Variant FCC RF Test Report

APPLICANT	**:**	**Honeywell International Inc.**
EQUIPMENT	**:**	**99EX mobile computer**
BRAND NAME	**:**	**Honeywell**
MODEL NAME	**:**	**99EX**
FCC ID	**:**	**HD599EXL0**
STANDARD	**:**	**FCC Part 15 Subpart E §15.407**
CLASSIFICATION	**:**	**(NII) Unlicensed National Information Infrastructure**

This is a variant report which is only valid together with the original test report. The product was received on Oct. 01, 2015 and testing was completed on Oct. 27, 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
FR0D0904-33	Rev. 01	This is a variant report by updating the standard. The original report which can be referred to Sporton Report Number FR0D0904-02.	Nov. 17, 2015
FR0D0904-33	Rev. 02	Adding WLAN Band 1~3 which is including 5600MHz ~ 5650MHz. Since the change of adding 5600MHz ~ 5650MHz is no need to be tested, all the test cases were performed with Band 4 (for new rule).	Nov. 23, 2015

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	≤ -17, -27 dBm/MHz &15.209(a)	Pass	Under limit 2.10 dB at 5722.920 MHz
3.5	15.407(g)	Frequency Stability	Within Operation Band	Pass	-
3.6	15.407(c)	Automatically Discontinue Transmission	Discontinue Transmission	Pass	-
3.7	15.203 & 15.407(a)	Antenna Requirement	N/A	Pass	-

Remark:

1. The conducted reuses test data from the FR0D0904-31 report and radiated emission test worse cases were performed on FR0D0904-31.
2. The similarity between these devices only difference is the integrated WWAN module.

1 General Description

1.1 Applicant

Honeywell International Inc.
9680 Old Bailes Road, Fort Mill, SC 29707 USA

1.2 Manufacturer

Honeywell International Inc.
9680 Old Bailes Road, Fort Mill, SC 29707 USA

1.3 Feature of Equipment Under Test

Product Feature	
Equipment	99EX mobile computer
Brand Name	Honeywell
Model Name	99EX
FCC ID	HD599EXL0
EUT supports Radios application	WLAN 11a/b/g/n HT20 Bluetooth v2.1 EDR
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. The samples are only different of shapes. The sample 2 is like gun shape.

1.4 Product Specification of Equipment Under Test

Product Specification subjective to this standard	
Tx/Rx Channel Frequency Range	5180 MHz ~ 5240 MHz 5260 MHz ~ 5320 MHz 5500 MHz ~ 5700 MHz 5745 MHz ~ 5825 MHz
Maximum Output Power	802.11a : 15.34 dBm / 0.0342 W 802.11n HT20 : 15.31 dBm / 0.0340 W
Type of Modulation	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)
Antenna Type	PIFA Antenna

Test Band		Antenna Gain			
		Standard (55key/34key)	**UPS**	**Gun-type (55key/34key)**	**non-WWAN**
WLAN-2.4GHz	**2450**	2.50	2.50	3.00	2.50
WLAN-5GHz	**5500**	3.50	3.50	3.20	3.50

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 1st 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.**
	TH05-HY

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

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd. Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	03CH10-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 E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v01
- ANSI C63.10-2009

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.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

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 (Z 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)
5150-5250 MHz Band 1 (U-NII-1)	36	5180	44	5220
	40	5200	48	5240

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5250-5350 MHz Band 2 (U-NII-2A)	52	5260	60	5300
	56	5280	64	5320

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5470-5725 MHz Band 3 (U-NII-2C)	100	5500	124	5620
	104	5520	128	5640
	108	5540	132	5660
	112	5560	136	5680
	116	5580	140	5700
	120	5600		

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

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.

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)	**15.34**	15.29	15.25	15.16	14.98	14.78	14.64	14.51

5GHz 802.11n HT20 mode								
Data Rate (MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
Average Power (dBm)	**15.31**	15.22	15.16	15.05	14.96	14.46	14.24	13.38

2.3 Test Mode

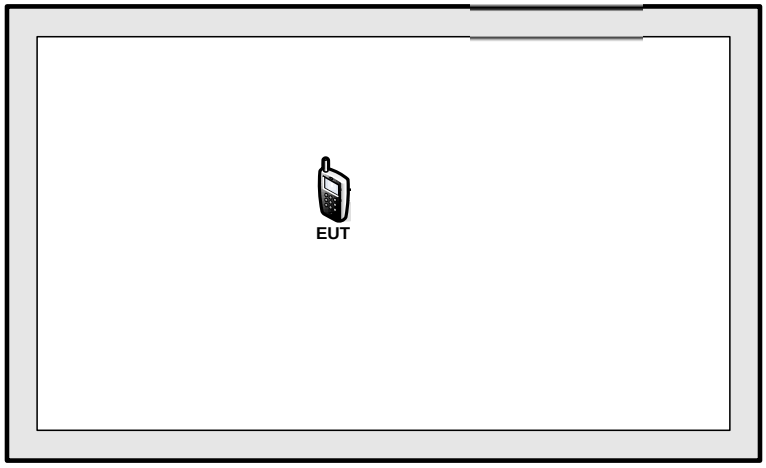
Final test mode of conducted test items and radiated spurious emissions are considering the modulation and worse data rates from the power table described in section 2.2.

Modulation	Data Rate
802.11a	6 Mbps
802.11n HT20	MCS0

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

2.4 Connection Diagram of Test System

<WLAN Tx Mode>



2.5 EUT Operation Test Setup

The programmed RF utility “TI1273_FCC Tools”, 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.

2.6 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.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 6dB, 26dB and 99% Occupied Bandwidth Measurement

3.1.1 Description of 6dB and 26dB and 99% Occupied Bandwidth

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

26dB and 99% Occupied bandwidth are reporting only.

3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

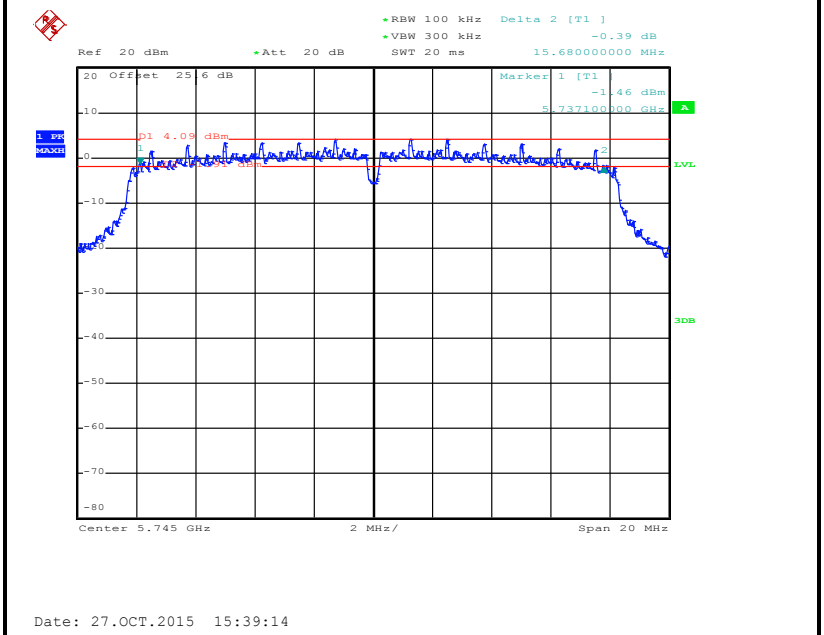
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01. Section C) Emission bandwidth for the band 5.725-5.85GHz
2. Set RBW = 100kHz.
3. Set the VBW ≥ 3 x RBW.
4. Detector = Peak.
5. Trace mode = max hold
6. Measure the maximum width of the emission that is 6 dB down from 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

Please refer to Appendix A.

Minimum 6dB Bandwidth



Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Maximum Conducted Output Power Measurement

3.2.1 Limit of Maximum Conducted Output Power

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.

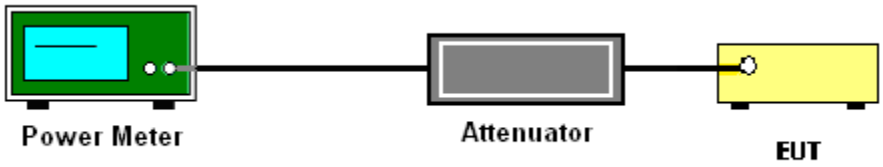
3.2.3 Test Procedures

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

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

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.

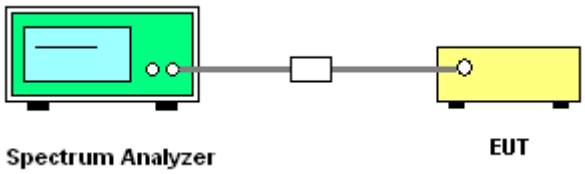
 # Method SA-2 #

(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 D02 General UNII Test Procedures New Rules v01.
   - Measure the duty cycle.
   - Set span to encompass the entire emission bandwidth (EBW) of the signal.
   - Set RBW = 300 kHz.
   - Set VBW ≥ 1 MHz.
   - Number of points in sweep ≥ 2 Span / RBW.
   - Sweep time = auto.
   - Detector = RMS
   - Trace average at least 100 traces in power averaging mode.
   - Add 10 log(500kHz/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 PPSD and record it.

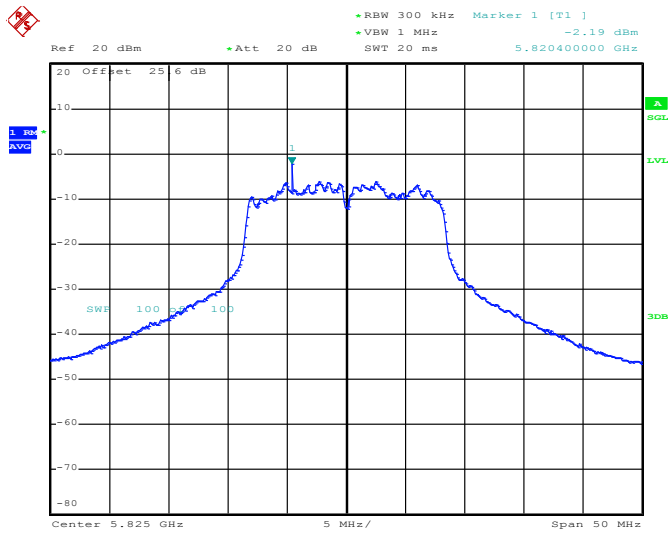
3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

Worst Case Power Density (dBm/300kHz)



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 Part15.205.

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 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.

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

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

(3) KDB 789033 D02 General UNII Test Procedures New Rules v01 G)2)c) 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 ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

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

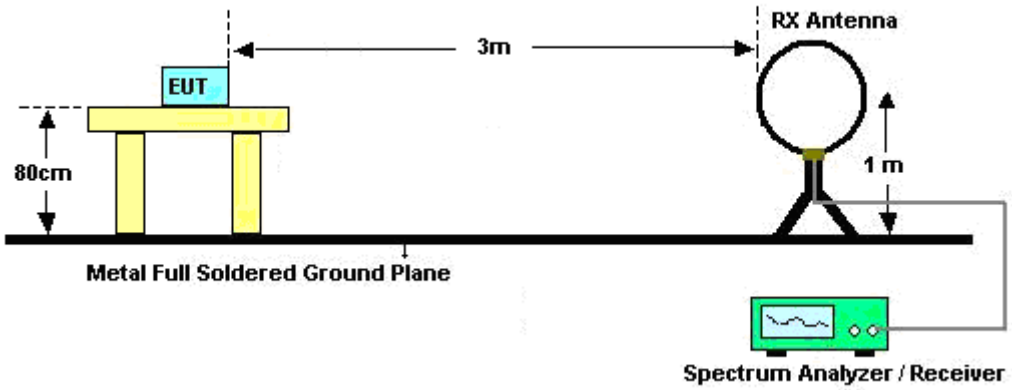
   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
1	802.11a	84.47	5440	0.18	300Hz
1	802.11n HT20	82.78	5000	0.20	300Hz

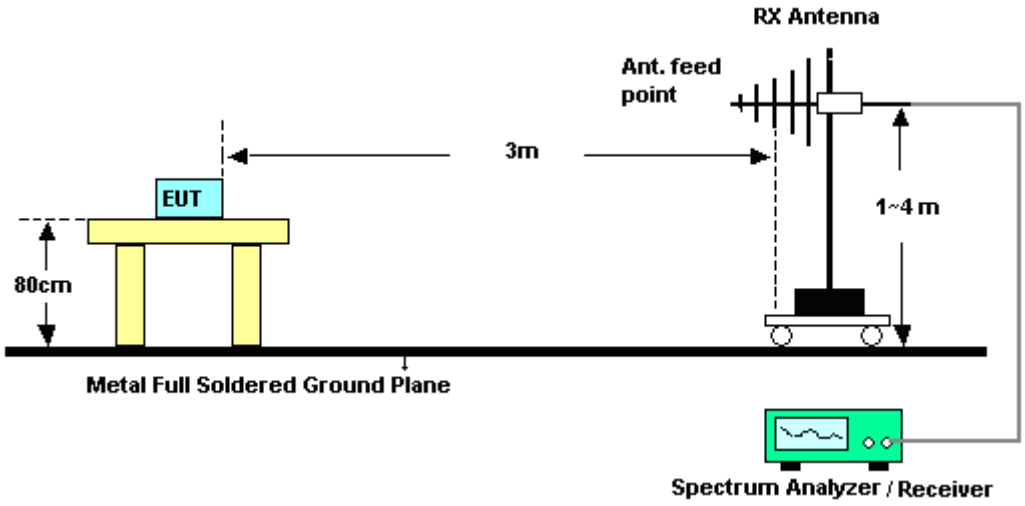
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband 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

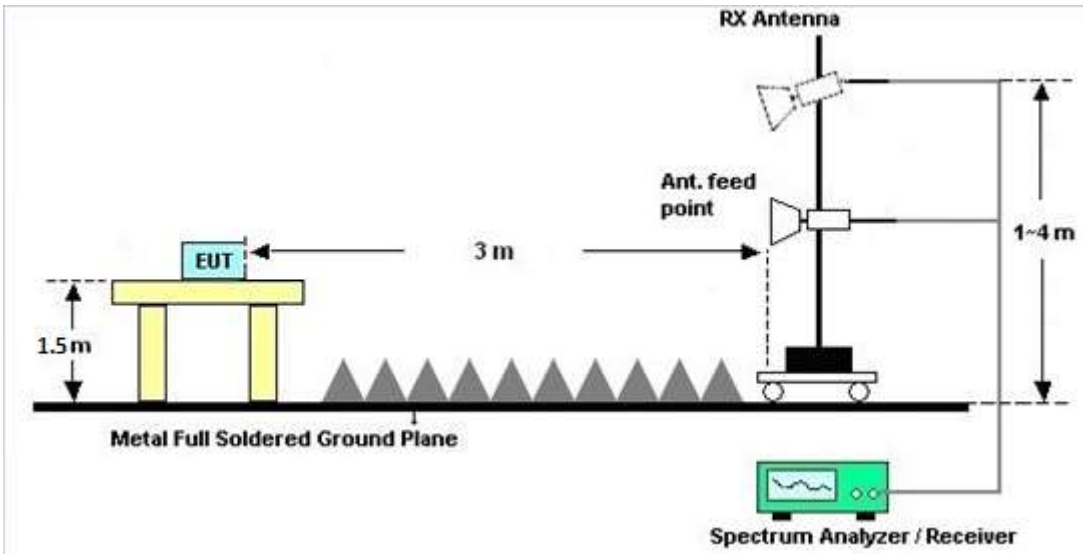
For radiated emissions below 30MHz



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 of Radiated Band Edges

Please refer to Appendix B.

3.4.7 Test Result of Unwanted Radiated Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix B.

3.5 Frequency Stability Measurement

3.5.1 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.

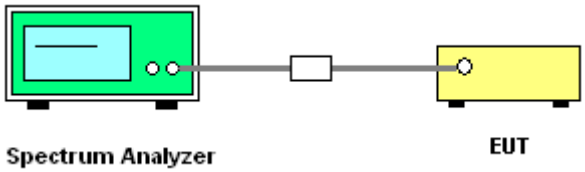
3.5.2 Measuring Instruments

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

3.5.3 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.

3.5.4 Test Setup



3.5.5 Test Result of Frequency Stability

Please refer to Appendix A.

3.6 Automatically Discontinue Transmission

3.6.1 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.

3.6.2 Measuring Instruments

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

3.6.3 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.

3.7 Antenna Requirements

3.7.1 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.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

The antenna gain 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. 18, 2015	Oct. 20, 2015~ Oct. 27, 2015	Jun. 17, 2016	Conducted (TH05-HY)
Power Meter	Anritsu	ML2495A	0932001	300MHz~40GHz	Oct. 05, 2015	Oct. 20, 2015~ Oct. 27, 2015	Oct. 04, 2016	Conducted (TH05-HY)
Power Sensor	Anritsu	MA2411B	0846202	300MHz~40GHz	Oct. 05, 2015	Oct. 20, 2015~ Oct. 27, 2015	Oct. 04, 2016	Conducted (TH05-HY)
Temperature Chamber	ESPEC	SU-241	92003713	-30~95°	Jun. 15, 2015	Oct. 20, 2015~ Oct. 27, 2015	Jun. 14, 2016	Conducted (TH05-HY)
Programmable Power Supply	GW Instek	PSS-2005	EL890001	1V~20V 0.5A~4A	Oct. 05, 2015	Oct. 20, 2015~ Oct. 27, 2015	Oct. 04, 2016	Conducted (TH05-HY)
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 03, 2014	Oct. 05, 2015~ Oct. 08, 2015	Nov. 02, 2015	Radiation (03CH10-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Sep. 02, 2015	Oct. 05, 2015~ Oct. 08, 2015	Sep. 01, 2016	Radiation (03CH10-HY)
Amplifier	SONOMA	310N	187311	9kHz~1GHz	Nov. 24, 2014	Oct. 05, 2015~ Oct. 08, 2015	Nov. 23, 2015	Radiation (03CH10-HY)
Bilog Antenna	TESEQ	CBL 6111D	35413	30MHz~1GHz	Oct. 24, 2014	Oct. 05, 2015~ Oct. 08, 2015	Oct. 23, 2015	Radiation (03CH10-HY)
EMI Test Receiver	Keysight	N9038A	MY54130085	20Hz ~ 8.4GHz	Nov. 05, 2014	Oct. 05, 2015~ Oct. 08, 2015	Nov. 04, 2015	Radiation (03CH10-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1325	1GHz ~ 18GHz	Sep. 30, 2015	Oct. 05, 2015~ Oct. 08, 2015	Sep. 29, 2016	Radiation (03CH10-HY)
Preamplifier	Keysight	83017A	MY53270078	1GHz~26.5GHz	Nov. 20, 2014	Oct. 05, 2015~ Oct. 08, 2015	Nov. 19, 2015	Radiation (03CH10-HY)
Preamplifier	MITEQ	AMF-7D-00101800-30-10P	1902246	1GHz~18GHz	Nov. 25, 2014	Oct. 05, 2015~ Oct. 08, 2015	Nov. 24, 2015	Radiation (03CH10-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz ~ 44GHZ	Oct. 14, 2014	Oct. 05, 2015~ Oct. 08, 2015	Oct. 13, 2015	Radiation (03CH10-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Oct. 05, 2015~ Oct. 08, 2015	N/A	Radiation (03CH10-HY)
Turn Table	EMEC	TT 2200	N/A	0-360 degree	N/A	Oct. 05, 2015~ Oct. 08, 2015	N/A	Radiation (03CH10-HY)
Preamplifier	MITEQ	JS44-18004000-33-8P	1840917	18GHz ~ 40GHz	Jun. 02, 2015	Oct. 05, 2015~ Oct. 08, 2015	Jun. 01, 2016	Radiation (03CH10-HY)

5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.90**

Appendix A. Conducted Test Results

Report Number : FR0D0904-33

Test Engineer:	Osolemio Chang / Tommy Lee	Temperature:	21~25	°C
Test Date:	2015/10/20~2015/10/27	Relative Humidity:	51~54	%

TEST RESULTS DATA
6dB and 26dB BW and 99% OBW

Band IV									
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Bandwidth (MHz)	26 dB Bandwidth (MHz)	6 dB Bandwidth (MHz)	6dB Bandwidth min. Limit (MHz)	Pass/Fail
11a	6M bps	1	149	5745	18.1	33	15.68	0.5	Pass
11a	6Mbps	1	157	5785	18.35	38	15.8	0.5	Pass
11a	6Mbps	1	165	5825	18.3	36.7	15.76	0.5	Pass
HT20	MCS 0	1	149	5745	19	34.2	15.92	0.5	Pass
HT20	MCS 0	1	157	5785	19.3	39.9	16.04	0.5	Pass
HT20	MCS 0	1	165	5825	19.15	38.5	16.04	0.5	Pass

TEST RESULTS DATA
Average Power Table

Band IV										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)		Pass/Fail
11a	6M bps	1	149	5745	0.73	15.01	30.00	3.50		Pass
11a	6Mbps	1	157	5785	0.73	15.34	30.00	3.50		Pass
11a	6Mbps	1	165	5825	0.73	15.21	30.00	3.50		Pass
HT20	MCS 0	1	149	5745	0.82	15.05	30.00	3.50		Pass
HT20	MCS 0	1	157	5785	0.82	15.31	30.00	3.50		Pass
HT20	MCS 0	1	165	5825	0.82	15.04	30.00	3.50		Pass

TEST RESULTS DATA
Power Spectral Density

Band IV										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	10log (500kHz /RBW) Factor (dB)	Average Power Density (dBm/500kHz)	Average PSD Limit (dBm/500kHz)	DG (dBi)	Pass/Fail
11a	6M bps	1	149	5745	0.73	2.22	-0.48	30.00	3.50	Pass
11a	6Mbps	1	157	5785	0.73	2.22	-2.18	30.00	3.50	Pass
11a	6Mbps	1	165	5825	0.73	2.22	0.76	30.00	3.50	Pass
HT20	MCS 0	1	149	5745	0.82	2.22	-0.17	30.00	3.50	Pass
HT20	MCS 0	1	157	5785	0.82	2.22	-2.48	30.00	3.50	Pass
HT20	MCS 0	1	165	5825	0.82	2.22	0.42	30.00	3.50	Pass

Report Number : FR0D0904-33

TEST RESULTS DATA
Frequency Stability

Band IV										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Center Frequency (MHz)	Frequency Deviation (MHz)	Frequency Stablility (ppm)	Temperature (°C)	Voltage (V)	Note
11a	6M bps	1	149	5745	5745.000	0.000	0.00	20	3.4	
11a	6M bps	1	149	5745	5745.050	0.050	8.70	20	4.2	
11a	6M bps	1	149	5745	5745.000	0.000	0.00	20	3.7	
11a	6M bps	1	149	5745	5745.000	0.000	0.00	-30	3.7	
11a	6M bps	1	149	5745	5745.050	0.050	8.70	50	3.7	

Appendix B. Radiated Spurious Emission

<For Sample 1>

Band 4 5725~5850MHz

WIFI 802.11n HT20 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		5713.16	64.57	-9.43	74	56.41	32.52	8.3	32.66	204	286	P	H
		5722.92	76.2	-2.1	78.3	68	32.53	8.33	32.66	204	286	P	H
		5714.84	49.09	-4.91	54	40.93	32.52	8.3	32.66	204	286	A	H
	*	5745	113.13	-	-	104.93	32.54	8.33	32.67	204	286	P	H
	*	5745	104.3	-	-	96.1	32.54	8.33	32.67	204	286	A	H
													H
802.11n													H
HT20													H
CH 149		5713.8	65.05	-8.95	74	56.89	32.52	8.3	32.66	189	324	P	V
5745MHz		5725	74.61	-3.69	78.3	66.41	32.53	8.33	32.66	189	324	P	V
		5715	46.63	-7.37	54	38.47	32.52	8.3	32.66	189	324	A	V
	*	5745	110.19	-	-	101.99	32.54	8.33	32.67	189	324	P	V
	*	5745	101.66	-	-	93.46	32.54	8.33	32.67	189	324	A	V
													V
													V
													V

Band 4 5725~5850MHz

WIFI 802.11n HT20 (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 149 5745MHz		11490	47.43	-26.57	74	57.64	40.01	12.58	62.8	100	100	P	H
		17235	52.5	-21.5	74	55.93	41.05	15.66	60.14	185	290	P	H
		17235	45.88	-8.12	54	49.31	41.05	15.66	60.14	185	290	A	H
													H
		11490	47.46	-26.54	74	57.67	40.01	12.58	62.8	100	100	P	V
		17235	52.56	-21.44	74	55.99	41.05	15.66	60.14	183	328	P	V
		17235	43.43	-10.57	54	46.86	41.05	15.66	60.14	183	328	A	V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

5GHz WIFI 802.11n HT20 (LF @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		31.62	18.53	-21.47	40	30.79	18.92	0.65	31.83			P	H
		97.5	13.49	-30.01	43.5	33.97	10.16	1.14	31.78			P	H
		269.49	20.65	-25.35	46	37.16	13.5	1.76	31.77			P	H
		358.1	26.47	-19.53	46	40.91	15.4	1.94	31.78	103	126	P	H
		427.4	22.99	-23.01	46	35.7	16.95	2.16	31.82			P	H
		987.4	28.77	-25.23	54	31.98	24.15	3.38	30.74			P	H
													H
													H
													H
													H
5GHz													H
802.11n													H
HT20		33.78	23	-17	40	36.34	17.84	0.65	31.83	108	214	P	V
LF		162.03	13.98	-29.52	43.5	33.53	10.9	1.33	31.78			P	V
		269.49	16.67	-29.33	46	33.18	13.5	1.76	31.77			P	V
		696.9	23.68	-22.32	46	32.32	20.58	2.82	32.04			P	V
		841.1	26.73	-19.27	46	32.95	22.43	3.07	31.72			P	V
		966.4	28.24	-25.76	54	31.54	24.23	3.38	30.91			P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

<For Sample 2>

Band 4 5725~5850MHz

WIFI 802.11n HT20 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		5713.72	69.74	-4.26	74	61.58	32.52	8.3	32.66	110	0	P	H
		5724.04	74.97	-3.33	78.3	66.77	32.53	8.33	32.66	110	0	P	H
		5715	49.68	-4.32	54	41.52	32.52	8.3	32.66	110	0	A	H
	*	5745	111.89	-	-	103.69	32.54	8.33	32.67	110	0	P	H
	*	5745	103.41	-	-	95.21	32.54	8.33	32.67	110	0	A	H
													H
802.11n													H
HT20													H
CH 149		5714.2	64.94	-9.06	74	56.78	32.52	8.3	32.66	100	8	P	V
5745MHz		5723.16	74.03	-4.27	78.3	65.83	32.53	8.33	32.66	100	8	P	V
		5715	46.53	-7.47	54	38.37	32.52	8.3	32.66	100	8	A	V
	*	5745	108.52	-	-	100.32	32.54	8.33	32.67	100	8	P	V
	*	5745	99.61	-	-	91.41	32.54	8.33	32.67	100	8	A	V
													V
													V
													V

Band 4 5725~5850MHz

WIFI 802.11n HT20 (Harmonic @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 149 5745MHz		11490	46.89	-27.11	74	57.1	40.01	12.58	62.8	100	0	P	H
		17235	51.52	-22.48	74	54.95	41.05	15.66	60.14	100	63	P	H
		17235	45.03	-8.97	54	48.46	41.05	15.66	60.14	100	63	A	H
													H
		11490	47.77	-26.23	74	57.98	40.01	12.58	62.8	100	0	P	V
		17235	52.6	-21.4	74	56.03	41.05	15.66	60.14	101	358	P	V
		17235	45.59	-8.41	54	49.02	41.05	15.66	60.14	101	358	A	V
													V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

5GHz WIFI 802.11n HT20 (LF @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		30.54	18.58	-21.42	40	30.3	19.46	0.65	31.83			P	H
		202.8	16.01	-27.49	43.5	36.13	10.18	1.48	31.78			P	H
		269.49	20.95	-25.05	46	37.46	13.5	1.76	31.77			P	H
		364.4	27.21	-18.79	46	41.48	15.58	1.94	31.79	132	214	P	H
		564.6	24.49	-21.51	46	35.05	18.96	2.47	31.99			P	H
		841.8	26.23	-19.77	46	32.43	22.44	3.07	31.71			P	H
													H
													H
													H
													H
5GHz													H
802.11n													H
HT20		31.62	19.86	-20.14	40	32.12	18.92	0.65	31.83			P	V
LF		201.99	16.9	-26.6	43.5	37.05	10.15	1.48	31.78			P	V
		270.57	19.38	-26.62	46	35.91	13.48	1.76	31.77			P	V
		444.2	19.74	-26.26	46	32.21	17.21	2.16	31.84			P	V
		667.5	24.95	-21.05	46	33.98	20.34	2.67	32.04			P	V
		947.5	28.46	-17.54	46	31.97	24.26	3.29	31.06	104	147	P	V
													V
													V
													V
													V
													V
													V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBµV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBµV/m) – Limit Line(dBµV/m)

For Peak Limit @ 2390MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBµV) – 35.86 (dB)

= 55.45 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 55.45(dBµV/m) – 74(dBµV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBµV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBµV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBµV) – 35.86 (dB)

= 43.54 (dBµV/m)

2. Over Limit(dB)

= Level(dBµV/m) – Limit Line(dBµV/m)

= 43.54(dBµV/m) – 54(dBµV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".

Appendix C. Setup Photographs

<Radiated Emission>

Z Plane

LF

HF