



# FCC RF Test Report

APPLICANT : DT Research Inc.  
EQUIPMENT : WLAN Module  
BRAND NAME : DT Research Inc.  
MODEL NAME : 600C  
FCC ID : YE3600C  
STANDARD : FCC Part 15 Subpart C §15.247  
CLASSIFICATION : (DSS) Spread Spectrum Transmitter

This is a partial report. The product was received on Oct. 03, 2014 and testing was completed on Jan. 11, 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



## SPORTON INTERNATIONAL INC.

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### REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR491670-01A	Rev. 01	Initial issue of report	Jan. 20, 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 3.57 dB at 30.000 MHz
3.2	15.207	RSS-Gen 7.2.4	AC Conducted Emission	15.207(a)	Pass	Under limit 14.10 dB at 28.702 MHz
3.3	15.203 & 15.247(b)	RSS-210 A8.4	Antenna Requirement	N/A	Pass	-



# 1 General Description

## 1.1 Applicant

DT Research Inc.  
6F, NO. 1, NingPo E. St., Taipei, 100 Taiwan, R.O.C.

## 1.2 Manufacturer

DT Research Inc.  
6F, NO. 1, NingPo E. St., Taipei, 100 Taiwan, R.O.C.

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	WLAN Module
Brand Name	DT Research Inc.
Model Name	600C
FCC ID	YE3600C
installed Mobile Tablet	Brand Name: DT Research Inc. Model Name: DT398H
EUT supports Radios application	CDMA/EV-DO/LTE WLAN 11a/b/g/n (HT20/HT40) WLAN 11ac (VHT20/VHT40/VHT80) Bluetooth v4.0 EDR/LE
EUT Stage	Production Unit

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 Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	79
Carrier Frequency of Each Channel	2402+n*1 MHz; n=0~78
Maximum Output Power to Antenna	Bluetooth BR(1Mbps) : 5.91 dBm (0.0039 W) Bluetooth EDR (2Mbps) : 6.23 dBm (0.0042 W) Bluetooth EDR (3Mbps) : 6.39 dBm (0.0044 W)
Antenna Type	PIFA Antenna type with gain 3.36 dBi
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK Bluetooth EDR (3Mbps) : 8-DPSK



### 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.

<b>Test Site</b>	SPORTON INTERNATIONAL INC.		
<b>Test Site Location</b>	No. 52, Hwa Ya 1 <sup>st</sup> 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		
<b>Test Site No.</b>	<b>Sporton Site No.</b>		
	TH02-HY	CO05-HY	03CH06-HY

**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 Public Notice DA 00-705
- ANSI C63.10-2013

**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 as an alternative in C63.10-2013 through inquiry tracking number 961829.



## 2 Test Configuration of Equipment Under Test

### 2.1 Descriptions of Test Mode

Preliminary tests were performed in different data rates and recorded the RF output power in the following table:

Channel	Frequency	Bluetooth RF Output Power		
		Data Rate / Modulation		
		GFSK	$\pi/4$ -DQPSK	8-DPSK
		1Mbps	2Mbps	3Mbps
Ch00	2402MHz	4.05 dBm	1.05 dBm	1.23 dBm
Ch39	2441MHz	5.80 dBm	6.15 dBm	6.28 dBm
Ch78	2480MHz	5.91 dBm	6.23 dBm	<b>6.39 dBm</b>

**Remark:**

1. All the test data for each data rate were verified, but only the worst case was reported.
  2. The data rate was set in 3Mbps for all the test items due to the highest RF output power.
- a. 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: conduction (150 kHz to 30 MHz), radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). Pre-scanned tests, X, Y, Z in three orthogonal panels, and different data rates were conducted to determine the final configuration (Y plane as worst plane) from all possible combinations, and the worst mode of radiated spurious emissions is Bluetooth 3Mbps mode, and recorded in this report.
  - b. AC power line Conducted Emission was tested under maximum output power.



## 2.2 Test Mode

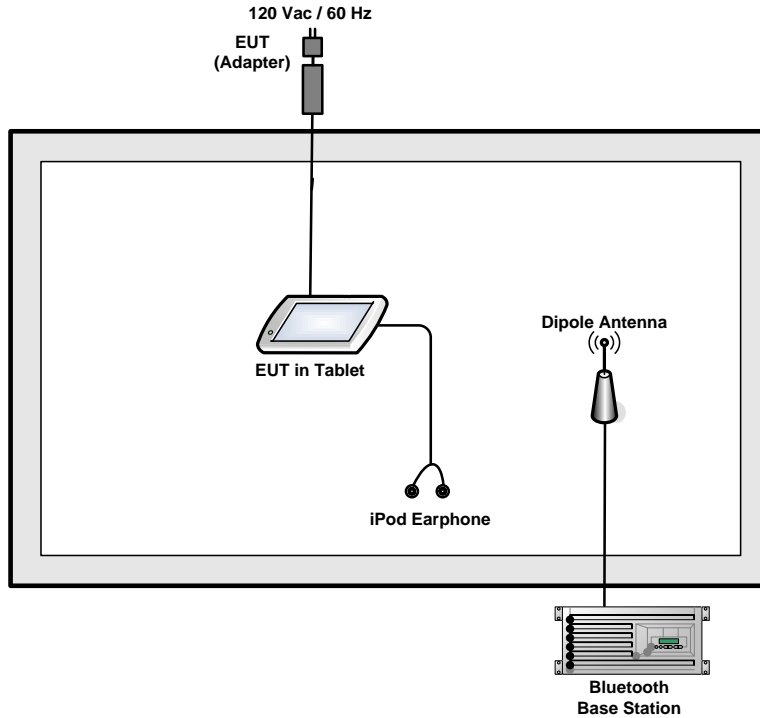
The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases			
Test Item	Data Rate / Modulation		
	Bluetooth BR 1Mbps GFSK	Bluetooth EDR 2Mbps $\pi/4$ -DQPSK	Bluetooth EDR 3Mbps 8-DPSK
Conducted Test Cases	Mode 1: CH00_2402 MHz	Mode 4: CH00_2402 MHz	Mode 7: CH00_2402 MHz
	Mode 2: CH39_2441 MHz	Mode 5: CH39_2441 MHz	Mode 8: CH39_2441 MHz
	Mode 3: CH78_2480 MHz	Mode 6: CH78_2480 MHz	Mode 9: CH78_2480 MHz
Radiated Test Cases	Bluetooth EDR 3Mbps 8-DPSK		
	Mode 1: CH00_2402 MHz		
	Mode 2: CH39_2441 MHz		
	Mode 3: CH78_2480 MHz		
AC Conducted Emission	Mode 1 :CDMA2000 BC0 Idle + Bluetooth Link + WLAN Link + e-SATA HDD + USB Cable (Charging from Adapter) + H-Pattern + MPEG4 + Camera + Smart Card + SD Card + Earphone		
<b>Remark:</b> 1. For radiated test cases, the worst mode data rate 3Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and the conducted spurious emissions and conducted band edge measurement for each data rate are no worse than 3Mbps, and no other significantly frequencies found in conducted spurious emission.			

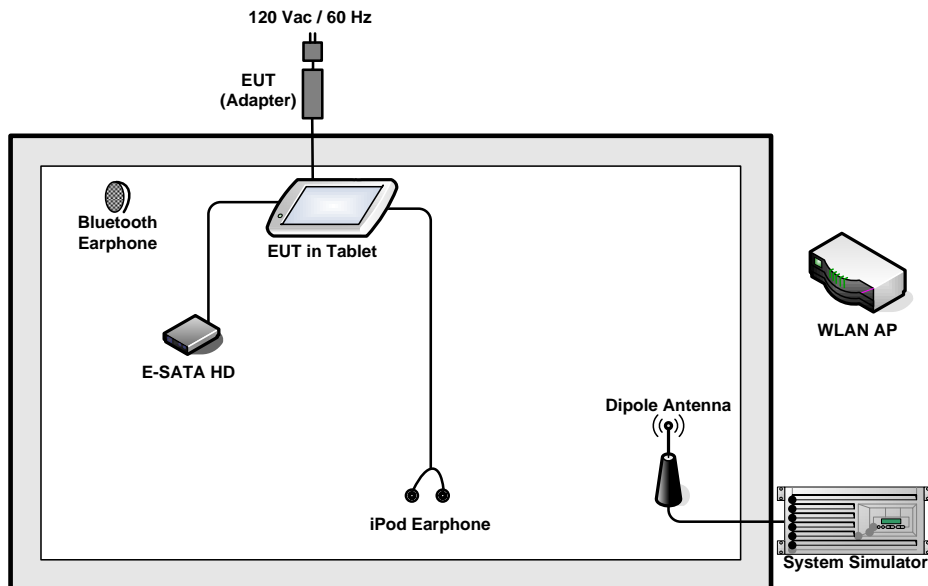


## 2.3 Connection Diagram of Test System

<Bluetooth Tx Mode>



<AC Conducted Emission Mode>





## 2.4 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.	System Simulator	R&S	CMW 500	N/A	N/A	Unshielded, 1.8 m
3.	Bluetooth Base Station	R&S	CBT32	N/A	N/A	Unshielded, 1.8 m
4.	WLAN AP	D-Link	DIR-628	KA2DIR628A2	N/A	Unshielded, 1.8 m
5.	eSATA	FREECOM	SSYBBA	FCC DoC	Shielded, 0.5m	Unshielded, 1.8 m
6.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A
7.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
8.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A
9.	Smart Card	N/A	N/A	N/A	N/A	N/A

## 2.5 EUT Operation Test Setup

For Bluetooth function, programmed RF utility, “DRTU Tool” installed in the EUT make the EUT provide functions like channel selection and power level for continuous transmitting and receiving signals.

## 2.6 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 Radiated Band Edges and Spurious Emission Measurement

##### 3.1.1 Limit of Radiated Band Edges and Spurious Emission

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. 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.



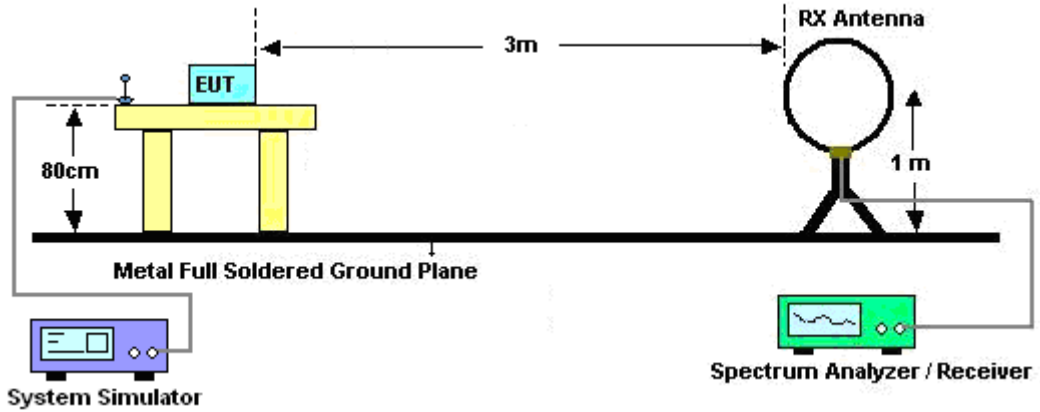
### 3.1.3 Test Procedures

1. The testing follows the guidelines in Spurious Radiated Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
1. 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.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, 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 to comply with the guidelines.
4. Set to the maximum power setting and enable the EUT transmit continuously.
5. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1 \text{ GHz}$ , RBW=1MHz for  $f > 1\text{GHz}$  ; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c).  
Duty cycle = On time/100 milliseconds  
On time =  $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$   
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level +  $20 * \log(\text{Duty cycle})$
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

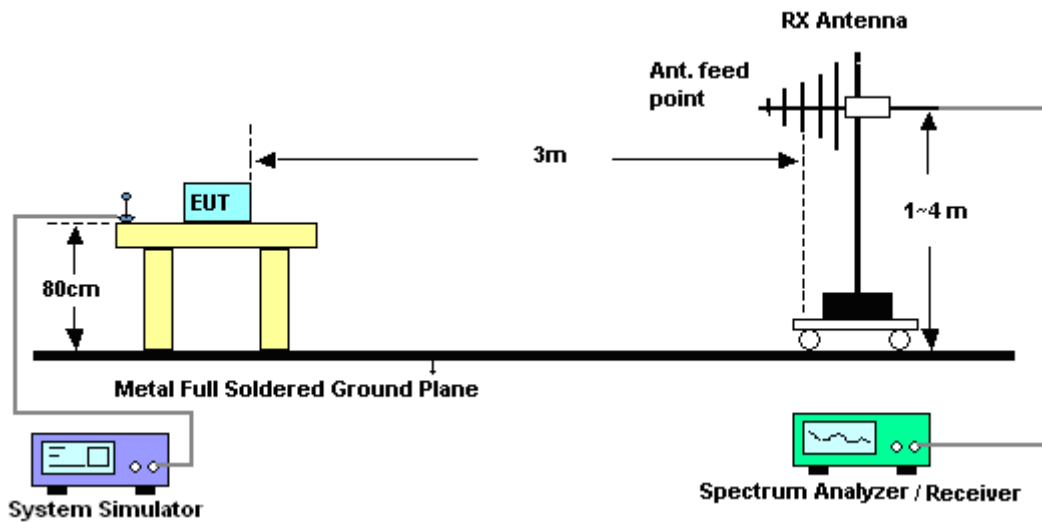
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.78dB) derived from  $20 \log(\text{dwell time}/100\text{ms})$ . This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

### 3.1.4 Test Setup

For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



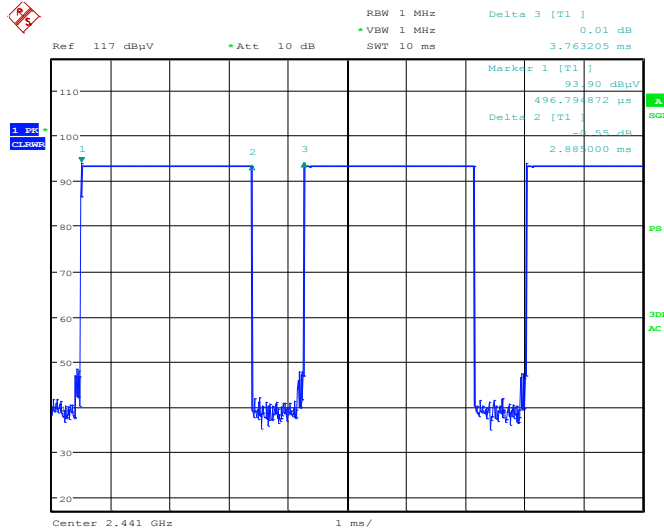
### 3.1.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

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.



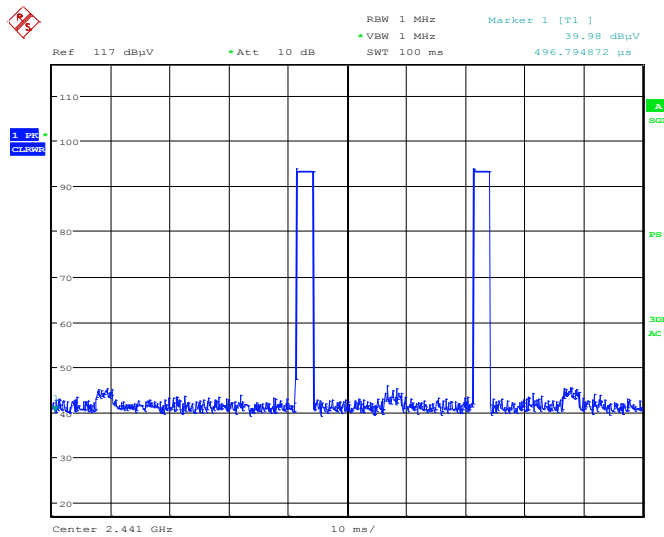
### 3.1.6 Duty cycle correction factor for average measurement

#### DH5 on time (One Pulse) Plot on Channel 39



Date: 11.JAN.2015 08:26:50

#### DH5 on time (Count Pulses) Plot on Channel 39



Date: 11.JAN.2015 08:30:51

**Note:**

1. Worst case Duty cycle = on time/100 milliseconds =  $2 * 2.885 / 100 = 5.77 \%$
2. Worst case Duty cycle correction factor =  $20 * \log(\text{Duty cycle}) = -24.78 \text{ dB}$
3. DH5 has the highest duty cycle worst case and is reported.



**Duty Cycle Correction Factor Consideration for AFH mode:**

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

$$2.885 \text{ ms} \times 20 \text{ channels} = 57.7 \text{ ms}$$

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period.  $[100\text{ms} / 57.6\text{ms}] = 2$  hops

Thus, the maximum possible ON time:

$$2.885 \text{ ms} \times 2 = 5.77 \text{ ms}$$

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

$$20 \times \log(5.77 \text{ ms}/100\text{ms}) = -24.78 \text{ dB}$$

**3.1.7 Test Result of Radiated Spurious at Band Edges**

Please refer to Appendix A.

**3.1.8 Test Result of Radiated Spurious Emission (30MHz ~ 10<sup>th</sup> Harmonic)**

Please refer to Appendix A.





### 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 (dBµV)	
	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.

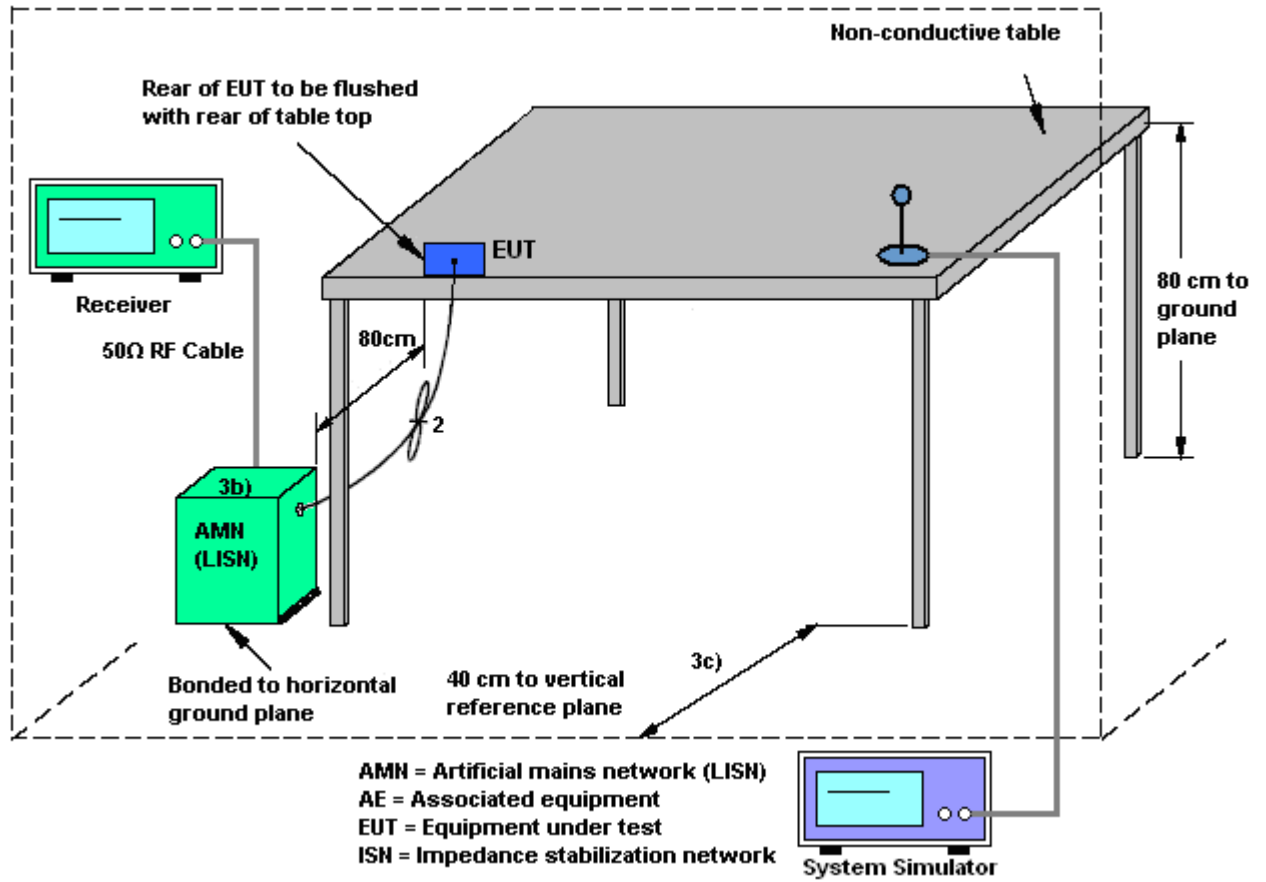
#### 3.2.2 Measuring Instruments

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 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. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

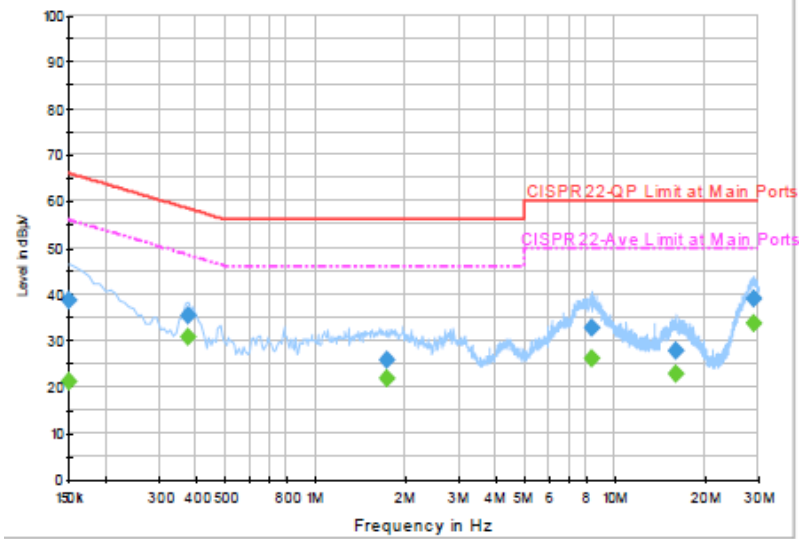
### 3.2.4 Test Setup





3.2.5 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Kai-Chun Chu	Relative Humidity :	46~48%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	CDMA2000 BC0 Idle + Bluetooth Link + WLAN Link + e-SATA HDD + USB Cable (Charging from Adapter) + H-Pattern + MPEG4 + Camera + Smart Card + SD Card + Earphone		



Final Result : Quasi-Peak

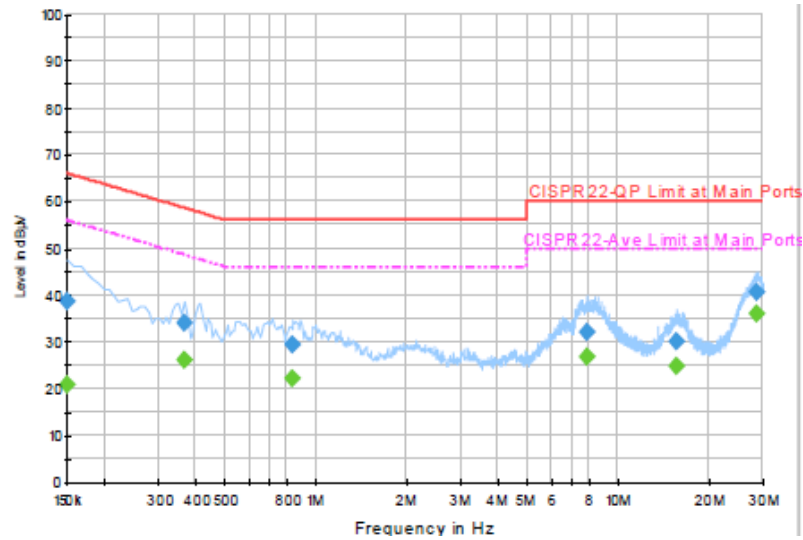
Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	38.5	Off	L1	19.4	27.5	66.0
0.374000	35.2	Off	L1	19.5	23.2	58.4
1.726000	25.7	Off	L1	19.6	30.3	56.0
8.350000	32.6	Off	L1	19.8	27.4	60.0
15.894000	27.7	Off	L1	19.9	32.3	60.0
29.086000	38.8	Off	L1	20.1	21.2	60.0

Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	21.2	Off	L1	19.4	34.8	56.0
0.374000	30.6	Off	L1	19.5	17.8	48.4
1.726000	21.7	Off	L1	19.6	24.3	46.0
8.350000	26.1	Off	L1	19.8	23.9	50.0
15.894000	22.7	Off	L1	19.9	27.3	50.0
29.086000	33.8	Off	L1	20.1	16.2	50.0



Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Kai-Chun Chu	Relative Humidity :	46~48%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	CDMA2000 BC0 Idle + Bluetooth Link + WLAN Link + e-SATA HDD + USB Cable (Charging from Adapter) + H-Pattern + MPEG4 + Camera + Smart Card + SD Card + Earphone		



Final Result : Quasi-Peak

Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	38.7	Off	N	19.4	27.3	66.0
0.366000	34.1	Off	N	19.5	24.5	58.6
0.838000	29.5	Off	N	19.6	26.5	56.0
7.822000	32.0	Off	N	19.7	28.0	60.0
15.566000	30.0	Off	N	19.9	30.0	60.0
28.702000	40.5	Off	N	20.2	19.5	60.0

Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	20.9	Off	N	19.4	35.1	56.0
0.366000	26.1	Off	N	19.5	22.5	48.6
0.838000	22.1	Off	N	19.6	23.9	46.0
7.822000	26.6	Off	N	19.7	23.4	50.0
15.566000	24.7	Off	N	19.9	25.3	50.0
28.702000	35.9	Off	N	20.2	14.1	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. 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**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



## 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	Nov. 18, 2014	Jun. 08, 2015	Conducted (TH02-HY)
Power Meter	Agilent	E4416A	GB41292344	300MHz~40GHz	Jan. 28, 2014	Nov. 18, 2014	Jan. 27, 2015	Conducted (TH02-HY)
Power Sensor	Agilent	E9327A	US40441548	300MHz~40GHz	Jan. 28, 2014	Nov. 18, 2014	Jan. 27, 2015	Conducted (TH02-HY)
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100356	9kHz ~ 2.75GHz	Nov. 15, 2013	Oct. 06, 2014	Nov. 14, 2014	Conduction (CO05-HY)
LISN (for auxiliary equipment)	Rohde & Schwarz	ENV216	100081	9kHz ~ 30MHz	Dec. 12, 2013	Oct. 06, 2014	Dec. 11, 2014	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz ~ 30MHz	Dec. 04, 2013	Oct. 06, 2014	Dec. 03, 2014	Conduction (CO05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Oct. 06, 2014	N/A	Conduction (CO05-HY)
Spectrum Analyzer	R&S	FSP30	101067	9kHz ~ 30GHz	Nov. 21, 2014	Jan. 11, 2015	Nov. 20, 2015	Radiation (03CH06-HY)
Spectrum Analyzer	Agilent	E4408B	MY44211030	9kHz ~ 26.5GHz	Nov. 27, 2014	Jan. 11, 2015	Nov. 26, 2015	Radiation (03CH06-HY)
EMI Test Receiver	R&S	ESVS10	834468/0003	20MHz ~ 1000MHz	May 06, 2014	Jan. 11, 2015	May 05, 2015	Radiation (03CH06-HY)
Loop Antenna	R&S	HFH2-Z2	100315	9 kHz~30 MHz	Jul. 28, 2014	Jan. 11, 2015	Jul. 27, 2015	Radiation (03CH06-HY)
Bilog Antenna	Schaffner	CBL6112B	2885	30MHz ~ 2GHz	Sep. 27, 2014	Jan. 11, 2015	Sep. 26, 2015	Radiation (03CH06-HY)
Double Ridge Horn Antenna	EMCO	3117	00066583	1GHz ~ 18GHz	Jul. 24, 2014	Jan. 11, 2015	Jul. 23, 2015	Radiation (03CH06-HY)
Amplifier	SONOMA	310N	186713	9kHz ~ 1GHz	Apr. 16, 2014	Jan. 11, 2015	Apr. 15, 2015	Radiation (03CH06-HY)
Preamplifier	EMCI	EMC051845	SN980048	1GHz ~ 18GHz	Jul. 17, 2014	Jan. 11, 2015	Jul. 16, 2015	Radiation (03CH06-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz- 40GHz	Oct. 02, 2014	Jan. 11, 2015	Oct. 01, 2015	Radiation (03CH06-HY)
Preamplifier	Agilent	8449B	3008A01917	1GHz ~ 26.5GHz	Apr. 10, 2014	Jan. 11, 2015	Apr. 09, 2015	Radiation (03CH06-HY)



## 5 Uncertainty of Evaluation

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

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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