FCC PART 15, SUBPART C

TEST REPORT

For

ClearCaptions, LLC

3001 Lava Ridge Ct #100,

Roseville, CA 95661, USA

FCC ID: 2ARIOCC0031

Report Type:	Product Type:
Original Report	Captioning Telephone

Prepared By:	Harry Zhao Test Engineer
Report Number:	R1809245-247 DSS
Report Date:	2018-12-13
Reviewed By:	Xiao Lin RF Engineer
	Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1809245-247 DSS	Original Report	2018-12-13

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *ClearCaptions, LLC,* and their product models: *BLUE,* FCC ID: 2ARIOCC0031 or the "EUT" as referred to in this report. The EUT is a Captioning Telephone.

1.2 Objective

This report is prepared on behalf of *ClearCaptions, LLC,* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's.

The tests were performed in order to determine the Bluetooth BDR and EDR mode of EUT compliance with FCC Part 15.247 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.

1.3 Related Submittal(s)/Grant(s)

FCC 15.247 Report: R1809245-247 DTS

1.4 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.

1.5 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 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.6 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.

1.7 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 3279.02)*****,** 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 3279.03)*** 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 & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & 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 3279.01)*** 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 & 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: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & 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:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & 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;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- 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 Android ADB, provided by *ClearCaptions, LLC,* the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
GFSK	2402	Default
	2441	Default
	2480	Default
π/4-DQPSK	2402	Default
	2441	Default
	2480	Default
8DPSK	2402	Default
	2441	Default
	2480	Default

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:

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

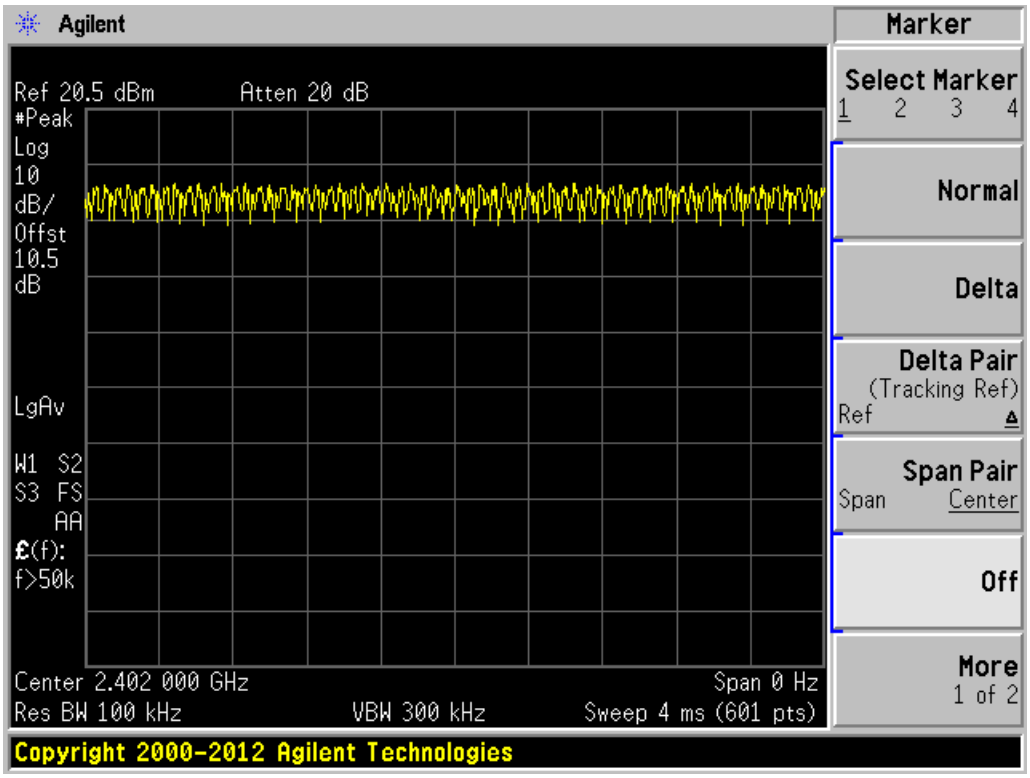
where: δ is the duty cycle correction factor (dB)
Δ is the duty cycle (dimensionless)

Radio Mode	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
GFSK	100	0
π/4-DQPSK	100	0
8DPSK	100	0

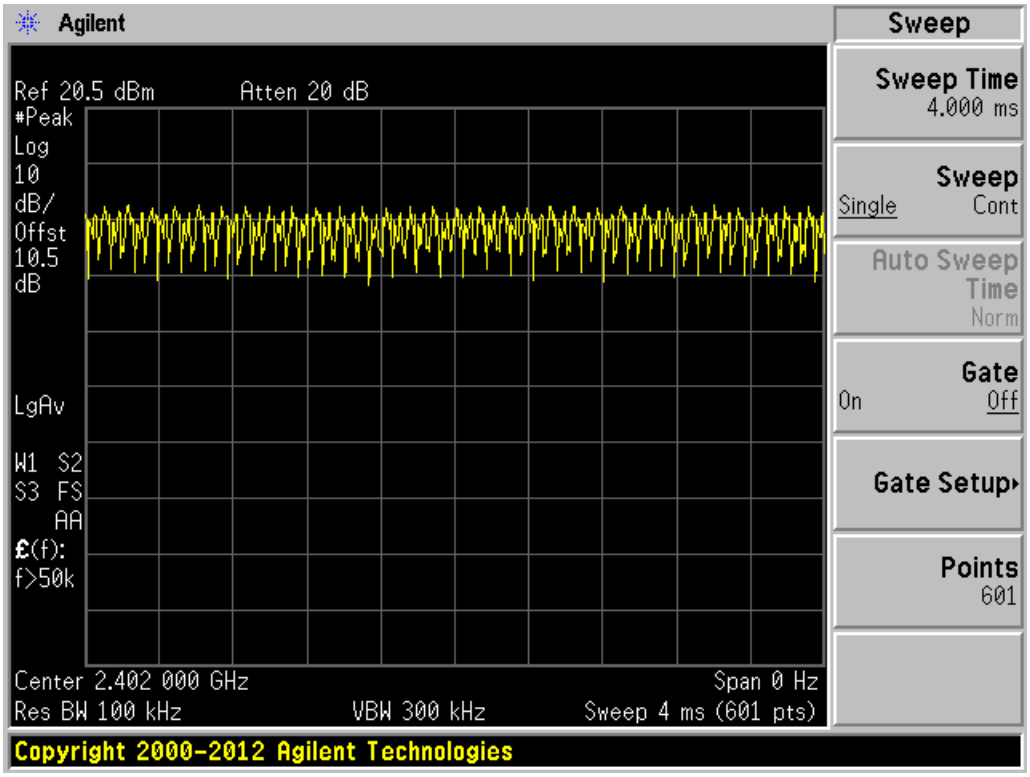
Duty Cycle = On Time (ms)/ Period (ms)

Please refer to the following plots.

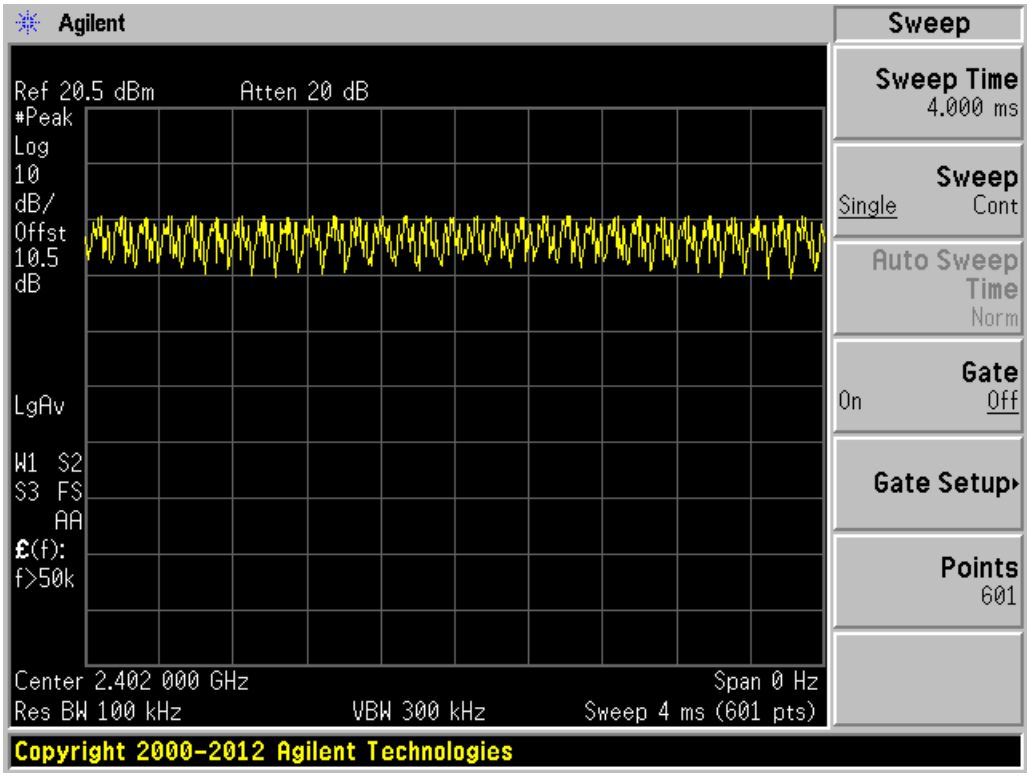
GFSK Mode



π/4-DQPSK Mode



8DPSK Mode



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	Latitude E6410	3CKRAQ1

2.6 Support Equipment

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

2.7 Power Supply/Adapter

Manufacturer	Description	Model
Adapter Tech.	AC adapter	ATS018T-W120U

2.8 Interface Ports and Cabling

Description	Length (m)	To	From
Cat5e	< 1 m	Router	EUT
RJ11	< 1 m	POTS Line	EUT
RJ9	< 1 m	Handset	EUT
U.F.L to SMA	< 1 m	PSA	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207	AC Line Conducted Emissions	Compliant
FCC §2.1091, §15.247(i)	RF Exposure	Compliant
FCC §2.1051, §15.247(d)	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247(d)	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1)	20 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(1)	Maximum Peak Output Power	Compliant
FCC §15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(a)(1)(iii)	Number of Hopping Channels	Compliant
FCC §15.247(a)(1)	Hopping Channel Separation	Compliant
FCC §15.247(a)(1)(iii)	Dwell Time	Compliant

4 FCC §15.203 - 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.

4.2 Antenna Description

The antennas used by the EUT have IPEX MHF Connector.

Frequency Range (MHz)	External/ Internal/ Integral	Antenna Type/ Pattern	Maximum Antenna Gain (dBi)
2402-2480	Internal	Omnidirectional	2.0

5 FCC §2.1091 & §15.247(i) - RF Exposure

5.1 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

5.2 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

5.3 MPE Results

Classic Bluetooth

Maximum peak output power at antenna input terminal (dBm):	10.03
Maximum peak output power at antenna input terminal (mW):	10.07
Prediction distance (cm):	20
Prediction frequency (MHz):	2441
Maximum Antenna Gain, typical (dBi):	2.0
Maximum Antenna Gain (numeric):	1.585
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0032
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0032 mW/cm^2. Limit is 1.0 mW/cm^2.

Note: Client declares that Bluetooth and 2.4 GHz Wi-Fi cannot transmit simultaneously.

6 FCC §15.207 - AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 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 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 Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100337	2017-07-15	2 years
Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2018-07-27	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150203	2018-02-28	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2018-04-04	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

***Statement of Traceability*:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

6.6 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	101.31 kPa

The testing was performed by Frank Wang on 2018-12-11 in Ground Test Site.

6.7 Summary of Test Results

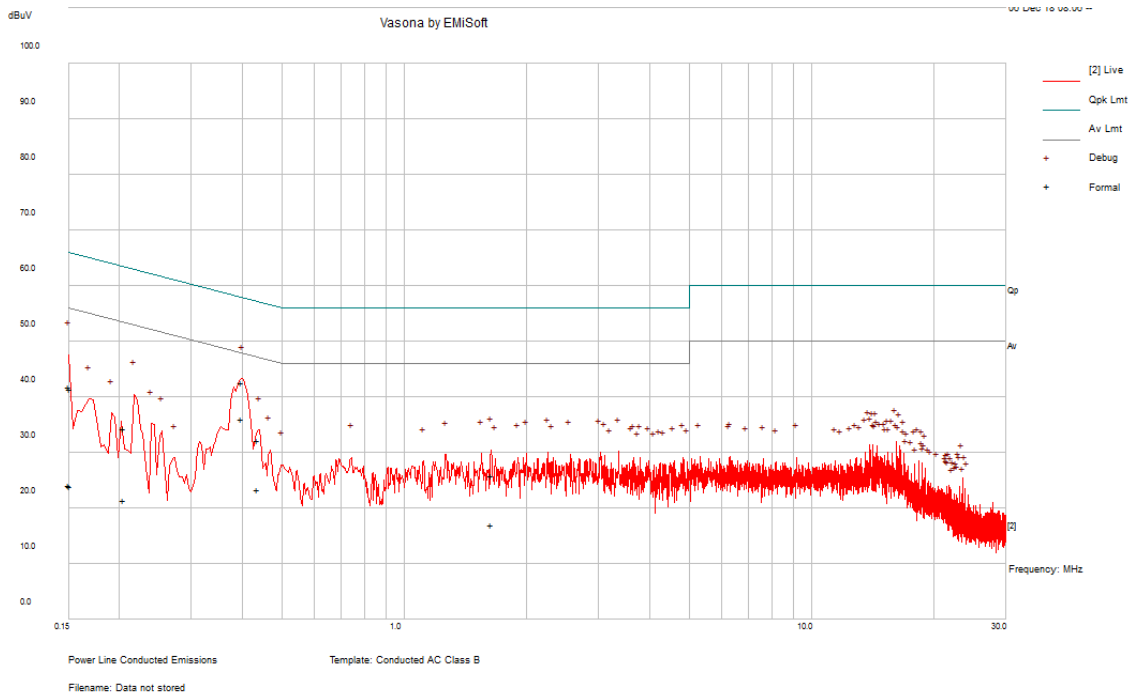
According to the recorded data in following table, the EUT complied with the FCC 15C standard's conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-11.72	0.398373	Line	0.15-30

6.8 Conducted Emissions Test Plots and Data

Classic Bluetooth, 8DPSK (2441 MHz)

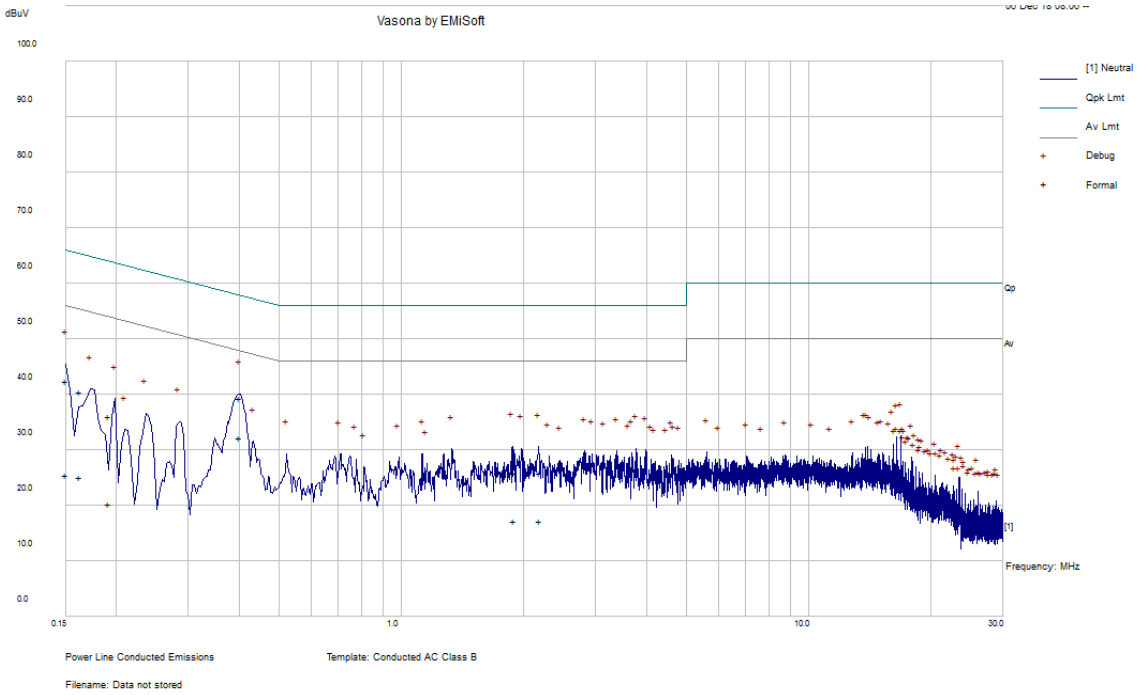
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.398373	42.6	Line	57.89	-15.29	QP
0.150332	41.86	Line	65.98	-24.12	QP
0.205287	34.42	Line	63.39	-28.98	QP
0.437403	32.26	Line	57.11	-24.85	QP
0.151126	41.47	Line	65.94	-24.47	QP
1.631892	25.9	Line	56	-30.1	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.398373	36.16	Line	47.89	-11.72	Ave.
0.150332	24.13	Line	55.98	-31.85	Ave.
0.205287	21.52	Line	53.39	-31.88	Ave.
0.437403	23.44	Line	47.11	-23.67	Ave.
0.151126	24.05	Line	55.94	-31.89	Ave.
1.631892	17.12	Line	46	-28.88	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.401037	39.33	Neutral	57.83	-18.5	QP
0.15009	42.46	Neutral	65.99	-23.53	QP
0.162255	40.46	Neutral	65.35	-24.88	QP
0.191454	36.03	Neutral	63.97	-27.94	QP
1.887687	25.93	Neutral	56	-30.07	QP
2.183117	25.92	Neutral	56	-30.08	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.401037	32.27	Neutral	47.83	-15.56	Ave.
0.15009	25.5	Neutral	55.99	-30.49	Ave.
0.162255	25.08	Neutral	55.35	-30.26	Ave.
0.191454	20.41	Neutral	53.97	-33.56	Ave.
1.887687	17.23	Neutral	46	-28.77	Ave.
2.183117	17.29	Neutral	46	-28.71	Ave.

7 FCC §15.209 & §15.247(d) - 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) 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 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 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).

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 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 = 100 ms
(2) Average: RBW = 1 / T / 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/m) + 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 & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2018-07-05	2 year
Agilent	Analyzer, Spectrum	E4446A	US44300386	2018-06-01	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2018-02-26	2 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2017-12-15	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2018-04-02	1 year
Insulated Wire INC	2.92mm (M) X2, 1501 Armor Neoprene, 396"	KPS-1501AN-3960-KPS	DC 1807	2018-03-13	1 year
-	SMA cable	-	C00011	Each time[1]	N/A
-	N-Type Cable	-	C00012	Each time[1]	N/A
-	N-Type Cable	-	C00014	Each time[1]	N/A
HP	Pre-Amplifier	8449B	3147A00400	2018-02-02	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2017-03-27	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 Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

7.6 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Frank Wang on 2018-12-06 in 5m chamber 3.

7.7 Summary of Test Results

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

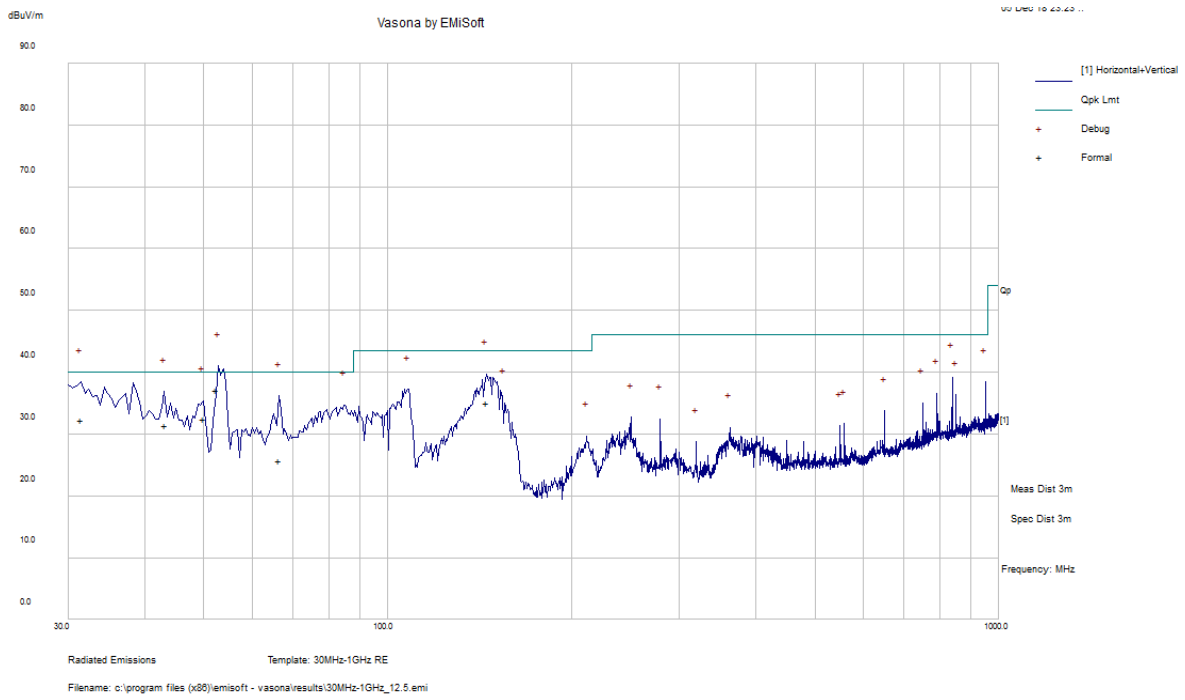
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-4.53	2483.5	Vertical	8DPSK, 2480 MHz

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

7.8 Radiated Emissions Test Result Data

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

Classic Bluetooth, 8DPSK (2441 MHz)



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
52.53825	37.07	100	V	27	40	-2.93	QP
31.4695	32.26	100	V	117	40	-7.74	QP
43.25775	31.4	100	V	342	40	-8.6	QP
145.1788	35.01	114	H	78	43.5	-8.49	QP
66.38775	25.73	284	V	28	40	-14.27	QP
50.05325	32.45	100	V	330	40	-7.55	QP

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		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz											
2402	71.62	87	211	H	28.94	5.083	0	105.65	-	-	PK
2402	70.99	87	211	H	28.94	5.083	0	105.02	-	-	AV
2402	67.68	91	215	V	28.93	5.083	0	101.70	-	-	PK
2402	66.66	91	215	V	28.93	5.083	0	100.68	-	-	AV
2390	28.08	0	100	H	28.94	5.083	0	62.11	74.00	-11.89	PK
2390	14.34	0	100	H	28.94	5.083	0	48.37	54.00	-5.63	AV
2390	28.15	0	100	V	28.93	5.083	0	62.17	74.00	-11.83	PK
2390	14.35	0	100	V	28.93	5.083	0	48.37	54.00	-5.63	AV
4804	46.20	0	100	H	32.54	7.427	33.15	53.02	74.00	-20.98	PK
4804	32.23	0	100	H	32.54	7.427	33.15	39.05	54.00	-14.95	AV
4804	46.40	0	100	V	32.56	7.427	33.15	53.24	74.00	-20.76	PK
4804	32.26	0	100	V	32.56	7.427	33.15	39.10	54.00	-14.90	AV
Middle Channel 2441 MHz											
2441	72.58	75	140	H	29.15	5.083	0	106.81	-	-	PK
2441	71.37	75	140	H	29.15	5.083	0	105.60	-	-	AV
2441	67.40	35	100	V	29.19	5.083	0	101.67	-	-	PK
2441	66.25	356	100	V	29.19	5.083	0	100.52	-	-	AV
4882	45.14	0	100	H	32.79	7.427	33.15	52.20	74.00	-21.80	PK
4882	31.85	0	100	H	32.79	7.427	33.15	38.91	54.00	-15.09	AV
4882	45.10	0	100	V	32.53	7.427	33.15	51.90	74.00	-22.10	PK
4882	31.80	0	100	V	32.53	7.427	33.15	38.60	54.00	-15.40	AV
High Channel 2480 MHz											
2480	72.37	105	257	H	29.15	5.083	0	106.60	-	-	PK
2480	71.35	105	257	H	29.15	5.083	0	105.58	-	-	AV
2480	67.02	20	100	V	29.19	5.083	0	101.29	-	-	PK
2480	66.46	20	100	V	29.19	5.083	0	100.73	-	-	AV
2483.5	28.64	0	100	H	29.18	5.083	0	62.90	74.00	-11.10	PK
2483.5	14.67	0	100	H	29.18	5.083	0	48.93	54.00	-5.07	AV
2483.5	28.43	0	100	V	29.18	5.083	0	62.69	74.00	-11.31	PK
2483.5	14.64	0	100	V	29.18	5.083	0	48.90	54.00	-5.10	AV
4960	46.49	0	100	H	32.81	7.600	33.15	53.75	74.00	-20.25	PK
4960	32.03	0	100	H	32.81	7.600	33.15	39.29	54.00	-14.71	AV
4960	46.56	0	100	V	32.70	7.600	33.15	53.71	74.00	-20.30	PK
4960	32.13	0	100	V	32.70	7.600	33.15	39.28	54.00	-14.73	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		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz											
2402	69.71	87	211	H	28.94	5.083	0	103.74	-	-	PK
2402	68.24	87	211	H	28.94	5.083	0	102.27	-	-	AV
2402	64.67	93	229	V	28.93	5.083	0	98.69	-	-	PK
2402	64.36	63	229	V	28.93	5.083	0	98.38	-	-	AV
2390	27.98	0	100	H	28.94	5.083	0	62.01	74.00	-11.99	PK
2390	14.33	0	100	H	28.94	5.083	0	48.36	54.00	-5.64	AV
2390	27.95	0	100	V	28.93	5.083	0	61.97	74.00	-12.03	PK
2390	14.35	0	100	V	28.93	5.083	0	48.37	54.00	-5.63	AV
4804	46.57	0	100	H	32.54	7.427	33.15	53.39	74.00	-20.61	PK
4804	31.98	0	100	H	32.54	7.427	33.15	38.80	54.00	-15.20	AV
4804	46.87	0	100	V	32.56	7.427	33.15	53.71	74.00	-20.29	PK
4804	31.99	0	100	V	32.56	7.427	33.15	38.83	54.00	-15.17	AV
Middle Channel 2441 MHz											
2441	71.10	105	100	H	29.15	5.083	0	105.33	-	-	PK
2441	69.56	105	100	H	29.15	5.083	0	103.79	-	-	AV
2441	65.33	35	100	V	29.19	5.083	0	99.60	-	-	PK
2441	64.27	356	100	V	29.19	5.083	0	98.54	-	-	AV
4882	47.24	0	100	H	32.79	7.427	33.15	54.30	74.00	-19.70	PK
4882	32.08	0	100	H	32.79	7.427	33.15	39.14	54.00	-14.86	AV
4882	47.52	0	100	V	32.53	7.427	33.15	54.32	74.00	-19.68	PK
4882	32.01	0	100	V	32.53	7.427	33.15	38.81	54.00	-15.19	AV
High Channel 2480 MHz											
2480	72.01	100	221	H	29.15	5.083	0	106.24	-	-	PK
2480	71.02	100	221	H	29.15	5.083	0	105.25	-	-	AV
2480	68.29	20	100	V	29.19	5.083	0	102.56	-	-	PK
2480	68.05	20	100	V	29.19	5.083	0	102.32	-	-	AV
2483.5	28.73	0	100	H	29.18	5.083	0	62.99	74.00	-11.01	PK
2483.5	14.94	0	100	H	29.18	5.083	0	49.20	54.00	-4.80	AV
2483.5	28.65	0	100	V	29.18	5.083	0	62.91	74.00	-11.09	PK
2483.5	14.92	0	100	V	29.18	5.083	0	49.18	54.00	-4.82	AV
4960	45.92	0	100	H	32.81	7.600	33.15	53.18	74.00	-20.82	PK
4960	31.59	0	100	H	32.81	7.600	33.15	38.85	54.00	-15.15	AV
4960	45.76	0	100	V	32.70	7.600	33.15	52.91	74.00	-21.10	PK
4960	31.55	0	100	V	32.70	7.600	33.15	38.70	54.00	-15.31	AV

8DPSK Mode

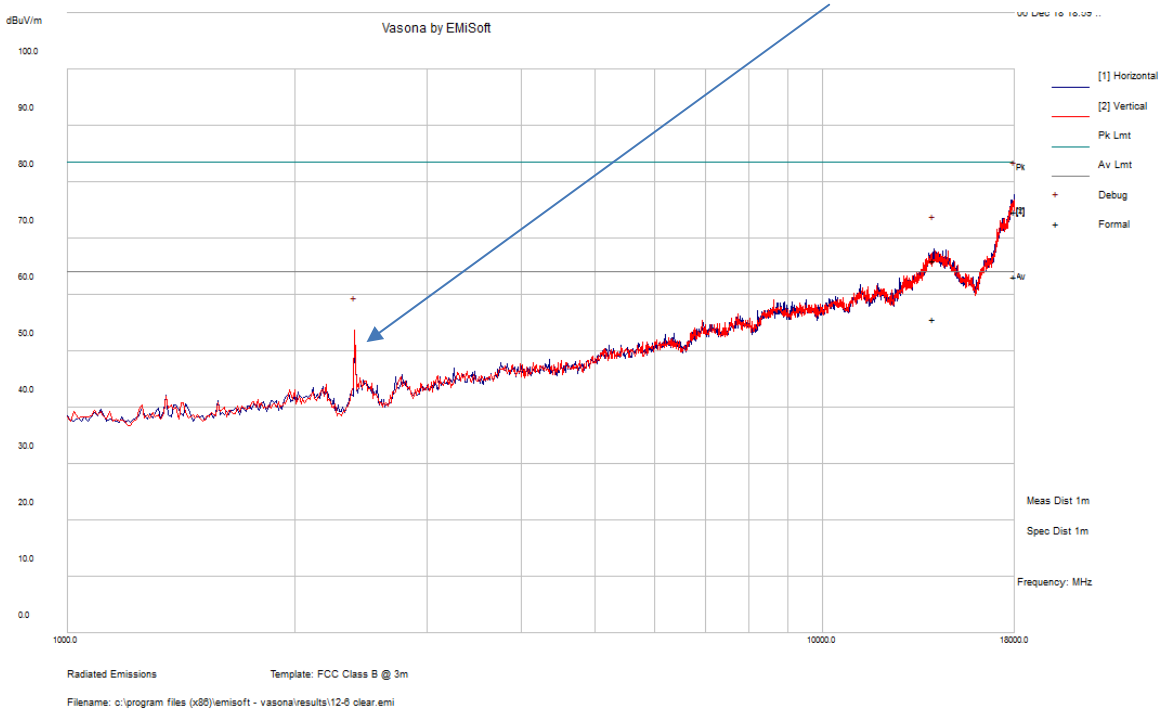
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2402 MHz											
2402	73.57	65	285	H	28.94	5.083	0	107.60	-	-	PK
2402	72.45	65	285	H	28.94	5.083	0	106.48	-	-	AV
2402	68.24	98	213	V	28.93	5.083	0	102.26	-	-	PK
2402	67.85	98	213	V	28.93	5.083	0	101.87	-	-	AV
2390	27.89	0	100	H	28.94	5.083	0	61.92	74.00	-12.08	PK
2390	14.61	0	100	H	28.94	5.083	0	48.64	54.00	-5.36	AV
2390	27.59	0	100	V	28.93	5.083	0	61.61	74.00	-12.39	PK
2390	14.41	0	100	V	28.93	5.083	0	48.43	54.00	-5.57	AV
4804	46.18	0	100	H	32.54	7.427	33.15	53.00	74.00	-21.00	PK
4804	32.62	0	100	H	32.54	7.427	33.15	39.44	54.00	-14.56	AV
4804	46.16	0	100	V	32.56	7.427	33.15	53.00	74.00	-21.00	PK
4804	32.78	0	100	V	32.56	7.427	33.15	39.62	54.00	-14.38	AV
Middle Channel 2441 MHz											
2441	74.80	94	287	H	29.15	5.083	0	109.03	-	-	PK
2441	74.14	94	287	H	29.15	5.083	0	108.37	-	-	AV
2441	65.32	35	285	V	29.19	5.083	0	99.59	-	-	PK
2441	64.48	35	285	V	29.19	5.083	0	98.75	-	-	AV
4882	46.04	0	100	H	32.79	7.427	33.15	53.10	74.00	-20.90	PK
4882	31.90	0	100	H	32.79	7.427	33.15	38.96	54.00	-15.04	AV
4882	46.58	0	100	V	32.53	7.427	33.15	53.38	74.00	-20.62	PK
4882	31.97	0	100	V	32.53	7.427	33.15	38.77	54.00	-15.23	AV
High Channel 2480 MHz											
2480	74.72	108	283	H	29.15	5.083	0	108.95	-	-	PK
2480	73.56	108	283	H	29.15	5.083	0	107.79	-	-	AV
2480	69.56	20	100	V	29.19	5.083	0	103.83	-	-	PK
2480	68.49	20	100	V	29.19	5.083	0	102.76	-	-	AV
2483.5	29.05	0	100	H	29.18	5.083	0	63.31	74.00	-10.69	PK
2483.5	15.02	0	100	H	29.18	5.083	0	49.28	54.00	-4.72	AV
2483.5	28.73	0	100	V	29.18	5.083	0	62.99	74.00	-11.01	PK
2483.5	15.21	0	100	V	29.18	5.083	0	49.47	54.00	-4.53	AV
4960	46.82	0	100	H	32.81	7.600	33.15	54.08	74.00	-19.92	PK
4960	32.05	0	100	H	32.81	7.600	33.15	39.31	54.00	-14.69	AV
4960	46.67	0	100	V	32.70	7.600	33.15	53.82	74.00	-20.19	PK
4960	31.87	0	100	V	32.70	7.600	33.15	39.02	54.00	-14.99	AV

Worst Plots, Measured at 1 meter

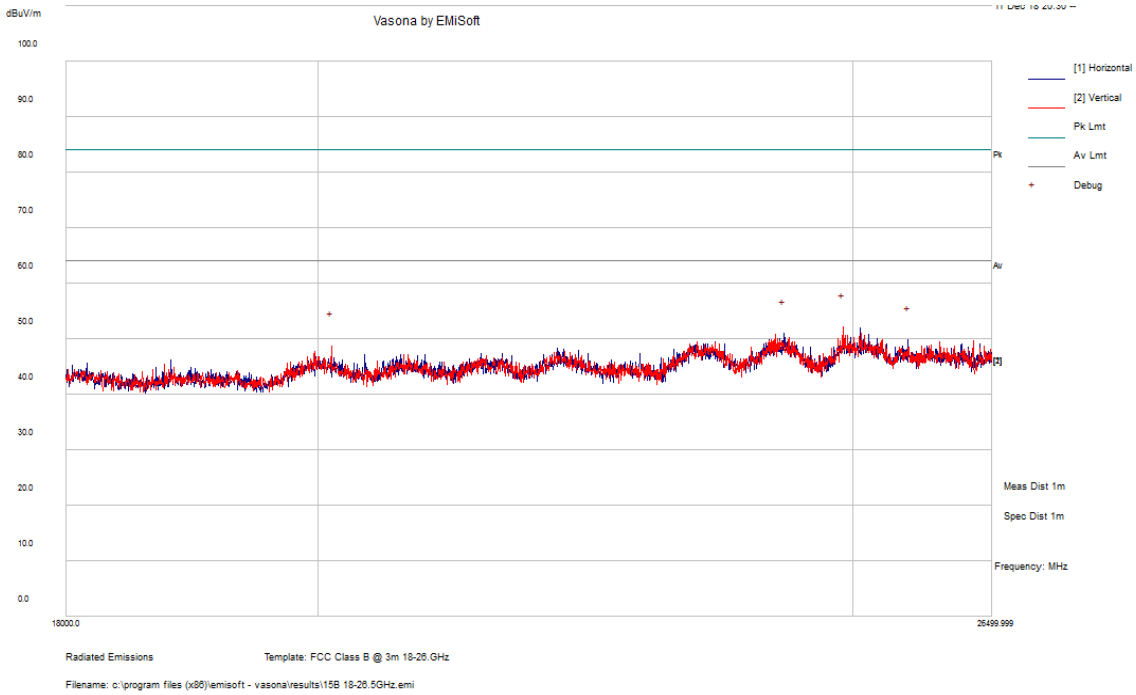
Classic Bluetooth, 8DPSK (2441 MHz)

1-18 GHz

Fundamental signal with 2.4 GHz notch filter



18-26.5 GHz



8 FCC §15.247(a) (1) - Emission Bandwidth

8.1 Applicable Standards

According to FCC §15.247(a) (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	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

8.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Frank Wang on 2018-12-11 in RF site.

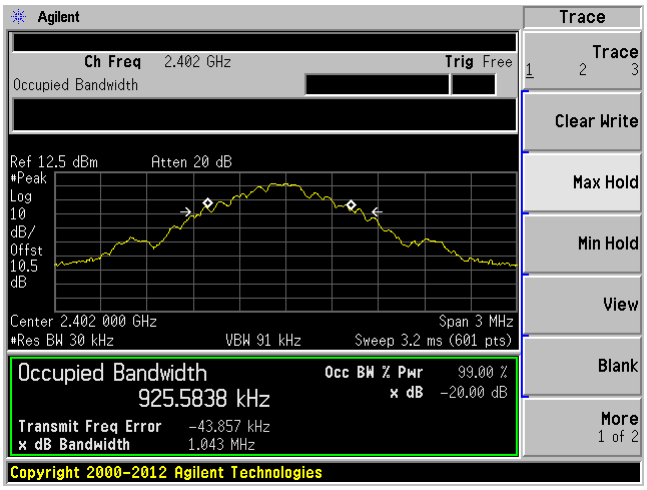
8.5 Test Results

Channel	Frequency (MHz)	99% OBW (kHz)	20 dB OBW (kHz)
GFSK			
Low	2402	925.5838	1043
Middle	2441	926.6576	1044
High	2480	929.0207	1045
π/4-DQPSK			
Low	2402	1209.6	1367
Middle	2441	1211.8	1368
High	2480	1213.0	1370
8DPSK			
Low	2402	1189.0	1309
Middle	2441	1190.9	1310
High	2480	1193.7	1311

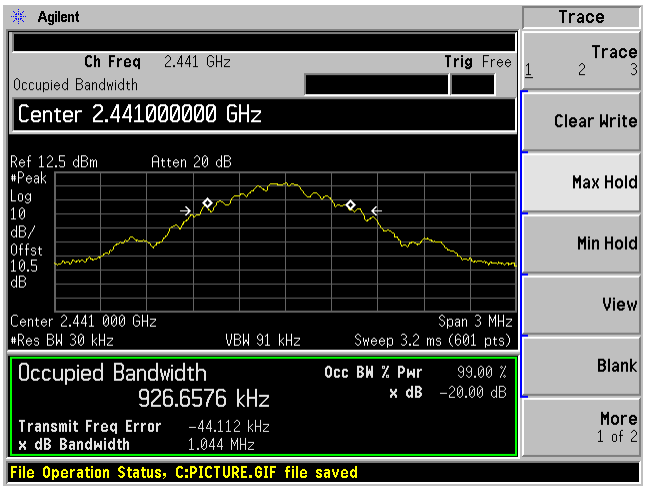
Please refer to the following plots for detailed test results.

GFSK

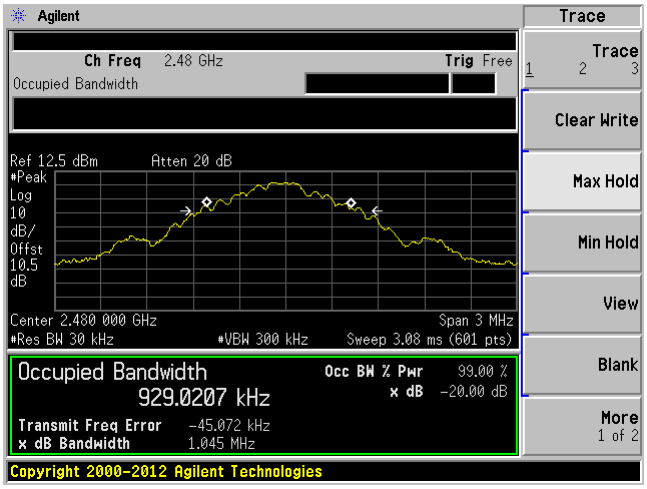
Low Channel 2402 MHz



Middle Channel 2441 MHz

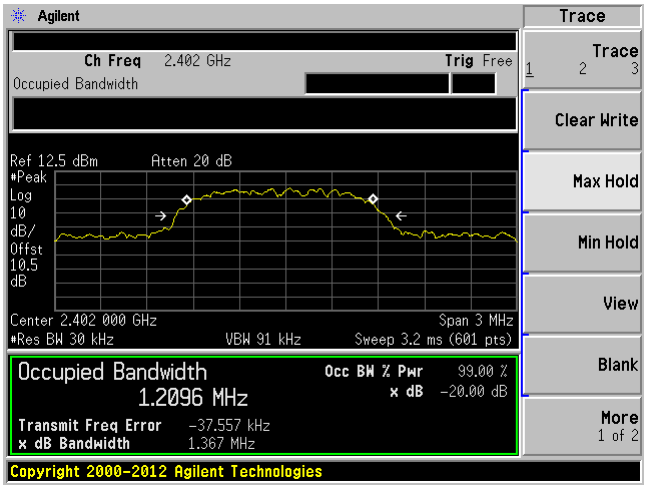


High Channel 2480 MHz

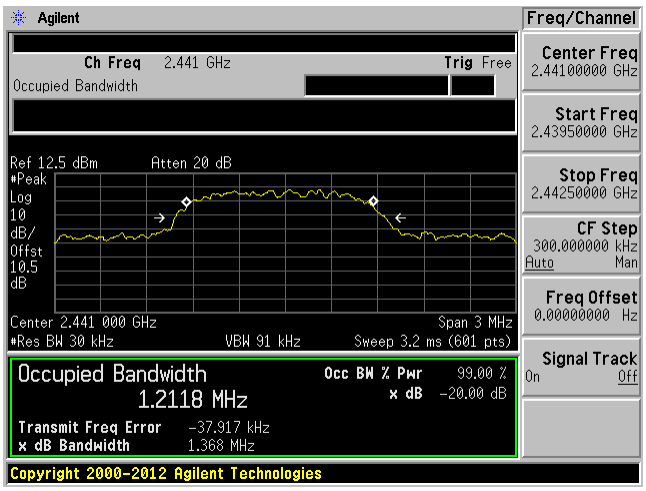


π/4-DQPSK

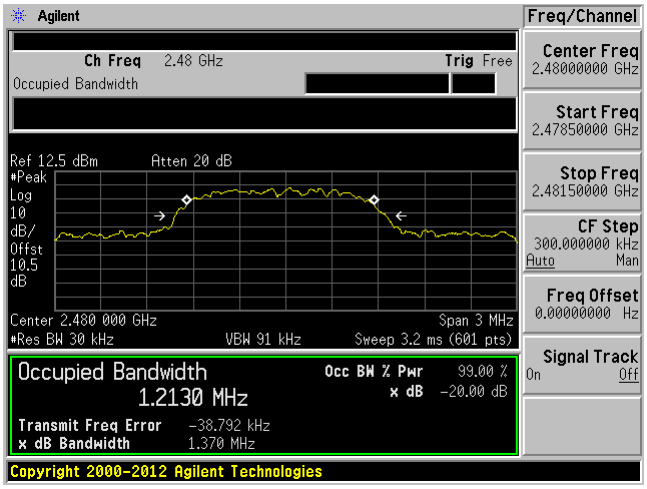
Low Channel 2402 MHz



Middle Channel 2441 MHz

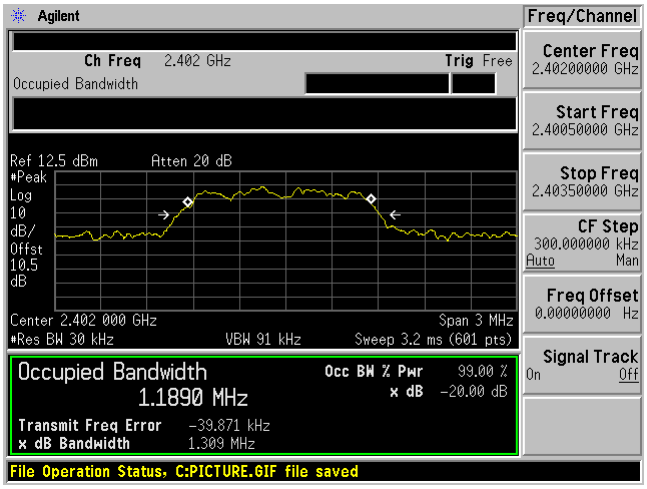


High Channel 2480 MHz

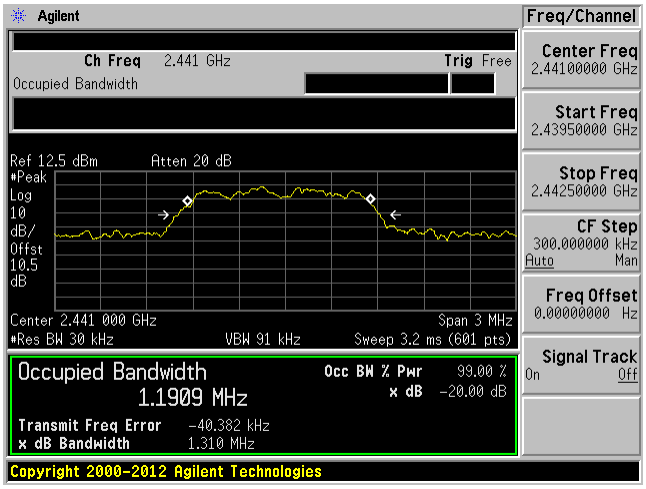


8DPSK

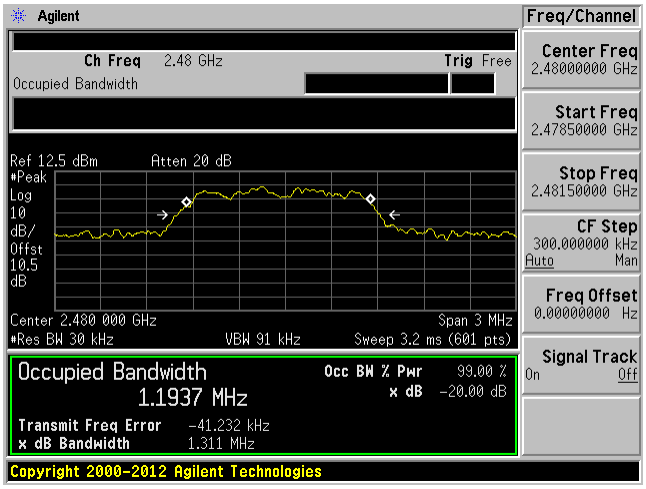
Low Channel 2402 MHz



Middle Channel 2441 MHz



High Channel 2480 MHz



9 FCC §15.247(b)(1) - Output Power

9.1 Applicable Standards

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 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.

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	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

9.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Frank Wang on 2018-12-11 in RF site.

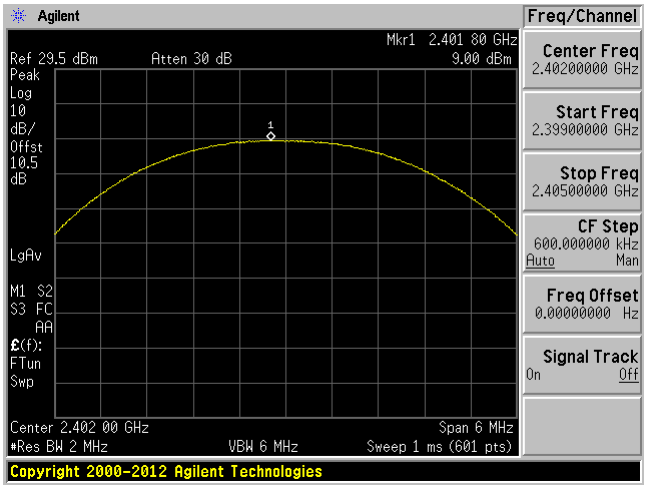
9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
GFSK			
Low	2402	9.00	21
Middle	2441	8.76	21
High	2480	8.70	21
π/4-DQPSK			
Low	2402	9.59	21
Middle	2441	9.86	21
High	2480	9.70	21
8DPSK			
Low	2402	9.78	21
Middle	2441	10.03	21
High	2480	9.93	21

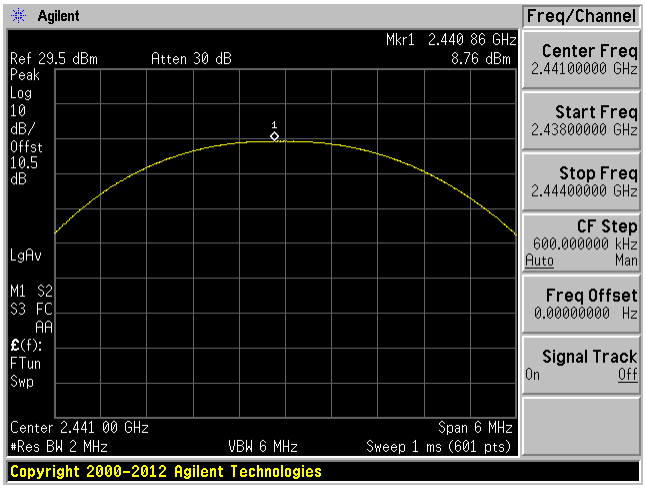
Please refer to the following plots for detailed test results.

GFSK

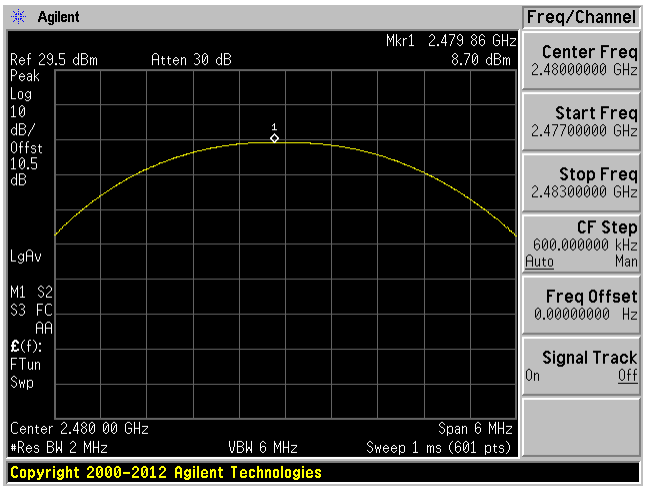
Low Channel 2402 MHz



Middle Channel 2441 MHz

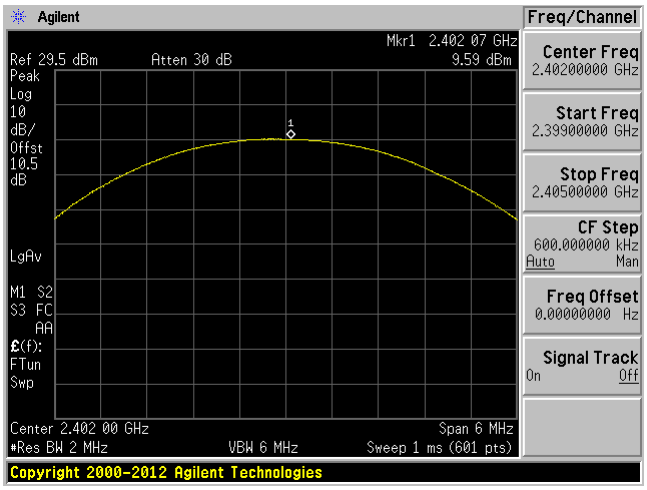


High Channel 2480 MHz

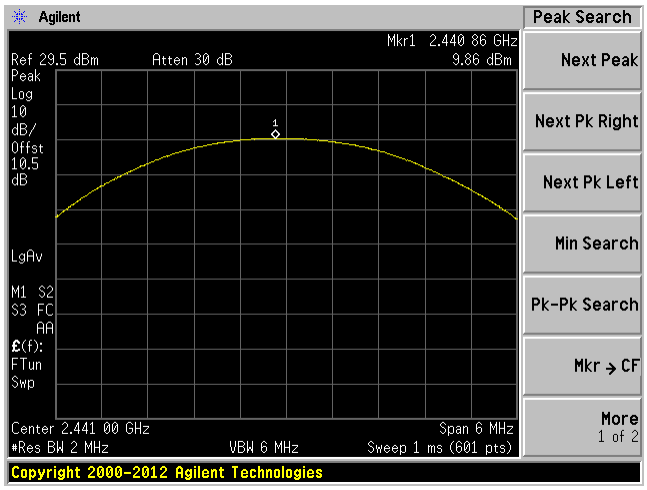


π/4-DQPSK

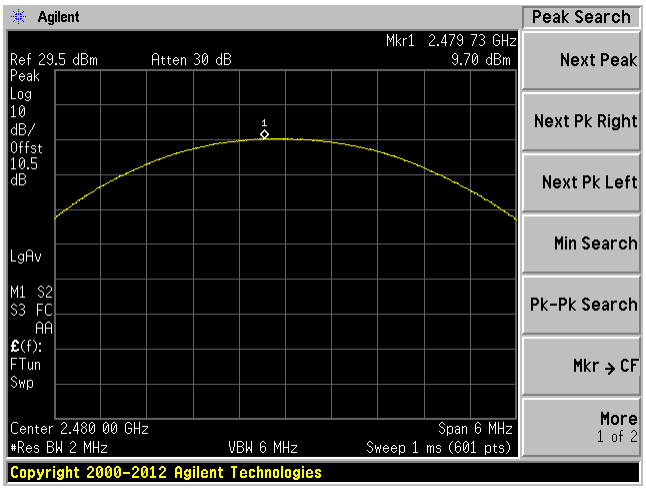
Low Channel 2402 MHz



Middle Channel 2441 MHz

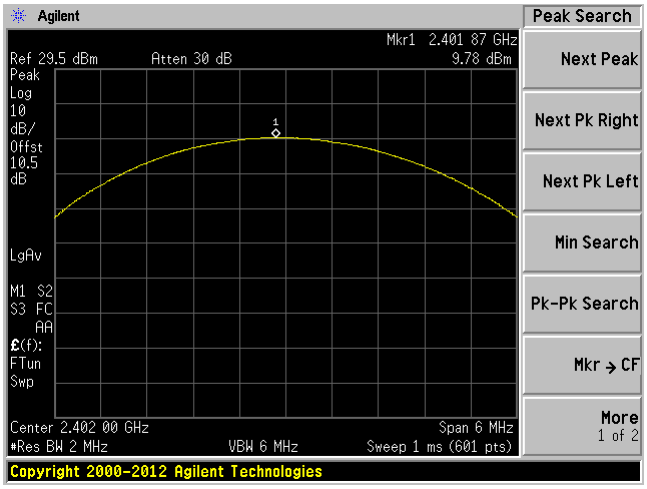


High Channel 2480 MHz

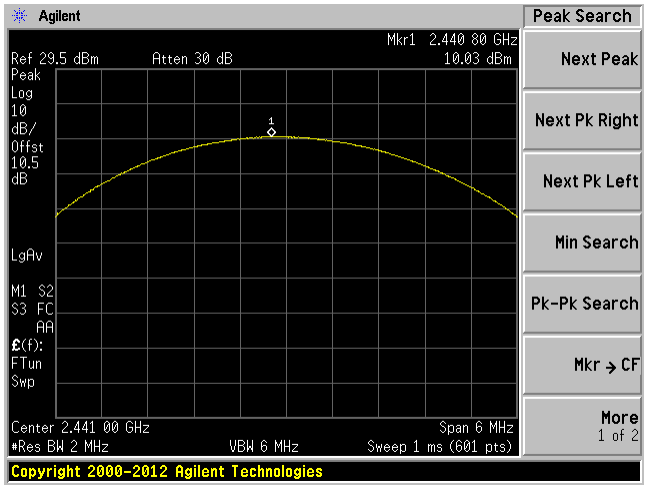


8DPSK

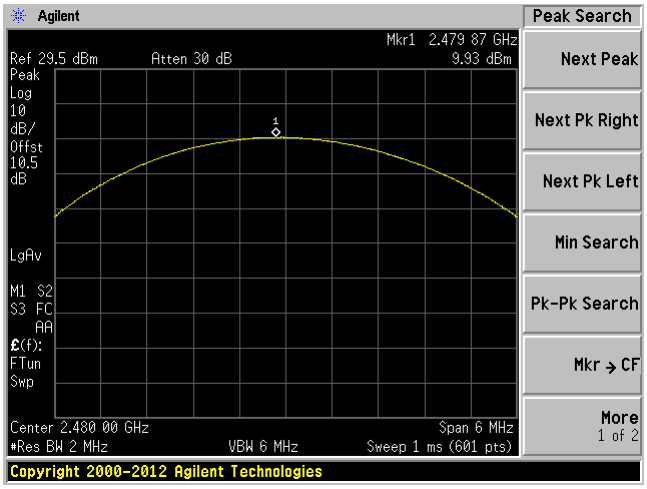
Low Channel 2402 MHz



Middle Channel 2441 MHz



High Channel 2480 MHz



10 FCC §15.247(d) - 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).

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	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

10.4 Test Environmental Conditions

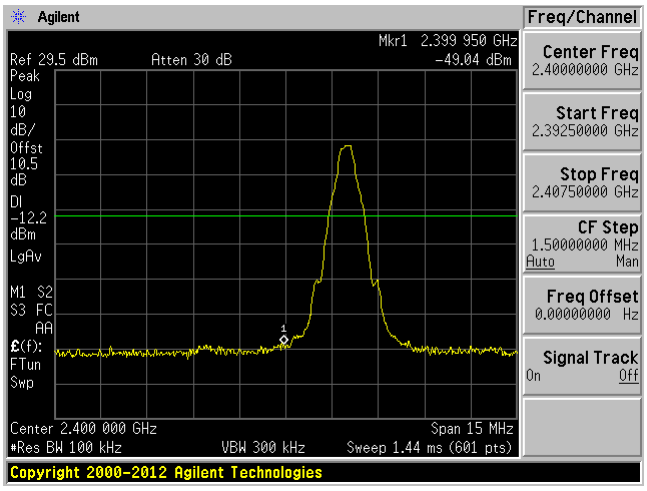
Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Frank Wang on 2018-12-11 in RF site.

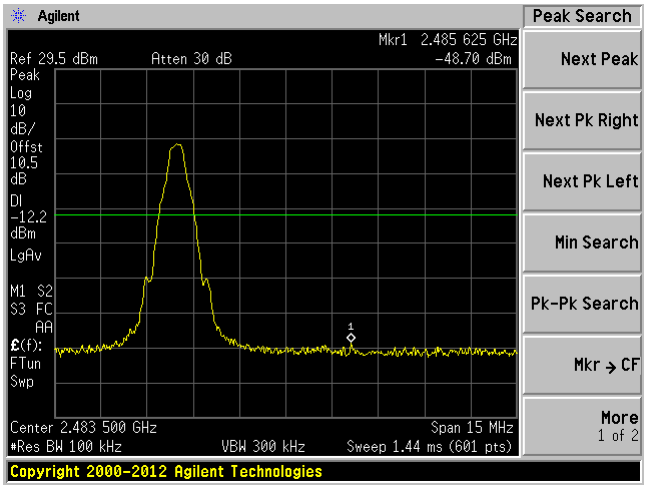
10.5 Test Results

GFSK (Fixed Channel)

Low Channel 2402 MHz

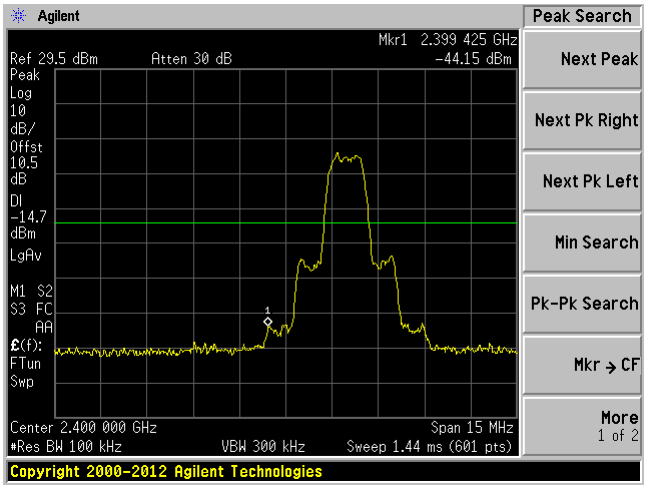


High Channel 2480 MHz

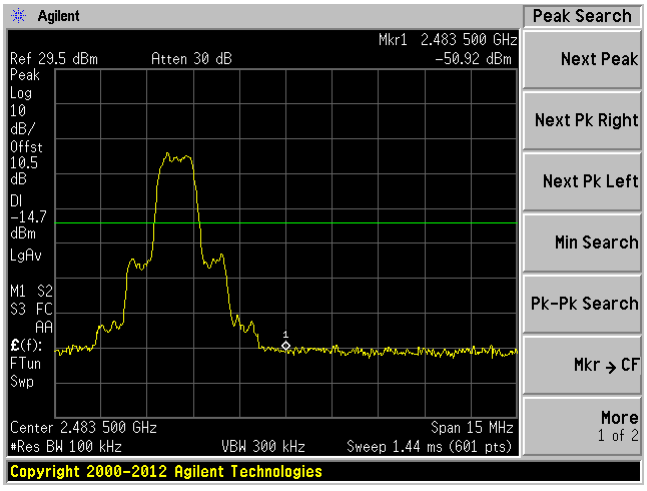


π/4-DQPSK (Fixed Channel)

Low Channel 2402 MHz

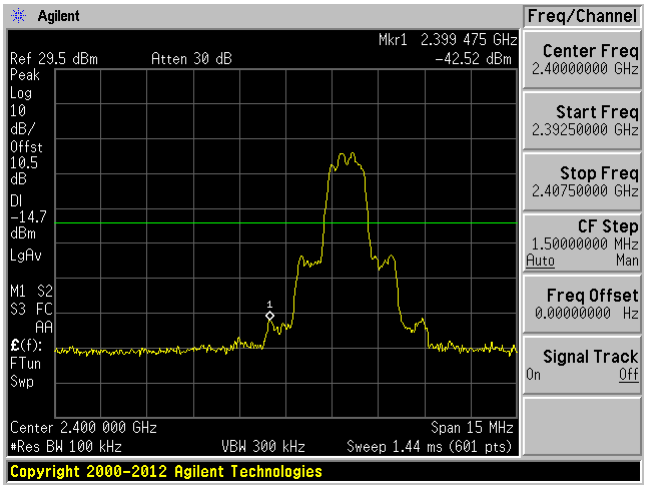


High Channel 2480 MHz

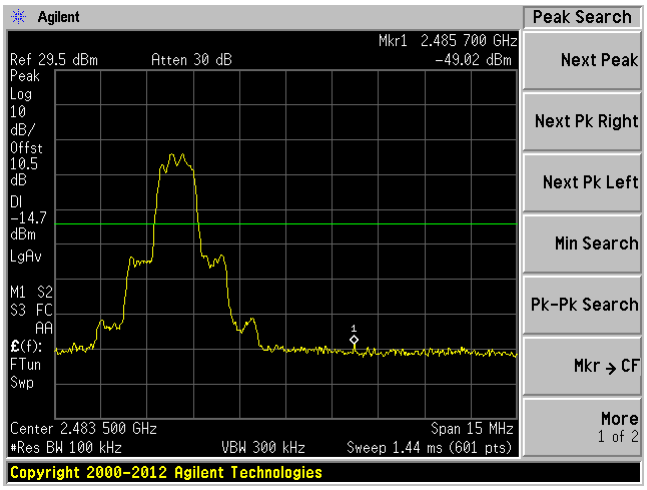


8DPSK (Fixed Channel)

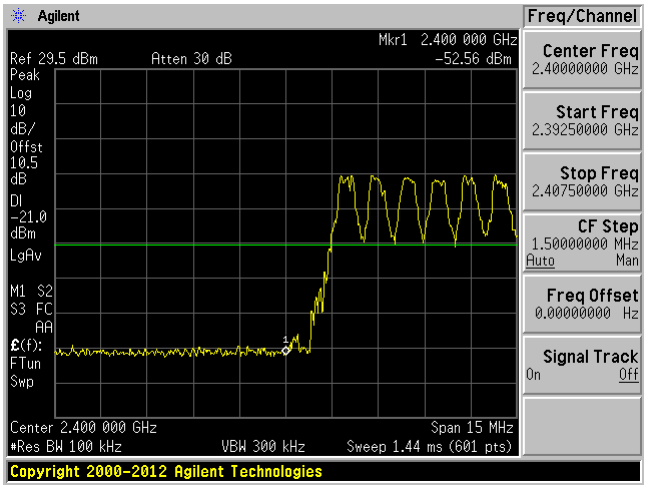
Low Channel 2402 MHz

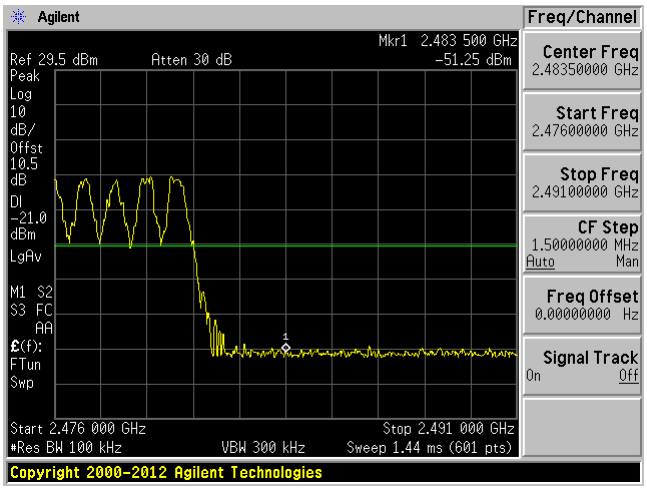


High Channel 2480 MHz

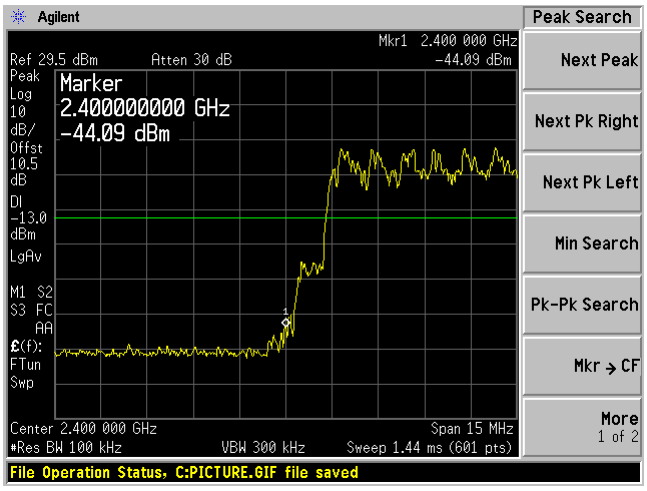


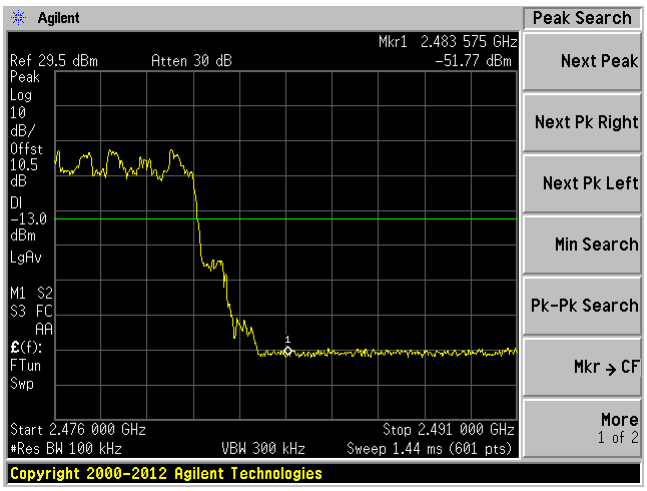
GFSK (Hopping)



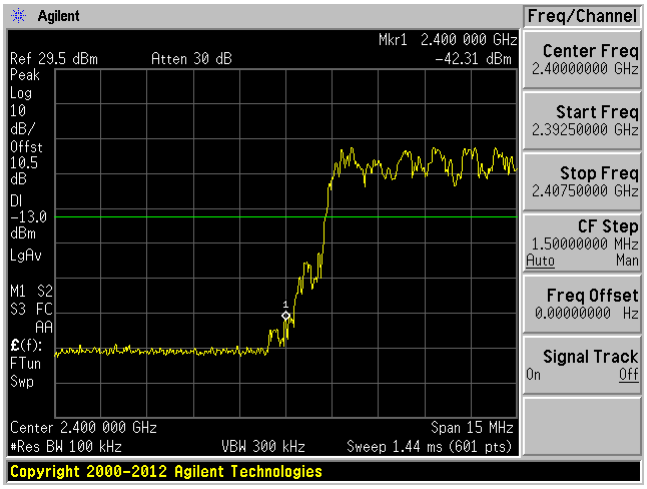


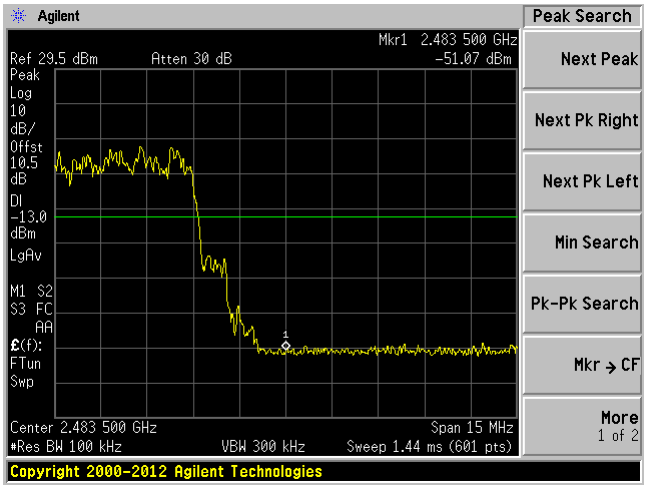
π/4-DQPSK (Hopping)





8DPSK (Hopping)





11 FCC §15.247(a)(1)(iii) - Dwell Time

11.1 Applicable Standards

According to FCC §15.247(a)(1)(iii), 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	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

11.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Frank Wang on 2018-12-11 in RF site.

11.5 Test Results

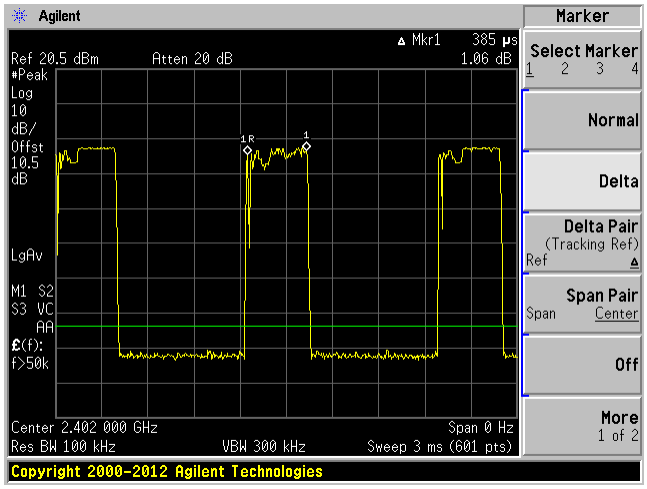
Channel	Pulse Width (ms)	Dwell Time (sec)	Limit (sec)	Results
GFSK, DH1				
Low	0.385	0.123	0.4	compliant
Middle	0.375	0.120	0.4	compliant
High	0.385	0.123	0.4	compliant
GFSK, DH3				
Low	1.627	0.260	0.4	compliant
Middle	1.640	0.262	0.4	compliant
High	1.613	0.258	0.4	compliant
GFSK, DH5				
Low	2.88	0.307	0.4	compliant
Middle	2.86	0.305	0.4	compliant
High	2.88	0.307	0.4	compliant
π/4-DQPSK, DH1				
Low	0.395	0.126	0.4	compliant
Middle	0.390	0.125	0.4	compliant
High	0.405	0.130	0.4	compliant
π/4-DQPSK, DH3				
Low	1.653	0.264	0.4	compliant
Middle	1.653	0.264	0.4	compliant
High	1.653	0.264	0.4	compliant
π/4-DQPSK, DH5				
Low	2.88	0.307	0.4	compliant
Middle	2.88	0.307	0.4	compliant
High	2.90	0.309	0.4	compliant
8DPSK, DH1				
Low	0.400	0.128	0.4	compliant
Middle	0.400	0.128	0.4	compliant
High	0.405	0.130	0.4	compliant
8DPSK, DH3				
Low	1.640	0.262	0.4	compliant
Middle	1.653	0.264	0.4	compliant
High	1.653	0.264	0.4	compliant
8DPSK, DH5				
Low	2.90	0.309	0.4	compliant
Middle	2.90	0.309	0.4	compliant
High	2.88	0.307	0.4	compliant

Note: DH1: Dwell time= Pulse time (ms) x (1600/2/79) x 31.6 s
DH3: Dwell time= Pulse time (ms) x (1600/4/79) x 31.6 s
DH5: Dwell time= Pulse time (ms) x (1600/6/79) x 31.6 s

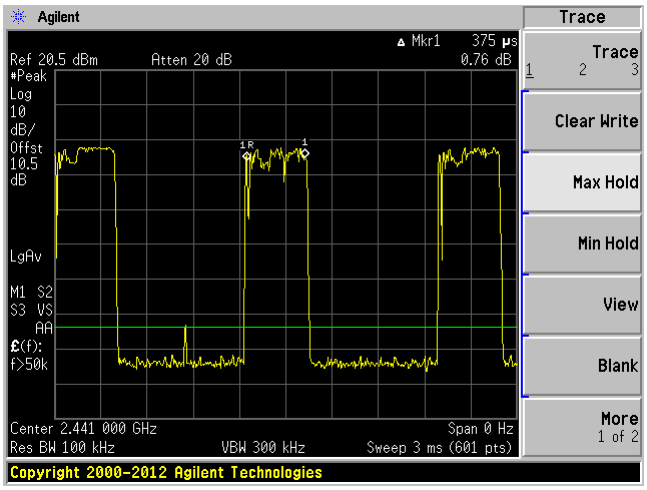
Please refer to the following plots for detailed test results.

GFSK, DH1 Pulse Width

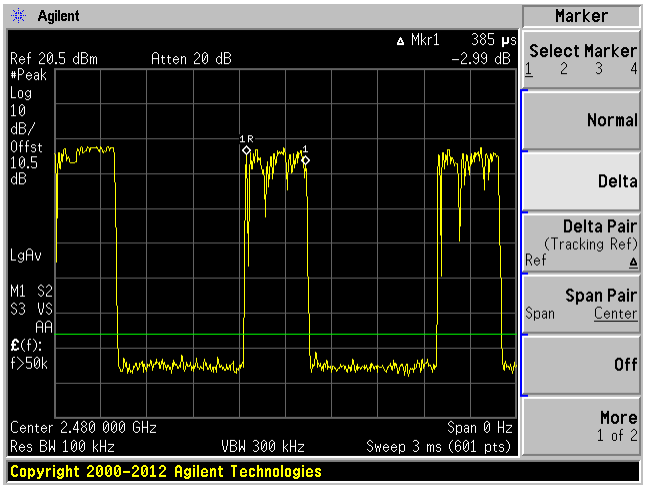
Low Channel 2402 MHz



Middle Channel 2441 MHz

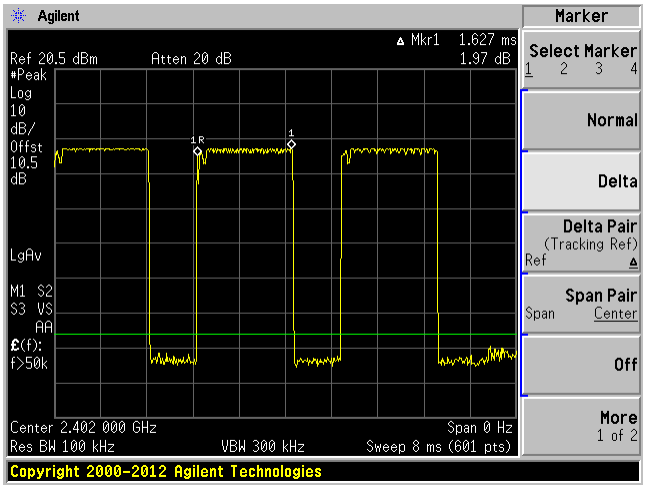


High Channel 2480 MHz

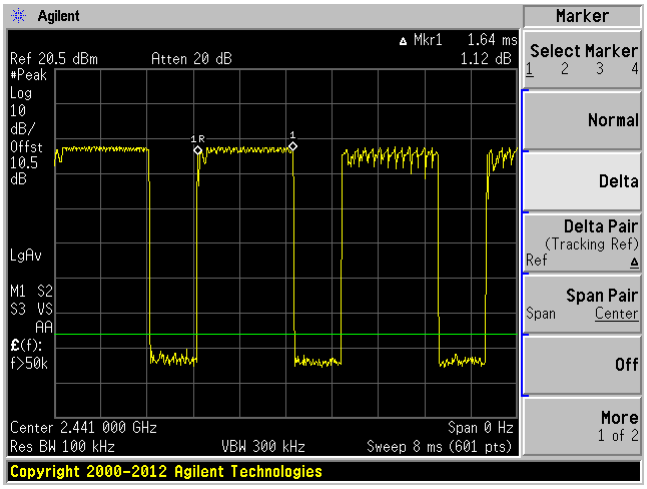


GFSK, DH3 Pulse Width

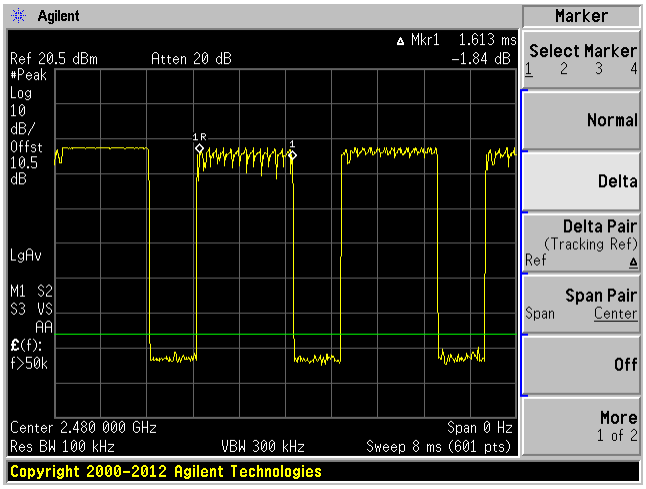
Low Channel 2402 MHz



Middle Channel 2441 MHz

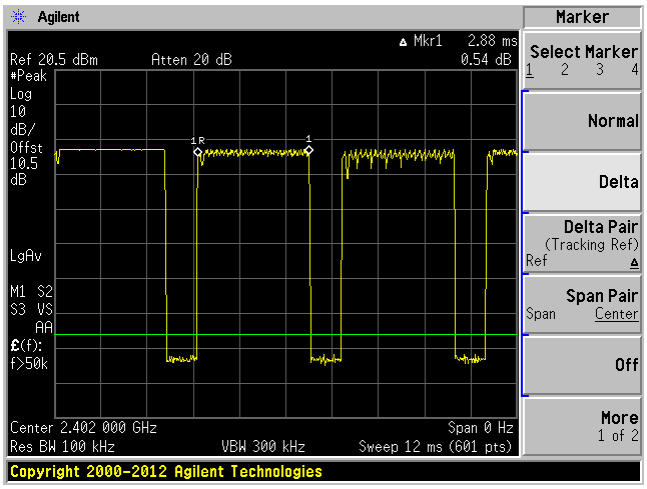


High Channel 2480 MHz

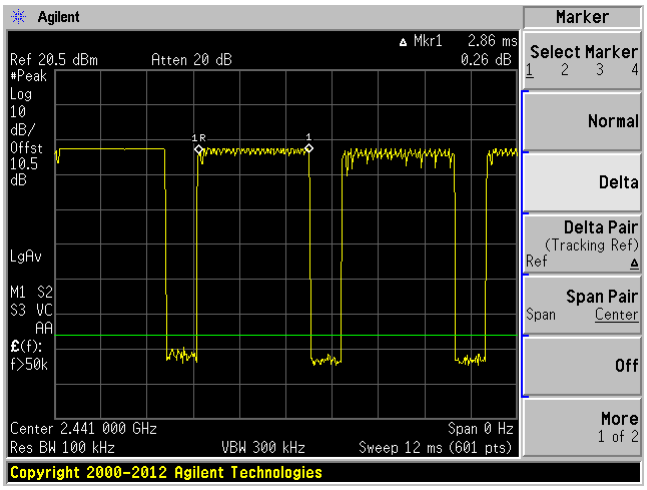


GFSK, DH5 Pulse Width

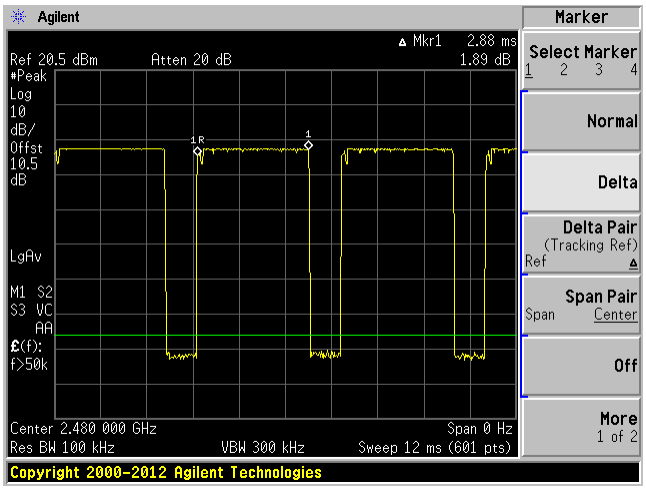
Low Channel 2402 MHz



Middle Channel 2441 MHz

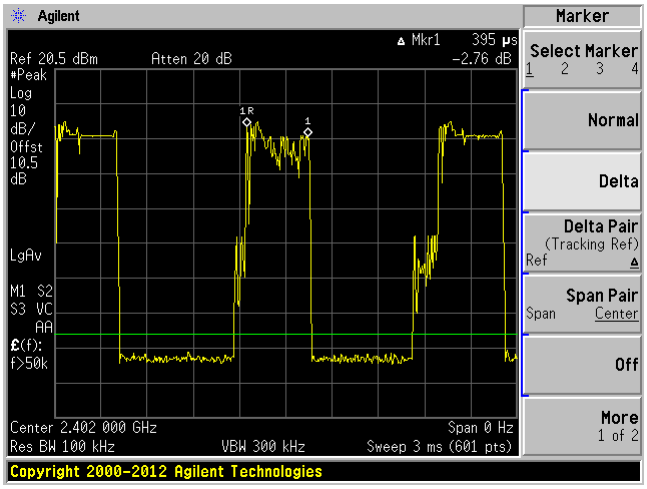


High Channel 2480 MHz

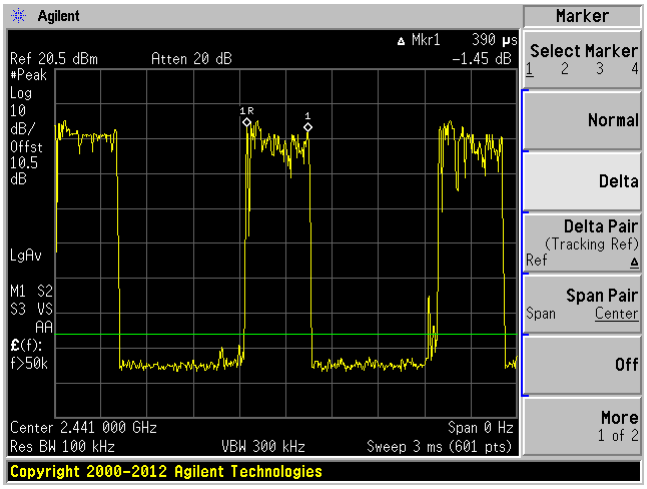


π/4-DQPSK, DH1 Pulse Width

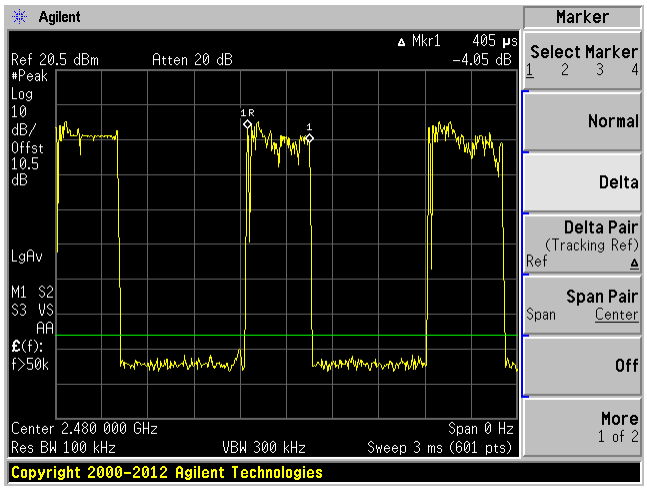
Low Channel 2402 MHz



Middle Channel 2441 MHz

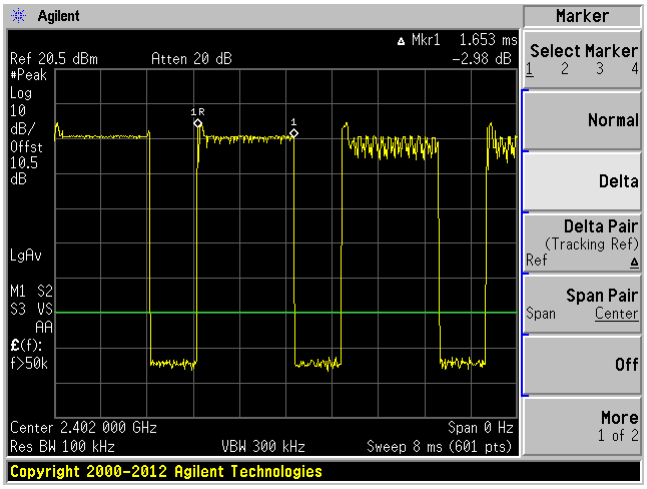


High Channel 2480 MHz

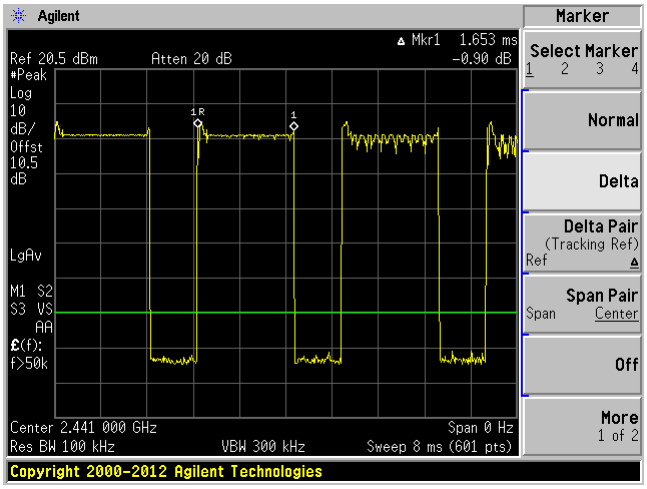


π/4-DQPSK, DH3 Pulse Width

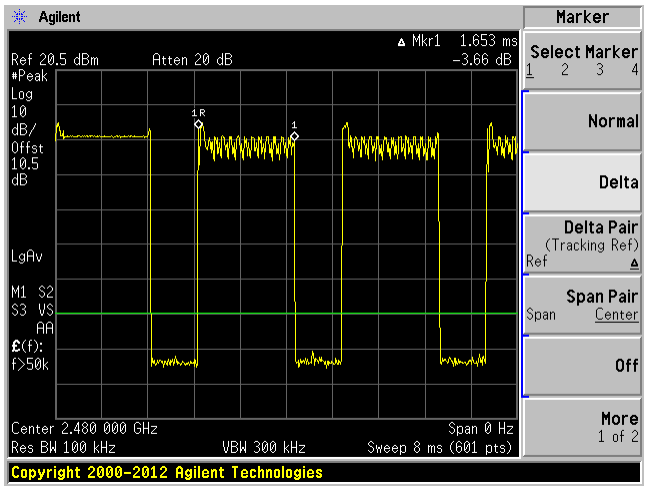
Low Channel 2402 MHz



Middle Channel 2441 MHz

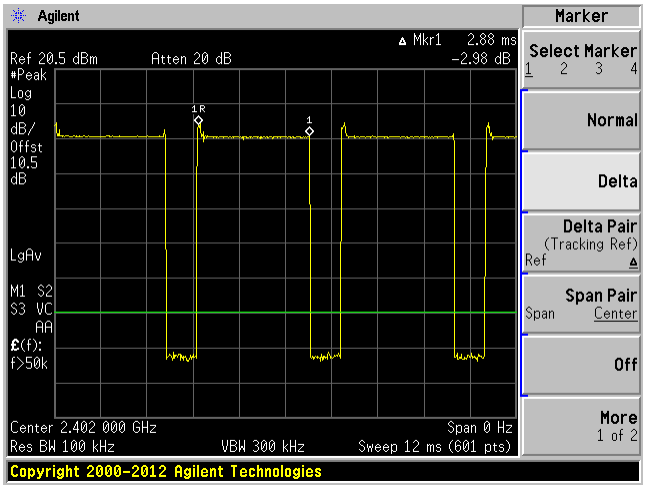


High Channel 2480 MHz

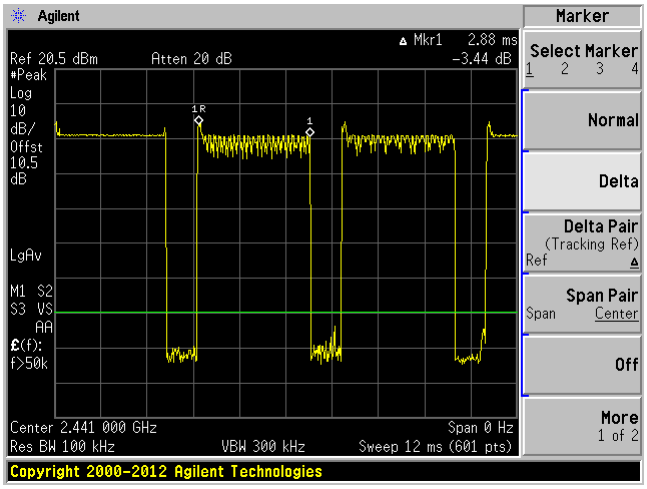


π/4-DQPSK, DH5 Pulse Width

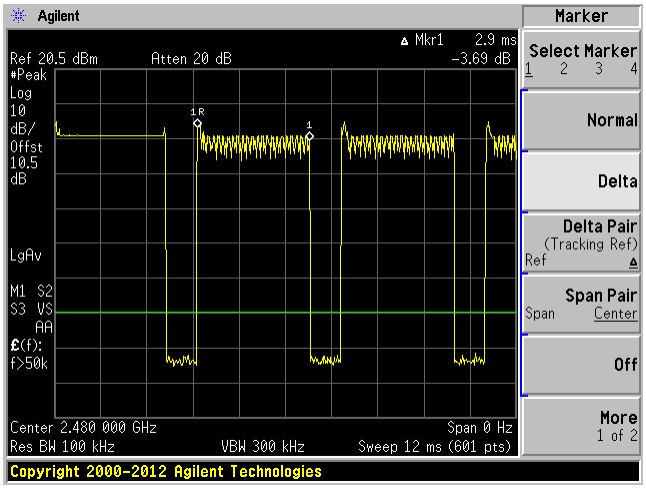
Low Channel 2402 MHz



Middle Channel 2441 MHz

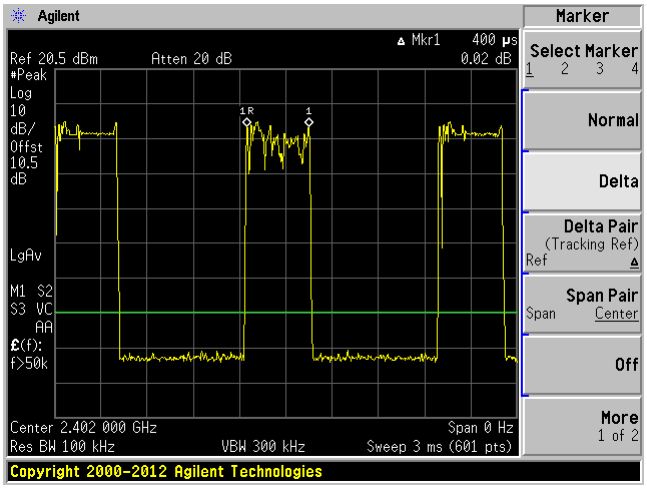


High Channel 2480 MHz

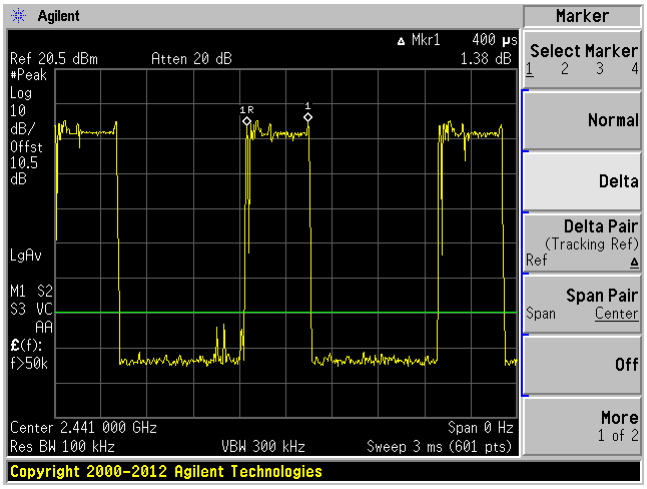


8DPSK, DH1 Pulse Width

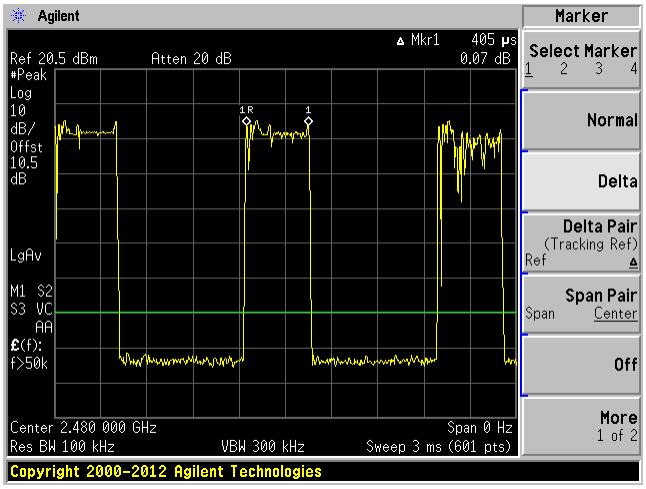
Low Channel 2402 MHz



Middle Channel 2441 MHz

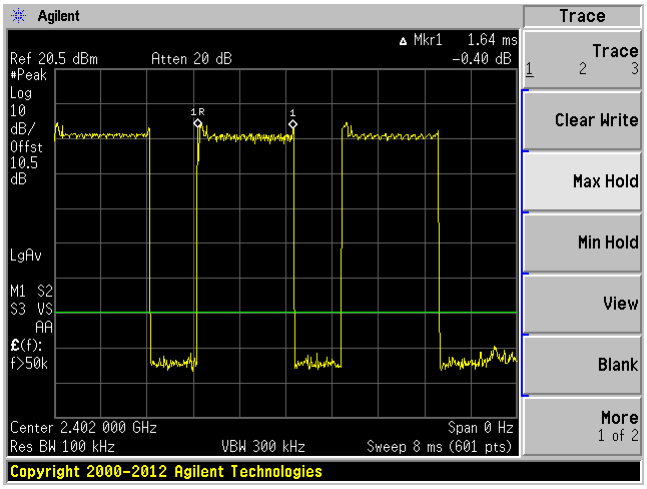


High Channel 2480 MHz

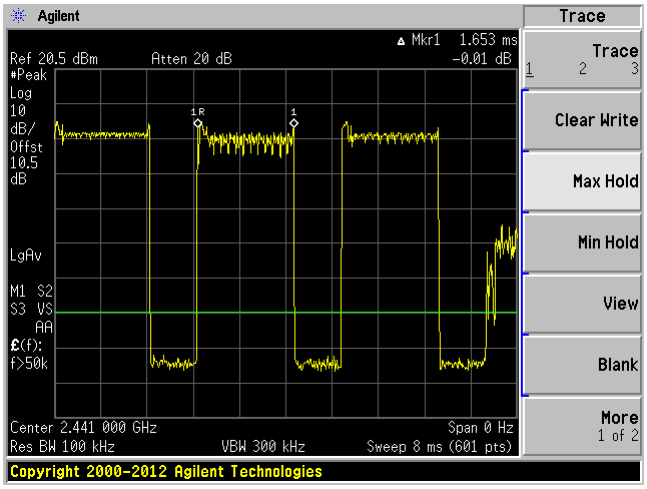


8DPSK, DH3 Pulse Width

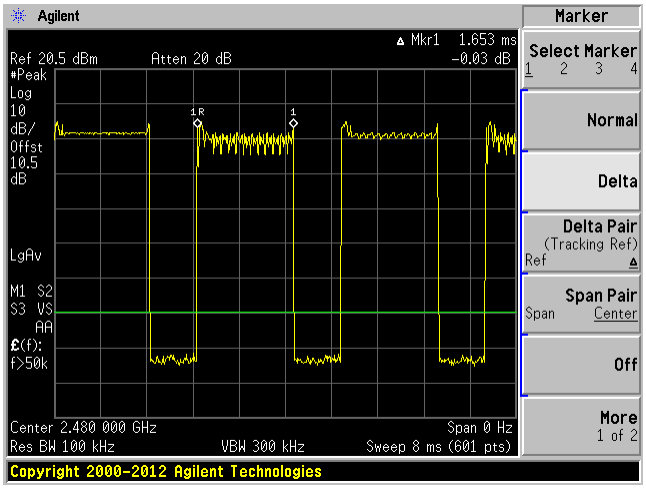
Low Channel 2402 MHz



Middle Channel 2441 MHz

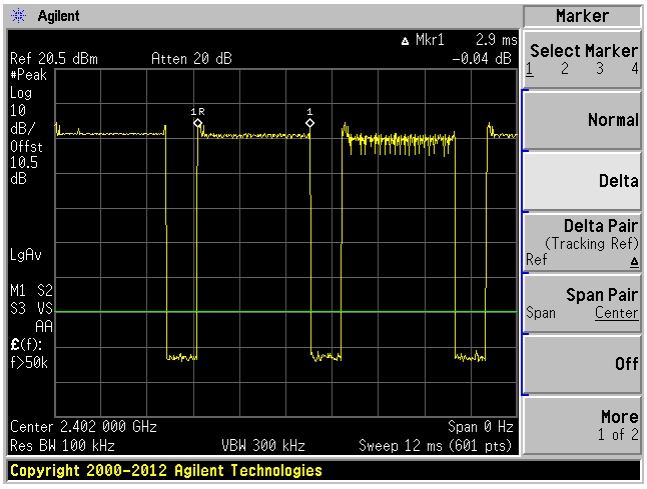


High Channel 2480 MHz

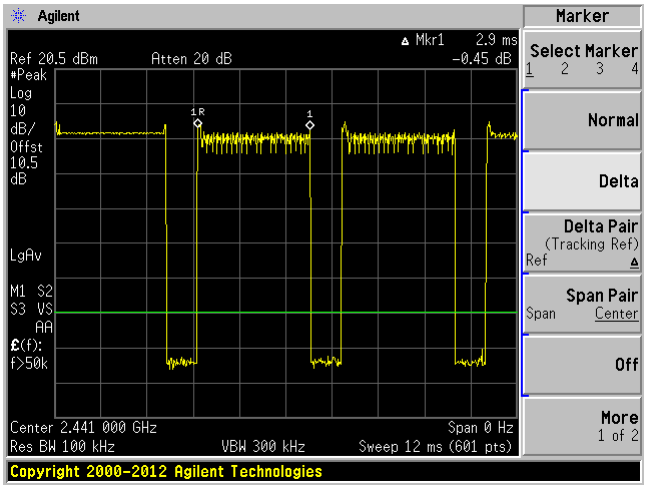


8DPSK, DH5 Pulse Width

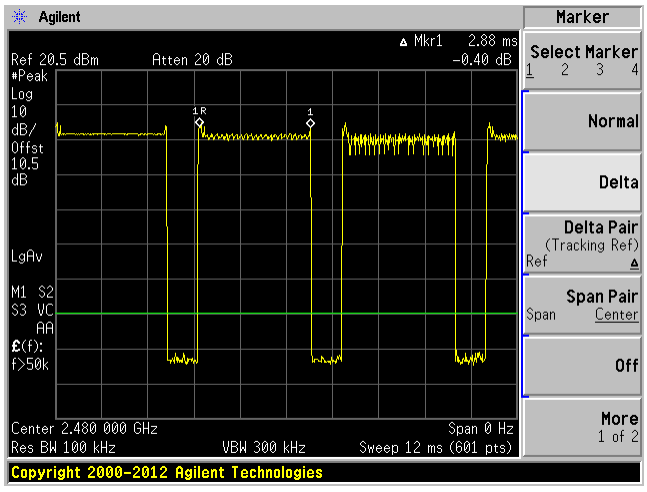
Low Channel 2402 MHz



Middle Channel 2441 MHz



High Channel 2480 MHz



12 FCC §15.247(a)(1)(iii) - Number of Hopping Channels

12.1 Applicable Standards

According to FCC §15.247(a) (1) (iii): 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	E4440A	US45303156	2018-02-26	1 year
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2017-06-08	2 years
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

12.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

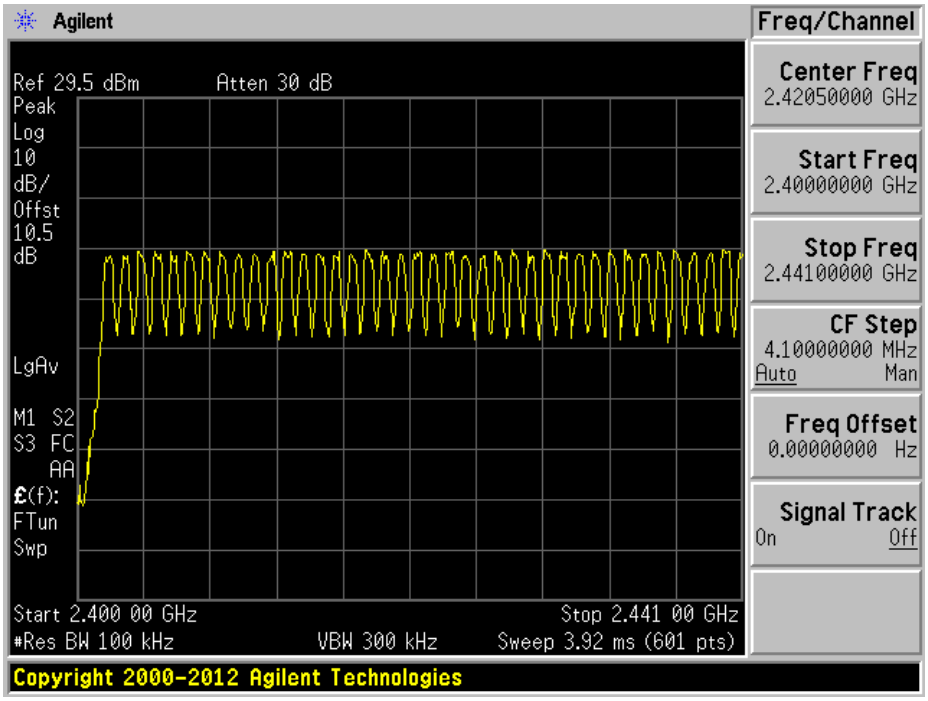
The testing was performed by Frank Wang on 2018-12-11 in RF site.

12.5 Test Results

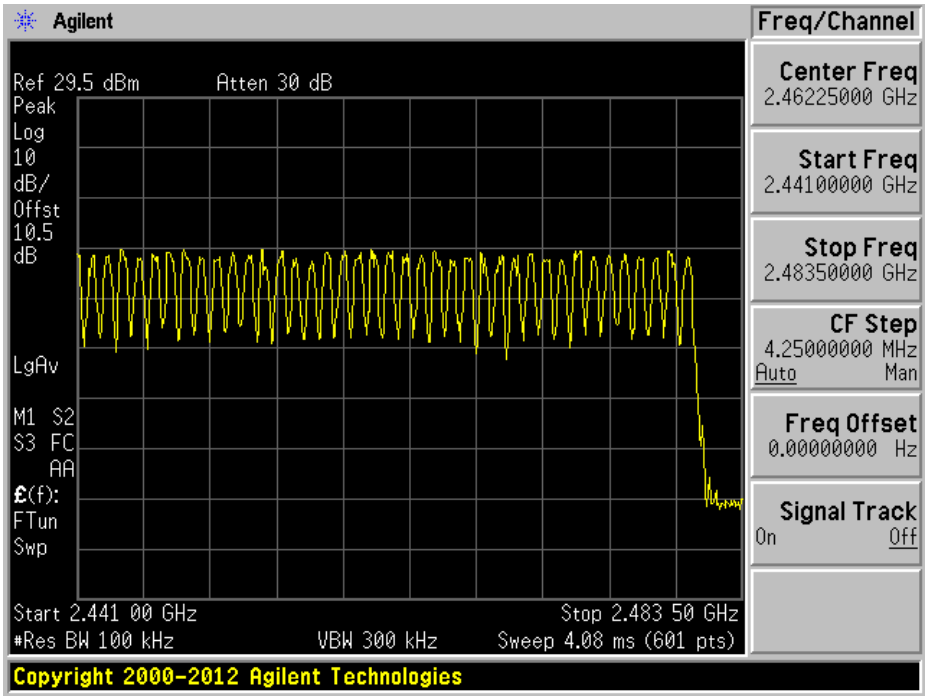
Total 79 channels; please refer to the plots hereinafter.

GSFK

39 Channels between 2400 to 2441 MHz

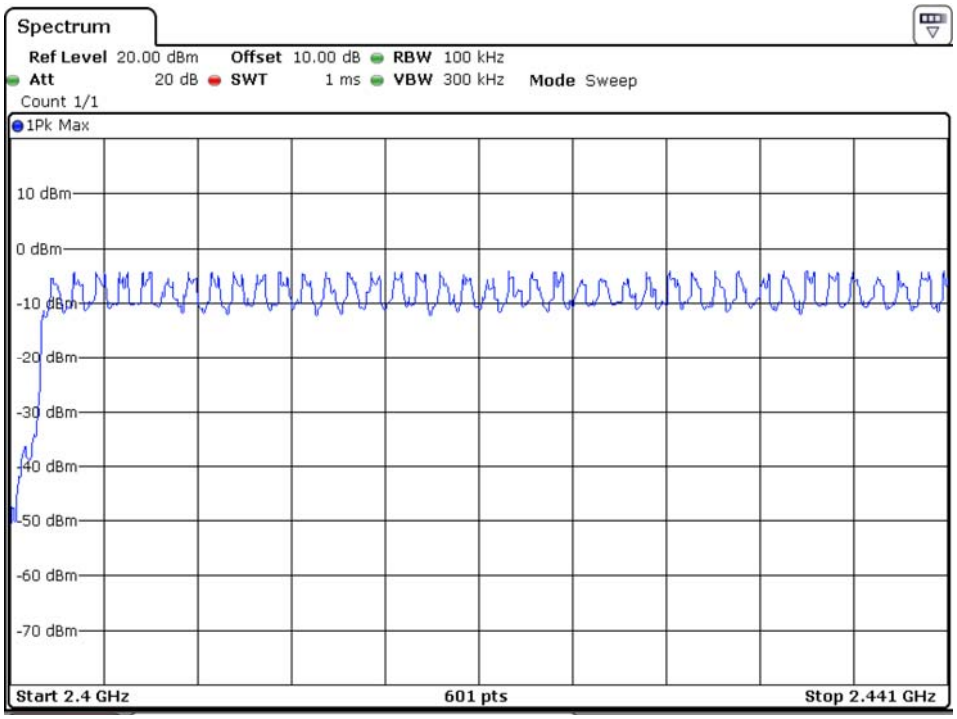


40 Channels Between 2441 to 2483.5 MHz

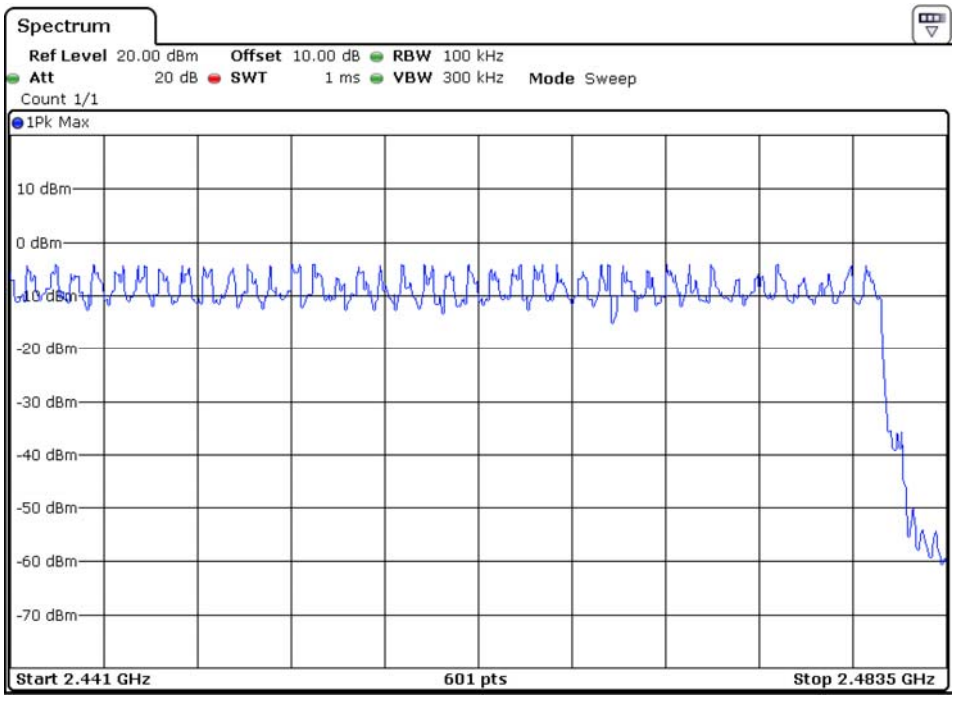


π/4-DQPSK

39 Channels between 2400 to 2441 MHz

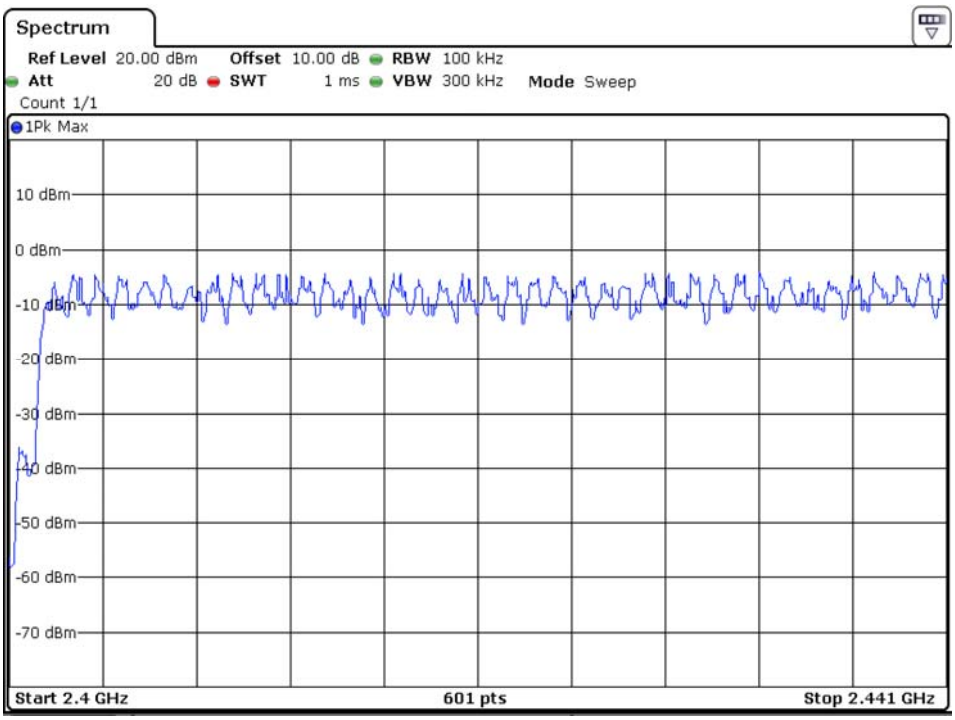


40 Channels Between 2441 to 2483.5 MHz

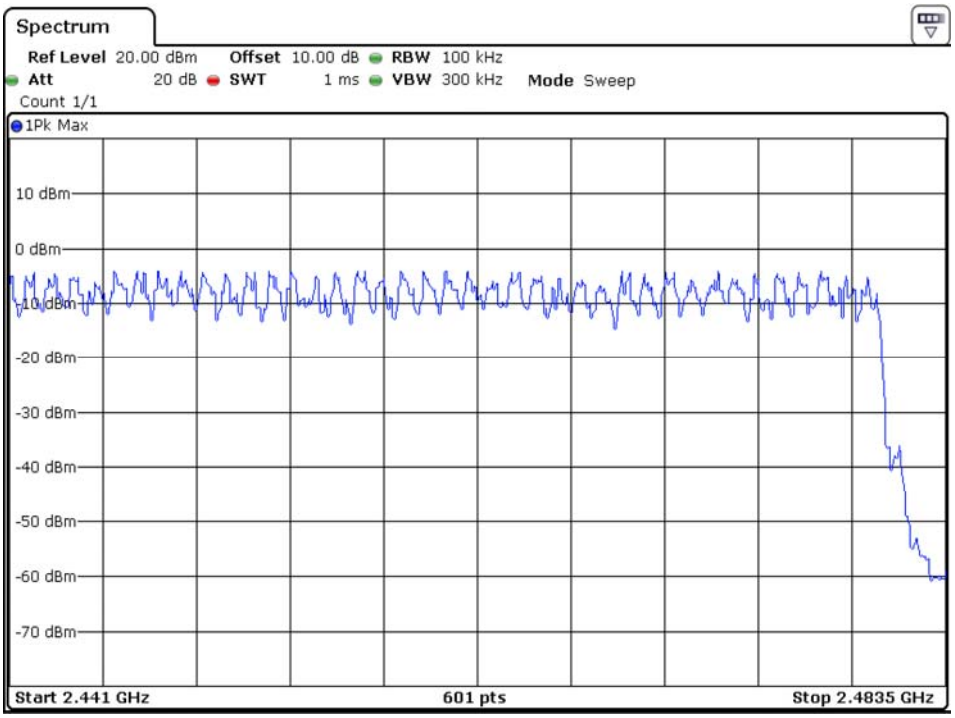


8DPSK

39 Channels between 2400 to 2441 MHz



40 Channels Between 2441 to 2483.5 MHz



13 FCC §15.247(a)(1) - Hopping Channel Separation

13.1 Applicable Standards

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.

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	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

13.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Frank Wang on 2018-12-11 in RF site.

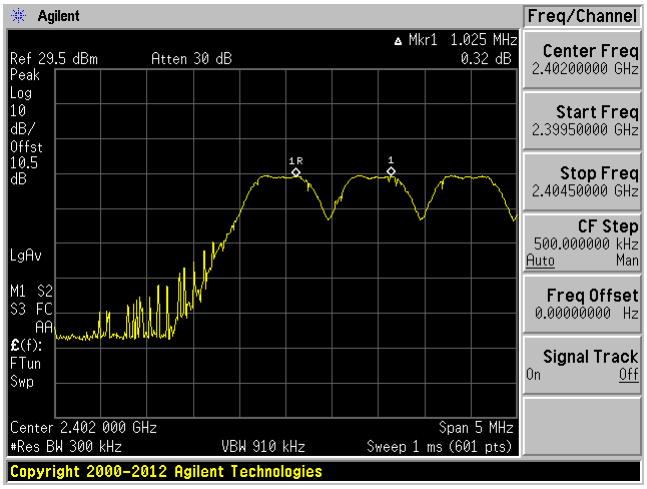
13.5 Test Results

Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 2/3 20 dB OBW (kHz)
GFSK			
Low	2402	1025	695.33
Middle	2441	1008	696.00
High	2480	1000	696.67
π/4-DQPSK			
Low	2402	1008	911.33
Middle	2441	1008	912.00
High	2480	1008	913.33
8DPSK			
Low	2402	1033	872.67
Middle	2441	1008	873.33
High	2480	967	874.00

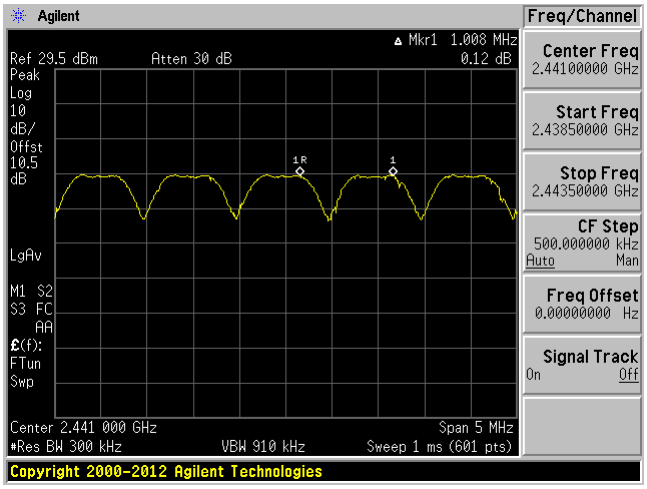
Please refer to following plots.

GFSK

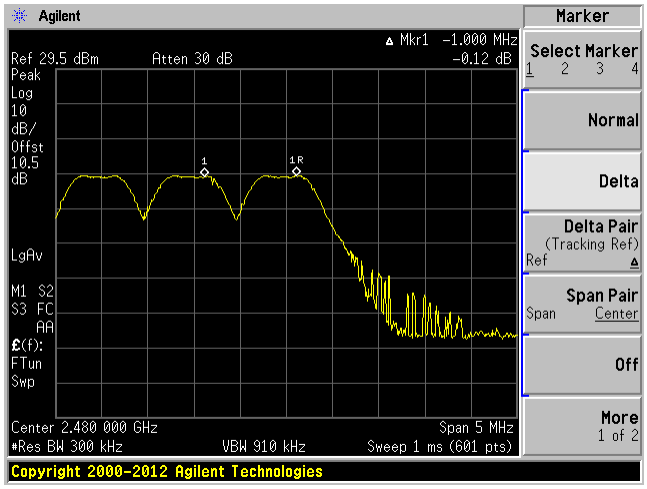
Low Channel 2402 MHz



Middle Channel 2441 MHz

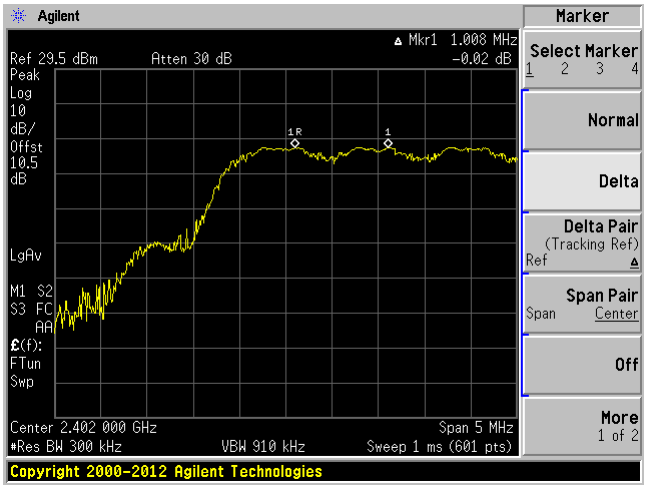


High Channel 2480 MHz

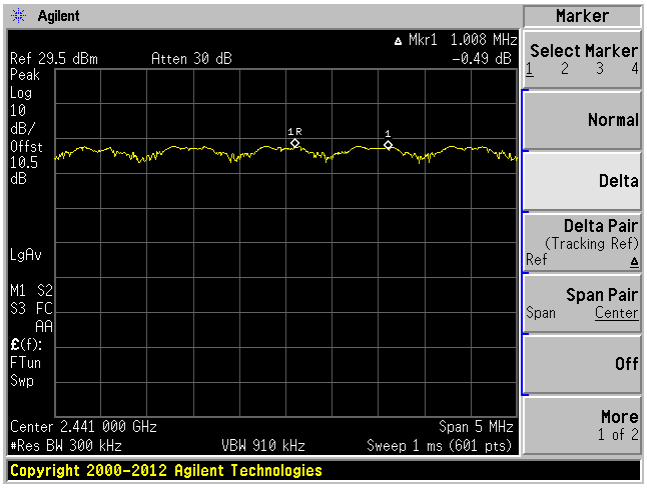


π/4-DQPSK

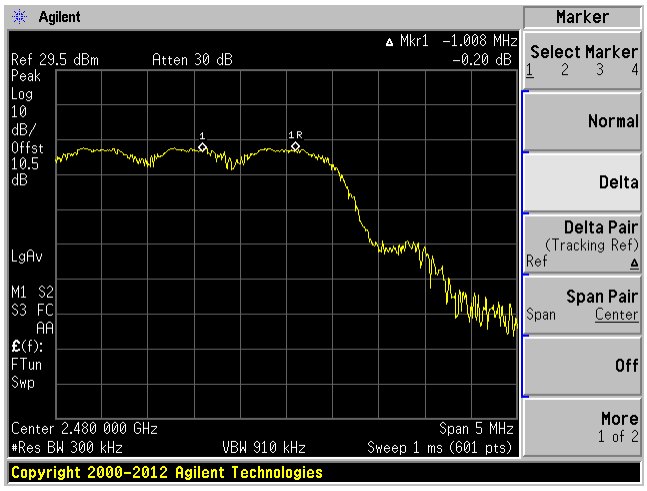
Low Channel 2402 MHz



Middle Channel 2441 MHz

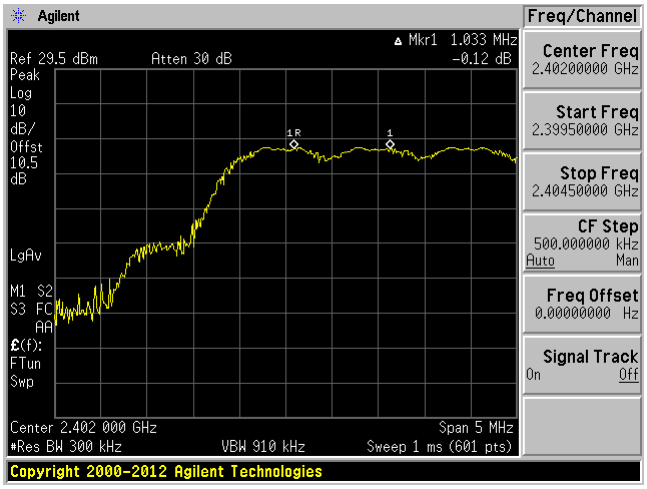


High Channel 2480 MHz

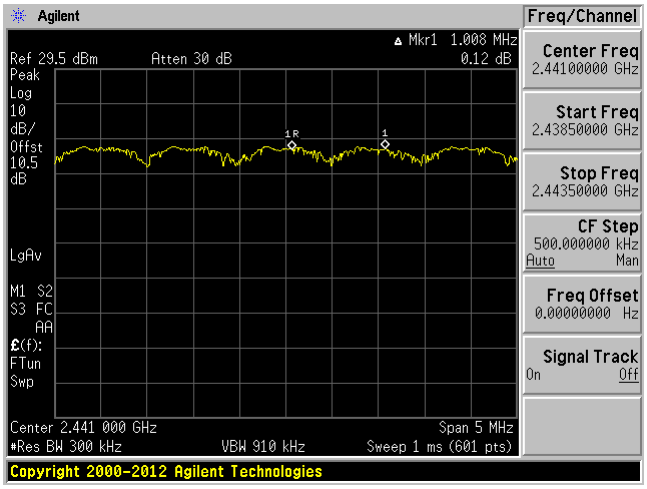


8DPSK

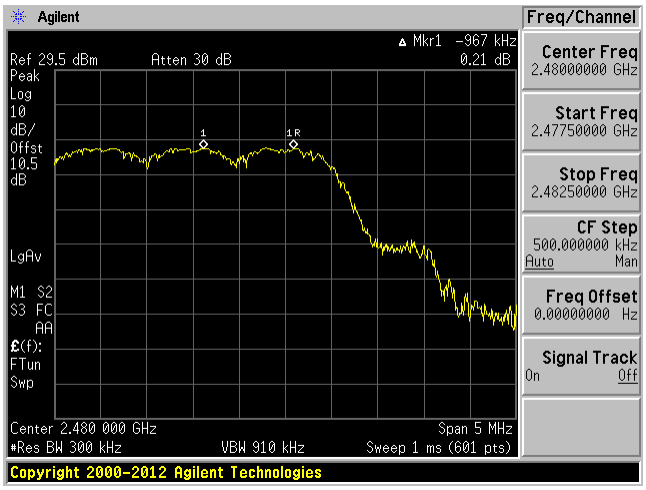
Low Channel 2402 MHz



Middle Channel 2441 MHz



High Channel 2480 MHz



14 FCC §15.247(d) - 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)).

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	E4440A	US45303156	2018-02-26	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

14.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

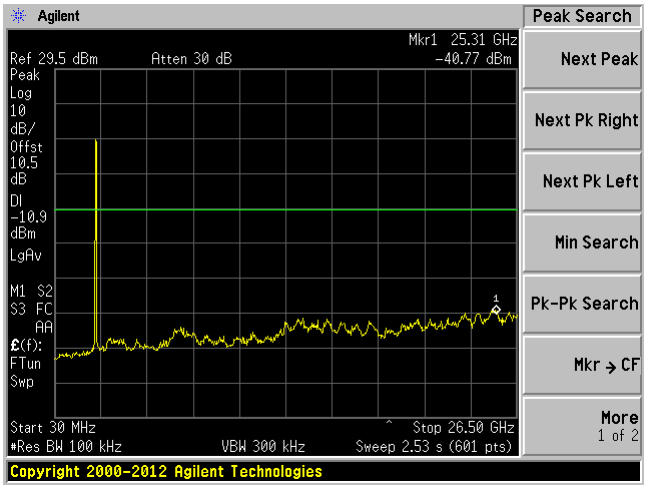
The testing was performed by Frank Wang on 2018-12-11 in RF site.

14.5 Test Results

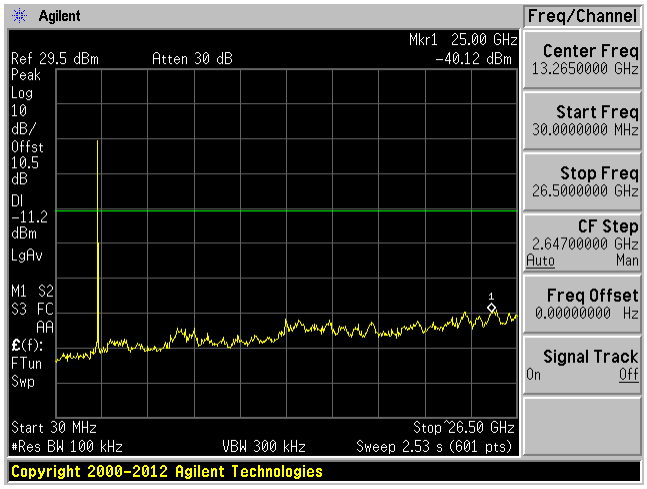
Please refer to following plots.

GFSK

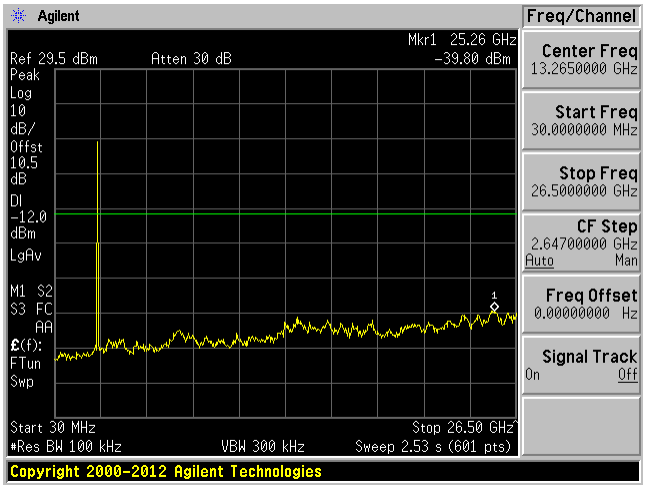
Low Channel 30 MHz to 26.5 GHz



Middle Channel 30 MHz to 26.5 GHz

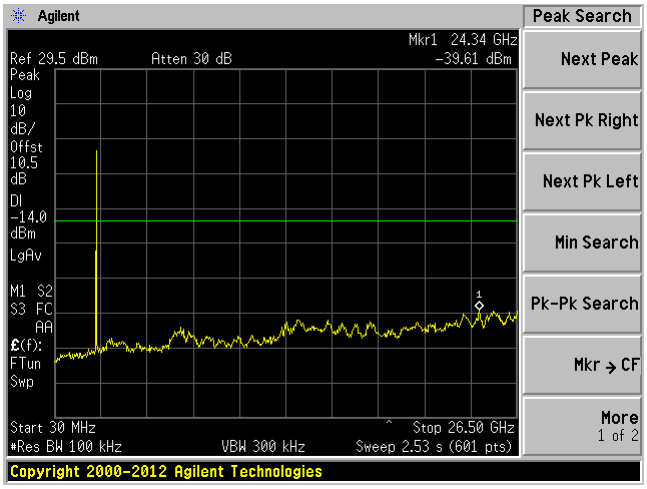


High Channel 30 MHz to 26.5 GHz

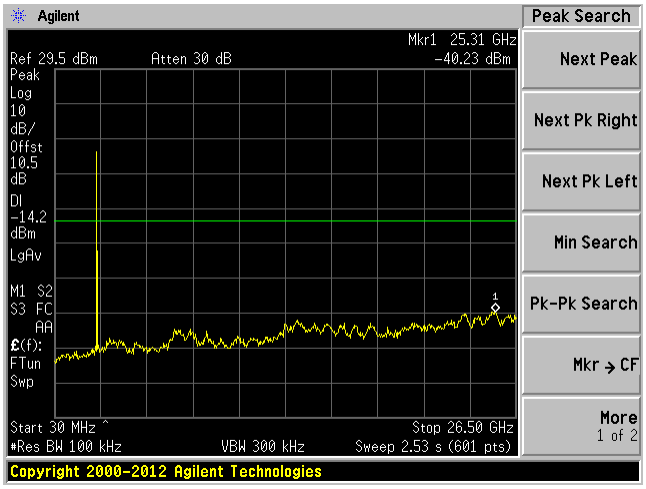


π/4-DQPSK

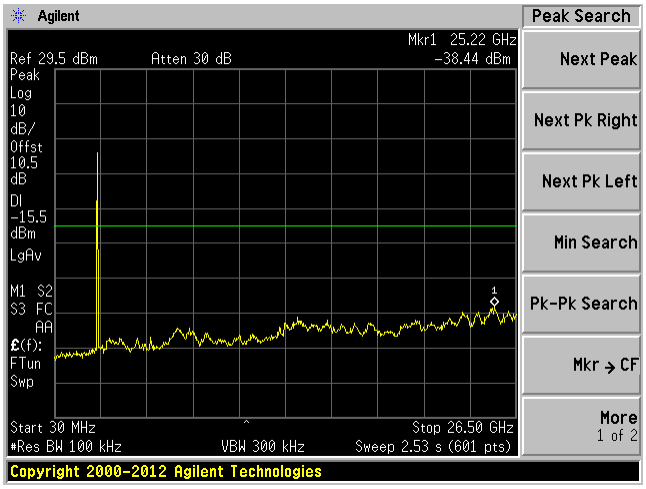
Low Channel 30 MHz to 26.5 GHz



Middle Channel 30 MHz to 26.5 GHz

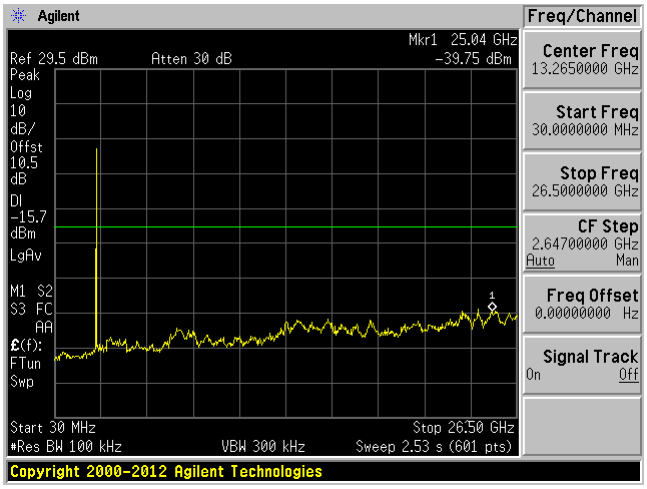


High Channel 30 MHz to 26.5 GHz

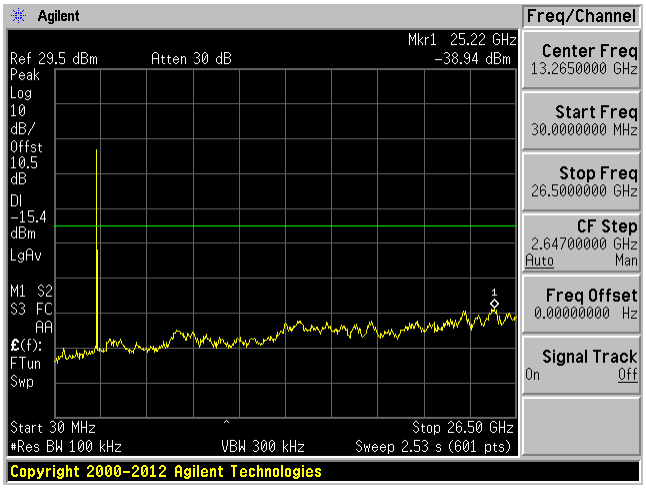


8DPSK

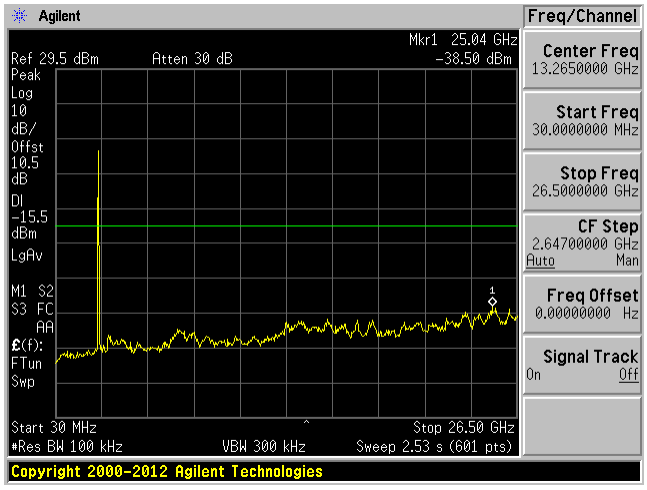
Low Channel 30 MHz to 25 GHz



Middle Channel 30 MHz to 25 GHz



High Channel 30 MHz to 25 GHz



15 Exhibit A - FCC Equipment Labeling Requirements

15.1 FCC ID Label Requirements

As per FCC §2.925,

(a) Each equipment covered in an application for equipment authorization shall bear a nameplate or label listing the following:

(1) FCC Identifier consisting of the two elements in the exact order specified in §2.926. The FCC Identifier shall be preceded by the term FCC ID in capital letters on a single line, and shall be of a type size large enough to be legible without the aid of magnification.

Example: FCC ID: XXX123

Where: XXX—Grantee Code, 123—Equipment Product Code

As per FCC §15.19,

(a) In addition to the requirements in part 2 of this chapter, a device subject to certification, or verification shall be labeled as follows:

(3) All other devices shall bear the following statement in a conspicuous location on the device:
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified above is required to be affixed only to the main control unit. If the EUT is integrated within another device then a label affixed to the host shall also state, "Contains FCC ID: XXXXXX"

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

12.3 Recommended Label Contents and Location

Bottom Side of EUT

17 Appendix A (Normative) - EUT Test Setup Photographs

Please see attachment.

18 Appendix B (Normative) – EUT External Photographs

Please see attachment.

19 Appendix C (Normative) – EUT Internal Photographs

Please see attachment.

20 Appendix D (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA *R222 - Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 2nd day of October 2018.

President and CEO
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2020

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

----- END OF REPORT -----