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

TEST AND MEASUREMENT REPORT

For

FUJITSU COMPONENT LIMITED

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Shinagawa-ku, Tokyo 141-8630, Japan

FCC ID: SQK-MBH7BTZXXC2
IC: 337L-MBH7BTZXXC2

Report Type:	**Product Type:**
Original Report	Class 2 Bluetooth Module

Test Engineer:	Lionel Lara
Report Number:	R1206111-247
Report Date:	2012-06-28
Reviewed By:	Victor Zhang RF/EMC Lead

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1206111-247	Original Report	2012-06-28

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of FUJITSU COMPONENT LIMITED and their product, *model:* MBH7BTZ40 and MBH7BTZ52, *FCC ID: SQK-MBH7BTZXXC2, IC: 337L-MBH7BTZXXC2* or the "EUT" as referred to this report. The EUT is a class 2 Bluetooth module with two antenna types.

The EUT has family models (MBH7BTZ40, MBH7BTZ42, MBH7BTZ43, MBH7BTZ50, MBH7BTZ52, MBH7BTZ53) with different interface, the RF portions are identical (Except MBH7BTZ40 has a 0 dBi Chip antenna and MBH7BTZ52 has a 1.4 dBi Mono-pole antenna) please refer to the DOS attached for more detail information.

1.2 Mechanical Description of EUT

The EUT measures approximately 32 mm **(L)** x 15 mm **(W)** x 2.5 mm **(H)** and weighs approximately 1.27 g for model MBH7BTZ40 and 17.6 mm **(L)** x 14 mm **(W)** x 1.9 mm **(H)** and weighs approximately 0.62 g for model MBH7BTZ52.

The data gathered are from a typical production sample provided by the manufacturer with serial number: 004 for the conducted testing and serial numbers: 001, 003 for the radiated testing provided by the manufacture.

1.3 Objective

This report is prepared on behalf of FUJITSU COMPONENT LIMITED 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.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in 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 NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from +2.0 for Conducted Emissions tests and +4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

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 system was configured for testing in accordance with ANSI C63.4-2009.
The EUT was tested in the 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.

Radio Mode	Frequency (MHz)		
	Low Channel	Middle Channel	High Channel
Bluetooth	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.
Dell	Laptop	Latitude D600	CX-0X2034-48643-3A6-8307
Fujitsu Component Limited	BT SPP Module Evaluation Board	-	-

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
USB Cable	1	EUT	Laptop
Serial Cable	< 1	EUT	Supporting Board

2.8 Internal Parts List and Details

Manufacturers	Descriptions	Models	Serial Numbers
Fujitsu Component Limited	BT module	MBH7BTZ40	004 Rev. S3
Fujitsu Component Limited	BT module	MBH7BTZ40	003 Rev. S3
Fujitsu Component Limited	BT module	MBH7BTZ52	001 Rev. S1

3 Summary of Test Results

FCC & IC Rules	Description of Test	Result
FCC §15.247 (i), §2.1091 IC RSS-102	RF Exposure	Compliant
FCC §15.203 IC RSS-Gen §7.1.4	Antenna Requirements	Compliant
FCC §15.207 (a) IC RSS-Gen §7.2.2	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, §2.6, RSS-210 §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)(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
FCC §15.247(a) IC RSS-210 §A8.1	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	Band Edge	Compliant
IC RSS-Gen §6	Receiver Spurious Emission	Compliant

4 FCC §15.203 & IC RSS-Gen §7.1.4 – Antenna Requirements

4.1 Applicable Standard

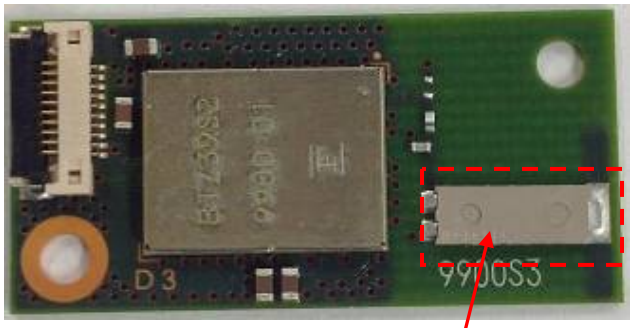
For intentional device, according to FCC Part §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

Per IC RSS-Gen §7.1.4, A transmitter can only be sold or operated with antennas with which it was certified. A transmitter maybe certified 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 certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. 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. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in IC RSS-210 or RSS-310 for devices of RF output powers of 10 milliwatts or less. For devices of output powers greater than 10 milliwatts, except devices subject to IC RSS-210 Annex 8 or RSS-210 Annex 9, the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to IC RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

4.2 Result

The EUT MBH7BTZ40 has maximum gain of 0 dBi chip antenna and EUT MBH7BTZ52 has maximum gain of 1.4 dBi mono-pole antenna, which in accordance to sections FCC Part 15.203 and IC RSS-Gen §7.1.4, is considered sufficient to comply with the provisions of these sections. Please refer to the EUT photos.



MBH7BTZ40, Chip Antenna

MBH7BTZ52, mono-pole Antenna

5 FCC §15.207 & RSS-Gen §7.2.2 - AC Line Conducted Emissions

5.1 Applicable Standards

As per FCC §15.207 & IC RSS-Gen §7.2.2 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 [1]	56 to 46 [1]
0.5-5	56	46
5-30	60	50

***Note* [1]:** *Decreases with the logarithm of the frequency.*

5.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2009 measurement procedure. The specification used was FCC Part15.207 and IC RSS-Gen limits.

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

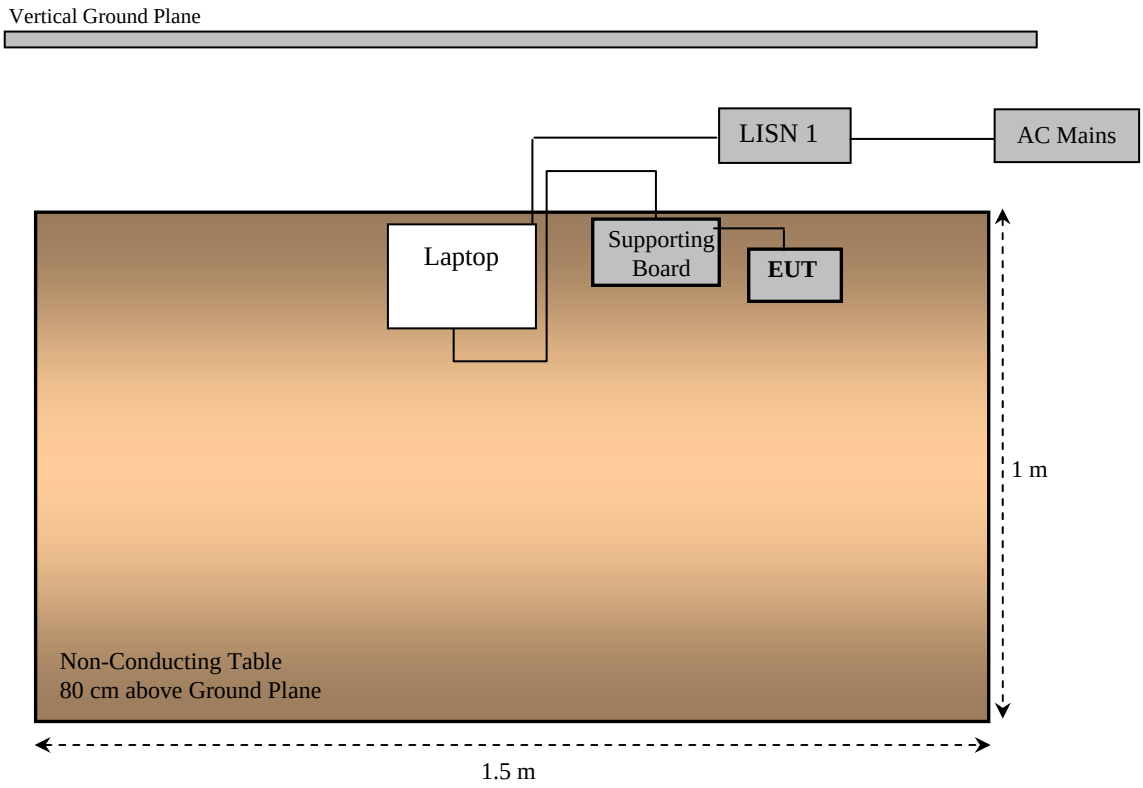
The AC/DC power adapter of the host PC was connected with LISN-1 which provided 120 V/60 Hz AC power.

5.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2012-03-22
Solar Electronics	LISN	9252-R-24-BNC	511205	2011-06-25
TTE	High Pass Filter	H985-150K-50-720N	M1149	2012-05-30

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

5.4 Test Setup Block Diagram



5.5 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".

5.6 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	60 %
ATM Pressure:	101.3kPa

The testing was performed by Lionel Lara on 2012-06-14 in 5 meter chamber 3.

5.7 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Cable Loss, and Attenuator Factor adding to the Indicated Reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Cable Loss + Attenuator Factor

For example, a Corrected Amplitude of 34.07 dBuV = Indicated Reading (23.85 dBuV) + Cable Factor (0.22 dB) + Attenuator Factor (10 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

5.8 Summary of Test Results

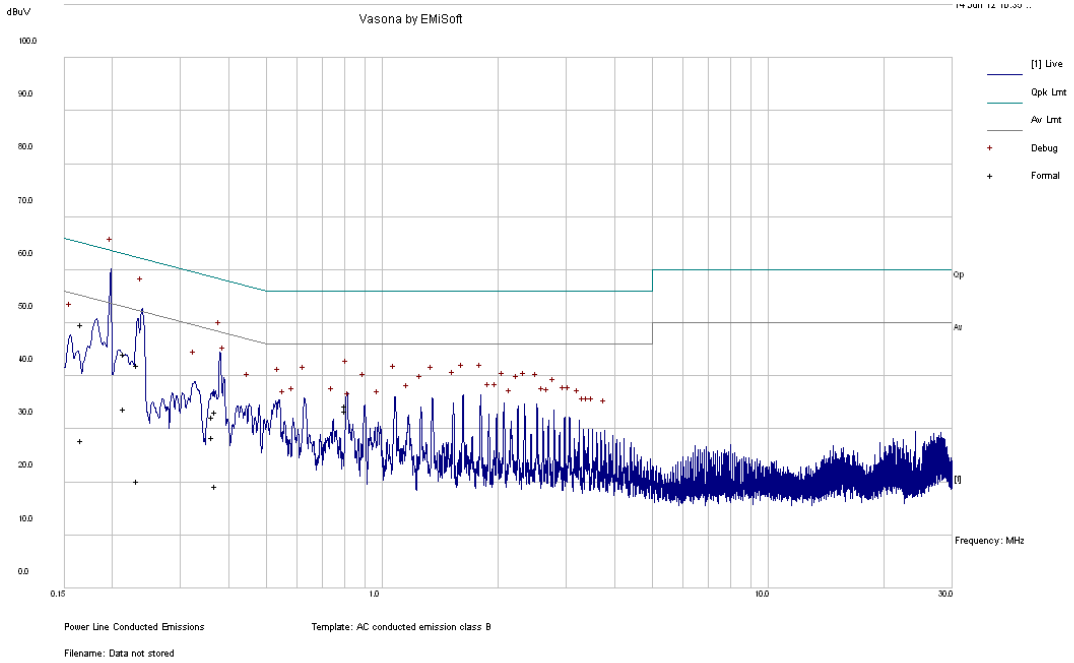
According to the recorded data in following table, the EUT complied with the FCC/IC standard's conducted emissions limits, with the margin reading of:

Connection: Laptop connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-12.66	0.807558	Line	0.15 to 30

5.9 Conducted Emissions Test Plots and Data

Modulation: 8DPSK, Low Channel

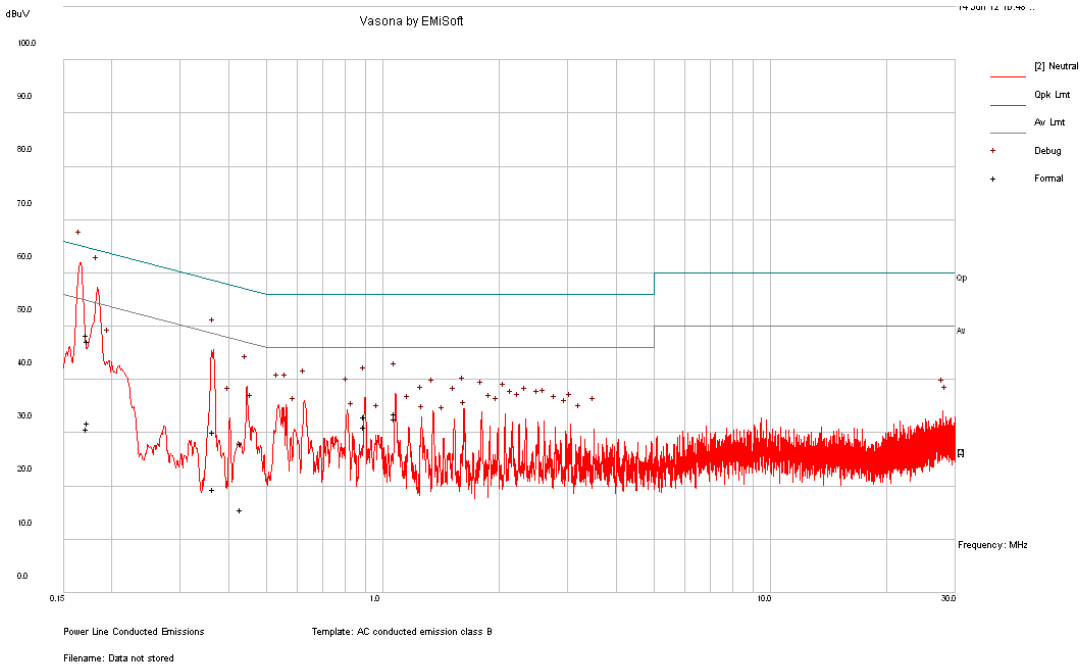
120V/60 Hz Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.16629	49.65	Quasi-Peak	L	65.14	-15.49
0.215094	44.26	Quasi-Peak	L	63.01	-18.74
0.232821	42.06	Quasi-Peak	L	62.35	-20.29
0.807558	34.41	Quasi-Peak	L	56.00	-21.59
0.370974	33.31	Quasi-Peak	L	58.48	-25.17
0.363408	32.2	Quasi-Peak	L	58.65	-26.45

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.807558	33.34	Average	L	46.00	-12.66
0.215094	33.76	Average	L	53.01	-19.24
0.363408	28.51	Average	L	48.65	-20.14
0.16629	27.81	Average	L	55.14	-27.33
0.370974	19.27	Average	L	48.48	-29.21
0.232821	20.3	Average	L	52.35	-32.04

120V/60 Hz Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.172986	48.41	Quasi-Peak	N	64.82	-16.4
0.173475	47.28	Quasi-Peak	N	64.79	-17.51
1.078572	33.6	Quasi-Peak	N	56	-22.4
0.896862	33.04	Quasi-Peak	N	56	-22.96
0.365919	30.15	Quasi-Peak	N	58.59	-28.45
0.431955	28.1	Quasi-Peak	N	57.22	-29.12

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (L/N)	Limit (dBuV)	Margin (dB)
1.078572	32.73	Average	N	46	-13.27
0.896862	31.1	Average	N	46	-14.9
0.173475	31.99	Average	N	54.79	-22.8
0.172986	30.78	Average	N	54.82	-24.03
0.365919	19.4	Average	N	48.59	-29.19
0.431955	15.59	Average	N	47.22	-31.63

6 FCC §15.205, §15.209, §15.247(d) & IC RSS-210 §2.2, §2.6, §A8.5 – Spurious Radiated Emissions

6.1 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**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

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

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.

6.2 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.

6.3 Test Procedure

For the radiated emissions test, the EUT 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 meters away from the testing antenna, which is varied from 1-4 meters, 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

6.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Cable Loss, and Attenuator Factor adding to the Indicated Reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Cable Loss + Attenuator Factor

For example, a Corrected Amplitude of 34.08 dBuV/m = Indicated Reading (23.85 dBuV) + Cable Factor (0.22 dB) + Attenuator Factor (10dB)

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

6.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
A.H Systems	Horn Antenna	SAS-200/571	261	2012-01-18
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2012-06-09
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2011-08-10
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2012-03-22
Sunol Science Corp	System Controller	SC99V	122303-1	N/R

Note 1: Two year calibration cycle.

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

6.6 Test Environmental Conditions

Temperature:	21-22 °C
Relative Humidity:	56-60 %
ATM Pressure:	101.6-101.8kPa

The testing was performed by Lionel Lara on 2012-06-12 to 2012-06-13 in 5 meter chamber 3.

6.7 Summary of Test Results

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

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-11.93	167.9895	Horizontal	High, 30 MHz–1 GHz

Above 1 GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-7.10	2483.56	Horizontal	High, 1– 25 GHz

6.8 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz, Radiated Spurious Emissions Measured at 3 meters

Chip Antenna

Frequency (MHz)	Corrected Amplitude (dB)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
8DPSK, Low Channel (2402 MHz)							
252.0295	33.8	116	H	0	46	-12.2	Quasi-Peak
167.972	30.15	114	H	121	43.5	-13.35	Quasi-Peak
240.0325	29.14	118	H	360	46	-16.86	Quasi-Peak
8DPSK, Middle Channel (2441 MHz)							
167.9893	31.47	201	H	111	43.5	-12.03	Quasi-Peak
252.046	33.81	115	H	11	46	-12.19	Quasi-Peak
135.3565	27.56	236	H	121	43.5	-15.94	Quasi-Peak
8DPSK, High Channel (2480 MHz)							
252.1645	33.2	99	H	11	46	-12.8	Quasi-Peak
167.9895	31.57	150	H	119	43.5	-11.93	Quasi-Peak
135.3485	28.05	198	H	320	43.5	-15.45	Quasi-Peak

Mono-pole Antenna

Frequency (MHz)	Corrected Amplitude (dB)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
8DPSK, Low Channel (2402 MHz)							
167.881	27.24	292	H	292	43.5	-16.26	Quasi-Peak
135.321	29.04	270	H	270	43.5	-14.46	Quasi-Peak
240.0245	28.76	122	H	122	46	-17.24	Quasi-Peak
8DPSK, Middle Channel (2441 MHz)							
167.847	27.91	127	H	90	43.5	-15.59	Quasi-Peak
135.34	30.66	165	H	120	43.5	-12.84	Quasi-Peak
240.0033	29.32	125	H	27	46	-16.68	Quasi-Peak
8DPSK, High Channel (2480 MHz)							
168.18	27.99	158	H	314	43.5	-15.51	Quasi-Peak
132.3028	14.46	194	H	329	43.5	-29.04	Quasi-Peak
240.1098	29.25	110	H	20	46	-16.75	Quasi-Peak

2) 1 – 25 GHz, Radiated Spurious Emissions Measured at 3 meters

Chip Antenna

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)	
8DPSK, Low Channel (2402 MHz)											
2402	69.52	302	100	H	28.36	3.12	0	101	Fund	-	Peak
2402	64.06	146	100	V	28.53	3.12	0	95.71	Fund	-	Peak
2402	31.66	302	100	H	28.36	3.12	0	63.14	Fund	-	Ave
2402	29.55	146	100	V	28.53	3.12	0	61.2	Fund	-	Ave
4804	45.24	321	101	H	33.47	4.56	27.78	55.49	74	-18.51	Peak
4804	43.56	163	100	V	33.59	4.56	27.78	53.93	74	-20.07	Peak
4804	28.47	321	101	H	33.47	4.56	27.78	38.72	54	-15.28	Ave
4804	28.32	163	100	V	33.59	4.56	27.78	38.69	54	-15.31	Ave
7206	39.58	0	100	H	38.5	5.49	27.59	55.98	74	-18.02	Peak
7206	39.58	0	100	V	38.65	5.49	27.59	56.13	74	-17.87	Peak
7206	25.76	0	100	H	38.5	5.49	27.59	42.16	54	-11.84	Ave
7206	25.76	0	100	V	38.65	5.49	27.59	42.31	54	-11.69	Ave
9608	39.47	0	100	H	38.54	6.54	27.05	57.5	74	-16.5	Peak
9608	39.47	0	100	V	38.54	6.54	27.05	57.5	74	-16.5	Peak
9608	24.48	0	100	H	38.54	6.54	27.05	42.51	54	-11.49	Ave
9608	24.48	0	100	V	38.54	6.54	27.05	42.51	54	-11.49	Ave
8DPSK, Middle Channel (2441 MHz)											
2441	68.4	302	100	H	28.36	3.12	0	99.88	Fund	-	Peak
2441	63.12	146	100	V	28.53	3.12	0	94.77	Fund	-	Peak
2441	30.87	302	100	H	28.36	3.12	0	62.35	Fund	-	Ave
2441	28.66	146	100	V	28.53	3.12	0	60.31	Fund	-	Ave
4882	43.25	315	100	H	33.57	4.54	27.67	53.69	74	-20.31	Peak
4882	41.77	160	100	V	33.59	4.54	27.67	52.23	74	-21.77	Peak
4882	27.45	315	100	H	33.57	4.54	27.67	37.89	54	-16.11	Ave
4882	26.59	160	100	V	33.59	4.54	27.67	37.05	54	-16.95	Ave
7323	40.14	0	100	H	38.27	5.57	27.59	56.39	74	-17.61	Peak
7323	40.14	0	100	V	38.33	5.57	27.59	56.45	74	-17.55	Peak
7323	25.92	0	100	H	38.27	5.57	27.59	42.17	54	-11.83	Ave
7323	25.92	0	100	V	38.33	5.57	27.59	42.23	54	-11.77	Ave
9764	39.34	0	100	H	38.23	6.58	26.98	57.17	74	-16.83	Peak
9764	39.34	0	100	V	38.15	6.58	26.98	57.09	74	-16.91	Peak
9764	24.4	0	100	H	38.23	6.58	26.98	42.23	54	-11.77	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)	
8DPSK, High Channel (2480 MHz)											
2480	66.99	305	100	H	29.12	3.35	0	99.46	Fund	-	Peak
2480	60.98	92	100	V	29.12	3.35	0	93.45	Fund	-	Peak
2480	37.09	305	100	H	29.12	3.35	0	69.56	Fund	-	Ave
2480	28.68	92	100	V	29.12	3.35	0	61.15	Fund	-	Ave
4960	40.68	315	100	H	33.95	4.52	27.7	51.45	74	-22.55	Peak
4960	39.91	0	100	V	33.91	4.52	27.7	50.64	74	-23.36	Peak
4960	24.63	315	100	H	33.95	4.52	27.7	35.4	54	-18.6	Ave
4960	24.36	0	100	V	33.91	4.52	27.7	35.09	54	-18.91	Ave
7440	40.58	0	100	H	38.2	5.66	27.53	56.91	74	-17.09	Peak
7440	40.58	0	100	V	38.28	5.66	27.53	56.99	74	-17.01	Peak
7440	25.96	0	100	H	38.2	5.66	27.53	42.29	54	-11.71	Ave
7440	25.96	0	100	V	38.28	5.66	27.53	42.37	54	-11.63	Ave
9920	39.79	0	100	H	38	6.67	27.01	57.45	74	-16.55	Peak
9920	39.79	0	100	V	37.9	6.67	27.01	57.35	74	-16.65	Peak
9920	24.1	0	100	H	38	6.67	27.01	41.76	54	-12.24	Ave
9920	24.1	0	100	V	37.9	6.67	27.01	41.66	54	-12.34	Ave

Mono-pole Antenna

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)	
8DPSK, Low Channel (2402 MHz)											
2402	64.62	40	100	H	28.36	3.12	0	96.1	Fund	-	Peak
2402	65.28	184	118	V	28.53	3.12	0	96.93	Fund	-	Peak
2402	29.94	40	100	H	28.36	3.12	0	61.42	Fund	-	Ave
2402	30.35	184	118	V	28.53	3.12	0	62	Fund	-	Ave
4804	46.19	315	132	H	33.47	4.56	27.78	56.44	74	-17.56	Peak
4804	41.79	31	100	V	33.59	4.56	27.78	52.16	74	-21.84	Peak
4804	27.95	315	132	H	33.47	4.56	27.78	38.2	54	-15.8	Ave
4804	26.19	100	31	V	33.59	4.56	27.78	36.56	54	-17.44	Ave
7206	39.9	0	100	H	38.5	5.49	27.59	56.3	74	-17.7	Peak
7206	39.9	0	100	V	38.65	5.49	27.59	56.45	74	-17.55	Peak
7206	25.8	0	100	H	38.5	5.49	27.59	42.2	54	-11.8	Ave
7206	25.8	0	100	V	38.65	5.49	27.59	42.35	54	-11.65	Ave
9608	39.41	0	100	H	38.54	6.54	27.05	57.44	74	-16.56	Peak
9608	39.41	0	100	V	38.54	6.54	27.05	57.44	74	-16.56	Peak
9608	24.96	0	100	H	38.54	6.54	27.05	42.99	54	-11.01	Ave
9608	24.96	0	100	V	38.54	6.54	27.05	42.99	54	-11.01	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)	
8DPSK, Middle Channel (2441 MHz)											
2441	64.3	40	100	H	28.36	3.12	0	95.78	Fund	-	Peak
2441	64.53	184	118	V	28.53	3.12	0	96.18	Fund	-	Peak
2441	30.08	40	100	H	28.36	3.12	0	61.56	Fund	-	Ave
2441	30.15	184	118	V	28.53	3.12	0	61.8	Fund	-	Ave
4882	44.64	314	100	H	33.57	4.54	27.67	55.08	74	-18.92	Peak
4882	42.7	136	101	V	33.59	4.54	27.67	53.16	74	-20.84	Peak
4882	26.87	314	100	H	33.57	4.54	27.67	37.31	54	-16.69	Ave
4882	25.88	136	101	V	33.59	4.54	27.67	36.34	54	-17.66	Ave
7323	40.69	0	100	H	38.27	5.57	27.59	56.94	74	-17.06	Peak
7323	40.69	0	100	V	38.33	5.57	27.59	57	74	-17	Peak
7323	25.9	0	100	H	38.27	5.57	27.59	42.15	54	-11.85	Ave
7323	25.9	0	100	V	38.33	5.57	27.59	42.21	54	-11.79	Ave
9764	38.76	0	100	H	38.23	6.58	26.98	56.59	74	-17.41	Peak
9764	38.76	0	100	V	38.15	6.58	26.98	56.51	74	-17.49	Peak
9764	24.39	0	100	H	38.23	6.58	26.98	42.22	54	-11.78	Ave
9764	24.39	0	100	V	38.15	6.58	26.98	42.14	54	-11.86	Ave
8DPSK, High Channel (2480 MHz)											
2480	64.32	130	100	H	29.12	3.35	0	96.79	Fund	-	Peak
2480	62.71	175	100	V	29.12	3.35	0	95.18	Fund	-	Peak
2480	30.16	130	100	H	29.12	3.35	0	62.63	Fund	-	Ave
2480	29.33	175	100	V	29.12	3.35	0	61.8	Fund	-	Ave
4960	43.91	315	100	H	33.95	4.52	27.7	54.68	74	-19.32	Peak
4960	43.77	286	100	V	33.91	4.52	27.7	54.5	74	-19.5	Peak
4960	26.29	315	100	H	33.95	4.52	27.7	37.06	54	-16.94	Ave
4960	26.18	286	100	V	33.91	4.52	27.7	36.91	54	-17.09	Ave
7440	40.94	0	100	H	38.2	5.66	27.53	57.27	74	-16.73	Peak
7440	40.94	0	100	V	38.28	5.66	27.53	57.35	74	-16.65	Peak
7440	25.9	0	100	H	38.2	5.66	27.53	42.23	54	-11.77	Ave
7440	25.9	0	100	V	38.28	5.66	27.53	42.31	54	-11.69	Ave
9920	39.51	0	100	H	38	6.67	27.01	57.17	74	-16.83	Peak
9920	39.51	0	100	V	37.9	6.67	27.01	57.07	74	-16.93	Peak
9920	24.1	0	100	H	38	6.67	27.01	41.76	54	-12.24	Ave
9920	24.1	0	100	V	37.9	6.67	27.01	41.66	54	-12.34	Ave

3) Spurious Emissions in Restricted Band

Chip Antenna, 8DPSK

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)	
(Near Band Edge) Lowest Channel											
2386	27.37	302	100	H	28.36	3.12	0	58.85	74	-15.15	Peak
2356.4	26.6	146	100	V	28.53	3.12	0	58.25	74	-15.75	Peak
2386	12.58	302	100	H	28.36	3.12	0	44.06	54	-9.94	Ave
2356.4	12.24	146	100	V	28.53	3.12	0	43.89	54	-10.11	Ave
(Near Band Edge): Highest Channel											
2483.56	31.73	305	100	H	29.12	3.35	0	64.2	74	-9.8	Peak
2483.53	28.07	92	100	V	29.12	3.35	0	60.54	74	-13.46	Peak
2483.56	14.43	305	100	H	29.12	3.35	0	46.9	54	-7.1	Ave
2483.53	13.23	92	100	V	29.12	3.35	0	45.7	54	-8.3	Ave

Mono-pole Antenna, 8DPSK

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)	
(Near Band Edge) Lowest Channel											
2379.6	26.89	40	100	H	28.36	3.12	0	58.37	74	-15.63	Peak
2362	26.89	184	118	V	28.53	3.12	0	58.54	74	-15.46	Peak
2379.6	12.29	40	100	H	28.36	3.12	0	43.77	54	-10.23	Ave
2362	12.3	184	118	V	28.53	3.12	0	43.95	54	-10.05	Ave
(Near Band Edge): Highest Channel											
2483.5	30.36	130	100	H	29.12	3.35	0	62.83	74	-11.17	Peak
2483.56	28.8	175	100	V	29.12	3.35	0	61.27	74	-12.73	Peak
2483.5	13.95	130	100	H	29.12	3.35	0	46.42	54	-7.58	Ave
2483.56	13.54	175	100	V	29.12	3.35	0	46.01	54	-7.99	Ave

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

7.1 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.

7.2 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.

7.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]

Note 1: Two year calibration cycle.

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:	23 °C
Relative Humidity:	58 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-06-11 at RF test site.

7.5 Test Results

Modulation: GFSK

Channel	Frequency (MHz)	20 dB Channel Bandwidth (kHz)
Low	2402	838.307
Mid	2441	833.369
High	2480	831.928

Modulation: DQPSK

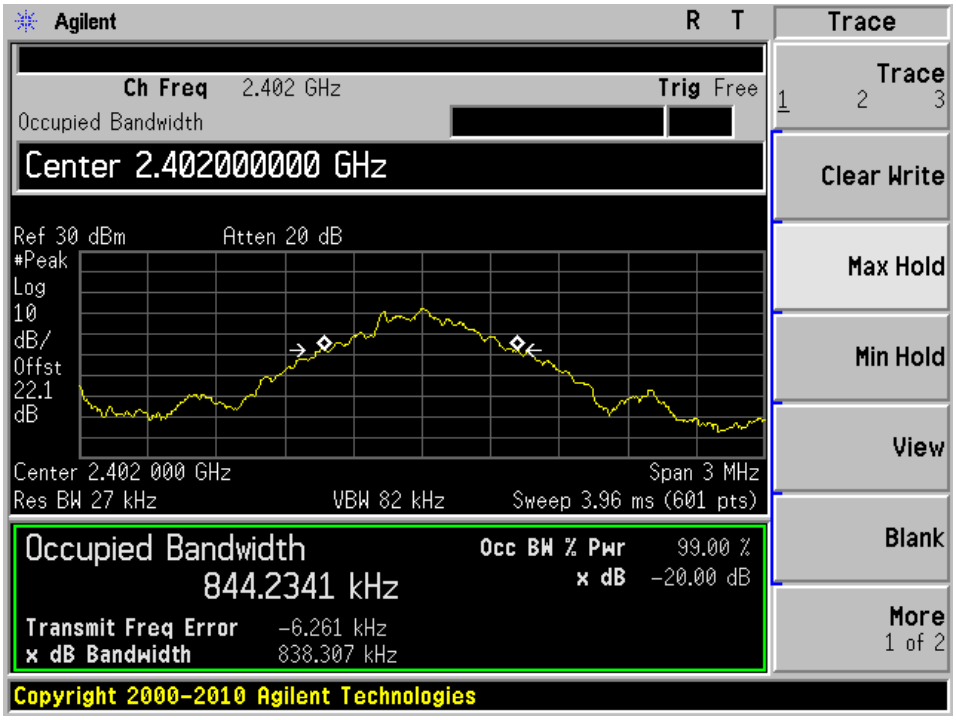
Channel	Frequency (MHz)	20 dB Channel Bandwidth (kHz)
Low	2402	1254
Mid	2441	1250
High	2480	1219

Modulation: 8DPSK

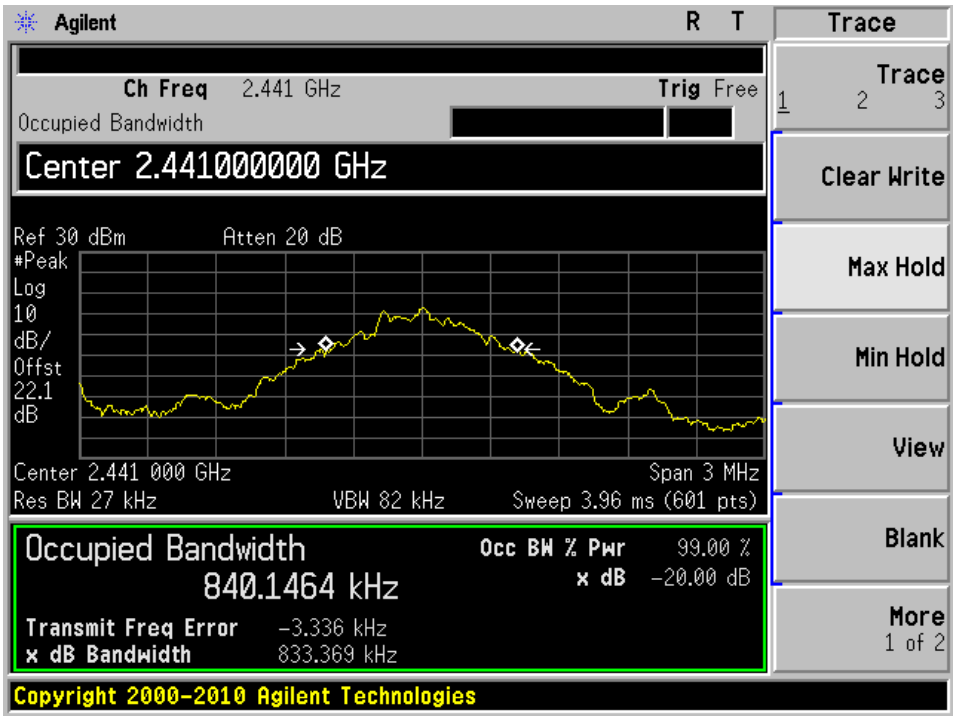
Channel	Frequency (MHz)	20 dB Channel Bandwidth (kHz)
Low	2402	1215
Mid	2441	1217
High	2480	1210

Please refer to the following plots.

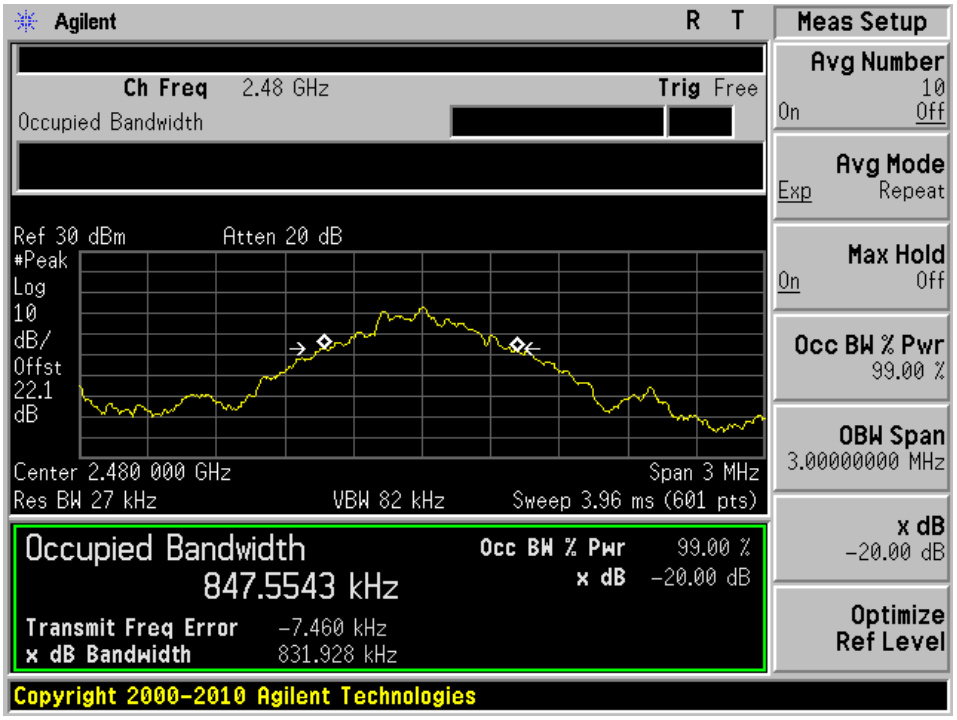
GFSK - Low Channel



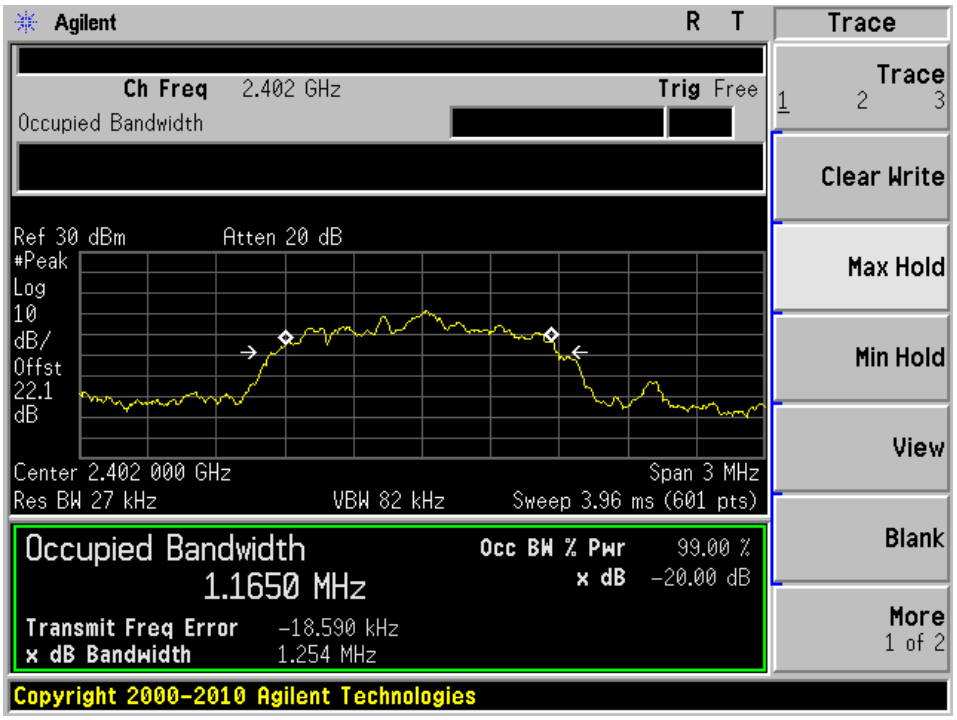
GFSK - Middle Channel



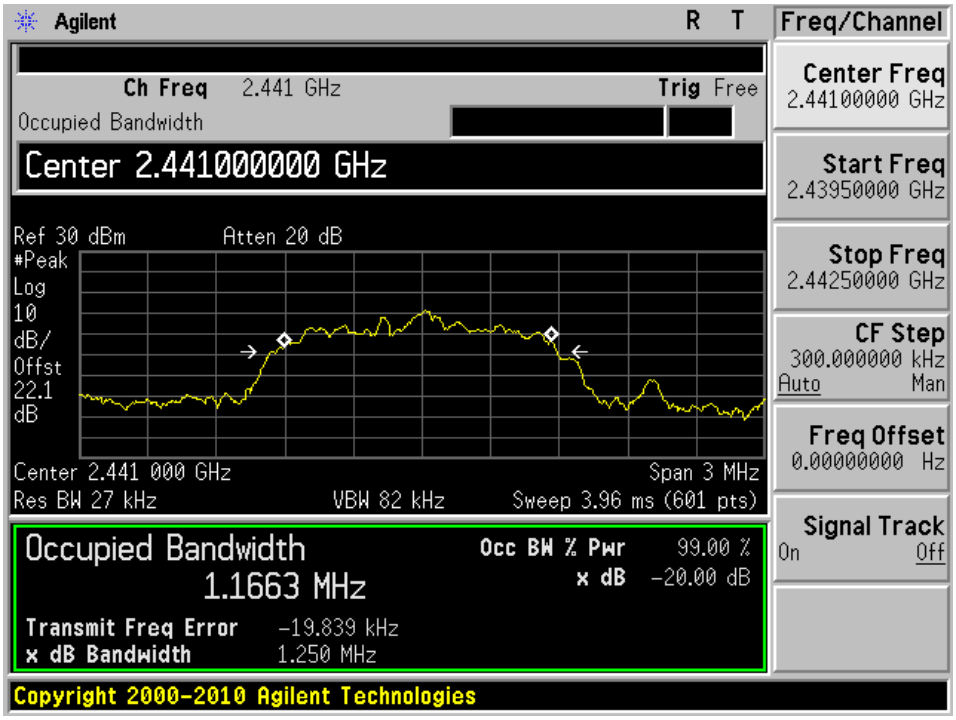
GFSK - High Channel



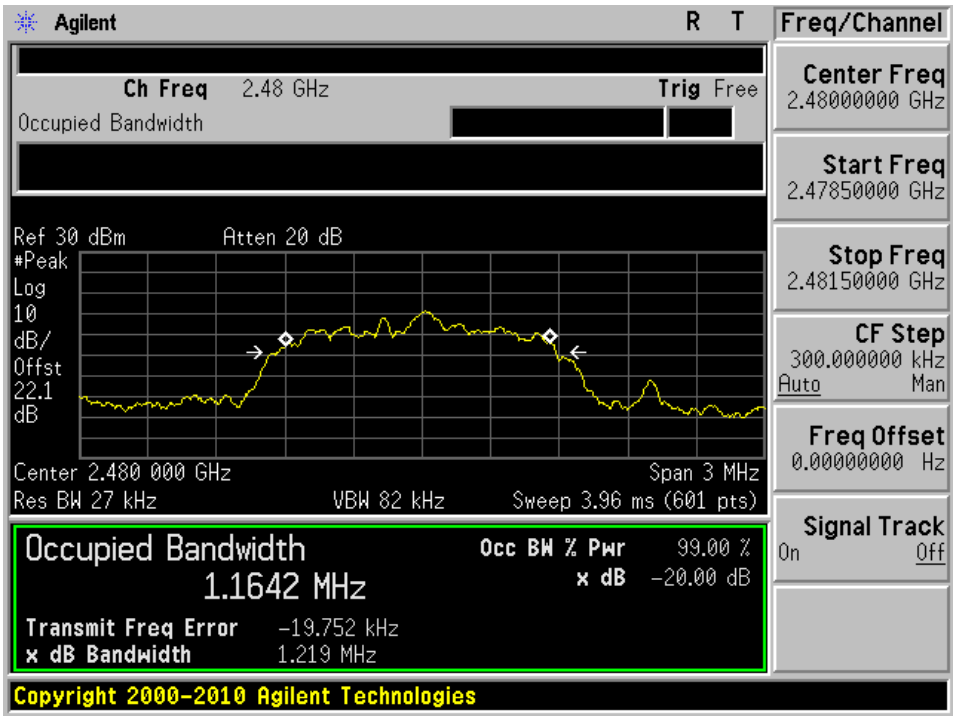
DQPSK - Low Channel



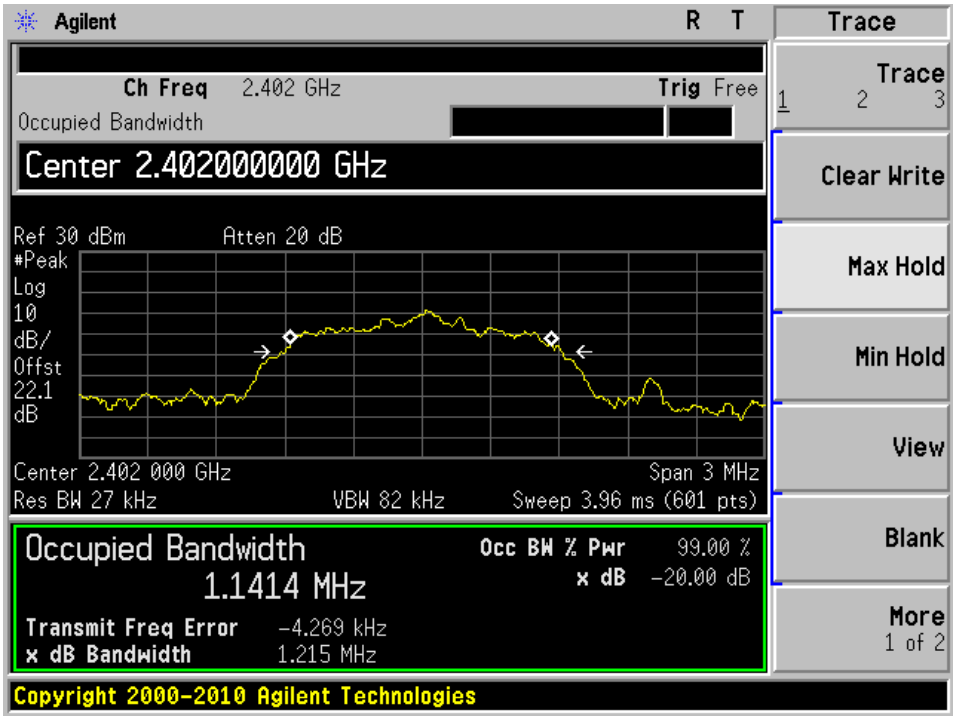
DQPSK - Middle Channel



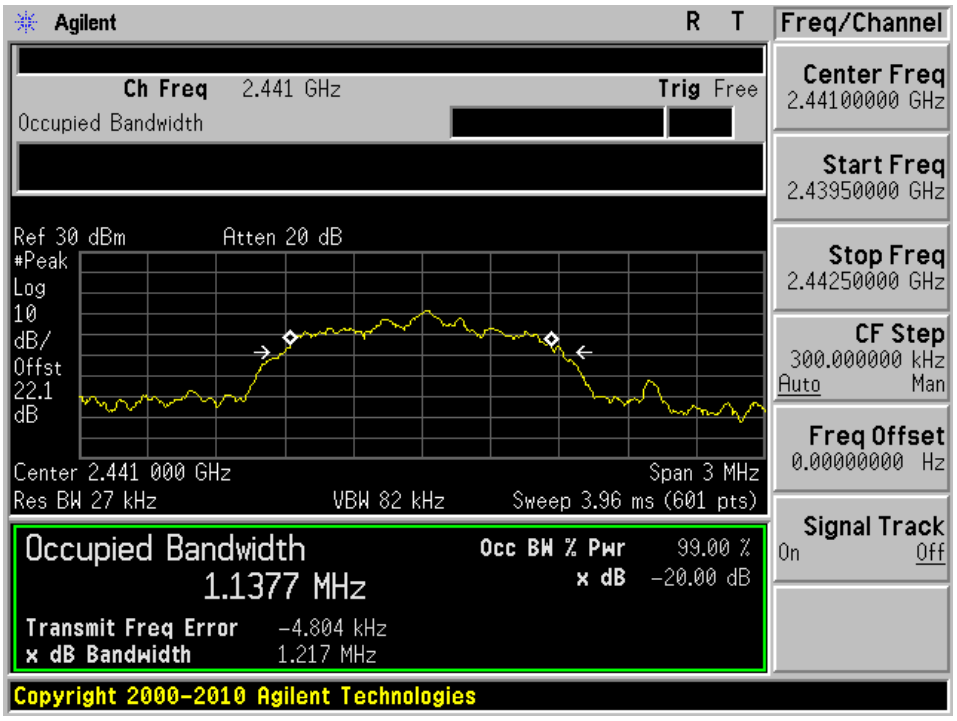
DQPSK - High Channel



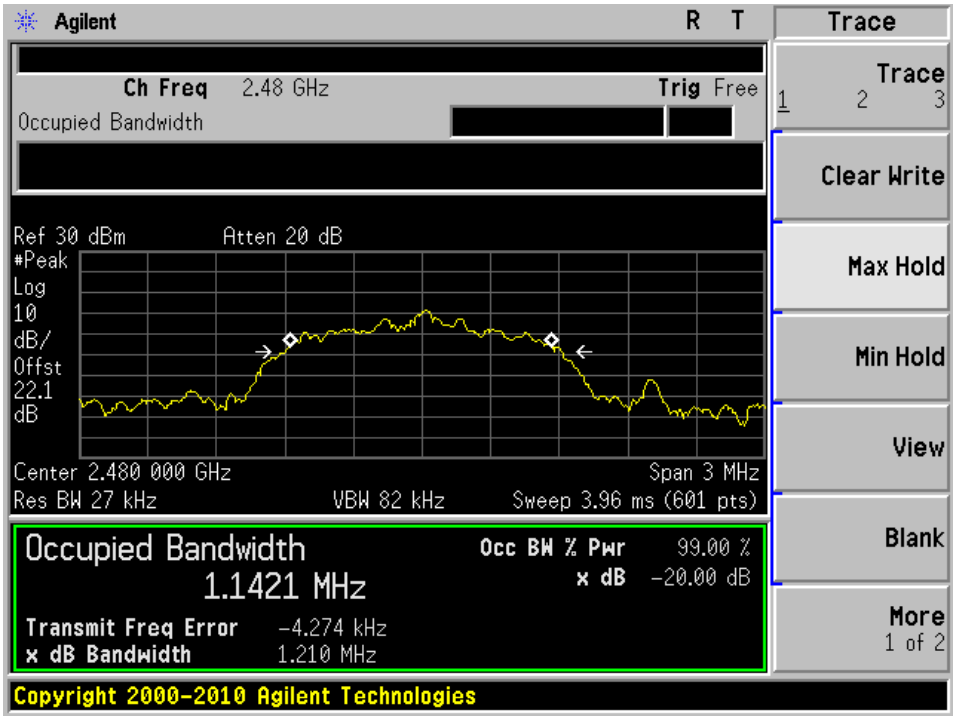
8DPSK - Low Channel



8DPSK - Middle Channel



8DPSK - High Channel



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

8.1 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.

8.2 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.

8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]

Note 1: Two year calibration cycle.

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

8.4 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	58 %
ATM Pressure:	101.5kPa

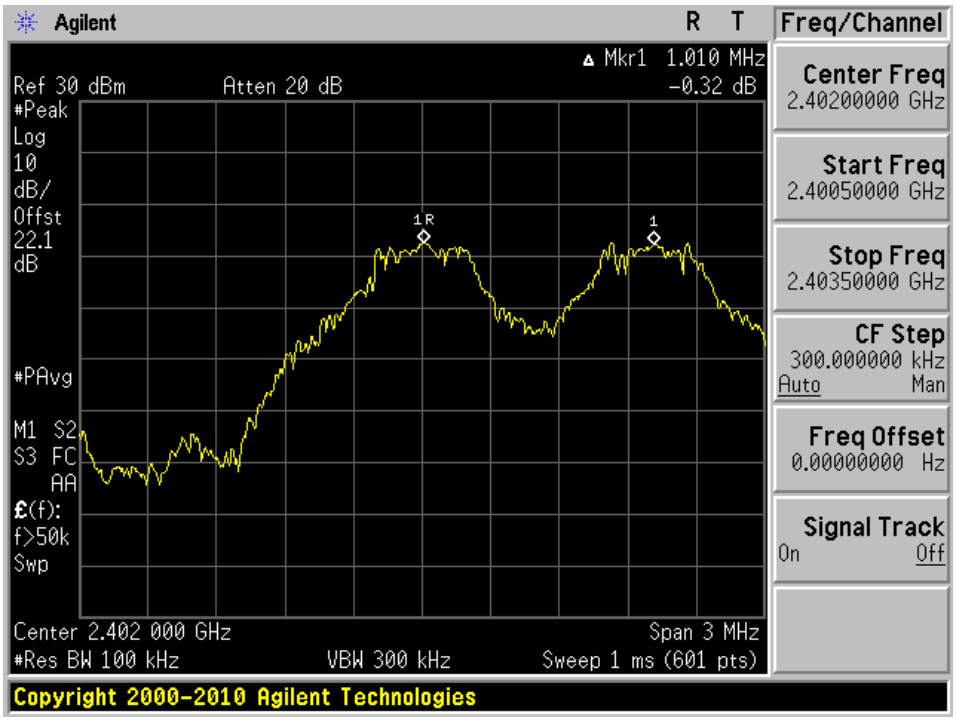
The testing was performed by Lionel Lara on 2012-06-11 at RF test site.

8.5 Test Results

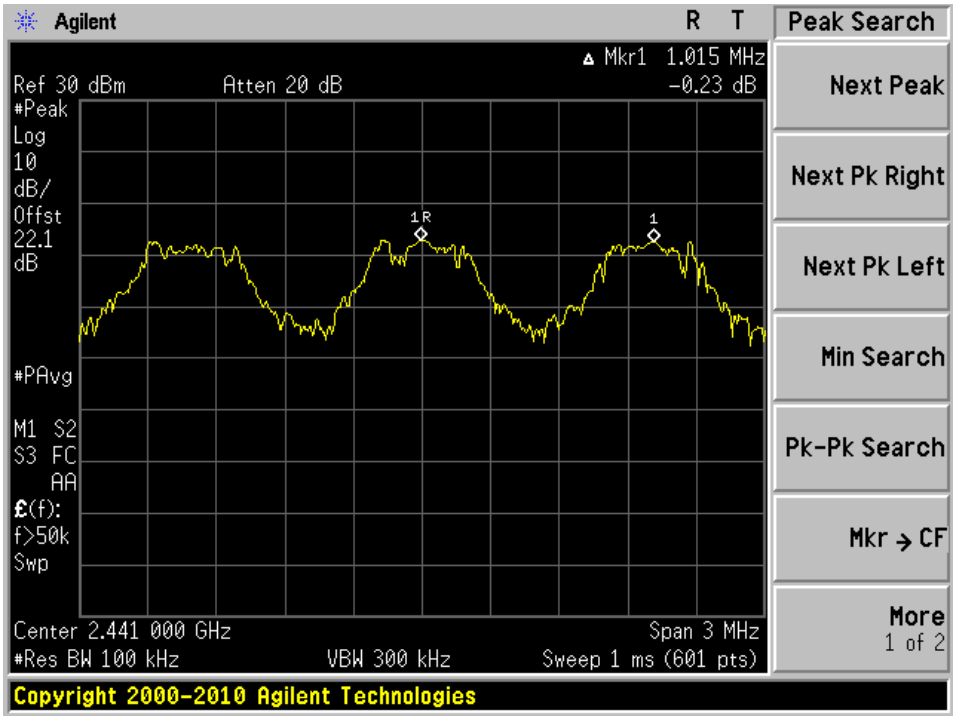
Channel	Frequency (MHz)	Channel Separation (kHz)	GFSK Limit > 2/3 20 dB BW (kHz)
Low	2402	1010	558.87
Mid	2441	1015	555.58
High	2480	1005	554.62

Please refer to the following plots.

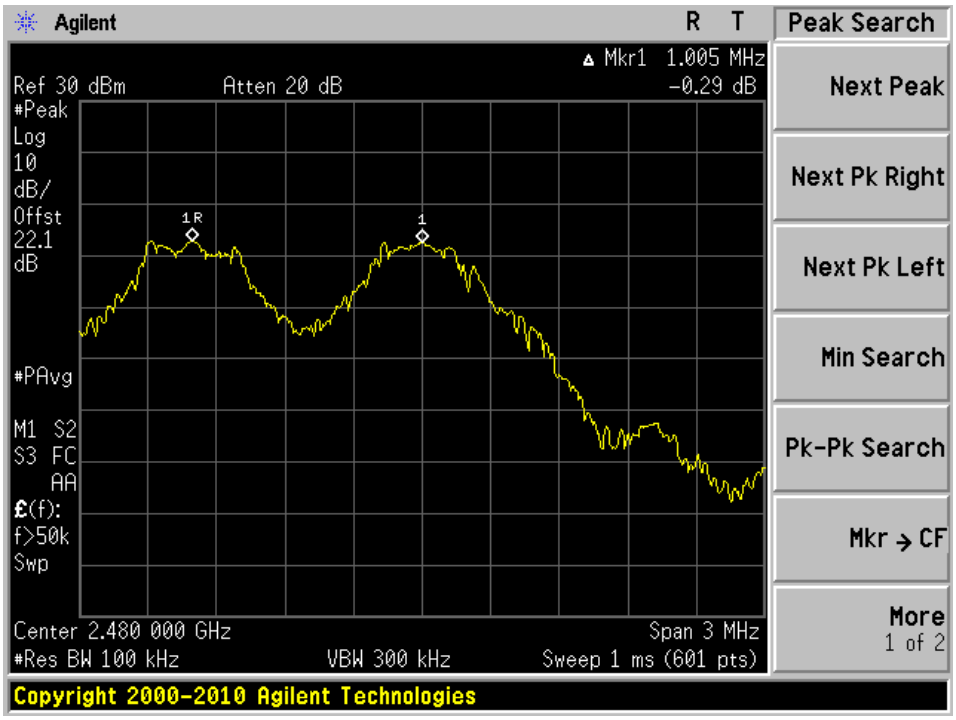
Low Channel



Middle Channel



High Channel



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

9.1 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.

9.2 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.

9.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]

Note 1: Two year calibration cycle.

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

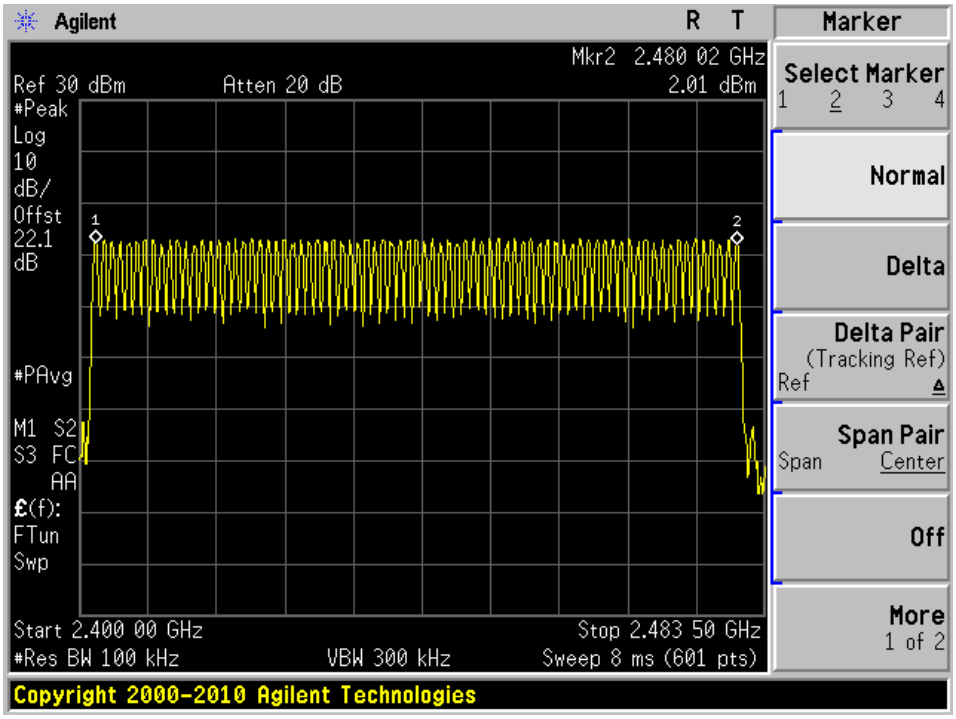
Temperature:	23 °C
Relative Humidity:	58 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-06-11 at RF test site.

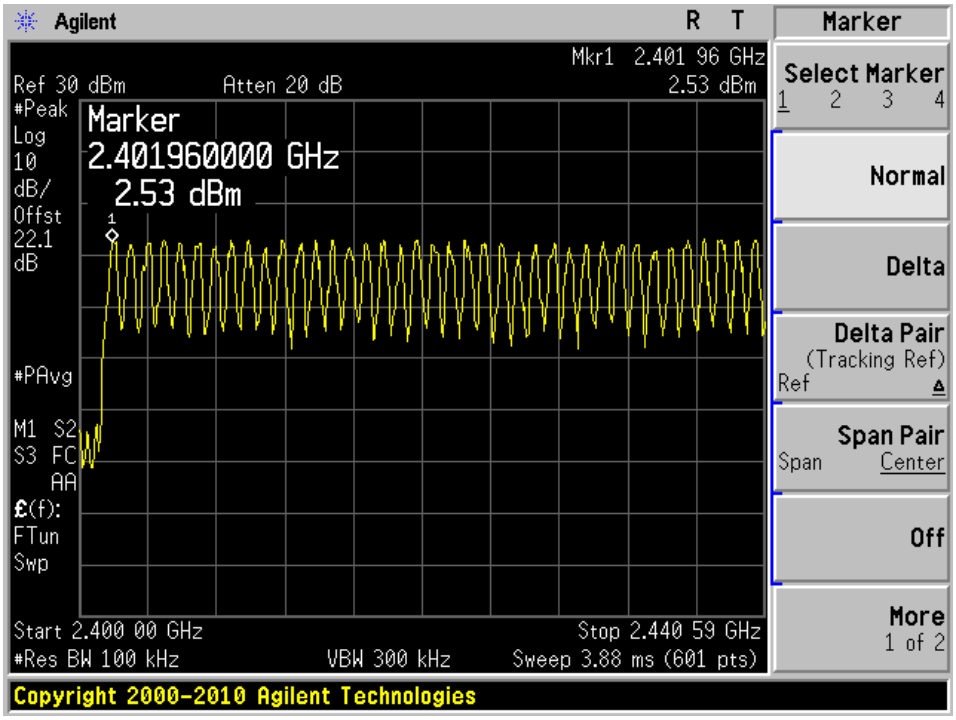
9.5 Test Results

Total 79 channels; please refer to the plots hereinafter.

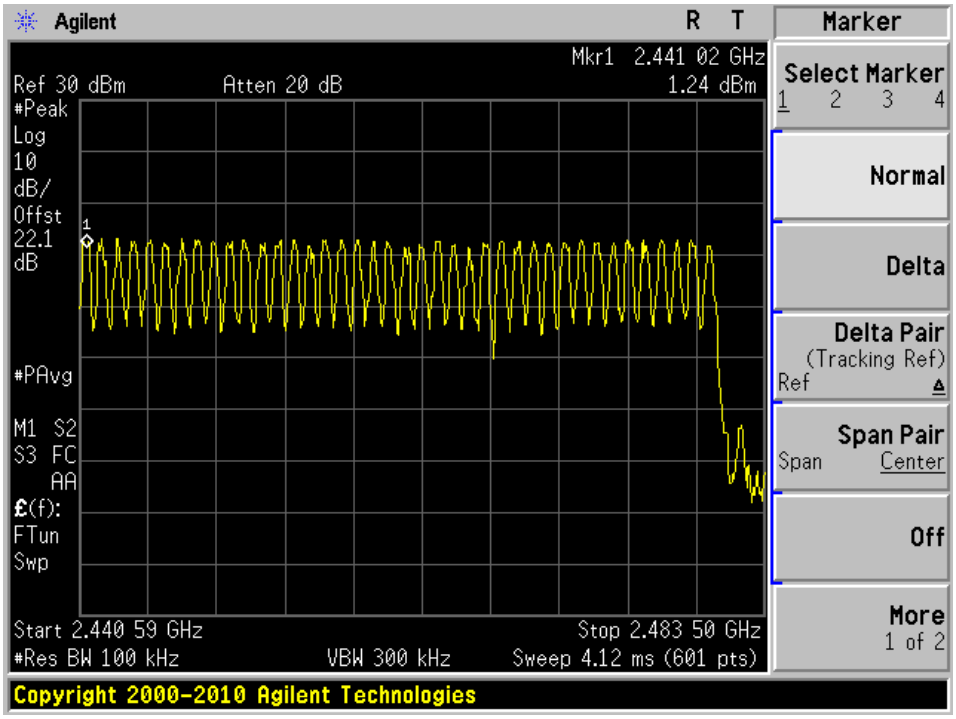
Hopping Channel Number: Total 79 Channels



39 Channels between 2400 to 2440.59 MHz



40 Channels between 2440.59 to 2483.5 MHz



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

10.1 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.

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 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.

10.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]

Note 1: Two year calibration cycle.

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:	23 °C
Relative Humidity:	58 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-06-11 at RF test site.

10.5 Test Results

GFSK, DH1: Packet Size = 27 byte

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	0.412	0.132	0.4	Pass
Mid	0.412	0.132	0.4	Pass
High	0.412	0.132	0.4	Pass

Note: Dwell time = Pulse time*(1600/2/79)*31.6S

GFSK, DH3: Packet Size = 183 bytes

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	1.674	0.268	0.4	Pass
Mid	1.674	0.268	0.4	Pass
High	1.679	0.268	0.4	Pass

Note: Dwell time = Pulse time*(1600/4/79)*31.6S

GFSK, DH5: Packet Size = 339 bytes

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	2.923	0.312	0.4	Pass
Mid	2.923	0.312	0.4	Pass
High	2.923	0.312	0.4	Pass

Note: Dwell time = Pulse time*(1600/6/79)*31.6S

DQPSK, DH1: Packet Size = 27 byte

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	0.432	0.138	0.4	Pass
Mid	0.432	0.138	0.4	Pass
High	0.432	0.138	0.4	Pass

Note: Dwell time = Pulse time*(1600/2/79)*31.6S

DQPSK, DH3: Packet Size = 183 bytes

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	1.693	0.271	0.4	Pass
Mid	1.691	0.271	0.4	Pass
High	1.684	0.270	0.4	Pass

Note: Dwell time = Pulse time*(1600/4/79)*31.6S

DQPSK, DH5: Packet Size = 339 bytes

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	2.938	0.313	0.4	Pass
Mid	2.938	0.313	0.4	Pass
High	2.938	0.313	0.4	Pass

Note: Dwell time = Pulse time*(1600/6/79)*31.6S

8DPSK, DH1: Packet Size = 27 byte

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	0.430	0.138	0.4	Pass
Mid	0.432	0.138	0.4	Pass
High	0.432	0.138	0.4	Pass

Note: Dwell time = Pulse time*(1600/2/79)*31.6S

8DPSK, DH3: Packet Size = 183 bytes

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	1.679	0.268	0.4	Pass
Mid	1.684	0.269	0.4	Pass
High	1.684	0.269	0.4	Pass

Note: Dwell time = Pulse time*(1600/4/79)*31.6S

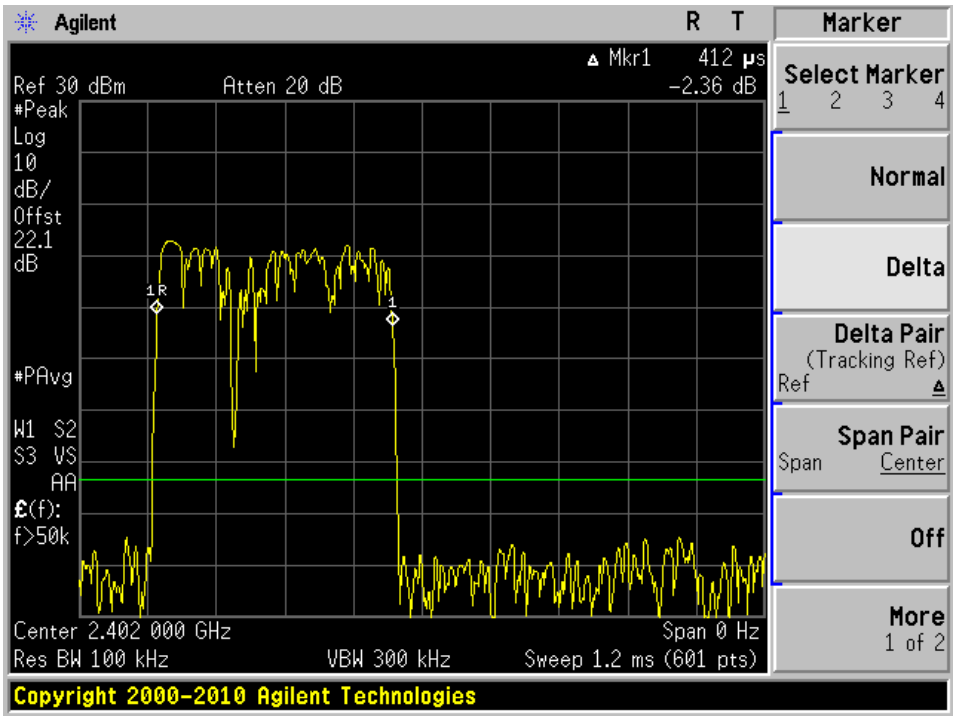
8DPSK, DH5: Packet Size = 339 bytes

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	2.938	0.313	0.4	Pass
Mid	2.938	0.313	0.4	Pass
High	2.938	0.313	0.4	Pass

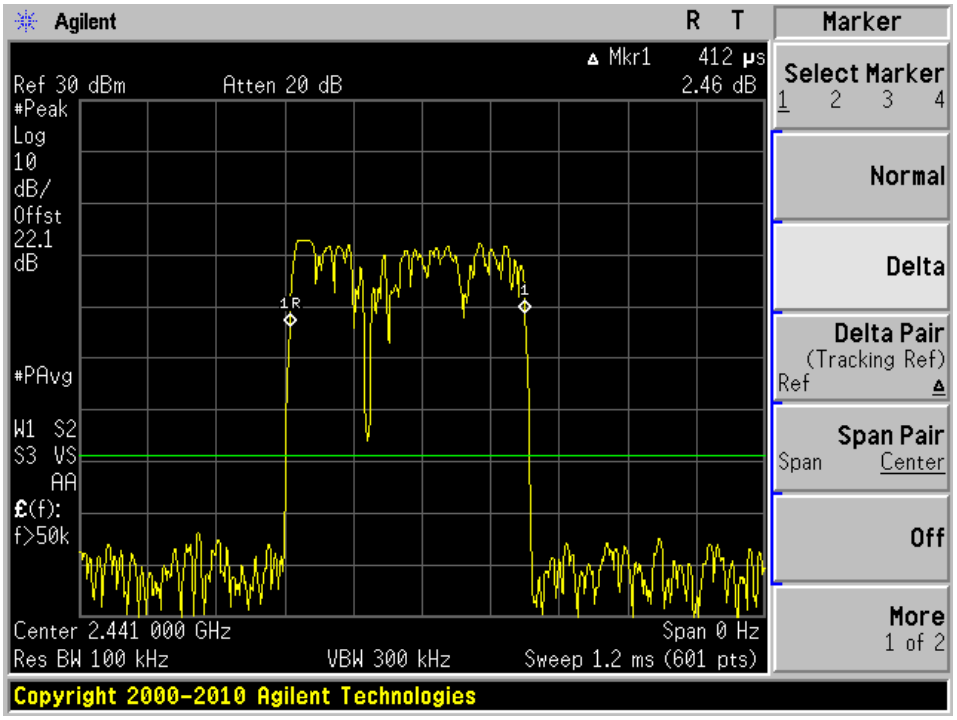
Note: Dwell time = Pulse time*(1600/6/79)*31.6S

Please refer to following plots:

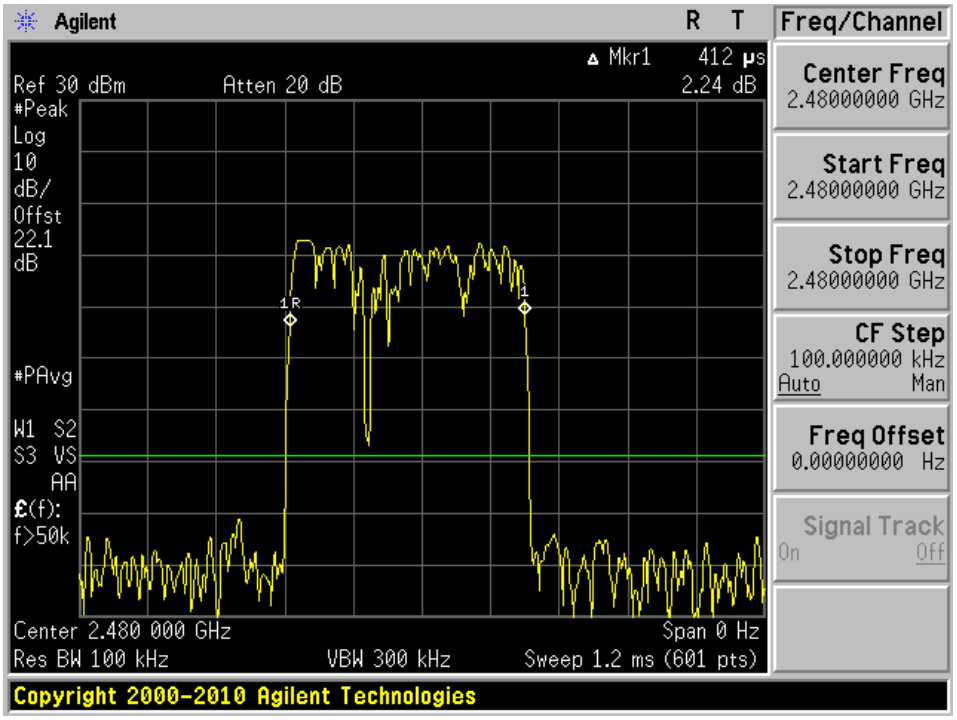
GFSK, DH1 - Low Channel



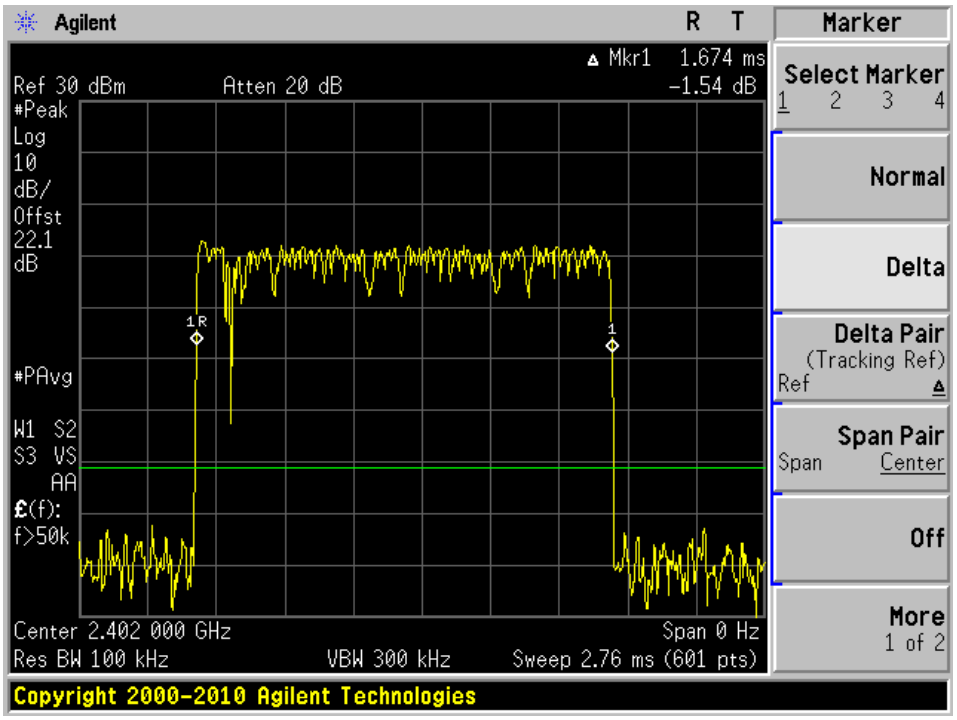
GFSK, DH1 - Middle Channel



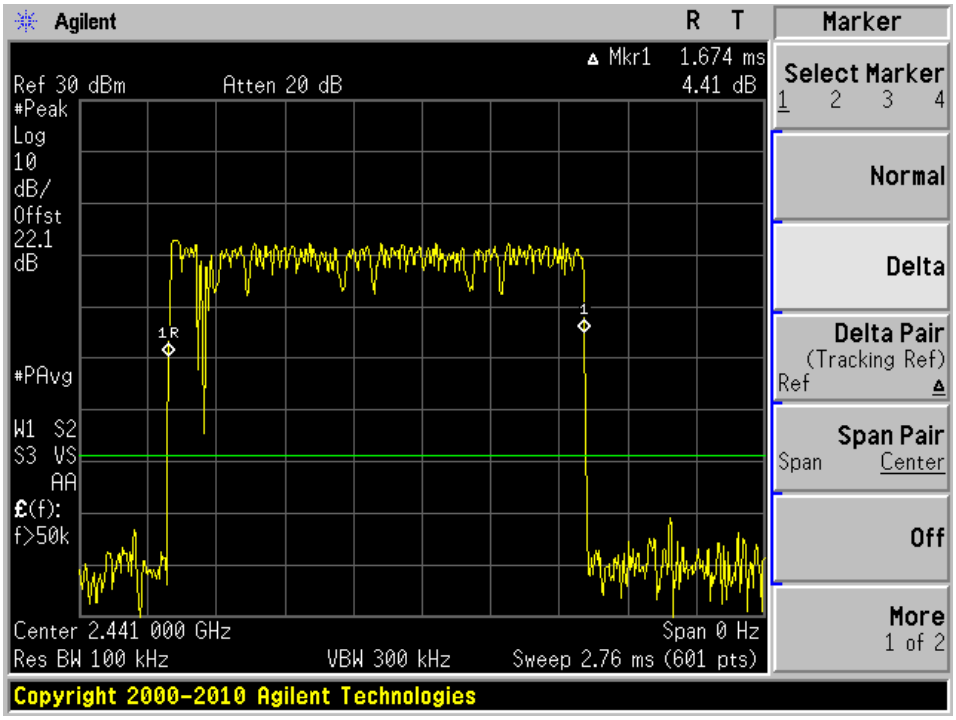
GFSK, DH1 - High Channel



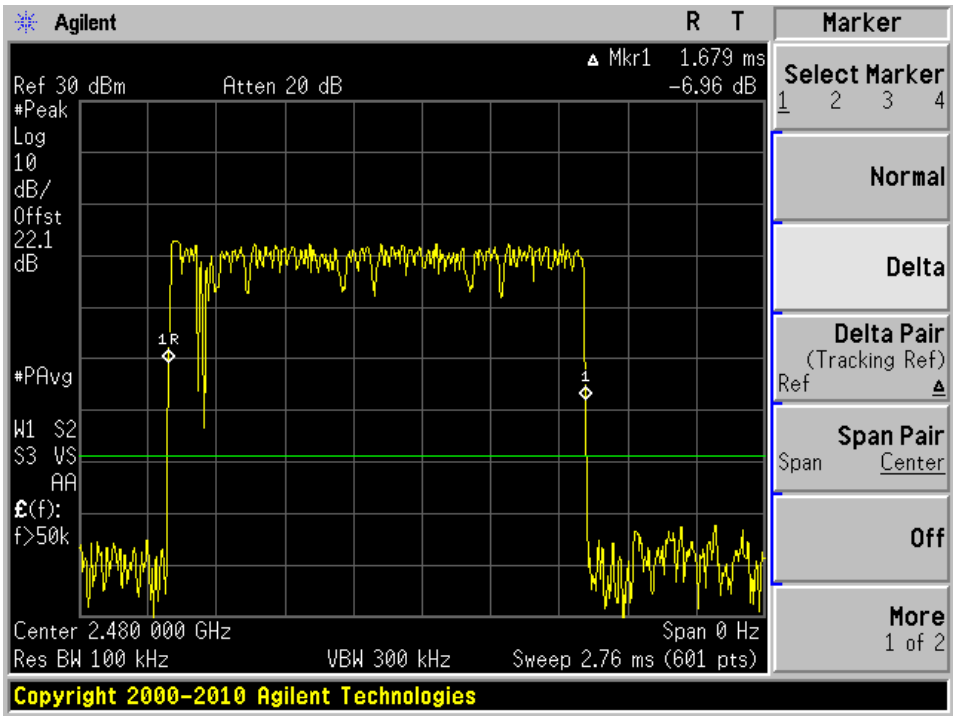
GFSK, DH3 - Low Channel



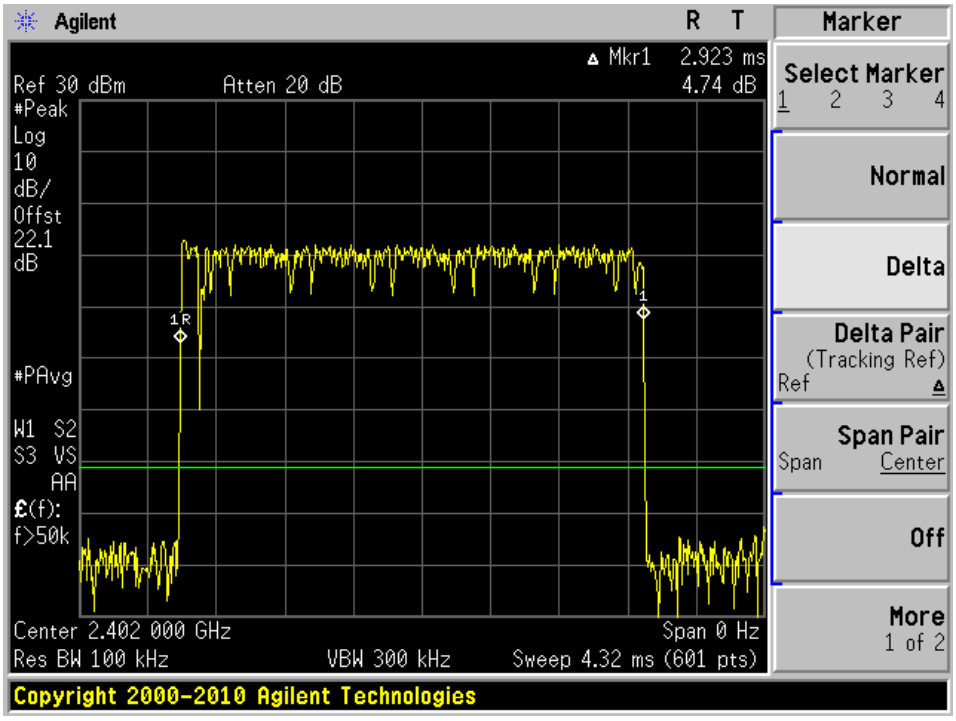
GFSK, DH3 - Middle Channel



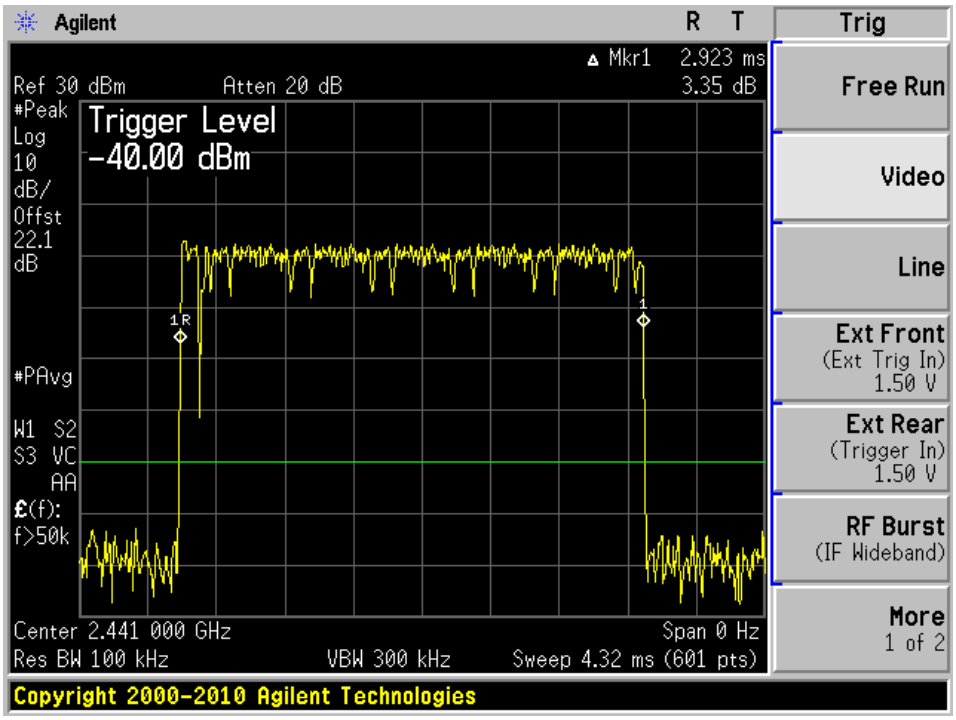
GFSK, DH3 - High Channel



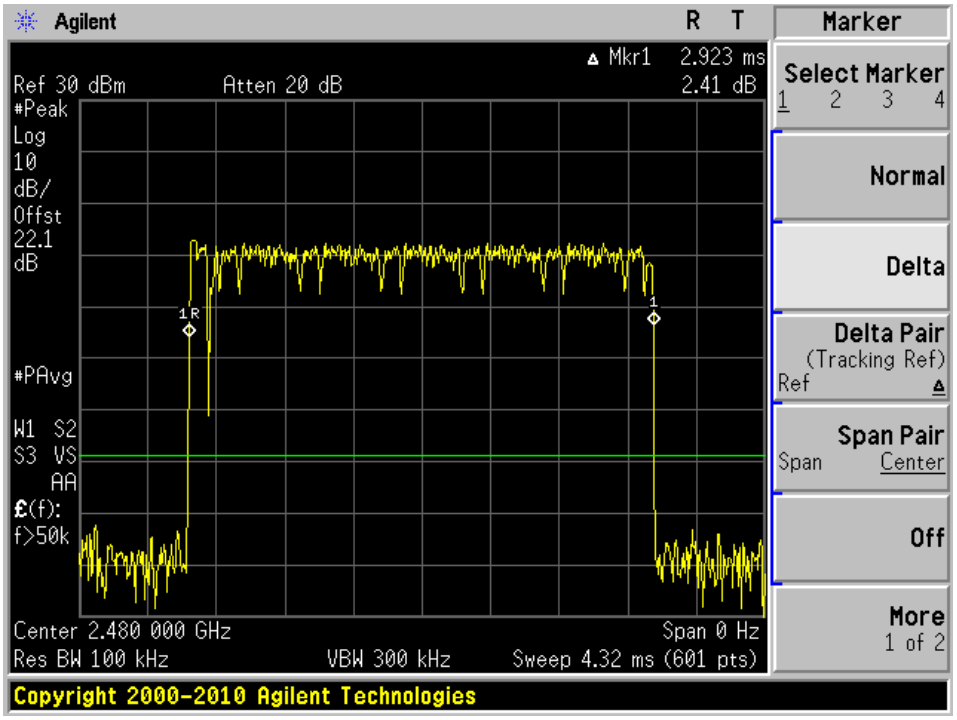
GFSK, DH5 - Low Channel



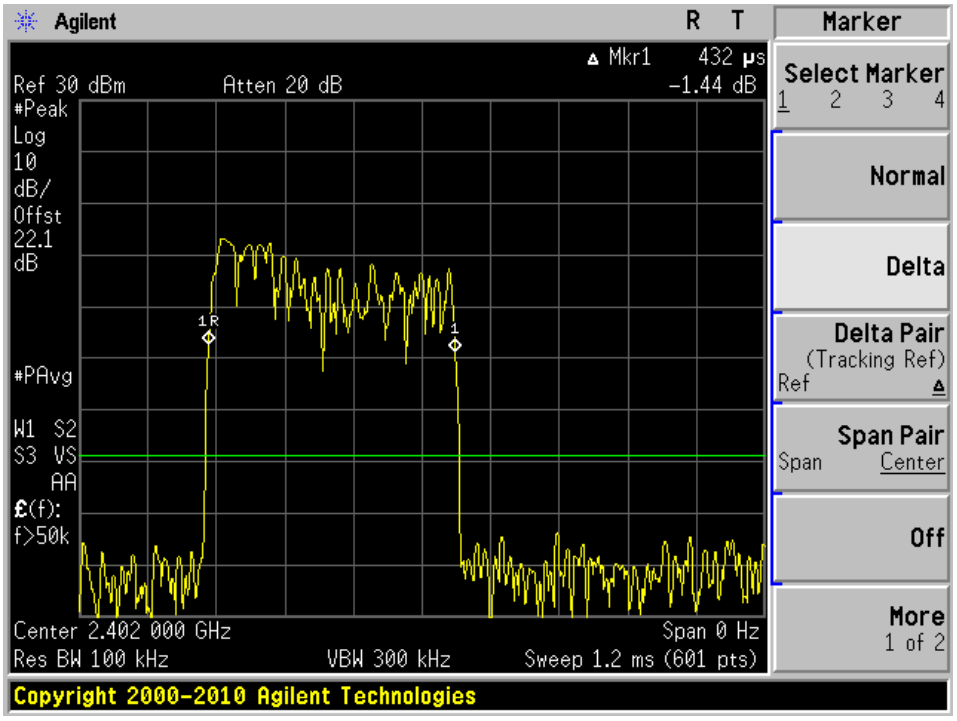
GFSK, DH5 - Middle Channel



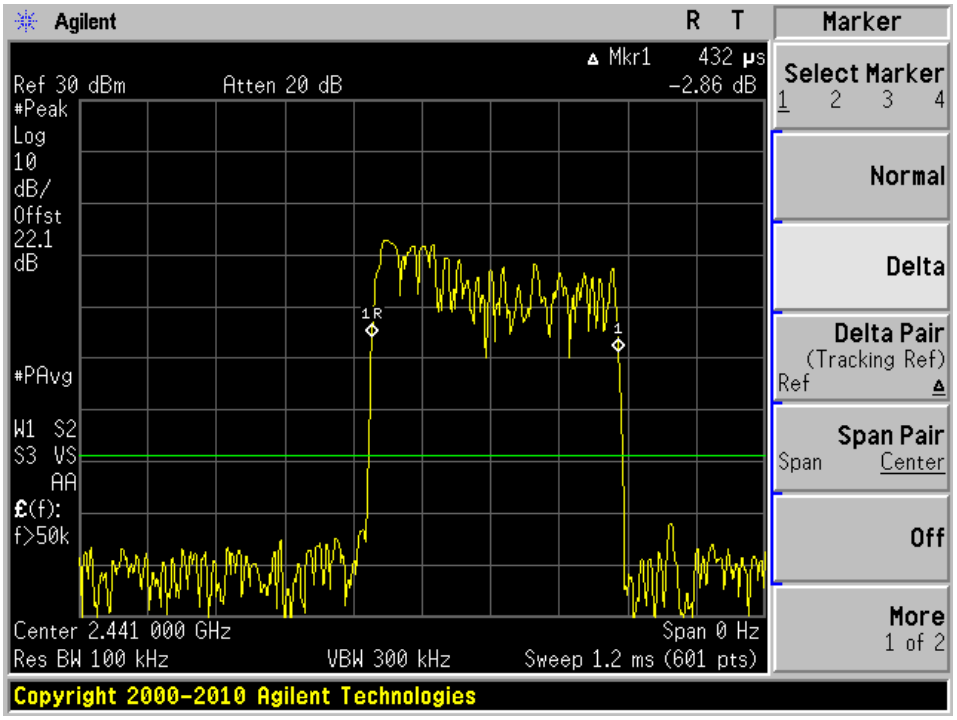
GFSK, DH5 - High Channel



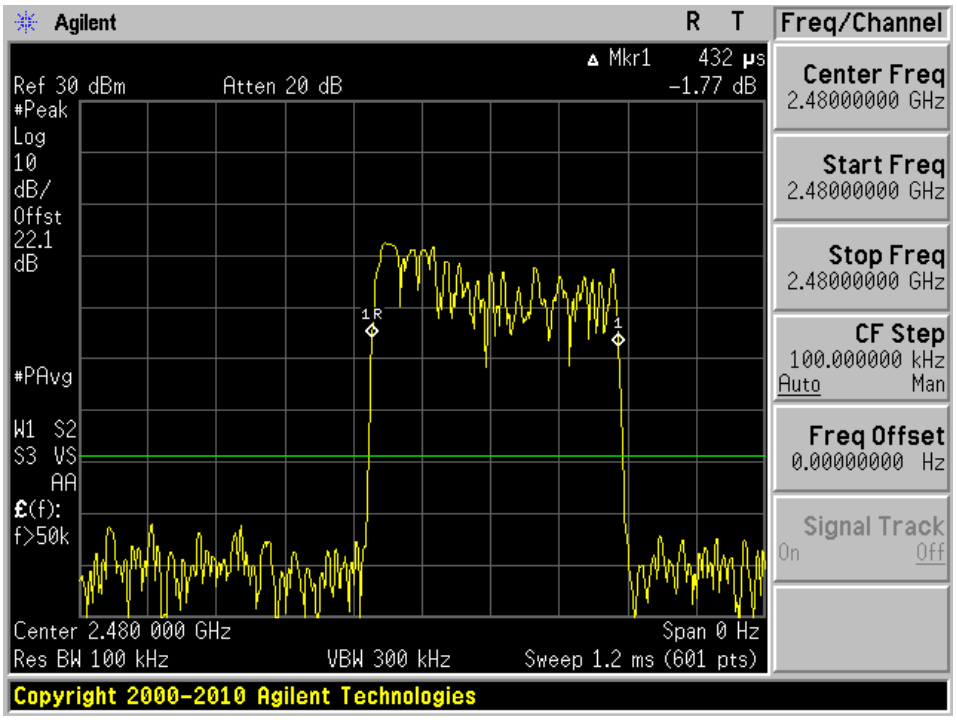
DQPSK, DH1 - Low Channel



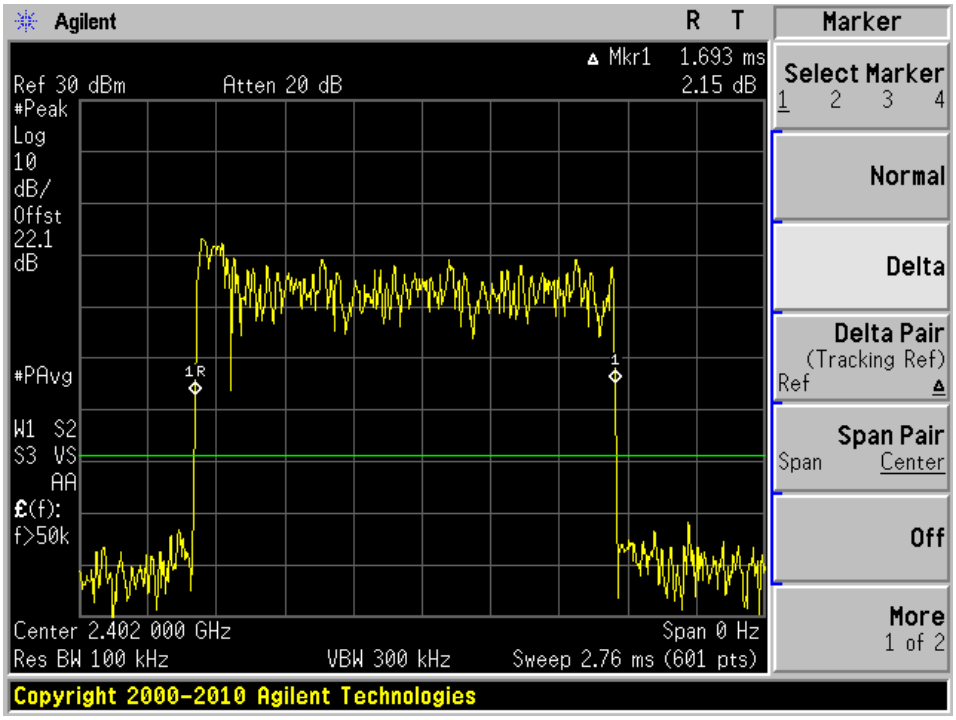
DQPSK, DH1 - Middle Channel



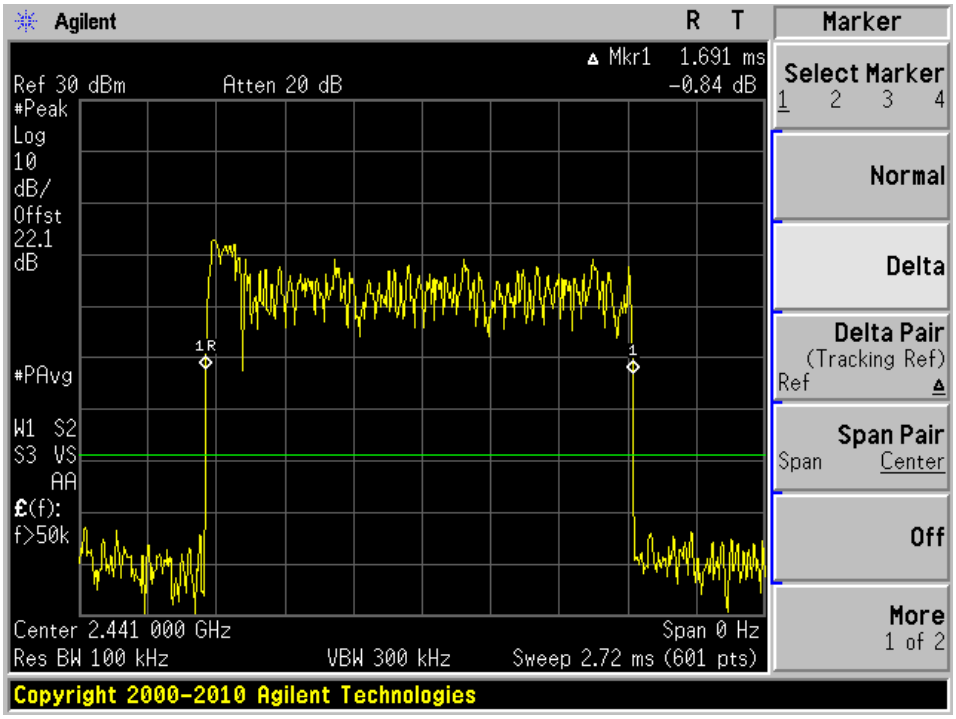
DQPSK, DH1 - High Channel



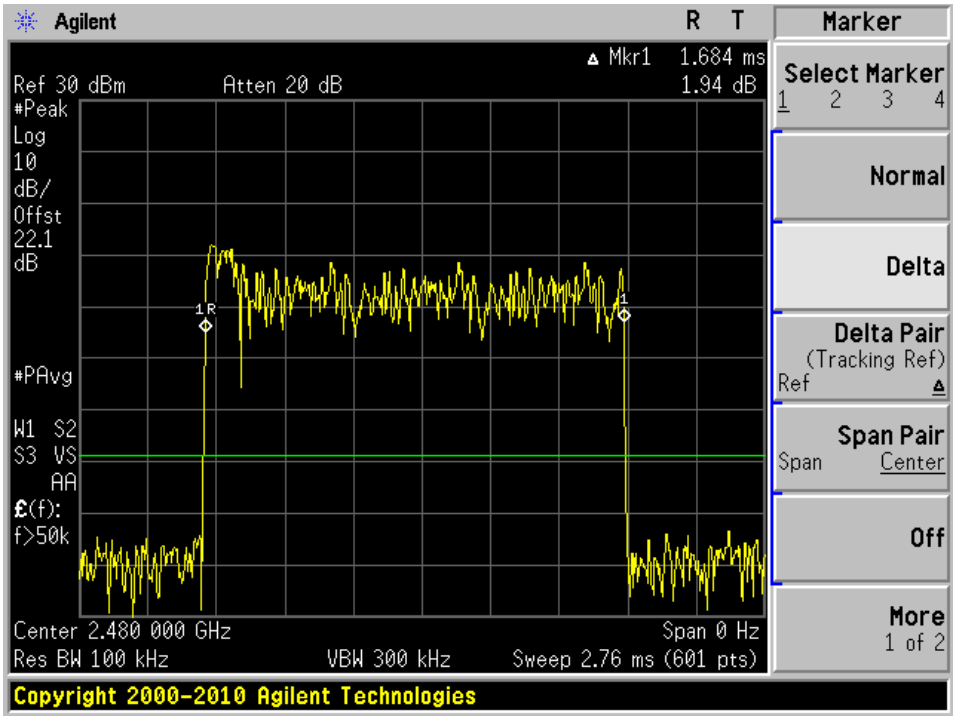
DQPSK, DH3 - Low Channel



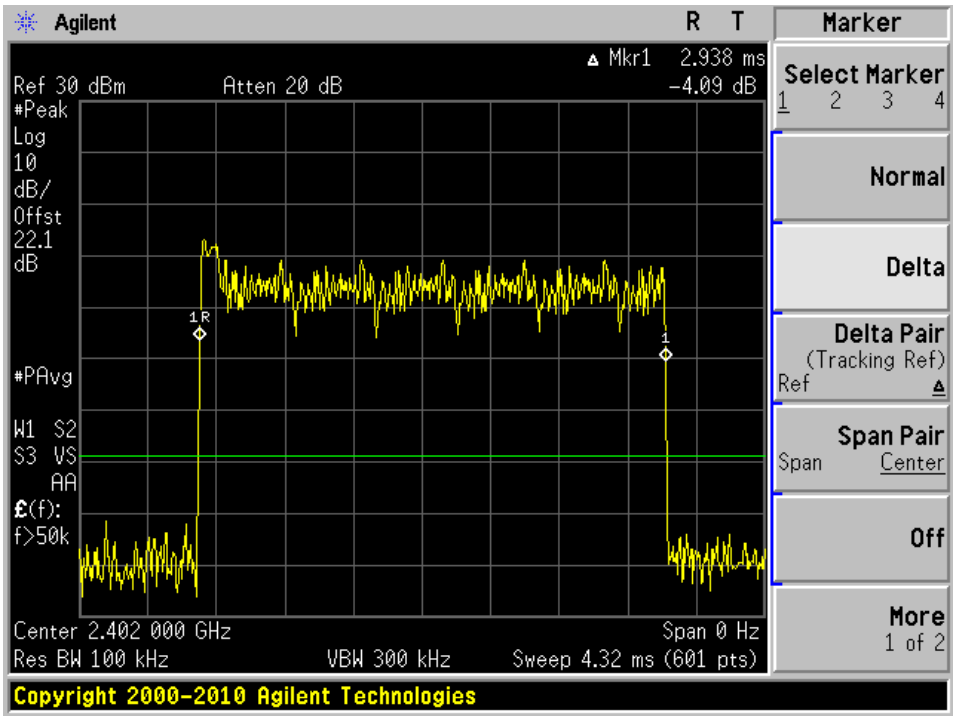
DQPSK, DH3 - Middle Channel



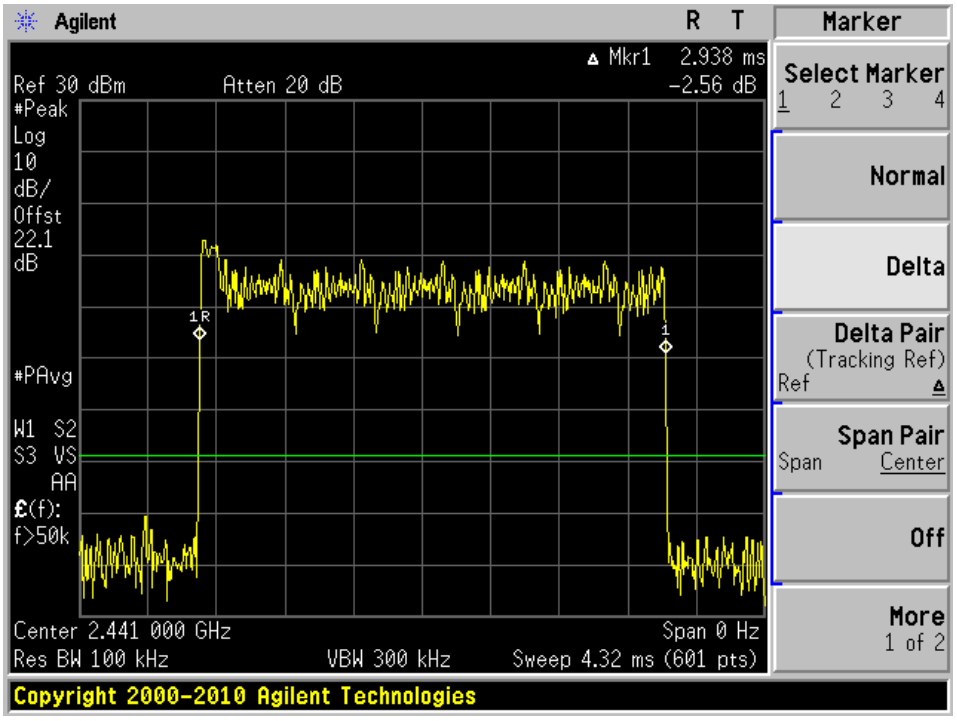
DQPSK, DH3 - High Channel



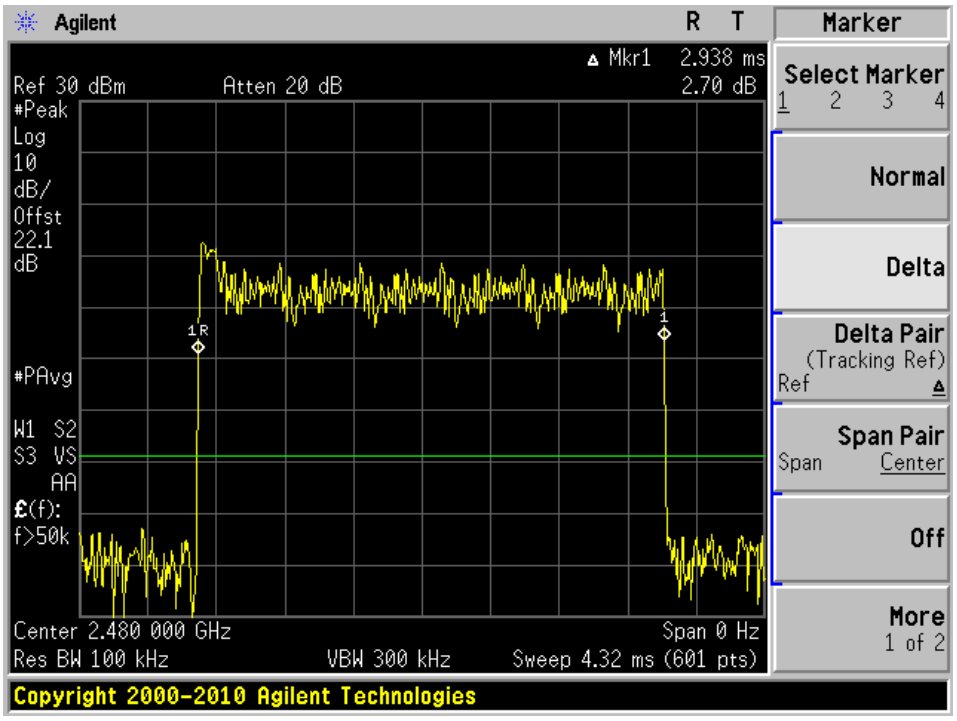
DQPSK, DH5 - Low Channel



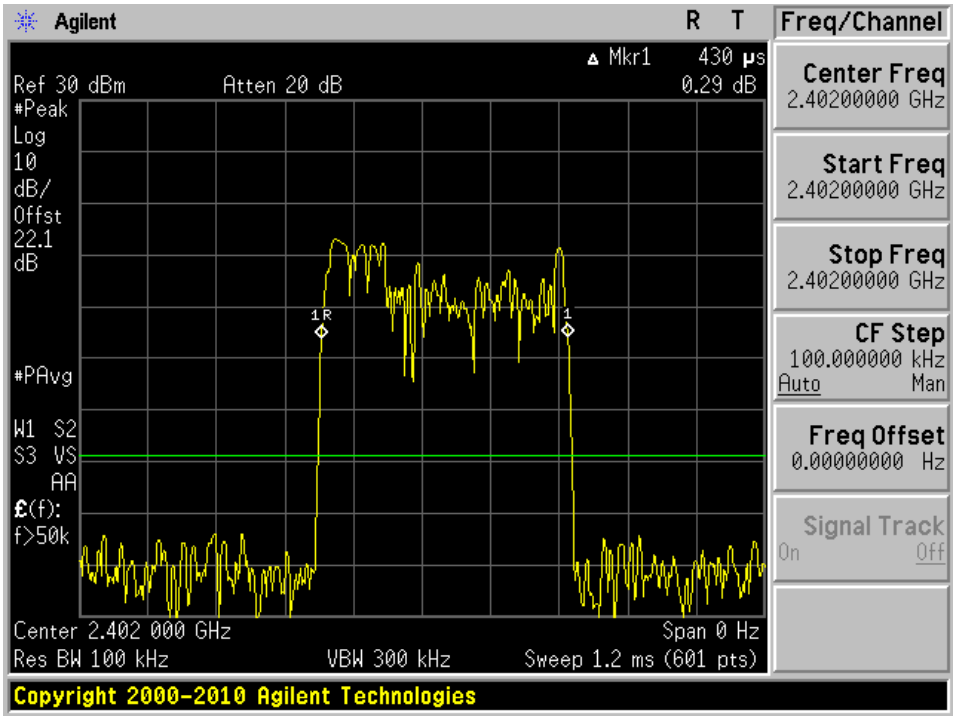
DQPSK, DH5 - Middle Channel



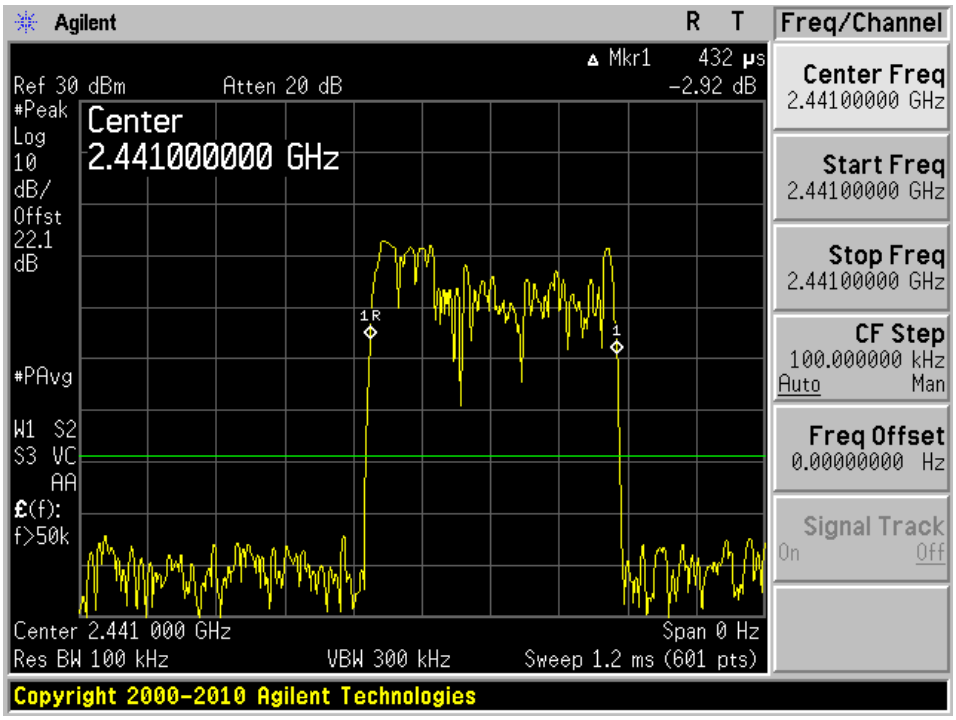
DQPSK, DH5 - High Channel



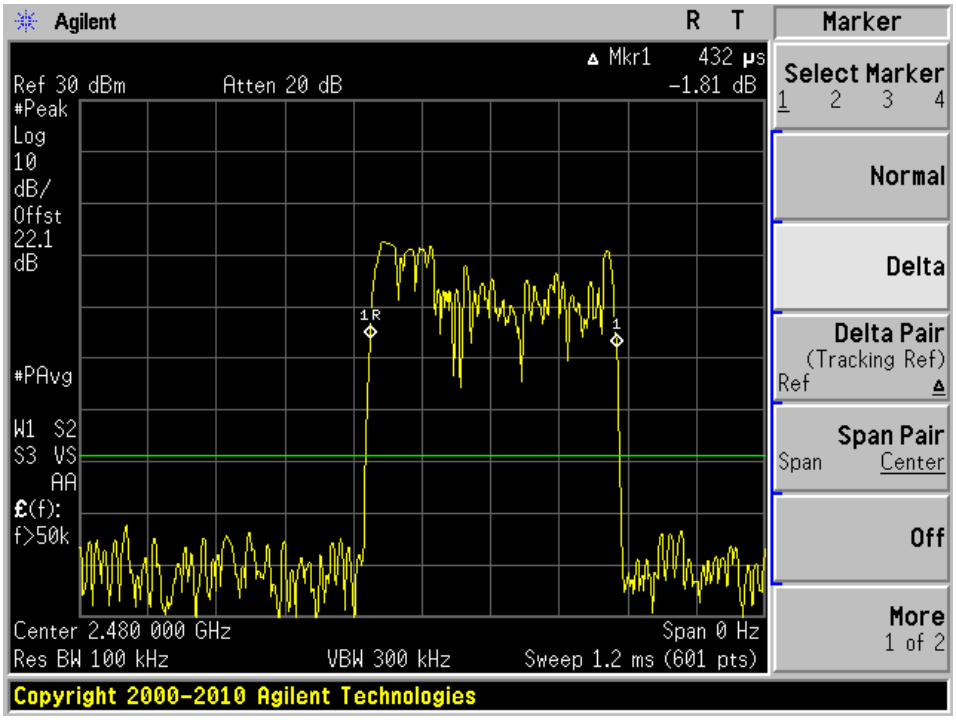
8DPSK, DH1 - Low Channel



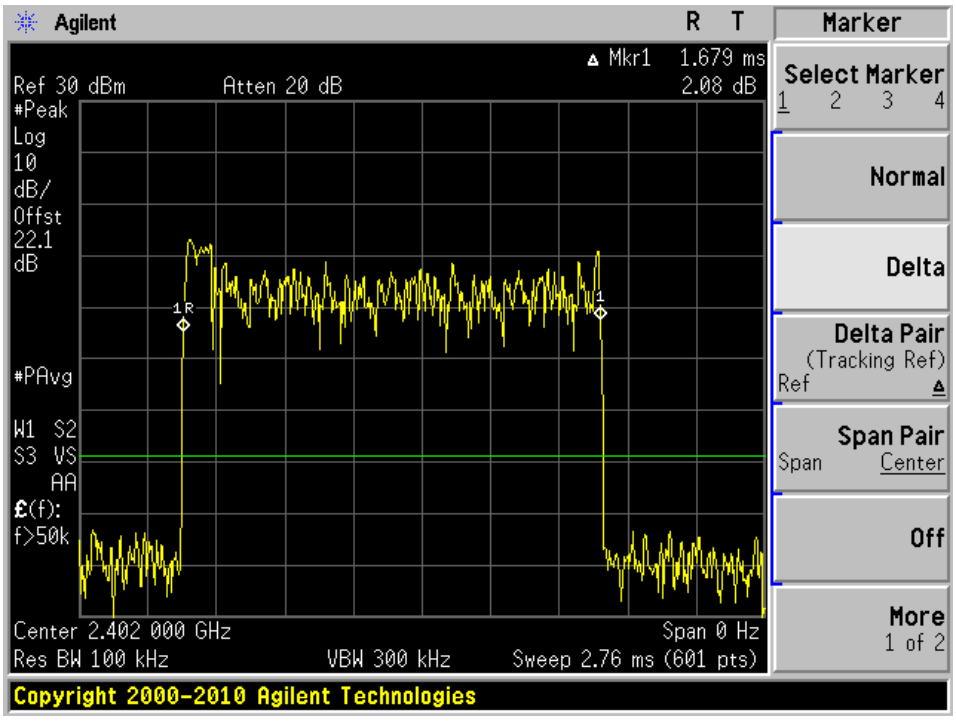
8DPSK, DH1 - Middle Channel



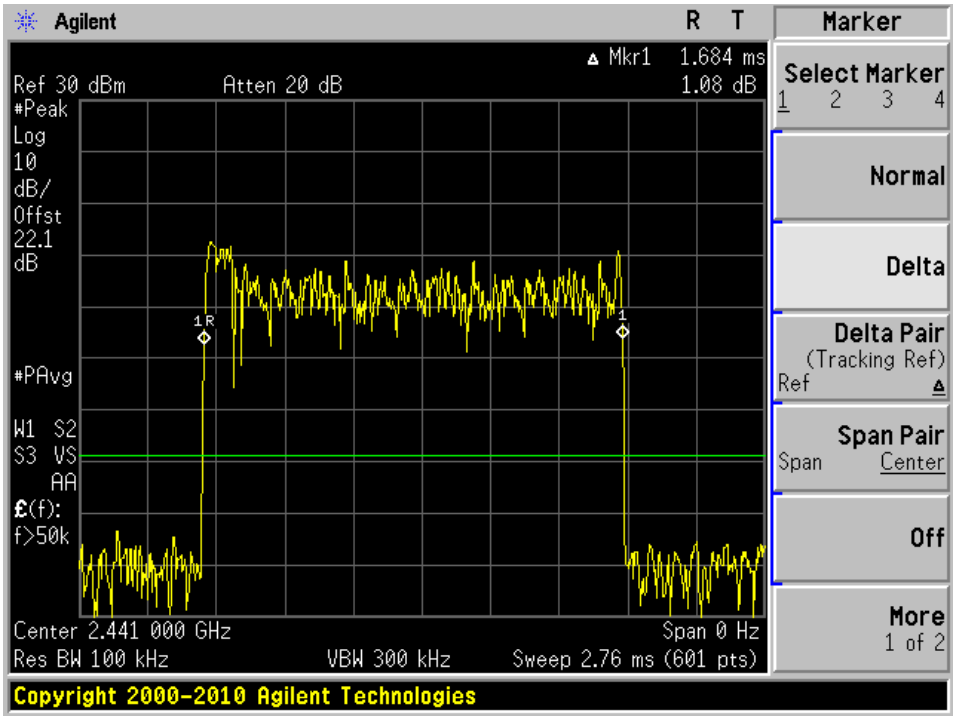
8DPSK, DH1 - High Channel



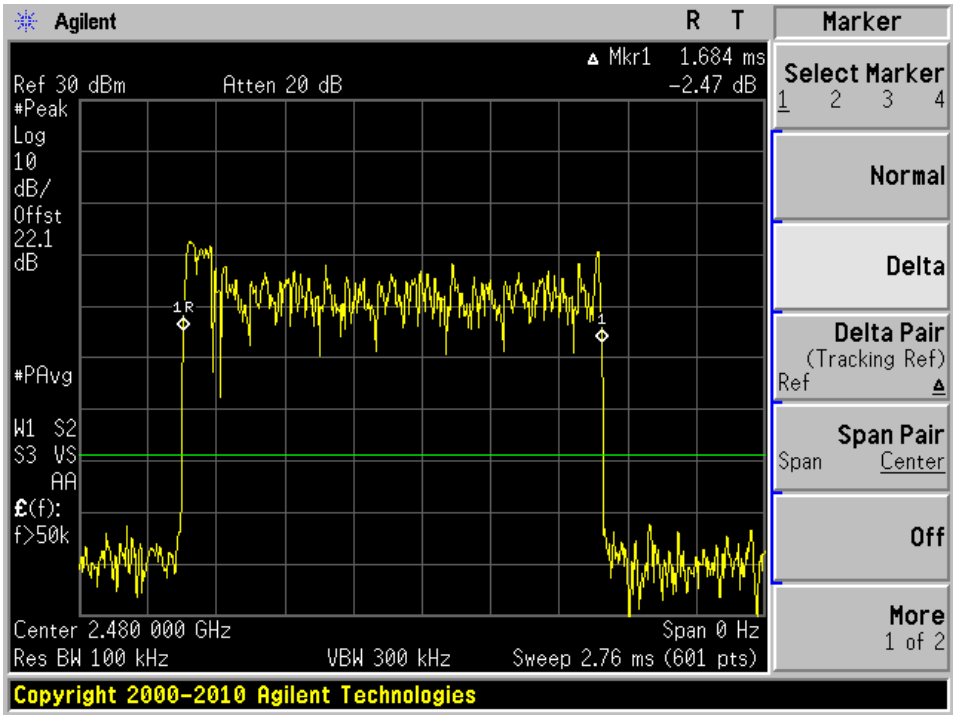
8DPSK, DH3 - Low Channel



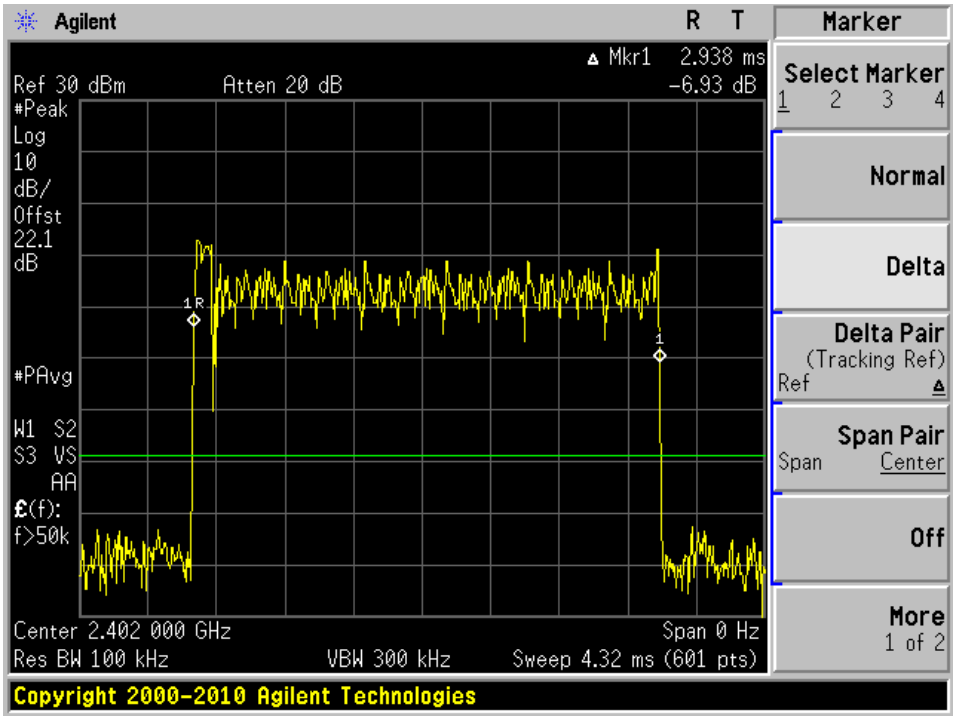
8DPSK, DH3 - Middle Channel



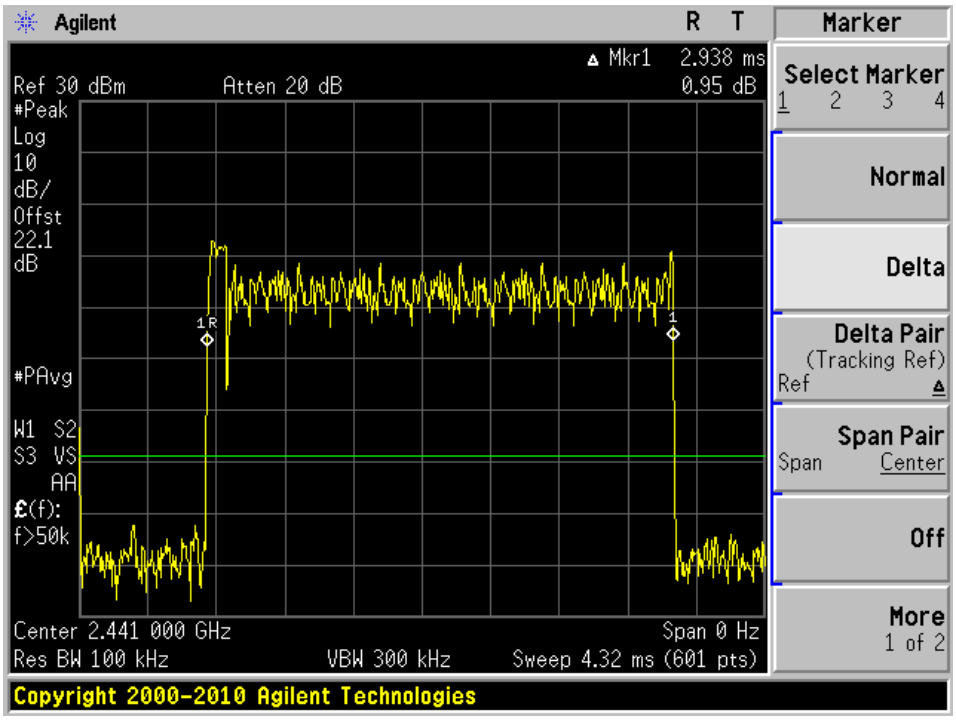
8DPSK, DH3 - High Channel



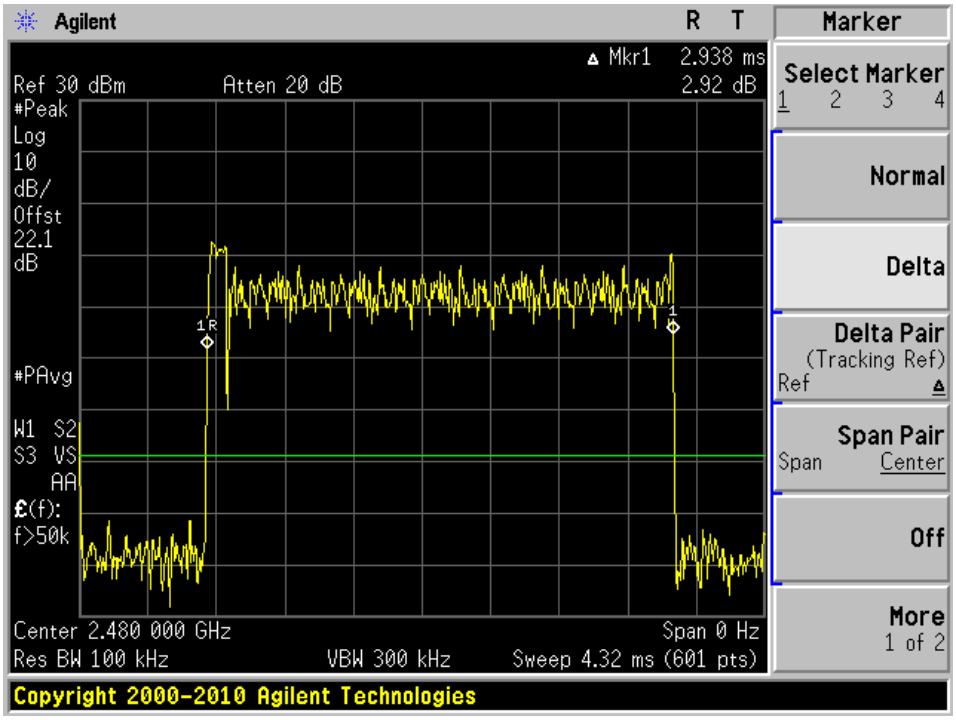
8DPSK, DH5 - Low Channel



8DPSK, DH5 - Middle Channel



8DPSK, DH5 - High Channel



11 FCC §15.247(b) & IC RSS-210 §A8.4 – Maximum Peak Output Power

11.1 Applicable Standard

According to FCC §15.247(b) (1), for frequency hopping systems in the 2400-2483.5MHz band employing at least 75 hopping channels, and all direct sequence systems, the maximum peak output power of the transmitter shall not exceed 1 Watt. For all other frequency hopping system in the 2400 – 2483.5 MHz band, the maximum peak output power of the transmitter shall not exceed 0.125 Watt.

According to IC RSS-210 §8.4(2), For frequency hopping systems operating in the band 2400-2483.5 MHz employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

11.2 Measurement Procedure

1. Place the EUT on the turntable 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 the spectrum analyzer.

11.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]

Note 1: Two year calibration cycle.

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:	23 °C
Relative Humidity:	58 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-06-11 at RF test site.

11.5 Test Results

Modulation GFSK:

Channel	Frequency (MHz)	Max Peak Output Power		Limit (mw)	Result
		(dBm)	(mw)		
Low	2402	2.65	1.84	125	Pass
Mid	2441	2.97	1.98	125	Pass
High	2480	2.95	1.97	125	Pass

Modulation DQPSK:

Channel	Frequency (MHz)	Max Peak Output Power		Limit (mw)	Result
		(dBm)	(mw)		
Low	2402	3.50	2.24	125	Pass
Mid	2441	3.36	2.17	125	Pass
High	2480	2.92	1.96	125	Pass

Modulation 8DPSK:

Channel	Frequency (MHz)	Max Peak Output Power		Limit (mw)	Result
		(dBm)	(mw)		
Low	2402	3.69	2.34	125	Pass
Mid	2441	3.56	2.27	125	Pass
High	2480	3.17	2.07	125	Pass

12 FCC §15.247(d) & IC RSS-210 §A 8.5 - Band Edges Emissions

12.1 Applicable Standard

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required.

According to IC RSS-210 §A 8.5.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.

12.2 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 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 100kHz 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.

12.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]

Note 1: Two year calibration cycle.

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

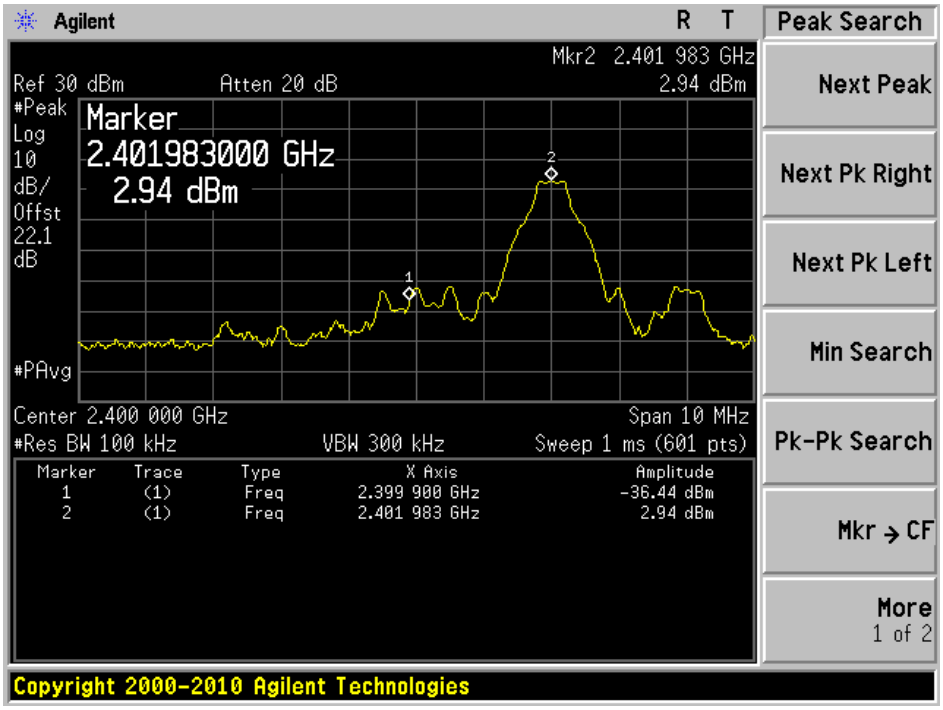
Temperature:	23 °C
Relative Humidity:	58 %
ATM Pressure:	101.5kPa

The testing was performed by Lionel Lara on 2012-06-11 at RF test site.

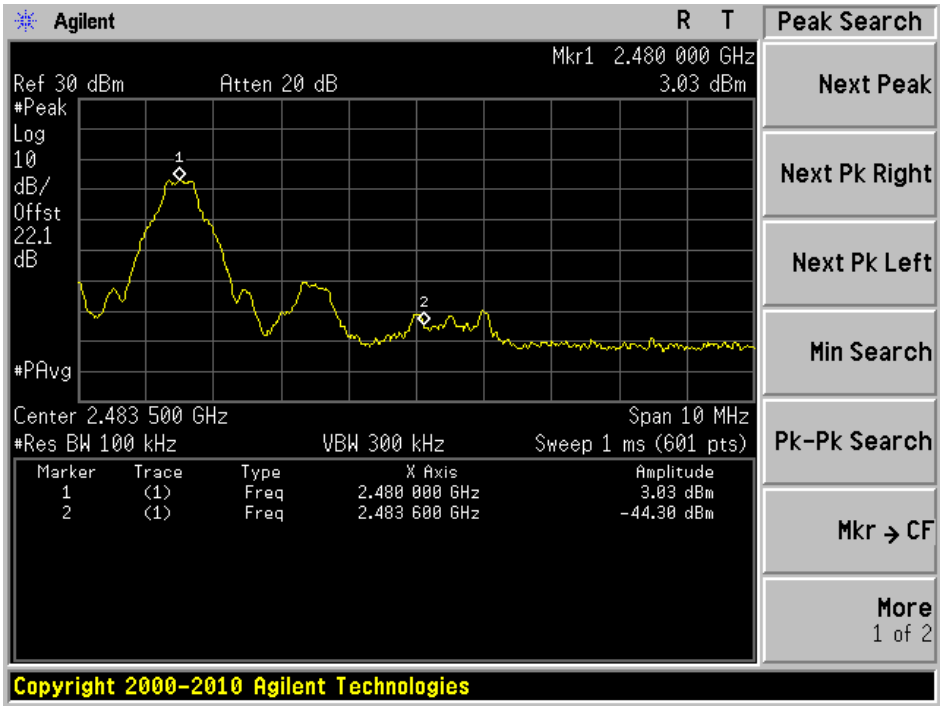
12.5 Test Results

Please refer to the following plots.

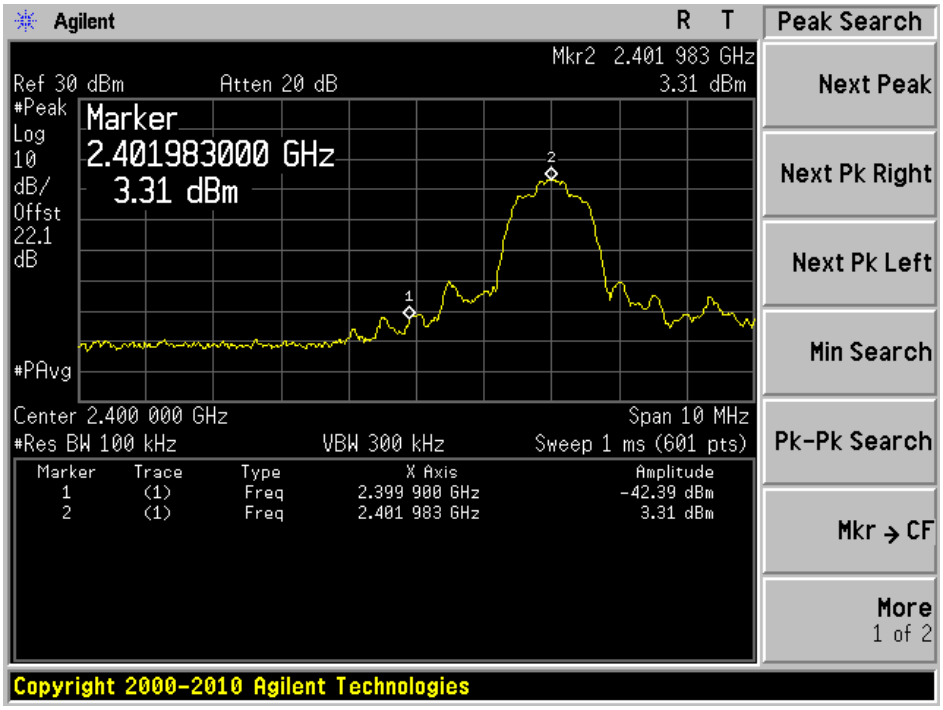
Band Edge: Lowest Channel GFSK



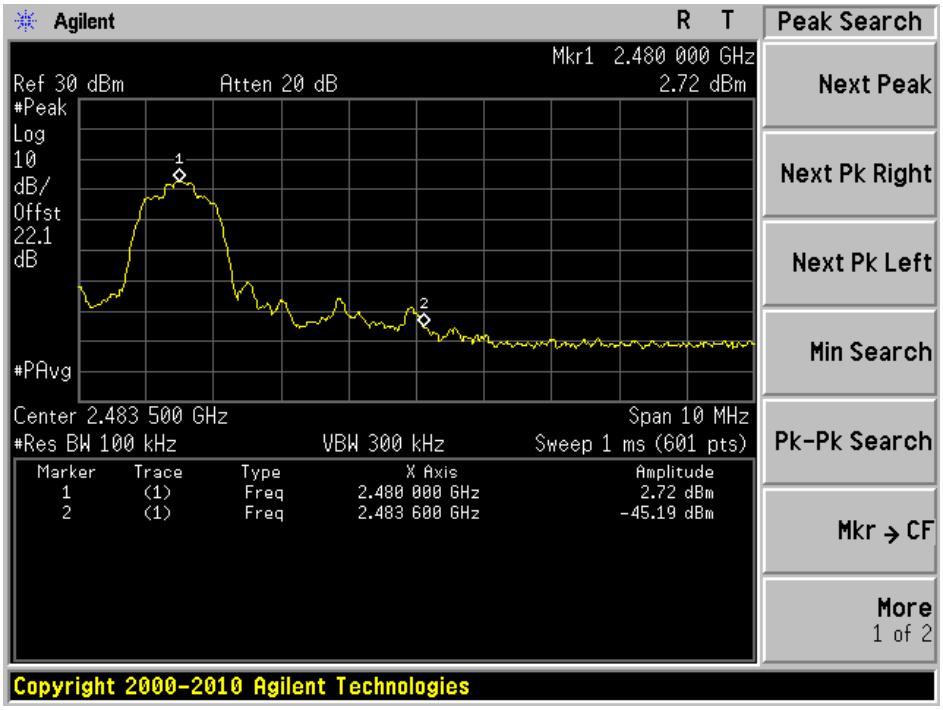
Band Edge: Highest Channel GFSK



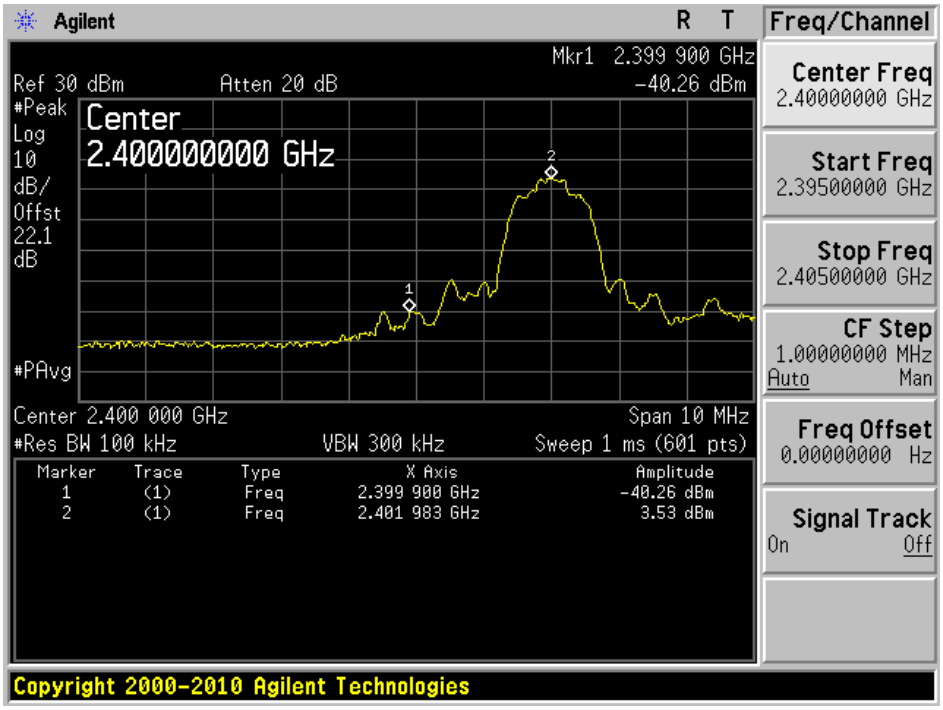
Band Edge: Lowest Channel QPSK



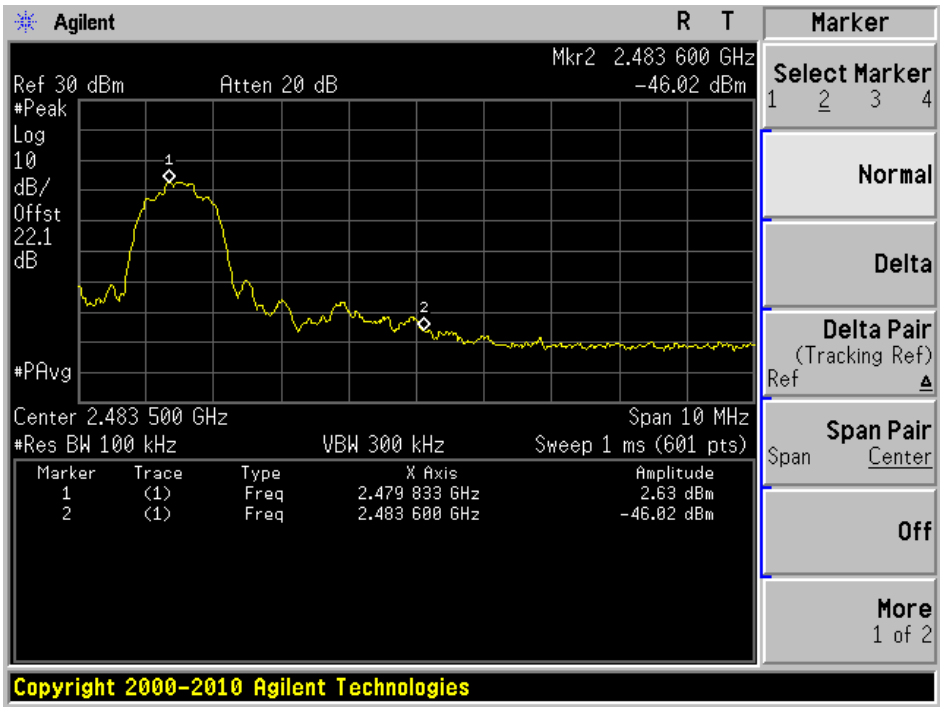
Band Edge: Highest Channel QPSK



Band Edge: Lowest Channel 8PSK



Band Edge: Highest Channel 8PSK



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

13.1 Applicable Standard

As per 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.

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 a bench 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 the SA on Max-Hold Mode, and then keep the EUT in transmitting 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
Agilent	PSA Series Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]

Note 1: Two year calibration cycle.

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

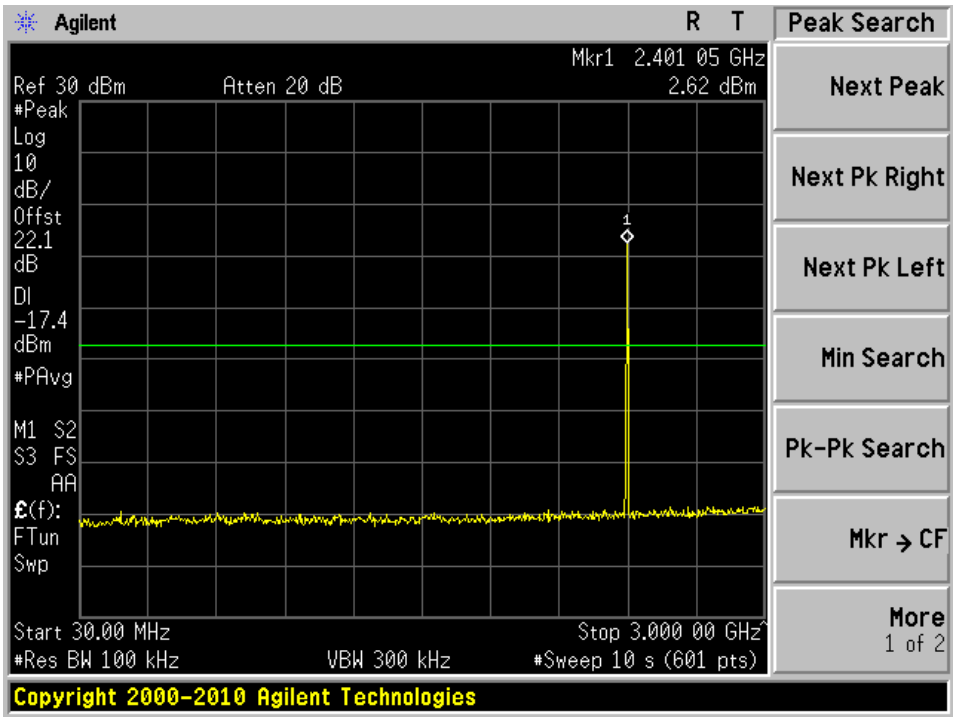
Temperature:	23 °C
Relative Humidity:	58 %
ATM Pressure:	101.5kPa

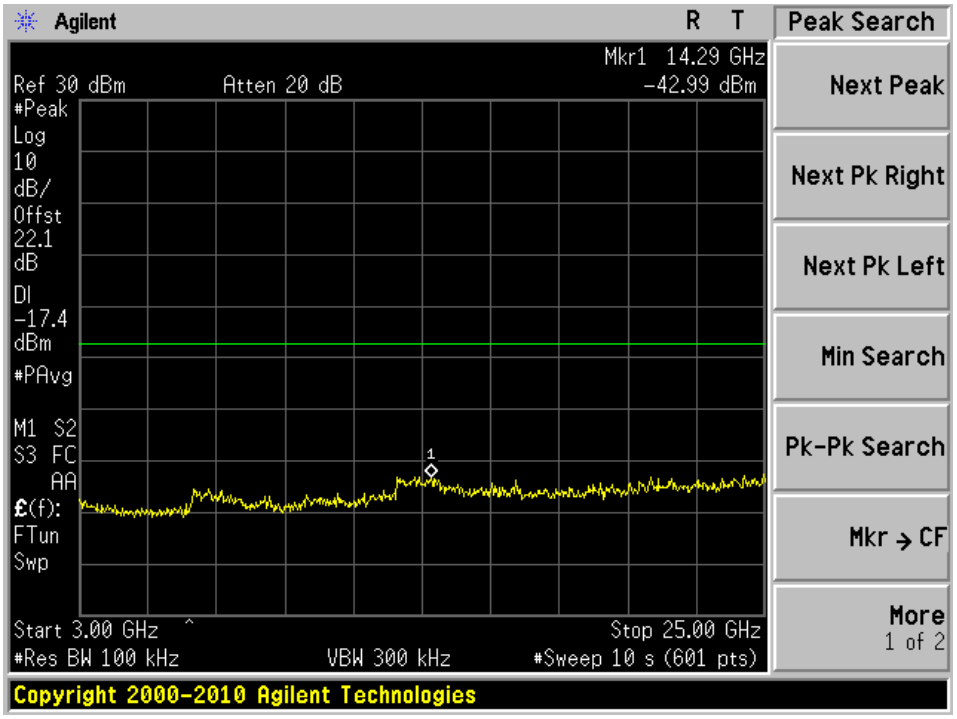
The testing was performed by Lionel Lara on 2012-06-11 at RF test site.

13.5 Test Results

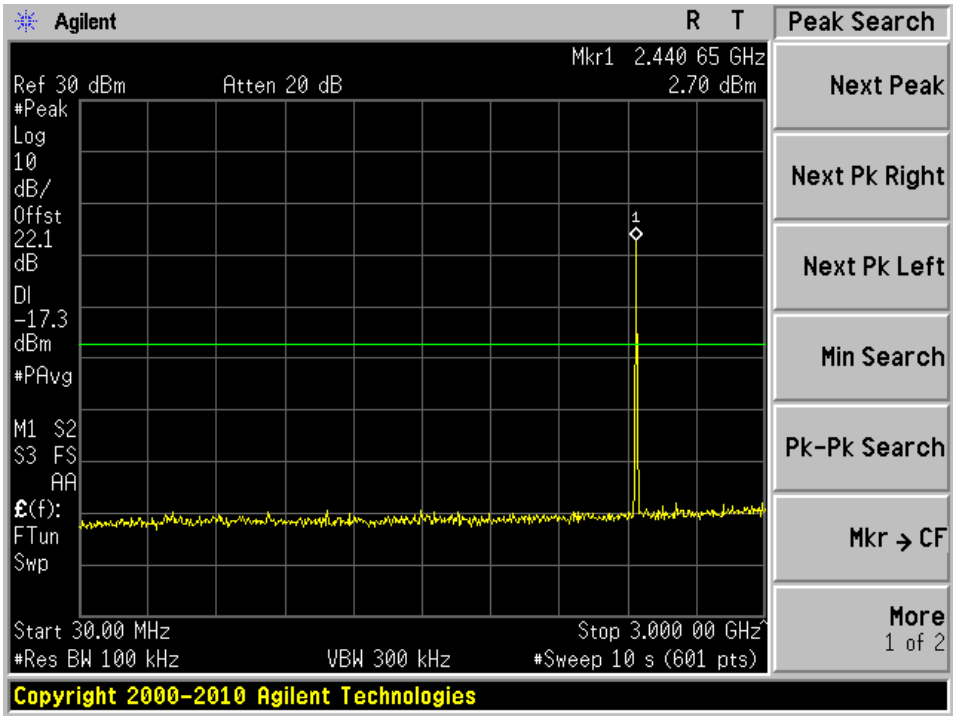
Please refer to the following plots.

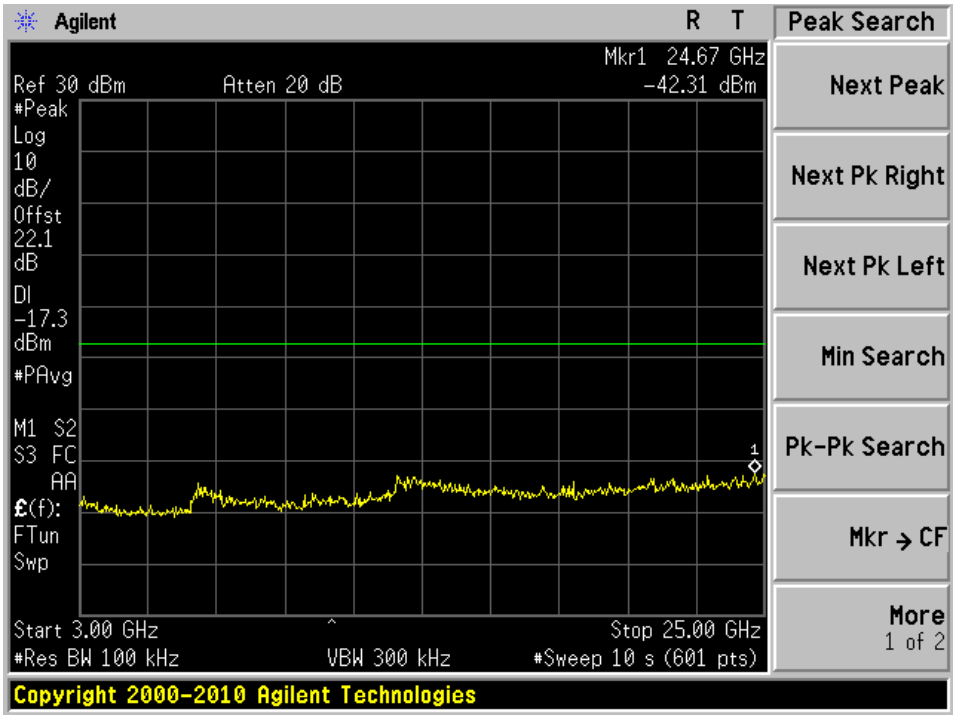
Low Channel GFSK



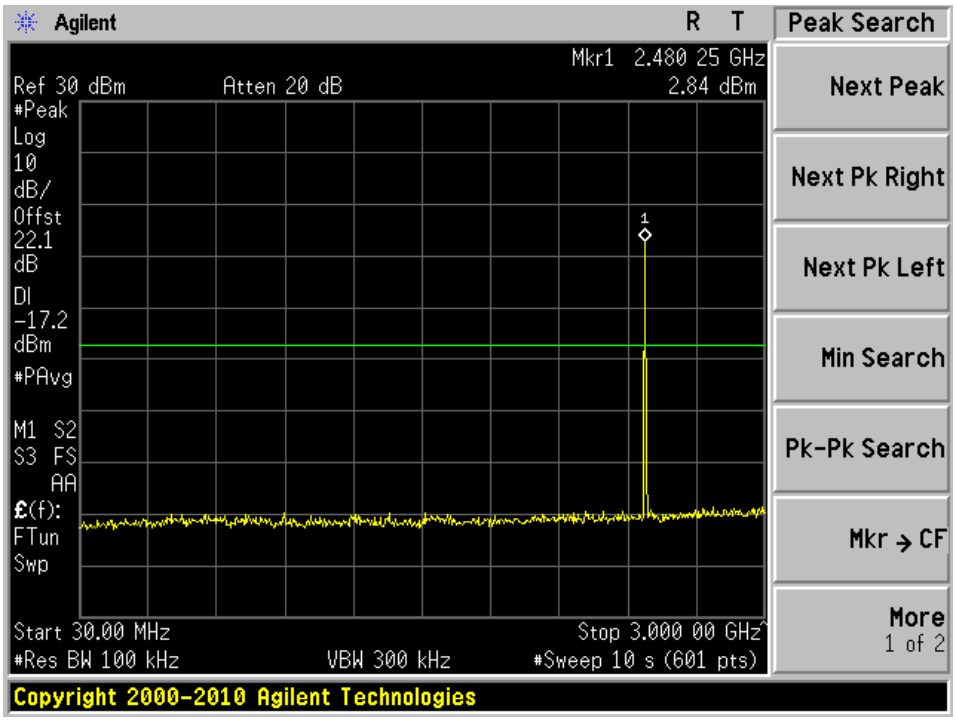


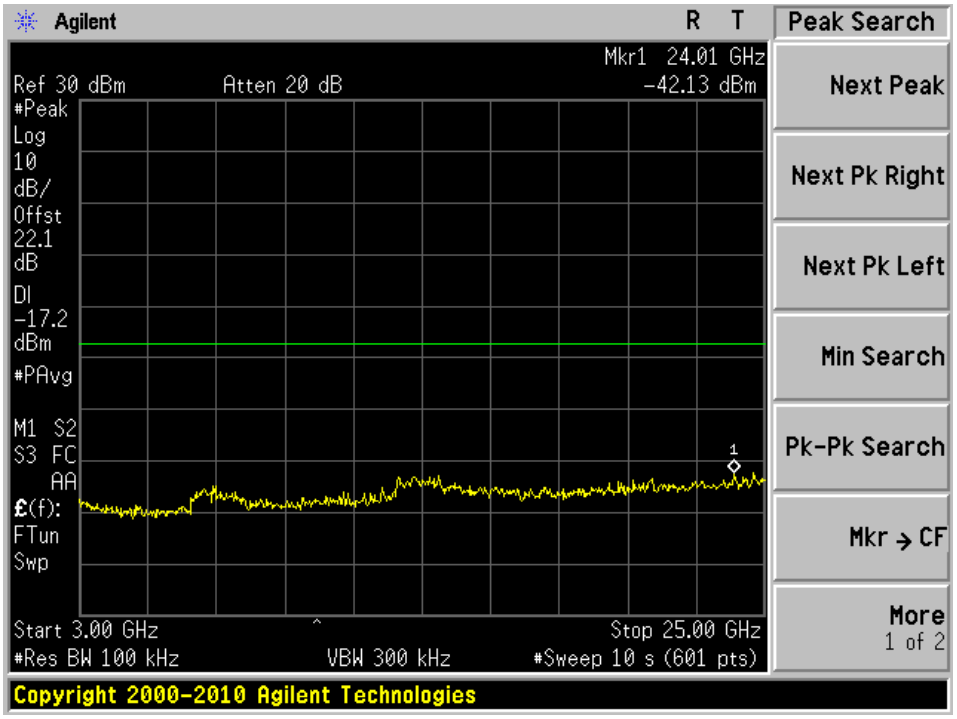
Middle Channel GFSK



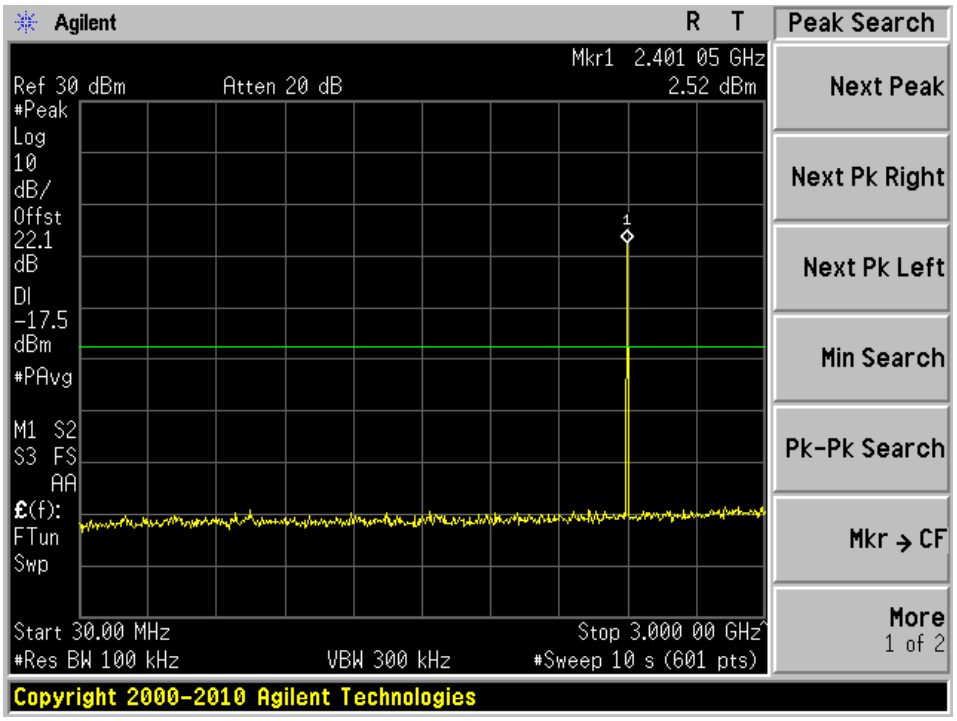


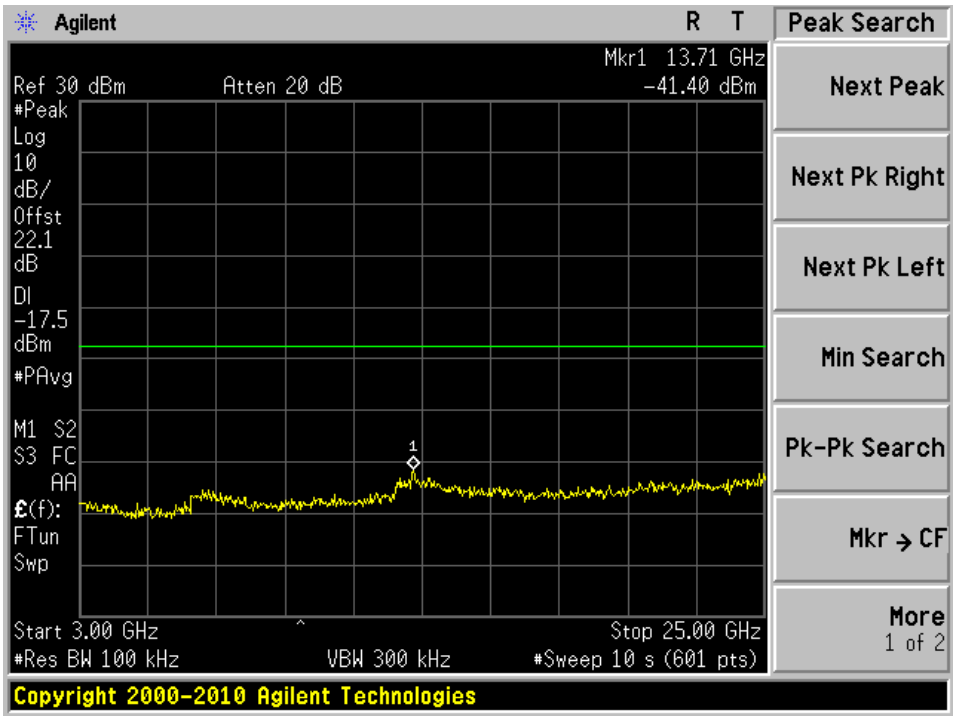
High Channel GFSK



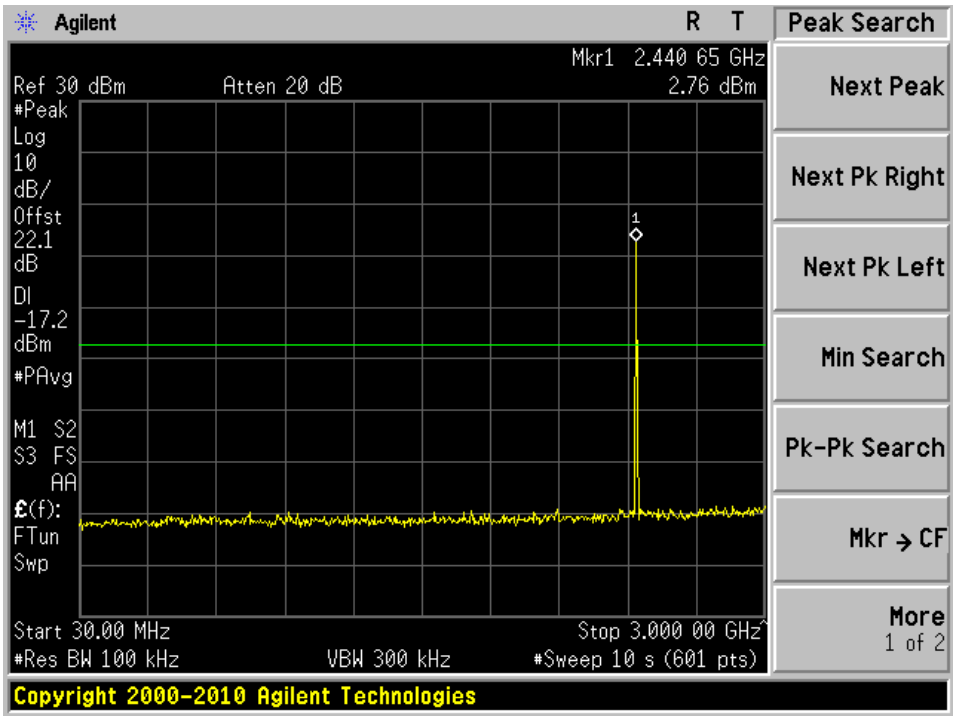


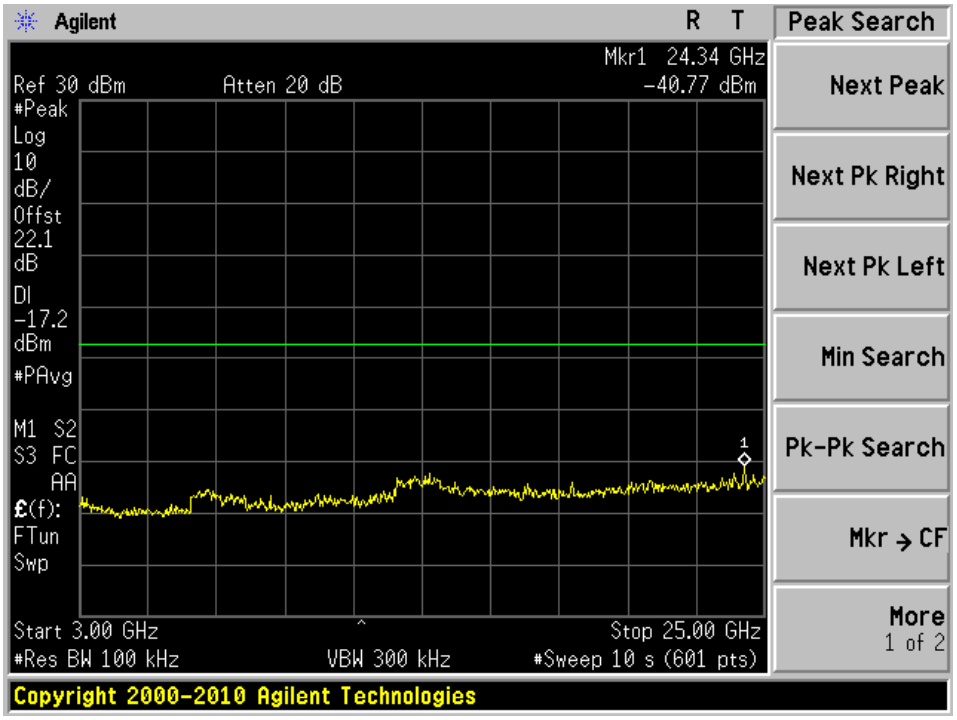
Low Channel DQPSK



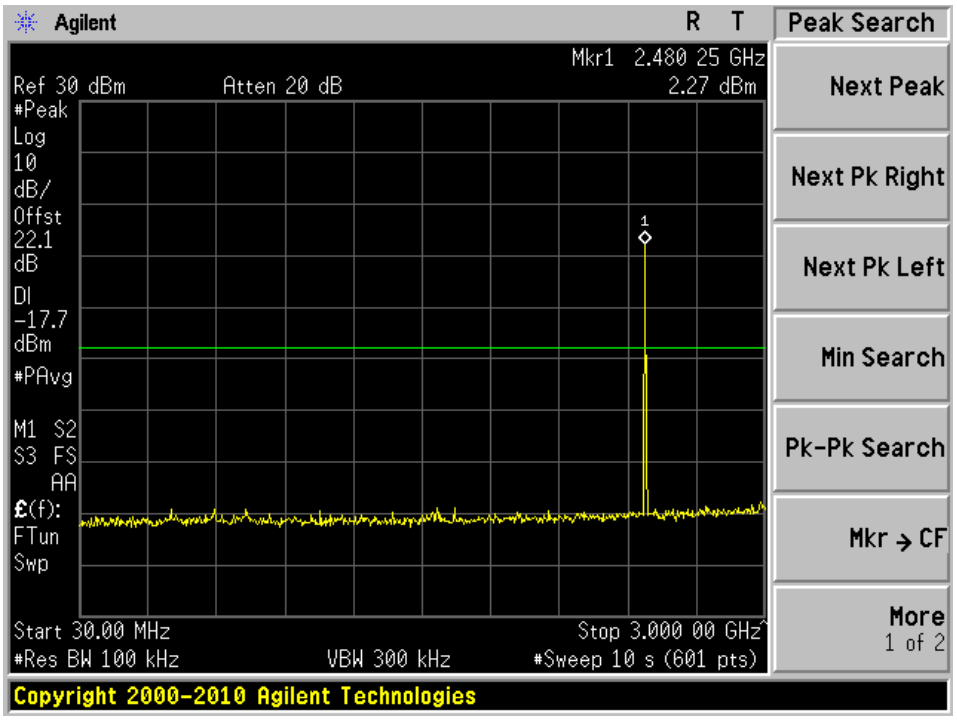


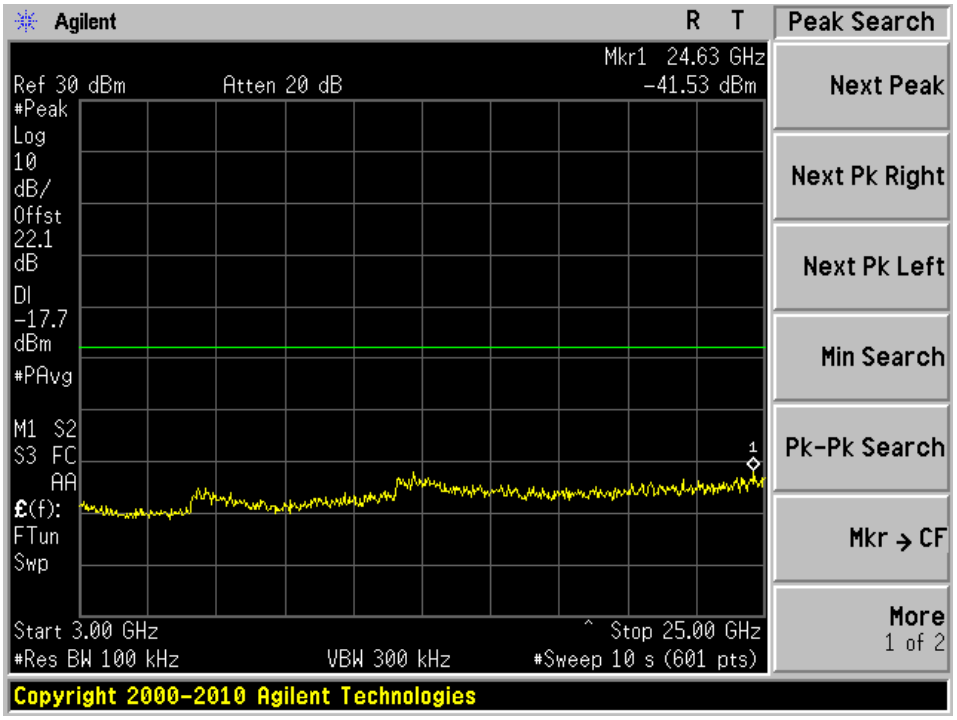
Middle Channel DQPSK



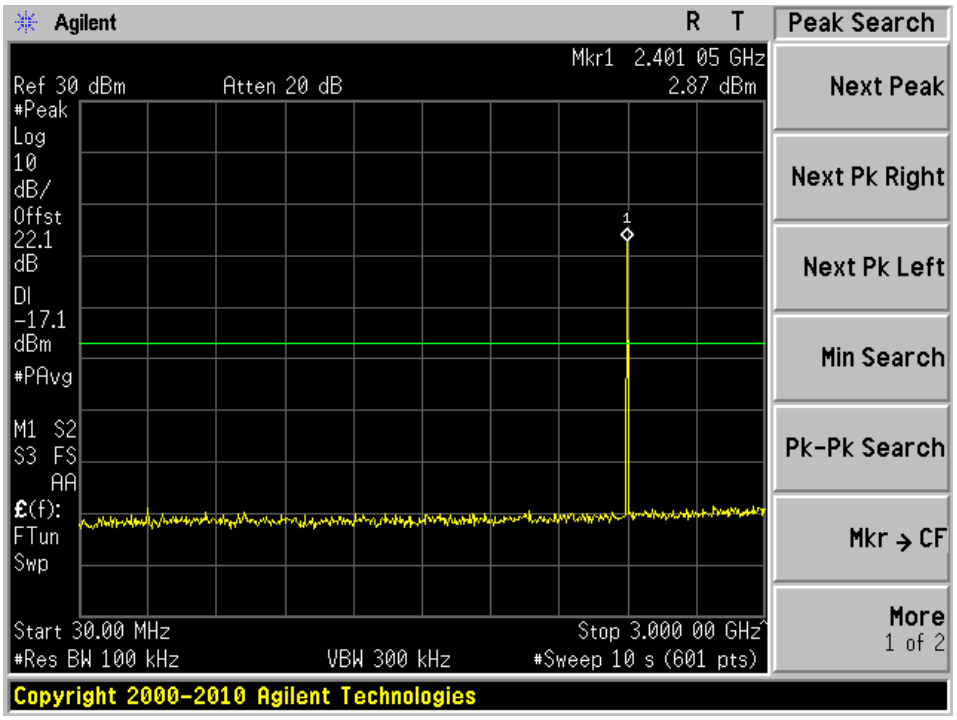


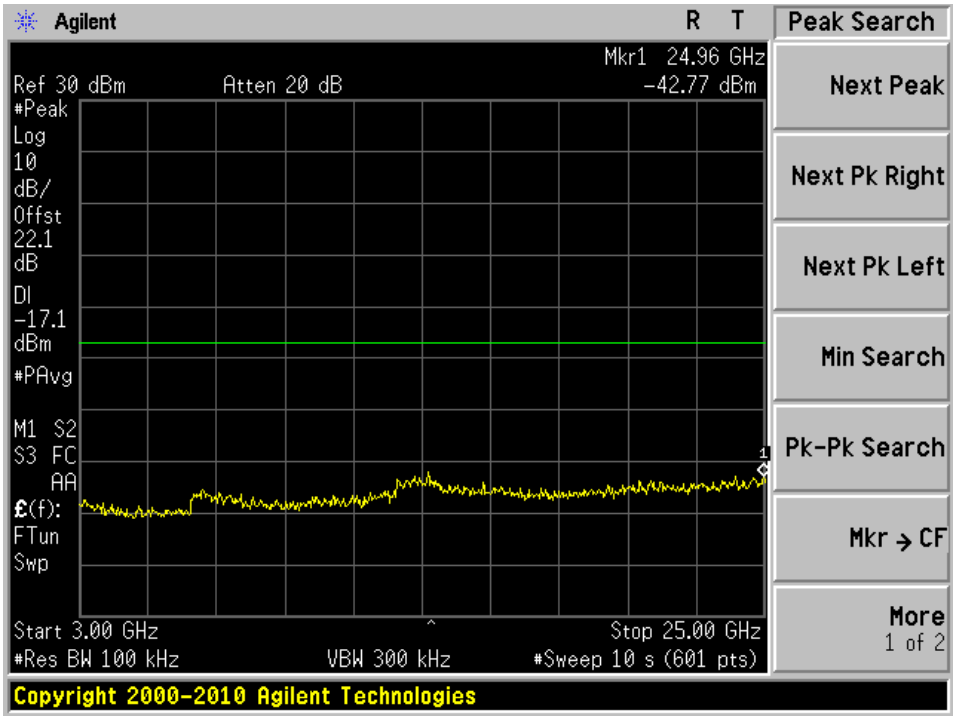
High Channel DQPSK



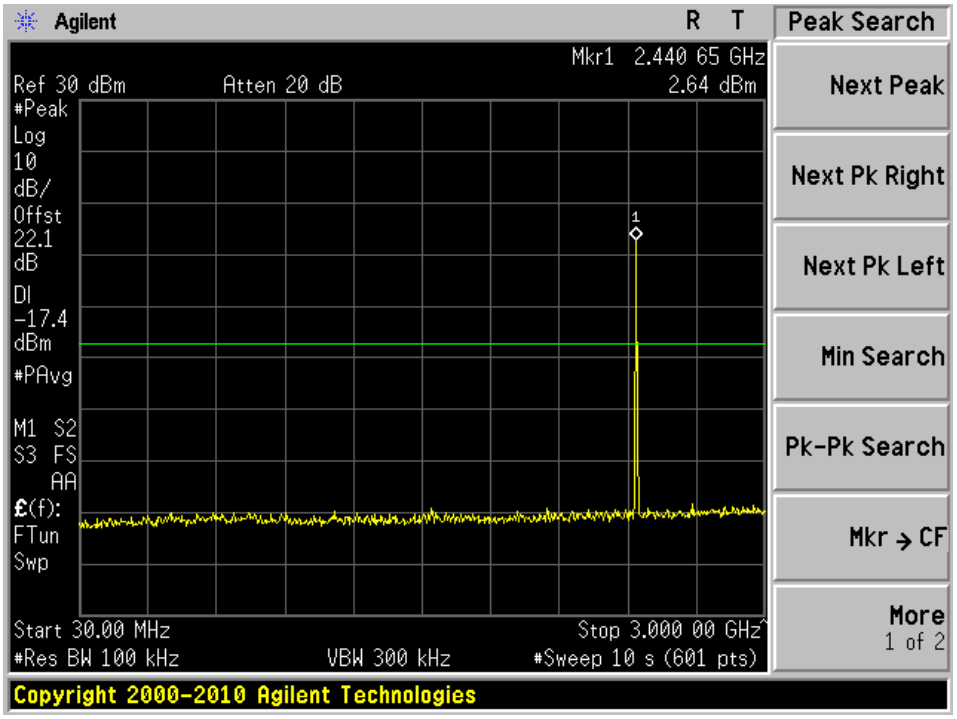


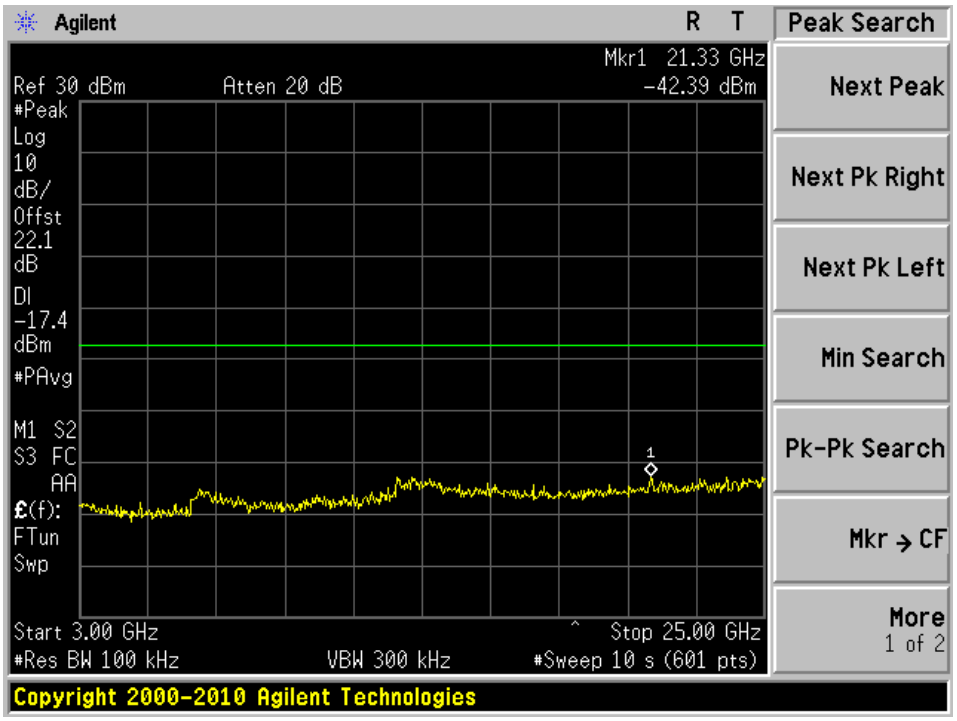
Low Channel 8DPSK



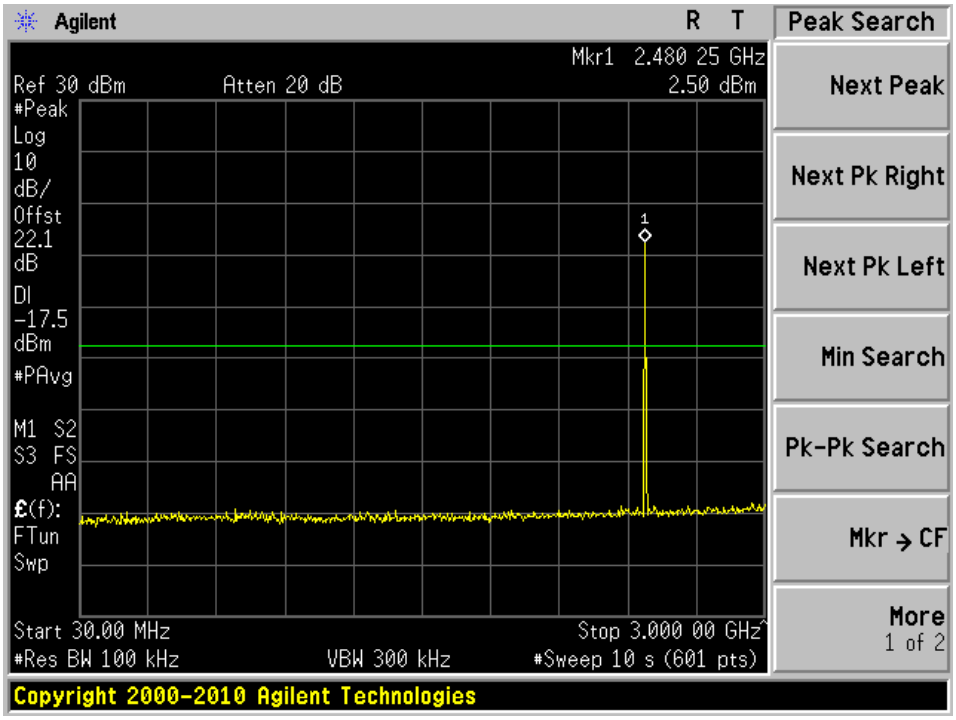


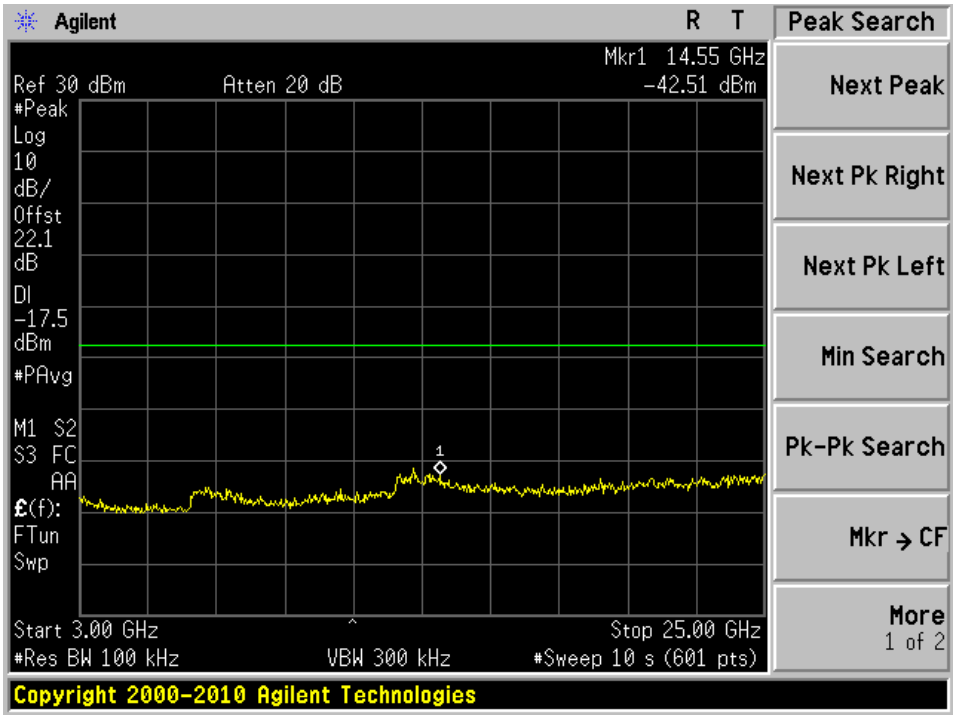
Middle Channel 8DPSK





High Channel 8DPSK





14 FCC §15.109 & IC RSS-Gen §6 - Receiver Radiated Spurious Emissions

14.1 Applicable Standards

FCC §15.109 and IC RSS-Gen §6

14.2 EUT Setup

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

14.3 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.

14.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

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

Margin = Corrected Amplitude - Limit

14.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
A.H Systems	Horn Antenna	SAS-200/571	261	2012-01-18
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2012-06-09
Agilent	Spectrum Analyzer	E4440A	US45303156	2010-08-09[1]
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2011-08-10
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2012-03-22
Sunol Science Corp	System Controller	SC99V	122303-1	N/R

Note 1: Two year calibration cycle.

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

14.6 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	56 %
ATM Pressure:	101.8kPa

The testing was performed by Lionel Lara on 2012-06-12 in 5 meter chamber 3.

14.7 Summary of Test Results

According to the test data,, the EUT complied with the FCC Part 15.109 and IC RSS-Gen, with the closest margins from the limit listed below:

Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-11.21	167.9803	Horizontal	30 to 1000 MHz
-[1]	-	-	1 – 25 GHz

Note 1: Spurious emissions at noise floor level.

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

14.8 Test Results

Chip Antenna

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

Frequency (MHz)	**Corrected Amplitude (dB)**	**Antenna Height (cm)**	**Antenna Polarity (H/V)**	**Turntable Azimuth (degrees)**	**Limit (dBµV/m)**	**Margin (dB)**	**Comments**
167.9728	30.07	166	H	133	43.5	-13.43	Quasi-Peak
252.2215	32.27	113	H	0	46	-13.73	Quasi-Peak
432.0673	29.78	197	H	79	46	-16.22	Quasi-Peak
135.3225	26.86	249	H	138	43.5	-16.64	Quasi-Peak
240.101	29.14	100	H	10	46	-16.86	Quasi-Peak
31.309	15.41	140	V	155	40	-24.59	Quasi-Peak

2) 1 – 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)**	
-[1]	-	-	-	H	-	-	-	-	-	-	-
-	-	-	-	V	-	-	-	-	-	-	-

Note 1: Spurious emissions at noise floor level.

Mono-pole Antenna

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

Frequency (MHz)	Corrected Amplitude (dB)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comments
167.9803	32.29	163	H	79	43.5	-11.21	Quasi-Peak
528.21	31.17	182	H	83	46	-14.83	Quasi-Peak
552.2208	31.03	203	H	273	46	-14.97	Quasi-Peak
144.0525	26.59	255	H	73	43.5	-16.91	Quasi-Peak
156.0683	24.19	151	H	82	43.5	-19.31	Quasi-Peak
504.3143	26.55	203	H	74	46	-19.45	Quasi-Peak

2) 1 – 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)	
-[1]	-	-	-	H	-	-	-	-	-	-	-
-	-	-	-	V	-	-	-	-	-	-	-

Note 1: Spurious emissions at noise floor level.

15 FCC §15.247(i), § 2.1091 & IC RSS-102 - RF Exposure Information

15.1 Applicable Standards

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 2 section 4.1, 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/m^2)	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	$0.158\ f^{0.5}$	$4.21 \times 10\text{ -4 } f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000 / f^{1.2}$

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

15.2 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

15.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	3.69
Maximum peak output power at antenna input terminal (mW):	2.34
Prediction distance (cm):	20
Prediction frequency (MHz):	2402
Maximum Antenna Gain, typical (dBi):	1.4
Maximum Antenna Gain (numeric):	1.38
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.000642
Power density of prediction frequency at 20.0 cm (W/m^2):	0.00642
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. The maximum power density at the distance of 20 cm is 0.000642 mW/cm^2 (0.00642 W/m^2), Limit is 1 mW/cm^2 (10 W/m^2).