

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

### INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT AND INDUSTRY CANADA RSS 210

OF

**Equipment Under Test:** Touch Pad Controller**Brand Name:** Panasonic**Model No.:** 060-2331**Model Difference:** N/A**FCC ID:** MG3-0602331**IC:** 2575A-0602331**Report No.:** ER/2014/A0023**Issue Date:** Oct. 31, 2014**FCC Rule Part:** §15.247, Cat: DSS**IC Rule Part:** RSS-210 issue 8 :2010, Annex 8**Prepared for:**  
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**VERIFICATION OF COMPLIANCE**

**Applicant:** Universal Electronics Inc.  
201 E. Sandpointe Ave, 8th Floor, Santa Ana CA 92707

**Equipment Under Test:** Touch Pad Controller

**Brand Name:** Panasonic

**Model No.:** 060-2331

**Model Difference:** N/A

**FCC ID:** MG3-0602331

**IC:** 2575A-0602331

**File Number:** ER/2014/A0023

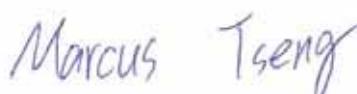
**Date of test:** Oct 03, 2014 ~ Oct. 31, 2014

**Date of EUT Received:** Oct 03, 2014

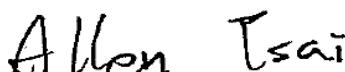
**We hereby certify that:**

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 and RSS-Gen. issue 3 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 and IC RSS 210 issue 8: 2010 Annex 8.

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

**Test By:****Date:**

Oct. 31, 2014

*Marcus Tseng / Engineer***Prepared By:****Date:**

Oct. 31, 2014

*Allen Tsai / Engineer***Approved By:****Date:**

Oct. 31, 2014

*Jim Chang / Supervisor*

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## Version

Version No.	Date	Description
00	Oct. 31, 2014	Initial creation of document

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## 1. GENERAL INFORMATION

### 1.1. Product description

General:

Equipment Under Test:	Touch Pad Controller
Brand Name:	Panasonic
Model No.:	060-2331
Model Difference:	N/A
Hardware Version:	V04
Software Version:	V57.7
Power Supply:	3.0VDC by AAA Battery*2

Bluetooth:

Bluetooth Version	Bluetooth V3.0 +HS
Frequency Range	2402 – 2480MHz
Channel number	79 channels max.
Rated Power	11.01 dBm (Peak)
Modulation type	GFSK + /4DQPSK + 8DPSK
Antenna Designation:	Raised metal Antenna, Gain: -1.5dBi
Type of Emission:	1M24G1D

The EUT is compliance with Bluetooth standard.

This test report applies for Bluetooth function.

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

This submittal(s) (test report) is intended for **FCC ID: MG3-0602331** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules and **IC: 2575A-0602331** filing to comply with Industry Canada RSS-210 issue 8: 2010 Annex 8. The composite system (digital device) is compliant 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 placed on a 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 placed on a 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

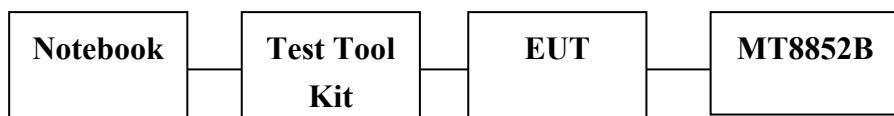
**Fig. 2-1 Radiated Emission Configuration**



**Remote Side**



**Fig. 2-2 Conducted (Antenna Port) Configuration**



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

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2.	Bluetooth Test Set	Anritsu	MT8852B	6k00006107	N/A	N/A
3.	Notebook	Lenovo	L412	LR-957X7	Shielded	Unshielded
4.	Test Tool Kit	N/A	N/A	N/A	N/A	N/A
5.	Bluetooth Test Set	Anritsu	MT8852B	1329002	N/A	N/A

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### 3. SUMMARY OF TEST RESULTS

FCC/IC Rules	Description Of Test	Result
§15.207(a) RSS-Gen §7.2.4	AC Power Line Conducted Emission	Compliant
§15.247(b)(1) RSS-210 issue 8,§A8.4(2)	Peak Output Power	Compliant
§15.247(a)(1) RSS-210 issue ,§A8.1(a) RSS-Gen §4.6.3 RSS-Gen §4.6.1	20dB Bandwidth & 99% Power Bandwidth	Compliant
§15.247(d) RSS-210 issue 8,§A8.5	100 kHz Bandwidth Of Frequency Band Edges	Compliant
\$15.247(d) §15.209(a) (f) RSS-Gen §7.2.5 RSS-210 issue 8,§A8.5	Spurious Emission	Compliant
§15.247(a)(1) RSS-210 issue 8,§A8.1(b)	Frequency Separation	Compliant
§15.247(a)(1)(iii) RSS-210 issue 8,§A8.1(d)	Number of hopping frequency	Compliant
§15.247(a)(1)(iii) RSS-210 issue 8,§A8.1(d)	Time of Occupancy	Compliant
§15.203, RSS- Gen issue §7.1.2	Antenna Requirement	Compliant
§1.1307(b)(1) RSS-102 §2.5.2	RF Exposure	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 (1/4 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 & 99% Power 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 : <b>Vertical</b> )	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB
Measurement uncertainty (Polarization : <b>Horizontal</b> )	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 and RSS-Gen §7.2.4, 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

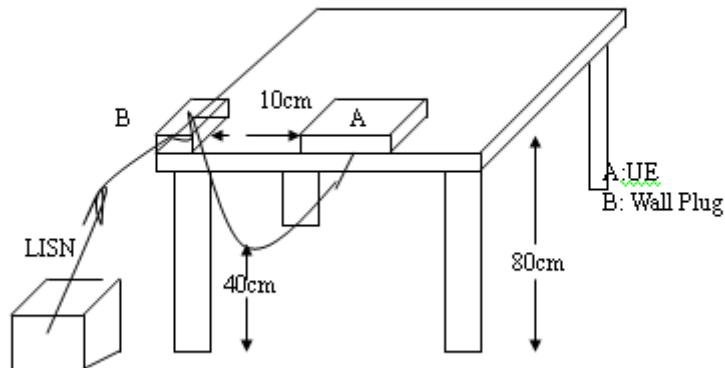
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4:2009.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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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

N/A, EUT powered by DC battery.

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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.

According to RSS-210 issue 8,§A8.4(2), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, the maximum conducted output power shall not exceed 1 W. For all other frequency hopping systems, the maximum peak conducted output power shall not exceed 0.125 W.

### 7.2. Measurement Equipment Used

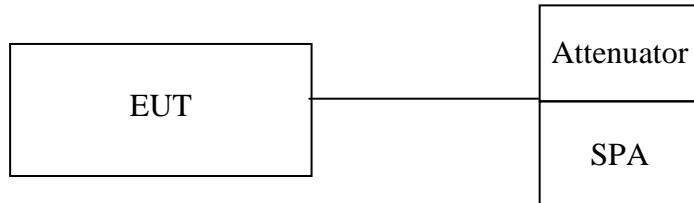
Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2495A	1005007	01/13/2014	01/12/2015
Power Sensor	Anritsu	MA2411B	917032	01/13/2014	01/12/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	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

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### 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.

***NOTE: cable loss as 4dB that offsets in the spectrum.***

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## 7.5. Measurement Result

### BR mode (GFSK):

Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)
2402.00	10.94	0.01242	1
2441.00	<b>11.01</b>	0.01262	1
2480.00	10.09	0.01021	1

### EDR mode ( $\pi/4$ DQPSK):

Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)
2402.00	10.17	0.01040	0.125
2441.00	10.09	0.01021	0.125
2480.00	8.82	0.00762	0.125

### EDR mode (8DPSK):

Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)
2402.00	10.60	0.01148	0.125
2441.00	10.55	0.01135	0.125
2480.00	9.25	0.00841	0.125

\*Note: offset 4dB.

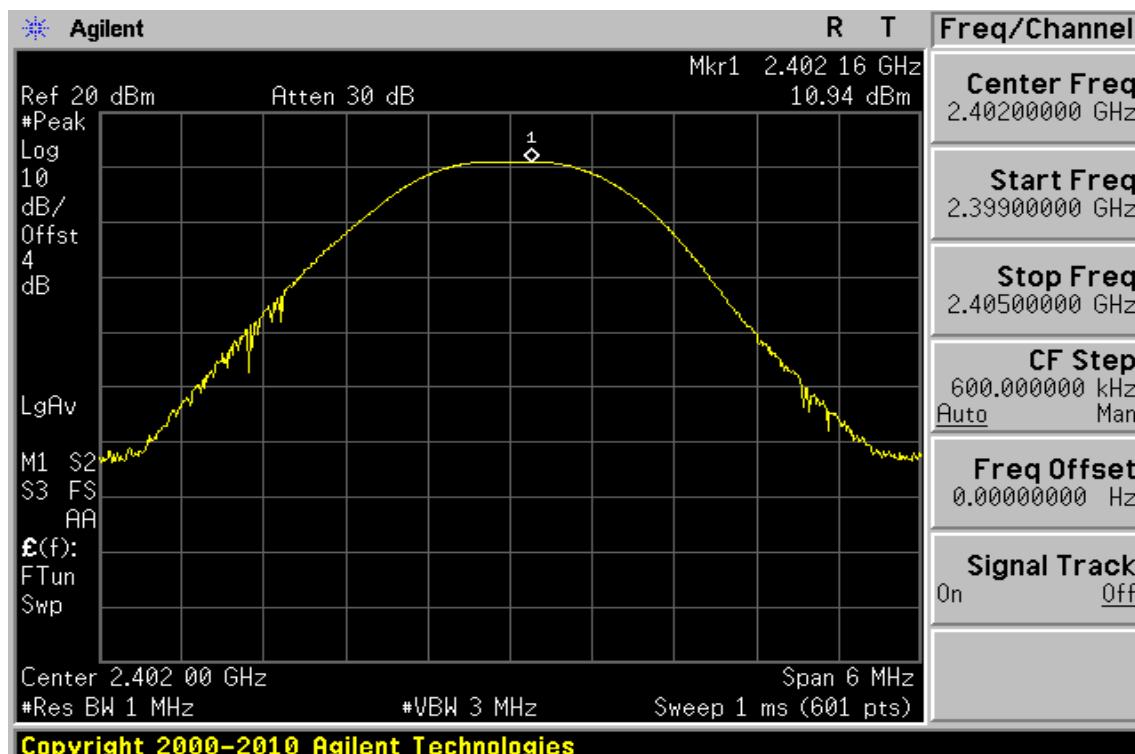
\*Note: Refer to next page for plots.

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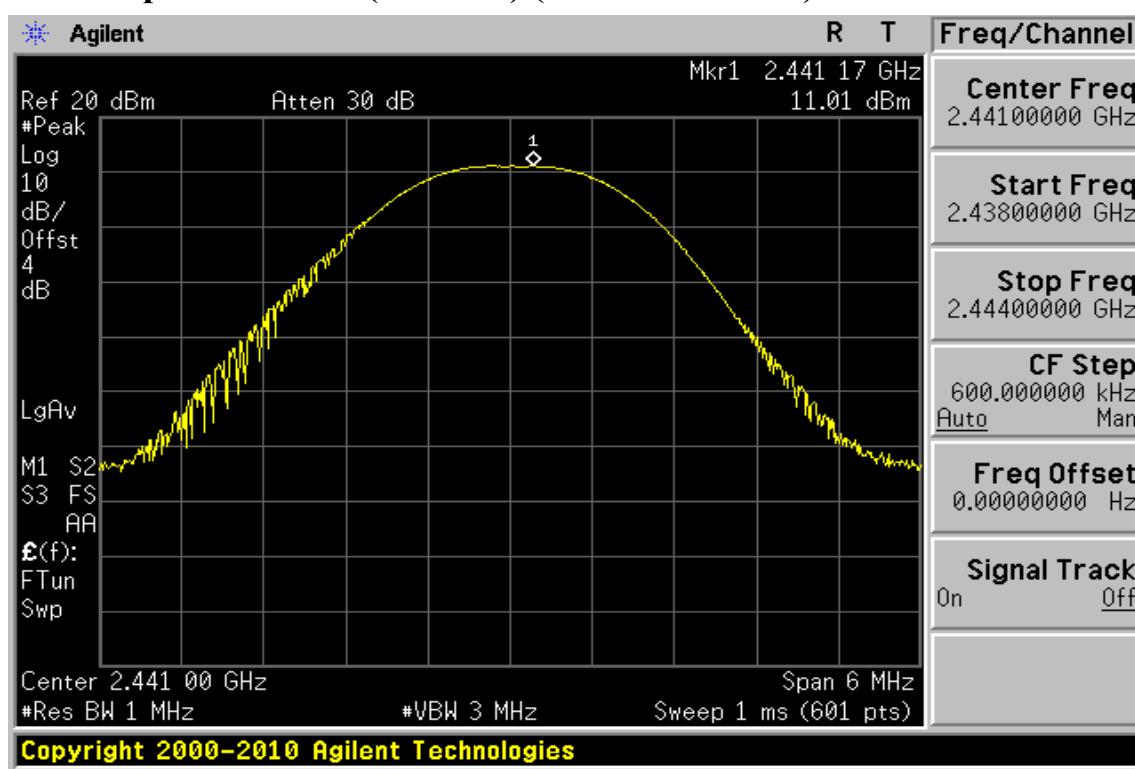
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## Peak Power Output Data Plot (CH Low) (BR mode GFSK)



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

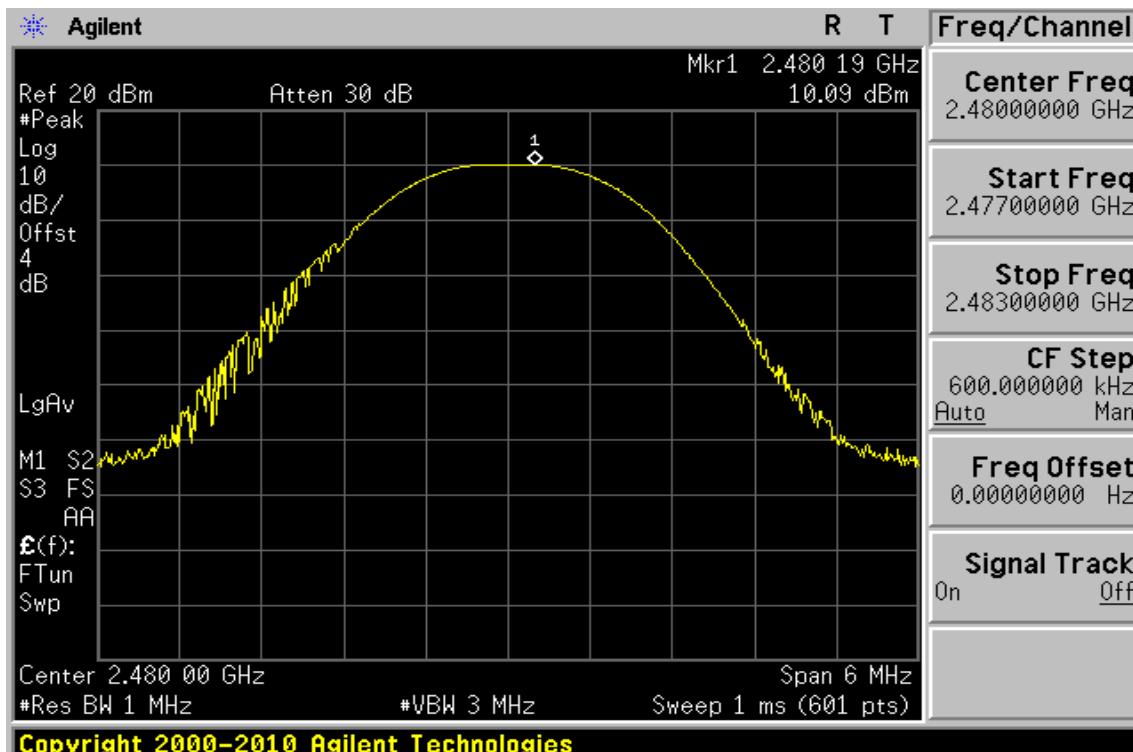
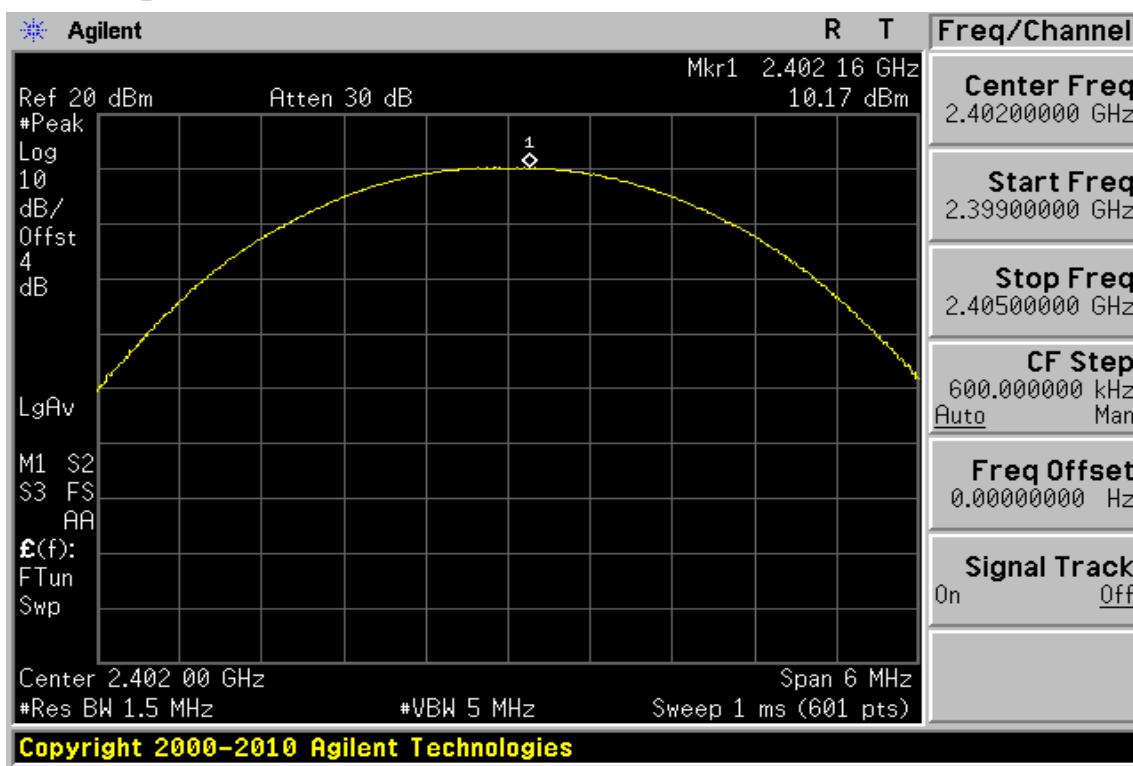


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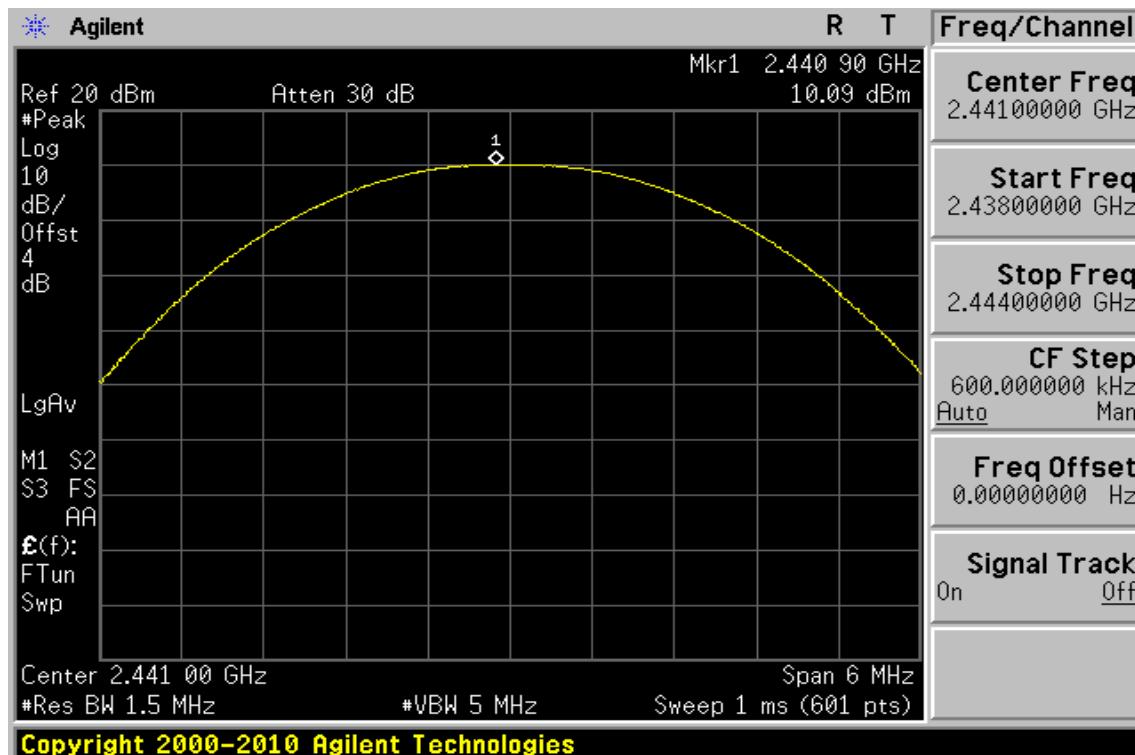
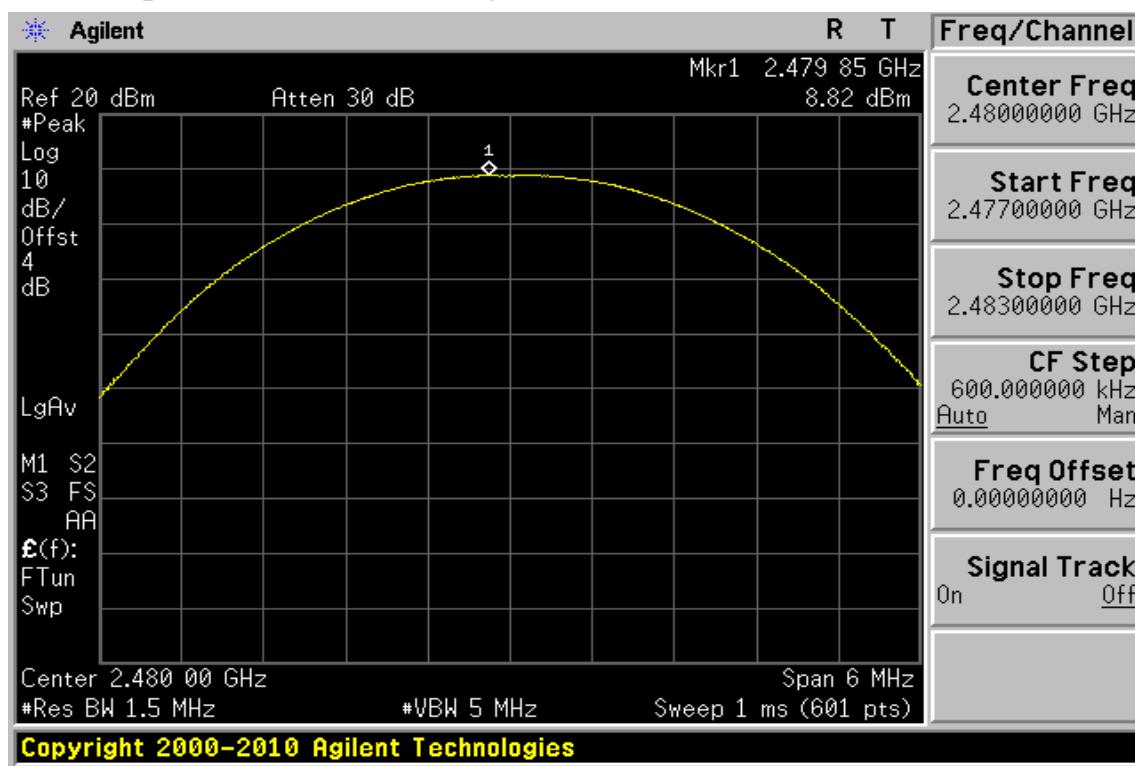
## Peak Power Output Data Plot (CH High) (BR mode GFSK)


 Peak Power Output Data Plot (CH Low) (EDR mode  $\pi/4$ DQPSK)


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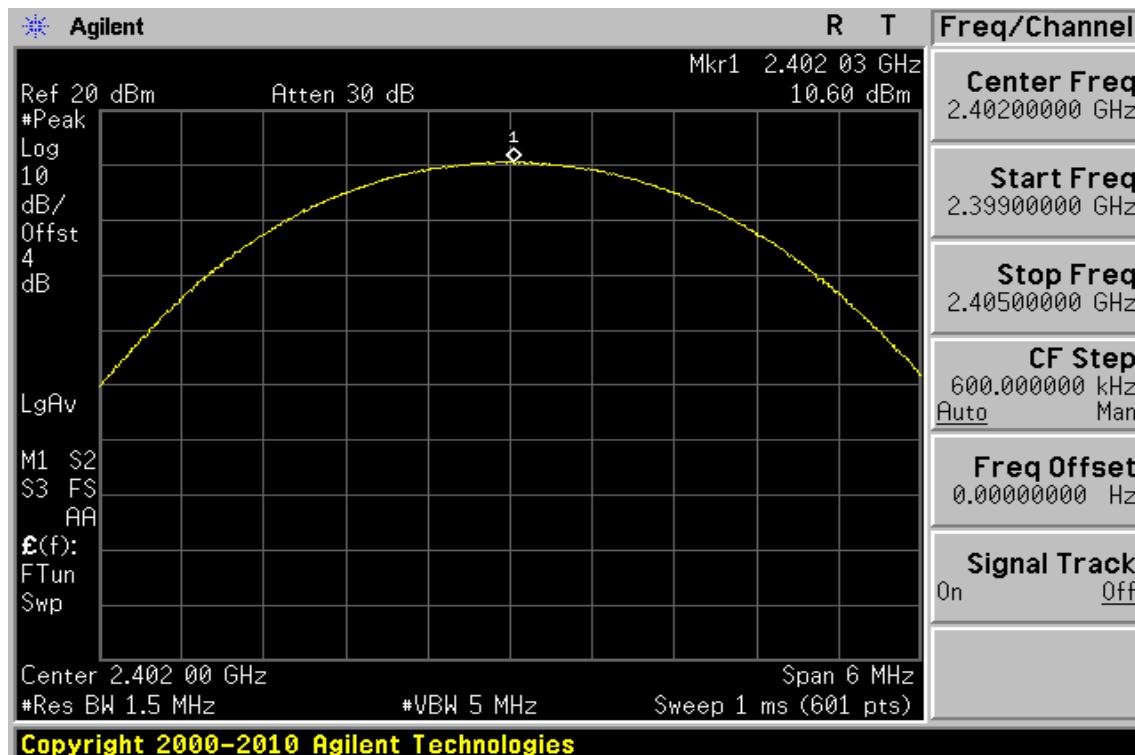
Peak Power Output Data Plot (CH Mid) (EDR mode  $\pi/4$ DQPSK)

 Peak Power Output Data Plot (CH High) (EDR mode  $\pi/4$ DQPSK)


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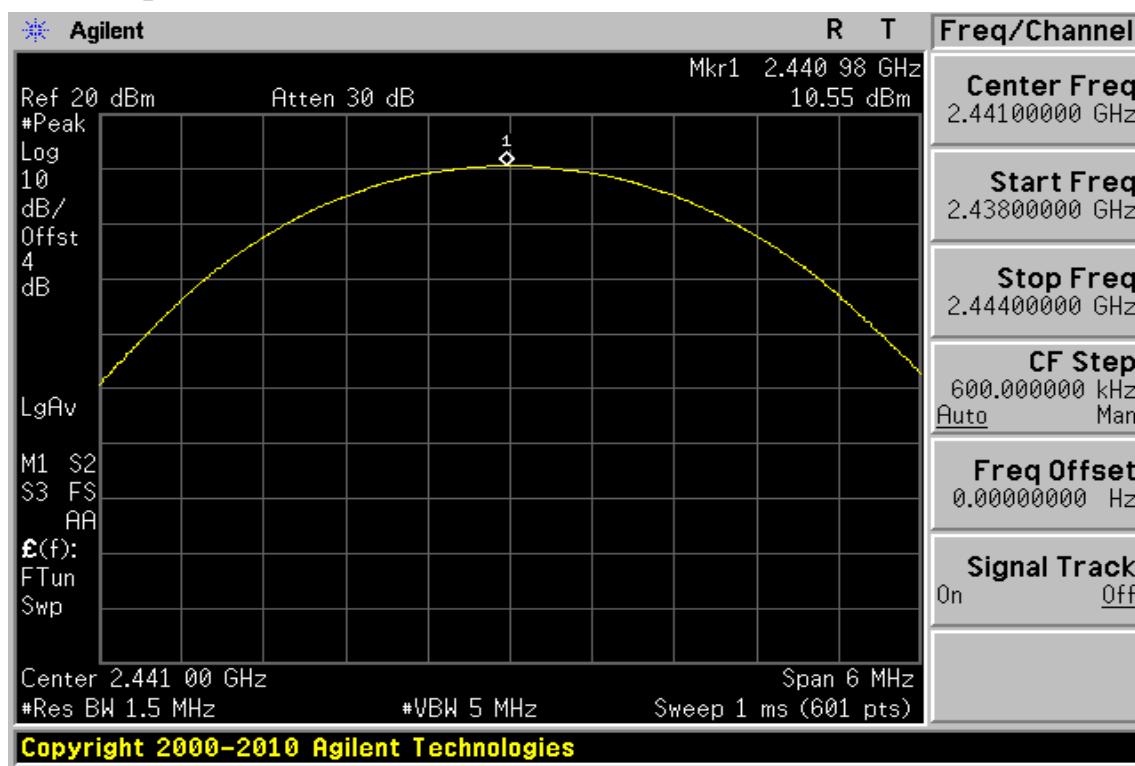
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## Peak Power Output Data Plot (CH Low) (EDR mode 8DPSK)



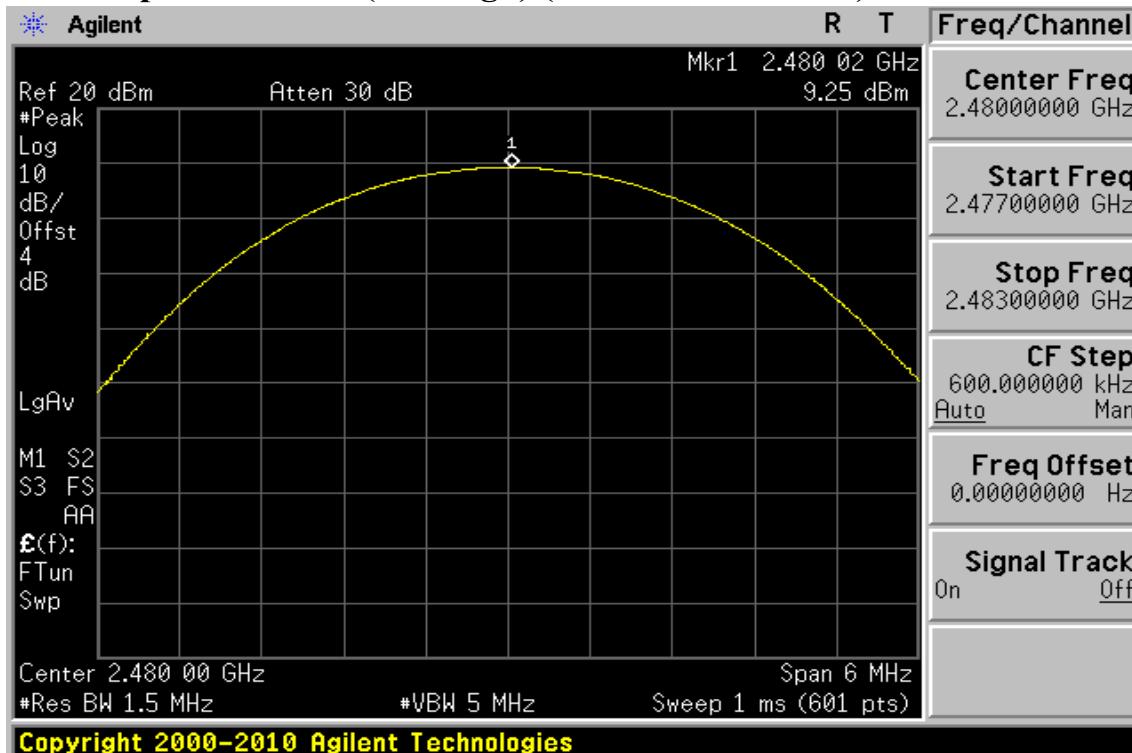
## Peak Power Output Data Plot (CH Mid) (EDR mode 8DPSK)



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

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## 8. 20dB BANDWIDTH & 99% BANDWIDTH

### 8.1. Standard Applicable

For 20dB Bandwidth

According to §15.247(a)(1) and RSS210 A8.1(b), for frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

For 99% Bandwidth

RSS-Gen §4.6.1, the transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

### 8.2. Measurement Equipment Used

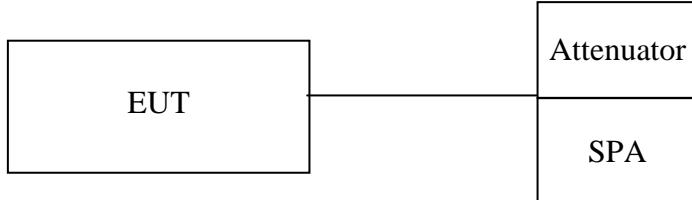
Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2495A	1005007	01/13/2014	01/12/2015
Power Sensor	Anritsu	MA2411B	917032	01/13/2014	01/12/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	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

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### 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

***NOTE: cable loss as 4dB 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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**8.5. Measurement Result:****20dB Bandwidth: BR mode (GFSK)**

CH	Bandwidth (kHz)
Lower	925.463
Mid	926.393
Higher	925.551

**20dB Bandwidth: EDR mode ( $\pi/4$ DQPSK)**

CH	Bandwidth (MHz)	2/3 Bandwidth (MHz)
Lower	1.344	0.896
Mid	1.349	0.899
Higher	1.342	0.895

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

CH	Bandwidth (MHz)	2/3 Bandwidth (MHz)
Lower	1.340	0.893
Mid	1.334	0.889
Higher	1.343	0.895

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**99% Bandwidth: BR mode (GFSK):**

CH	Bandwidth (kHz)
Lower	842.5421
Mid	839.5691
Higher	869.5912

**99% Bandwidth: EDR mode (1/4DQPSK)**

CH	Bandwidth (MHz)
Lower	1.2286
Mid	1.2352
Higher	1.2316

**99% Bandwidth: EDR mode (8DPSK)**

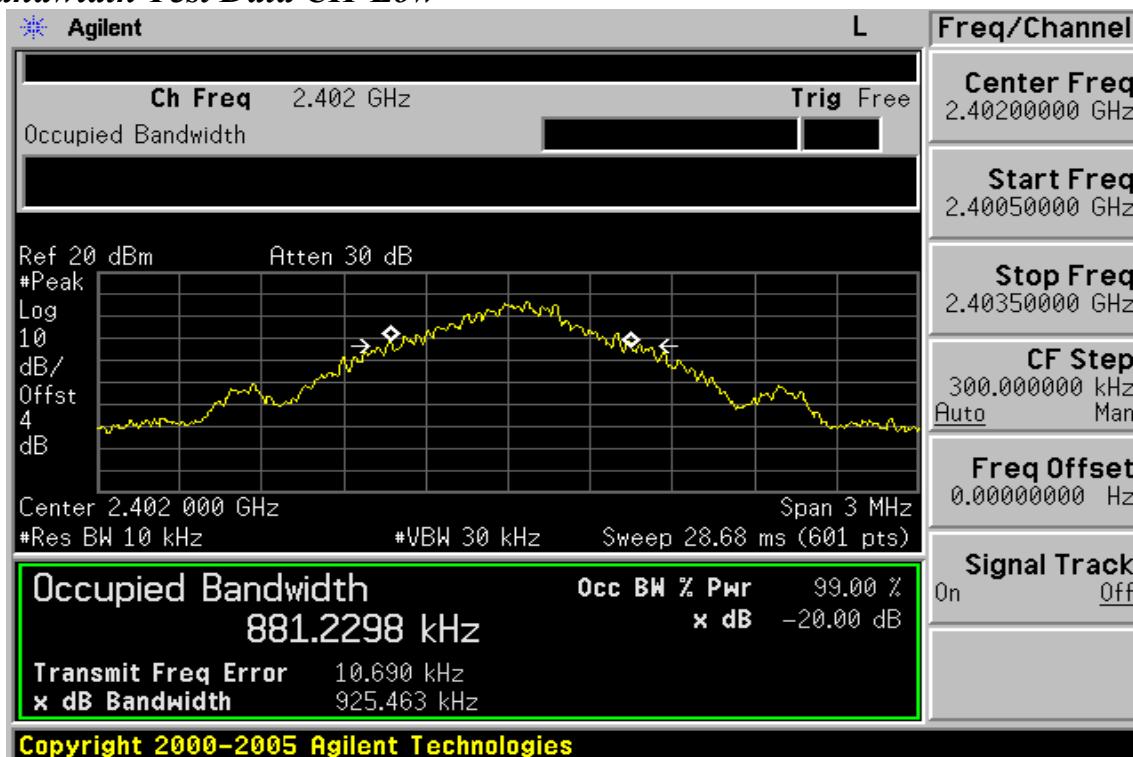
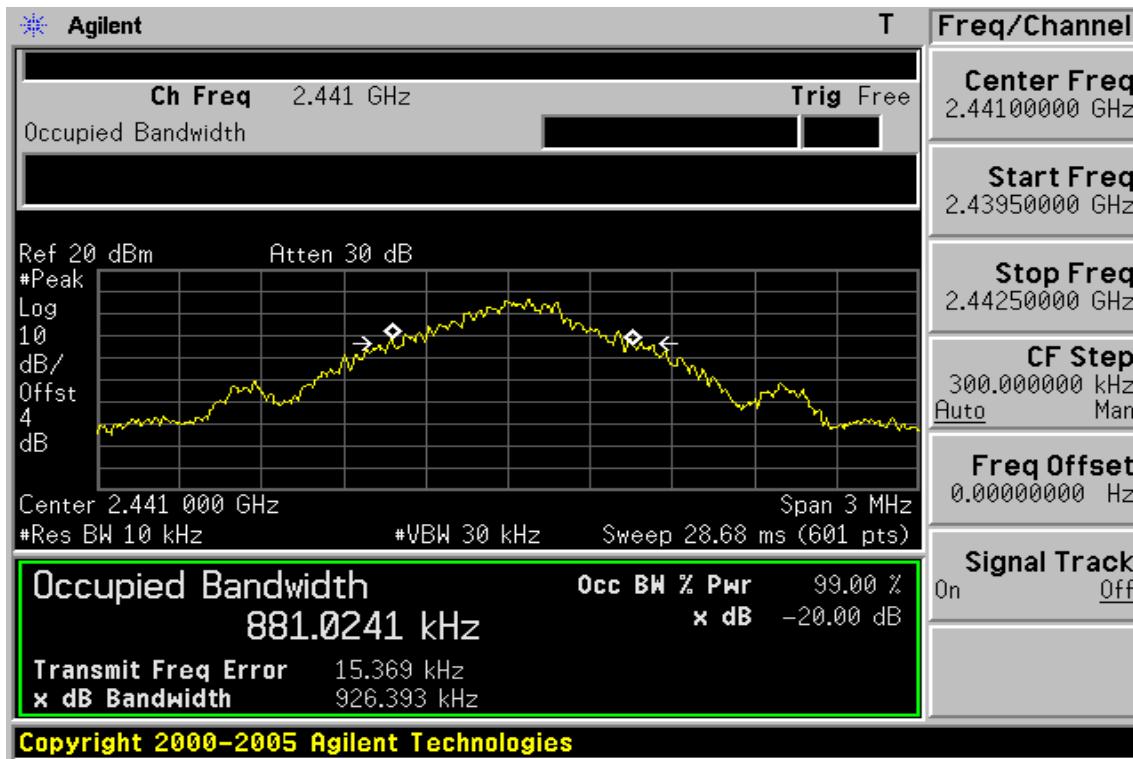
CH	Bandwidth (MHz)
Lower	1.2065
Mid	1.2168
Higher	1.2297

*Note: Refer to next page for plots.*

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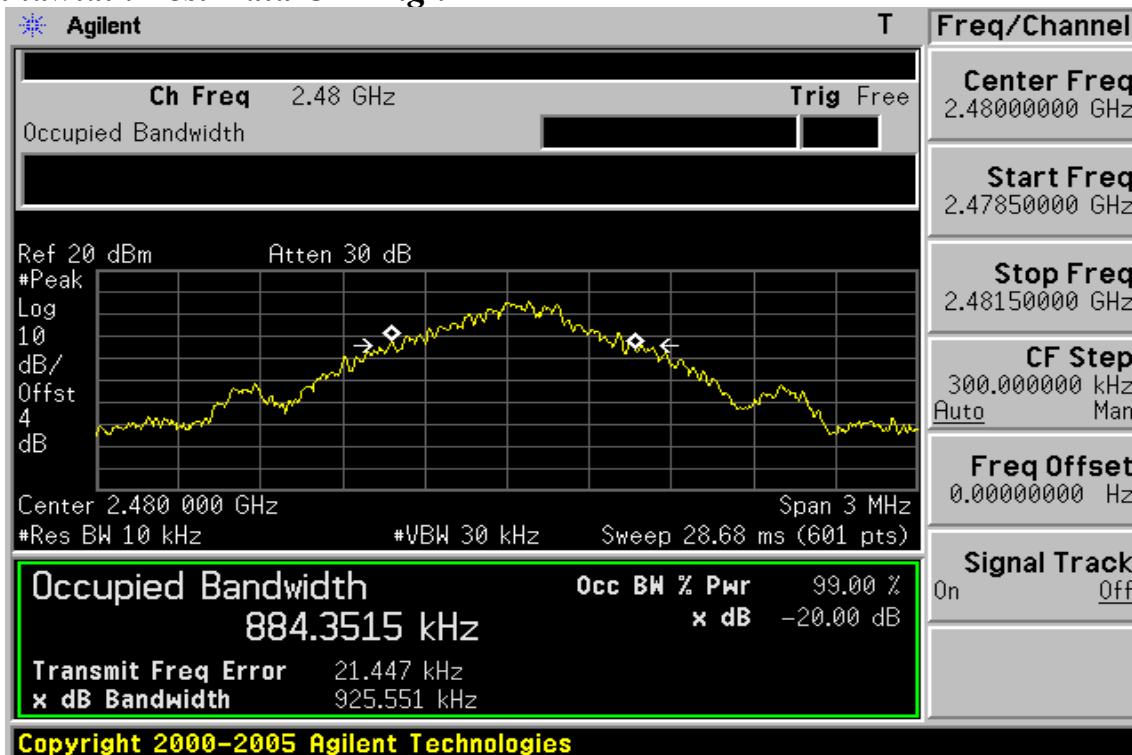
**BR Mode (GFSK)****20dB Bandwidth Test Data CH-Low****20dB Bandwidth Test Data CH-Mid**

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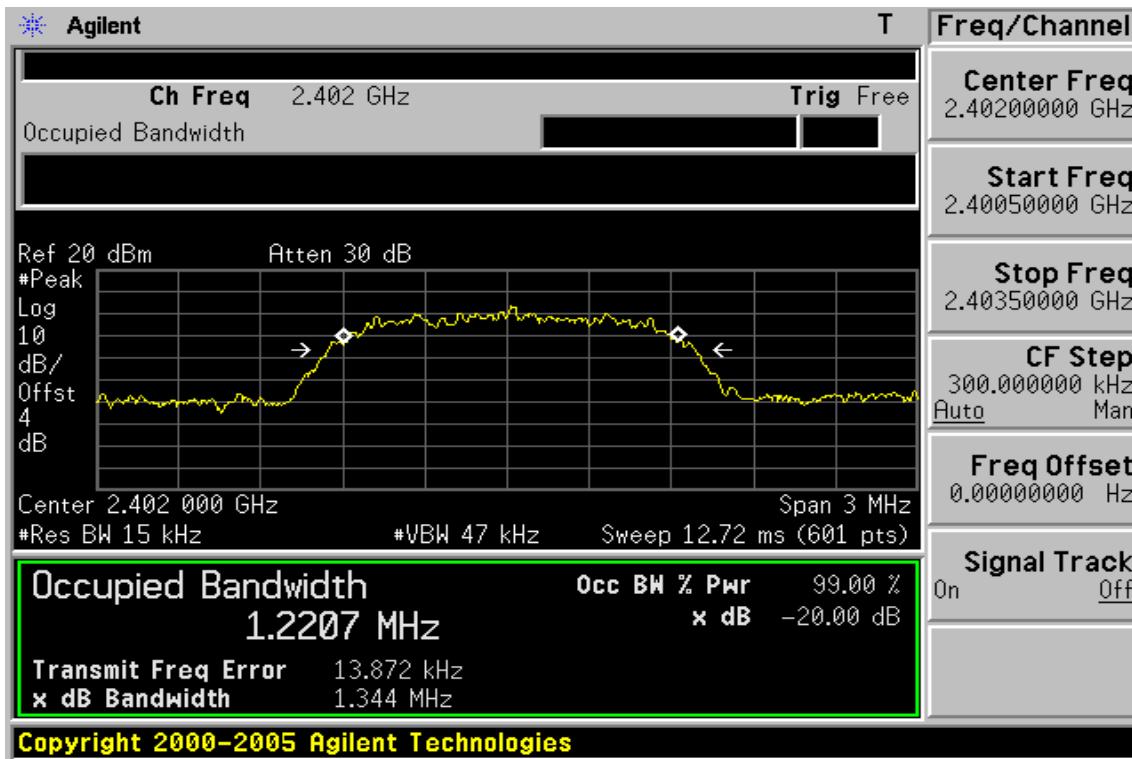
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## 20dB Bandwidth Test Data CH-High

EDR Mode ( $\pi/4$ DQPSK)

## 20dB Bandwidth Test Data CH-Low

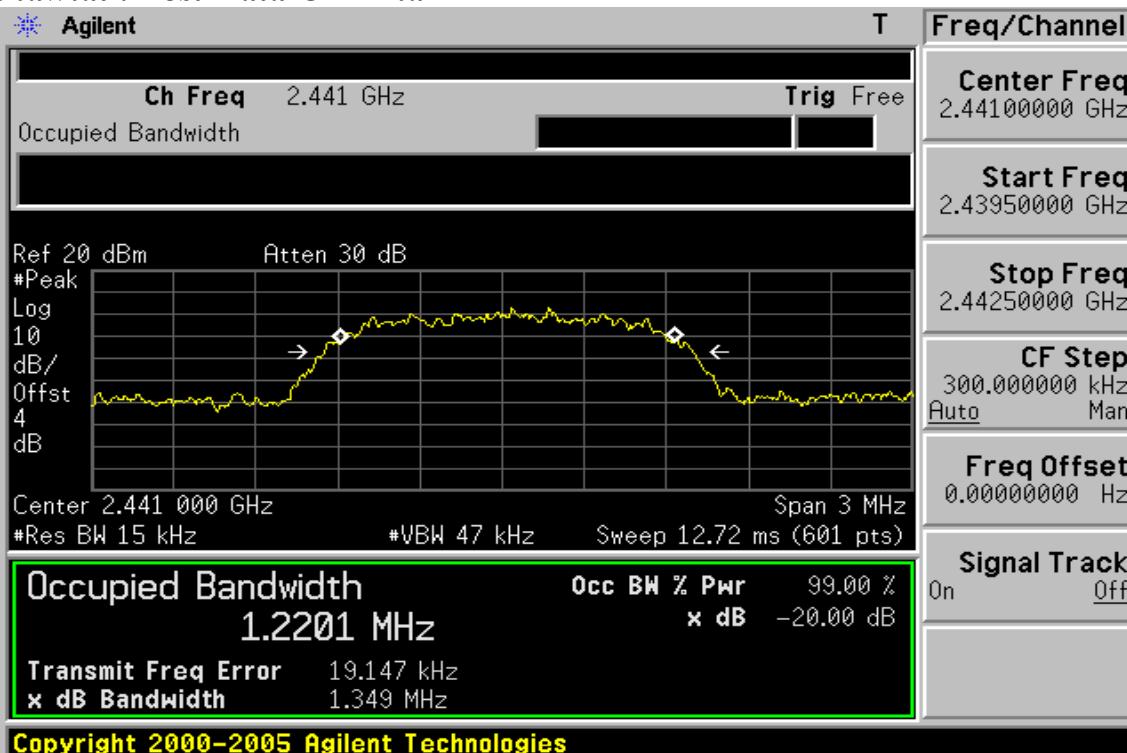


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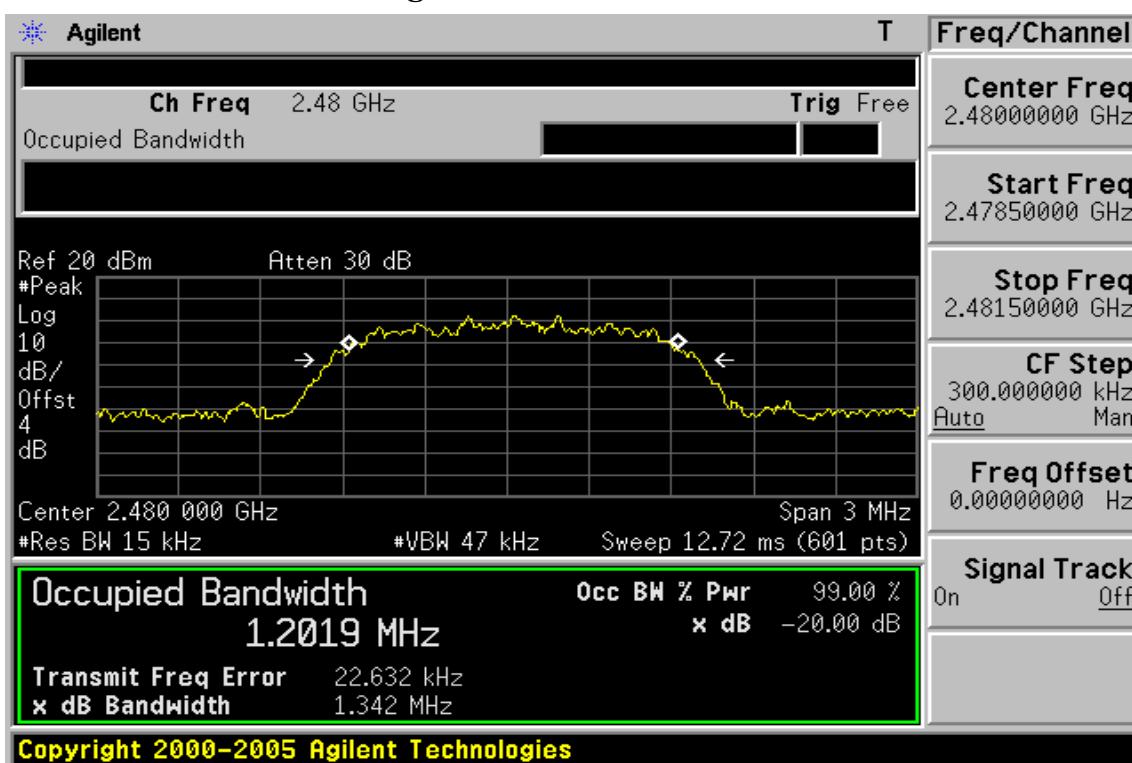
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## 20dB Bandwidth Test Data CH-Mid



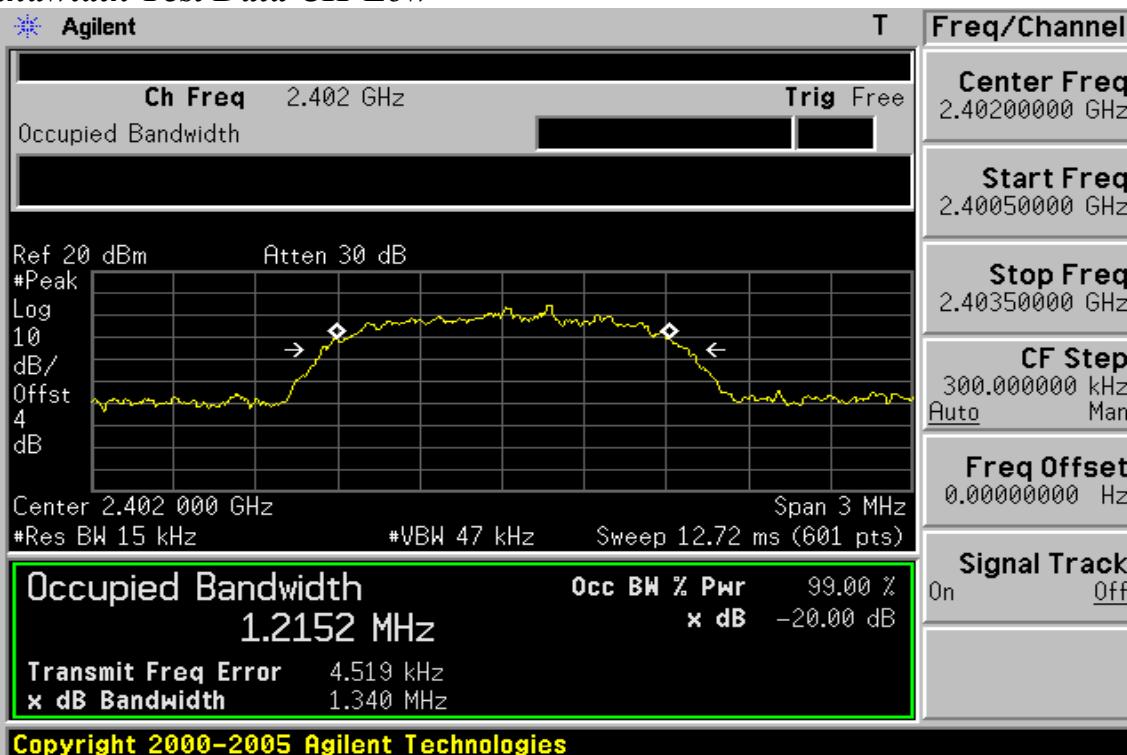
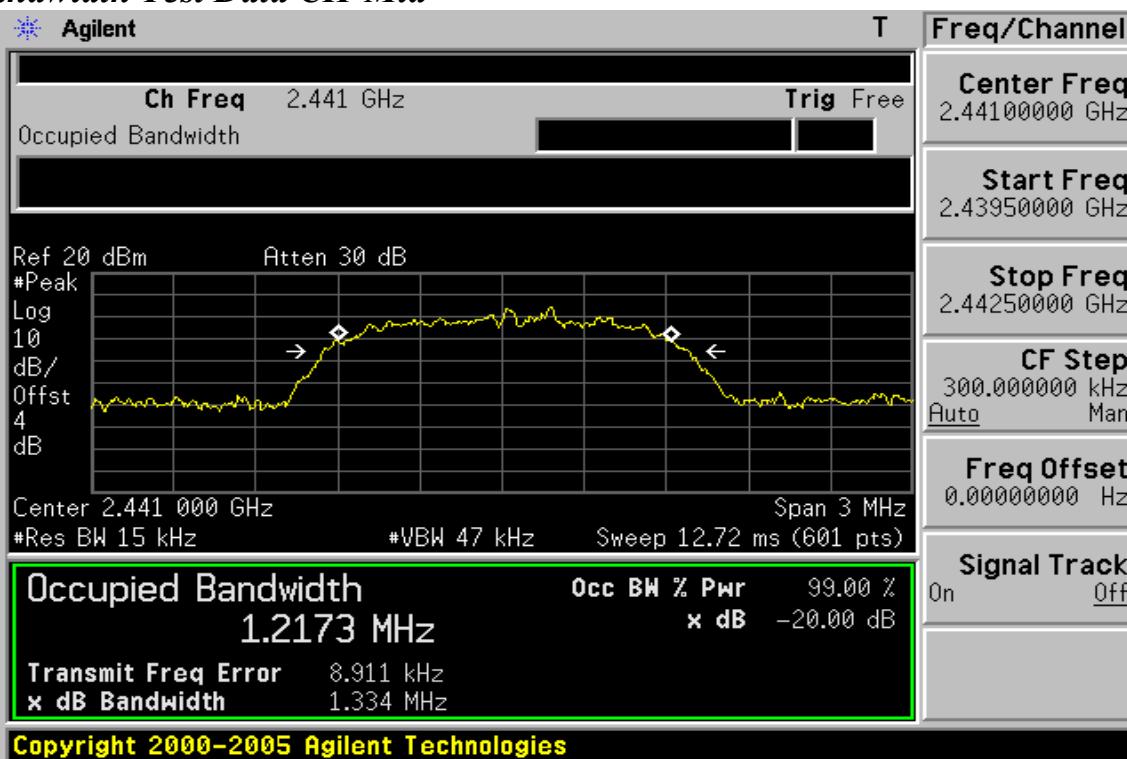
## 20dB Bandwidth Test Data CH-High



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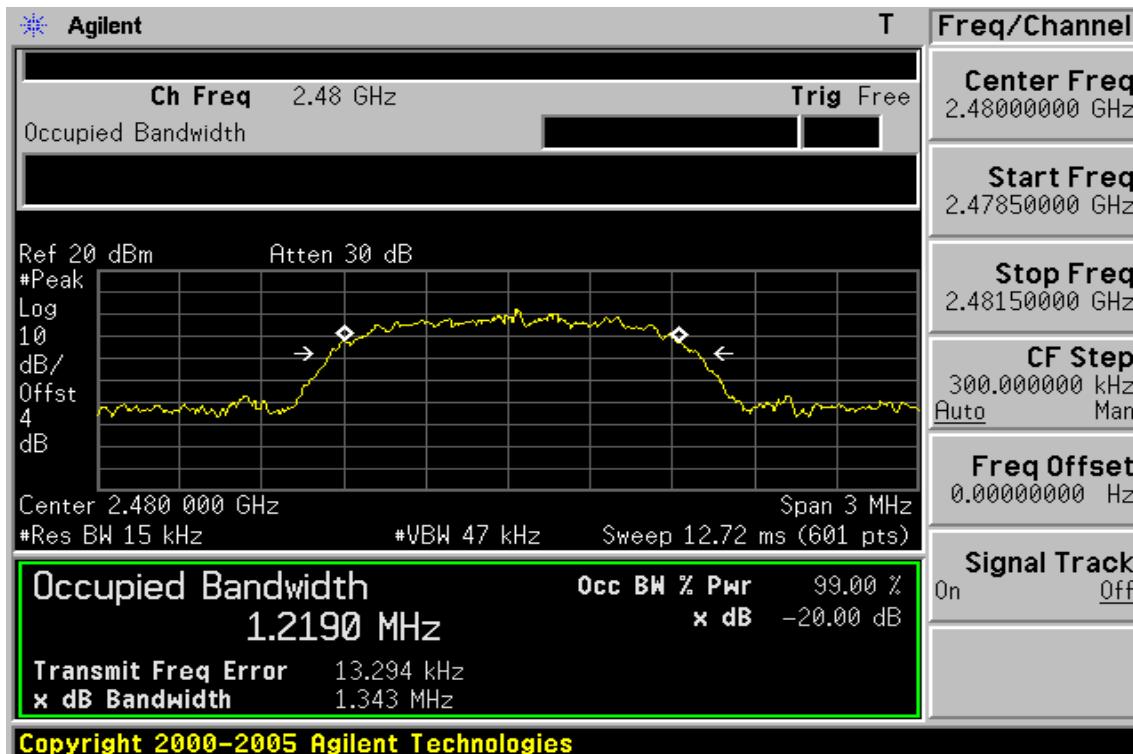
**EDR Mode (8DPSK)****20dB Bandwidth Test Data CH-Low****20dB Bandwidth Test Data CH-Mid**

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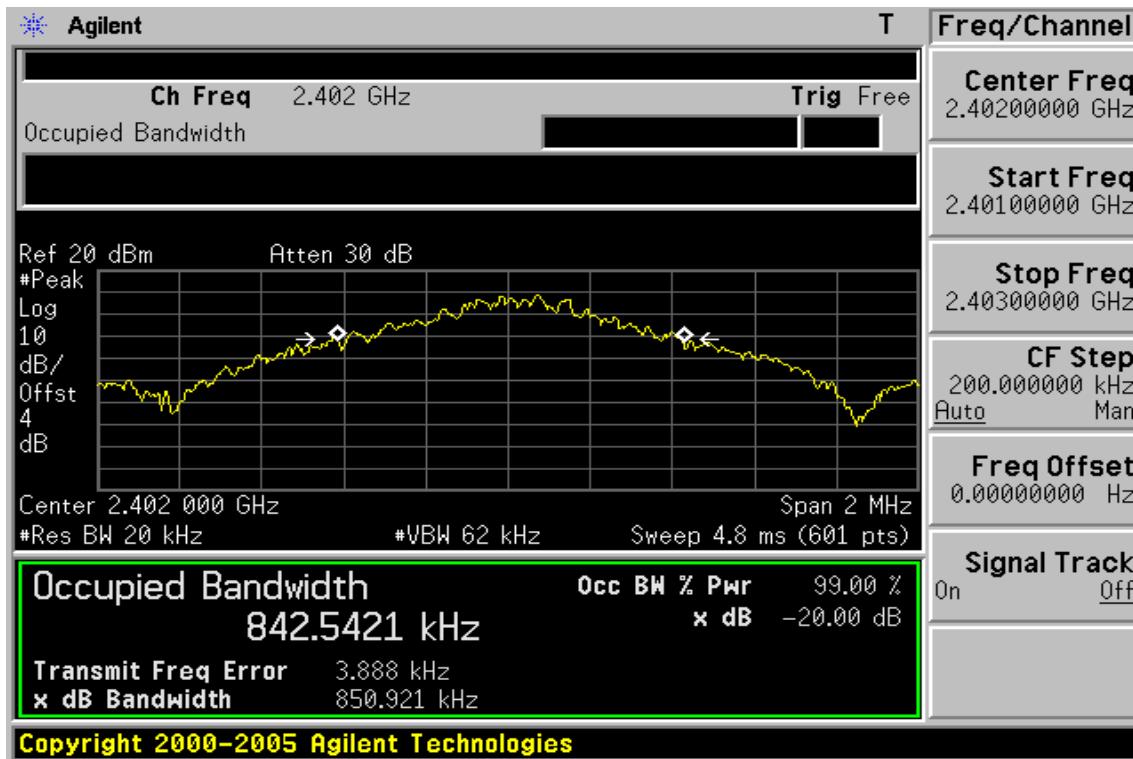
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## 20dB Bandwidth Test Data CH-High



## BR Mode (GFSK)

## 99% Band Width Test Data CH-Low

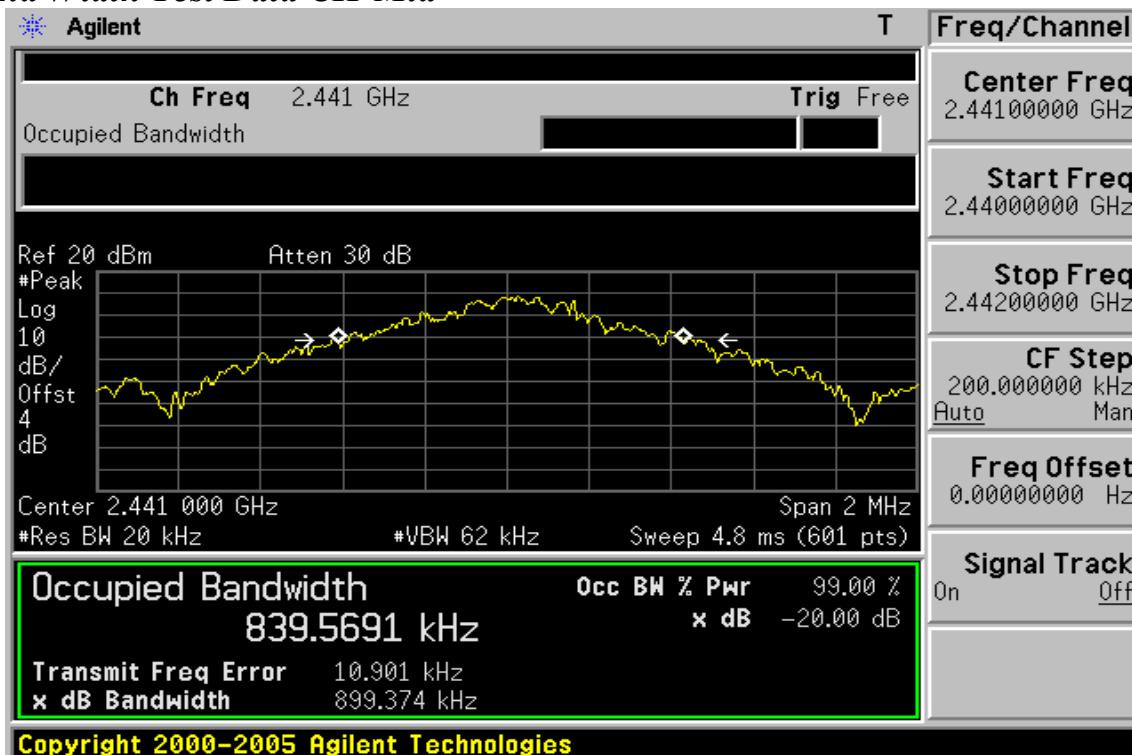


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## 99% Band Width Test Data CH-Mid



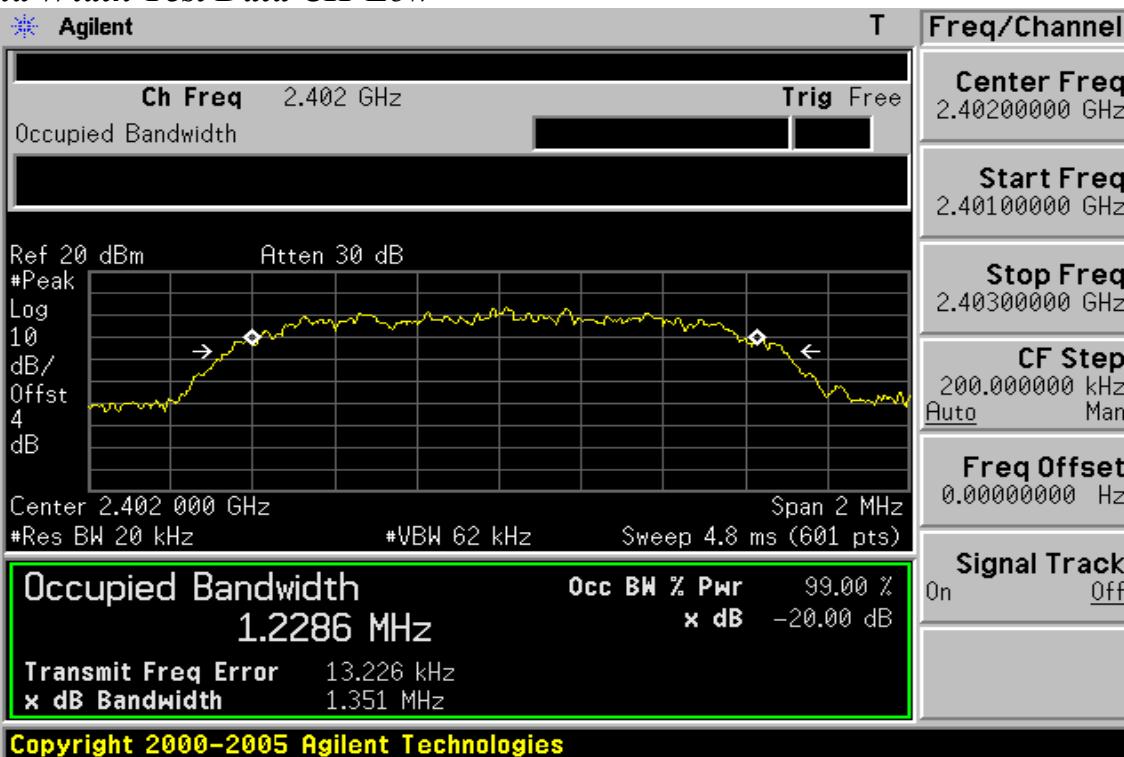
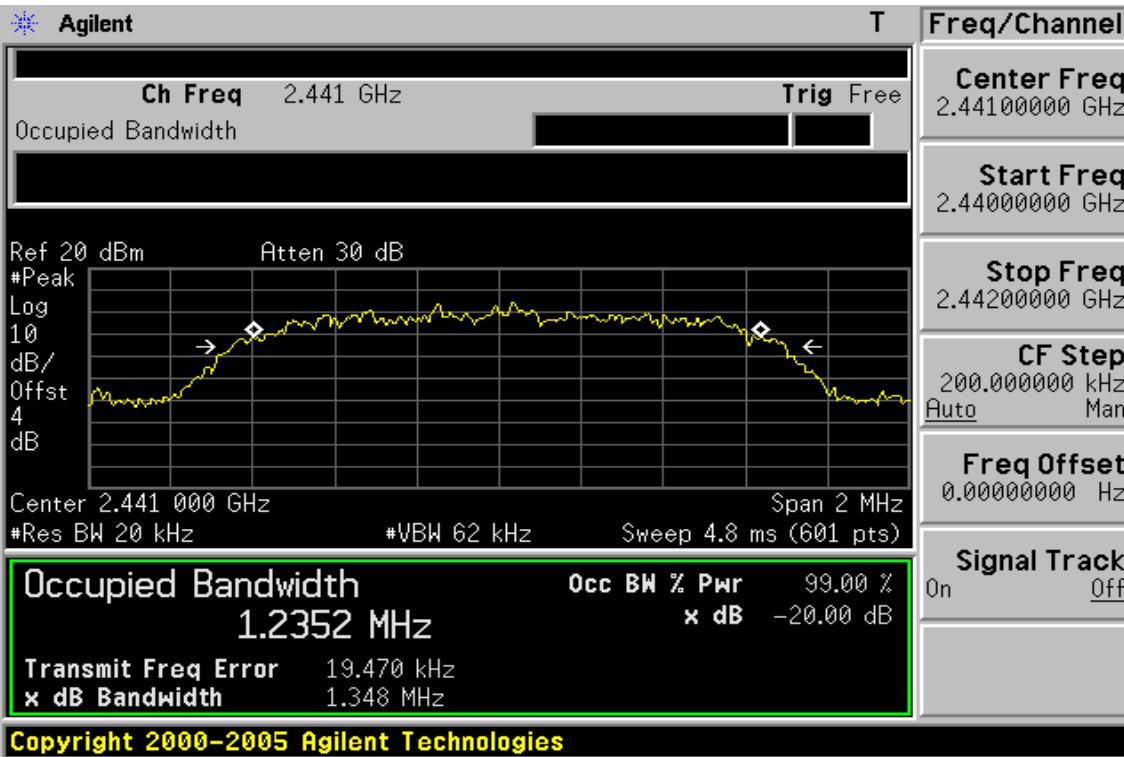
## 99% Band Width Test Data CH-High



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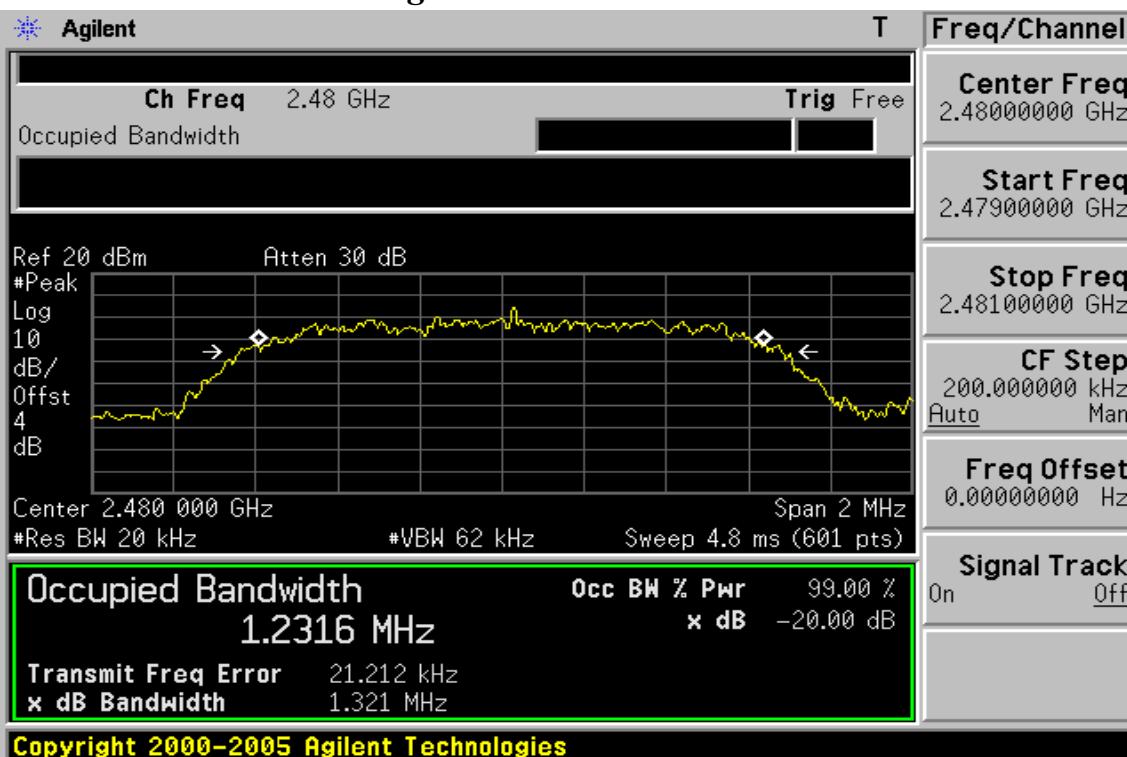
**EDR Mode ( $\pi/4$ DQPSK)**  
**99% Band Width Test Data CH-Low****99% Band Width Test Data CH-Mid**

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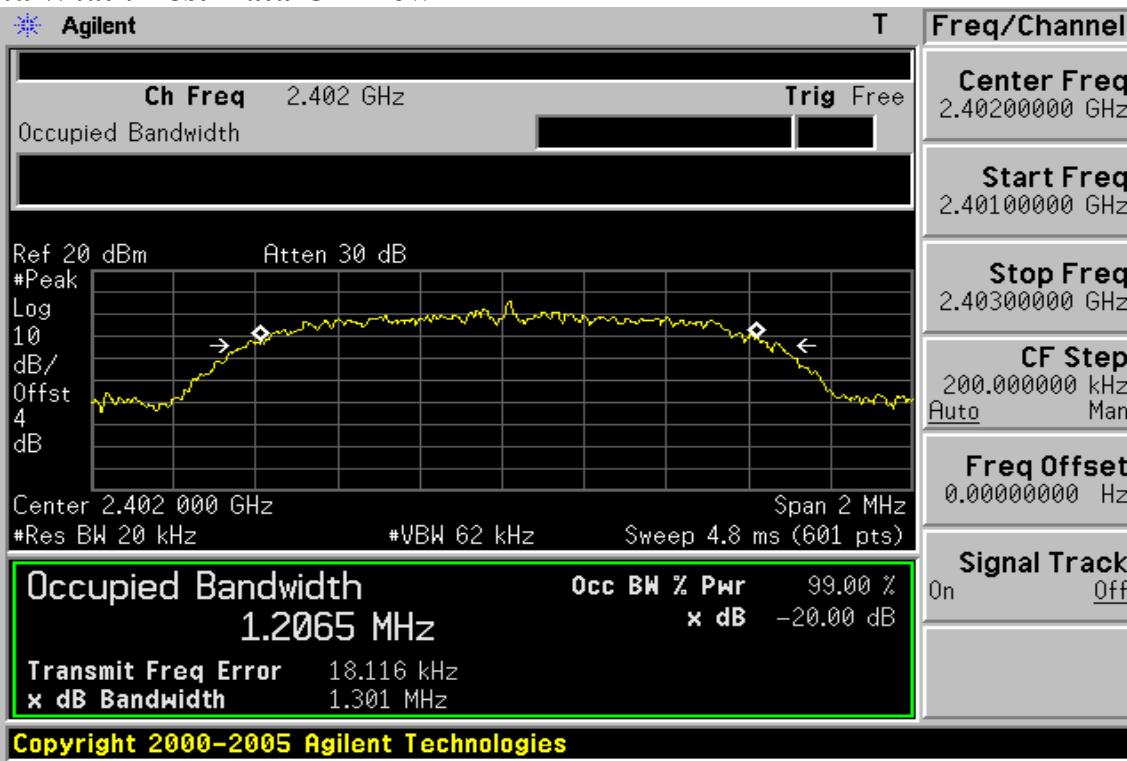
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## 99% Band Width Test Data CH-High



## EDR Mode (8DPSK)

## 99% Band Width Test Data CH-Low

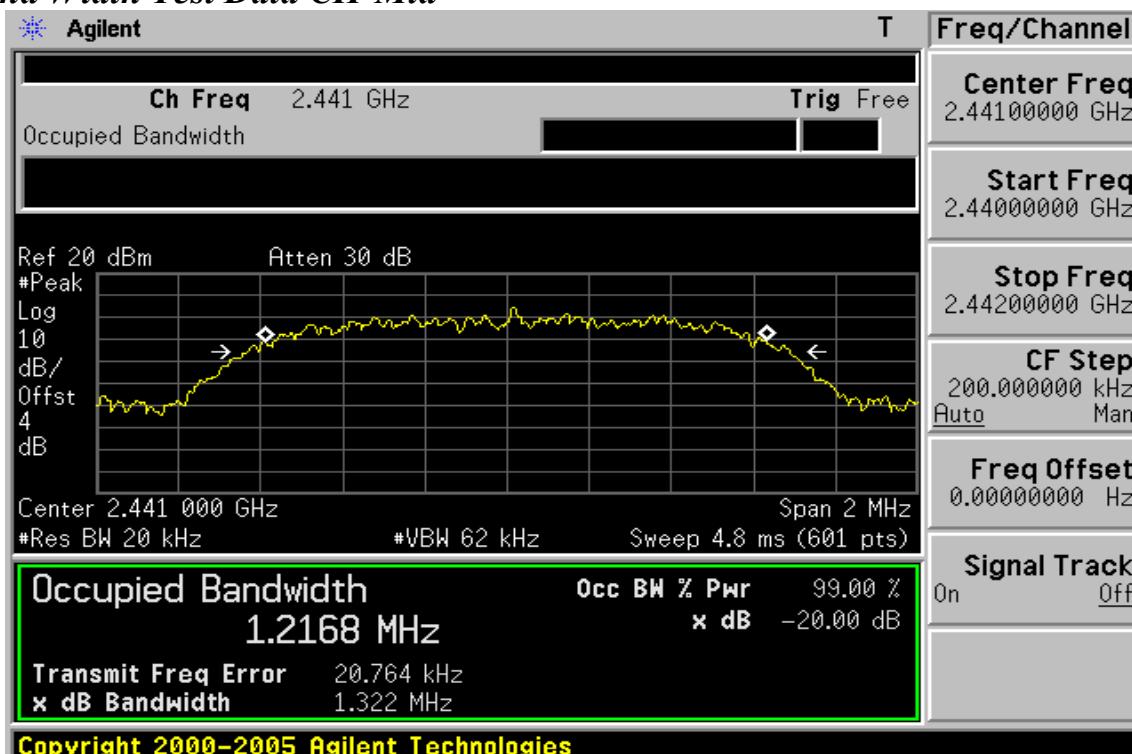


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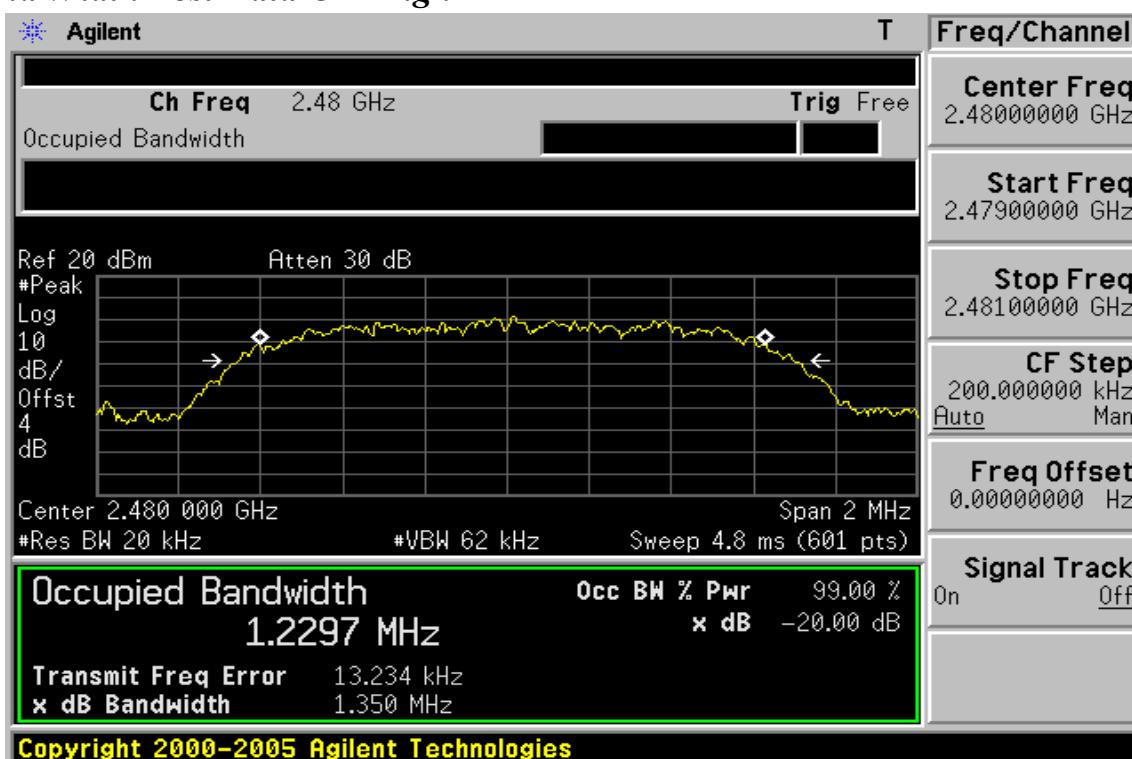
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## 99% Band Width Test Data CH-Mid



## 99% Band Width 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 is 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 in 15.209(a).

According to RSS-Gen §7.2.5 and RSS-210 issue 8, §A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 5 and 6 is not required. In addition, radiated emissions which fall in the restricted bands of Table 3 must also comply with the radiated emission limits specified in Tables 5 and 6.

### 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

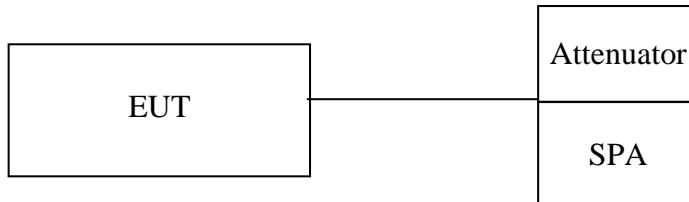
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### 9.3. Test SET-UP:

#### 9.3.1. Conducted Emission at antenna port:



### 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.

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## 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 4dB that offsets in the spectrum***

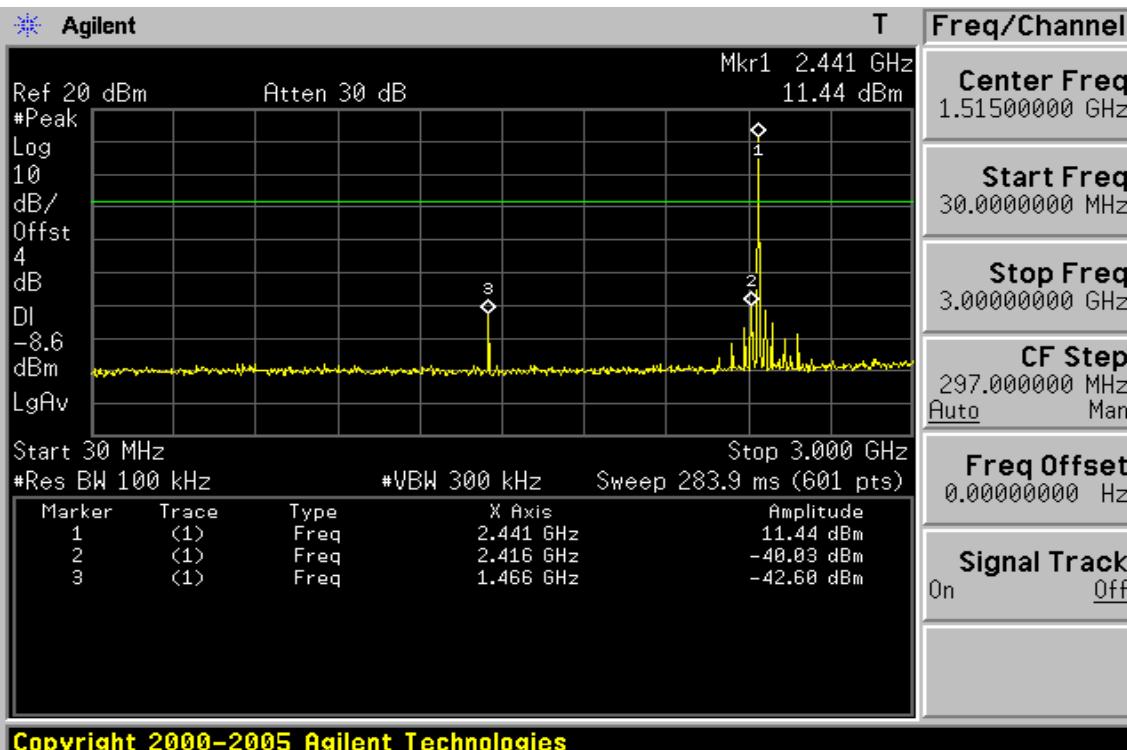
***NOTE: the occurrence of the spike on the conducted emission is the signal of the fundamental emission.***

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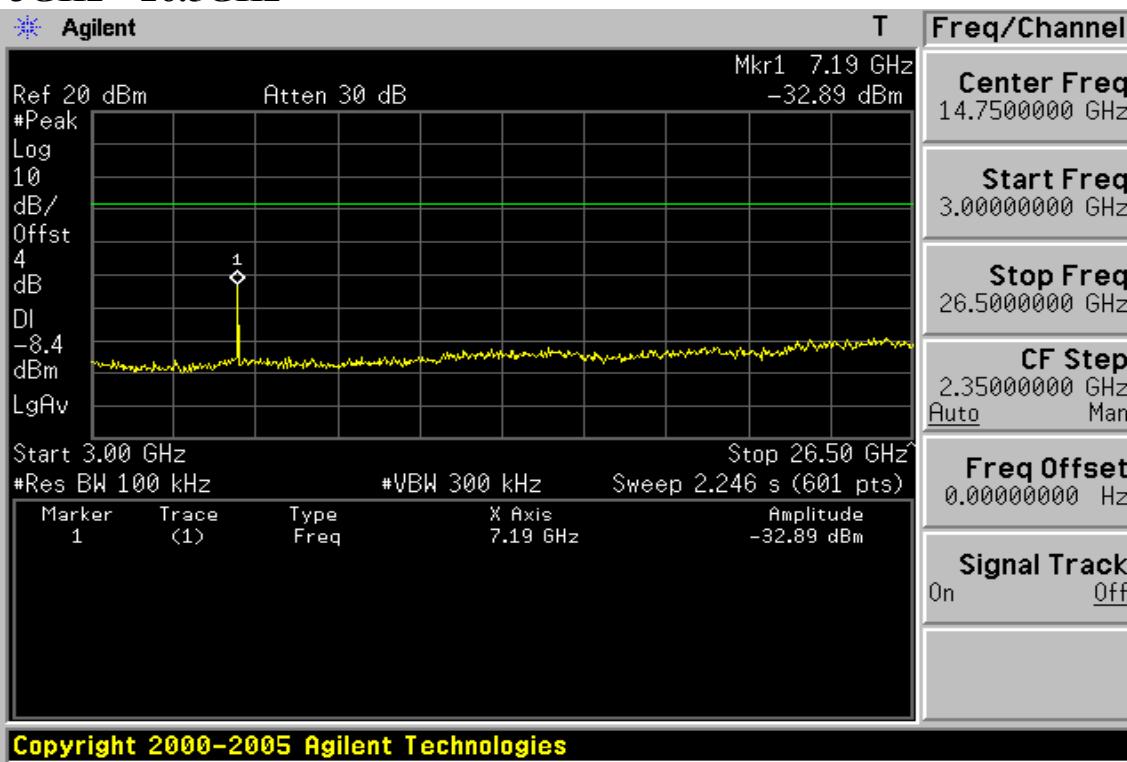
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## 9.7 Measurement Result -1 Conducted Spurious Emission Measurement Result (Worst: BR mode) Ch Low 30MHz – 3GHz



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## Ch Low 3GHz – 26.5GHz



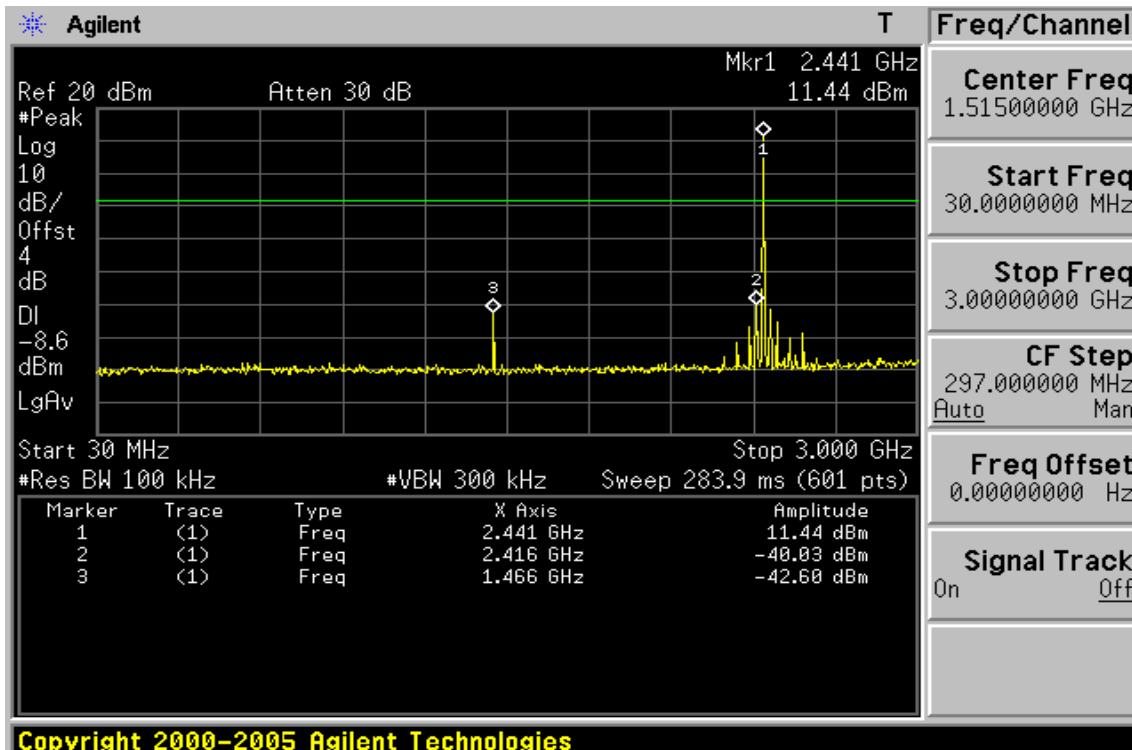
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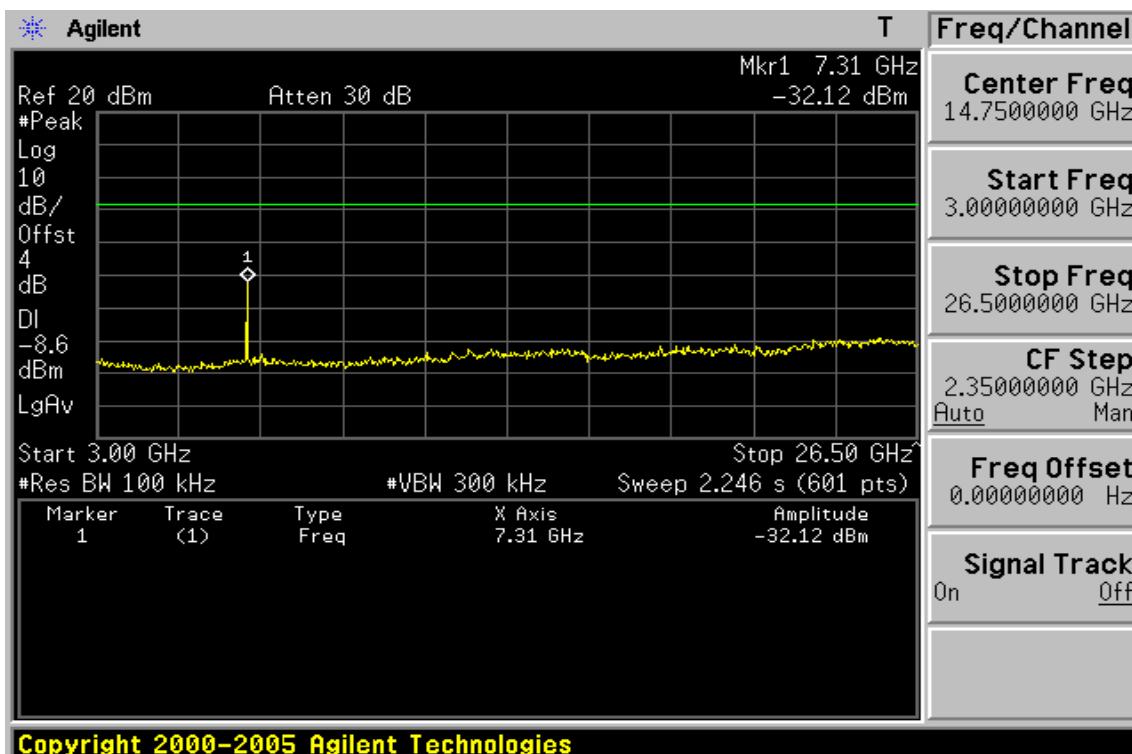
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## Ch Mid 30MHz – 3GHz



## Ch Mid 3GHz – 26.5GHz

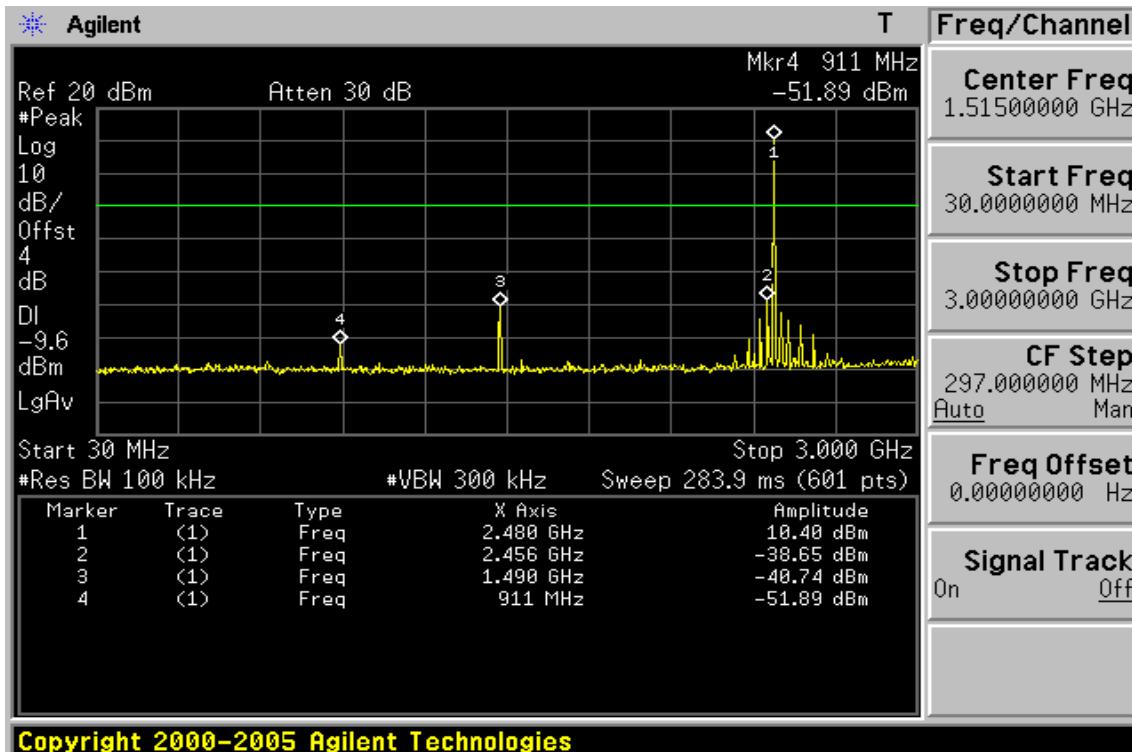


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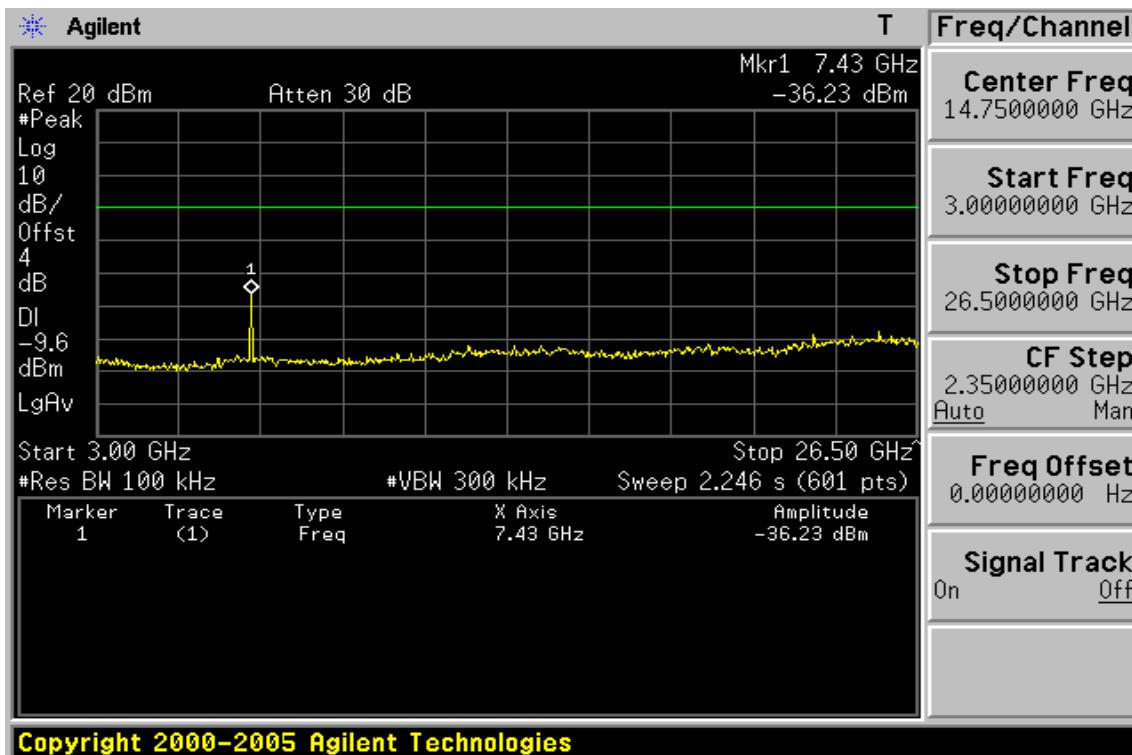
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## Ch High 30MHz – 3GHz



## Ch High 3GHz – 26.5GHz

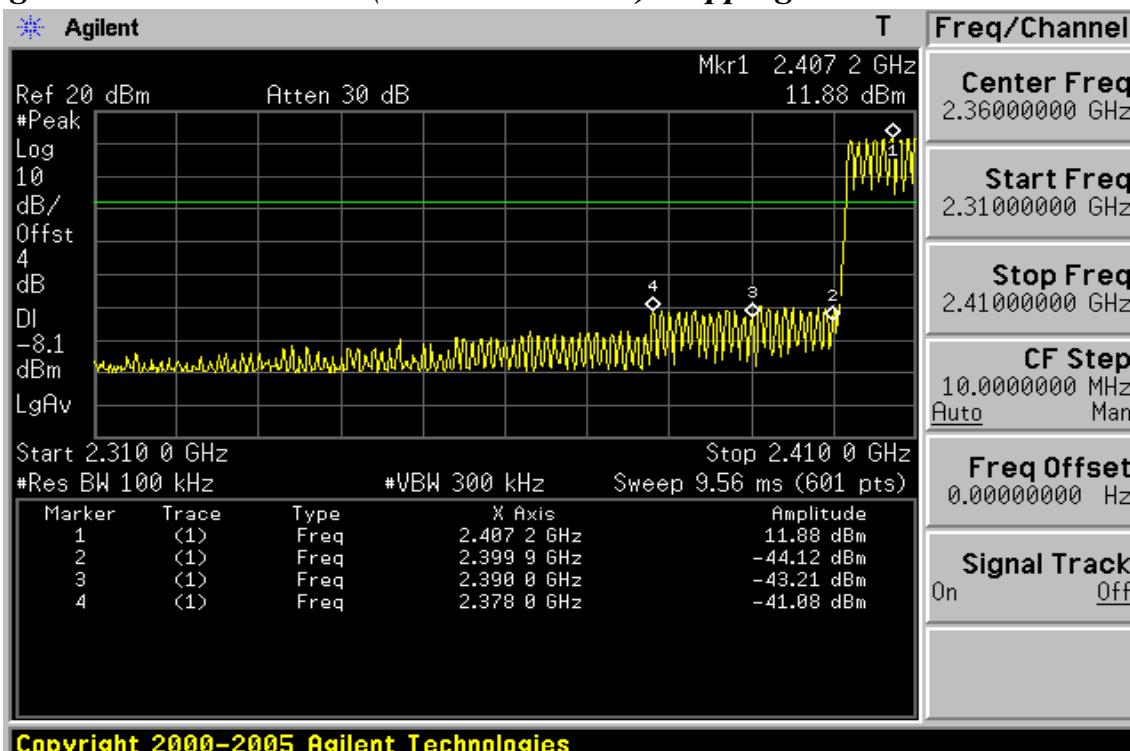


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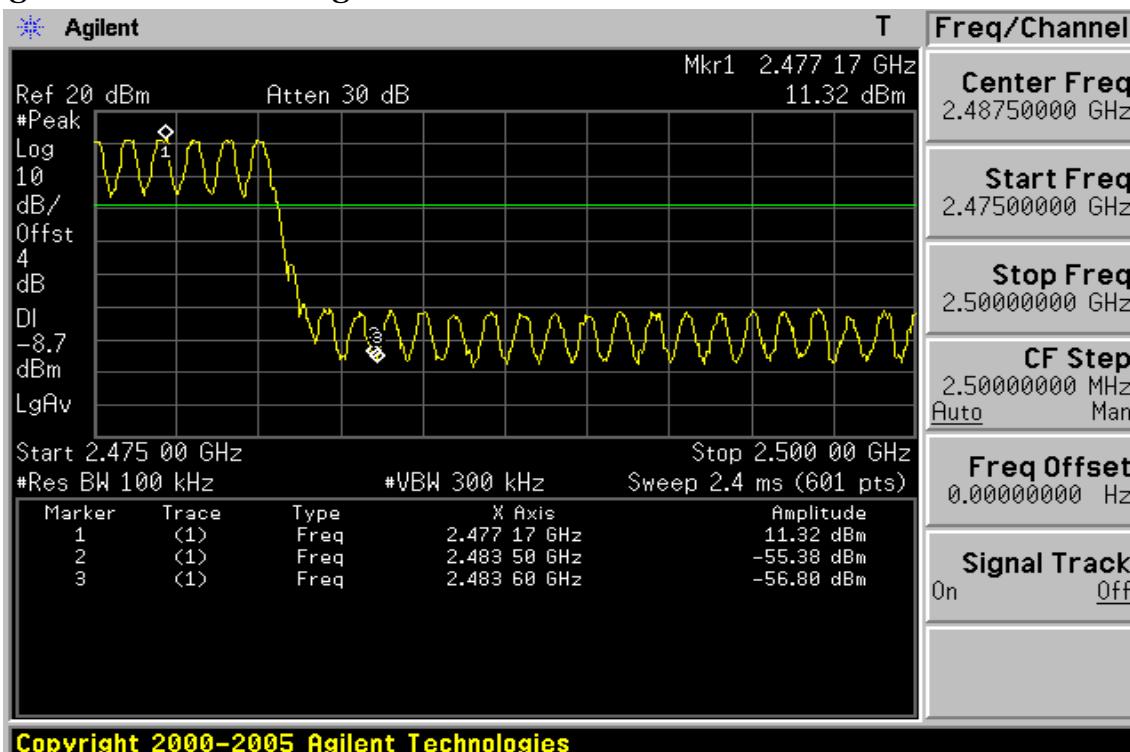
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## 9.7 Measurement Result -2 100 kHz BANDWIDTH OF BNAD EDGE: *Band Edges Test Data CH-Low (Worst: BR mode) Hopping mode*



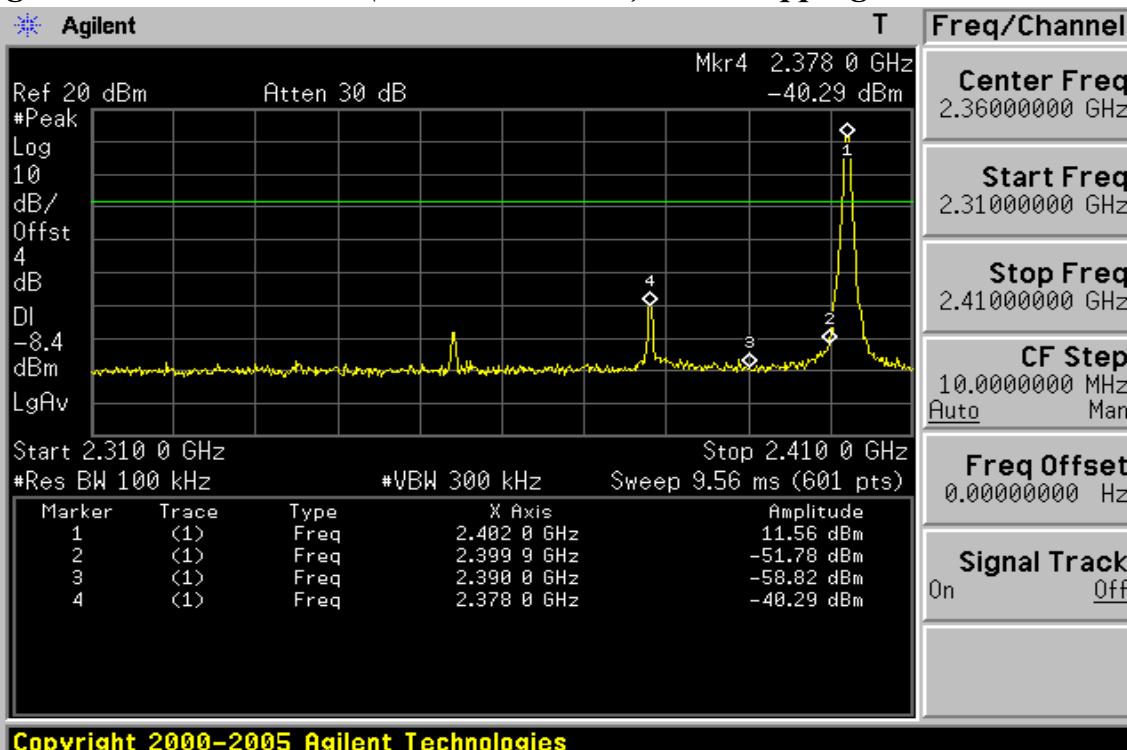
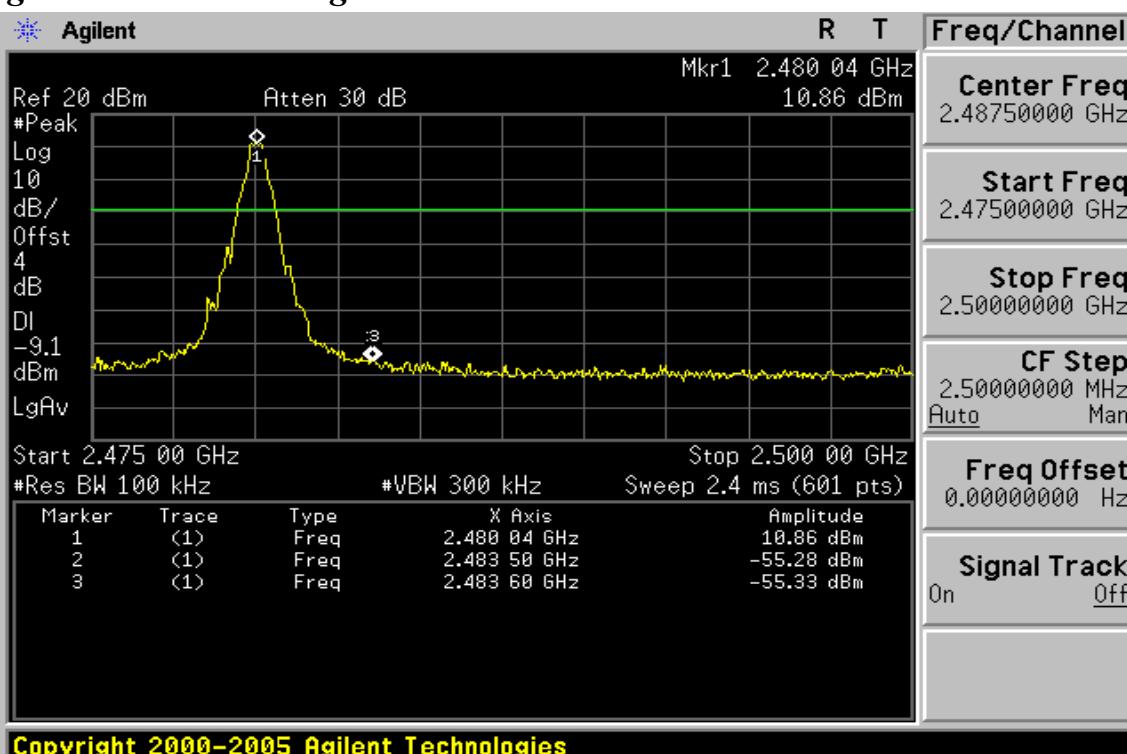
## Band Edges Test Data CH-High



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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.

According to RSS-Gen §7.2.5 and RSS-210 issue 8,§A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 5 and 6 is not required. In addition, radiated emissions which fall in the restricted bands of Table 3 must also comply with the radiated emission limits specified in Tables 5 and 6 of RSS-GEN.

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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.

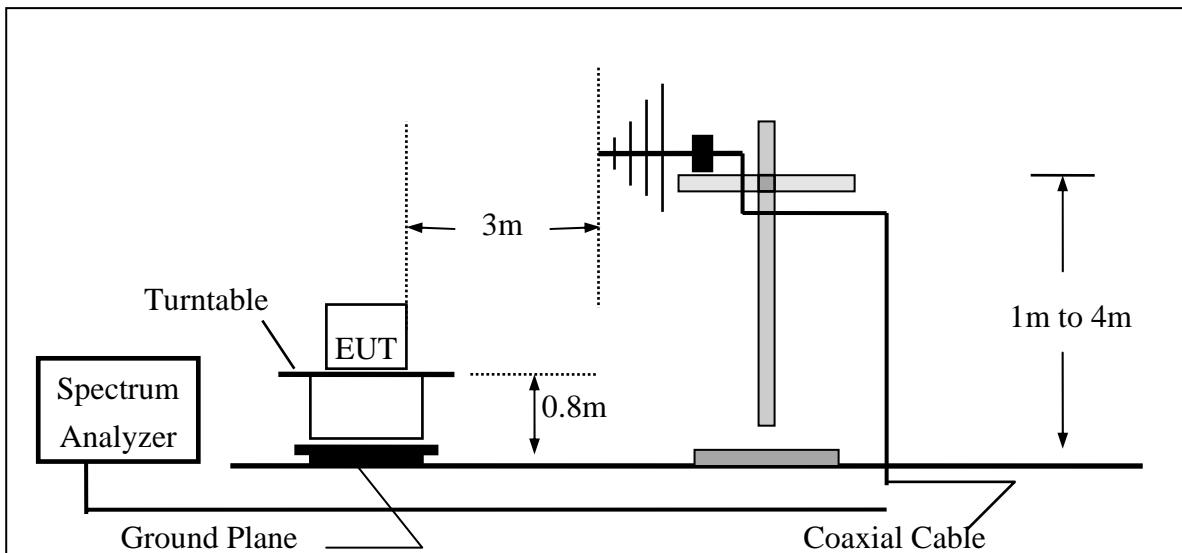
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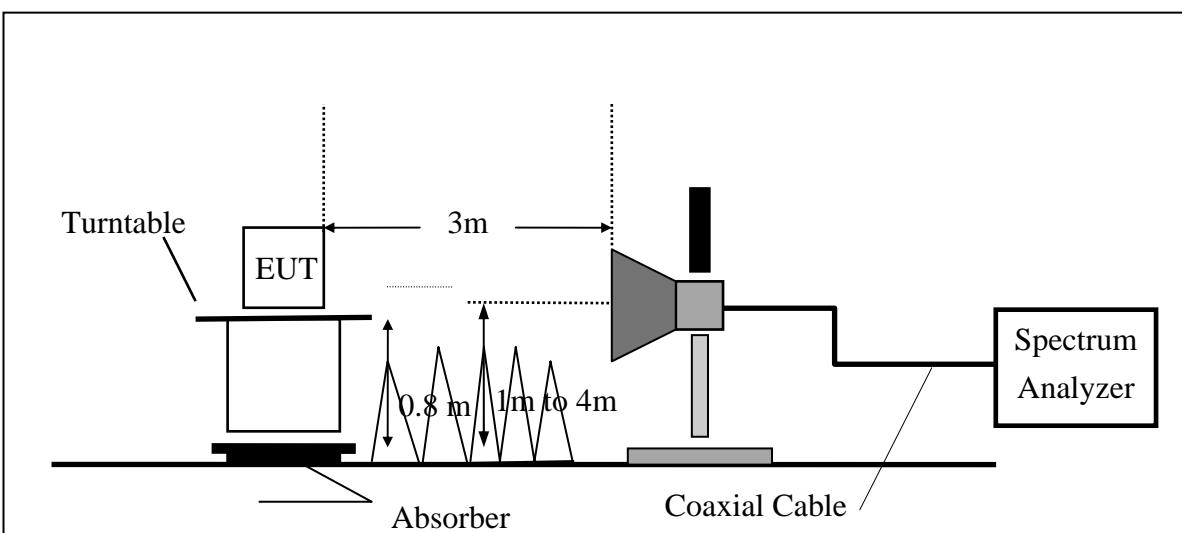
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**10.3. Test SET-UP:****10.3.1. Radiated emission:**

(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  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz

VBW  $\geq$  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 dB $\mu$ V/m, which converts  $20 * \log(\mu\text{V}/\text{m})$
2. Factor(dB) = Antenna Factor(dB $\mu$ V/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	:2014-10-21
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20 deg_C / 64 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			Reading Level dB $\mu$ V				
2390.00	E	Average	33.02	2.48	35.50	54.00	-18.50
2390.00	E	Peak	51.01	2.48	53.49	74.00	-20.51

Operation Band	:BR+Hopping	Test Date	:2014-10-21
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20 deg_C / 64 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			Reading Level dB $\mu$ V				
2390.00	E	Average	34.22	2.48	36.70	54.00	-17.30
2390.00	E	Peak	55.06	2.48	57.54	74.00	-16.46

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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  
 Fundamental Frequency :2480 MHz  
 Operation Mode :Band Edge HIGH  
 EUT Pol. :H Plane

Test Date :2014-10-21  
 Temp./Humi. :20 deg\_C / 64 RH  
 Engineer :Tin  
 Measurement Antenna Pol. :VERTICAL

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			Mode	Reading Level				
2483.50	E	Average		32.08	2.84	34.92	54.00	-19.08
2483.50	E	Peak		48.72	2.84	51.56	74.00	-22.44

Operation Band :BR+Hopping  
 Fundamental Frequency :2480 MHz  
 Operation Mode :Band Edge HIGH  
 EUT Pol. :H Plane

Test Date :2014-10-21  
 Temp./Humi. :20 deg\_C / 64 RH  
 Engineer :Tin  
 Measurement Antenna Pol. :HORIZONTAL

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			Mode	Reading Level				
2483.50	E	Average		34.73	2.84	37.57	54.00	-16.43
2483.50	E	Peak		54.90	2.84	57.74	74.00	-16.26

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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

Operation Band	:BR	Test Date	:2014-10-21
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20 deg_C / 64 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			PK/QP/AV	dB $\mu$ V				
2390.00	E	Average		32.05	2.48	34.53	54.00	-19.47
2390.00	E	Peak		48.34	2.48	50.82	74.00	-23.18

Operation Band	:BR	Test Date	:2014-10-21
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20 deg_C / 64 RH
Operation Mode	:Band Edge LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			PK/QP/AV	dB $\mu$ V				
2390.00	E	Average		33.99	2.48	36.47	54.00	-17.53
2390.00	E	Peak		55.92	2.48	58.40	74.00	-15.60

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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Operation Band :BR Test Date :2014-10-21  
 Fundamental Frequency :2480 MHz Temp./Humi. :20 deg\_C / 64 RH  
 Operation Mode :Band Edge HIGH Engineer :Tin  
 EUT Pol. :H Plane Measurement Antenna Pol. :VERTICAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2483.50	E	Average	32.02	2.84	34.86	54.00	-19.14	
2483.50	E	Peak	49.06	2.84	51.90	74.00	-22.10	

Operation Band :BR Test Date :2014-10-21  
 Fundamental Frequency :2480 MHz Temp./Humi. :20 deg\_C / 64 RH  
 Operation Mode :Band Edge HIGH Engineer :Tin  
 EUT Pol. :H Plane Measurement Antenna Pol. :HORIZONTAL

Freq.	Note	Detector	Spectrum		Factor	Actual	Limit	Margin
			Mode	Reading Level				
MHz	F/H/E/S	PK/QP/AV	dB $\mu$ V	dB	dB $\mu$ V/m	dB $\mu$ V/m	dB	
2483.50	E	Average	33.55	2.84	36.39	54.00	-17.61	
2483.50	E	Peak	54.57	2.84	57.41	74.00	-16.59	

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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	Test Date	:2014-10-21
Fundamental Frequency	:2402 MHz	Temp./Humi.	:20 deg_C / 64 RH
Operation Mode	:TX LOW	Engineer	:Tin
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)Factor(dB) = Antenna Factor(dB $\mu$ V/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.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual	Limit @3m dB $\mu$ V/m	Margin dB
					FS dB $\mu$ V/m		
36.79	S	Peak	44.12	-13.75	30.37	40.00	-9.63
110.51	S	Peak	40.28	-15.96	24.32	43.50	-19.18
196.84	S	Peak	32.16	-15.10	17.06	43.50	-26.44
492.69	S	Peak	29.16	-7.53	21.63	46.00	-24.37
683.78	S	Peak	28.32	-3.63	24.69	46.00	-21.31
948.59	S	Peak	27.53	0.25	27.78	46.00	-18.22
4804.00	H	Average	32.87	6.75	39.62	54.00	-14.38
4804.00	H	Peak	40.97	6.75	47.72	74.00	-26.28
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 Test Date :2014-10-21  
 Fundamental Frequency :2402 MHz Temp./Humi. :20 deg\_C / 64 RH  
 Operation Mode :TX LOW Engineer :Tin  
 EUT Pol. :H Plane Measurement Antenna Pol. :HORIZONTAL

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual	Limit @3m dB $\mu$ V/m	Margin dB
					FS dB $\mu$ V/m		
116.33	S	Peak	40.78	-15.37	25.41	43.50	-18.09
227.88	S	Peak	42.55	-14.07	28.48	46.00	-17.52
266.68	S	Peak	38.54	-12.24	26.30	46.00	-19.70
404.42	S	Peak	32.87	-8.94	23.93	46.00	-22.07
683.78	S	Peak	28.08	-3.63	24.45	46.00	-21.55
941.80	S	Peak	29.29	0.16	29.45	46.00	-16.55
4804.00	H	Average	36.94	6.75	43.69	54.00	-10.31
4804.00	H	Peak	44.17	6.75	50.92	74.00	-23.08
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  
 Fundamental Frequency :2441 MHz  
 Operation Mode :TX MID  
 EUT Pol. :H Plane

Test Date :2014-10-21  
 Temp./Humi. :20 deg\_C / 64 RH  
 Engineer :Tin  
 Measurement Antenna Pol. :VERTICAL

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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.

Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor dB	Actual FS	Limit @3m	Margin
			dB $\mu$ V		dB $\mu$ V/m	dB $\mu$ V/m	dB
36.79	S	Peak	43.64	-13.75	29.89	40.00	-10.11
114.39	S	Peak	39.33	-15.56	23.77	43.50	-19.73
374.35	S	Peak	28.20	-9.60	18.60	46.00	-27.40
625.58	S	Peak	29.59	-5.78	23.81	46.00	-22.19
760.41	S	Peak	28.32	-2.52	25.80	46.00	-20.20
950.53	S	Peak	29.69	0.28	29.97	46.00	-16.03
4882.00	H	Average	29.97	6.93	36.90	54.00	-17.10
4882.00	H	Peak	39.76	6.93	46.69	74.00	-27.31
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  
 Fundamental Frequency :2441 MHz  
 Operation Mode :TX MID  
 EUT Pol. :H Plane

Test Date :2014-10-21  
 Temp./Humi. :20 deg\_C / 64 RH  
 Engineer :Tin  
 Measurement Antenna Pol. :HORIZONTAL

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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.

Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
118.27	S	Peak	40.36	-15.18	25.18	43.50	-18.32	
246.31	S	Peak	39.74	-13.12	26.62	46.00	-19.38	
369.50	S	Peak	33.73	-9.70	24.03	46.00	-21.97	
430.61	S	Peak	33.92	-8.83	25.09	46.00	-20.91	
732.28	S	Peak	28.86	-3.48	25.38	46.00	-20.62	
935.98	S	Peak	27.82	0.06	27.88	46.00	-18.12	
4882.00	H	Average	33.57	6.93	40.50	54.00	-13.50	
4882.00	H	Peak	42.07	6.93	49.00	74.00	-25.00	
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 Test Date :2014-10-21  
 Fundamental Frequency :2480 MHz Temp./Humi. :20 deg\_C / 64 RH  
 Operation Mode :TX HIGH Engineer :Tin  
 EUT Pol. :H Plane Measurement Antenna Pol. :VERTICAL

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual		Margin dB
					FS dB $\mu$ V/m	@3m dB $\mu$ V/m	
36.79	S	Peak	43.28	-13.75	29.53	40.00	-10.47
107.60	S	Peak	40.23	-16.47	23.76	43.50	-19.74
191.02	S	Peak	33.15	-14.86	18.29	43.50	-25.21
425.76	S	Peak	28.27	-8.81	19.46	46.00	-26.54
683.78	S	Peak	28.26	-3.63	24.63	46.00	-21.37
958.29	S	Peak	27.48	0.34	27.82	46.00	-18.18
4960.00	H	Average	31.27	7.08	38.35	54.00	-15.65
4960.00	H	Peak	39.43	7.08	46.51	74.00	-27.49
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  
 Fundamental Frequency :2480 MHz  
 Operation Mode :TX HIGH  
 EUT Pol. :H Plane

Test Date :2014-10-21  
 Temp./Humi. :20 deg\_C / 64 RH  
 Engineer :Tin  
 Measurement Antenna Pol. :HORIZONTAL

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/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.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual	Limit	Margin
					FS dB $\mu$ V/m	@3m dB $\mu$ V/m	dB
117.30	S	Peak	41.41	-15.28	26.13	43.50	-17.37
168.71	S	Peak	39.87	-12.86	27.01	43.50	-16.49
216.24	S	Peak	43.13	-14.59	28.54	46.00	-17.46
268.62	S	Peak	40.91	-12.14	28.77	46.00	-17.23
412.18	S	Peak	34.01	-8.77	25.24	46.00	-20.76
776.90	S	Peak	28.75	-2.66	26.09	46.00	-19.91
4960.00	H	Average	32.08	7.08	39.16	54.00	-14.84
4960.00	H	Peak	41.80	7.08	48.88	74.00	-25.12
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

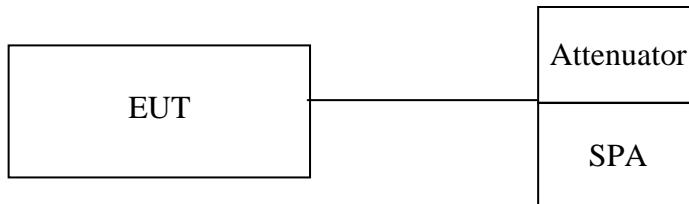
According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the 2/3\*20dB bandwidth of the hopping channel, whichever is greater.

According to RSS 210 issue 8, A8.1(b), 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.

### 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 2/3 times 20dB bandwidth	PASS

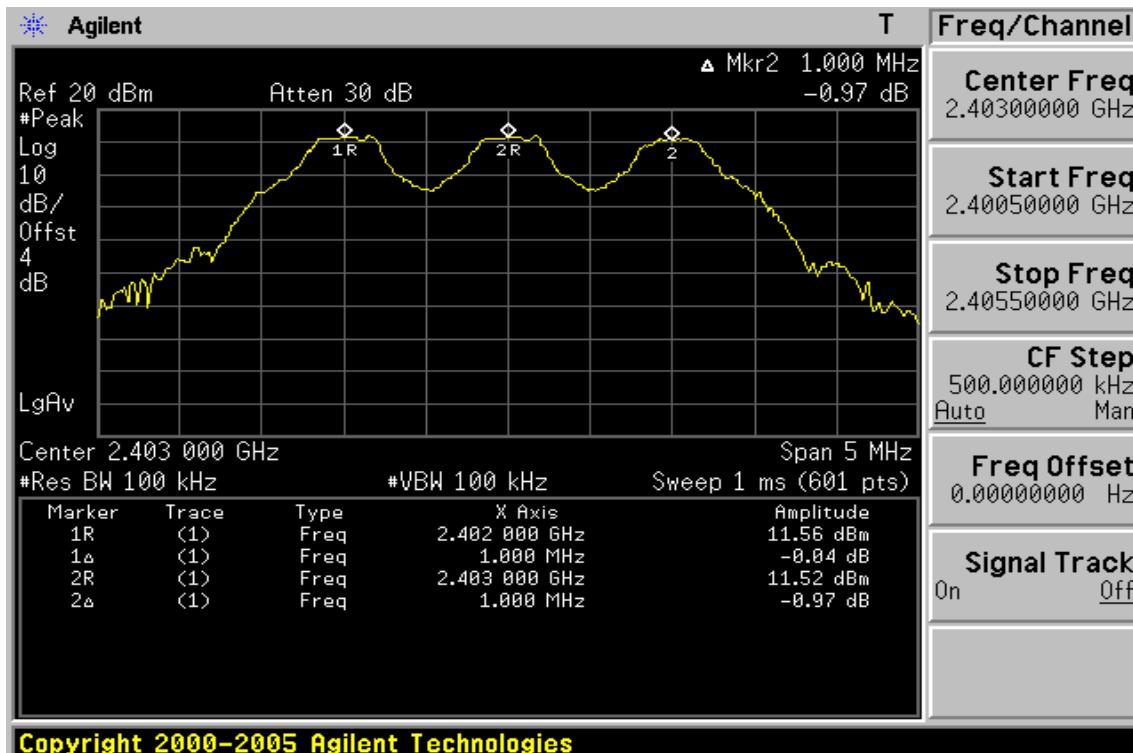
Note: Refer to next page for plots.

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## 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.

According to RSS-210 issue 8,§A8.1(d), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 15 hopping channels, the maximum conducted output power shall not exceed 1 W. For all other frequency hopping systems, the maximum peak conducted output power shall not exceed 0.125 W.

### 12.2. Measurement Equipment Used:

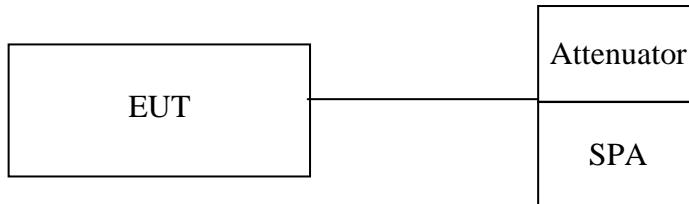
Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2495A	1005007	01/13/2014	01/12/2015
Power Sensor	Anritsu	MA2411B	917032	01/13/2014	01/12/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	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

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### 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.

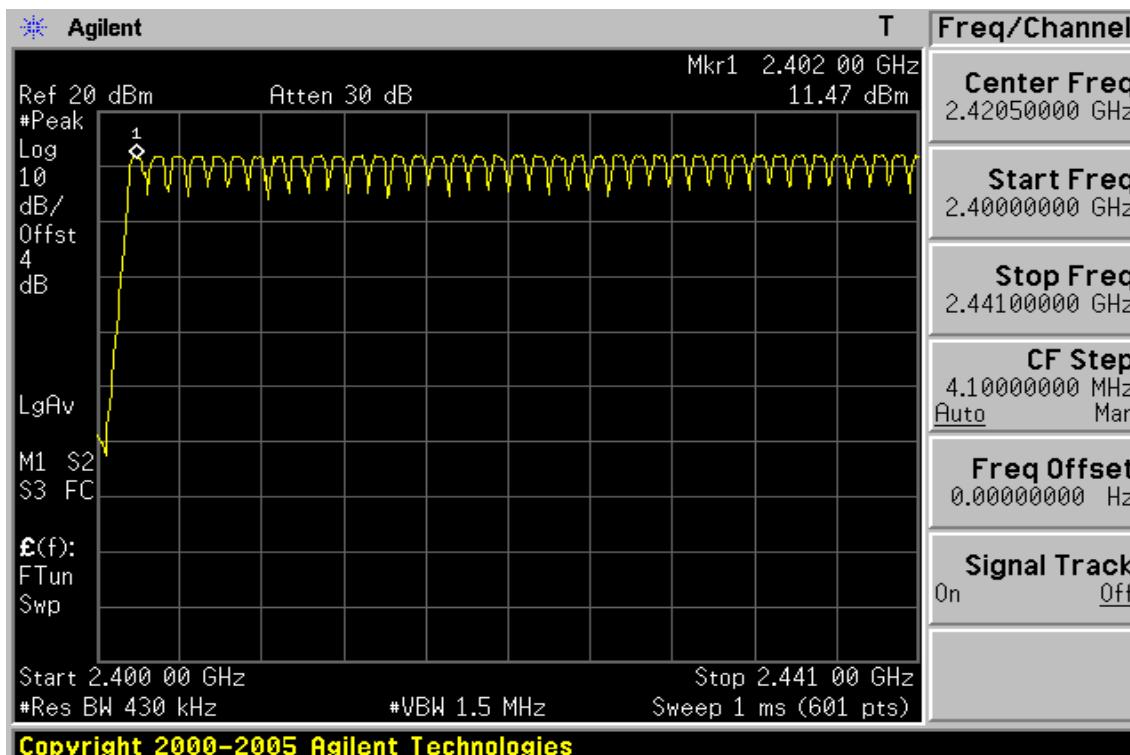
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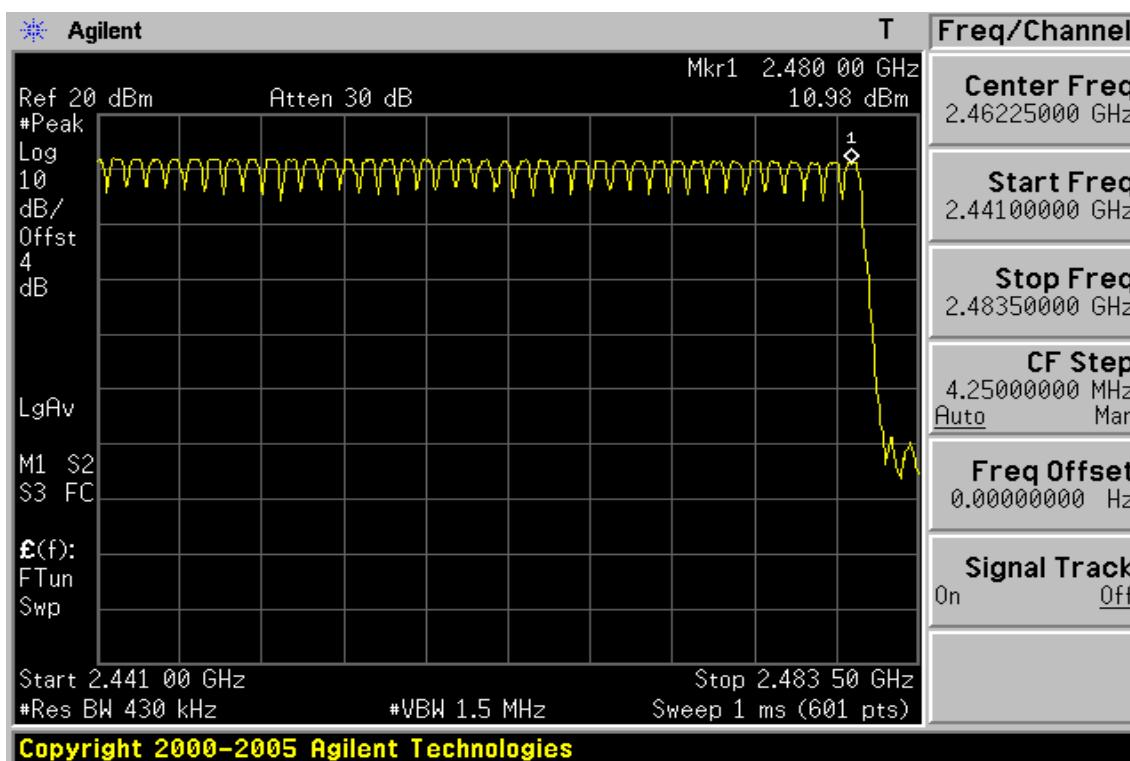
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## Channel Number

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.

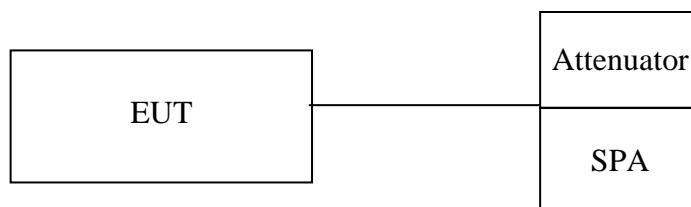
According to RSS-210 issue 8,§A8.1(d), Frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

**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	121.60	400ms
	DH3	261.28	400ms
	DH5	307.52	400ms
Middle:	DH1	121.60	400ms
	DH3	261.28	400ms
	DH5	307.52	400ms
High:	DH1	121.60	400ms
	DH3	261.28	400ms
	DH5	307.52	400ms

2Mbps (1/4 DQPSK):

Test Channel:	Mode:	Measurement Result (ms):	Limit (ms):
Middle:	2DH1	121.60	400ms
	2DH3	261.28	400ms
	2DH5	307.52	400ms

3Mbps (8DPSK):

Test Channel:	Mode:	Measurement Result (ms):	Limit (ms):
Middle:	3DH1	121.60	400ms
	3DH3	261.28	400ms
	3DH5	307.52	400ms

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

1Mbps:

CH Low	DH1 time slot = 0.380 (ms) * (1600/2/79) * 31.6 = 121.60 (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 = 0.380 (ms) * (1600/2/79) * 31.6 = 121.60 (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 = 0.380 (ms) * (1600/2/79) * 31.6 = 121.60 (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 = 0.380 (ms) * (1600/2/79) * 31.6 = 121.60 (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 = 0.380 (ms) * (1600/2/79) * 31.6 = 121.60 (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)

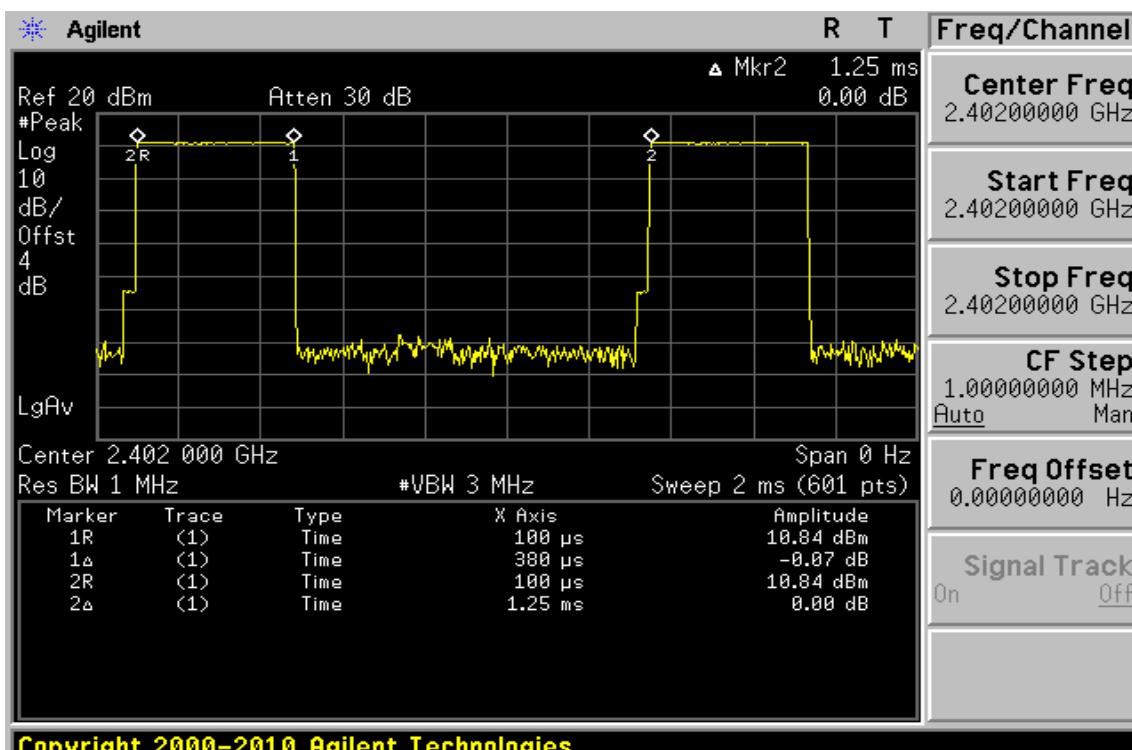
### 13.6. Measurement Result:

Note: Refer to next page for plots.

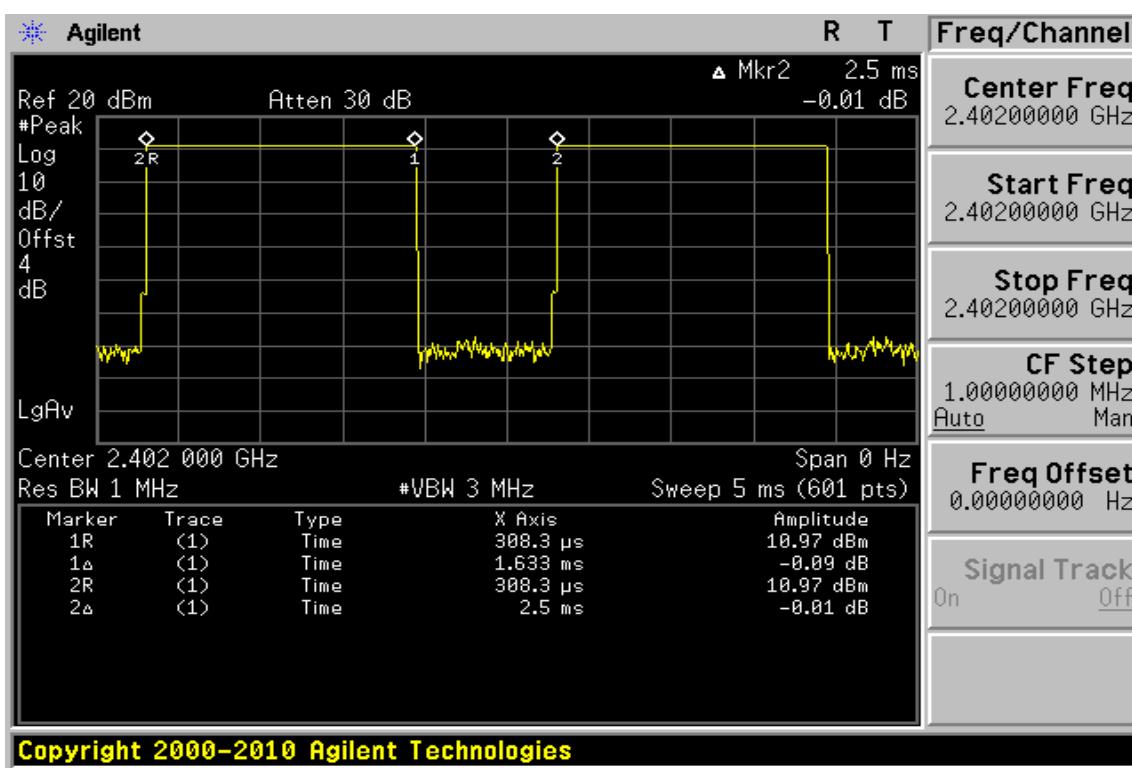
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CH-Low  
 DH1


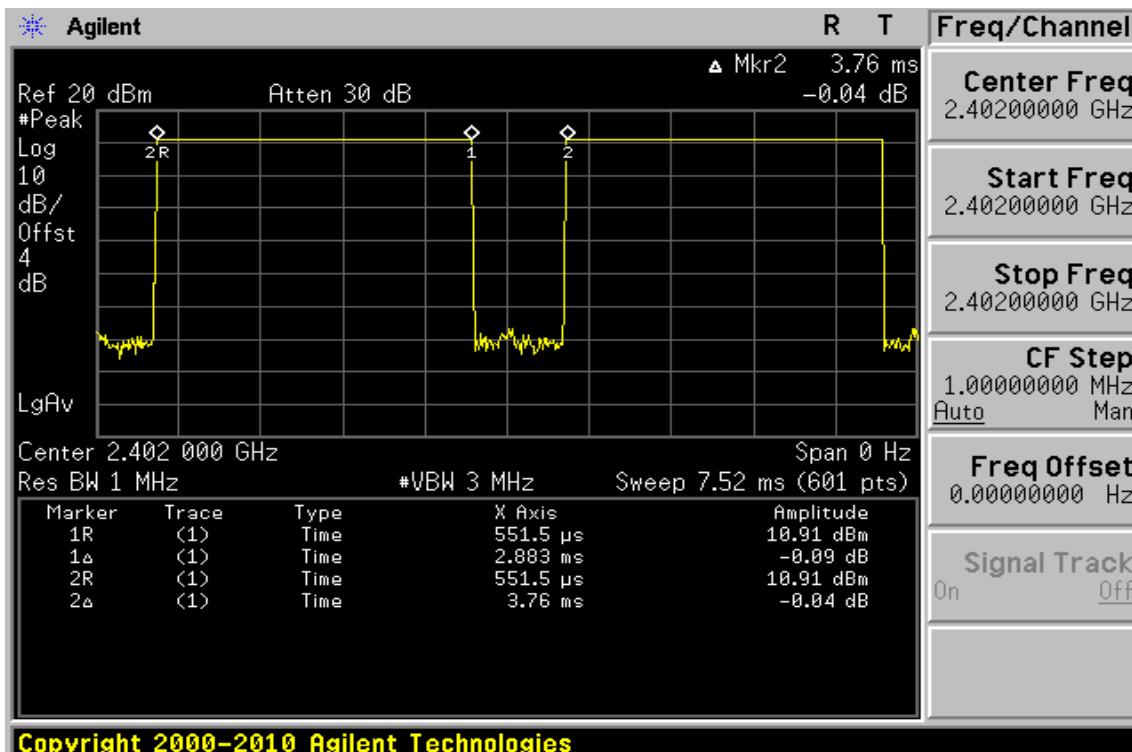
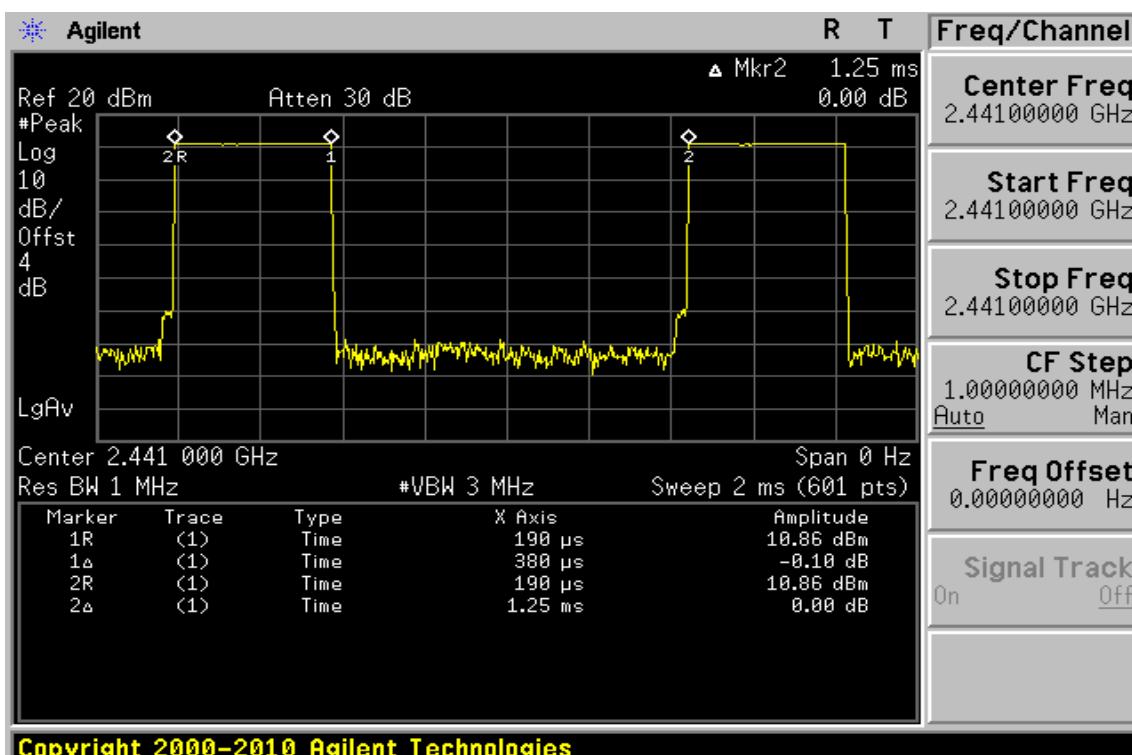
## DH3



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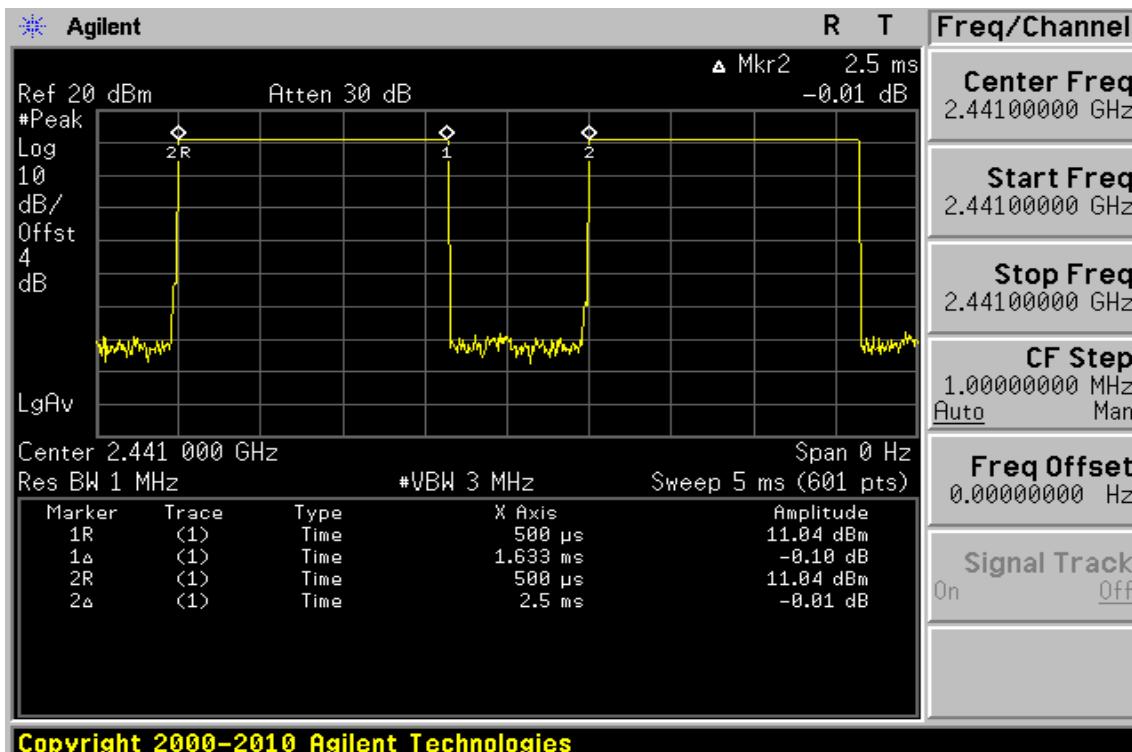
**DH5**

**CH-Mid**
**DH1**


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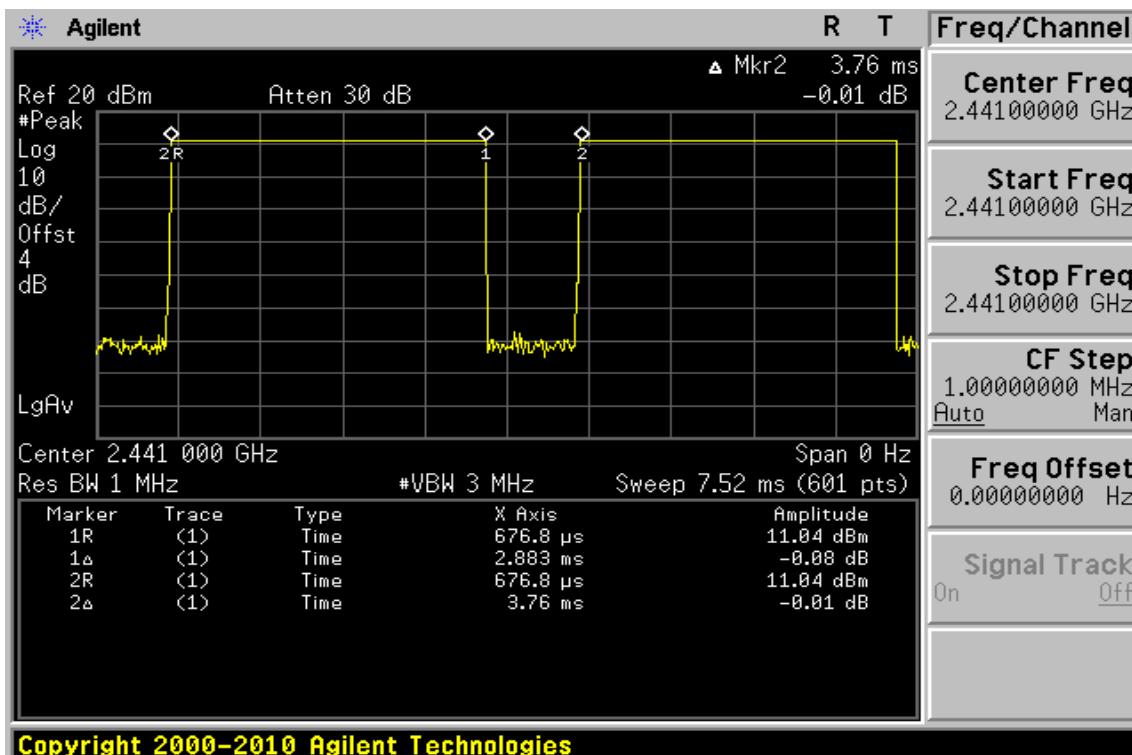
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### DH3



### DH5



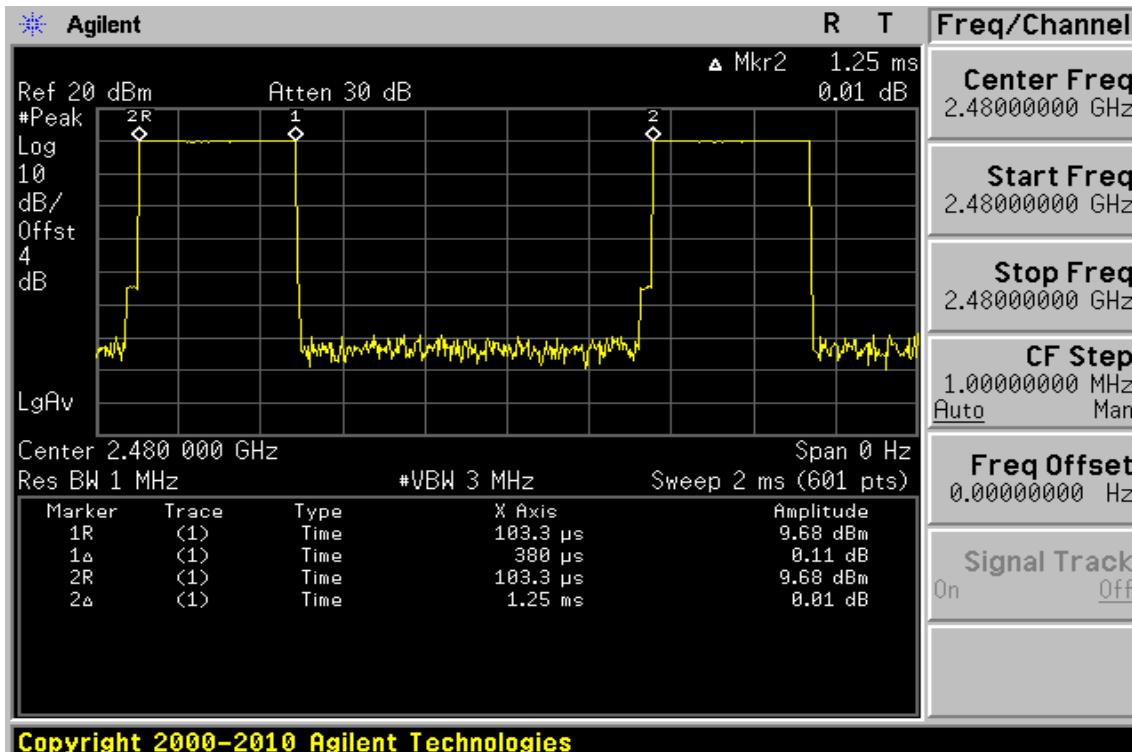
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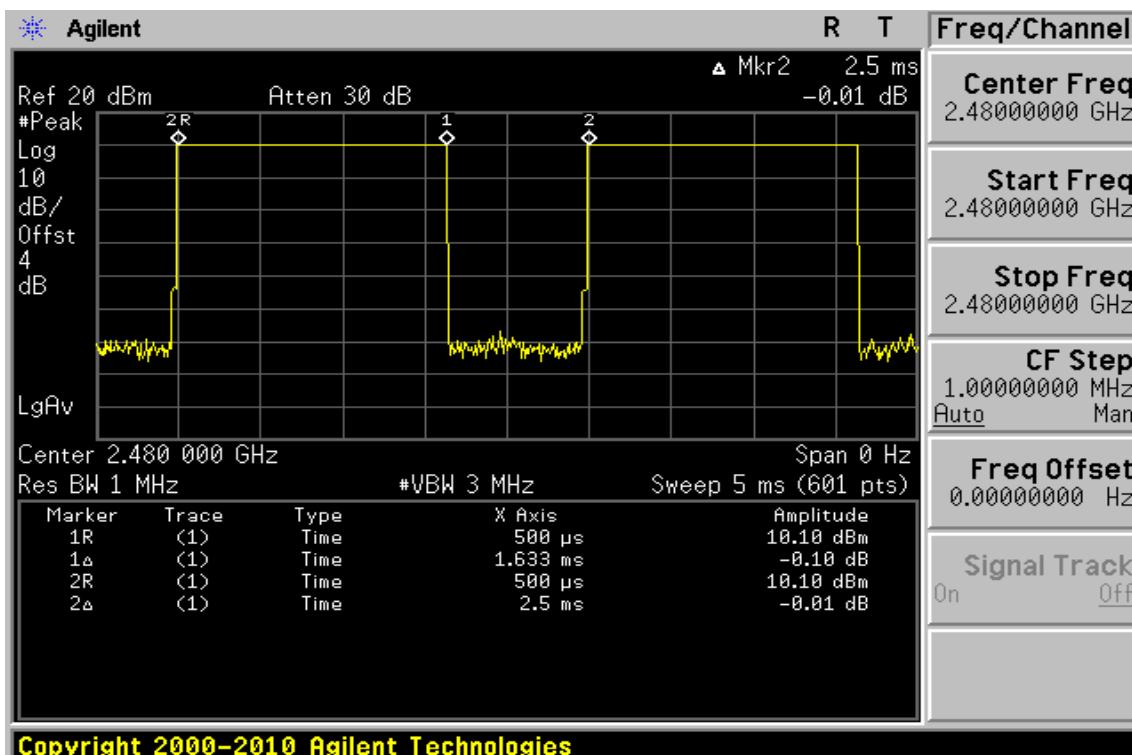
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## CH-High

### DH1



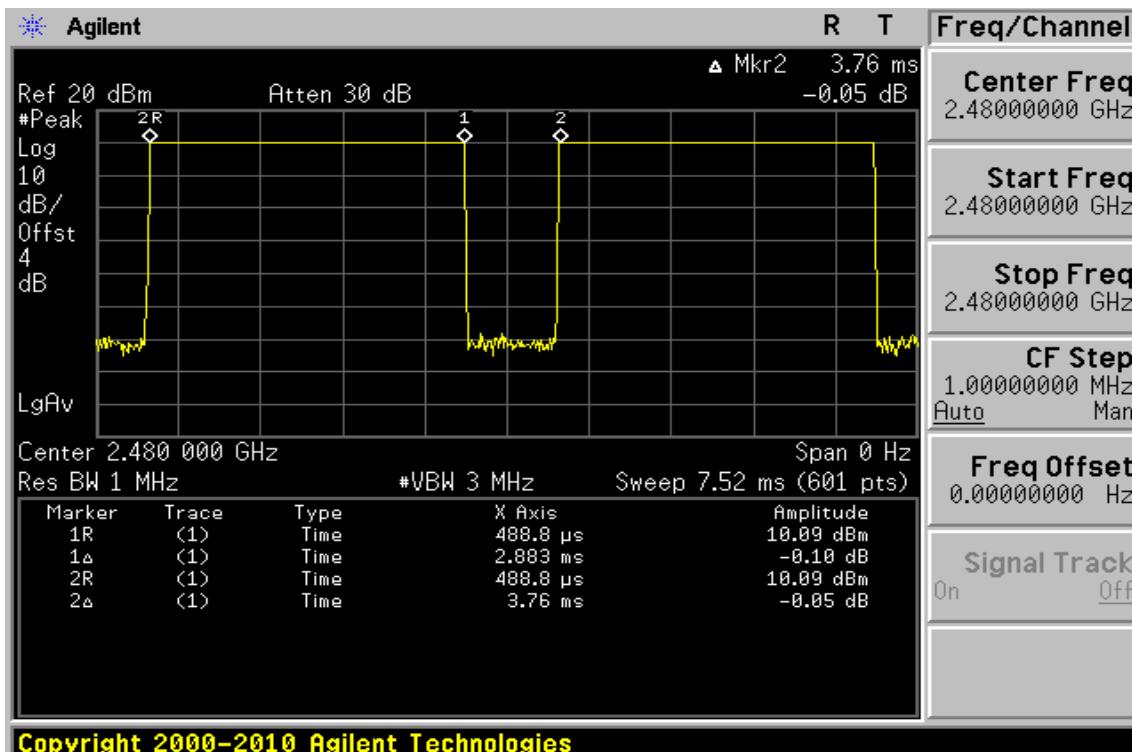
### DH3



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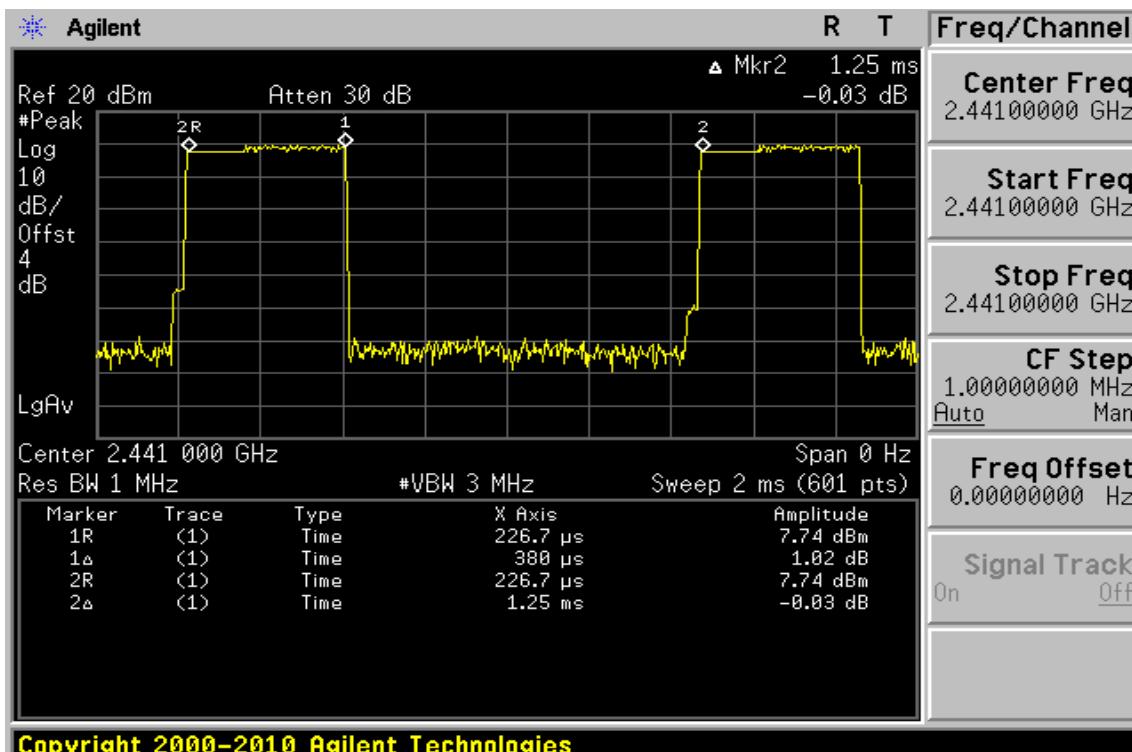
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**DH5**

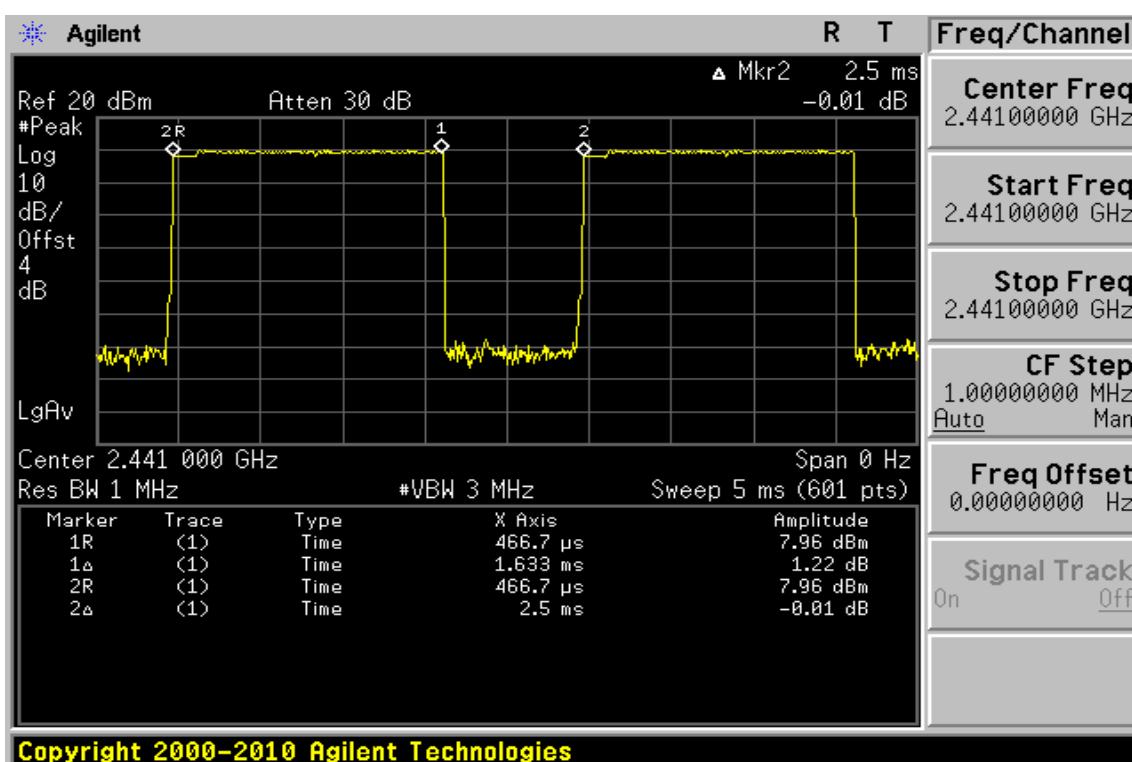
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CH-Mid  
 2DH1


## 2DH3

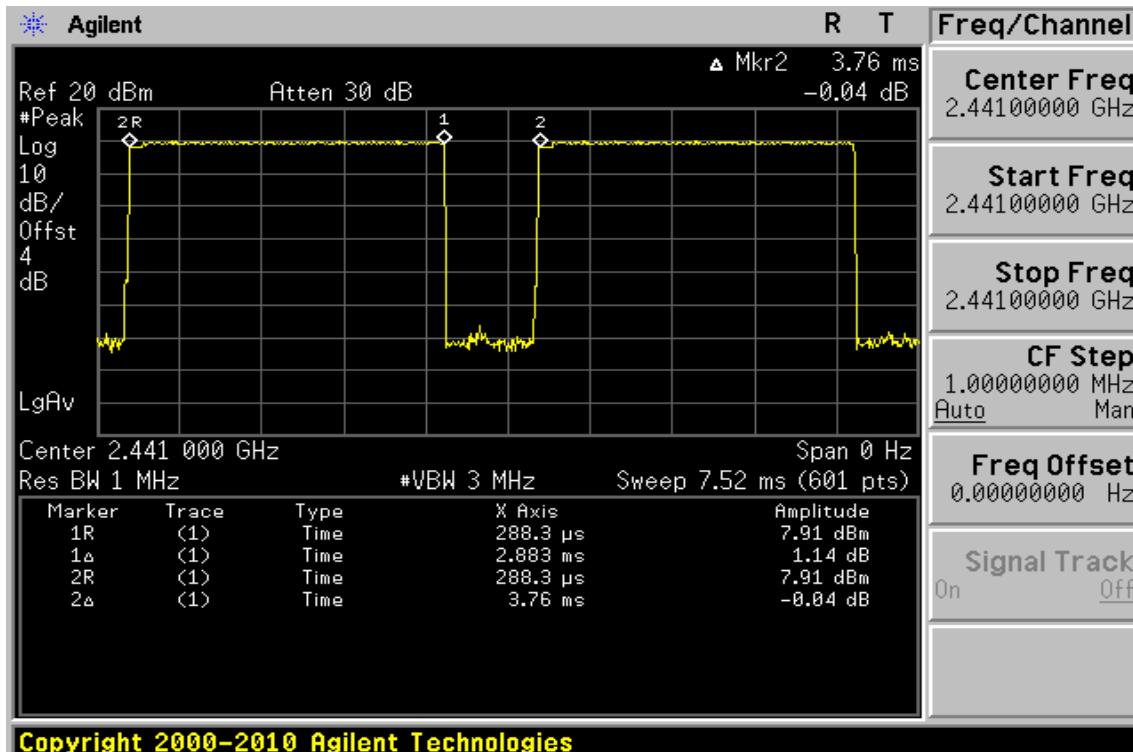


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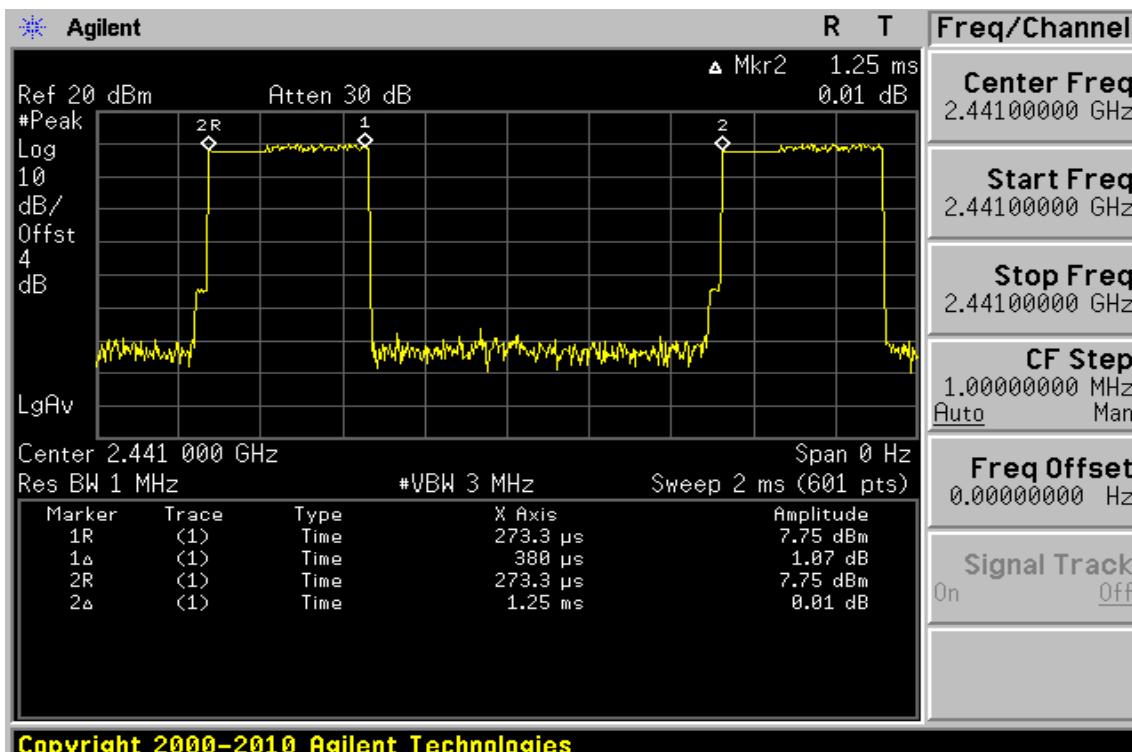
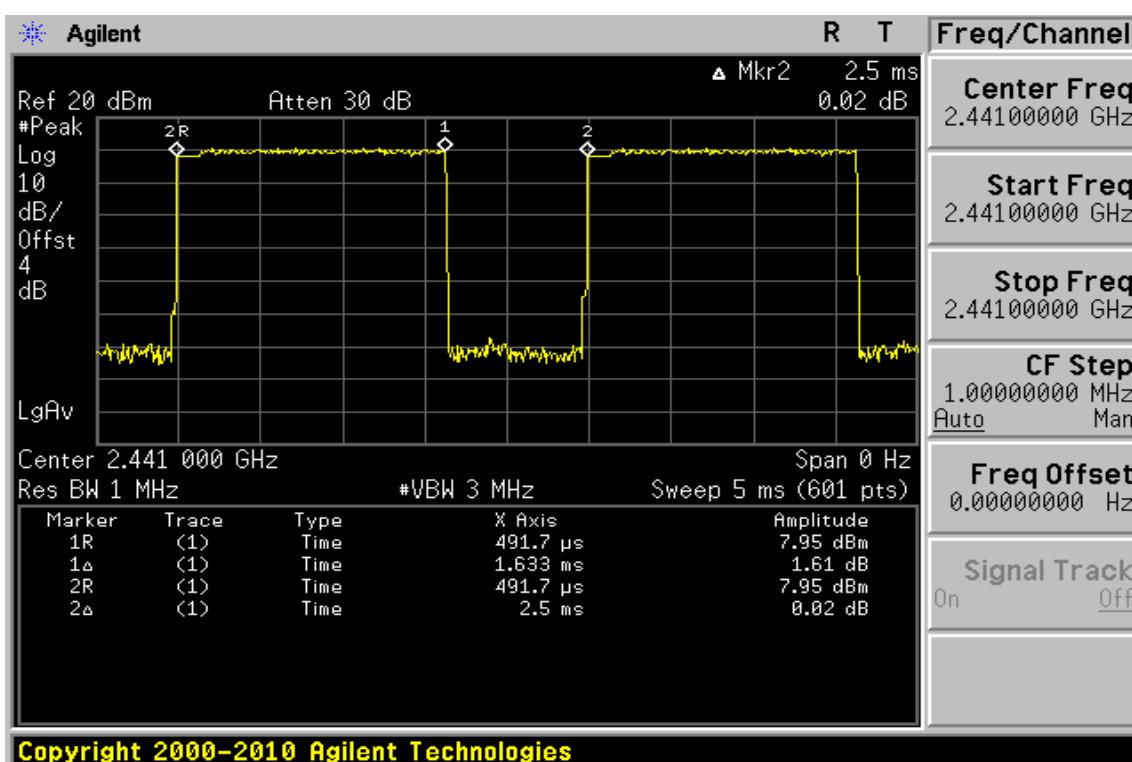
2DH5



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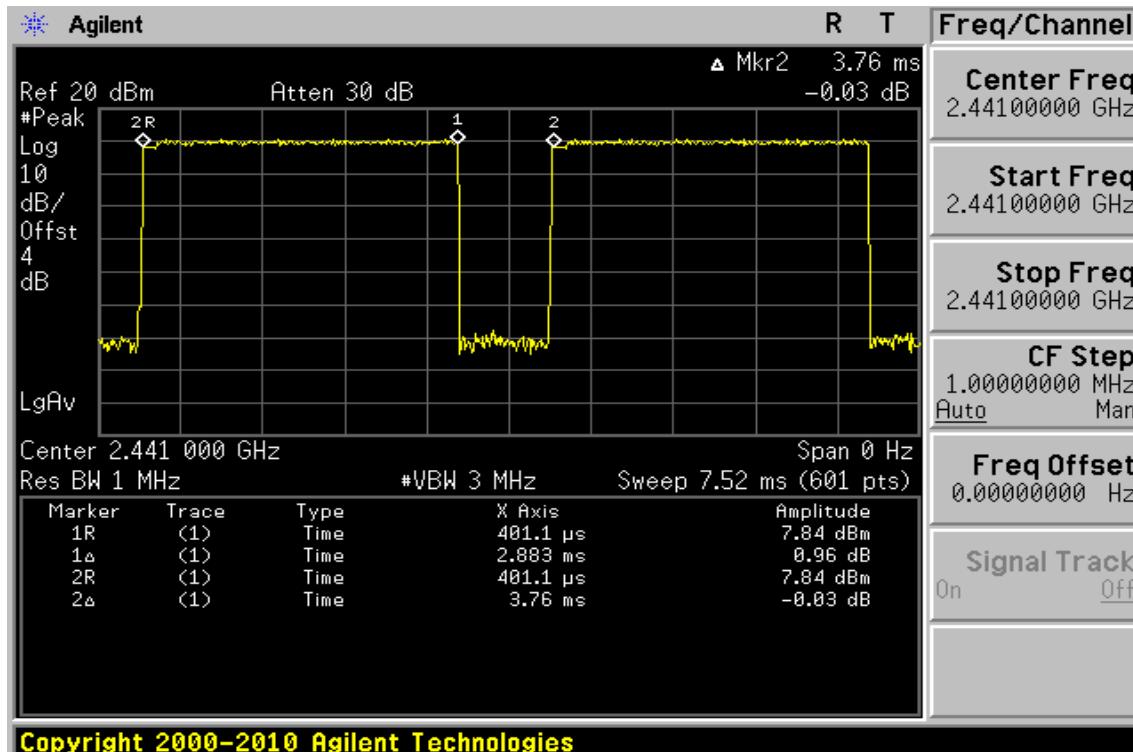
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**CH-Mid**  
**3DH1****3DH3**

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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.

According to RSS-GEN 7.1.2, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 milliwatts or less. For devices of output powers greater than 10 milliwatts, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

### 14.2. Antenna Connected Construction

The directional gains of antenna used for transmitting is -1.5dBi, 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.

~ *End of Report* ~

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