



Hong Kong

## FCCID – Test report

Report Number : **60/790.14.025.03** Date of Issue: November 19, 2014

Model : Hercules Universal DJ

Product Type : Wireless DJ Controller

Applicant : GUILLEMOT CORPORATION S,A.

Address : Place Du Granier– B.P.97143. 35571 CHANTEPIE CEDEX, FRANCE

Production Facility : --

Address : --

Test Result :  **Positive**     **Negative**

Total pages including Appendices : 65

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## 2. Details about the Test Laboratory

### Details about the Test Laboratory

#### Test site 1

Company name: TÜV SÜD HONG KONG LTD.  
3/F, West Wing, Lakeside 2,  
10 Science Park West Avenue,  
Science Park, Shatin  
HK.

Telephone: 852 2776 1323

Fax: 852 2776 1372

#### Test site 2

Company name: Shenzhen Academy of Metrology and Quality Inspection  
No.4 TongFa Road, Xili TownNanshan District, Shenzhen, China  
Test Firm FCC Registration number:994606

National Digital Electronic Product Test  
No.4 TongFa Road, Xili TownNanshan District, Shenzhen, China  
IC Assigned Code: 11177A

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### 3. Description of the Equipment Under Test

#### Description of the Equipment Under Test

Product:	Wireless DJ Controller
Model no.:	Hercules Universal DJ
Serial number:	NIL
Options and accessories:	NIL
FCC ID:	NAM5061920
Rated Voltage:	5VDC(Powered by PC USB port)
Rated Current:	NIL
Rated Power:	NIL
Frequency:	2402-2480MHz
RF Transmission Frequency:	2402-2480MHz
Antenna gain:	0 dBi
No. of Operated Channel:	79
Modulation:	GFSK / 1/4 DQPSK / 8DPSK

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#### 4. Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C, Intentional Radiators, 10-1-12 Edition	PART 15 – RADIO FREQUENCY DEVICES Subpart C – Intentional Radiators

#### 5. Mode of 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: GFSK for 1Mbps Link Mode
Mode 2: 8DPSK for 3MbpsLink Mode
--

Note1: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 2: After pre-test, the emission of  $\pi/4$ -DQPSK mode is no worse than 8DPSK mode.

#### 6. Assistant Equipment Used in Test

Assistant Equipment	Brand	Model
Notebook	Lenovo	B490
speaker	--	K20403



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## 7. Summary of Test Standards and Results

Emission Tests					
Test Condition	Pages	Test site	Test Result		
			Pass	Fail	N/A
Maximum Conducted Output Power	9	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conducted Emission Measurement	11	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Radiated Interference Measurement	15	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20dB RF Bandwidth	20	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carrier Frequency Separation	23	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of Hopping	25	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time of Occupancy (Dwell Time)	27	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Out of Band Conducted Spurious Emission	32	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Band Edge Measurement	42	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Antenna Requirement	48	Site 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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## 8. General Remarks

### Remarks

This submittal(s) (test report) is intended for FCC ID: NAM5061920complies with the FCC Part 15, Subpart C Rules.

All the configurations of the product were tested and only the worst test results are listed in the report.

### SUMMARY:

All tests according to the regulations cited on page 7 were

- Performed
- **Not** Performed

The Equipment Under Test

- **Fulfills** the general approval requirements.
- **Does not** fulfill the general approval requirements.

Sample Received Date: November 3, 2014

Testing Start Date: November 6, 2014

Testing End Date: November 19, 2014

- TÜV SÜD HONG KONG LTD. -

Reviewed by:

Edmond FUNG



1 by:

CHAN Kwong Ngai

Report Number: **60/790.14.025.03**

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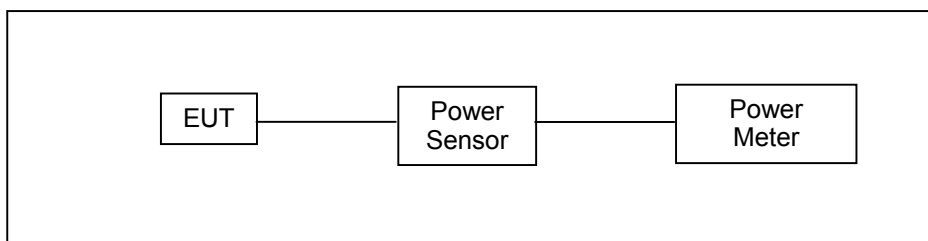
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## 9. Test Results

### 8.1 Maximum Conducted Output Power Measurement Limit

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels < 1 watt.

#### Test Setup



#### Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Power Sensor	Agilent	U2021XA	MY53180015	05/24/2014	(1)
USB Modular Simultaneous Data Acquisition	Agilent	U2531A	TW53353509	N.C.R.	
0.5M RF Cable	Agilent	--	S02-140409-052	06/22/2014	(1)

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

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

#### 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.

### Test Result

Model Number	Hercules Universal DJ			
Test Item	Maximum Conducted Output Power			
Test Mode	Mode 1: GFSK Link Mode			
Date of Test	2014-11-06			
Frequency (MHz)	Packet Type	Peak Power		Limit (mW)
		(dBm)	(mW)	
2402	DH1	2.93	1.963	<1000
	DH3	2.87	1.936	
	DH5	2.91	1.954	
2441	DH1	4.98	3.148	
	DH3	4.75	2.985	
	DH5	4.46	2.792	
2480	DH1	4.03	2.529	
	DH3	3.99	2.506	
	DH5	3.78	2.388	

Model Number	Hercules Universal DJ			
Test Item	Maximum Conducted Output Power			
Test Mode	Mode 2: 8DPSK Link Mode			
Date of Test	2014-11-06			
Frequency (MHz)	Packet Type	Peak Power		Limit (mW)
		(dBm)	(mW)	
2402	DH1	1.00	1.259	<1000
	DH3	1.21	1.321	
	DH5	1.05	1.274	
2441	DH1	3.40	2.188	
	DH3	3.60	2.291	
	DH5	3.09	2.037	
2480	DH1	2.36	1.722	
	DH3	2.16	1.644	
	DH5	2.44	1.754	

Note: The relevant measured result has the offset with cable loss already.

## 8.2 Conducted Emission Measurement

### 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

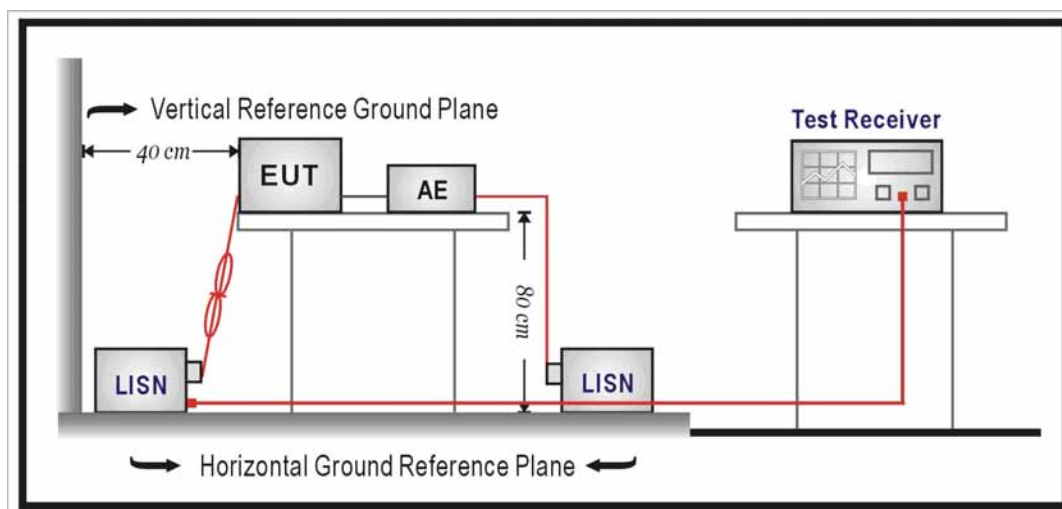
### Test Instruments

Describe	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Test Receiver	R&S	ESCI30	SB3319	01/20/2014	(1)
LISN	R&S	ENV216	SB4357	01/20/2014	(1)
4.5M RF Cable	R&S	--	436922	01/20/2014	(1)

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

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

### Test Setup





Hong Kong

## Test Procedure

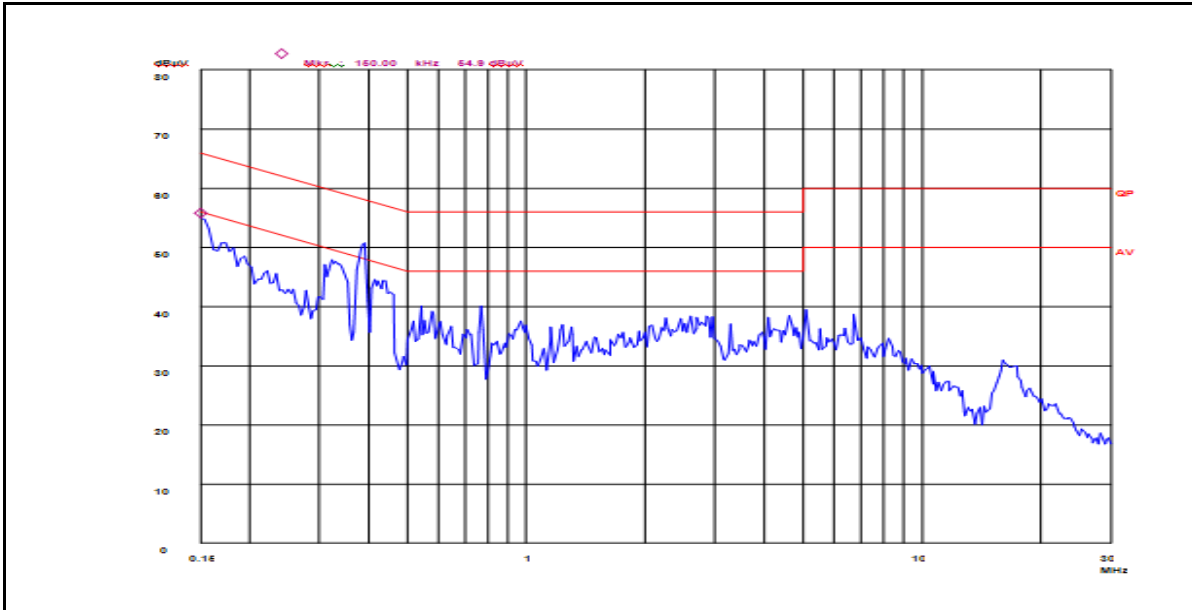
The power line conducted emission measurements were performed in a shielded enclosure. The EUT was assembled on a wooden table which is 80 centimeters high, was placed 40 centimeters from the back wall and at least 1 meter from the sidewall.

Power was fed to the EUT from the public utility power grid through a line filter and EMCO Model 3162/2 SH Line Impedance Stabilization Networks (LISN). The LISN housing, measuring instrumentation case, ground plane, etc., were electrically bonded together at the same RF potential. The Spectrum analyzer was connected to the AC line through an isolation transformer. The 50-ohm output of the LISN was connected to the spectrum analyzer directly. Conducted emission levels were in the CISPR quasi-peak detection mode. The analyzer's 6 dB bandwidth was set to 9 KHz. No post-detector video filter was used.

The spectrum was scanned from 150 KHz to 30 MHz. The physical arrangement of the test system and associated cabling was varied (within the scope of arrangements likely to be encountered in actual use) to determine the effect on the unit's emanations in amplitude and frequency. All spurious emission frequencies were observed. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in paragraph 4.1.

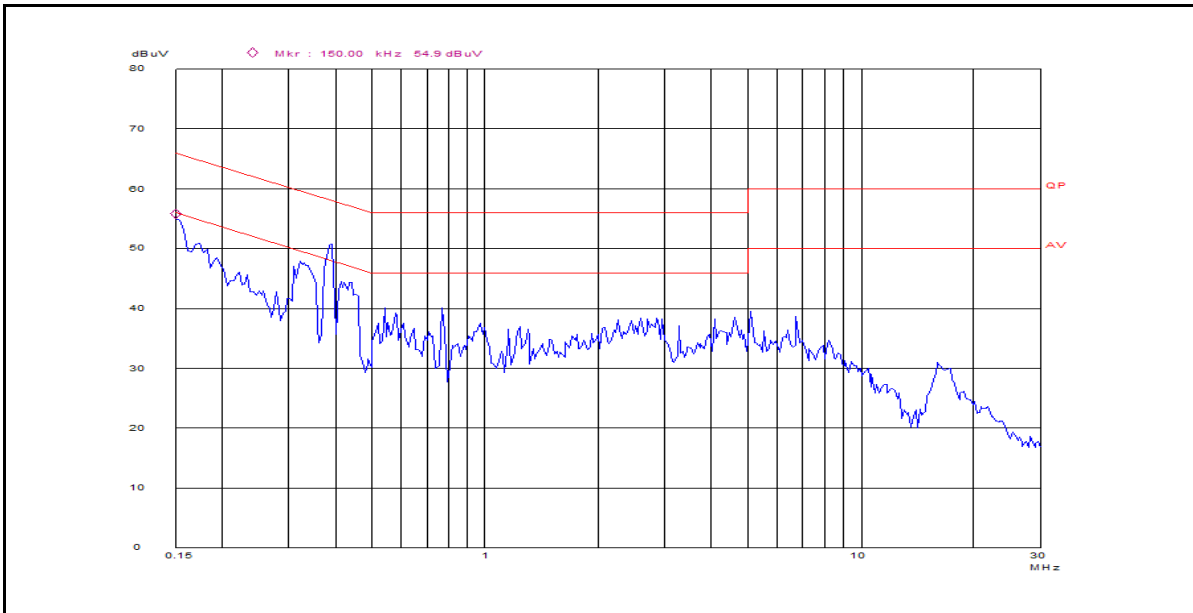
### Test Result

Standard:	FCC Part 15C	Line:	L
Test item:	Conducted Emission	Power:	DC 5V
Model Number:	Hercules Universal DJ	Temp.( )/Hum.(%RH):	24( )/57%RH
Mode:	Mode 1	Date:	2014/11/08
Description:Line			



	Frequency (MHz)	Quasi-Peak		Average	
		Emission Level (dBµV)	Limits (dBµV)	Emission Level (dBµV)	Limits (dBµV)
Line	0.154	47.6	65.8	41.2	55.8
	0.410	47.2	57.6	43.0	47.6
	0.722	37.8	56.0	31.9	46.0
	/	/	/	/	/
	/	/	/	/	/
	/	/	/	/	/

Standard:	FCC Part 15C	Line:	N
Test item:	Conducted Emission	Power:	AC 120V/60Hz
Model Number:	Hercules Universal DJ	Temp.( )/Hum.(%RH):	24( )/57%RH
Mode:	Mode 1	Date:	2014/11/08
Description: Neutral			



	Frequency (MHz)	Quasi-Peak		Average	
		Emission Level (dBµV)	Limits (dBµV)	Emission Level (dBµV)	Limits (dBµV)
Neutral	0.162	47.3	65.4	40.8	55.4
	0.242	44.1	62.0	37.1	52.0
	0.410	47.2	57.6	43.0	47.6
	/	/	/	/	/
	/	/	/	/	/
	/	/	/	/	/

### 8.3 Radiated Interference Measurement

#### 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 ( $\mu\text{V}/\text{m}$ 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 frequencybands 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.

#### Test Instruments

3 Meter Chamber					
Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
EMI Test Receiver	R&S	ESU40	SB8501/09	05/16/2014	(1)
Bilog Antenna	SCHWARZBECK	VULB9163	SB8501/04	01/20/2014	(1)
Horn Antenna	R&S	HF906	SB3435	01/20/2014	(1)
3-dimensional loop antenna	SCHWARZBECK	HXYZ9170	9124	01/20/2014	(1)
Amplifier(1-18GHz)	R&S	--	SB3435/01	01/20/2014	(1)
Amplifier(18-40GHz)	R&S	--	SB3435/02	01/20/2014	(1)
Horn Antenna	Amplifier Research	AT4560	SB5392/02	05/16/2014	(1)
RF cable(0.4m)	Woken	/	S02-1404-09-065	05/11/2014	(1)
RF cable(3.5m)	Woken	/	S02-1404-09-047	05/11/2014	(1)
RF cable(1.2m)	Woken	/	S02-1404-09-052	05/11/2014	(1)
3m Semi-anechoic chamber	Albatross Projects	9X6X6	SB3450/01	10/12/2014	(1)

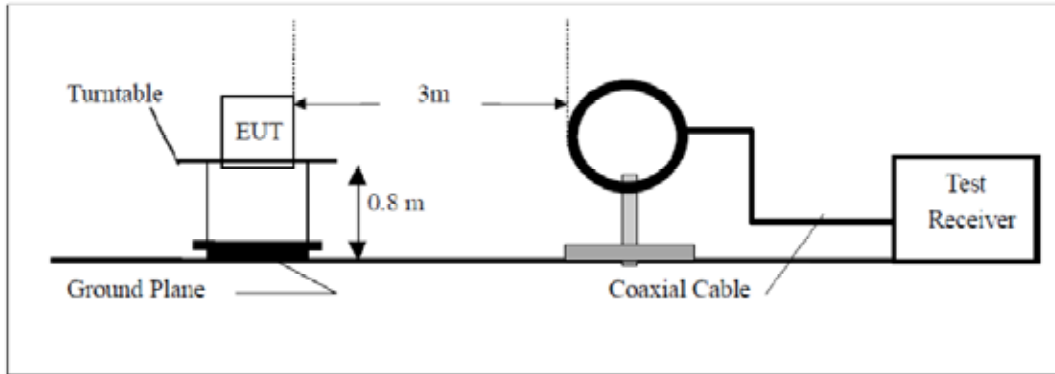
Remark: (1)Calibration period 1 year. (2)Calibration period 2 years. (3) Calibration period 3 years.

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

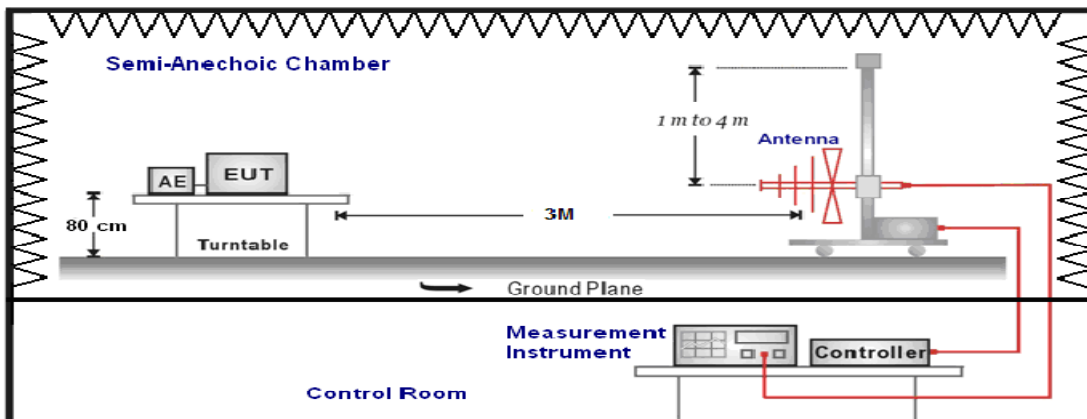


## Setup

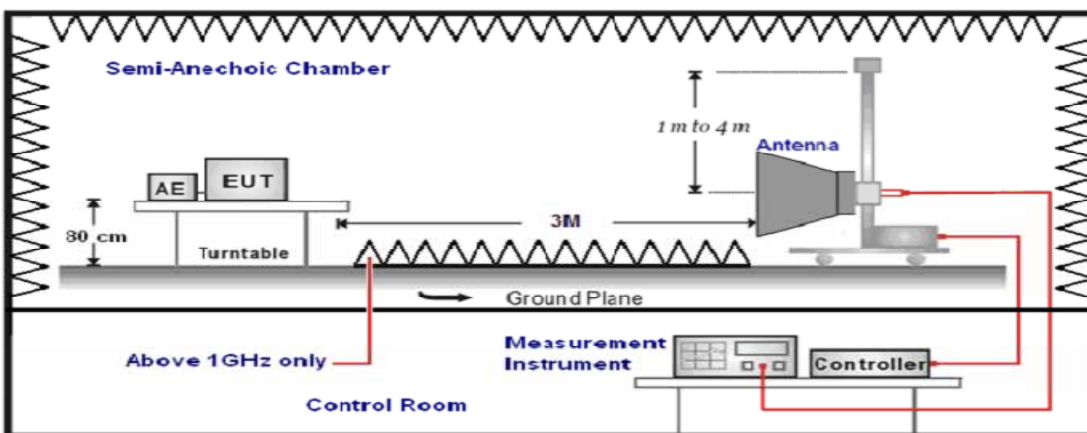
9KHz-30MHz



30MHz-1GHz



Above 1GHz



## 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 & Measurement spectrum range from 9kHz 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 supporting 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.

SCHWARZBECK MESS-ELEKTRONIK Biconilog Antenna (mode VULB9163) at 3 Meter and the SCHWARZBECK Double Ridged Guide Antenna (model BBHA9120D&9170) was used in frequencies 1 – 26.5 GHz at a 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 (dBuV) into field intensity in micro volts per meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro volts per meter (dBuV/m).

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

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

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

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

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

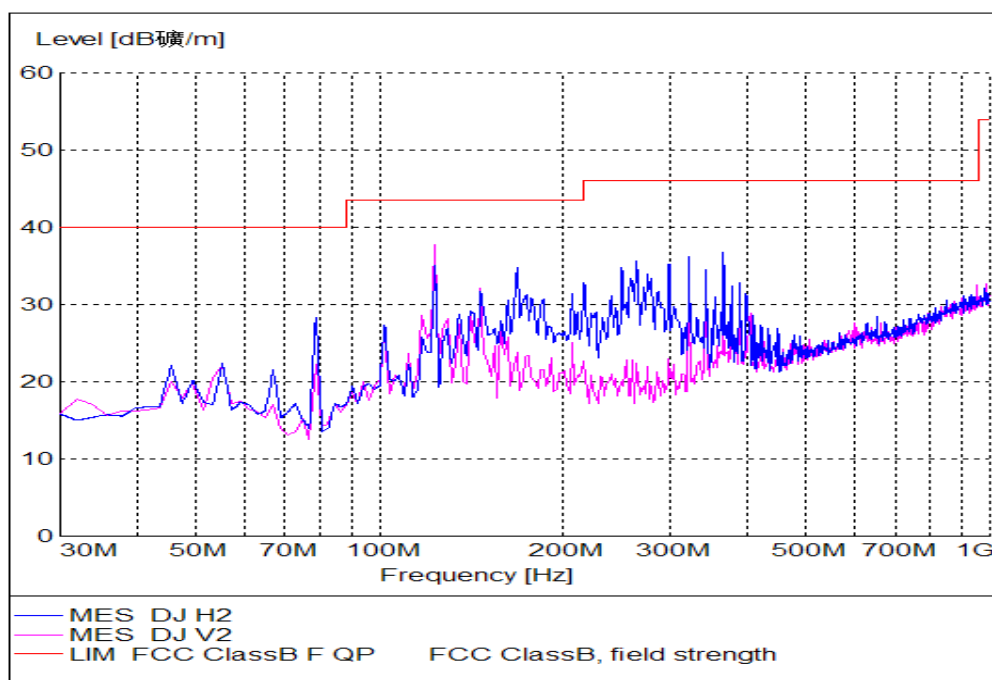
(a) For fundamental frequency : Transmitter Output < +30dBm

(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.

### Test Result Below 1GHz

Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	5V DC
Model Number:	Hercules Universal DJ	Temp.( )/Hum.(%RH):	23( )/50%RH
Mode:	Mode 1	Date:	2014/11/10



Frequency (MHz)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
--	--	--	--	--	QP	H
--	--	--	--	--	QP	H
--	--	--	--	--	QP	H
--	--	--	--	--	QP	H
--	--	--	--	--	QP	H
--	--	--	--	--	QP	H
--	--	--	--	--	QP	V
--	--	--	--	--	QP	V
--	--	--	--	--	QP	V
--	--	--	--	--	QP	V
--	--	--	--	--	QP	V
--	--	--	--	--	QP	V

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

**1GHz-25GHz**

Standard:		FCC Part 15C		Test Distance:		3m	
Test item:		Radiated Emission		Power:		5V DC	
Model Number:		Hercules Universal DJ		Temp.( )/Hum.(%RH):		23( )/50%RH	
Mode:		Mode 1		Date:		2014/11/10	
Frequency:		2402 MHz		Test By:			
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4804	41.6	-5.4	36.2	74.0	37.8	peak	H
4804	33.5	-5.4	28.1	54.0	25.9	Average	H
7206	--	-2.7	--	74.0	--	peak	H
7206	--	-2.7	--	54.0	--	Average	H
4804	40.8	-5.4	35.4	74.0	38.6	peak	V
4804	32.6	-5.4	27.2	54.0	26.8	Average	V
7206	--	-2.7	--	74.0	--	peak	V
7206	--	-2.7	--	54.0	--	Average	V

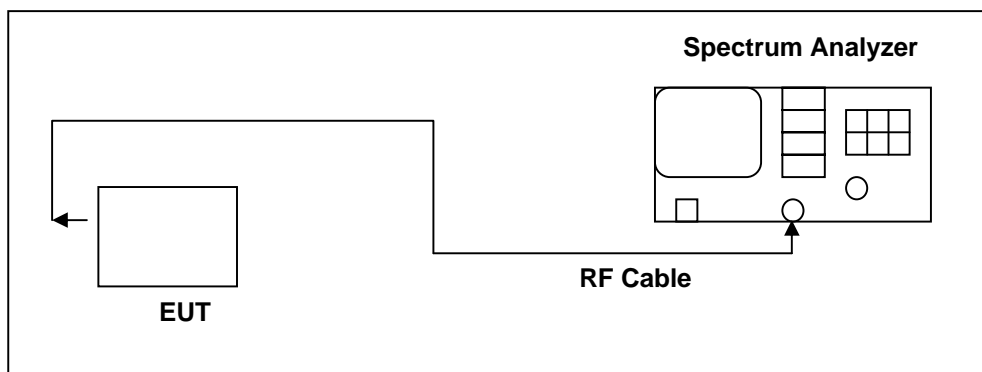
Standard:		FCC Part 15C		Test Distance:		3m	
Test item:		Radiated Emission		Power:		5V DC	
Model Number:		Hercules Universal DJ		Temp.( )/Hum.(%RH):		23( )/50%RH	
Mode:		Mode 1		Date:		2014/11/10	
Frequency:		2441 MHz		Test By:			
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4882	42.3	-5.4	36.9	74.0	37.1	peak	H
4882	31.8	-5.4	26.4	54.0	27.6	Average	H
7323	--	-2.5	--	74.0	--	peak	H
7323	--	-2.5	--	54.0	--	Average	H
4882	42.3	-5.4	36.9	74.0	37.1	peak	V
4882	34.4	-5.4	29.0	54.0	25.0	Average	V
7323	--	-2.5	--	74.0	--	peak	V
7323	--	-2.5	--	54.0	--	Average	V

Standard:		FCC Part 15C		Test Distance:		3m	
Test item:		Radiated Emission		Power:		5V DC	
Model Number:		Hercules Universal DJ		Temp.( )/Hum.(%RH):		23( )/50%RH	
Mode:		Mode 1		Date:		2014/11/10	
Frequency:		2480 MHz		Test By:			
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4960	43.9	-5.4	38.5	74.0	35.5	peak	H
4960	30.9	-5.4	25.5	54.0	28.5	Average	H
7440	--	-2.1	--	74.0	--	peak	H
7440	--	-2.1	--	54.0	--	Average	H
4960	44.5	-5.4	39.1	74.0	34.9	peak	V
4960	32.6	-5.4	27.2	54.0	26.8	Average	V
7440	--	-2.1	--	74.0	--	peak	V
7440	--	-2.1	--	54.0	--	Average	V

## 8.4 20dB Bandwidth & 99% OBW Measurement Limit

N/A

### Test Setup



### Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	E4445A	MY46181814	11/12/2014	(1)

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

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

### 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


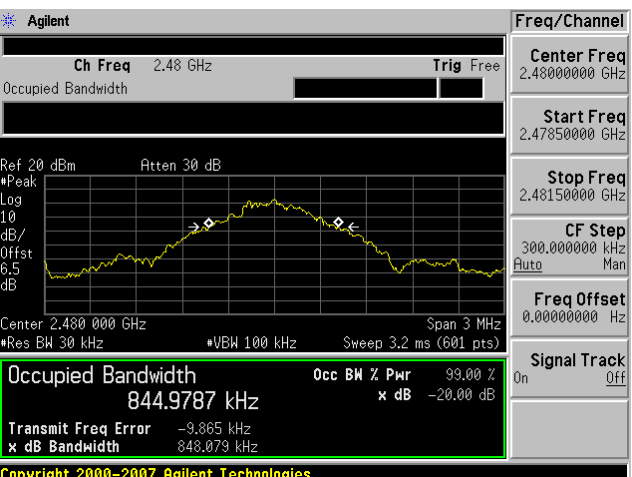
The trace was allowed to stabilize. The EUT was transmitting at its maximum data rate. The marker-to-peak function was used to set the marker to the peak of the emission. The marker-delta function was used to measure 20dB down on one side of the emission. The marker-delta function and marker was moved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

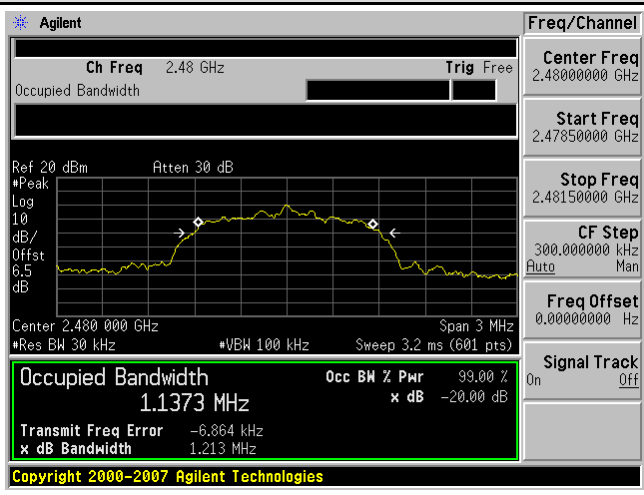
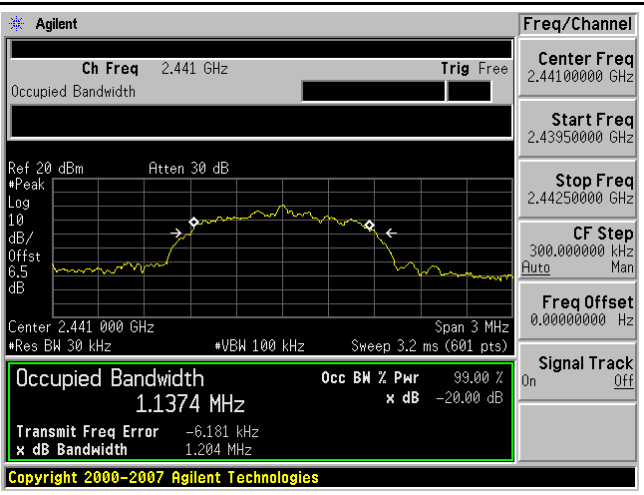
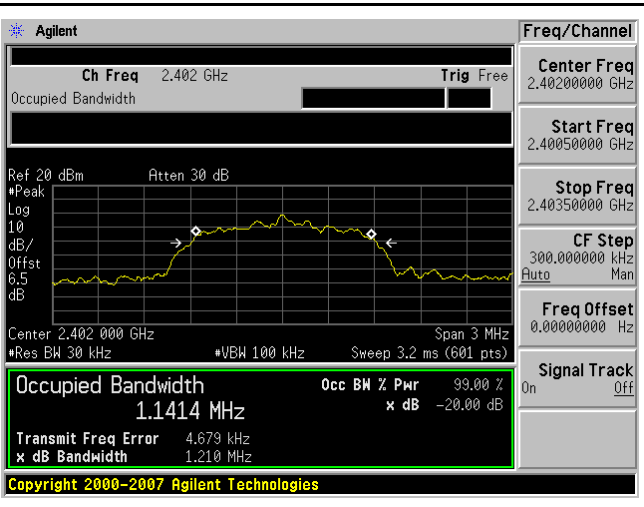
### Test Result

Model Number	Hercules Universal DJ		
Test Item	20dB Bandwidth& 99% OBW		
Test Mode	Mode 1: GFSK Link Mode		
Date of Test	2014/11/11	Test Site	TE02
Frequency (MHz)	20dB Bandwidth (MHz)	99% OBW (MHz)	Limit (MHz)
2402	0.930	0.823	----
2441	0.886	0.833	----
2480	0.848	0.845	----

Model Number	Hercules Universal DJ		
Test Item	20dB Bandwidth& 99% OBW		
Test Mode	Mode 2: 8DPSK Link Mode		
Date of Test	2014/11/11	Test Site	TE02
Frequency (MHz)	20dB Bandwidth (MHz)	99% OBW (MHz)	Limit (MHz)
2402	1.213	1.1373	----
2441	1.204	1.1374	----
2480	1.210	1.1414	----

## Test Graphs

Mode 1: GFSK Link Mode	
2402	 <p>Agilent</p> <p>Ch Freq 2.402 GHz Trig Free</p> <p>Center Freq 2.4020000 GHz</p> <p>Start Freq 2.40050000 GHz</p> <p>Stop Freq 2.40350000 GHz</p> <p>CF Step 300.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/Offst 6.5 dB</p> <p>Center 2.402 000 GHz Span 3 MHz</p> <p>#Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms (601 pts)</p> <p>Occupied Bandwidth 823.1103 kHz Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error -115.794 Hz x dB Bandwidth 930.110 kHz</p> <p>Copyright 2000-2007 Agilent Technologies</p>
2441	 <p>Agilent</p> <p>Ch Freq 2.441 GHz Trig Free</p> <p>Center Freq 2.4410000 GHz</p> <p>Start Freq 2.43950000 GHz</p> <p>Stop Freq 2.44250000 GHz</p> <p>CF Step 300.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/Offst 6.5 dB</p> <p>Center 2.441 000 GHz Span 3 MHz</p> <p>#Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms (601 pts)</p> <p>Occupied Bandwidth 833.1835 kHz Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error -16.143 kHz x dB Bandwidth 885.772 kHz</p> <p>Copyright 2000-2007 Agilent Technologies</p>
2480	 <p>Agilent</p> <p>Ch Freq 2.48 GHz Trig Free</p> <p>Center Freq 2.4800000 GHz</p> <p>Start Freq 2.47850000 GHz</p> <p>Stop Freq 2.48150000 GHz</p> <p>CF Step 300.000000 kHz Auto Man</p> <p>Freq Offset 0.00000000 Hz</p> <p>Signal Track On Off</p> <p>Ref 20 dBm Atten 30 dB</p> <p>#Peak Log 10 dB/Offst 6.5 dB</p> <p>Center 2.480 000 GHz Span 3 MHz</p> <p>#Res BW 30 kHz #VBW 100 kHz Sweep 3.2 ms (601 pts)</p> <p>Occupied Bandwidth 844.9787 kHz Occ BW % Pwr 99.00 % x dB -20.00 dB</p> <p>Transmit Freq Error -9.865 kHz x dB Bandwidth 848.079 kHz</p> <p>Copyright 2000-2007 Agilent Technologies</p>

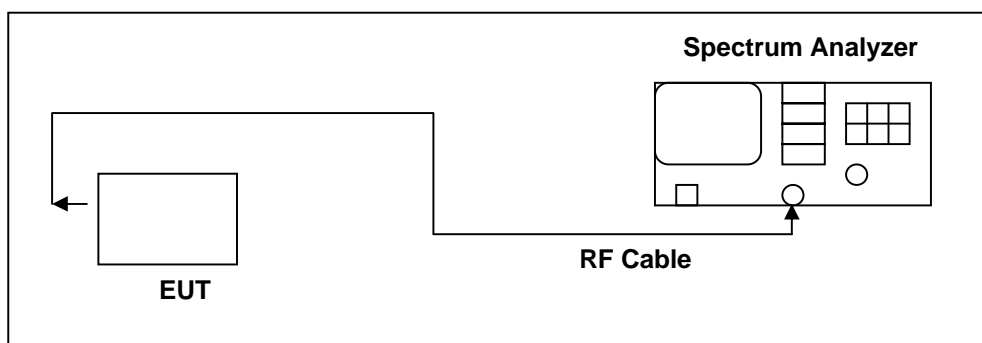
Mode 2: 8DPSK Link Mode	
2402	
2441	
2480	



## 8.5 Carrier Frequency Separation Measurement 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.

### Test Setup



### Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	E4445A	MY46181814	11/12/2014	(1)

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

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

### 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:

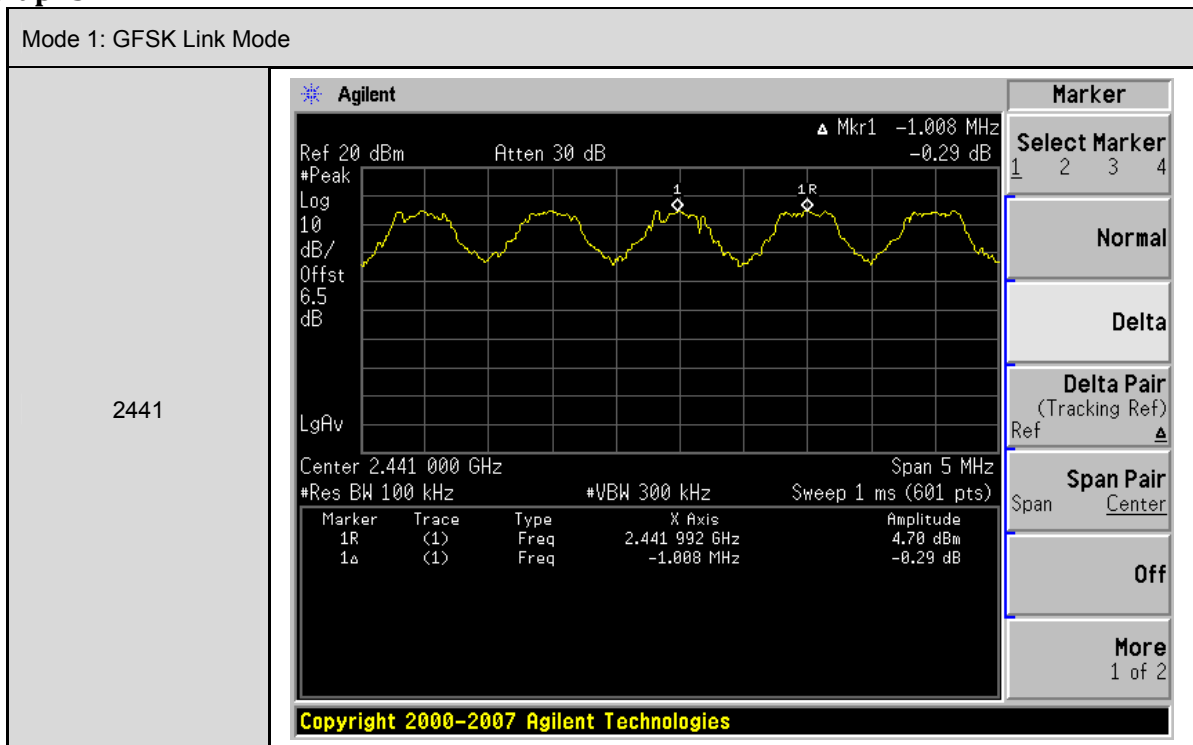
1. Span = wide enough to capture the peaks of two adjacent channels
2. Resolution (or IF) Bandwidth (RBW)  $\geq$  1% of the span
3. Video (or Average) Bandwidth (VBW)  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

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

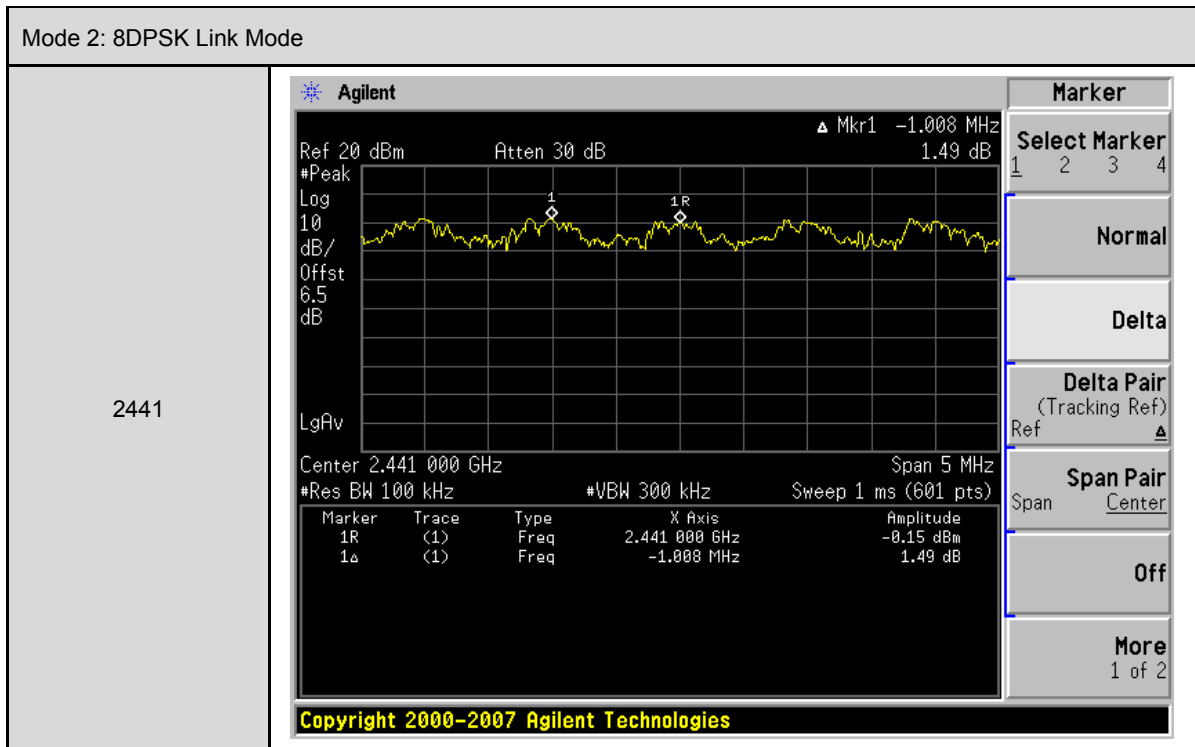
### Test Result

Model Number	Hercules Universal DJ		
Test Item	Carrier Frequency Separation		
Test Mode	Mode 1: GFSK Link Mode		
Date of Test	2014/11/12	Test Site	TE02
Frequency (MHz)	Measurement (MHz)	Limit (MHz)	
2441	1.008	>0.563	

### Test Graphs



Model Number	Hercules Universal DJ		
Test Item	Carrier Frequency Separation		
Test Mode	Mode 2: 8DPSK Link Mode		
Date of Test	2014/11/12	Test Site	TE02
Frequency (MHz)	Measurement (MHz)	Limit (MHz)	
2441	1.008	>0.761	

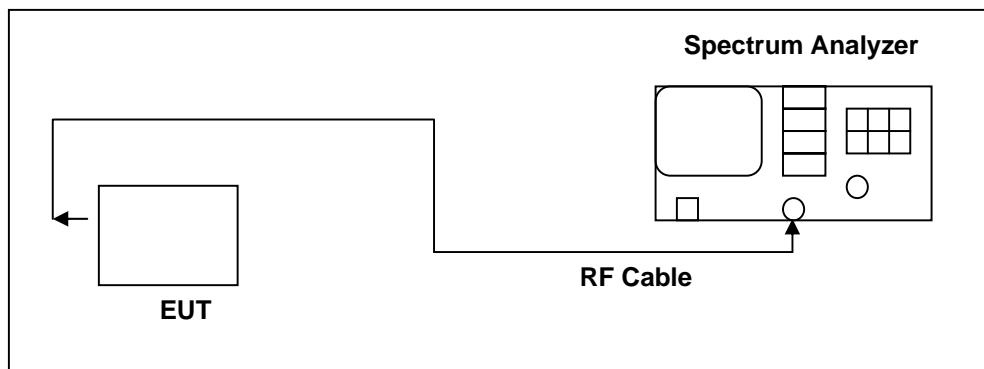


## 8.6 Number of Hopping Measurement

### Limit

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

### Test Setup



### Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	E4445A	MY46181814	11/12/2014	(1)

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

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

### 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:

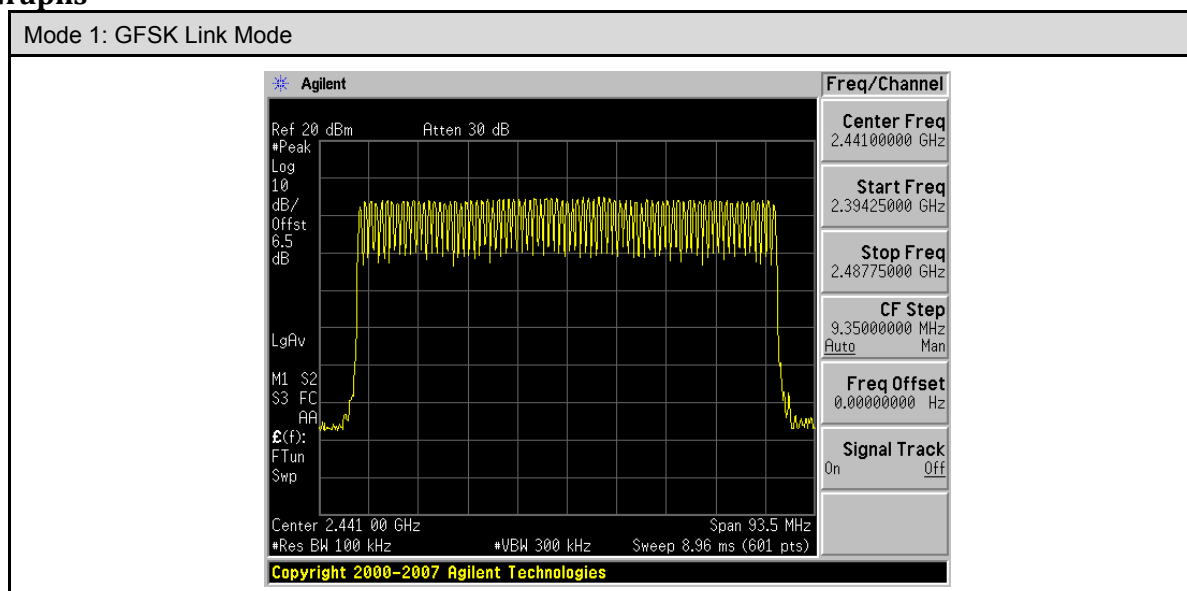
1. Span = the frequency band of operation
2. RBW  $\geq$  1% of the span
3. VBW  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize.

### Test Result

Model Number	Hercules Universal DJ		
Test Item	Number of Hopping		
Test Mode	Mode 1: GFSK Link Mode		
Date of Test	2014/11/12	Test Site	TE02
FrequencyRange (MHz)	Measurement (ch)	Limit (ch)	
2402 - 2480	79	> 15	

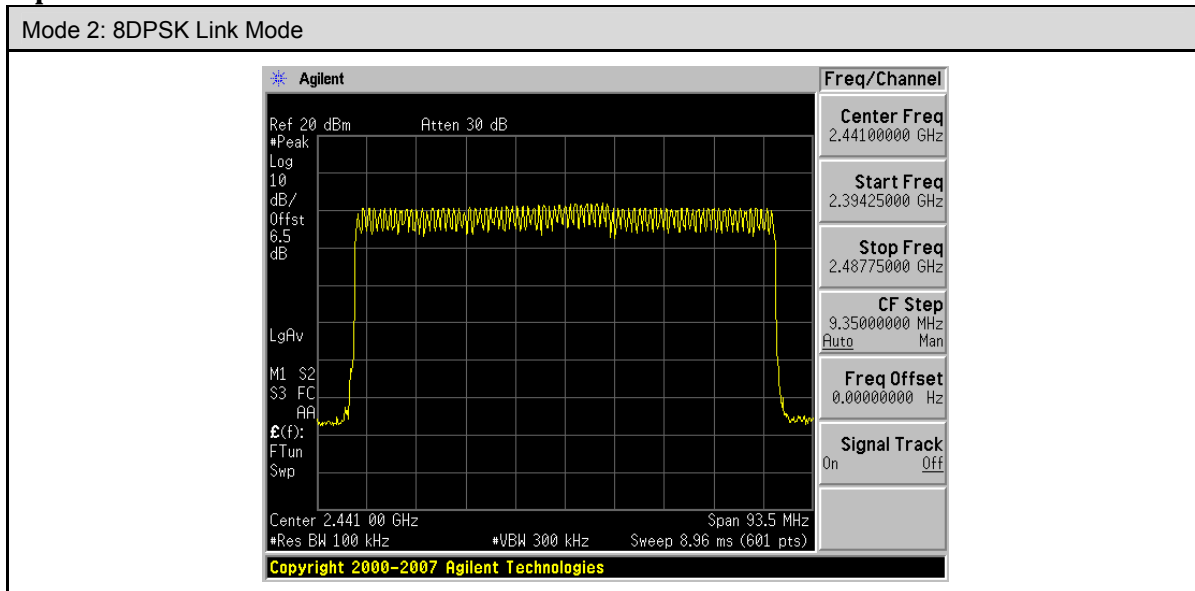
### Test Graphs



### Test Result

Model Number	Hercules Universal DJ		
Test Item	Number of Hopping		
Test Mode	Mode 2: 8DPSK Link Mode		
Date of Test	2014/11/12	Test Site	TE02
FrequencyRange (MHz)	Measurement (ch)		Limit (ch)
2402 - 2480	79		> 15

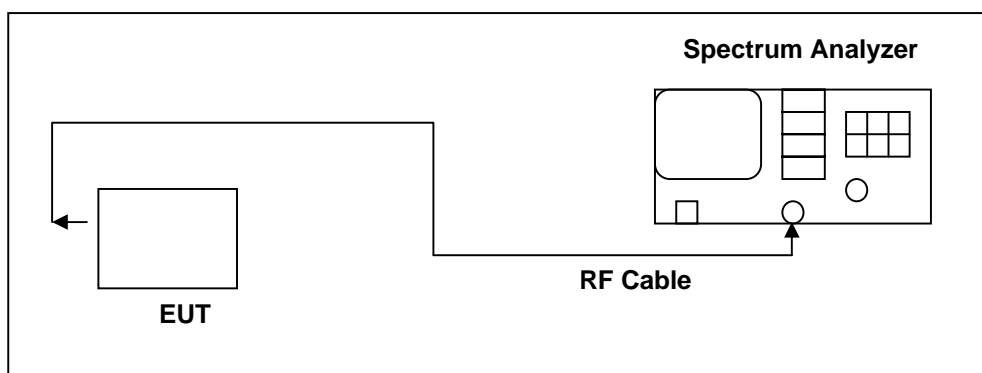
### Test Graphs



## 8.7 Time of Occupancy (Dwell Time) Measurement 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.

### Test Setup



### Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	E4445A	MY46181814	11/12/2014	(1)

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

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

### 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.



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## Test Result

Model Number	Hercules Universal DJ		
Test Item	Time of Occupancy (Dwell Time)		
Test Mode	Mode 1: GFSK Link Mode		
Date of Test	2014/11/13	Test Site	TE02
DH1			
Length of per burst(ms)	0.427		
Number of burst in 5 seconds	51		
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$		
Dwell Times	$31.6/5 * 51 * 0.427 = 137.631$		
LIMIT(msec)	$< = 400$		
DH3			
Length of per burst(ms)	1.6		
Number of burst in 5 seconds	26		
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$		
Dwell Times	$31.6/5 * 26 * 1.600 = 262.912$		
LIMIT(msec)	$< = 400$		
DH5			
Length of per burst(ms)	2.94		
Number of burst in 5 seconds	17		
Cycle Calculate	$79\text{CH} * 0.4 = 31.6 \text{ (sec)}$		
Dwell Times	$31.6/5 * 17 * 2.94 = 315.874$		
LIMIT(msec)	$< = 400$		

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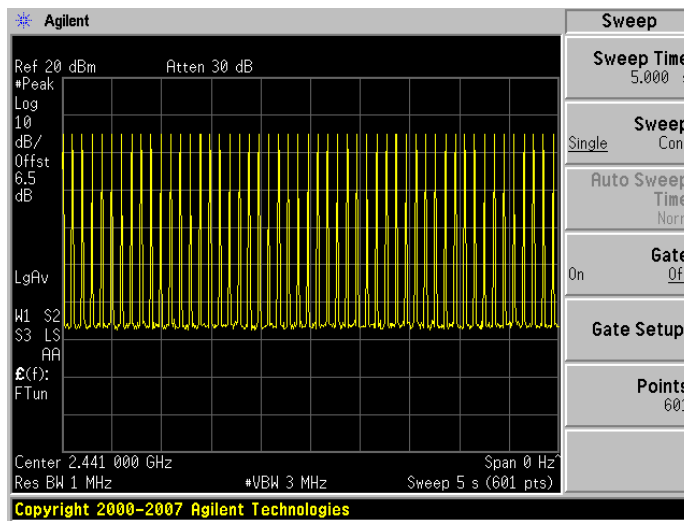
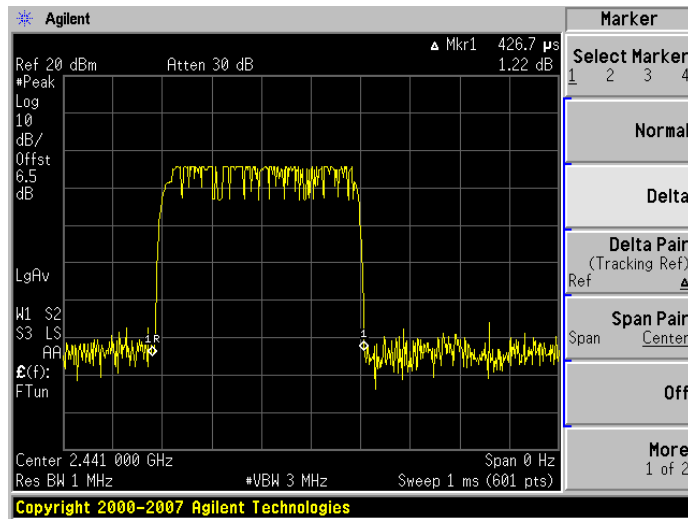
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Model Number	Hercules Universal DJ		
Test Item	Time of Occupancy (Dwell Time)		
Test Mode	Mode 2: 8DPSK Link Mode		
Date of Test	2014/11/13	Test Site	TE02
3-DH1			
Length of per burst(ms)	0.443		
Number of burst in 5 seconds	51		
Cycle Calculate	$79CH * 0.4 = 31.6$ (sec)		
Dwell Times	$31.6/5 * 51 * 0.443 = 142.788$		
LIMIT(msec)	$< = 400$		
3-DH3			
Length of per burst(ms)	1.700		
Number of burst in 5 seconds	25		
Cycle Calculate	$79CH * 0.4 = 31.6$ (sec)		
Dwell Times	$31.6/5 * 25 * 1.700 = 268.600$		
LIMIT(msec)	$< = 400$		
3-DH5			
Length of per burst(ms)	2.975		
Number of burst in 5 seconds	17		
Cycle Calculate	$79CH * 0.4 = 31.6$ (sec)		
Dwell Times	$31.6/5 * 17 * 2.975 = 319.634$		
LIMIT(msec)	$< = 400$		

## Test Graphs

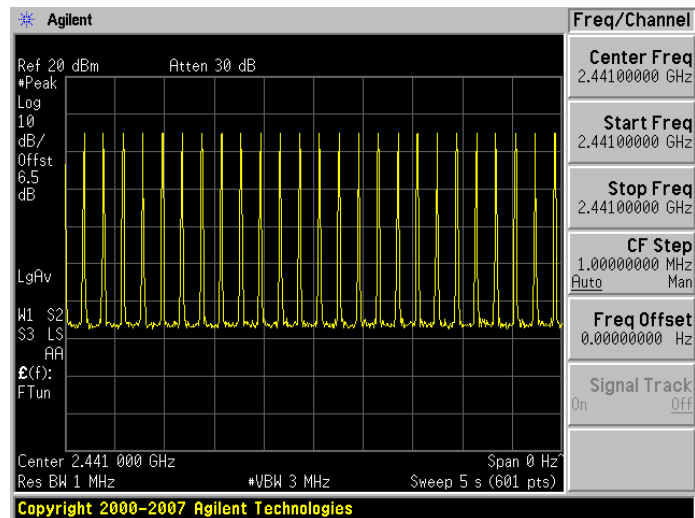
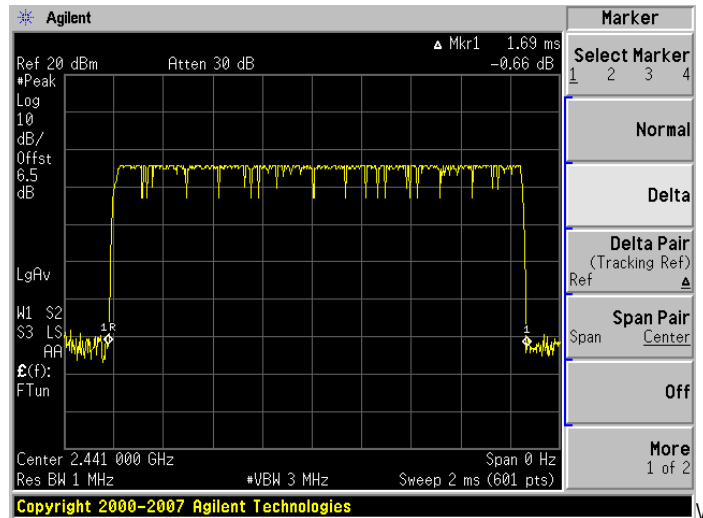
Mode 1: GFSK Link Mode

DH1



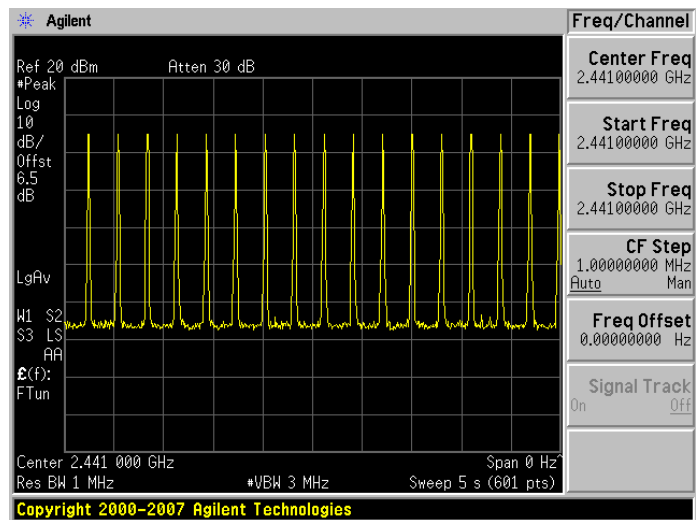
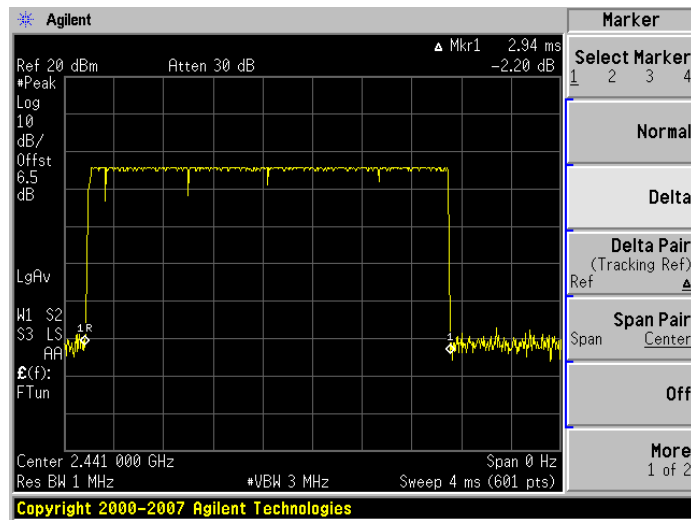
Mode 1: GFSK Link Mode

DH3

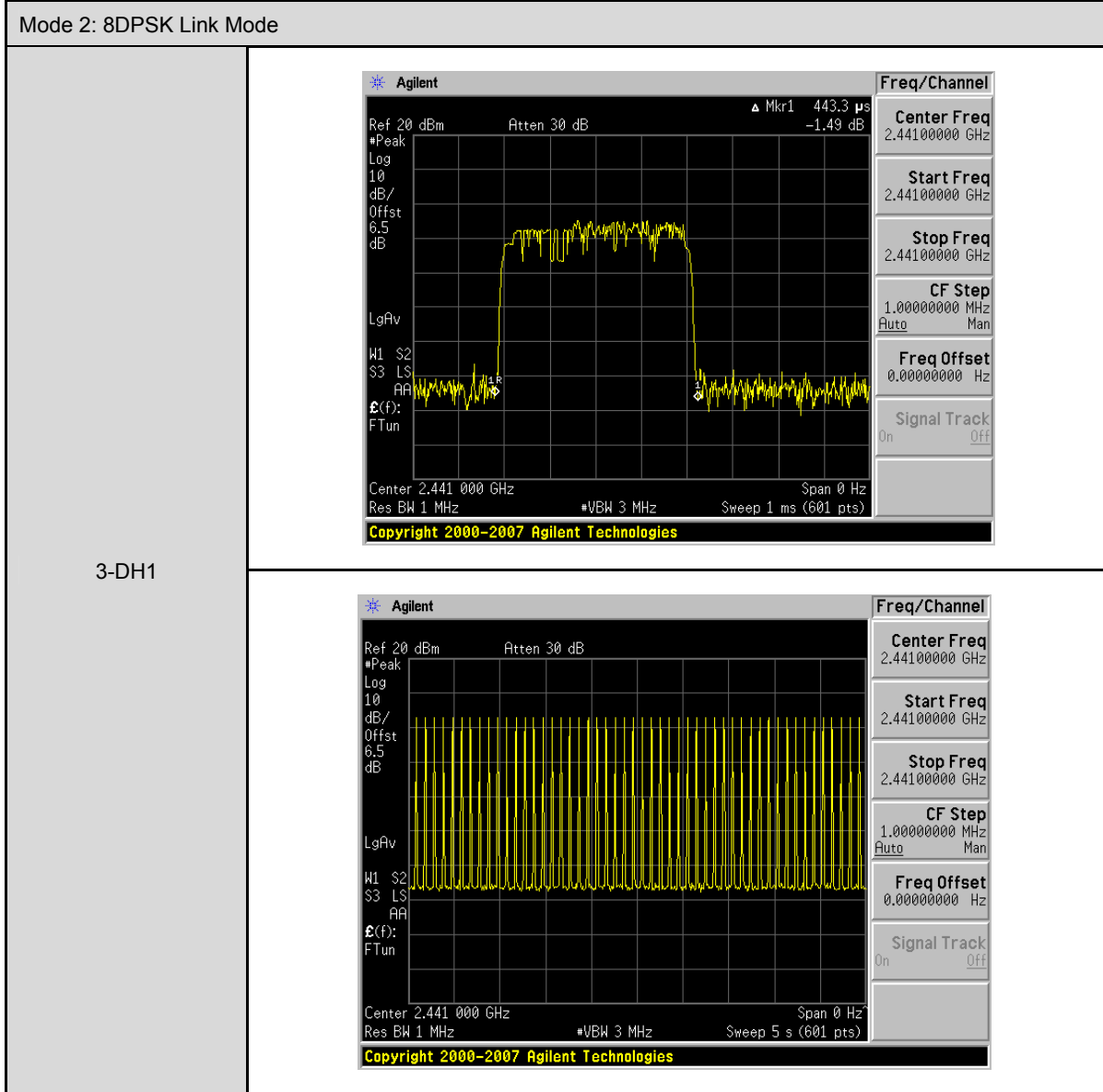


Mode 1: GFSK Link Mode

DH5



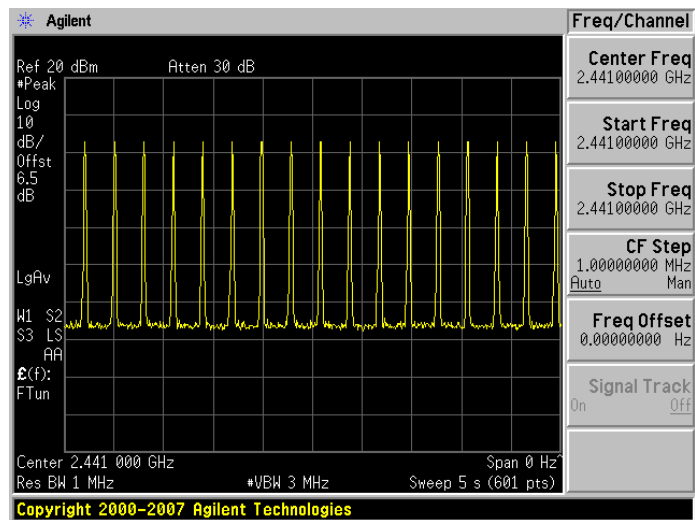
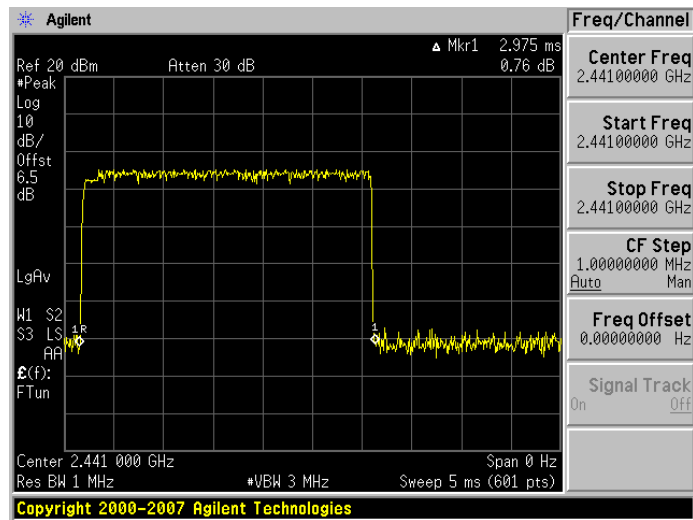
### Test Graphs





Mode 2: 8DPSK Link Mode

3-DH5

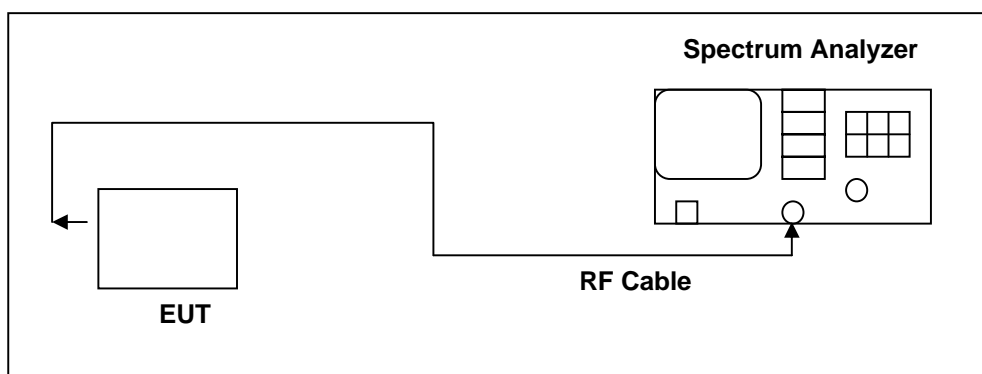


## 8.8 Out of Band Conducted Emissions Measurement

### 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

### Test Setup



### Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9020A	MY53420615	05/12/2014	(1)
Spectrum Analyzer	Agilent	E4445A	MY46181814	11/12/2014	(1)

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

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

### Test Procedure

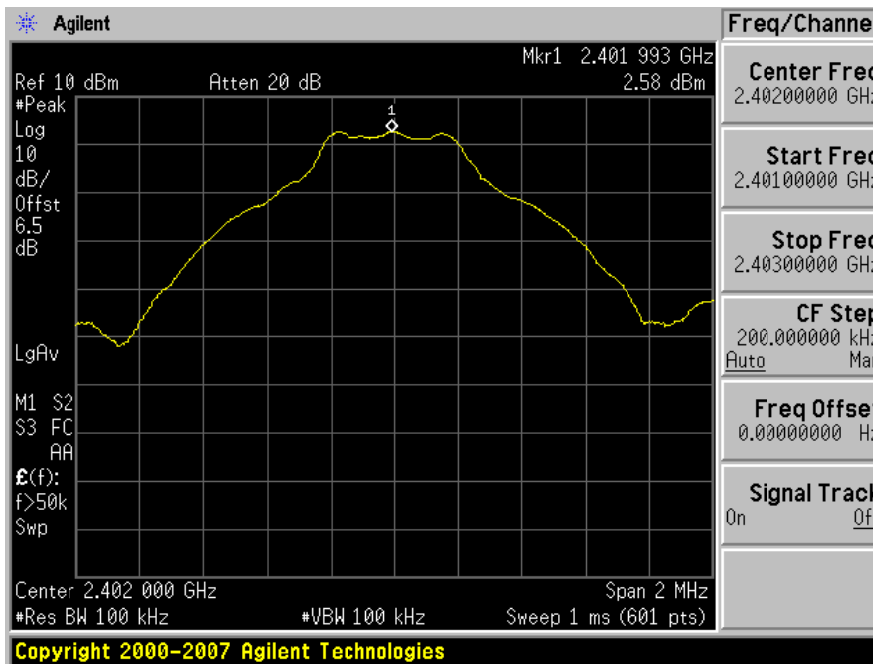
Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products 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)



## Test Graphs Mode1:GFSK Link Mode

Low channel: 2402MHz

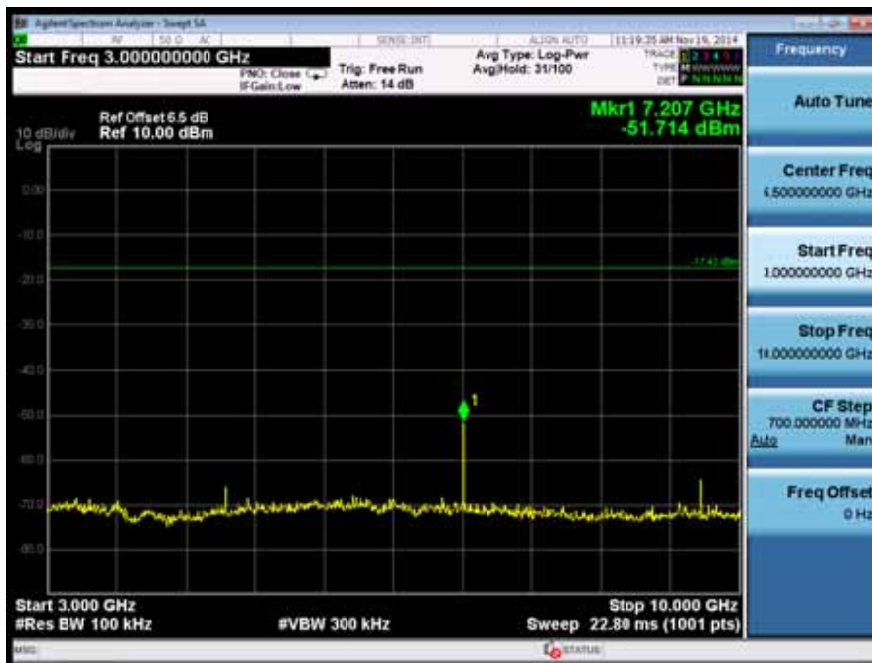
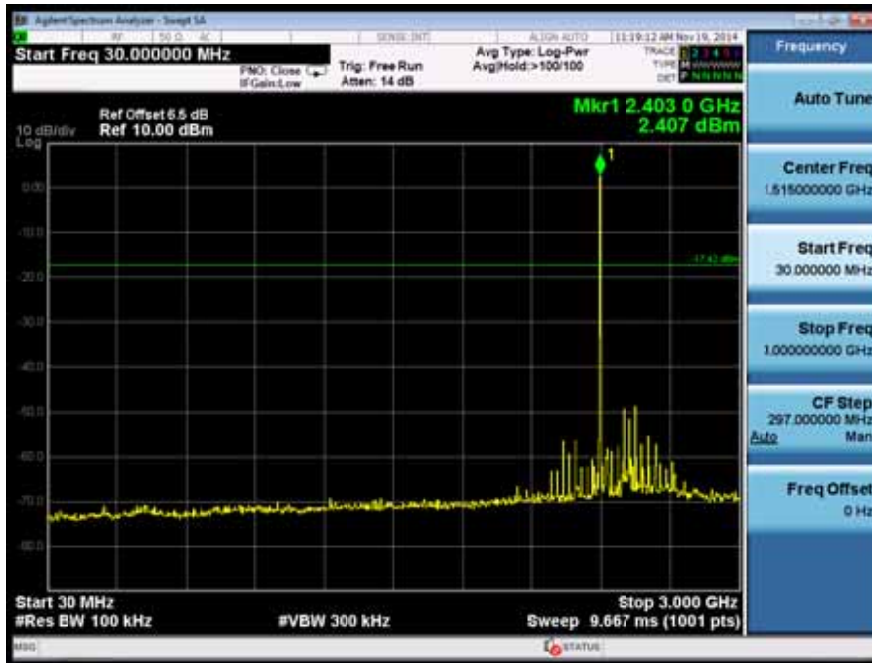


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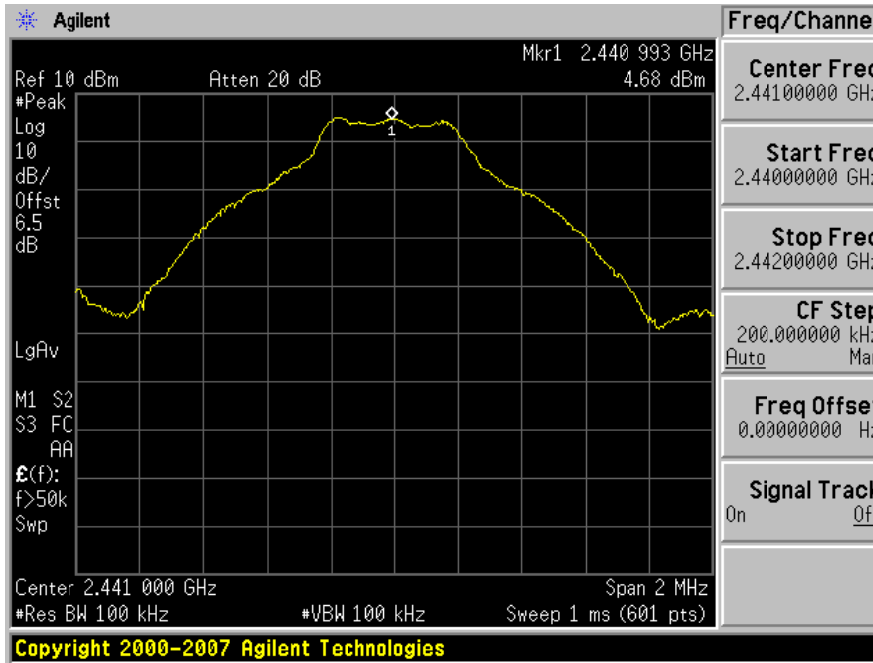
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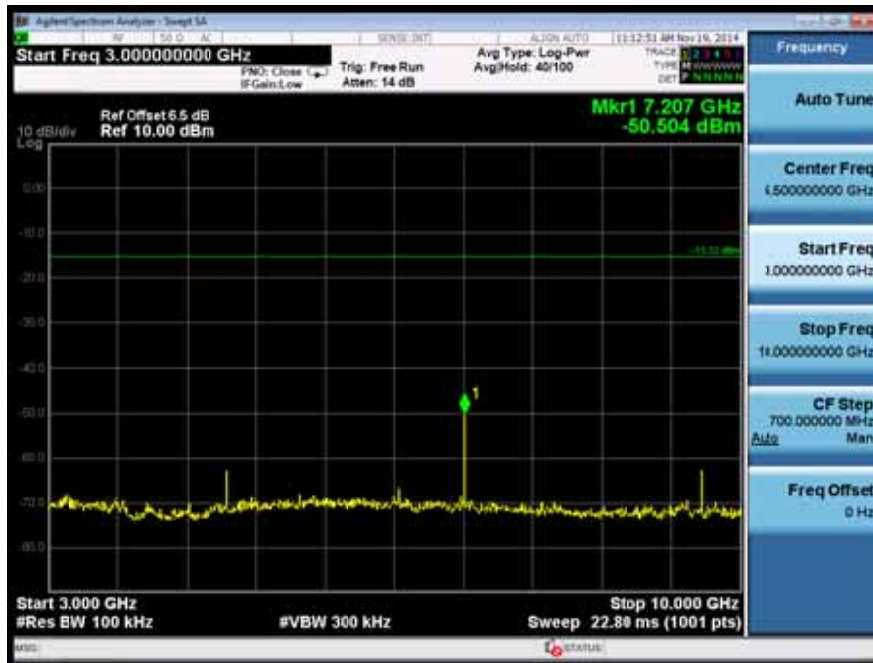
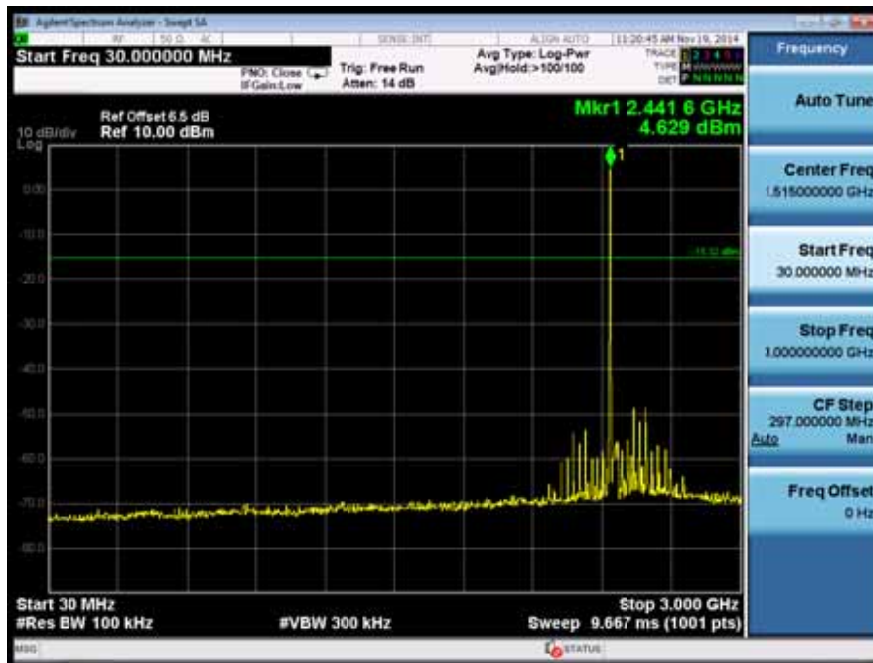
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Middle channel: 2441MHz

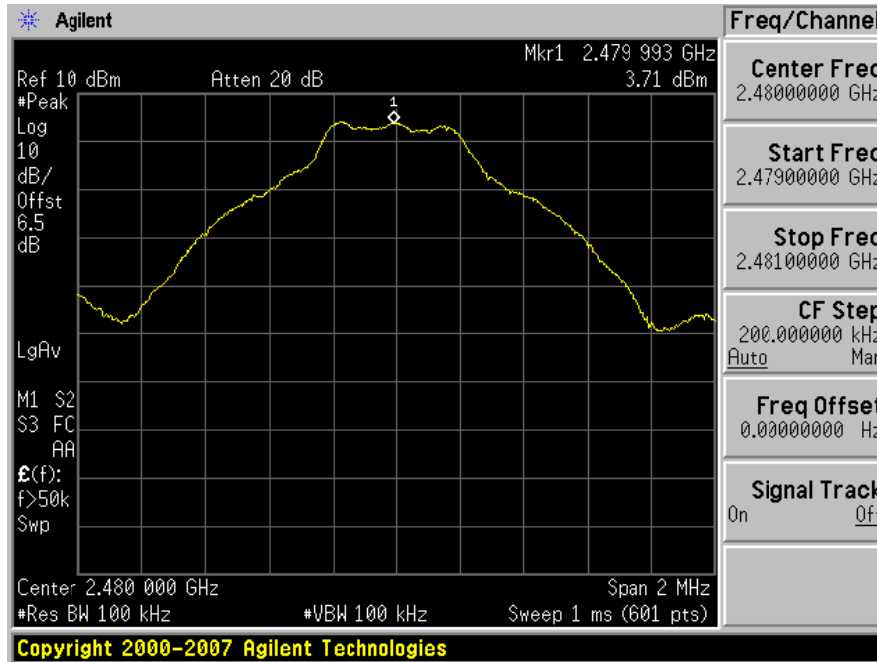


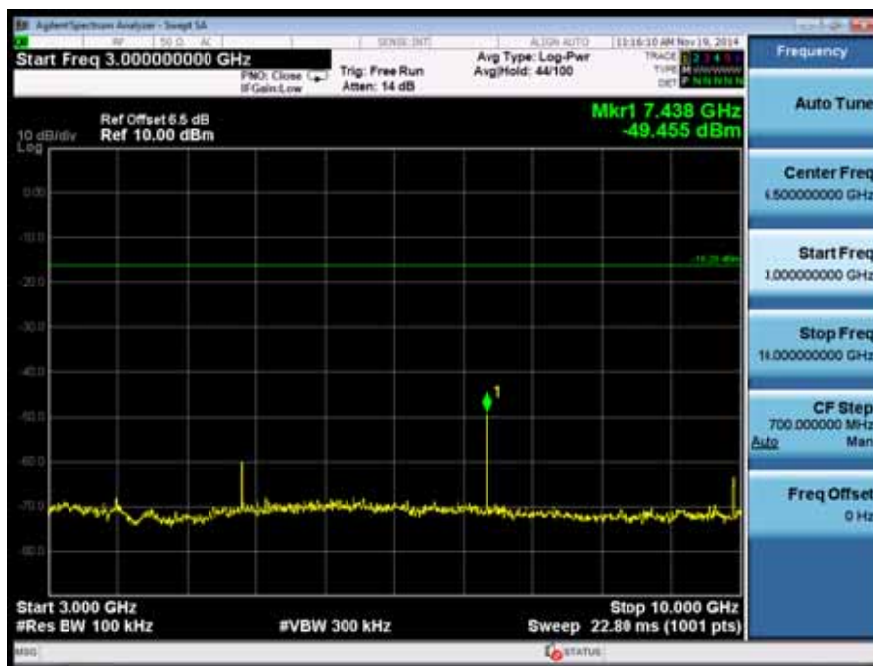
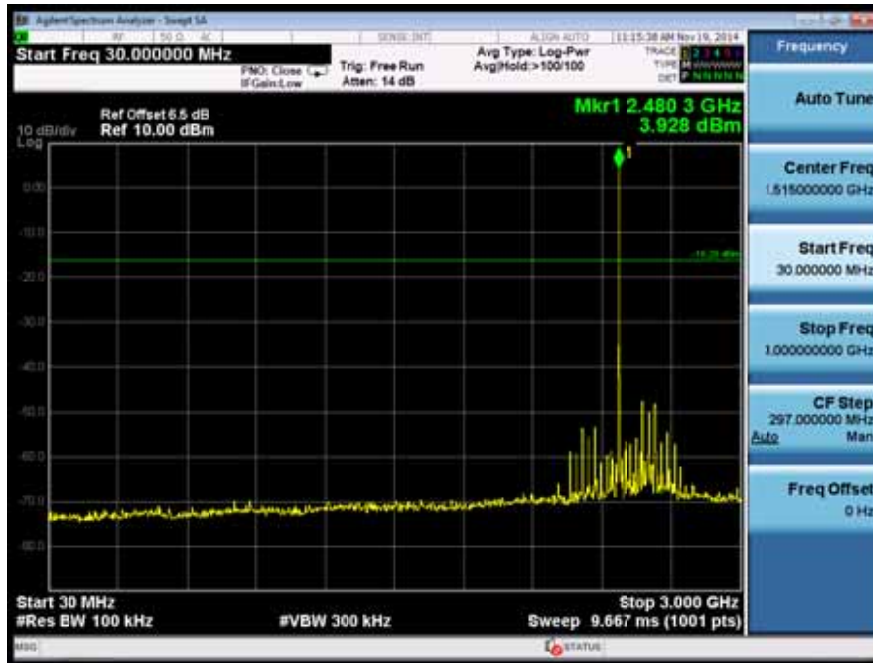






High channel: 2480MHz



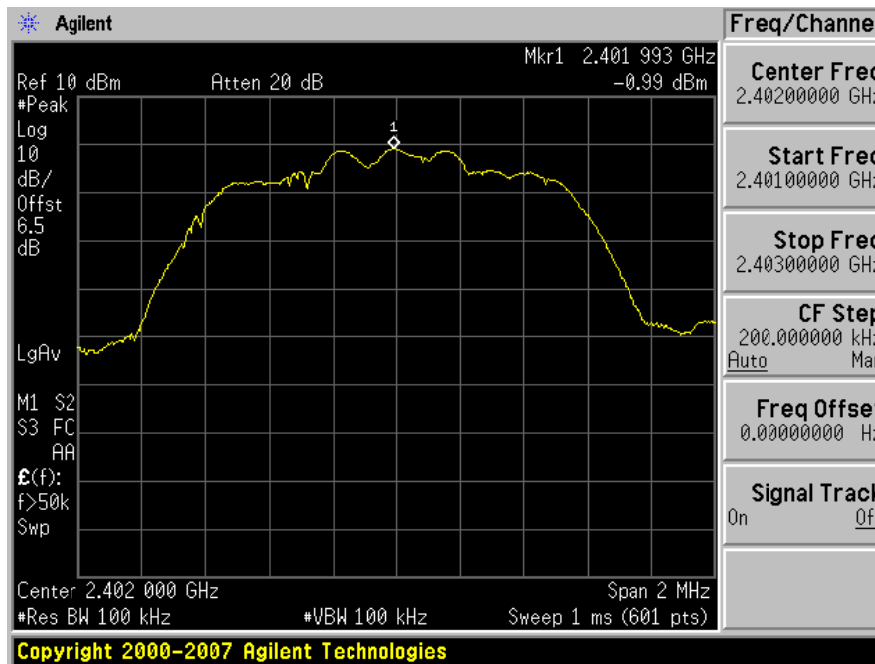






## Mode2:8DPSK Link Mode

Low channel: 2402MHz

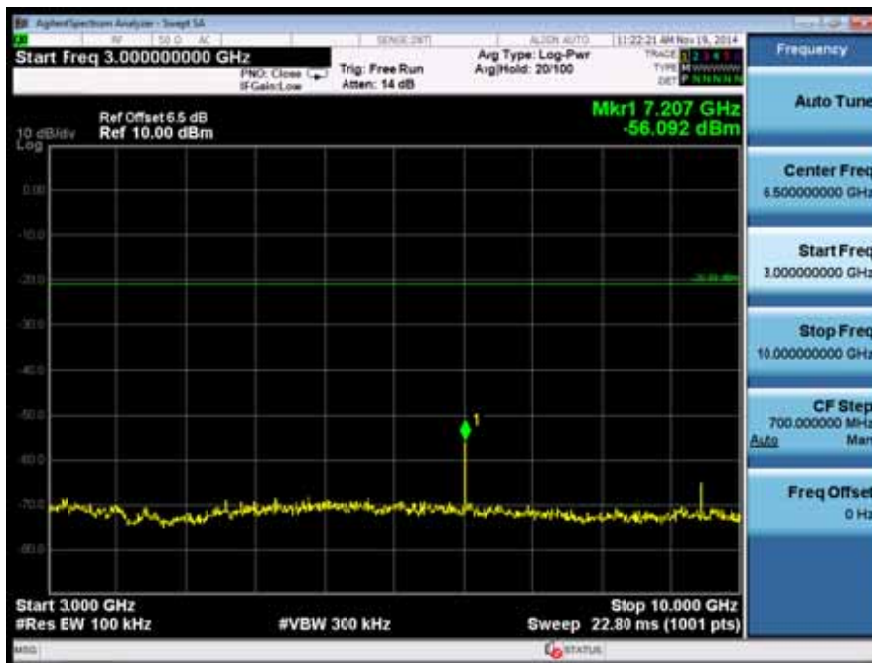
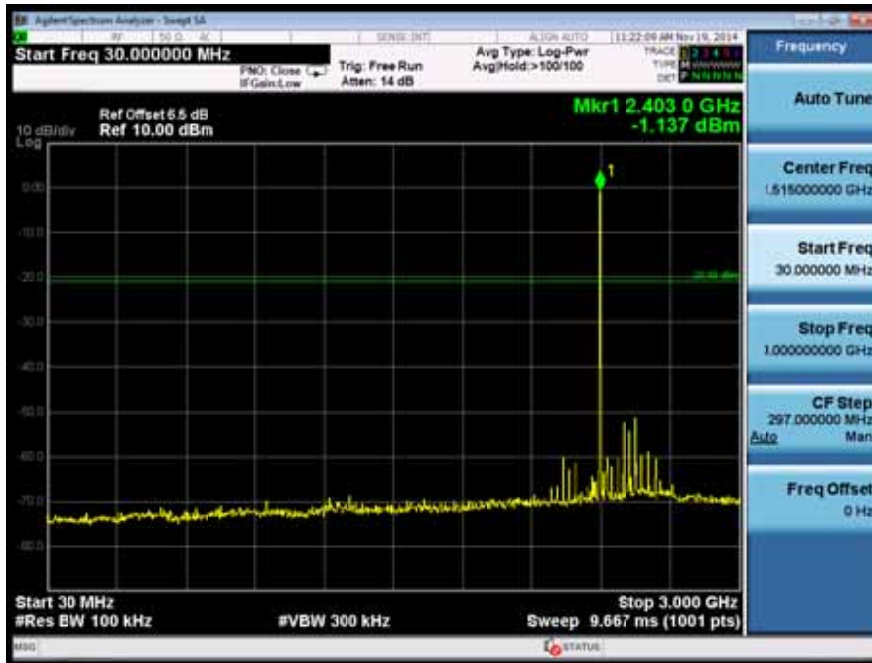


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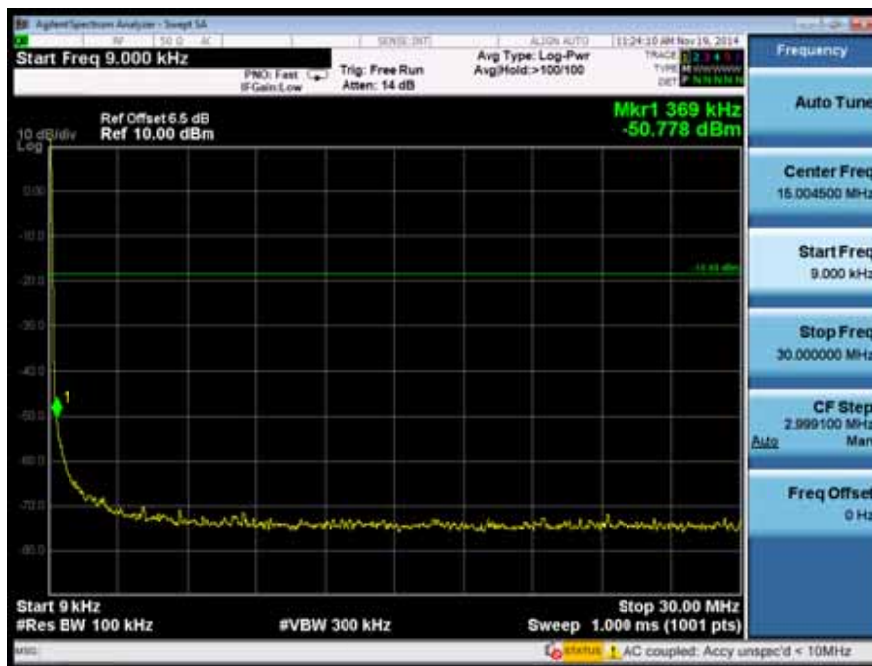
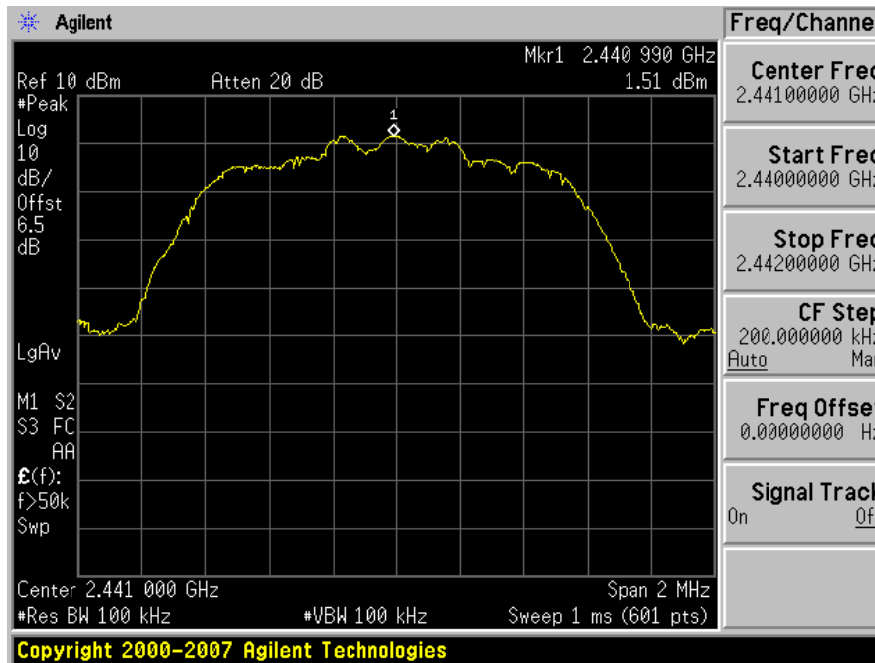
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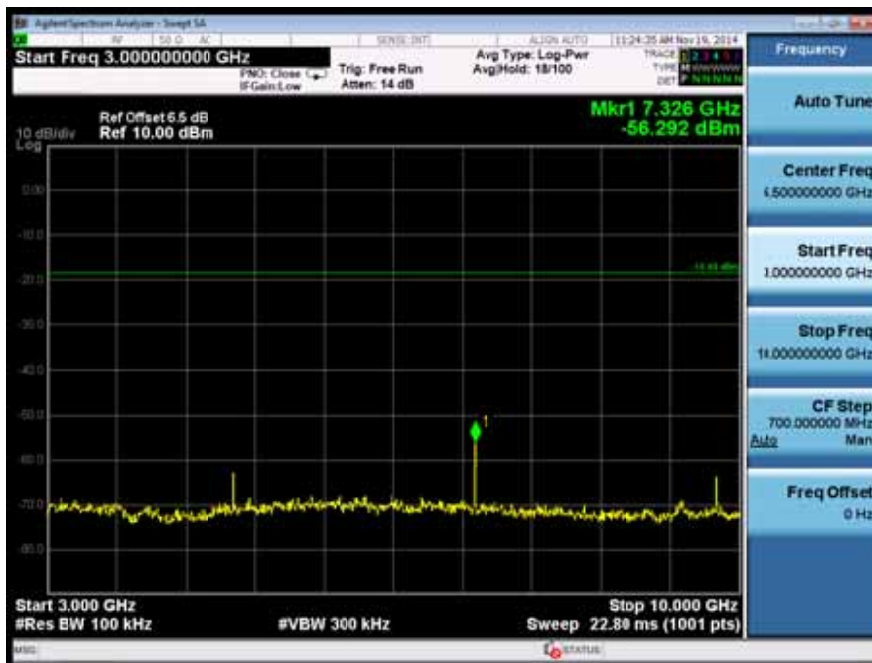
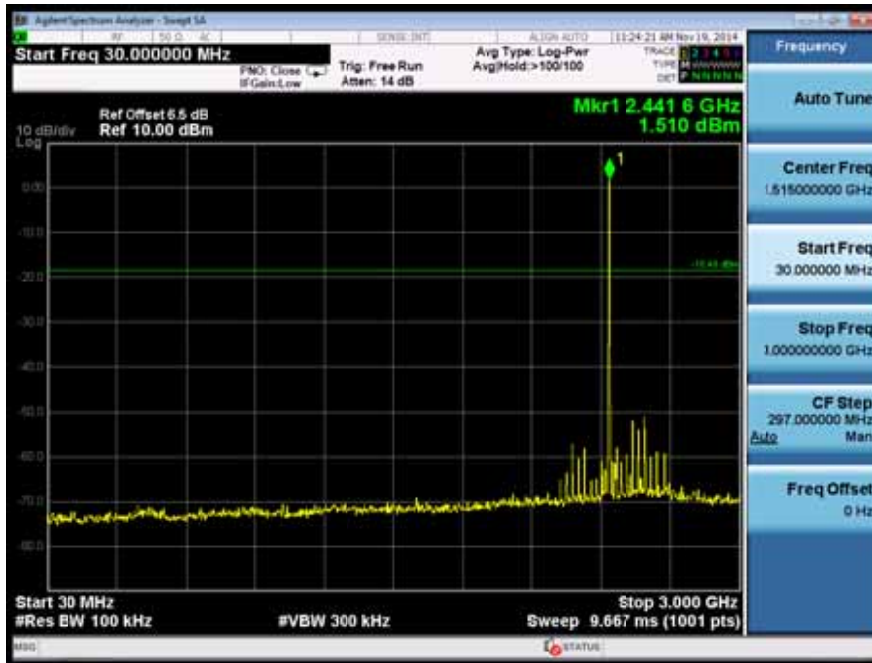
Rev. no.: 2.1





Middle channel: 2441MHz

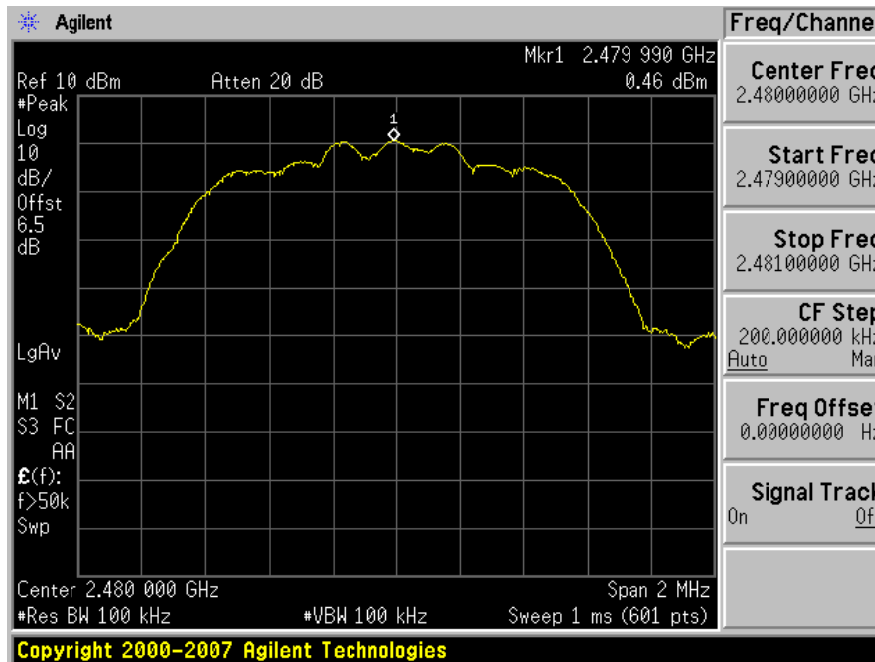




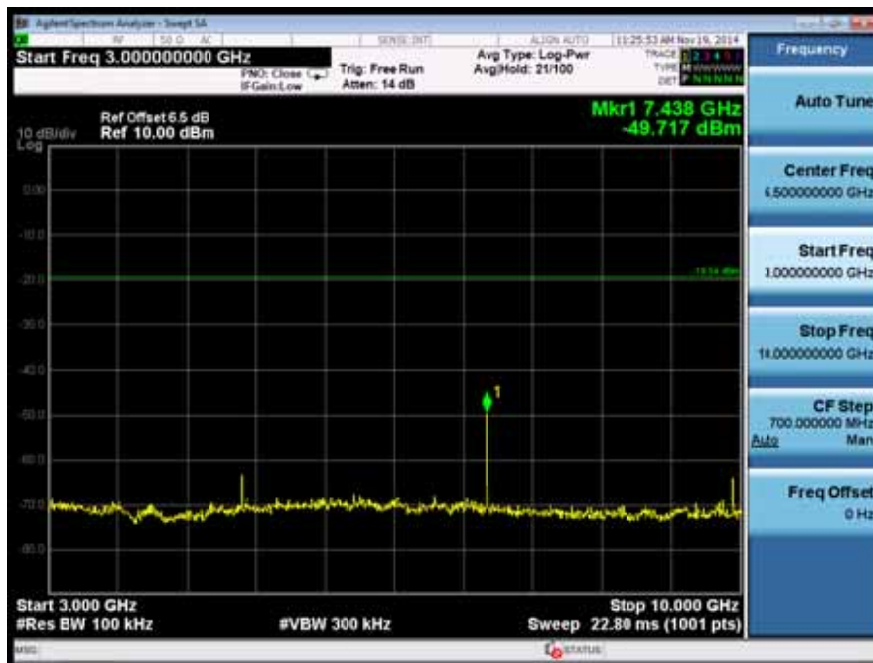
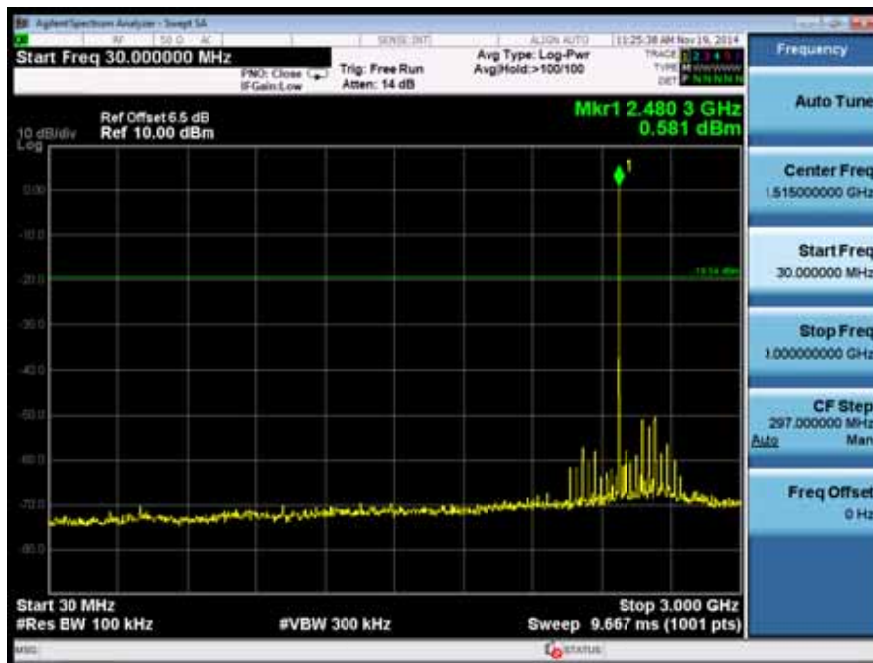




High channel: 2480MHz









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Report Number: [60/790.14.025.03](#)

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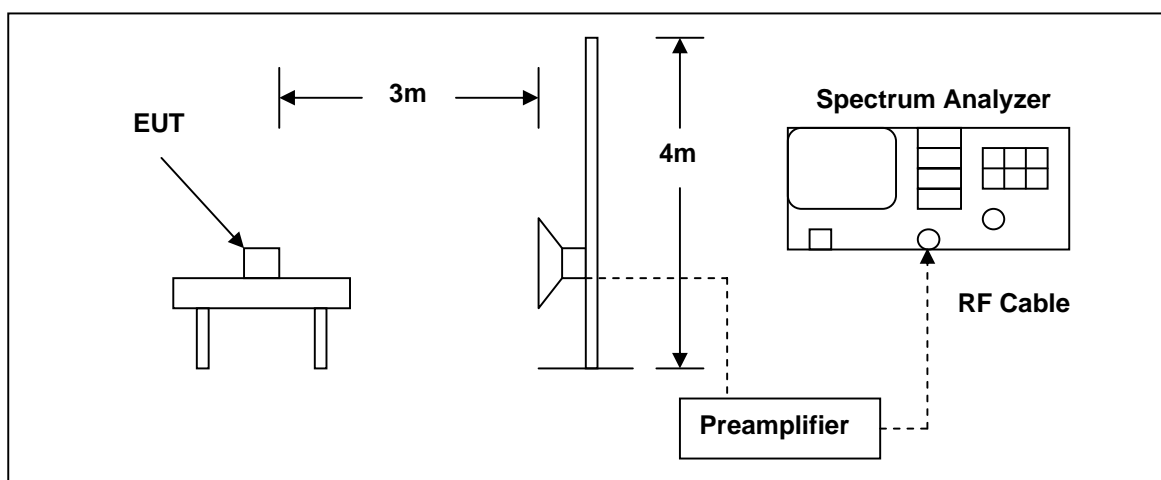
Rev. no.: 2.1

## 8.9 Band Edges Measurement

### 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

### Test Setup



### Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
EMI Test Receiver	R&S	ESU40	SB8501/09	05/16/2014	(1)
Bilog Antenna	Schwarzbeck	Schwarzbeck	SB8501/04	01/20/2014	(1)
Horn Antenna	R&S	HF906	SB3435	01/20/2014	(1)
Amplifier(1-18GHz)	R&S	--	SB3435/01	01/20/2014	(1)
Amplifier(18-40GHz)	R&S	--	SB3435/02	01/20/2014	(1)
Horn Antenna	Amplifier Research	AT4560	SB5392/02	05/16/2014	(1)
RF cable(0.4m)	Woken	/	S02-1404-09-065	05/11/2014	(1)
RF cable(3.5m)	Woken	/	S02-1404-09-047	05/11/2014	(1)
RF cable(1.2m)	Woken	/	S02-1404-09-052	05/11/2014	(1)
3m Semi-anechoic chamber	Albatross Projects	9X6X6	SB3450/01	10/12/2014	(1)

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

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



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## 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.

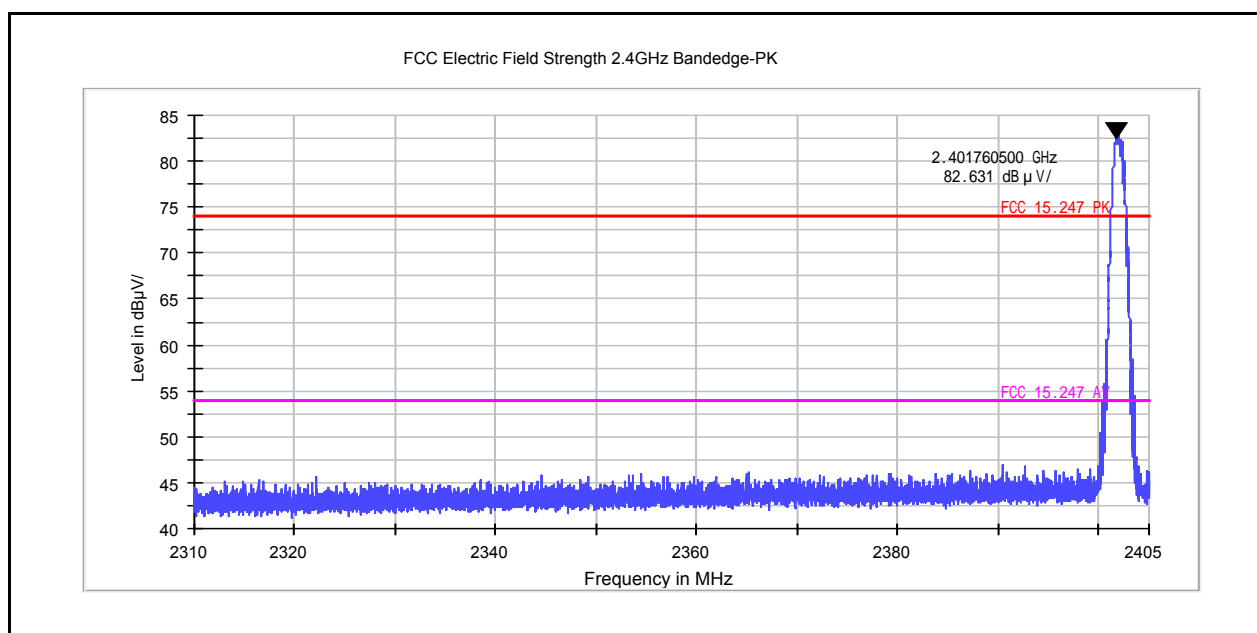
The transmitter was configured with the worst case antenna and setup to transmit at the highest channel. Then the field strength was measured at 2483.5 MHz.

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.

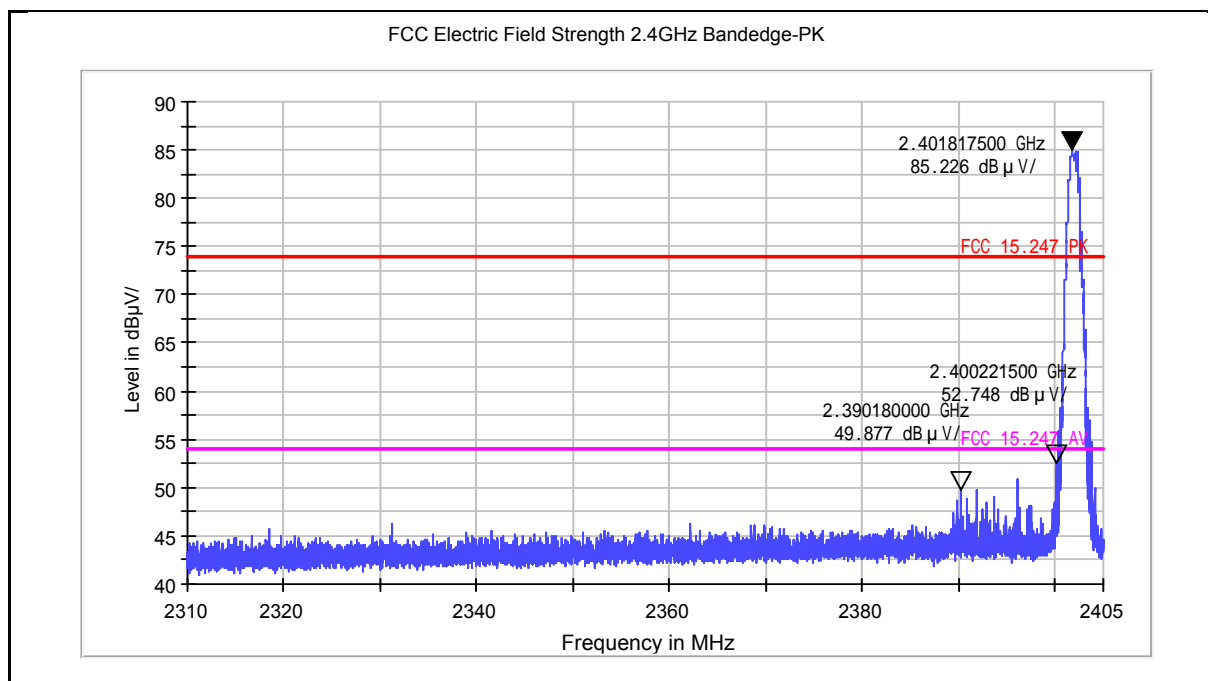
### Test Result

Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	5V DC
Model Number:	Hercules Universal DJ	Temp.( )/Hum.(%RH):	25( )/58%RH
Mode:	Mode 1	Date:	2014/11/16
Frequency:	2402 MHz	Test By:	
Ant.Polar.:	Horizontal		



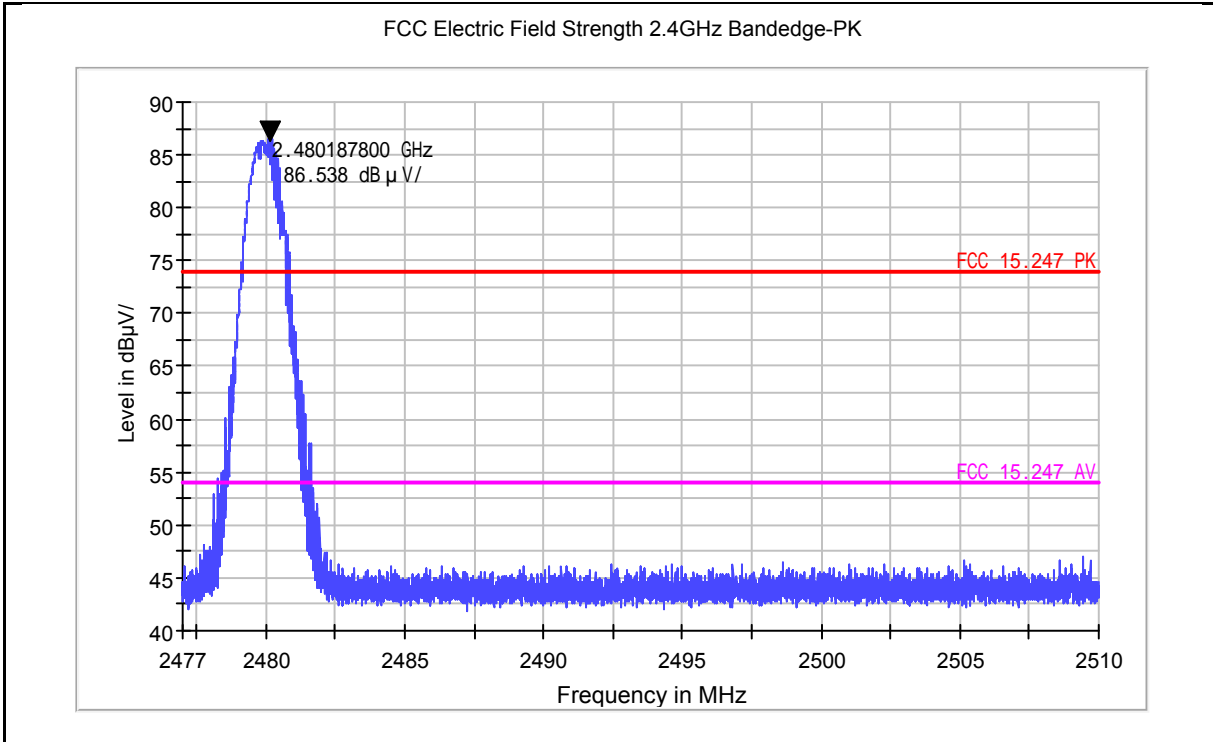
Channel	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
2402MHz	2390	32.6	74.00	41.4	peak	H
	2390	21.4	54.00	32.6	Average	H

Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	5V DC
Model Number:	Hercules Universal DJ	Temp.( )/Hum.(%RH):	25( )/58%RH
Mode:	Mode 1	Date:	2014/11/16
Frequency:	2402 MHz	Test By:	
Ant.Polar.:	Vertical		



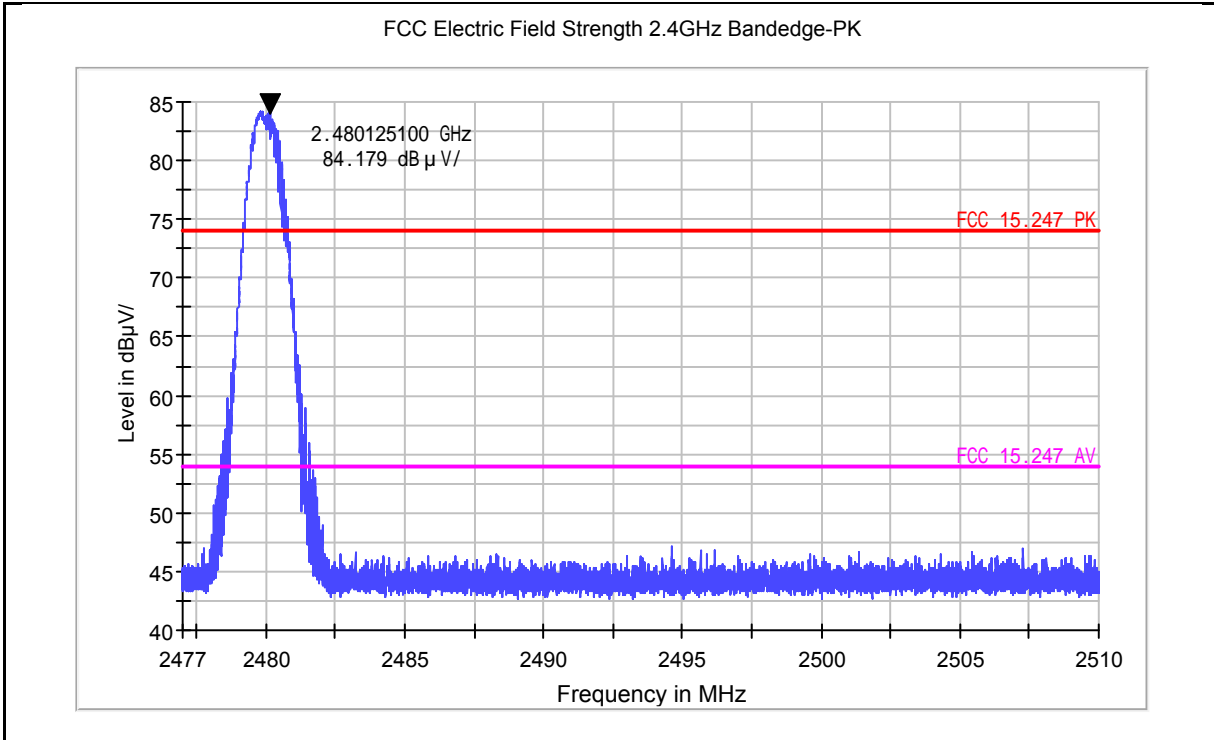
Channel	Frequency (MHz)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Remark	Ant.Polar. H / V
2402MHz	2390	49.9	74.00	24.1	peak	V
	2390	35.1	54.00	18.9	Average	V

Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	5V DC
Model Number:	Hercules Universal DJ	Temp.( )/Hum.(%RH):	25( )/58%RH
Mode:	Mode 1	Date:	2014/11/16
Frequency:	2480 MHz	Test By:	
Ant.Polar.:	Horizontal		



Channel	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
2480MHz	2483.5	36.6	74.00	37.4	peak	H
	2483.5	25.8	54.00	28.2	Average	H

Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	5V DC
Model Number:	Hercules Universal DJ	Temp.( )/Hum.(%RH):	25( )/58%RH
Mode:	Mode 1	Date:	2014/11/16
Frequency:	2480 MHz	Test By:	
Ant.Polar.:	Vertical		



Channel	Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
2480MHz	2483.5	37.1	74.00	36.9	peak	V
	2483.5	29.9	54.00	24.1	Average	V





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## 8.10 Antenna Measurement

### 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.

### Antenna Connector Construction

The antenna used in this product is an integrated PCB monopole antenna. And the maximum Gain of this antenna is 0.0 dBi.