HYPER CORP

"Wireless that Works"SM

Address	1279 Quarry Lane, Suite B Pleasanton, CA 94566-8499 USA
Phone:	+1.925.462.9105
Fax:	+1.925.280.7751

EMC Test Report

Report Number	138-0210004-BTMOD
Product Name	Wilcoxon Bluetooth Radio Module
Issue Date	January 15, 2003
Applicant:	Wilcoxon Research
Address	21 Firstfield Road Gaithersburg, MD 20878 USA
Phone	+1.301.330.8811
Fax	+1.301.330.8873

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Certificate Number 1708-1

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Signature Page

Hyper Corporation Personnel listed below are responsible for the contents of this Test Report.

Test Engineer(s)

Original Signature on File	01/15/2003
Munir Chhibber	Date
Original Signature on File	01/15/2003
William Elliott	Date

Reviewed by:

Original Signature on File	01/15/2003
Kevin Marquess	Date

1. List of Revisions

Version	Date	Author(s)	Description
001	January 15, 2003	William Elliott	Initial Version

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2. Disclaimer Notice

This test report applies only to the EUT (Equipment Under Test) and the results of the specifications called out in this report.

The test results contained herein relate only to the model(s) identified. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics.

This Report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government.

3. Reproduction Clause

4. General Information

4.1 Identification of the EUT

Manufacturer: Wilcoxon

EUT ID: Wilcoxon Research's C1B

Hardware Version: V6

Software Version: VER 443 BCO2X_HCI_(V)_15.3_56

FCC ID: QAQMAYMAN

Frequency Range: 2402 MHz ~ 2480 MHz

Channel Number: 79

Frequency of Each Channel: 2402 + k (MHz), k=0~78

Type of Modulation: GFSK

Sample Received Date: December 15, 2002

Test Dates: January 14,2003

Test Facility: Hyper Corporation
1279 Quarry Lane, Suite B
Pleasanton, CA 94566, USA

4.2 Antenna Description

Antenna(e):

1) 1 Wavelength PCB Patch Antenna
peak gain = 2.43 dBi

2) Half-Wavelength Center-Feed Balanced Dipole
peak gain = 2.20 dBi

5. Test Summary

This test report is prepared for the project of Wilcoxon Bluetooth Radio Module.

5.1 Summary of Test Results

Test	Reference	Results
Carrier Frequency Separation	FCC 15.247(a)(1) IC RSS210 6.2.2(o)(a1)	Compliant
Number of Hopping Frequencies	FCC 15.247(a)(1)(ii) IC RSS210 6.2.2(o)(a3)	Compliant
Time of Occupancy (Dwell Time)	FCC 15.247(a)(1)(ii) IC RSS210 6.2.2(o)(a3)	Compliant
20 dB Bandwidth	FCC 15.247(a)(1)(ii) IC RSS210 6.2.2(o)(a1)	Compliant
Peak Output Power	FCC 15.247(b)(1) IC RSS210 6.2.2(o)(a3)	Compliant
Band-edge Compliance of RF Conducted Emissions	FCC 15.247(c) IC RSS210 6.2.2(o)(d1)	Compliant
Spurious RF Conducted Emissions	FCC 15.247(c) IC RSS210 6.2.2(o)(e1)	Compliant

5.2 Test Specifications

The EUT was tested according to the procedures in FCC Part 15 Subpart C section 15.247 and FCC Public Notice DA 00-705, and also to demonstrate compliance with Industry Canada RSS-210 6.2.2 (O).

5.3 Operation Mode

The EUT module was tested using the CSR Casira as the support test host. The EUT was embedded in and received power and data I/O from the host. A PC connection allowed commands to the module to be issued using the CSR Bluetest software to put the device into the correct test modes.

5.4 Documentation of test device

Documentation of the tested device has been reviewed by Hyper Corporation Engineers and found to be in compliance with applicable test specifications. All documentation is kept at Hyper Corporation's Quality Department in the 0210004 EMC Test Folder.

5.5 General and Special Conditions

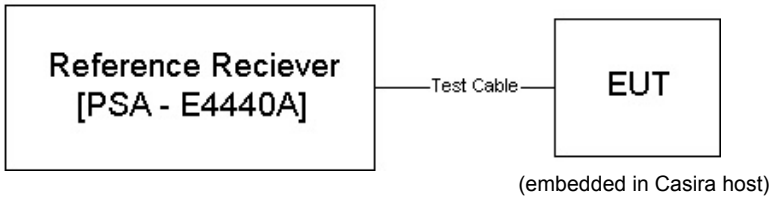
The EUT received power from the test host, which was powered using an AC adaptor plugged into the ac mains. All testing was done in an indoor controlled environment with an average temperature of 24º C and relative humidity of 40%.

5.6 Equipment and Cable Configurations

The EUT was tested in the Casira develop system test platform for embedded Bluetooth modules. The only cabling considerations were the cable used to connect the antenna port to the measuring equipment.

Manufacturer	Description	Model Number	Serial Number	CAL Due Date
Agilent Technology	PSA Series Spec. Analyzer	E4440A	US40420768	04/23/03
Agilent Technology	E1852B Bluetooth Test Set	E1852B	DK42050128	01/02/03
Dell	PC	Precision	N/A	N/A
Agilent Technology	Power Splitter	11667B	52557	04/18/03
CSR	CASIRA	BCES301 199/1	3188310700	N/A

5.7 Test Setup Block Diagram



6. Test Results

6.1 Carrier Frequency Separation

6.1.1 Operation Environment

Temperature: 25.8°C

Relative Humidity: 45%

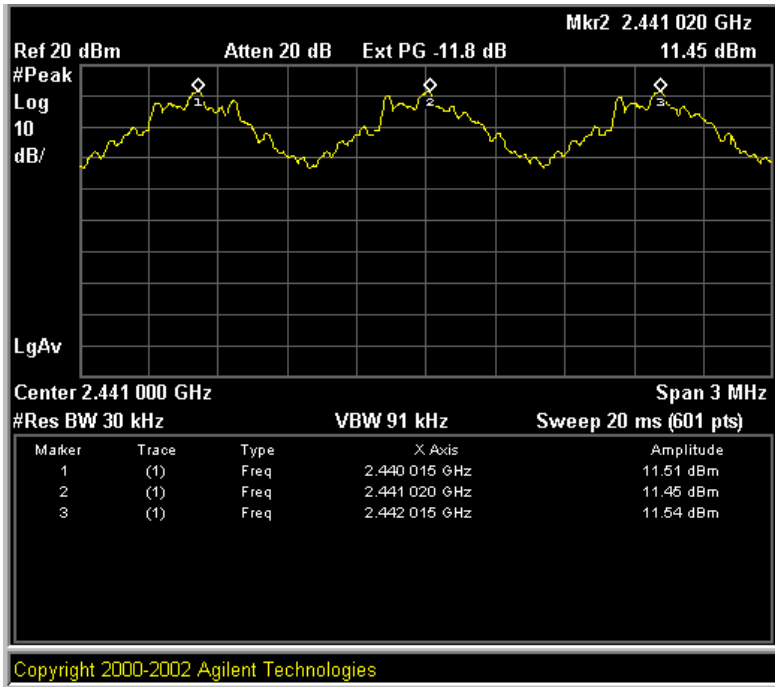
6.1.2 Test procedure

The carrier frequency separation per FCC 15.247(a)(1) / IC RSS210 6.2.2(o)(a1) was measured using a spectrum analyzer with the resolution (or IF) bandwidth (RBW) ≥ 1% of the span, the span should be wide enough to capture the peaks of two adjacent channels, and the video (or average) bandwidth (VBW) should be ≥ RBW. The carrier frequency separation result is described as below:

6.1.3 Measured data

Channel	Frequency (MHz)	Measurement Frequency Separation (MHz)
1	2440.015	1.005
2	2441.020	-------
3	2442.015	.995

Figure 6.1-1: Carrier Frequency Separation



6.2 Number of Hopping Frequencies

6.2.1 Operation Environment

Temperature: 25.8°C

Relative Humidity: 45%

6.2.2 Test procedure

The carrier frequency separation per FCC 15.247(a)(1)(ii)/
IC RSS210 6.2.2(o)(a3) was measured using a spectrum analyzer with RBW ≥ 1% of the span. The VBW is ≥ RBW and the span shall be equal to the frequency band of operation. The number of hopping frequencies measured data is shown below.

6.2.3 Measured data of test results

Frequency Range (GHz)	Number of hopping frequencies	Total hopping channels
2.400 ~ 2.441	39.5	79
2.441 ~ 2.4835	39.5	

Figure 6.2-1 Channels in the Frequency range 2.400-2.441GHz

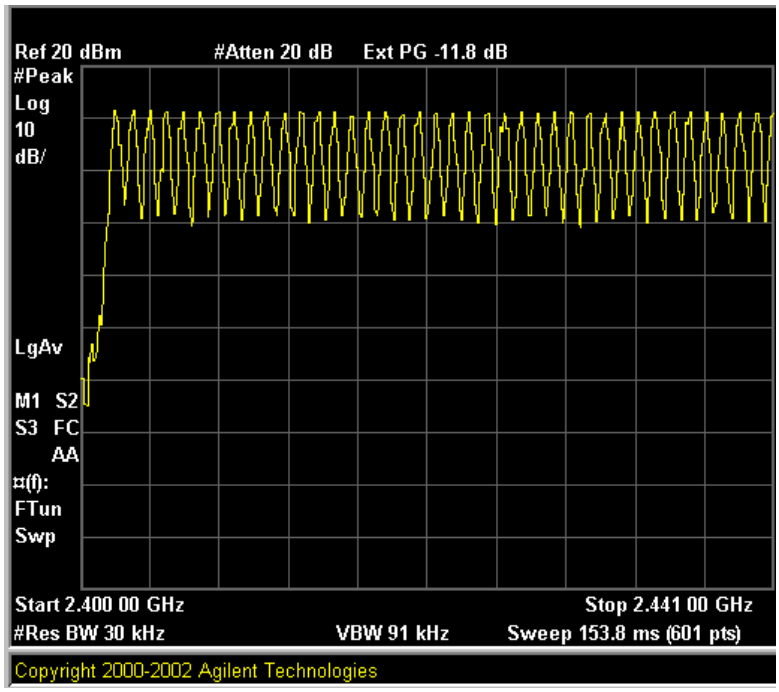
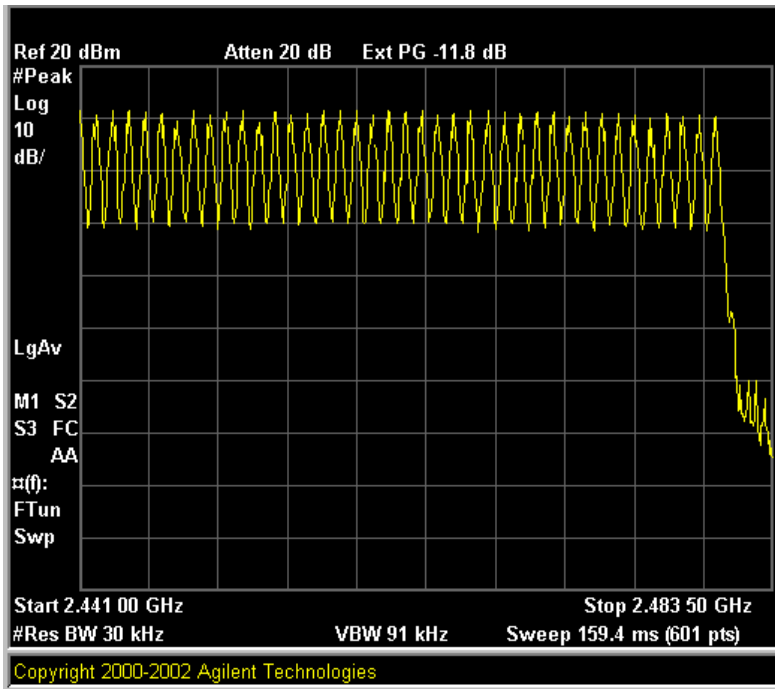


Figure 6.2-2 Channels in the Frequency range 2.440-2.4835GHz



6.3 Time of Occupancy (Dwell Time)

6.3.1 Operation Environment

Temperature: 25.8°C

Relative Humidity: 46%

6.3.2 Test procedure

The Time of Occupancy test case per FCC 15.247(a)(1)(ii)/ IC RSS210 6.2.2(o)(a3) was measured using a spectrum analyzer with RBW = 1 MHz. The VBW ≥ RBW and the zero span function of spectrum analyzer were enabled.

The worst case time of occupancy (Dwell Time) is (DH5 packet) (4 X 2.933 ms) (dwell time in 1 sec) X 30 seconds= 351.96 ms = 0.35196 sec < 0.4s in 30 sec. – Compliant

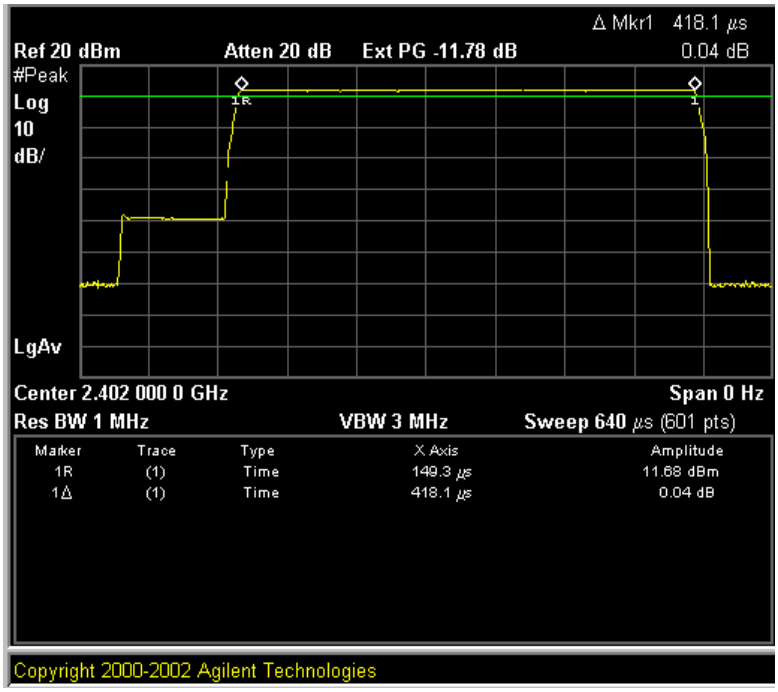
Summary Table

Packet Type	Dwell Time
DH1	418.1 μsec
DH3	1.676 msec
DH5	2.933 msec
DH5 in 30 seconds	351.96 msec

Limit [15.247 (a)(1)(ii)]

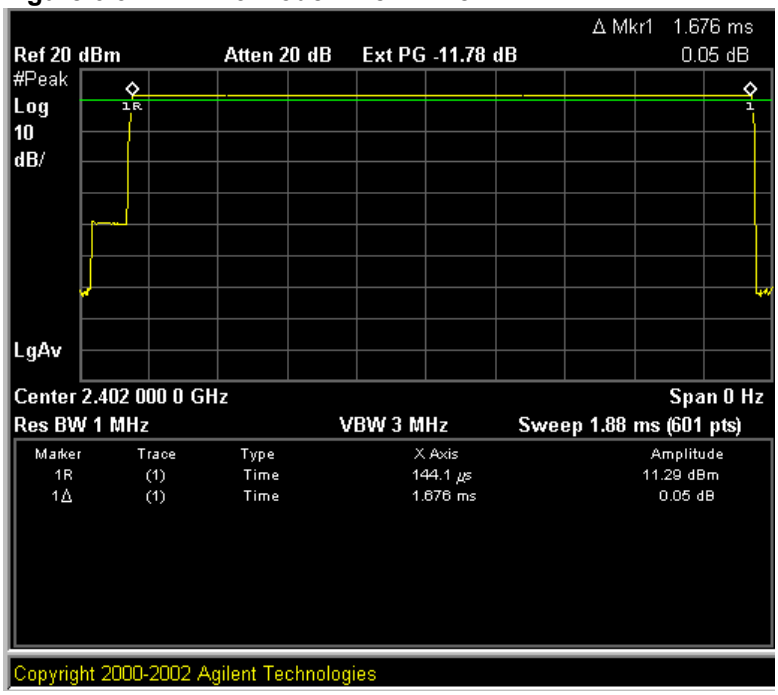
The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period

Figure 6.3-1: DH1 Mode Dwell Time



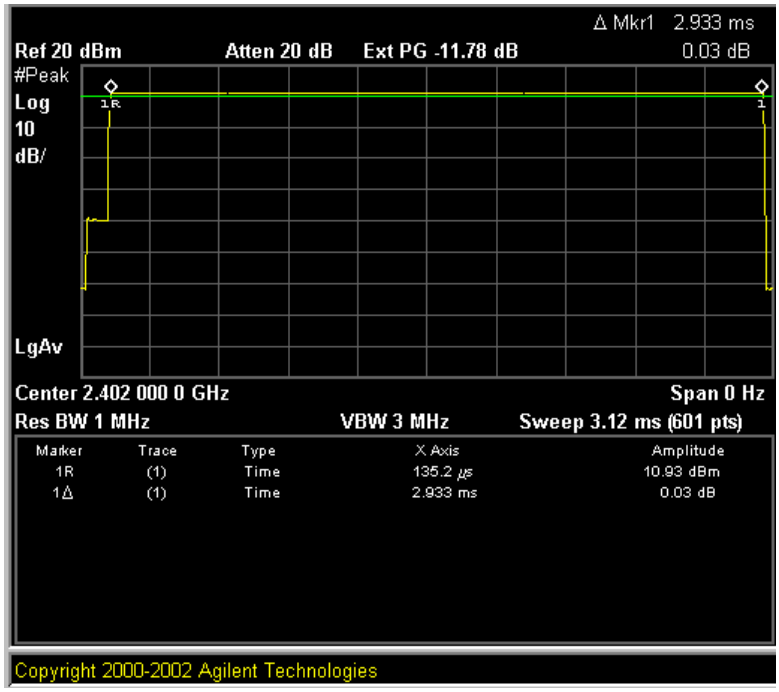
DH1 Data Packet – Dwell Time = 418.1 µsec

Figure 6.3-2: DH3 Mode Dwell Time



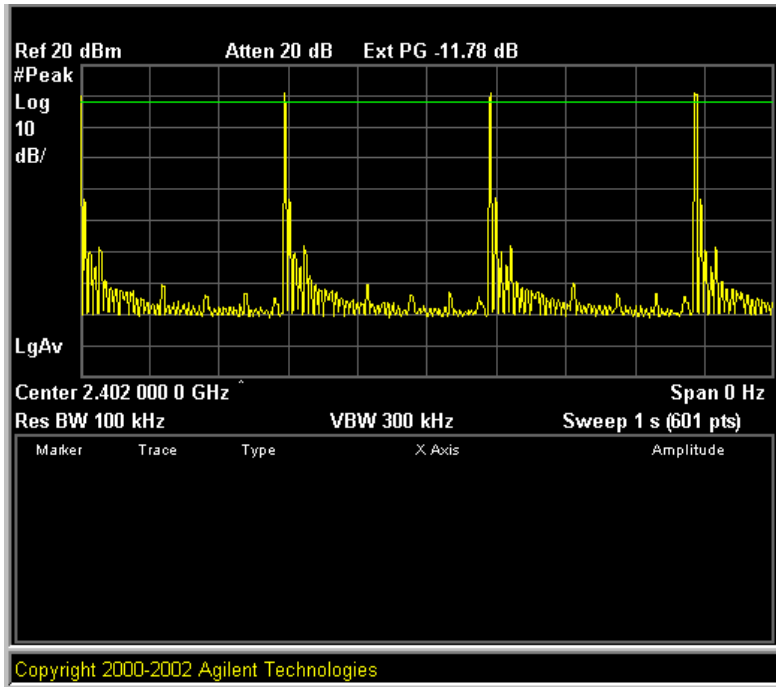
DH3 Data Packet – Dwell Time = 1.676 msec

Figure 6.3-3: DH5 Mode Dwell Time



DH5 Data Packet – Dwell Time = 2.933 msec

Figure 6.3-4: Plot showing numbers of pulses in 1 second in DH5 Mode



4 occurrences of DH5 packets in 1 second

6.4 20 dB Bandwidth

6.4.1 Operation Environment

Temperature: 26°C

Relative Humidity: 40%

6.4.2 Test procedure

The 20dB bandwidth per FCC 15.247(a)(1)(ii)/
IC RSS210 6.2.2(o)(a1) was measured using spectrum analyzer with the resolution bandwidth > 1% of the 20 dB bandwidth. The VBW shall be ≥ RBW, and the span shall equal to approximately 2 to 3 times the 20 dB bandwidth. This test was performed at 3 different channels (low, mid and high), and the maximum 20dB modulation bandwidth is listed below:

6.4.3 Measured data

Channel	Frequency (MHz)	Bandwidth (MHz)
Low	2402	0.840
Middle	2441	0.865
High	2480	0.835

Figure 6.4-1: Bandwidth of the 2402 MHz channel

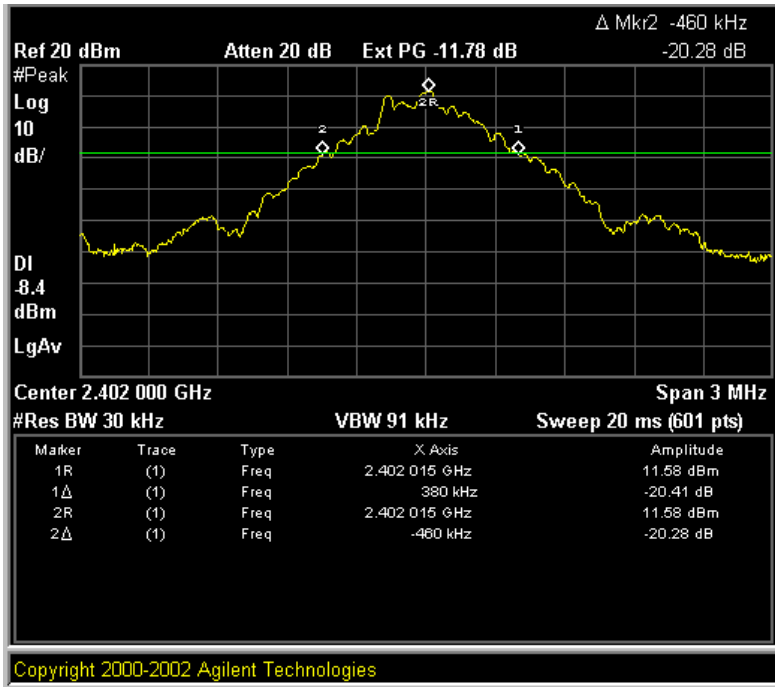


Figure 6.4-2: Bandwidth of the 2441 MHz channel

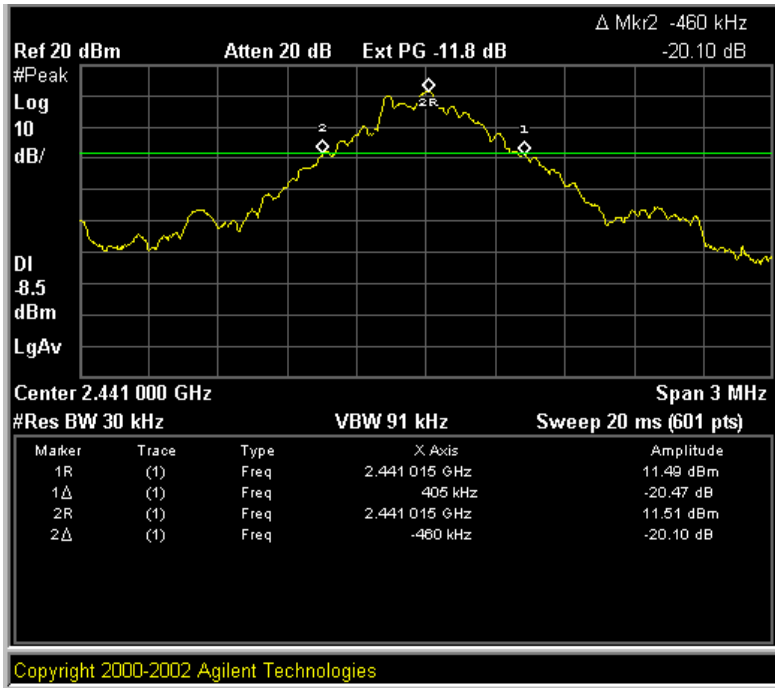
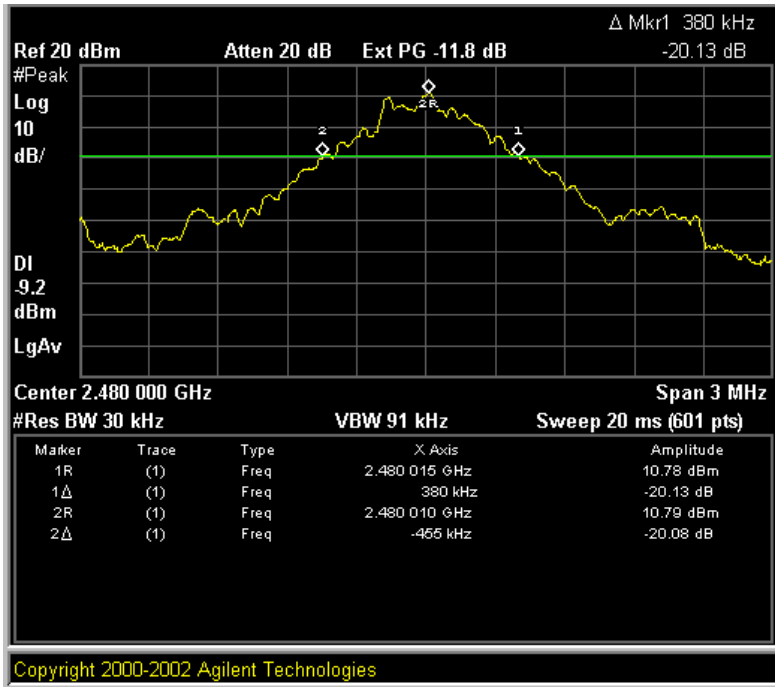


Figure 6.4-3: Bandwidth of the 2480 MHz channel



6.5 Peak Output Power

6.5.1 Operation Environment

Temperature: 26°C

Relative Humidity: 46%

6.5.2 Test procedure

The Peak Output Power per FCC 15.247(b)(1)/
IC RSS210 6.2.2(o)(a3) was measured on the EUT using a 50-Ohm SMA cable connected to the spectrum analyzer.

6.5.3 Measured data of test results

Channel	Frequency (MHz)	Transmitter Peak Output Power (dBm)
Low	2402	11.82
Middle	2441	11.69
High	2480	10.95

Figure 6.5-1: Power Output on 2402 MHz

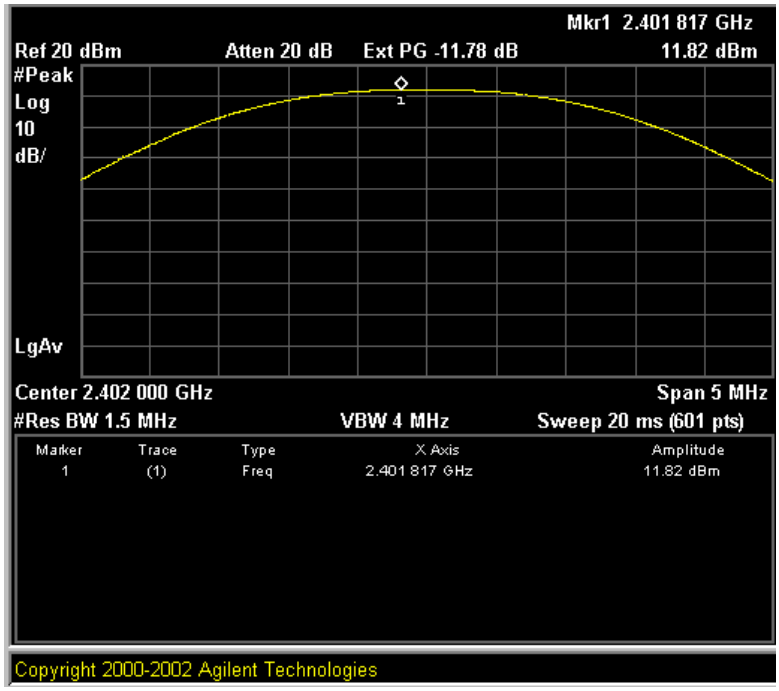


Figure 6.5-2: Power Output on 2441 MHz

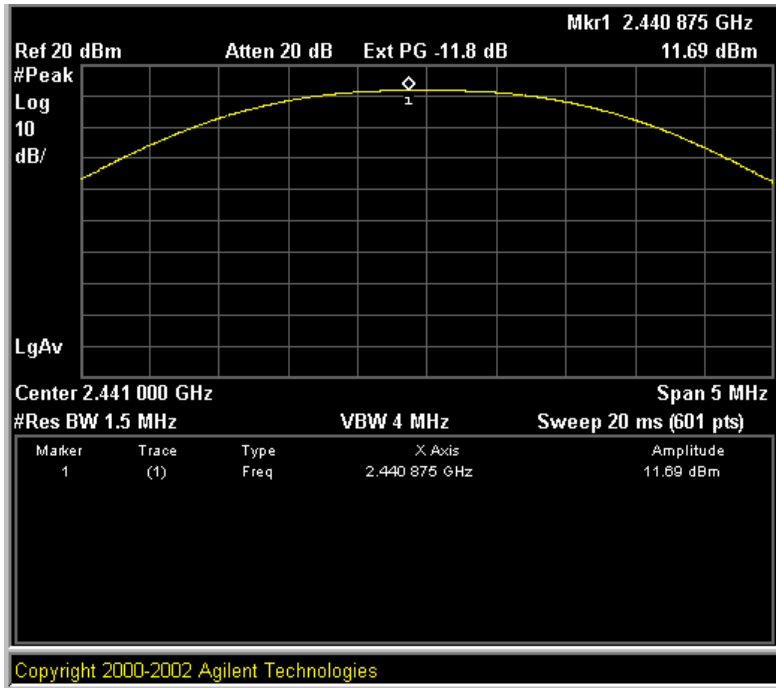
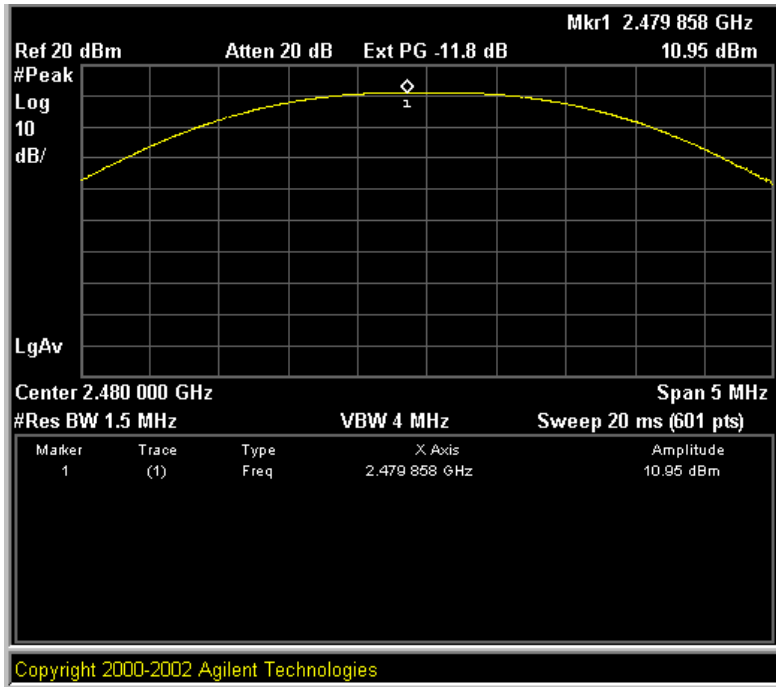


Figure 6.5-3: Power Output on 2480 MHz



6.6 Band-edge Compliance of RF Conducted Emissions

6.6.1 Operation Environment

Temperature: 26°C

Relative Humidity: 46%

6.6.2 Test procedure

The band-edge compliance of RF conducted emissions of the EUT was measured per FCC 15.247(c)/IC RSS210 6.2.2(o)(d1). The EUT was set to operate on the lowest operating frequency and the level at the lower band-edge was measured. The upper band-edge level was then measured with the EUT operating on the highest operating frequency.

6.6.3 Measured data of test results

Band-edge Frequency (MHz)	Attenuation (dB) Relative to Peak Carrier Power
2400	-40.46
2483.5	-42.05

Figure 6.6-1: Lower Band-edge measurement

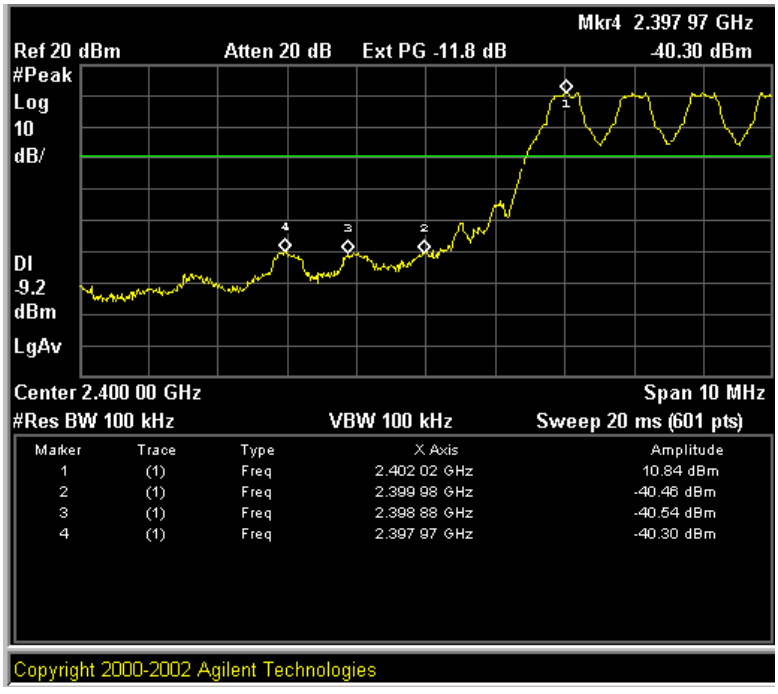
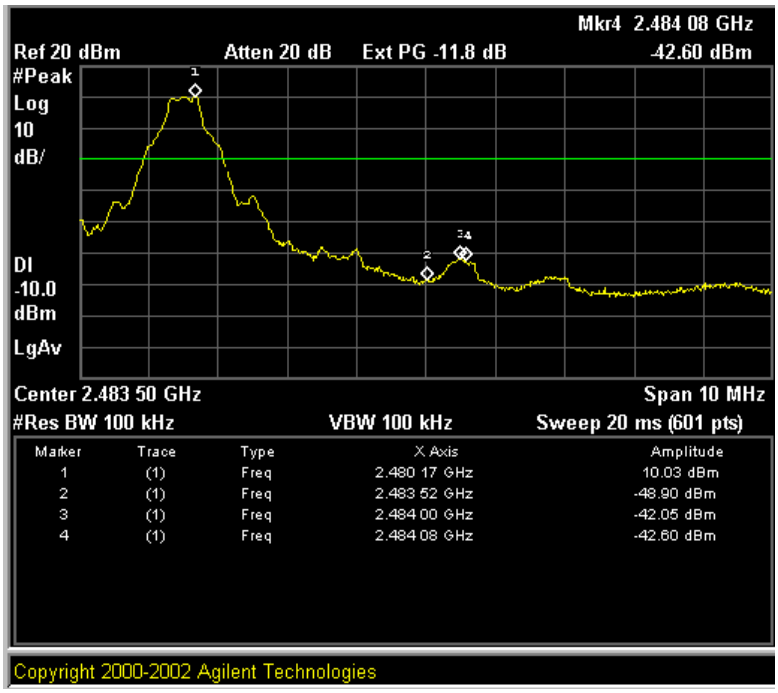


Figure 6.6-2: Upper Band-edge measurement



6.7 Spurious RF Conducted Emissions

6.7.1 Operation Environment

Temperature: 25.8°C

Relative Humidity: 46%

6.7.2 Test procedure

The spurious RF conducted emissions were measured with the EUT set to low, middle, and high transmit frequencies per FCC 15.247(c)
IC RSS210 6.2.2(o)(e1). The EUT was transmitting at its maximum data rate with the maximum channel occupancy time. At each frequency the spectrum was scanned from 0 MHz to 26.5 GHz.

Spectrum plots with transmitter operating on 2.402GHz non-hopping:

Figure 6.7-1: 30 MHz - 3.0GHz Spectrum

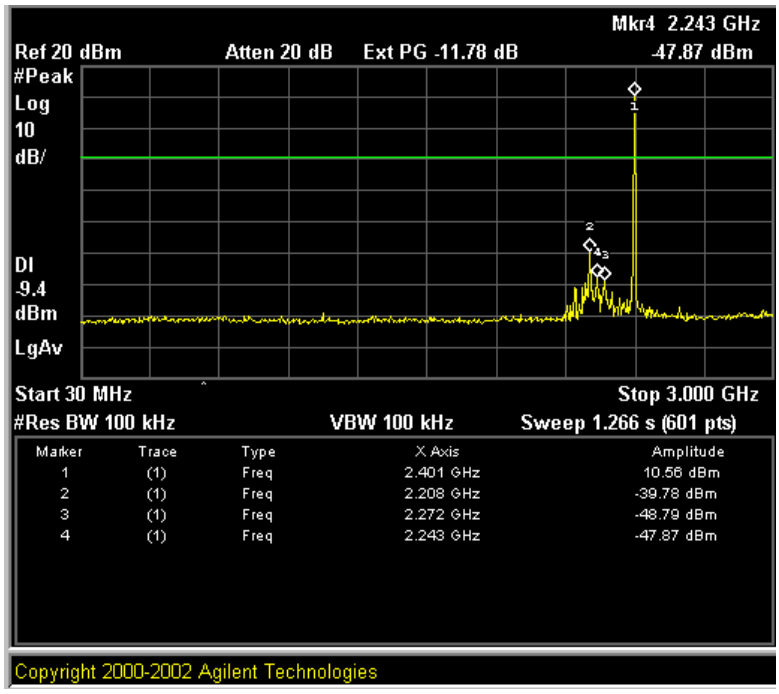


Figure 6.7-2: 3.0 – 10.0 GHz Spectrum

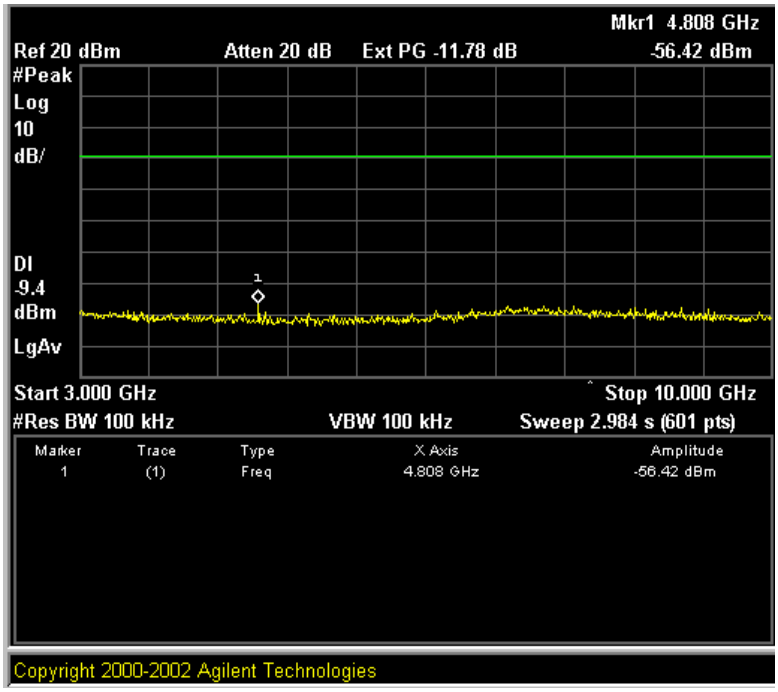
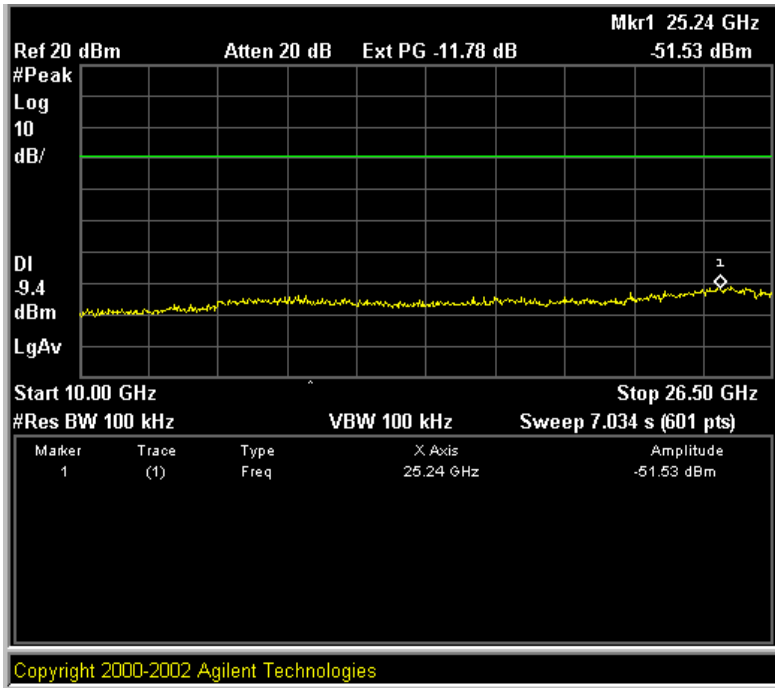


Figure 6.7-3: 10.0 – 26.0 GHz Spectrum



Spectrum plots with transmitter operating on 2.440GHz non-hopping:

Figure 6.7-4: 30 MHz - 3.0GHz Spectrum

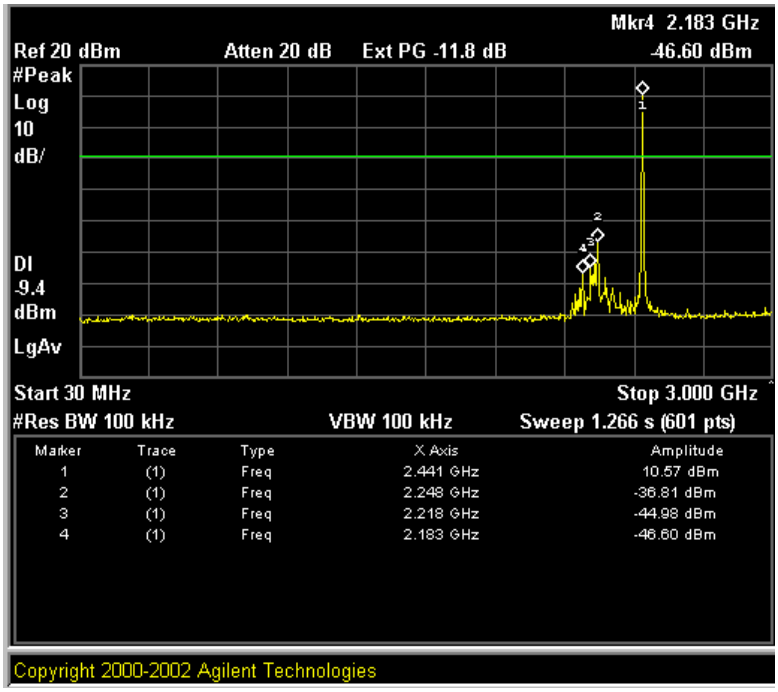


Figure 6.7-5: 3.0 – 10.0 GHz Spectrum

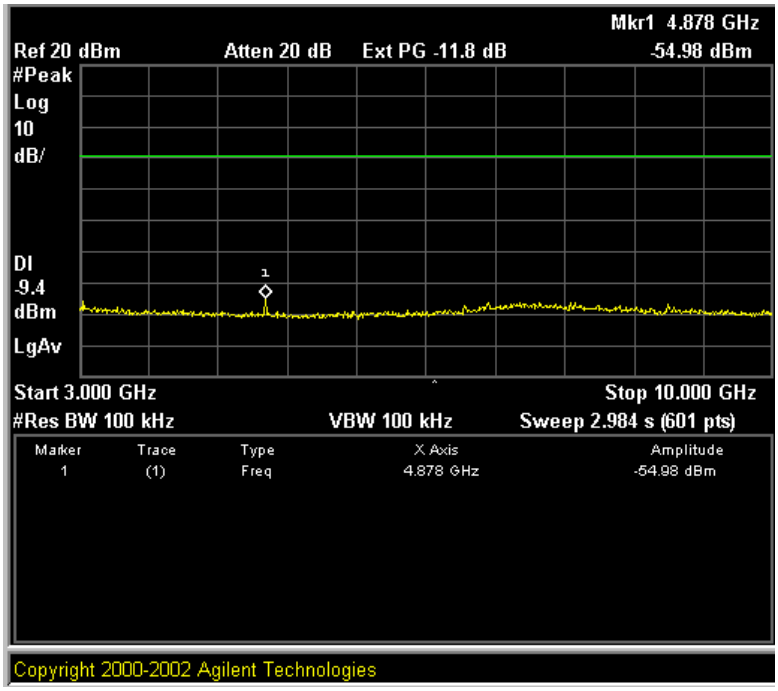
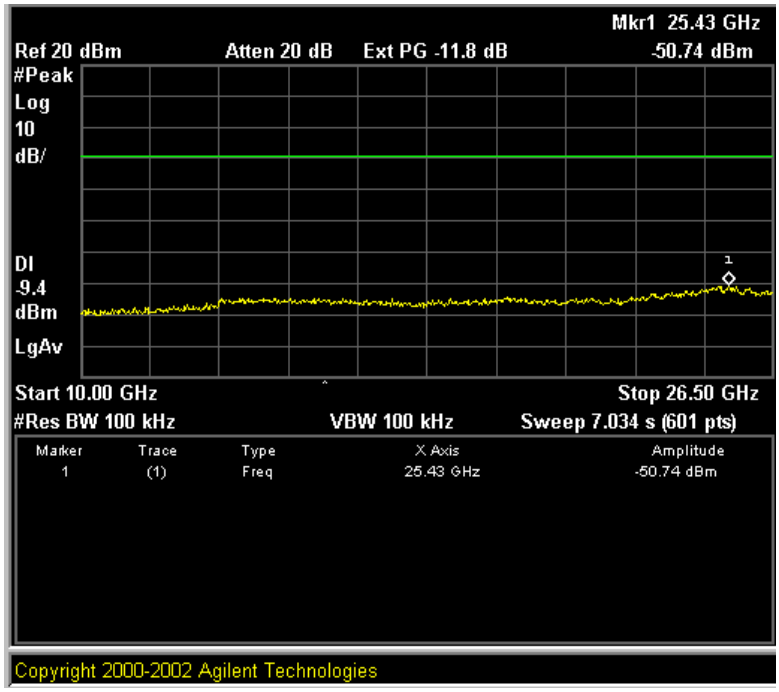


Figure 6.7-6: 10.0 – 26.0 GHz Spectrum



Spectrum plots with transmitter operating on 2.480GHz non-hopping:

Figure 6.7-7: 30 MHz - 3.0GHz Spectrum

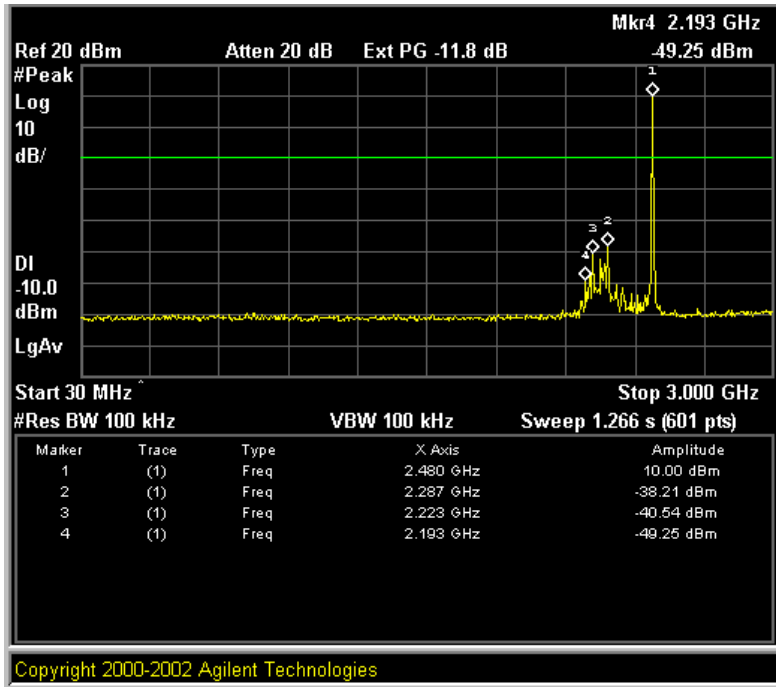


Figure 6.7-8: 3.0 – 10.0 GHz Spectrum

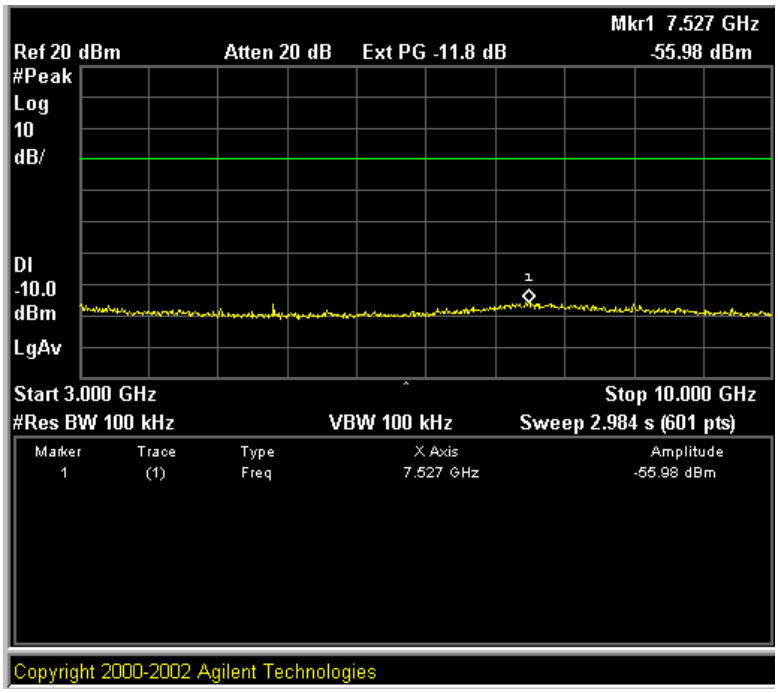


Figure 6.7-9: 10.0 – 26.0 GHz Spectrum