

2.4 GHz Bluetooth Radio Test Report (FHSS)

**For
CP-8821 IP Phone with**

2.4GHz / 5.0GHz Wi-Fi Radio 802.11a/ac/b/g/n + Bluetooth v3.0

FCC ID: LDK88211296
IC ID: 2461B-88211296

Against the following Specifications:

47 CFR 15.247

47 CFR 15.209

47 CFR 15.205

RSS-Gen issue 4

RSS-247 issue 1

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Title: See EDCS

Revision: See EDCS

This report replaces any previously entered test report under EDCS – **875270**. This test report has been electronically authorized and archived using the CISCO Engineering Document Control system. Test Report Template EDCS# 1526148



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Section 1: Overview

1.1 Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:



Specifications
FCC 15.247 RSS-247 Issue 1: May 2015 RSS-Gen Issue 4: Nov 2015

Notes: Measurements were made in accordance with FCC docket #: DA 00-0705, ET docket 96-8 measurement method of spurious emission tolerance to the International Telecommunication Union (ITU) Recommendation SM329.

Section 2: Assessment Information

2.1 General

This report contains an assessment of an apparatus against Radio Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

- a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.
- b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.
- c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).
- d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%
- e) All AC testing was performed at one or more of the following supply voltages:

110V 60 Hz (+/-20%)

2.2 Units of Measurement

The units of measurements defined in the appendices are reported in specific terms, which are test dependent. Where radiated measurements are concerned these are defined at a particular distance. Basic voltage measurements are defined in units of [dBuV]

As an example, the basic calculation for all measurements is as follows:

Emission level [dBuV] = Indicated voltage level [dBuV] + Cable Loss [dB] + Other correction factors [dB]

The combinations of correction factors are dependent upon the exact test configurations [see test equipment lists for further details] and may include:-

Antenna Factors, Pre Amplifier Gain, LISN Loss, Pulse Limiter Loss and Filter Insertion Loss..

Note: to convert the results from dBuV/m to uV/m use the following formula:-

Level in uV/m = Common Antilogarithm [(X dBuV/m)/20] = Y uV/m

Measurement Uncertainty Values

voltage and power measurements	± 2 dB
conducted EIRP measurements	± 1.4 dB
radiated measurements	± 3.2 dB
frequency measurements	$\pm 2.4 \times 10^{-7}$
temperature measurements	$\pm 0.54^\circ$.
humidity measurements	$\pm 2.3\%$
DC and low frequency measurements	$\pm 2.5\%$.

Where relevant measurement uncertainty levels have been estimated for tests performed on the apparatus. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Radiated emissions (expanded uncertainty, confidence interval 95%)

30 MHz - 300 MHz	+/- 3.8 dB
300 MHz - 1000 MHz	+/- 4.3 dB
1 GHz - 10 GHz	+/- 4.0 dB
10 GHz - 18GHz	+/- 8.2 dB
18GHz - 26.5GHz	+/- 4.1 dB
26.5GHz - 40GHz	+/- 3.9 dB

Conducted emissions (expanded uncertainty, confidence interval 95%)

30 MHz – 40GHz	+/- 0.38 dB
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A product is considered to comply with a requirement if the nominal measured value is below the limit line. The product is considered to not be in compliance in case the nominal measured value is above the limit line.

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2.3 Date of testing (Initial sample receipt date to last date of testing)

September 08 2015 to June 27, 2016

2.4 Report Issue Date

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

2.5 Testing facilities

This assessment was performed by:

Testing Laboratories

Cisco Systems, Inc.
125 West Tasman Drive (Building P)
San Jose, CA 95134
USA

Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134
USA

Registration Numbers for Industry Canada

Cisco System Site	Address	Site Identifier
Building P, 10m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-2
Building P, 5m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-1
Building I, 5m Chamber	285 W. Tasman Drive San Jose, California 95134	Company #: 2461M-1
Building N, 5m Chamber	125 Rio Robles San Jose, California 95134	Company #: 6111A

Test Engineer

Dann Le

2.6 Equipment Assessed (EUT)

CP-8821

2.7 EUT Description

The CP-8821 is the next generation IP Phone with Wi-Fi (802.11a/ac/b/g/n) and Bluetooth module support. The specification is applied to IEEE802.11a/ac/b/g/n + Bluetooth Basic rate/ EDR

Here is a brief summary of the Heracles hardware:

- IEEE 802.11 a/b/g/n/ac compliant wireless LAN
- USB 2.0/OTG interface (Shared with docking connector)
- 2.4-inch TFT LCD display, with 240 x 320 pixels, 16M colors
- Capacitive standard 12-key backlit keypad, 2 soft keys, volume and ringer control hard keys, mute hard key, speakerphone hard key, push-to-talk hard key, dedicated end call button (shared with power-on and off function) and send/dial button, 5-way joystick/navigation keys
- 512MB LPDDR2 RAM, 4GB eMMC flash storage, version4.41
- 2020 mAh removable standard battery
- Ring, Wireless low signal, battery condition and MWI LED
- Shared antenna for 802.11a/b/g/n/ac and Bluetooth Basic rate /EDR.
- Separate ringer and voice speaker
- 3.5 mm headset interface
- Vibrate alert support
- Two Digital Microphone & Two loud speaker Interface
- Audio codec support, MP3, WAV, AAC etc.
- IP67 certified water and dust proof.

Section 3: Result Summary

Conducted emissions

Basic Standard	Technical Requirements / Details	Result
FCC 15.247 RSS-247	20 dB Bandwidth: The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped, between upper and Lower Frequency from top carrier (dBc) down.	Pass
FCC 15.247 RSS-247	Maximum Peak Conducted Output Power: 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 Watt.	Pass
FCC 15.247 RSS-247	Carrier Frequency Separation: For frequency hopping systems according to a hopping channel carrier Frequencies that are separated by 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.	Pass
FCC 15.247 RSS-247	No. of Hopping Frequencies / Time Occupancy: 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.	Pass
FCC 15.247 RSS-247	Conducted Band-Edge: 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	Pass
FCC15.247/15.205 RSS-Gen 8.10	Restricted band: Unwanted emissions falling within the restricted bands, as defined in FCC 15.205 (a) and RSS-Gen 6.13 must also comply with the radiated emission limits specified in FCC 15.209 (a) and RSS-Gen 8.10	Pass

Conducted emissions (continue)



Basic Standard	Technical Requirements / Details	Result
FCC15.207 RSS-Gen 8.8	AC Power Line Conducted Emissions: FCC: (a) Except as shown in paragraphs (b) and (c) of this section, 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). RSS: Except when the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply, either directly or indirectly (such as with battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits table 3 shown in section 8.8	Pass

Radiated Emissions

Basic Standard	Technical Requirements / Details	Result
FCC15.209/205 RSS-Gen6.13/8.10	TX Spurious Emissions and Restricted Bands: The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the table specified in the table in FCC§15.209(a) and in RSS-Gen 8.9.	Pass
RSS-Gen 5.0	RX Spurious Emissions: Receivers are required to comply with the limits of spurious emissions as set out in this section. Receiver emission measurements are to be performed as per the normative test method referenced in Section 3.	Pass

Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. Please also refer to the “Justification for worst Case test Configuration” section of this report for further details on the selection of EUT samples.

4.1 Sample Details

Sample No.	Equipment Details	Manufacturer	Hardware Rev.	Firmware Rev.	Software Rev.	Serial Number
S01 (Radiated)	CP-8821	Cisco Systems, Inc.	01	Sip8821.10-3-2HER-157 dev	Rootfs8821.10-3-2HER-157-dev	FCH192180BK
S02 (Conducted)	CP-8821	Cisco Systems, Inc.	01	Sip8821.10-2-1-HE1-3.1-diagnostics	Sip8821.10-2-1-HE1-3.1-diagnostics	FCH18528TEU

4.2 Antenna Information

The following antennas are supported by this product series.

Frequency (MHz)	Part Number	Antenna Type	Antenna Gain (dBi)
2400-2483.5	Internal	Monopole	2.4

4.3 Mode of Operation Details

Mode#	Description	Comments
1	Diagnostic	Diagnostic version allows to do conducted testing at antenna port of EUT. Image version : Sip8821.10-2-1-HE1-3.1-diagnostics

Measurements were made in accordance with

- ANSI C63.10:2013,
- Public Notice #: DA 00-0705

4.4 Test Mode, Modulation and Data Packet Type Description

Test Mode	Modulation	Data Packet
A	GFSK	DH1
B	$\pi/4$ -DQPSK	2-DH3
C	8-DPSK	3-DH1
Note1: Table above represents the worst case scenarios for all modulation and data packet type combinations.		

Appendix A: Conducted Test Results

A.1 20dB Bandwidth

The 20 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 20 dB below the maximum in-band spectral density of the modulated signal

A.1.1 Limits

FCC 15.247, RSS- 247 5.1(1)

There is no limit for 20 dB bandwidth.

A.1.2 Test Procedure

Step 1:

- Edit the spectrum analyzer settings according to the parameters below.
 - Center Frequency: frequency under test
 - Span: approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
 - RBW: $\geq 1\%$ of the 20 dB bandwidth
 - VBW: $\geq$ RBW
 - Sweep: Auto Couple
 - Ref Level: 10dB (or higher if required)
 - Attenuation: 20dB (if required)
 - Detector: Peak
 - Trace Mode: Max Hold

Step 2:

- The EUT is set in a transmitter mode at its maximum data rate. Allow the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission. Then use the marker-normal function to place at the 20 dB down on one side of the emission. Reset with the marker-delta function and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. Record data.

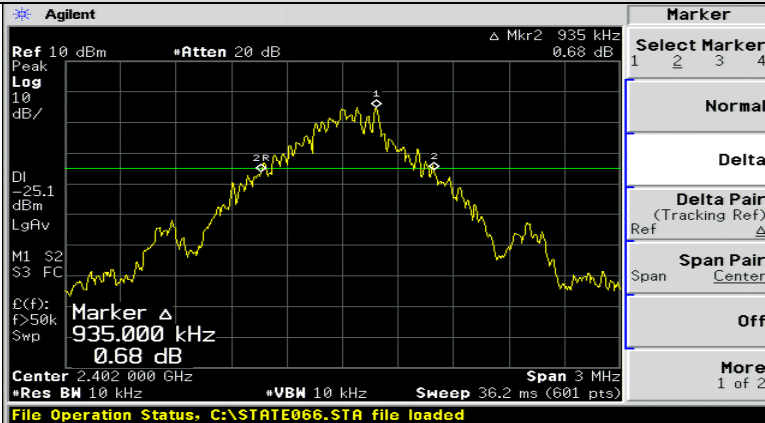
A.1.3 20dB Bandwidth Data Table

20dB Bandwidth		
Packet Type	Frequency (MHz)	20dB BW (KHz)
Modulation type : GFSK		
DH5	2402	935 KHz
	2441	935 KHz
	2480	930 KHz
DH3	2402	930 KHz
	2441	935 KHz
	2480	930 KHz
DH1	2402	930 KHz
	2441	935 KHz
	2480	935 KHz
Modulation type : $\pi/4$ -DQPSK		
2-DH5	2402	1340 KHz
	2441	1335 KHz
	2480	1335 KHz
2-DH3	2402	1340 KHz
	2441	1340 KHz
	2480	1345 KHz
2-DH1	2402	1350 KHz
	2441	1315 KHz
	2480	1350 KHz
Modulation type : 8-DPSK		
3-DH5	2402	1290 KHz
	2441	1315 KHz
	2480	1300 KHz
3-DH3	2402	1325 KHz
	2441	1320 KHz
	2480	1285 KHz
3-DH1	2402	1290 KHz
	2441	1315 KHz
	2480	1320 KHz

A.1.4 20dB Bandwidth Graphical Test Results

20dB Bandwidth Graphical Test Results

Modulation : GFSK / Packet Type: DH5 / Frequency: 2402 MHz



Modulation: GFSK / Packet Type: DH5 / Frequency: 2441 MHz

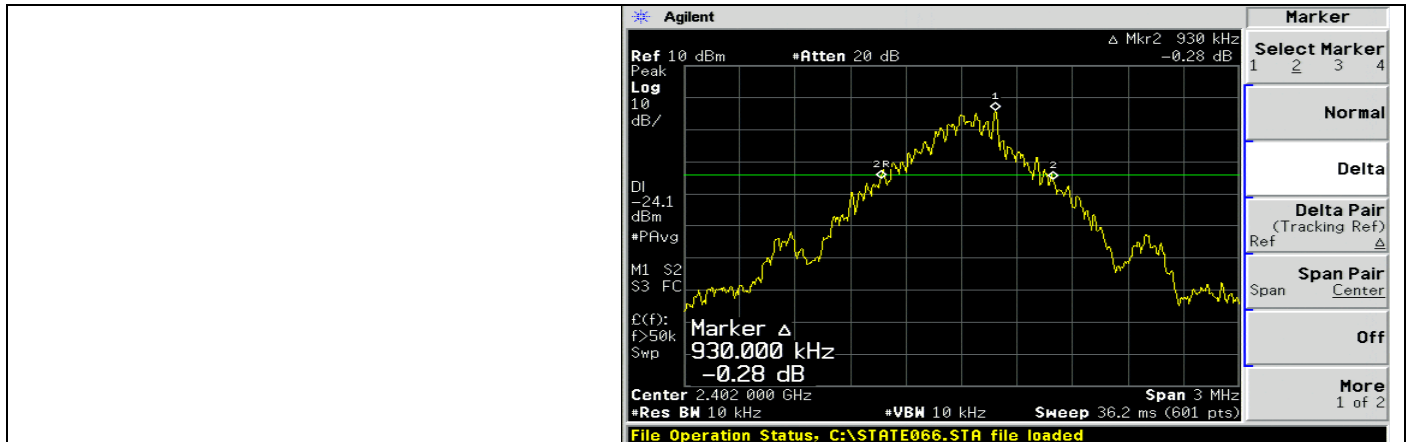


Modulation: GFSK / Packet Type: DH5 / Frequency: 2480 MHz

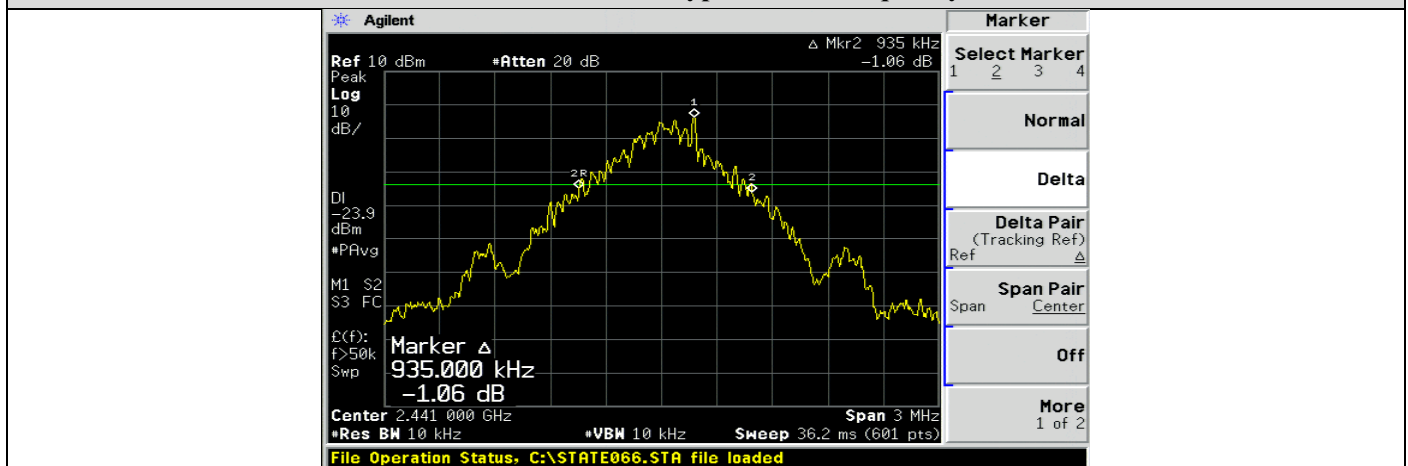


20dB Bandwidth Graphical Test Results

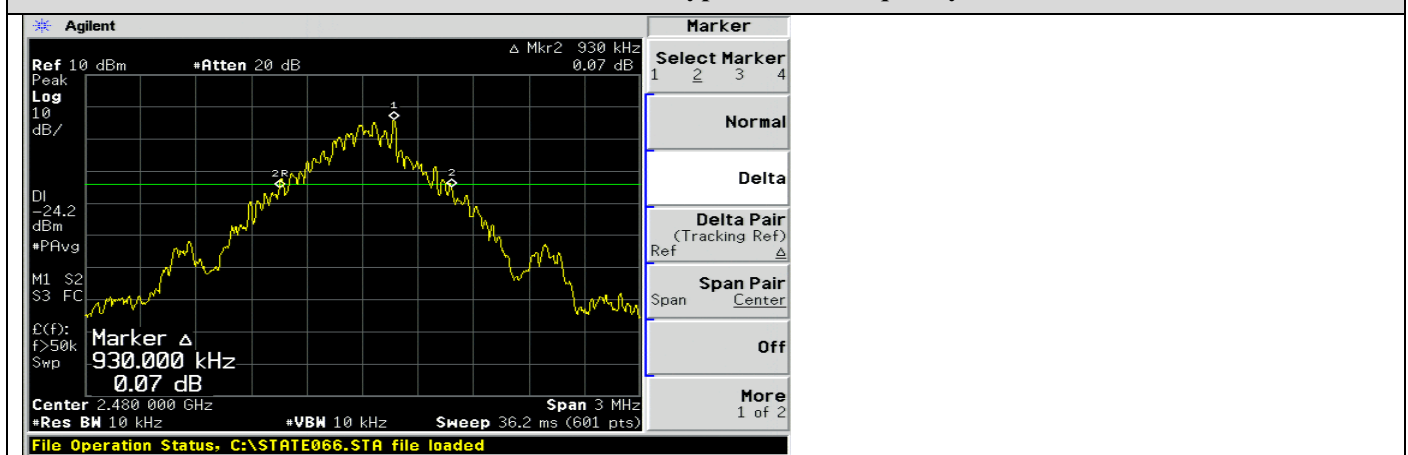
Modulation : GFSK / Packet Type: DH3 / Frequency: 2402 MHz



Modulation : GFSK / Packet Type: DH3 / Frequency: 2441 MHz

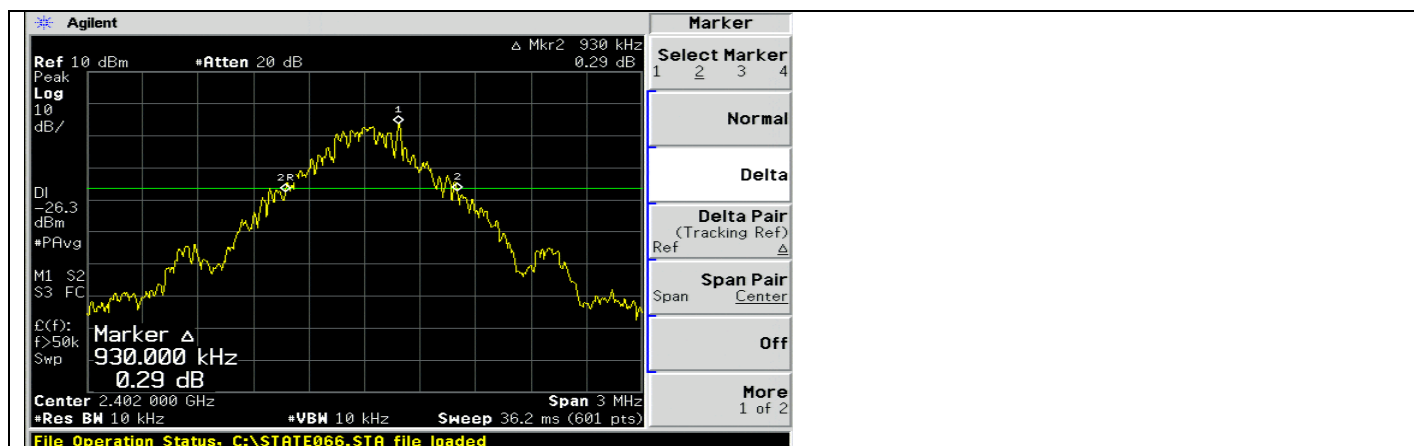


Modulation : GFSK / Packet Type: DH3 / Frequency: 2480 MHz



20dB Bandwidth Graphical Test Results

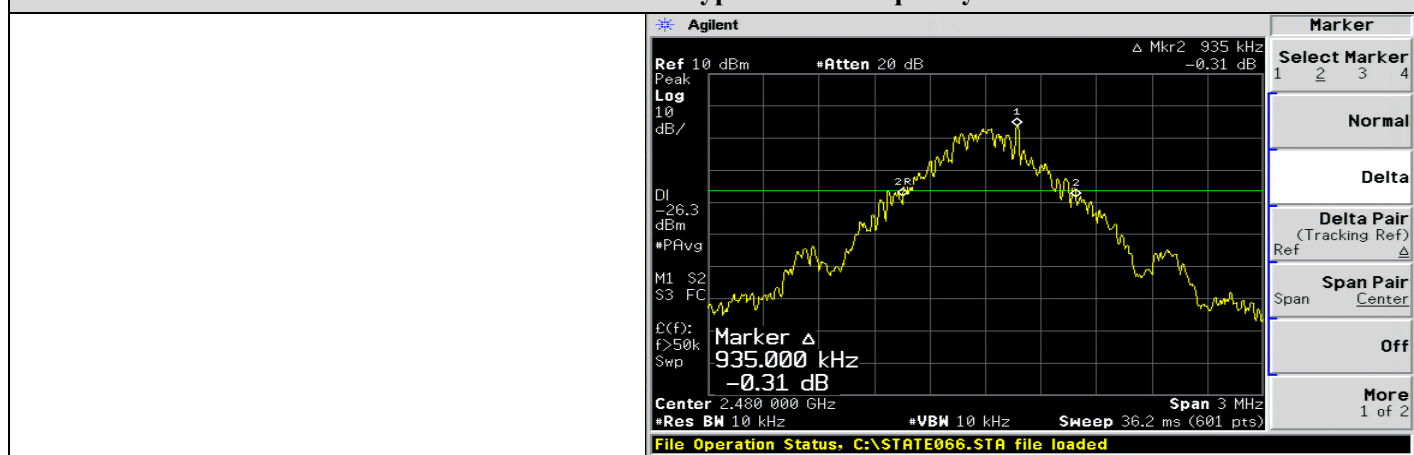
Modulation : GFSK / Packet Type: DH1 / Frequency: 2402 MHz



Modulation : GFSK / Packet Type: DH1 / Frequency: 2441 MHz

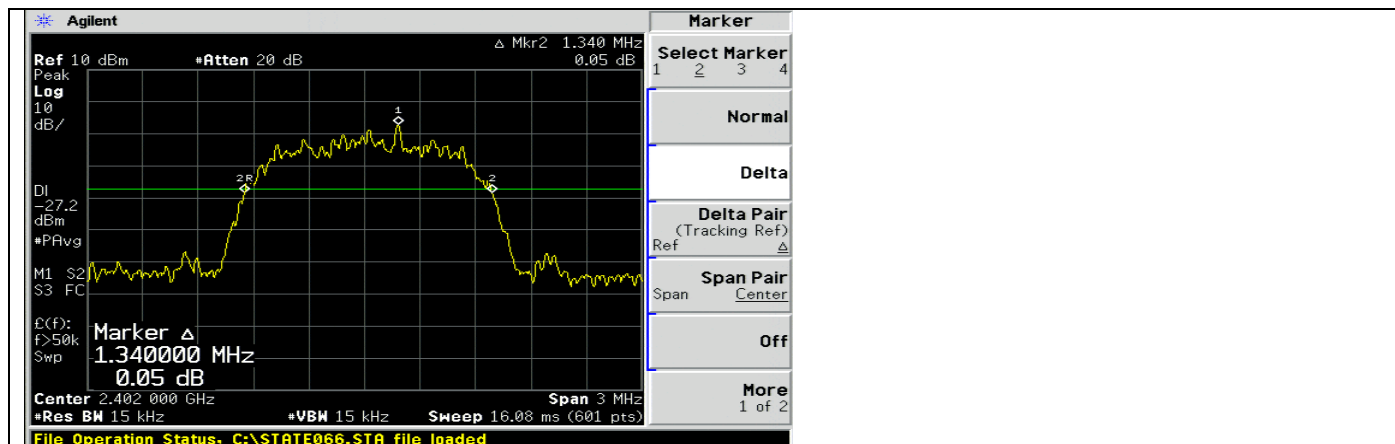


Modulation : GFSK / Packet Type: DH1 / Frequency: 2480 MHz

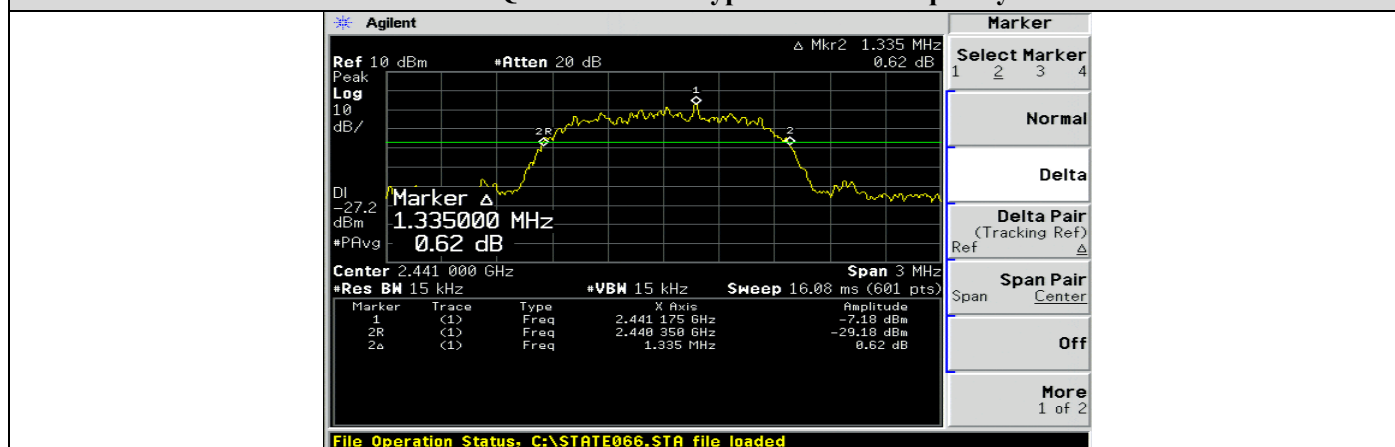


20dB Bandwidth Graphical Test Results

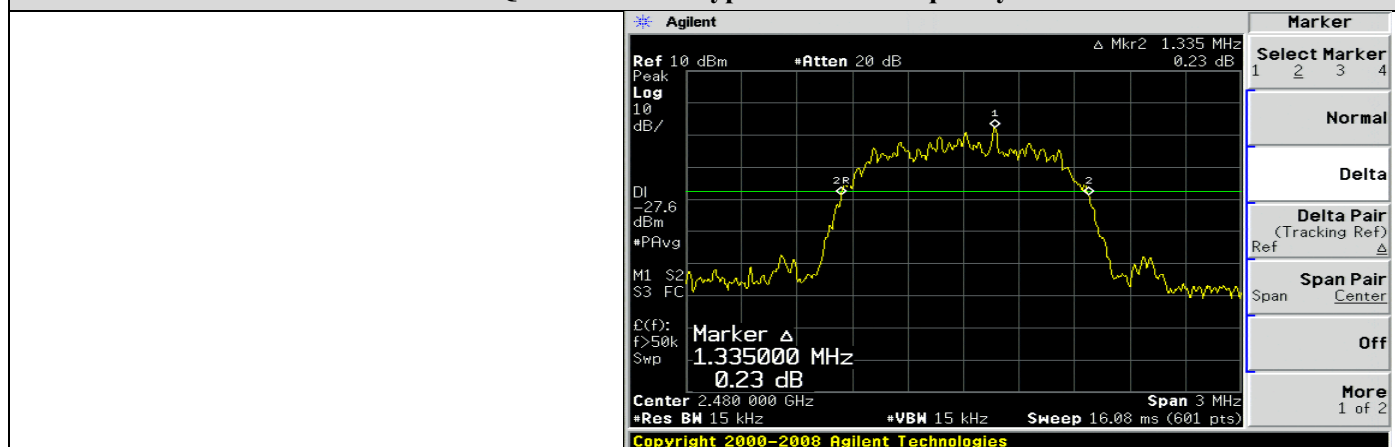
Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH5 / Frequency: 2402 MHz



Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH5 / Frequency: 2441 MHz

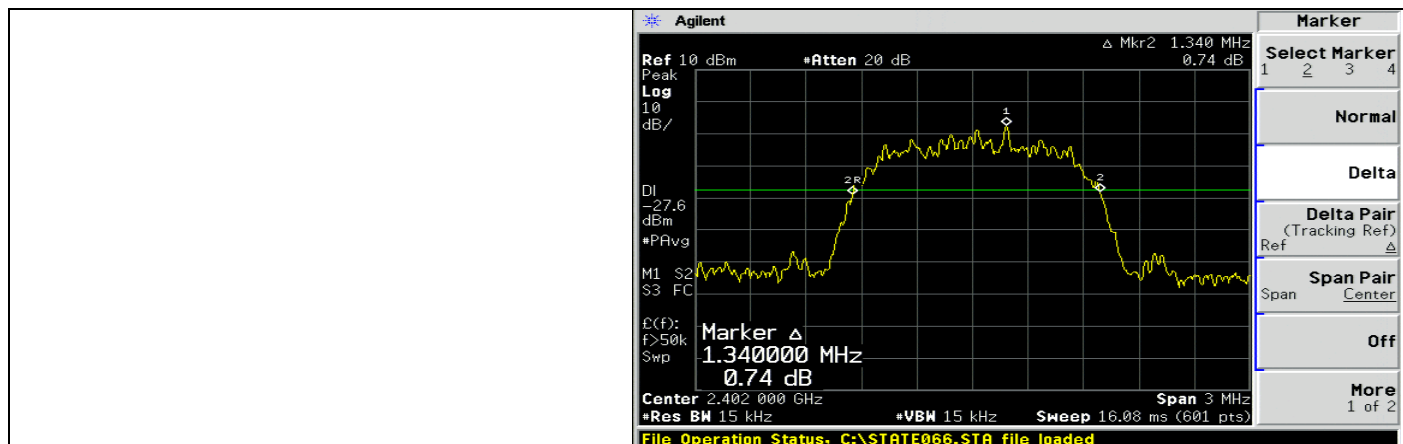


Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH5 / Frequency: 2480 MHz

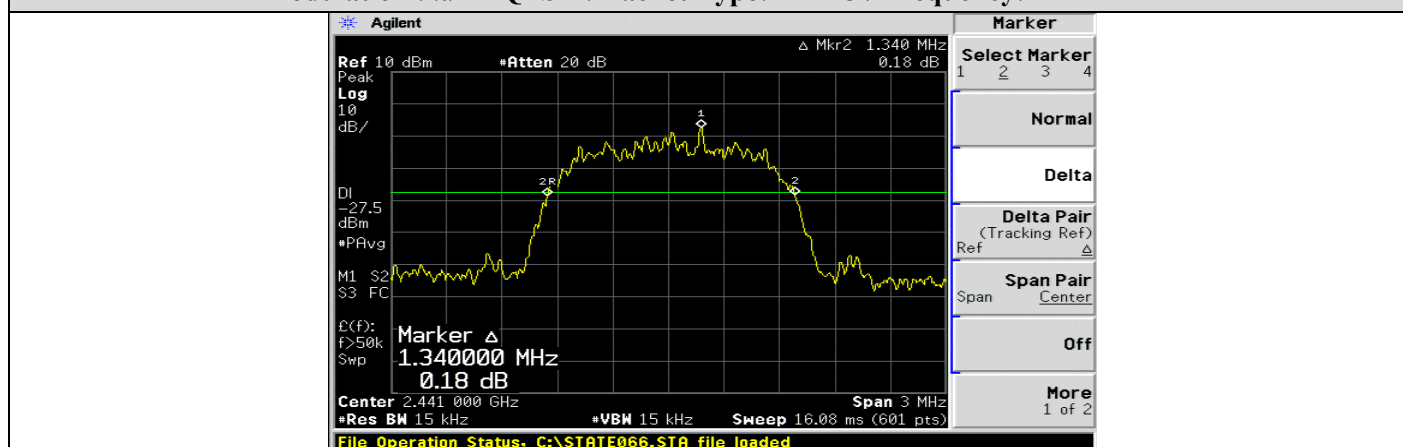


20dB Bandwidth Graphical Test Results

Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH3 / Frequency: 2402 MHz



Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH3 / Frequency: 2441 MHz



Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH3 / Frequency: 2480 MHz

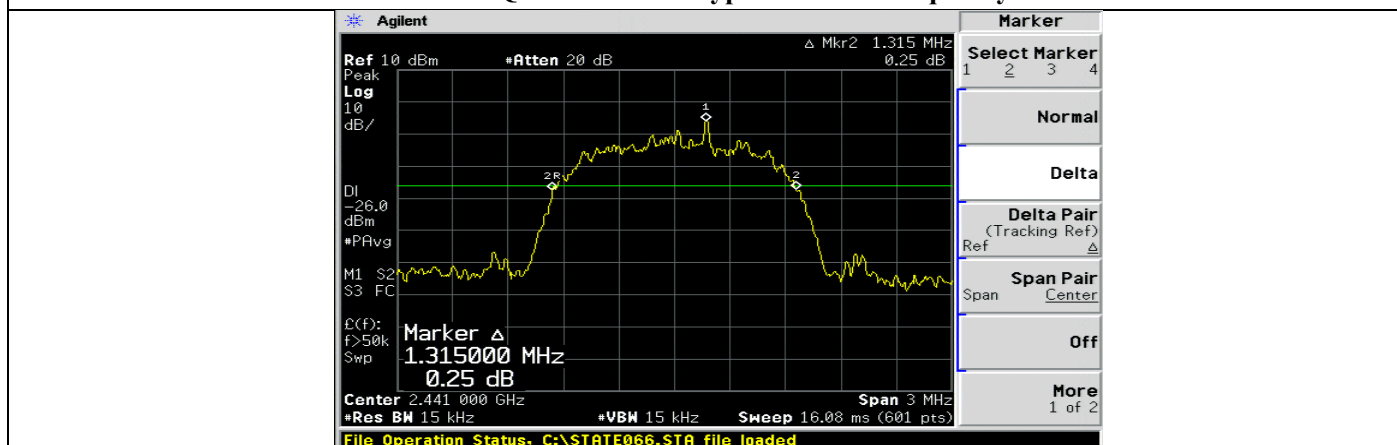


20dB Bandwidth Graphical Test Results

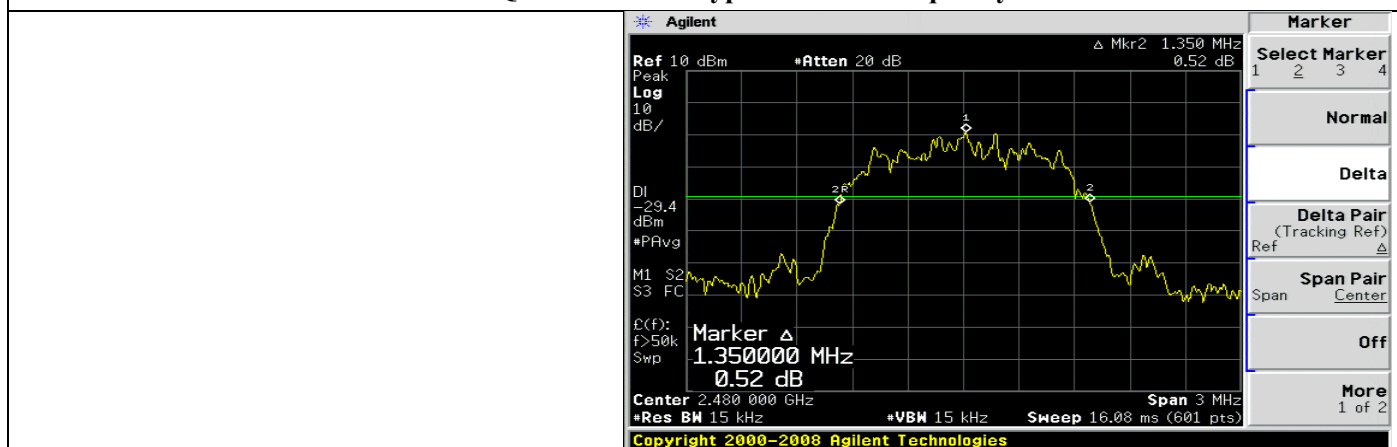
Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH1 / Frequency: 2402 MHz



Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH1 / Frequency: 2441 MHz

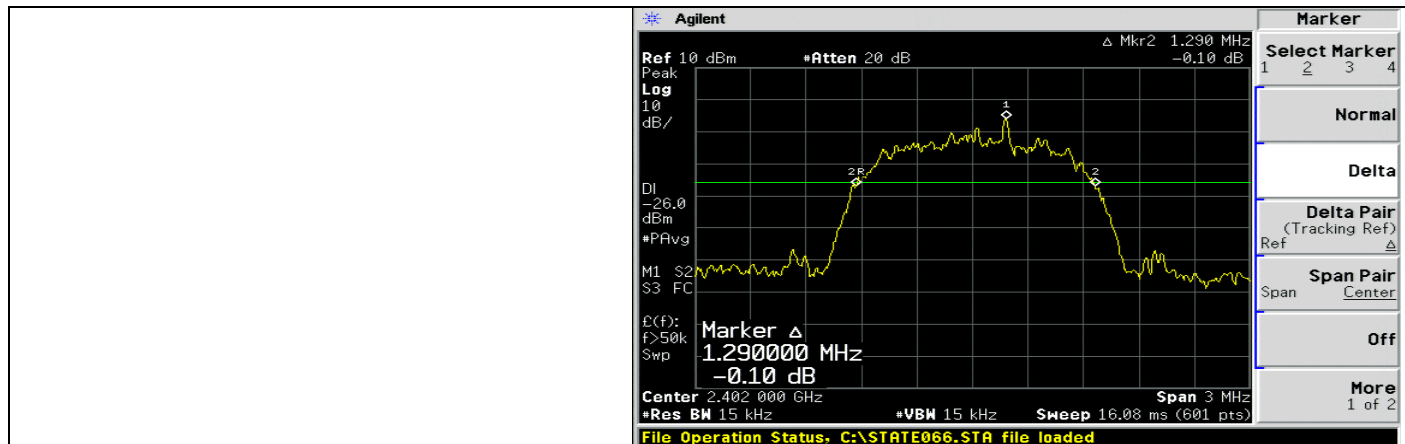


Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH1 / Frequency: 2480 MHz

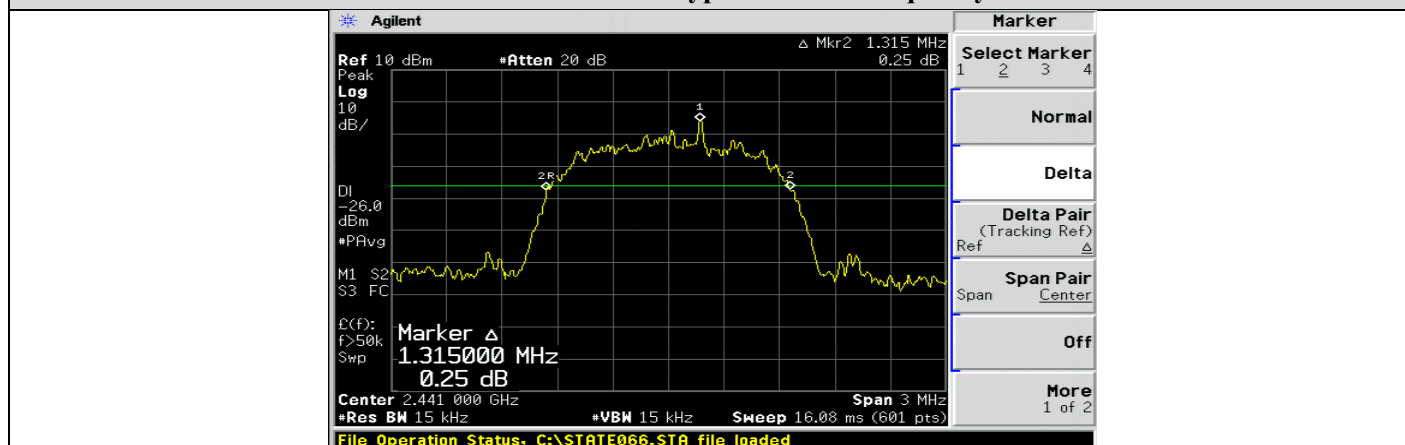


20dB Bandwidth Graphical Test Results

Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2402 MHz



Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2441 MHz



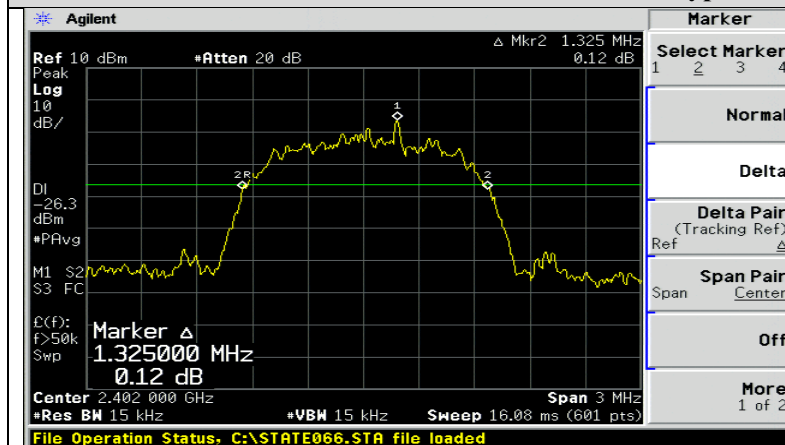
Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2480 MHz



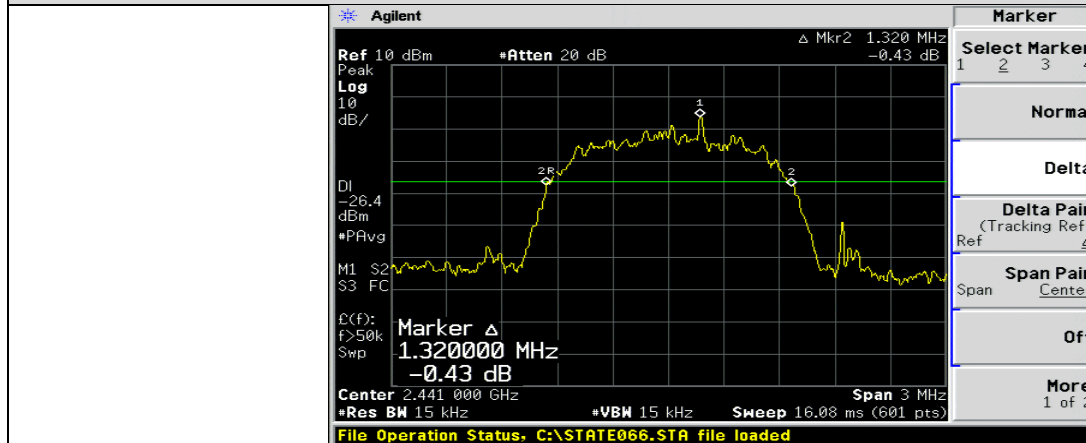


20dB Bandwidth Graphical Test Results

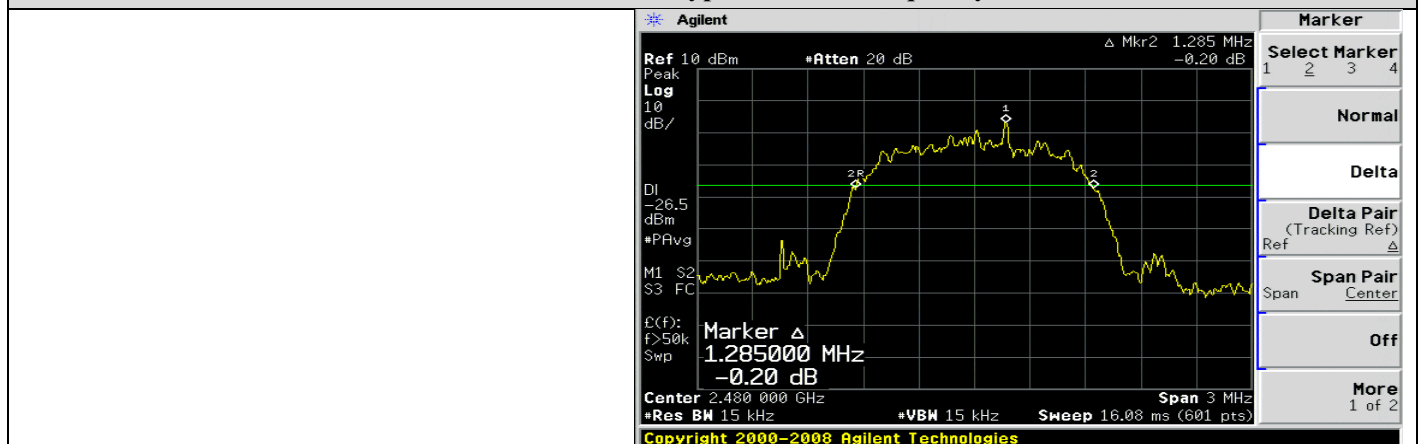
Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2402 MHz



Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2441 MHz



Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2480 MHz

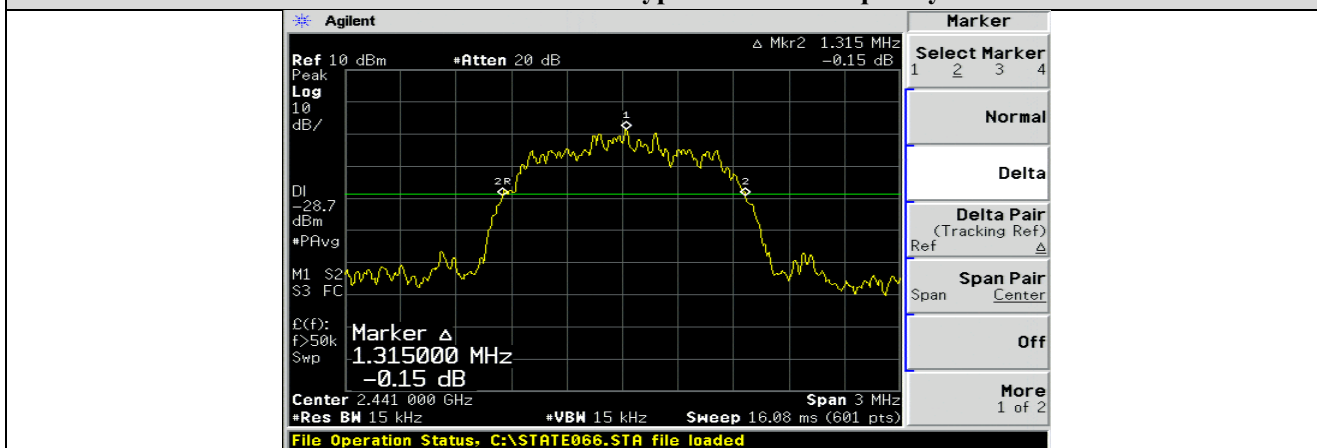


20dB Bandwidth Graphical Test Results

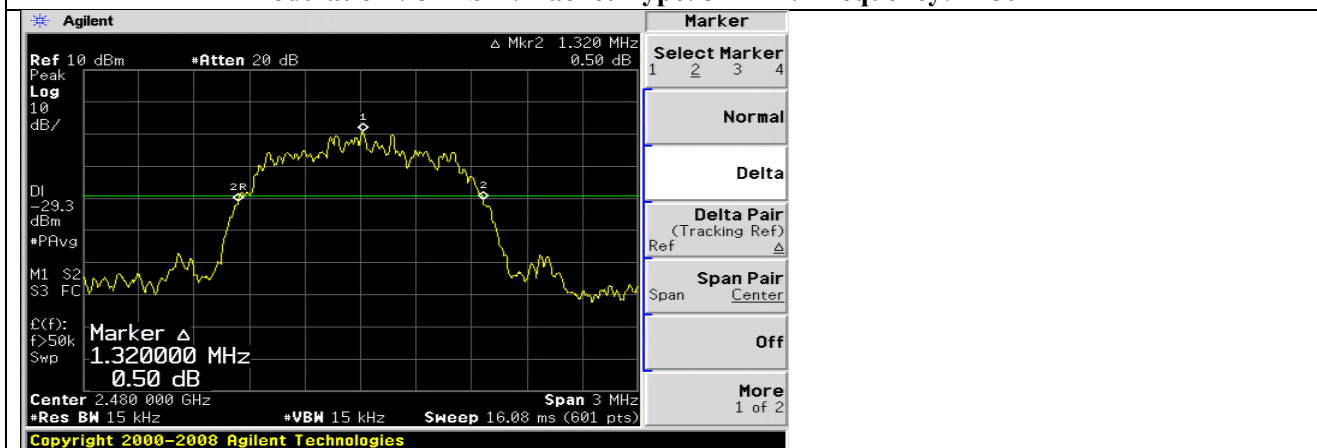
Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2402 MHz



Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2441 MHz



Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2480 MHz



A.2 Maximum Peak Conducted Output Power

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth. However, when a filter with adequate width is not available, an integrated method utilizing a peak detector is acceptable.

A.2.1 Limits

FCC 15.247 (b) (3)

The maximum conducted output power of the intentional radiator for systems using frequency hopping systems in the 2400-2483.5MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS 247 5.4 (2)

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

A.2.3 Test Procedure

Refer to Public Notice DA 00-705

- Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- RBW > the 20 dB bandwidth of the emission being measured
- VBW $\geq$ RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission.



A.2.4 Maximum Peak Conducted Output Power Data Table

Modulation	GFSK	Maximum Peak Conducted Output Power & E.I.R.P				
Packet type:	DH5					
Transmit Chains:	1					
Data Rate:	1 MBps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	6.54	30	2.4	8.94	36	Pass
2441	6.91	30	2.4	9.31	36	Pass
2480	6.59	30	2.4	8.99	36	Pass

Modulation	GFSK	Maximum Peak Conducted Output Power & E.I.R.P				
Packet type:	DH3					
Transmit Chains:	1					
Data Rate:	1 MBps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	6.54	30	2.4	8.94	36	Pass
2441	6.94	30	2.4	9.34	36	Pass
2480	6.65	30	2.4	9.05	36	Pass



Modulation	GFSK	Maximum Peak Conducted Output Power & E.I.R.P				
Packet type:	DH1					
Transmit Chains:	1					
Data Rate:	1 Mbps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	5.34	30	2.4	7.74	36	Pass
2441	5.75	30	2.4	8.15	36	Pass
2480	5.52	30	2.4	7.92	36	Pass
Modulation	$\pi/4$ DQPSK	Maximum Peak Conducted Output Power & E.I.R.P				
Packet type:	2-DH5					
Transmit Chains:	1					
Data Rate:	2 Mbps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	5.10	30	2.4	7.50	36	Pass
2441	5.22	30	2.4	7.62	36	Pass
2480	4.70	30	2.4	7.10	36	Pass



Modulation	$\pi/4$ DQPSK	Maximum Peak Conducted Output Power & E.I.R.P				
Packet type:	2- DH3					
Transmit Chains:	1					
Data Rate:	2 MBps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	5.00	30	2.4	7.40	36	Pass
2441	5.16	30	2.4	7.56	36	Pass
2480	4.65	30	2.4	7.05	36	Pass

Modulation	$\pi/4$ DQPSK	Maximum Peak Conducted Output Power & E.I.R.P				
Packet type:	2-DH1					
Transmit Chains:	1					
Data Rate:	2 MBps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	4.06	30	2.4	6.46	36	Pass
2441	4.16	30	2.4	6.56	36	Pass
2480	3.65	30	2.4	6.05	36	Pass
Modulation	8-DPSK	Maximum Peak Conducted Output Power & E.I.R.P				
Packet type:	3-DH5					
Transmit Chains:	1					
Data Rate:	1 MBps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	4.48	30	2.4	6.88	36	Pass
2441	4.60	30	2.4	7.00	36	Pass
2480	4.12	30	2.4	6.52	36	Pass

Modulation	8-DPSK	Maximum Peak Conducted Output Power & E.I.R.P
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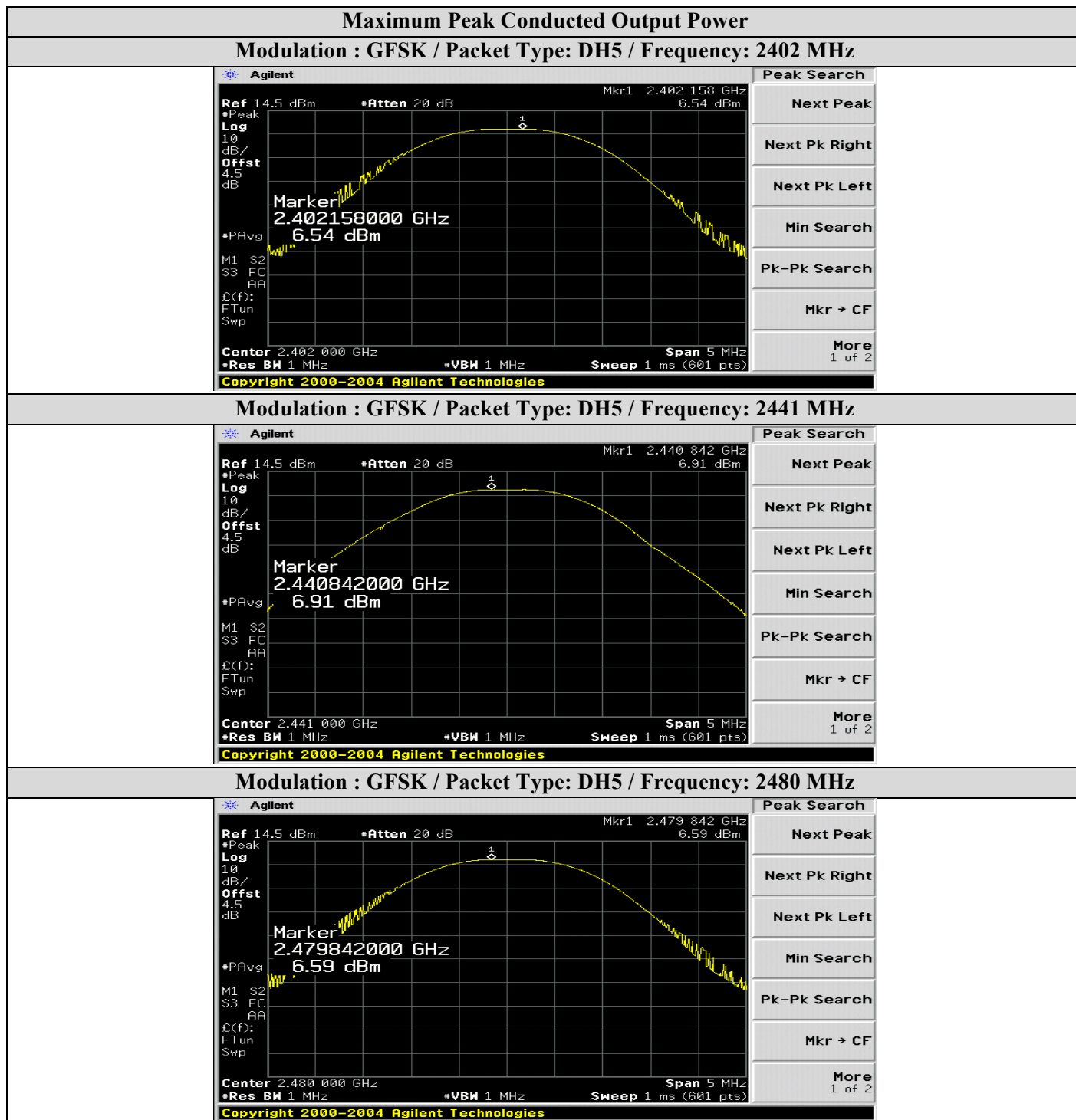
Packet type:	3-DH3					
Transmit Chains:	1					
Data Rate:	3 MBps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	4.48	30	2.4	6.88	36	Pass
2441	4.62	30	2.4	7.02	36	Pass
2480	4.10	30	2.4	6.50	36	Pass

Modulation	8-DPSK	Maximum Peak Conducted Output Power & E.I.R.P				
Packet type:	3-DH1					
Transmit Chains:	1					
Data Rate:	3 MBps					
Frequency (MHz)	Peak Conducted Output Power (dBm)	Peak Conducted Power Limit (dBm)	Antenna Gain (dBi)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	Result
2402	4.55	30	2.4	6.95	36	Pass
2441	4.64	30	2.4	7.04	36	Pass
2480	4.20	30	2.4	6.60	36	Pass

Note: Worst case is determined as the modulation with Highest Output Power.

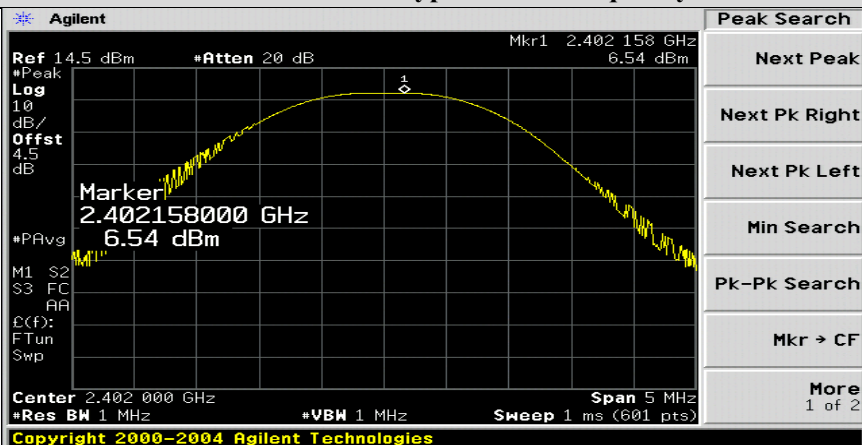
Worst cases emissions to be determined as GFSK / DH-3

A.2.5 Maximum Peak Conducted Output Power Graphical Test Results

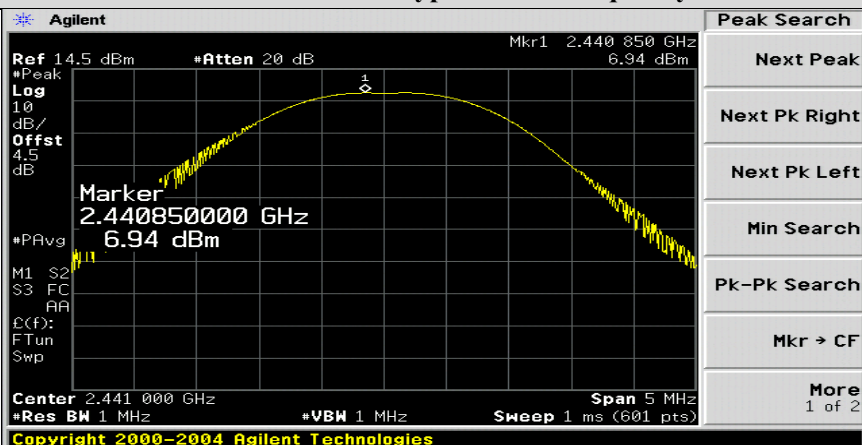


Maximum Peak Conducted Output Power

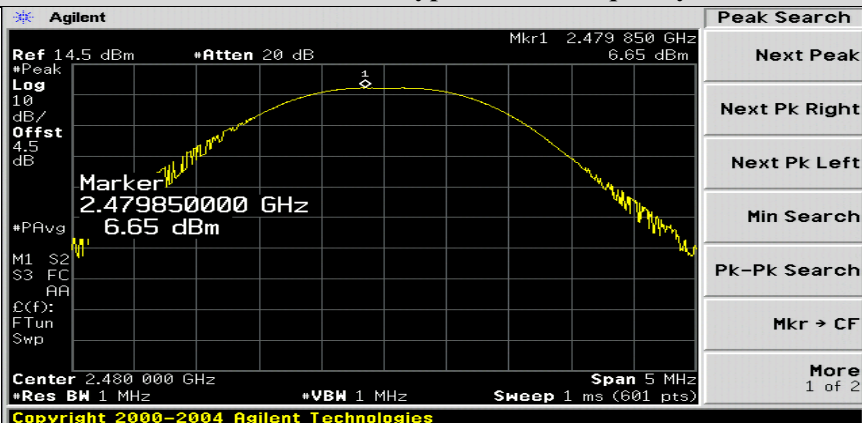
Modulation : GFSK / Packet Type: DH3 / Frequency: 2402 MHz



Modulation : GFSK / Packet Type: DH3 / Frequency: 2441 MHz



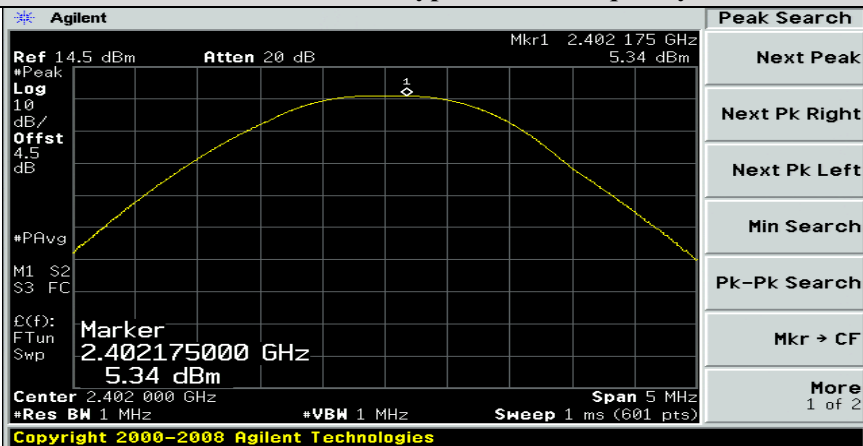
Modulation : GFSK / Packet Type: DH3 / Frequency: 2480 MHz



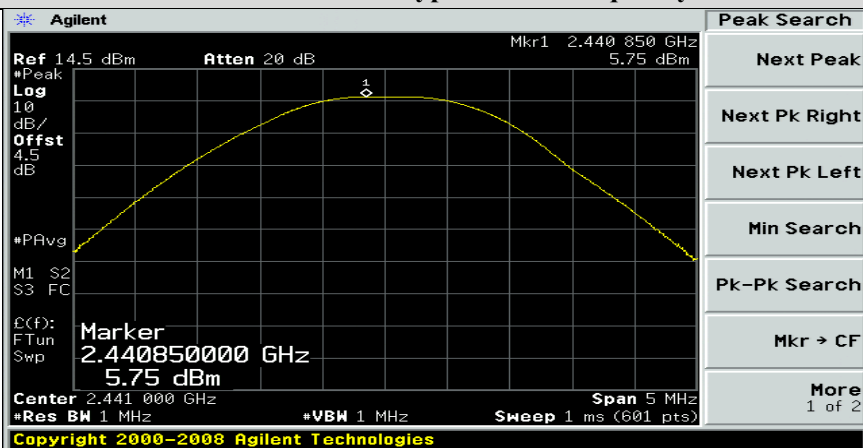
Maximum Peak Conducted Output Power



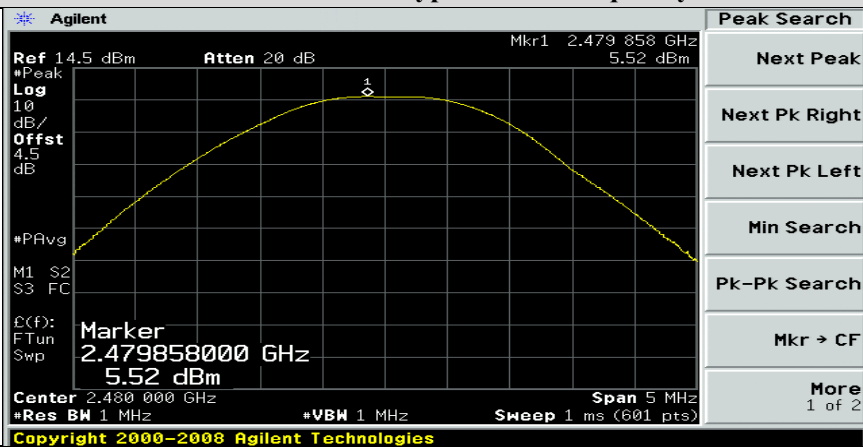
Modulation : GFSK / Packet Type: DH1 / Frequency: 2402 MHz



Modulation : GFSK / Packet Type: DH1 / Frequency: 2441 MHz

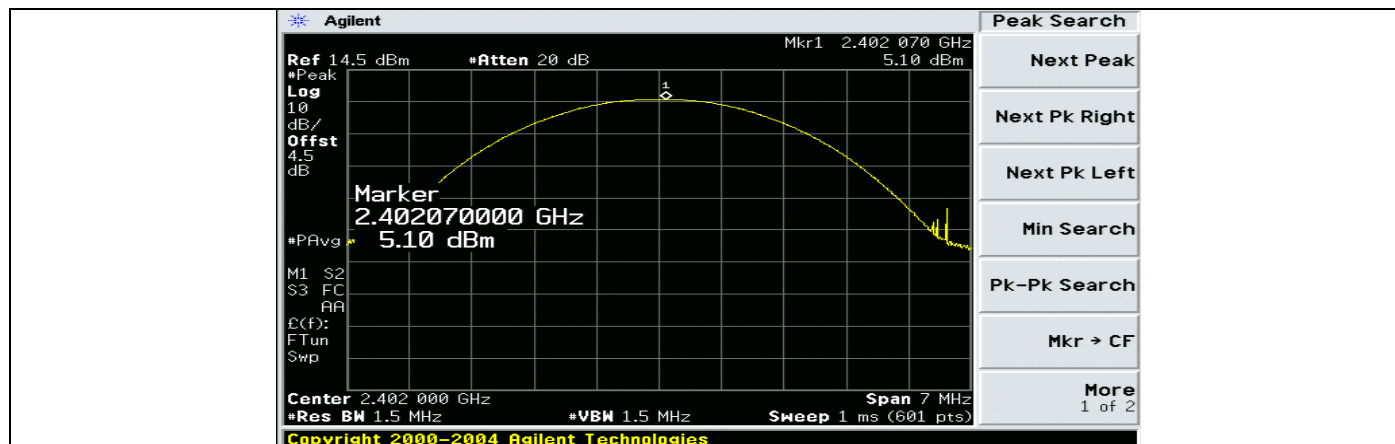


Modulation : GFSK / Packet Type: DH1 / Frequency: 2480 MHz

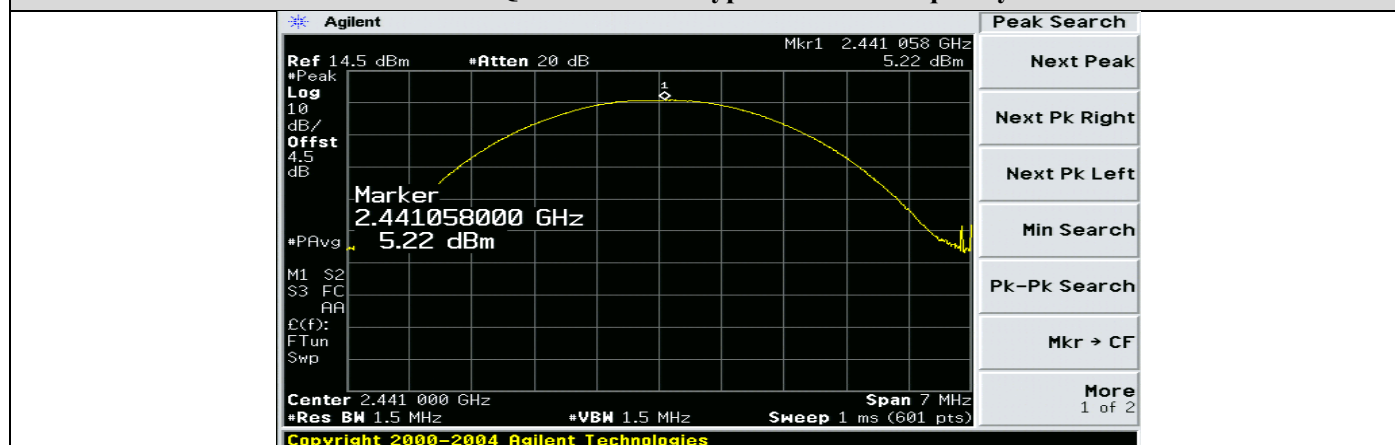


Maximum Peak Conducted Output Power

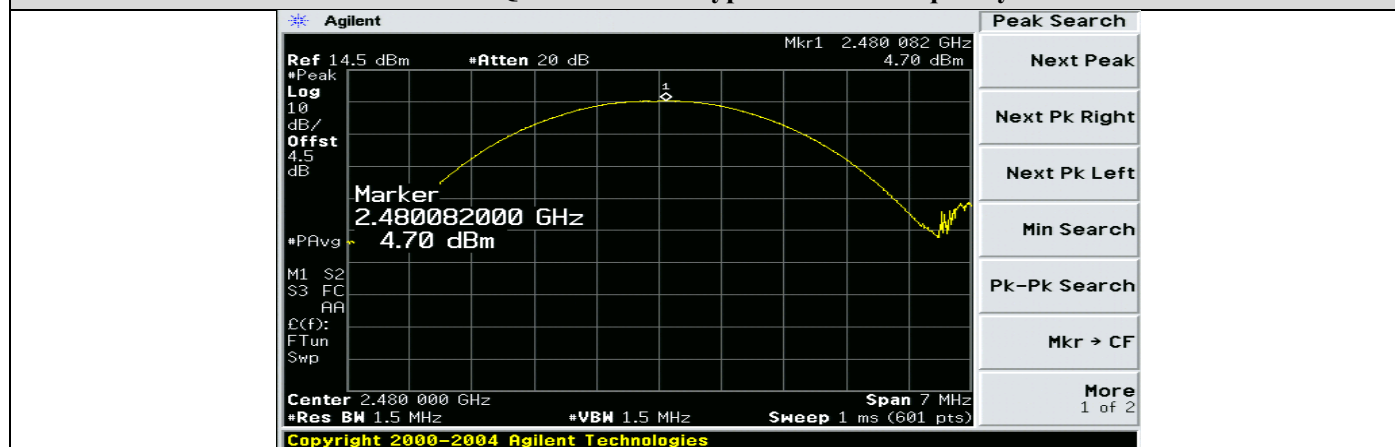
Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH5 / Frequency: 2402 MHz



Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH5 / Frequency: 2441 MHz

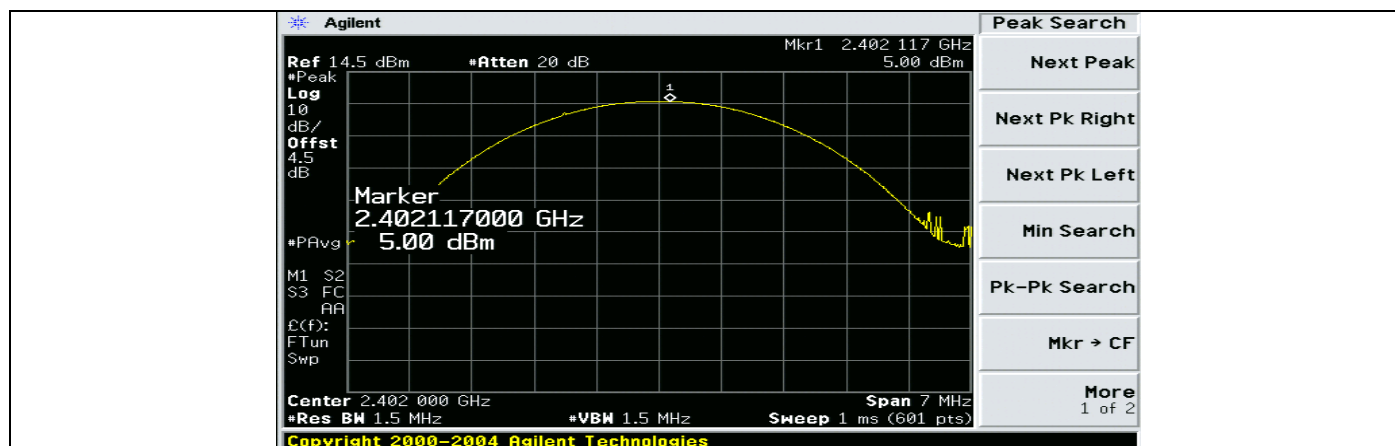


Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH5 / Frequency: 2480 MHz

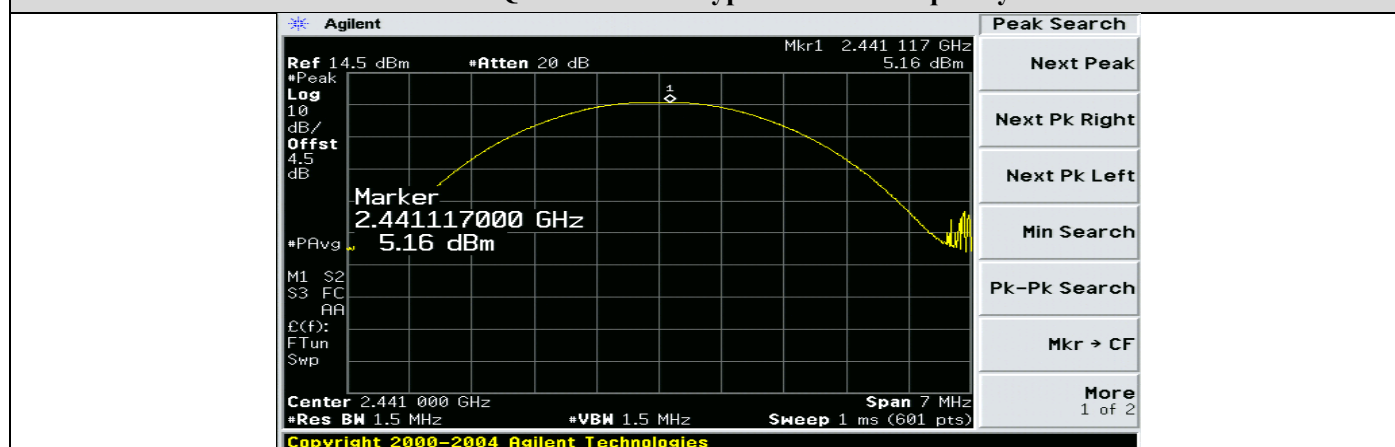


Maximum Peak Conducted Output Power

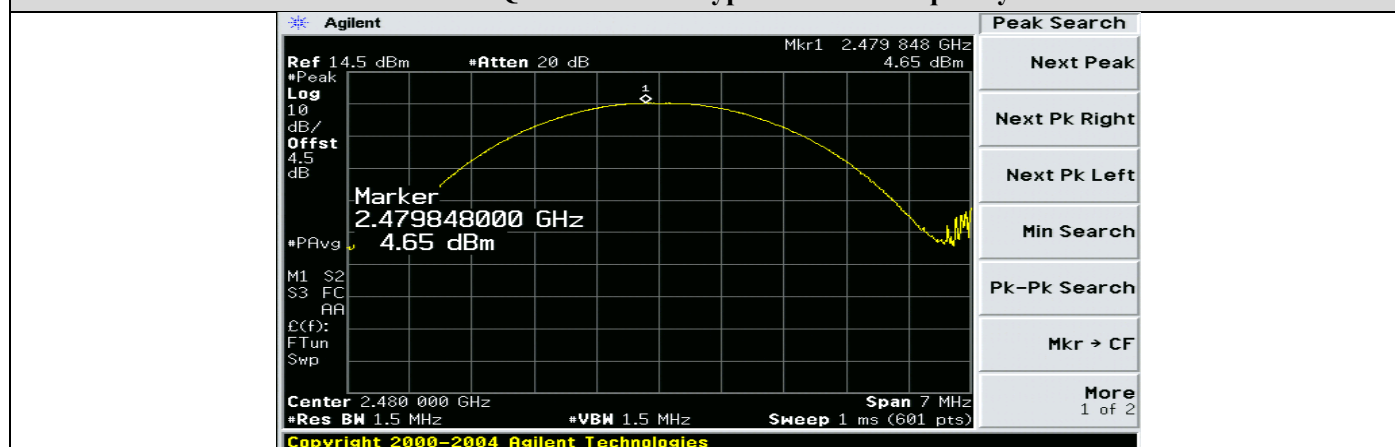
Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH3 / Frequency: 2402 MHz



Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH3 / Frequency: 2441 MHz

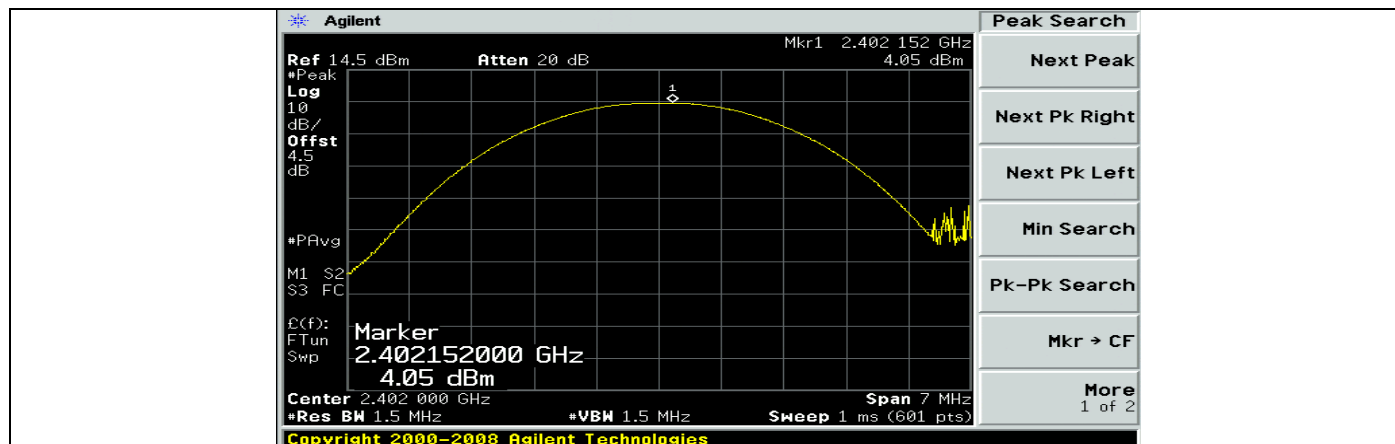


Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH3 / Frequency: 2480 MHz

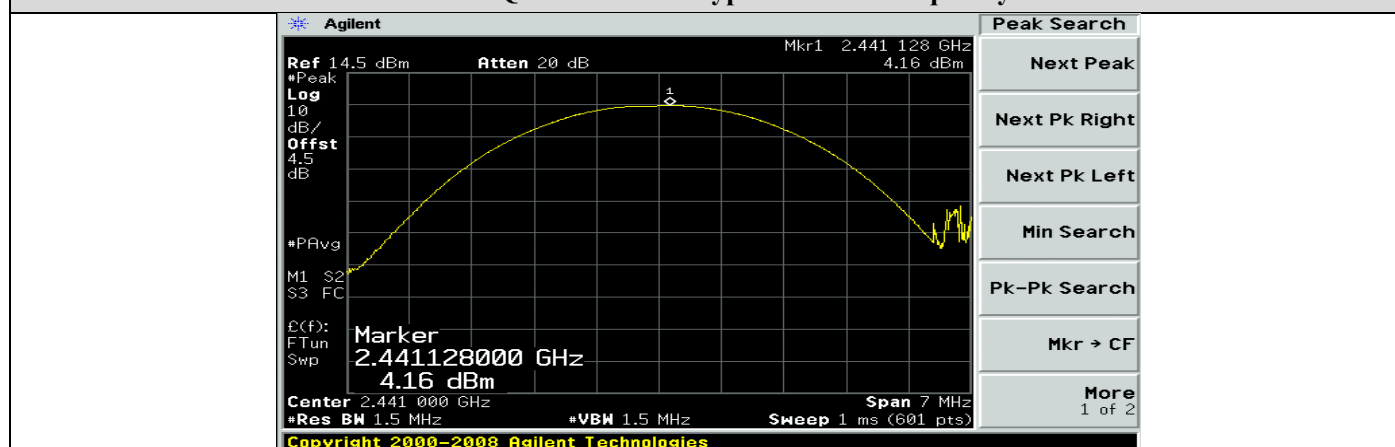


Maximum Peak Conducted Output Power

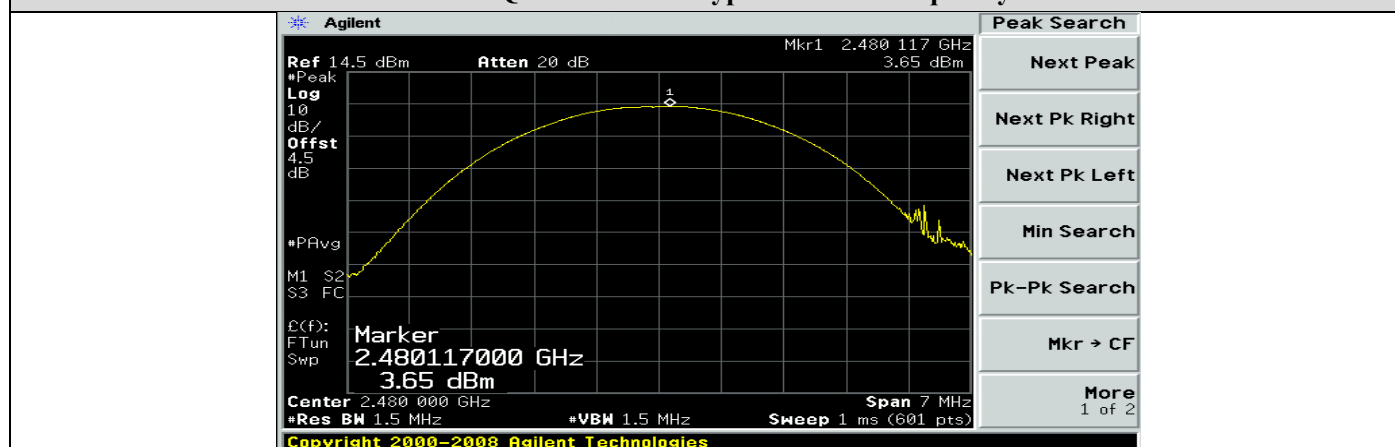
Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH1 / Frequency: 2402 MHz



Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH1 / Frequency: 2441 MHz

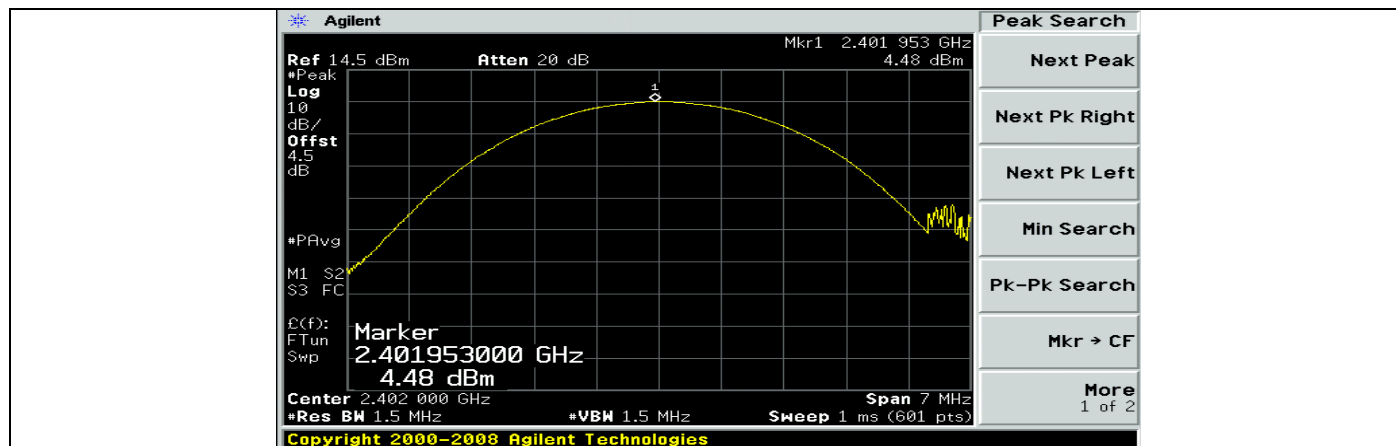


Modulation : $\pi/4$ DQPSK / Packet Type: 2-DH1 / Frequency: 2480 MHz

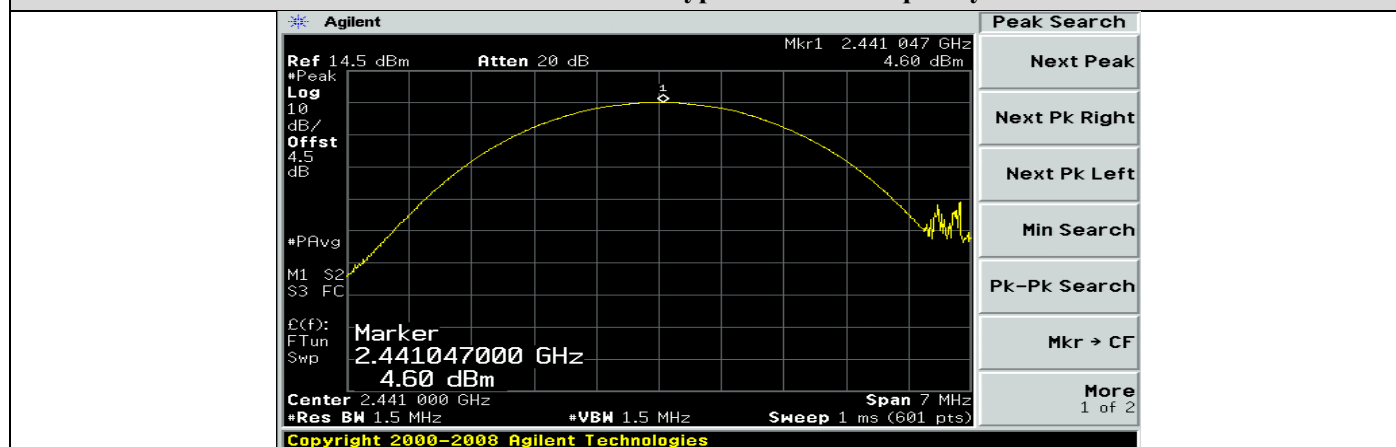


Maximum Peak Conducted Output Power

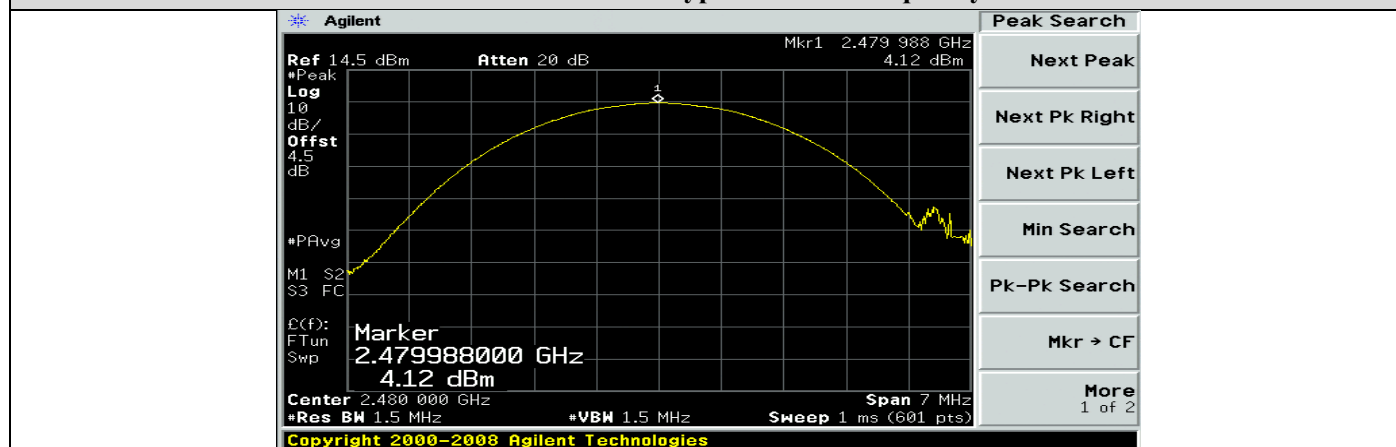
Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2402 MHz



Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2441 MHz

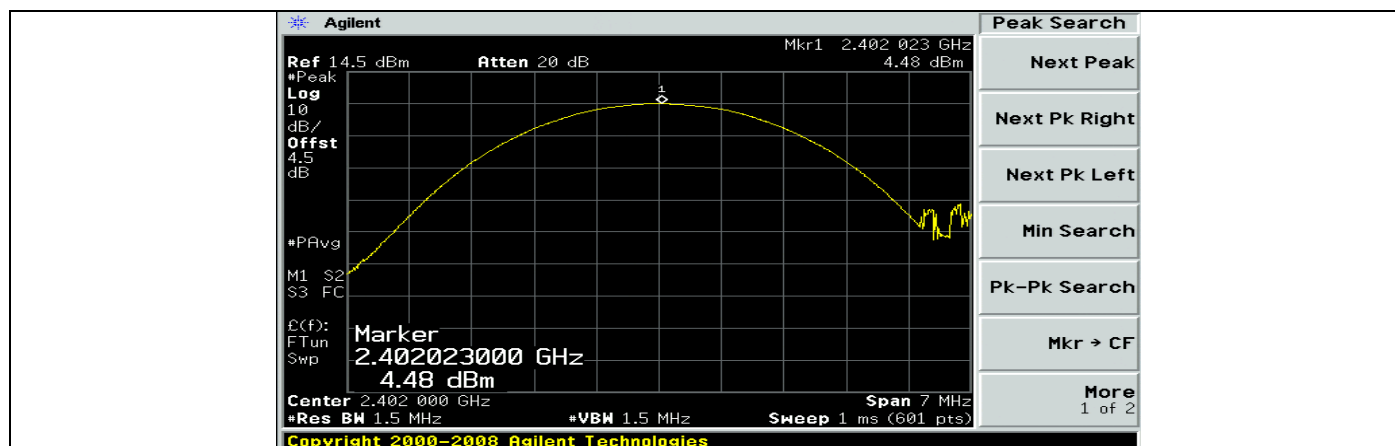


Modulation : 8DPSK / Packet Type: 3-DH5 / Frequency: 2480 MHz

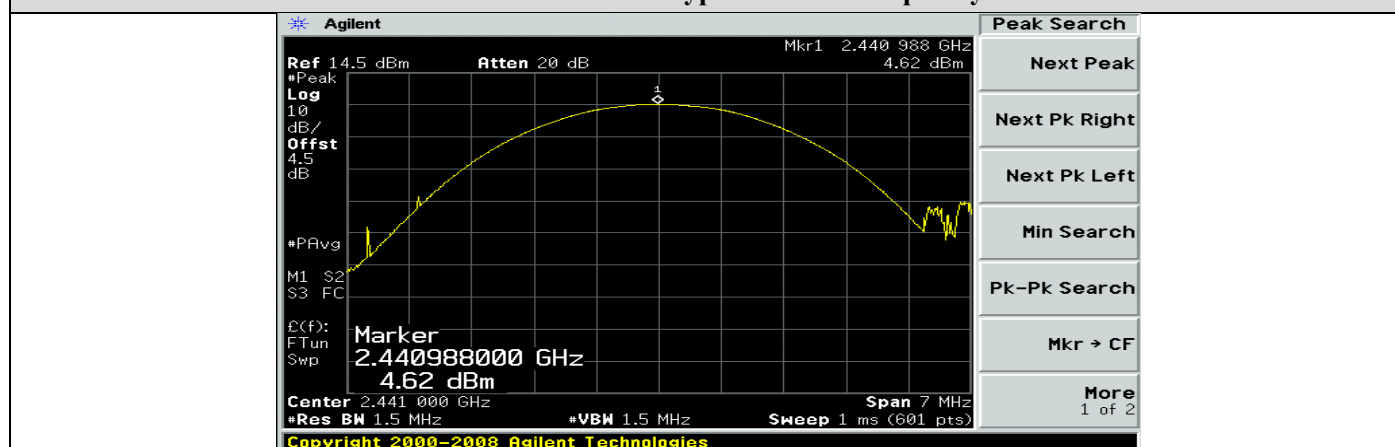


Maximum Peak Conducted Output Power

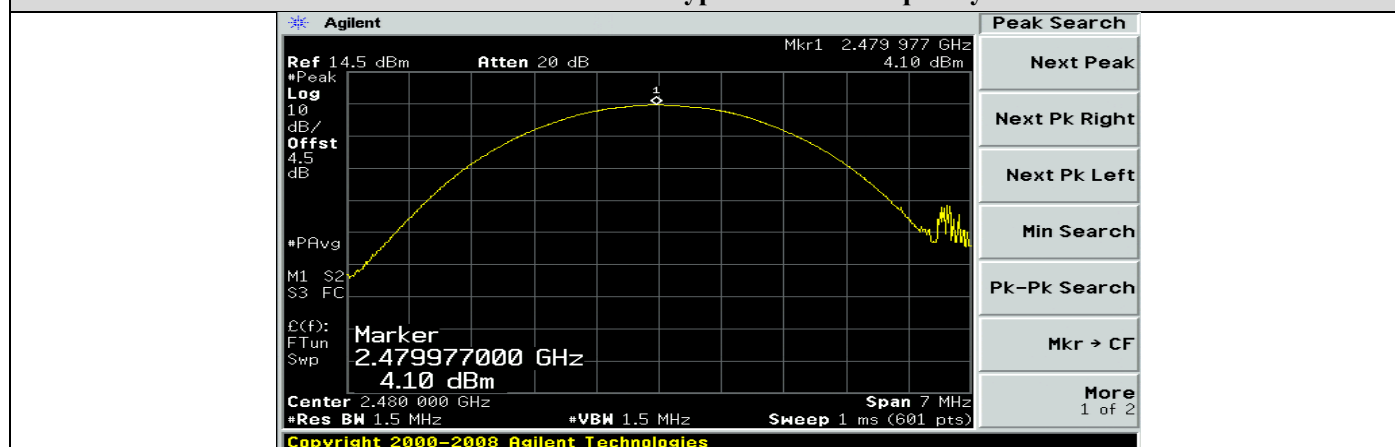
Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2402 MHz



Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2441 MHz

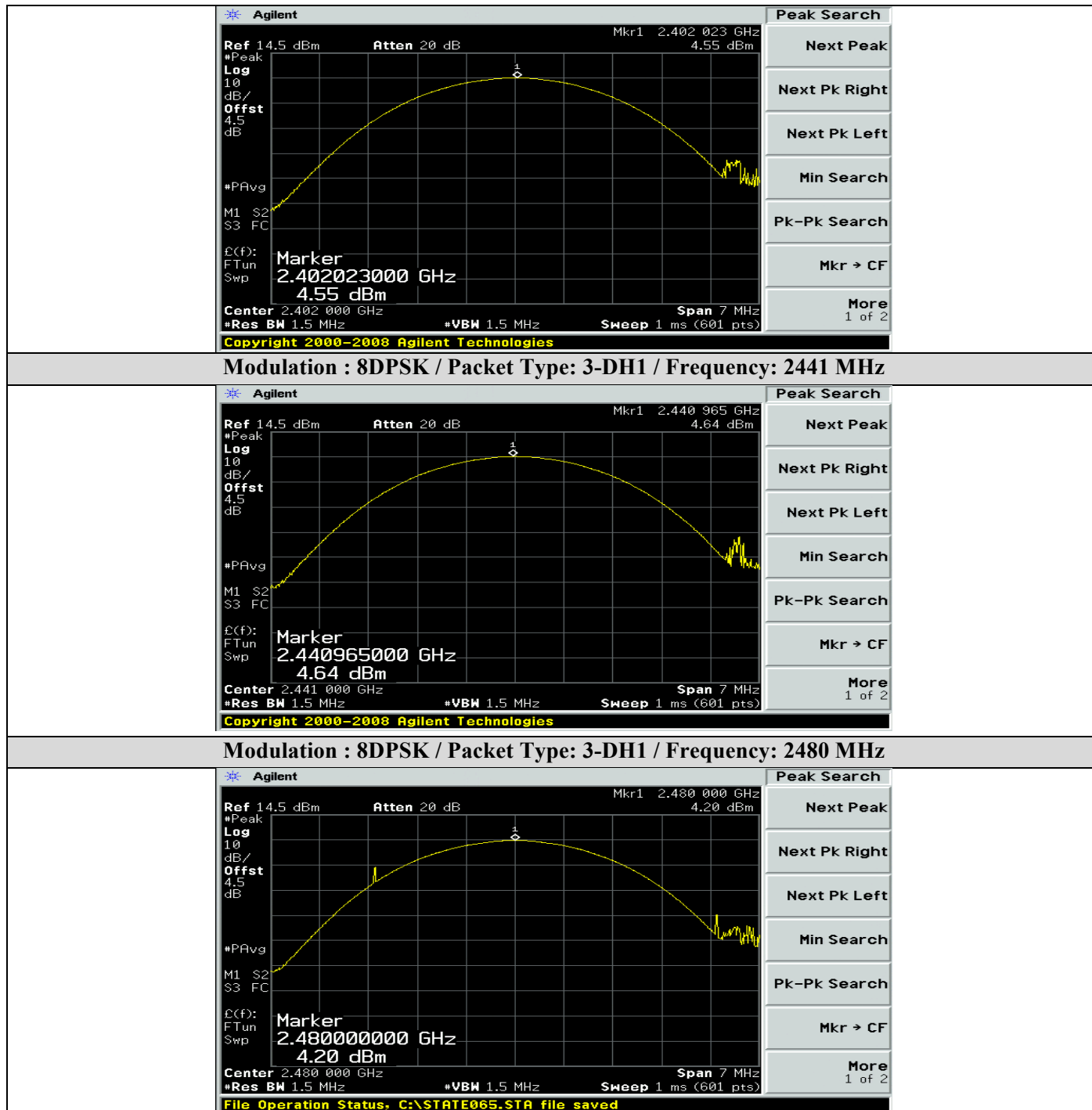


Modulation : 8DPSK / Packet Type: 3-DH3 / Frequency: 2480 MHz



Maximum Peak Conducted Output Power

Modulation : 8DPSK / Packet Type: 3-DH1 / Frequency: 2402 MHz



A.3 Carrier Frequency Separation

A.3.1 Limits

FCC 15.247(a) (1) & & RSS-247 5.1(2)

For frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel frequencies that are separated by 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternately, frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.

A.3.2 Test Procedure

Refer Public Notice DA 00-705

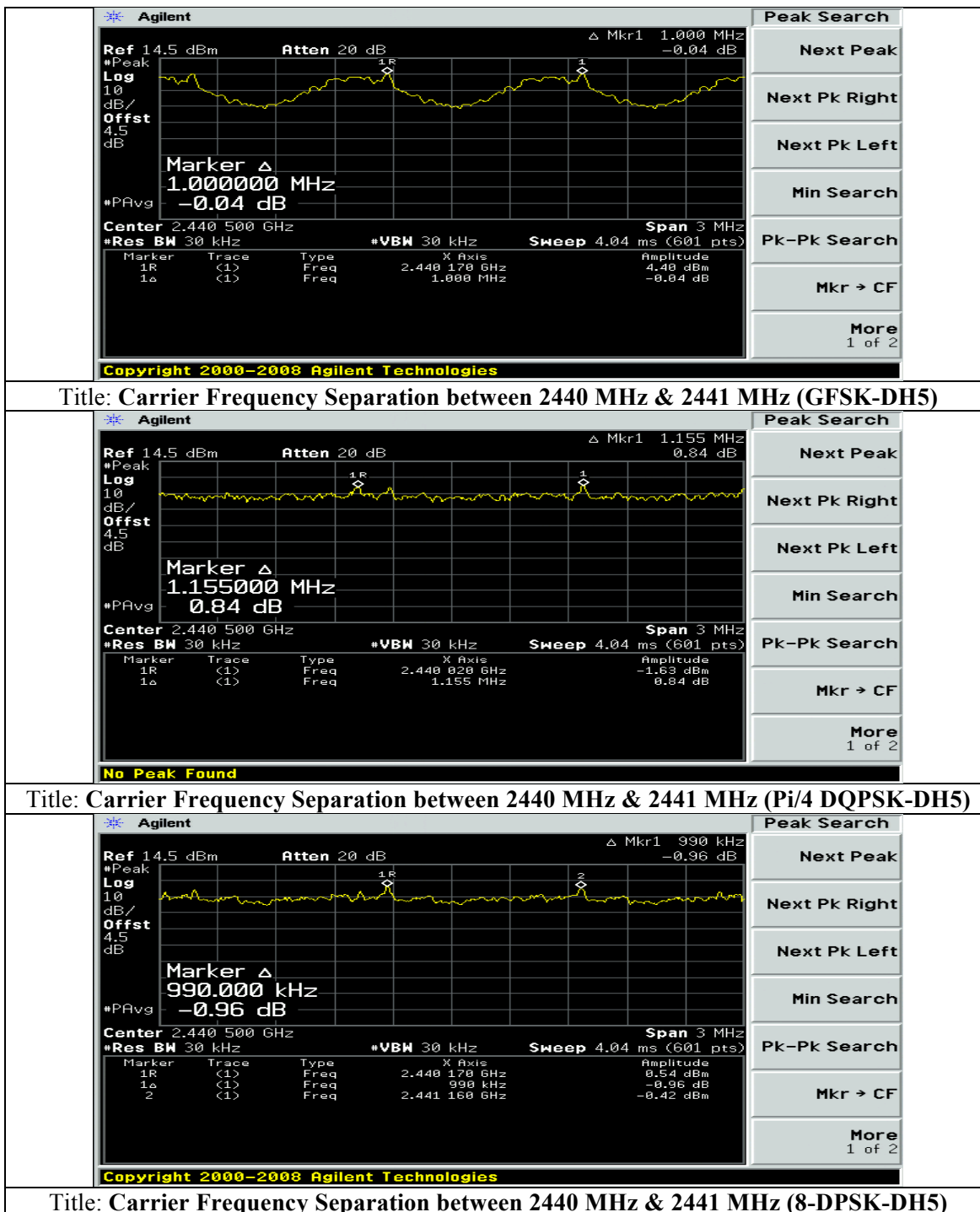
The EUT must have its hopping function enabled. Use the following spectrum analyzer Settings:

- Span = wide enough to capture the peaks of two adjacent channels
- Resolution (or IF) Bandwidth (RBW) > 1% of the span
- Video (or Average) Bandwidth (VBW) > RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

A.3.3 Carrier Frequency Separation Data Table

Frequency (MHz)	Modulation Systems	Carrier Frequency Separation (KHz)	Limits (KHz)	Results
2440 & 2441	GFSK	1000.00	935	Pass
2440 & 2441	$\pi/4$ DQPSK	1155.00	900	Pass
2440 & 2441	8- DPSK	990.00	882	Pass

A.3.4 Carrier Frequency Separation Graphical Results



A.4 Number of Hopping Frequencies

A.4.1 Limits

FCC 15.247(a) (iii) & RSS-247 (5.1) (4)

Frequency hopping systems operating in the band 2400-2483.5MHz shall use at least 15 hopping channels.

A.4.2 Test Procedures

Refer to Public Notice DA 00-705

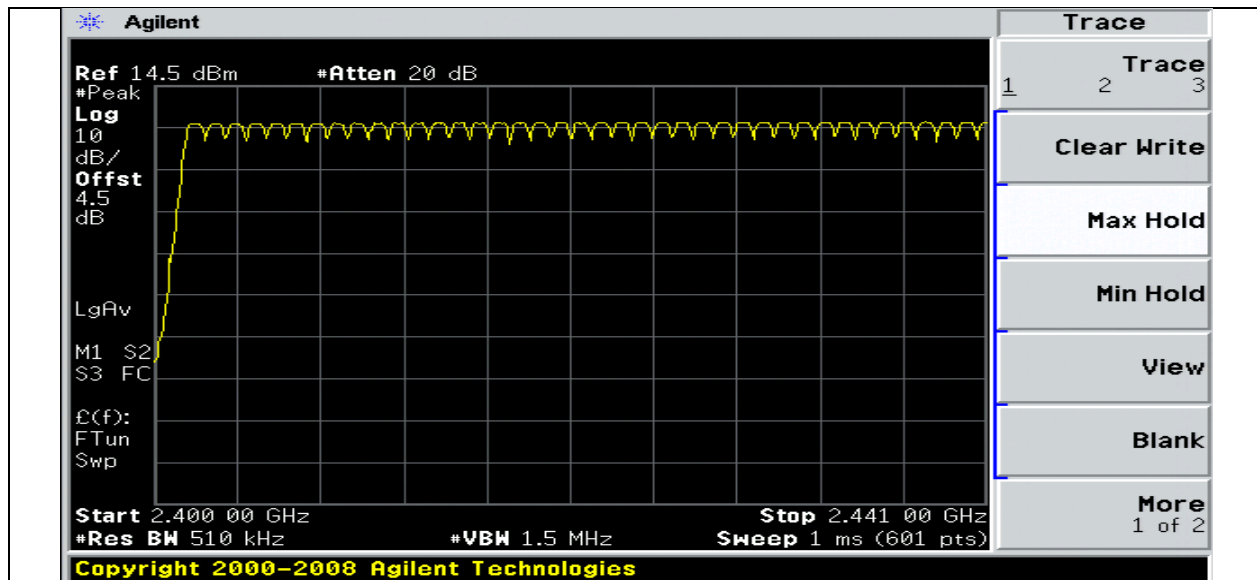
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span = the frequency band of operation
- RBW > 1% of the span
- VBW > RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

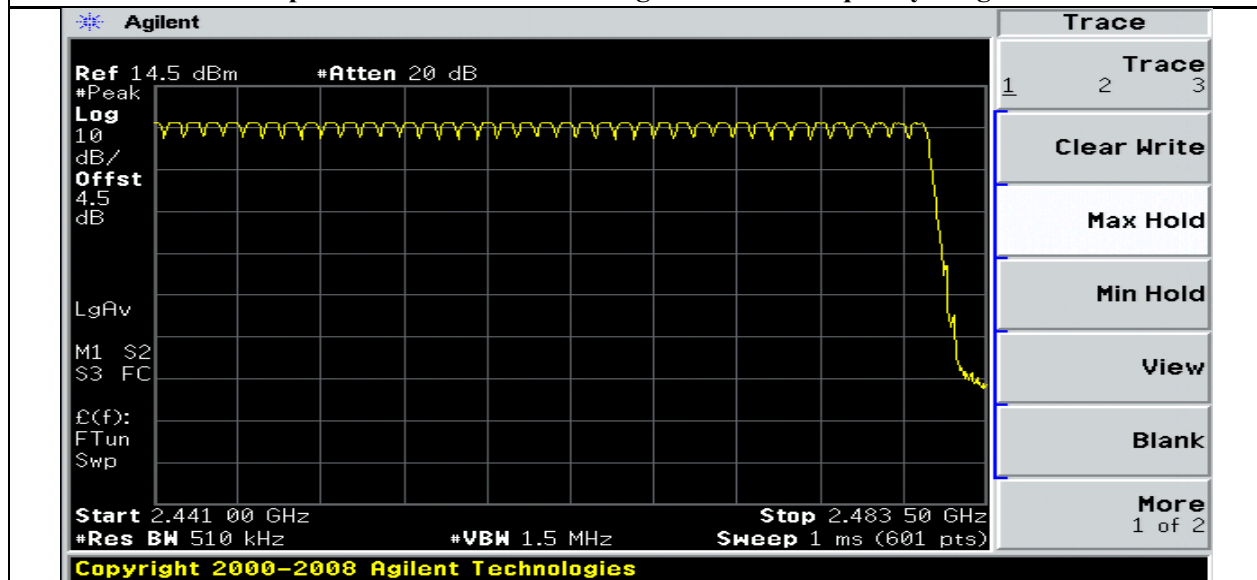
A.4.3 Number of Hopping Frequencies Data Table

Frequency (MHz)	Total No. of Channels	Limits	Results
2400 – 2483.5	79	≥ 15	Pass
Total number of hopping frequencies in the 2400-2483.5MHz Band = 79 Channels			

A.4.3 Number of Hopping Frequencies Graphical Test Results



Title: Total No. of Hops Channels = 39.5 for 1st segment in the frequency range 2400-2440MHz



Title: Total No. of Hops Channels = 39.5 for 2nd segment in the frequency range 2441-2483.5MHz

A.5 Average Time of Occupancy

A.5.1 Limits

FCC 15.247 (a) (iii) & RSS-247 (5.1) (4)

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.

A.5.2 Test Procedure

Refer to Public Notice DA 00 705

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

- Span = zero span, centered on a hopping channel
- RBW = 1 MHz
- VBW $\geq$ RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector function = peak
- Trace = max hold
- If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation

The total sweep time is $0.4(79) = 31.6$ seconds.

Due to the number of hops in the 31.6s sweep we determined to reduce the sweep time to 15.80, count the number of hops and multiply by 2. The total number of hops will be multiplied by the measured time of one pulse.

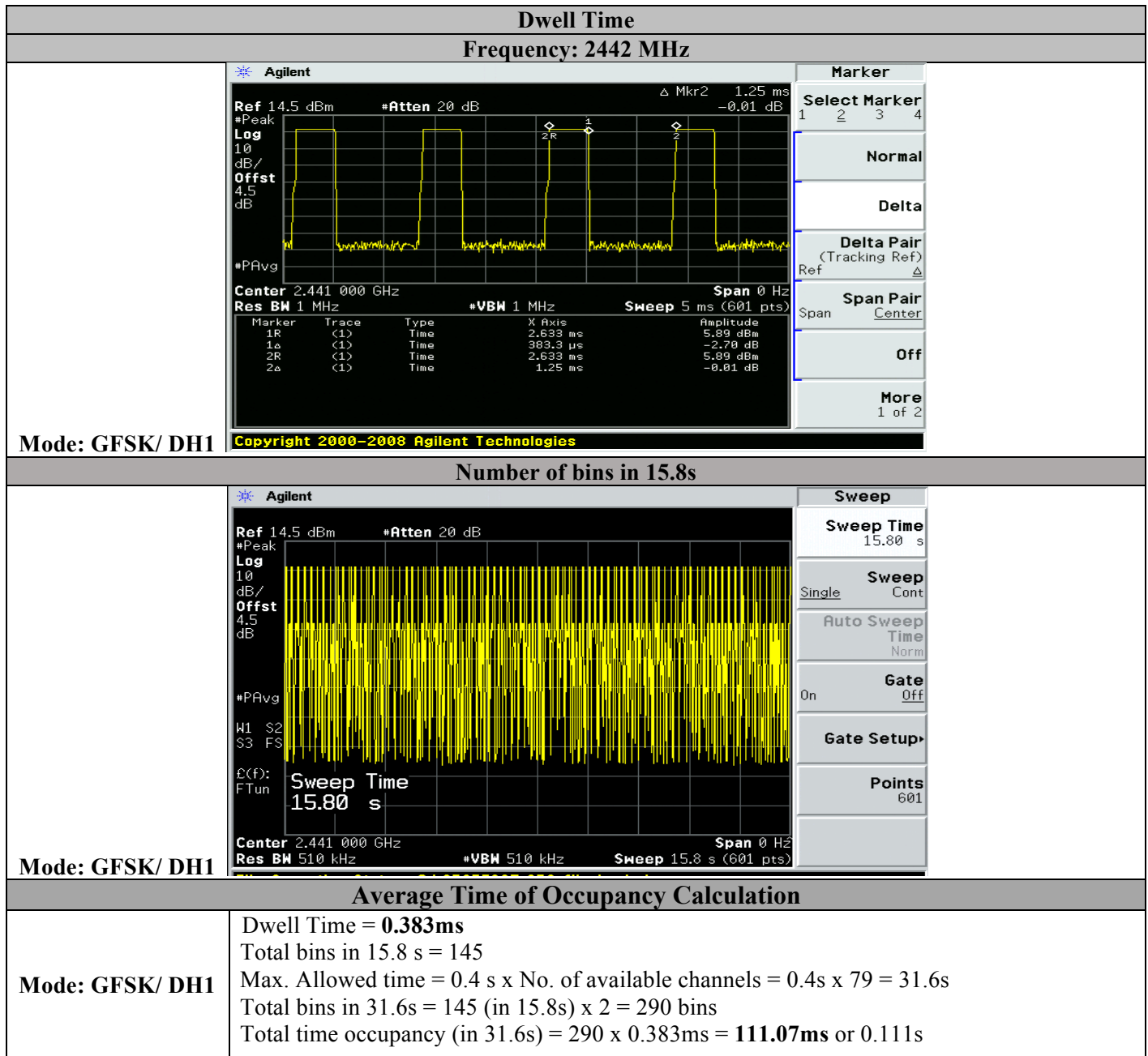
Example: Number of Hops in 15.80s = 80. Total Number of Hops in 31.6s = $80(2) = 160$
Single Pulse Width = 0.001s. Time of Occupancy = $160(0.001) = 0.160$ s



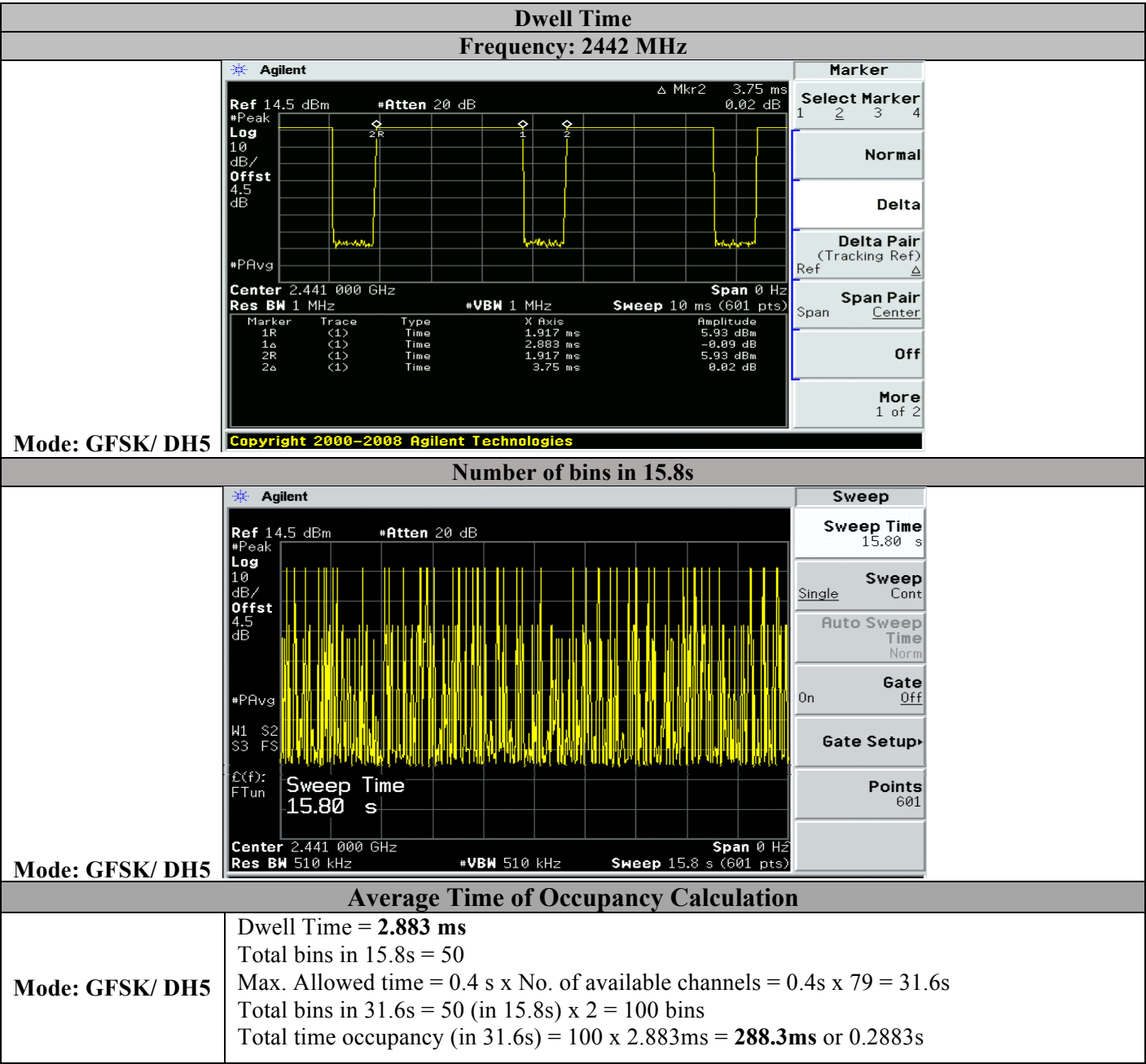
A.5.3 Average Time of Occupancy and Dwell Time Data table

Frequency (MHz)	Packet Type	Dwell Time (ms)	Time Occupancy (ms)	Limits (ms)	Results
2441	DH1	0.383	111.07	400	Pass
2441	DH3	1.65	264.0	400	Pass
2441	DH5	2.883	288.3	400	Pass
2441	2-DH1	0.3917	116.816	400	Pass
2441	2-DH3	1.65	260.8	400	Pass
2441	2-DH5	2.9	235.586	400	Pass
2441	3-DH1	0.3917	113.68	400	Pass
2441	3-DH3	1.63	270.6	400	Pass
2441	3-DH5	2.873	266.8	400	Pass

A.5.4 Average Time of Occupancy, Dwell Time Graphical Test Results & Calculation



Dwell Time																										
Frequency: 2441 MHz																										
Agilent Ref 14.5 dBm *Peak Log 10 dB/ Offst 4.5 dB *Atten 20 dB Δ Mkr2 2.5 ms 0.02 dB Center 2.441 000 GHz Res BW 1 MHz *VBW 1 MHz Sweep 10 ms (601 pts) <table><tr><th>Marker</th><th>Trace</th><th>Type</th><th>X Axis</th><th>Amplitude</th></tr><tr><td>1R</td><td>(1)</td><td>Time</td><td>4.433 ms</td><td>5.85 dBm</td></tr><tr><td>1Δ</td><td>(1)</td><td>Time</td><td>1.65 ms</td><td>-0.32 dB</td></tr><tr><td>2R</td><td>(1)</td><td>Time</td><td>4.433 ms</td><td>5.85 dBm</td></tr><tr><td>2Δ</td><td>(1)</td><td>Time</td><td>2.5 ms</td><td>0.02 dB</td></tr></table> Marker Select Marker 1 2 3 4 Normal Delta Delta Pair (Tracking Ref) Ref Δ Span Pair Span Center Off More 1 of 2	Marker	Trace	Type	X Axis	Amplitude	1R	(1)	Time	4.433 ms	5.85 dBm	1Δ	(1)	Time	1.65 ms	-0.32 dB	2R	(1)	Time	4.433 ms	5.85 dBm	2Δ	(1)	Time	2.5 ms	0.02 dB	Mode: GFSK/ DH3 Copyright 2000–2008 Agilent Technologies
Marker	Trace	Type	X Axis	Amplitude																						
1R	(1)	Time	4.433 ms	5.85 dBm																						
1Δ	(1)	Time	1.65 ms	-0.32 dB																						
2R	(1)	Time	4.433 ms	5.85 dBm																						
2Δ	(1)	Time	2.5 ms	0.02 dB																						
Number of bins in 15.8s																										
Agilent Ref 14.5 dBm *Peak Log 10 dB/ Offst 4.5 dB *Atten 20 dB Center 2.441 000 GHz Res BW 510 kHz *VBW 510 kHz Sweep 15.8 s (601 pts) W1 S2 S3 FS Δ(F): FTun Marker Select Marker 1 2 3 4 Normal Delta Delta Pair (Tracking Ref) Ref Δ Span Pair Span Center Off More 1 of 2	Mode: GFSK/ DH3																									
Mode: GFSK/ DH3	Dwell Time = 1.65ms Total bins in 15.8 s = 80 Max. Allowed time = 0.4 s x No. of available channels = 0.4s x 79 = 31.6s Total bins in 31.6s = 80 (in 15.8s) x 2 = 160 bins Total time occupancy (in 31.6s) = 160 x 1.65ms = 264ms or 0.264s																									





Dwell Time	
Frequency: 2442 MHz	
Mode: $\pi/4$ DQPSK	Agilent Ref 14.5 dBm #Peak Log 10 dB/ Offst 4.5 dB #PAvg Center 2.441 000 GHz Res BW 1 MHz #VBW 1 MHz Sweep 5 ms (601 pts) Span 0 Hz Marker Trace Type X Axis Amplitude 1R (1) Time 1.808 ms 2.07 dBm 1a (1) Time 391.7 μs 0.85 dB 2R (1) Time 1.808 ms 2.07 dBm 2a (1) Time 1.25 ms -0.01 dB Marker Select Marker 1 2 3 4 Normal Delta Delta Pair (Tracking Ref) Ref Span Pair Span Center Off More 1 of 2 Copyright 2000–2008 Agilent Technologies

