

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name: Game Controller
Brand Name: ION
Model No.: iCade Core, iCade
Model Difference: iCade Core: Remove slab of wood & modify plastic molding
FCC ID: Y4O-ICG05
Report No.: ER/2011/B0012
Issue Date: Dec. 13, 2011
FCC Rule Part: §15.247, Cat: DSS
Prepared for: ION AUDIO LLC
200SCENIC VIEW DRIVE, SUITE 201, CUMBERLAND, RI02864, USA
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: ION AUDIO LLC
200SCENIC VIEW DRIVE, SUITE 201, CUMBERLAND, RI02864,
USA

Product Name: Game Controller

FCC ID: Y4O-ICG05

Brand Name: ION

Model No.: iCade Core, iCade

Model Difference: iCade Core: Remove slab of wood & modify plastic molding

File Number: ER/2011/B0012

Date of test: Nov. 25, 2011 ~ Dec. 12, 2011

Date of EUT Received: Nov. 25, 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. 13, 2011

Bondi Liu / Sr. Engineer

Prepared By:

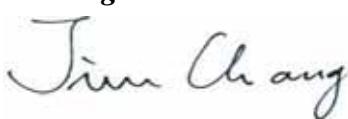


Date:

Dec. 13, 2011

Gigi Yeh / Clerk

Approved By:



Date:

Dec. 13, 2011

Jim Chang / Supervisor

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Version

Version No.	Date	Description
00	Dec. 13, 2011	Initial creation of document

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1. GENERAL INFORMATION

1.1. Product Description

General:

Product Name:	Game Controller
Brand Name:	ION
Model No.:	iCade Core, iCade
Model Difference:	iCade Core: Remove slab of wood & modify plastic molding
Hardware Version:	N/A
Software Version:	N/A
Power Supply:	5Vdc from AC/DC adapter, model: HK-U-050A050-CP or 1.5Vdc from AA battery *2

Bluetooth:

Frequency Range:	2402 – 2480MHz
Bluetooth Version:	V3.0 (GFSK)
Channel number:	79 channels
Transmit Power:	3.88 dBm (Peak)
Modulation type:	Frequency Hopping Spread Spectrum
Antenna Designation:	PIFA antenna, 1.07dBi
Type of Emission:	962KF1D

The EUT is compliance with Bluetooth 3.0 (GFSK)

This report applies for Bluetooth 3.0 (GFSK)

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

This submittal(s) (test report) is intended for FCC ID: Y4O-ICG05 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

1.3. 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

1.4. 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: 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.

1.5. Special Accessories

Not available for this EUT intended for grant.

1.6. 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 as 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 as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level.

EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna. according to the requirements in Section 8 and 13 and Subclause 8.3.1.2 of ANSI C63.4: 2003 and DA 00-705.

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2.4. Configuration of Tested System

Fig. 2-1 AC Power line and Radiated Emission Configuration



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1.	Notebook	DELL	D505	20995915456	Un-shield	Un-shield
2.	Bluetooth Test Set	Anritsu	MT8852B	6k00006107	N/A	N/A

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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
§15.247	Peak Power Density	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 mode is programmed.

Channel Low, Mid and High with highest rated data rate were 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 Bluetooth Transmitter for channel Low, Mid and High the worst case E2 position was reported and BDR mode and DH5 data rate will be worst case.

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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	09/23/2011	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	11/26/2011	11/25/2012

5.5. Measurement Result

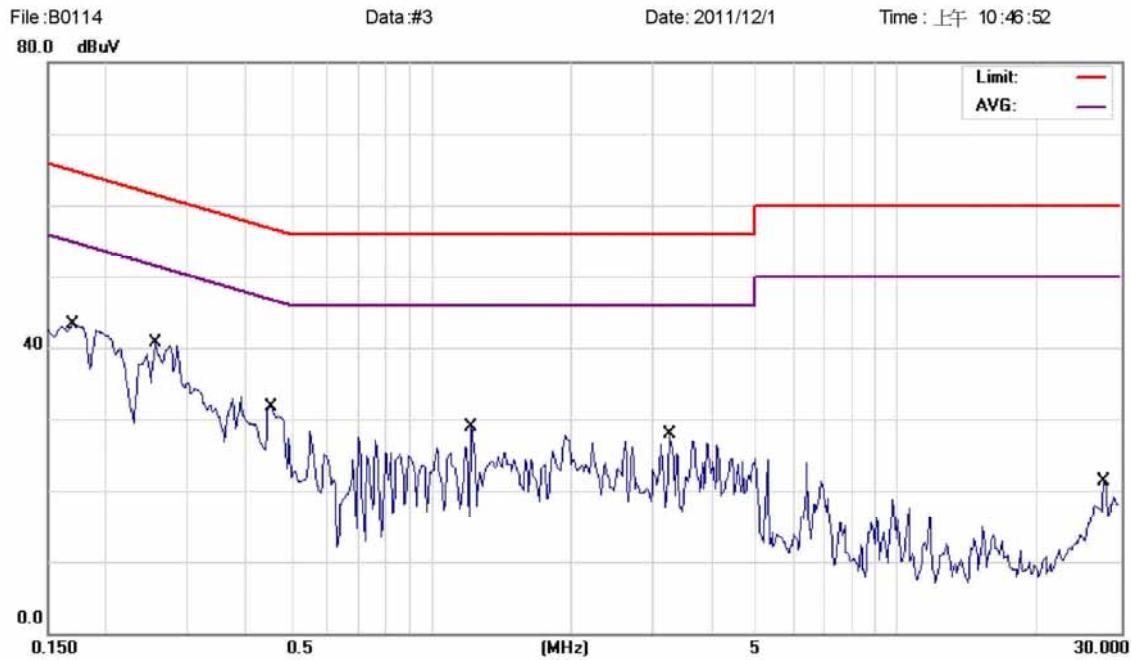
The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Bluetooth Mode	Test Date:	Nov. 30, 2011
		Test By:	Jay

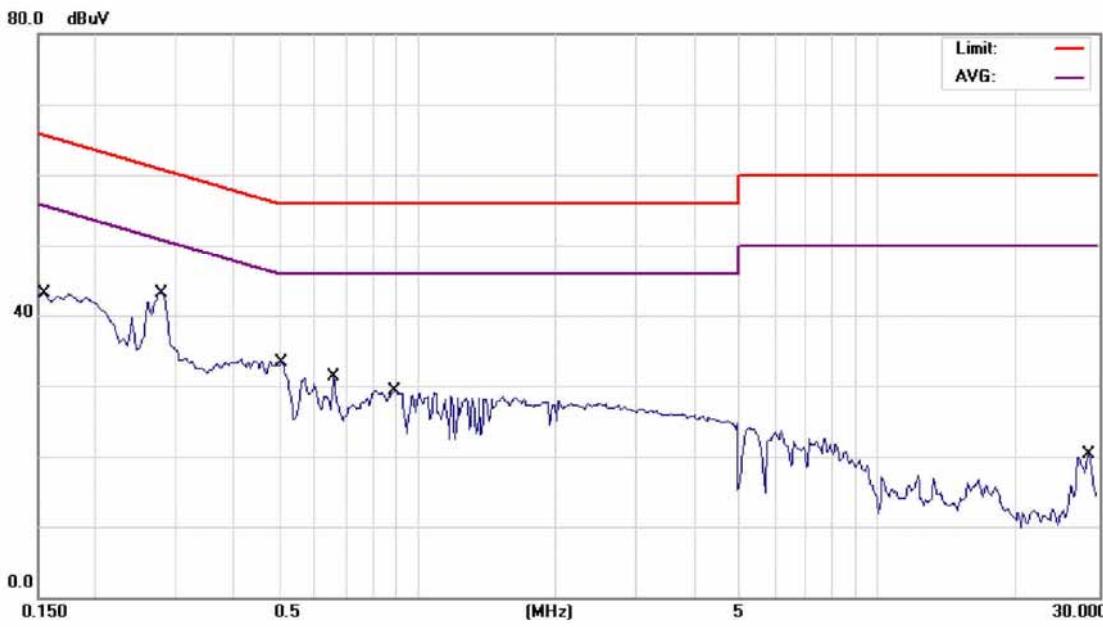


Site: SGS CONDUCTED #1 Phase: **L1** Temperature: 26 °C
Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 59%
EUT: iCadeCore Distance: Air Pressure: hpa
M/N: ICG05
Note: Operation mode (BT link)

No.	Mk.	Freq.	Reading Level	Factor	Measure- ment	Limit	Over	
							dB	Detector
1		0.1700	43.08	0.13	43.21	64.96	-21.75	QP
2 *		0.2550	40.52	0.11	40.63	61.59	-20.96	QP
3		0.4550	31.64	0.10	31.74	56.78	-25.04	QP
4		1.2200	28.85	0.09	28.94	56.00	-27.06	QP
5		3.2500	27.83	0.10	27.93	56.00	-28.07	QP
6		28.0000	21.12	0.20	21.32	60.00	-38.68	QP

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Site SGS CONDUCTED #1
Limit: FCC Class B Conduction(QP)
EUT: iCadeCore
M/N: ICG05
Note: Operation mode (BT link)

Phase: **N**

Power: AC 120V/60Hz

Temperature: 26 °C

Humidity: 59%

Distance:

Air Pressure: hpa

M/N: ICG05

Note: Operation mode (BT link)

No.	Mk.	Freq.	Reading Level	Factor	Measure- ment	Limit	Over			
							dB	dBuV	dB	Detector
1		0.1550	42.97	0.14	43.11	65.73	-22.62	QP		
2	*	0.2800	43.03	0.11	43.14	60.82	-17.68	QP		
3		0.5100	33.13	0.10	33.23	56.00	-22.77	QP		
4		0.6600	31.18	0.10	31.28	56.00	-24.72	QP		
5		0.8900	29.29	0.09	29.38	56.00	-26.62	QP		
6		29.0200	20.18	0.20	20.38	60.00	-39.62	QP		

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6. PEAK OUTPUT POWER MEASUREMENT

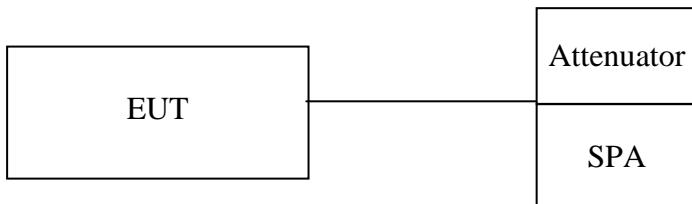
6.1. Standard Applicable

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. (BDR model: max peak RBW/VBW = 1MHz, EDR model: max peak RBW = 1.5MHz VBW = 5MHz)
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

6.5. Measurement Result

BDR Mode

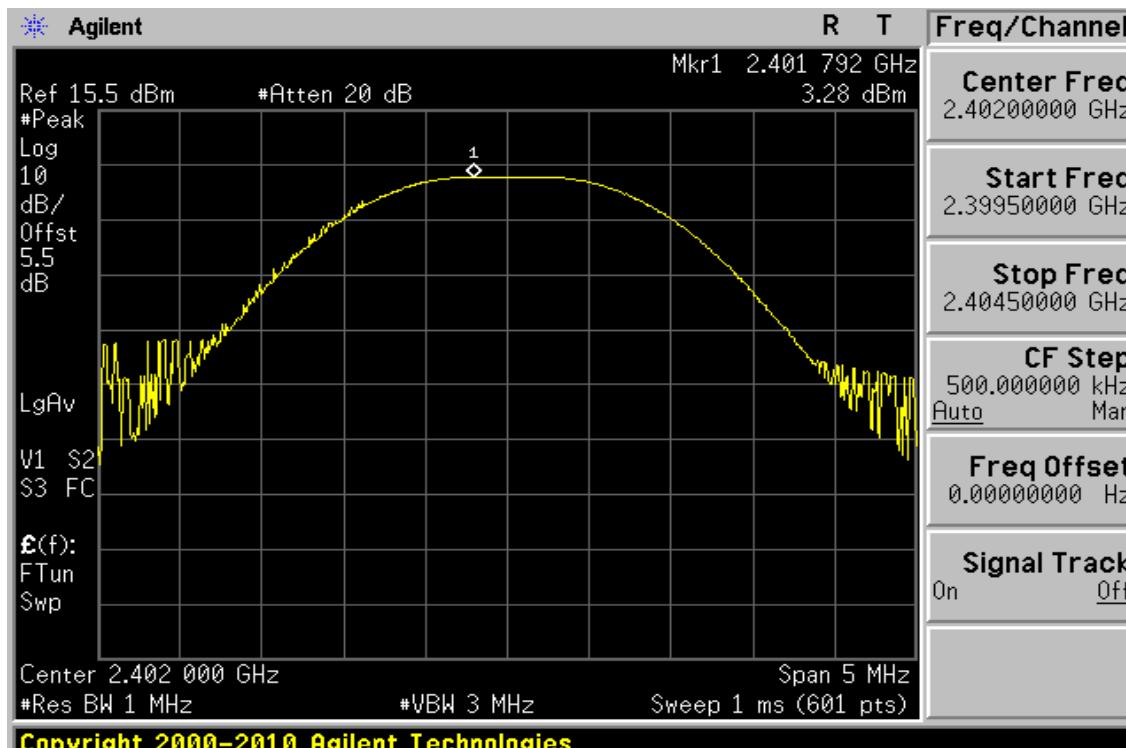
Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	3.28	0.00	3.28	0.00213	1
2441.00	3.22	0.00	3.22	0.00210	1
2480.00	3.88	0.00	3.88	0.00244	1

offset: 5.5dB

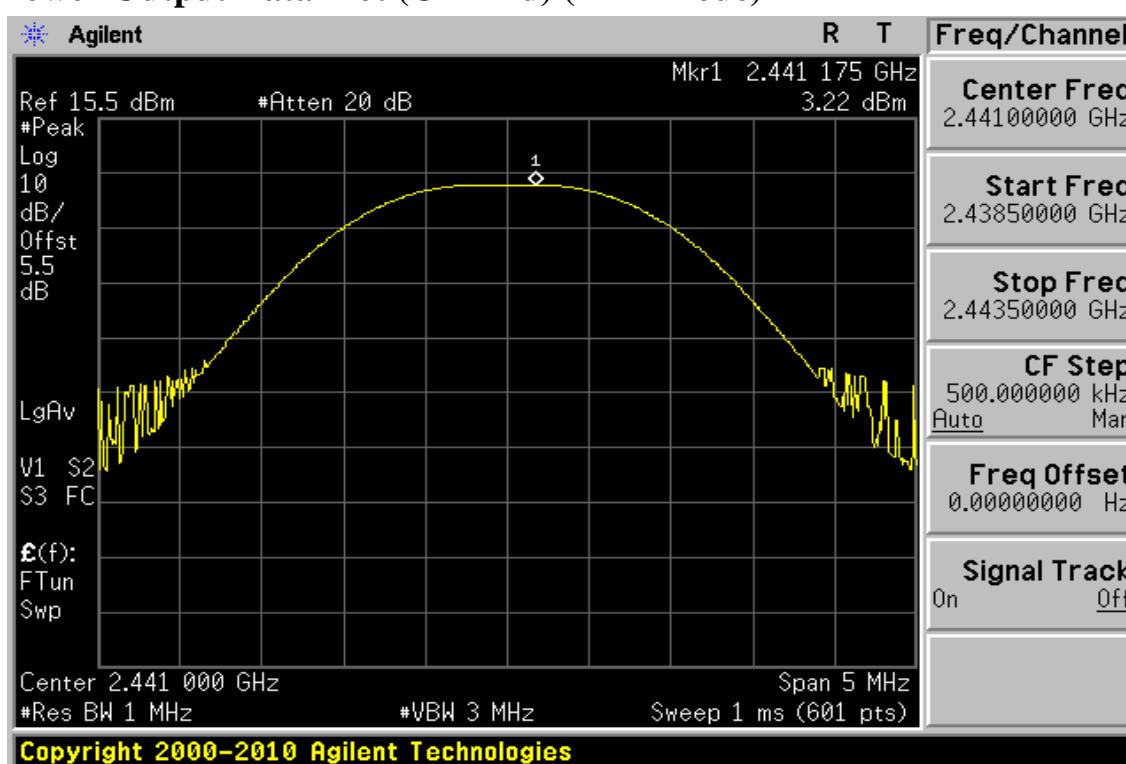
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Peak Power Output Data Plot (CH Low) (BDR mode)



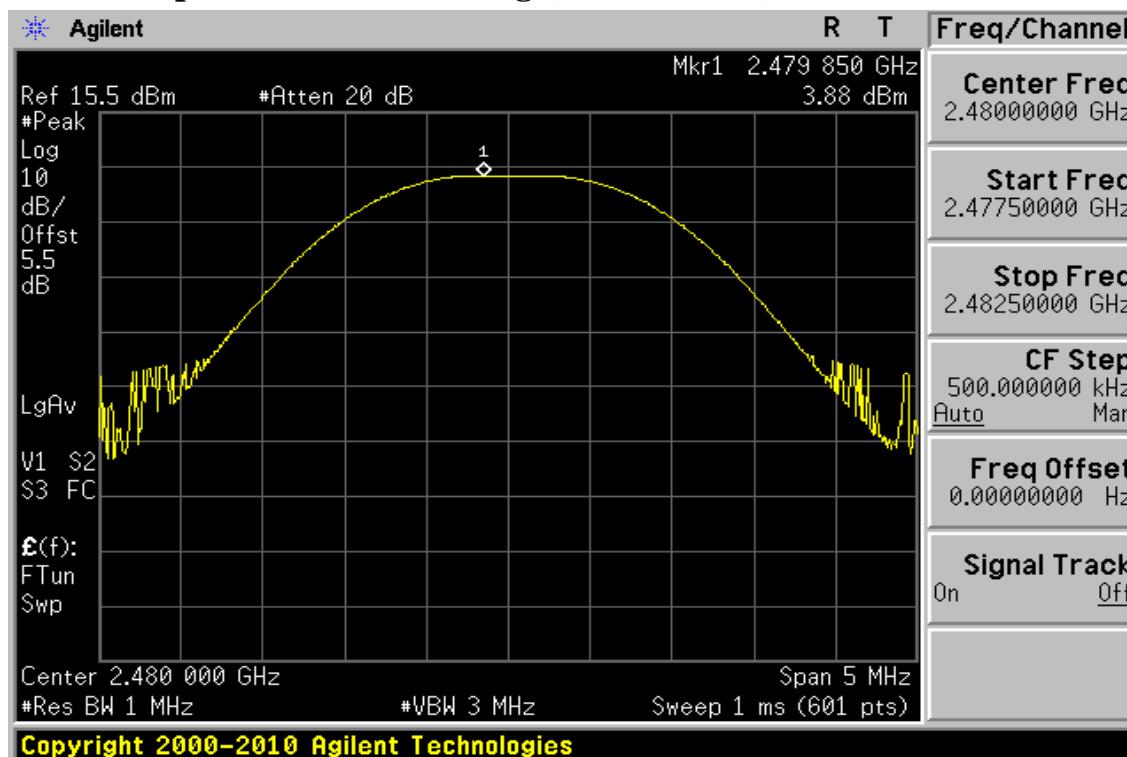
Peak Power Output Data Plot (CH Mid) (BDR mode)



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Peak Power Output Data Plot (CH High) (BDR 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 > 1 % of Bandwidth., VBW > 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 (MHz)
Lower	0.970
Mid	1.015
Higher	0.919

Note: Offset: 5.5dB

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20dB Band Width Test Data CH-Low (BDR mode)**20dB Band Width Test Data CH-Mid (BDR mode)**

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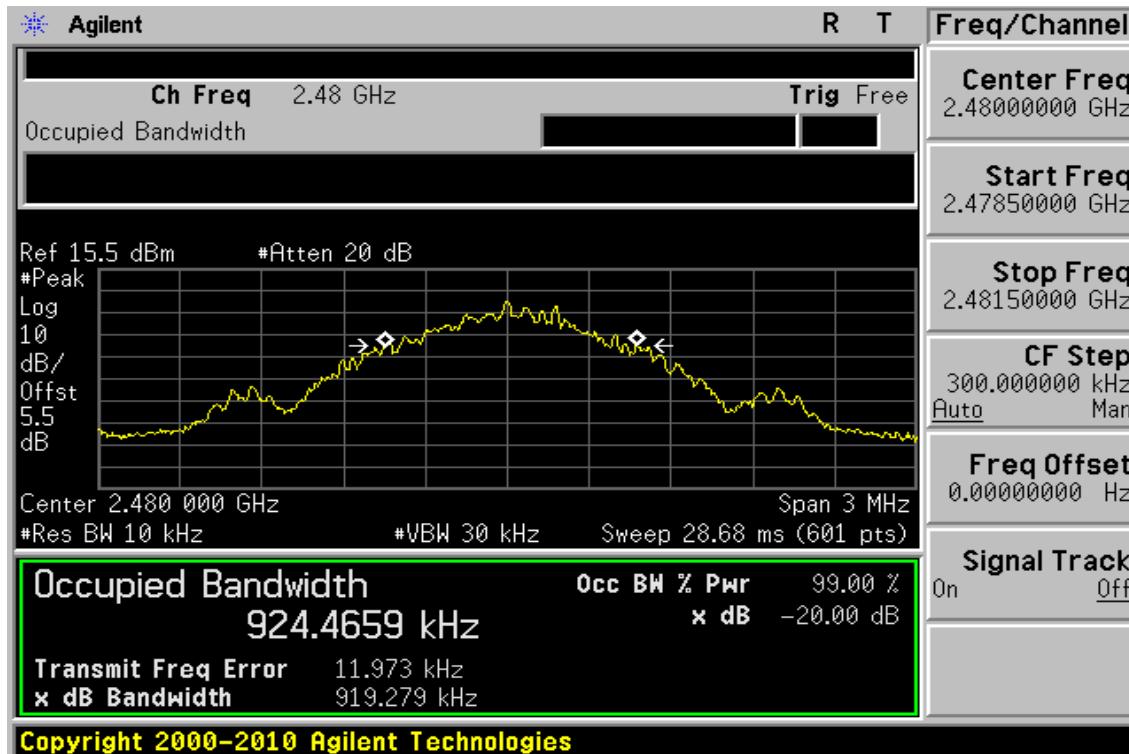
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20dB Band Width Test Data CH-High (BDR mode)

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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.
EMI Test Receiver	R&S	ESCI7	100759	05/30/2011	05/19/2012
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/15/2011	04/14/2013
Bilog Antenna	SCHWAZBECK	VULB9170	378	12/23/2009	12/22/2011
Horn antenna	SCHWAZBECK	BBHA 9120D	803	12/23/2009	12/22/2011
Pre-Amplifier	Agilent	8447D	2944A07676	01/05/2011	01/04/2012
Pre-Amplifier	EMC Instruments Corp.	EMC0126530	980038	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	966_Rx_3M_11.5m(25M~26.5G)	9	01/05/2011	01/04/2012
3m Site	SGS	966 chamber	N/A	07/15/2011	07/14/2012

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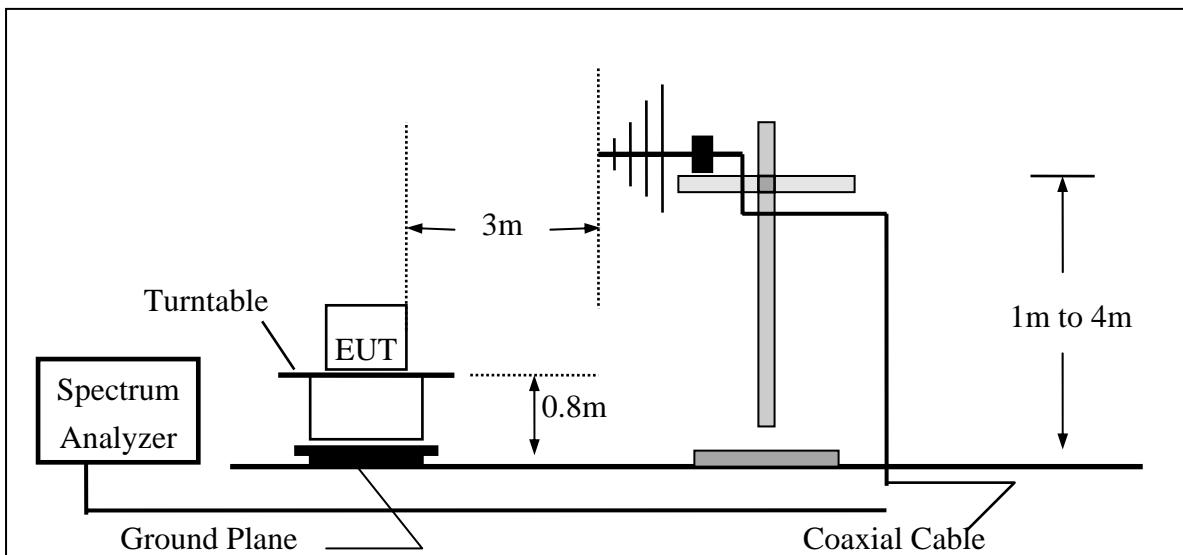
8.3. Test SET-UP:

8.3.1. Conducted Emission at antenna port:

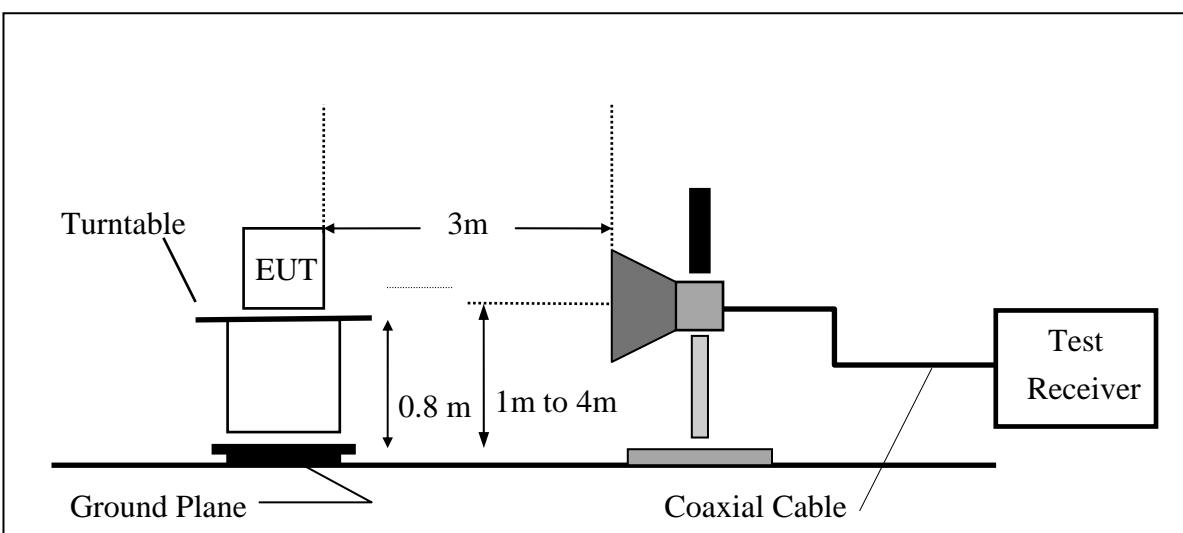
Refer to section 6.3 for details.

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=25MHz, 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.
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:

$$\mathbf{FS = RA + AF - CL - AG}$$

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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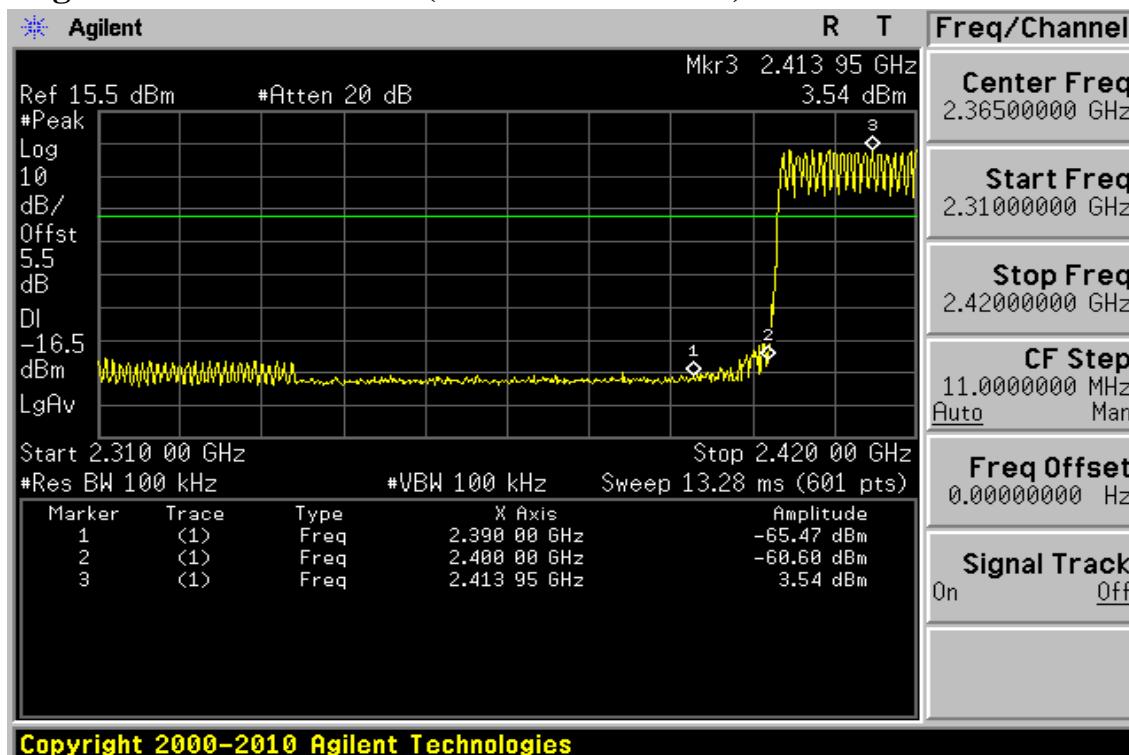
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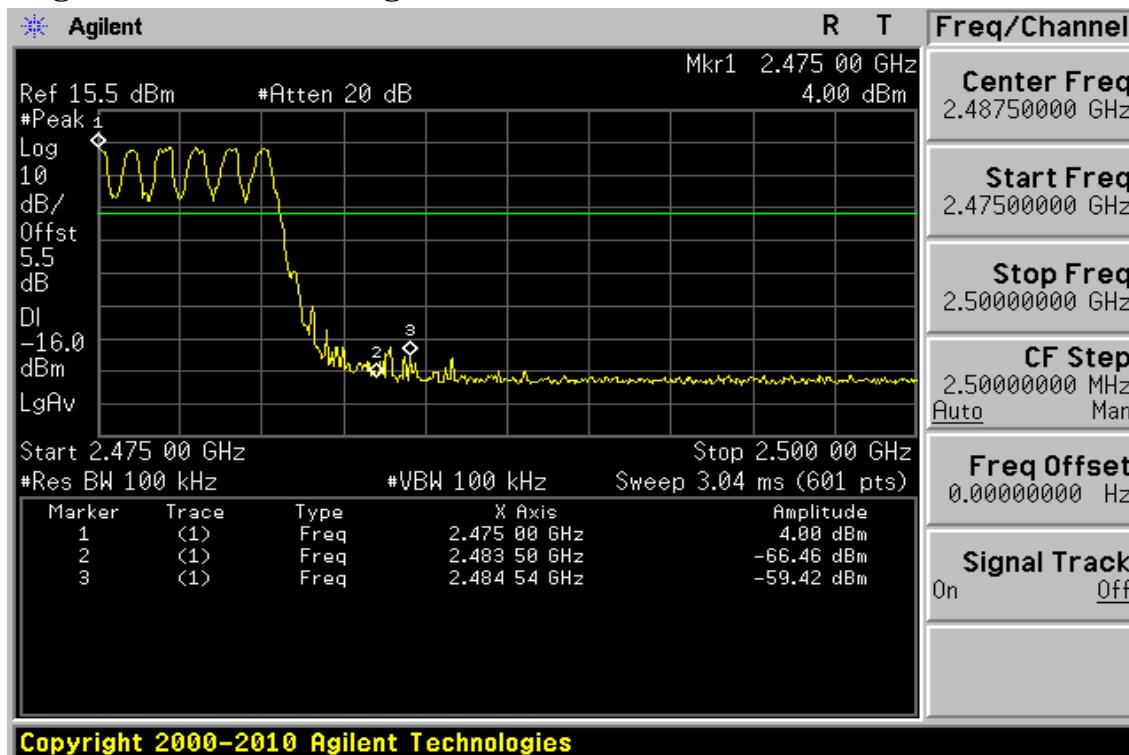
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Band Edges Test Data CH-Low (Worst: BDR mode)



Band Edges Test Data CH-High



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Radiated Emission: (Worst: BDR mode)

Operation Mode TX CH Low
 Fundamental Frequency 2402 MHz
 Temperature 25 °C
 Humidity 65 %

Test Date Nov. 30, 2011
 Test By Jay
 Pol Ver.

Freq. MHz	Note	Detector Mode	Spectrum Reading Level	Factor	Actual	Limit	Safe
					FS	@3m	Margin
F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB	

2390.00 E Peak 46.04 5.17 51.21 74.00 -22.79

Operation Mode TX CH Low
 Fundamental Frequency 2402 MHz
 Temperature 25
 Humidity 65 %

Test Date Nov. 30, 2011
 Test By Jay
 Pol Hor.

Freq. MHz	Note	Detector Mode	Spectrum Reading Level	Factor	Actual	Limit	Safe
					FS	@3m	Margin
F/H/E/S	PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB	

2390.00 E Peak 46.92 5.79 52.71 74.00 -21.29

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

Factor(dB) = Antenna Factor(dB μ 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.

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Radiated Emission: (Worst: BDR mode)

Operation Mode	TX CH High	Test Date	Nov. 30, 2011
Fundamental Frequency	2480 MHz	Test By	Jay
Temperature	25	Pol	Ver.
Humidity	65 %		

Freq. MHz	Note	Detector Mode	Spectrum Reading Level	Factor	Actual	Limit	Safe
					FS	@3m	Margin
2483.50	E	Peak	45.57	6.72	52.29	74.00	-21.71

Operation Mode	TX CH High	Test Date	Nov. 30, 2011
Fundamental Frequency	2480 MHz	Test By	Jay
Temperature	25	Pol	Hor.
Humidity	65 %		

Freq. MHz	Note	Detector Mode	Spectrum Reading Level	Factor	Actual	Limit	Safe
					FS	@3m	Margin
2483.50	E	Peak	46.26	5.69	51.95	74.00	-22.05

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

Factor(dB) = Antenna Factor(dB μ 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.

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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 8.2 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 8.3 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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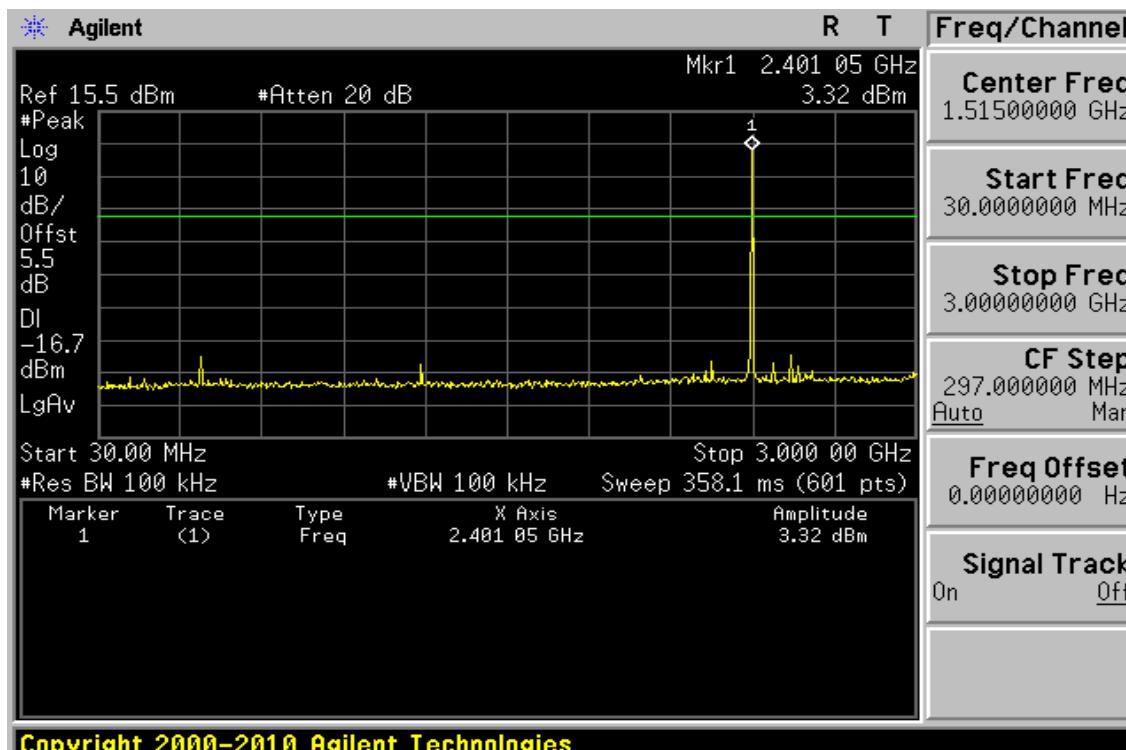
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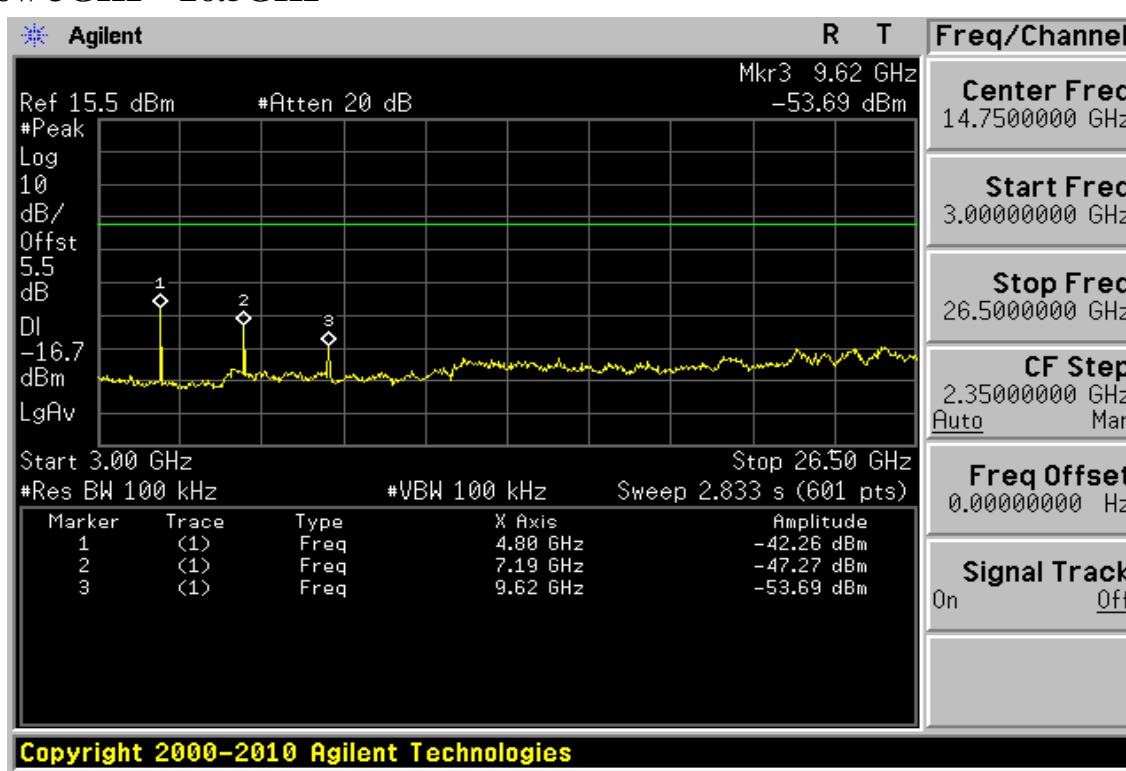
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Conducted Spurious Emission Measurement Result (Worst: BDR mode)

Ch Low 30MHz – 3GHz



Ch Low 3GHz – 26.5GHz

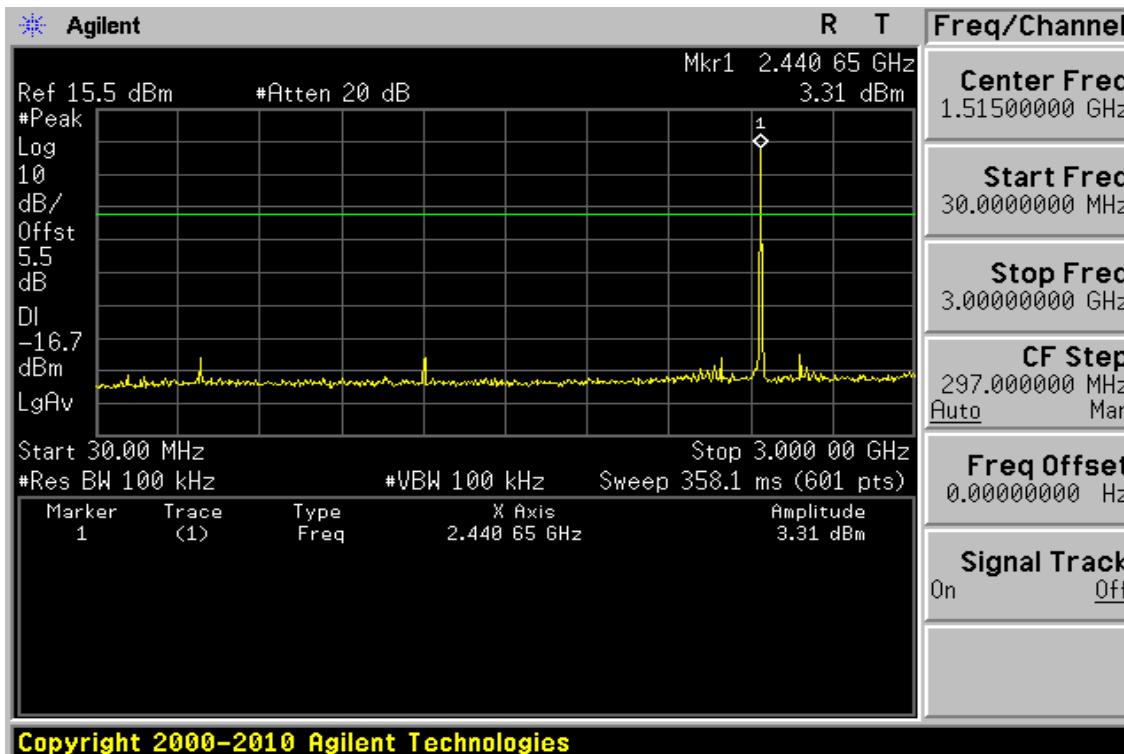


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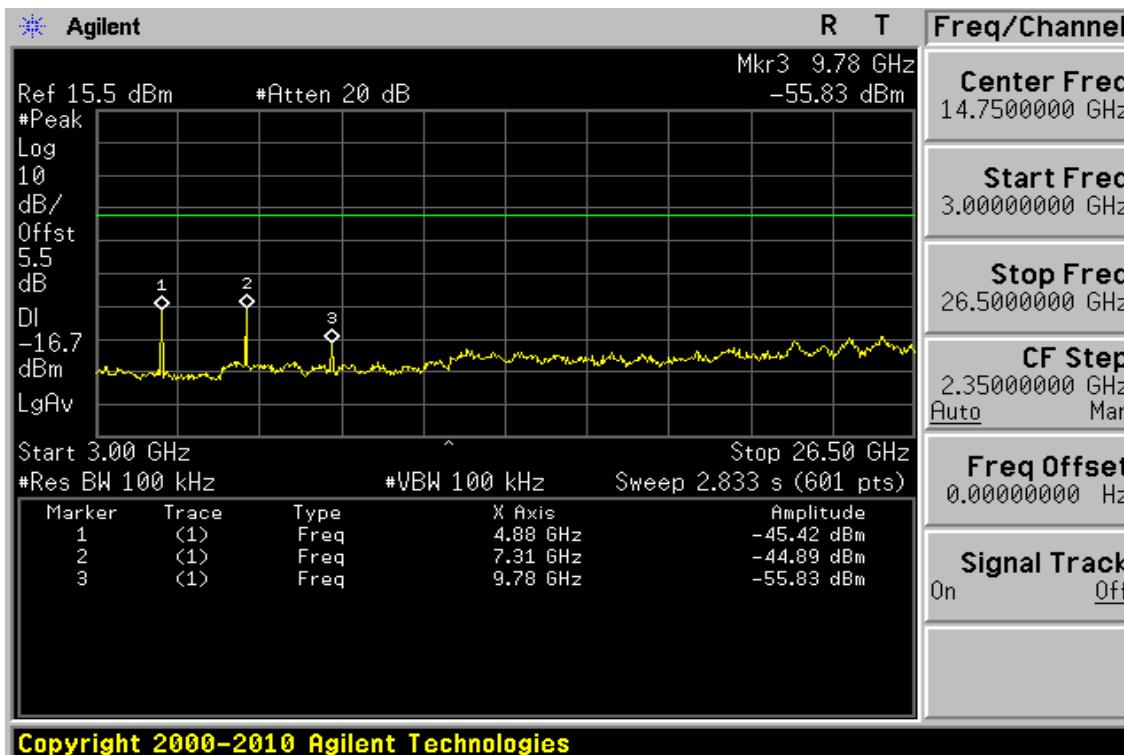
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Ch Mid 30MHz – 3GHz



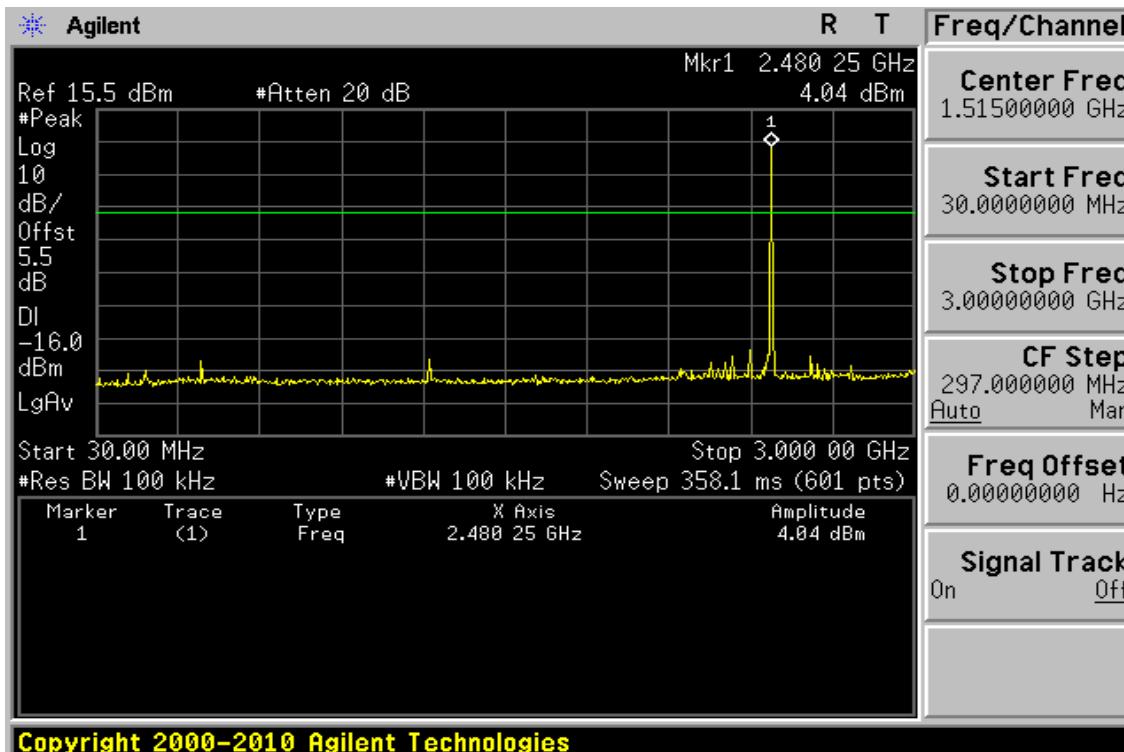
Ch Mid 3GHz – 26.5GHz



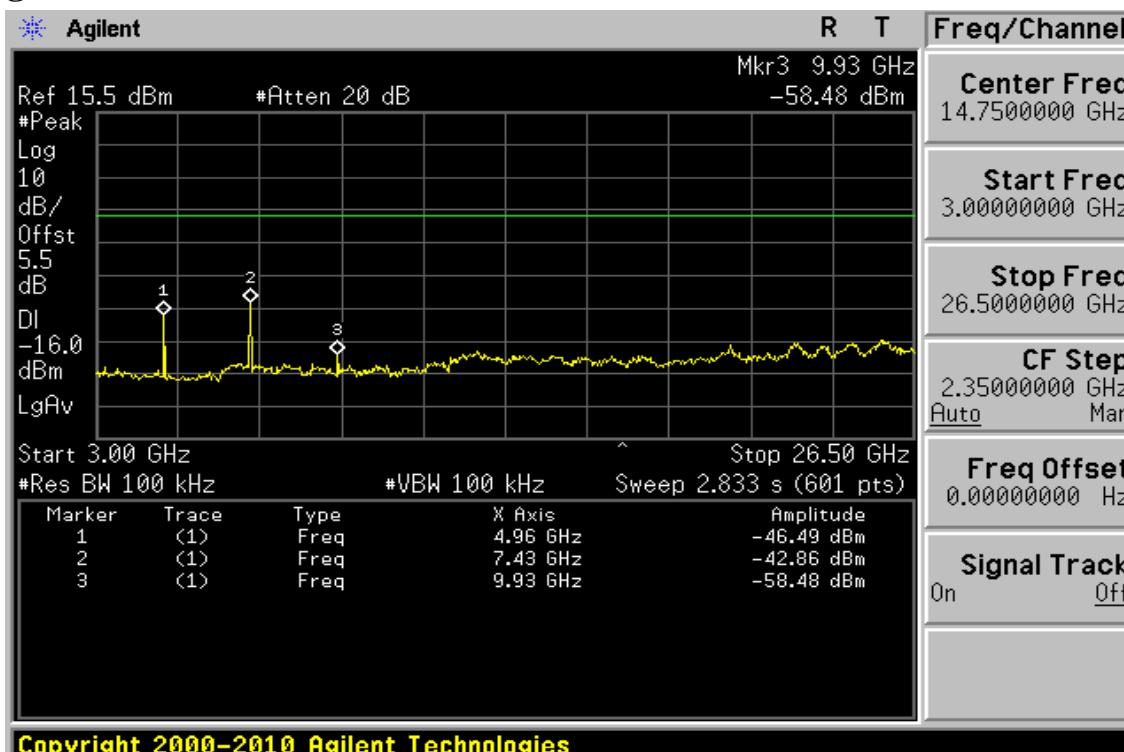
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Ch High 30MHz – 3GHz



Ch High 3GHz – 26.5GHz



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Radiated Spurious Emission Measurement Result

Operation Band	:BDR	Test Date	:2011-11-30
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 μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ 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 μ V/m	@3m dB μ V/m	Margin dB
40.67	S	Peak	46.03	-13.24	32.79	40.00	-7.21
144.46	S	Peak	54.02	-12.22	41.80	43.50	-1.70
263.77	S	Peak	45.63	-12.81	32.82	46.00	-13.18
288.02	S	Peak	38.35	-12.07	26.28	46.00	-19.72
455.83	S	Peak	35.27	-9.28	25.99	46.00	-20.01
600.36	S	Peak	34.06	-6.82	27.24	46.00	-18.76
4804.00	H	Peak	35.46	9.94	45.40	74.00	-28.60
7206.00	---						
9608.00	---						
12010.00	---						
14412.00	---						
16814.00	---						
19216.00	---						
21618.00	---						
24020.00	---						

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Radiated Spurious Emission Measurement Result

Operation Band	:BDR	Test Date	:2011-11-30
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 μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ 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 μ V/m	@3m dB μ V/m	Margin dB
144.46	S	Peak	51.84	-12.22	39.62	43.50	-3.88
191.99	S	Peak	51.12	-15.03	36.09	43.50	-7.41
263.77	S	Peak	50.95	-12.81	38.14	46.00	-7.86
408.30	S	Peak	42.34	-10.09	32.25	46.00	-13.75
504.33	S	Peak	36.55	-8.65	27.90	46.00	-18.10
600.36	S	Peak	34.58	-6.82	27.76	46.00	-18.24
4804.00	H	Peak	36.35	9.98	46.33	74.00	-27.67
7206.00	---						
9608.00	---						
12010.00	---						
14412.00	---						
16814.00	---						
19216.00	---						
21618.00	---						
24020.00	---						

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Radiated Spurious Emission Measurement Result

Operation Band	:BDR	Test Date	:2011-11-30
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 μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ 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 μ V/m	@3m dB μ V/m	Margin dB
40.67	S	Peak	45.42	-13.24	32.18	40.00	-7.82
144.46	S	Peak	53.97	-12.22	41.75	43.50	-1.75
263.77	S	Peak	45.22	-12.81	32.41	46.00	-13.59
408.30	S	Peak	36.50	-10.09	26.41	46.00	-19.59
504.33	S	Peak	36.04	-8.65	27.39	46.00	-18.61
600.36	S	Peak	34.08	-6.82	27.26	46.00	-18.74
4882.00	H	Peak	35.20	10.29	45.49	74.00	-28.51
7323.00	---						
9764.00	---						
12205.00	---						
14646.00	---						
17087.00	---						
19528.00	---						
21969.00	---						
24410.00	---						

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Radiated Spurious Emission Measurement Result

Operation Band	:BDR	Test Date	:2011-11-30
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 μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ 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 μ V/m	@3m dB μ V/m	Margin dB
144.46	S	Peak	51.80	-12.22	39.58	43.50	-3.92
191.99	S	Peak	51.24	-15.03	36.21	43.50	-7.29
263.77	S	Peak	50.86	-12.81	38.05	46.00	-7.95
408.30	S	Peak	42.55	-10.09	32.46	46.00	-13.54
504.33	S	Peak	36.51	-8.65	27.86	46.00	-18.14
600.36	S	Peak	34.64	-6.82	27.82	46.00	-18.18
4882.00	H	Peak	35.92	10.24	46.16	74.00	-27.84
7323.00	---						
9764.00	---						
12205.00	---						
14646.00	---						
17087.00	---						
19528.00	---						
21969.00	---						
24410.00	---						

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Radiated Spurious Emission Measurement Result

Operation Band	:BDR	Test Date	:2011-11-30
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 μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ 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 μ V/m	@3m dB μ V/m	Margin dB
41.64	S	Peak	46.16	-13.39	32.77	40.00	-7.23
144.46	S	Peak	53.77	-12.22	41.55	43.50	-1.95
263.77	S	Peak	45.77	-12.81	32.96	46.00	-13.04
455.83	S	Peak	35.73	-9.28	26.45	46.00	-19.55
551.86	S	Peak	36.41	-7.85	28.56	46.00	-17.44
600.36	S	Peak	33.69	-6.82	26.87	46.00	-19.13
4960.00	H	Peak	34.22	10.91	45.13	74.00	-28.87
7440.00	---						
9920.00	---						
12400.00	---						
14880.00	---						
17360.00	---						
19840.00	---						
22320.00	---						
24800.00	---						

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Radiated Spurious Emission Measurement Result

Operation Band	:BDR	Test Date	:2011-11-30
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 μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ 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 μ V/m	@3m dB μ V/m	Margin dB
144.46	S	Peak	52.00	-12.22	39.78	43.50	-3.72
191.99	S	Peak	51.19	-15.03	36.16	43.50	-7.34
263.77	S	Peak	50.55	-12.81	37.74	46.00	-8.26
408.30	S	Peak	42.53	-10.09	32.44	46.00	-13.56
504.33	S	Peak	35.79	-8.65	27.14	46.00	-18.86
600.36	S	Peak	34.27	-6.82	27.45	46.00	-18.55
4960.00	H	Peak	36.82	10.76	47.58	74.00	-26.42
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*20dB 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/100KHz, Adjust Span to 3.0 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	$\geq 25\text{KHz}$ or 2/3 times 20dB bandwidth	PASS

Note: Refer to next page for plots.

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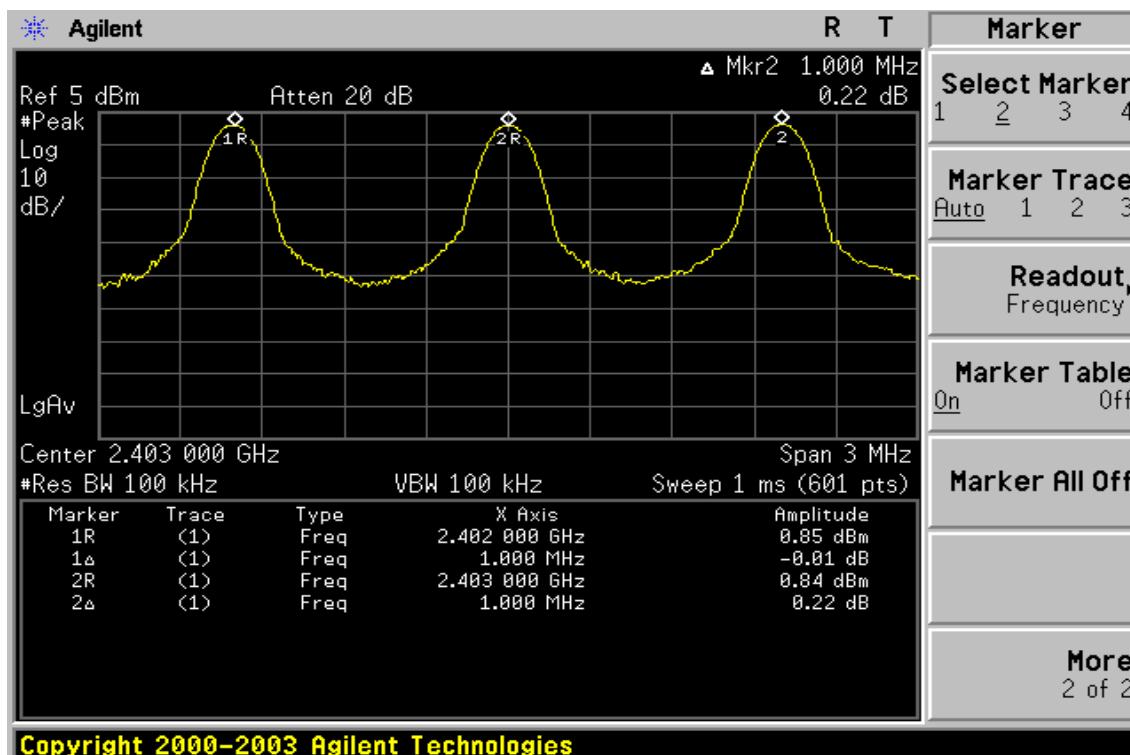
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Frequency Separation Test Data



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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, VBW=430KHz/1.3MHz,
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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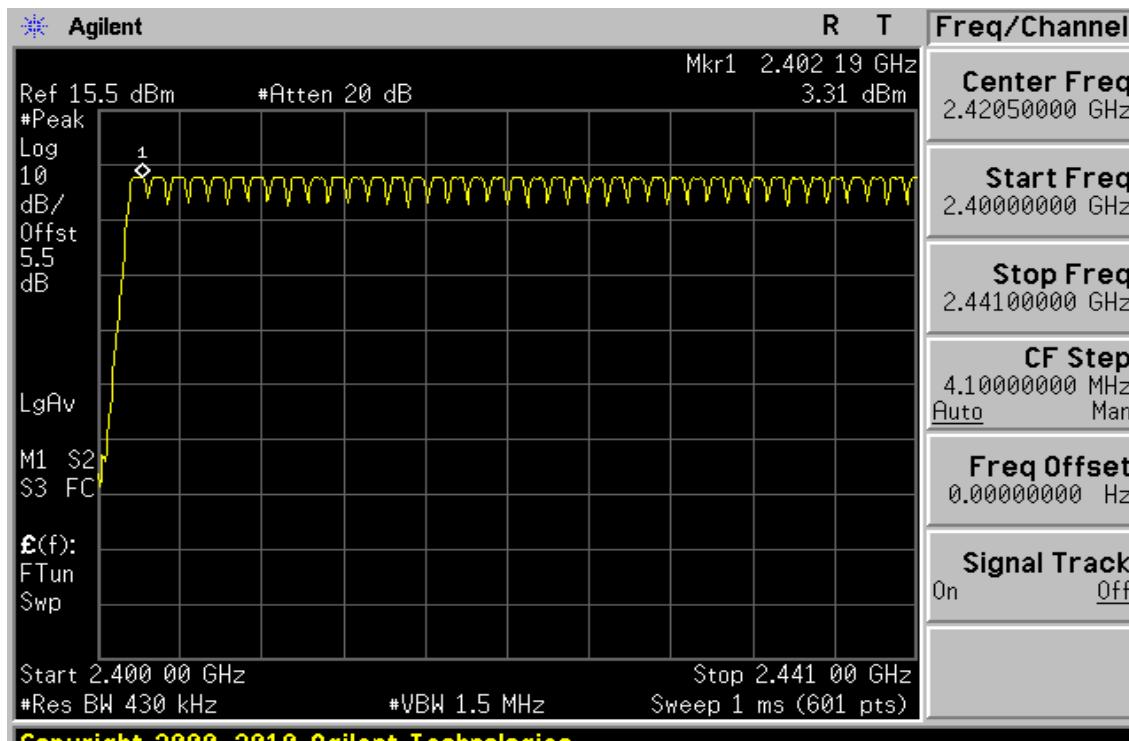
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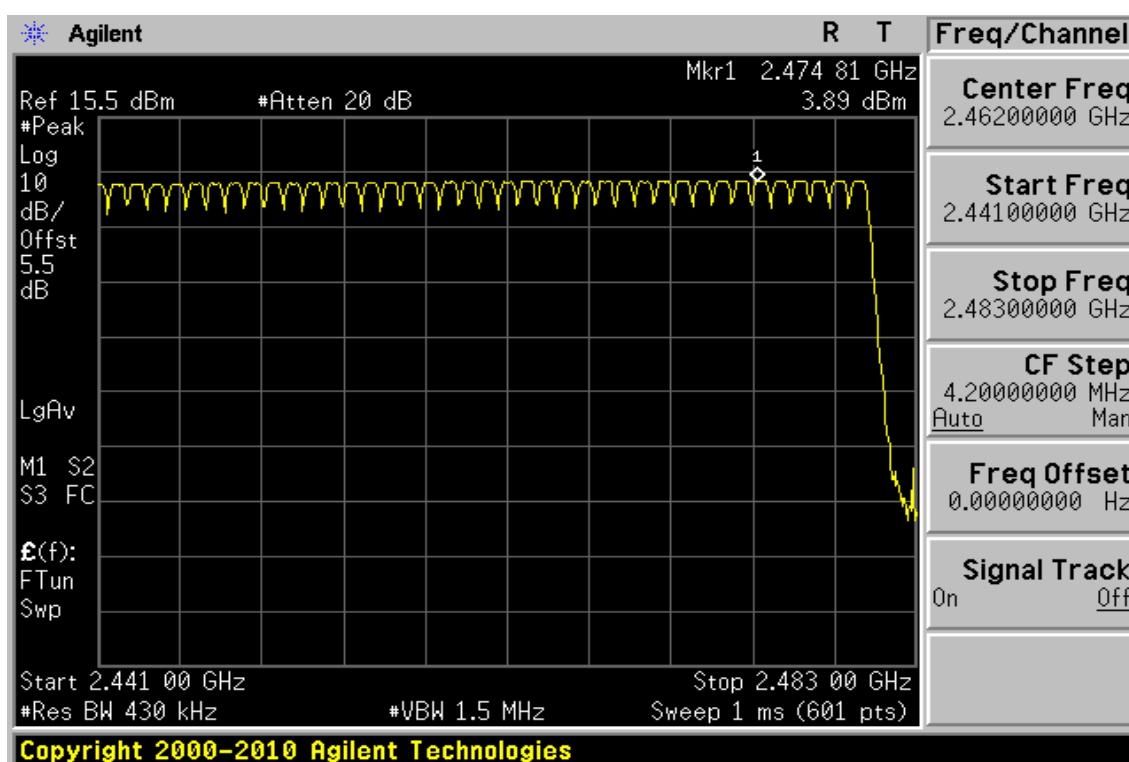
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Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



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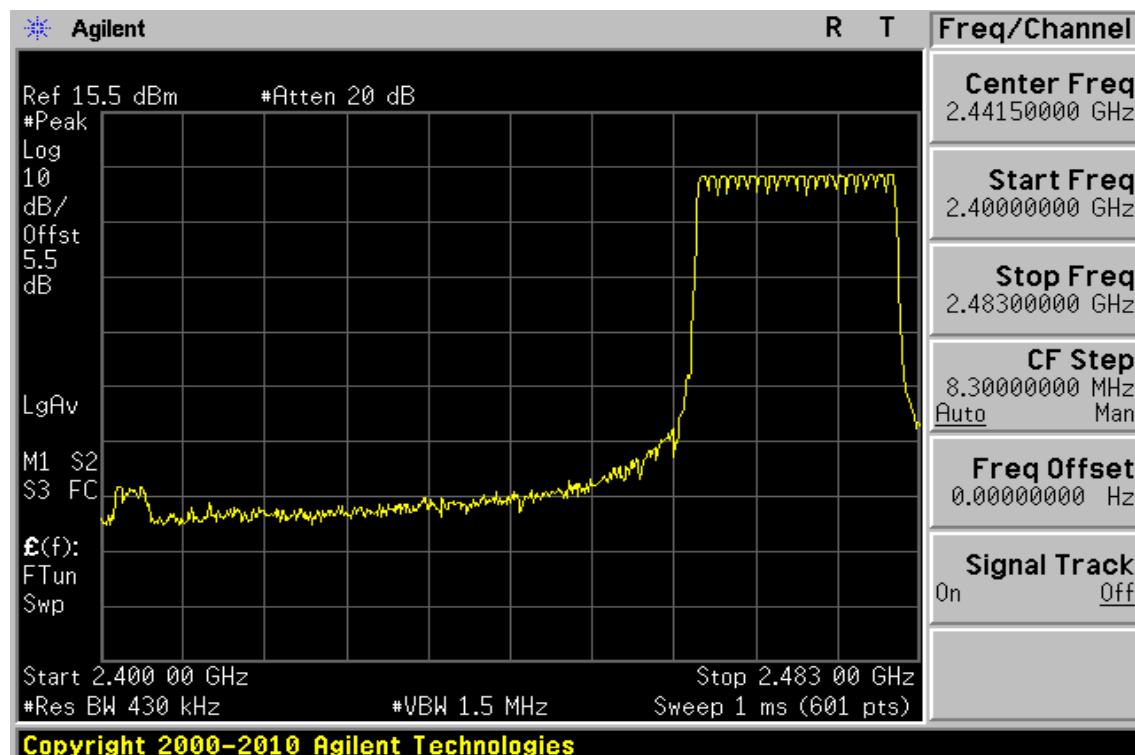
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AFH Mode



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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,VBW=1MHz/1MHz, Span = 0Hz , Adjust Sweep = 2ms-5ms.
5. Repeat above procedures until all frequency measured were complete.

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12.5. Measurement Result

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

CH Low DH1 time slot = 0.39 (ms) * (1600/2/79) * 31.6 = 124.80 (ms)

 DH3 time slot = 1.645 (ms) * (1600/4/79) * 31.6 = 263.20 (ms)

 DH5 time slot = 2.892 (ms) * (1600/6/79) * 31.6 = 308.48 (ms)

CH Mid DH1 time slot = 0.39 (ms) * (1600/2/79) * 31.6 = 124.80 (ms)

 DH3 time slot = 1.65 (ms) * (1600/4/79) * 31.6 = 264.00 (ms)

 DH5 time slot = 2.892 (ms) * (1600/6/79) * 31.6 = 308.48 (ms)

CH High DH1 time slot = 0.39 (ms) * (1600/2/79) * 31.6 = 124.80 (ms)

 DH3 time slot = 1.65 (ms) * (1600/4/79) * 31.6 = 264.00 (ms)

 DH5 time slot = 2.892 (ms) * (1600/6/79) * 31.6 = 308.48 (ms)

Note: Refer to next page for plots.

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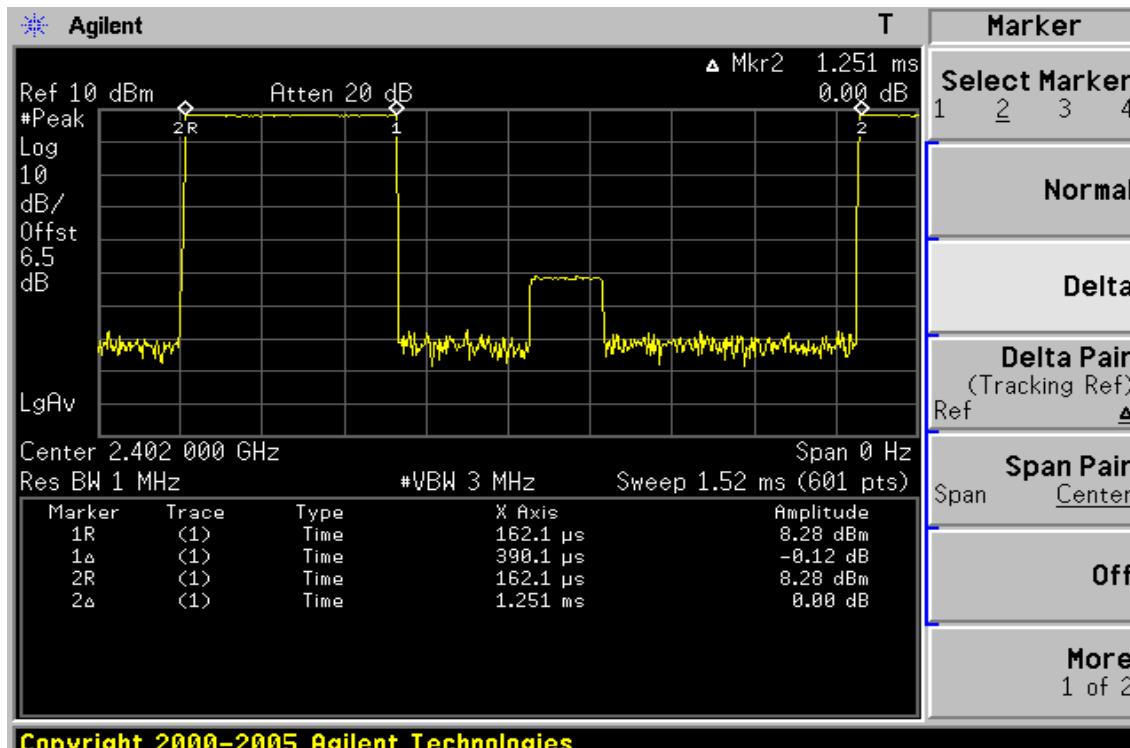
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CH-Low
DH1


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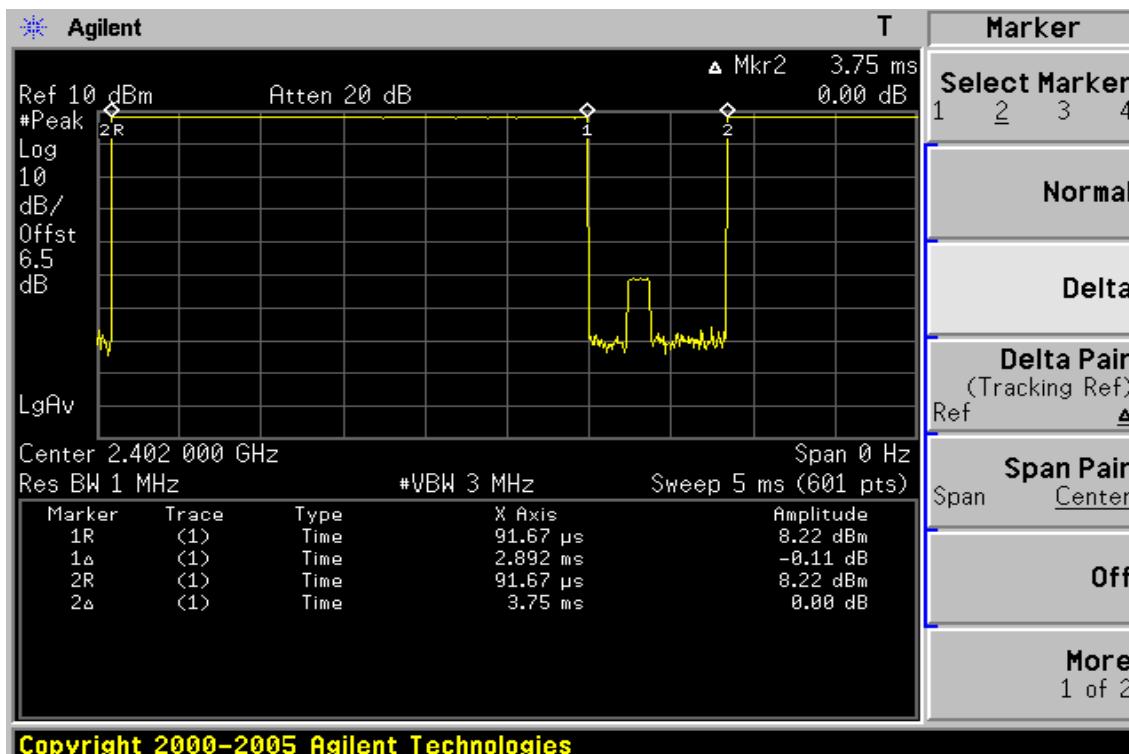
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DH5

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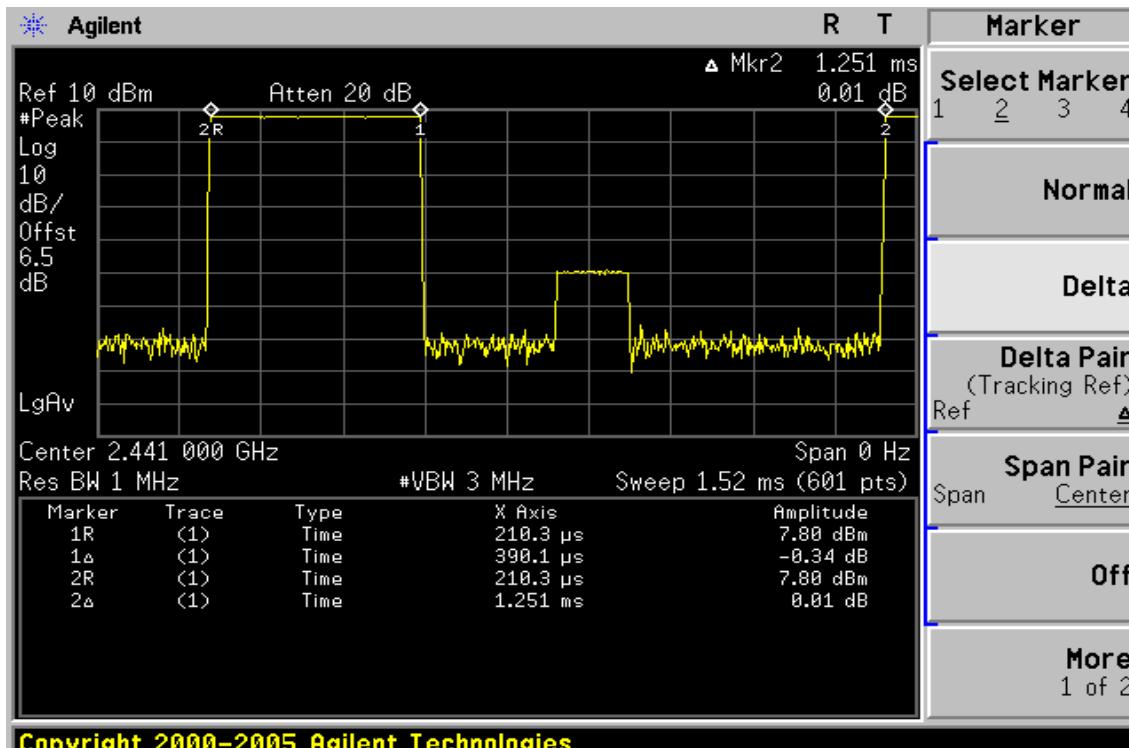
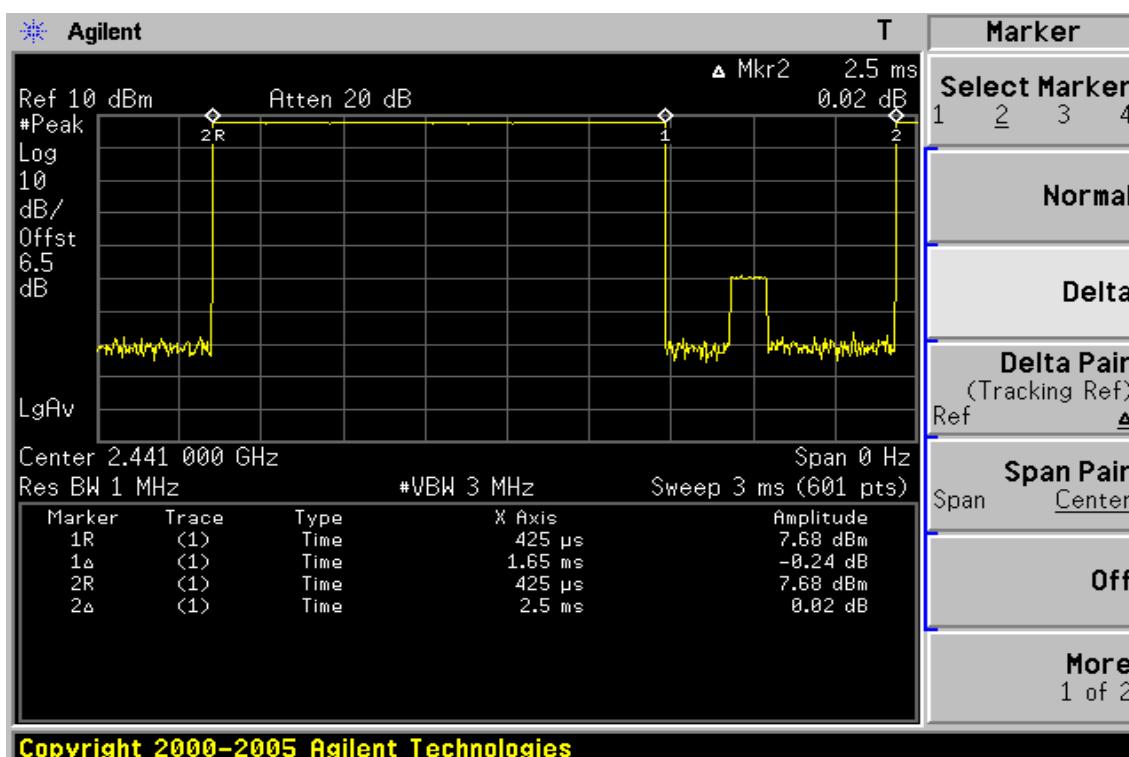
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CH-Mid
DH1

DH3


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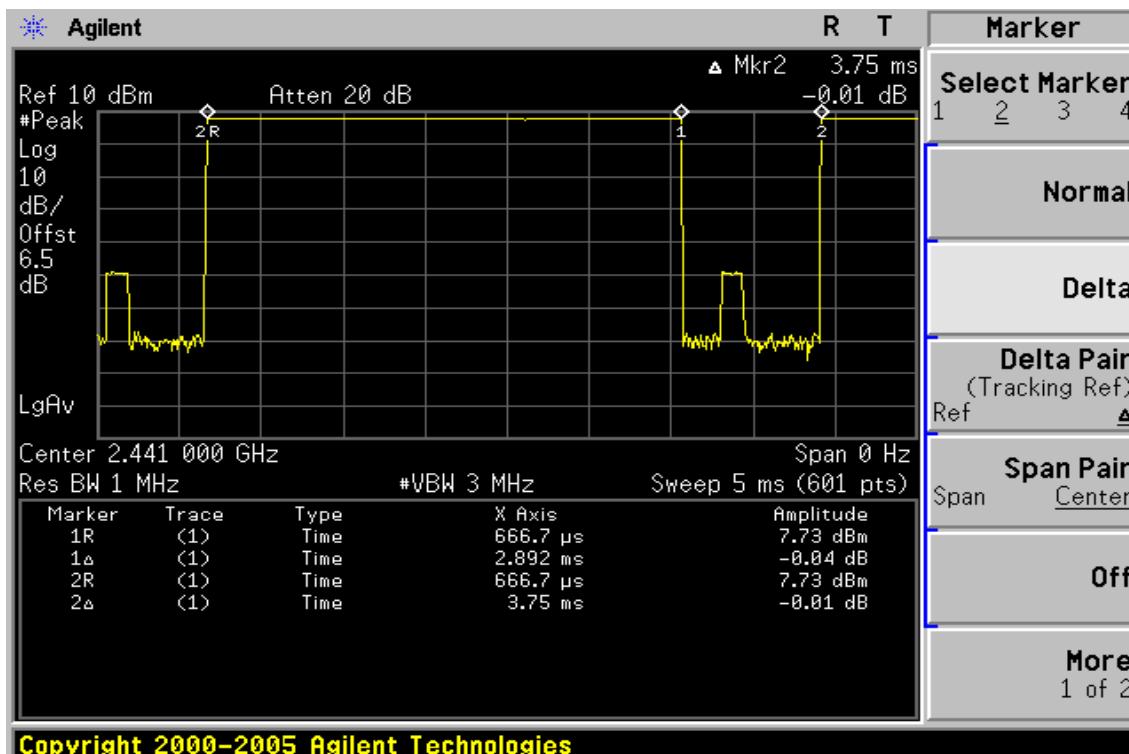
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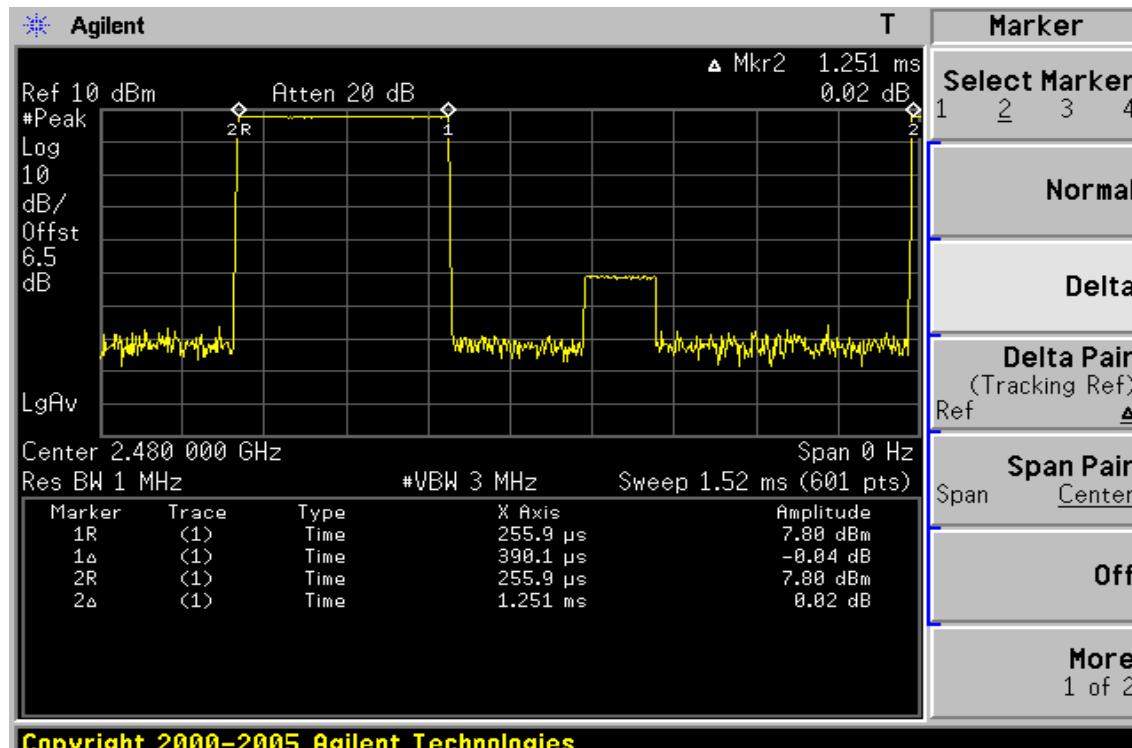
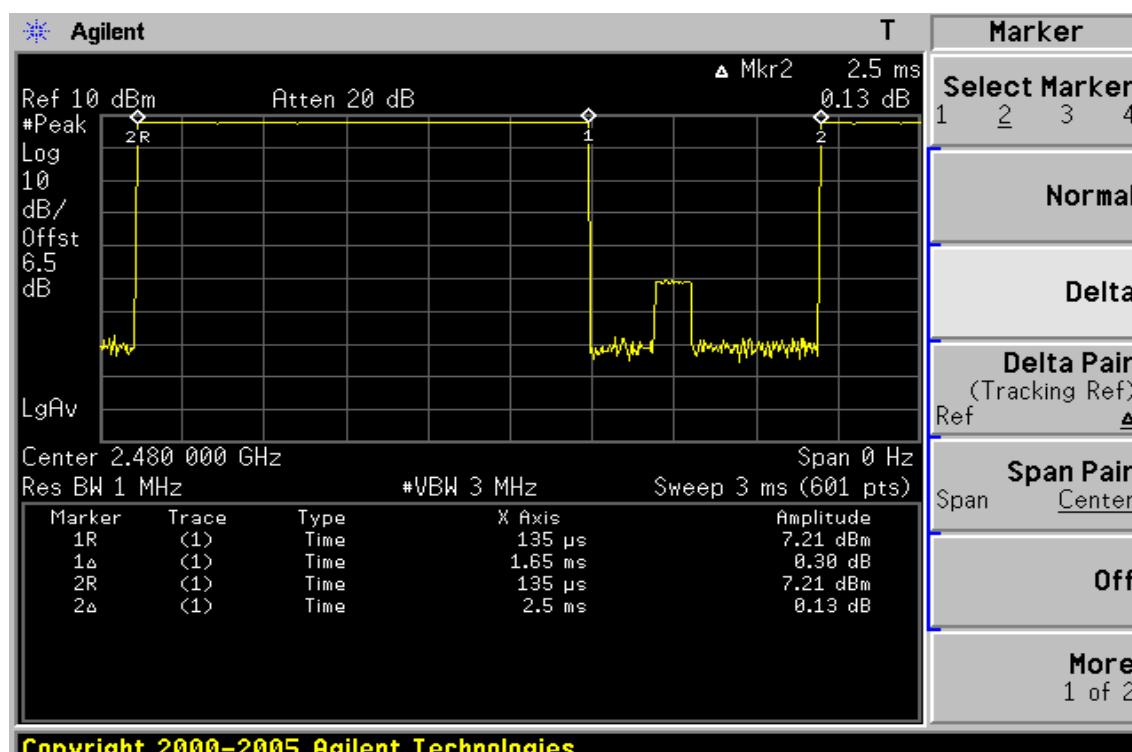
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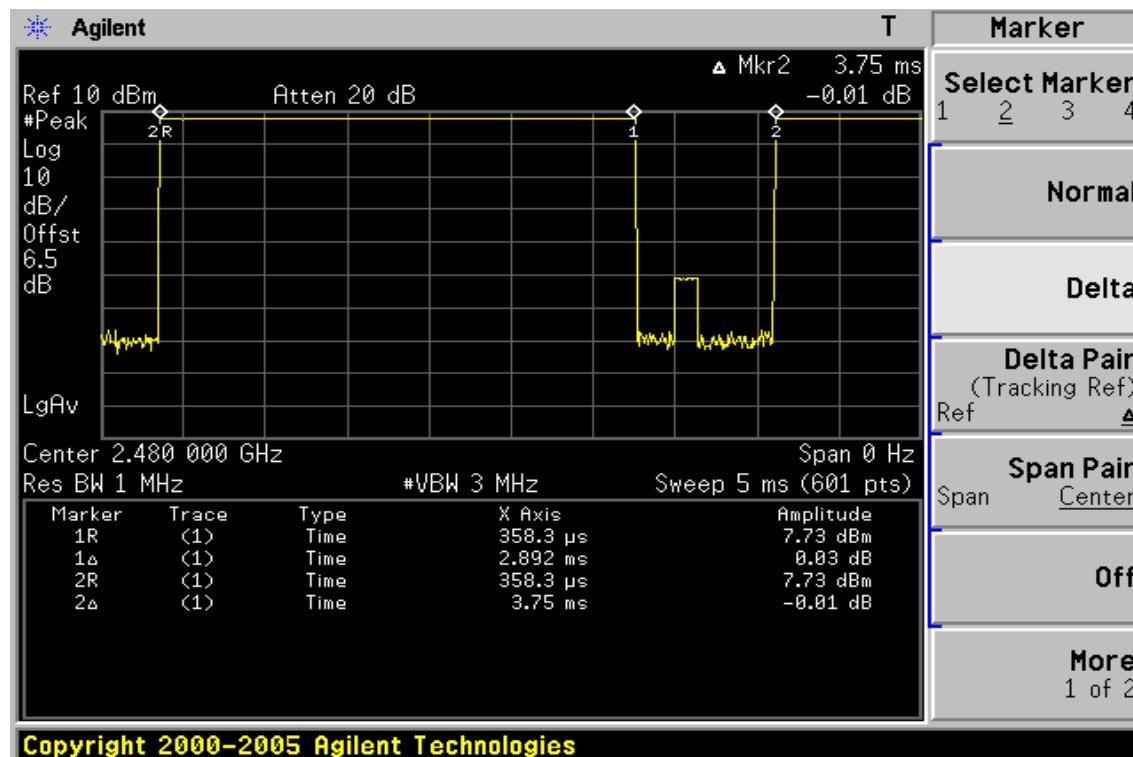
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CH-High
DH1

DH3


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DH5


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13. Peak Power Spectral Density

13.1. Standard Applicable

According to §15.247(d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3kHz band during any time interval of continuous transmission.

13.2. Measurement Equipment Used:

Refer to section 6.2 for details.

13.3. Test Set-up:

Refer to section 6.3 for details.

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 the spectrum analyzer as RBW = 3KHz, VBW = 10KHz, Span = 1.5MHz, Sweep=100s
4. Record the max. reading.
5. Repeat above procedures until all frequency measured were complete.

13.5. Measurement Result

CH	RF Power Density Reading (dBm)	Cable loss (dB)	RF Power Density Level (dBm)	Maximum Limit (dBm)
Low	-7.92	0.00	-7.92	8
Mid	-8.22	0.00	-8.22	8
High	-7.31	0.00	-7.31	8

offset 5.5dB

Note: Refer to next page for plots.

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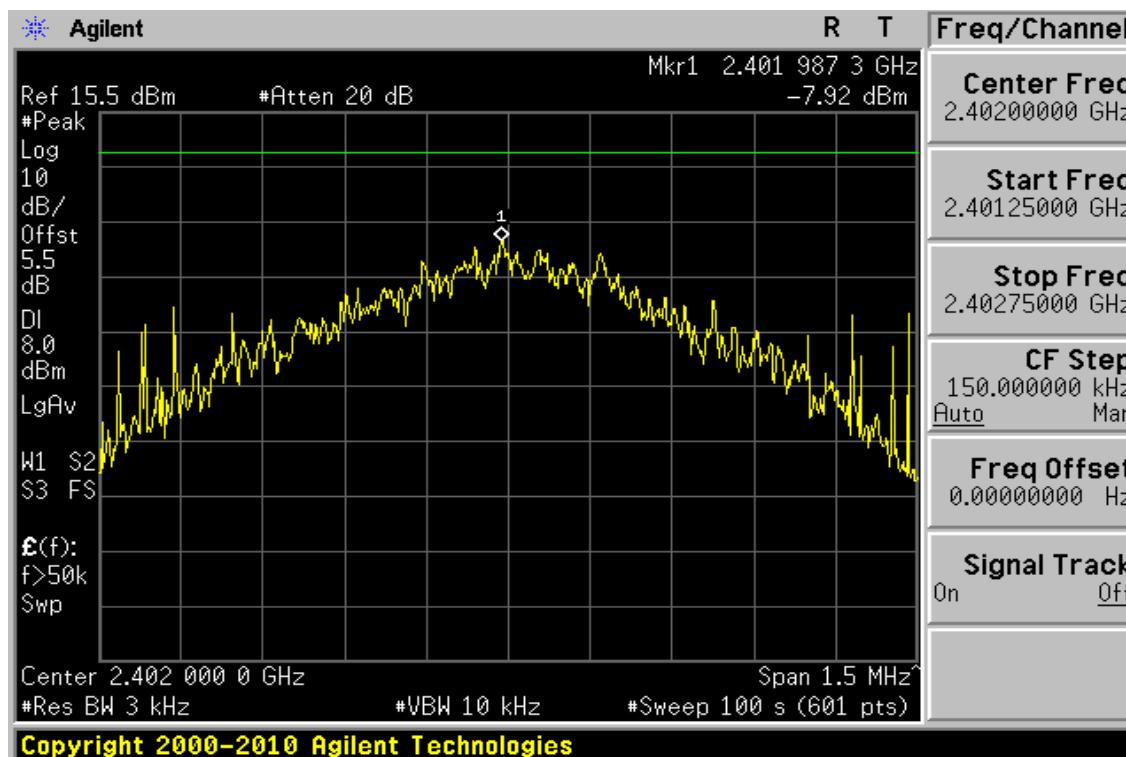
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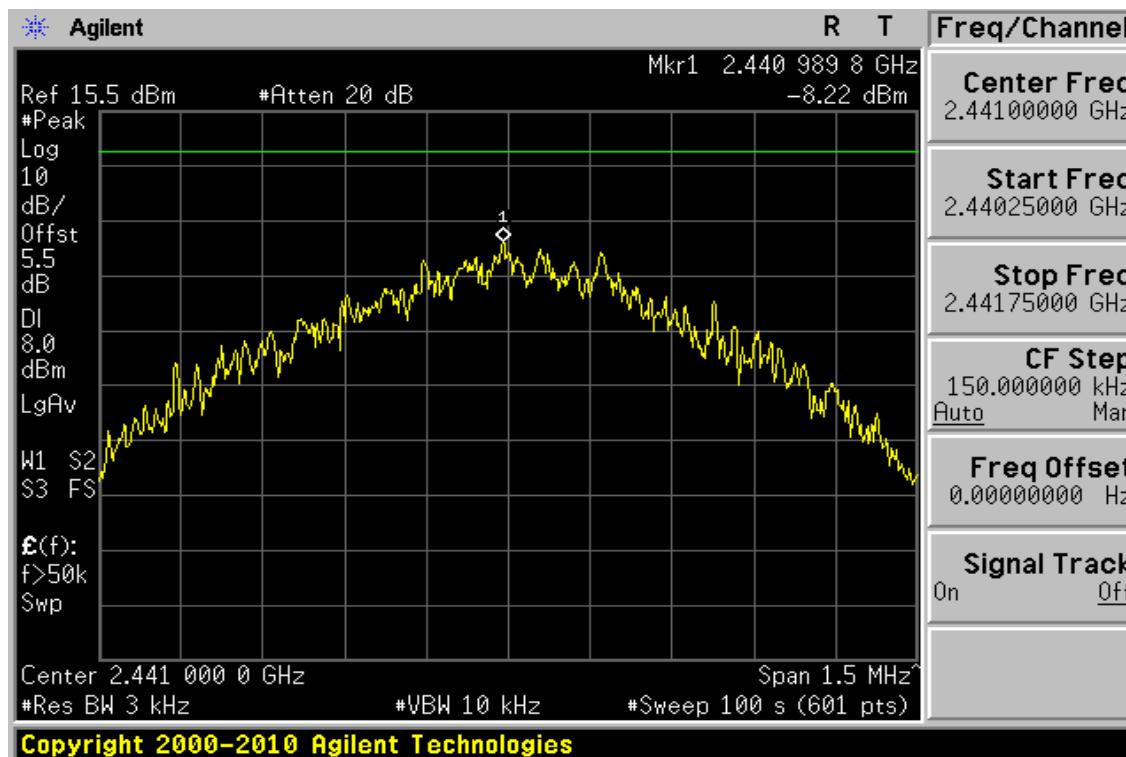
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Power Spectral Density Test Plot (Worst: BDR mode) (CH-Low)



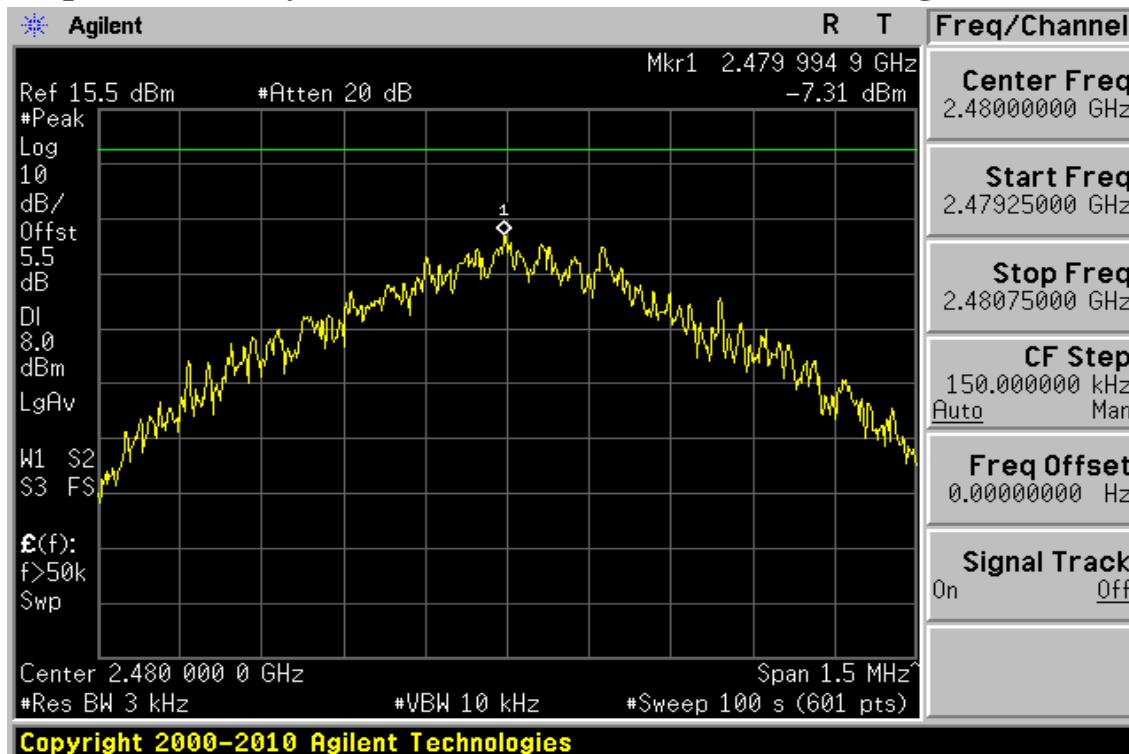
Power Spectral Density Test Plot (Worst: BDR mode) (CH-Mid)



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Power Spectral Density Test Plot (Worst: BDR mode) (CH-High)

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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.

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.

14.2. Antenna Connected Construction

The directional gains of antenna used for transmitting is 1.07dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

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