



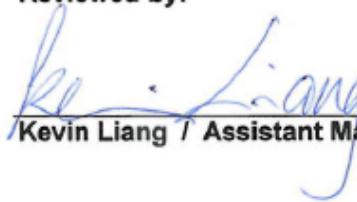
# FCC Test Report

**Equipment** : Nest Cam Outdoor  
**Brand Name** : Nest Labs  
**Model No.** : A0033  
**FCC ID** : ZQANC21  
**Standard** : 47 CFR FCC Part 15.247  
**Frequency** : 2400 MHz – 2483.5 MHz  
**FCC Classification** : DTS  
**Function** :  Point-to-multipoint;  Point-to-point  
**Applicant** : Nest Labs Inc.  
3400 Hillview Ave, Pola Alto, CA 94304 USA  
**Manufacturer** : Chicony Electronics (Dong Guan ) Co., Ltd.  
San Zhong Guan Li Qu, Qingxi Town, Dongguan City  
Guangdong 523651 China

The product sample received on May 16, 2016 and completely tested on Jul. 04, 2016. We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:

  
/Kevin Liang / Assistant Manager



Testing Laboratory  
1190



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**Appendix I. Test Result of AC Power-line Conducted Emissions****Appendix A. Test Result of Emission Bandwidth****Appendix B. Test Result of Maximum Conducted Output Power****Appendix C. Test Result of Power Spectral Density****Appendix D. Test Result of Transmitter Radiated Bandedge Emissions****Appendix E. Test Result of Transmitter Radiated Unwanted Emissions****Appendix F. Test Photos****Appendix G. Photographs of EUT**



## Summary of Test Result

Conformance Test Specifications					
Report Clause	Ref. Std. Clause	Description	Measured	Limit	Result
1.1.2	15.203	Antenna Requirement	Antenna connector mechanism complied	FCC 15.203	Complied
3.1	15.207	AC Power-line Conducted Emissions	[dBuV]: 15.15MHz 35.03(Margin 14.97dB) - AV 40.37(Margin 19.63dB) - QP	FCC 15.207	Complied
3.2	15.247(a)	DTS Bandwidth	Refer as Appendix A	$\geq 500\text{kHz}$	Complied
3.3	15.247(b)	Fundamental Emission Output Power	Refer as Appendix B	Power [dBm]:30	Complied
3.4	15.247(e)	Power Spectral Density	Refer as Appendix C	PSD [dBm/3kHz]:8	Complied
3.5	15.247(d)	Emissions in Restricted Frequency Bands	Refer as Appendix D	Non-Restricted Bands:> 20 dBc Bands: FCC 15.209	Complied
3.6	15.247(d)	Emissions in Non-restricted Frequency Bands	Refer as Appendix E	Restricted Bands: FCC 15.209	Complied



## Revision History



## 1 General Description

### 1.1 Information

#### 1.1.1 RF General Information

Band	Mode	BWch (MHz)	Nss-Min	Nant
2.4G	Zigbee	5	1	1

Note:

- 2.4G is the 2.4GHz Band (2.4-2.4835GHz).
- Zigbee using O-QPSK modulation for DTS digital modulation.
- BWch is the nominal channel bandwidth.
- Nss-Min is the minimum number of spatial streams.
- Nant is the number of outputs.

#### 1.1.2 Antenna Information

Antenna Category	
<input checked="" type="checkbox"/>	Integral antenna (antenna permanently attached)
<input checked="" type="checkbox"/>	Temporary RF connector provided
<input type="checkbox"/>	No temporary RF connector provided Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path.

Antenna General Information			
No.	Ant. Cat.	Ant. Type	Gain (dBi)
1	Integral	PIFA	-0.08



### 1.1.3 Type of EUT

Identify EUT	
EUT Serial Number	N/A
Presentation of Equipment	<input checked="" type="checkbox"/> Production ; <input type="checkbox"/> Pre-Production ; <input type="checkbox"/> Prototype
Type of EUT	
<input checked="" type="checkbox"/> Stand-alone	
<input type="checkbox"/> Combined (EUT where the radio part is fully integrated within another device) Combined Equipment - Brand Name / Model No.: ...	
<input type="checkbox"/> Plug-in radio (EUT intended for a variety of host systems) Host System - Brand Name / Model No.: ...	
<input type="checkbox"/> Other:	

### 1.1.4 Mode Test Duty Cycle

Operated Mode for Worst Duty Cycle	
Test Signal Duty Cycle (x)	Power Duty Factor [dB] – (10 log 1/x)
<input checked="" type="checkbox"/> 22.60% - Zigbee	6.46
DC;Zigbee;BWch:5	
Ch Freq RBW VBW Sweep Time Total Sample Sample Time TX Time DC	
2.475GHz   10MHz   10MHz   100ms   32001   3.125us   22.6125ms   0.226	



### 1.1.5 EUT Operational Condition

Supply Voltage	<input checked="" type="checkbox"/> AC mains	<input checked="" type="checkbox"/> DC	
Type of DC Source	<input checked="" type="checkbox"/> External AC adapter	<input checked="" type="checkbox"/> From Host System	<input type="checkbox"/> Battery

## 1.2 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR FCC Part 15
- ♦ ANSI C63.10-2013
- ♦ FCC KDB 558074 D01 v03r05

## 1.3 Testing Location Information

Testing Location						
<input checked="" type="checkbox"/>	HWA YA	ADD :	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.			
			TEL :	886-3-327-3456	FAX :	
Test Condition		Test Site No.	Test Engineer	Test Environment	Test Date	
AC Conduction		CO04-HY	Ryan	24°C / 58%	Jun. 07, 2016	
RF Conducted		TH01-HY	Howard	23°C / 63%	Jul. 04, 2016	
Radiated		03CH09-HY	Joe	22.2°C / 51.8%	Jun. 02, 2016	

Test site registered number [ 553509 ] with FCC.



## 1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty		
Test Item	Uncertainty	
AC power-line conducted emissions	±2.3 dB	
Emission bandwidth, 6dB bandwidth	±0.6 %	
RF output power, conducted	±0.1 dB	
Power density, conducted	±0.6 dB	
Unwanted emissions, conducted	9 – 150 kHz	±0.4 dB
	0.15 – 30 MHz	±0.4 dB
	30 – 1000 MHz	±0.6 dB
	1 – 18 GHz	±0.5 dB
	18 – 40 GHz	±0.5 dB
	40 – 200 GHz	N/A
All emissions, radiated	9 – 150 kHz	±2.5 dB
	0.15 – 30 MHz	±2.3 dB
	30 – 1000 MHz	±2.6 dB
	1 – 18 GHz	±3.6 dB
	18 – 40 GHz	±3.8 dB
	40 – 200 GHz	N/A
Temperature	±0.8 °C	
Humidity	±5 %	
DC and low frequency voltages	±0.9%	
Time	±1.4 %	
Duty Cycle	±0.6 %	



## 2 Test Configuration of EUT

### 2.1 Test Channel Mode

Test Software		Dos					
---------------	--	-----	--	--	--	--	--

Band	Mode	BWch (MHz)	Nss-Min	Nant	Ch. (MHz)	Range	Power Setting
2.4G	Zigbee	5	1	1	2405	L	-4
2.4G	Zigbee	5	1	1	2440	M	-4
2.4G	Zigbee	5	1	1	2475	H	-5

#### Abbreviation Explanation

Band	Mode	BWch (MHz)	Nss-Min	Nant	Ch. (MHz)	Range	Test Cond.	Abbreviation
2.4G	Zigbee,	5	1	1	2405	L	TN,VN	2.4G;Zigbee;5;1;1;2405;TN,VN

#### Note:

- ◆ Test range channel consist of L (Low Ch.), M (Middle Ch.), H (High Ch.), S (Single Ch).



## 2.2 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral Test Voltage: 120Vac / 60Hz
Operating Mode	Operating Mode Description
1	USB Mode
2	Adapter Mode

The Worst Case Mode for Following Conformance Tests	
Tests Item	DTS Bandwidth, Fundamental Emission Output Power, Power Spectral Density, Emissions in Non-restricted Frequency Bands
Test Condition	Conducted measurement at transmit chains

The Worst Case Mode for Following Conformance Tests							
Tests Item	Emissions in Restricted Frequency Bands						
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.						
User Position	<input type="checkbox"/> EUT will be placed in fixed position. <input checked="" type="checkbox"/> EUT will be placed in mobile position and operating multiple positions. EUT shall be performed three orthogonal planes. <input type="checkbox"/> EUT will be a hand-held or body-worn battery-powered devices and operating multiple positions. EUT shall be performed two or three orthogonal planes.						
Operating Mode < 1GHz	<input checked="" type="checkbox"/> 1. USB Mode <input checked="" type="checkbox"/> 2. Adapter Mode						
Orthogonal Planes of EUT	<table><thead><tr><th>X Plane</th><th>Y Plane</th><th>Z Plane</th></tr></thead><tbody><tr><td></td><td></td><td></td></tr></tbody></table>	X Plane	Y Plane	Z Plane			
X Plane	Y Plane	Z Plane					
Worst Planes of EUT	V						



## 2.3 Accessories and Support Equipment

Accessories Information				
AC Adapter	Brand Name	I.T.E	Model Name	A0038
	Power Rating	I/P: 100-240Vac, 0.35A, O/P: 5 Vdc, 1.4A		
	Power Cord	4.4 meter, non-shielded cable, with w/o ferrite core		

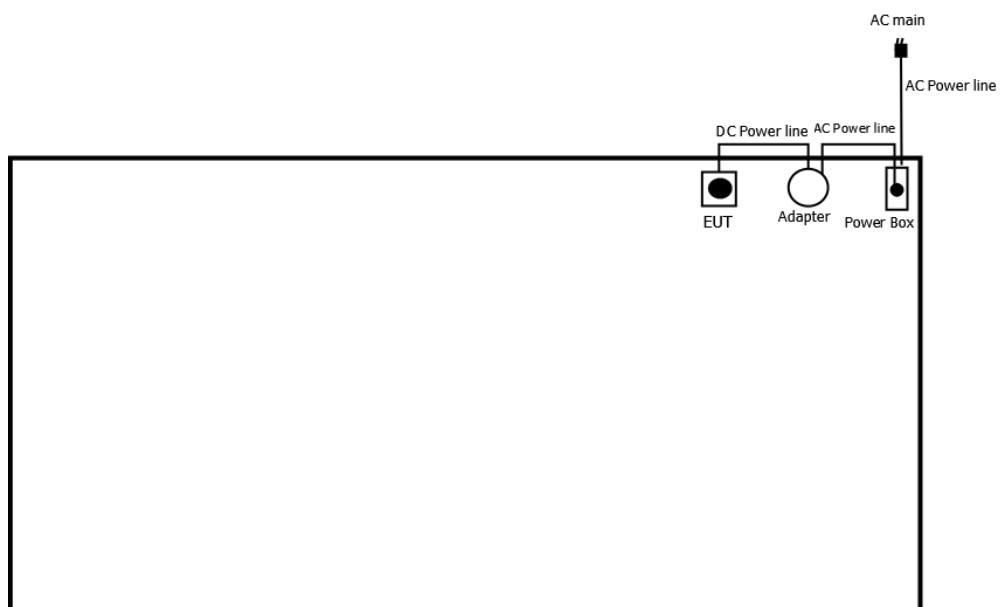
Reminder: Regarding to more detail and other information, please refer to user manual.

Support Equipment - RF Conducted			
No.	Equipment	Brand Name	Model Name
1	Notebook	DELL	E6400
2	AC Adapter for Notebook	DELL	HA65NM130

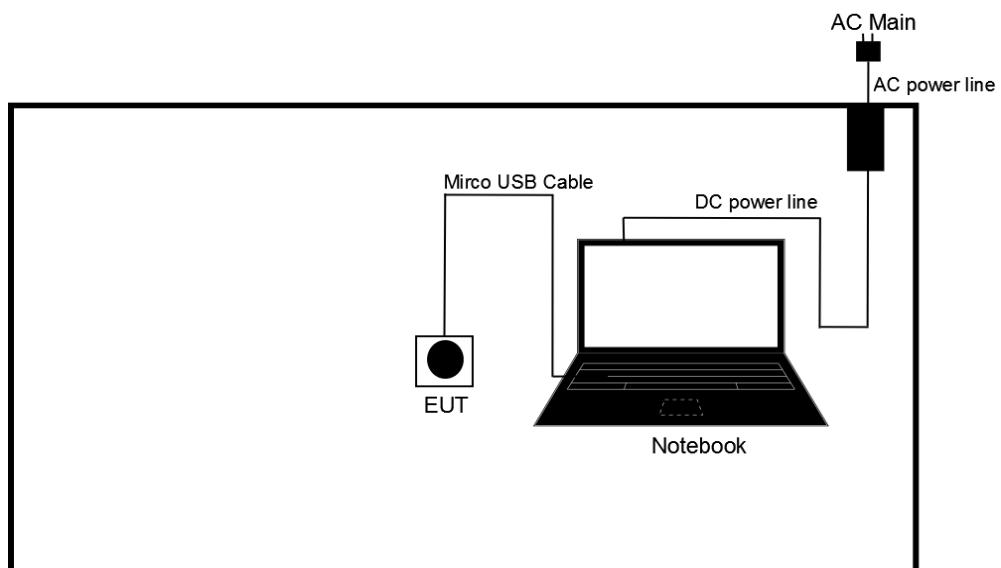
Support Equipment - AC Conduction and Radiated Emission			
No.	Equipment	Brand Name	Model Name
1	Notebook	DELL	E5540
2	AC Adapter for Notebook	DELL	LA65NS2-01

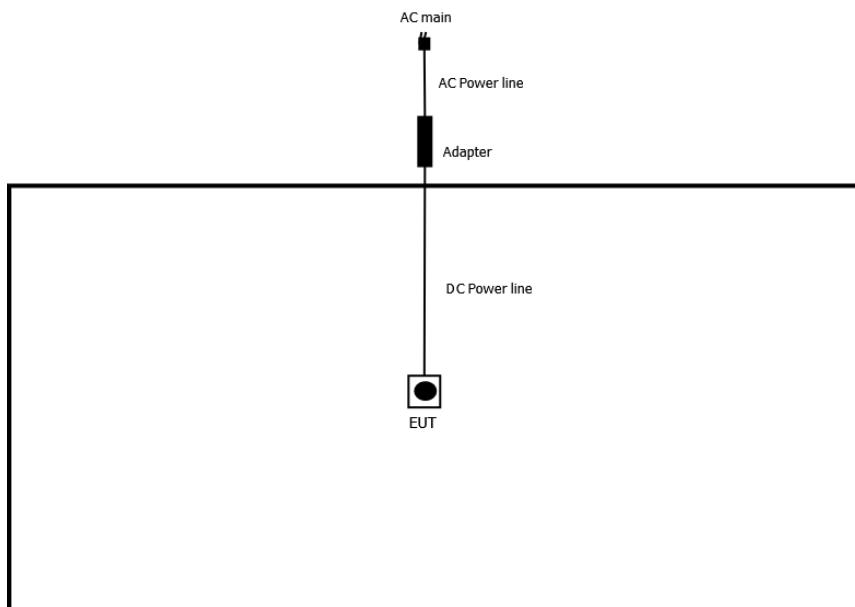
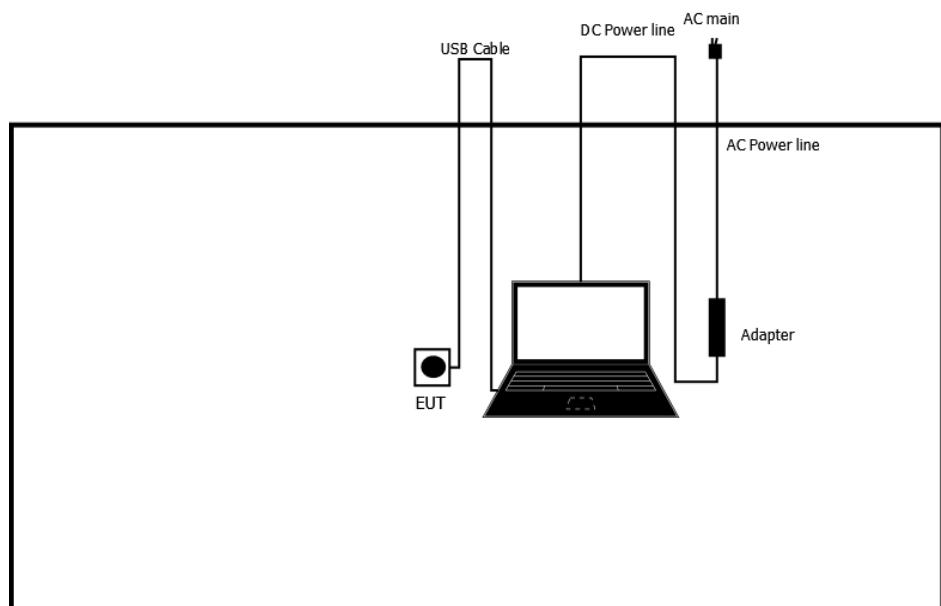
## 2.4 Test Setup Diagram

**Test Setup Diagram – AC Line Conducted Emission Test (Mode 1)**



**Test Setup Diagram – AC Line Conducted Emission Test (Mode 2)**



**Test Setup Diagram - Radiated Test (Mode 1)****Test Setup Diagram - Radiated Test (Mode 2)**

### 3 Transmitter Test Result

#### 3.1 AC Power-line Conducted Emissions

##### 3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: \* Decreases with the logarithm of the frequency.

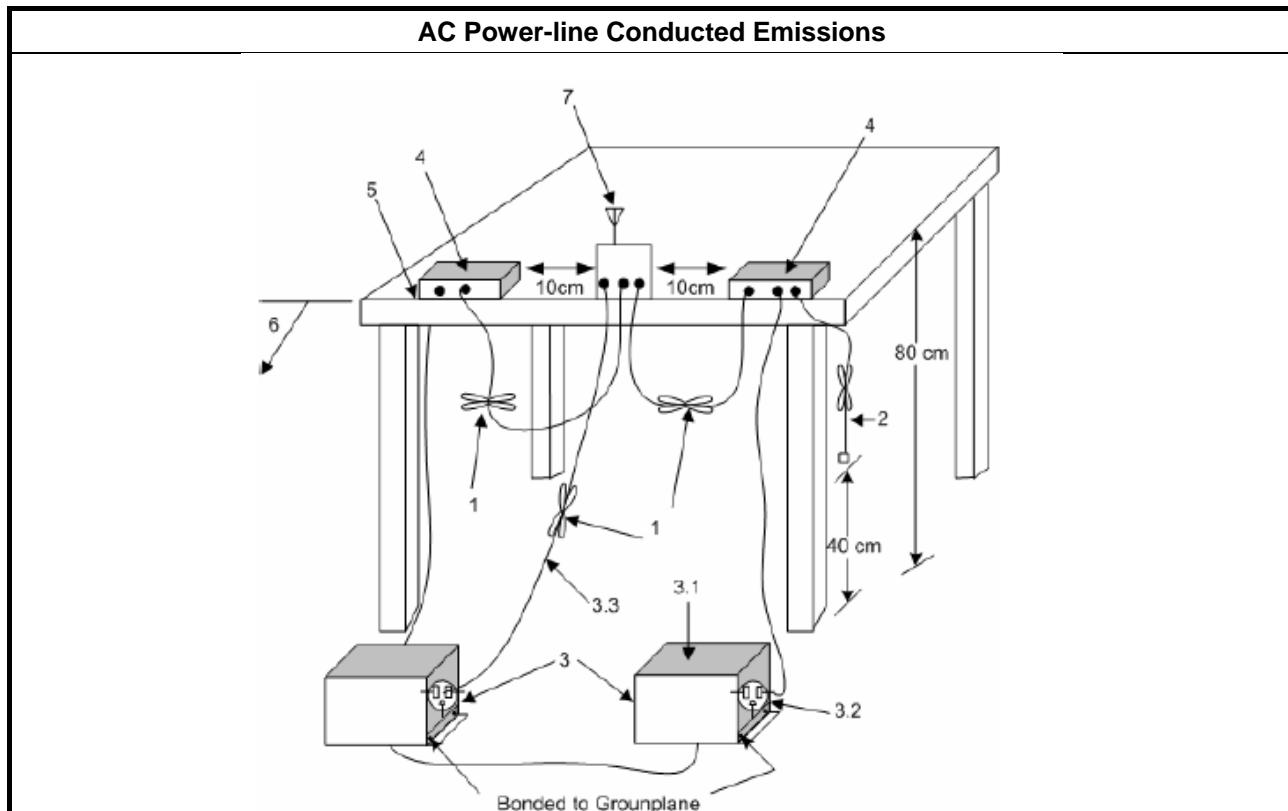
##### 3.1.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

##### 3.1.3 Test Procedures

Test Method
▪ Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions.

##### 3.1.4 Test Setup





### **3.1.5 Test Result of AC Power-line Conducted Emissions**

Refer as Appendix I

## 3.2 DTS Bandwidth

### 3.2.1 6dB Bandwidth Limit

6dB Bandwidth Limit
<b>Systems using digital modulation techniques:</b>
▪ 6 dB bandwidth $\geq$ 500 kHz.

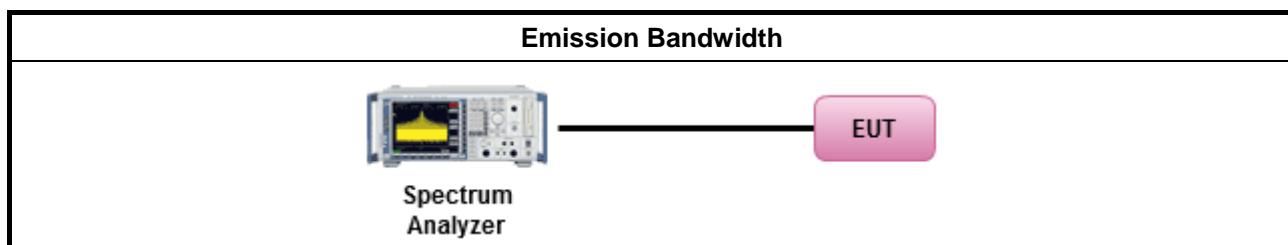
### 3.2.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

### 3.2.3 Test Procedures

Test Method
▪ For the emission bandwidth shall be measured using one of the options below:
<input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 8.1 Option 1 for 6 dB bandwidth measurement.
<input type="checkbox"/> Refer as FCC KDB 558074, clause 8.2 Option 2 for 6 dB bandwidth measurement.
<input checked="" type="checkbox"/> Refer as ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.

### 3.2.4 Test Setup



### 3.2.5 Test Result of Emission Bandwidth

Refer as Appendix A



### 3.3 Fundamental Emission Output Power

#### 3.3.1 Fundamental Emission Output Power Limit

Maximum Peak Conducted Output Power or Maximum Conducted Output Power Limit	
▪ 2400-2483.5 MHz Band:	
	▪ If $G_{TX} \leq 6 \text{ dBi}$ , then $P_{Out} \leq 30 \text{ dBm}$ (1 W)
	▪ Point-to-multipoint systems (P2M): If $G_{TX} > 6 \text{ dBi}$ , then $P_{Out} = 30 - (G_{TX} - 6) \text{ dBm}$
	▪ Point-to-point systems (P2P): If $G_{TX} > 6 \text{ dBi}$ , then $P_{Out} = 30 - (G_{TX} - 6)/3 \text{ dBm}$
	▪ Smart antenna system (SAS):
	- Single beam: If $G_{TX} > 6 \text{ dBi}$ , then $P_{Out} = 30 - (G_{TX} - 6)/3 \text{ dBm}$
	- Overlap beam: If $G_{TX} > 6 \text{ dBi}$ , then $P_{Out} = 30 - (G_{TX} - 6)/3 \text{ dBm}$
	- Aggregate power on all beams: If $G_{TX} > 6 \text{ dBi}$ , then $P_{Out} = 30 - (G_{TX} - 6)/3 + 8 \text{ dB dBm}$
<b>e.i.r.p. Power Limit:</b>	
▪ 2400-2483.5 MHz Band	
	▪ Point-to-multipoint systems (P2M): $P_{eirp} \leq 36 \text{ dBm}$ (4 W)
	▪ Point-to-point systems (P2P): $P_{eirp} \leq \text{MAX}(36, [P_{Out} + G_{TX}]) \text{ dBm}$
	▪ Smart antenna system (SAS)
	- Single beam: $P_{eirp} \leq \text{MAX}(36, P_{Out} + G_{TX}) \text{ dBm}$
	- Overlap beam: $P_{eirp} \leq \text{MAX}(36, P_{Out} + G_{TX}) \text{ dBm}$
	- Aggregate power on all beams: $P_{eirp} \leq \text{MAX}(36, [P_{Out} + G_{TX} + 8]) \text{ dBm}$
<b><math>P_{Out}</math></b> = maximum peak conducted output power or maximum conducted output power in dBm, <b><math>G_{TX}</math></b> = the maximum transmitting antenna directional gain in dBi. <b><math>P_{eirp}</math></b> = e.i.r.p. Power in dBm.	



### 3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

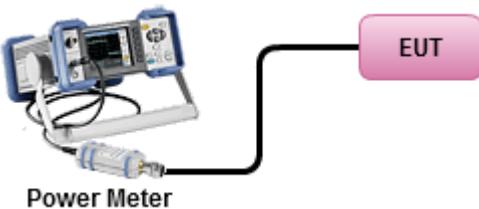
### 3.3.3 Test Procedures

Test Method	
▪ Maximum Peak Conducted Output Power	<input type="checkbox"/> Refer as FCC KDB 558074, clause 9.1.1 Option 1 (RBW $\geq$ EBW method). <input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 9.1.2 Option 2 (peak power meter for VBW $\geq$ DTS BW)
▪ Maximum Conducted Output Power	<p>[duty cycle <math>\geq</math> 98% or external video / power trigger]</p> <input type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.2.2 Method AVGSA-1 (spectral trace averaging). <input type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.2.3 Method AVGSA-1 Alt. (slow sweep speed)
	duty cycle $<$ 98% and average over on/off periods with duty factor
	<input type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.2.4 Method AVGSA-2 (spectral trace averaging). <input type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.2.5 Method AVGSA-2 Alt. (slow sweep speed)
	RF power meter and average over on/off periods with duty factor or gated trigger
	<input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 9.2.3 Method AVGPM (using an RF average power meter).
<input checked="" type="checkbox"/> For conducted measurement.	<p><input type="checkbox"/> If the EUT supports multiple transmit chains using options given below: Refer as FCC KDB 662911, In-band power measurements. Using the measure-and-sum approach, measured all transmit ports individually. Sum the power (in linear power units e.g., mW) of all ports for each individual sample and save them.</p> <p><input type="checkbox"/> If multiple transmit chains, EIRP calculation could be following as methods: <math>P_{total} = P_1 + P_2 + \dots + P_n</math> (calculated in linear unit [mW] and transfer to log unit [dBm]) <math>EIRP_{total} = P_{total} + DG</math></p>

Note: Duty cycle correction factor already take into account in shown result by adding offset during measurement.

### 3.3.4 Test Setup

RF Output Power (Power Meter)



### 3.3.5 Test Result of Maximum Peak Conducted Output Power

Refer as Appendix B

### 3.3.6 Test Result of Maximum Average Conducted Output Power

Refer as Appendix B



## 3.4 Power Spectral Density

### 3.4.1 Power Spectral Density Limit

Power Spectral Density Limit
▪ Power Spectral Density (PSD) $\leq 8 \text{ dBm/3kHz}$

### 3.4.2 Measuring Instruments

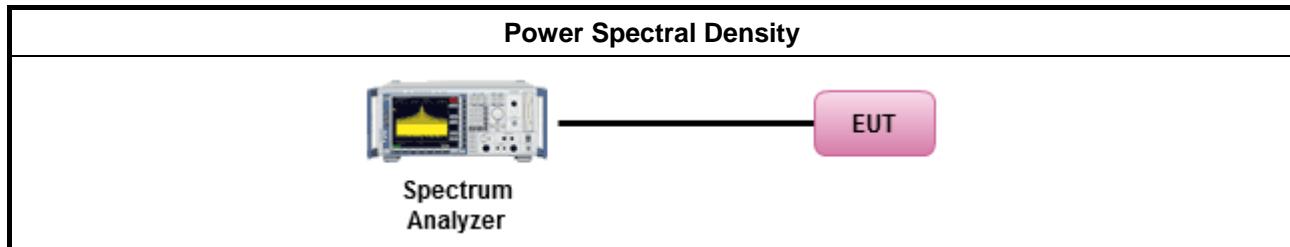
Refer a test equipment and calibration data table in this test report.

### 3.4.3 Test Procedures

Test Method			
▪ Peak power spectral density procedures that the same method as used to determine the conducted output power. If maximum peak conducted output power was measured to demonstrate compliance to the output power limit, then the peak PSD procedure below (Method PKPSD) shall be used. If maximum conducted output power was measured to demonstrate compliance to the output power limit, then one of the average PSD procedures shall be used, as applicable based on the following criteria (the peak PSD procedure is also an acceptable option).			
<input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 10.2 Method PKPSD (RBW=3-100kHz; Detector=peak). [duty cycle $\geq 98\%$ or external video / power trigger]			
<input type="checkbox"/> Refer as FCC KDB 558074, clause 10.3 Method AVGPSD-1 (spectral trace averaging).			
<input type="checkbox"/> Refer as FCC KDB 558074, clause 10.4 Method AVGPSD-2 (slow sweep speed)			
duty cycle $< 98\%$ and average over on/off periods with duty factor			
<input type="checkbox"/> Refer as FCC KDB 558074, clause 10.5 Method AVGPSD-1 Alt (spectral trace averaging).			
<input type="checkbox"/> Refer as FCC KDB 558074, clause 10.6 Method AVGPSD-2 Alt. (slow sweep speed)			
<input checked="" type="checkbox"/> For conducted measurement.			
<input type="checkbox"/> If The EUT supports multiple transmit chains using options given below: <table border="1"><tr><td><input type="checkbox"/> Option 1: Measure and sum the spectra across the outputs. Refer as FCC KDB 662911, In-band power spectral density (PSD). Sample all transmit ports simultaneously using a spectrum analyzer for each transmit port. Where the trace bin-by-bin of each transmit port summing can be performed. (i.e., in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 and that from the first spectral bin of output 3, and so on up to the <math>N_{TX}</math> output to obtain the value for the first frequency bin of the summed spectrum.). Add up the amplitude (power) values for the different transmit chains and use this as the new data trace.</td></tr><tr><td><input type="checkbox"/> Option 2: Measure and sum spectral maxima across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs. These operations shall be performed separately over frequency spans that have different out-of-band or spurious emission limits,</td></tr><tr><td><input type="checkbox"/> Option 3: Measure and add <math>10 \log(N)</math> dB, where N is the number of transmit chains. Refer as FCC KDB 662911, In-band power spectral density (PSD). Performed at each transmit chains and each transmit chains shall be compared with the limit have been reduced with <math>10 \log(N)</math>. Or each transmit chains shall be add <math>10 \log(N)</math> to compared with the limit.</td></tr></table>	<input type="checkbox"/> Option 1: Measure and sum the spectra across the outputs. Refer as FCC KDB 662911, In-band power spectral density (PSD). Sample all transmit ports simultaneously using a spectrum analyzer for each transmit port. Where the trace bin-by-bin of each transmit port summing can be performed. (i.e., in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 and that from the first spectral bin of output 3, and so on up to the $N_{TX}$ output to obtain the value for the first frequency bin of the summed spectrum.). Add up the amplitude (power) values for the different transmit chains and use this as the new data trace.	<input type="checkbox"/> Option 2: Measure and sum spectral maxima across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs. These operations shall be performed separately over frequency spans that have different out-of-band or spurious emission limits,	<input type="checkbox"/> Option 3: Measure and add $10 \log(N)$ dB, where N is the number of transmit chains. Refer as FCC KDB 662911, In-band power spectral density (PSD). Performed at each transmit chains and each transmit chains shall be compared with the limit have been reduced with $10 \log(N)$ . Or each transmit chains shall be add $10 \log(N)$ to compared with the limit.
<input type="checkbox"/> Option 1: Measure and sum the spectra across the outputs. Refer as FCC KDB 662911, In-band power spectral density (PSD). Sample all transmit ports simultaneously using a spectrum analyzer for each transmit port. Where the trace bin-by-bin of each transmit port summing can be performed. (i.e., in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 and that from the first spectral bin of output 3, and so on up to the $N_{TX}$ output to obtain the value for the first frequency bin of the summed spectrum.). Add up the amplitude (power) values for the different transmit chains and use this as the new data trace.			
<input type="checkbox"/> Option 2: Measure and sum spectral maxima across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs. These operations shall be performed separately over frequency spans that have different out-of-band or spurious emission limits,			
<input type="checkbox"/> Option 3: Measure and add $10 \log(N)$ dB, where N is the number of transmit chains. Refer as FCC KDB 662911, In-band power spectral density (PSD). Performed at each transmit chains and each transmit chains shall be compared with the limit have been reduced with $10 \log(N)$ . Or each transmit chains shall be add $10 \log(N)$ to compared with the limit.			



### 3.4.4 Test Setup



### 3.4.5 Test Result of Power Spectral Density

Refer as Appendix C

### 3.5 Emissions in Non-restricted Frequency Bands

#### 3.5.1 Emissions in Non-restricted Frequency Bands Limit

Un-restricted Band Emissions Limit	
RF output power procedure	Limit (dB)
Peak output power procedure	20
Average output power procedure	30
<p>Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.</p> <p>Note 2: If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.</p>	

#### 3.5.2 Measuring Instruments

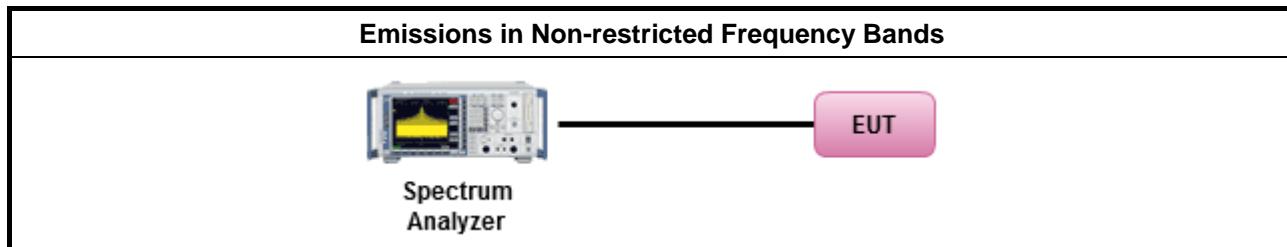
Refer a test equipment and calibration data table in this test report.

#### 3.5.3 Test Procedures

Test Method
▪ Refer as FCC KDB 558074, clause 11 for unwanted emissions into non-restricted bands.

Test setting	
Bandedge Emissions	RBW/VBW
Non-restricted Band	100k/300k
Restricted Band	Peak : 1M/3M Average : 1M/1k

#### 3.5.4 Test Setup



#### 3.5.5 Test Result of Emissions in Non-restricted Frequency Bands

Refer as Appendix D



### 3.6 Transmitter Radiated Unwanted Emissions

#### 3.6.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

#### 3.6.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.



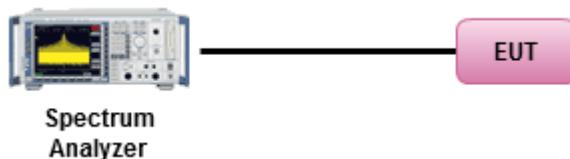
### 3.6.3 Test Procedures

Test Method	
<ul style="list-style-type: none"> <li>The average emission levels shall be measured in [duty cycle <math>\geq</math> 98 or duty factor].</li> </ul>	
<ul style="list-style-type: none"> <li>Refer as ANSI C63.10, clause 6.9.2.2 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.</li> </ul>	
<ul style="list-style-type: none"> <li>For the transmitter unwanted emissions shall be measured using following options below:</li> </ul>	
<ul style="list-style-type: none"> <li>Refer as FCC KDB 558074, clause 12 for unwanted emissions into restricted bands.</li> </ul>	
	<input type="checkbox"/> Refer as FCC KDB 558074, clause 12.2.5.1 Option 1 (trace averaging for duty cycle $\geq 98\%$ )
	<input type="checkbox"/> Refer as FCC KDB 558074, clause 12.2.5.2 Option 2 (trace averaging + duty factor).
	<input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 12.2.5.3 Option 3 (Reduced VBW $\geq 1/T$ ).
	<input type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.3 (Reduced VBW). VBW $\geq 1/T$ , where T is pulse time.
	<input type="checkbox"/> Refer as ANSI C63.10, clause 4.2.3.2.4 average value of pulsed emissions.
	<input checked="" type="checkbox"/> Refer as FCC KDB 558074, clause 12.2.4 measurement procedure peak limit.
<ul style="list-style-type: none"> <li>For the transmitter band-edge emissions shall be measured using following options below:</li> </ul>	
	<ul style="list-style-type: none"> <li>Refer as FCC KDB 558074 clause 13.1, When the performing peak or average radiated measurements, emissions within 2 MHz of the authorized band edge may be measured using the marker-delta method described below.</li> </ul>
	<ul style="list-style-type: none"> <li>Refer as FCC KDB 558074, clause 13.2 (ANSI C63.10, clause 6.9.3) for marker-delta method for band-edge measurements.</li> </ul>
	<ul style="list-style-type: none"> <li>Refer as FCC KDB 558074, clause 13.3 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz).</li> </ul>
	<input checked="" type="checkbox"/> For conducted and cabinet radiation measurement, refer as FCC KDB 558074, clause 12.2.2.
	<input type="checkbox"/> For conducted unwanted emissions into restricted bands (absolute emission limits). Devices with multiple transmit chains using options given below: <ul style="list-style-type: none"> <li>(1) Measure and sum the spectra across the outputs or</li> <li>(2) Measure and add <math>10 \log(N)</math> dB</li> </ul>
	<input type="checkbox"/> For FCC KDB 662911 The methodology described here may overestimate array gain, thereby resulting in apparent failures to satisfy the out-of-band limits even if the device is actually compliant. In such cases, compliance may be demonstrated by performing radiated tests around the frequencies at which the apparent failures occurred.

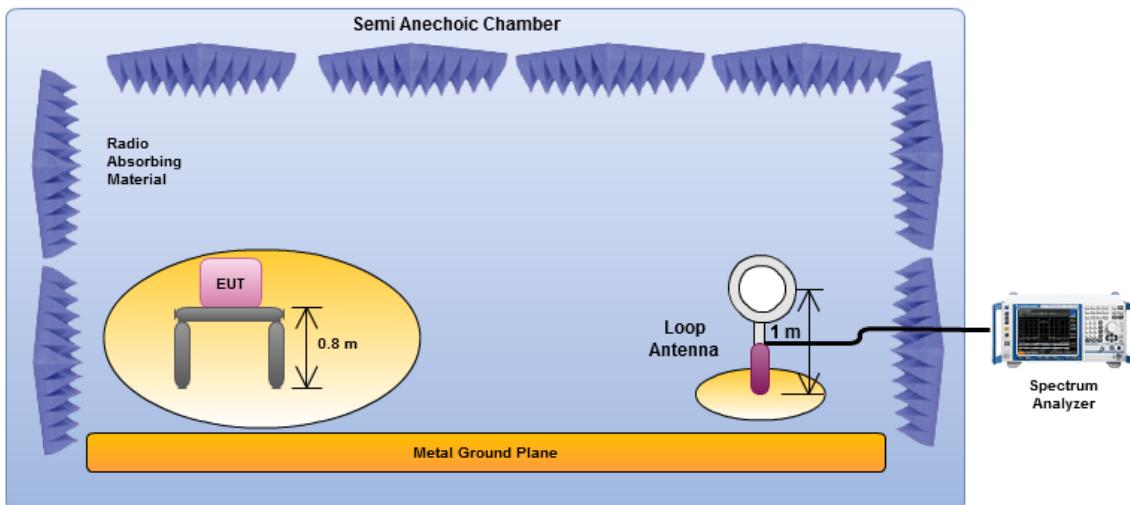
Test setting	
Unwanted emissions	RBW/VBW (CSE&RSE)
Below 1G	100k/300k
Above 1G	Peak : 1M/3M Average : 1M/1k

### 3.6.4 Test Setup

#### Emissions in Non-restricted Frequency Bands

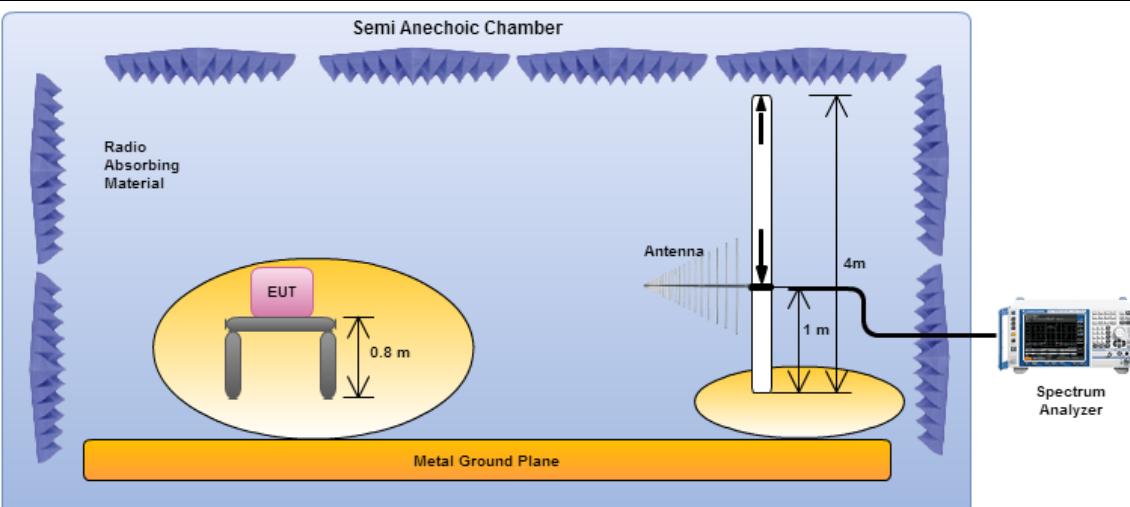


#### Transmitter Spurious and Out of Band Emissions (9 kHz - 30 MHz)

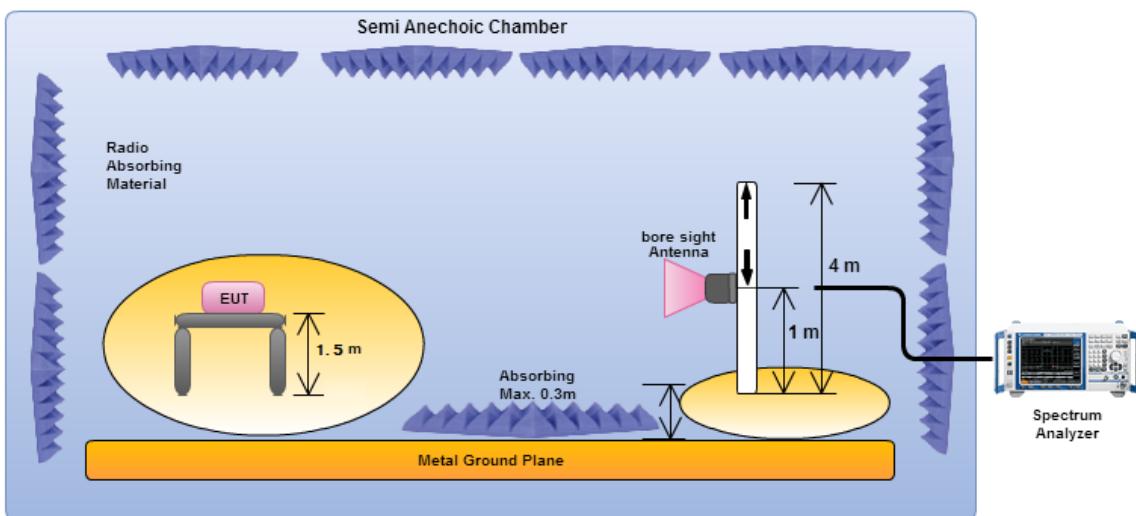


Magnetic field tests shall be performed in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna.

#### Transmitter Radiated Unwanted Emissions (below 1GHz)



Electric field tests shall be performed in the frequency range of 30 MHz to 1000 MHz using a calibrated bi-log antenna.

**Transmitter Radiated Unwanted Emissions (above 1GHz)**

Electric field tests shall be performed in the frequency range of 1 GHz to 10th harmonic of highest fundamental frequency or 40 GHz using a calibrated horn antenna.

**3.6.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)**

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

**3.6.6 Transmitter Radiated Unwanted Emissions**

Refer as Appendix E



## 4 Test Equipment and Calibration Data

### Instrument for AC Conduction

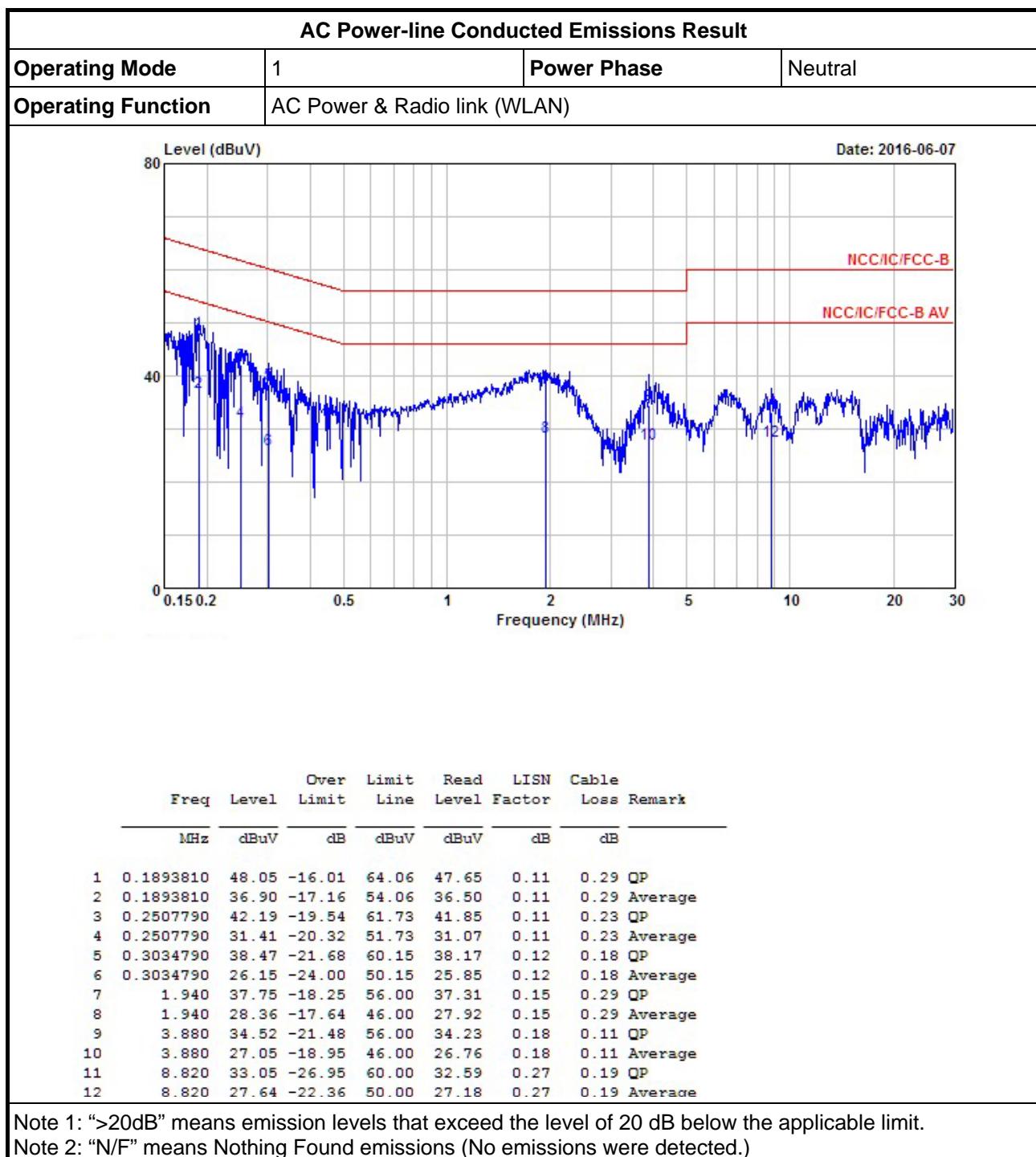
Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Last Cal.	Calibration Due Date
EMC Receiver	KEYSIGHT	N9038A	MY54130031	20Hz ~ 8.4GHz	Apr. 14, 2016	Apr. 13, 2017
LISN	SCHWARZBECK MESS-ELEKTRONIK	NSLK 8127	8127-477	9kHz ~ 30MHz	Jan. 26, 2016	Jan. 25, 2017
RF Cable-CON	HUBER+SUHNER	RG213/U	07611832020001	9kHz ~ 30MHz	Oct. 30, 2015	Oct. 29, 2016
EMI Filter	LINDGREN	LRE-2030	2651	< 450 Hz	NCR	NCR

### Instrument for Conducted Test

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Last Cal.	Calibration Due Date
Spectrum Analyzer	R&S	FSV 40	101500	9KHz~40GHz	May 12, 2016	May 11, 2017
Power Sensor	Anritsu	MA2411B	917017	300MHz ~ 40GHz	Feb. 04, 2016	Feb. 03, 2017
Power Meter	Anritsu	ML2495A	949003	300MHz ~ 40GHz	Feb. 04, 2016	Feb. 03, 2017
Signal Generator	R&S	SMR40	100116	10MHz ~ 40GHz	Jul. 28, 2015	Jul. 27, 2016

### Instrument for Radiated Test

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Last Cal.	Calibration Due Date
3m Semi Anechoic Chamber	TDK	SAC-3M	03CH09-HY	30MHz ~ 1GHz 3m	May 14, 2016	May 13, 2017
3m Semi Anechoic Chamber	TDK	SAC-3M	03CH09-HY	1GHz ~ 18GHz 3m	Jul. 01, 2015	Jun. 30, 2016
3m Semi Anechoic Chamber	TDK	SAC-3M	03CH09-HY	1GHz ~ 18GHz 3m	Jul. 01, 2016	Jun. 30, 2017
Amplifier	EMC	EMC9135	980232	9kHz ~ 1.0GHz	Jan. 29, 2016	Jan. 28, 2017
Amplifier	Agilent	8449B	3008A02096	1GHz ~ 26.5GHz	Apr. 11, 2016	Apr. 10, 2017
Spectrum	KEYSIGHT	N9010A	MY54200885	10Hz ~ 44GHz	Jul. 15, 2015	Jul. 14, 2016
Bilog Antenna & 5dB Attenuator	TESEQ & MTJ	CBL 6111D & MTJ6102	35418	30MHz ~ 1GHz	Mar. 31, 2016	Mar. 30, 2017
Horn Antenna	SCHWARZBECK	BBHA 9120D	BBHA 9120D 1534	1GHz ~ 18GHz	Apr. 22, 2016	Apr. 21, 2017
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170614	18GHz ~ 40GHz	Jan. 04, 2016	Jan. 03, 2017
Amplifier	MITEQ	JS44-18004000-33-8P	1840917	18GHz ~ 40GHz	Jun. 02, 2015	Jun. 01, 2017
Loop Antenna	ROHDE&SCHWARZ	HFH2-Z2	100330	9 kHz-30 MHz	Nov. 10, 2014	Nov. 09, 2016





**AC Power-line Conducted Emissions Result**

Operating Mode	1	Power Phase	Line
Operating Function	AC Power & Radio link (WLAN)		

Level (dBuV)

Date: 2016-06-07

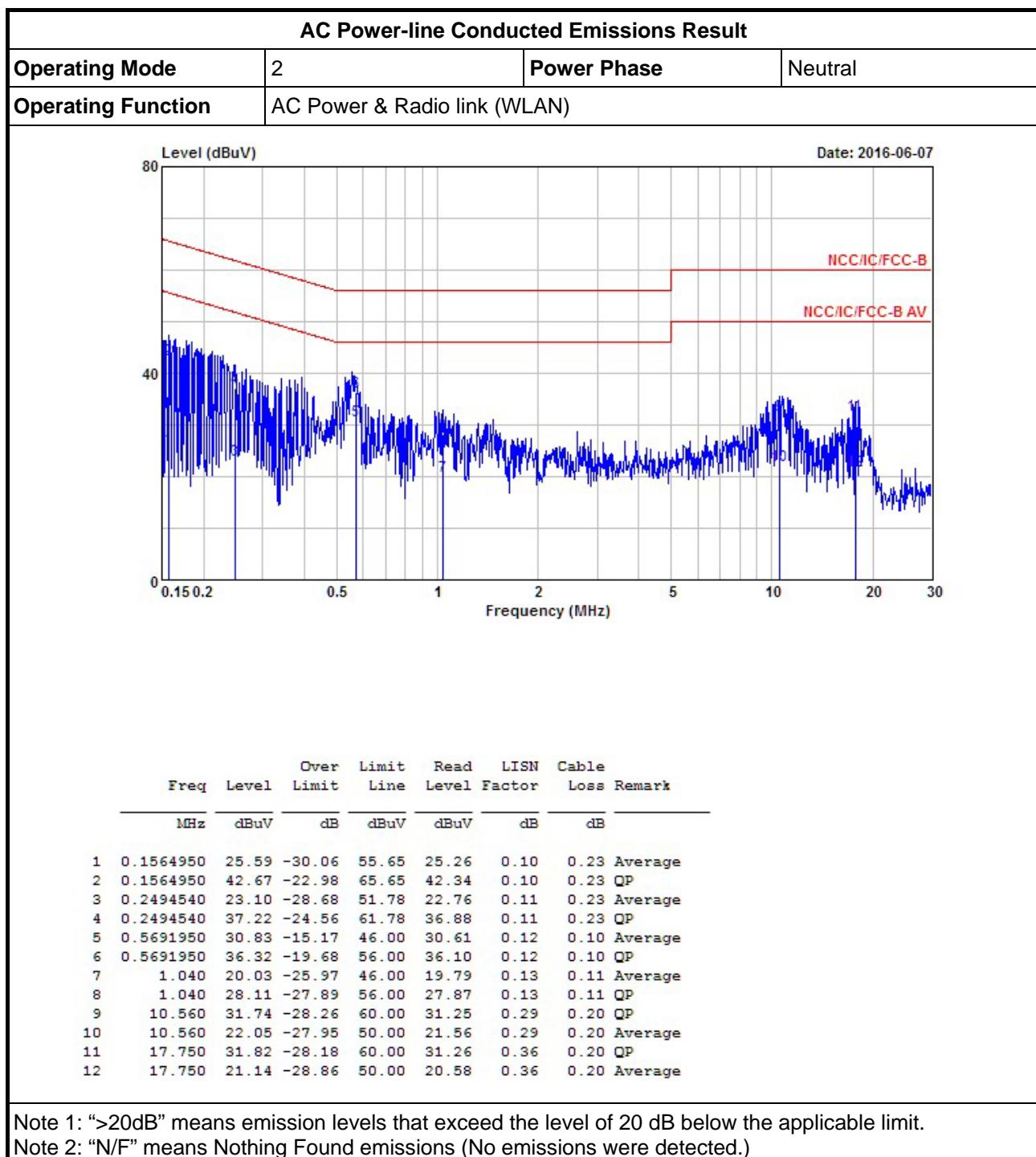
Freq	Level	Over	Limit	Read	LISN	Cable	
		Limit	Line	Level	Factor	Loss	Remark
MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.2039630	45.99	-17.46	63.45	45.59	0.11	0.29 QP
2	0.2039630	33.04	-20.41	53.45	32.64	0.11	0.29 Average
3	0.2700880	40.03	-21.09	61.12	39.71	0.11	0.21 QP
4	0.2700880	26.73	-24.39	51.12	26.41	0.11	0.21 Average
5	0.3320820	34.25	-25.15	59.40	33.98	0.12	0.15 QP
6	0.3320820	22.27	-27.13	49.40	22.00	0.12	0.15 Average
7	2.220	36.13	-19.87	56.00	35.71	0.15	0.27 QP
8	2.220	26.60	-19.40	46.00	26.18	0.15	0.27 Average
9	6.250	34.32	-25.68	60.00	33.96	0.21	0.15 QP
10	6.250	28.35	-21.65	50.00	27.99	0.21	0.15 Average
11	15.150	40.37	-19.63	60.00	39.86	0.31	0.20 QP
12	15.150	35.03	-14.97	50.00	34.52	0.31	0.20 Average

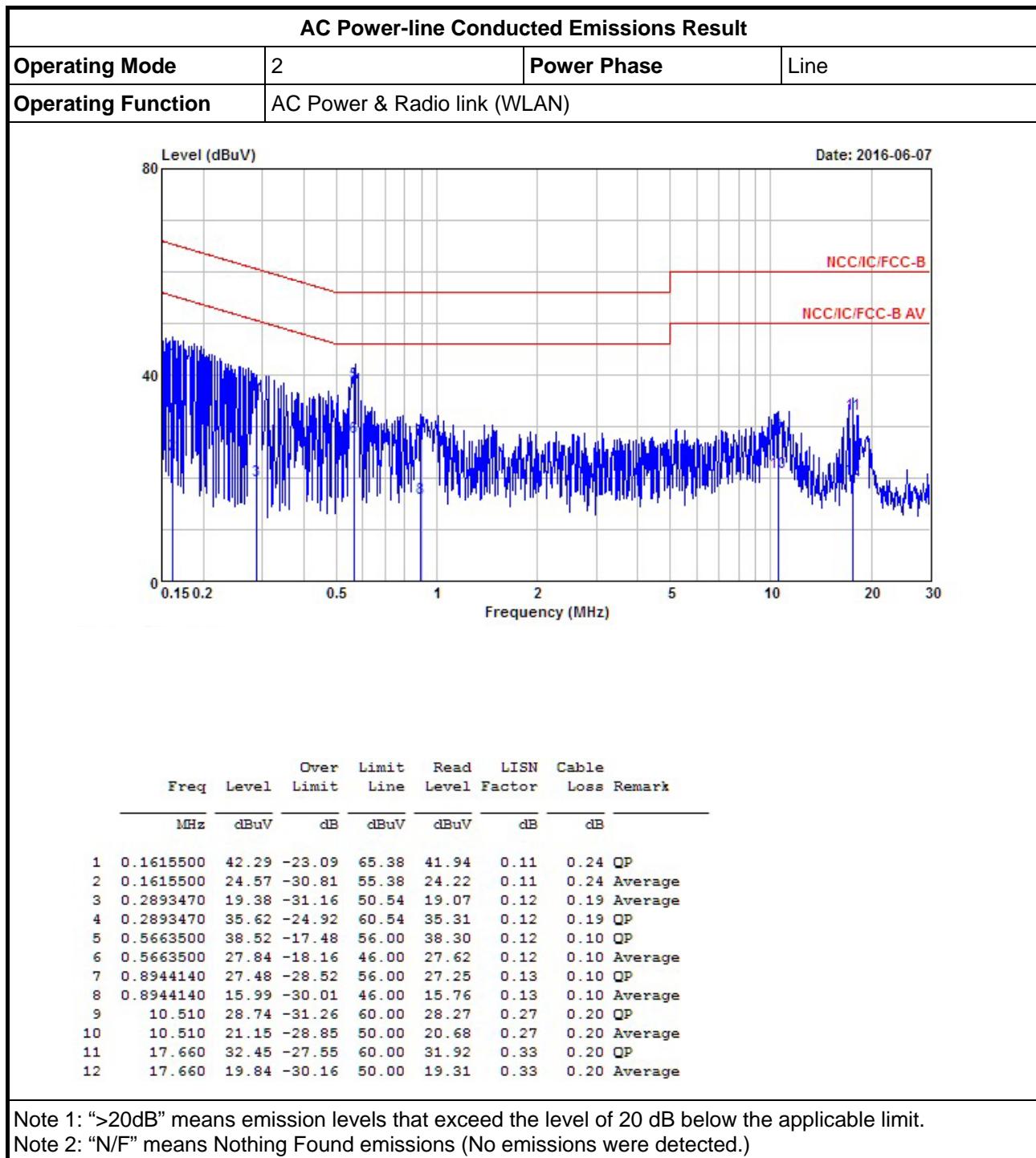
Note 1: ">20dB" means emission levels that exceed the level of 20 dB below the applicable limit.

Note 2: "N/F" means Nothing Found emissions (No emissions were detected.)

Note 1: “>20dB” means emission levels that exceed the level of 20 dB below the applicable limit.

Note 2: "N/F" means Nothing Found emissions (No emissions were detected.)



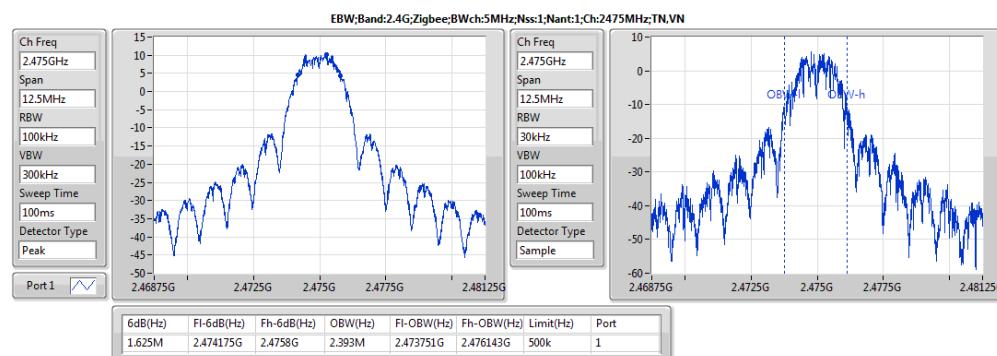
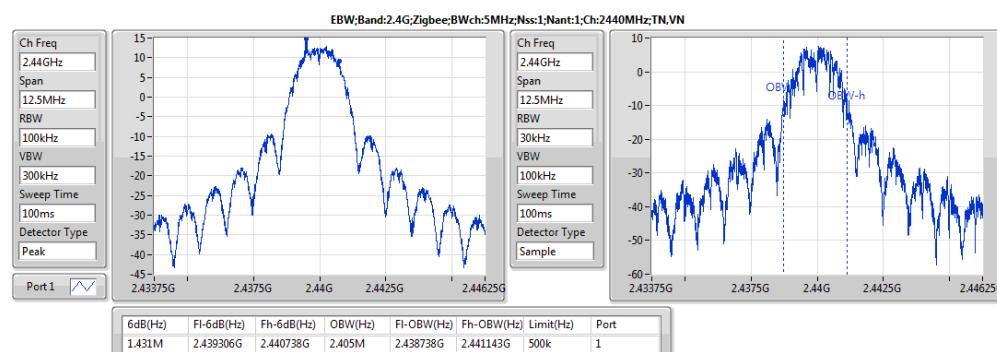
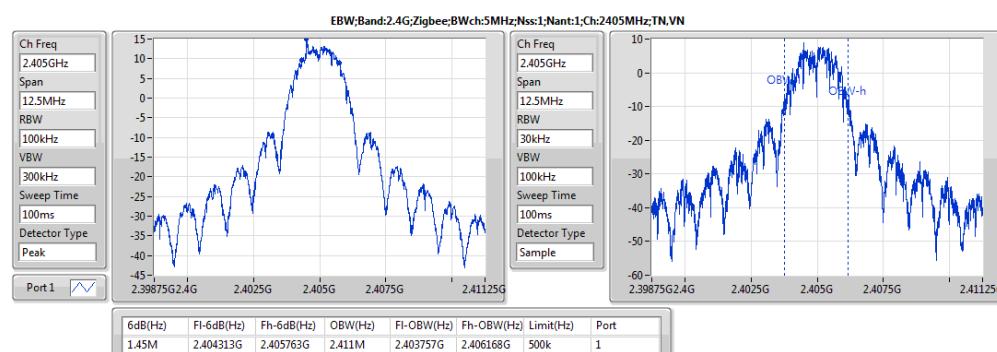


**Summary**

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
2.4G;Zigbee;5;1;1	1.625M	2.411M	2M41G1D	1.431M	2.393M

**Result**

Mode	Result	Limit	P1-N dB (Hz)	P1-OBW (Hz)
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	500k	1.45M	2.411M
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	500k	1.431M	2.405M
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	500k	1.625M	2.393M



**Summary**

Mode	Sum (dBm)	Sum (W)	EIRP (dBm)	EIRP (W)
2.4G;Zigbee;5;1;1	18.09	0.06442	18.01	0.06324

**Result**

Mode	Result	DG (dBi)	EIRP (dBm)	EIRP Lim. (dBm)	Sum (dBm)	Sum Lim. (dBm)	P1 (dBm)
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	-0.08	18.01	36.00	18.09	30.00	18.09
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	-0.08	17.01	36.00	17.09	30.00	17.09
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	-0.08	15.60	36.00	15.68	30.00	15.68

**Summary**

Mode	Sum (dBm)	Sum (W)	EIRP (dBm)	EIRP (W)
2.4G;Zigbee;5;1;1	17.91	0.0618	17.83	0.06067

**Result**

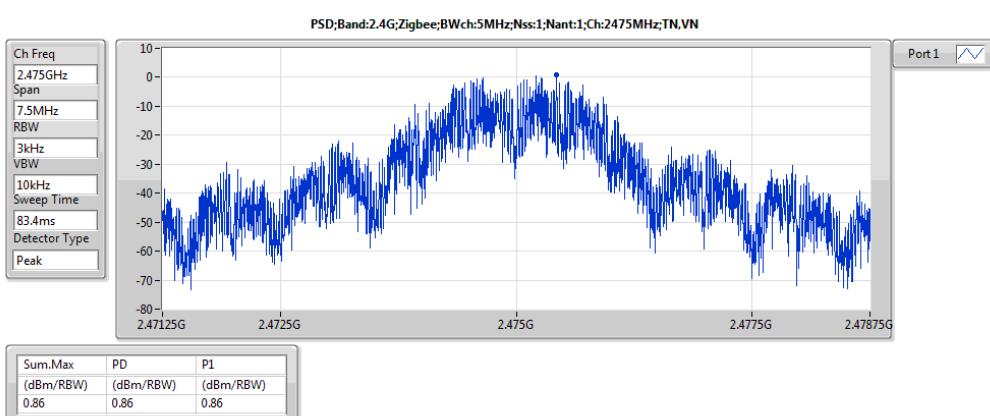
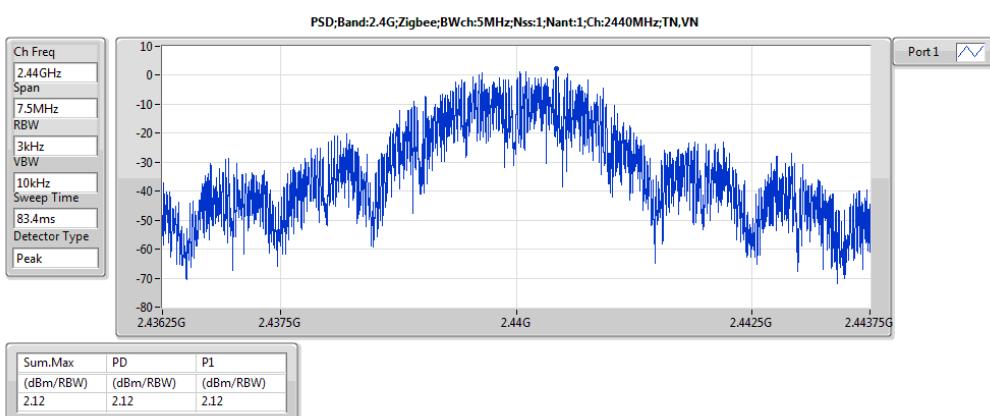
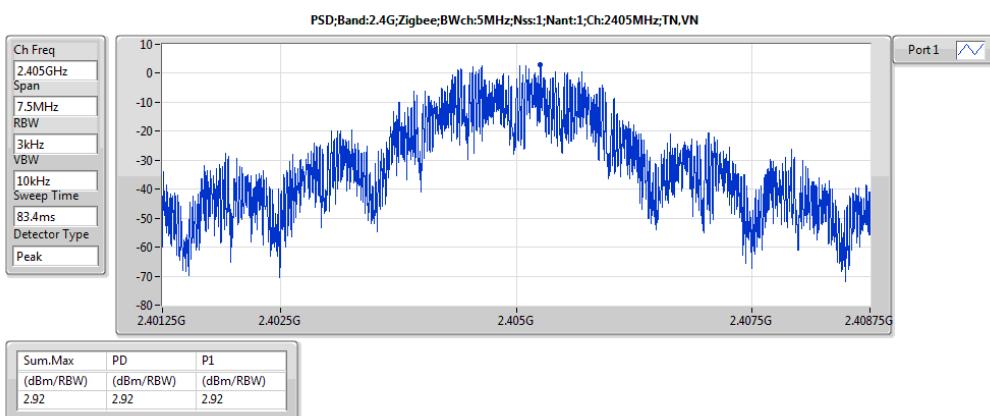
Mode	Result	DG (dBi)	EIRP (dBm)	EIRP Lim. (dBm)	Sum (dBm)	Sum Lim. (dBm)	P1 (dBm)
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	-0.08	17.83	36.00	17.91	30.00	17.91
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	-0.08	16.76	36.00	16.84	30.00	16.84
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	-0.08	15.43	36.00	15.51	30.00	15.51

**Summary**

Mode	PD (dBm/RBW)	EIRP.PD (dBm/RBW)
2.4G;Zigbee;5;1;1	2.92	2.84

**Result**

Mode	Result	Meas.RBW (Hz)	Lim.RBW (Hz)	BWCF (dB)	DG (dBi)	Sum.Max (dBm/RBW)	PD (dBm/RBW)	PD.Limit (dBm/RBW)	EIRP.PD (dBm/RBW)	EIRP.PD.Li m (dBm/RBW)	P1 (dBm/RBW)
2.4G;Zigbee;5;1;1:2405;L;TN,VN	Pass	3k	3k	0.00	-0.08	2.92	2.92	8.00	2.84	Inf	2.92
2.4G;Zigbee;5;1;1:2440;M;TN,VN	Pass	3k	3k	0.00	-0.08	2.12	2.12	8.00	2.04	Inf	2.12
2.4G;Zigbee;5;1;1:2475;H;TN,VN	Pass	3k	3k	0.00	-0.08	0.86	0.86	8.00	0.78	Inf	0.86



**Summary**

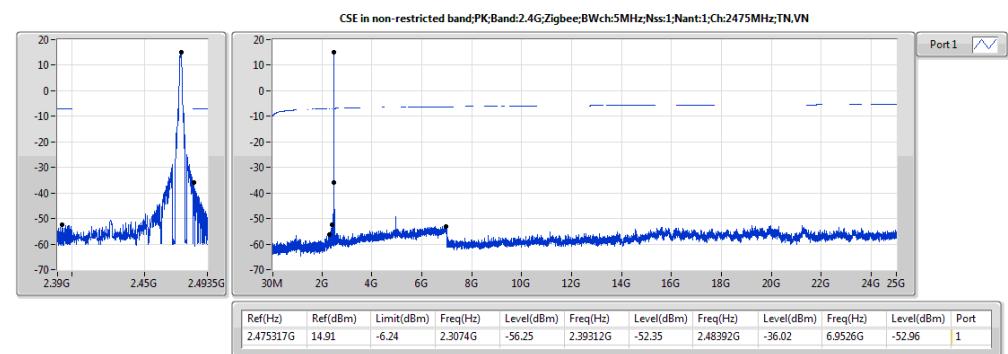
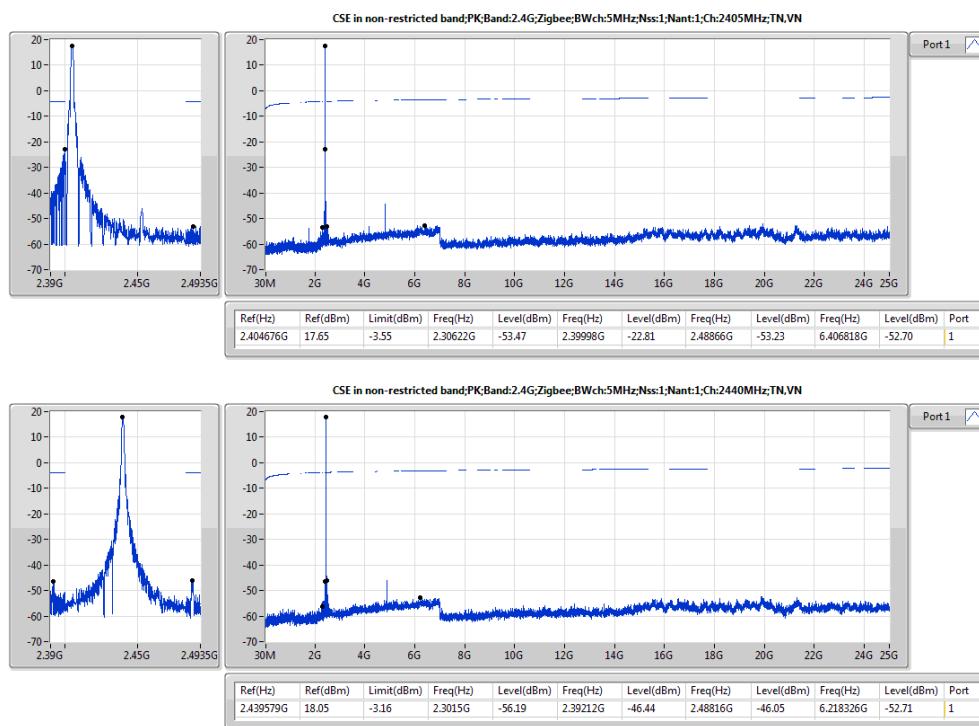
Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Port						
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	2.404676G	17.65	-2.35	2.30622G	-53.47	2.39998G	-22.81	2.48866G	-53.23	6.406818G	-52.70	1

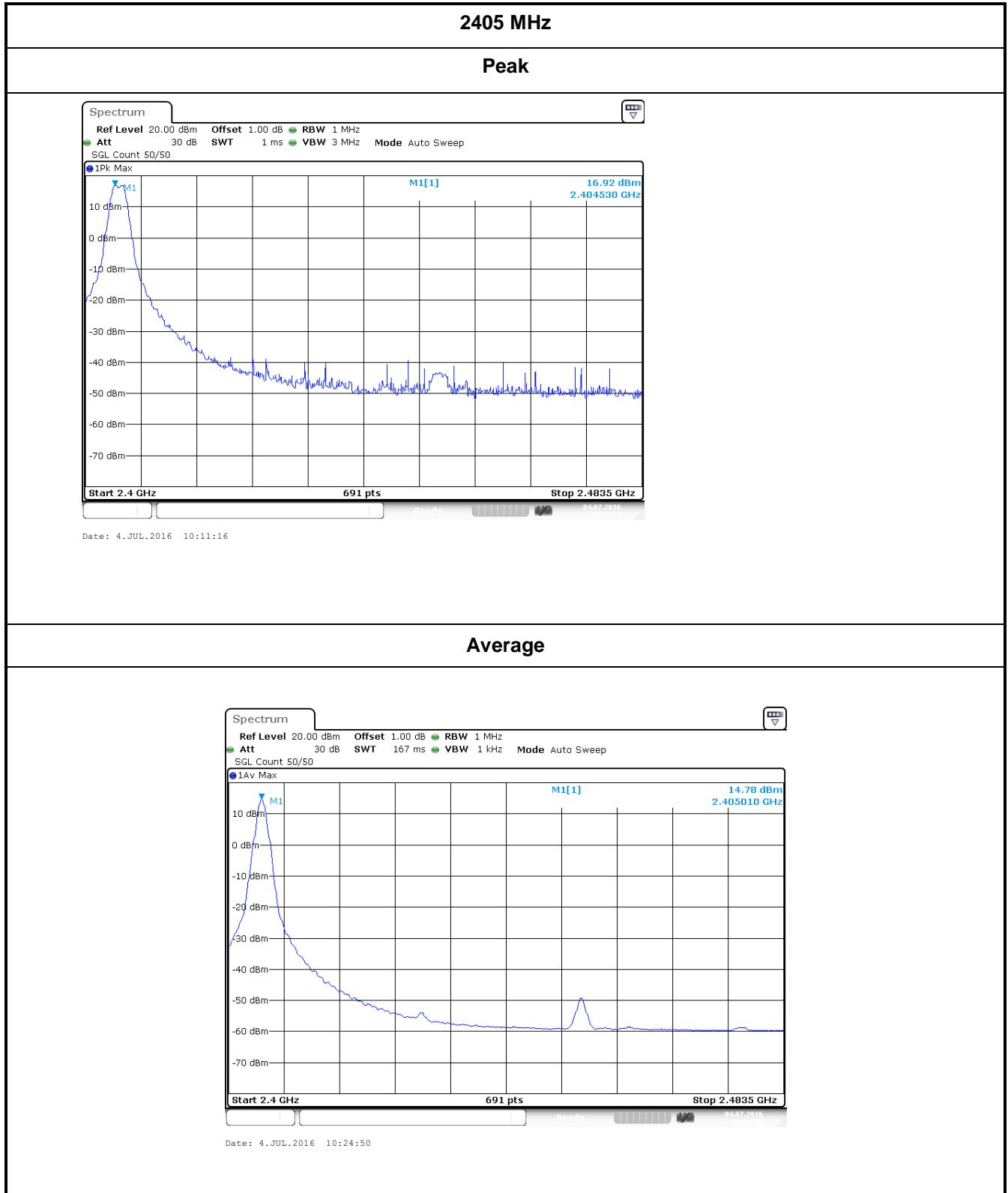
**Result**

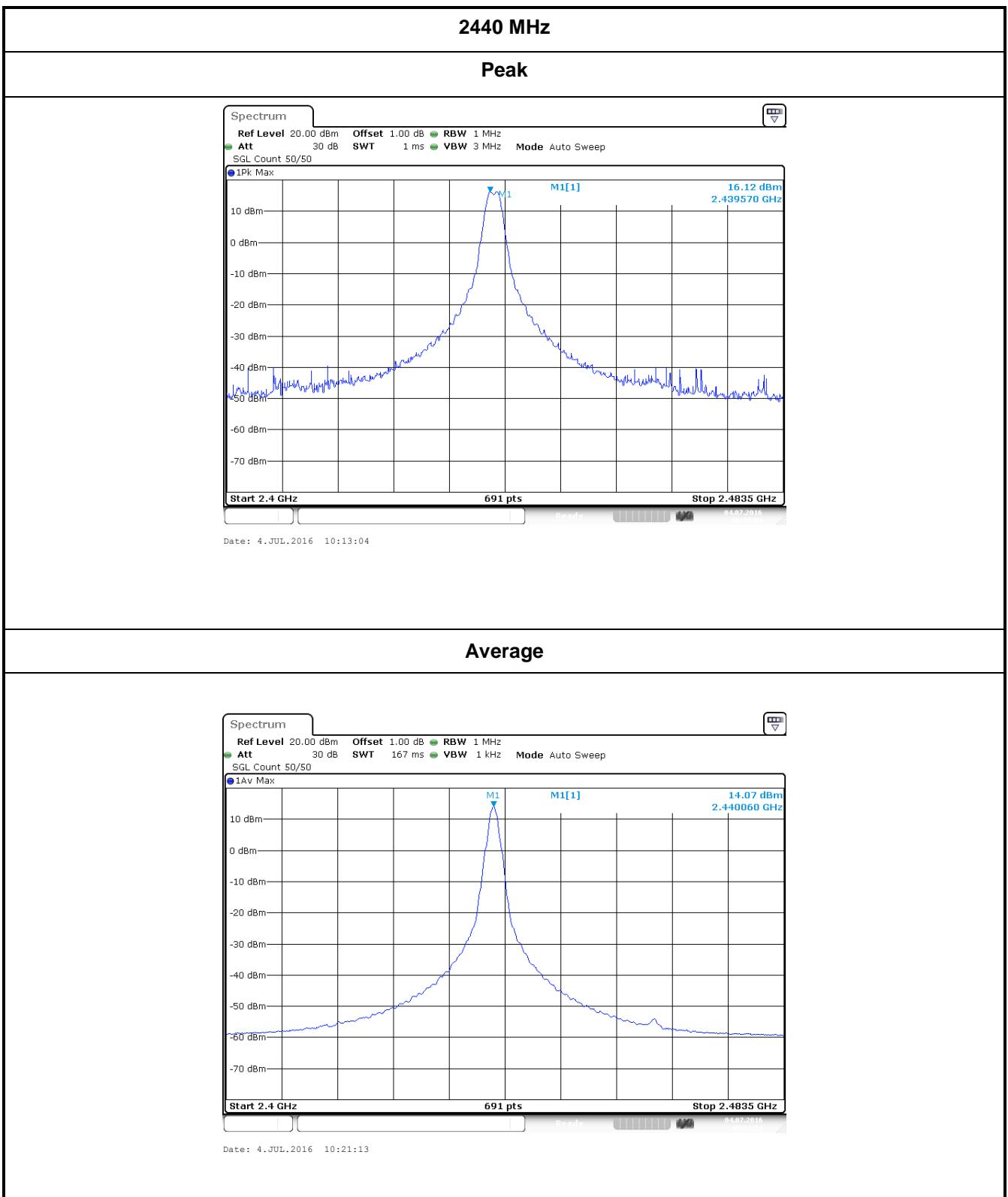
Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Port						
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	2.404676G	17.65	-2.35	2.30622G	-53.47	2.39998G	-22.81	2.48866G	-53.23	6.406818G	-52.70	1
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	2.439579G	18.05	-1.95	2.3015G	-56.19	2.39212G	-46.44	2.48816G	-46.05	6.218326G	-52.71	1
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	2.475317G	14.91	-5.09	2.3074G	-56.25	2.39312G	-52.35	2.48392G	-36.02	6.9526G	-52.96	1

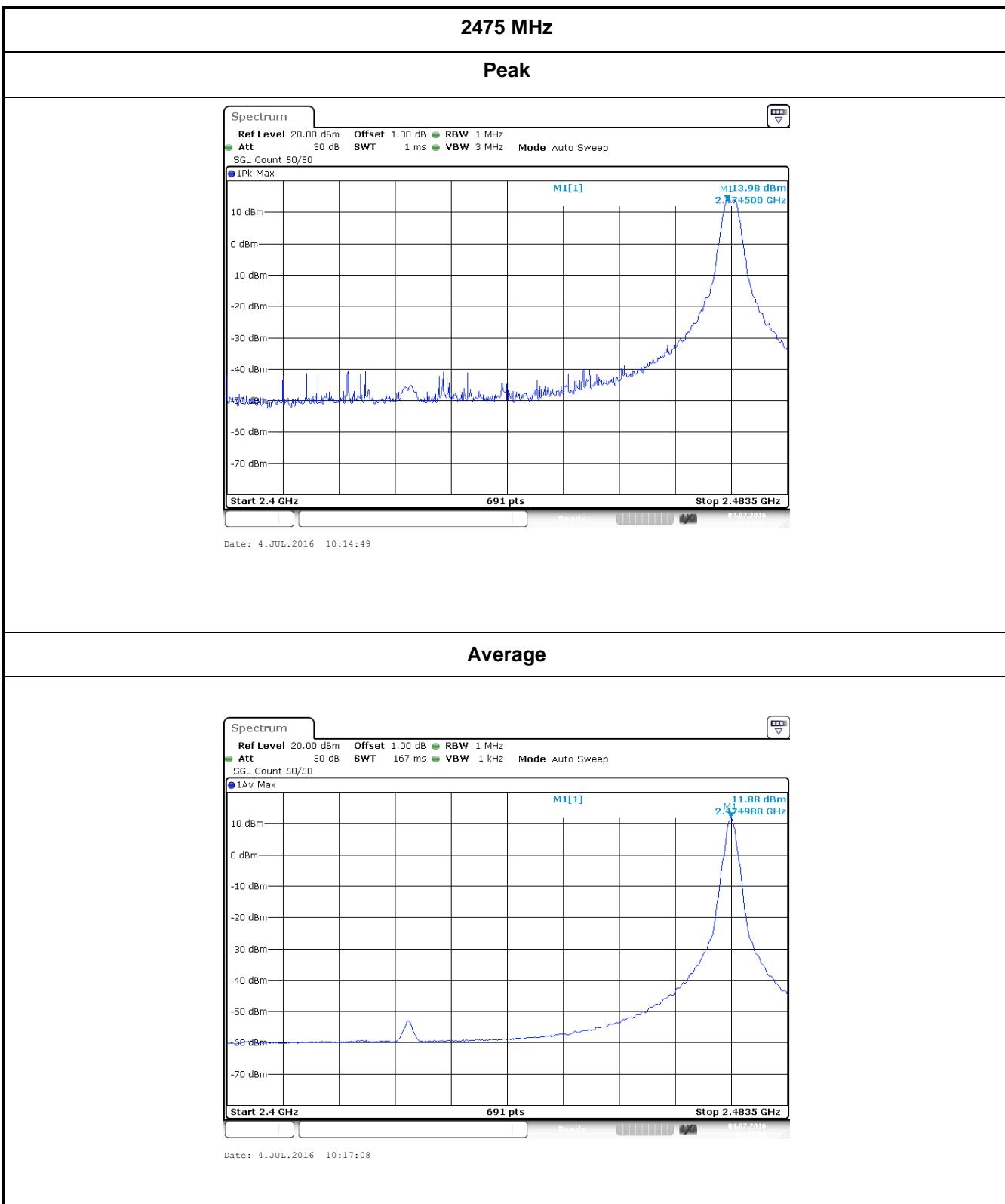
## CSEndB Result

## Appendix D









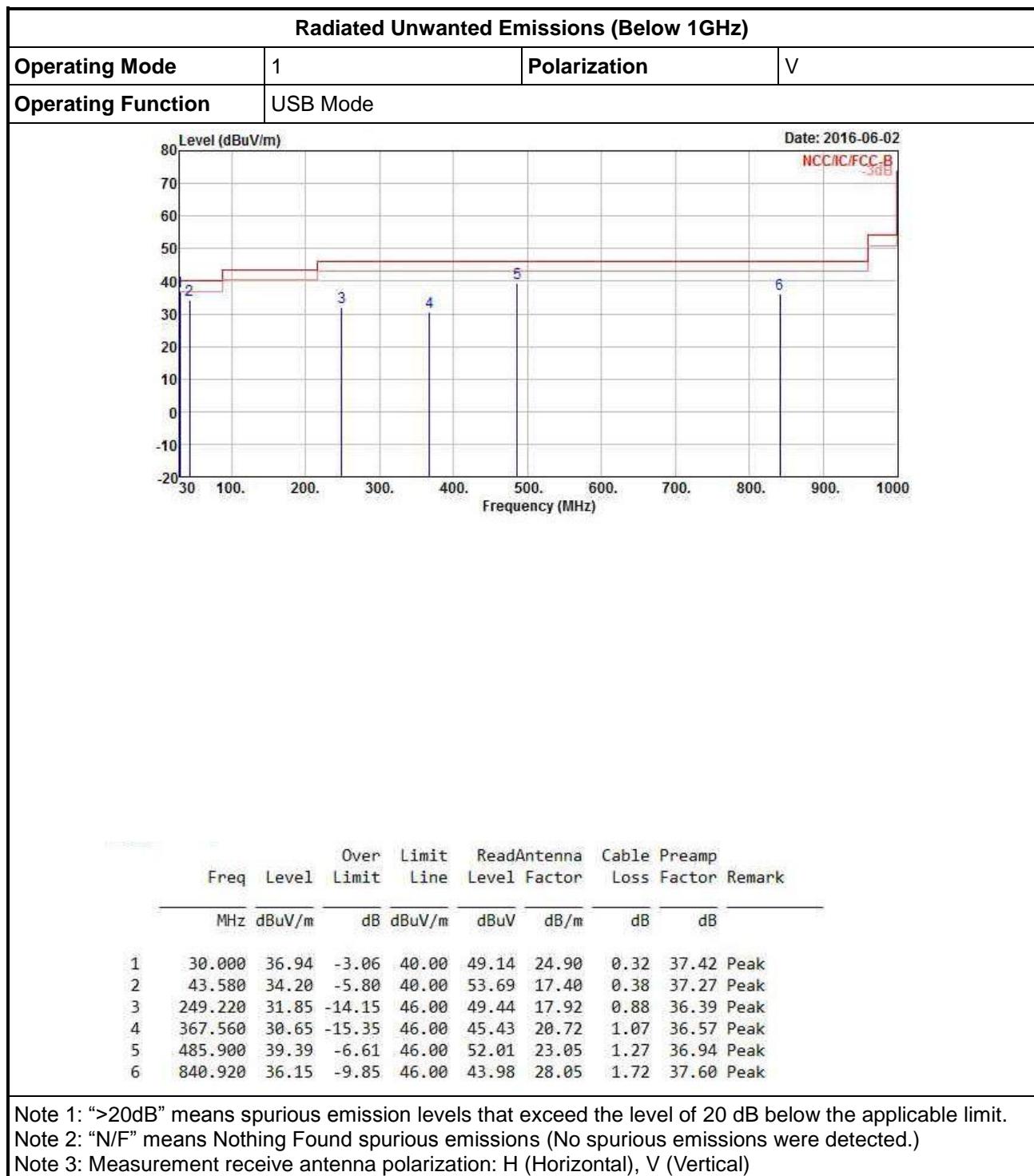
**Summary**

Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Type	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Margin (dB)	DG (dBi)	Loss (dB)	Refl (dB)	Psum (dBm)	P1 (dBm)
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	2.4835G	2.4935G	1M	AV	2.48352G	-41.83	-41.30	-0.53	2.00	1.00	0.00	-43.83	-43.83

**Result**

Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Type	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Margin (dB)	DG (dBi)	Loss (dB)	Refl (dB)	Psum (dBm)	P1 (dBm)
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	1G	2.39G	1M	PK	2.39G	-34.84	-21.30	-13.54	2.00	1.00	0.00	-36.84	-36.84
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	2.4835G	2.4935G	1M	PK	2.48466G	-38.56	-21.30	-17.26	2.00	1.00	0.00	-40.56	-40.56
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	2.4935G	25G	1M	PK	4.808856G	-35.97	-21.30	-14.67	2.00	1.94	0.00	-37.97	-37.97
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	1G	2.39G	1M	AV	2.39G	-48.13	-41.30	-6.83	2.00	1.00	0.00	-50.13	-50.13
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	2.4835G	2.4935G	1M	AV	2.48426G	-62.83	-41.30	-21.53	2.00	1.00	0.00	-64.83	-64.83
2.4G;Zigbee;5;1;1;2405;L;TN,VN	Pass	2.4935G	25G	1M	AV	4.808856G	-43.45	-41.30	-2.15	2.00	1.94	0.00	-45.45	-45.45
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	1G	2.39G	1M	PK	2.39G	-37.93	-21.30	-16.63	2.00	1.00	0.00	-39.93	-39.93
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	2.4835G	2.4935G	1M	PK	2.48434G	-38.26	-21.30	-16.96	2.00	1.00	0.00	-40.26	-40.26
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	2.4935G	25G	1M	PK	4.879189G	-38.55	-21.30	-17.25	2.00	1.96	0.00	-40.55	-40.55
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	1G	2.39G	1M	AV	2.34552G	-54.80	-41.30	-13.50	2.00	1.00	0.00	-56.80	-56.80
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	2.39G	2.4G	1M	AV	2.39G	-60.85	-41.30	-19.55	2.00	1.00	0.00	-62.85	-62.85
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	2.4835G	2.4935G	1M	AV	2.48802G	-47.32	-41.30	-6.02	2.00	1.00	0.00	-49.32	-49.32
2.4G;Zigbee;5;1;1;2440;M;TN,VN	Pass	2.4935G	25G	1M	AV	4.879189G	-45.04	-41.30	-3.74	2.00	1.96	0.00	-47.04	-47.04
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	1G	2.39G	1M	PK	2.39G	-38.51	-21.30	-17.21	2.00	1.00	0.00	-40.51	-40.51
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	2.4835G	2.4935G	1M	PK	2.48356G	-29.38	-21.30	-8.08	2.00	1.00	0.00	-31.38	-31.38
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	2.4935G	25G	1M	PK	4.949522G	-39.51	-21.30	-18.21	2.00	1.99	0.00	-41.51	-41.51
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	1G	2.39G	1M	AV	2.38166G	-56.01	-41.30	-14.71	2.00	1.00	0.00	-58.01	-58.01
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	2.39G	2.4G	1M	AV	2.39G	-62.05	-41.30	-20.75	2.00	1.00	0.00	-64.05	-64.05
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	2.4835G	2.4935G	1M	AV	2.48352G	-41.83	-41.30	-0.53	2.00	1.00	0.00	-43.83	-43.83
2.4G;Zigbee;5;1;1;2475;H;TN,VN	Pass	2.4935G	25G	1M	AV	4.949522G	-46.86	-41.30	-5.56	2.00	1.99	0.00	-48.86	-48.86

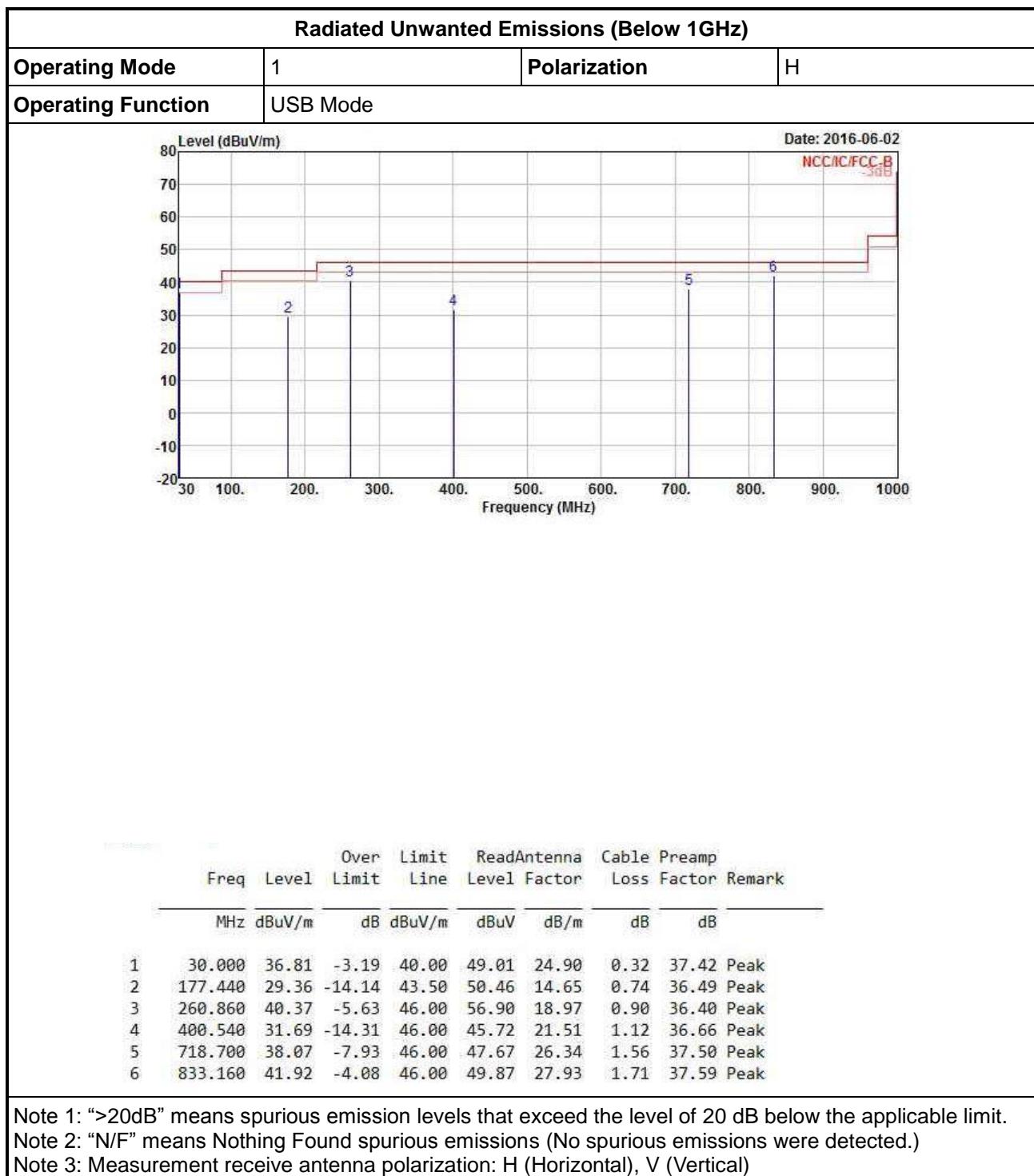


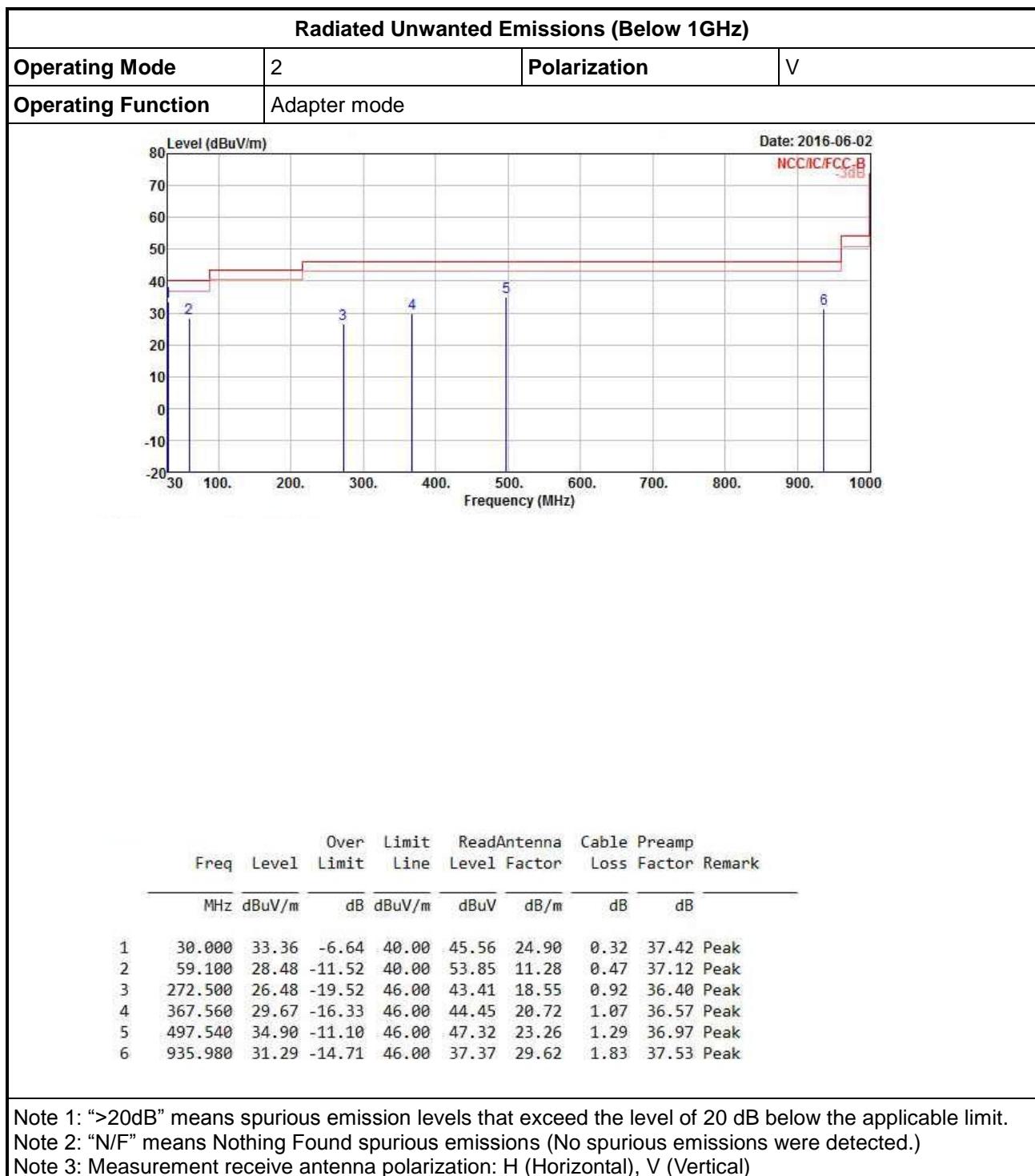
**Transmitter Radiated Unwanted Emissions (Below 1GHz)**


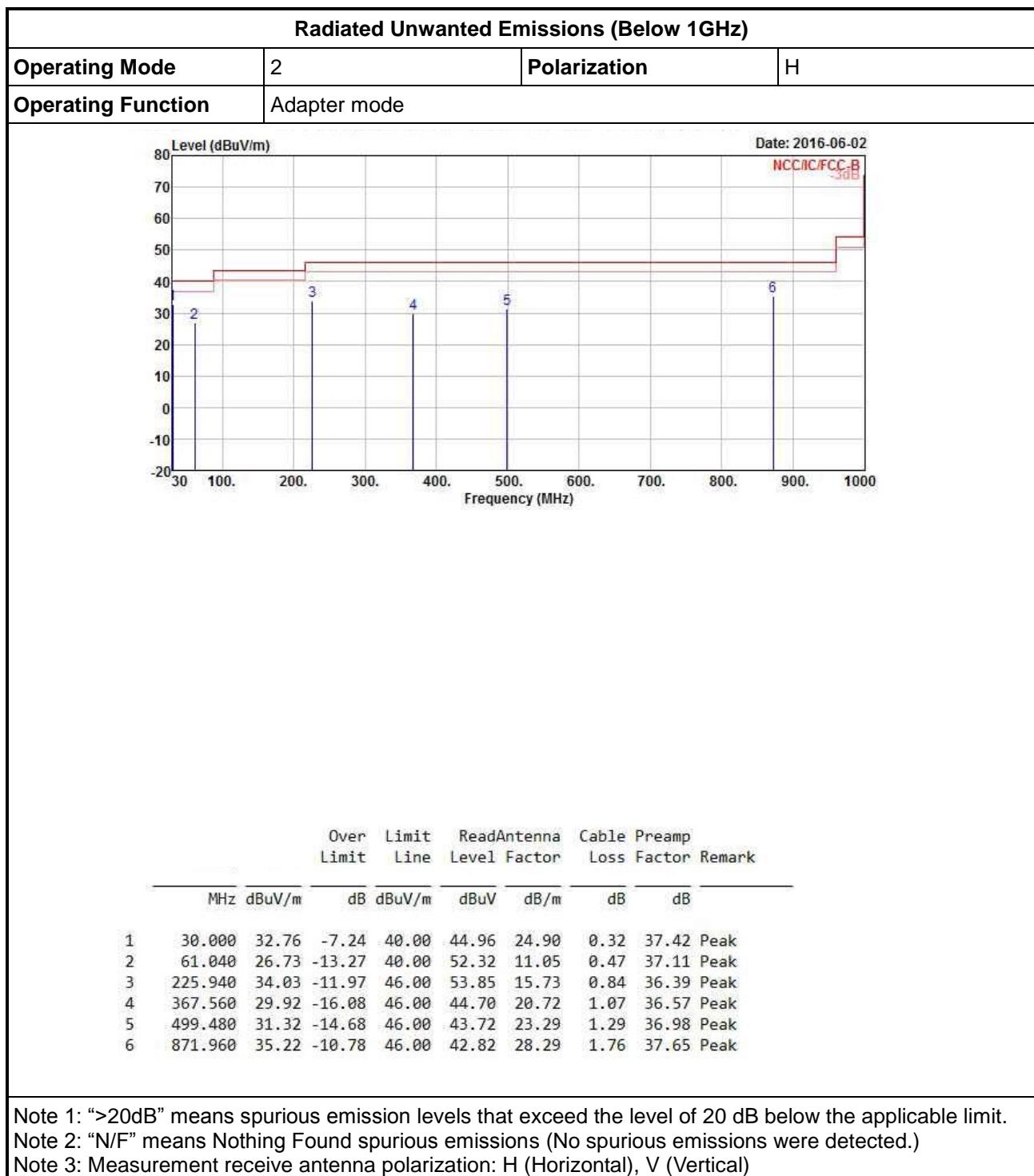
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Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)



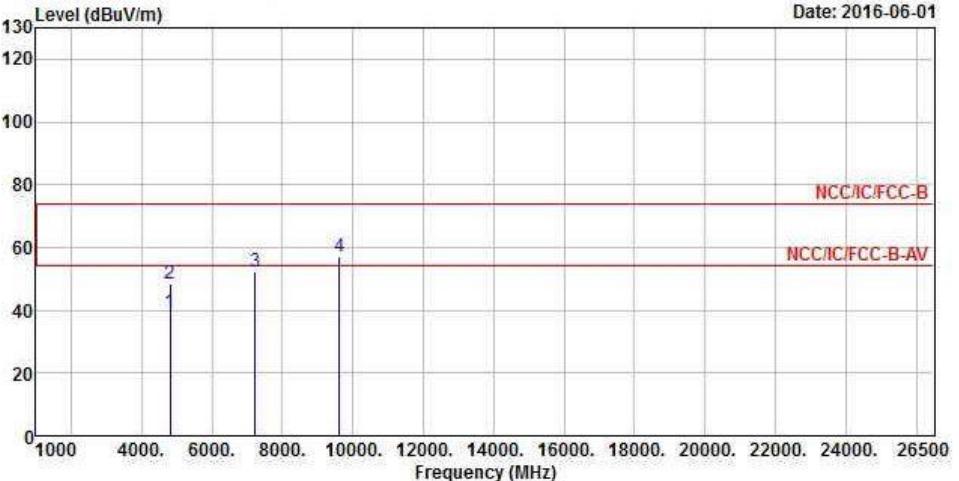






## Transmitter Radiated Unwanted Emissions (Above 1GHz)

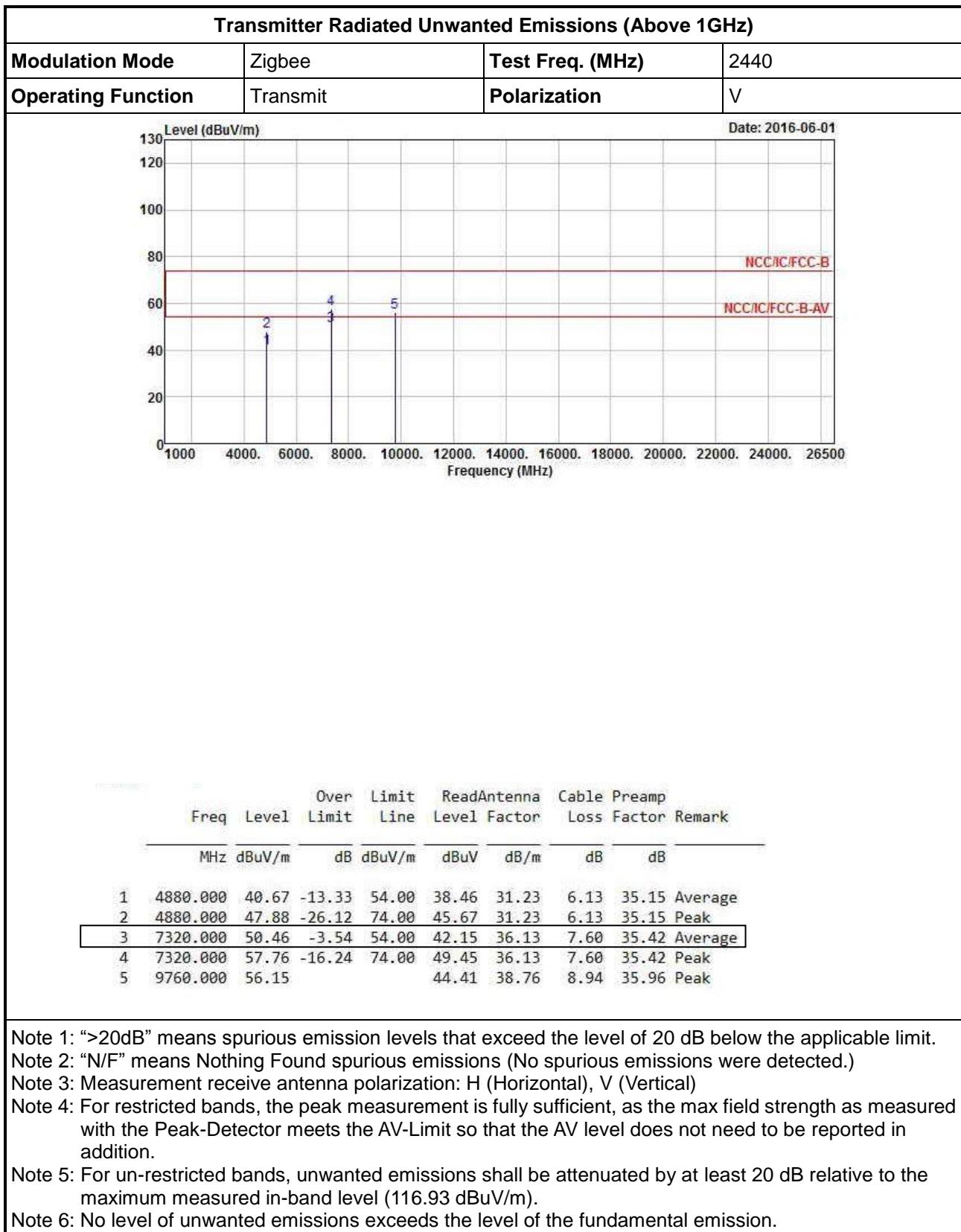
## Transmitter Radiated Unwanted Emissions (Above 1GHz)

Modulation Mode	Zigbee		Test Freq. (MHz)	2405					
Operating Function	Transmit		Polarization	V					
Level (dB <sub>B</sub> V/m)							Date: 2016-06-01		
									
Over Limit Read Antenna Cable Preamp									
Freq	Level	Limit	Line	Antenna	Level	Factor	Remark		
	MHz	dB <sub>B</sub> V/m	dB	dB <sub>B</sub> V/m	dB <sub>B</sub> V	dB/m	dB	dB	
1	4810.000	39.18	-14.82	54.00	37.10	31.13	6.11	35.16 Average	
2	4810.000	48.29	-25.71	74.00	46.21	31.13	6.11	35.16 Peak	
3	7215.000	52.53			44.52	35.86	7.56	35.41 Peak	
4	9620.000	57.28			45.81	38.67	8.75	35.95 Peak	

Note 1: ">20dB" means spurious emission levels that exceed the level of 20 dB below the applicable limit.  
 Note 2: "N/F" means Nothing Found spurious emissions (No spurious emissions were detected.)  
 Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)  
 Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.  
 Note 5: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level (117.76 dB<sub>B</sub>V/m).  
 Note 6: No level of unwanted emissions exceeds the level of the fundamental emission.



Transmitter Radiated Unwanted Emissions (Above 1GHz)																																																																					
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Operating Function	Transmit			Polarization		H																																																																									
Level (dBuV/m)									Date: 2016-06-01																																																																						
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