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

TEST AND MEASUREMENT REPORT

For

Wi2Wi, Inc.

2107 North 1st Street, Suite 540,

San Jose, CA 95131, USA

FCC ID: U9R-W2CBW0016
IC: 7089A-W2CBW0016

Report Type:	**Product Type:**
Original Report	Wi-Fi and BT Combo Module

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Report Number: R1302143-247 DSS

Report Date: 2013-06-14

Reviewed By: Quinn Jiang, Test Engineer

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1302143-247DSS	Original Report	2013-06-14

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Wi2Wi, Inc.* and their product, *model: W2CBW0016, FCC ID: U9R-W2CBW0016, IC: 7089A-W2CBW0016* or the "EUT" as referred to this report. The EUT is Bluetooth and 802.11b/g/n Wi-Fi combo module.

1.2 Mechanical Description of EUT

The EUT measures approximately 10 mm (L) x 10 mm (W) x 1 mm (H) and weighs approximately 0.5 g.

The data gathered are from a typical production sample provided by the manufacturer with serial number: GCI-072565

1.3 Objective

This report is prepared on behalf of *Wi2Wi, Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commissions 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)

DTS filing of FCC Part 15.247/IC RSS-210 with FCC ID: U9R-W2CBW0016 and IC: 7089A-W2CBW0016.

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 CISPR16-4-2:2007, 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.
IBM	Laptop	X41	LV-K5206 06/05

2.6 Power Supply and Line Filters

N/A

2.7 Interface Ports and Cabling

Cable Description	Length (m)	From	To
RF Cable	<1	EUT	Spectrum Analyzer

2.8 Supporting Parts List and Details

Manufacturers	Descriptions	Models	Serial Numbers
Marvell	Test Board	W2CBW0016 Test Board	GCI-072565

3 Summary of Test Results

FCC & IC Rules	Description of Test	Result (s)
FCC §15.247 (i), §2.1091 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), §2.1091 & IC RSS-102 - RF Exposure

4.1 Applicable Standard

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF fields.

According to IC RSS-102 Issue 4 section 4.2, RF limits used for general public will be applied to the EUT.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m2)	Time Averaging (min)
0.003 - 1	280	2.19	-	6
1 - 10	280 / f	2.19 / f	-	6
10 - 30	28	2.19 / f	-	6
30 – 300	28	0.073	2*	6
300 – 1 500	$1.585\ f^{0.5}$	$0.0042\ f^{0.5}$	f / 150	6
1 500 – 15 000	61.4	0.163	10	6
15 000 – 150 000	61.4	0.163	10	$616000 / f^{1.2}$
150 000- 300 000	$0.158\ f^{0.5}$	$4.21 \times 10\ -4\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000 / f^{1.2}$

Note: *f* is frequency in MHz
* = Power density limit is applicable at frequencies greater than 100 MHz

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	10.15
Maximum peak output power at antenna input terminal (mW):	10.35
Prediction distance (cm):	20
Prediction frequency (MHz):	2441
Maximum Antenna Gain, typical (dBi):	3.1
Maximum Antenna Gain (numeric):	2.042
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.00421
Power density of prediction frequency at 20.0 cm (W/m^2):	0.0421
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	10

The device is compliant with the requirement MPE limit for uncontrolled exposure at 20 cm distance.

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 3.1 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 – AC Line 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.

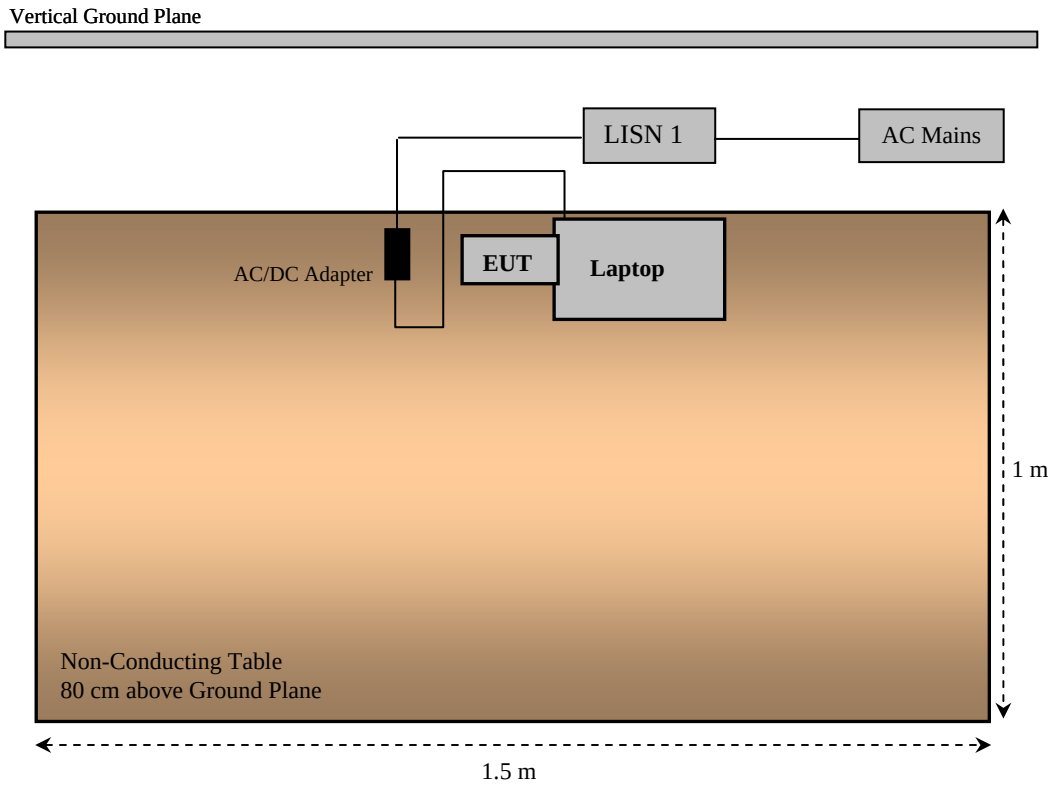
6.3 Test Procedure

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	100044	2012-04-18	1year
Solar Electronics	LISN	9252-R-24-BNC	511205	2012-06-25	1year
TTE	Filter, High Pass	H9962-150K-50-21378	K7133	2012-05-30	1year

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:	20 ºC
Relative Humidity:	49 %
ATM Pressure:	101.9 KPa

The testing was performed by Glenn Escano on 2013-03-04 in 10m chamber1.

6.8 Summary of Test Results

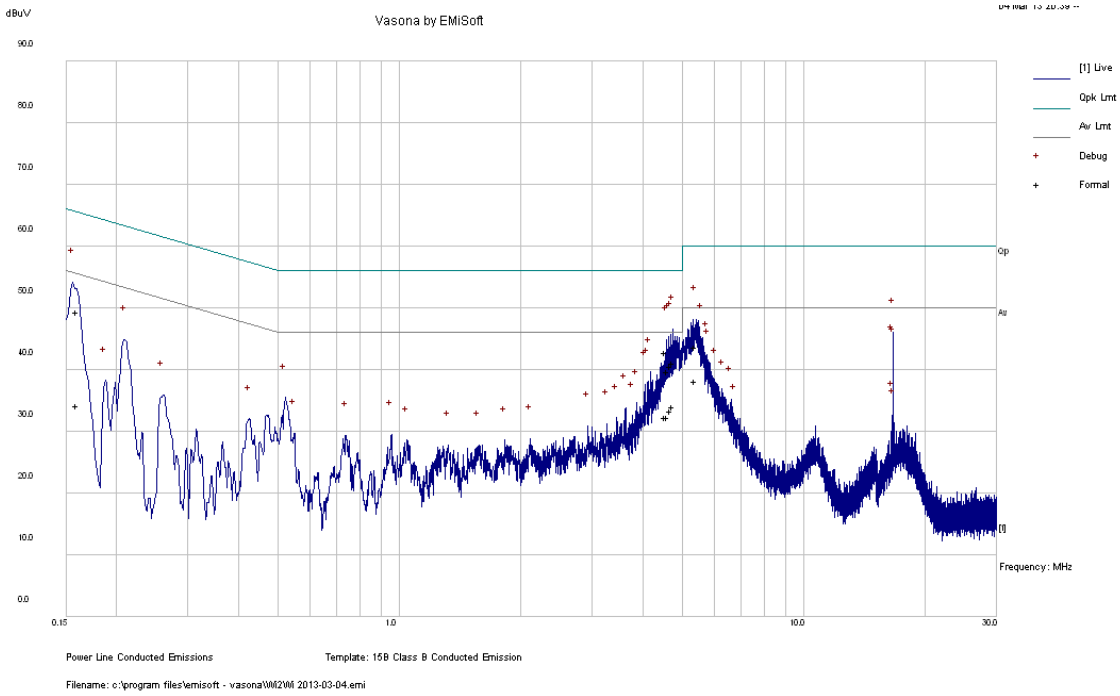
According to the recorded data in following table, the EUT complied with the FCC and IC standard's conducted emissions limits, with a worst case margin of:

Transmitter Mode Worst Case GFSK Middle Channel

Connection: AC/DC adapter of Laptop connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor (Line/Neutral)**	**Range (MHz)**
-4.67	16.62489	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

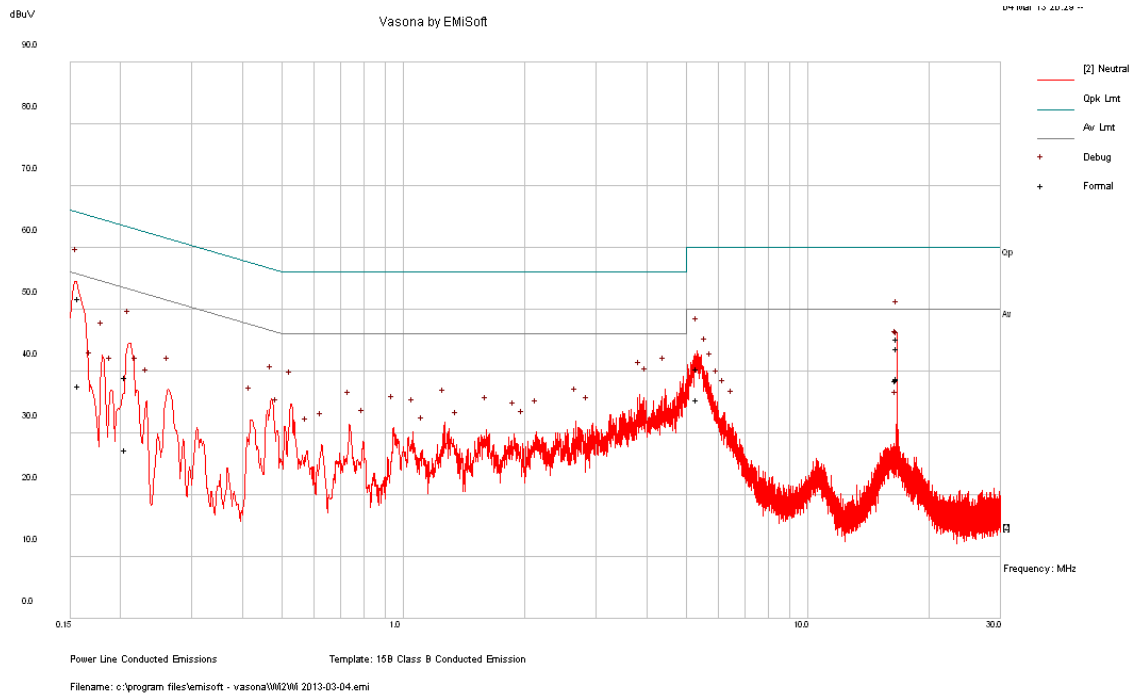
BT: GFSK, Middle Channel – 120 V, 60 Hz Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
4.563314	42.94	L	56	-13.06	QP
4.748996	41.09	L	56	-14.91	QP
4.702136	40.57	L	56	-15.43	QP
0.159485	49.45	L	65.49	-16.04	QP
4.621406	39.79	L	56	-16.21	QP
5.404658	43.67	L	60	-16.33	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
5.404658	38.12	L	50	-11.88	Ave.
4.748996	34.05	L	46	-11.95	Ave.
4.702136	33.4	L	46	-12.60	Ave.
4.621406	32.41	L	46	-13.59	Ave.
4.563314	32.25	L	46	-13.75	Ave.
0.159485	34.22	L	55.49	-21.27	Ave.

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



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.157505	51.8	N	65.59	-13.80	QP
16.62489	43.66	N	60	-16.34	QP
5.342888	40.42	N	60	-19.58	QP
16.65778	38.81	N	60	-21.19	QP
16.59256	38.57	N	60	-21.43	QP
0.206132	39.06	N	63.36	-24.30	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
16.62489	45.33	N	50	-4.67	Ave.
16.65778	38.73	N	50	-11.27	Ave.
16.59256	38.49	N	50	-11.51	Ave.
5.342888	35.36	N	50	-14.64	Ave.
0.157505	37.65	N	55.59	-17.94	Ave.
0.206132	27.3	N	53.36	-26.06	Ave.

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

7.1 Applicable Standard

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:	21 °C
Relative Humidity:	29 %
ATM Pressure:	102.4 KPa

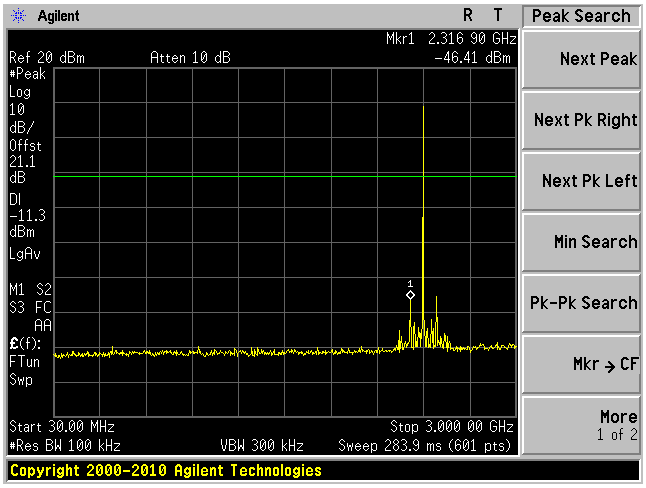
The testing was performed by Jeffery Wu on 2013-02-26 at RF test site.

7.5 Test Results

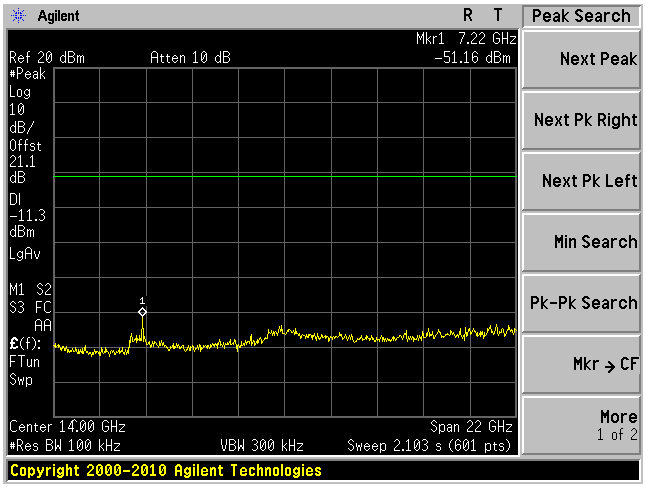
Please refer to following plots.

GFSK Low Channel 2402 MHz

30 MHz – 3 GHz

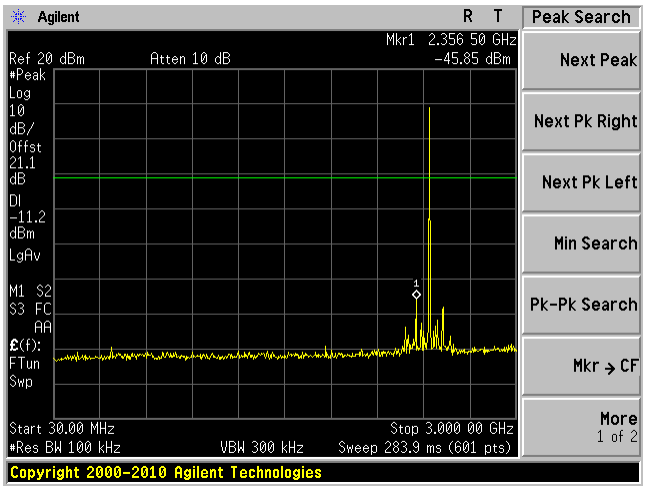


3 GHz – 25 GHz

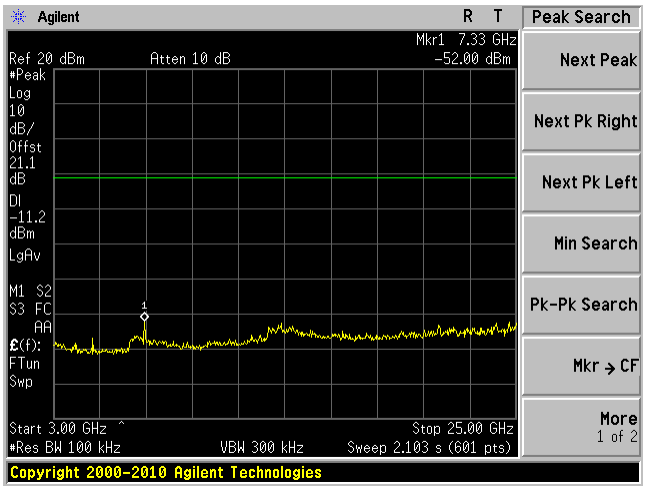


GFSK Middle Channel 2441 MHz

30 MHz – 3 GHz

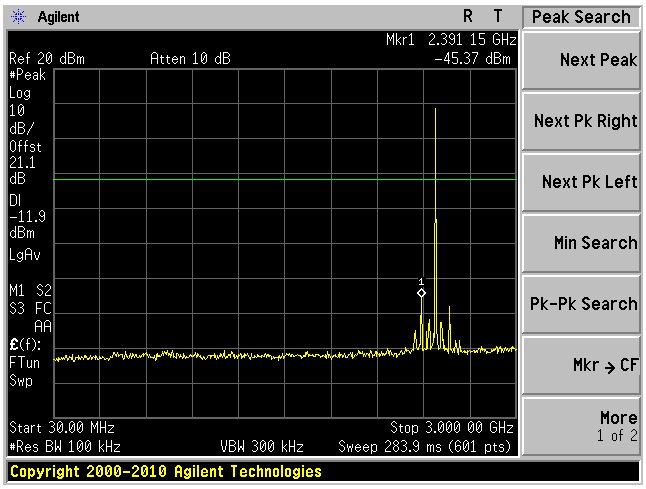


3 GHz – 25 GHz

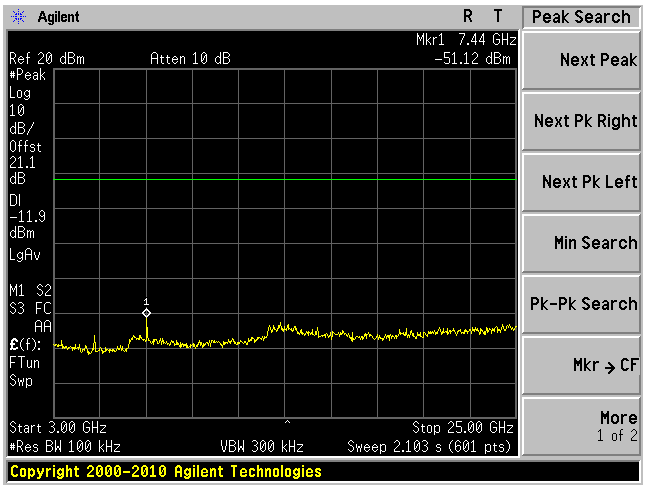


GFSK High Channel 2480 MHz

30 MHz – 3 GHz

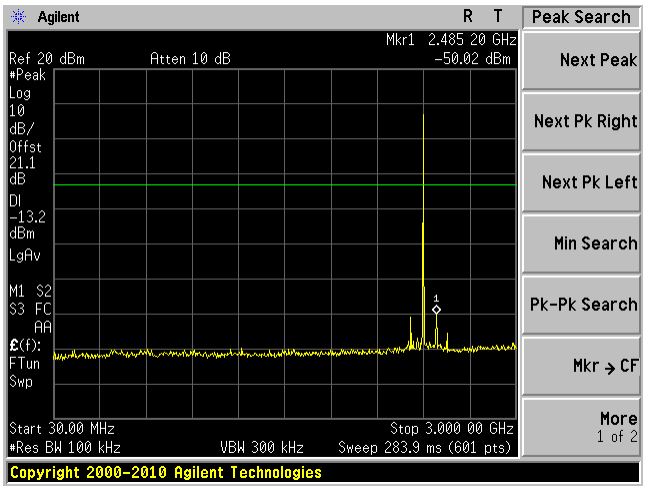


3 GHz – 25 GHz

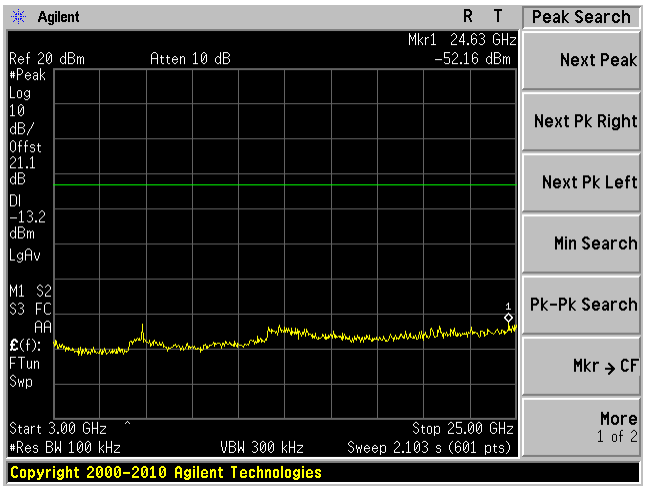


DQPSK Low Channel 2402 MHz

30 MHz – 3 GHz

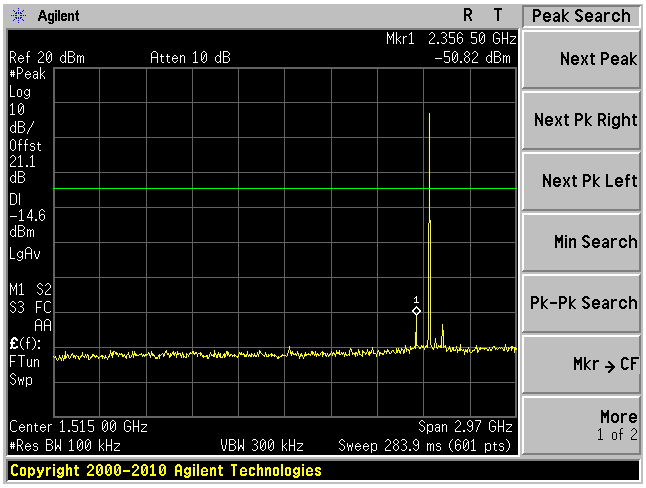


3 GHz – 25 GHz

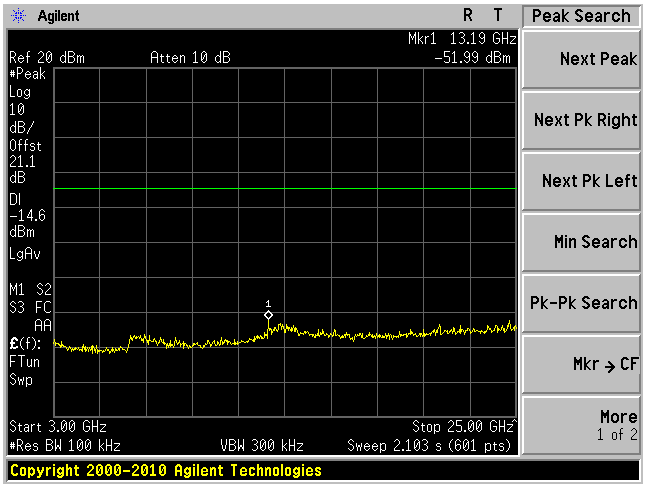


DQPSK Middle Channel 2441 MHz

30 MHz – 3 GHz

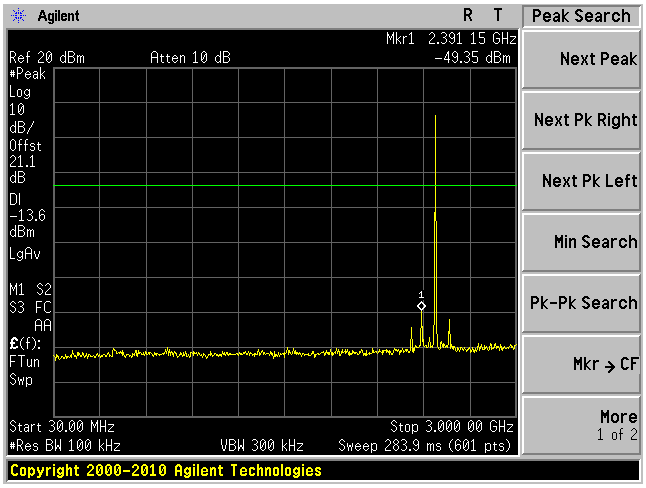


3 GHz – 25 GHz

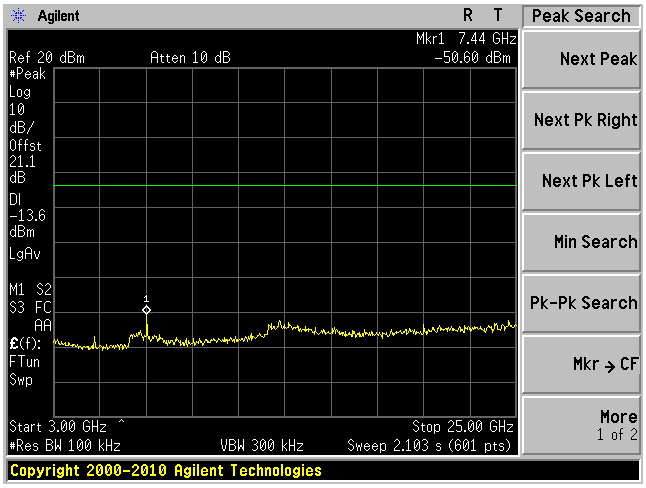


DQPSK High Channel 2480 MHz

30 MHz – 3 GHz

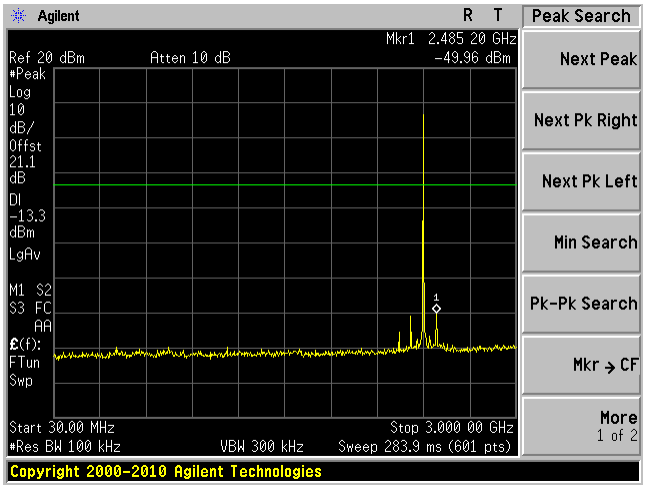


3 GHz – 25 GHz

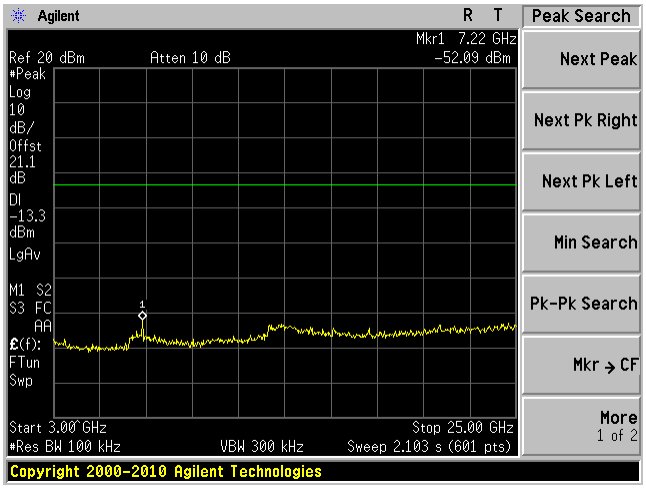


8PSK Low Channel 2402 MHz

30 MHz – 3 GHz

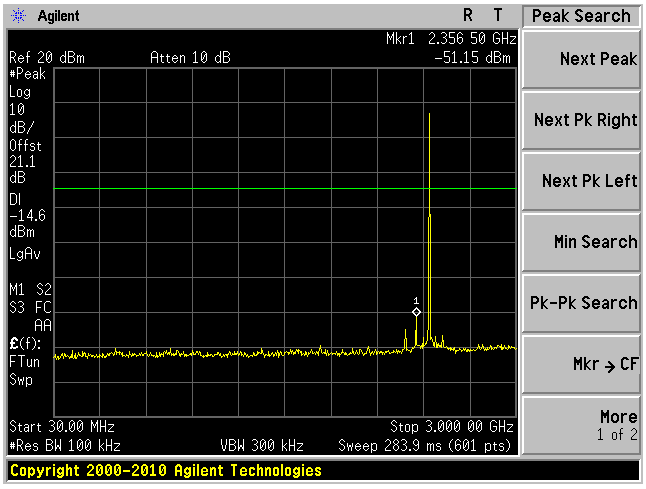


3 GHz – 25 GHz

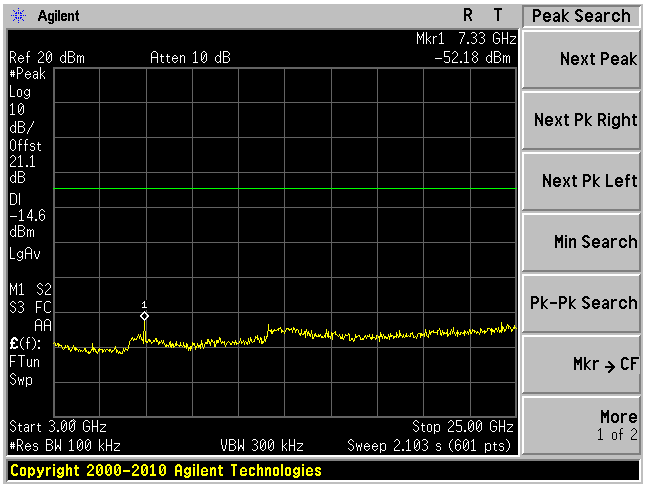


8PSK Middle Channel 2441 MHz

30 MHz – 3 GHz

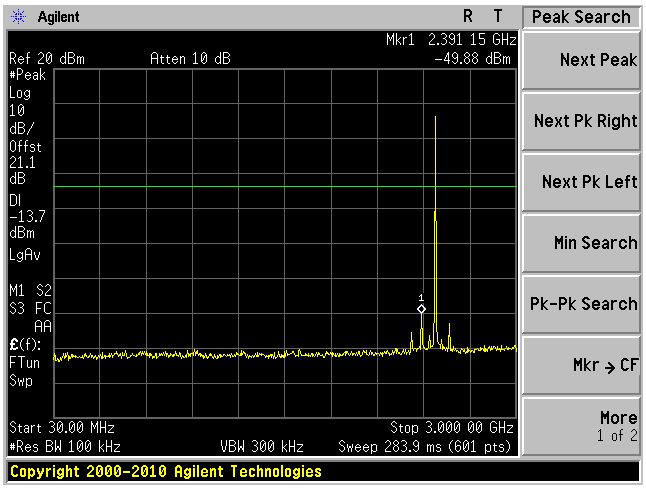


3 GHz – 25 GHz

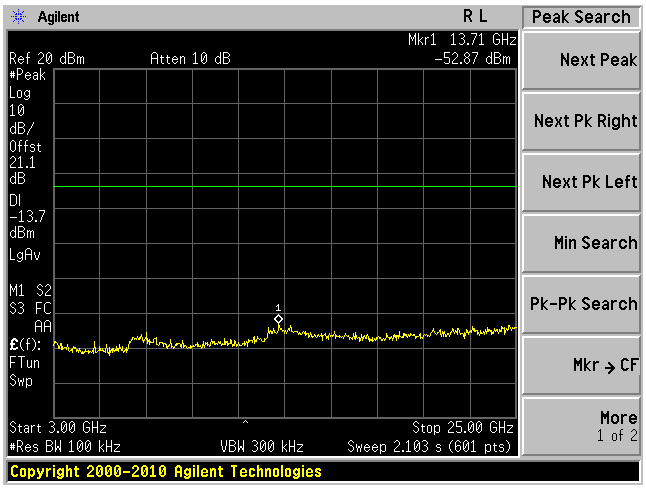


8PSK High Channel 2480 MHz

30 MHz – 3 GHz



3 GHz – 25 GHz



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

8.1 Applicable Standard

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	100338	2012-09-19	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:	20 °C
Relative Humidity:	49 %
ATM Pressure:	102.47 kPa

The testing was performed by Glenn Escano on 2013-03-01 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**
-0.063	7323	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

1) 30–25 GHz, Measured at 3 meters

GFSK:

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	68.15	173	123	V	28.838	3.12	0	100.108	NA	NA	Fund/Peak
2402	64.88	173	123	V	28.838	3.12	0	96.838	NA	NA	Fund/Ave
2402	60.01	210	100	H	28.838	3.12	0	91.968	NA	NA	Fund/Peak
2402	56.94	210	100	H	28.838	3.12	0	88.898	NA	NA	Fund/Ave
2390	21.91	173	123	V	28.192	3.12	0	53.222	74	-20.778	Spur/Peak
2390	10.76	173	123	V	28.192	3.12	0	42.072	54	-11.928	Spur/Ave
2390	21.79	210	100	H	28.192	3.12	0	53.102	74	-20.898	Spur/Peak
2390	10.71	210	100	H	28.192	3.12	0	42.022	54	-11.978	Spur/Ave
4804	42.58	297	130	V	33.1	4.06	27.78	51.944	74	-22.056	Harm/peak
4804	40.59	8	121	H	33.1	4.06	27.78	49.954	74	-24.046	Harm/peak
4804	36.16	297	130	V	33.1	4.06	27.78	45.524	54	-8.476	Harm/Ave
4804	30.53	8	121	H	33.1	4.06	27.78	39.894	54	-14.106	Harm/Ave
7206	49.55	308	185	V	35.9	4.93	27.6	62.818	80.108	-17.290	Harm/peak
7206	45.1	347	118	H	35.9	4.93	27.6	58.368	71.968	-13.6	Harm/peak
7206	43.51	308	185	V	35.9	4.93	27.6	56.778	76.838	-20.060	Harm/Ave
7206	36.88	347	118	H	35.9	4.93	27.6	50.148	68.898	-18.750	Harm/Ave
9608	41.44	326	147	V	37.9	5.82	27.05	58.156	80.108	-21.952	Harm/peak
9608	39.49	58	0	H	37.9	5.82	27.05	56.206	71.968	-15.762	Harm/peak
9608	30.15	326	147	V	37.9	5.82	27.05	46.866	76.838	-29.972	Harm/Ave
9608	25.85	58	0	H	37.9	5.82	27.05	42.566	68.898	-26.332	Harm/Ave

All 30 MHz–1 GHz spurious are digital related with 16.6 MHz SDIO clock, other emissions are on the noise floor level. Report only the worst case data as shown below: (The data listed below are based on the worst point on the worst result with GFSK Middle Channel 2441MHz)

Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type (QP/Ave.)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
325.972	24.75	QP	V	330	269	46	-21.25

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	67.97	173	123	V	28.921	3.21	0	100.101	NA	NA	Fund/Peak
2441	64.72	173	123	V	28.921	3.21	0	96.851	NA	NA	Fund/Ave
2441	59.89	210	100	H	28.921	3.21	0	92.021	NA	NA	Fund/Peak
2441	56.47	210	100	H	28.921	3.21	0	88.601	NA	NA	Fund/Ave
4882	45.02	298	111	V	33.3	4.10	27.7	54.777	74	-19.223	Harm/peak
4882	41.47	70	134	H	33.3	4.10	27.7	51.227	74	-22.773	Harm/peak
4882	37.52	298	111	V	33.3	4.10	27.7	47.277	54	-6.723	Harm/Ave
4882	31.98	70	134	H	33.3	4.10	27.7	41.737	54	-12.263	Harm/Ave
7323	46.93	325	203	V	36.357	4.88	27.51	60.657	74	-13.343	Harm/peak
7323	45.72	192	100	H	36.357	4.88	27.51	59.447	74	-14.553	Harm/peak
7323	40.21	325	203	V	36.357	4.88	27.51	53.937	54	-0.063	Harm/Ave
7323	36.35	192	100	H	36.357	4.88	27.51	50.077	54	-3.923	Harm/Ave
9764	42.71	0	151	V	38.3	5.77	27.0	59.787	80.101	-20.314	Harm/peak
9764	40.21	119	101	H	38.3	5.77	27.0	57.287	72.021	-14.734	Harm/peak
9764	33.14	0	151	V	38.3	5.77	27.0	50.217	76.851	-26.634	Harm/Ave
9764	27.35	119	101	H	38.3	5.77	27.0	44.427	68.601	-24.174	Harm/Ave

All 30 MHz–1 GHz spurious are digital related with 16.6 MHz SDIO clock, other emissions are on the noise floor level. Report only the worst case data as shown below: (The data listed below are based on the worst point on the worst result with GFSK Middle Channel 2441 MHz)

Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type (QP/Ave.)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
325.972	24.75	QP	V	330	269	46	-21.25

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	67.4	172	120	V	29.066	3.25	0	99.716	NA	NA	Fund/Peak
2480	64.23	172	120	V	29.066	3.25	0	96.546	NA	NA	Fund/Ave
2480	59.78	210	100	H	29.066	3.25	0	92.096	NA	NA	Fund/Peak
2480	56.21	210	100	H	29.066	3.25	0	88.526	NA	NA	Fund/Ave
2483.5	26.61	172	120	V	29.066	3.27	0	58.946	74	-15.054	Spur/Peak
2483.5	20.93	172	120	V	29.066	3.27	0	53.266	54	-0.734	Spur/Ave
2483.5	22.77	210	100	H	29.066	3.27	0	55.106	74	-18.894	Spur/Peak
2483.5	17.04	210	100	H	29.066	3.27	0	49.376	54	-4.624	Spur/Ave
4960	40.91	267	109	V	33.5	4.21	27.7	50.877	74	-23.123	Harm/peak
4960	40.23	57	140	H	33.5	4.21	27.7	50.197	74	-23.803	Harm/peak
4960	27.35	267	109	V	33.5	4.21	27.7	37.317	54	-16.683	Harm/Ave
4960	27.82	57	140	H	33.5	4.21	27.7	37.787	54	-16.213	Harm/Ave
7440	47.74	169	168	V	36.5	4.89	27.5	61.605	74	-12.395	Harm/peak
7440	43.9	119	137	H	36.5	4.89	27.5	57.765	74	-16.235	Harm/peak
7440	38.48	169	168	V	36.5	4.89	27.5	52.345	54	-1.655	Harm/Ave
7440	32.34	119	137	H	36.5	4.89	27.5	46.205	54	-7.795	Harm/Ave
9920	41.75	327	100	V	38.5	5.92	27.0	59.201	79.716	-20.515	Harm/peak
9920	39.45	0	100	H	38.5	5.92	27.0	56.901	72.096	-15.195	Harm/peak
9920	27.87	327	100	V	38.5	5.92	27.0	45.321	76.546	-31.225	Harm/Ave
9920	24.39	0	100	H	38.5	5.92	27.0	41.841	68.526	-26.685	Harm/Ave

All 30 MHz–1 GHz spurious are digital related with 16.6 MHz SDIO clock, other emissions are on the noise floor level. Report only the worst case data as shown below: (The data listed below are based on the worst point on the worst result with GFSK Middle Channel 2441 MHz)

Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type (QP/Ave.)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
325.972	24.75	QP	V	330	269	46	-21.25

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	66.19	173	123	V	28.838	3.12	0	98.148	NA	NA	Fund/Peak
2402	62.43	173	123	V	28.838	3.12	0	94.388	NA	NA	Fund/Ave
2402	58.21	211	100	H	28.838	3.12	0	90.168	NA	NA	Fund/Peak
2402	55.01	211	100	H	28.838	3.12	0	86.968	NA	NA	Fund/Ave
2390	22.03	173	123	V	28.192	3.12	0	53.342	74	-20.658	Spur/Peak
2390	10.97	173	123	V	28.192	3.12	0	42.282	54	-11.718	Spur/Ave
2390	22.01	211	100	H	28.192	3.12	0	53.322	74	-20.678	Spur/Peak
2390	10.78	211	100	H	28.192	3.12	0	42.092	54	-11.908	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	65	172	120	V	29.066	3.25	0	97.316	NA	NA	Fund/Peak
2480	59.17	172	120	V	29.066	3.25	0	91.486	NA	NA	Fund/Ave
2480	57.71	210	100	H	29.066	3.25	0	90.026	NA	NA	Fund/Peak
2480	54.29	210	100	H	29.066	3.25	0	86.606	NA	NA	Fund/Ave
2483.5	25.13	172	120	V	29.066	3.27	0	57.466	74	-16.534	Spur/Peak
2483.5	19.65	172	120	V	29.066	3.27	0	51.986	54	-2.014	Spur/Ave
2483.5	22.68	210	100	H	29.066	3.27	0	55.016	74	-18.984	Spur/Peak
2483.5	15.07	210	100	H	29.066	3.27	0	47.406	54	-6.594	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	66.49	173	123	V	28.838	3.12	0	98.448	NA	NA	Fund/Peak
2402	62.57	173	123	V	28.838	3.12	0	94.528	NA	NA	Fund/Ave
2402	58.73	211	100	H	28.838	3.12	0	90.688	NA	NA	Fund/Peak
2402	55.39	211	100	H	28.838	3.12	0	87.348	NA	NA	Fund/Ave
2390	21.97	173	123	V	28.192	3.12	0	53.282	74	-20.718	Spur/Peak
2390	10.67	173	123	V	28.192	3.12	0	41.982	54	-12.018	Spur/Ave
2390	21.09	211	100	H	28.192	3.12	0	52.402	74	-21.598	Spur/Peak
2390	10.37	211	100	H	28.192	3.12	0	41.682	54	-12.318	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	65.24	172	120	V	29.066	3.25	0	97.556	NA	NA	Fund/Peak
2480	59.41	172	120	V	29.066	3.25	0	91.726	NA	NA	Fund/Ave
2480	57.87	210	100	H	29.066	3.25	0	90.186	NA	NA	Fund/Peak
2480	54.38	210	100	H	29.066	3.25	0	86.696	NA	NA	Fund/Ave
2483.5	25.49	172	120	V	29.066	3.27	0	57.826	74	-16.174	Spur/Peak
2483.5	19.67	172	120	V	29.066	3.27	0	52.006	54	-1.994	Spur/Ave
2483.5	22.71	210	100	H	29.066	3.27	0	55.046	74	-18.954	Spur/Peak
2483.5	15.13	210	100	H	29.066	3.27	0	47.466	54	-6.534	Spur/Ave

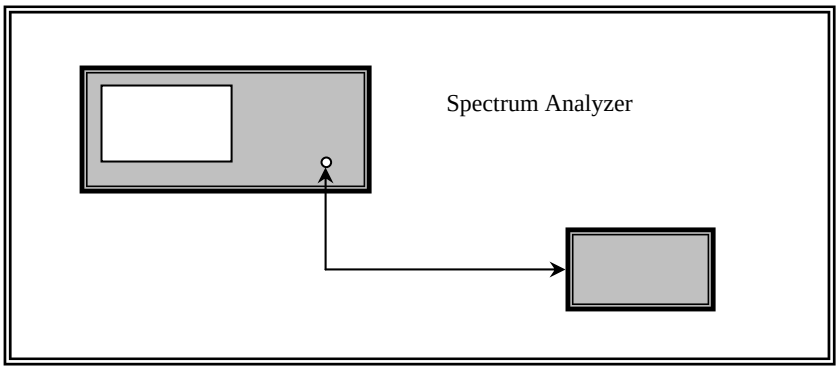
9 FCC §15.247(b) & IC RSS-210 §A8.4 - Peak Output Power Measurement

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:	25 °C
Relative Humidity:	35 %
ATM Pressure:	101.9 kPa

The testing was performed by Victor Zhang on 2013-02-22 at RF test site.

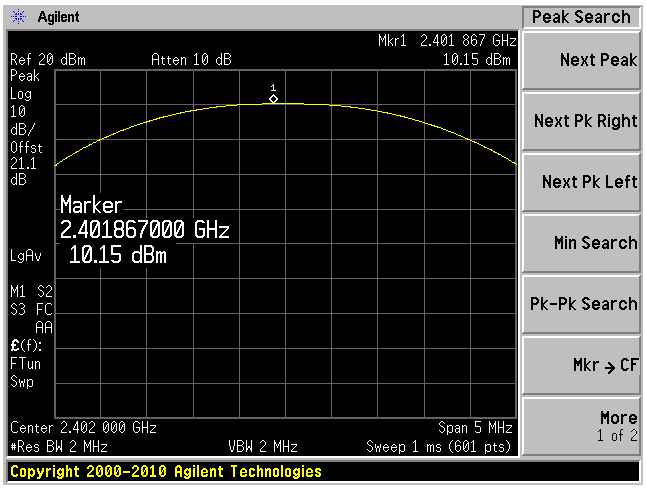
9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
GFSK				
Low	2402	10.15	30	-19.85
Middle	2441	9.99	30	-20.01
High	2480	9.19	30	-20.81
DQPSK				
Low	2402	8.28	30	-21.72
Middle	2441	8.22	30	-21.78
High	2480	7.43	30	-22.57
8PSK				
Low	2402	8.77	30	-21.23
Middle	2441	8.7	30	-21.3
High	2480	7.88	30	-22.12

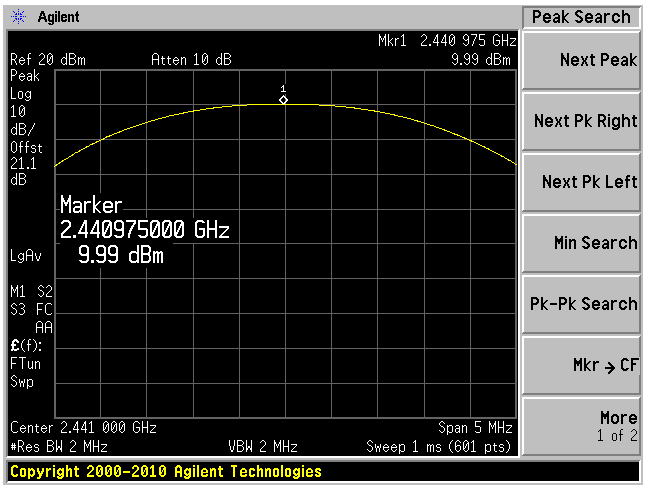
Please refer to the following plots.

GFSK

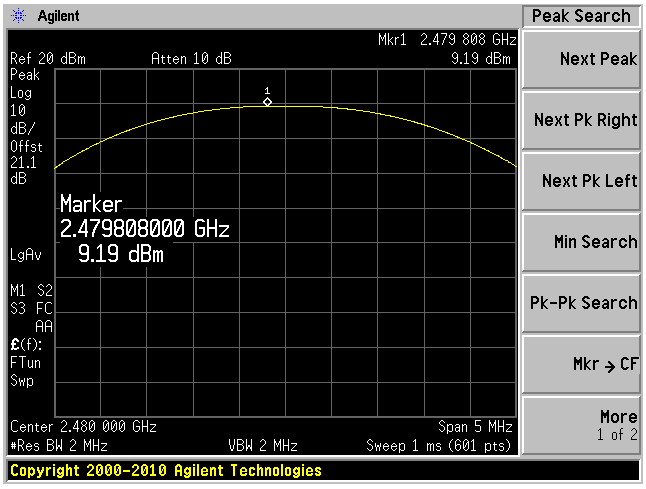
Low channel: 2402 MHz



Middle Channel: 2441 MHz

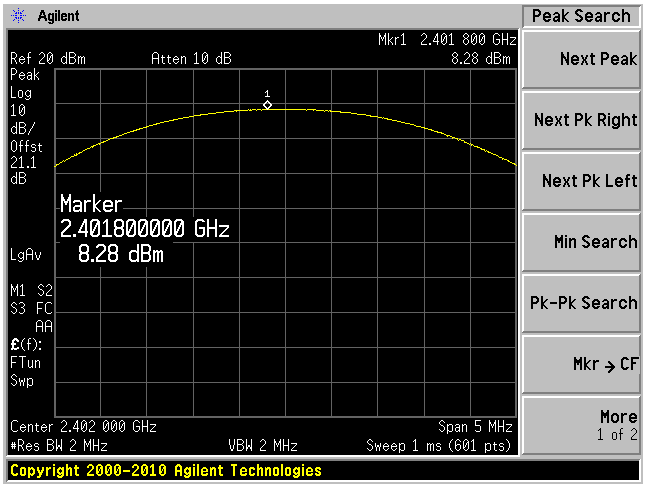


High Channel: 2480 MHz

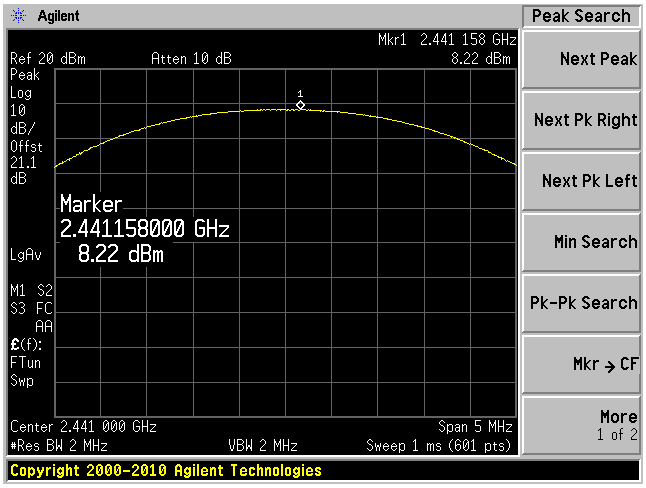


DQPSK

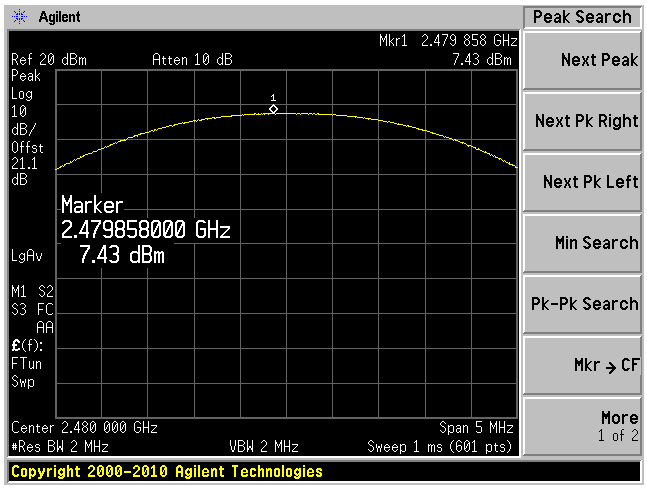
Low channel: 2402 MHz



Middle Channel: 2441 MHz

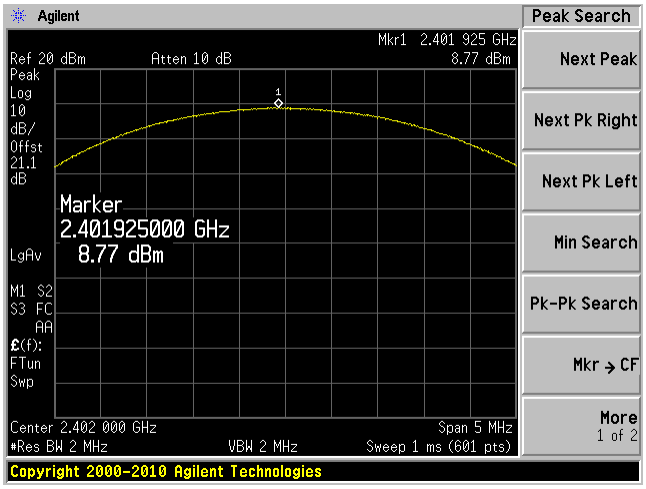


High Channel: 2480 MHz

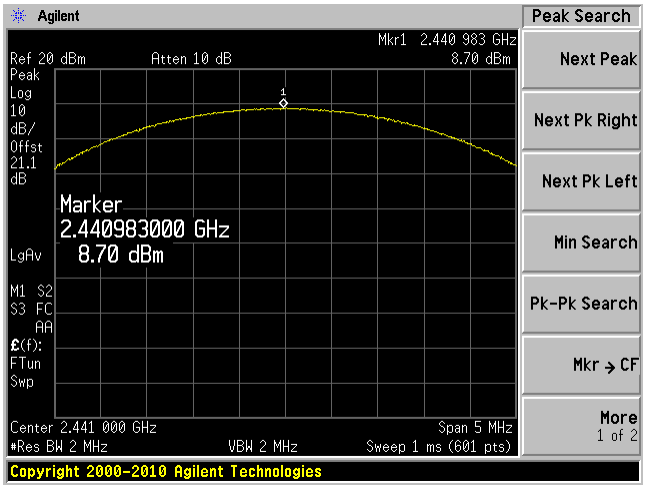


8PSK

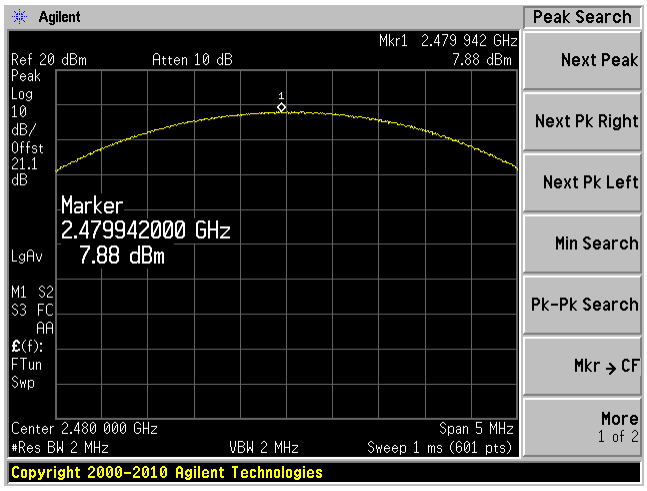
Low channel: 2402 MHz



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:	21 °C
Relative Humidity:	29 %
ATM Pressure:	102.4 kPa

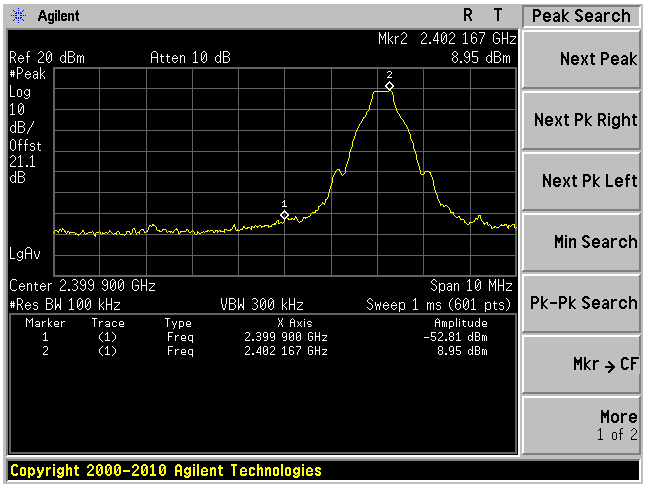
The testing was performed by Victor Zhang on 2013-02-26 at RF test site.

10.5 Test Results

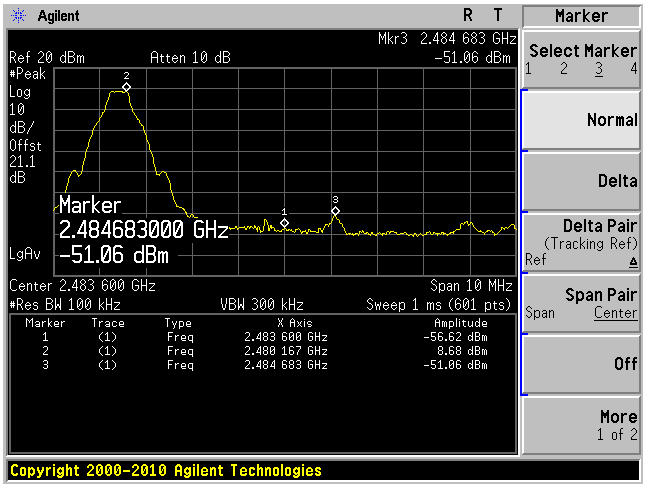
Please refer to following pages for plots of band edge.

GFSK

Low Band Edge

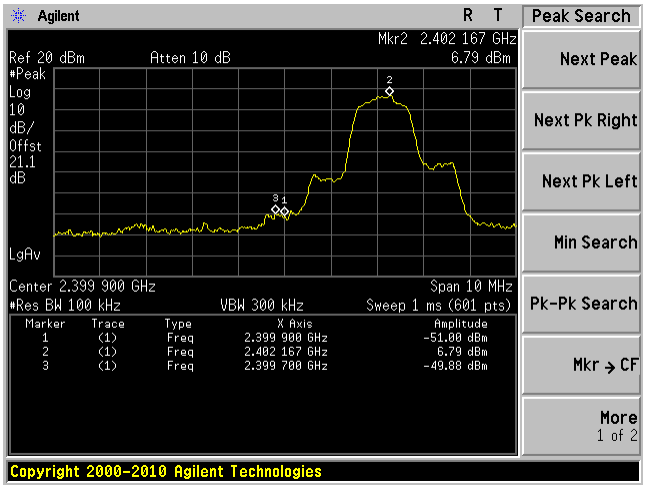


High Band Edge

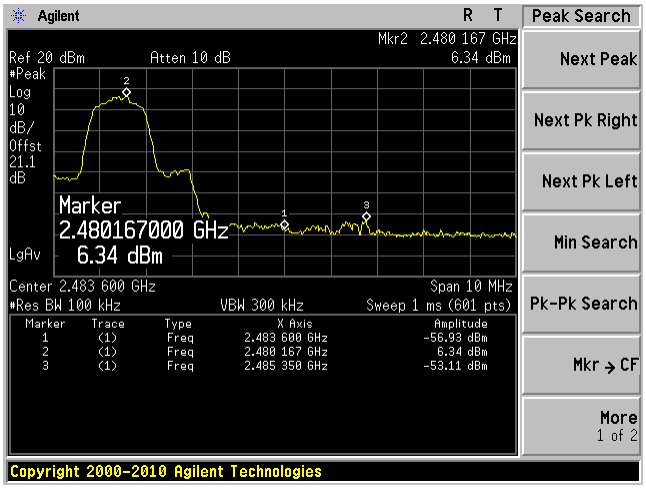


DQPSK

Low Band Edge

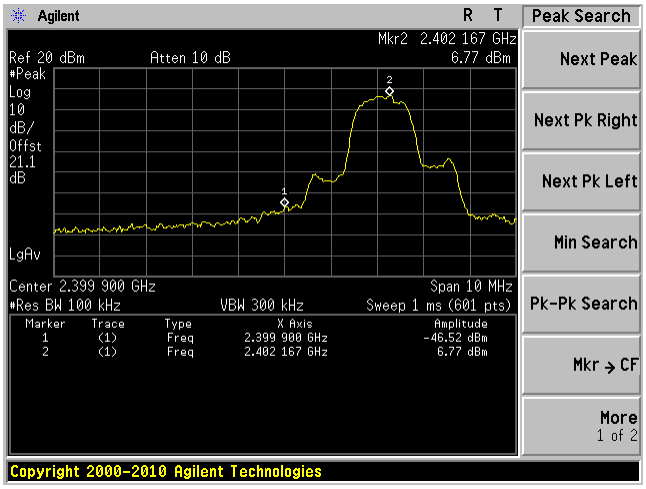


High Band Edge

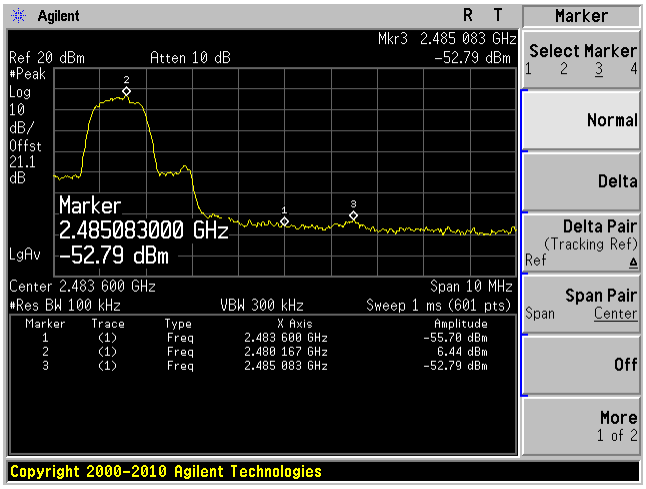


8PSK

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:	21 °C
Relative Humidity:	29 %
ATM Pressure:	102.4 kPa

The testing was performed by Victor Zhang on 2013-02-26 at RF test site.

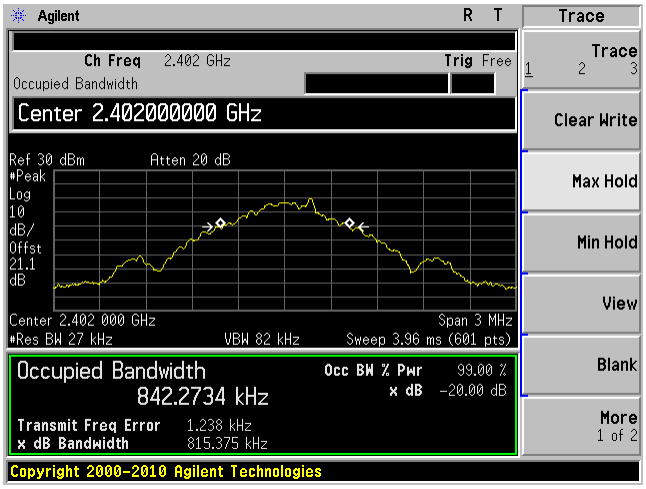
11.5 Test Results

Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	20 dB Emission Bandwidth (MHz)
GFSK			
Low	2402	0.8422374	0.815375
Middle	2441	0.8516947	0.861176
High	2480	0.8502352	0.860742
DQPSK			
Low	2402	1.1163	1.23
Middle	2441	1.1644	1.231
High	2480	1.1715	1.232
8PSK			
Low	2402	1.1728	1.258
Middle	2441	1.1741	1.258
High	2480	1.1913	1.258

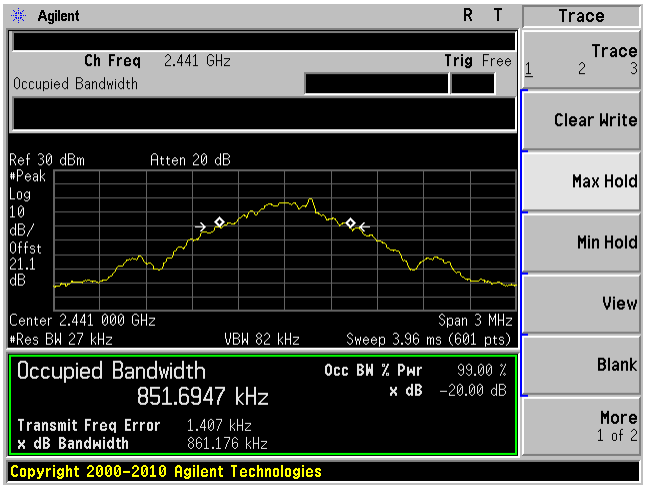
Please refer to the following plots.

GFSK

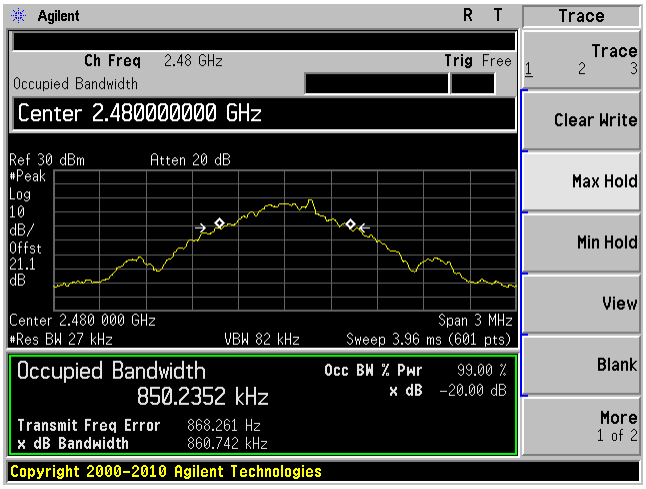
Low channel: 2402 MHz



Middle Channel: 2441 MHz

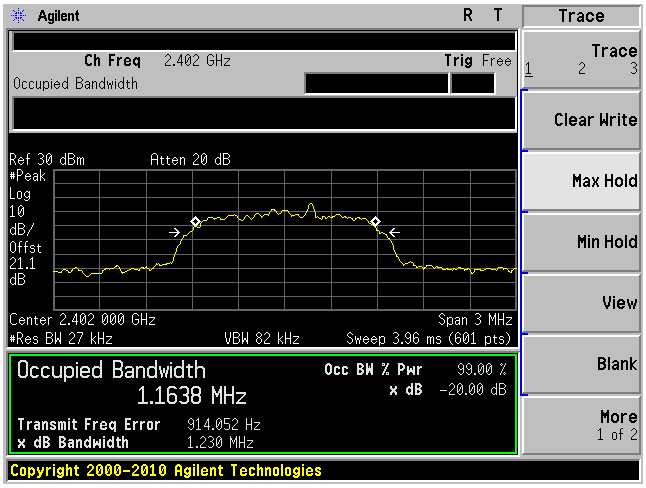


High Channel: 2480 MHz

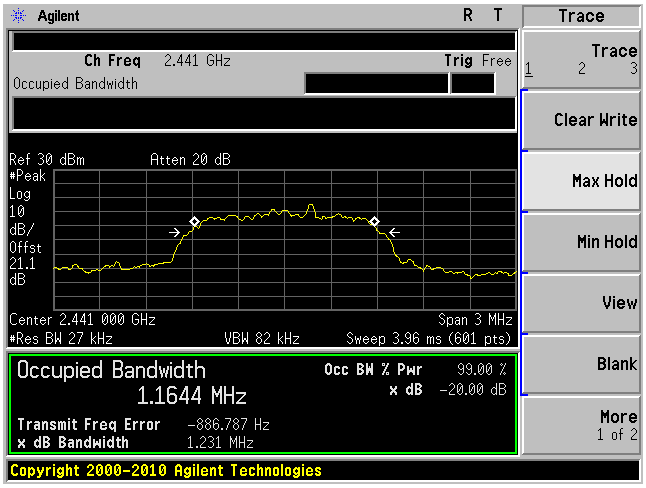


DQPSK

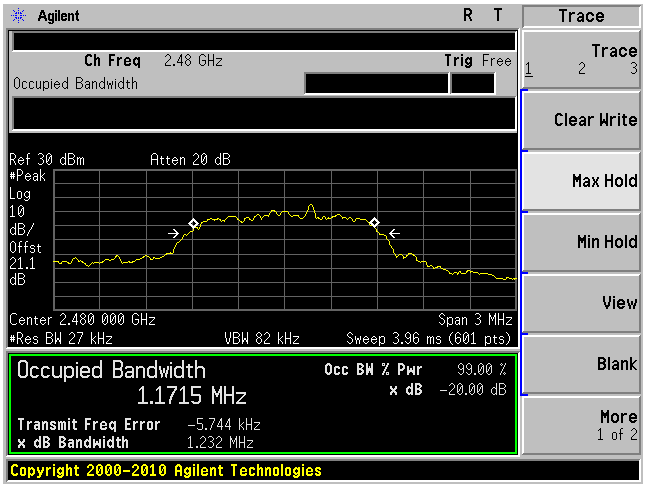
Low channel: 2402 MHz



Middle Channel: 2441 MHz

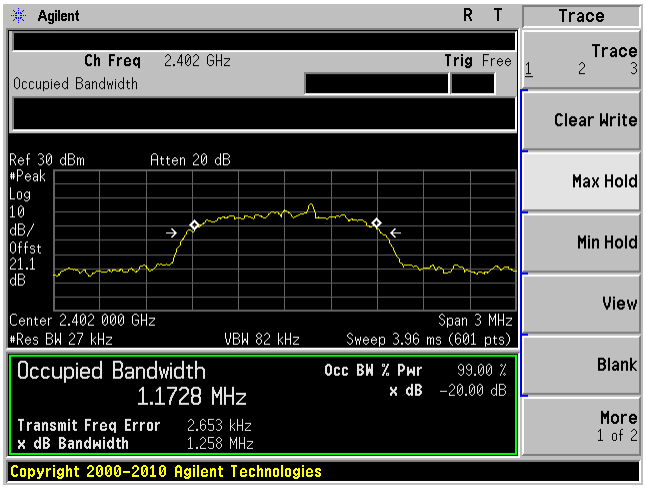


High Channel: 2480 MHz

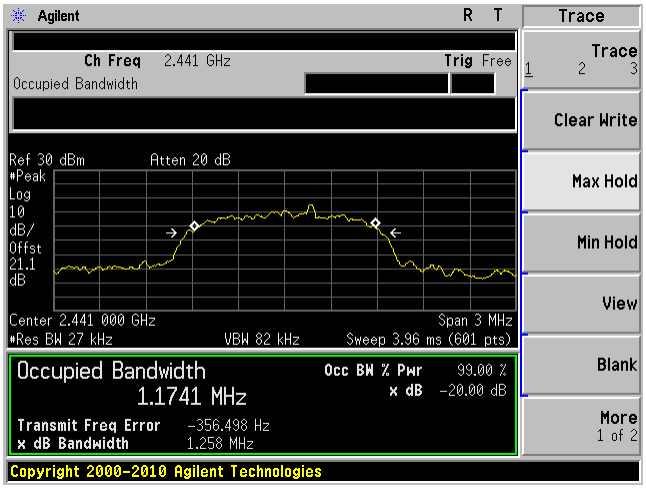


8PSK

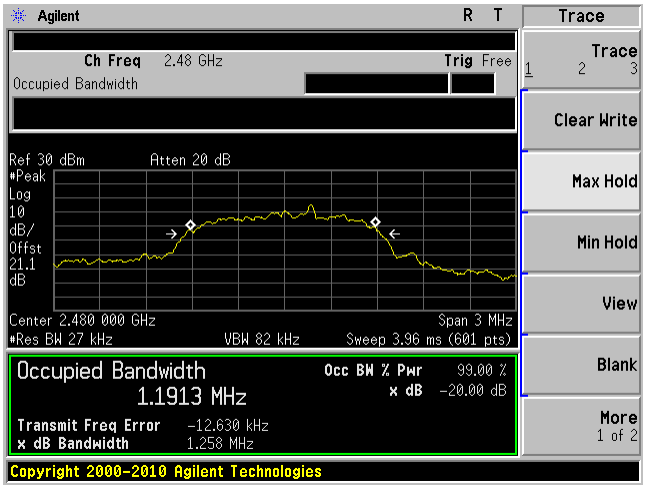
Low channel: 2402 MHz



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:	21 °C
Relative Humidity:	29 %
ATM Pressure:	102.4 kPa

The testing was performed by Victor Zhang on 2013-02-26 at RF test site.

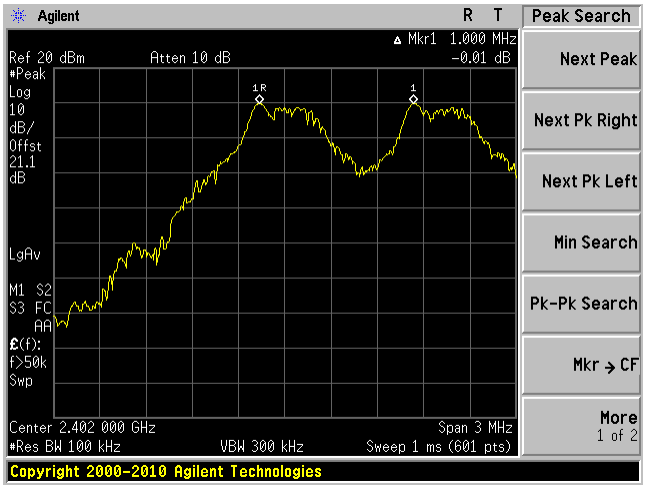
12.5 Test Results

Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 2/3 20 dB OBW (kHz)
GFSK			
Low	2402	1000	543.58
Middle	2441	1005	574.12
High	2480	1005	573.83
DQPSK			
Low	2402	1000	820.00
Middle	2441	1005	820.67
High	2480	1005	821.33
8PSK			
Low	2402	1000	838.67
Middle	2441	995	838.67
High	2480	1010	838.67

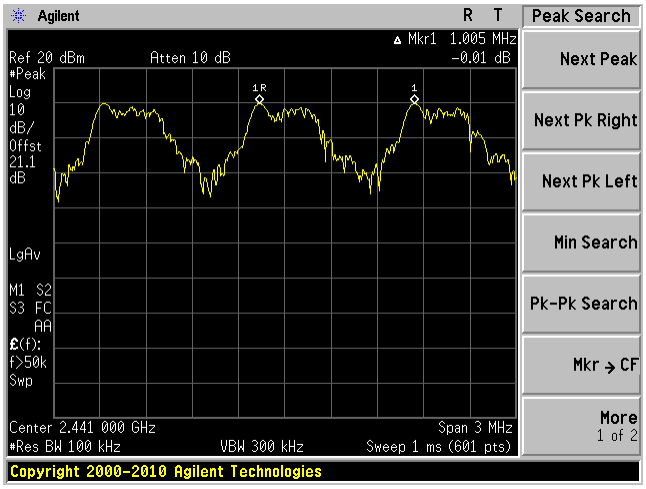
Please refer to the following plots.

GFSK

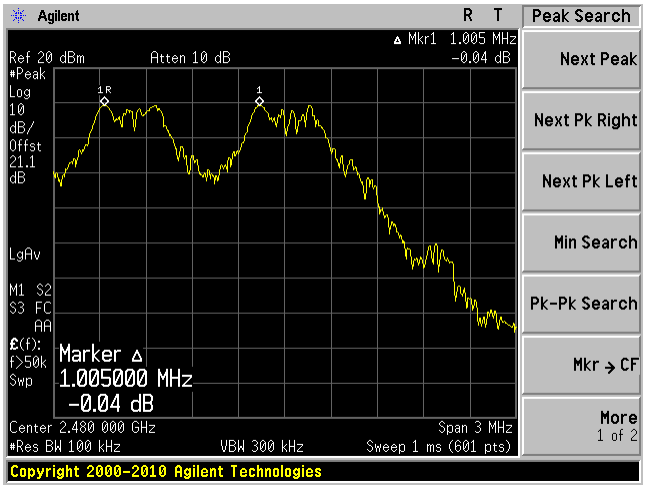
Low channel: 2402 MHz



Middle Channel: 2441 MHz

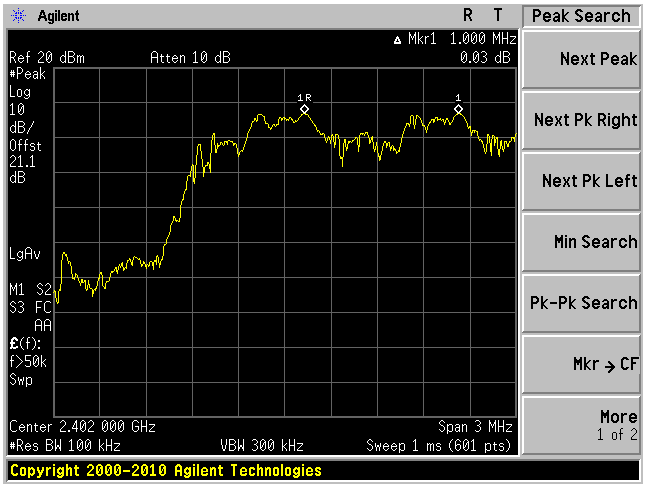


High Channel: 2480 MHz

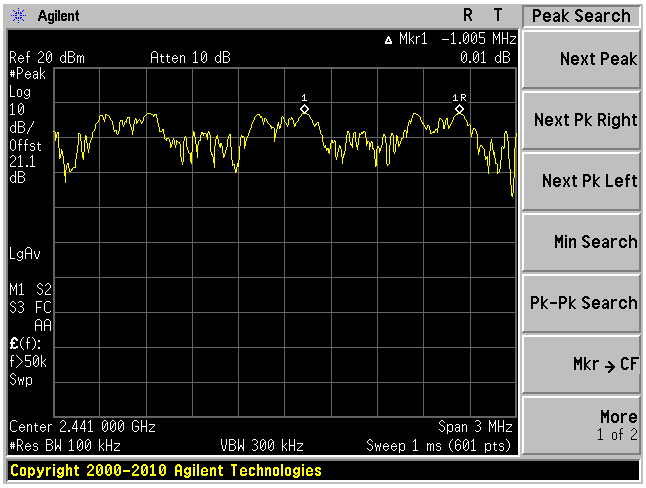


DQPSK

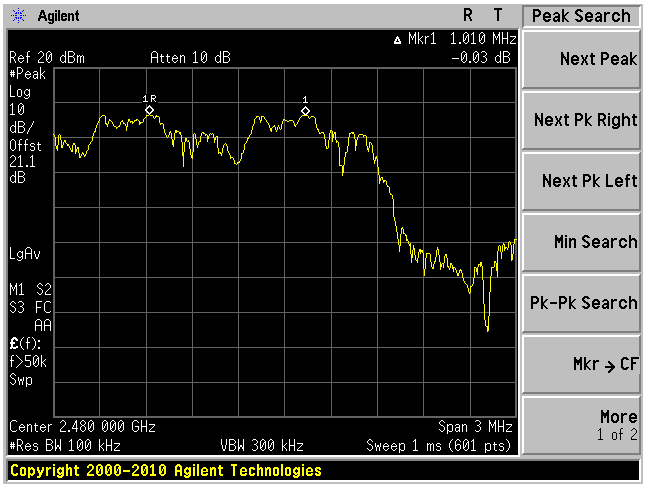
Low channel: 2402 MHz



Middle Channel: 2441 MHz

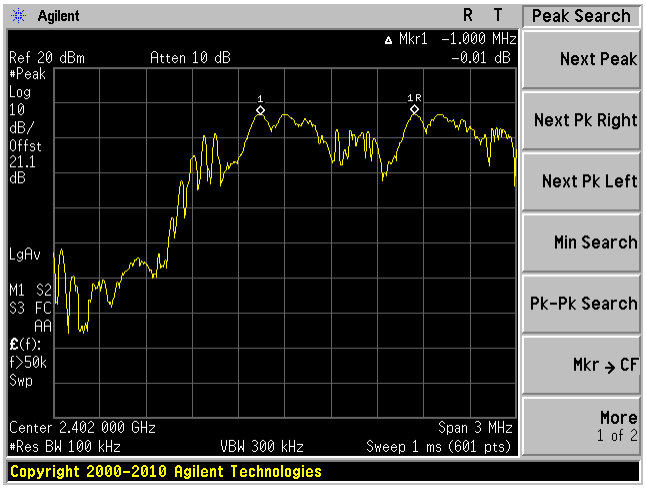


High Channel: 2480 MHz

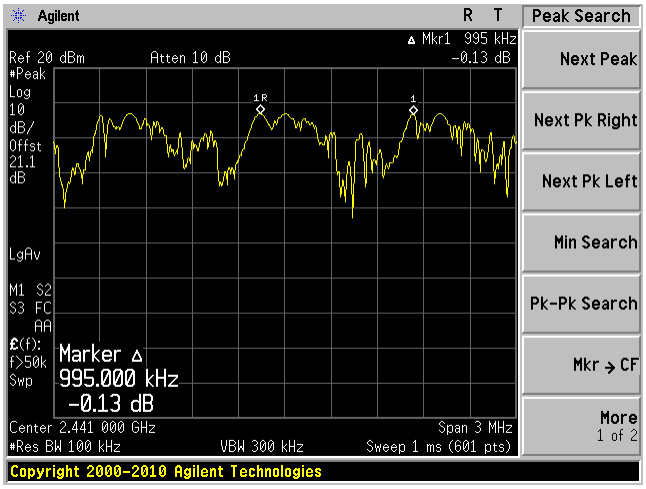


8PSK

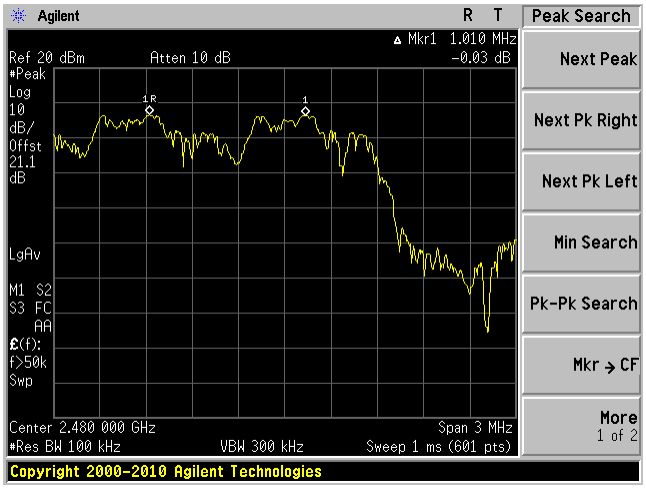
Low channel: 2402 MHz



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

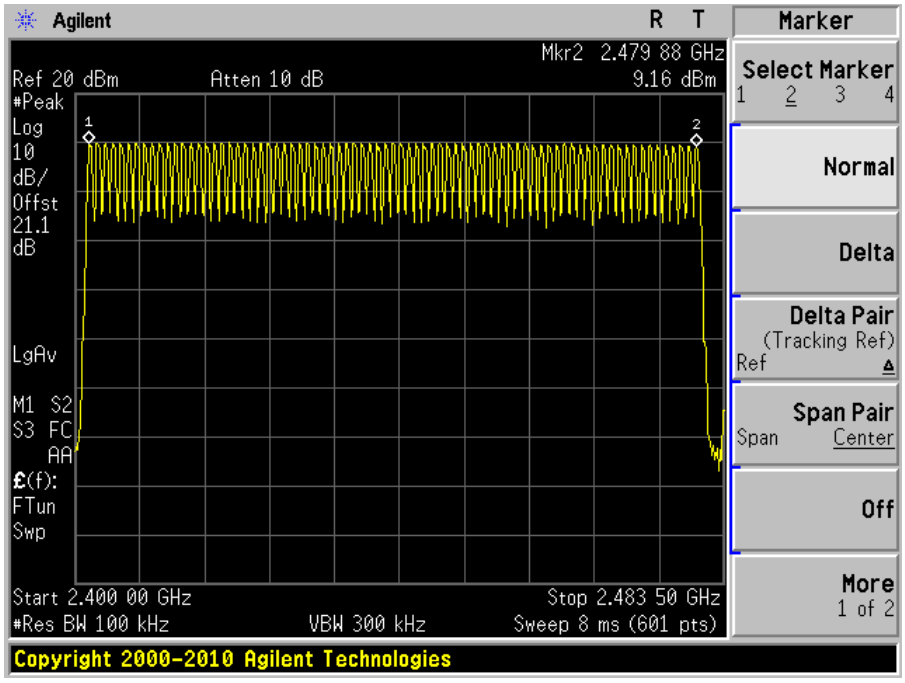
Temperature:	21 °C
Relative Humidity:	29 %
ATM Pressure:	102.4 kPa

The testing was performed by Victor Zhang on 2013-02-26 at RF test site.

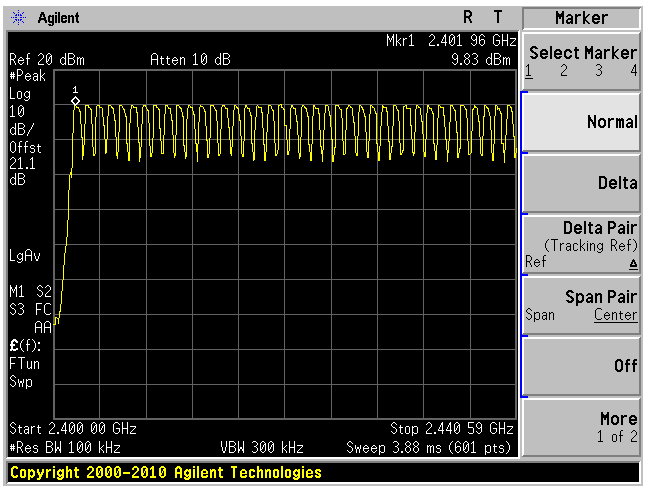
13.5 Test Results

Total 79 channels; please refer to the plots hereinafter.

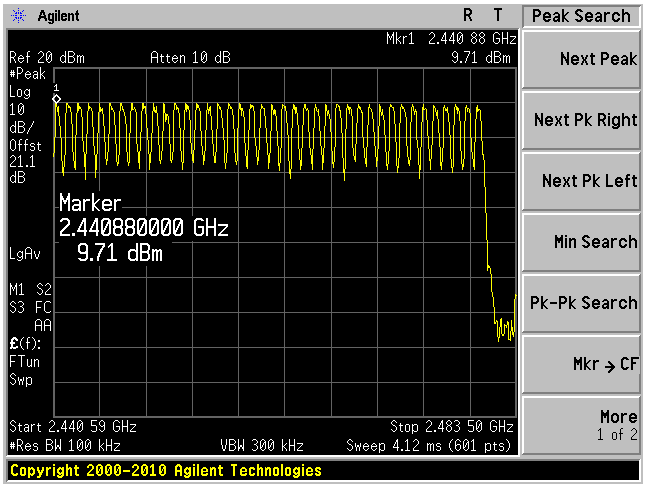
Hopping Channel Number: Total 79 Channels



39 Channels between 2400 to 2440.8 MHz



40 Channels between 2440.59 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:	21 °C
Relative Humidity:	26 %
ATM Pressure:	102.3 kPa

The testing was performed by Victor Zhang on 2013-02-27 at RF test site.

14.5 Test Results

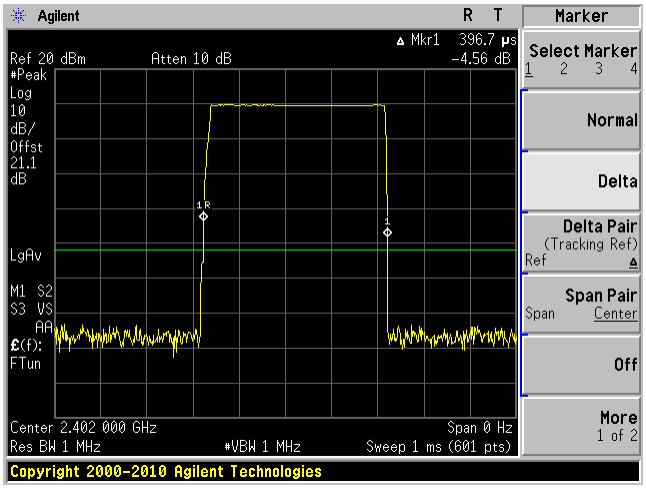
Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
GFSK, DH1: Packet Size = 27 byte				
Low	0.3967	0.13	0.4	Pass
Mid	0.3917	0.13	0.4	Pass
High	0.395	0.13	0.4	Pass
GFSK, DH3: Packet Size = 183 bytes				
Low	1.659	0.27	0.4	Pass
Mid	1.659	0.27	0.4	Pass
High	1.659	0.27	0.4	Pass
GFSK, DH5: Packet Size = 339 bytes				
Low	2.907	0.31	0.4	Pass
Mid	2.907	0.31	0.4	Pass
High	2.907	0.31	0.4	Pass
DQPSK, DH1: Packet Size = 27 byte				
Low	0.4	0.13	0.4	Pass
Mid	0.4	0.13	0.4	Pass
High	0.4	0.13	0.4	Pass
DQPSK, DH3: Packet Size = 183 bytes				
Low	1.655	0.26	0.4	Pass
Mid	1.655	0.26	0.4	Pass
High	1.651	0.26	0.4	Pass
DQPSK, DH5: Packet Size = 339 bytes				
Low	2.913	0.31	0.4	Pass
Mid	2.907	0.31	0.4	Pass
High	2.913	0.31	0.4	Pass
8PSK, DH1: Packet Size = 27 byte				
Low	0.4	0.13	0.4	Pass
Mid	0.4	0.13	0.4	Pass
High	0.4	0.13	0.4	Pass
8PSK, DH3: Packet Size = 183 bytes				
Low	1.646	0.26	0.4	Pass
Mid	1.638	0.26	0.4	Pass
High	1.642	0.26	0.4	Pass
8PSK, DH5: Packet Size = 339 bytes				
Low	2.9	0.31	0.4	Pass
Mid	2.9	0.31	0.4	Pass
High	2.9	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

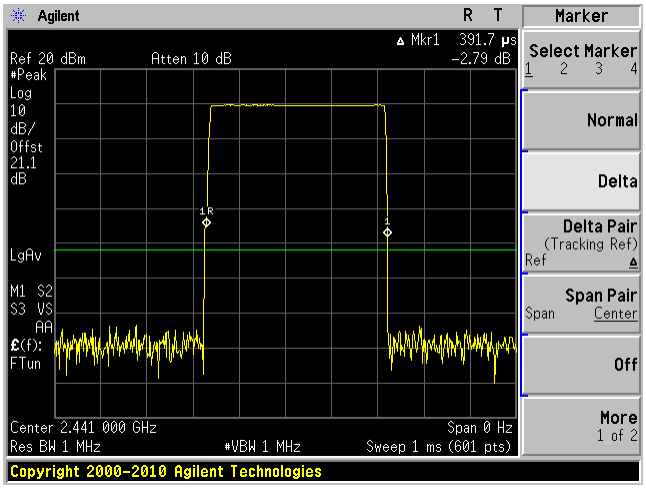
Please refer to following plots.

GFSK – DH1

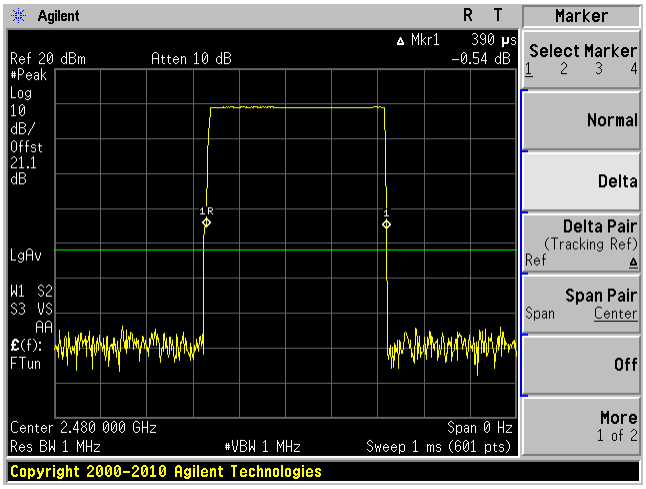
Low channel: 2402 MHz



Middle Channel: 2441 MHz

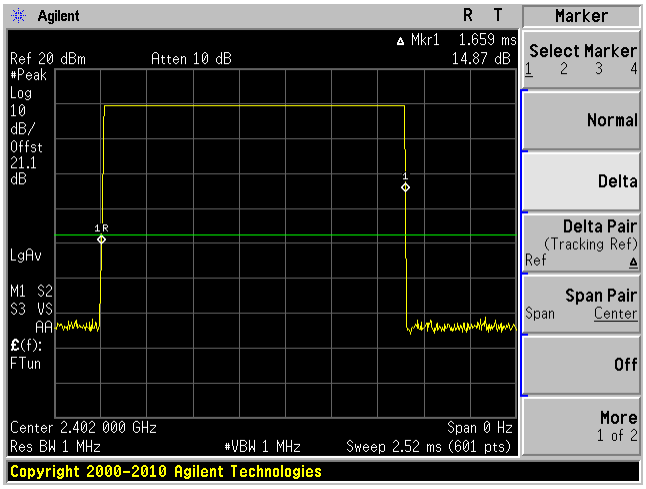


High Channel: 2480 MHz

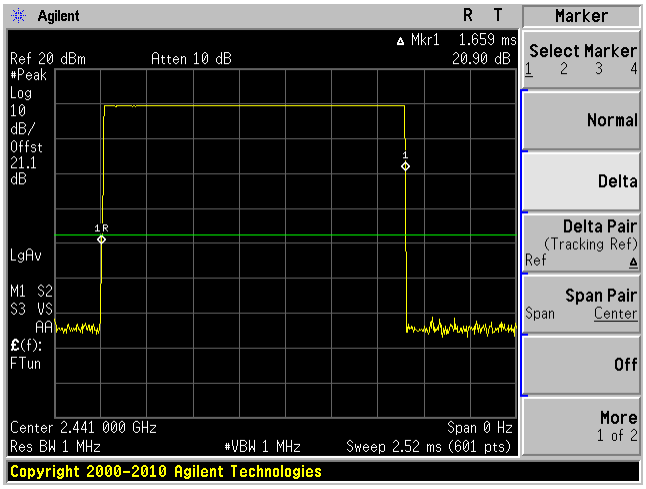


GFSK – DH3

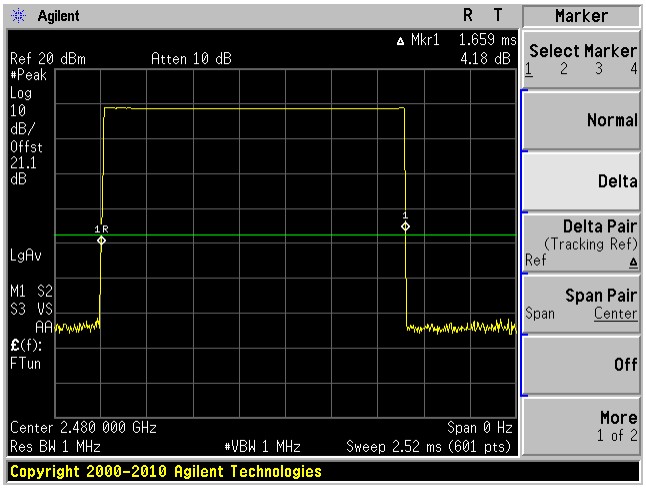
Low channel: 2402 MHz



Middle Channel: 2441 MHz

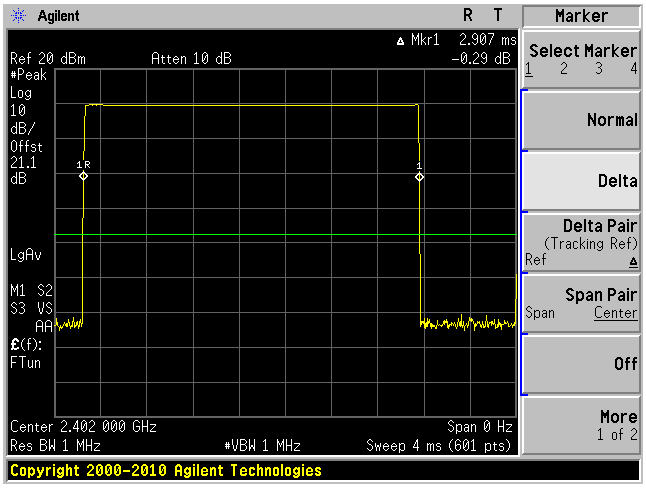


High Channel: 2480 MHz

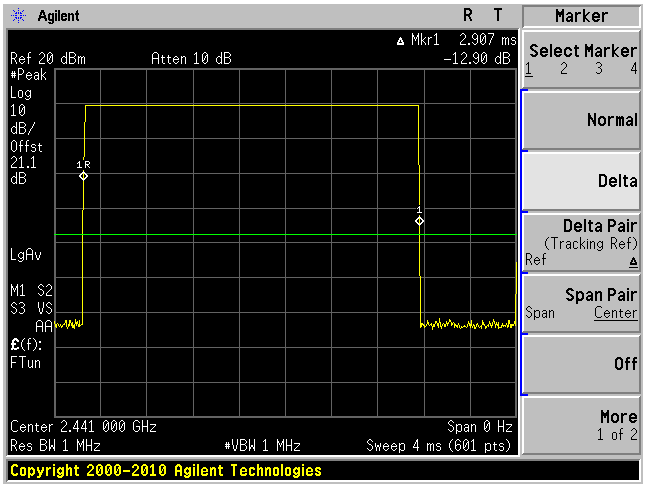


GFSK – DH5

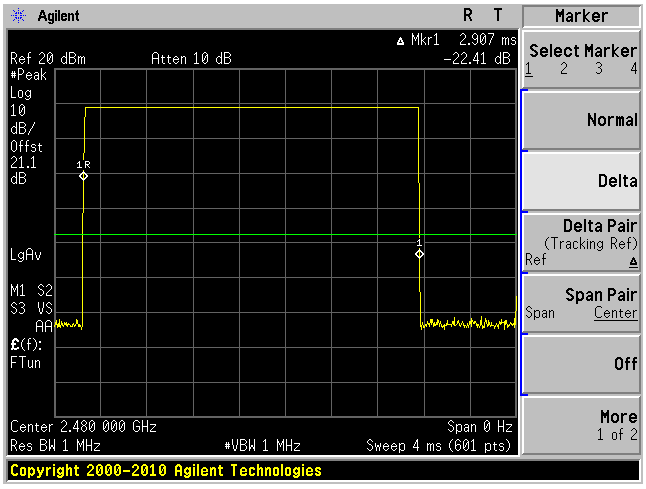
Low channel: 2402 MHz



Middle Channel: 2441 MHz

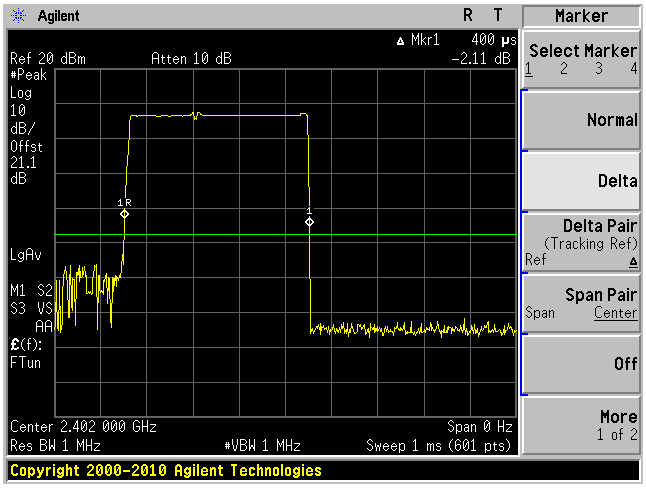


High Channel: 2480 MHz

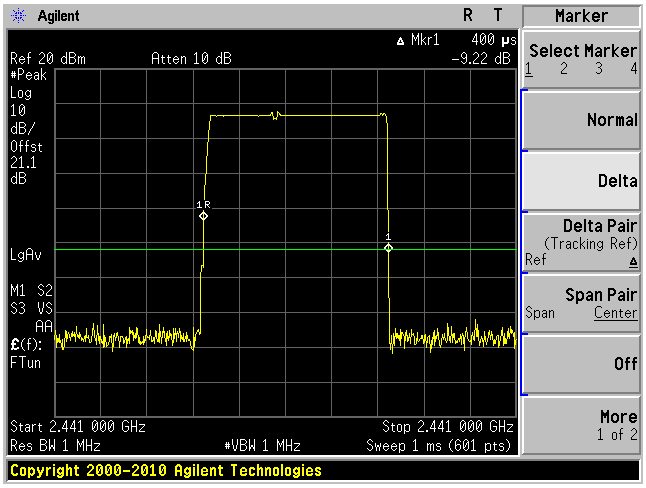


DQPSK – DH1

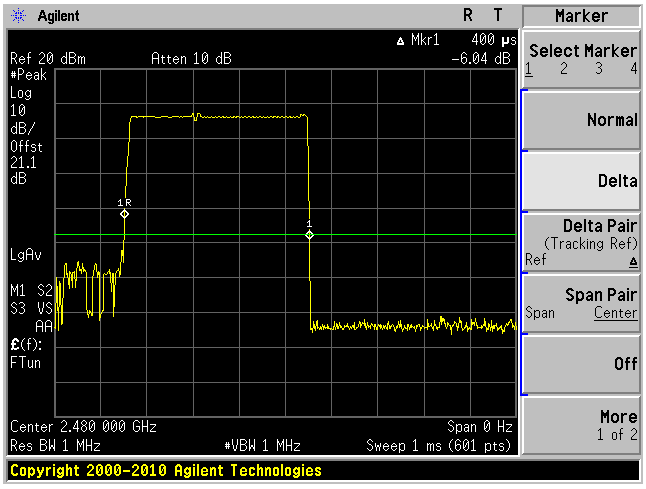
Low channel: 2402 MHz



Middle Channel: 2441 MHz

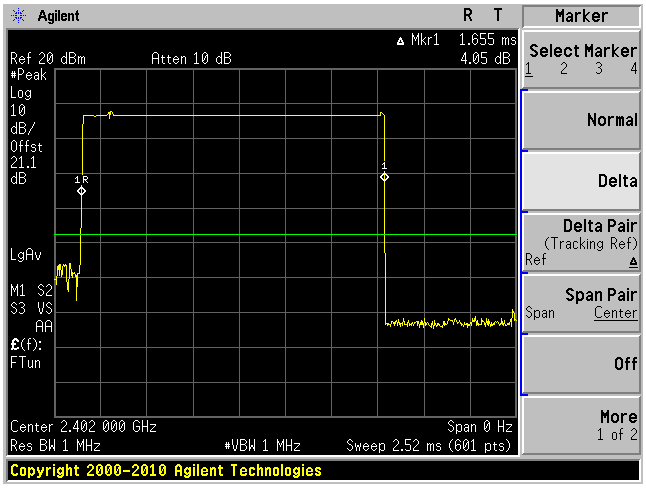


High Channel: 2480 MHz

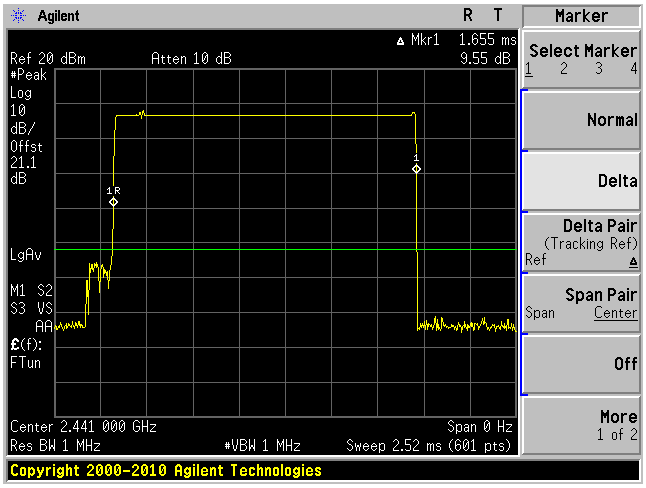


DQPSK – DH3

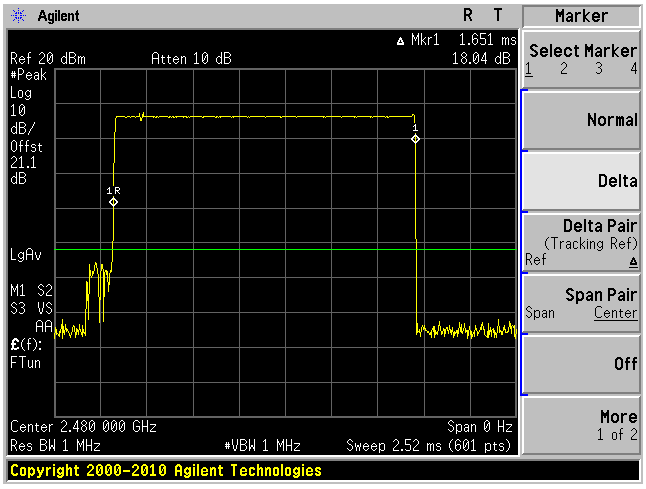
Low channel: 2402 MHz



Middle Channel: 2441 MHz

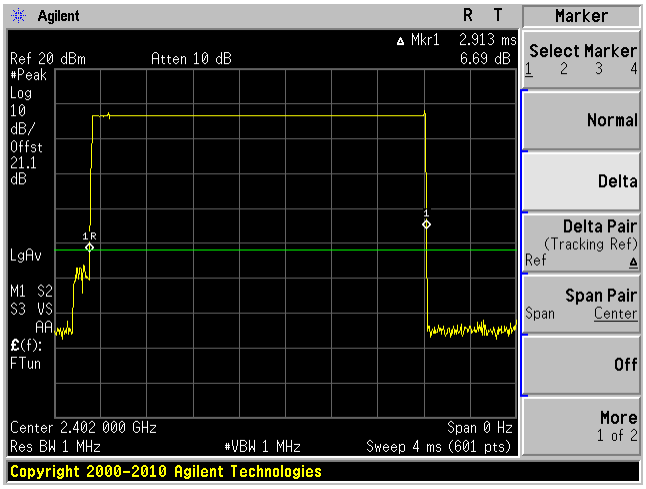


High Channel: 2480 MHz

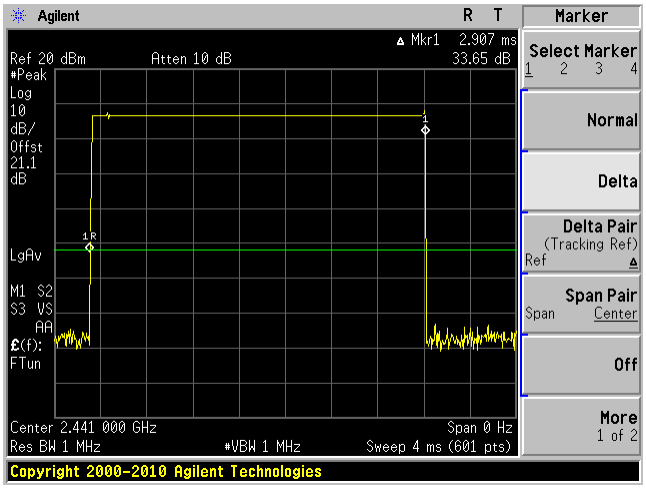


DQPSK – DH5

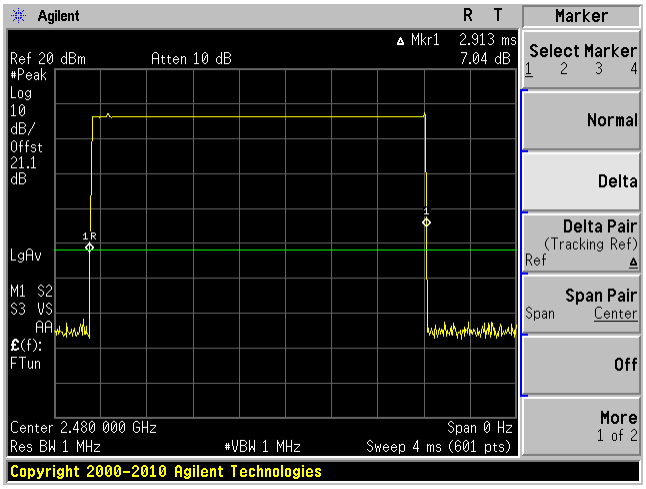
Low channel: 2402 MHz



Middle Channel: 2441 MHz

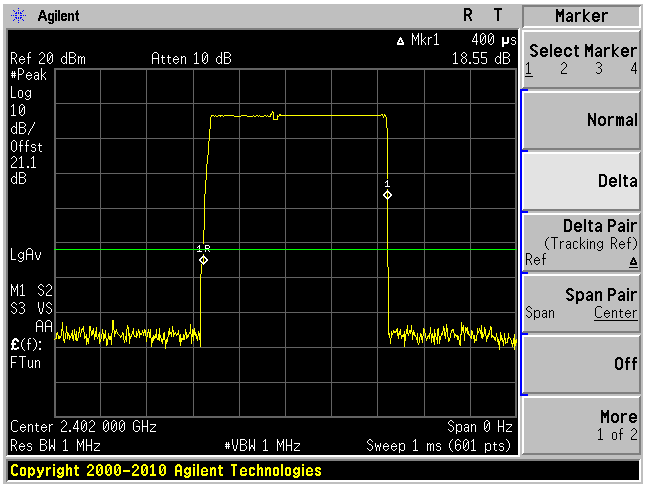


High Channel: 2480 MHz

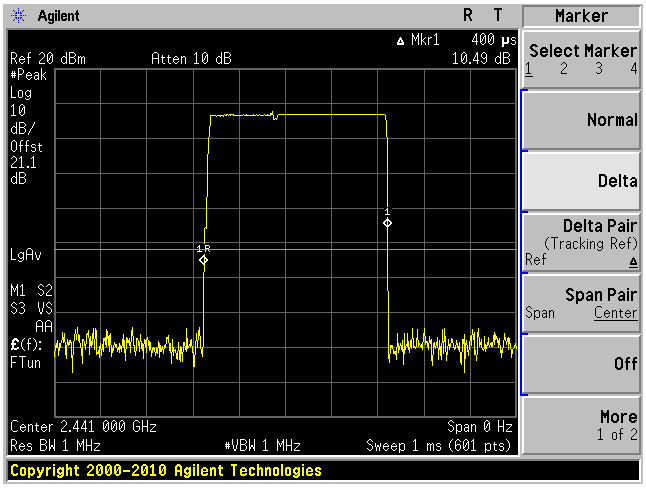


8PSK – DH1

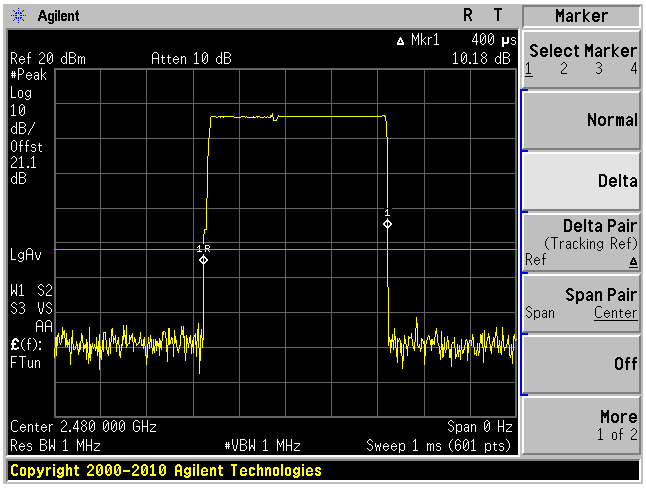
Low channel: 2402 MHz



Middle Channel: 2441 MHz

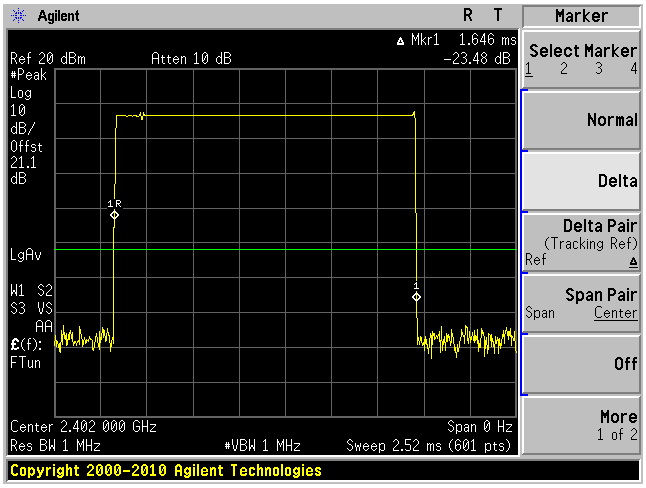


High Channel: 2480 MHz

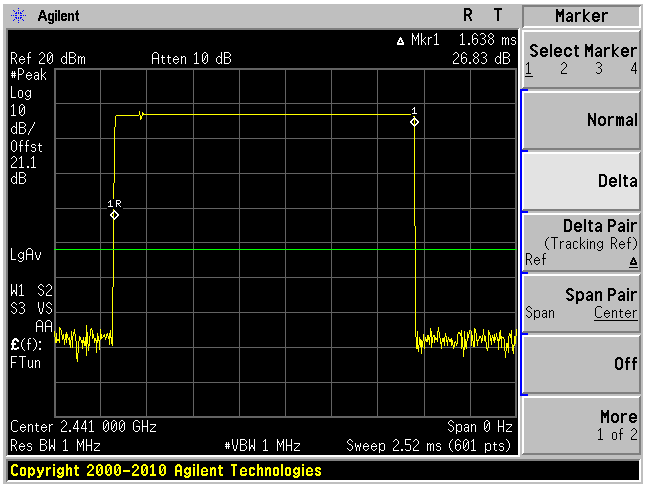


8PSK – DH3

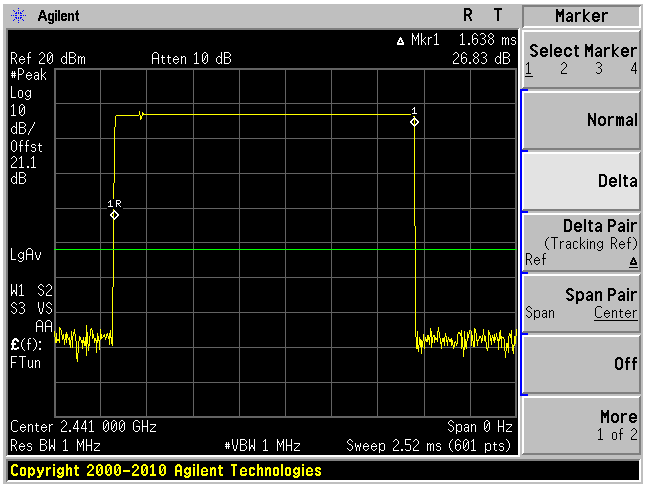
Low channel: 2402 MHz



Middle Channel: 2441 MHz

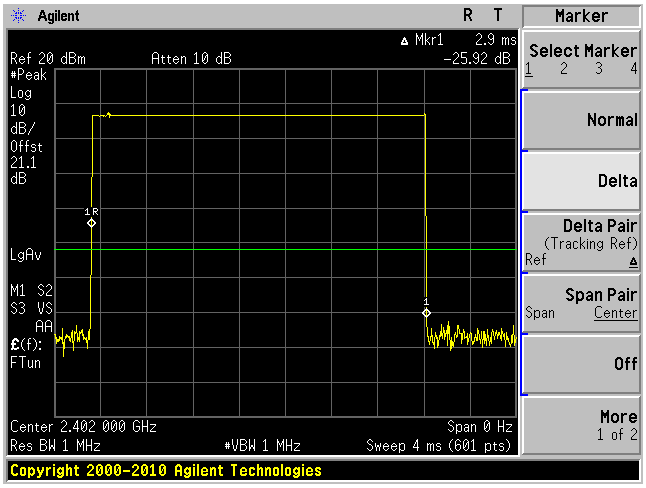


High Channel: 2480 MHz

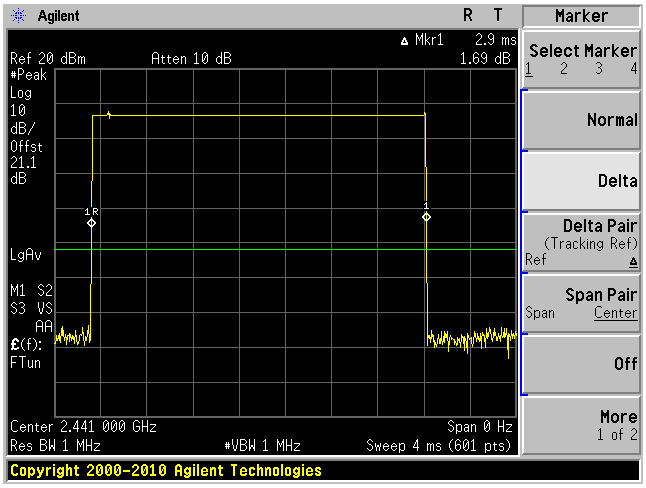


8PSK – DH5

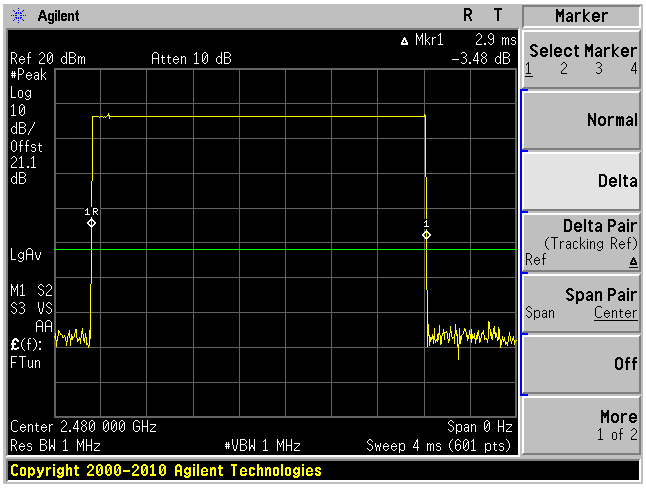
Low channel: 2402 MHz



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.

Table 2: General Field Strength Limits for Transmitters and Receivers at Frequencies above 30 MHz (Note)

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	100338	2012-09-19	1 year
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10	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:	23 °C
Relative Humidity:	49 %
ATM Pressure:	102.01 kPa

The testing was performed by Glenn Escano on 2013-03-27 at 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)**
-7.616	15900	Vertical/Horizontal (Noise Floor)	30–25000

15.8 Test Results

30 MHz -25 GHz, Measured at 3 meters

Receiving Mode

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)	
1070	37.92	0	100	V	25.0	1.88	27.07	37.740	74	-36.260	Peak *
1070	37.92	0	100	H	25.0	1.88	27.07	37.740	74	-36.260	Peak *
1070	24.13	0	100	V	25.0	1.88	27.07	23.950	54	-30.050	Ave *
1070	24.13	0	100	H	25.0	1.88	27.07	23.950	54	-30.050	Ave *
7800	38.95	0	100	V	36.4	5.40	27.5	53.314	74	-20.686	Peak *
7800	38.95	0	100	H	36.4	5.40	27.5	53.314	74	-20.686	Peak *
7800	25.07	0	100	V	36.4	5.40	27.5	39.434	54	-14.566	Ave *
7800	25.07	0	100	H	36.4	5.40	27.5	39.434	54	-14.566	Ave *
15900	41.21	0	100	V	37.9	7.71	26.06	60.774	74	-13.226	Peak *
15900	41.21	0	100	H	37.9	7.71	26.06	60.774	74	-13.226	Peak *
15900	26.82	0	100	V	37.9	7.71	26.06	46.384	54	-7.616	Ave *
15900	26.82	0	100	H	37.9	7.71	26.06	46.384	54	-7.616	Ave *

Note: * Noise Floor Level.

All 30 MHz–1 GHz spurious are digital related with 16.6 MHz SDIO clock, 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 (QP/Ave.)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
86.93625	25.38	QP	H	201	360	40	-14.62
41.05975	10.2	QP	H	151	118	40	-29.8
323.5553	29.87	QP	H	99	103	46	-16.13