

# FCC TEST REPORT (WLAN 15.407)

**REPORT NO.:** RF140527E05-1

**MODEL NO.:** QLivebox

**FCC ID:** 2ACFN-QLIVEBOX

**RECEIVED:** May 27, 2014

**TESTED:** June 14 to 19, 2014 and Sep. 18, 2014

**ISSUED:** Nov. 17, 2014

**APPLICANT:** QNAP Systems, Inc.

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**ISSUED BY:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory

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## RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF140527E05-1	Original release	Nov. 17, 2014




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## 1. CERTIFICATION

**PRODUCT:** QLivebox  
**BRAND NAME:** QNAP  
**MODEL NO.:** QLivebox  
**TEST SAMPLE:** MASS-PRODUCTION  
**APPLICANT:** QNAP Systems, Inc.  
**TESTED:** June 14 to 19, 2014 and Sep. 18, 2014  
**STANDARDS:** **FCC Part 15, Subpart E (Section 15.407)**  
ANSI C63.10-2009

The above equipment (Model: QLivebox) has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

**Prepared By :** , **Date:** Nov. 17, 2014  
( Lori Chung, Specialist )

**Approved By :** , **Date:** Nov. 17, 2014  
( May Chen, Manager )

## 2. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC PART 15, SUBPART E (SECTION 15.407)			
STANDARD SECTION	TEST TYPE	RESULT	REMARK
15.407(b)(6)	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is -23.54dB at 0.52891MHz
15.407 (b)(1/2/3/4/6)	Radiated Emissions & Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -1.2dB at 5150.00MHz.
15.407(a/1/2/3)	Transmit Power	PASS	Meet the requirement of limit.
15.407(a/1/2/3)	Peak Power Spectral Density	PASS	Meet the requirement of limit.
15.407(g)	Frequency Stability	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

**NOTE:** 1. The EUT was operating in 2400 ~ 2483.5MHz, 5.15~5.25GHz frequencies band. This report was recorded the RF parameters including 5.15~5.25GHz. For the 2400 ~ 2483.5MHz RF parameters was recorded in another test report.

## 2.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

Measurement	Value
Conducted emissions	2.86 dB
Radiated emissions (30MHz-1GHz)	5.43 dB
Radiated emissions (1GHz -6GHz)	3.65 dB
Radiated emissions (6GHz -18GHz)	3.88 dB
Radiated emissions (18GHz -40GHz)	4.11 dB

### 3. GENERAL INFORMATION

#### 3.1 GENERAL DESCRIPTION OF EUT (WLAN)

PRODUCT	QLivebox
MODEL NO.	QLivebox
POWER SUPPLY	DC 12V from power adapter
MODULATION TYPE	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
MODULATION TECHNOLOGY	DSSS,OFDM
TRANSFER RATE	802.11b: up to 11Mbps 802.11a / g: up to 54Mbps 802.11n: up to 300Mbps
OPERATING FREQUENCY	<b>For 15.407</b> 5.18 ~ 5.24GHz
	<b>For 15.247</b> 2.412 ~ 2.462GHz
NUMBER OF CHANNEL	<b>For 15.407</b> 4 for 802.11a, 802.11n (HT20) 2 for 802.11n (HT40)
	<b>For 15.247</b> 11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
MAXIMUM OUTPUT POWER	<b>For 15.407</b> 802.11a: 44.486mW 802.11n (HT20): 44.674mW 802.11n (HT40): 42.125mW <b>For 15.247</b> 802.11b: 132.05mW 802.11g: 496.964mW 802.11n (HT20): 462.538mW 802.11n (HT40): 150.356mW
ANTENNA TYPE	Please see NOTE
DATA CABLE	HDMI cable (Shielded, 0.6m) x 1
I/O PORTS	Refer to user's manual
ASSOCIATED DEVICES	Adapter x 1



**NOTE:**

1. There are WLAN (2.4GHz and 5GHz) and Zigbee technology used for the EUT.
2. WLAN and Zigbee technology can transmit at same time.
3. For WLAN, 2.4GHz and 5GHz technology can not transmit at same time.
4. The emission of the simultaneous operation (WLAN & Zigbee) has been evaluated and no non-compliance was found.
5. The antennas provided to the EUT, please refer to the following table:

For WLAN							
Ant. No.	Transmitter Circuit	Brand	Model	Antenna Type	Antenna Gain (dBi)	Connector type	Frequency range (GHz to GHz)
1	Chain (0)	Unictron	AA077	chip	1.4	NA	2.4~2.5
	Chain (1)						
2	Chain (0)						
	Chain (1)						
For Zigbee							
Ant. No.		Brand	Model	Antenna Type	Antenna Gain (dBi)	Connector type	Frequency range (GHz to GHz)
3		Unictron	AA055	chip	2.5	NA	2.4~2.5

6. The EUT could be supplied with a power adapter as the following table:

Brand	Model No.	Spec.
Atechoem	ADS012PM-W 120100	AC I/P: 100-240V, 0.5A, 50/60Hz DC O/P: 12V, 1A DC output cable (Unshielded, 1.5m)

7. The EUT incorporates a MIMO function without beamforming.

MODULATION MODE	DATA RATE (MCS)	TX & RX CONFIGURATION	
802.11a	6 ~ 54Mbps	2TX CDD	2RX
802.11b	1 ~ 11Mbps	2TX CDD	2RX
802.11g	6 ~ 54Mbps	2TX CDD	2RX
802.11n (HT20)	MCS 0~7	2TX CDD	2RX
	MCS 8~15	2TX	2RX
802.11n (HT40)	MCS 0~7	2TX CDD	2RX
	MCS 8~15	2TX	2RX

8. The above EUT information was declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

### 3.2 DESCRIPTION OF TEST MODES

#### Operated in 5150 ~ 5250MHz band:

4 channels are provided for 802.11a, 802.11n (HT20):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
36	5180 MHz	44	5220 MHz
40	5200 MHz	48	5240 MHz

2 channels are provided for 802.11n (HT40):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
38	5190 MHz	46	5230 MHz

### 3.2.1 TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	PLC	RE < 1G	RE ≥ 1G	APCM	
-	√	√	√	√	-

Where **PLC**: Power Line Conducted Emission

**RE < 1G**: Radiated Emission below 1GHz

**RE ≥ 1G**: Radiated Emission above 1GHz

**APCM**: Antenna Port Conducted Measurement

#### **POWER LINE CONDUCTED EMISSION TEST:**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11n (HT20)	36 to 48	48	OFDM	BPSK	6.5

#### **RADIATED EMISSION TEST (BELOW 1 GHz):**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11n (HT20)	36 to 48	48	OFDM	BPSK	6.5

#### **RADIATED EMISSION TEST (ABOVE 1 GHz):**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATI ON TYPE	DATA RATE (Mbps)
802.11a	36 to 48	36, 40, 48	OFDM	BPSK	6
802.11n (HT20)	36 to 48	36, 40, 48	OFDM	BPSK	6.5
802.11n (HT40)	38 to 46	38, 46	OFDM	BPSK	13.5

#### **ANTENNA PORT CONDUCTED MEASUREMENT:**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATI ON TYPE	DATA RATE (Mbps)
802.11a	36 to 48	36, 40, 48	OFDM	BPSK	6
802.11n (HT20)	36 to 48	36, 40, 48	OFDM	BPSK	6.5
802.11n (HT40)	38 to 46	38, 46	OFDM	BPSK	13.5

#### **TEST CONDITION:**

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
PLC	25deg. C, 70%RH	120Vac, 60Hz	Mike Hsieh
RE<1G	25deg. C, 73%RH	120Vac, 60Hz	Gary Cheng
RE≥1G	18deg. C, 64%RH	120Vac, 60Hz	Tim Ho
APCM	25deg. C, 60%RH	120Vac, 60Hz	Robert Cheng



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### **3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS**

The EUT is a RF product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**FCC Part 15, Subpart E (15.407)**

**789033 D02 General UNII Test Procedures New Rules v01**

**662911 D01 Multiple Transmitter Output v02r01**

**ANSI C63.10-2009**

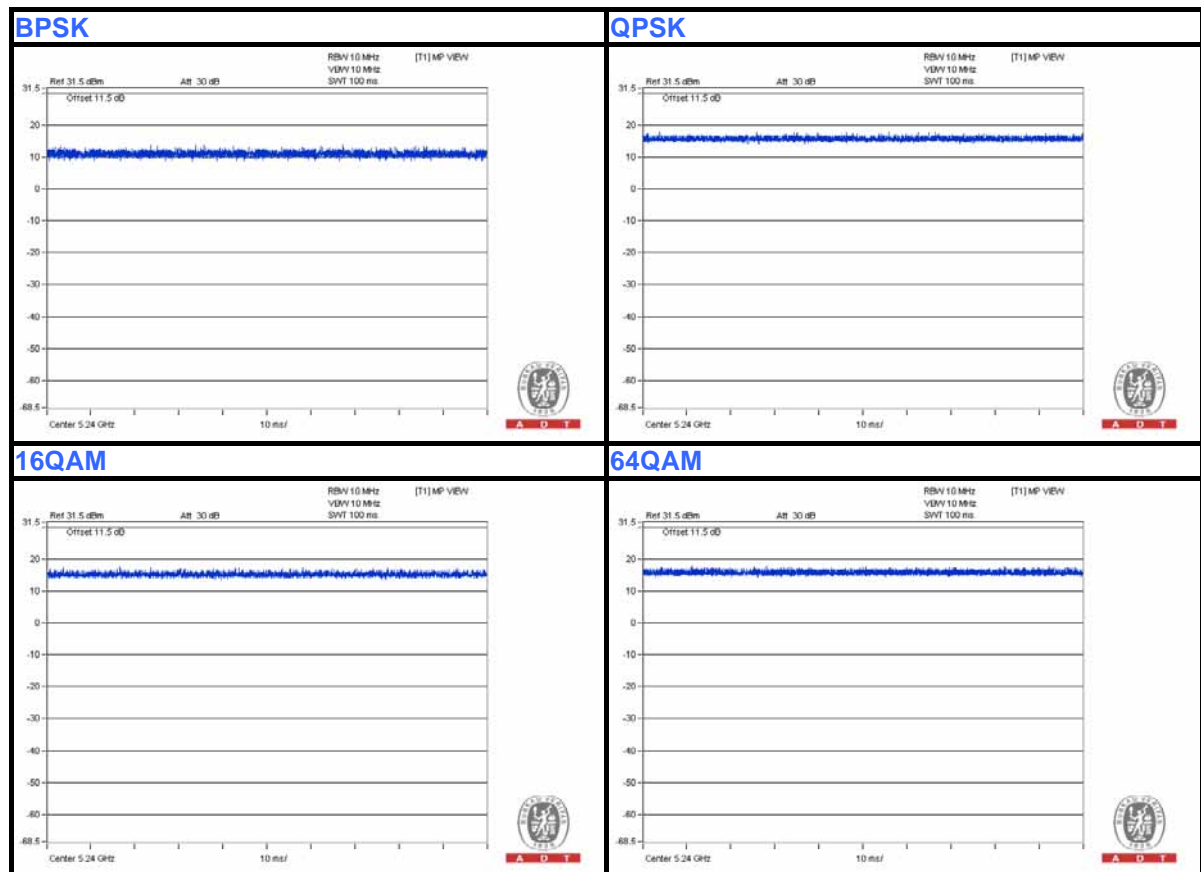
All test items have been performed and recorded as per the above standards.

**Note:** The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

### 3.4 DUTY CYCLE OF TEST SIGNAL

Duty cycle of test signal is 100 %, duty factor is not required.

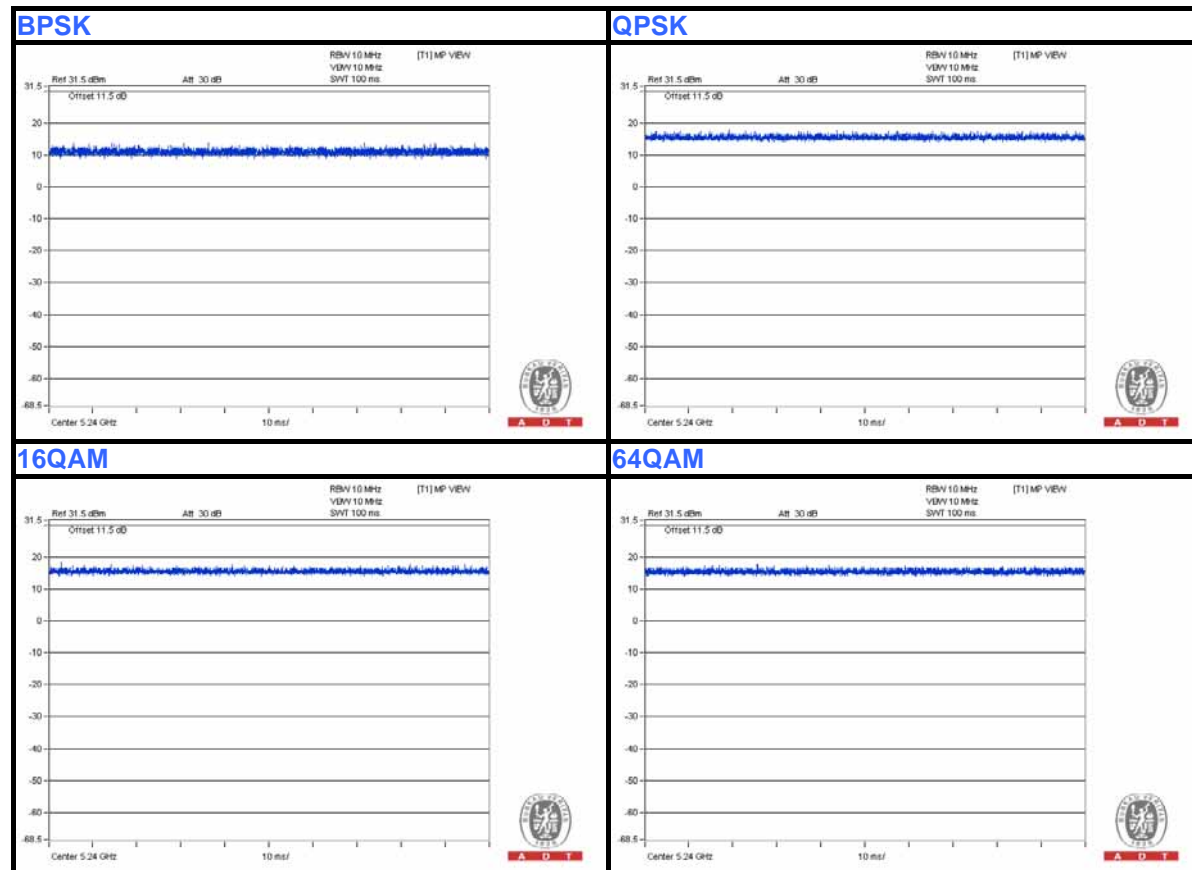
#### 802.11a





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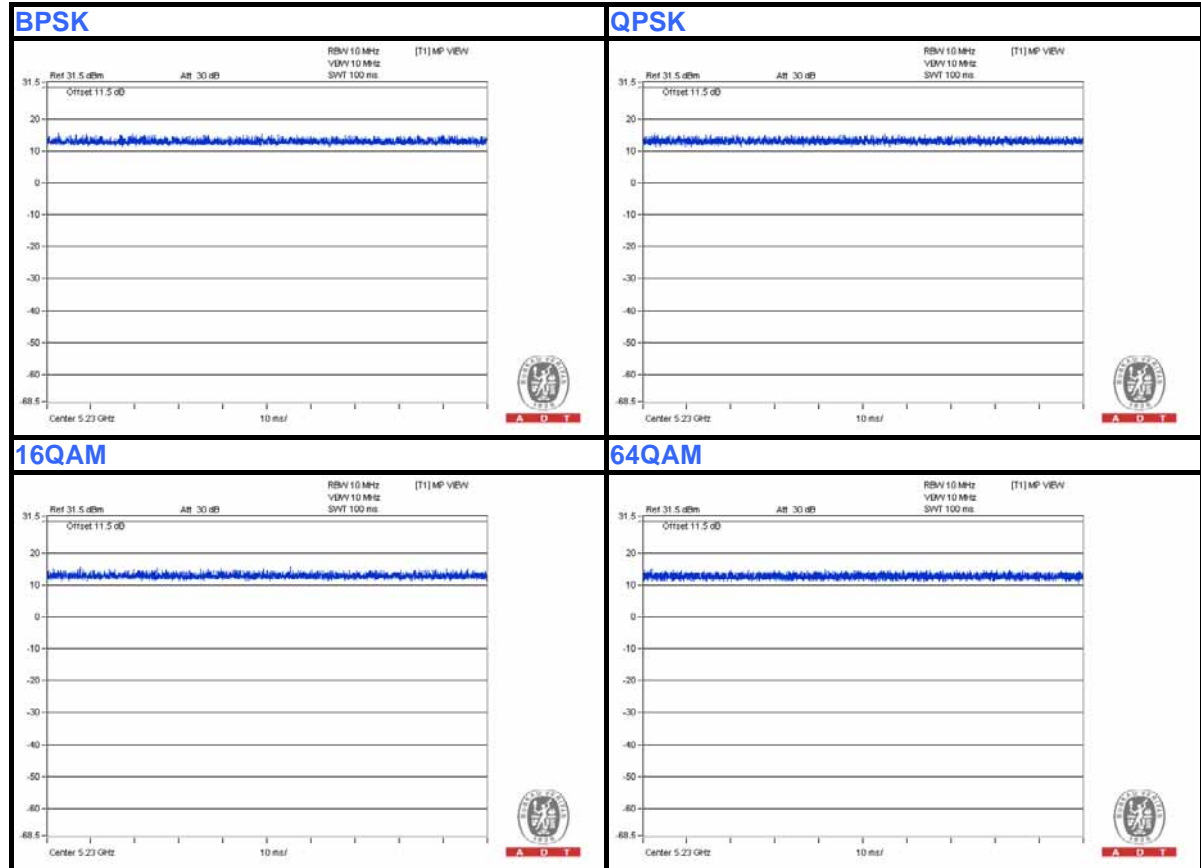
## 802.11n (HT20)





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## 802.11n (HT40)







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### 3.5 DESCRIPTION OF SUPPORT UNITS

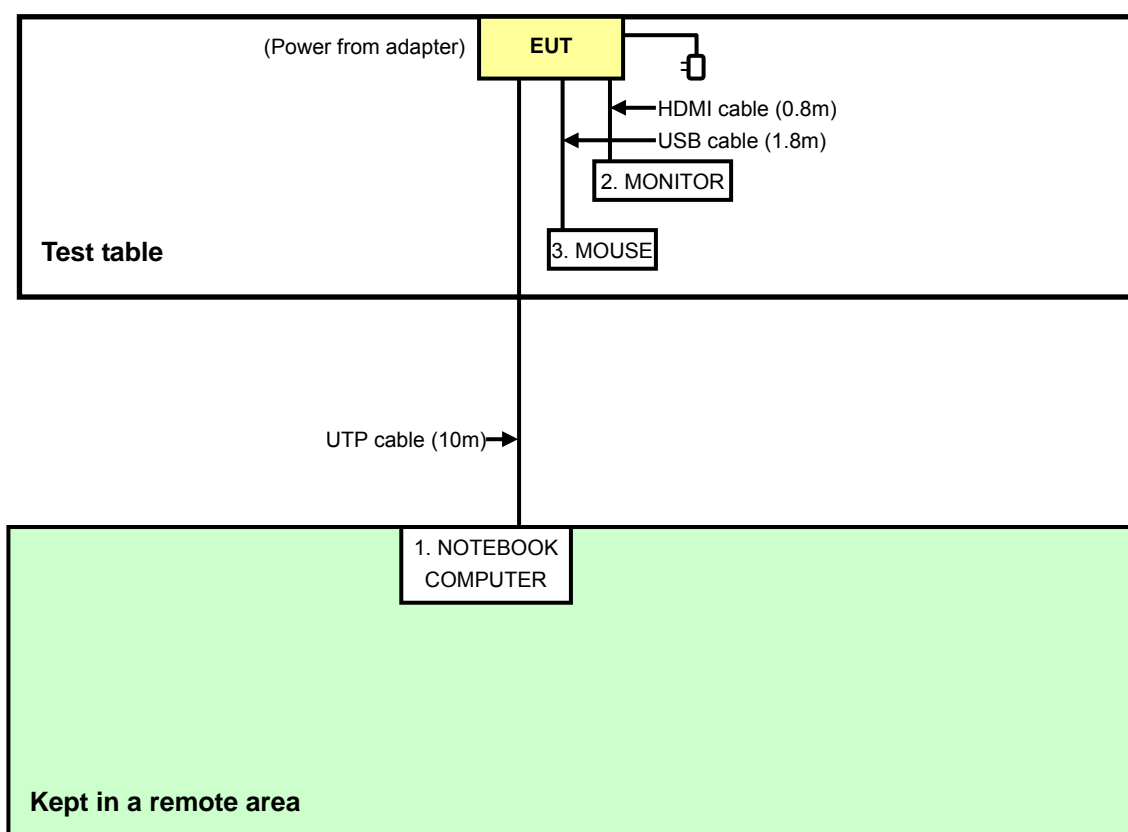
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

No.	Product	Brand	Model No.	Serial No.	FCC ID
1	NOTEBOOK COMPUTER	DELL	PP32LA	FSLB32S	FCC DoC
2	MONITOR	DELL	U2410F	CNOJ257M728729A G14ML	FCC DoC
3	MOUSE	DELL	MOC5UO	I1406CUN	FCC DoC

No.	Signal cable description
1	UTP cable (10m)
2	HDMI cable (0.8m)
3	USB cable (1.8m)

Note: The power cords of the above support units were unshielded (1.8m).

### 3.6 CONFIGURATION OF SYSTEM UNDER TEST



## 4. TEST TYPES AND RESULTS

### 4.1 CONDUCTED EMISSION MEASUREMENT

#### 4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

- NOTE:** 1. The lower limit shall apply at the transition frequencies.  
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

#### 4.1.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver ROHDE & SCHWARZ	ESCS 30	100375	Apr. 29, 2014	Apr. 28, 2015
Line-Impedance Stabilization Network (for EUT) SCHWARZBECK	NSLK8127	8127-522	Sep. 12, 2013	Sep. 11, 2014
Line-Impedance Stabilization Network (for Peripheral)	ENV216	100071	Nov. 13, 2013	Nov. 12, 2014
RF Cable (JYEBAO)	5DFB	COCCAB-001	Mar. 10, 2014	Mar. 09, 2015
50 ohms Terminator	N/A	EMC-03	Sep. 24, 2013	Sep. 23, 2014
50 ohms Terminator	N/A	EMC-02	Oct. 01, 2013	Sep. 30, 2014
Software ADT	BV ADT_Cond_V7.3.7. 3	NA	NA	NA

**Note:**

- The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
- The test was performed in Shielded Room No. C.
- The VCCI Con C Registration No. is C-3611.
- Tested Date: June 18, 2014

### 4.1.3 TEST PROCEDURES

- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN.
- The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission level under (Limit – 20dB) was not recorded.

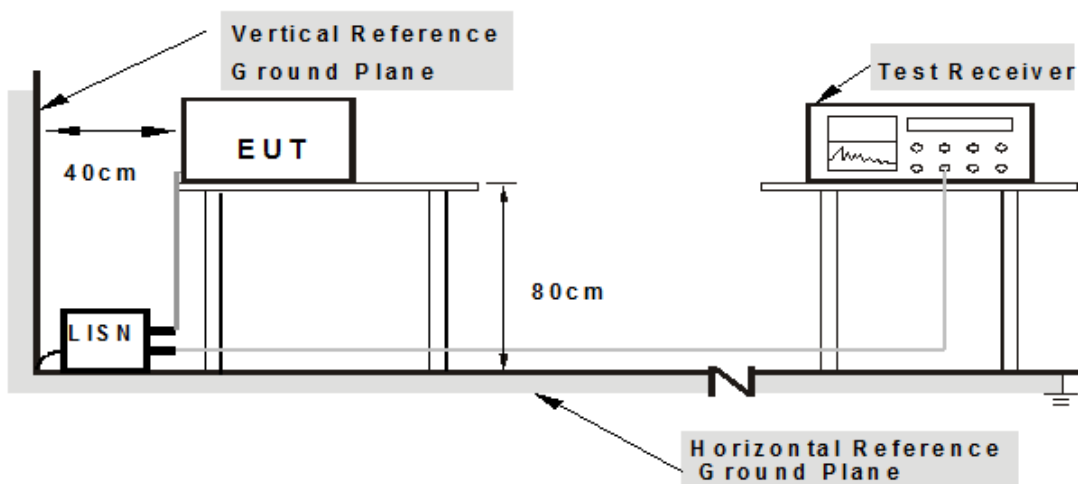
#### NOTE:

- The resolution bandwidth of test receiver is 9kHz for Quasi-peak detection (QP) & Average detection (AV).

### 4.1.4 DEVIATION FROM TEST STANDARD

No deviation

### 4.1.5 TEST SETUP



**Note: 1. Support units were connected to second LISN.**

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

#### 4.1.6 EUT OPERATING CONDITIONS

1. Placed the EUT on testing table.
2. Prepared computer system (support units 1) to act as communication partner.
3. The communication partner ran test program “HyperTerminal paste command” to enable EUT under transmission/receiving condition continuously.

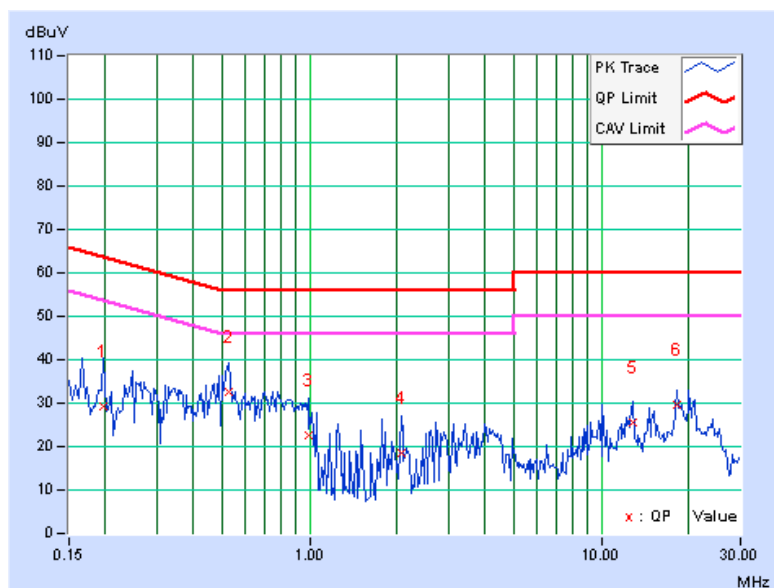
#### 4.1.7 TEST RESULTS

PHASE	Line (L)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)
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No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.19687	0.07	29.02	6.63	29.09	6.70	63.74	53.74	-34.65	-47.04
2	<b>0.52891</b>	<b>0.10</b>	<b>32.36</b>	<b>8.08</b>	<b>32.46</b>	<b>8.18</b>	<b>56.00</b>	<b>46.00</b>	<b>-23.54</b>	<b>-37.82</b>
3	0.98984	0.13	22.42	-0.52	22.55	-0.39	56.00	46.00	-33.45	-46.39
4	2.05469	0.17	18.19	-2.22	18.36	-2.05	56.00	46.00	-37.64	-48.05
5	12.78125	0.53	25.13	18.09	25.66	18.62	60.00	50.00	-34.34	-31.38
6	18.24219	0.67	28.88	21.71	29.55	22.38	60.00	50.00	-30.45	-27.62

#### REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission Level – Limit value
4. Correction Factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

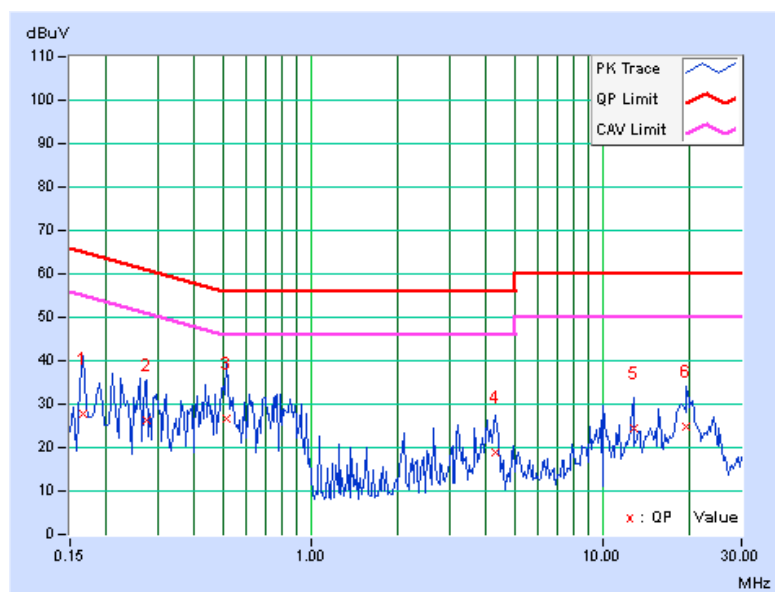


PHASE	Neutral (N)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)
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No	Freq.	Corr. Factor	Reading Value		Emission Level		Limit		Margin	
			[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16562	0.07	27.56	4.61	27.63	4.68	65.18	55.18	-37.54	-50.49
2	0.27500	0.08	26.29	1.20	26.37	1.28	60.97	50.97	-34.60	-49.69
3	0.51719	0.10	26.52	3.63	26.62	3.73	56.00	46.00	-29.38	-42.27
4	4.31250	0.27	18.78	6.28	19.05	6.55	56.00	46.00	-36.95	-39.45
5	12.77734	0.52	24.08	13.78	24.60	14.30	60.00	50.00	-35.40	-35.70
6	19.47266	0.69	24.27	11.17	24.96	11.86	60.00	50.00	-35.04	-38.14

#### REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission Level – Limit value
4. Correction Factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



## 4.2 RADIATED EMISSION AND BANDEDGE MEASUREMENT

### 4.2.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table:

Frequencies (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:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.



## 4.2.2 LIMITS OF UNWANTED EMISSION OUT OF THE RESTRICTED BANDS

APPLICABLE TO		LIMIT	
√	789033 D02 General UNII Test Procedures New Rules v01	FIELD STRENGTH AT 3m	
		PK:74 (dBμV/m)	AV:54 (dBμV/m)
APPLICABLE TO		EIRP LIMIT	EQUIVALENT FIELD STRENGTH AT 3m
	15.407(b)(1)	PK:-27 (dBm/MHz)	PK:68.2(dBμV/m)
	15.407(b)(2)		
	15.407(b)(3)		
	15.407(b)(4)	PK:-27 (dBm/MHz) <sup>*1</sup> PK:-17 (dBm/MHz) <sup>*2</sup>	PK: 68.2(dBμV/m) <sup>*1</sup> PK:78.2 (dBμV/m) <sup>*2</sup>

**NOTE:** <sup>\*1</sup> beyond 10MHz of the band edge <sup>\*2</sup> within 10 MHz of band edge

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

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



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## 4.2.3 TEST INSTRUMENTS

For below 1GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
MXE EMI Receiver Agilent	N9038A	MY50010156	Aug. 11, 2014	Aug. 10, 2015
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-04	Nov. 13, 2013	Nov. 12, 2014
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Feb. 27, 2014	Feb. 26, 2015
RF Cable	NA	CHHCAB_001	Oct. 06, 2013	Oct. 05, 2014
Spectrum Analyzer R&S	FSV40	100964	July 05, 2014	July 04, 2015
Horn_Antenna AISI	AIH.8018	0000220091110	Dec. 06, 2013	Dec. 05, 2014
Pre-Amplifier Agilent	8449B	3008A01923	Oct. 29, 2013	Oct. 28, 2014
RF Cable	NA	RF104-205 RF104-207 RF104-202	Dec. 12, 2013	Dec. 11, 2014
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Nov. 13, 2013	Nov. 12, 2014
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Oct. 08, 2013	Oct. 07, 2014
Software	ADT_Radiated _V8.7.07	NA	NA	NA
Antenna Tower & Turn Table CT	NA	NA	NA	NA

**Note:**

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
3. The test was performed in 966 Chamber No. H.
4. The FCC Site Registration No. is 797305.
5. The CANADA Site Registration No. is IC 7450H-3.
6. Tested Date: Sep. 18, 2014



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**For above 1GHz test:**

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
MXE EMI Receiver Agilent	N9038A	MY51210105	Jan. 21, 2014	Jan. 20, 2015
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-03	Nov. 13, 2013	Nov. 12, 2014
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-360	Feb. 26, 2014	Feb. 25, 2015
RF Cable	NA	CHGCAB_001	Oct. 05, 2013	Oct. 04, 2014
Spectrum Analyzer R&S	FSV40	100964	July 15, 2013	July 14, 2014
Horn_Antenna AISI	AIH.8018	0000320091110	Nov. 18, 2013	Nov. 17, 2014
Pre-Amplifier Agilent	8449B	3008A02578	June 25, 2013	June 24, 2014
RF Cable	NA	RF104-201 RF104-203 RF104-204	Dec. 12, 2013	Dec. 11, 2014
Spectrum Analyzer Agilent	E4446A	MY48250253	Aug. 28, 2013	Aug. 27, 2014
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Nov. 13, 2013	Nov. 12, 2014
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Oct. 08, 2013	Oct. 07, 2014
Software	ADT_Radiated _V8.7.07	NA	NA	NA
Antenna Tower & Turn Table CT	NA	NA	NA	NA

**Note:**

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
- 3 The test was performed in 966 Chamber No. G.
4. The FCC Site Registration No. is 966073.
- 5 The VCCI Site Registration No. is G-137.
- 6 The CANADA Site Registration No. is IC 7450H-2.
- 7 Tested Date: June 14, 2014

#### 4.2.4 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

**Note:**

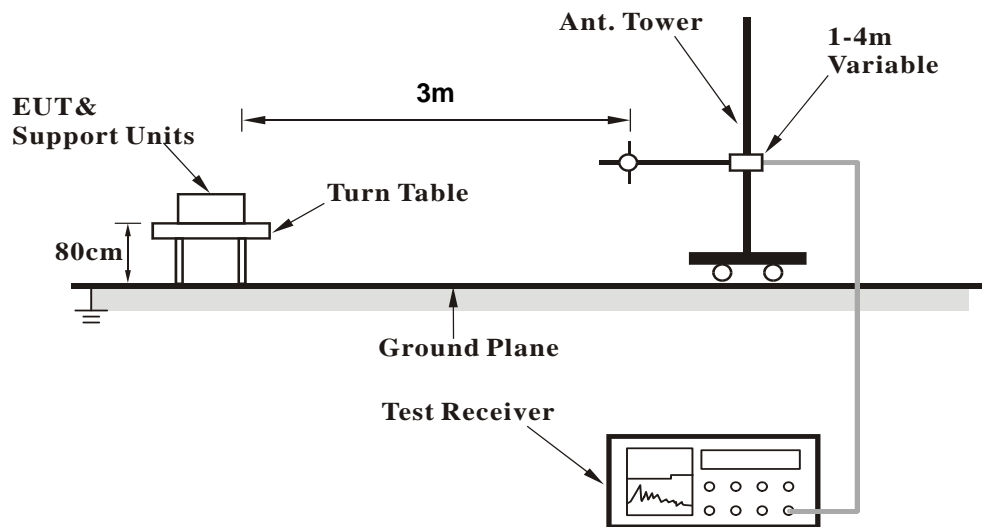
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average (Duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor ( $10 \log(1/\text{duty cycle})$ ).
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.2.5 DEVIATION FROM TEST STANDARD

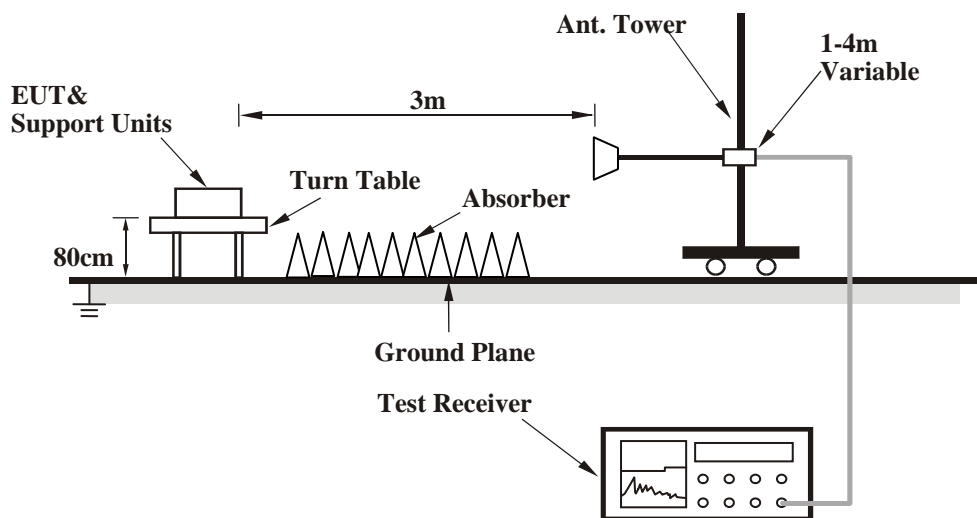
No deviation

## 4.2.6 TEST SETUP

### <Frequency Range below 1GHz>



### <Frequency Range above 1GHz>



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

## 4.2.7 EUT OPERATING CONDITION

Same as 4.1.6

## 4.2.8 TEST RESULTS

### BELOW 1GHz WORST-CASE DATA

#### 802.11n (HT20)

CHANNEL	TX Channel 48	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	Below 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	49.50	36.7 QP	40.0	-3.3	2.00 H	87	49.65	-12.95
2	56.97	33.9 QP	40.0	-6.1	1.50 H	256	47.12	-13.20
3	135.97	36.1 QP	43.5	-7.4	2.00 H	87	49.43	-13.33
4	146.99	39.6 QP	43.5	-3.9	1.50 H	95	52.23	-12.61
5	443.18	38.9 QP	46.0	-7.1	2.00 H	298	46.73	-7.83
6	742.53	41.2 QP	46.0	-4.8	1.00 H	0	43.09	-1.88
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	30.05	37.9 QP	40.0	-2.1	1.50 V	30	52.19	-14.29
2	49.51	33.8 QP	40.0	-6.2	2.00 V	34	46.75	-12.95
3	60.01	38.2 QP	40.0	-1.8	1.00 V	281	51.71	-13.49
4	136.12	40.4 QP	43.5	-3.1	1.00 V	253	53.70	-13.32
5	742.51	37.6 QP	46.0	-8.4	1.00 V	275	39.51	-1.88
6	903.00	39.1 QP	46.0	-6.9	2.00 V	324	38.51	0.63

#### REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

## ABOVE 1GHz DATA

### 802.11a

<b>CHANNEL</b>	TX Channel 36	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	5150.00	65.1 PK	74.0	-8.9	1.00 H	186	58.40	6.70
2	5150.00	50.1 AV	54.0	-3.9	1.00 H	186	43.40	6.70
3	*5180.00	104.5 PK			1.00 H	186	97.50	7.00
4	*5180.00	96.1 AV			1.00 H	186	89.10	7.00
5	#10360.00	52.9 PK	74.0	-21.1	1.03 H	164	39.90	13.00
6	#10360.00	40.7 AV	54.0	-13.3	1.03 H	164	27.70	13.00
7	15540.00	62.4 PK	74.0	-11.6	1.01 H	267	43.70	18.70
8	15540.00	49.9 AV	54.0	-4.1	1.01 H	267	31.20	18.70
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	5150.00	65.4 PK	74.0	-8.6	1.09 V	317	58.70	6.70
2	5150.00	51.0 AV	54.0	-3.0	1.09 V	317	44.30	6.70
3	*5180.00	105.2 PK			1.09 V	317	98.20	7.00
4	*5180.00	97.1 AV			1.09 V	317	90.10	7.00
5	#10360.00	53.2 PK	74.0	-20.8	1.14 V	91	40.20	13.00
6	#10360.00	41.0 AV	54.0	-13.0	1.14 V	91	28.00	13.00
7	15540.00	62.7 PK	74.0	-11.3	1.32 V	34	44.00	18.70
8	15540.00	50.1 AV	54.0	-3.9	1.32 V	34	31.40	18.70

#### REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



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CHANNEL	TX Channel 40	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5200.00	104.6 PK			1.00 H	186	97.50	7.10
2	*5200.00	95.6 AV			1.00 H	186	88.50	7.10
3	#10400.00	53.2 PK	74.0	-20.8	1.05 H	179	40.00	13.20
4	#10400.00	41.0 AV	54.0	-13.0	1.05 H	179	27.80	13.20
5	15600.00	62.5 PK	74.0	-11.5	1.04 H	260	43.80	18.70
6	15600.00	49.7 AV	54.0	-4.3	1.04 H	260	31.00	18.70
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5200.00	104.8 PK			1.09 V	316	97.70	7.10
2	*5200.00	96.8 AV			1.09 V	316	89.70	7.10
3	#10400.00	53.8 PK	74.0	-20.2	1.17 V	78	40.60	13.20
4	#10400.00	41.4 AV	54.0	-12.6	1.17 V	78	28.20	13.20
5	15600.00	62.5 PK	74.0	-11.5	1.32 V	44	43.80	18.70
6	15600.00	49.9 AV	54.0	-4.1	1.32 V	44	31.20	18.70

**REMARKS:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.





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CHANNEL	TX Channel 48	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

**ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M**

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5240.00	104.7 PK			1.00 H	186	97.50	7.20
2	*5240.00	95.7 AV			1.00 H	186	88.50	7.20
3	5350.00	50.1 PK	74.0	-23.9	1.00 H	186	42.70	7.40
4	5350.00	39.8 AV	54.0	-14.2	1.00 H	186	32.40	7.40
5	#10480.00	52.9 PK	74.0	-21.1	1.00 H	156	39.80	13.10
6	#10480.00	40.4 AV	54.0	-13.6	1.00 H	156	27.30	13.10
7	15720.00	62.7 PK	74.0	-11.3	1.02 H	258	44.30	18.40
8	15720.00	50.0 AV	54.0	-4.0	1.02 H	258	31.60	18.40

**ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M**

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5240.00	106.8 PK			1.10 V	315	99.60	7.20
2	*5240.00	97.2 AV			1.10 V	315	90.00	7.20
3	5350.00	51.1 PK	74.0	-22.9	1.10 V	315	43.70	7.40
4	5350.00	40.6 AV	54.0	-13.4	1.10 V	315	33.20	7.40
5	#10480.00	52.6 PK	74.0	-21.4	1.18 V	91	39.50	13.10
6	#10480.00	40.7 AV	54.0	-13.3	1.18 V	91	27.60	13.10
7	15720.00	62.6 PK	74.0	-11.4	1.35 V	41	44.20	18.40
8	15720.00	50.1 AV	54.0	-3.9	1.35 V	41	31.70	18.40

**REMARKS:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



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## 802.11n (HT20)

CHANNEL	TX Channel 36	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	5150.00	60.7 PK	74.0	-13.3	1.00 H	186	54.00	6.70
2	5150.00	51.0 AV	54.0	-3.0	1.00 H	186	44.30	6.70
3	*5180.00	104.5 PK			1.00 H	186	97.50	7.00
4	*5180.00	95.2 AV			1.00 H	186	88.20	7.00
5	#10360.00	52.9 PK	74.0	-21.1	1.08 H	151	39.90	13.00
6	#10360.00	40.9 AV	54.0	-13.1	1.08 H	151	27.90	13.00
7	15540.00	62.7 PK	74.0	-11.3	1.00 H	263	44.00	18.70
8	15540.00	50.2 AV	54.0	-3.8	1.00 H	263	31.50	18.70
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	5150.00	61.5 PK	74.0	-12.5	1.68 V	318	54.80	6.70
2	5150.00	52.3 AV	54.0	-1.7	1.68 V	318	45.60	6.70
3	*5180.00	104.7 PK			1.68 V	318	97.70	7.00
4	*5180.00	95.4 AV			1.68 V	318	88.40	7.00
5	#10360.00	53.6 PK	74.0	-20.4	1.11 V	91	40.60	13.00
6	#10360.00	41.1 AV	54.0	-12.9	1.11 V	91	28.10	13.00
7	15540.00	62.4 PK	74.0	-11.6	1.33 V	27	43.70	18.70
8	15540.00	49.6 AV	54.0	-4.4	1.33 V	27	30.90	18.70

## REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



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CHANNEL	TX Channel 40	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5200.00	104.4 PK			1.01 H	176	97.30	7.10
2	*5200.00	95.0 AV			1.01 H	176	87.90	7.10
3	#10400.00	52.4 PK	74.0	-21.6	1.13 H	155	39.20	13.20
4	#10400.00	40.5 AV	54.0	-13.5	1.13 H	155	27.30	13.20
5	15600.00	62.6 PK	74.0	-11.4	1.02 H	279	43.90	18.70
6	15600.00	49.9 AV	54.0	-4.1	1.02 H	279	31.20	18.70
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5200.00	104.9 PK			1.68 V	315	97.80	7.10
2	*5200.00	95.4 AV			1.68 V	315	88.30	7.10
3	#10400.00	53.8 PK	74.0	-20.2	1.11 V	84	40.60	13.20
4	#10400.00	41.3 AV	54.0	-12.7	1.11 V	84	28.10	13.20
5	15600.00	63.0 PK	74.0	-11.0	1.30 V	21	44.30	18.70
6	15600.00	50.3 AV	54.0	-3.7	1.30 V	21	31.60	18.70

#### REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



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CHANNEL	TX Channel 48	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5240.00	104.8 PK			1.05 H	178	97.60	7.20
2	*5240.00	95.7 AV			1.05 H	178	88.50	7.20
3	5350.00	50.9 PK	74.0	-23.1	1.05 H	178	43.50	7.40
4	5350.00	40.6 AV	54.0	-13.4	1.05 H	178	33.20	7.40
5	#10480.00	53.1 PK	74.0	-20.9	1.06 H	162	40.00	13.10
6	#10480.00	41.3 AV	54.0	-12.7	1.06 H	162	28.20	13.10
7	15720.00	62.9 PK	74.0	-11.1	1.00 H	248	44.50	18.40
8	15720.00	50.4 AV	54.0	-3.6	1.00 H	248	32.00	18.40
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5240.00	107.2 PK			1.66 V	317	100.00	7.20
2	*5240.00	97.4 AV			1.66 V	317	90.20	7.20
3	5350.00	51.8 PK	74.0	-22.2	1.66 V	317	44.40	7.40
4	5350.00	41.2 AV	54.0	-12.8	1.66 V	317	33.80	7.40
5	#10480.00	52.9 PK	74.0	-21.1	1.17 V	104	39.80	13.10
6	#10480.00	41.0 AV	54.0	-13.0	1.17 V	104	27.90	13.10
7	15720.00	63.0 PK	74.0	-11.0	1.29 V	27	44.60	18.40
8	15720.00	50.4 AV	54.0	-3.6	1.29 V	27	32.00	18.40

**REMARKS:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



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# 802.11n (HT40)

CHANNEL	TX Channel 38	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	5150.00	64.1 PK	74.0	-9.9	1.00 H	186	57.40	6.70
2	5150.00	52.1 AV	54.0	-1.9	1.00 H	186	45.40	6.70
3	*5190.00	97.8 PK			1.00 H	186	90.70	7.10
4	*5190.00	88.1 AV			1.00 H	186	81.00	7.10
5	#10380.00	52.9 PK	74.0	-21.1	1.11 H	159	39.70	13.20
6	#10380.00	41.0 AV	54.0	-13.0	1.11 H	159	27.80	13.20
7	15570.00	62.4 PK	74.0	-11.6	1.01 H	271	43.80	18.60
8	15570.00	49.8 AV	54.0	-4.2	1.01 H	271	31.20	18.60
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	5150.00	64.7 PK	74.0	-9.3	1.08 V	318	58.00	6.70
2	5150.00	52.8 AV	54.0	-1.2	1.08 V	318	46.10	6.70
3	*5190.00	98.2 PK			1.09 V	318	91.10	7.10
4	*5190.00	88.8 AV			1.09 V	318	81.70	7.10
5	#10380.00	53.1 PK	74.0	-20.9	1.18 V	106	39.90	13.20
6	#10380.00	41.1 AV	54.0	-12.9	1.18 V	106	27.90	13.20
7	15570.00	62.9 PK	74.0	-11.1	1.37 V	48	44.30	18.60
8	15570.00	50.1 AV	54.0	-3.9	1.37 V	48	31.50	18.60

## REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



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CHANNEL	TX Channel 46	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5230.00	103.2 PK			1.00 H	186	96.00	7.20
2	*5230.00	94.1 AV			1.00 H	186	86.90	7.20
3	5350.00	51.9 PK	74.0	-22.1	1.00 H	186	44.50	7.40
4	5350.00	40.2 AV	54.0	-13.8	1.00 H	186	32.80	7.40
5	#10460.00	53.0 PK	74.0	-21.0	1.11 H	148	39.80	13.20
6	#10460.00	40.9 AV	54.0	-13.1	1.11 H	148	27.70	13.20
7	15690.00	62.4 PK	74.0	-11.6	1.00 H	270	44.00	18.40
8	15690.00	50.2 AV	54.0	-3.8	1.00 H	270	31.80	18.40
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*5230.00	104.1 PK			1.08 V	316	96.90	7.20
2	*5230.00	95.0 AV			1.08 V	316	87.80	7.20
3	5350.00	52.4 PK	74.0	-21.6	1.08 V	316	45.00	7.40
4	5350.00	41.2 AV	54.0	-12.8	1.08 V	316	33.80	7.40
5	#10460.00	53.5 PK	74.0	-20.5	1.18 V	93	40.30	13.20
6	#10460.00	41.0 AV	54.0	-13.0	1.18 V	93	27.80	13.20
7	15690.00	62.5 PK	74.0	-11.5	1.36 V	32	44.10	18.40
8	15690.00	49.7 AV	54.0	-4.3	1.36 V	32	31.30	18.40

#### REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

### 4.3 TRANSMIT POWER MEASUREMENT

#### 4.3.1 LIMITS OF TRANSMIT POWER MEASUREMENT

Operation Band	EUT Category		LIMIT
U-NII-1		Outdoor Access Point	1 Watt (30 dBm) (Max. e.i.r.p $\leq$ 125mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon)
		Fixed point-to-point Access Point	1 Watt (30 dBm)
		Indoor Access Point	1 Watt (30 dBm)
	√	Mobile and Portable client device	250mW (24 dBm)
U-NII-2A	---		250mW (24 dBm) or 11 dBm+10 log B*
U-NII-2C	---		250mW (24 dBm) or 11 dBm+10 log B*
U-NII-3	---		1 Watt (30 dBm)

**Note:** Where B is the 26dB emission bandwidth in MHz.

Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for NANT  $\leq$  4;

Array Gain = 0 dB (i.e., no array gain) for channel widths  $\geq$  40 MHz for any NANT;

Array Gain = 5 log(NANT/NSS) dB or 3 dB, whichever is less for 20-MHz channel widths with NANT  $\geq$  5.

For power measurements on all other devices: Array Gain = 10 log(NANT/NSS) dB.

## 4.3.2 TEST INSTRUMENTS

### FOR POWER OUTPUT MEASUREMENT

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Power meter Anritsu	ML2495A	1014008	Apr. 30, 2014	Apr. 29, 2015
Power sensor Anritsu	MA2411B	0917122	Apr. 30, 2014	Apr. 29, 2015

#### Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. Tested date : June 19, 2014

### FOR 26dB OCCUPIED BANDWIDTH

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014

#### Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. Tested date : June 19, 2014

## 4.3.3 TEST PROCEDURE

### FOR POWER OUTPUT MEASUREMENT

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

### FOR 26dB OCCUPIED BANDWIDTH

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

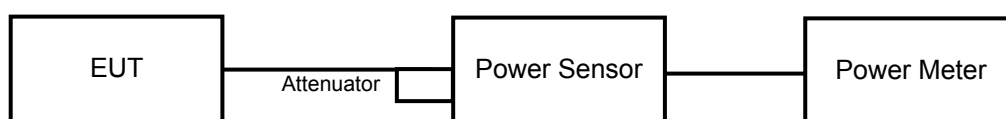


#### 4.3.4 DEVIATION FROM TEST STANDARD

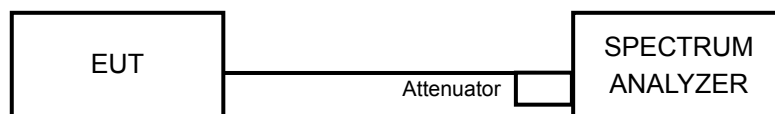
No deviation

#### 4.3.5 TEST SETUP

##### FOR POWER OUTPUT MEASUREMENT



##### FOR 26dB OCCUPIED BANDWIDTH



#### 4.3.6 EUT OPERATING CONDITIONS

The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.

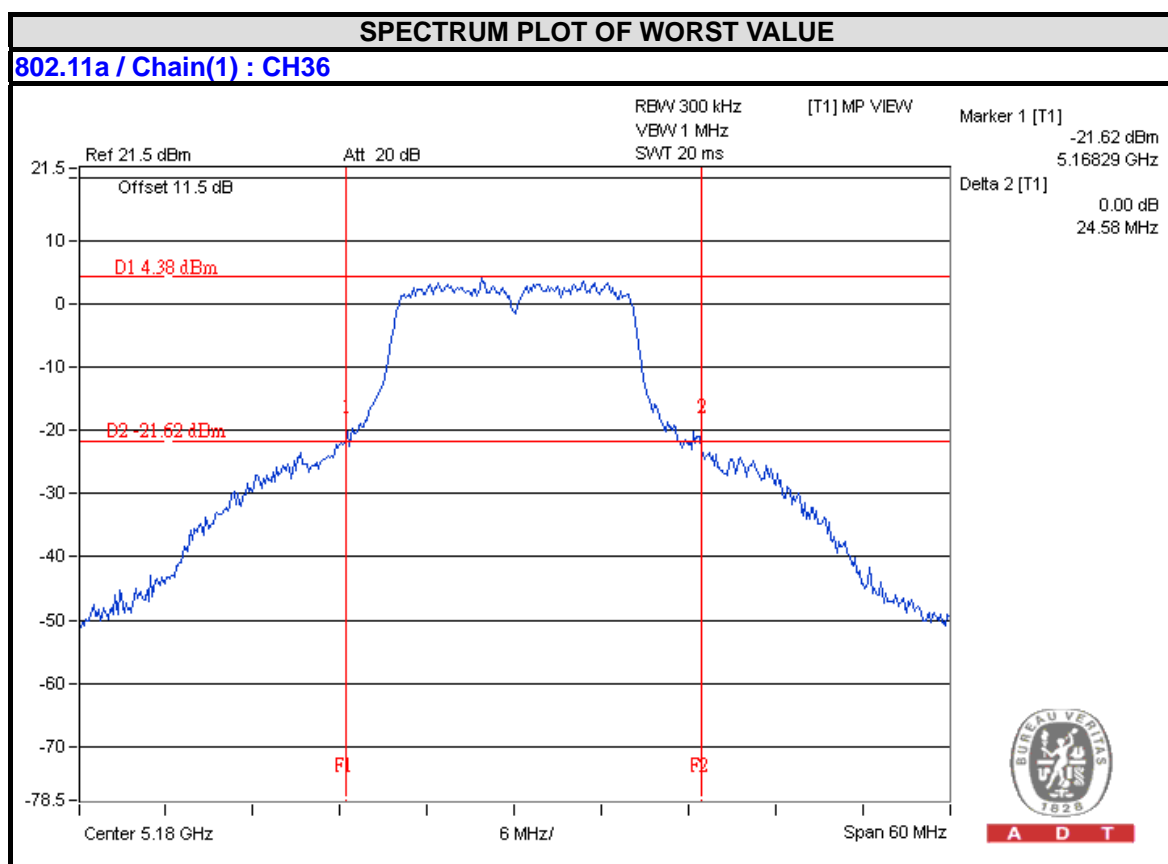
### 4.3.7 TEST RESULTS

#### 802.11a

CHAN.	CHAN. FREQ. (MHz)	AVERAGE POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1				
36	5180	13.29	13.29	42.66	16.30	24	PASS
40	5200	13.31	13.18	42.226	16.26	24	PASS
48	5240	13.34	13.60	44.486	16.48	24	PASS

#### 26dB OCCUPIED BANDWIDTH:

CHANNEL	CHANNEL FREQUENCY (MHz)	26dBc BANDWIDTH (MHz)	
		CHAIN 0	CHAIN 1
36	5180	33.71	24.58
40	5200	33.72	25.13
48	5240	33.84	25.35

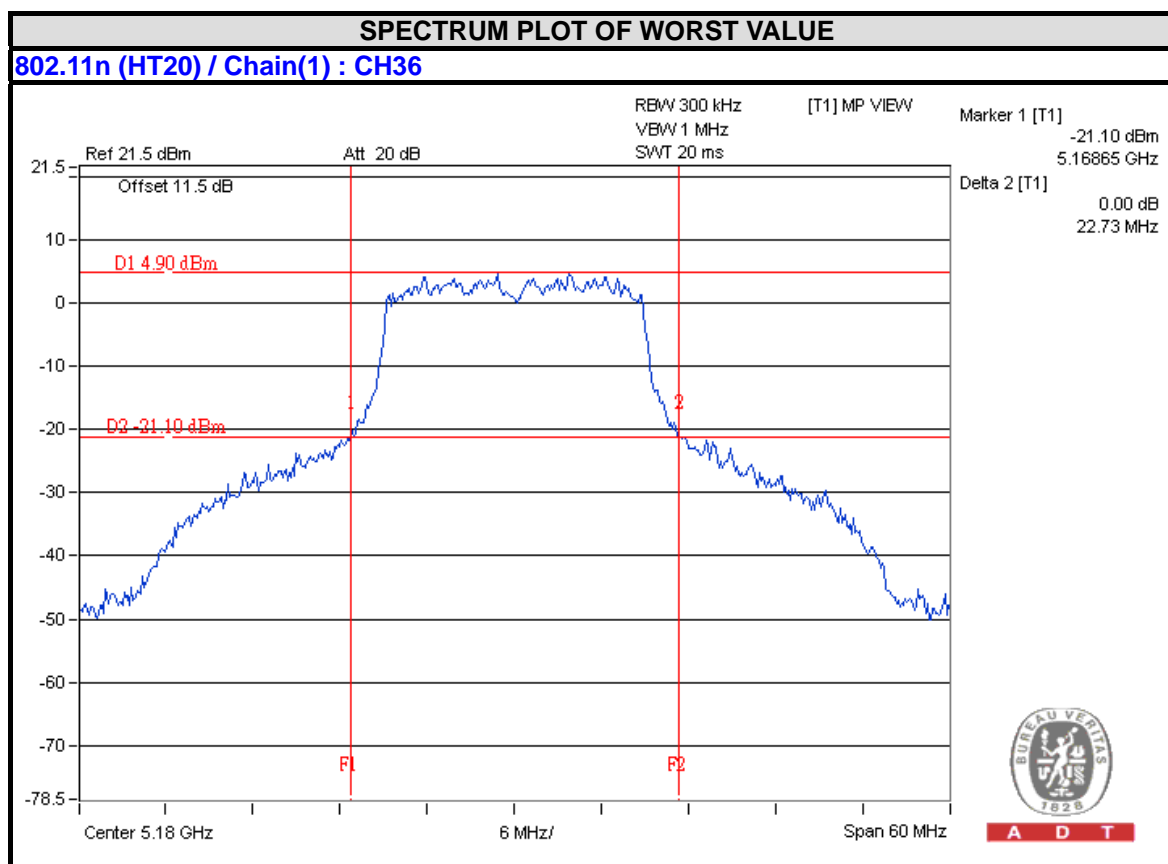


### 802.11n (HT20)

CHAN.	CHAN. FREQ. (MHz)	AVERAGE POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1				
36	5180	13.07	13.28	41.558	16.19	24	PASS
40	5200	13.24	13.13	41.645	16.20	24	PASS
48	5240	13.44	13.54	44.674	16.50	24	PASS

### 26dB OCCUPIED BANDWIDTH:

CHANNEL	CHANNEL FREQUENCY (MHz)	26dBc BANDWIDTH (MHz)	
		CHAIN 0	CHAIN 1
36	5180	33.27	22.73
40	5200	33.15	22.91
48	5240	33.06	23.06

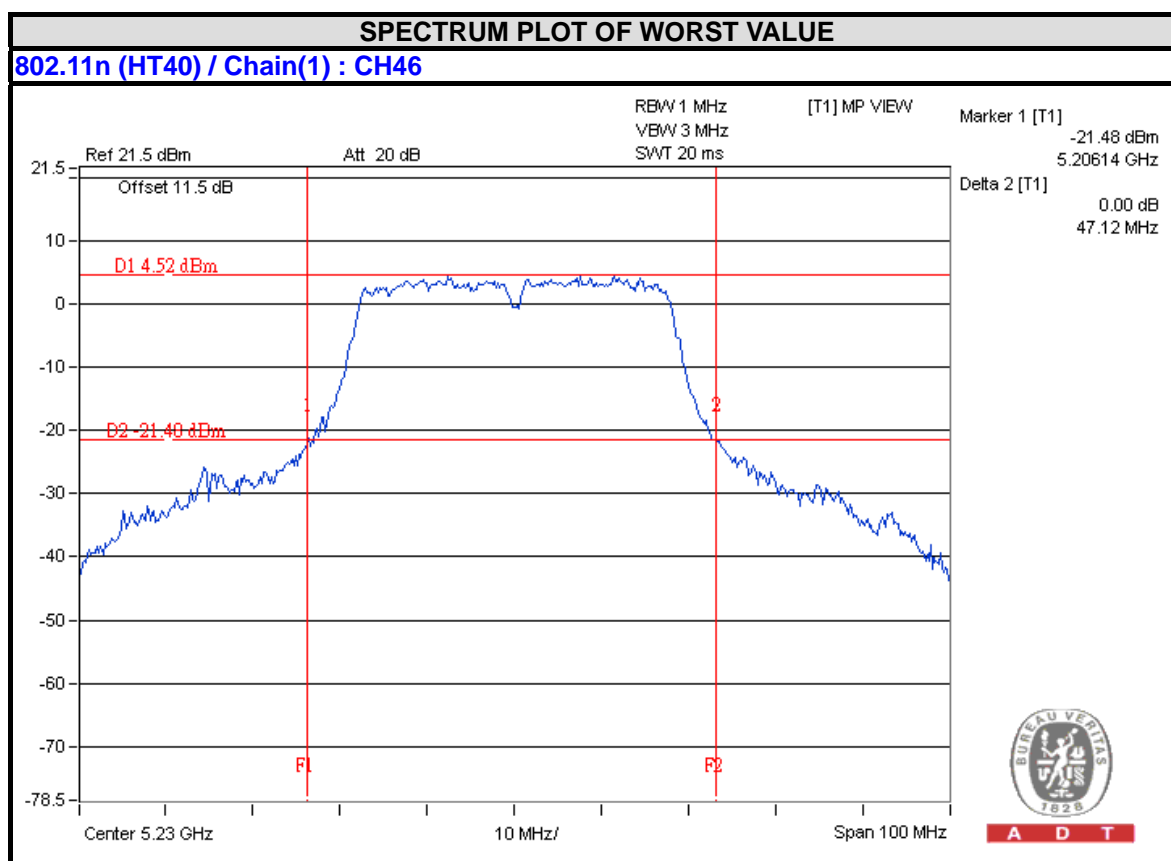


### 802.11n (HT40)

CHAN.	CHAN. FREQ. (MHz)	AVERAGE POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1				
38	5190	9.44	9.95	18.676	12.71	24	PASS
46	5230	13.44	13.02	42.125	16.25	24	PASS

### 26dB OCCUPIED BANDWIDTH:

CHANNEL	CHANNEL FREQUENCY (MHz)	26dBc BANDWIDTH (MHz)	
		CHAIN 0	CHAIN 1
38	5190	50.04	47.21
46	5230	51.84	47.12



## 4.4 PEAK POWER SPECTRAL DENSITY MEASUREMENT

### 4.4.1 LIMITS OF PEAK POWER SPECTRAL DENSITY MEASUREMENT

Operation Band	EUT Category		LIMIT
U-NII-1		Outdoor Access Point	17dBm/ MHz
		Fixed point-to-point Access Point	
		Indoor Access Point	
	√	Mobile and Portable client device	11dBm/ MHz
U-NII-2A	---		11dBm/ MHz
U-NII-2C	---		11dBm/ MHz
U-NII-3	---		30dBm/ 500kHz

### 4.4.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014

**Note:**

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. Tested date : June 19, 2014

#### 4.4.3 TEST PROCEDURES

1. Set span to encompass the entire emission bandwidth (EBW) of the signal.
2. Set RBW = 1 MHz, Set VBW  $\geq$  3 MHz, Detector = RMS
3. Sweep time = auto, trigger set to “free run”.
4. Trace average at least 100 traces in power averaging mode.
5. Record the max value and for duty cycle of test signal is  $< 98\%$  add  $10 \log (1/\text{duty cycle})$

#### 4.4.4 DEVIATION FROM TEST STANDARD

No deviation

#### 4.4.5 TEST SETUP



#### 4.4.6 EUT OPERATING CONDITIONS

Same as 4.3.6

## 4.4.7 TEST RESULTS

### 802.11a

CHANNEL	CHANNEL FREQUENCY (MHz)	PSD (dBm)		TOTAL POWER DENSITY (dBm)	MAX. LIMIT (dBm)	PASS/FAIL
		CHAIN 0	CHAIN 1			
36	5180	-1.43	-1.56	1.52	11	PASS
40	5200	-1.33	-1.67	1.51	11	PASS
48	5240	-1.45	-1.25	1.66	11	PASS

**NOTE:** 1. Method a) of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.

2. **5150~5250MHz:** Directional gain =  $2.3\text{dBi} + 10\log(2) = 5.31\text{dBi} < 6\text{dBi}$ , so the power density limit shall not be reduced.

### 802.11n (HT20)

CHANNEL	CHANNEL FREQUENCY (MHz)	PSD (dBm)		TOTAL POWER DENSITY (dBm)	MAX. LIMIT (dBm)	PASS/FAIL
		CHAIN 0	CHAIN 1			
36	5180	-1.51	-1.86	1.33	11	PASS
40	5200	-1.22	-1.62	1.60	11	PASS
48	5240	-1.45	-1.69	1.44	11	PASS

**NOTE:** 1. Method a) of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.

2. **5150~5250MHz:** Directional gain =  $2.3\text{dBi} + 10\log(2) = 5.31\text{dBi} < 6\text{dBi}$ , so the power density limit shall not be reduced.

### 802.11n (HT40)

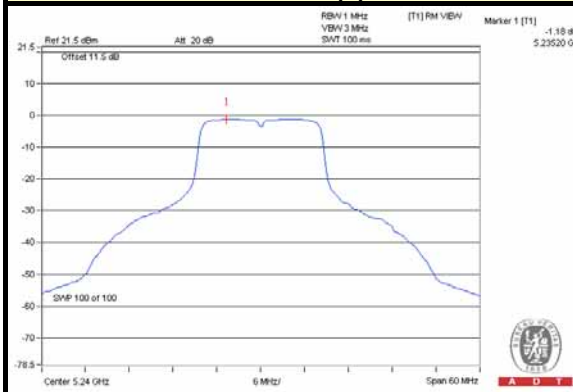
CHANNEL	CHANNEL FREQUENCY (MHz)	PSD (dBm)		TOTAL POWER DENSITY (dBm)	MAX. LIMIT (dBm)	PASS/FAIL
		CHAIN 0	CHAIN 1			
38	5190	-7.34	-7.62	-4.47	11	PASS
46	5230	-4.00	-3.97	-0.97	11	PASS

**NOTE:** 1. Method a) of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.

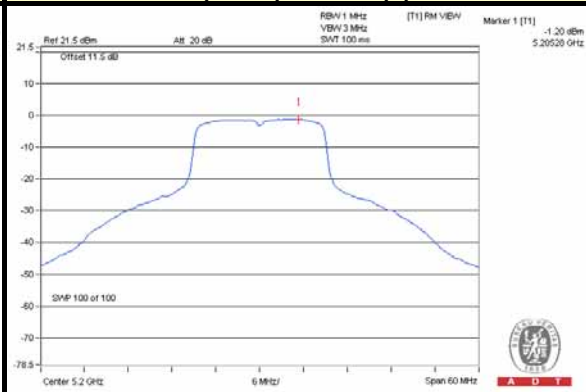
2. **5150~5250MHz:** Directional gain =  $2.3\text{dBi} + 10\log(2) = 5.31\text{dBi} < 6\text{dBi}$ , so the power density limit shall not be reduced.

### SPECTRUM PLOT OF WORST VALUE

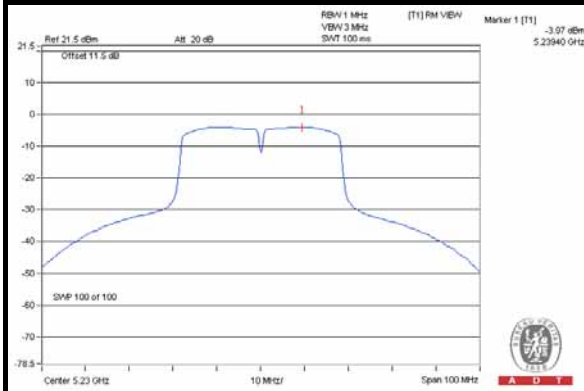
802.11a / Chain(1) : CH48



802.11n (HT20) / Chain(0) : CH40



802.11n (HT40) / Chain(1) : CH46





## 4.5 FREQUENCY STABILITY

### 4.5.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

The frequency of the carrier signal shall be maintained within band of operation

### 4.5.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014
Temperature & Humidity Chamber GIANTFORCE	GTH-150-40-SP-AR	MAA0812-008	Jan. 13, 2014	Jan. 12, 2015

**Note:**

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. Tested date : June 19, 2014

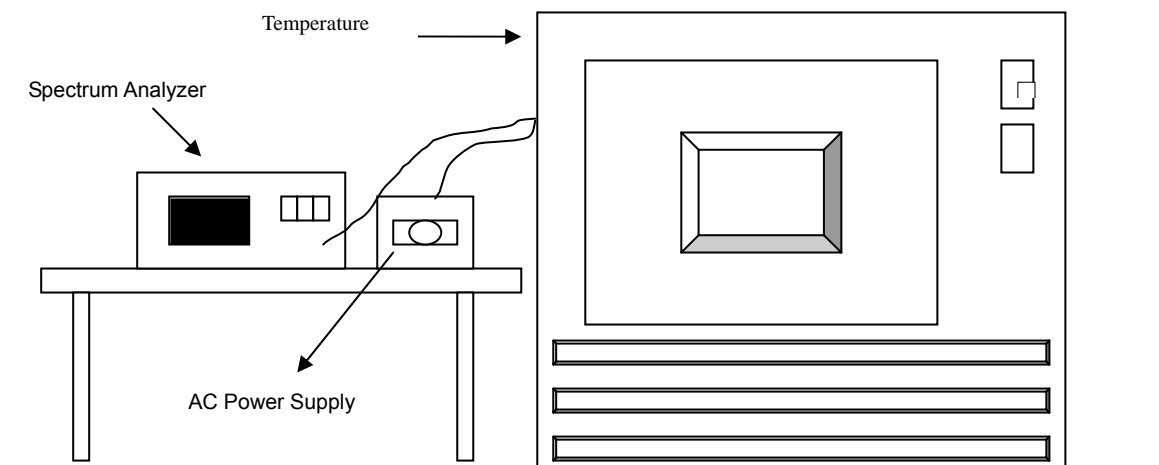
### 4.5.3 TEST PROCEDURE

1. The EUT was placed inside the environmental test chamber and powered by nominal AC voltage.
2. Turn the EUT on and couple its output to a spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 minutes.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

#### 4.5.4 DEVIATION FROM TEST STANDARD

No deviation

#### 4.5.5 TEST SETUP



#### 4.5.6 EUT OPERATING CONDITION

Set the EUT transmit at un-modulation mode to test frequency stability.



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## 4.5.7 TEST RESULTS

FREQUENCY STABILITY VERSUS TEMP.									
OPERATING FREQUENCY: 5240MHz									
TEMP. (°C)	POWER SUPPLY (Vac)	0 MINUTE		2 MINUTE		5 MINUTE		10 MINUTE	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
50	120	5240.0025	0.00005	5240.0021	0.00004	5240.0012	0.00002	5239.9979	-0.00004
40	120	5239.9847	-0.00029	5239.9868	-0.00025	5239.9859	-0.00027	5239.9876	-0.00024
30	120	5240.0004	0.00001	5240.0008	0.00002	5239.9997	-0.00001	5240.0036	0.00007
20	120	5240.0134	0.00026	5240.0143	0.00027	5240.0127	0.00024	5240.0115	0.00022
10	120	5239.973	-0.00052	5239.9765	-0.00045	5239.9774	-0.00043	5239.9758	-0.00046
0	120	5240.0137	0.00026	5240.0092	0.00018	5240.0094	0.00018	5240.012	0.00023
-10	120	5239.9968	-0.00006	5239.9981	-0.00004	5239.9967	-0.00006	5240.0001	0.00000
-20	120	5240.0117	0.00022	5240.0127	0.00024	5240.0143	0.00027	5240.0138	0.00026
-30	120	5239.9727	-0.00052	5239.9726	-0.00052	5239.9736	-0.00050	5239.9724	-0.00053

FREQUENCY STABILITY VERSUS VOLTAGE									
OPERATING FREQUENCY: 5240MHz									
TEMP. (°C)	POWER SUPPLY (Vac)	0 MINUTE		2 MINUTE		5 MINUTE		10 MINUTE	
		Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift	Measured Frequency	Frequency Drift
		(MHz)	%	(MHz)	%	(MHz)	%	(MHz)	%
20	138	5240.0136	0.00026	5240.0134	0.00026	5240.0117	0.00022	5240.0122	0.00023
	120	5240.0134	0.00026	5240.0143	0.00027	5240.0127	0.00024	5240.0115	0.00022
	102	5240.0126	0.00024	5240.0144	0.00027	5240.0136	0.00026	5240.0105	0.00020

## 5. PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).



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## 6. INFORMATION ON THE TESTING LABORATORIES

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

**Linko EMC/RF Lab:**

Tel: 886-2-26052180

Fax: 886-2-26052943

**Hsin Chu EMC/RF/Telecom Lab:**

Tel: 886-3-5935343

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**Hwa Ya EMC/RF/Safety Lab:**

Tel: 886-3-3183232

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**Email:** [service.adt@tw.bureauveritas.com](mailto:service.adt@tw.bureauveritas.com)

**Web Site:** [www.bureauveritas-adt.com](http://www.bureauveritas-adt.com)

The address and road map of all our labs can be found in our web site also.



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## **7. APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB**

No modifications were made to the EUT by the lab during the test.

**--- END ---**