

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

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

OF

**Product Name:** Data Collection Terminal  
**Brand Name:** unitech  
**Model No.:** RH768  
**Model Differences:** N/A  
**FCC ID:** HLERH768BTGF  
**Report No.:** EF/2011/B0016  
**Issue Date:** Dec. 15, 2011  
**FCC Rule Part:** §15.247, Cat: DSS  
**Prepared for:** unitech electronics co., ltd.  
5F, No. 136, Lane 235, Pao-Chiao Rd.,  
Hsin-Tien Dist., New Taipei City, Taiwan  
**Prepared by:** SGS Taiwan Ltd.  
Electronics & Communication Laboratory  
No. 134, Wu Kung Rd., Wuku Industrial Zone,  
Taipei County, Taiwan



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## VERIFICATION OF COMPLIANCE

**Applicant:** unitech electronics co., ltd.  
5F, No. 136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist.,  
New Taipei City, Taiwan

**Product Name:** Data Collection Terminal

**Brand Name:** unitech

**Model No.:** RH768

**Model Different:** N/A

**FCC ID:** HLERH768BTGF

**File Number:** EF/2011/B0016

**Date of test:** Nov. 21, 2011 ~ Dec. 14, 2011

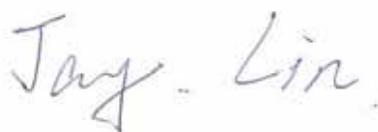
**Date of EUT Received:** Nov. 21, 2011

### We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4:2003 and 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:**



**Date:**

Dec. 15, 2011

*Jay Lin / Engineer*

**Prepared By:**

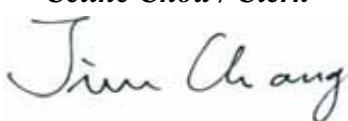


**Date:**

Dec. 15, 2011

*Celine Chou / Clerk*

**Approved By:**



**Date:**

Dec. 15, 2011

*Jim Chang / Supervisor*

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## Version

Version No.	Date	Description
00	Dec. 15, 2011	Initial creation of document

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## 1. GENERAL INFORMATION

### General:

Product Name:	Data Collection Terminal	
Brand Name:	unitech	
Model No.:	RH768	
Model Difference:	N/A	
Data Cable:	Model No.: 1550-602714G, Supplier: SINBON	
Power Supply:	7.4Vdc Lithium Ion battery or 12Vdc by AC/DC power adapter	
	Battery:	Model No.: 1400-900006G, Supplier: Joules Miles Co., Ltd Model No.: 204052G, Supplier: HELIX CO., LTD.
	Adapter:	Model No.: 3A-242DB12, Supplier: ENG ELECTRONICS CO., LTD.

### Bluetooth:

Frequency Range:	2402 – 2480MHz
Bluetooth Version:	V2.1 + EDR (GFSK + $\pi/4$ DQPSK + 8DPSK)
Channel number:	79 channels
Modulation type:	Frequency Hopping Spread Spectrum
Transmit Power:	2.59 dBm (Peak)
Dwell Time:	<= 0.4s
Operating Mode:	Point-to-Point
Antenna Designation:	PIFA Antenna / Gain: -0.24dBi

This test report applies for Bluetooth function.

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

This submittal(s) (test report) is intended for **FCC ID: HLERH768BTGF** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (digital device) is compliance with Subpart B is authorized under a Doc procedure.

## 1.2. Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2003. Radiated testing was performed at an antenna to EUT distance 3 meters.

Tested in accordance with FCC Public Notice DA 00-705

## 1.3. 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: 2003. FCC Registration Number are: 990257 and 236194, Canada Registration Number: 4620A-4

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No. 29, Pau-Tou-Tsuo Valley Chia-Pau Tsuen, Linkou Hsiang, Taipei county, which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. SGS Site No. 1(3 & 10 meters) and FCC Registration Number: 94644.

## 1.4. Special Accessories

Not available for this EUT intended for grant.

## 1.5. Equipment Modifications

Not available for this EUT intended for grant.

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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

The EUT (Transmitter) was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

### 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 requirements in Section 7 and 13 of ANSI C63.4: 2003. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and Average detector mode.

#### 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 Subclause 8.3.1.2 of ANSI C63.4: 2003.

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## 2.4. Configuration of Tested System

Fig. 2-1 Configuration of Tested System

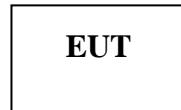


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Bluetooth Test Set	Anritsu	MT8852B	6k00006107	N/A	Un-Shield

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### 3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	Conducted Emission	Compliant
§15.247(b)(1)	Peak Output Power	Compliant
§15.247(a)	20dB Bandwidth	No Limit
§15.247I	100 KHz Bandwidth Of Frequency Band Edges	Compliant
§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, §15.247(b)(4)(i)	Antenna Requirement	Compliant

### 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 (2402MHz)、mid (2441MHz) and high (2480MHz) with worst case BDR mode and DH5 highest data rate are chosen 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 channel Low, Mid and High the worst case E2 position was reported.

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## 5. CONDUCTED EMISSION TEST

### 5.1. Standard Applicable

According to §15.207. frequency within 150KHz 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.

### 5.2. EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4: 2003.
2. The EUT was plug-in the AC/DC Power adapter. The host system was placed on the center of the back edge on the test table. The peripherals was placed on the side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.
3. The spacing between the peripherals was 10 centimeters.
4. External I/O cables were draped along the edge of the test table and bundle when necessary.
5. The host system was connected with 120Vac/60Hz power source.

### 5.3. 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.

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#### 5.4. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCS30	828985/004	09/23/2010	09/22/2012
LISN	Rolf-Heine	NNB-2/16Z	99012	03/31/2011	03/30/2012
LISN	FCC	FCC-LISN-50/250-25-2-01	04034	03/31/2011	03/30/2012
Coaxial Cables	N/A	WK CE Cable	N/A	11/28/2011	11/27/2012

#### 5.5. Measurement Result

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

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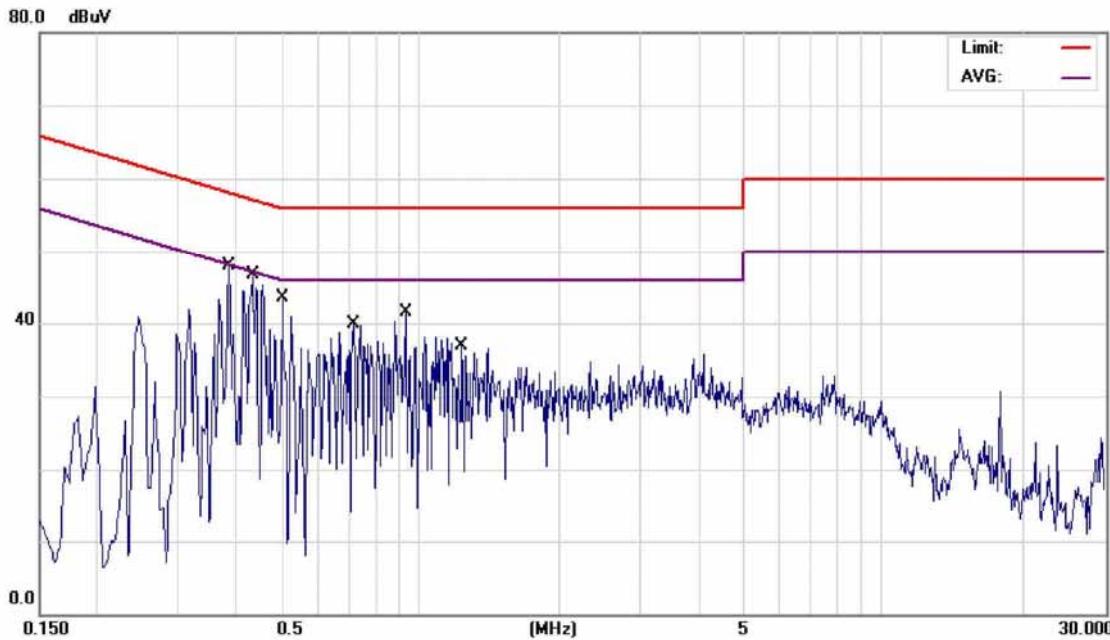
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## AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Bluetooth Mode		Test Date:	Dec. 14, 2011
Temperature:	23	Humidity:	58 %	Test By: Jay



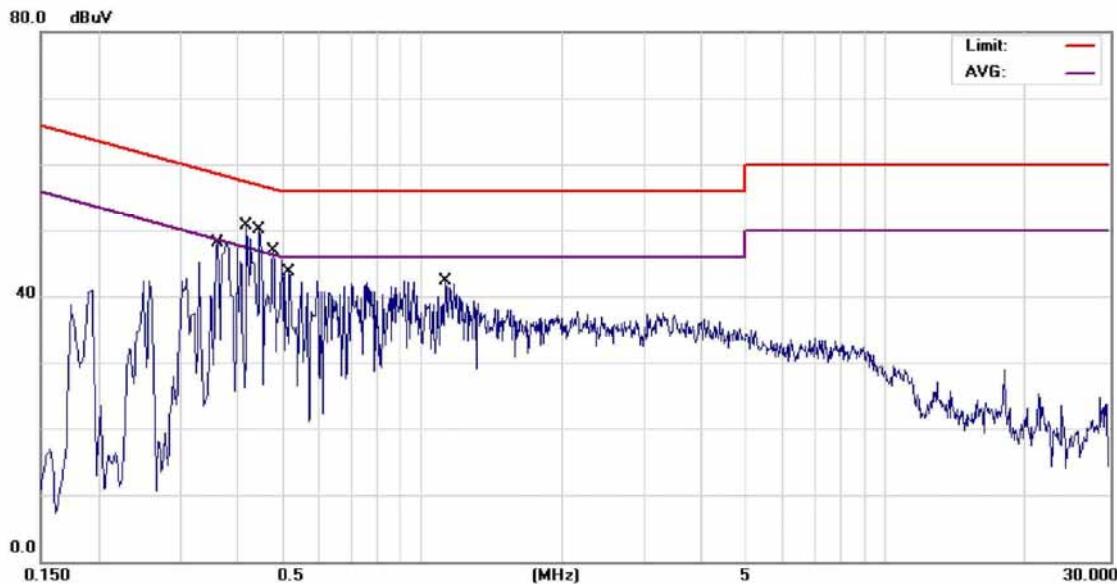
Site: SGS CONDUCTED #1	Phase: <b>L1</b>	Temperature: 26 °C
Limit: FCC Class B Conduction(QP)	Power: AC 110V/60Hz	Humidity: 59%
EUT: Data Collection Terminal	Distance:	Air Pressure: hpa
M/N: RH768		
Note: BT		

No.	Mk.	Freq. MHz	Reading Level dBuV	Factor dB	Measure- ment dBuV	Limit dB	Over	
							Detector	Comment
1	*	0.3860	47.76	0.12	47.88	58.15	-10.27	QP
2		0.4340	46.67	0.12	46.79	57.18	-10.39	QP
3		0.5020	43.30	0.12	43.42	56.00	-12.58	QP
4		0.7180	39.83	0.11	39.94	56.00	-16.06	QP
5		0.9300	41.46	0.11	41.57	56.00	-14.43	QP
6		1.2340	36.78	0.12	36.90	56.00	-19.10	QP

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Site: SGS CONDUCTED #1	Phase: <b>N</b>	Temperature: 26 °C
Limit: FCC Class B Conduction(QP)	Power: AC 110V/60Hz	Humidity: 59%
EUT: Data Collection Terminal	Distance:	Air Pressure: hpa
M/N: RH768		
Note: BT		

No.	Mk.	Freq.	Reading Level	Factor	Measure- ment	Limit	Over		
							dB	Detector	Comment
1		0.3620	48.00	0.16	48.16	58.68	-10.52	QP	
2 *		0.4180	47.30	0.16	47.46	57.49	-10.03	QP	
3		0.4180	31.52	0.16	31.68	47.49	-15.81	AVG	
4		0.4460	46.29	0.16	46.45	56.95	-10.50	QP	
5		0.4460	31.02	0.16	31.18	46.95	-15.77	AVG	
6		0.4780	43.76	0.16	43.92	56.37	-12.45	QP	
7		0.4780	29.36	0.16	29.52	46.37	-16.85	AVG	
8		0.5180	43.50	0.16	43.66	56.00	-12.34	QP	
9		1.1220	42.09	0.15	42.24	56.00	-13.76	QP	

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## 6. PEAK OUTPUT POWER MEASUREMENT

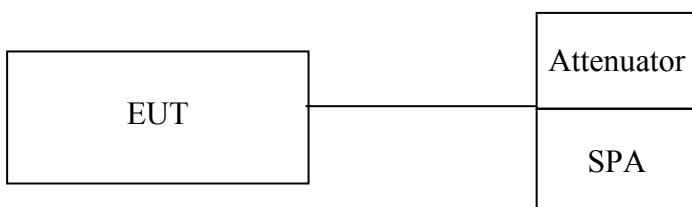
### 6.1. Standard Applicable

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: 0.125 Watts.

### 6.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Sensor	Anritsu	MA2411B	917032	01/21/2010	01/20/2012
Power Meter	Anritsu	ML2495A	1005007	02/17/2010	02/16/2012
Spectrum Analyzer	Agilent	E4446A	MY43360126	04/19/2010	04/18/2012
Spectrum Analyzer	Agilent	E4440A	MY45304525	01/25/2011	01/24/2012
DC Block	Agilent	BLK-18	155452	07/05/2011	07/04/2012
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/05/2011	01/04/2012
Attenuator	Mini-Circuit	BW-S6W5	001	01/05/2011	01/04/2012
Attenuator	Mini-Circuit	BW-S10W5	001	01/05/2011	01/04/2012
Attenuator	Mini-Circuit	BW-S20W5	001	01/05/2011	01/04/2012
Splitter	Agilent	11636B	N/A	01/05/2011	01/04/2012

### 6.3. Test Set-up:



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#### 6.4. 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 peak function, >20dB bandwidth, >=RBW)
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

#### 6.5. Measurement Result

##### BDR mode:

Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	2.59	2.59	0.00182	1
2441.00	2.42	2.42	0.00175	1
2480.00	1.75	1.75	0.00150	1

##### EDR mode:

Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	2.33	2.33	0.00171	1
2441.00	2.39	2.39	0.00173	1
2480.00	1.69	1.69	0.00148	1

\*Note: offset 16.5dB

Note: Refer to next page for plots.

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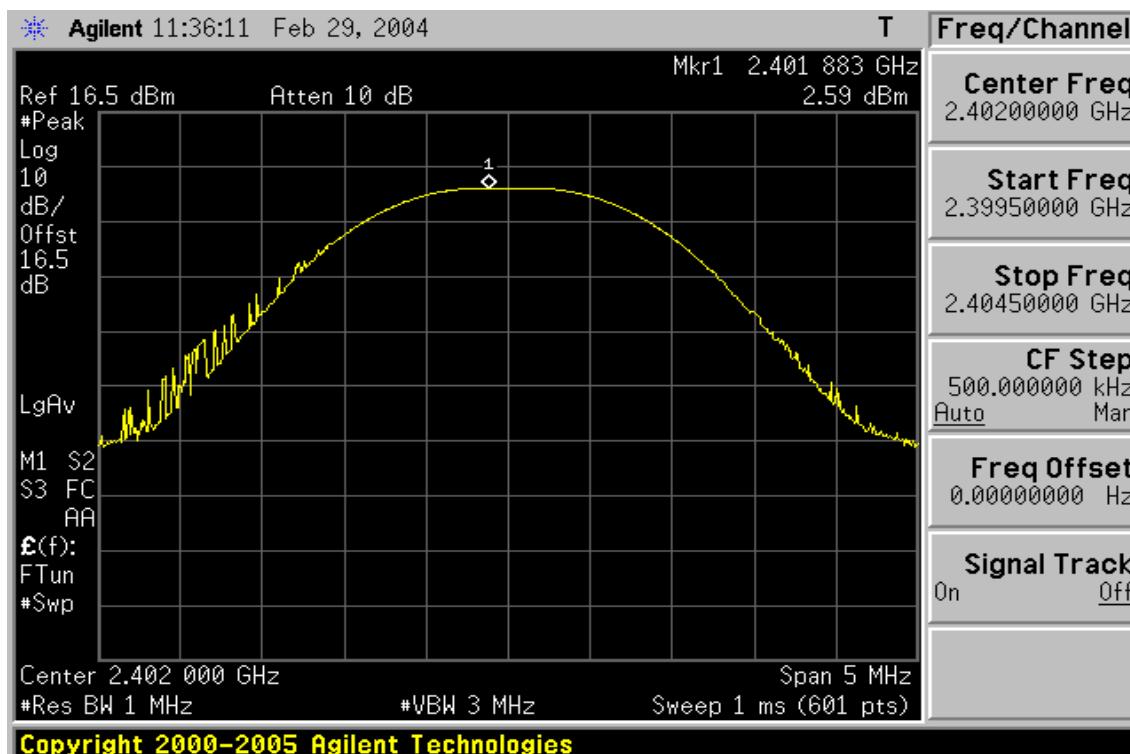
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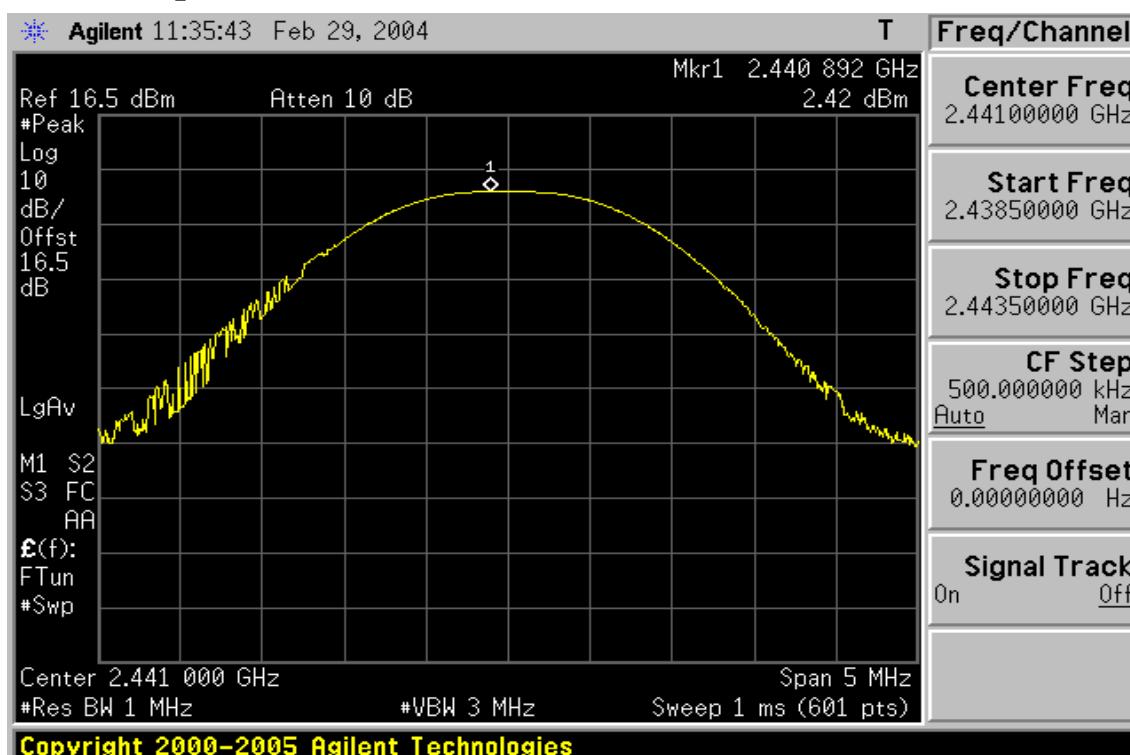
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## Peak Power Output Data Plot (CH Low) (BDR mode)



## Peak Power Output Data Plot (CH Mid) (BDR mode)



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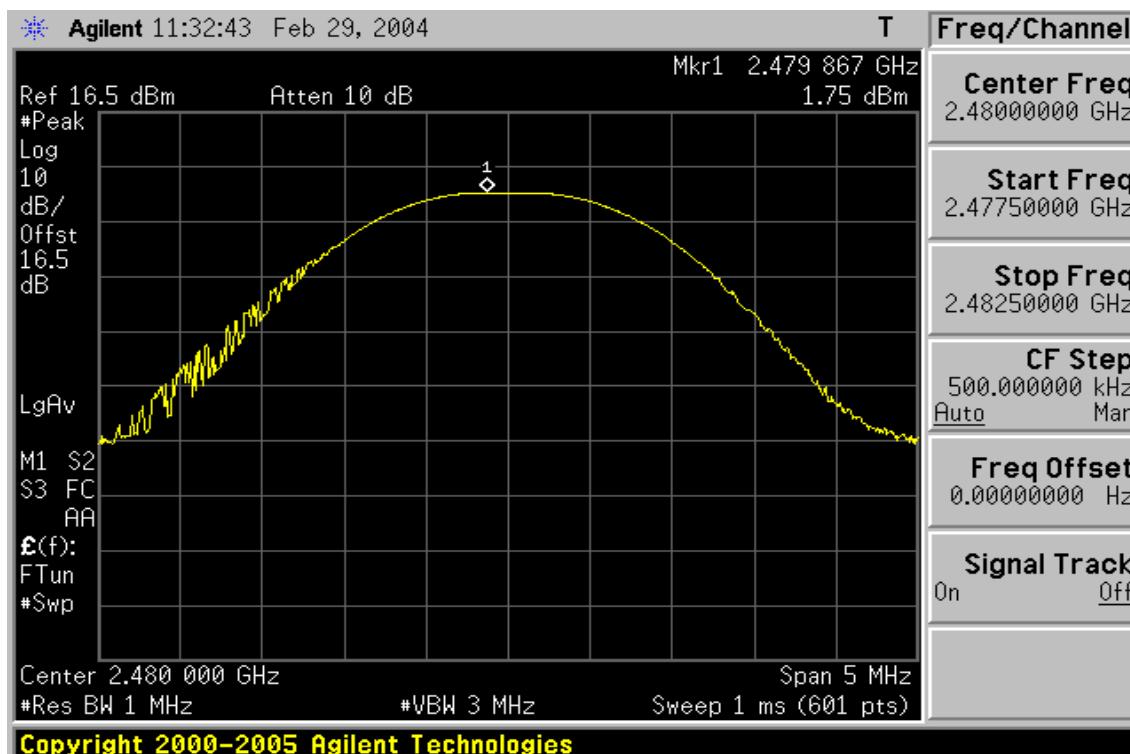
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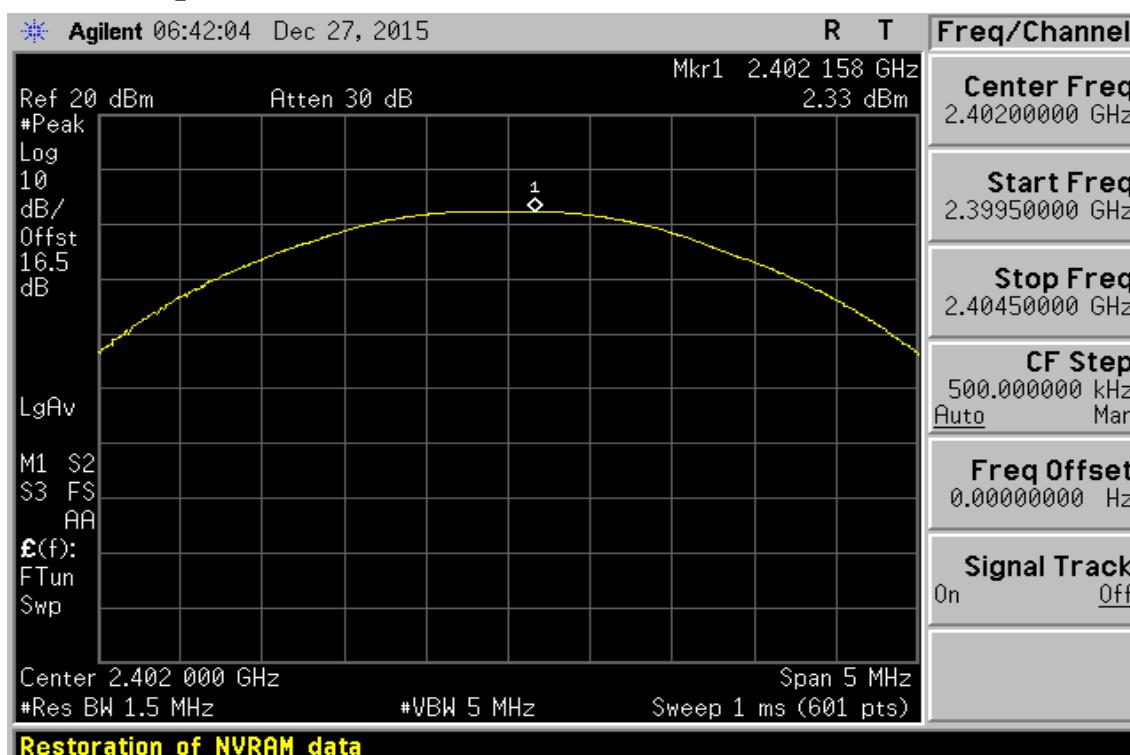
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## Peak Power Output Data Plot (CH High) (BDR mode)



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



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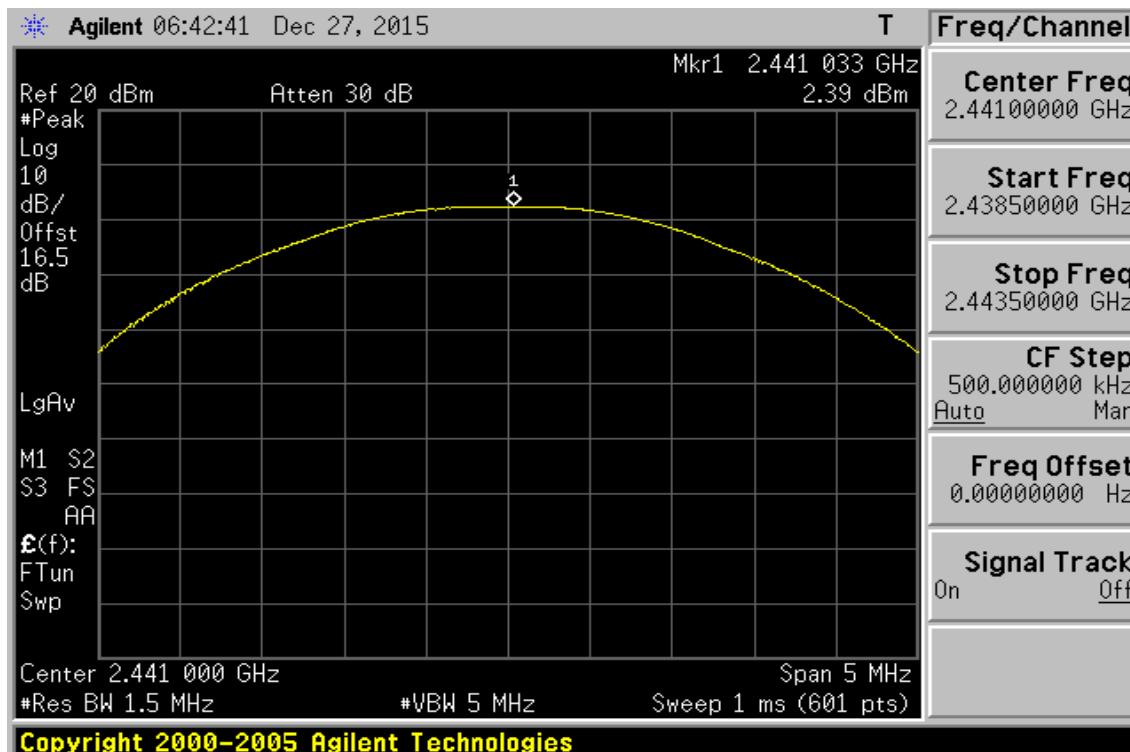
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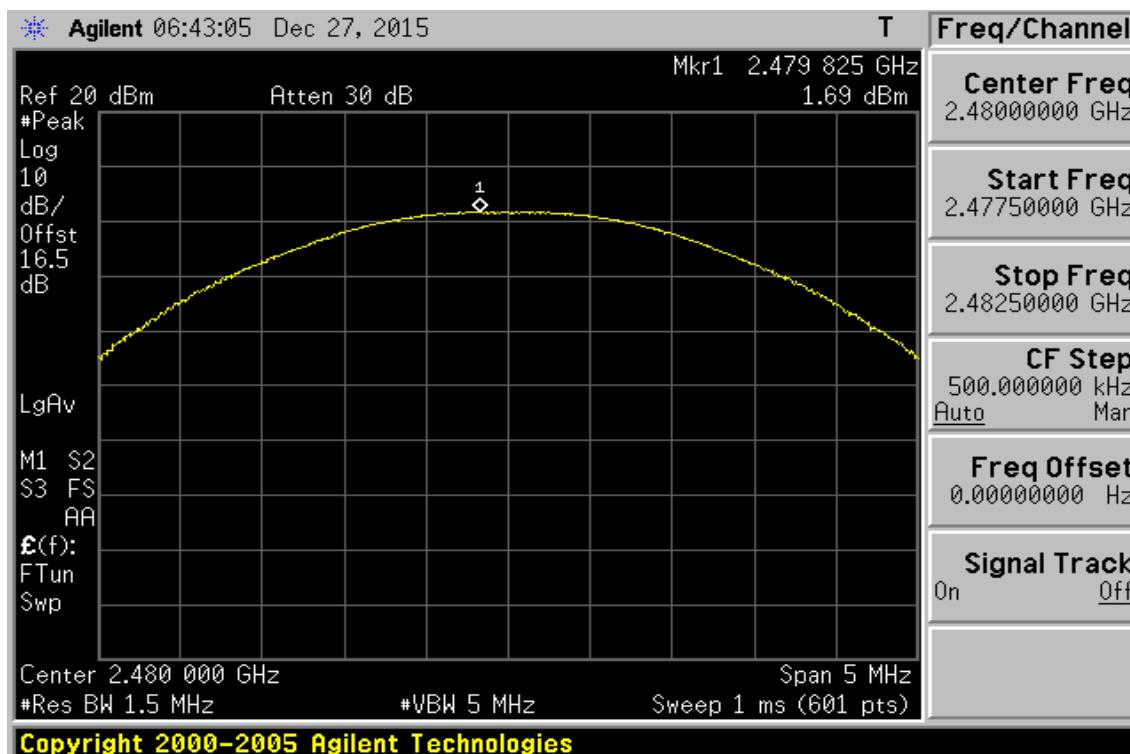
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## Peak Power Output Data Plot (CH Mid) (EDR mode)



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



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## 7. 20dB BAND WIDTH

### 7.1. Standard Applicable

For frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

### 7.2. Measurement Equipment Used

Refer to section 6.2 for details.

### 7.3. Test Set-up

Refer to section 6.3 for details.

### 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 spectrum analyzer.
3. Set the spectrum analyzer as RBW=10KHz (1 % of Bandwidth.), VBW = 3\*RBW, Span= 3MHz, Sweep=auto
4. Mark the peak frequency and -20dB (upper and lower) frequency.
5. Repeat above procedures until all frequency measured were complete.

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## 7.5. Measurement Result:

### BDR mode

CH	Bandwidth (kHz)
Lower	924.850
Mid	926.511
Higher	926.125

### EDR mode

CH	Bandwidth (MHz)	2/3 Bandwidth (MHz)
Lower	1.283	0.855
Mid	1.275	0.850
Higher	1.271	0.847

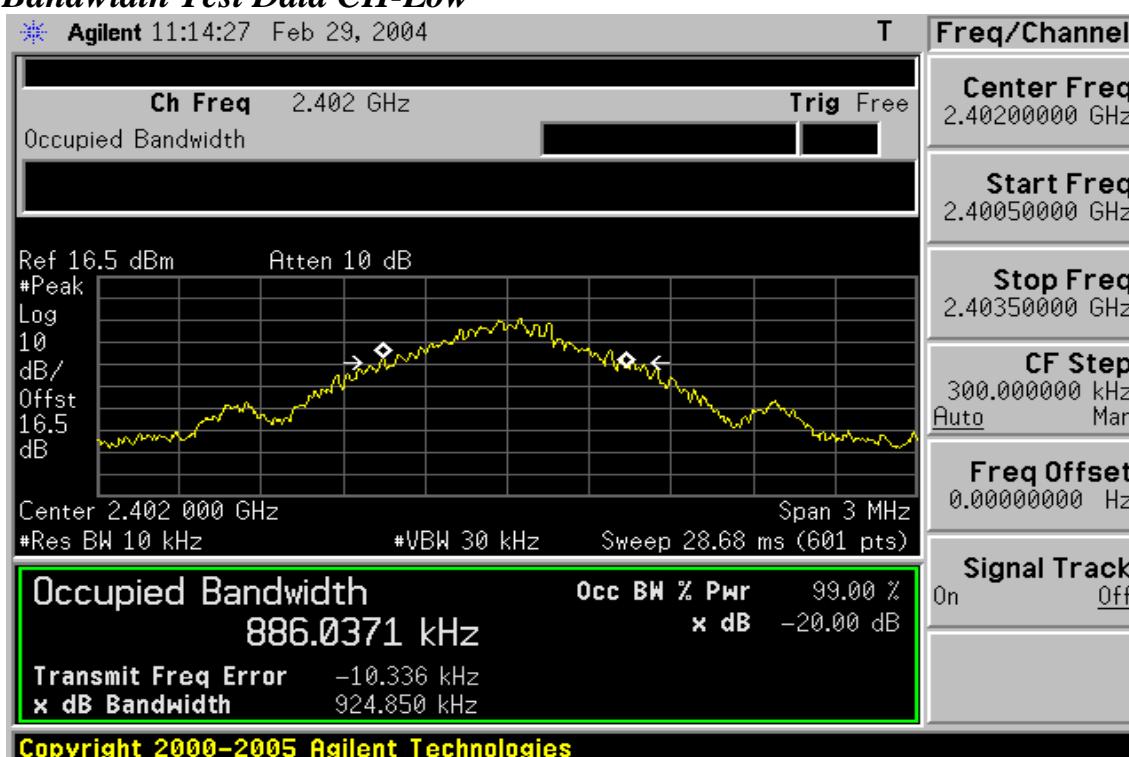
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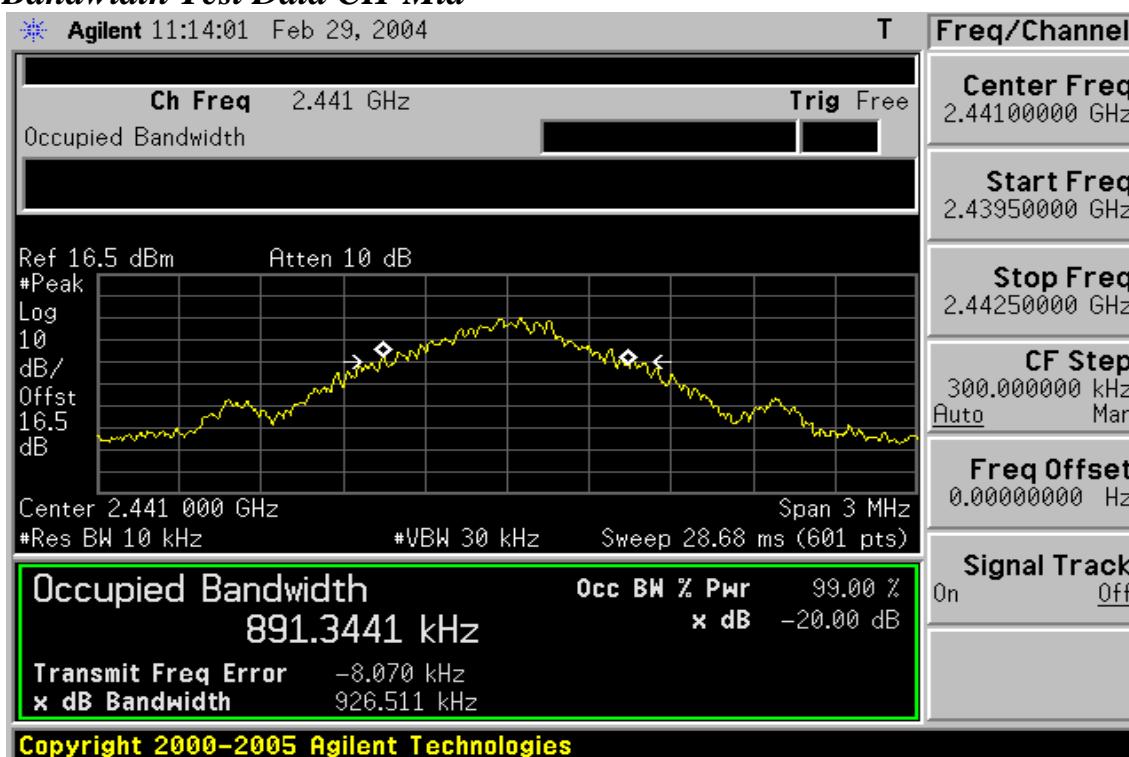
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### BDR Mode

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



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

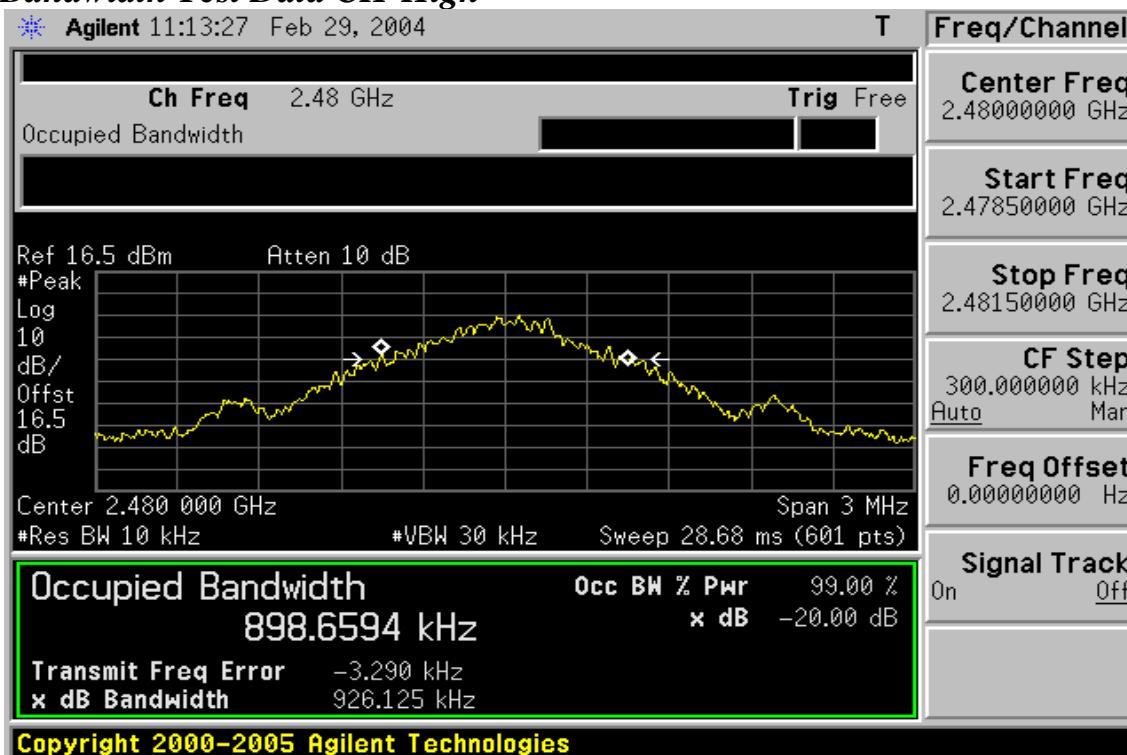


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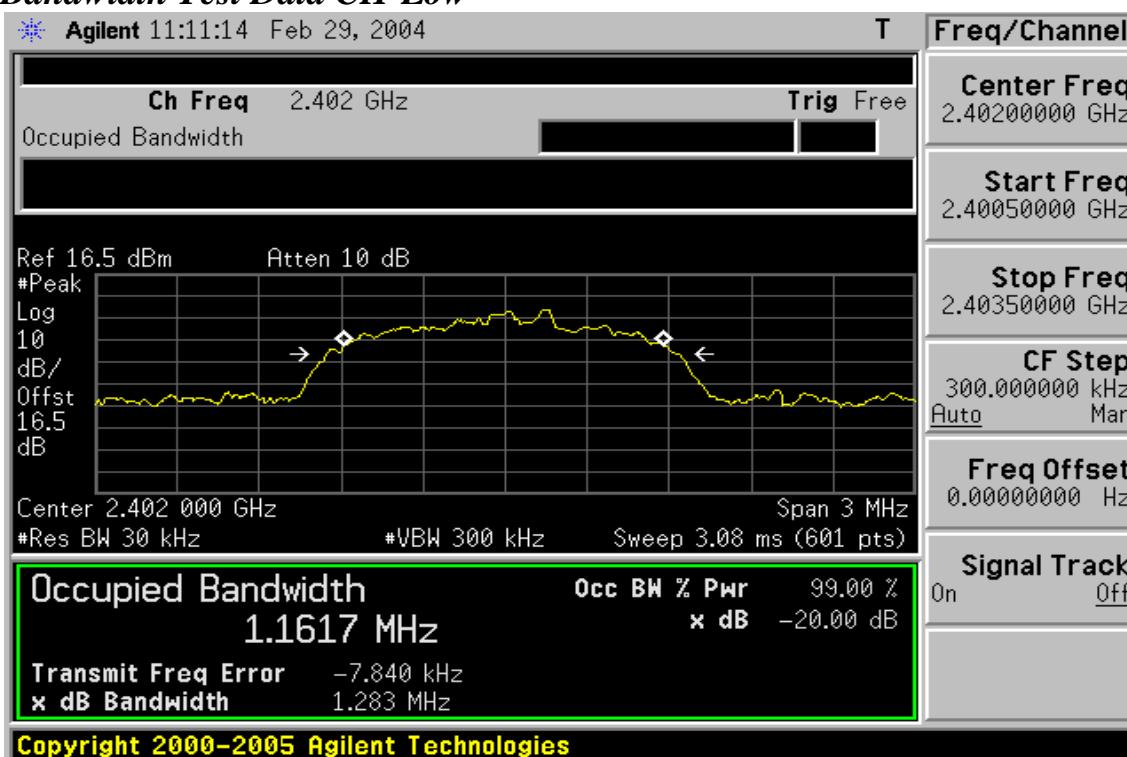
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### 20dB Bandwidth Test Data CH-High



### EDR Mode

### 20dB Bandwidth Test Data CH-Low

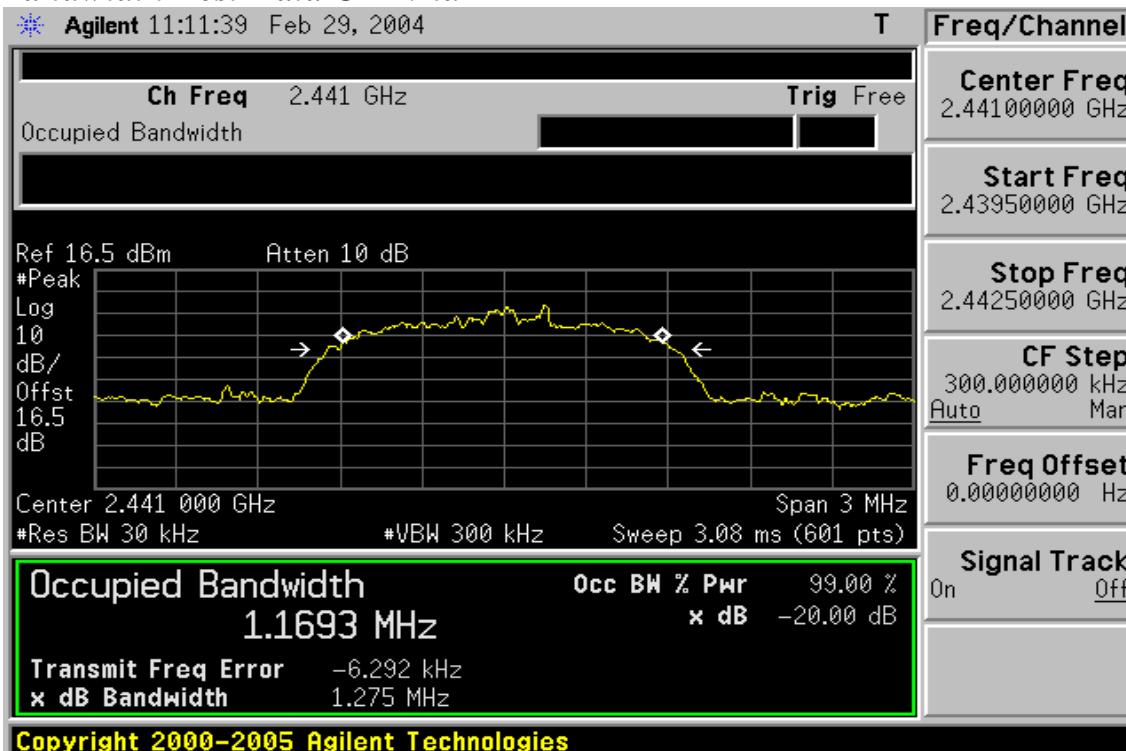


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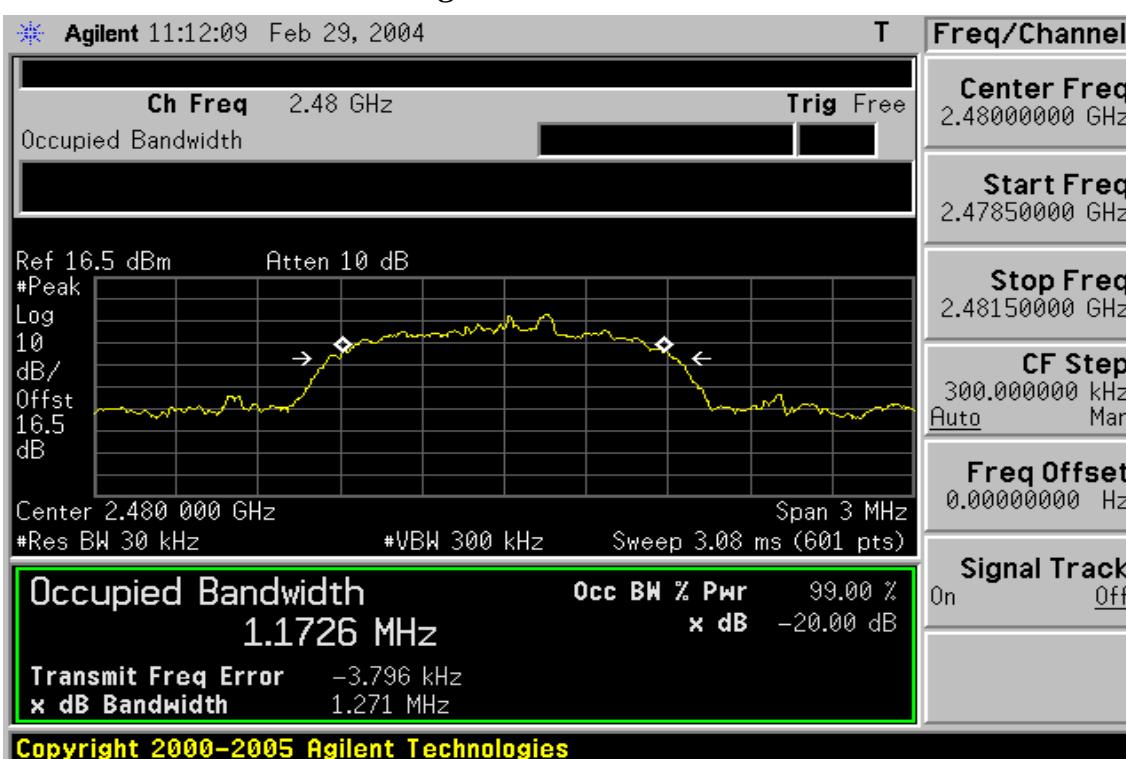
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### 20dB Bandwidth Test Data CH-Mid



### 20dB Bandwidth Test Data CH-High



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## 8. 100KHz BANDWIDTH OF BAND EDGES MEASUREMENT

### 8.1. Standard Applicable

According to §15.247(c), 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 100KHz 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).

### 8.2. Measurement Equipment Used

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

Refer to section 6.2 for details.

#### 8.2.2. Radiated emission:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	R&S	FSP 40	100034	03/30/2011	03/29/2012
Bilog Antenna	SCHWAZBECK	VULB9160	3136	11/19/2011	11/18/2012
Horn antenna	SCHWAZBECK	BBHA 9120D	309/320	01/22/2010	01/21/2012
Pre-Amplifier	Agilent	8447D	1937A02834	11/28/2011	11/27/2012
Pre-Amplifier	Agilent	8449B	3008A01973	01/05/2011	01/04/2012
Radio Communication Analyzer	R & S	CMU200	102189	08/12/2010	08/11/2012
DC Block	Agilent	BLK-18	155452	01/05/2011	01/04/2012
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	SUCOFLEX 104PEA-10M	10m	01/05/2011	01/04/2012
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	01/05/2011	01/04/2012
3m Site	SGS	966 chamber	N/A	07/15/2011	07/14/2012

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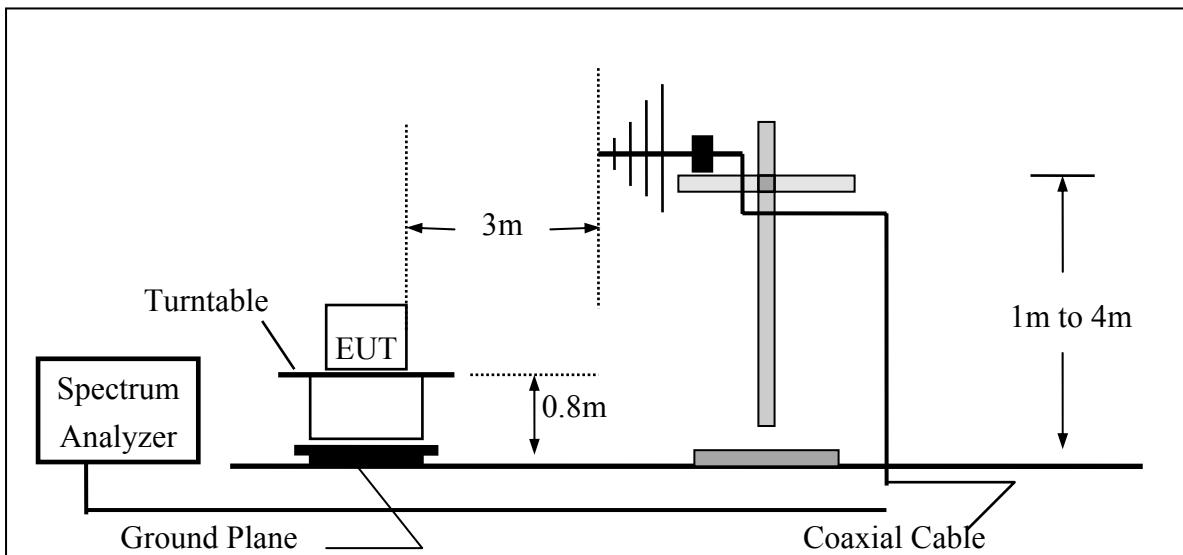
### 8.3. Test SET-UP:

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

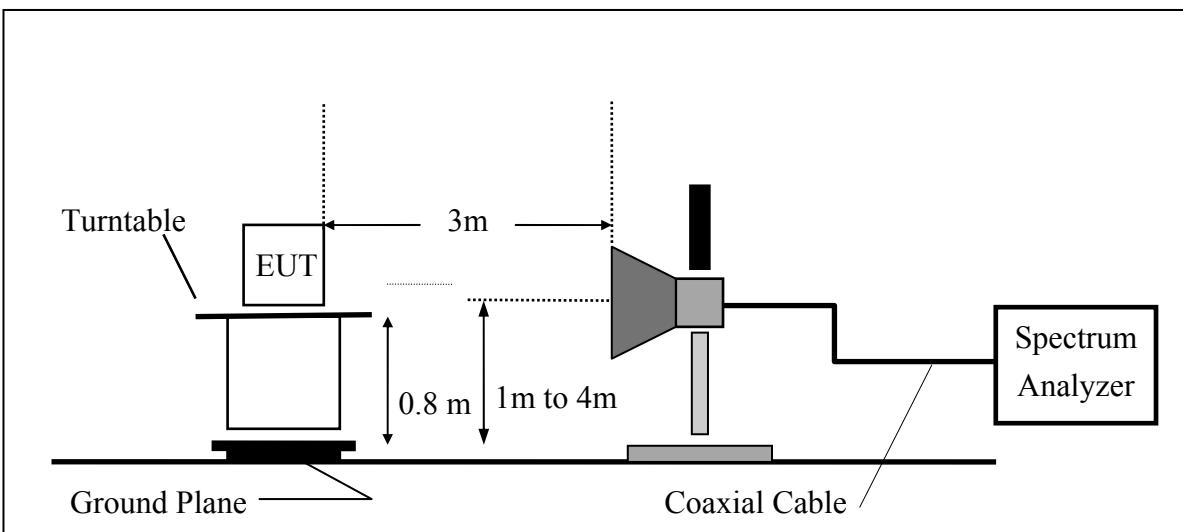
Refer to section 6.3 for details.

#### 8.3.2. 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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#### 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 center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100KHz, Span=10MHz, Sweep = auto
5. Mark Peak, 2.310GHz – 2.390GHz and 2.4835GHz – 2.500GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.
7. Radiated Emission refer to section 9.

#### 8.5. 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	

#### 8.6. Measurement Result

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

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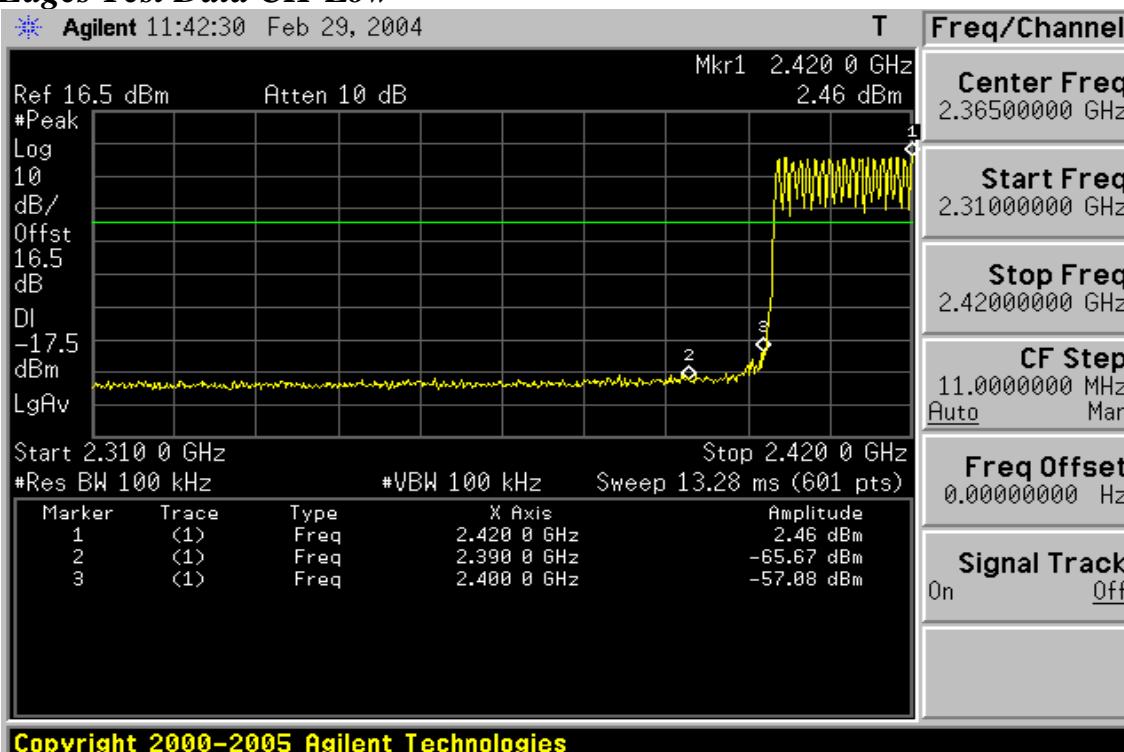
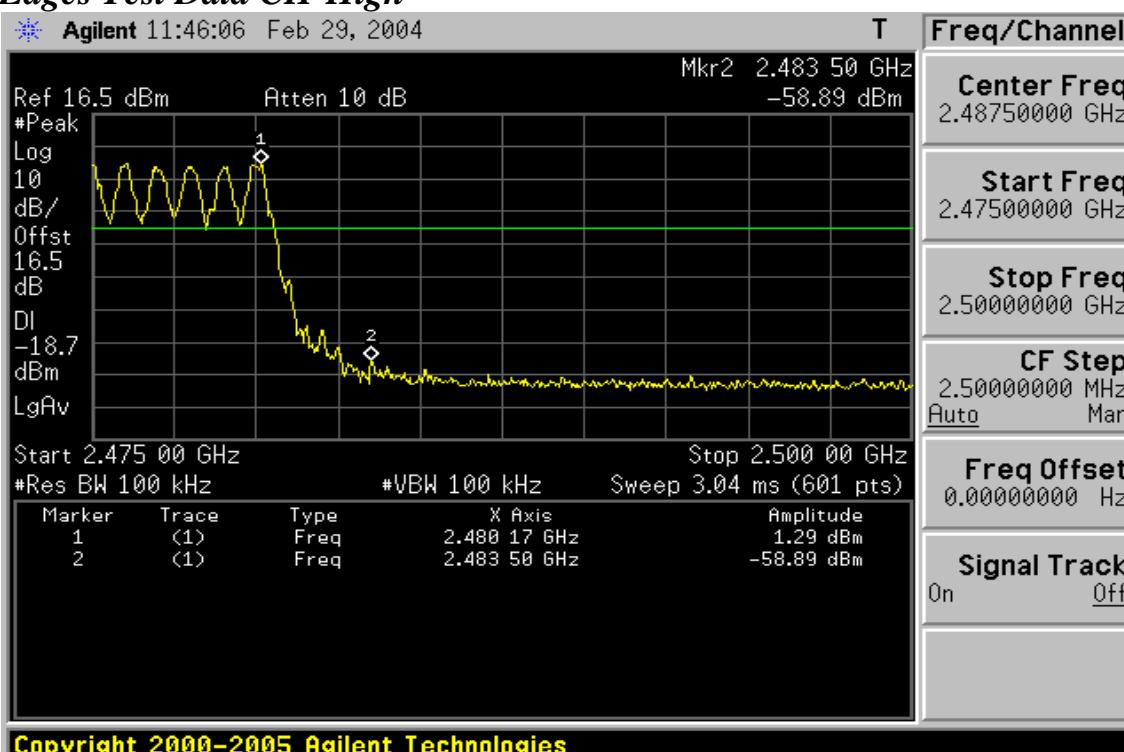
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**BDR Mode**
**Band Edges Test Data CH-Low**

**Band Edges Test Data CH-High**


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**Radiated Emission: (BDR mode)**

Operation Band :BDR Test Date :2011-11-23  
Fundamental Frequency :2402 Temp./Humi. :27 deg\_C / 66 RH  
Operation Mode :TX LOW Bandedge Engineer :Jay  
EUT Pol. :E2 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.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	PK/QP/AV	Mode	Reading Level	FS	@3m	Margin
2390.00	E	Peak	45.71	5.17	50.88	74.00	-23.12

Operation Band :BDR Test Date :2011-11-23  
Fundamental Frequency :2402 Temp./Humi. :27 deg\_C / 66 RH  
Operation Mode :TX LOW Bandedge Engineer :Jay  
EUT Pol. :E2 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.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	PK/QP/AV	Mode	Reading Level	FS	@3m	Margin
2390.00	E	Peak	45.36	5.79	51.15	74.00	-22.85

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Operation Band :BDR Test Date :2011-11-23  
 Fundamental Frequency :2480 Temp./Humi. :27 deg\_C / 66 RH  
 Operation Mode :TX HIGH Bandedge Engineer :Jay  
 EUT Pol. :E2 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 FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Safe Margin dB
2483.50	E	Peak	45.16	5.69	50.85	74.00	-23.15

Operation Band :BDR Test Date :2011-11-23  
 Fundamental Frequency :2480 Temp./Humi. :27 deg\_C / 66 RH  
 Operation Mode :TX HIGH Bandedge Engineer :Jay  
 EUT Pol. :E2 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)

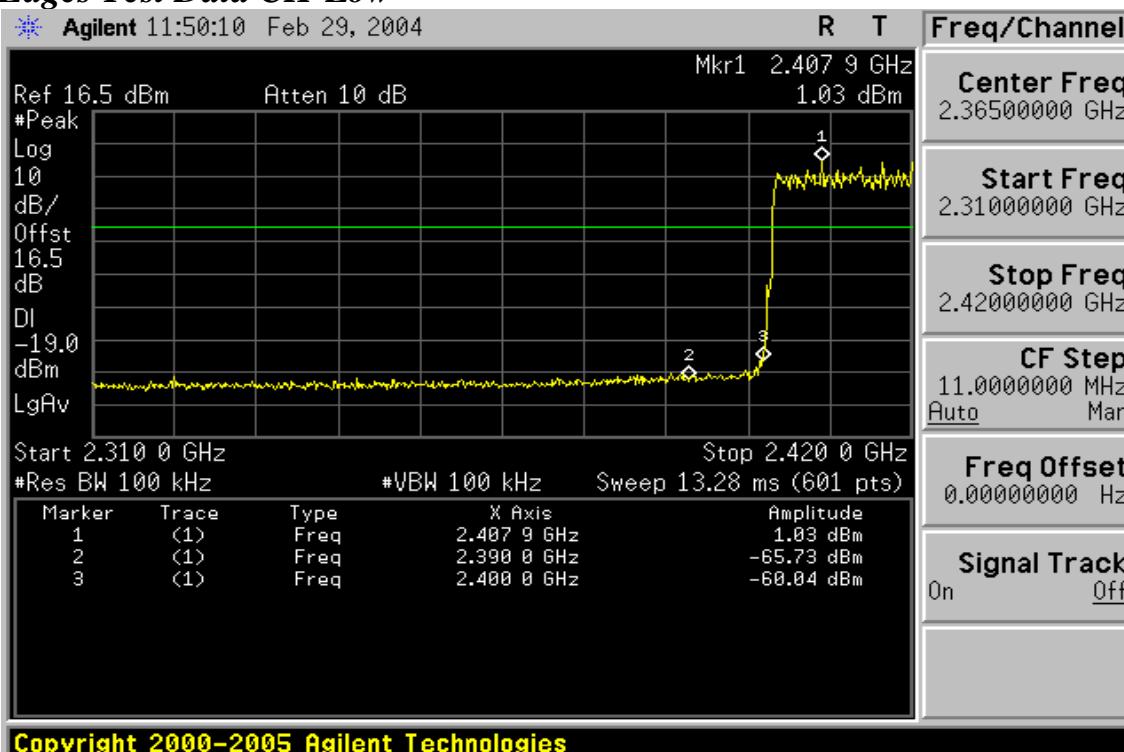
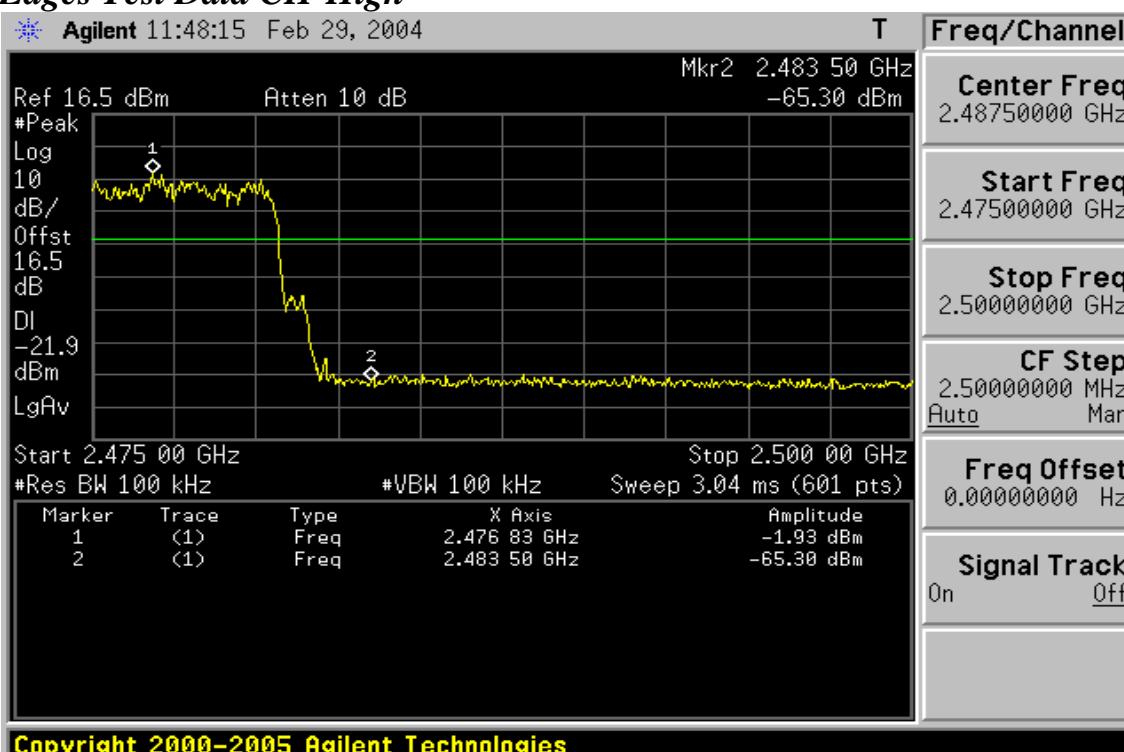
Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.  
 “E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.  
 “---“ : denotes Noise Floor.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB $\mu$ V	Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Safe Margin dB
2483.50	E	Peak	45.17	6.72	51.89	74.00	-22.11

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**EDR Mode**
**Band Edges Test Data CH-Low**

**Band Edges Test Data CH-High**


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**Radiated Emission: (EDR mode)**

Operation Band :EDR Test Date :2011-11-23  
Fundamental Frequency :2402 Temp./Humi. :27 deg\_C / 66 RH  
Operation Mode :TX LOW Bandedge Engineer :Jay  
EUT Pol. :E2 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.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	PK/QP/AV	Mode	Reading Level	FS	@3m	Margin

2390.00 E Peak 45.09 5.17 50.26 74.00 -23.74

Operation Band :EDR Test Date :2011-11-23  
Fundamental Frequency :2402 Temp./Humi. :27 deg\_C / 66 RH  
Operation Mode :TX LOW Bandedge Engineer :Jay  
EUT Pol. :E2 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.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	PK/QP/AV	Mode	Reading Level	FS	@3m	Margin

2390.00 E Peak 45.14 5.79 50.93 74.00 -23.07

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Operation Band :EDR Test Date :2011-11-23  
Fundamental Frequency :2480 Temp./Humi. :27 deg\_C / 66 RH  
Operation Mode :TX HIGH Bandedge Engineer :Jay  
EUT Pol. :E2 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 PK/QP/AV	Spectrum		Factor dB	Actual dBµV/m	Limit @3m dBµV/m	Safe Margin dB
			Mode	Reading Level dBµV				
2483.50	E	Peak	45.41	5.69	51.10	74.00	-22.90	

Operation Band :EDR Test Date :2011-11-23  
Fundamental Frequency :2480 Temp./Humi. :27 deg\_C / 66 RH  
Operation Mode :TX HIGH Bandedge Engineer :Jay  
EUT Pol. :E2 Measurement Antenna Pol. :HORIZONTAL

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

Factor(dB) = Antenna Factor(dBuV/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.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
MHz	F/H/E/S	PK/QP/AV	Mode	Reading	Level	FS	@3m	Margin
2483.50	E	Peak	45.50	6.72	52.22	74.00	-21.78	

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## 9. SPURIOUS RADIATED EMISSION TEST

### 9.1. Standard Applicable

According to §15.247(c), all other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). 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.

### 9.2. Measurement Equipment Used:

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

Refer to section 6.2 for details.

#### 9.2.2. Radiated emission:

Refer to section 7.2 for details.

### 9.3. Test SET-UP:

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

Refer to section 6.3 for details.

#### 9.3.2. Radiated emission:

Refer to section 7.3 for details.

### 9.4. Measurement Procedure:

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 measured were complete.

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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:

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

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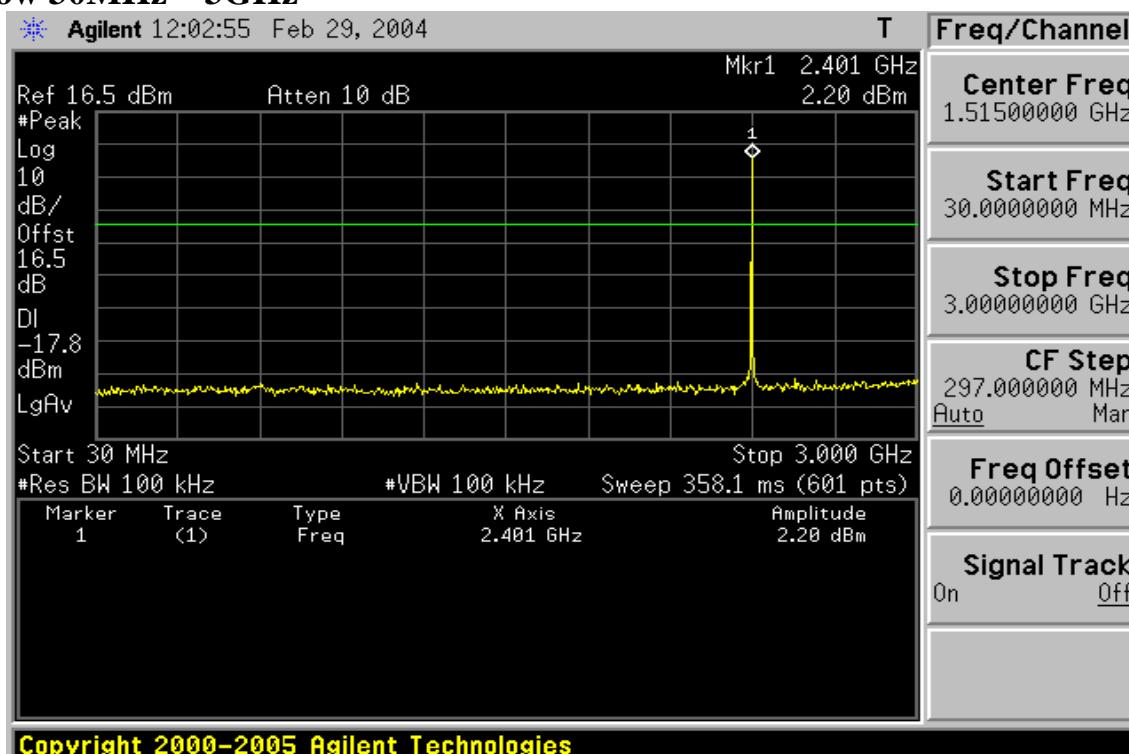
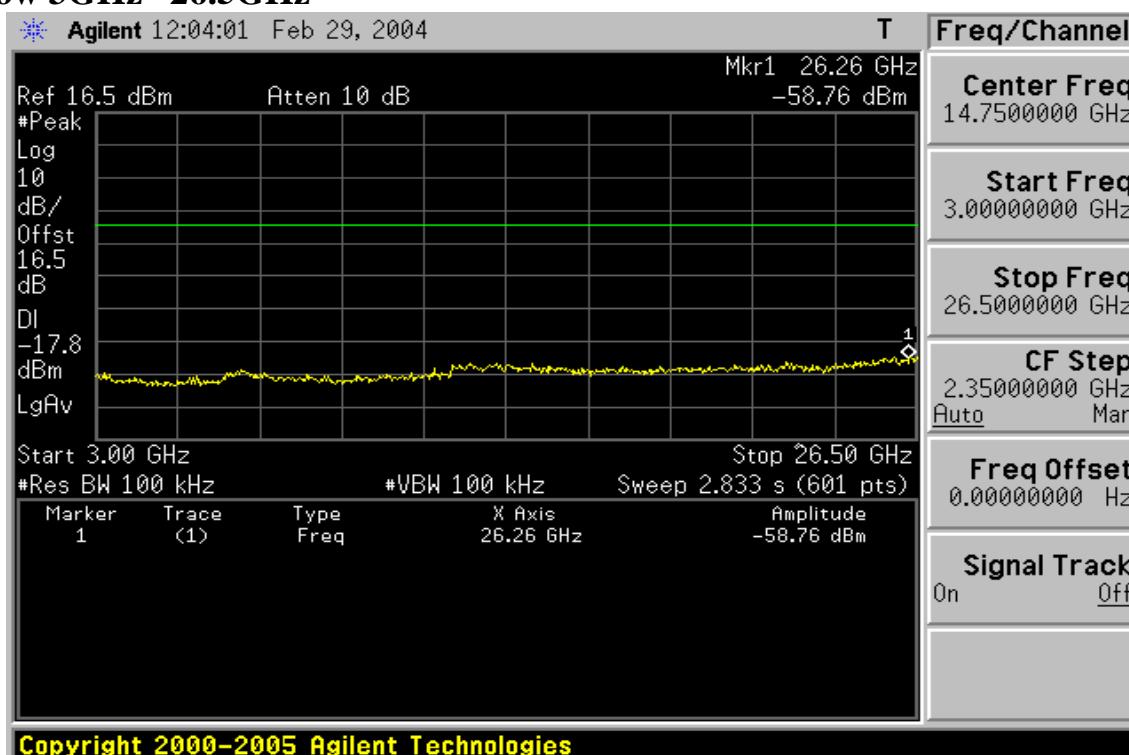
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**BDR Mode Conducted Spurious Emission Measurement Result (Worst Case)**  
**Ch Low 30MHz – 3GHz****Ch Low 3GHz –26.5GHz**

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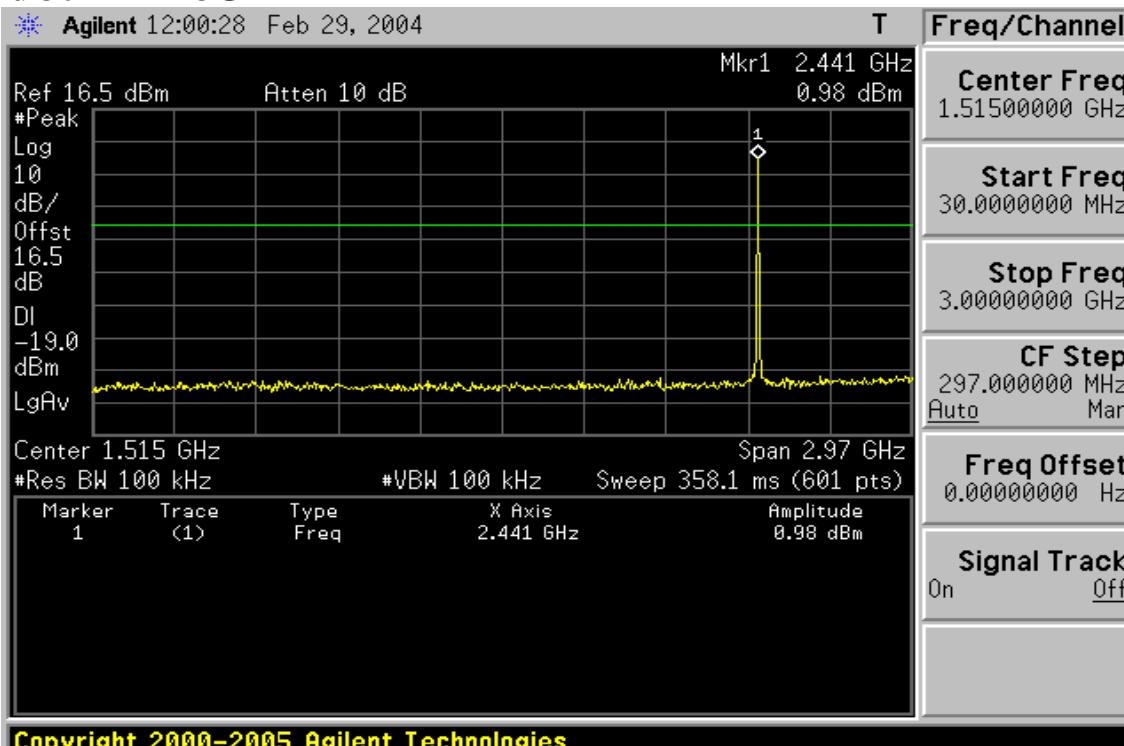
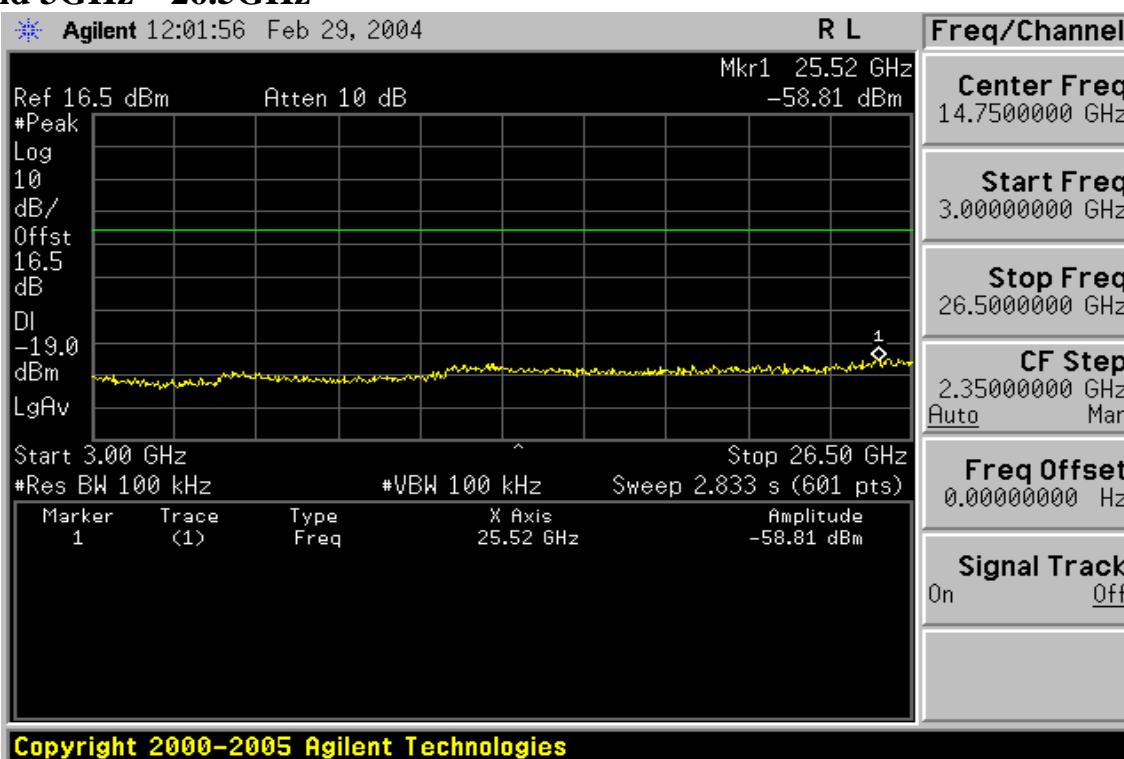
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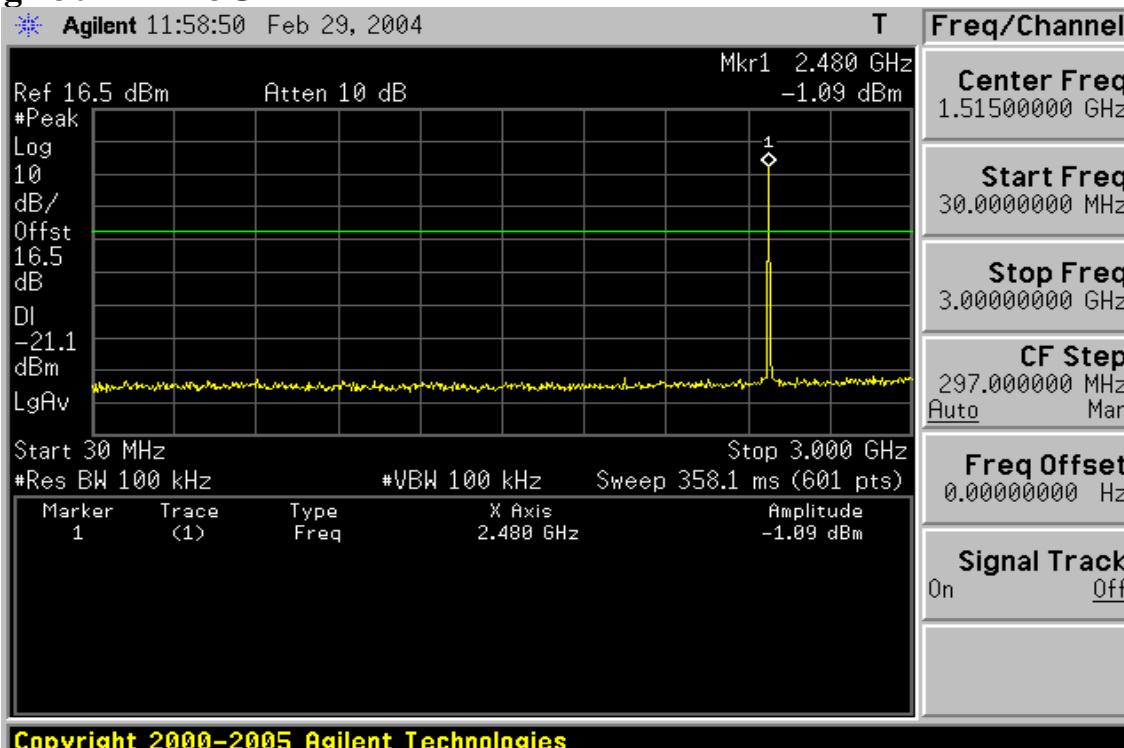
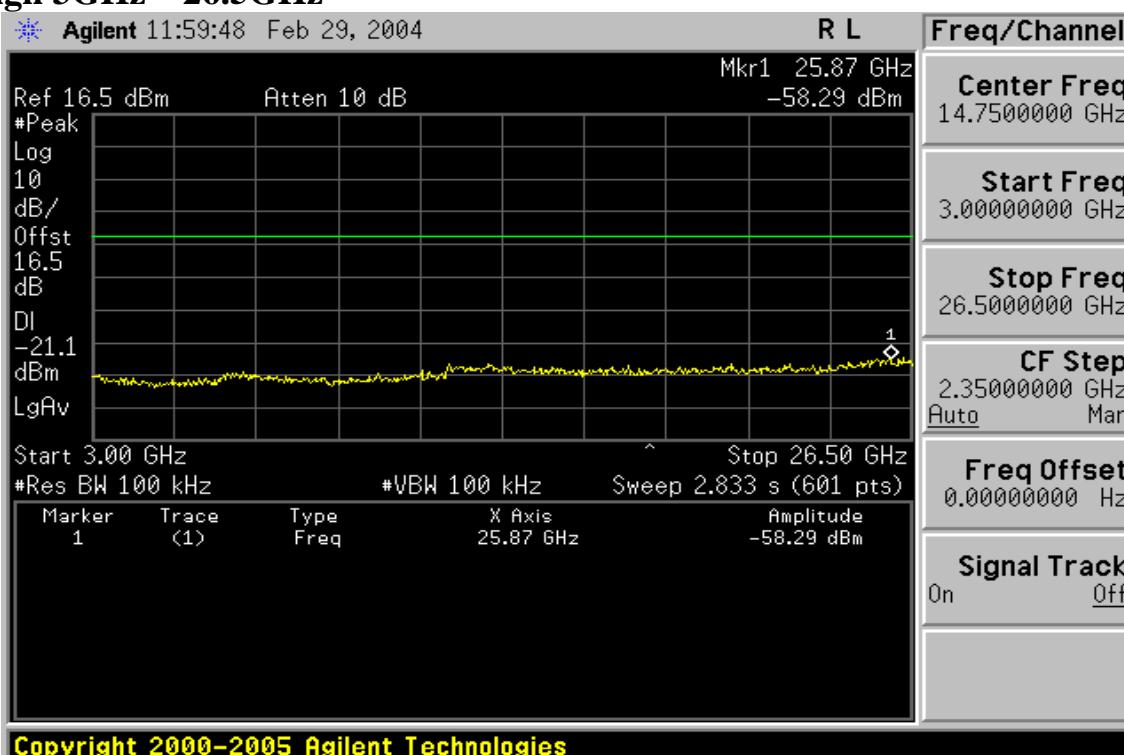
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**Ch Mid 30MHz – 3GHz**

**Ch Mid 3GHz – 26.5GHz**


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**Ch High 30MHz – 3GHz**

**Ch High 3GHz – 26.5GHz**


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**Radiated Spurious Emission Measurement Result (below 1GHz) (Worst BDR mode)**

Operation Band :BDR Test Date :2011-11-23  
Fundamental Frequency :2402 Temp./Humi. :27 deg\_C / 66 RH  
Operation Mode :TX LOW Engineer :Jay  
EUT Pol. :E2 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		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Safe Margin dB
			Reading	Level dB $\mu$ V				
191.99	S	Peak	47.08	-15.03	32.05	43.50	-11.45	
292.87	S	Peak	46.29	-12.01	34.28	46.00	-11.72	
409.27	S	Peak	39.76	-10.09	29.67	46.00	-16.33	
532.46	S	Peak	36.15	-8.29	27.86	46.00	-18.14	
676.02	S	Peak	41.19	-5.50	35.69	46.00	-10.31	
696.39	S	Peak	38.60	-5.17	33.43	46.00	-12.57	
1656.50	S	Peak	41.25	1.78	43.03	74.00	-30.97	
4804.00	H	Peak	34.74	9.95	44.69	74.00	-29.31	
7206.00	---							
9608.00	---							
12010.00	---							
14412.00	---							
16814.00	---							
19216.00	---							
21618.00	---							
24020.00	---							

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Operation Band	:BDR	Test Date	:2011-11-23
Fundamental Frequency	:2402	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX LOW	Engineer	:Jay
EUT Pol.	:E2	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 Reading Level	Factor dB	Actual	Limit	Safe
					FS dB $\mu$ V	dB $\mu$ V/m	dB $\mu$ V/m
214.30	S	Peak	50.42	-14.78	35.64	43.50	-7.86
292.87	S	Peak	54.56	-12.01	42.55	46.00	-3.45
409.27	S	Peak	41.86	-10.09	31.77	46.00	-14.23
696.39	S	Peak	37.48	-5.17	32.31	46.00	-13.69
738.10	S	Peak	37.84	-4.34	33.50	46.00	-12.50
779.81	S	Peak	36.51	-3.77	32.74	46.00	-13.26
1617.50	S	Peak	42.75	1.94	44.69	74.00	-29.31
4804.00	H	Peak	34.93	9.99	44.92	74.00	-29.08
7206.00	---						
9608.00	---						
12010.00	---						
14412.00	---						
16814.00	---						
19216.00	---						
21618.00	---						
24020.00	---						

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Operation Band	:BDR	Test Date	:2011-11-23
Fundamental Frequency	:2441	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX MID	Engineer	:Jay
EUT Pol.	:E2	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	Limit	Safe
					FS dB $\mu$ V	dB $\mu$ V/m	dB $\mu$ V/m
194.90	S	Peak	47.31	-15.13	32.18	43.50	-11.32
292.87	S	Peak	46.44	-12.01	34.43	46.00	-11.57
409.27	S	Peak	39.91	-10.09	29.82	46.00	-16.18
509.18	S	Peak	38.01	-8.57	29.44	46.00	-16.56
634.31	S	Peak	34.54	-6.04	28.50	46.00	-17.50
717.73	S	Peak	37.20	-4.74	32.46	46.00	-13.54
4882.00	H	Peak	34.89	10.28	45.17	74.00	-28.83
7323.00	---						
9764.00	---						
12205.00	---						
14646.00	---						
17087.00	---						
19528.00	---						
21969.00	---						
24410.00	---						

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Operation Band :BDR Test Date :2011-11-23  
Fundamental Frequency :2441 Temp./Humi. :27 deg\_C / 66 RH  
Operation Mode :TX MID Engineer :Jay  
EUT Pol. :E2 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 Reading Level	Factor dB	Actual	Limit	Safe
					FS dB $\mu$ V	dB $\mu$ V/m	dB $\mu$ V/m
214.30	S	Peak	50.64	-14.78	35.86	43.50	-7.64
292.87	S	Peak	54.67	-12.01	42.66	46.00	-3.34
370.47	S	Peak	41.90	-10.58	31.32	46.00	-14.68
409.27	S	Peak	41.96	-10.09	31.87	46.00	-14.13
623.64	S	Peak	36.00	-6.19	29.81	46.00	-16.19
738.10	S	Peak	35.52	-4.34	31.18	46.00	-14.82
2664.00	S	Peak	42.18	6.48	48.66	74.00	-25.34
4882.00	H	Peak	35.08	10.22	45.30	74.00	-28.70
7323.00	---						
9764.00	---						
12205.00	---						
14646.00	---						
17087.00	---						
19528.00	---						
21969.00	---						
24410.00	---						

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Operation Band	:BDR	Test Date	:2011-11-23
Fundamental Frequency	:2480	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX HIGH	Engineer	:Jay
EUT Pol.	:E2	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	Limit	Safe
					FS dB $\mu$ V	dB $\mu$ V/m	dB $\mu$ V/m
191.99	S	Peak	47.08	-15.03	32.05	43.50	-11.45
292.87	S	Peak	46.15	-12.01	34.14	46.00	-11.86
409.27	S	Peak	40.40	-10.09	30.31	46.00	-15.69
546.04	S	Peak	35.90	-7.92	27.98	46.00	-18.02
717.73	S	Peak	38.13	-4.74	33.39	46.00	-12.61
832.19	S	Peak	28.49	-3.08	25.41	46.00	-20.59
2196.00	S	Peak	39.71	4.83	44.54	74.00	-29.46
4960.00	H	Peak	34.36	10.91	45.27	74.00	-28.73
7440.00	---						
9920.00	---						
12400.00	---						
14880.00	---						
17360.00	---						
19840.00	---						
22320.00	---						
24800.00	---						

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Operation Band	:BDR	Test Date	:2011-11-23
Fundamental Frequency	:2480	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX HIGH	Engineer	:Jay
EUT Pol.	:E2	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 Reading Level		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Safe Margin dB
			PK/QP/AV	dB $\mu$ V				
214.30	S	Peak	50.51	-14.78	35.73	43.50	-7.77	
292.87	S	Peak	54.44	-12.01	42.43	46.00	-3.57	
409.27	S	Peak	41.95	-10.09	31.86	46.00	-14.14	
623.64	S	Peak	36.56	-6.19	30.37	46.00	-15.63	
696.39	S	Peak	37.66	-5.17	32.49	46.00	-13.51	
841.89	S	Peak	33.60	-2.95	30.65	46.00	-15.35	
1643.50	S	Peak	41.19	2.37	43.56	74.00	-30.44	
4960.00	H	Peak	34.58	10.76	45.34	74.00	-28.66	
7440.00	---							
9920.00	---							
12400.00	---							
14880.00	---							
17360.00	---							
19840.00	---							
22320.00	---							
24800.00	---							

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## 10. FREQUENCY SEPARATION

### 10.1. Standard Applicable

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

### 10.2. Measurement Equipment Used:

Refer to section 6.2 for details.

### 10.3. Test Set-up:

Refer to section 6.3 for details.

### 10.4. 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=100KHz, Adjust Span to 5 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

### 10.5. Measurement Result:

Channel separation (MHz)	Limit	Result
1	$\geq 25$ KHz or $2/3$ times 20dB bandwidth	PASS

Note: Refer to next page for plots.

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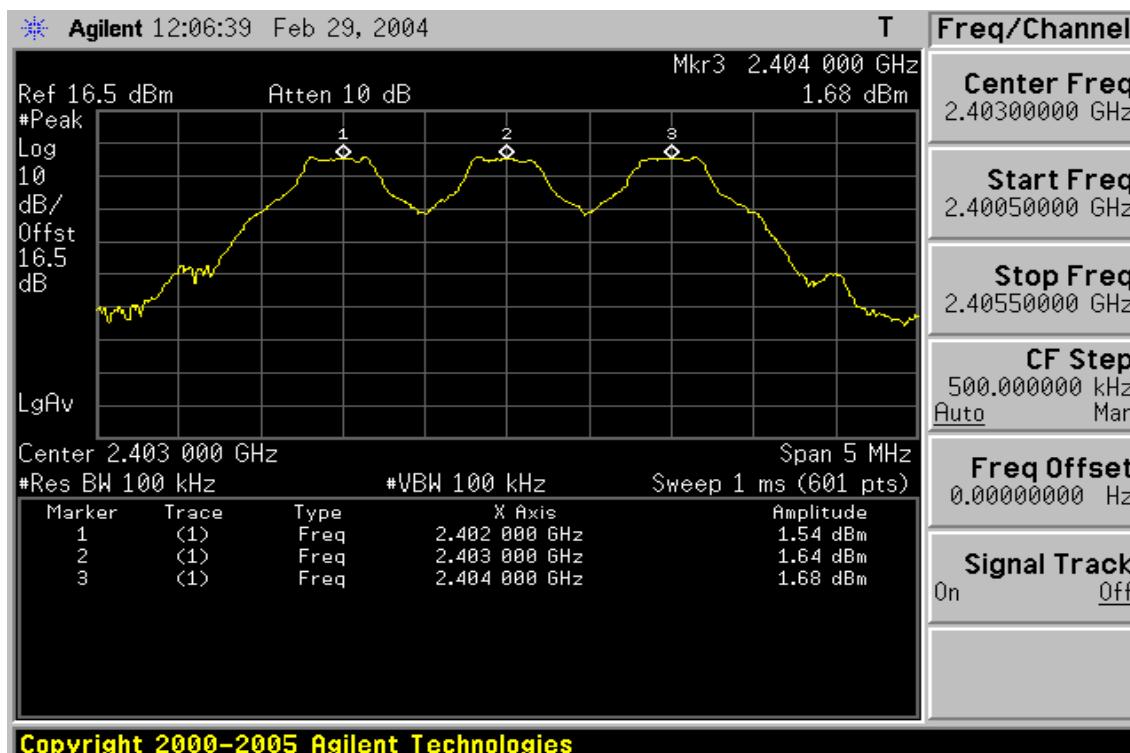
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## Frequency Separation Test Data



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## 11. NUMBER OF HOPPING FREQUENCY

### 11.1. 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.

### 11.2. Measurement Equipment Used:

Refer to section 6.2 for details.

### 11.3. Test Set-up:

Refer to section 6.3 for details.

### 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 spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=430KHz, VBW=1.5MHz.
5. Max hold, view and count how many channel in the band.

### 11.5. Measurement Result:

Note: Refer to next page for plots.

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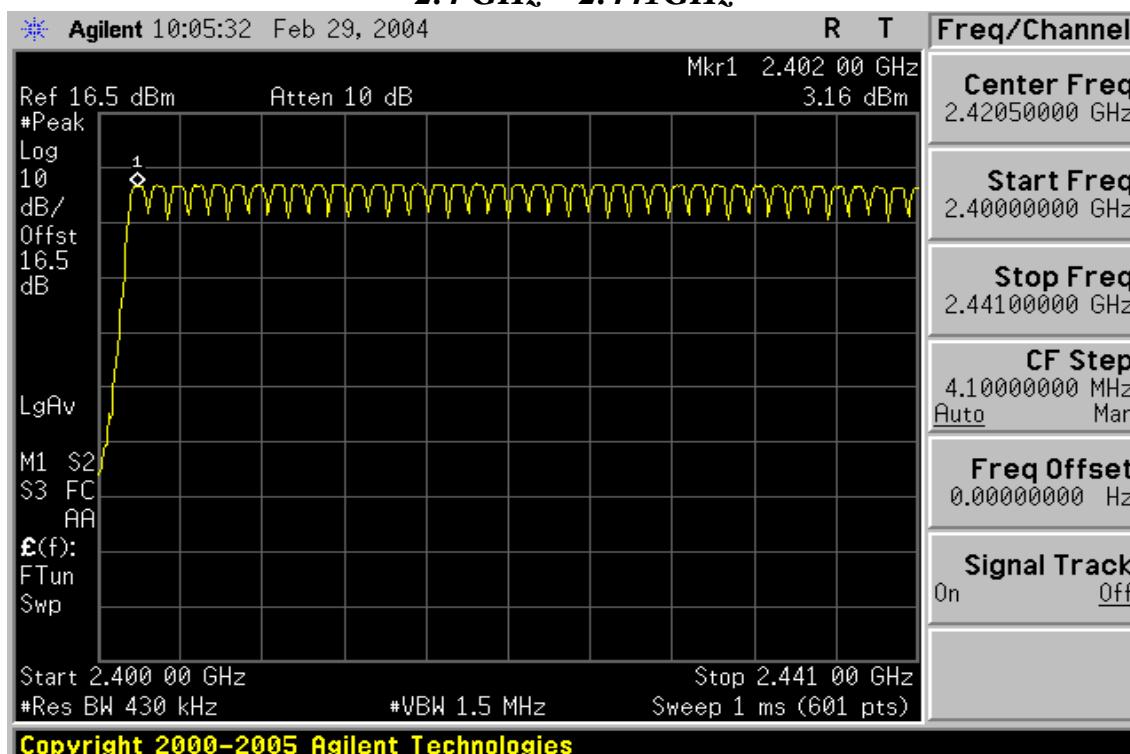
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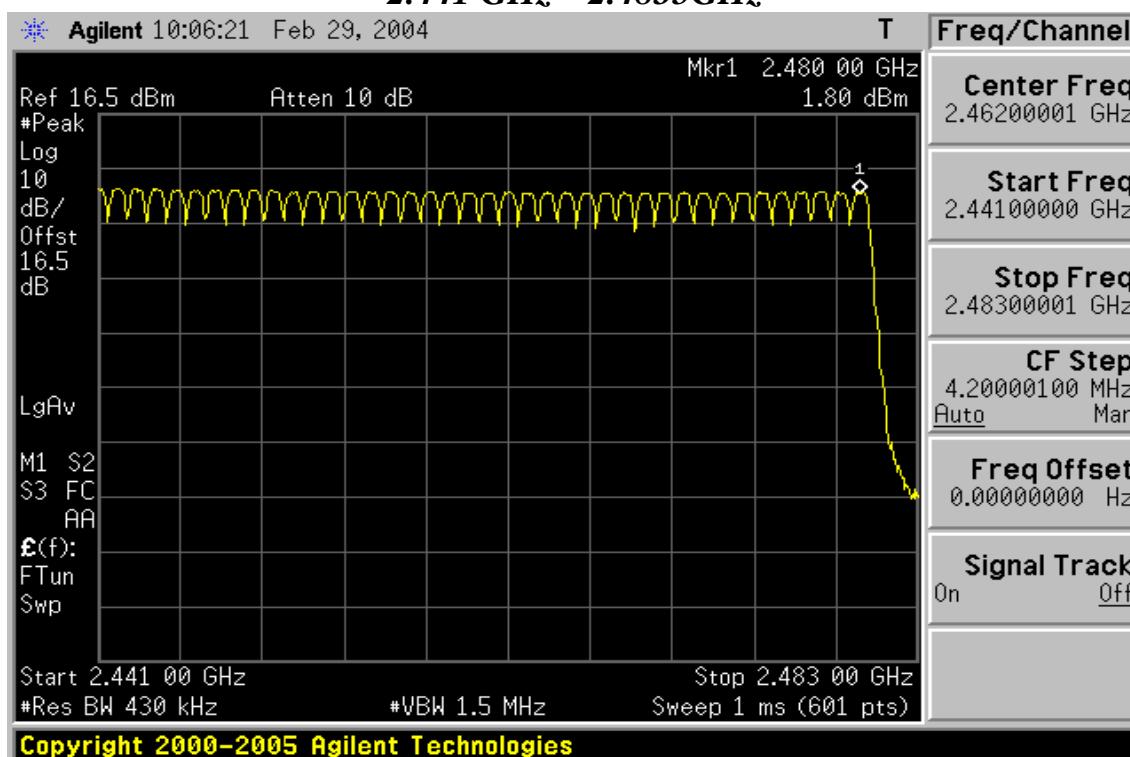
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## Channel Number

### 2.4 GHz – 2.441GHz



### 2.441 GHz – 2.4835GHz



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## 12. TIME OF OCCUPANCY (DWELL TIME)

### 12.1. 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.

### 12.2. Measurement Equipment Used:

Refer to section 6.2 for details.

### 12.3. Test Set-up:

Refer to section 6.3 for details.

### 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 center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW = 1MHz, VBW = 3MHz, Span = 0Hz , Adjust Sweep = 2~7ms.
5. Repeat above procedures until all frequency measured were complete.

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## 12.5. Measurement Result

A period time =  $0.4 \text{ (s)} * 79 = 31.6 \text{ (s)}$

CH Low:      DH1 time slot =  $0.380 \text{ (ms)} * (1600/(2*79)) * 31.6 = 121.60 \text{ (ms)}$   
DH3 time slot =  $1.642 \text{ (ms)} * (1600/(4*79)) * 31.6 = 262.72 \text{ (ms)}$   
DH5 time slot =  $2.895 \text{ (ms)} * (1600/(6*79)) * 31.6 = 308.80 \text{ (ms)}$

CH Mid:      DH1 time slot =  $0.380 \text{ (ms)} * (1600/(2*79)) * 31.6 = 121.60 \text{ (ms)}$   
DH3 time slot =  $1.642 \text{ (ms)} * (1600/(4*79)) * 31.6 = 262.72 \text{ (ms)}$   
DH5 time slot =  $2.895 \text{ (ms)} * (1600/(6*79)) * 31.6 = 308.80 \text{ (ms)}$

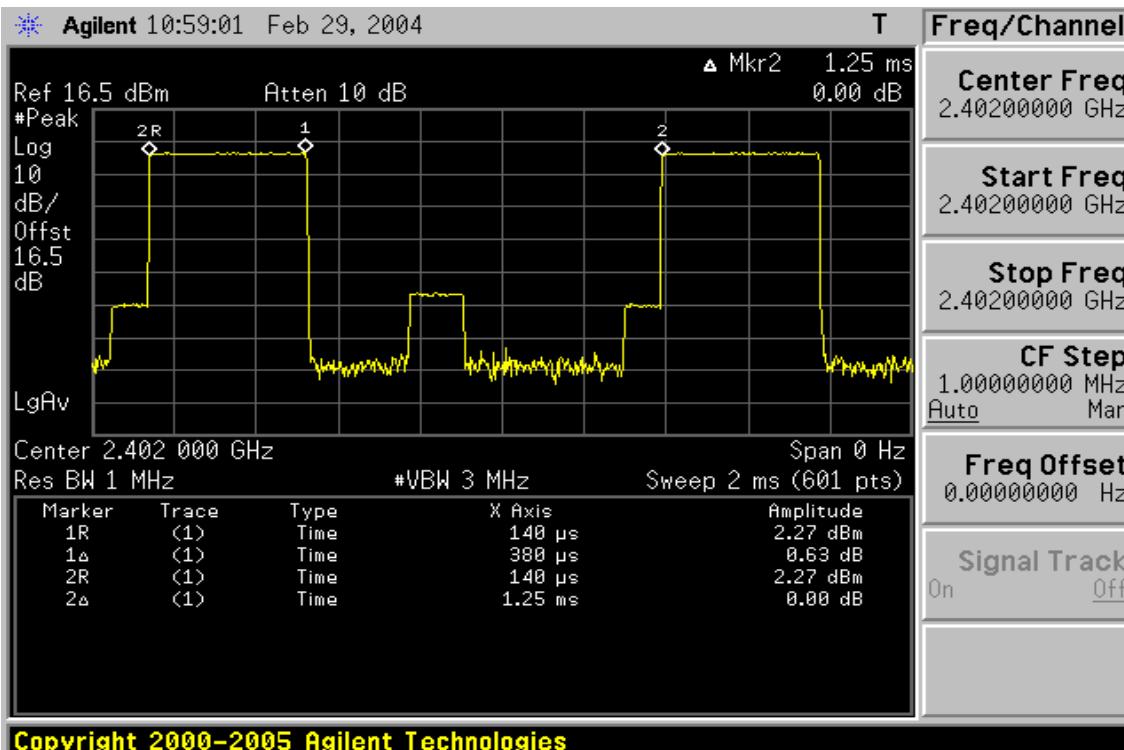
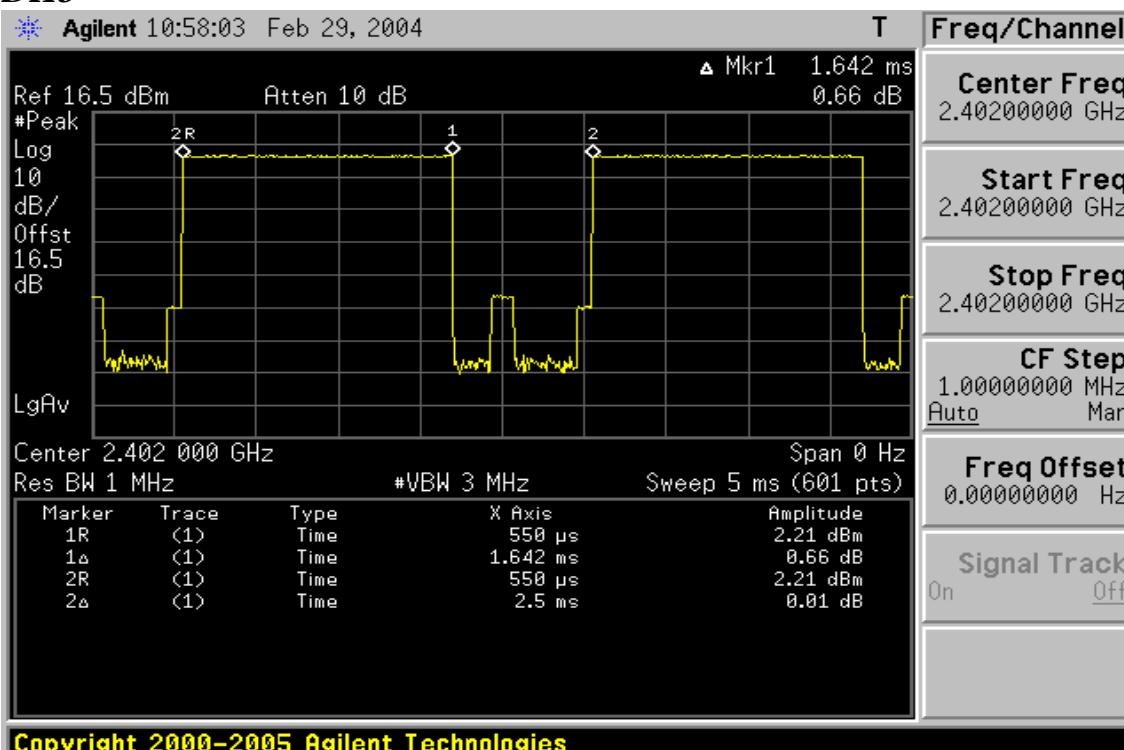
CH High:      DH1 time slot =  $0.380 \text{ (ms)} * (1600/(2*79)) * 31.6 = 121.60 \text{ (ms)}$   
DH3 time slot =  $1.633 \text{ (ms)} * (1600/(4*79)) * 31.6 = 261.28 \text{ (ms)}$   
DH5 time slot =  $2.883 \text{ (ms)} * (1600/(6*79)) * 31.6 = 307.52 \text{ (ms)}$

Note: Refer to next page for plots.

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**CH-Low**
**DH1**

**DH3**


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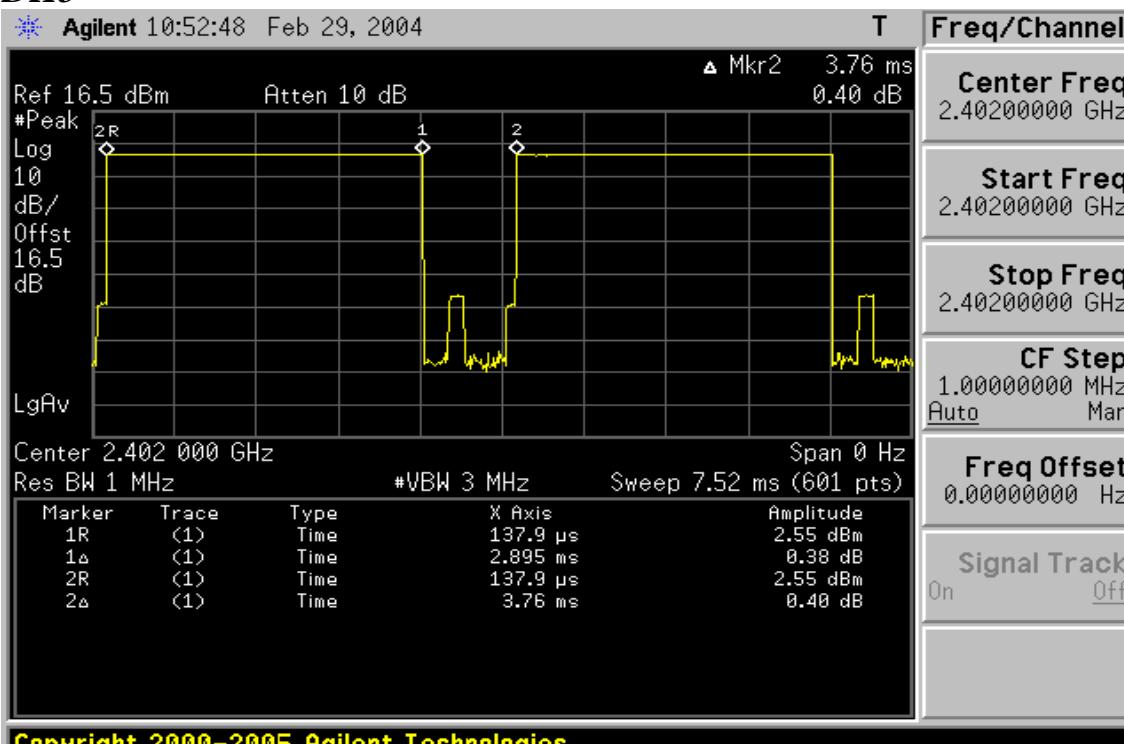
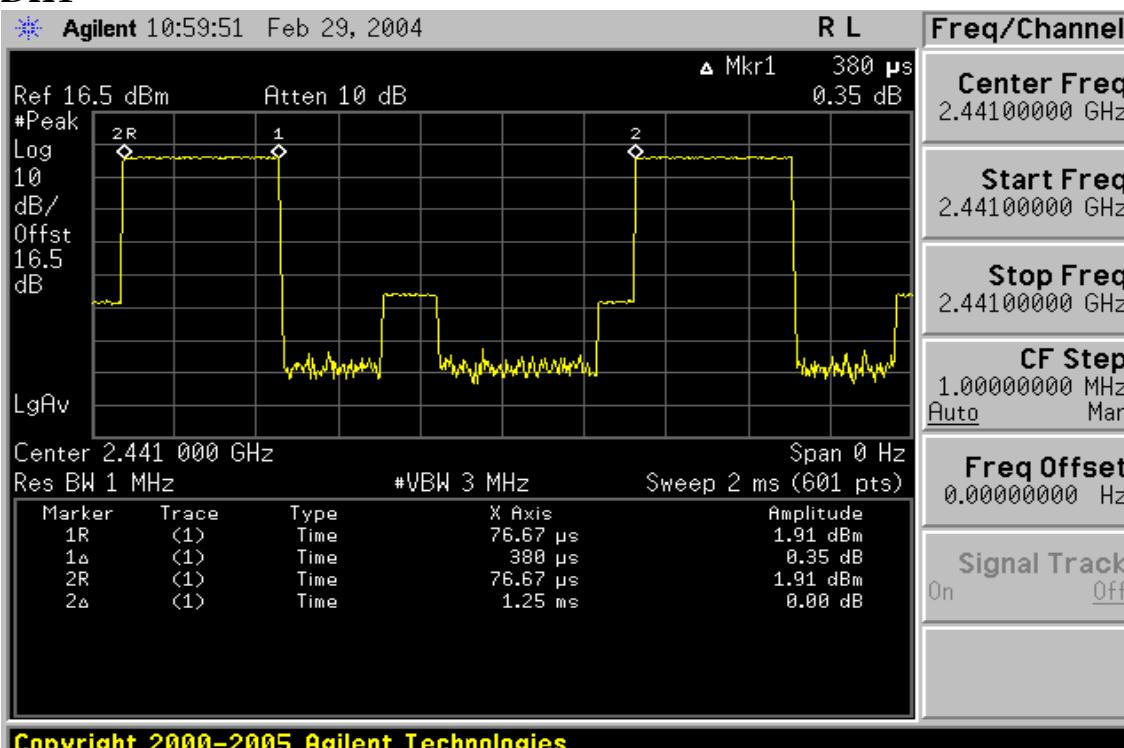
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**DH5**

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

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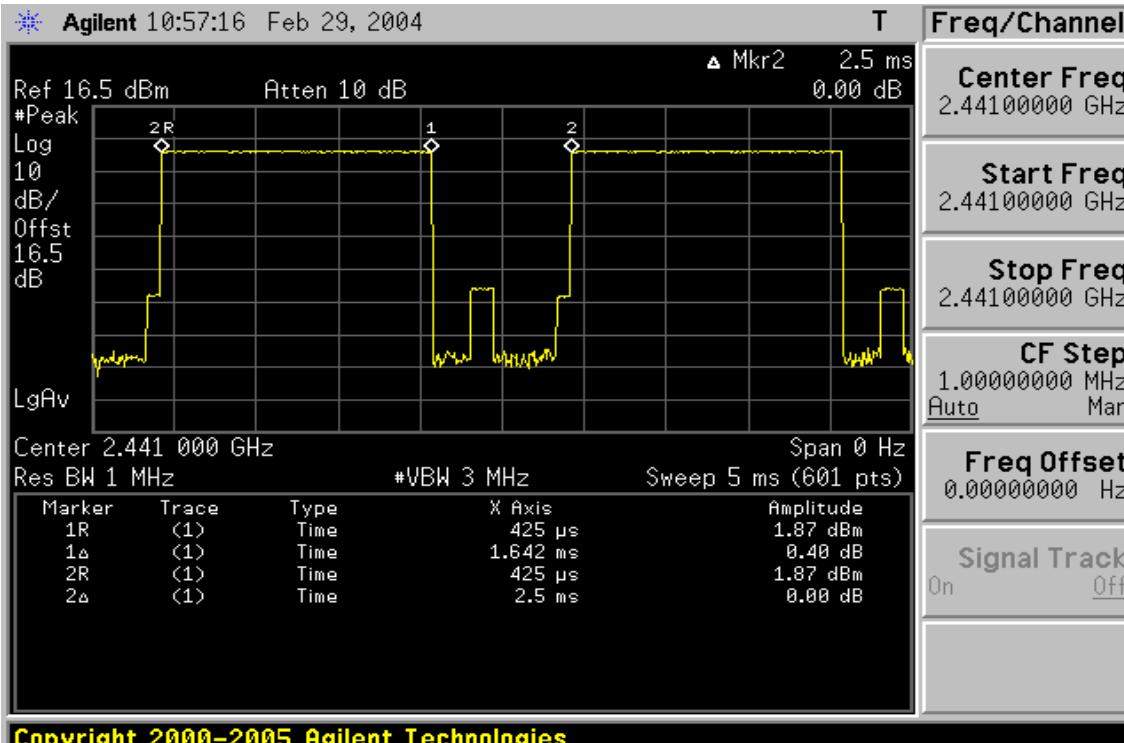
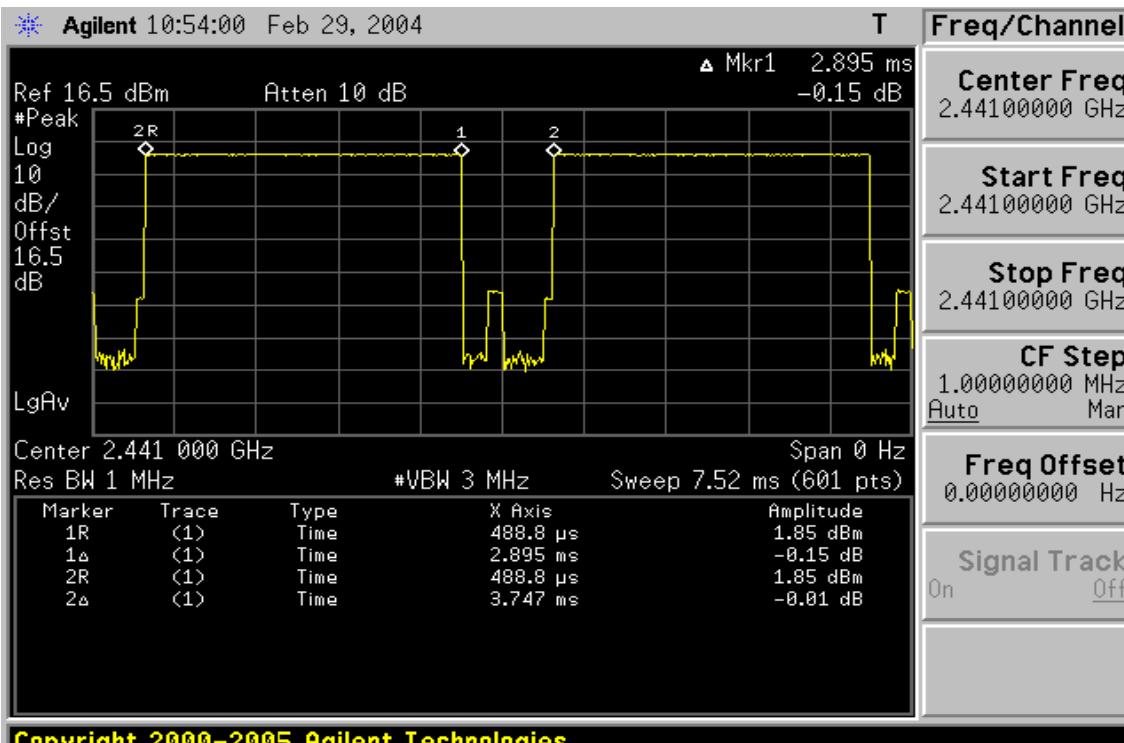
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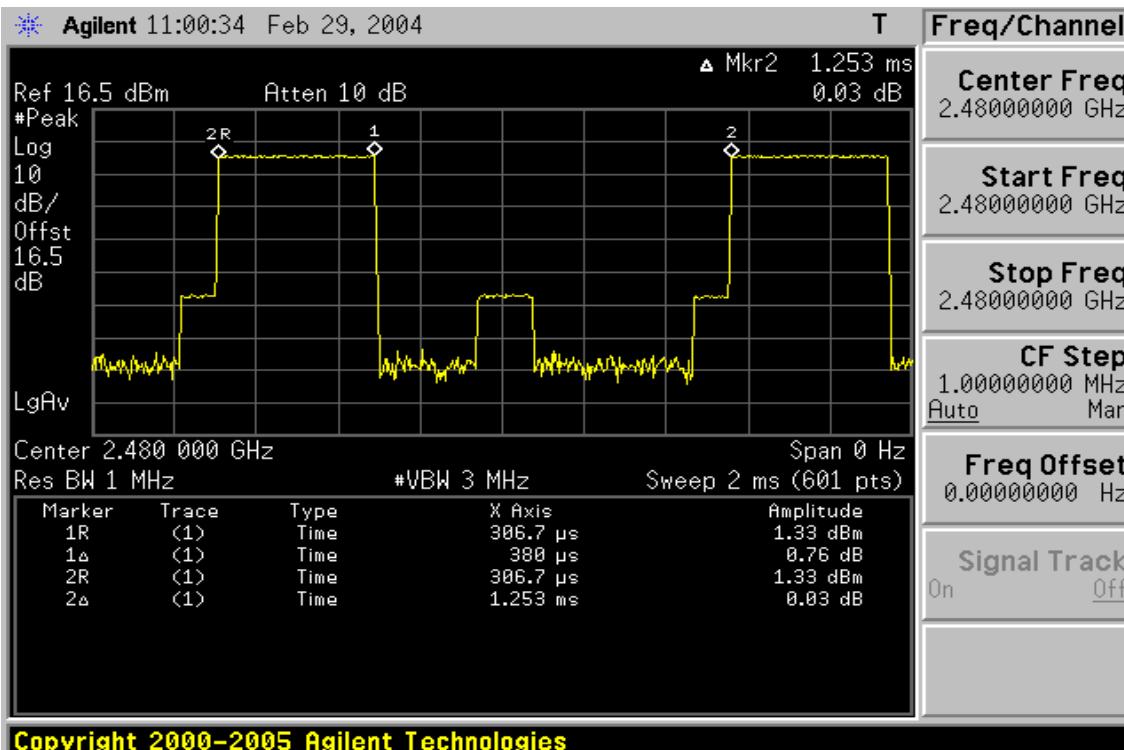
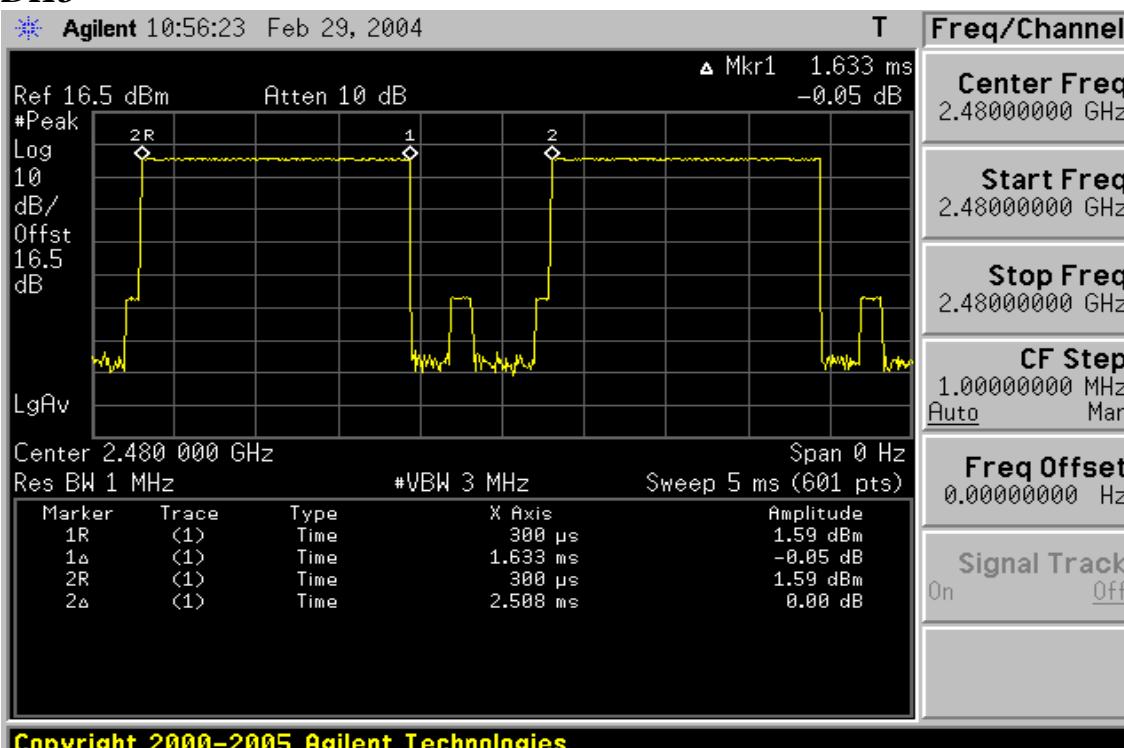
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**DH3**

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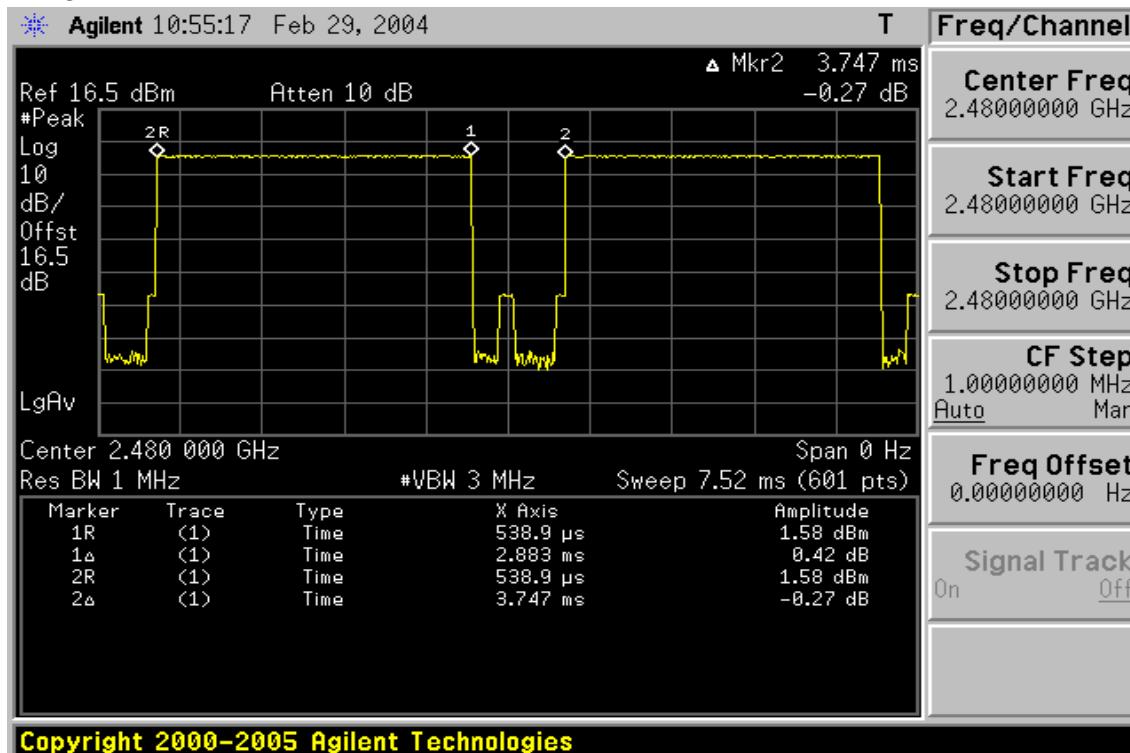
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**CH-High**
**DH1**

**DH3**


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**DH5**

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## 13. ANTENNA REQUIREMENT

### 13.1. 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.

And according to §15.247(4)(1), system operating in the 2400-2483.5MHz bands that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

### 13.2. Antenna Connected Construction

The directional gains of antenna used for transmitting is -0.24 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

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