# RF TEST REPORT

| | | |
|---|---|---|
| Test item | : | Cellular/PCS GSM/GPRS/EDGE(RX Only)/WCDMA/HSDPA Phone with Bluetooth, WLAN |
| Model No. | : | LG-E425g, LG-E425G, LGE425g, LGE425G, E425g, E425G LG-E431g, LG-E431G, LGE431g, LGE431G, E431g, E431G |
| Order No. | : | DEMC1301-00299 |
| Date of receipt | : | 2013-01-23 |
| Test duration | : | 2013-01-30 ~ 2013-02-06 |
| Date of issue | : | 2013-03-05 |
| Use of report | : | FCC Original Grant |

Applicant : LG Electronics MobileComm U.S.A., Inc.
1000 Sylvan Avenue, Englewood Cliffs NJ 07632

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Kyunggi-Do, 449-080, Korea

| | | |
|---|---|---|
| Test specification | : | FCC Part 15 Subpart C 247 |
| Test environment | : | See appended test report |
| Test result | : | ☒ Pass ☐ Fail |



| Tested by: | Witnessed by: | Reviewed by: |
|---|---|---|
| Engineer<br>Hyun-Su, Son | N/A | Technical Director<br>Harvey Sung |

# Test Report Version

| Test Report No. | Date | Description |
|---|---|---|
| DRTFCC1303-0198 | Mar. 05, 2013 | Initial issue |
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# 1.General Information

## 1.1 Testing Laboratory

**Digital EMC Co., Ltd.**
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Kyunggi-Do, 449-080, Korea
www.digitalemc.com
Telephone : + 82-31-321-2664
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## 1.2 Details of Applicant

Applicant : LG Electronics MobileComm U.S.A., Inc.
Address : 1000 Sylvan Avenue, Englewood Cliffs NJ 07632
Contact person : CheolGooLee
Phone No. : +82-2-2033-1111

## 1.3 Description of EUT

| | |
|---|---|
| **Product** | Cellular/PCS GSM/GPRS/EDGE(RX Only)/WCDMA/HSDPA Phone with Bluetooth, WLAN |
| **Model Name** | LG-E425g, LG-E425G, LGE425g, LGE425G, E425g, E425G<br>LG-E431g, LG-E431G, LGE431g, LGE431G, E431g, E431G<br>※12 models are same mechanical, electrical and functional.<br>※The only difference is the model name, which are changed for marketing purpose. |
| **Serial Number** | Identical prototype |
| **Power Supply** | LithiumIonBattery: DC 3.7V |
| **Frequency Range** | 2402 ~ 2480MHz |
| **Modulation Technique** | GFSK, π/4-DQPSK, 8DPSK |
| **Number of Channels** | 79 |
| **Antenna Type** | InternalAntenna |
| **Antenna Gain** | PK :0.21dBi |

## 1.4. Declaration by the manufacturer

- N/A

## 1.5. Information about the FHSS characteristics:

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:
  A) The hopping sequence is pseudorandom
  B) All channels are used equally on average
  C) The receiver input bandwidth equals the transmit bandwidth
  D) The receiver hops in sequence with the transmit signal
- 15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.
- 15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.
- 15.247(h): The EUT employs Adaptive Frequency Hopping (AFH) which identifies sources of interference namely devices operating in 802.11 WLAN and excludes them from the list of available channels. The process of re-mapping reduces the number of test channels from 79 channels to a minimum number of 20 channels.

## 1.6. Test Equipment List

| Type | Manufacturer | Model | Cal.Date (yy/mm/dd) | Next.Cal.Date (yy/mm/dd) | S/N |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent | E4440A | 12/09/18 | 13/09/18 | MY45304199 |
| Spectrum Analyzer | Rohde Schwarz | FSQ26 | 12/02/06 | 13/02/06 | 200445 |
| | | | 13/02/14 | 14/02/14 | |
| Power Splitter | Anritsu | K241B | 12/09/17 | 13/09/17 | 020611 |
| Digital Multimeter | H.P | 34401A | 12/03/05 | 13/03/05 | 3146A13475 |
| | | | 13/02/27 | 14/02/27 | |
| Signal Generator | Rohde Schwarz | SMR20 | 12/03/05 | 13/03/05 | 101251 |
| | | | 13/02/27 | 14/02/27 | |
| Bluetooth Tester | TESCOM | TC-3000B | 12/07/01 | 13/07/01 | 3000B640046 |
| Thermo hygrometer | BODYCOM | BJ5478 | 12/06/20 | 13/06/20 | 120612-2 |
| DC Power Supply | HP | 6622A | 12/03/05 | 13/03/05 | 3448A03760 |
| | | | 13/02/27 | 14/02/27 | |
| High-pass filter | Wainwright | WHNX3.0 | 12/09/17 | 13/09/17 | 9 |
| LOOP Antenna | Schwarzbeck | FMZB1513 | 12/09/24 | 13/09/24 | 1513-128 |
| BILOG ANTENNA | SCHAFFNER | CBL6112B | 12/11/16 | 14/11/16 | 2737 |
| HORN ANT | ETS | 3115 | 12/02/20 | 14/02/20 | 6419 |
| HORN ANT | A.H.Systems | SAS-574 | 11/03/25 | 13/03/25 | 154 |
| Amplifier (22dB) | H.P | 8447E | 13/01/08 | 14/01/08 | 2945A02865 |
| Amplifier (30dB) | Agilent | 8449B | 12/03/05 | 13/03/05 | 3008A00370 |
| | | | 13/02/27 | 14/02/27 | |
| EMI TEST RECEIVER | R&S | ESU | 13/01/08 | 14/01/08 | 100014 |
| EMI TEST RECEIVER | R&S | ESCI | 12/03/06 | 13/03/06 | 100364 |
| | | | 13/02/27 | 14/02/27 | |
| CVCF | KIKUSUI | PCR1000L | 12/09/15 | 13/09/15 | 14110610 |
| LISN | R&S | ESH2-Z5 | 12/09/18 | 13/09/18 | 828739/006 |

## 1.7. Summary of Test Results

| FCC Part Section(s) | Parameter | Limit (Using in 2400~ 2483.5MHz) | Test Condition | Status Note 1 |
|---|---|---|---|---|
| 15.247(a)<br>RSS-210 A8.1 | Carrier Frequency Separation | >= 20dB BW or >= Two-Thirds of the 20dB BW | Conducted | C |
| | Number of Hopping Frequencies | >= 15 hops | | C |
| | 20 dB Bandwidth | None | | C |
| | Dwell Time | =< 0.4 seconds | | C |
| 15.247(b)<br>RSS-210 A8.4 | Transmitter Output Power | =< 1Watt , if CHs >= 75 Others =<0.125W | | C |
| 15.247(d)<br>RSS-210 A8.5 | Band-edge | The radiated emission to any 100 kHz of out-band shall be at least 20dB below the highest in-band spectral density. | | C |
| | Conducted Spurious Emissions | | | C |
| 15.205<br>15.209<br>RSS-210 A8.5 | RadiatedEmissions | FCC 15.209 Limits | Radiated | C |
| 15.207<br>RSS-Gen 7.2.4 | AC Conducted Emissions | FCC 15.207 Limits | AC Line Conducted | C |
| 15.203 | Antenna Requirements | FCC 15.203 | - | C |

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2:The sample was tested according to the following specification:
ANSI C63.10-2009, DA00-705

## 1.8 Conclusion of worst-case and operation mode

The EUT has three type of modulation (GFSK, π/4DQPSK and 8DPSK).

Therefore all applicable requirements were tested with all the modulations.

The field strength of spurious emission was measured in three orthogonal EUT positions(X-axis, Y-axis and Z-axis).

Tested frequency information,

- Hopping Function: Enable

| | TXFrequency(MHz) | RX Frequency(MHz) |
|---|---|---|
| **Hopping Band** | 2402 ~ 2480 | 2402 ~ 2480 |

- Hopping Function: Disable

| | TXFrequency(MHz) | RX Frequency(MHz) |
|---|---|---|
| **Lowest Channel** | 2402 | 2402 |
| **Middle Channel** | 2441 | 2441 |
| **Highest Channel** | 2480 | 2480 |

# 2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

## 2.1. Test Setup

Refer to the APPENDIX I.

## 2.2. Limit

According to §15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 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) | Limit (uV/m) | Measurement Distance (meter) |
|---|---|---|
| 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 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | MHz | GHz | GHz |
|---|---|---|---|---|---|
| 0.009 ~ 0.110 | 8.41425 ~ 8.41475 | 108 ~ 121.94 | 1300 ~ 1427 | 3600 ~ 4400 | 14.47 ~ 14.5 |
| 0.495 ~ 0.505 | 12.29 ~ 12.293 | 123 ~ 138 | 1435 ~ 1626.5 | 4.5 ~ 5.15 | 15.35 ~ 16.2 |
| 2.1735 ~ 2.1905 | 12.51975 ~ 12.52025 | 149.9 ~ 150.05 | 1645.5 ~ 1646.5 | 5.35 ~ 5.46 | 17.7 ~ 21.4 |
| 4.125 ~ 4.128 | 12.57675 ~ 12.57725 | 156.52475 ~ | 1660 ~ 1710 | 7.25 ~ 7.75 | 22.01 ~ 23.12 |
| 4.17725 ~ 4.17775 | 13.36 ~ 13.41 | 156.52525 | 1718.8 ~ 1722.2 | 8.025 ~ 8.5 | 23.6 ~ 24.0 |
| 4.20725 ~ 4.20775 | 16.42 ~ 16.423 | 156.7 ~ 156.9 | 2200 ~ 2300 | 9.0 ~ 9.2 | 31.2 ~ 31.8 |
| 6.215 ~ 6.218 | 16.69475 ~ 16.69525 | 162.0125 ~ 167.17 | 2310 ~ 2390 | 9.3 ~ 9.5 | 36.43 ~ 36.5 |
| 6.26775 ~ 6.26825 | 16.80425 ~ 16.80475 | 167.72 ~ 173.2 | 2483.5 ~ 2500 | 10.6 ~ 12.7 | Above 38.6 |
| 6.31175 ~ 6.31225 | 25.5 ~ 25.67 | 240 ~ 285 | 2655 ~ 2900 | 13.25 ~ 13.4 | |
| 8.291 ~ 8.294 | 37.5 ~ 38.25 | 322 ~ 335.4 | 3260 ~ 3267 | | |
| 8.362 ~ 8.366 | 73 ~ 74.6 | 399.90 ~ 410 | 3332 ~ 3339 | | |
| 8.37625 ~ 8.38675 | 74.8 ~ 75.2 | 608 ~ 614 | 3345.8 ~ 3358 | | |
| | | 960 ~ 1240 | | | |

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

## 2.3. Test Procedures

Radiated emissions from the EUT were measured according to the ANSI C63.10-2009

### 2.3.1. Test Procedures for Radiated Spurious Emissions

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 ㏈lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

**Note : Measurement Instrument Setting for Radiated Emission Measurements.**

1. **Frequency Range =< 1 GHz**
   RBW = 100 or 120 KHz, VBW = 3 x RBW , Detector = Peak or Quasi Peak

2. **Frequency Range > 1 GHz**

   **Peak Measurement > 1 GHz**
   RBW = 1 MHz , VBW = 3 MHz, Detector = Peak

   **Average Measurement > 1GHz**
   VBW = 1 KHz (Reduce VBW to at least 100 times less than the RBW, but no lessthan 10 Hz.)

   Note1: The reduced VBW measurement method of Section 4.2.3.2.3 in ANSI C63.10 is used.
   Note2: If necessary, ANSI C63.10 Section 4.2.3.2.4 is applied for pulsed emissions as following description. 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 byaveraging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s. As an alternative (provided the unlicensed wireless device operates for longer than 0.1 s) or in cases where the pulse train exceeds 0.1 s, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval while the field strength is at its maximum value. Please see Note 4 of the radiated emission tables for calculation of Duty cycle Correction Factor (DCF).

### 2.3.2. Test Procedures for Conducted Spurious Emissions

1.The transmitter output was connected to the spectrum analyzer.
2.The **reference level** of the fundamental frequency was measured with the spectrum analyzer using RBW=100 ㎑, VBW=300㎑.
3. The conducted spurious emission was performed using the spectrum analyzer's spurious measurement function from 30 MHz to 25 GHz with the 12 sub measurementranges.The each sub ranges were set as below.

**RBW= 1 MHz, VBW= 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SPAN = MAX 3 GHz (Below 10 GHz) and MAX 5 GHz (Above 10 GHz) , BINS = 10001 (Each sub range below 10 GHz) and 20001 (Each sub range above 10 GHz)**
**LIMIT LINE = 20 dB below of the reference level of above measurement procedure. (RBW = 100 KHz , VBW = 300 KHz)**

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 KHz, VBW = 300 KHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 KHz BW.
Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.

## 2.4. Test Results

Ambient temperature : 21°C
Relative humidity : 44%

### 2.4.1. Radiated Emission

### 9KHz ~ 25GHz Data(Modulation: *GFSK*)

▪ Lowest Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.96 | H | X | PK | 30.10 | 20.00 | - | -40.00 | 10.10 | 29.50 | 19.40 |
| 971.62 | H | X | PK | 28.36 | -3.80 | - | - | 24.56 | 54.00 | 29.44 |
| 2338.08 | H | Y | PK | 56.76 | -5.24 | - | - | 51.52 | 74.00 | 22.48 |
| 2338.00 | H | Y | AV | 49.38 | -5.24 | - | - | 44.14 | 54.00 | 9.86 |
| 4804.19 | H | X | PK | 50.11 | 2.11 | - | - | 52.22 | 74.00 | 21.78 |
| 4804.08 | H | X | AV | 42.04 | 2.11 | - | - | 44.15 | 54.00 | 9.85 |

▪ Middle Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.97 | H | X | PK | 30.10 | 20.00 | - | -40.00 | 10.10 | 29.50 | 19.40 |
| 971.86 | H | X | PK | 28.40 | -4.00 | - | - | 24.40 | 54.00 | 29.60 |
| 4882.18 | H | X | PK | 54.59 | 2.16 | - | - | 56.75 | 74.00 | 17.25 |
| 4882.07 | H | X | AV | 46.74 | 2.16 | - | - | 48.90 | 54.00 | 5.10 |

▪ Highest Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.97 | H | X | PK | 30.17 | 20.00 | - | -40.00 | 10.17 | 29.50 | 19.33 |
| 971.87 | H | X | PK | 28.44 | -4.00 | - | - | 24.44 | 54.00 | 29.56 |
| 2483.52 | H | Y | PK | 59.77 | -4.99 | - | - | 54.78 | 74.00 | 19.22 |
| 2483.50 | H | Y | AV | 45.38 | -4.99 | - | - | 40.39 | 54.00 | 13.61 |
| 4959.75 | H | X | PK | 49.10 | 1.70 | - | - | 50.80 | 74.00 | 23.20 |
| 4960.07 | H | X | AV | 42.63 | 1.70 | - | - | 44.33 | 54.00 | 9.67 |

**Note.**

1. Measurement Distance = 3m
2. No other spurious and harmonic emissions were found greater than listed emissions on above table.
3. Above listed point data is the worst case data.
4. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F + D.C.F + Distance Factor / T.F = AF + CL – AG
   Where,T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   Distance Factor = 20log(Measurement distance / The measured distance)$^2$
   D.C.F = Duty Cycle Correction Factor.
5. D.C.F Calculation. (D.C.F. = Duty Cycle Correction Factor)
   - Time to cycle through all channels= $\Delta t = \tau_{[ms]}$ X 79 channels , where $\tau$ = pulse width
   - 100ms / $\Delta t_{[ms]}$ = *H* -> Round up to next highest integer, to account for worst case, *H'*
   - The Worst Case Dwell Time = $\tau_{[ms]}$ X *H'*
   - Duty Cycle Correction = 20 x Log(The Worst Case Dwell Time / 100ms) [dB]

## 9KHz ~ 25GHz Data(Modulation: *π/4DQPSK*)

▪ Lowest Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.98 | H | X | PK | 30.14 | 20.00 | - | -40.00 | 10.14 | 29.50 | 19.36 |
| 971.85 | H | X | PK | 28.40 | -4.00 | - | - | 24.40 | 54.00 | 29.60 |
| 2337.60 | H | Y | PK | 56.72 | -5.24 | - | - | 51.48 | 74.00 | 22.52 |
| 2337.84 | H | Y | AV | 48.38 | -5.24 | - | - | 43.14 | 54.00 | 10.86 |
| 4804.32 | H | X | PK | 48.99 | 2.11 | - | - | 51.10 | 74.00 | 22.90 |
| 4804.14 | H | X | AV | 39.04 | 2.11 | - | - | 41.15 | 54.00 | 12.85 |

▪ Middle Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.96 | H | X | PK | 30.13 | 20.00 | - | -40.00 | 10.13 | 29.50 | 19.37 |
| 971.63 | H | X | PK | 28.51 | -3.80 | - | - | 24.71 | 54.00 | 29.29 |
| 4882.42 | H | X | PK | 51.17 | 2.16 | - | - | 53.33 | 74.00 | 20.67 |
| 4881.99 | H | X | AV | 43.13 | 2.16 | - | - | 45.29 | 54.00 | 8.71 |

▪ Highest Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.97 | H | X | PK | 30.15 | 20.00 | - | -40.00 | 10.15 | 29.50 | 19.35 |
| 971.83 | H | Y | PK | 28.56 | -4.00 | - | - | 24.56 | 54.00 | 29.44 |
| 2483.62 | H | Y | PK | 59.14 | -4.99 | - | - | 54.15 | 74.00 | 19.85 |
| 2483.62 | H | Y | AV | 44.89 | -4.99 | - | - | 39.90 | 54.00 | 14.10 |
| 4959.90 | H | X | PK | 49.50 | 1.70 | - | - | 51.20 | 74.00 | 22.80 |
| 4960.02 | H | X | AV | 39.28 | 1.70 | - | - | 40.98 | 54.00 | 13.02 |

**Note.**

1. Measurement Distance = 3m
2. No other spurious and harmonic emissions were found greater than listed emissions on above table.
3. Above listed point data is the worst case data.
4. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F + D.C.F + Distance Factor / T.F = AF + CL – AG
   Where,T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   Distance Factor = 20log(Measurement distance / The measured distance)$^2$
   D.C.F = Duty Cycle Correction Factor.
5. D.C.F Calculation. (D.C.F. = Duty Cycle Correction Factor)
   - Time to cycle through all channels= $\Delta t = \tau_{[ms]}$ X 79 channels , where $\tau$ = pulse width
   - 100ms / $\Delta t_{[ms]}$ = $H$ -> Round up to next highest integer, to account for worst case, $H'$
   - The Worst Case Dwell Time = $\tau_{[ms]}$ X $H'$
   - Duty Cycle Correction = 20 x Log(The Worst Case Dwell Time / 100ms) [dB]

## 9KHz ~ 25GHz Data(Modulation: ***8DPSK***)

▪ Lowest Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.98 | H | X | PK | 30.20 | 20.00 | - | -40.00 | 10.20 | 29.50 | 19.30 |
| 971.83 | H | X | PK | 28.60 | -4.00 | - | - | 24.60 | 54.00 | 29.40 |
| 2338.32 | H | Y | PK | 56.99 | -5.24 | - | - | 51.75 | 74.00 | 22.25 |
| 2337.92 | H | Y | AV | 48.64 | -5.24 | - | - | 43.40 | 54.00 | 10.60 |
| 4804.15 | H | X | PK | 49.04 | 2.11 | - | - | 51.15 | 74.00 | 22.85 |
| 4804.02 | H | X | AV | 39.97 | 2.11 | - | - | 42.08 | 54.00 | 11.92 |

▪ Middle Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.98 | H | X | PK | 30.22 | 20.00 | - | -40.00 | 10.22 | 29.50 | 19.28 |
| 971.63 | H | X | PK | 28.54 | -3.80 | - | - | 24.74 | 54.00 | 29.26 |
| 4881.92 | H | X | PK | 52.43 | 2.16 | - | - | 54.59 | 74.00 | 19.41 |
| 4882.07 | H | X | AV | 43.14 | 2.16 | - | - | 45.30 | 54.00 | 8.70 |

▪ Highest Channel

| Frequency (MHz) | ANT Pol | The worst case EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | D.C.F. (dB) | Distance Factor(dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 26.99 | H | X | PK | 30.25 | 20.00 | - | -40.00 | 10.25 | 29.50 | 19.25 |
| 971.87 | H | X | PK | 28.61 | -4.00 | - | - | 24.61 | 54.00 | 29.39 |
| 2483.55 | H | Y | PK | 59.99 | -4.99 | - | - | 55.00 | 74.00 | 19.00 |
| 2483.50 | H | Y | AV | 44.90 | -4.99 | - | - | 39.91 | 54.00 | 14.09 |
| 4959.61 | H | X | PK | 49.21 | 1.70 | - | - | 50.91 | 74.00 | 23.09 |
| 4960.07 | H | X | AV | 39.31 | 1.70 | - | - | 41.01 | 54.00 | 12.99 |

**Note.**

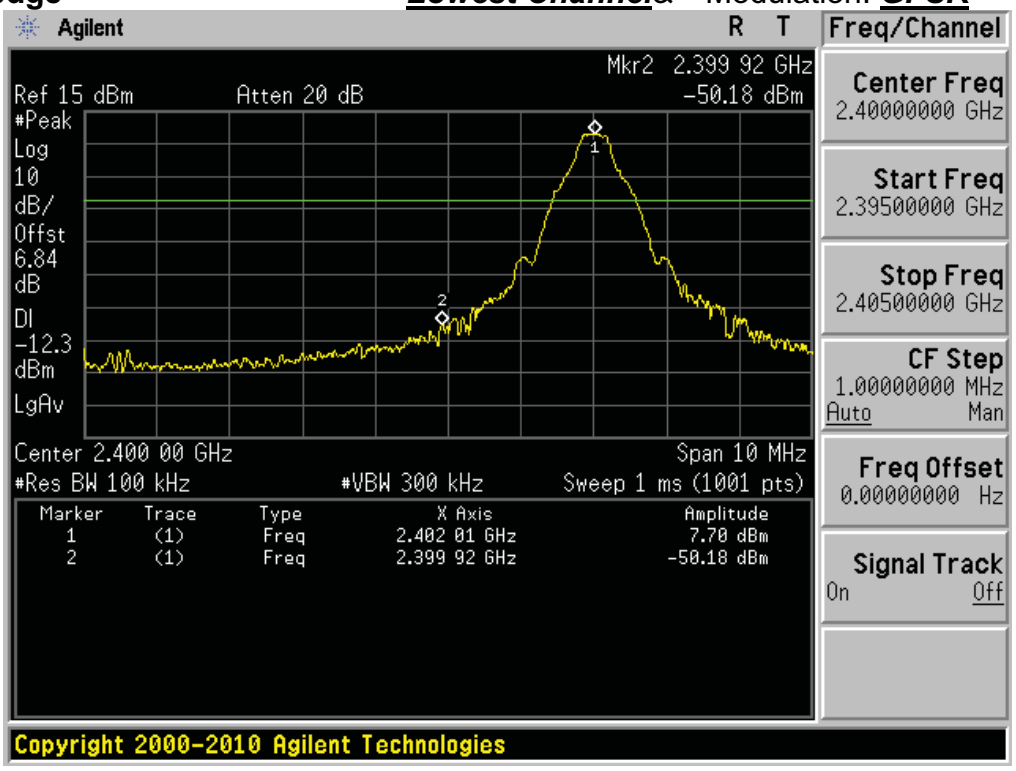
1. Measurement Distance = 3m
2. No other spurious and harmonic emissions were found greater than listed emissions on above table.
3. Above listed point data is the worst case data.
4. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F + D.C.F + Distance Factor / T.F = AF + CL – AG
   Where,T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   Distance Factor = 20log(Measurement distance / The measured distance)$^2$
   D.C.F = Duty Cycle Correction Factor.

4.D.C.F Calculation. (D.C.F. = Duty Cycle Correction Factor)

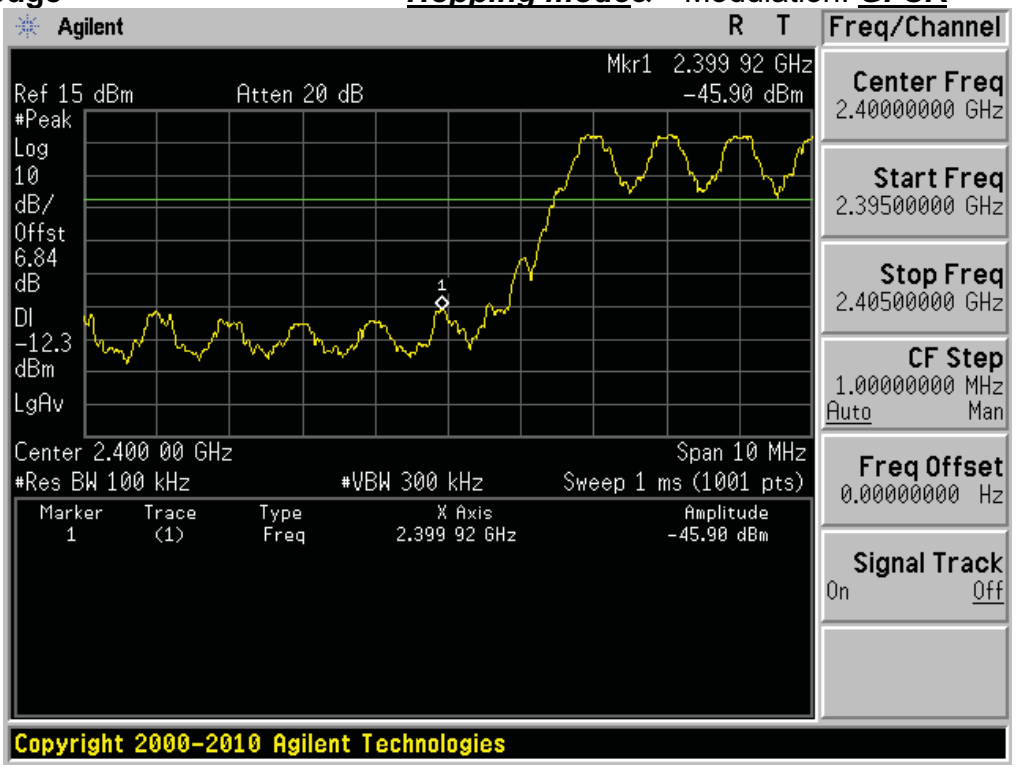
- Time to cycle through all channels= $\Delta t = \tau_{[ms]}$ X 79 channels , where $\tau$ = pulse width
- 100ms / $\Delta t_{[ms]} = H$ -> Round up to next highest integer, to account for worst case, $H'$
- The Worst Case Dwell Time = $\tau_{[ms]}$ X $H'$
- Duty Cycle Correction = 20 x Log(The Worst Case Dwell Time / 100ms) [dB]

### 2.4.2. Conducted Spurious Emissions

**Low Band-edge** ***Lowest Channel***& Modulation: ***GFSK***

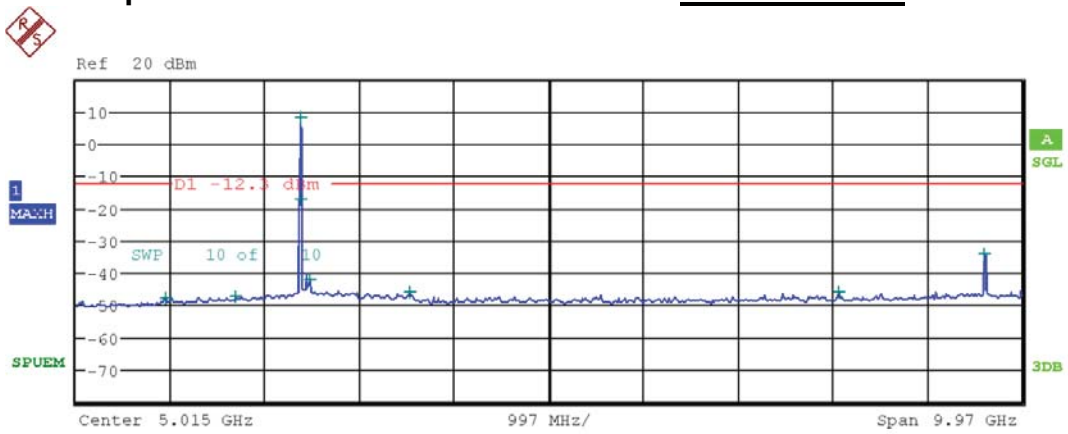



**Low Band-edge** ***Hopping mode***& Modulation: ***GFSK***

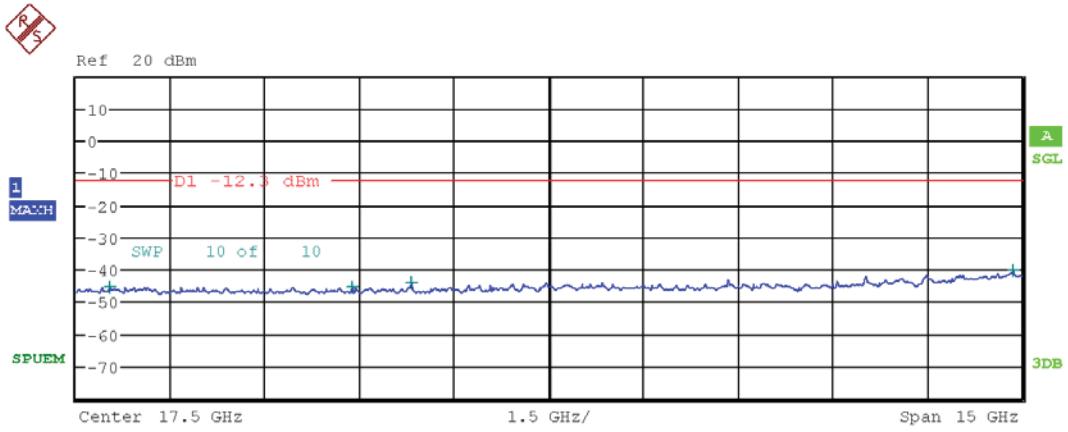


## Conducted Spurious Emissions

***Lowest Channel*** & Modulation: ***GFSK***

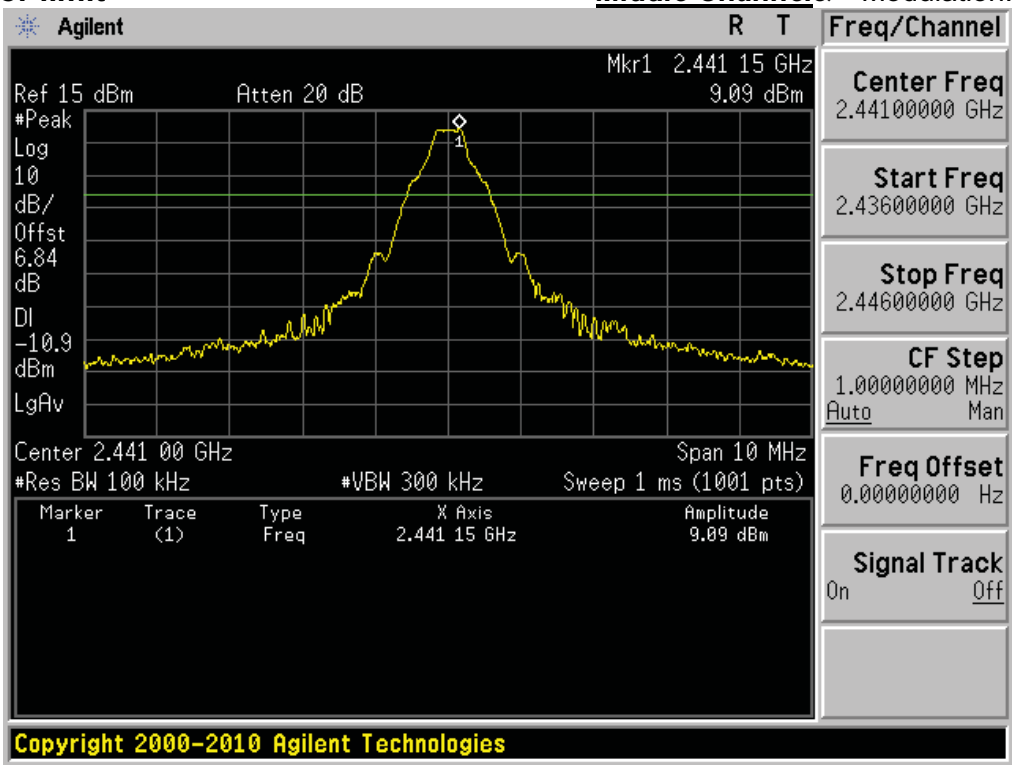



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | ΔLimit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 969.251000 M | -47.67 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.712200 G | -47.34 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.400000 G | -17.34 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.401829 G | 7.96 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.497962 G | -42.37 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.538200 G | -46.18 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 8.061300 G | -46.18 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.607700 G | -34.11 | -200.00 |

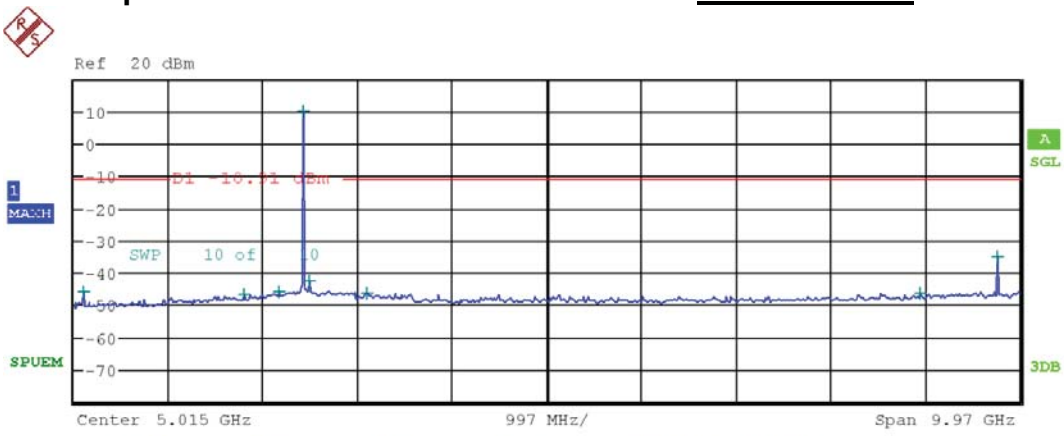



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | ΔLimit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 10.537200 G | -45.41 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 14.368950 G | -45.37 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 15.312250 G | -43.94 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.846250 G | -40.38 | -200.00 |

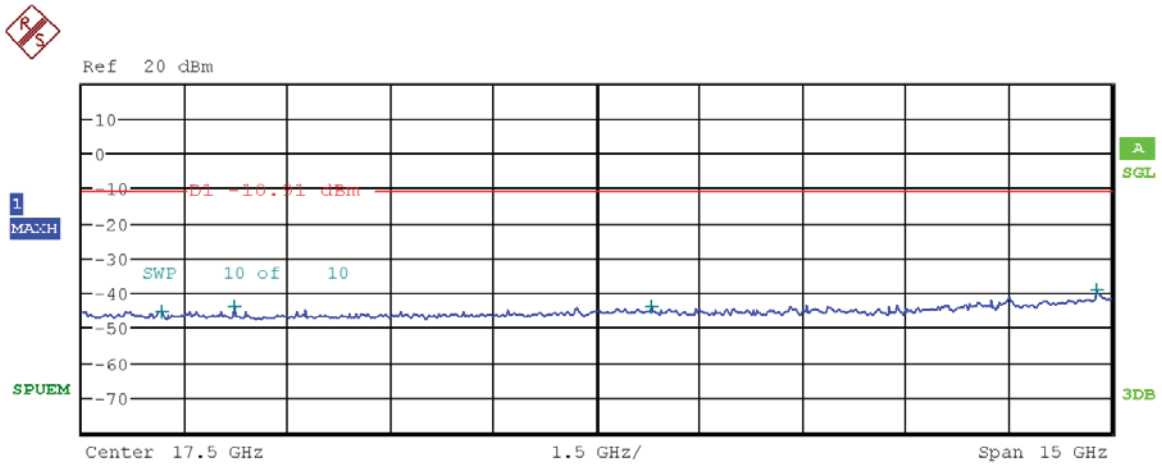
**Reference for limit** ***Middle Channel***& Modulation: ***GFSK***




**Conducted Spurious Emissions** ***Middle Channel***& Modulation: ***GFSK***

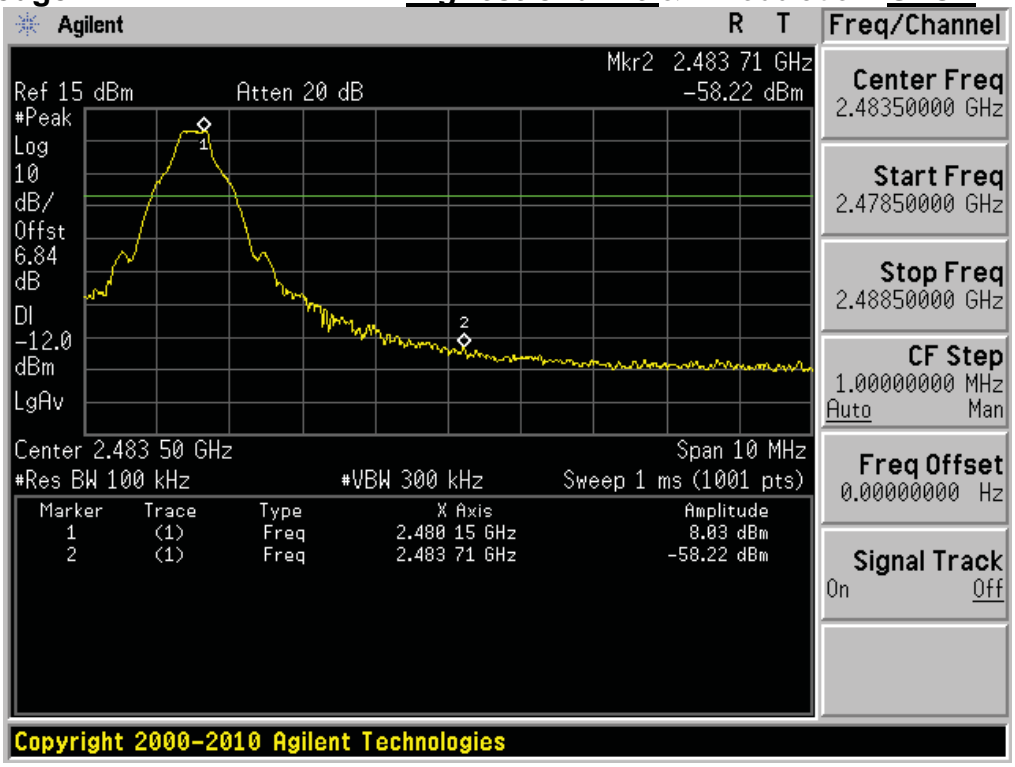



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 126.612000 M | -45.99 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.821000 G | -46.98 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.181160 G | -46.09 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.441149 G | 9.74 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.505400 G | -42.62 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.110400 G | -46.47 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 8.940600 G | -46.58 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.763500 G | -35.01 | -200.00 |

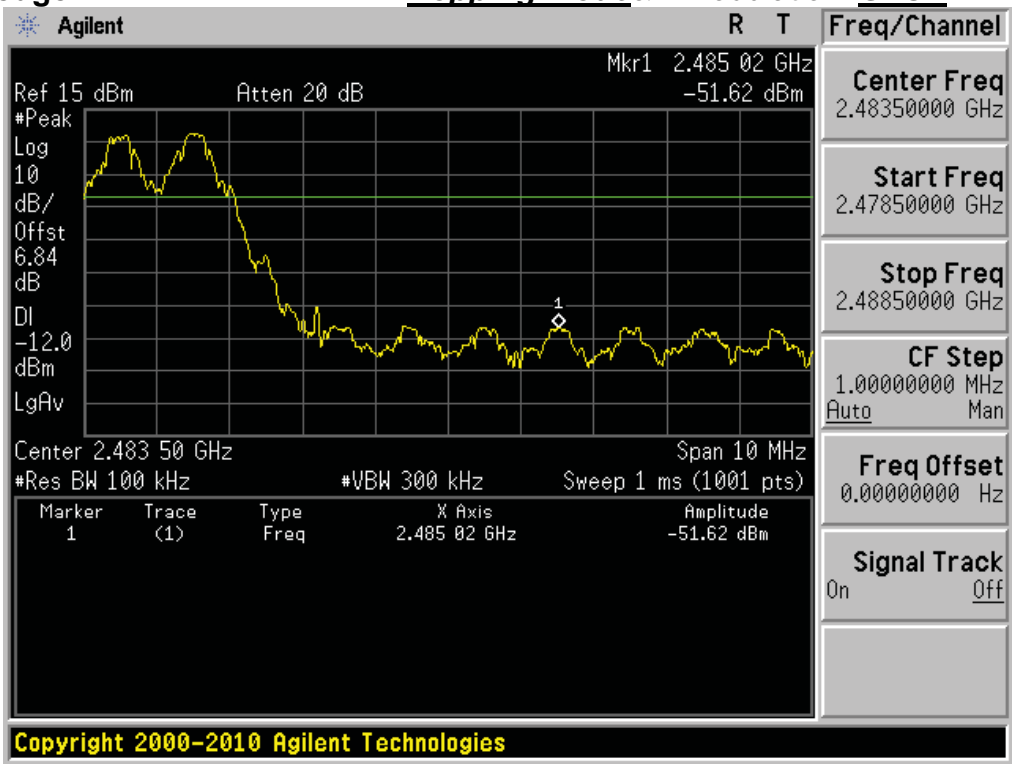



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 11.153000 G | -45.34 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 12.204000 G | -44.27 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 18.300500 G | -44.29 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.786500 G | -39.39 | -200.00 |

**High Band-edge** ***Highest Channel***& Modulation: ***GFSK***

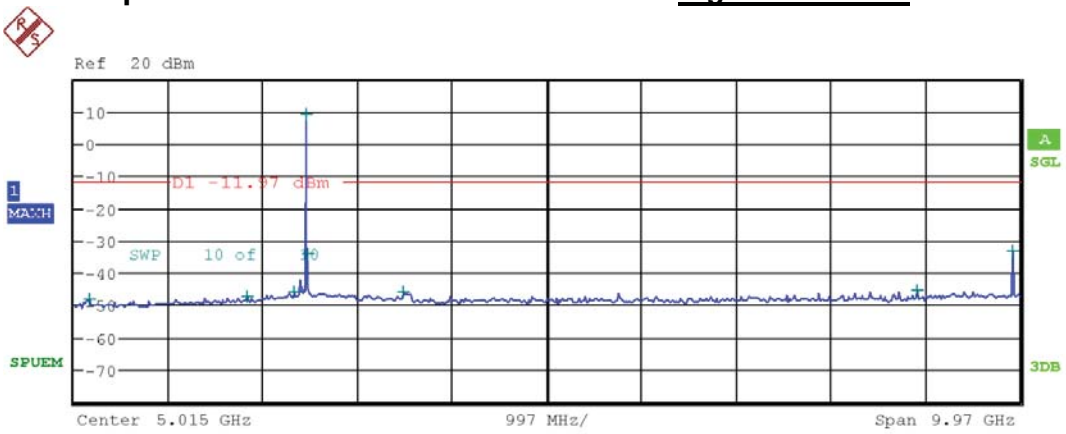



**High Band-edge** ***Hopping mode***& Modulation: ***GFSK***

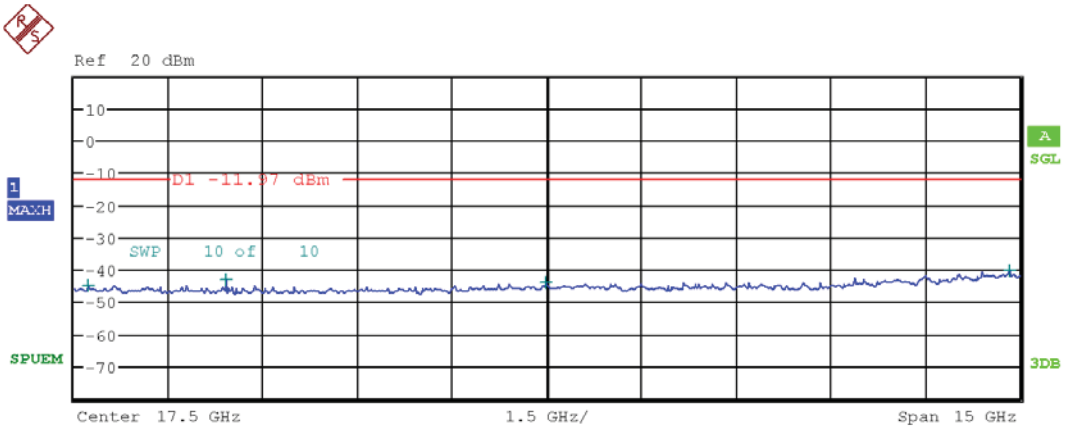


## Conducted Spurious Emissions

***Highest Channel***& Modulation: ***GFSK***

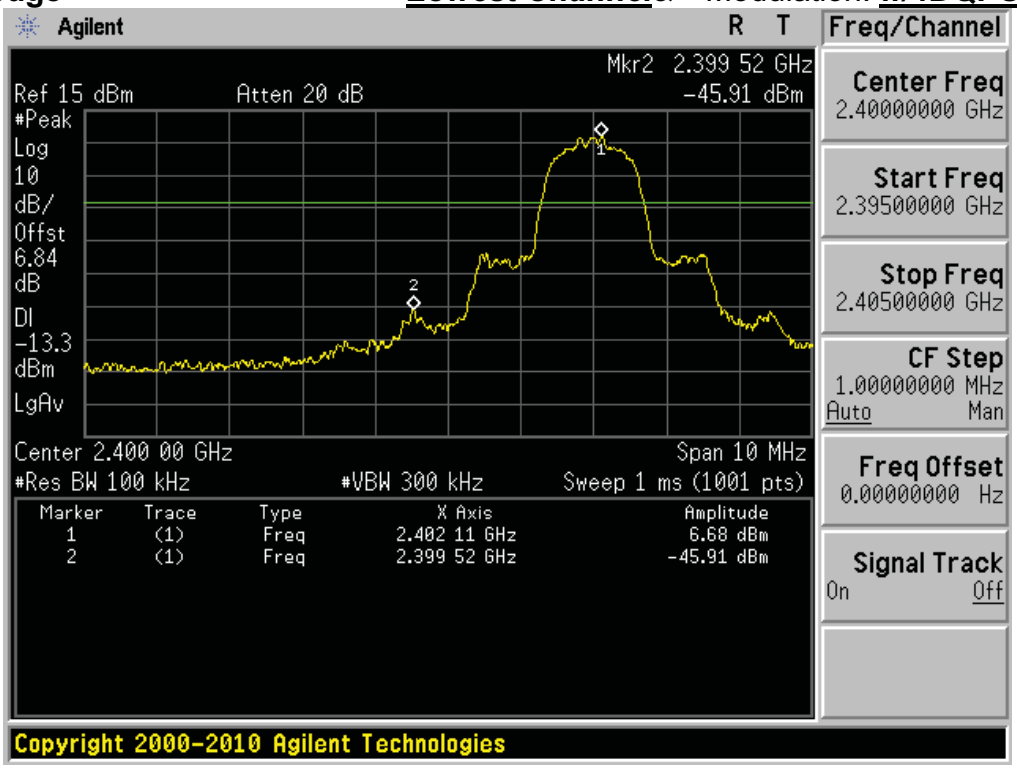



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 191.990000 M | -48.16 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.853500 G | -47.25 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.345960 G | -45.82 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.479876 G | 8.95 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.483500 G | -34.20 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.502200 G | -45.96 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 8.906400 G | -45.58 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.919700 G | -33.39 | -200.00 |

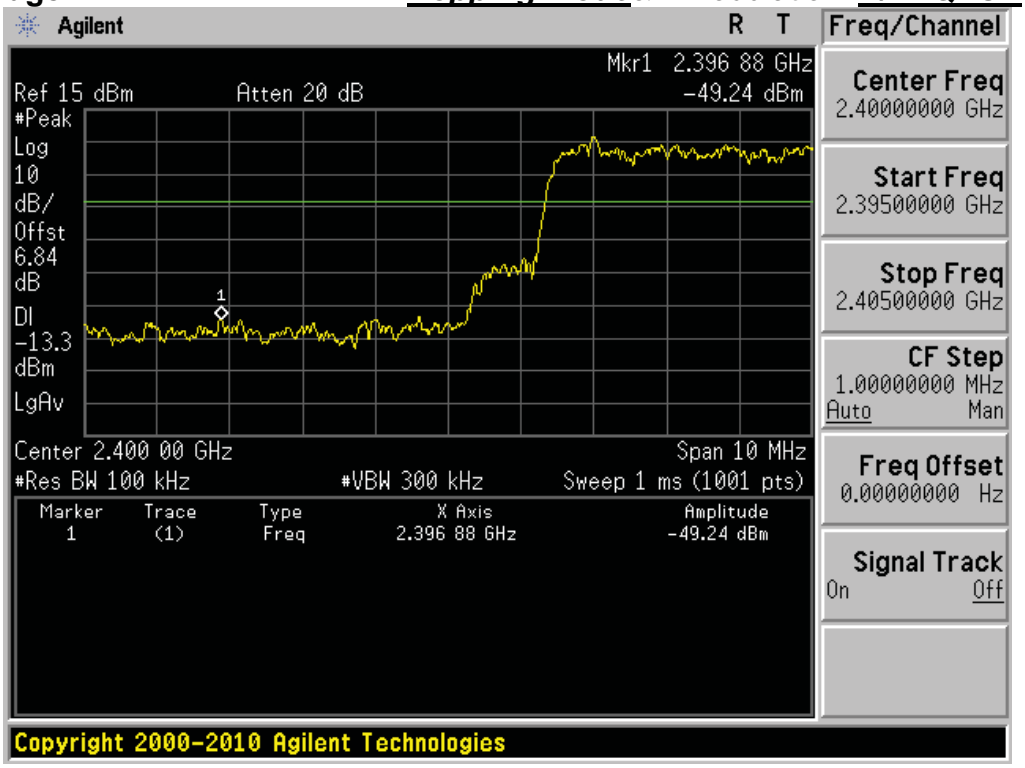



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 10.223000 G | -44.99 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 12.399600 G | -43.31 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 17.476500 G | -43.96 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.821250 G | -40.41 | -200.00 |

**Low Band-edge** ***Lowest Channel***& Modulation: ***π/4DQPSK***

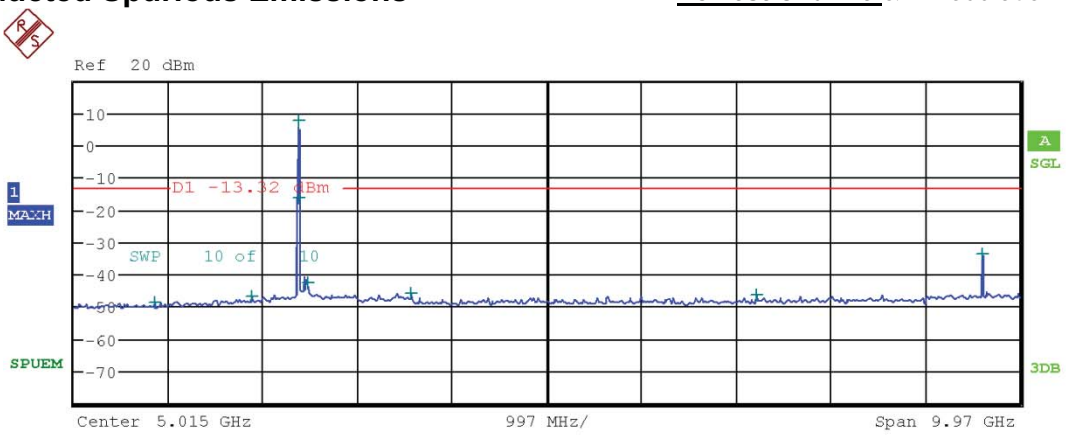



**Low Band-edge** ***Hopping mode***& Modulation: ***π/4DQPSK***

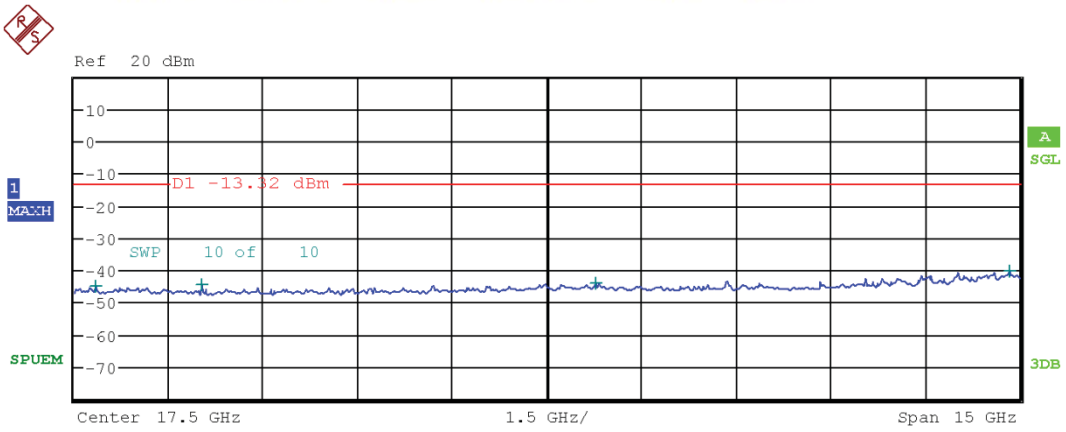


## Conducted Spurious Emissions

***Lowest Channel***& Modulation: ***π/4DQPSK***



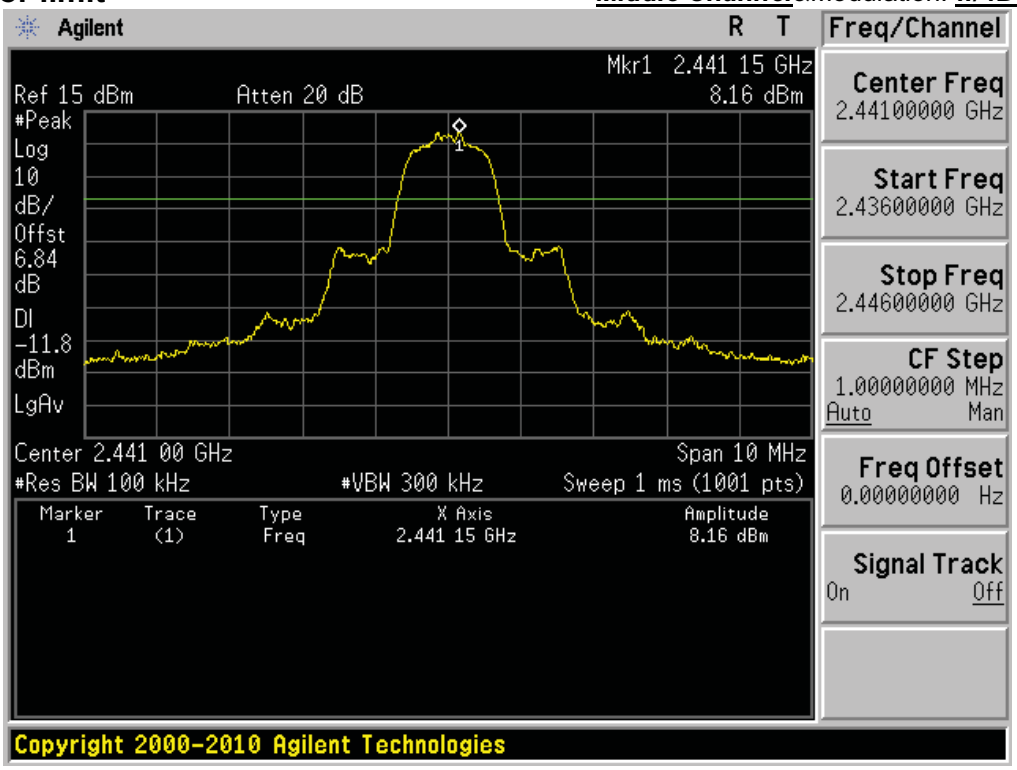

| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 882.145000 M | -48.65 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.898900 G | -46.70 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.400000 G | -16.26 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.402229 G | 7.71 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.497807 G | -42.56 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.584400 G | -45.93 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 7.219200 G | -46.60 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.608400 G | -33.77 | -200.00 |




| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 10.335100 G | -44.85 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 12.009300 G | -44.43 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 18.263250 G | -43.89 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.826250 G | -40.47 | -200.00 |

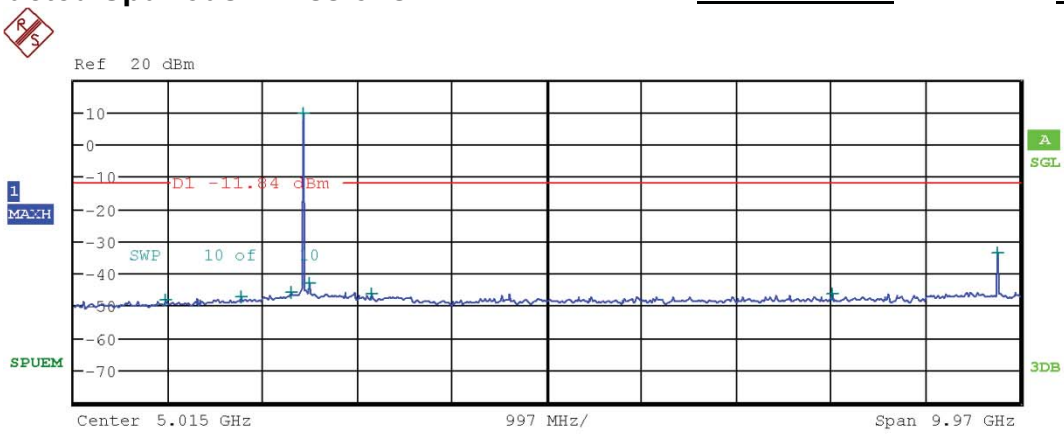
## Reference for limit

***Middle Channel***&Modulation: ***π/4DQPSK***

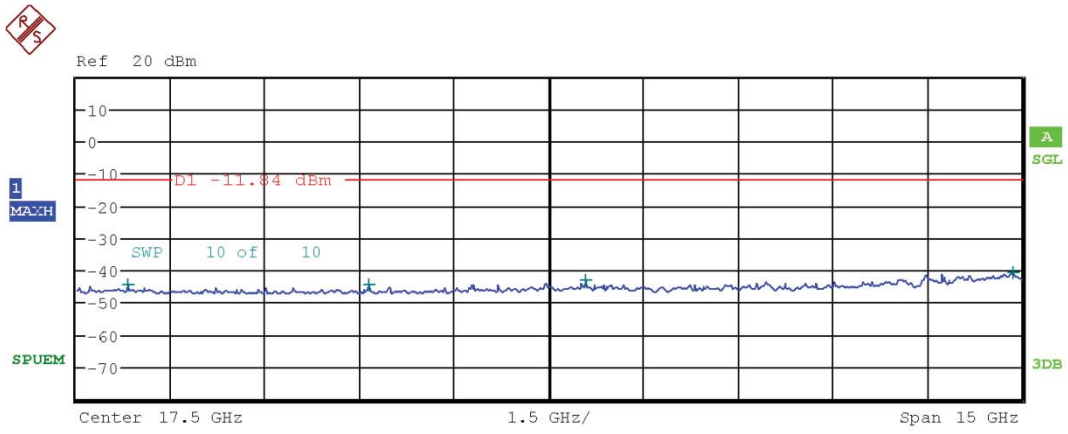



## Conducted Spurious Emissions

***Middle Channel***&Modulation: ***π/4DQPSK***

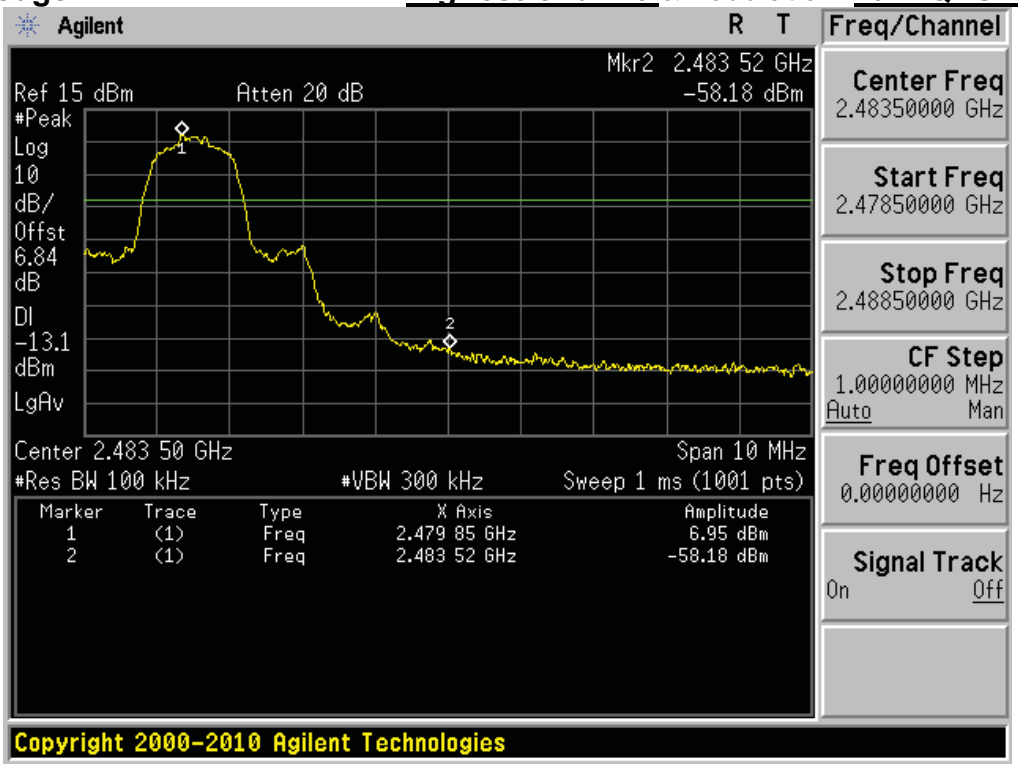



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 988.845000 M | -48.42 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.788000 G | -47.42 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.312520 G | -45.92 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.440832 G | 9.47 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.505348 G | -43.33 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.154200 G | -46.39 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 8.019000 G | -46.32 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.764200 G | -33.72 | -200.00 |

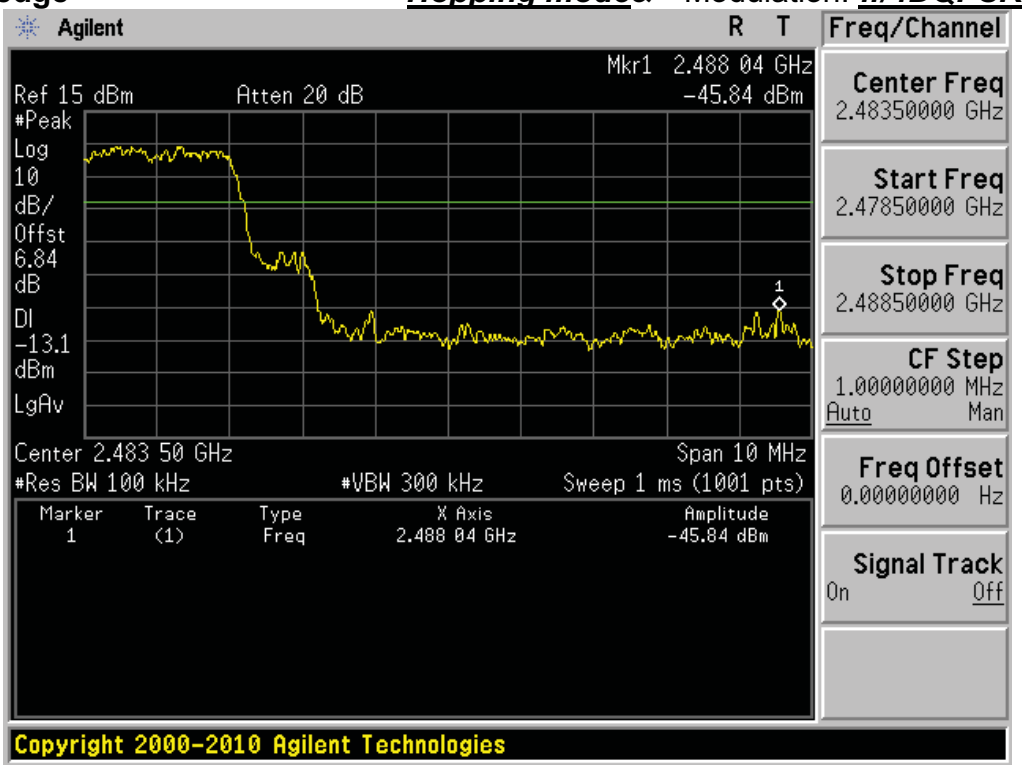



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 10.807300 G | -44.34 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 14.646600 G | -44.40 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 18.076250 G | -43.23 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.847250 G | -40.98 | -200.00 |

**High Band-edge** ***Highest Channel***&Modulation: ***π/4DQPSK***

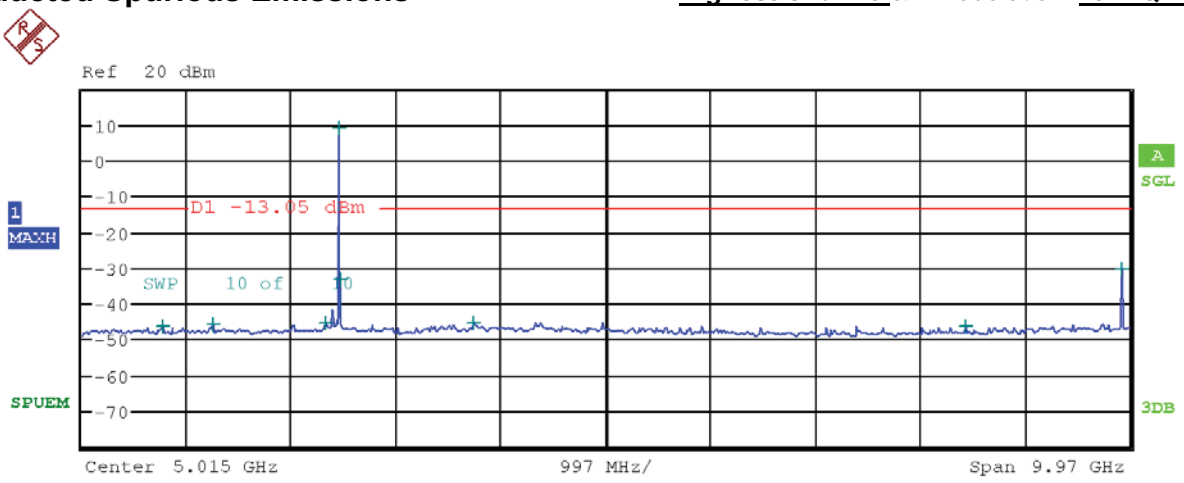



**High Band-edge** ***Hopping mode***& Modulation: ***π/4DQPSK***

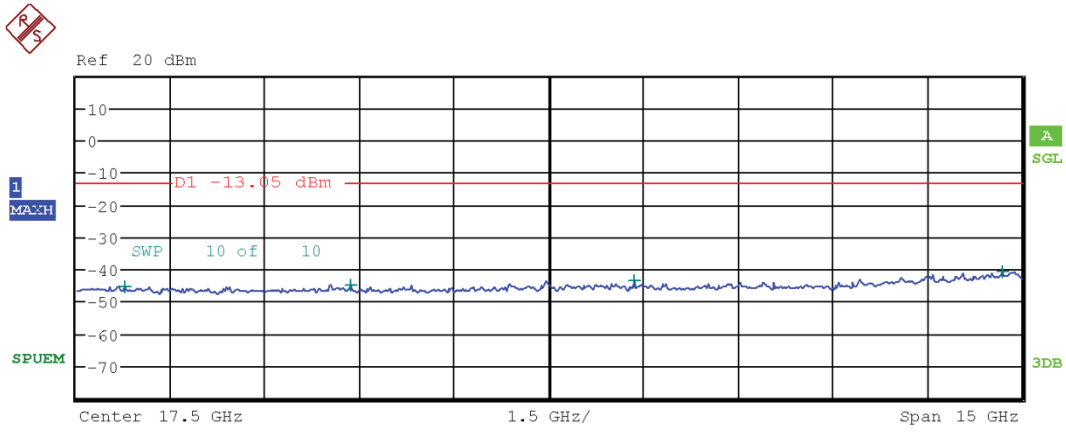


## Conducted Spurious Emissions

***Highest Channel***& Modulation: ***π/4DQPSK***

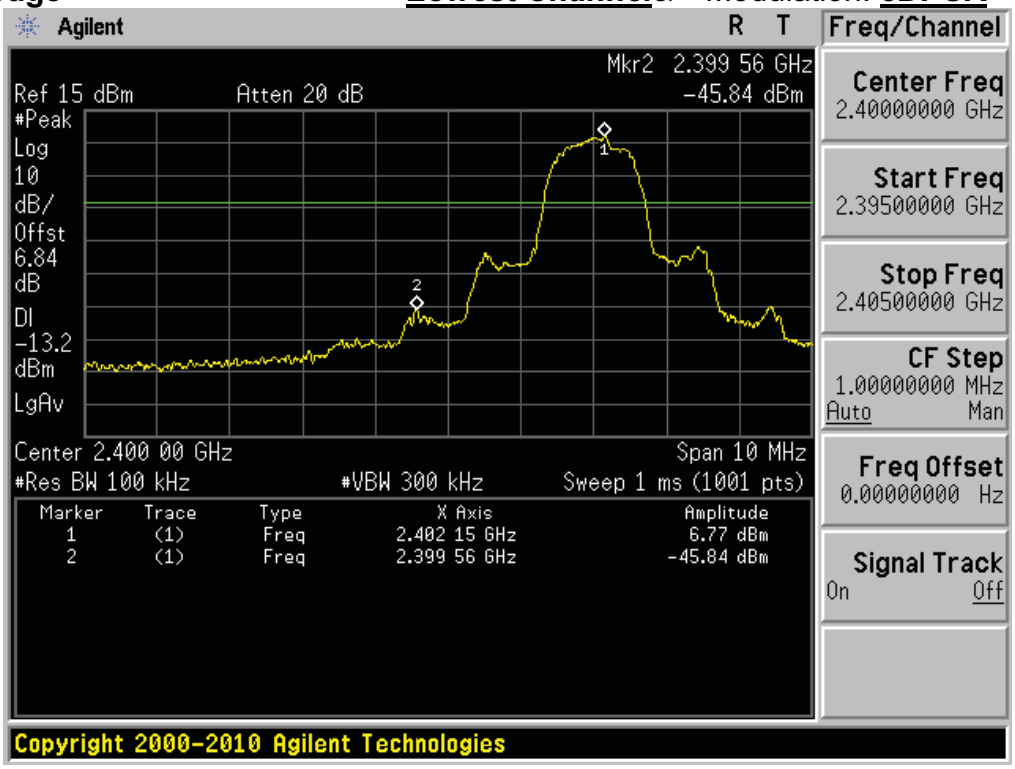



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 800.471000 M | -46.57 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.269400 G | -46.17 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.352160 G | -45.68 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.480152 G | 9.06 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.483500 G | -33.11 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.749700 G | -45.29 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 8.436000 G | -46.31 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.920000 G | -30.43 | -200.00 |

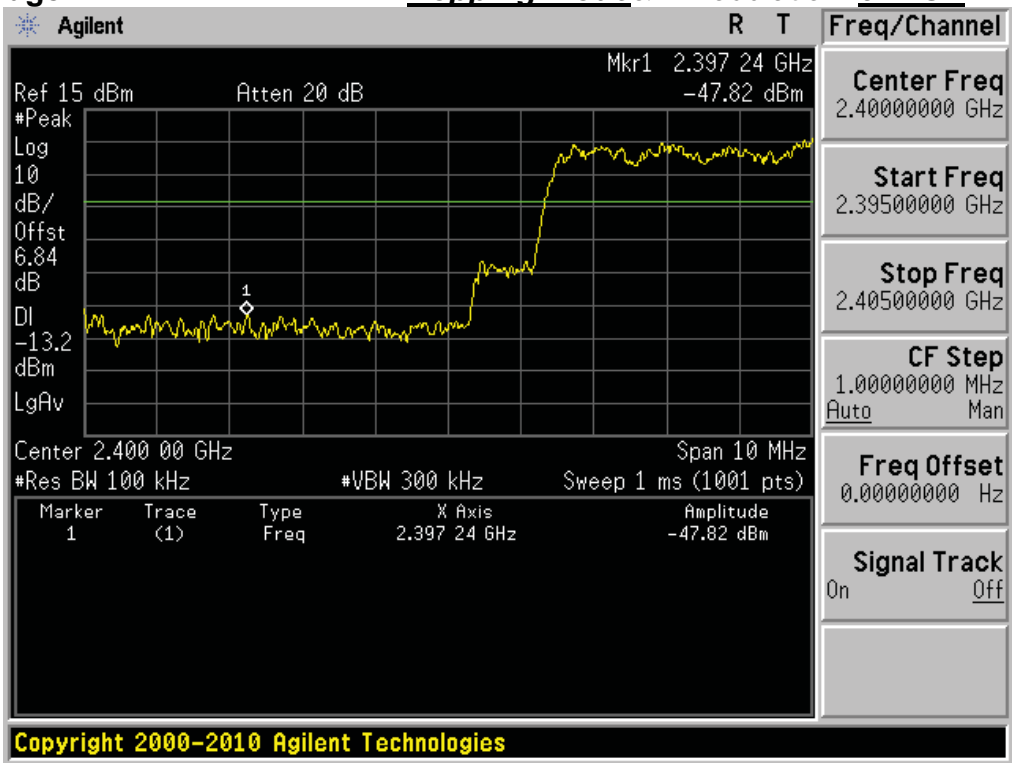



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 10.765300 G | -45.36 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 14.352600 G | -44.87 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 18.849750 G | -43.50 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.678250 G | -40.73 | -200.00 |

**Low Band-edge** ***Lowest Channel***& Modulation: ***8DPSK***

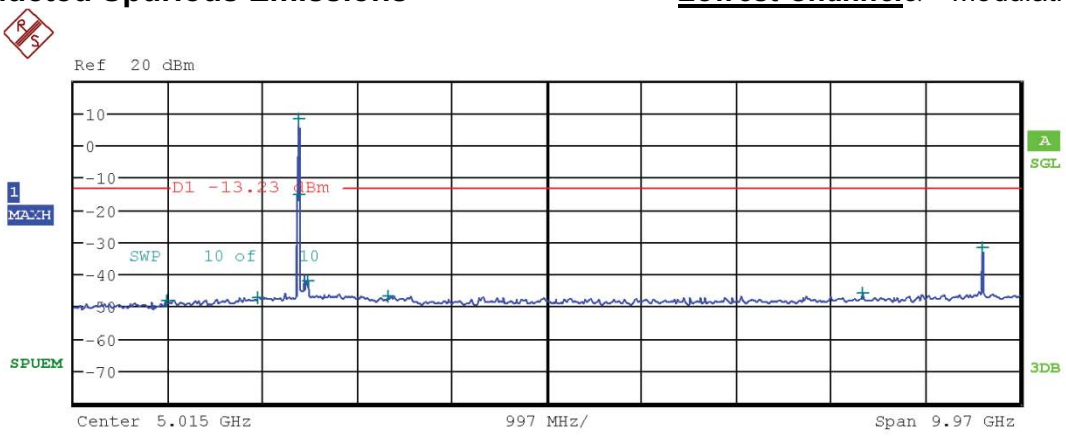



**Low Band-edge** ***Hopping mode***& Modulation: ***8DPSK***

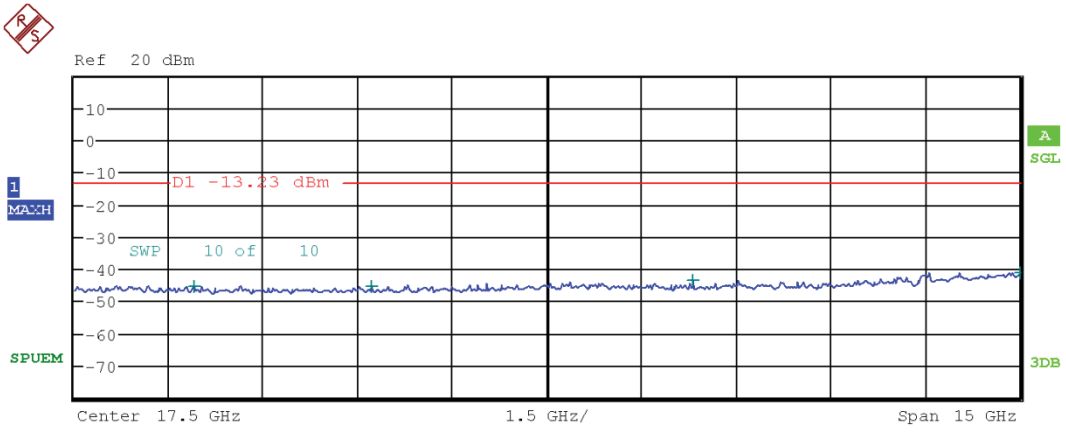


## Conducted Spurious Emissions

***Lowest Channel***& Modulation: ***8DPSK***

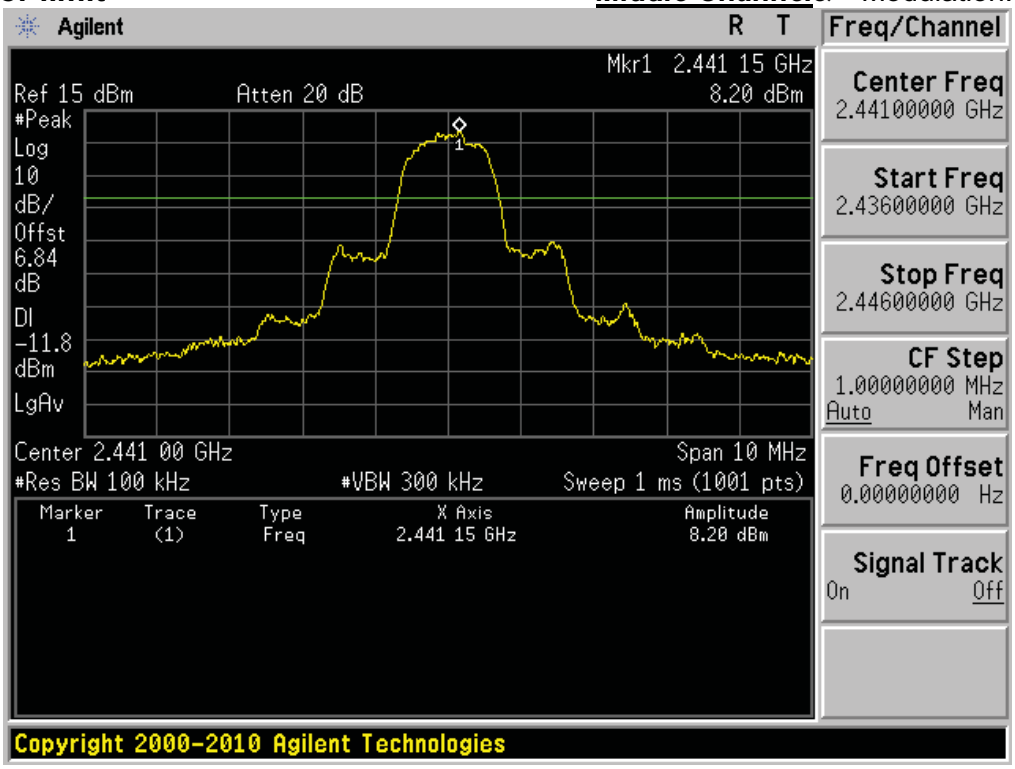



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | ΔLimit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 998.739000 M | -48.18 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.965500 G | -47.19 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.399960 G | -15.30 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.401987 G | 7.96 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.498272 G | -42.06 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.330000 G | -46.79 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 8.334900 G | -45.89 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.607900 G | -31.83 | -200.00 |

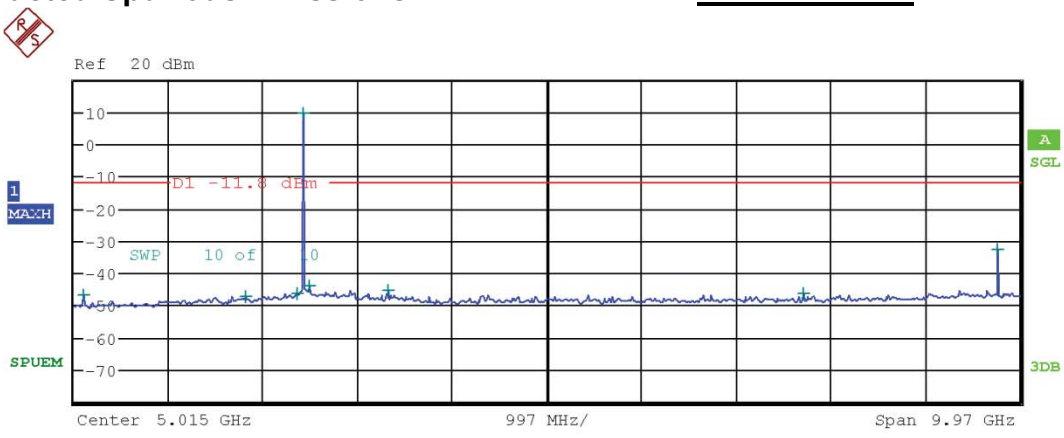



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | ΔLimit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 11.902500 G | -45.29 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 14.715900 G | -45.26 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 19.806000 G | -43.59 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.994250 G | -41.04 | -200.00 |

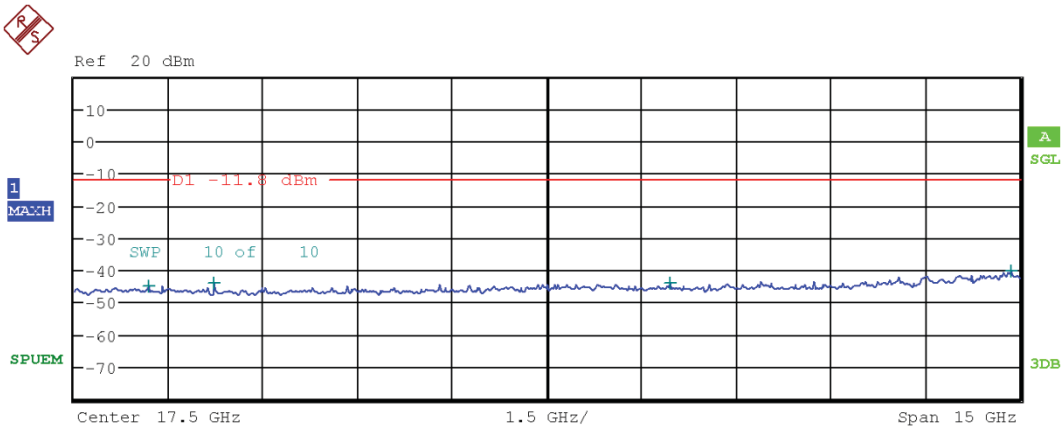
**Reference for limit** ***Middle Channel***& Modulation: ***8DPSK***




**Conducted Spurious Emissions** ***Middle Channel***& Modulation: ***8DPSK***

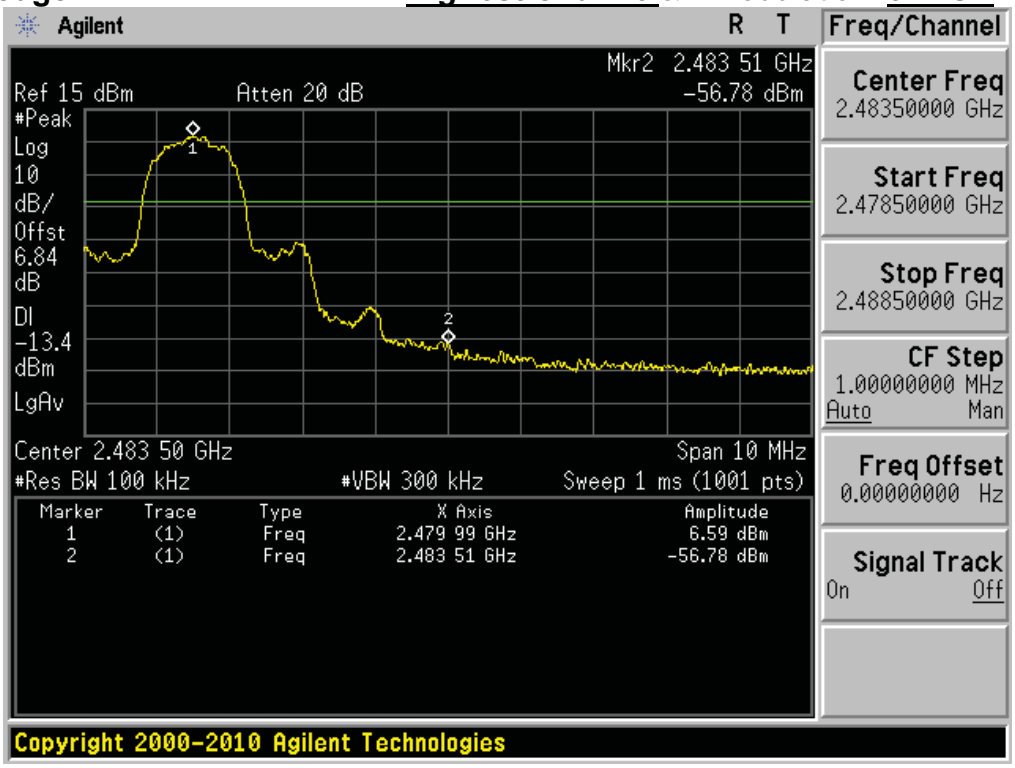



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 126.418000 M | -46.70 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.836600 G | -47.38 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.377200 G | -46.52 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.441007 G | 9.65 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.505555 G | -44.12 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.331800 G | -45.36 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 7.713300 G | -46.52 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.764000 G | -32.91 | -200.00 |

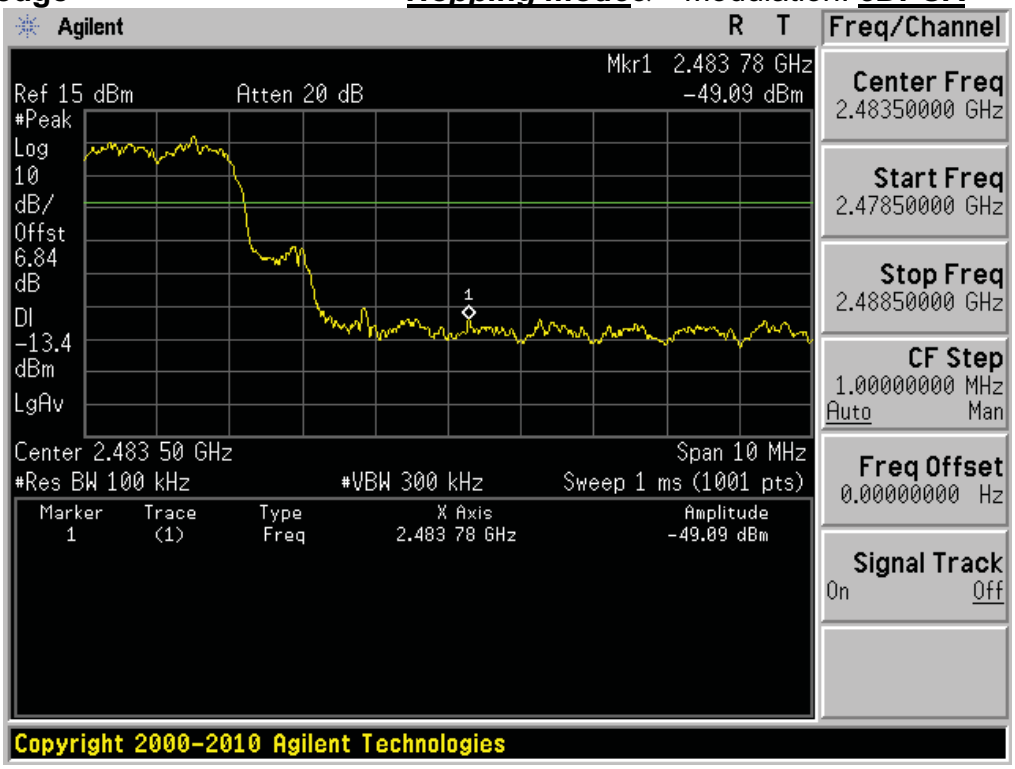



| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 11.171300 G | -44.98 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 12.204450 G | -44.04 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 19.449250 G | -44.05 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.851750 G | -40.36 | -200.00 |

**High Band-edge** ***Highest Channel***& Modulation: ***8DPSK***

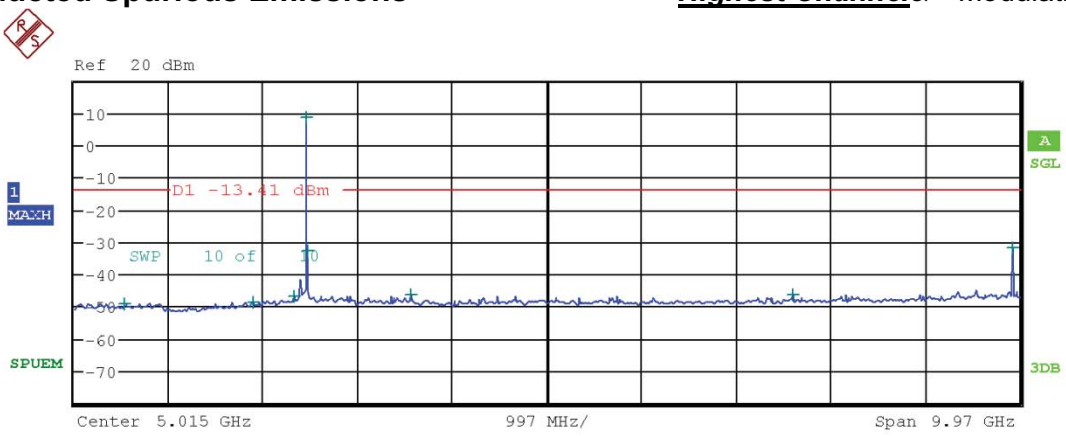



**High Band-edge** ***Hopping mode***& Modulation: ***8DPSK***

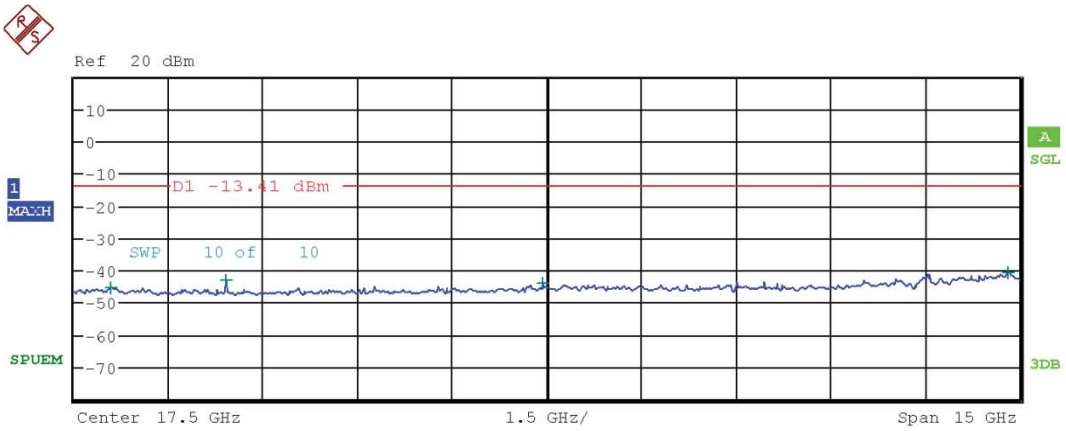


## Conducted Spurious Emissions

***Highest Channel***& Modulation: ***8DPSK***




| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 30.000 M | 1.000 G | 1.00 M | 549.338000 M | -49.12 | -200.00 |
| 1.000 G | 2.000 G | 1.00 M | 1.919700 G | -48.66 | -200.00 |
| 2.000 G | 2.400 G | 1.00 M | 2.345840 G | -46.72 | -200.00 |
| 2.400 G | 2.483 G | 1.00 M | 2.480001 G | 8.46 | -200.00 |
| 2.483 G | 3.000 G | 1.00 M | 2.483500 G | -32.84 | -200.00 |
| 3.000 G | 6.000 G | 1.00 M | 3.570600 G | -46.42 | -200.00 |
| 6.000 G | 9.000 G | 1.00 M | 7.599300 G | -46.29 | -200.00 |
| 9.000 G | 10.000 G | 1.00 M | 9.920000 G | -31.67 | -200.00 |




| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 10.000 G | 12.000 G | 1.00 M | 10.565700 G | -45.50 | -200.00 |
| 12.000 G | 15.000 G | 1.00 M | 12.399900 G | -43.28 | -200.00 |
| 15.000 G | 20.000 G | 1.00 M | 17.419250 G | -43.91 | -200.00 |
| 20.000 G | 25.000 G | 1.00 M | 24.804500 G | -40.97 | -200.00 |

# 3. Carrier Frequency Separation

## 3.1.Test Setup

Refer to the APPENDIX I.

## 3.2. Limit

Limit: >= 20dB BW or >= Two-Thirds of the 20dB BW

**- Procedure:**

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

Span = wide enough to capture the peaks of two adjacent channels

RBW = 1% of the span

Sweep = auto

VBW = ≥ RBW

Detector function = peak

Trace = max hold

**- Measurement Data: Comply**

**- FH mode**

| Hopping Mode | Test Mode | Peak of adjacent Channel (MHz) | Peak of center channel (MHz) | Test Result (MHz) |
|---|---|---|---|---|
| Enable | Test Case 1 | 2440.013 | 2441.015 | 1.002 |
| | Test Case 2 | 2439.836 | 2440.841 | 1.005 |
| | Test Case 3 | 2440.997 | 2441.999 | 1.002 |

**- AFH mode**

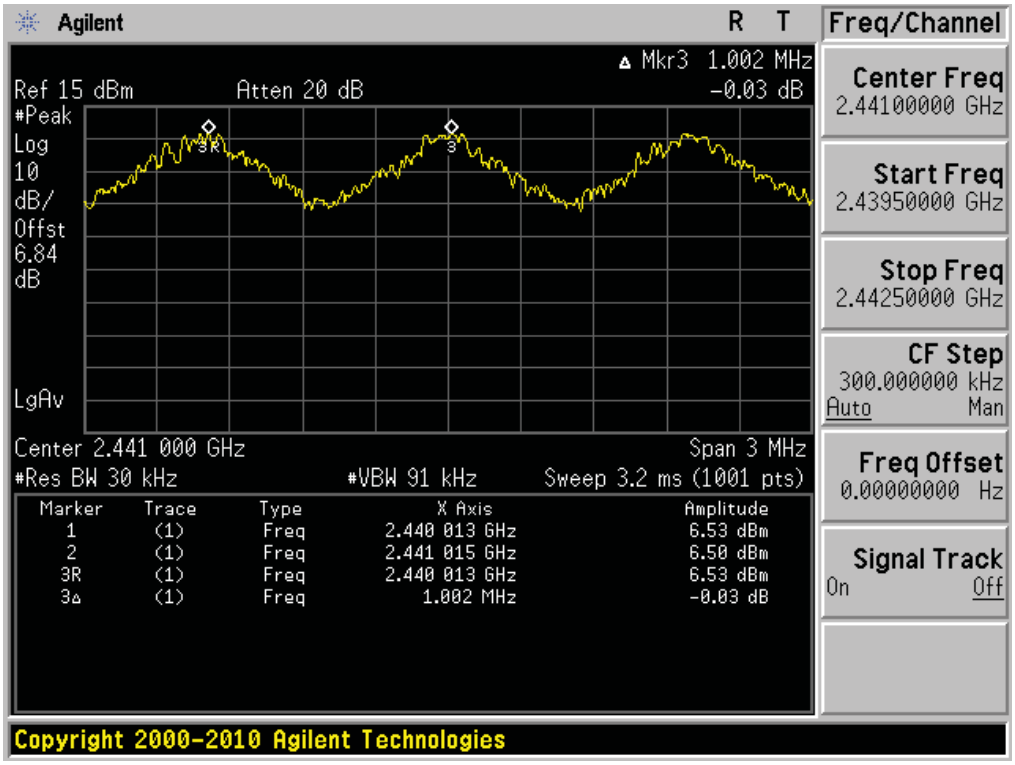
| Hopping Mode | Test Mode | Peak of adjacent Channel (MHz) | Peak of center channel (MHz) | Test Result (MHz) |
|---|---|---|---|---|
| Enable | Test Case 1 | 2410.985 | 2411.987 | 1.002 |
| | Test Case 2 | 2411.147 | 2412.152 | 1.005 |
| | Test Case 3 | 2410.997 | 2412.002 | 1.005 |

Note 1: See next pages for actual measured spectrum plots.

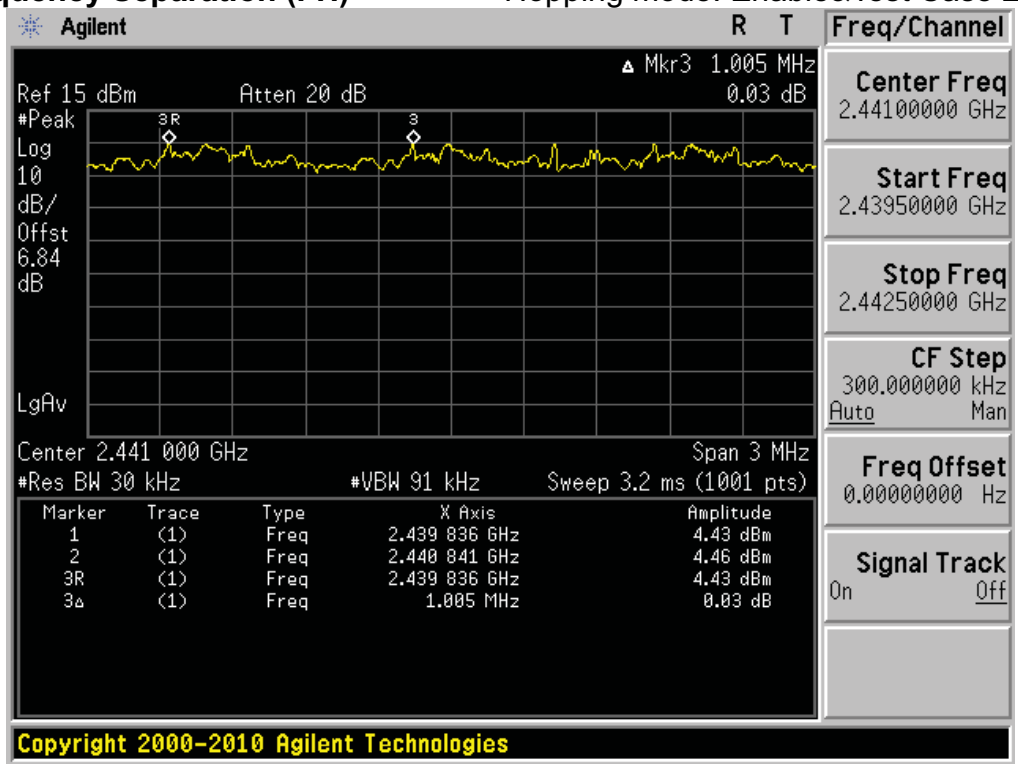
**- Minimum Standard:**

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

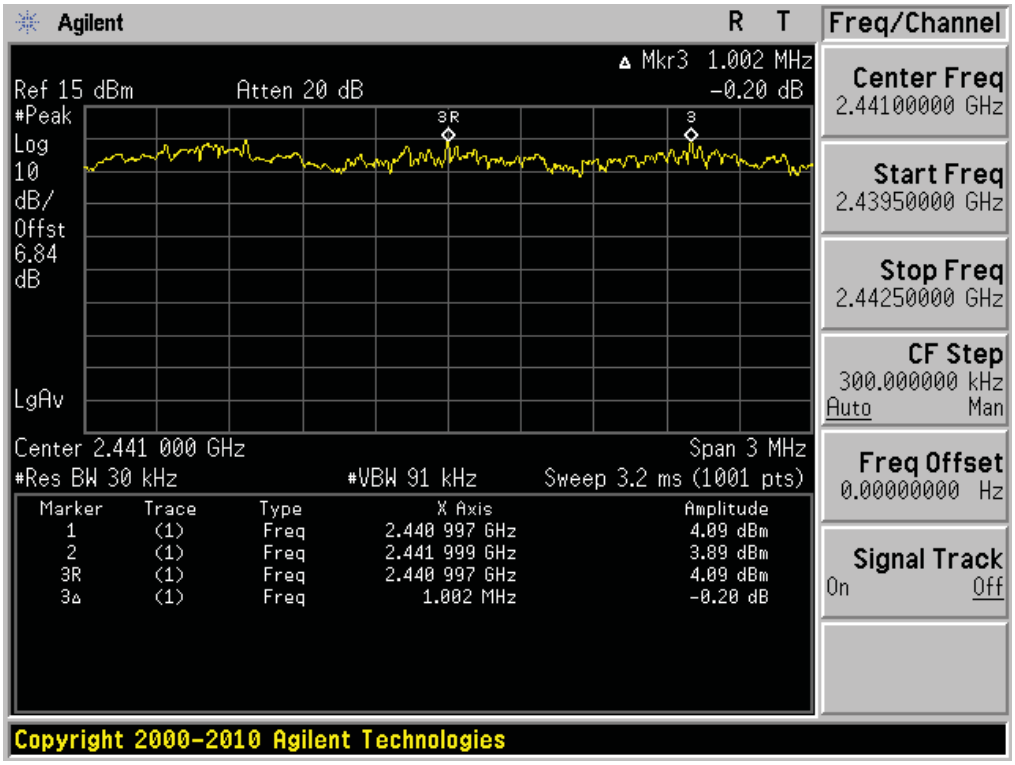
**Carrier Frequency Separation (FH)** Hopping mode: Enable&Test Case 1



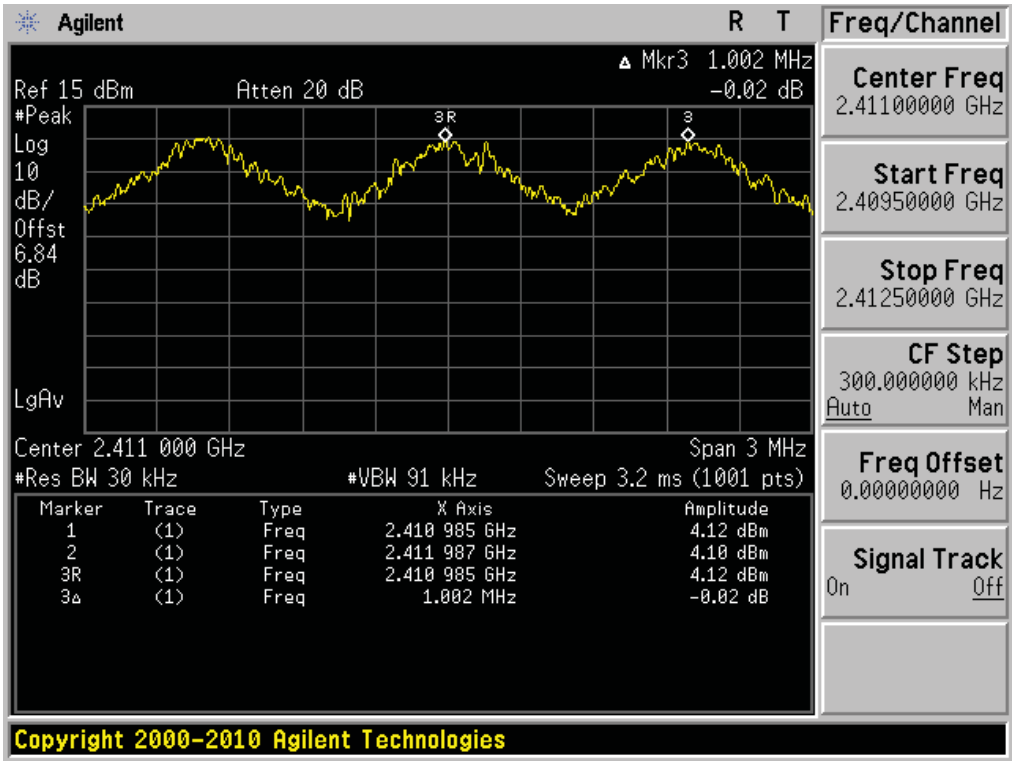

**Carrier Frequency Separation (FH)** Hopping mode: Enable&Test Case 2



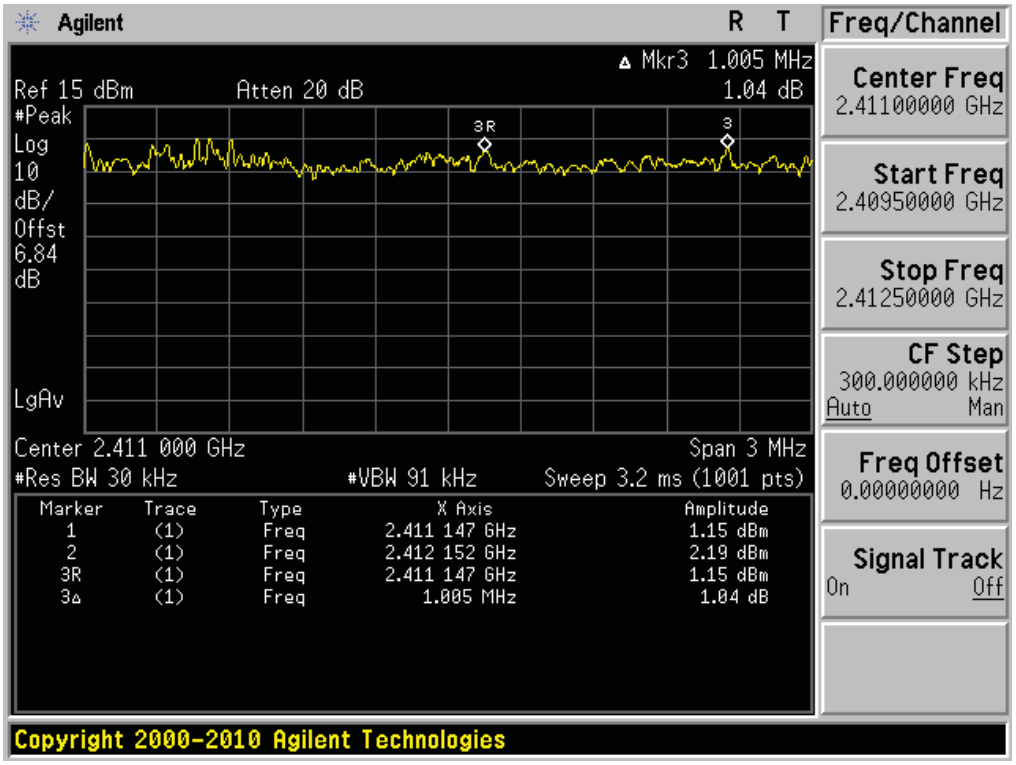
**Carrier Frequency Separation (FH)** Hopping mode: Enable&Test Case 3



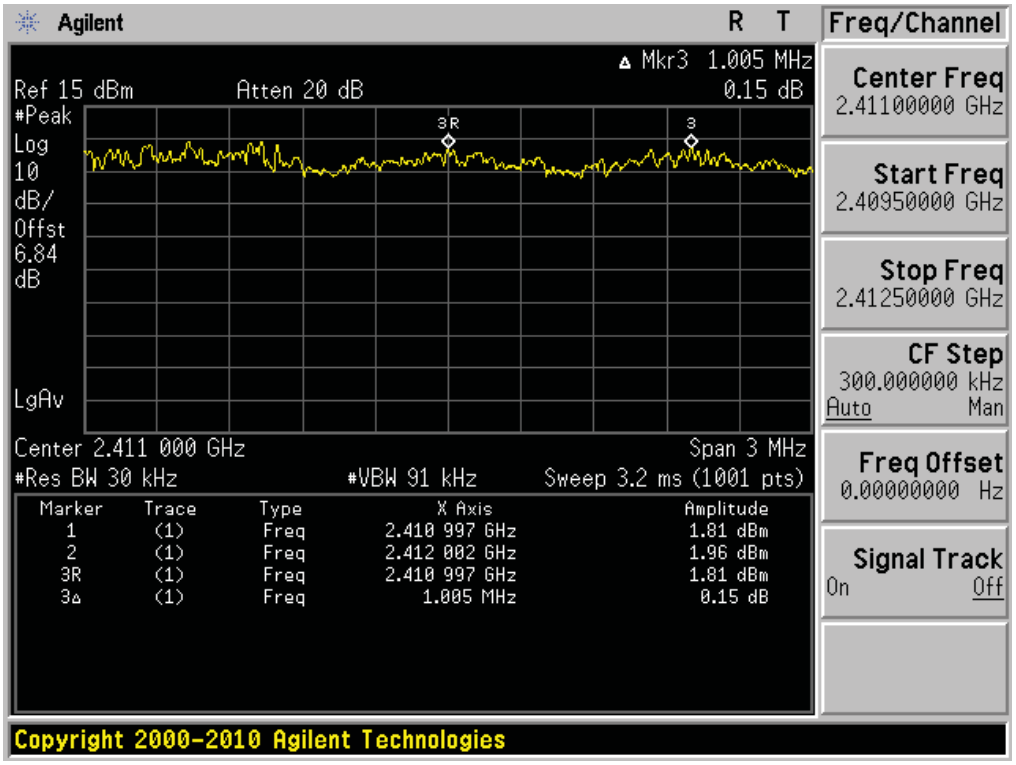
**Carrier Frequency Separation (AFH)** Hopping mode: Enable&Test Case 1




**Carrier Frequency Separation (AFH)** Hopping mode: Enable&Test Case 2



**Carrier Frequency Separation (AFH)** Hopping mode: Enable&Test Case 3



# 4.Number of Hopping Frequencies

## 4.1.Test Setup

Refer to the APPENDIX I.

## 4.2. Limit

Limit: >= 15 hops

**- Procedure:**

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.
To get higher resolution, four frequency ranges within the 2400 ~ 2483.5 MHz FH band were examined.

The spectrum analyzer is set to:

Span = 25MHz
Plot 1: Start Frequency = 2389.5MHz, Stop Frequency = 2414.5 MHz
Plot 2: Start Frequency = 2414.5MHz, Stop Frequency = 2439.5 MHz
Plot 3: Start Frequency = 2439.5MHz, Stop Frequency = 2464.5 MHz
Plot 4: Start Frequency = 2464.5MHz, Stop Frequency = 2489.5 MHz

RBW = 1% of the span or more
Sweep = auto
VBW = ≥ RBW
Detector function = peak
Trace = max hold

**- Measurement Data: Comply**

**- FH mode**

| Hopping mode | Test mode | Test Result (Total Hops) |
|---|---|---|
| Enable | Test Case 1 | 79 |
| | Test Case 2 | 79 |
| | Test Case 3 | 79 |

**- AFH mode**

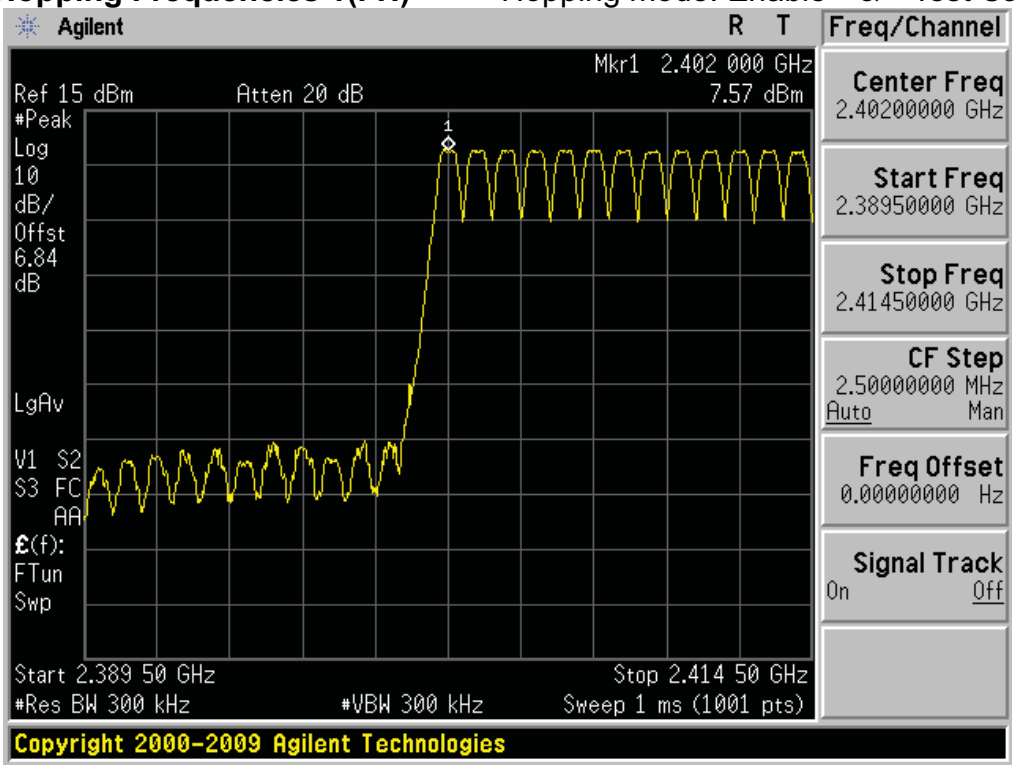
| Hopping mode | Test mode | Test Result (Total Hops) |
|---|---|---|
| Enable | Test Case 1 | 20 |
| | Test Case 2 | 20 |
| | Test Case 3 | 20 |

Note 1: See next pages for actual measured spectrum plots.

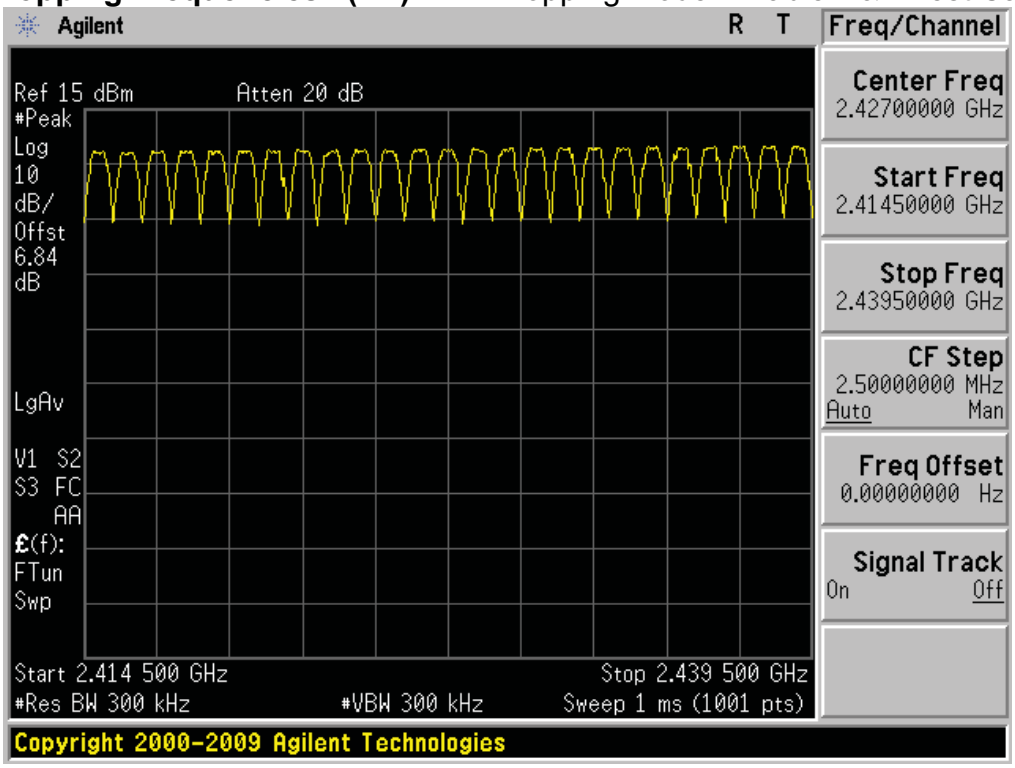
**- Minimum Standard:**

| |
|---|
| At least 15 hopes |

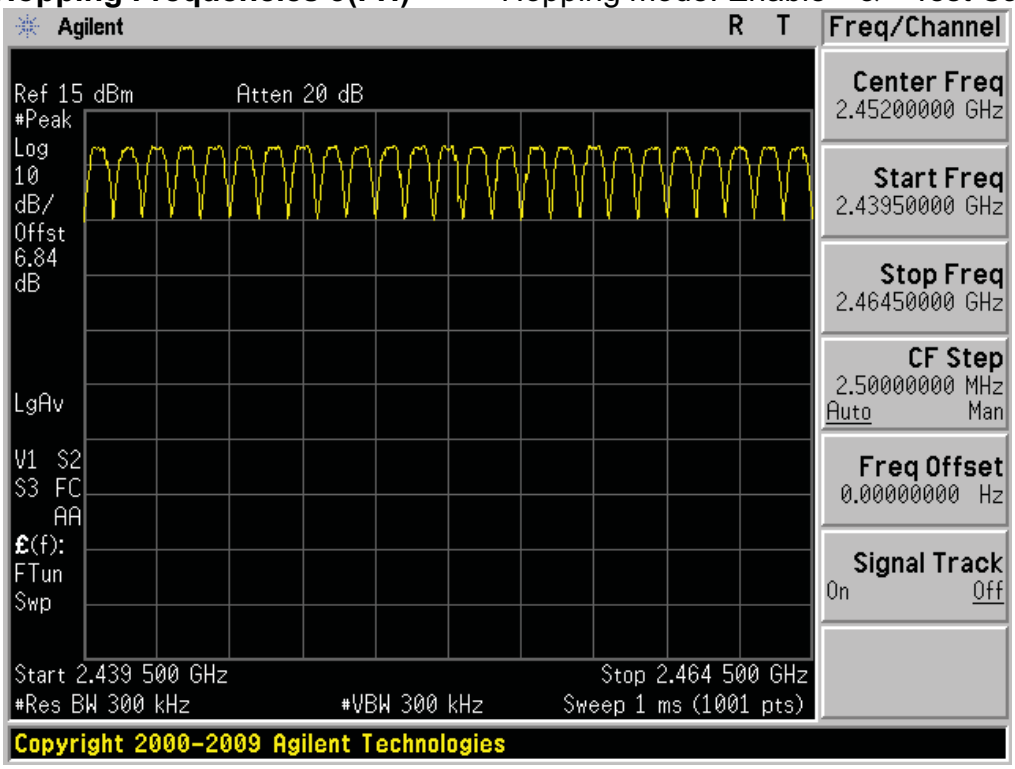
**Number of Hopping Frequencies 1(FH)** Hopping mode: Enable & Test Case 1



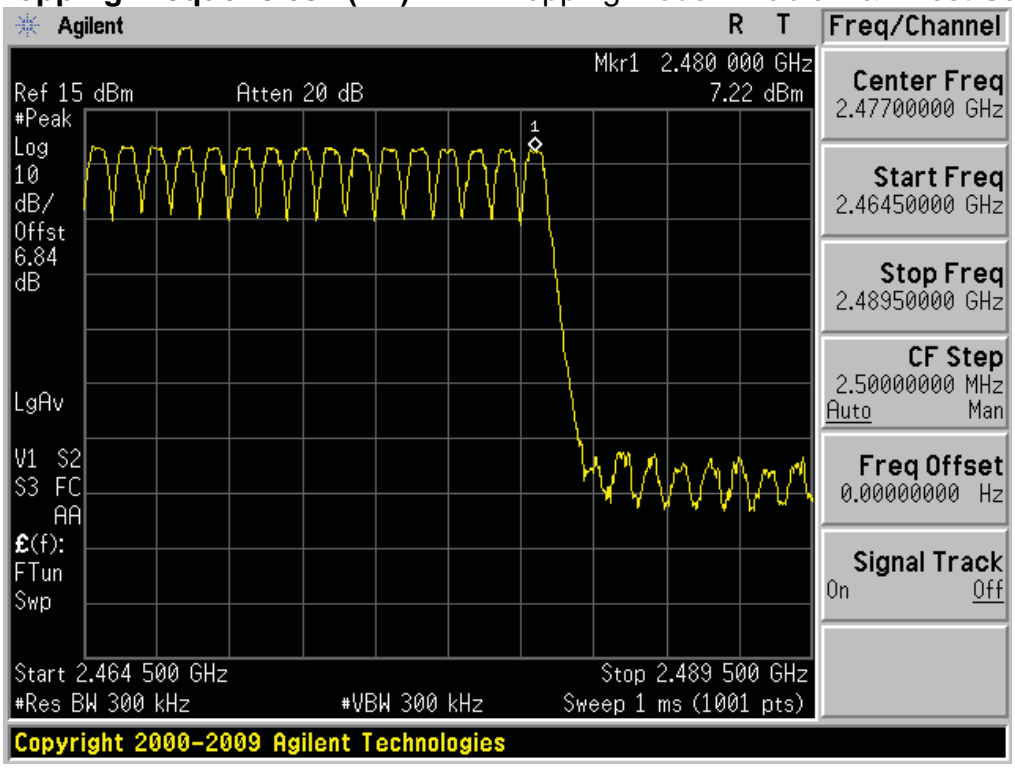

**Number of Hopping Frequencies 2(FH)** Hopping mode: Enable & Test Case 1



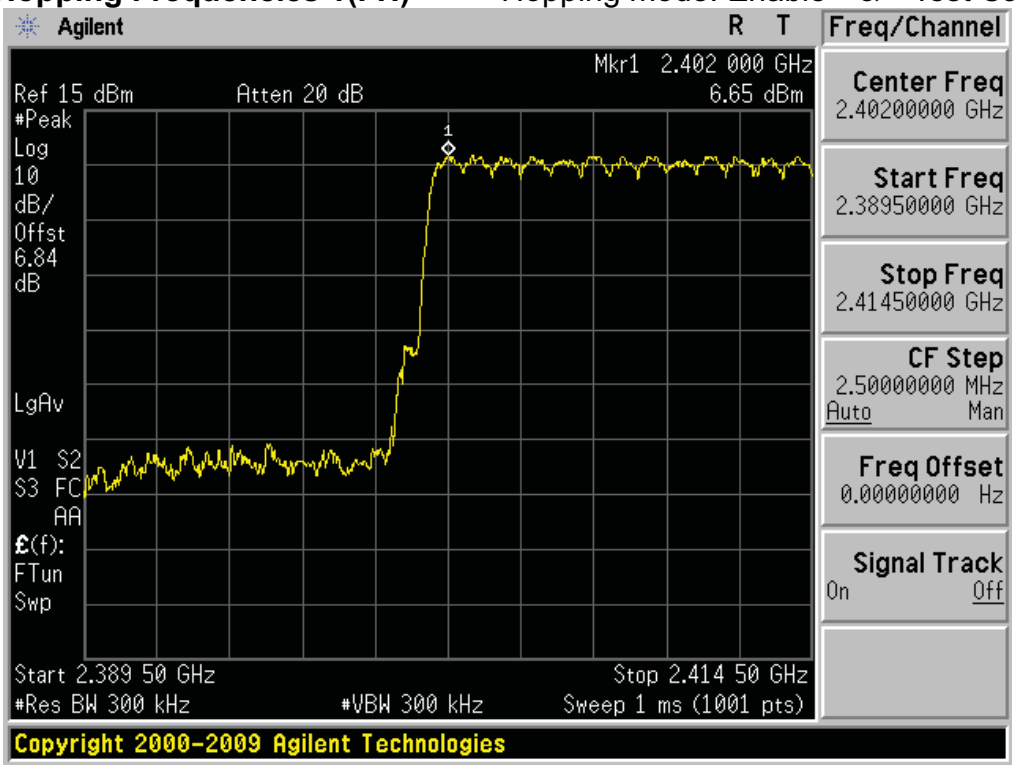
**Number of Hopping Frequencies 3(FH)** Hopping mode: Enable & Test Case 1



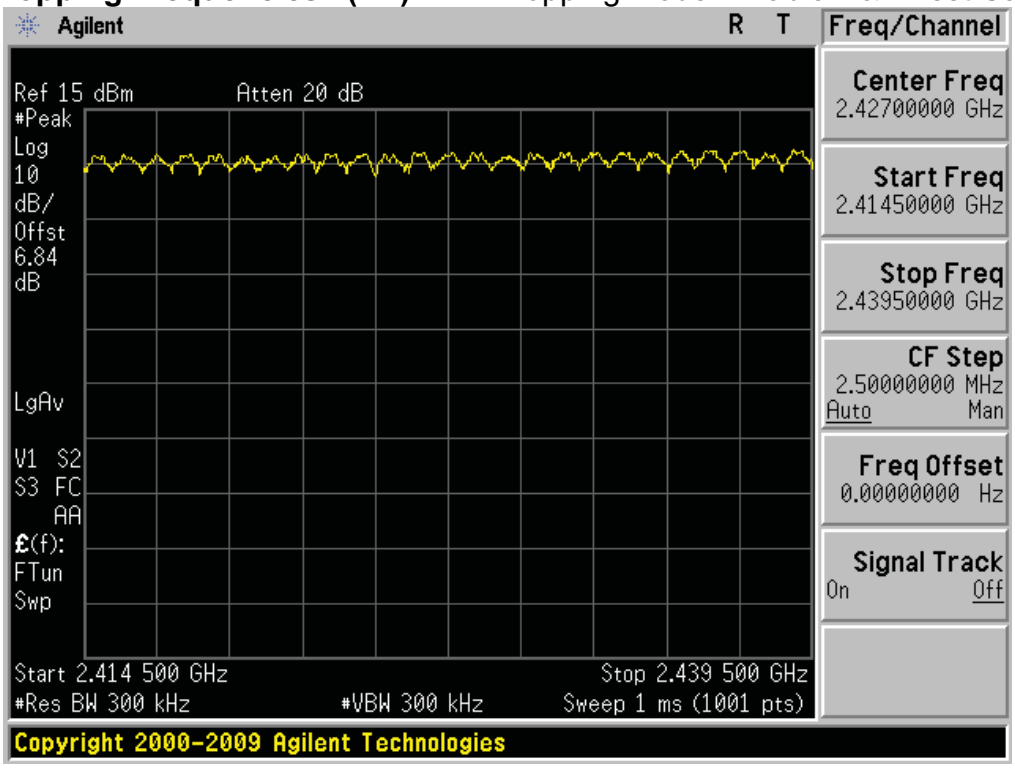

**Number of Hopping Frequencies 4(FH)** Hopping mode: Enable & Test Case 1



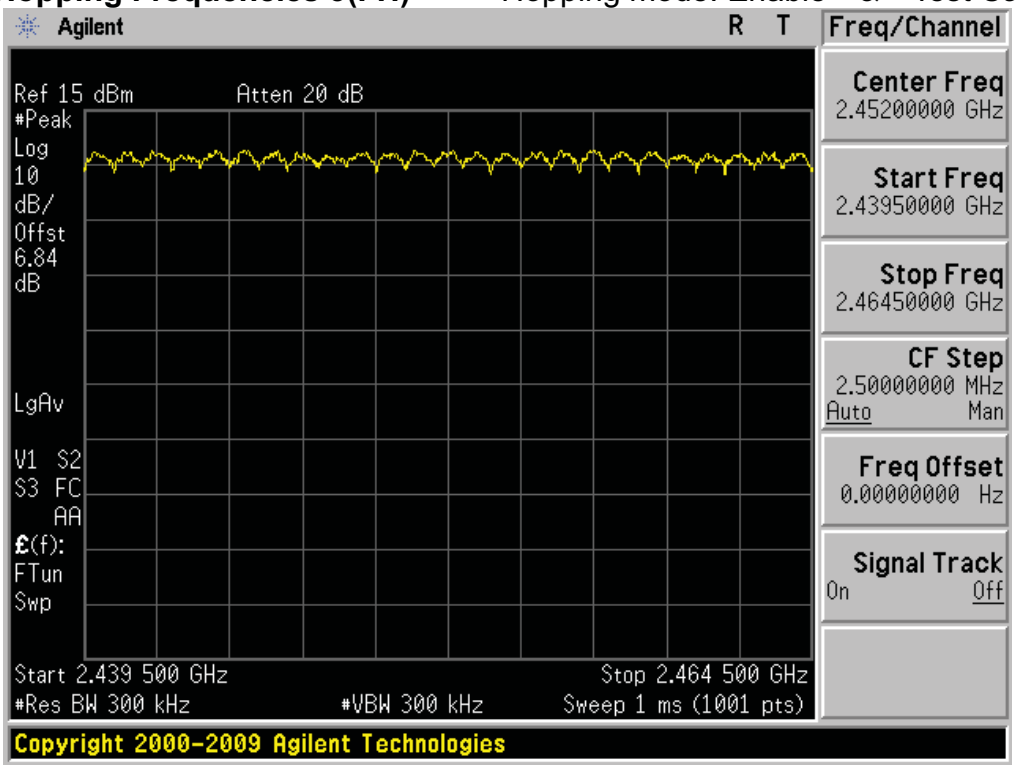
**Number of Hopping Frequencies 1(FH)** Hopping mode: Enable & Test Case 2



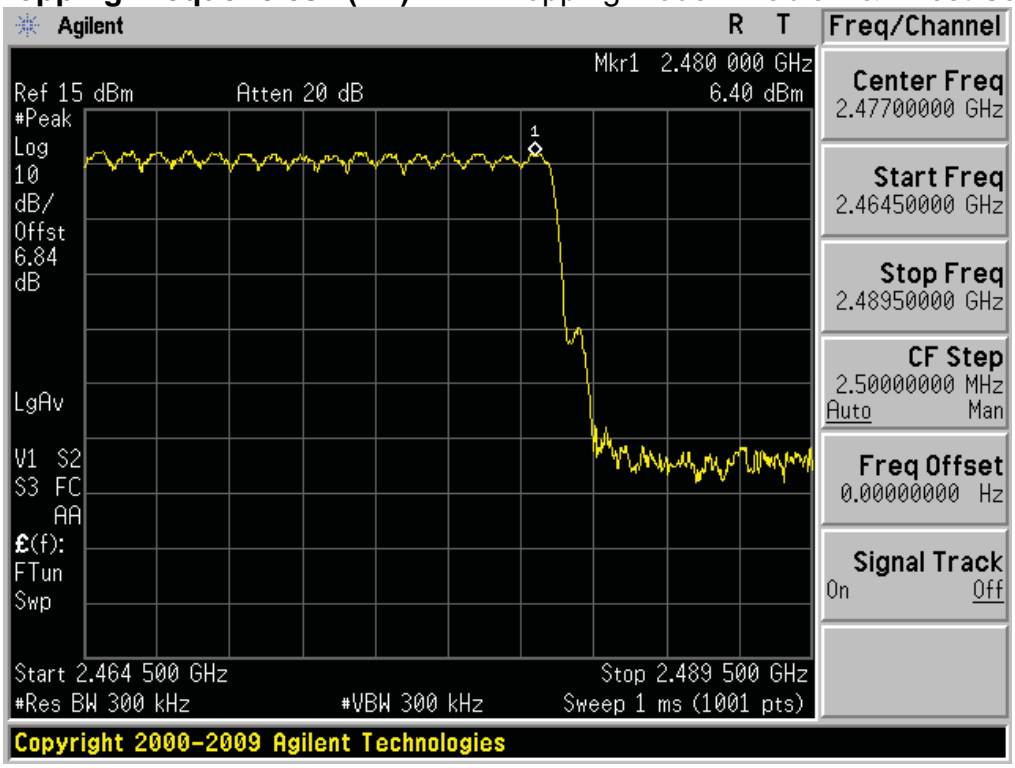

**Number of Hopping Frequencies 2(FH)** Hopping mode: Enable & Test Case 2



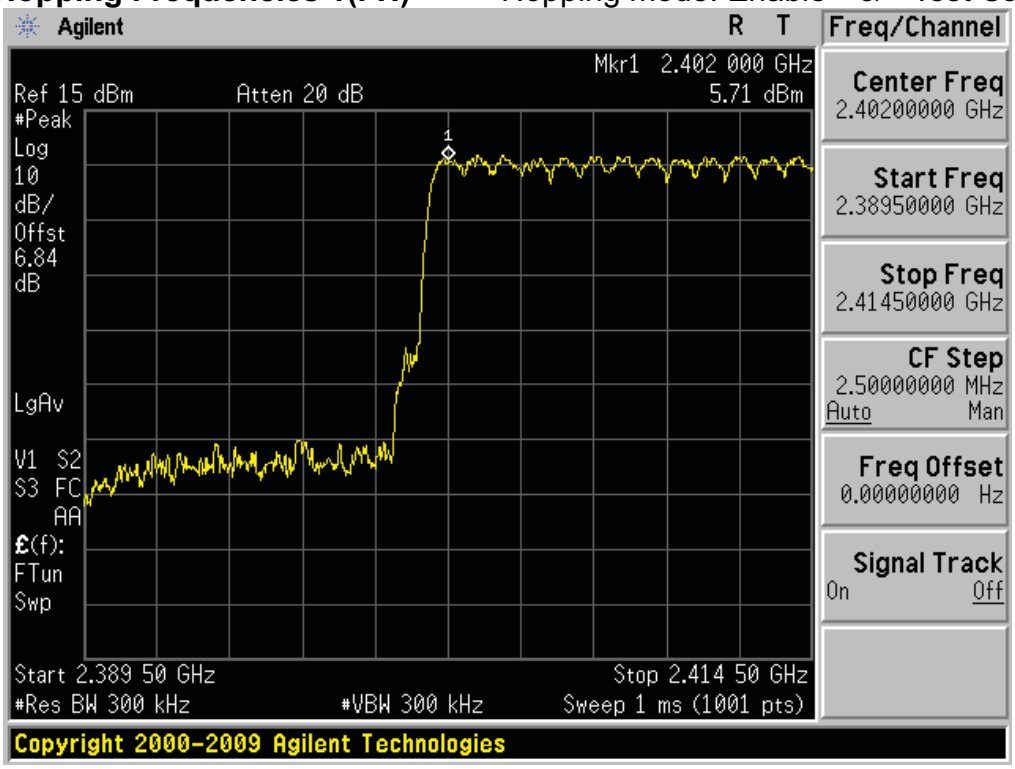
**Number of Hopping Frequencies 3(FH)** Hopping mode: Enable & Test Case 2



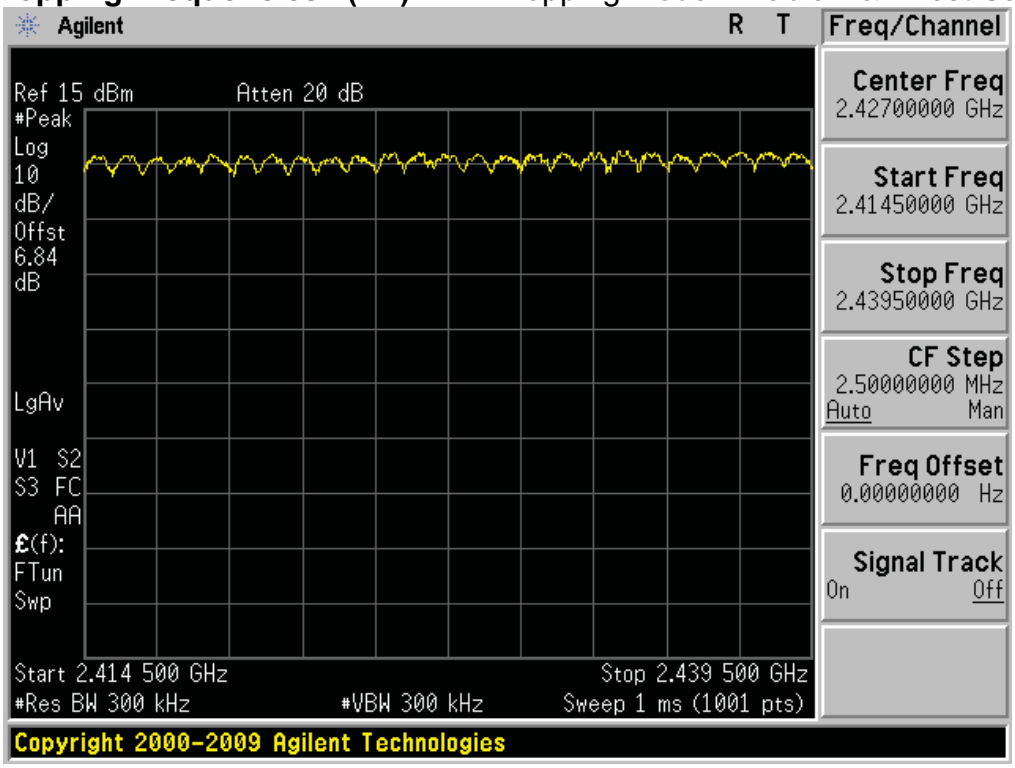

**Number of Hopping Frequencies 4(FH)** Hopping mode: Enable & Test Case 2



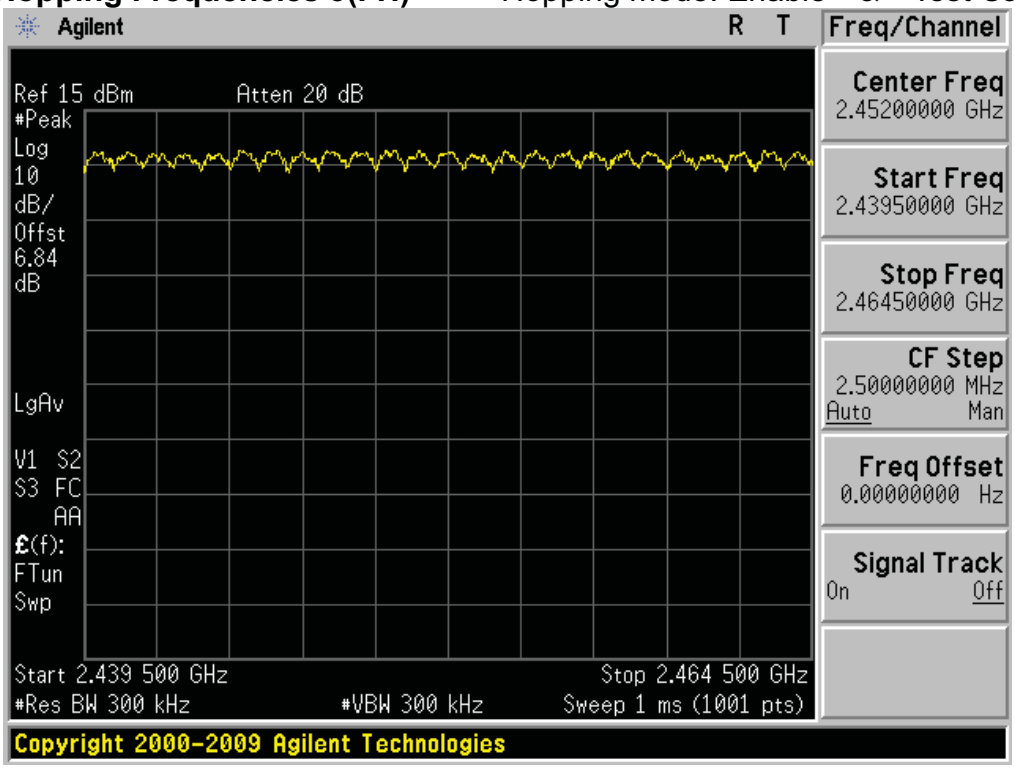
**Number of Hopping Frequencies 1(FH)** Hopping mode: Enable & Test Case 3



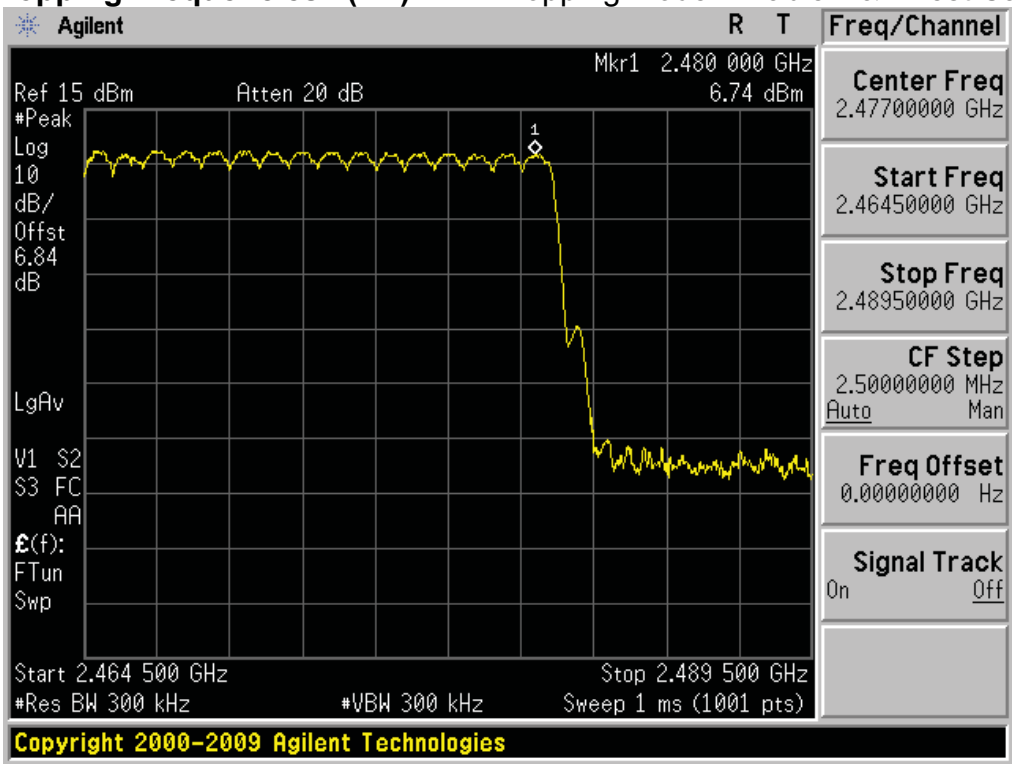

**Number of Hopping Frequencies 2(FH)** Hopping mode: Enable & Test Case 3



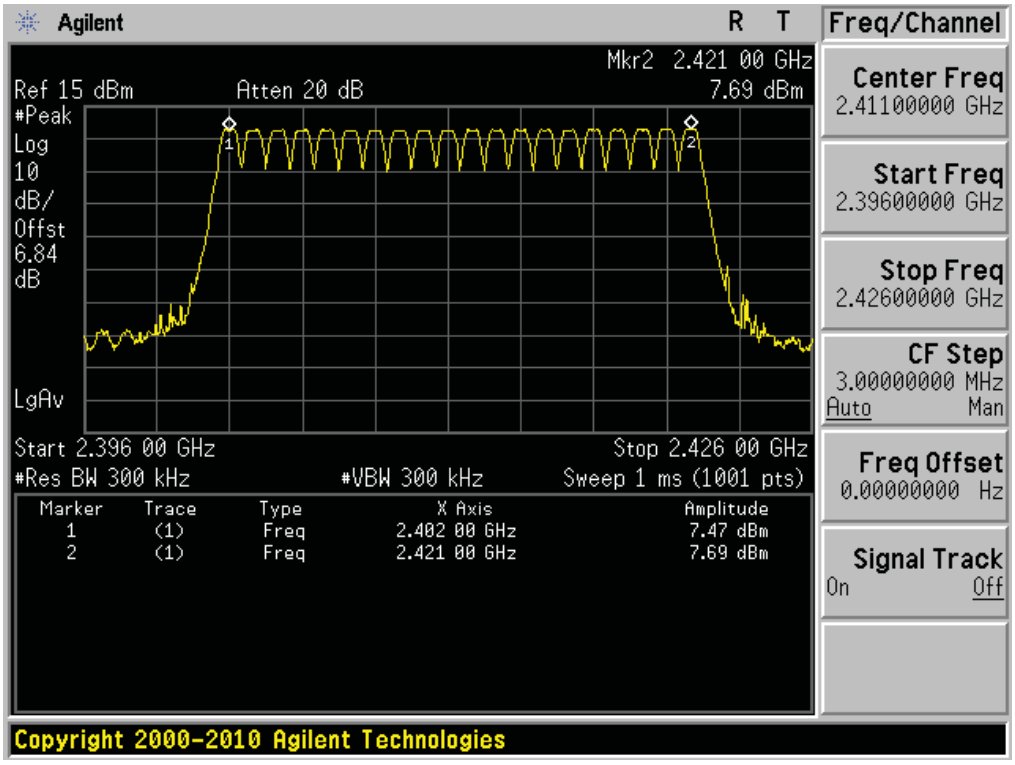
**Number of Hopping Frequencies 3(FH)** Hopping mode: Enable & Test Case 3



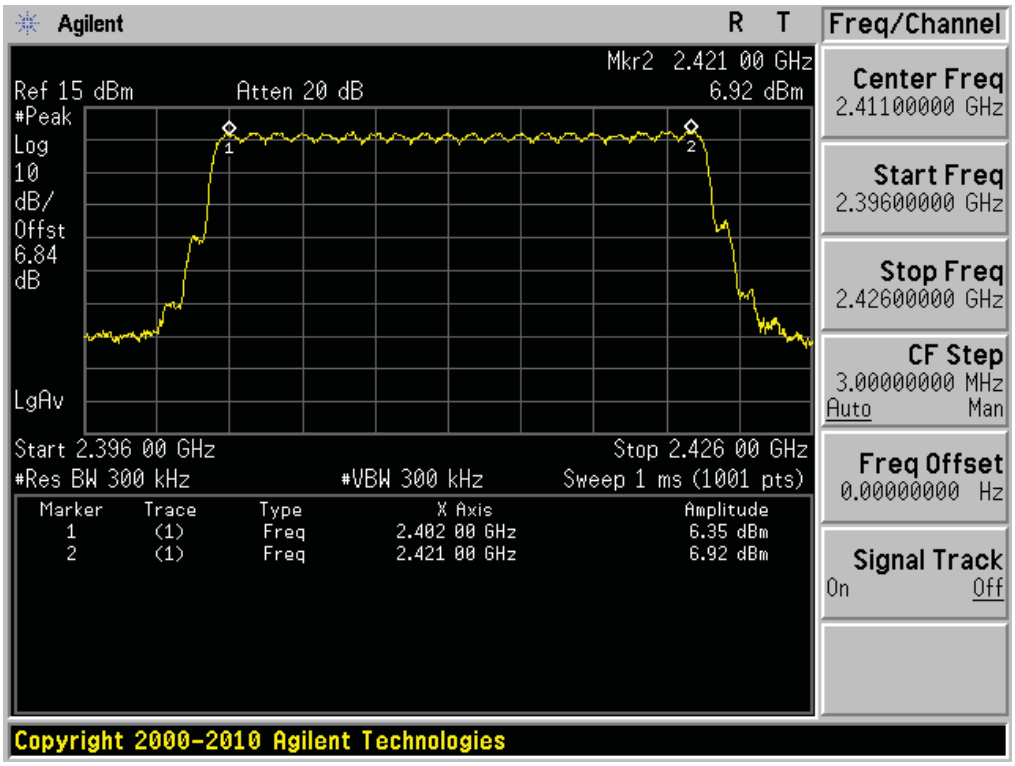

**Number of Hopping Frequencies 4(FH)** Hopping mode: Enable & Test Case 3



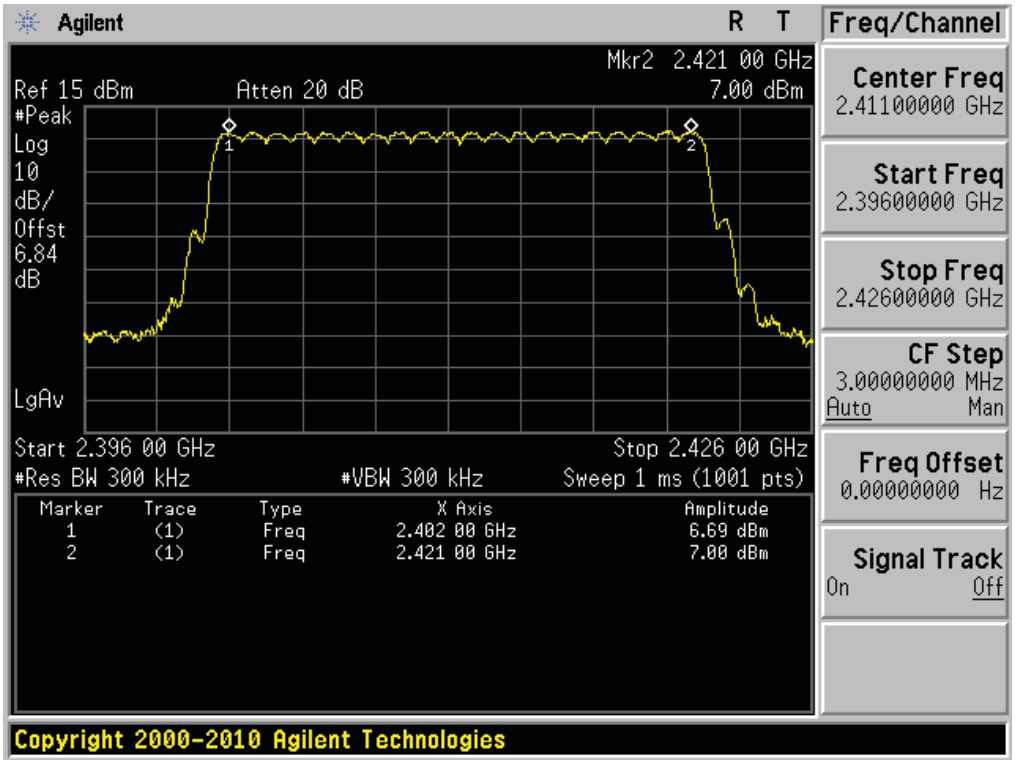
**Number of Hopping Frequencies 1(AFH)** Hopping mode: Enable & Test Case 1




**Number of Hopping Frequencies 1(AFH)** Hopping mode: Enable & Test Case 2



**Number of Hopping Frequencies 1(AFH)** Hopping mode: Enable & Test Case 3



# 5. 20dBc BW

## 5.1. Test Setup

Refer to the APPENDIX I.

## 5.2. Limit

Limit: Not Applicable

## 5.3. Test Procedure

1. The 20dBcbandwidthwere measured with a spectrum analyzer connected to RF antenna connector(conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.

2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW ≥ 1% of the 20 dB bandwidth, VBW ≥RBW, Span = 3㎒.

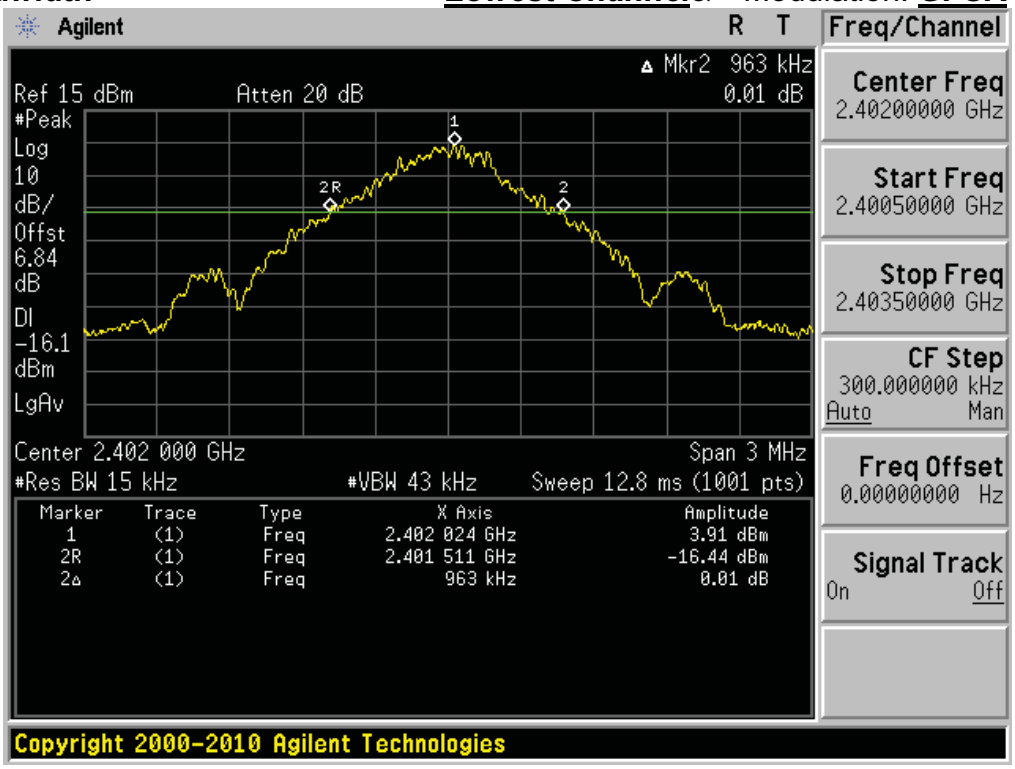
## 5.4. Test Results

Ambient temperature : 24°C
Relative humidity : 43%

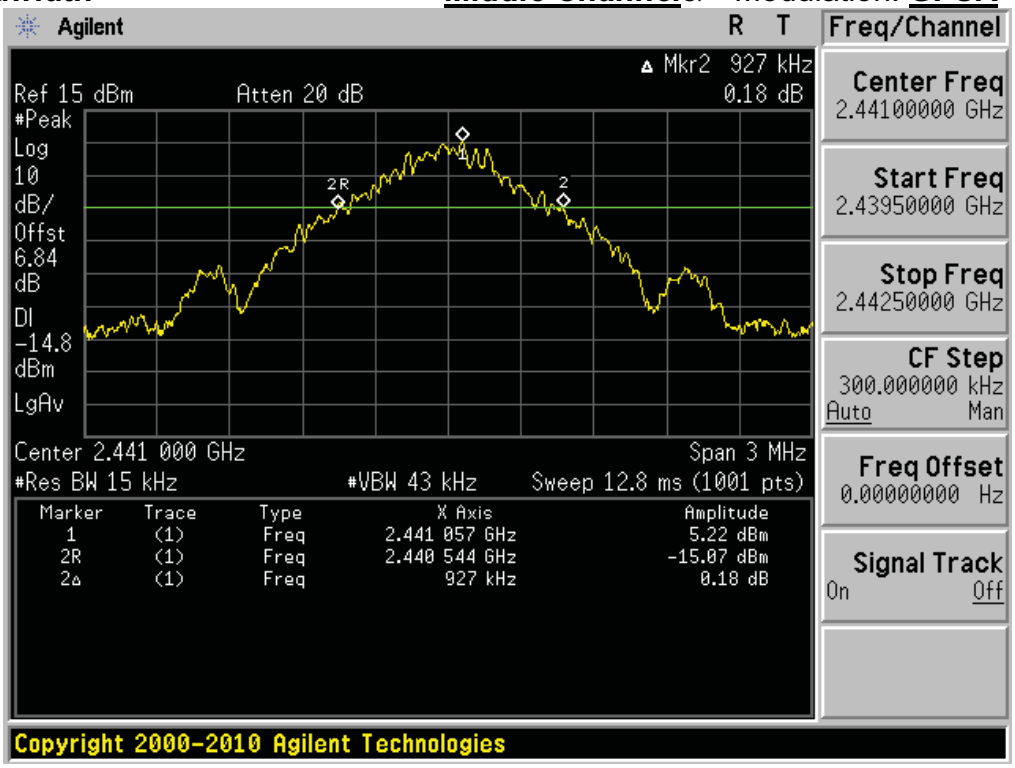
| Modulation | Tested Channel | 20dBc BW (MHz) |
|---|---|---|
| ***GFSK*** | **Lowest** | **0.963** |
| | **Middle** | **0.927** |
| | **Highest** | **0.930** |
| ***π/4DQPSK*** | **Lowest** | **1.323** |
| | **Middle** | **1.326** |
| | **Highest** | **1.335** |
| ***8DPSK*** | **Lowest** | **1.293** |
| | **Middle** | **1.293** |
| | **Highest** | **1.296** |

Note 1: See next pages for actual measured spectrum plots.

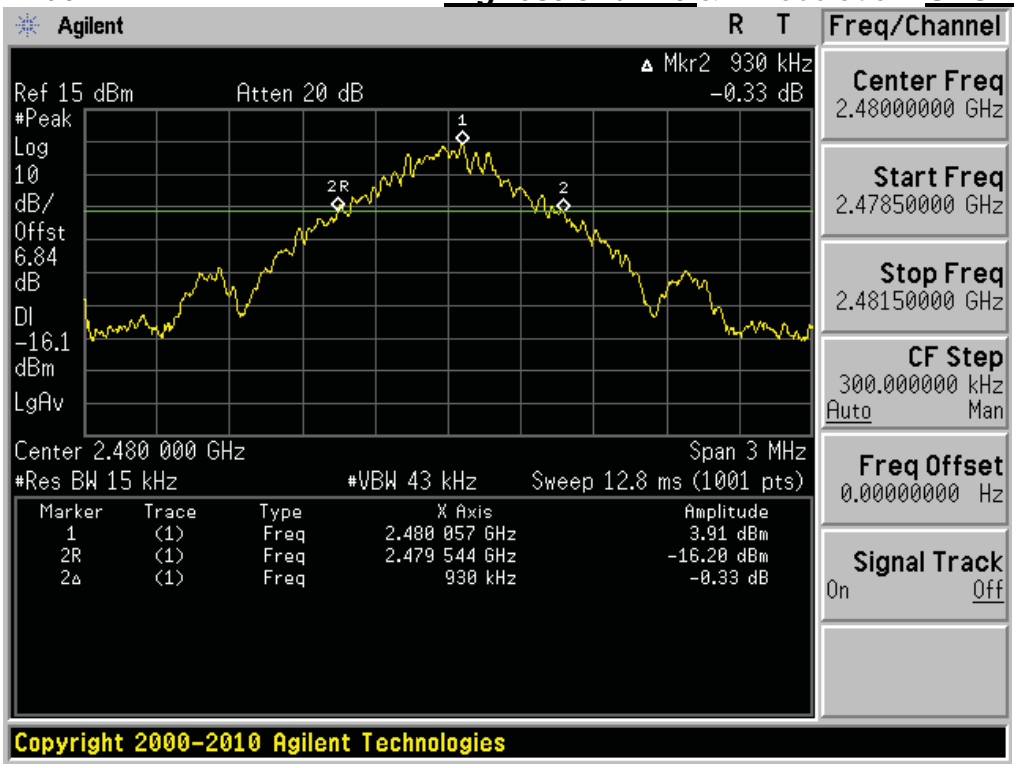
**20dBc Bandwidth** ***Lowest Channel***& Modulation: ***GFSK***



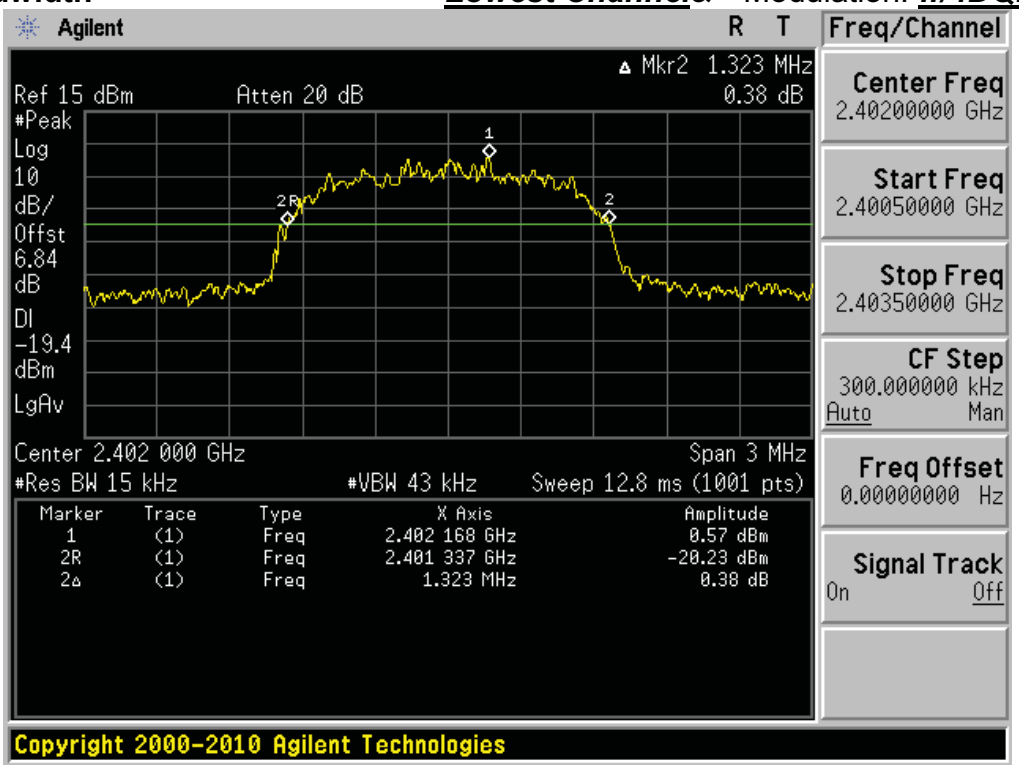

**20dBc Bandwidth** ***Middle Channel***& Modulation: ***GFSK***



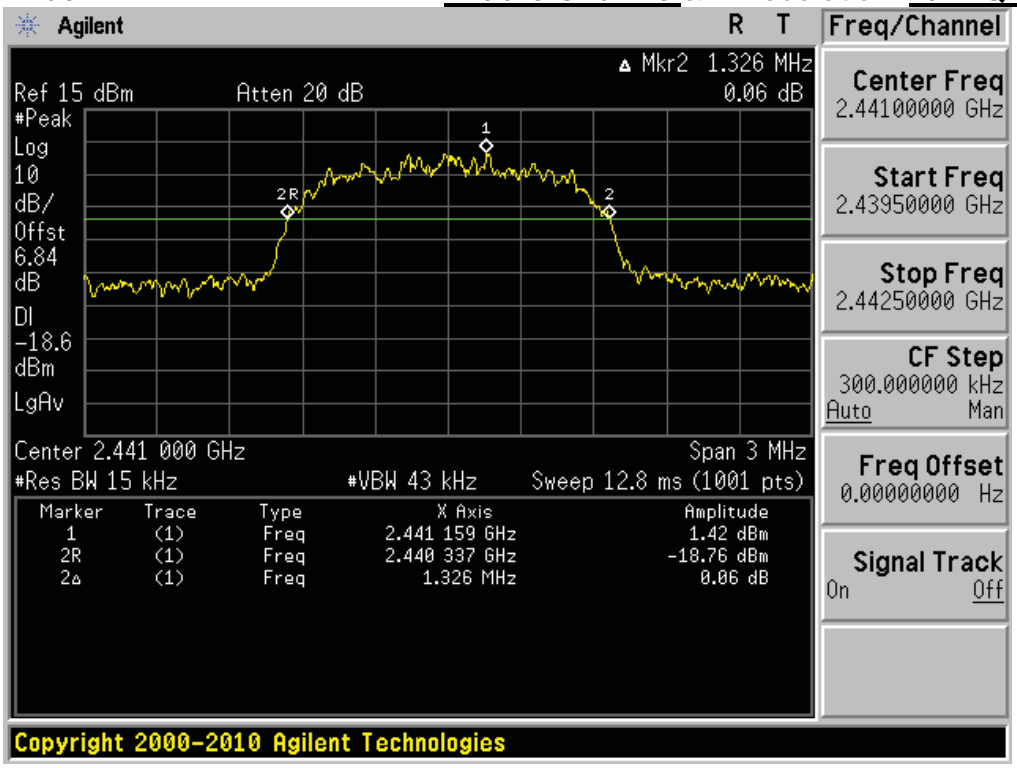
**20dBc Bandwidth** ***Highest Channel***& Modulation: ***GFSK***



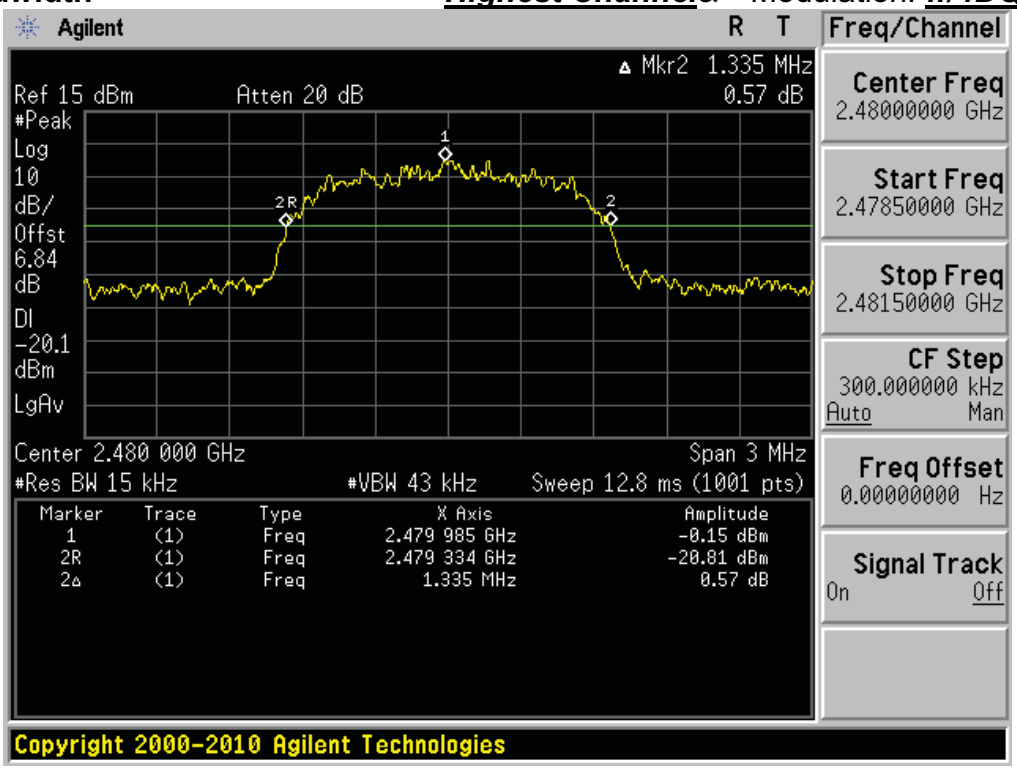

**20dBc Bandwidth** ***Lowest Channel***& Modulation: ***π/4DQPSK***



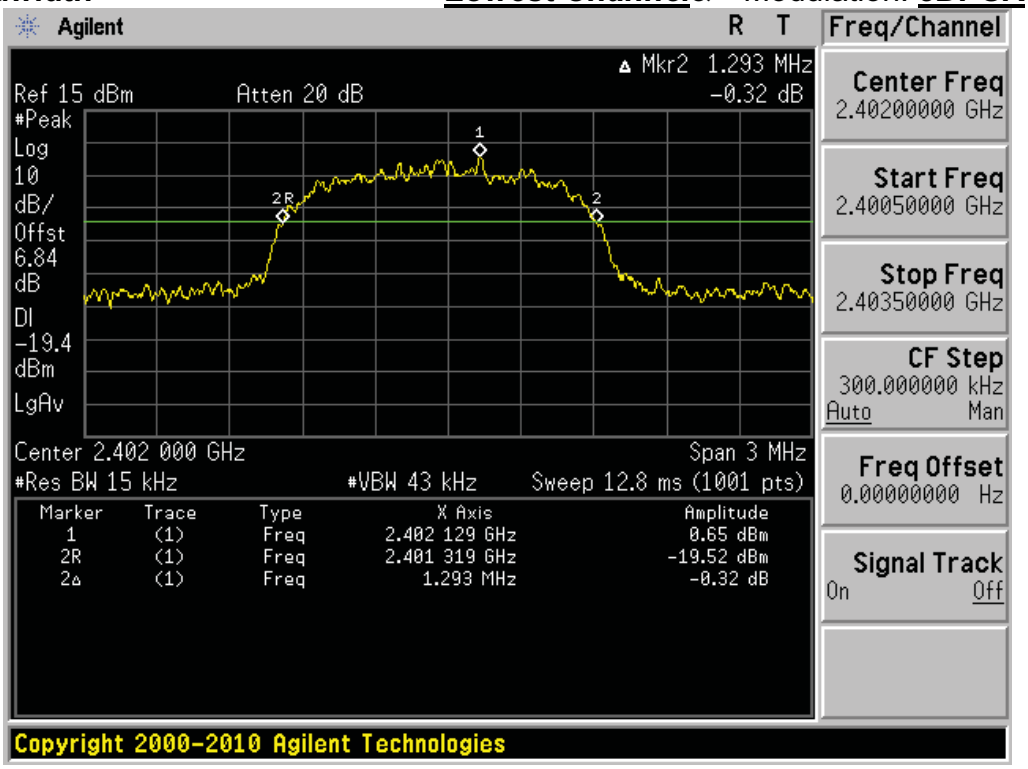
**20dBc Bandwidth** ***Middle Channel***& Modulation: ***π/4DQPSK***



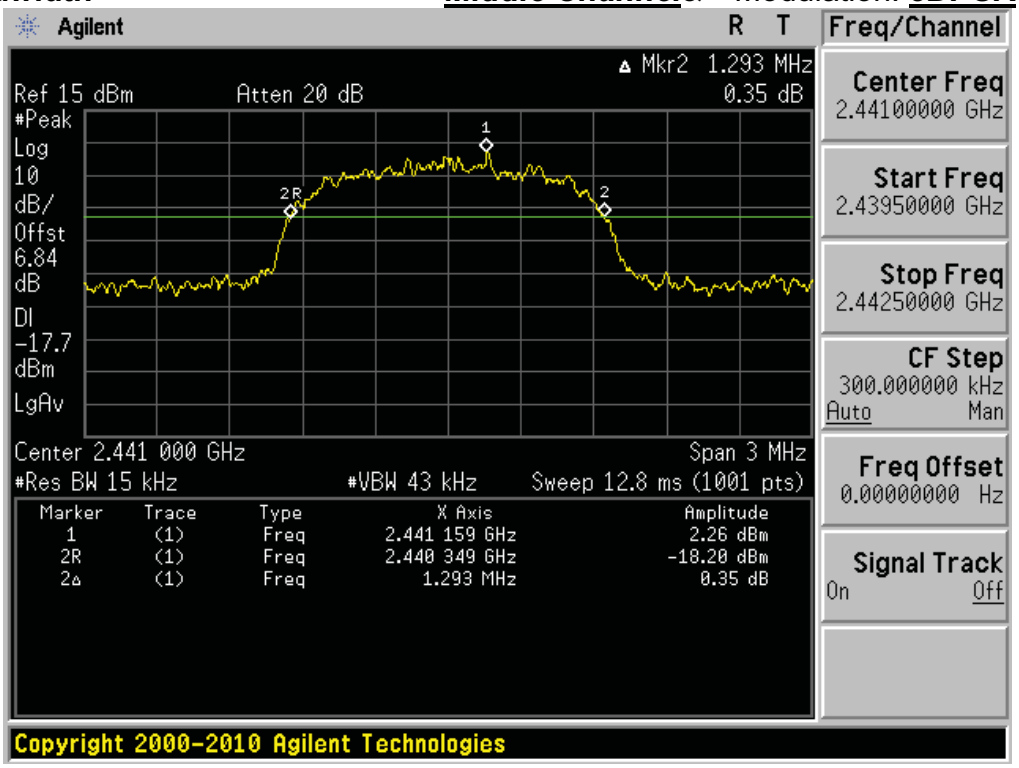

**20dBc Bandwidth** ***Highest Channel***& Modulation: ***π/4DQPSK***



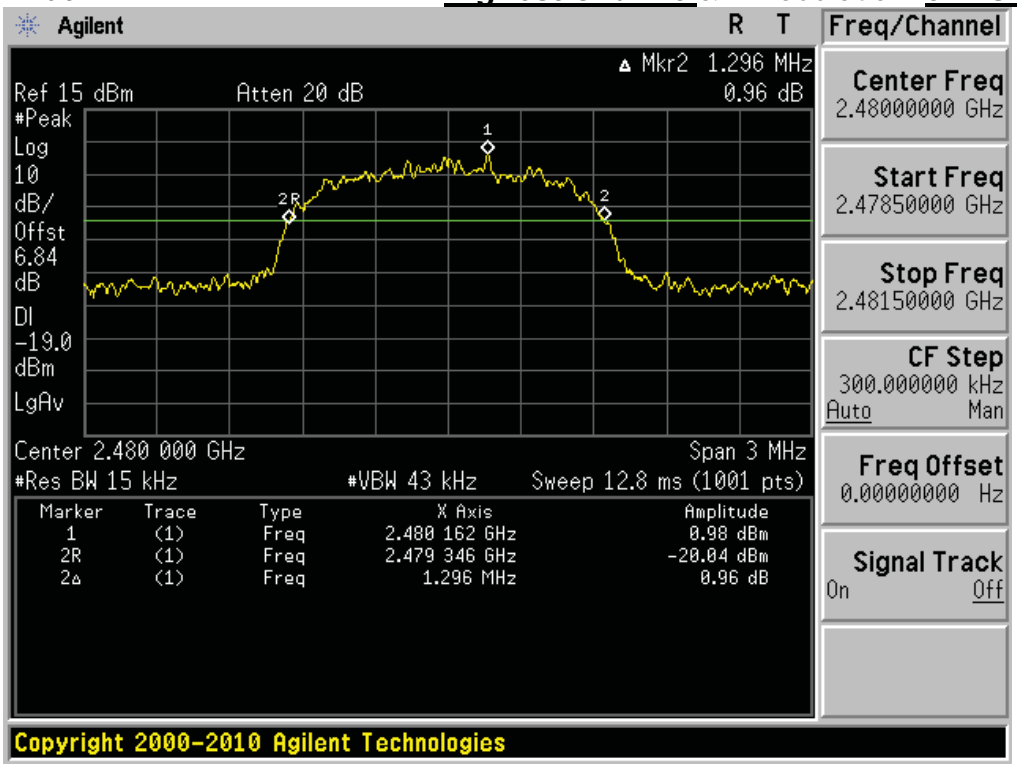
**20dBc Bandwidth** ***Lowest Channel***& Modulation: ***8DPSK***




**20dBc Bandwidth** ***Middle Channel***& Modulation: ***8DPSK***



**20dBc Bandwidth** ***Highest Channel***& Modulation: ***8DPSK***



# 6. Time of Occupancy (Dwell Time)

## 6.1. Test Setup

Refer to the APPENDIX I.

## 6.2. Limit

Limit: Not Applicable

## 6.3. Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Center frequency = 2441 MHz
Span = zero
RBW = 1 MHz
VBW = ≥ RBW
Trace = max hold
Detector function = peak

## 6.4. Test Results

Ambient temperature : 24°C
Relative humidity : 43 %

**- FH mode**

| Hopping mode | Packet Type | Number of hopping Channels | Burst On Time (ms) | Period (ms) | Test Result (sec) |
|---|---|---|---|---|---|
| Enable | DH 5 | 79 | 2.89 | 3.75 | 0.308 |
| | 2 DH 5 | 79 | 2.89 | 3.75 | 0.308 |
| | 3 DH 5 | 79 | 2.89 | 3.75 | 0.308 |

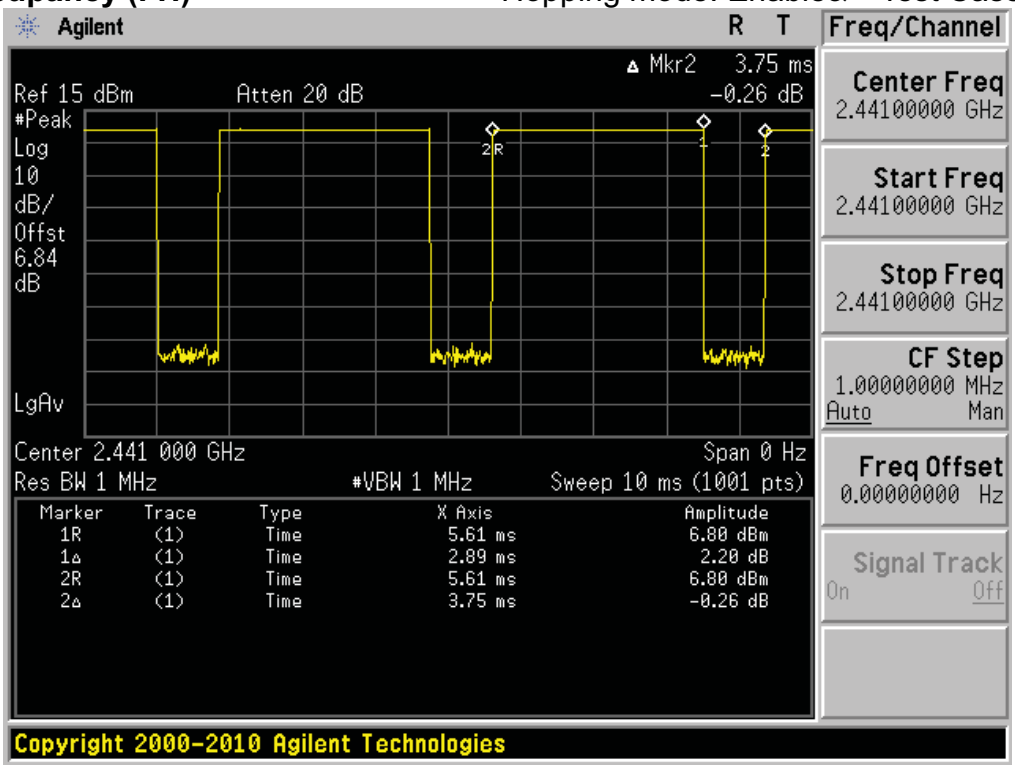
**- AFH mode**

| Hopping mode | Packet Type | Number of hopping Channels | Burst On Time (ms) | Period (ms) | Test Result (sec) |
|---|---|---|---|---|---|
| Enable | DH 5 | 20 | 2.89 | 3.75 | 0.154 |
| | 2 DH 5 | 20 | 2.89 | 3.75 | 0.154 |
| | 3 DH 5 | 20 | 2.89 | 3.75 | 0.154 |

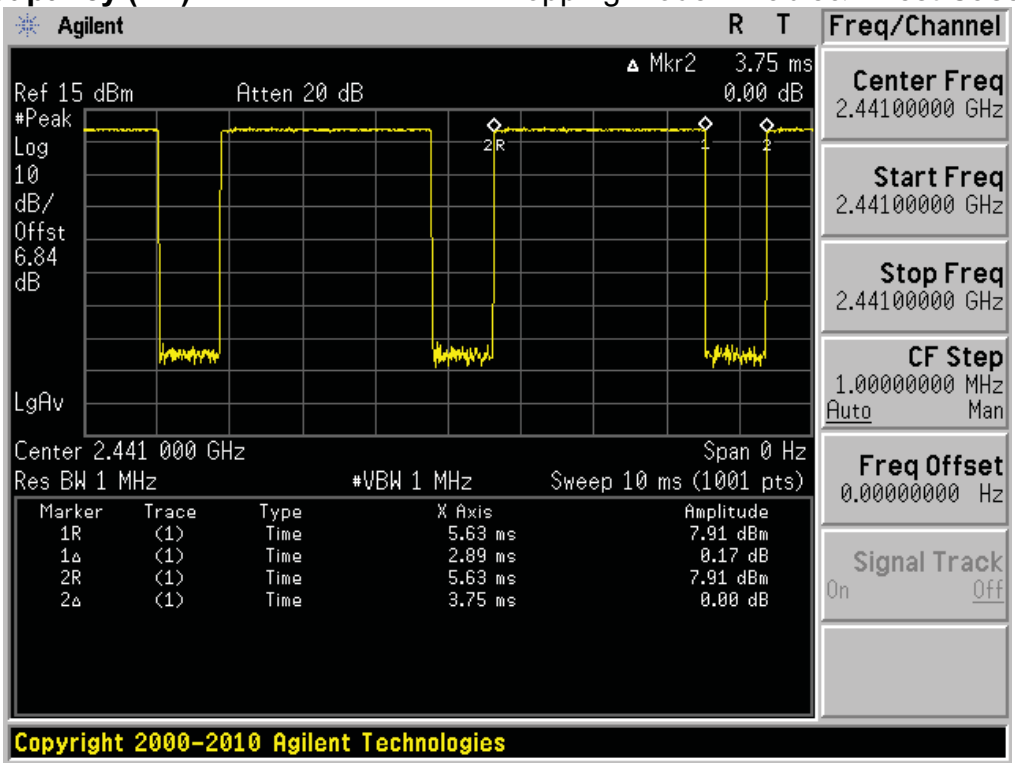
Note 1: $\text{Dwell Time} = 0.4 \times \text{Hopping channel} \times \text{Burst ON time} \times ((\text{Hopping rate} \div \text{Time slots}) \div \text{Hopping channel})$
- Time slots for DH5 = 6 slots(TX = 5 slot / RX = 1 slot)
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2: See next pages for actual measured spectrum plots.

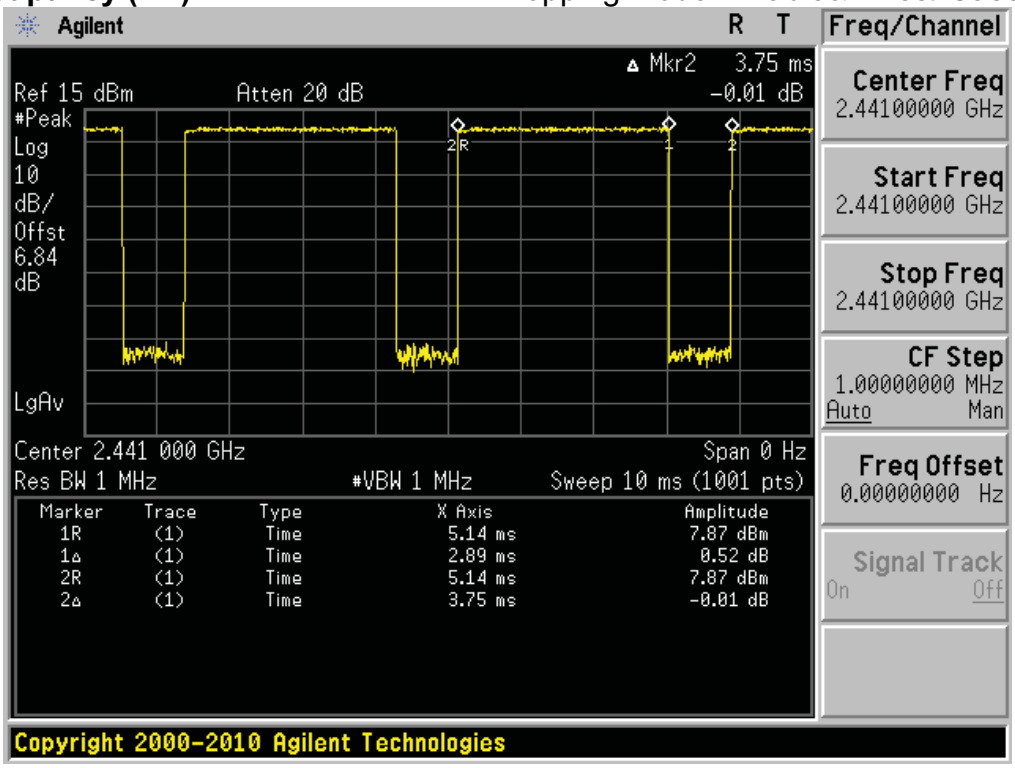
**Time of Occupancy (FH)** Hopping mode: Enable& Test Case 1



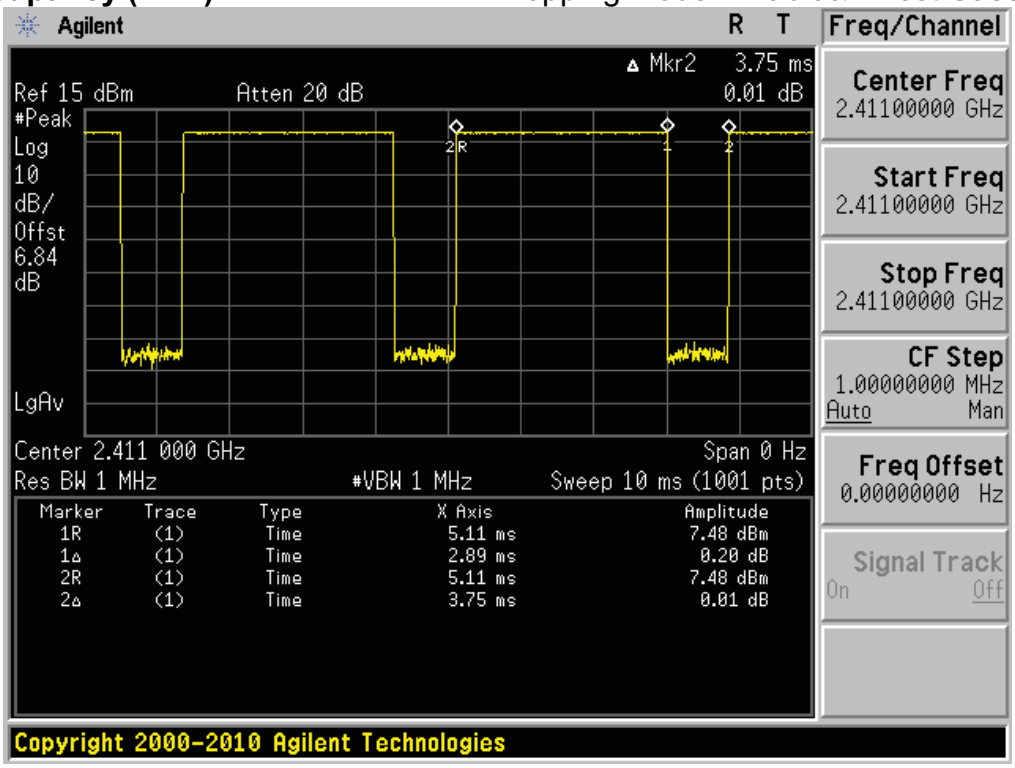

**Time of Occupancy (FH)** Hopping mode: Enable& Test Case 2



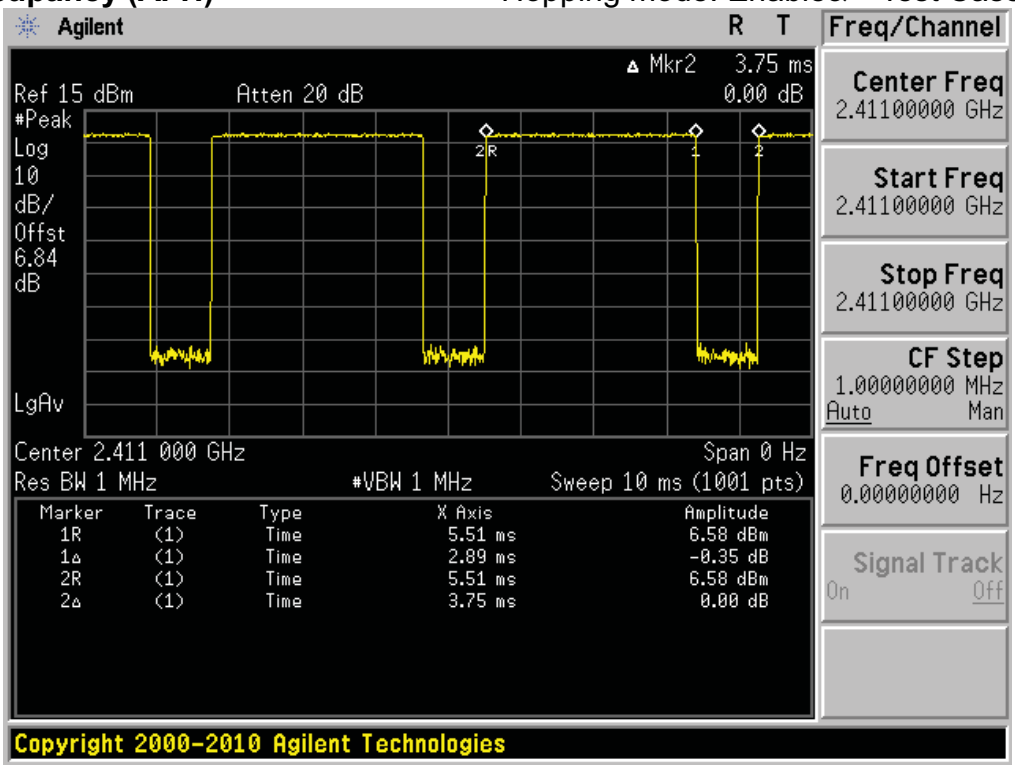
**Time of Occupancy (FH)** Hopping mode: Enable& Test Case 3



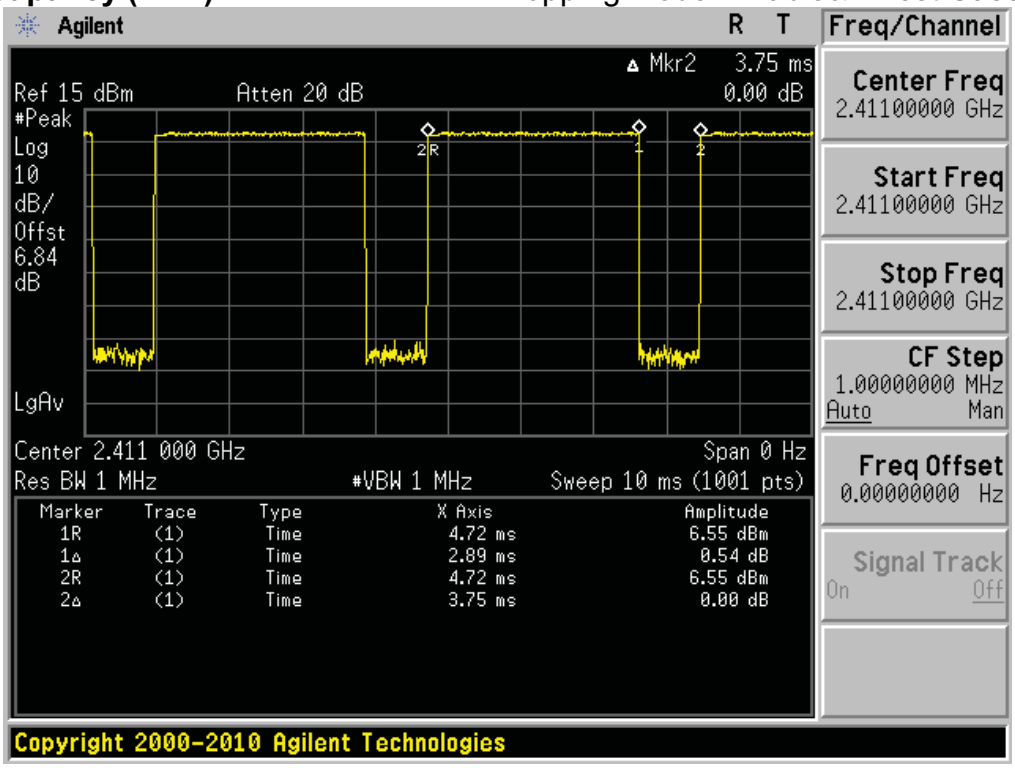
**Time of Occupancy (AFH)** Hopping mode: Enable& Test Case 1




**Time of Occupancy (AFH)** Hopping mode: Enable& Test Case 2



**Time of Occupancy (AFH)** Hopping mode: Enable& Test Case 3



# 7. Maximum Peak Output Power Measurement

## 7.1. Test Setup

Refer to the APPENDIX I.

## 7.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following :

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

2. §15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 ㎒ employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 ㎒ band: 1 Watt.

## 7.3. Test Procedure

1. The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector (conductedmeasurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.

2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using ;
   Span = approximately 5 times the 20 ㏈bandwidth, centered on a hopping channel
   RBW ≥ 20㏈BW
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

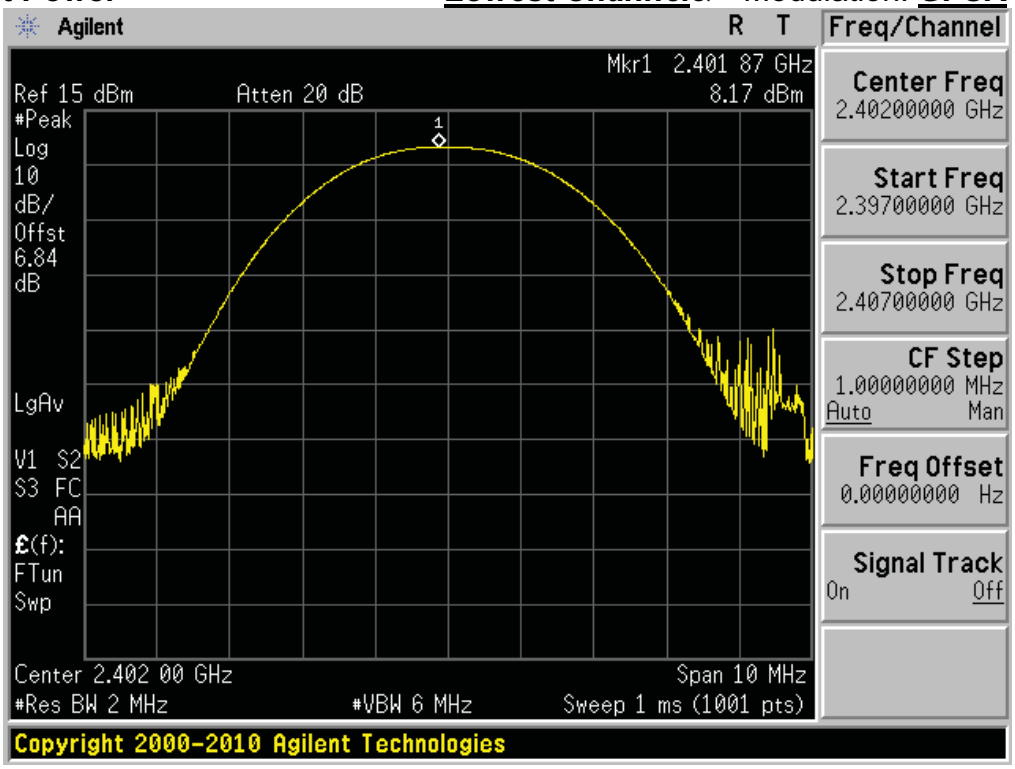
## 7.4. Test Results

Ambient temperature : 24°C
Relative humidity : 53 %

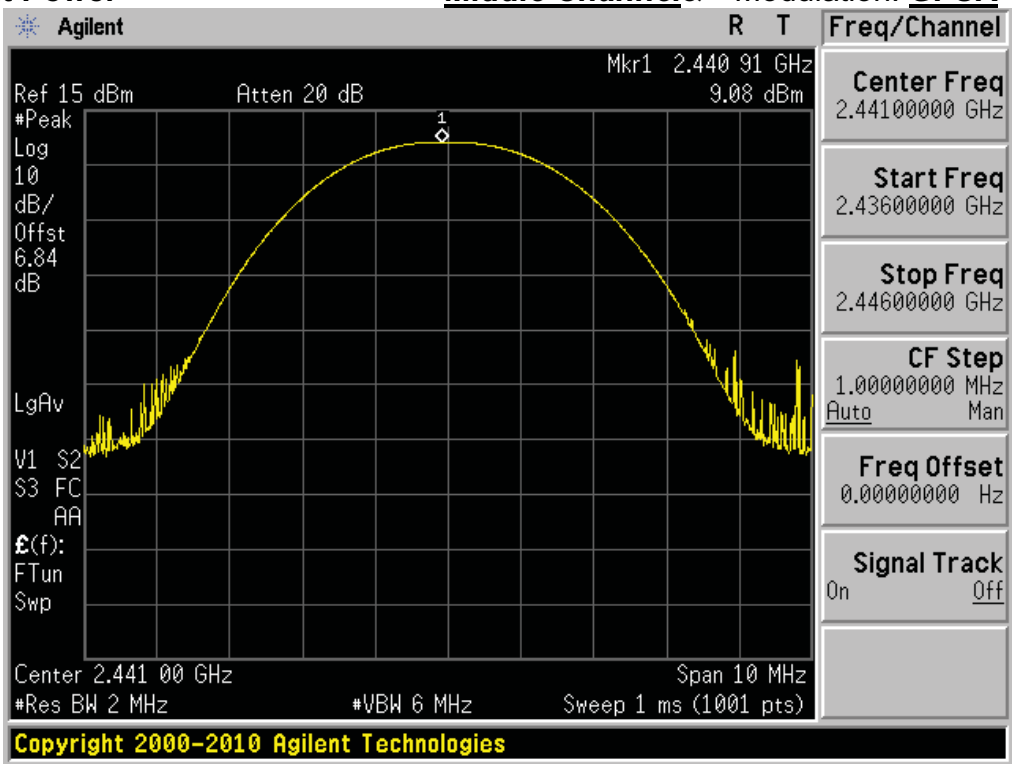
| Modulation | Tested Channel | Peak Output Power | |
|---|---|---|---|
| | | dBm | mW |
| ***GFSK*** | **Lowest** | 8.17 | 6.561 |
| | **Middle** | **9.08** | **8.091** |
| | **Highest** | 7.97 | 6.266 |
| ***π/4DQPSK*** | **Lowest** | 8.72 | 7.447 |
| | **Middle** | **9.94** | **9.863** |
| | **Highest** | 8.80 | 7.586 |
| ***8DPSK*** | **Lowest** | 9.18 | 8.279 |
| | **Middle** | **10.16** | **10.375** |
| | **Highest** | 9.09 | 8.110 |

Note 1: See next pages for actual measured spectrum plots.

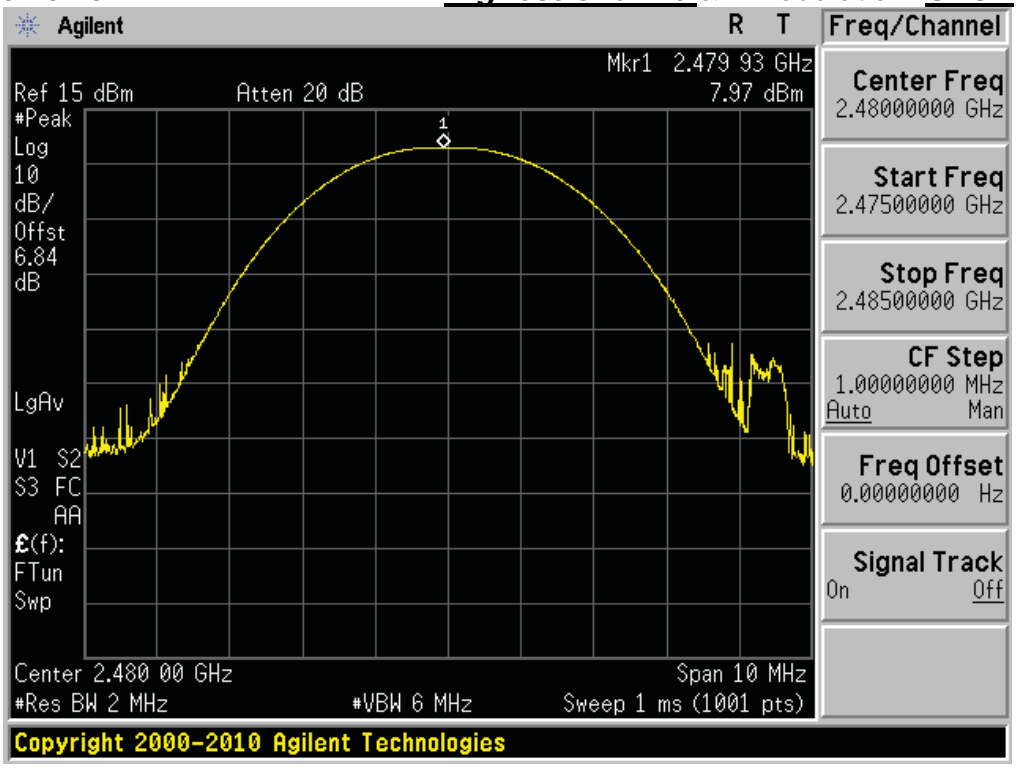
**Peak Output Power** ***Lowest Channel***& Modulation: ***GFSK***



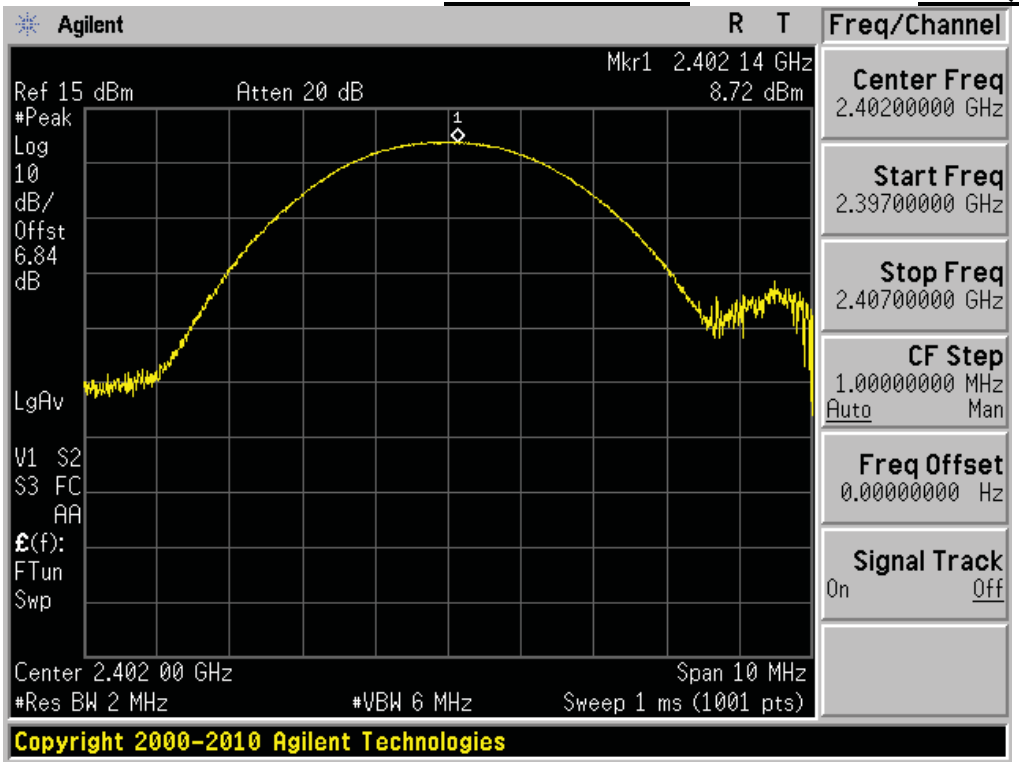

**Peak Output Power** ***Middle Channel***& Modulation: ***GFSK***



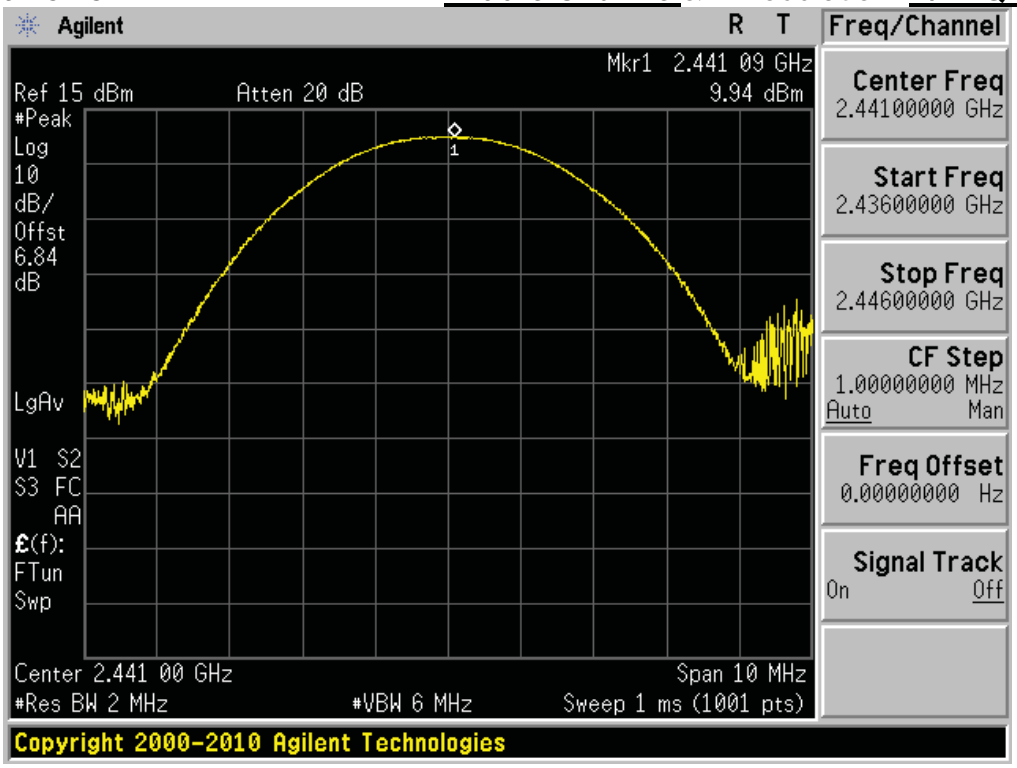
**Peak Output Power** ***Highest Channel***& Modulation: ***GFSK***



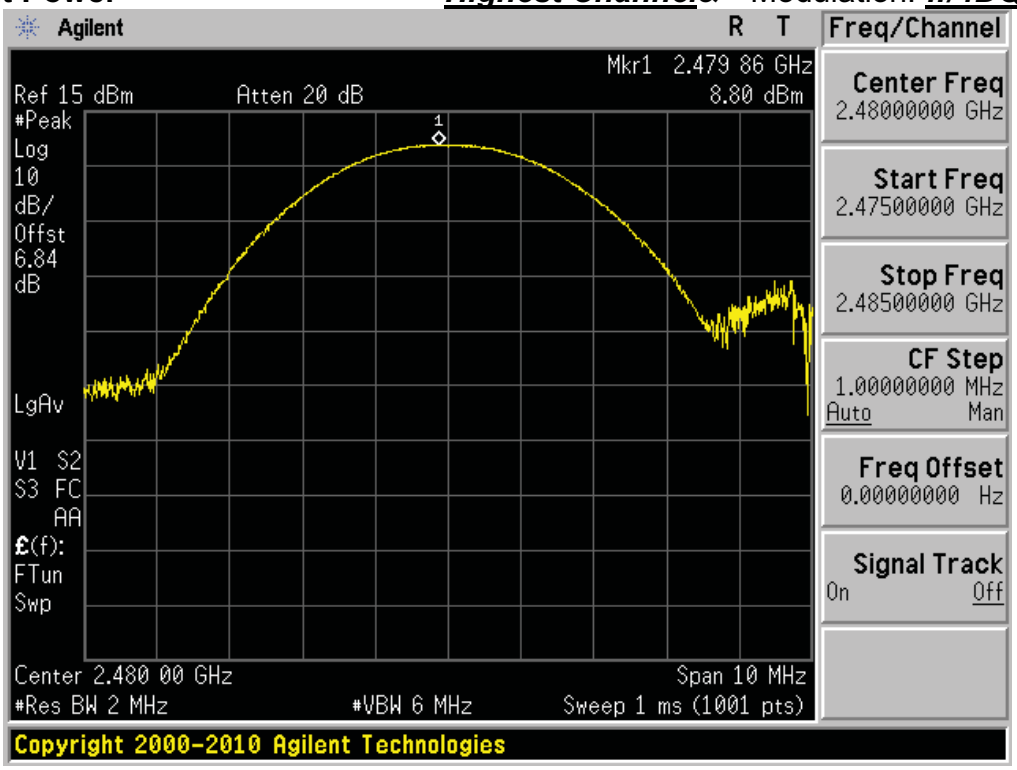

**Peak Output Power** ***Lowest Channel***& Modulation: ***π/4DQPSK***



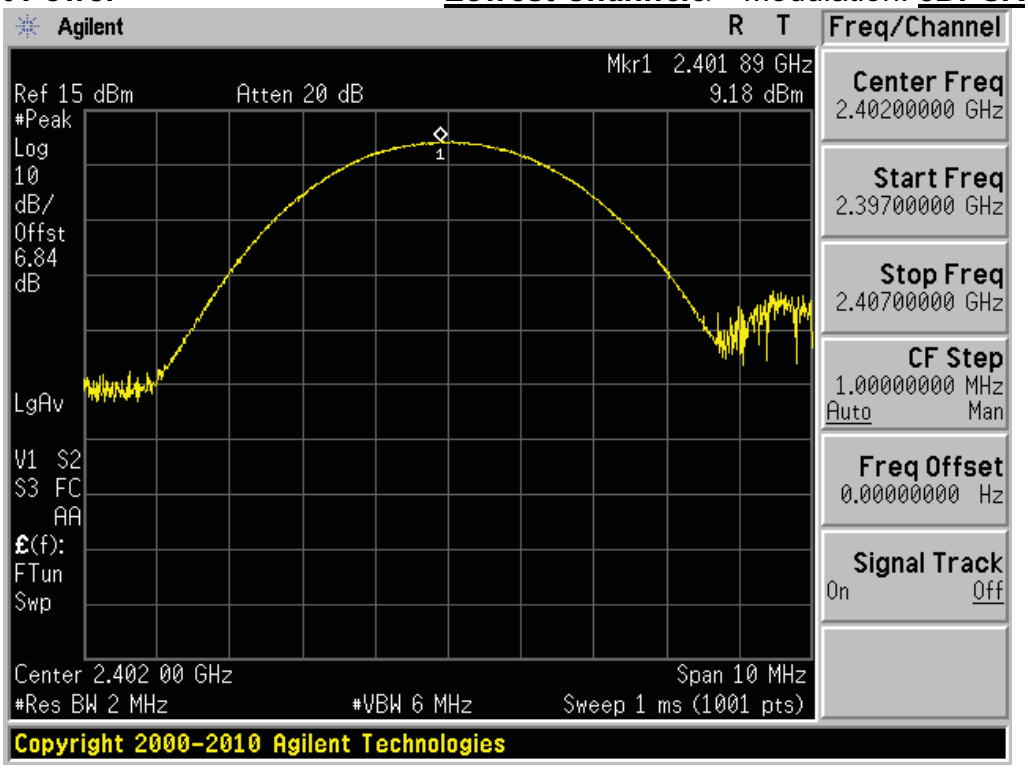
**Peak Output Power** ***Middle Channel***& Modulation: ***π/4DQPSK***



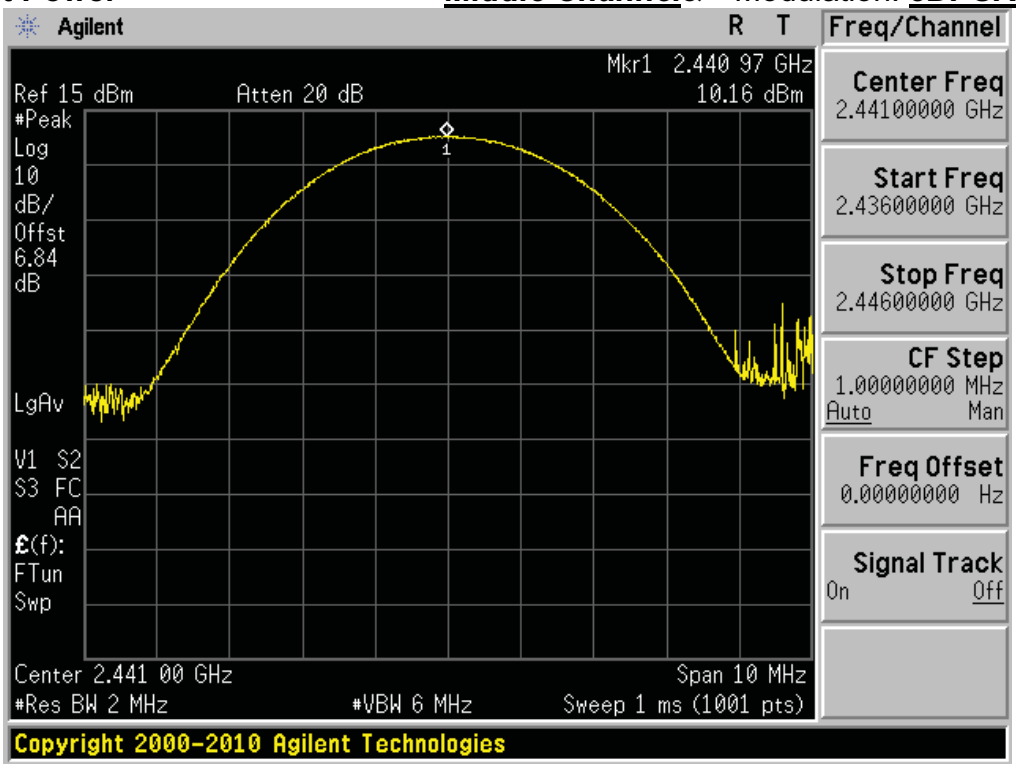

**Peak Output Power** ***Highest Channel***& Modulation: ***π/4DQPSK***



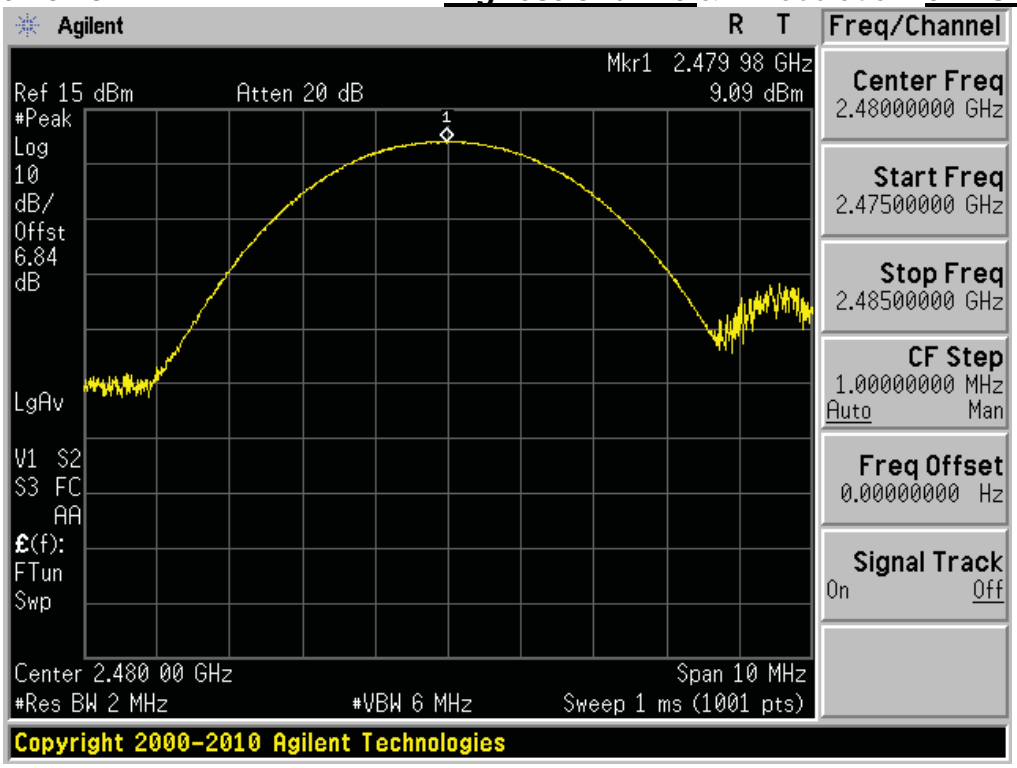
**Peak Output Power** ***Lowest Channel***& Modulation: ***8DPSK***




**Peak Output Power** ***Middle Channel***& Modulation: ***8DPSK***



**Peak Output Power** ***Highest Channel***& Modulation: ***8DPSK***



# 8. Transmitter AC Power Line Conducted Emission

## 8.1. Test Setup

Refer to test setup photo.

## 8.2. Limit

According to §15.207(a) 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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).
Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

| Frequency Range (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15 ~ 0.5 | 66 to 56 * | 56 to 46 * |
| 0.5 ~ 5 | 56 | 46 |
| 5 ~ 30 | 60 | 50 |

* Decreases with the logarithm of the frequency

## 8.3. Test Procedures

Conducted emissions from the EUT were measured according to the dictates of ANSI C63.10-2009

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

## 8.4. Test Results

### AC Line Conducted Emissions (Graph)& Modulation: ***GFSK***

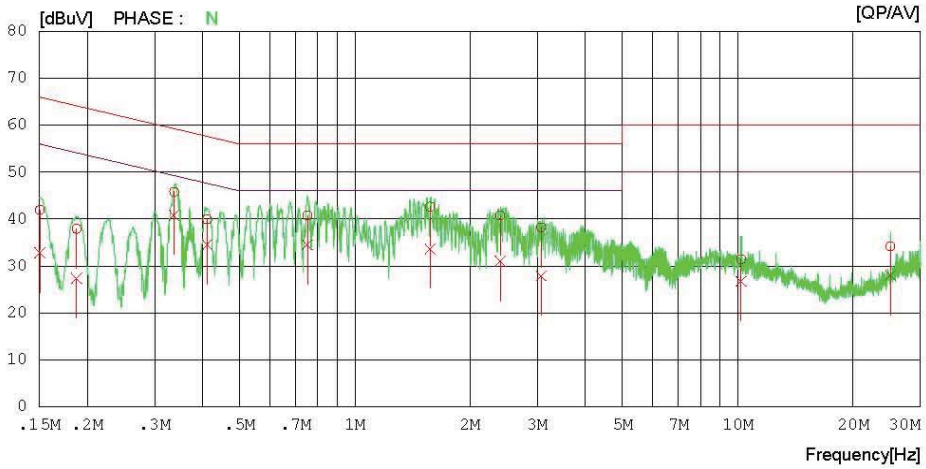
Digital EMC

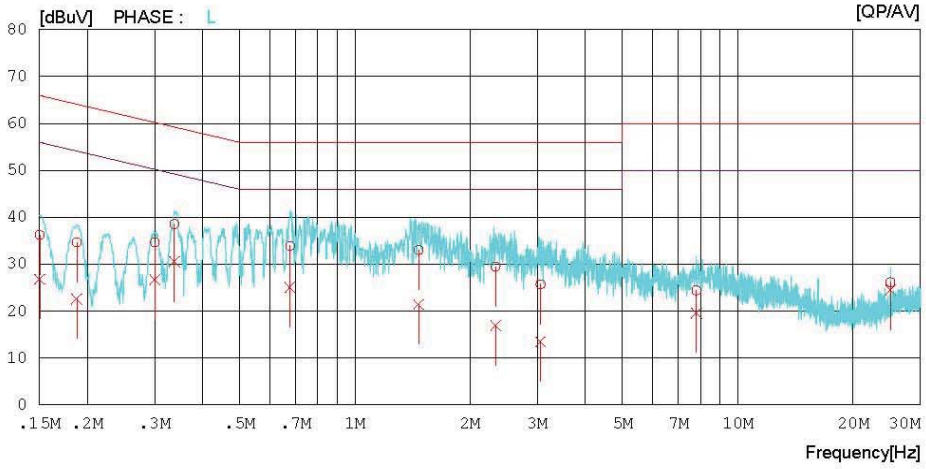
Results of Conducted Emission

Digital EMC
Date : 2013-02-02

| | | | | | |
|---|---|---|---|---|---|
| Model No. | : | LG-E425g | Referrence No. | : | |
| Type | : | | Power Supply | : | 120 V 60 Hz |
| Serial No. | : | Identical prototype | Temp/Humi. | : | 23 'C 45 % R.H. |
| Test Condition | : | BT | Operator | : | H.S SON |
| Memo | : | Hopping Mode | | | |

LIMIT : FCC P15.207 QP
FCC P15.207 AV



**AC Line Conducted Emissions (List)**& Modulation: ***GFSK***

## Results of Conducted Emission

Digital EMC
Date : 2013-02-02

| | | | | | |
|---|---|---|---|---|---|
| Model No. | : | LG-E425g | Referrence No. | : | |
| Type | : | | Power Supply | : | 120 V 60 Hz |
| Serial No. | : | Identical prototype | Temp/Humi. | : | 23 'C 45 % R.H. |
| Test Condition | : | BT | Operator | : | H.S SON |

Memo : Hopping Mode

LIMIT : FCC P15.207 QP
FCC P15.207 AV

| NO | FREQ | READING QP | READING AV | C.FACTOR | RESULT QP | RESULT AV | LIMIT QP | LIMIT AV | MARGIN QP | MARGIN AV | PHASE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | [MHz] | [dBuV] | [dBuV] | [dB] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | [dBuV] | |
| 1 | 0.15050 | 41.7 | 32.6 | 0.2 | 41.9 | 32.8 | 66.0 | 56.0 | 24.1 | 23.2 | N |
| 2 | 0.18771 | 37.7 | 27.2 | 0.2 | 37.9 | 27.4 | 64.1 | 54.1 | 26.2 | 26.7 | N |
| 3 | 0.33750 | 45.6 | 40.6 | 0.2 | 45.8 | 40.8 | 59.3 | 49.3 | 13.5 | 8.5 | N |
| 4 | 0.41188 | 39.7 | 34.3 | 0.2 | 39.9 | 34.5 | 57.6 | 47.6 | 17.7 | 13.1 | N |
| 5 | 0.75173 | 40.5 | 34.3 | 0.2 | 40.7 | 34.5 | 56.0 | 46.0 | 15.3 | 11.5 | N |
| 6 | 1.57250 | 42.3 | 33.3 | 0.3 | 42.6 | 33.6 | 56.0 | 46.0 | 13.4 | 12.4 | N |
| 7 | 2.39600 | 40.4 | 30.7 | 0.3 | 40.7 | 31.0 | 56.0 | 46.0 | 15.3 | 15.0 | N |
| 8 | 3.06750 | 37.9 | 27.6 | 0.3 | 38.2 | 27.9 | 56.0 | 46.0 | 17.8 | 18.1 | N |
| 9 | 10.20050 | 30.8 | 26.0 | 0.7 | 31.5 | 26.7 | 60.0 | 50.0 | 28.5 | 23.3 | N |
| 10 | 25.05600 | 33.1 | 27.1 | 1.0 | 34.1 | 28.1 | 60.0 | 50.0 | 25.9 | 21.9 | N |
| 11 | 0.15024 | 36.0 | 26.6 | 0.2 | 36.2 | 26.8 | 66.0 | 56.0 | 29.8 | 29.2 | L |
| 12 | 0.18789 | 34.5 | 22.4 | 0.2 | 34.7 | 22.6 | 64.1 | 54.1 | 29.4 | 31.5 | L |
| 13 | 0.30048 | 34.5 | 26.5 | 0.2 | 34.7 | 26.7 | 60.2 | 50.2 | 25.5 | 23.5 | L |
| 14 | 0.33813 | 38.4 | 30.3 | 0.2 | 38.6 | 30.5 | 59.2 | 49.2 | 20.6 | 18.7 | L |
| 15 | 0.67779 | 33.7 | 24.9 | 0.2 | 33.9 | 25.1 | 56.0 | 46.0 | 22.1 | 20.9 | L |
| 16 | 1.46750 | 32.7 | 21.1 | 0.3 | 33.0 | 21.4 | 56.0 | 46.0 | 23.0 | 24.6 | L |
| 17 | 2.33250 | 29.2 | 16.7 | 0.3 | 29.5 | 17.0 | 56.0 | 46.0 | 26.5 | 29.0 | L |
| 18 | 3.05450 | 25.4 | 13.2 | 0.3 | 25.7 | 13.5 | 56.0 | 46.0 | 30.3 | 32.5 | L |
| 19 | 7.80000 | 23.9 | 19.1 | 0.5 | 24.4 | 19.6 | 60.0 | 50.0 | 35.6 | 30.4 | L |
| 20 | 25.05800 | 25.2 | 23.5 | 1.0 | 26.2 | 24.5 | 60.0 | 50.0 | 33.8 | 25.5 | L |

# 9. Antenna Requirement

■ **Procedure:**

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

■ **Conclusion:** **Comply**

The internal antenna isattached on the main PCBusing the special spring tension. (Refer to Internal Photo file.)

■ **Minimum Standard:**

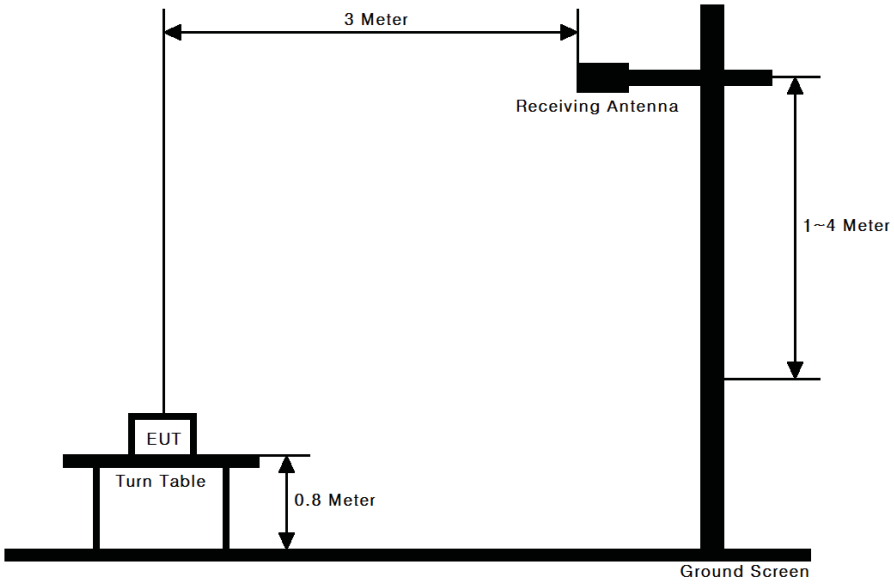
| |
|---|
| An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions. |

# APPENDIX I

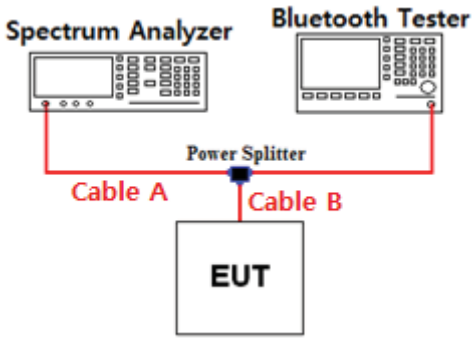
## Test set upDiagrams&PathlossInformation

### ▪Radiated Measurement

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 25㎓ Emissions.




### ▪Conducted Measurement




**Offset value information**

| Frequency (GHz) | Path Loss (dB) | Frequency (GHz) | Path Loss (dB) |
|---|---|---|---|
| 0.03 | 5.80 | 15 | 8.48 |
| 1 | 6.36 | 20 | 8.77 |
| 2.402 & 2.441 & 2.480 | 6.84 | 26.5 | 9.32 |
| 5 | 7.24 | - | - |
| 10 | 7.86 | - | - |

Note. 1: The path loss from EUT to Spectrum analyzer were measured and used for test.
Path loss ( = S/A's Offset value) = Cable A + Power Splitter + Cable B
Note. 2: For conducted spurious emissions, the offset values were saved as the transducer factors on the spurious measurement function of the spectrum analyzer and the transducer factor of tested frequency is calculated and corrected automatically by the spectrum analyzer's measurement function.