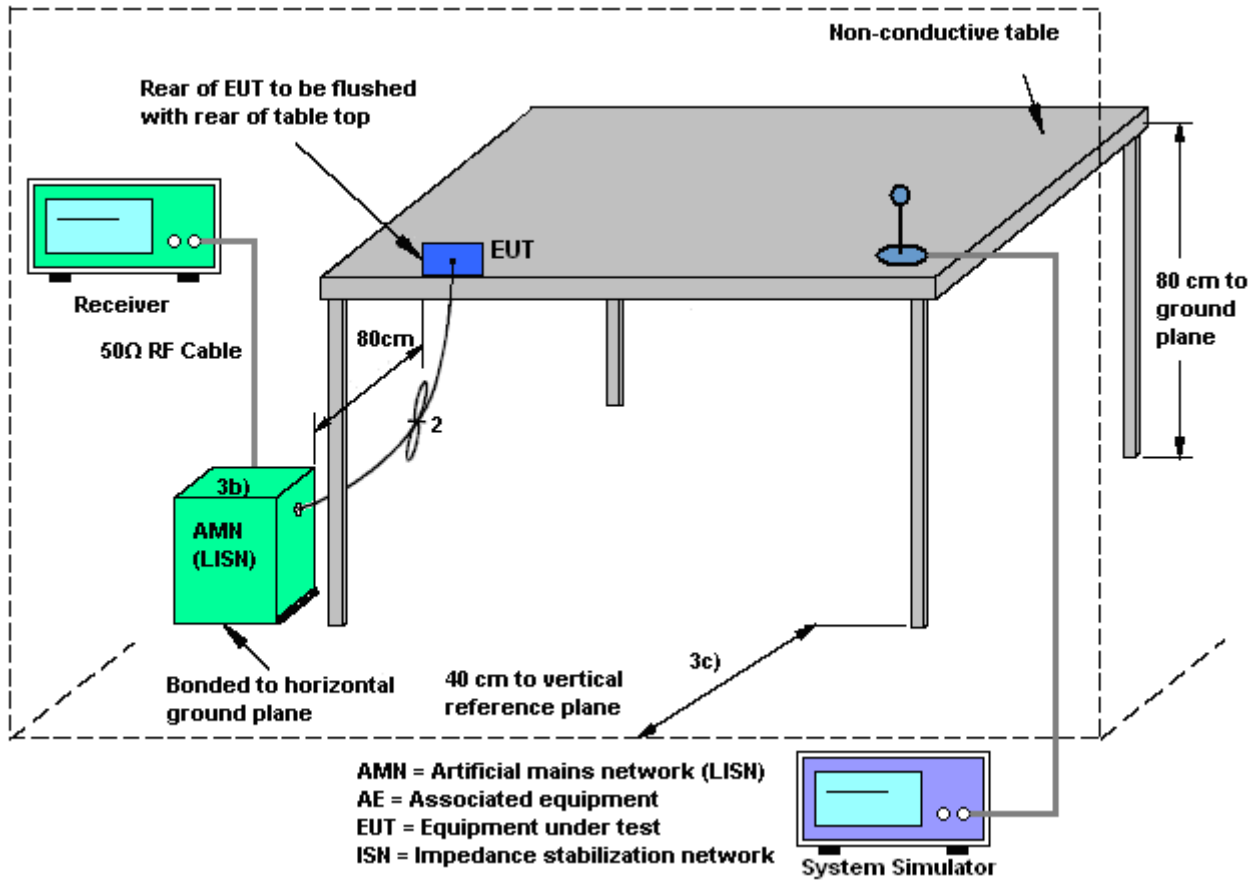
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

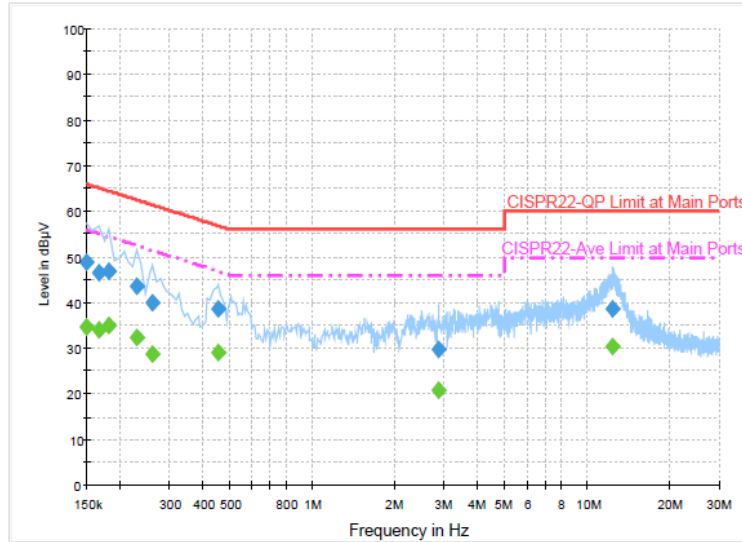
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other 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 (IF bandwidth = 9kHz) with Maximum Hold Mode.

3.2.4 Test Setup



3.2.5 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	21~23°C
Test Engineer :	Eric Jeng	Relative Humidity :	46~48%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	GSM850 (GPRS Class 8) Idle + WLAN Link + Adapter + GPS Rx + LAN Link + USB Flash Drive + SD Card		



Final Result : QuasiPeak

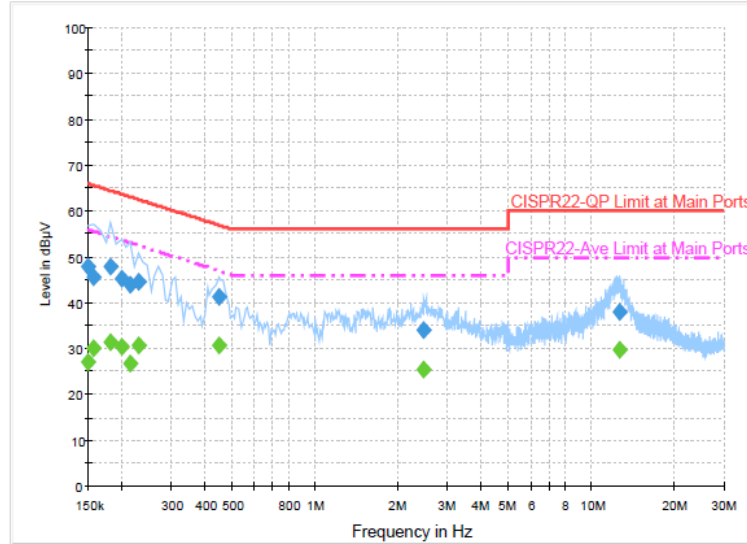
Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	49.0	Off	L1	19.5	17.0	66.0
0.166000	46.6	Off	L1	19.4	18.6	65.2
0.182000	46.8	Off	L1	19.5	17.6	64.4
0.230000	43.6	Off	L1	19.5	18.8	62.4
0.262000	40.1	Off	L1	19.5	21.3	61.4
0.454000	38.5	Off	L1	19.5	18.3	56.8
2.854000	29.8	Off	L1	19.6	26.2	56.0
12.246000	38.7	Off	L1	19.8	21.3	60.0

Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	34.8	Off	L1	19.5	21.2	56.0
0.166000	34.0	Off	L1	19.4	21.2	55.2
0.182000	35.1	Off	L1	19.5	19.3	54.4
0.230000	32.2	Off	L1	19.5	20.2	52.4
0.262000	28.6	Off	L1	19.5	22.8	51.4
0.454000	29.1	Off	L1	19.5	17.7	46.8
2.854000	20.9	Off	L1	19.6	25.1	46.0
12.246000	30.4	Off	L1	19.8	19.6	50.0



Test Mode :	Mode 1	Temperature :	21~23°C
Test Engineer :	Eric Jeng	Relative Humidity :	46~48%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	GSM850 (GPRS Class 8) Idle + WLAN Link + Adapter + GPS Rx + LAN Link + USB Flash Drive + SD Card		



Final Result : QuasiPeak

Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	48.0	Off	N	19.5	18.0	66.0
0.158000	45.5	Off	N	19.5	20.1	65.6
0.182000	47.7	Off	N	19.5	16.7	64.4
0.198000	45.2	Off	N	19.4	18.5	63.7
0.214000	44.0	Off	N	19.5	19.0	63.0
0.230000	44.7	Off	N	19.5	17.7	62.4
0.446000	41.3	Off	N	19.5	15.6	56.9
2.470000	34.0	Off	N	19.5	22.0	56.0
12.606000	38.0	Off	N	19.9	22.0	60.0

Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	27.1	Off	N	19.5	28.9	56.0
0.158000	30.0	Off	N	19.5	25.6	55.6
0.182000	31.5	Off	N	19.5	22.9	54.4
0.198000	30.3	Off	N	19.4	23.4	53.7
0.214000	26.7	Off	N	19.5	26.3	53.0
0.230000	30.5	Off	N	19.5	21.9	52.4
0.446000	30.8	Off	N	19.5	16.1	46.9
2.470000	25.5	Off	N	19.5	20.5	46.0
12.606000	29.6	Off	N	19.9	20.4	50.0



3.3 Antenna Requirements

3.3.1 Standard Applicable

If directional gain of transmitting Antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the Antenna exceeds 6 dBi. The use of a permanently attached Antenna or of an Antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 Antenna Gain

FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

For CDD transmissions, directional gain is calculated as

$$\text{Directional gain} = G_{\text{ANT}} + \text{Array Gain, where Array Gain is as follows.}$$

For power spectral density (PSD) measurements on all devices,

$$\text{Array Gain} = 10 \log(N_{\text{ANT}}/N_{\text{SS}}=1) \text{ dB.}$$

For power measurements on IEEE 802.11 devices,

$$\text{Array Gain} = 0 \text{ dB (i.e., no array gain) for } N_{\text{ANT}} \leq 4.$$

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)
2.4 GHz	2.00	2.00	2.00	5.01	0.00	0.00

$$\text{Power Limit Reduction} = DG(\text{Power}) - 6\text{dBi, (min = 0)}$$

$$\text{PSD Limit Reduction} = DG(\text{PSD}) - 6\text{dBi, (min = 0)}$$



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Power Meter	Anritsu	ML2495A	1036004	300MHz~40GHz	Aug. 09, 2014	Jan. 16, 2015	Aug. 08, 2015	Conducted (TH02-HY)
Power Sensor	Anritsu	MA2411B	1027253	300MHz~40GHz	Aug. 09, 2014	Jan. 16, 2015	Aug. 08, 2015	Conducted (TH02-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9 kHz~7 GHz	Aug. 30, 2014	Feb. 03, 2015~ Feb. 04, 2015	Aug. 29, 2015	Radiation (03CH07-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV30	101749	10Hz ~ 30GHz	Feb. 10, 2014	Feb. 03, 2015~ Feb. 04, 2015	Feb. 09, 2015	Radiation (03CH07-HY)
Loop Antenna	R&S	HFH2-Z2	100315	9 kHz~30 MHz	Jul. 28, 2014	Feb. 03, 2015~ Feb. 04, 2015	Jul. 27, 2015	Radiation (03CH07-HY)
Bilog Antenna	Schaffner	CBL6111C	2726	30MHz ~ 1GHz	Sep. 27, 2014	Feb. 03, 2015~ Feb. 04, 2015	Sep. 26, 2015	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	75962	1GHz~18GHz	Aug. 19, 2014	Feb. 03, 2015~ Feb. 04, 2015	Aug. 18, 2015	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170 251	18GHz~40GHz	Oct. 02, 2014	Feb. 03, 2015~ Feb. 04, 2015	Oct. 01, 2015	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10 MHz ~ 1000MHz	Mar. 17, 2014	Feb. 03, 2015~ Feb. 04, 2015	Mar. 16, 2015	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A023 62	1 GHz~26.5 GHz	Oct. 21, 2014	Feb. 03, 2015~ Feb. 04, 2015	Oct. 20, 2015	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	DC~18 GHz	Apr. 21, 2014	Feb. 03, 2015~ Feb. 04, 2015	Apr. 20, 2015	Radiation (03CH07-HY)
Turn Table	ChainTek	ChainTek 3000	N/A	0 ~ 360 degree	N/A	Feb. 03, 2015~ Feb. 04, 2015	N/A	Radiation (03CH07-HY)
Antenna Mast	ChainTek	ChainTek 3000	N/A	N/A	N/A	Feb. 03, 2015~ Feb. 04, 2015	N/A	Radiation (03CH07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100356	9kHz ~ 2.75GHz	Dec. 01, 2014	Dec. 15, 2014	Nov. 30, 2015	Conduction (CO05-HY)
LISN (for auxiliary equipment)	Rohde & Schwarz	ENV216	100081	9kHz ~ 30MHz	Dec. 08, 2014	Dec. 15, 2014	Dec. 07, 2015	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz ~ 30MHz	Dec. 02, 2014	Dec. 15, 2014	Dec. 01, 2015	Conduction (CO05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Dec. 15, 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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