



FCC/IC RF Test Report

APPLICANT : Wistron Corporation
EQUIPMENT : Tablet PC
BRAND NAME : Lenovo
MODEL NAME : TP00065A
FCC ID : PU5-TP00065A
IC : 4182A-TP00065A
STANDARD : FCC Part 15 Subpart E §15.407
CLASSIFICATION : (NII) Unlicensed National Information Infrastructure

This is a partial report which is included the radiated band edges and spurious emission measurement test items. The product was received on Jul. 22, 2014 and testing was completed on Sep. 20, 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
FR471416-04E	Rev. 01	Initial issue of report	Sep. 26, 2014



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.407(b)	Unwanted Emissions	$\leq -17, -27$ dBm/MHz &15.209(a)	Pass	Under limit 0.28 dB at 5714.440 MHz



1 General Description

1.1 Applicant

Wistron Corporation

21F, No. 88, Sec. 1, Hsin Tai Wu Rd., Hsichih Dist, New Taipei City 221, Taiwan R.O.C.

1.2 Manufacturer

Wistron Corporation

21F, No. 88, Sec. 1, Hsin Tai Wu Rd., Hsichih Dist, New Taipei City 221, Taiwan R.O.C.

1.3 Feature of Equipment Under Test

Product Feature	
Equipment	Tablet PC
Brand Name	Lenovo
Model Name	TP00065A
DUT Description	A tablet (PAD) computer, contains 802.11a/b/g/n/ac and Bluetooth transceiver (radio module)
FCC ID	PU5-TP00065A
IC	4182A-TP00065A
EUT supports Radios application	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.



Antenna Information					
Antenna 1	Manufacturer	High-tek			
	P/N	Main Antenna :	025.9004Q.0011	Aux. Antenna :	025.9004R.0011
	Antenna Type		PIFA Antenna		PIFA Antenna
	Peak gain		WLAN(2.4GHz): 0.06dBi		WLAN(2.4GHz): -0.33dBi
			WLAN(5GHz): 1.66dBi		Bluetooth : -0.33dBi
					WLAN(5GHz): 1.70dBi
Antenna 2	Manufacturer	WNC			
	P/N	Main Antenna :	025.9004O.0001	Aux. Antenna :	025.9004O.0001
	Antenna Type		PIFA Antenna		PIFA Antenna
	Peak gain		WLAN(2.4GHz): 0.06dBi		WLAN (2.4GHz): -0.35dBi
			WLAN(5GHz): 1.42Bi		Bluetooth:-0.35dBi
					WLAN(5GHz): 1.49dBi

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		<5725 MHz ~ 5850 MHz> <Ant. 1> 802.11a : 16.37 dBm / 0.0434 W <Ant. 2> 802.11a : 16.32 dBm / 0.0429 W <SISO Ant. 1> 802.11n HT20 : 16.38 dBm / 0.0435 W 802.11n HT40 : 15.08 dBm / 0.0322 W 802.11ac VHT20: 16.35 dBm / 0.0432 W 802.11ac VHT40: 15.21 dBm / 0.0332 W 802.11ac VHT80: 11.19 dBm / 0.0132 W <SISO Ant. 2> 802.11n HT20 : 16.18 dBm / 0.0415 W 802.11n HT40 : 15.48 dBm / 0.0353 W 802.11ac VHT20: 16.29 dBm / 0.0426 W 802.11ac VHT40: 15.31 dBm / 0.0340 W 802.11ac VHT80: 11.40 dBm / 0.0138 W <MIMO Ant. 1 + 2> 802.11n HT20 : 16.49 dBm / 0.0446 W 802.11n HT40 : 16.01 dBm / 0.0399 W 802.11ac VHT20: 16.43 dBm / 0.0440 W 802.11ac VHT40: 16.00 dBm / 0.0398 W 802.11ac VHT80: 13.87 dBm / 0.0244 W													
Type of Modulation		802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)													
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/ac SISO</td><td>V</td><td>V</td></tr><tr><td>802.11 n/ac MIMO</td><td>V</td><td>V</td></tr></table>			Ant. 1	Ant. 2	802.11 a	V	V	802.11 n/ac SISO	V	V	802.11 n/ac MIMO	V	V
	Ant. 1	Ant. 2													
802.11 a	V	V													
802.11 n/ac SISO	V	V													
802.11 n/ac 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: +886-3-3273456 / FAX: +886-3-3284978		
Test Site No.	Sporton Site No.		IC Registration No.
	TH02-HY	03CH06-HY	4086B-1

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
- ♦ IC RSS-210 Issued 8
- ♦ IC RSS-Gen Issue 3
- ♦ NOTICE 2012-DRS0126

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. Per the section 2.2.3 of Notice of 2012-DRS0126, " Receivers Excluded from Industry Canada Requirements", only radio-communication 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). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y 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>

Channel	Frequency	5GHz 802.11a Average Power (dBm) (800ns)
		Data Rate
		6 Mbps
CH 149	5745 MHz	16.25
CH 157	5785 MHz	16.37
CH 165	5825 MHz	16.31

<SISO Ant. 1>

Channel	Frequency	5GHz 802.11n HT20 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 149	5745 MHz	16.38
CH 157	5785 MHz	16.30
CH 165	5825 MHz	16.28

Channel	Frequency	5GHz 802.11n HT40 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 151	5755MHz	14.27
CH 159	5795MHz	15.08

Channel	Frequency	5GHz 802.11ac VHT20 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 149	5745 MHz	16.35
CH 157	5785 MHz	16.29
CH 165	5825 MHz	16.23

Channel	Frequency	5GHz 802.11ac VHT40 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 151	5755MHz	14.37
CH 159	5795MHz	15.21

Channel	Frequency	55GHz 802.11ac VHT80 Average Power (dBm) (800ns)
		Data Rate
		MCS0



CH 155	5775MHz	11.19
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<Ant. 2>

Channel	Frequency	5GHz 802.11a Average Power (dBm) (800ns)
		Data Rate
		6 Mbps
CH 149	5745 MHz	16.10
CH 157	5785 MHz	16.32
CH 165	5825 MHz	16.19

<SISO Ant. 2>

Channel	Frequency	5GHz 802.11n HT20 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 149	5745 MHz	16.18
CH 157	5785 MHz	16.03
CH 165	5825 MHz	16.05

Channel	Frequency	5GHz 802.11n HT40 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 151	5755MHz	14.49
CH 159	5795MHz	15.48

Channel	Frequency	5GHz 802.11ac VHT20 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 149	5745 MHz	16.29
CH 157	5785 MHz	16.23
CH 165	5825 MHz	16.17

Channel	Frequency	5GHz 802.11ac VHT40 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 151	5755MHz	14.43
CH 159	5795MHz	15.31

Channel	Frequency	55GHz 802.11ac VHT80 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 155	5775MHz	11.40

<MIMO Ant. 1+2>

Channel	Frequency	5GHz 802.11n HT20 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 149	5745 MHz	16.41
CH 157	5785 MHz	16.49
CH 165	5825 MHz	16.39

Channel	Frequency	5GHz 802.11n HT40 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 151	5755MHz	14.81
CH 159	5795MHz	16.01

Channel	Frequency	5GHz 802.11ac VHT20 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 149	5745 MHz	16.43
CH 157	5785 MHz	16.39
CH 165	5825 MHz	16.07

Channel	Frequency	5GHz 802.11ac VHT40 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 151	5755MHz	14.78
CH 159	5795MHz	16.00

Channel	Frequency	55GHz 802.11ac VHT80 Average Power (dBm) (800ns)
		Data Rate
		MCS0
CH 155	5775MHz	13.87

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.

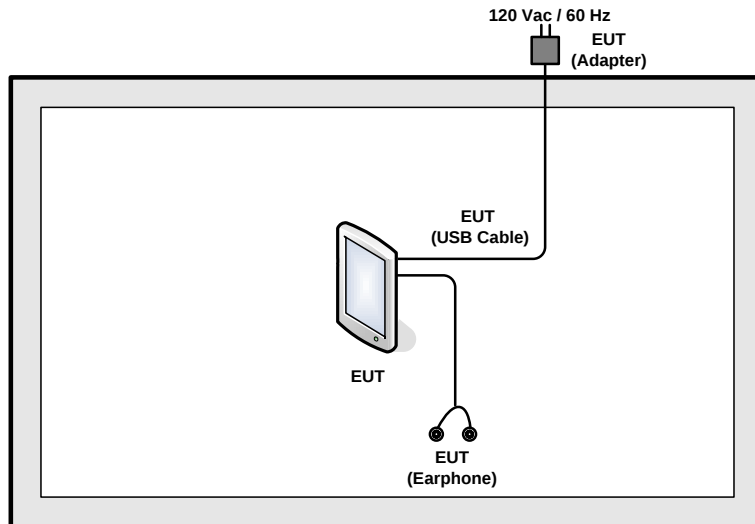
Test Cases				
Conducted TCs	Test Items	Mode	Data rate	Test Channel
	Output Power	802.11a	6 Mbps	L/M/H
		802.11n HT20	MCS0/ MCS8	L/M/H
		802.11n HT40	MCS0/ MCS8	L/M/H
		802.11ac VHT20	MCS0	L/M/H
		802.11ac VHT40	MCS0	L/M/H
		802.11ac VHT80	MCS0	M
Radiated TCs	Radiated Band Edge	802.11a	6 Mbps	L/M/H
		802.11n HT20	MCS0/ MCS8	L/M/H
		802.11n HT40	MCS0/ MCS8	L/M/H
		802.11ac VHT80	MCS0	M
	Radiated Spurious Emission	802.11a	6 Mbps	L/M/H
		802.11n HT20	MCS0/ MCS8	L/M/H
		802.11n HT40	MCS0/ MCS8	L/M/H
		802.11ac VHT80	MCS0	M

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

Ch. #		Band IV : 5725-5850 MHz		
		802.11ac VHT20	802.11ac VHT40	802.11ac VHT80
L	Low	149	151	-
M	Middle	157	-	155
H	High	165	159	-

2.4 Connection Diagram of Test System

<WLAN Tx Mode>



2.5 EUT Operation Test Setup

For WLAN function, programmed RF utility, “Continuous Tx” make the EUT provide functions like channel selection and power level for continuous transmitting and receiving signals.

3 Test Result

3.1 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 Part15.205.

3.1.1 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 Part15.205 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.

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

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.





3.1.2 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 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

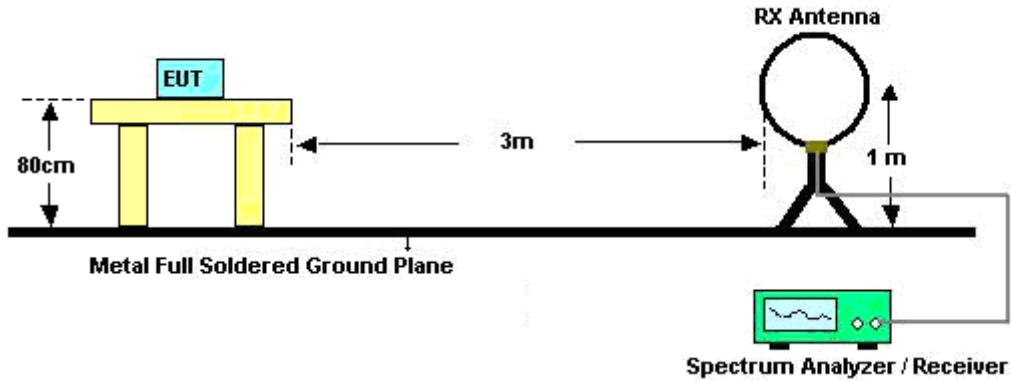
- RBW = 1 MHz
- VBW = 10 Hz, when duty cycle is no less than 98 percent.
- VBW $\geq$ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
1	802.11a	98.57	-	-	3kHz
2	802.11a	98.57	-	-	3kHz
1	802.11n HT20	98.47	-	-	3kHz
2	802.11n HT20	98.46	-	-	3kHz
1	802.11n HT40	97.53	948	1.05	3kHz
2	802.11n HT40	96.93	948	1.05	3kHz
1	802.11n VHT80	94.07	444	2.25	3kHz
2	802.11n VHT80	94.07	444	2.25	3kHz
1+2	802.11n HT40 for Ant1	97.25	990	1.01	3kHz
1+2	802.11n HT20 for Ant2	97.06	990	1.01	3kHz
1+2	802.11n HT40 for Ant1	94.66	496	2.02	3kHz
1+2	802.11n HT40 for Ant2	94.7	500	2.00	3kHz
1+2	802.11n VHT80 for Ant1	90.14	256	3.91	10kHz
1+2	802.11n VHT80 for Ant2	90.85	258	3.88	10kHz

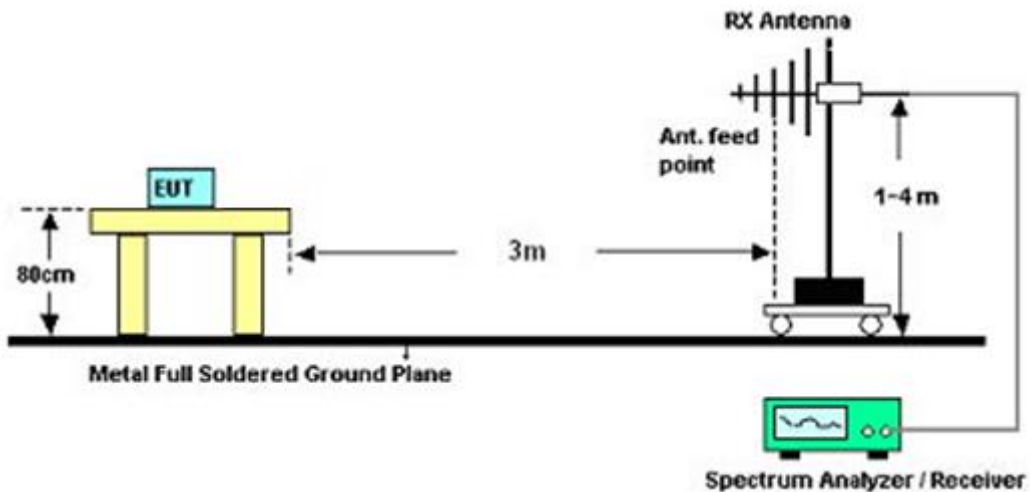
- The EUT was placed on a rotatable table top 0.8 meter above ground.
- The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
- 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.
- 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.
- 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.

3.1.4 Test Setup

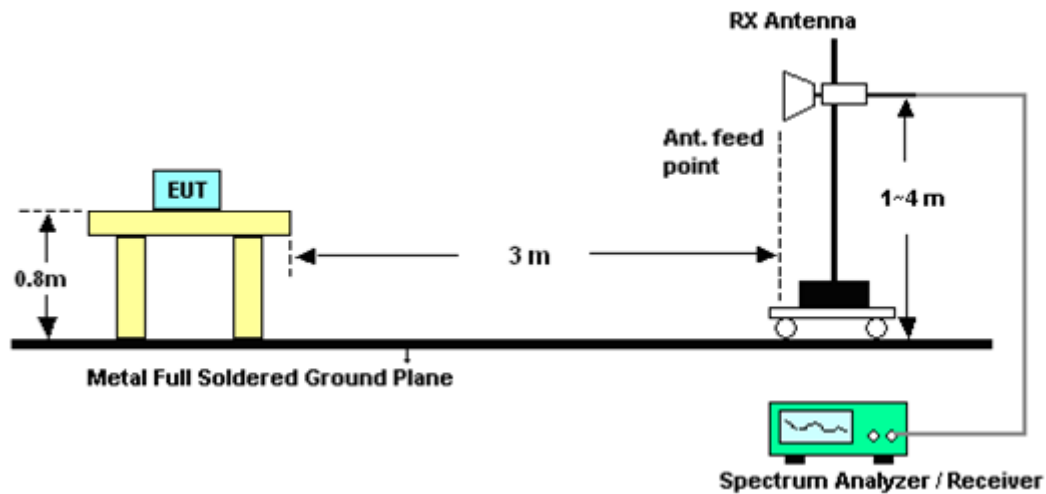
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.1.5 Test Results of Radiated Emissions (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 Test Result

Please refer to appendix A as below.



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	Aug. 02, 2014	Aug. 08, 2015	Conducted (TH02-HY)
Power Sensor	Anritsu	MA2411B	1027253	300MHz~40GHz	Aug. 09, 2014	Aug. 02, 2014	Aug. 08, 2015	Conducted (TH02-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz~40GHz	Jun. 09, 2014	Sep. 07, 2014~ Sep. 20, 2014	Jun. 08, 2015	Radiation (03CH05-HY)
Bilog Antenna	Schaffner	CBL6111C	2725	30MHz~1GHz	Oct. 10, 2013	Sep. 07, 2014~ Sep. 20, 2014	Oct. 09, 2014	Radiation (03CH05-HY)
Double Ridged Guide Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1241	1GHz~18GHz	Apr. 16, 2014	Sep. 07, 2014~ Sep. 20, 2014	Apr. 15, 2015	Radiation (03CH05-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz~40GHz	Oct. 03, 2013	Sep. 07, 2014~ Sep. 20, 2014	Oct. 02, 2014	Radiation (03CH05-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590074	100kHz~18GHz	Jul. 07, 2014	Sep. 07, 2014~ Sep. 20, 2014	Jul. 06, 2015	Radiation (03CH05-HY)
Preamplifier	EMCI	EMC011830	980148	DC~18GHz	Jun. 23, 2014	Sep. 07, 2014~ Sep. 20, 2014	Jun. 22, 2015	Radiation (03CH05-HY)
Preamplifier	COM-POWER	PA-103	161075	9kHz~30MHz	Apr. 15, 2014	Sep. 07, 2014~ Sep. 20, 2014	Apr. 14, 2015	Radiation (03CH05-HY)
Preamplifier	Miteq	TTA0204	1872107	18GHz~40GHz	May 23, 2014	Sep. 07, 2014~ Sep. 20, 2014	May 22, 2015	Radiation (03CH05-HY)
Turn Table	HD	HD100	420/611	0 - 360 degree	N/A	Sep. 07, 2014~ Sep. 20, 2014	N/A	Radiation (03CH05-HY)
Antenna Mast	HD	HD100	240/666	1 m - 4 m	N/A	Sep. 07, 2014~ Sep. 20, 2014	N/A	Radiation (03CH05-HY)



5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	5.10
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