

# FC

## Test Report

Product Name	2.4G NRM
Model No	319-NRM001
FCC ID.	YKH319-NRM001

Applicant	NUMA Electronics Inc.
Address	7F.-8, No.107, Sec. 1, Zhongshan Rd., Xinzhuang Dist., New Taipei City 242, Taiwan (R.O.C.)

Date of Receipt	Oct. 18, 2011
Issue Date	Nov. 22, 2012
Report No.	12A306R-RFUSP42V01
Report Version	V1.0



The test results relate only to the samples tested.

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# Test Report Certification

Issue Date: Nov. 22, 2012

Report No.: 12A306R-RFUSP42V01


**Accredited by NIST (NVLAP)**

NVLAP Lab Code: 200533-0

Product Name	2.4G NRM
Applicant	NUMA Electronics Inc.
Address	7F.-8, No.107, Sec. 1, Zhongshan Rd., Xinzhuang Dist., New Taipei City 242, Taiwan (R.O.C.)
Manufacturer	NUMA Electronics Inc.
Model No.	319-NRM001
EUT Rated Voltage	DC 1.9V~3.6V
EUT Test Voltage	DC 5V(Power by USB)
Trade Name	NUMA
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2010 ANSI C63.4: 2003, ANSI C63.10: 2009
Test Result	Complied

The test results relate only to the samples tested.

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## 1. GENERAL INFORMATION

### 1.1. EUT Description

Product Name	2.4G NRM
Trade Name	NUMA
Model No.	319-NRM001
FCC ID.	YKH319-NRM001
Frequency Range	2405~2470MHz
Channel Separation	3-24 MHz
Channel Number	10
Type of Modulation	GFSK
Antenna Type	Printed on PCB
Antenna Gain	Refer to the table “Antenna List”
Channel Control	Auto

#### Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	NUMA	N/A	Printed on PCB antenna	-2.7 dBi for 2.4 GHz

Note: The antenna of EUT is conform to FCC 15.203

#### Center Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 05:	2405MHz	Channel 08:	2408MHz	Channel 11:	2411 MHz	Channel 32:	2432 MHz
Channel 35:	2435MHz	Channel 39:	2439MHz	Channel 41:	2441 MHz	Channel 65:	2465 MHz
Channel 68:	2468 MHz	Channel 70:	2470 MHz				

#### Note:

1. The EUT is a 2.4G NRM with a built-in 2.4GHz transceiver.
2. This module is "Limited Modular Approval" (LMA).
3. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.
4. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.
5. These tests are conducted on a sample for the purpose of demonstrating compliance of 2.4GHz transmitter with Part 15 Subpart C Paragraph 15.247 of spread spectrum devices

Test Mode:	Mode 1: Transmit
------------	------------------

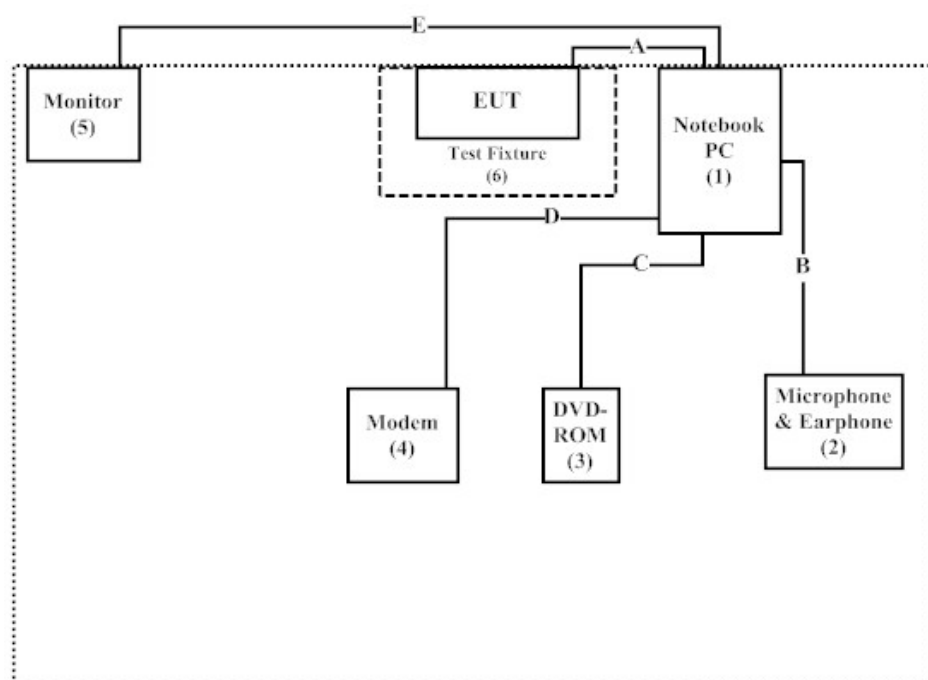
### 1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	FCC ID	Power Cord
1 Notebook PC	DELL	PPT	N/A	DoC	Non-Shielded, 0.8m
2 Microphone & Earphone	PCHOME	N/A	N/A	N/A	N/A
3 DVD-ROM	DELL	PD01S	P0690 A01	N/A	N/A
4 Modem	ACEEX	DM-1414	0102027536	N/A	Non-Shielded, 1.8m
5 Monitor	LG	W2261VT	907YHZK07373	N/A	Non-Shielded, 1.8m
6 Test Fixture	Numa Electronics Inc	KC-52002B	N/A	N/A	N/A

Signal Cable Type	Signal cable Description
A USB to USB Cable	Non-Shielded, 0.5m
B Microphone & Earphone Cable	Non-Shielded, 1m
C DVD-ROM Cable	Shielded, 0.5m
D Modem Cable	Shielded, 1.5m
E VGA Cable	Shielded, 1.8m, with two ferrite cores bonded.

### 1.4. Configuration of Tested System



## **1.5. EUT Exercise Software**

- (1) Setup the EUT as shown in section 1.4.
- (2) Press and hold the button.
- (3) Start transmits continually.
- (4) Verify that the EUT works properly.



## 1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	50-65
Barometric pressure (mbar)	860-1060	950-1000

The related certificate for our laboratories about the test site and management system can be downloaded from

Quietek Corporation's Web Site : <http://tw.quietek.com/tw/emc/accreditations/accreditations.htm>

The address and introduction of Quietek Corporation's laboratories can be founded in our Web site :

<http://www.quietek.com/>

Site Description: File on  
Federal Communications Commission  
FCC Engineering Laboratory  
7435 Oakland Mills Road  
Columbia, MD 21046  
Registration Number: 92195

Accreditation on NVLAP  
NVLAP Lab Code: 200533-0

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E-Mail : [service@quietek.com](mailto:service@quietek.com)

FCC Accreditation Number: TW1014

## 2. Conducted Emission

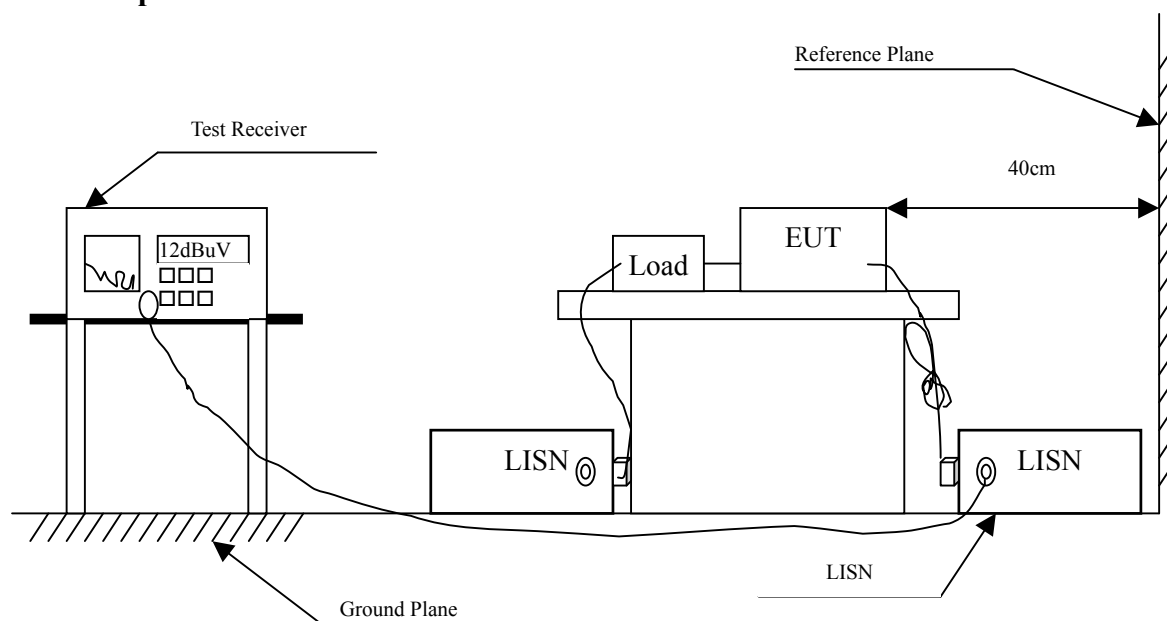
### 2.1. Test Equipment

	Equipment	Manufacturer	Model No. / Serial No.	Last Cal.	Remark
X	Test Receiver	R & S	ESCS 30 / 825442/018	Sep., 2012	
X	Artificial Mains Network	R & S	ENV4200 / 848411/10	Feb., 2012	Peripherals
X	LISN	R & S	ESH3-Z5 / 825562/002	Feb., 2012	EUT
	DC LISN	Schwarzbeck	8226 / 176	Mar, 2012	EUT
X	Pulse Limiter	R & S	ESH3-Z2 / 357.8810.52	Feb., 2012	
	No.1 Shielded Room				

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked by "X" are used to measure the final test results.

### 2.2. Test Setup



### 2.3. Limits

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

### 2.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2003 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

### 2.5. Uncertainty

± 2.26 dB

## 2.6. Test Result of Conducted Emission

Product : 2.4G NRM  
Test Item : Conducted Emission Test  
Power Line : Line 1  
Test Mode : Mode 1: Transmit

Frequency MHz	Correct Factor dB	Reading Level dBuV	Measurement Level dBuV	Margin dB	Limit dBuV
<b>LINE 1</b>					
<b>Quasi-Peak</b>					
0.170	9.830	25.030	34.860	-30.569	65.429
0.502	9.830	19.880	29.710	-26.290	56.000
0.588	9.830	17.870	27.700	-28.300	56.000
2.087	9.840	18.470	28.310	-27.690	56.000
4.763	9.865	16.630	26.495	-29.505	56.000
15.908	10.110	23.180	33.290	-26.710	60.000
<b>Average</b>					
0.170	9.830	24.040	33.870	-21.559	55.429
0.502	9.830	19.170	29.000	-17.000	46.000
0.588	9.830	14.520	24.350	-21.650	46.000
2.087	9.840	17.300	27.140	-18.860	46.000
4.763	9.865	11.570	21.435	-24.565	46.000
15.908	10.110	11.650	21.760	-28.240	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : 2.4G NRM  
 Test Item : Conducted Emission Test  
 Power Line : Line 2  
 Test Mode : Mode 1: Transmit

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV	dB	dBuV
<b>LINE 2</b>					
<b>Quasi-Peak</b>					
0.166	9.838	27.970	37.808	-27.735	65.543
0.252	9.830	23.010	32.840	-30.246	63.086
0.502	9.840	26.460	36.300	-19.700	56.000
2.091	9.860	21.810	31.670	-24.330	56.000
6.959	9.948	14.710	24.658	-35.342	60.000
20.716	10.300	19.610	29.910	-30.090	60.000
<b>Average</b>					
0.166	9.838	25.900	35.738	-19.805	55.543
0.252	9.830	22.740	32.570	-20.516	53.086
0.502	9.840	26.110	35.950	-10.050	46.000
2.091	9.860	21.670	31.530	-14.470	46.000
6.959	9.948	5.890	15.838	-34.162	50.000
20.716	10.300	12.120	22.420	-27.580	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

### 3. Peak Power Output

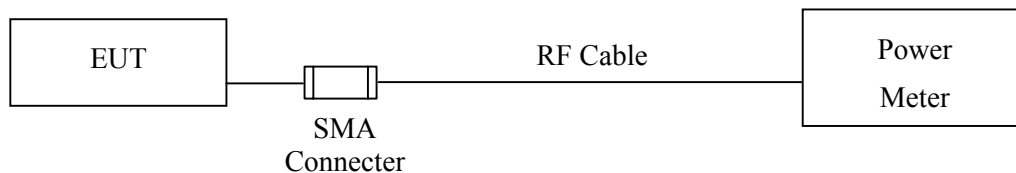
#### 3.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Power Meter	Anritsu	ML2495A/6K00003357	May, 2012
X	Power Sensor	Anritsu	MA2411B/0738448	Jun, 2012

Note: 1. All instruments are calibrated every one year.  
2. The test instruments marked by “X” are used to measure the final test results.

#### 3.2. Test Setup

Conducted Measurement



#### 3.3. Limits

The maximum peak power shall be less 1 Watt.

#### 3.4. Test Procedure

The EUT was tested according to DTS test procedure of ANSI C63.10: 2009 for compliance to FCC 47CFR 15.247 requirements.

#### 3.5. Uncertainty

$\pm 1.27$  dB

### 3.6. Test Result of Peak Power Output

Product : 2.4G NRM  
 Test Item : Peak Power Output Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
05	2405.00	-2.56	<30dBm	Pass
41	2441.00	-3.28	<30dBm	Pass
70	2470.00	-3.85	<30dBm	Pass

Note: Peak Power Output Value = Reading value on power meter + cable loss

## 4. Radiated Emission

### 4.1. Test Equipment

The following test equipment are used during the radiated emission test:

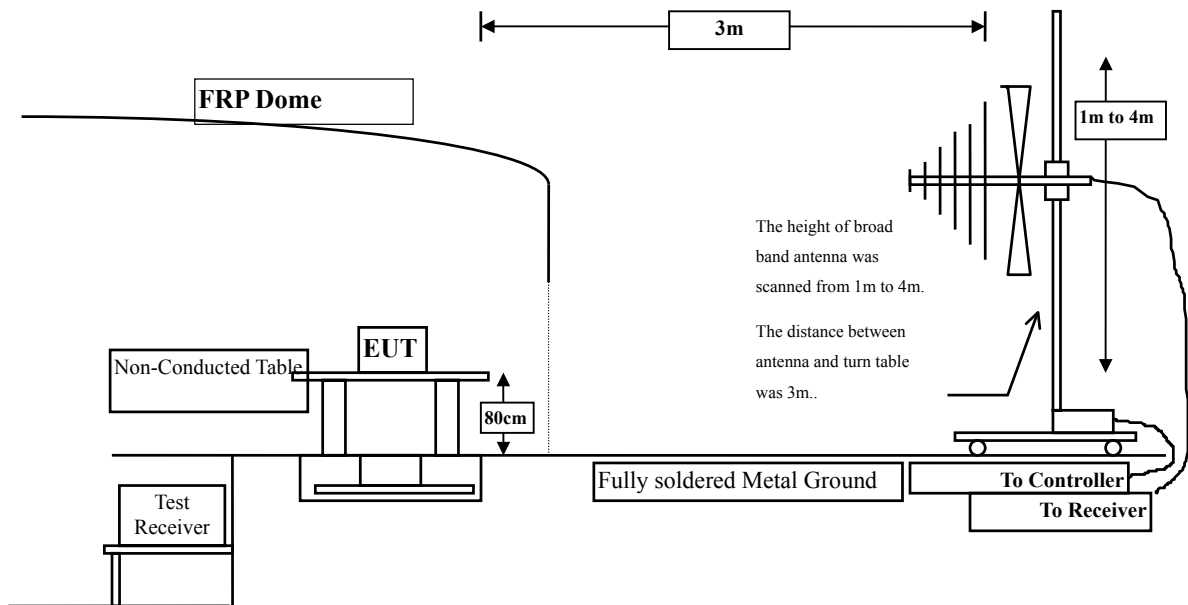
Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
<input checked="" type="checkbox"/> Site # 3	X	Bilog Antenna	Schaffner Chase	CBL6112B/2673	Sep., 2012
	X	Horn Antenna	Schwarzbeck	BBHA9120D/D305	Sep., 2012
	X	Horn Antenna	Schwarzbeck	BBHA9170/208	Jul., 2012
	X	Pre-Amplifier	QTK	QTK-AMP-03 / 0003	May, 2012
	X	Pre-Amplifier	QTK	AP-180C / CHM 0906076	Sep., 2012
	X	Pre-Amplifier	MITEQ	AMF-4D-180400-45-6P/ 925975	Mar, 2012
	X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2012
	X	Test Receiver	R & S	ESCS 30/ 825442/018	Sep., 2012
	X	Coaxial Cable	QuieTek	QTK-CABLE/ CAB5	Feb., 2012
	X	Controller	QuieTek	QTK-CONTROLLER/ CTRL3	N/A
	X	Coaxial Switch	Anritsu	MP59B/6200265729	N/A

- Note:
1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
  2. The test instruments marked with "X" are used to measure the final test results.

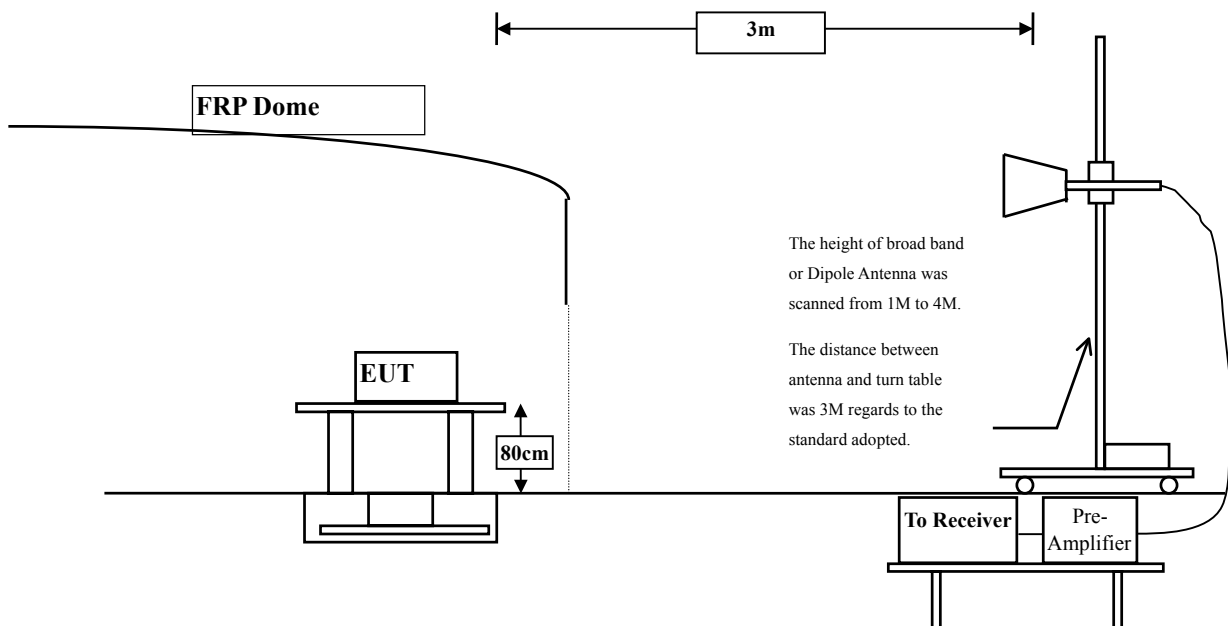


## 4.2. Test Setup

### Radiated Emission Below 1GHz



### Radiated Emission Above 1GHz



#### 4.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits		
Frequency MHz	uV/m @3m	dBuV/m@3m
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Remarks: E field strength (dBuV/m) = 20 log E field strength (uV/m)

#### 4.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2003 and tested according to DTS test procedure of ANSI C63.10: 2009 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4:2003 on radiated measurement.

The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

Radiated emission measurements below 1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The worst radiated emission is measured in the Open Area Test Site on the Final Measurement. The measurement frequency range from 30MHz - 10th Harmonic of fundamental was investigated.

#### 4.5. Uncertainty

± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

#### 4.6. Test Result of Radiated Emission

Product : 2.4G NRM  
Test Item : Harmonic Radiated Emission Data  
Test Site : No.3 OATS  
Test Mode : Mode 1: Transmit (2405MHz)

Frequency	Correct	Reading	Measurement	Margin	Limit
	Factor	Level	Level		
MHz	dB	dBuV	dBuV/m	dB	dBuV/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
4810.000	3.323	46.560	49.883	-24.117	74.000
7215.000	10.289	43.500	53.790	-20.210	74.000
9620.000	13.595	37.710	51.306	-22.694	74.000
<b>Vertical</b>					
<b>Peak Detector:</b>					
4810.000	6.591	49.710	56.301	-17.699	74.000
7215.000	11.151	47.390	58.542	-15.458	74.000
9620.000	14.014	37.100	51.115	-22.885	74.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

**Average Detector:**

Frequency	Peak	Duty Cycle	Measurement	Margin	Limit
MHz	Measurement	Correct Factor	Level		
	dBuV/m	dB	dBuV/m	dB	dBuV/m
<b>Vertical</b>					
4810	56.301	-14.960	41.341	-12.659	54.000
7215	58.542	-14.960	43.582	-10.418	54.000

Note:

1. AVG Measurement=Peak Measurement - Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 9.

Product : 2.4G NRM  
Test Item : Harmonic Radiated Emission Data  
Test Site : No.3 OATS  
Test Mode : Mode 1: Transmit (2441MHz)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
4882.000	3.001	45.540	48.541	-25.459	74.000
7323.000	11.846	42.060	53.907	-20.093	74.000
9764.000	12.563	35.980	48.543	-25.457	74.000
<b>Vertical</b>					
<b>Peak Detector:</b>					
4882.000	5.713	50.240	55.954	-18.046	74.000
7323.000	12.727	44.220	56.948	-17.052	74.000
9764.000	13.028	36.650	49.678	-24.322	74.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss –Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

**Average Detector:**

Frequency	Peak	Duty Cycle	Measurement	Margin	Limit
MHz	Measurement	Correct Factor	Level		
	dBuV/m	dB	dBuV/m	dB	dBuV/m
<b>Vertical</b>					
4882	55.594	-14.960	40.634	-13.366	54.000
7323	56.948	-14.960	41.988	-12.012	54.000

Note:

1. AVG Measurement=Peak Measurement - Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 9.

Product : 2.4G NRM  
 Test Item : Harmonic Radiated Emission Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit (2470MHz)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
4940.000	2.816	45.710	48.525	-25.475	74.000
7410.000	12.286	41.640	53.926	-20.074	74.000
9888.000	13.231	37.950	51.181	-22.819	74.000
<b>Vertical</b>					
<b>Peak Detector:</b>					
4940.000	5.538	50.600	56.137	-17.863	74.000
7410.000	13.386	43.590	56.976	-17.024	74.000
9888.000	13.833	38.330	52.164	-21.836	74.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

**Average Detector:**

Frequency	Peak	Duty Cycle	Measurement	Margin	Limit
MHz	Measurement	Correct Factor	Level		
	dBuV/m	dB	dBuV/m	dB	dBuV/m
<b>Vertical</b>					
4940	56.137	-14.960	41.177	-12.823	54.000
7410	56.976	-14.960	42.016	-11.984	54.000

Note:

1. AVG Measurement=Peak Measurement - Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 9.



Product : 2.4G NRM  
 Test Item : General Radiated Emission Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit (2441Hz)

Frequency	Correct	Reading	Measurement	Margin	Limit
MHz	Factor	Level	Level		
	dB	dBuV	dBuV/m	dB	dBuV/m
<b>Horizontal</b>					
167.740	-10.799	44.680	33.881	-9.619	43.500
507.240	0.759	34.330	35.089	-10.911	46.000
608.120	4.384	29.480	33.864	-12.136	46.000
664.380	2.062	34.156	36.218	-9.782	46.000
747.800	3.296	30.646	33.942	-12.058	46.000
809.880	5.049	27.731	32.780	-13.220	46.000
<b>Vertical</b>					
136.700	-5.143	37.744	32.601	-10.899	43.500
303.540	-6.794	35.482	28.688	-17.312	46.000
507.240	-0.471	32.204	31.733	-14.267	46.000
664.380	-1.918	34.834	32.916	-13.084	46.000
749.740	2.510	33.531	36.041	-9.959	46.000
932.100	6.152	24.468	30.620	-15.380	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

## 5. RF antenna conducted test

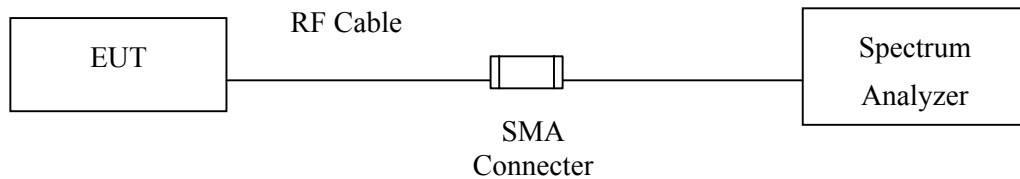
### 5.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2012
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2012
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2012

- Note:
1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
  2. The test instruments marked with “X” are used to measure the final test results.

### 5.2. Test Setup

#### RF antenna Conducted Measurement:



### 5.3. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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)).

#### **5.4. Test Procedure**

The EUT was tested according to DTS test procedure of ANSI C63.10: 2009 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Set VBW > RBW, scan up through 10th harmonic.

#### **5.5. Uncertainty**

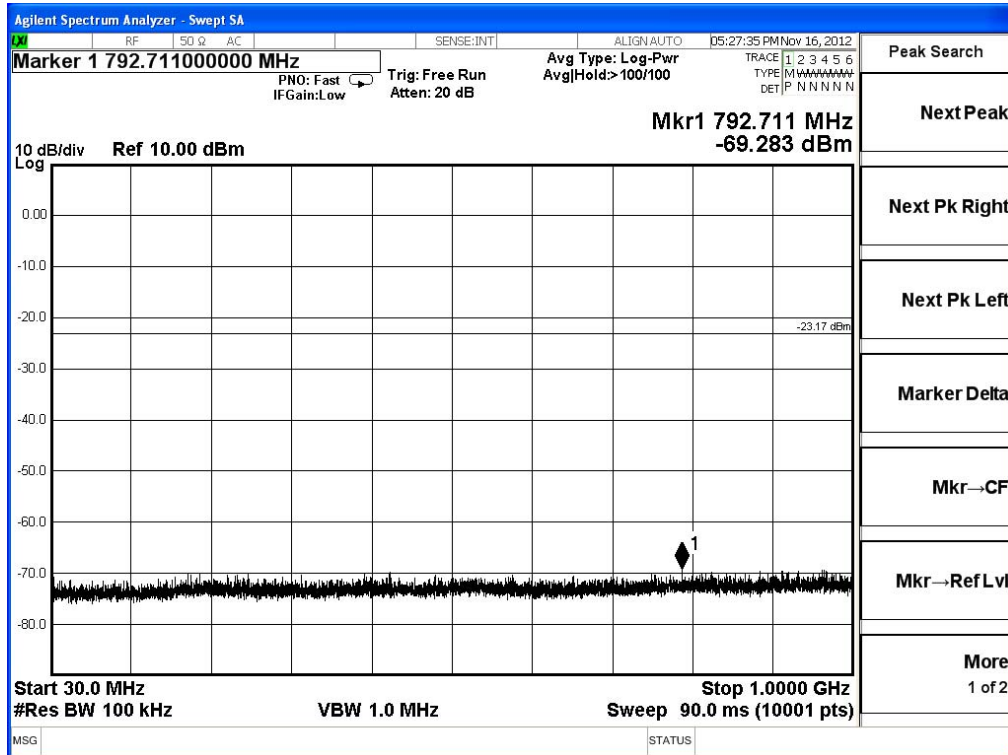
The measurement uncertainty

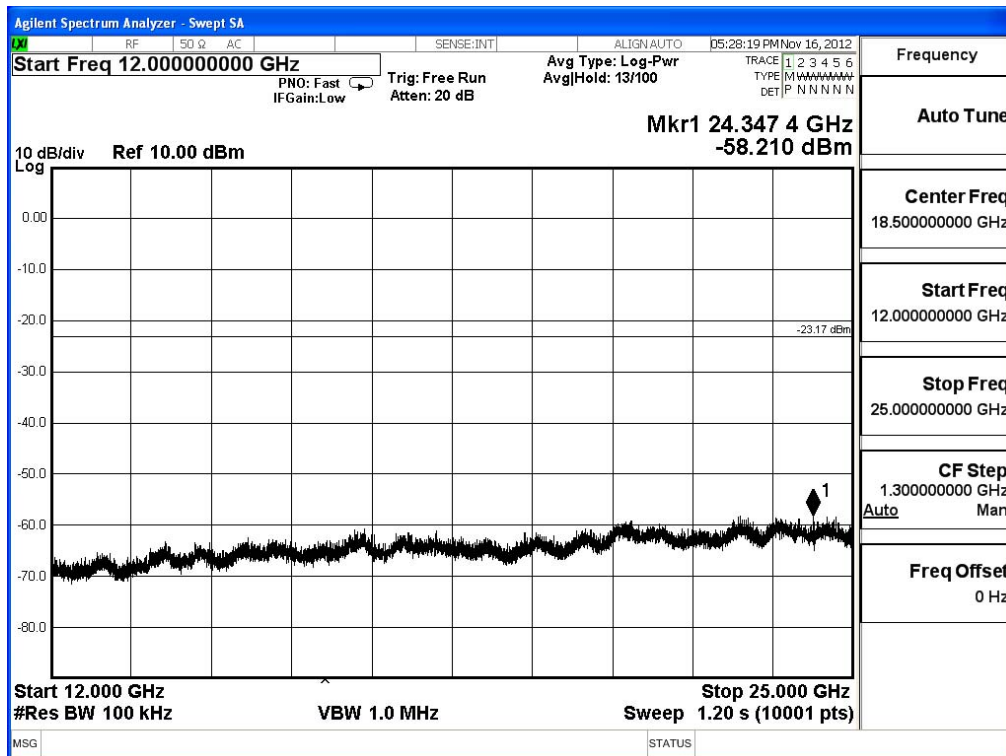
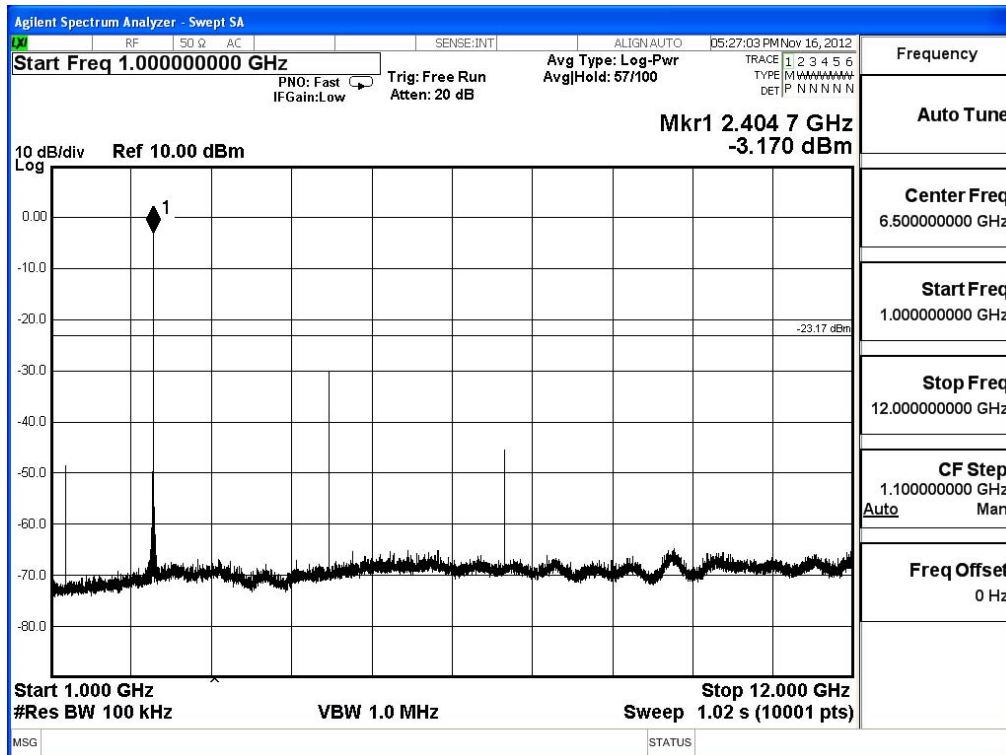
Conducted is defined as  $\pm 1.27\text{dB}$

## 5.6. Test Result of RF antenna conducted test

Product : 2.4G NRM  
 Test Item : RF antenna conducted test  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit

### Channel 05 (2405Hz)





Agilent Spectrum Analyzer - Swept SA

RF 50  $\Omega$  AC SENSE:INT ALIGN:AUTO 05:21:19 PM Nov 16, 2012

Marker 1 774.863000000 MHz

PNO: Fast IF Gain: Low Trig: Free Run Atten: 20 dB

Avg Type: Log-Pwr Avg/Hold: >100/100

TRACE 1 2 3 4 5 6  
TYPE M M M M M M M M  
DET P N N N N N N

Peak Search

Next Peak

Next Pk Right

Next Pk Left

Marker Delta

Mkr → CF

Mkr → Ref Lvl

More

1 of 2

10 dB/div Ref 10.00 dBm

Log

0.00

-10.0

-20.0

-30.0

-40.0

-50.0

-60.0

-70.0

-80.0

-23.59 dBm

1

Start 30.0 MHz

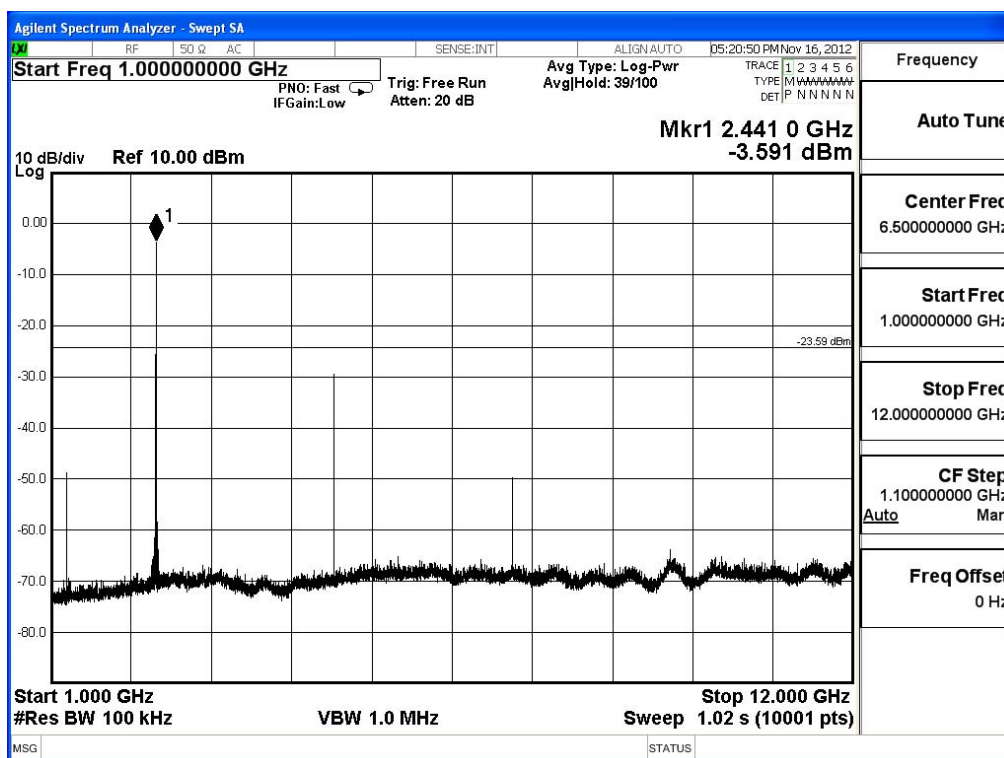
Stop 1.0000 GHz

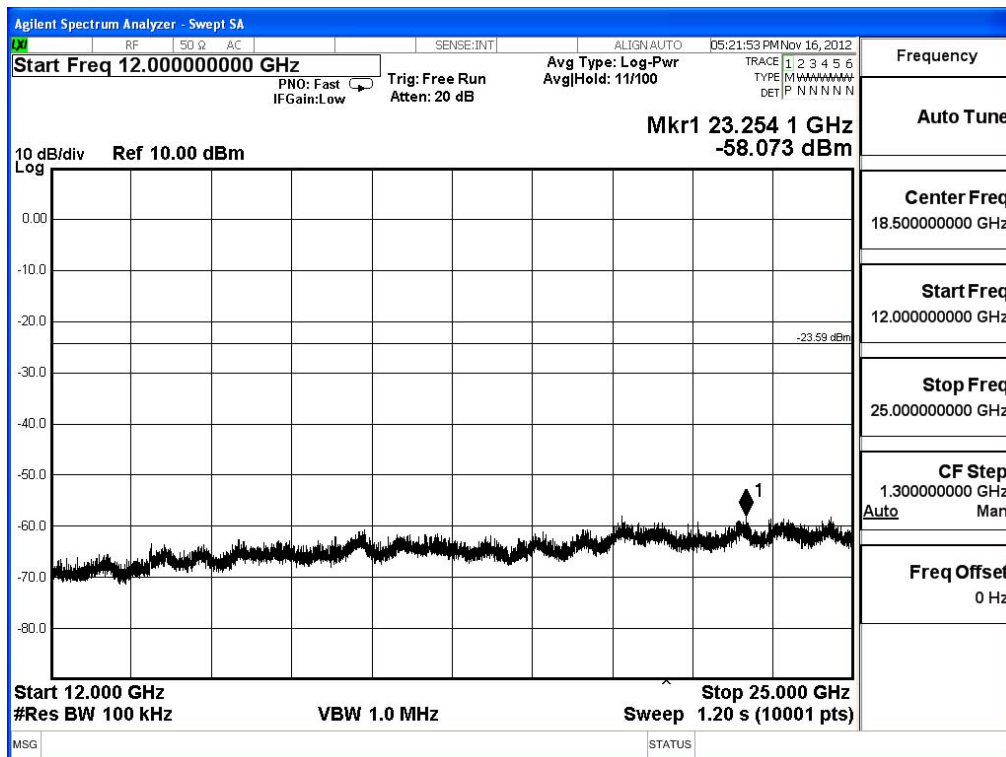
#Res BW 100 kHz

VBW 1.0 MHz

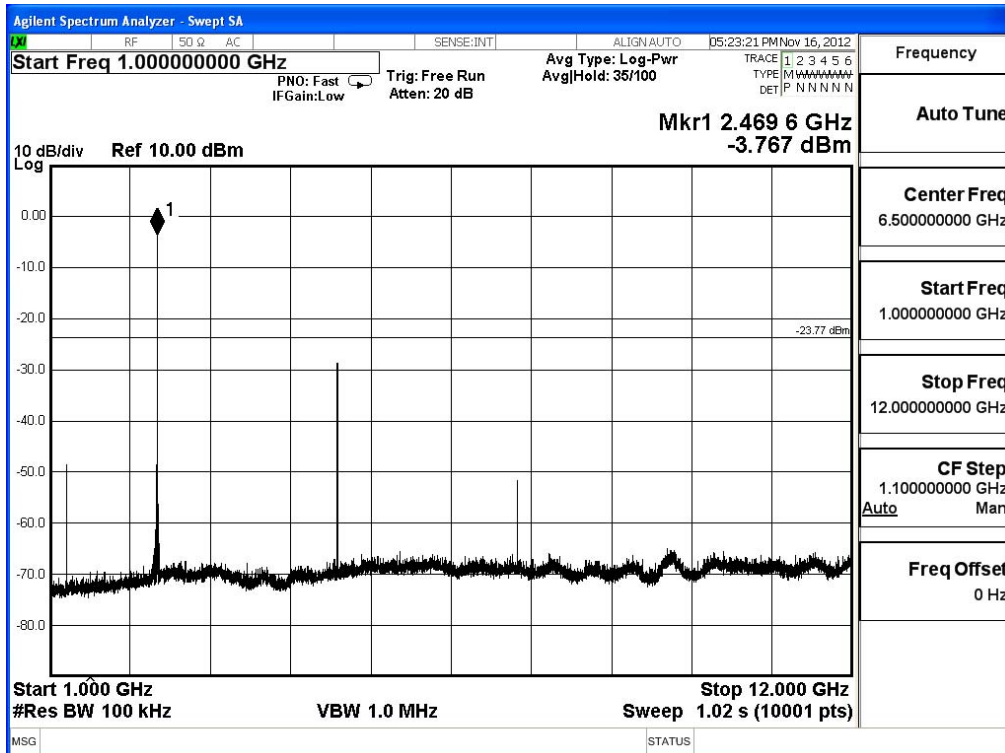
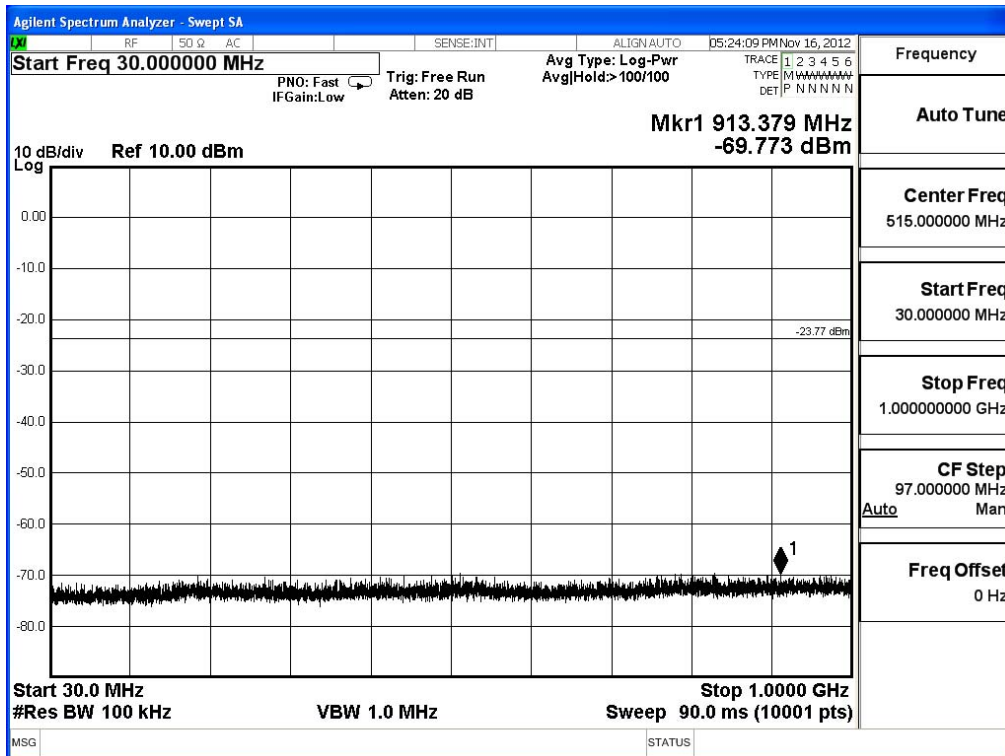
Sweep 90.0 ms (10001 pts)

MSG STATUS

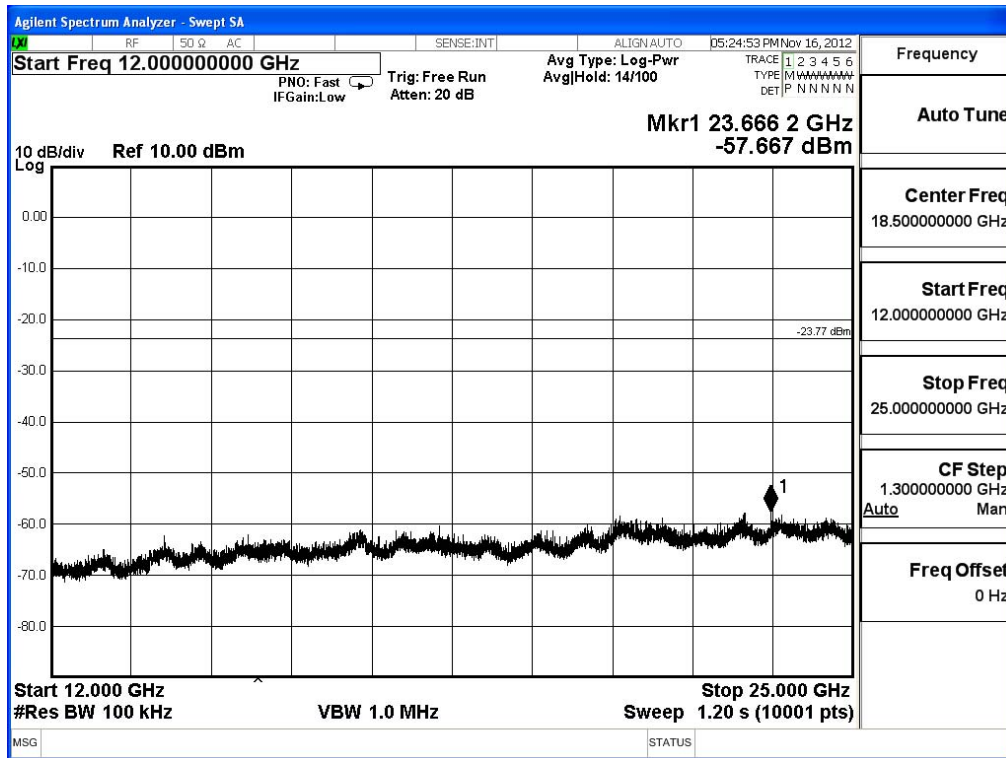




### Channel 70 (2470MHz)







## 6. Band Edge

### 6.1. Test Equipment

#### RF Conducted Measurement

The following test equipments are used during the band edge tests:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2012
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2012
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2012

Note:

1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.
2. The test instruments marked with “X” are used to measure the final test results.

#### RF Radiated Measurement:

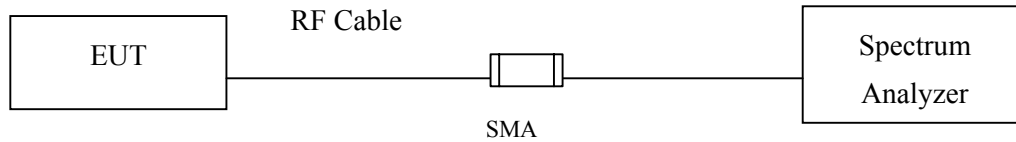
The following test equipments are used during the band edge tests:

Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
Site # 3		Bilog Antenna	Schaffner Chase	CBL6112B/2673	Sep., 2012
	X	Horn Antenna	Schwarzbeck	BBHA9120D/D305	Sep., 2012
		Horn Antenna	Schwarzbeck	BBHA9170/208	Jul., 2012
		Pre-Amplifier	QTK	QTK-AMP-03 / 0003	May, 2012
	X	Pre-Amplifier	QTK	AP-180C / CHM_0906076	Sep., 2012
		Pre-Amplifier	MITEQ	AMF-4D-180400-45-6P/ 925975	Mar, 2012
	X	Spectrum Analyzer	Agilent	E4407B / US39440758	May, 2012
		Test Receiver	R & S	ESCS 30/ 825442/018	Sep., 2012
	X	Coaxial Cable	Quietek	QTK-CABLE/ CAB5	Feb., 2012
	X	Controller	Quietek	QTK-CONTROLLER/ CTRL3	N/A
	X	Coaxial Switch	Anritsu	MP59B/6200265729	N/A

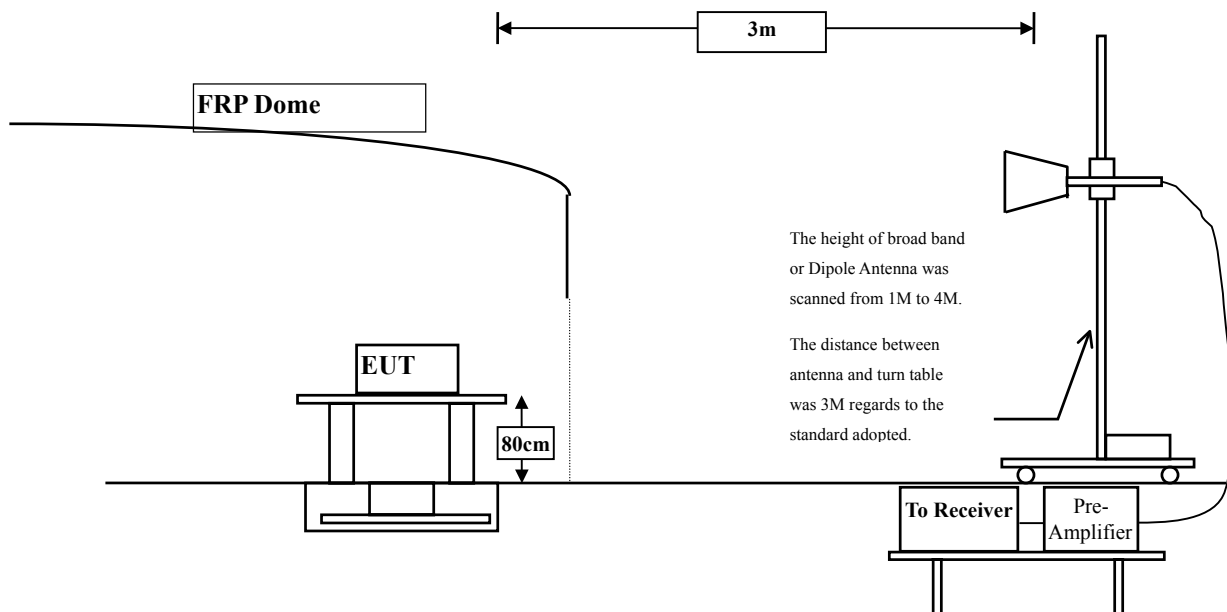
- Note:
1. All instruments are calibrated every one year.
  2. The test instruments marked by “X” are used to measure the final test results.

## 6.2. Test Setup

### RF Conducted Measurement



### RF Radiated Measurement:



## 6.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

#### **6.4. Test Procedure**

The EUT was setup according to ANSI C63.4, 2003 and tested according to DTS test procedure of ANSI C63.10: 2009 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4:2003 on radiated measurement.

#### **6.5. Uncertainty**

± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

## 6.6. Test Result of Band Edge

Product : 2.4G NRM  
Test Item : Band Edge Data  
Test Site : No.3 OATS  
Test Mode : Mode 1: Transmit

### Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2405	31.593	53.26	84.853	Peak
Vertical	2405	30.926	62.99	93.916	Peak

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

### Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	$\Delta$ (dB)	Band Edge Field Strength (dBuV/m)	Limit (dBuV/m)	Detector
Horizontal	2390	84.853	36.868	47.985	74.000	Peak
Vertical	2390	93.916	36.868	57.048	74.000	Peak

Note:

The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F -  $\Delta$

F = Fundamental field Strength (Peak or Average)

$\Delta$  = Conducted Band Edge Delta (Peak or Average)

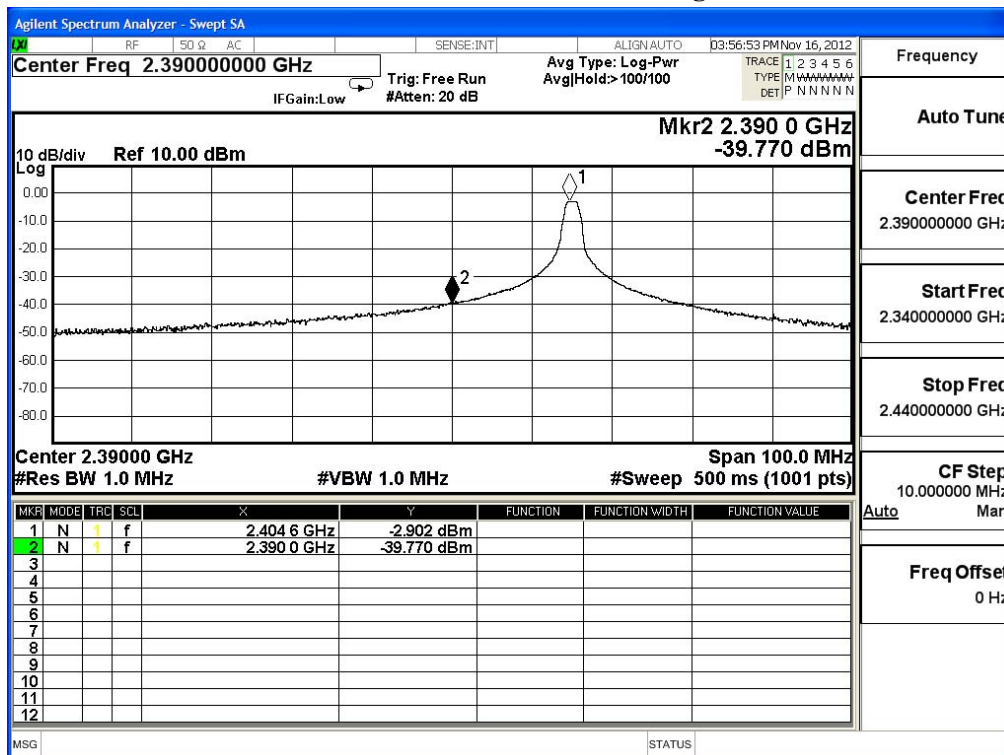
**Average Detector:**

Frequency	Peak Measurement	Duty Cycle Correct Factor	Measurement Level	Margin	Limit
MHz	dBuV/m	dB	dBuV/m	dB	dBuV/m
<b>Horizontal</b>					
2390	47.985	-14.960	33.025	-20.975	54.000
<b>Vertical</b>					
2390	57.048	-14.960	42.088	-11.912	54.000

Note:

1. AVG Measurement=Peak Measurement - Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 9.

**Peak Detector of conducted Band Edge Delta**



Product : 2.4G NRM  
 Test Item : Band Edge Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit

### Fundamental Filed Strength

Antenna Pole	Frequency [MHz]	Correction Factor [dB/m]	Reading Level [dBuV]	Emission Level [dBuV/m]	Detector
Horizontal	2470	32.08	49.36	81.44	Peak
Vertical	2470	31.344	59.96	91.304	Peak

Note: 1:Spectrum Analyzer setting:

Peak detector: RBW=1MHz, VBW=1MHz

Average detector: RBW=1MHz, VBW=10Hz

### Band Edge Test Data

Antenna Pole	Test Frequency (MHz)	Fundamental (dBuV/m)	$\Delta$ (dB)	Band Edge Field Strength (dBuV/m)	Limit (dBuV/m)	Detector
Horizontal	2483.5	81.44	36.106	45.334	74.000	Peak
Vertical	2483.5	91.304	36.106	55.198	74.000	Peak

Note:

The Band Edge Field Strength was calculated using the Fundamental and Conducted Band Edge measurements per the Marker-Delta Method with the following formula:

Band Edge field Strength = F -  $\Delta$

F = Fundamental field Strength (Peak or Average)

$\Delta$  = Conducted Band Edge Delta (Peak or Average)

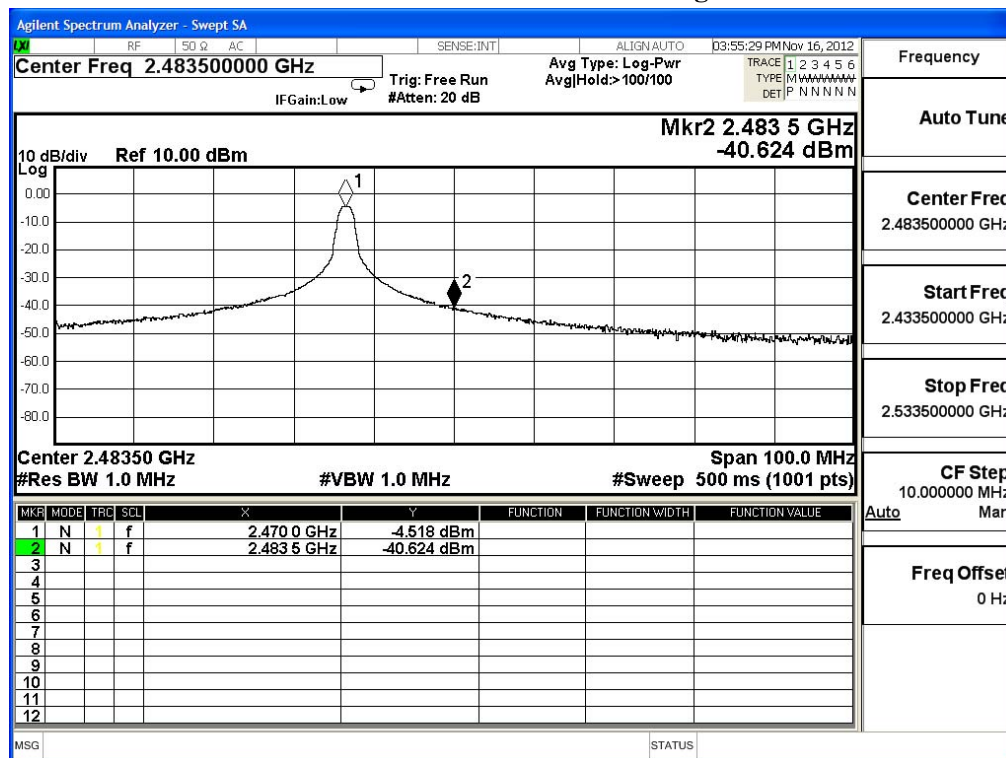
**Average Detector:**

Frequency	Peak Measurement	Duty Cycle Correct Factor	Measurement Level	Margin	Limit
MHz	dBuV/m	dB	dBuV/m	dB	dBuV/m
<b>Horizontal</b>					
2483.5	45.334	-14.960	30.374	-23.626	54.000
<b>Vertical</b>					
2483.5	55.198	-14.960	40.238	-13.762	54.000

Note:

1. AVG Measurement=Peak Measurement - Duty Cycle Correct Factor
2. The Duty Cycle is refer to section 9.

**Peak Detector of conducted Band Edge Delta**





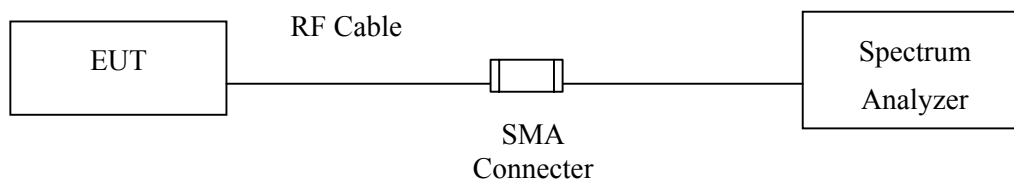
## 7. Occupied Bandwidth

### 7.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2012
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2012
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2012

Note: 1. All instruments are calibrated every one year.  
2. The test instruments marked by "X" are used to measure the final test results.

### 7.2. Test Setup



### 7.3. Limits

The minimum bandwidth shall be at least 500 kHz.

### 7.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2003; tested according to DTS test procedure of ANSI C63.10: 2009 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 1-5% of the emission bandwidth,  $VBW \geq 3 \cdot RBW$

### 7.5. Uncertainty

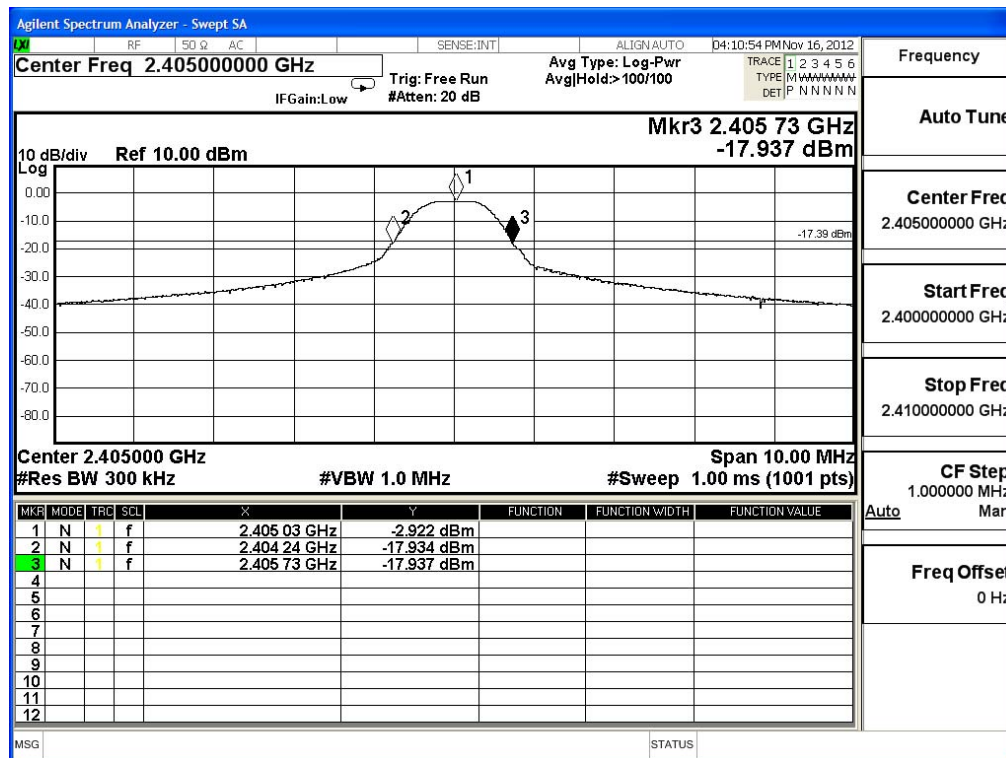
$\pm 150\text{Hz}$

## 7.6. Test Result of Occupied Bandwidth

Product : 2.4G NRM  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit (2405MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
05	2405.00	1490	>500	Pass

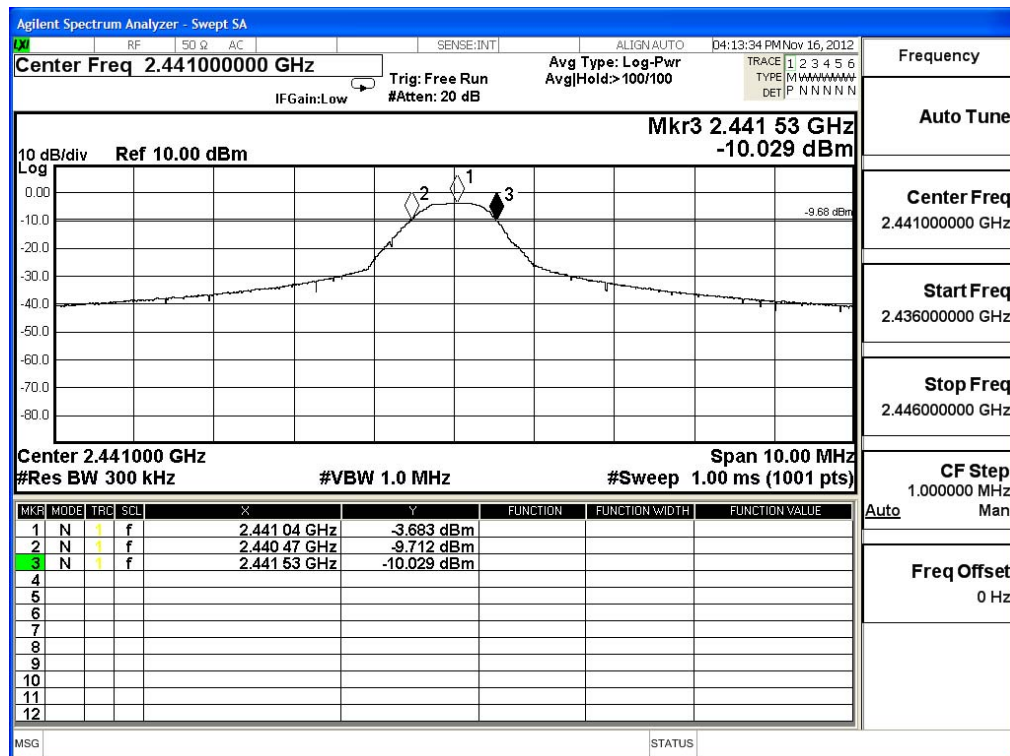
Figure Channel 05:



Product : 2.4G NRM  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit (2441MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
41	2441.00	1060	>500	Pass

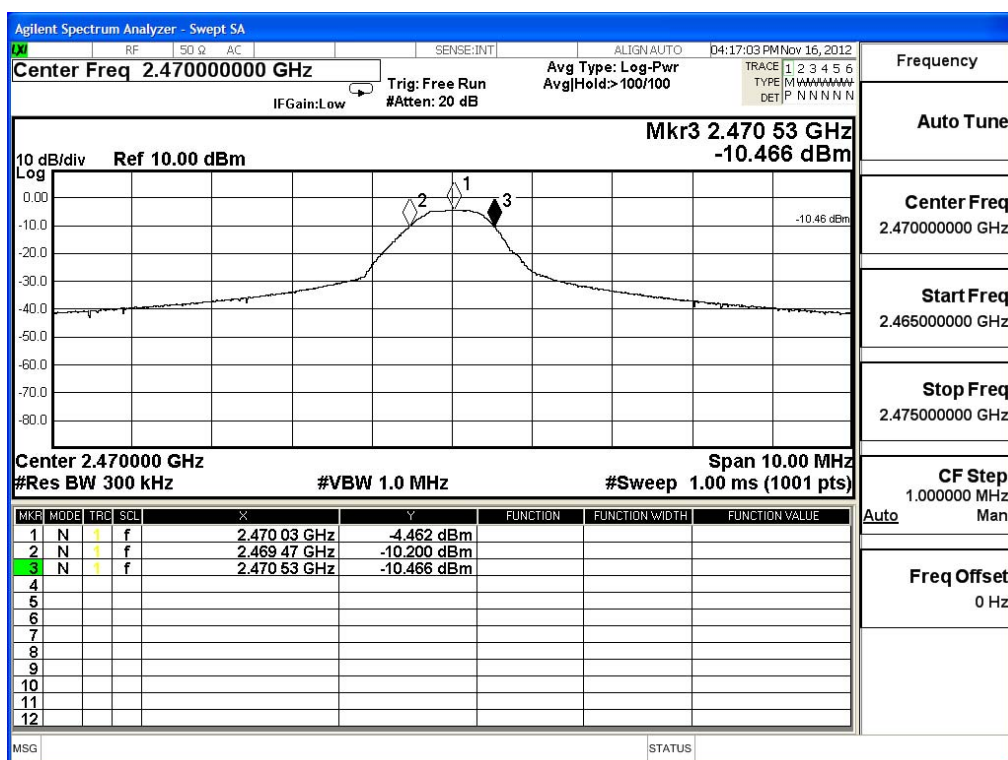
Figure Channel 08:



Product : 2.4G NRM  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit (2470MHz)

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
70	2470.00	1060	>500	Pass

Figure Channel 70:



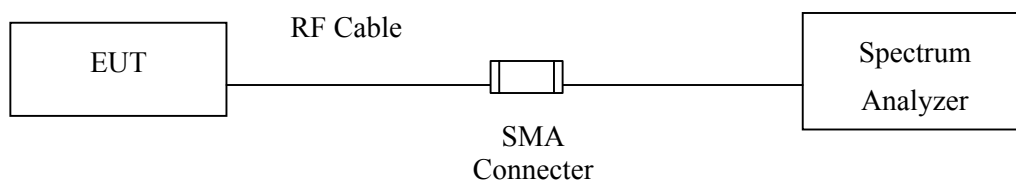
## 8. Power Density

### 8.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2012
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2012
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2012

Note: 1. All equipments are calibrated every one year.  
2. The test instruments marked by "X" are used to measure the final test results.

### 8.2. Test Setup



### 8.3. Limits

The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3kHz bandwidth.

### 8.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2003; tested according to DTS test procedure of ANSI C63.10: 2009 for compliance to FCC 47CFR 15.247 requirements.

Set RBW= 100 kHz, VBW $\geq$ 300KHz, SPAN to 5-30 % greater than the EBW,

Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log (3 kHz/100 kHz = -15.2 dB).

### 8.5. Uncertainty

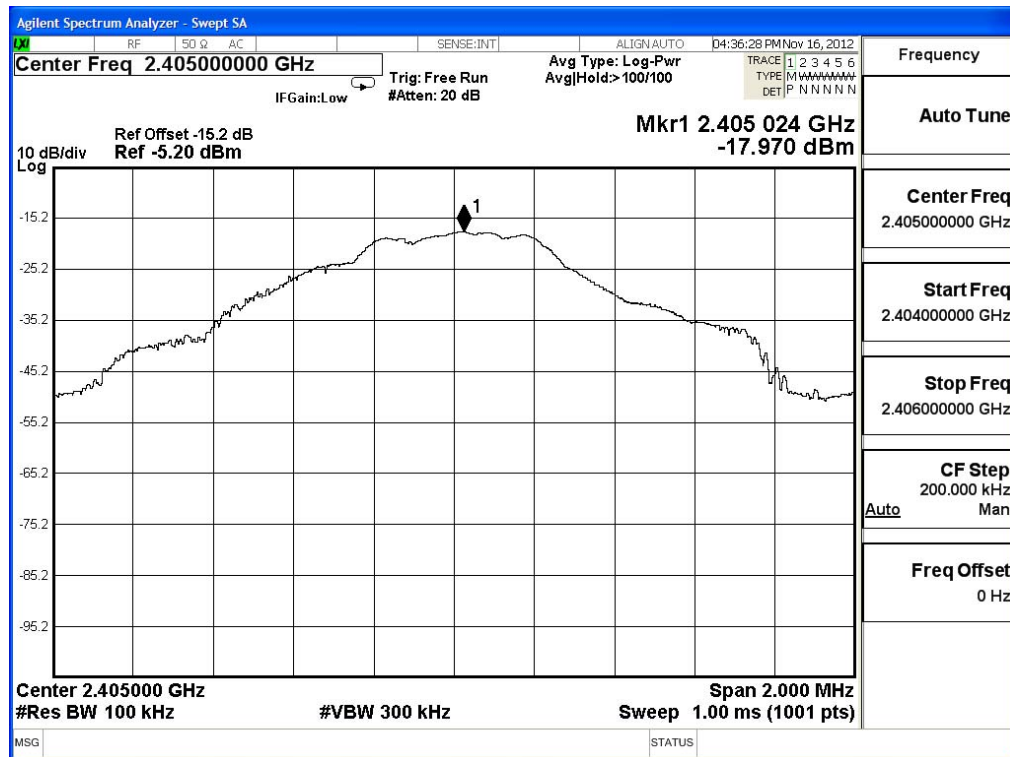
$\pm 1.27$  dB

## 8.6. Test Result of Power Density

Product : 2.4G NRM  
 Test Item : Power Density Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit(2405MHz)

Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
05	2405.00	-17.97	< 8dBm	Pass

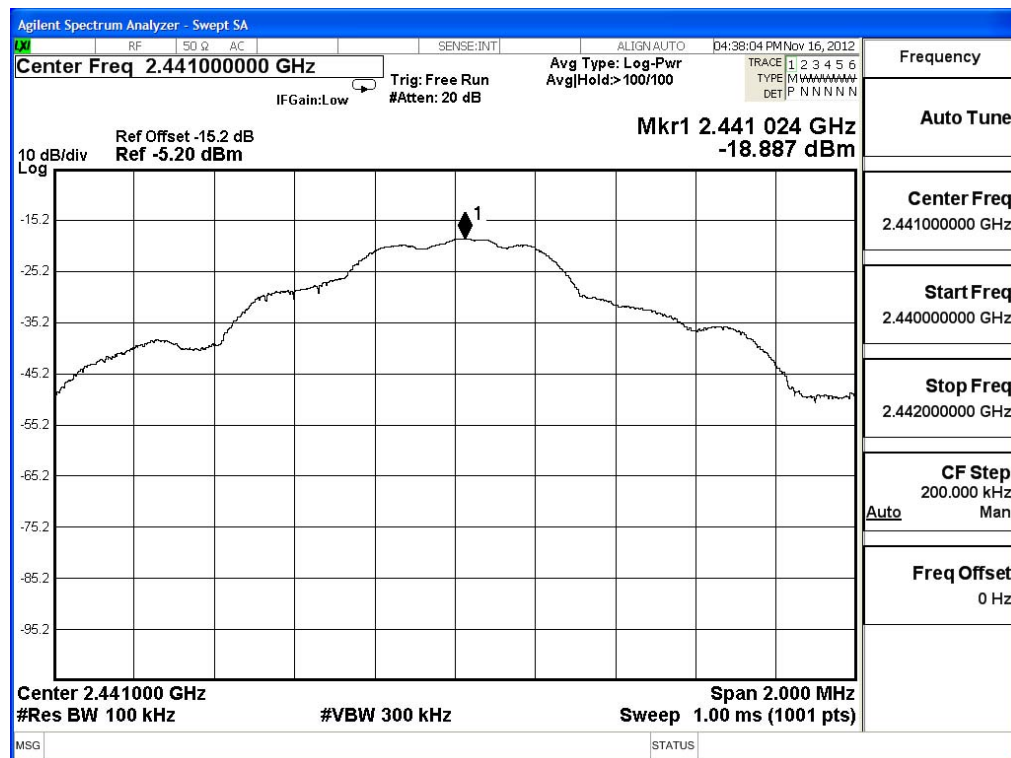
**Figure Channel 05:**



Product : 2.4G NRM  
 Test Item : Power Density Data  
 Test Site : No.3OATS  
 Test Mode : Mode 1: Transmit (2441MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
41	2441.00	-18.887	< 8dBm	Pass

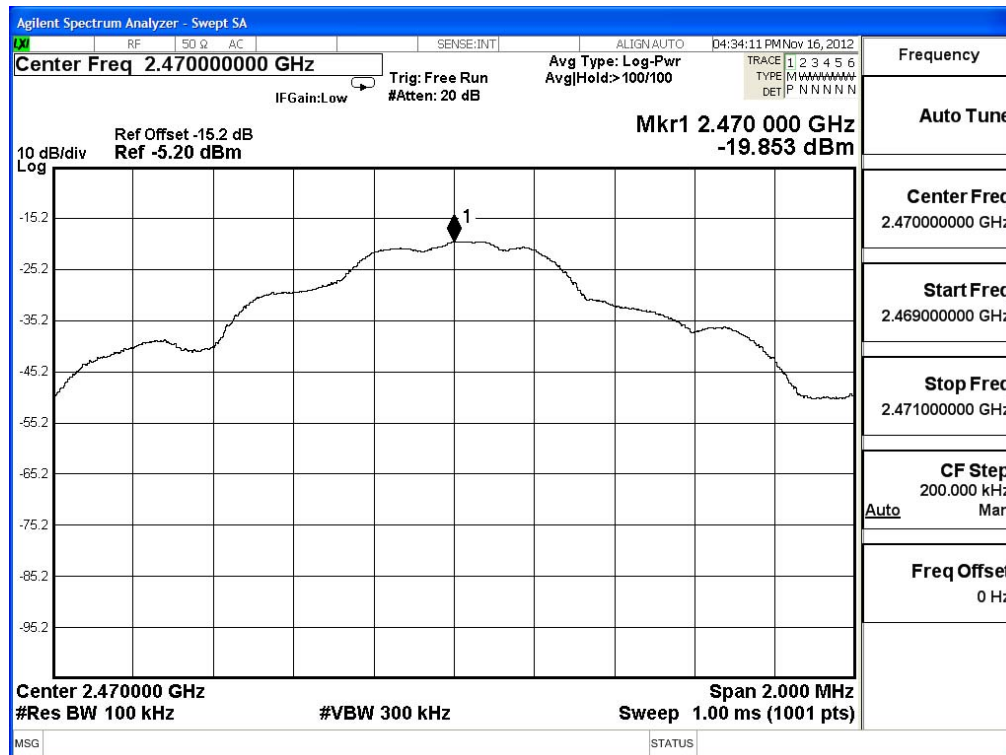
Figure Channel 41:



Product : 2.4G NRM  
 Test Item : Power Density Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit (2470MHz)

Channel No.	Frequency (MHz)	Measurement Level (dBm)	Required Limit (dBm)	Result
70	2470.00	-19.853	< 8dBm	Pass

Figure Channel 70:





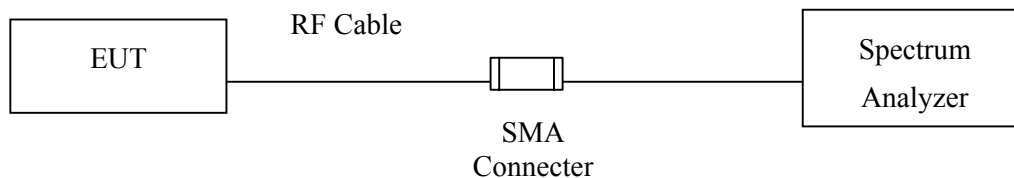
## 9. Duty Cycle

### 9.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2012
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2012
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2012

Note: 1. All equipments are calibrated every one year.  
2. The test equipments marked by "X" are used to measure the final test results.

### 9.2. Test Setup

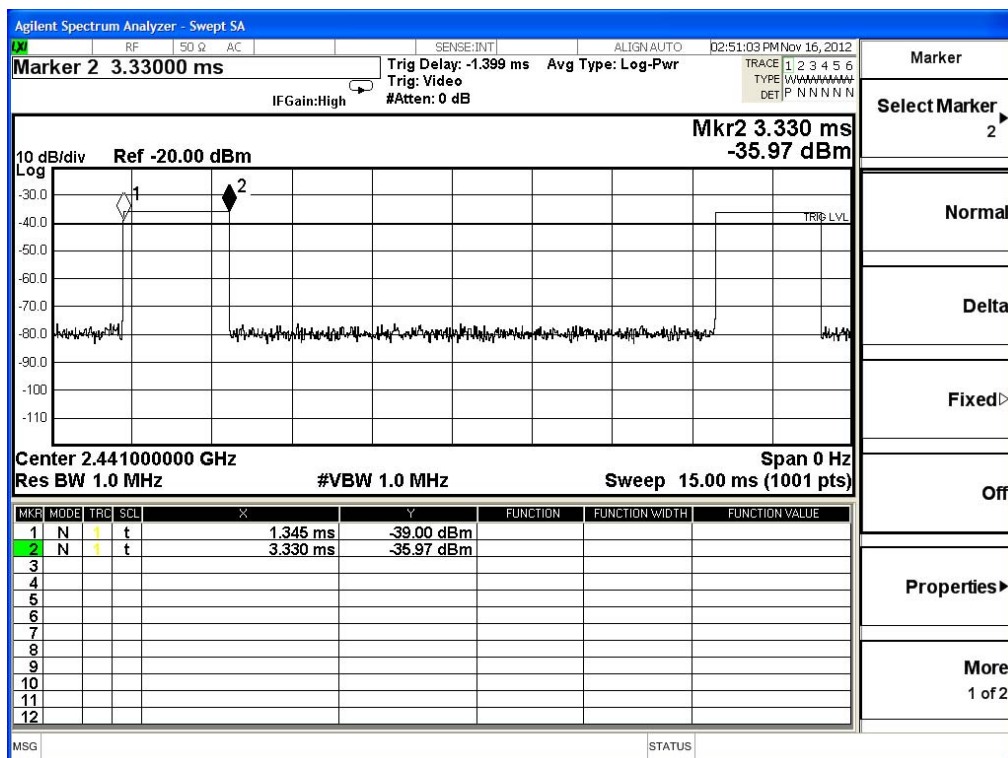
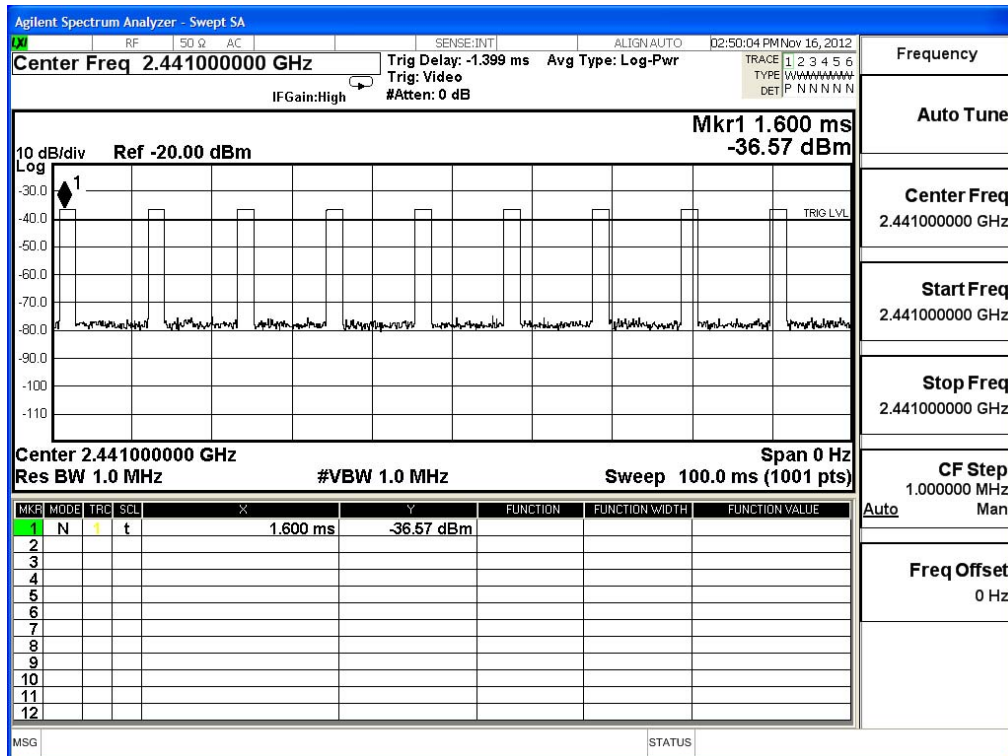


### 9.3. Uncertainty

$\pm 150\text{Hz}$

## 9.4. Test Result of Duty Cycle

Product : 2.4G NRM  
 Test Item : Duty Cycle Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit



Time on of 100ms= (1.985ms\*9) = 17.865 ms

Duty Cycle= 17.865ms / 100ms= 0.17865

Duty Cycle correction factor= 20 LOG 0.17865= -14.960 dB

Duty Cycle correction factor	-14.960	dB
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## **10. EMI Reduction Method During Compliance Testing**

No modification was made during testing.