

## FCC Test Report

**Report No.:** RF160831C13-1

**FCC ID:** HFS-M99

**Test Model:** QTAXU1

**Received Date:** Aug. 31, 2016

**Test Date:** Sep. 09, 2016 ~ Sep. 10, 2016

**Issued Date:** Sep. 21, 2016

**Applicant:** Quanta Computer Inc.

**Address:** No.188, Wenhua 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan

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

**Lab Address:** No. 47-2, 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 Vil., Kwei Shan Dist., Taoyuan City  
33383, Taiwan, R.O.C.



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### Release Control Record

Issue No.	Description	Date Issued
RF160831C13-1	Original Release	Sep. 21, 2016

## 1 Certificate of Conformity

**Product:** Wearable device  
**Test Model:** QTAXU1  
**Sample Status:** Engineering Sample  
**Applicant:** Quanta Computer Inc.  
**Test Date:** Sep. 09, 2016 ~ Sep. 10, 2016  
**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)  
ANSI C63.10:2013

The above equipment 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 :** Rona Chen, **Date:** Sep. 21, 2016  
Rona Chen / Specialist

**Approved by :** Stanley Wu, **Date:** Sep. 21, 2016  
Stanley Wu / Assistant Manager

## 2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	N/A	Without AC power port of the EUT EUT consumes DC power
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -10.68 dB at 2389.92 MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.247(a)(2)	6 dB Bandwidth	Pass	Meet the requirement of limit.
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	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:

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

<b>Product</b>	Wearable device
<b>Test Model</b>	QTAXU1
<b>Status of EUT</b>	Engineering Sample
<b>Power Supply Rating</b>	3.85 Vdc (Li-ion battery)
<b>Modulation Type</b>	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
<b>Modulation Technology</b>	DSSS, OFDM
<b>Transfer Rate</b>	802.11b: 11.0 / 5.5 / 2.0 / 1.0 Mbps 802.11g: 54.0 / 48.0 / 36.0 / 24.0 / 18.0 / 12.0 / 9.0 / 6.0 Mbps 802.11n: up to MCS7
<b>Operating Frequency</b>	2412 ~ 2462 MHz
<b>Number of Channel</b>	11 for 802.11b, 802.11g, 802.11n (HT20)
<b>Output Power</b>	116.68 mW
<b>Antenna Type</b>	Monopole antenna with 1.02 dBi gain
<b>Antenna Connector</b>	N/A
<b>Accessory Device</b>	Refer to Note as below
<b>Data Cable Supplied</b>	Refer to Note as below

Note:

- The EUT provides 1 completed transmitter and 1 receiver.

Modulation Mode	TX Function
802.11b	1TX
802.11g	1TX
802.11n (HT20)	1TX

- The EUT contains following accessory devices.

Product	Brand	Model	Description
Battery	WELLTECH ENERGY INC.	EXGU111K2003	3.85 Vdc, 450 mAh
Wireless Charger	N/A	QXU1	--
LTE Chip	Qualcomm	WTR2965	--
WLAN Chip	Qualcomm	WCN3620	--
NFC Chip	NXP	PN5482D2EV	--

- The above EUT information is 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

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		



### 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 1 GHz      **RE<1G**: Radiated Emission below 1 GHz  
**PLC**: Power Line Conducted Emission      **APCM**: Antenna Port Conducted Measurement

**NOTE:** 1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-plane**.  
 2. "-" means no effect.

#### **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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	MCS0

#### **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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11n (HT20)	1 to 11	1	OFDM	BPSK	MCS0

#### **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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 11	1, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 11	OFDM	BPSK	MCS0

**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.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	MCS0

**Test Condition:**

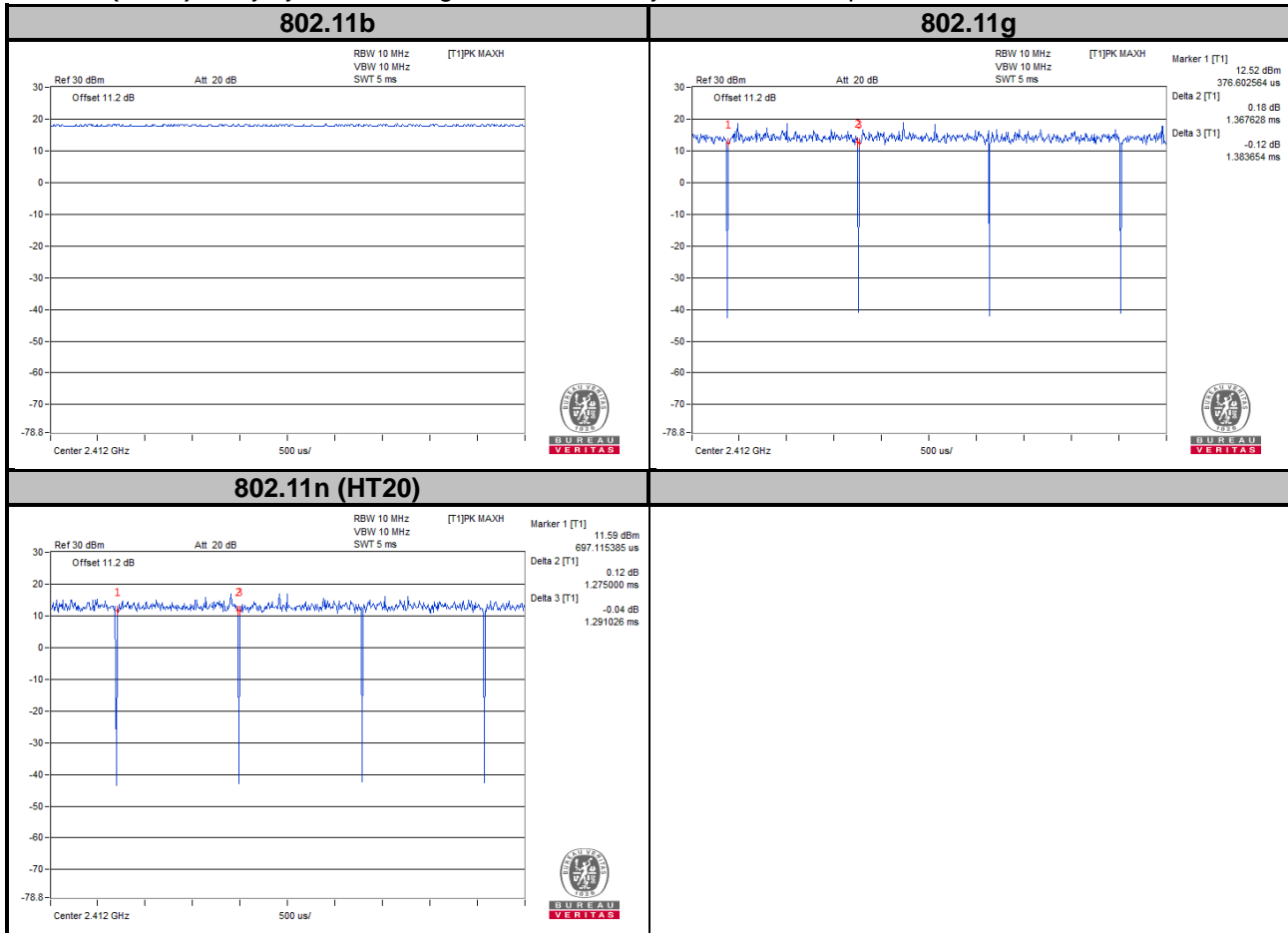
Applicable To	Environmental Conditions	Input Power	Tested by
RE $\geq$ 1G	25 deg. C, 65 % RH	3.85 Vdc	Toby Tian
RE<1G	25 deg. C, 65 % RH	3.85 Vdc	Toby Tian
APCM	25 deg. C, 65 % RH	3.85 Vdc	Taylor Liu

### 3.3 Duty Cycle of Test Signal

**802.11b:** Duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.

**802.11g:** Duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.

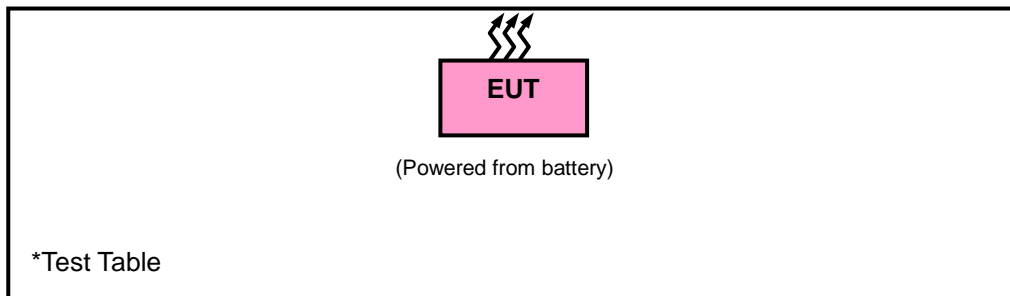
**802.11n (HT20):** Duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.



### 3.4 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

#### 3.4.1 Configuration of System under Test



### 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 C (15.247)**

**558074 D01 DTS Meas Guidance v03r05**

ANSI C63.10-2013

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.

## 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. Other emissions shall be at least 20 dB below the highest level of the desired power:

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 1000 MHz, 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 20 dB under any condition of modulation.

#### 4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Jan. 21, 2015	Jan. 21, 2016
Spectrum Analyzer Agilent	N9010A	MY52220314	Oct. 23, 2015	Oct. 22, 2016
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 17, 2015	Dec. 16, 2016
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Jan. 07, 2016	Jan. 06, 2017
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-969	Jan. 04, 2016	Jan. 03, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	9170-480	Jan. 08, 2016	Jan. 07, 2017
Loop Antenna	EM-6879	269	Aug. 11, 2016	Aug. 10, 2017
Preamplifier EMCI	EMC 012645	980115	Dec. 21, 2015	Dec. 20, 2016
Preamplifier EMCI	EMC 184045	980116	Dec. 21, 2015	Dec. 20, 2016
Preamplifier EMCI	EMC 330H	980112	Dec. 28, 2015	Dec. 27, 2016
Power Meter Anritsu	ML2495A	1232002	Sep. 21, 2015	Sep. 20, 2016
Power Sensor Anritsu	MA2411B	1207325	Sep. 21, 2015	Sep. 20, 2016
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	309219/4 2950114	Oct. 12, 2015	Oct. 11, 2016
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	250130/4	Oct. 12, 2015	Oct. 11, 2016
RF Coaxial Cable Worken	8D-FB	Cable-Ch10-01	Oct. 12, 2015	Oct. 11, 2016
Software BV ADT	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 test was performed in HwaYa Chamber 10.
3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The FCC Site Registration No. is 690701.
5. The IC Site Registration No. is IC7450F-10.

#### 4.1.3 Test Procedures

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) 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 detected 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:**

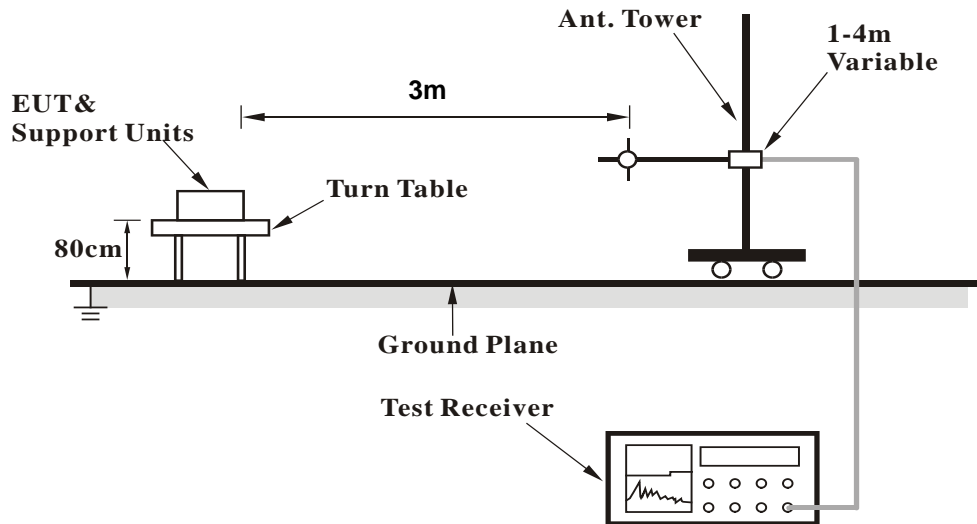
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 KHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for RMS Average (Duty cycle < 98 %) for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle  $\geq$  98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

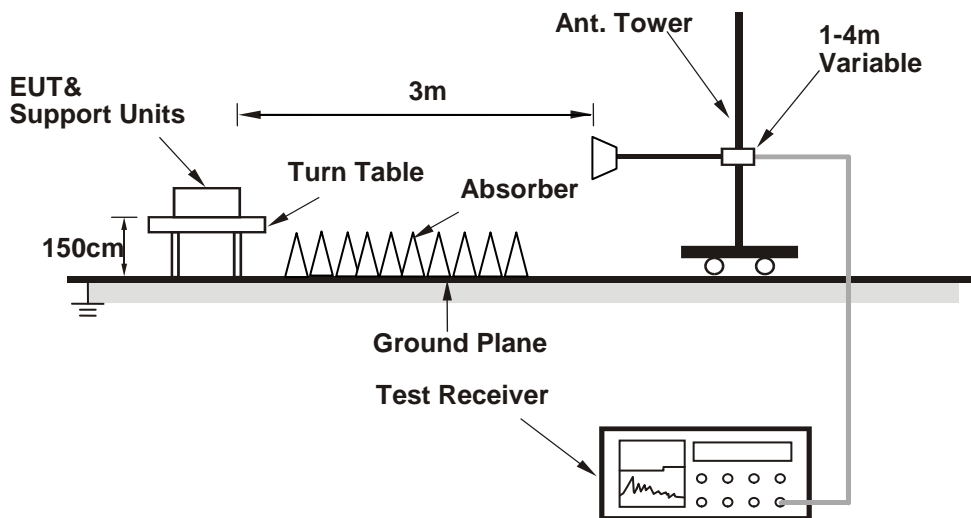
No deviation.

#### 4.1.5 Test Set Up

##### <Frequency Range below 1 GHz>



##### <Frequency Range above 1 GHz>



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

#### 4.1.6 EUT Operating Conditions

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



## 4.1.7 Test Results

## Above 1 GHz Data :

## 802.11b

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (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
2361.75	57.33	63.96	74	-16.67	26.81	4.05	37.49	175	256	Peak
2387.49	38.26	44.77	54	-15.74	26.91	4.08	37.5	175	256	Average
2412	101.35	107.82			26.96	4.09	37.52	175	256	Average
2412	105.02	111.49			26.96	4.09	37.52	175	256	Peak
4824	34.63	49.93	54	-19.37	30.99	6.79	53.08	188	75	Average
4824	45.05	60.35	74	-28.95	30.99	6.79	53.08	188	75	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (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
2350.95	56.7	63.37	74	-17.3	26.77	4.05	37.49	201	334	Peak
2389.83	37.38	43.91	54	-16.62	26.91	4.08	37.52	201	334	Average
2412	100.15	106.62			26.96	4.09	37.52	201	334	Average
2412	104.04	110.51			26.96	4.09	37.52	201	334	Peak
4824	34.27	49.57	54	-19.73	30.99	6.79	53.08	176	213	Average
4824	44.9	60.2	74	-29.1	30.99	6.79	53.08	176	213	Peak

## Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2412 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (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
2337.9	56.98	63.64	74	-17.02	26.77	4.04	37.47	173	254	Peak
2389.92	36.45	42.98	54	-17.55	26.91	4.08	37.52	173	254	Average
2437	101.48	107.76			27.06	4.12	37.46	173	254	Average
2437	105.06	111.34			27.06	4.12	37.46	173	254	Peak
2484.24	36.96	42.98	54	-17.04	27.15	4.15	37.32	173	254	Average
2488.16	57.79	63.75	74	-16.21	27.2	4.16	37.32	173	254	Peak
4874	34.7	49.84	54	-19.3	31.06	6.85	53.05	183	61	Average
4874	44.8	59.94	74	-29.2	31.06	6.85	53.05	183	61	Peak

Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (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
2316.48	37.4	44.17	54	-16.6	26.67	4.03	37.47	201	337	Average
2358.24	57.13	63.76	74	-16.87	26.81	4.05	37.49	201	337	Peak
2437	100.33	106.61			27.06	4.12	37.46	201	337	Average
2437	104.08	110.36			27.06	4.12	37.46	201	337	Peak
2484.04	37.16	43.18	54	-16.84	27.15	4.15	37.32	201	337	Average
2486.96	57.81	63.83	74	-16.19	27.15	4.15	37.32	201	337	Peak
4874	34.54	49.68	54	-19.46	31.06	6.85	53.05	173	220	Average
4874	45.23	60.37	74	-28.77	31.06	6.85	53.05	173	220	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (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
2462	101.54	107.7			27.1	4.13	37.39	172	256	Average
2462	105.24	111.4			27.1	4.13	37.39	172	256	Peak
2483.6	38.29	44.31	54	-15.71	27.15	4.15	37.32	172	256	Average
2496.8	57.58	63.47	74	-16.42	27.2	4.16	37.25	172	256	Peak
4924	33.91	48.94	54	-20.09	31.12	6.88	53.03	180	52	Average
4924	43.9	58.93	74	-30.1	31.12	6.88	53.03	180	52	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (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
2462	100.26	106.42			27.1	4.13	37.39	203	333	Average
2462	104.08	110.24			27.1	4.13	37.39	203	333	Peak
2486.16	37.99	44.01	54	-16.01	27.15	4.15	37.32	203	333	Average
2493.36	57.02	62.91	74	-16.98	27.2	4.16	37.25	203	333	Peak
4924	33.98	49.01	54	-20.02	31.12	6.88	53.03	172	232	Average
4924	44.71	59.74	74	-29.29	31.12	6.88	53.03	172	232	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.

**802.11g**

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

**Antennal Polarity & Test Distance: Horizontal at 3 m**

Frequency (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
2389.56	54.2	60.71	74	-19.8	26.91	4.08	37.5	176	258	Peak
2389.92	40.84	47.37	54	-13.16	26.91	4.08	37.52	176	258	Average
2412	93.59	100.06			26.96	4.09	37.52	176	258	Average
2412	101.54	108.01			26.96	4.09	37.52	176	258	Peak
4824	33.86	49.16	54	-20.14	30.99	6.79	53.08	180	50	Average
4824	44.71	60.01	74	-29.29	30.99	6.79	53.08	180	50	Peak

**Antennal Polarity & Test Distance: Vertical at 3 m**

Frequency (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
2359.77	41.99	48.62	54	-12.01	26.81	4.05	37.49	202	346	Average
2389.74	53.4	59.91	74	-20.6	26.91	4.08	37.5	202	346	Peak
2412	92.36	98.83			26.96	4.09	37.52	202	346	Average
2412	100.54	107.01			26.96	4.09	37.52	202	346	Peak
4824	33.35	48.65	54	-20.65	30.99	6.79	53.08	173	221	Average
4824	44.31	59.61	74	-29.69	30.99	6.79	53.08	173	221	Peak

## Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2412 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (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
2383.8	46.99	53.55	74	-27.01	26.86	4.08	37.5	174	254	Peak
2388.66	36.52	43.03	54	-17.48	26.91	4.08	37.5	174	254	Average
2437	93.5	99.78			27.06	4.12	37.46	174	254	Average
2437	101.67	107.95			27.06	4.12	37.46	174	254	Peak
2483.72	37.77	43.79	54	-16.23	27.15	4.15	37.32	174	254	Average
2486.92	47.76	53.78	74	-26.24	27.15	4.15	37.32	174	254	Peak
4874	33.63	48.77	54	-20.37	31.06	6.85	53.05	185	75	Average
4874	43.63	58.77	74	-30.37	31.06	6.85	53.05	185	75	Peak

Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (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
2369.22	40.21	46.78	54	-13.79	26.86	4.07	37.5	200	357	Average
2389.56	51.51	58.02	74	-22.49	26.91	4.08	37.5	200	357	Peak
2437	92.53	98.81			27.06	4.12	37.46	200	357	Average
2437	100.34	106.62			27.06	4.12	37.46	200	357	Peak
2483.64	37.56	43.58	54	-16.44	27.15	4.15	37.32	200	357	Average
2483.72	47.98	54	74	-26.02	27.15	4.15	37.32	200	357	Peak
4874	33.61	48.75	54	-20.39	31.06	6.85	53.05	170	211	Average
4874	43.35	58.49	74	-30.65	31.06	6.85	53.05	170	211	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (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
2462	93.53	99.69			27.1	4.13	37.39	174	256	Average
2462	101.37	107.53			27.1	4.13	37.39	174	256	Peak
2483.56	39.87	45.89	54	-14.13	27.15	4.15	37.32	174	256	Average
2483.96	51.23	57.25	74	-22.77	27.15	4.15	37.32	174	256	Peak
4924	34.91	49.94	54	-19.09	31.12	6.88	53.03	188	66	Average
4924	45.15	60.18	74	-28.85	31.12	6.88	53.03	188	66	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (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
2462	92.59	98.75			27.1	4.13	37.39	201	348	Average
2462	100.32	122.22			27.1	4.62	53.62	201	348	Peak
2483.52	41.51	47.53	54	-12.49	27.15	4.15	37.32	201	348	Average
2483.56	56.63	62.65	74	-17.37	27.15	4.15	37.32	201	348	Peak
4924	33.71	48.74	54	-20.29	31.12	6.88	53.03	177	201	Average
4924	44.54	59.57	74	-29.46	31.12	6.88	53.03	177	201	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.

802.11n (HT20)

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

**Antennal Polarity & Test Distance: Horizontal at 3 m**

Frequency (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
2389.56	56.62	63.13	74	-17.38	26.91	4.08	37.5	178	254	Peak
<b>2389.92</b>	<b>43.32</b>	<b>49.85</b>	<b>54</b>	<b>-10.68</b>	<b>26.91</b>	<b>4.08</b>	<b>37.52</b>	<b>178</b>	<b>254</b>	<b>Average</b>
2412	93.29	99.76			26.96	4.09	37.52	178	254	Average
2412	101.33	107.8			26.96	4.09	37.52	178	254	Peak
4824	34.56	49.86	54	-19.44	30.99	6.79	53.08	179	49	Average
4824	43.68	58.98	74	-30.32	30.99	6.79	53.08	179	49	Peak

**Antennal Polarity & Test Distance: Vertical at 3 m**

Frequency (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
2389.74	53.1	59.61	74	-20.9	26.91	4.08	37.5	202	344	Peak
2389.83	41.49	48.02	54	-12.51	26.91	4.08	37.52	202	344	Average
2412	92.35	98.82			26.96	4.09	37.52	202	344	Average
2412	100.33	106.8			26.96	4.09	37.52	202	344	Peak
4824	34.55	49.85	54	-19.45	30.99	6.79	53.08	170	219	Average
4824	45.12	60.42	74	-28.88	30.99	6.79	53.08	170	219	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2412 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (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
2385.06	37.56	44.12	54	-16.44	26.86	4.08	37.5	175	255	Average
2388.39	47.32	53.83	74	-26.68	26.91	4.08	37.5	175	255	Peak
2437	93.44	99.72			27.06	4.12	37.46	175	255	Average
2437	101.37	107.65			27.06	4.12	37.46	175	255	Peak
2483.68	37.76	43.78	54	-16.24	27.15	4.15	37.32	175	255	Average
2485.92	48.41	54.43	74	-25.59	27.15	4.15	37.32	175	255	Peak
4874	33.72	48.86	54	-20.28	31.06	6.85	53.05	186	77	Average
4874	42.72	57.86	74	-31.28	31.06	6.85	53.05	186	77	Peak

Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (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
2389.83	41.09	47.62	54	-12.91	26.91	4.08	37.52	200	350	Average
2389.92	51.17	57.7	74	-22.83	26.91	4.08	37.52	200	350	Peak
2437	92.38	98.66			27.06	4.12	37.46	200	350	Average
2437	100.43	106.71			27.06	4.12	37.46	200	350	Peak
2484.2	48.56	54.58	74	-25.44	27.15	4.15	37.32	200	350	Peak
2484.56	38.61	44.63	54	-15.39	27.15	4.15	37.32	200	350	Average
4874	34.37	49.51	54	-19.63	31.06	6.85	53.05	174	235	Average
4874	43.37	58.51	74	-30.63	31.06	6.85	53.05	174	235	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.



EUT Test Condition		Measurement Detail	
Channel	Channel 11	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (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
2462	93.38	99.54			27.1	4.13	37.39	172	257	Average
2462	101.69	107.85			27.1	4.13	37.39	172	257	Peak
2483.52	42.31	48.33	54	-11.69	27.15	4.15	37.32	172	257	Average
2484.12	55.77	61.79	74	-18.23	27.15	4.15	37.32	172	257	Peak
4924	32.71	47.74	54	-21.29	31.12	6.88	53.03	189	63	Average
4924	43.45	58.48	74	-30.55	31.12	6.88	53.03	189	63	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (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
2462	92.38	98.54			27.1	4.13	37.39	200	335	Average
2462	100.52	106.68			27.1	4.13	37.39	200	335	Peak
2483.52	42.28	48.3	54	-11.72	27.15	4.15	37.32	200	335	Average
2484.48	57.72	63.74	74	-16.28	27.15	4.15	37.32	200	335	Peak
4924	33.28	48.31	54	-20.72	31.12	6.88	53.03	170	231	Average
4924	42.3	57.33	74	-31.7	31.12	6.88	53.03	170	231	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.

**9 kHz ~ 30 MHz DATA:**

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

**30 MHz ~ 1 GHz WORST-CASE DATA:**

**802.11n (HT20)**

EUT Test Condition		Measurement Detail	
Channel	Channel 1	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Toby Tian

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (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
42.61	17.08	33.92	40	-22.92	13.58	0.66	31.08	106	156	Peak
152.22	14.77	32.6	43.5	-28.73	12.71	1.12	31.66	110	326	Peak
232.73	13.86	33.53	46	-32.14	10.75	1.42	31.84	121	228	Peak
353.98	17.56	33.44	46	-28.44	14.24	1.77	31.89	108	356	Peak
479.11	21.16	34.05	46	-24.84	16.91	2.05	31.85	127	323	Peak
645.95	23.95	33.49	46	-22.05	20.16	2.35	32.05	101	5	Peak

Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (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
40.67	16.05	32.87	40	-23.95	13.55	0.65	31.02	102	107	Peak
136.7	16.6	35.03	43.5	-26.9	12.14	1.14	31.71	126	221	Peak
249.22	14.87	33.87	46	-31.13	11.44	1.49	31.93	105	260	Peak
415.09	18.84	33.28	46	-27.16	15.64	1.94	32.02	116	164	Peak
549.92	22	33.31	46	-24	18.46	2.18	31.95	140	239	Peak
658.56	25	34.28	46	-21	20.31	2.37	31.96	118	247	Peak

Remarks:

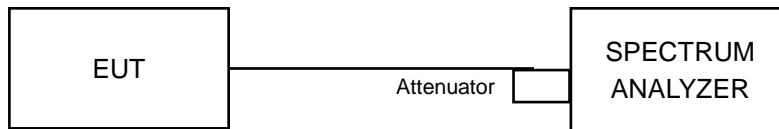
- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value

## 4.2 6 dB Bandwidth Measurement

### 4.2.1 Limits of 6 dB Bandwidth Measurement

The minimum of 6 dB Bandwidth Measurement is 0.5 MHz.

### 4.2.2 Test Setup



### 4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.2.4 Test Procedure

- a. Set resolution bandwidth (RBW) = 100 kHz
- b. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW, Detector = Peak.
- c. Trace mode = max hold.
- d. Sweep = auto couple.
- e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

### 4.2.5 Deviation from Test Standard

No deviation.

### 4.2.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

#### 4.2.7 Test Result

##### 802.11b

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	8.55	0.5	Pass
6	2437	8.08	0.5	Pass
11	2462	8.05	0.5	Pass

##### 802.11g

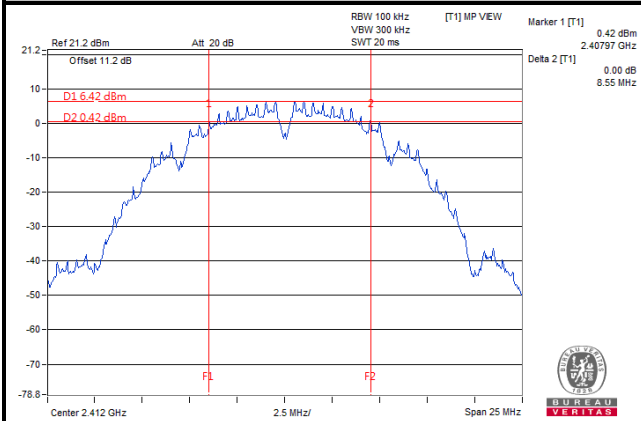
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	16.37	0.5	Pass
6	2437	16.45	0.5	Pass
11	2462	16.39	0.5	Pass

##### 802.11n (HT20)

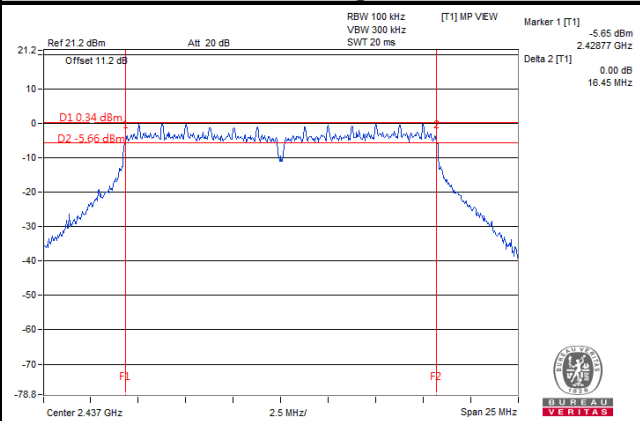
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
1	2412	17.33	0.5	Pass
6	2437	17.64	0.5	Pass
11	2462	17.64	0.5	Pass

### Spectrum Plot of Worst Value

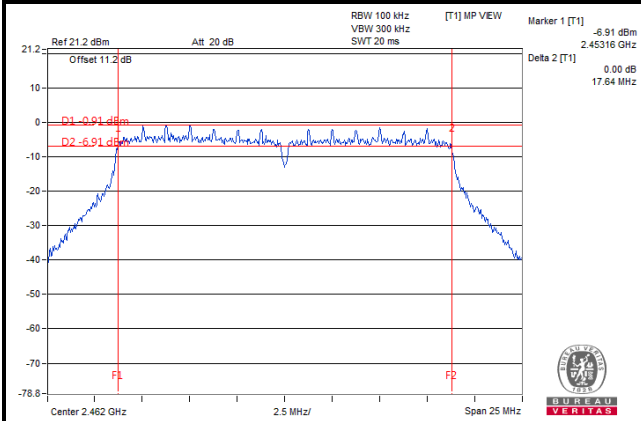
#### 802.11b



#### 802.11g



#### 802.11n (HT20)

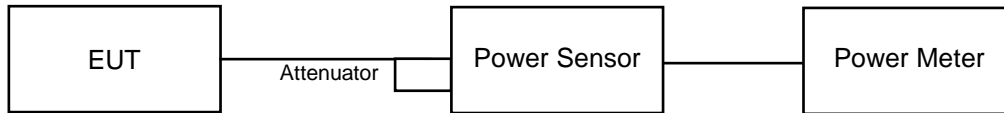


### 4.3 Conducted Output Power Measurement

#### 4.3.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30 dBm)

#### 4.3.2 Test Setup



#### 4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

#### 4.3.4 Test Procedures

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

#### 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 lowest, middle and highest channel frequencies individually.

#### 4.3.7 Test Results

##### 802.11b

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	57.68	17.61	30	Pass
6	2437	60.67	17.83	30	Pass
11	2462	60.12	17.79	30	Pass

##### 802.11g

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	111.43	20.47	30	Pass
6	2437	116.68	20.67	30	Pass
11	2462	115.61	20.63	30	Pass

##### 802.11n (HT20)

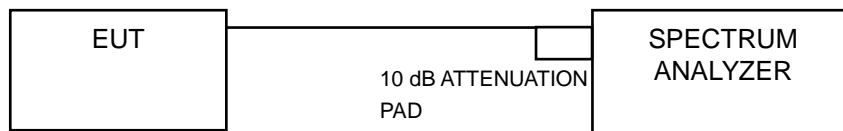
Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	85.11	19.30	30	Pass
6	2437	92.26	19.65	30	Pass
11	2462	90.99	19.59	30	Pass

#### 4.4 Power Spectral Density Measurement

##### 4.4.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8 dBm.

##### 4.4.2 Test Setup



##### 4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

##### 4.4.4 Test Procedure

- a. Set analyzer center frequency to DTS channel center frequency.
- b. Set the span to 1.5 times the DTS bandwidth.
- c. Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- d. Set the VBW  $\geq 3 \times \text{RBW}$ .
- e. Detector = peak.
- f. Sweep time = auto couple.
- g. Trace mode = max hold.
- h. Allow trace to fully stabilize.
- i. Use the peak marker function to determine the maximum amplitude level within the RBW.

##### 4.4.5 Deviation from Test Standard

No deviation.

##### 4.4.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.



#### 4.4.7 Test Results

##### 802.11b

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Pass / Fail
1	2412	-7.52	8	Pass
6	2437	-7.80	8	Pass
11	2462	-7.70	8	Pass

##### 802.11g

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Pass / Fail
1	2412	-14.24	8	Pass
6	2437	-14.64	8	Pass
11	2462	-13.87	8	Pass

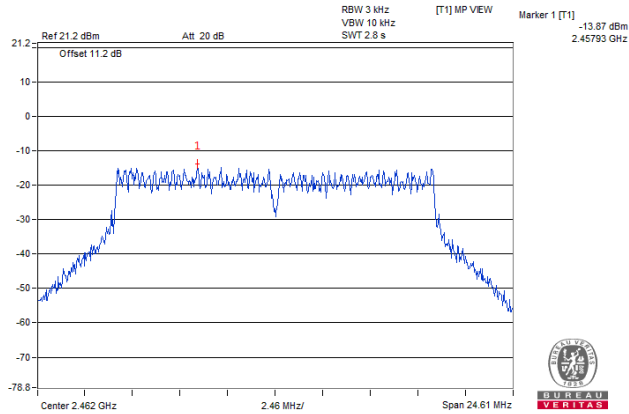
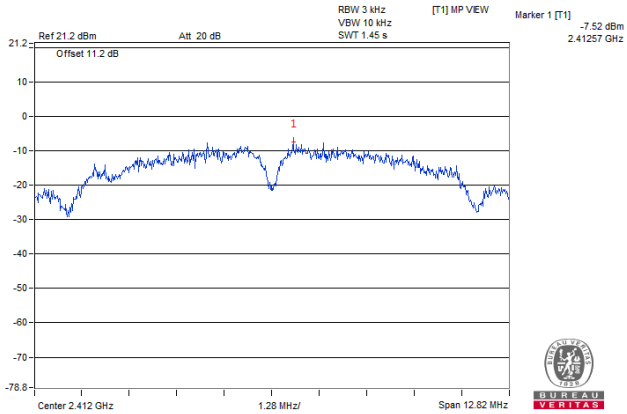
##### 802.11n (HT20)

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Pass / Fail
1	2412	-13.98	8	Pass
6	2437	-14.63	8	Pass
11	2462	-14.91	8	Pass

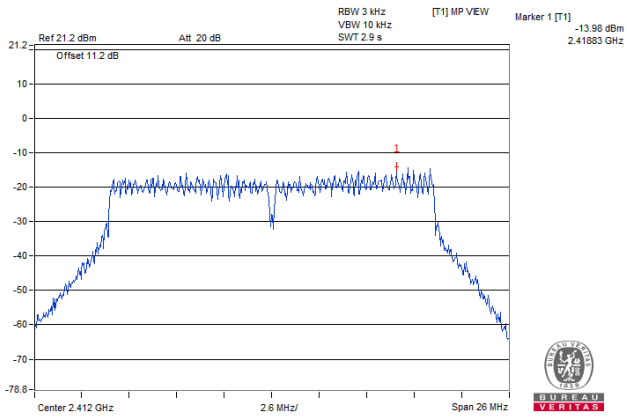
## Spectrum Plot of Worst Value

### 802.11b

### 802.11g



### 802.11n (HT20)

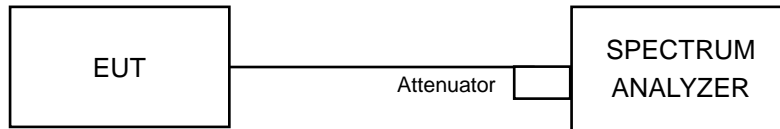


## 4.5 Conducted Out of Band Emission Measurement

### 4.5.1 Limits of Conducted Out of Band Emission Measurement

Below 20 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

### 4.5.2 Test Setup



### 4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.5.4 Test Procedure

#### MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

#### MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

### 4.5.5 Deviation from Test Standard

No deviation.

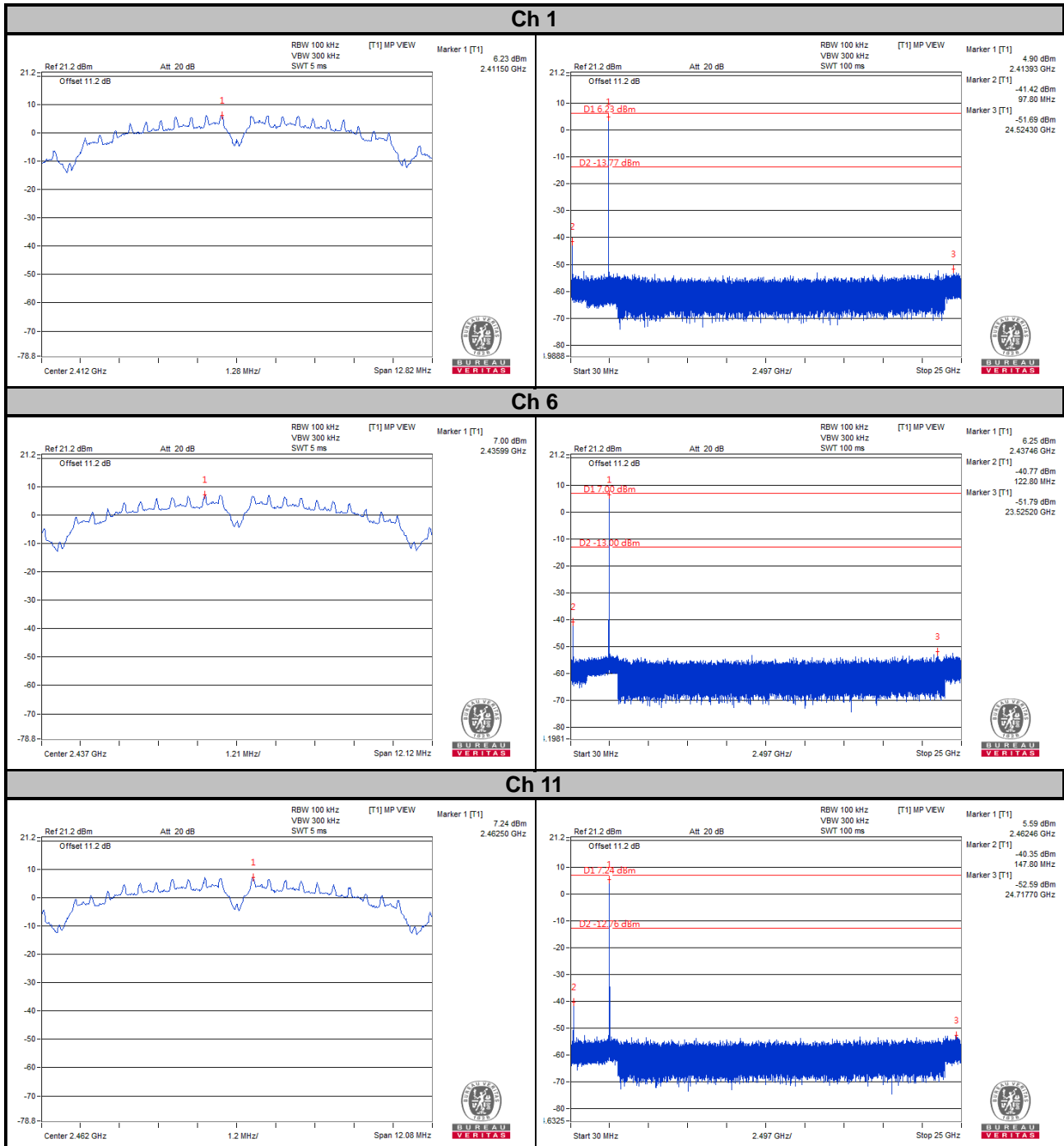
### 4.5.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

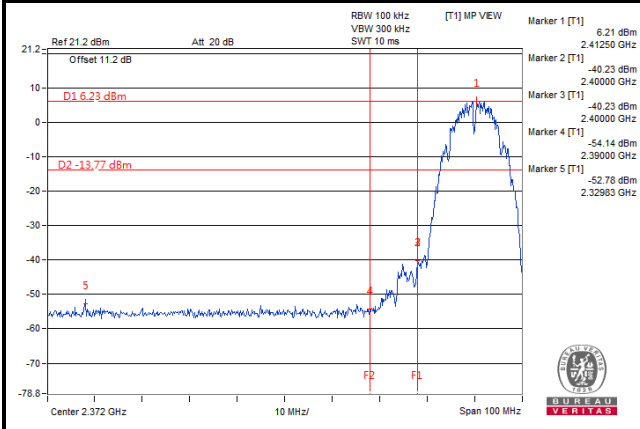
### 4.5.7 Test Results

The spectrum plots are attached on the following images. D1 line indicates the highest level, and D2 line indicates the 20 dB offset below D1. It shows compliance with the requirement.

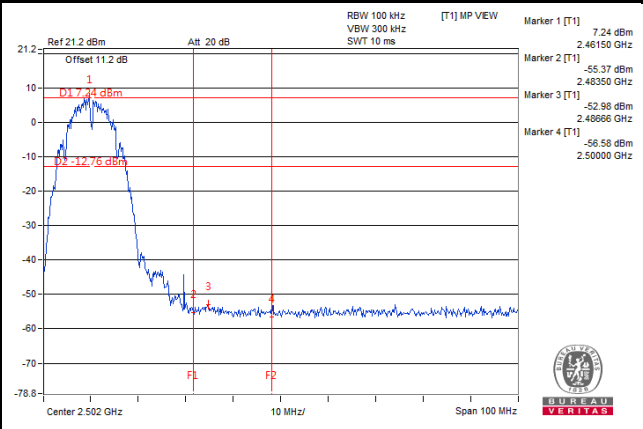
#### 802.11b



### Ch 1 Band Edge

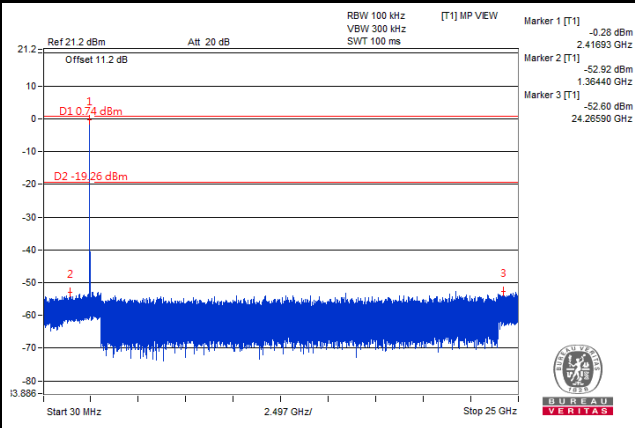
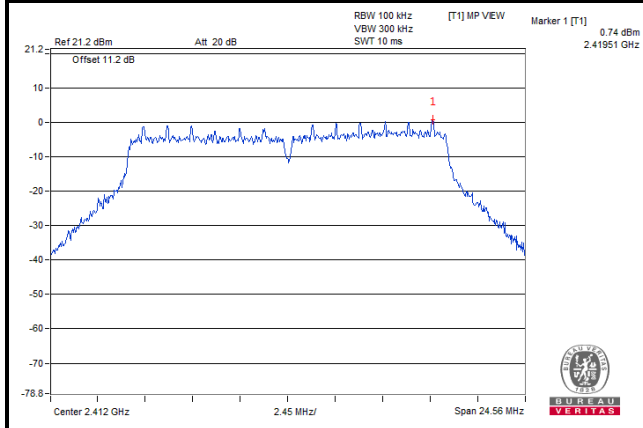


### Ch 11 Band Edge

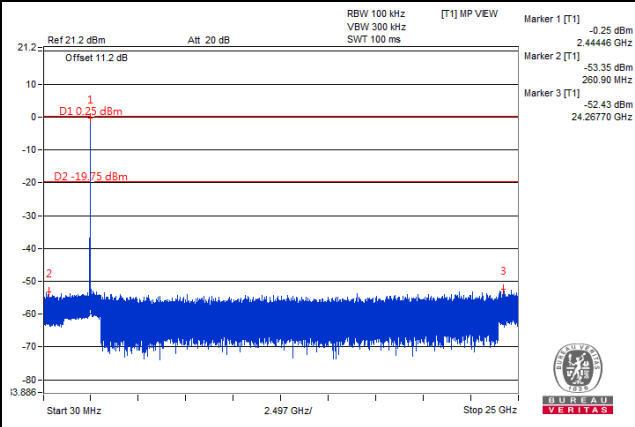
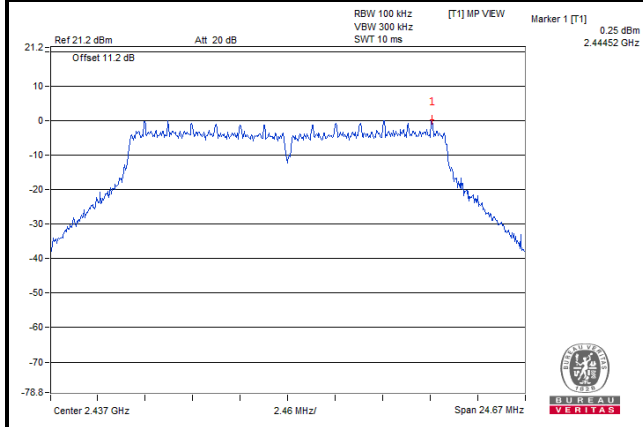


# 802.11g

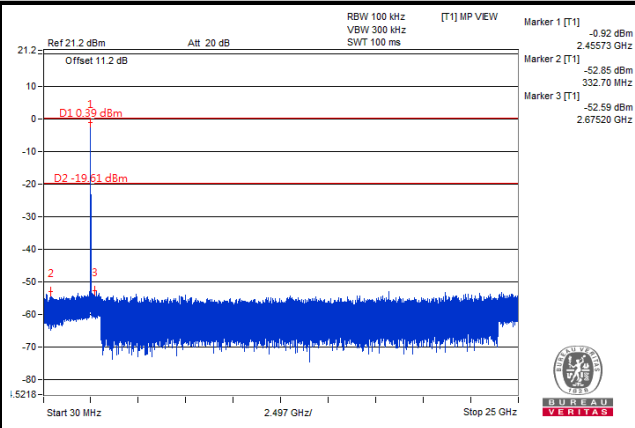
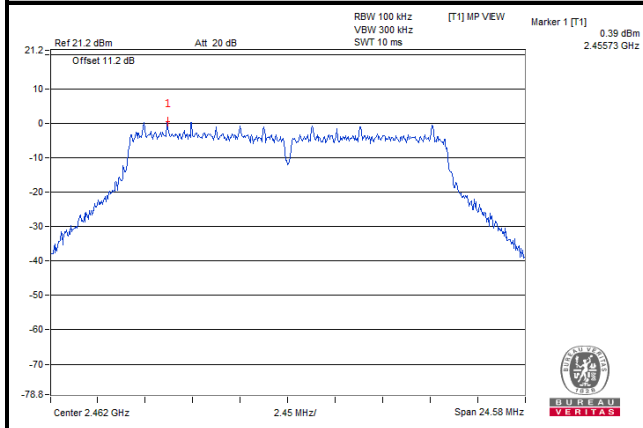
## Ch 1



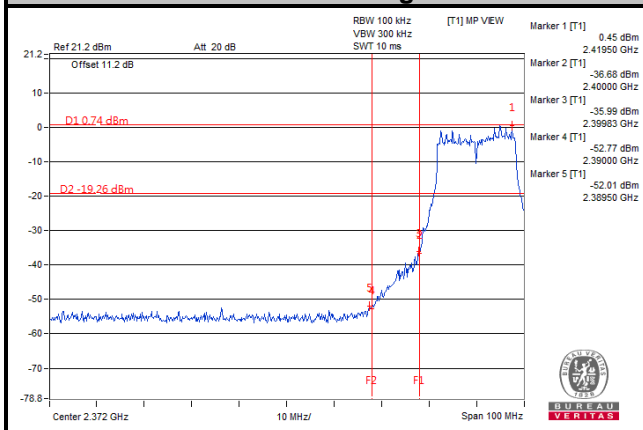
## Ch 6



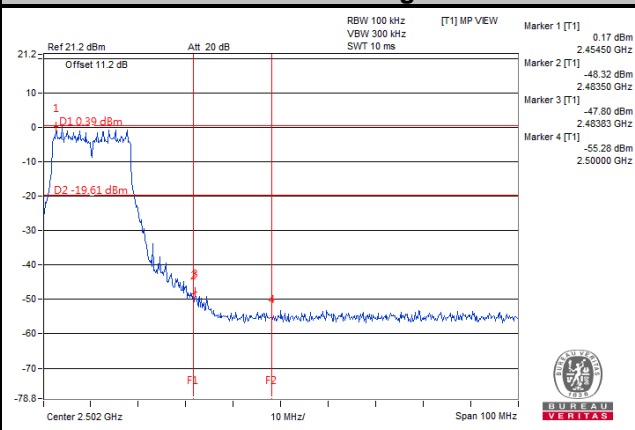
## Ch 11



### Ch 1 Band Edge

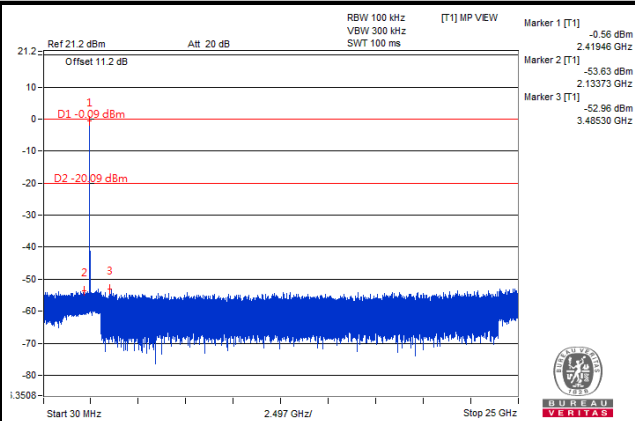
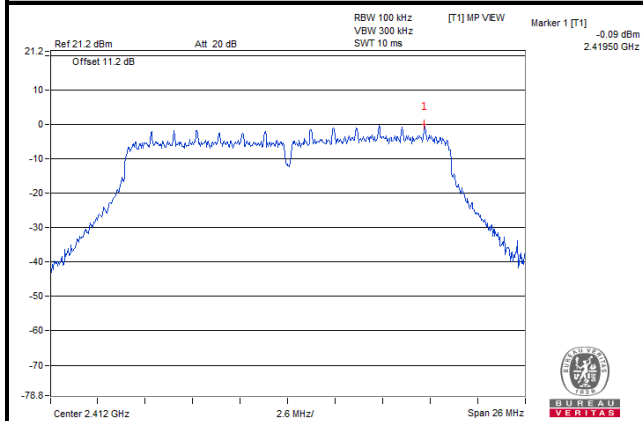


### Ch 11 Band Edge

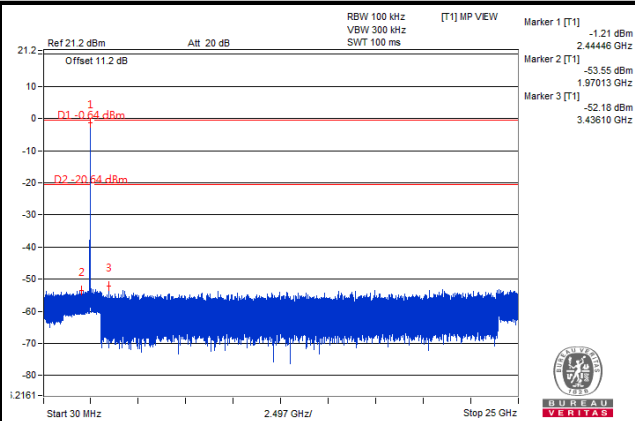
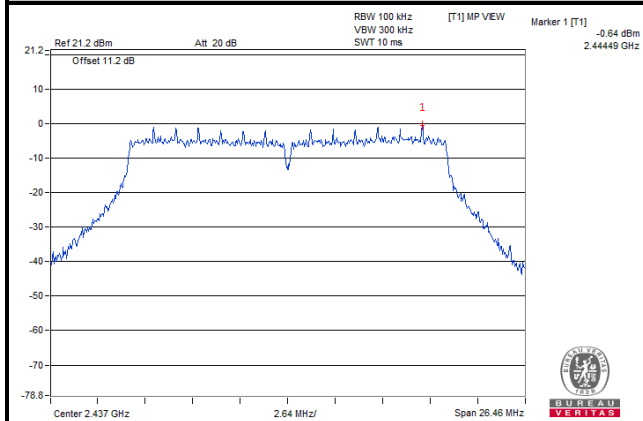


# 802.11n (HT20)

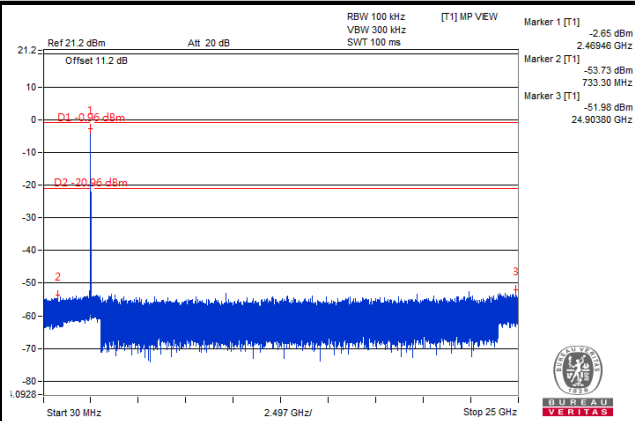
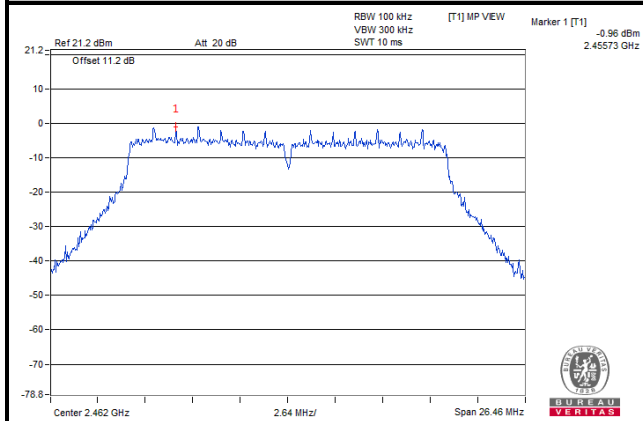
## Ch 1



## Ch 6

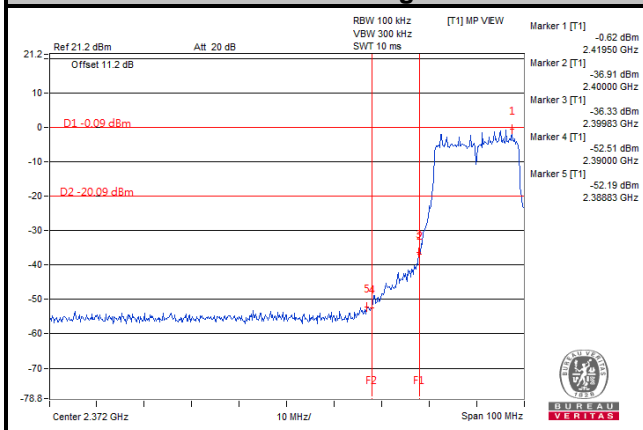


## Ch 11

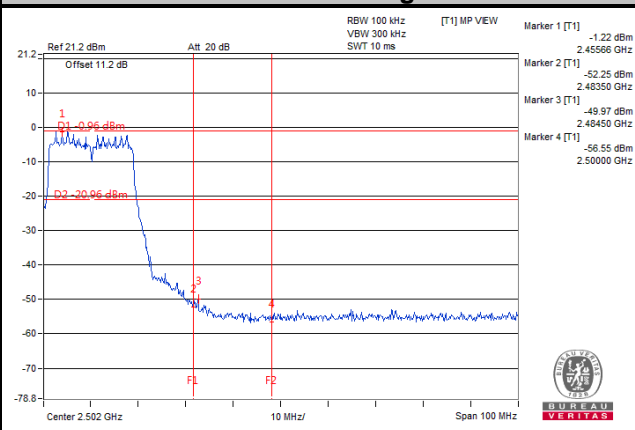




### Ch 1 Band Edge



### Ch 11 Band Edge



## 5 Pictures of Test Arrangements

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

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

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

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