FCC TEST REPORT (15.407)

REPORT NO.:	RF141024C24B-1
MODEL NO.:	FORTIAP-224Dxxxxxx, FortiAP-224Dxxxxxx, FAP-224Dxxxxxx (Refer to 3.1 for more details)
FCC ID:	TVE-24122013
RECEIVED:	Oct. 24, 2014
TESTED:	Nov. 07 to 25, 2014
ISSUED:	Dec. 17, 2014
APPLICANT:	Fortinet Inc.
ADDRESS:	899 Kifer Road Sunnyvale, CA 94086, USA
ISSUED BY:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
LAB ADDRESS :	No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, R.O.C.
TEST LOCATION (1):	No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, R.O.C.
TEST LOCATION (2):	No. 49, Ln. 206, Wende Rd., Shangshan Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, R.O.C.

This report should not be used by the client to claim product certification, approval, or endorsement by TAF or any government agencies.

Testing Laboratory 2022

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF141024C24B-1	Original release	Dec. 17, 2014

1. CERTIFICATION

PRODUCT:	Secured Wireless Access Point
BRAND NAME:	Fortinet
MODEL NO.:	FORTIAP-224Dxxxxxx, FortiAP-224Dxxxxxx, FAP-224Dxxxxxx (Refer to 3.1 for more details)
TEST SAMPLE:	ENGINEERING SAMPLE
APPLICANT:	Fortinet Inc.
TESTED:	Nov. 07 to 25, 2014
STANDARDS:	**FCC Part 15, Subpart E (Section 15.407)**
	ANSI C63.10-2009

The above equipment (Model: FAP-224D) 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:** Dec. 17, 2014
(Claire Kuan, Specialist)

Approved by : _____ , **Date:** Dec. 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 -7.62dB at 0.55234MHz
15.407 (b)(1/2/3/4/6)	Radiated Emissions & Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -0.9dB at 5144.00MHz
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	Antenna connector is R-SMA not a standard connector.

NOTE: 1. This report is prepared for FCC class II permissive change. All test Measurement were presented in this 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)	5.37 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

PRODUCT	Secured Wireless Access Point
MODEL NO.	FORTIAP-224Dxxxxxx, FortiAP-224Dxxxxxx, FAP-224Dxxxxxx (Refer to Note for more details)
POWER SUPPLY	DC 12V from power adapter or DC 48V from POE
MODULATION TYPE	64QAM, 16QAM, QPSK, BPSK for OFDM
MODULATION TECHNOLOGY	OFDM
TRANSFER RATE	802.11a: up to 54Mbps 802.11n: up to 300Mbps
OPERATING FREQUENCY	5.18 ~ 5.24GHz
NUMBER OF CHANNEL	4 for 802.11a, 802.11n (HT20) 2 for 802.11n (HT40)
MAXIMUM OUTPUT POWER	802.11a: 19.591mW 802.11n (HT20): 19.65mW 802.11n (HT40): 19.066mW
ANTENNA TYPE	Please see Note
DATA CABLE	NA
I/O PORTS	Refer to user's manual
ASSOCIATED DEVICES	POE x 1

Note:

1. This report is prepared for FCC class II permissive change. The difference compared with the Report No.: RF141024C24-1 design is as the following information:
   - Add 5.15~5.25GHz frequencies band.
2. According to above condition, all test to be performed. And all data was verified to meet the requirements.
3. The EUT has below model names, which are identical to each other in all aspects except for the following information:

Brand Name	Model Name	Description
Fortinet	FORTIAP-224Dxxxxxx	where "x" can be used as "A-Z", or "0-9", or "-", or blank for software changes or marketing purposes only
	FortiAP-224Dxxxxxx	
	FAP-224Dxxxxxx	
From the above models, model: **FAP-224D** was selected as the representative model for the test and its data is recorded in this report.		

4. The EUT must be supplied with a power adapter or an POE as below table:

Adapter 1 (test only, not for sale)		
Brand	Model No.	Spec.
Powertron Electronics Corp.	PA1015-2I PA1015-2I120125	Input: 100-240V, 0.4A, 50-60Hz Output: 12V, 1.25A, 15W Max DC output cable(unshielded,1.5m)
Adapter 2 (test only, not for sale)		
Brand	Model No.	Spec.
DELTA ELECTRONICS, INC.	EADP-30HB B PA1015-2I120125	Input: 100-240V, 1A, 50-60Hz Output: 12V, 2.5A DC output cable(unshielded,1.5m)
POE*		
Brand	Model No.	Spec.
Fortinet	EPE-5818Gaf	DC48V, 0.375A

* The POE must be supplied with the following adapter:

Brand	Model No.	Spec.
Powertron Electronics Corp.	PA1040-480IB080	Input: 100-240V, 1.5A, 50-60Hz AC input cable(unshielded, 1.55m with 1 core) Output: 48V, 0.8A, 38.4W Max

5. The antennas provided to the EUT, please refer to the following table:

For 2.4GHz used						
Ant. No.	Transmitter Circuit	Model No.	Ant. Gain (dBi) Include cable loss	Frequency range (MHz to MHz)	Ant. Type	Connecter Type
1	Chain (0)	98141MRSX003	5	2400~2483.5	Dipole	R-SMA
2	Chain (1)	98141MRSX003	5	2400~2483.5	Dipole	R-SMA
For 5GHz used						
Ant. No.	Transmitter Circuit	Model No.	Ant. Gain (dBi) Include cable loss	Frequency range (MHz to MHz)	Ant. Type	Connecter Type
1	Chain (0)	98141URSX002	5	5150~5850	Dipole	R-SMA
2	Chain (1)	98141URSX002	5	5150~5850	Dipole	R-SMA

6. The EUT incorporates a MIMO function.

For 2.4G Band		
MODULATION MODE	**DATA RATE (MCS)**	**TX & RX CONFIGURATION**
802.11b	1 ~ 11Mbps	2TX / 2RX
802.11g	6 ~ 54Mbps	2TX / 2RX
802.11n (HT20) & 802.11n (HT40)	MCS 0~7	2TX / 2RX
	MCS 8~15	2TX / 2RX
For 5G Band		
802.11a	6 ~ 54Mbps	2TX / 2RX
802.11n (HT20) & 802.11n (HT40)	MCS 0~7	2TX / 2RX
	MCS 8~15	2TX / 2RX

7. EUT has been pre-tested under following pre-test modes.

Pre-test Mode	Power
A	Adapter
B	POE
From the above modes, the radiated emission worse case was found in **Mode A**. Therefore only the test data of the mode was recorded in this report.	

8. The emission of the simultaneous operation (2.4GHz & 5GHz) has been evaluated and no non-compliance was found.
9. 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	
1	√	√	√	√	Adapter mode
2	√	-	-	-	POE mode

Where **PLC:** Power Line Conducted Emission **RE < 1G:** Radiated Emission below 1GHz

RE ≥ 1G: Radiated Emission above 1GHz **APCM:** Antenna Port Conducted Measurement

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane** (for below 1GHz) and **Z-plane** (for above 1GHz).

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 (HT40)	38 to 46	38	OFDM	BPSK	13.5

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 (HT40)	38 to 46	38	OFDM	BPSK	13.5

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	MODULATION 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	MODULATION 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	24deg. C, 68,%RH	120Vac, 60Hz	Wythe Lin
	26deg. C, 67,%RH	120Vac, 60Hz	Wythe Lin
RE<1G	26deg. C, 68%RH	120Vac, 60Hz	Tim Ho
RE≥1G	24deg. C, 69%RH	120Vac, 60Hz	Tim Ho
APCM	25deg. C, 60%RH	120Vac, 60Hz	Anderson Chen

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

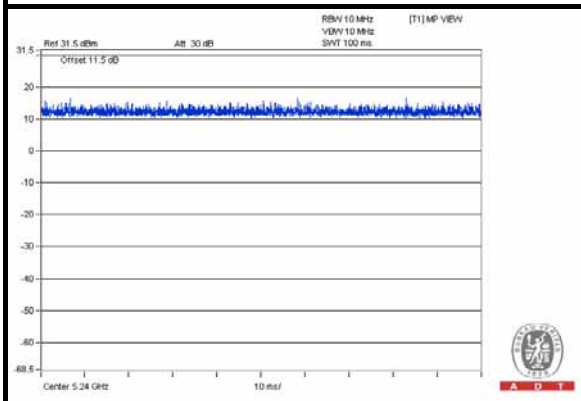
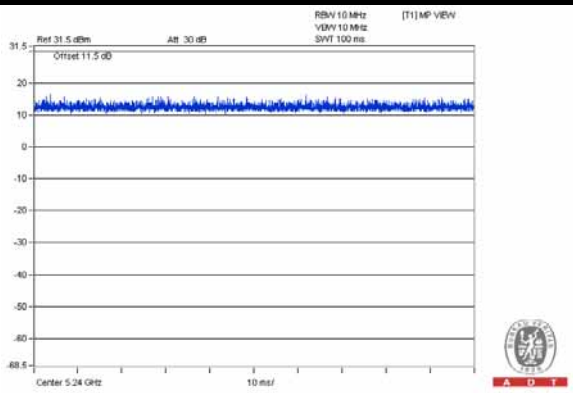
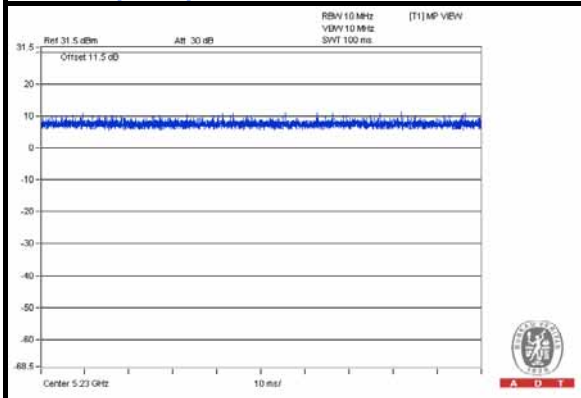
ANSI C63.10-2009

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	802.11n (HT20)
	
802.11n (HT40)	
	

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	Remark
A	NOTEBOOK COMPUTER	DELL	E5430	GM1SKV1	FCC DoC	Provided by Lab
B	Adapter (for conducted test)	DELTA ELECTRONICS, INC.	EADP-30HB B PA1015-2I120 125	NA	NA	Supplied by Client
	Adapter (for other test)	Powertron Electronics Corp.	PA1015-2I PA1015-2I120 125	NA	NA	Supplied by Client

NOTE:

1. All power cords of the above support units are non-shielded (1.8 m).

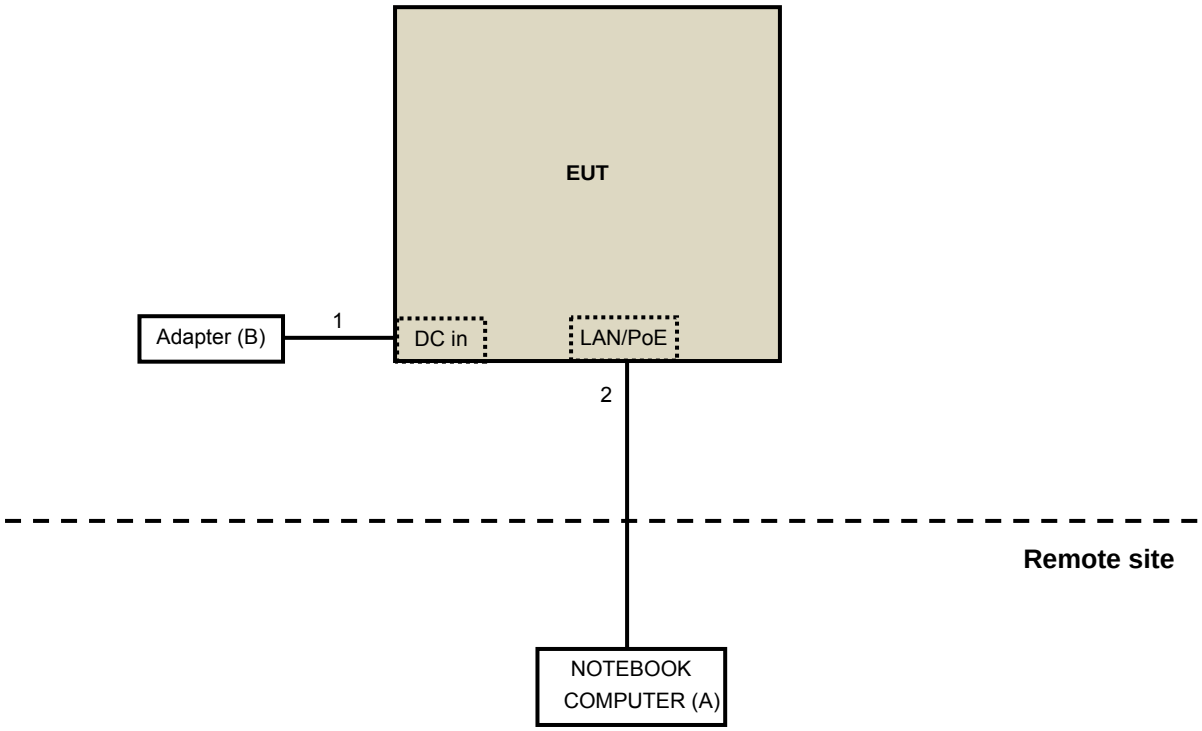
No.	Cable	Qty.	Length (m)	Shielded (Yes/ No)	Cores (Number)	Remark
1.	DC	1	1.5	No	0	Supplied by Client
2.	RJ-45	1	10	No	0	Provided by Lab
3.	DC	1	1.55	No	1	Supplied by Client
4.	GND	1	1.6	No	0	Provided by Lab
5.	RJ-45	1	3	No	0	Provided by Lab

NOTE:

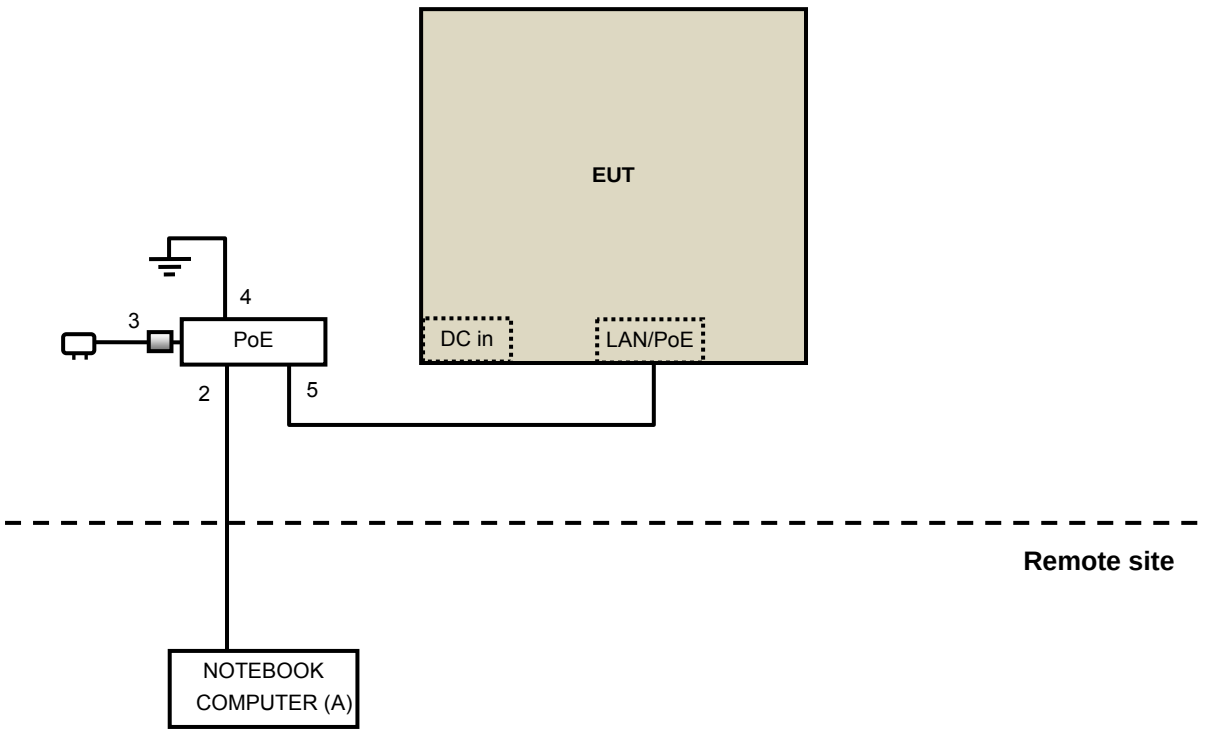
1. The core(s) is(are) originally attached to the cable(s).

3.6 CONFIGURATION OF SYSTEM UNDER TEST

For Adapter Mode:



For PoE Mode:



4. TEST TYPES AND RESULTS

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15-0.5 0.5-5 5-30	66 to 56 56 60	56 to 46 46 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	NSLK-8127	8127-522	Sep. 15, 2014	Sep. 14, 2015
Line-Impedance Stabilization Network (for Peripheral) ROHDE & SCHWARZ	ENV216	100071	Nov. 10, 2014	Nov. 09, 2015
RF Cable (JYEBAO)	5DFB	COCCAB-001	Mar. 10 , 2014	Mar. 09, 2015
50 ohms Terminator	N/A	EMC-03	Sep. 22, 2014	Sep. 21, 2015
50 ohms Terminator	N/A	EMC-02	Sep. 30, 2014	Sep. 29, 2015
Software ADT	BV ADT_Cond_V7.3.7.3	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 test was performed in Shielded Room No. C.
3 The VCCI Con C Registration No. is C-3611.
4 Tested Date: Nov. 21 to 25, 2014

4.1.3 TEST PROCEDURES

a. 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.

b. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

c. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

d. The frequency range from 150kHz to 30MHz was searched. Emission level under (Limit – 20dB) was not recorded.

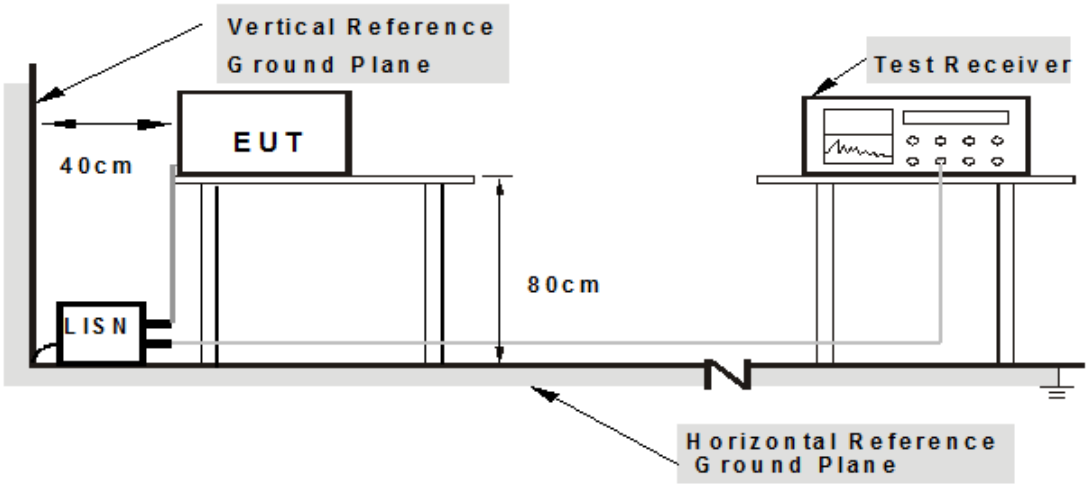
NOTE:

1. 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. Connect the EUT with the support unit A (Notebook Computer) which is placed on table in remote site.
2. The communication partner run test program “artgui.exe” to enable EUT under transmission/receiving condition continuously at specific channel frequency.

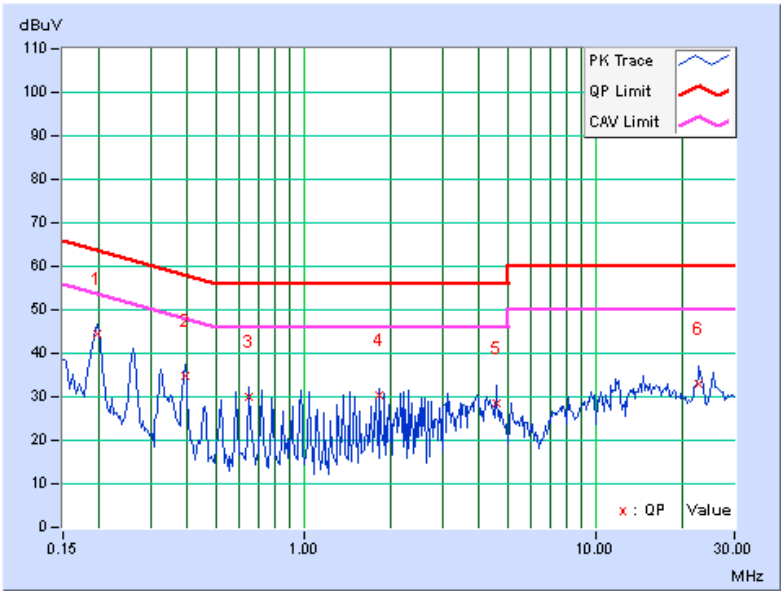
4.1.7 TEST RESULTS (MODE 1)

PHASE	Line (L)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)

	Freq.	Corr.	Reading Value		Emission Level		Limit		Margin	
No		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.19687	0.07	44.47	34.18	44.54	34.25	63.74	53.74	-19.20	-19.49
2	0.39219	0.09	34.91	29.68	35.00	29.77	58.02	48.02	-23.02	-18.25
3	0.65391	0.11	29.95	28.56	30.06	28.67	56.00	46.00	-25.94	-17.33
4	1.82813	0.17	30.16	28.22	30.33	28.39	56.00	46.00	-25.67	-17.61
5	4.57031	0.27	28.18	22.66	28.45	22.93	56.00	46.00	-27.55	-23.07
6	22.73438	0.75	32.17	27.31	32.92	28.06	60.00	50.00	-27.08	-21.94

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

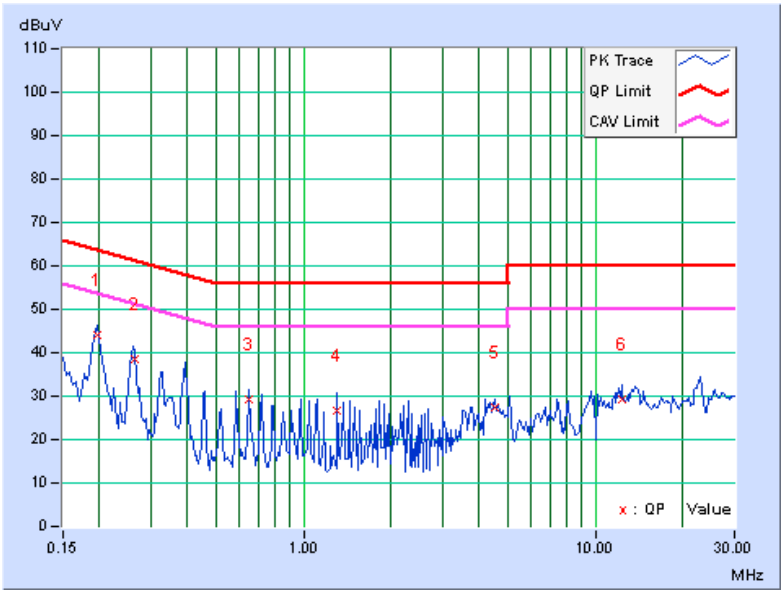


PHASE	Neutral (N)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)

	Freq.	Corr.	Reading Value		Emission Level		Limit		Margin	
No		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.19687	0.06	44.13	33.04	44.19	33.10	63.74	53.74	-19.55	-20.64
2	0.26328	0.07	38.50	29.34	38.57	29.41	61.33	51.33	-22.76	-21.92
3	0.65391	0.11	29.31	27.55	29.42	27.66	56.00	46.00	-26.58	-18.34
4	1.30469	0.15	26.65	20.74	26.80	20.89	56.00	46.00	-29.20	-25.11
5	4.50391	0.28	27.07	22.38	27.35	22.66	56.00	46.00	-28.65	-23.34
6	12.32813	0.53	28.64	24.10	29.17	24.63	60.00	50.00	-30.83	-25.37

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



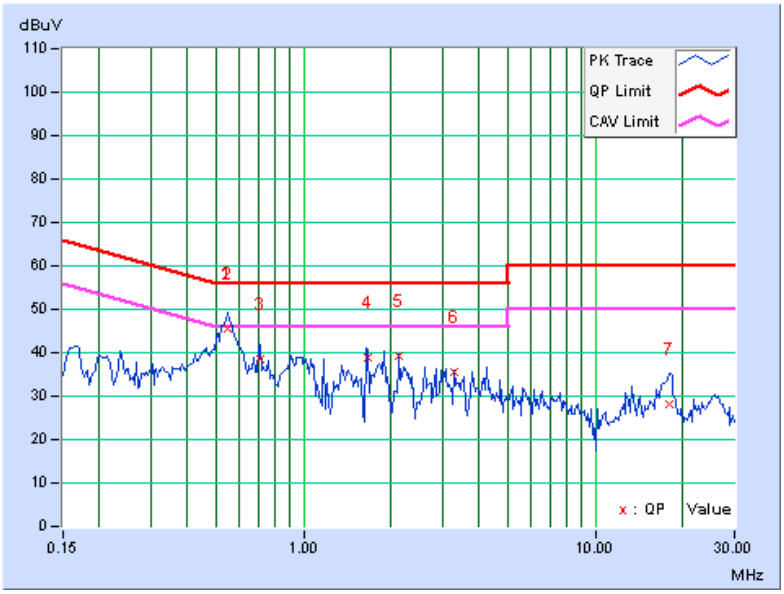
4.1.8 TEST RESULTS (MODE 2)

PHASE	Line (L)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)

	Freq.	Corr.	Reading Value		Emission Level		Limit		Margin	
No		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	**0.55234**	**0.10**	**45.52**	**38.28**	**45.62**	**38.38**	**56.00**	**46.00**	**-10.38**	**-7.62**
2	0.55234	0.10	45.48	37.73	45.58	37.83	56.00	46.00	-10.42	-8.17
3	0.70859	0.11	38.41	35.48	38.52	35.59	56.00	46.00	-17.48	-10.41
4	1.65319	0.16	38.88	36.73	39.04	36.89	56.00	46.00	-16.96	-9.11
5	2.12500	0.18	39.03	36.36	39.21	36.54	56.00	46.00	-16.79	-9.46
6	3.30469	0.23	35.31	32.81	35.54	33.04	56.00	46.00	-20.46	-12.96
7	18.01953	0.65	27.36	20.35	28.01	21.00	60.00	50.00	-31.99	-29.00

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

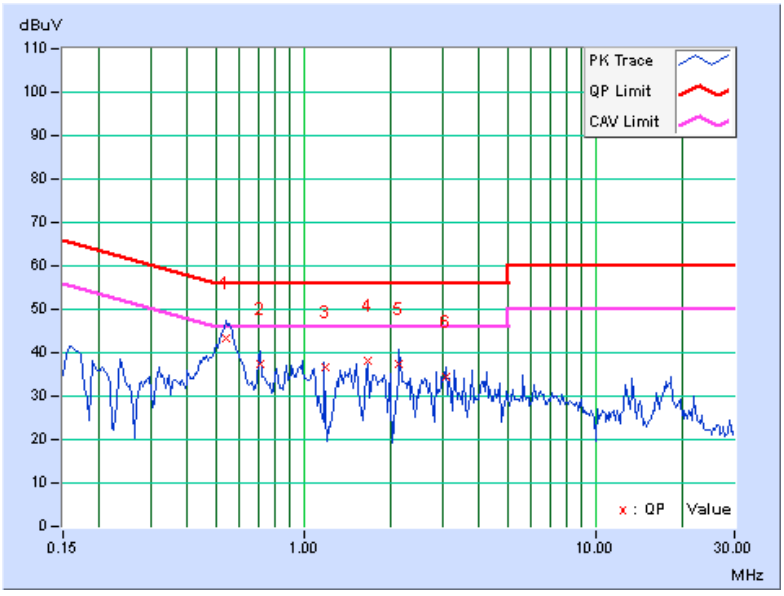


PHASE	Neutral (N)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)

	Freq.	Corr.	Reading Value		Emission Level		Limit		Margin	
No		Factor	[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.54063	0.10	43.10	34.91	43.20	35.01	56.00	46.00	-12.80	-10.99
2	0.70859	0.11	37.16	34.67	37.27	34.78	56.00	46.00	-18.73	-11.22
3	1.18181	0.14	36.49	35.07	36.63	35.21	56.00	46.00	-19.37	-10.79
4	1.65409	0.16	38.11	36.05	38.27	36.21	56.00	46.00	-17.73	-9.79
5	2.12891	0.19	37.05	34.32	37.24	34.51	56.00	46.00	-18.76	-11.49
6	3.07422	0.22	34.35	31.28	34.57	31.50	56.00	46.00	-21.43	-14.50

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) *1 PK:-17 (dBm/MHz) *2	PK: 68.2(dBμV/m) *1 PK:78.2 (dBμV/m) *2

NOTE: *1 beyond 10MHz of the band edge *2 within 10 MHz of band edge

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

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

4.2.3 TEST INSTRUMENTS

For Below 1GHz:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
MXE EMI Receiver Agilent	N9038A	MY51210105	July 21, 2014	July 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. 04, 2014	Oct. 03, 2015
Horn_Antenna AISI	AIH.8018	0000320091110	Aug. 27, 2014	Aug. 26, 2015
Pre-Amplifier Agilent	8449B	3008A02578	June 24, 2014	June 23, 2015
RF Cable	NA	131205 131214 SNMY23684/4	Jan. 17, 2014	Jan. 16, 2015
Spectrum Analyzer R&S	FSV40	100964	July 05, 2014	July 04, 2015
Pre-Amplifier EMCI	EMC184045	980143	Jan. 17, 2014	Jan. 16, 2015
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Aug. 26, 2014	Aug. 25, 2015
RF Cable	NA	RF104-121 RF104-204	Dec. 12, 2013	Dec. 11, 2014
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: Nov. 07, 2014

For Above 1GHz:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
MXE EMI Receiver Agilent	N9038A	MY51210105	July 21, 2014	July 20, 2015
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-03	Nov. 12, 2014	Nov. 11, 2015
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-360	Feb. 26, 2014	Feb. 25, 2015
RF Cable	NA	CHGCAB_001	Oct. 04, 2014	Oct. 03, 2015
Horn_Antenna AISI	AIH.8018	0000320091110	Aug. 27, 2014	Aug. 26, 2015
Pre-Amplifier Agilent	8449B	3008A02578	June 24, 2014	June 23, 2015
RF Cable	NA	131205 131214 SNMY23684/4	Jan. 17, 2014	Jan. 16, 2015
Spectrum Analyzer R&S	FSV40	100964	July 05, 2014	July 04, 2015
Pre-Amplifier EMCI	EMC184045	980143	Jan. 17, 2014	Jan. 16, 2015
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Aug. 26, 2014	Aug. 25, 2015
RF Cable	NA	RF104-121 RF104-204	Dec. 12, 2013	Dec. 11, 2014
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: Nov. 24, 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:

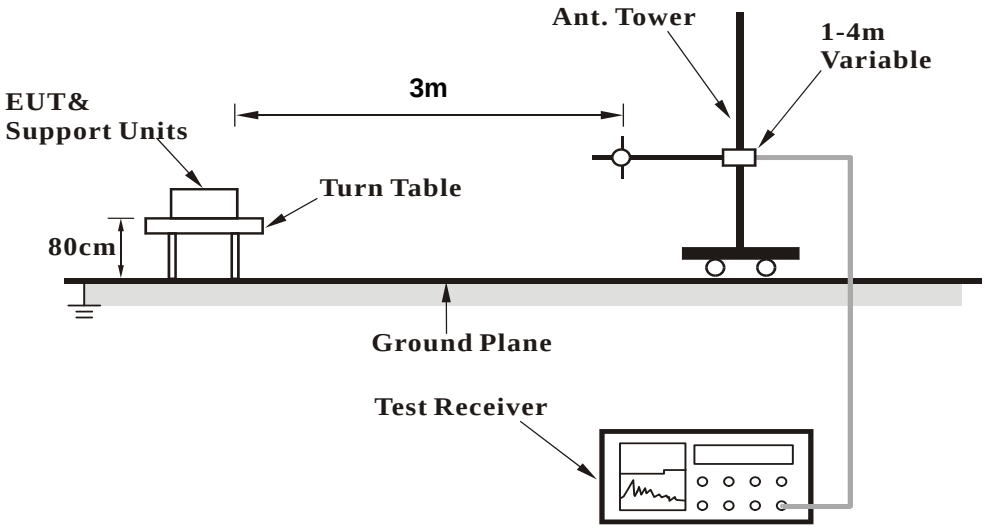
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
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/duty cycle)).
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (Duty cycle ≥ 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

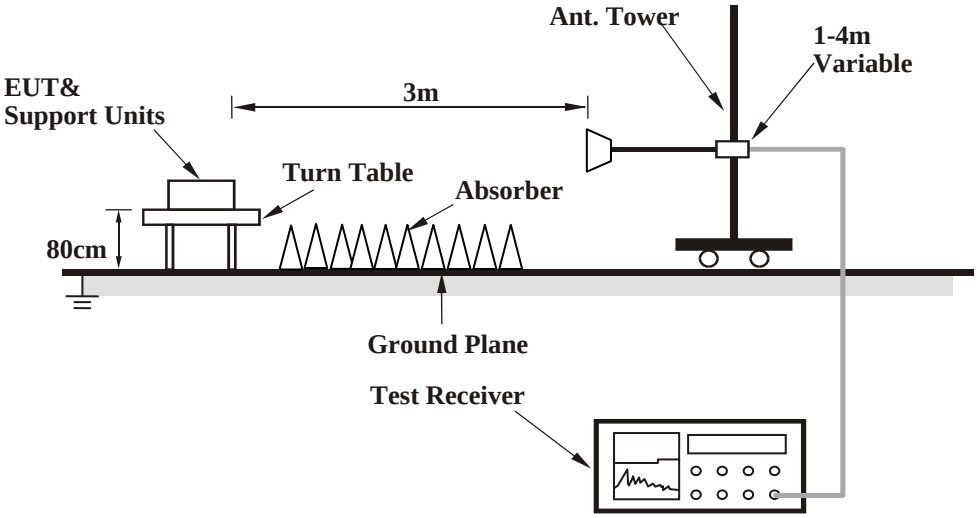
No deviation

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 (HT40)

CHANNEL	TX Channel 38	**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	41.45	31.1 QP	40.0	-8.9	1.50 H	251	44.95	-13.83
2	125.01	34.1 QP	43.5	-9.4	1.50 H	290	49.22	-15.10
3	256.20	40.2 QP	46.0	-5.8	1.00 H	29	54.47	-14.23
4	262.95	41.4 QP	46.0	-4.6	1.00 H	360	55.39	-13.96
5	625.00	35.6 QP	46.0	-10.4	1.00 H	360	39.95	-4.31
6	833.89	41.9 QP	46.0	-4.1	1.00 H	354	42.59	-0.67
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	38.24	37.8 QP	40.0	-2.2	1.00 V	282	51.84	-14.02
2	70.84	35.7 QP	40.0	-4.3	1.00 V	81	51.55	-15.87
3	125.01	39.5 QP	43.5	-4.0	1.00 V	345	54.59	-15.10
4	261.15	42.1 QP	46.0	-3.9	1.50 V	9	56.17	-14.04
5	625.00	43.4 QP	46.0	-2.6	1.50 V	0	47.71	-4.31
6	834.08	43.8 QP	46.0	-2.2	1.50 V	1	44.46	-0.67

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

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	5136.00	61.2 PK	74.0	-12.8	1.00 H	182	54.46	6.74
2	5136.00	50.2 AV	54.0	-3.8	1.00 H	182	43.46	6.74
3	5150.00	72.6 PK	74.0	-1.4	1.00 H	183	65.80	6.80
4	5150.00	48.4 AV	54.0	-5.6	1.00 H	183	41.60	6.80
5	*5180.00	114.8 PK			1.00 H	183	107.85	6.95
6	*5180.00	105.1 AV			1.00 H	183	98.15	6.95
7	#6906.00	63.7 PK	68.2	-4.5	1.16 H	169	51.05	12.65
8	#10360.00	65.0 PK	68.2	-3.2	1.20 H	238	51.89	13.11
9	15540.00	61.2 PK	74.0	-12.8	1.17 H	215	42.51	18.69
10	15540.00	49.3 AV	54.0	-4.7	1.17 H	215	30.61	18.69
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	5136.00	57.1 PK	74.0	-16.9	1.10 V	260	50.36	6.74
2	5136.00	46.2 AV	54.0	-7.8	1.10 V	260	39.46	6.74
3	5150.00	56.2 PK	74.0	-17.8	1.08 V	260	49.40	6.80
4	5150.00	45.1 AV	54.0	-8.9	1.08 V	260	38.30	6.80
5	*5180.00	107.2 PK			1.08 V	260	100.25	6.95
6	*5180.00	98.2 AV			1.08 V	260	91.25	6.95
7	#6906.00	61.4 PK	68.2	-6.8	1.00 V	110	48.75	12.65
8	#10360.00	65.7 PK	68.2	-2.5	1.05 V	336	52.59	13.11
9	15540.00	60.6 PK	74.0	-13.4	1.07 V	328	41.91	18.69
10	15540.00	48.7 AV	54.0	-5.3	1.07 V	328	30.01	18.69

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.

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	5146.00	69.5 PK	74.0	-4.5	1.00 H	182	62.73	6.77
2	5146.00	52.8 AV	54.0	-1.2	1.00 H	182	46.03	6.77
3	*5200.00	120.2 PK			1.00 H	182	113.15	7.05
4	*5200.00	109.3 AV			1.00 H	182	102.25	7.05
5	#10400.00	65.9 PK	68.2	-2.3	1.22 H	248	52.68	13.22
6	15600.00	62.1 PK	74.0	-11.9	1.25 H	201	43.40	18.70
7	15600.00	50.2 AV	54.0	-3.8	1.25 H	201	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	5146.00	56.8 PK	74.0	-17.2	1.08 V	271	50.03	6.77
2	5146.00	46.3 AV	54.0	-7.7	1.08 V	271	39.53	6.77
3	*5200.00	113.1 PK			1.06 V	263	106.05	7.05
4	*5200.00	102.1 AV			1.06 V	263	95.05	7.05
5	#10400.00	65.4 PK	68.2	-2.8	1.06 V	338	52.18	13.22
6	15600.00	60.2 PK	74.0	-13.8	1.13 V	313	41.50	18.70
7	15600.00	48.4 AV	54.0	-5.6	1.13 V	313	29.70	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.

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	5146.00	63.3 PK	74.0	-10.7	1.00 H	182	56.53	6.77
2	5146.00	46.0 AV	54.0	-8.0	1.00 H	182	39.23	6.77
3	*5240.00	122.5 PK			1.00 H	183	115.34	7.16
4	*5240.00	111.8 AV			1.00 H	183	104.64	7.16
5	#6986.00	64.4 PK	68.2	-3.8	1.15 H	169	51.47	12.93
6	#10480.00	66.1 PK	68.2	-2.1	1.21 H	249	52.94	13.16
7	15720.00	64.3 PK	74.0	-9.7	1.36 H	220	45.90	18.40
8	15720.00	52.9 AV	54.0	-1.1	1.36 H	220	34.50	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	5146.00	57.1 PK	74.0	-16.9	1.02 V	265	50.33	6.77
2	5146.00	46.1 AV	54.0	-7.9	1.02 V	265	39.33	6.77
3	*5240.00	115.1 PK			1.05 V	252	107.94	7.16
4	*5240.00	104.5 AV			1.05 V	252	97.34	7.16
5	#10480.00	65.9 PK	68.2	-2.3	1.02 V	351	52.74	13.16
6	15720.00	62.8 PK	74.0	-11.2	1.04 V	319	44.40	18.40
7	15720.00	51.1 AV	54.0	-2.9	1.04 V	319	32.70	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.

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	73.0 PK	74.0	-1.0	1.00 H	154	66.20	6.80
2	5150.00	51.2 AV	54.0	-2.8	1.00 H	154	44.40	6.80
3	*5180.00	115.1 PK			1.00 H	181	108.15	6.95
4	*5180.00	104.2 AV			1.00 H	181	97.25	6.95
5	#6906.00	63.8 PK	68.2	-4.4	1.18 H	182	51.15	12.65
6	#10360.00	66.6 PK	68.2	-1.6	1.23 H	239	53.49	13.11
7	15540.00	61.5 PK	74.0	-12.5	1.21 H	209	42.81	18.69
8	15540.00	49.8 AV	54.0	-4.2	1.21 H	209	31.11	18.69
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	56.1 PK	74.0	-17.9	1.04 V	269	49.30	6.80
2	5150.00	45.1 AV	54.0	-8.9	1.04 V	269	38.30	6.80
3	*5180.00	108.3 PK			1.13 V	275	101.35	6.95
4	*5180.00	97.1 AV			1.13 V	275	90.15	6.95
5	#10360.00	65.7 PK	68.2	-2.5	1.04 V	344	52.59	13.11
6	15540.00	60.1 PK	74.0	-13.9	1.08 V	313	41.41	18.69
7	15540.00	48.2 AV	54.0	-5.8	1.08 V	313	29.51	18.69

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.

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	5144.00	65.8 PK	74.0	-8.2	1.00 H	182	59.03	6.77
2	**5144.00**	**53.1 AV**	**54.0**	**-0.9**	**1.00 H**	**182**	**46.33**	**6.77**
3	*5200.00	118.1 PK			1.00 H	182	111.05	7.05
4	*5200.00	106.9 AV			1.00 H	182	99.85	7.05
5	5456.00	56.2 PK	74.0	-17.8	1.04 H	182	48.32	7.88
6	5456.00	45.1 AV	54.0	-8.9	1.04 H	182	37.22	7.88
7	#10400.00	66.0 PK	68.2	-2.2	1.08 H	248	52.78	13.22
8	15600.00	63.8 PK	74.0	-10.2	1.31 H	202	45.10	18.70
9	15600.00	50.4 AV	54.0	-3.6	1.31 H	202	31.70	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	112.1 PK			1.02 V	248	105.05	7.05
2	*5200.00	99.2 AV			1.02 V	248	92.15	7.05
3	#10400.00	65.7 PK	68.2	-2.5	1.03 V	348	52.48	13.22
4	15600.00	59.4 PK	74.0	-14.6	1.10 V	306	40.70	18.70
5	15600.00	48.7 AV	54.0	-5.3	1.10 V	306	30.00	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.

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	5150.00	58.8 PK	74.0	-15.2	1.07 H	182	52.00	6.80
2	5150.00	44.7 AV	54.0	-9.3	1.07 H	182	37.90	6.80
3	*5240.00	120.1 PK			1.07 H	182	112.94	7.16
4	*5240.00	108.2 AV			1.07 H	182	101.04	7.16
5	5374.00	59.2 PK	74.0	-14.8	1.07 H	182	51.60	7.60
6	5374.00	45.7 AV	54.0	-8.3	1.07 H	182	38.10	7.60
7	#6986.00	64.2 PK	68.2	-4.0	1.21 H	151	51.27	12.93
8	#10480.00	65.3 PK	68.2	-2.9	1.20 H	247	52.14	13.16
9	15720.00	64.1 PK	74.0	-9.9	1.32 H	219	45.70	18.40
10	15720.00	52.6 AV	54.0	-1.4	1.32 H	219	34.20	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	106.5 PK			1.04 V	252	99.34	7.16
2	*5240.00	97.8 AV			1.04 V	252	90.64	7.16
3	#10480.00	65.1 PK	68.2	-3.1	1.00 V	350	51.94	13.16
4	15720.00	61.4 PK	74.0	-12.6	1.03 V	315	43.00	18.40
5	15720.00	50.5 AV	54.0	-3.5	1.03 V	315	32.10	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.

802.11n (HT40)

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

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	72.9 PK	74.0	-1.1	1.00 H	181	66.10	6.80
2	5150.00	53.0 AV	54.0	-1.0	1.00 H	181	46.20	6.80
3	*5190.00	104.1 PK			1.00 H	181	97.10	7.00
4	*5190.00	93.4 AV			1.00 H	181	86.40	7.00
5	#10380.00	62.5 PK	68.2	-5.7	1.20 H	235	49.33	13.17
6	15570.00	59.4 PK	74.0	-14.6	1.20 H	221	40.71	18.69
7	15570.00	48.2 AV	54.0	-5.8	1.20 H	221	29.51	18.69
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	56.6 PK	74.0	-17.4	1.04 V	269	49.80	6.80
2	5150.00	46.0 AV	54.0	-8.0	1.04 V	269	39.20	6.80
3	*5190.00	96.9 PK			1.10 V	246	89.90	7.00
4	*5190.00	86.1 AV			1.10 V	246	79.10	7.00
5	#10380.00	61.5 PK	68.2	-6.7	1.00 V	340	48.33	13.17
6	15570.00	58.7 PK	74.0	-15.3	1.00 V	320	40.01	18.69
7	15570.00	46.1 AV	54.0	-7.9	1.00 V	320	27.41	18.69

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.

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	5150.00	72.1 PK	74.0	-1.9	1.00 H	181	65.30	6.80
2	5150.00	52.9 AV	54.0	-1.1	1.00 H	181	46.10	6.80
3	*5230.00	108.7 PK			1.00 H	181	101.58	7.12
4	*5230.00	97.0 AV			1.00 H	181	89.88	7.12
5	#10460.00	65.1 PK	68.2	-3.1	1.18 H	245	51.92	13.18
6	15690.00	60.1 PK	74.0	-13.9	1.14 H	210	41.72	18.38
7	15690.00	48.5 AV	54.0	-5.5	1.14 H	210	30.12	18.38
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	55.9 PK	74.0	-18.1	1.08 V	259	49.10	6.80
2	5150.00	45.1 AV	54.0	-8.9	1.08 V	259	38.30	6.80
3	*5230.00	101.2 PK			1.14 V	259	94.08	7.12
4	*5230.00	89.9 AV			1.14 V	259	82.78	7.12
5	#10460.00	65.6 PK	68.2	-2.6	1.04 V	334	52.42	13.18
6	15690.00	58.2 PK	74.0	-15.8	1.05 V	315	39.82	18.38
7	15690.00	47.2 AV	54.0	-6.8	1.05 V	315	28.82	18.38

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 ≦ 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 ≤ 4;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 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 ≥ 5.

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

4.3.2 TEST INSTRUMENTS

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 : Nov. 25, 2014

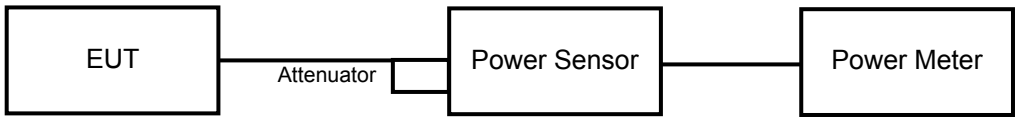
4.3.3 TEST PROCEDURE

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.

4.3.4 DEVIATION FROM TEST STANDARD

No deviation

4.3.5 TEST SETUP



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

For 5.18~5.24GHz:

802.11a

CONDUCTED POWER:

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)
		CHAIN 0	CHAIN 1		
36	5180	9.69	10.12	19.591	12.92
40	5200	9.56	9.86	18.719	12.72
48	5240	9.48	9.85	18.533	12.68

EIRP POWER:

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP POWER (mW)	EIRP POWER (dBm)	EIRP POWER LIMIT (dBm)	PASS/FAIL
36	5180	123.896	20.93	21	PASS
40	5200	118.381	20.73	21	PASS
48	5240	117.205	20.69	21	PASS

Note: 1. Equivalent antenna gain = 5dBi + 10log(2) = 8.01dBi.
2. EIRP power = Conducted power + Equivalent antenna gain

802.11n (HT20)

CONDUCTED POWER:

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)
		CHAIN 0	CHAIN 1		
36	5180	9.65	9.94	19.089	12.81
40	5200	9.42	10.19	19.197	12.83
48	5240	9.75	10.09	19.65	12.93

EIRP POWER:

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP POWER (mW)	EIRP POWER (dBm)	EIRP POWER LIMIT (dBm)	PASS/FAIL
36	5180	120.721	20.82	21	PASS
40	5200	121.404	20.84	21	PASS
48	5240	124.269	20.94	21	PASS

Note: 1. Equivalent antenna gain = 5dBi + 10log(2) = 8.01dBi.
2. EIRP power = Conducted power + Equivalent antenna gain

802.11n (HT40)

CONDUCTED POWER:

CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)		TOTAL POWER (mW)	TOTAL POWER (dBm)
		CHAIN 0	CHAIN 1		
38	5190	9.23	10.29	19.066	12.80
46	5230	9.61	9.89	18.891	12.76

EIRP POWER:

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP POWER (mW)	EIRP POWER (dBm)	EIRP POWER LIMIT (dBm)	PASS/FAIL
38	5190	120.576	20.81	21	PASS
46	5230	119.469	20.77	21	PASS

Note: 1. Equivalent antenna gain = 5dBi + 10log(2) = 8.01dBi.
2. EIRP power = Conducted power + Equivalent antenna gain

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	FSP 40	100060	May 08, 2014	May 07, 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 : Nov. 25, 2014

4.4.3 TEST PROCEDURES

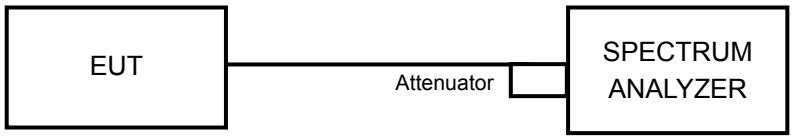
Using method SA-1

1. Set span to encompass the entire emission bandwidth (EBW) of the signal.
2. Set RBW = 1 MHz, Set VBW ≥ 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

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

CHAN.	CHANNEL FREQUENCY (MHz)	PSD (dBm)		TOTAL POWER DENSITY (dBm)	MAX. LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1			
36	5180	-6.10	-3.96	-1.89	14.99	PASS
40	5200	-6.06	-4.67	-2.30	14.99	PASS
48	5240	-6.06	-4.79	-2.37	14.99	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. Directional gain = 5dBi + 10log(2) = 8.01dBi > 6dBi , so the power density limit shall be reduced to 17-(8.01-6) = 14.99dBm.

802.11n (HT20)

CHAN.	CHANNEL FREQUENCY (MHz)	PSD (dBm)		TOTAL POWER DENSITY (dBm)	MAX. LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1			
36	5180	-6.36	-4.69	-2.44	14.99	PASS
40	5200	-5.96	-5.25	-2.58	14.99	PASS
48	5240	-6.80	-5.49	-3.09	14.99	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.

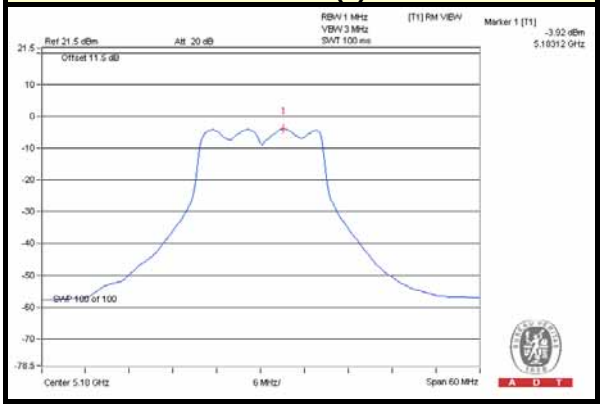
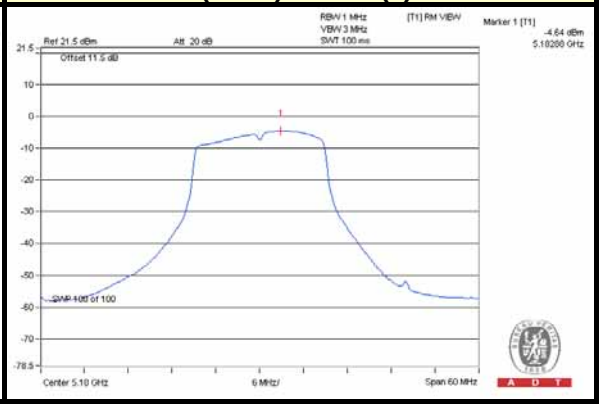
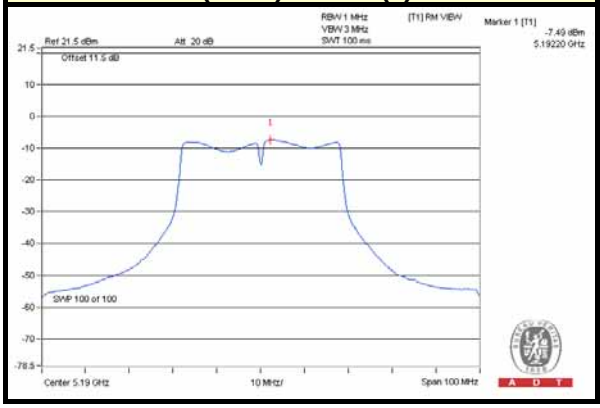
2. Directional gain = 5dBi + 10log(2) = 8.01dBi > 6dBi , so the power density limit shall be reduced to 17-(8.01-6) = 14.99dBm.

802.11n (HT40)

CHAN.	CHANNEL FREQUENCY (MHz)	PSD (dBm)		TOTAL POWER DENSITY (dBm)	MAX. LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1			
38	5190	-8.98	-7.51	-5.17	14.99	PASS
46	5230	-8.65	-7.61	-5.09	14.99	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. Directional gain = 5dBi + 10log(2) = 8.01dBi > 6dBi , so the power density limit shall be reduced to 17-(8.01-6) = 14.99dBm.

SPECTRUM PLOT OF WORST VALUE	
802.11a / Chain(1) : CH36	**802.11n (HT20) / Chain(1) : CH36**
	
802.11n (HT40) / Chain(1) : CH38	
	

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	FSP 40	100060	May 08, 2014	May 07, 2015
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 : Nov. 25, 2014

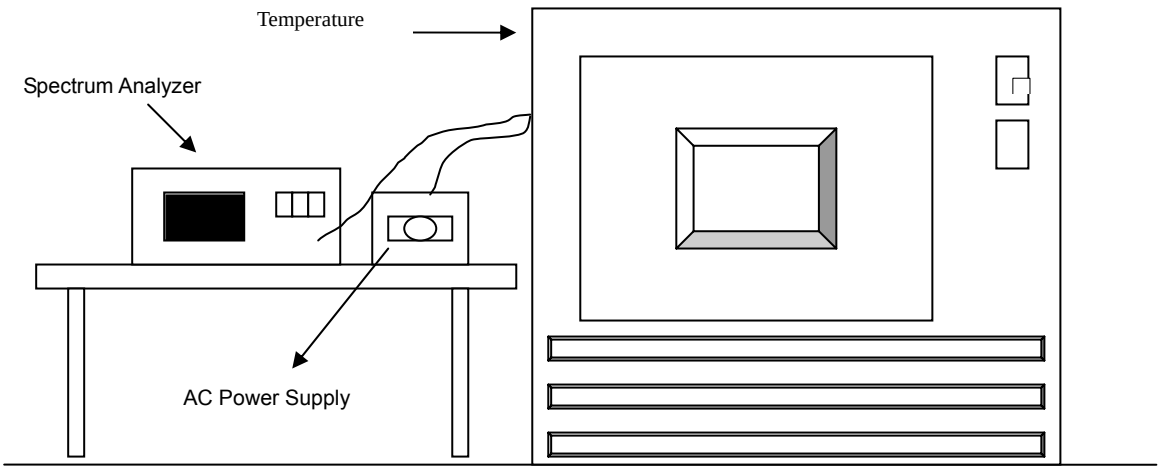
4.5.3 TEST PROCEDURE

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.

4.5.7 TEST RESULTS

FREQUEMCY STABILITY VERSUS TEMP.									
OPERATING FREQUENCY: 5240MHz									
TEMP. (℃)	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	5239.9776	-0.00043	5239.9793	-0.00040	5239.9815	-0.00035	5239.9773	-0.00043
40	120	5239.9755	-0.00047	5239.9762	-0.00045	5239.9773	-0.00043	5239.9746	-0.00048
30	120	5240.0187	0.00036	5240.0197	0.00038	5240.0183	0.00035	5240.0182	0.00035
20	120	5240.0057	0.00011	5240.0032	0.00006	5240.0069	0.00013	5240.0046	0.00009
10	120	5240.0012	0.00002	5240.0052	0.00010	5240.0035	0.00007	5240.0023	0.00004
0	120	5240.0092	0.00018	5240.0071	0.00014	5240.008	0.00015	5240.0102	0.00019
-10	120	5239.9751	-0.00048	5239.9744	-0.00049	5239.9752	-0.00047	5239.9726	-0.00052
-20	120	5239.9956	-0.00008	5239.9953	-0.00009	5239.9957	-0.00008	5239.9927	-0.00014
-30	120	5240.006	0.00011	5240.002	0.00004	5240.0033	0.00006	5240.0041	0.00008

FREQUEMCY STABILITY VERSUS VOLTAGE									
OPERATING FREQUENCY: 5240MHz									
TEMP. (℃)	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	5240.0053	0.00010	5240.003	0.00006	5240.0065	0.00012	5240.0036	0.00007
	120	5240.0057	0.00011	5240.0032	0.00006	5240.0069	0.00013	5240.0046	0.00009
	102	5240.0054	0.00010	5240.0024	0.00005	5240.0062	0.00012	5240.0054	0.00010

5. PHOTOGRAPHS OF THE TEST CONFIGURATION

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

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:

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Fax: 886-3-3270892

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Web Site: www.bureauveritas-adt.com

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

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.

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