# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

*OF*

| | |
|---|---|
| **Product Name:** | **Tablet** |
| **Brand Name:** | **HP** |
| **Marketing Name:** | **HP 7 Plus G2** |
| **Model No.:** | **HSTNH-B407D** |
| **Model Difference:** | **N/A** |
| **FCC ID:** | **B94HHB407D** |
| **Report No.:** | **ER/2014/70094** |
| **Issue Date:** | **Sep. 18, 2014** |
| **FCC Rule Part:** | **§15.247, Cat: DSS** |
| **Prepared for:** | **Hewlett-Packard Company<br>1501 Page Mill Road,Palo Alto, CA 94304,United States** |
| **Prepared by:** | **SGS Taiwan Ltd.<br>Electronics & Communication Laboratory<br>No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803** |

Testing Laboratory 0513

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# VERIFICATION OF COMPLIANCE

| | |
|---|---|
| **Applicant:** | Hewlett-Packard Company<br>1501 Page Mill Road,Palo Alto, CA 94304,United States |
| **Product Name:** | Tablet |
| **Brand Name:** | HP |
| **Marketing Name:** | HP 7 Plus G2 |
| **Model No.:** | HSTNH-B407D |
| **Model Difference:** | N/A |
| **File Number:** | ER/2014/70094 |
| **FCC ID:** | B94HHB407D |
| **Date of test:** | Jul. 29, 2014 ~ Aug. 22, 2014 |
| **Date of EUT Received:** | Jul. 29, 2014 |

## We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4:2009 the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247.

The test results of this report relate only to the tested sample identified in this report.

| | | | |
|---|---|---|---|
| ***Test By:*** | Marcus Tseng | ***Date:*** | Sep. 18, 2014 |
| | ***Marcus Tseng / Engineer*** | | |
| ***Prepared By:*** | Julia Chang | ***Date:*** | Sep. 18, 2014 |
| | ***Julia Chang / Clerk*** | | |
| ***Approved By:*** | Jim Chang | ***Date:*** | Sep. 18, 2014 |
| | ***Jim Chang / Supervisor*** | | |

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# Version

| Version No. | Date | Description |
|---|---|---|
| 00 | Aug. 22, 2014 | Initial creation of document |
| 01 | Sep. 18, 2014 | Update adapter supplier at page 7 |
| | | |

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# 1. GENERAL INFORMATION

## 1.1. Product description

General:

| | | |
|---|---|---|
| Product Name: | Tablet | |
| Brand Name: | HP | |
| Marketing Name: | HP 7 Plus G2 | |
| Model No.: | HSTNH-B407D | |
| Model Difference: | N/A | |
| Hardware Version: | B1 | |
| Software Version: | 1.1.37 | |
| Data Cable (USB): | Model No.:N/A, Supplier: N/A | |
| Power Supply: | 3.7Vdc form Rechargeable Li-ion Battery or 5Vdc from adapter | |
| | Battery: | Model No.: WD3058150P,<br>Supplier: Shenzhen WISEWOD Technology CO.,LTD |
| | Adapter: | Model No.: A31-501000<br>Supplier: Shenzhen Aohai Technology Co.,Ltd |

Bluetooth:

| | |
|---|---|
| Bluetooth Version: | Bluetooth V4.0 (dual mode) + HS |
| Frequency Range: | 2402 – 2480MHz |
| Channel number: | 79 channels max. |
| Rated Power: | -0.46 dBm (Peak) |
| Modulation type: | GFSK + π/4DQPSK + 8DPSK |
| Dwell Time: | <=0.4s |
| Antenna Designation: | Monopole Antenna, Peak Gain: 1.63dBi. |

The EUT is compliance with Bluetooth V4.0 (dual mode) + HS standard.

This test report applies for Bluetooth.

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## 1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: B94HHB407D** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (digital device) is compliance with FCC part 15; Subpart B is authorized under the doc procedure.

## 1.3. Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4:2009. Radiated testing was performed at an antenna to EUT distance 3 meters. Tested in accordance with FCC Public Notice DA 00-705 – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

## 1.4. Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei Country, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2009. FCC Registration Number: 990257.The address of SGS Taiwan Ltd. Electronics & Communication Laboratory 1F, No.134, Wukung Road New Taipei City TAIWAN 24803, Canada Registration Number: 4620A-5

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan Township, Taoyuan County,Taiwan which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. FCC Registration Number: 455997. The address of SGS Taiwan Ltd. Electronics & Communication Laboratory 1F, No.134, Wukung Road New Taipei City TAIWAN 24803, IC Registration Number: 4620A-6.

## 1.5. Special Accessories

There is no special accessory used while test was conducted.

## 1.6. Equipment Modifications

There was no modification incorporated into the EUT.

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# 2. SYSTEM TEST CONFIGURATION

## 2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

## 2.2. EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

## 2.3. Test Procedure

### 2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the general criterion in Section 7.1 of ANSI C63.4:2009.Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz, and the measurement procedure 7.3 in ANSI 63.4:2009 is followed to carry out the test. The CISPR Quasi-Peak and Average detector mode is employed according to §15.107

### 2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna according to the requirements in Section 8 and 13 and of ANSI C63.4:2009 and DA 00-705.

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## 2.4. Configuration of Tested System

**Fig. 2-1 Radiated Emission & Conducted (Antenna Port) Configuration**

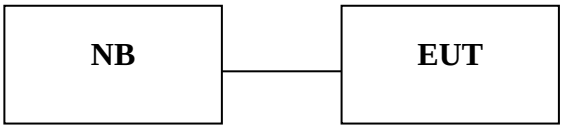


**Fig. 2-2 AC Power Line Conducted Emission**

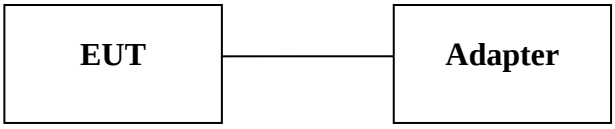


**Table 2-1 Equipment Used in Tested System**

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|---|---|---|---|---|---|---|
| 1. | BT Test Software | N/A | N/A | N/A | N/A | N/A |
| 2. | Notebook | Lenovo | L412 | LR-957X7 | shielding | un-shielding |

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# 3. SUMMARY OF TEST RESULTS

| FCC Rules | Description Of Test | Result |
|---|---|---|
| §15.207(a) | AC Power Line Conducted Emission | Compliant |
| §15.247(b)(1) | Peak Output Power | Compliant |
| §15.247(a)(1) | 20dB Bandwidth | Compliant |
| §15.247(d) | 100 kHz Bandwidth Of Frequency Band Edges | Compliant |
| $15.247(d)<br>§15.209(a) (f) | Spurious Emission | Compliant |
| §15.247(a)(1) | Frequency Separation | Compliant |
| §15.247(a)(1)(iii) | Number of hopping frequency | Compliant |
| §15.247(a)(1)(iii) | Time of Occupancy | Compliant |
| §15.203, | Antenna Requirement | Compliant |

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# 4. DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel Low, Mid and High with highest rated data rate were chosen as worst case for full testing. The field strength of spurious radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth Transmitter for channel Low, Mid and High the worst case H position was reported.

Channel Low: channel 1 at 2402MHz
Channel Mid: channel 39 at 2441MHz
Channel High: channel 78 at 2480MHz

In comparison with BR and EDR mode, emission carried out by BR is chosen as the most representative measurement to perform measurement of radiated spurious emission pursuant to Part 15C.Modulation, BR, is selected to be performed for 100 kHz Bandwidth Band Edge, Conducted Spurious Emission, Frequency Separation, Number of hopping frequency due to its characteristics of wider bandwidth.

Data type being used to conduct the measurement:
DH1/DH3/DH5 (GFSK) with 1Mbps
2DH1/2DH3/2DH5 (∏/4 DQPSK) with 2Mbps
3DH1/3DH3/3DH5 (8DPSK) with 3Mbps

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# 5. MEASUREMENT UNCERTAINTY

| Test Items | Uncertainty |
|---|---|
| AC Power Line Conducted Emission | +/- 2.586 dB |
| Peak Output Power | +/- 1.55 dB |
| 20dB Bandwidth | +/- 123.36 Hz |
| 100 KHz Bandwidth Of Frequency Band Edges | +/- 1.55 dB |
| Frequency Separation | +/- 123.36 Hz |
| Number of hopping frequency | +/- 123.36 Hz |
| Time of Occupancy | +/- 123.36 Hz |
| Temperature | +/- 0.8 °C |
| Humidity | +/- 4.7 % |
| DC / AC Power Source | DC= +/- 1%, AC= +/- 0.2% |

Radiated Spurious Emission:

| | |
|---|---|
| Measurement uncertainty (Polarization : **Vertical**) | 30MHz - 180MHz: +/- 3.37dB |
| | 180MHz -417MHz: +/- 3.19dB |
| | 0.417GHz-1GHz: +/- 3.19dB |
| | 1GHz - 18GHz: +/- 4.04dB |
| | 18GHz - 40GHz: +/- 4.04dB |

| | |
|---|---|
| Measurement uncertainty (Polarization : **Horizontal**) | 30MHz - 167MHz: +/- 4.22dB |
| | 167MHz -500MHz: +/- 3.44dB |
| | 0.5GHz-1GHz: +/- 3.39dB |
| | 1GHz - 18GHz: +/- 4.08dB |
| | 18GHz - 40GHz: +/- 4.08dB |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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# 6. CONDUCTED EMISSION TEST

## 6.1. Standard Applicable

According to §15.207, frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

| Frequency range MHz | Limits dB(uV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

Note
1.The lower limit shall apply at the transition frequencies
2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

## 6.2. Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE** | **MFR** | **MODEL NUMBER** | **SERIAL NUMBER** | **LAST CAL.** | **CAL DUE.** |
| EMI Test Receiver | R&S | ESCI7 | 100760 | 05/26/2014 | 05/25/2015 |
| LISN | Rolf-Heine | NNB-2/16Z | 99012 | 03/26/2014 | 03/25/2015 |
| LISN | FCC | FCC-LISN-50/250-25-2-01 | 04034 | 03/19/2014 | 03/18/2015 |
| Coaxial Cables | N/A | WK CE Cable | N/A | 11/26/2013 | 11/25/2014 |

## 6.3. EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4:2009.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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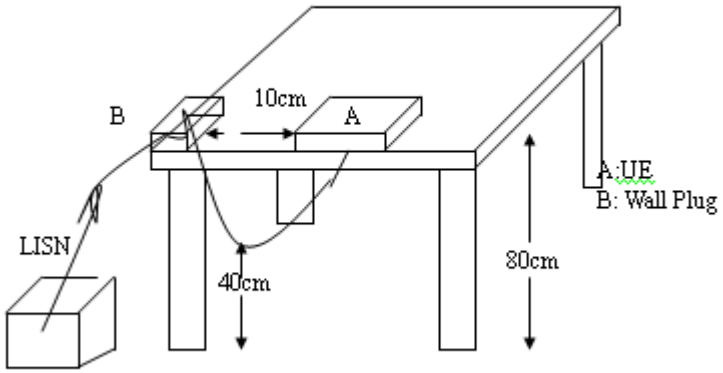
## 6.4. Test SET-UP (Block Diagram of Configuration)




## 6.5. Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

## 6.6. Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit

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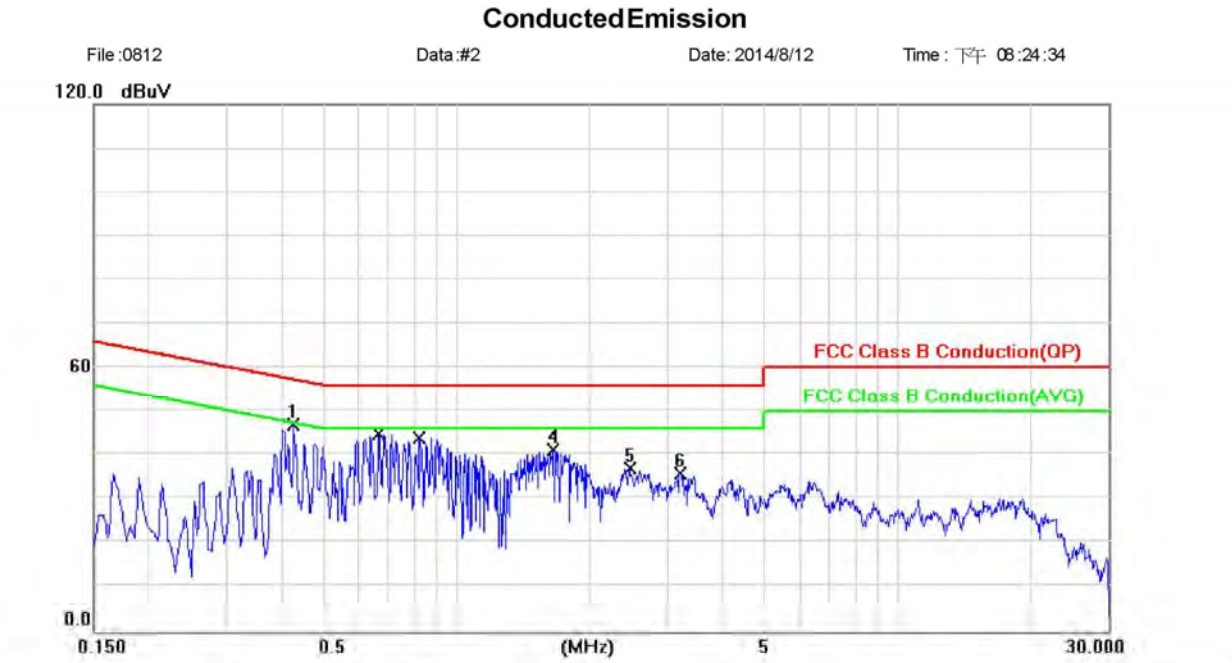
# AC POWER LINE CONDUCTED EMISSION TEST DATA

| | | | | | |
|---|---|---|---|---|---|
| Operation Mode: | Operation Mode | | | Test Date: | Aug. 12, 2014 |
| Temperature: | 26 ℃ | Humidity: | 60 % | Test By: | Nick |

Site ConductionRoom
Limit: FCC Class B Conduction(QP)
Mode: Operation

Phase: L1
Power: AC 120V/60Hz

Temperature: 26 ℃
Humidity: 60%




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | * | 0.4260 | 46.92 | 0.07 | 46.99 | 57.33 | -10.34 | peak | |
| 2 | | 0.6660 | 40.56 | 0.08 | 40.64 | 56.00 | -15.36 | QP | |
| 3 | | 0.8260 | 41.60 | 0.09 | 41.69 | 56.00 | -14.31 | QP | |
| 4 | | 1.6580 | 41.15 | 0.12 | 41.27 | 56.00 | -14.73 | peak | |
| 5 | | 2.4660 | 36.95 | 0.14 | 37.09 | 56.00 | -18.91 | peak | |
| 6 | | 3.2100 | 35.84 | 0.16 | 36.00 | 56.00 | -20.00 | peak | |

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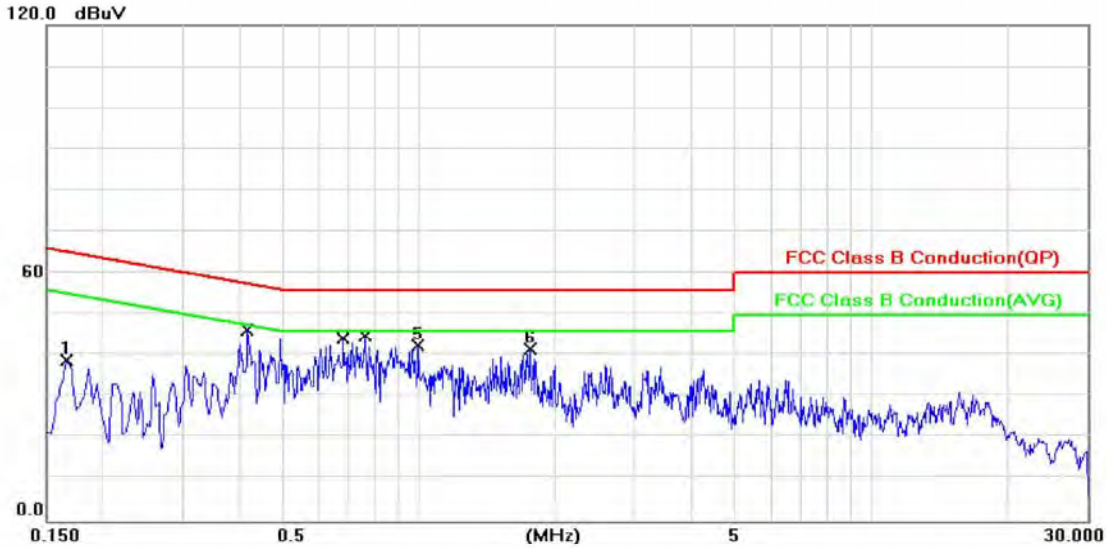
Site ConductionRoom | Phase: N | Temperature: 26 ℃
Limit: FCC Class B Conduction(QP) | Power: AC 120V/60Hz | Humidity: 60%
Mode: Operation

## Conducted Emission

File :0812 Data :#1 Date: 2014/8/12 Time : 下午 08:23:18




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 0.1660 | 38.66 | 0.05 | 38.71 | 65.16 | -26.45 | peak | |
| 2 | * | 0.4180 | 45.58 | 0.07 | 45.65 | 57.49 | -11.84 | QP | |
| 3 | | 0.6820 | 41.40 | 0.08 | 41.48 | 56.00 | -14.52 | QP | |
| 4 | | 0.7620 | 38.27 | 0.09 | 38.36 | 56.00 | -17.64 | QP | |
| 5 | | 0.9980 | 42.32 | 0.10 | 42.42 | 56.00 | -13.58 | peak | |
| 6 | | 1.7540 | 41.44 | 0.13 | 41.57 | 56.00 | -14.43 | peak | |

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# 7. PEAK OUTPUT POWER MEASUREMENT

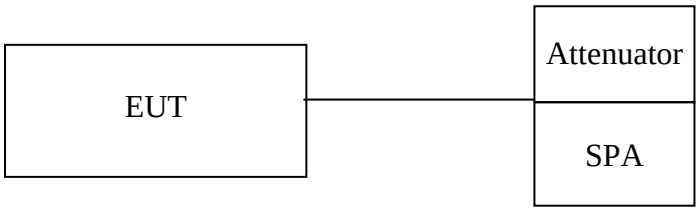
## 7.1. Standard Applicable

According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, The Limit: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: The Limit: 0.125 Watts.

## 7.2. Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Power Meter | Anritsu | ML2495A | 1005007 | 01/13/2014 | 01/12/2015 |
| Power Sensor | Anritsu | MA2411B | 917032 | 01/13/2014 | 01/12/2015 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 05/19/2014 | 05/18/2015 |
| Spectrum Analyzer | Agilent | E4440A | MY45304525 | 03/08/2014 | 03/07/2015 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 02/27/2014 | 02/26/2015 |
| Low Loss Cable | HUBER+SUHNER | SUCOFLEX 104PEA | N/A | 01/03/2014 | 01/02/2015 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 002 | 02/27/2014 | 02/26/2015 |
| Splitter | Agilent | 11636B | N/A | 02/27/2014 | 02/26/2015 |

## 7.3. Test Set-up:




## 7.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Max Hold, Detector = Peak, RBW >=20dB bandwidth)
3. Record the max. reading.
4. Repeat above procedures until all default test channel is completed.

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## 7.5. Measurement Result

**BR mode (GFSK):**

| Frequency (MHz) | Reading Power (dBm) | Output Power (W) | Limit (W) |
|---|---|---|---|
| 2402.00 | -2.02 | 0.00063 | 1 |
| 2441.00 | -0.78 | 0.00084 | 1 |
| 2480.00 | **-0.46** | 0.00090 | 1 |

**EDR mode (π/4DQPSK):**

| Frequency (MHz) | Reading Power (dBm) | Output Power (W) | Limit (W) |
|---|---|---|---|
| 2402.00 | -5.30 | 0.00030 | 0.125 |
| 2441.00 | -4.44 | 0.00036 | 0.125 |
| 2480.00 | -4.27 | 0.00037 | 0.125 |

**EDR mode (8DPSK):**

| Frequency (MHz) | Reading Power (dBm) | Output Power (W) | Limit (W) |
|---|---|---|---|
| 2402.00 | -4.81 | 0.00033 | 0.125 |
| 2441.00 | -3.95 | 0.00040 | 0.125 |
| 2480.00 | -3.76 | 0.00042 | 0.125 |

**Note: offset 4.9dB*

*Note: Refer to next page for plots.*

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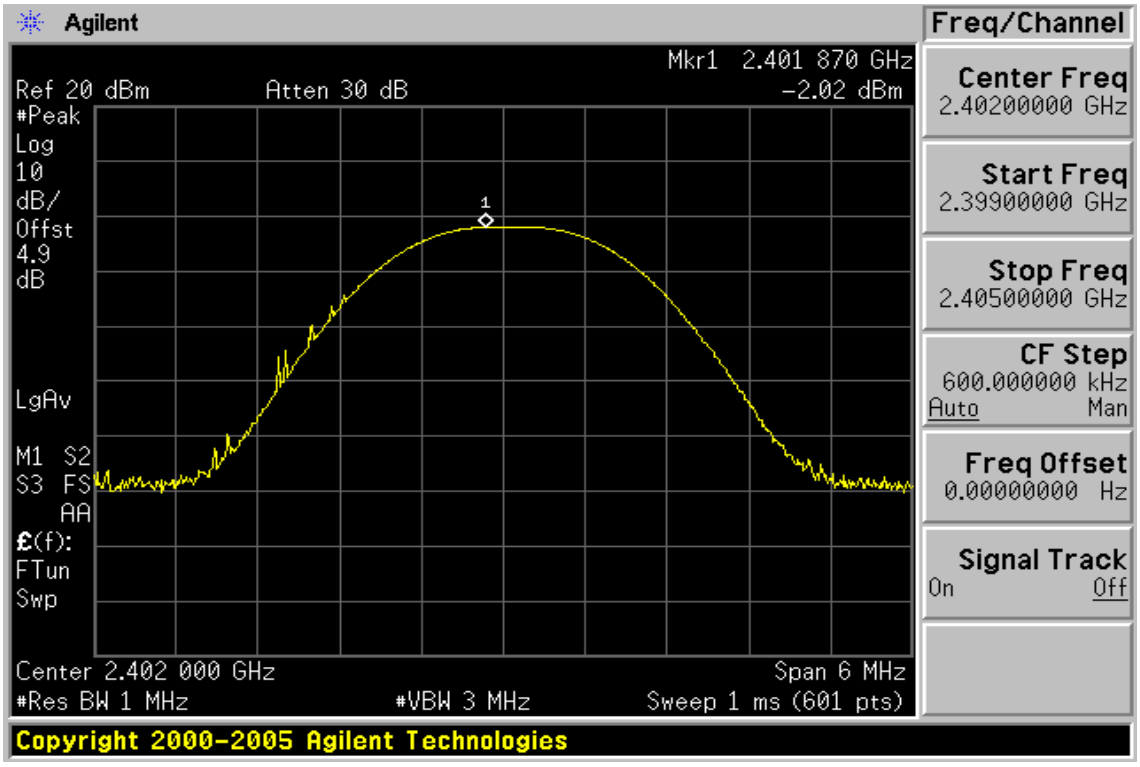
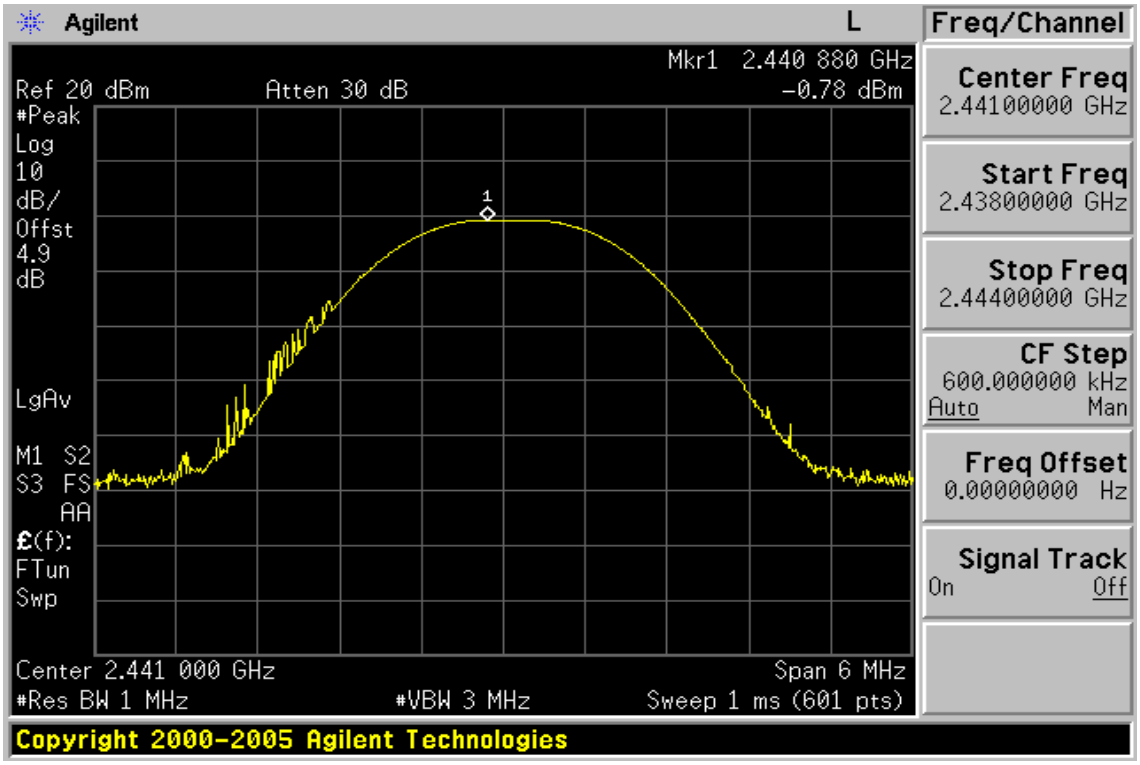
## Peak Power Output Data Plot (CH Low) (BR mode GFSK)




## Peak Power Output Data Plot (CH Mid) (BR mode GFSK)

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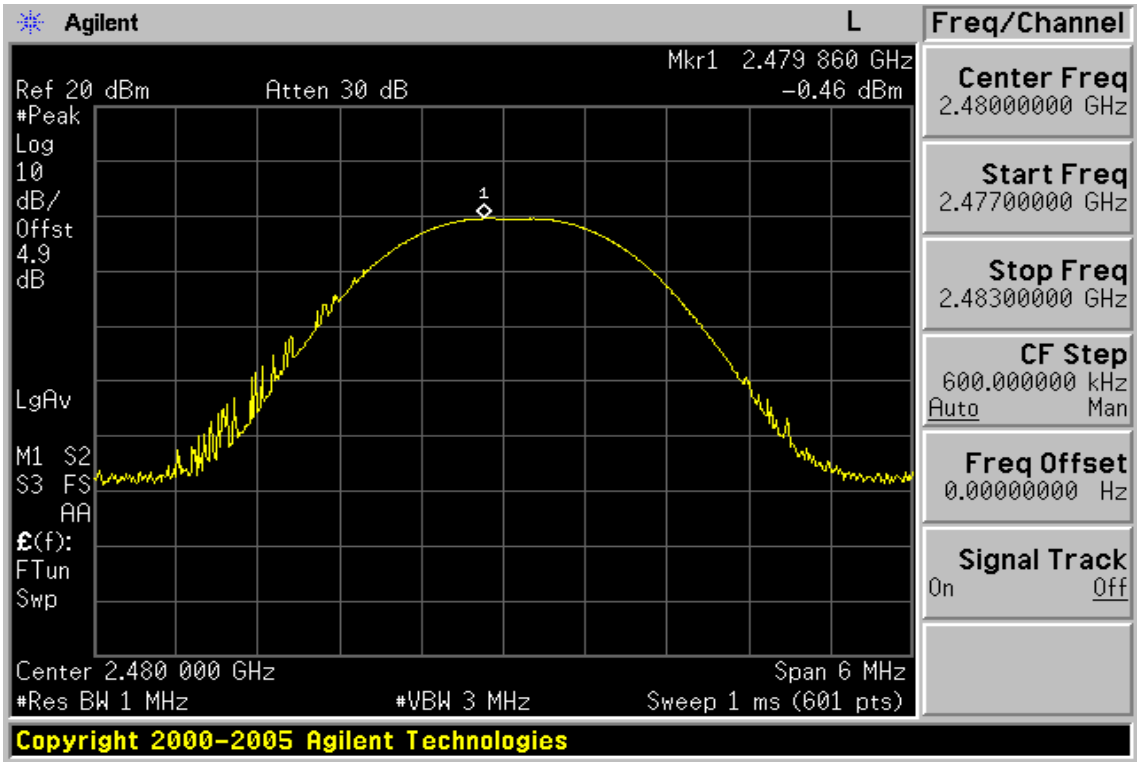
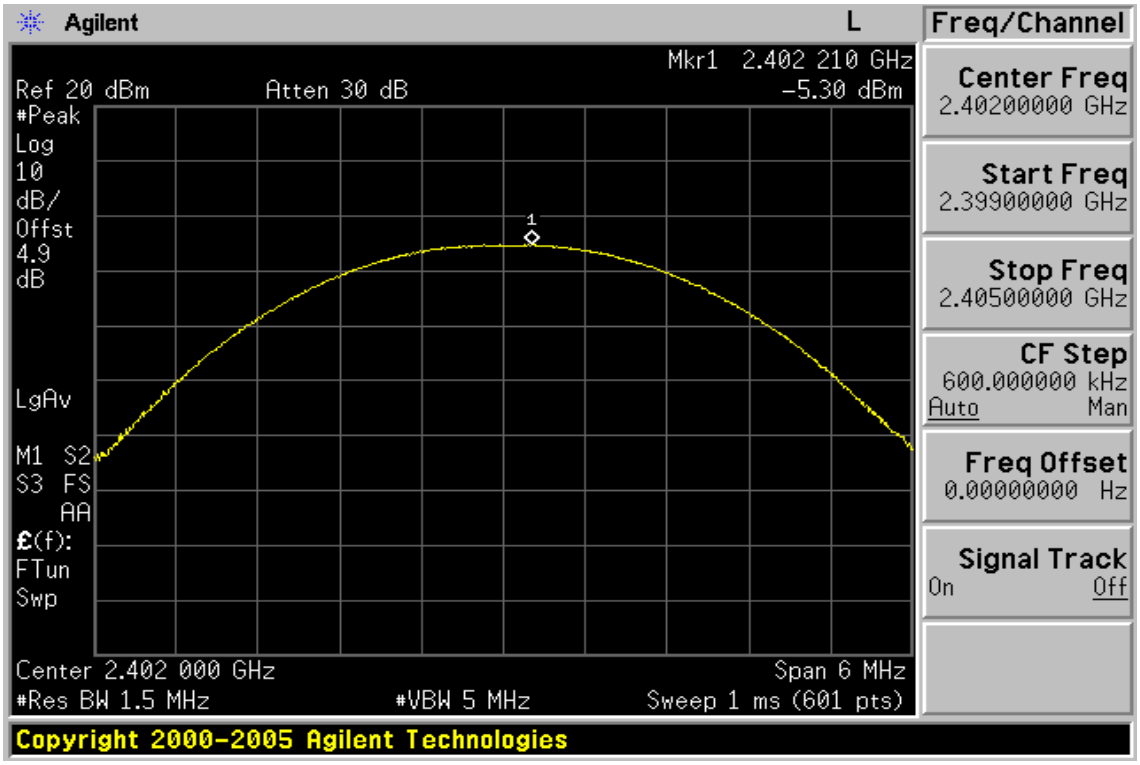
## Peak Power Output Data Plot (CH High) (BR mode GFSK)




## Peak Power Output Data Plot (CH Low) (EDR mode π/4DQPSK)

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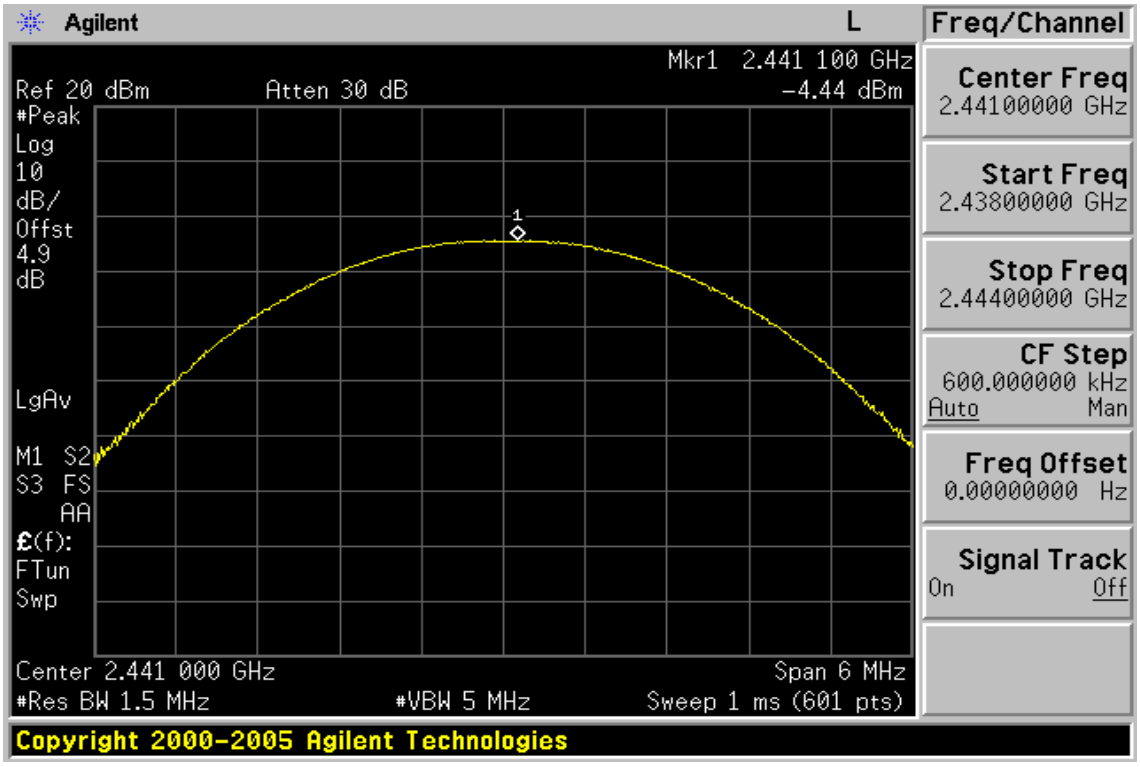
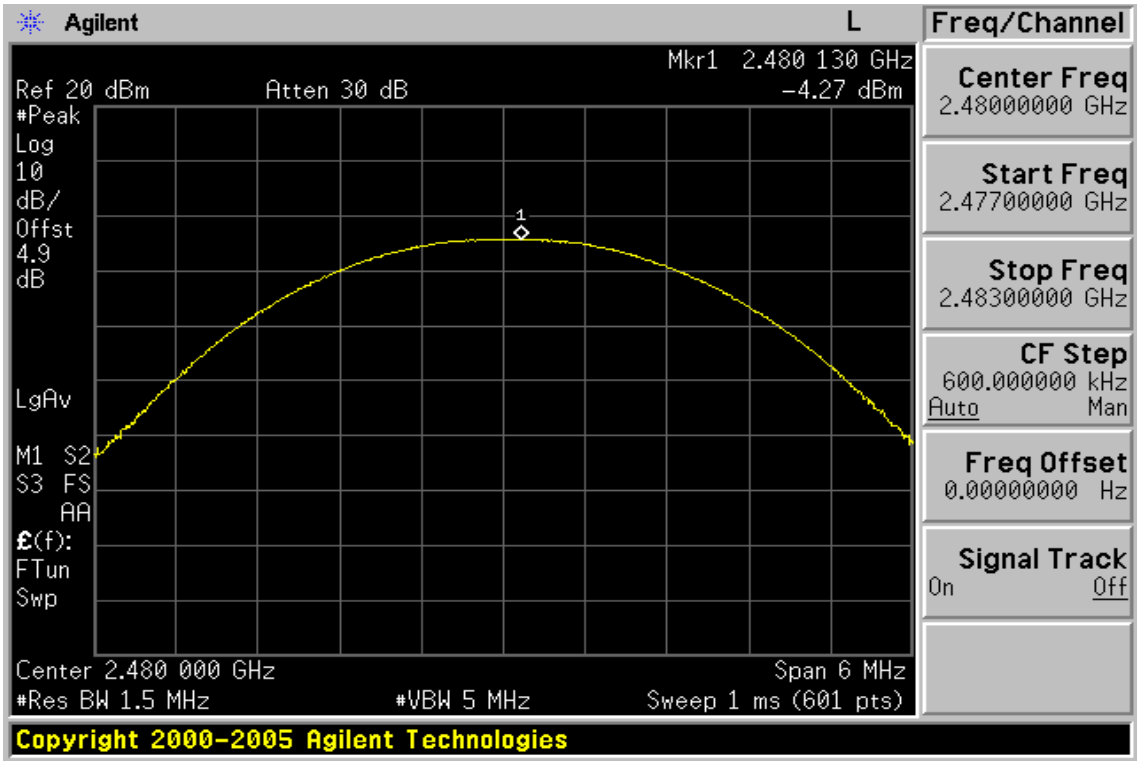
## Peak Power Output Data Plot (CH Mid) (EDR mode π/4DQPSK)




## Peak Power Output Data Plot (CH High) (EDR mode π/4DQPSK)

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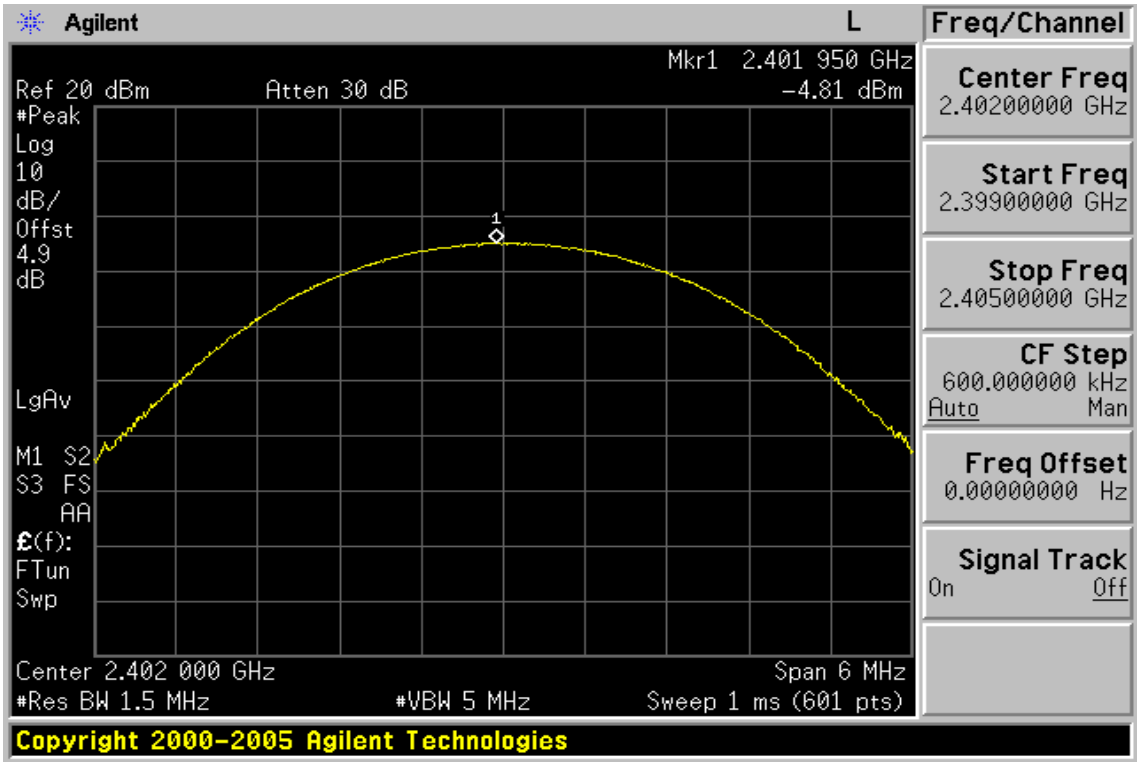
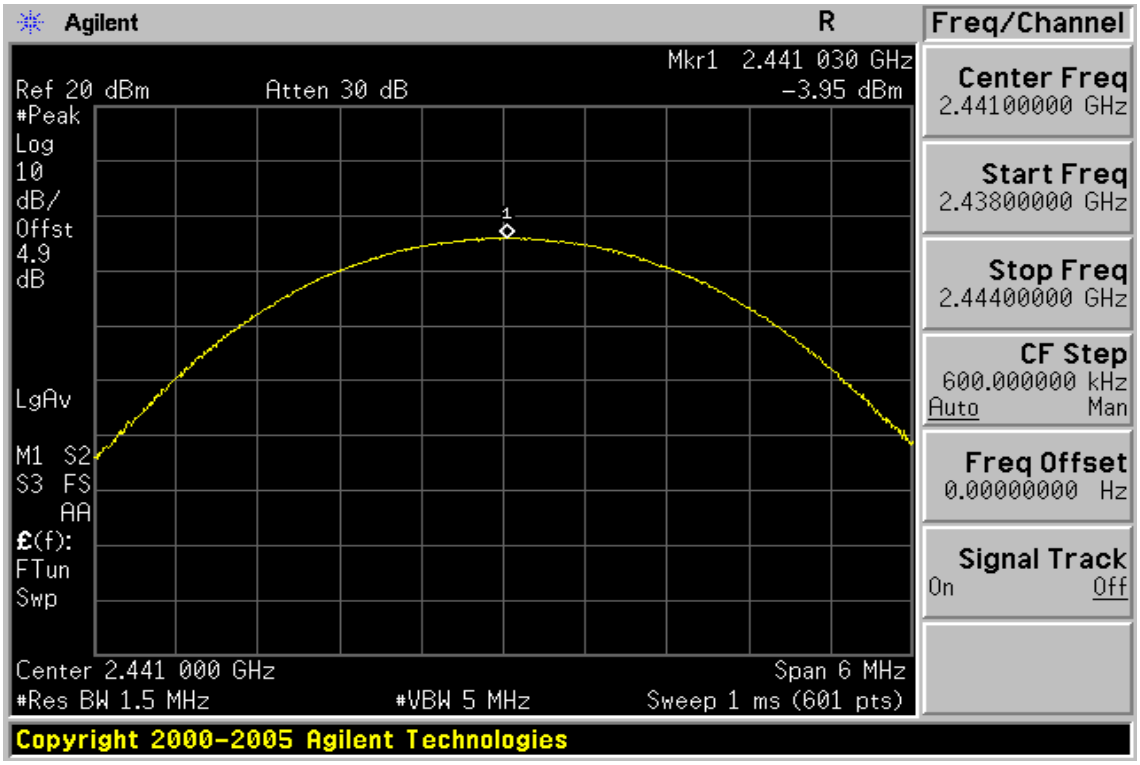
## Peak Power Output Data Plot (CH Low) (EDR mode 8DPSK)




## Peak Power Output Data Plot (CH Mid) (EDR mode 8DPSK)

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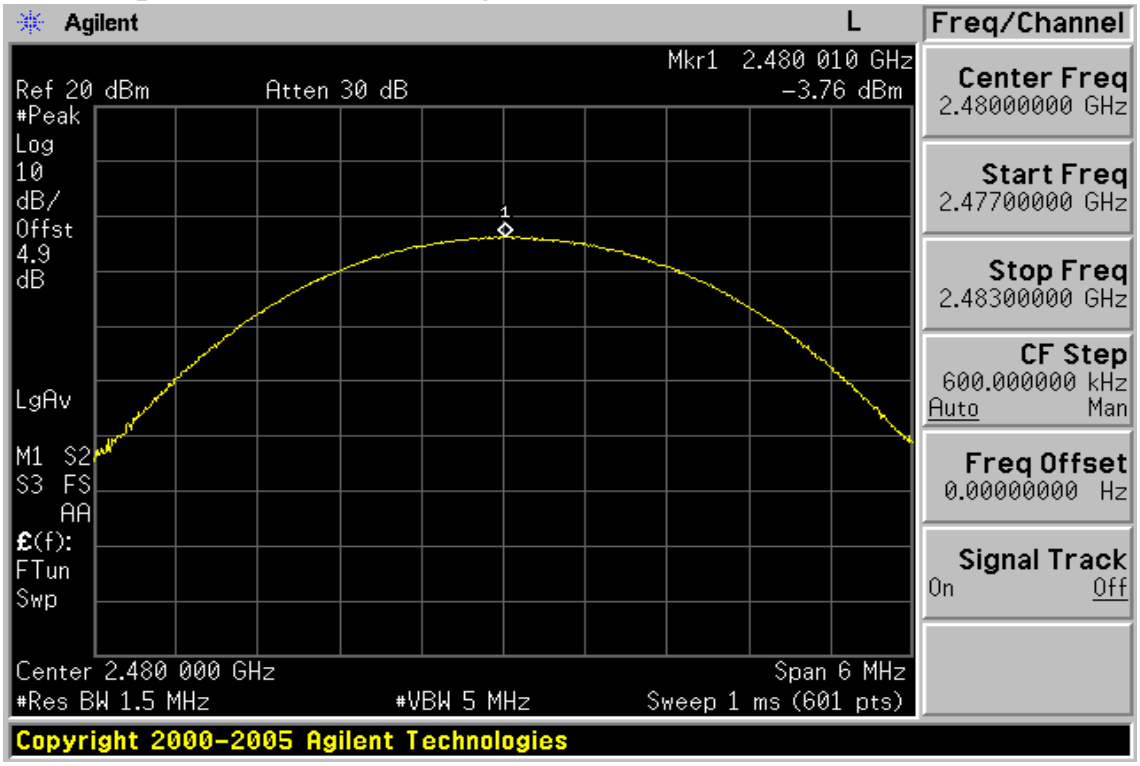
# Peak Power Output Data Plot (CH High) (EDR mode 8DPSK)

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# 8. 20dB BANDWIDTH

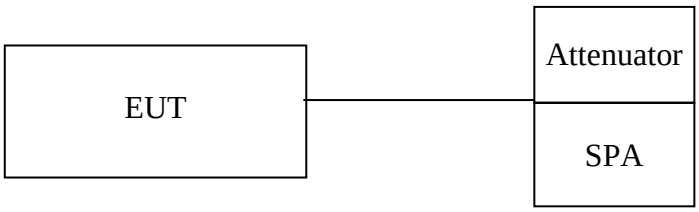
## 8.1. Standard Applicable

According to §15.247(a)(1), for frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

## 8.2. Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Power Meter | Anritsu | ML2495A | 1005007 | 01/13/2014 | 01/12/2015 |
| Power Sensor | Anritsu | MA2411B | 917032 | 01/13/2014 | 01/12/2015 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 05/19/2014 | 05/18/2015 |
| Spectrum Analyzer | Agilent | E4440A | MY45304525 | 03/08/2014 | 03/07/2015 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 02/27/2014 | 02/26/2015 |
| Low Loss Cable | HUBER+SUHNER | SUCOFLEX 104PEA | N/A | 01/03/2014 | 01/02/2015 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 002 | 02/27/2014 | 02/26/2015 |
| Splitter | Agilent | 11636B | N/A | 02/27/2014 | 02/26/2015 |

## 8.3. Test Set-up




## 8.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=10 kHz (1 % of 20 dB Bandwidth.), VBW = 30 kHz, Span= 3MHz, Sweep=auto, Detector = Peak, and Max hold for 20dB Bandwidth test.
4. Mark the peak frequency and –20dB (upper and lower) frequency and Turn on the 99% bandwidth function, max reading.
5. Repeat above procedure for 99% Bandwidth, but set RBW to 1% of the span, and detector = peak.
6. Repeat above procedures until all test default channel is completed

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## 8.5. Measurement Result:

### 20dB Bandwidth : BR mode (GFSK)

| CH | Bandwidth (kHz) |
|---|---|
| Lower | 927.736 |
| Mid | 926.925 |
| Higher | 927.640 |

### 20dB Bandwidth : EDR mode (π/4DQPSK)

| CH | Bandwidth (MHz) | 2/3 Bandwidth (MHz) |
|---|---|---|
| Lower | 1.341 | 0.894 |
| Mid | 1.341 | 0.894 |
| Higher | 1.342 | 0.895 |

### 20dB Bandwidth : EDR mode (8DPSK)

| CH | Bandwidth (MHz) | 2/3 Bandwidth (MHz) |
|---|---|---|
| Lower | 1.315 | 0.877 |
| Mid | 1.314 | 0.876 |
| Higher | 1.339 | 0.893 |

***NOTE1: cable loss as 4.9dB that offsets in the spectrum***

***NOTE2: For the plot of bandwidth measurement, the marker of the 99% bandwidth is diamond-shape while the marker of the 20dB BW is arrow-mark***

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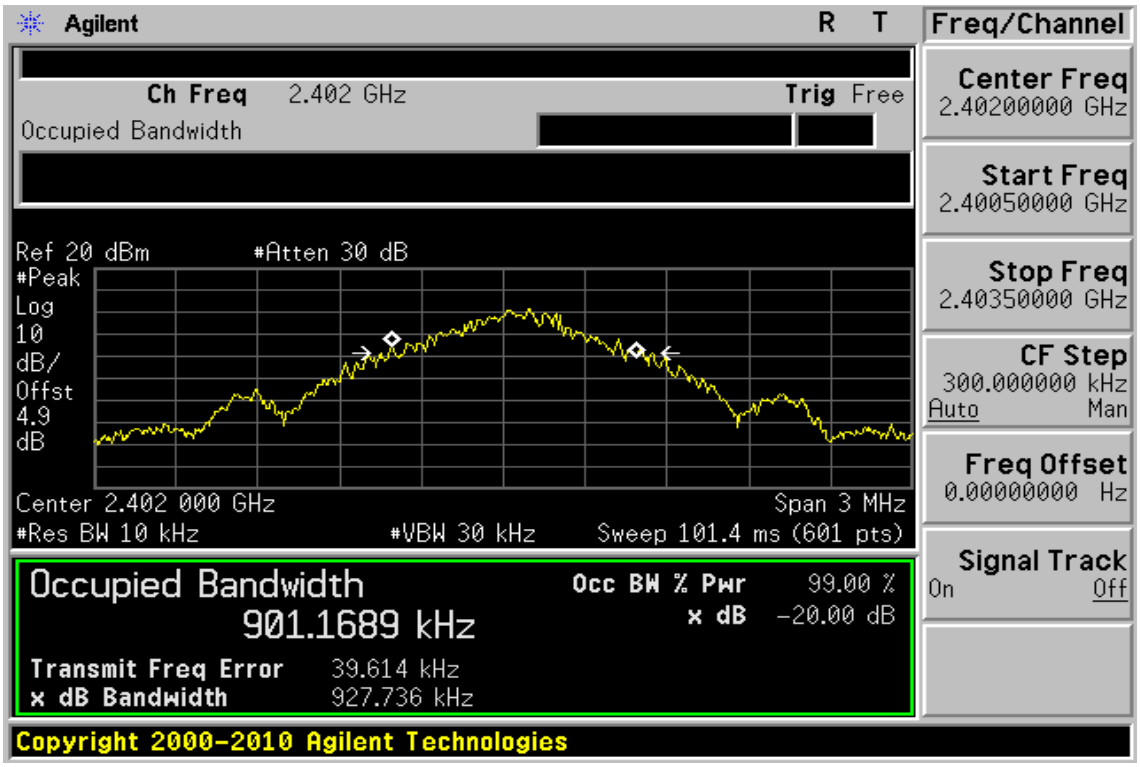
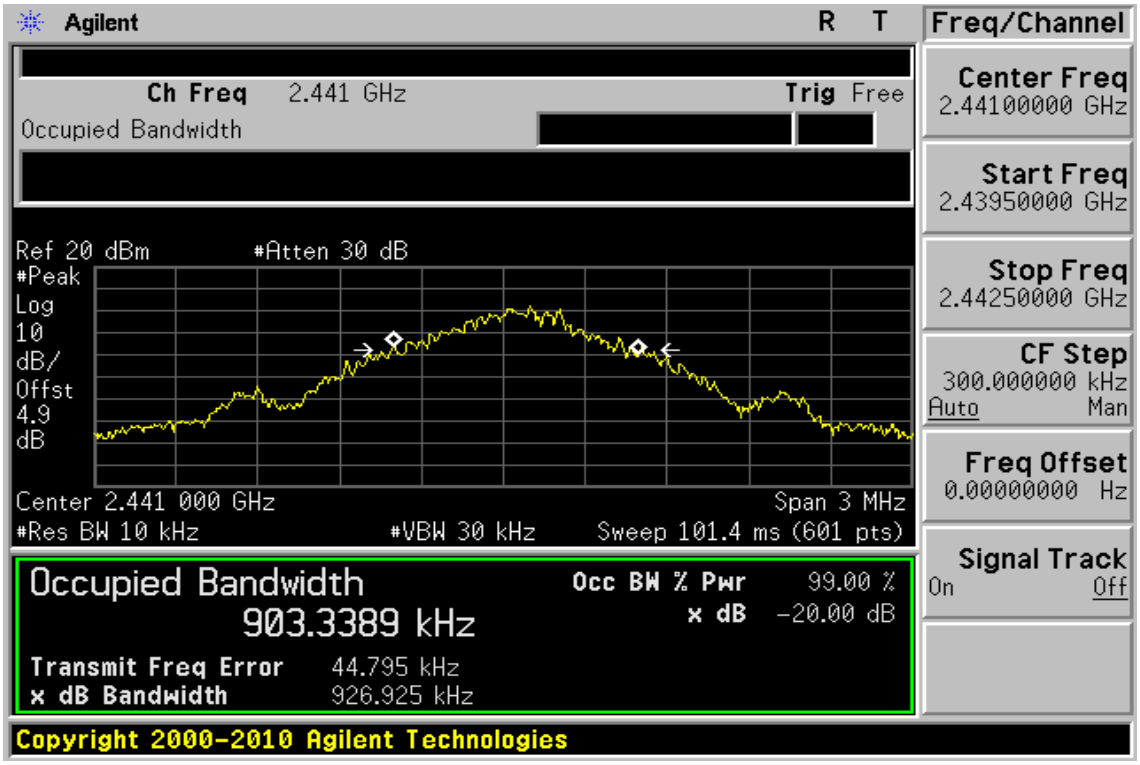
## *BR Mode (GFSK)*

## *20dB Bandwidth Test Data CH-Low*




## *20dB Bandwidth Test Data CH-Mid*

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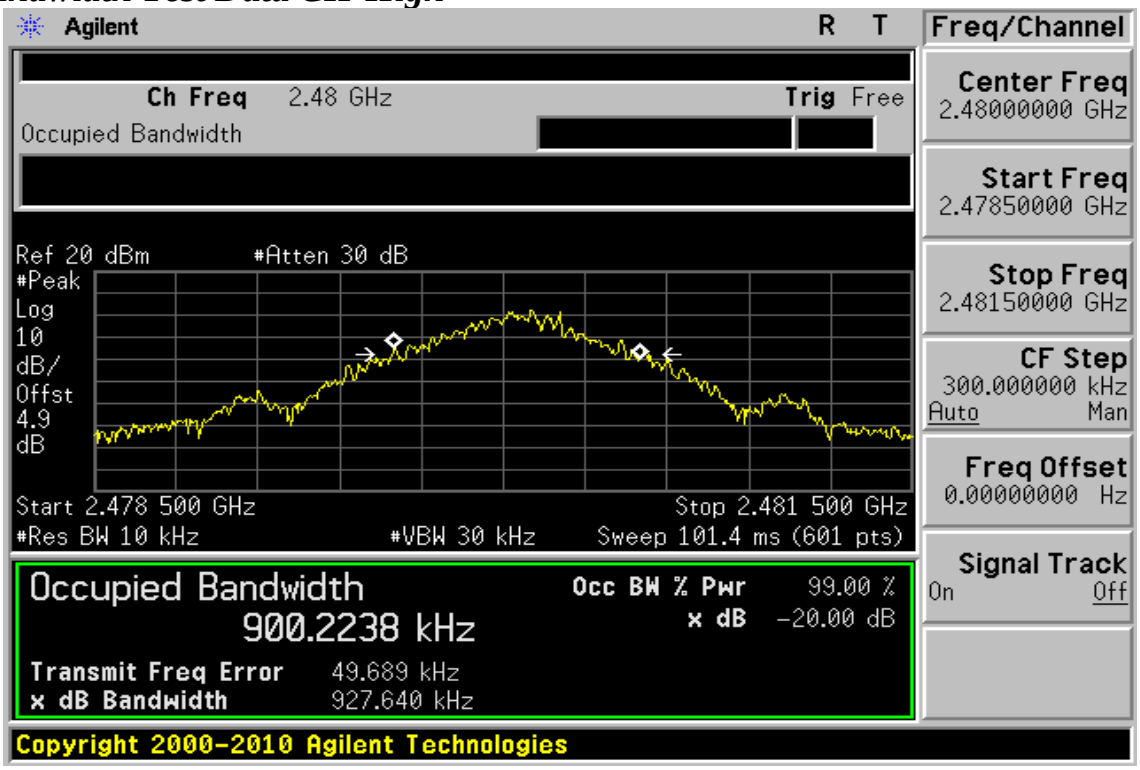
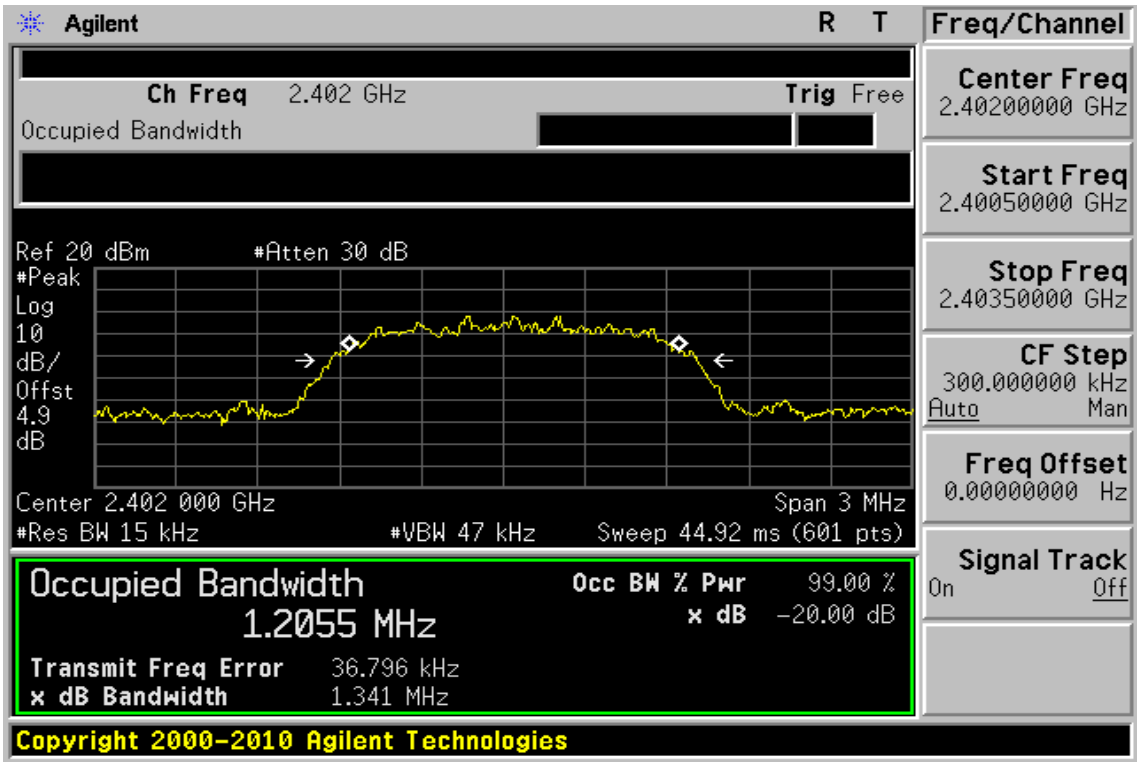
## *20dB Bandwidth Test Data CH-High*




## *EDR Mode (π/4DQPSK)*

## *20dB Bandwidth Test Data CH-Low*

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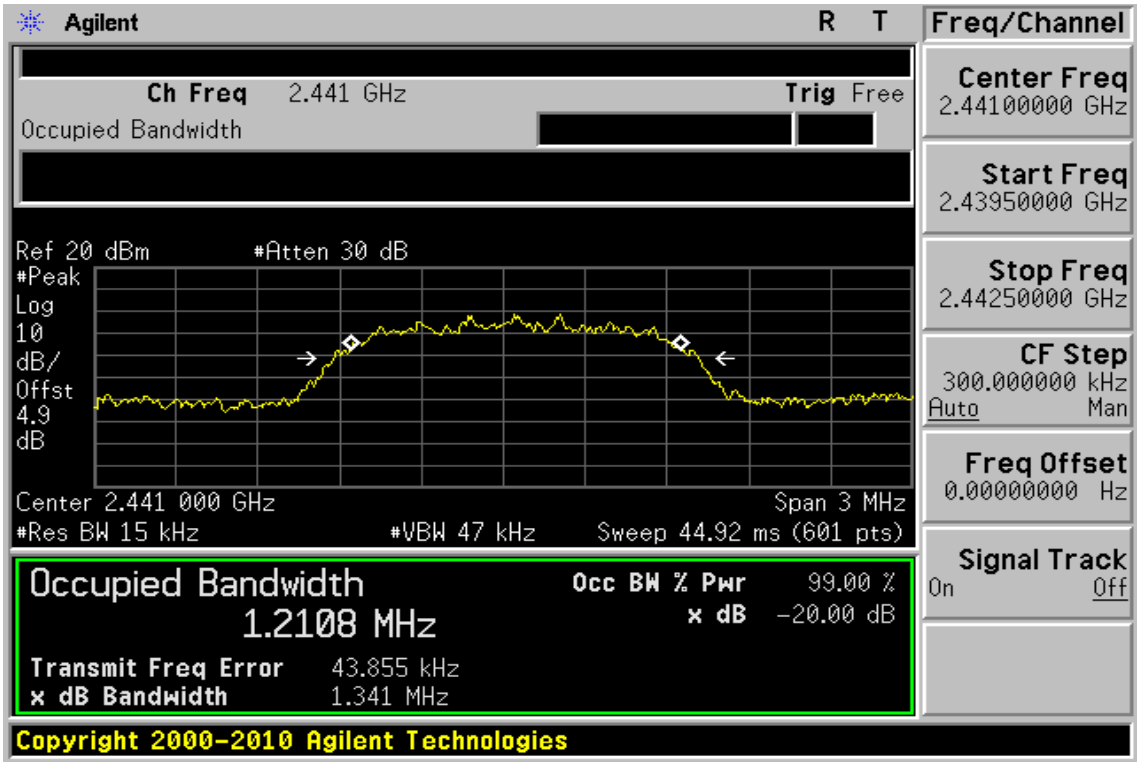
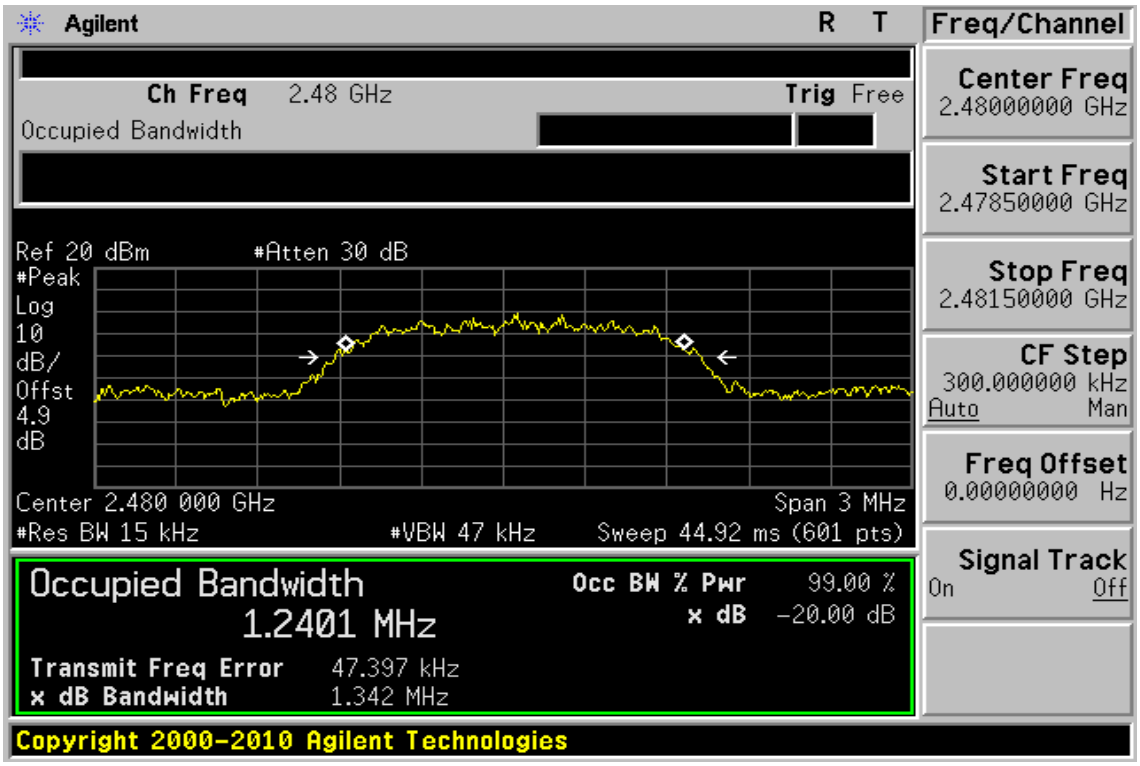
## *20dB Bandwidth Test Data CH-Mid*




## *20dB Bandwidth Test Data CH-High*

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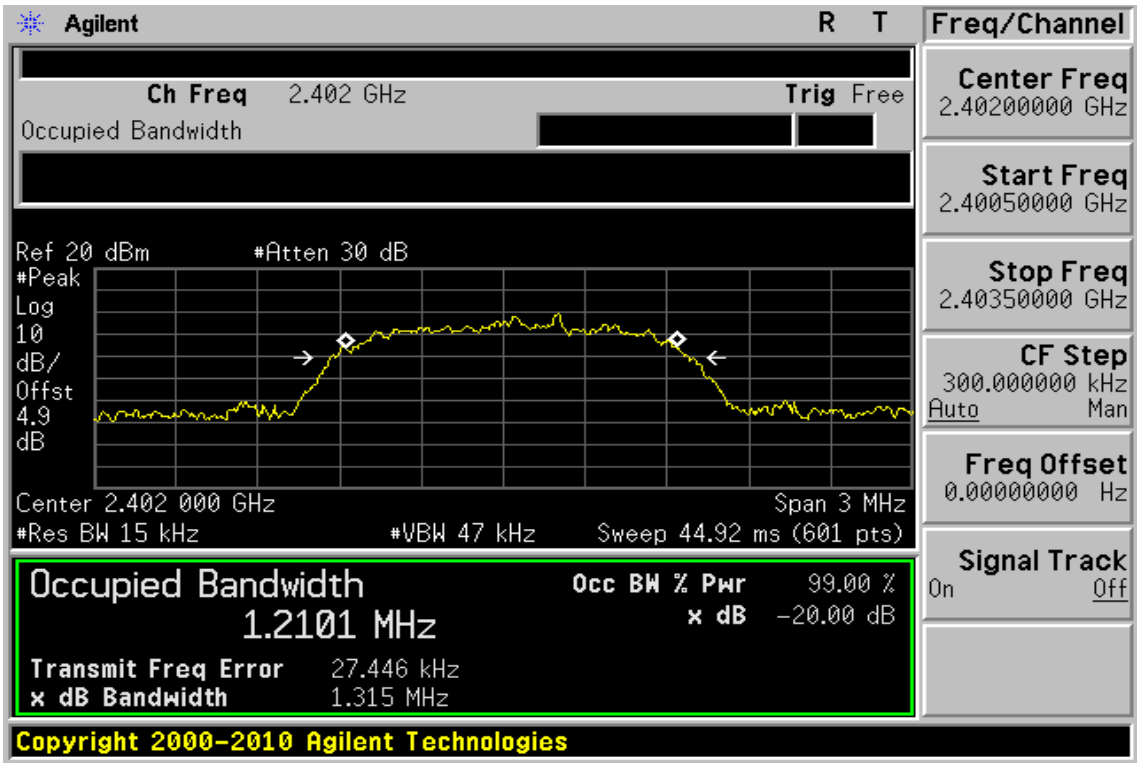
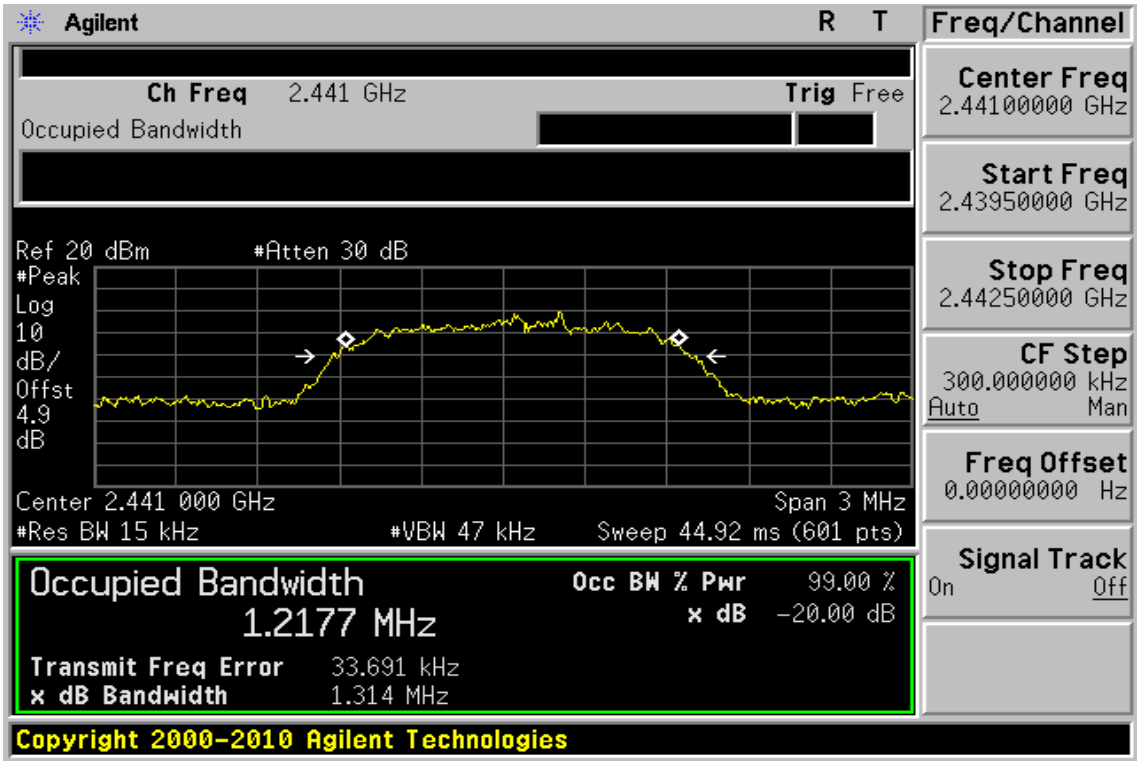
## *EDR Mode (8DPSK)*

### *20dB Bandwidth Test Data CH-Low*




### *20dB Bandwidth Test Data CH-Mid*

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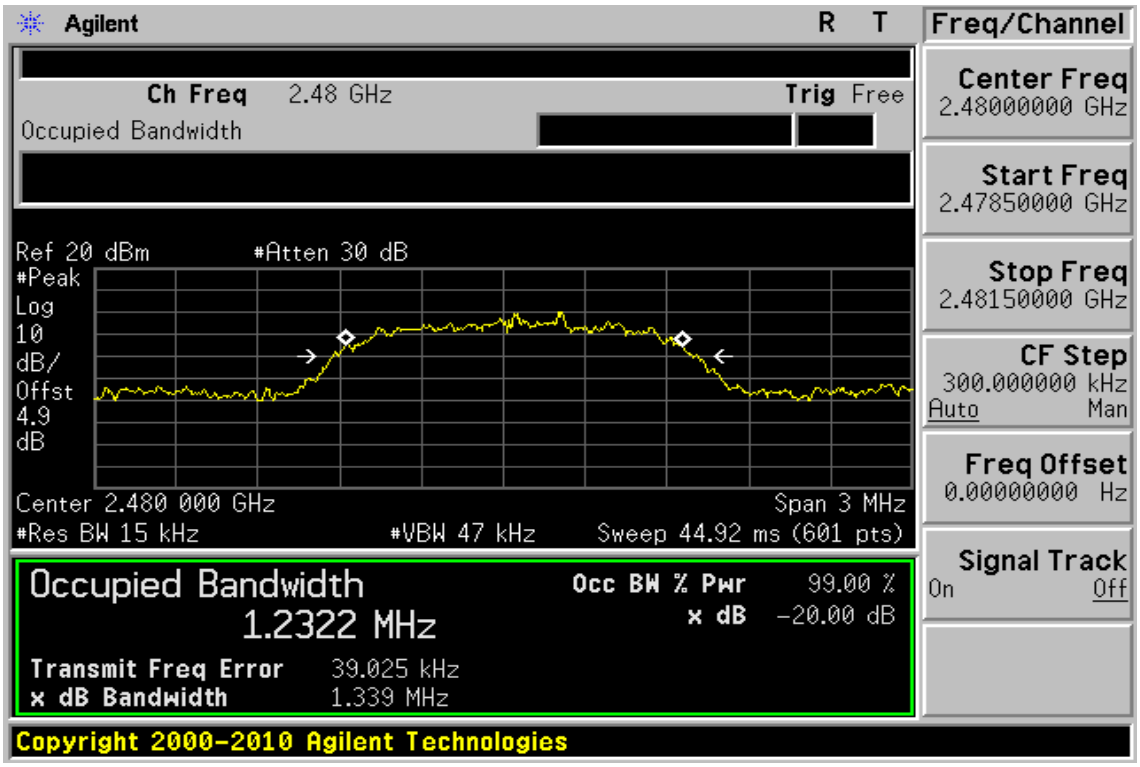
## *20dB Bandwidth Test Data CH-High*

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# 9. BAND EDGES EMISSION MEASUREMENT

## 9.1. Standard Applicable

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in15.209(a).

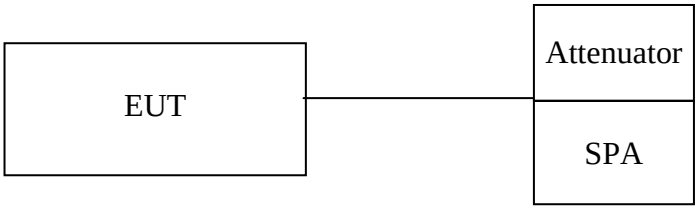
## 9.2. Measurement Equipment Used

### 9.2.1. Conducted Emission at antenna port:

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Power Meter | Anritsu | ML2495A | 1005007 | 01/13/2014 | 01/12/2015 |
| Power Sensor | Anritsu | MA2411B | 917032 | 01/13/2014 | 01/12/2015 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 05/19/2014 | 05/18/2015 |
| Spectrum Analyzer | Agilent | E4440A | MY45304525 | 03/08/2014 | 03/07/2015 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 02/27/2014 | 02/26/2015 |
| Low Loss Cable | HUBER+SUHNER | SUCOFLEX 104PEA | N/A | 01/03/2014 | 01/02/2015 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 002 | 02/27/2014 | 02/26/2015 |
| Splitter | Agilent | 11636B | N/A | 02/27/2014 | 02/26/2015 |

## 9.3. Test SET-UP:

### 9.3.1. Conducted Emission at antenna port:

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## 9.4. Measurement Procedure

**100 kHz BANDWIDTH OF BAND EDGES:**

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=300 kHz, Sweep = auto
5. Mark Peak, 2.390GHz and 2.4835GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

**Out-Of-Band EMISSION**

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100K & VBW = 300K on Spectrum.
3. Sweep the frequency to determine spurious emission as seen on spectrum from span of 30MHz to 3G, 3G to 8G, 8G to 13G, 13G to 18G and 18G to 26.5GHz
4. Via Software, combine 5 spans of frequency range into two plots containing the range of 30MHz to 3GHz, and 3GHz to 26.5GHz.

## 9.5. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

| | | |
|---|---|---|
| Where | FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| | RA = Reading Amplitude | AG = Amplifier Gain |
| | AF = Antenna Factor | |

## 9.6. Measurement Result -1 Out-Of-Band EMISSION:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

***NOTE: cable loss as 4.9dB that offsets in the spectrum***

***NOTE: the occurrence of the spike on the conducted emission is the signal of the fundamental emission.***

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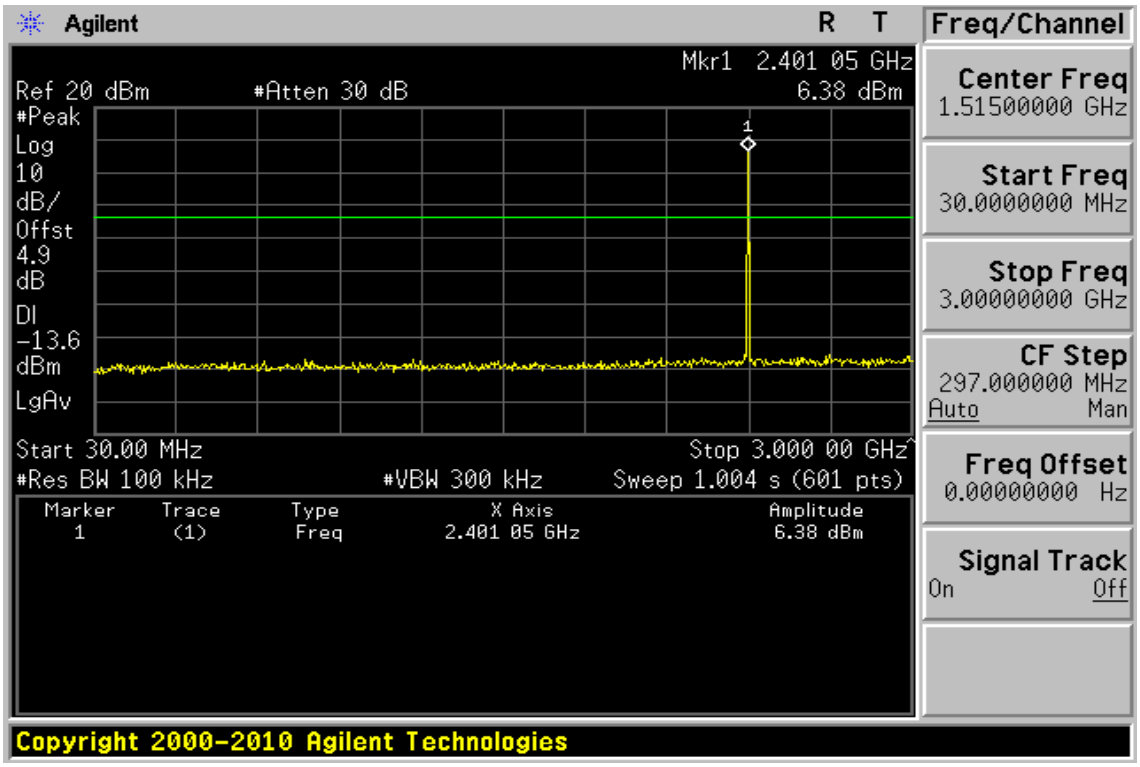
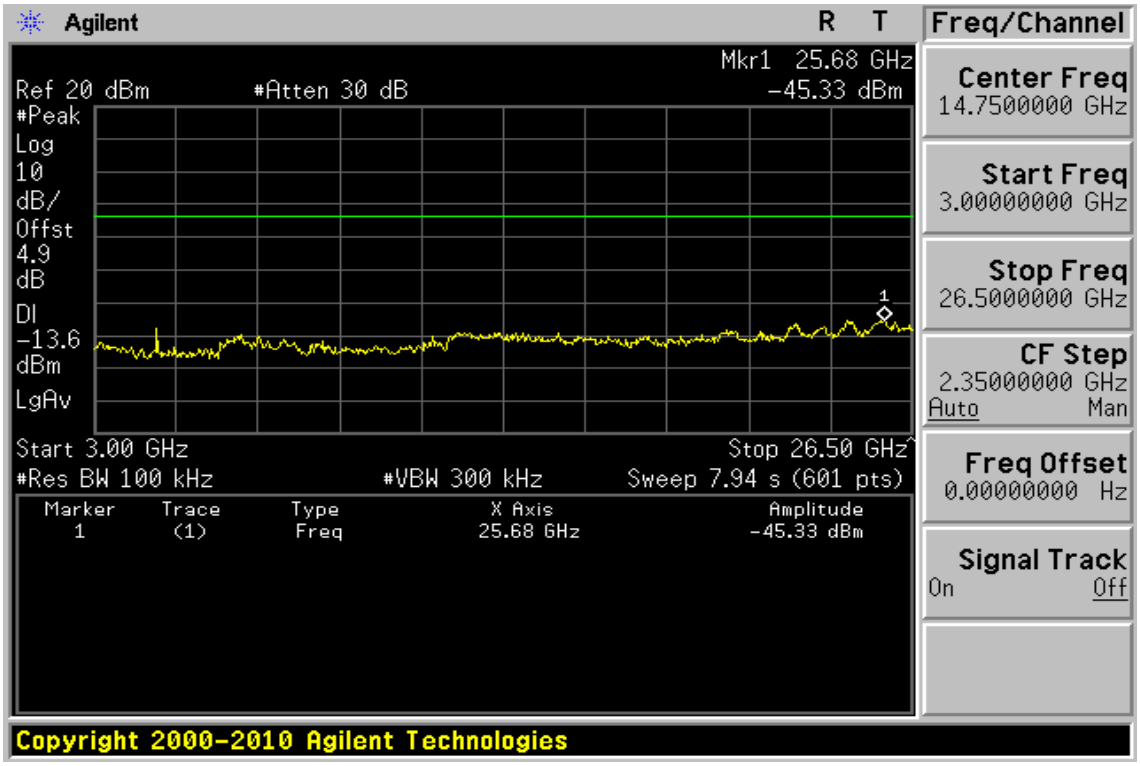
## 9.7 Measurement Result -1 Conducted Spurious Emission Measurement Result

## Ch Low 30MHz – 3GHz (Worst: BR mode)




## Ch Low 3GHz – 26.5GHz

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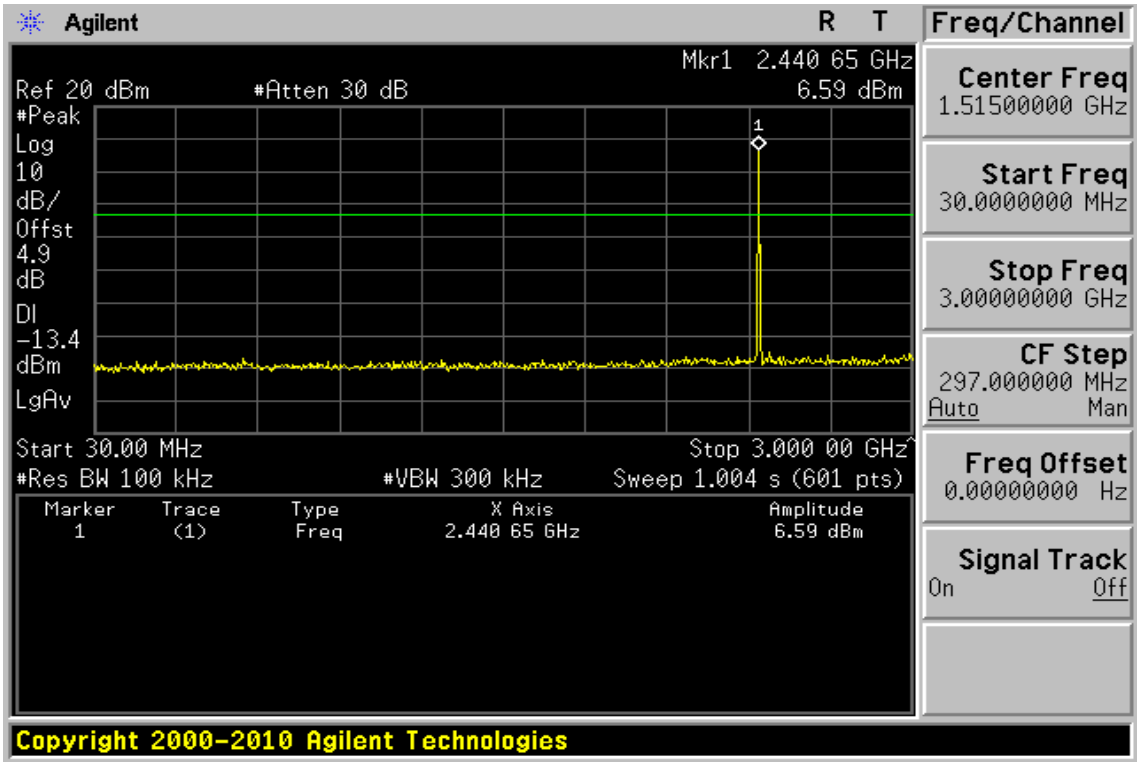
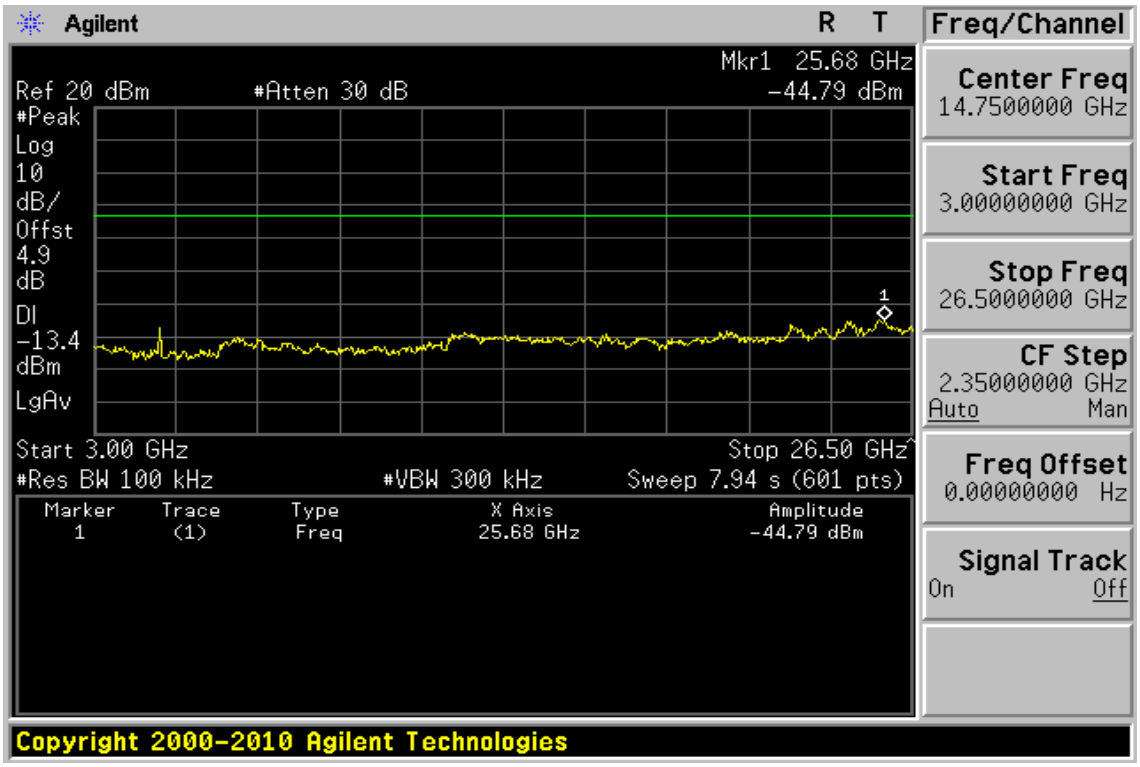
## Ch Mid 30MHz – 3GHz




## Ch Mid 3GHz – 26.5GHz

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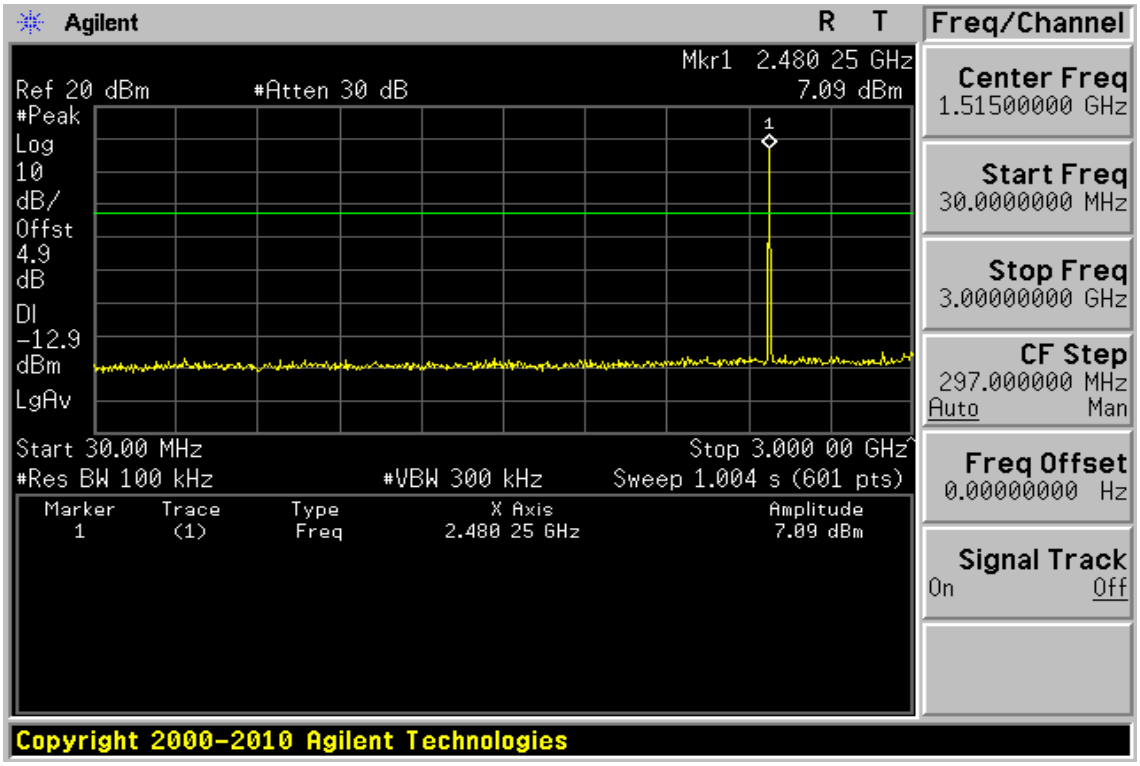
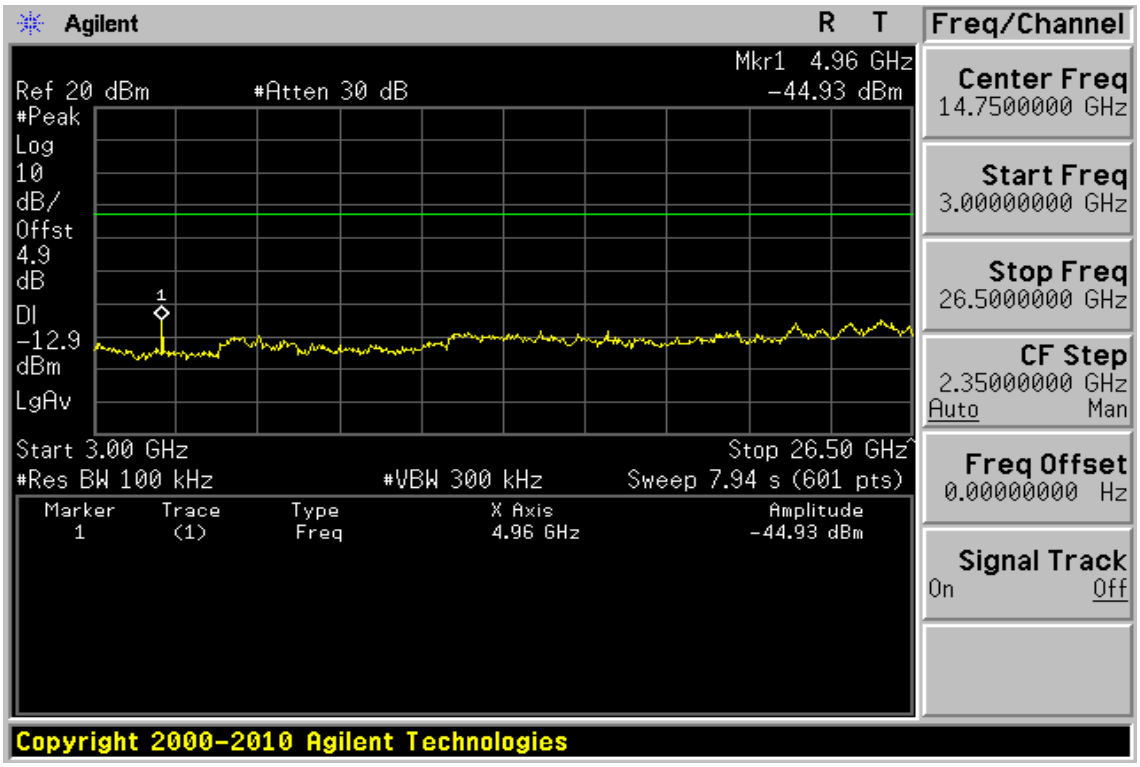
## Ch High 30MHz – 3GHz




## Ch High 3GHz – 26.5GHz

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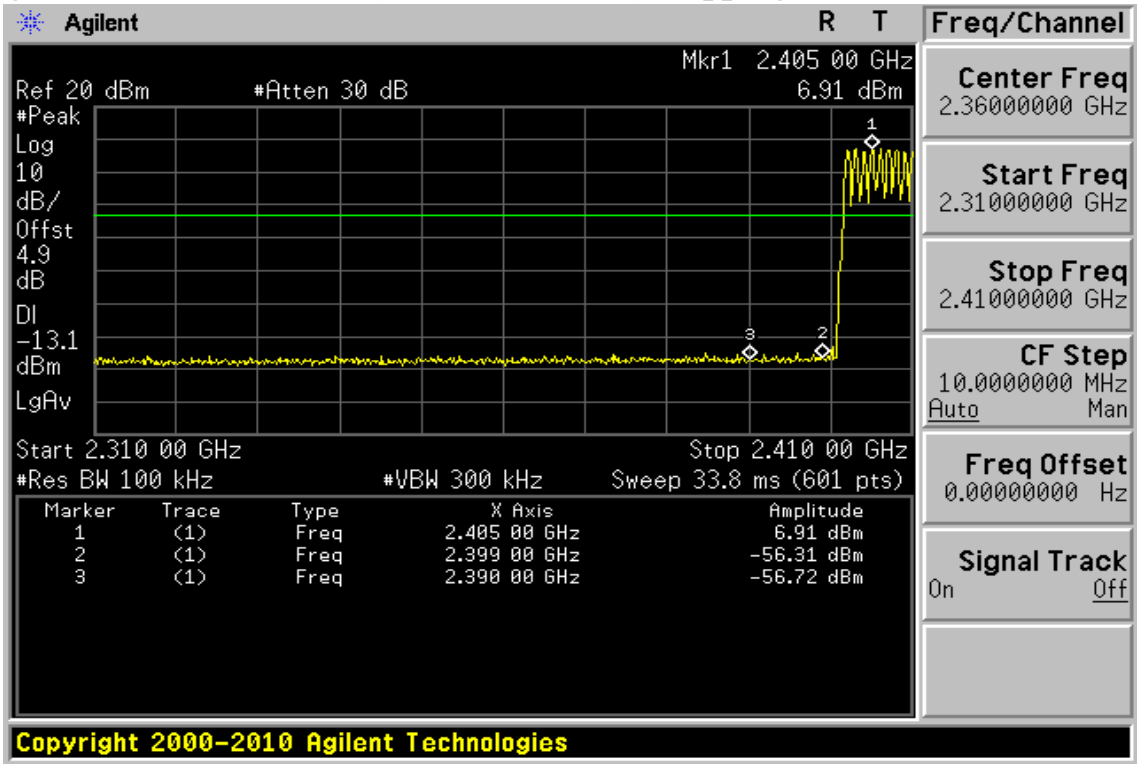
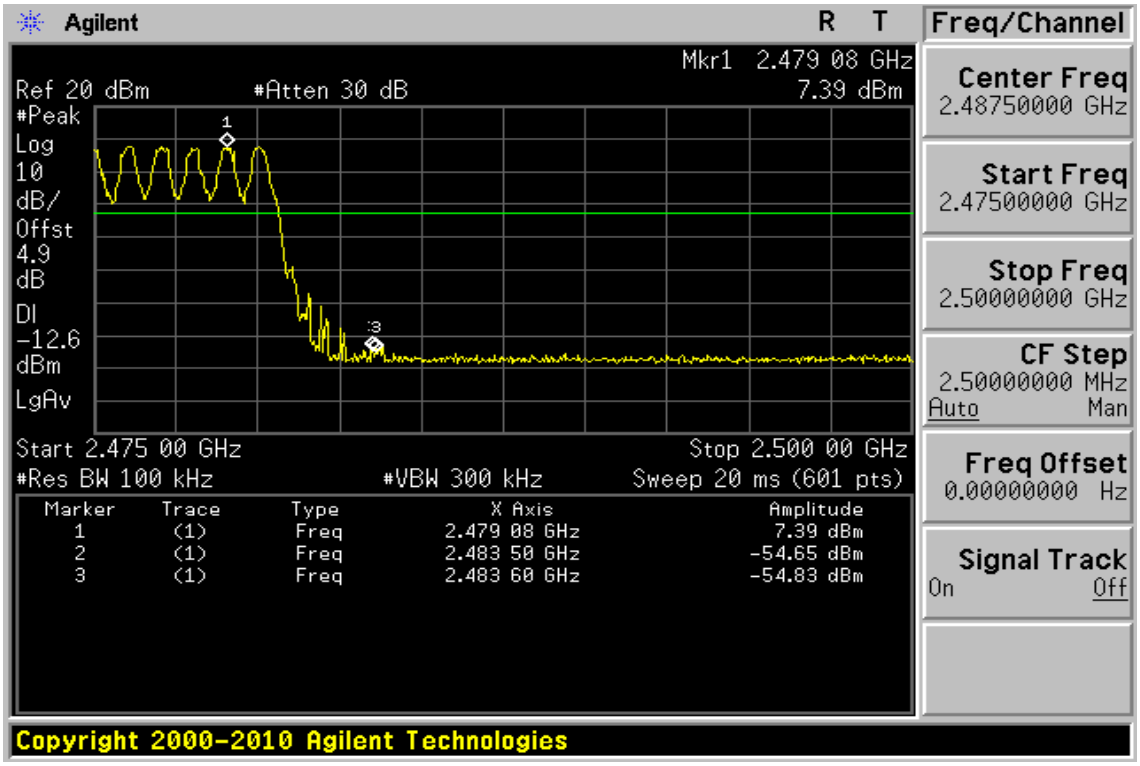
## 9.8 Measurement Result -2 100 kHz BANDWIDTH OF BNAD EDGE:

### *Band Edges Test Data CH-Low (Worst: BR mode) Hopping mode*




### *Band Edges Test Data CH-High*

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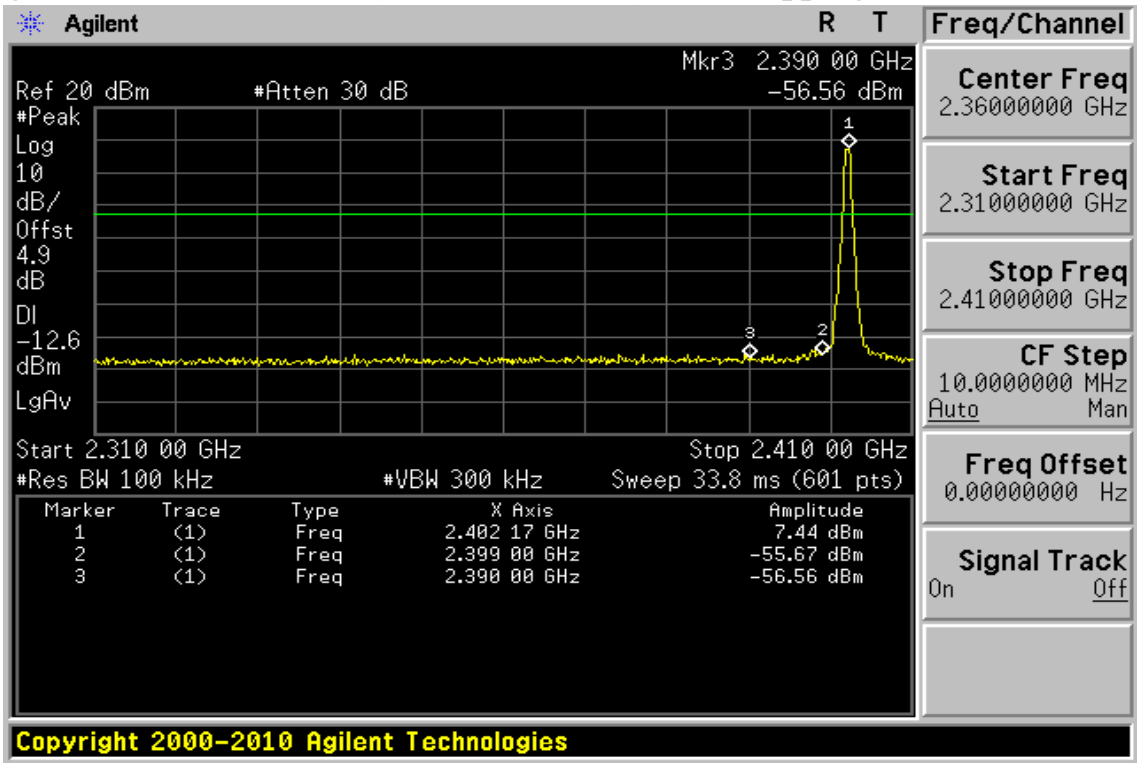
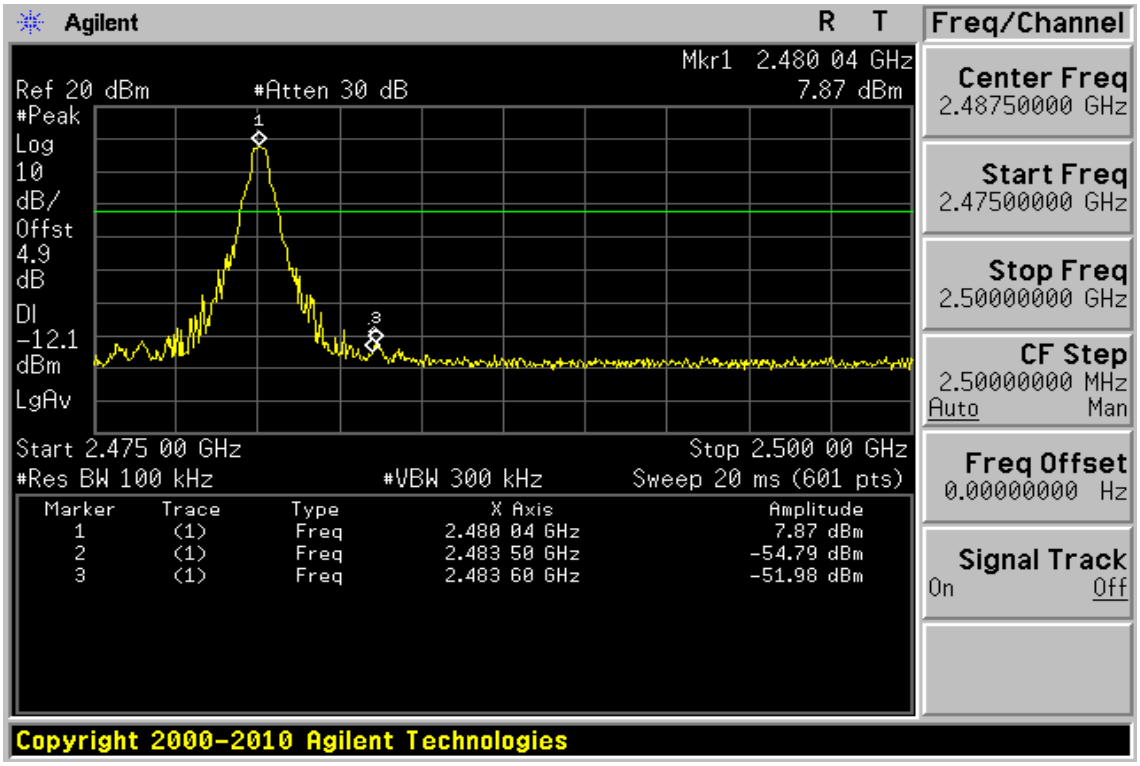
## *Band Edges Test Data CH-Low (Worst: BR mode) Non-Hopping mode*




## *Band Edges Test Data CH-High*

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# 10. SPURIOUS RADIATED EMISSION TEST

## 10.1. Standard Applicable

According to §15.247(d),

Emission at antenna port:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Radiated Spurious Emission

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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## 10.2. Measurement Equipment Used:

### 10.2.1. Radiated emission:

| 966 Chamber | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EMI Test Receiver | R&S | ESCI7 | 100760 | 05/26/2014 | 05/25/2015 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 05/19/2014 | 05/18/2015 |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 01/20/2014 | 01/19/2015 |
| Spectrum Analyzer | R&S | FSV-30 | 101398 | 10/22/2013 | 10/21/2014 |
| Loop Antenna | ETS.LINDGREN | 6502 | 00148045 | 07/03/2014 | 07/02/2015 |
| Bilog Antenna | SCHWAZBECK | VULB9168 | 378 | 01/02/2014 | 01/01/2015 |
| Horn antenna | ETS.LINDGREN | 3117 | 123995 | 05/19/2014 | 05/18/2015 |
| Horn Antenna | Schwarzbeck | BBHA9170 | 184 | 01/23/2014 | 01/22/2015 |
| Pre-Amplifier | Agilent | 8447D | 2944A07676 | 01/03/2014 | 01/02/2015 |
| Pre-Amplifier | Agilent | 8449B | 3008A00578 | 01/03/2014 | 01/02/2015 |
| Pre-Amplifier | EMC Instruments Corp. | EMC184045 | 980135 | 01/24/2014 | 01/23/2015 |
| Filter 2400-2483.5 MHz | EWT | EWT-14-0166 | M2 | 02/27/2014 | 02/26/2015 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 004 | 02/27/2014 | 02/26/2015 |
| Turn Table | HD | DT420 | N/A | N.C.R | N.C.R |
| Antenna Tower | HD | MA240-N | 240/657 | N.C.R | N.C.R |
| Controller | HD | HD100 | N/A | N.C.R | N.C.R |
| Low Loss Cable | Huber Suhner | 966_Rx | 9 | 01/03/2014 | 01/02/2015 |
| 3m Site NSA | SGS | 966 chamber | N/A | 07/15/2014 | 07/14/2015 |

NOTE: N.C.R refers to Not Calibrated Required.

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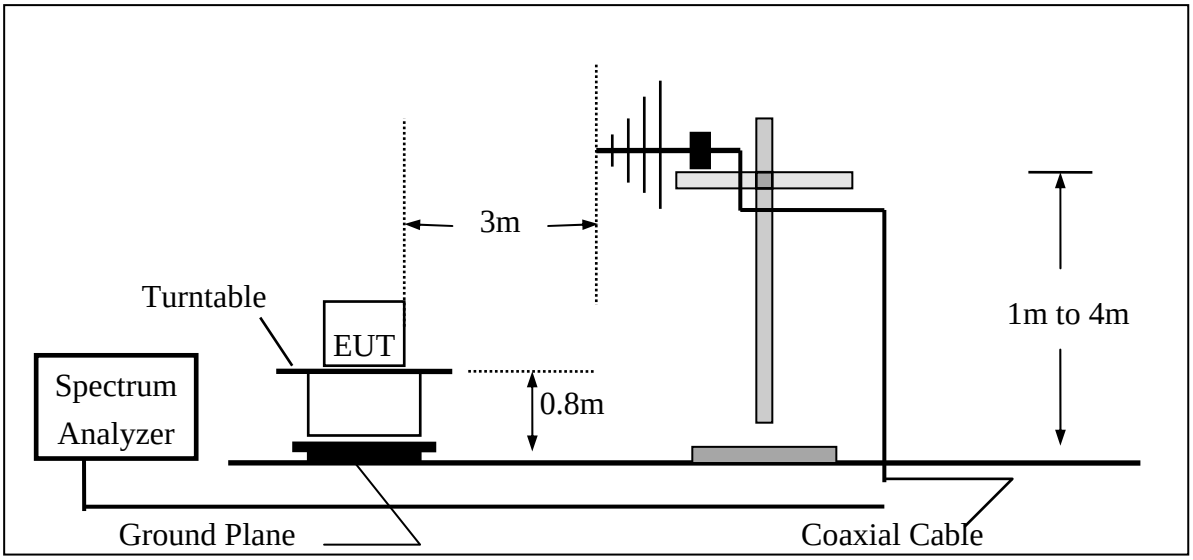
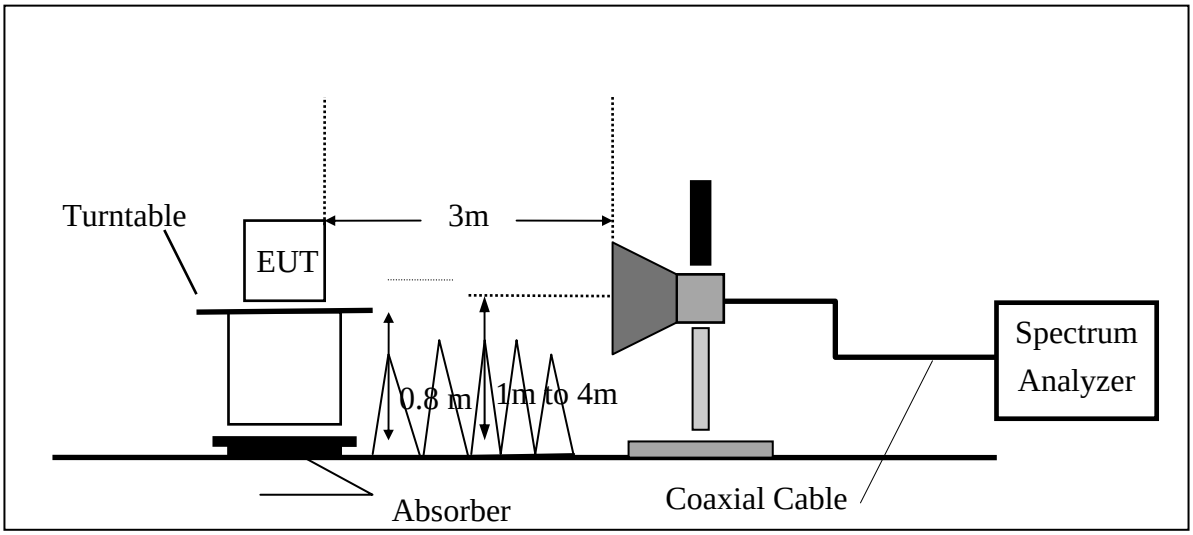
## 10.3. Test SET-UP:

### 10.3.1. Radiated emission:

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz




(B) Radiated Emission Test Set-UP Frequency Over 1 GHz

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## 10.4. Measurement Procedure:

**Radiated Emission:**

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency of the interest measured were complete.

Auxiliary Procedure (Setting on Spectrum to capture the reading of emission level):

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

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## 10.5. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

| | |
|---|---|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude | AG = Amplifier Gain |
| AF = Antenna Factor | |

Remark:

1. The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)
2. Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

## 10.6. Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

Note: For the tabular table as presents below, “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency. “E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---“ : denotes Noise Floor

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### 10.6.1 Radiated Emission – Band Edge: (Worst: BR mode) Hopping mode

| | | | |
|---|---|---|---|
| Operation Band | :BR+Hopping | Test Date | :2014-08-08 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :Band Edge LOW | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :VERTICAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBuV/m | dB | dBuV/m | dBuV/m | dB |
| 2390.00 | E | Average | 30.85 | 2.48 | 33.33 | 54.00 | -20.67 |
| 2390.00 | E | Peak | 41.72 | 2.48 | 44.20 | 74.00 | -29.80 |

| | | | |
|---|---|---|---|
| Operation Band | :BR+Hopping | Test Date | :2014-08-08 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :Band Edge LOW | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :HORIZONTAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBuV/m | dB | dBuV/m | dBuV/m | dB |
| 2390.00 | E | Average | 30.78 | 2.48 | 33.26 | 54.00 | -20.74 |
| 2390.00 | E | Peak | 42.62 | 2.48 | 45.10 | 74.00 | -28.90 |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

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| | | | |
|---|---|---|---|
| Operation Band | :BR+Hopping | Test Date | :2014-08-08 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :Band Edge HIGH | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :VERTICAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBuV/m | dB | dBuV/m | dBuV/m | dB |
| 2483.50 | E | Average | 31.07 | 2.84 | 33.91 | 54.00 | -20.09 |
| 2483.50 | E | Peak | 43.27 | 2.84 | 46.11 | 74.00 | -27.89 |

| | | | |
|---|---|---|---|
| Operation Band | :BR+Hopping | Test Date | :2014-08-08 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :Band Edge HIGH | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :HORIZONTAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBuV/m | dB | dBuV/m | dBuV/m | dB |
| 2483.50 | E | Average | 32.03 | 2.84 | 34.87 | 54.00 | -19.13 |
| 2483.50 | E | Peak | 47.04 | 2.84 | 49.88 | 74.00 | -24.12 |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

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**Band Edge: (Worst: BR mode) Non-Hopping mode**

| | | | |
|---|---|---|---|
| Operation Band | :BR | Test Date | :2014-08-08 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :Band Edge LOW | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :VERTICAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBuV/m | dB | dBuV/m | dBuV/m | dB |
| 2390.00 | E | Average | 31.03 | 2.48 | 33.51 | 54.00 | -20.49 |
| 2390.00 | E | Peak | 42.90 | 2.48 | 45.38 | 74.00 | -28.62 |

| | | | |
|---|---|---|---|
| Operation Band | :BR | Test Date | :2014-08-08 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :Band Edge LOW | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :HORIZONTAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBuV/m | dB | dBuV/m | dBuV/m | dB |
| 2390.00 | E | Average | 30.97 | 2.48 | 33.45 | 54.00 | -20.55 |
| 2390.00 | E | Peak | 43.44 | 2.48 | 45.92 | 74.00 | -28.08 |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

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| | | | |
|---|---|---|---|
| Operation Band | :BR | Test Date | :2014-08-08 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :Band Edge HIGH | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :VERTICAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBuV/m | dB | dBuV/m | dBuV/m | dB |
| 2483.50 | E | Average | 34.00 | 2.84 | 36.84 | 54.00 | -17.16 |
| 2483.50 | E | Peak | 46.07 | 2.84 | 48.91 | 74.00 | -25.09 |

| | | | |
|---|---|---|---|
| Operation Band | :BR | Test Date | :2014-08-08 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :Band Edge HIGH | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :HORIZONTAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBuV/m | dB | dBuV/m | dBuV/m | dB |
| 2483.50 | E | Average | 37.78 | 2.84 | 40.62 | 54.00 | -13.38 |
| 2483.50 | E | Peak | 50.95 | 2.84 | 53.79 | 74.00 | -20.21 |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

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## 10.6.2 Radiated Spurious Emission Measurement Result (worst case BR mode)

| | | | |
|---|---|---|---|
| Operation Band | :BR | | |
| ARFCN | :CH 00 | Test Date | :2014-08-04 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :TX LOW | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 36.79 | S | Peak | 48.94 | -13.75 | 35.19 | 40.00 | -4.81 |
| 156.10 | S | Peak | 34.45 | -12.48 | 21.97 | 43.50 | -21.53 |
| 419.94 | S | Peak | 34.71 | -8.77 | 25.94 | 46.00 | -20.06 |
| 540.22 | S | Peak | 39.88 | -7.45 | 32.43 | 46.00 | -13.57 |
| 756.53 | S | Peak | 28.22 | -2.51 | 25.71 | 46.00 | -20.29 |
| 896.21 | S | Peak | 31.83 | -1.01 | 30.82 | 46.00 | -15.18 |
| 4804.00 | H | Average | 32.05 | 6.75 | 38.80 | 54.00 | -15.20 |
| 4804.00 | H | Peak | 39.09 | 6.75 | 45.84 | 74.00 | -28.16 |
| 7206.00 | H | --- | | | | | |
| 9608.00 | H | --- | | | | | |
| 12010.00 | H | --- | | | | | |
| 14412.00 | H | --- | | | | | |
| 16814.00 | H | --- | | | | | |
| 19216.00 | H | --- | | | | | |
| 21618.00 | H | --- | | | | | |
| 24020.00 | H | --- | | | | | |

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| | | | |
|---|---|---|---|
| Operation Band | :BR | | |
| ARFCN | :CH 00 | Test Date | :2014-08-04 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :TX LOW | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 66.86 | S | Peak | 44.70 | -14.65 | 30.05 | 40.00 | -9.95 |
| 176.47 | S | Peak | 44.00 | -13.65 | 30.35 | 43.50 | -13.15 |
| 344.28 | S | Peak | 42.07 | -10.30 | 31.77 | 46.00 | -14.23 |
| 540.22 | S | Peak | 43.22 | -7.45 | 35.77 | 46.00 | -10.23 |
| 660.50 | S | Peak | 36.79 | -4.36 | 32.43 | 46.00 | -13.57 |
| 896.21 | S | Peak | 32.44 | -1.01 | 31.43 | 46.00 | -14.57 |
| 4804.00 | H | Average | 36.90 | 6.75 | 43.65 | 54.00 | -10.35 |
| 4804.00 | H | Peak | 44.00 | 6.75 | 50.75 | 74.00 | -23.25 |
| 7206.00 | H | --- | | | | | |
| 9608.00 | H | --- | | | | | |
| 12010.00 | H | --- | | | | | |
| 14412.00 | H | --- | | | | | |
| 16814.00 | H | --- | | | | | |
| 19216.00 | H | --- | | | | | |
| 21618.00 | H | --- | | | | | |
| 24020.00 | H | --- | | | | | |

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| | | | |
|---|---|---|---|
| Operation Band | :BR | | |
| ARFCN | :CH 39 | Test Date | :2014-08-04 |
| Fundamental Frequency | :2441 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :TX MID | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 36.79 | S | Peak | 49.11 | -13.75 | 35.36 | 40.00 | -4.64 |
| 265.71 | S | Peak | 36.33 | -12.31 | 24.02 | 46.00 | -21.98 |
| 419.94 | S | Peak | 35.41 | -8.77 | 26.64 | 46.00 | -19.36 |
| 540.22 | S | Peak | 39.84 | -7.45 | 32.39 | 46.00 | -13.61 |
| 726.46 | S | Peak | 29.95 | -3.80 | 26.15 | 46.00 | -19.85 |
| 896.21 | S | Peak | 31.21 | -1.01 | 30.20 | 46.00 | -15.80 |
| 4882.00 | H | Average | 36.02 | 6.93 | 42.95 | 54.00 | -11.05 |
| 4882.00 | H | Peak | 43.01 | 6.93 | 49.94 | 74.00 | -24.06 |
| 7323.00 | H | --- | | | | | |
| 9764.00 | H | --- | | | | | |
| 12205.00 | H | --- | | | | | |
| 14646.00 | H | --- | | | | | |
| 17087.00 | H | --- | | | | | |
| 19528.00 | H | --- | | | | | |
| 21969.00 | H | --- | | | | | |
| 24410.00 | H | --- | | | | | |

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| | | | |
|---|---|---|---|
| Operation Band | :BR | | |
| ARFCN | :CH 39 | Test Date | :2014-08-04 |
| Fundamental Frequency | :2441 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :TX MID | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 69.77 | S | Peak | 45.96 | -15.17 | 30.79 | 40.00 | -9.21 |
| 177.44 | S | Peak | 44.87 | -13.76 | 31.11 | 43.50 | -12.39 |
| 344.28 | S | Peak | 43.07 | -10.30 | 32.77 | 46.00 | -13.23 |
| 540.22 | S | Peak | 42.92 | -7.45 | 35.47 | 46.00 | -10.53 |
| 659.53 | S | Peak | 37.11 | -4.39 | 32.72 | 46.00 | -13.28 |
| 896.21 | S | Peak | 31.62 | -1.01 | 30.61 | 46.00 | -15.39 |
| 4882.00 | H | Average | 36.87 | 6.93 | 43.80 | 54.00 | -10.20 |
| 4882.00 | H | Peak | 43.85 | 6.93 | 50.78 | 74.00 | -23.22 |
| 7323.00 | H | --- | | | | | |
| 9764.00 | H | --- | | | | | |
| 12205.00 | H | --- | | | | | |
| 14646.00 | H | --- | | | | | |
| 17087.00 | H | --- | | | | | |
| 19528.00 | H | --- | | | | | |
| 21969.00 | H | --- | | | | | |
| 24410.00 | H | --- | | | | | |

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| | | | |
|---|---|---|---|
| Operation Band | :BR | | |
| ARFCN | :CH 78 | Test Date | :2014-08-04 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :TX HIGH | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 36.79 | S | Peak | 48.44 | -13.75 | 34.69 | 40.00 | -5.31 |
| 272.50 | S | Peak | 33.96 | -11.95 | 22.01 | 46.00 | -23.99 |
| 419.94 | S | Peak | 34.55 | -8.77 | 25.78 | 46.00 | -20.22 |
| 540.22 | S | Peak | 40.66 | -7.45 | 33.21 | 46.00 | -12.79 |
| 748.77 | S | Peak | 29.58 | -2.54 | 27.04 | 46.00 | -18.96 |
| 896.21 | S | Peak | 30.70 | -1.01 | 29.69 | 46.00 | -16.31 |
| 4960.00 | H | Average | 34.90 | 7.08 | 41.98 | 54.00 | -12.02 |
| 4960.00 | H | Peak | 42.08 | 7.08 | 49.16 | 74.00 | -24.84 |
| 7440.00 | H | --- | | | | | |
| 9920.00 | H | --- | | | | | |
| 12400.00 | H | --- | | | | | |
| 14880.00 | H | --- | | | | | |
| 17360.00 | H | --- | | | | | |
| 19840.00 | H | --- | | | | | |
| 22320.00 | H | --- | | | | | |
| 24800.00 | H | --- | | | | | |

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| | | | |
|---|---|---|---|
| Operation Band | :BR | | |
| ARFCN | :CH 78 | Test Date | :2014-08-04 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :23 deg_C / 63 RH |
| Operation Mode | :TX HIGH | Engineer | :Curry |
| EUT Pol. | :H Plane | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 69.77 | S | Peak | 45.23 | -15.17 | 30.06 | 40.00 | -9.94 |
| 177.44 | S | Peak | 42.91 | -13.76 | 29.15 | 43.50 | -14.35 |
| 344.28 | S | Peak | 43.01 | -10.30 | 32.71 | 46.00 | -13.29 |
| 540.22 | S | Peak | 43.08 | -7.45 | 35.63 | 46.00 | -10.37 |
| 660.50 | S | Peak | 36.87 | -4.36 | 32.51 | 46.00 | -13.49 |
| 896.21 | S | Peak | 32.60 | -1.01 | 31.59 | 46.00 | -14.41 |
| 4960.00 | H | Average | 34.06 | 7.08 | 41.14 | 54.00 | -12.86 |
| 4960.00 | H | Peak | 41.28 | 7.08 | 48.36 | 74.00 | -25.64 |
| 7440.00 | H | --- | | | | | |
| 9920.00 | H | --- | | | | | |
| 12400.00 | H | --- | | | | | |
| 14880.00 | H | --- | | | | | |
| 17360.00 | H | --- | | | | | |
| 19840.00 | H | --- | | | | | |
| 22320.00 | H | --- | | | | | |
| 24800.00 | H | --- | | | | | |

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# 11. FREQUENCY SEPARATION

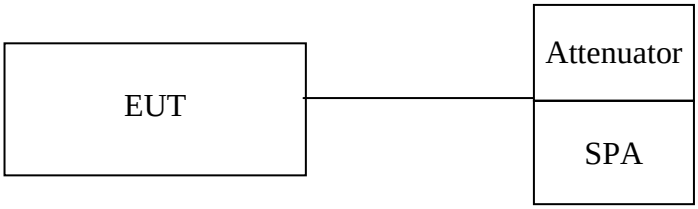
## 11.1. Standard Applicable

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

## 11.2. Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Power Meter | Anritsu | ML2495A | 1005007 | 01/13/2014 | 01/12/2015 |
| Power Sensor | Anritsu | MA2411B | 917032 | 01/13/2014 | 01/12/2015 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 05/19/2014 | 05/18/2015 |
| Spectrum Analyzer | Agilent | E4440A | MY45304525 | 03/08/2014 | 03/07/2015 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 02/27/2014 | 02/26/2015 |
| Low Loss Cable | HUBER+SUHNER | SUCOFLEX 104PEA | N/A | 01/03/2014 | 01/02/2015 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 002 | 02/27/2014 | 02/26/2015 |
| Splitter | Agilent | 11636B | N/A | 02/27/2014 | 02/26/2015 |

## 11.3. Test Set-up:

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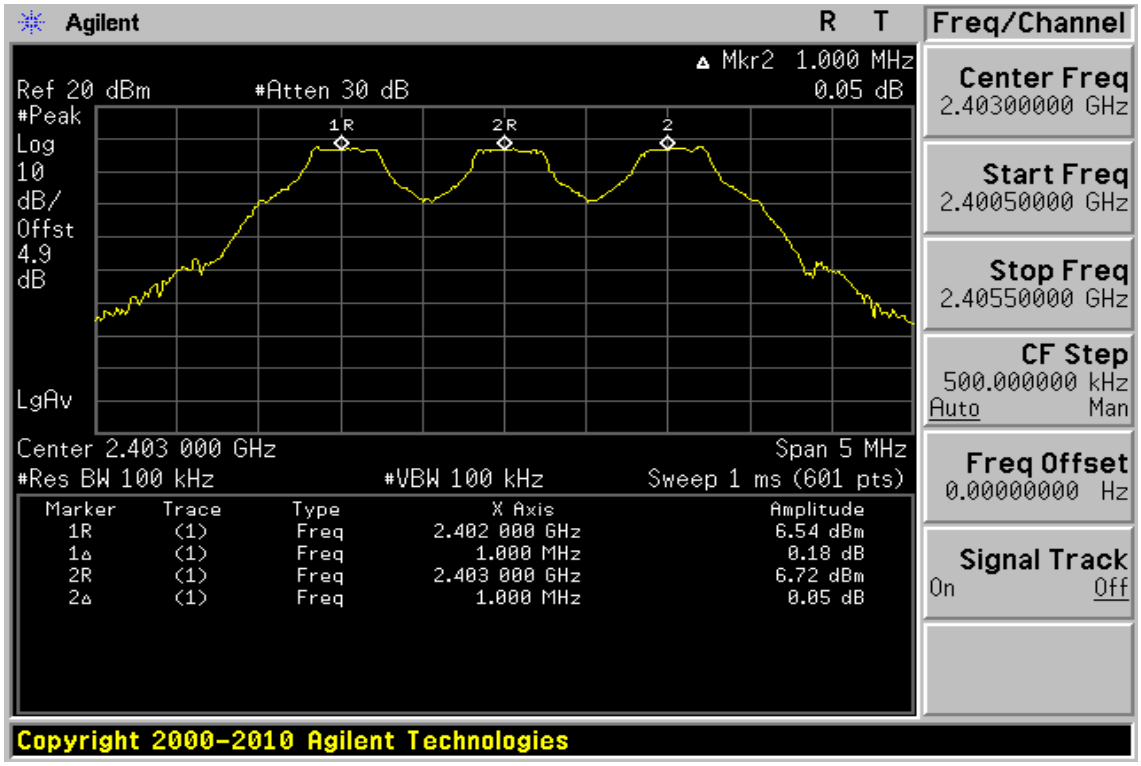
## 11.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 5MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

## 11.5. Measurement Result:

| Channel separation (MHz) | Limit | Result |
|---|---|---|
| 1 | >=25 kHz or<br>2/3 times 20dB bandwidth | PASS |

## Frequency Separation Test Data

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# 12. NUMBER OF HOPPING FREQUENCY

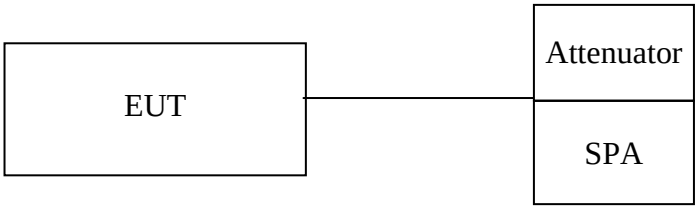
## 12.1. Standard Applicable

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

## 12.2. Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Power Meter | Anritsu | ML2495A | 1005007 | 01/13/2014 | 01/12/2015 |
| Power Sensor | Anritsu | MA2411B | 917032 | 01/13/2014 | 01/12/2015 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 05/19/2014 | 05/18/2015 |
| Spectrum Analyzer | Agilent | E4440A | MY45304525 | 03/08/2014 | 03/07/2015 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 02/27/2014 | 02/26/2015 |
| Low Loss Cable | HUBER+SUHNER | SUCOFLEX 104PEA | N/A | 01/03/2014 | 01/02/2015 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 002 | 02/27/2014 | 02/26/2015 |
| Splitter | Agilent | 11636B | N/A | 02/27/2014 | 02/26/2015 |

## 12.3. Test Set-up:




## 12.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=430 kHz, VBW=1.5MHz., Detector = Peak
5. Max hold, view and count how many channel in the band.

## 12.5. Measurement Result:

Note: Refer to next page for plots.

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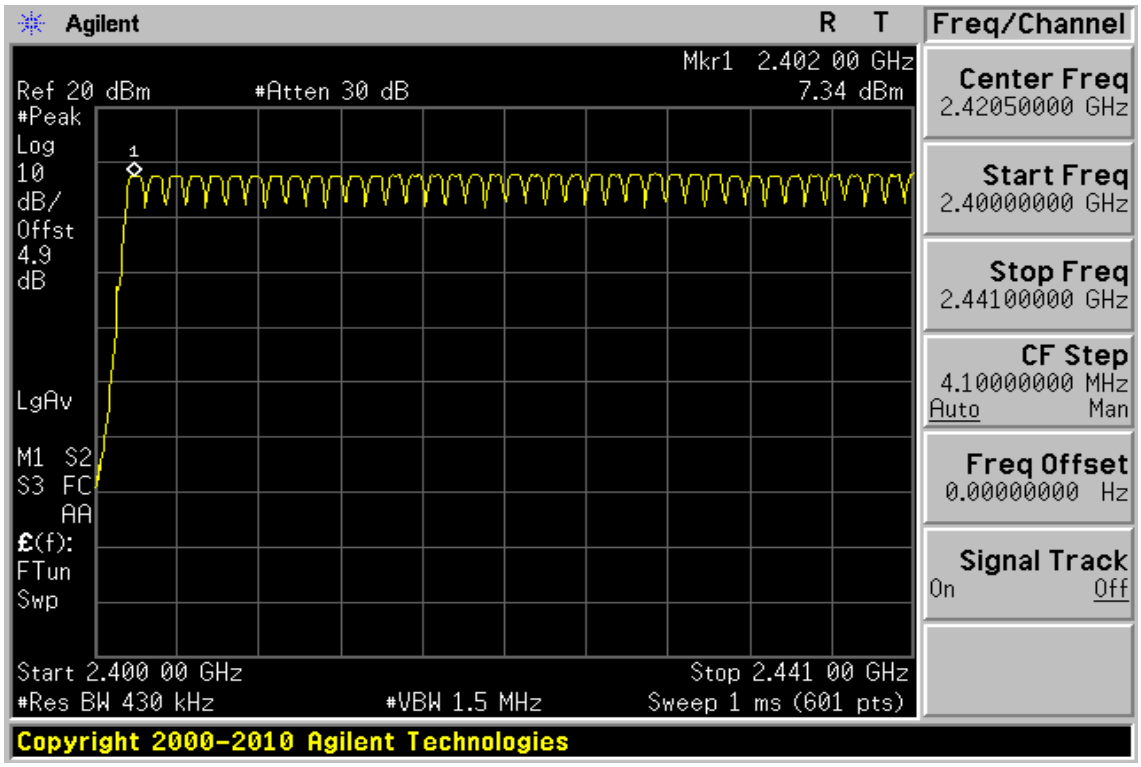
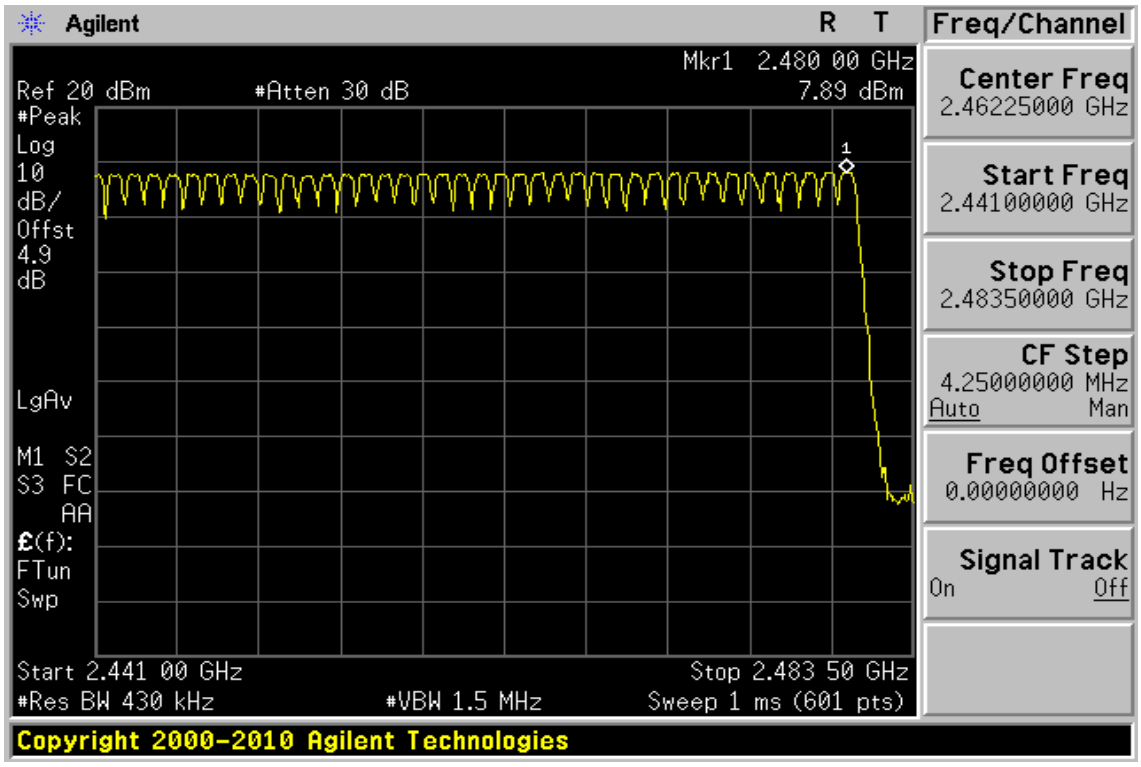
# Channel Number

*2.4 GHz – 2.441GHz*




*2.441 GHz – 2.4835GHz*

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# 13. TIME OF OCCUPANCY (DWELL TIME)

## 13.1. Standard Applicable

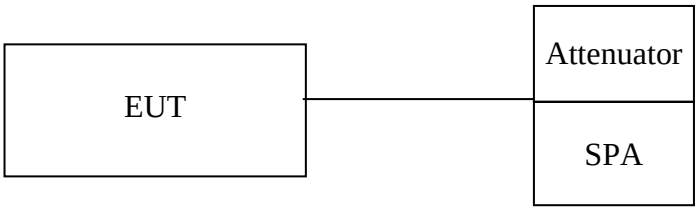
According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

**Limit: 0.4s = 400ms**

## 13.2. Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE** | **MFR** | **MODEL NUMBER** | **SERIAL NUMBER** | **LAST CAL.** | **CAL DUE.** |
| Power Meter | Anritsu | ML2495A | 1005007 | 01/13/2014 | 01/12/2015 |
| Power Sensor | Anritsu | MA2411B | 917032 | 01/13/2014 | 01/12/2015 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 05/19/2014 | 05/18/2015 |
| Spectrum Analyzer | Agilent | E4440A | MY45304525 | 03/08/2014 | 03/07/2015 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 02/27/2014 | 02/26/2015 |
| Low Loss Cable | HUBER+SUHNER | SUCOFLEX 104PEA | N/A | 01/03/2014 | 01/02/2015 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 002 | 02/27/2014 | 02/26/2015 |
| Splitter | Agilent | 11636B | N/A | 02/27/2014 | 02/26/2015 |

## 13.3. Test Set-up:

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## 13.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz , Detector = Peak, Adjust Sweep = 2~7ms.
5. Repeat above procedures until all frequency of the interest measured were complete.

Formula Deduced: time occupancy of one time slot X Hopping rate / total slot in one channel / total channel that hops X period of working channels.

Where, standard hopping rate is 1600 hops/s, slot in one channel for DH1, DH3, and DH5 is 2, 4, and 6, respectively.

DH1 consists of single time slot of the uplink, and one slot of the downlink Total Slot: 2

DH3 consists of three time slot of the uplink, and one slot of the downlink. Total Slot: 4

DH5 consists of five time slot of the uplink, and one slot of the downlink. Total Slot: 6

Note: the result of the complete test default channel at 1Mbps is recorded on the test report, 2Mbps, and 3Mbps only records the measurement result at middle channel that reveals no much deviation.

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## 13.5. Tabular Result of the Measurement:

1Mbps (GFSK):

| Test Channel: | Mode: | Measurement Result (ms): | Limit (ms): |
|---|---|---|---|
| Low: | DH1 | 122.56 | 400ms |
| | DH3 | 261.28 | 400ms |
| | DH5 | 307.52 | 400ms |
| Middle: | DH1 | 122.56 | 400ms |
| | DH3 | 261.28 | 400ms |
| | DH5 | 307.52 | 400ms |
| High: | DH1 | 122.56 | 400ms |
| | DH3 | 261.28 | 400ms |
| | DH5 | 307.52 | 400ms |

2Mbps (Π/4 DQPSK):

| Test Channel: | Mode: | Measurement Result (ms): | Limit (ms): |
|---|---|---|---|
| Middle: | 2DH1 | 122.56 | 400ms |
| | 2DH3 | 261.28 | 400ms |
| | 2DH5 | 307.52 | 400ms |

3Mbps (8DPSK):

| Test Channel: | Mode: | Measurement Result (ms): | Limit (ms): |
|---|---|---|---|
| Middle: | 3DH1 | 122.56 | 400 |
| | 3DH3 | 261.28 | 400 |
| | 3DH5 | 307.52 | 400 |

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A period time = 0.4 (s) * 79 = 31.6 (s)

1Mbps:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CH Low | DH1 time slot | = | 0.383 (ms) * (1600/2/79) | * 31.6 = | 122.56 | (ms) |
| | DH3 time slot | = | 1.633 (ms) * (1600/4/79) | * 31.6 = | 261.28 | (ms) |
| | DH5 time slot | = | 2.883 (ms) * (1600/6/79) | * 31.6 = | 307.52 | (ms) |
| CH Mid | DH1 time slot | = | 0.383 (ms) * (1600/2/79) | * 31.6 = | 122.56 | (ms) |
| | DH3 time slot | = | 1.633 (ms) * (1600/4/79) | * 31.6 = | 261.28 | (ms) |
| | DH5 time slot | = | 2.883 (ms) * (1600/6/79) | * 31.6 = | 307.52 | (ms) |
| CH High | DH1 time slot | = | 0.383 (ms) * (1600/2/79) | * 31.6 = | 122.56 | (ms) |
| | DH3 time slot | = | 1.633 (ms) * (1600/4/79) | * 31.6 = | 261.28 | (ms) |
| | DH5 time slot | = | 2.883 (ms) * (1600/6/79) | * 31.6 = | 307.52 | (ms) |

2Mbps:

| | | | | | | |
|---|---|---|---|---|---|---|
| CH Mid | 2DH1 time slot | = | 0.383 (ms) * (1600/2/79) | * 31.6 = | 122.56 | (ms) |
| | 2DH3 time slot | = | 1.633 (ms) * (1600/4/79) | * 31.6 = | 261.28 | (ms) |
| | 2DH5 time slot | = | 2.883 (ms) * (1600/6/79) | * 31.6 = | 307.52 | (ms) |

3Mbps:

| | | | | | | |
|---|---|---|---|---|---|---|
| CH Mid | 3DH1 time slot | = | 0.383 (ms) * (1600/2/79) | * 31.6 = | 122.56 | (ms) |
| | 3DH3 time slot | = | 1.633 (ms) * (1600/4/79) | * 31.6 = | 261.28 | (ms) |
| | 3DH5 time slot | = | 2.883 (ms) * (1600/6/79) | * 31.6 = | 307.52 | (ms) |

## 13.6. Measurement Result:

Note: Refer to next page for plots.

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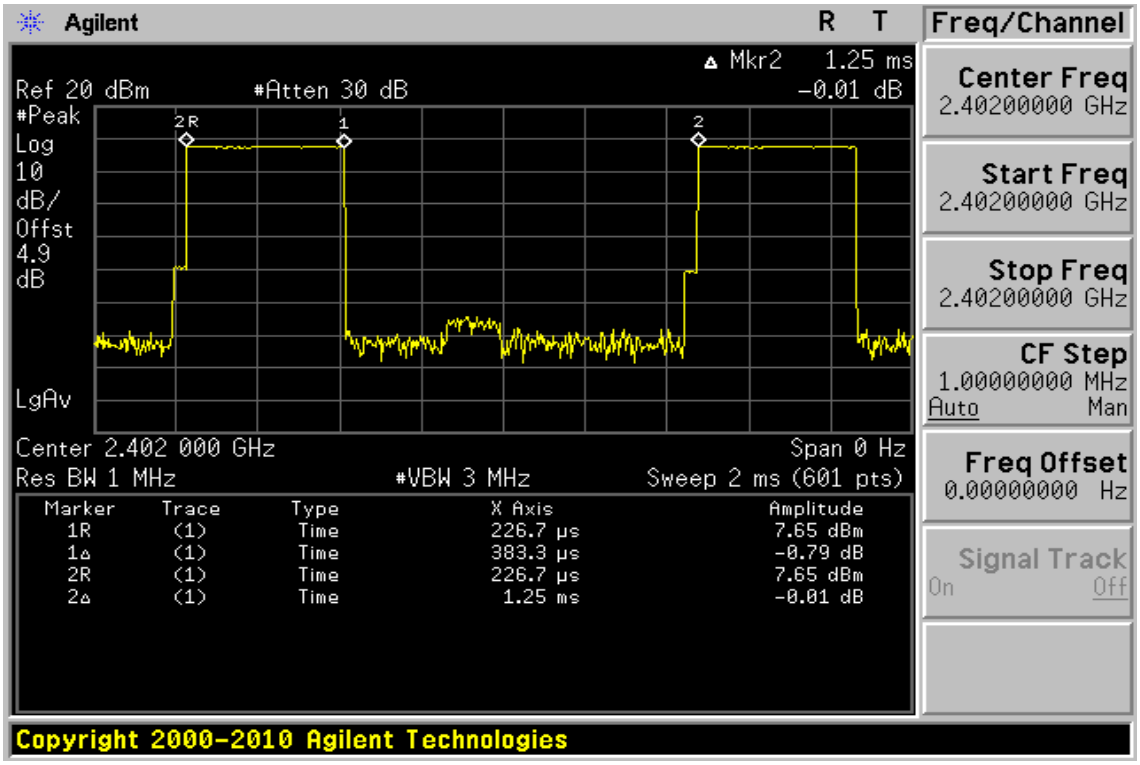
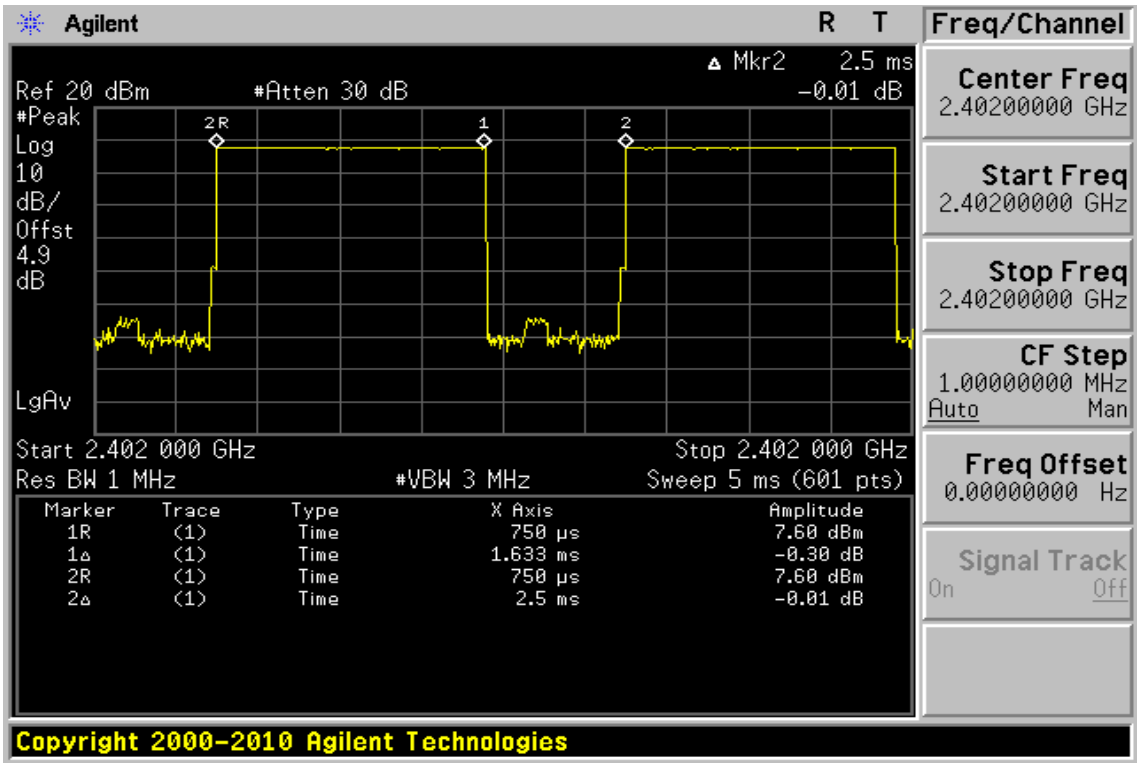
## *CH-Low*

## *DH1*




## *DH3*

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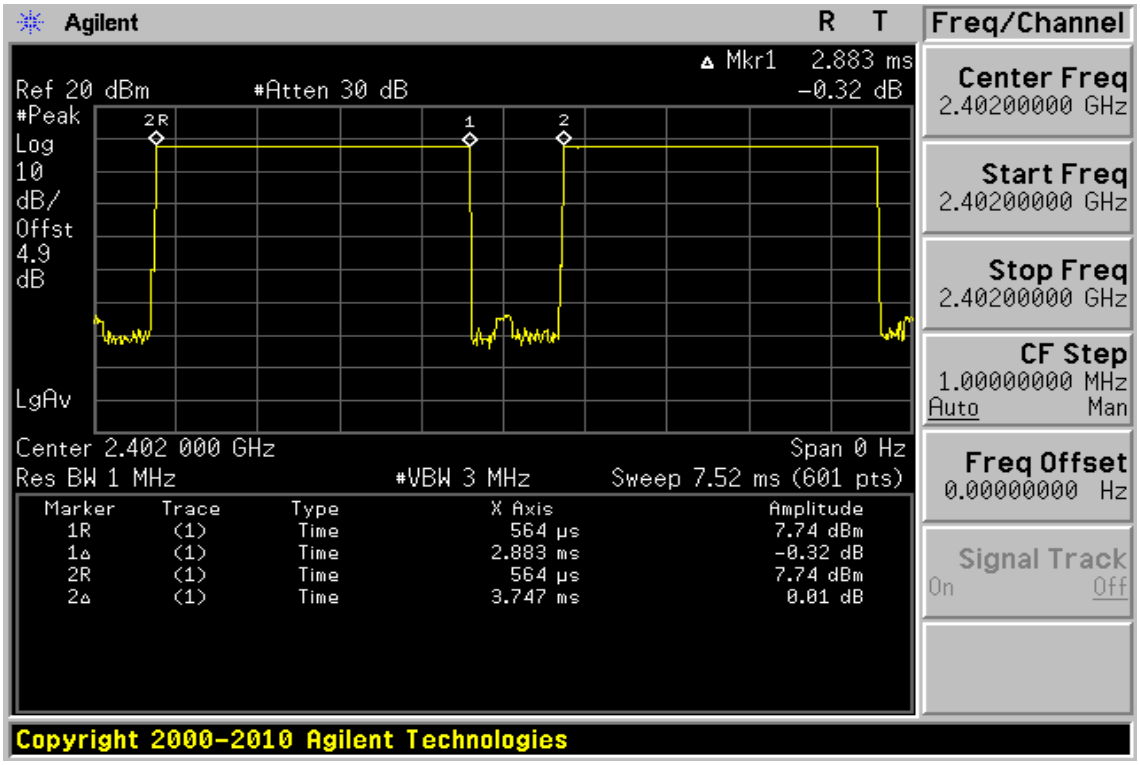
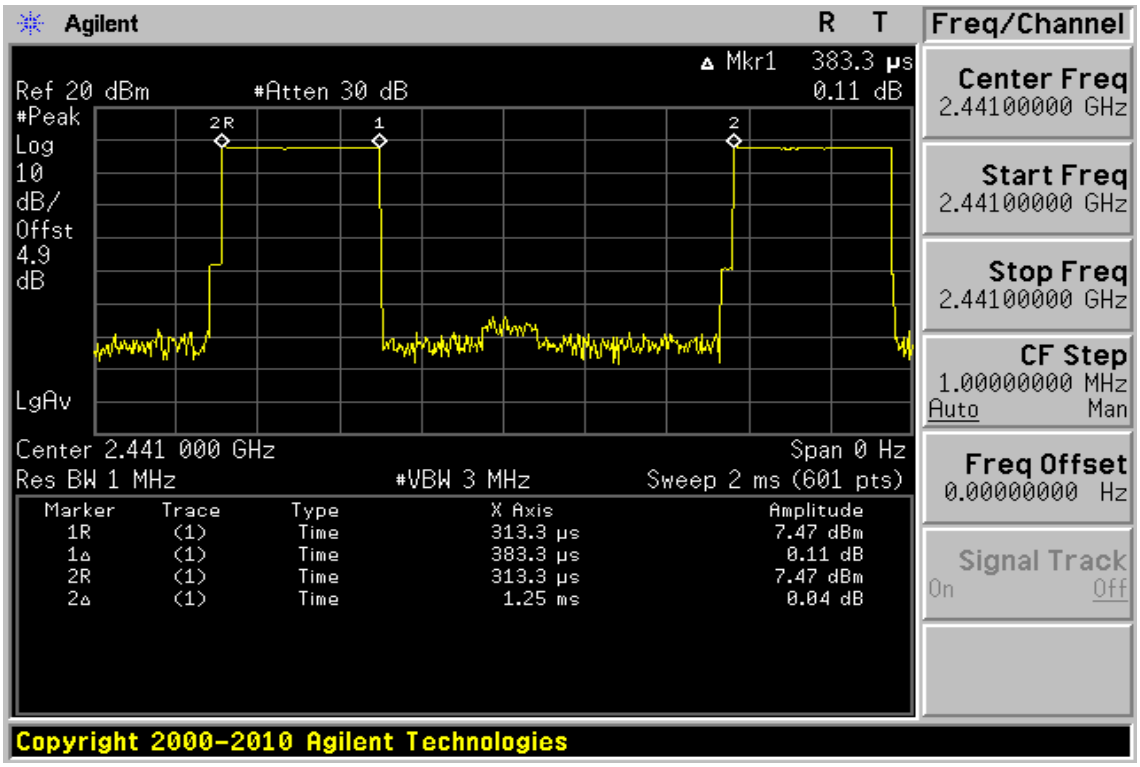
## *DH5*




## *CH-Mid*

## *DH1*

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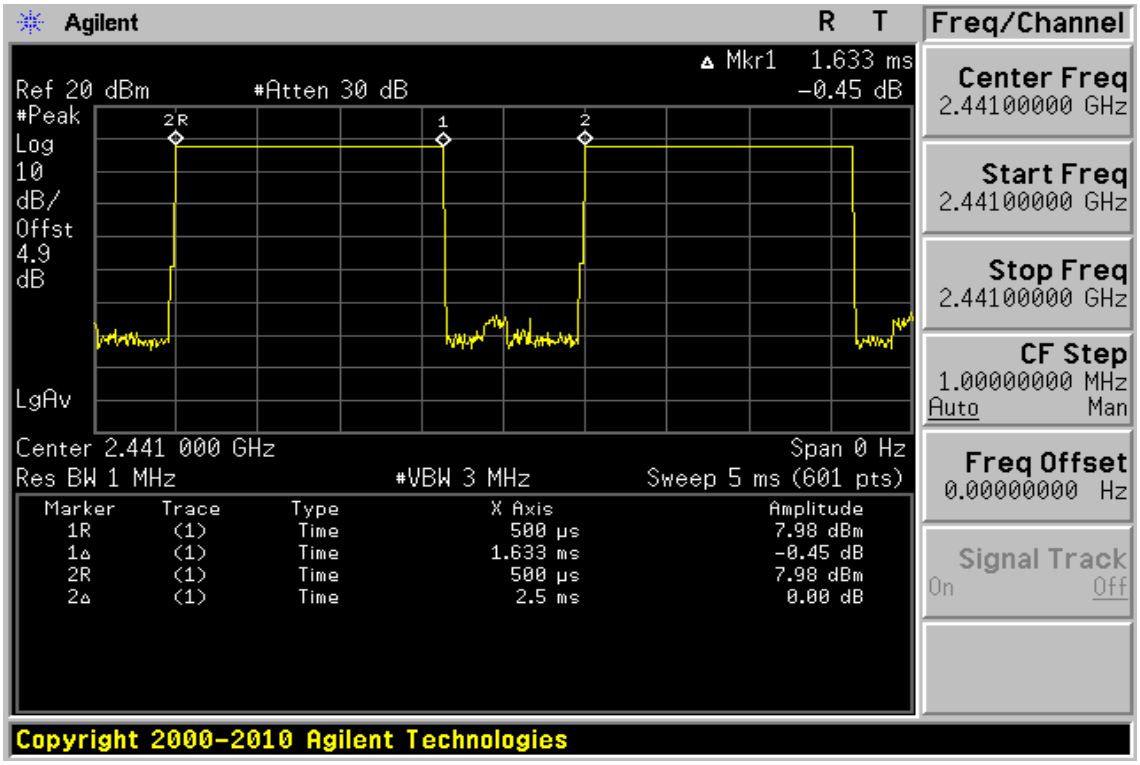
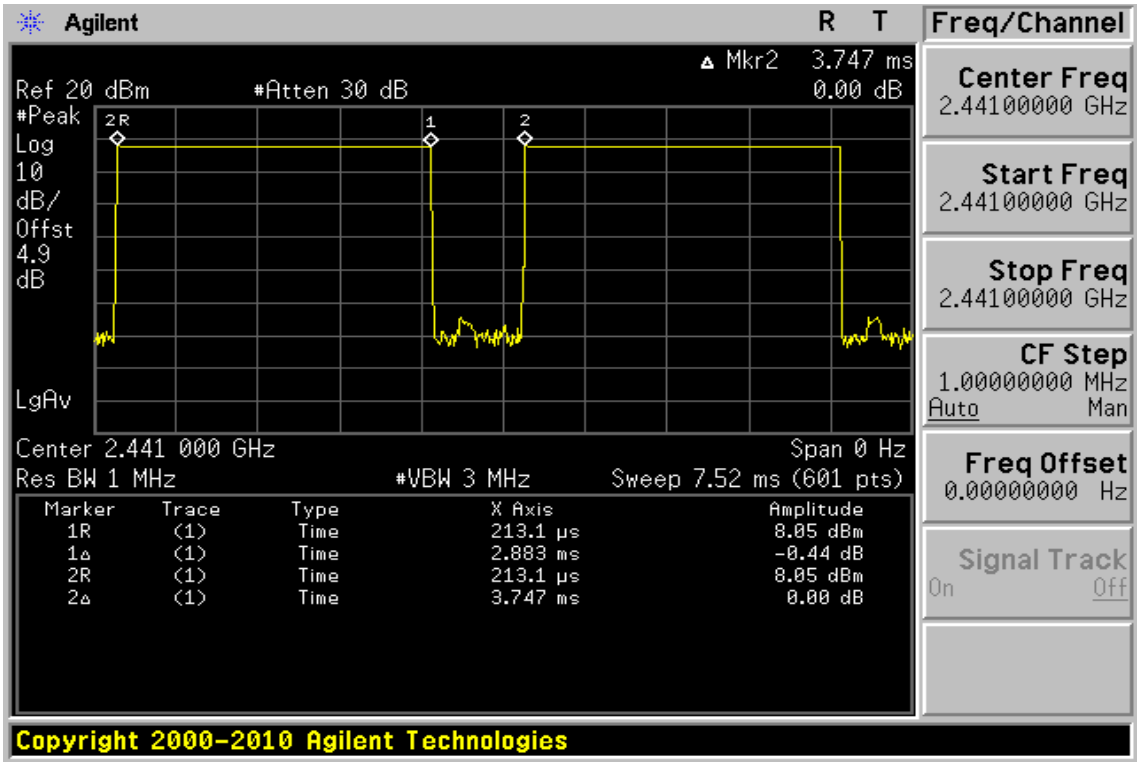
## *DH3*




## *DH5*

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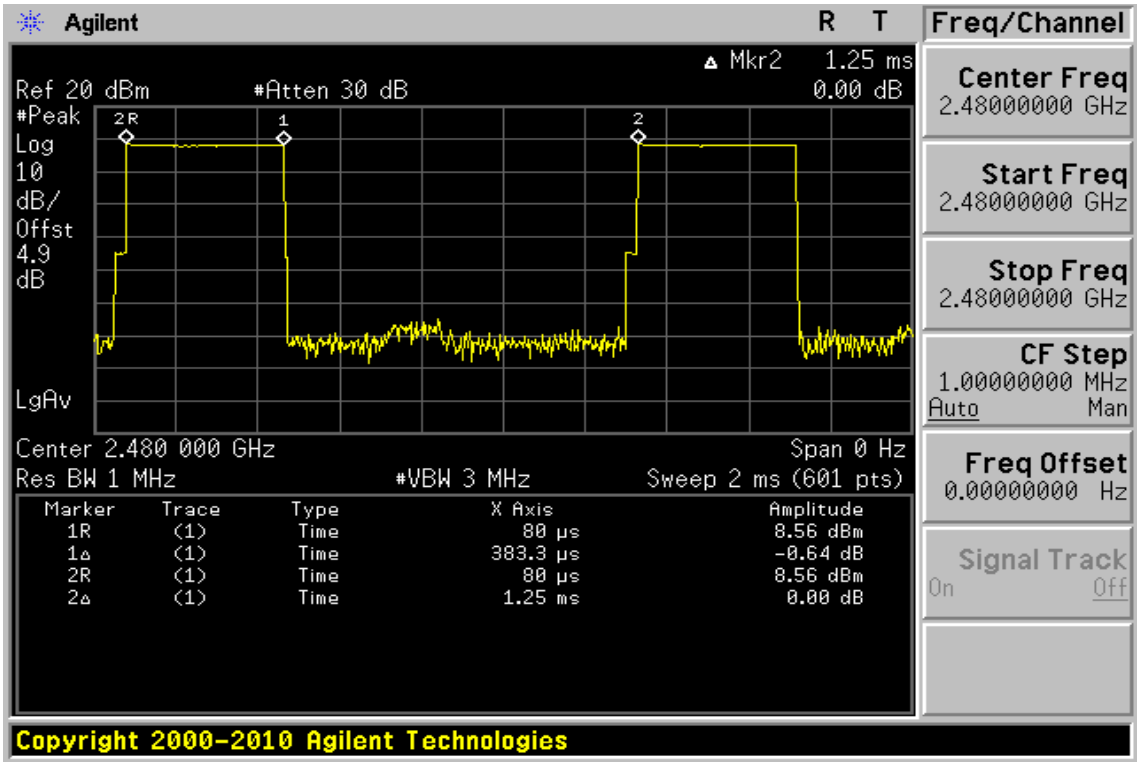
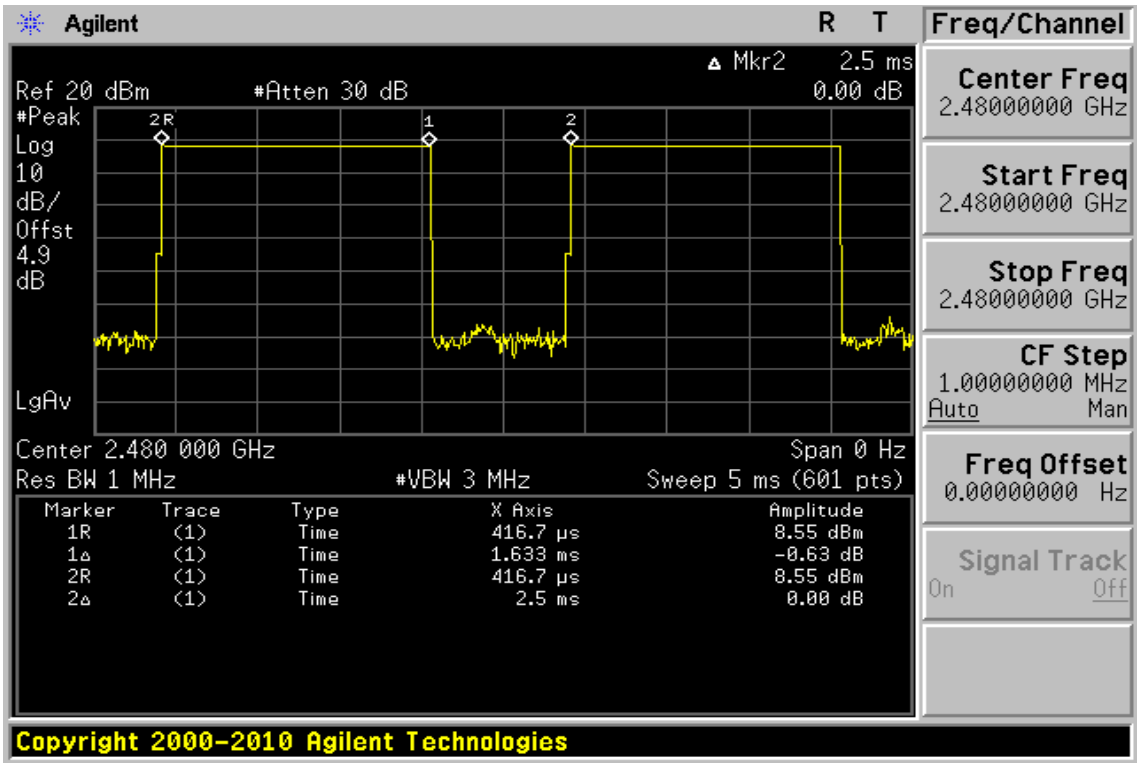
## *CH-High*

### *DH1*




### *DH3*

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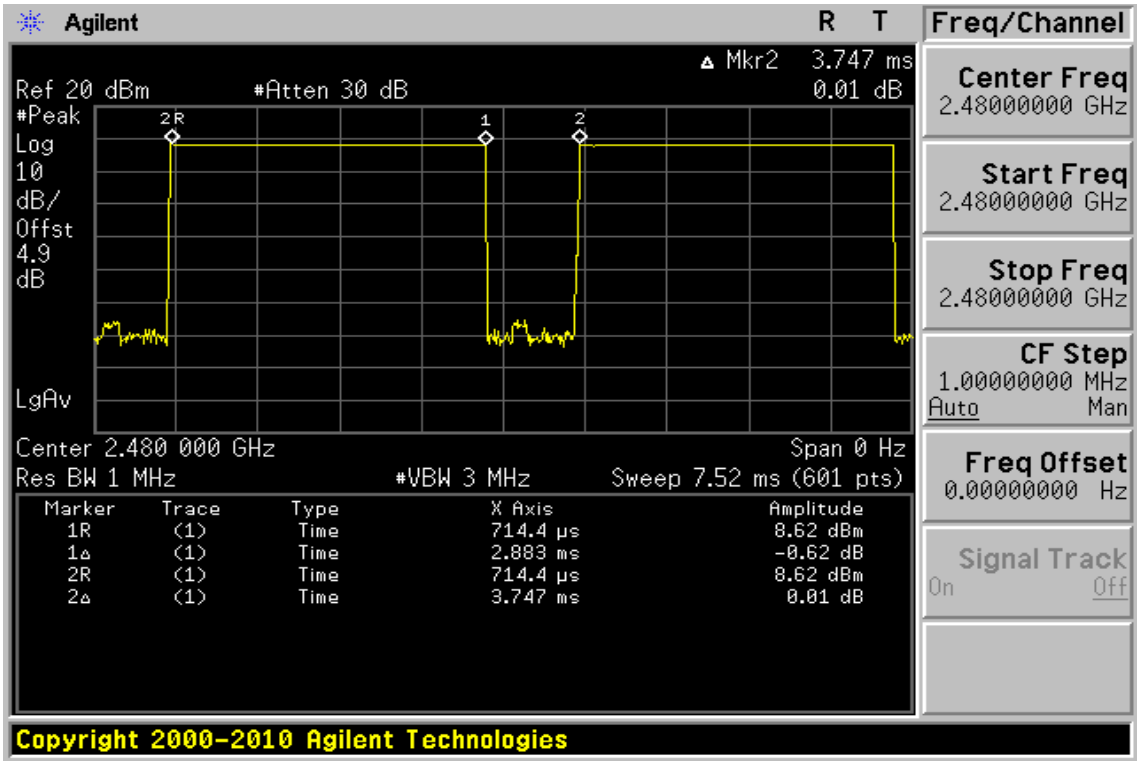
***DH5***

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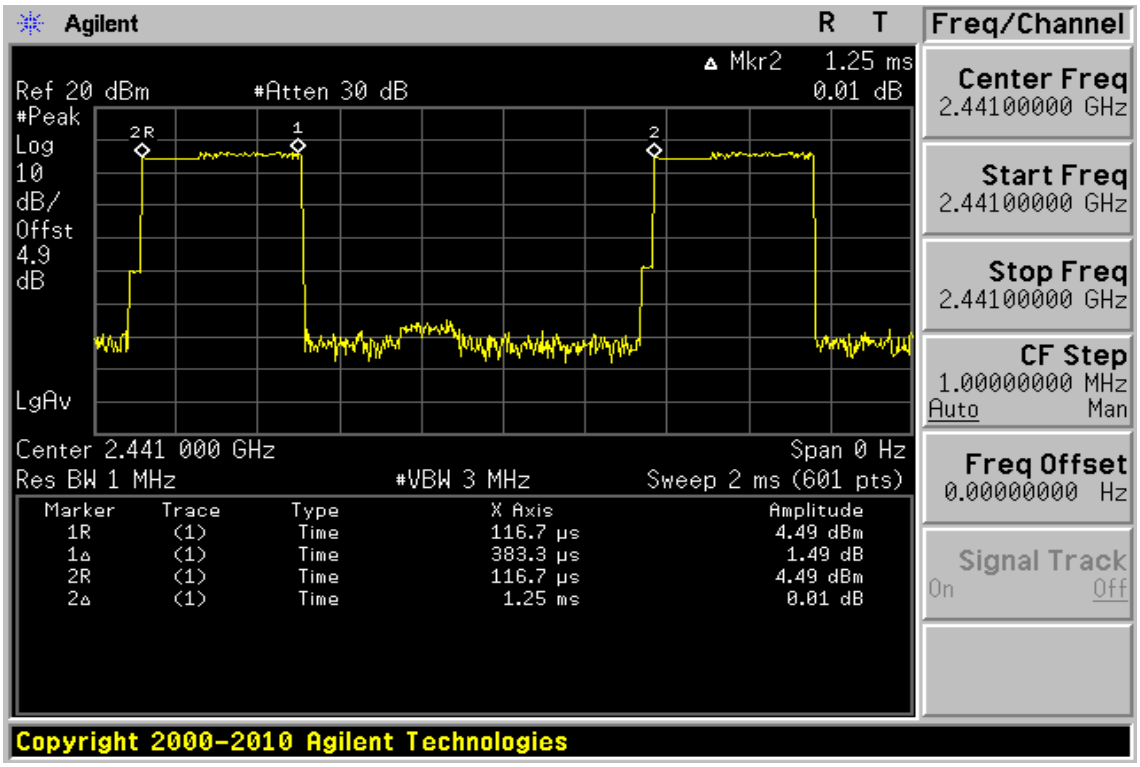
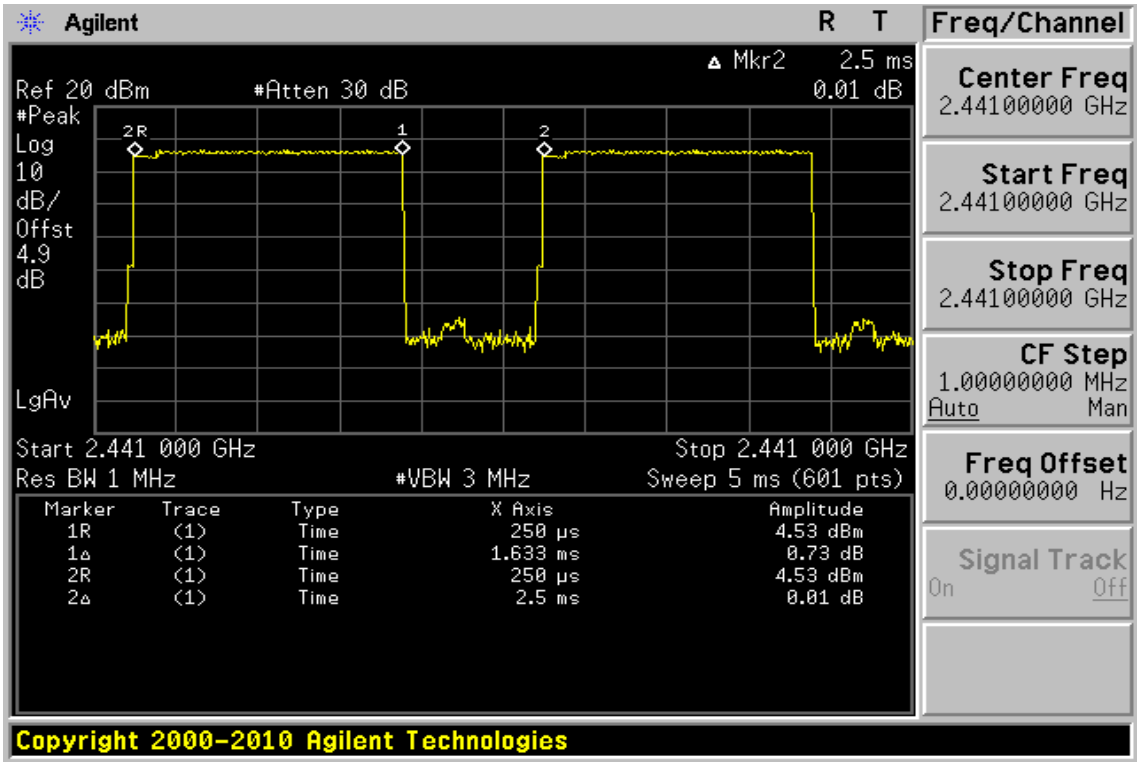
## *CH-Mid*

## *2DH1*




## *2DH3*

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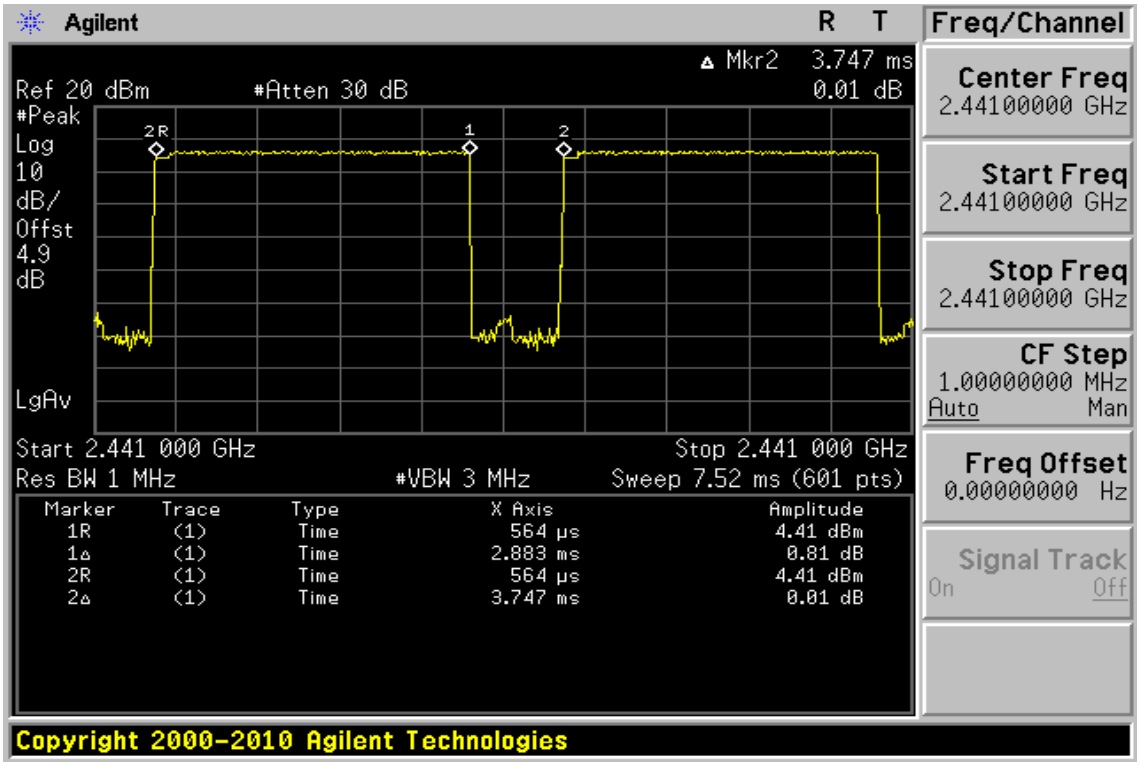
***2DH5***

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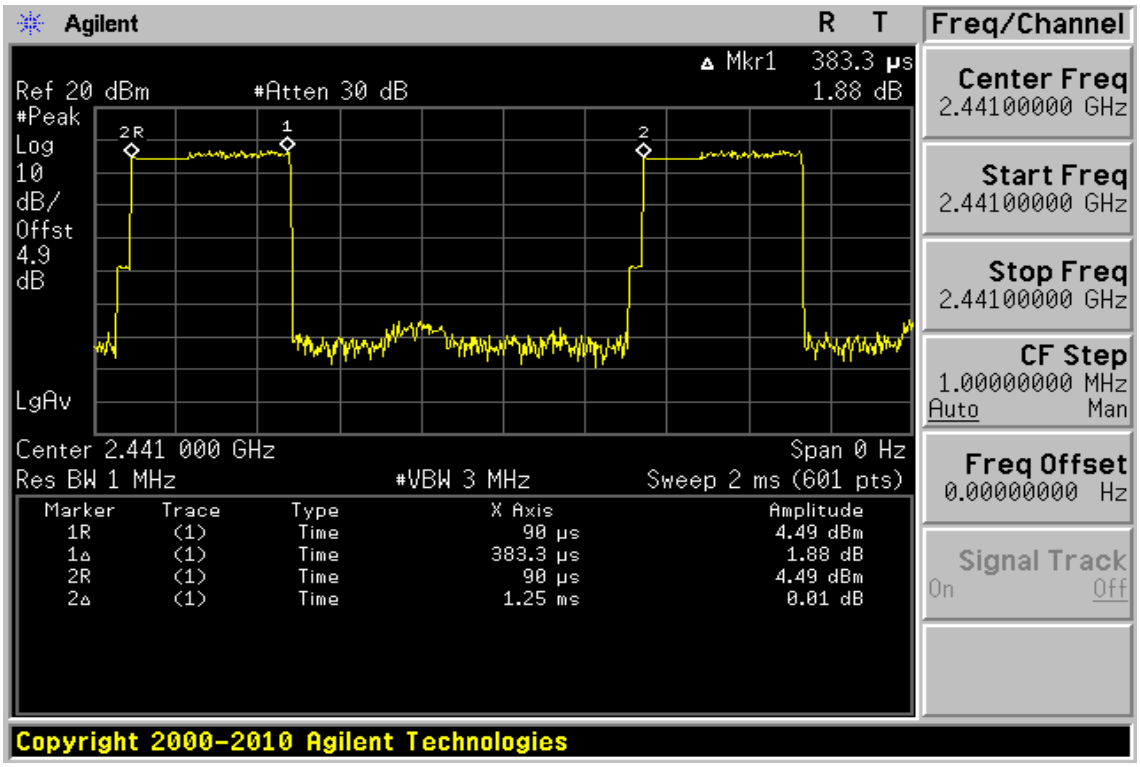
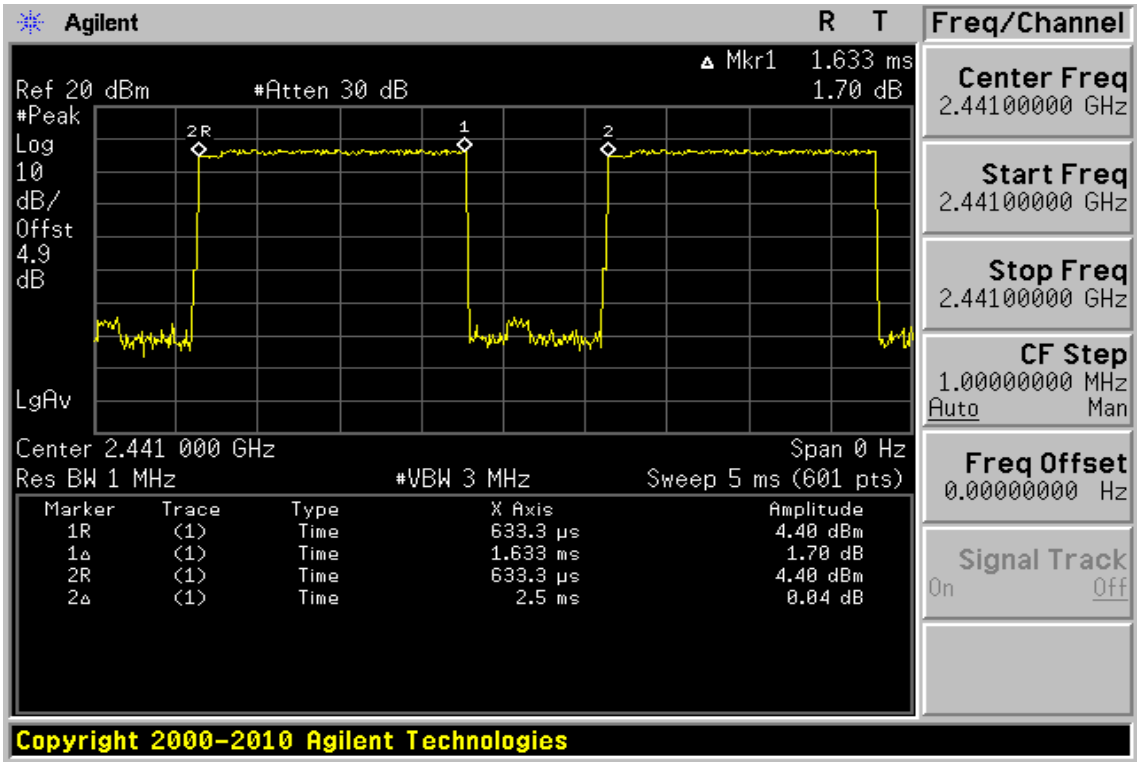
## *CH-Mid*

## *3DH1*




## *3DH3*

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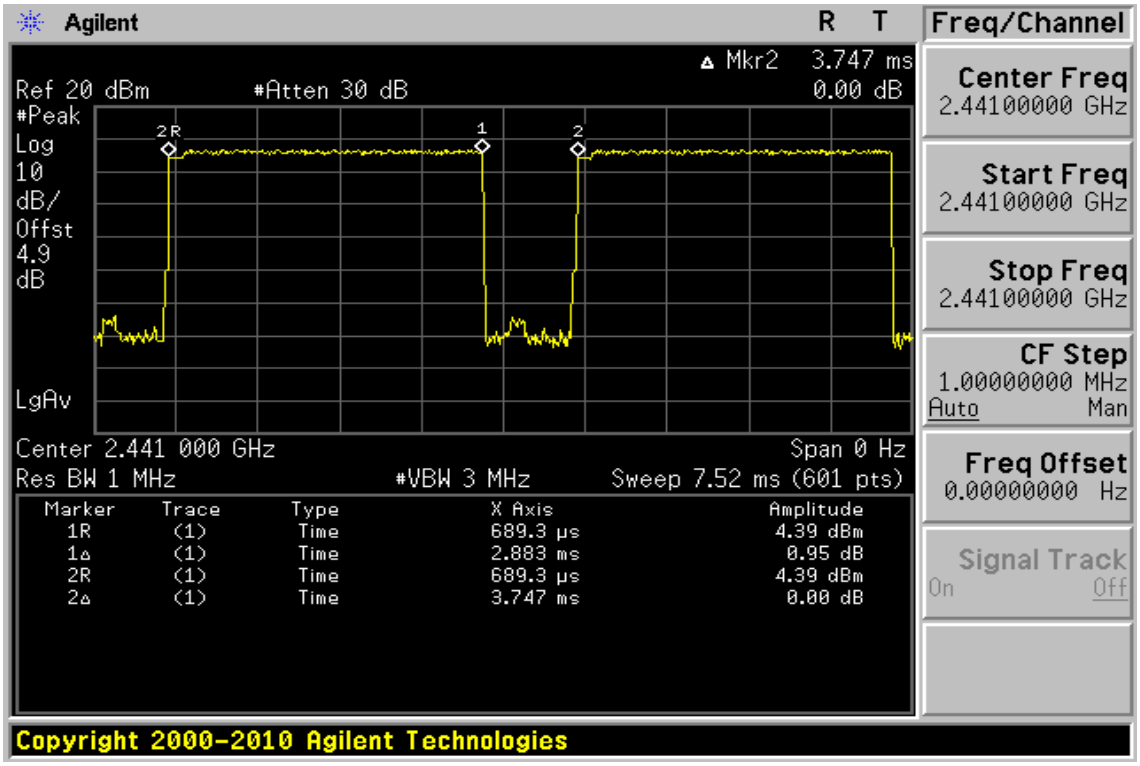
***3DH5***

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# 14. ANTENNA REQUIREMENT

## 14.1. Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

## 14.2. Antenna Connected Construction

The directional gains of antenna used for transmitting is 1.63dBi, and the antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

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