

FCC Certification Test Report

**Miragii, LLC
Miragii Necklace
Model: MIRAGII-N-A**

FCC ID:2AEUB-M1

**REPORT# 15WB0430004F-01 Rev 0
20 June, 2015**

Prepared for:

**Miragii, LLC
16885 West Bernardo Drive, Suite 320, San Diego, CA USA**

Prepared by:

WASHINGTON TECHNOLOGY INTERNATIONAL LIMITED

This report applies only to the sample evaluated prior to the preparation date stated above.

This report must be copied in its entirety, including all technical documents.

FCC Certification Test Report

For the
Miragii, LLC
Miragii Necklace
Model: MIRAGII-N-A

FCC ID:2AEUB-M1

WLL REPORT# 15WB0430004F-01 Rev 0
20 June, 2015

Prepared by:



Henry guo

Reviewed by:



Steven yang

Abstract

This report has been prepared on behalf of Miragii, LLC to support the attached Application for Equipment Authorization. The test report and application are submitted for a Spread Spectrum Transceiver under Part 15.247 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for Miragii, LLC

The above equipment was tested by A Test Lab Techno Corp.Taiwan Accreditation Foundation accreditation number: 1330

And the tested by Shenzhen Academy of Metrology and Quality Inspection. The FCC Registration Number is 806614

The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2009 and KDB 558074, and the energy emitted by the sample tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247 . The test results of this report relate only to the tested sample identified in this report.

Miragii Necklace is a Bluetooth V3.0 compliant device and complies with the limits for a Direct Sequence Spread Spectrum Transmitter device under Part 15.247 of the FCC Rules and Regulations.

Revision History	Reason	Date
Rev 0	Initial Release	June 20, 2015

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1 Introduction

1.1 Compliance Statement

After the modifications listed in Section 2.5 were installed:

Miragii, LLC Miragii Necklace complies with the limits for a Spread Spectrum Transceiver device under Part 15.247 of the FCC Rules and Regulations.

1.2 Test Scope Summary

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2009 version of ANSI C63.10

Standard	Item	Result	Remark
FCC 15.207&FCC15.247			
15.207	AC Power Conducted Emission	PASS	-----
15.247(b)(1)	Max. Output Power	PASS	-----
15.247(c)	Transmitter Radiated Emissions	PASS	-----
15.247(a)(1)	20dB RF Bandwidth	PASS	-----
15.247(a)(1)(iii)	Carrier Frequency Separation	PASS	-----
15.247(a)(1)(iii)	Number of Hopping	PASS	-----
15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	PASS	-----
15.247(c)	Out of Band Conducted Spurious Emission	PASS	-----
15.247(c)	Band Edge Measurement	PASS	-----
15.247(c)	Occupied Bandwidth Measurement	PASS	-----
15.203	Antenna Requirement	PASS	-----

The test results of this report relate only to the tested sample(s) identified in this report. Manufacturer or whom it may concern should recognize the pass or fail of the test result.

NOTE: The EUT is also considered as a kind of other class B digital device it has been verified to comply with the requirements of FCC Part 15B Class B (Verification) the test report has been issued by WUIL.

1.3 Contract Information

Customer: Miragii, LLC

16885 West Bernardo Drive, Suite 320, San Diego,
CA USA

1.4 Test and Support Personnel

Murphy WangA Test Lab Techno Corp.

No. 140-1, Changan Street, Bade City,
Taoyuan County 334, Taiwan R.O.C.

Peter LinShenzhen Academy of Metrology and Quality Inspection
No.4 TongFa Road, Xili Town Nanshan
District, Shenzhen, China

1.5 Abbreviations

A	Ampere
ac	alternating current
AM	Amplitude Modulation
Amps	Ampères
b/s	bits per second
BW	BandWidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	deciBel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
LISN	Line Impedance Stabilization Network
M	Mega - prefix for 10^6 multiplier
m	meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
QP	Quasi-Peak
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification

The results obtained relate only to the item(s) tested.

Table 1: Overview of Miragii Necklace, Equipment Under Test

Product	Miragii Necklace				
Trade Name	Miragii				
Model Number	Miragii-N-A				
Applicant	Miragii, LLC 16885 West Bernardo Drive, Suite 320, San Diego, CA USA				
FCC ID	2AEUB-M1				
Frequency Range	2402 ~ 2480 MHz				
Modulation Type	Bluetooth 3.0+EDR	GFSK for 1Mbps			
		8DPSK for 3Mbps			
Antenna Type	Sheet Metal Antenna				
Antenna Gain	0.5dBi				
RF Output Power (Conducted)	BT3.0 GFSK for 1Mbps BT3.0 8DPSK for 3Mbps	2.523 dBm / 0.583 dBm	1.786 mW 1.143 mW		
20dB Bandwidth	BT 3.0 GFSK: 1.242MHz BT3.0 8DPSK: 1.384MHz				

2.2 Test Methodology

2.2.1 Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Normal Working Mode
Mode 2: GFSK Link Mode
Mode 3: $\pi/4$ -DQPSK Link Mode
Mode 4: 8DPSK Link Mode
--

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "X axis" position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

Note: We only show worse data with GFSK Link Mode and 8DPSK Link Mode in this report.

2.2.2 EUT Exercise Software

1	Setup the EUT as shown on 2.3
2	Turn on the power of all EUT.
3	Keep EUT in continuous transmitting under the help of PC software CSR BlueTest3.

2.3 Test Configuration

Miragii, LLC Miragii Necklace, Equipment Under Test (EUT), was operated from 5VDC from adapter.

The EUT firmware/software was set up to control power, bit rate, and channel selection.

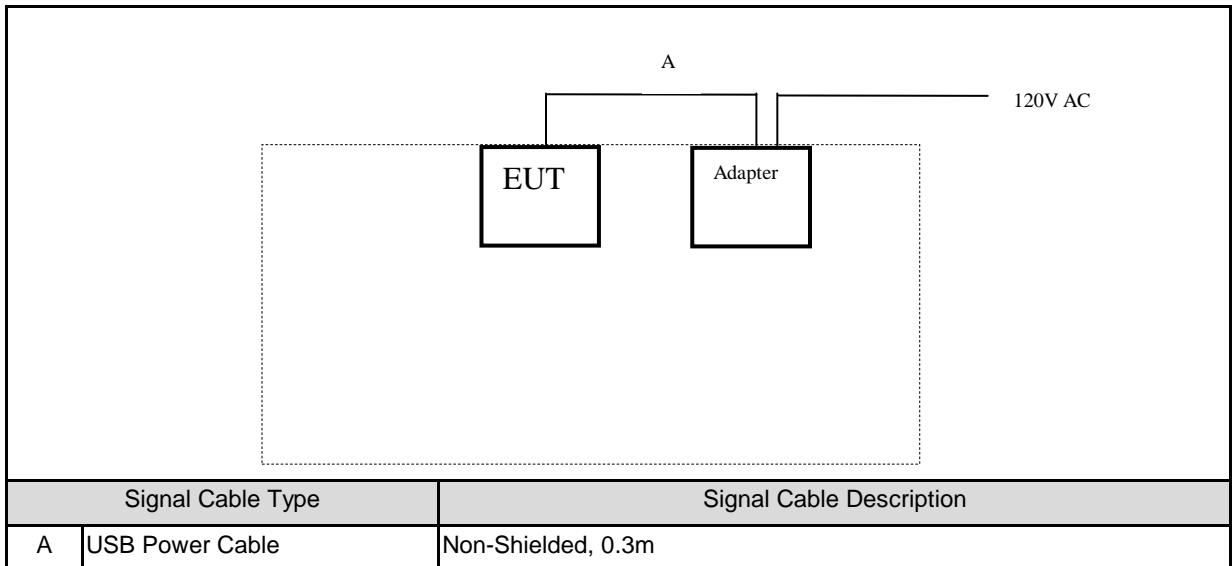


Figure 1: Test Configuration

Auxiliary equipment description				
Product		Manufacturer	Model Number	S/N
(1)	Power Adapter	Sony	--	3513W51304150
--	--	--	--	--

2.4 Test Site Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	26
Humidity (%RH)	25-75	60
Barometric pressure (mbar)	860-1060	950

2.5 EUT Modifications

N/A

2.6 Test Location

Site 1:

A Test Lab Techno Corp.

No. 140-1, Changan Street, Bade City,

Taoyuan County 334, Taiwan R.O.C.

Tel: +886-3-2710188 / Fax: +886-3-2710190

Taiwan Accreditation Foundation accreditation number: 1330

<http://www.atl-lab.com.tw/e-index.htm>

Site 2:

Shenzhen Academy of Metrology and Quality Inspection

No.4 TongFa Road, Xili Town Nanshan District, Shenzhen, China

2.7 Measurements

2.7.1 Measurement Method

All measurements were performed according to the 2009 version of ANSI C63.10 for testing compliance of a wide variety of unlicensed wireless devices

2.7.2 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm \sqrt{\frac{a^2}{div_a^2} + \frac{b^2}{div_b^2} + \frac{c^2}{div_c^2} +}$$

where u_c = standard uncertainty
 $a, b, c,..$ = individual uncertainty elements
 $\text{div}_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution
divisor = 1.732 for rectangular distribution
divisor = 2 for normal distribution
divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

where U = expanded uncertainty
 k = coverage factor
 $k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)
 u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2 below.

Table 2: Expanded Uncertainty List

Test Item	Frequency Range	Uncertainty (dB)
Conducted Emission	9kHz ~ 30MHz	3.50
Radiated Emission	30MHz ~ 1000MHz	4.50
	1000MHz ~ 18000MHz	4.60
	18000MHz ~ 40000MHz	5.12

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Conducted Emission

Describe	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
SB3319	EMI Test Receiver	Rohde & Schwarz	ESCS30	Jan.20,2015	1 Year
SB4357	AMN	Rohde & Schwarz	ENV216	Jan.20,2015	1 Year

Radiated Emission

3 Meter Chamber					
Model No.	Equipment	Manufacturer	Serial Number	Cal. Date	Remark
ESU40	EMI Test Receiver	R&S	SB8501/09	Jan.20, 2015	1 Year
VULB9163	Bilog Antenna	Schwarzbeck	SB8501/04	Jan.20, 2015	1 Year
HF906	Horn Antenna	R&S	SB3435	Jan.20, 2015	1 Year
--	Amplifier(1-18GHz)	R&S	SB3435/01	Jan.20, 2015	1 Year
--	Amplifier(18-40GHz)	R&S	SB3435/02	Jan.20, 2015	1 Year
AT4560	Horn Antenna	Amplifier Research	SB5392/02	Jan.20, 2015	1 Year
9X6X6	3m Semi-anechoic chamber	Albatross Projects	SB3450/01	Oct.12, 2013	2 Years
ESI26	EMI Test Receiver	Rohde & Schwarz	SB3436	Jan.20,2015	1 Year
VULB9163	Broadband antenna	SCHWARZBECK	SB3955	Jan.20,2015	1 Year
HF907	Horn Antenna	R&S	SB8501/01	Aug.15,2014	1 Year

Remark: (1) Calibration period 1 year. (2) Calibration period 2 years. (3) Calibration period 3 years.

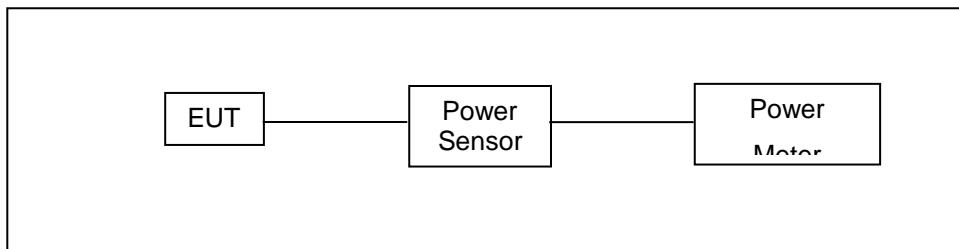
Note: N.C.R. = No Calibration Request

4 Maximum Conducted Output Power Measurement

4.1 Limit

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

4.2 Test Setup



4.3 Test Instruments

Describe	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Single Channel PK Power Sensor	Agilent	N1911A	MY45101619	Dec.21, 2014	1Year
Wideband Power Meter	Agilent	N1921A	MY45241957	Dec.21, 2014	1Year

4.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The tests below are run with the EUT's transmitter set at high power in TX mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to power sensor. The maximum peak output power shall not exceed 1 watt.

Use a direct connection between the antenna port of transmitter and the power sensor, for prevent the power sensor input attenuation 40-50 dB. Set the RBW Bandwidth of the emission or use a channel power meter mode.

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm). For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to $(GAIN - 6)/3$ dBm.

The antenna port of the EUT was connected to the input of a power sensor. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

4.5 Test Result

Model Number	MIRAGII-N-A		
Test Item	Maximum Conducted Output Power		
Test Mode	Mode 2 Link Mode		
Date of Test	2015/05/26		
Modulation technology	Frequency (MHz)	Peak Power	
		(dBm)	(mW)
GFSK	2402	-0.563	0.879
	2441	2.523	1.786
	2480	2.047	1.603

Model Number	MIRAGII-N-A		
Test Item	Maximum Conducted Output Power0		
Test Mode	Mode 4Link Mode		
Date of Test	2015/05/26		
Modulation technology	Frequency (MHz)	Peak Power	
		(dBm)	(mW)
8DPSK	2402	-2.011	0.630
	2441	0.583	1.143
	2480	0.124	1.028

5 Conducted Emission Measurement

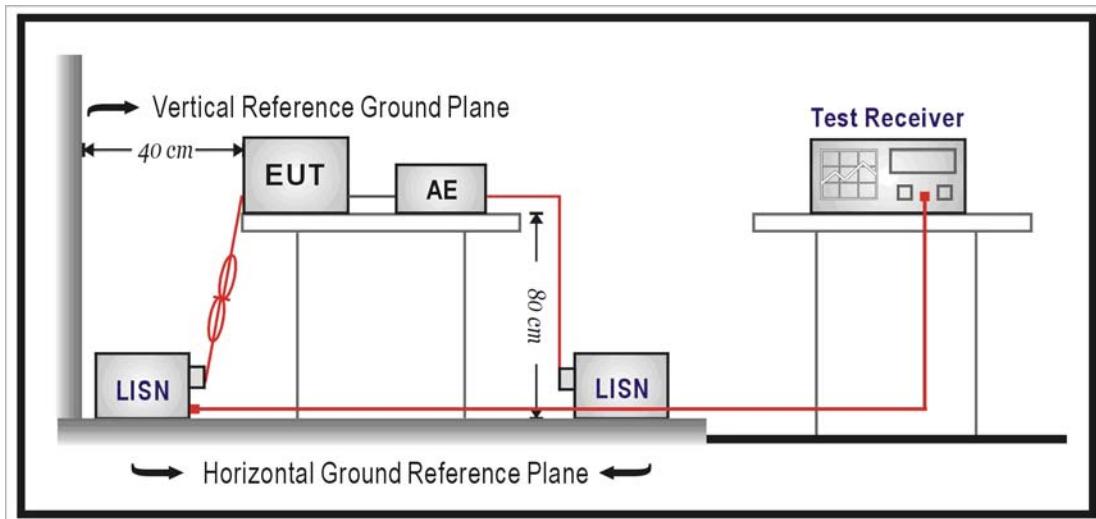
5.1 Limit

Frequency (MHz)	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

5.2 Test Instruments

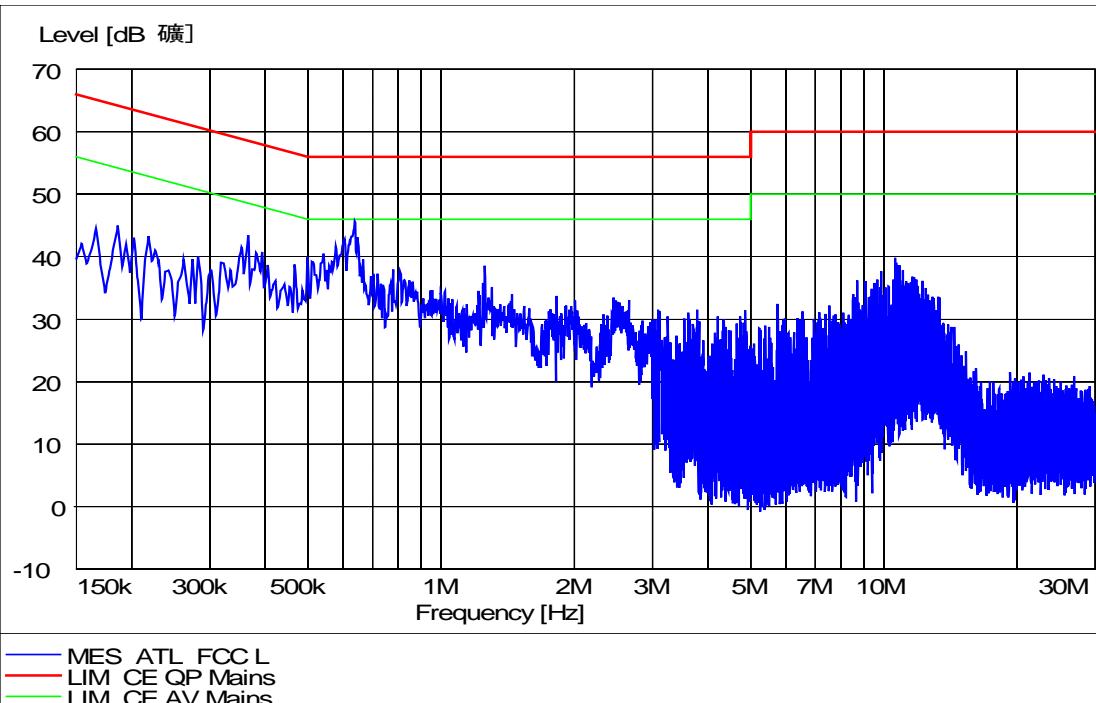
Describe	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
SB3319	EMI Test Receiver	Rohde & Schwarz	ESCS30	Jan.20,2015	1 Year
SB4357	AMN	Rohde & Schwarz	ENV216	Jan.20,2015	1 Year

5.3 Test Setup



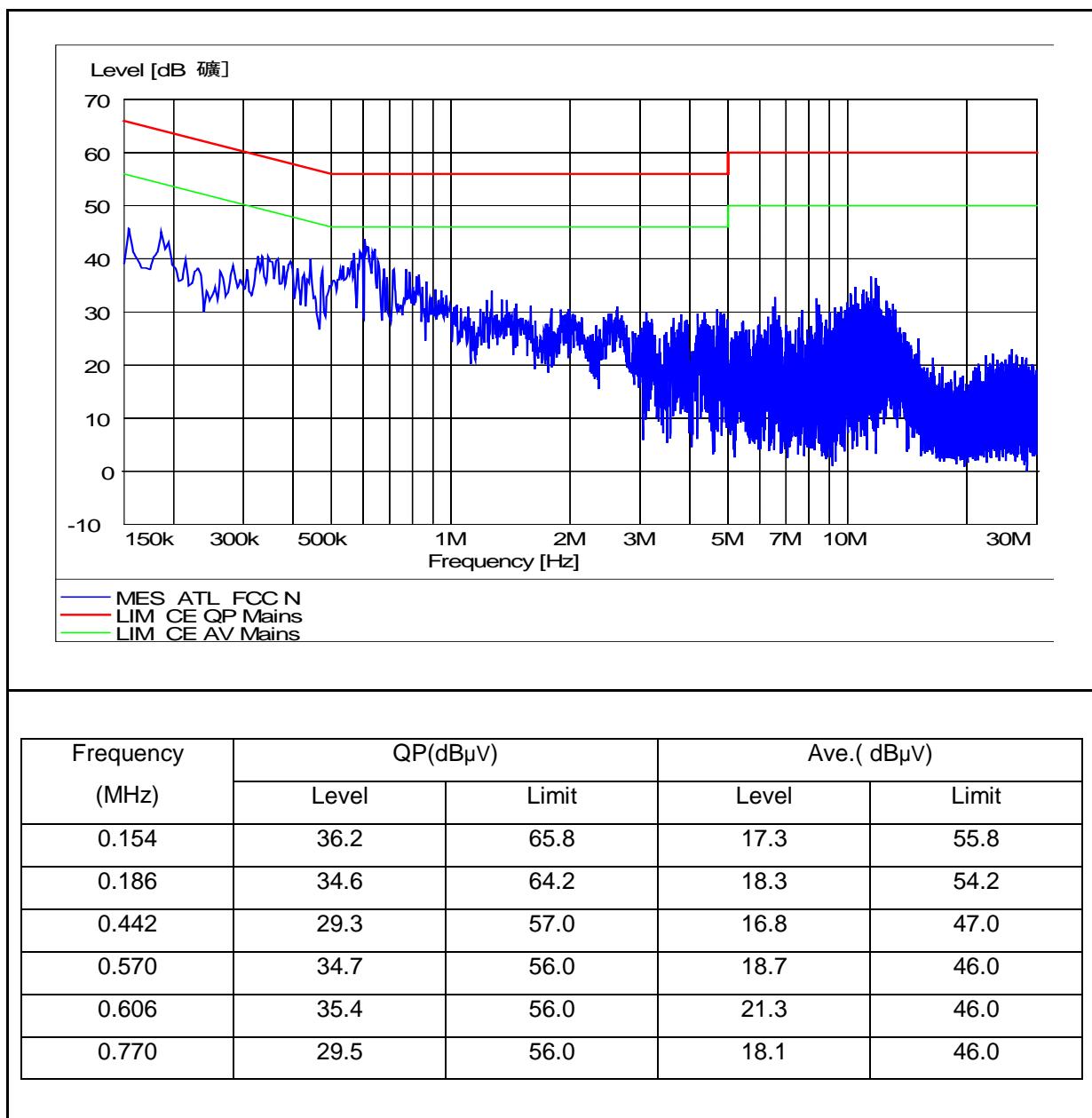
5.4 Test Result

Standard:	FCC 15.107	Line:	L1
Test item:	Conducted Emission	Power:	AC 120V/60Hz
Model Number:	MIRAGII-N-A	Temp.(°C)/Hum.(%RH):	18(°C)/50%RH
Mode:	2	Date:	2015/06/10
Test By:			Fly Lu
Description: L line			



Frequency (MHz)	QP(dB μ V)		Ave.(dB μ V)	
	Level	Limit	Level	Limit
0.186	35.2	64.2	18.3	54.2
0.218	34.1	62.9	21.6	52.9
0.366	34.4	58.6	19.3	48.6
0.606	36.7	56.0	20.8	46.0
0.638	38.4	56.0	22.5	46.0
1.254	27.9	56.0	16.8	46.0

Standard:	FCC 15.207	Line:	N
Test item:	Conducted Emission	Power:	AC 120V/60Hz
Model Number:	MIRAGII-N-A	Temp.(°C)/Hum.(%RH):	18(°C)/50%RH
Mode:	2	Date:	2015/06/10
Test By:			Fly Lu
Description: N line			



6 Radiated Interference Measurement

6.1 Limit

According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μ V/m at 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

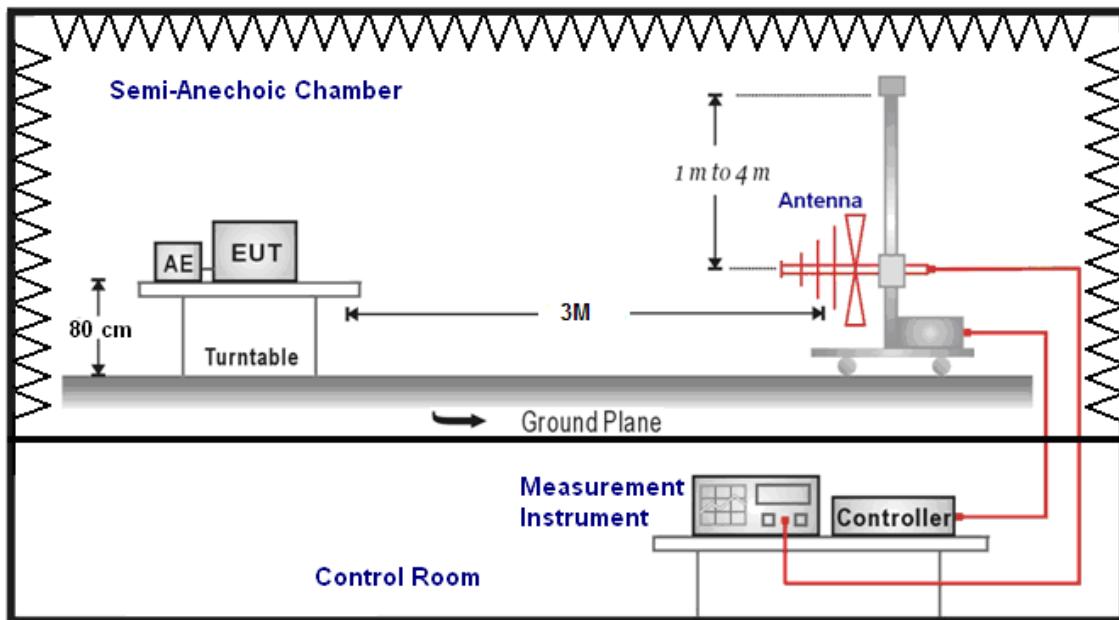
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

6.2 Test Instruments

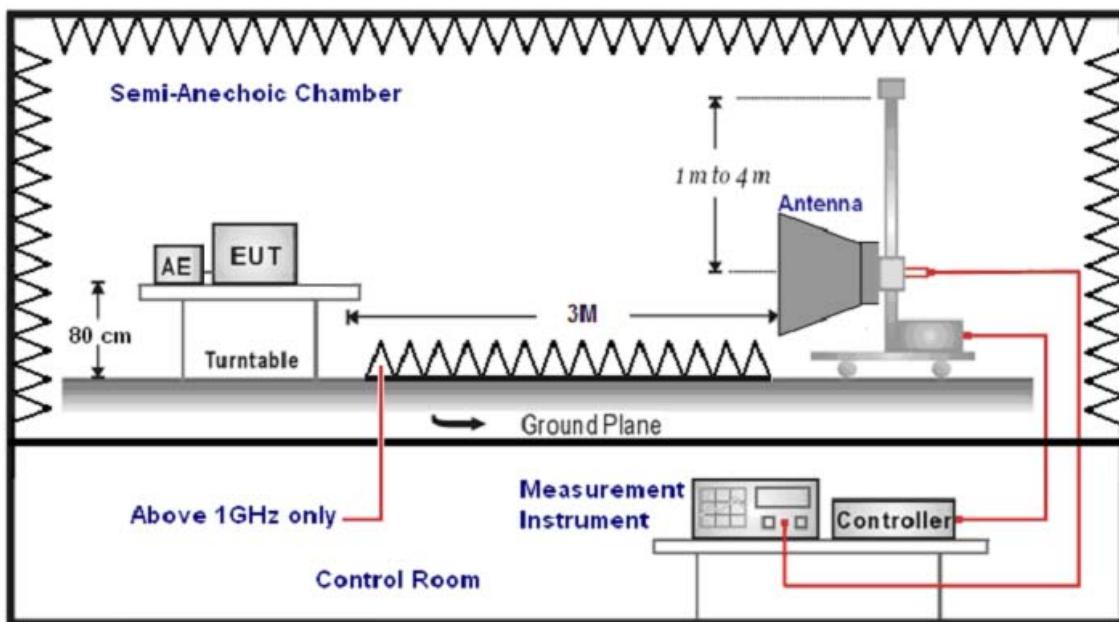
3 Meter Chamber					
Model No.	Equipment	Manufacturer	Serial Number	Cal. Date	Remark
ESU40	EMI Test Receiver	R&S	SB8501/09	Jan.20, 2015	1 Year
VULB9163	Bilog Antenna	Schwarzbeck	SB8501/04	Jan.20, 2015	1 Year
HF906	Horn Antenna	R&S	SB3435	Jan.20, 2015	1 Year
--	Amplifier(1-18GHz)	R&S	SB3435/01	Jan.20, 2015	1 Year
--	Amplifier(18-40GHz)	R&S	SB3435/02	Jan.20, 2015	1 Year
AT4560	Horn Antenna	Amplifier Research	SB5392/02	Jan.20, 2015	1 Year
9X6X6	3m Semi-anechoic chamber	Albatross Projects	SB3450/01	Oct.12, 2013	2 Years
ESI26	EMI Test Receiver	Rohde & Schwarz	SB3436	Jan.20,2015	1 Year
VULB9163	Broadband antenna	SCHWARZBECK	SB3955	Jan.20,2015	1 Year
HF907	Horn Antenna	R&S	SB8501/01	Aug.15,2014	1 Year
Spectrum Analyzer	Agilent	N9039A	MY46520256	Jan.10, 2015	2 Years

6.3 Setup

Below 1GHz



Above 1GHz



6.4 Test Procedure

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously & Measurements spectrum range from 9 kHz to 26.5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

A nonconductive material surrounded the EUT to support the EUT for standing on three orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

Biconilog Antenna (mode VULB9163) at 3 Meter and Horn antenna was used in frequencies 1 – 18 GHz at a distance of 3 meter while 18-40GHz at distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20dB/decade).

For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dB_{UV}) into field intensity in micro volts per meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt is to field intensity in micro coulombs per meter (dB_{UV/m}).

The actual field intensity in referenced to 1 microvolt per meter (dB_{UV/m}) is determined by algebraically adding the measured reading in dB_{UV}, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

$$(1) \text{ Amplitude (dB}_{\text{UV}}/\text{m}) = \text{FI (dB}_{\text{UV}}) + \text{AF (dB}_{\text{UV}}) + \text{CL (dB}_{\text{UV}}) - \text{Gain (dB)}$$

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

$$(2) \text{ Actual Amplitude (dB}_{\text{UV}}/\text{m}) = \text{Amplitude (dB}_{\text{UV}}) - \text{Dis(dB)}$$

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

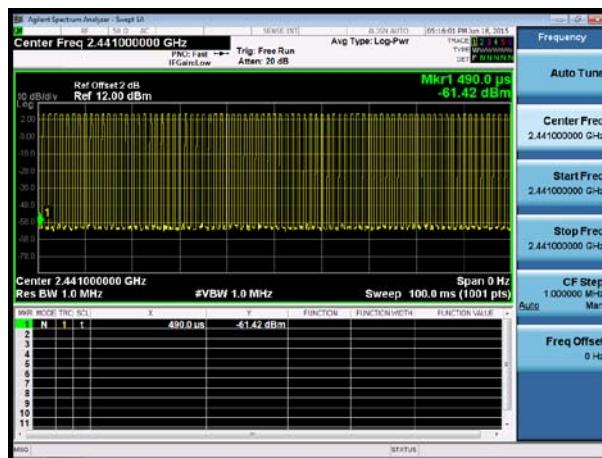
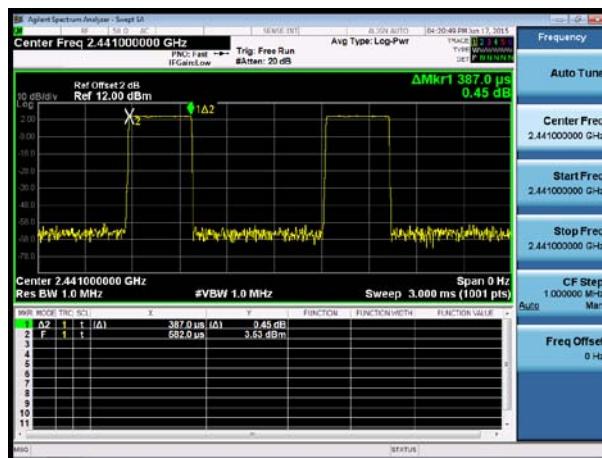
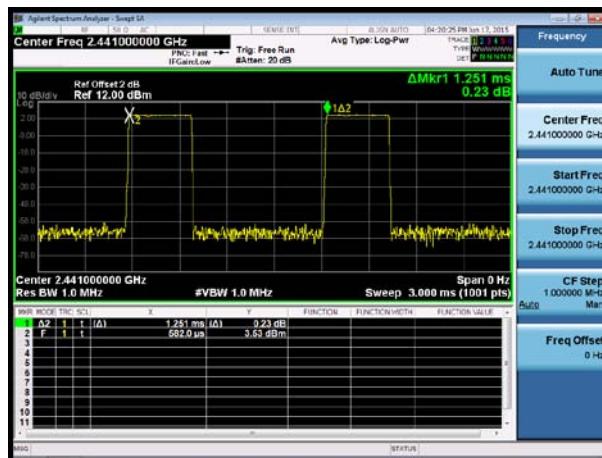
- (a) For fundamental frequency : Transmitter Output < +30dBm
- (b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Data of measurement within this frequency range without mark 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.

Note: The duty cycle factor for calculate average level is 10.19 dB, and average limit is 20 dB blowe peak limit, so if peak measured level comply with average limit, the average level was deemed to comply with average limit.

Duty cycle(ms)=Ton/T=0.387/1.251*100%=30.94%

Duty cycle factor=20log (1/duty cycle)=10.19



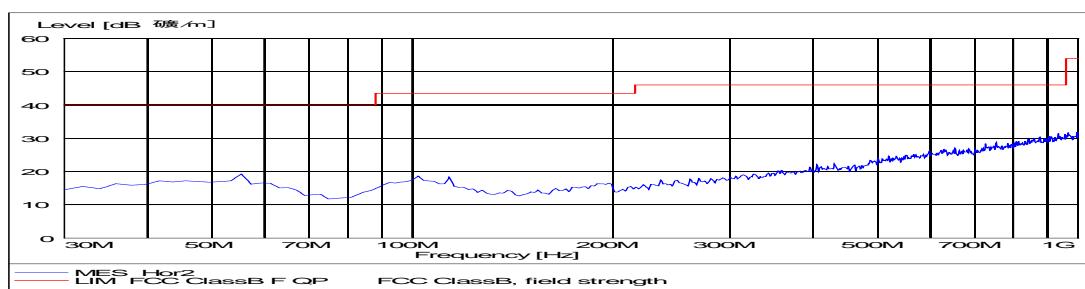
6.5 Test Result

Below 1GHz

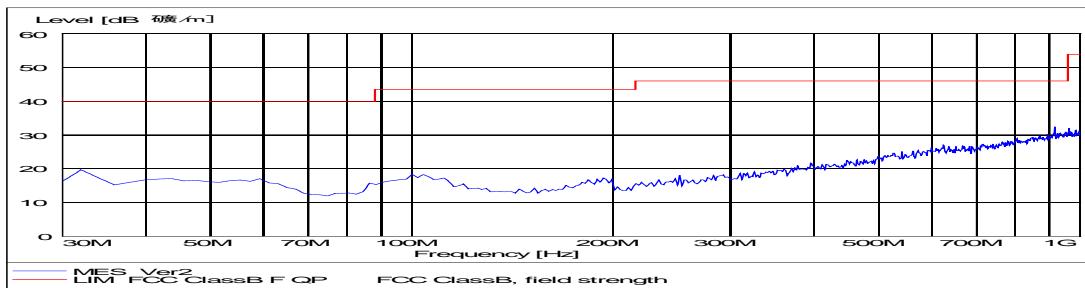
Standard:	FCC Part 15C		Test Distance:	3m			
Test item:	Radiated Emission		Power:	AC 120V/60HZ			
Model Number:	MIRAGII-N-A		Temp.(°C)/Hum.(%RH):	26(°C)/60%RH			
Mode:	Mode 2		Date:	2015/05/21			
			Test By:	Fly Lu			
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dB)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
148.40	3.83	13.07	16.9	43.5	26.6	QP	H
457.04	7.09	12.53	19.62	43.5	23.88	QP	H
192.81	9.56	11.51	21.07	43.5	22.43	QP	H
205.22	5.05	12.44	17.49	43.5	26.01	QP	H
537.69	2.76	21.08	23.84	46.0	22.16	QP	H
667.80	3.73	22.93	26.66	46.0	19.34	QP	H
42.5							
37.69	9.43	16.41	25.84	40.0	14.16	QP	V
108.21	7.21	13.70	20.91	43.5	22.59	QP	V
132.79	5.86	14.24	20.1	43.5	23.4	QP	V
166.63	8.71	12.17	20.88	43.5	22.62	QP	V
174.45	8.09	11.71	19.8	43.5	23.7	QP	V
255.59	4.86	15.14	20	46.0	26	QP	V

Note: No emission found between lowest internal used/generated frequencies to 30MHz (9 kHz~30MHz).

Horizontal



Vertical

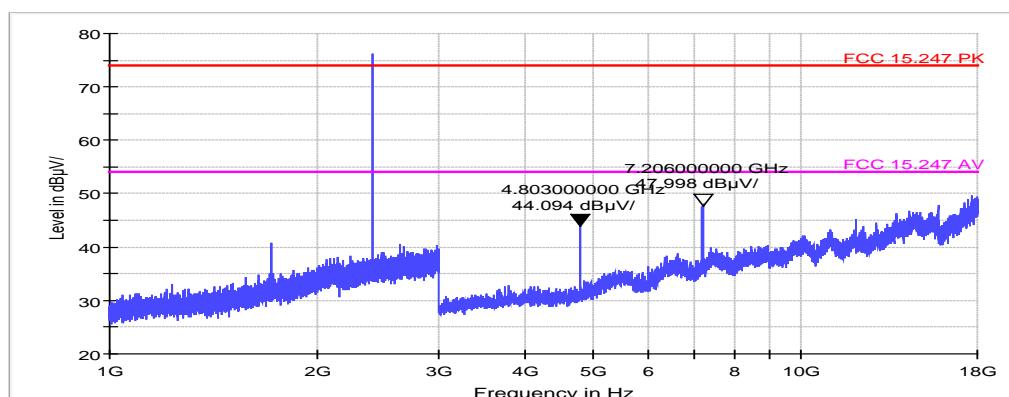


Above 1GHz

Standard:	FCC Part 15C			Test Distance:	3m		
Test item:	Radiated Emission			Power:	AC 120V/60HZ		
Model Number:	MIRAGII-N-A			Temp.(°C)/Hum.(%RH):	26(°C)/60%RH		
Mode:	Mode 2			Date:	2015/05/21		
Frequency:	2402 MHz			Test By:	Fly Lu		
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar.
4803	38.29	5.8	44.09	74.0	29.91	peak	H
7206	41.20	6.8	48.00	74.0	26.00	peak	H
4803	36.35	5.8	42.15	74.0	31.85	peak	V
7206	42.30	6.8	49.10	74.0	24.90	peak	V

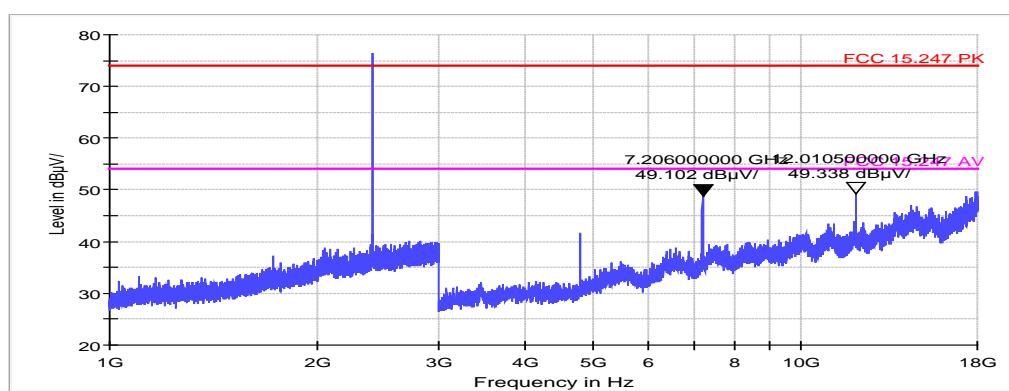
Horizontal

FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Vertical

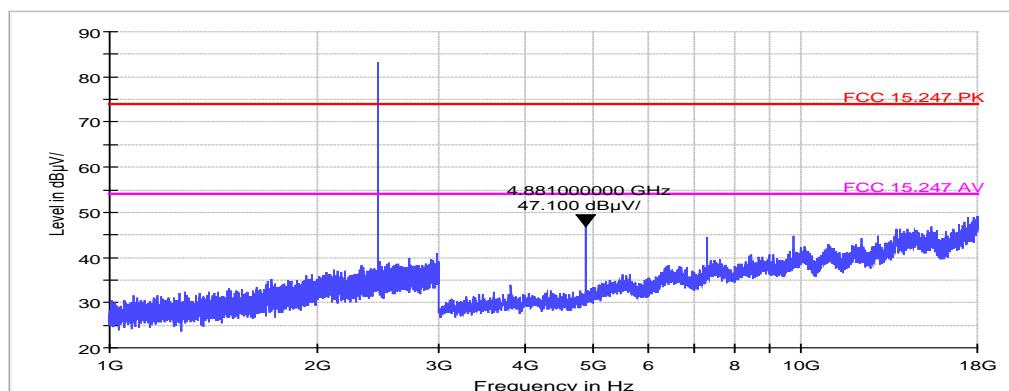
FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Standard:	FCC Part 15C			Test Distance:	3m		
Test item:	Radiated Emission			Power:	AC 120V/60HZ		
Model Number:	MIRAGII-N-A			Temp.(°C)/Hum.(%RH):	26(°C)/60%RH		
Mode:	Mode 2			Date:	2015/05/21		
Frequency:	2441 MHz			Test By:	Fly Lu		
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar.
4881	41.20	5.9	47.10	74.0	26.90	peak	H
7323	38.12	6.8	44.92	74.0	29.08	peak	H
4881	46.48	5.9	52.38	74.0	21.62	peak	V
7323	42.95	6.8	49.75	74.0	24.25	peak	V

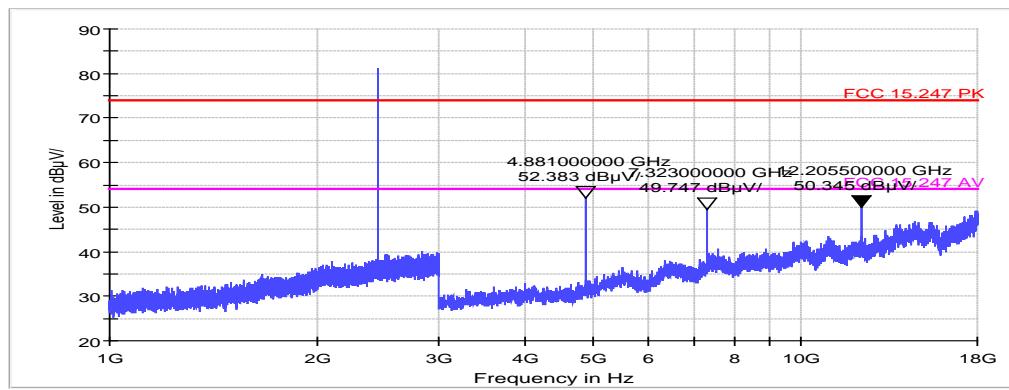
Horizontal

FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Vertical

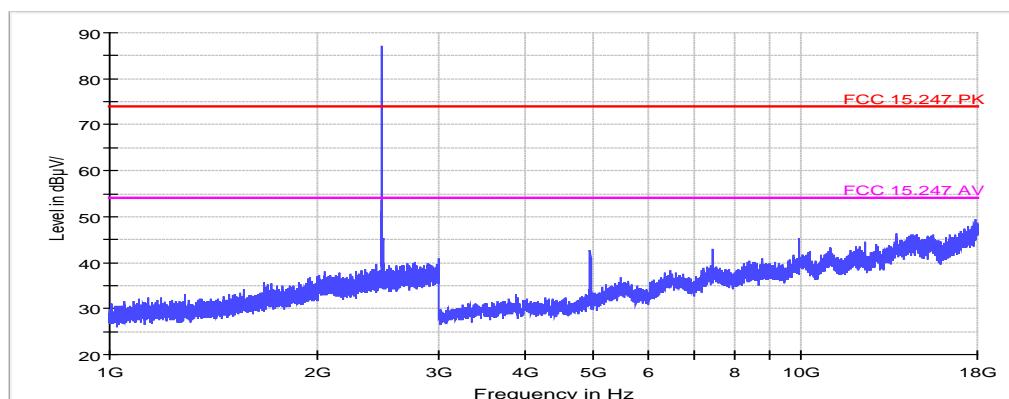
FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Standard:	FCC Part 15C			Test Distance:	3m		
Test item:	Radiated Emission			Power:	AC 120V/60HZ		
Model Number:	MIRAGII-N-A			Temp.(°C)/Hum.(%RH):	26(°C)/60%RH		
Mode:	Mode 2			Date:	2015/05/21		
Frequency:	2480 MHz			Test By:	Fly Lu		
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar.
4960	37.99	5.9	43.89	74.0	30.11	peak	H
7440	35.75	6.8	42.55	74.0	31.45	peak	H
4960	38.04	5.9	43.94	74.0	30.06	peak	V
7440	35.46	6.8	42.26	74.0	31.74	peak	V

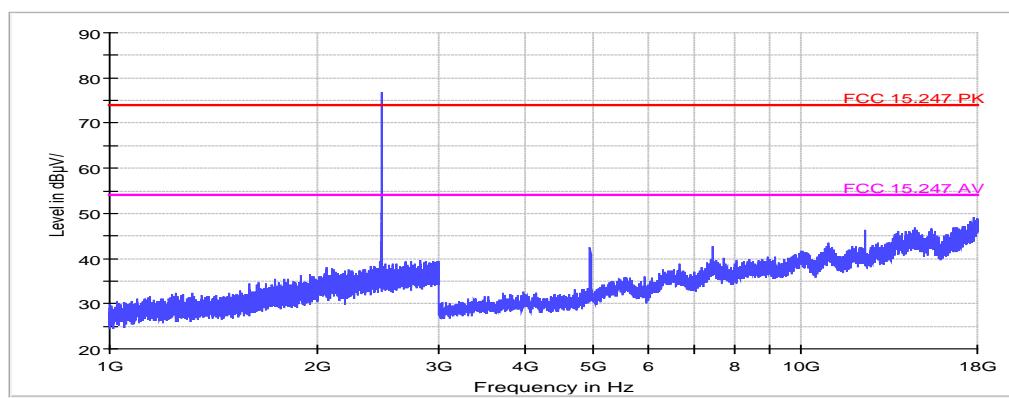
Horizontal

FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Vertical

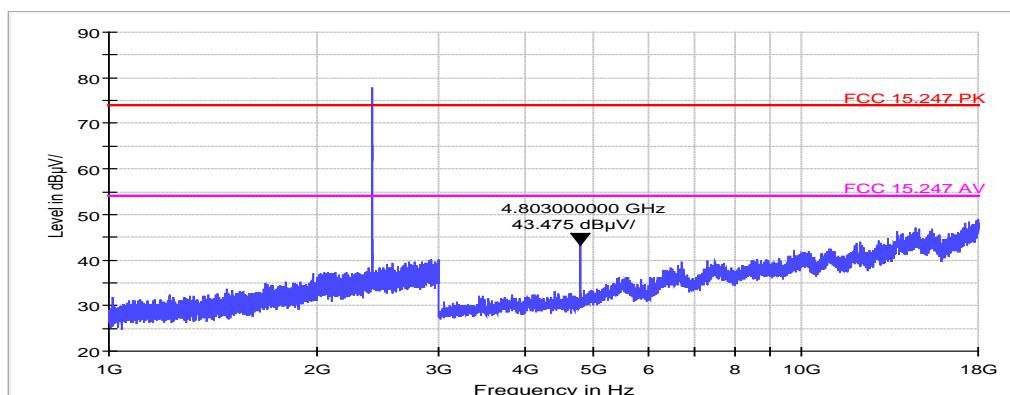
FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Standard:	FCC Part 15C		Test Distance:	3m			
Test item:	Radiated Emission			Power:	AC 120V/60HZ		
Model Number:	MIRAGII-N-A			Temp.(°C)/Hum.(%RH):	26(°C)/60%RH		
Mode:	Mode 4			Date:	2015/05/21		
Frequency:	2402 MHz			Test By:	Fly Lu		
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar.
4803	37.68	5.8	43.48	74.0	30.52	peak	H
7206	32.25	6.8	39.05	74.0	34.95	peak	H
4803	38.80	5.8	44.60	74.0	29.40	peak	V
7206	31.89	6.8	38.69	74.0	35.31	peak	V

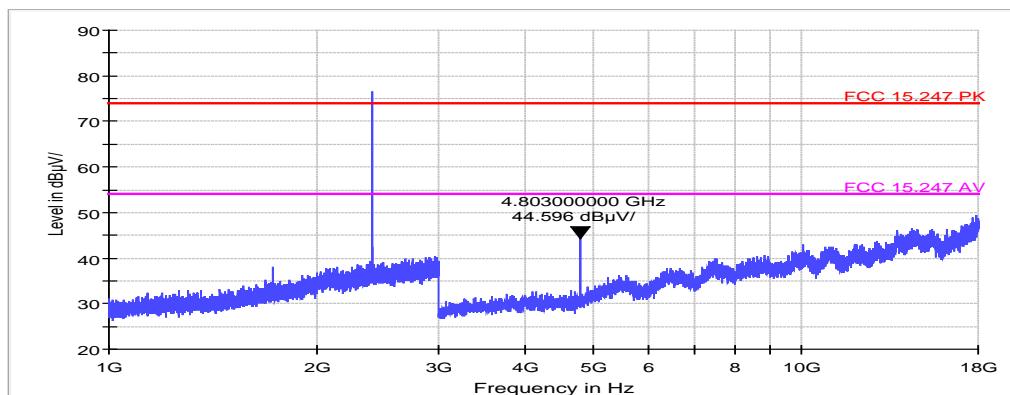
Horizontal

FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Vertical

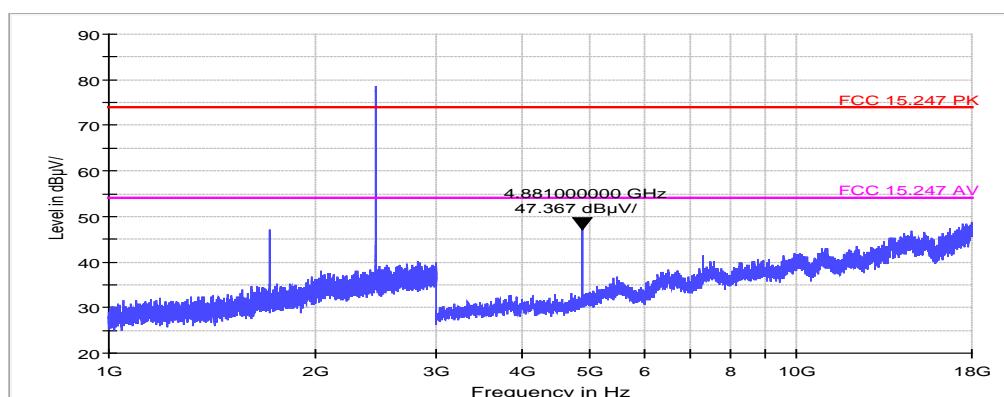
FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Standard:	FCC Part 15C		Test Distance:	3m			
Test item:	Radiated Emission			Power:	AC 120V/60HZ		
Model Number:	MIRAGII-N-A			Temp.(°C)/Hum.(%RH):	26(°C)/60%RH		
Mode:	Mode 4			Date:	2015/05/21		
Frequency:	2441 MHz			Test By:	Fly Lu		
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar.
4881	41.58	5.9	47.38	74.0	26.62	peak	H
7323	35.86	6.8	42.66	74.0	31.34	peak	H
4882	43.79	5.9	49.59	74.0	24.41	peak	V
7323	32.46	6.8	39.26	74.0	34.74	peak	V

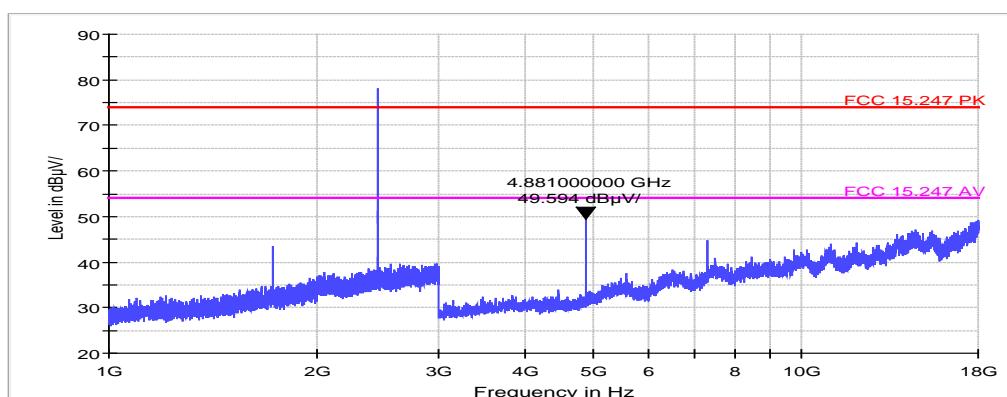
Horizontal

FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Vertical

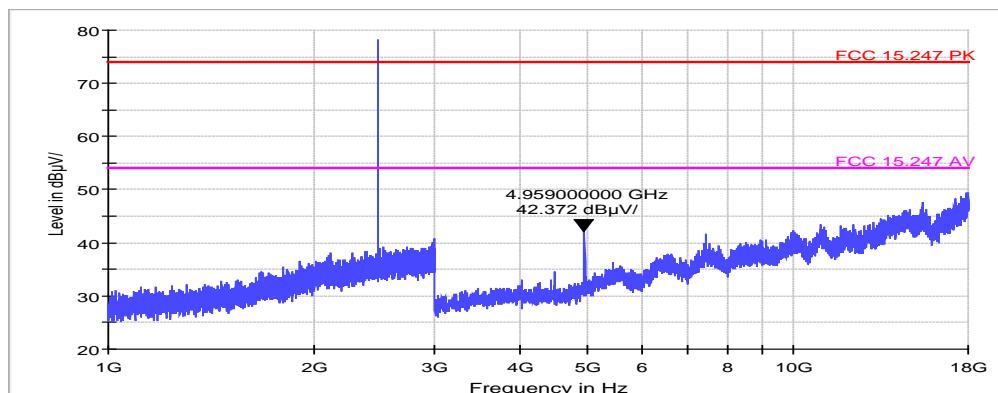
FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Standard:	FCC Part 15C			Test Distance:	3m		
Test item:	Radiated Emission			Power:	AC 120V/60HZ		
Model Number:	MIRAGII-N-A			Temp.(°C)/Hum.(%RH):	26(°C)/60%RH		
Mode:	Mode 4			Date:	2015/05/21		
Frequency:	2480 MHz			Test By:	Fly Lu		
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar.
4959	36.47	5.9	42.37	74.0	31.63	peak	H
7438	35.37	6.8	42.17	74.0	31.83	peak	H
4959	30.57	5.9	36.47	74.0	37.53	peak	V
7438	38.89	6.8	45.69	74.0	28.31	peak	V

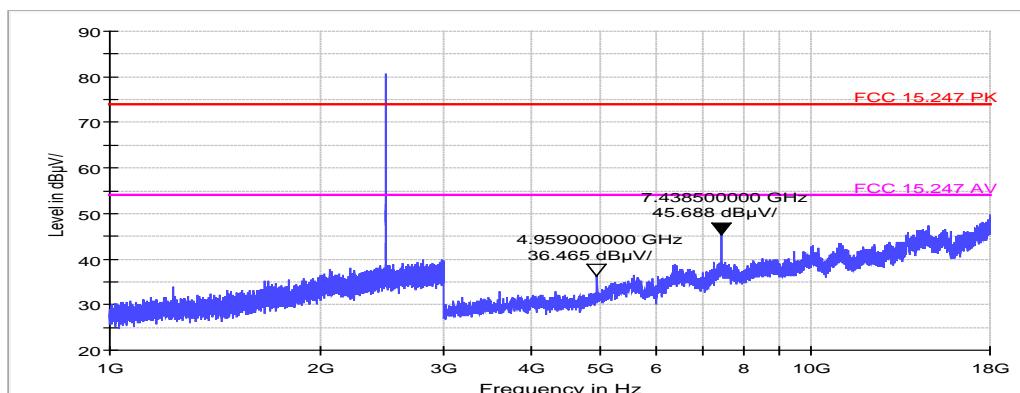
Horizontal

FCC Electric Field Strength 1-18GHz operate on 2.4GHz



Vertical

FCC Electric Field Strength 1-18GHz operate on 2.4GHz

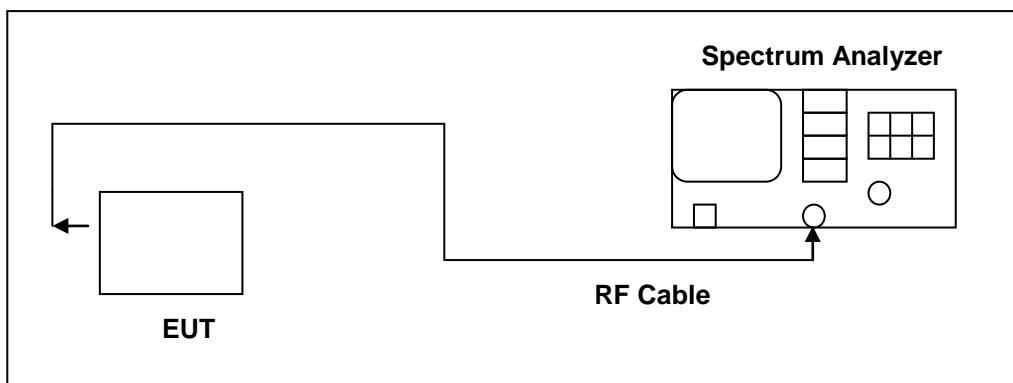


7 20dB RF Bandwidth Measurement

7.1 Limit

N/A

7.2 Test Setup



7.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9039A	MY46520256	01/10/2015	2 Years
Test Site	ATL	TE02	TE02	N.C.R.	-----

7.4 Test Procedure

20dB RF Bandwidth

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth frequency hopping function of the EUT was enabled. The spectrum analyzer used the following settings:

1. Span = approx. 2 to 3 times the 20dB bandwidth, centered on a hopping frequency
2. RBW $\geq 1\%$ of the 20dB span
3. VBW \geq RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize. The EUT was transmitting at its maximum data rate. The marker-to-peak function was used to set the marker to the peak of the emission. The marker-delta function was used to measure 20dB down one side of the emission. The marker-delta function and marker was moved to the other side of the

emission until it was even with the reference marker. The marker-delta reading at this point was the 20dB bandwidth of the emission.

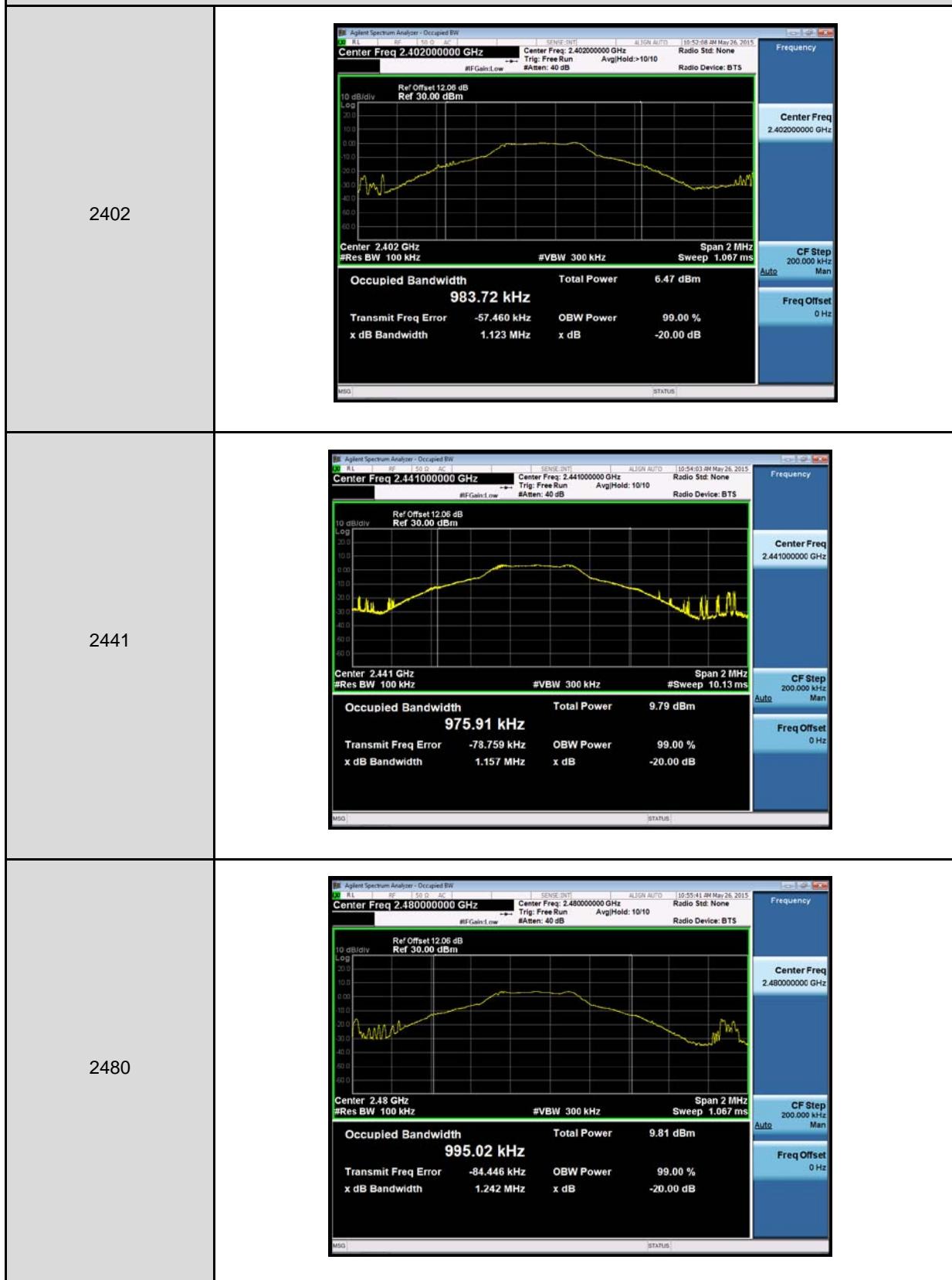
7.5 Test Result

Model Number	MIRAGII-N-A	
Test Item	20dB RF Bandwidth and 99 % Occupied Bandwidth	
Test Mode	Mode 2: GFSK Link Mode	
Date of Test	2015/05/26	
Frequency (MHz)	20dB RF Bandwidth (MHz)	Limit (MHz)
2402	1.123	-----
2441	1.157	-----
2480	1.242	-----

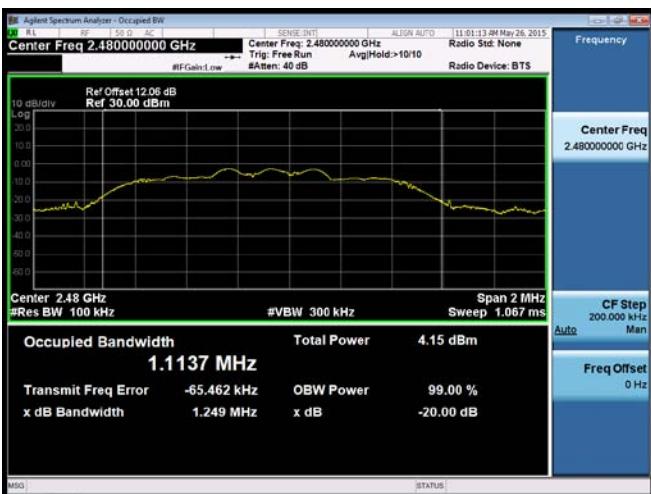
Model Number	MIRAGII-N-A	
Test Item	20dB RF Bandwidth and 99 % Occupied Bandwidth	
Test Mode	Mode 4: 8DPSK Link Mode	
Date of Test	2015/05/26	
Frequency (MHz)	20dB RF Bandwidth (MHz)	Limit (MHz)
2402	1.324	-----
2441	1.384	-----
2480	1.249	-----

7.6 Test Graphs

Mode 2: GFSK Link Mode



Mode 4: 8DPSK Link Mode

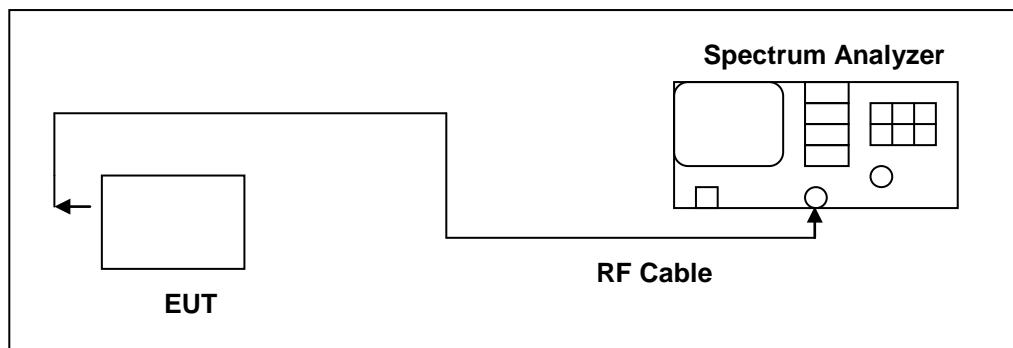
2402	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.441000000 GHz SENSE: INT ALIGN: AUTO 10:59:41 AM May 26, 2015</p> <p>Ref Offset 12.06 dB Ref 30.00 dBm</p> <p>Span 2 MHz #VBW 300 kHz Sweep 1.067 ms</p> <p>Occupied Bandwidth: 1.2973 MHz</p> <p>Total Power: 4.53 dBm</p> <p>Transmit Freq Error: -64.751 kHz OBW Power: 99.00 %</p> <p>x dB Bandwidth: 1.384 MHz x dB: -20.00 dB</p>
2441	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.480000000 GHz SENSE: INT ALIGN: AUTO 11:01:13 AM May 26, 2015</p> <p>Ref Offset 12.06 dB Ref 30.00 dBm</p> <p>Span 2 MHz #VBW 300 kHz Sweep 1.067 ms</p> <p>Occupied Bandwidth: 1.1137 MHz</p> <p>Total Power: 4.15 dBm</p> <p>Transmit Freq Error: -65.462 kHz OBW Power: 99.00 %</p> <p>x dB Bandwidth: 1.249 MHz x dB: -20.00 dB</p>
2480	 <p>Agilent Spectrum Analyzer - Occupied BW</p> <p>Center Freq: 2.480000000 GHz SENSE: INT ALIGN: AUTO 11:01:13 AM May 26, 2015</p> <p>Ref Offset 12.06 dB Ref 30.00 dBm</p> <p>Span 2 MHz #VBW 300 kHz Sweep 1.067 ms</p> <p>Occupied Bandwidth: 1.1137 MHz</p> <p>Total Power: 4.15 dBm</p> <p>Transmit Freq Error: -65.462 kHz OBW Power: 99.00 %</p> <p>x dB Bandwidth: 1.249 MHz x dB: -20.00 dB</p>

8 Carrier Frequency Separation Measurement

8.1 Limit

Title 47 of the CFR, Part 15 Subpart (c) 15.247(a)(1)(i) requires the measurement of the bandwidth of the transmission between the -20 dB points on the transmitted spectrum. The results of this test determine the limits for channel spacing. The channel spacing shall be a minimum of 25 kHz or the 20 dB bandwidth.

8.2 Test Setup



8.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Signal Analyzer	Agilent	N9020A	MY53420615	12/19/2014	1Year

8.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth transmitter of the V6 had its hopping function enabled. The following spectrum analyzer settings were used:

1. Span = wide enough to capture the peaks of two adjacent channels
2. Resolution (or IF) Bandwidth (RBW) $\geq 1\%$ of the span
3. Video (or Average) Bandwidth (VBW) \geq RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

8.5 Test Result

Model Number	MIRAGII-N-A	
Test Item	Carrier Frequency Separation	
Test Mode	Mode 2: GFSK Link Mode	
Date of Test	2015/05/26	
Frequency (MHz)	Measurement (MHz)	Limit (MHz)
2441	0.935	>0.832

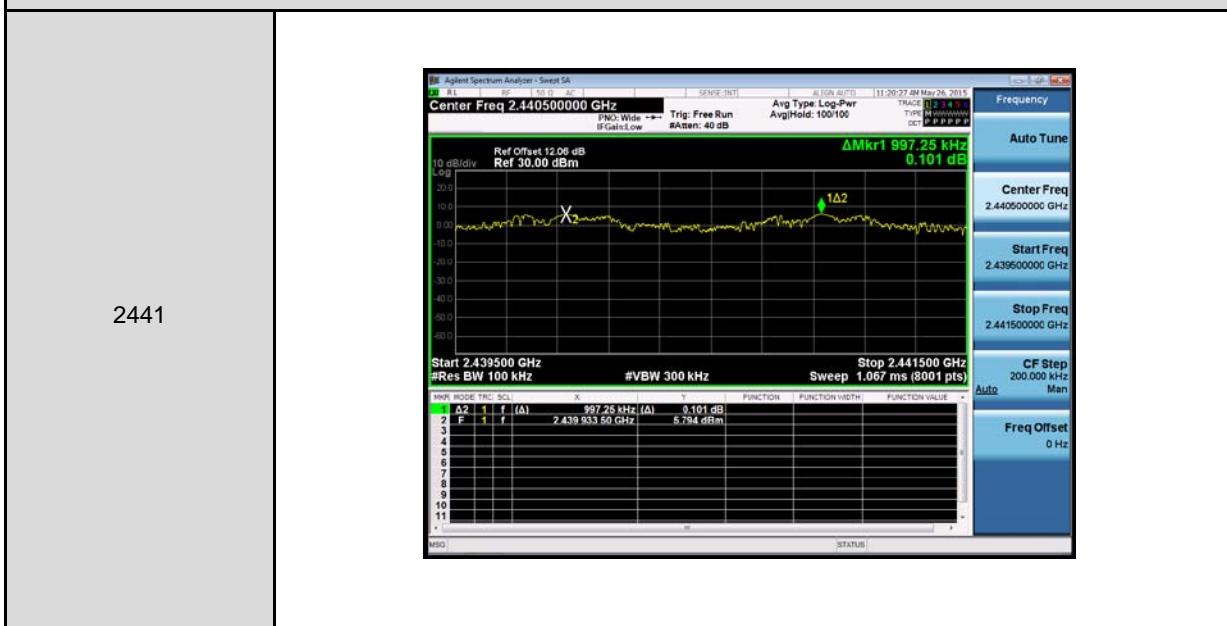
Model Number	MIRAGII-N-A	
Test Item	Carrier Frequency Separation	
Test Mode	Mode 4: 8DPSK Link Mode	
Date of Test	2015/05/26	
Frequency (MHz)	Measurement (MHz)	Limit (MHz)
2441	0.997	>0.927

8.6 Test Graphs

Mode 2: GFSK Link Mode



Mode 4: 8DPSK Link Mode

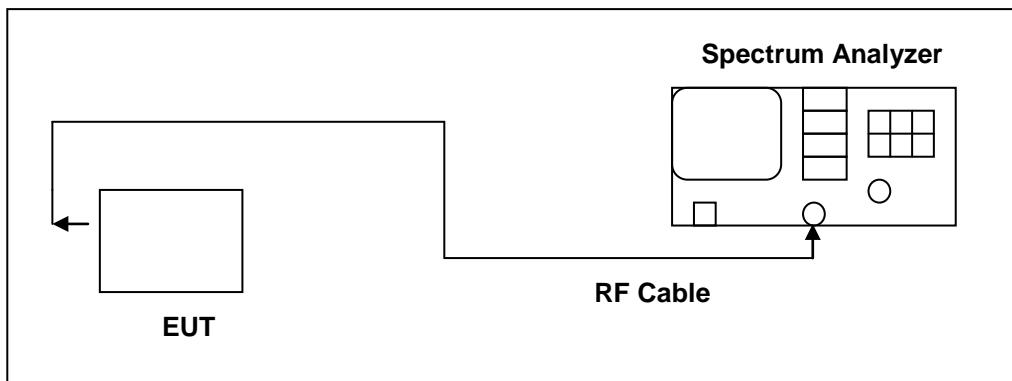


9 Number of Hopping Measurement

9.1 Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

9.2 Test Setup



9.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9039A	MY46520256	01/10/2015	2 Years
Test Site	ATL	TE02	TE02	N.C.R.	-----

9.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth frequency hopping function of the EUT was enabled. The spectrum analyzer used the following settings:

1. Span = the frequency band of operation
2. RBW $\geq 1\%$ of the span
3. VBW \geq RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize.

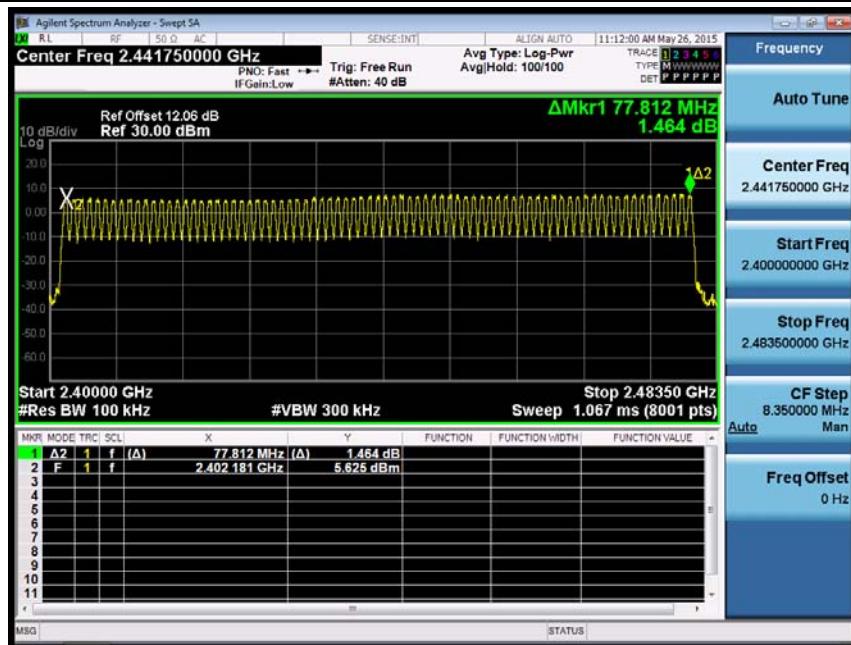
9.5 Test Result

Model Number	MIRAGII-N-A	
Test Item	Number of Hopping	
Test Mode	Mode 2: GFSK Link Mode	
Date of Test	2015/05/26	
Frequency Range (MHz)	Measurement (ch)	Limit (ch)
2402 - 2480	79	> 15

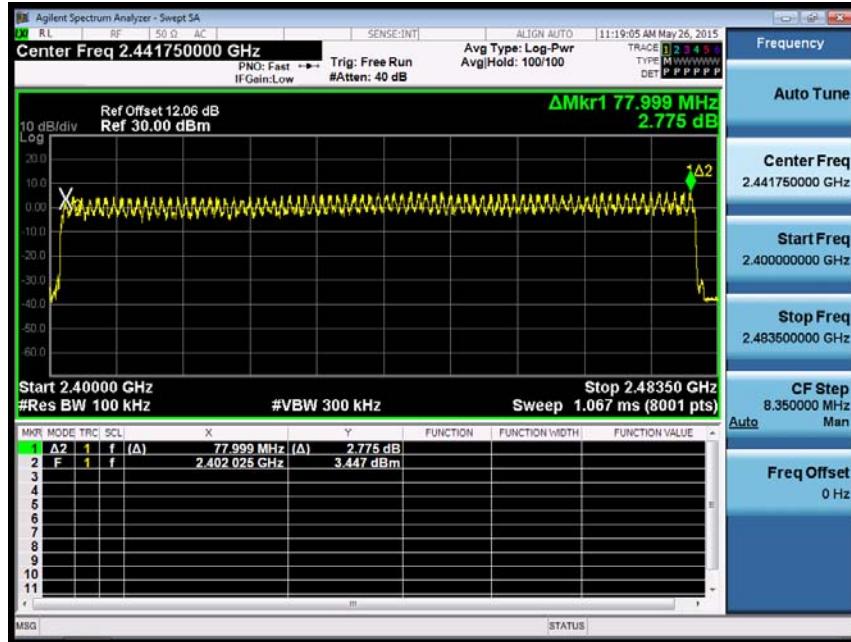
Model Number	MIRAGII-N-A	
Test Item	Number of Hopping	
Test Mode	Mode 4: 8DPSK Link Mode	
Date of Test	2015/05/26	
Frequency Range (MHz)	Measurement (ch)	Limit (ch)
2402 - 2480	79	> 15

9.6 Test Graphs

Mode 2: GFSK Link Mode



Mode 4: 8DPSK Link Mode

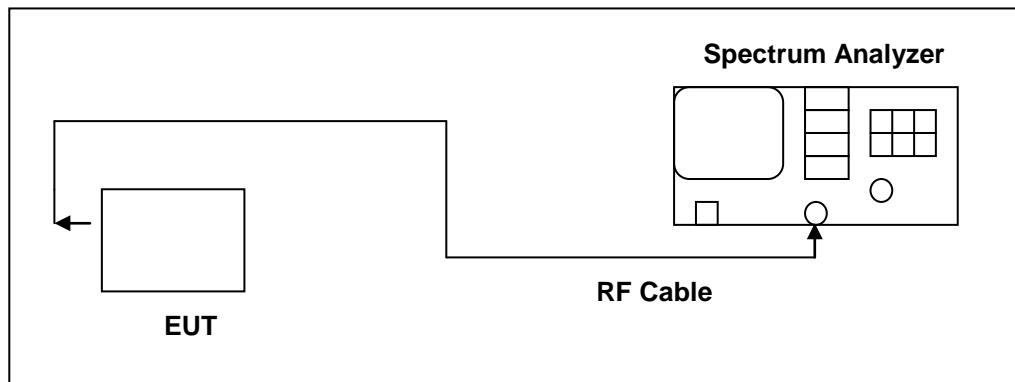


10 Time of Occupancy (Dwell Time) Measurement

10.1 Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

10.2 Test Setup



10.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9039A	MY46520256	01/10/2015	2 Years
Test Site	ATL	TE02	TE02	N.C.R.	-----

10.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage. The Bluetooth hopping function of the EUT was enabled. The following spectrum analyzer settings were used:

1. Span = zero span, centered on a hopping channel
2. RBW = 1 MHz
3. VBW \geq RBW
4. Sweep = as necessary to capture the entire dwell time per hopping channel
5. Detector function = peak
6. Trace = max hold

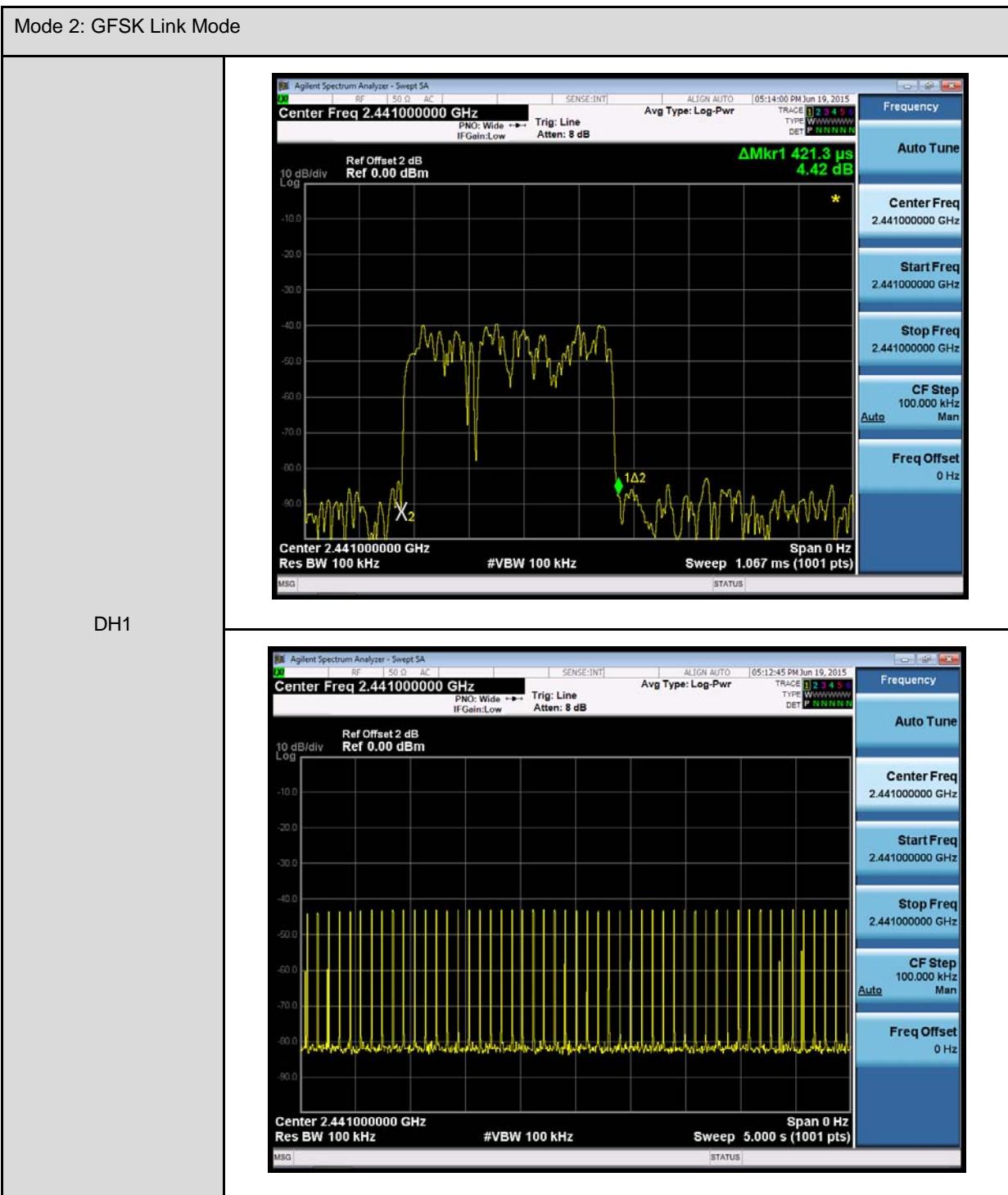
The marker-delta function was used to determine the dwell time.

10.5 Test Result

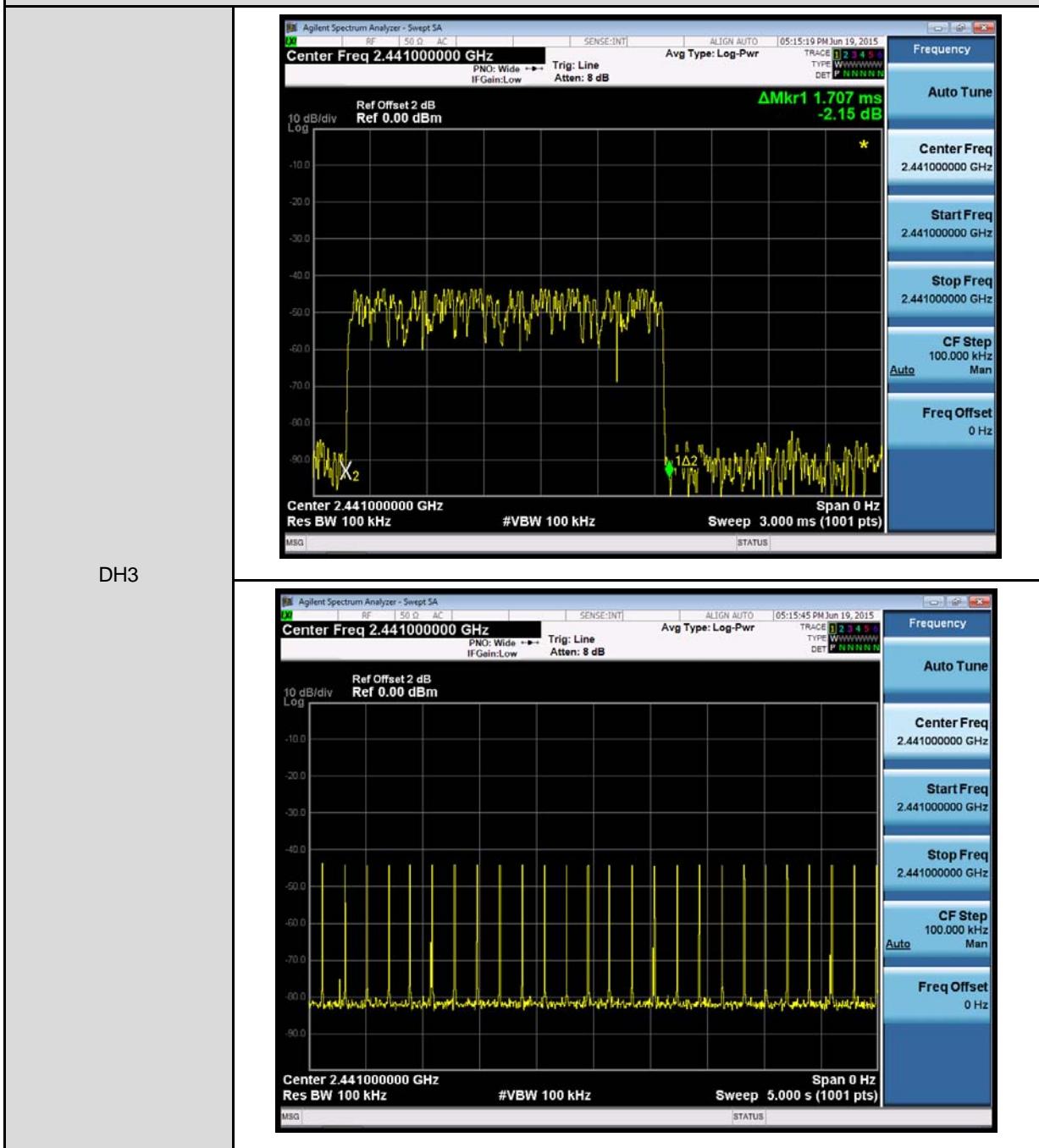
Model Number	MIRAGII-N-A
Test Item	Time of Occupancy (Dwell Time)
Test Mode	Mode 2: GFSK Link Mode
Date of Test	2015/06/19
DH1	
Length of per burst(ms)	0.4213
Number of burst in 5 seconds	51
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$
Dwell Times	$31.6/5*51*0.4213 = 135.793$
LIMIT(msec)	< = 400
DH3	
Length of per burst(ms)	1.707
Number of burst in 5 seconds	27
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$
Dwell Times	$31.6/5*25*1.707 = 269.706$
LIMIT(msec)	< = 400
DH5	
Length of per burst(ms)	2.955
Number of burst in 5 seconds	18
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$
Dwell Times	$31.6/5*17*2.955 = 336.161$
LIMIT(msec)	< = 400

Model Number	MIRAGII-N-A
Test Item	Time of Occupancy (Dwell Time)
Test Mode	Mode 4: 8DPSK Link Mode
Date of Test	2015/06/19
DH1	
Length of per burst(ms)	0.438
Number of burst in 5 seconds	51
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$
Dwell Times	$31.6/5*51*0.438 = 141.176$
LIMIT(msec)	< = 400
DH3	
Length of per burst(ms)	1.695
Number of burst in 5 seconds	26
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$
Dwell Times	$31.6/5*25*1.695 = 278.522$
LIMIT(msec)	< = 400
DH5	
Length of per burst(ms)	2.970
Number of burst in 5 seconds	18
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$
Dwell Times	$31.6/5*17*2.970 = 337.867$
LIMIT(msec)	< = 400

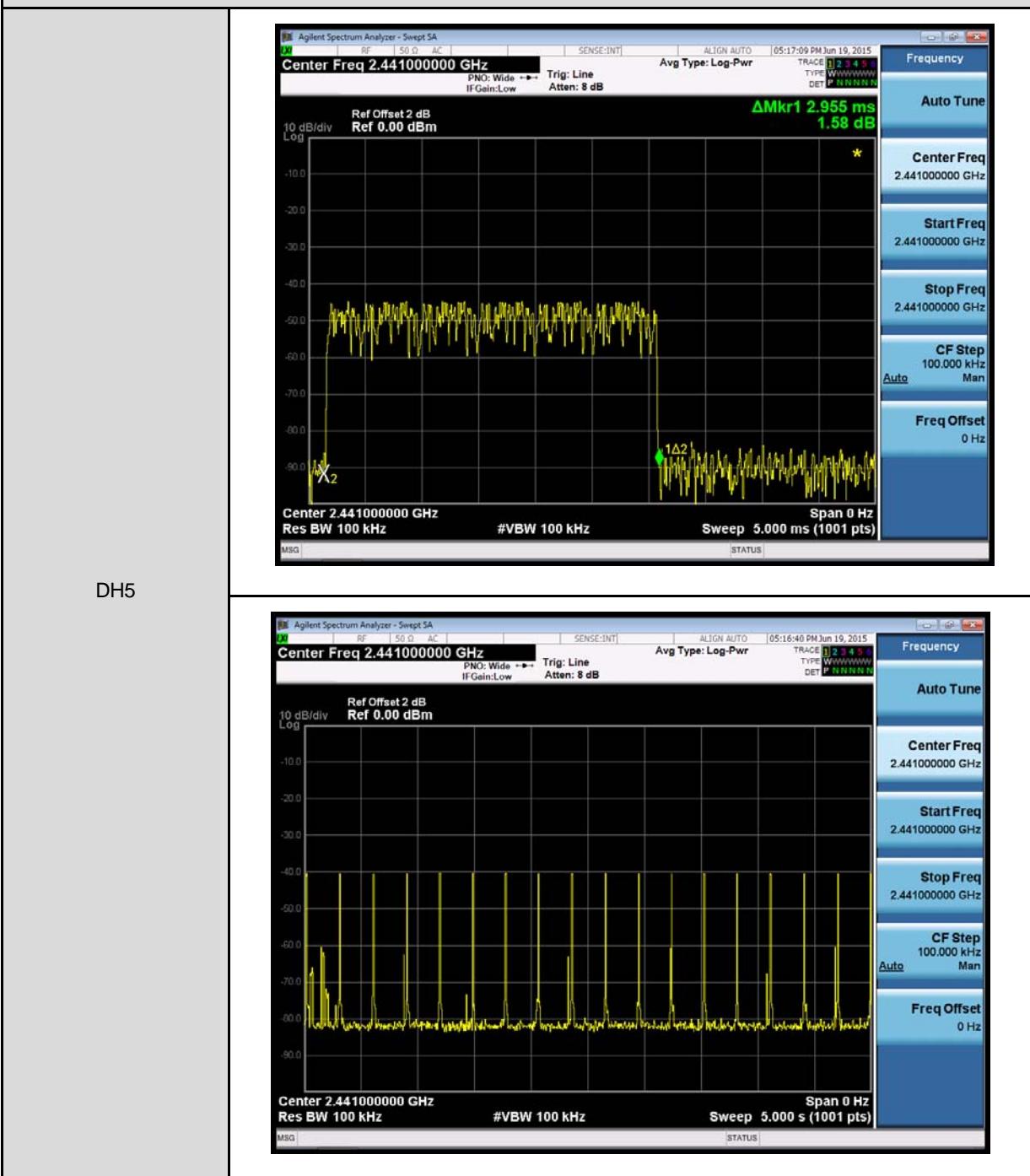
10.6 Test Graphs



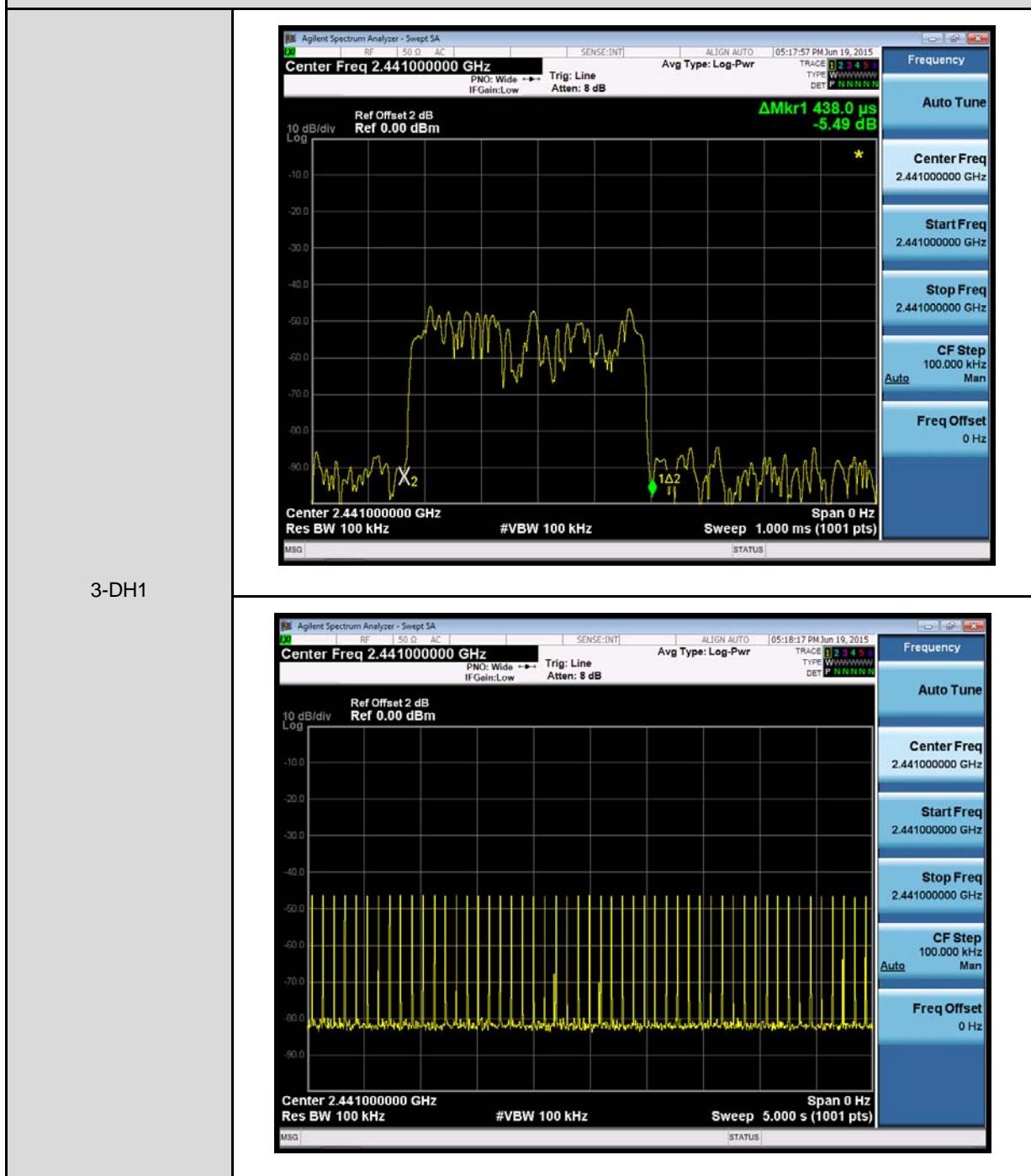
Mode 2: GFSK Link Mode



Mode 2: GFSK Link Mode

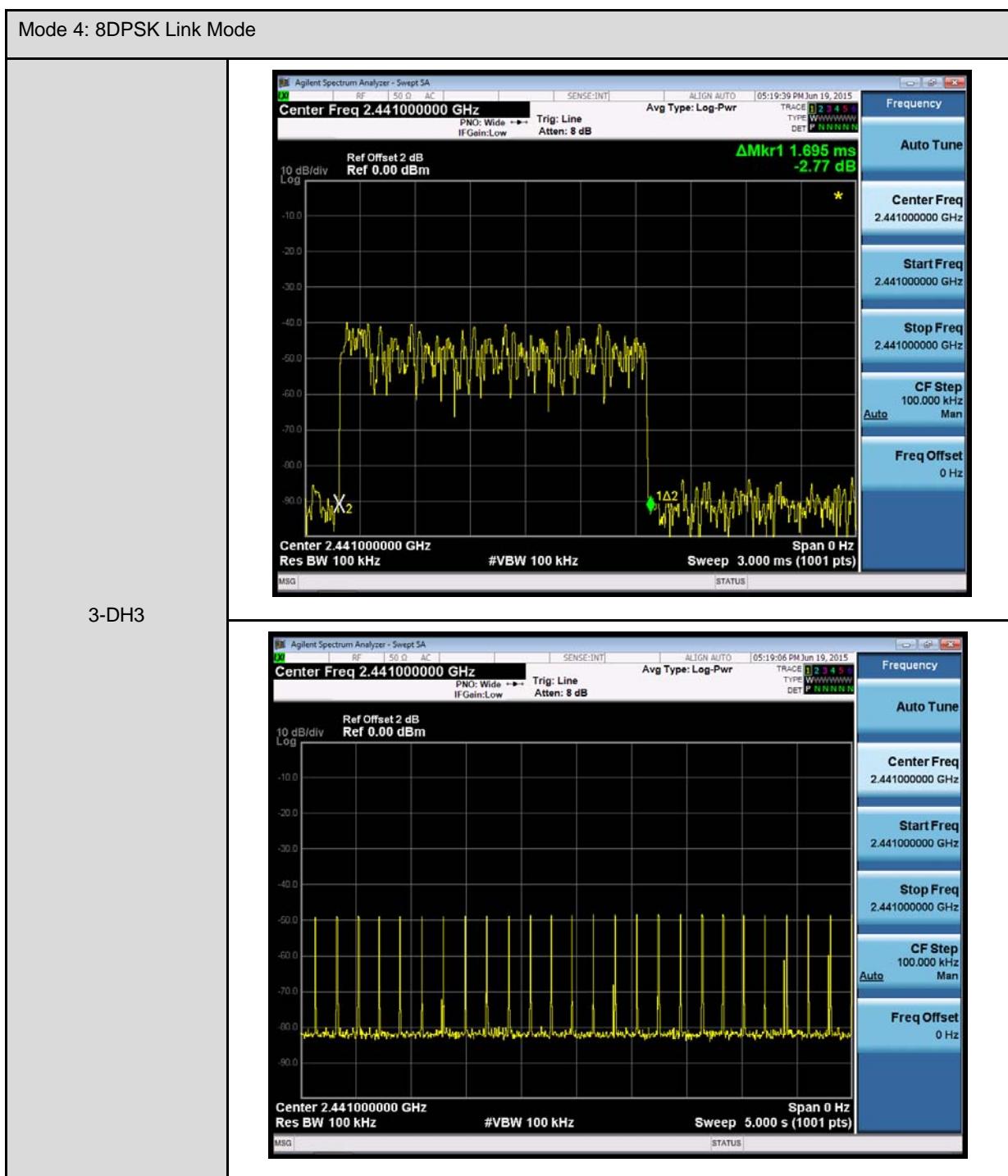


Mode 4: 8DPSK Link Mode

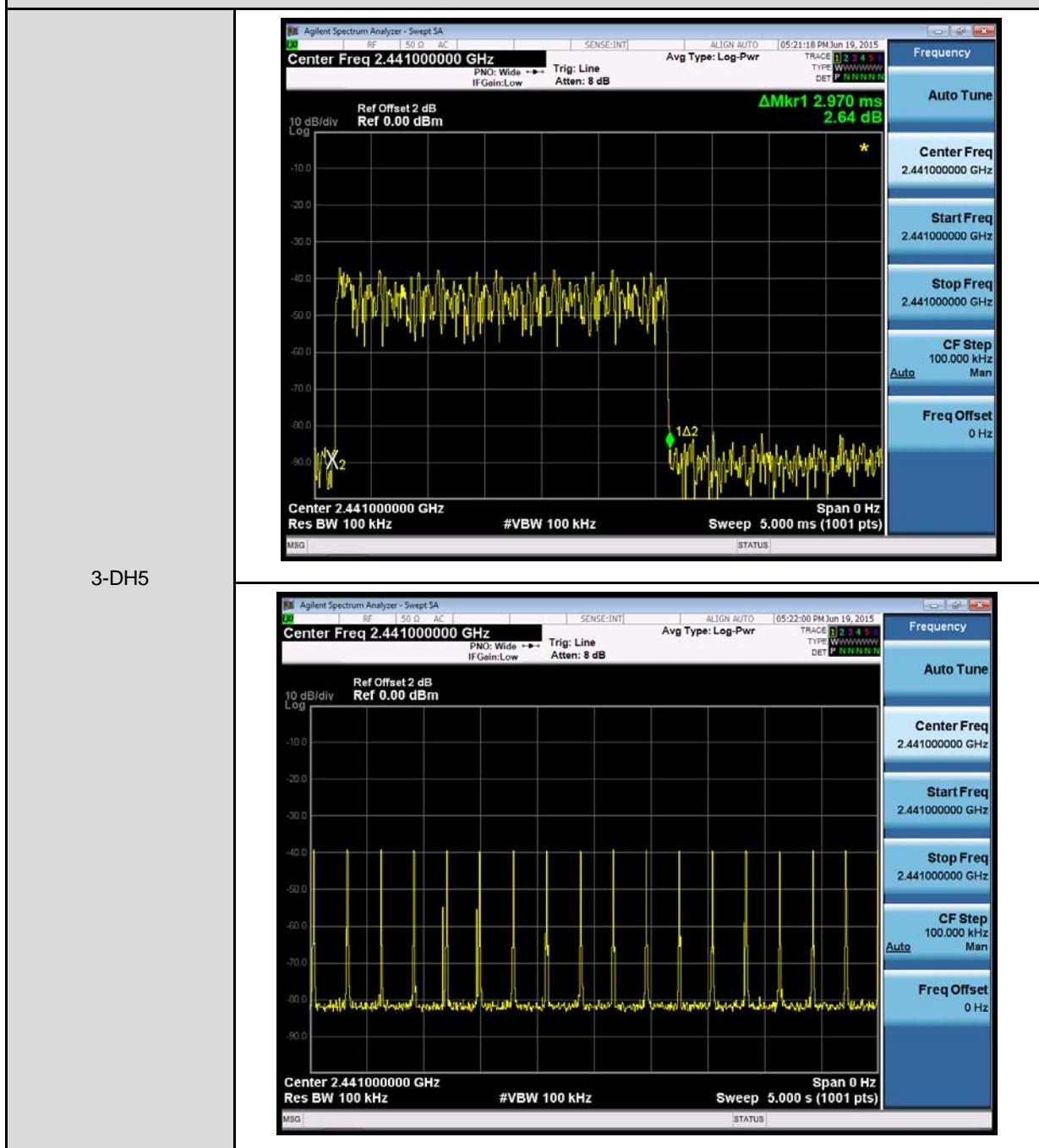


3-DH1

Mode 4: 8DPSK Link Mode



Mode 4: 8DPSK Link Mode



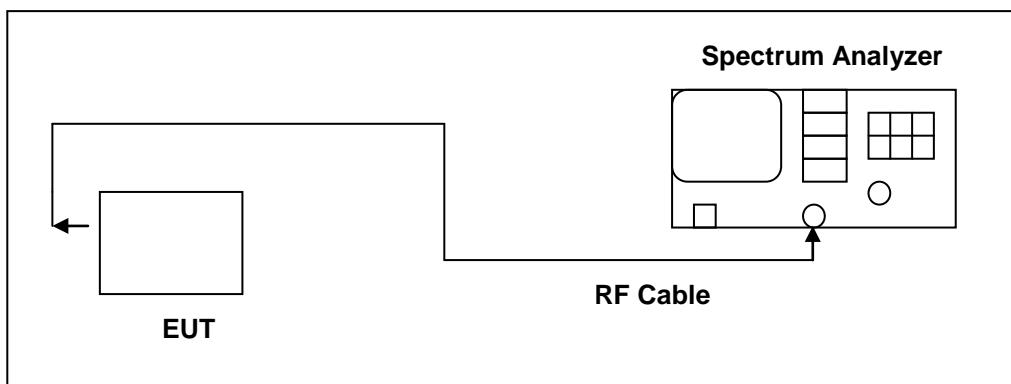
3-DH5

11 Out of Band Conducted Emissions Measurement

11.1 Limit

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

11.2 Test Setup



11.3 Test Instruments

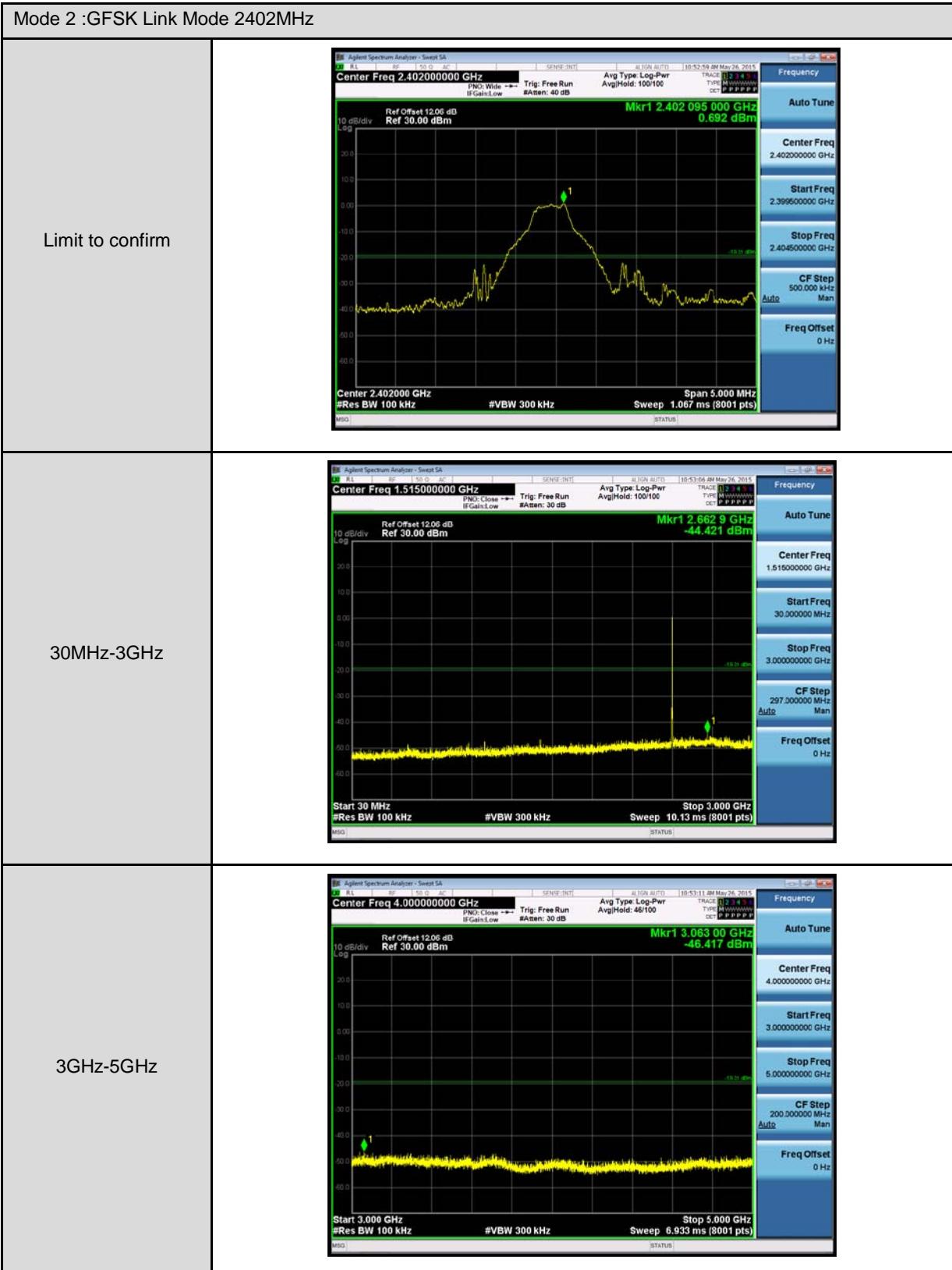
Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9039A	MY46520256	01/10/2015	2 Years
Test Site	ATL	TE02	TE02	N.C.R.	-----

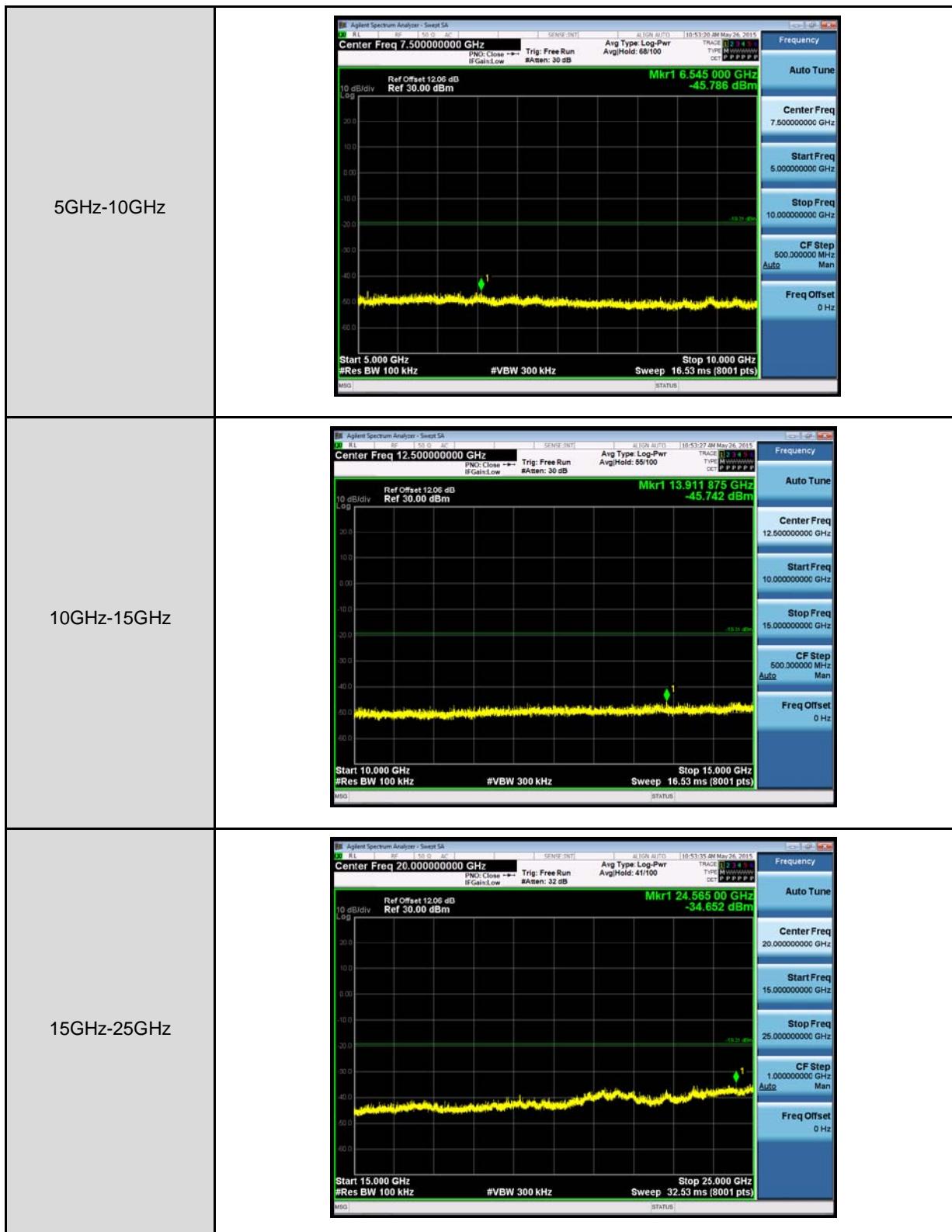
11.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band. The test was performed at 3 channels (Channel 0, 39, 78)

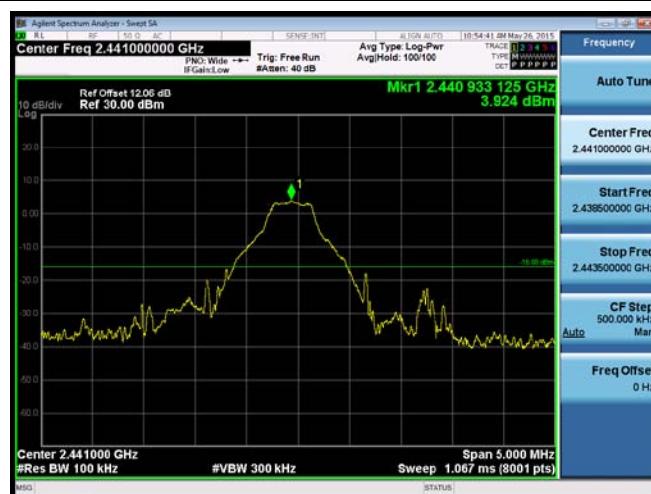
11.5 Test Graphs





Mode 2 :GFSK Link Mode 2441MHz

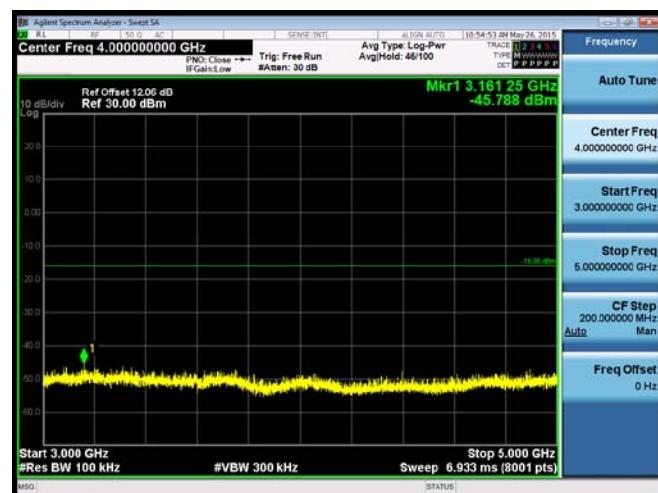
Limit to confirm

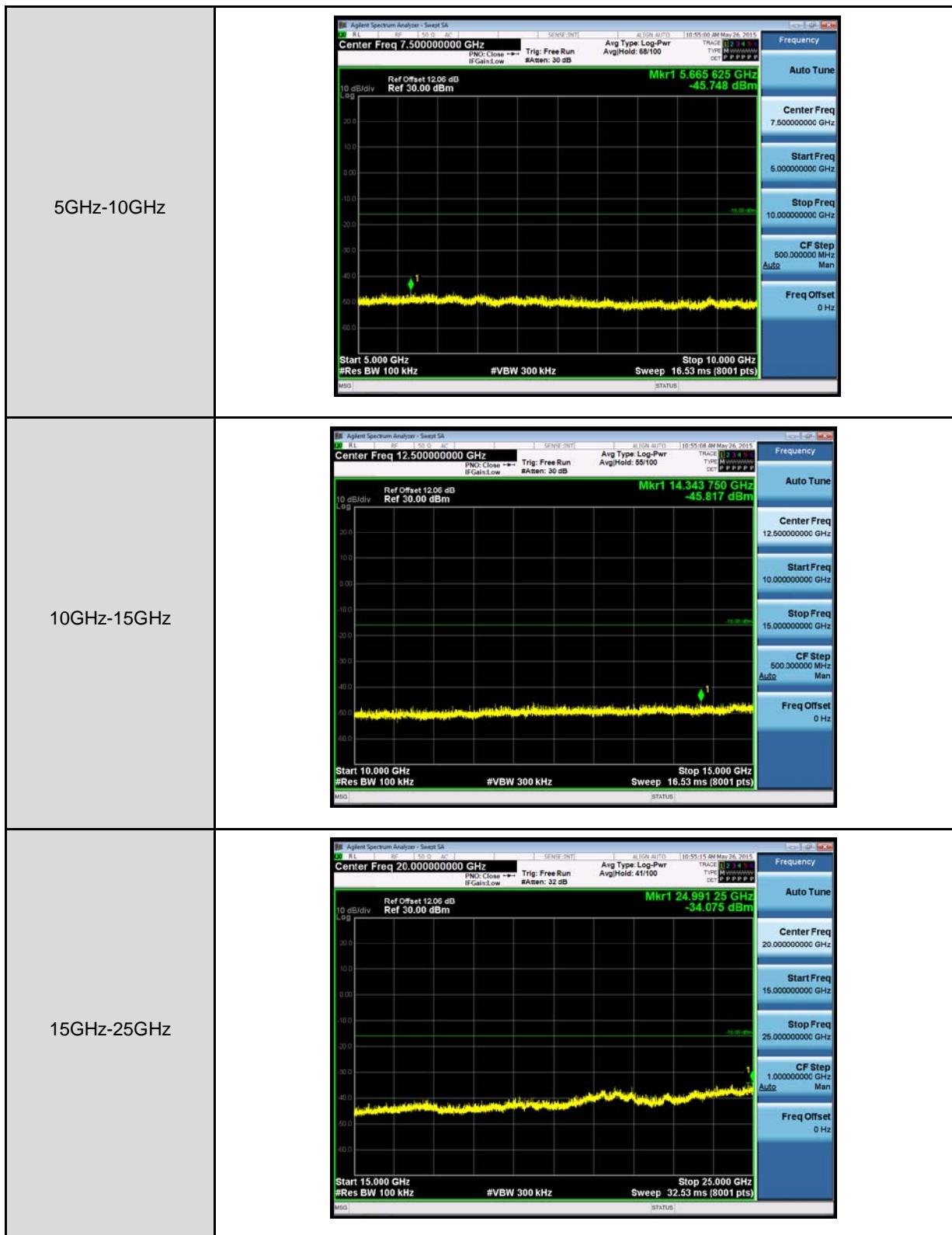


30MHz-3GHz



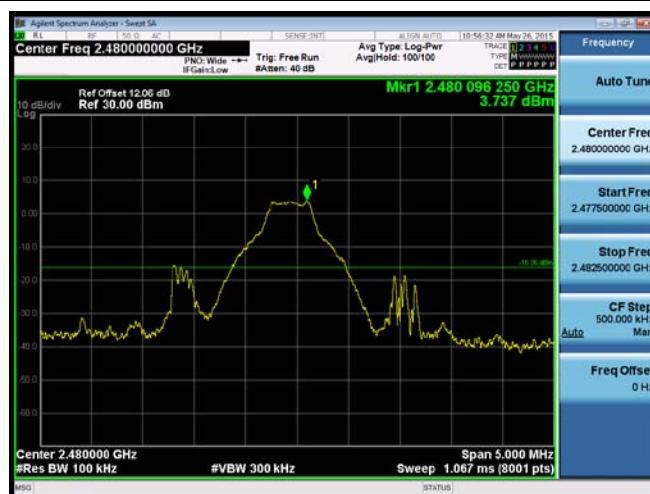
3GHz-5GHz



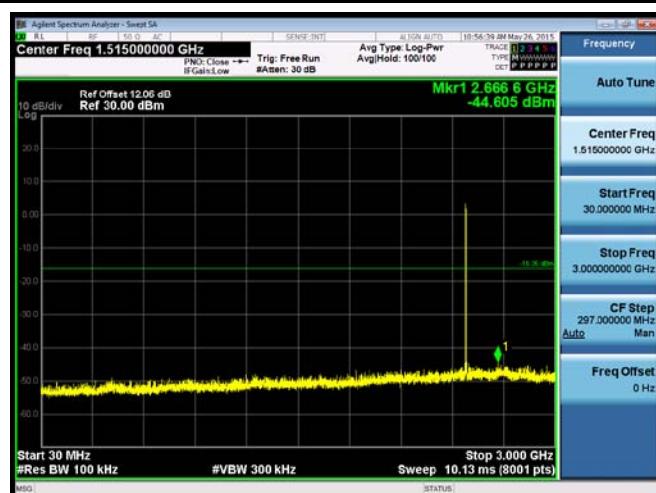


Mode 2 :GFSK Link Mode 2480MHz

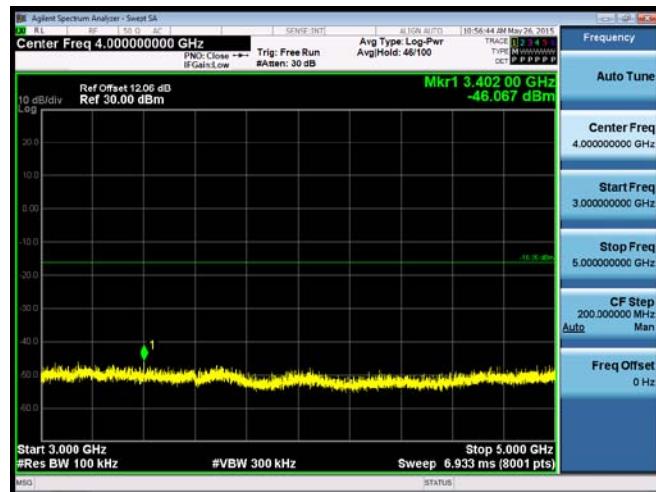
Limit to confirm

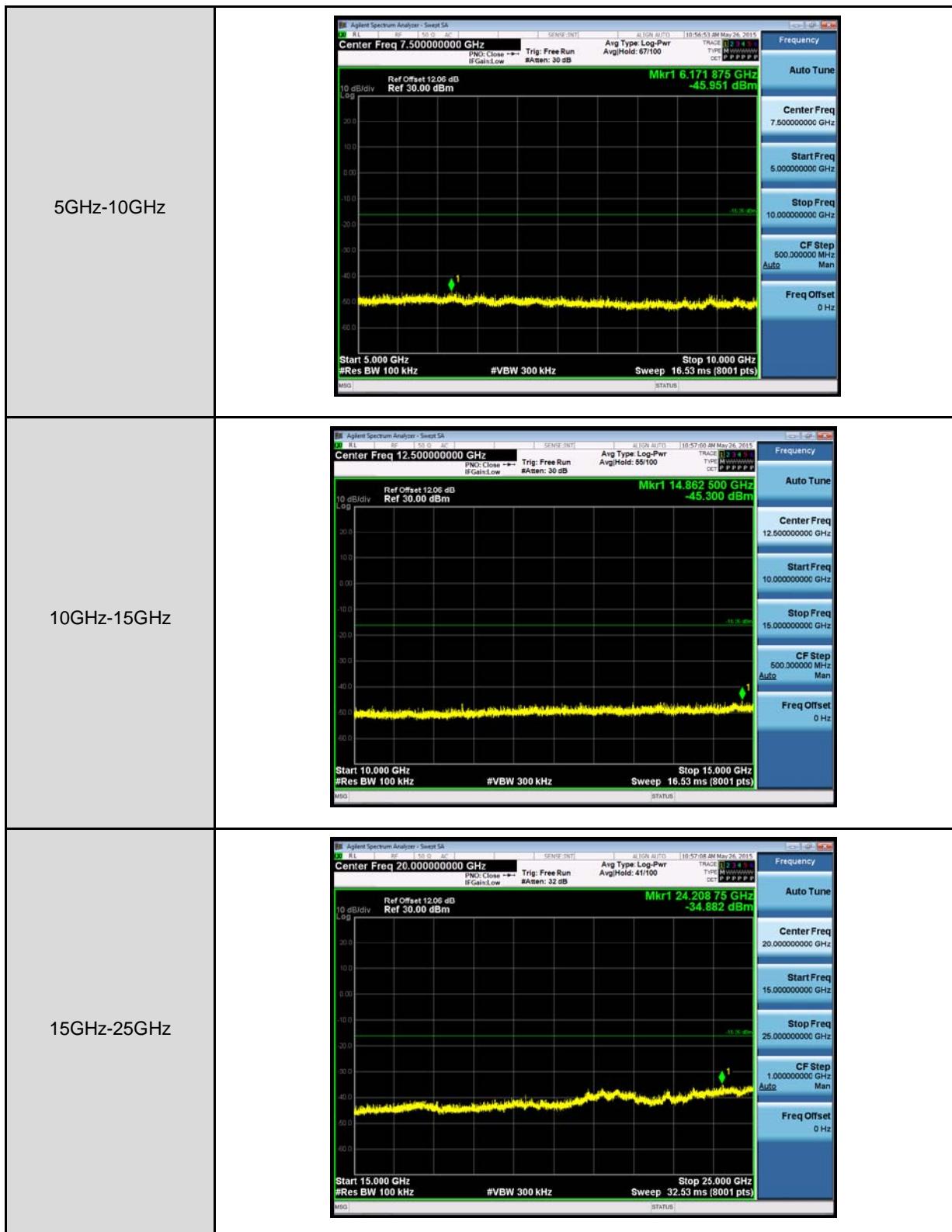


30MHz-3GHz



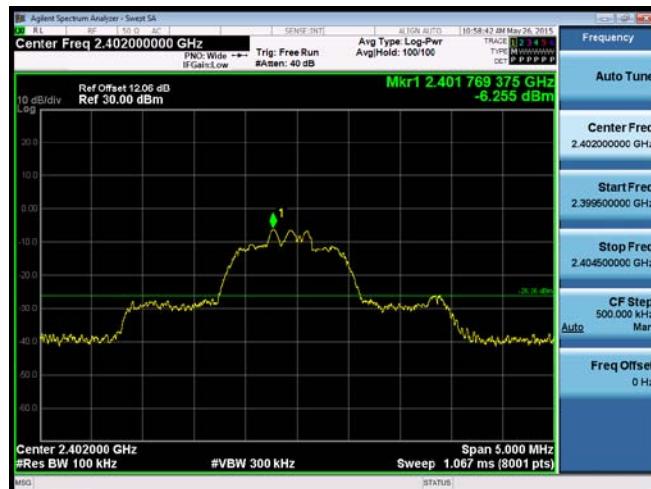
3GHz-5GHz



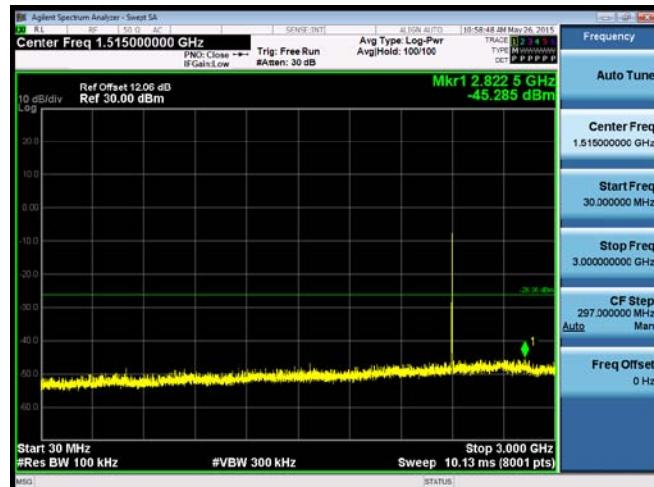


Mode 4 :8DPSK Link Mode 2402MHz

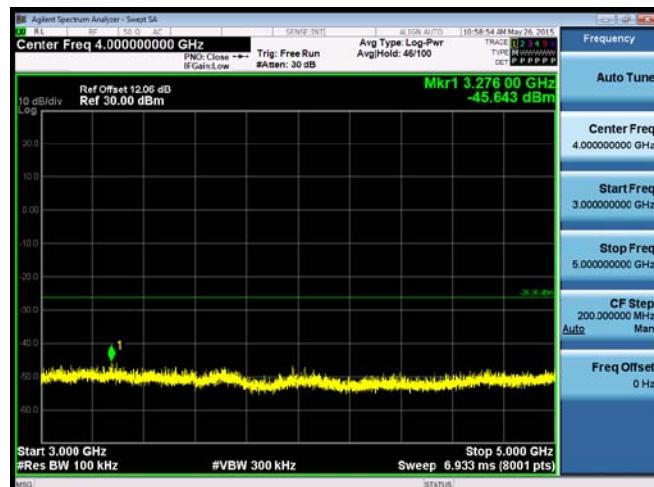
Limit to confirm

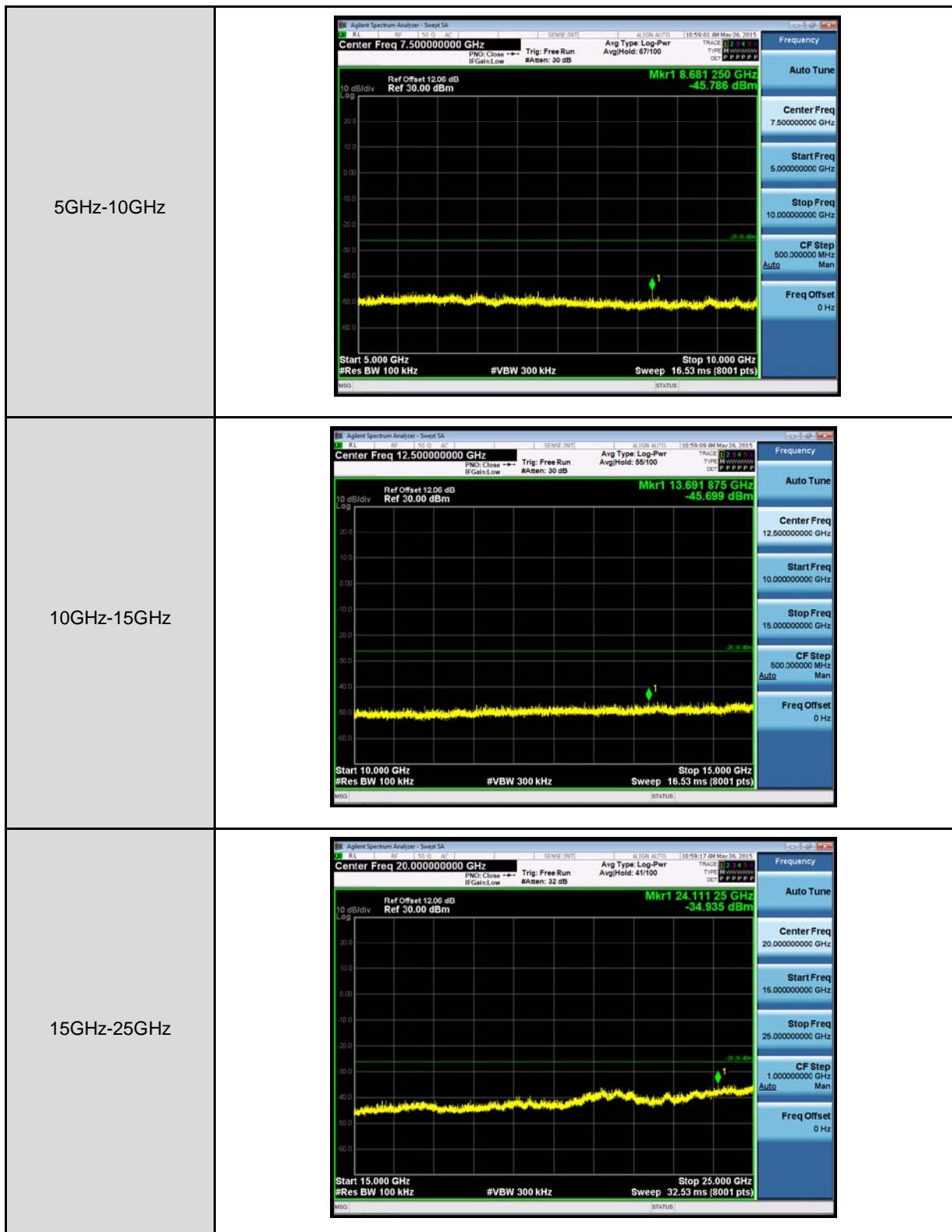


30MHz-3GHz



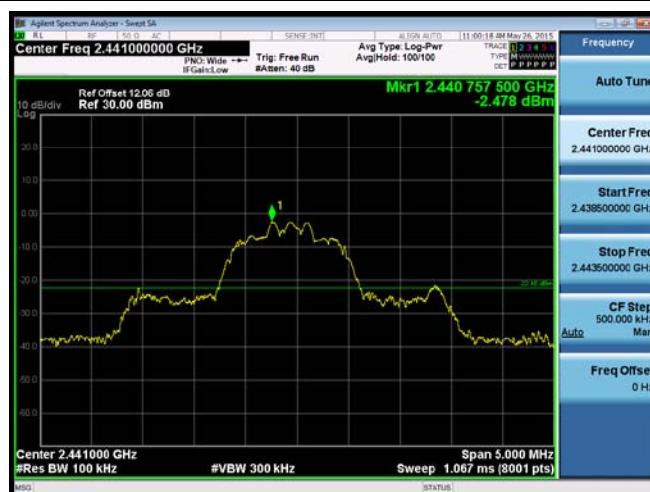
3GHz-5GHz



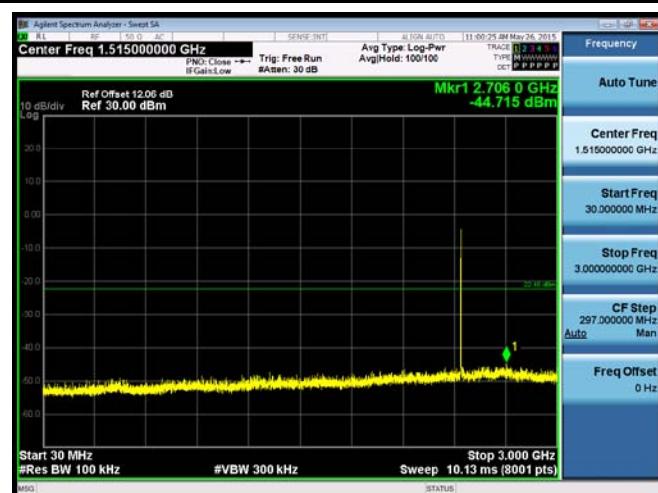


Mode 4 :8DPSK Link Mode 2441MHz

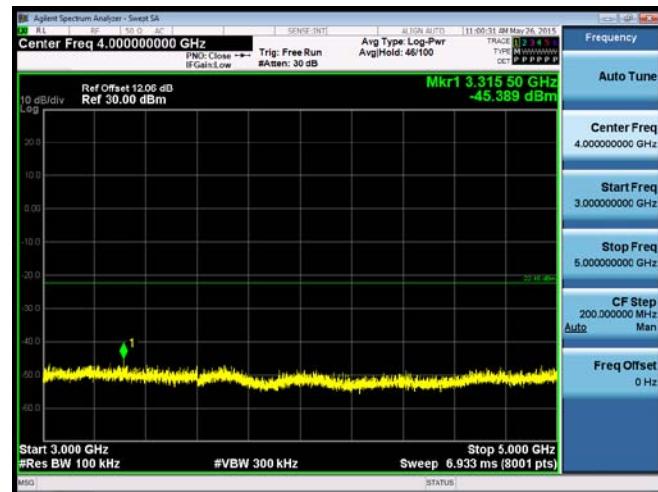
Limit to confirm

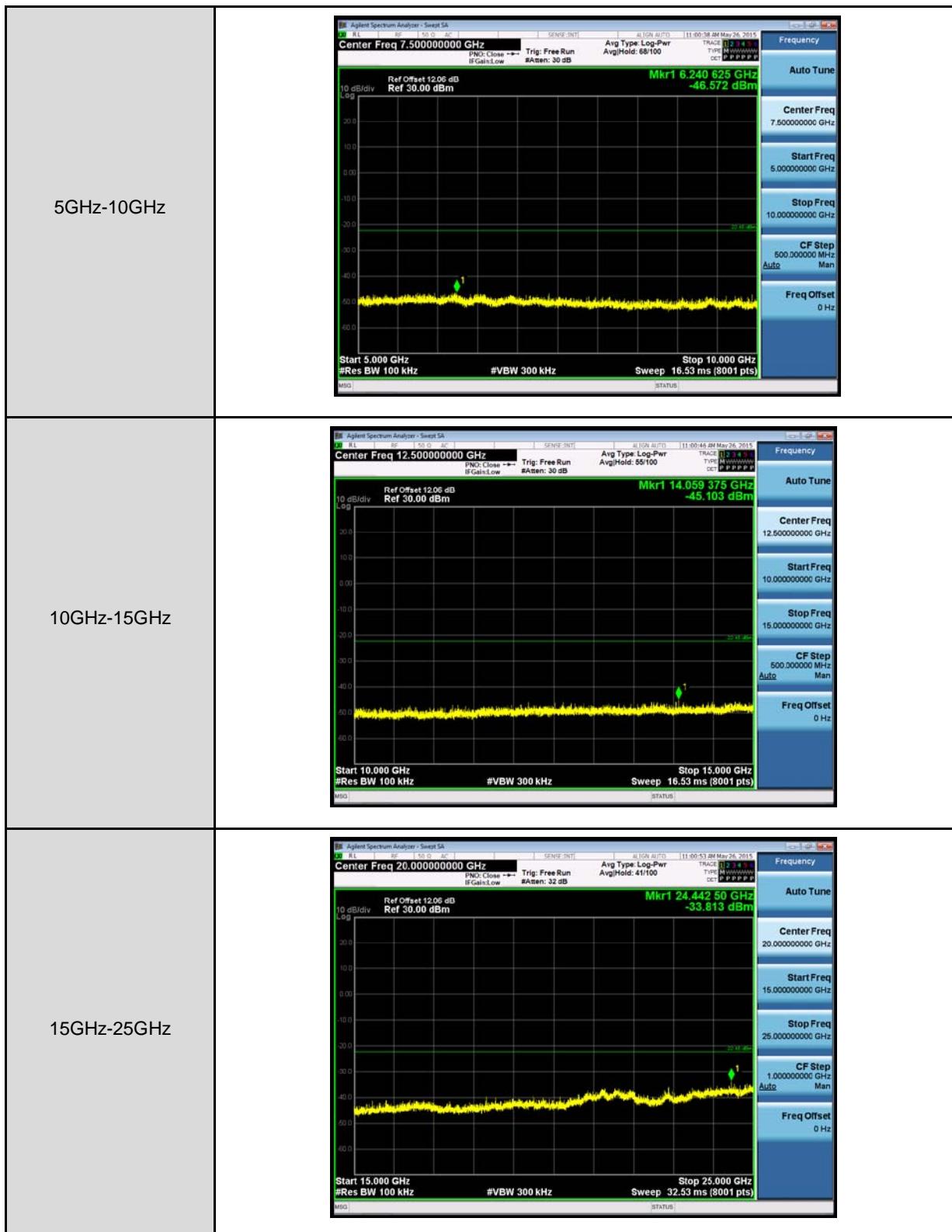


30MHz-3GHz



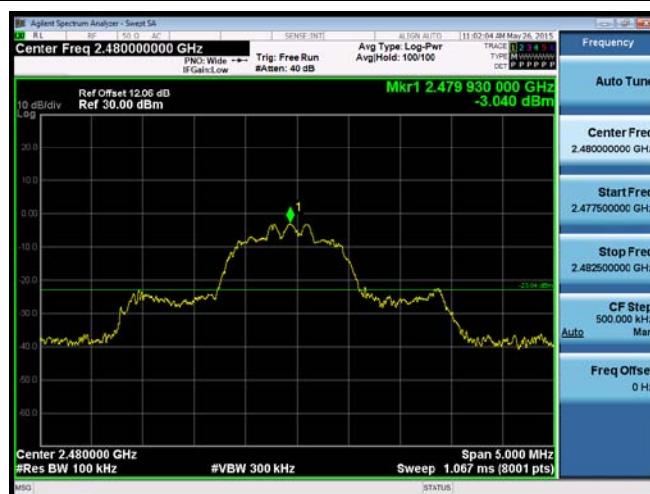
3GHz-5GHz



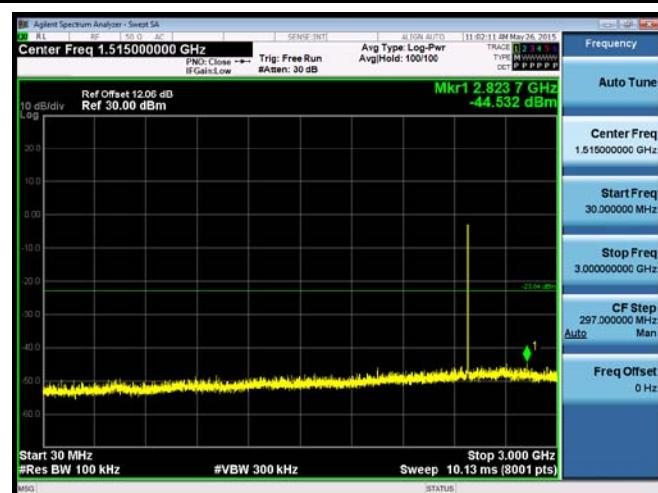


Mode 4 :8DPSK Link Mode 2480MHz

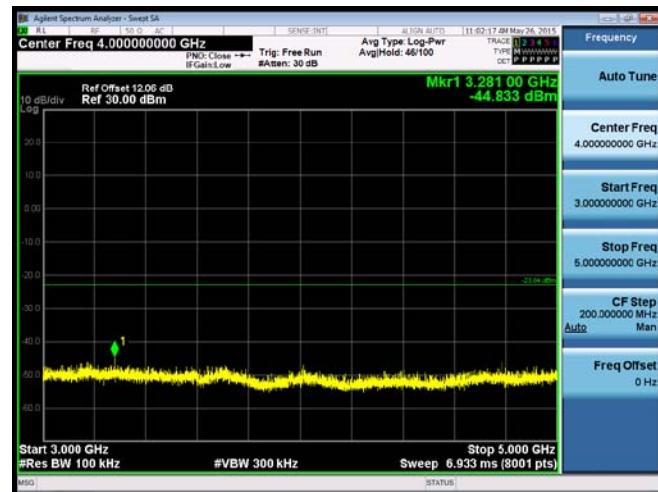
Limit to confirm

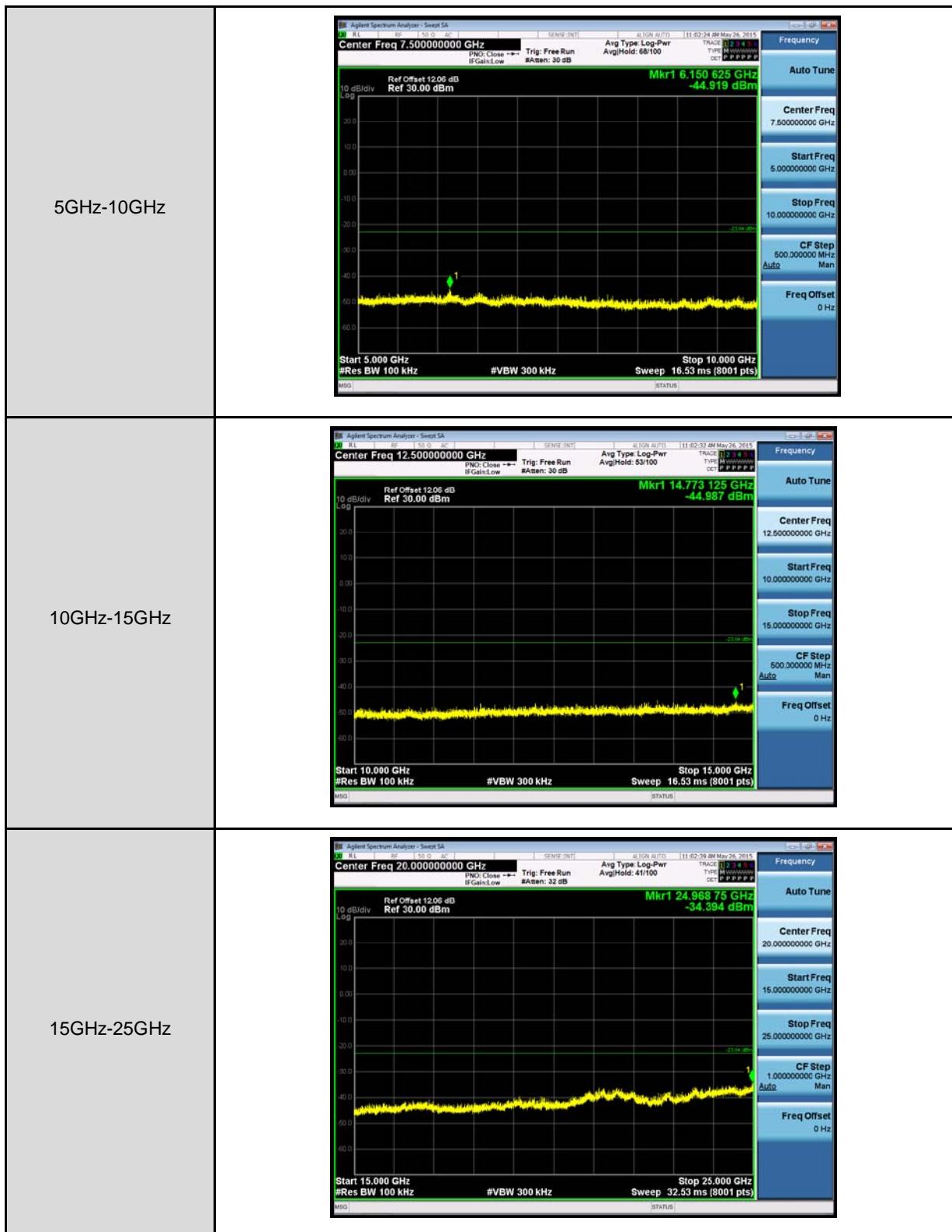


30MHz-3GHz



3GHz-5GHz





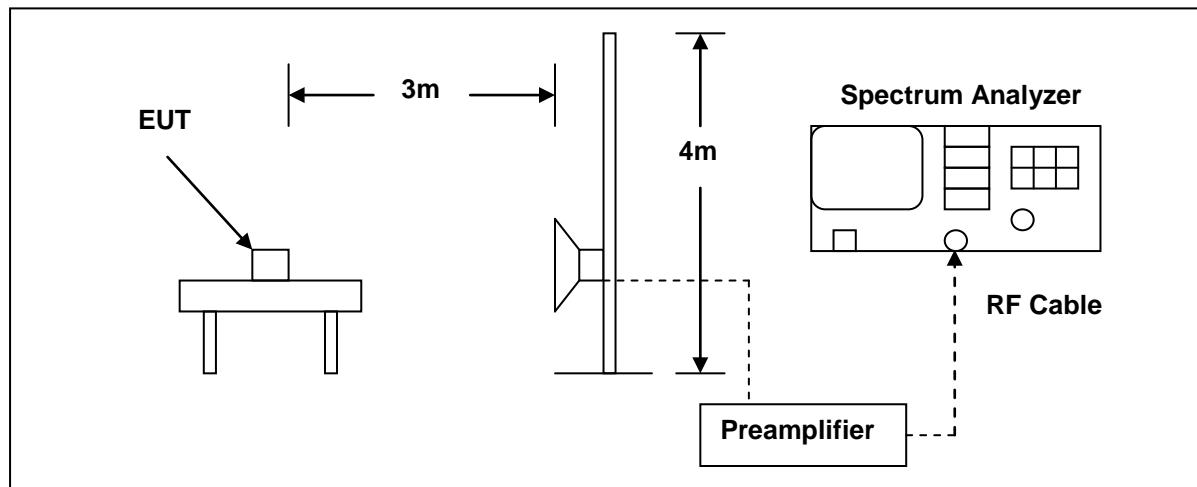
Note: No emission found between lowest internal used/generated frequencies to 30MHz (9 kHz~30MHz).

12 Band Edges Measurement

12.1 Limit

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

12.2 Test Setup



12.3 Test Instruments

3 Meter Chamber					
Model No.	Equipment	Manufacturer	Serial Number	Cal. Date	Remark
ESU40	EMI Test Receiver	R&S	SB8501/09	May.16, 2015	1 Year
VULB9163	Bilog Antenna	Schwarzbeck	SB8501/04	Jan.20, 2015	1 Year
HF906	Horn Antenna	R&S	SB3435	Jan.20, 2015	1 Year
--	Amplifier(1-18GHz)	R&S	SB3435/01	Jan.20, 2015	1 Year
--	Amplifier(18-40GHz)	R&S	SB3435/02	May.16, 2015	1 Year
AT4560	Horn Antenna	Amplifier Research	SB5392/02	May.16, 2015	1 Year
9X6X6	3m Semi-anechoic chamber	Albatross Projects	SB3450/01	Oct.12, 2013	2 Years
ESI26	EMI Test Receiver	Rohde & Schwarz	SB3436	Jan.20,2015	1 Year
VULB9163	Broadband antenna	SCHWARZBECK	SB3955	Jan.20,2015	1 Year

HF907	Horn Antenna	R&S	SB8501/01	Aug.15,2014	1 Year
Spectrum Analyzer	Agilent	N9039A	MY46520256	Jan.10, 2015	2 Years

12.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The emissions on the harmonics frequencies, the limits, and the margin of compliance are presented. These tests were made when the transmitter was in full radiated power. The additional test was performed to show compliance with the requirement at the band-edge frequency 2483.5 MHz and up to 2500 MHz and at 2390.0 MHz

The transmitter was configured with the worst case antenna and setup to transmit at the highest channel. Then the field strength was measured at 2483.5 MHz

The transmitter was then configured with the worst case antenna and setup to transmit at the lowest channel. Then the field strength was measured at 2390.0 MHz these tests were performed at 4 different bit rates.

For measurements the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

12.5 Test Result

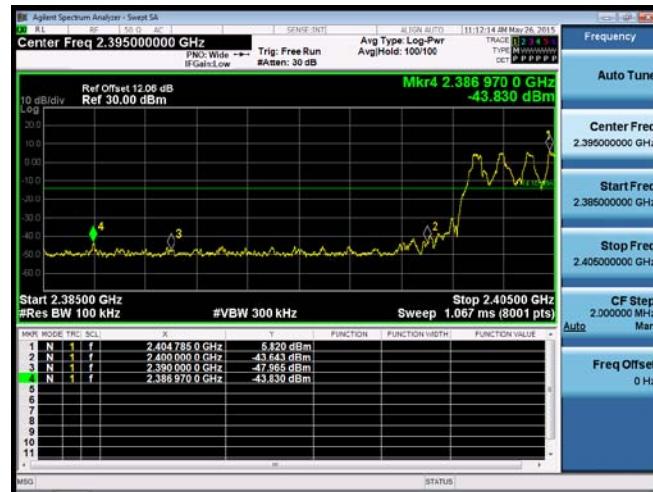
Conducted Band Edge

Mode 2: GFSK Link Mode

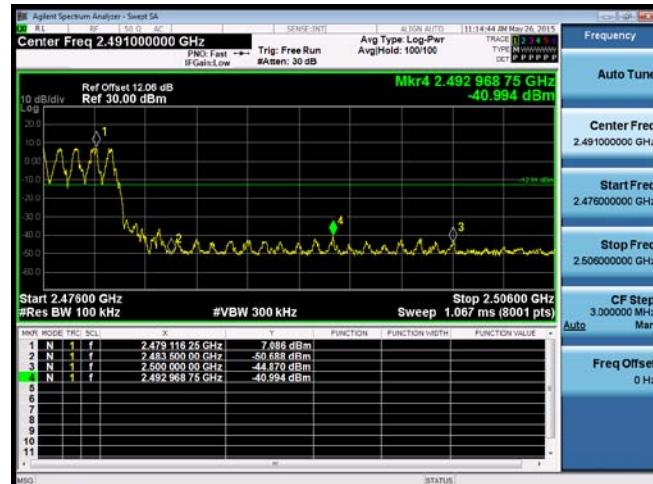


Mode 2: GFSK Link Mode

2402 Hopping

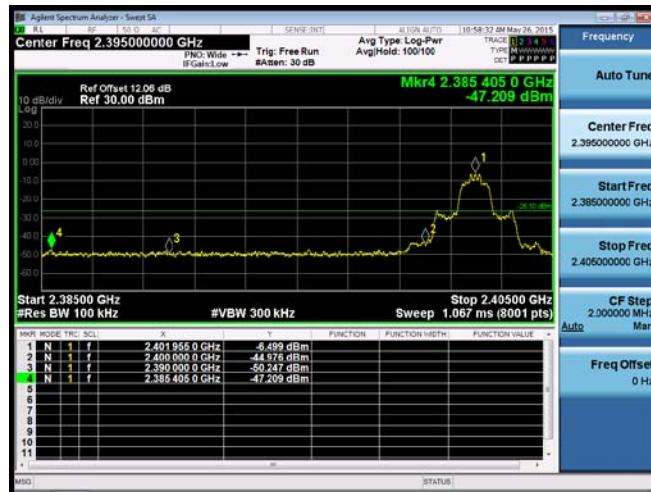


2480Hopping

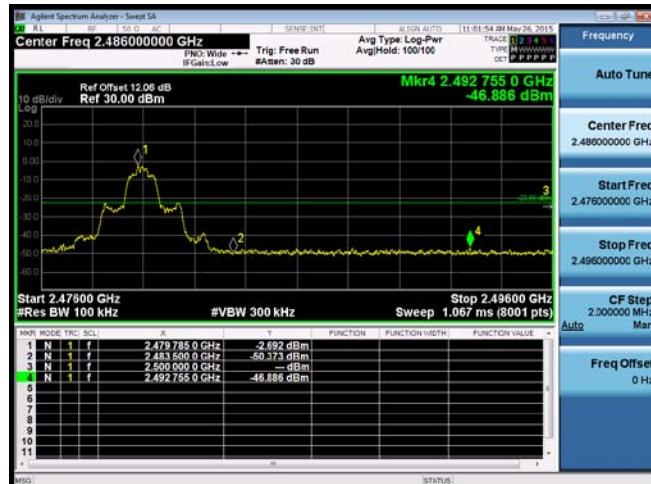


Mode 4:8DPSK Link Mode

2402 No-Hopping



2480No-Hopping

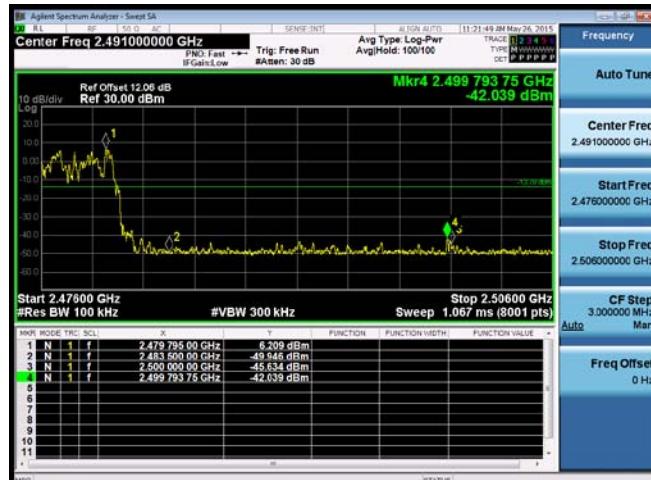


Mode 4: 8DPSK Link Mode

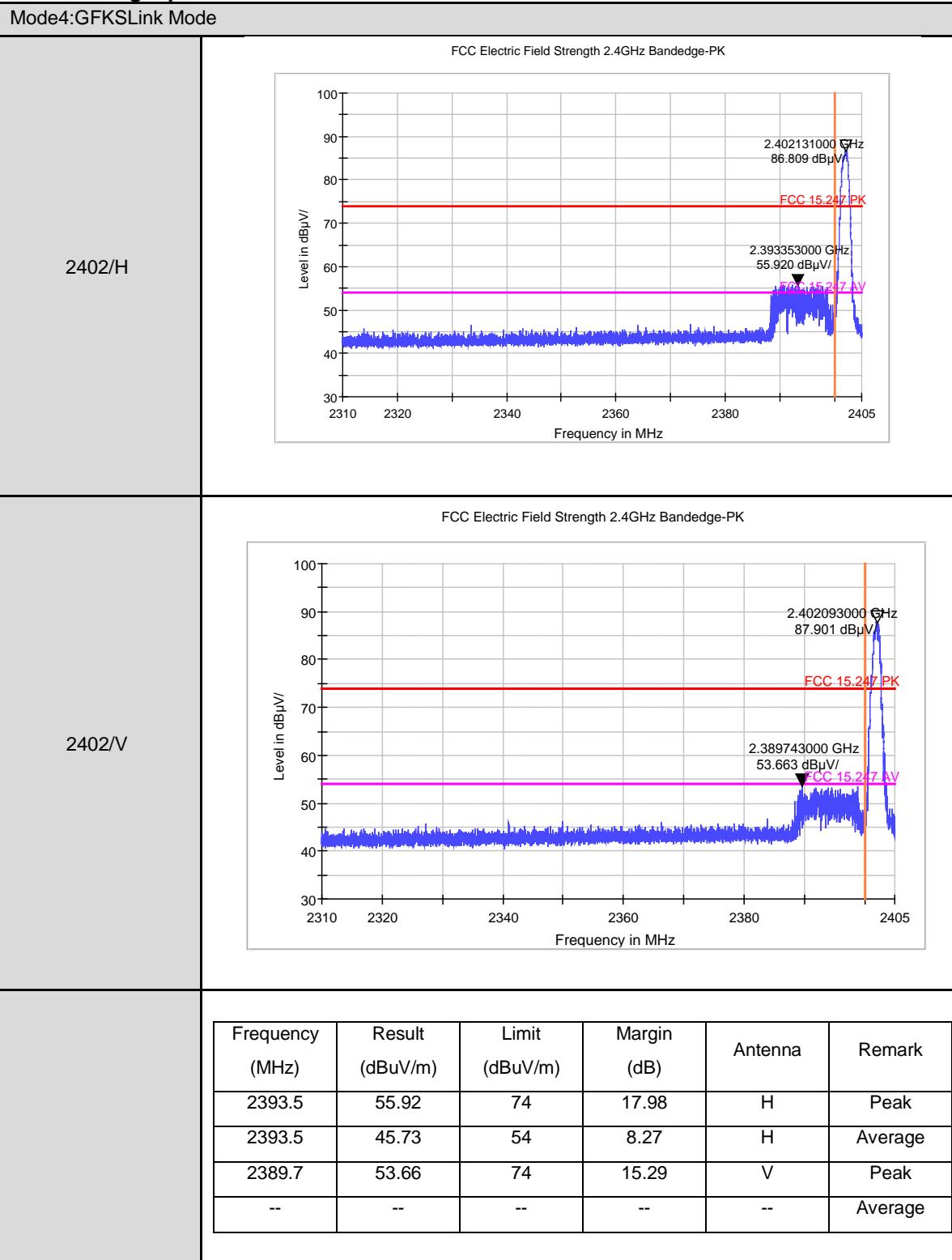
2402 Hopping

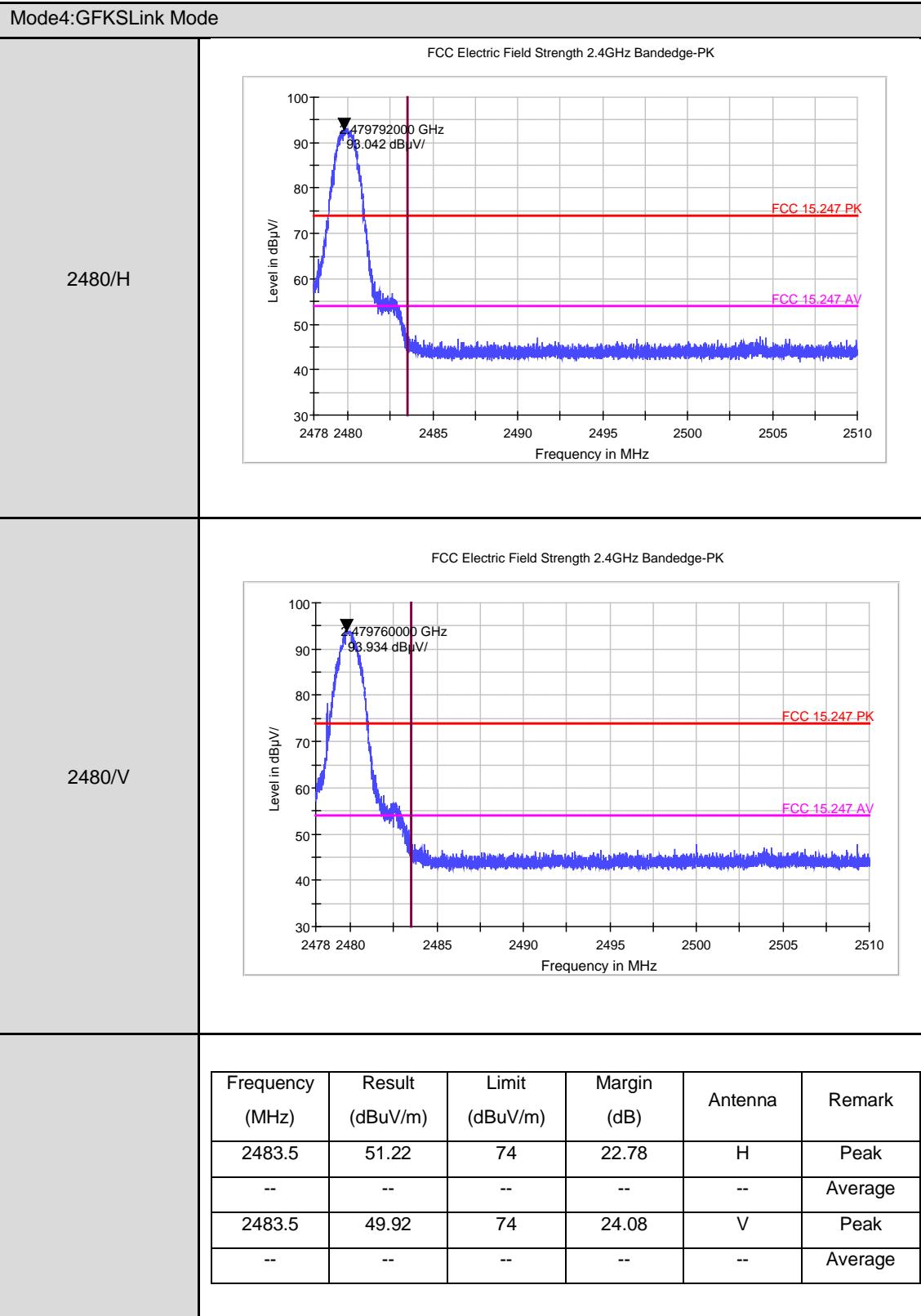


2480Hopping



Radiated Band Edge Spurious Emission

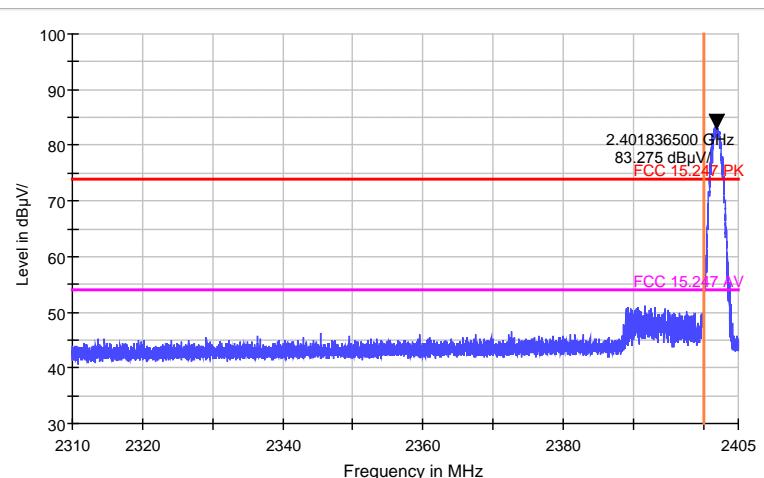




Mode4:8DPSK Link Mode

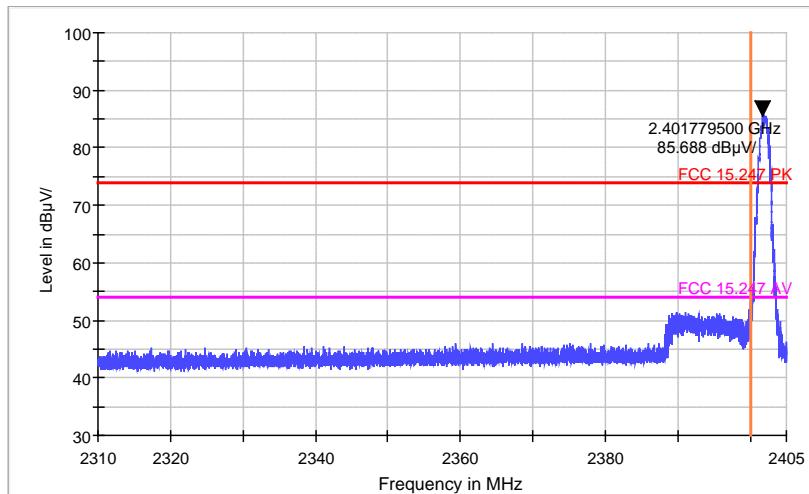
2402/H

FCC Electric Field Strength 2.4GHz Bandedge-PK

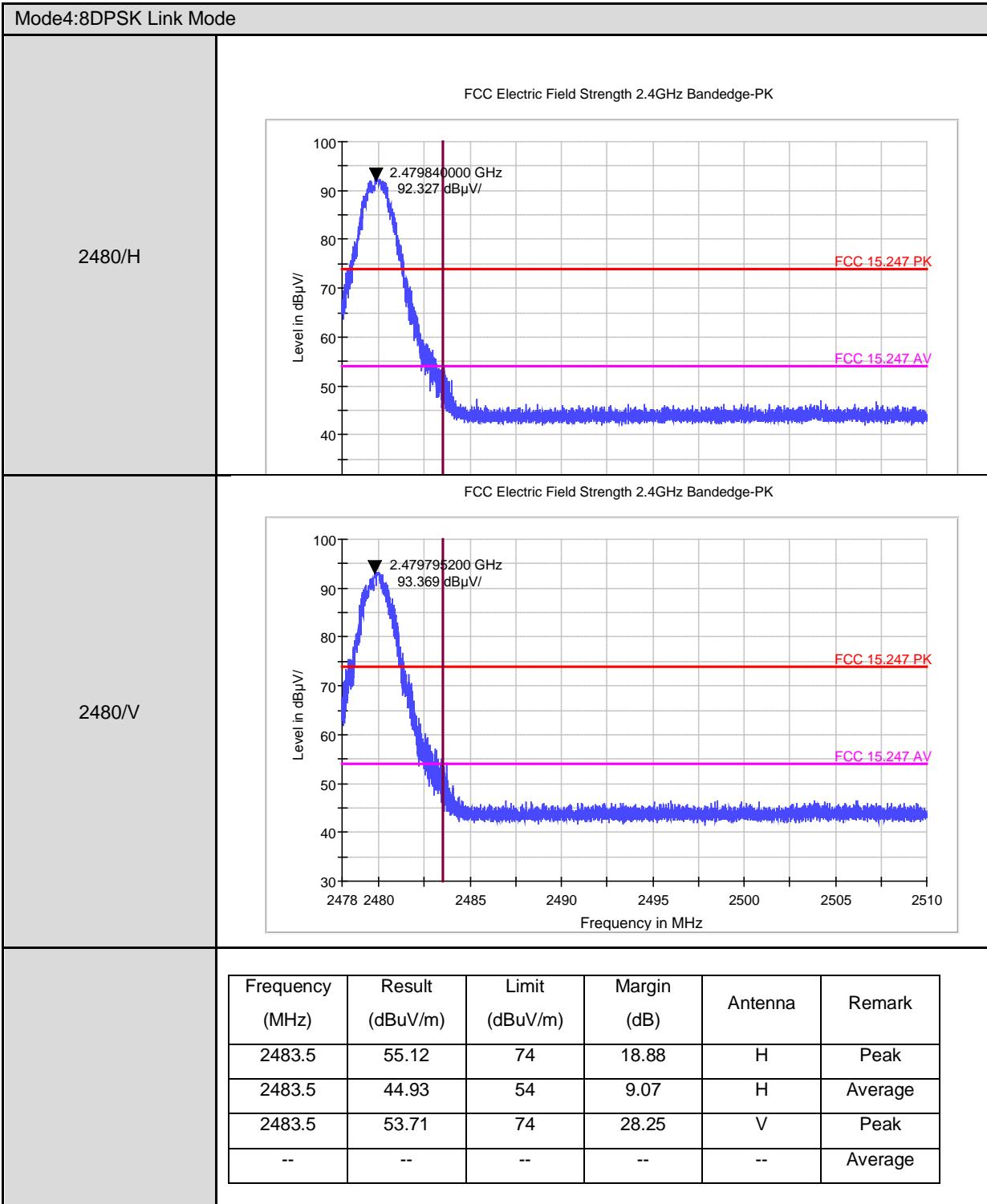


2402/V

FCC Electric Field Strength 2.4GHz Bandedge-PK



Frequency (MHz)	Result (dB _μ V/m)	Limit (dB _μ V/m)	Margin (dB)	Antenna	Remark
2399.2	52.08	74	21.92	H	Peak
--	--	--	--	--	Average
2390.1	53.05	74	20.95	V	Peak
--	--	--	--	--	Average



13 Antenna Measurement

13.1 Limit

For intentional device, 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.

And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

13.2 AntennaConnector Construction

The antenna used in this product isinternalPCB antenna. And the maximum Gain of this antenna is 0.5dBi.

-----The End-----