FCC PART 15, SUBPART C
ISED RSS-247, ISSUE 2, FEBRUARY 2017

TEST AND MEASUREMENT REPORT

For

Intel Corporation

2200 Mission College Blvd.,
Santa Clara, CA 95054, USA

FCC ID: 2AB8ZND26
IC: 1000X-ND26

Report Type:	**Product Type:**
Original Report	Smart Watch

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1705182-247 DSS	Original Report	2017-06-23

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Intel Corporation*, and their product model: *SBF81,* FCC ID: 2AB8ZND26, IC: 1000X-ND26 or the "EUT" as referred to in this report. It is a smart watch with Wi-Fi, NFC, Bluetooth Classic, and Bluetooth Low Energy functions.

1.2 Mechanical Description of EUT

The EUT measures approximately 4.7625 cm (L) x 4.445 cm (W) x 1.5875 cm (H) and weight 0.052 kg.

The test data gathered are from typical production sample, serial number: SCDV15HR716000H and SCDV1EHR7160006 assigned by Intel Corporation.

1.3 Objective

This report is prepared on behalf of *Intel Corporation,* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's rules and ISED RSS-247 Issue 2, FEBRUARY 2017.

The objective is to determine compliance with FCC Part 15.247 and ISED RSS-247 rules for Output Power, Antenna Requirements, 20 dB Bandwidth, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions, Number of Hopping Channels, Dwell Time, and Hopping Channel Separation.

1.4 Related Submittal(s)/Grant(s)

FCC Part 15, Subpart C, Equipment DTS with FCC ID: 2AB8ZND26, IC: 1000X-ND26
FCC Part 15, Subpart C, Equipment DXX with FCC ID: 2AB8ZND26, IC: 1000X-ND26

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 ºC
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02)*****,** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile and Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime and Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes and Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D. A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Industry Canada - IC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I and Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - Radio and Teleterminal Equipment (RandTTE) Directive 1995/5/EC
    US -EU EMC and Telecom MRA CAB
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I and Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Development Authority - IDA) APEC Tel MRA -Phase I and Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing in accordance to ANSI C63.10-2013.
The worst-case data rates are determined by measuring the peak power across all data rates.

2.2 EUT Exercise Software

The test firmware used was the Android Debug Bridge program and the command lines were provided by *Intel Corporation.* The software is compliant with the standard requirements being tested against.

2.3 Duty Cycle Correction Factor

According to ANSI C63.10-2013 section 7.5:

Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s (100 ms). In cases where the pulse train exceeds 0.1 s, the measured field strength shall be determined during a 0.1 s interval. The following procedure is an example of how the average value may be determined. The average field strength may be found by measuring the peak pulse amplitude (in log equivalent units) and determining the duty cycle correction factor (in dB) associated with the pulse modulation as shown in following equation:

$\delta(dB) = 20\log(\Delta)$

where
δ is the duty cycle correction factor (dB)
Δ is the duty cycle (dimensionless)

GFSK

Type	On Time (µs)	Period (µs)	Duty Cycle (%)	Radiated Duty Cycle Correction Factor (dB)
DH1	380	1250	30.40	-10.34
DH3	1642	2500	65.68	-3.65
DH5	2900	3750	77.33	-2.23

π/4-DQPSK

Type	On Time (µs)	Period (µs)	Duty Cycle (%)	Radiated Duty Cycle Correction Factor (dB)
DH1	390	1250	31.20	-10.12
DH3	1642	2500	65.68	-3.65
DH5	2883	3773	76.41	-2.34

8DPSK

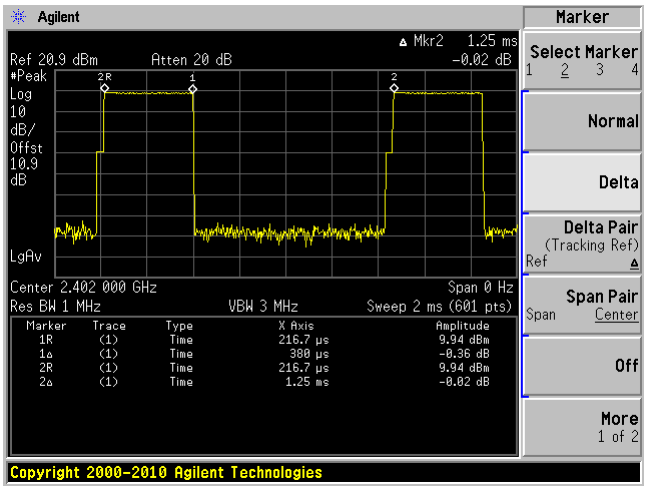
Type	On Time (µs)	Period (µs)	Duty Cycle (%)	Radiated Duty Cycle Correction Factor (dB)
DH1	390	1250	31.20	-10.12
DH3	1633	2500	65.32	-3.70
DH5	2883	3750	76.88	-2.28

Duty Cycle = On Time (ms)/ Period (ms)

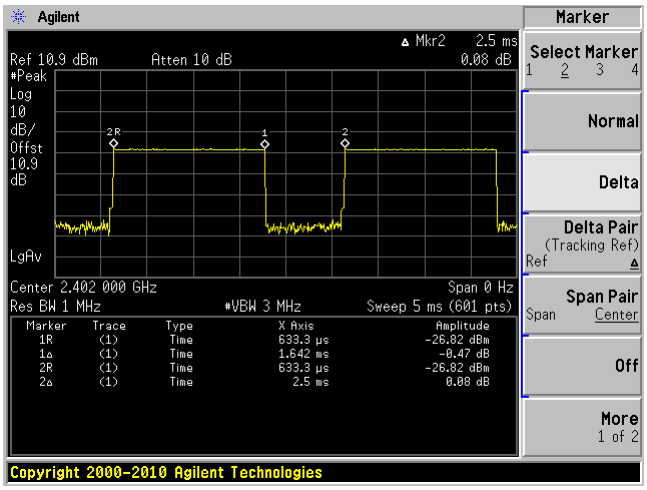
Please refer to the following plots.

GFSK Mode

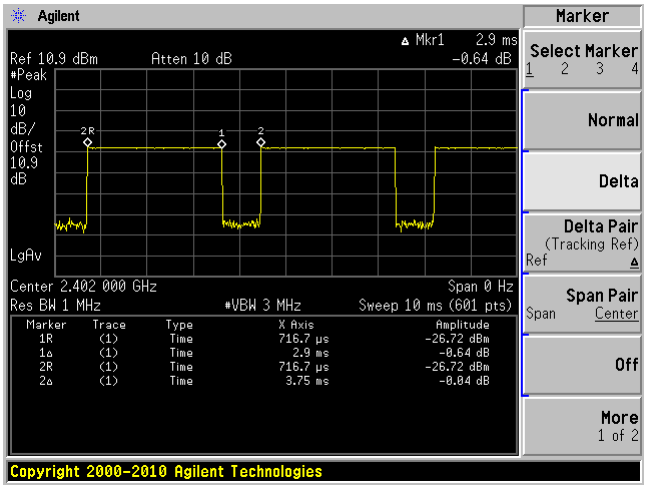
DH1



DH3

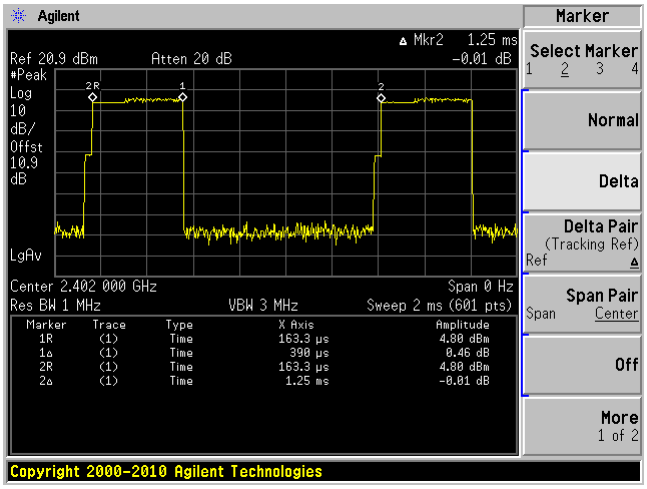


DH5

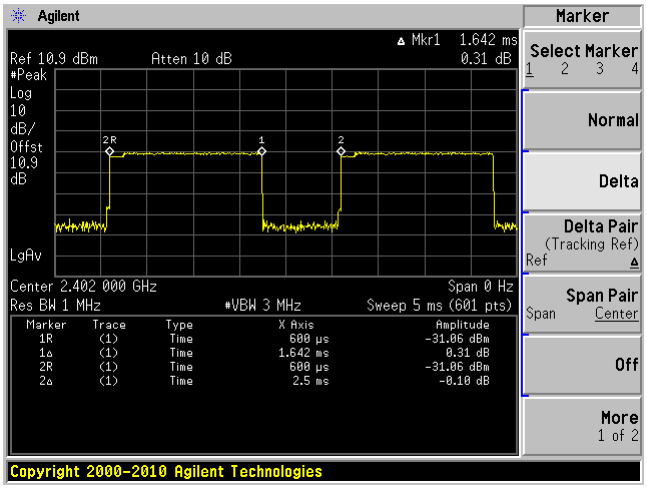


π/4-DQPSK Mode

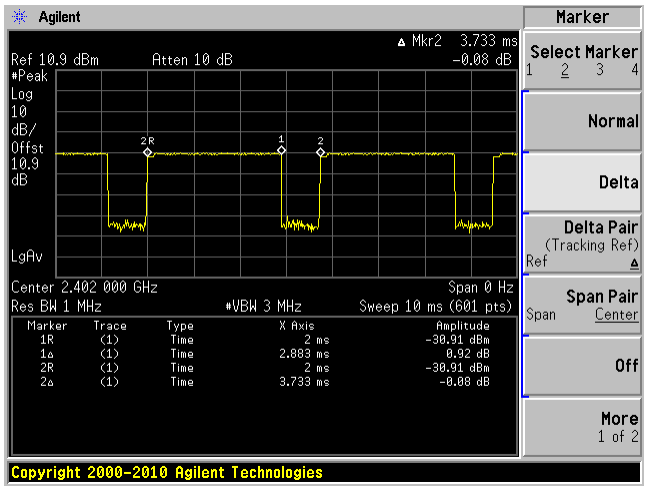
DH1



DH3

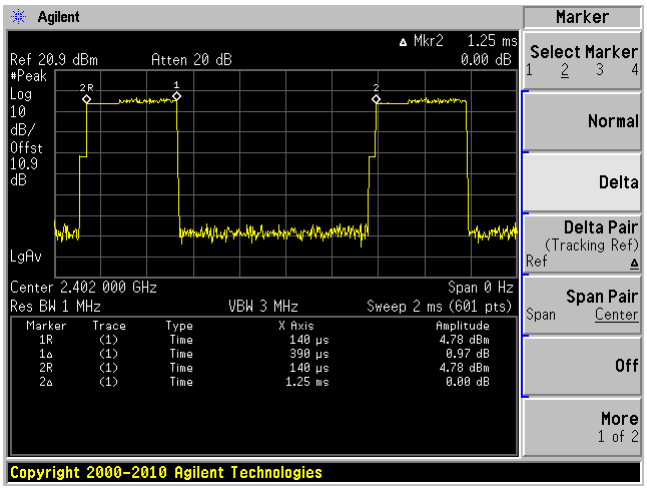


DH5

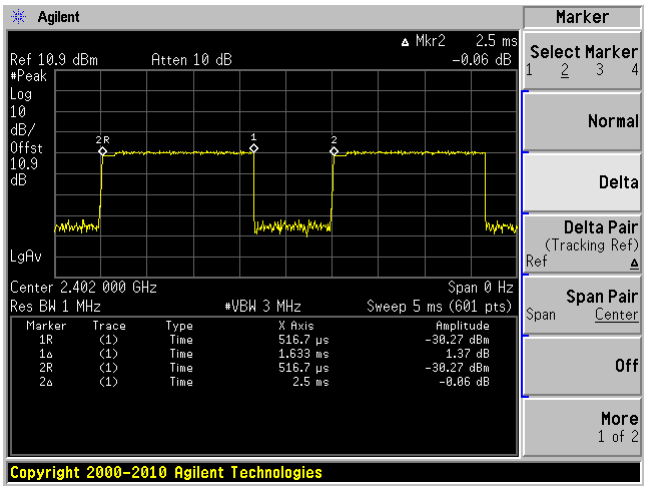


8DPSK Mode

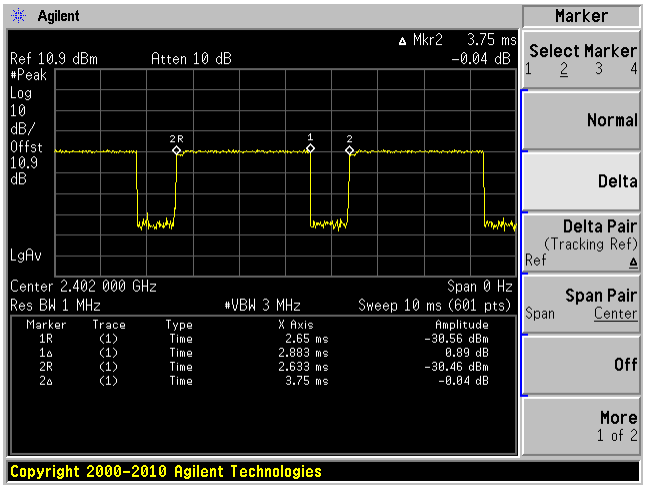
DH1



DH3



DH5



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model
Lenovo	Laptop	20332

2.6 Support Equipment

There was no support equipment included, or intended for use with EUT during these tests.

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	< 1 m	Laptop	EUT
RF Cable	< 1 m	EUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISED Rules	Description of Test	Results
FCC §15.203 ISED RSS-Gen §8.3	Antenna Requirement	Compliant
FCC §15.207 ISED RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §2.1093, §15.247(i) ISED RSS-102	RF Exposure	Compliant[1]
FCC §2.1051, §15.247 (d) ISED RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247(d) ISED RSS-247 §5.5 ISED RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1) ISED RSS-247 §5.1 (1)	20 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(1) ISED RSS-247 §5.1(2)	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISED RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(a)(1)(iii) ISED RSS-247 §5.1(4)	Number of Hopping Channels	Compliant
FCC §15.247(a)(1) ISED RSS-247 §5.1 (2)	Hopping Channel Separation	Compliant
FCC §15.247(a)(1)(iii) ISED RSS-247 §5.1 (4)	Dwell Time	Compliant

Note[1]: RF exposure analysis is covered in a separate report. Please refers to R1705182-SAR

4 FCC §15.203 and ISED RSS-Gen §8.3 - Antenna Requirements

4.1 Applicable Standards

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 ISED RSS-Gen §8.3: Transmitter Antenna

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the license-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

License-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the license-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of license-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. 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 a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

4.2 Antenna Description

The antennas used by the EUT are permanent attached antennas.

Radio Antenna	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Wi-Fi/Bluetooth	2400-2483.5	-7.432

5 FCC §2.1093, §15.247(i) and ISED RSS-102 - RF Exposure

5.1 Applicable Standards

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

5.2 Test Results

Please refer to the SAR Report: R1705182-SAR.

6 FCC §15.207 and ISED RSS-Gen §8.8 - AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and ISED RSS-Gen §8.8 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 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.
Note 2: A linear average detector is required

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used was FCC §15.207 and ISED RSS-Gen §8.8 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 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 and the power cords of support equipment were connected to LISN-2.

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

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

6.4 Corrected Amplitude and Margin Calculation

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

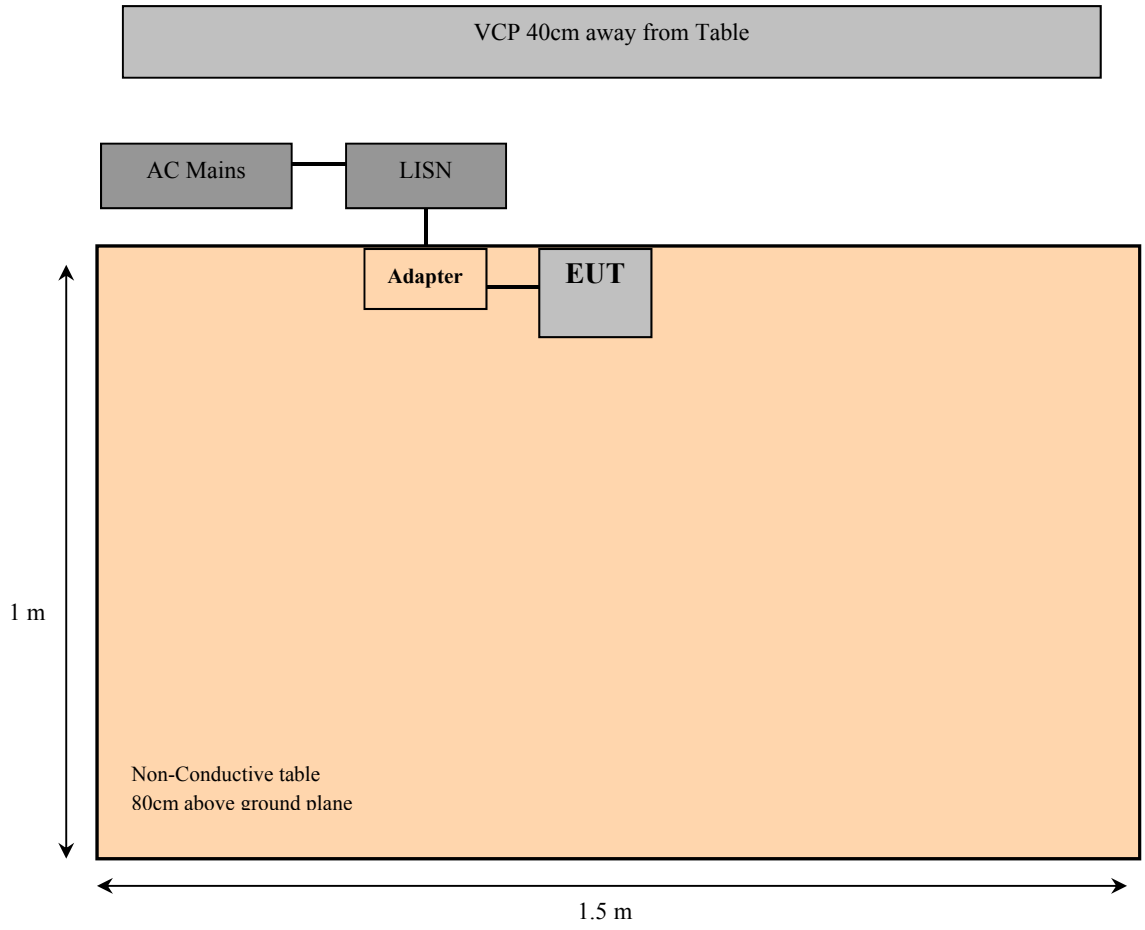
CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (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

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2016-02-04	2 year
Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2016-07-22	1 year
Keysight Technologies	RF Limiter	11867A	MY42242932	2016-12-15	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2017-03-09	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	2017-03-05	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

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:	22 ºC
Relative Humidity:	42 %
ATM Pressure:	102 kPa

The testing was performed by Frank Wang on 2017-06-06 in site.

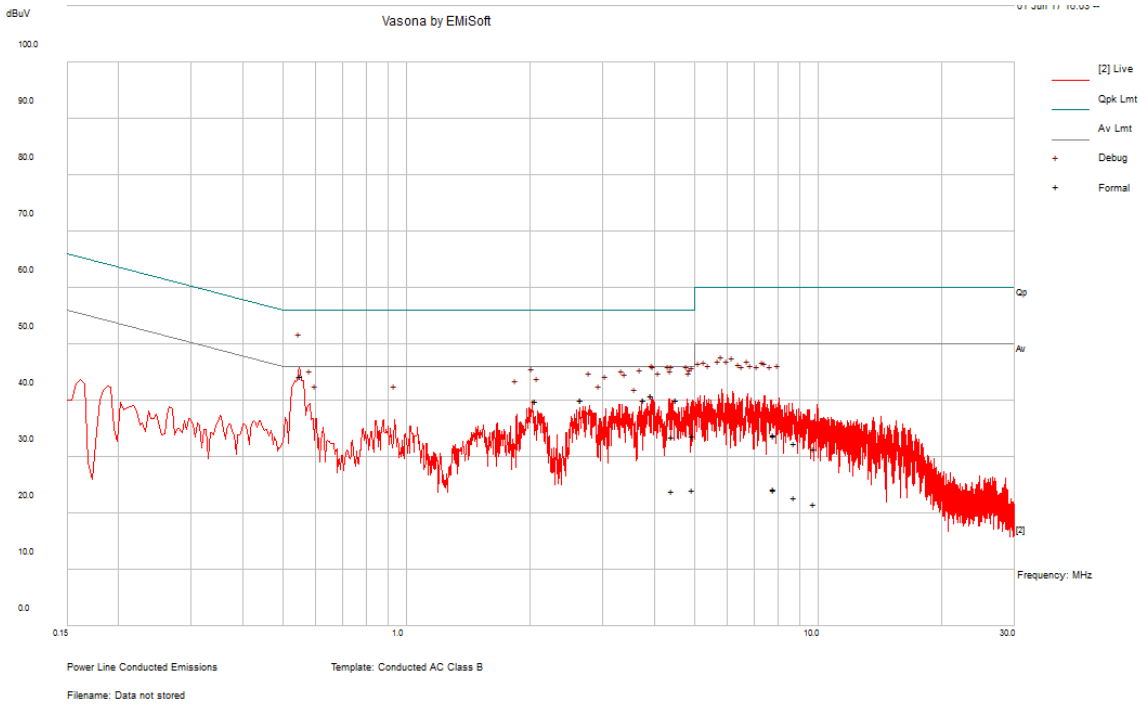
6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C and ISED RSS-Gen standard's conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-10.3	0.549024	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

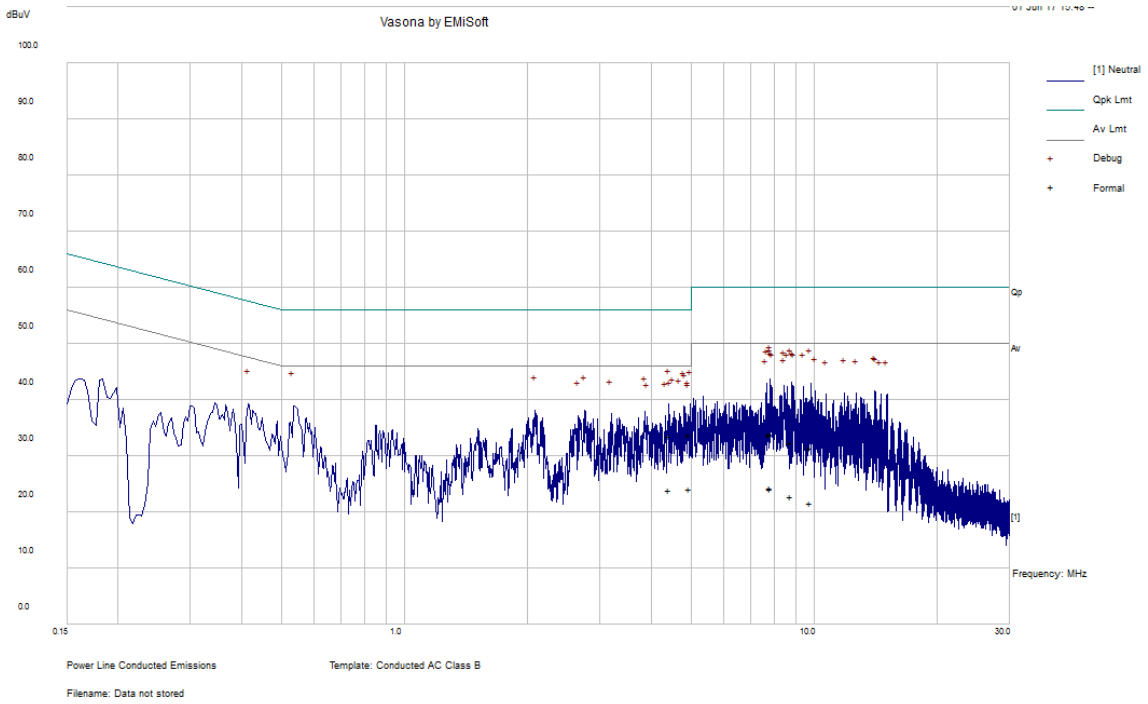
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.547219	44.38	Line	56	-11.62	QP
0.549024	43.94	Line	56	-12.06	QP
0.537306	43.14	Line	56	-12.86	QP
3.951452	36.09	Line	56	-19.91	QP
3.946664	35.96	Line	56	-20.04	QP
3.97257	35.83	Line	56	-20.17	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.547219	35.65	Line	46	-10.35	Ave.
0.549024	35.7	Line	46	**-10.3**	Ave.
0.537306	34.33	Line	46	-11.67	Ave.
3.951452	27.9	Line	46	-18.1	Ave.
3.946664	27.95	Line	46	-18.05	Ave.
3.97257	27.8	Line	46	-18.2	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
7.794744	34.03	Neutral	60	-25.97	QP
4.430855	33.65	Neutral	56	-22.35	QP
4.971696	33.84	Neutral	56	-22.16	QP
8.784861	32.36	Neutral	60	-27.64	QP
7.799282	33.83	Neutral	60	-26.17	QP
9.795239	31.56	Neutral	60	-28.44	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
7.794744	24.3	Neutral	50	-25.7	Ave.
4.430855	24	Neutral	46	-22	Ave.
4.971696	24.14	Neutral	46	-21.86	Ave.
8.784861	22.75	Neutral	50	-27.25	Ave.
7.799282	24.27	Neutral	50	-25.73	Ave.
9.795239	21.6	Neutral	50	-28.4	Ave.

7 FCC §15.209, §15.247(d) and ISED RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions

7.1 Applicable Standards

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

As Per FCC §15.205(a) and RSS-Gen 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		
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	4. 5 – 5. 15
2.1735 – 2.1905	25.5 – 25.67	1300 – 1427	5. 35 – 5. 46
4.125 – 4.128	37.5 – 38.25	1435 – 1626.5	7.25 – 7.75
4.17725 – 4.17775	73 – 74.6	1645.5 – 1646.5	8.025 – 8.5
4.20725 – 4.20775	74.8 – 75.2	1660 – 1710	9.0 – 9.2
6.215 – 6.218	108 – 121.94	1718.8 – 1722.2	9.3 – 9.5
6.26775 – 6.26825	123 – 138	2200 – 2300	10.6 – 12.7
6.31175 – 6.31225	149.9 – 150.05	2310 – 2390	13.25 – 13.4
8.291 – 8.294	156.52475 – 156.52525	2483.5 – 2500	14.47 – 14.5
8.362 – 8.366	156.7 – 156.9	2690 – 2900	15.35 – 16.2
8.37625 – 8.38675	162.0125 –167.17	3260 – 3267	17.7 – 21.4
8.41425 – 8.41475	167.72 – 173.2	3.332 – 3.339	22.01 – 23.12
12.29 – 12.293	240 – 285	3 3458 – 3 358	23.6 – 24.0
12.51975 – 12.52025	322 – 335.4	3.600 – 4.400	31.2 – 31.8
12.57675 – 12.57725	399.9 – 410		36.43 – 36.5
13.36 – 13.41	608 – 614		Above 38.6

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (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 §15.247 (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 ISED RSS-Gen 8.9,

> Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz

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

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

As per ISED RSS-247 §5.5, 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 5.4(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.

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C and ISED RSS-247 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.

7.3 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 was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, 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 > 1/*T* Hz / Sweep = Auto

7.4 Corrected Amplitude and 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

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2016-02-04	2 year
Agilent	Analyzer, Spectrum	E4446A	US44300386	2016-06-10	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	2 years
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2016-06-28	1 year
IW	Armored High Frequency Cable	DC 1531	KPS-1501A3960KPS	2016-08-05	1 year
-	SMA cable	-	C0002	Each time[1]	N/A
-	N-Type Cable	-	C00014	2017-05-28	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2017-03-23	1 year
Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2015-10-22	2 years
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

7.6 Test Environmental Conditions

Temperature:	20-22 ºC
Relative Humidity:	42-46 %
ATM Pressure:	102 kPa

The testing was performed by Frank Wang from 2017-05-28 to 2017-6-05 in 5m chamber 3.

7.7 Summary of Test Results

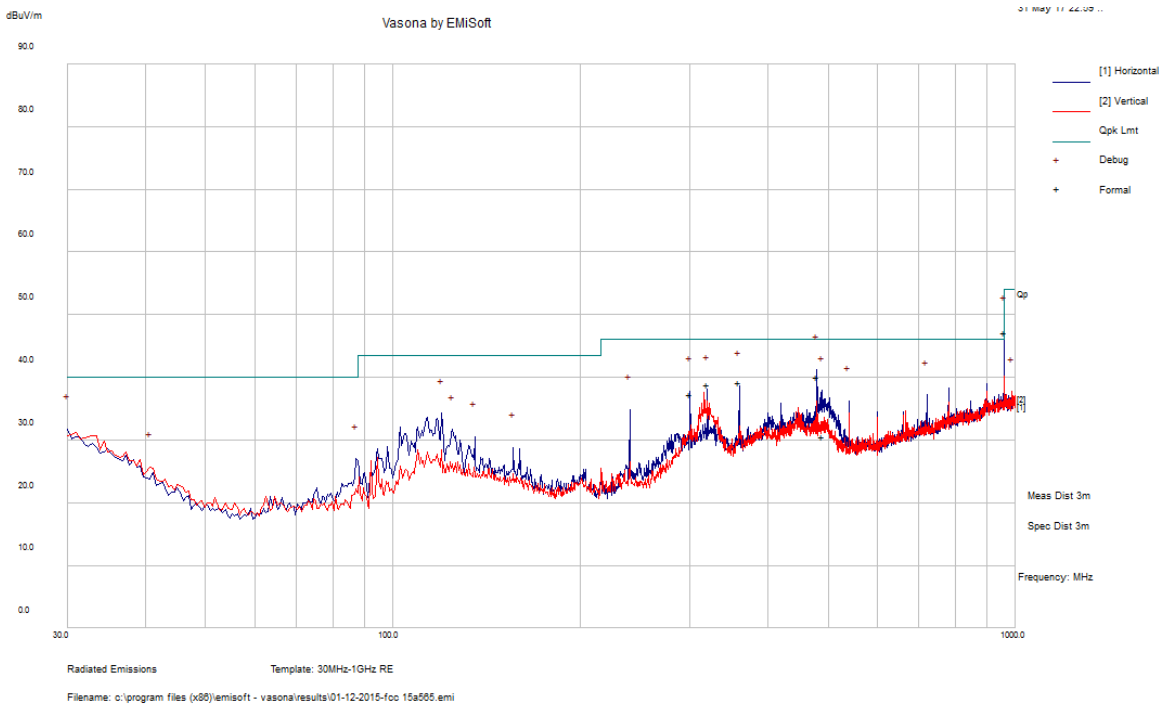
According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C and ISED RSS-247 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-3.81	2483.5	Vertical	GFSK, 2480 MHz

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

7.8 Radiated Emissions Test Results

1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
480.0013	40.04	202	H	360	46	-5.96	QP
960.0018	47.2	100	H	342	54	-6.8	QP
359.997	39.25	100	H	136	46	-6.75	QP
320.0005	38.92	101	H	282	46	-7.08	QP
489.9395	30.5	245	H	128	46	-15.5	QP
300.0093	37.34	113	H	287	46	-8.66	QP

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2) 1–25 GHz Measured at 3 meters

GFSK mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz											
2402	66.29	272	282	H	29.04	5.19	0	100.52	-	-	PK
2402	65.60	272	282	H	29.04	5.19	0	99.83	-	-	AV
2402	64.01	0	282	V	29.04	5.19	0	98.24	-	-	PK
2402	62.91	0	282	V	29.04	5.19	0	97.14	-	-	AV
2390	27.23	0	100	H	29.04	5.19	0	61.46	74.00	-12.54	PK
2390	15.10	0	100	H	29.04	5.19	0	49.33	54.00	-4.67	AV
2390	27.81	0	100	V	29.04	5.19	0	62.04	74.00	-11.96	PK
2390	15.42	0	100	V	29.04	5.19	0	49.65	54.00	-4.35	AV
4804	47.70	0	100	H	32.47	8.71	38.56	50.32	74.00	-23.68	PK
4804	35.79	0	100	H	32.47	8.71	38.56	38.41	54.00	-15.59	AV
7206	46.31	0	100	H	36.69	11.17	37.9	56.27	74.00	-17.73	PK
7206	35.15	0	100	H	36.39	11.17	37.9	44.81	54.00	-9.19	AV
9608	47.97	0	100	H	37.77	13.41	38.29	60.86	74.00	-13.14	PK
9608	35.57	0	100	H	37.77	13.41	38.29	48.46	54.00	-5.54	AV
Middle Channel 2441 MHz											
2441	67.89	281	280	H	29.04	5.19	0.00	102.12	-	-	PK
2441	66.96	281	280	H	29.04	5.19	0.00	101.19	-	-	AV
2441	63.64	0	273	V	29.04	5.19	0.00	97.87	-	-	PK
2441	62.67	0	273	V	29.04	5.19	0.00	96.90	-	-	AV
4882	47.79	0	100	H	32.64	8.71	38.54	50.60	74.00	-23.40	PK
4882	36.19	0	100	H	32.64	8.71	38.54	39.00	54.00	-15.00	AV
7323	46.21	0	100	H	37.15	11.17	37.90	56.63	74.00	-17.37	PK
7323	35.05	0	100	H	37.15	11.17	37.90	45.47	54.00	-8.53	AV
9764	47.30	0	100	H	37.92	13.41	38.29	60.34	74.00	-13.66	PK
9764	35.88	0	100	H	37.92	13.41	38.29	48.92	54.00	-5.08	AV

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2480 MHz											
2480	67.02	279	190	H	29.41	5.19	0.00	101.62	-	-	PK
2480	65.35	279	190	H	29.41	5.19	0.00	99.95	-	-	AV
2480	62.55	199	100	V	29.41	5.19	0.00	97.15	-	-	PK
2480	61.67	199	100	V	29.41	5.19	0.00	96.27	-	-	AV
2483.5	27.50	0	100	H	29.41	5.19	0.00	62.10	74.00	-11.90	PK
2483.5	15.57	0	100	H	29.41	5.19	0.00	50.17	54.00	-3.83	AV
2483.5	27.60	0	100	V	29.41	5.19	0.00	62.20	74.00	-11.80	PK
2483.5	15.59	0	100	V	29.41	5.19	0.00	50.19	54.00	**-3.81**	AV
4960	48.03	0	100	H	32.64	8.71	38.54	50.84	74.00	-23.16	PK
4960	36.41	0	100	H	32.64	8.71	38.54	39.22	54.00	-14.78	AV
7440	46.17	0	100	H	37.14	11.17	37.89	56.59	74.00	-17.41	PK
7440	34.74	0	100	H	37.14	11.17	37.89	45.16	54.00	-8.84	AV
9920	46.21	0	100	H	37.99	13.41	38.33	59.28	74.00	-14.72	PK
9920	34.98	0	100	H	37.99	13.41	38.33	48.05	54.00	-5.95	AV

π/4-DQPSK mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz											
2402	61.91	281	262	H	29.04	5.19	0	96.14	-	-	PK
2402	52.83	281	262	H	29.04	5.19	0	87.06	-	-	AV
2402	59.12	148	253	V	29.04	5.19	0	93.35	-	-	PK
2402	49.41	148	253	V	29.04	5.19	0	83.64	-	-	AV
2390	26.70	0	100	H	29.04	5.19	0	60.93	74.00	-13.07	PK
2390	12.85	0	100	H	29.04	5.19	0	47.08	54.00	-6.92	AV
2390	27.72	0	100	V	29.04	5.19	0	61.95	74.00	-12.05	PK
2390	12.82	0	100	V	29.04	5.19	0	47.05	54.00	-6.95	AV
4804	49.44	0	100	H	32.47	8.71	38.56	52.06	74.00	-21.94	PK
4804	33.57	0	100	H	32.47	8.71	38.56	36.19	54.00	-17.81	AV
7206	47.26	0	100	H	36.69	11.17	37.9	57.22	74.00	-16.78	PK
7206	33.19	0	100	H	36.39	11.17	37.9	42.85	54.00	-11.15	AV
9608	47.42	0	100	H	37.77	13.41	38.29	60.31	74.00	-13.69	PK
9608	33.51	0	100	H	37.77	13.41	38.29	46.40	54.00	-7.60	AV
Middle Channel 2441 MHz											
2441	64.05	253	232	H	29.04	5.19	0.00	98.28	-	-	PK
2441	54.40	253	232	H	29.04	5.19	0.00	88.63	-	-	AV
2441	62.10	168	278	V	29.04	5.19	0.00	96.33	-	-	PK
2441	52.38	168	278	V	29.04	5.19	0.00	86.61	-	-	AV
4882	47.00	0	100	H	32.64	8.71	38.54	49.81	74.00	-24.19	PK
4882	33.06	0	100	H	32.64	8.71	38.54	35.87	54.00	-18.13	AV
7323	47.25	0	100	H	37.15	11.17	37.90	57.67	74.00	-16.33	PK
7323	32.68	0	100	H	37.15	11.17	37.90	43.10	54.00	-10.90	AV
9764	46.84	0	100	H	37.92	13.41	38.29	59.88	74.00	-14.12	PK
9764	32.87	0	100	H	37.92	13.41	38.29	45.91	54.00	-8.09	AV
High Channel 2480 MHz											
2480	61.48	241	282	H	29.41	5.19	0.00	96.08	-	-	PK
2480	52.40	241	282	H	29.41	5.19	0.00	87.00	-	-	AV
2480	60.65	5	100	V	29.41	5.19	0.00	95.25	-	-	PK
2480	51.74	5	100	V	29.41	5.19	0.00	86.34	-	-	AV
2483.5	27.36	0	100	H	29.41	5.19	0.00	61.96	74.00	-12.04	PK
2483.5	13.48	0	100	H	29.41	5.19	0.00	48.08	54.00	-5.92	AV
2483.5	27.10	0	100	V	29.41	5.19	0.00	61.70	74.00	-12.30	PK
2483.5	13.47	0	100	V	29.41	5.19	0.00	48.07	54.00	-5.93	AV
4960	47.03	0	100	H	32.64	8.71	38.54	49.84	74.00	-24.16	PK
4960	33.70	0	100	H	32.64	8.71	38.54	36.51	54.00	-17.49	AV
7440	46.22	0	100	H	37.14	11.17	37.89	56.64	74.00	-17.36	PK
7440	32.51	0	100	H	37.14	11.17	37.89	42.93	54.00	-11.07	AV
9920	45.75	0	100	H	37.99	13.41	38.33	58.82	74.00	-15.18	PK
9920	32.48	0	100	H	37.99	13.41	38.33	45.55	54.00	-8.45	AV

8DPSK mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz											
2402	63.37	280	269	H	29.04	5.19	0	97.60	-	-	PK
2402	53.90	280	269	H	29.04	5.19	0	88.13	-	-	AV
2402	59.94	165	243	V	29.04	5.19	0	94.17	-	-	PK
2402	50.18	165	243	V	29.04	5.19	0	84.41	-	-	AV
2390	27.08	0	100	H	29.04	5.19	0	61.31	74.00	-12.69	PK
2390	12.85	0	100	H	29.04	5.19	0	47.08	54.00	-6.92	AV
2390	27.37	0	100	V	29.04	5.19	0	61.60	74.00	-12.40	PK
2390	12.84	0	100	V	29.04	5.19	0	47.07	54.00	-6.93	AV
4804	46.32	0	100	H	32.47	8.71	38.56	48.94	74.00	-25.06	PK
4804	33.51	0	100	H	32.47	8.71	38.56	36.13	54.00	-17.87	AV
7206	46.40	0	100	H	36.69	11.17	37.9	56.36	74.00	-17.64	PK
7206	32.76	0	100	H	36.39	11.17	37.9	42.42	54.00	-11.58	AV
9608	46.58	0	100	H	37.77	13.41	38.29	59.47	74.00	-14.53	PK
9608	33.48	0	100	H	37.77	13.41	38.29	46.37	54.00	-7.63	AV
Middle Channel 2441 MHz											
2441	64.21	232	282	H	29.04	5.19	0.00	98.44	-	-	PK
2441	54.77	232	282	H	29.04	5.19	0.00	89.00	-	-	AV
2441	61.16	0	100	V	29.04	5.19	0.00	95.39	-	-	PK
2441	51.64	0	100	V	29.04	5.19	0.00	85.87	-	-	AV
4880	46.63	0	100	H	32.64	8.71	38.54	49.44	74.00	-24.56	PK
4880	33.17	0	100	H	32.64	8.71	38.54	35.98	54.00	-18.02	AV
7320	45.70	0	100	H	37.15	11.17	37.90	56.12	74.00	-17.88	PK
7320	32.52	0	100	H	37.15	11.17	37.90	42.94	54.00	-11.06	AV
9760	47.11	0	100	H	37.92	13.41	38.29	60.15	74.00	-13.85	PK
9760	33.30	0	100	H	37.92	13.41	38.29	46.34	54.00	-7.66	AV
High Channel 2480 MHz											
2480	61.74	228	287	H	29.41	5.19	0.00	96.34	-	-	PK
2480	52.35	228	287	H	29.41	5.19	0.00	86.95	-	-	AV
2480	60.00	159	112	V	29.41	5.19	0.00	94.60	-	-	PK
2480	50.54	159	112	V	29.41	5.19	0.00	85.14	-	-	AV
2483.5	26.55	0	100	H	29.41	5.19	0.00	61.15	74.00	-12.85	PK
2483.5	13.30	0	100	H	29.41	5.19	0.00	47.90	54.00	-6.10	AV
2483.5	27.06	0	100	V	29.41	5.19	0.00	61.66	74.00	-12.34	PK
2483.5	13.25	0	100	V	29.41	5.19	0.00	47.85	54.00	-6.15	AV
4960	47.75	0	100	H	32.64	8.71	38.54	50.56	74.00	-23.44	PK
4960	33.81	0	100	H	32.64	8.71	38.54	36.62	54.00	-17.38	AV
7440	45.76	0	100	H	37.14	11.17	37.89	56.18	74.00	-17.82	PK
7440	32.62	0	100	H	37.14	11.17	37.89	43.04	54.00	-10.96	AV
9920	45.27	0	100	H	37.99	13.41	38.33	58.34	74.00	-15.66	PK
9920	32.68	0	100	H	37.99	13.41	38.33	45.75	54.00	-8.25	AV

8 FCC §15.247(a) (1) and ISED RSS-247 §5.1, RSS-Gen §6.6 - Emission Bandwidth

8.1 Applicable Standards

According to FCC §15.247(a) (1) and ISED RSS-247 §5.1: the maximum 20 dB bandwidth of the hopping channel shall be presented.

8.2 Measurement Procedure

Span = approximately 2 to 5 times the 99% occupied bandwidth, centered on a hopping channel

RBW = 1% to 5 % of the 99% occupied bandwidth

VBW = 3RBW

Sweep = auto

Detector function = peak

Trace = max hold

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2016-06-10	1 year
-	RF Cable	-	-	Each time[1]	Each time[1]
-	10 dB attenuator	-	-	Each time[1]	Each time[1]

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

8.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Frank Wang on 2017-06-07 in RF site.

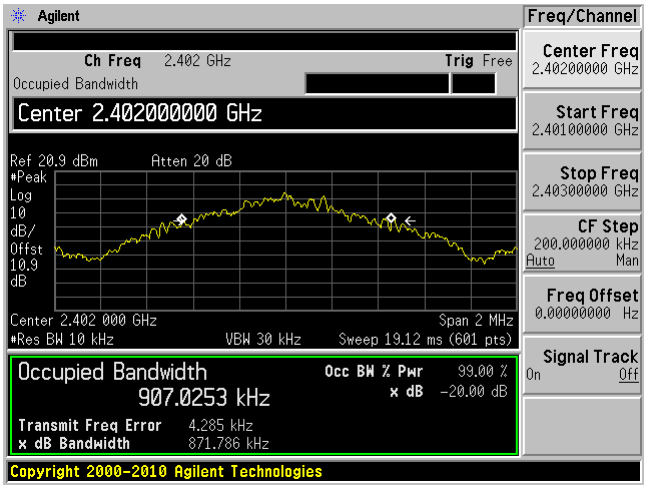
8.5 Test Results

Channel	Frequency (MHz)	99% OBW (kHz)	20 dB OBW (kHz)
GFSK			
Low	2402	907.0253	871.786
Middle	2441	905.1002	871.590
High	2480	898.2454	871.417
π/4-DQPSK			
Low	2402	1178.6	1241
Middle	2441	1181.5	1244
High	2480	1179.9	1244
8DPSK			
Low	2402	1169.6	1205
Middle	2441	1171.1	1204
High	2480	1170.5	1204

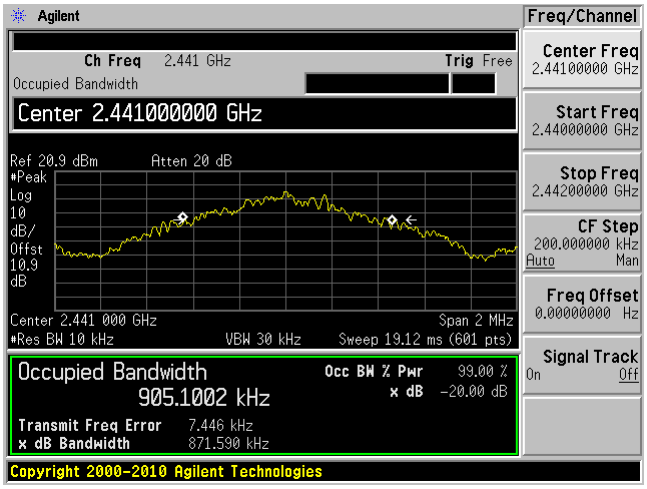
Please refer to the following plots for detailed test results.

GFSK

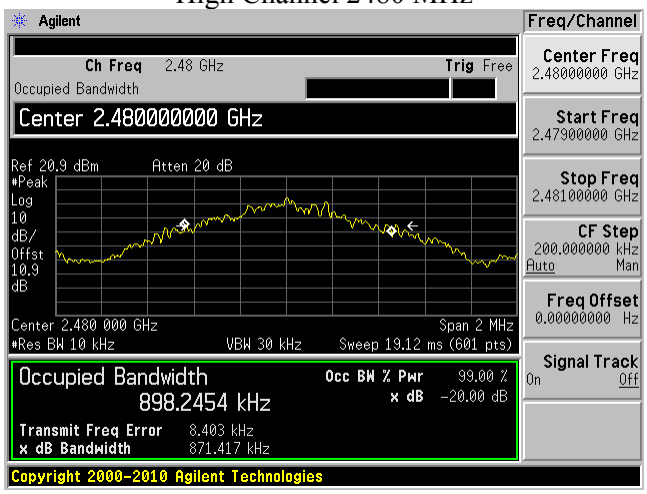
Low Channel 2402 MHz



Middle Channel 2441 MHz

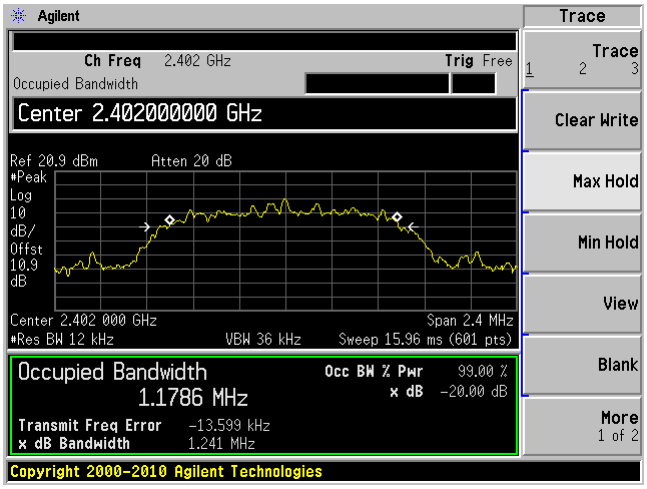


High Channel 2480 MHz

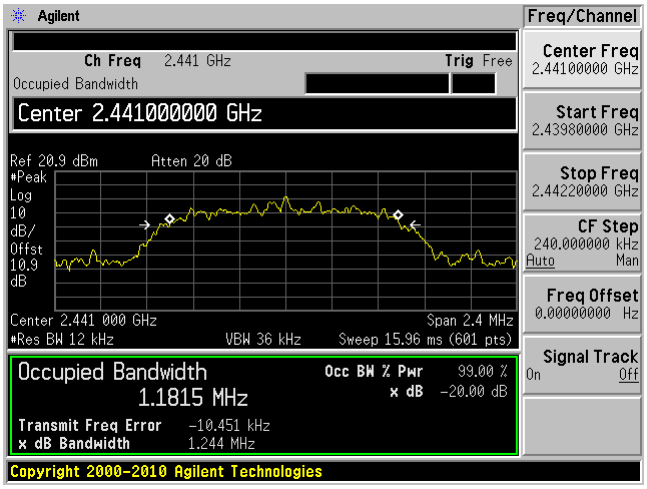


π/4-DQPSK

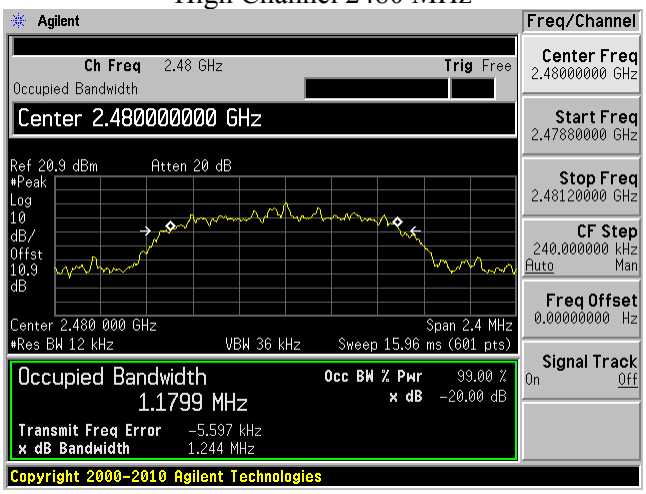
Low Channel 2402 MHz



Middle Channel 2441 MHz

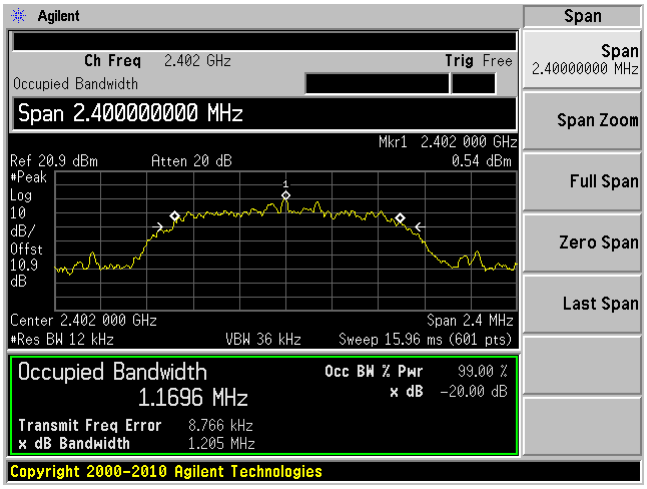


High Channel 2480 MHz

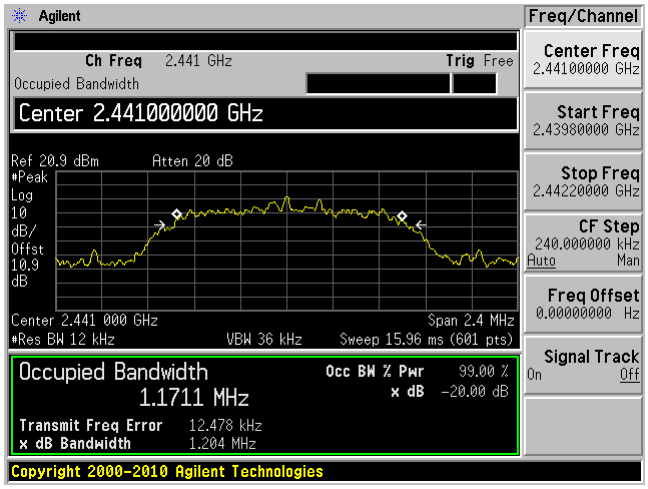


8DPSK

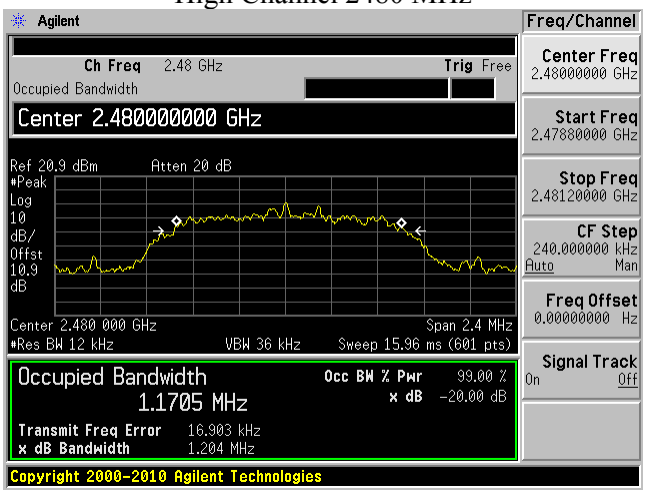
Low Channel 2402 MHz



Middle Channel 2441 MHz



High Channel 2480 MHz



9 FCC §15.247(b) (1) and ISED RSS-247 §5.4 – RF Output Power

9.1 Applicable Standards

According to FCC §15.247(b) (1): 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.

According to RSS-247 §5.4: For frequency hopping systems operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels.

9.2 Measurement Procedure

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2016-06-10	1 year
-	RF Cable	-	-	Each time[1]	Each time[1]
-	10 dB attenuator	-	-	Each time[1]	Each time[1]

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

9.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Frank Wang on 2017-06-06 in RF site.

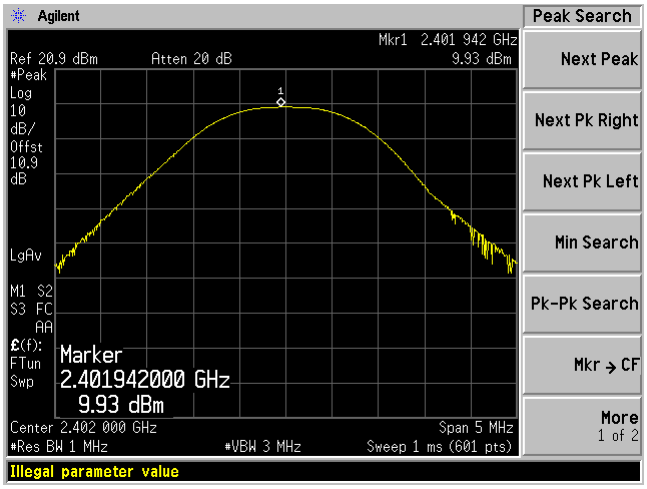
9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
GFSK			
Low	2402	9.93	30
Middle	2441	11.08	30
High	2480	9.91	30
Π/4-DQPSK			
Low	2402	7.38	30
Middle	2441	8.47	30
High	2480	7.41	30
8DPSK			
Low	2402	7.75	30
Middle	2441	8.80	30
High	2480	7.73	30

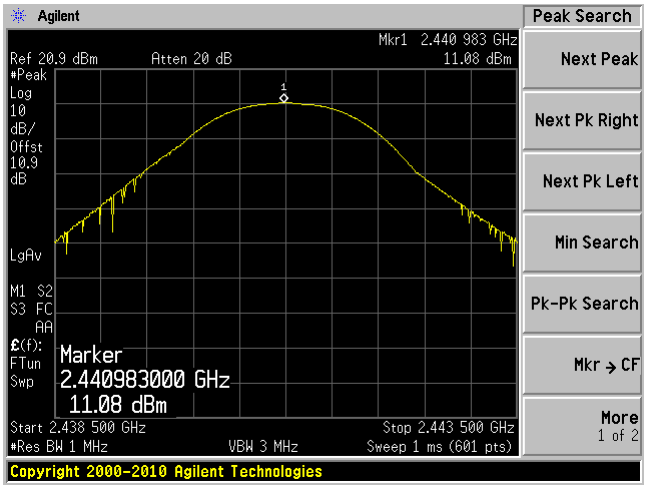
Please refer to the following plots for detailed test results.

GFSK

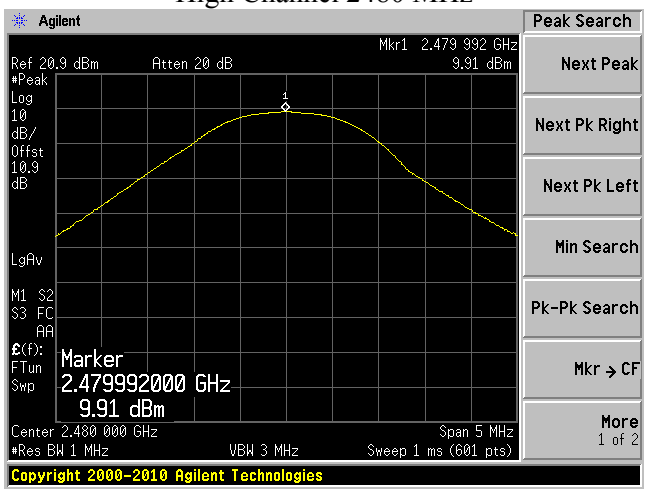
Low Channel 2402 MHz



Middle Channel 2441 MHz

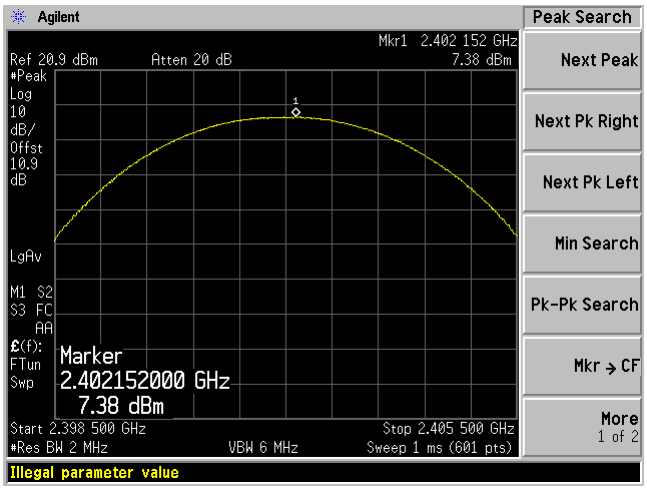


High Channel 2480 MHz

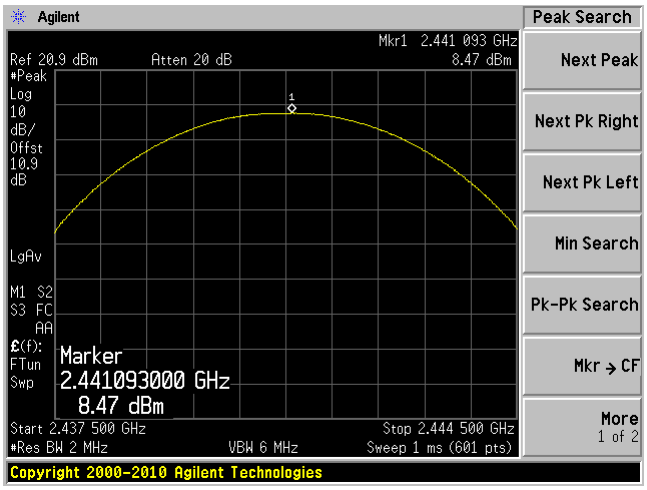


π/4-DQPSK

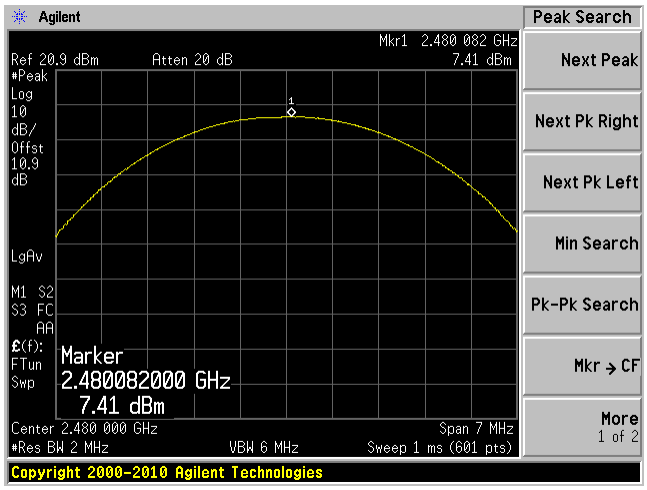
Low Channel 2402 MHz



Middle Channel 2441 MHz

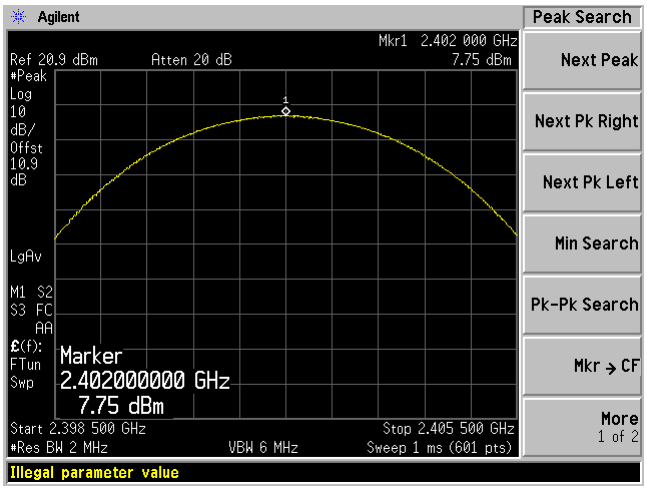


High Channel 2480 MHz

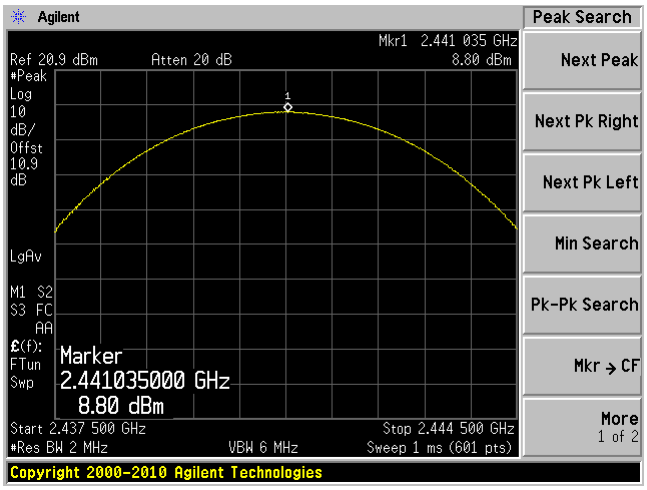


8DPSK

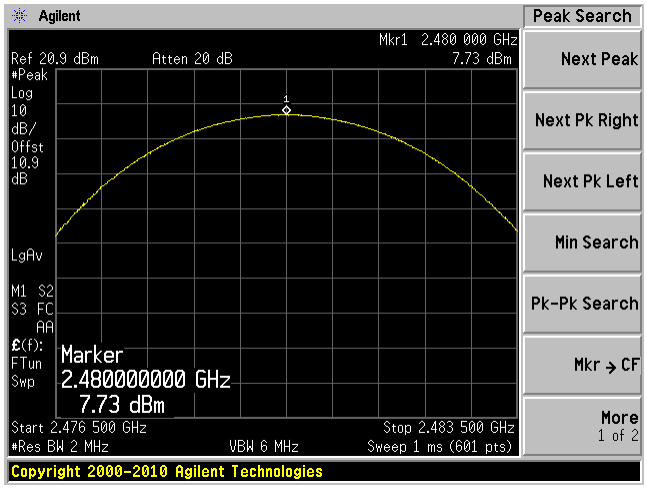
Low Channel 2402 MHz



Middle Channel 2441 MHz



High Channel 2480 MHz



10 FCC §15.247(d) and ISED RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges

10.1 Applicable Standards

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 ISED RSS-247 §5.5.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 5.4(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.

10.2 Measurement Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW = 100 kHz
VBW = 300 kHz
Sweep = coupled
Detector function = peak
Trace = max hold

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2016-06-10	1 year
-	RF Cable	-	-	Each time[1]	Each time[1]
-	10 dB attenuator	-	-	Each time[1]	Each time[1]

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

10.4 Test Environmental Conditions

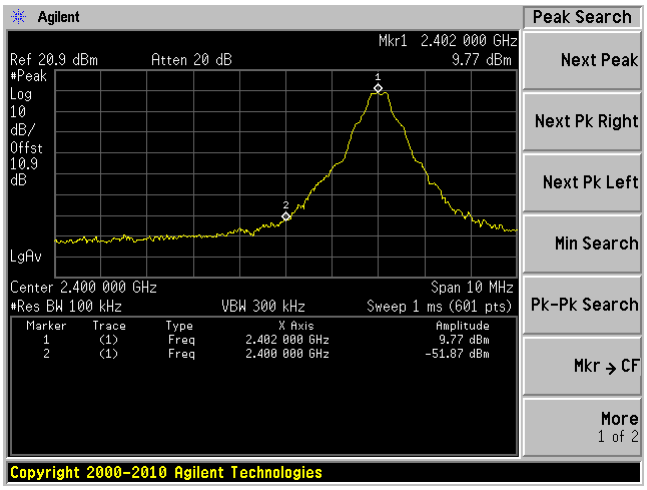
Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Frank Wang on 2017-06-07 in RF site.

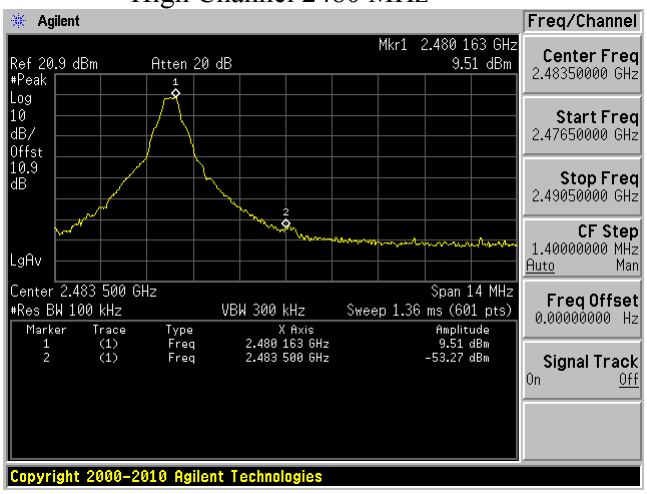
10.5 Test Results

GFSK

Low Channel 2402 MHz

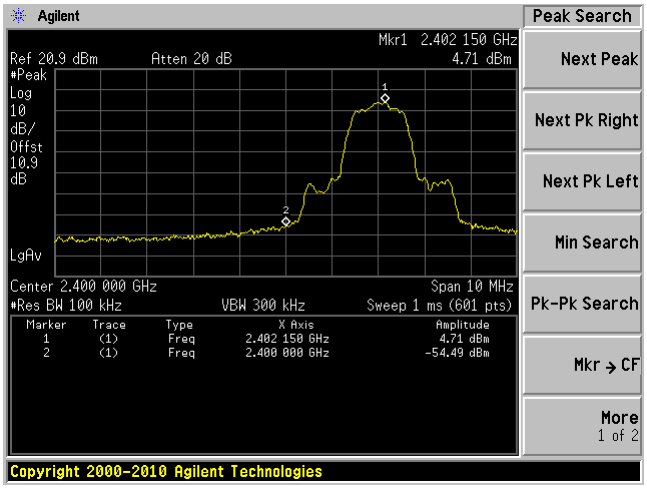


High Channel 2480 MHz

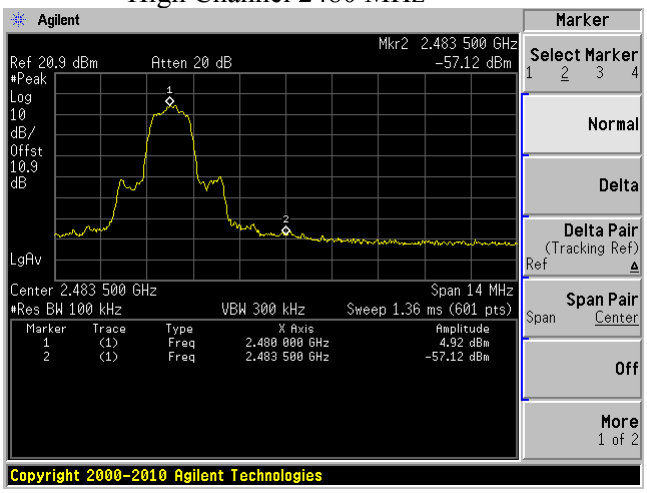


π/4-DQPSK

Low Channel 2402 MHz

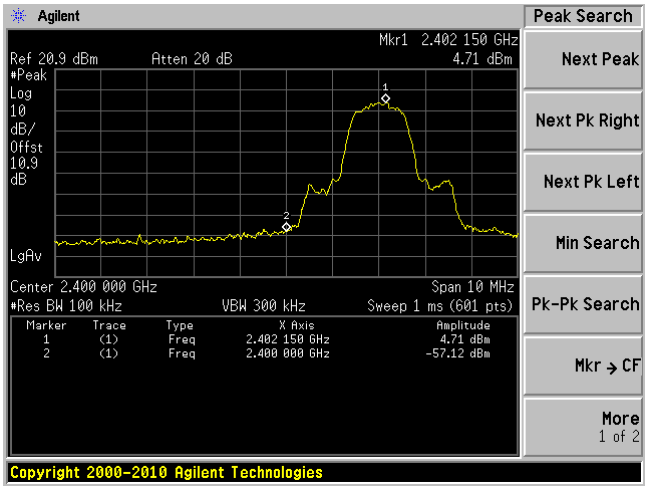


High Channel 2480 MHz

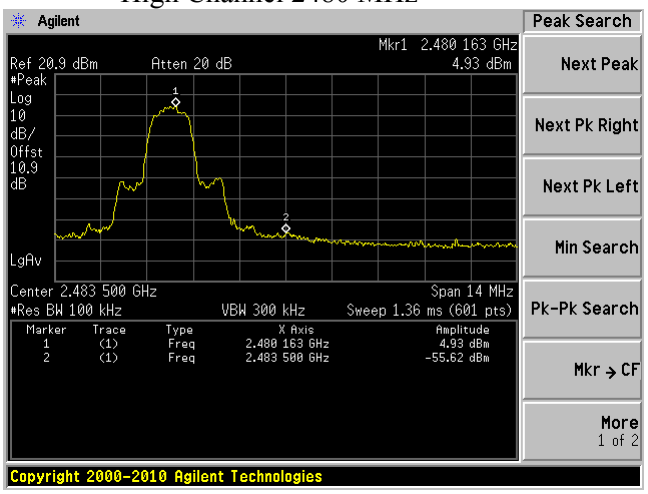


8DPSK

Low Channel 2402 MHz



High Channel 2480 MHz



11 FCC §15.247(a)(1)(iii) and ISED RSS-247 §5.1 (4) - Dwell Time

11.1 Applicable Standards

According to FCC §15.247(a) (1) (iii) and RSS-247 §5.1(4), 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

11.2 Measurement Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel
RBW ≤ channel spacing and where possible RBW should be set >> 1/*T*, where *T* is the expected dwell time per channel
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) =
(number of hops on spectrum analyzer) x (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2016-06-10	1 year
-	RF Cable	-	-	Each time[1]	Each time[1]
-	10 dB attenuator	-	-	Each time[1]	Each time[1]

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

11.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Frank Wang on 2017-06-05 in RF site.

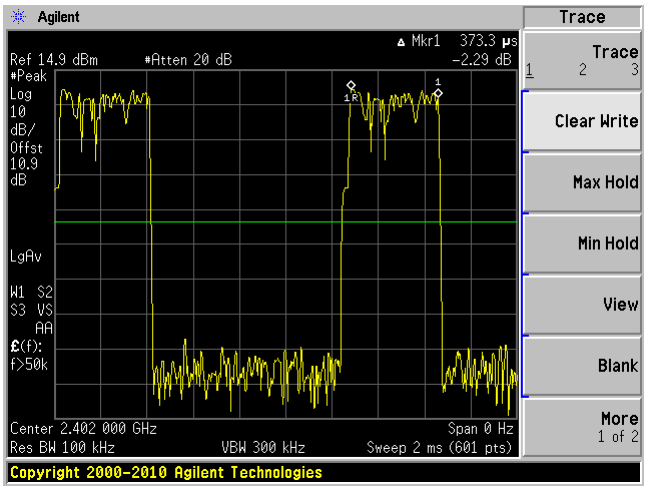
11.5 Test Results

Channel	Pulse Width (ms)	Number of Hops in the Period Specified in the Requirements	Average Time of Occupancy (s)	Limit (sec)	Results
GFSK, DH1					
Low	0.3733	320	0.119456	0.4	compliant
Middle	0.3733	320	0.119456	0.4	compliant
High	0.3767	310	0.11677	0.4	compliant
GFSK, DH3					
Low	1.633	190	0.31027	0.4	compliant
Middle	1.633	130	0.21229	0.4	compliant
High	1.633	170	0.27761	0.4	compliant
GFSK, DH5					
Low	2.883	90	0.25947	0.4	compliant
Middle	2.867	130	0.37271	0.4	compliant
High	2.883	60	0.17298	0.4	compliant
Π/4-DQPSK, DH1					
Low	0.375	320	0.12	0.4	compliant
Middle	0.375	320	0.12	0.4	compliant
High	0.375	310	0.11625	0.4	compliant
Π/4-DQPSK, DH3					
Low	1.633	140	0.22862	0.4	compliant
Middle	1.617	140	0.22638	0.4	compliant
High	1.667	170	0.28339	0.4	compliant
Π/4-DQPSK, DH5					
Low	2.867	130	0.37271	0.4	compliant
Middle	2.867	110	0.31537	0.4	compliant
High	2.833	110	0.31163	0.4	compliant
8DPSK, DH1					
Low	0.4583	320	0.146656	0.4	compliant
Middle	0.3917	320	0.125344	0.4	compliant
High	0.3917	320	0.125344	0.4	compliant
8DPSK, DH3					
Low	1.633	160	0.26128	0.4	compliant
Middle	1.600	190	0.304	0.4	compliant
High	1.633	170	0.27761	0.4	compliant
8DPSK, DH5					
Low	2.900	90	0.261	0.4	compliant
Middle	2.875	80	0.23	0.4	compliant
High	2.825	100	0.2825	0.4	compliant

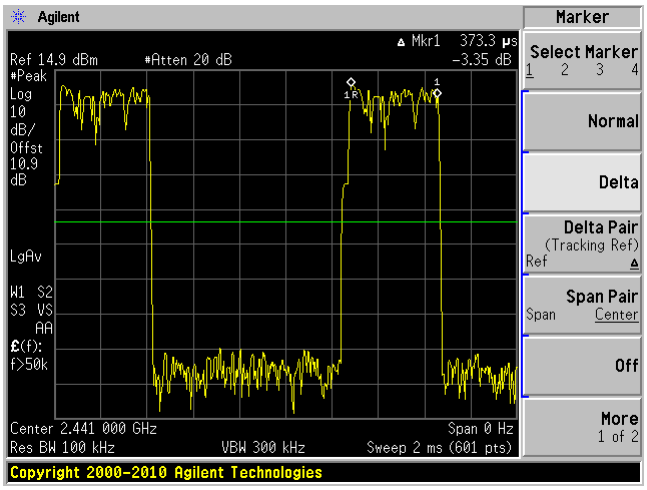
Please refer to the following plots for detailed test results.

GFSK, DH1 Pulse Width

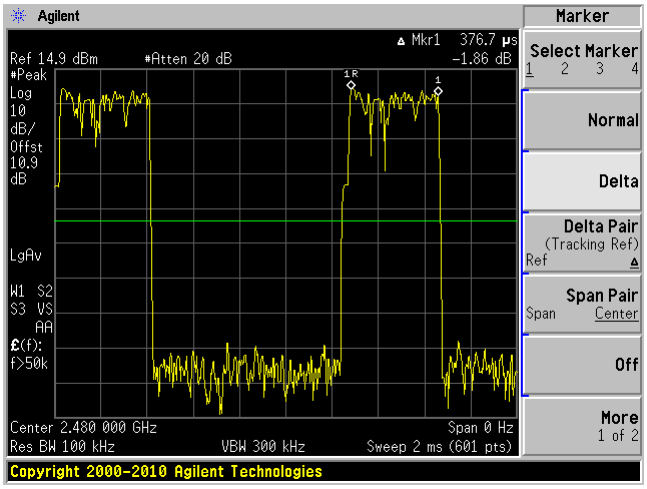
Low Channel 2402 MHz



Middle Channel 2441 MHz

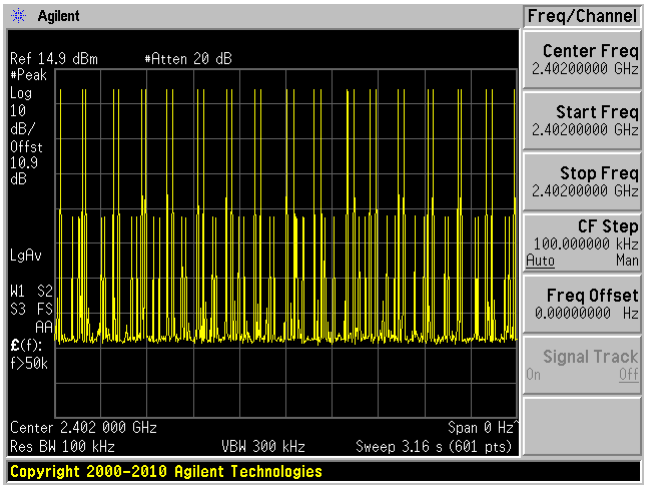


High Channel 2480 MHz

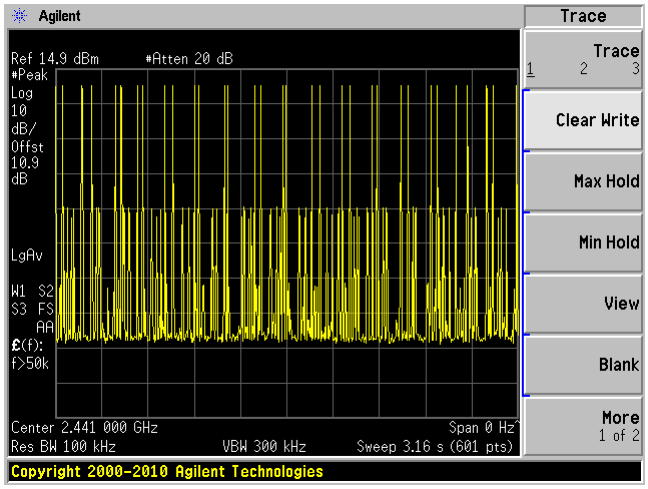


GFSK, DH1 Number of Pulses within a Specified Time

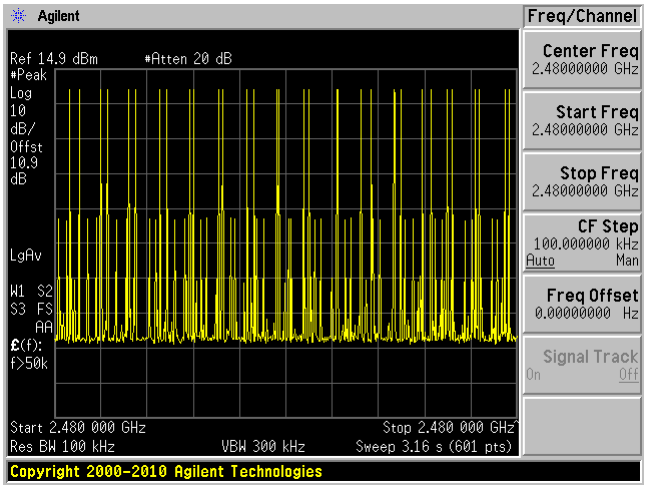
Low Channel 2402 MHz



Middle Channel 2441 MHz

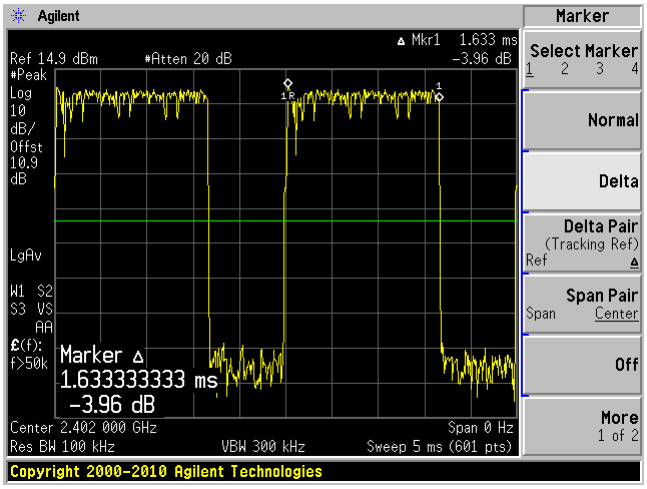


High Channel 2480 MHz

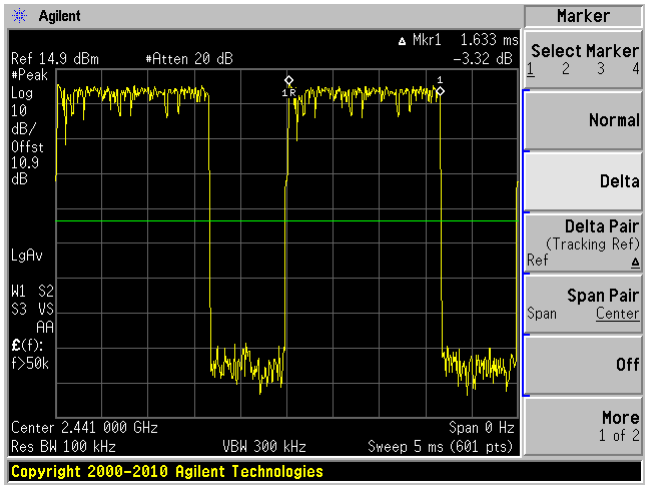


GFSK, DH3 Pulse Width

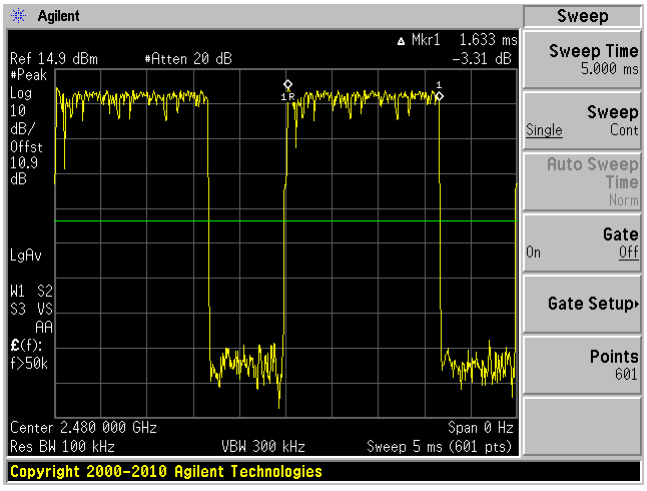
Low Channel 2402 MHz



Middle Channel 2441 MHz

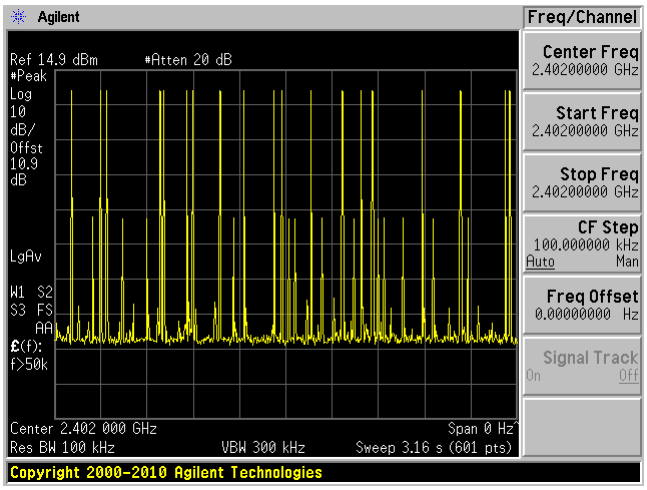


High Channel 2480 MHz

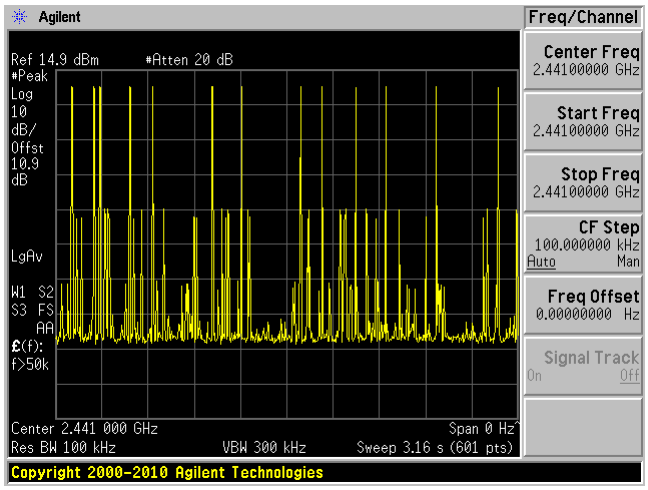


GFSK, DH3 Number of Pulses within a Specified Time

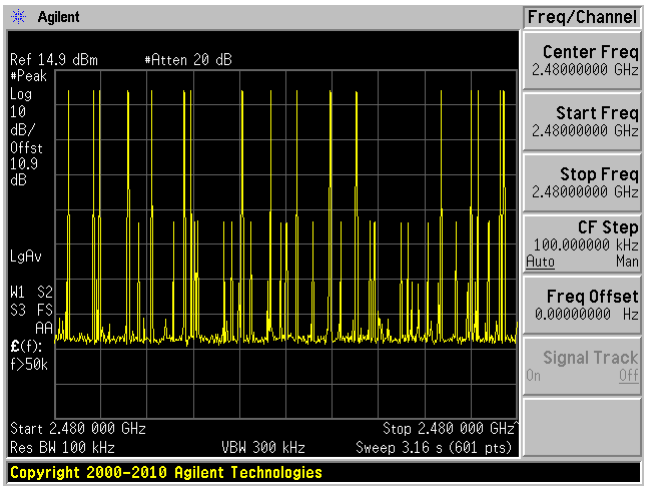
Low Channel 2402 MHz



Middle Channel 2441 MHz

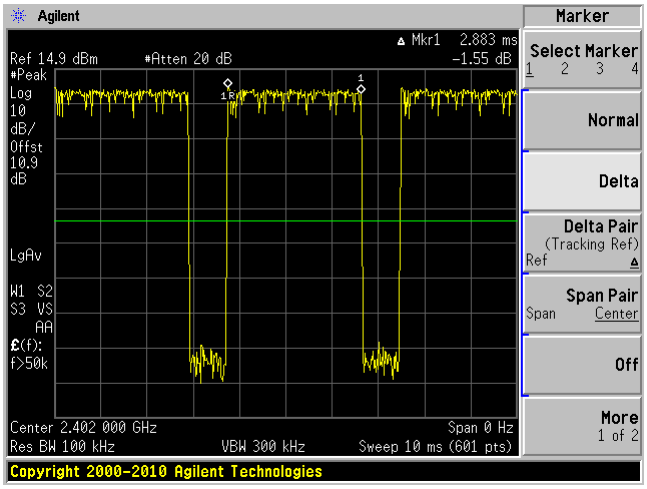


High Channel 2480 MHz

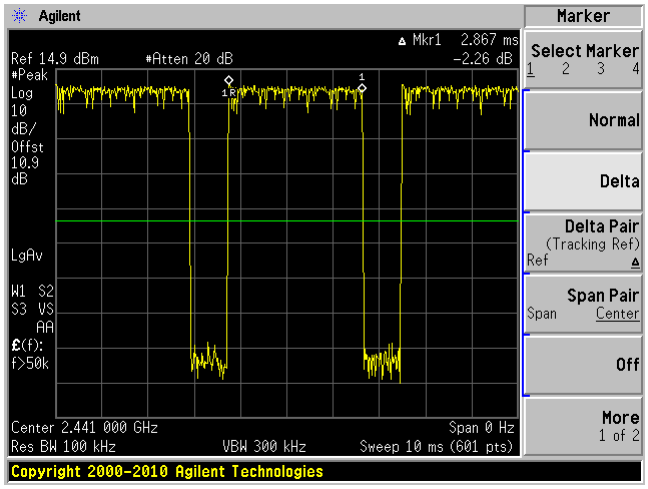


GFSK, DH5 Pulse Width

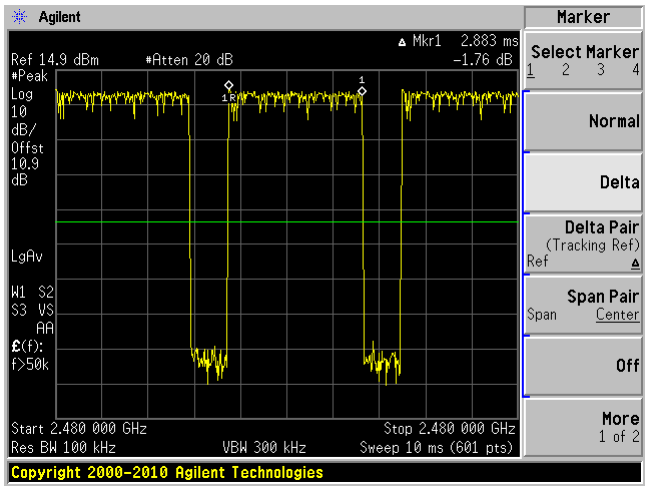
Low Channel 2402 MHz



Middle Channel 2441 MHz

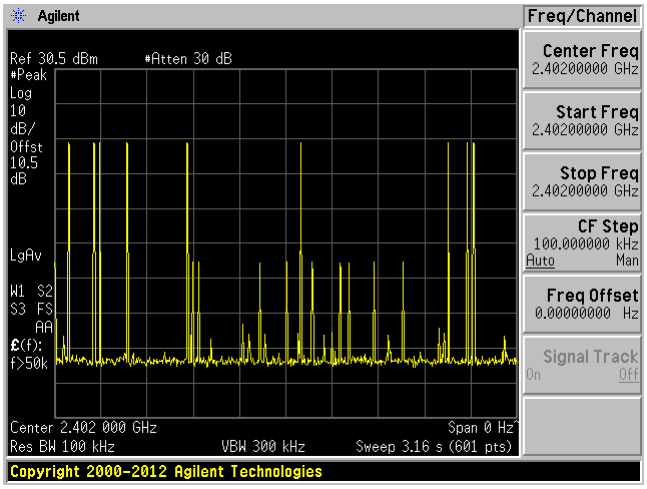


High Channel 2480 MHz

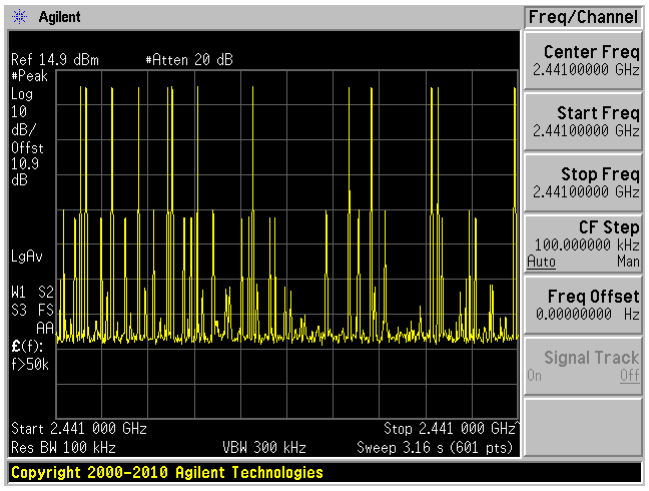


GFSK, DH5 Number of Pulses within a Specified Time

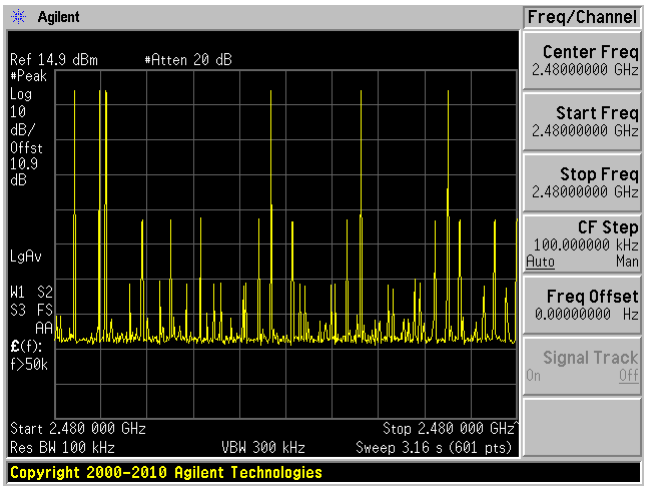
Low Channel 2402 MHz



Middle Channel 2441 MHz

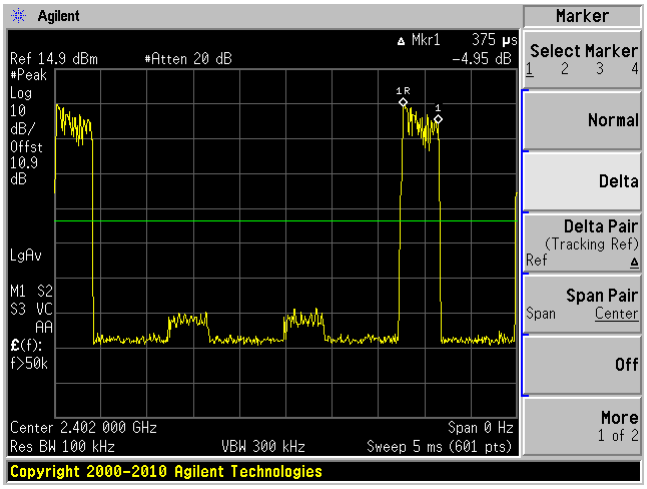


High Channel 2480 MHz

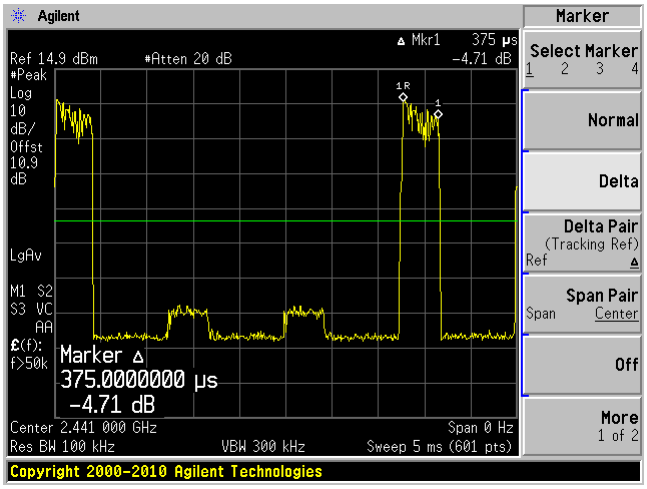


Π/4-DQPSK, DH1 Pulse Width

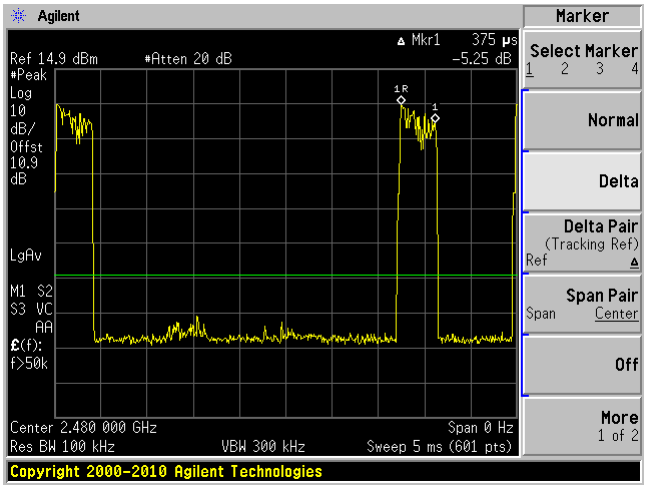
Low Channel 2402 MHz



Middle Channel 2441 MHz

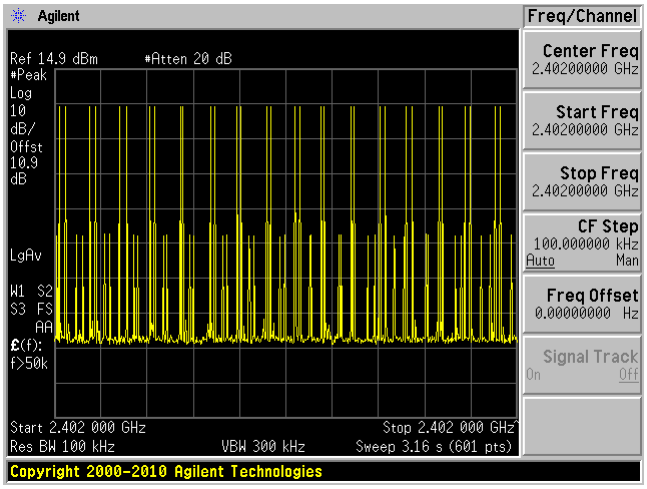


High Channel 2480 MHz

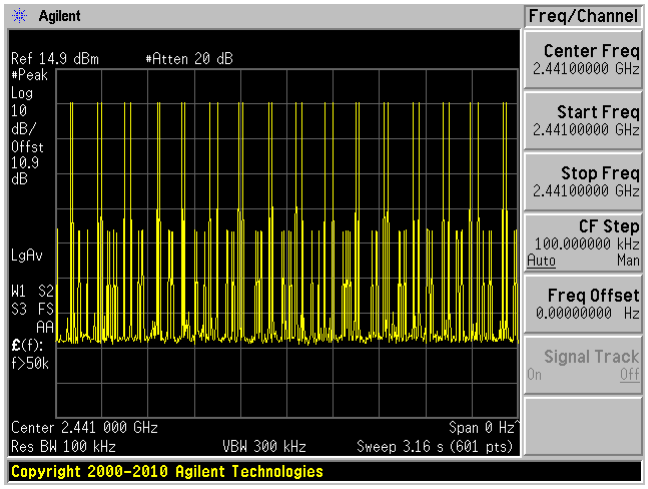


II/4-DQPSK, DH1 Number of Pulses within a Specified Time

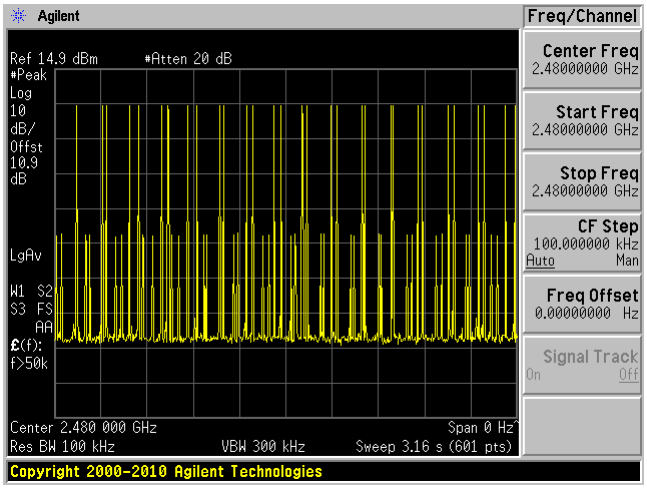
Low Channel 2402 MHz



Middle Channel 2441 MHz

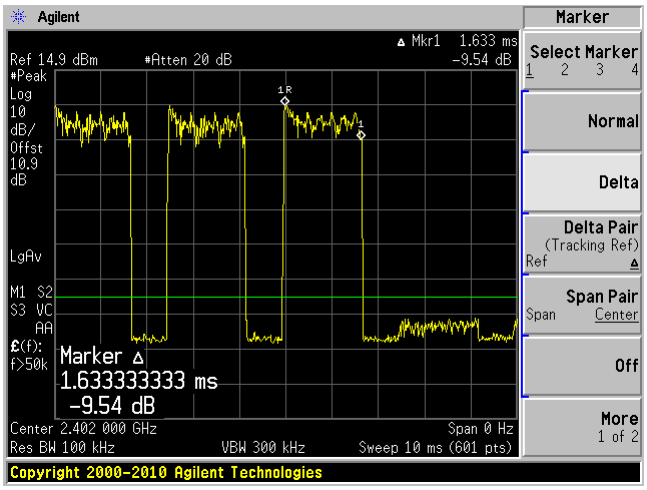


High Channel 2480 MHz

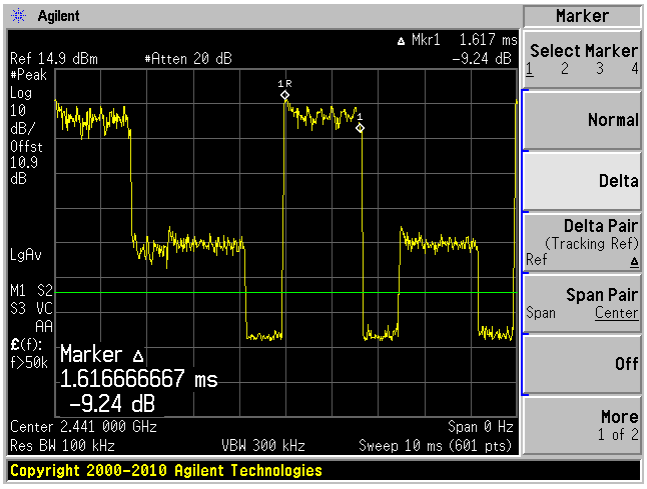


Π/4-DQPSK, DH3 Pulse Width

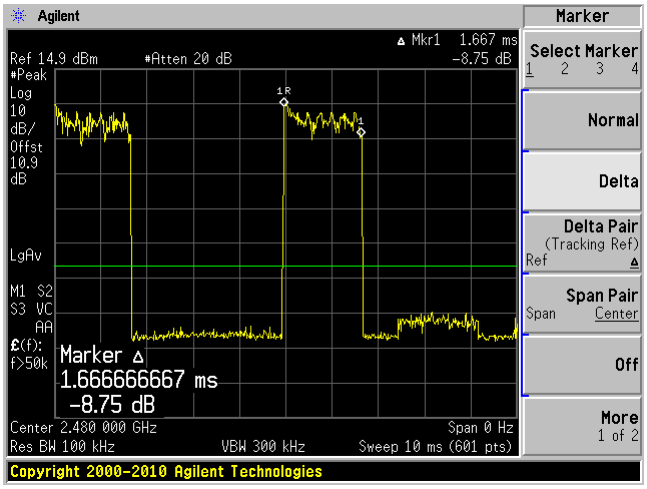
Low Channel 2402 MHz



Middle Channel 2441 MHz

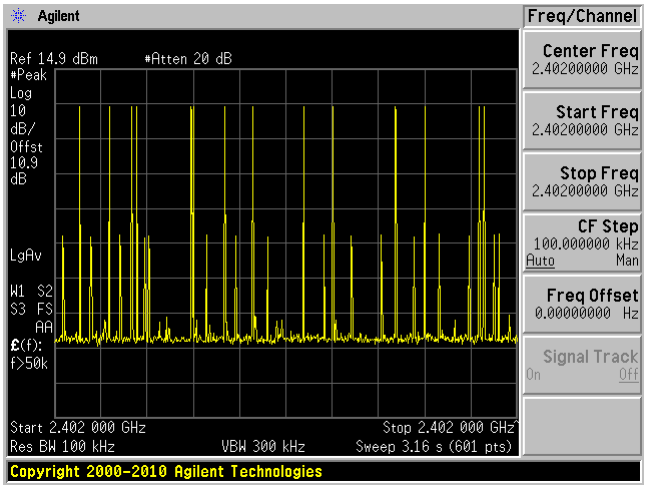


High Channel 2480 MHz

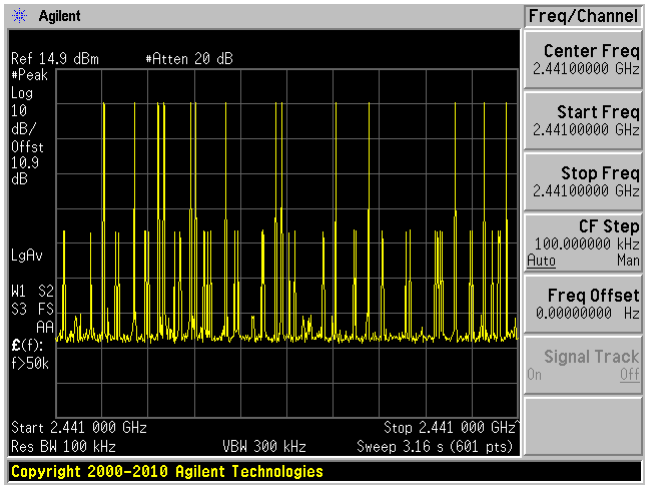


II/4-DQPSK, DH3 Number of Pulses within a Specified Time

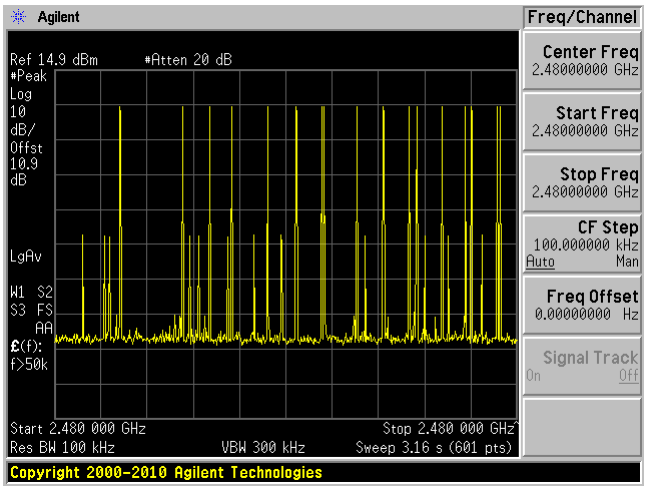
Low Channel 2402 MHz



Middle Channel 2441 MHz

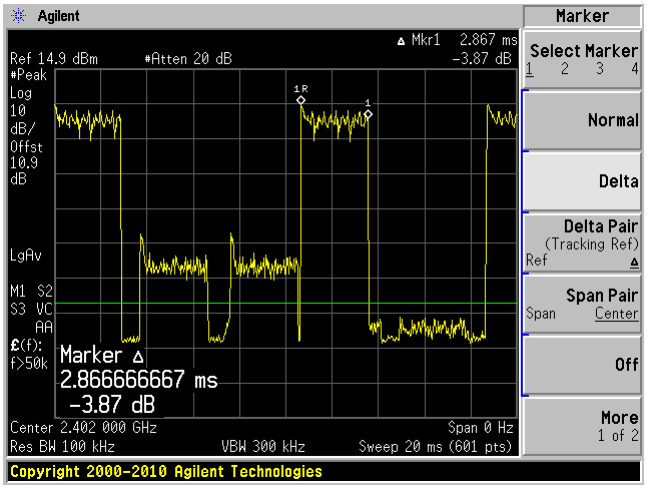


High Channel 2480 MHz

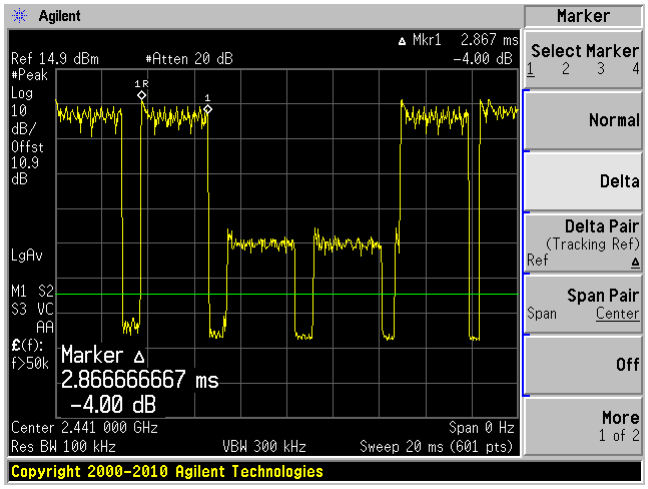


Π/4-DQPSK, DH5 Pulse Width

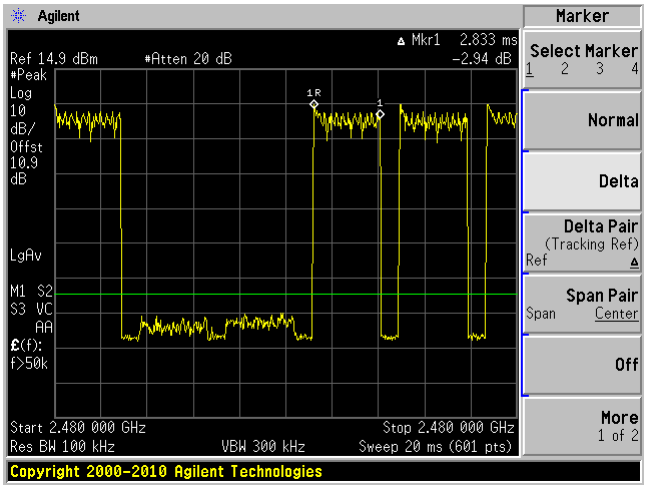
Low Channel 2402 MHz



Middle Channel 2441 MHz

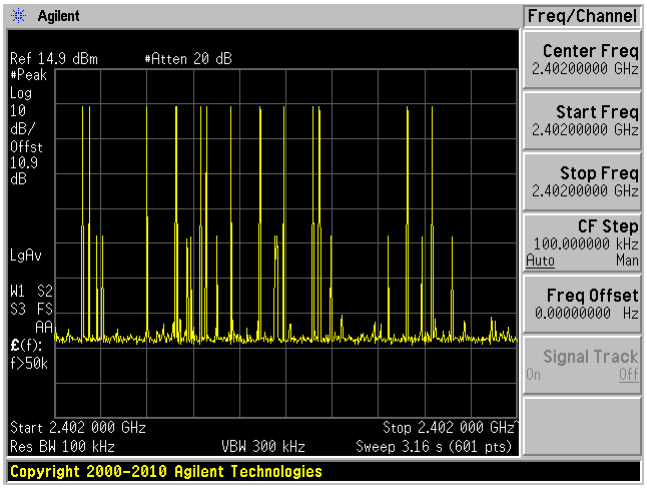


High Channel 2480 MHz

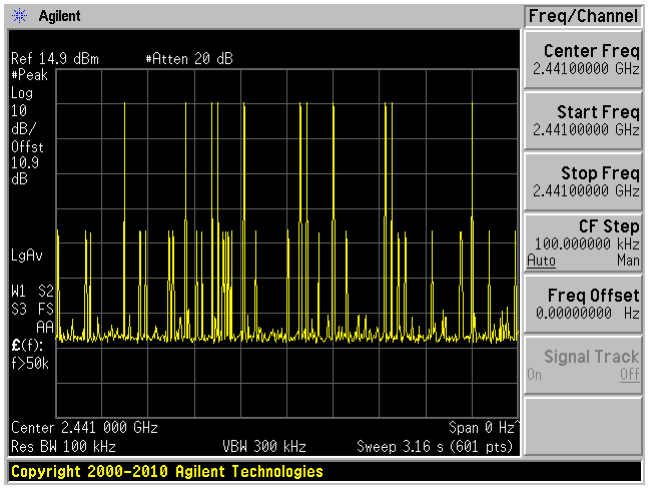


II/4-DQPSK, DH5 Number of Pulses within a Specified Time

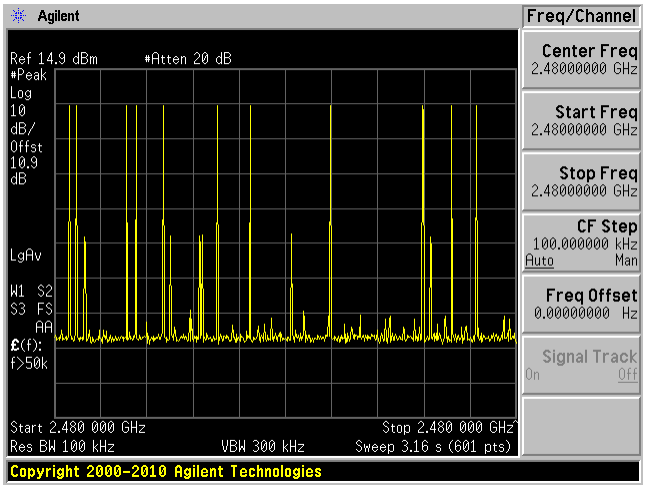
Low Channel 2402 MHz



Middle Channel 2441 MHz

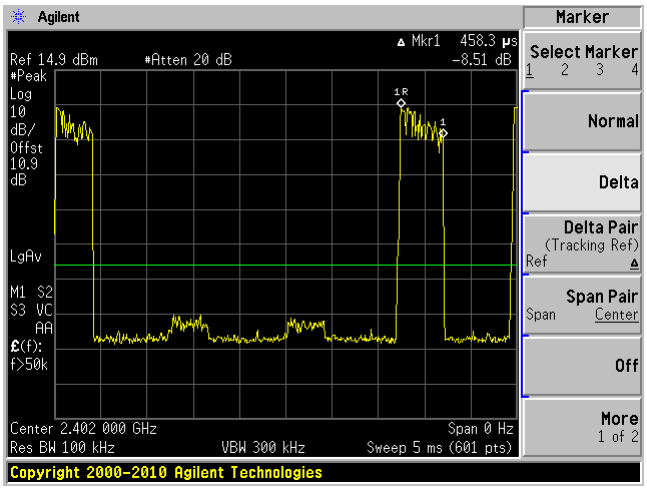


High Channel 2480 MHz

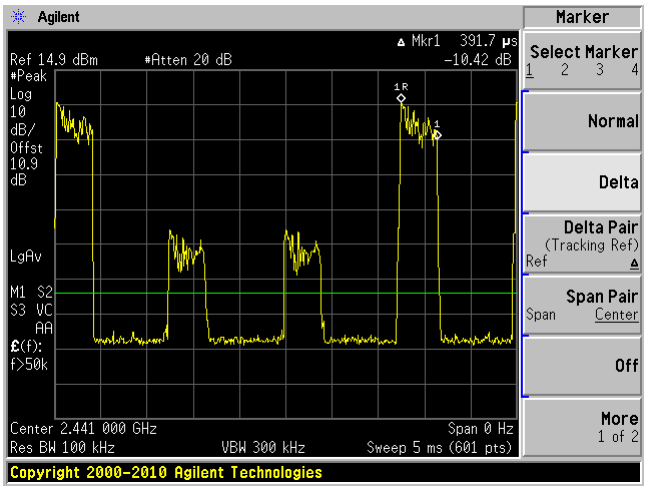


8DPSK, DH1 Pulse Width

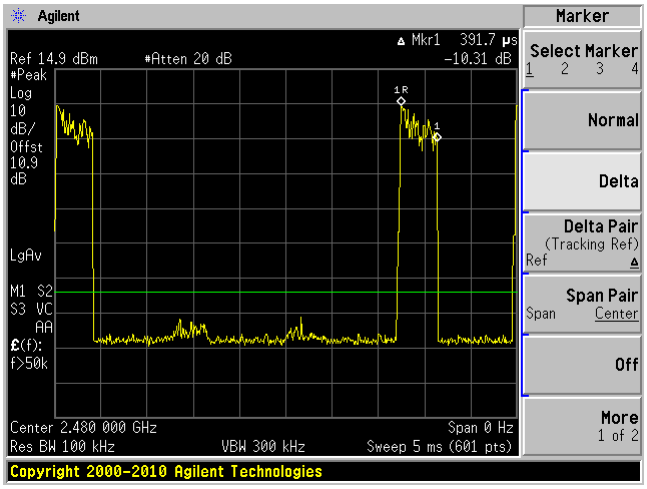
Low Channel 2402 MHz



Middle Channel 2441 MHz

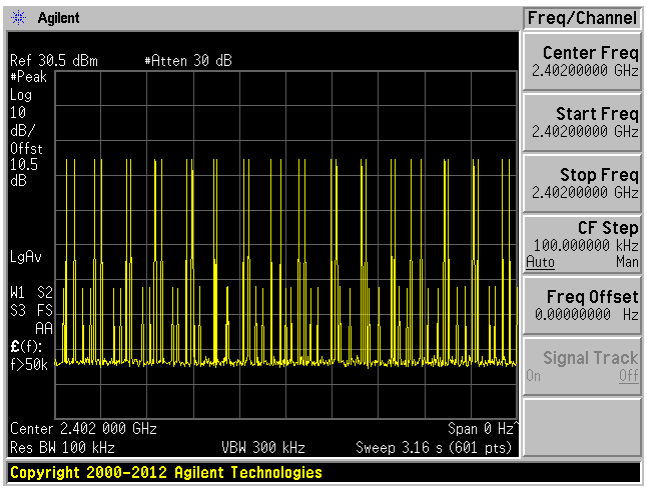


High Channel 2480 MHz

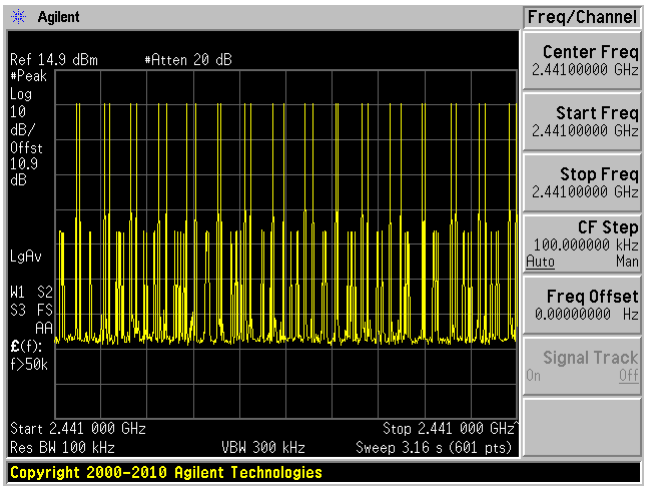


8DPSK, DH1 Number of Pulses within a Specified Time

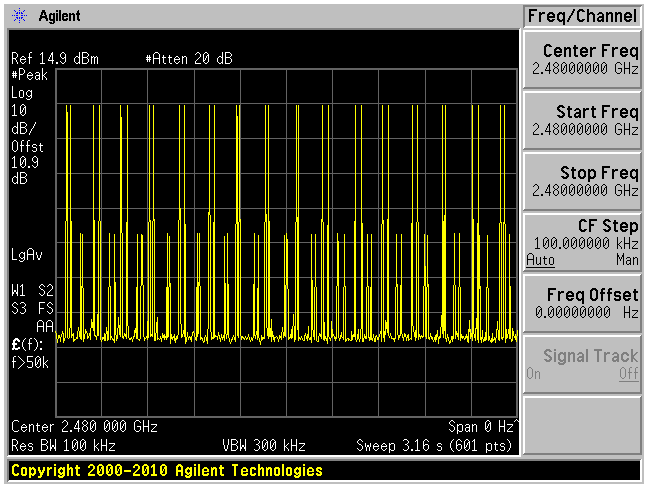
Low Channel 2402 MHz



Middle Channel 2441 MHz

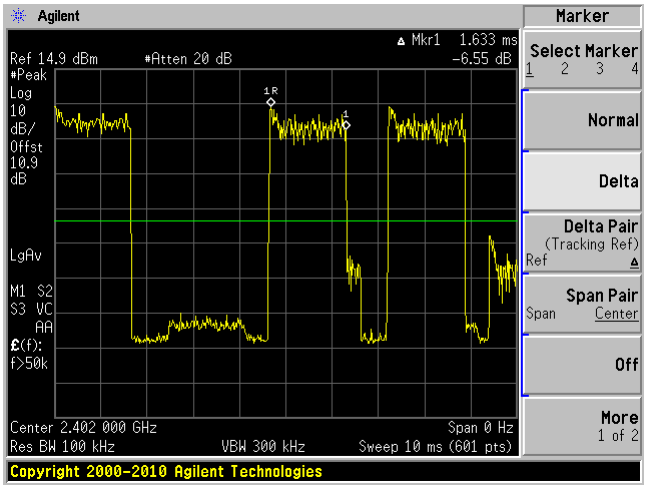


High Channel 2480 MHz

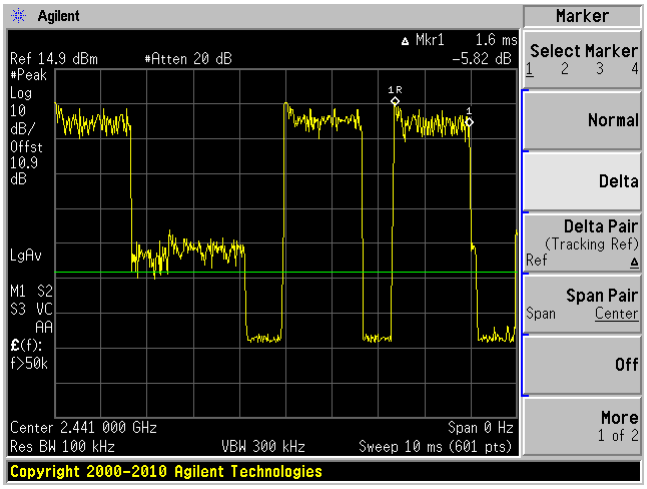


8DPSK, DH3 Pulse Width

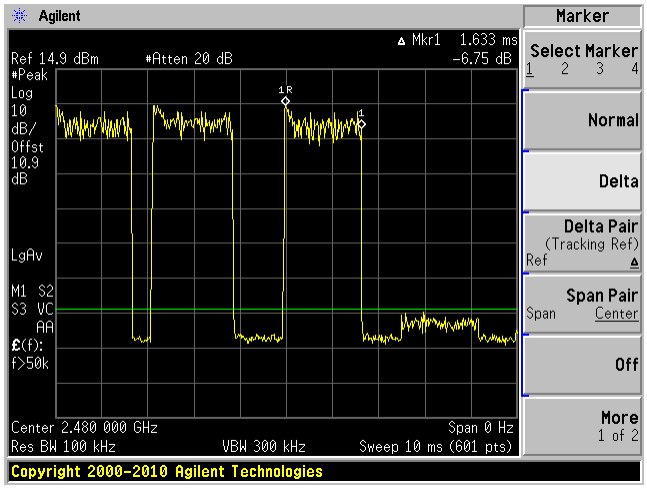
Low Channel 2402 MHz



Middle Channel 2441 MHz

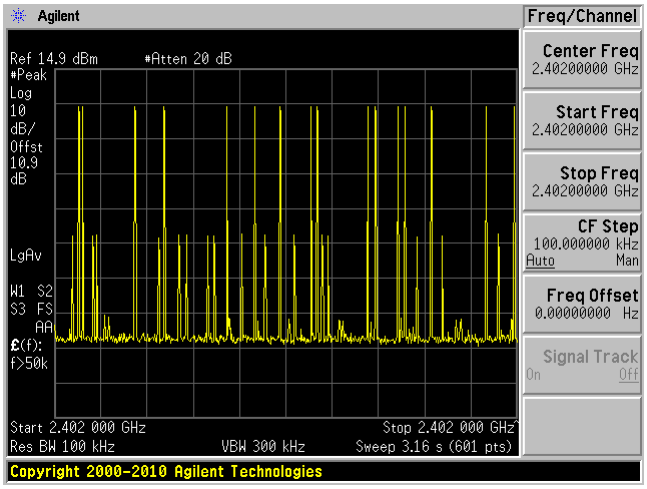


High Channel 2480 MHz

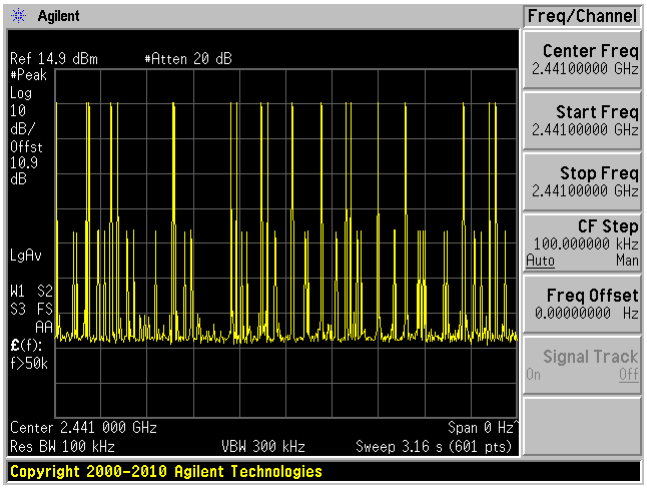


8DPSK, DH3 Number of Pulses within a Specified Time

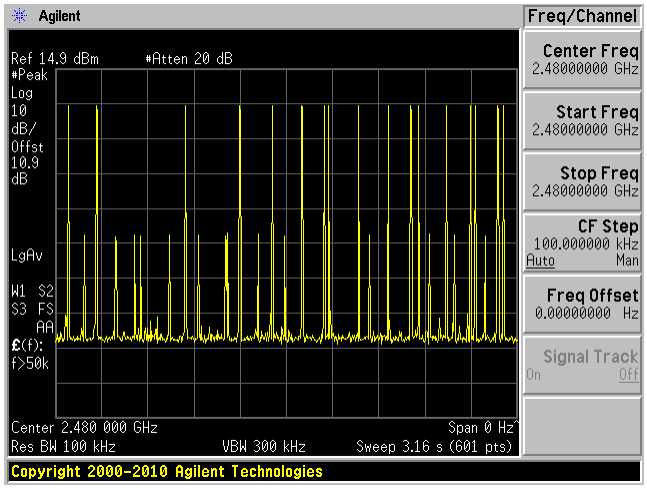
Low Channel 2402 MHz



Middle Channel 2441 MHz

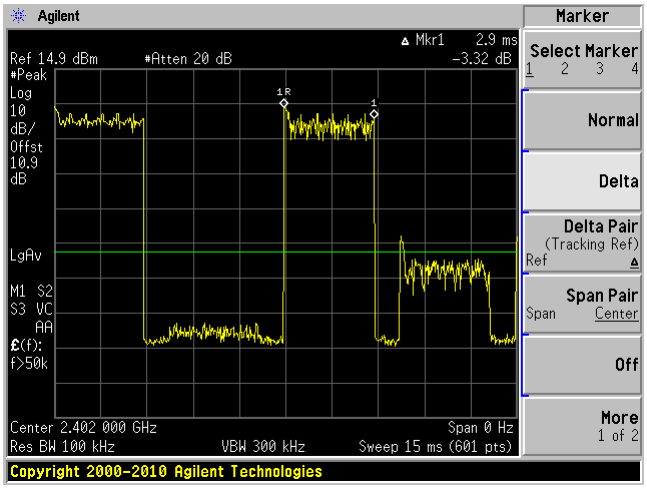


High Channel 2480 MHz

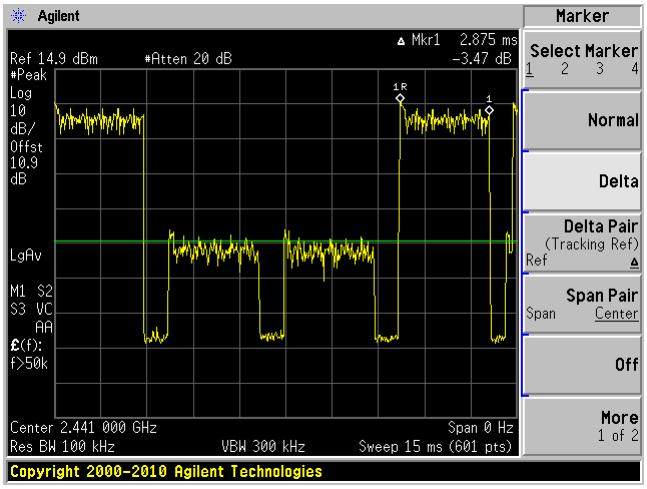


8DPSK, DH5 Pulse Width

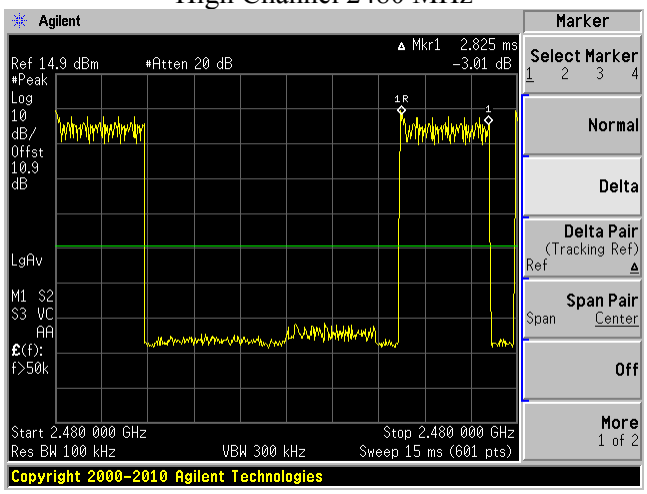
Low Channel 2402 MHz



Middle Channel 2441 MHz

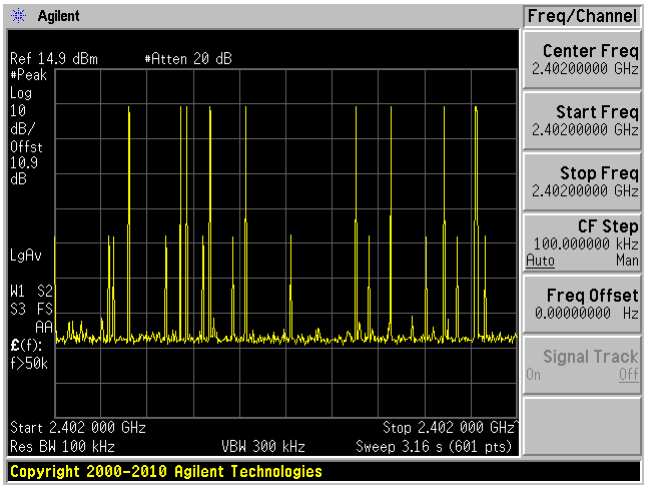


High Channel 2480 MHz

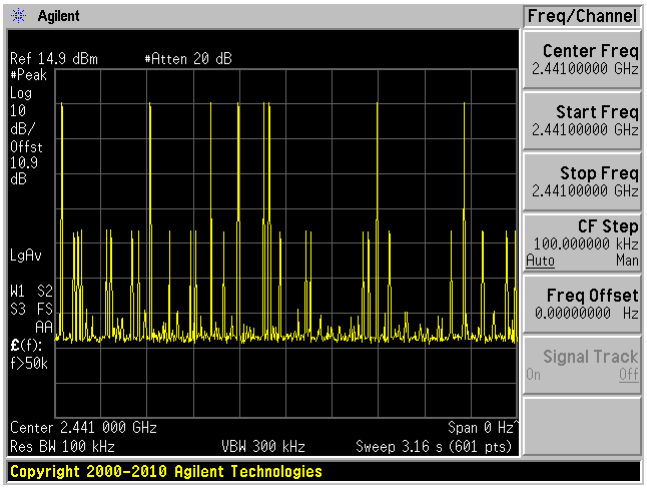


8DPSK, DH5 Number of Pulses within a Specified Time

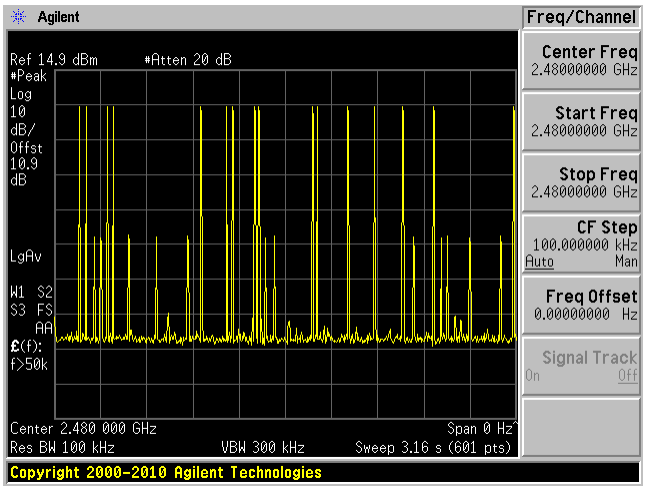
Low Channel 2402 MHz



Middle Channel 2441 MHz



High Channel 2480 MHz



12 FCC §15.247(a)(1)(iii) and ISED RSS-247 §5.1(4) - Number of Hopping Channels

12.1 Applicable Standards

According to FCC §15.247(a) (1) (iii) and RSS-247 §5.1(4): 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

12.2 Test Procedure

Span = the frequency band of operation

RBW < 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2016-06-10	1 year
-	RF Cable	-	-	Each time[1]	Each time[1]
-	10 dB attenuator	-	-	Each time[1]	Each time[1]

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

12.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

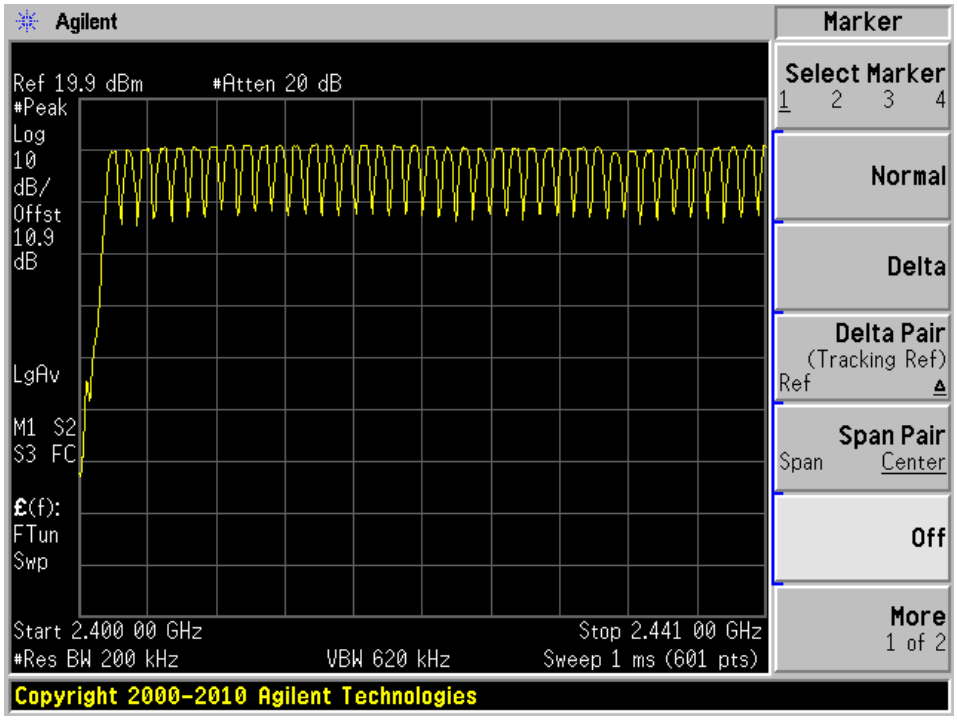
The testing was performed by Frank Wang on 2017-06-05 in RF site.

12.5 Test Results

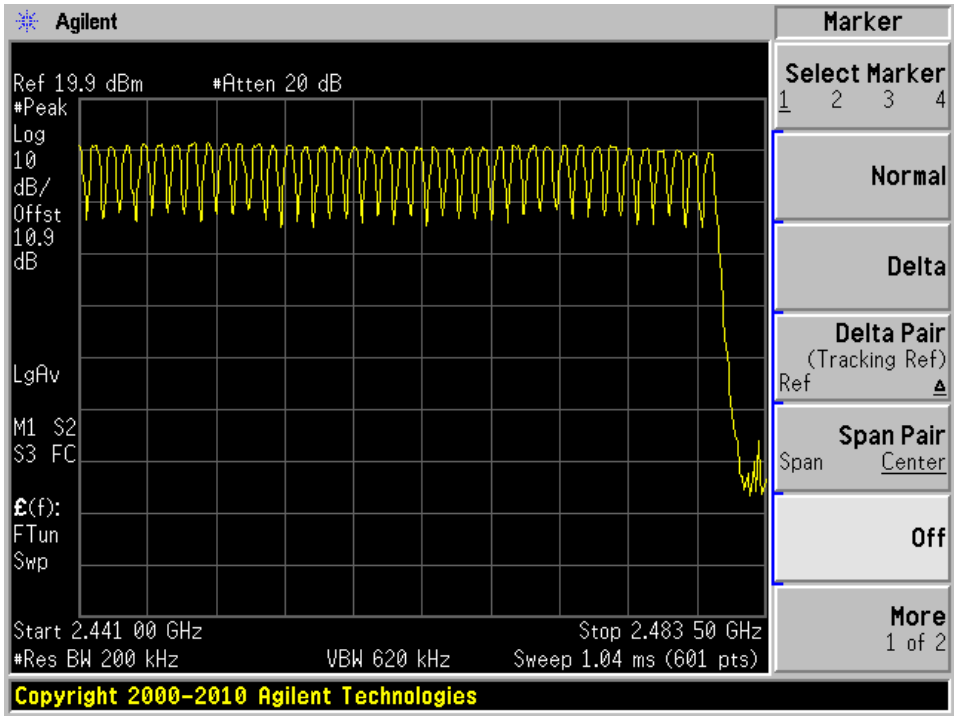
Total 79 channels; please refer to the plots hereinafter.

GFSK

40 Channels between 2400 to 2441 MHz

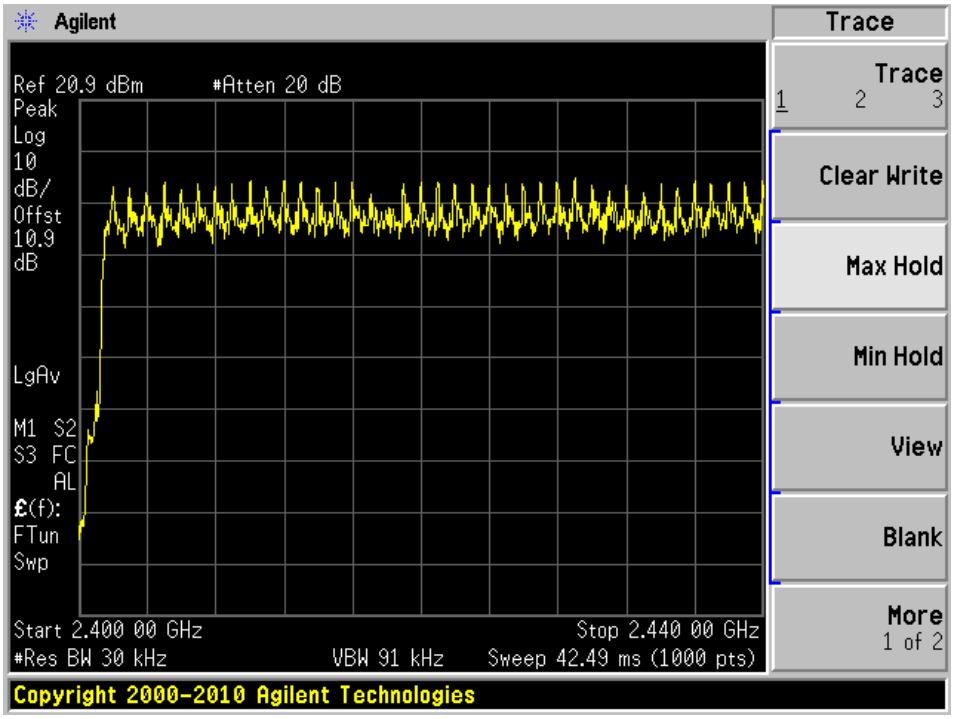


39 Channels between 2441 to 2483.5 MHz

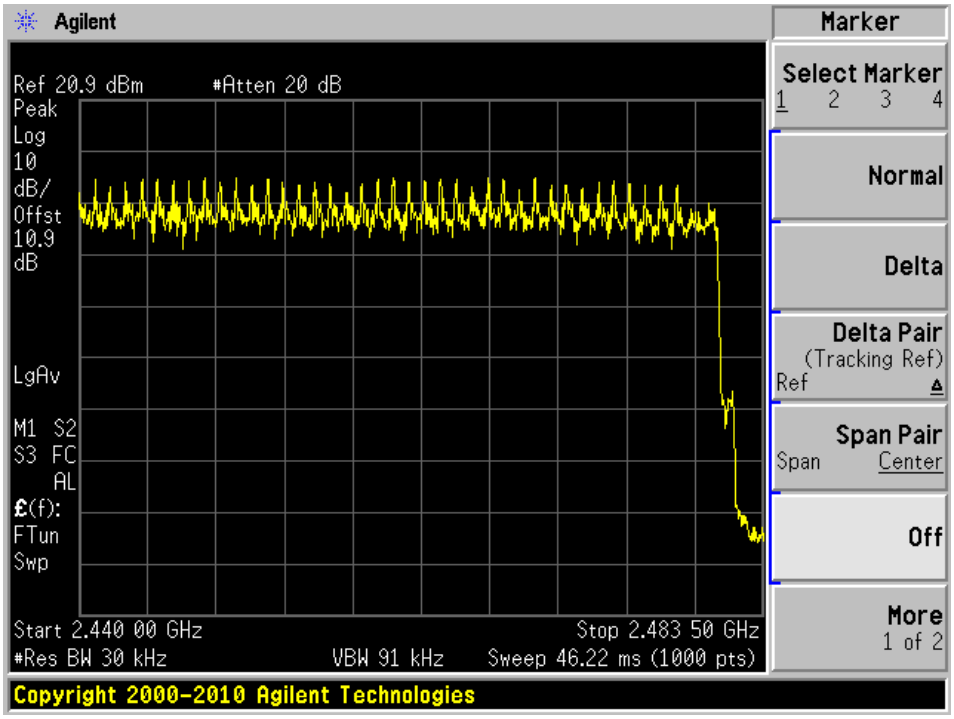


Π/4-DQPSK

39 Channels between 2400 to 2440 MHz

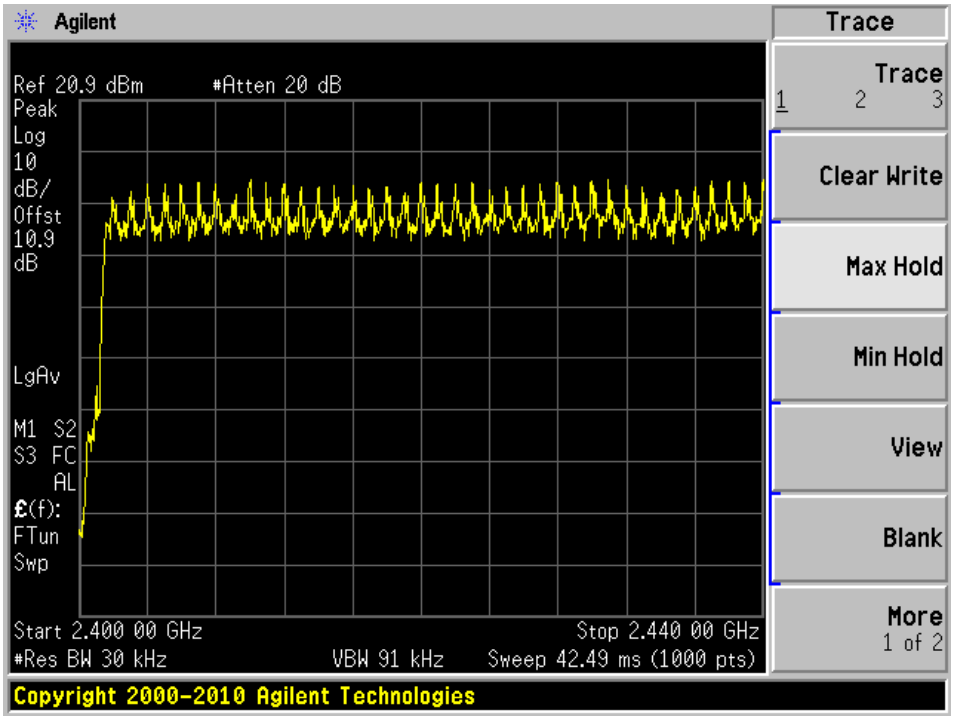


40 Channels between 2440 to 2483.5 MHz

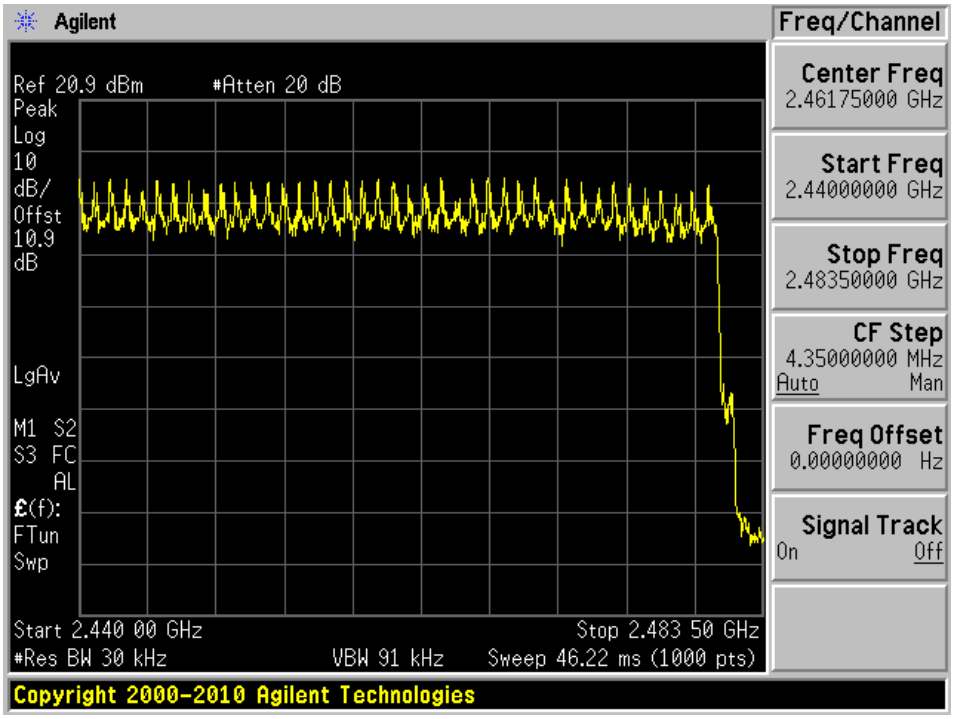


8DPSK

39 Channels between 2400 to 2440 MHz



40 Channels between 2440 to 2483.5 MHz



13 FCC §15.247(a) (1) and ISED RSS-247 §5.1(2) - Hopping Channel Separation

13.1 Applicable Standards

According to FCC §15.247(a) (1) and RSS-247 §5.1(2): 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.

13.2 Test Procedure

Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) ≈ 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel

Video (or Average) Bandwidth (VBW) ≥RBW
Sweep = auto
Detector function = peak
Trace = max hold

13.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2016-06-10	1 year
-	RF Cable	-	-	Each time[1]	Each time[1]
-	10 dB attenuator	-	-	Each time[1]	Each time[1]

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

13.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

The testing was performed by Frank Wang on 2017-06-05 in RF site.

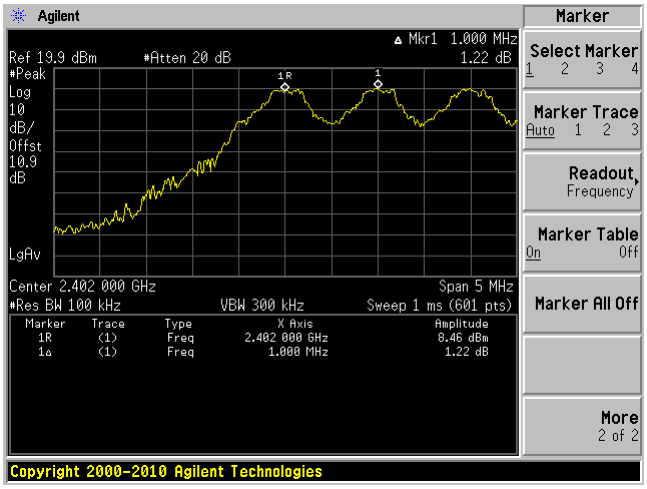
13.5 Test Results

Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 2/3 20 dB OBW (kHz)
GFSK			
Low	2402	1000	581.19
Middle	2441	983	583.06
High	2480	1017	580.94
π/4-DQPSK			
Low	2402	942	827.33
Middle	2441	992	829.33
High	2480	958	829.33
8DPSK			
Low	2402	1008	803.33
Middle	2441	958	802.66
High	2480	983	802.66

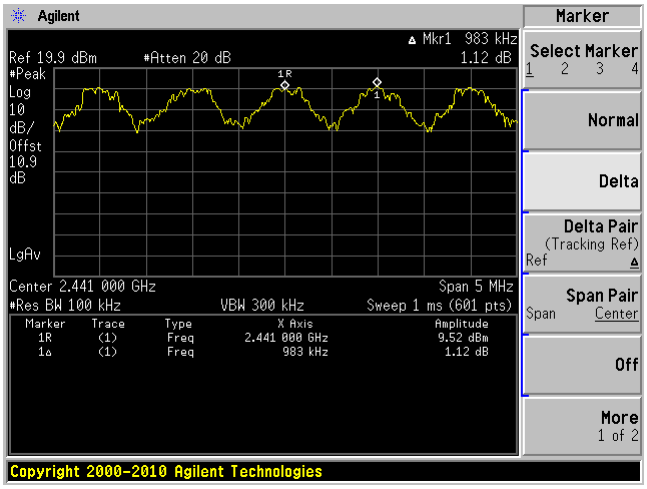
Please refer to following plots.

GFSK

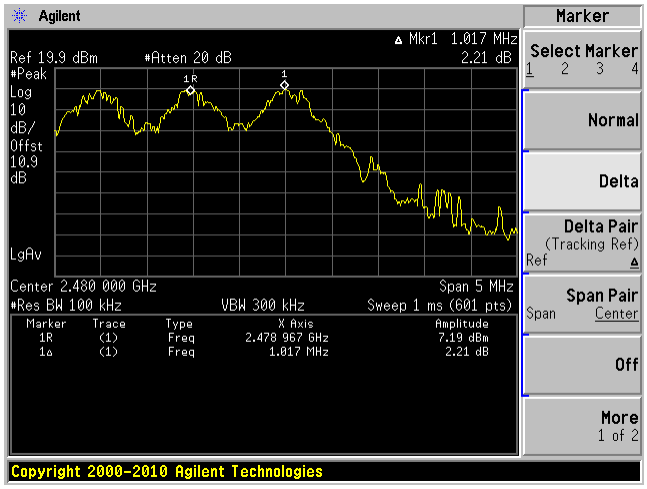
Low Channel 2402 MHz



Middle Channel 2441 MHz

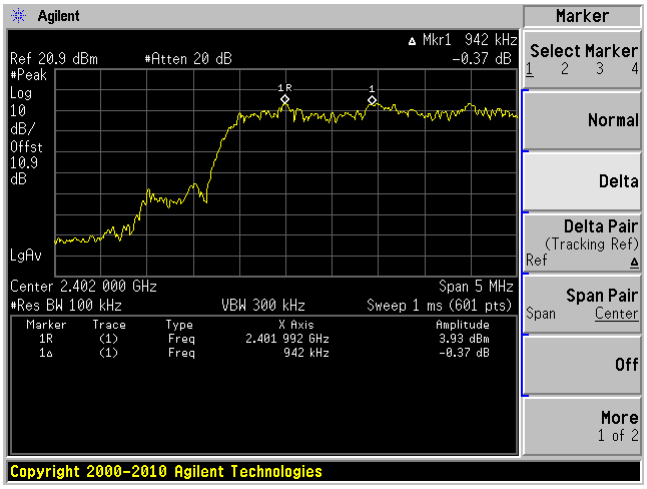


High Channel 2480 MHz

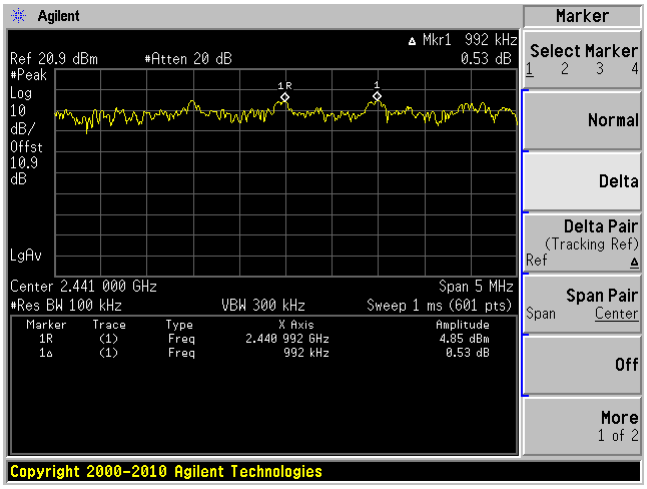


π/4-DQPSK

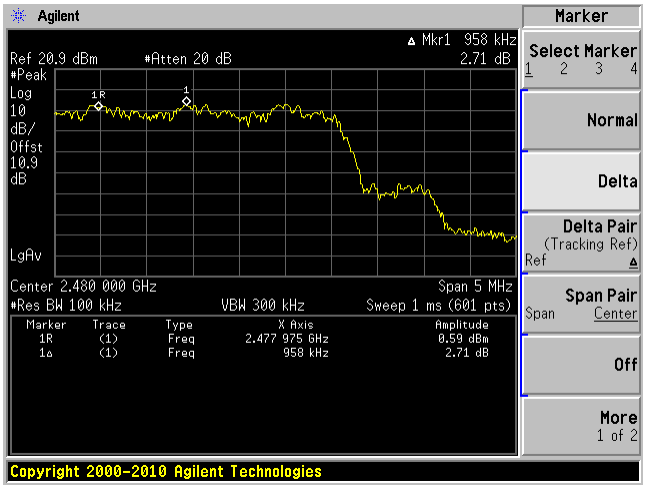
Low Channel 2402 MHz



Middle Channel 2441 MHz

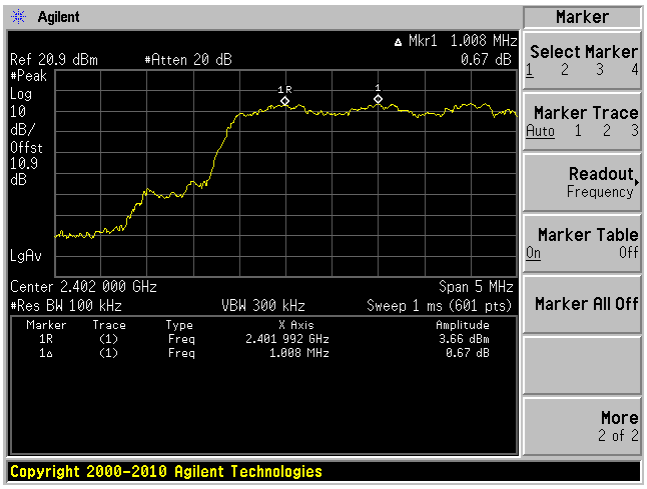


High Channel 2480 MHz

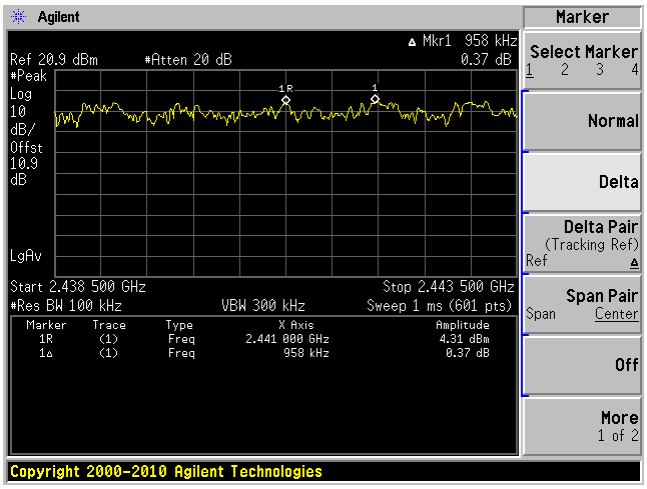


8DPSK

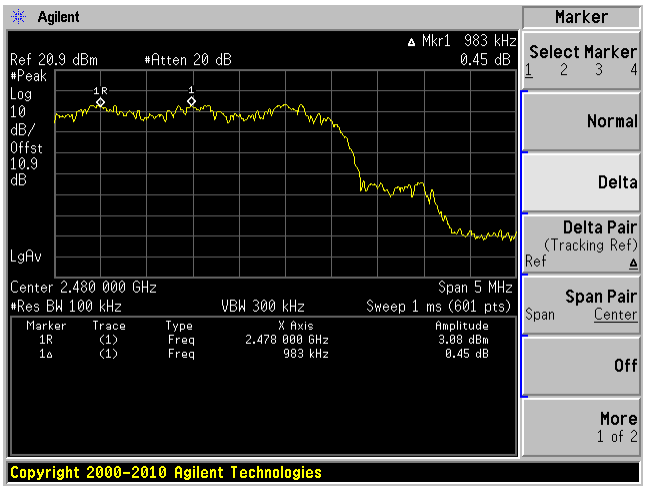
Low Channel 2402 MHz



Middle Channel 2441 MHz



High Channel 2480 MHz



14 FCC §15.247(d) and ISED RSS-247 §5.5 - Spurious Emissions at Antenna Terminals

14.1 Applicable Standards

For 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 ISED RSS-247 §5.5, 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 5.4(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.

14.2 Test 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.

14.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2016-06-10	1 year
-	RF Cable	-	-	Each time[1]	Each time[1]
-	10 dB attenuator	-	-	Each time[1]	Each time[1]

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

14.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.5 KPa

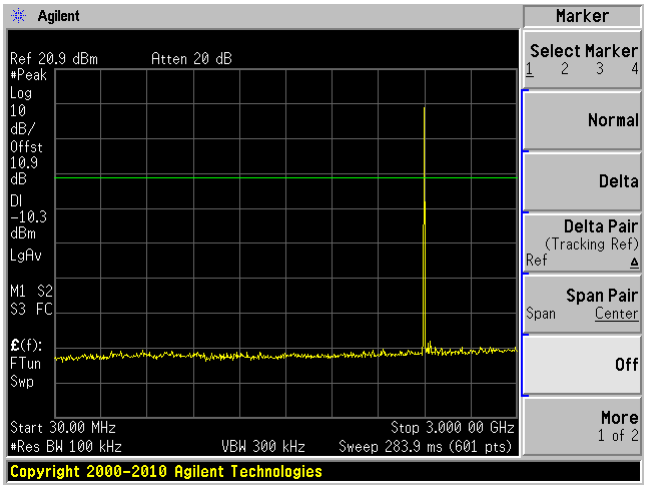
The testing was performed by Frank Wang on 2017-06-05 in RF site.

14.5 Test Results

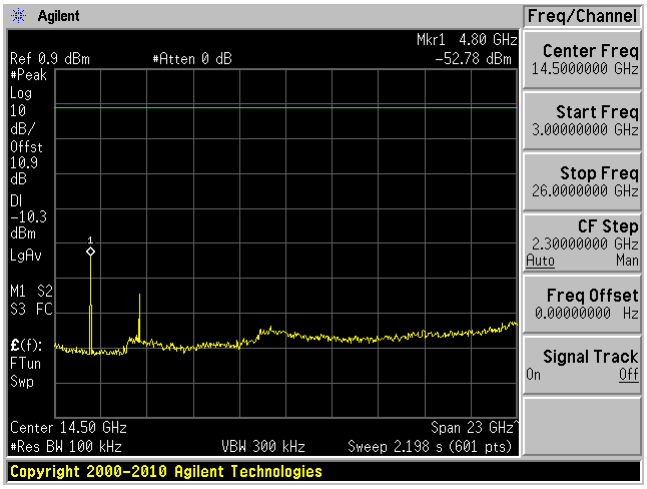
Please refer to following plots.

GFSK

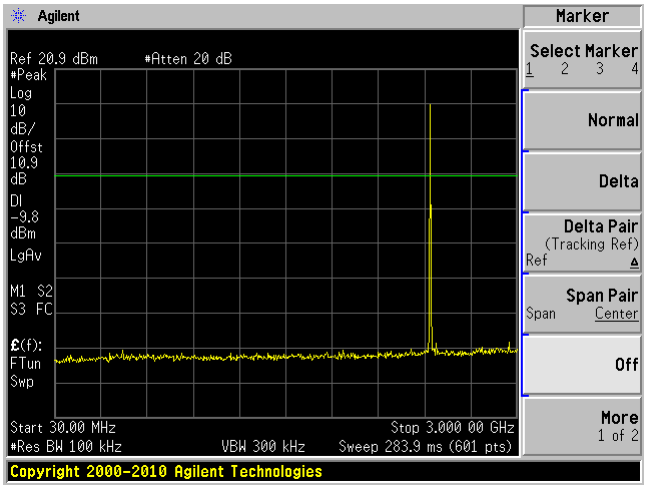
Low Channel 30 MHz – 1 GHz



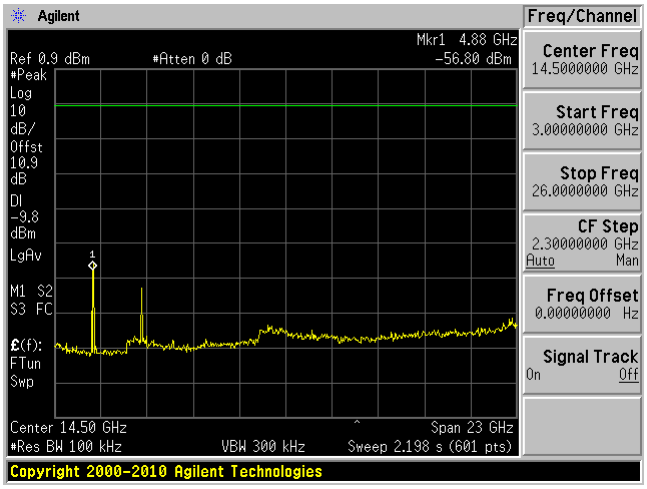
Low Channels 1GHz – 25 GHz



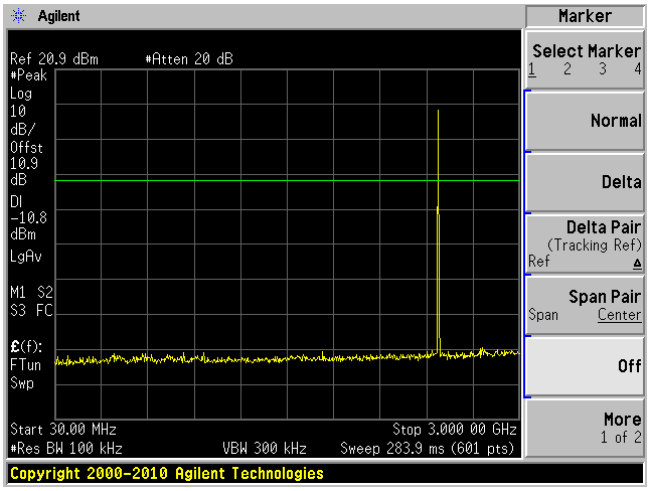
Middle Channel 30 MHz – 1 GHz



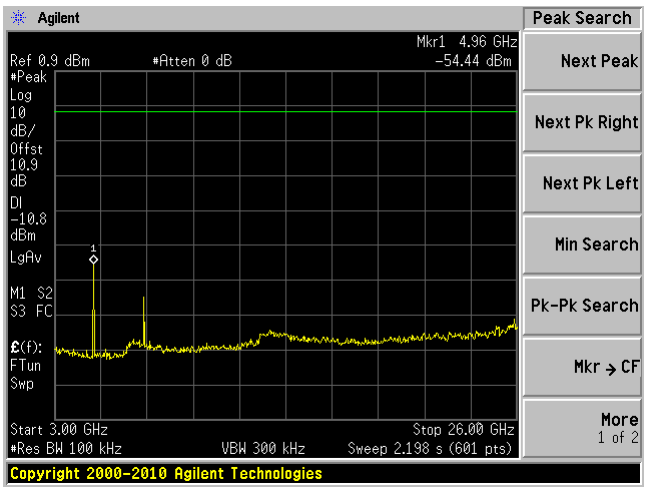
Middle Channels 1 GHz – 25 GHz



High Channel 30 MHz – 1 GHz

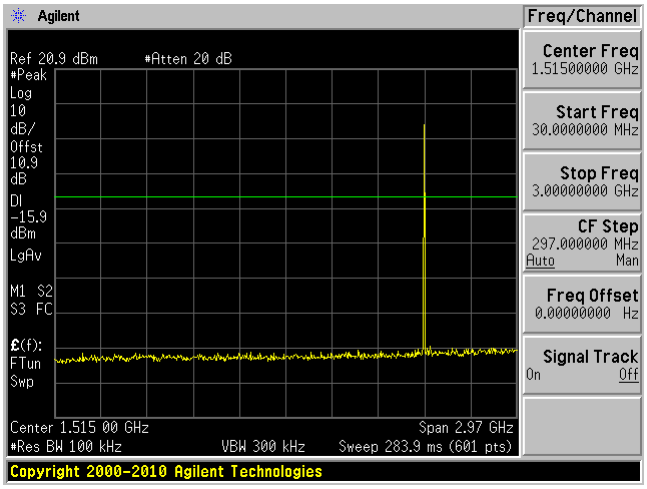


High Channels 1 GHz – 25 GHz

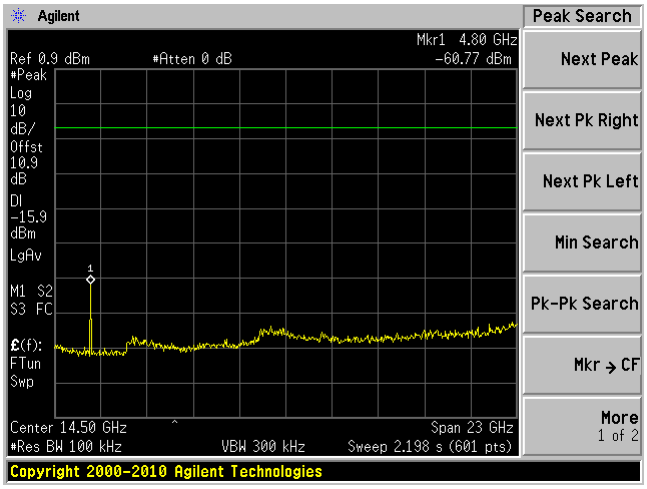


π/4-DQPSK

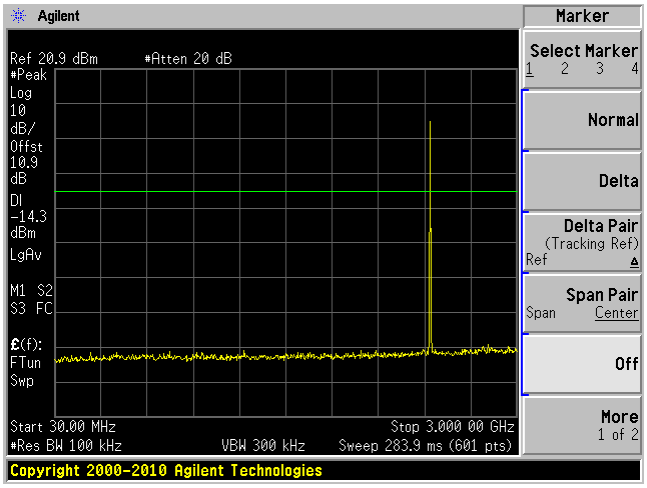
Low Channel 30 MHz – 1 GHz



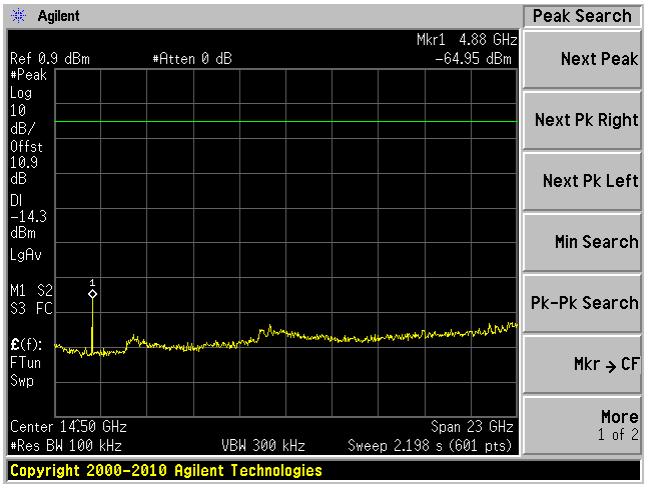
Low Channels 1 GHz – 25 GHz



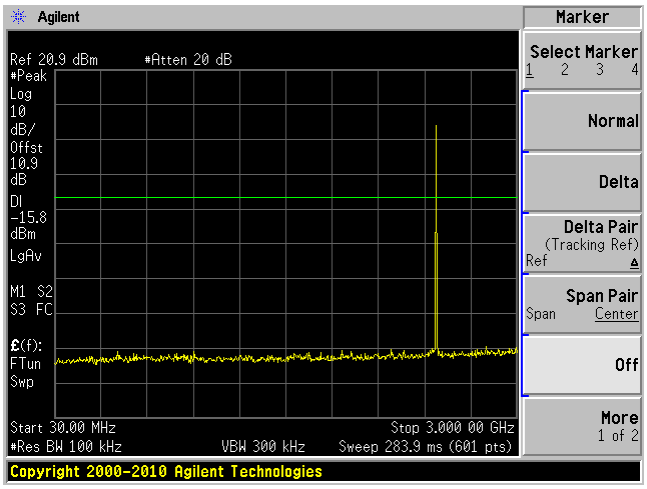
Middle Channel 30 MHz – 1 GHz



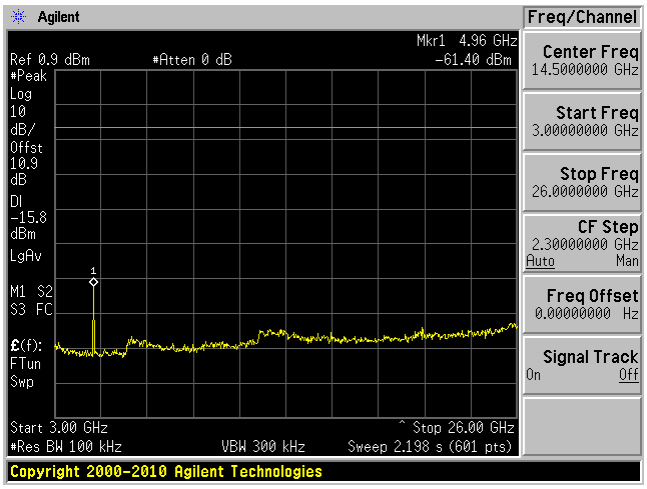
Middle Channels 1 GHz – 25 GHz



High Channel 30 MHz – 1 GHz

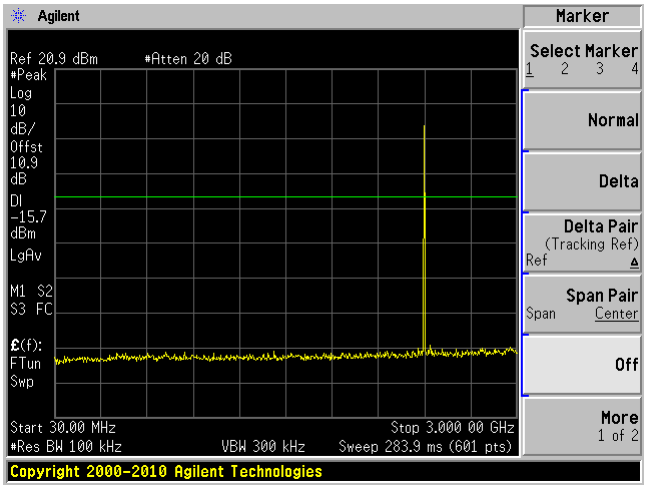


High Channels 1 GHz – 25 GHz

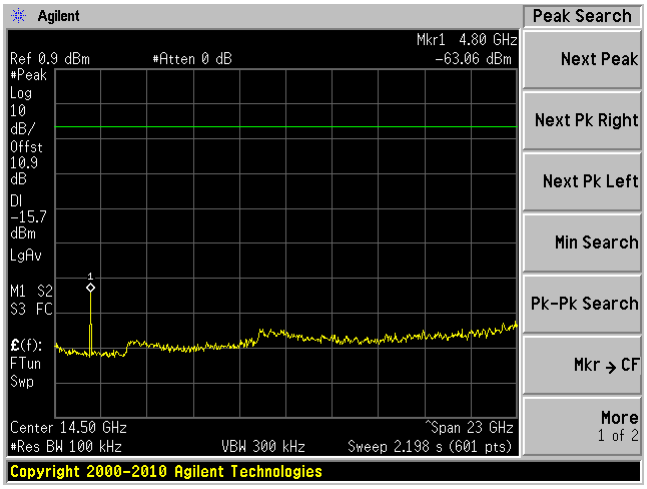


8DPSK

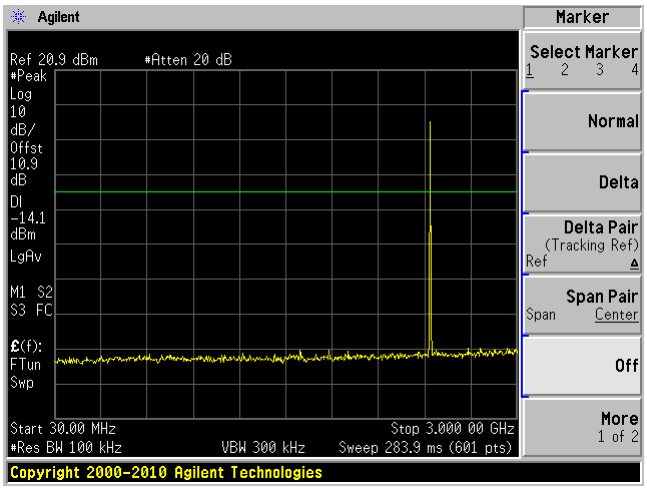
Low Channel 30 MHz –1 GHz



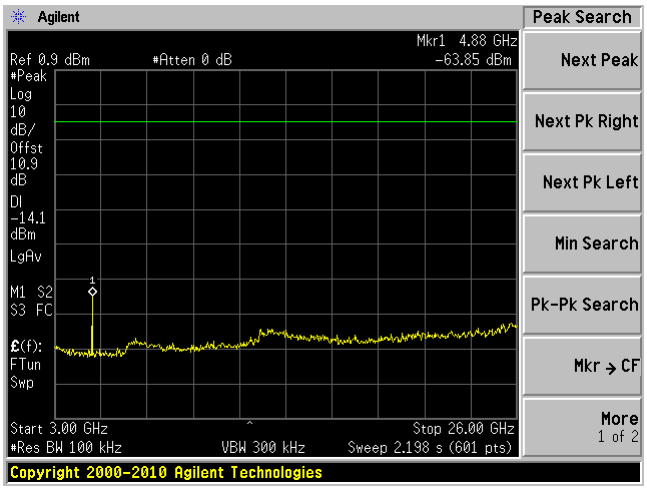
Low Channels 1 GHz – 25 GHz



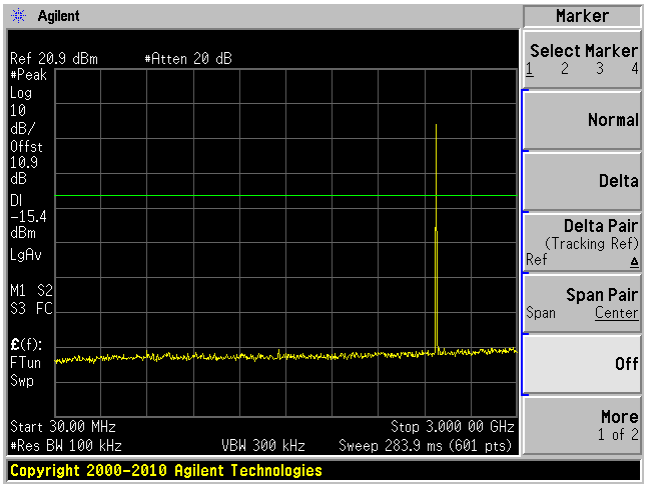
Middle Channel 30 MHz – 1 GHz



Middle Channels 1 GHz – 25 GHz



High Channel 30 MHz – 1 GHz



High Channels 1 GHz – 25 GHz