

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name: PDA Scanner

Brand Name: unitech

Model No.: PA969

Model Difference: N/A

FCC ID: HLEPA969BTP

Report No.: EH/2011/B0037

Issue Date: Apr. 13, 2012

FCC Rule Part: §15.247, Cat: DSS

Prepared for: unitech electronics co., ltd.
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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: PDA Scanner

FCC ID: HLEPA969BTP

Brand Name: unitech

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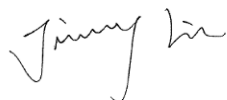
Date of test: Dec. 02, 2011 ~ Mar. 29, 2012

Date of EUT Received: Dec. 02, 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:**

Apr. 13, 2012

*Jimmy Lin / Engineer***Prepared By:****Date:**

Apr. 13, 2012

*Gigi Yeh / Clerk***Approved By:****Date:**

Apr. 13, 2012

Jim Chang / Supervisor

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Version

Version No.	Date	Description
00	Apr. 13, 2012	Initial creation of document

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Table of Contents

1. GENERAL INFORMATION	7
1.1. Product Description	7
1.2. Related Submittal(s) / Grant (s)	8
1.3. Test Methodology	8
1.4. Test Facility	8
1.5. Special Accessories	8
1.6. Equipment Modifications	8
2. SYSTEM TEST CONFIGURATION	9
2.1. EUT Configuration	9
2.2. EUT Exercise	9
2.3. Test Procedure	9
2.4. Configuration of Tested System	10
3. SUMMARY OF TEST RESULTS	11
4. DESCRIPTION OF TEST MODES	11
5. CONDUCTED EMISSION TEST	13
5.1. Standard Applicable	13
5.2. EUT Setup	13
5.3. Measurement Procedure	13
5.4. Measurement Equipment Used:	14
5.5. Measurement Result	14
6. PEAK OUTPUT POWER MEASUREMENT	17
6.1. Standard Applicable	17
6.2. Measurement Equipment Used	17
6.3. Test Set-up:	17
6.4. Measurement Procedure:	18
6.5. Measurement Result	18
7. 20dB BAND WIDTH	23
7.1. Standard Applicable	23
7.2. Measurement Equipment Used	23
7.3. Test Set-up	23
7.4. Measurement Procedure:	23
7.5. Measurement Result:	24

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8. 100KHz BANDWIDTH OF BAND EDGES MEASUREMENT.....	29
8.1. Standard Applicable	29
8.2. Measurement Equipment Used	29
8.3. Test SET-UP:.....	30
8.4. Measurement Procedure.....	31
8.5. Field Strength Calculation	31
8.6. Measurement Result.....	31
9. SPURIOUS RADIATED EMISSION TEST.....	35
9.1. Standard Applicable	35
9.2. Measurement Equipment Used:	35
9.3. Test SET-UP:.....	35
9.4. Measurement Procedure:	36
9.5. Field Strength Calculation	36
9.6. Measurement Result:	36
10. FREQUENCY SEPARATION	46
10.1. Standard Applicable	46
10.2. Measurement Equipment Used:	46
10.3. Test Set-up:	46
10.4. Measurement Procedure:	46
10.5. Measurement Result:	46
11. NUMBER OF HOPPING FREQUENCY	48
11.1. Standard Applicable	48
11.2. Measurement Equipment Used:	48
11.3. Test Set-up:	48
11.4. Measurement Procedure:	48
11.5. Measurement Result:	48
12. TIME OF OCCUPANCY (DWELL TIME)	51
12.1. Standard Applicable	51
12.2. Measurement Equipment Used:	51
12.3. Test Set-up:	51
12.4. Measurement Procedure:	51
12.5. Measurement Result.....	52

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

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13. Peak Power Spectral Density	59
13.1. Standard Applicable	59
13.2. Measurement Equipment Used:	59
13.3. Test Set-up:	59
13.4. Measurement Procedure:	59
13.5. Measurement Result.....	59
14. ANTENNA REQUIREMENT	62
14.1. Standard Applicable	62
14.2. Antenna Connected Construction	62

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1. GENERAL INFORMATION

1.1. Product Description

General:

Product Name:	PDA Scanner	
Brand Name:	unitech	
Model No.:	PA969	
Model difference:	N/A	
Hardware Version:	V3.1	
Software Version:	V1.2.1	
Power Supply:	7.4Vdc form Li-Ion battery or 5Vdc form adapter.	
	Battery:	Model No.: 1400-900006G
	Adapter :	Model No.: 3A-242DB12

Bluetooth:

Frequency Range:	2402 – 2480MHz
Bluetooth Version:	V2.1 + EDR (GFSK + $\pi/4$ DQPSK + 8DPSK)
Channel number:	79 channels
Transmit Power:	1.78 dBm (Peak)
Modulation type:	Frequency Hopping Spread Spectrum
Antenna Designation:	PIFA antenna, -0.24dBi
Type of Emission:	1M19F1D

The EUT is compliance with Bluetooth V2.1 + EDR (GFSK + $\pi/4$ DQPSK + 8DPSK)

This report applies for Bluetooth V2.1 + EDR (GFSK + $\pi/4$ DQPSK + 8DPSK)

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

This submittal(s) (test report) is intended for FCC ID: **HLEPA969BTP** 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 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 30 MHz 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 and DA 00-705.

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2.4. Configuration of Tested System

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

EUT

Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1.	Software	BT-PA969-Test	N/A	N/A	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. MEASUREMENT UNCERTAINTY FOR FIELD STRENGTH OF SPURIOUS RADIATION

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

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

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6. CONDUCTED EMISSION TEST

6.1. 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.		

6.2. 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.

6.3. 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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6.4. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100759	05/20/2011	05/19/2013
EMI Receiver	R&S	ESCS 30	828985/004	09/23/2011	09/22/2012
LISN	Rolf-Heine	NNB-2/16Z	99012	03/23/2012	03/22/2013
LISN	FCC	FCC-LISN-50/250-25-2-01	04034	03/23/2012	03/22/2013
Coaxial Cables	N/A	WK CE Cable	N/A	01/04/2011	01/03/2013

6.5. 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.

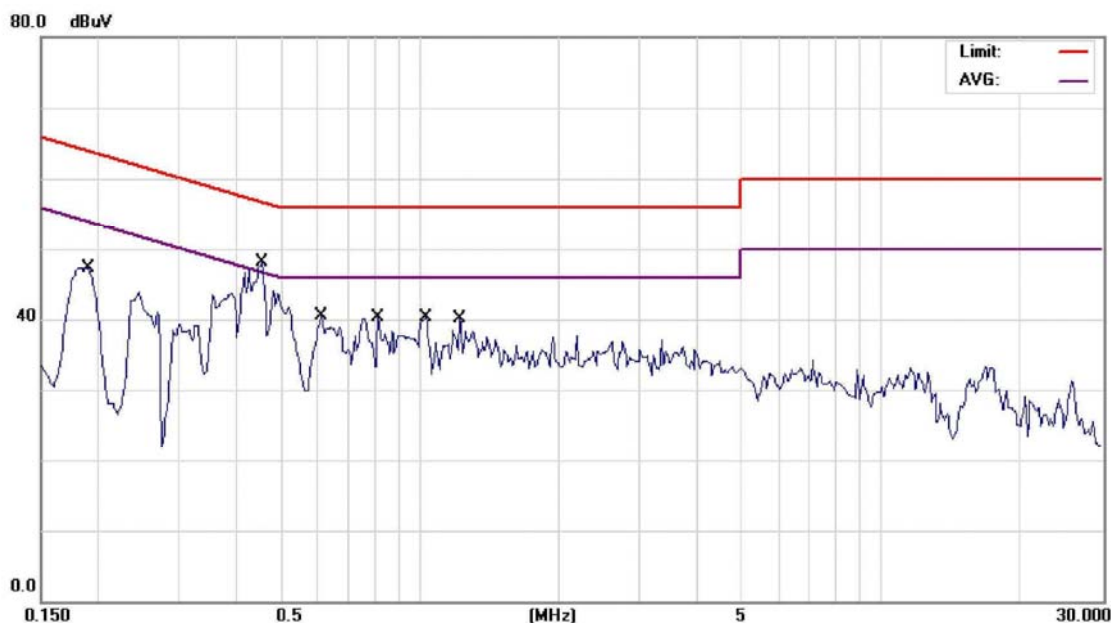
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Bluetooth Mode	Test Date:	Apr. 12, 2012
		Test By:	Jimmy



Site: SGS CONDUCTED #1
Limit: FCC Class B Conduction(QP)
EUT: PDA Scanner
M/N: PA969
Note: BT MODE

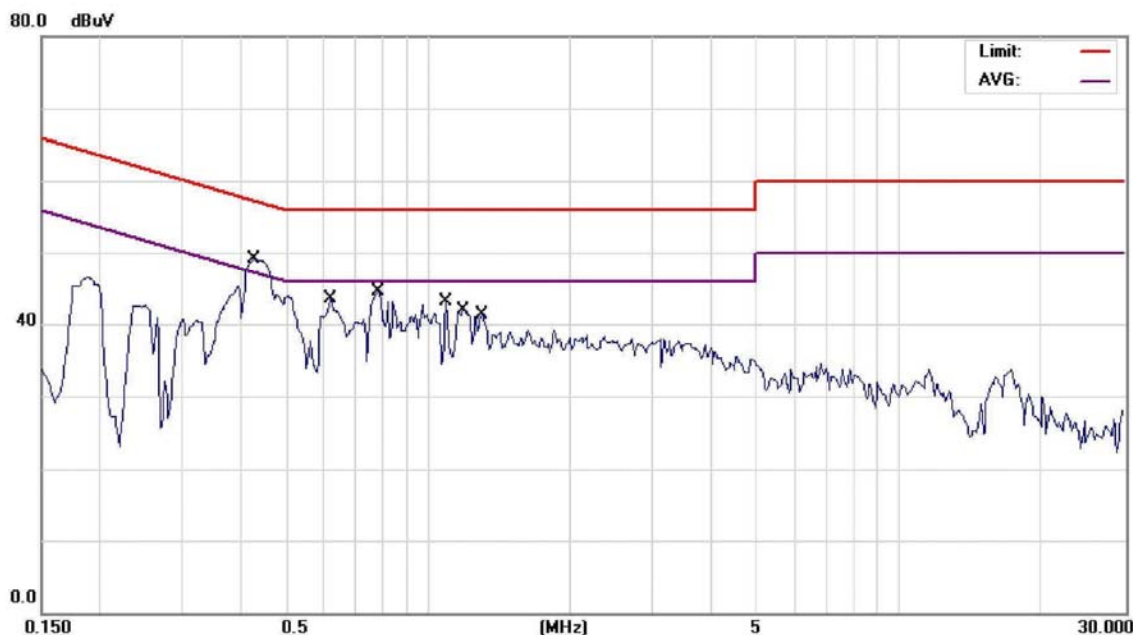
Phase: L1
Power: AC 120V/60Hz
Distance:

Temperature: 26 °C
Humidity: 59%
Air Pressure: hpa

No.	Mk.	Freq. MHz	Reading Level dBuV	Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1900	47.30	0.10	47.40	64.04	-16.64	QP	
2	*	0.4550	41.40	0.09	41.49	56.78	-15.29	QP	
3		0.4550	26.50	0.09	26.59	46.78	-20.19	AVG	
4		0.6100	40.48	0.09	40.57	56.00	-15.43	QP	
5		0.8100	40.29	0.08	40.37	56.00	-15.63	QP	
6		1.0300	40.27	0.08	40.35	56.00	-15.65	QP	
7		1.2200	40.09	0.08	40.17	56.00	-15.83	QP	

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Site SGS CONDUCTED #1

Phase: N

Temperature: 26 °C

Limit: FCC Class B Conduction(QP)

Power: AC 120V/60Hz

Humidity: 59%

EUT: PDA Scanner

Distance:

Air Pressure: hpa

M/N: PA969

Note: BT MODE

No.	Mk.	Freq. MHz	Reading Level dBuV	Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.4250	45.80	0.13	45.93	57.35	-11.42	QP	
2		0.4250	33.50	0.13	33.63	47.35	-13.72	AVG	
3		0.6200	43.46	0.13	43.59	56.00	-12.41	QP	
4		0.7800	44.41	0.12	44.53	56.00	-11.47	QP	
5		1.0900	43.02	0.12	43.14	56.00	-12.86	QP	
6		1.1900	41.82	0.12	41.94	56.00	-14.06	QP	
7		1.3000	41.27	0.12	41.39	56.00	-14.61	QP	

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7. PEAK OUTPUT POWER MEASUREMENT

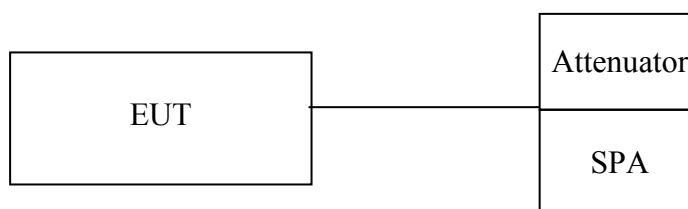
7.1. Standard Applicable

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.

7.2. Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Sensor	Anritsu	ML2495A	1005007	02/08/2012	02/07/2014
Power Meter	Anritsu	MA2411B	917032	02/08/2012	02/07/2014
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/15/2011	04/14/2013
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/17/2012	03/16/2014
DC Block	Mini-Circuits	BLK-18-S+	1	02/28/2012	02/27/2013
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/05/2012	01/04/2013
Attenuator	Mini-Circuit	BW-S10W2+	002	02/28/2012	02/27/2013
Splitter	Agilent	11636B	N/A	02/28/2012	02/27/2013

7.3. Test Set-up:



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7.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (BDR model: max peak RBW= 1MHz ,VBW = 3MHz, EDR model: max peak RBW = 1.5MHz VBW = 5MHz)
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

7.5. Measurement Result

BDR Mode

Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	-0.02	-0.02	0.00100	1
2441.00	-0.10	-0.10	0.00098	1
2480.00	-0.62	-0.62	0.00087	1

**Note: offset 7dB*

EDR Mode

Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	1.79	1.79	0.00151	1
2441.00	1.78	1.78	0.00151	1
2480.00	1.26	1.26	0.00134	1

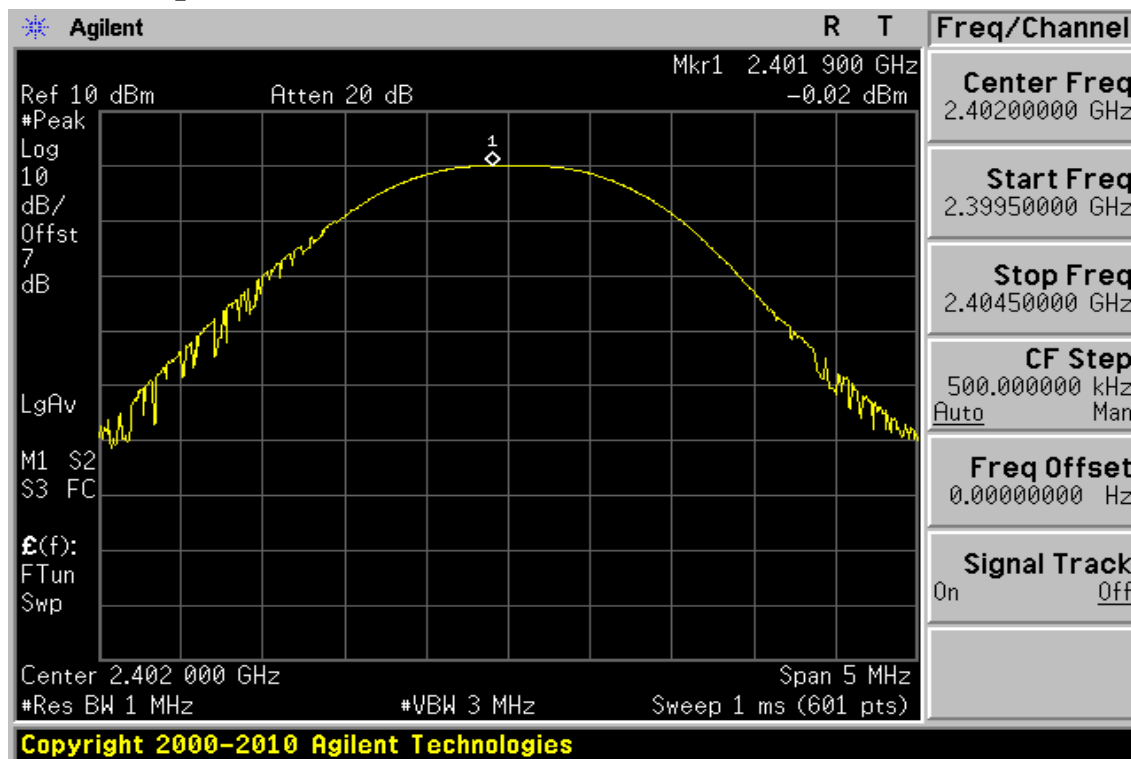
**Note: offset 7dB*

Note: Refer to next page for plots.

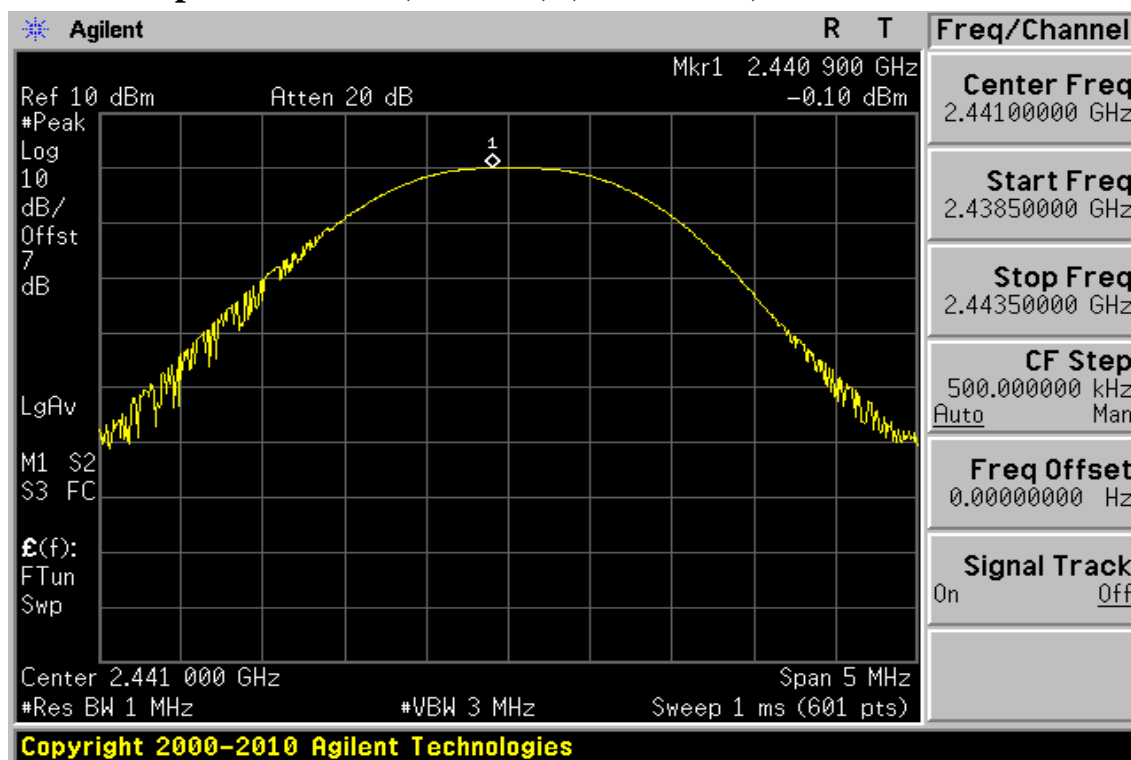
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Peak Power Output Data Plot (CH Low) (BDR mode)



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

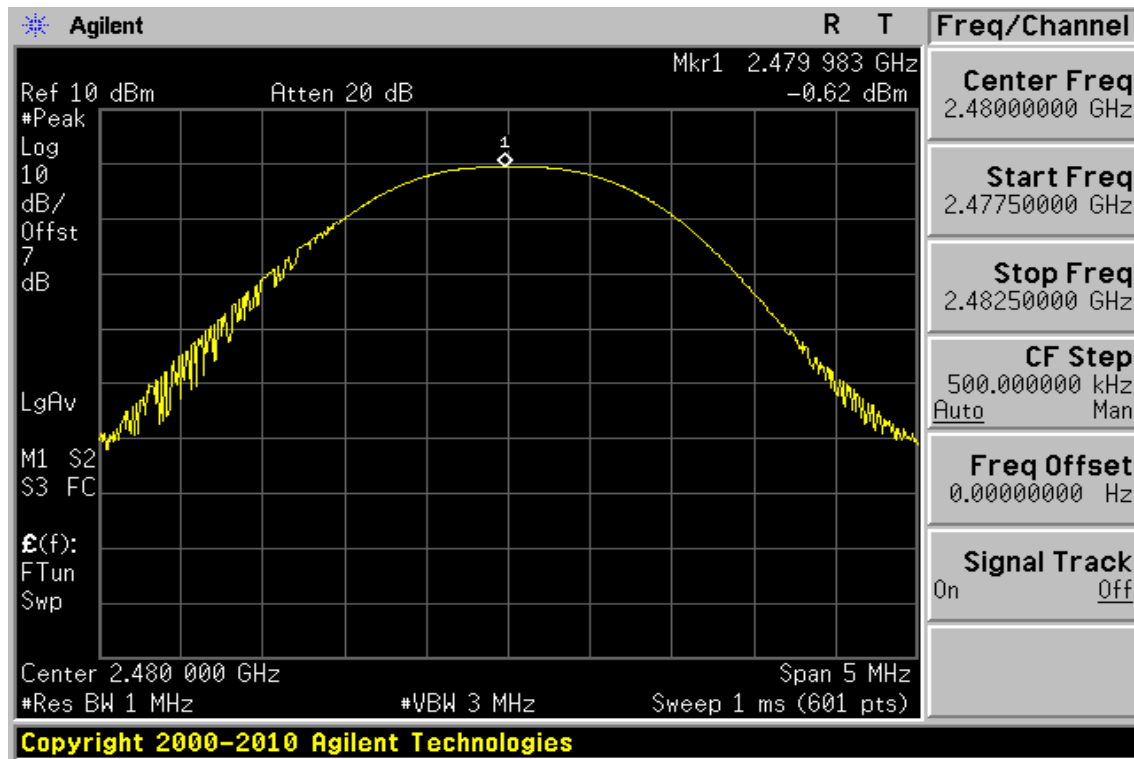


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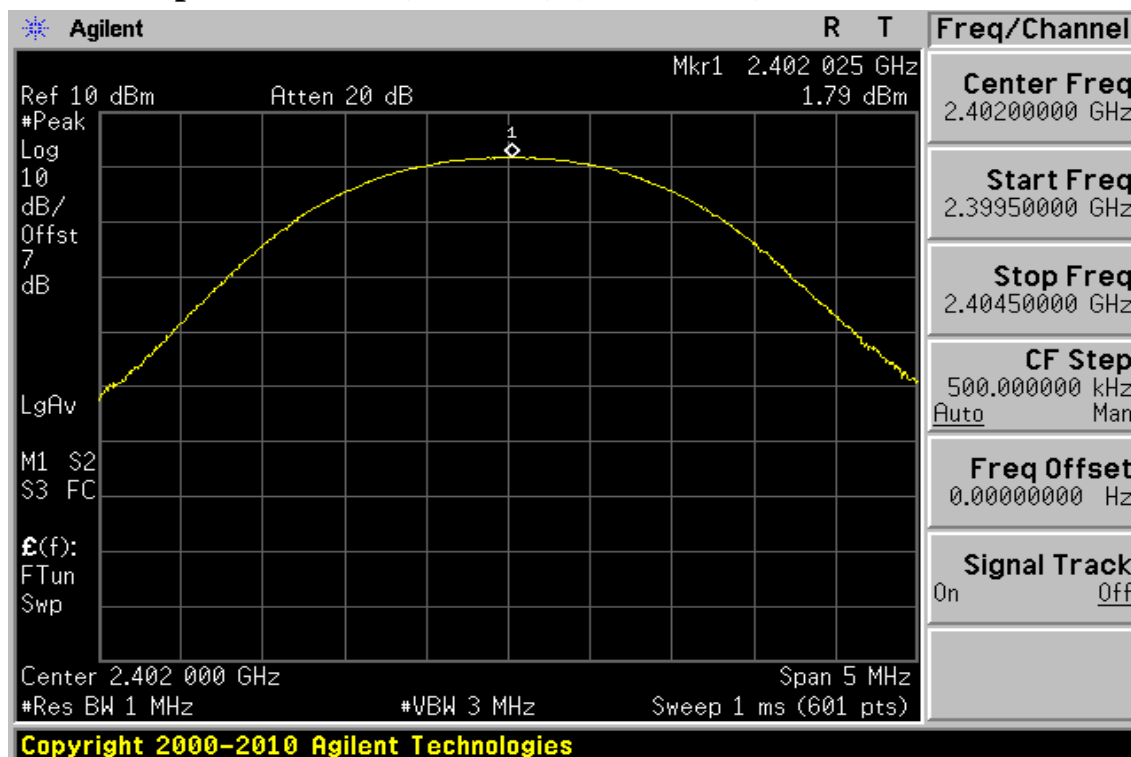
Peak Power Output Data Plot (CH High) (BDR mode)



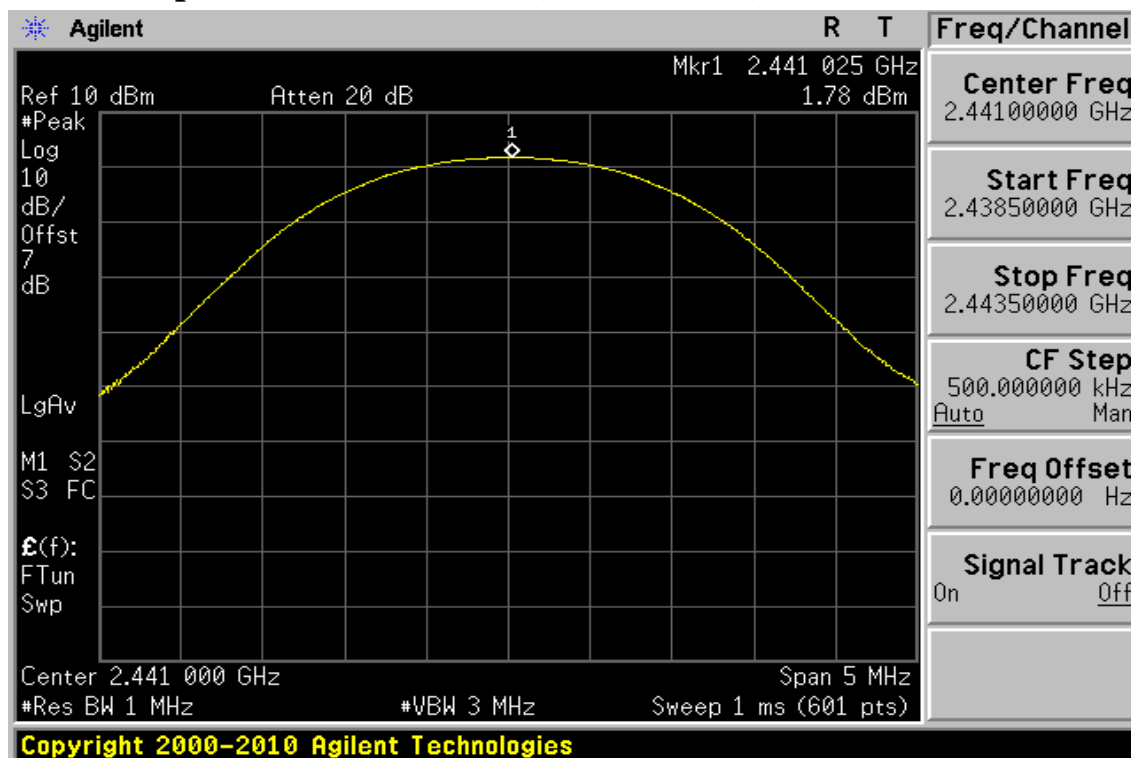
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Peak Power Output Data Plot (CH Low) (EDR mode)



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

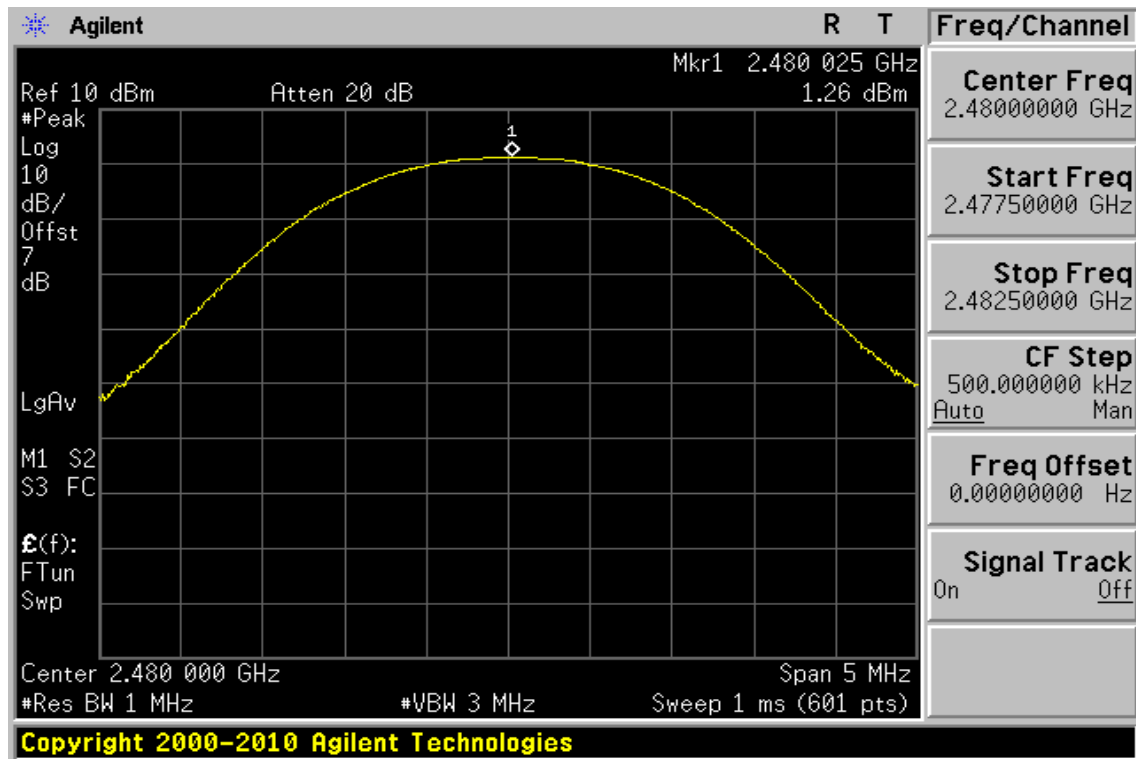


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Peak Power Output Data Plot (CH High) (EDR mode)



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8. 20dB BAND WIDTH

8.1. Standard Applicable

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

8.2. Measurement Equipment Used

Refer to section 7.2 for details.

8.3. Test Set-up

Refer to section 7.3 for details.

8.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as $RBW > 1\%$ 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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8.5. Measurement Result:

20dB Bandwidth : BDR mode

BDR Mode

CH	Bandwidth (MHz)
Lower	0.886
Mid	0.887
Higher	0.884

Note: Offset: 7dB

20dB Bandwidth : EDR mode

CH	Bandwidth (MHz)	2/3 Bandwidth (MHz)
Lower	1.309	0.873
Mid	1.287	0.858
Higher	1.291	0.861

Note: Offset: 7dB

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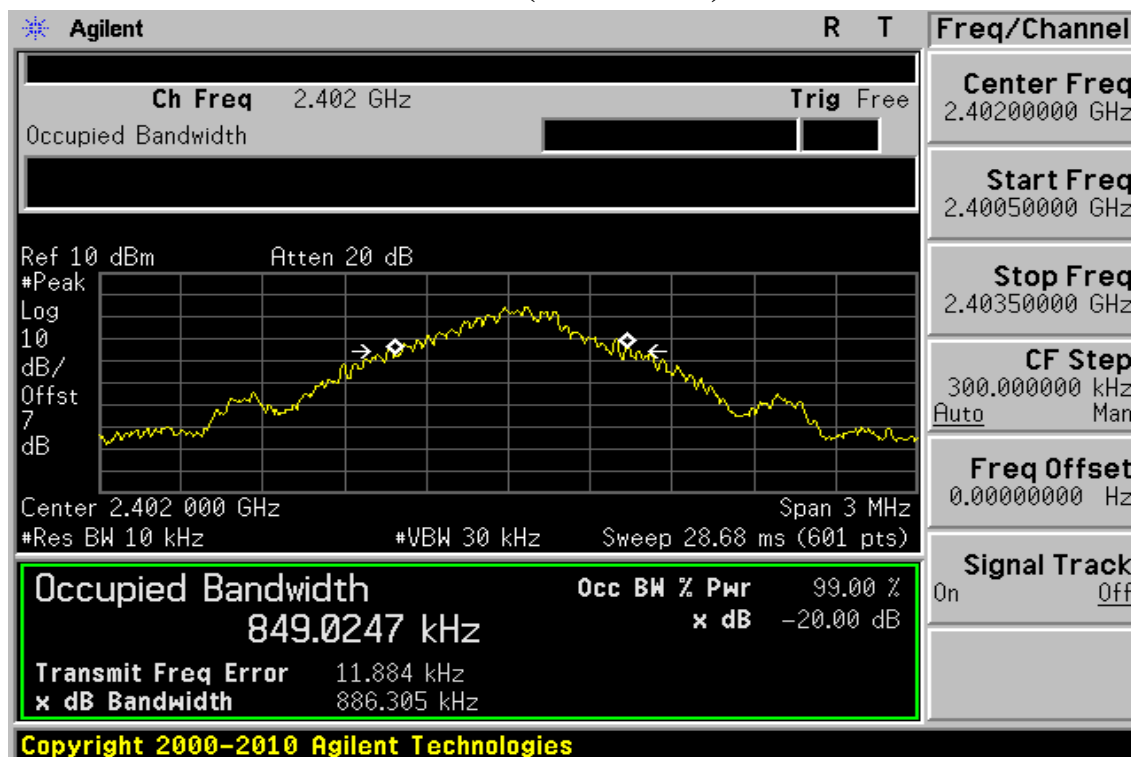
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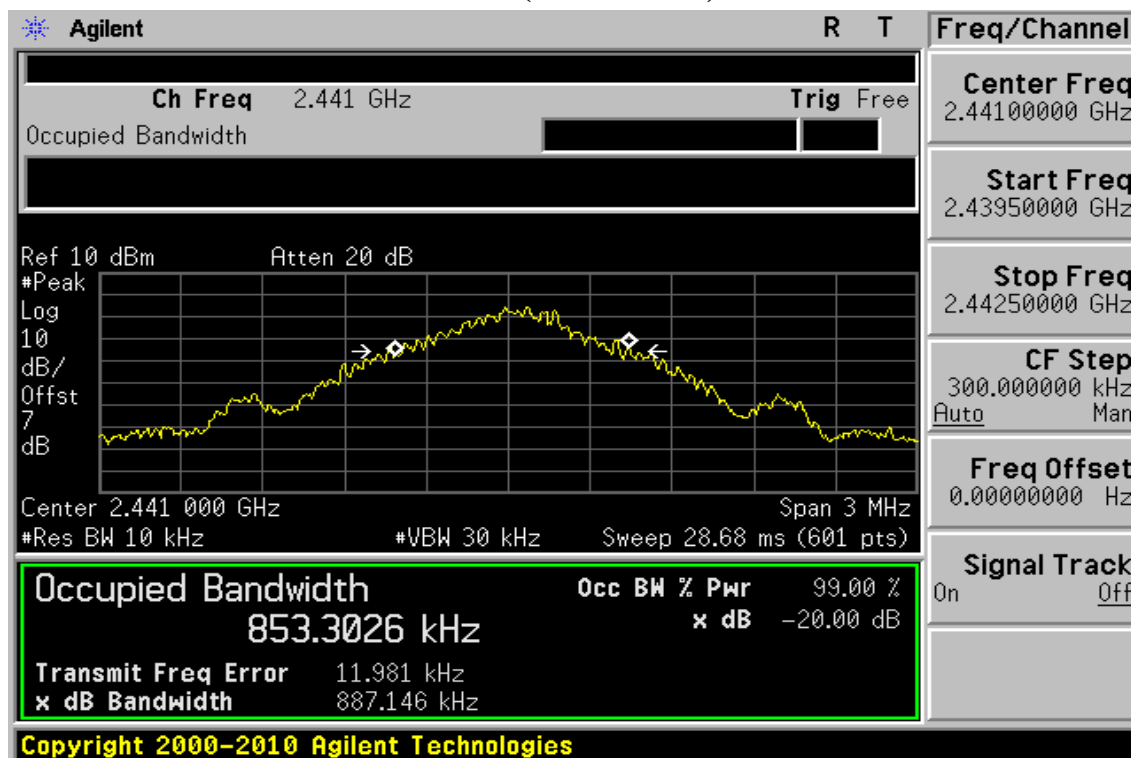
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20dB Band Width Test Data CH-Low (BDR mode)



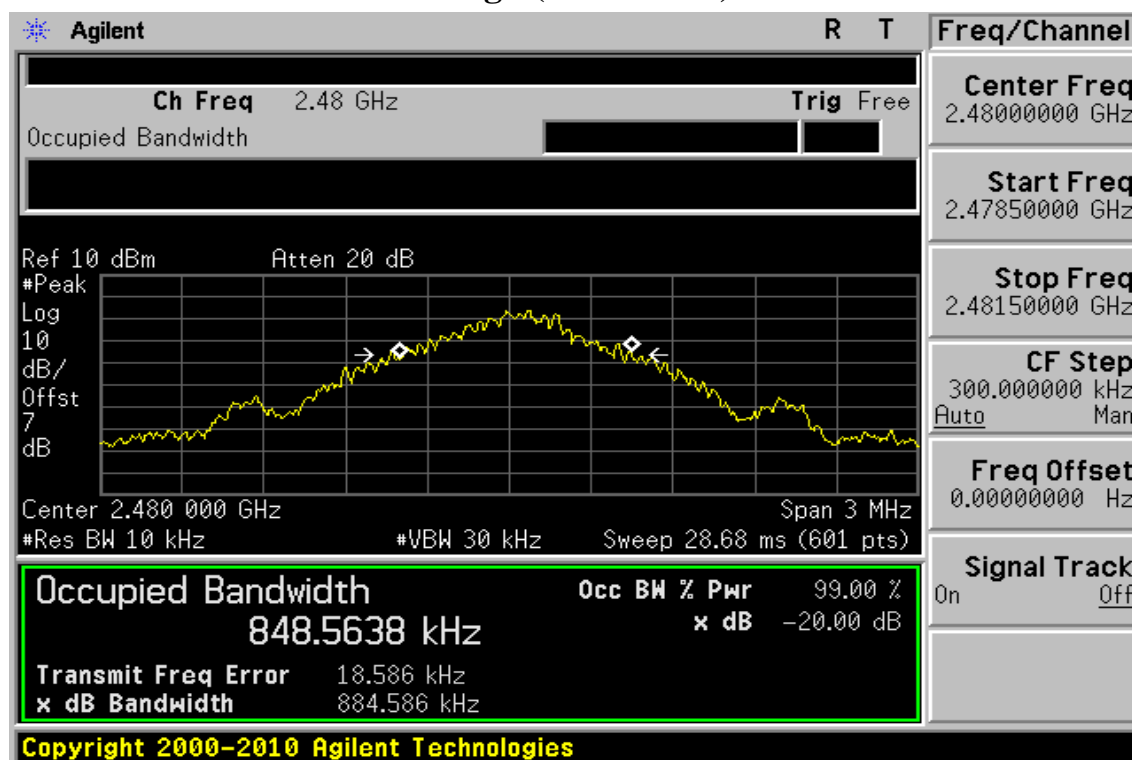
20dB Band Width Test Data CH-Mid (BDR mode)



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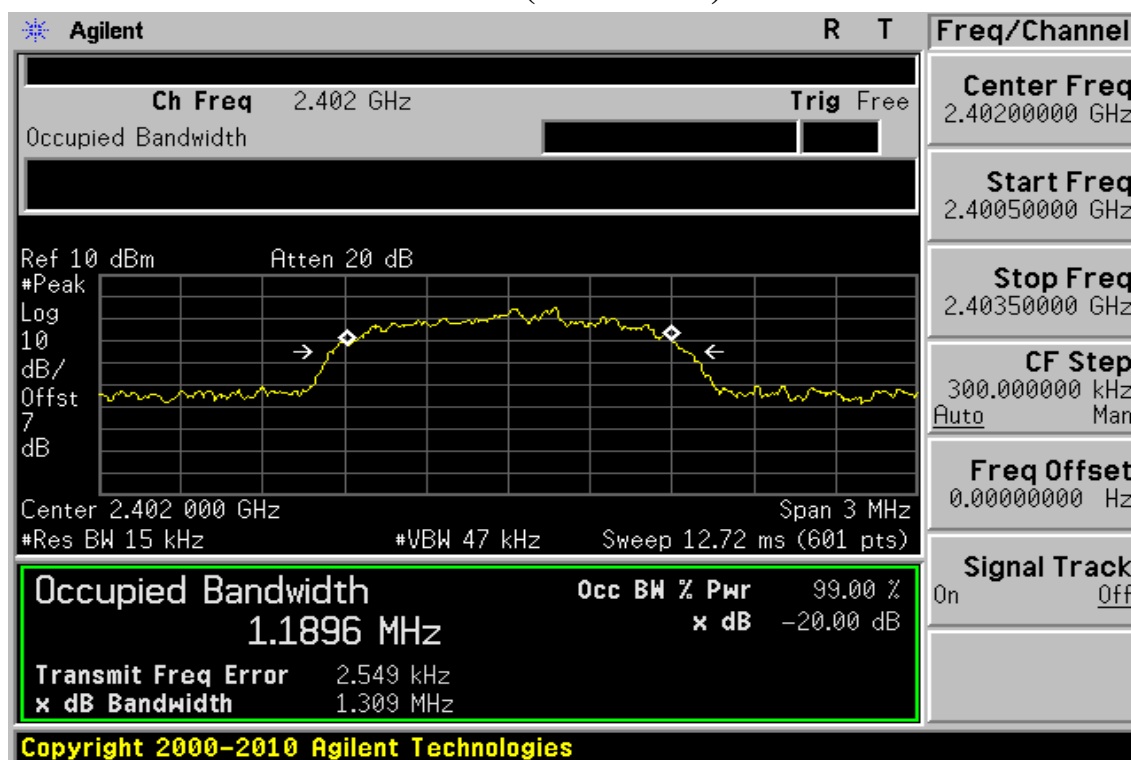
20dB Band Width Test Data CH-High (BDR mode)



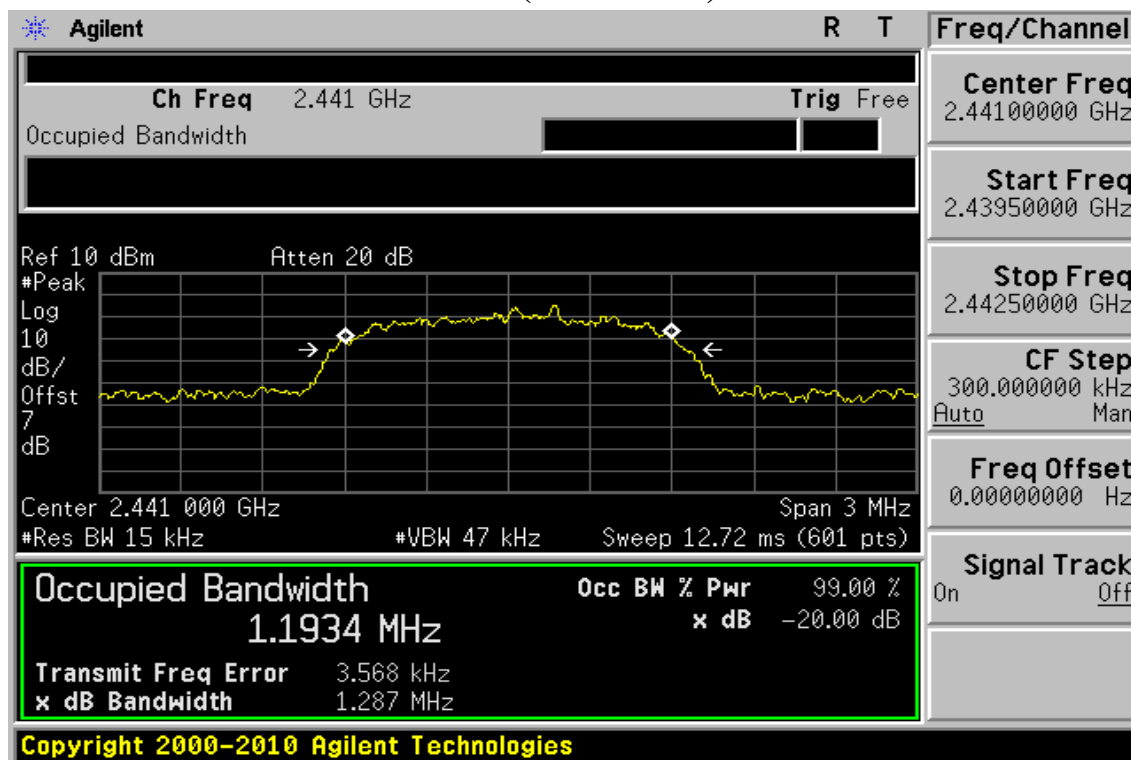
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20dB Band Width Test Data CH-Low (EDR mode)



20dB Band Width Test Data CH-Mid (EDR mode)

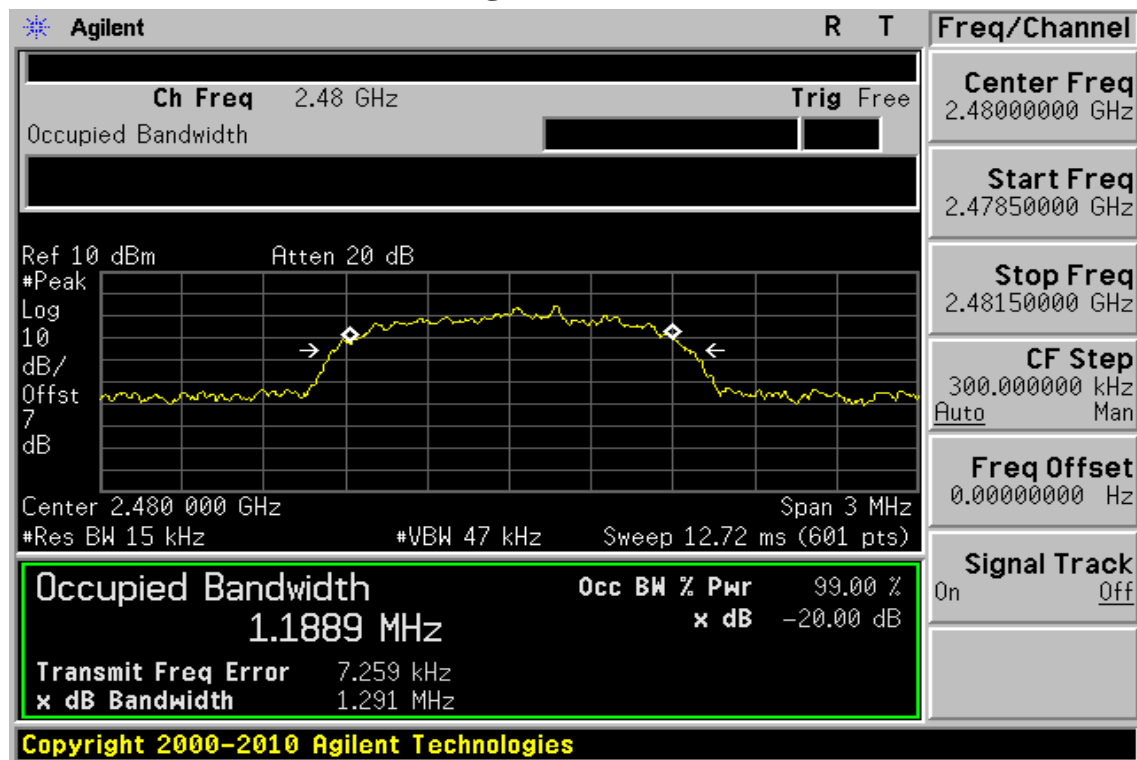


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20dB Band Width Test Data CH-High (EDR mode)



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9. 100KHz BANDWIDTH OF BAND EDGES MEASUREMENT

9.1. 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).

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:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100759	05/20/2011	05/19/2012
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/15/2011	04/14/2013
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	02/15/2011	02/14/2013
Spectrum Analyzer	R&S	FSV-30	101398	10/18/2011	10/17/2013
Bilog Antenna	SCHWAZBECK	VULB9168	378	01/10/2012	01/09/2014
Horn antenna	ETS.LINDGREN	3117	123995	05/19/2011	05/18/2013
Horn Antenna	Schwarzbeck	BBHA9170	185	07/11/2011	07/10/2013
Pre-Amplifier	Agilent	8447D	2944A07676	01/04/2012	01/03/2013
Pre-Amplifier	EMC Instruments Corp.	EMC0126530	980038	01/04/2012	01/03/2013
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M2	05/25/2011	05/24/2012
Attenuator	Mini-Circuit	BW-S10W2+	004	02/28/2012	02/27/2013
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_Rx	9	01/04/2012	01/03/2013
3m Site NSA	SGS	966 chamber	N/A	07/15/2011	07/14/2012

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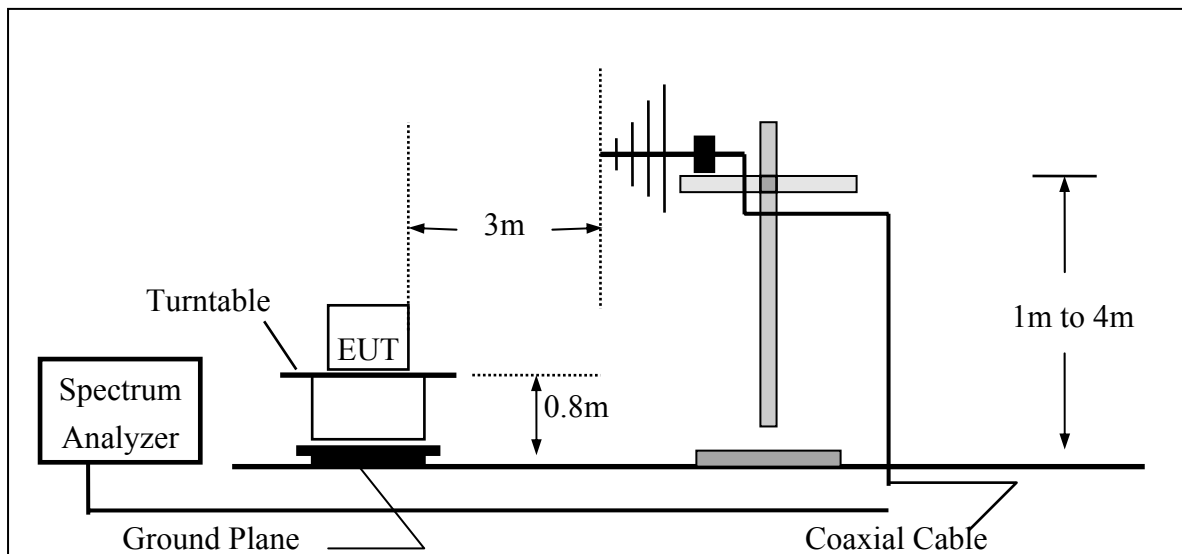
9.3. Test SET-UP:

9.3.1. Conducted Emission at antenna port:

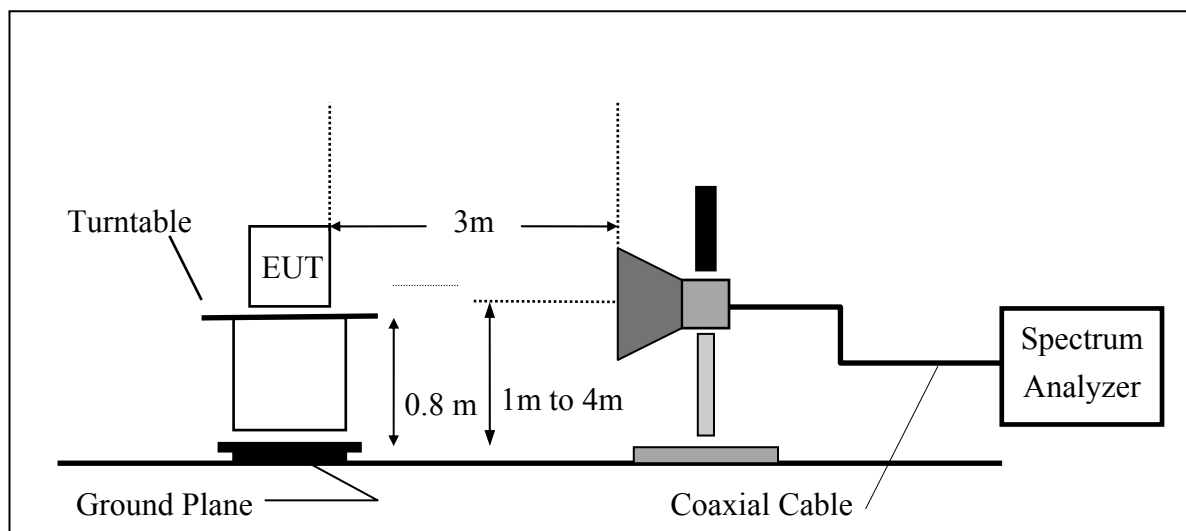
Refer to section 6.3 for details.

9.3.2. Radiated emission:

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



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



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9.4. 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.

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	

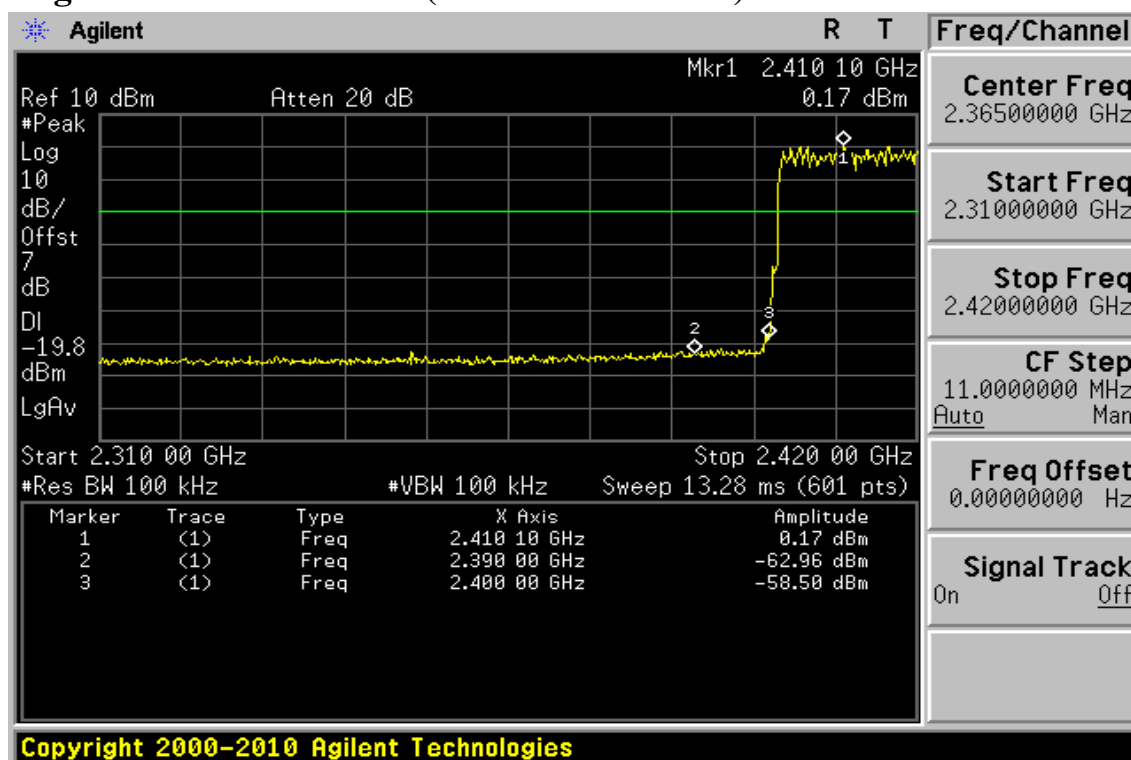
9.6. Measurement Result

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

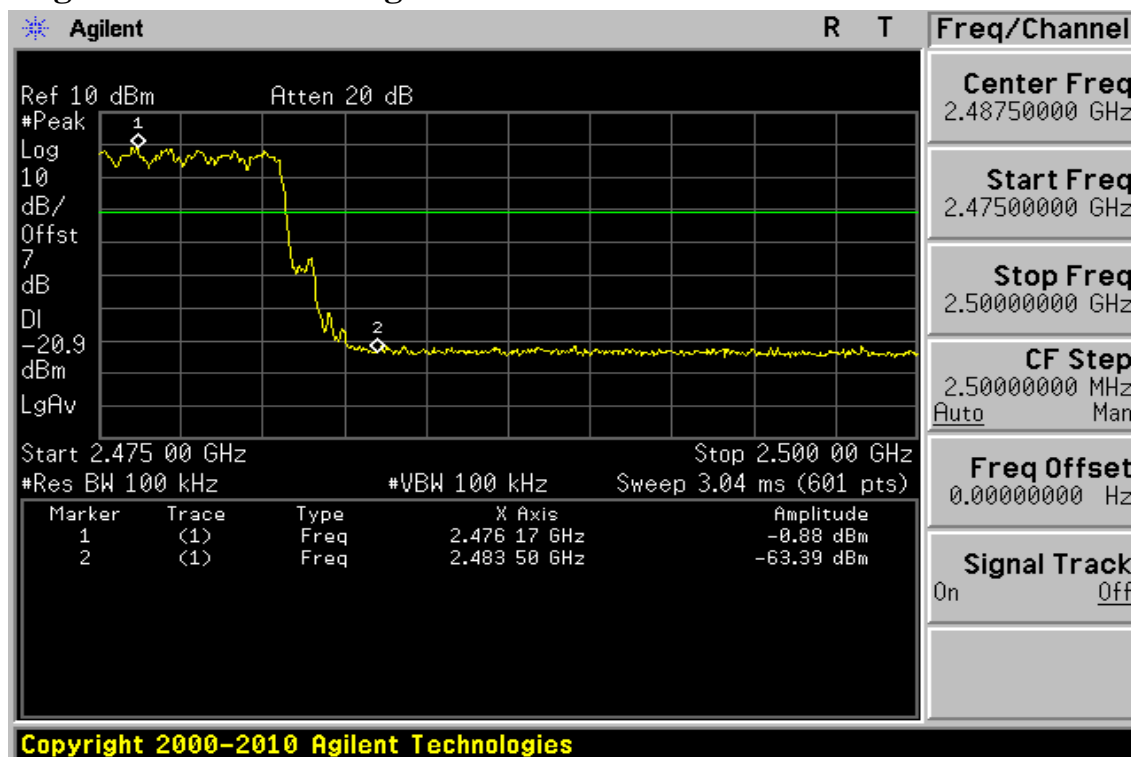
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Band Edges Test Data CH-Low (Worst: EDR mode)



Band Edges Test Data CH-High



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Radiated Emission: (Worst: EDR mode)

Operation Band	:EDR	Test Date	:2012-04-10
Fundamental Frequency	:2402	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX LOW Bandedge	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:VERTICAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Safe Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Peak	45.06	5.17	50.23	74.00	-23.77

Operation Band	:EDR	Test Date	: 2012-04-10
Fundamental Frequency	:2402	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX LOW Bandedge	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:HORIZONTAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Safe Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Peak	44.97	5.79	50.76	74.00	-23.24

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Operation Band	:EDR	Test Date	: 2012-04-10
Fundamental Frequency	:2480	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX HIGH Bandedge	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:VERTICAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Peak	45.02	5.69	50.71	74.00	-23.29

Operation Band	:EDR	Test Date	: 2012-04-10
Fundamental Frequency	:2480	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX HIGH Bandedge	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:HORIZONTAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Peak	45.16	6.72	51.88	74.00	-22.12

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10. SPURIOUS RADIATED EMISSION TEST

10.1. 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.

10.2. Measurement Equipment Used:

10.2.1. Conducted Emission at antenna port:

Refer to section 7.2 for details.

10.2.2. Radiated emission:

Refer to section 9.2 for details.

10.3. Test SET-UP:

10.3.1. Conducted Emission at antenna port:

Refer to section 7.3 for details.

10.3.2. Radiated emission:

Refer to section 9.3 for details.

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10.4. 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.

Conducted Emission:

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

10.5. Field Strength Calculation

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

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

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

10.6. Measurement Result:

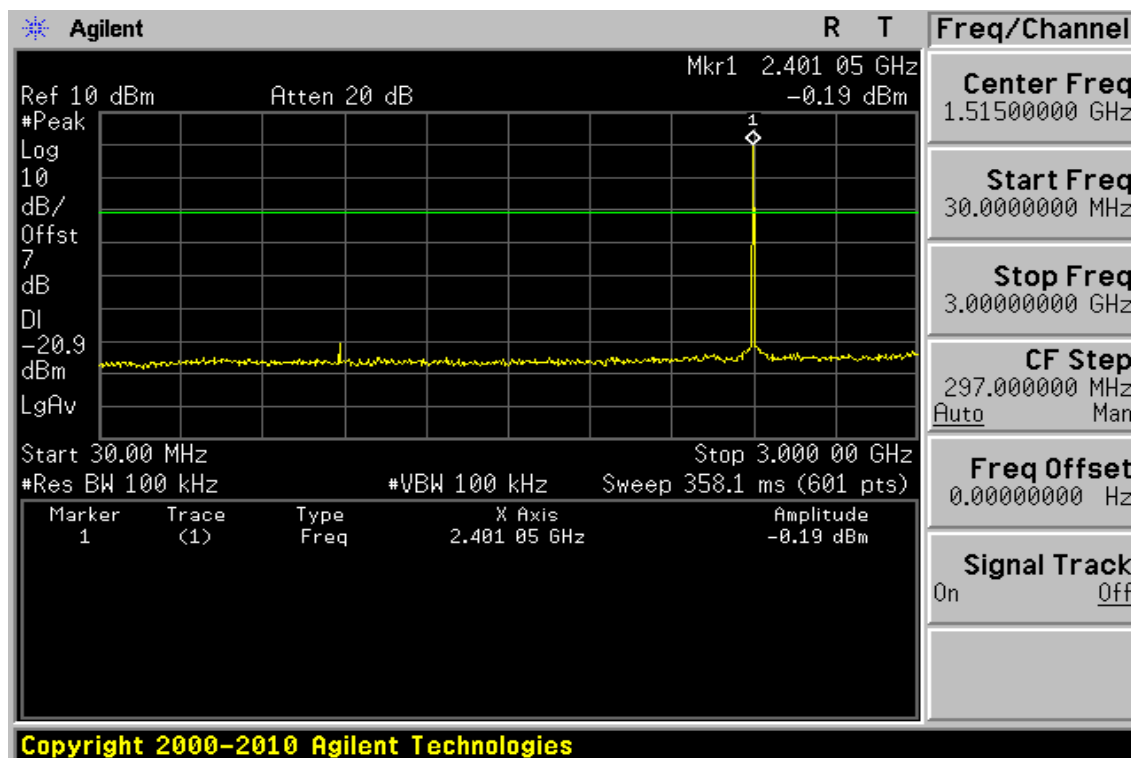
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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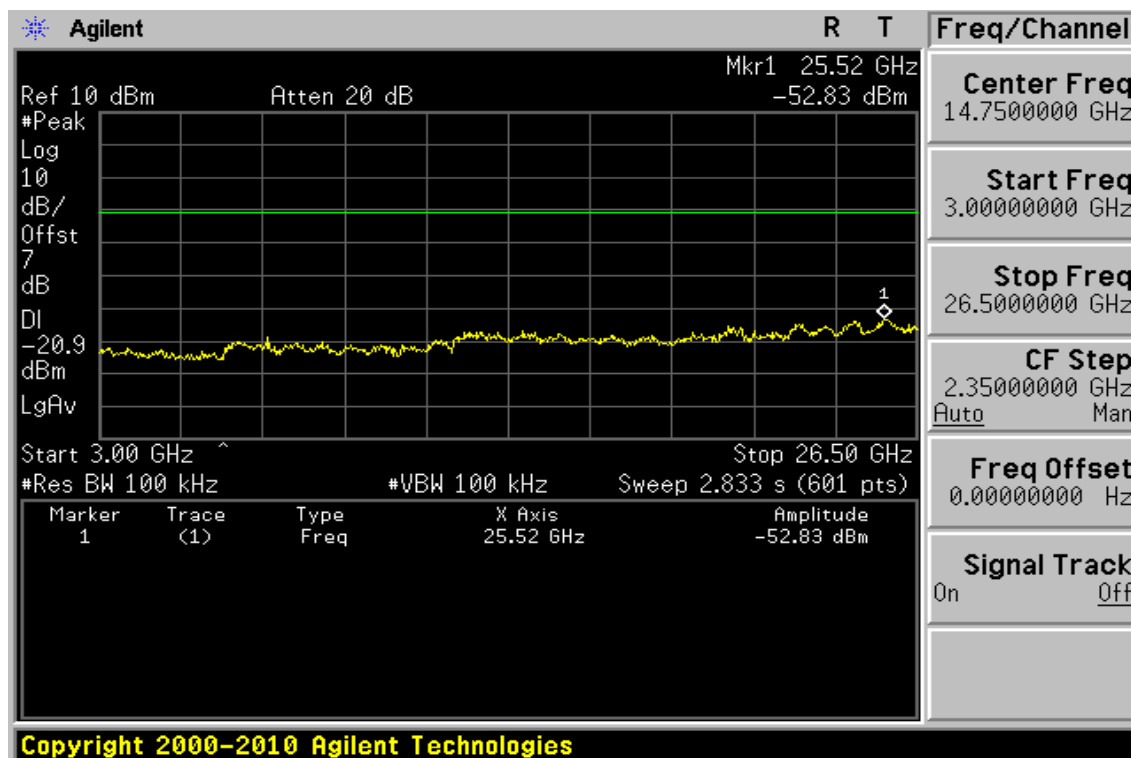
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Conducted Spurious Emission Measurement Result (Worst: EDR mode)

Ch Low 30MHz – 3GHz



Ch Low 3GHz – 26.5GHz

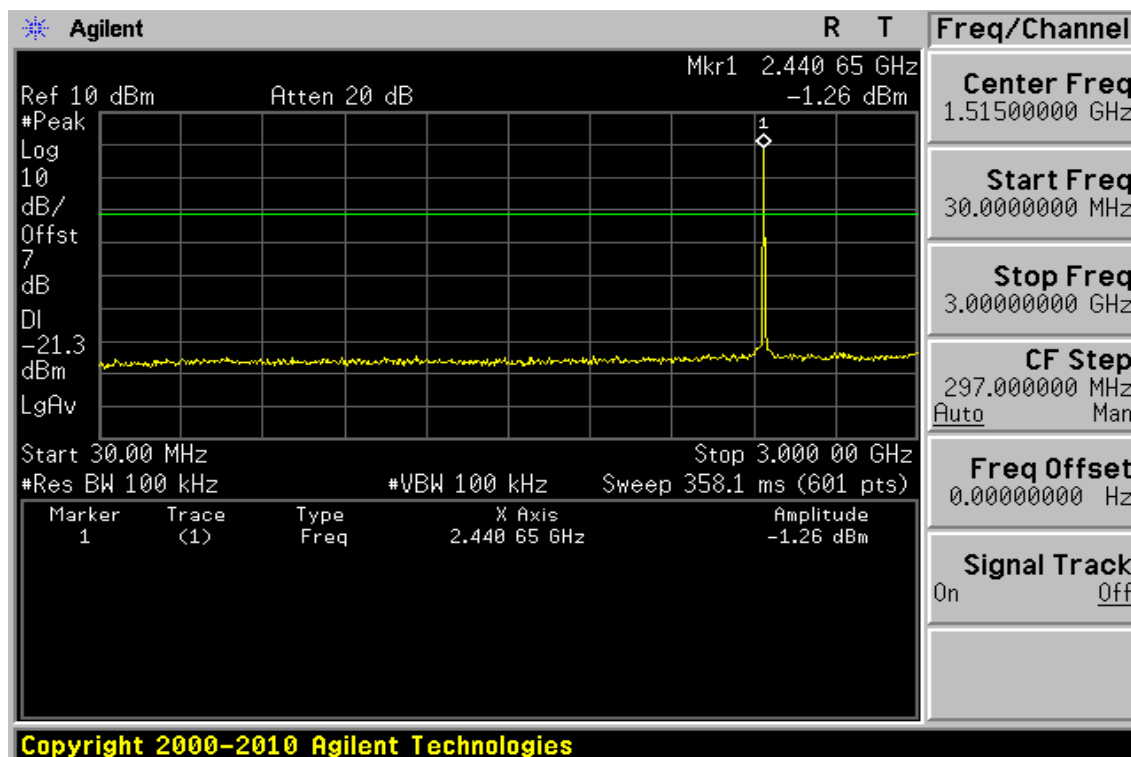


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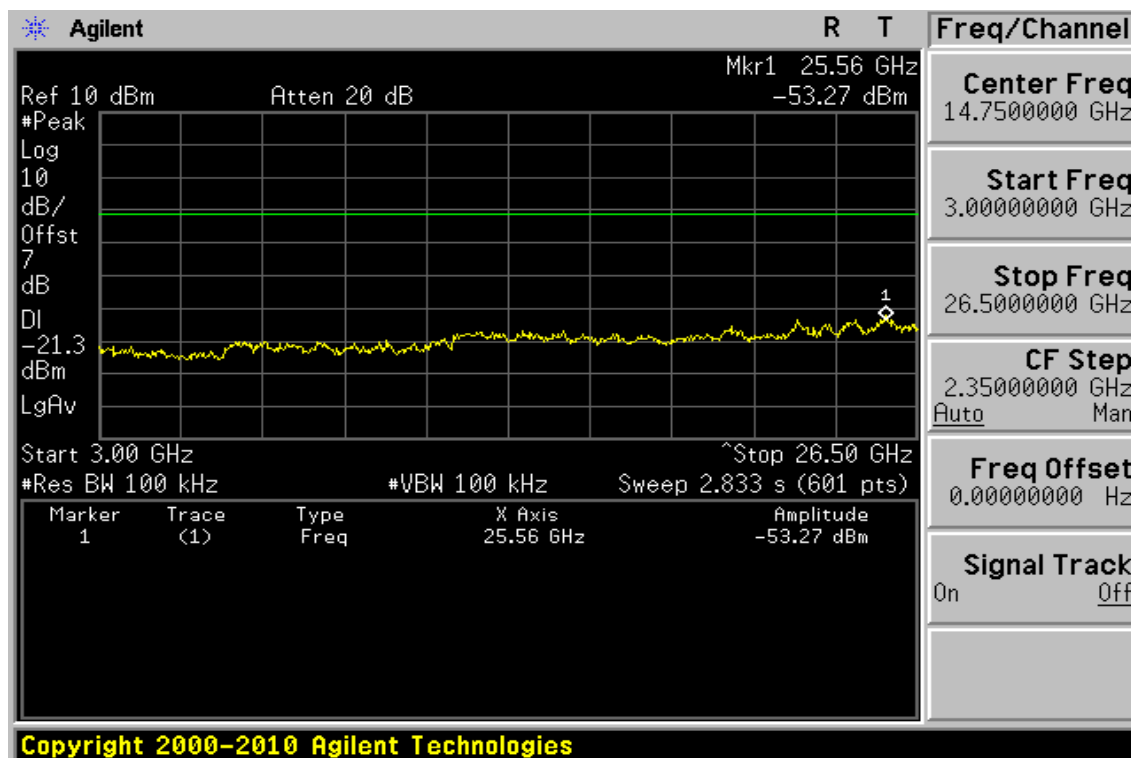
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Ch Mid 30MHz – 3GHz



Ch Mid 3GHz – 26.5GHz

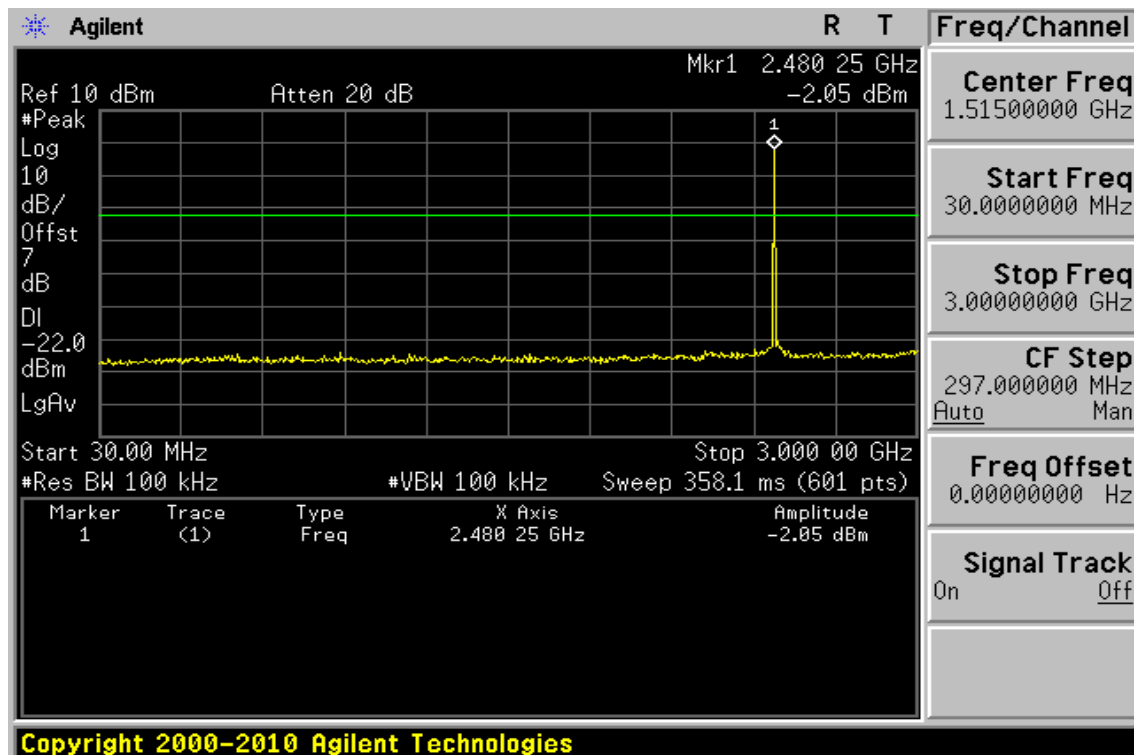


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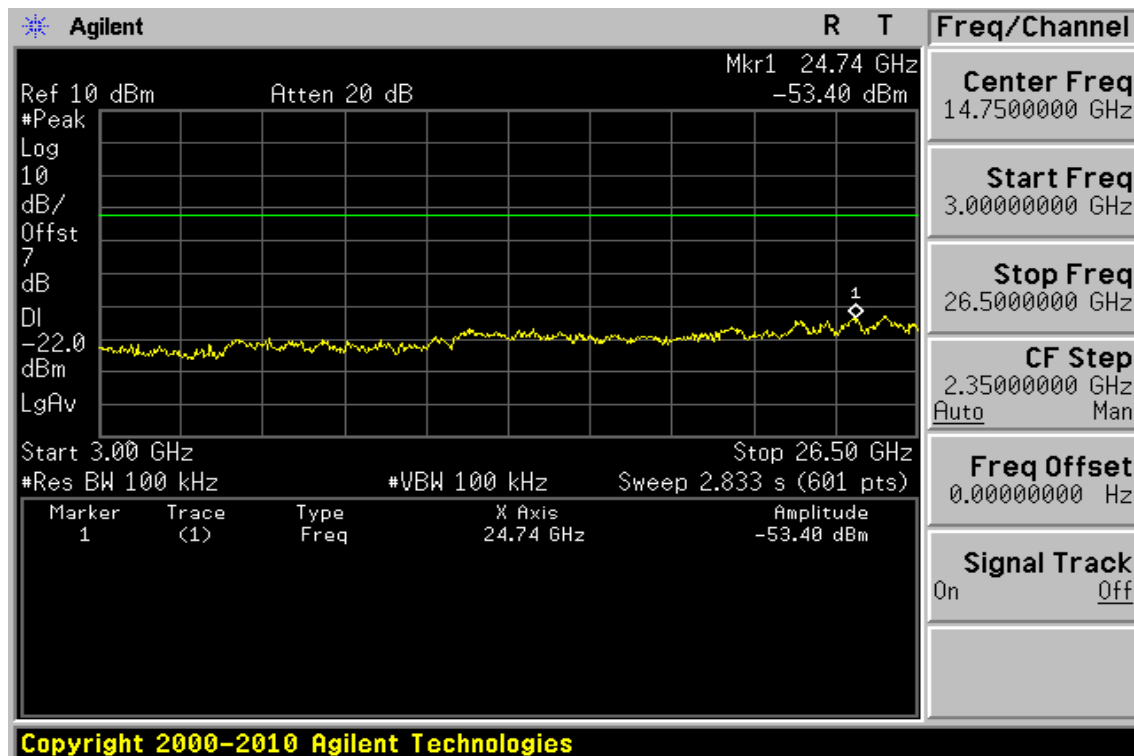
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Ch High 30MHz – 3GHz



Ch High 3GHz – 26.5GHz



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Radiated Spurious Emission Measurement Result

Operation Band	:EDR	Test Date	:2011-11-28
Fundamental Frequency	:2402	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX LOW	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:VERTICAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	Margin
		PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
77.53	S	Peak	47.46	-17.62	29.84	40.00	-10.16
195.87	S	Peak	41.96	-15.20	26.76	43.50	-16.74
399.57	S	Peak	35.80	-10.35	25.45	46.00	-20.55
460.68	S	Peak	41.21	-9.21	32.00	46.00	-14.00
533.43	S	Peak	50.54	-8.22	42.32	46.00	-3.68
666.32	S	Peak	30.95	-5.63	25.32	46.00	-20.68
4804.00	H	Peak	34.94	9.94	44.88	74.00	-29.12
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

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Operation Band	:EDR	Test Date	:2011-11-28
Fundamental Frequency	:2402	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX LOW	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:HORIZONTAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
94.02	S	Peak	42.66	-16.77	25.89	43.50	-17.61
266.68	S	Peak	38.42	-12.77	25.65	46.00	-20.35
460.68	S	Peak	35.78	-9.21	26.57	46.00	-19.43
533.43	S	Peak	40.93	-8.22	32.71	46.00	-13.29
666.32	S	Peak	32.41	-5.63	26.78	46.00	-19.22
884.57	S	Peak	29.14	-2.34	26.80	46.00	-19.20
4804.00	H	Peak	34.62	9.98	44.60	74.00	-29.40
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

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Radiated Spurious Emission Measurement Result

Operation Band	:EDR	Test Date	:2011-11-28
Fundamental Frequency	:2441	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX MID	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:VERTICAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	Margin
		PK/QP/AV	dBμV		dBμV/m	dBμV/m	dB
48.43	S	Peak	48.15	-13.85	34.30	40.00	-5.70
171.62	S	Peak	39.75	-12.63	27.12	43.50	-16.38
460.68	S	Peak	41.05	-9.21	31.84	46.00	-14.16
533.43	S	Peak	50.57	-8.22	42.35	46.00	-3.65
666.32	S	Peak	32.17	-5.63	26.54	46.00	-19.46
874.87	S	Peak	27.39	-2.52	24.87	46.00	-21.13
4882.00	H	Peak	34.24	10.29	44.53	74.00	-29.47
7323.00	H	---					
9764.00	H	---					
12205.00	H	---					
14646.00	H	---					
17087.00	H	---					
19528.00	H	---					
21969.00	H	---					
24410.00	H	---					

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Operation Band	:EDR	Test Date	:2011-11-28
Fundamental Frequency	:2441	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX MID	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:HORIZONTAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	Margin
		PK/QP/AV	dBμV		dBμV/m	dBμV/m	dB
94.02	S	Peak	42.18	-16.77	25.41	43.50	-18.09
194.90	S	Peak	40.06	-15.13	24.93	43.50	-18.57
266.68	S	Peak	37.99	-12.77	25.22	46.00	-20.78
533.43	S	Peak	40.89	-8.22	32.67	46.00	-13.33
666.32	S	Peak	34.36	-5.63	28.73	46.00	-17.27
800.18	S	Peak	31.33	-3.52	27.81	46.00	-18.19
4882.00	H	Peak	34.18	10.24	44.42	74.00	-29.58
7323.00	H	---					
9764.00	H	---					
12205.00	H	---					
14646.00	H	---					
17087.00	H	---					
19528.00	H	---					
21969.00	H	---					
24410.00	H	---					

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Radiated Spurious Emission Measurement Result

Operation Band	:EDR	Test Date	:2011-11-28
Fundamental Frequency	:2480	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX HIGH	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:VERTICAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	Margin
		PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
76.56	S	Peak	47.72	-17.42	30.30	40.00	-9.70
195.87	S	Peak	41.83	-15.20	26.63	43.50	-16.87
399.57	S	Peak	36.08	-10.35	25.73	46.00	-20.27
460.68	S	Peak	41.24	-9.21	32.03	46.00	-13.97
533.43	S	Peak	50.45	-8.22	42.23	46.00	-3.77
674.08	S	Peak	30.80	-5.52	25.28	46.00	-20.72
4960.00	H	Peak	35.22	10.91	46.13	74.00	-27.87
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

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Operation Band	:EDR	Test Date	:2011-11-28
Fundamental Frequency	:2480	Temp./Humi.	:27 deg_C / 66 RH
Operation Mode	:TX HIGH	Engineer	:Jay
EUT Pol.	:H	Measurement Antenna Pol.	:HORIZONTAL

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

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

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	Margin
		PK/QP/AV	dBμV		dBμV/m	dBμV/m	dB
94.02	S	Peak	42.87	-16.77	26.10	43.50	-17.40
162.89	S	Peak	36.18	-11.80	24.38	43.50	-19.12
266.68	S	Peak	38.52	-12.77	25.75	46.00	-20.25
412.18	S	Peak	35.72	-10.03	25.69	46.00	-20.31
533.43	S	Peak	41.08	-8.22	32.86	46.00	-13.14
666.32	S	Peak	31.52	-5.63	25.89	46.00	-20.11
4960.00	H	Peak	35.62	10.76	46.38	74.00	-27.62
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

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11. FREQUENCY SEPARATION

11.1. Standard Applicable

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

11.2. Measurement Equipment Used:

Refer to section 7.2 for details.

11.3. Test Set-up:

Refer to section 7.3 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 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.

11.5. Measurement Result:

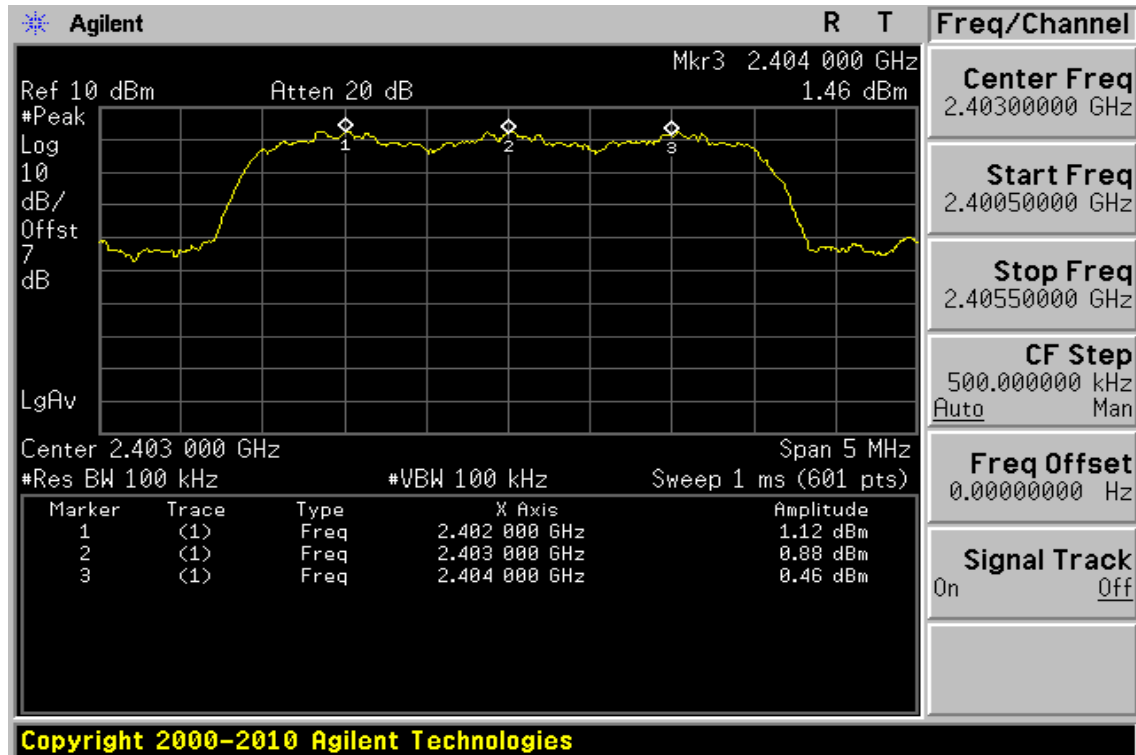
Channel separation (MHz)	Limit	Result
1	$\geq 25\text{KHz}$ or $2/3$ times 20dB bandwidth	PASS

Note: Refer to next page for plots.

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Frequency Separation Test Data



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12. NUMBER OF HOPPING FREQUENCY

12.1. Standard Applicable

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

12.2. Measurement Equipment Used:

Refer to section 7.2 for details.

12.3. Test Set-up:

Refer to section 7.3 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 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.

12.5. Measurement Result:

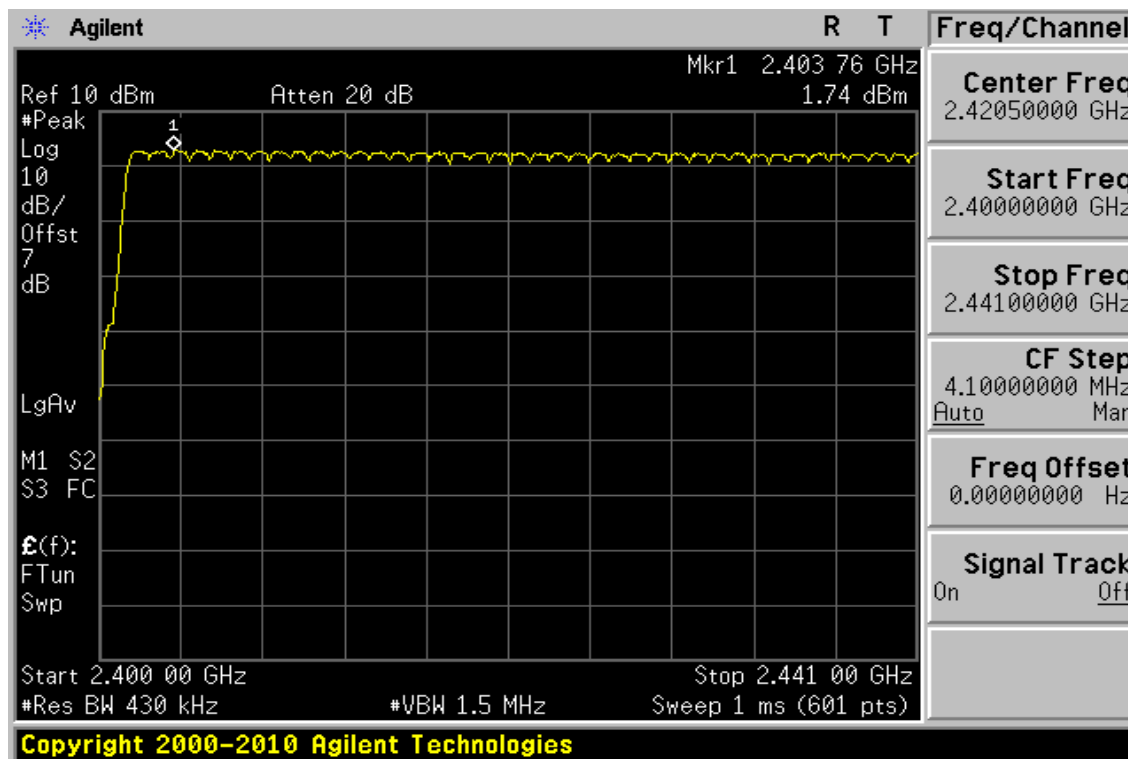
Note: Refer to next page for plots.

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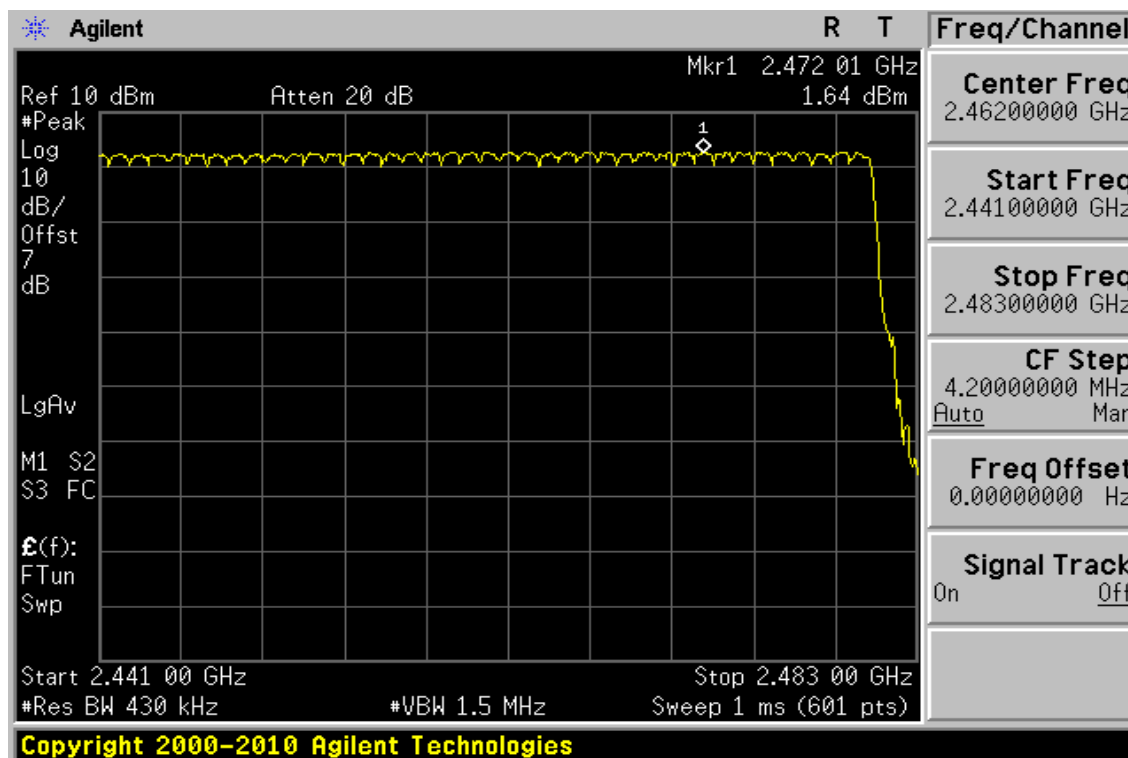
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Channel Number

2.4 GHz – 2.441GHz



2.441 GHz – 2.4835GHz



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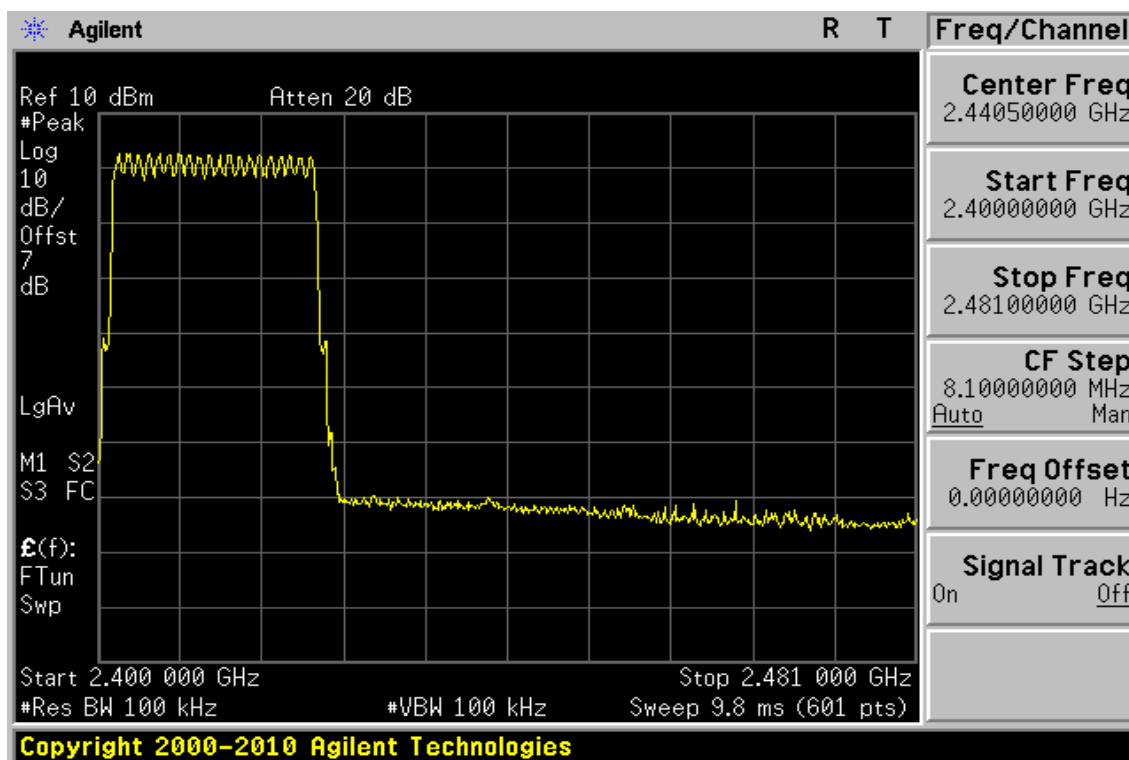
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AFH Mode



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13. TIME OF OCCUPANCY (DWELL TIME)

13.1. Standard Applicable

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

13.2. Measurement Equipment Used:

Refer to section 7.2 for details.

13.3. Test Set-up:

Refer to section 7.3 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 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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13.5. Measurement Result

A period time = 0.4 (ms) * 79 = 31.6 (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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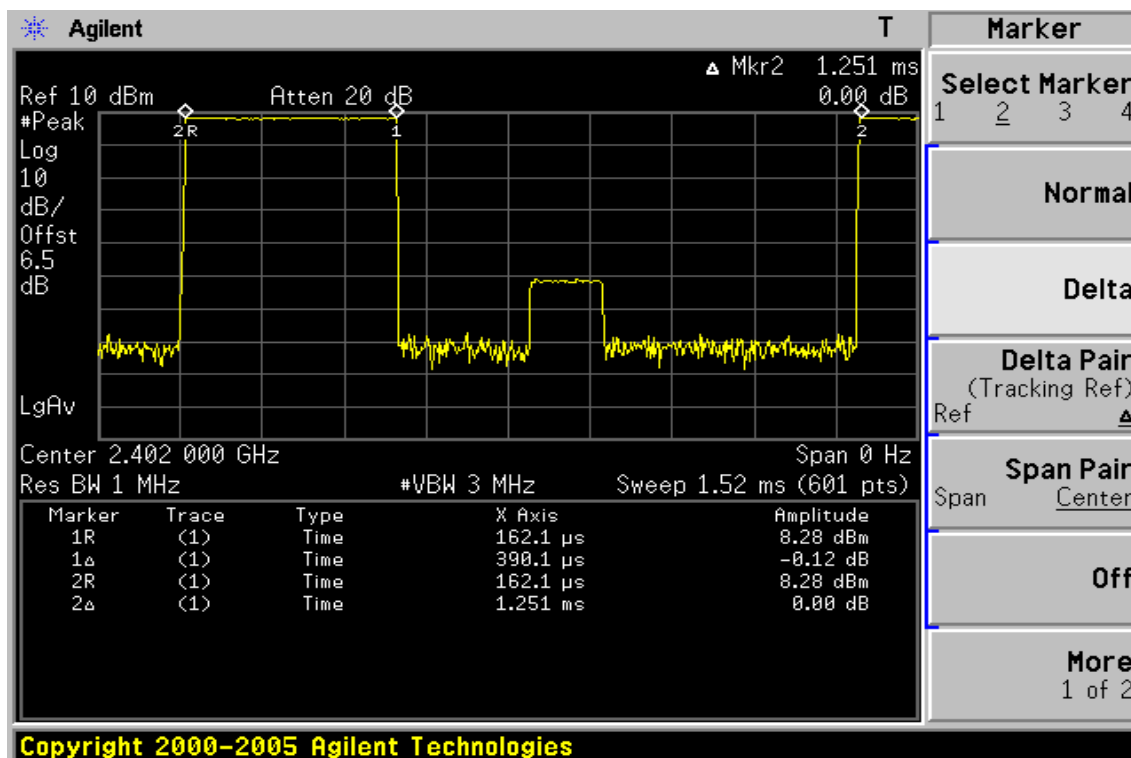
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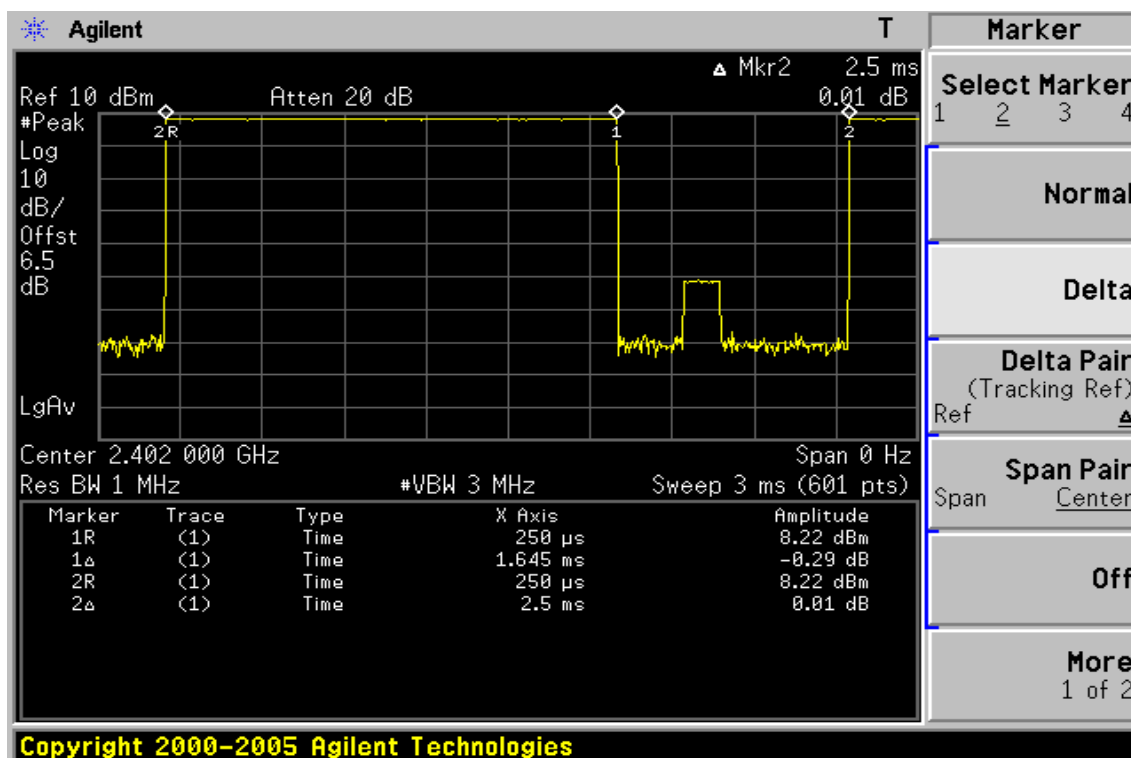
Member of SGS Group

CH-Low

DH1



DH3

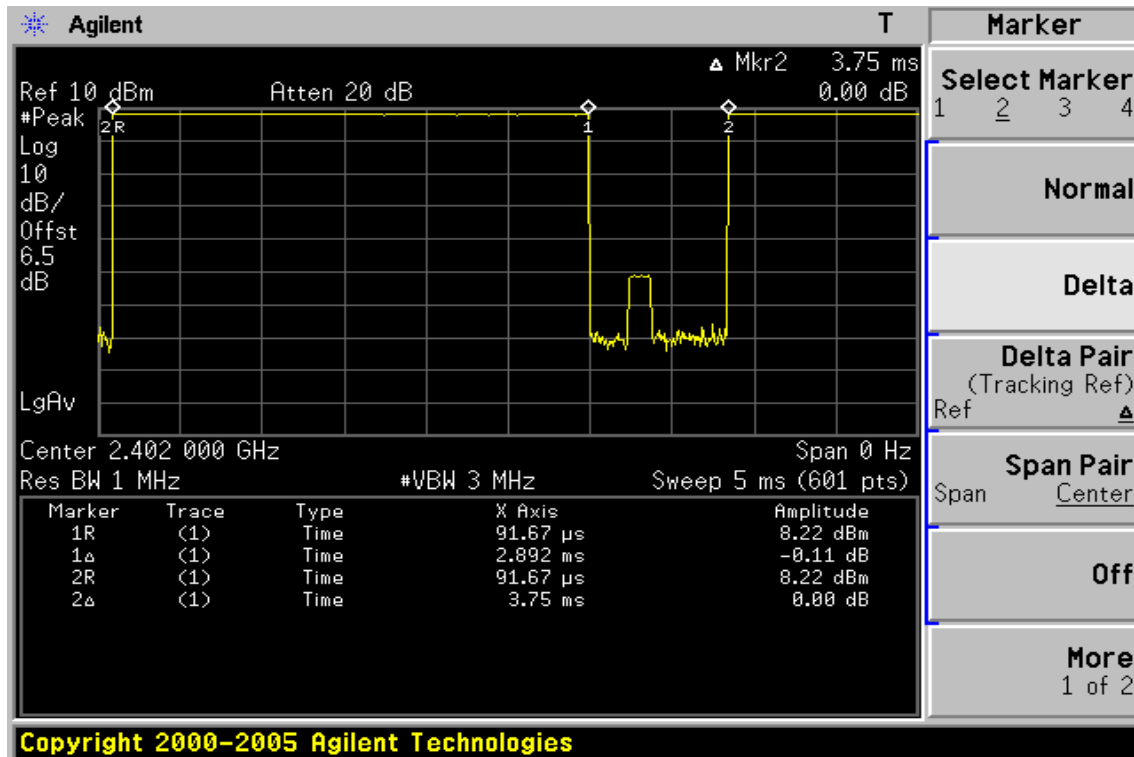


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DH5



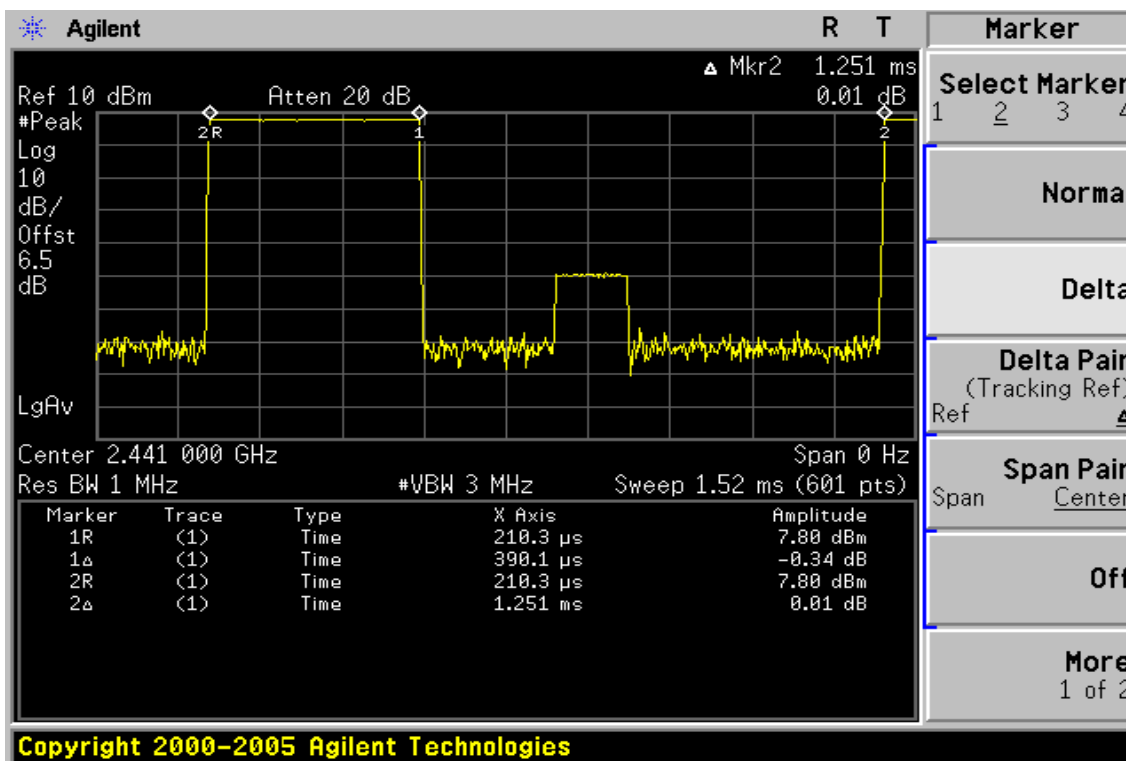
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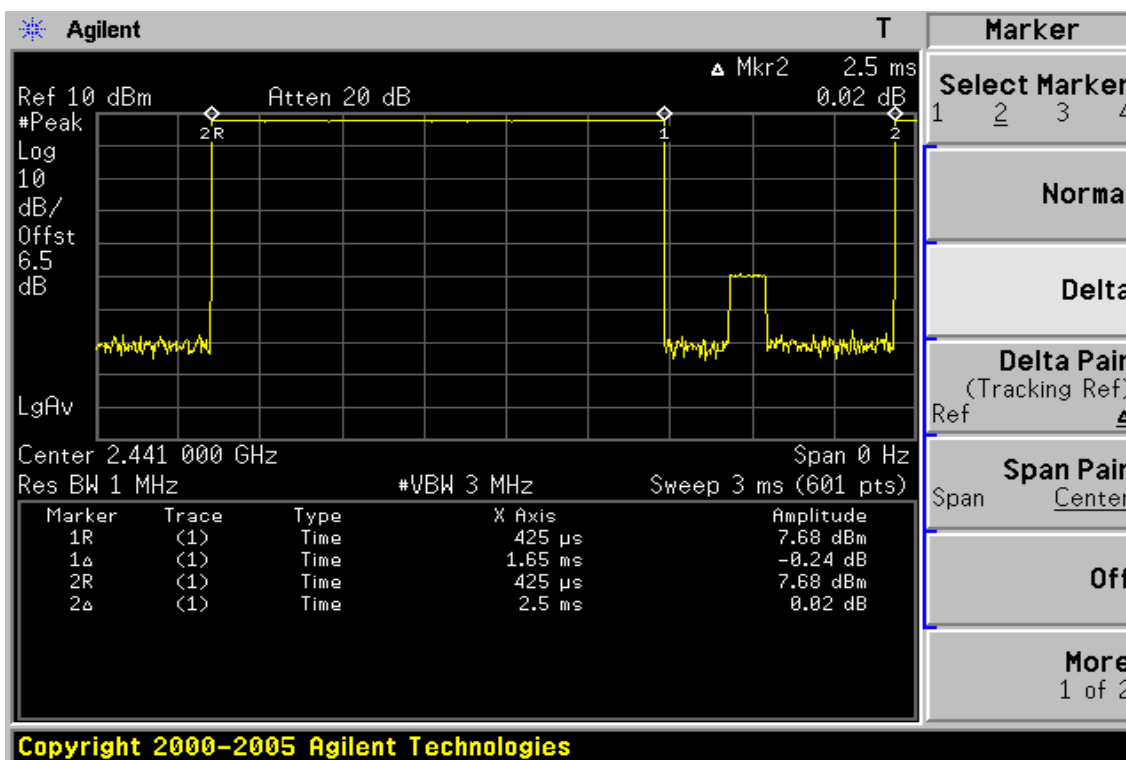
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CH-Mid

DH1



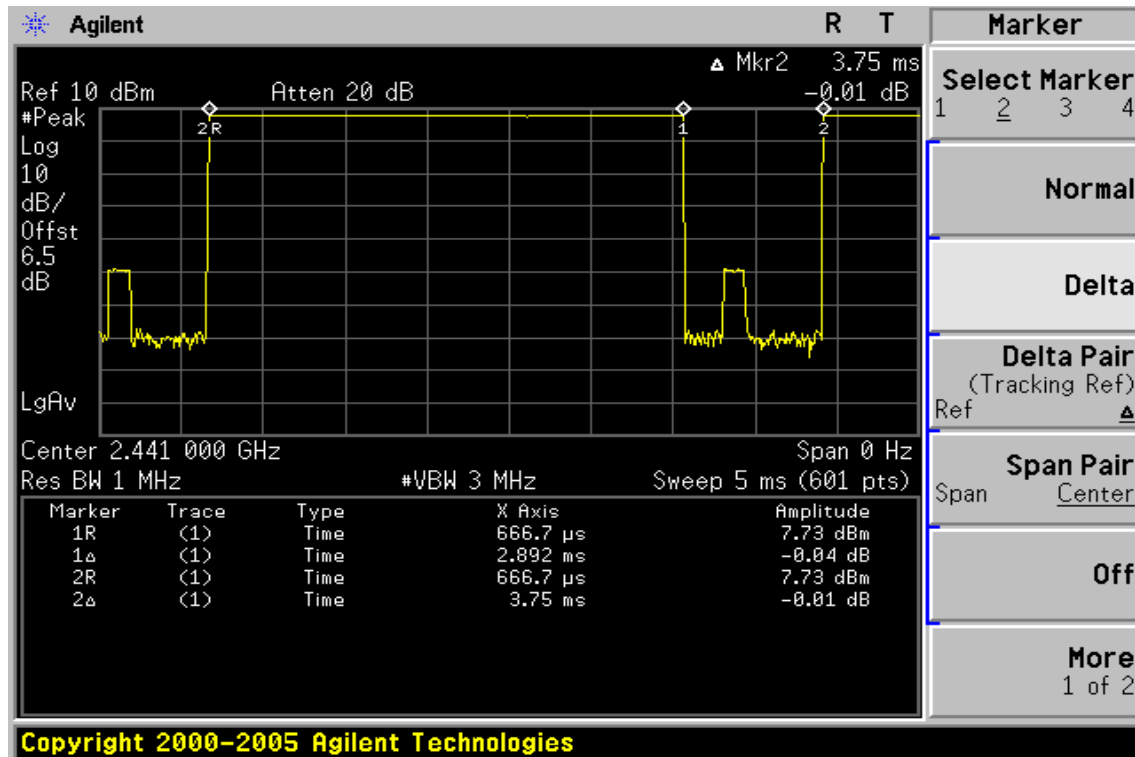
DH3



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DH5



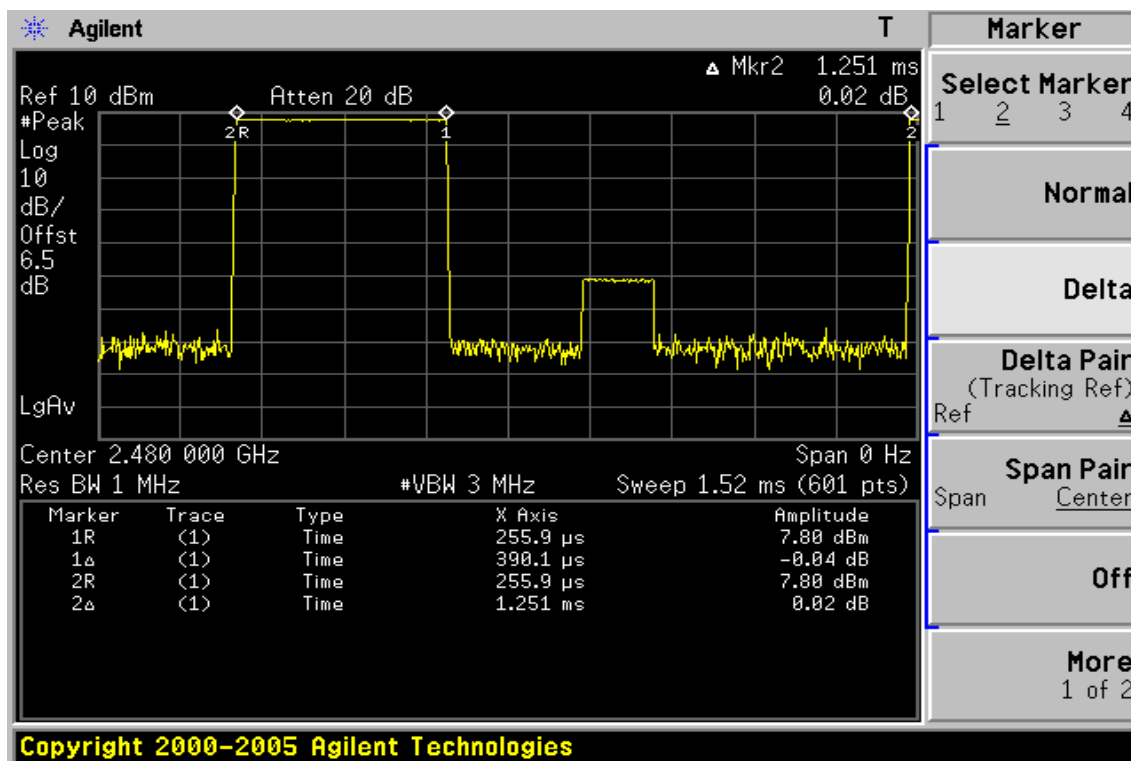
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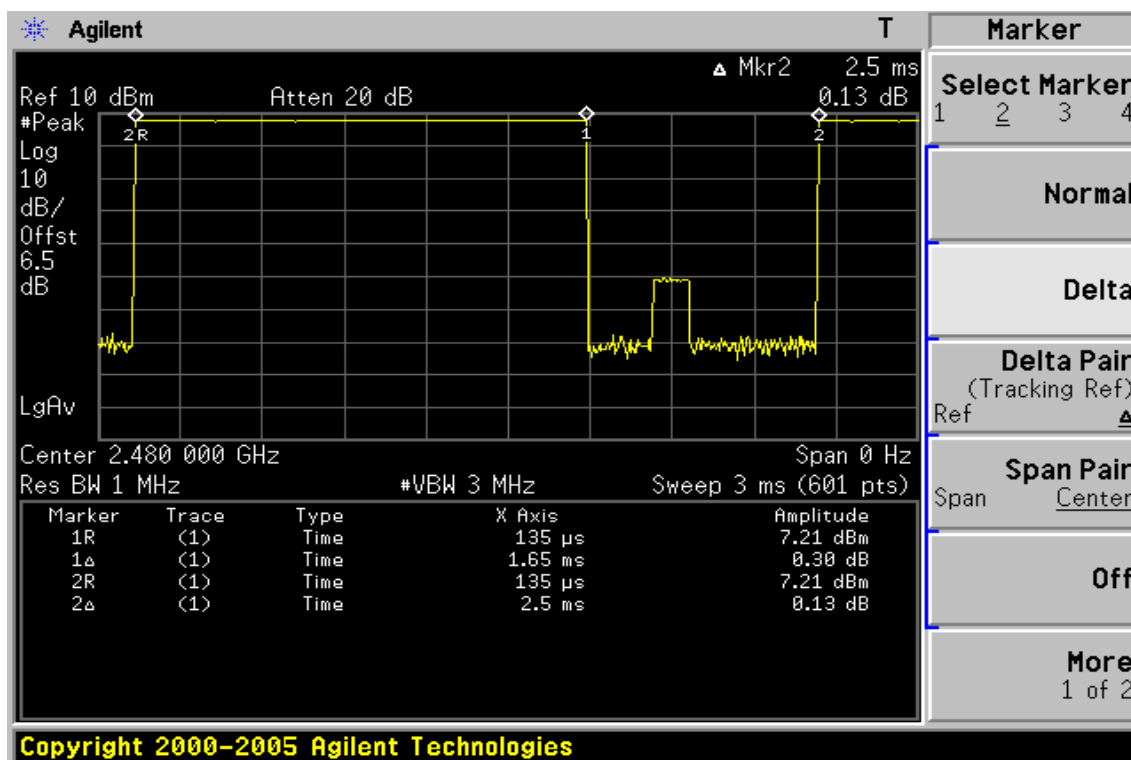
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CH-High

DH1



DH3

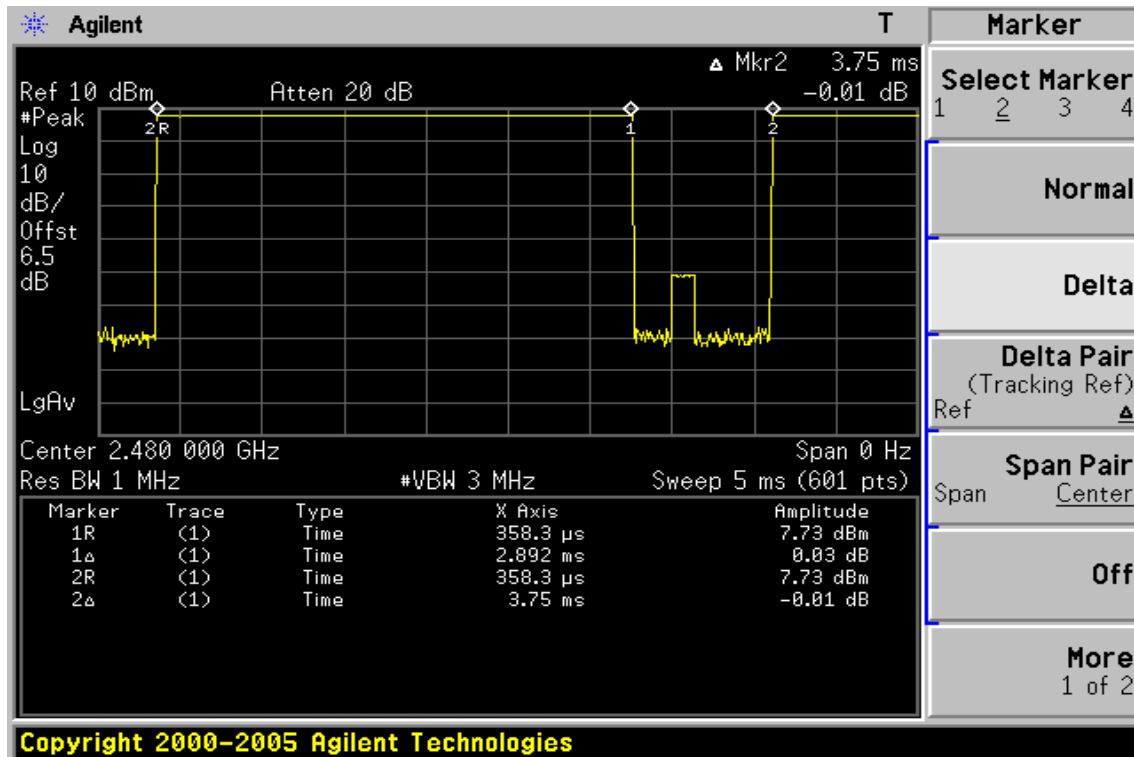


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DH5



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14. Peak Power Spectral Density

14.1. 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.

14.2. Measurement Equipment Used:

Refer to section 7.2 for details.

14.3. Test Set-up:

Refer to section 7.3 for details.

14.4. 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.

14.5. Measurement Result

CH	RF Power Density Reading (dBm)	RF Power Density Level (dBm)	Maximum Limit (dBm)
Low	-13.55	-13.55	8
Mid	-13.70	-13.70	8
High	-14.35	-14.35	8

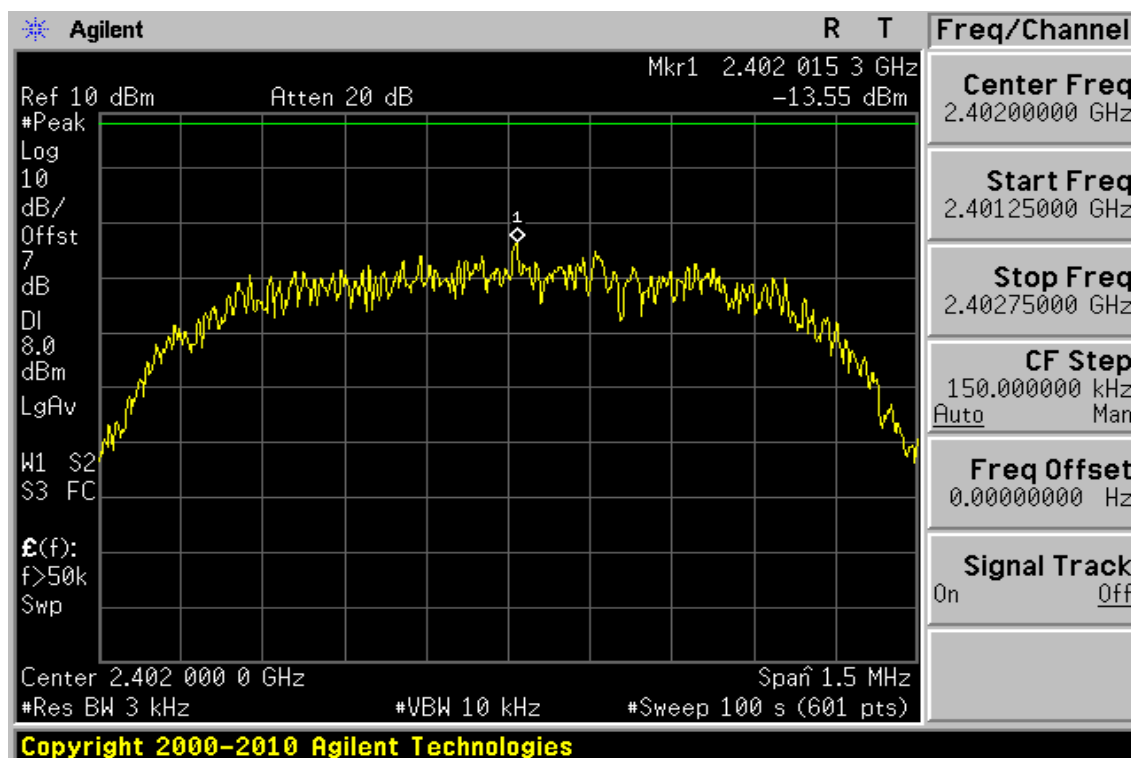
Note : Offset: 7dB

Note: Refer to next page for plots.

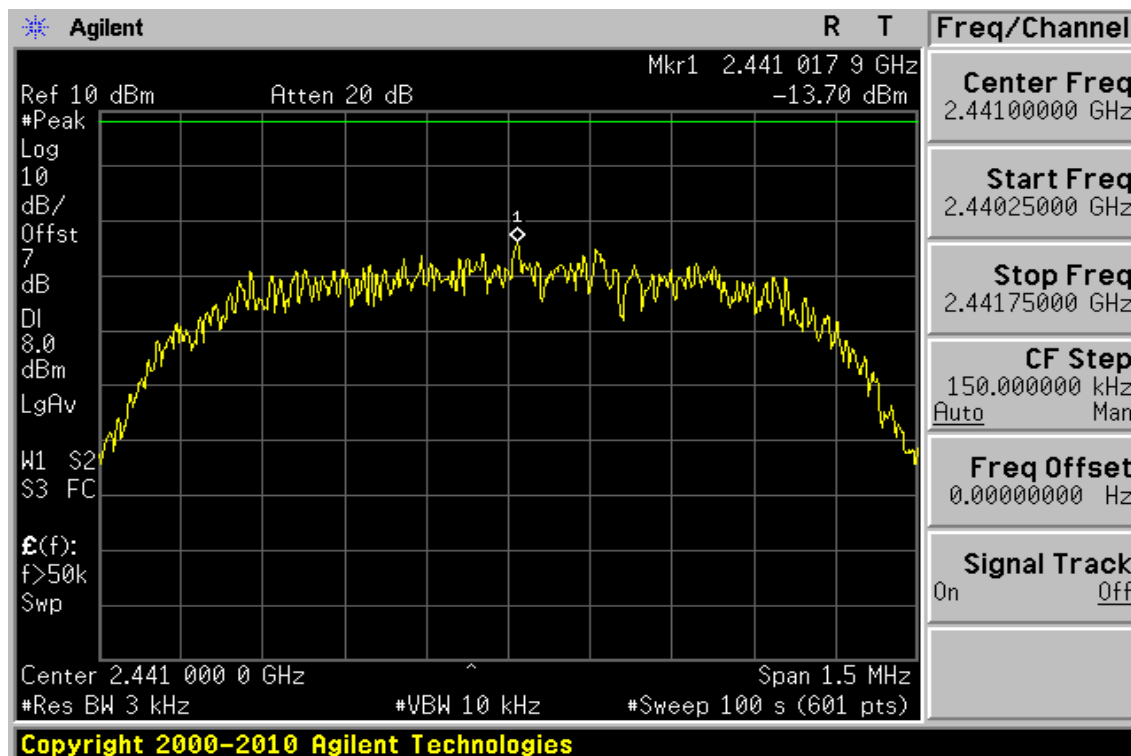
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Power Spectral Density Test Plot (Worst: EDR mode) (CH-Low)



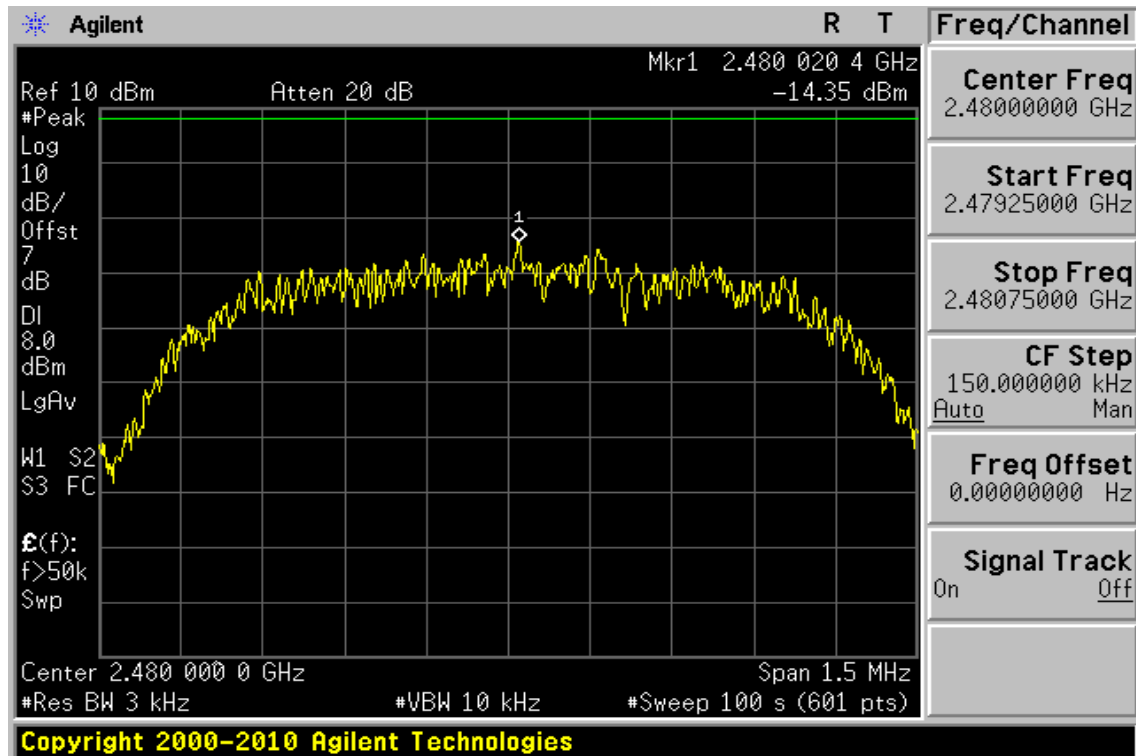
Power Spectral Density Test Plot (Worst: EDR mode) (CH-Mid)



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



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15. ANTENNA REQUIREMENT

15.1. 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.

15.2. Antenna Connected Construction

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

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