FCC PART 15, SUBPART C

TEST REPORT

For

Roku Inc.

150 Winchester Circle,

Los Gatos, CA 95032, USA

FCC ID: TC2-R1023

Report Type:	**Model:**
Original Report	9030X

Prepared By:	Vincent Licata Test Engineer
Report Number:	R1808081-247 DSS
Report Date:	2018-09-17
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1808081-247 DSS	Original Report	2018-09-17

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Roku Inc.,* and their product model: 9030X, FCC ID: TC2-R1023 or the "EUT" as referred to in this report.

1.2 Objective

This report is prepared on behalf of *Roku Inc.,* in accordance with Part 2, Subpart J, and Part 15 and C of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 15.247 for Output Power, Antenna Requirements, RF Exposure, 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 15.407 Report: R1808081-407
FCC 15.247 Report: R1808081-247 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 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 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 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 - ISEDC) 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:
  - EMC Directive 2004/108/EC US-EU EMC and Telecom MRA CAB
  - Radio and Teleterminal Equipment (Rand TTE) Directive 1995/5/EC US -EU EMC and 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 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;
  - 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 EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring peak power across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test firmware used was Tera Term and commands provided by *Roku Inc.*, the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
GFSK	2402	23
	2441	23
	2480	23
π/4-DQPSK	2402	23
	2441	23
	2480	23
8DPSK	2402	23
	2441	23
	2480	23

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:

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

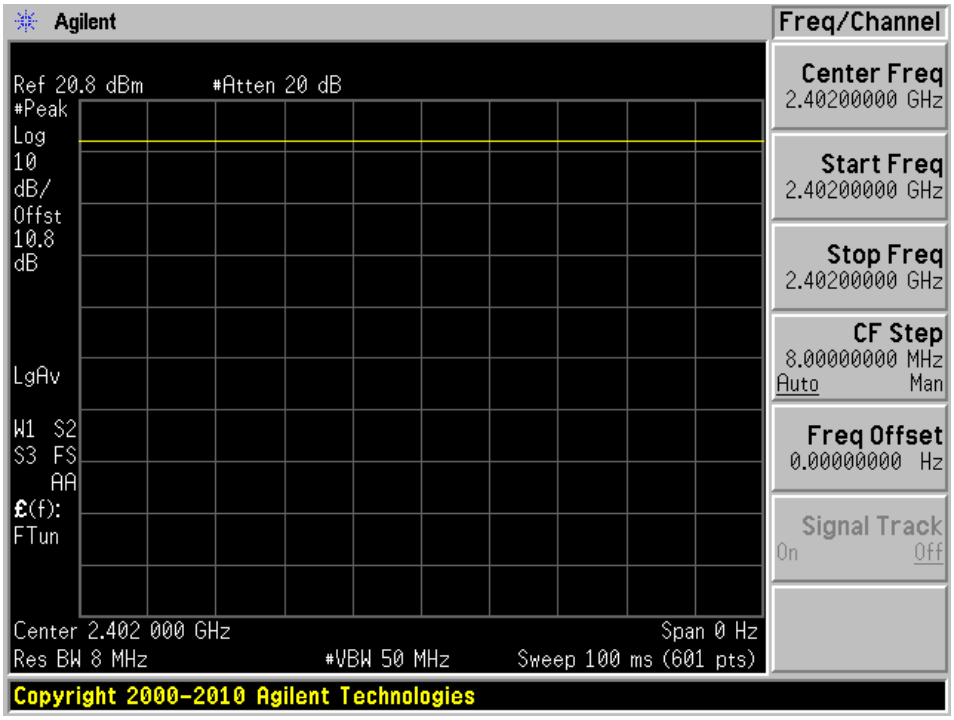
where
δ is the duty cycle correction factor (dB)
Δ is the duty cycle (dimensionless)

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

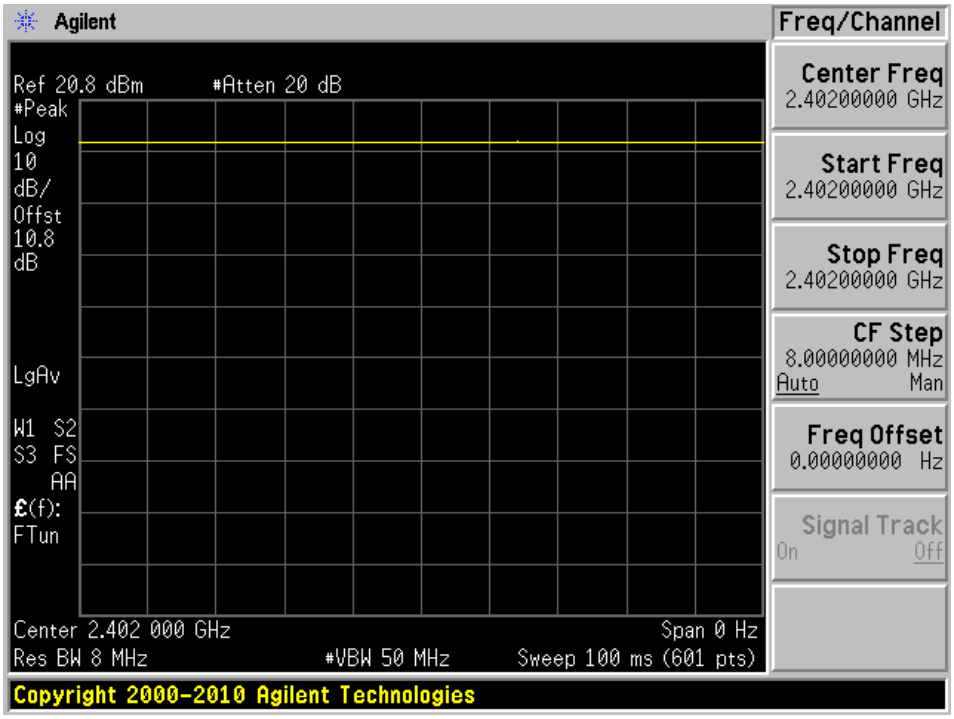
Duty Cycle = On Time (ms) / Period (ms)

Please refer to the following plots.

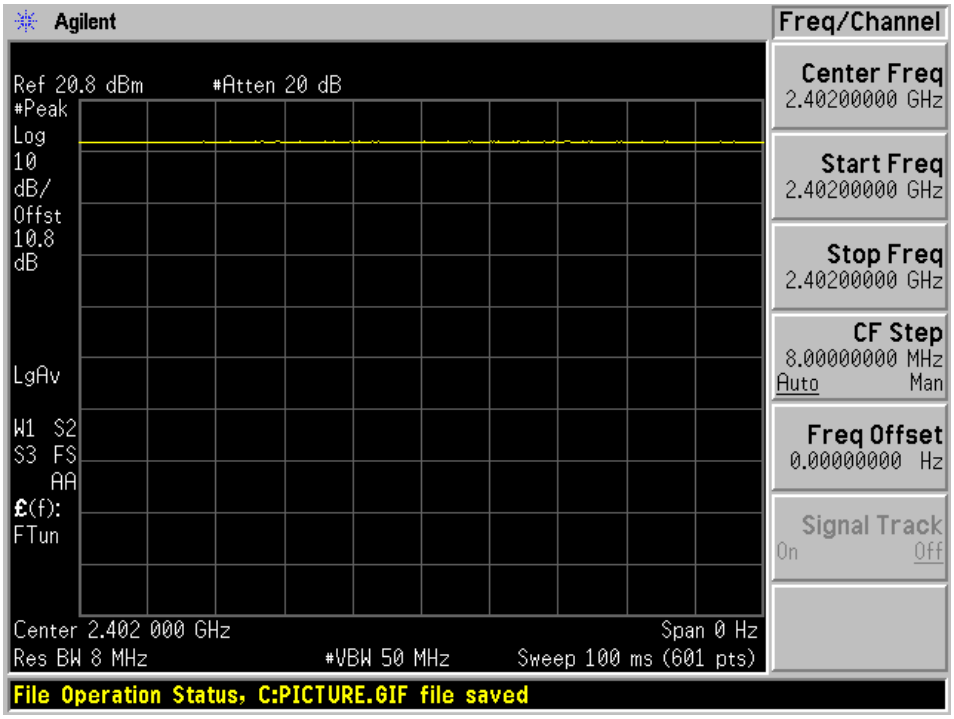
GFSK Mode



π/4-DQPSK



8DPSK



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

Manufacturer	Description	Model
Roku	Debug Board	Unknown

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB 2.0 A-Male to B-Male	2 m	Laptop	EUT
RF Cable	< 1 m	EUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

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

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.

4.2 Antenna Description

The antennas used by the EUT are permanent attached antennas.

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Wi-Fi and Bluetooth	2400-2483.5	1.0
Wi-Fi	5000-6000	1.0

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

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

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

2.4 GHz Wi-Fi

Maximum output power at antenna input terminal (dBm):	23.06
Maximum output power at antenna input terminal (mW):	202.3019
Prediction distance (cm):	20
Prediction frequency (MHz):	2412
Maximum Antenna Gain, typical (dBi):	1.0
Maximum Antenna Gain (numeric):	1.258925
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.050668
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 0.050668 mW/cm^2. Limit is 1.0 mW/cm^2.

2.4 GHz Classic Bluetooth

Maximum peak output power at antenna input terminal (dBm):	12.87
Maximum peak output power at antenna input terminal (mW):	19.36422
Prediction distance (cm):	20
Prediction frequency (MHz):	2441
Maximum Antenna Gain, typical (dBi):	1.0
Maximum Antenna Gain (numeric):	1.258925
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.004850
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 0.004850 mW/cm^2. Limit is 1.0 mW/cm^2.

5 GHz Wi-Fi

Maximum output power at antenna input terminal (dBm):	19.04
Maximum output power at antenna input terminal (mW):	80.16781
Prediction distance (cm):	20
Prediction frequency (MHz):	5825
Maximum Antenna Gain, typical (dBi):	1.0
Maximum Antenna Gain (numeric):	1.258925
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0200785
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 0.0200785 mW/cm^2. Limit is 1.0 mW/cm^2.

Worst case colocation 2.4 GHz/5GHz Wi-Fi and 2.4 GHz Classic Bluetooth.

Frequency Band	Max Conducted Power(dBm)	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
Worst Case							
2.4 GHz WiFi	23.06	20	0.050668	1.0	5.0668%	5.5518%	100%
2.4 GHz Classic Bluetooth	12.87	20	0.004850	1.0	0.485%		
5 GHz WiFi	19.04	20	0.0200785	1.0	2.00785%	2.49285%	100%
2.4 GHz Classic Bluetooth	12.87	20	0.0048500	1.0	0.485%		

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 Note1	56 to 46 Note2
0.5-5	56	46
5-30	60	50

Note1: Decreases with the logarithm of the frequency.
Note2: 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 were 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.

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

All data were recorded in the peak, 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 & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2018-07-05	2 years
Rohde & 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
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2018-07-05	2 years

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 09 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 Vincent Licata on 2018-08-16 in 5 meter chamber 3.

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:

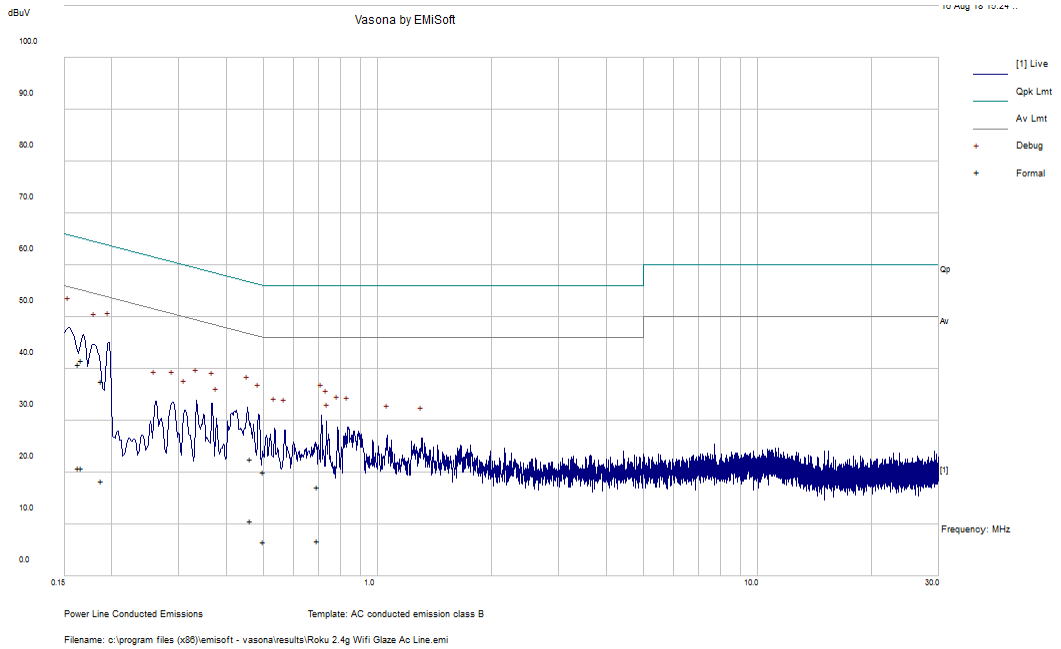
Colocation 2.4 GHz Wi-Fi and 2.4 GHz Classic Bluetooth

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-21.14	0.152987	Neutral	0.15-30

6.8 Conducted Emissions Test Plots and Data

Worst Case Colocation, 2.4 GHz Wi-Fi b mode (2412 MHz) and 2.4 GHz Classic Bluetooth 8DPSK (2441 MHz)

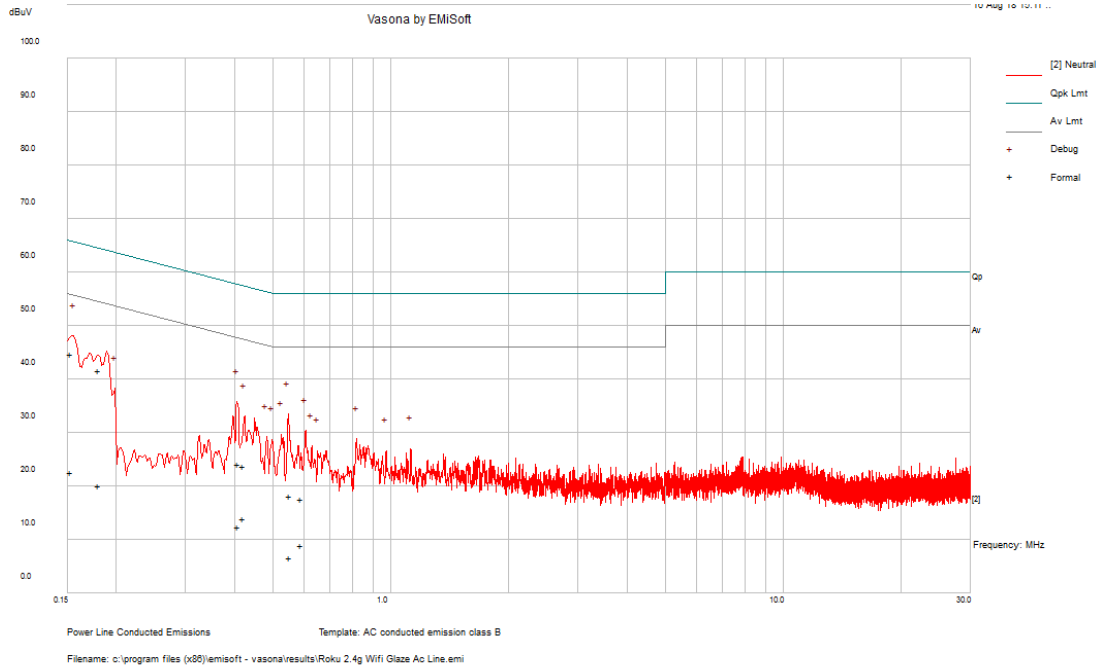
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.166529	41.71	Line	65.13	-23.42	QP
0.188664	37.54	Line	64.1	-26.55	QP
0.163648	40.91	Line	65.28	-24.37	QP
0.464924	22.67	Line	56.6	-33.93	QP
0.697332	17.29	Line	56	-38.71	QP
0.503376	20.11	Line	56	-35.89	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.166529	20.92	Line	55.13	-34.21	Ave.
0.188664	18.41	Line	54.1	-35.68	Ave.
0.163648	20.98	Line	55.28	-34.29	Ave.
0.464924	10.78	Line	46.6	-35.83	Ave.
0.697332	6.9	Line	46	-39.1	Ave.
0.503376	6.62	Line	46	-39.38	Ave.

120 V, 60 Hz – Neutral

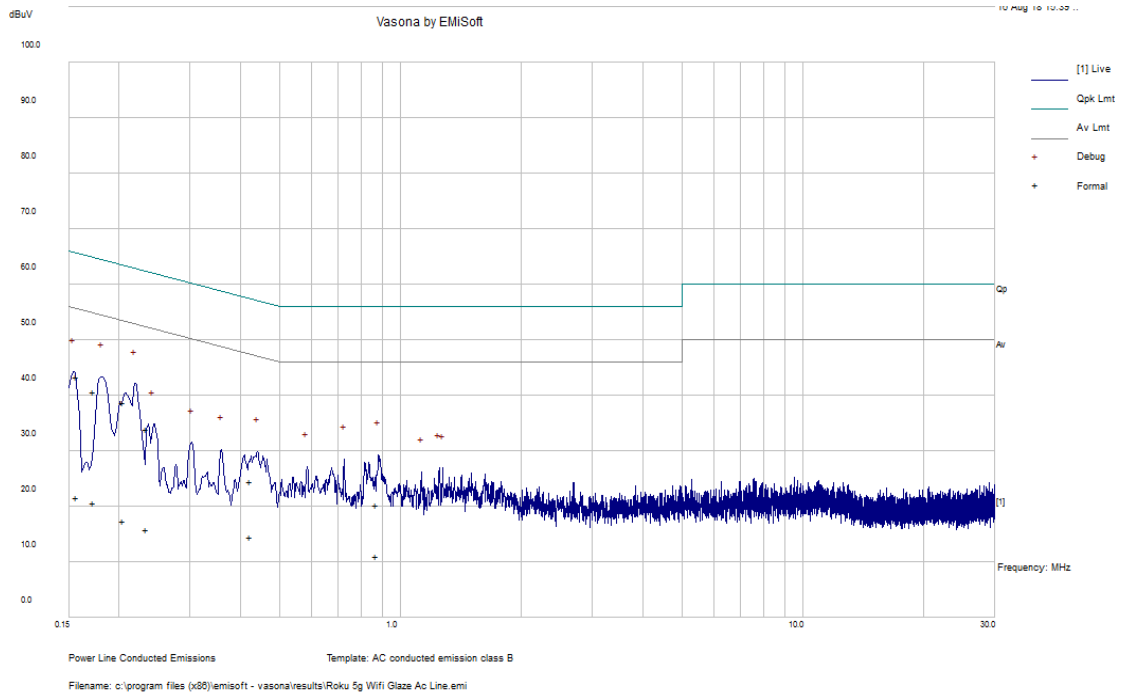


Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.152987	**44.7**	**Neutral**	**65.84**	**-21.14**	**QP**
0.40795	24.2	Neutral	57.69	-33.49	QP
0.552014	18.2	Neutral	56	-37.8	QP
0.422087	23.77	Neutral	57.41	-33.64	QP
0.180593	41.64	Neutral	64.46	-22.82	QP
0.591532	17.65	Neutral	56	-38.35	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.152987	22.68	Neutral	55.84	-33.16	Ave.
0.40795	12.53	Neutral	47.69	-35.16	Ave.
0.552014	6.77	Neutral	46	-39.23	Ave.
0.422087	13.93	Neutral	47.41	-33.48	Ave.
0.180593	20.2	Neutral	54.46	-34.26	Ave.
0.591532	8.91	Neutral	46	-37.09	Ave.

Worst Case Colocation, 5 GHz Wi-Fi a mode (5745 MHz) and 2.4 GHz Classic Bluetooth 8DPSK (2441 MHz)

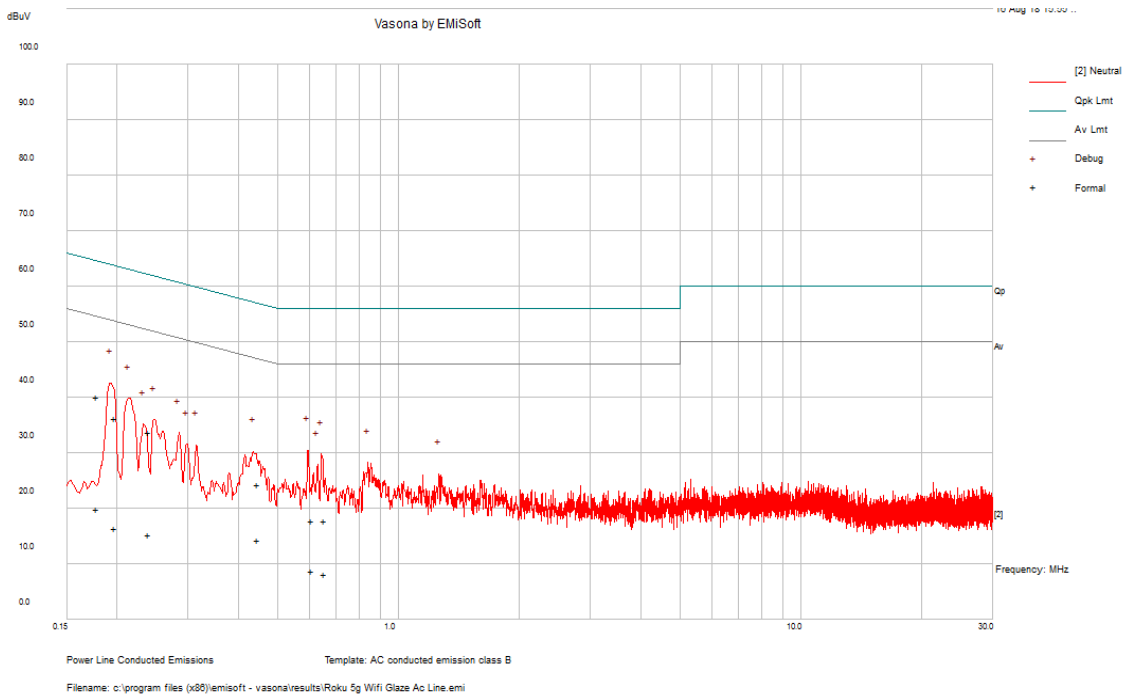
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.204156	38.77	Line	63.44	-24.67	QP
0.172498	40.61	Line	64.84	-24.23	QP
0.156647	**43.48**	**Line**	**65.64**	**-22.15**	**QP**
0.869306	20.38	Line	56	-35.62	QP
0.423306	24.47	Line	57.38	-32.91	QP
0.234527	34.03	Line	62.29	-28.26	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.204156	17.38	Line	53.44	-36.06	Ave.
0.172498	20.65	Line	54.84	-34.19	Ave.
0.156647	21.73	Line	55.64	-33.91	Ave.
0.869306	11.17	Line	46	-34.83	Ave.
0.423306	14.53	Line	47.38	-32.85	Ave.
0.234527	15.9	Line	52.29	-36.39	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.177751	40.11	Neutral	64.59	-24.48	QP
0.197731	36.26	Neutral	63.71	-27.45	QP
0.607633	17.81	Neutral	56	-38.19	QP
0.23968	33.72	Neutral	62.11	-28.39	QP
0.656226	17.83	Neutral	56	-38.17	QP
0.448328	24.28	Neutral	56.91	-32.63	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.177751	19.96	Neutral	54.59	-34.63	Ave.
0.197731	16.41	Neutral	53.71	-37.3	Ave.
0.607633	8.74	Neutral	46	-37.26	Ave.
0.23968	15.28	Neutral	52.11	-36.83	Ave.
0.656226	8.18	Neutral	46	-37.82	Ave.
0.448328	14.42	Neutral	46.91	-32.49	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) 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 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 = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz or 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) + 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	100337	2017-07-15	2 years
Agilent	Analyzer, Spectrum	E4446A	MY48250238	2018-05-08	1 year
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
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
IW	AOBOR Hi frequency Co AX Cable	DC 1531	KPS-1501A3960K PS	2018-01-11	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 *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:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Vincent Licata from 2018-08-13 to 2018-08-16 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:

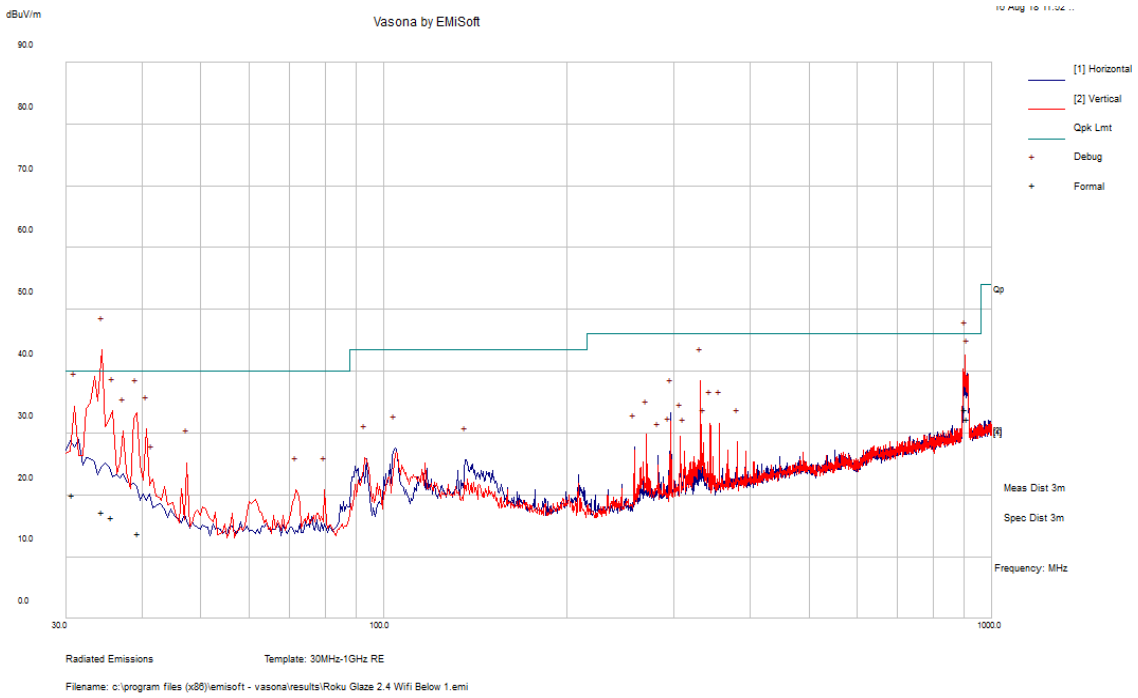
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-5.06	7440	Horizontal	GFSK, High

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

7.8 Radiated Emissions Test Results

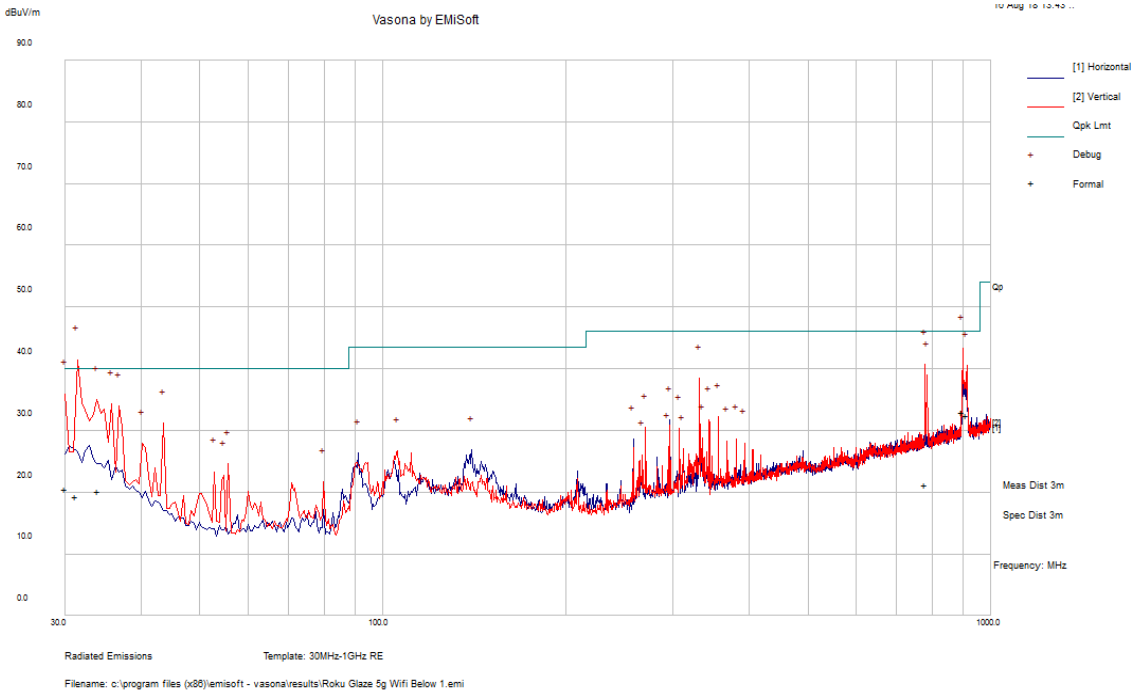
1) 30 MHz – 1 GHz Worst Case on Middle Channel, Measured at 3 meters

Colocation, 2.4 GHz Wi-Fi b mode (2412 MHz) and 2.4 GHz 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
34.4095	17.2	107	V	341	40	-22.8	QP
903.6605	33.81	99	V	351	46	-12.19	QP
30.75675	19.96	151	V	182	40	-20.04	QP
911.5313	32.25	110	H	324	46	-13.75	QP
35.71	16.4	300	V	360	40	-23.6	QP
39.3835	13.87	144	V	261	40	-26.13	QP

Worst Case Colocation, 5 GHz Wi-Fi a mode (5745 MHz) and 2.4 GHz 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
31.22575	19.32	162	V	173	40	-20.68	QP
898.5675	33.09	161	V	0	46	-12.91	QP
30	20.5	181	V	15	40	-19.5	QP
34.0435	20.28	127	V	127	40	-19.72	QP
779.4028	21.16	280	V	131	46	-24.84	QP
913.3198	32.56	105	V	45	46	-13.44	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	72.02	132	139	H	28.93	5.76	0	106.71	-	-	PK
2402	71.63	132	139	H	28.93	5.76	0	106.32	-	-	AV
2402	71.32	291	245	V	28.93	5.76	0	106.01	-	-	PK
2402	70.87	291	245	V	28.93	5.76	0	105.56	-	-	AV
2390	48.28	132	139	H	28.93	6.489	32.207	51.50	74.00	-22.51	PK
2390	37.53	132	139	H	28.93	6.489	32.207	40.75	54.00	-13.26	AV
2390	48.09	291	245	V	28.93	6.489	32.207	51.31	74.00	-22.70	PK
2390	37.32	291	245	V	28.93	6.489	32.207	40.54	54.00	-13.47	AV
4804	46.08	0	100	H	32.56	9.36	32.993	55.01	74.00	-18.99	PK
4804	33.83	0	100	H	32.56	9.36	32.993	42.76	54.00	-11.24	AV
7206	44.51	0	100	H	36.88	12.01	33.248	60.15	74.00	-13.85	PK
7206	32.36	0	100	H	36.88	12.01	33.248	48.00	54.00	-6.00	AV
Middle Channel 2441 MHz											
2441	71.92	311	138	H	28.93	5.76	0	106.61	-	-	PK
2441	71.44	311	138	H	28.93	5.76	0	106.13	-	-	AV
2441	71.26	282	300	V	28.93	5.76	0	105.95	-	-	PK
2441	70.96	282	300	V	28.93	5.76	0	105.65	-	-	AV
4882	45.91	0	100	H	32.53	9.46	32.993	54.90	74.00	-19.10	PK
4882	34.32	0	100	H	32.53	9.46	32.993	43.31	54.00	-10.69	AV
7323	44.43	0	100	H	36.99	11.97	33.248	60.14	74.00	-13.86	PK
7323	32.68	0	100	H	36.99	11.97	33.248	48.39	54.00	-5.61	AV
High Channel 2480 MHz											
2480	71.20	143	192	H	29.19	5.86	0	106.25	-	-	PK
2480	70.90	143	192	H	29.19	5.86	0	105.95	-	-	AV
2480	70.09	276	300	V	29.19	5.86	0	105.14	-	-	PK
2480	69.80	276	300	V	29.19	5.86	0	104.85	-	-	AV
2483.5	51.66	143	192	H	29.18	6.61	32.207	55.24	74.00	-18.76	PK
2483.5	42.61	143	192	H	29.18	6.61	32.207	46.19	54.00	-7.81	AV
2483.5	50.87	276	300	V	29.18	6.61	32.207	54.45	74.00	-19.55	PK
2483.5	41.98	276	300	V	29.18	6.61	32.207	45.56	54.00	-8.44	AV
4960	45.82	0	100	H	32.70	9.42	32.993	54.94	74.00	-19.06	PK
4960	33.88	0	100	H	32.70	9.42	32.993	43.00	54.00	-11.00	AV
7440	44.36	0	100	H	37.10	12.01	33.248	60.22	74.00	-13.78	PK
7440	33.08	0	100	H	37.10	12.01	33.248	48.94	54.00	**-5.06**	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	72.59	130	138	H	28.93	5.76	0	107.28	-	-	PK
2402	70.38	130	138	H	28.93	5.76	0	105.07	-	-	AV
2402	71.82	271	273	V	28.93	5.76	0	106.51	-	-	PK
2402	69.79	271	273	V	28.93	5.76	0	104.48	-	-	AV
2390	53.55	130	138	H	28.93	6.489	32.207	56.77	74.00	-17.24	PK
2390	37.92	130	138	H	28.93	6.489	32.207	41.14	54.00	-12.87	AV
2390	48.02	271	273	V	28.93	6.489	32.207	51.24	74.00	-22.77	PK
2390	36.78	271	273	V	28.93	6.489	32.207	40.00	54.00	-14.01	AV
4804	46.60	0	100	H	32.56	9.36	32.993	55.53	74.00	-18.47	PK
4804	34.41	0	100	H	32.56	9.36	32.993	43.34	54.00	-10.66	AV
7206	45.60	0	100	H	36.88	12.01	33.248	61.24	74.00	-12.76	PK
7206	33.21	0	100	H	36.88	12.01	33.248	48.85	54.00	-5.15	AV
Middle Channel 2441 MHz											
2441	71.45	145	190	H	28.93	5.76	0	106.14	-	-	PK
2441	69.44	145	190	H	28.93	5.76	0	104.13	-	-	AV
2441	70.56	283	263	V	28.93	5.76	0	105.25	-	-	PK
2441	68.26	283	263	V	28.93	5.76	0	102.95	-	-	AV
4882	45.87	0	100	H	32.53	9.46	32.993	54.86	74.00	-19.14	PK
4882	33.73	0	100	H	32.53	9.46	32.993	42.72	54.00	-11.28	AV
7323	44.28	0	100	H	36.99	11.97	33.248	59.99	74.00	-14.01	PK
7323	32.69	0	100	H	36.99	11.97	33.248	48.40	54.00	-5.60	AV
High Channel 2480 MHz											
2480	70.40	144	148	H	29.19	5.86	0	105.45	-	-	PK
2480	68.26	144	148	H	29.19	5.86	0	103.31	-	-	AV
2480	69.71	278	282	V	29.19	5.86	0	104.76	-	-	PK
2480	67.48	278	282	V	29.19	5.86	0	102.53	-	-	AV
2483.5	53.73	144	148	H	29.18	6.61	32.207	57.31	74.00	-16.69	PK
2483.5	42.70	144	148	H	29.18	6.61	32.207	46.28	54.00	-7.72	AV
2483.5	53.29	278	282	V	29.18	6.61	32.207	56.87	74.00	-17.13	PK
2483.5	42.08	278	282	V	29.18	6.61	32.207	45.66	54.00	-8.34	AV
4960	45.80	0	100	H	32.70	9.42	32.993	54.92	74.00	-19.08	PK
4960	33.88	0	100	H	32.70	9.42	32.993	43.00	54.00	-11.00	AV
7440	44.62	0	100	H	37.10	12.01	33.248	60.48	74.00	-13.52	PK
7440	33.07	0	100	H	37.10	12.01	33.248	48.93	54.00	-5.07	AV

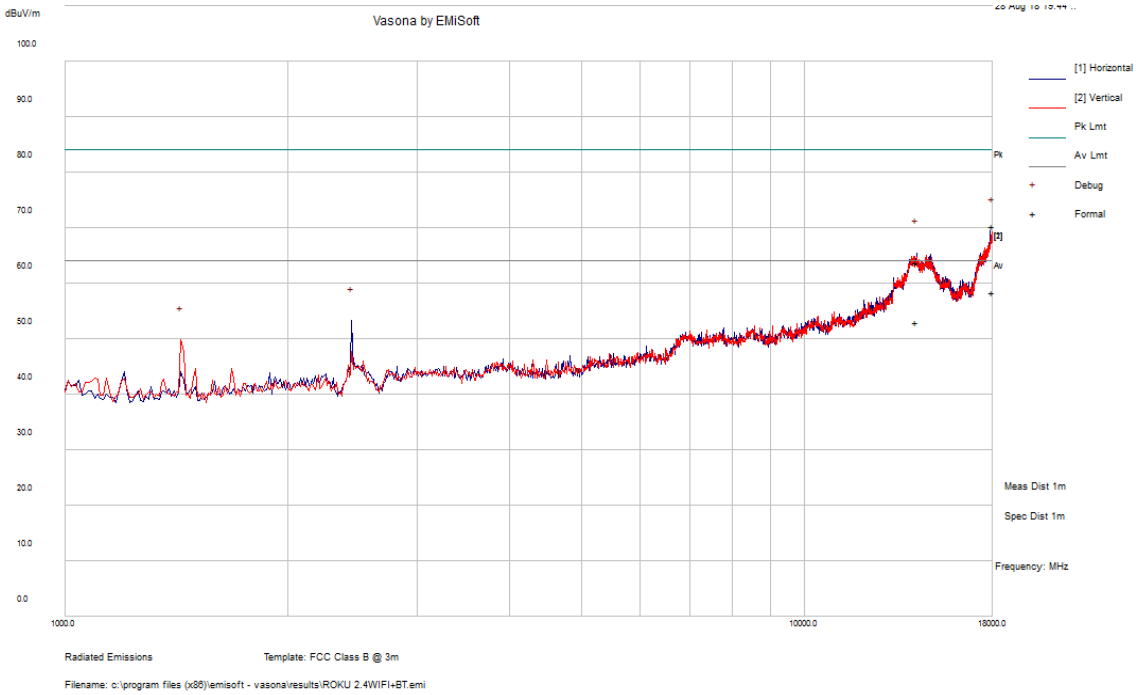
8DPSK mode

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	72.26	130	139	H	28.93	5.76	0	106.95	-	-	PK
2402	70.24	130	139	H	28.93	5.76	0	104.93	-	-	AV
2402	71.83	270	270	V	28.93	5.76	0	106.52	-	-	PK
2402	69.75	270	270	V	28.93	5.76	0	104.44	-	-	AV
2390	57.50	130	139	H	28.93	6.489	32.207	60.72	74.00	-13.29	PK
2390	36.95	130	139	H	28.93	6.489	32.207	40.17	54.00	-13.84	AV
2390	56.30	270	270	V	28.93	6.489	32.207	59.52	74.00	-14.49	PK
2390	36.78	270	270	V	28.93	6.489	32.207	40.00	54.00	-14.01	AV
4804	45.80	0	100	H	32.56	9.36	32.993	54.73	74.00	-19.27	PK
4804	34.49	0	100	H	32.56	9.36	32.993	43.42	54.00	-10.58	AV
7206	45.07	0	100	H	36.88	12.01	33.248	60.71	74.00	-13.29	PK
7206	33.12	0	100	H	36.88	12.01	33.248	48.76	54.00	-5.24	AV
Middle Channel 2441 MHz											
2441	71.58	144	193	H	28.93	5.76	0	106.27	-	-	PK
2441	69.53	144	193	H	28.93	5.76	0	104.22	-	-	AV
2441	70.61	263	290	V	28.93	5.76	0	105.30	-	-	PK
2441	68.53	263	290	V	28.93	5.76	0	103.22	-	-	AV
4882	45.52	0	100	H	32.53	9.46	32.993	54.51	74.00	-19.49	PK
4882	33.81	0	100	H	32.53	9.46	32.993	42.80	54.00	-11.20	AV
7323	44.42	0	100	H	36.99	11.97	33.248	60.13	74.00	-13.87	PK
7323	32.84	0	100	H	36.99	11.97	33.248	48.55	54.00	-5.45	AV
High Channel 2480 MHz											
2480	70.44	144	148	H	29.19	5.86	0	105.49	-	-	PK
2480	68.27	144	148	H	29.19	5.86	0	103.32	-	-	AV
2480	68.93	267	281	V	29.19	5.86	0	103.98	-	-	PK
2480	66.74	267	281	V	29.19	5.86	0	101.79	-	-	AV
2483.5	54.93	144	148	H	29.18	6.61	32.207	58.51	74.00	-15.49	PK
2483.5	43.31	144	148	H	29.18	6.61	32.207	46.89	54.00	-7.11	AV
2483.5	52.05	267	281	V	29.18	6.61	32.207	55.63	74.00	-18.37	PK
2483.5	41.36	267	281	V	29.18	6.61	32.207	44.94	54.00	-9.06	AV
4960	44.38	0	100	H	32.70	9.42	32.993	53.50	74.00	-20.50	PK
4960	32.72	0	100	H	32.70	9.42	32.993	41.84	54.00	-12.16	AV
7440	44.75	0	100	H	37.10	12.01	33.248	60.61	74.00	-13.39	PK
7440	33.05	0	100	H	37.10	12.01	33.248	48.91	54.00	-5.09	AV

The worst case middle channel plot has been listed below.

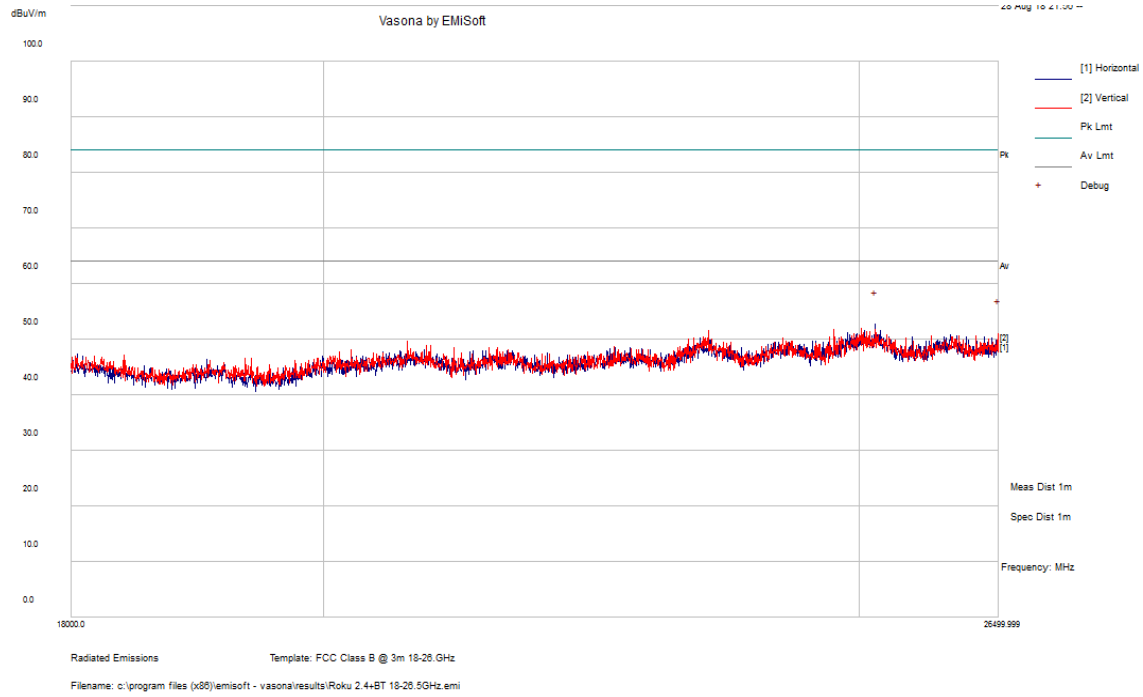
1-18 GHz

Colocation, 2.4 GHz Wi-Fi b mode (2412 MHz) and 2.4 GHz Classic Bluetooth 8DPSK (2441 MHz)



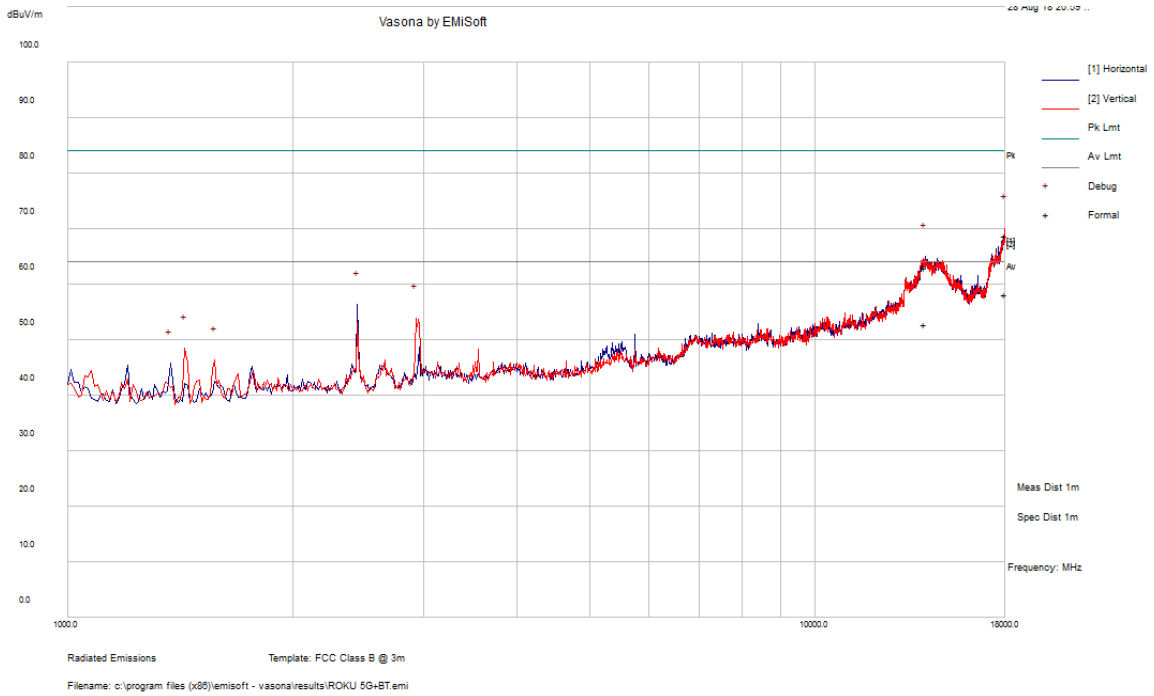
18-26.5 GHz

Colocation, 2.4 GHz Wi-Fi b mode (2412 MHz) and 2.4 GHz Classic Bluetooth 8DPSK (2441 MHz)



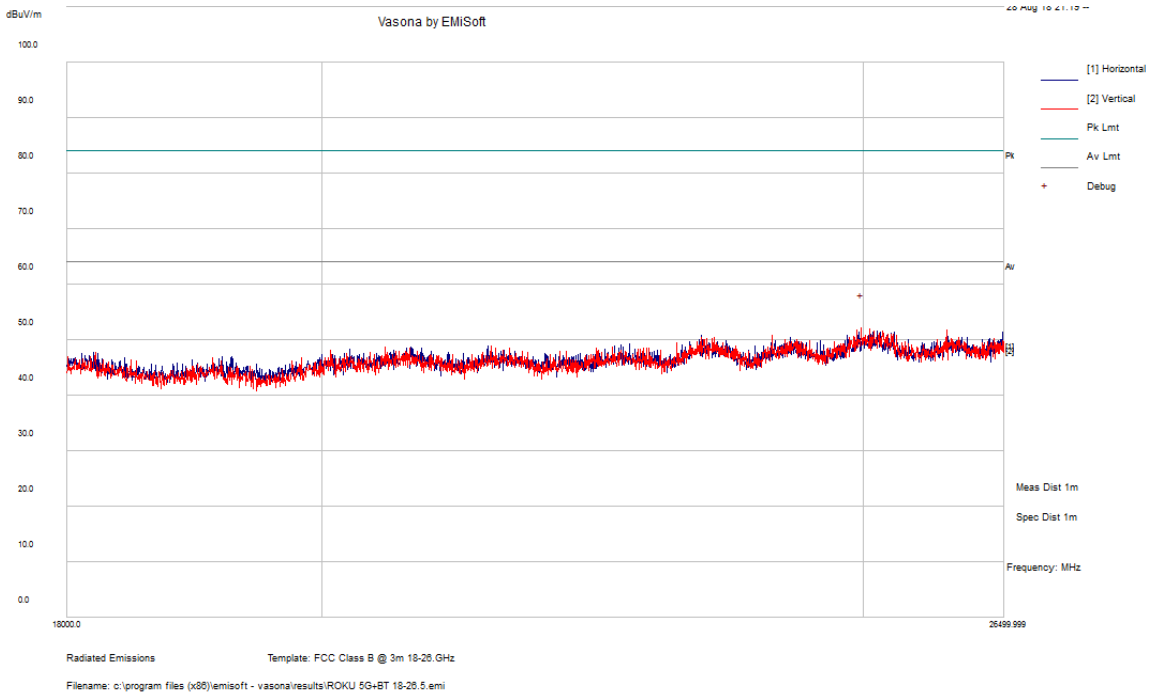
1-18 GHz

Worst Case Colocation, 5 GHz Wi-Fi a mode (5745 MHz) and 2.4 GHz Classic Bluetooth 8DPSK(2441 MHz)



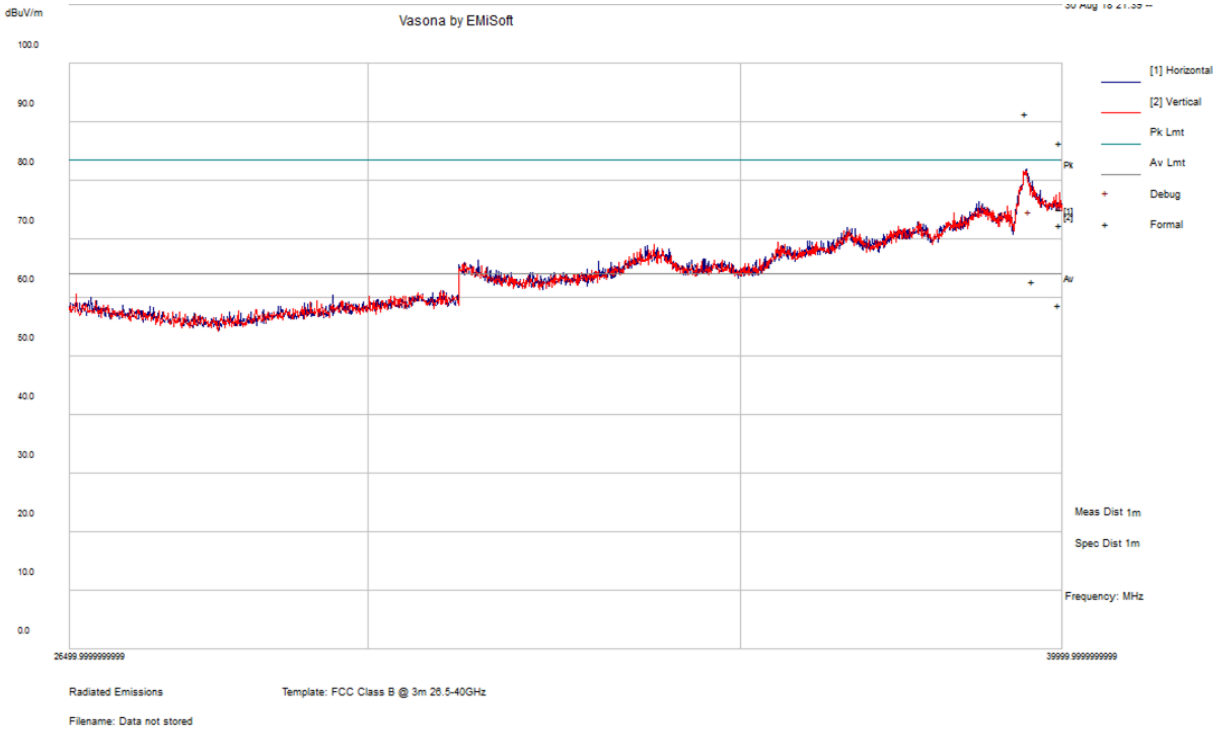
18-26.5 GHz

Worst Case Colocation, 5 GHz Wi-Fi a mode (5745 MHz) and 2.4 GHz Classic Bluetooth 8DPSK (2441 MHz)



26.5-40 GHz

Worst Case Colocation, 5 GHz Wi-Fi a mode (5745 MHz) and 2.4 GHz Classic Bluetooth 8DPSK (2441 MHz)



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	E4446A	MY48250238	2018-05-08	1 year
-	10 dB Attenuator	-	-	Each time[1]	N/A
-	RF cable	-	-	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 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:	102.7 KPa

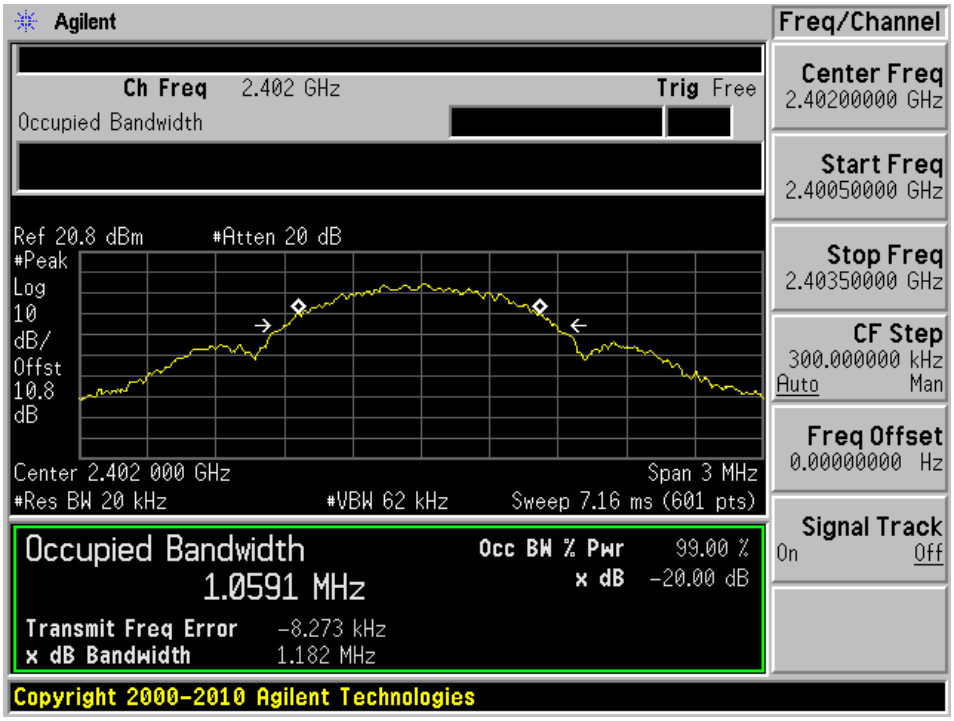
The testing was performed by Vincent Licata from 2018-08-14 to 2018-08-15 in RF site.

8.5 Test Results

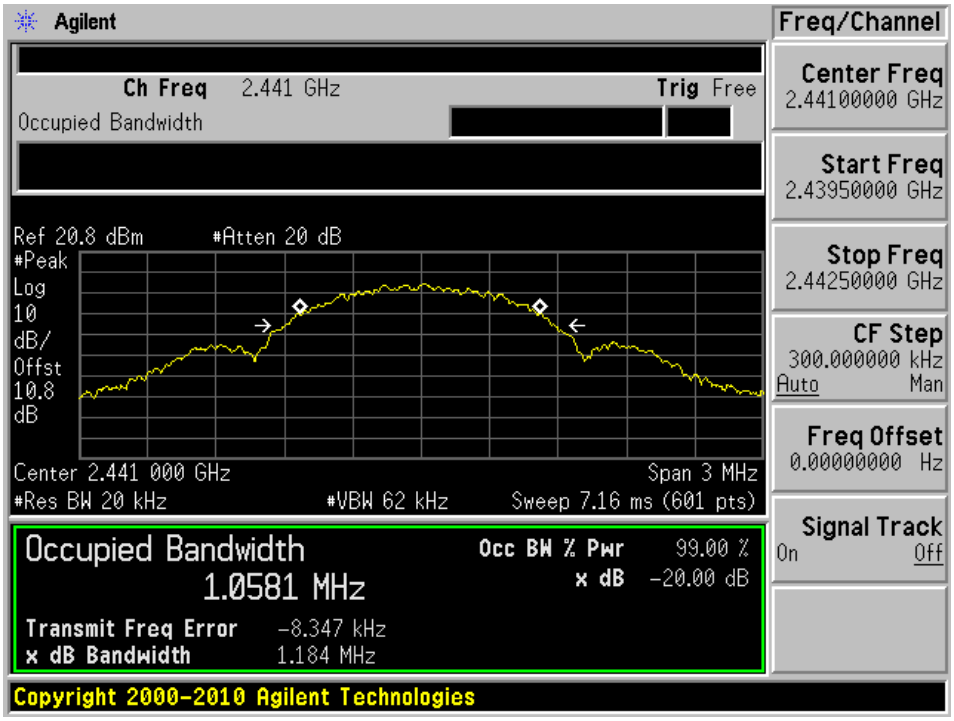
Channel	Frequency (MHz)	99% OBW (MHz)	20 dB OBW (MHz)
GFSK			
Low	2402	1.5091	1.182
Middle	2441	1.0581	1.184
High	2480	1.0630	1.198
π/4-DQPSK			
Low	2402	1.0573	1.183
Middle	2441	1.0597	1.189
High	2480	1.0603	1.197
8DPSK			
Low	2402	1.0595	1.187
Middle	2441	1.0597	1.184
High	2480	1.0577	1.191

Please refer to the following plots for detailed test results.

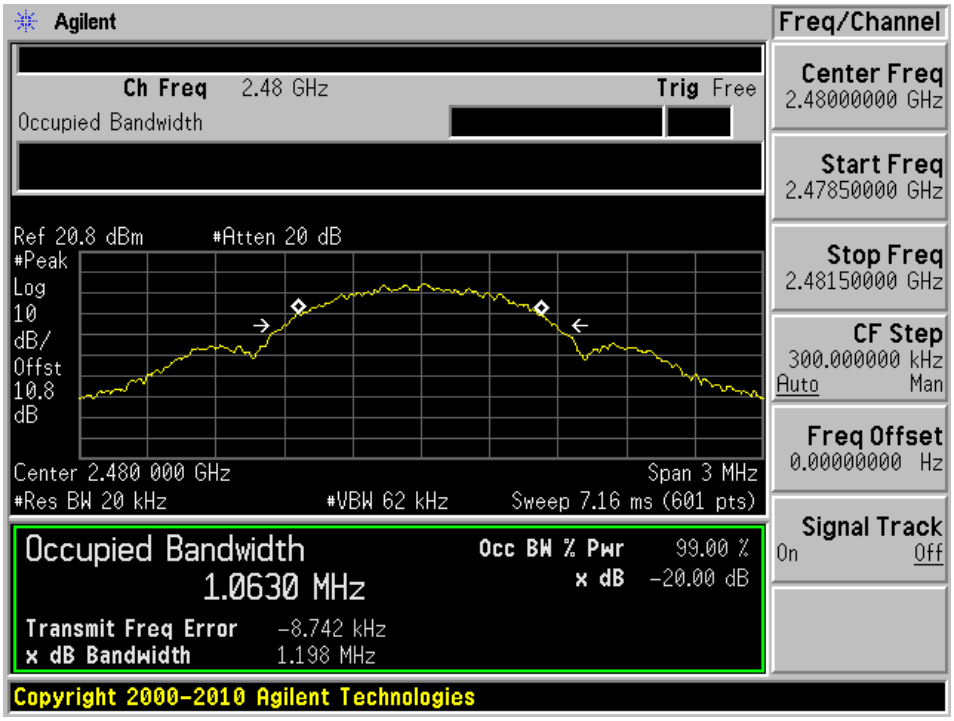
GFSK Mode 2402 MHz Low Channel OBW



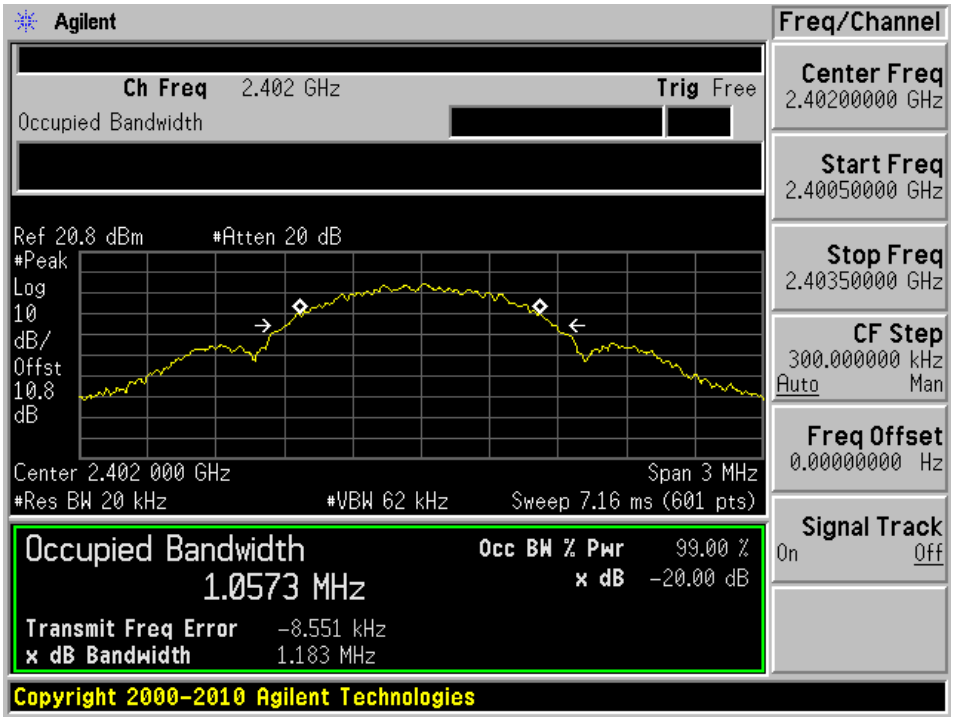
GFSK Mode 2441 MHz Mid Channel OBW



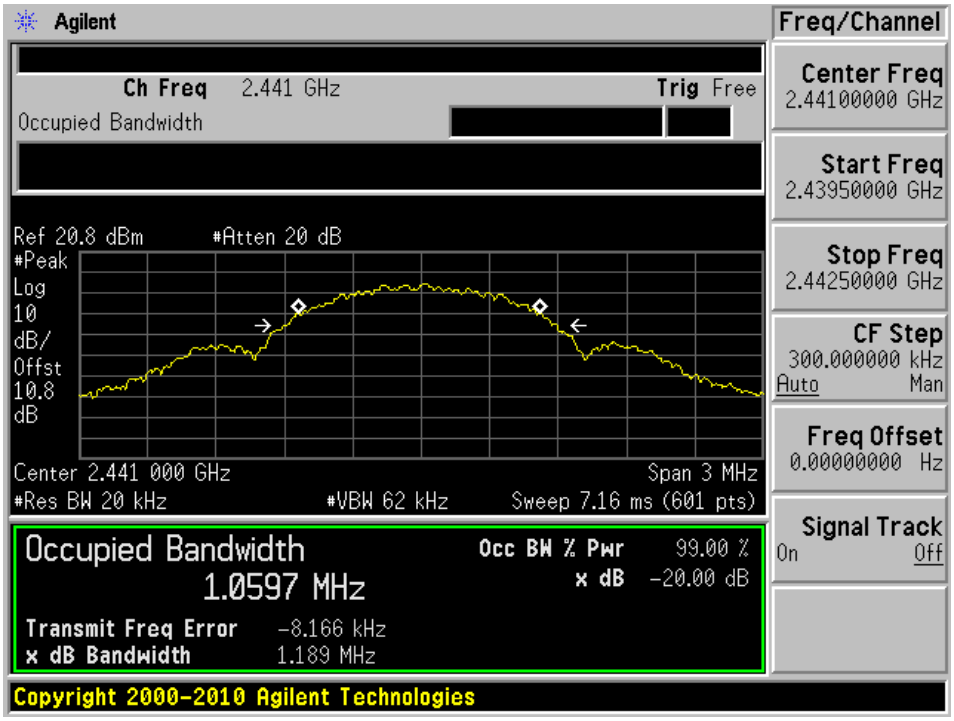
GFSK Mode 2480 MHz High Channel OBW



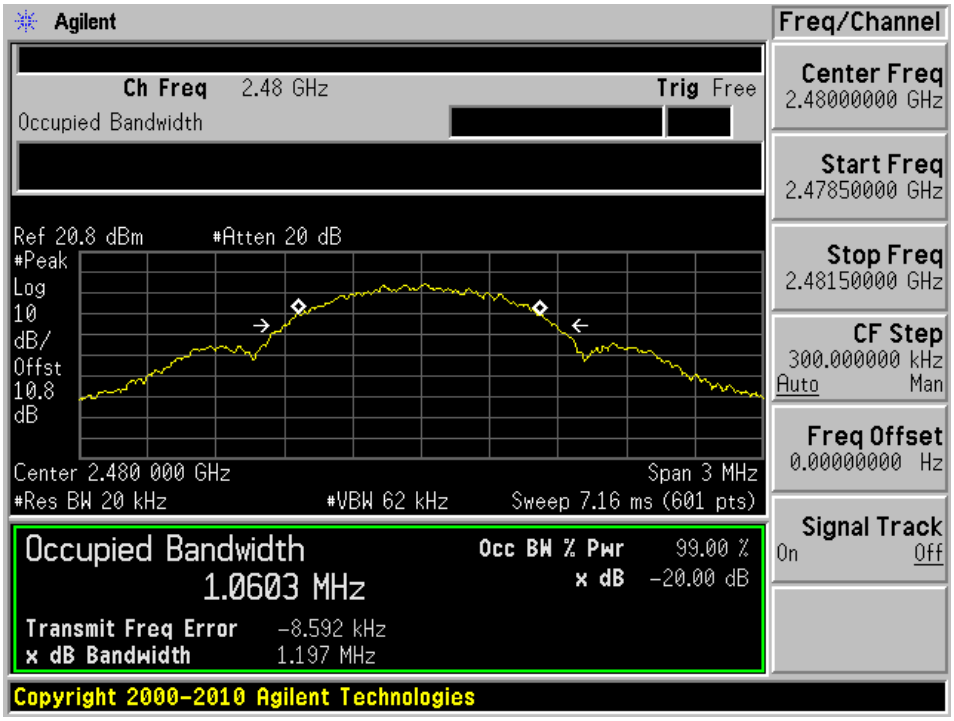
π/4-DQPSK Mode 2402 MHz Low Channel OBW



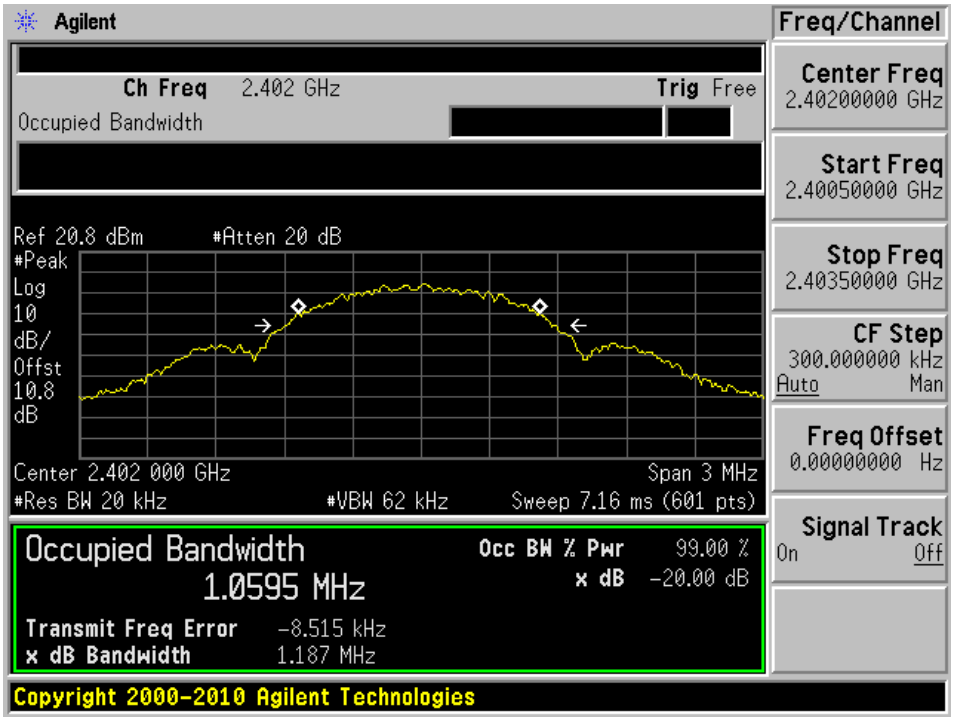
π/4-DQPSK Mode 2441 MHz Mid Channel OBW



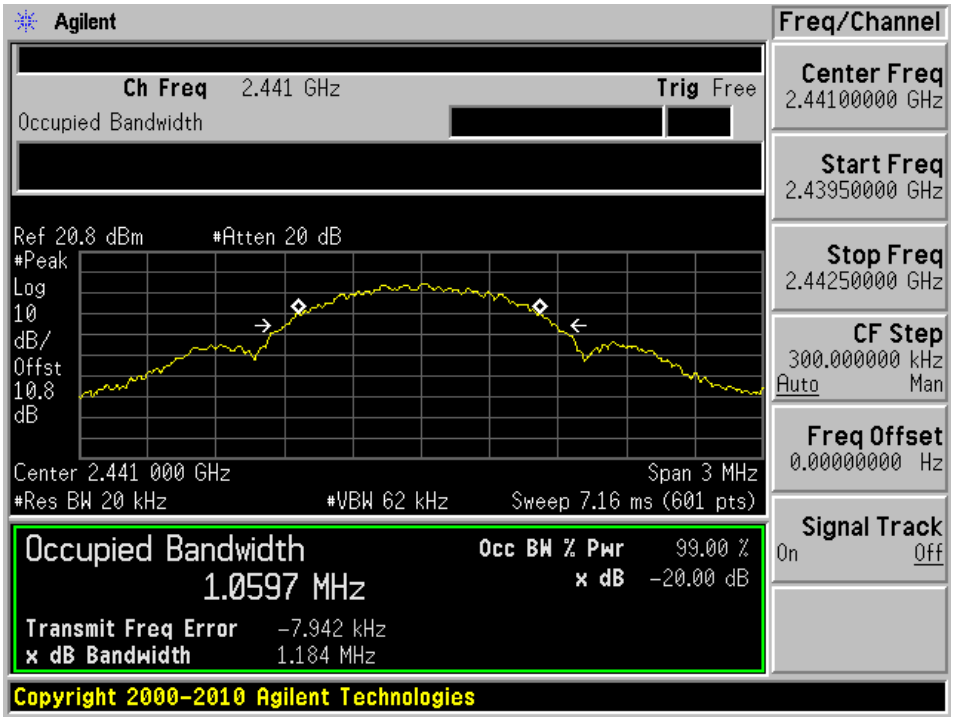
π/4-DQPSK Mode 2480 MHz High Channel OBW



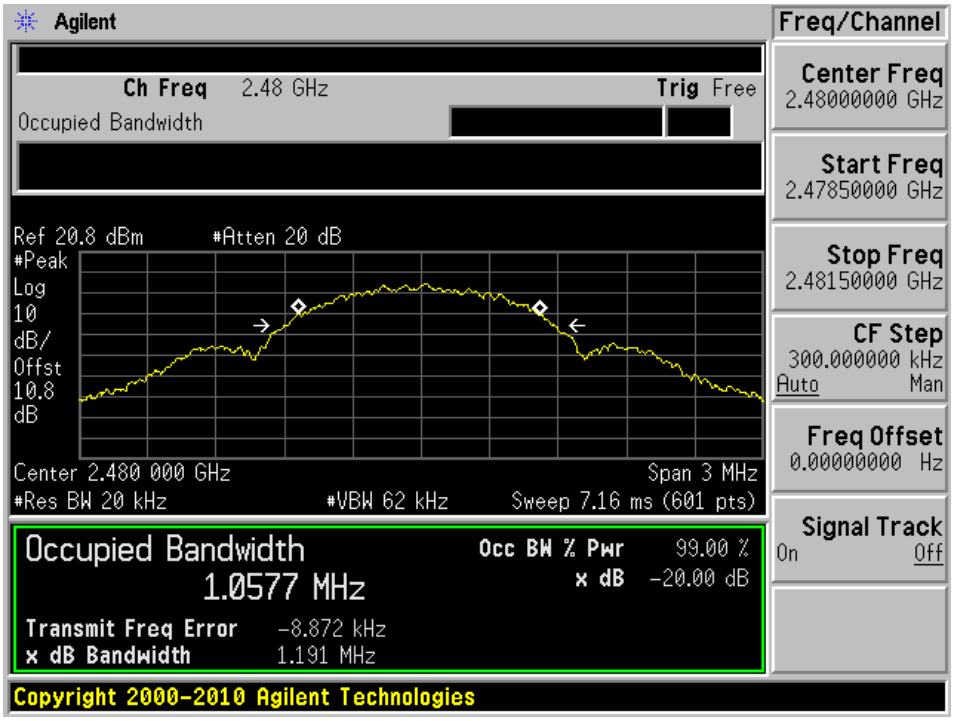
8DPSK Mode 2402 MHz Low Channel OBW



8DPSK Mode 2441 MHz Mid Channel OBW



8DPSK Mode 2480 MHz High Channel OBW



9 FCC §15.247(b) (1) - 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.

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	MY48250238	2018-05-08	1 year
-	10 dB Attenuator	-	-	Each time[1]	N/A
-	RF cable	-	-	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 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:	102.7 KPa

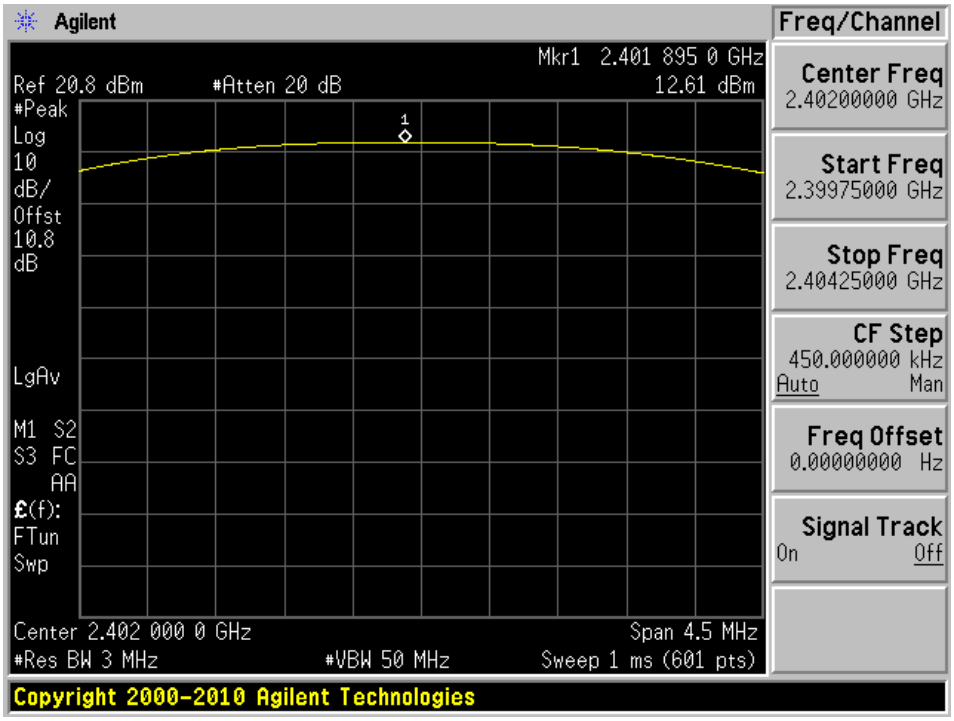
The testing was performed by Vincent Licata from 2018-08-14 to 2018-08-15 in RF site.

9.5 Test Results

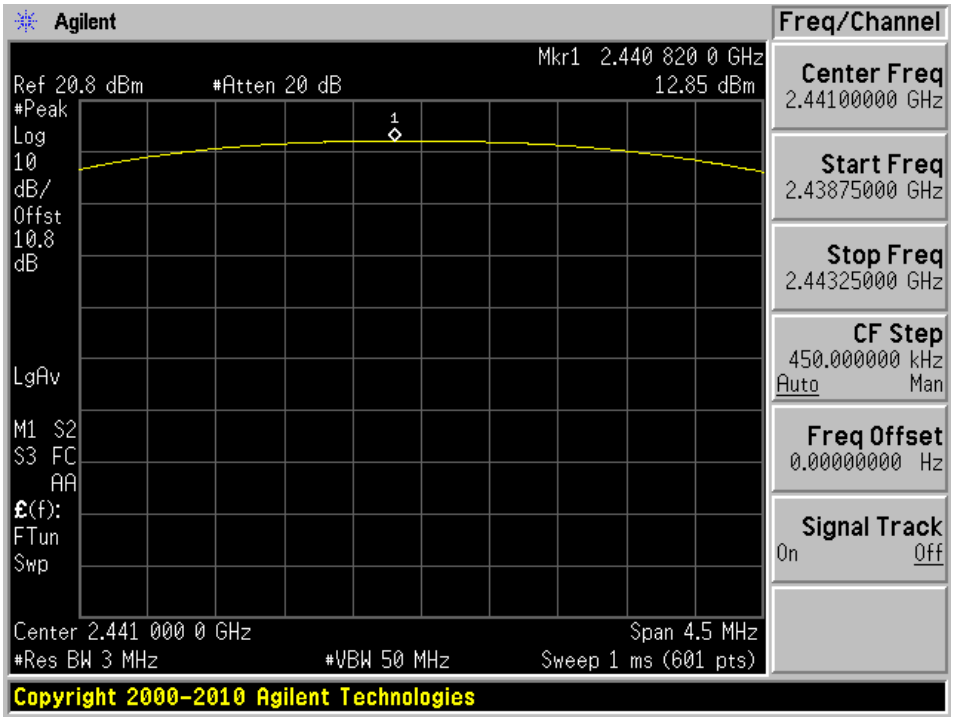
Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
GFSK			
Low	2402	12.61	21
Middle	2441	12.85	21
High	2480	12.42	21
π/4-DQPSK			
Low	2402	12.65	21
Middle	2441	12.85	21
High	2480	12.41	21
8DPSK			
Low	2402	12.59	21
Middle	2441	12.87	21
High	2480	12.40	21

Please refer to the following plots for detailed test results.

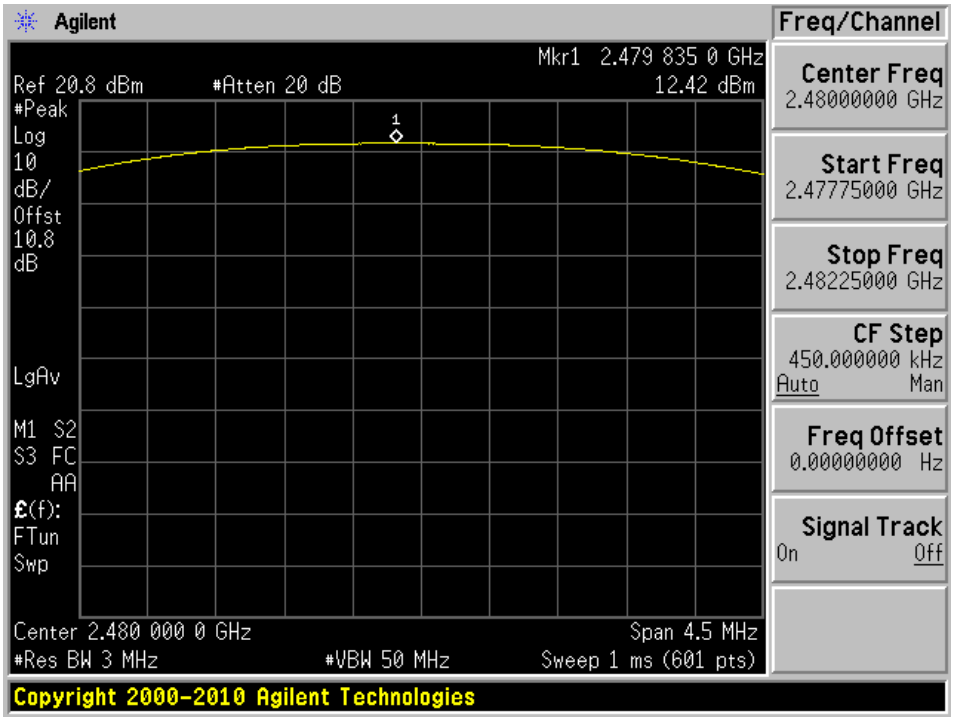
GFSK Mode 2402 MHz Low Channel Power



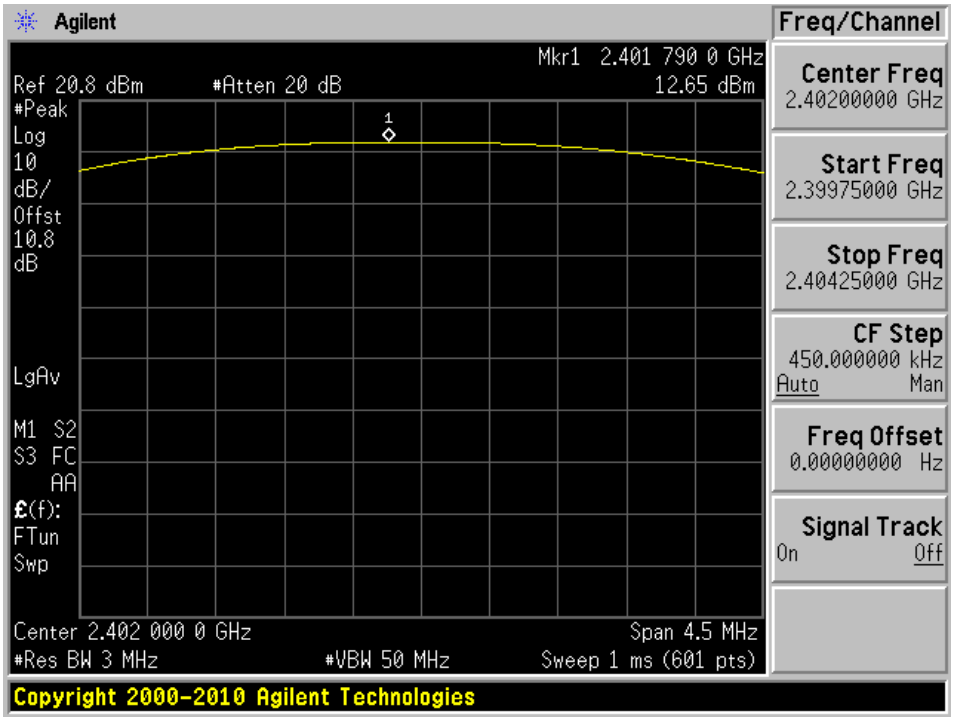
GFSK Mode 2441 MHz Mid Channel Power



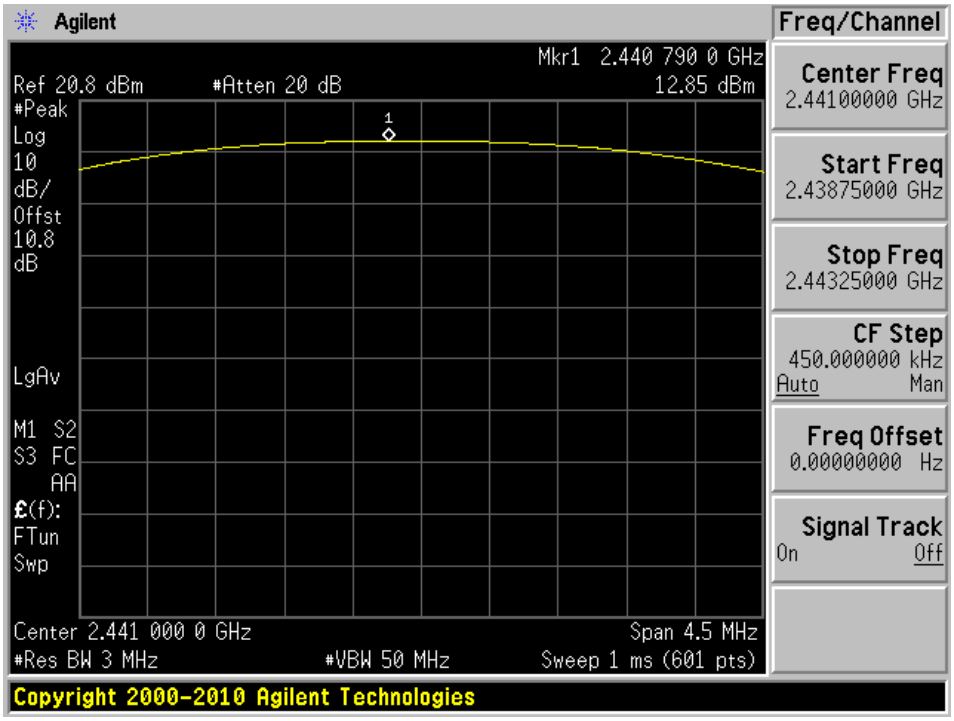
GFSK Mode 2480 MHz High Channel Power



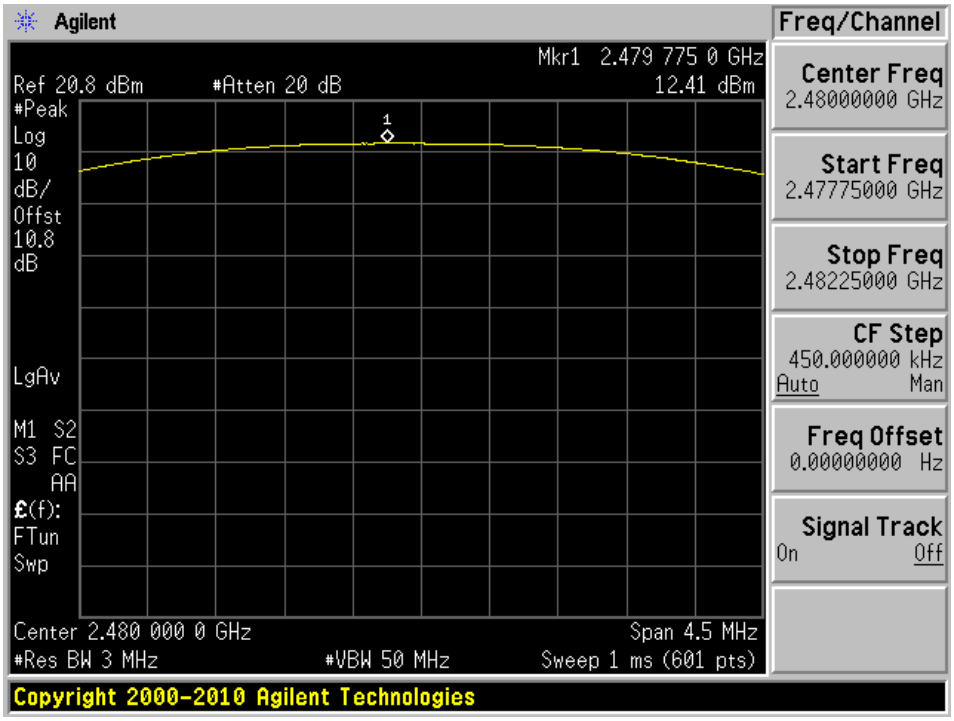
π/4-DQPSK Mode 2402 MHz Low Channel Power



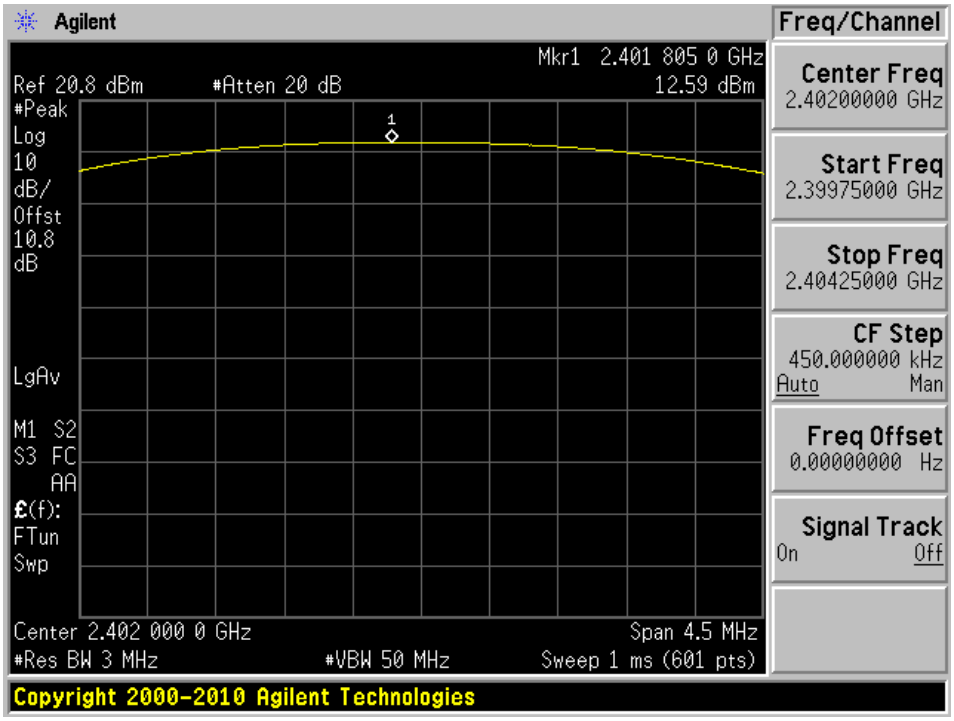
π/4-DQPSK Mode 2441 MHz Mid Channel Power



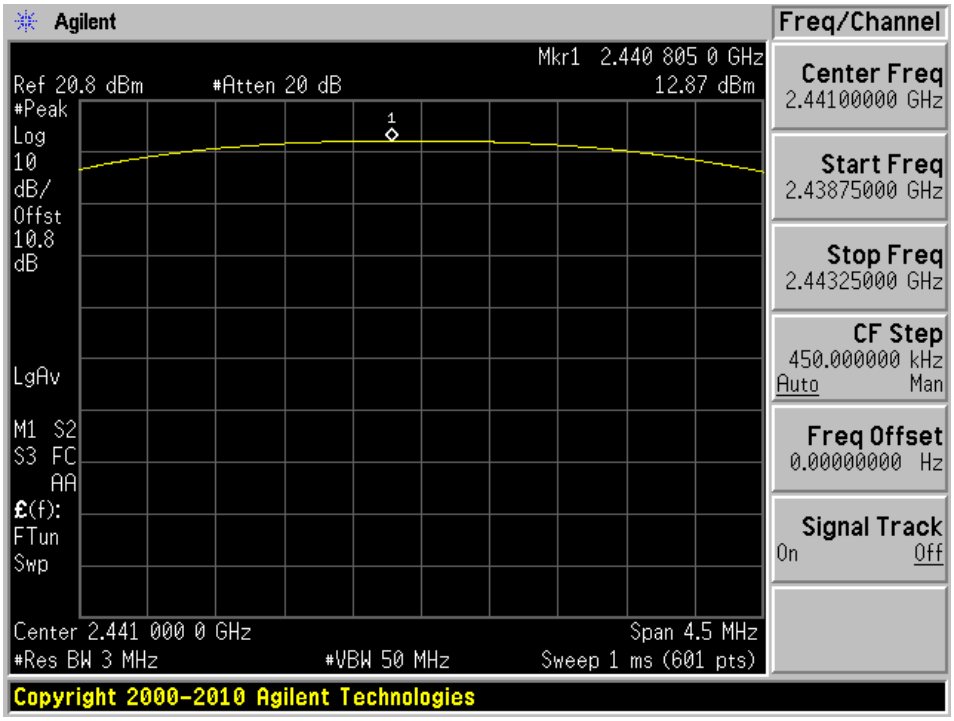
π/4-DQPSK Mode 2480 MHz High Channel Power



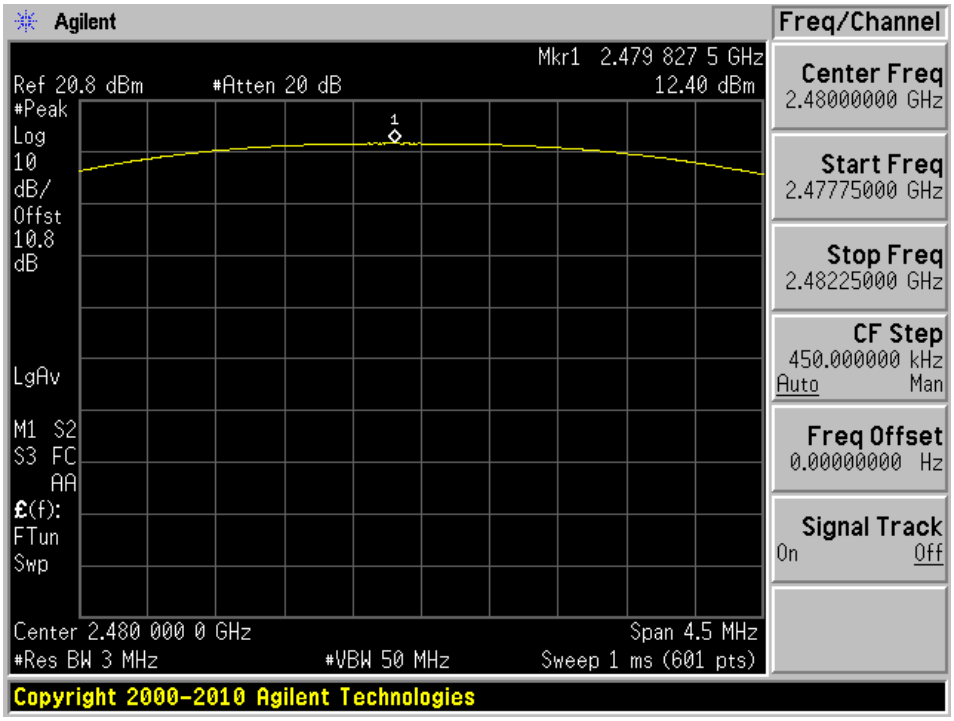
8DPSK Mode 2402 MHz Low Channel Power



8DPSK Mode 2441 MHz Mid Channel Power



8DPSK Mode 2480 MHz High Channel Power



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	E4446A	MY48250238	2018-05-08	1 year
-	10 dB Attenuator	-	-	Each time[1]	N/A
-	RF cable	-	-	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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

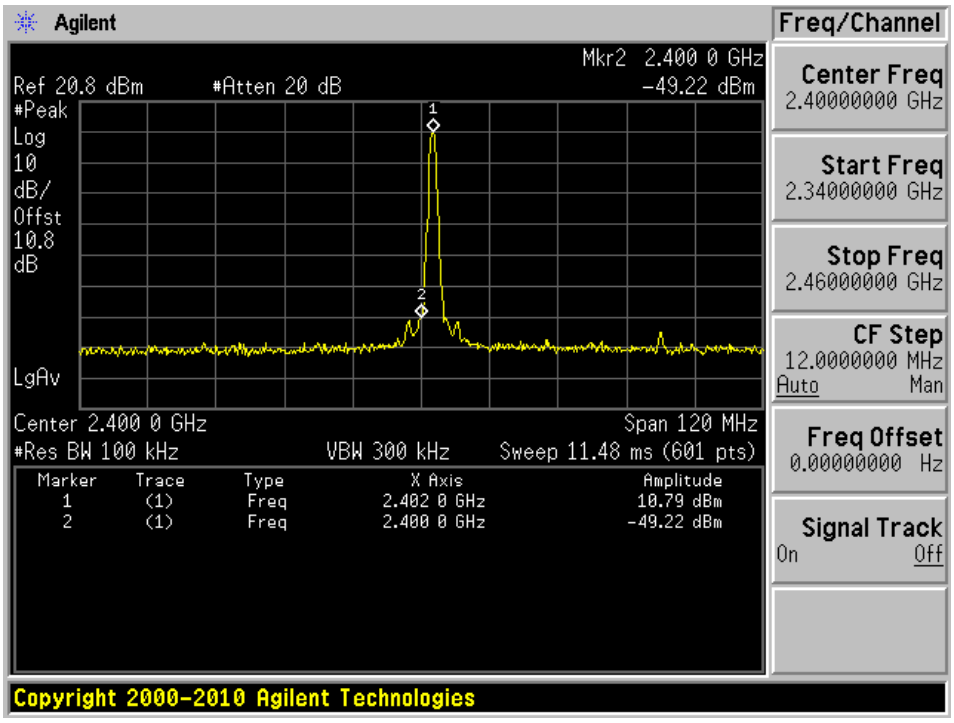
10.4 Test Environmental Conditions

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

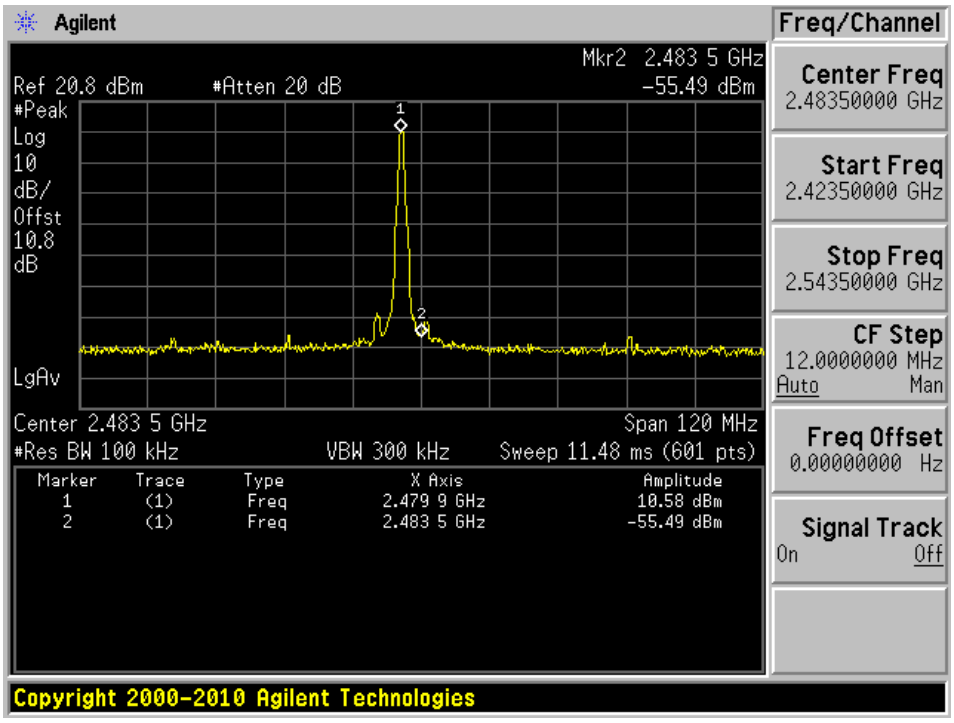
The testing was performed by Vincent Licata from 2018-08-14 to 2018-08-15 in RF site.

10.5 Test Results

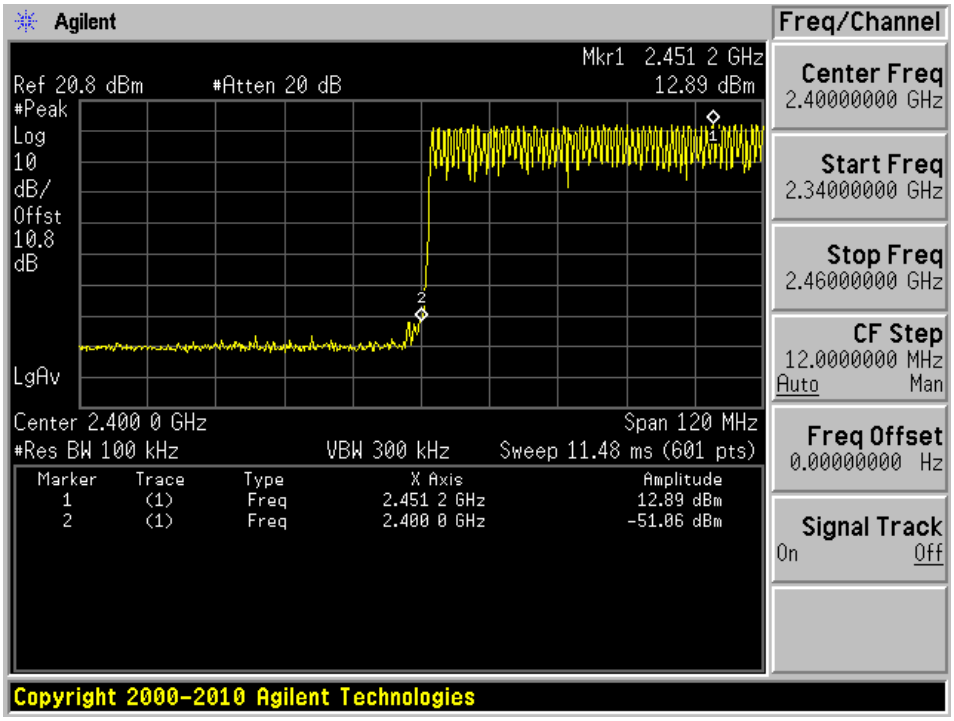
GFSK Mode 2402 MHz Low Channel Band Edge Fixed



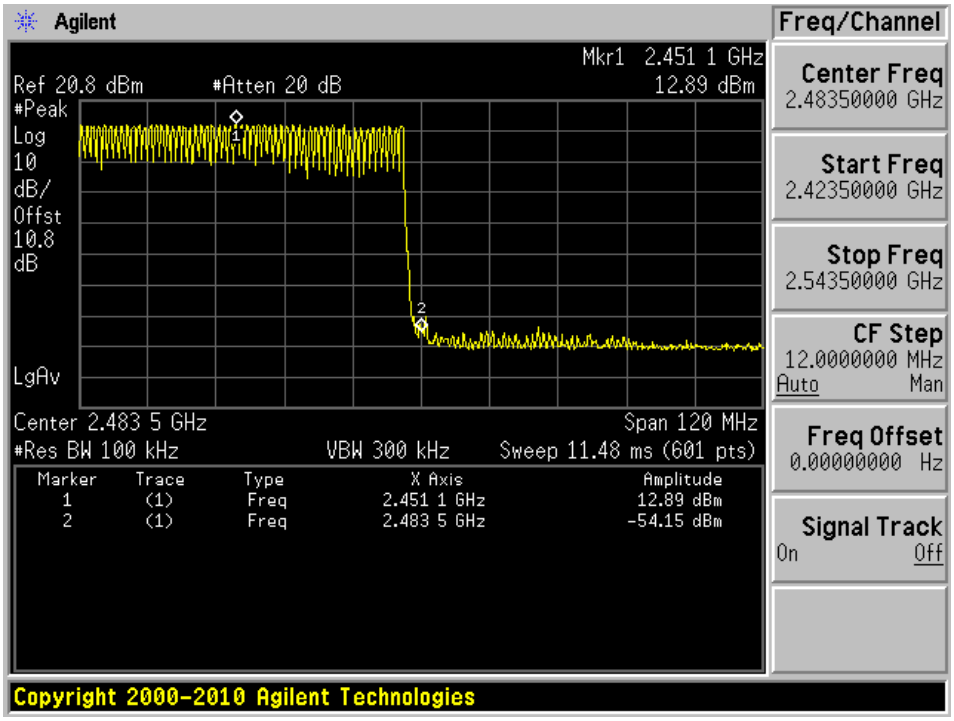
GFSK Mode 2480 MHz High Channel Band Edge Fixed



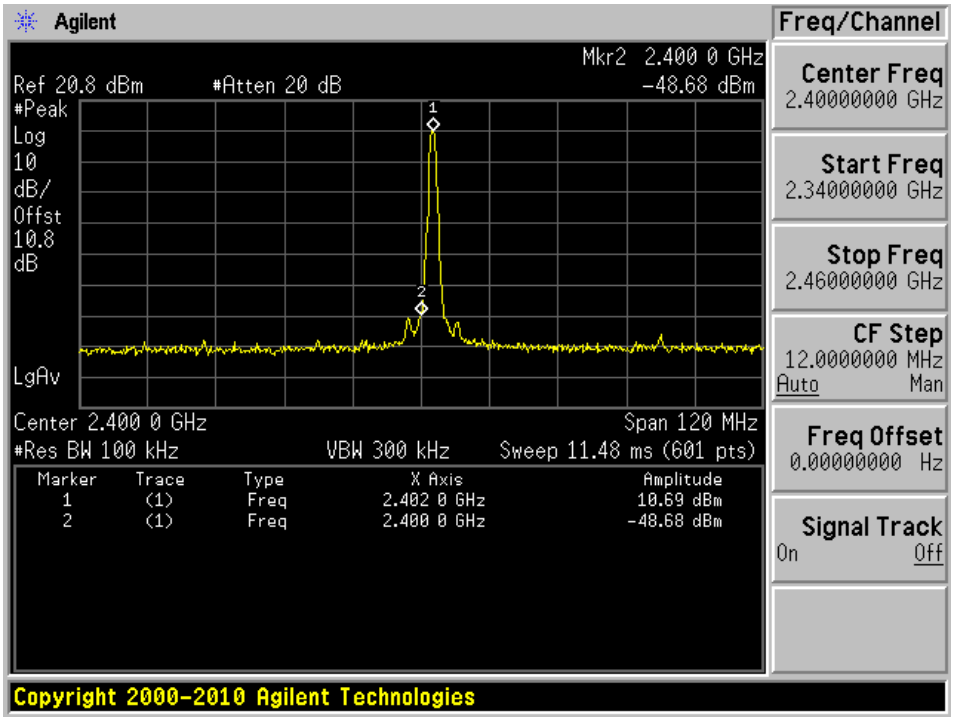
GFSK Mode 2402 MHz Low Channel Band Edge Hopping



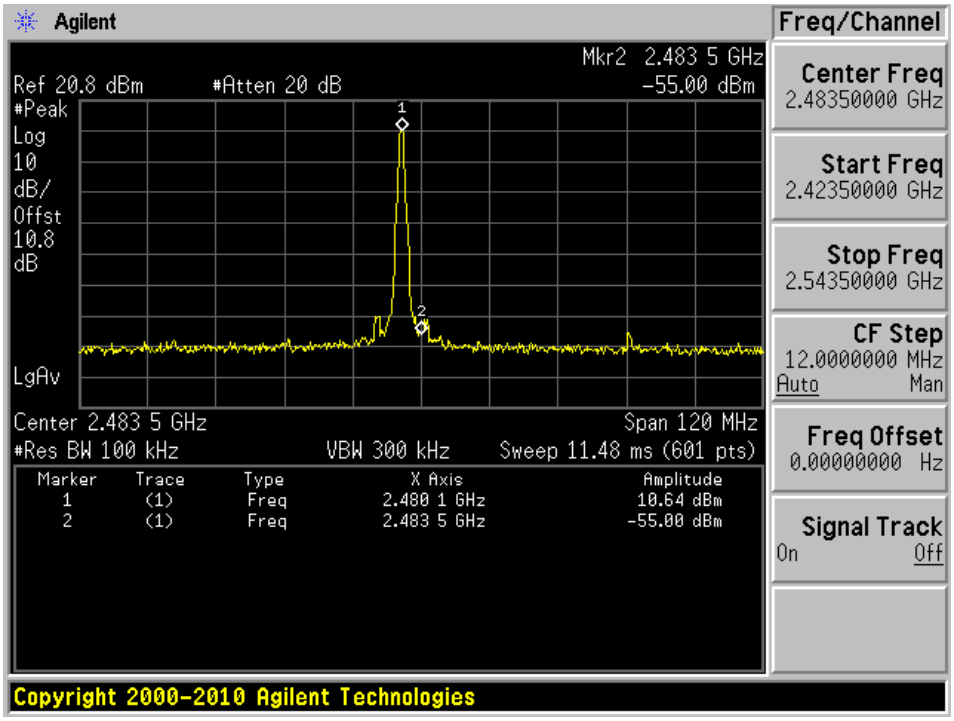
GFSK Mode 2480 MHz High Channel Band Edge Hopping



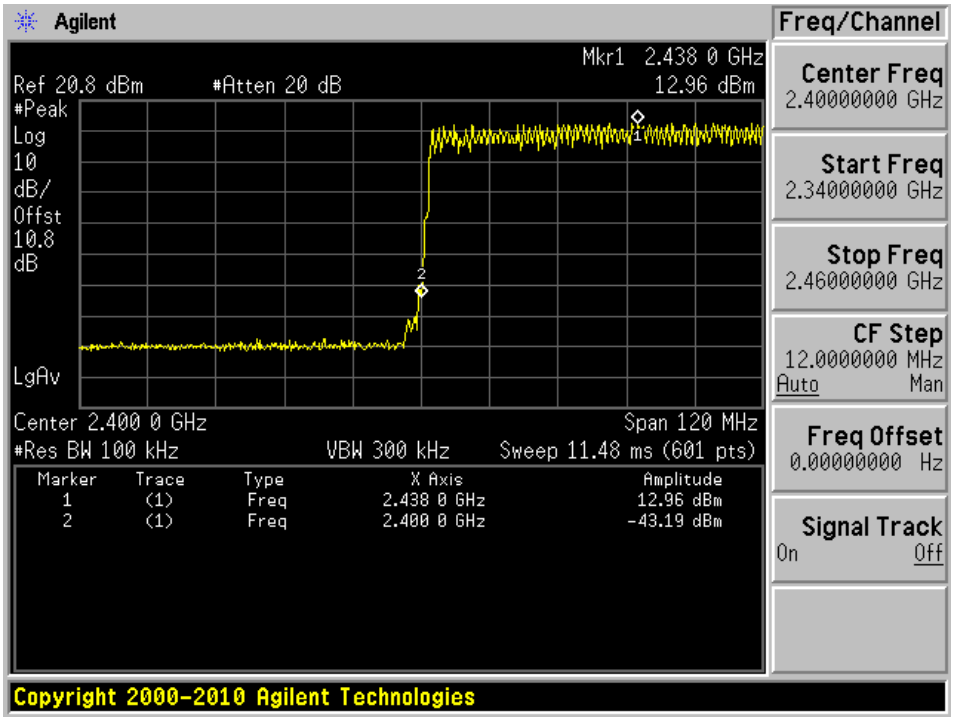
π/4-DQPSK Mode 2402 MHz Low Channel Band Edge Fixed



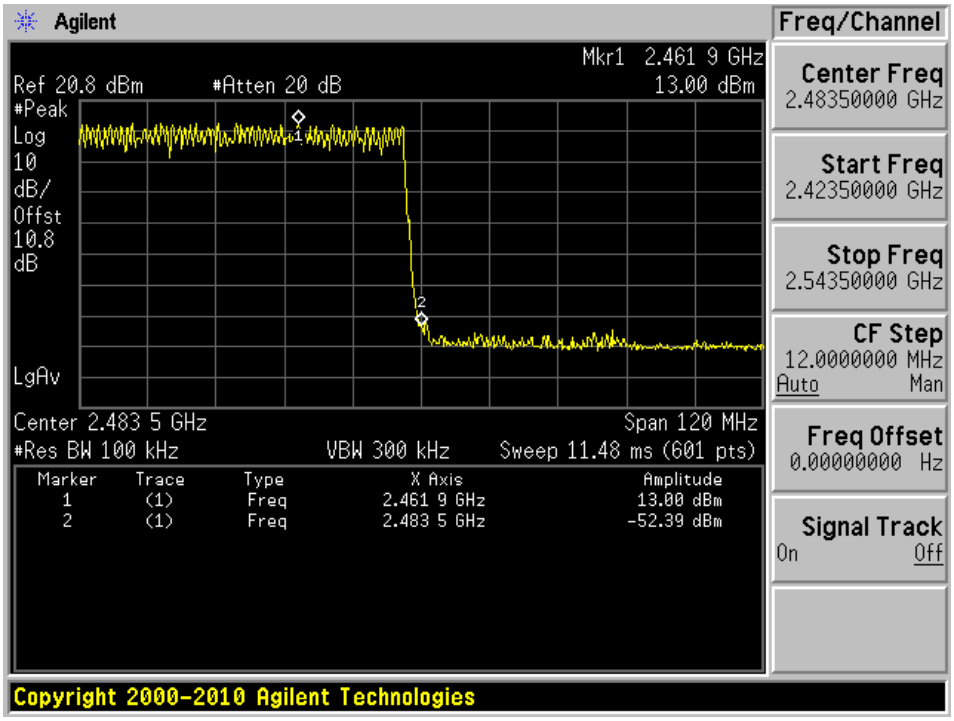
π/4-DQPSK Mode 2480 MHz High Channel Band Edge Fixed



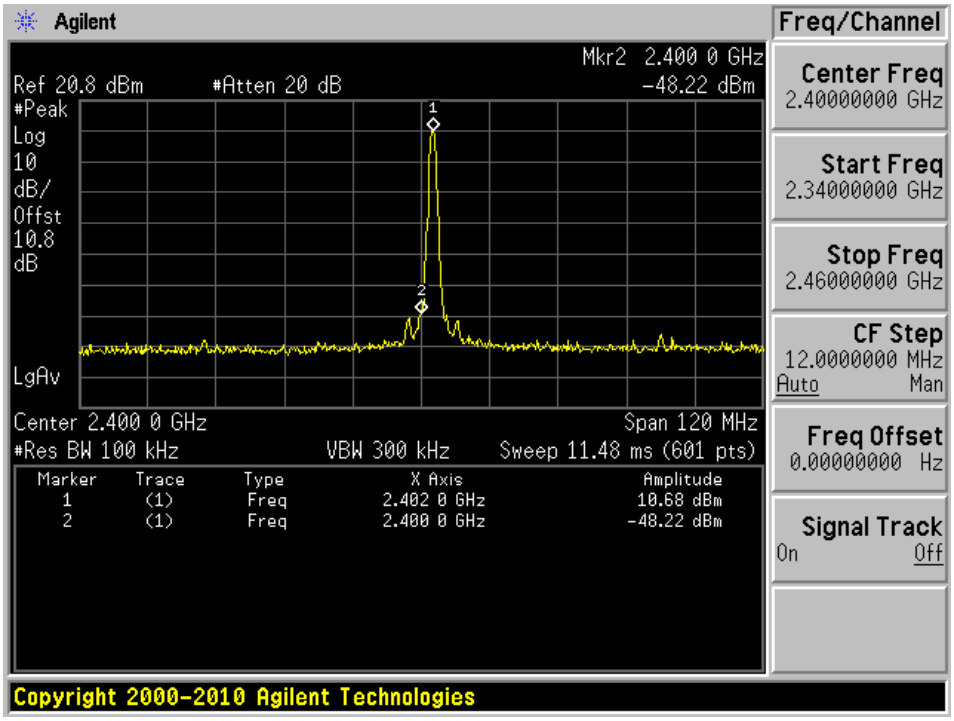
π/4-DQPSK Mode 2402 MHz Low Channel Band Edge Hopping



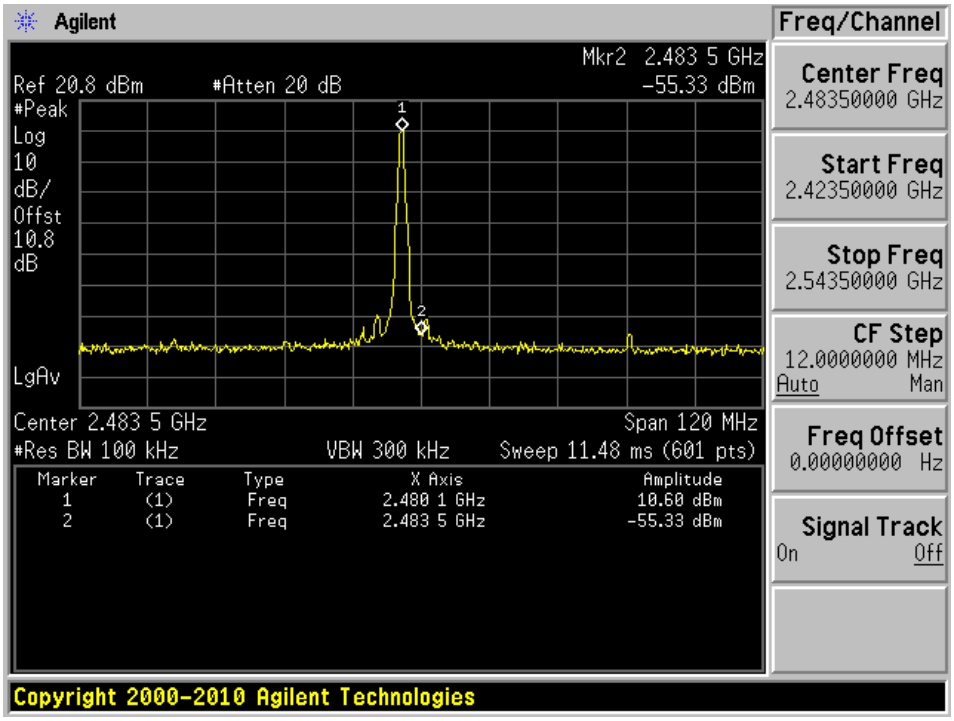
π/4-DQPSK Mode 2480 MHz High Channel Band Edge Hopping



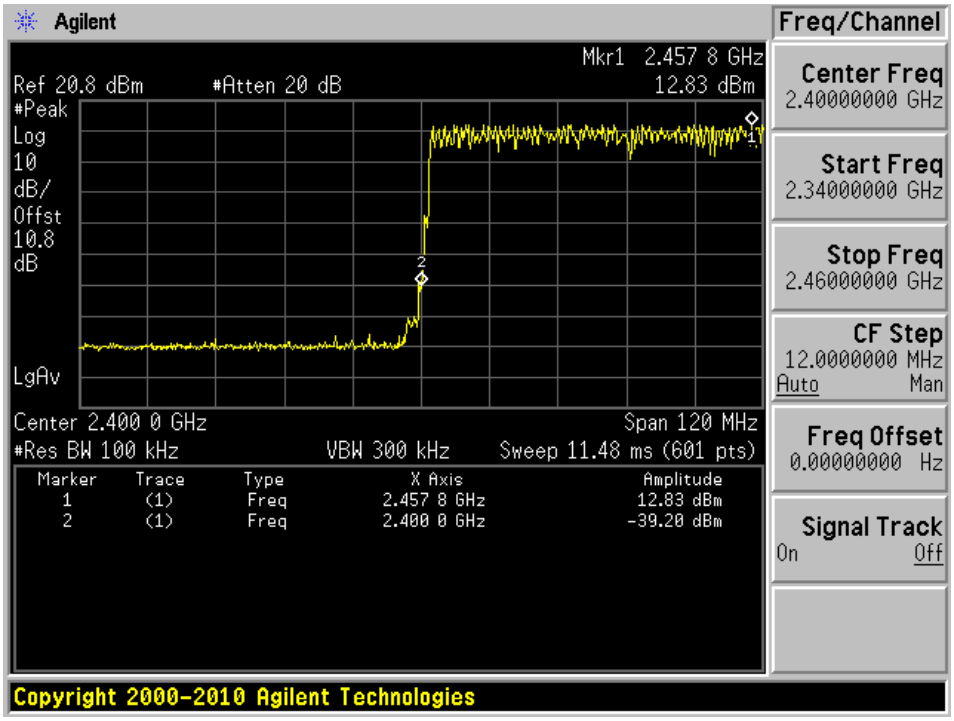
8DPSK Mode 2402 MHz Low Channel Band Edge Fixed



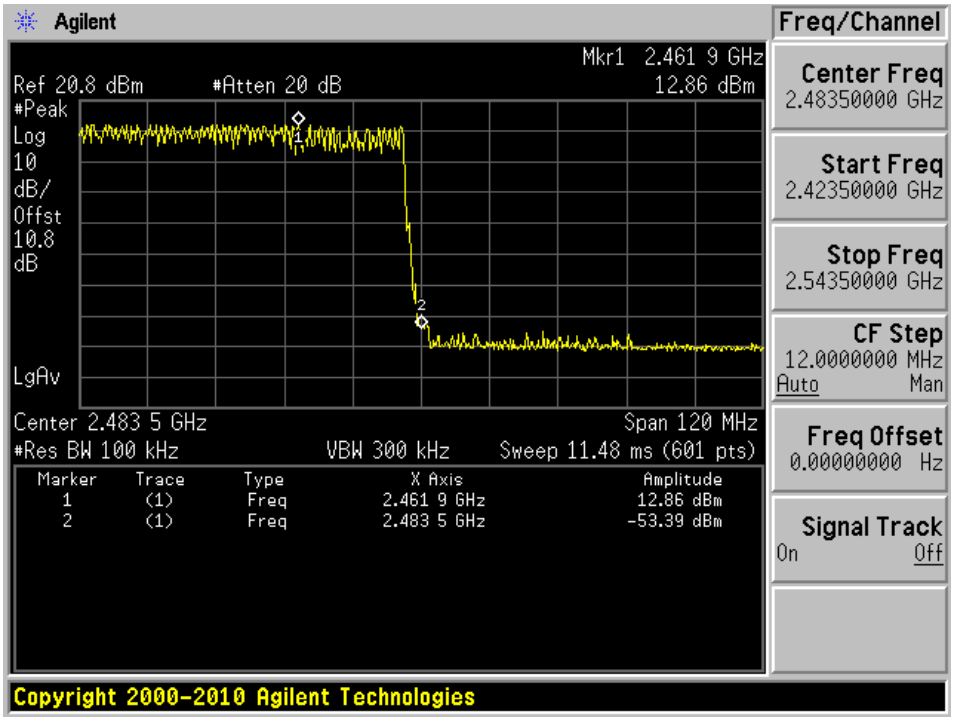
8DPSK Mode 2480 MHz High Channel Band Edge Fixed



8DPSK Mode 2402 MHz Low Channel Band Edge Hopping



8DPSK Mode 2480 MHz High Channel Band Edge 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	E4446A	MY48250238	2018-05-08	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10 dB 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 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:	102.7 KPa

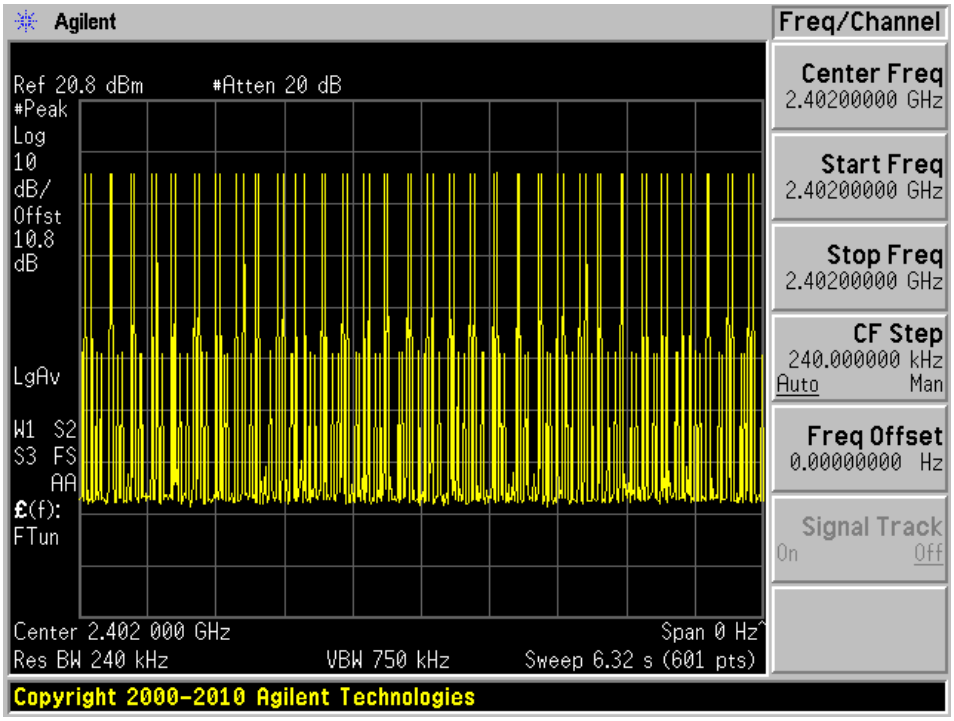
The testing was performed by Vincent Licata from 2018-08-14 to 2018-08-15 in RF site.

11.5 Test Results

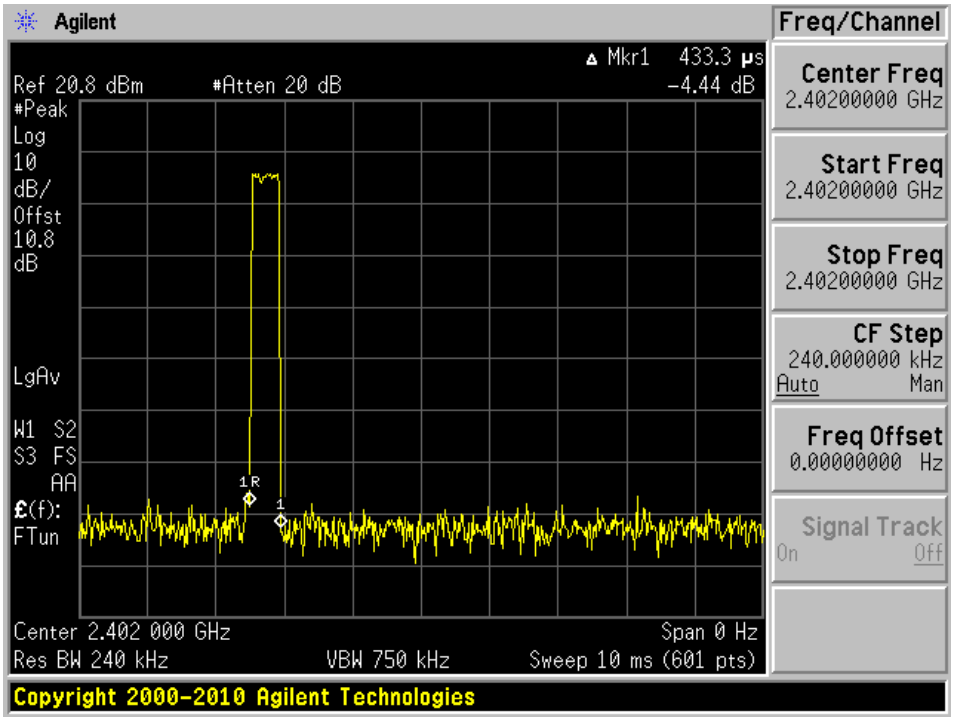
Channel	Pulse Width (ms)	Number of Hops in the Period Specified in the Requirements	Average Time of Occupancy (s)	Limit (sec)	Results
GFSK,DH1					
Low	0.4333	320	0.139	0.4	compliant
Middle	0.4333	310	0.134	0.4	compliant
High	0.4333	320	0.139	0.4	compliant
GFSK,DH3					
Low	1.617	160	0.259	0.4	compliant
Middle	1.617	165	0.267	0.4	compliant
High	1.617	160	0.259	0.4	compliant
GFSK,DH5					
Low	2.867	135	0.387	0.4	compliant
Middle	2.867	120	0.344	0.4	compliant
High	2.867	120	0.344	0.4	compliant
π/4-DQPSK,DH1					
Low	0.4333	320	0.139	0.4	compliant
Middle	0.4333	300	0.130	0.4	compliant
High	0.4333	320	0.139	0.4	compliant
π/4-DQPSK,DH3					
Low	1.617	170	0.275	0.4	compliant
Middle	1.617	170	0.275	0.4	compliant
High	1.617	170	0.275	0.4	compliant
π/4-DQPSK,DH5					
Low	2.867	135	0.387	0.4	compliant
Middle	2.867	125	0.358	0.4	compliant
High	2.867	135	0.387	0.4	compliant
8DPSK,DH1					
Low	0.4333	320	0.139	0.4	compliant
Middle	0.4333	320	0.139	0.4	compliant
High	0.4333	320	0.139	0.4	compliant
8DPSK,DH3					
Low	1.617	160	0.259	0.4	compliant
Middle	1.617	160	0.259	0.4	compliant
High	1.617	165	0.267	0.4	compliant
8DPSK,DH5					
Low	2.867	130	0.373	0.4	compliant
Middle	2.867	130	0.373	0.4	compliant
High	2.867	130	0.373	0.4	compliant

Please refer to the following plots for detailed test results.

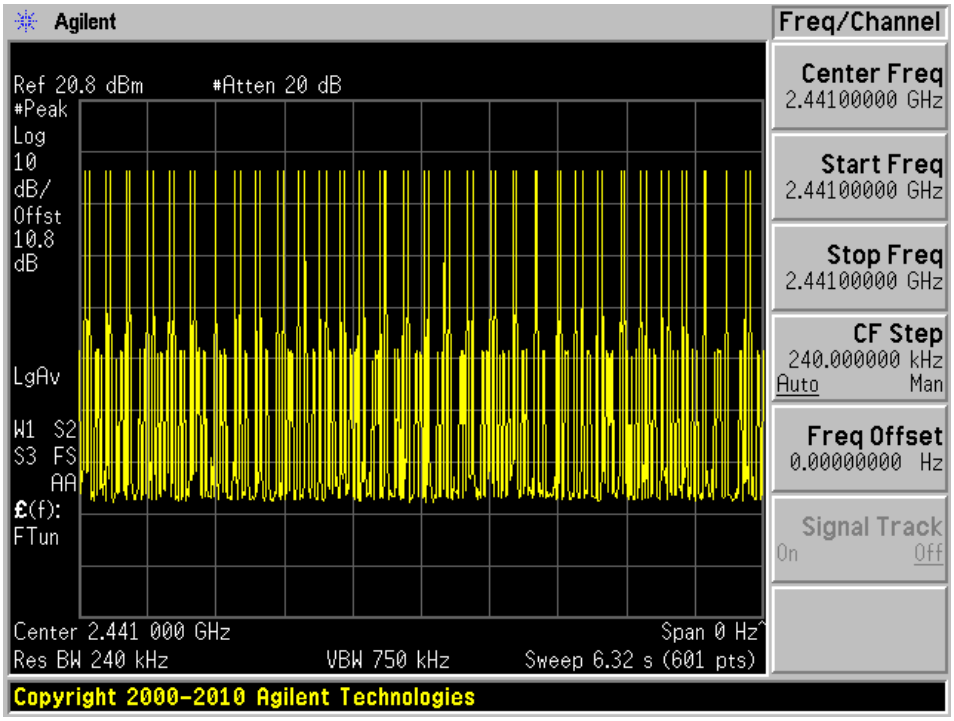
DH1 Mode 2402 MHz Low Channel # of Pulses



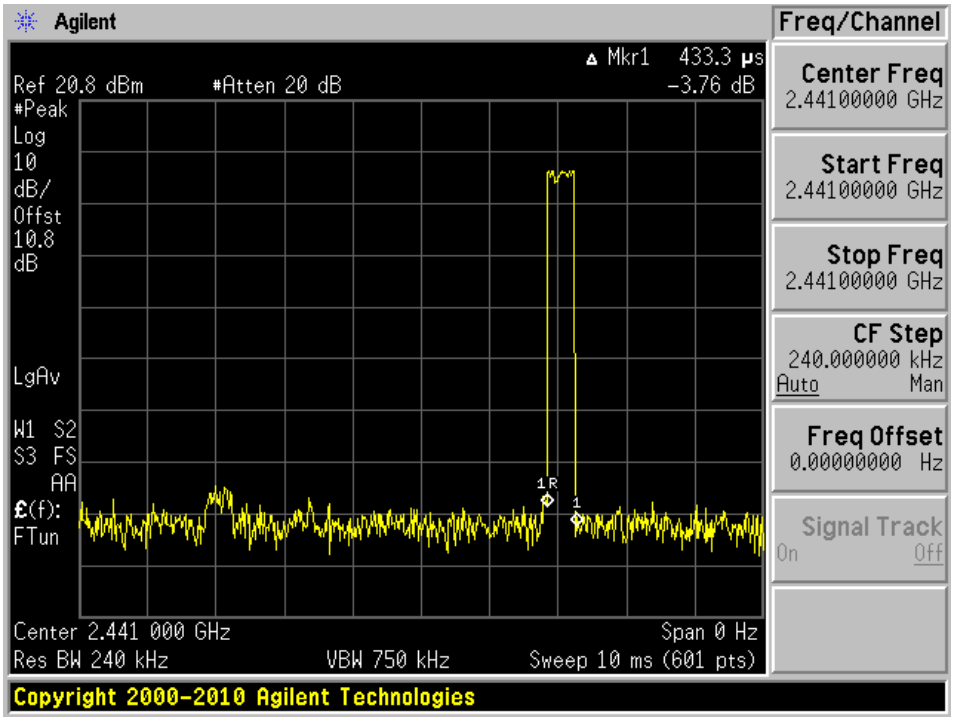
DH1 Mode 2402 MHz Low Channel Pulse Width



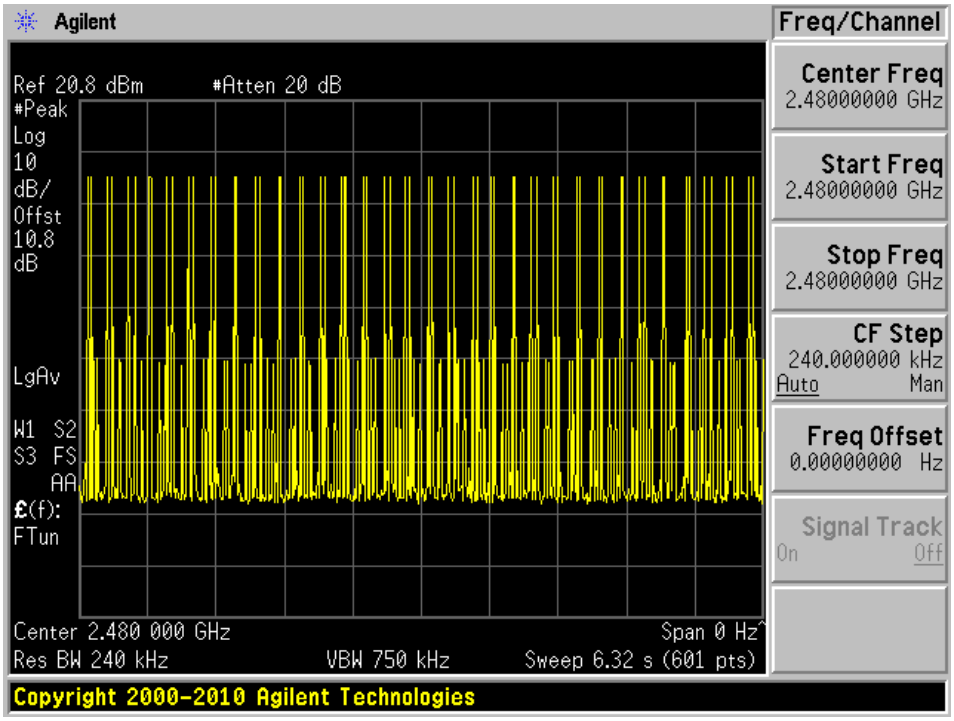
DH1 Mode 2441 MHz Mid Channel # of Pulses



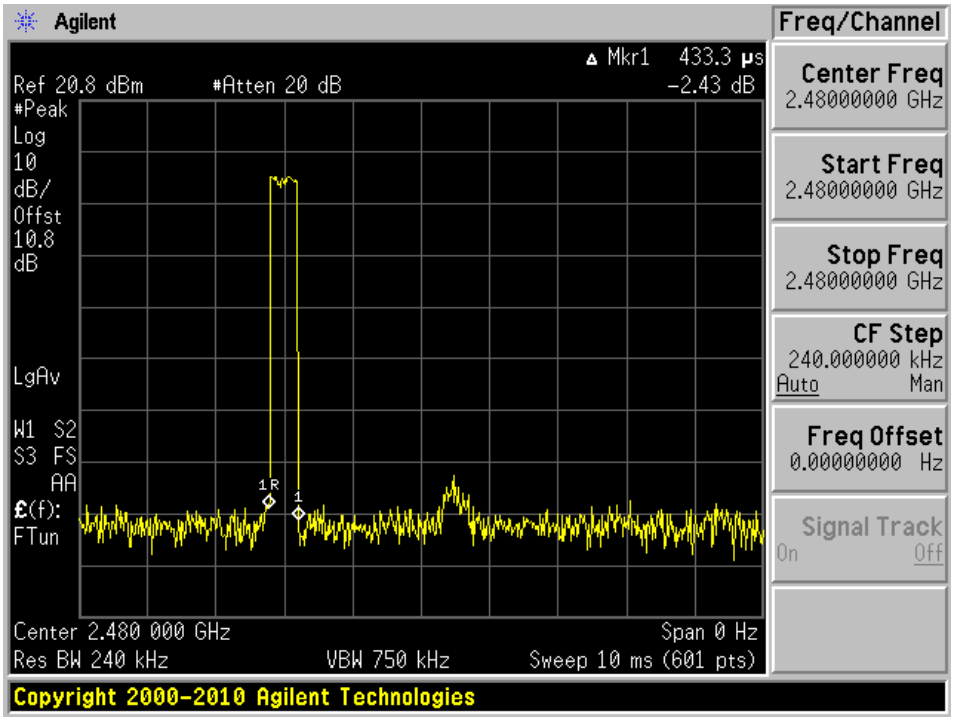
DH1 Mode 2441 MHz Mid Channel Pulse Width



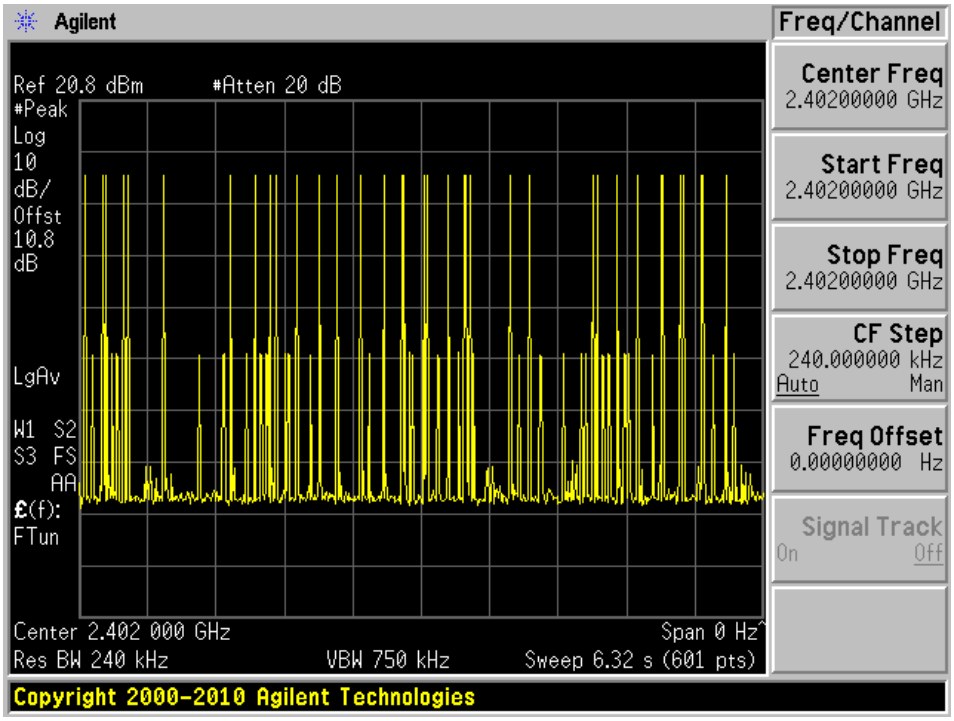
DH1 Mode 2480 MHz High Channel # of Pulses



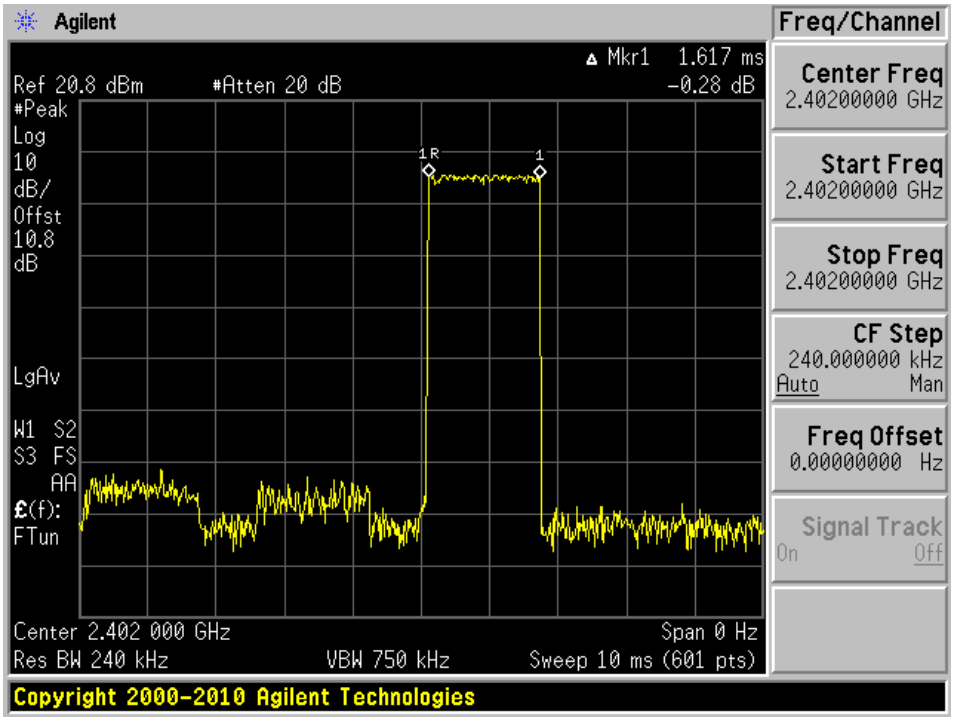
DH1 Mode 2480 MHz High Channel Pulse Width



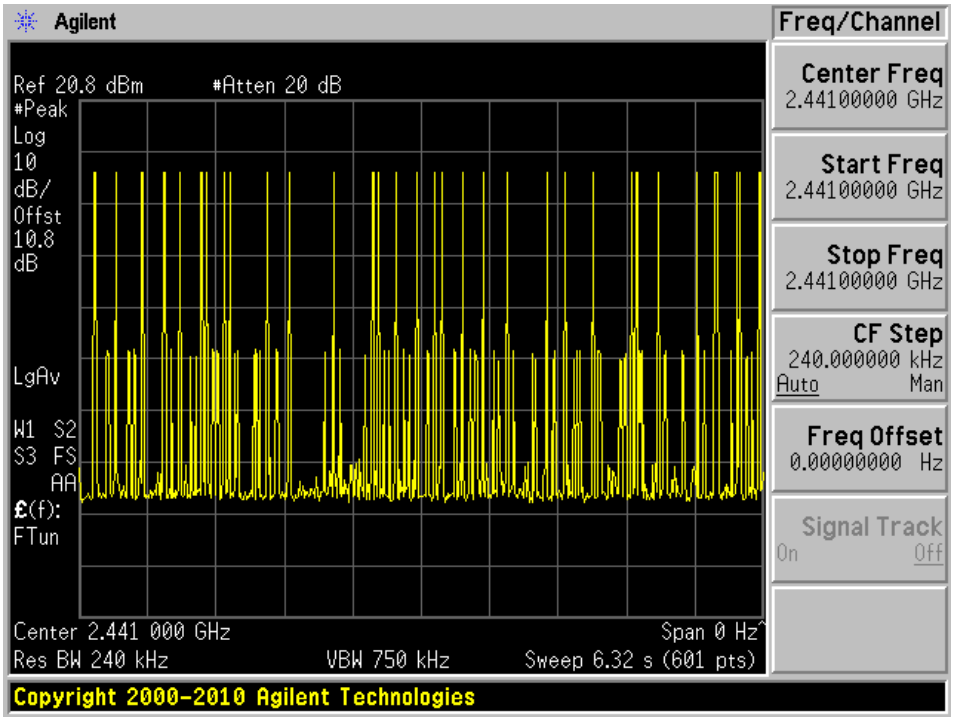
DH3 Mode 2402 MHz Low Channel # of Pulses



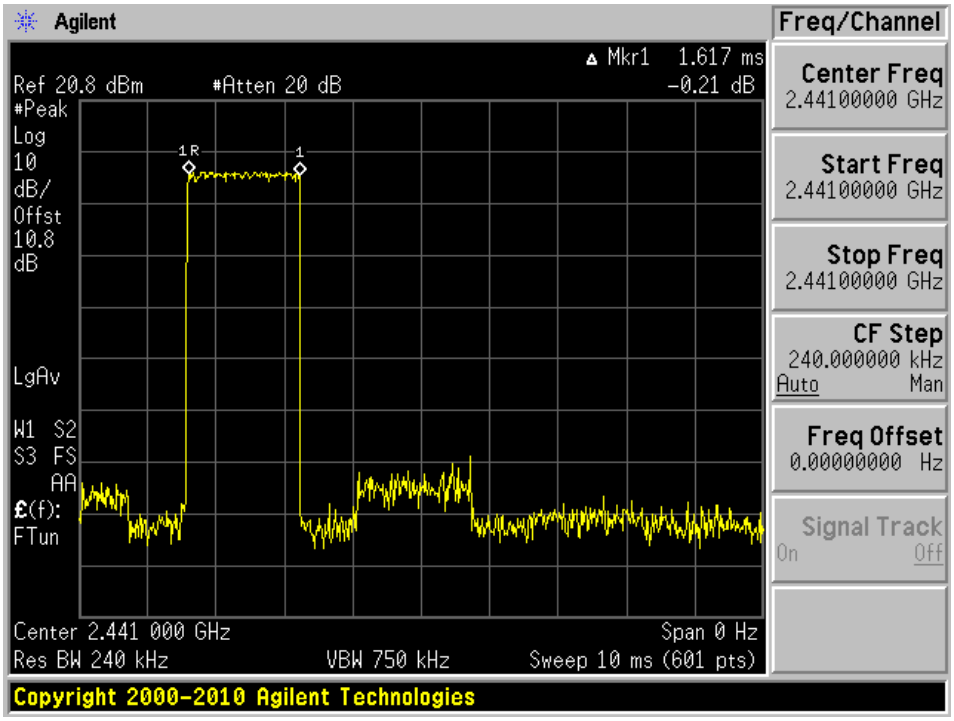
DH3 Mode 2402 MHz Low Channel Pulse Width



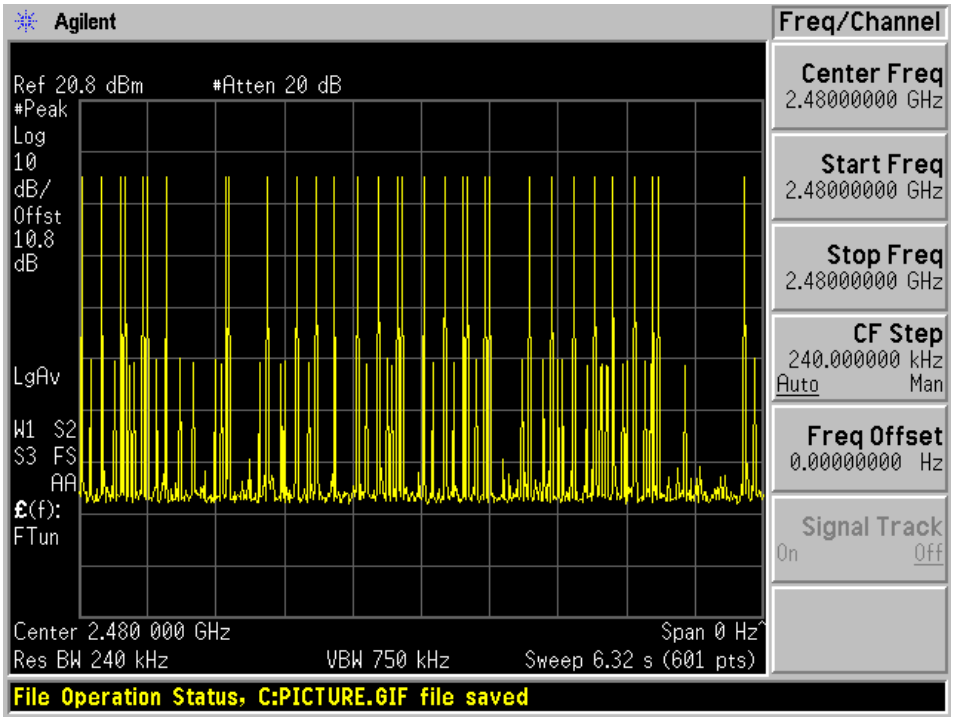
DH3 Mode 2441 MHz Mid Channel # of Pulses



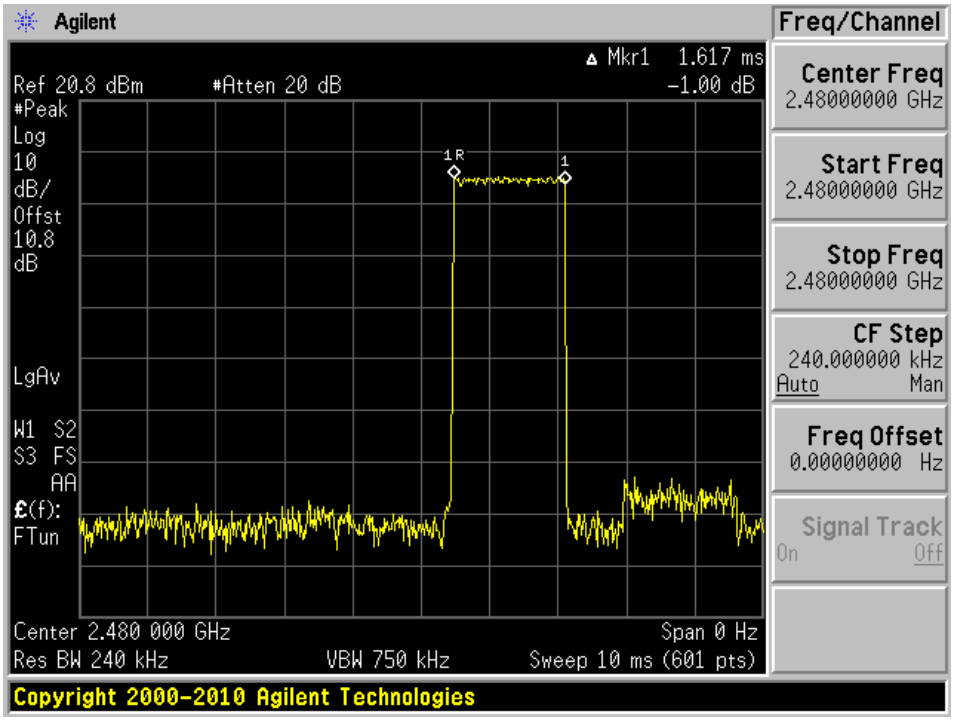
DH3 Mode 2441 MHz Mid Channel Pulse Width



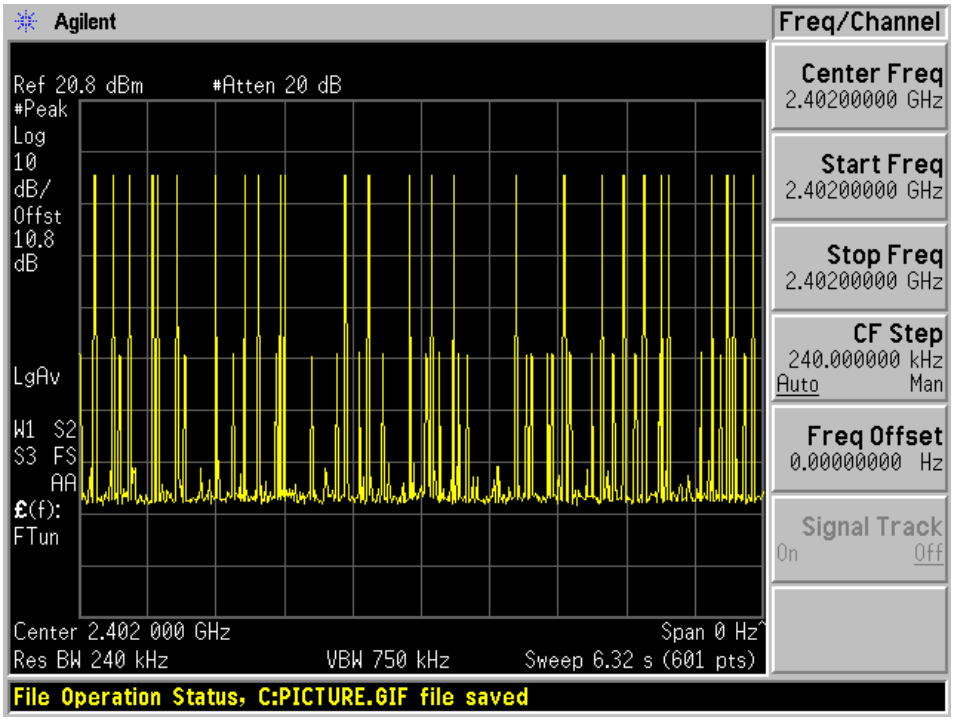
DH3 Mode 2480 MHz High Channel # of Pulses



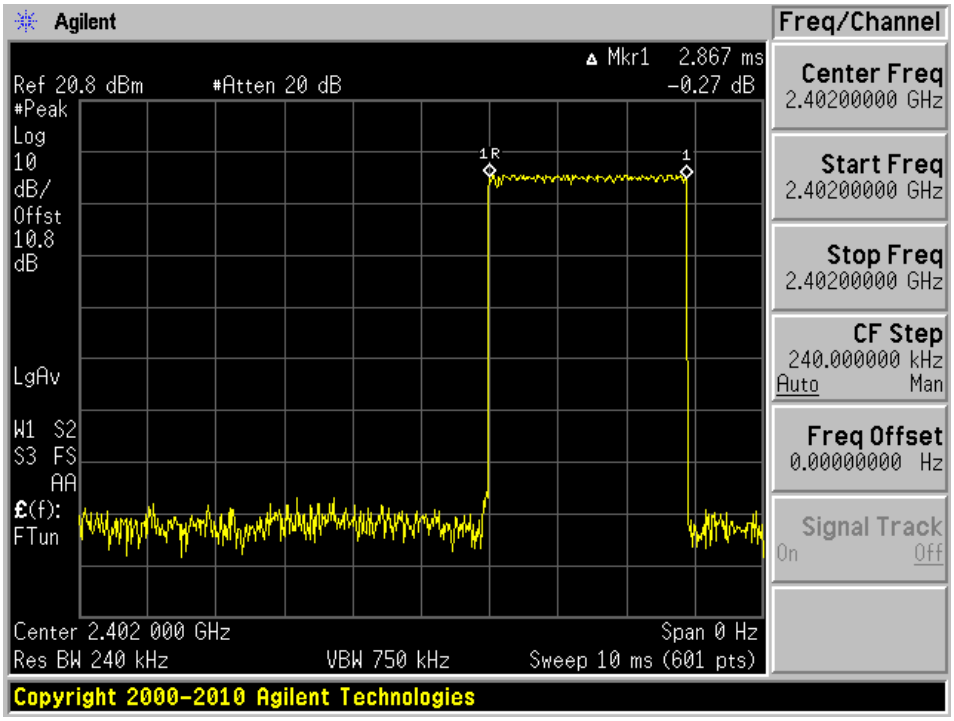
DH3 Mode 2480 MHz High Channel Pulse Width



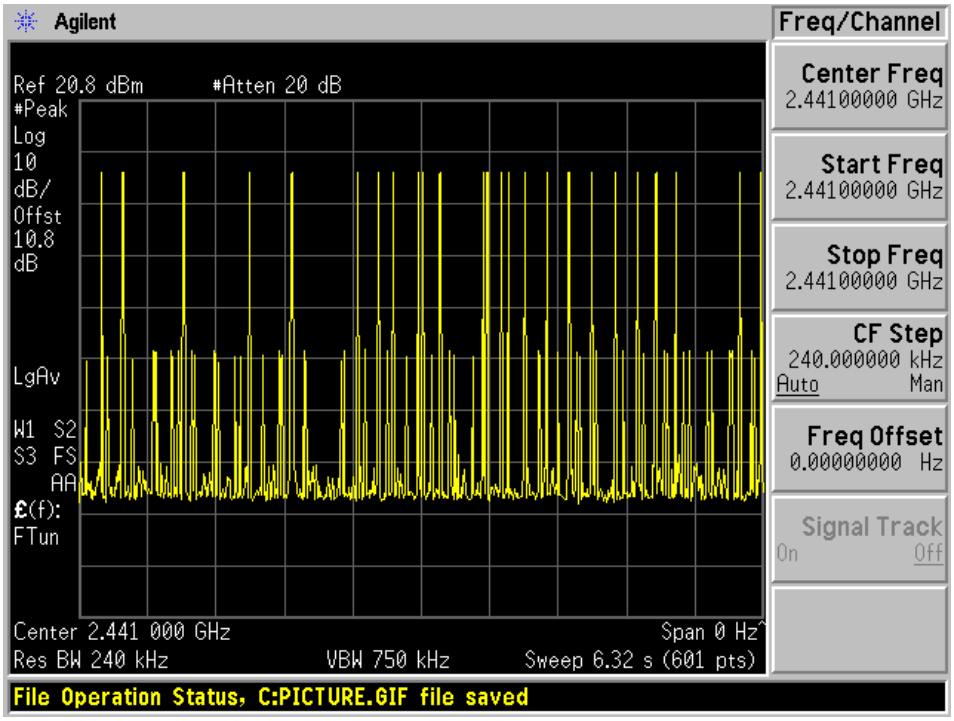
DH5 Mode 2402 MHz Low Channel # of Pulses



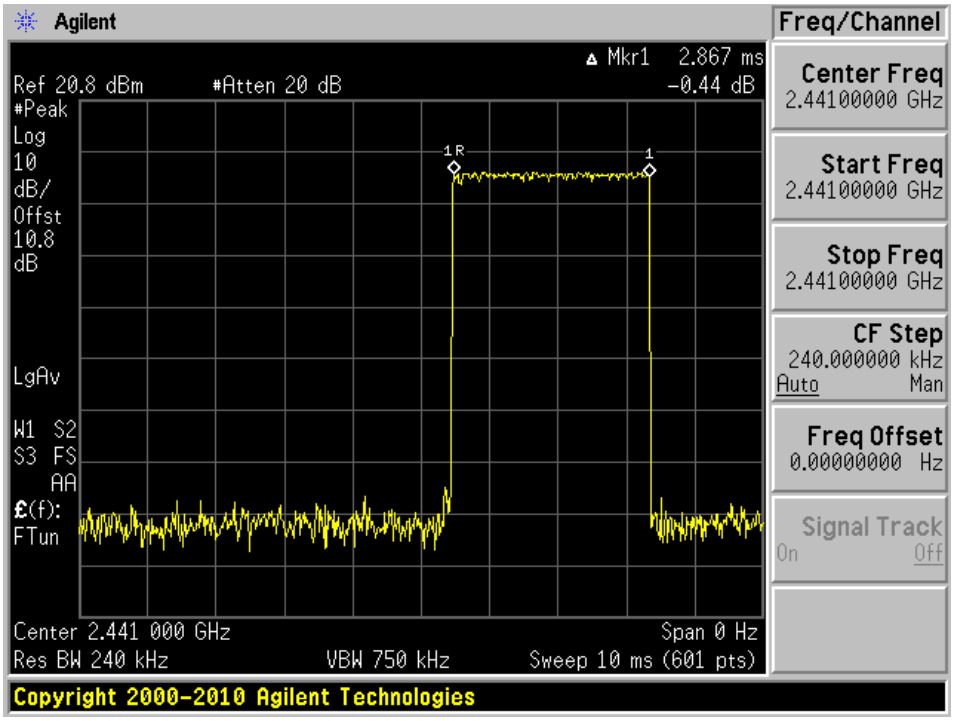
DH5 Mode 2402 MHz Low Channel Pulse Width



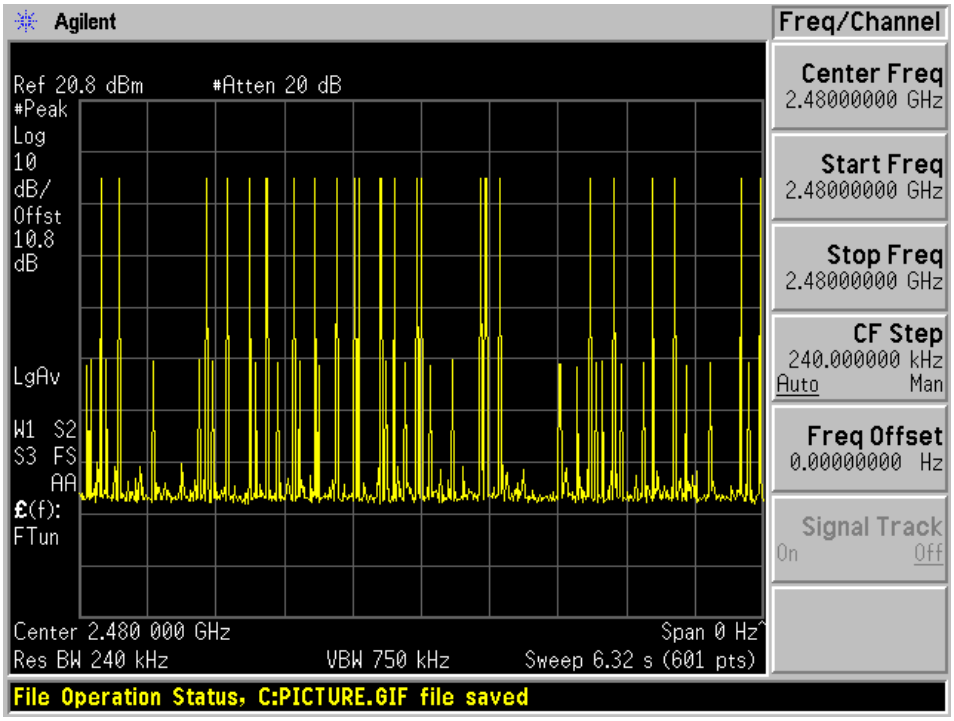
DH5 Mode 2441 MHz Mid Channel # of Pulses



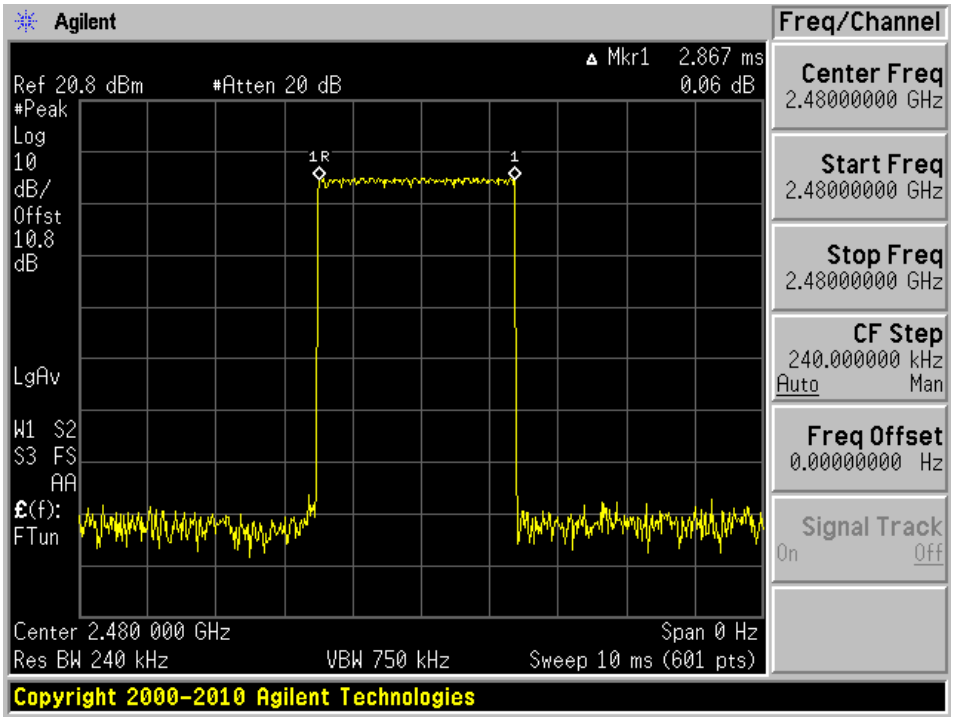
DH5 Mode 2441 MHz Mid Channel Pulse Width



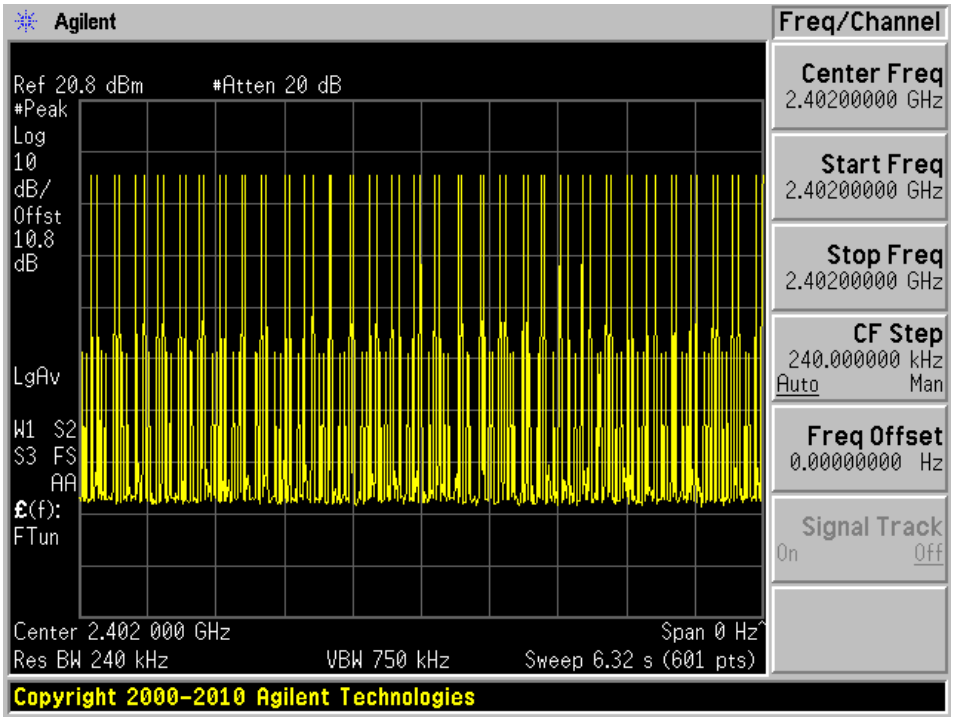
DH5 Mode 2480 MHz High Channel # of Pulses



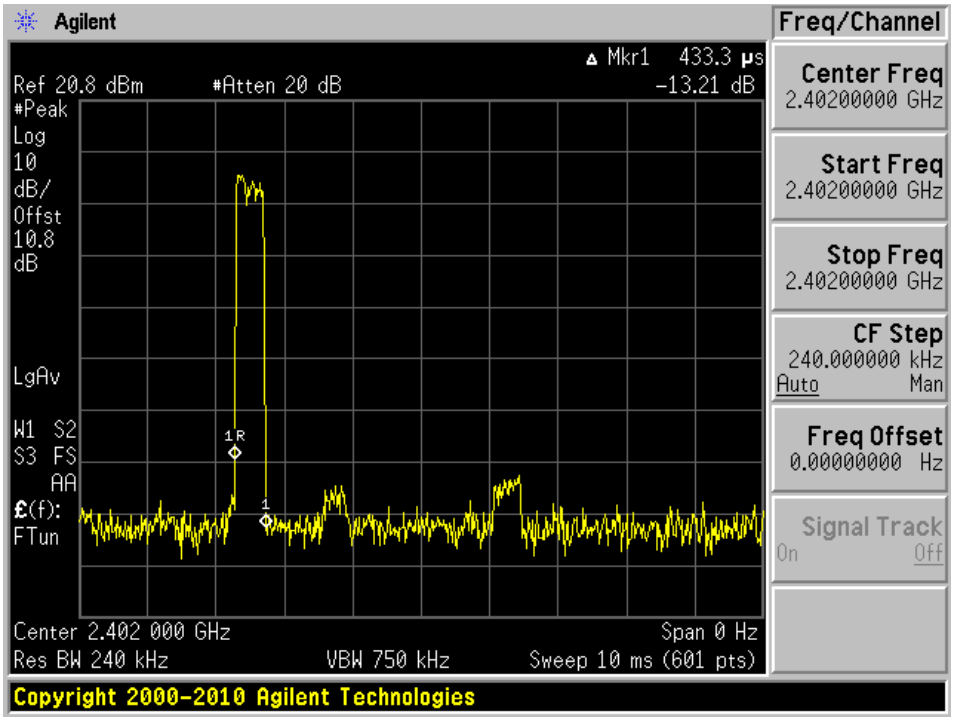
DH5 Mode 2480 MHz High Channel Pulse Width



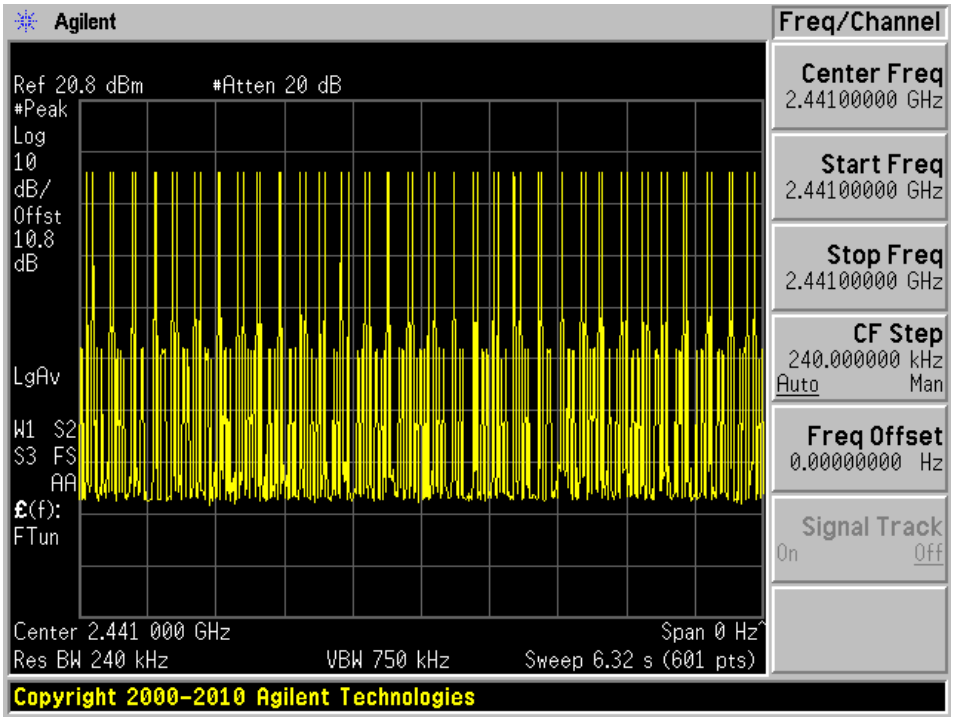
2DH1 Mode 2402 MHz Low Channel # of Pulses



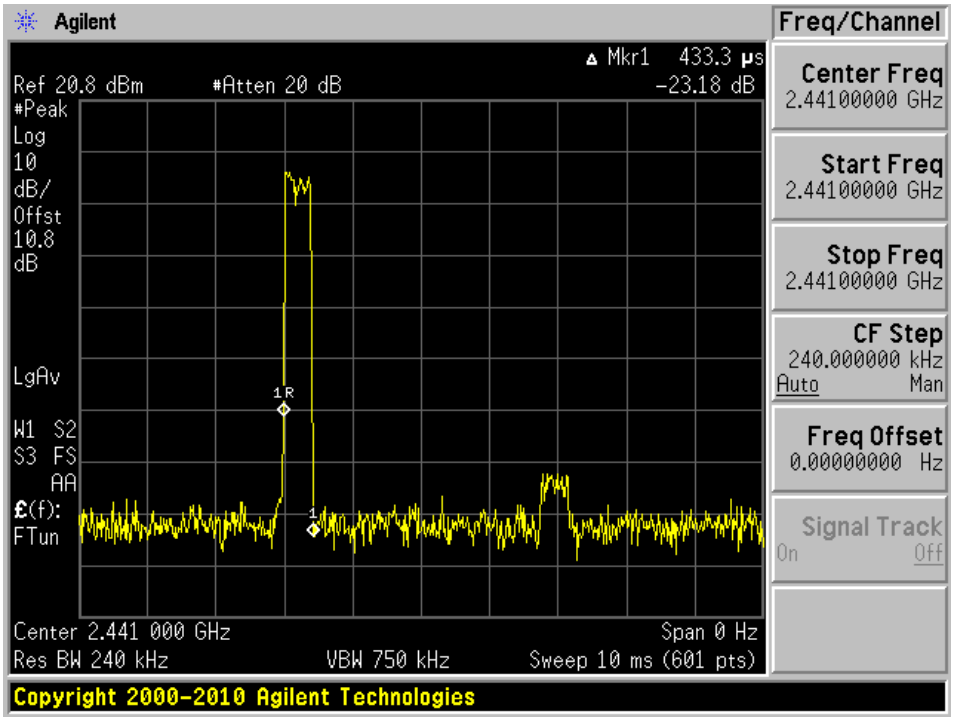
2DH1 Mode 2402 MHz Low Channel Pulse Width



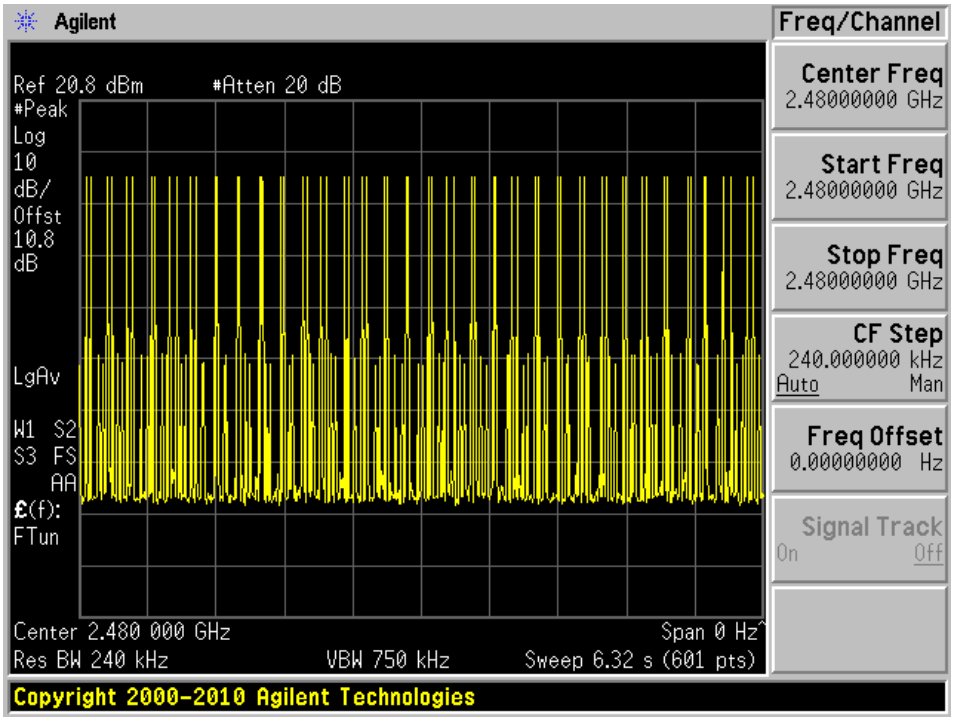
2DH1 Mode 2441 MHz Mid Channel # of Pulses



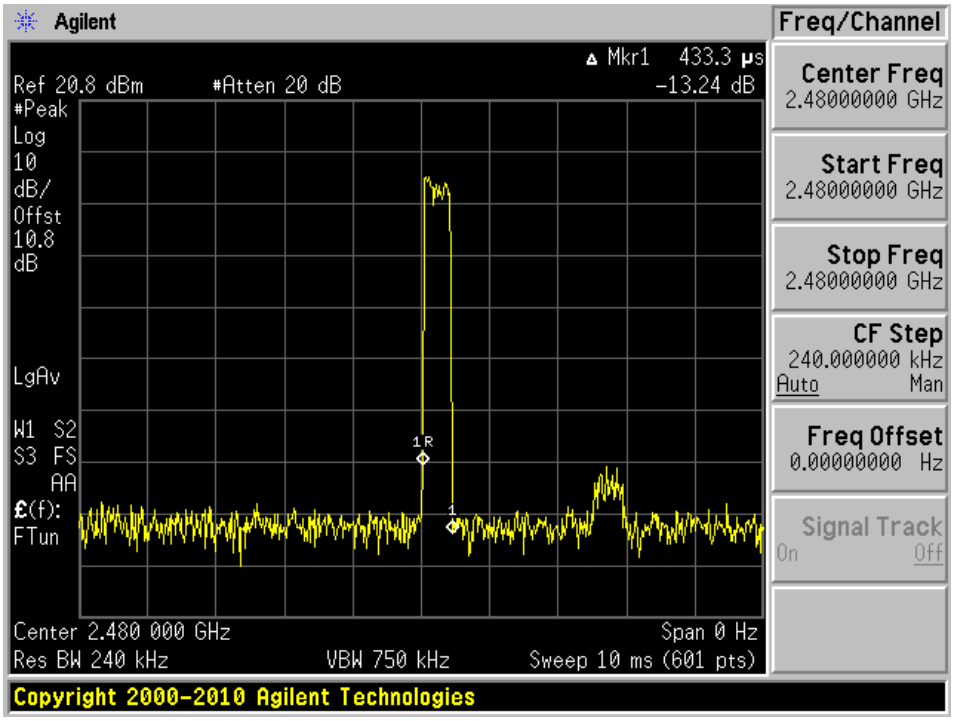
2DH1 Mode 2441 MHz Mid Channel Pulse Width



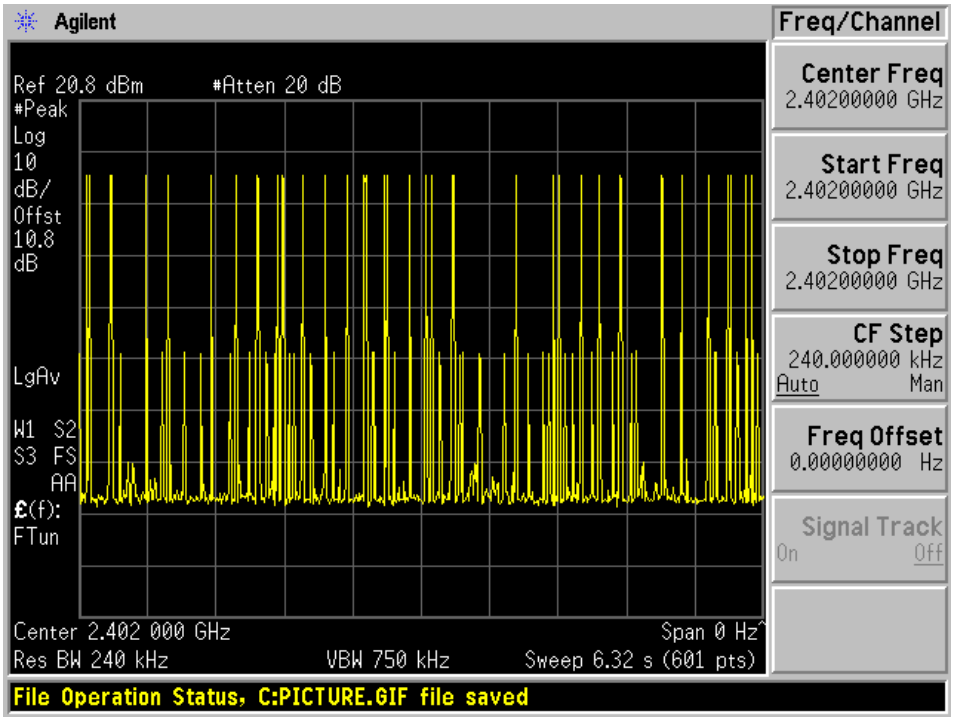
2DH1 Mode 2480 MHz High Channel # of Pulses



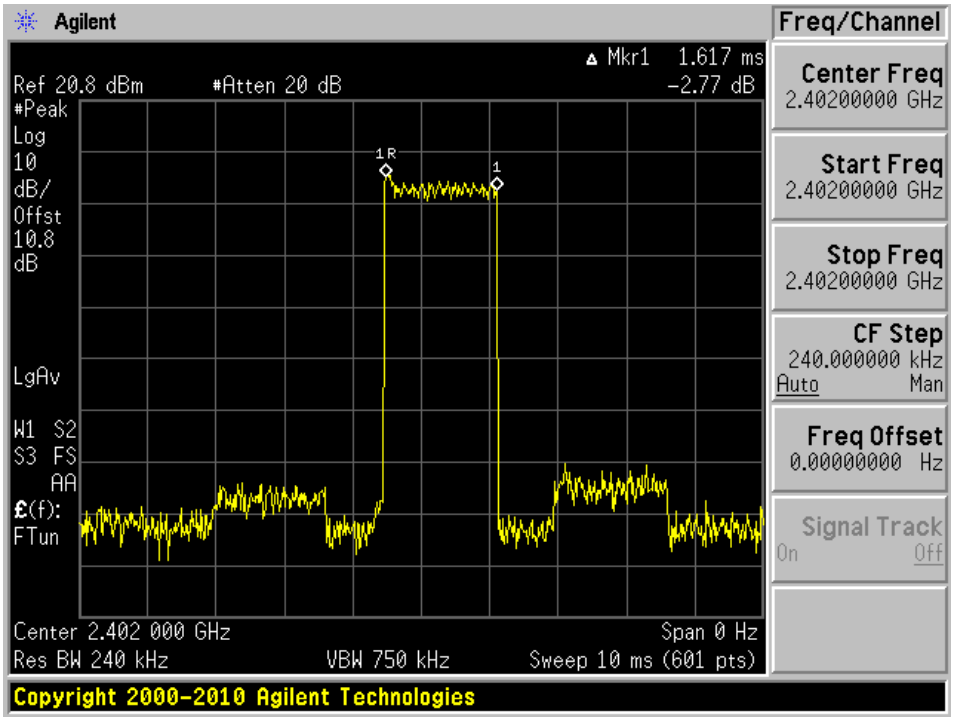
2DH1 Mode 2480 MHz High Channel Pulse Width



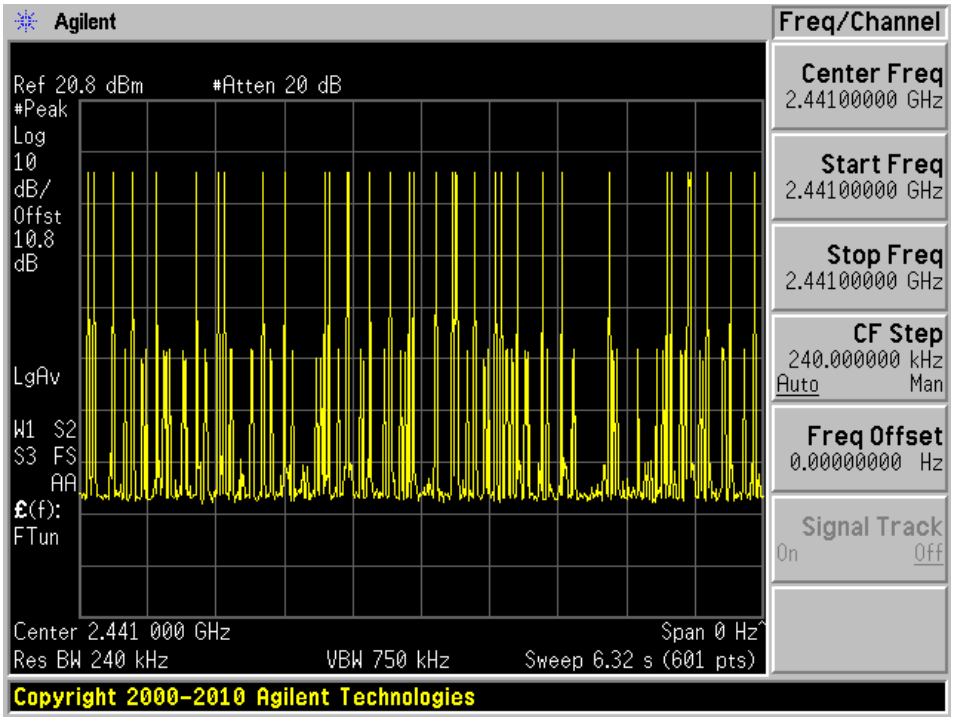
2DH3 Mode 2402 MHz Low Channel # of Pulses



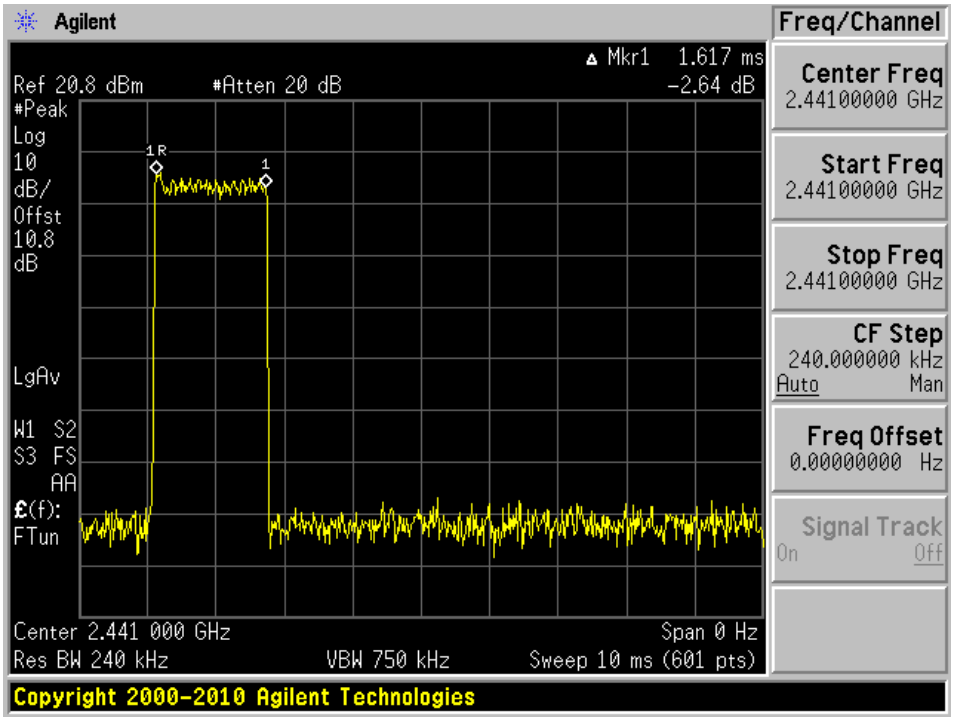
2DH3 Mode 2402 MHz Low Channel Pulse Width



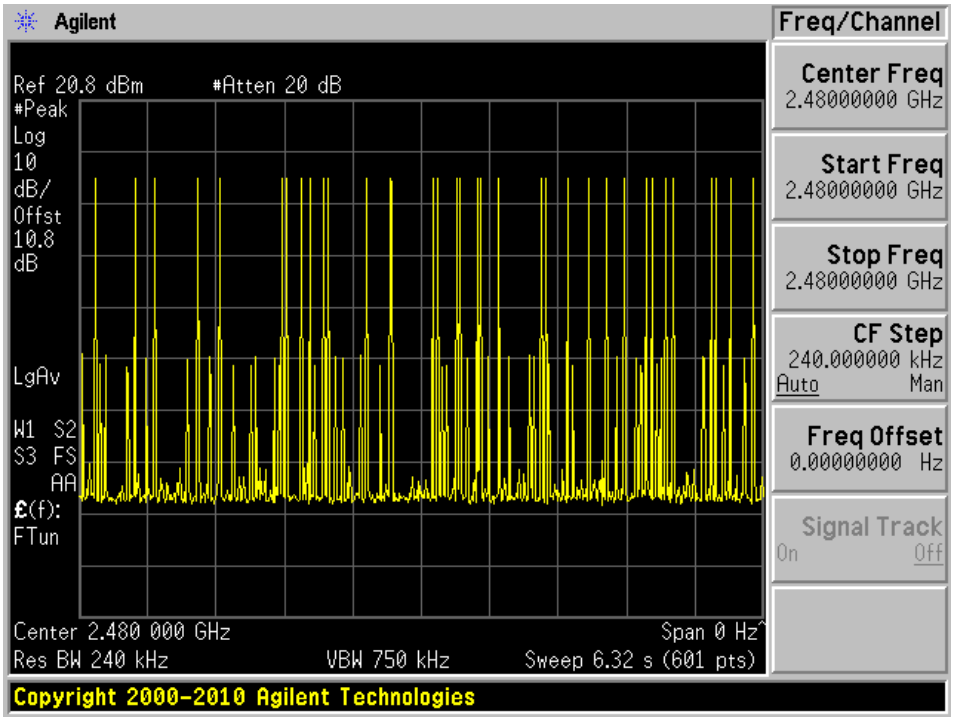
2DH3 Mode 2441 MHz Mid Channel # of Pulses



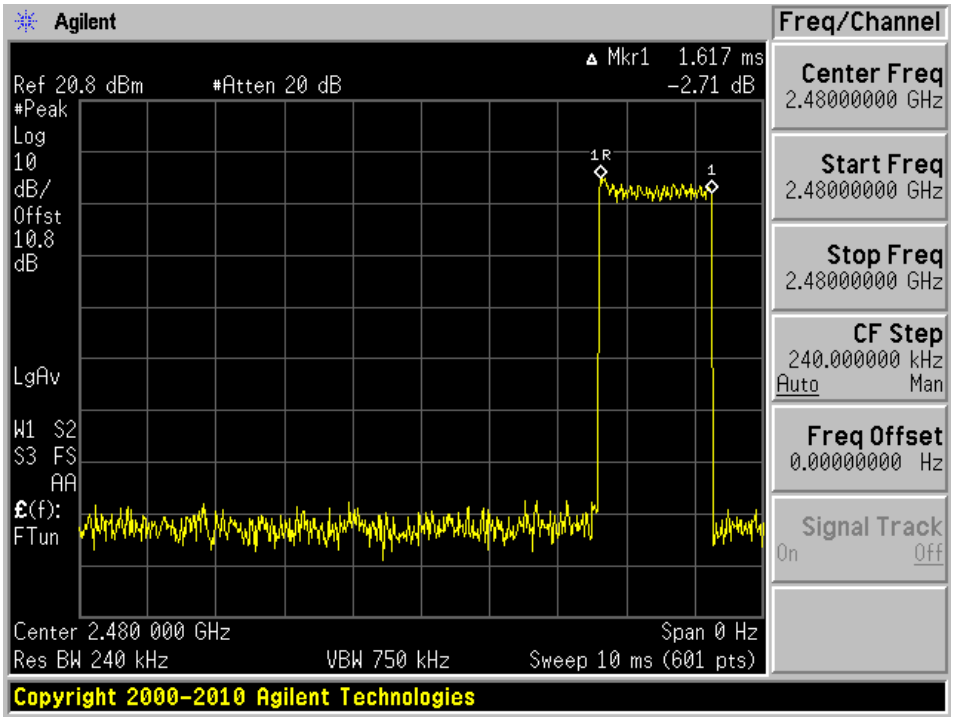
2DH3 Mode 2441 MHz Mid Channel Pulse Width



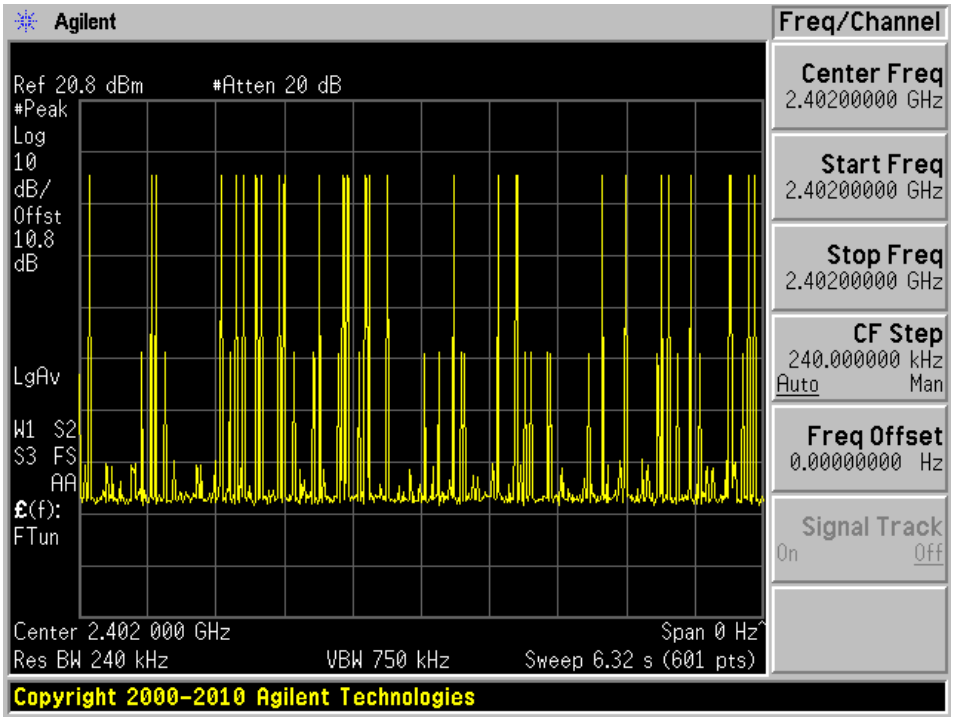
2DH3 Mode 2480 MHz High Channel # of Pulses



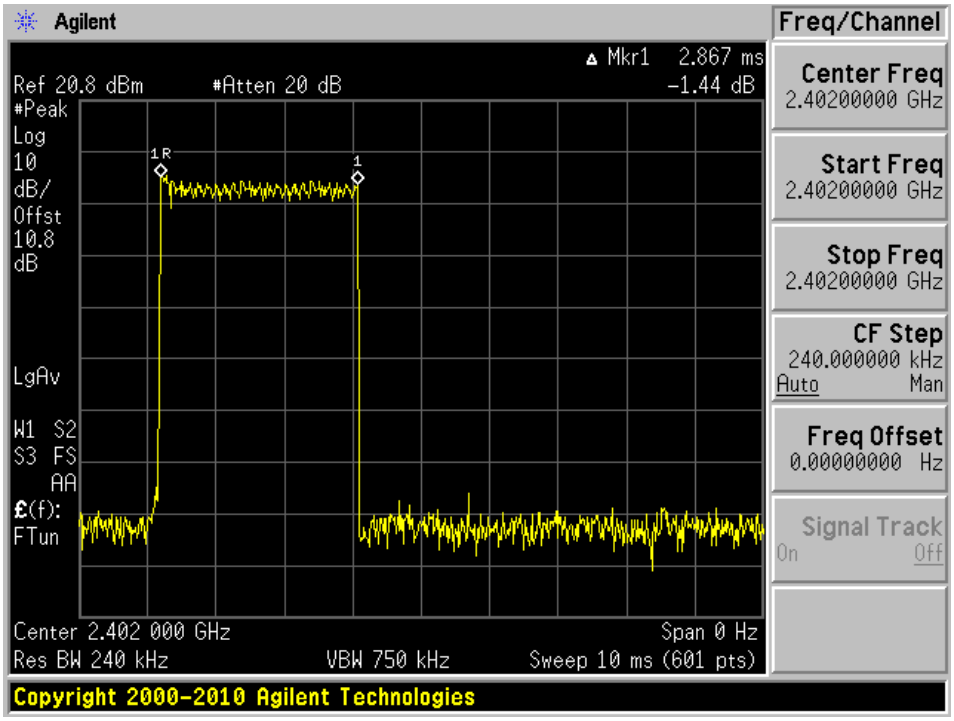
2DH3 Mode 2480 MHz High Channel Pulse Width



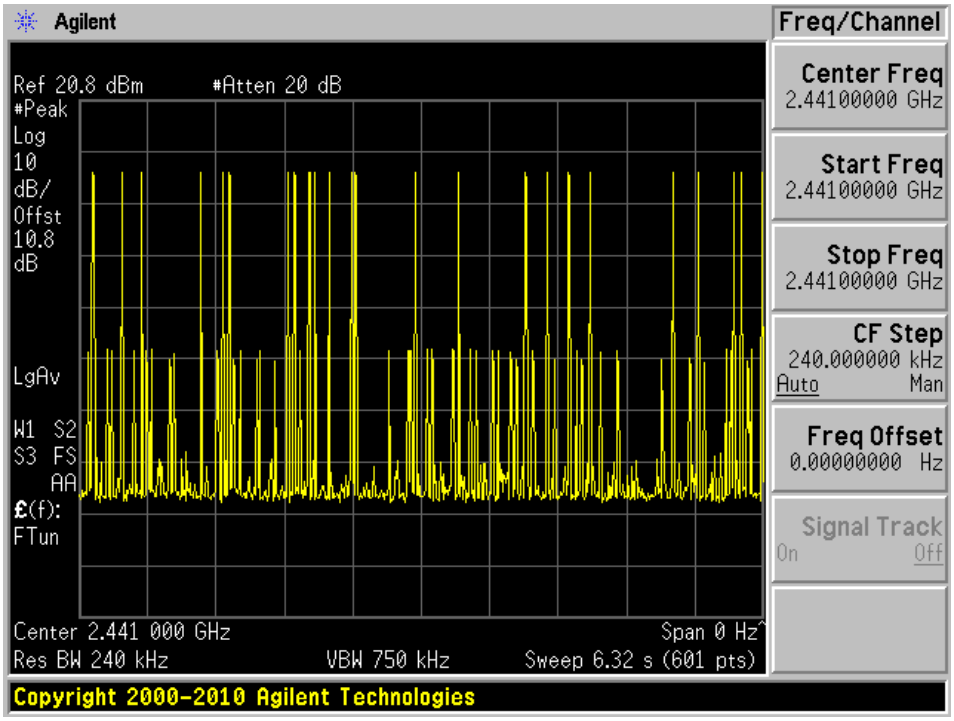
2DH5 Mode 2402 MHz Low Channel # of Pulses



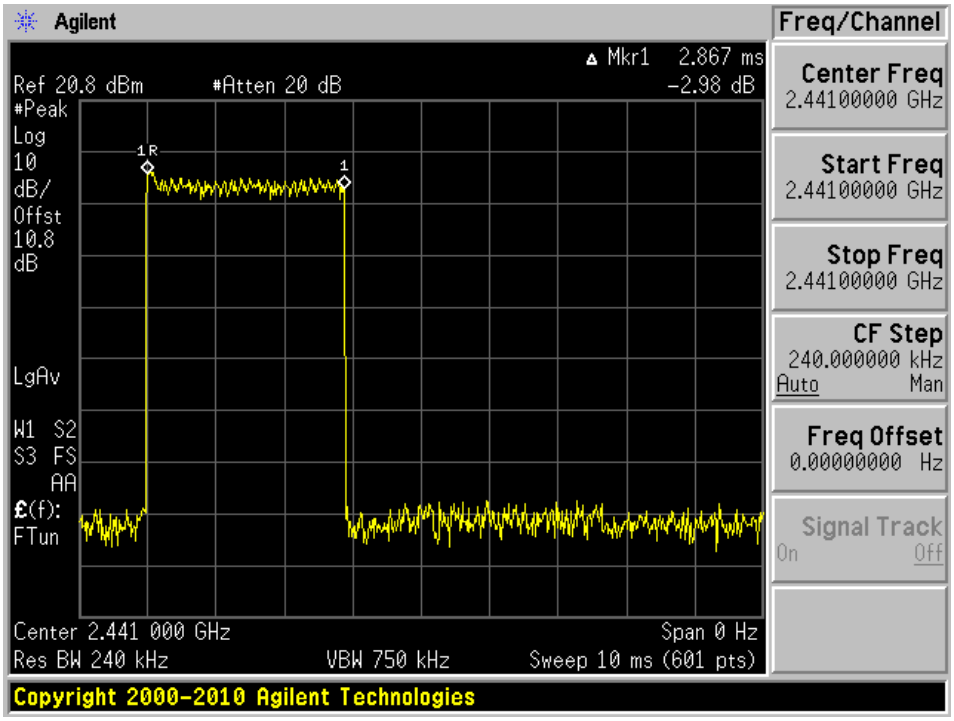
2DH5 Mode 2402 MHz Low Channel Pulse Width



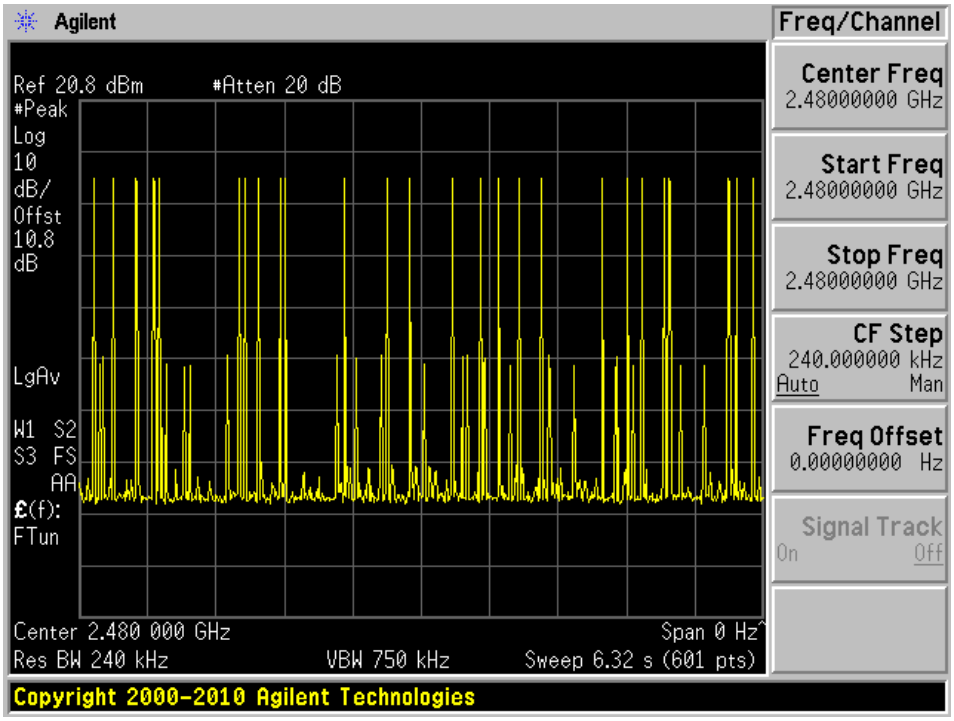
2DH5 Mode 2441 MHz Mid Channel # of Pulses



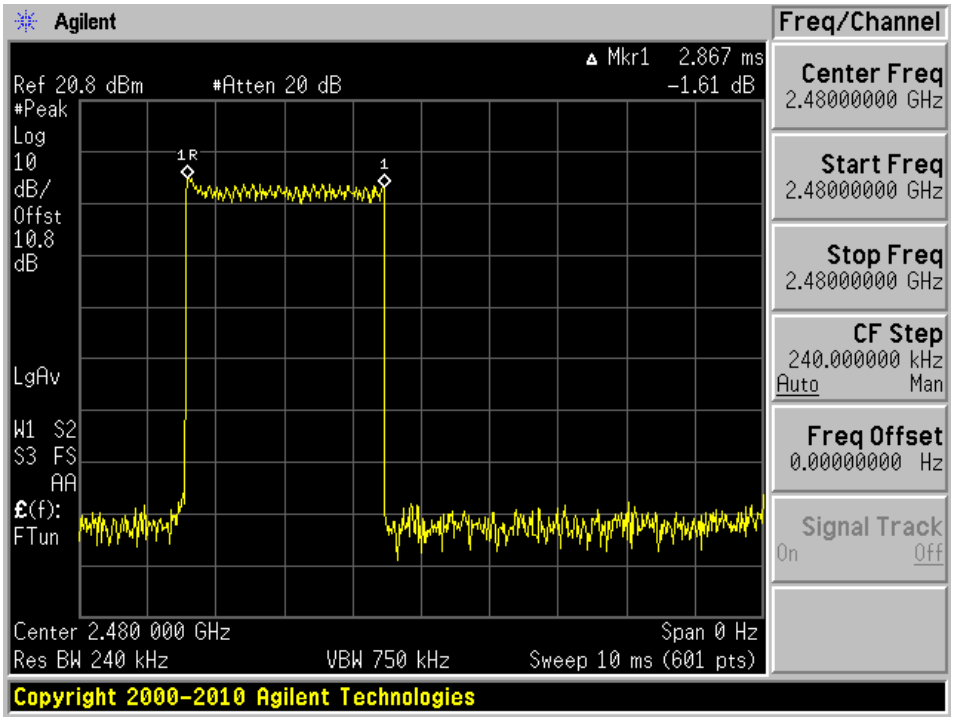
2DH5 Mode 2441 MHz Mid Channel Pulse Width



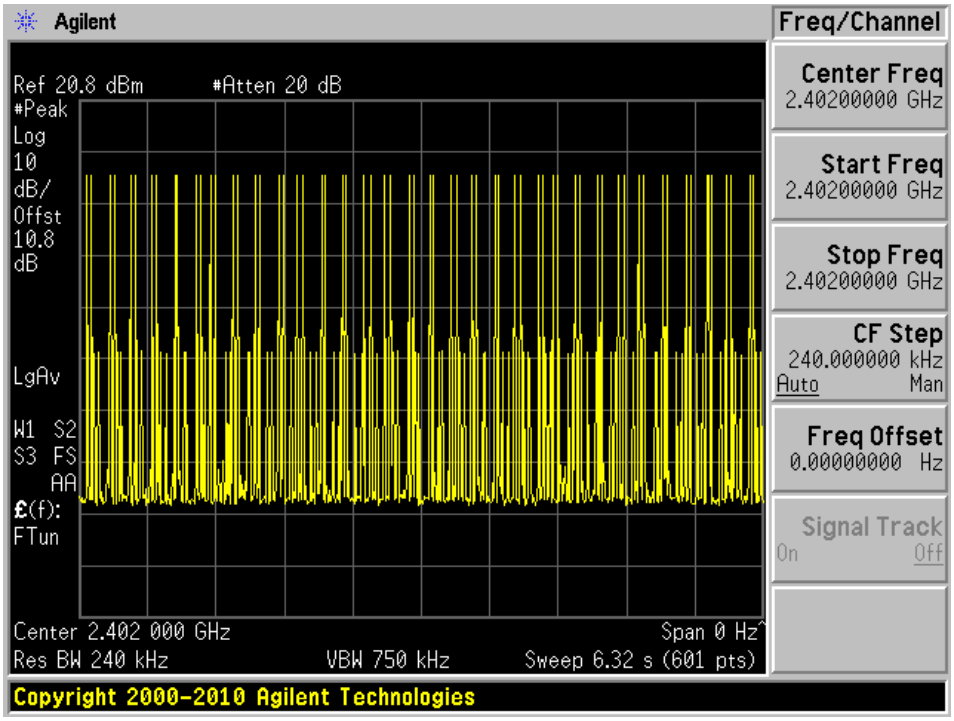
2DH5 Mode 2480 MHz High Channel # of Pulses



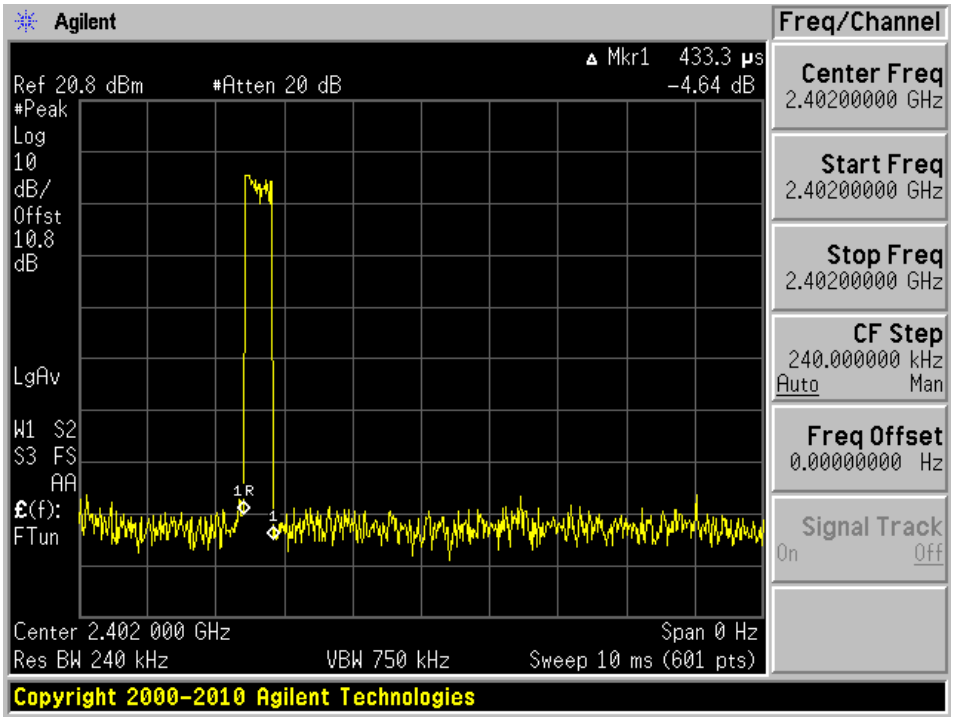
2DH5 Mode 2480 MHz High Channel Pulse Width



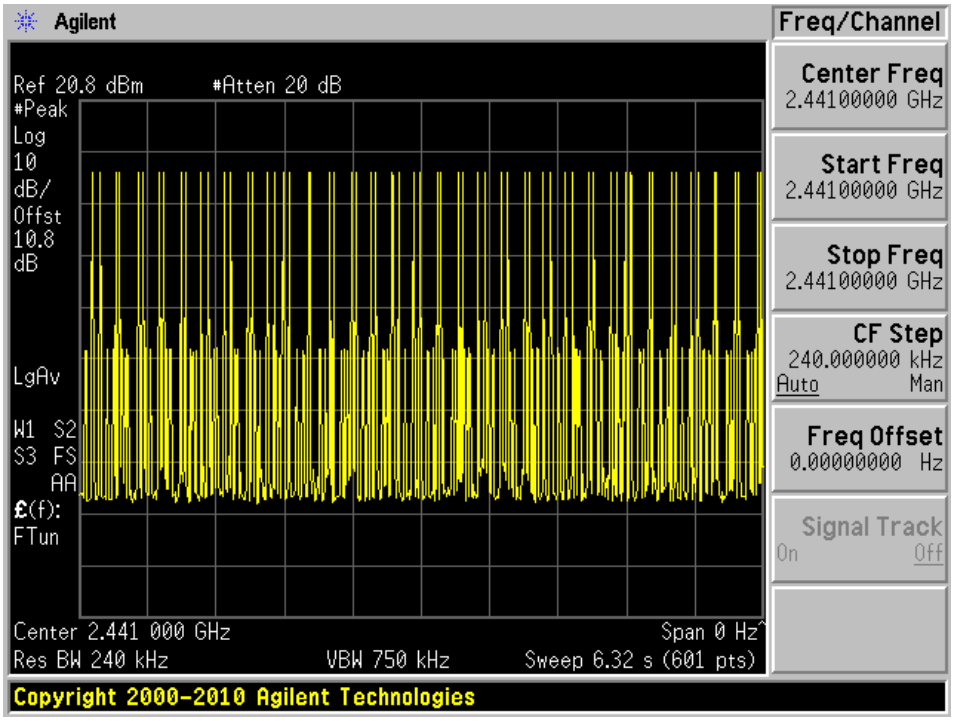
3DH1 Mode 2402 MHz Low Channel # of Pulses



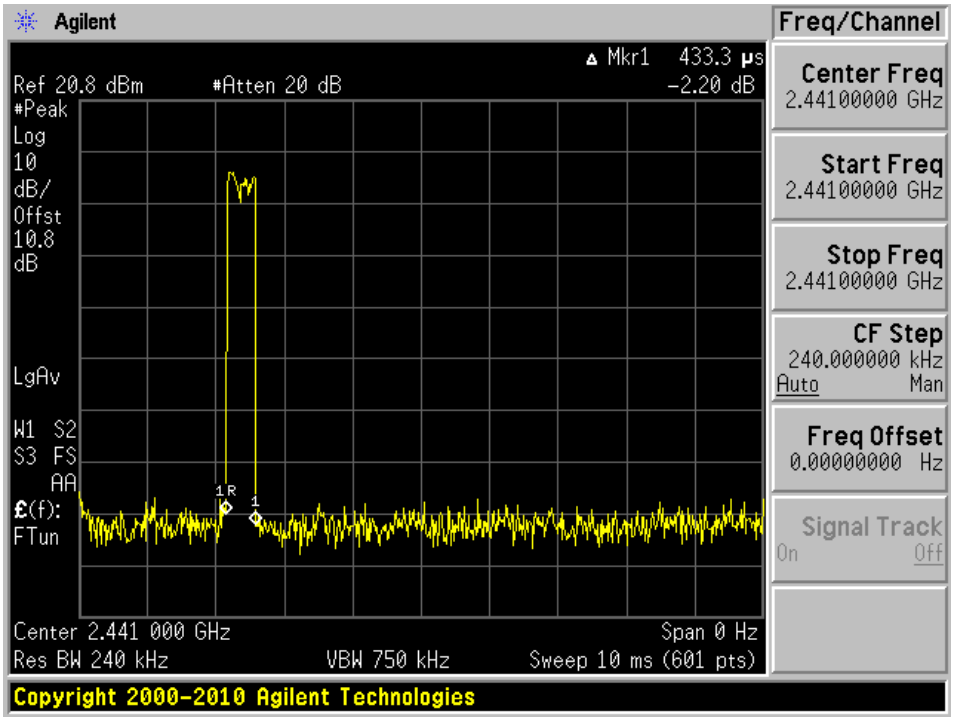
3DH1 Mode 2402 MHz Low Channel Pulse Width



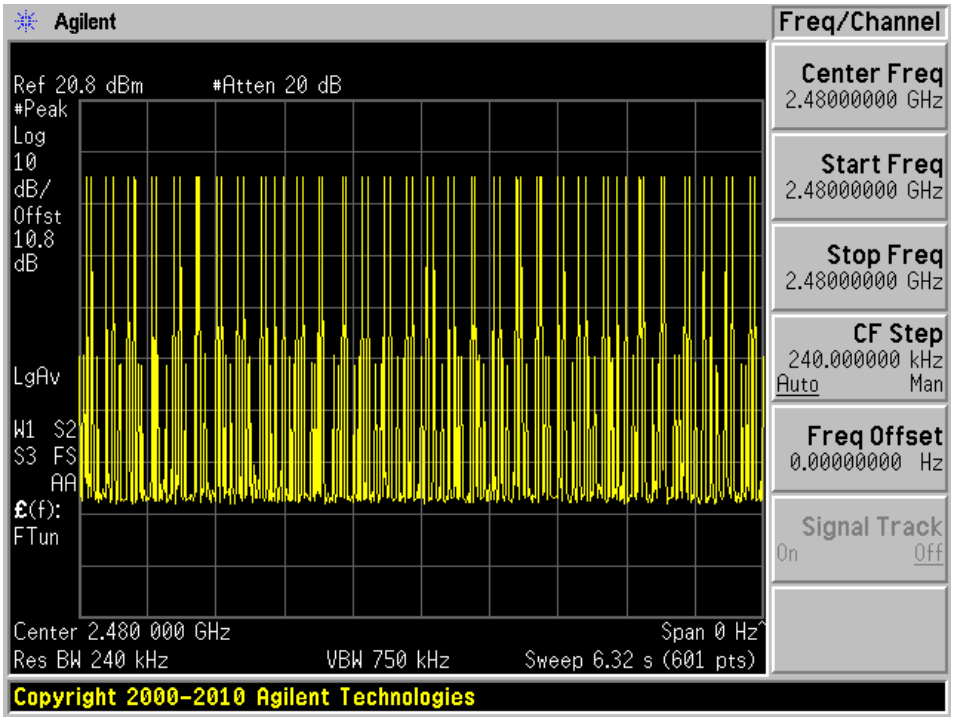
3DH1 Mode 2441 MHz Mid Channel # of Pulses



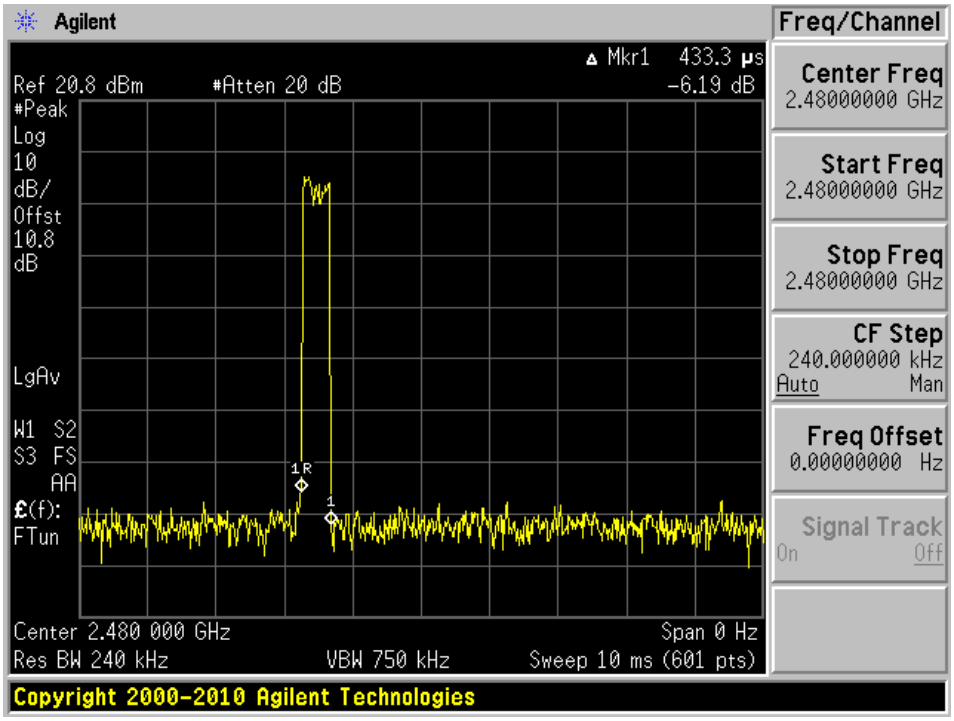
3DH1 Mode 2441 MHz Mid Channel Pulse Width



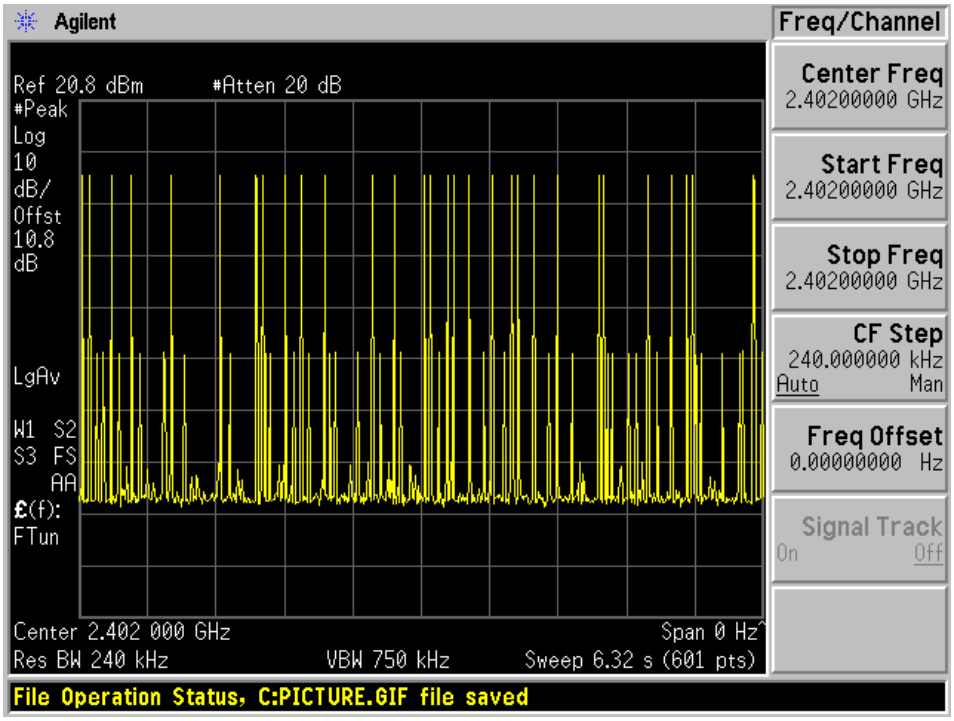
3DH1 Mode 2480 MHz High Channel # of Pulses



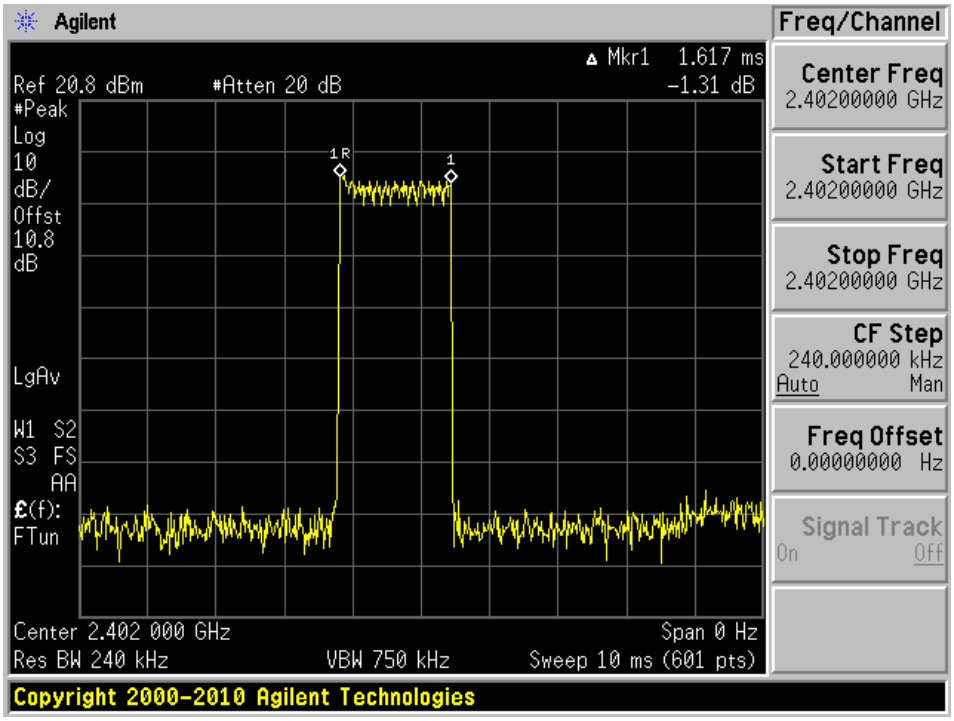
3DH1 Mode 2480 MHz High Channel Pulse Width



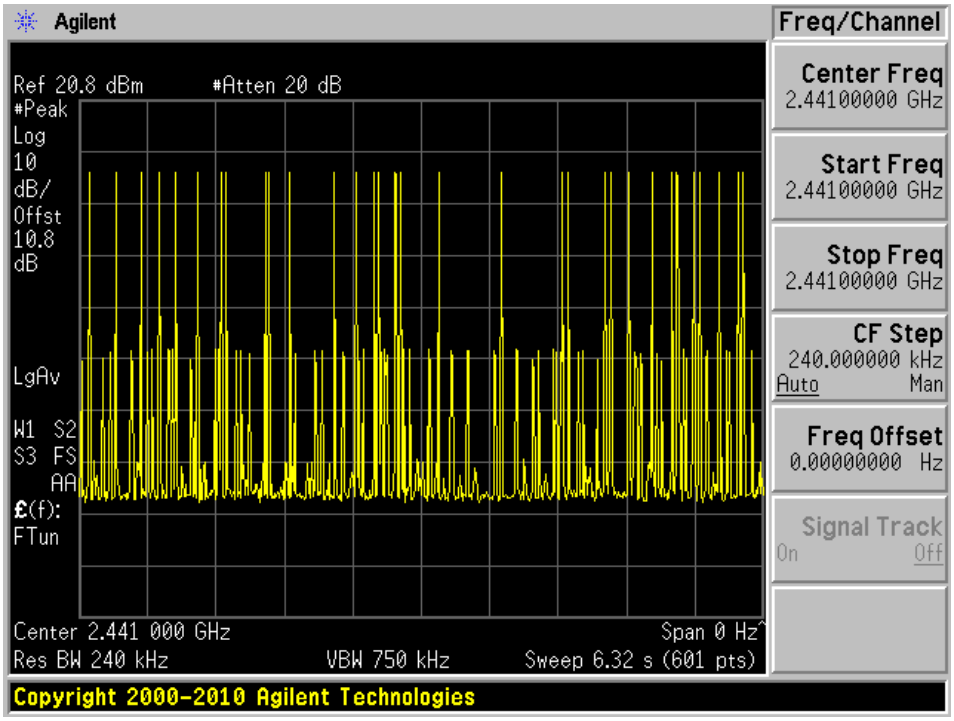
3DH3 Mode 2402 MHz Low Channel # of Pulses



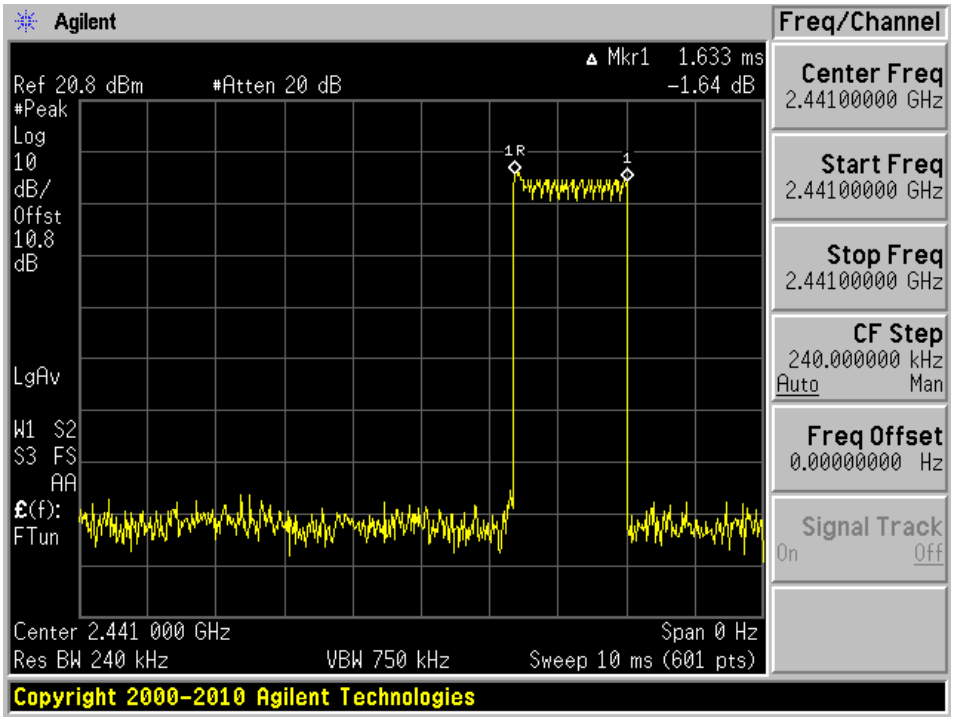
3DH3 Mode 2402 MHz Low Channel Pulse Width



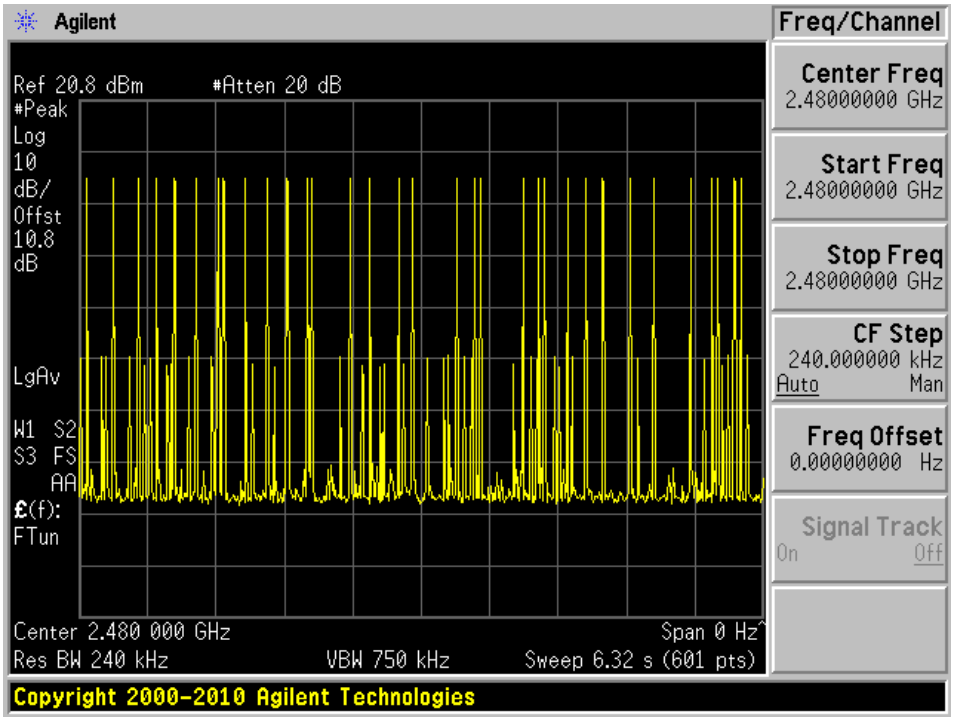
3DH3 Mode 2441 MHz Mid Channel # of Pulses



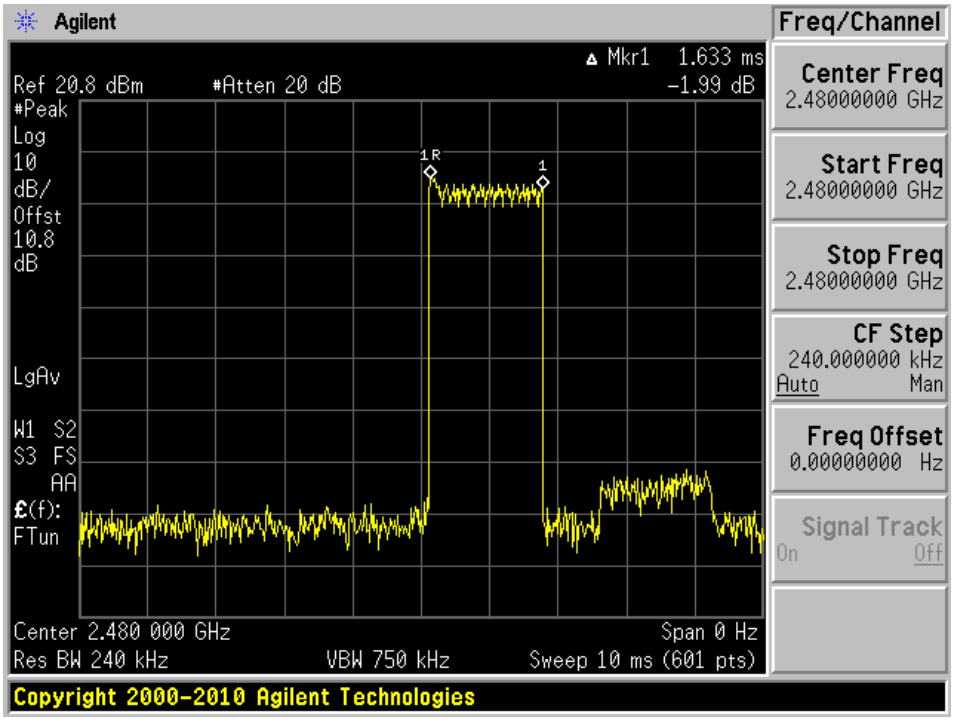
3DH3 Mode 2441 MHz Mid Channel Pulse Width



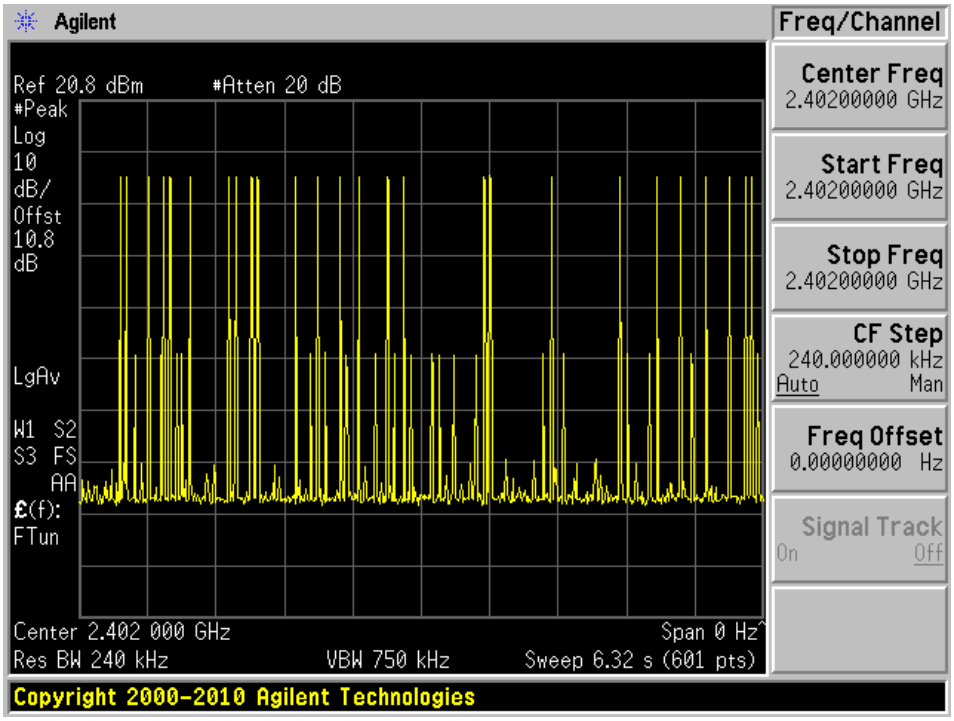
3DH3 Mode 2480 MHz High Channel # of Pulses



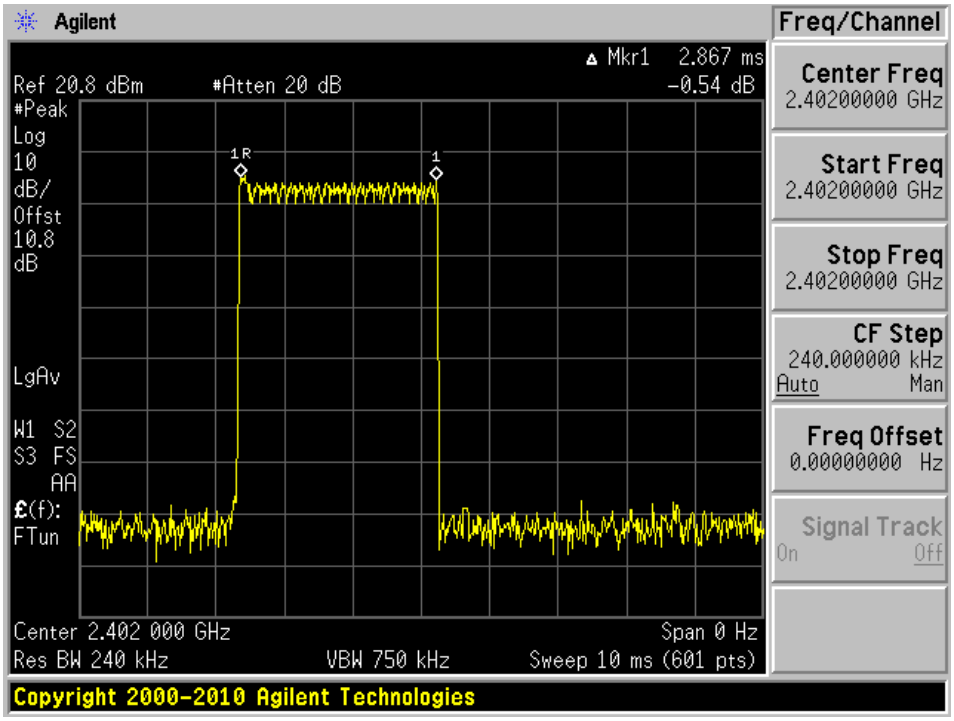
3DH3 Mode 2480 MHz High Channel Pulse Width



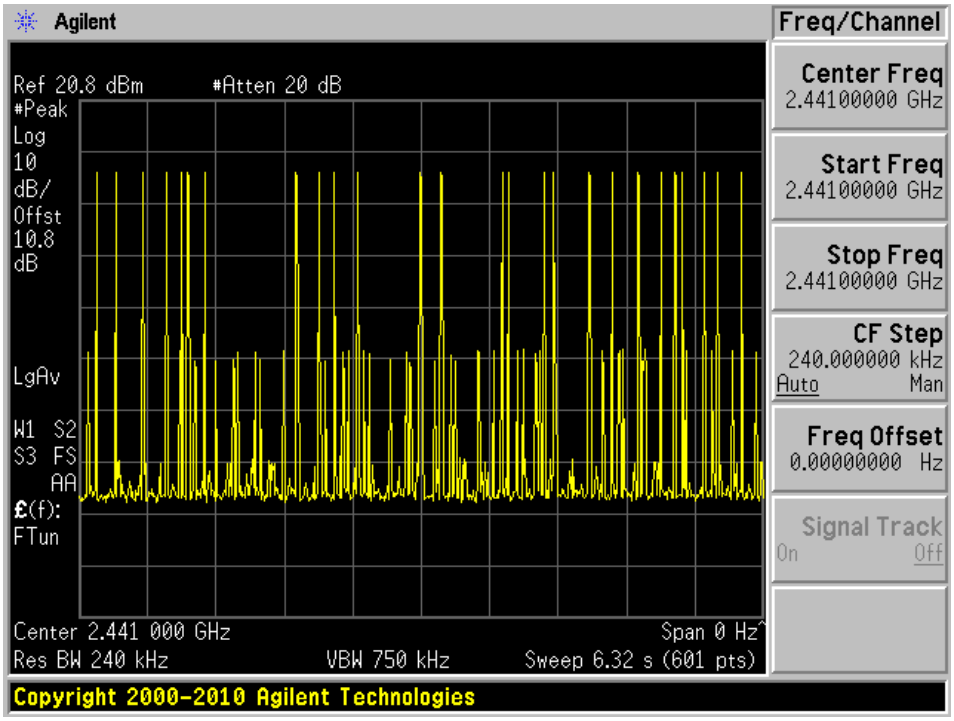
3DH5 Mode 2402 MHz Low Channel # of Pulses



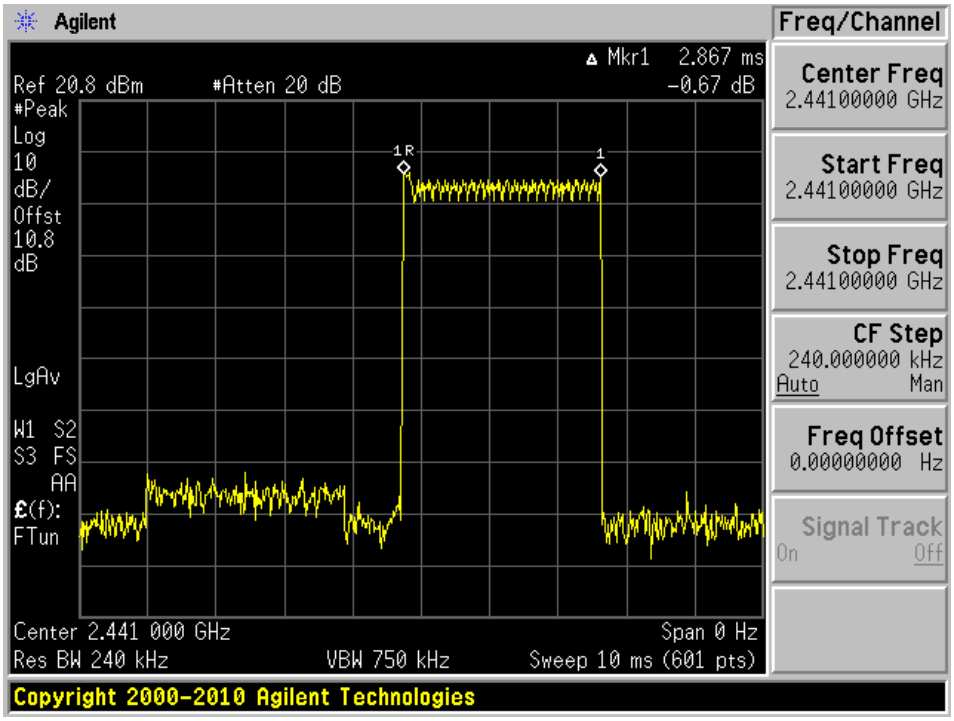
3DH5 Mode 2402 MHz Low Channel Pulse Width



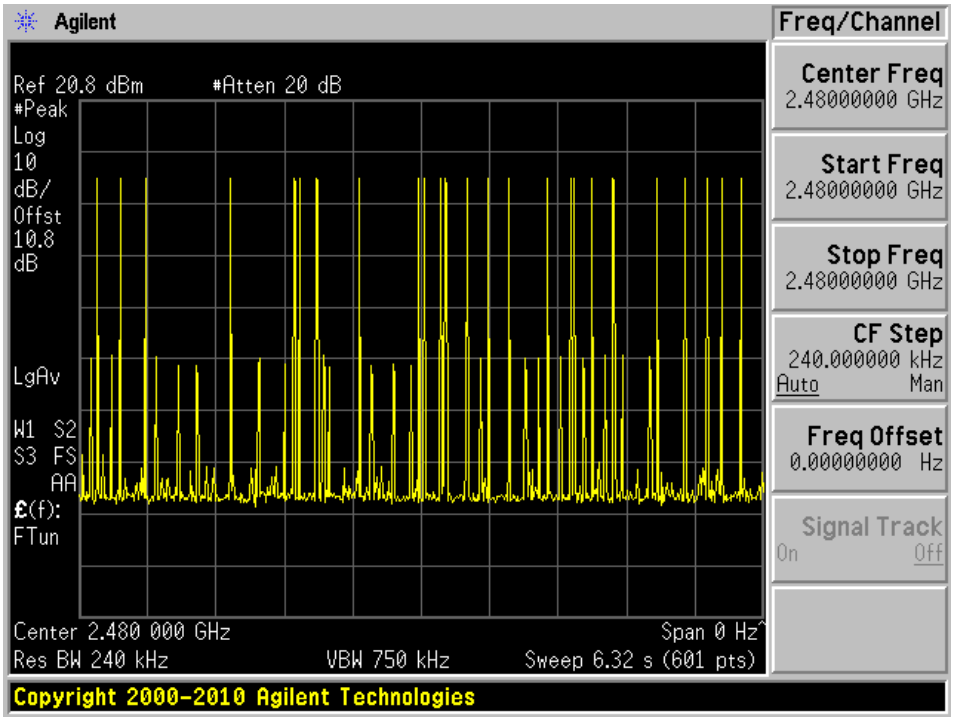
3DH5 Mode 2441 MHz Mid Channel # of Pulses



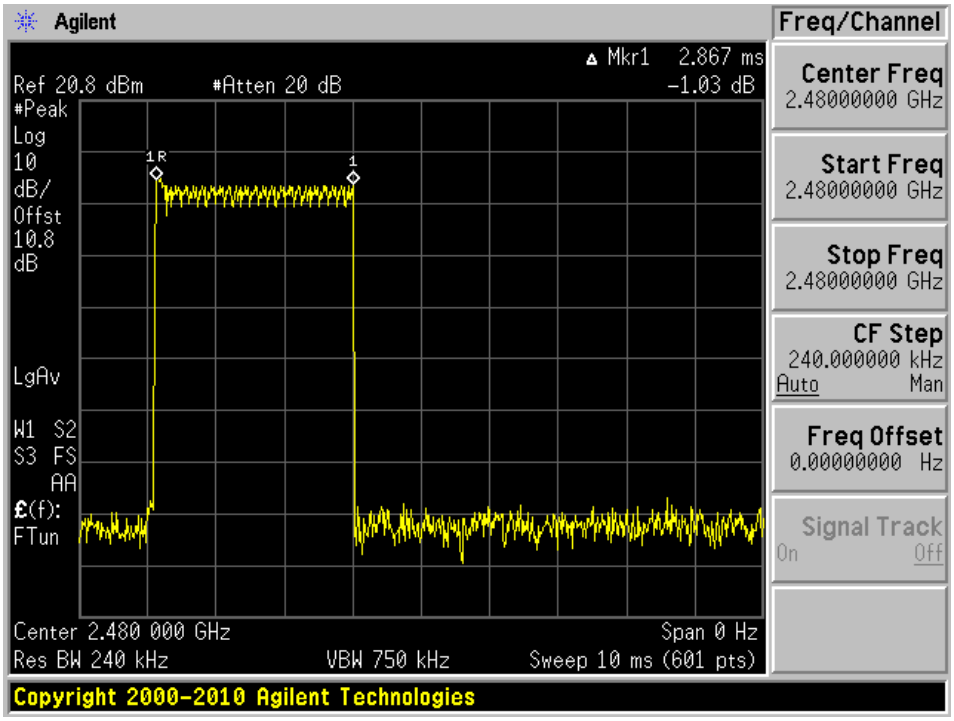
3DH5 Mode 2441 MHz Mid Channel Pulse Width



3DH5 Mode 2480 MHz High Channel # of Pulses



3DH5 Mode 2480 MHz High Channel Pulse Width



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	E4446A	MY48250238	2018-05-08	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10 dB 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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

12.4 Test Environmental Conditions

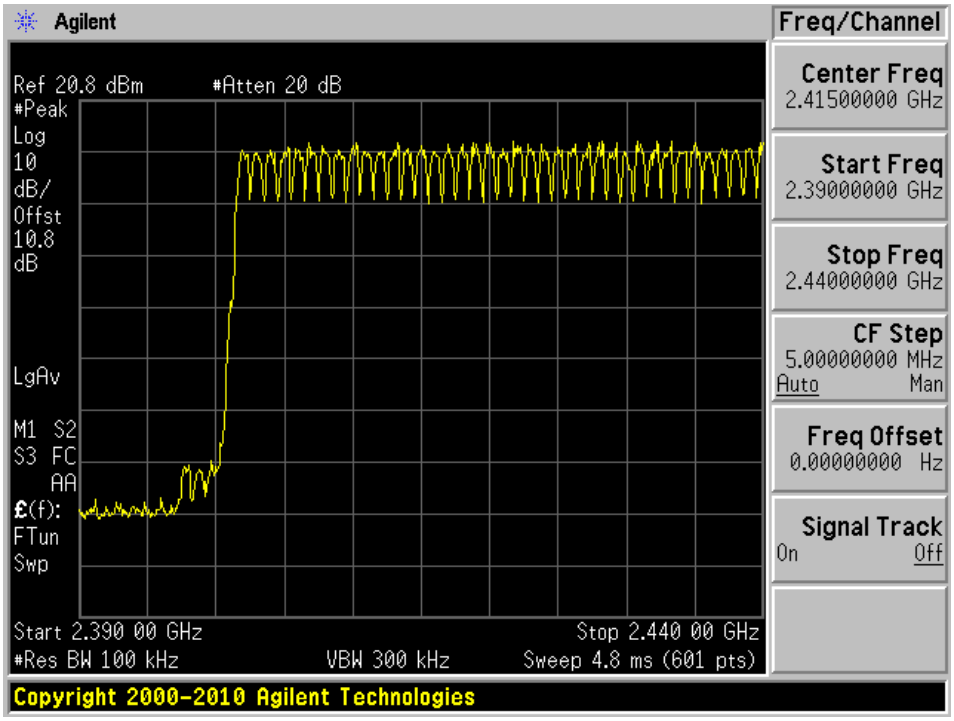
Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Vincent Licata from 2018-08-14 to 2018-08-15 in RF site.

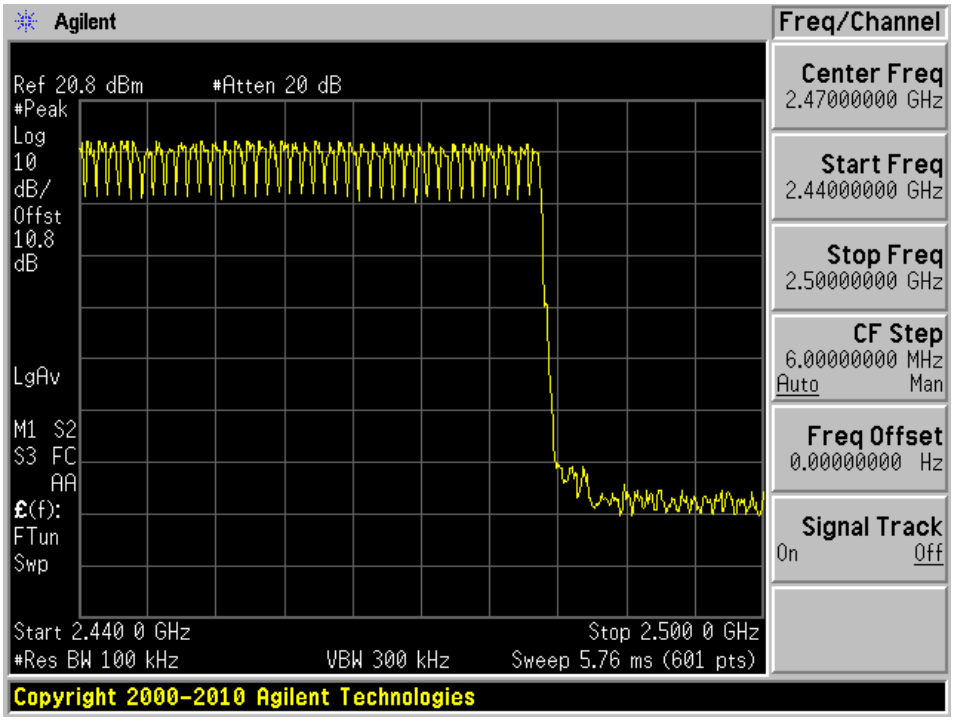
12.5 Test Results

Total 79 channels; please refer to the plots hereinafter.

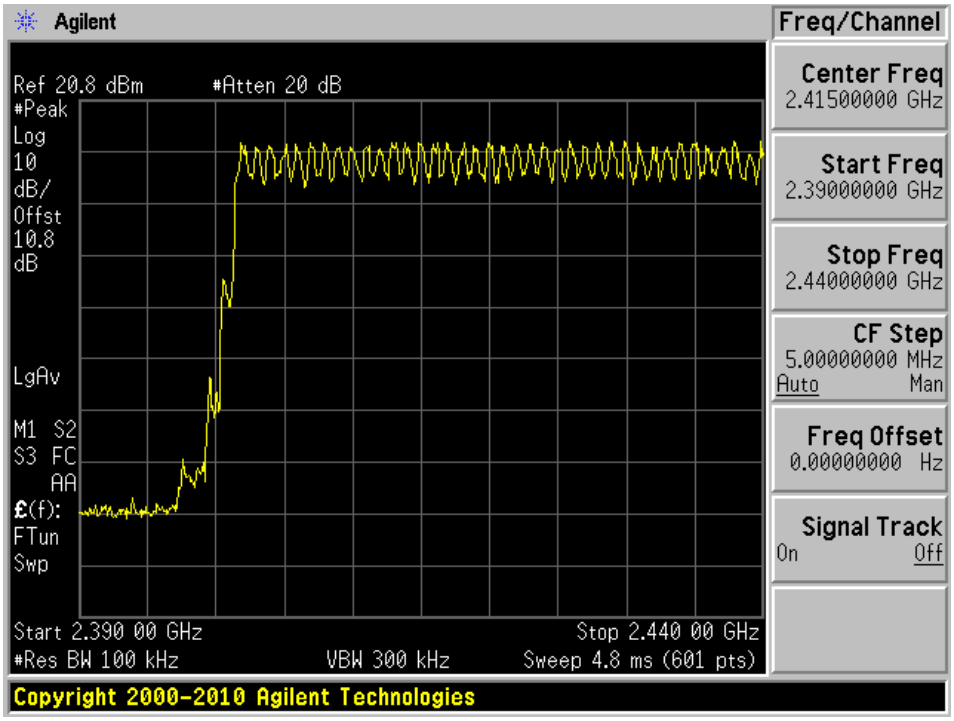
GFSK Mode Number of Hopping Channels_1



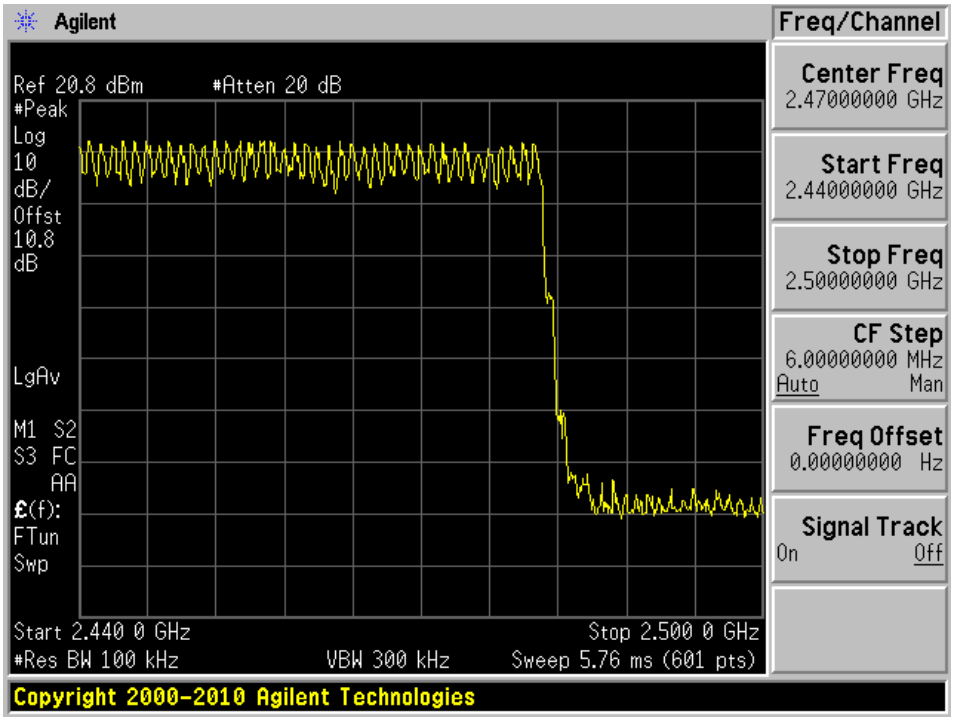
GFSK Mode Number of Hopping Channels_2



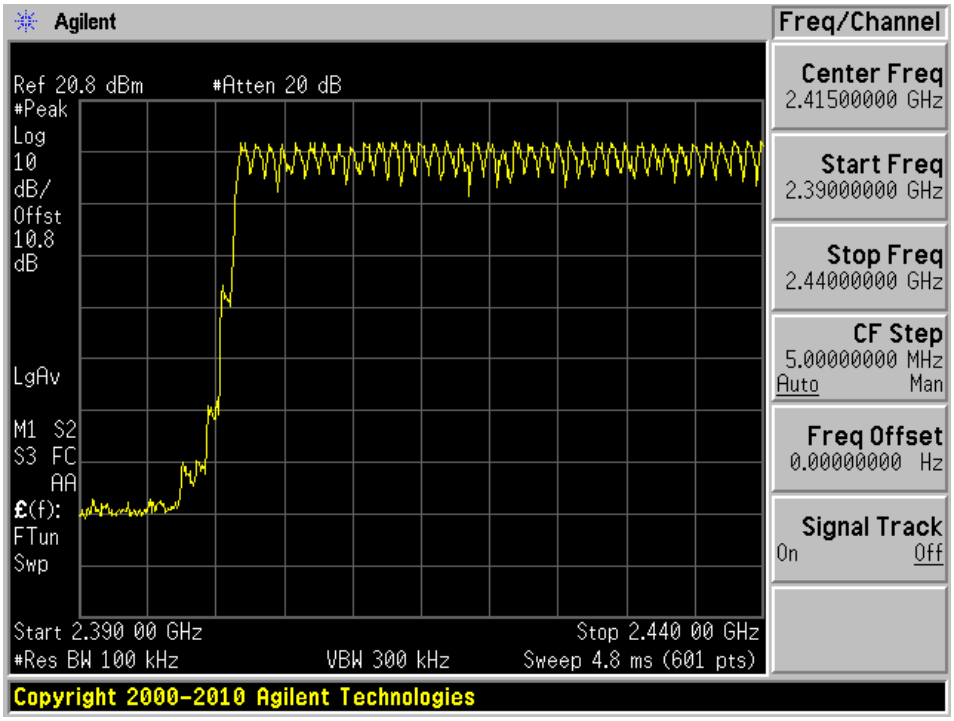
π/4-DQPSK Mode Number of Hopping Channels_1



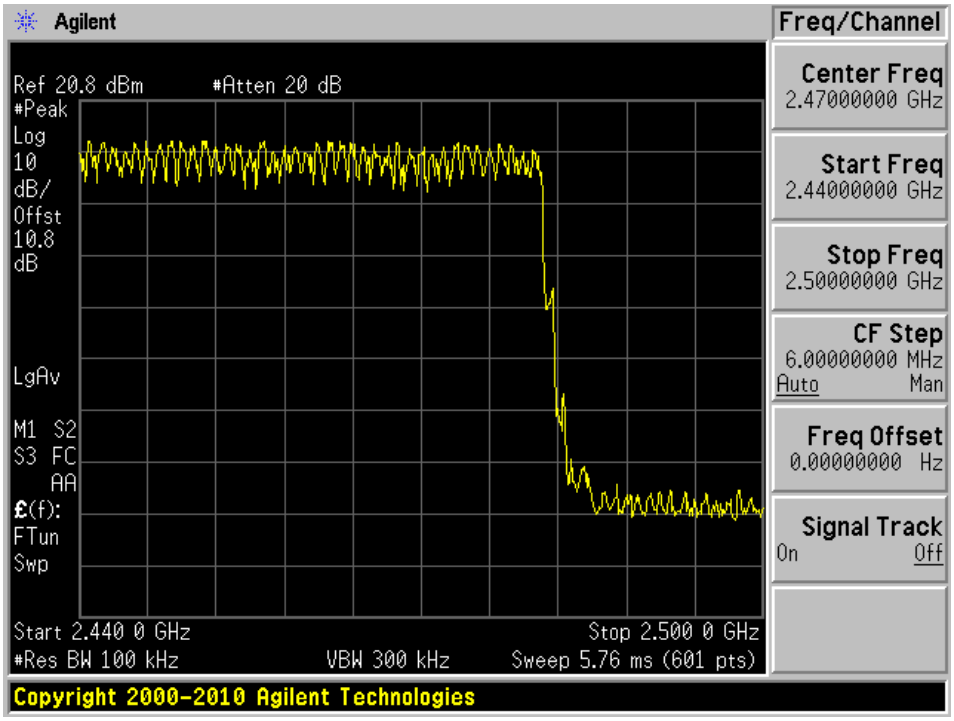
π/4-DQPSK Mode Number of Hopping Channels_2



8DPSK Mode Number of Hopping Channels_1



8DPSK Mode Number of Hopping Channels_2



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	E4446A	MY48250238	2018-05-08	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10 dB 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 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:	102.7 KPa

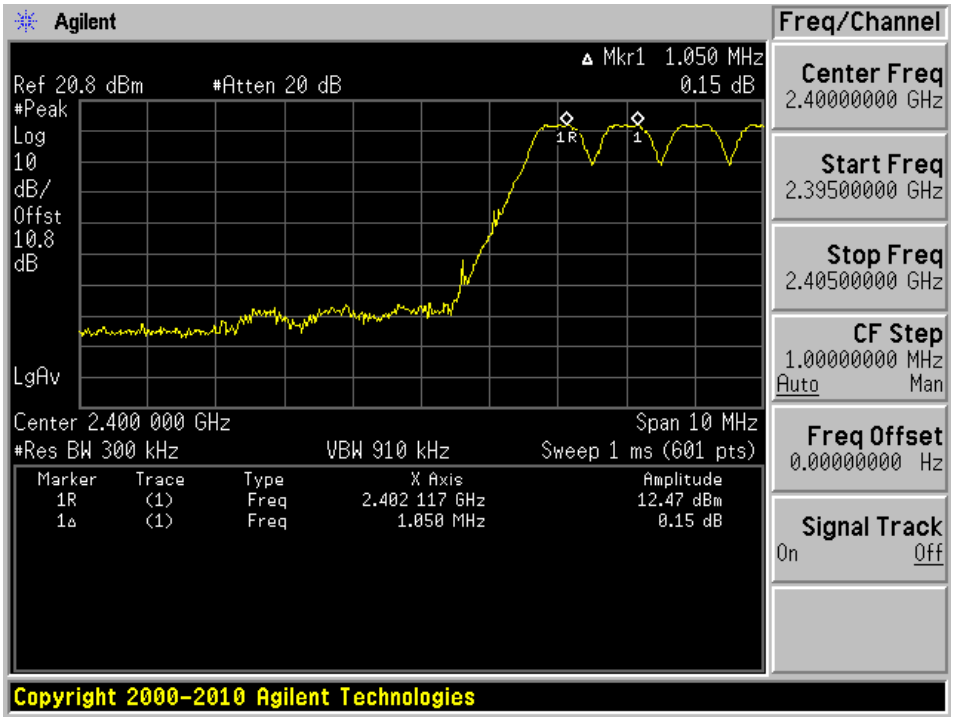
The testing was performed by Vincent Licata from 2018-08-14 to 2018-08-15 in RF site.

13.5 Test Results

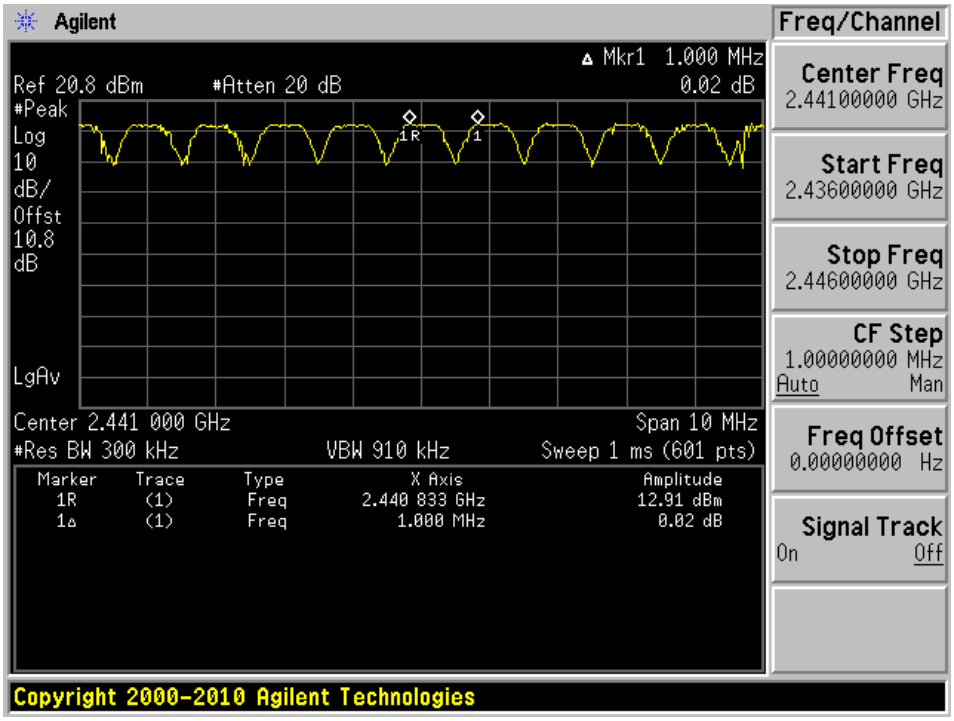
Channel	Frequency (MHz)	Channel Separation (kHz)	2/3 20 dB OBW (kHz)
GFSK			
Low	2402	1050	788
Middle	2445	1000	789
High	2480	983	799
π/4-DQPSK			
Low	2402	1000	789
Middle	2445	1050	792
High	2480	983	798
8DPSK			
Low	2402	1000	791
Middle	2445	1000	789
High	2480	1017	794

Please refer to following plots.

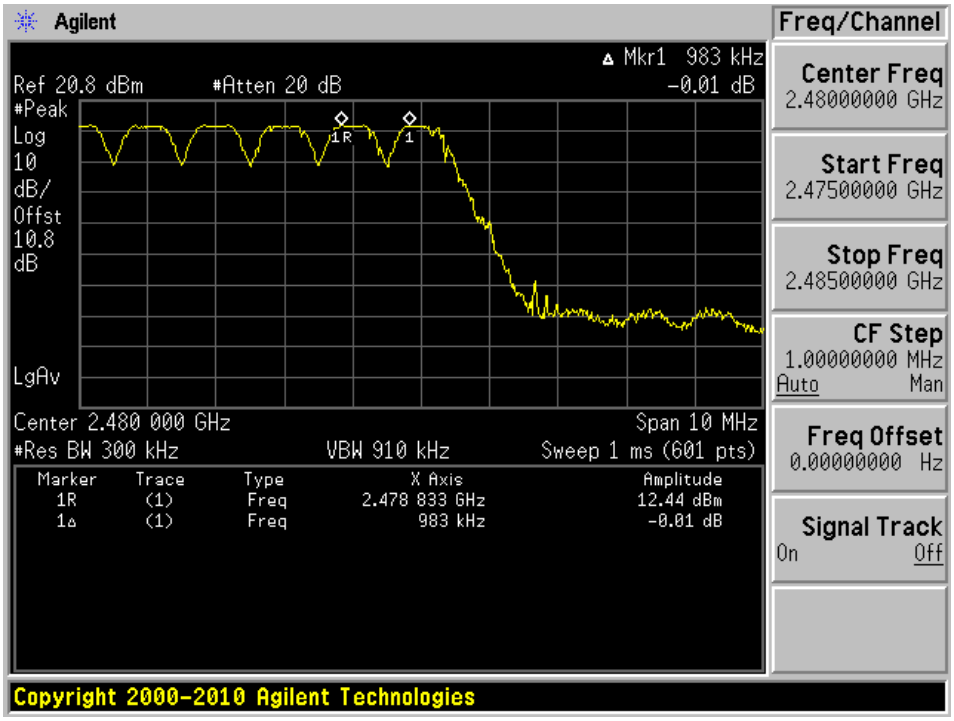
GFSK Mode 2402 MHz Low Channel Hopping Channel Separation



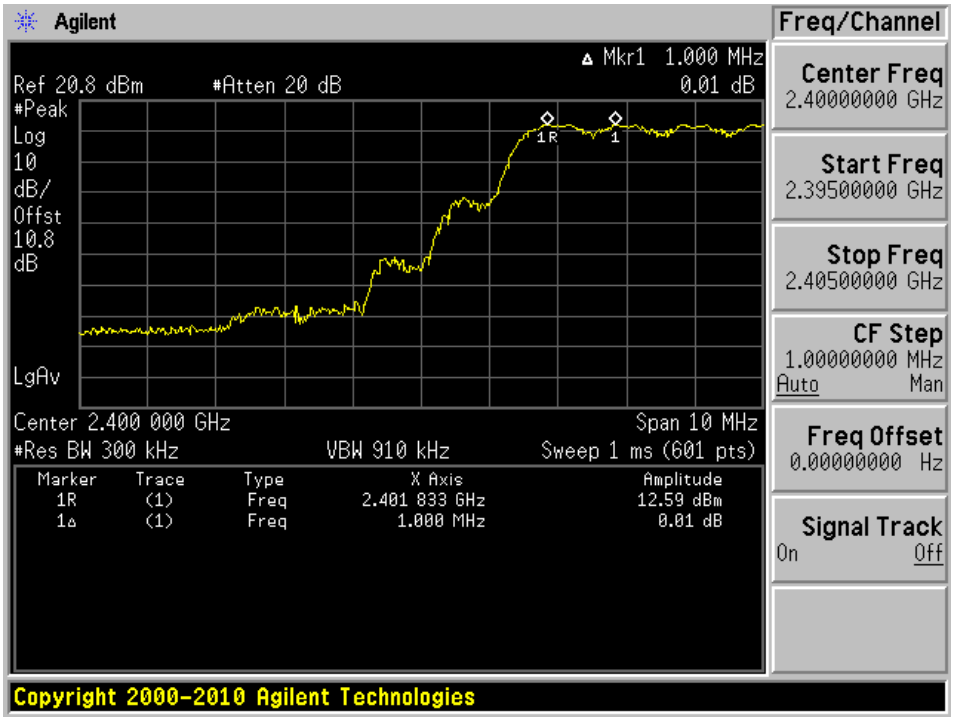
GFSK Mode 2441 MHz Mid Channel Hopping Channel Separation



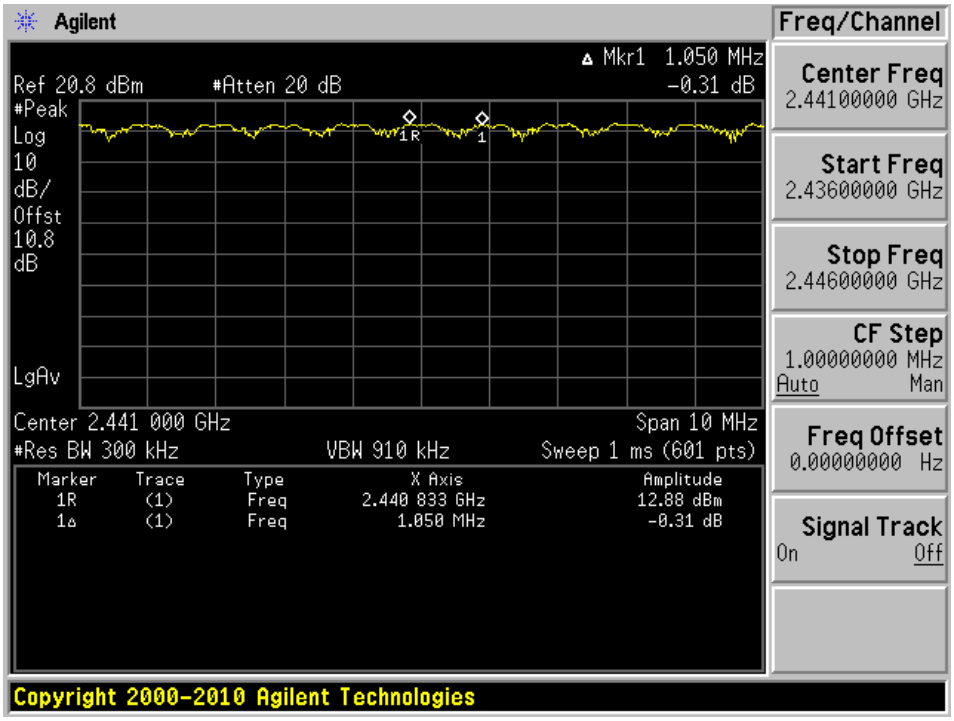
GFSK Mode 2480 MHz High Channel Hopping Channel Separation



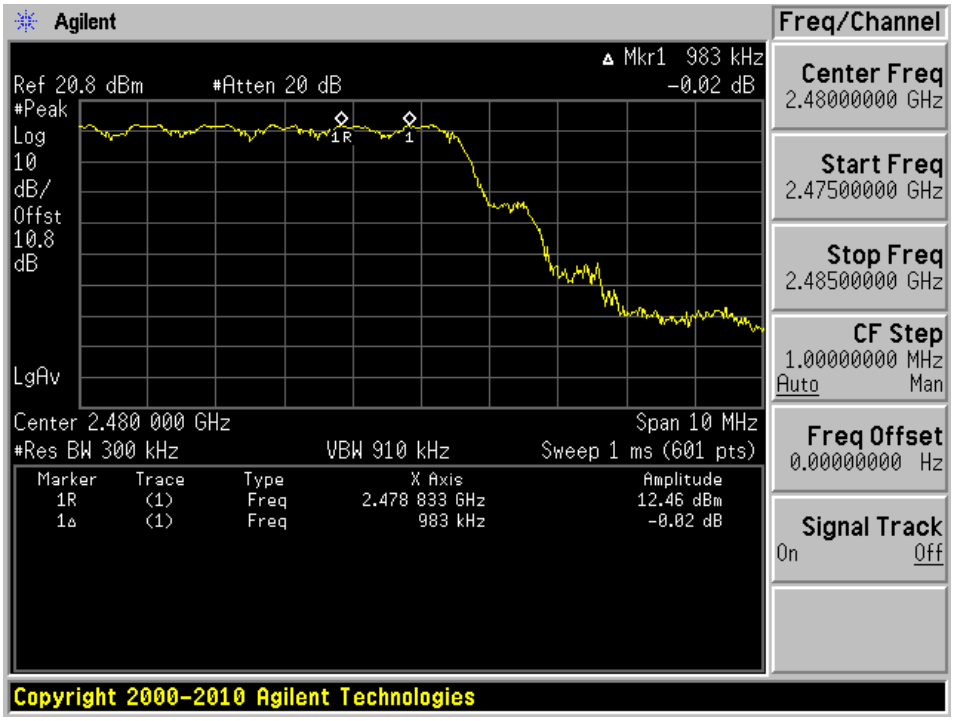
π/4-DQPSK Mode 2402 MHz Low Channel Hopping Channel Separation



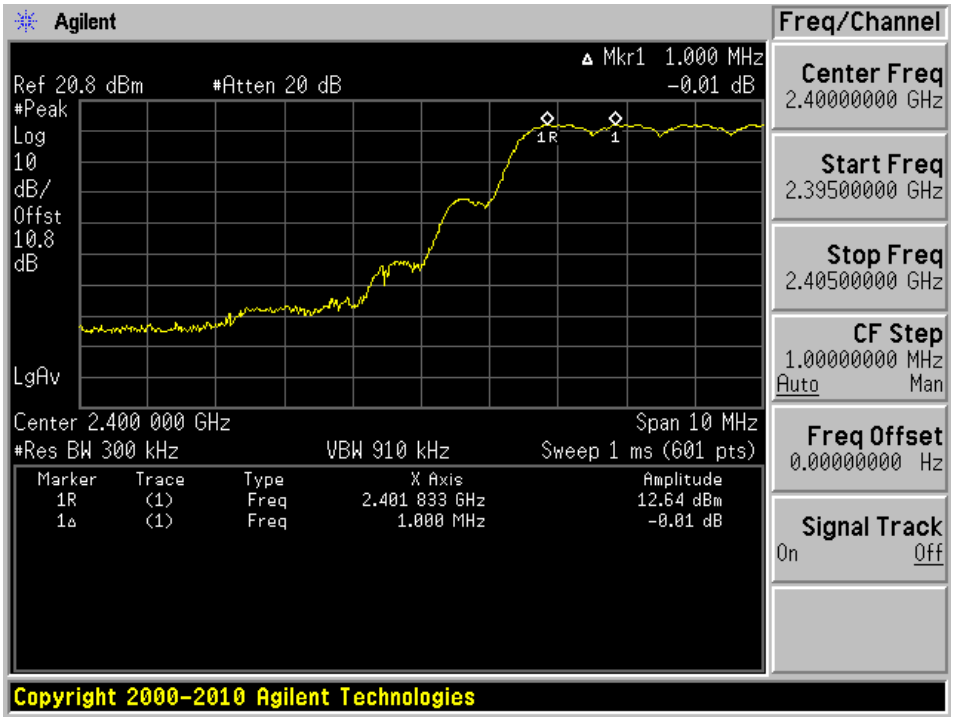
π/4-DQPSK Mode 2441 MHz Mid Channel Hopping Channel Separation



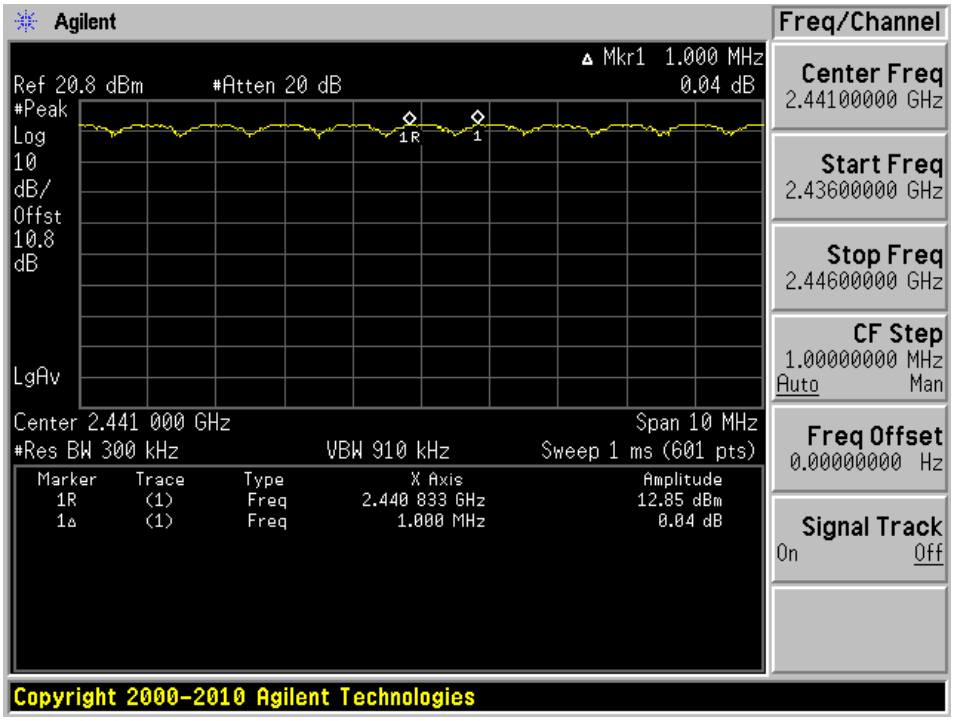
π/4-DQPSK Mode 2480 MHz High Channel Hopping Channel Separation



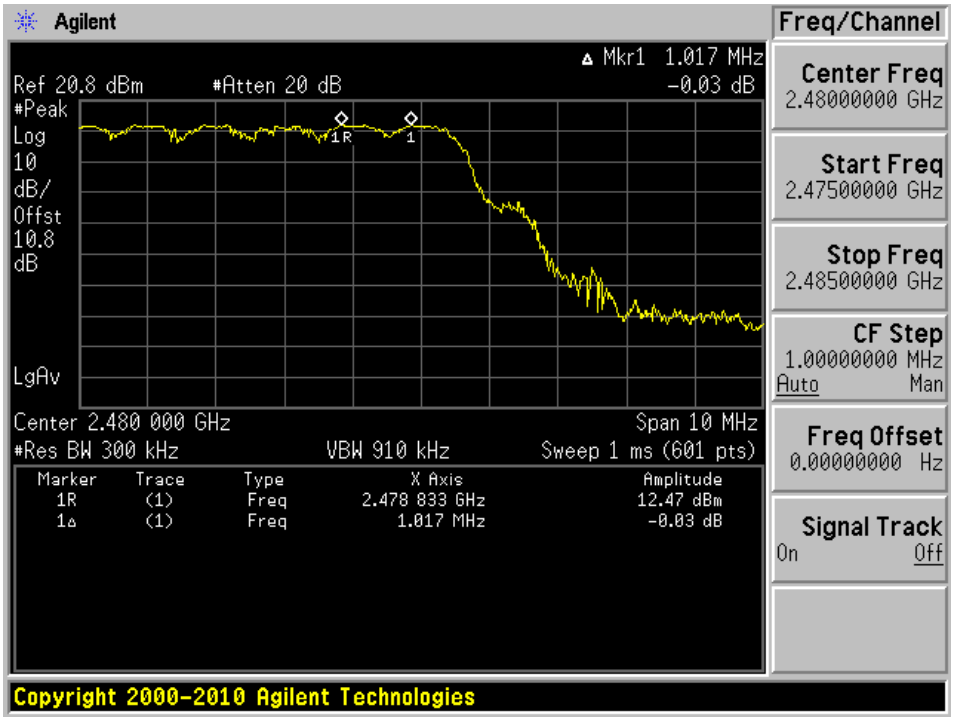
8DPSK Mode 2402 MHz Low Channel Hopping Channel Separation



8DPSK Mode 2441 MHz Mid Channel Hopping Channel Separation



8DPSK Mode 2480 MHz High Channel Hopping Channel Separation



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	E4446A	MY48250238	2018-05-08	1 year
-	RF cable	-	-	Each time[1]	N/A
-	10 dB 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 calibrations have been performed per the A2LA requirements, traceable to the NIST.*

14.4 Test Environmental Conditions

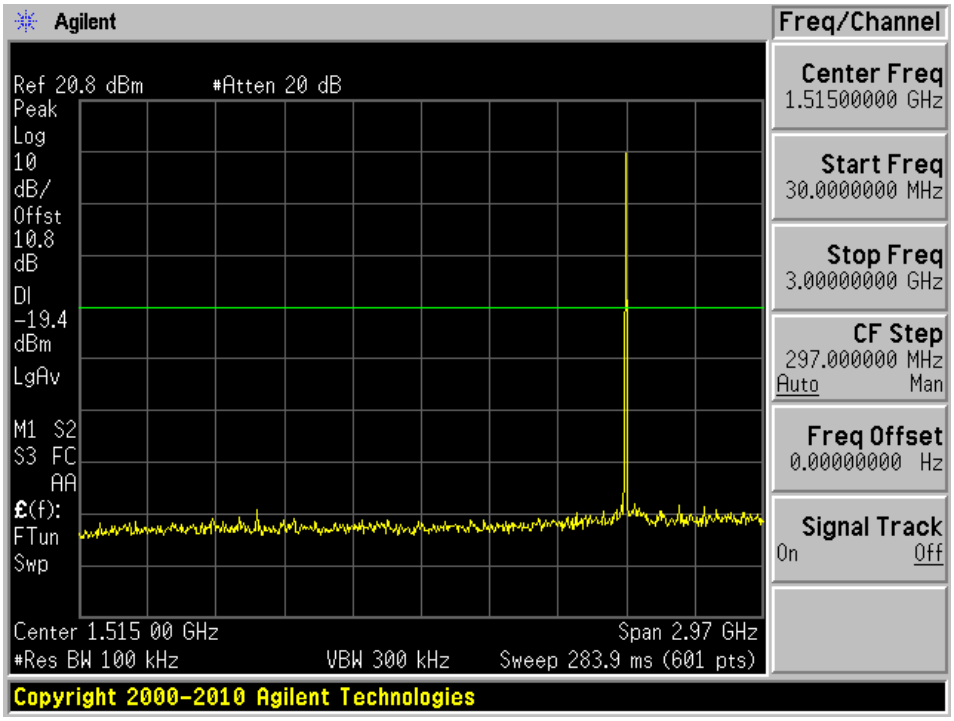
Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Vincent Licata from 2018-08-14 to 2018-08-15 in RF site.

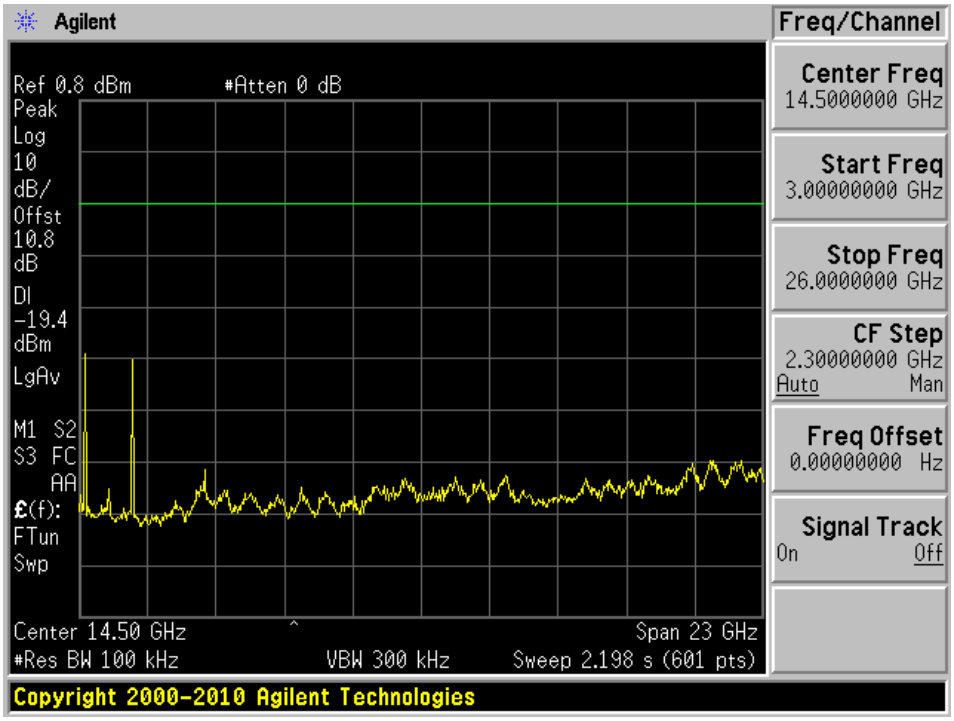
14.5 Test Results

Please refer to following plots.

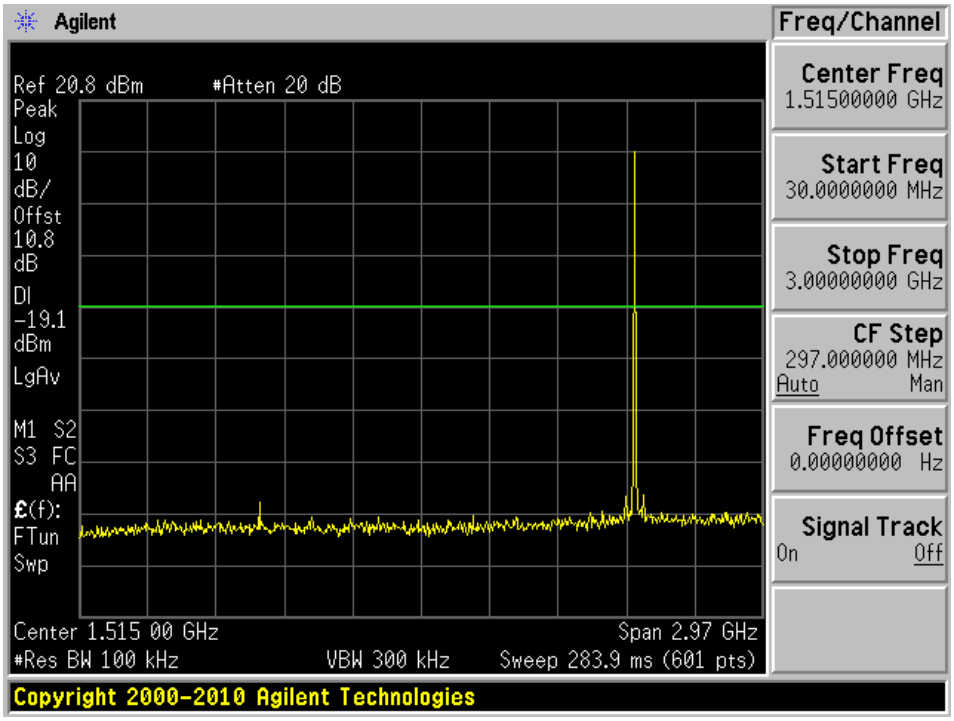
GFSK Mode 2402 MHz Low Channel Spurious Emission_1



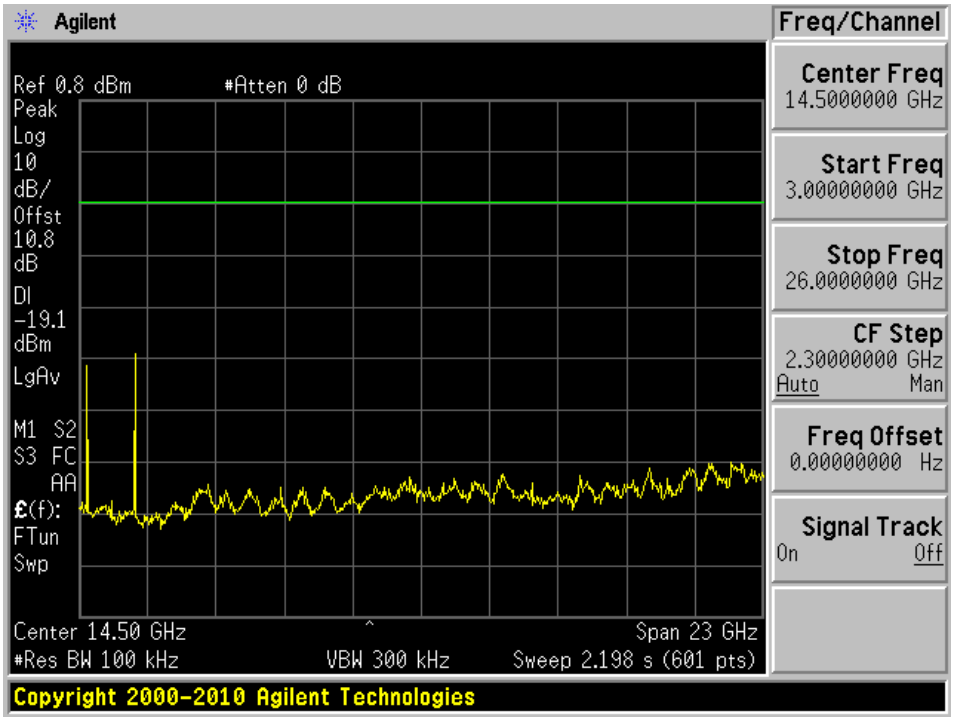
GFSK Mode 2402 MHz Low Channel Spurious Emission_2



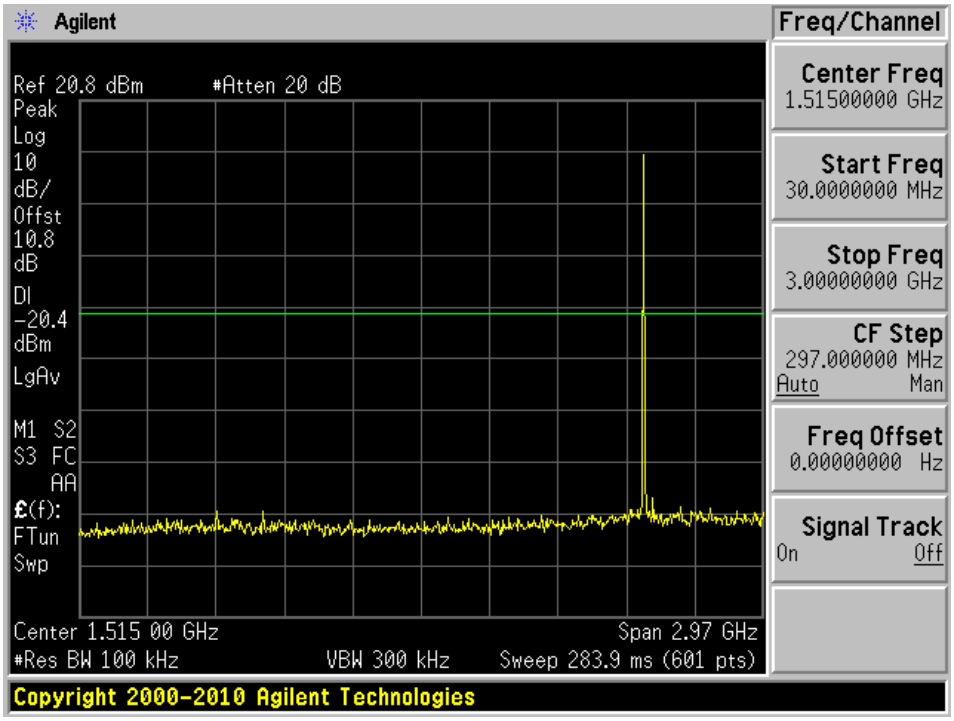
GFSK Mode 2441 MHz Mid Channel Spurious Emission_1



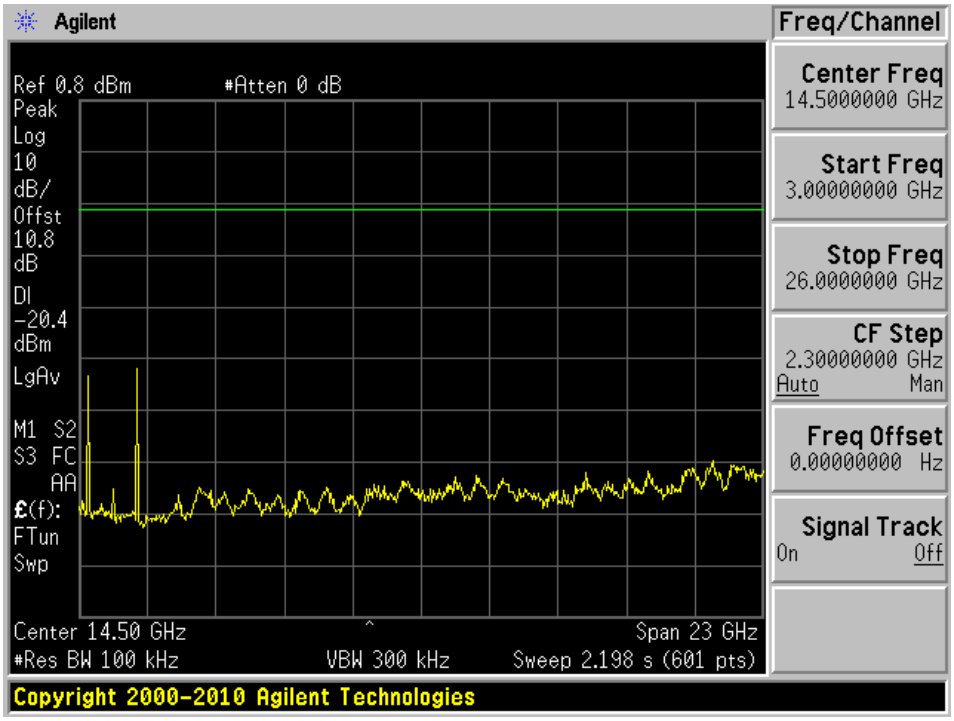
GFSK Mode 2441 MHz Mid Channel Spurious Emission_2



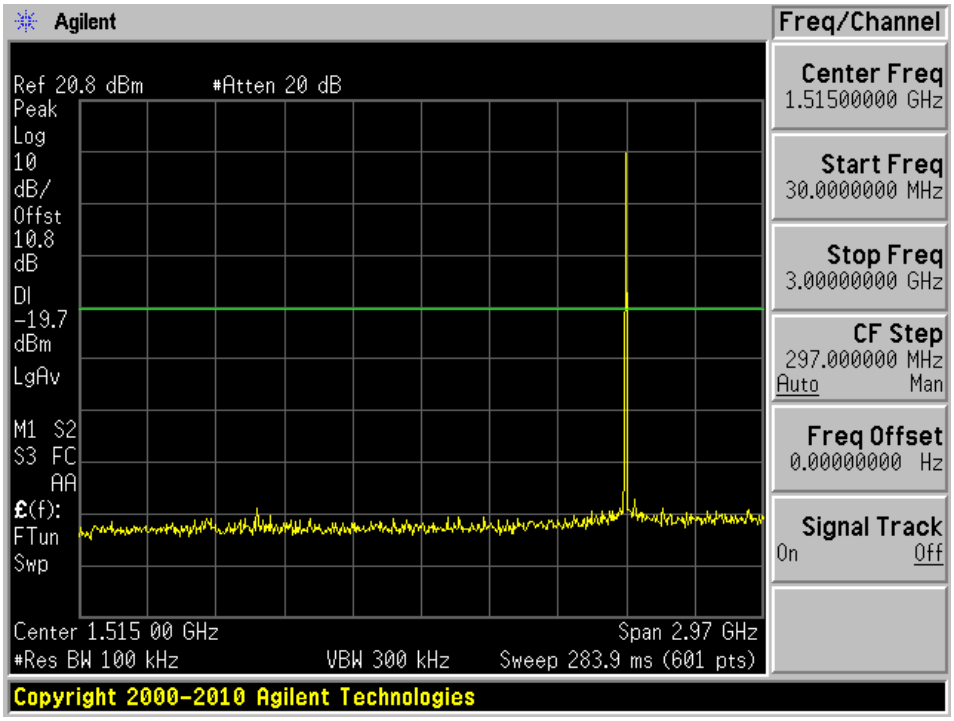
GFSK Mode 2480 MHz High Channel Spurious Emission_1



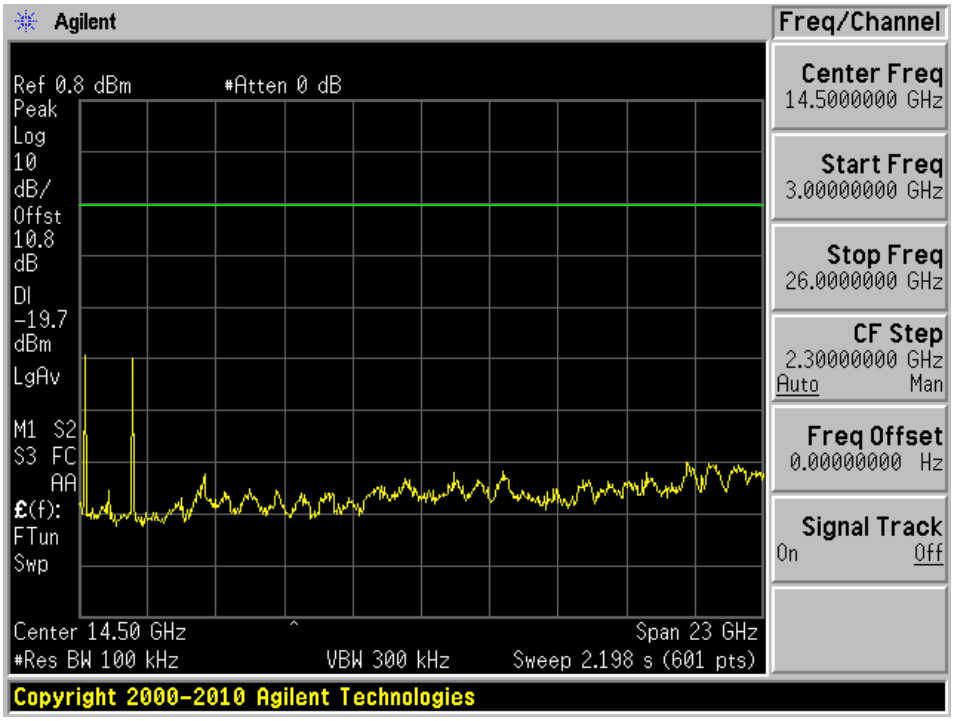
GFSK Mode 2480 MHz High Channel Spurious Emission_2



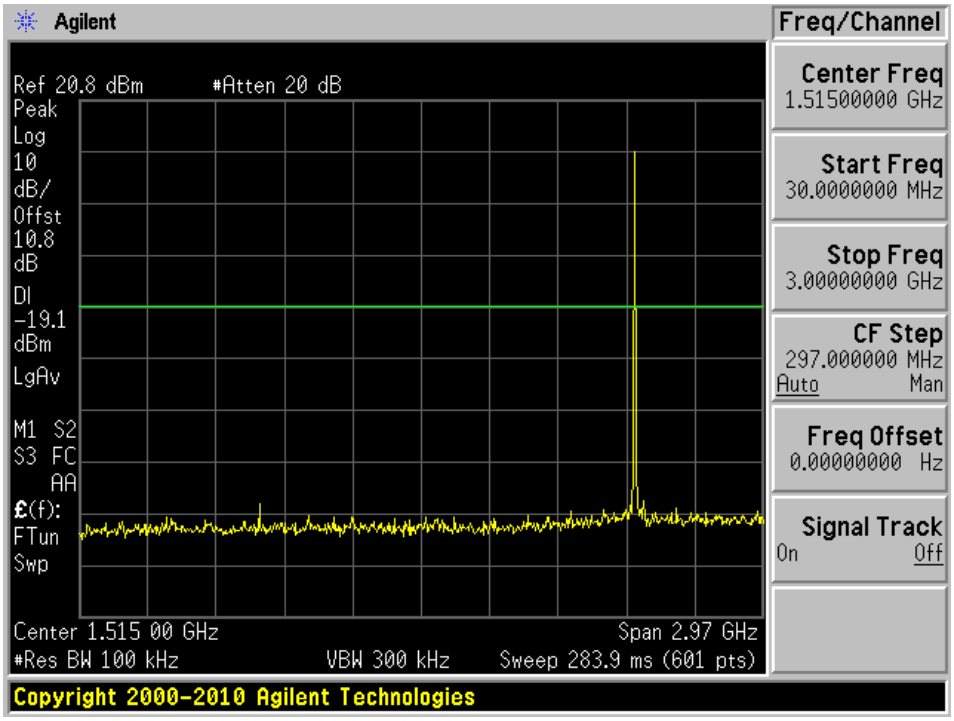
π/4-DQPSK Mode 2402 MHz Low Channel Spurious Emission_1



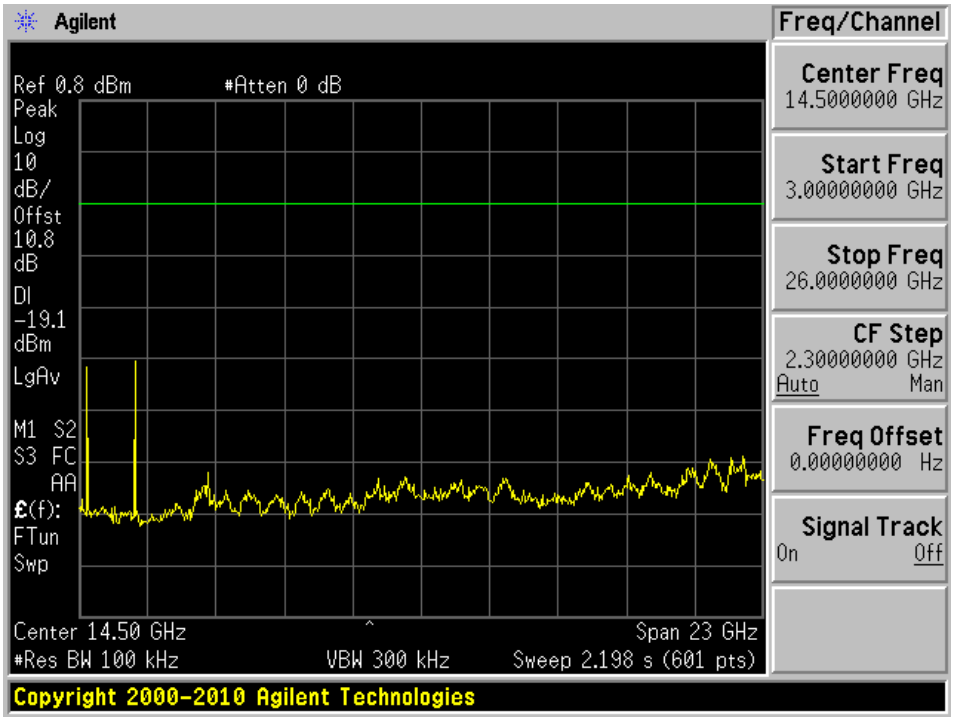
π/4-DQPSK Mode 2402 MHz Low Channel Spurious Emission_2



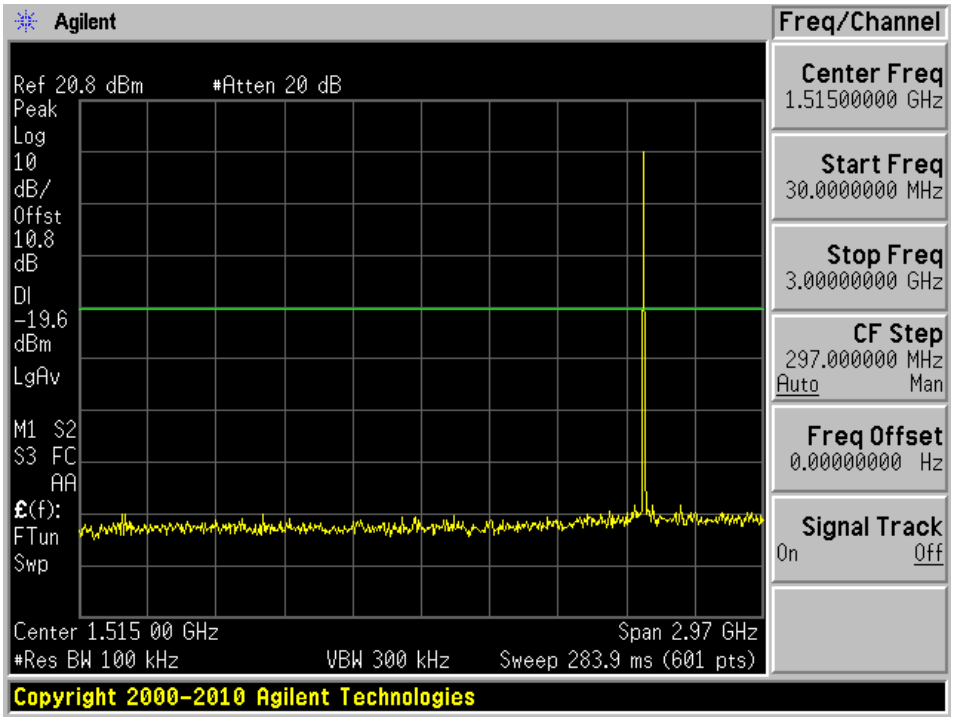
π/4-DQPSK Mode 2441 MHz Mid Channel Spurious Emission_1



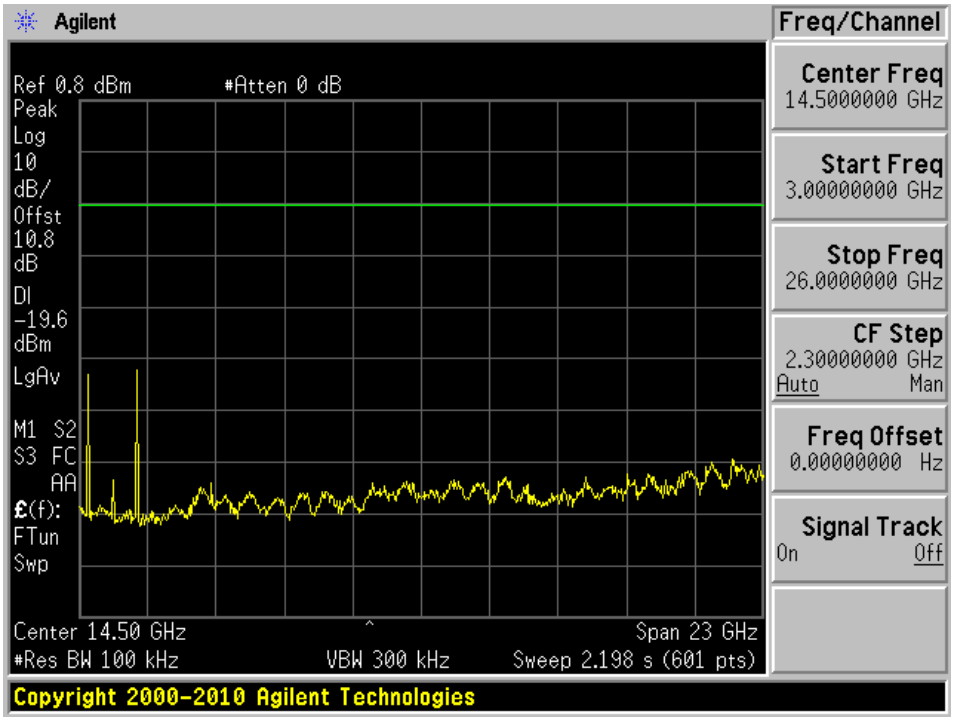
π/4-DQPSK Mode 2441 MHz Mid Channel Spurious Emission_2



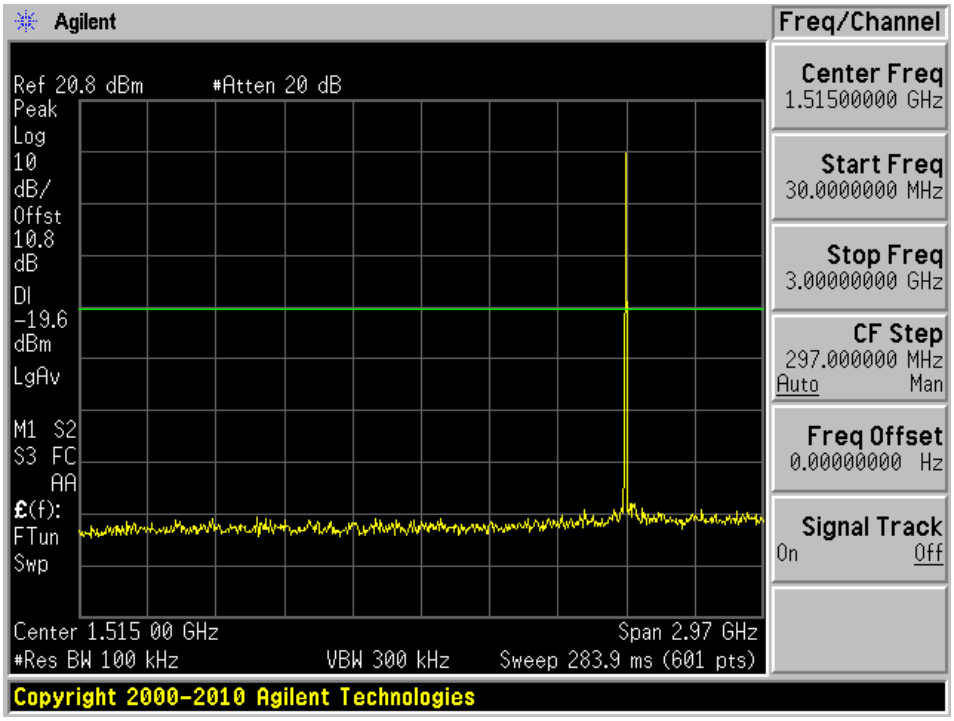
π/4-DQPSK Mode 2480 MHz High Channel Spurious Emission_1



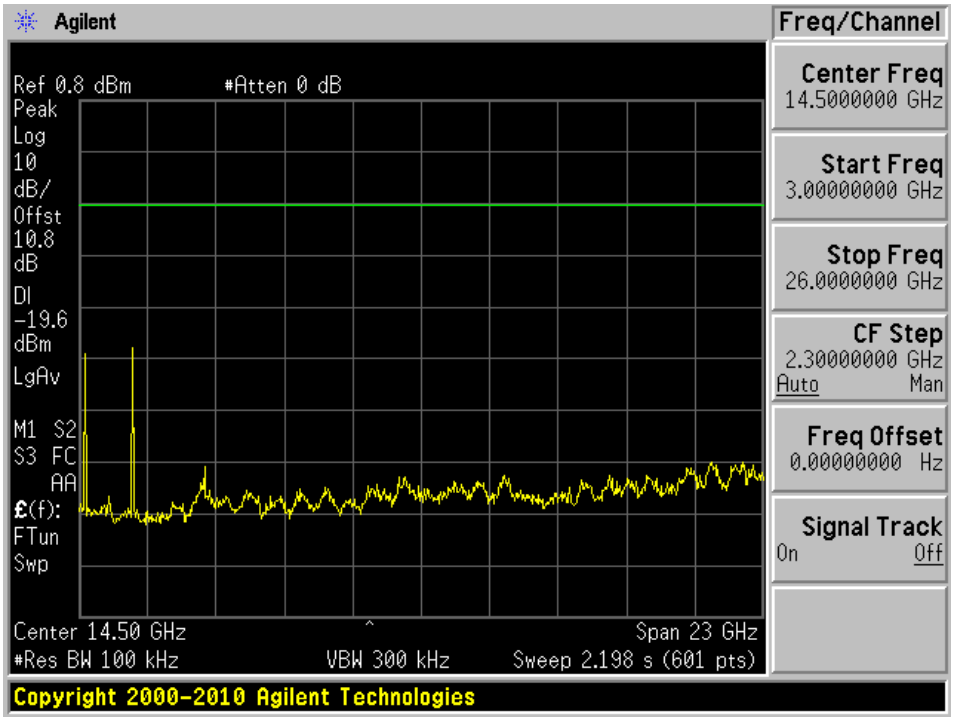
π/4-DQPSK Mode 2480 MHz High Channel Spurious Emission_2



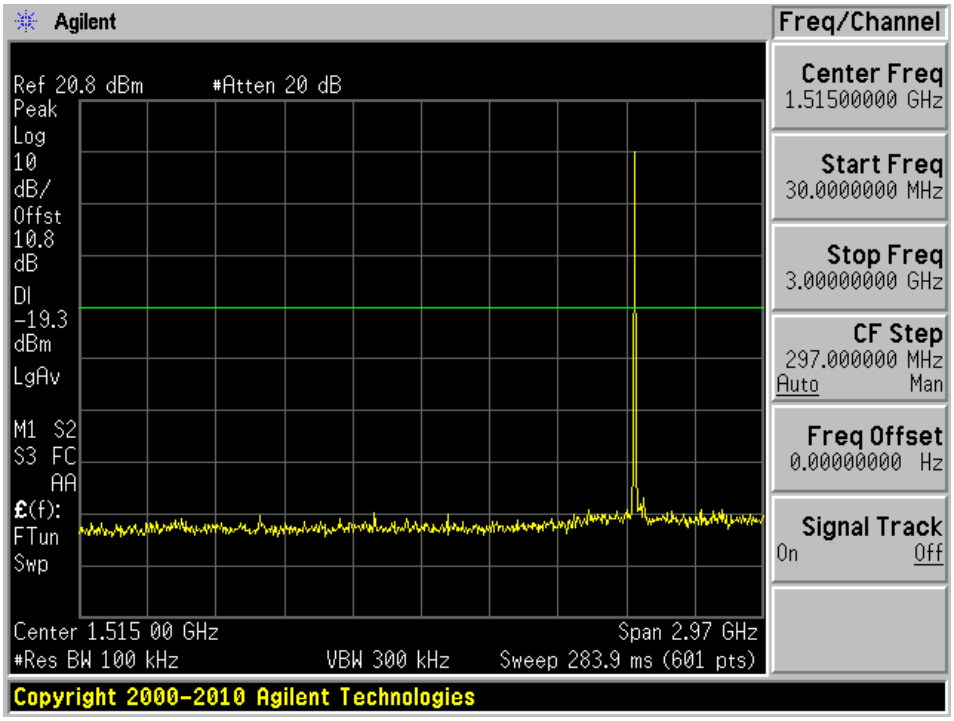
8DPSK Mode 2402 MHz Low Channel Spurious Emission_1



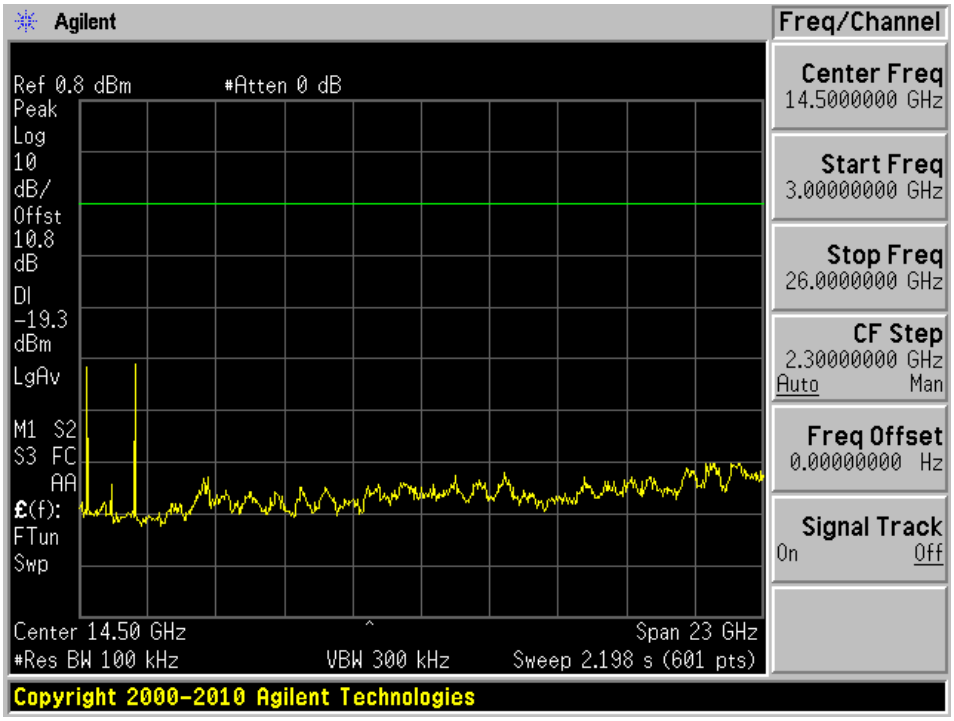
8DPSK Mode 2402 MHz Low Channel Spurious Emission_2



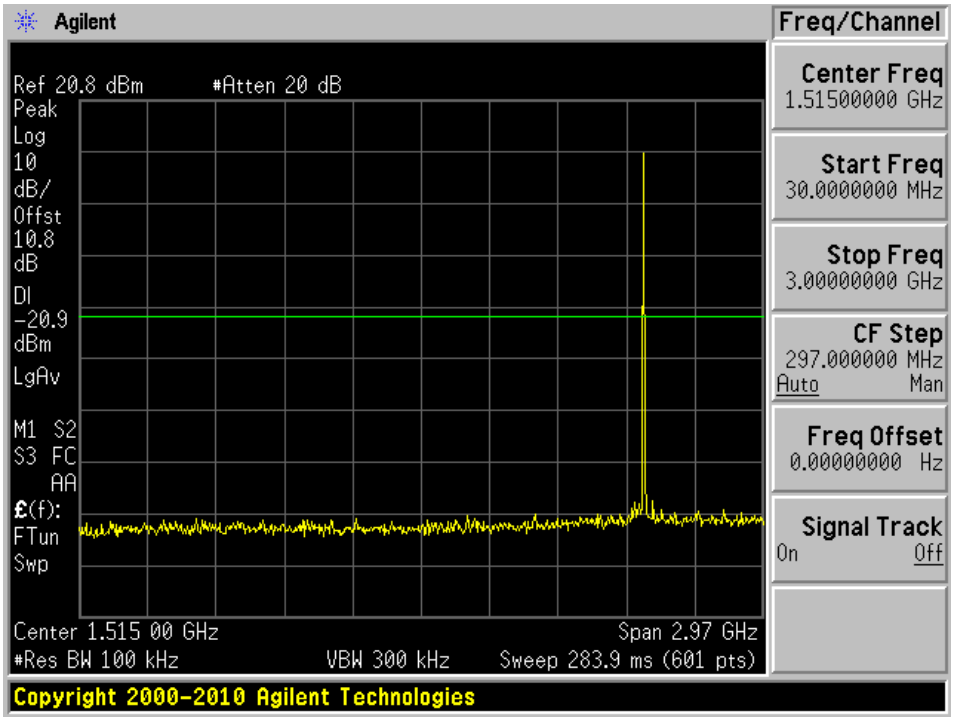
8DPSK Mode 2441 MHz Mid Channel Spurious Emission_1



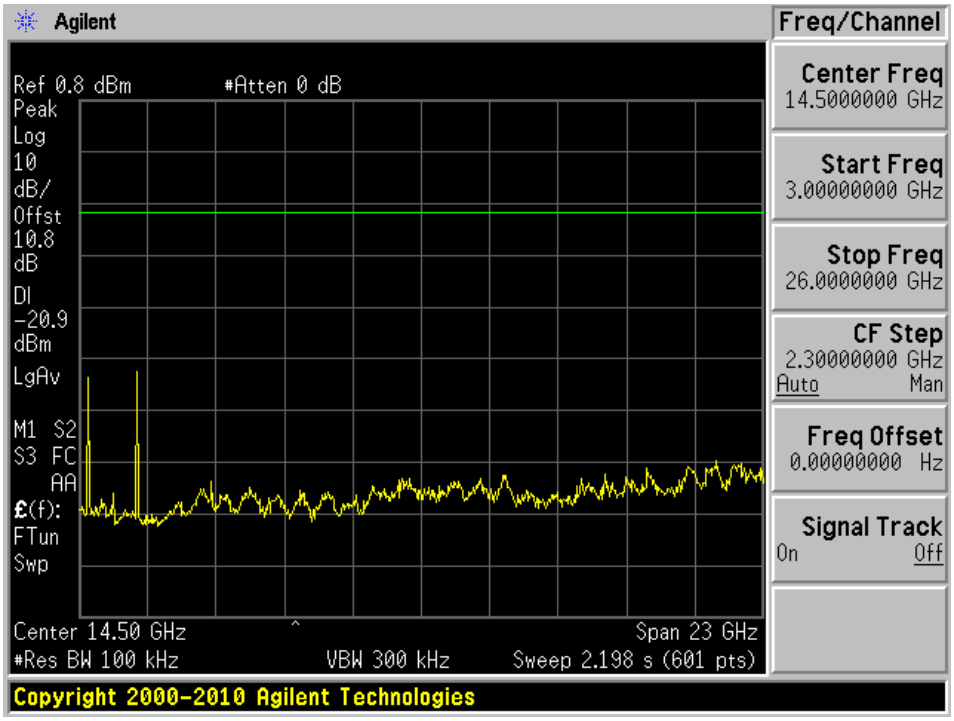
8DPSK Mode 2441 MHz Mid Channel Spurious Emission_2



8DPSK Mode 2480 MHz High Channel Spurious Emission_1



8DPSK Mode 2480 MHz High Channel Spurious Emission_2



15 Annex A (Informative) - 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 the requirements of any additional program requirements in the Electrical field. 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 8 January 2009)*.

Presented this 30th day of August 2016.

President and CEO
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2018
Revised November 14, 2016

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

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