

## FCC TEST REPORT

For

Connectiviot LLC

WIFI Smart Switch

Model No.: CT-WS01

Prepared for	:	Connectiviot LLC
Address	:	15014 SE 20th ST, BELLEVUE, WA 98007, USA
Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Tel	:	(+86)755-82591330
Fax	:	(+86)755-82591332
Web	:	www.LCS-cert.com
Mail	:	webmaster@LCS-cert.com
Date of receipt of test sample	:	Sep 22, 2016
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	Sep 22, 2016~Dec 05, 2016
Date of Report	:	Dec 05, 2016

**FCC TEST REPORT**  
**FCC CFR 47 PART 15 C(15.247): 2016****Report Reference No.** ..... : **LCS1609221783E**

Date of Issue ..... : Dec 05, 2016

**Testing Laboratory Name**..... : **Shenzhen LCS Compliance Testing Laboratory Ltd.**Address ..... : 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue,  
Bao'an District, Shenzhen, Guangdong, ChinaTesting Location/ Procedure ..... : Full application of Harmonised standards ■  
Partial application of Harmonised standards □  
Other standard testing method □**Applicant's Name**..... : **Connectiviot LLC**

Address ..... : 15014 SE 20th ST, BELLEVUE, WA 98007, USA

**Test Specification**

Standard ..... : FCC CFR 47 PART 15 C(15.247): 2015

**Test Report Form No.** ..... : LCSEMC-1.0

TRF Originator ..... : Shenzhen LCS Compliance Testing Laboratory Ltd.

Master TRF ..... : Dated 2011-03

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**EUT Description.** ..... : **WIFI Smart Switch**

Trade Mark ..... : N/A

Model/ Type reference ..... : CT-WS01

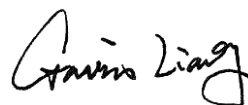
Ratings ..... : AC100-240V, 50/60Hz, 5A

Result ..... : **Positive****Compiled by:**

Calvin Weng/ Administrators

**Supervised by:**

Glin Lu/ Technique principal

**Approved by:**

Gavin Liang/ Manager

## FCC -- TEST REPORT

Test Report No. : LCS1609221783E	Dec 05, 2016 Date of issue
----------------------------------	-------------------------------

EUT.....	: WIFI Smart Switch
Type / Model.....	: CT-WS01
<b>Applicant</b> .....	: <b>Connectiviot LLC</b>
Address.....	: 15014 SE 20th ST, BELLEVUE, WA 98007, USA
Telephone.....	:
Fax.....	:
<b>Manufacturer</b> .....	: <b>Connectiviot LLC</b>
Address.....	: 15014 SE 20th ST, BELLEVUE, WA 98007, USA
Telephone.....	:
Fax.....	:
<b>Factory</b> .....	: <b>Connectiviot LLC</b>
Address.....	: 15014 SE 20th ST, BELLEVUE, WA 98007, USA
Telephone.....	:
Fax.....	:

Test Result	Positive
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The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

**Revision History**

Revision	Issue Date	Revisions	Revised By
00	2016-12-05	Initial Issue	Gavin Liang

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## 1. GENERAL INFORMATION

### 1.1. Description of Device (EUT)

EUT : WIFI Smart Switch

Test Model : CT-WS01

Power Supply : AC 100-240V, 50/60Hz, 5A

Frequency Range : 2412.00~2462.00MHz

Channel Number : 11 Channels for WIFI 20MHz Bandwidth(802.11b/g/n-HT20)

Modulation Technology : IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK)  
IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)  
IEEE 802.11n: OFDM (64QAM, 16QAM,QPSK,BPSK)

Data Rates : IEEE 802.11b: 1~11Mbps  
IEEE 802.11g: 6~54Mbps  
IEEE 802.11n: MCS0~MCS7

Antenna Type And Gain : PCB antenna, 1.0 dBi

### 1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
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### 1.3. External I/O Cable

I/O Port Description	Quantity	Cable
--	--	--

#### 1.4. Description of Test Facility

CNAS Registration Number. is L4595.  
 FCC Registration Number. is 899208.  
 Industry Canada Registration Number. is 9642A-1.  
 VCCI Registration Number. is C-4260 and R-3804.  
 ESMD Registration Number. is ARCB0108.  
 UL Registration Number. is 100571-492.  
 TUV SUD Registration Number. is SCN1081.  
 TUV RH Registration Number. is UA 50296516-001

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

#### 1.5. Statement of The Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

#### 1.6. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.10dB	(1)
		30MHz~200MHz	±2.96dB	(1)
		200MHz~1000MHz	±3.10dB	(1)
		1GHz~26.5GHz	±3.80dB	(1)
		26.5GHz~40GHz	±3.90dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±1.63dB	(1)
Power disturbance	:	30MHz~300MHz	±1.60dB	(1)

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

#### 1.7. Description Of Test Modes

The EUT has been tested under operating condition.

This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.

Worst-case mode and channel used for 150kHz-30 MHz power line conducted emissions was the mode and channel with the highest output power, that was determined to be 802.11b mode(Mid Channel).

Worst-case mode and channel used for 9kHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be 802.11b mode(Mid Channel).

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case datarates used during the testing are as follows:

802.11b Mode: 1 Mbps, DSSS.

802.11g Mode: 6 Mbps, OFDM.

802.11n Mode HT20: MCS0, OFDM.

## Channel List &amp; Frequency

IEEE 802.11b/g/n HT20

Frequency Band	Channel No.	Frequency(MHz)	Channel No.	Frequency(MHz)
2412~2462MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437	--	--



## 2. TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd..

### 2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

### 2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to FCC's request, Test Procedure KDB558074 D01 DTS Meas. Guidance v03r05 and KDB 6622911 are required to be used for this kind of FCC 15.247 digital modulation device.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

### 2.3. General Test Procedures

#### 2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

#### 2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013

### 3. SYSTEM TEST CONFIGURATION

#### 3.1. Justification

The system was configured for testing in a continuous transmit condition.

#### 3.2. EUT Exercise Software

N/A

#### 3.3. Special Accessories

N/A

#### 3.4. Block Diagram/Schematics

Please refer to the related document

#### 3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

#### 3.6. Test Setup

Please refer to the test setup photo.

## 4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C		
FCC Rules	Description of Test	Result
§15.247(b)	Maximum Conducted Output Power	Compliant
§15.247(e)	Power Spectral Density	Compliant
§15.247(a)(2)	6dB Bandwidth	Compliant
§15.247(a)	Occupied Bandwidth	Compliant
§15.209, §15.247(d)	Radiated and Conducted Spurious Emissions	Compliant
§15.205	Emissions at Restricted Band	Compliant
§15.207(a)	Conducted Emissions	Compliant
§15.203	Antenna Requirements	Compliant
§15.247(i)§2.1091	RF Exposure	Compliant

## 5. TEST RESULT

### 5.1. On Time and Duty Cycle

#### 5.1.1. Standard Applicable

None; for reporting purpose only.

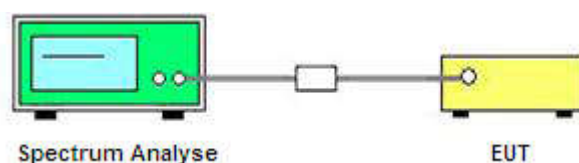
#### 5.1.2. Measuring Instruments and Setting

Please refer to section 6 of equipments list in this report. The following table is the setting of the spectrum analyse.

#### 5.1.3. Test Procedures

1. Set the centre frequency of the spectrum analyse to the transmitting frequency;
2. Set the span=0MHz, RBW=8MHz, VBW=50MHz, Sweep time=5ms;
3. Detector = peak;
4. Trace mode = Single hold.

#### 5.1.4. Test Setup Layout



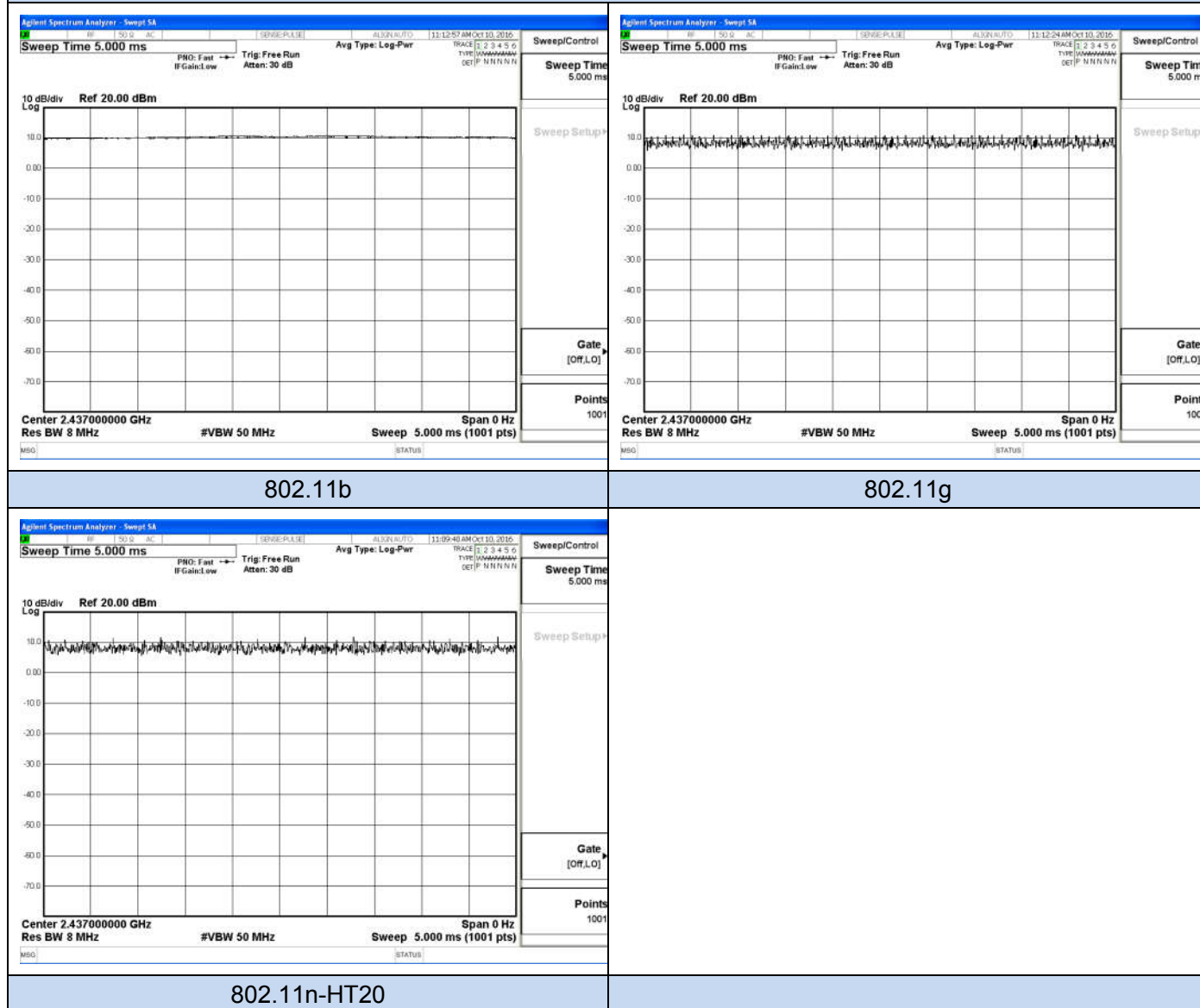
#### 5.1.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

#### 5.1.6. Test result

Mode	On Time B (ms)	Period (ms)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW(KHz)
802.11b	5.0	5.0	1	100	0	0.01
802.11g	5.0	5.0	1	100	0	0.01
802.11n -HT20	5.0	5.0	1	100	0	0.01

## Test plot of On Time and Duty Cycle



## 5.2. Maximum Conducted Output Power Measurement

### 5.2.1. Standard Applicable

According to §15.247(b): For systems using digital modulation in the 2400-2483.5 MHz and 5725-5850 MHz band, the limit for maximum peak conducted output power is 30dBm. The limit has to be reduced by the amount in dB that the gain of the antenna exceeds 6dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi without any corresponding reduction in transmitter peak output power.

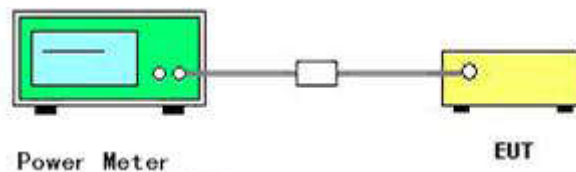
### 5.2.2. Measuring Instruments and Setting

Please refer to section 6 of equipments list in this report. The following table is the setting of the power meter.

### 5.2.3. Test Procedures

The transmitter output (antenna port) was connected to the power meter.

### 5.2.4. Test Setup Layout



### 5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

## 5.2.6. Test Result of Maximum Conducted Output Power

Temperature	25°C	Humidity	60%
Test Engineer	Chaz	Configurations	802.11b/g/n

## 802.11b

Channel	Frequency (MHz)	Conducted Power(Peak)	Max. Limit (dBm)	Result
1	2412	18.73	30	Complies
6	2437	18.97	30	Complies
11	2462	18.21	30	Complies

## 802.11g

Channel	Frequency (MHz)	Conducted Power(Peak)	Max. Limit (dBm)	Result
1	2412	15.71	30	Complies
6	2437	15.96	30	Complies
11	2462	15.23	30	Complies

## 802.11n (HT20)

Channel	Frequency (MHz)	Conducted Power(Peak)	Max. Limit (dBm)	Result
1	2412	14.67	30	Complies
6	2437	14.91	30	Complies
11	2462	14.37	30	Complies

### 5.3. Power Spectral Density Measurement

#### 5.3.1. Standard Applicable

According to §15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

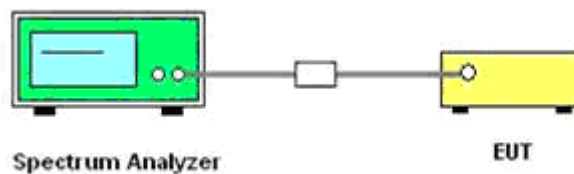
#### 5.3.2. Measuring Instruments and Setting

Please refer to section 6 of equipments list in this report. The following table is the setting of Spectrum Analyzer.

#### 5.3.3. Test Procedures

1. The transmitter was connected directly to a Spectrum Analyzer through a directional couple.
2. The power was monitored at the coupler port with a Spectrum Analyzer. The power level was set to the maximum level.
3. Set the RBW = 3 kHz~100kHz.
4. Set the VBW  $\geq 3 \times$  RBW
5. Set the span to 1.5 times the DTS channel bandwidth.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum power level in any 3 kHz band segment within the fundamental EBW.

#### 5.3.4. Test Setup Layout



#### 5.3.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.



## 5.3.6. Test Result of Power Spectral Density

Temperature	25℃	Humidity	60%
Test Engineer	Chaz	Configurations	802.11b/g/n

## 802.11b

Channel	Frequency (MHz)	Mearsured Power Density (dBm/100KHz)	Max. Limit (dBm/3KHz)	Result
1	2412	1.143	8	Complies
6	2437	1.117	8	Complies
11	2462	1.154	8	Complies

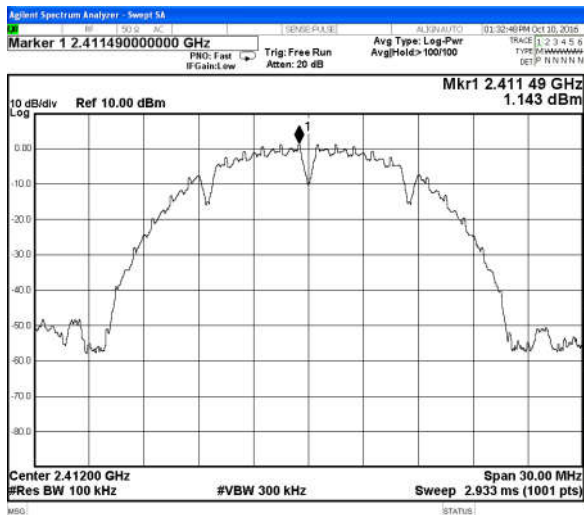
## 802.11g

Channel	Frequency (MHz)	Mearsured Power Density (dBm/100KHz)	Max. Limit (dBm/3KHz )	Result
1	2412	-8.892	8	Complies
6	2437	-9.134	8	Complies
11	2462	-8.970	8	Complies

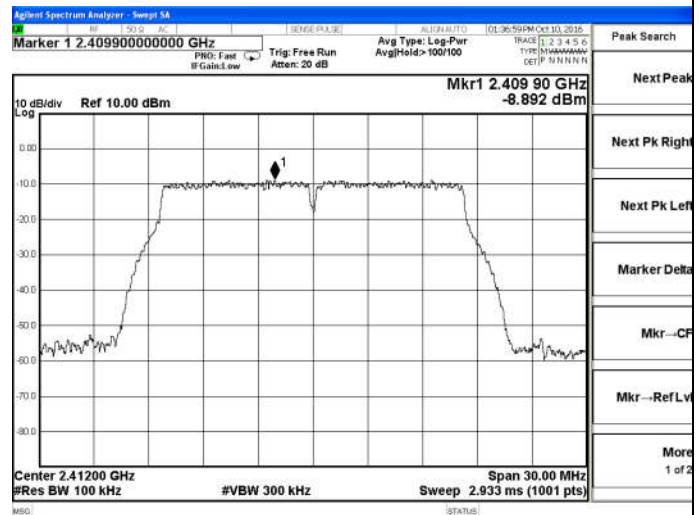
## 802.11n-HT20

Channel	Frequency (MHz)	Mearsured Power Density (dBm/100KHz)	Max. Limit (dBm/3KHz )	Result
1	2412	-8.849	8	Complies
6	2437	-8.884	8	Complies
11	2462	-8.725	8	Complies

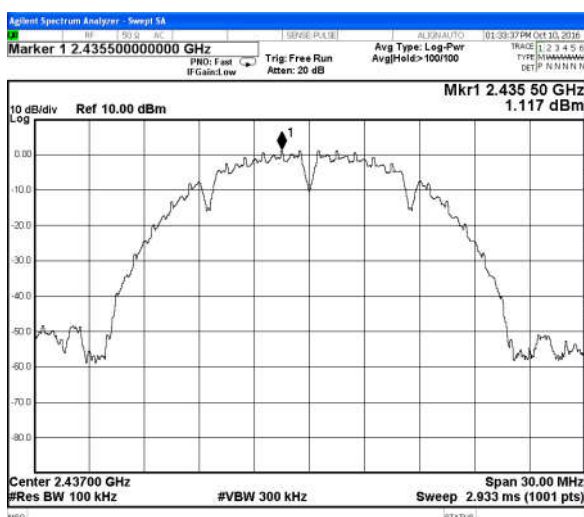
## Test plot of Power Spectral Density



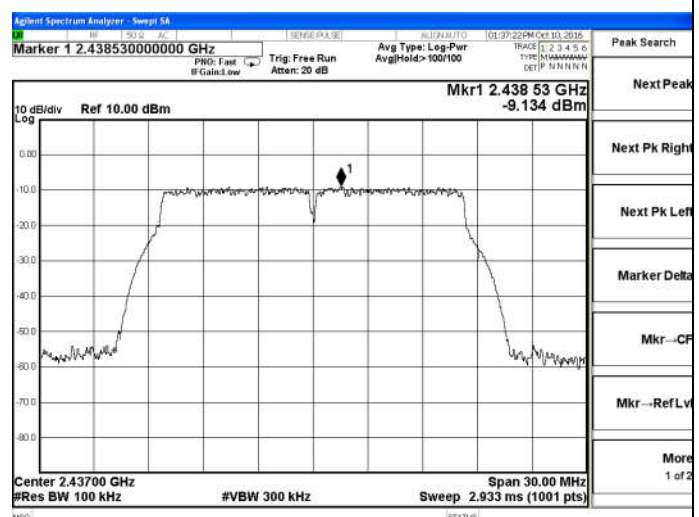
802.11b-Low channel



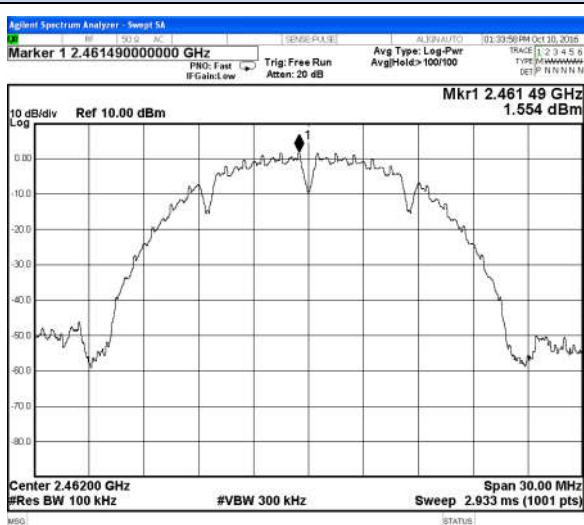
802.11g-Low channel



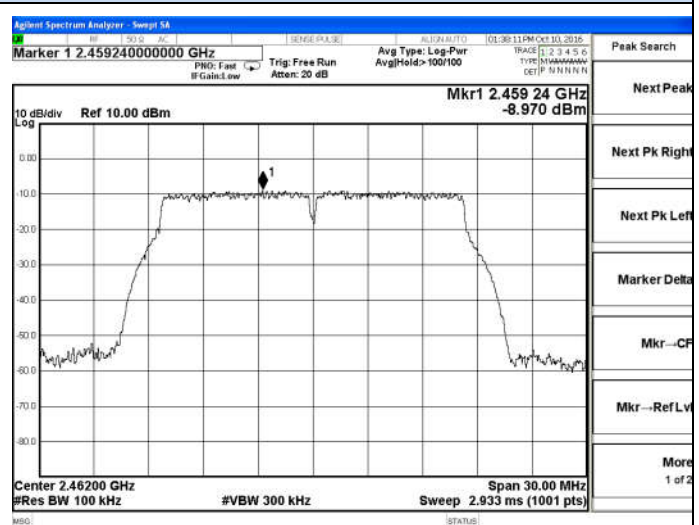
802.11b-Middle channel



802.11g-Middle channel

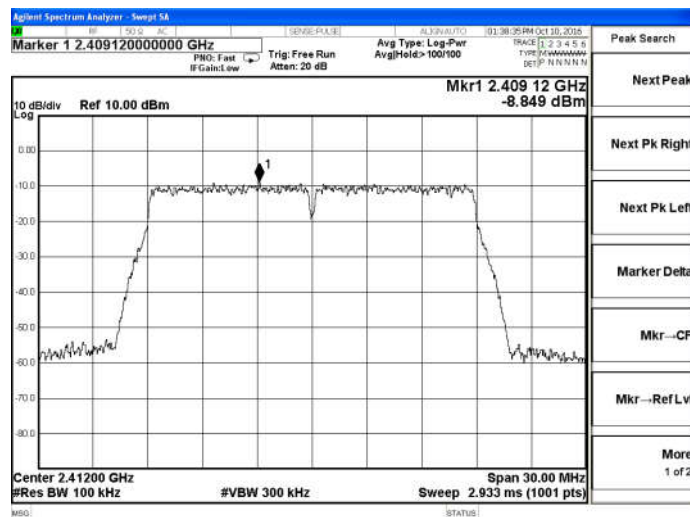


802.11b-High channel

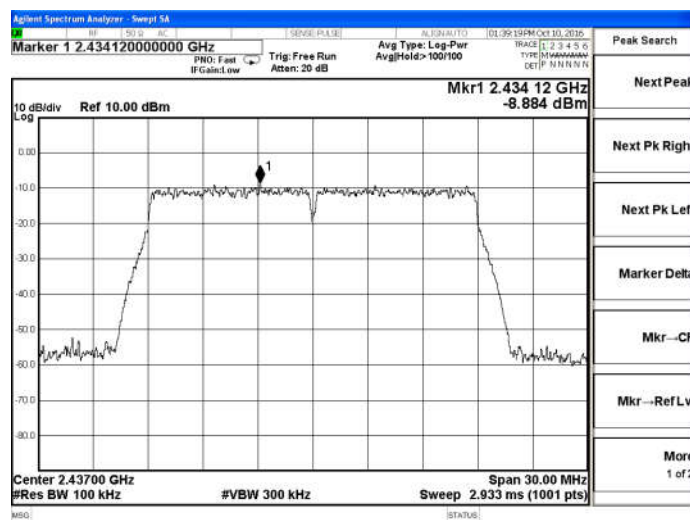


802.11g-High channel

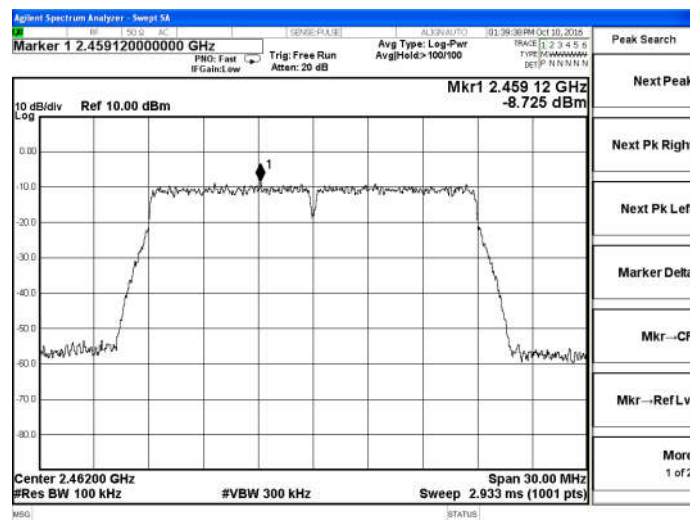
## Test plot of Power Spectral Density



802.11n(HT20)-Low channel



802.11n(HT20)-Middle channel



802.11n(HT20)-High channel

## 5.4. 6 dB Spectrum Bandwidth Measurement

### 5.4.1. Standard Applicable

According to §15.247(a)(2): For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

### 5.4.2. Measuring Instruments and Setting

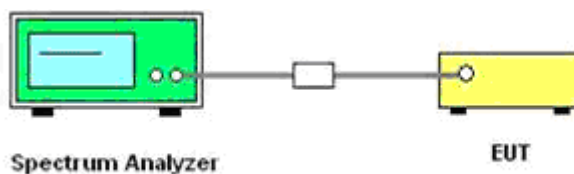
Please refer to section 6 of equipments list in this report. The following table is the setting of the Spectrum Analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> RBW
Detector	Peak
Trace	Max Hold
Sweep Time	100ms

### 5.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
2. The resolution bandwidth and the video bandwidth were set according to KDB558074.
3. Measured the spectrum width with power higher than 6dB below carrier.

### 5.4.4. Test Setup Layout



### 5.4.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

## 5.4.6. Test Result of 6dB Spectrum Bandwidth

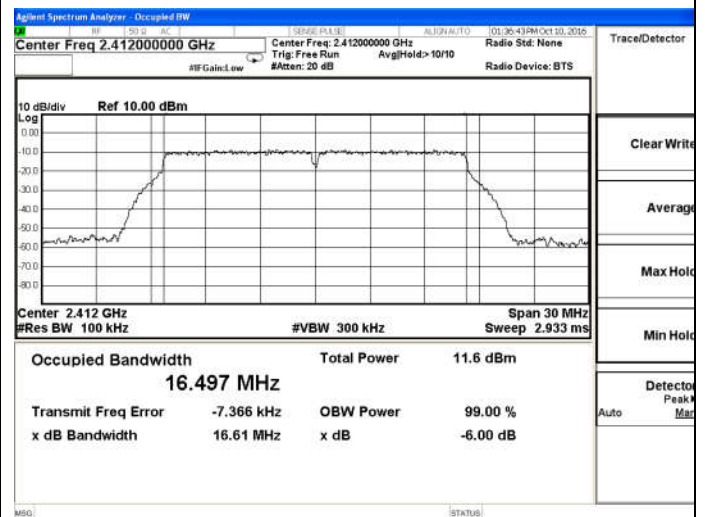
Temperature	25°C	Humidity	60%
Test Engineer	Chaz	Configurations	802.11b/g/n

802.11b				
Channel	Frequency	6dB Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2412	10.000	500	Complies
6	2437	9.996	500	Complies
11	2462	9.993	500	Complies

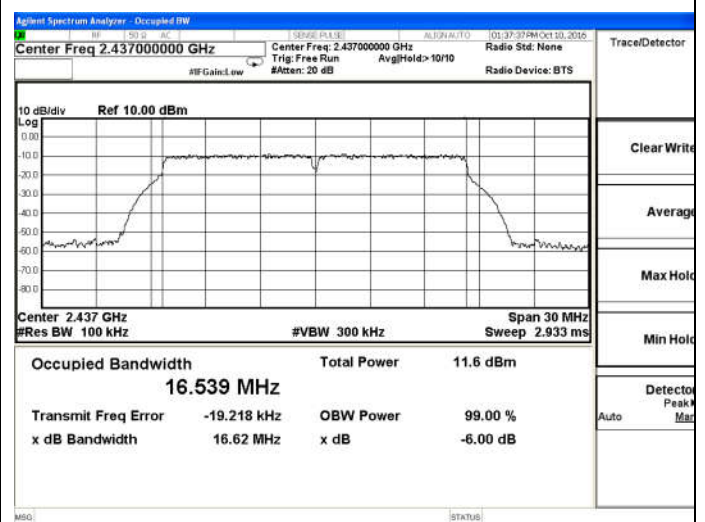
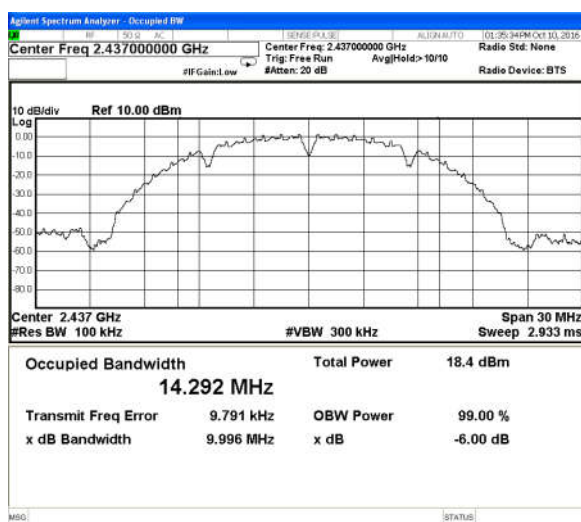
802.11g				
Channel	Frequency	6dB Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2412	16.61	500	Complies
6	2437	16.62	500	Complies
11	2462	16.61	500	Complies

802.11n HT20				
Channel	Frequency	6dB Bandwidth (MHz)	Min. Limit (kHz)	Result
1	2412	17.83	500	Complies
6	2437	17.82	500	Complies
11	2462	17.81	500	Complies

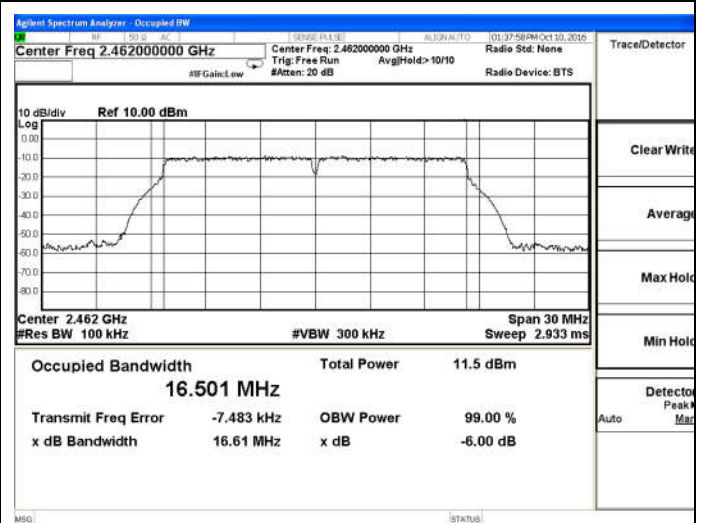
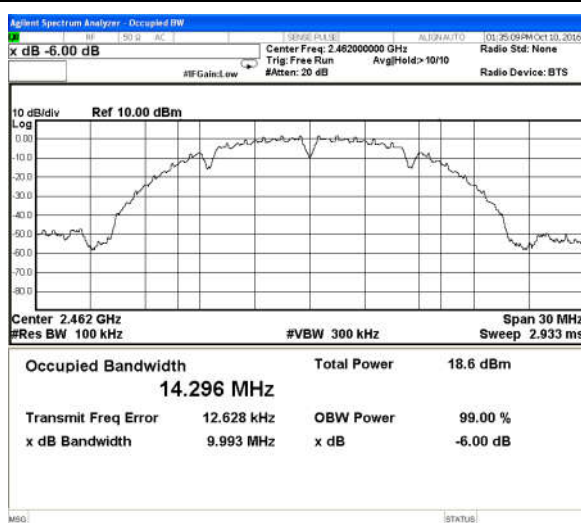
## Test plot of 6 dB Bandwidth



## 802.11b-Low channel



## 802.11b-Middle channel

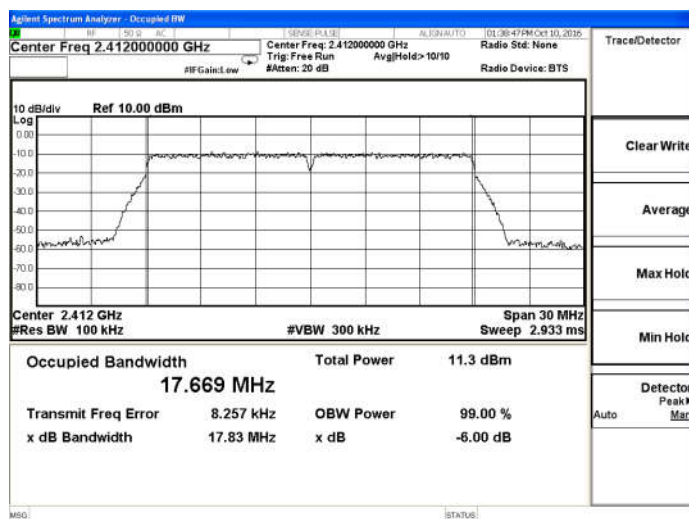


## 802.11b-High channel

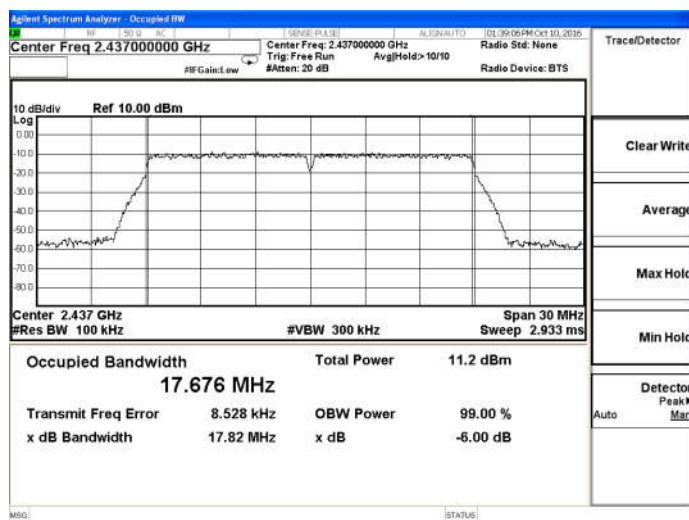
## 802.11g-High channel



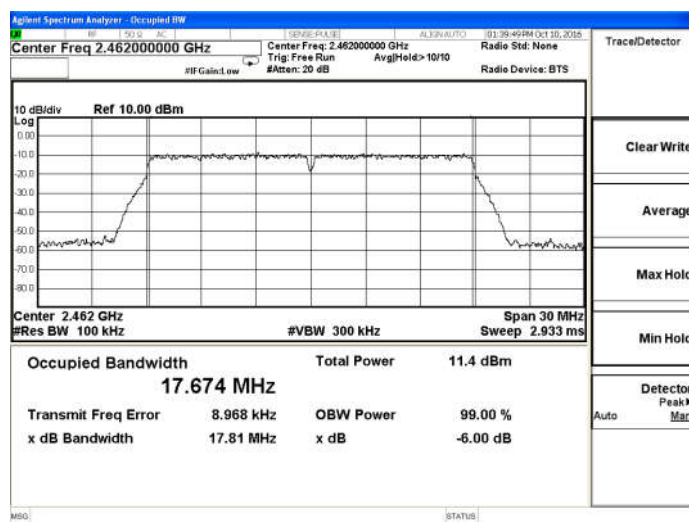
## Test plot of 6 dB Bandwidth



## 802.11n(HT20)-Low channel



## 802.11n(HT20)-Middle channel



## 802.11n(HT20)-High channel

## 5.5. Radiated Emissions Measurement

### 5.5.1. Standard Applicable

15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
\1\ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(\2\)
13.36-13.41			

\1\ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

\2\ Above 38.6

According to §15.247 (d): 20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

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



### 5.5.2. Measuring Instruments and Setting

Please refer to section 6 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB 100kHz for QP

### 5.5.3. Test Procedures

#### 1) Sequence of testing 9 kHz to 30 MHz

##### **Setup:**

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

##### **Premeasurement:**

- The turntable rotates from 0° to 360° using 45° steps.
- The antenna height is 0.8 meter.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

##### **Final measurement:**

- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

## 2) Sequence of testing 30 MHz to 1 GHz

### Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

### Premeasurement:

- The turntable rotates from 0° to 360° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 meter.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ( $\pm 45^\circ$ ) and antenna movement between 1 and 4 meter.
- The final measurement will be done with QP detector with an EMI receiver.
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

### 3) Sequence of testing 1 GHz to 18 GHz

#### Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

#### Premeasurement:

- The turntable rotates from 0° to 360° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

#### Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ( $\pm 45^\circ$ ) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

#### 4) Sequence of testing above 18 GHz

**Setup:**

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

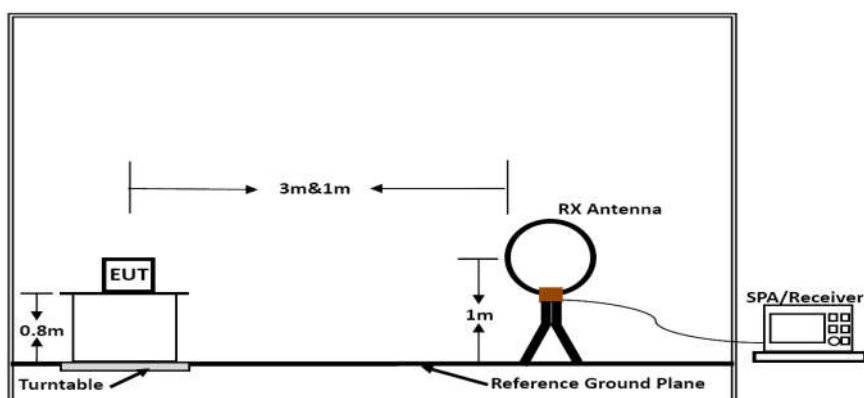
**Premeasurement:**

- The antenna is moved spherical over the EUT in different polarisations of the antenna.

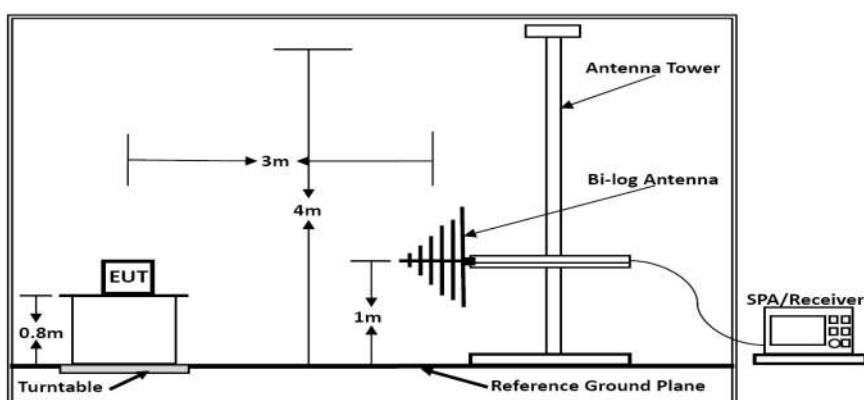
**Final measurement:**

- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

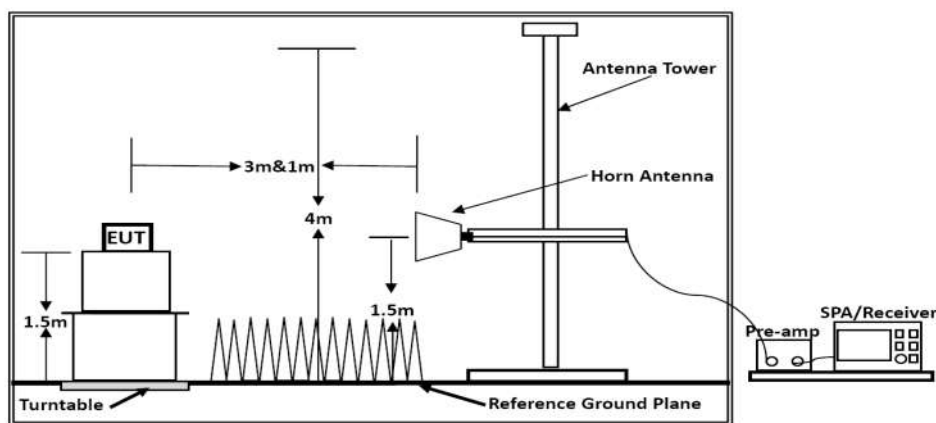
## 5.5.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1.5m.

Distance extrapolation factor =  $20 \log (\text{specific distance [3m]} / \text{test distance [1.5m]})$  (dB);  
 Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

## 5.5.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

## 5.5.6. Results of Radiated Emissions (9kHz~30MHz)

Temperature	25℃	Humidity	60%
Test Engineer	Chaz	Configurations	802.11b/g/n

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

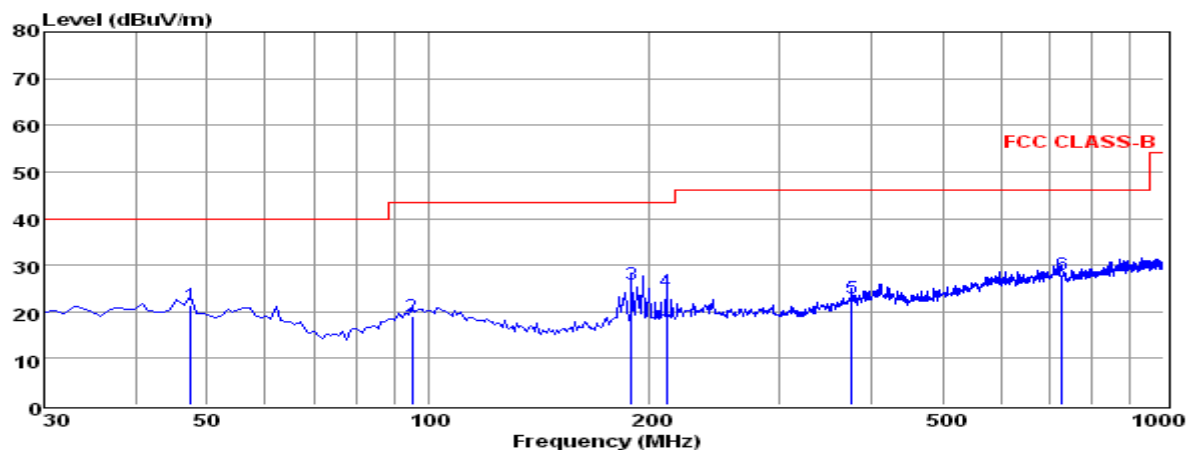
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

## 5.5.7. Results of Radiated Emissions (30MHz~1GHz)

Temperature	24℃	Humidity	56%
Test Engineer	Chaz	Configurations	802.11b (Mid CH)

Test result for 802.11b (Mid Channel)



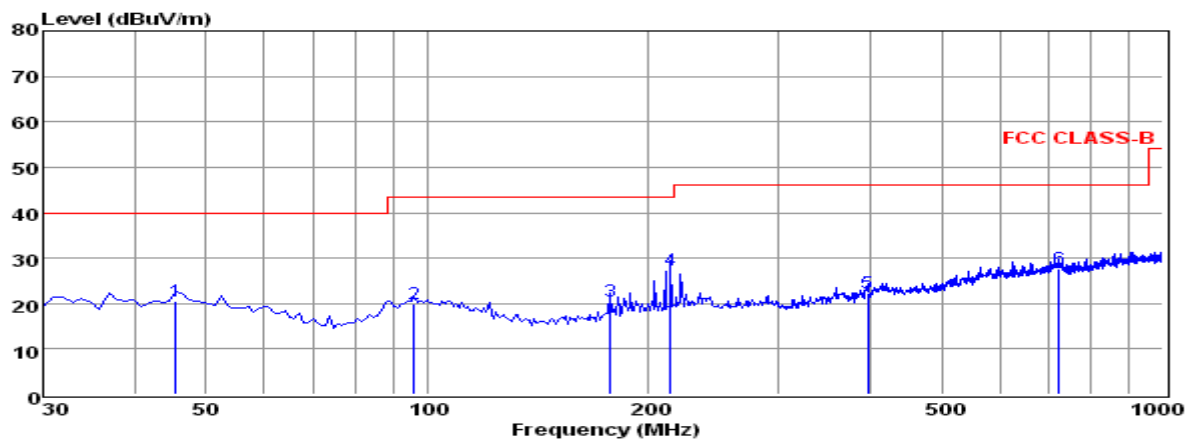
Env./Ins: 24℃/56%  
pol: HORIZONTAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	47.46	7.71	0.35	13.40	21.46	40.00	-18.54	QP
2	94.99	5.76	0.58	12.84	19.18	43.50	-24.32	QP
3	189.08	14.66	0.86	10.48	26.00	43.50	-17.50	QP
4	210.42	12.46	0.93	10.90	24.29	43.50	-19.21	QP
5	376.29	7.18	1.30	14.56	23.04	46.00	-22.96	QP
6	727.43	7.25	1.70	19.15	28.10	46.00	-17.90	QP

Note: 1. All readings are Quasi-peak values.

2. Measured= Reading + Antenna Factor + Cable Loss

3. The emission that are 20dB below the official limit are not reported



Env./Ins: 24°C/56%  
 pol: VERTICAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	45.52	6.64	0.41	13.52	20.57	40.00	-19.43	QP
2	95.96	6.36	0.58	12.90	19.84	43.50	-23.66	QP
3	177.44	10.04	0.89	9.50	20.43	43.50	-23.07	QP
4	214.30	15.38	0.95	11.02	27.35	43.50	-16.15	QP
5	397.63	6.16	1.22	15.00	22.38	46.00	-23.62	QP
6	722.58	6.89	1.63	19.09	27.61	46.00	-18.39	QP

Note: 1. All readings are Quasi-peak values.  
 2. Measured= Reading + Antenna Factor + Cable Loss  
 3. The emission that ate 20db blow the offfficial limit are not reported

#### Note:

- 1). Pre-scan all mode and recorded the worst case results in this report (802.11b (Mid Channel)).  
 Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 2). Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.



## 5.5.8. Results for Radiated Emissions (Above 1GHz)

802.11b

Channel 1

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4824.00	58.06	33.06	35.04	3.94	60.02	74	-13.98	Peak	Horizontal
4824.00	44.38	33.06	35.04	3.94	46.34	54	-7.66	Average	Horizontal
4824.00	59.24	33.06	35.04	3.94	61.20	74	-12.80	Peak	Vertical
4824.00	45.22	33.06	35.04	3.94	47.18	54	-6.82	Average	Vertical

Channel 6

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4874.00	59.91	33.16	35.15	3.96	61.88	74	-12.12	Peak	Horizontal
4874.00	45.61	33.16	35.15	3.96	47.58	54	-6.42	Average	Horizontal
4874.00	59.03	33.16	35.15	3.96	61.00	74	-13.00	Peak	Vertical
4874.00	46.70	33.16	35.15	3.96	48.67	54	-5.33	Average	Vertical

Channel 11

Freq. MHz	Reading dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4924.00	59.63	33.26	35.14	3.98	61.73	74	-12.27	Peak	Horizontal
4924.00	46.22	33.26	35.14	3.98	48.32	54	-5.68	Average	Horizontal
4924.00	59.38	33.26	35.14	3.98	61.48	74	-12.52	Peak	Vertical
4924.00	47.61	33.26	35.14	3.98	49.71	54	-4.29	Average	Vertical

## Notes:

- 1). Measuring frequencies from 9k~10th harmonic or 26.5GHz (which is less), No emission found between lowest internal used/generated frequency to 30MHz.
- 2). Radiated emissions measured in frequency range from 9k~10th harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.
- 3). Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 4) All test modes were verified, and only recorded the worst case test data.

## 5.5.9. Results of Restricted Bands Test (Radiated)

802.11b						
Freq. MHz	Reading Level dBm	Antenna Gain dBi	Calculated E dBuV/m	Limit dBuV/m	Margin dB	Remark
2310.000	-55.54	1.00	40.69	74.00	-33.31	Peak
2310.000	-64.84	1.00	31.39	54.00	-22.61	Average
2390.000	-46.65	1.00	49.58	74.00	-24.42	Peak
2390.000	-59.75	1.00	36.48	54.00	-17.52	Average
2483.500	-50.63	1.00	45.60	74.00	-28.40	Peak
2483.500	-59.55	1.00	36.68	54.00	-17.32	Average
2500.000	-51.22	1.00	45.01	74.00	-28.99	Peak
2500.000	-61.16	1.00	35.07	54.00	-18.93	Average

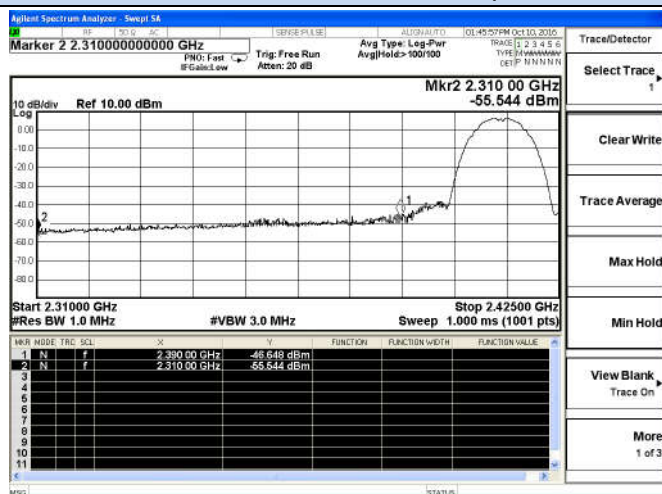
802.11g						
Freq. MHz	Reading Level dBm	Antenna Gain dBi	Calculated E dBuV/m	Limit dBuV/m	Margin dB	Remark
2310.000	-56.38	1.00	39.85	74.00	-34.15	Peak
2310.000	-66.02	1.00	30.21	54.00	-23.79	Average
2390.000	-50.44	1.00	45.79	74.00	-28.21	Peak
2390.000	-59.16	1.00	37.07	54.00	-16.93	Average
2483.500	-49.16	1.00	47.07	74.00	-26.93	Peak
2483.500	-58.79	1.00	37.44	54.00	-16.56	Average
2500.000	-49.94	1.00	46.29	74.00	-27.71	Peak
2500.000	-60.35	1.00	35.88	54.00	-18.12	Average

802.11n(HT20)						
Freq. MHz	Reading Level dBm	Antenna Gain dBi	Calculated E dBuV/m	Limit dBuV/m	Margin dB	Remark
2310.000	-56.26	1.00	39.97	74.00	-34.03	Peak
2310.000	-66.61	1.00	29.62	54.00	-24.38	Average
2390.000	-47.25	1.00	48.98	74.00	-25.02	Peak
2390.000	-59.07	1.00	37.16	54.00	-16.84	Average
2483.500	-49.04	1.00	47.19	74.00	-26.81	Peak
2483.500	-59.61	1.00	36.62	54.00	-17.38	Average
2500.000	-49.55	1.00	46.68	74.00	-27.32	Peak
2500.000	-60.42	1.00	35.81	54.00	-18.19	Average

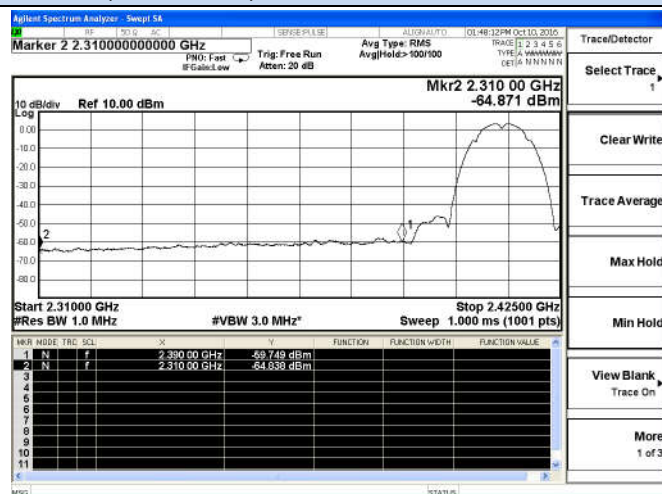
Note:

- 1). All modes have been tested and we only record the worst test result;
- 2). Measured E=Reading Level + Antenna Gain+104.77-(20LogD), Where D is 3,  
so E= Reading Level + Antenna Gain + 95.23

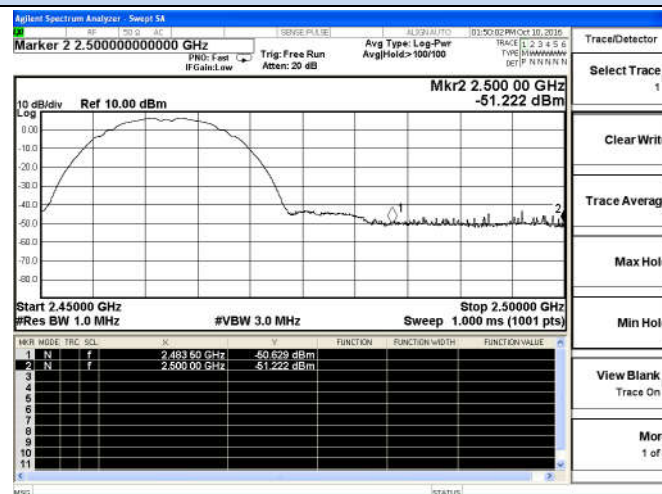
Test plot of Restricted Bands (Conducted)



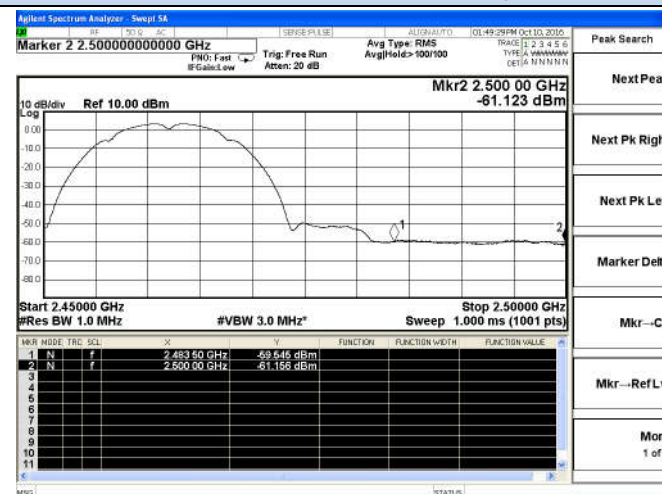
802.11b-Low channel(Peak)



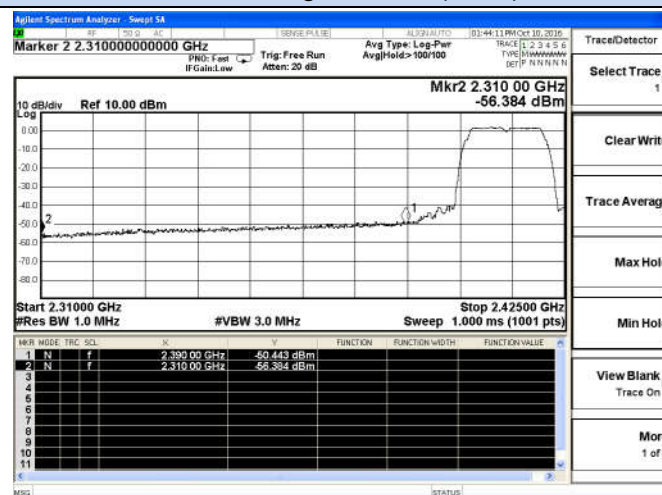
802.11b-Low channel(Average)



802.11b-High channel(Peak)



802.11b-High channel(Average)

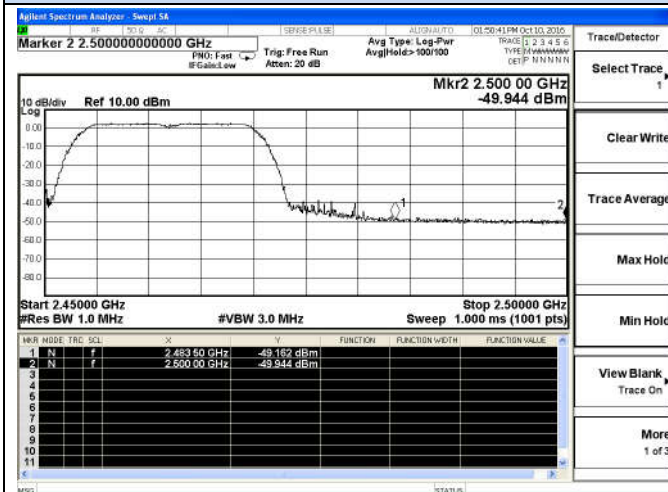


802.11g-Low channel(Peak)

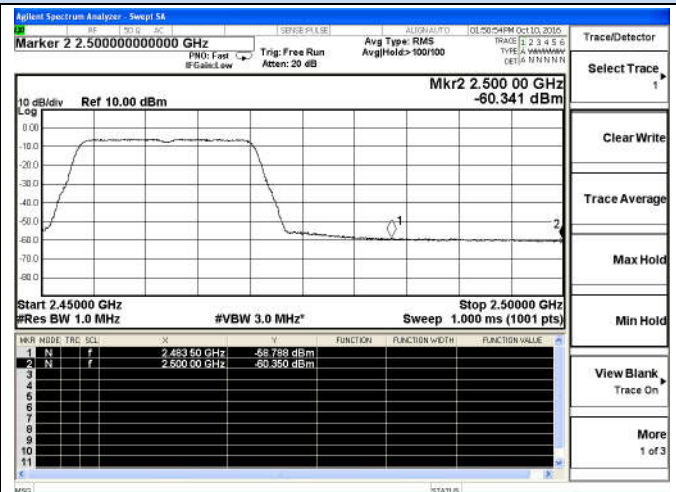


802.11g-Low channel(Average)

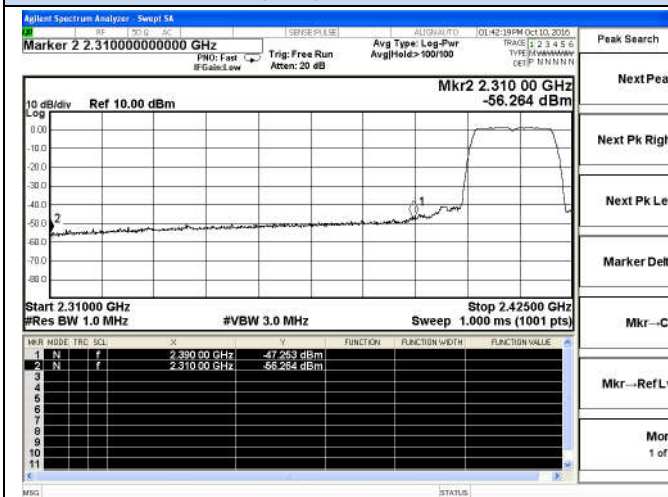
## Test plot of Restricted Bands



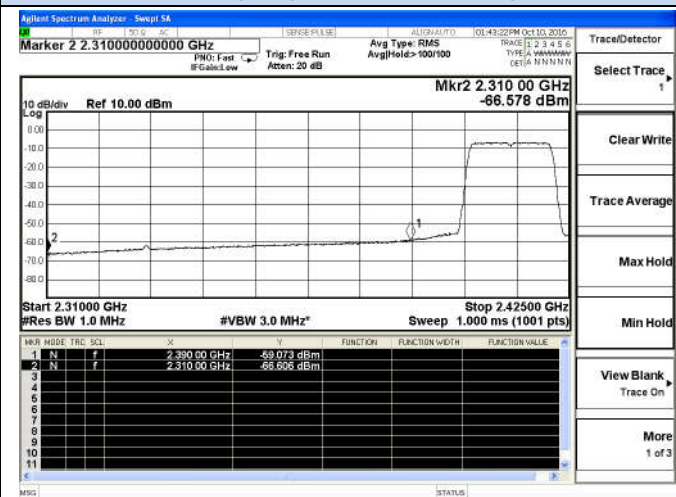
802.11g-High channel(Peak)



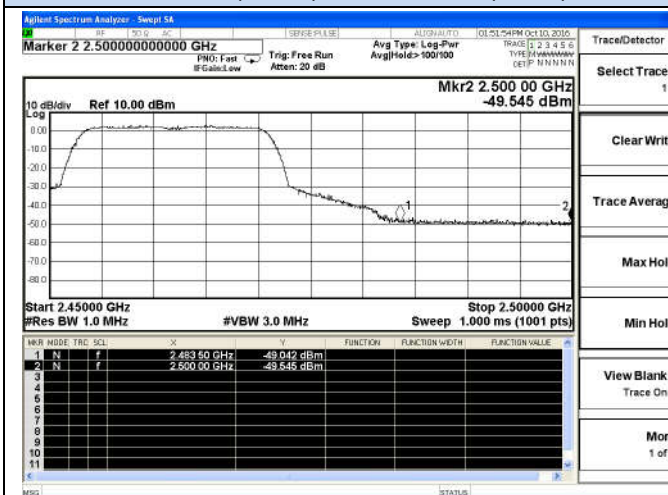
802.11g-High channel(Average)



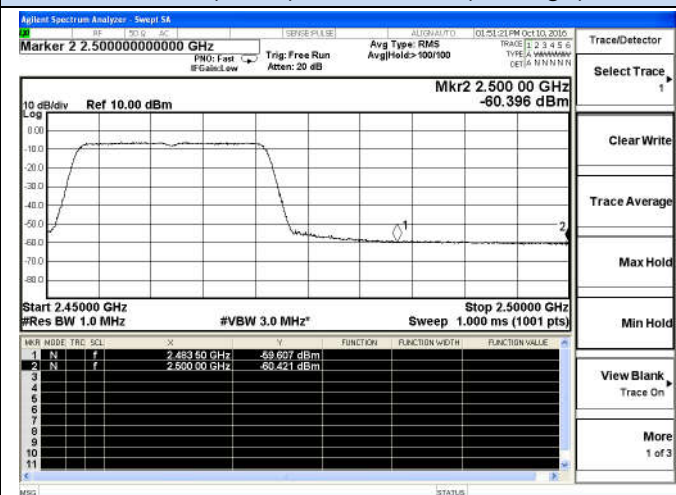
802.11n(HT20)-Low channel(Peak)



802.11n(HT20)-Low channel(Average)



802.11n(HT20)-High channel(Peak)



802.11n(HT20)-High channel(Average)

## 5.6. Conducted Spurious Emissions and Band Edges Test

### 5.6.1. Standard Applicable

According to §15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

### 5.6.2. Measuring Instruments and Setting

Please refer to section 6 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Detector	Peak
Attenuation	Auto
RB / VB (Emission in restricted band)	100KHz/300KHz
RB / VB (Emission in non-restricted band)	100KHz/300KHz

### 5.6.3. Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz

The spectrum from 9kHz to 26.5GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

### 5.6.4. Test Setup Layout

This test setup layout is the same as that shown in section 5.4.4.

### 5.6.5. EUT Operation during Test

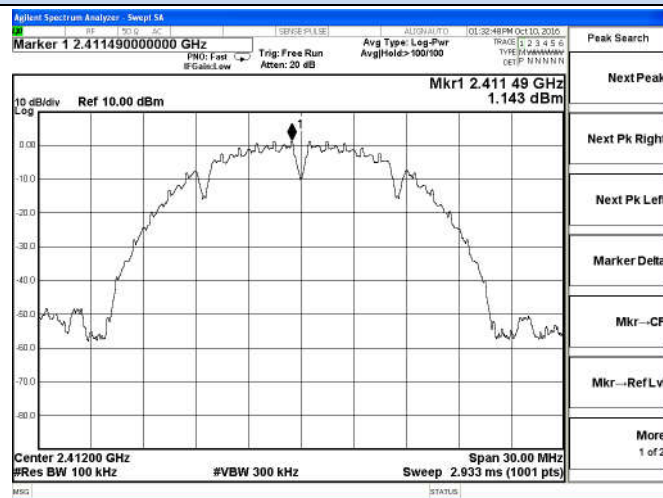
The EUT was programmed to be in continuously transmitting mode.

### 5.6.6. Test Results of Conducted Spurious Emissions

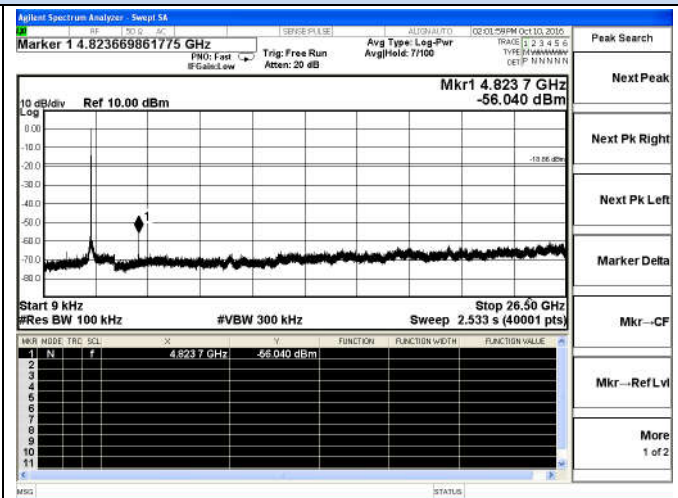


## RF Conducted Spurious Emissions

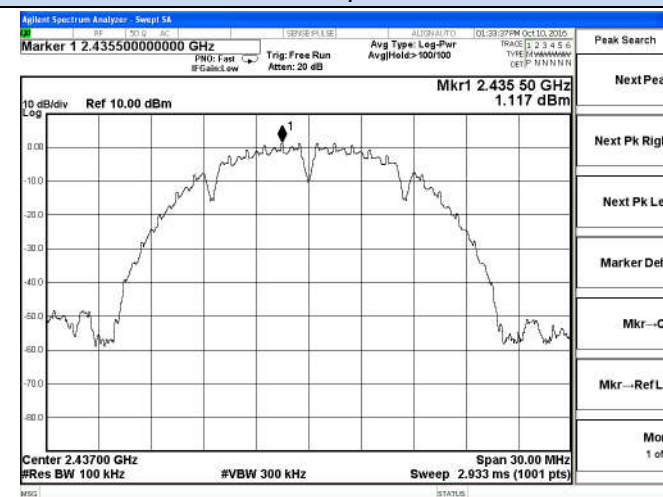
## IEEE 802.11b



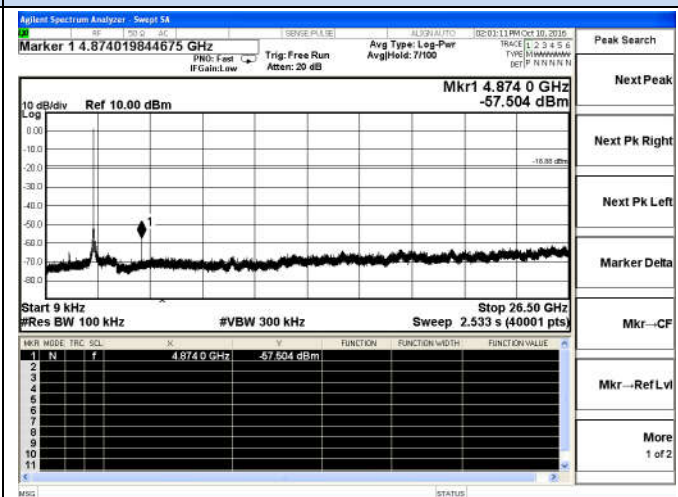
Reference peak value



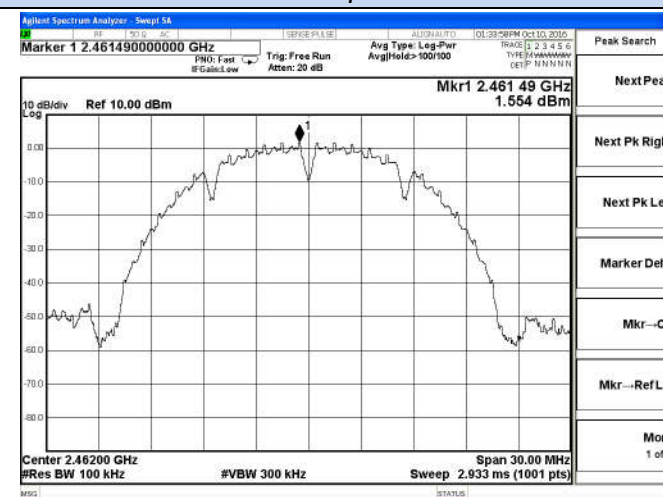
9 KHz - 26.5 GHz



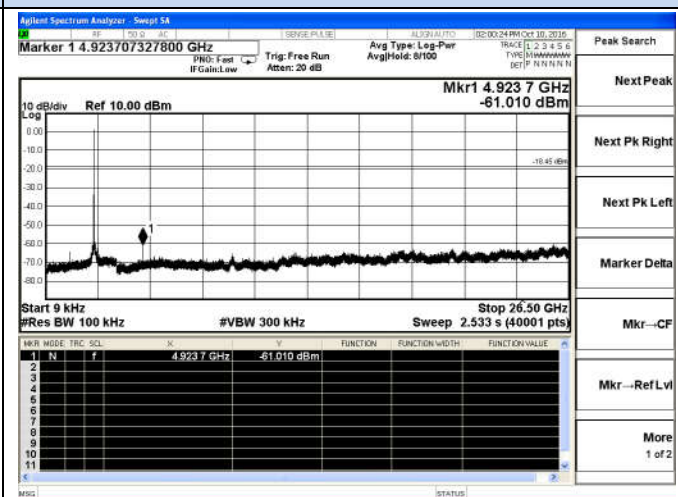
Reference peak value



9 KHz - 26.5 GHz



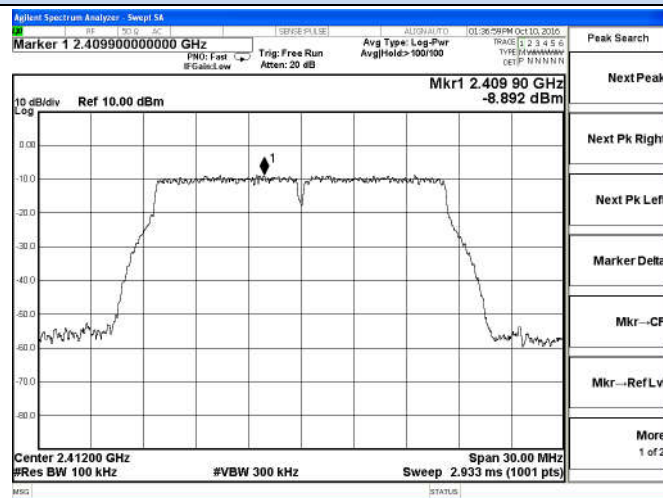
Reference peak value



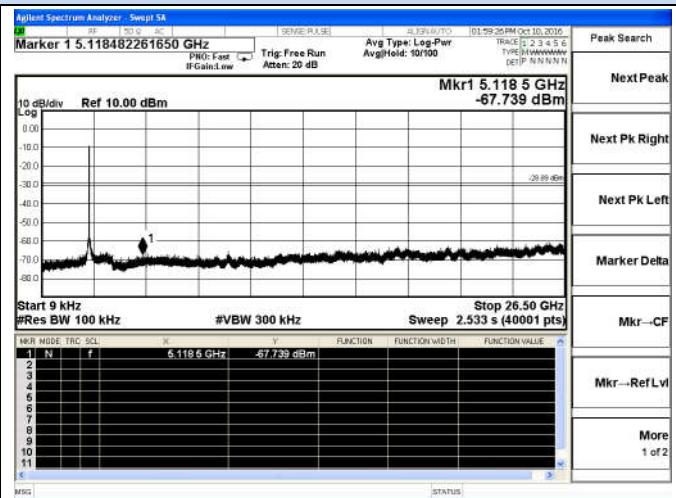
9 KHz - 26.5 GHz

## RF Conducted Spurious Emissions

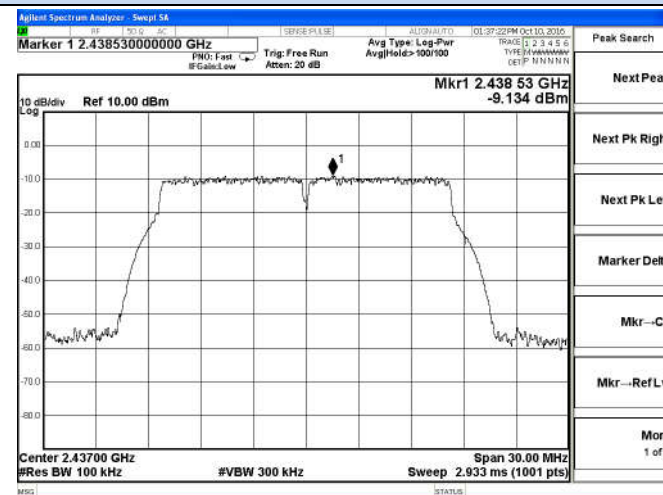
## IEEE 802.11g



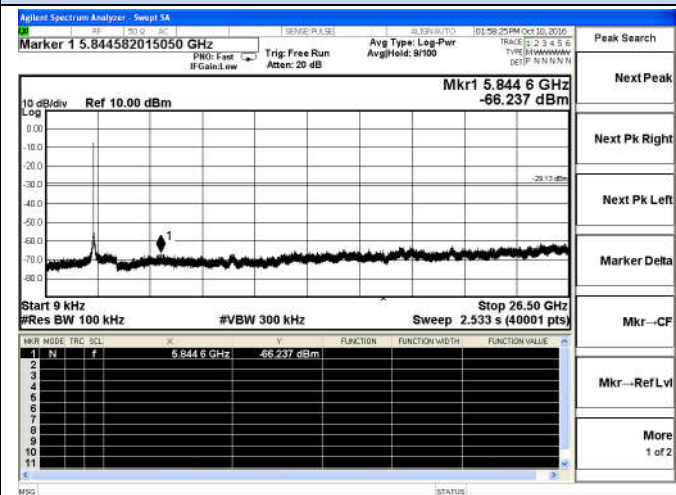
Reference peak value



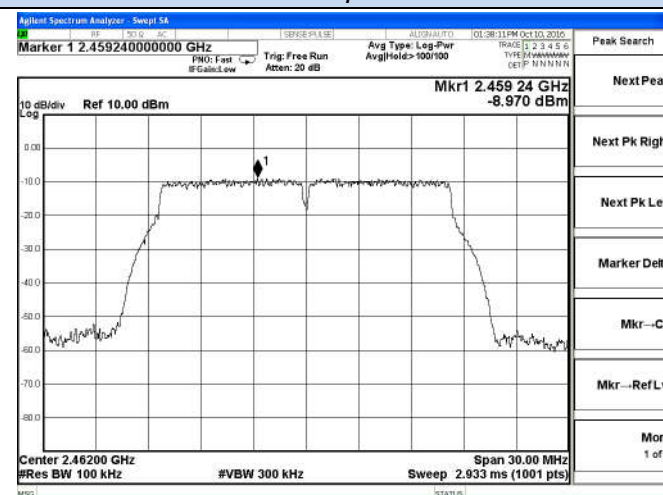
9 KHz - 26.5 GHz



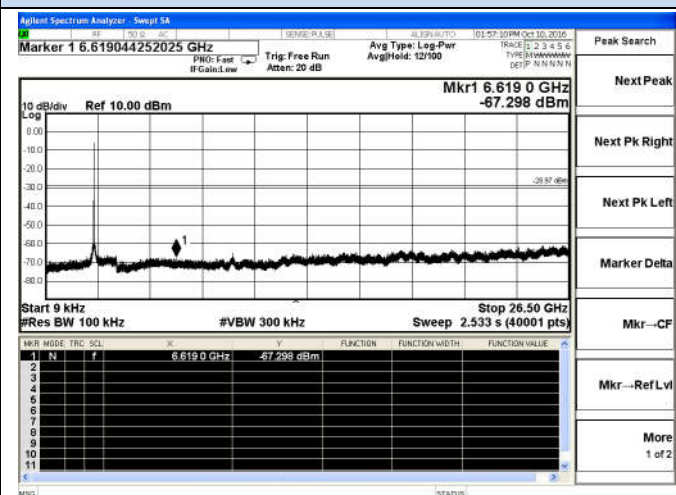
Reference peak value



9 KHz - 26.5 GHz



Reference peak value

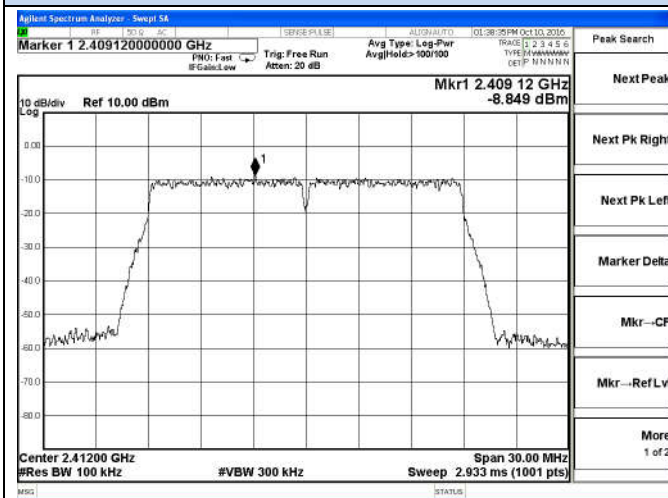


9 KHz - 26.5 GHz

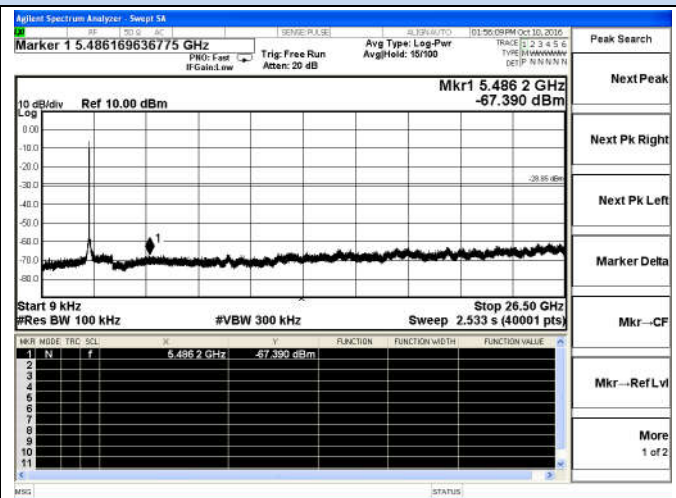


## RF Conducted Spurious Emissions

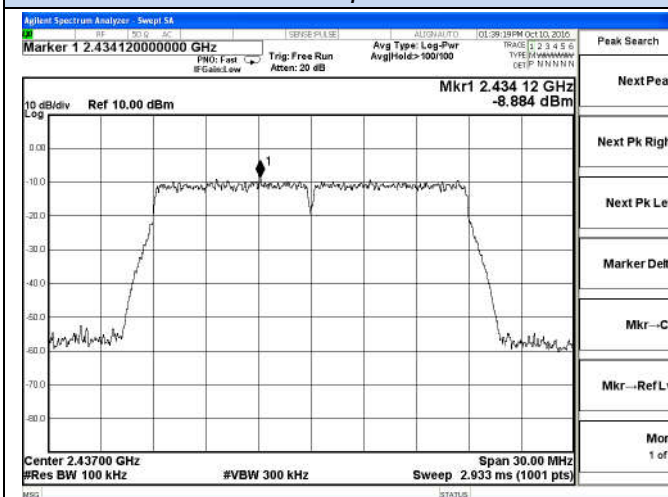
## IEEE 802.11n HT20



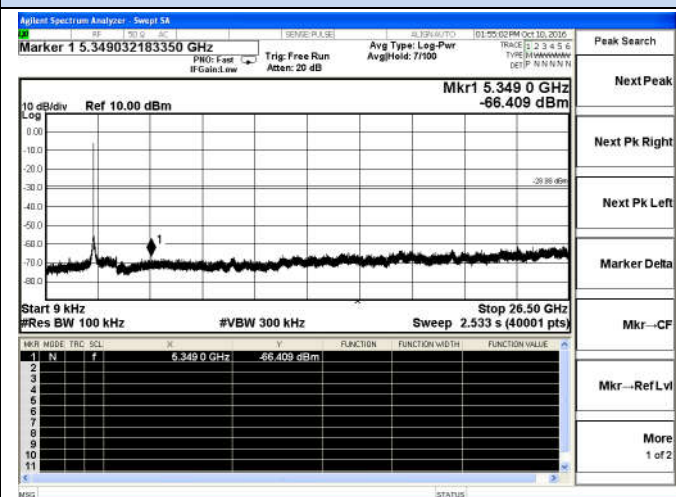
Reference peak value



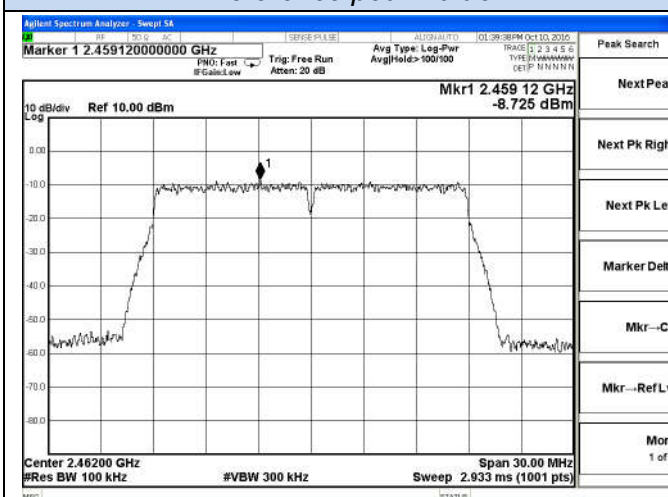
9 KHz – 26.5 GHz



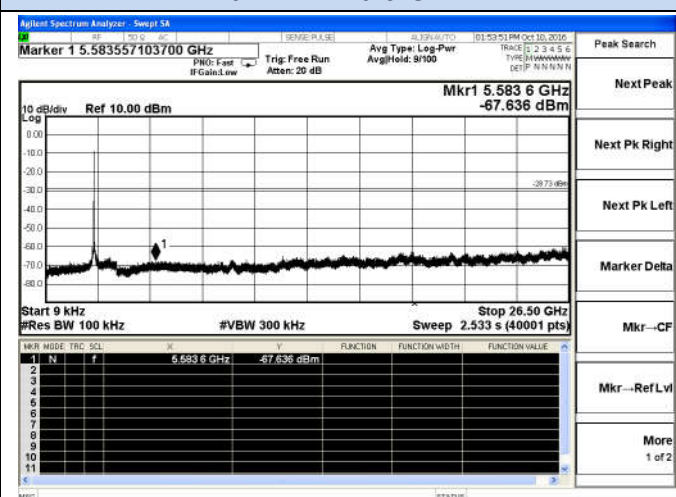
Reference peak value



9 KHz – 26.5 GHz



Reference peak value

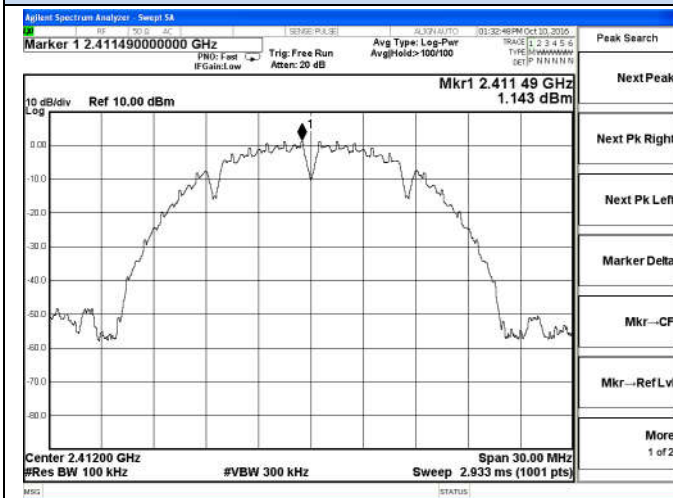


9 KHz – 26.5 GHz

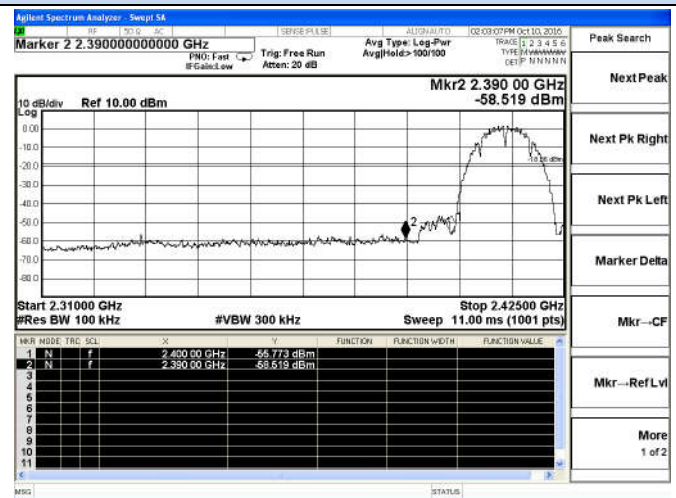
## 5.6.7. Test Results of Band Edges Test

## Band-edge measurements for conducted emissions

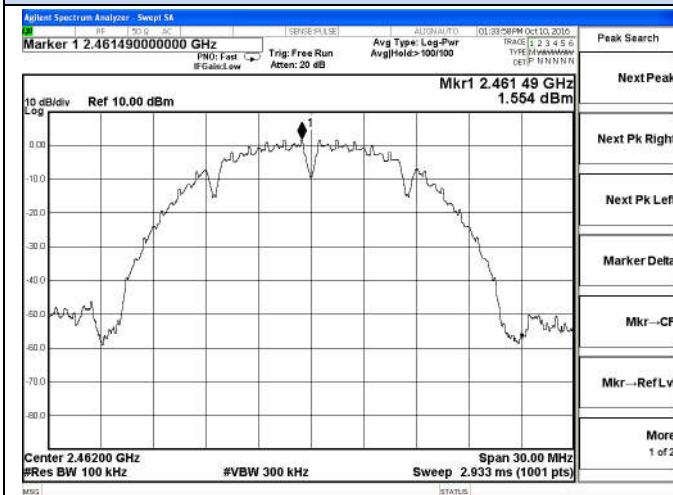
## IEEE 802.11b



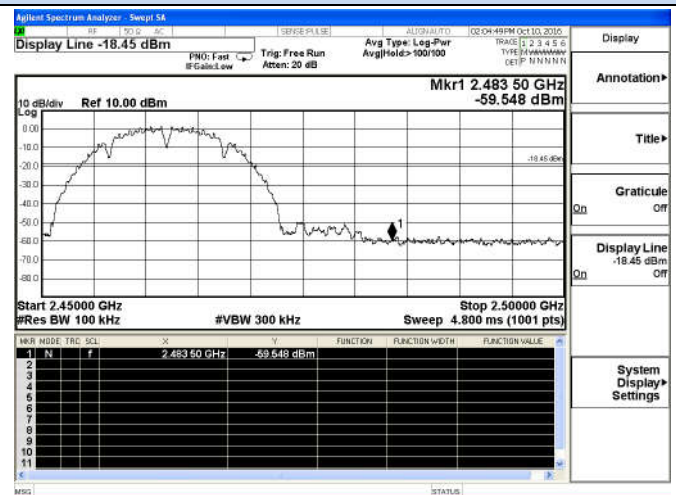
## Reference peak value



## Channel 1 / 2412 MHz

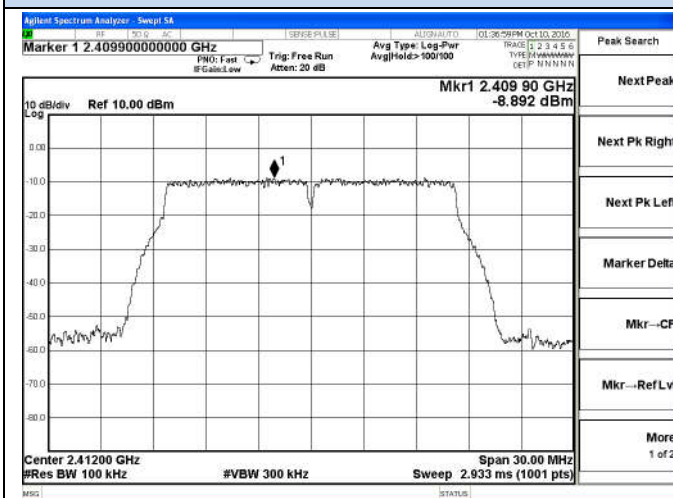


## Reference peak value

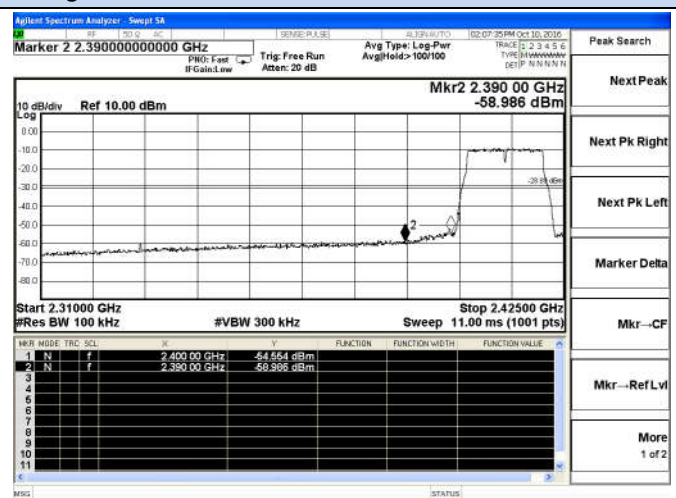


## Channel 11 / 2462 MHz

## IEEE 802.11g



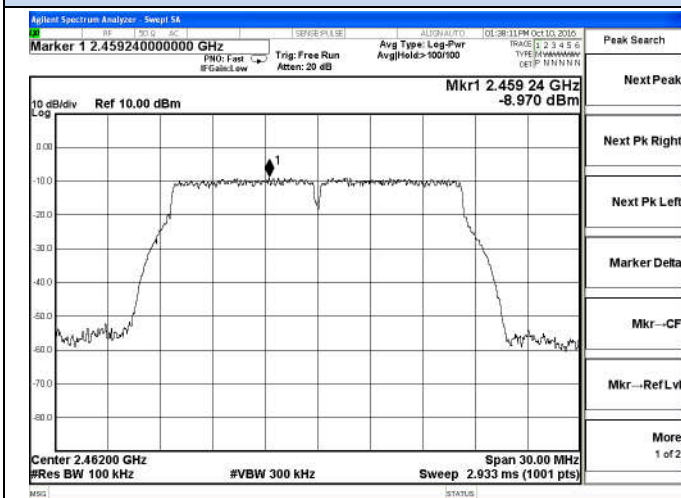
## Reference peak value



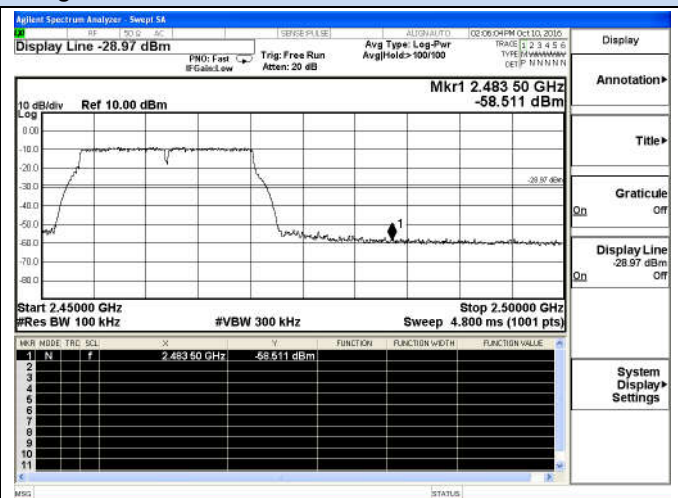
## Channel 1 / 2412 MHz

## Band-edge measurements for conducted emissions

## IEEE 802.11g

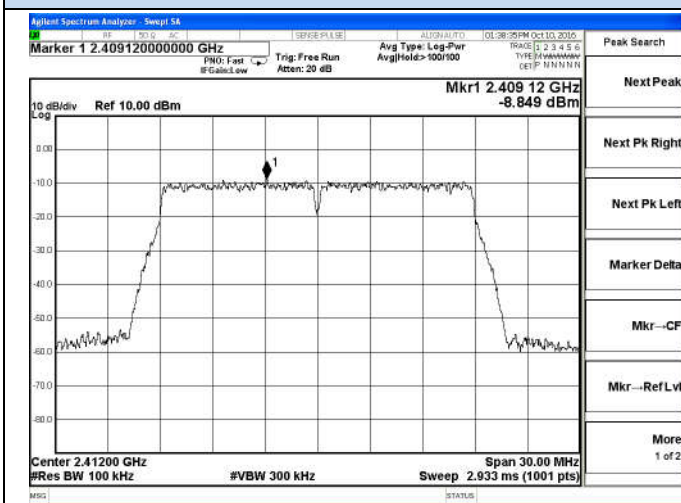


Reference peak value

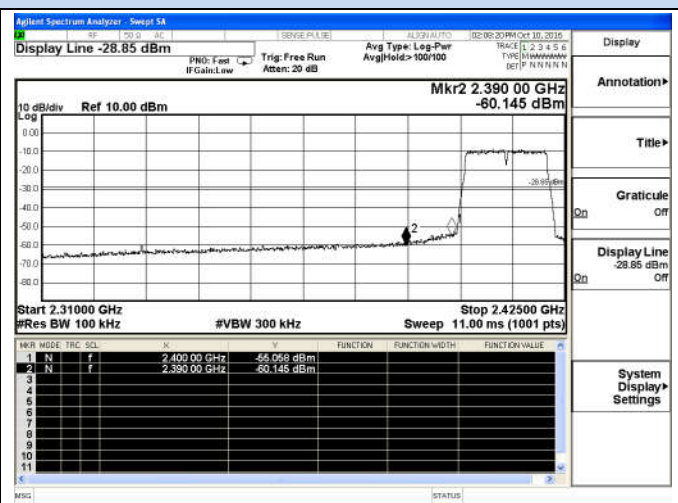


Channel 11 / 2462 MHz

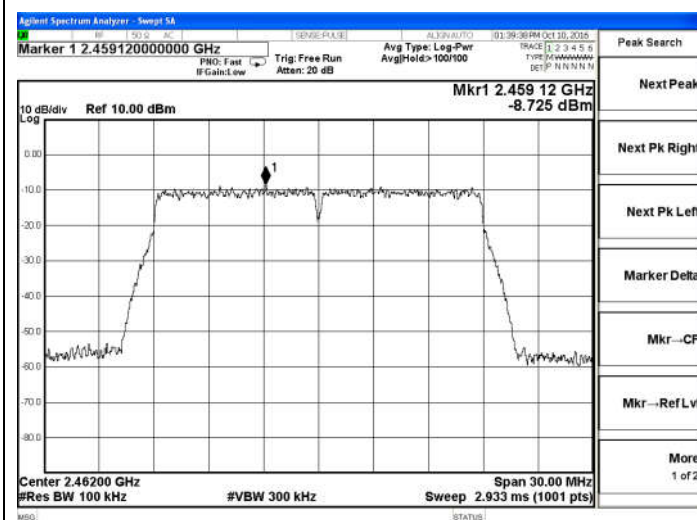
## IEEE 802.11n HT20



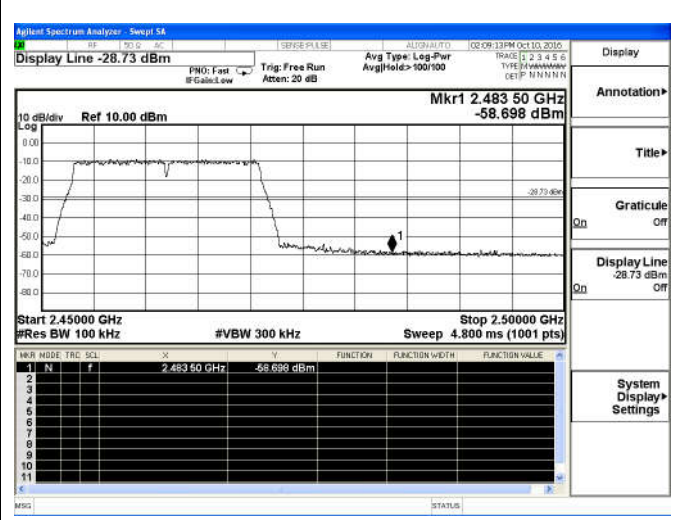
Reference peak value



Channel 1 / 2412 MHz



Reference peak value



Channel 11 / 2462 MHz

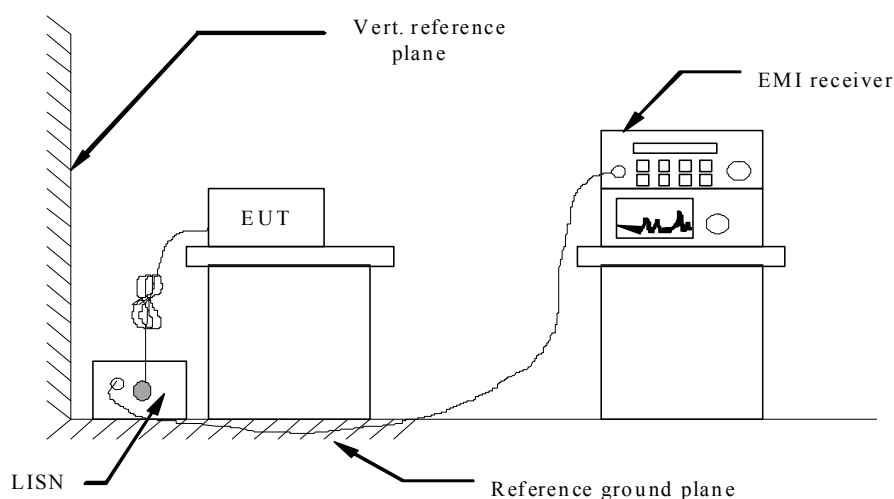
## 5.7. Power line conducted emissions

### 5.7.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

### 5.7.2 Block Diagram of Test Setup



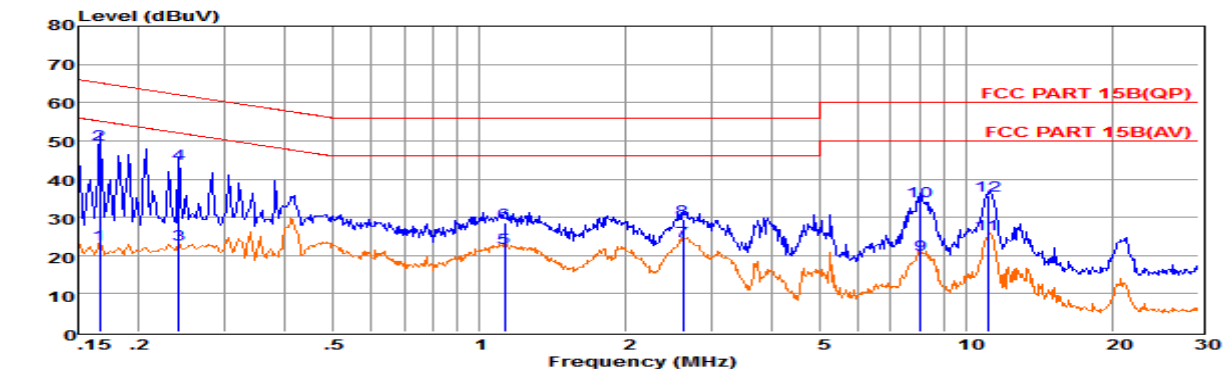
### 5.7.3 Test Results

**PASS.**

The test data please refer to following page.

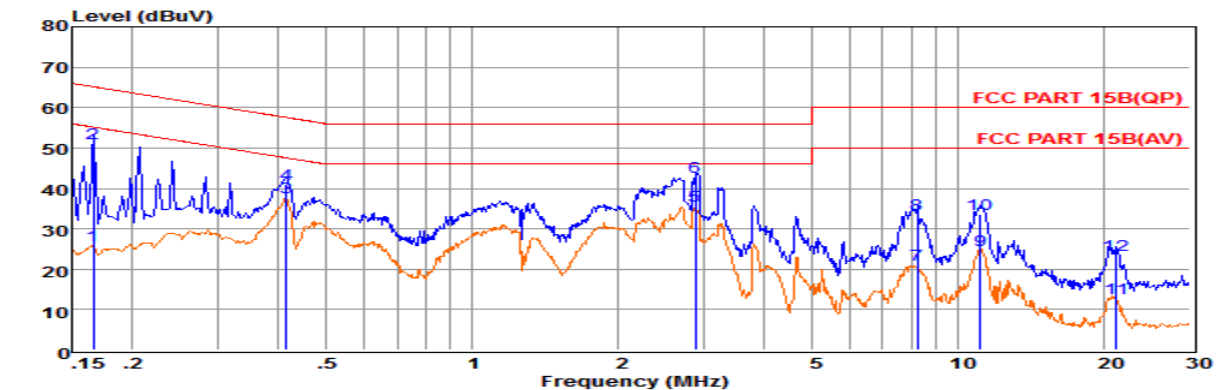


## Test result for 802.11b(AC 240V)



Env. Ins:	24*/56%								
Pol:	LINE								
	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.17	3.20	9.59	0.02	10.00	22.81	55.16	-32.35	Average
2	0.17	29.47	9.59	0.02	10.00	49.08	65.16	-16.08	QP
3	0.24	3.34	9.63	0.03	10.00	23.00	52.04	-29.04	Average
4	0.24	24.25	9.63	0.03	10.00	43.91	62.04	-18.13	QP
5	1.13	2.23	9.63	0.05	10.00	21.91	46.00	-24.09	Average
6	1.13	8.82	9.63	0.05	10.00	28.50	56.00	-27.50	QP
7	2.62	4.25	9.64	0.05	10.00	23.94	46.00	-22.06	Average
8	2.62	9.69	9.64	0.05	10.00	29.38	56.00	-26.62	QP
9	8.06	0.49	9.68	0.07	10.00	20.24	50.00	-29.76	Average
10	8.06	14.54	9.68	0.07	10.00	34.29	60.00	-25.71	QP
11	11.08	5.84	9.70	0.09	10.00	25.63	50.00	-24.37	Average
12	11.08	15.81	9.70	0.09	10.00	35.60	60.00	-24.40	QP

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.  
 2. The emission levels that are 20dB below the official limit are not reported.



Env. Ins:	24*/56%								
Pol:	NEUTRAL								
	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dB	dBuV	dBuV	dB
1	0.17	6.23	9.66	0.02	10.00	25.91	55.16	-29.25	Average
2	0.17	31.61	9.66	0.02	10.00	51.29	65.16	-13.87	QP
3	0.41	17.97	9.61	0.04	10.00	37.62	47.55	-9.93	Average
4	0.41	21.27	9.61	0.04	10.00	40.92	57.55	-16.63	QP
5	2.88	16.05	9.64	0.06	10.00	35.75	46.00	-10.25	Average
6	2.88	23.23	9.64	0.06	10.00	42.93	56.00	-13.07	QP
7	8.24	1.35	9.70	0.07	10.00	21.12	50.00	-28.88	Average
8	8.24	13.78	9.70	0.07	10.00	33.55	60.00	-26.45	QP
9	11.14	4.77	9.73	0.09	10.00	24.59	50.00	-25.41	Average
10	11.14	13.81	9.73	0.09	10.00	33.63	60.00	-26.37	QP
11	21.15	-7.26	9.84	0.12	10.00	12.70	50.00	-37.30	Average
12	21.15	3.59	9.84	0.12	10.00	23.55	60.00	-36.45	QP

Remarks: 1. Measured = Reading +Cable Loss +Aux2 Fac.  
 2. The emission levels that are 20dB below the official limit are not reported.

\*\*\*Note: Pre-scan all mode and only recorded the worst case results in this report @240VAC.

## 5.8. Antenna Requirements

### 5.8.1 Standard Applicable

According to antenna requirement of §15.203.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

### 5.8.2 Antenna Connected Construction

#### 5.8.2.1. Standard Applicable

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

#### 5.8.2.2. Antenna Connector Construction

The directional gains of antenna used for transmitting is 1.0dBi, and the antenna is an PCB antenna and no consideration of replacement. Please see EUT photo for details.

#### 5.8.2.3. Results: Compliance.

## 6. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Cal Date	Due Date
EMC Receiver	R&S	ESCS 30	100174	9kHz – 2.75GHz	June 18, 2016	June 17, 2017
Signal analyzer	Agilent	E4448A(External mixers to 40GHz)	US44300469	9kHz~40GHz	July 16, 2016	July 15, 2017
Signal analyzer	Agilent	N9020A	MY50510140	9kHz~26.5GHz	October 27, 2015	October 27, 2016
LISN	MESS Tec	NNB-2/16Z	99079	9KHz-30MHz	June 18, 2016	June 17, 2017
LISN (Support Unit)	EMCO	3819/2NM	9703-1839	9KHz-30MHz	June 18, 2016	June 17, 2017
RF Cable-CON	UTIFLEX	3102-26886-4	CB049	9KHz-30MHz	June 18, 2016	June 17, 2017
ISN	SCHAFFNER	ISN ST08	21653	9KHz-30MHz	June 18, 2016	June 17, 2017
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30M-18GHz 3m	June 18, 2016	June 17, 2017
Amplifier	SCHAFFNER	COA9231A	18667	9kHz-2GHz	June 18, 2016	June 17, 2017
Amplifier	Agilent	8449B	3008A02120	1GHz-26.5GHz	July 16, 2016	July 15, 2017
Amplifier	MITEQ	AMF-6F-260400	9121372	26.5GHz-40GHz	July 16, 2016	July 15, 2017
Loop Antenna	R&S	HFH2-Z2	860004/001	9k-30MHz	June 18, 2016	June 17, 2017
By-log Antenna	SCHWARZBECK	VULB9163	9163-470	30MHz-1GHz	June 10, 2016	June 09, 2017
Horn Antenna	EMCO	3115	6741	1GHz-18GHz	June 10, 2016	June 09, 2017
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170154	15GHz-40GHz	June 10, 2016	June 09, 2017
RF Cable-R03m	Jye Bao	RG142	CB021	30MHz-1GHz	June 18, 2016	June 17, 2017
RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	1GHz-40GHz	June 18, 2016	June 17, 2017
Power Meter	R&S	NRVS	100444	DC-40GHz	June 18, 2016	June 17, 2017
Power Sensor	R&S	NRV-Z51	100458	DC-30GHz	June 18, 2016	June 17, 2017
Power Sensor	R&S	NRV-Z32	10057	30MHz-6GHz	June 18, 2016	June 17, 2017
AC Power Source	HPC	HPA-500E	HPA-9100024	AC 0~300V	June 18, 2016	June 17, 2017
DC power Source	GW	GPC-6030D	C671845	DC 1V-60V	June 18, 2016	June 17, 2017
Temp. and Humidity Chamber	Giant Force	GTH-225-20-S	MAB0103-00	N/A	June 18, 2016	June 17, 2017
RF CABLE-1m	JYE Bao	RG142	CB034-1m	20MHz-7GHz	June 18, 2016	June 17, 2017
RF CABLE-2m	JYE Bao	RG142	CB)35-2m	20MHz-1GHz	June 18, 2016	June 17, 2017

Note: All equipment through GRGT EST calibration

## **7. TEST SETUP PHOTOGRAPHS OF EUT**

Please refer to separated files for Test Setup Photos of the EUT.

## **8. EXTERIOR PHOTOGRAPHS OF THE EUT**

Please refer to separated files for External Photos of the EUT.

## **9. INTERIOR PHOTOGRAPHS OF THE EUT**

Please refer to separated files for Internal Photos of the EUT.

-----THE END OF REPORT-----