FCC PART 15 SUBPART C
IC RSS-210, ISSUE 8, DEC 2010

TEST AND MEASUREMENT REPORT

For

NVIDIA Corporation

2701 San Tomas Expressway,

Santa Clara, CA 95050, USA

FCC ID: VOB-P2450A
IC: 7361A-P2450A
Model: P2450

Report Type:	**Product Type:**
Original Report	Portable Gaming Device

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Report Number: R1304241-247A DSS

Report Date: 2013-06-13

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1304241-247 DSS	Original Report	2013-05-23
1	R1304241-247A DSS	Updated report data	2013-06-13

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report has been compiled on behalf of *NVIDIA Corporation*, and their product, FCC ID: VOB-P2450A, IC: 7361A-P2450A, model number: P2450, which henceforth is referred to as the EUT (Equipment Under Test.), The EUT is a portable gaming device operates in 2.4 GHz and 5 GHz bands.

1.2 Mechanical Description of EUT

The EUT measures approximately 160 mm (L) x 135 mm (W) x 55 mm (H) and weighs approximately 585 g.

The data gathered are from a typical production sample provided by the manufacturer with serial number: TRB2-0016

1.3 Objective

This report is prepared on behalf of *NVIDIA Corporation* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules and IC RSS-210 Issue 8, Dec 2010.

The objective is to determine compliance with FCC Part 15.247 and IC RSS-210 rules.

1.4 Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS, 15.407 NII with FCC IC: VOB-P2450A and IC RSS-210 with IC: 7361A-P2450A.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2003, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2009.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

2.2 EUT Exercise Software

The software is provided by customer. The EUT exercise program used during radiated testing was designed to exercise the system components.

The EUT had been tested with the following data rate settings:

Radio Mode	Modulation	Frequency/Data rate		
		Low CH	Mid CH	High CH
Bluetooth	GFSK (EDR1)	2402	2441	2480
Bluetooth	DQPSK (EDR2)	2402	2441	2480
Bluetooth	8PSK (EDR3)	2402	2441	2480

2.3 Special Accessories

N/A

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Lenovo	Laptop	G560-0679	CB08585694

2.6 EUT Internal Configuration Details

Manufacturer	Description	Type	Serial Number
NVIDIA Corporation	Joystick board	Gaming control stick	0511613700054
NVIDIA Corporation	Control panel	Button board	0511613600173
Sanyo	Battery	Battery	027-0012-000
NVIDIA Corporation	Mother board	Mother Board	0511613500407
Delta Electronics Inc.	Fan	Fan	-

2.7 Power Supply and Line Filters

Manufacturer	Description	Model	Part Number
NVIDIA Corporation	Power Adapter	P2551	-

2.8 Interface Ports and Cabling

Cable Description	Length (m)	To	From
RF Cable	<1.0	PSA	EUT
USB Cable	<1.0	Laptop	EUT

3 Summary of Test Results

FCC & IC Rules	Description of Test	Results
FCC §15.247(i), §2.1093 IC RSS-102	RF Exposure	Compliant
FCC §15.203 IC RSS-Gen §7.1.2	Antenna Requirements	Compliant
FCC §15.207 (a) IC RSS-Gen §7.2.4	AC Line Conducted Emissions	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	Spurious Emissions at Antenna Port	Compliant
FCC §15.205, §15.209, §15.247(d) IC RSS-210 §2.2, §A8.5	Restricted Bands, Spurious Radiated Emissions	Compliant
FCC §15.247 (a)(1) IC RSS-210 §A8.1	20 dB Channel Bandwidth	Compliant
FCC §15.247(a) IC RSS-210 §A8.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	Band Edge	Compliant
FCC §15.247 (a)(1) IC RSS-210 §A8.1(b)	Hopping Channel Separation	Compliant
FCC §15.247 (a)(1) IC RSS-210 §A8.1(d)	Dwell Time	Compliant
FCC §15.247(b)(1) IC RSS-210 §A8.1	Number of Hopping Channels	Compliant
IC RSS-210 §2.3 IC RSS-Gen §6.1	Receiver Spurious Emission	Compliant

4 FCC §15.247(i), §2.1093 & IC RSS-102 – RF Exposure

4.1 Applicable Standard

FCC §2.1093, §15.247(i) and IC RSS-102

4.2 SAR Exemption Guidelines

According to FCC KDB 447498 D01, Appendix A:

SAR Test Exclusion Thresholds for 100 MHz-6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distance are illustrated in the following Table:

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

According to IC RSS-102 §2.5.1: Exemption from Routine Evaluation Limits-SAR evaluation

SAR evaluation is required if the separation distance between the user and the radiated element of the device is less than or equal to 20 cm, except when the device operates as follows.

- Above 2.2 GHz and up to 3GHz inclusively, and with output power (i.e. the higher of the conducted or radiated(e.i.r.p.) source-based, time-average output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled used;

4.3 Evaluation Result

The maximum conducted output power of this device is 8.59 dBm, the antenna gain is 2.83 dBi, the maximum e.i.r.p. is 8.59 + 2.83 = 11.42 dBm, i.e. 13.87 mW which is less than the SAR threshold of 19 mw (FCC KDB 447498 D01 Appendix A), and 20 mw (IC RSS-102 §2.5.1). Standalone SAR evaluation is not required for BT antenna. Please refer to the report R1304241-SAR for detail SAR evaluation.

5 FCC §15.203 & IC RSS-Gen §7.1.2 – Antenna Description

5.1 Applicable Standard

According to FCC §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), 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 6 dBi.

According to IC RSS-Gen §7.1.2: A transmitter can only be sold or operated with antennas with which it was approved. Transmitter may be approved with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest gain antenna of each combination of transmitter and antenna type for which approval is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type having equal or lesser gain as an antenna that had been successfully tested with the transmitter, will also be considered approved with the transmitter, and may be used and marketed with the transmitter. For Category I transmitters, the manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. For transmitters of RF output power of 10 milliwatts or less, only the portion of the antenna gain that is in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power to demonstrate compliance with the radiated power limits specified in the applicable standard. For transmitters of output power greater than 10 milliwatts, the total antenna gain shall be added to the measured RF output power to demonstrate compliance to the specified radiated power limits.

5.2 Antenna Connector Construction

The EUT has one chip antenna with 2.83 dBi max antenna gain and will be soldered onto the PCB. This is in accordance to sections FCC Part 15.203 and IC RSS-Gen §7.1.2, is considered sufficient to comply with the provisions of these sections. Please refer to the EUT photos.

6 FCC §15.207 & IC RSS-Gen §7.2.4 - Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §7.2.4 Conducted limits:

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 1
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

6.2 Test Setup

The measurement was performed in a shielded room. The test setup and measurement procedure was per ANSI C63.4-2009. The specification limits were in accordance with FCC §15.207 and IC RSS-Gen §7.2.4.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

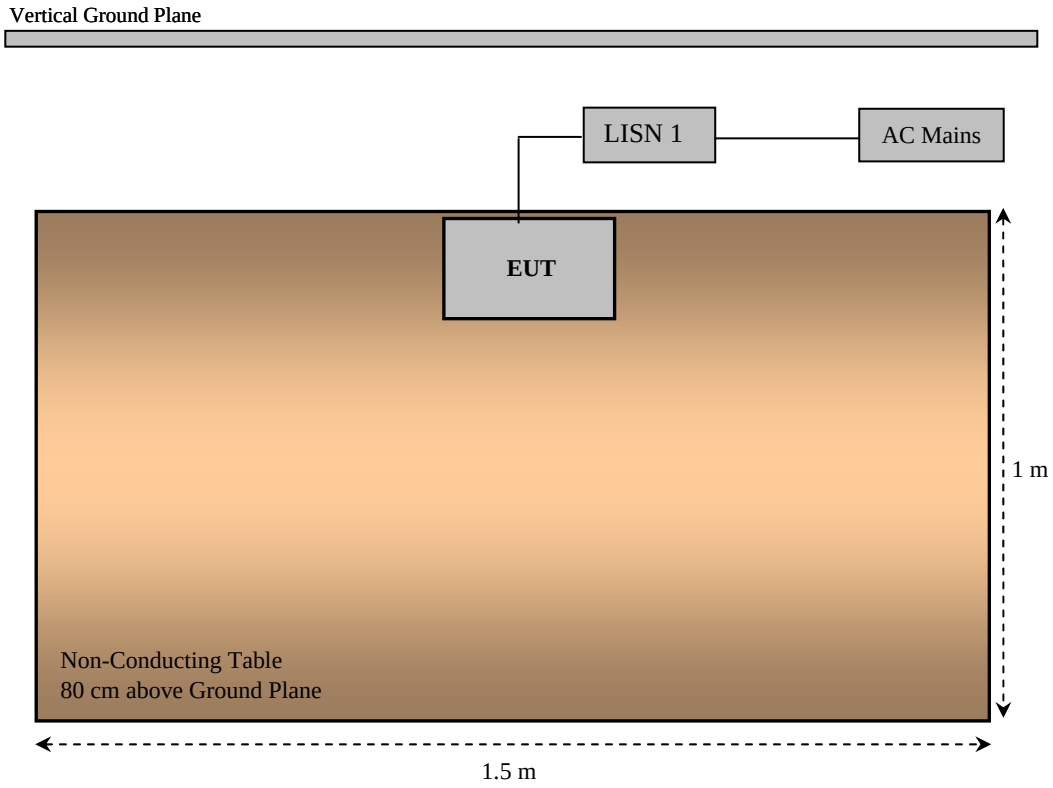
6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Cable Loss (CL) plus the High Pass Filter/Attenuator value (HA) and subtracting the Amplifier Gain (Ga) to the indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + CL + HA – Ga

For example, a corrected amplitude (CA) of 36 dBuV = Indicated Amplitude reading (Ai) of 50.0 dBuV + Cable Loss (CL) 1.0 dB + High Pass Filter/Attenuator (IA) 5 dB - Amplifier Gain (Ga) 20 dB

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin (dB) = Corrected Amplitude (dBuV) - Limit (dBuV)

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2013-03-28	1 year
Solar Electronics	LISN	9252-50-R-24-N	511205	2012-06-25	1yr
TTE	Filter, High Pass	H962-150k-50-21378	K7133	2012-05-30	1yr

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

6.7 Test Environmental Conditions

Temperature:	21º C
Relative Humidity:	41%
ATM Pressure:	102.10KPa

The testing was performed by Bo Li on 2013-05-09 in 5m chamber3.

6.8 Summary of Test Results

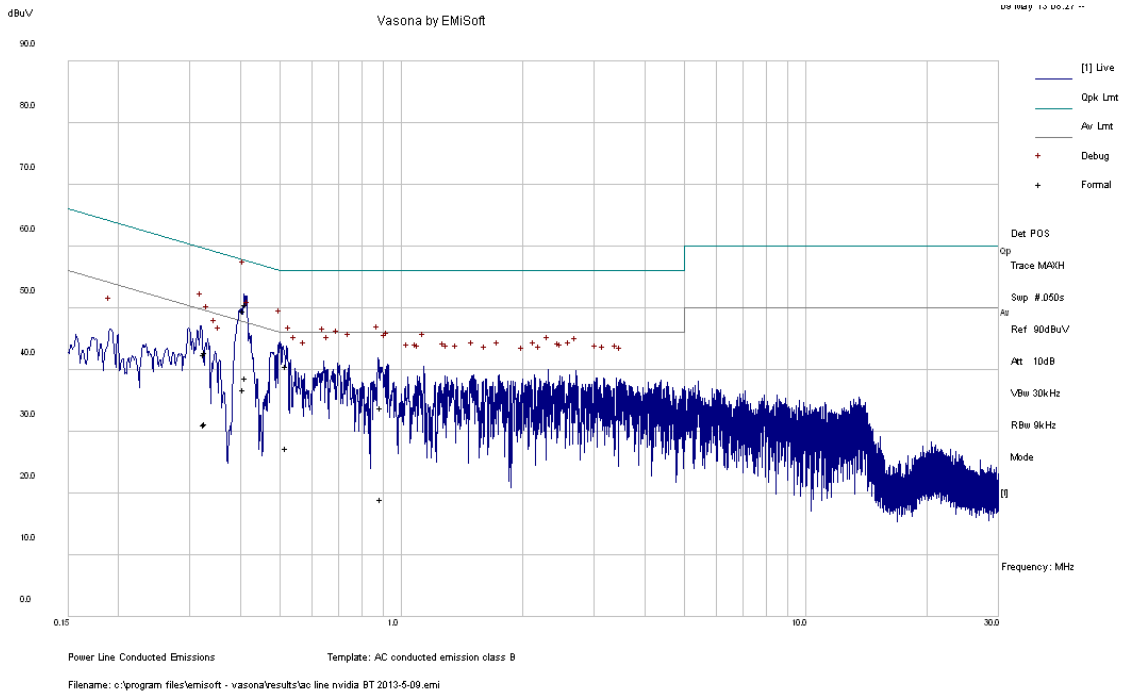
According to the recorded data in following table, the EUT complied with the FCC and IC standards' conducted emissions limits, with a worst case margin of:

Transmitter Mode Worst Case GFSK Middle Channel

Connection: 120V/60Hz			
Margin (dB)	**Frequency (MHz)**	**Conductor (Line/Neutral)**	**Range (MHz)**
-5.52	0.412083	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

BT: GFSK, Middle Channel – 120 V, 60 Hz Line



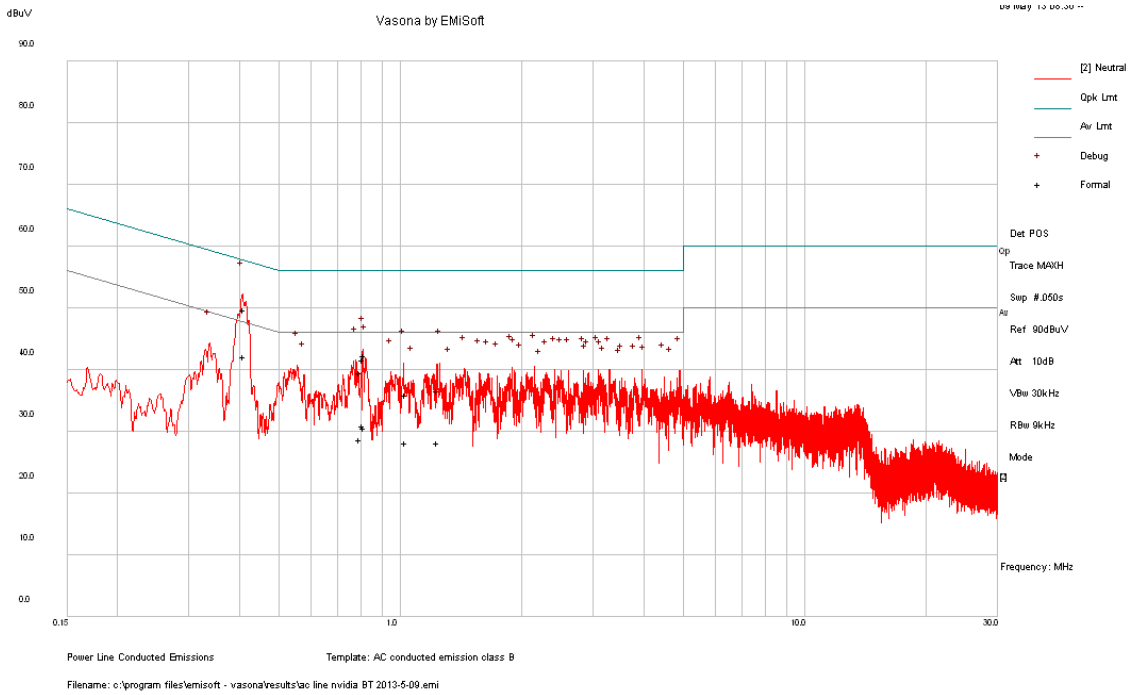
Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.413211	50.56	L	57.58	-7.02
0.408765	49.59	L	57.67	-8.08
0.519471	40.55	L	56	-15.45
0.32751	42.92	L	59.51	-16.60
0.325653	42.55	L	59.56	-17.01
0.891264	33.81	L	56	-22.19

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.413211	38.68	L	47.58	-8.90
0.408765	36.81	L	47.67	-10.87
0.32751	31.36	L	49.51	-18.16
0.325653	31.06	L	49.56	-18.50
0.519471	27.28	L	46	-18.72
0.891264	19.06	L	46	-26.94

BT: GFSK, Middle Channel – 120 V, 60 Hz Neutral



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.412083	49.69	N	57.61	-7.91
0.814551	42.28	N	56	-13.72
0.812154	41.68	N	56	-14.32
0.794976	39.55	N	56	-16.45
1.237263	36.58	N	56	-19.42
1.033206	36.01	N	56	-19.99

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.412083	42.08	N	47.61	-5.52
0.812154	31.02	N	46	-14.98
0.814551	30.65	N	46	-15.35
0.794976	28.78	N	46	-17.22
1.033206	28.21	N	46	-17.79
1.237263	28.12	N	46	-17.88

7 FCC §15.247(d) & IC RSS-210 §A8.5 - Spurious Emissions at Antenna Terminals

7.1 Applicable Standards

For FCC §15.247(d) and IC RSS-210 §A8.5 in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

7.2 Measurement Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

7.4 Test Environmental Conditions

Temperature:	29º C
Relative Humidity:	40%
ATM Pressure:	102 KPa

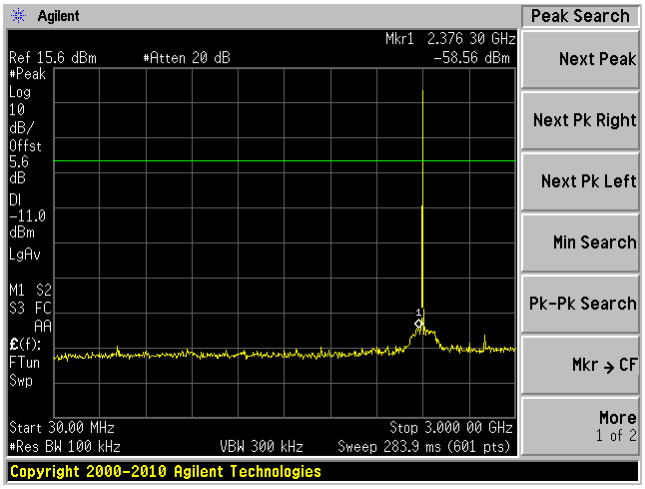
The testing was performed by Bo Li on 2013-05-03 at RF test site.

7.5 Test Results

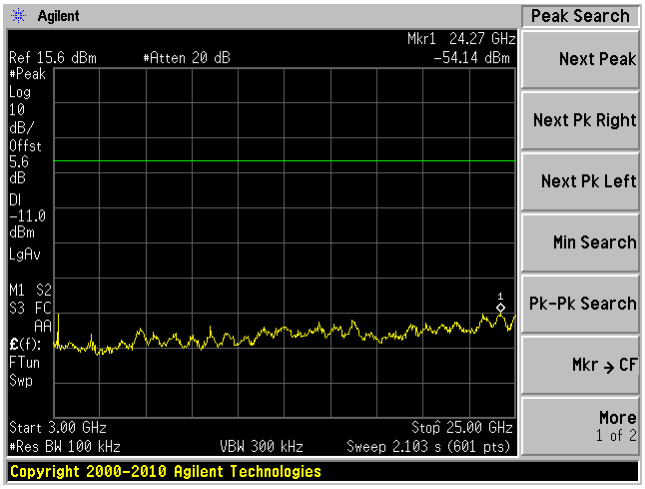
Please refer to the following plots.

GFSK, Low Channel 2402 MHz

30 MHz – 3 GHz

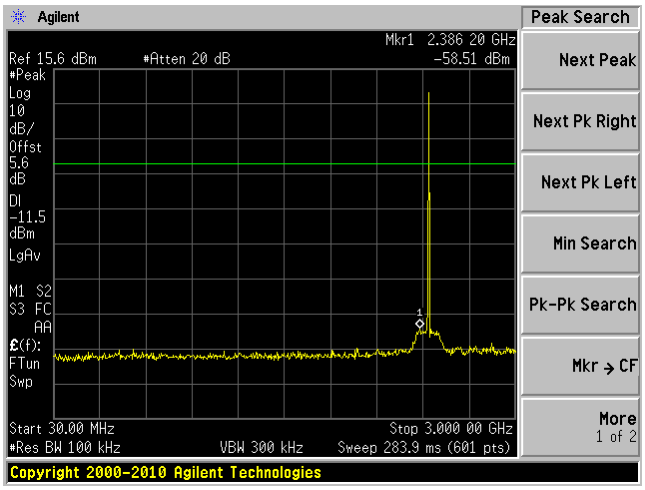


3 – 25 GHz

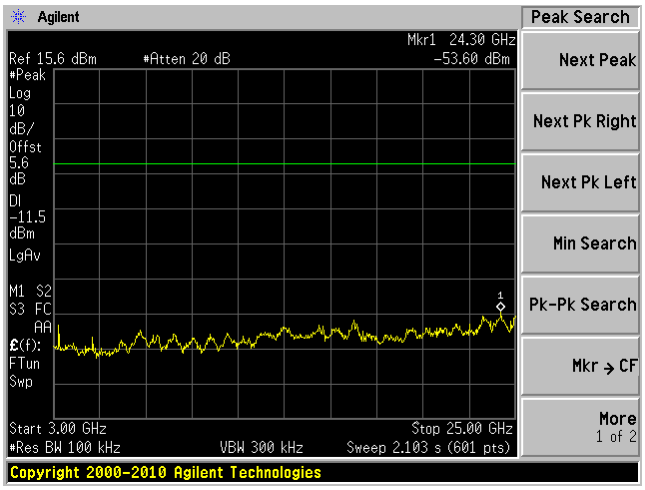


GFSK, Middle Channel 2441 MHz

30 MHz – 3 GHz

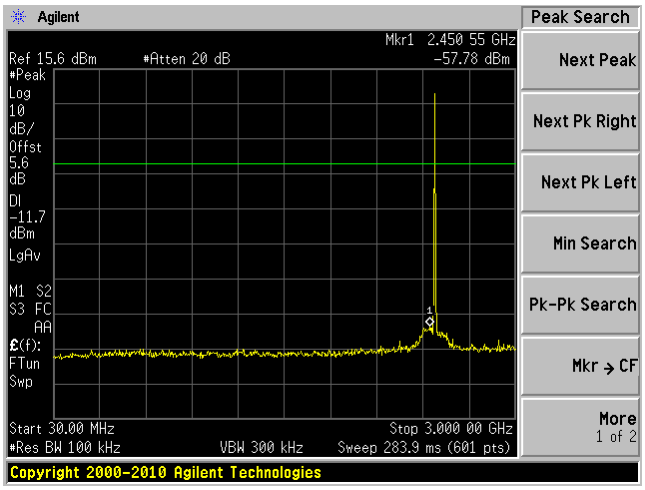


3 – 25 GHz

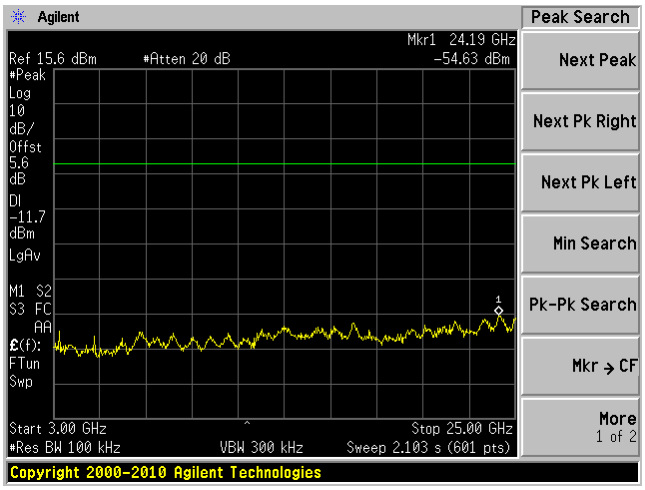


GFSK, High Channel 2480 MHz

30 MHz – 3 GHz

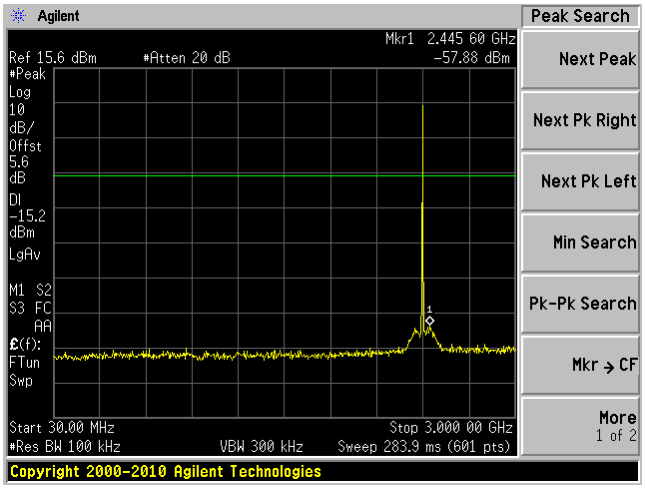


3 – 25GHz

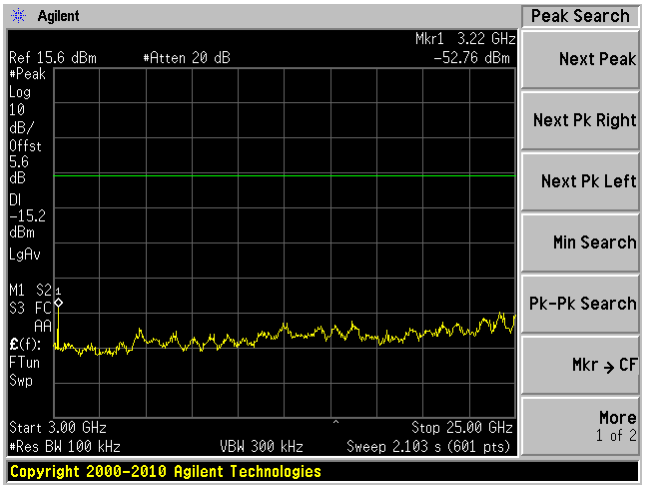


DQPSK, Low Channel 2402 MHz

30 MHz – 3 GHz

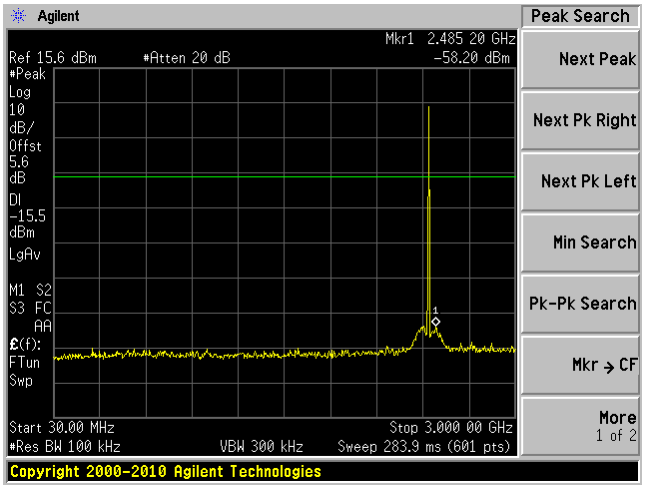


3 – 25 GHz

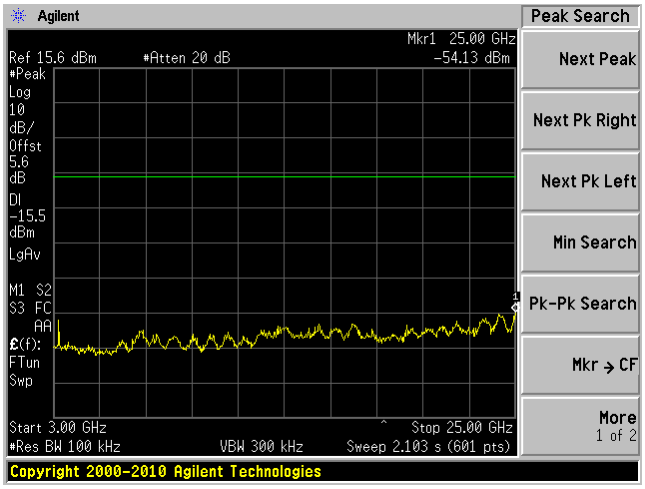


DQPSK, Middle Channel 2441 MHz

30 MHz – 3 GHz

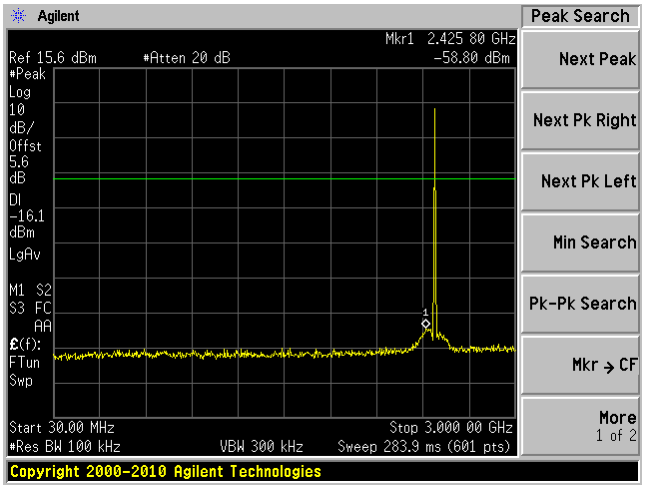


3 – 25 GHz

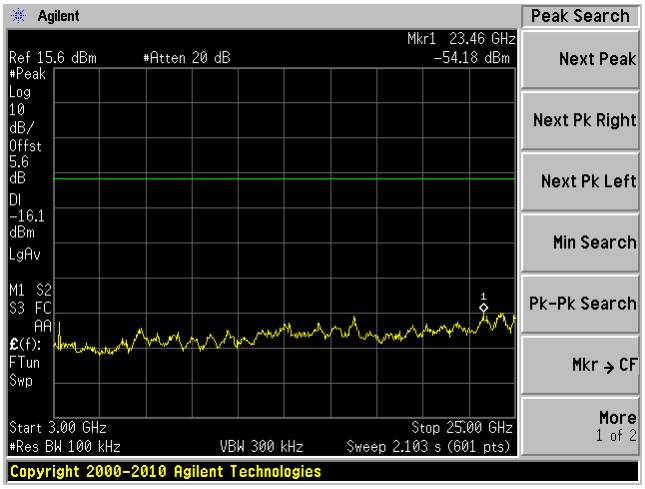


DQPSK, High Channel 2480 MHz

30 MHz – 3 GHz

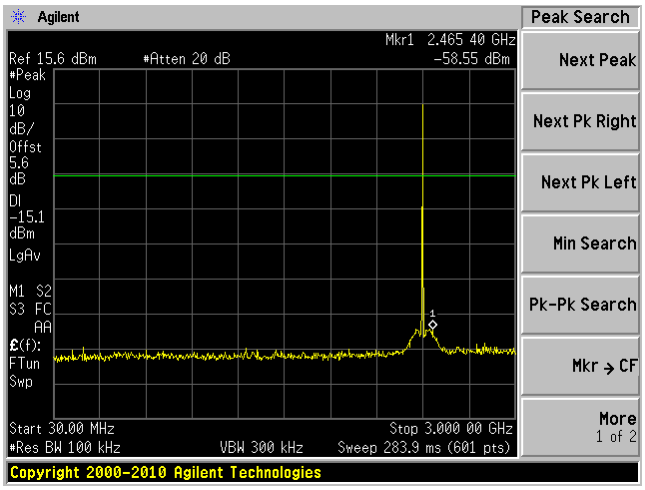


3 – 25 GHz

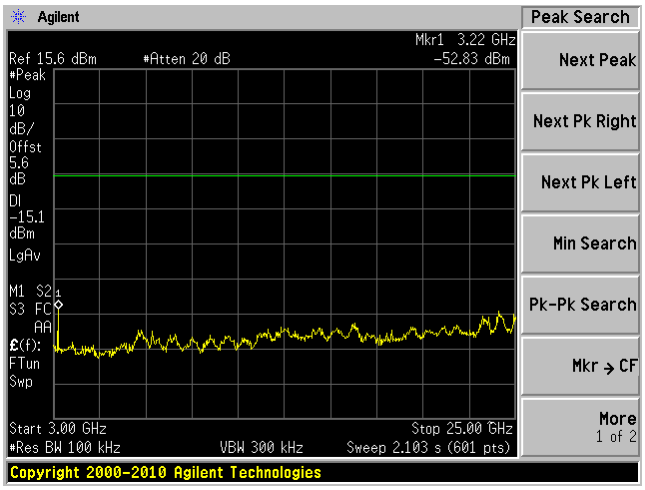


8PSK, Low Channel 2402 MHz

30 MHz – 3 GHz

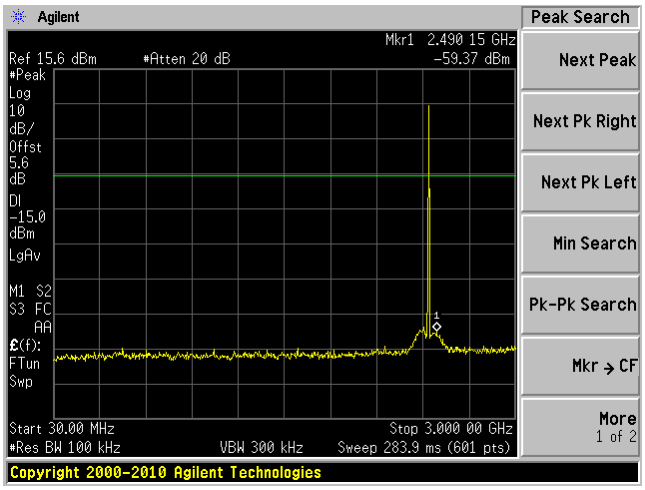


3 – 25 GHz

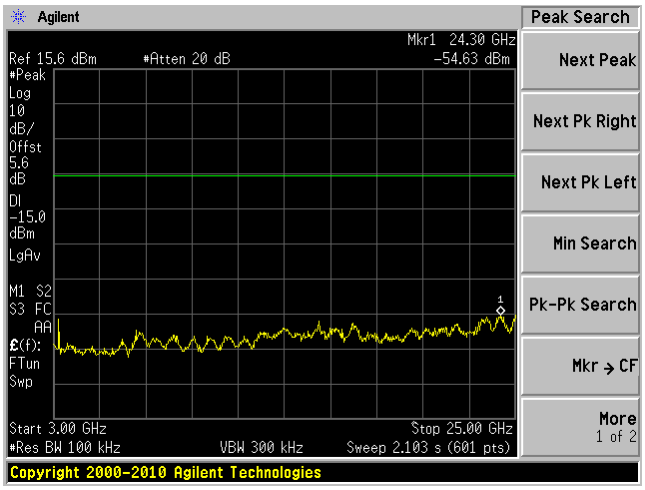


8PSK, Middle Channel 2441 MHz

30 MHz – 3 GHz

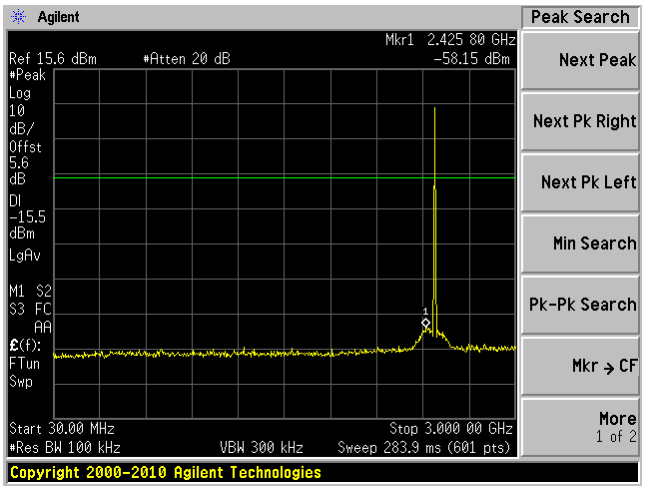


3 – 25 GHz

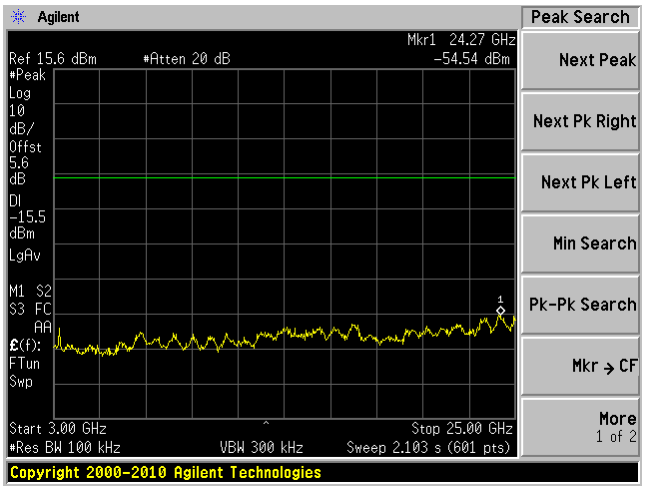


8PSK, High Channel 2480 MHz

30 MHz – 3 GHz



3 – 25GHz



8 FCC §15.205, §15.209 & §15.247(d) & IC RSS-210 §A8.5 - Spurious Radiated Emissions

8.1 Applicable Standards

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(a) and RSS-210: 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 (micro volts/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 Note 2	3
88 - 216	150 Note 2	3
216 - 960	200 Note 2	3
Above 960	500	3

Note 2: 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.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

As per IC RSS-210 §A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

8.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15C and IC RSS-210 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

8.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

8.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to the indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, the Corrected Amplitude (CA) of 40.3 dBuV/m = indicated Amplitude reading (Ai) 32.5 dBuV + Antenna Factor (AF) 23.5dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 29.4 dB

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin (dB) = Corrected Amplitude (dBuV/m) - Limit (dBuV/m)

8.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2013-03-28	1 year
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2012-06-18	1 year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2013-03-08	1 year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 year

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

8.6 Test Environmental Conditions

Temperature:	20º C
Relative Humidity:	49%
ATM Pressure:	102.4 KPa

The testing was performed by Bo Li on 2013-05-04 in 5 meter chamber 3.

8.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C and IC RSS-210 standard's radiated emissions limits, and had a worst case margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Worst Channel, Range**
-5.65	39.1575	Vertical	GFSK Middle Channel 30 MHz-25 GHz

Please refer to the following table and plots for specific test result details.

8.8 Radiated Emissions Test Data and Plots

GFSK

30–25 GHz, Measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz, measured at 3 meters											
2402	72.87	71	100	V	28.956	3.12	0	104.946	NA	NA	Fund/Peak
2402	75.9	42	190	H	28.956	3.12	0	107.976	NA	NA	Fund/Ave
2402	72.45	71	100	V	28.956	3.12	0	104.526	NA	NA	Fund/Peak
2402	75.52	42	190	H	28.956	3.12	0	107.596	NA	NA	Fund/Ave
2390	27.21	0	100	V	28.192	3.12	0	58.522	74	-15.478	Spur/Peak
2390	26.77	0	100	H	28.192	3.12	0	58.082	74	-15.918	Spur/Ave
2390	12.34	0	100	V	28.192	3.12	0	43.652	54	-10.348	Spur/Peak
2390	12.41	0	100	H	28.192	3.12	0	43.722	54	-10.278	Spur/Ave
4804	36.70	47	100	V	33.097	4.56	27.7	46.657	74	-27.343	Harm/Peak
4804	36.21	137	124	H	33.097	4.56	27.7	46.167	74	-27.833	Harm/Peak
4804	29.68	47	100	V	33.097	4.56	27.7	39.637	54	-14.363	Harm/Ave
4804	28.57	137	124	H	33.097	4.56	27.7	38.527	54	-15.473	Harm/Ave
7206	33.33	0	100	V	35.928	5.49	27.58	47.168	84.946	-37.778	Harm/Peak
7206	33.08	0	100	H	35.928	5.49	27.58	46.918	87.976	-41.058	Harm/Peak
7206	18.73	0	100	V	35.928	5.49	27.58	32.568	84.526	-51.958	Harm/Ave
7206	18.484	0	100	H	35.928	5.49	27.58	32.322	87.596	-55.274	Harm/Ave
9608	32.01	41	100	V	37.954	6.54	27.06	49.444	84.946	-35.502	Harm/Peak
9608	32.32	138	109	H	37.954	6.54	27.06	49.754	87.976	-38.222	Harm/Peak
9608	19.33	41	100	V	37.954	6.54	27.06	36.764	84.526	-47.762	Harm/Ave
9608	20.57	138	109	H	37.954	6.54	27.06	38.004	87.596	-49.592	Harm/Ave

All 30 MHz – 1 GHz spurious are digital, other emissions are on the noise floor level. Report only the worst case data as shown below:

Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
39.1035	32.75	QP	V	139	98	40.00	-7.25
220.2555	35.53	QP	V	99	201	46.00	-10.47
399.9785	34.59	QP	V	102	165	46.00	-11.41
130.08275	24.24	QP	V	101	185	43.50	-19.26
119.85525	17.77	QP	H	189	311	43.50	-25.73
255.21075	17.20	QP	V	154	77	46.00	-28.80

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Middle Channel 2441 MHz, measured at 3 meters											
2441	71.8	91	111	V	28.956	3.12	0	103.876	NA	NA	Fund/Peak
2441	76.89	44	179	H	28.956	3.12	0	108.966	NA	NA	Fund/Ave
2441	71.45	91	111	V	28.956	3.12	0	103.526	NA	NA	Fund/Peak
2441	76.56	44	179	H	28.956	3.12	0	108.636	NA	NA	Fund/Ave
4882	36.18	36	100	V	33.327	4.54	27.76	46.287	74	-27.713	Harm/Peak
4882	35.77	139	100	H	33.327	4.54	27.76	45.877	74	-28.123	Harm/Peak
4882	27.96	36	100	V	33.327	4.54	27.76	38.067	54	-15.933	Harm/Ave
4882	27.58	139	100	H	33.327	4.54	27.76	37.687	54	-16.313	Harm/Ave
7323	33.10	0	100	V	36.369	5.57	27.51	47.529	74	-26.471	Harm/Peak
7323	32.76	0	100	H	36.369	5.57	27.51	47.189	74	-26.811	Harm/Peak
7323	17.97	0	100	V	36.369	5.57	27.51	32.399	54	-21.601	Harm/Ave
7323	17.987	0	100	H	36.369	5.57	27.51	32.416	54	-21.584	Harm/Ave
9764	33.94	270	100	V	38.287	6.62	26.98	51.867	83.876	-32.009	Harm/Peak
9764	34.33	53	100	H	38.287	6.62	26.98	52.257	88.966	-36.709	Harm/Peak
9764	22.71	270	100	V	38.287	6.62	26.98	40.637	83.526	-42.889	Harm/Ave
9764	24.24	53	100	H	38.287	6.62	26.98	42.167	88.636	-46.469	Harm/Ave

All 30 MHz – 1 GHz spurious are digital, other emissions are on the noise floor level. Report only the worst case data as shown below:

Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
39.1575	34.35	QP	V	116	308	40.00	-5.65
900.29	35.82	QP	V	108	233	46.00	-10.18
130.45625	22.44	QP	V	123	201	43.50	-21.06
408.637	20.00	QP	V	109	171	46.00	-26.00
998.414	23.32	QP	V	250	332	54.00	-30.68
264.825	14.82	QP	V	301	346	46.00	-31.18

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2480 MHz, measured at 3 meters											
2480	72.57	96	115	V	29.155	3.25	0	104.975	NA	NA	Fund/Peak
2480	75.64	54	175	H	29.155	3.25	0	108.045	NA	NA	Fund/Ave
2480	72.2	96	115	V	29.155	3.25	0	104.605	NA	NA	Fund/Peak
2480	75.24	54	175	H	29.155	3.25	0	107.645	NA	NA	Fund/Ave
2483.5	29.18	96	114	V	29.155	3.25	0	61.585	74	-12.415	Spur/Peak
2483.5	30.46	52	176	H	29.155	3.25	0	62.865	74	-11.135	Spur/Ave
2483.5	14.76	96	114	V	29.155	3.25	0	47.165	54	-6.835	Spur/Peak
2483.5	15.71	52	176	H	29.155	3.25	0	48.115	54	-5.885	Spur/Ave
4960	35.36	326	111	V	33.327	4.52	27.75	45.457	74	-28.543	Harm/Peak
4960	34.69	65	100	H	33.327	4.52	27.75	44.787	74	-29.213	Harm/Peak
4960	27.56	326	111	V	33.327	4.52	27.75	37.657	54	-16.343	Harm/Ave
4960	25.02	65	100	H	33.327	4.52	27.75	35.117	54	-18.883	Harm/Ave
7440	33.01	0	100	V	36.565	5.62	27.51	47.685	74	-26.315	Harm/Peak
7440	32.86	0	100	H	36.565	5.62	27.51	47.535	74	-26.465	Harm/Peak
7440	17.17	0	100	V	36.565	5.62	27.51	31.845	54	-22.155	Harm/Ave
7440	18.14	0	100	H	36.565	5.62	27.51	32.815	54	-21.185	Harm/Ave
9920	31.32	0	100	V	38.287	6.55	26.98	49.177	88.225	-39.048	Harm/Peak
9920	31.03	0	100	H	38.287	6.55	26.98	48.887	90.605	-41.718	Harm/Peak
9920	17.34	0	100	V	38.287	6.55	26.98	35.197	85.235	-50.038	Harm/Ave
9920	16.88	0	100	H	38.287	6.55	26.98	34.737	87.905	-53.168	Harm/Ave

All 30 MHz – 1 GHz spurious are digital, other emissions are on the noise floor level. Report only the worst case data as shown below:

Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
39.012	31.64	QP	V	99	225	40	-8.36
400.00375	34.71	QP	V	117	174	46	-11.29
333.28125	27.06	QP	H	104	256	46	-18.94
253.188	18.52	QP	H	107	301	46	-27.48
999.512	24.37	QP	V	217	93	54	-29.63

DQPSK

Only Field Strength and Restricted band was tested, other emissions was tested and reported in the worst modulation (GFSK) as the power output is the highest and the bandwidth is smaller.

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz, measured at 3 meters											
2402	71.27	139	100	V	28.956	3.12	0	103.346	NA	NA	Fund/Peak
2402	74.68	0	142	H	28.956	3.12	0	106.756	NA	NA	Fund/Ave
2402	67.70	139	100	V	28.956	3.12	0	99.776	NA	NA	Fund/Peak
2402	71.17	0	142	H	28.956	3.12	0	103.246	NA	NA	Fund/Ave
2390	27.01	0	100	V	28.192	3.12	0	58.322	74	-15.678	Spur/Peak
2390	26.94	0	100	H	28.192	3.12	0	58.252	74	-15.748	Spur/Ave
2390	12.39	0	100	V	28.192	3.12	0	43.702	54	-10.298	Spur/Peak
2390	12.68	0	100	H	28.192	3.12	0	43.992	54	-10.008	Spur/Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2480 MHz, measured at 3 meters											
2480	68.69	65	104	V	29.155	3.25	0	101.095	NA	NA	Fund/Peak
2480	73.06	4	174	H	29.155	3.25	0	105.465	NA	NA	Fund/Ave
2480	64.90	65	104	V	29.155	3.25	0	97.305	NA	NA	Fund/Peak
2480	69.37	4	174	H	29.155	3.25	0	101.775	NA	NA	Fund/Ave
2483.5	30.77	65	104	V	29.155	3.25	0	63.175	74	-10.825	Spur/Peak
2483.5	33.70	6	174	H	29.155	3.25	0	66.105	74	-7.895	Spur/Ave
2483.5	13.55	65	104	V	29.155	3.25	0	45.955	54	-8.045	Spur/Peak
2483.5	14.36	6	174	H	29.155	3.25	0	46.765	54	-7.235	Spur/Ave

8PSK

Only Field Strength and Restricted band was tested, other emissions was tested and reported in the worst modulation (GFSK) as the power output is the highest and the bandwidth is smaller.

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz, measured at 3 meters											
2402	70.95	92	110	V	28.956	3.12	0	103.026	NA	NA	Fund/Peak
2402	74.67	4	187	H	28.956	3.12	0	106.746	NA	NA	Fund/Ave
2402	66.98	92	110	V	28.956	3.12	0	99.056	NA	NA	Fund/Peak
2402	70.84	4	187	H	28.956	3.12	0	102.916	NA	NA	Fund/Ave
2390	27.08	0	100	V	28.192	3.12	0	58.392	74	-15.608	Spur/Peak
2390	26.78	0	100	H	28.192	3.12	0	58.092	74	-15.908	Spur/Ave
2390	12.45	0	100	V	28.192	3.12	0	43.762	54	-10.238	Spur/Peak
2390	12.55	0	100	H	28.192	3.12	0	43.862	54	-10.138	Spur/Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2480 MHz, measured at 3 meters											
2480	69.11	65	106	V	29.155	3.25	0	101.515	NA	NA	Fund/Peak
2480	73.68	4	171	H	29.155	3.25	0	106.085	NA	NA	Fund/Ave
2480	64.93	65	106	V	29.155	3.25	0	97.335	NA	NA	Fund/Peak
2480	69.45	4	171	H	29.155	3.25	0	101.855	NA	NA	Fund/Ave
2483.5	31.03	65	106	V	29.155	3.25	0	63.435	74	-10.565	Spur/Peak
2483.5	33.61	6	175	H	29.155	3.25	0	66.015	74	-7.985	Spur/Ave
2483.5	14.61	65	106	V	29.155	3.25	0	47.015	54	-6.985	Spur/Peak
2483.5	14.35	6	175	H	29.155	3.25	0	46.755	54	-7.245	Spur/Ave

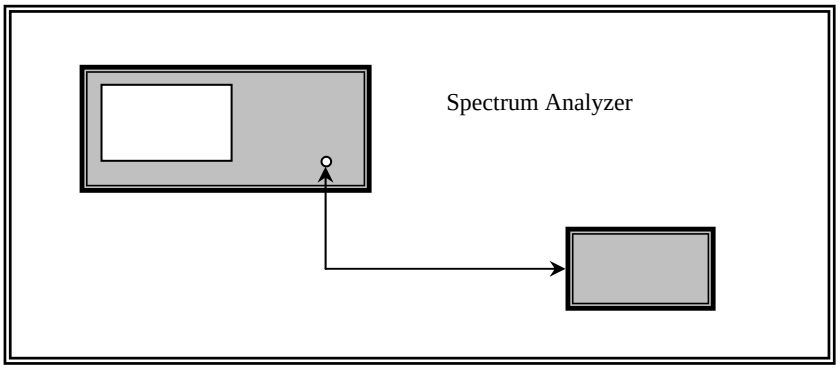
9 FCC §15.247(b) & IC RSS-210 §A8.4 - Peak Output Power Measurement

9.1 Applicable Standard

According to FCC §15.247(b) and IC RSS-210 §A8.4 (4) 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.

9.2 Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.



9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	20 °C
Relative Humidity:	29 %
ATM Pressure:	102kPa

The testing was performed by Bo Li on 2013-05-03 at RF test site.

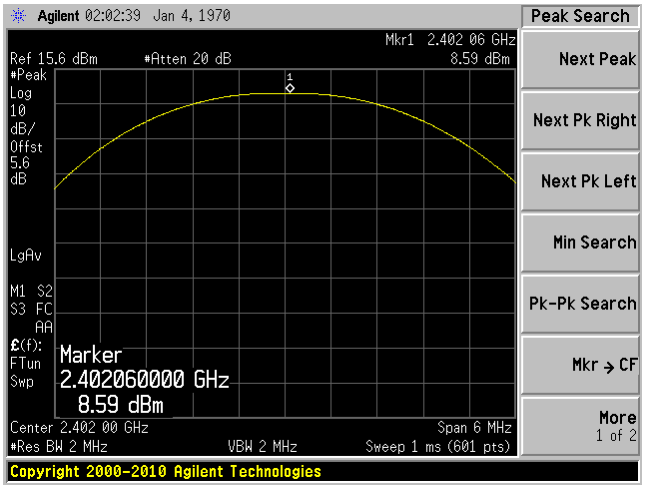
9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/IC Limit (dBm)	Margin (dB)
GFSK				
Low	2402	8.59	30	-21.41
Middle	2441	8.43	30	-21.57
High	2480	7.82	30	-22.18
DQPSK				
Low	2402	8.24	30	-21.76
Middle	2441	8.08	30	-21.92
High	2480	7.43	30	-22.57
8PSK				
Low	2402	8.59	30	-21.41
Middle	2441	8.34	30	-21.66
High	2480	7.82	30	-22.18

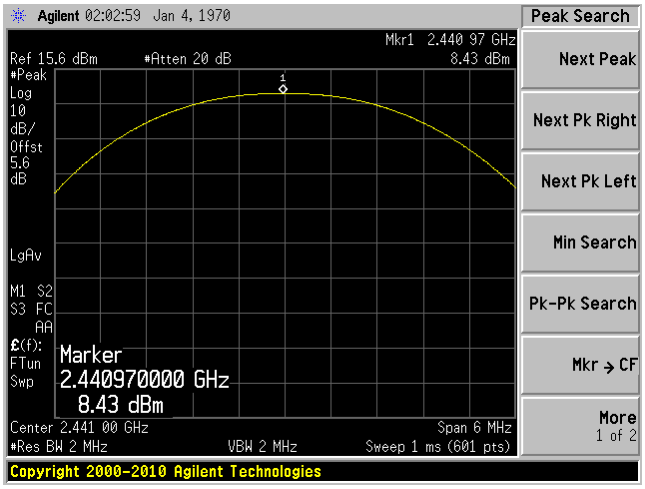
Please refer to the following plots.

GFSK

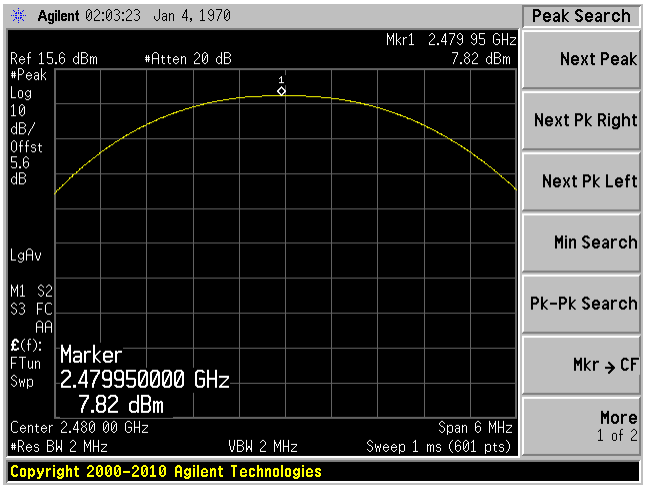
Low channel: 2402 MHz



Middle Channel: 2441 MHz

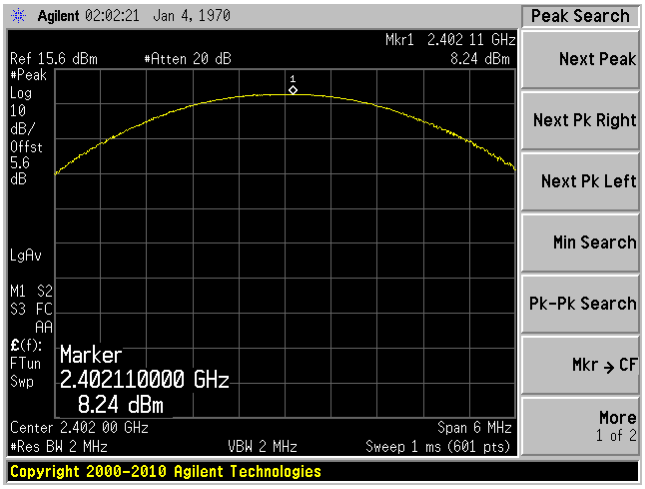


High Channel: 2480 MHz

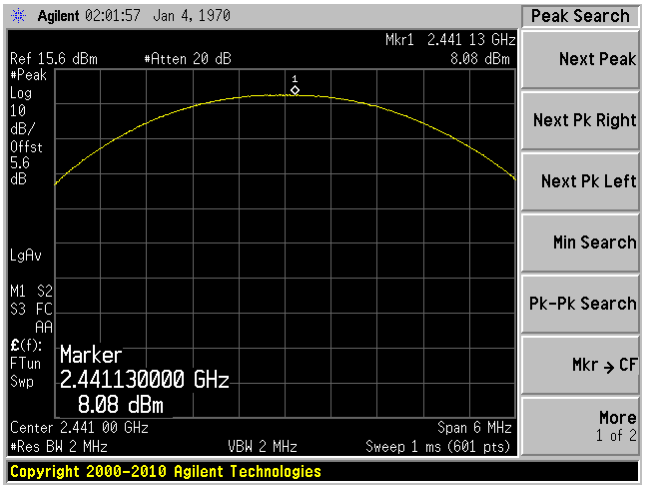


DQPSK

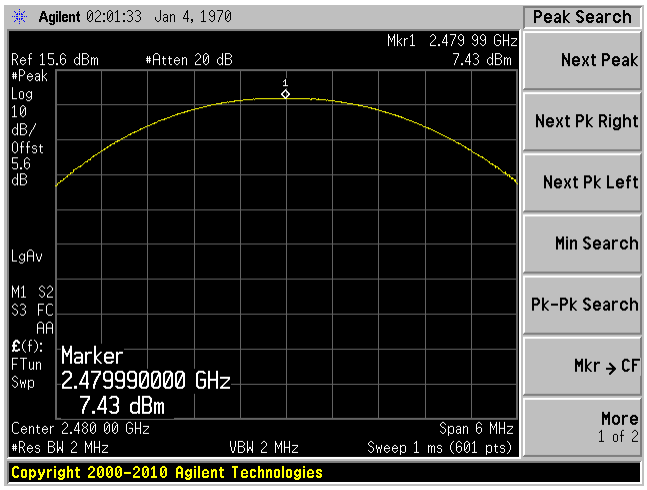
Low channel: 2402 MHz



Middle Channel: 2441 MHz

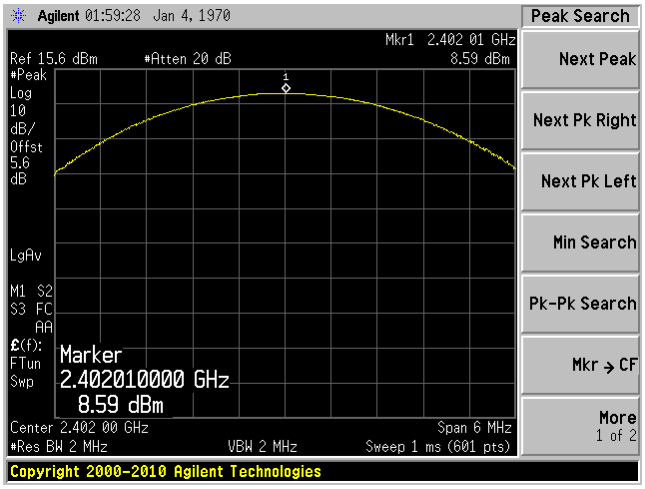


High Channel: 2480 MHz

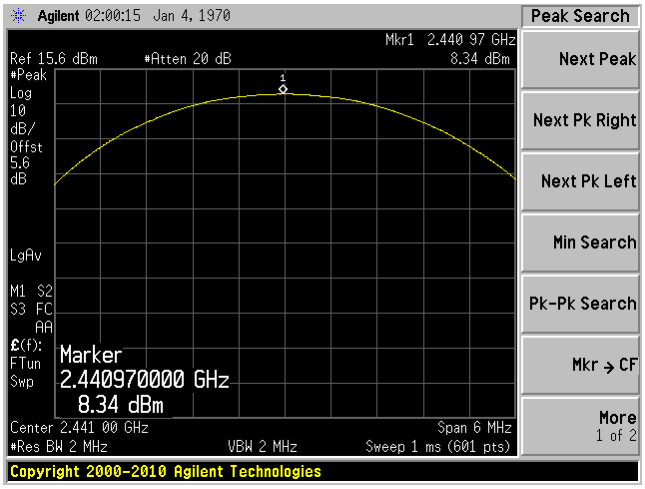


8PSK

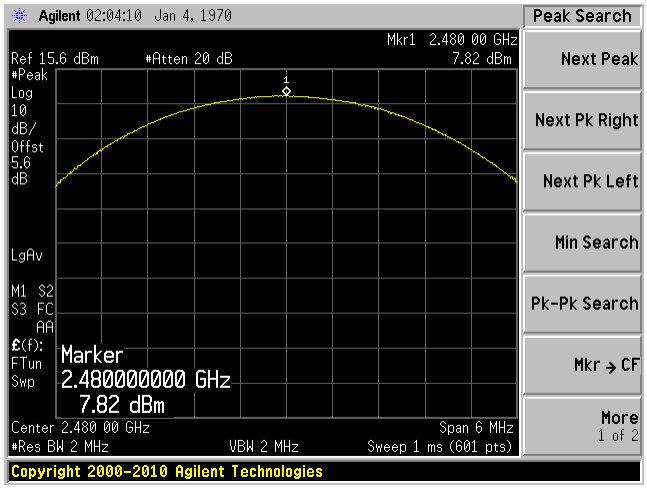
Low channel: 2402 MHz



Middle Channel: 2441 MHz



High Channel: 2480 MHz



10 FCC §15.247(d) & IC RSS-210§A8.5 - 100 kHz Bandwidth of Band Edges

10.1 Applicable Standard

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

According to IC RSS-210 §A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

10.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

10.4 Test Environmental Conditions

Temperature:	20 °C
Relative Humidity:	29 %
ATM Pressure:	102kPa

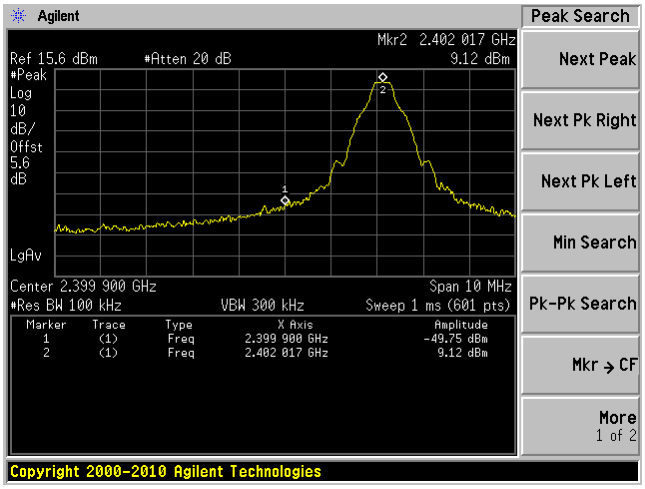
The testing was performed by Bo Li on 2013-05-03 at RF test site.

10.5 Test Results

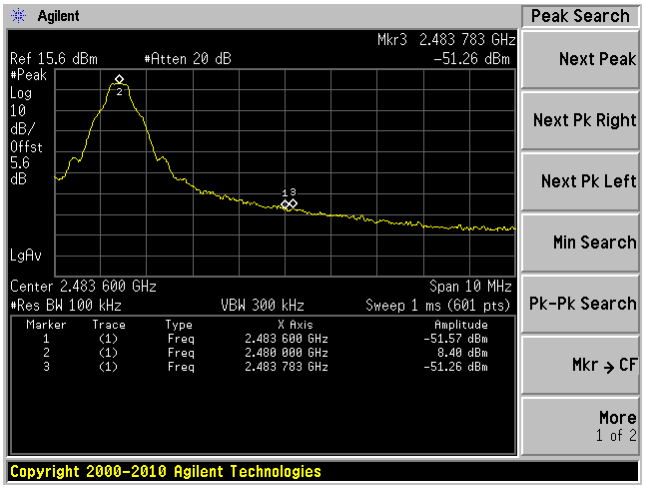
Please refer to following pages for plots of band edge.

GFSK

Low Band Edge

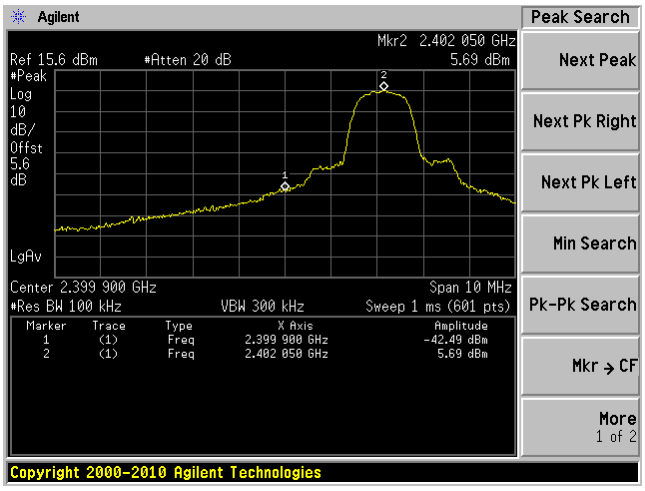


High Band Edge

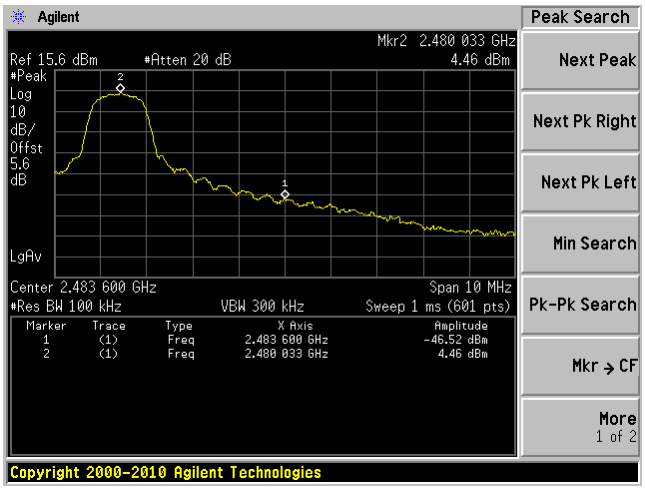


DQPSK

Low Band Edge

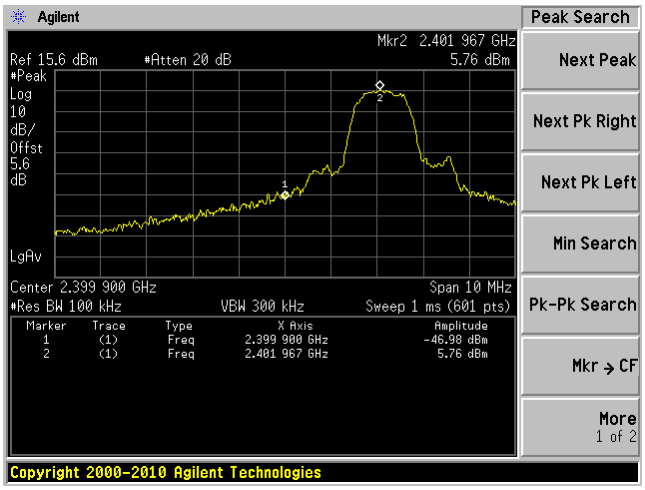


High Band Edge

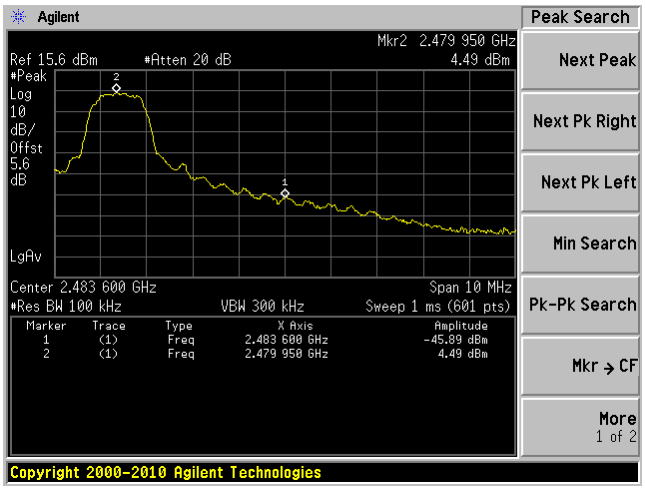


8PSK

Low Band Edge



High Band Edge



11 FCC §15.247(a) & IC RSS-210 §A8.1 – Hopping Channel Bandwidth

11.1 Applicable Standard

According to FCC§15.247(a) (l) & RSS-210 §A8.1 (a), the maximum 20 dB bandwidth of the hopping channel shall be presented.

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emissions bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

11.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

11.4 Test Environmental Conditions

Temperature:	20 °C
Relative Humidity:	29 %
ATM Pressure:	102kPa

The testing was performed by Bo Li on 2013-05-03 at RF test site.

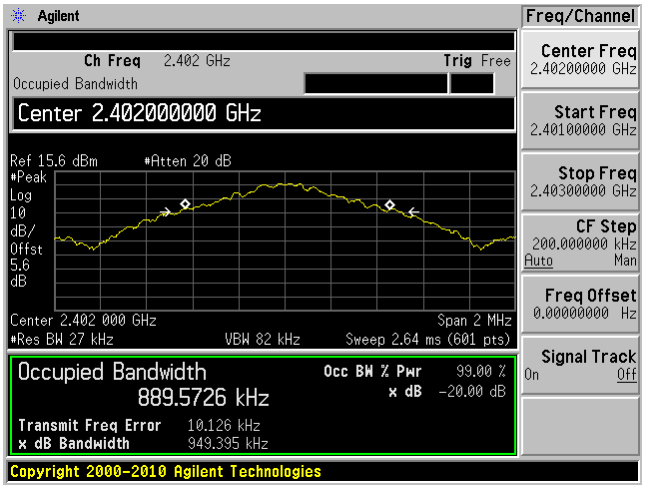
11.5 Test Results

Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	20 dB Emission Bandwidth (MHz)
GFSK			
Low	2402	0.8896	0.9494
Middle	2441	0.8911	0.9571
High	2480	0.8957	0.9560
DQPSK			
Low	2402	1.2283	1.39
Middle	2441	1.2359	1.4
High	2480	1.2322	1.388
8PSK			
Low	2402	1.2261	1.369
Middle	2441	1.2345	1.378
High	2480	1.2338	1.383

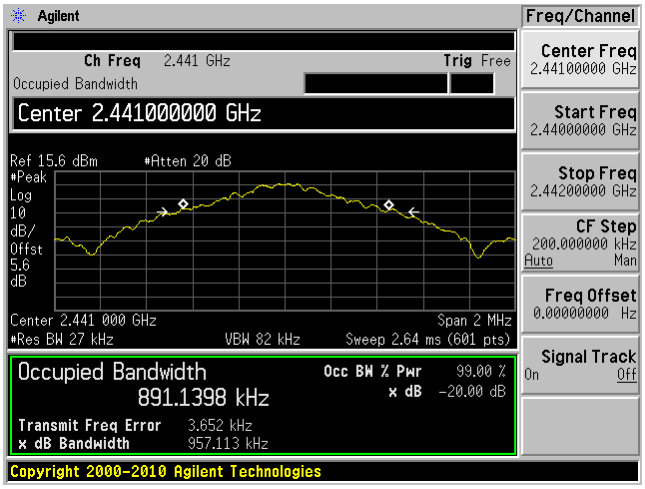
Please refer to the following plots.

GFSK

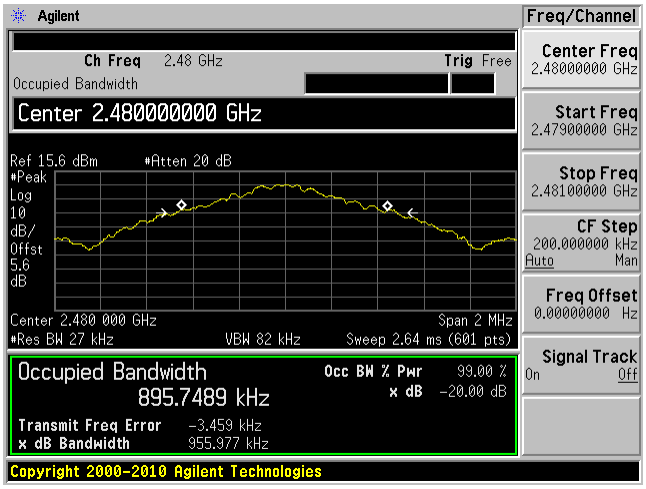
Low channel: 2402 MHz



Middle Channel: 2441 MHz

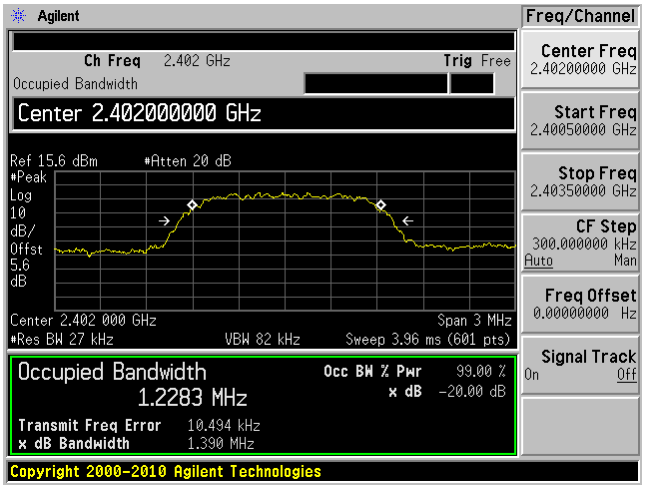


High Channel: 2480 MHz

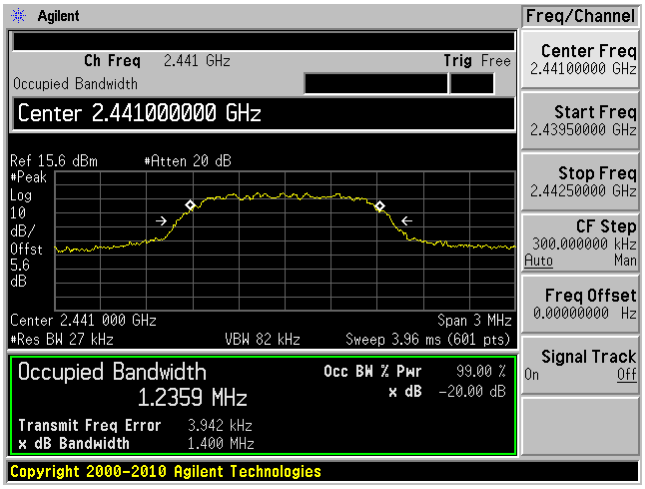


DQPSK

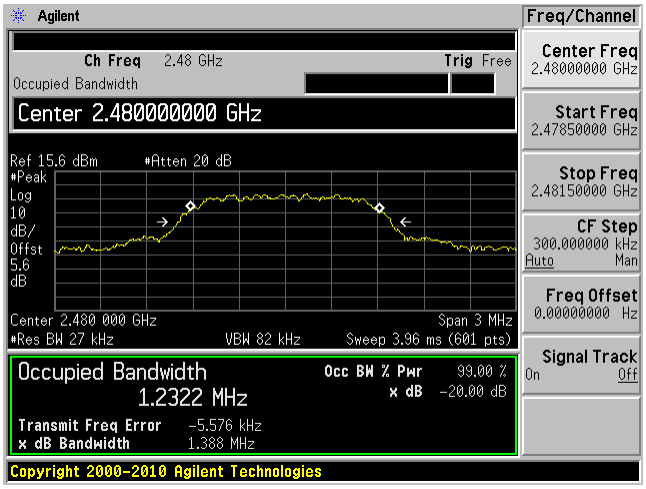
Low channel: 2402 MHz



Middle Channel: 2441 MHz

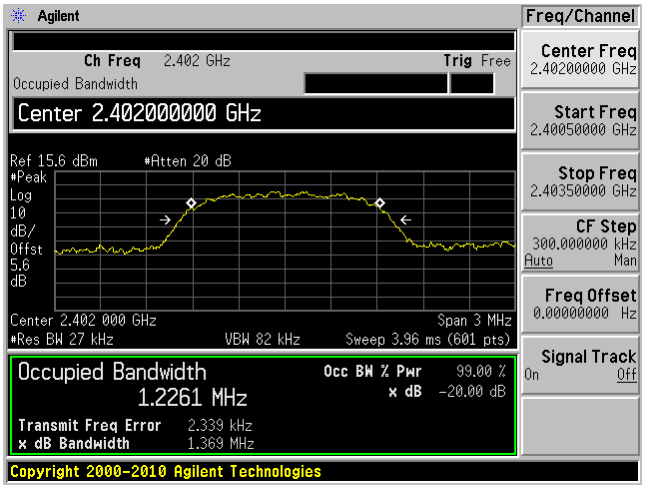


High Channel: 2480 MHz

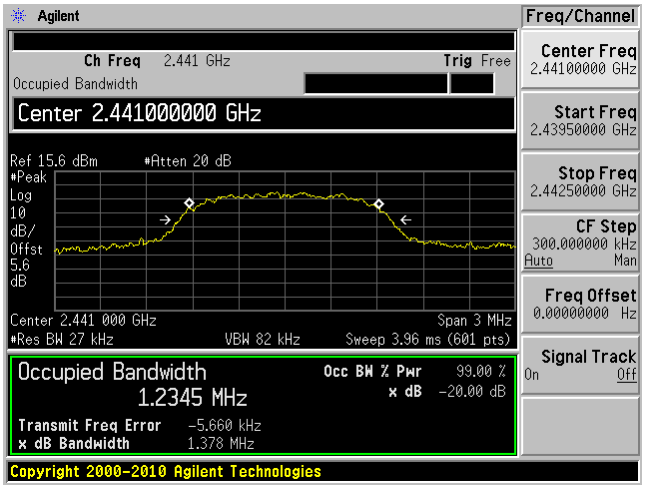


8PSK

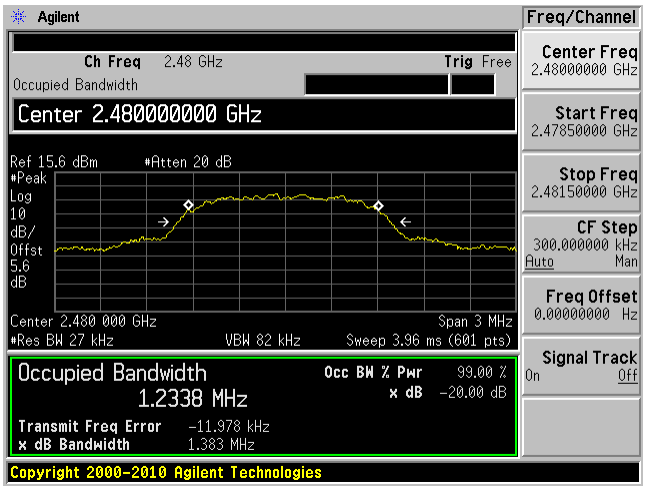
Low channel: 2402 MHz



Middle Channel: 2441 MHz



High Channel: 2480 MHz



12 FCC §15.247(a) & IC RSS-210 §A8.1 – Hopping Channel Separation

12.1 Applicable Standard

According to FCC §15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

According to IC RSS-210 §A8.1(b)(1)Frequency hopping systems shall have hoping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

12.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument Turn on the EUT and set it to any one convenient frequency within its operating range.
3. By using the Max-Hold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function, and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

12.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

12.4 Test Environmental Conditions

Temperature:	20 °C
Relative Humidity:	29 %
ATM Pressure:	102 kPa

The testing was performed by Bo Li on 2013-05-03 at RF test site.

12.5 Test Results

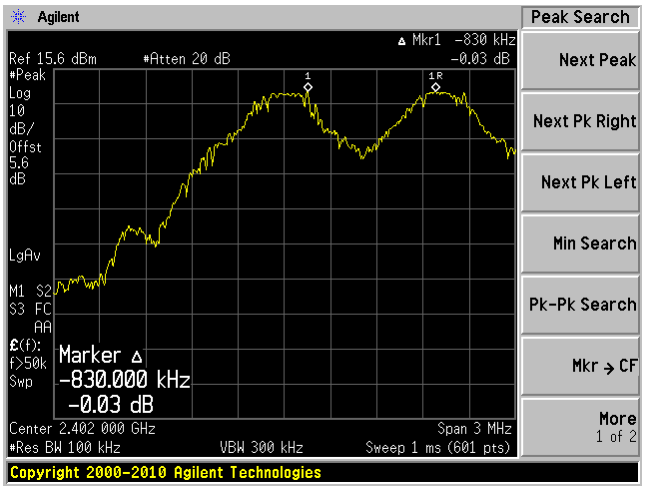
GFSK

Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 2/3 20 dB OBW (kHz)
GFSK			
Low	2402	830	632.93
Middle	2441	1180	638.075
High	2480	915	637.318
DQPSK			
Low	2402	940	926.67
Middle	2441	1145	933.33
High	2480	985	925.33
8PSK			
Low	2402	1215	912.67
Middle	2441	1000	918.67
High	2480	1170	922

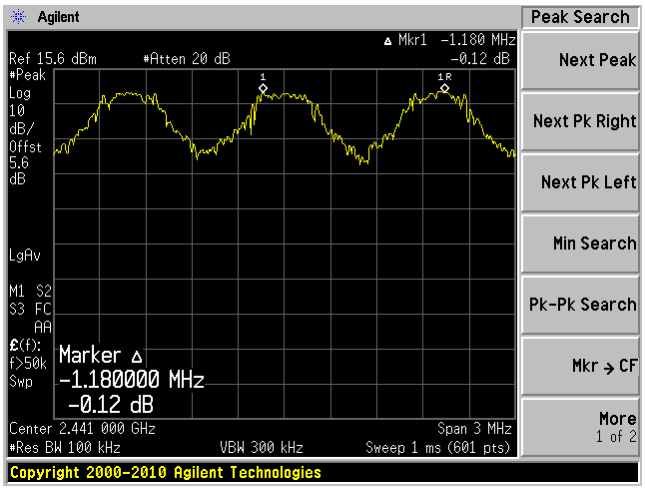
Please refer to the following plots.

GFSK

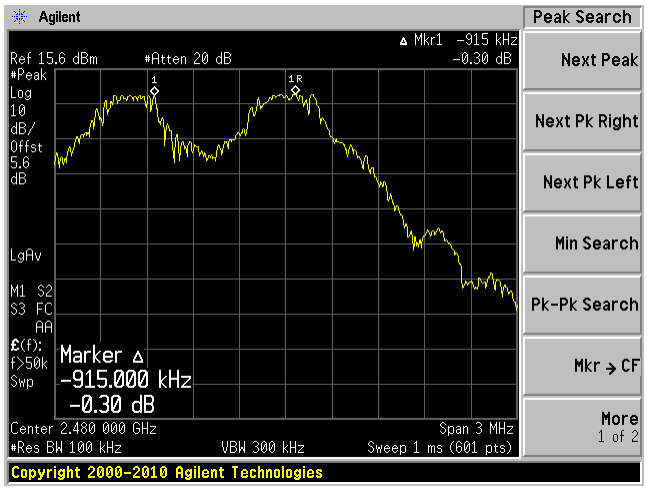
Low channel: 2402 MHz



Middle Channel: 2441 MHz

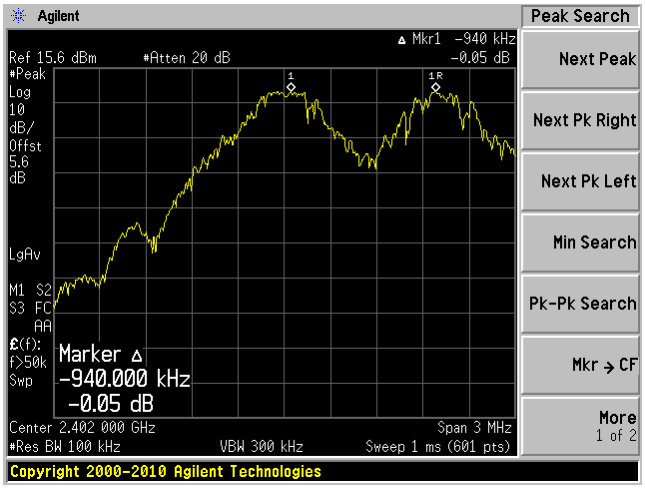


High Channel: 2480 MHz

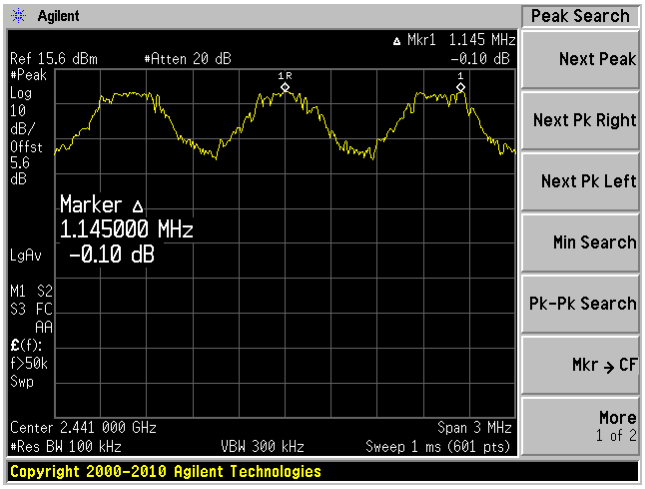


DQPSK

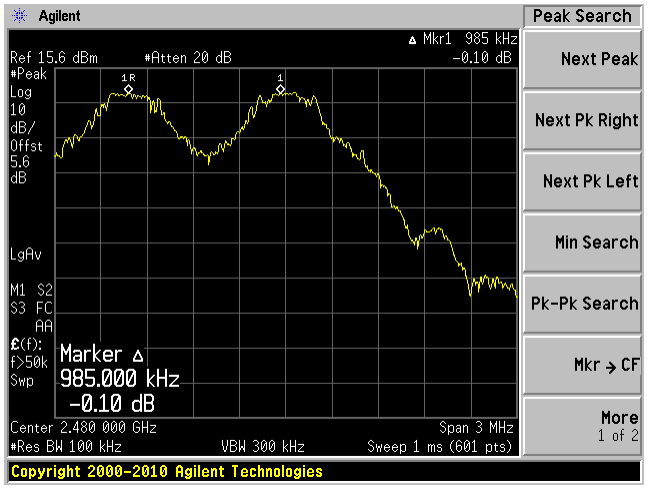
Low channel: 2402 MHz



Middle Channel: 2441 MHz

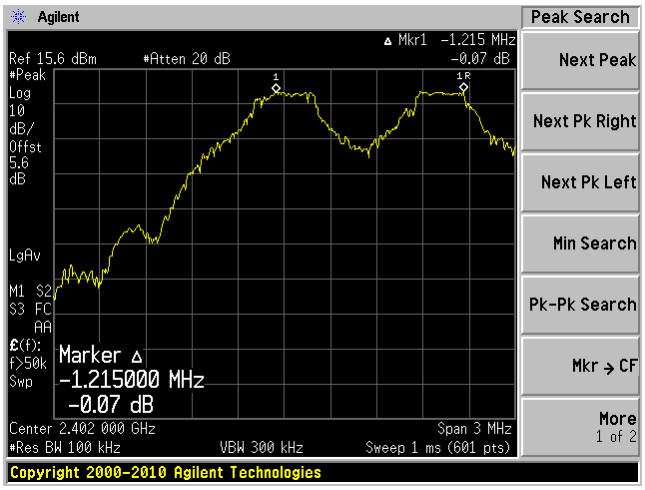


High Channel: 2480 MHz

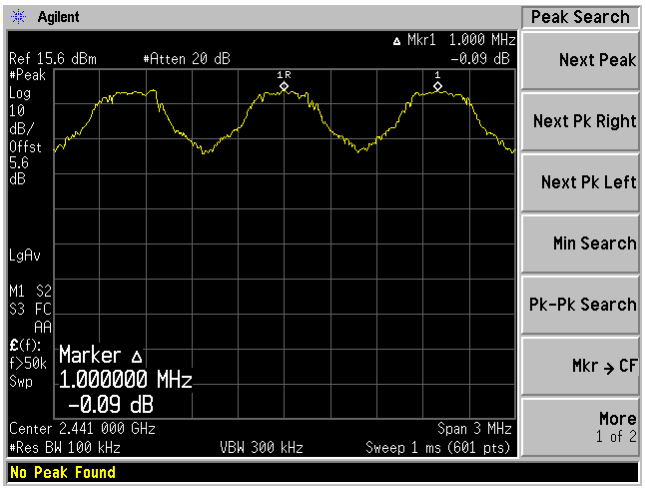


8PSK

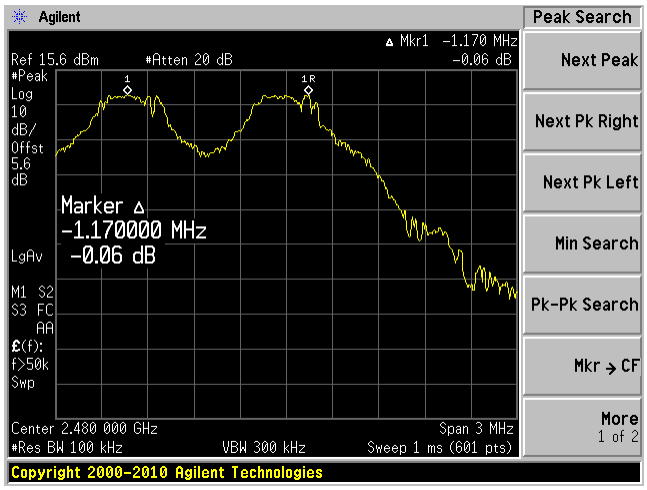
Low channel: 2402 MHz



Middle Channel: 2441 MHz



High Channel: 2480 MHz



13 FCC §15.247(a) & IC RSS-210 §A8.1 - Number of Hopping Channels

13.1 Applicable Standard

According to FCC §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

According to IC RSS-210 §A8.1 (d), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

13.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the bench without connection to measurement instrument. Turn on the EUT and set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

13.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

13.4 Test Environmental Conditions

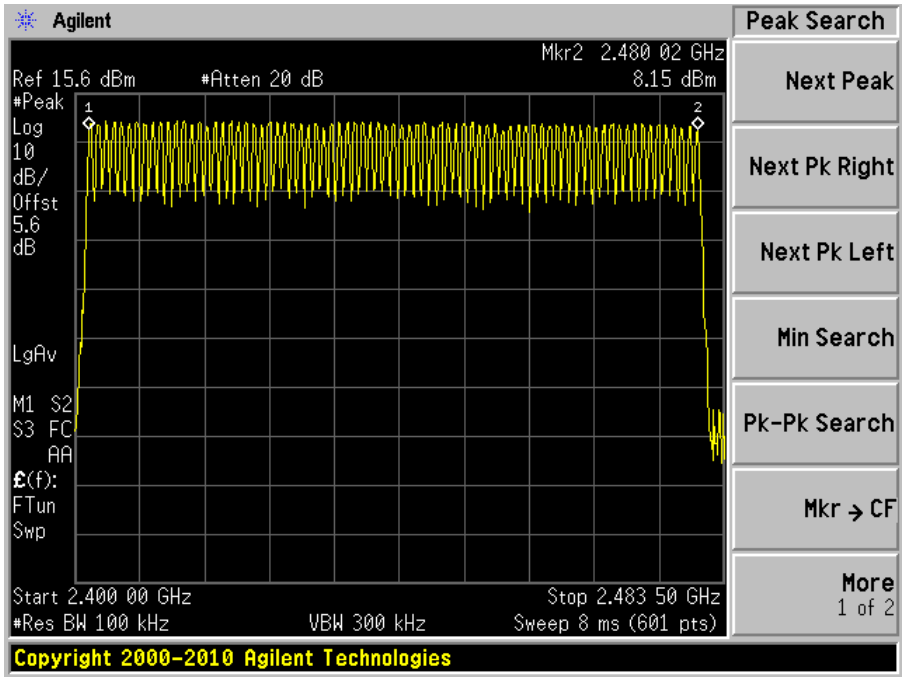
Temperature:	20 °C
Relative Humidity:	29 %
ATM Pressure:	102 kPa

The testing was performed by Bo Li on 2013-05-03 at RF test site.

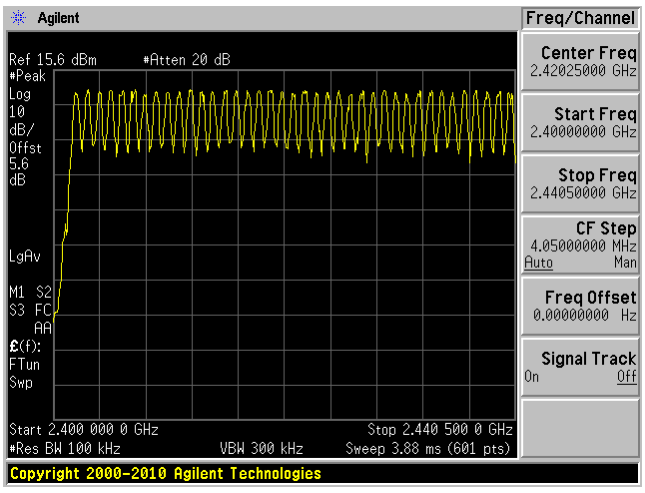
13.5 Test Results

Total 79 channels; please refer to the plots hereinafter.

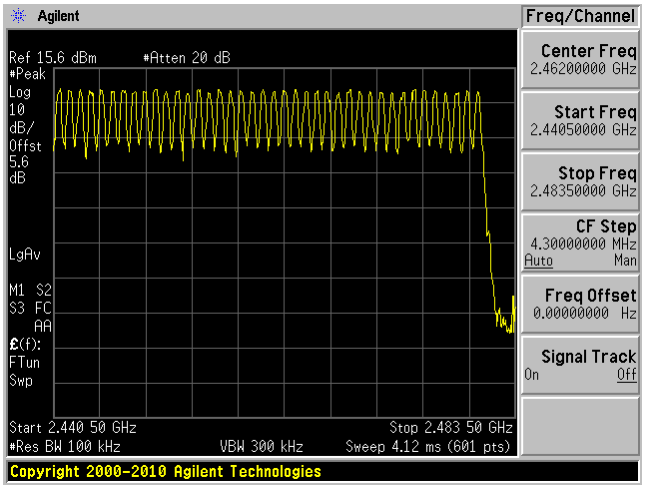
Hopping Channel Number: Total 79 Channels



39 Channels between 2400 to 2440.5 MHz



40 Channels between 2440.5 to 2483.5 MHz



14 FCC §15.247(a) & IC RSS-210 §A8.1 - Dwell Time

14.1 Applicable Standard

According to FCC §15.247 (a)(1)(iii), 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.

According to IC RSS-210 §A8.1 (d) ,Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

14.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

14.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year

Statement of Traceability: **BACL Corp.** attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

14.4 Test Environmental Conditions

Temperature:	20 °C
Relative Humidity:	29 %
ATM Pressure:	102 kPa

The testing was performed by Bo Li on 2013-05-03 at RF test site.

14.5 Test Results

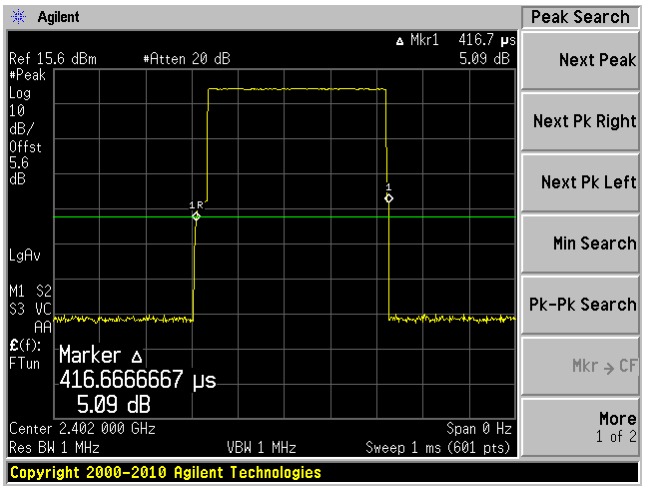
Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
GFSK, DH1: Packet Size = 27 byte				
Low	0.41667	0.13	0.4	Pass
Mid	0.41167	0.13	0.4	Pass
High	0.41167	0.13	0.4	Pass
GFSK, DH3: Packet Size = 183 bytes				
Low	1.6716	0.27	0.4	Pass
Mid	1.6716	0.27	0.4	Pass
High	1.6716	0.27	0.4	Pass
GFSK, DH5: Packet Size = 339 bytes				
Low	2.92	0.31	0.4	Pass
Mid	2.92	0.31	0.4	Pass
High	2.9133	0.31	0.4	Pass
DQPSK, DH1: Packet Size = 27 byte				
Low	0.3733	0.13	0.4	Pass
Mid	0.3733	0.13	0.4	Pass
High	0.3733	0.13	0.4	Pass
DQPSK, DH3: Packet Size = 183 bytes				
Low	1.7766	0.26	0.4	Pass
Mid	1.7724	0.26	0.4	Pass
High	1.7724	0.26	0.4	Pass
DQPSK, DH5: Packet Size = 339 bytes				
Low	2.92	0.31	0.4	Pass
Mid	2.9133	0.31	0.4	Pass
High	2.9067	0.31	0.4	Pass
8PSK, DH1: Packet Size = 27 byte				
Low	0.37333	0.13	0.4	Pass
Mid	0.37167	0.13	0.4	Pass
High	0.37	0.13	0.4	Pass
8PSK, DH3: Packet Size = 183 bytes				
Low	1.7682	0.26	0.4	Pass
Mid	1.7682	0.26	0.4	Pass
High	1.7682	0.26	0.4	Pass
8PSK, DH5: Packet Size = 339 bytes				
Low	2.92	0.31	0.4	Pass
Mid	2.92	0.31	0.4	Pass
High	2.9133	0.31	0.4	Pass

Note: DH1: Dwell time = Pulse time*(1600/2/79)*31.6S
DH3: Dwell time = Pulse time*(1600/4/79)*31.6S
DH5: Dwell time = Pulse time*(1600/6/79)*31.6S

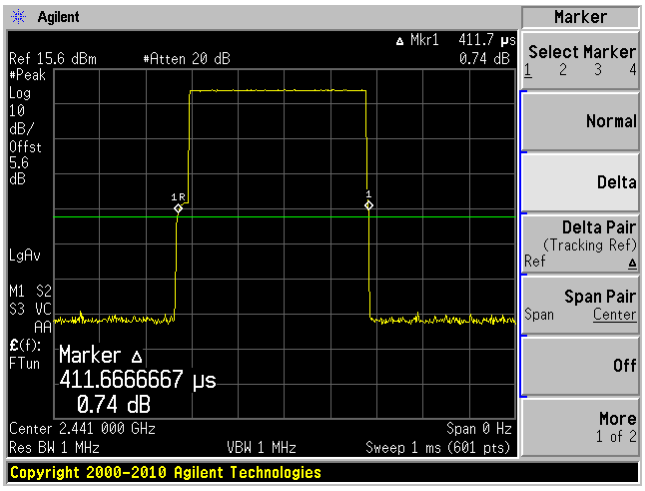
Please refer to following plots:

GFSK – DH1

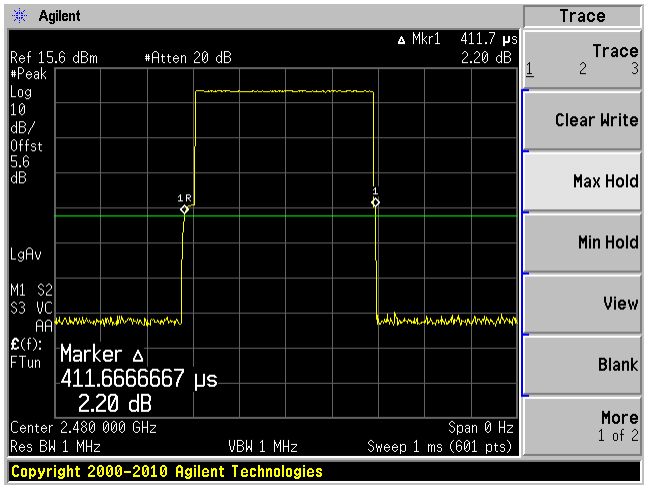
Low channel: 2402 MHz



Middle channel: 2441 MHz

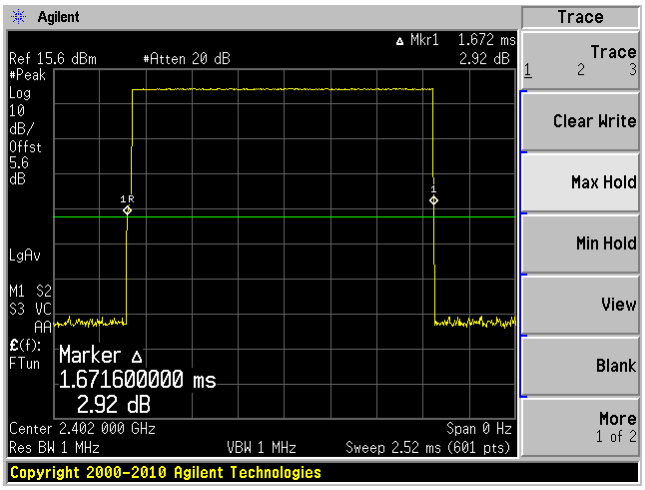


High channel: 2480 MHz

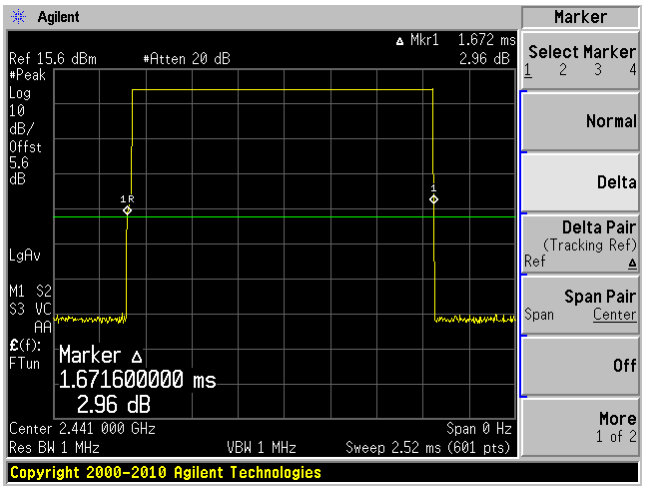


GFSK – DH3

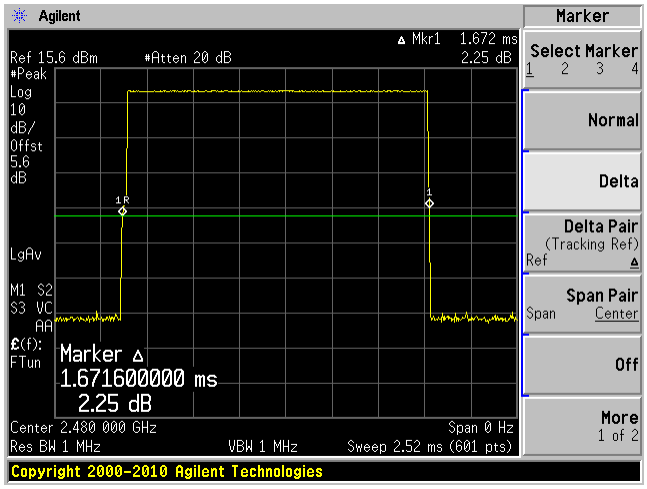
Low channel: 2402 MHz



Middle channel: 2441 MHz

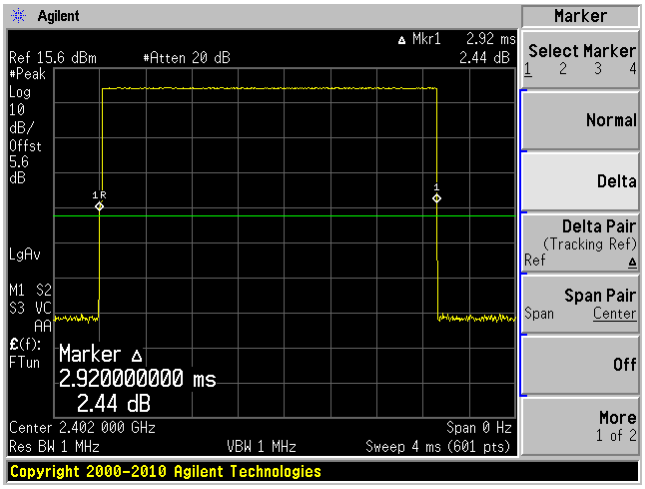


High channel: 2480 MHz

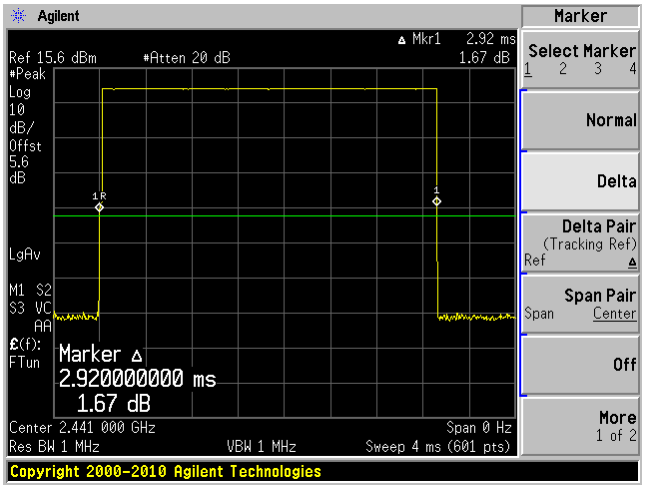


GFSK – DH5

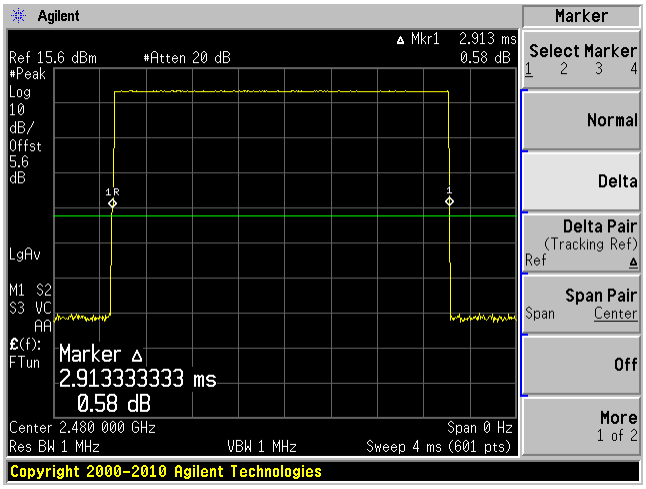
Low channel: 2402 MHz



Middle channel: 2441 MHz

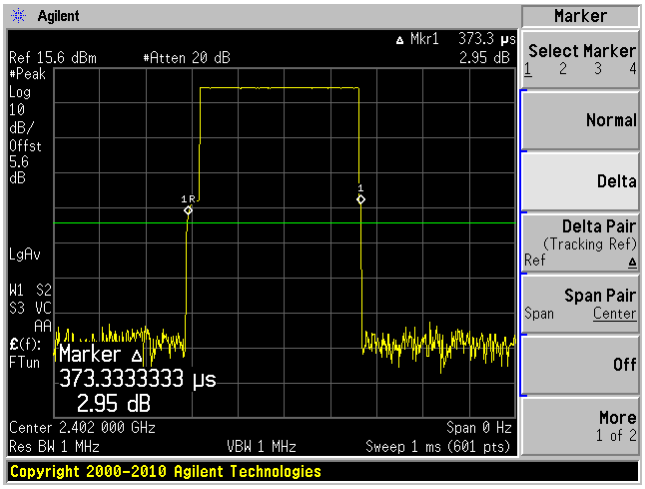


High channel: 2480 MHz

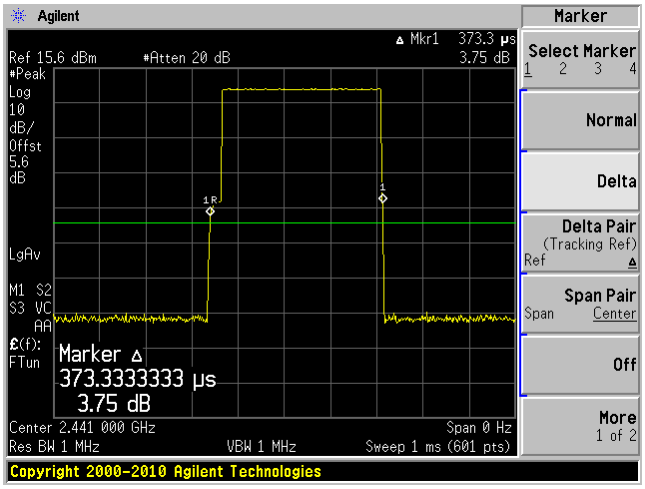


DQPSK – DH1

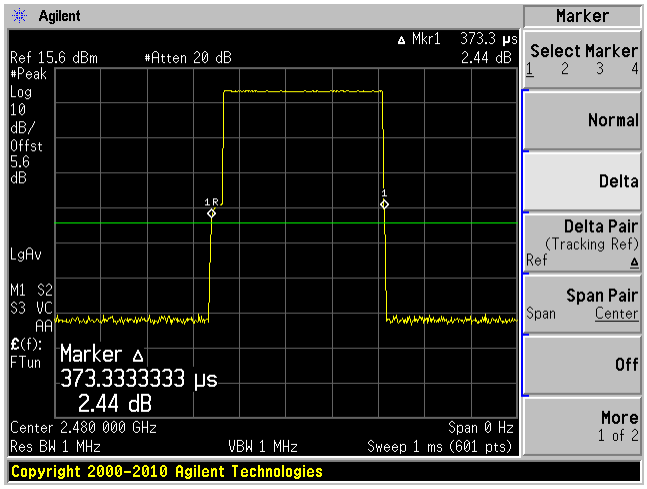
Low channel: 2402 MHz



Middle channel: 2441 MHz

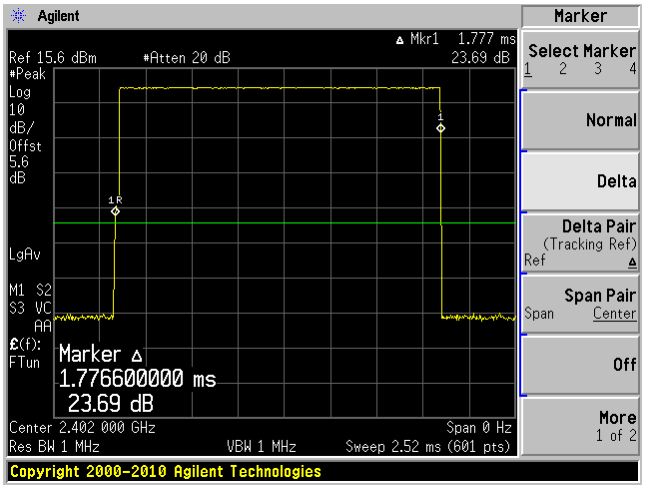


High channel: 2480 MHz

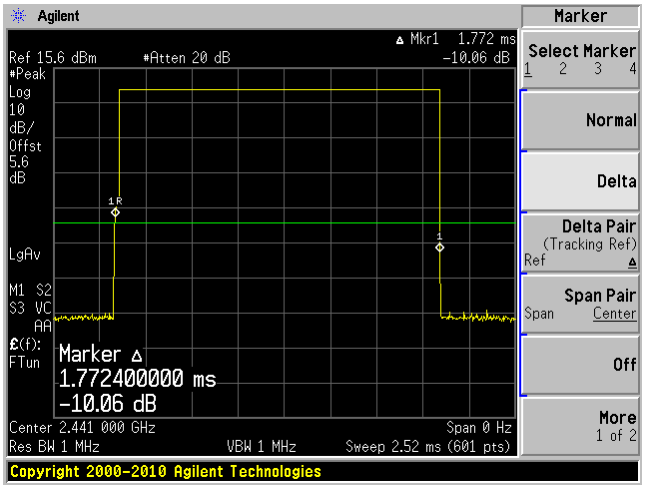


DQPSK – DH3

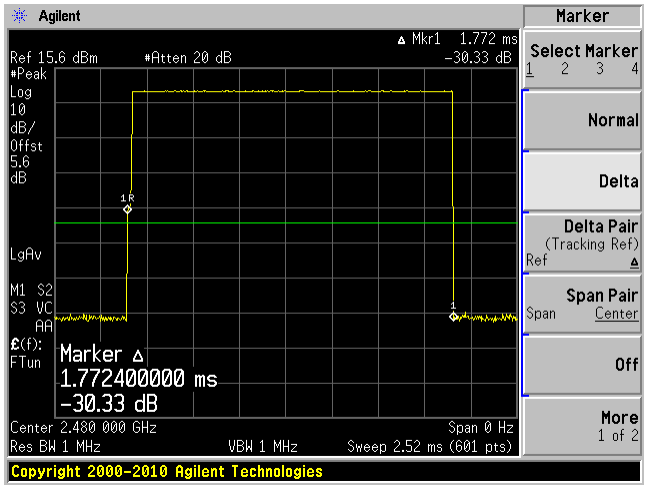
Low channel: 2402 MHz



Middle channel: 2441 MHz

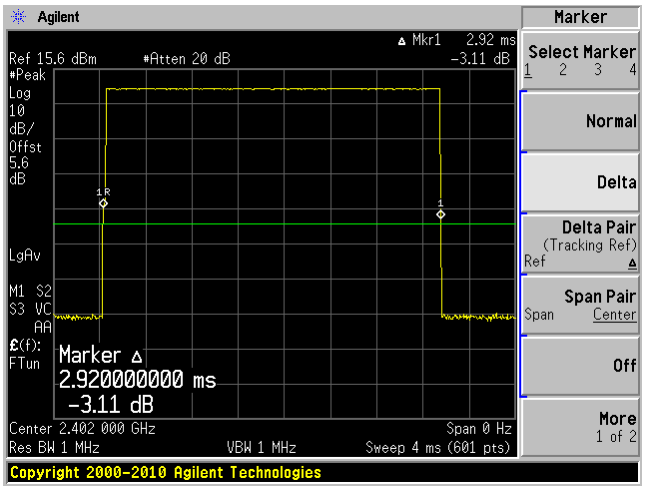


High channel: 2480 MHz

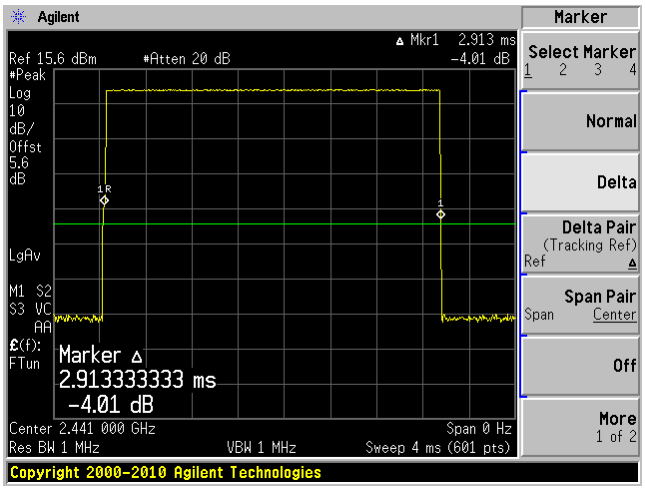


DQPSK – DH5

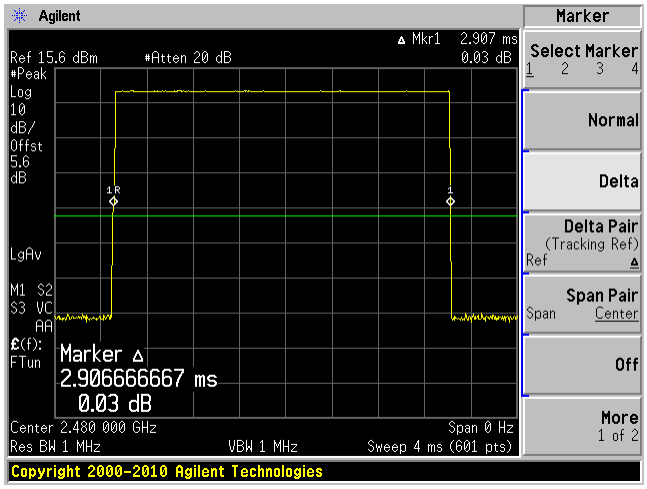
Low channel: 2402 MHz



Middle channel: 2441 MHz

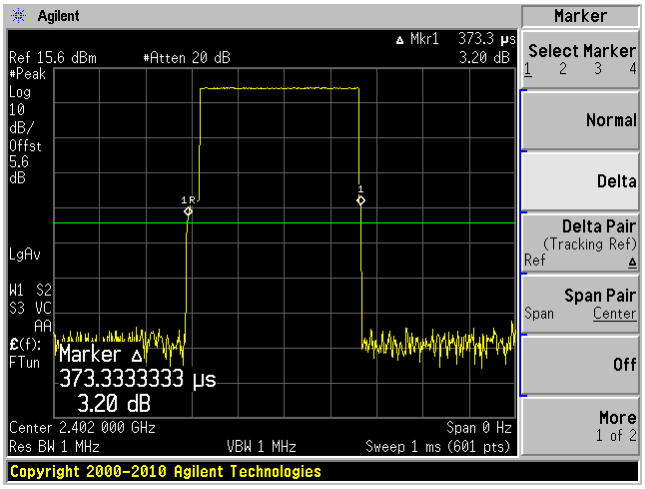


High channel: 2480 MHz

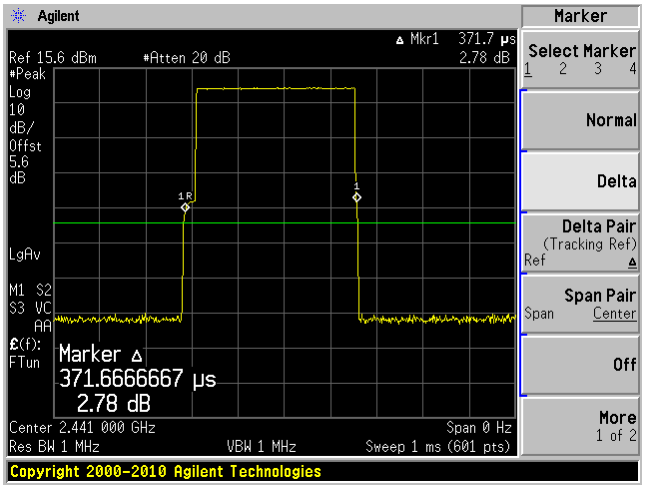


8PSK – DH1

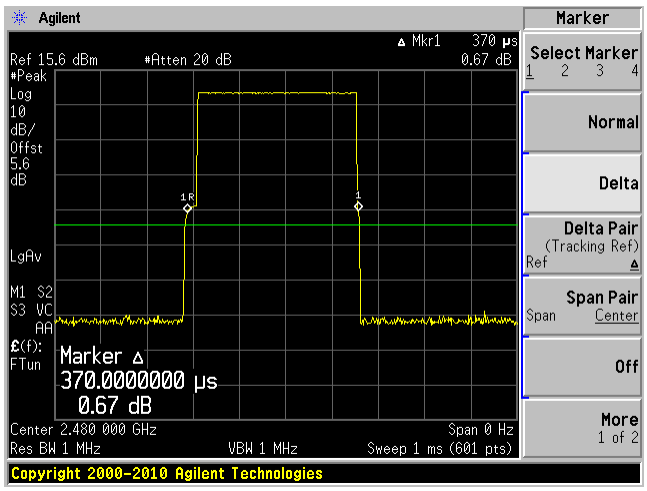
Low channel: 2402 MHz



Middle channel: 2441 MHz

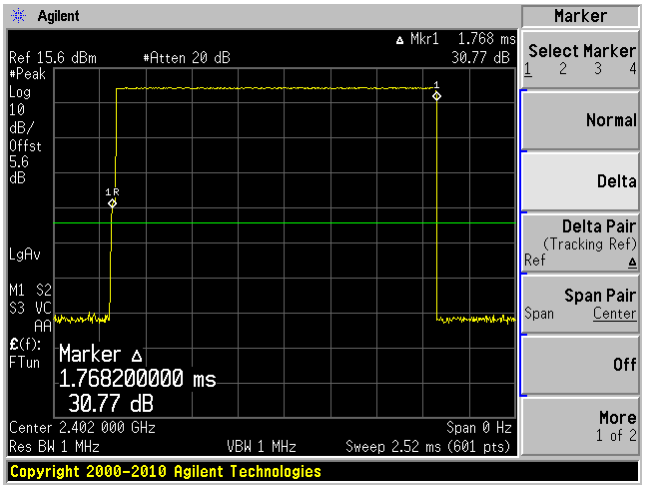


High channel: 2480 MHz

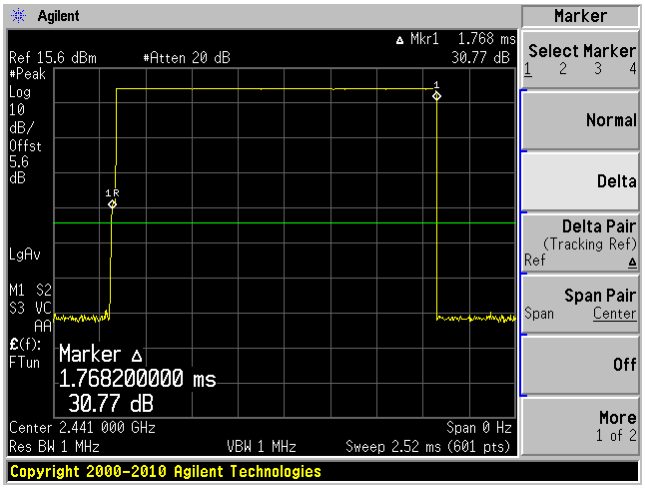


8PSK – DH3

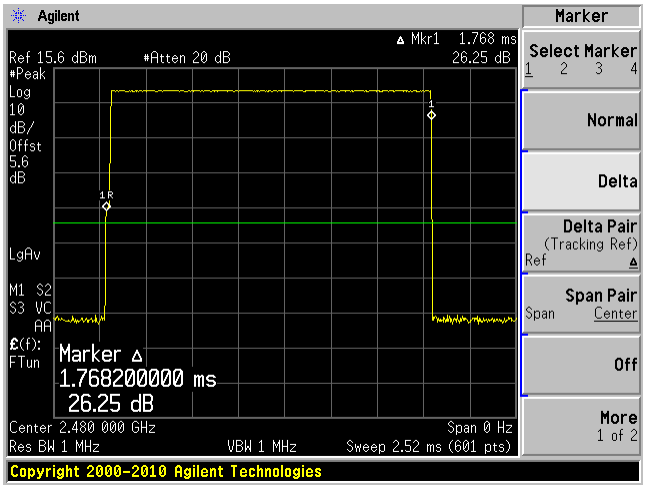
Low channel: 2402 MHz



Middle channel: 2441 MHz

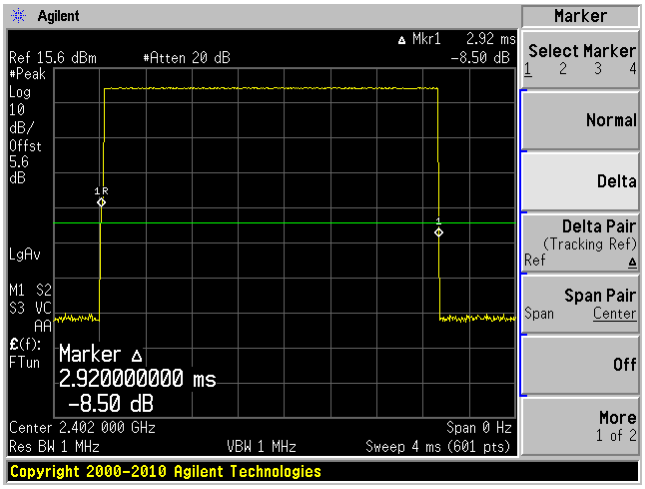


High channel: 2480 MHz

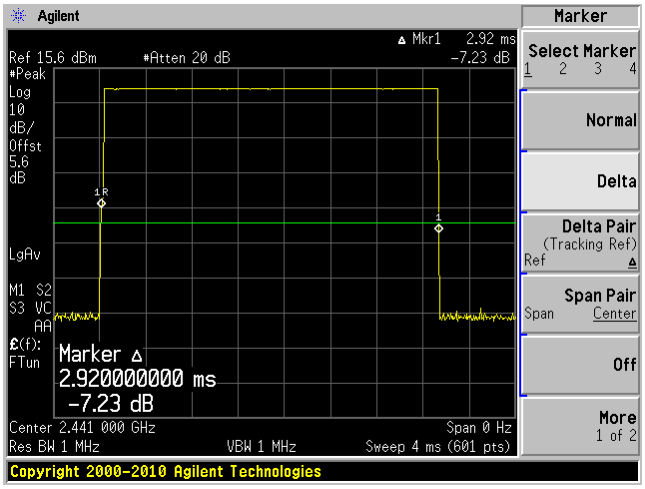


8PSK – DH5

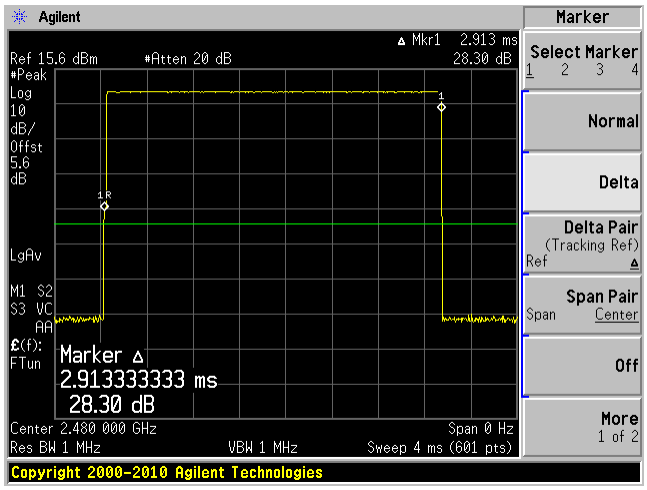
Low channel: 2402 MHz



Middle channel: 2441 MHz



High channel: 2480 MHz



15 IC RSS-210 §2.3 RSS-Gen §6.1 - Receiver Spurious Radiated Emissions

15.1 Applicable Standard

According to IC RSS-Gen §6.1, spurious emissions from receivers shall not exceed the radiated limits shown in the table below.

Frequency (MHz)	Field Strength Microvolts/m at 3 meters
30-88	100
88-216	150
216-960	200
Above 960	500

15.2 EUT Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2009.

15.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**QP**" in the data table.

15.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

15.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2013-03-28	1 year
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-10-16	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2012-06-18	1 year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2013-03-08	1 year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 year

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

15.6 Test Environmental Conditions

Temperature:	20°C
Relative Humidity:	49%
ATM Pressure:	102.4kPa

The testing was performed by Bo Li on 2013-05-04 in 5 meter chamber 3.

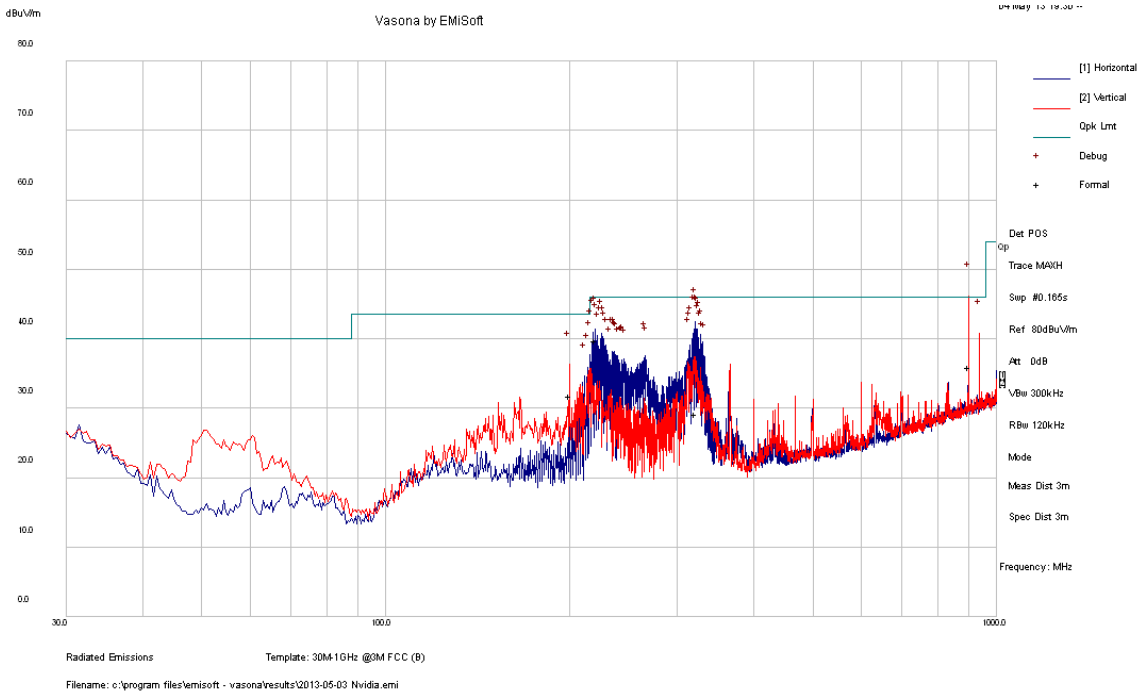
15.7 Summary of Test Results

According to the test data, the EUT complied with IC RSS-210/RSS-Gen, with the closest margins from the limit listed below:

Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-6.29	220.20375	Horizontal	30 – 25000

15.8 Test Data and Plots

1) 30 MHz -1 GHz, Measured at 3 meters



All 30 MHz – 1 GHz spurious are digital, other emissions are on the noise floor level. Report only the worst case data as shown below:

Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
220.20375	39.71	QP	H	136	85	46	-6.29
900.282	36.02	QP	V	99	219	46	-9.98
199.98825	31.74	QP	V	99	51	43.50	-11.76
321.0805	29.16	QP	H	99	264	46	-16.84

2) 1 GHz -25 GHz, Measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC & IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
1350	51.11	202	100	V	25.884	2.23	27.44	51.784	74	-22.216	Peak
1350	49.69	239	100	H	25.884	2.23	27.44	50.364	74	-23.636	Peak
1350	26.5	202	100	V	25.884	2.23	27.44	27.174	54	-26.826	Ave
1350	25.76	239	100	H	25.884	2.23	27.44	26.434	54	-27.566	Ave
6300	44.02	238	112	V	34.791	5.14	27.57	56.381	74	-17.619	Peak
6300	39.7	207	100	H	34.791	5.14	27.57	52.061	74	-21.939	Peak
6300	29.284	238	112	V	34.791	5.14	27.57	41.645	54	-12.355	Ave
6300	24.54	207	100	H	34.791	5.14	27.57	36.901	54	-17.099	Ave
15834	33.34	0	100	V	37.928	8.44	26.04	53.668	74	-20.332	Peak1
15834	33.1	0	100	H	37.928	8.44	26.04	53.428	74	-20.572	Peak1
15834	17.81	0	100	V	37.928	8.44	26.04	38.138	54	-15.862	Ave1
15834	17.78	0	100	H	37.928	8.44	26.04	38.108	54	-15.892	Ave1

Note: 1 Noise Floor Level.