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Report No.: 1510RSU01801
Report Version: V03
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MEASUREMENT REPORT

FCC PART 15.247 WLAN 802.11b/g/n

FCC ID: 2AG6XHUDONE

APPLICANT: Cognitive AI Technologies Inc.

Application Type: Certification

Product: Head Up Display

Model No.: HUD One

Brand Name: Carloudy

FCC Classification: Digital Transmission System (DTS)

FCC Rule Part(s): Part 15.247

Test Procedure(s): ANSI C63.10-2013, KDB 558074 D01v03r05

Test Date: October 20 ~ December 28, 2015

Reviewed By
Manager : Robin Wu
(Robin Wu)

Approved By
CEO : Marlin Chen
(Marlin Chen)



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 558074 D01v03r05. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date
1510RSU01801	Rev. 01	Initial report	06-16-2016
1510RSU01801	Rev. 02	Added the test engineer in each test item	06-19-2016
1510RSU01801	Rev. 03	Added the storage location of software	06-23-2016

CONTENTS

Description	Page
1. INTRODUCTION	6
1.1. Scope	6
1.2. MRT Test Location	6
2. PRODUCT INFORMATION	7
2.1. Feature of Equipment under Test	7
2.2. Product Specification Subjective to this Report.....	7
2.3. Working Frequencies for this Report.....	7
2.4. Device Capabilities	8
2.5. Test Configuration	8
2.6. EMI Suppression Device(s)/Modifications.....	8
2.7. Labeling Requirements.....	8
2.8. Test Software	8
3. DESCRIPTION OF TEST	9
3.1. Evaluation Procedure	9
3.2. AC Line Conducted Emissions	9
3.3. Radiated Emissions	10
4. ANTENNA REQUIREMENTS.....	11
5. TEST EQUIPMENT CALIBRATION DATE	12
6. MEASUREMENT UNCERTAINTY.....	13
7. TEST RESULT	14
7.1. Summary	14
7.2. 6dB Bandwidth Measurement.....	15
7.2.1. Test Limit	15
7.2.2. Test Procedure used.....	15
7.2.3. Test Setting.....	15
7.2.4. Test Setup.....	15
7.2.5. Test Result.....	16
7.3. Output Power Measurement.....	20
7.3.1. Test Limit	20
7.3.2. Test Procedure Used	20
7.3.3. Test Setting.....	20
7.3.4. Test Setup.....	20
7.3.5. Test Result.....	21

7.4.	Power Spectral Density Measurement	23
7.4.1.	Test Limit	23
7.4.2.	Test Procedure Used	23
7.4.3.	Test Setting	23
7.4.4.	Test Setup	23
7.4.5.	Test Result	24
7.5.	Conducted Band Edge and Out-of-Band Emissions	28
7.5.1.	Test Limit	28
7.5.2.	Test Procedure Used	28
7.5.3.	Test Setting	28
7.5.4.	Test Setup	29
7.5.5.	Test Result	30
7.6.	Radiated Spurious Emission Measurement	37
7.6.1.	Test Limit	37
7.6.2.	Test Procedure Used	37
7.6.3.	Test Setting	37
7.6.4.	Test Setup	39
7.6.5.	Test Result	41
7.7.	Radiated Restricted Band Edge Measurement	48
7.7.1.	Test Result	48
7.8.	AC Conducted Emissions Measurement	56
7.8.1.	Test Limit	56
7.8.2.	Test Setup	56
7.8.3.	Test Result	57
8.	CONCLUSION.....	59

§2.1033 General Information

Applicant:	Cognitive AI Technologies Inc.			
Applicant Address:	233 S. Wacker Drive, 84th Floor, Chicago, IL 60606, USA			
Manufacturer:	Cognitive AI Technologies Inc.			
Manufacturer Address:	233 S. Wacker Drive, 84th Floor, Chicago, IL 60606, USA			
Test Site:	MRT Technology (Suzhou) Co., Ltd			
Test Site Address:	D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China			
MRT FCC Registration No.:	809388			
FCC Rule Part(s):	Part 15.247			
Model No.:	HUD One			
FCC ID:	2AG6XHUDONE			
Test Device Serial No.:	N/A	<input type="checkbox"/> Production	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Engineering
FCC Classification:	Digital Transmission System (DTS)			

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- MRT facility is a FCC registered (MRT Reg. No. 809388) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.
- MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.
- MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.



1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Feature of Equipment under Test

Product Name	Head Up Display
Model No.	HUD One
Brand Name	Carloudy
Wi-Fi Specification	802.11b/g/n-HT20
Bluetooth Version	v3.0 + HS, v4.0
Components	
Adapter	M/N: HKC0055010-2D INPUT: 100-240V ~ 50/60Hz, 0.2A OUTPUT: 5Vdc, 1.0A

2.2. Product Specification Subjective to this Report

Frequency Range	802.11b/g/n-HT20: 2412 ~ 2462 MHz
Maximum Output Power	802.11b: 8.63dBm; 802.11g: 8.51dBm; 802.11n-HT20: 8.72dBm;
Type of Modulation	802.11b: DSSS 802.11g/n: OFDM
Antenna Type	PCB Antenna
Antenna Gain	2.0dBi

2.3. Working Frequencies for this Report

Channel List for 802.11b/g/n-HT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
01	2412 MHz	02	2417 MHz	03	2422 MHz
04	2427 MHz	05	2432 MHz	06	2437 MHz
07	2442 MHz	08	2447 MHz	09	2452 MHz
10	2457 MHz	11	2462 MHz	--	--

2.4. Device Capabilities

This device contains the following capabilities:

802.11b/g/n WLAN (DTS), Bluetooth (v3.0 + HS, v4.0)

Note: 2.4GHz WLAN (DTS) operation is possible in 20MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than $50/T$, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

- 802.11b - 100%
- 802.11g - 100%
- 802.11n-HT20 - 100%

2.5. Test Configuration

The **Head Up Display FCC ID: 2AG6XHUDONE** was tested per the guidance of KDB 558074 D01v03r05. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.6. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.7. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase.

However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

2.8. Test Software

The test utility software (adb Tool, v1.0.1) have been stored in the PC and controlled this device to operate in the engineering mode to fix T_X frequency.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 558074 D01v03r05 were used in the measurement of the **Head Up Display FCC ID: 2AG6XHUDONE**.

Deviation from measurement procedure..........**None**

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions were used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

Line conducted emissions test results are shown in Section 7.8.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the Antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable. For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive Antenna height using a broadband Antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn Antennas were used. For frequencies below 30MHz, a calibrated loop Antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband Antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive Antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn Antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive Antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive Antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn Antenna, the horn Antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- The antenna of the **Head Up Display** is **permanently attached**.
- There are no provisions for connection to an external antenna.

Conclusion:

The **Head Up Display** FCC ID: **2AG6XHUDONE** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions – SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2016/11/03
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2016/11/03
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2016/11/03
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06182	1 year	2016/12/20

Radiated Emissions – AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	E4447A	MRTSUE06028	1 year	2016/12/08
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2016/11/03
Preamplifier	Agilent	83017A	MRTSUE06076	1 year	2017/03/28
Preamplifier	Schwarzbeck	BBV9721	MRTSUE06121	1 year	2017/04/15
Loop Antenna	Schwarzbeck	FMZB1519	MRTSUE06025	1 year	2016/12/14
TRILOG Antenna	Schwarzbeck	VULB9162	MRTSUE06022	1 year	2016/11/07
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2016/11/07
Broadband Horn Antenna	Schwarzbeck	BBHA9170	MRTSUE06024	1 year	2017/01/04
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06183	1 year	2016/12/20

Conducted Test Equipment – TR3

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2017/05/07
USB Wideband Power Sensor	Boonton	55006	MRTSUE06109	1 year	2017/05/07
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06180	1 year	2016/12/20

Software	Version	Function
e3	V8.3.5	EMI Test Software

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test 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 $k = 2$.

AC Conducted Emission Measurement – SR2
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement – AC1
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_c(y)$): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB

7. TEST RESULT

7.1. Summary

Company Name: Cognitive AI Technologies Inc.
FCC ID: 2AG6XHUDONE
FCC Classification: Digital Transmission System (DTS)
Data Rate(s) Tested: 1Mbps ~ 11Mbps (b); 6Mbps ~ 54Mbps (g);
6.5/7.2Mbps ~ 65/72.2Mbps (n-HT20);

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	6dB Bandwidth	$\geq 500\text{kHz}$	Conducted	Pass	Section 7.2
15.247(b)(3)	Output Power	$\leq 1\text{Watt}$		Pass	Section 7.3
15.247(e)	Power Spectral Density	$\leq 8\text{dBm} / 3\text{kHz Band}$		Pass	Section 7.4
15.247(d)	Band Edge / Out-of-Band Emissions	$\geq 20\text{dBc(Peak)}$		Pass	Section 7.5
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 7.6 & 7.7
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.8

Notes:

- 1) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

7.2. 6dB Bandwidth Measurement

7.2.1. Test Limit

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

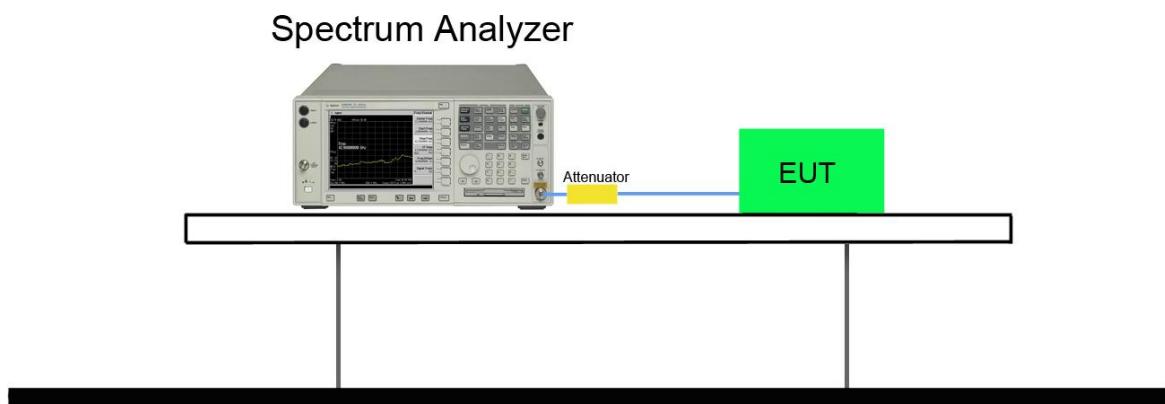
7.2.2. Test Procedure used

KDB 558074 D01v03r05 - Section 8.2 Option 2

7.2.3. Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW $\geq 3 \times$ RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

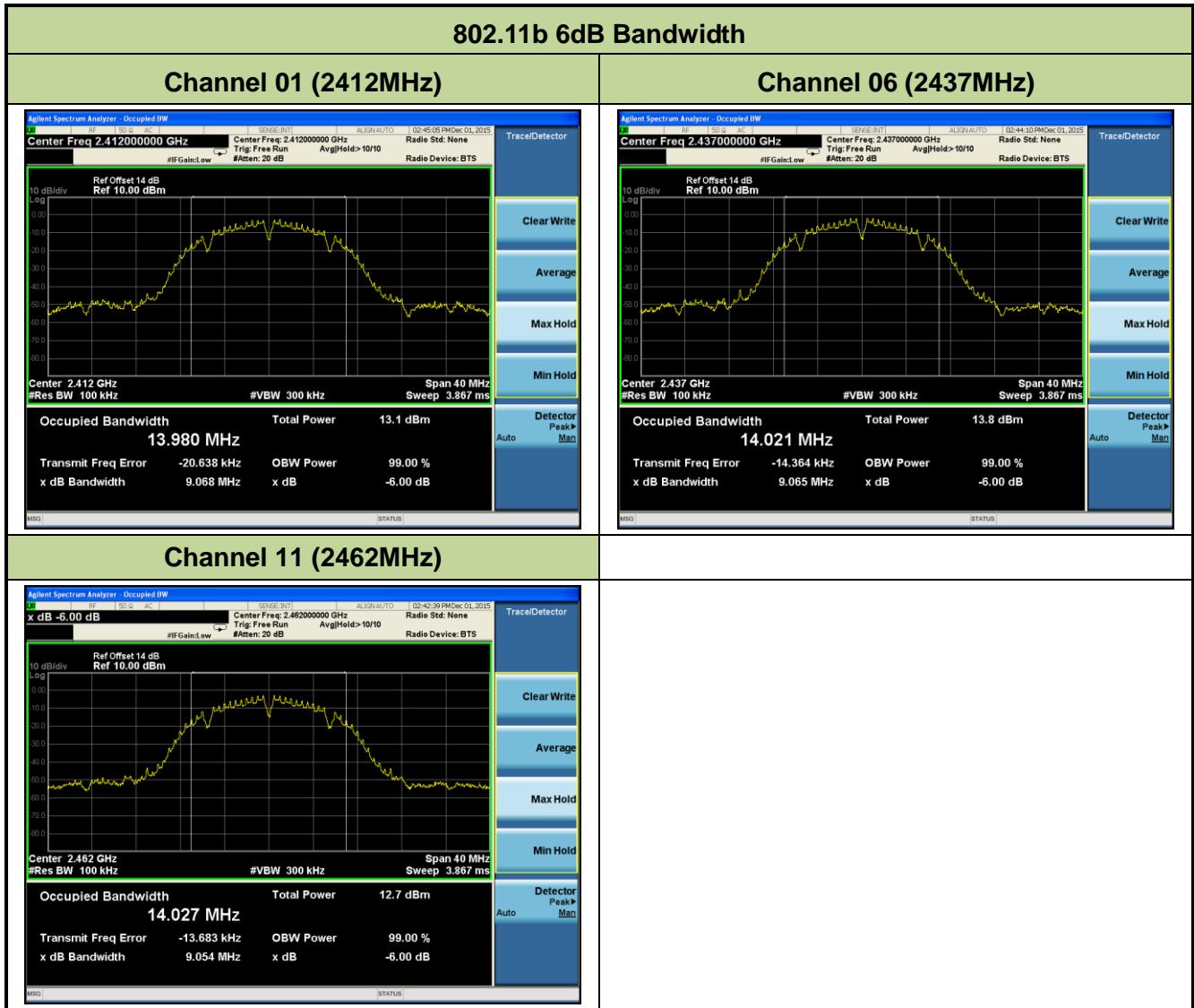
7.2.4. Test Setup

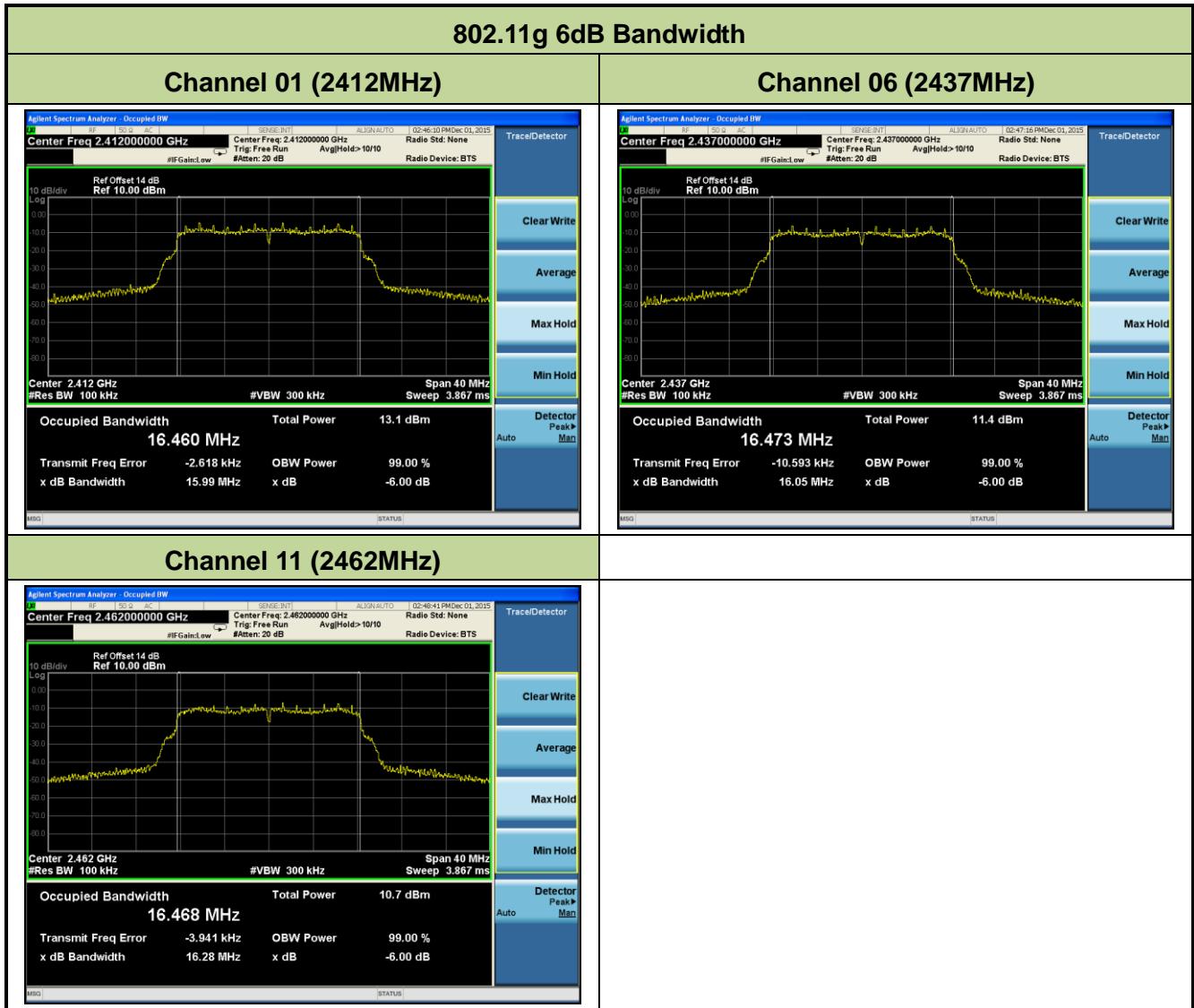


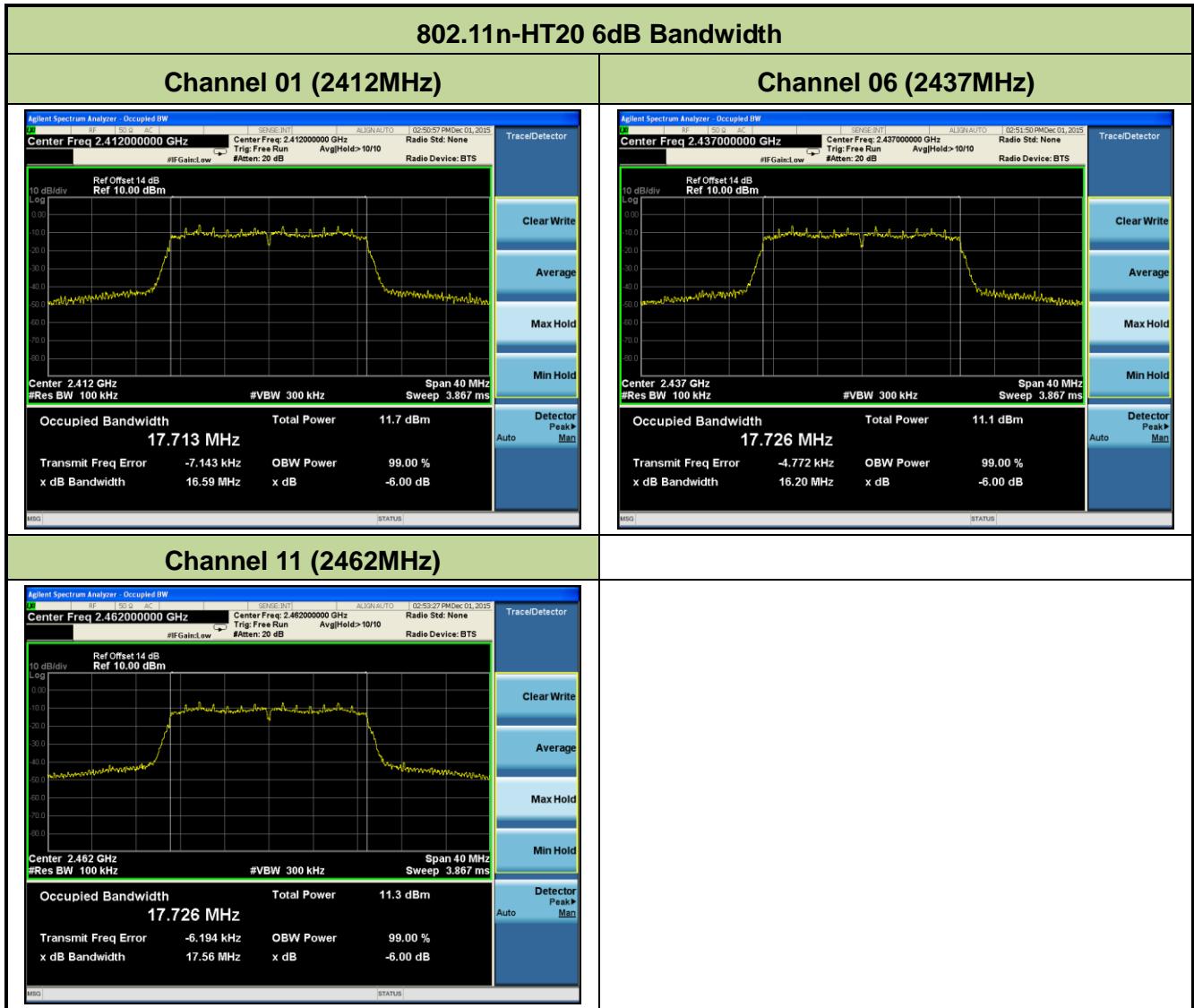
7.2.5. Test Result

Product	Head Up Display	Temperature	25°C
Test Engineer	Andy Zhu	Relative Humidity	58%
Test Site	TR3	Test Date	2015/12/01
Test Item	6dB Bandwidth		

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11b	1	01	2412	9.07	≥ 0.5	Pass
802.11b	1	06	2437	9.07	≥ 0.5	Pass
802.11b	1	11	2462	9.05	≥ 0.5	Pass
802.11g	6	01	2412	15.99	≥ 0.5	Pass
802.11g	6	06	2437	16.05	≥ 0.5	Pass
802.11g	6	11	2462	16.28	≥ 0.5	Pass
802.11n-HT20	6.5	01	2412	16.59	≥ 0.5	Pass
802.11n-HT20	6.5	06	2437	16.20	≥ 0.5	Pass
802.11n-HT20	6.5	11	2462	17.56	≥ 0.5	Pass







7.3. Output Power Measurement

7.3.1. Test Limit

The maximum out power shall be less 1 Watt (30dBm).

7.3.2. Test Procedure Used

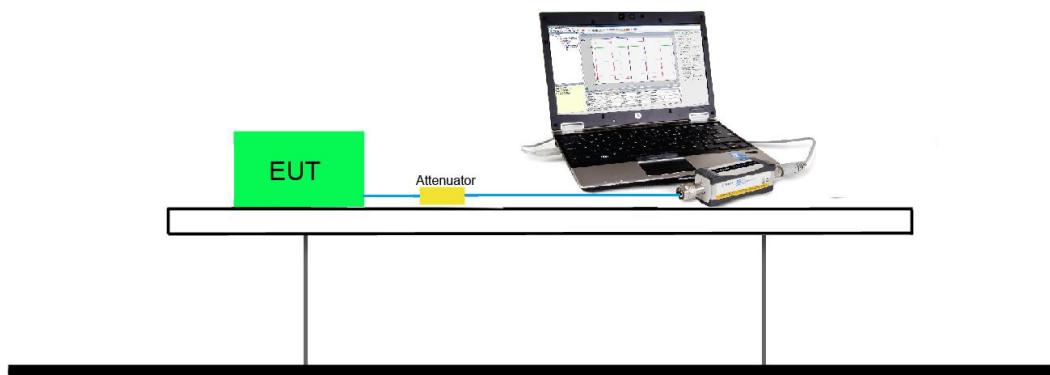
KDB 558074 D01v03r05 - Section 9.1.2 PKPM1 - Peak Power Method

7.3.3. Test Setting

Method PKPM1 (Peak Power Measurement of Signals with DTS BW ≤ 50MHz)

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

7.3.4. Test Setup



7.3.5. Test Result

Product	Head Up Display	Temperature	25°C
Test Engineer	Andy Zhu	Relative Humidity	58%
Test Site	TR3	Test Date	2015/12/01
Test Item	Output Power		

Output power at various data rates:

Test Mode	Bandwidth (MHz)	Channel No.	Frequency (MHz)	Data Rate (Mbps)	Peak Power (dBm)
802.11b	20	6	2437	1	8.57
				5.5	8.34
				11	8.19
802.11g	20	6	2437	6	8.29
				24	8.16
				54	8.03
802.11n	20	6	2437	6.5	8.26
				39	8.10
				65	8.04

Test Result of Peak Output Power

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Result
11b	1	1	2412	8.63	≤ 30	Pass
11b	1	6	2437	8.57	≤ 30	Pass
11b	1	11	2462	8.12	≤ 30	Pass
11g	6	1	2412	8.43	≤ 30	Pass
11g	6	6	2437	8.29	≤ 30	Pass
11g	6	11	2462	8.51	≤ 30	Pass
11n-HT20	6.5	1	2412	8.72	≤ 30	Pass
11n-HT20	6.5	6	2437	8.26	≤ 30	Pass
11n-HT20	6.5	11	2462	8.12	≤ 30	Pass

Test Result of Average Output Power (Reporting Only)

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	Average Power (dBm)	Limit (dBm)	Result
11b	1	1	2412	6.63	≤ 30	Pass
11b	1	6	2437	6.11	≤ 30	Pass
11b	1	11	2462	6.51	≤ 30	Pass
11g	6	1	2412	3.48	≤ 30	Pass
11g	6	6	2437	2.89	≤ 30	Pass
11g	6	11	2462	2.25	≤ 30	Pass
11n-HT20	6.5	1	2412	3.22	≤ 30	Pass
11n-HT20	6.5	6	2437	2.98	≤ 30	Pass
11n-HT20	6.5	11	2462	2.29	≤ 30	Pass

7.4. Power Spectral Density Measurement

7.4.1. Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

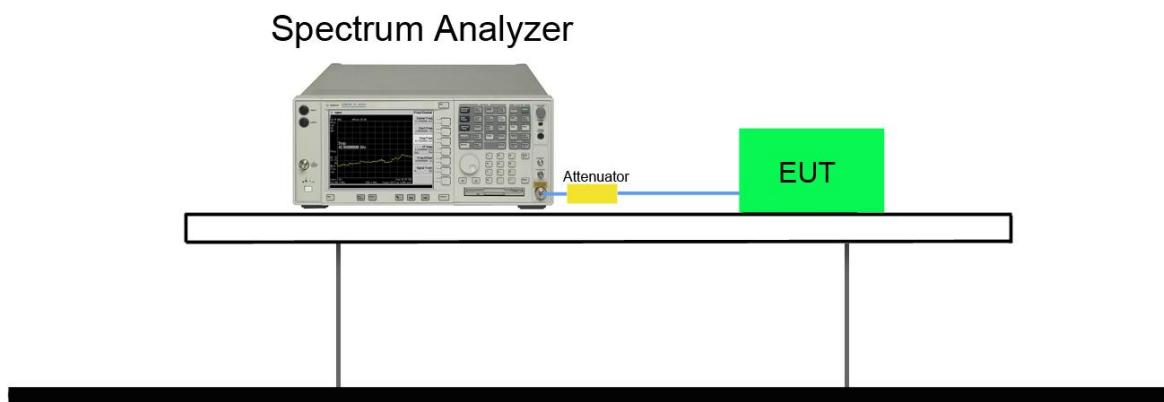
7.4.2. Test Procedure Used

KDB 558074 D01v03r05 - Section 10.2 Method PKPSD

7.4.3. Test Setting

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 10kHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

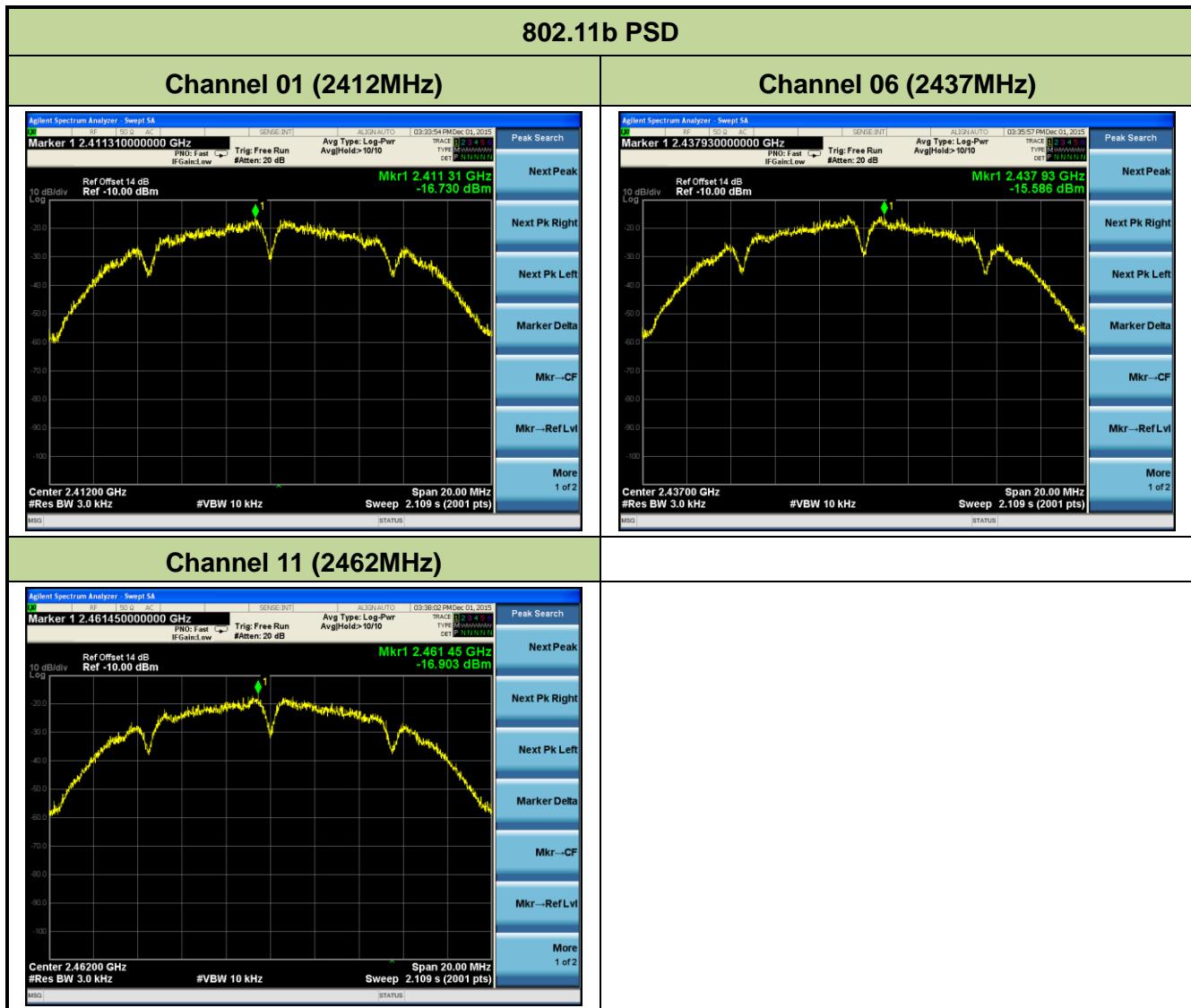
7.4.4. Test Setup

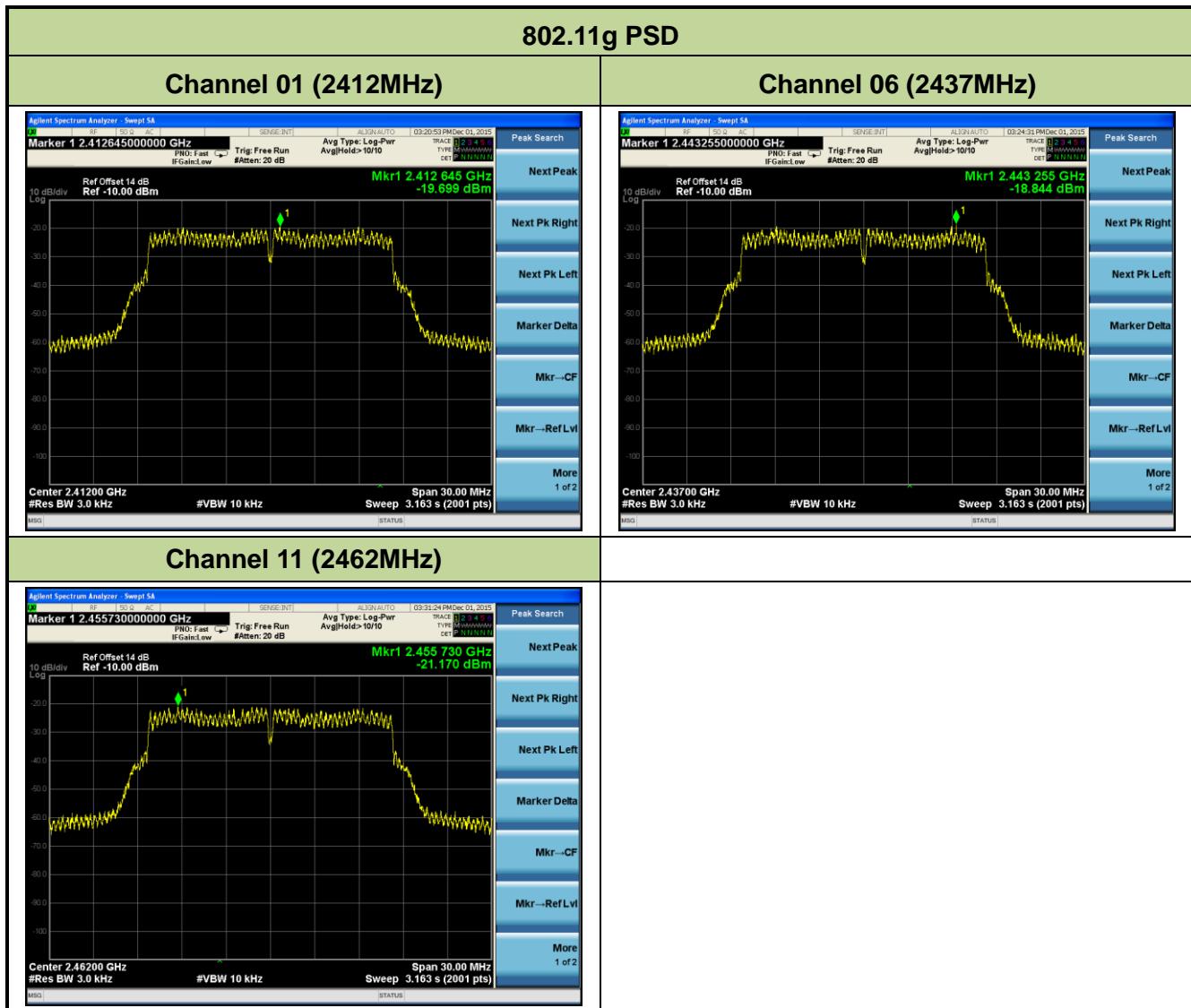


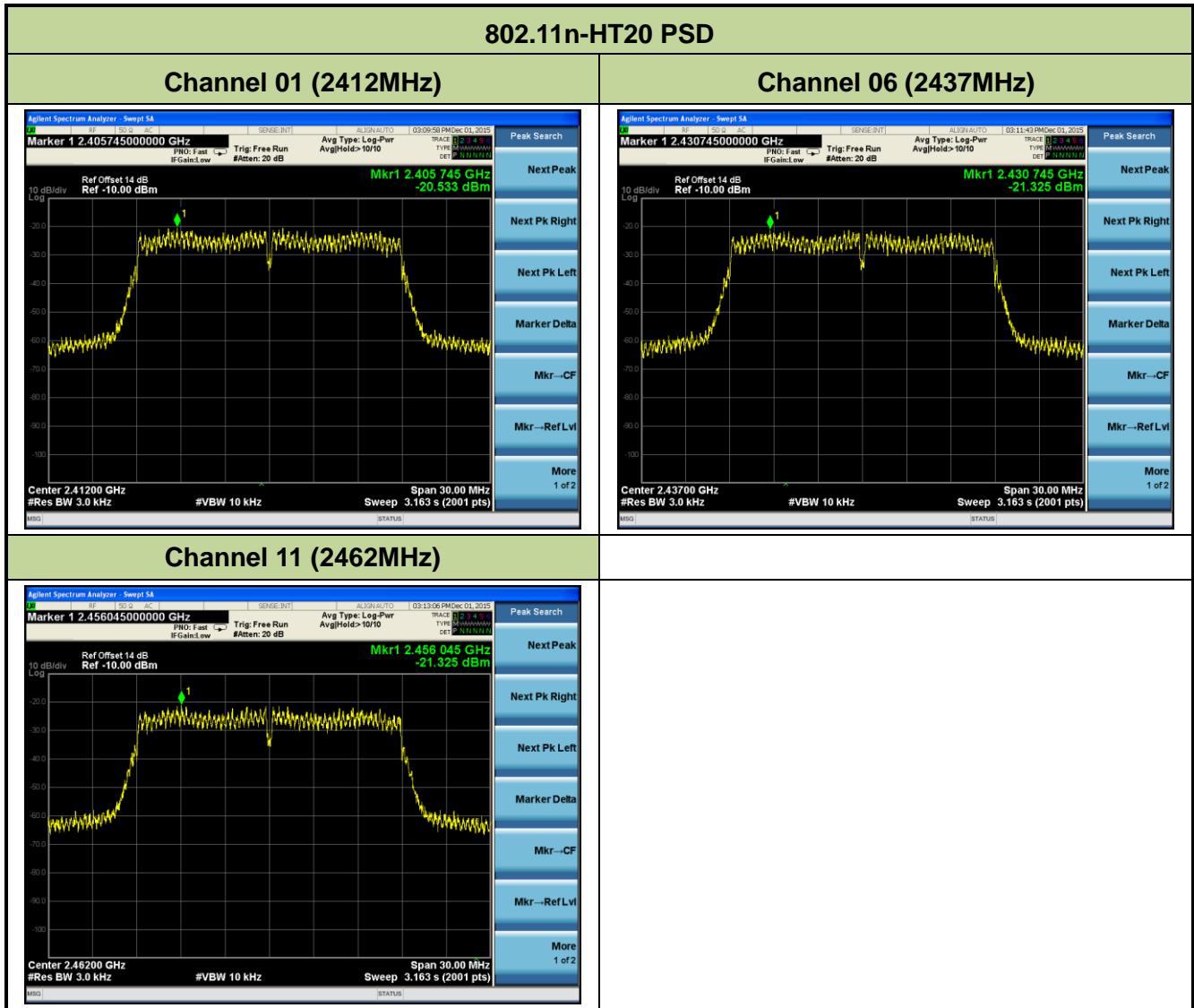
7.4.5. Test Result

Product	Head Up Display	Temperature	25°C
Test Engineer	Andy Zhu	Relative Humidity	58%
Test Site	TR3	Test Date	2015/12/01
Test Item	Power Spectral Density		

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	PSD Result (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
11b	1	1	2412	-16.73	≤ 8	Pass
11b	1	6	2437	-15.59	≤ 8	Pass
11b	1	11	2462	-16.90	≤ 8	Pass
11g	6	1	2412	-19.70	≤ 8	Pass
11g	6	6	2437	-18.84	≤ 8	Pass
11g	6	11	2462	-21.17	≤ 8	Pass
11n-HT20	6.5	1	2412	-20.53	≤ 8	Pass
11n-HT20	6.5	6	2437	-21.33	≤ 8	Pass
11n-HT20	6.5	11	2462	-21.33	≤ 8	Pass







7.5. Conducted Band Edge and Out-of-Band Emissions

7.5.1. Test Limit

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the PSD procedure.

7.5.2. Test Procedure Used

KDB 558074 D01v03r05 - Section 11.2 & Section 11.3

7.5.3. Test Setting

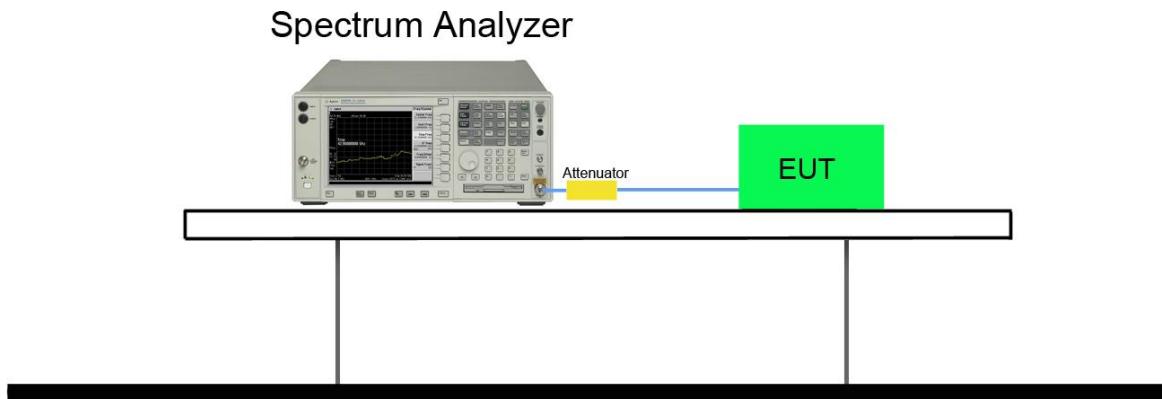
1. Reference level measurement

- (a) Set instrument center frequency to DTS channel center frequency
- (b) Set the span to \geq 1.5 times the DTS bandwidth
- (c) Set the RBW = 100 kHz
- (d) Set the VBW \geq 3 x RBW
- (e) Detector = peak
- (f) Sweep time = auto couple
- (g) Trace mode = max hold
- (h) Allow trace to fully stabilize

2. Emission level measurement

- (a) Set the center frequency and span to encompass frequency range to be measured
- (b) RBW = 100kHz
- (c) VBW = 300kHz
- (d) Detector = Peak
- (e) Number of sweep points \geq 2 x Span/RBW
- (f) Trace mode = max hold
- (g) Sweep time = auto couple
- (h) The trace was allowed to stabilize

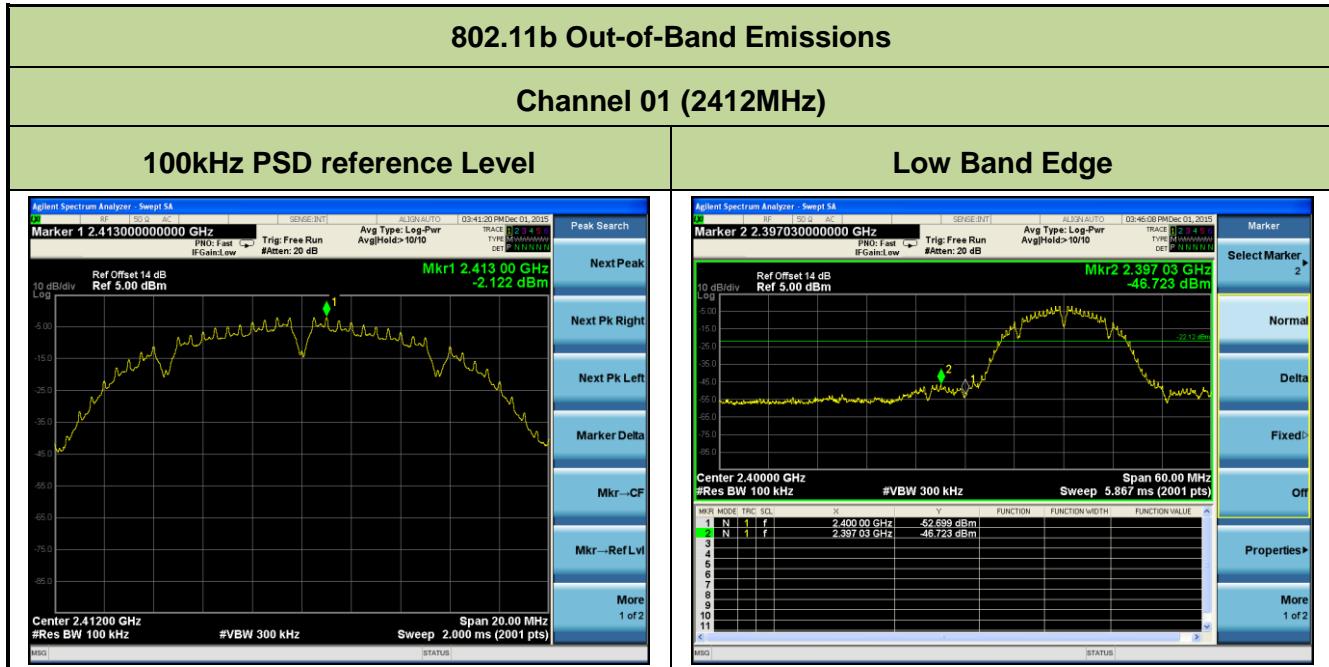
7.5.4. Test Setup

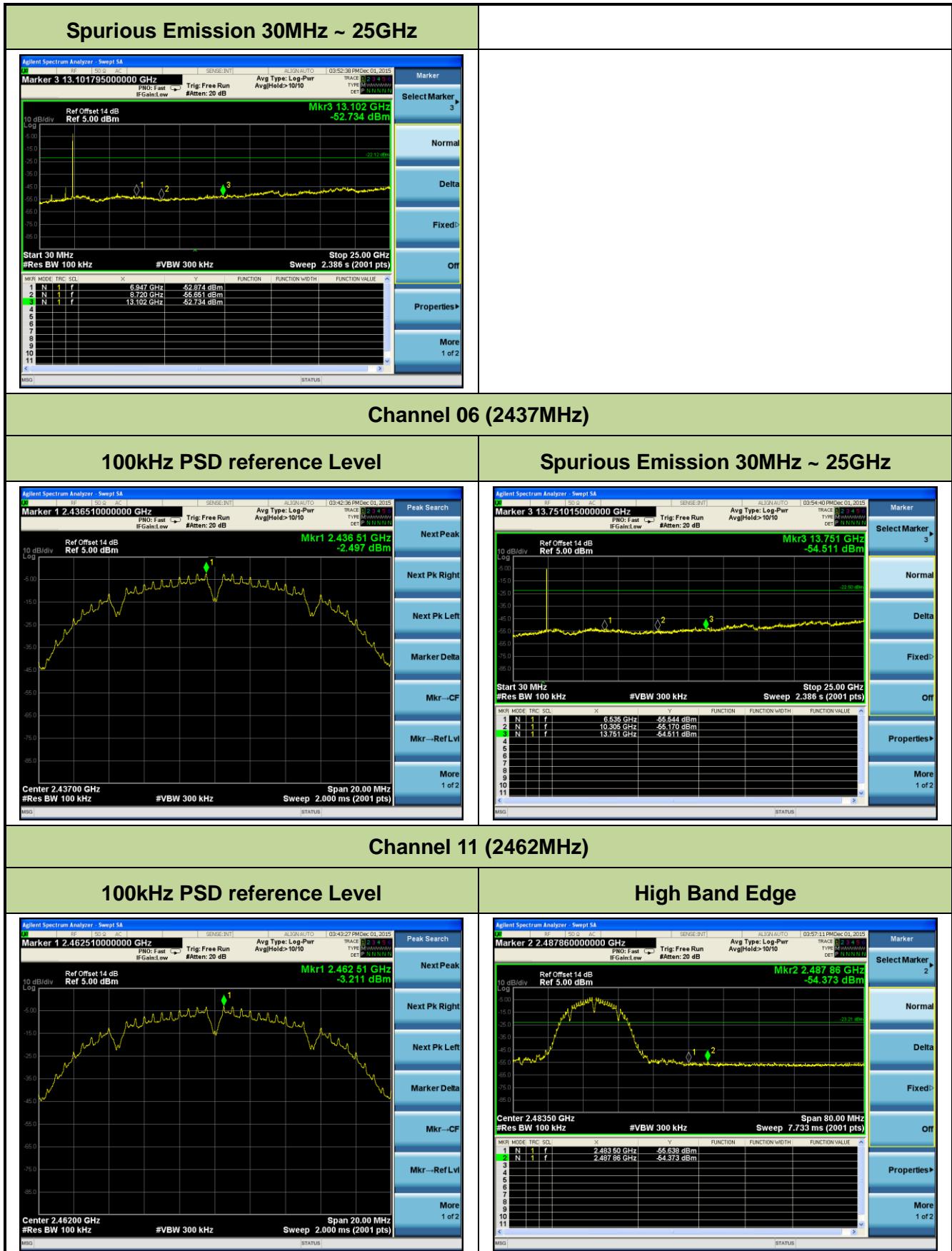


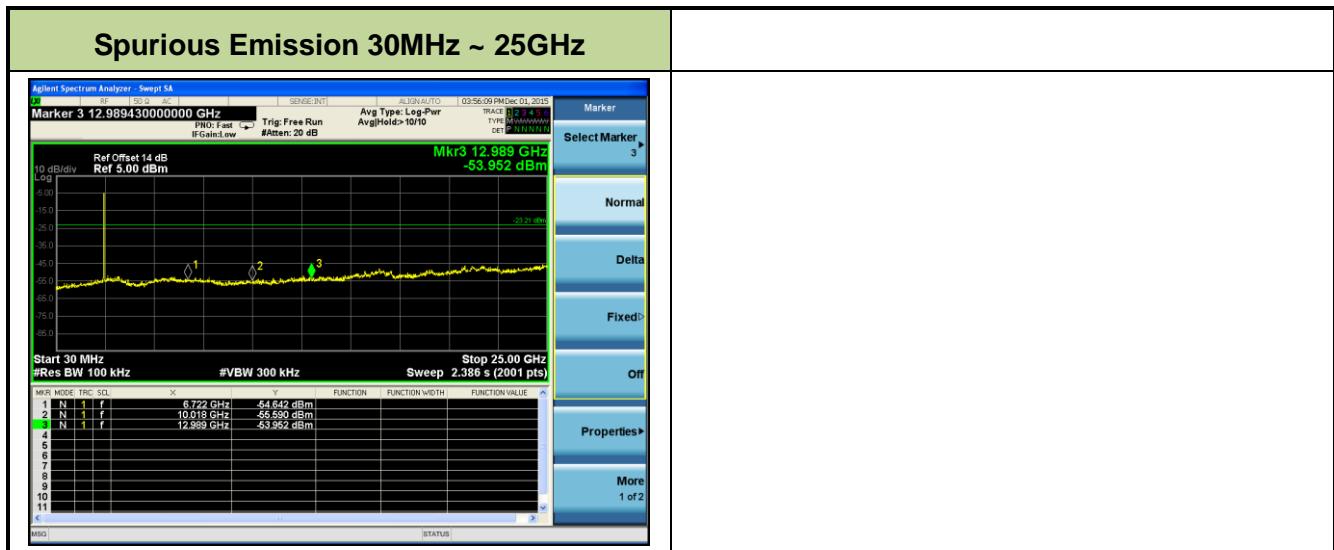
7.5.5. Test Result

Product	Head Up Display	Temperature	25°C
Test Engineer	Andy Zhu	Relative Humidity	58%
Test Site	TR3	Test Date	2015/12/01
Test Item	Conducted Band Edge and Out-of-Band Emissions		

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	Limit	Result
802.11b	1	01	2412	20dBc	Pass
802.11b	1	06	2437	20dBc	Pass
802.11b	1	11	2462	20dBc	Pass
802.11g	6	01	2412	20dBc	Pass
802.11g	6	06	2437	20dBc	Pass
802.11g	6	11	2462	20dBc	Pass
802.11n-HT20	6.5	01	2412	20dBc	Pass
802.11n-HT20	6.5	6	2437	20dBc	Pass
802.11n-HT20	6.5	11	2462	20dBc	Pass







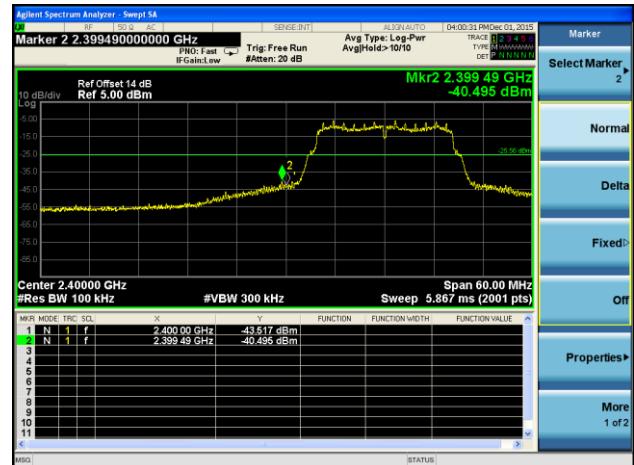
802.11g Out-of-Band Emissions

Channel 01 (2412MHz)

100kHz PSD reference Level



Low Band Edge

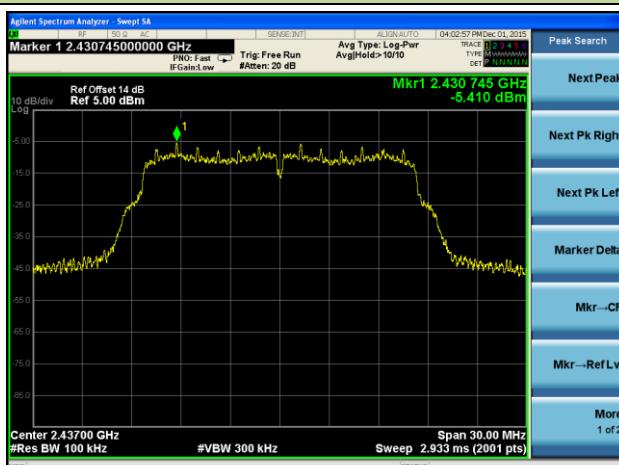


Spurious Emission 30MHz ~ 25GHz

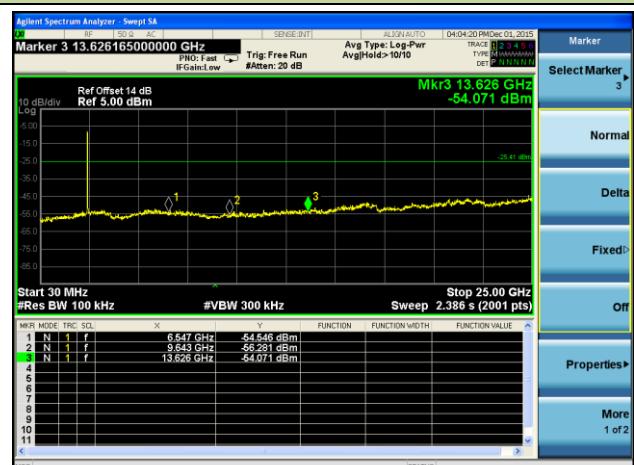


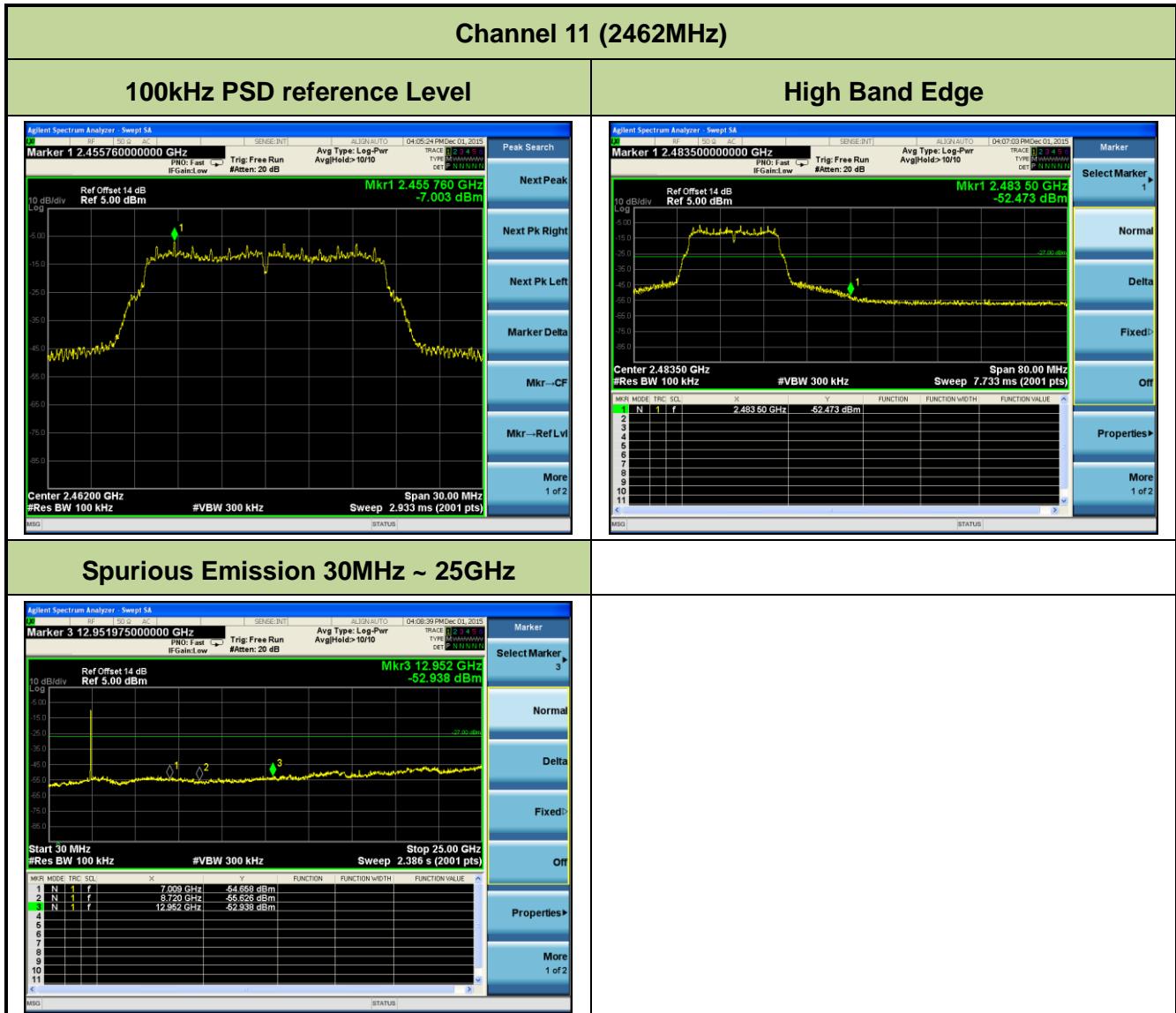
Channel 06 (2437MHz)

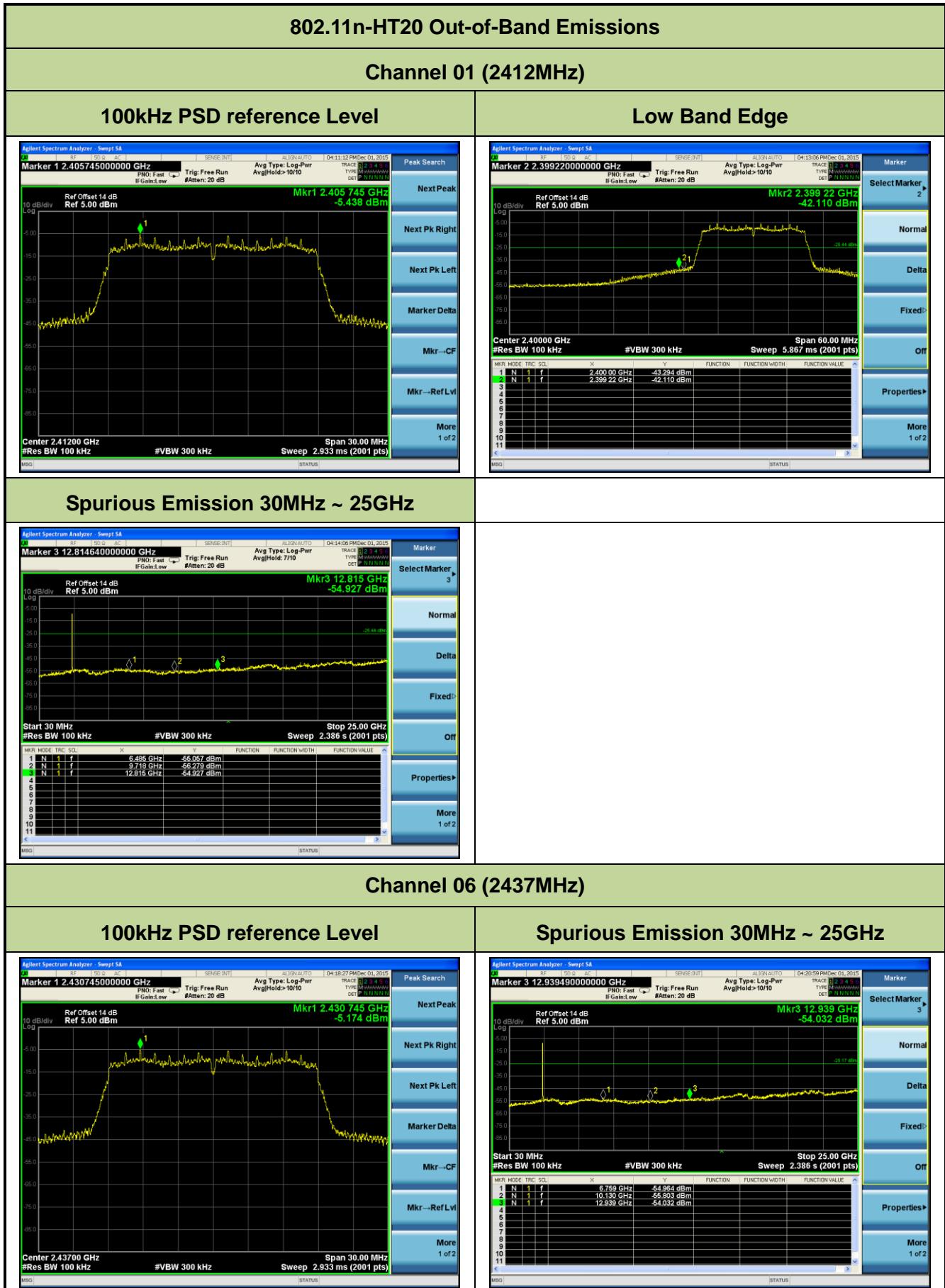
100kHz PSD reference Level

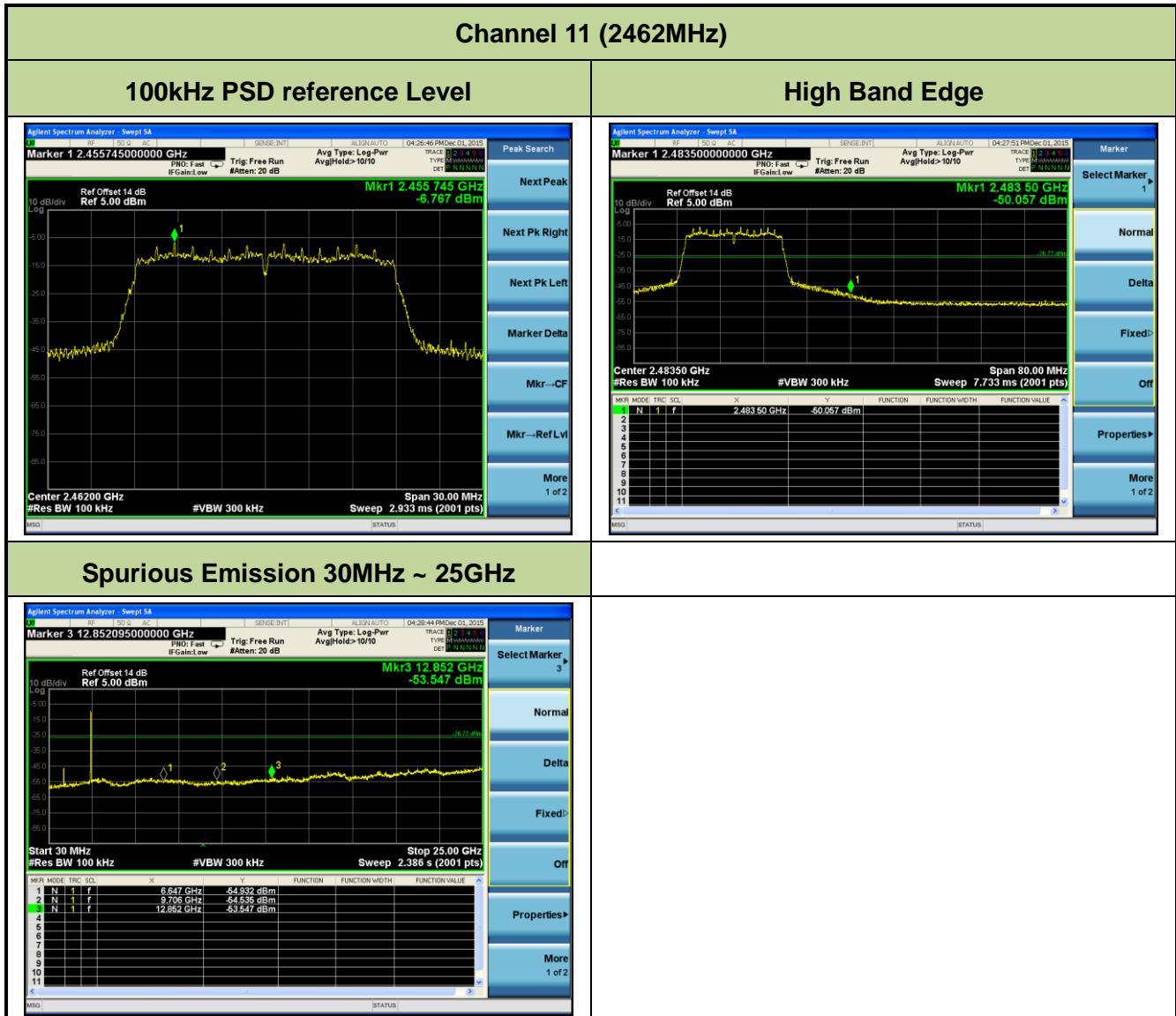


Spurious Emission 30MHz ~ 25GHz









7.6. Radiated Spurious Emission Measurement

7.6.1. Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [V/m]	Measured Distance [Meters]
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

7.6.2. Test Procedure Used

KDB 558074 D01v03r05 - Section 12.2.3 (quasi-peak measurements)

KDB 558074 D01v03r05 - Section 12.2.4 (peak power measurements)

KDB 558074 D01v03r05 - Section 12.2.5 (average power measurements)

7.6.3. Test Setting

Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 D01v03r05

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in Table 1
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple

6. Trace mode = max hold
7. Trace was allowed to stabilize

Table 1 - RBW as a function of frequency

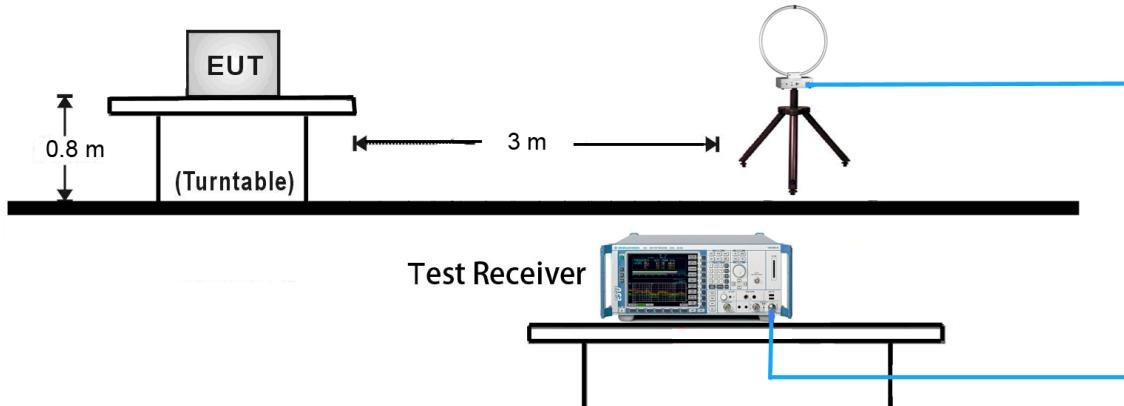
Frequency	RBW
9 ~ 150 kHz	200 ~ 300 Hz
0.15 ~ 30 MHz	9 ~ 10 kHz
30 ~ 1000 MHz	100 ~ 120 kHz
> 1000 MHz	1 MHz

Average Field Strength Measurements

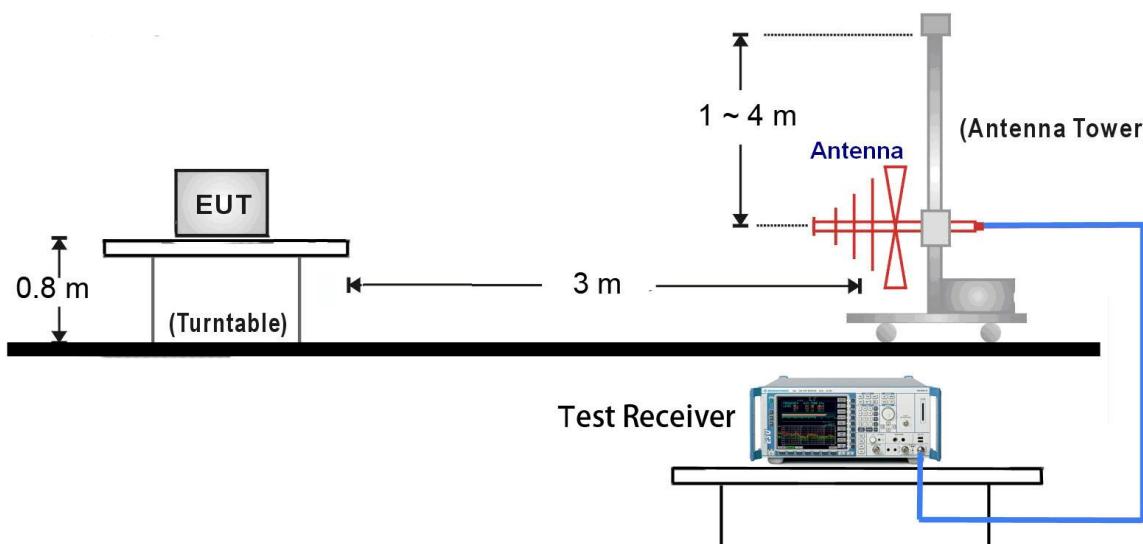
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW $\geq 1/T$
4. De As an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode in order to accomplish this. Others have a setting for Average-VBW Type, which can be set to "Voltage" regardless of the display mode
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow max hold to run for at least 50 times (1/duty cycle) traces

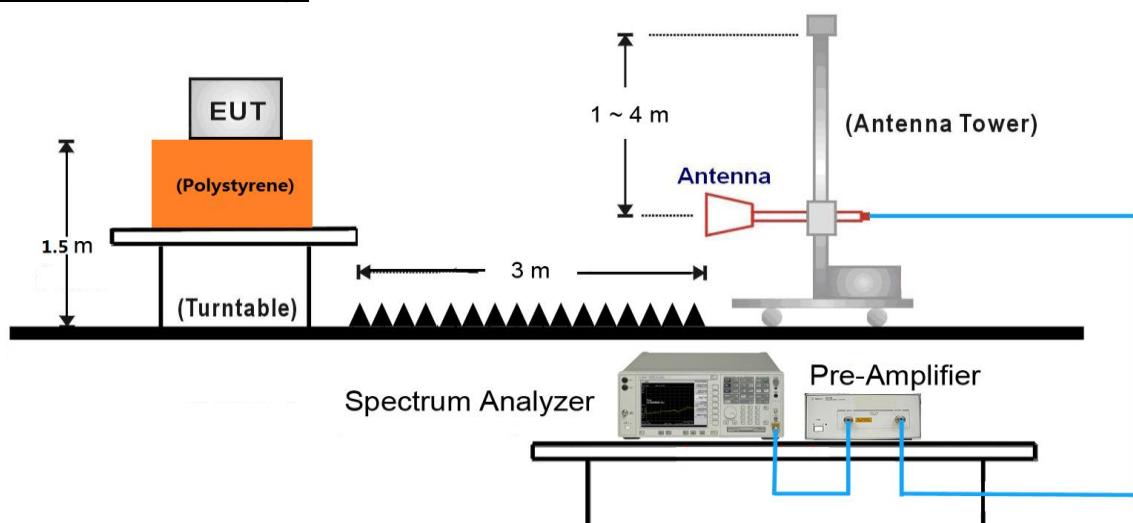
7.6.4. Test Setup

9kHz ~ 30MHz Test Setup:



30MHz ~ 1GHz Test Setup:



1GHz ~ 25GHz Test Setup:

7.6.5. Test Result

Test Mode:	802.11g	Test Site:	AC1
Test Channel:	01	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. The worst case of Radiated Spurious Emission. 3. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dB μ V)	Factor (dB)	Measure Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Polarization
*	3176.0	39.4	-1.6	37.8	81.7	-43.9	Peak	Horizontal
*	3499.0	39.8	-1.1	38.7	81.7	-43.0	Peak	Horizontal
	4816.5	38.5	2.7	41.2	74.0	-32.8	Peak	Horizontal
	7434.5	36.9	8.0	44.9	74.0	-29.1	Peak	Horizontal
*	3193.0	40.0	-1.6	38.4	81.7	-43.3	Peak	Vertical
*	3533.0	38.0	-1.0	37.0	81.7	-44.7	Peak	Vertical
	4782.5	37.2	2.7	39.9	74.0	-34.1	Peak	Vertical
	7536.5	36.8	8.3	45.1	74.0	-28.9	Peak	Vertical

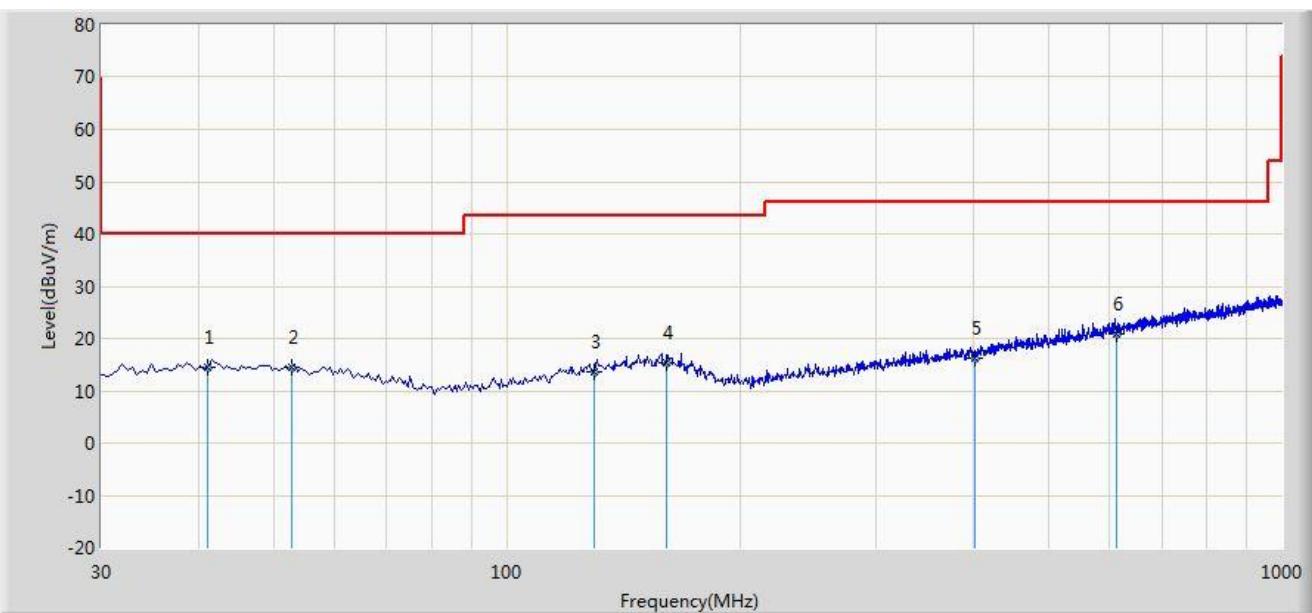
Note 1: “*” is not in restricted band, its limit is 20dBc of the fundamental emission level (101.7dB μ V/m).

Note 2: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB)

The worst case of Radiated Emission below 1GHz:

Site: AC1	Time: 2015/12/24 - 11:12
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: VULB9162_0.03-8GHz	Polarity: Horizontal
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: 802.11g at Channel 2412MHz	

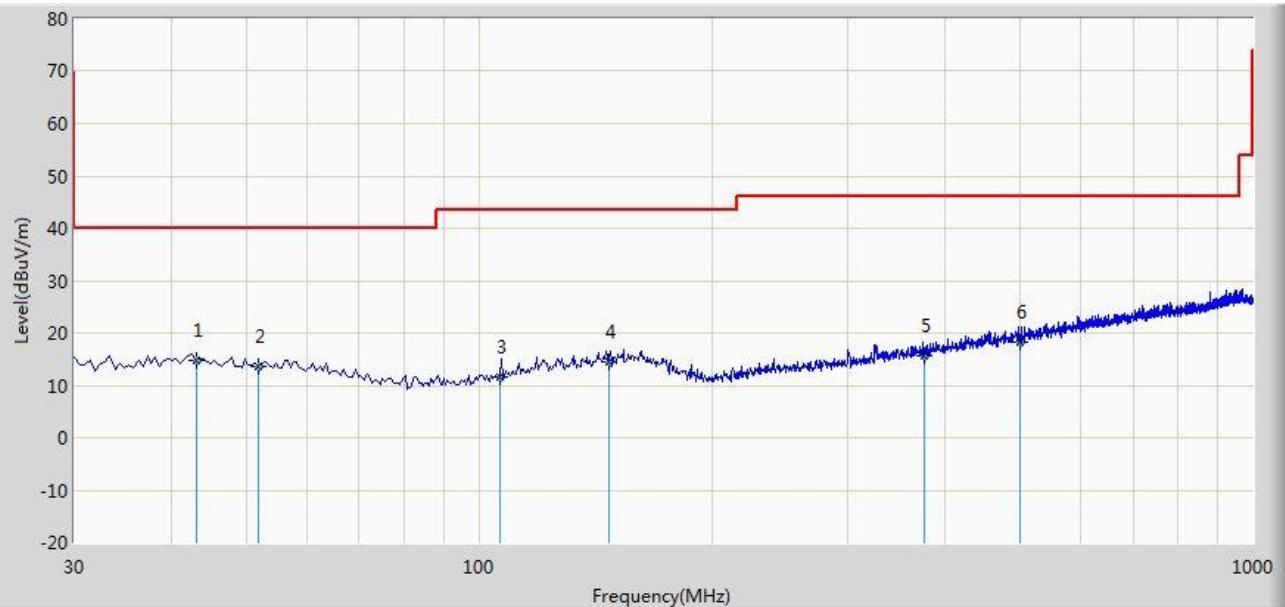


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			41.155	14.357	13.864	-25.643	40.000	0.493	QP
2			52.795	14.474	13.936	-25.526	40.000	0.538	QP
3			129.425	13.652	12.721	-29.848	43.500	0.932	QP
4			160.950	15.292	14.237	-28.208	43.500	1.055	QP
5			402.480	16.119	14.360	-29.881	46.000	1.759	QP
6	*		611.515	20.915	18.743	-25.085	46.000	2.172	QP

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2015/12/24 - 11:15
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: VULB9162_0.03-8GHz	Polarity: Vertical
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: 802.11g at Channel 2412MHz	

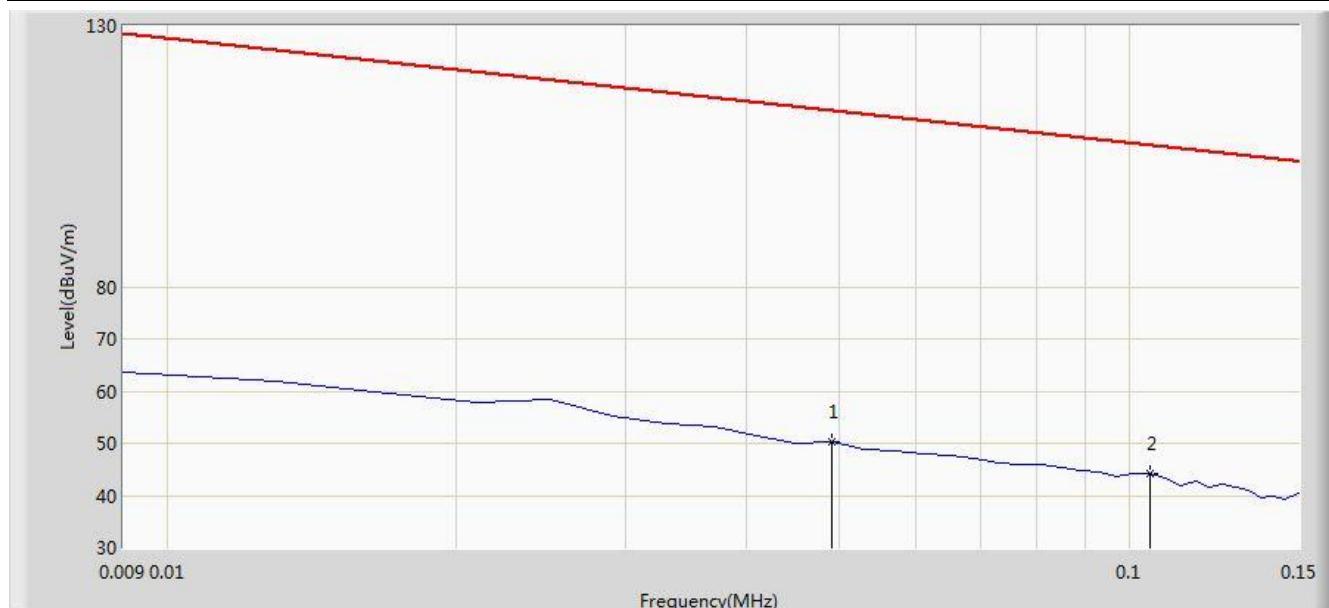


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dB μ V/m)	Factor (dB)	Type
1		*	43.095	14.862	14.360	-25.138	40.000	0.503	QP
2			51.825	13.479	12.954	-26.521	40.000	0.525	QP
3			106.630	11.624	10.780	-31.876	43.500	0.844	QP
4			147.370	14.405	13.398	-29.095	43.500	1.007	QP
5			375.805	15.655	13.968	-30.345	46.000	1.687	QP
6			500.935	18.227	16.253	-27.773	46.000	1.974	QP

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2015/12/12 - 15:32
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: FMZB1519_0.009-30MHz	Polarity: Face On
EUT: Head Up Display	Power: AC 120V/60Hz
Note: There is the ambient noise within frequency range 9kHz~30MHz.	

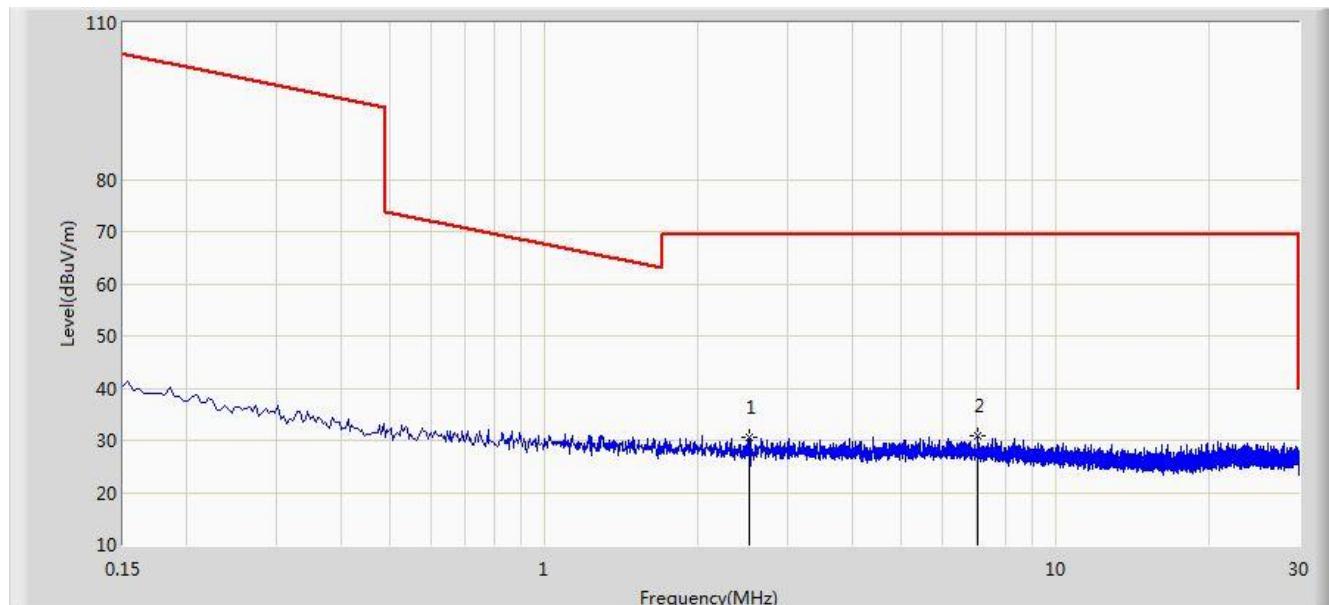


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			0.049	50.367	29.861	-63.422	113.789	20.505	QP
2		*	0.105	44.143	23.996	-63.029	107.173	20.147	QP

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2015/12/12 - 15:41
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: FMZB1519_0.009-30MHz	Polarity: Face On
EUT: Head Up Display	Power: AC 120V/60Hz
Note: There is the ambient noise within frequency range 9kHz~30MHz.	

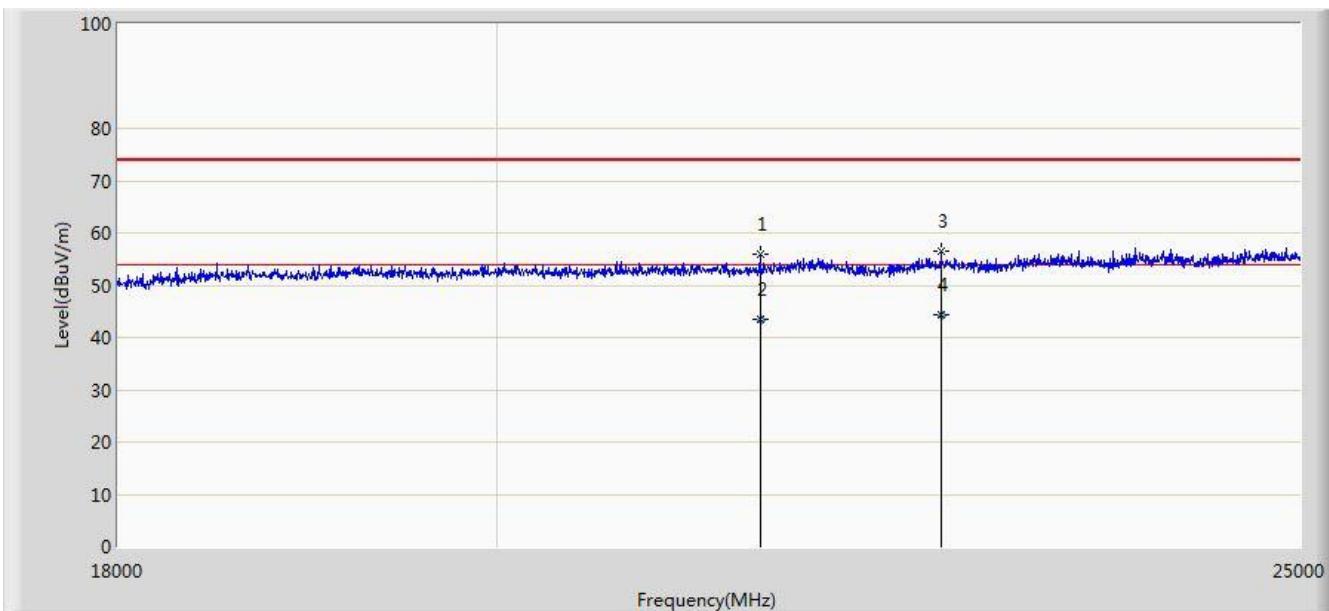


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2.513	30.495	10.336	-39.005	69.500	20.159	QP
2		*	7.041	30.974	10.579	-38.526	69.500	20.395	QP

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC1	Time: 2015/12/12 - 15:41
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9170_18-40GHz	Polarity: Horizontal
EUT: Head Up Display	Power: AC 120V/60Hz
Note: There is the ambient noise within frequency range 18GHz~25GHz.	

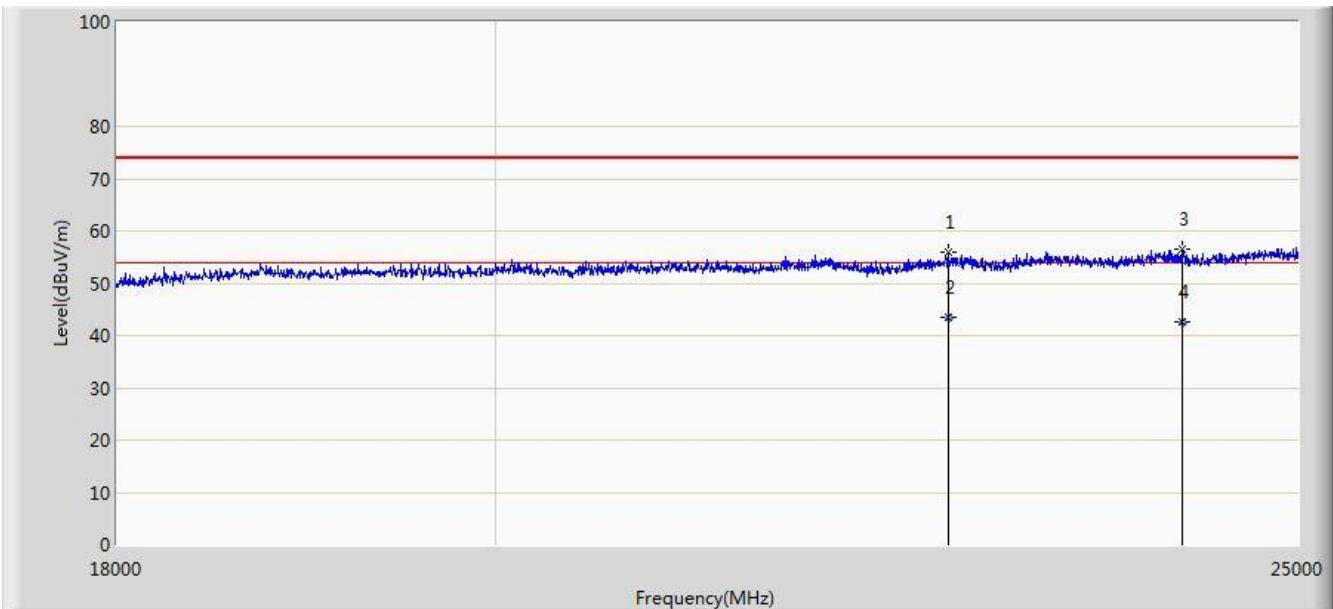


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dB μ V/m)	Factor (dB)	Type
1			21517.500	55.869	17.883	-18.131	74.000	37.986	PK
2			21517.650	43.351	5.365	-10.649	54.000	37.986	AV
3			22630.500	56.509	18.223	-17.491	74.000	38.286	PK
4		*	22630.540	44.310	6.024	-9.690	54.000	38.286	AV

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB)

Site: AC1	Time: 2015/12/12 - 15:41
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9170_18-40GHz	Polarity: Vertical
EUT: Head Up Display	Power: AC 120V/60Hz
Note: There is the ambient noise within frequency range 18GHz~25GHz.	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			22686.500	55.811	17.457	-18.189	74.000	38.354	PK
2			22686.540	43.598	5.244	-10.402	54.000	38.354	AV
3			24205.500	56.430	17.607	-17.570	74.000	38.823	PK
4		*	24205.658	42.518	3.695	-11.482	54.000	38.823	AV

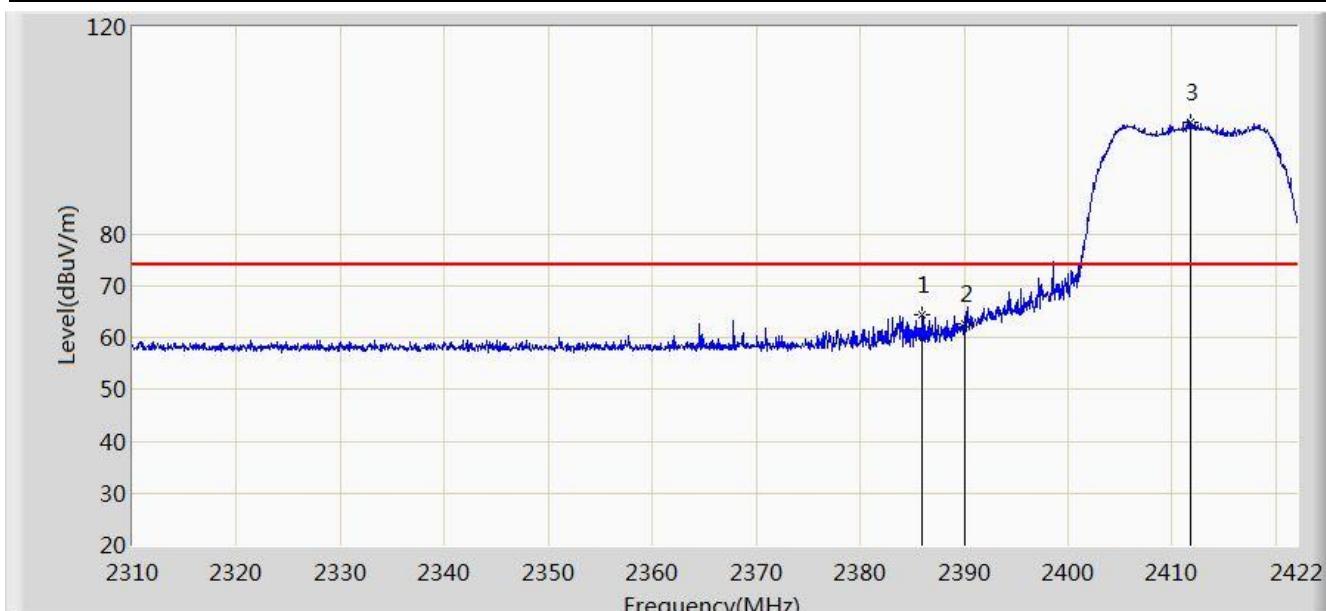
Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB)

7.7. Radiated Restricted Band Edge Measurement

7.7.1. Test Result

Site: AC 1	Time: 2015/11/26 - 15:22
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: Transmit by 802.11g at channel 2412MHz	

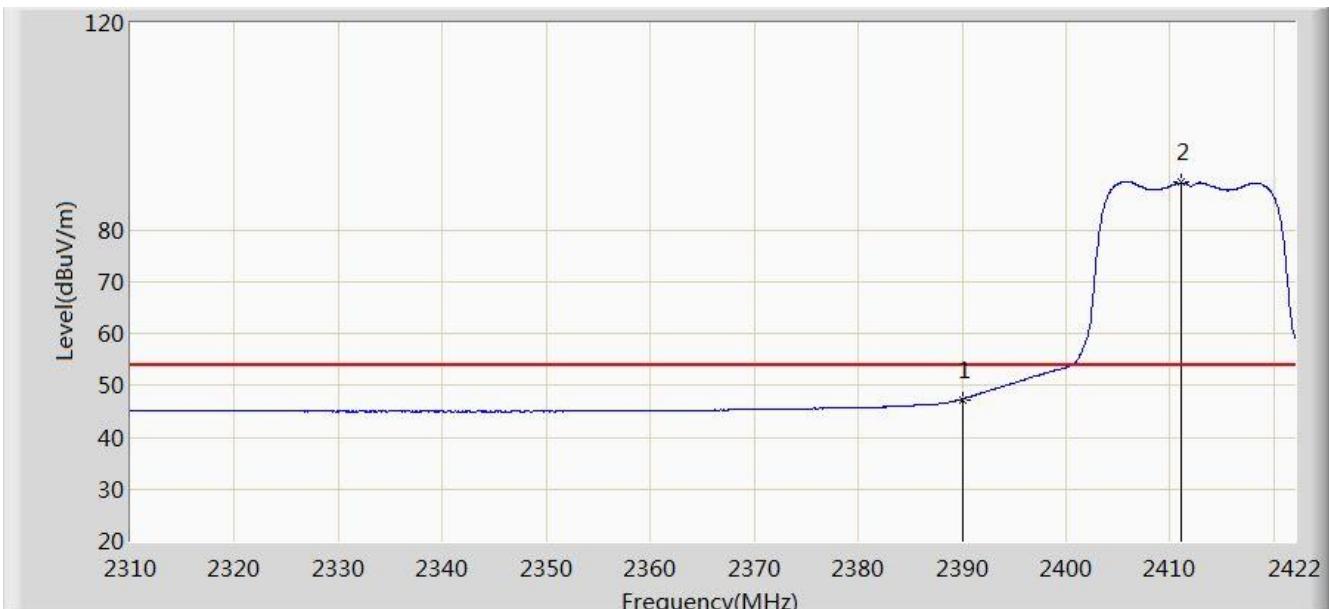


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2385.880	64.552	33.342	-9.448	74.000	31.211	PK
2			2390.000	62.787	31.584	-11.213	74.000	31.203	PK
3	*	*	2411.808	101.653	70.483	N/A	N/A	31.170	PK

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC 1	Time: 2015/11/26 - 15:38
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: Transmit by 802.11g at channel 2412MHz	

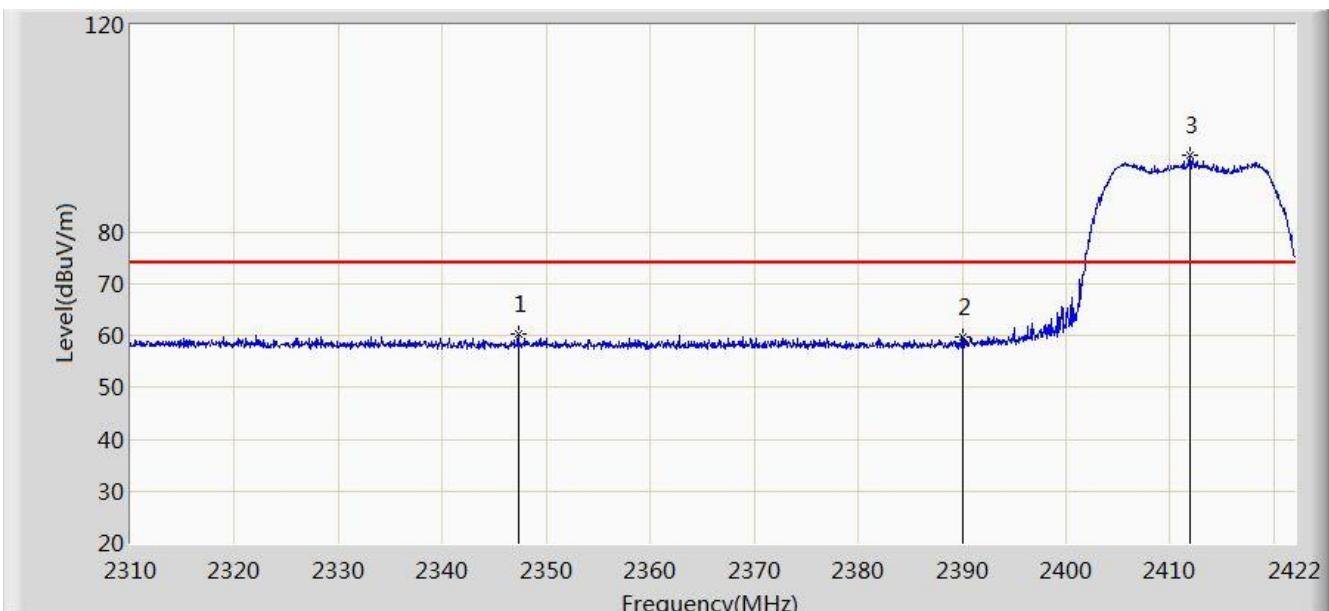


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dB μ V/m)	Factor (dB)	Type
1			2390.000	47.333	16.130	-6.667	54.000	31.203	AV
2		*	2411.136	89.159	57.988	N/A	N/A	31.171	AV

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC 1	Time: 2015/11/26 - 15:39
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: Transmit by 802.11g at channel 2412MHz	

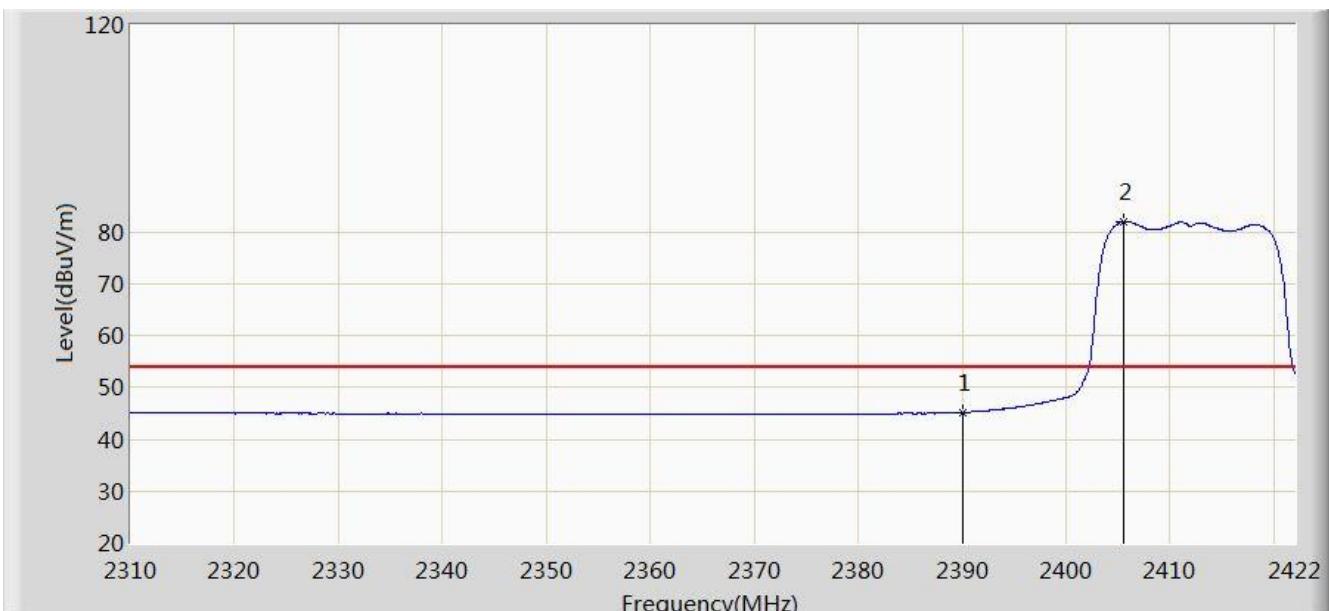


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dB μ V/m)	Factor (dB)	Type
1			2347.296	60.252	28.949	-13.748	74.000	31.303	PK
2			2390.000	59.661	28.458	-14.339	74.000	31.203	PK
3		*	2411.864	94.758	63.588	N/A	N/A	31.170	PK

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC 1	Time: 2015/11/26 - 15:44
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: Transmit by 802.11g at channel 2412MHz	

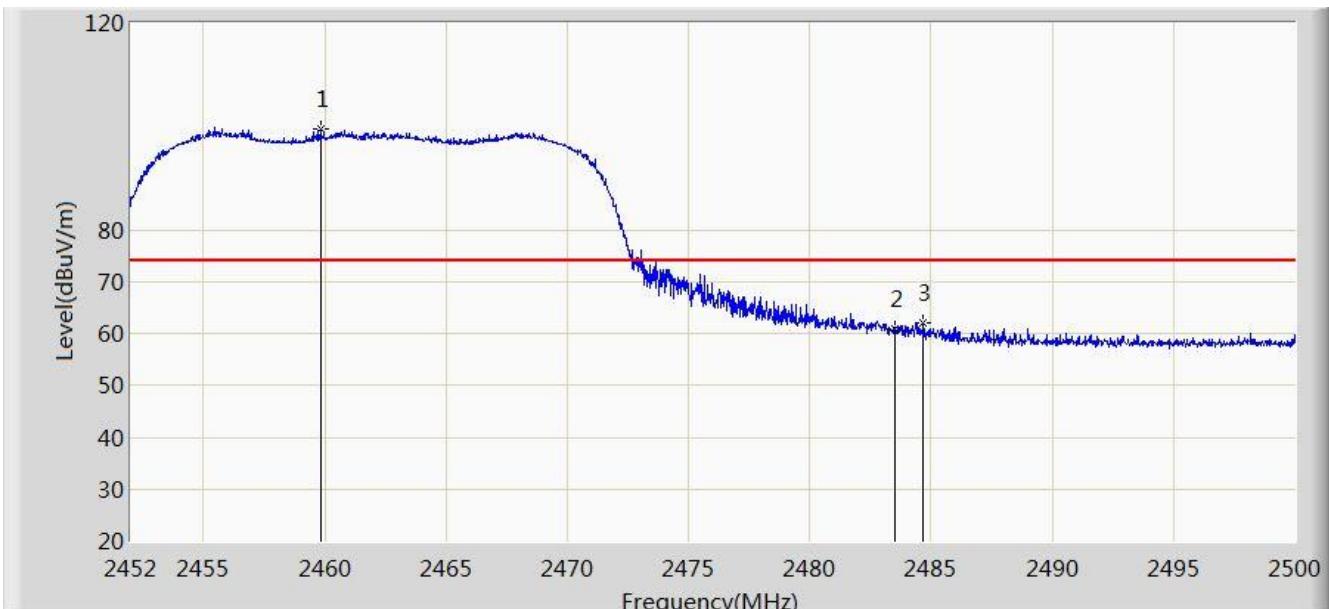


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	45.202	13.999	-8.798	54.000	31.203	AV
2		*	2405.592	82.049	50.870	N/A	N/A	31.179	AV

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC 1	Time: 2015/11/26 - 16:08
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: Transmit by 802.11n-HT20 at channel 2462MHz	

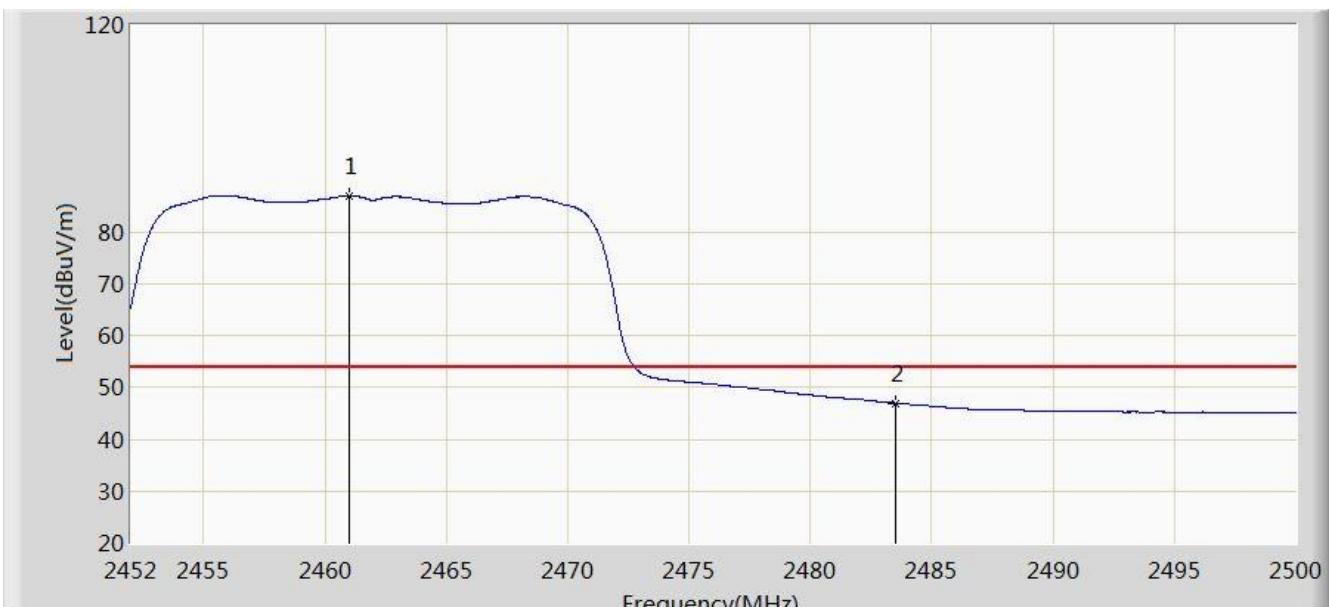


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dB μ V/m)	Factor (dB)	Type
1		*	2459.824	99.484	68.353	N/A	N/A	31.131	PK
2			2483.500	60.829	29.636	-13.171	74.000	31.194	PK
3			2484.688	62.170	30.974	-11.830	74.000	31.197	PK

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC 1	Time: 2015/11/26 - 16:14
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: Transmit by 802.11n-HT20 at channel 2462MHz	

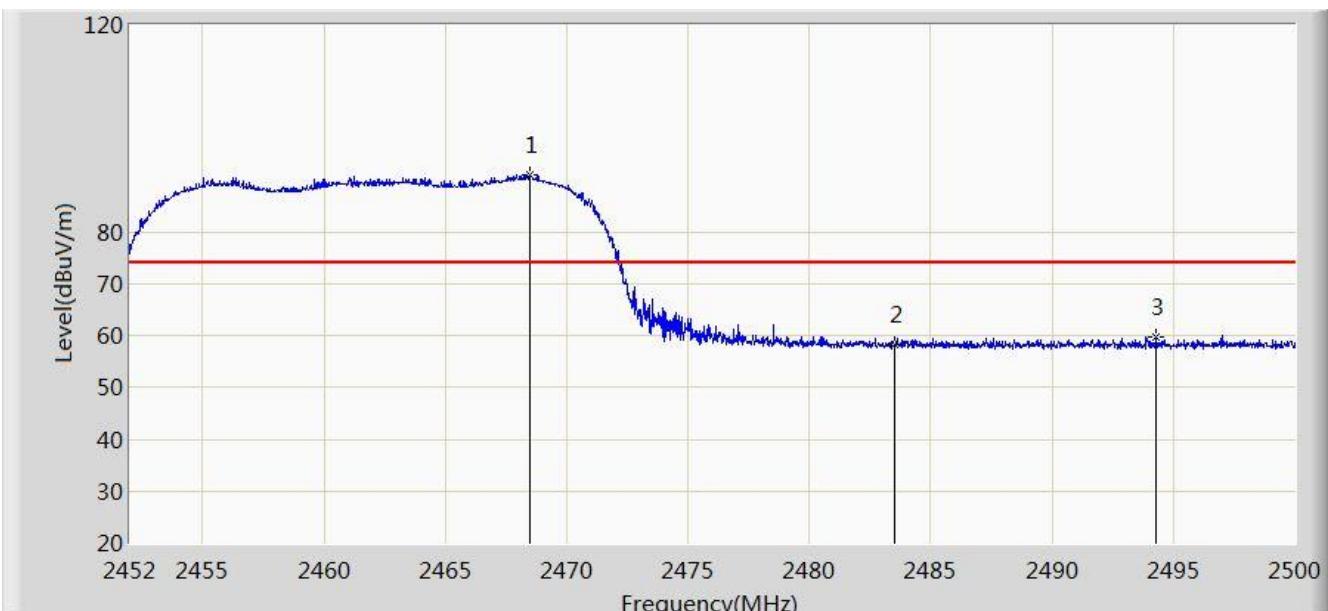


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dB μ V/m)	Factor (dB)	Type
1		*	2461.000	87.039	55.905	N/A	N/A	31.133	AV
2			2483.500	46.988	15.795	-7.012	54.000	31.194	AV

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC 1	Time: 2015/11/26 - 16:14
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: Transmit by 802.11n-HT20 at channel 2462MHz	

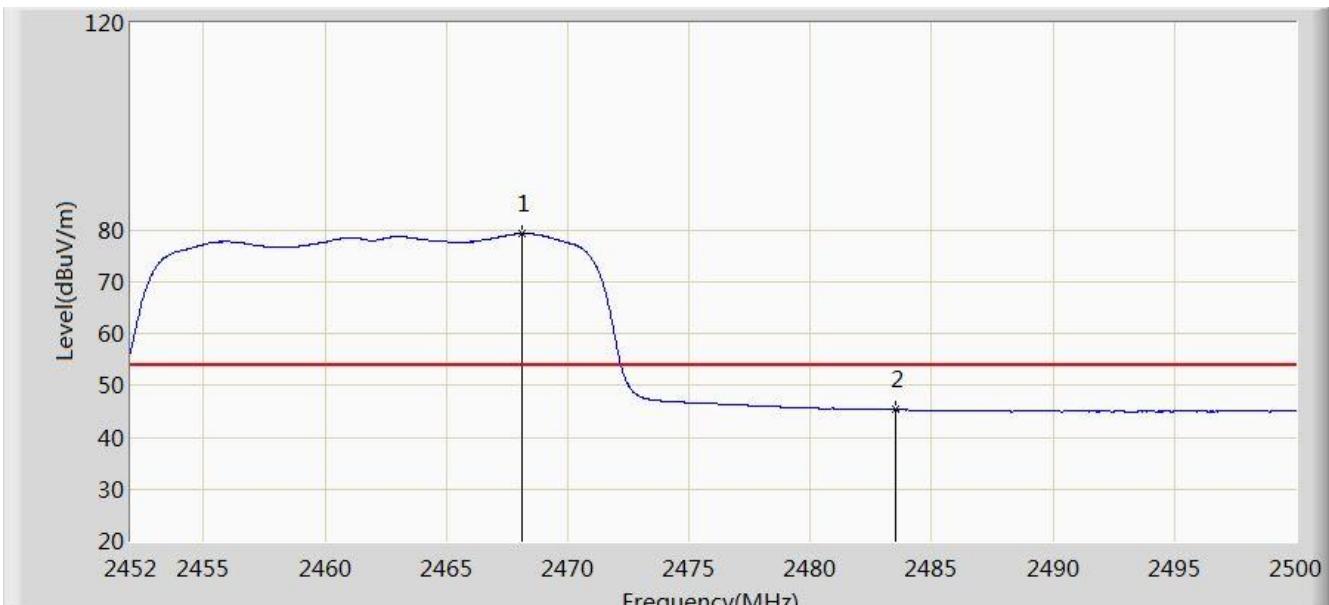


No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dB μ V/m)	Factor (dB)	Type
1		*	2468.464	91.047	59.895	N/A	N/A	31.151	PK
2			2483.500	58.342	27.149	-15.658	74.000	31.194	PK
3			2494.288	59.731	28.509	-14.269	74.000	31.222	PK

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Site: AC 1	Time: 2015/11/26 - 16:18
Limit: FCC_Part15.209_RE(3m)	Engineer: Roy Cheng
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Head Up Display	Power: AC 120V/60Hz
Worse Case Mode: Transmit by 802.11n-HT20 at channel 2462MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dB μ V/m)	Reading Level (dB μ V)	Over Limit (dB)	Limit (dB μ V/m)	Factor (dB)	Type
1		*	2468.104	79.289	48.138	N/A	N/A	31.151	AV
2			2483.500	45.301	14.108	-8.699	54.000	31.194	AV

Note: Measure Level (dB μ V/m) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

7.8. AC Conducted Emissions Measurement

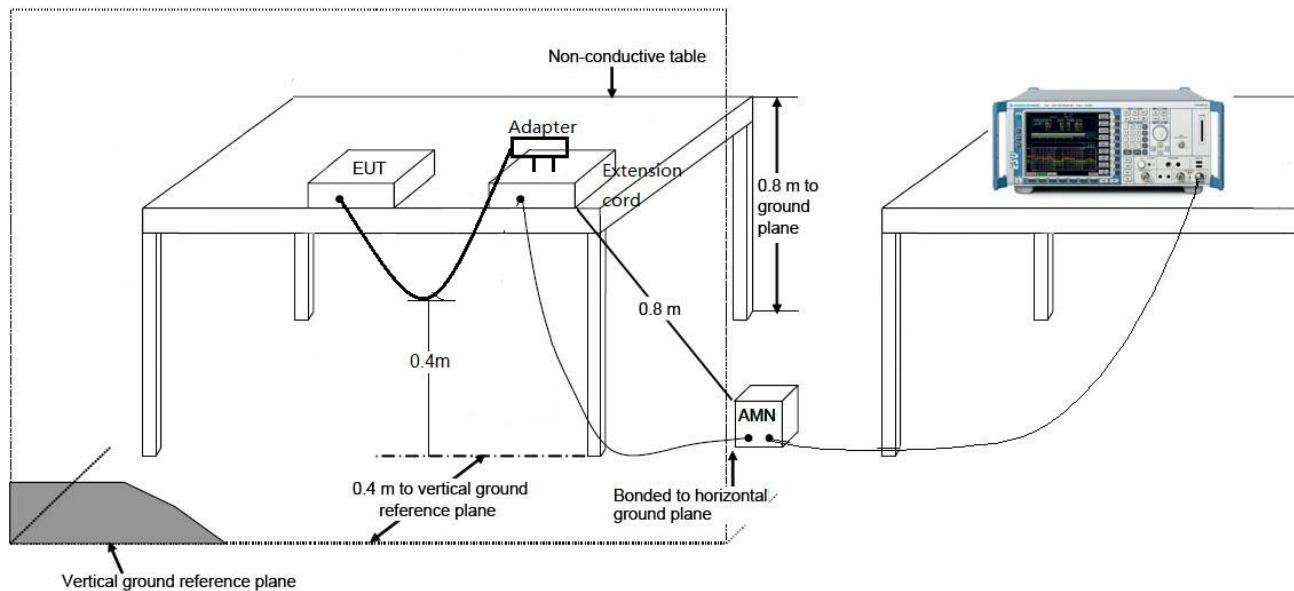
7.8.1. Test Limit

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	QP (dBuV)	AV (dBuV)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

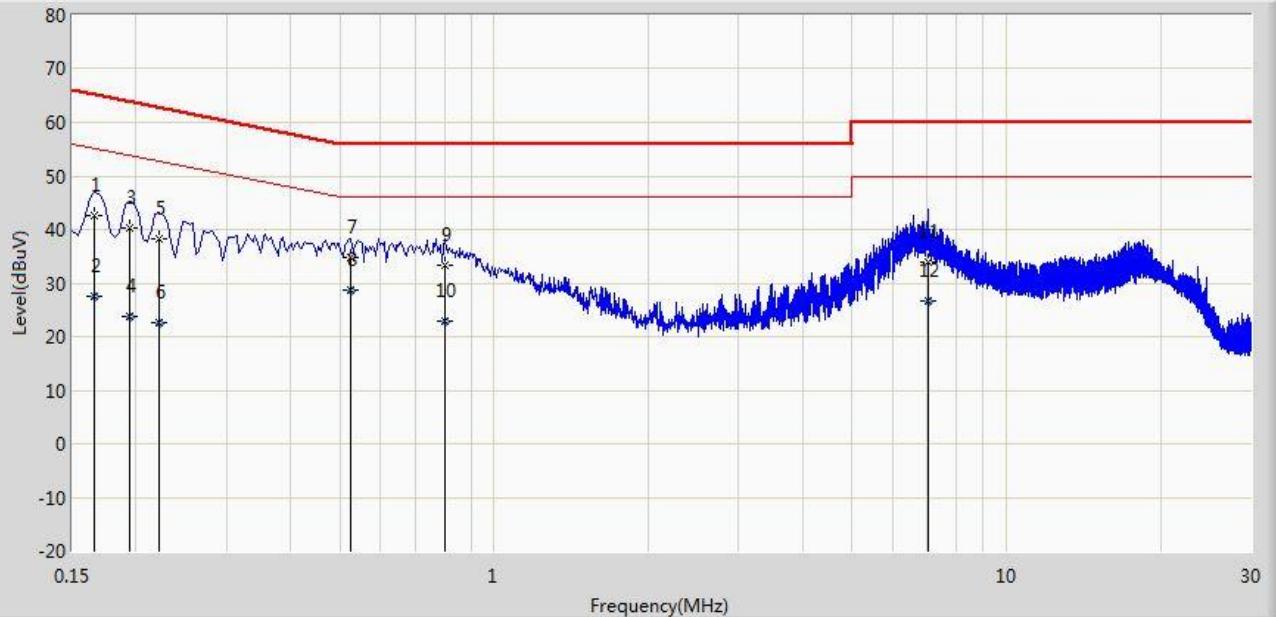
7.8.2. Test Setup



7.8.3. Test Result

Site: SR2	Time: 2015/12/11 - 09:14
Limit: FCC_Part15.207_CE_AC Power	Engineer: Line Chen
Probe: ENV216_101683_Filter On	Polarity: Line
EUT: Head Up Display	Power: AC 120V/60Hz

Test Mode: Transmit by 802.11g at channel 2412MHz

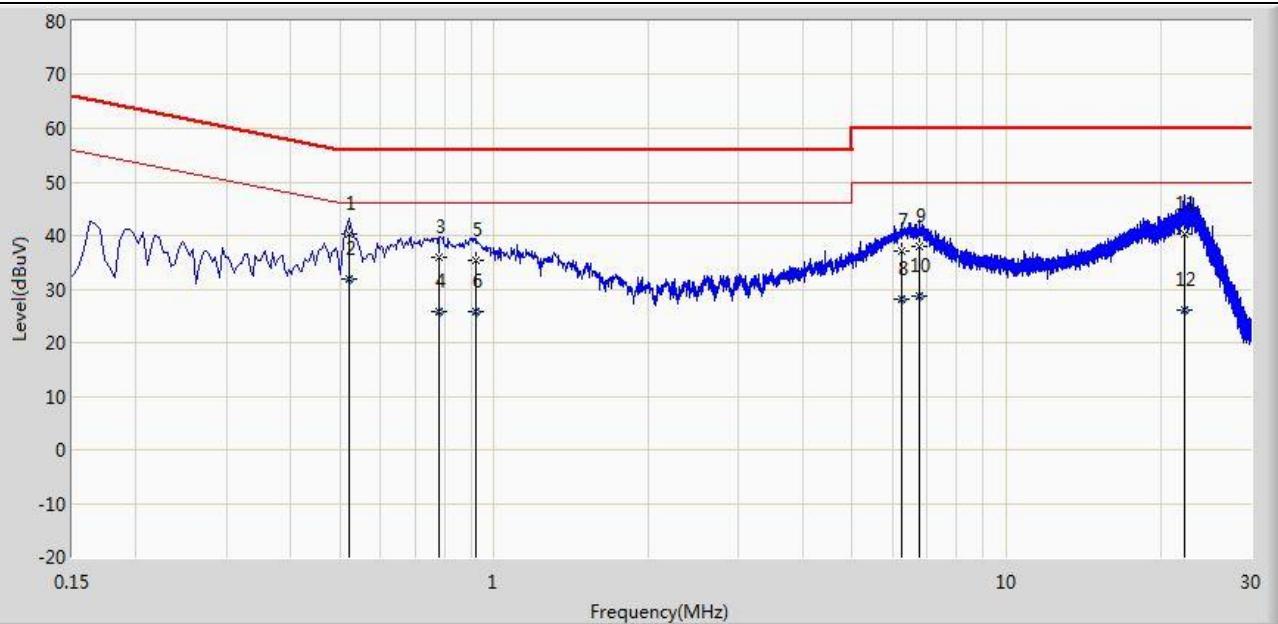


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1			0.166	42.538	32.450	-22.620	65.158	10.087	QP
2			0.166	27.463	17.376	-27.695	55.158	10.087	AV
3			0.194	40.408	30.391	-23.456	63.864	10.017	QP
4			0.194	23.888	13.871	-29.976	53.864	10.017	AV
5			0.222	38.257	28.316	-24.487	62.744	9.941	QP
6			0.222	22.524	12.584	-30.219	52.744	9.941	AV
7			0.526	34.767	24.614	-21.233	56.000	10.153	QP
8	*		0.526	28.757	18.604	-17.243	46.000	10.153	AV
9			0.802	33.252	23.243	-22.748	56.000	10.010	QP
10			0.802	22.921	12.911	-23.079	46.000	10.010	AV
11			7.018	33.932	23.779	-26.068	60.000	10.153	QP
12			7.018	26.639	16.486	-23.361	50.000	10.153	AV

Note: Measure Level (dB μ V) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

Site: SR2	Time: 2015/12/11 - 09:28
Limit: FCC_Part15.207_CE_AC Power	Engineer: Line Chen
Probe: ENV216_101683_Filter On	Polarity: Neutral
EUT: Head Up Display	Power: AC 120V/60Hz
Test Mode: Transmit by 802.11g at channel 2412MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1			0.522	40.296	30.122	-15.704	56.000	10.174	QP
2	*		0.522	31.747	21.573	-14.253	46.000	10.174	AV
3			0.782	35.976	25.946	-20.024	56.000	10.029	QP
4			0.782	25.870	15.841	-20.130	46.000	10.029	AV
5			0.922	35.468	25.516	-20.532	56.000	9.952	QP
6			0.922	25.871	15.919	-20.129	46.000	9.952	AV
7			6.246	37.203	27.066	-22.797	60.000	10.137	QP
8			6.246	28.014	17.877	-21.986	50.000	10.137	AV
9			6.762	37.831	27.670	-22.169	60.000	10.161	QP
10			6.762	28.791	18.629	-21.209	50.000	10.161	AV
11			22.210	40.387	30.167	-19.613	60.000	10.220	QP
12			22.210	26.035	15.814	-23.965	50.000	10.220	AV

Note: Measure Level (dB μ V) = Reading Level (dB μ V) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

8. CONCLUSION

The data collected relate only the item(s) tested and show that the **Head Up Display FCC ID: 2AG6XHUDONE** is in compliance with Part 15C of the FCC Rules.

The End
