

# FCC TEST REPORT (15.407)

**REPORT NO.:** RF130715C28-1

**MODEL NO.:** WAP-7410

**FCC ID:** 2AATB-000001

**RECEIVED:** Jul. 15, 2013

**TESTED:** Jul. 23, 2013 ~ Jul. 26, 2013

**ISSUED:** Aug. 05, 2013

**APPLICANT:** TATUNG TECHNOLOGY INC

**ADDRESS:** 22, CHUNGSHAN N.RD., 3RD SEC., TAIPEI, TAIWAN, 10435

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

**LAB ADDRESS:** No. 47, 14th Ling, Chia Pau Vil., Lin Kou Dist.,  
New Taipei City, Taiwan ( R.O.C )

**TEST LOCATION:** No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei  
Shan Hsiang, Taoyuan Hsien 333, 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.



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification

## TABLE OF CONTENTS

RELEASE CONTROL RECORD	4
1. CERTIFICATION	5
2. SUMMARY OF TEST RESULTS	6
2.1 MEASUREMENT uncertainty	6
3. GENERAL INFORMATION	7
3.1 GENERAL DESCRIPTION OF EUT	7
3.2 DESCRIPTION OF TEST MODES	7
3.2.1 Test Mode Applicability and tested channel detail	8
3.3 DESCRIPTION OF SUPPORT UNITS	10
3.3.1 CONFIGURATION OF SYSTEM UNDER TEST	10
3.4 Duty cycle of test signal	11
3.5 GENERAL DESCRIPTION OF APPLIED STANDARDS	11
4. TEST TYPES AND RESULTS	12
4.1 Radiated Emission AND BANDEDGE Measurement	12
4.1.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT	12
4.1.2 LIMITS OF UNWANTED EMISSION OUT OF THE RESTRICTED BANDS	13
4.1.3 TEST INSTRUMENTS	14
4.1.4 TEST PROCEDURES	15
4.1.5 DEVIATION FROM TEST STANDARD	15
4.1.6 TEST SETUP	16
4.1.7 EUT OPERATING CONDITION	16
4.1.8 Test RESULTS	17
4.2 CONDUCTED EMISSION MEASUREMENT	20
4.2.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT	20
4.2.2 TEST INSTRUMENTS	20
4.2.3 TEST PROCEDURES	21
4.2.4 DEVIATION FROM TEST STANDARD	21
4.2.5 TEST SETUP	21
4.2.6 EUT OPERATING CONDITIONS	21
4.2.7 TEST RESULTS	22
4.3 Peak transmit power MEASUREMENT	24
4.3.1 LIMITS OF PEAK TRANSMIT POWER MEASUREMENT	24
4.3.2 TEST SETUP	24
4.3.3 TEST INSTRUMENTS	24
4.3.4 TEST PROCEDURE	25
4.3.5 DEVIATION FROM TEST STANDARD	25
4.3.6 EUT OPERATING CONDITIONS	25
4.3.7 TEST RESULTS	26
4.4 PEAK power spectral density measurement	27
4.4.1 LIMITS OF PEAK POWER SPECTRAL DENSITY MEASUREMENT	27
4.4.2 TEST SETUP	27



A D T

4.4.3	TEST INSTRUMENTS	27
4.4.4	TEST PROCEDURES	27
4.4.5	DEVIATION FROM TEST STANDARD	28
4.4.6	EUT OPERATING CONDITIONS	28
4.4.7	TEST RESULTS	28
4.5	Peak power EXCURSION MEASUREMENT	29
4.5.1	LIMITS OF PEAK POWER EXCURSION MEASUREMENT	29
4.5.2	TEST SETUP	29
4.5.3	TEST INSTRUMENTS	29
4.5.4	TEST PROCEDURE	29
4.5.5	DEVIATION FROM TEST STANDARD	29
4.5.6	EUT OPERATING CONDITIONS	29
4.5.7	TEST RESULTS	30
4.6	FREQUENCY STABILITY	31
4.6.1	LIMITS OF FREQUENCY STABILITY MEASUREMENT	31
4.6.2	TEST SETUP	31
4.6.3	TEST INSTRUMENTS	31
4.6.4	TEST PROCEDURE	32
4.6.5	DEVIATION FROM TEST STANDARD	32
4.6.6	EUT OPERATING CONDITION	32
4.6.7	TEST RESULTS	33
5.	PHOTOGRAPHS OF THE TEST CONFIGURATION	34
6.	INFORMATION ON THE TESTING LABORATORIES	35
7.	APPENDIX A - Modifications recorders for engineering changes to the eut BY THE LAB	36



## RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF130715C28-1	Original release	Aug. 05, 2013

## 1. CERTIFICATION

**PRODUCT:** Video Bridge  
**MODEL NO.:** WAP-7410  
**BRAND:** TATUNG TECHNOLOGY INC  
**APPLICANT:** TATUNG TECHNOLOGY INC  
**TESTED:** Jul. 23, 2013 ~ Jul. 26, 2013  
**TEST SAMPLE:** Production Unit  
**STANDARDS:** **FCC Part 15, Subpart E (Section 15.407)**  
ANSI C63.10-2009

The above equipment (model: WAP-7410) 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** : Vera Huang , **DATE** : Aug. 05, 2013

Vera Huang / Specialist

**APPROVED BY** : Sam chen , **DATE** : Aug. 05, 2013

Sam Chen / Assistant 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 -9.72dB at 0.17734MHz.
15.407(b/1/2/3)(b)(6)	Spurious Emissions	PASS	Meet the requirement of limit. Minimum passing margin is -3.26dB at 5150MHz.
15.407(a/1/2)	Peak Transmit Power	PASS	Meet the requirement of limit.
15.407(a)(6)	Peak Power Excursion	PASS	Meet the requirement of limit.
15.407(a/1/2)	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.

### 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:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.44 dB
Radiated emissions	30MHz ~ 200MHz	2.93 dB
	200MHz ~1000MHz	2.95 dB
	1GHz ~ 18GHz	2.26 dB
	18GHz ~ 40GHz	1.94 dB

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

### 3. GENERAL INFORMATION

#### 3.1 GENERAL DESCRIPTION OF EUT

<b>EUT</b>	Video Bridge
<b>MODEL NO.</b>	WAP-7410
<b>POWER SUPPLY</b>	9Vdc (adapter)
<b>MODULATION TYPE</b>	64QAM, 16QAM, QPSK, BPSK
<b>MODULATION TECHNOLOGY</b>	OFDM
<b>TRANSFER RATE</b>	802.11n: up to MCS7
<b>OPERATING FREQUENCY</b>	5190 ~ 5230MHz
<b>NUMBER OF CHANNEL</b>	2 for 802.11n (40MHz)
<b>OUTPUT POWER</b>	44.323mW
<b>ANTENNA TYPE</b>	PCB antenna with 2.99dBi gain
<b>ANTENNA CONNECTOR</b>	NA
<b>DATA CABLE</b>	Refer to Note as below
<b>I/O PORTS</b>	Refer to user's manual
<b>ACCESSORY DEVICES</b>	Refer to Note as below

#### NOTE:

1. The EUT has following accessories.

ITEM	BRAND	MODEL	DESCRIPTION
AC Adapter	DVE	DSA-9PFB-09 FUS 090100	I/P: 100-240Vac, 50-60Hz, 0.3A O/P: 9Vdc, 1A

2. The EUT incorporates a MIMO function. Physically, the EUT provides 4 completed transmitters and 4 receivers.

MODULATION MODE	TX FUNCTION
802.11n (40MHz)	4TX

3. The above EUT information is declared by the manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

#### 3.2 DESCRIPTION OF TEST MODES

2 channels are provided for 802.11n (40MHz):

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
	RE $\geq$ 1G	RE<1G	PLC	APCM	
-	√	√	√	√	-

Where **RE $\geq$ 1G**: Radiated Emission above 1GHz **RE<1G**: Radiated Emission below 1GHz  
**PLC**: Power Line Conducted Emission **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 **Z-plane**.

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

- ☒ 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	FREQ. BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11n (40MHz)	5190-5230	38 to 46	38, 46	OFDM	BPSK	13.5

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

- ☒ 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	FREQ. BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11n (40MHz)	5190-5230	38 to 46	38	OFDM	BPSK	13.5

#### POWER LINE CONDUCTED EMISSION TEST:

The EUT was tested with the following mode.

TEST CONDITION
WLAN (5G) Link + Adapter

### BANDEDGE 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	FREQ. BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11n (40MHz)	5190-5230	38 to 46	38, 46	OFDM	BPSK	13.5

### ANTENNA PORT CONDUCTED MEASUREMENT:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ 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	FREQ. BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
802.11n (40MHz)	5190-5230	38 to 46	38, 46	OFDM	BPSK	13.5

### TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE $\geq$ 1G	25deg. C, 65%RH	120Vac, 60Hz	Anson Lin
RE<1G	25deg. C, 65%RH	120Vac, 60Hz	Anson Lin
PLC	25deg. C, 65%RH	120Vac, 60Hz	Johnson Liao
APCM	25deg. C, 65%RH	120Vac, 60Hz	Howard Kao

### 3.3 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.

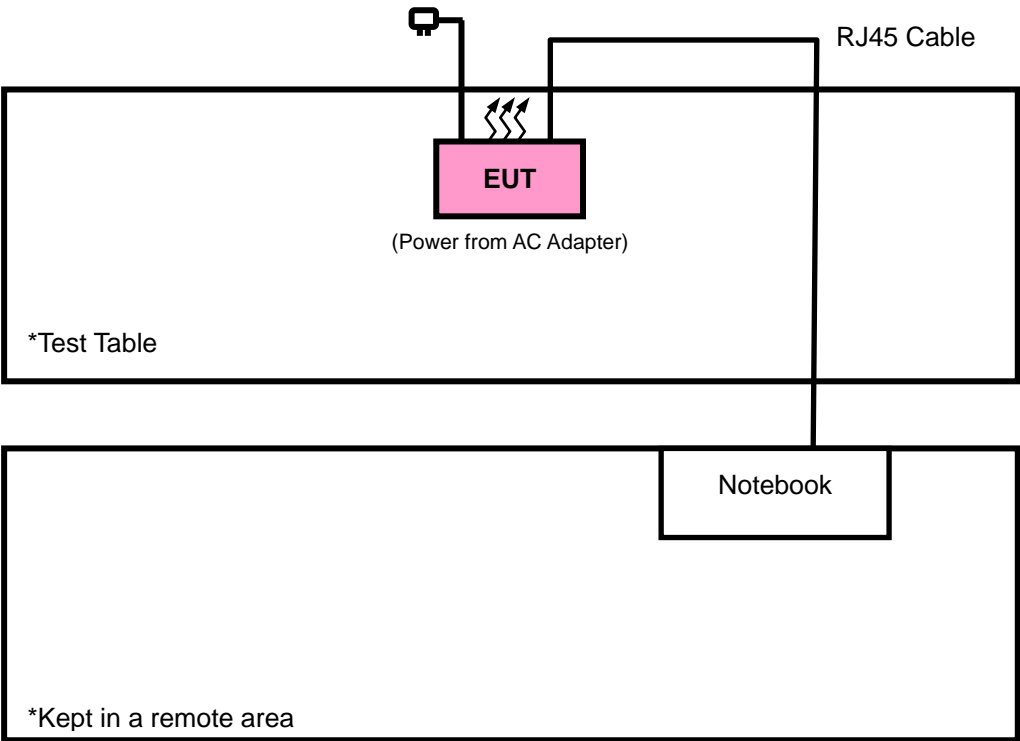
NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	NOTEBOOK	DELL	D531	CN-0XM006-48643 -81U-2973	QDS-BRCM1020

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	NA

**NOTE:**

1. All power cords of the above support units are non shielded (1.8m).
2. Items 1 acted as a communication partner to transfer data.

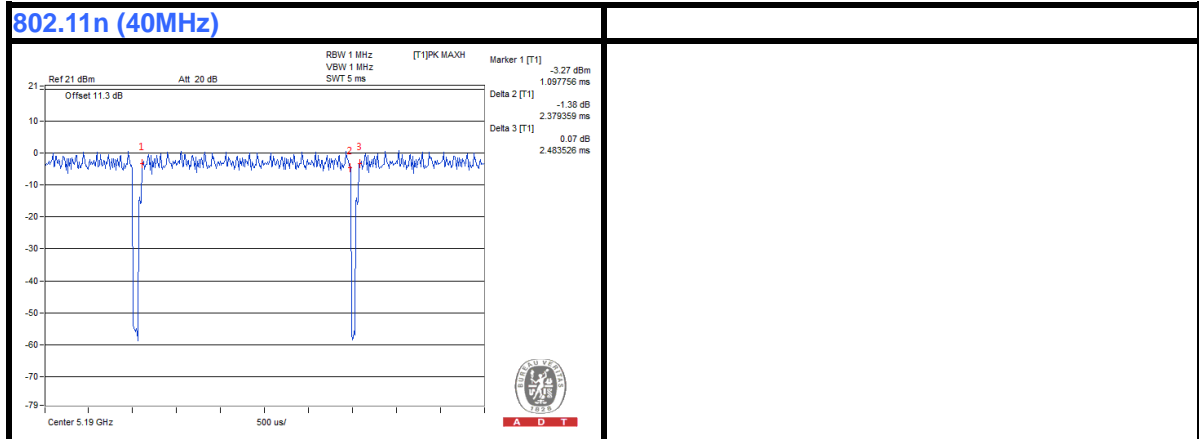
#### 3.3.1 CONFIGURATION OF SYSTEM UNDER TEST



### 3.4 DUTY CYCLE OF TEST SIGNAL

If duty cycle is < 98%, duty factor shall be considered.

**802.11n (40MHz):** Duty cycle =  $2.379/2.484 = 0.958$ , Duty factor =  $10 * \log(1/0.958) = 0.19$



### 3.5 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)**

ANSI C63.10-2009

KDB 789033 D01 General UNII Test Procedures v01r02

662911 D01 Multiple Transmitter Output v01 r02

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

## 4. TEST TYPES AND RESULTS

### 4.1 RADIATED EMISSION AND BANDEDGE MEASUREMENT

#### 4.1.1 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.

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

APPLICABLE TO	LIMIT	
√	FIELD STRENGTH AT 3m (dBμV/m)	
	PK	AV
	74	54
	EIRP LIMIT (dBm)	EQUIVALENT FIELD STRENGTH AT 3m (dBμV/m)
	PK	PK
	-27	68.3

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

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



## 4.1.3 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
Test Receiver ROHDE & SCHWARZ	ESCI	100424	Aug. 21, 2012	Aug. 20, 2013
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 17, 2012	Dec. 16, 2013
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Mar. 25, 2013	Mar. 24, 2014
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-969	Jan. 07, 2013	Jan. 06, 2014
HORN Antenna SCHWARZBECK	BBHA 9170	9170-480	Dec. 25, 2012	Dec. 24, 2013
Loop Antenna	HFH2-Z2	100070	Jan. 31, 2012	Jan. 30, 2014
Preamplifier EMCI	EMC 012645	980115	Dec. 28, 2012	Dec. 27, 2013
Preamplifier EMCI	EMC 184045	980116	Dec. 28, 2012	Dec. 27, 2013
Preamplifier EMCI	EMC 330H	980112	Dec. 28, 2012	Dec. 27, 2013
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	309219/4	Oct. 19, 2012	Oct. 18, 2013
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	250130/4	Oct. 19, 2012	Oct. 18, 2013
RF signal cable Worken	RG-213	NA	Dec. 29, 2012	Dec. 28, 2013
Software	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	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 calibration interval of the loop antenna is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in HwaYa Chamber 10.
4. The horn antenna and HP preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
5. The FCC Site Registration No. is 690701.
6. The IC Site Registration No. is IC 7450F-10.

#### 4.1.4 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. 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 antenna is a broadband antenna, and its height 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 Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

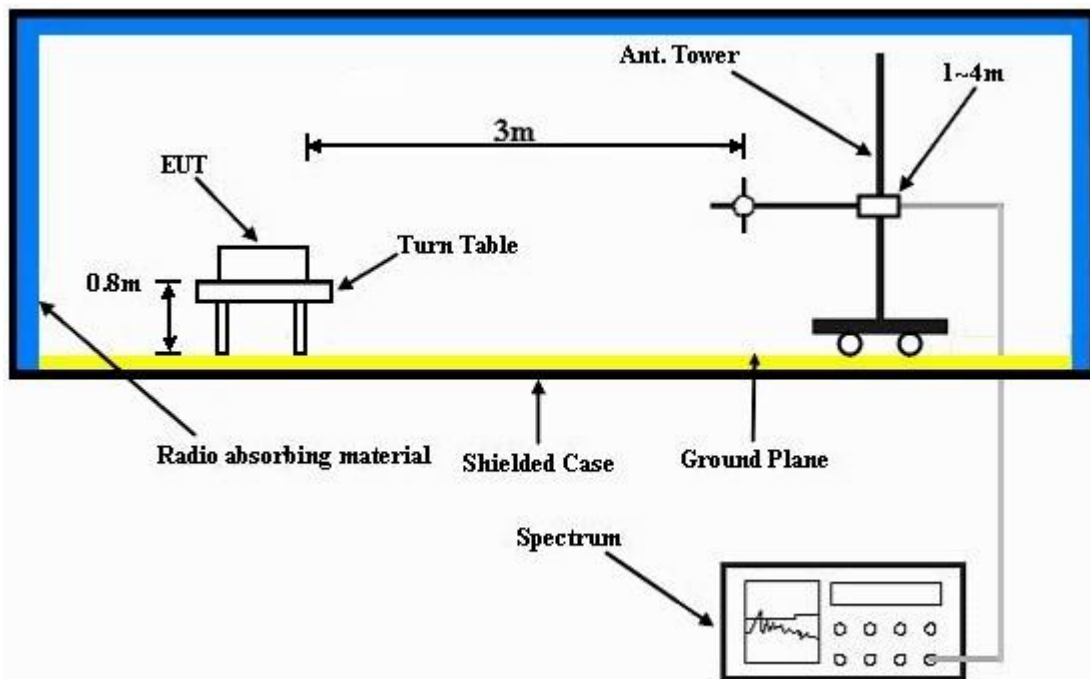
**NOTE:**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 1kHz for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.5 DEVIATION FROM TEST STANDARD

No deviation.

#### 4.1.6 TEST SETUP



For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.1.7 EUT OPERATING CONDITION

- Placed the EUT on a testing table.
- Use the software to control the EUT under transmission condition continuously at specific channel frequency.



A D T

## 4.1.8 TEST RESULTS

## ABOVE 1GHz DATA:

## 802.11n (40MHz)

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 38	FREQUENCY RANGE	1GHz ~ 40GHz
INPUT POWER (SYSTEM)	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK) Average (AV)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Anson Lin

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
5150	50.74	51.45	54	-3.26	31.32	5.29	37.32	100	99	Average
5150	66.21	66.92	74	-7.79	31.32	5.29	37.32	100	99	Peak
5190	97.53	98.2			31.35	5.32	37.34	100	99	Average
5190	105.81	106.48			31.35	5.32	37.34	100	99	Peak
5360	44.96	45.27	54	-9.04	31.48	5.39	37.18	100	99	Average
5360	57.08	57.39	74	-16.92	31.48	5.39	37.18	100	99	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
5146	47.79	48.5	54	-6.21	31.32	5.29	37.32	100	306	Average
5146	59.2	59.91	74	-14.8	31.32	5.29	37.32	100	306	Peak
5190	99.73	100.4			31.35	5.32	37.34	100	306	Average
5190	107.66	108.33			31.35	5.32	37.34	100	306	Peak
5366	48.1	48.39	54	-5.9	31.49	5.4	37.18	100	306	Average
5366	54.57	54.86	74	-19.43	31.49	5.4	37.18	100	306	Peak

REMARKS: 5190MHz: Fundamental frequency.



A D T

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 46	FREQUENCY RANGE	1GHz ~ 40GHz
INPUT POWER (SYSTEM)	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK) Average (AV)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Anson Lin

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
5148	44.41	45.12	54	-9.59	31.32	5.29	37.32	114	101	Average
5148	57.28	57.99	74	-16.72	31.32	5.29	37.32	114	101	Peak
5230	97.74	98.34			31.39	5.33	37.32	114	101	Average
5230	106.37	106.97			31.39	5.33	37.32	114	101	Peak
5434	44.75	44.91	54	-9.25	31.55	5.42	37.13	114	101	Average
5434	57.91	58.07	74	-16.09	31.55	5.42	37.13	114	101	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
5150	43.89	44.6	54	-10.11	31.32	5.29	37.32	103	19	Average
5150	55.71	56.42	74	-18.29	31.32	5.29	37.32	103	19	Peak
5230	100.29	100.89			31.39	5.33	37.32	103	19	Average
5230	107.66	108.26			31.39	5.33	37.32	103	19	Peak
5390	46.35	46.61	54	-7.65	31.51	5.41	37.18	103	19	Average
5390	56.91	57.17	74	-17.09	31.51	5.41	37.18	103	19	Peak

**REMARKS:** 5230MHz: Fundamental frequency.



## BELOW 1GHz WORST-CASE DATA : 802.11n (40MHz)

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 38	FREQUENCY RANGE	30MHz ~ 1GHz
INPUT POWER (SYSTEM)	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK) Average (AV)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Anson Lin

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
57	31.02	49.31	40	-8.98	12.25	0.81	31.35	106	214	Peak
125.04	28.23	47.56	43.5	-15.27	11.35	1.21	31.89	100	331	Peak
224.94	26.38	46.02	46	-19.62	10.42	1.72	31.78	100	148	Peak
320.3	29.23	45.57	46	-16.77	13.43	2.12	31.89	102	160	Peak
440	32.57	45.85	46	-13.43	16.14	2.58	32	100	259	Peak
775.3	29.42	35.28	46	-16.58	21.87	3.63	31.36	103	142	Peak
ANTENNA POLARITY & test distance: VERTICAL at 3 m										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
38.37	33.94	50.91	40	-6.06	13.39	0.64	31	100	36	Peak
75.09	27.26	48.44	40	-12.74	9.57	0.93	31.68	102	115	QP
200.1	23.51	44.33	43.5	-19.99	9.36	1.59	31.77	115	278	Peak
374.9	25.53	40.39	46	-20.47	14.75	2.33	31.94	100	103	Peak
500.2	32.09	43.6	46	-13.91	17.33	2.78	31.62	100	229	Peak
680.1	27.67	35.58	46	-18.33	20.57	3.36	31.84	100	81	Peak

## 4.2 CONDUCTED EMISSION MEASUREMENT

### 4.2.1 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 0.50MHz.  
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

### 4.2.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
Test Receiver ROHDE & SCHWARZ	ESCS30	100288	Nov. 09, 2012	Nov. 08, 2013
RF signal cable Woken	5D-FB	Cable-HYCO2-01	Dec. 28, 2012	Dec. 27, 2013
LISN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Dec. 21, 2012	Dec. 20, 2013
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Jul. 02, 2013	Jul. 01, 2014
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 HwaYa Shielded Room 2.  
 3. The VCCI Site Registration No. is C-2047.

### 4.2.3 TEST PROCEDURES

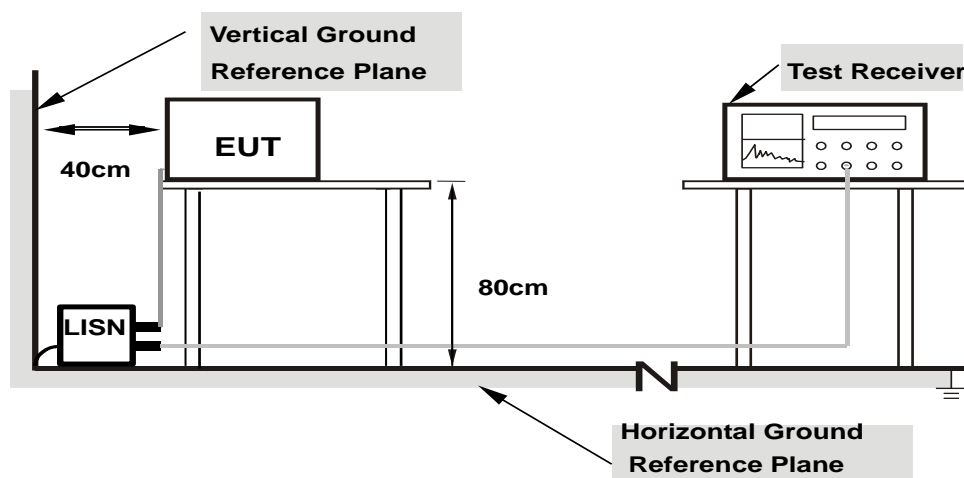
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance 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 levels under (Limit - 20dB) was not recorded.

**NOTE:** All modes of operation were investigated and the worst-case emissions are reported.

### 4.2.4 DEVIATION FROM TEST STANDARD

No deviation.

### 4.2.5 TEST SETUP



**Note:** 1.Support units were connected to second LISN.  
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

For the actual test configuration, please refer to the attached file (Test Setup Photo).

### 4.2.6 EUT OPERATING CONDITIONS

Same as 4.1.6.

## 4.2.7 TEST RESULTS

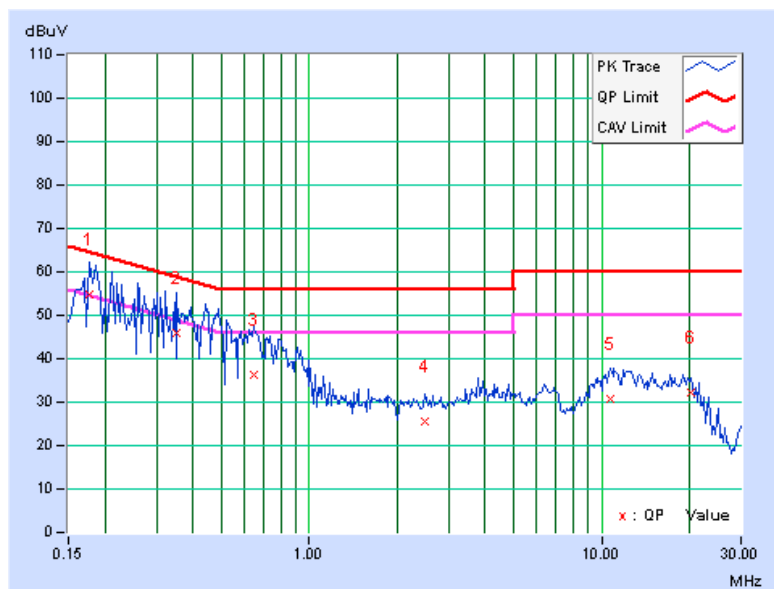
### CONDUCTED WORST-CASE DATA : 802.11n (40MHz)

PHASE	Line 1	6dB BANDWIDTH	9kHz
-------	--------	---------------	------

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	0.17734	0.17	54.72	31.72	54.89	31.89	64.61	54.61	-9.72	-22.72
2	0.35313	0.20	45.77	31.01	45.97	31.21	58.89	48.89	-12.92	-17.68
3	0.64609	0.23	36.15	21.83	36.38	22.06	56.00	46.00	-19.62	-23.94
4	2.48828	0.30	25.30	17.84	25.60	18.14	56.00	46.00	-30.40	-27.86
5	10.69922	0.44	30.26	22.81	30.70	23.25	60.00	50.00	-29.30	-26.75
6	20.25781	0.64	31.53	25.57	32.17	26.21	60.00	50.00	-27.83	-23.79

#### 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

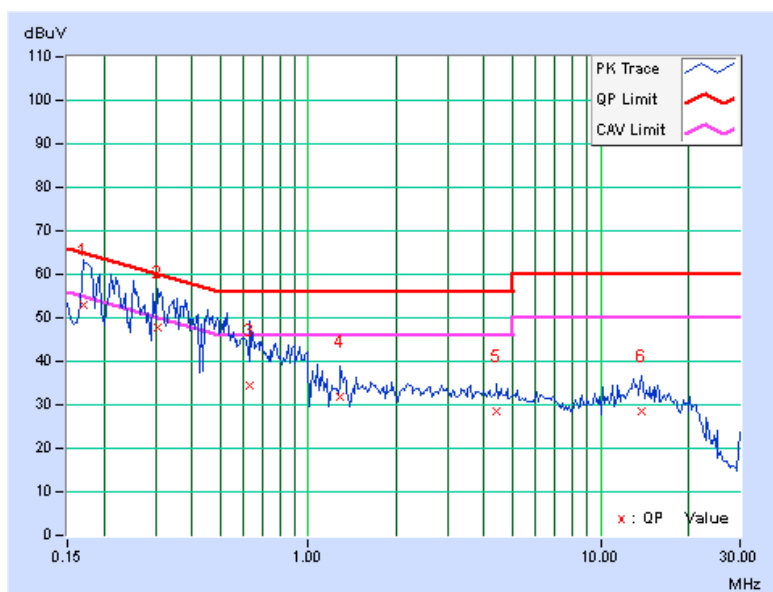


PHASE	Line 2	6dB BANDWIDTH	9kHz
-------	--------	---------------	------

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value		Emission Level		Limit		Margin	
			[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16953	0.18	52.60	36.34	52.78	36.52	64.98	54.98	-12.20	-18.46
2	0.30625	0.22	47.61	30.06	47.83	30.28	60.07	50.07	-12.24	-19.79
3	0.63047	0.24	34.20	20.11	34.44	20.35	56.00	46.00	-21.56	-25.65
4	1.28516	0.24	31.59	25.83	31.83	26.07	56.00	46.00	-24.17	-19.93
5	4.41797	0.40	27.94	22.51	28.34	22.91	56.00	46.00	-27.66	-23.09
6	13.74609	0.57	27.95	20.32	28.52	20.89	60.00	50.00	-31.48	-29.11

#### 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



### 4.3 PEAK TRANSMIT POWER MEASUREMENT

#### 4.3.1 LIMITS OF PEAK TRANSMIT POWER MEASUREMENT

FREQUENCY BAND	LIMIT
5.15 ~ 5.25GHz	The lesser of 50mW (17dBm) or 4dBm + 10logB

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

Per KDB 662911 D01 Multiple Transmitter Output v01r02 Method of conducted output power measurement on IEEE 802.11 devices,

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

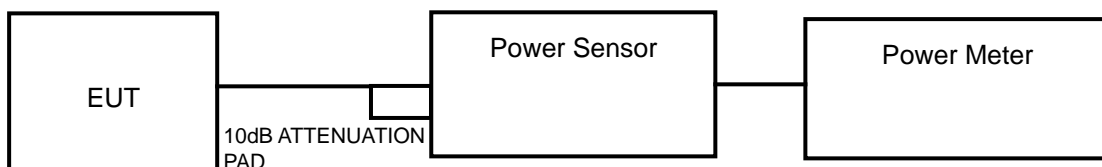
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any NANT;

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

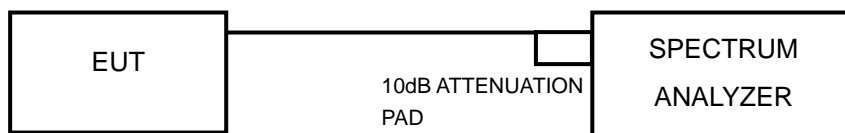
For power measurements on all other devices: Array Gain = 10 log(NANT/NSS) dB.

#### 4.3.2 TEST SETUP

##### FOR POWER OUTPUT MEASUREMENT



##### FOR 26dB BANDWIDTH



#### 4.3.3 TEST INSTRUMENTS

Refer to section 4.1.3 to get information of above instrument.

#### 4.3.4 TEST PROCEDURE

##### FOR AVERAGE POWER 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 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%.

#### 4.3.5 DEVIATION FROM TEST STANDARD

No deviation.

#### 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

##### POWER OUTPUT:

##### 802.11n (40MHz)

CH.	CHAN. FREQ. (MHz)	AVERAGE POWER (dBm)				TOTAL POWER (mW)	TOTAL POWER (dBm)	POWER LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1	CHAIN 2	CHAIN 3				
38	5190	9.84	10.05	11.4	10.32	44.323	16.47	17	PASS
46	5230	9.75	9.9	11.7	10	44.004	16.43	17	PASS

##### 26dB BANDWIDTH:

##### 802.11n (40MHz)

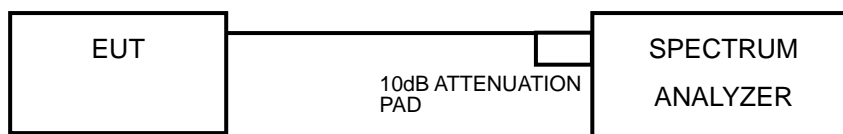
CH.	CHANNEL FREQUENCY (MHz)	26dBc BANDWIDTH (MHz)				PASS / FAIL
		chain 0	chain 1	CHAIN 2	CHAIN 3	
38	5190	44.81	44.58	47.54	44.55	PASS
46	5230	44.38	44.72	45.62	44.85	PASS

## 4.4 PEAK POWER SPECTRAL DENSITY MEASUREMENT

### 4.4.1 LIMITS OF PEAK POWER SPECTRAL DENSITY MEASUREMENT

FREQUENCY BAND	LIMIT
5.150 ~ 5.250GHz	4dBm

### 4.4.2 TEST SETUP



### 4.4.3 TEST INSTRUMENTS

Refer to section 4.1.3 to get information of above instrument.

### 4.4.4 TEST PROCEDURES

Using method SA-2 alternative

- 1) Set span to encompass the entire emission bandwidth (EBW) of the signal.
- 2) Set RBW = 30 kHz, Set VBW  $\geq$  1 MHz, Detector = RMS
- 3) Set Channel power measure = 1MHz
- 4) Sweep time = 30ms
- 5) Perform a single sweep.
- 6) Record the max value and add 10 log (1/duty cycle)

#### 4.4.5 DEVIATION FROM TEST STANDARD

No deviation.

#### 4.4.6 EUT OPERATING CONDITIONS

Same as 4.3.6.

#### 4.4.7 TEST RESULTS

##### 802.11n (40MHz)

CH.	CHAN. FREQ. (MHz)	PSD W/O DUTY FACTOR (dBm)				DUTY FACTOR	PSD W/ DUTY FACTOR (dBm)				TOTAL PSD WITH DUTY FACTOR (dBm)	MAX. LIMIT (dBm)	PASS / FAIL
		CHAIN 0	CHAIN 1	CHAIN 2	CHAIN 3		CHAIN 0	CHAIN 1	CHAIN 2	CHAIN 3			
38	5190	-4.45	-5.99	-5.29	-5.71	0.19	-4.26	-5.80	-5.10	-5.52	0.89	0.99	PASS
46	5230	-4.45	-6.21	-5.44	-5.71	0.19	-4.26	-6.02	-5.25	-5.52	0.80	0.99	PASS

##### NOTE:

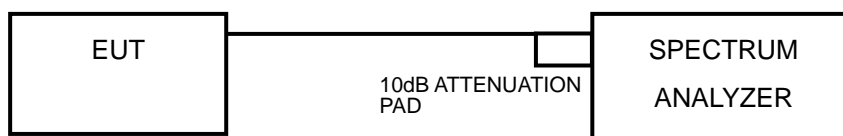
1. Method 1 of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
2. Directional gain =  $2.99\text{dBi} + 10\log(4) = 9.01\text{dBi} > 6\text{dBi}$  , so the power density limit shall be reduced to  $4-(9.01-6) = 0.99\text{dBm}$ .
3. Refer to section 3.3 for duty cycle spectrum plot.

## 4.5 PEAK POWER EXCURSION MEASUREMENT

### 4.5.1 LIMITS OF PEAK POWER EXCURSION MEASUREMENT

Shall not exceed 13 dB.

### 4.5.2 TEST SETUP



### 4.5.3 TEST INSTRUMENTS

Refer to section 4.1.3 to get information of above instrument.

### 4.5.4 TEST PROCEDURE

- 1) Set RBW = 1 MHz, VBW  $\geq$  3 MHz, Detector = peak.
- 2) Trace mode = max-hold. Allow the sweeps to continue until the trace stabilizes.
- 3) Use the peak search function to find the peak of the spectrum.
- 4) Measure the PPSD.
- 5) Compute the ratio of the maximum of the peak-max-hold spectrum to the PPSD.

### 4.5.5 DEVIATION FROM TEST STANDARD

No deviation.

### 4.5.6 EUT OPERATING CONDITIONS

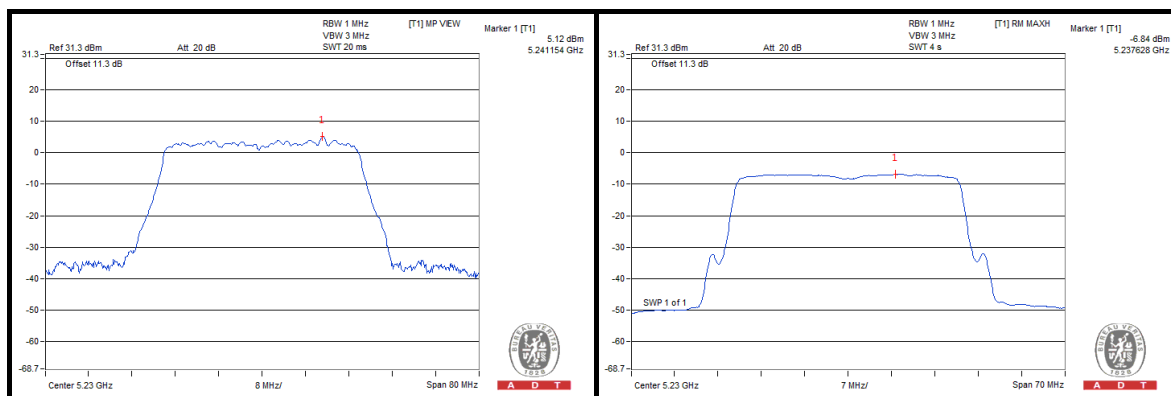
Same as 4.2.6

## 4.5.7 TEST RESULTS

### 802.11n (40MHz)

Modulation Mode	Modulation type	Channel Frequency (MHz)	PEAK VALUE (dBm)				PPSD WITHOUT DUTY FACTOR (dBm)			
			CHAIN 0	CHAIN 1	CHAIN 2	CHAIN 3	CHAIN 0	CHAIN 1	CHAIN 2	CHAIN 3
HT 40 _MCS0	BPSK	5230	4.82	2.67	3.30	3.14	-4.45	-5.99	-5.29	-5.71
	QPSK		4.51	2.18	2.99	3.60	-4.63	-6.72	-6.71	-6.31
	16QAM		5.31	2.85	3.86	3.47	-4.55	-6.50	-6.49	-5.91
	64QAM		6.39	3.65	5.12	4.00	-4.42	-6.97	-6.84	-6.14

PPSD WITH DUTY FACTOR (dBm)				PEAK Excursion (dB)				LIMIT (dB)	PASS /FAIL
CHAIN 0	CHAIN 1	CHAIN 2	CHAIN 3	CHAIN 0	CHAIN 1	CHAIN 2	CHAIN 3		
-4.26	-5.80	-5.10	-5.52	9.08	8.47	8.40	8.66	13	PASS
-4.44	-6.53	-6.52	-6.12	8.95	8.71	9.51	9.72	13	PASS
-4.36	-6.31	-6.30	-5.72	9.67	9.16	10.16	9.19	13	PASS
-4.23	-6.78	-6.65	-5.95	10.62	10.43	11.77	9.95	13	PASS

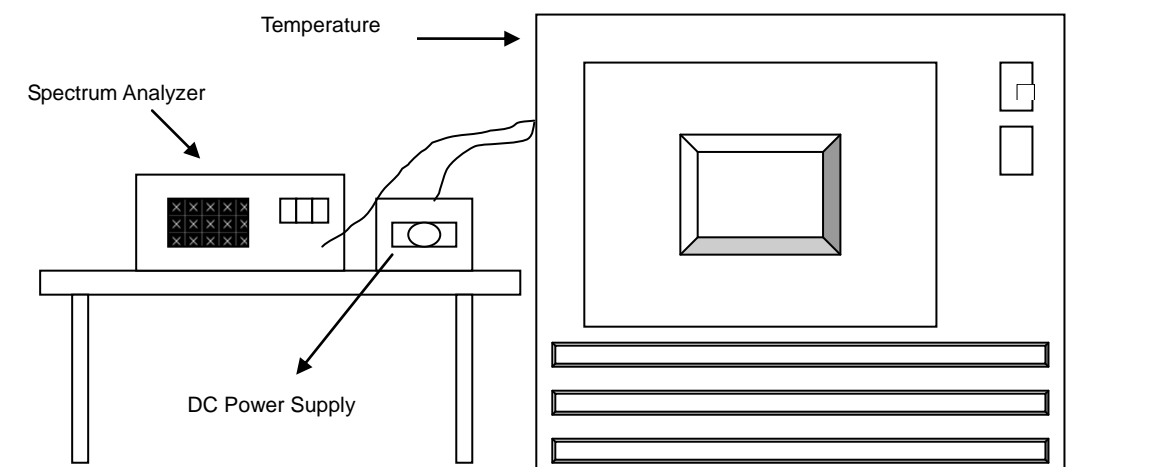


## 4.6 FREQUENCY STABILITY

### 4.6.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

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

### 4.6.2 TEST SETUP



### 4.6.3 TEST INSTRUMENTS

Refer to section 4.1.3 to get information of above instrument.

#### 4.6.4 TEST PROCEDURE

- a. To ensure emission at the band edge is maintained within the authorized band, those values shall be measured by radiation emissions at upper and lower frequency points, and finally compensated by frequency deviation as procedures below.
- b. The EUT was operated at the maximum output power, and connected to the spectrum analyzer, which is set to maximum hold function and peak detector. The peak value of the power envelope was measured and noted. The upper and lower frequency points were respectively measured relatively 10dB lower than the measured peak value.
- c. The frequency deviation was calculated by adding the upper frequency point and the lower frequency point divided by two. Those detailed values of frequency deviation are provided in table below.

#### 4.6.5 DEVIATION FROM TEST STANDARD

No deviation.

#### 4.6.6 EUT OPERATING CONDITION

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



## 4.6.7 TEST RESULTS

FREQUENCY STABILITY VERSUS TEMP.									
OPERATING FREQUENCY: 5190MHz									
TEMP. (°C)	POWER SUPPLY (Vdc)	0 MINUTE		2 MINUTE		5 MINUTE		10 MINUTE	
		Measured Frequency (MHz)	Frequency Drift (ppm)	Measured Frequency (MHz)	Frequency Drift (ppm)	Measured Frequency (MHz)	Frequency Drift (ppm)	Measured Frequency (MHz)	Frequency Drift (ppm)
50	9.0	5190.042414	8.172	5190.042105	8.113	5190.042654	8.218	5190.042042	8.101
40	9.0	5190.042921	8.270	5190.043240	8.331	5190.043148	8.314	5190.042940	8.274
30	9.0	5190.044037	8.485	5190.043968	8.472	5190.043741	8.428	5190.044254	8.527
20	9.0	5190.045317	8.732	5190.045042	8.679	5190.045270	8.723	5190.045175	8.704
10	9.0	5190.046761	9.010	5190.046322	8.925	5190.046611	8.981	5190.046698	8.998
0	9.0	5190.045587	8.784	5190.045446	8.756	5190.044836	8.639	5190.045305	8.729
-10	9.0	5190.043813	8.442	5190.043879	8.455	5190.043427	8.367	5190.043762	8.432
-20	9.0	5190.043022	8.289	5190.043182	8.320	5190.042816	8.250	5190.043212	8.326
-30	9.0	5190.042239	8.139	5190.041751	8.045	5190.041892	8.072	5190.041744	8.043

FREQUENCY STABILITY VERSUS VOLTAGE									
OPERATING FREQUENCY: 5190MHz									
TEMP. (°C)	POWER SUPPLY (Vac)	0 MINUTE		2 MINUTE		5 MINUTE		10 MINUTE	
		Measured Frequency (MHz)	Frequency Drift (ppm)	Measured Frequency (MHz)	Frequency Drift (ppm)	Measured Frequency (MHz)	Frequency Drift (ppm)	Measured Frequency (MHz)	Frequency Drift (ppm)
20	8.5	5190.044772	8.627	5190.044754	8.623	5190.044702	8.613	5190.044614	8.596
	9.0	5190.045317	8.732	5190.045042	8.679	5190.045270	8.723	5190.045175	8.704
	9.5	5190.046268	8.915	5190.046449	8.950	5190.046289	8.919	5190.046013	8.866

## 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:

**Linko EMC/RF Lab:**

Tel: 886-2-26052180

Fax: 886-2-26051924

**Hsin Chu EMC/RF Lab:**

Tel: 886-3-5935343

Fax: 886-3-5935342

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

Tel: 886-3-3183232

Fax: 886-3-3270892

**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.

## **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---**