

FCC Part 15 Test Report

for the
Apple Bluetooth 2.0+EDR Module

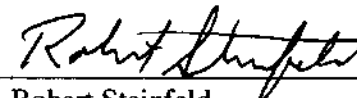
Model # A1115
Apple Computer, Inc.

March 18, 2005

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TABLE OF CONTENTS

1	Test Report Summary	3
2	EUT Description	4
3	Test Methodology	5
4	Facilities and Accreditation	5
5	Calibration and Uncertainty	6
6	Setup of Equipment Under Test	8
7	Applicable Limits and Test Results	13
7.1	99% Bandwidth and 20 dB Bandwidth	13
7.2	Hopping Frequency Separation	20
7.3	Number of Hopping Channels	21
7.4	Average Time of Occupancy	27
7.5	Output Power	30
7.6	Average Power	31
7.7	Power Spectral Density	32
7.8	Conducted Spurious Emissions	36
7.9	Radiated Emissions	42
7.10	AC Power Line	68

1 Test Report Summary

Specification	Test or Requirement	Result	Comment
N/A – For reporting purposes only	99% Bandwidth and 20 dB Bandwidth	N/A	Section 7.1
CFR 15.247(a)(1)	Hopping Frequency Separation	Pass	Section 7.2
CFR 15.247(a)(1)(iii)	Number of Hopping Channels	Pass	Section 7.3
CFR 15.247(b)(1)(iii)	Average Time of Occupancy	Pass	Section 7.4
CFR 15.247(b)(1) CFR 15.247(b)(4)	Output Power	Pass	Section 7.5
N/A – For reporting purposes only	Average Power	N/A	Section 7.6
CFR 15.247(d) CFR 15.247(f)	Peak Power Spectral Density	Pass	Section 7.7
CFR 15.247(c)	Conducted Spurious Emissions	Pass	Section 7.8
CFR 15.205(a) CFR 15.209(a)	Radiated Emissions	Pass	Section 7.9
CFR 15.207(a)	AC Power Line Conducted Emissions	Pass	Section 7.10

2 EUT Description

The Apple Bluetooth Module, model number A1115, operates in the 2.4 GHz unlicensed Industrial, Scientific and Medical band and uses Frequency Hopping Spread Spectrum. This device uses the CSR BC417143B BlueCore4 External which is a single chip radio and baseband IC for Bluetooth 2.0+EDR including enhanced data rates (EDR) to 3 Mbps. Technical Information on the Apple Bluetooth Module is provided in the table below.

Apple Bluetooth Module Information	
Product	Transceiver
Trade Name	Apple Bluetooth Module
Model Number	A1115
Power Supply	3.3V DC Power Supply
Frequency Range	2402-2480 MHz
Modulation Technique	FHSS
Emission Designator	866KF1D
Output Power	5.7 dBm

Apple Bluetooth Module Antenna Information

Antenna Model Number	Maximum Gain (dBi)
A1067	+2.4
613-5956	-2.6

3 Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.4-2003 and FCC CFR 47 Part 2 and Part 15c.

4 Facilities and Accreditation

4.1 Facilities and Equipment

The ac power line and RF conducted emissions measurements were performed at the Apple Computer, Inc. facility located at 20650 Valley Green Drive, Cupertino, California 95014. The radiated emissions measurements were performed at the Apple Computer, Inc. Evelyn 1, 10 meter semi-anechoic chamber located at 123 East Evelyn Ave., Mountain View, California 94041. Both of these facilities are constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 22.

All Receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

4.2 Laboratory Accreditation

The test facilities at Apple Computer, Inc. used to perform radiated and conducted emissions measurements are accredited by National Voluntary Laboratory Accreditation Program to perform Electromagnetic Interference tests according to FCC Part 15 and CISPR 22. The Apple Computer, Inc. NVLAP Lab Code is 200071-0 and is effective through September 30, 2005. The Apple Computer, Inc. Evelyn 1 10 meter Semi-anechoic chamber is currently listed with the FCC. The FCC Registration Number is 90450 and is effective through Jan 5, 2007.

No part of this report may be used as a claim or endorsement by NVLAP or any agency of the US Government.

5 Calibration and Uncertainty

5.1 Measurement Instrument Calibration

The measurement instruments utilized to perform the tests documented in this report have been calibrated in accordance with the manufacturer's recommendations and are traceable to national standards.

5.2 Measurement Uncertainty

The Apple measurement uncertainty policy, available upon request under Apple File Number EMC20, ensures uncertainty has been calculated using the proper procedure. Apple will use this measurement uncertainty knowledge in determining the pass / fail criteria from the test data. The measurement uncertainty has been determined to be the following:

Conducted Emissions = +/- 2.3 dB

Radiated Emissions = +/- 4.1 dB

5.3 Test Equipment

The following test equipment was used.

Description	Manufacturer	Model No.	Identification No.	Last Cal	Next Cal
Spectrum Analyzer	R&S	ESIB 40	100105	Oct 2004	Oct 2005
Spectrum Analyzer	R&S	ESCI	1166.5950.03	July 2004	July 2005
Spectrum Analyzer	HP	4403B	MY41140805	May 2004	May 2005
Receiver	R & S	ESCS 30	1102.4500.30	Jan 2005	Jan 2006
Antenna	Sunol	JB1	A122302-1	Jan 2005	Jan 2006
Antenna	Sunol	JB1	A122302-2	Jan 2005	Jan 2006
Amplifier	Amplifier Research	AR	Amp 16	Nov 2004	Nov 2005
Amplifier	Amplifier Research	AR	Amp 17	Nov 2004	Nov 2005
Amplifier	HP	8449	3008A00713	March, 2004	March 2005
Horn Antenna	EMCO	3117	34197	March 2004	March 2009
Horn Antenna	EMCO	3160-09	011269-0041264	Sept 2001	Sept 2006
Power Meter	Boonton	4532	165201	May 2004	May 2005
Power Meter Sensor	Boonton	57318	3890	May 2004	May 2005

6 Setup of Equipment Under Test

EUT Support Equipment

Peripheral Support Equipment				
Description	Manufacturer	Model	Serial Number	FCC ID
Desktop Computer	Apple	G5	SG85013NWSPA7	DoC
4 GB USB iPod	Apple	A1051	JQ437FPBPFW	DoC
4 GB Firewire iPod	Apple	A1051	JQ437GJBPFW	DoC
17" CINEMA Display	Apple	A1081	2A430351PKK	DoC
20 GB iPod	Apple	A1059	JQ436JMP59	DoC
Headphones/Mic	Andy-May	AM-333	N/A	N/A
Display AC adapter	Apple	A1096	Eh429k2vquk	DoC
USB Keyboard	Apple	A1048	KY44003MGQL3B	DoC
USB Mouse	Apple	A31	VJ302009EN38A	DoC
Airport Express	Apple	A1084	HS5028SOQVO	BCGA1084
Audio Amp	Creative Labs	Digital 5500	SW3300347100071	N/A

EUT I/O Cables

I/O Cable List				
Port	Manufacturer	Shielded?	Ferrite?	Length
AC Power	Apple	No	No	1.8 meters
USB iPod	Apple	Yes	No	1.0 meters
DVI Display	Apple	Yes	No	2.0 meters
Ethernet	CMG	Yes	No	2.2 meters
Fiber Optic for Airport	Apple	No	No	2 meters
Fiber Optic	Creative	No	No	5 meters
Firewire	Apple	Yes	No	1 meter
Headphones / Mic	Andy May	No	No	2.5 meters
USB Keyboard / Mouse	Apple	Yes	No	0.8 meters

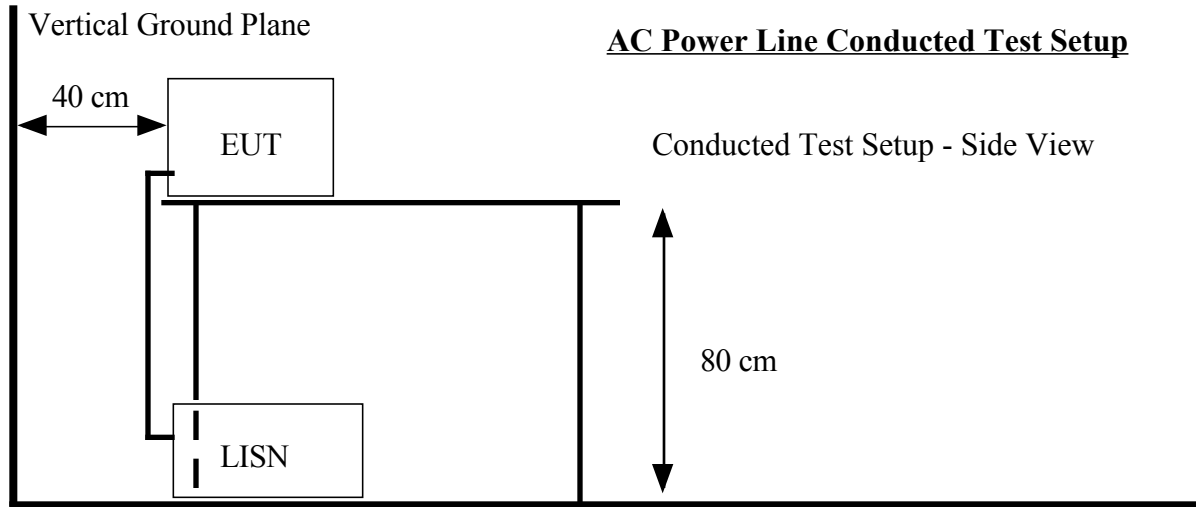
EUT Operating Conditions

All of the equipment and cables were placed in the worst-case configuration to maximize the emissions during the tests. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

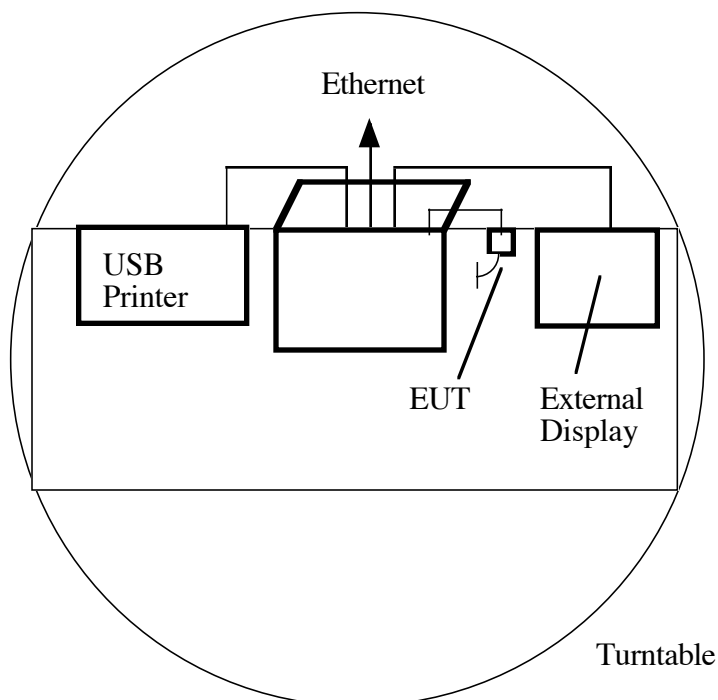
For scans below 1 GHz, the EUT transceiver and all the host system I/O ports were filled. The EUT was activated by using special test software which put the EUT into a continuous transmit mode. Each of the low, mid and high channels was activate at full power and the EUT continuously transmitted at the active channel.

Test Setup Block Diagrams

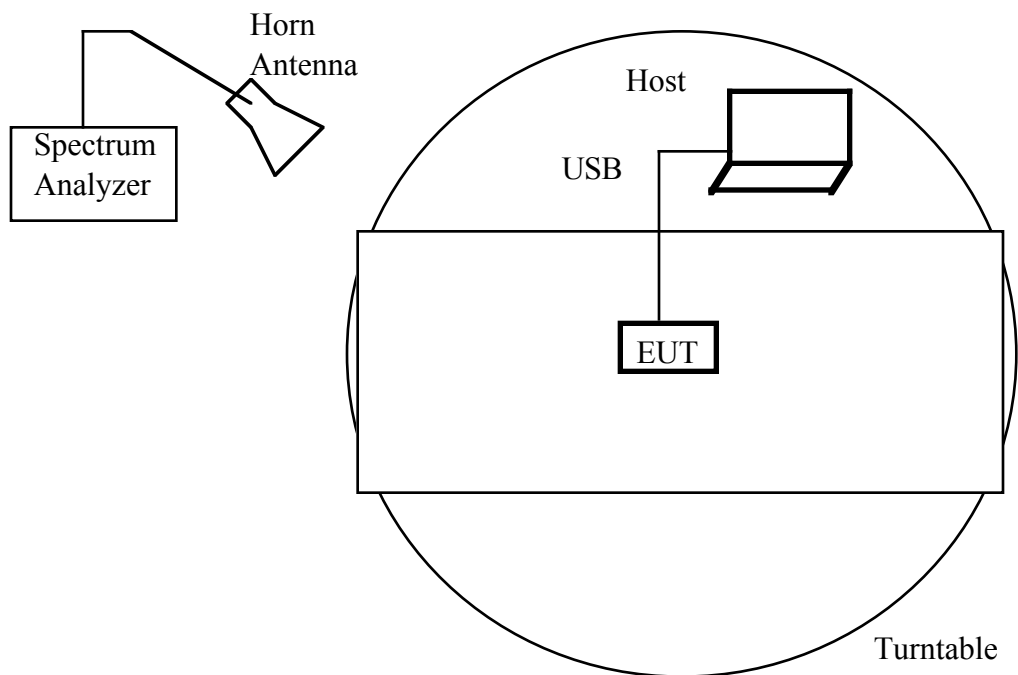
For AC Power Line conducted and RF Radiated Emissions, the EUT was placed on a nonmetallic table, 80 cm above the metallic ground-plane. The EUT and peripherals were powered from a filtered ac mains supply. Since the EUT power comes from the USB connection to the host, ac power line emissions were measured from the host computer.



RF Radiated Emissions Test Setup Below 1 GHz



RF Radiated Emissions Test Setup Above 1 GHz



7 Applicable Limits and Test Results

7.1 99% Bandwidth and 20 dB Bandwidth

Limit

None; for reporting purposes only

99% Test Procedure

The transmitter is connected to a spectrum analyzer and set to continuously transmit. The Spectrum Analyzer has a 99% Bandwidth Function built-in. The resolution Bandwidth is set to 10 kHz and the Video Bandwidth is set to 30 kHz.

99% Bandwidth Results

Channel	Frequency - (MHz)	99% Bandwidth (kHz)
Low	2402	866
Mid	2441	866
High	2480	864

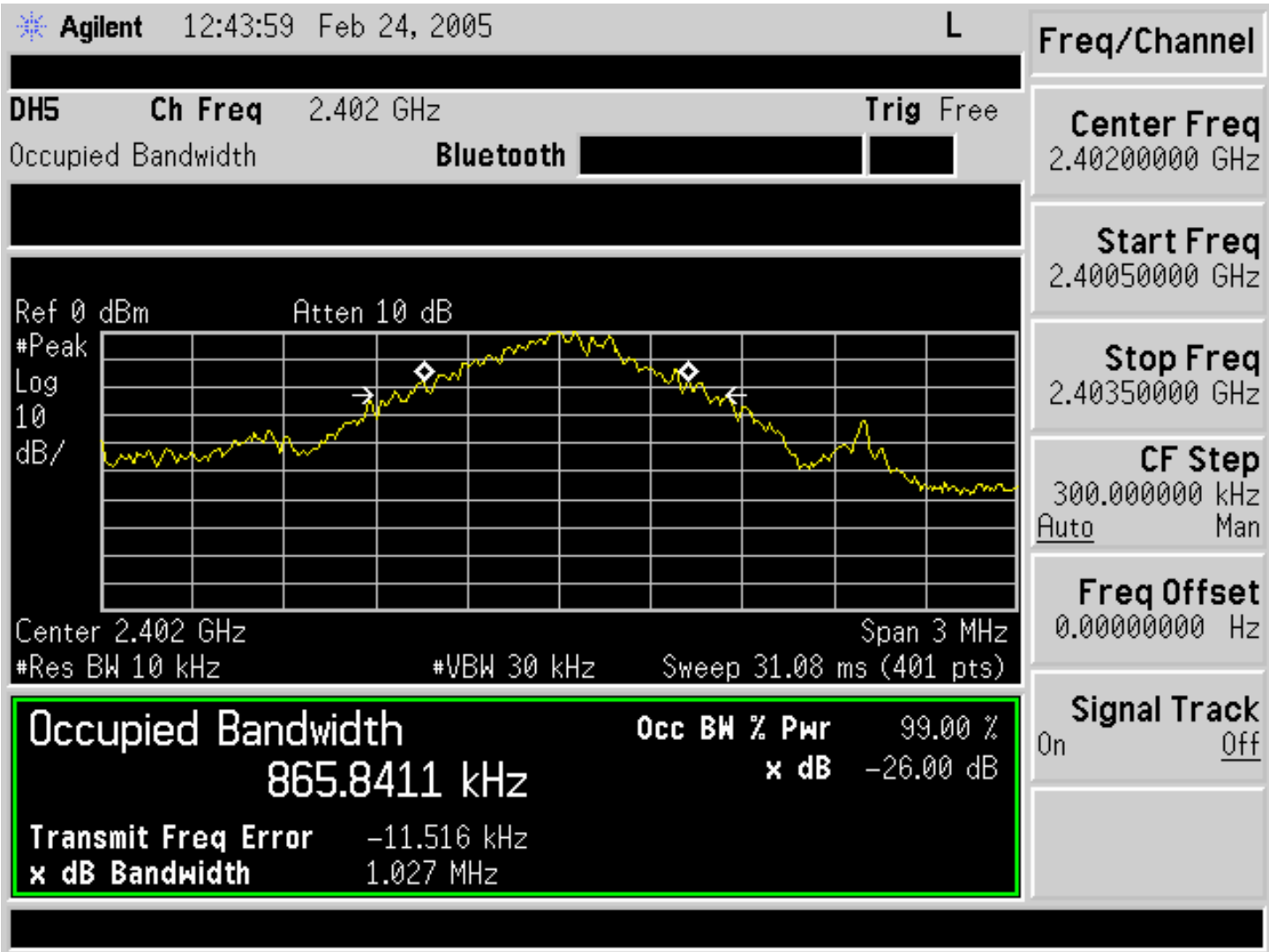
20 dB Test Procedure

The transmitter is connected to a spectrum analyzer and set to continuously transmit. The resolution Bandwidth is set to 10 kHz and the Video Bandwidth is set to 10 kHz.

20 dB Results

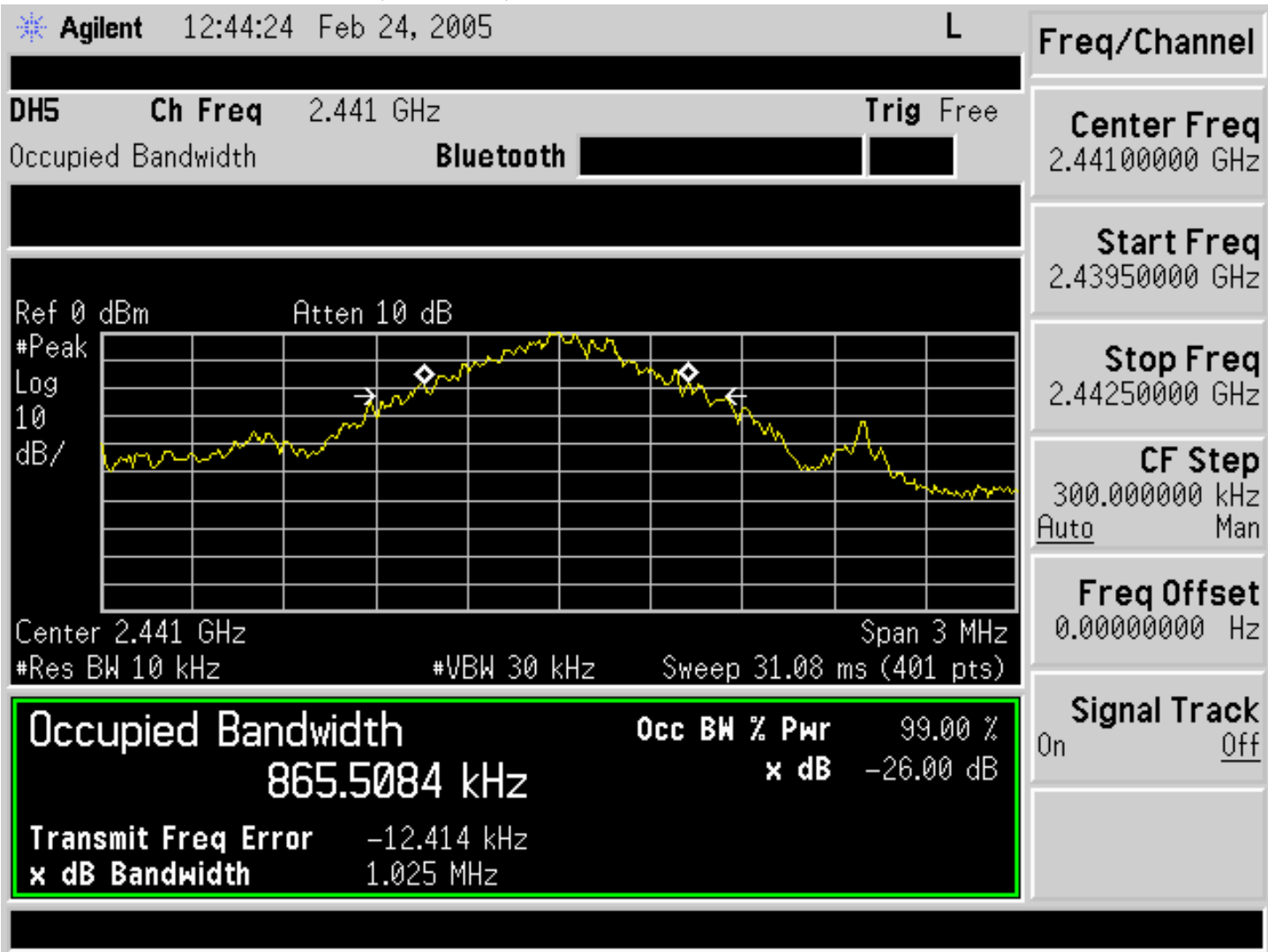
Channel	Frequency - (MHz)	20 dB Bandwidth (kHz)
Low	2402	935
Mid	2441	935
High	2480	920

99% Bandwidth – Low Channel (2402 MHz)



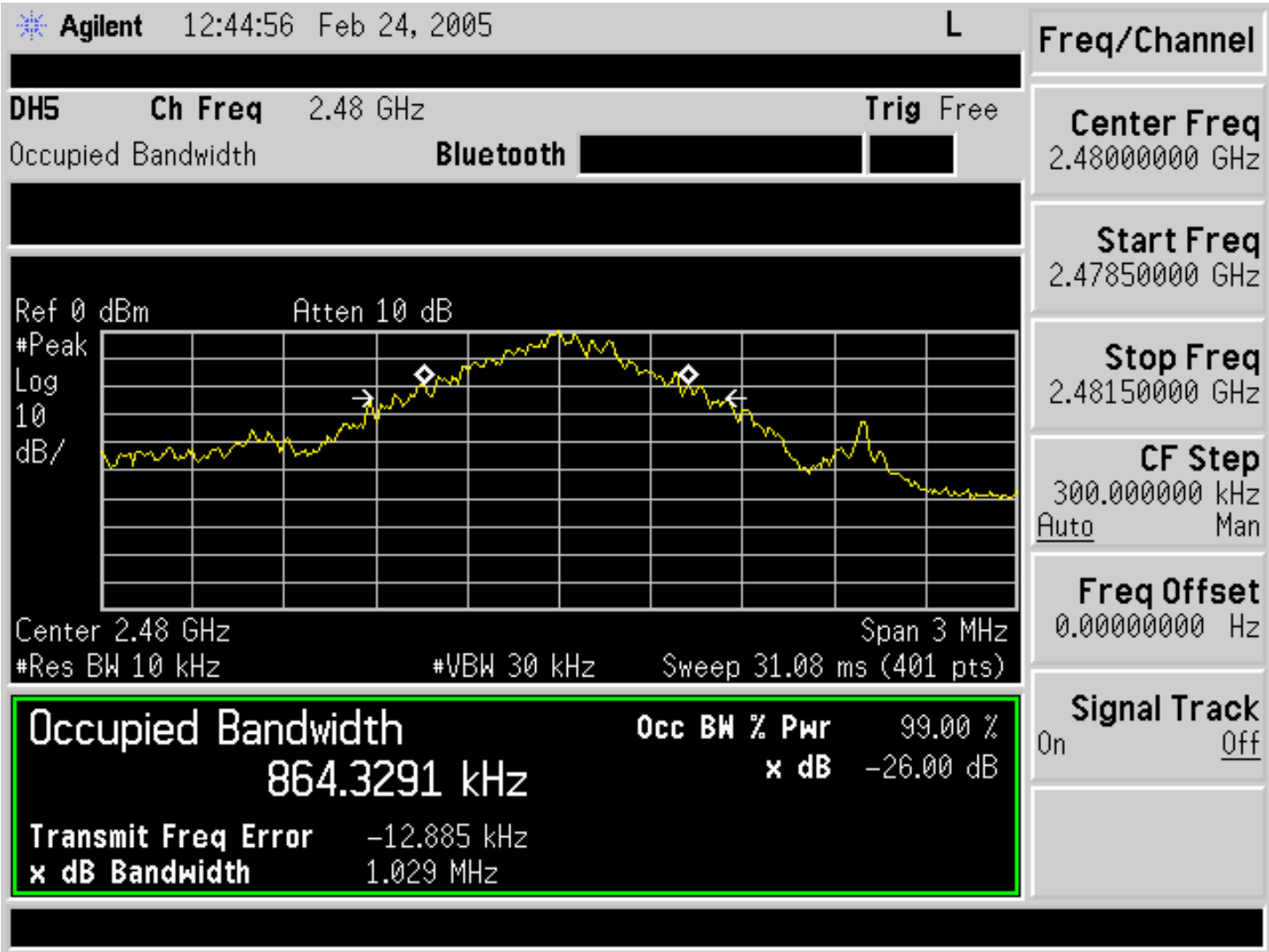
Date of Test: February 24, 2005

99% Bandwidth – Mid Channel (2441 MHz)



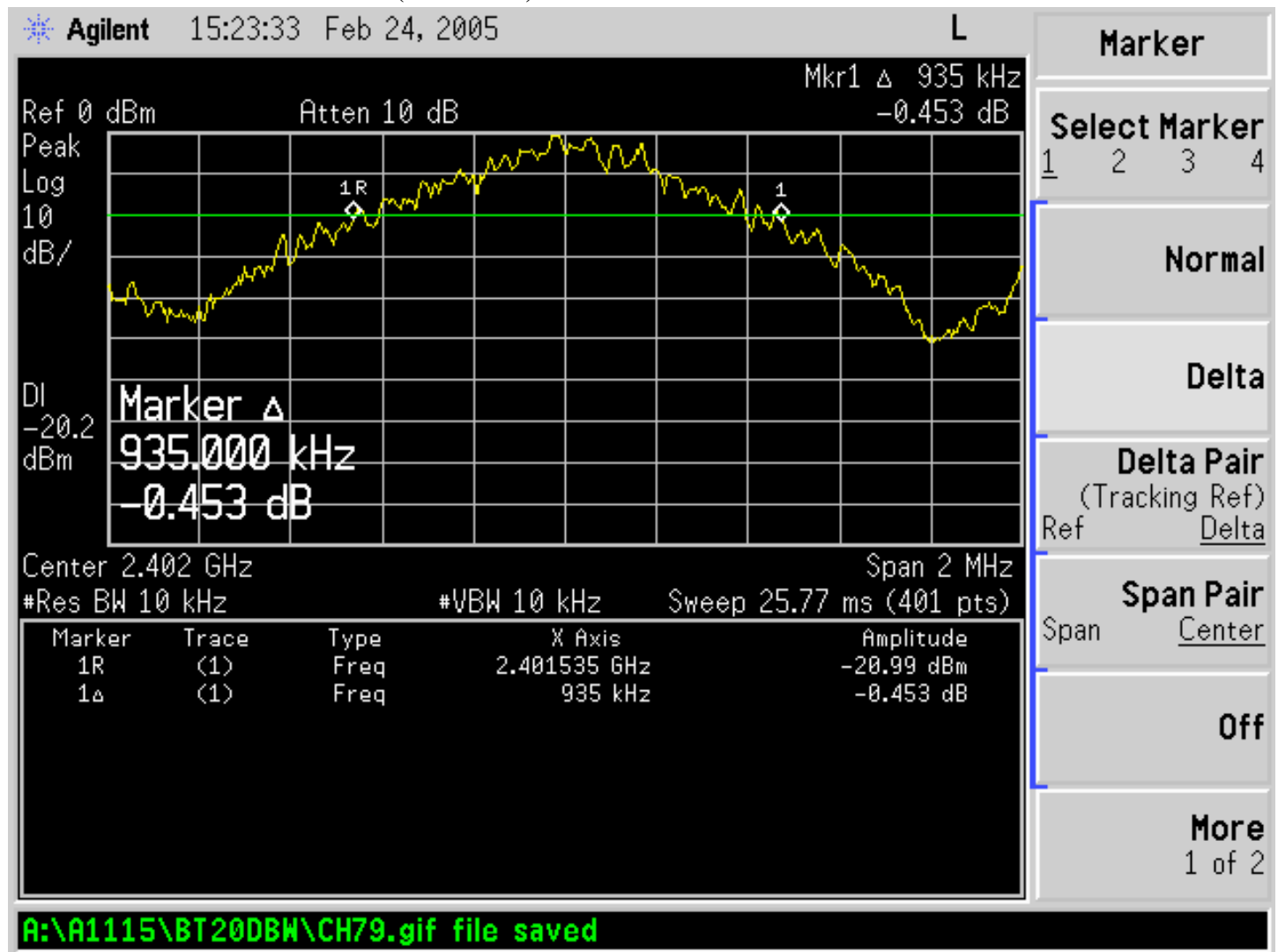
Date of Test: February 24, 2005

99% Bandwidth – High Channel (2480 MHz)



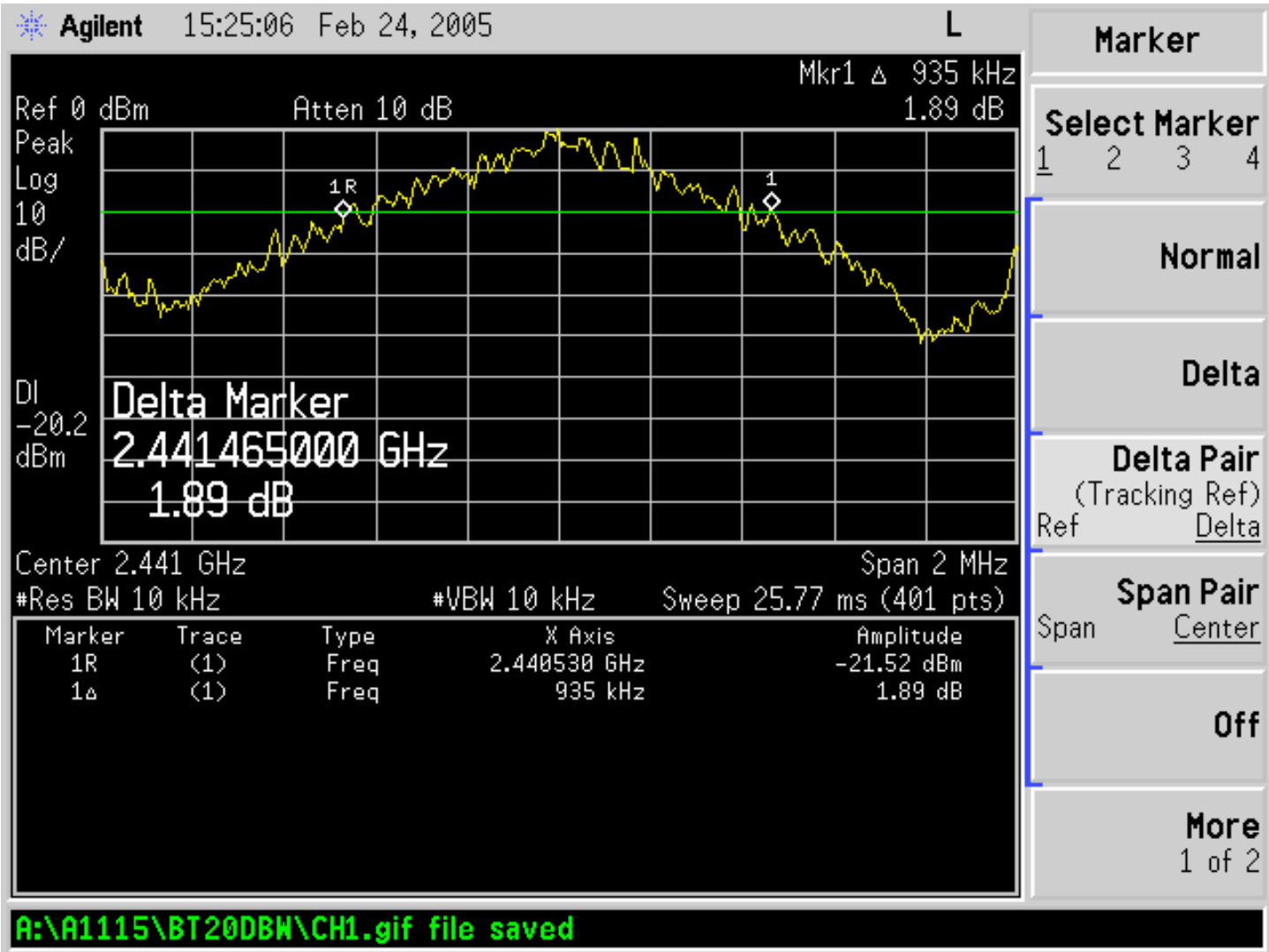
Date of Test: February 24, 2005

20 dB Bandwidth – Low Channel (2402 MHz)



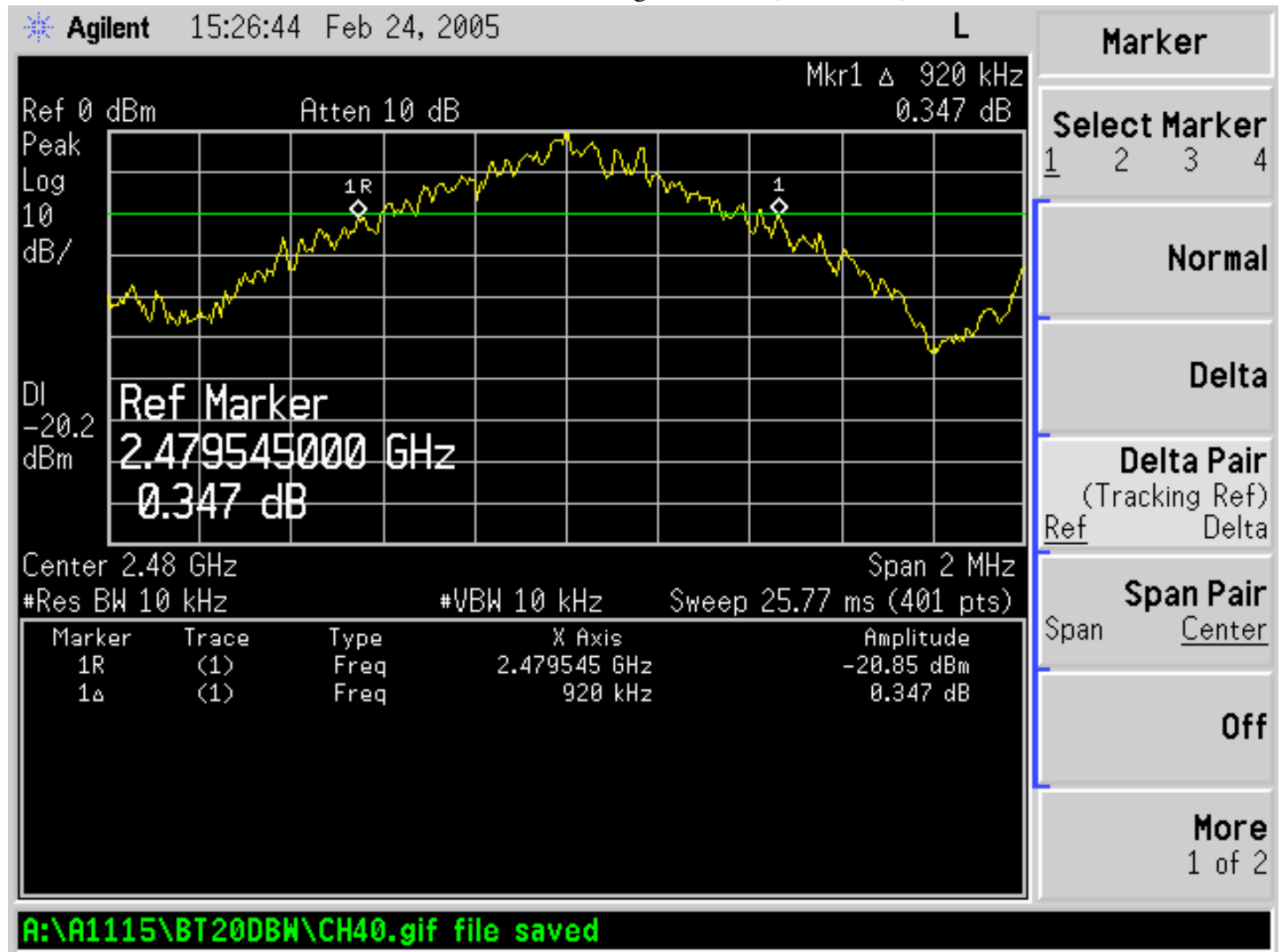
Date of Test: February 24, 2005

20 dB Bandwidth – Mid Channel (2441 MHz)



Date of Test: February 24, 2005

20 dB Bandwidth – High Channel (2480 MHz)



Date of Test: February 24, 2005

7.2 Hopping Frequency Separation

Limit

Frequency Hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB Bandwidth of the hopping channel, whichever is greater.

Test Procedure

The Apple Bluetooth module was placed in continuous transmit mode while hopping over all 79 channels. The transmitter output is connected to a spectrum analyzer RF input. The bandwidth of the spectrum analyzer is set to 30 kHz.

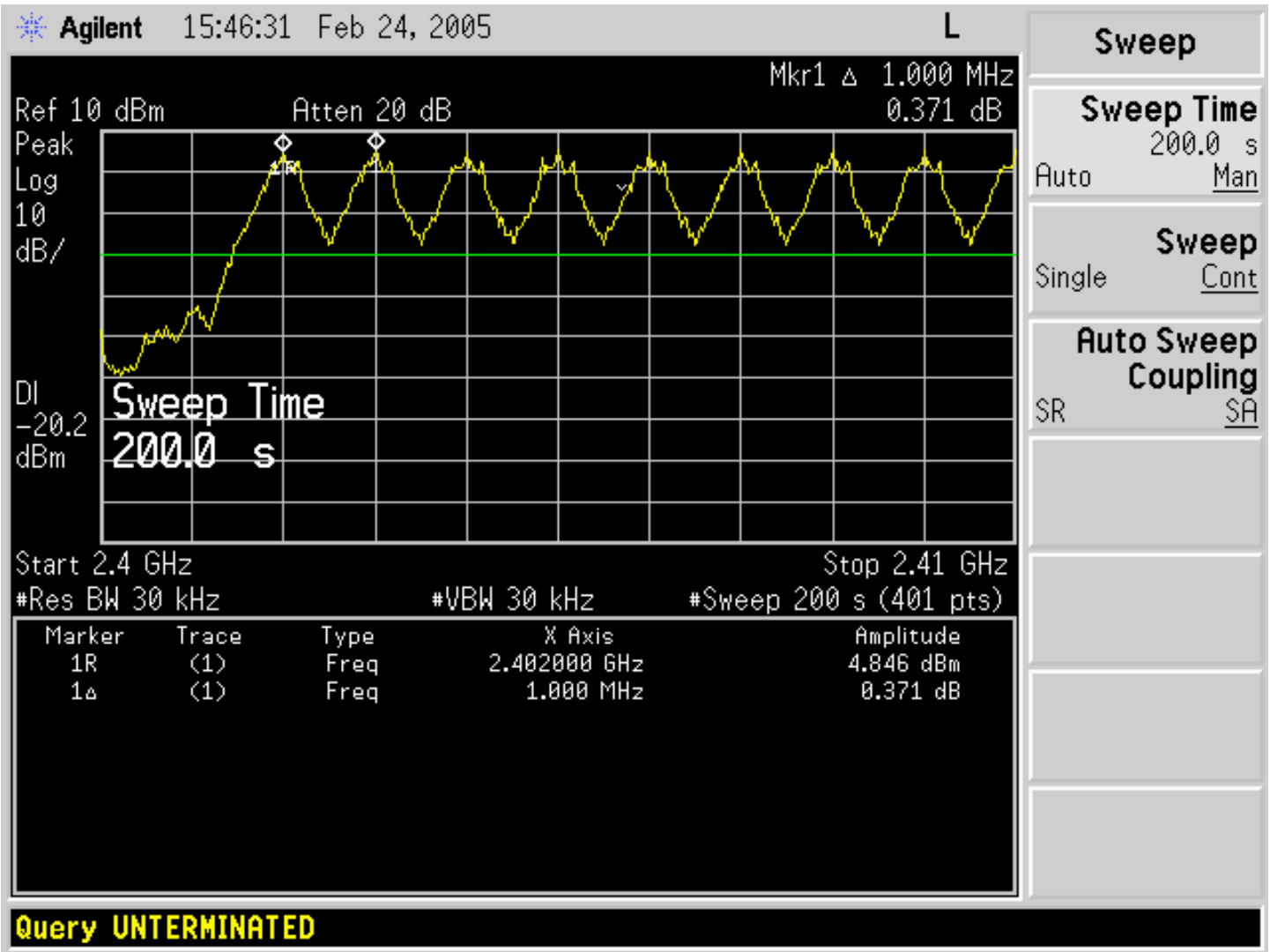
Test Results

Based on the results of this report, no non-compliance was found.

Hopping Frequency Separation Instrument Settings:

Reference Level	Attenuation	Resolution BW	Video Bandwidth	Span	Sweep Time
10 dBm	10 dB	30 kHz	30 kHz	10 MHz	200 Seconds

Hopping Frequency Separation – Lower Channels



Date of Test: February 24, 2005

Channels	Frequencies (MHz)	Marker 1 (MHz)	Marker 2 (MHz)	Channel Separation (MHz)
1 and 2	2402, 2403	2402	2403	1 MHz

7.3 Number of Hopping Channels

Limit

Frequency Hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

The Apple Bluetooth module was placed in continuous transmit mode while hopping over all 79 channels. The transmitter output is connected to a spectrum analyzer RF input. A total of 4 adjacent spans were measured from 2400 to 2480. These scans were combined into a single graph to reveal a total of 79 channels.

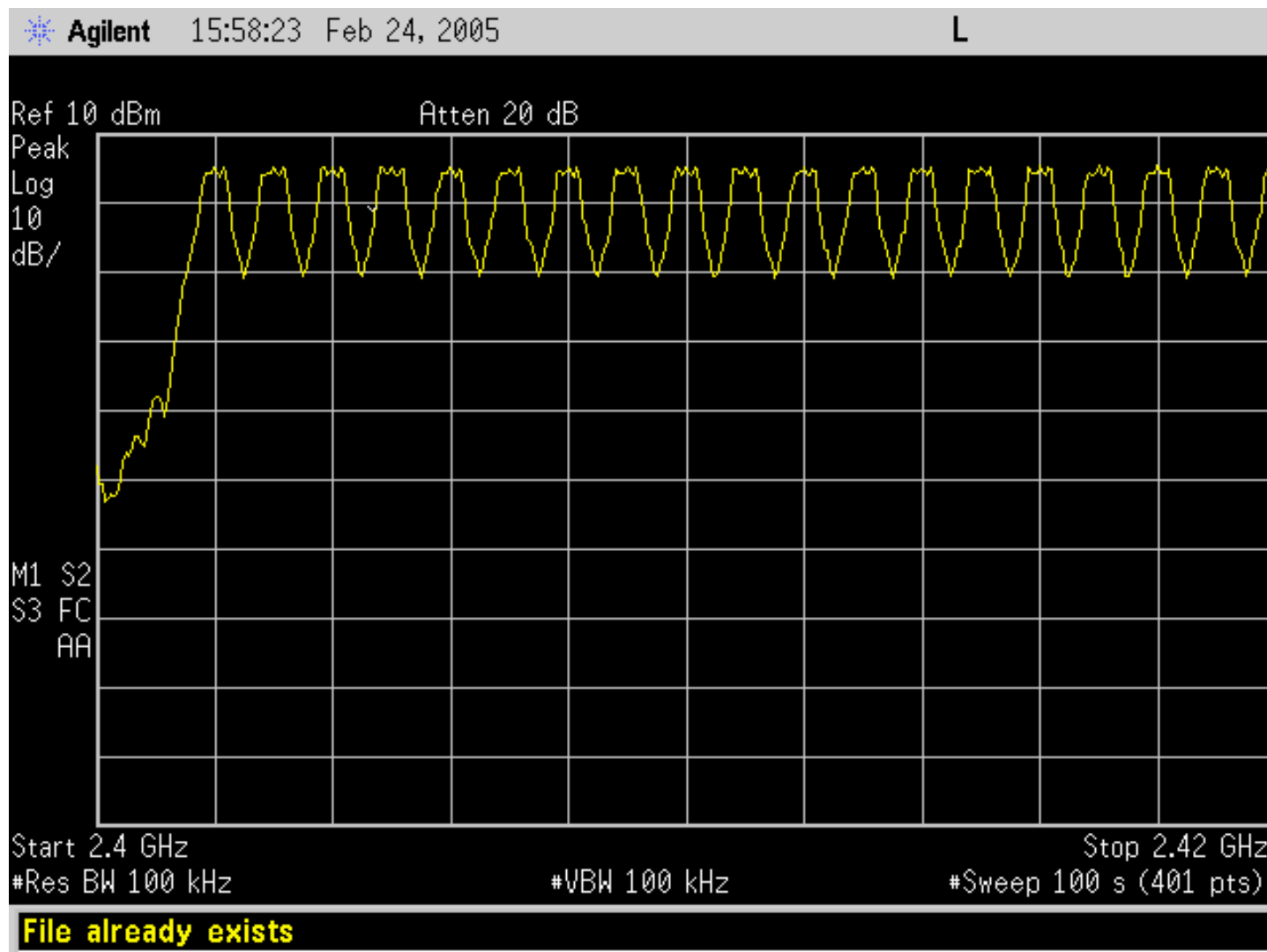
Test Results

79 Hopping Channels were observed. Based on the results of this report, no non-compliance was found.

Number of Hopping Channels - Instrument Settings:

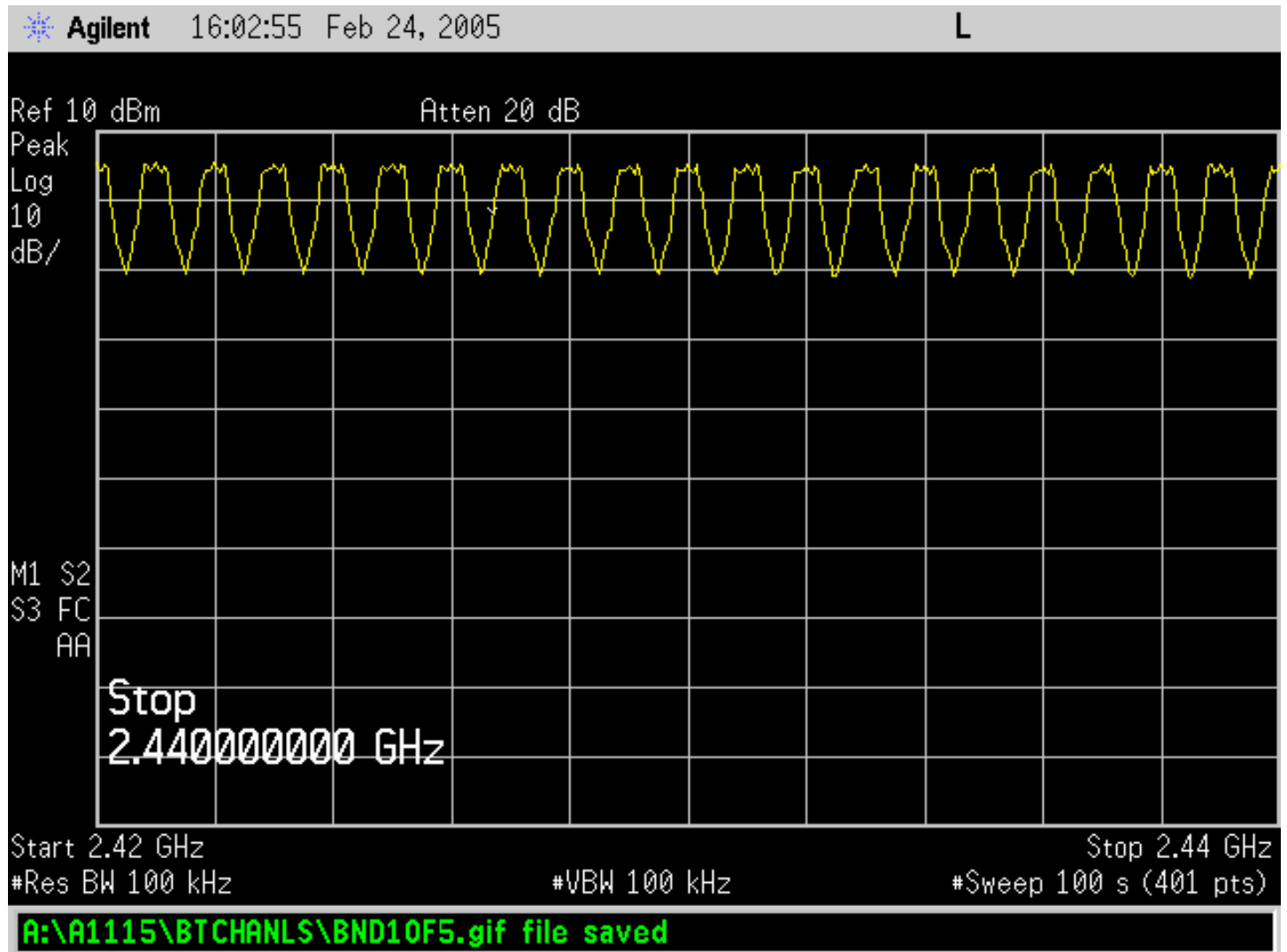
Reference Level	Attenuation	Resolution BW	Video Bandwidth	Span	Sweep Time
10 dBm	20 dB	100 kHz	100 kHz	20 MHz	100 Seconds

Channels from 2400 – 2420 MHz



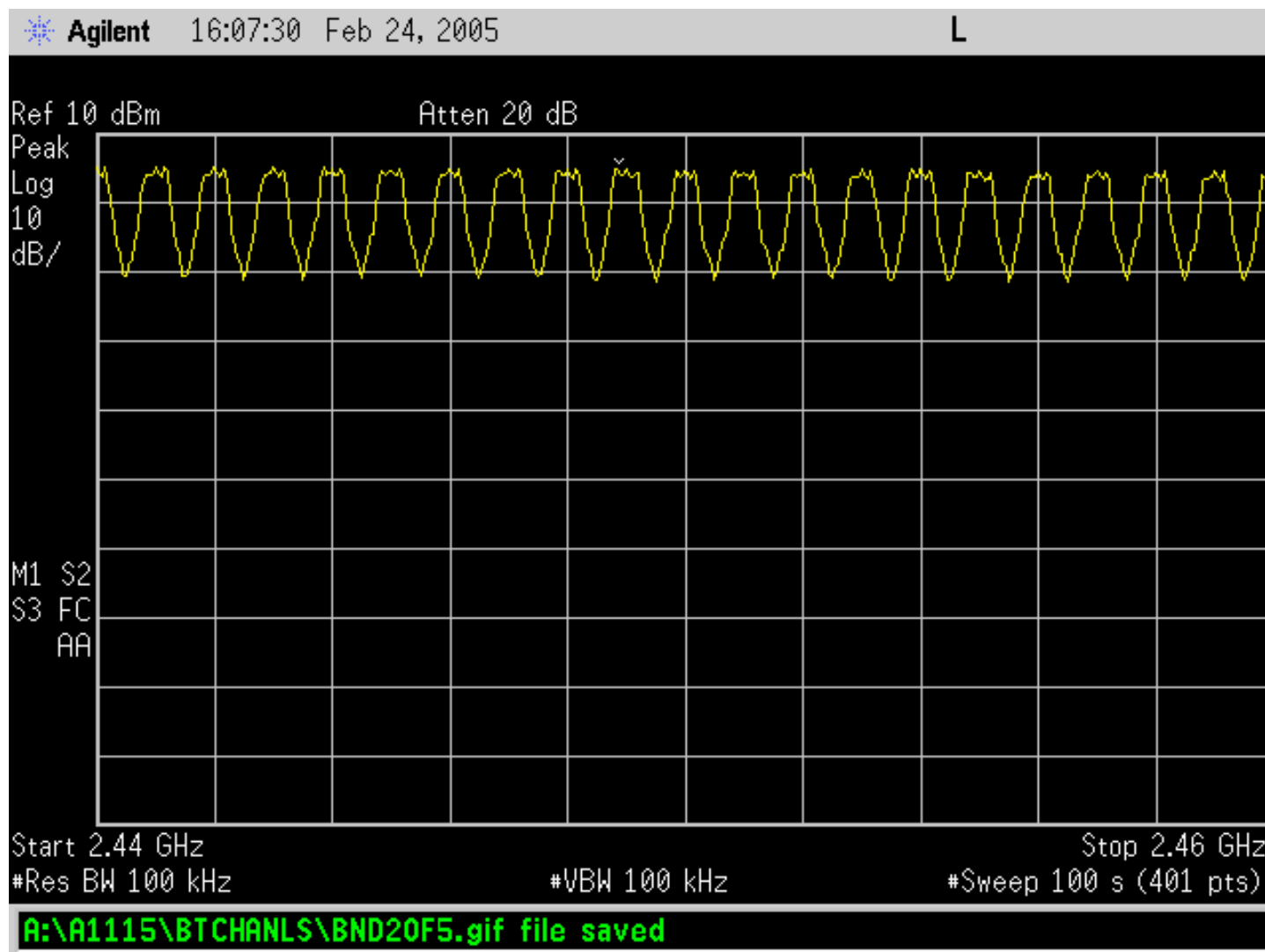
Date of Test: February 24, 2005

Channels from 2420 – 2440 MHz



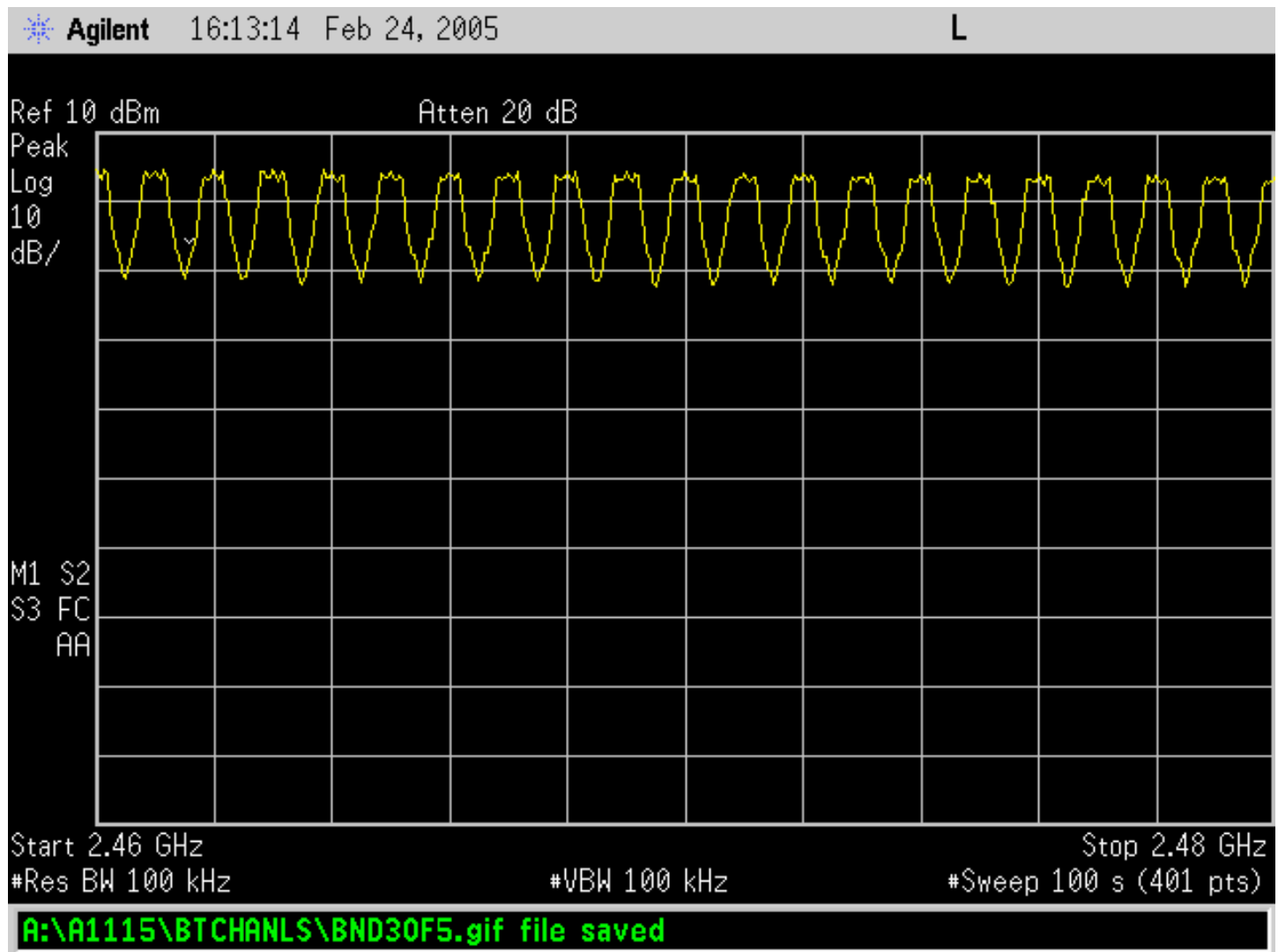
Date of Test: February 24, 2005

Channels from 2440 – 2460 MHz



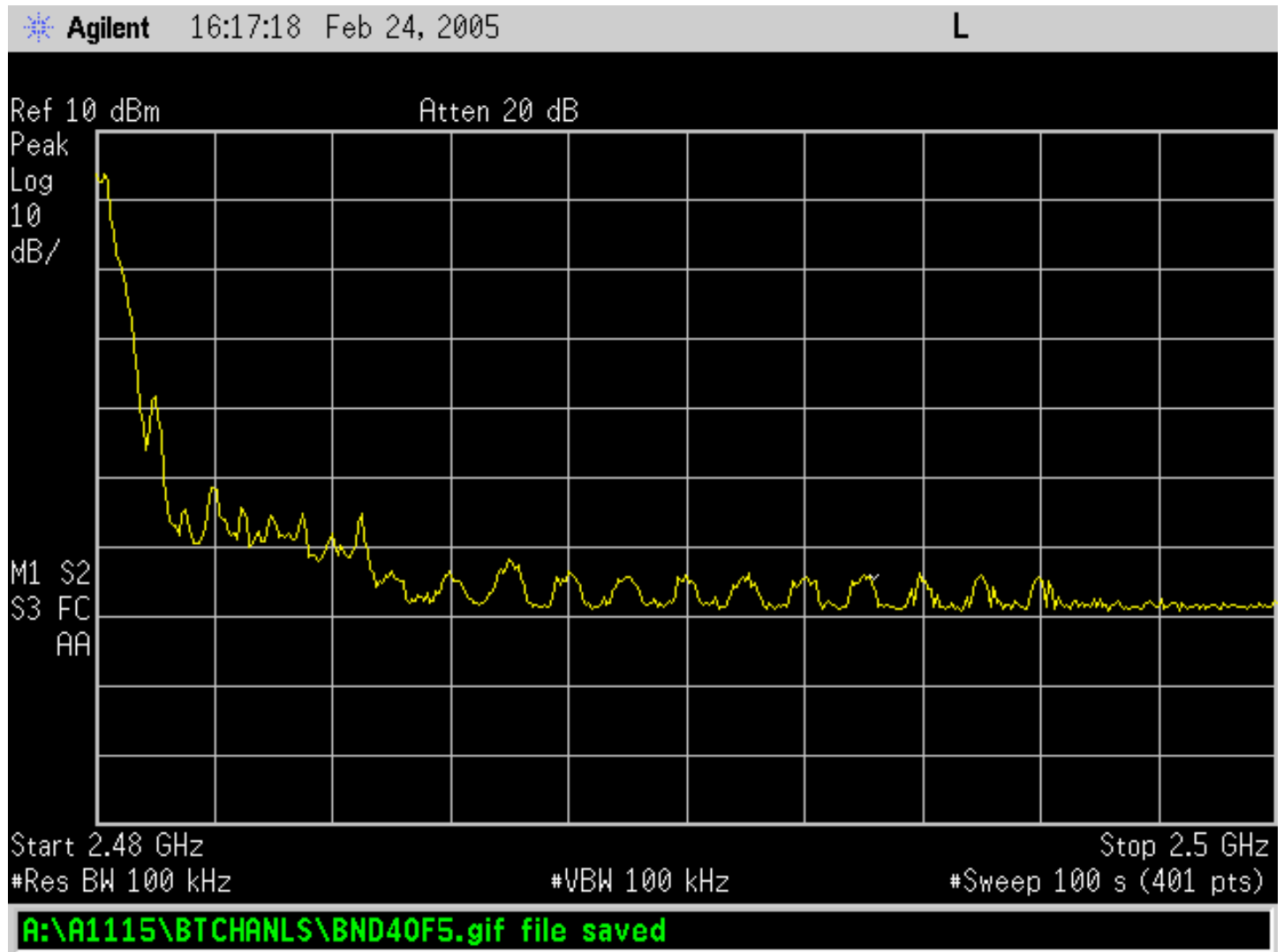
Date of Test: February 24, 2005

Channels from 2460 – 2480 MHz



Date of Test: February 24, 2005

Channels from 2480 – 2500 MHz



Date of Test: February 24, 2005

7.4 Average Time of Occupancy

Limit

Frequency Hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

The Apple Bluetooth module was placed in continuous transmit mode while hopping over all 79 channels. The transmitter output is connected to a spectrum analyzer RF input. The width of a single channel is measured in a fast scan of 4 mS sweep time. The number of pulses in a 3.16 second period are counted and multiplied by 10.

The average occupancy time in the specified 31.6 second period (79 channels x 0.4 S = 31.6) is equal to

10 x (number of pulses in 3.16 s) x pulse width.

Test Results

Based on the results of this report, no non-compliance was found.

Average Time of Occupancy - Instrument Settings:

Reference Level	Attenuation	Resolution BW	Video Bandwidth	Span	Sweep Time
10 dBm	20 dB	1 MHz	1 MHz	0 Hz	0.004 Seconds or 3.16 Seconds

Pulse Width (DH1) = 410 uS

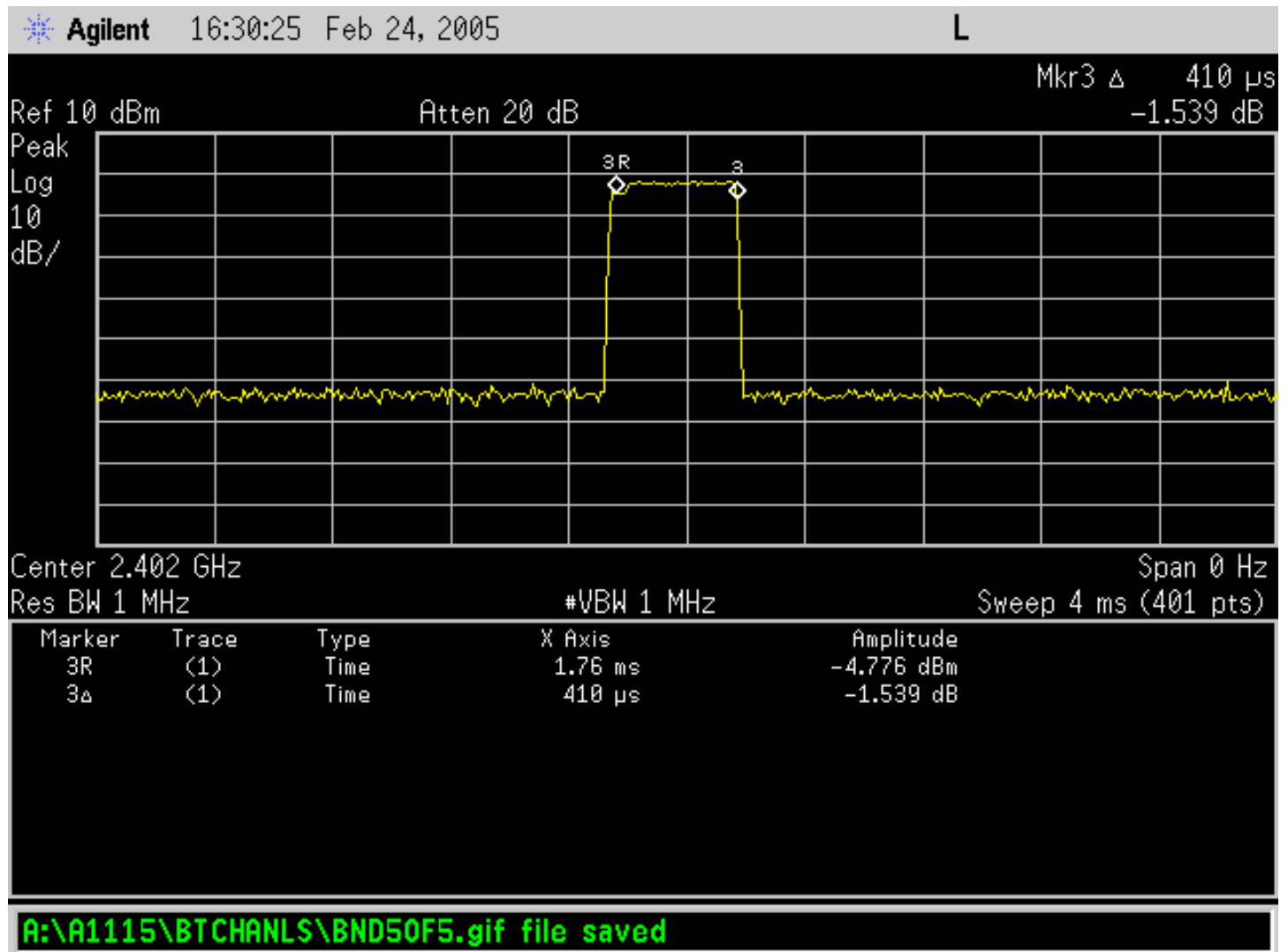
Number of Pulses in 3.16 Seconds = 32

Number of Pulses in 31.6 Seconds = 320

Average Time of occupancy = 320 x 410 uS = 134 mS

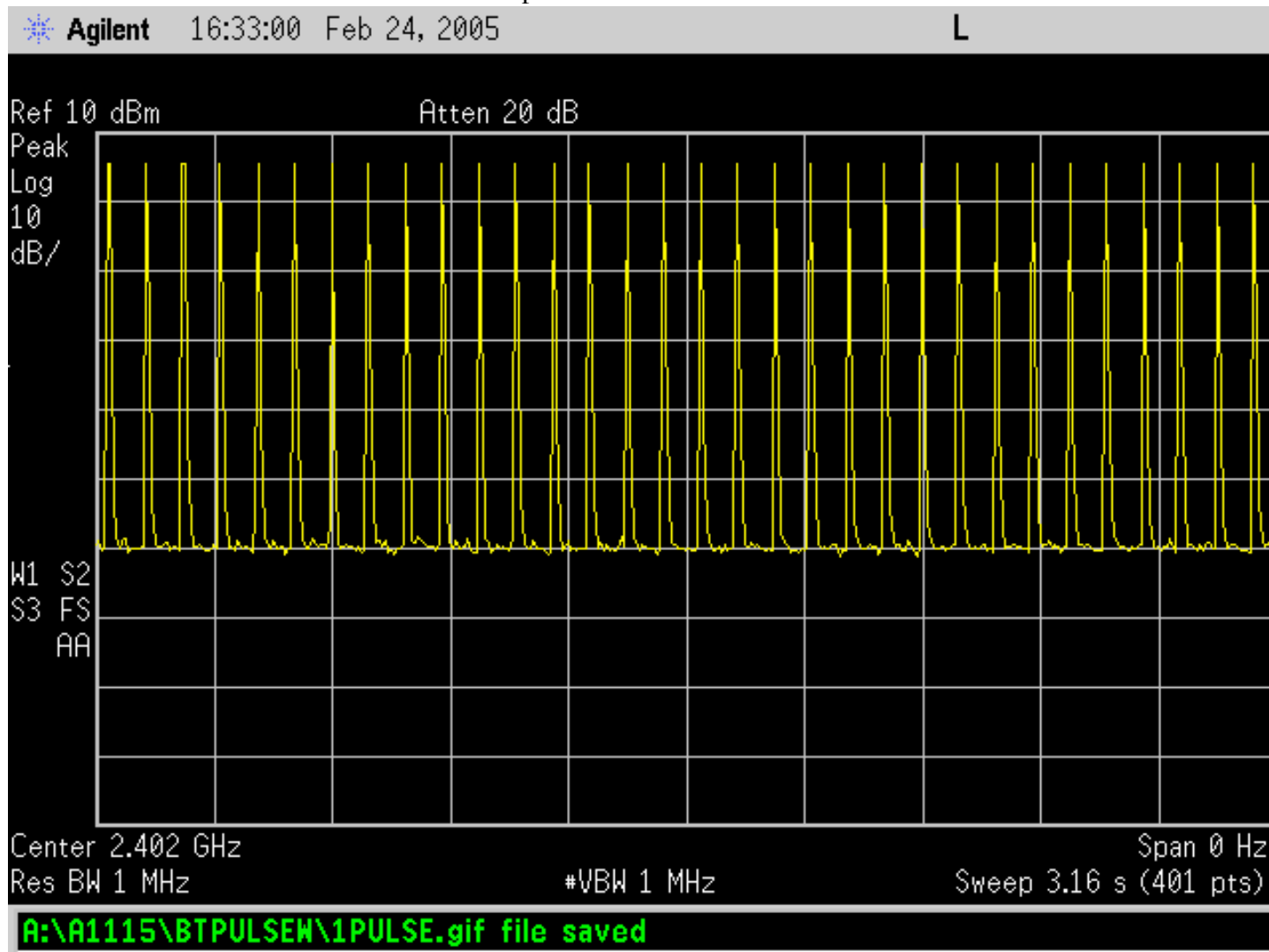
Average Time of Occupancy (Seconds)	Limit (Seconds)	Margin (Seconds)
0.131	0.4	0.269

Pulse Width – Channel 1 (2402 MHz) Horizontal scale set to 4 mSecond, Pulse Width = 410 uS



Date of Test: February 24, 2005

Number of Pulses on Channel 1 (2402 MHz) with a 0 Hz Span. Horizontal Scale set to 3.16 Seconds. The Number of Pulses observed in a 3.16 Second period = 32



Date of Test: February 24, 2005

7.5 Output Power

Limit

The output power is not to exceed 1.0 Watt and the EIRP not to exceed 6 dBW.

The maximum antenna gain for the Apple Bluetooth module is 2.4 dBi and it uses 79 hopping frequencies therefore the limit is 30 dBm.

Test Setup

The transmitter is connected to a peak power meter and set to continuously transmit.

Maximum Peak Output Power Test Results

Based on the results of this report, no non-compliance were found.

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.7	30	-24.3
Mid	2441	5.6	30	-24.4
High	2480	4.5	30	-25.5

Date of Test: February 3, 2005

7.6 Average Power

Average Power Limit

None; for reporting purposes only

Test Procedure

The transmitter is connected to an average power meter and set to transmit continuously.

Average Power Test Results

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	3.8
Mid	2441	3.7
High	2480	2.6

Date of Test: February 3, 2005

7.7 Power Spectral Density

Limit

The transmitter power spectral density (into the antenna) shall not be greater than 8 dBm in any 3 kHz band.

Test Procedure

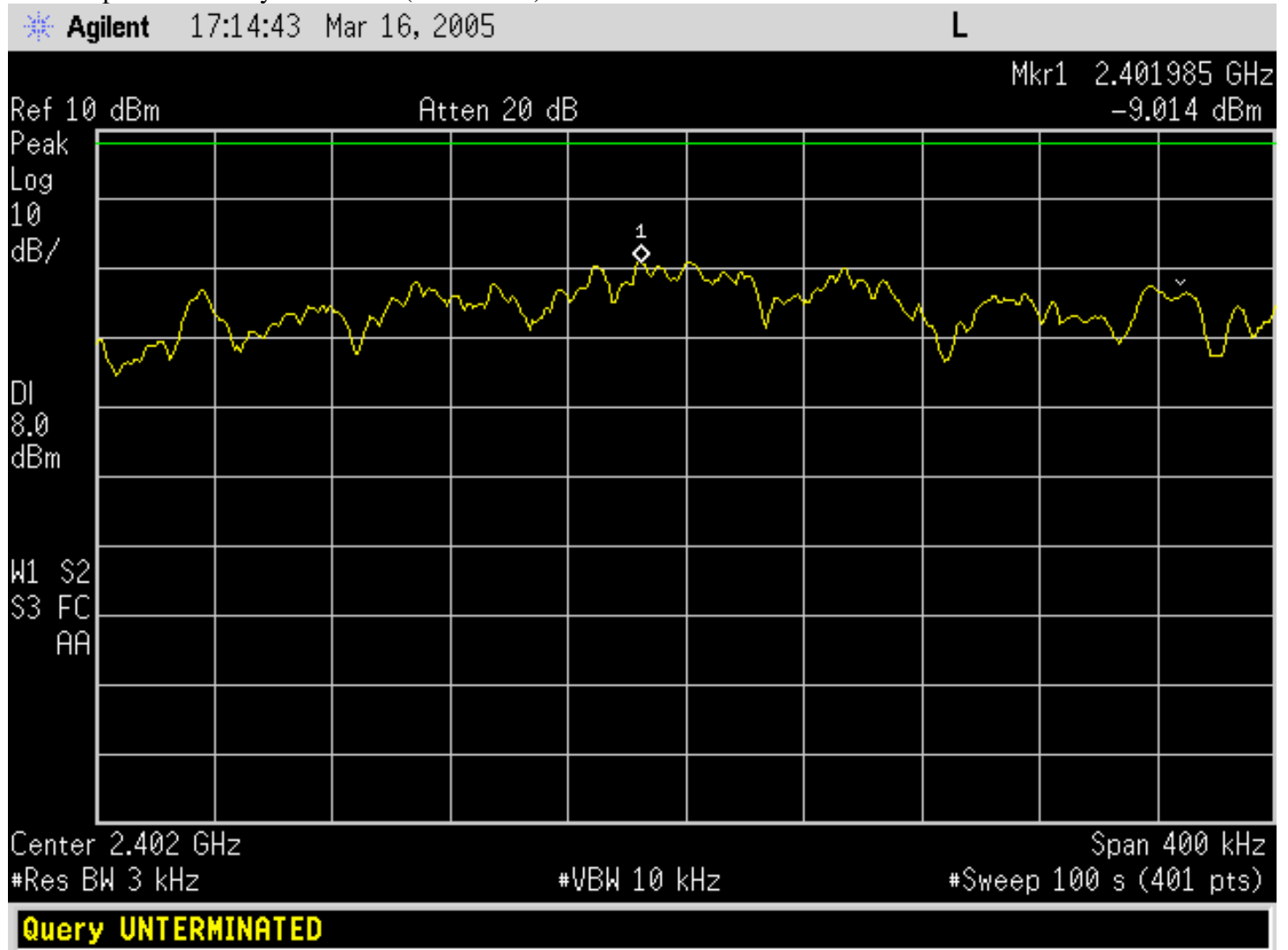
The transmitter output was connected to a spectrum analyzer. The maximum level in a 3 kHz bandwidth is measured with the spectrum analyzer using RBW = 3 kHz, VBW = 10 kHz, span = 400 kHz and a sweep time of 100 Seconds. This process was performed for the low, mid and high channels.

Power Spectral Density Test Results

Based on the results of this report, no non-compliance was found.

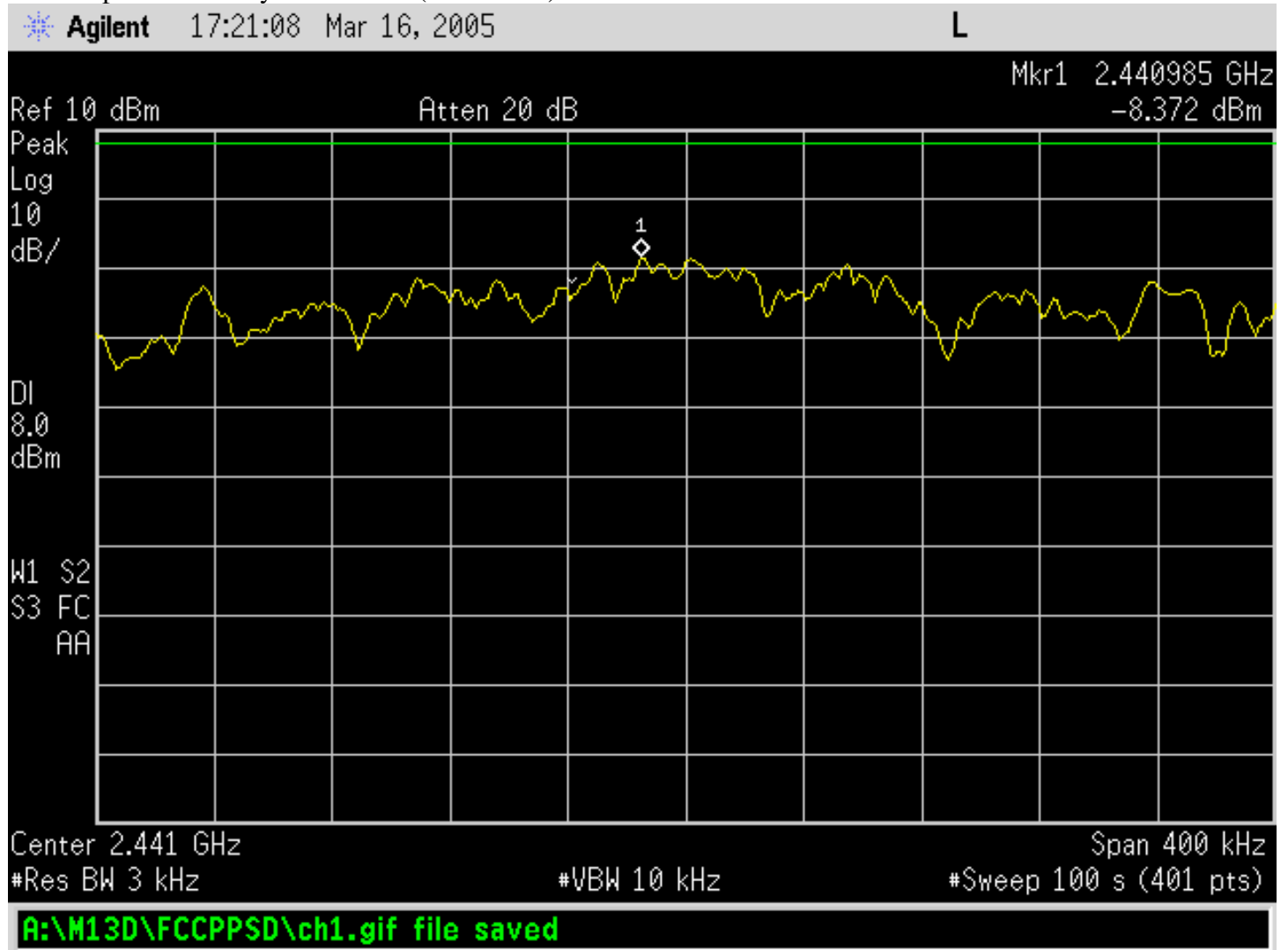
Channel	Frequency (MHz)	Peak Power Spectral Density (dBm)	Limit (dBm)
Low	2402	-9.04	8
Mid	2441	-8.37	8
High	2480	-7.97	8

Power Spectral Density Channel 1 (2402 MHz)



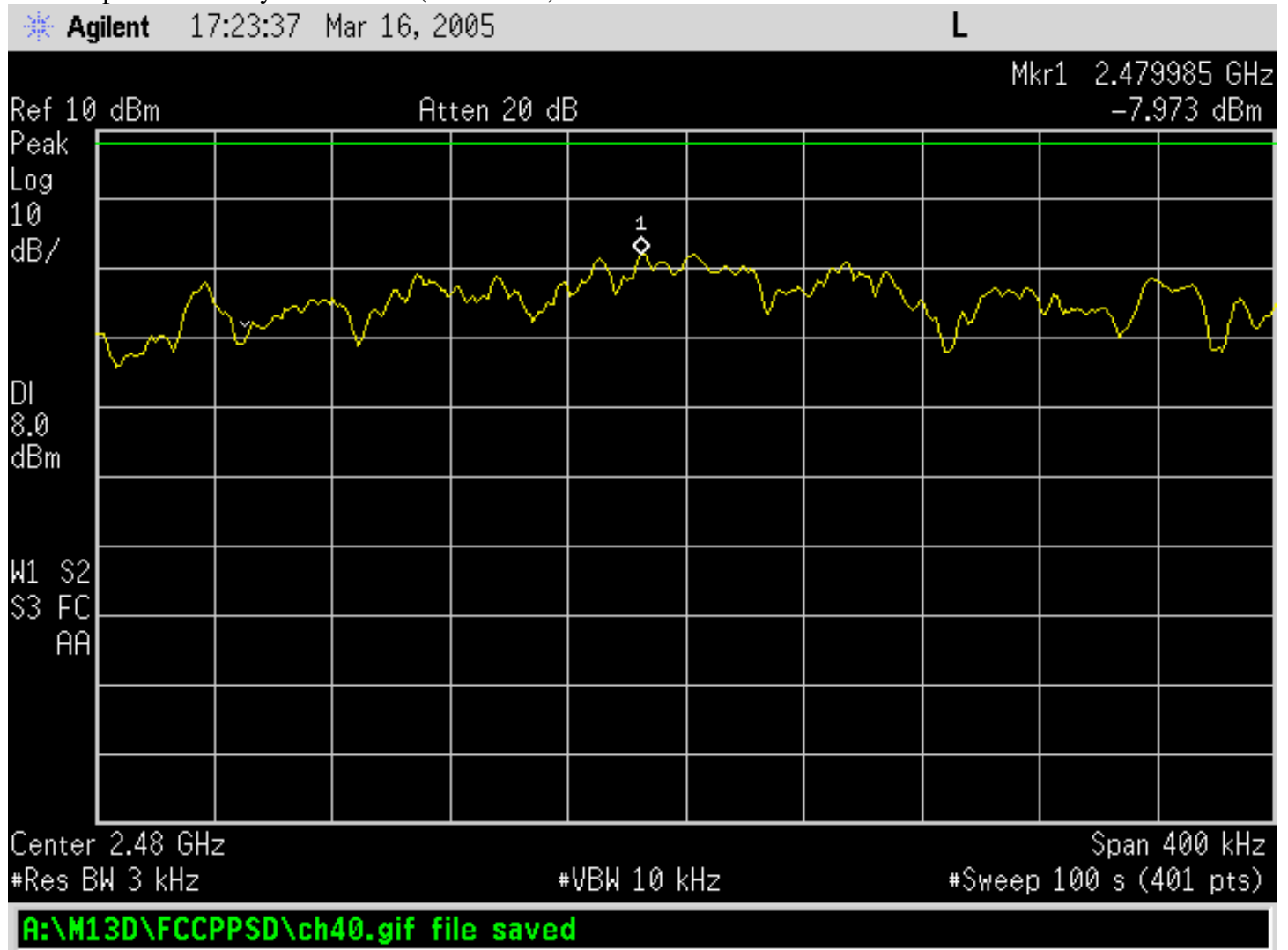
Date of Test: March 16, 2005

Power Spectral Density Channel 40 (2441 MHz)



Date of Test: March 16, 2005

Power Spectral Density Channel 79 (2480 MHz)



Date of Test: March 16, 2005

7.8 Conducted Spurious Emissions

Limit

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

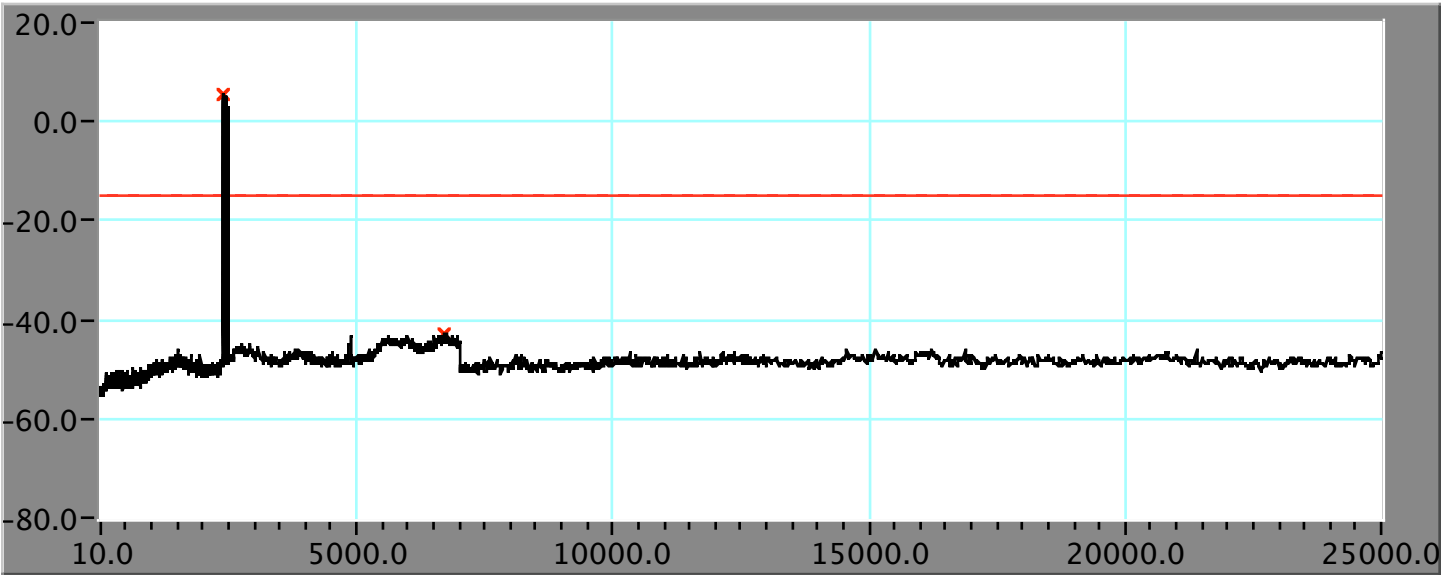
Test Procedure

The transmitter is set to continuously transmit and the transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The spectrum from 30 MHz to 25 GHz is investigated when transmitting on the low, mid and high channels and the band edges are investigated with hopping enabled.

Test Results

Based on the results of this report, no non-compliance was found.

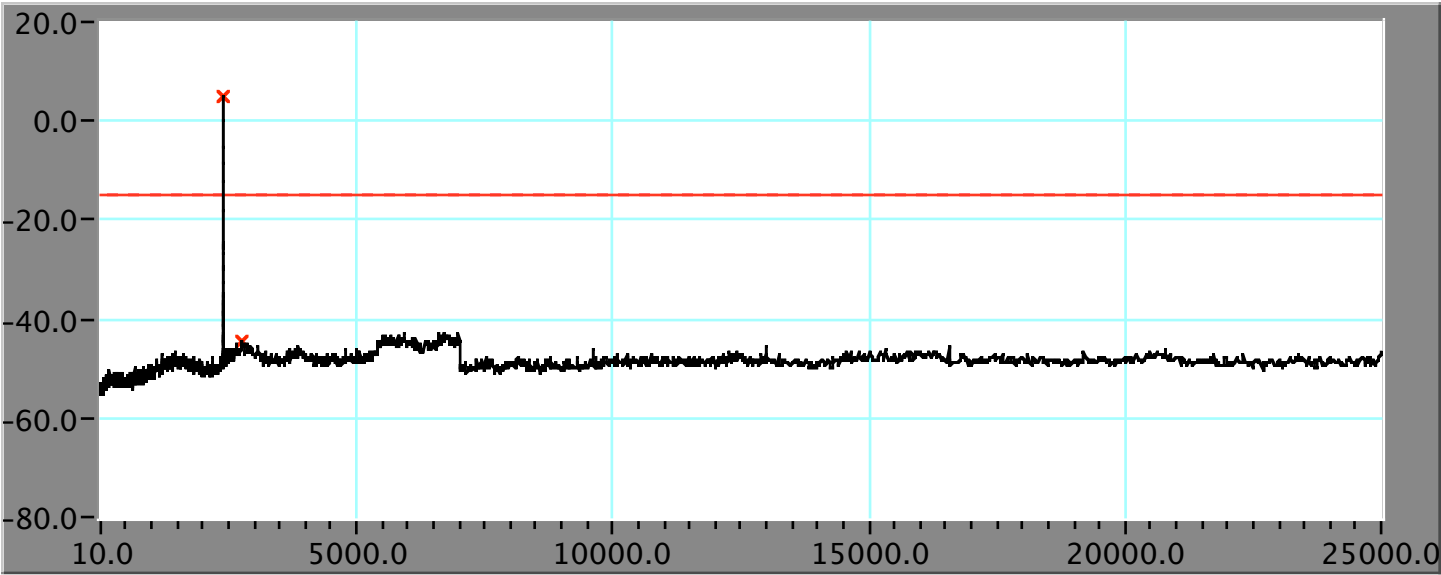
-20 dBc Conducted Spurious Emissions - Hopping Enabled



Frequency - MHz	Level - dBm	Limit - dBm
2419	5.4	N/A
6737	-42.7	-14.6

Date of Test: February 24, 2005

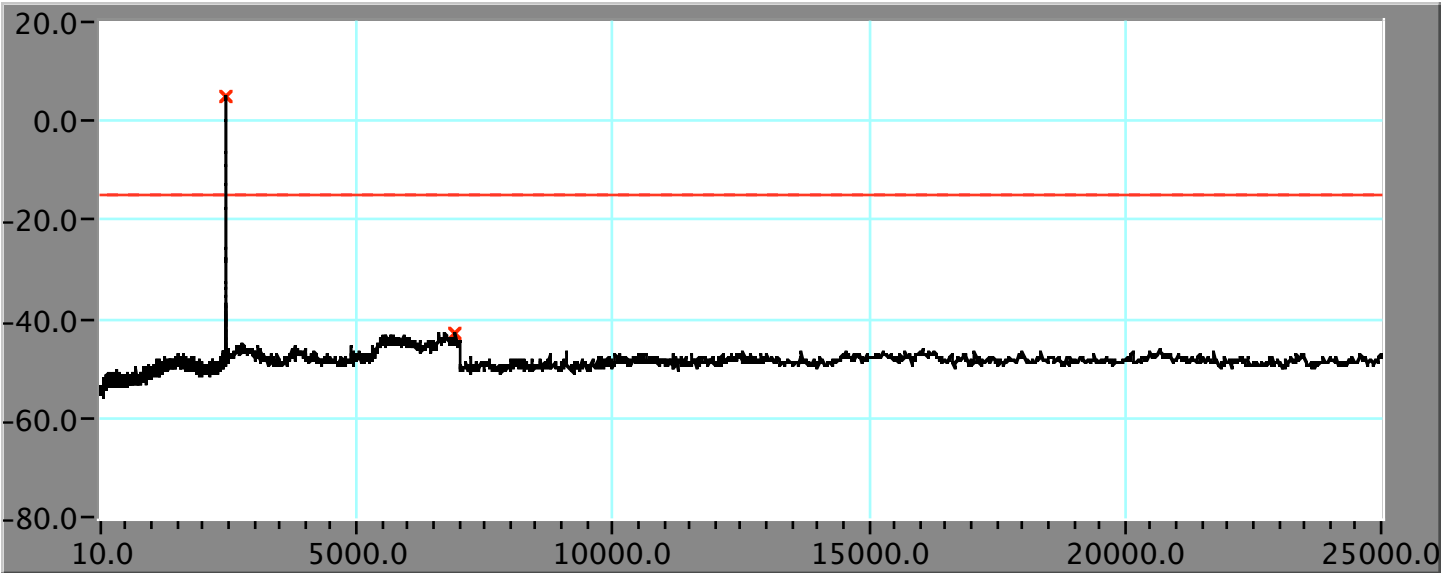
-20 dBc Conducted Spurious Emissions Low Channel (2402 MHz)



Frequency - MHz	Level - dBm	Limit - dBm
2402	5	N/A
2764	-44.7	-15

Date of Test: February 24, 2005

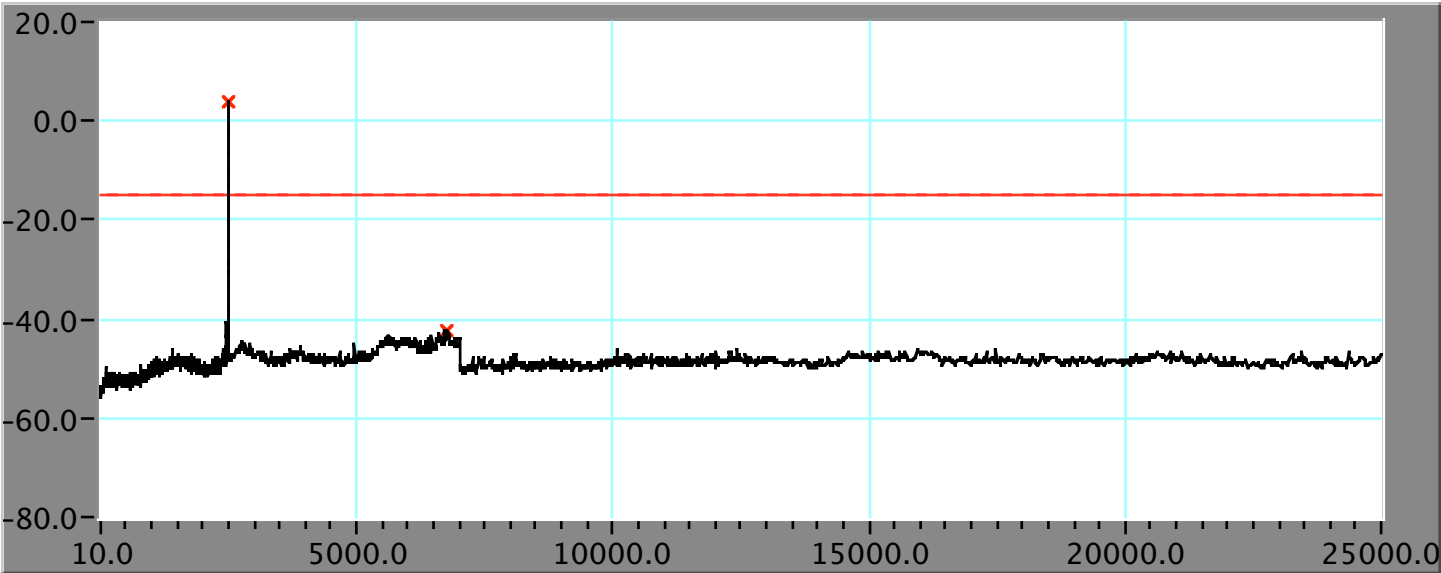
-20 dBc Conducted Spurious Emissions Mid Channel (2441 MHz)



Frequency - MHz	Level - dBm	Limit - dBm
2441	4.9	N/A
6945.7	-42.8	-15.1

Date of Test: February 24, 2005

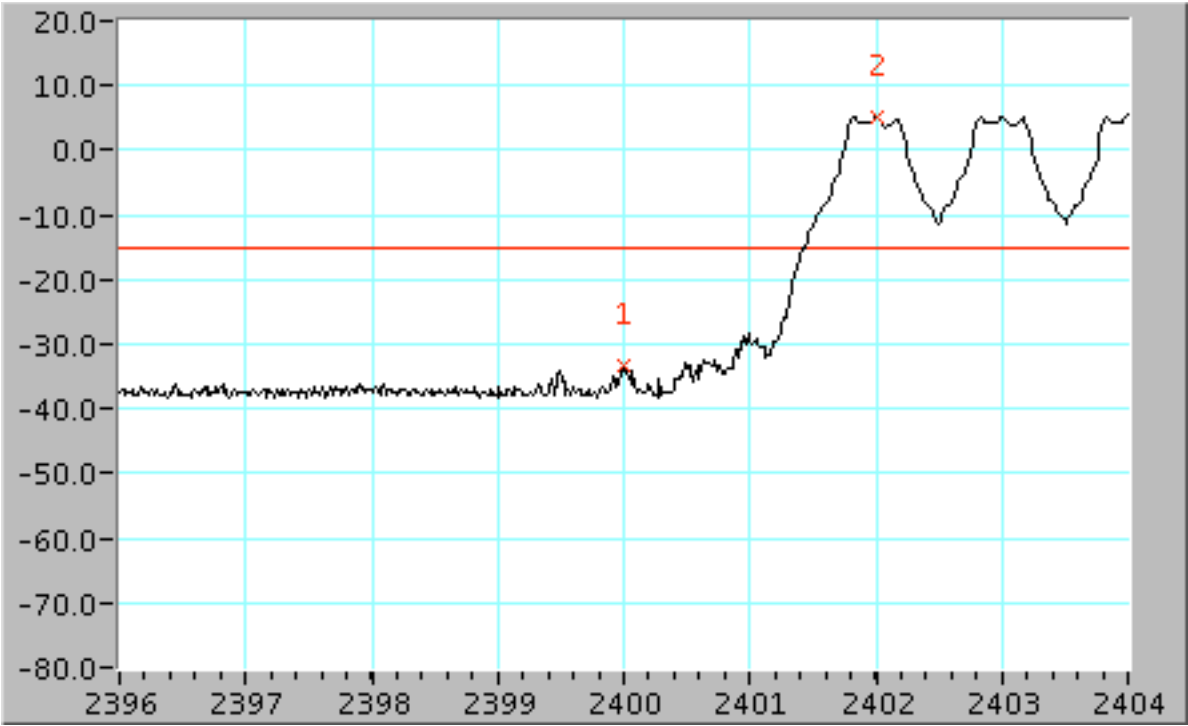
-20 dBc Conducted Spurious Emissions High Channel (2480 MHz)



Frequency - MHz	Level - dBm	Limit - dBm
2480	3.9	N/A
6782.8	-42.3	-16.1

Date of Test: February 24, 2005

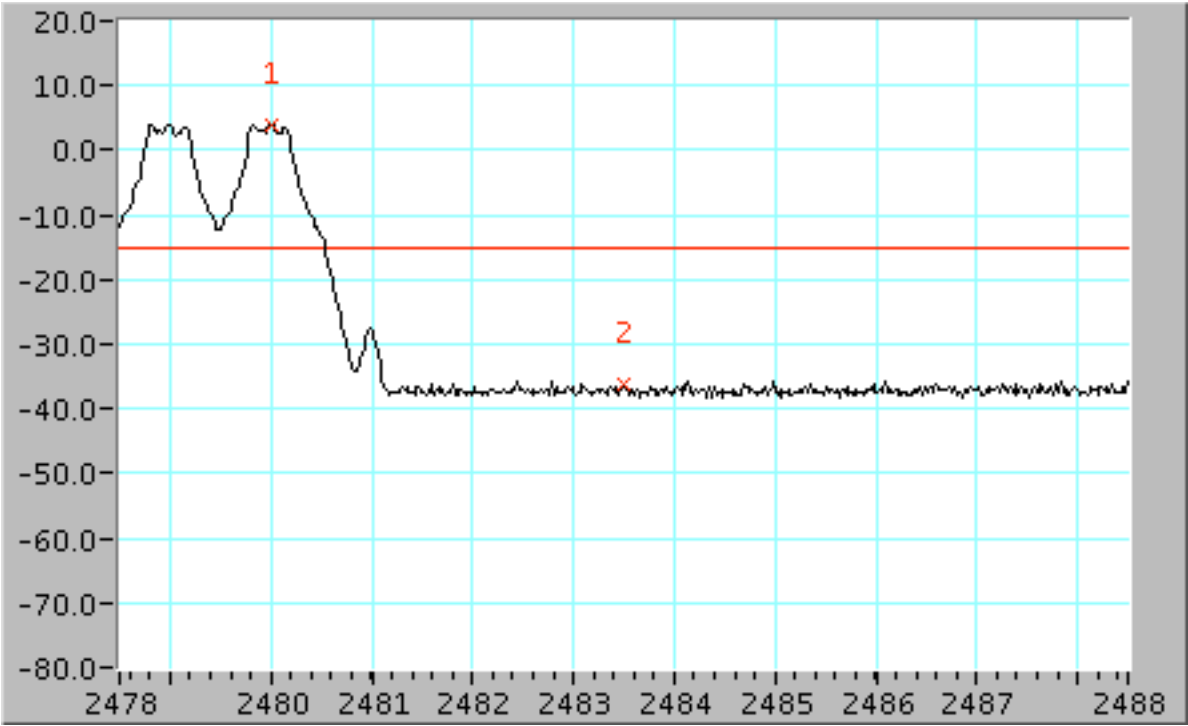
-20 dBc Conducted Spurious Emissions – Hopping Enabled, Lower Bandedge



Frequency - MHz	Level - dBm	Limit - dBm	Delta – dB
2400	-33.5	5 dBm -20 dB = -15 dBm	-18.5

Date of Test: February 24, 2005

-20 dBc Conducted Spurious Emissions – Hopping Enabled, Upper Bandedge



Frequency - MHz	Level - dBm	Limit - dBm	Delta – dB
2483.5	-36.1	3.8 dBm -20 = -16.2 dBm	-19.9

Date of Test: February 24, 2005

7.9 Radiated Emissions

7.9.1 Transmitter Radiated Spurious Emissions

Limits

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

Test Procedure

Emission measurements were performed at the Apple Computer Evelyn 1, semi-anechoic chamber located at 123 East Evelyn Avenue, Mountain View, California. The EUT was placed on a nonmetallic table, 80 cm above the metallic ground-plane. The EUT and peripherals were powered from a filtered main supply.

The frequency spectrum from 30 MHz to 25 GHz was scanned and the emission levels maximized at each frequency. The antenna was varied in height and the system was rotated 360 degrees while scanning for maximum emission amplitudes. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

For Peak Detection measurements below 1 GHz, the RBW is set to 120 kHz and the VBW is set to 300 kHz. For Quasi-Peak detection measurements, 120 kHz bandwidths were used. Peak detection was used unless otherwise noted as Quasi-Peak. For peak measurements above 1 GHz, the RBW is set to 1 MHz and the VBW is set to 1 MHz. For Average measurements the RBW is set to 1 MHz and the VBW is set to 10 Hz. Radiated Emission measurements below 1 GHz were performed at an EUT to antenna distance of 3 meters and measurements above 1 GHz were performed at an EUT to antenna distance of 1 meter.

Radiated emissions measurements were performed with the transmitter set to continuously transmit using the low, mid and highest channel using maximum transmit power.

- low (channel 1) - 2.402 GHz
- mid (channel 40) - 2.441 GHz
- high (channel 80) - 2.480 GHz

Two sets of Radiated Emissions measurements from 30 MHz to 25 GHz were performed using two unique antennas. The module was tested outside of an enclosure when testing with Antenna MODEL 613-5956 and the module was installed in a host system when testing with Antenna A1067.

Test Results

Based on the results of this report, no non-compliance was found.

7.9.2 Transmitter Radiated Spurious Emissions above 1 GHz

Restricted Bands

The adjacent restricted bands at the lower and upper edges of the 2.4 GHz ISM band were scanned for the maximum radiated emissions with the transmitter set to continuously transmit at the corresponding lowest and highest channels.

The actual frequency range of the adjacent restricted bands is from 2310 MHz to 2390 MHz and from 2483.5 MHz to 2500 MHz. However, for testing purposes, the scanned range was extended to allow maximizing on the intentional transmitter emissions.

Restricted Bands Instrument Settings

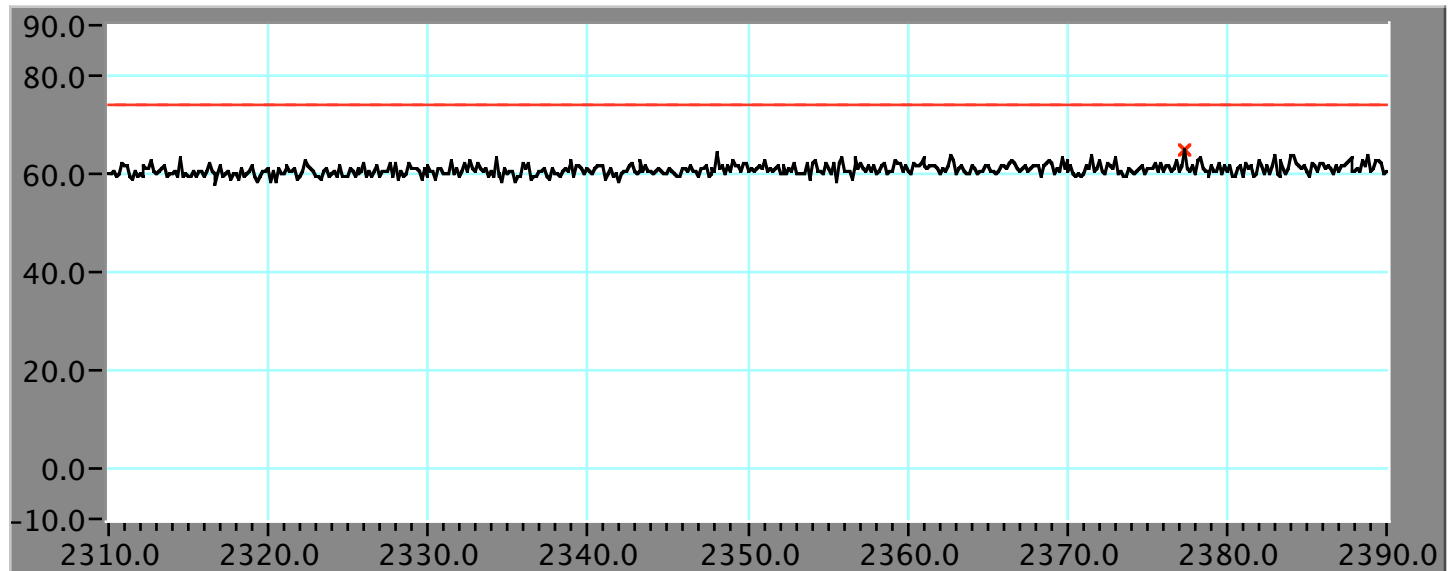
Peak Measurement Instrument Settings

Frequency Range	Reference Level	Attenuation	Resolution BW	Video BW	Sweep Rate
2310-2400 MHz	80 dBuV/m	10 dB	1 MHz	1 MHz	5 mS
2482-2500 MHz	80 dBuV/m	10 dB	1 MHz	1 MHz	5 mS

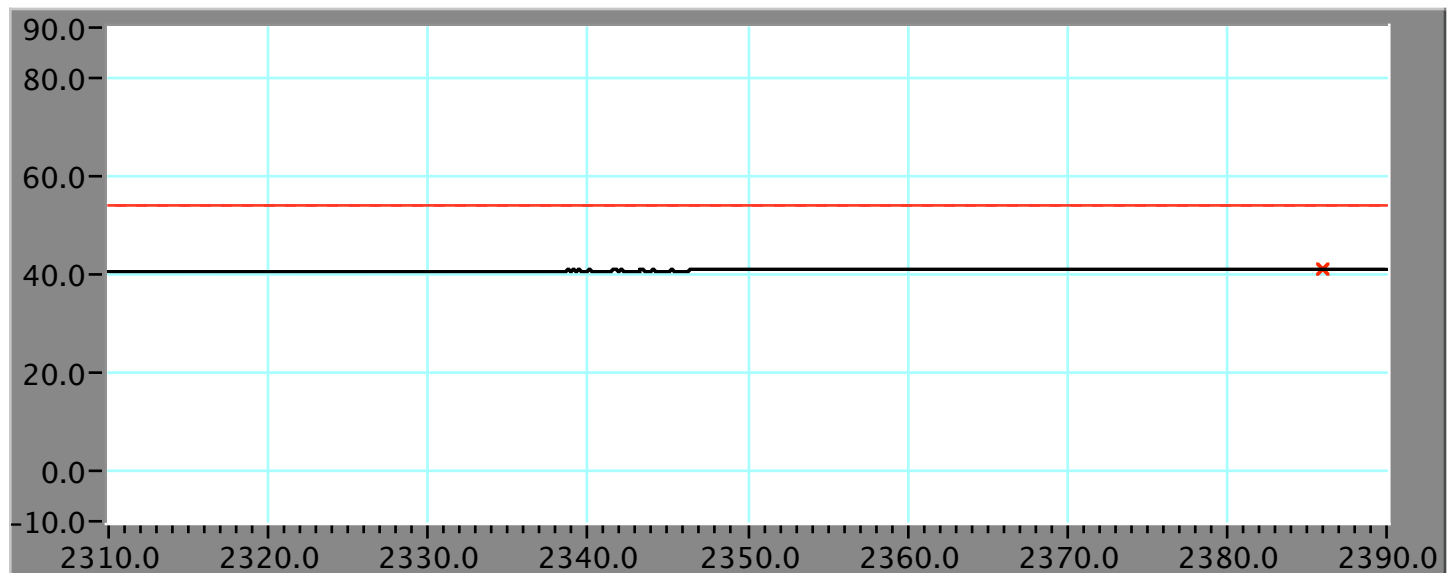
Average Measurement Instrument Settings

Frequency Range	Reference Level	Attenuation	Resolution BW	Video BW	Sweep Rate
2310-2400 MHz	80 dBuV/m	10 dB	1 MHz	10 Hz	22.5 Seconds
2482-2500 MHz	80 dBuV/m	10 dB	1 MHz	10 Hz	6.4 Seconds

2310 MHz - 2390 MHz Restricted Band - Vertical, channel 1 (2.402 GHz), Peak Detection
Antenna Model 613-5956



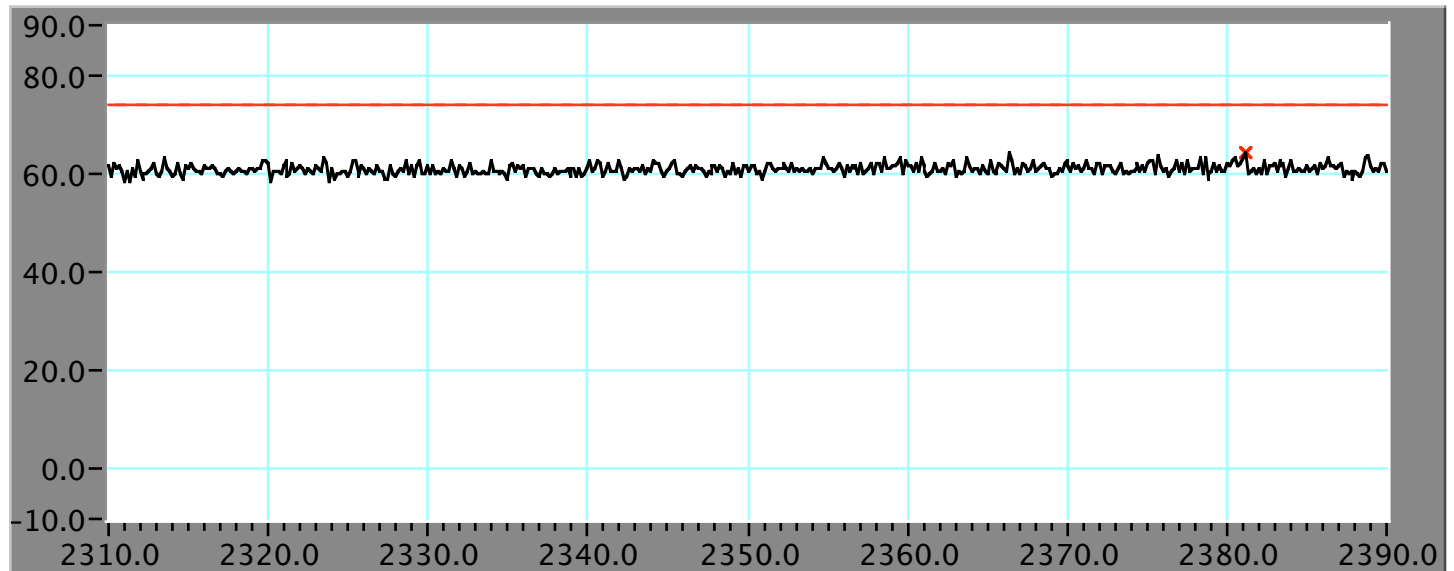
2310 MHz - 2390 MHz Restricted Band - Vertical, channel 1 (2.402 GHz), Average Detection
Antenna Model 613-5956



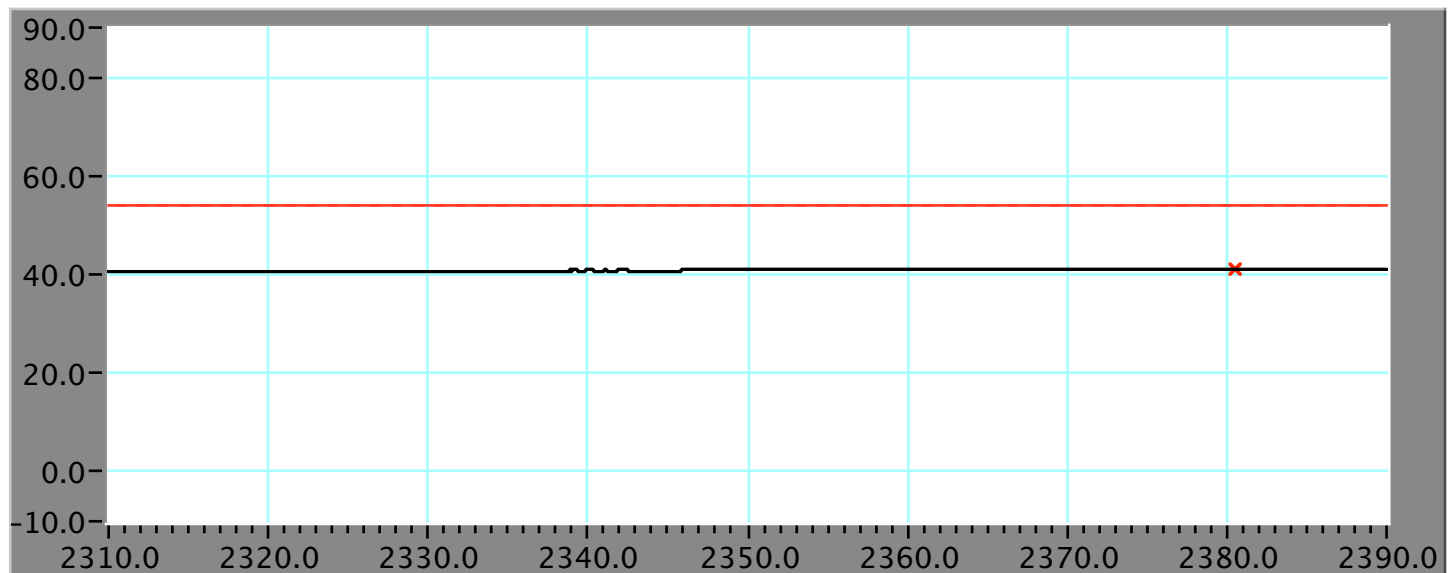
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2377	64.6	74	-9.4	37.52	32.28	4.29	9.5
2386	41.2	54	-12.8	14.10	33.29	4.30	9.5

Date of Test: February 24, 2005

2310 MHz - 2390 MHz Restricted Band - Horizontal, channel 1 (2.402 GHz), Peak Detection
Antenna Model 613-5956



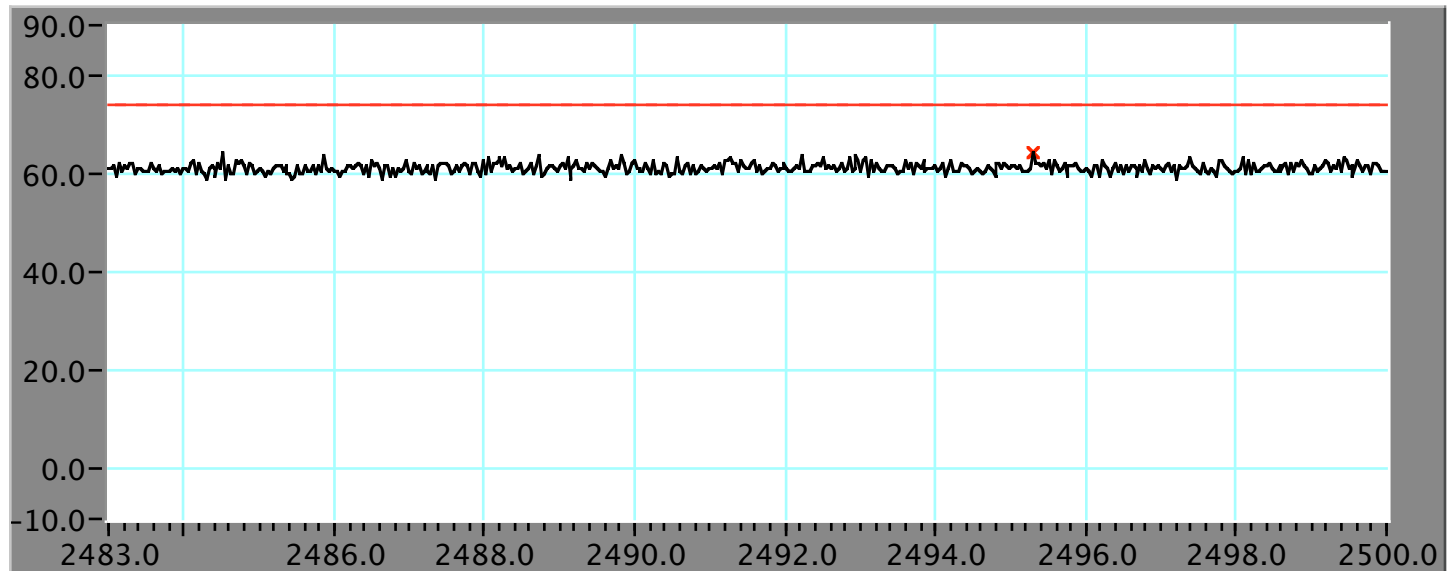
2310 MHz - 2390 MHz Restricted Band - Horizontal, channel 1 (2.402 GHz), Average Detection
Antenna Model 613-5956



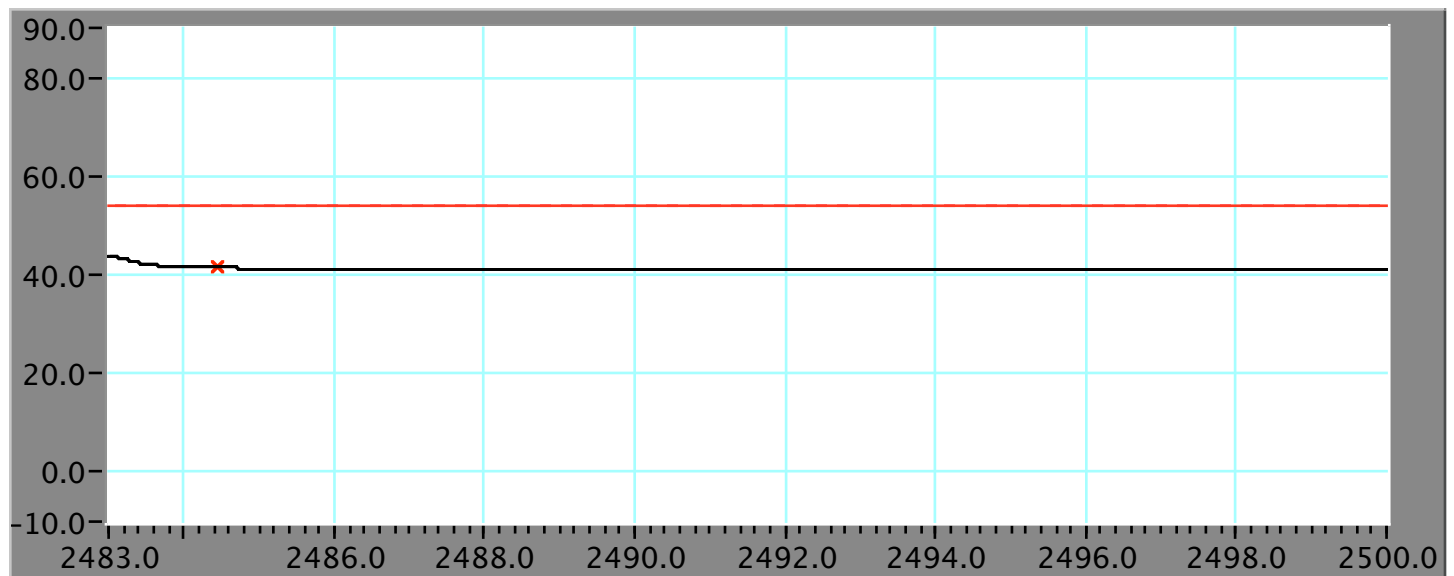
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2381.2	64.2	74	-9.8	37.16	32.28	4.29	9.5
2380.54	41.2	54	-12.8	14.12	32.28	4.29	9.5

Date of Test: February 24, 2005

2483.5 MHz - 2500 MHz Restricted Band - Vertical, channel 79 (2.480 GHz), Peak Detection
Antenna Model 613-5956



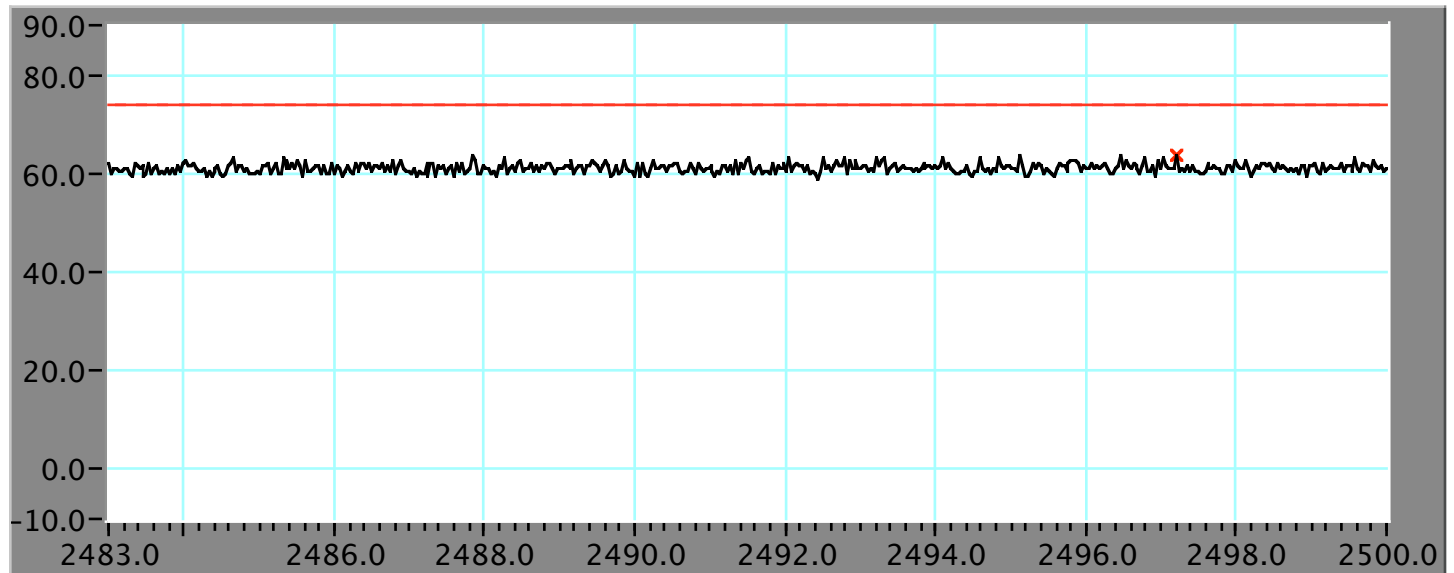
2483.5 MHz - 2500 MHz Restricted Band - Vertical, channel 79 (2.480 GHz), Average Detection
Antenna Model 613-5956



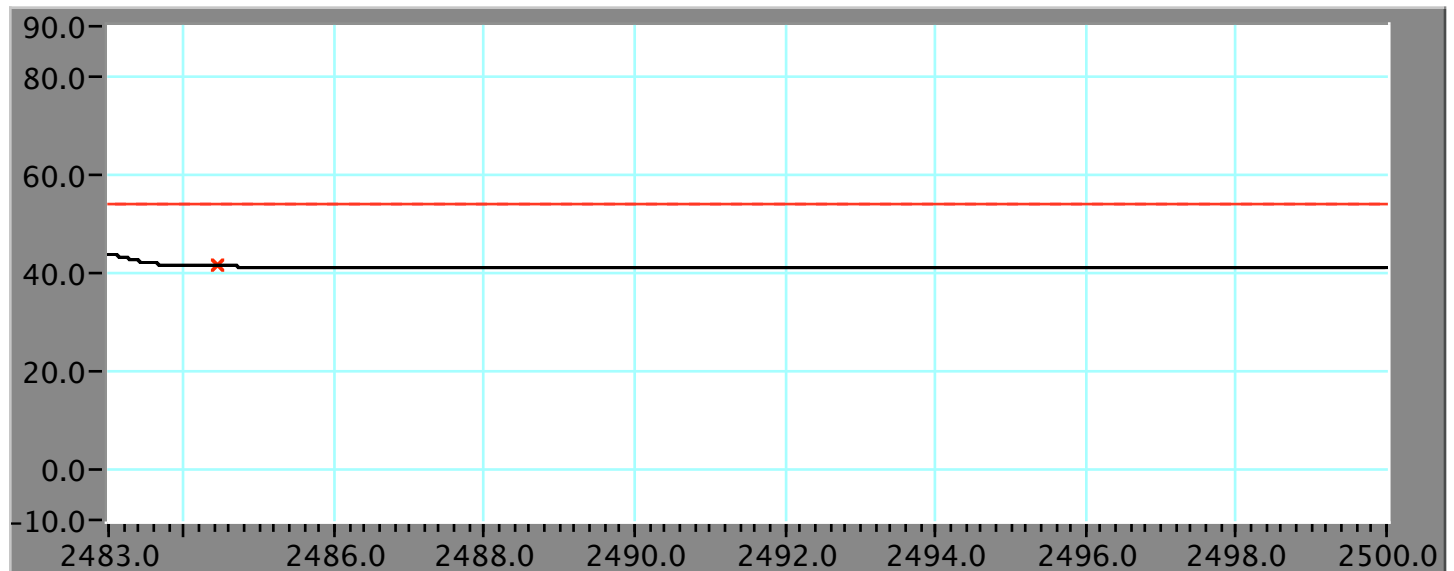
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2495.3	64.3	74	-9.7	36.96	32.4	4.4	9.5
2484.45	41.5	54	-12.5	14.18	32.38	4.4	9.5

Date of Test: February 25, 2005

2483.5 MHz - 2500 MHz Restricted Band - Horizontal, channel 79 (2.480 GHz), Peak Detection
Antenna Model 613-5956



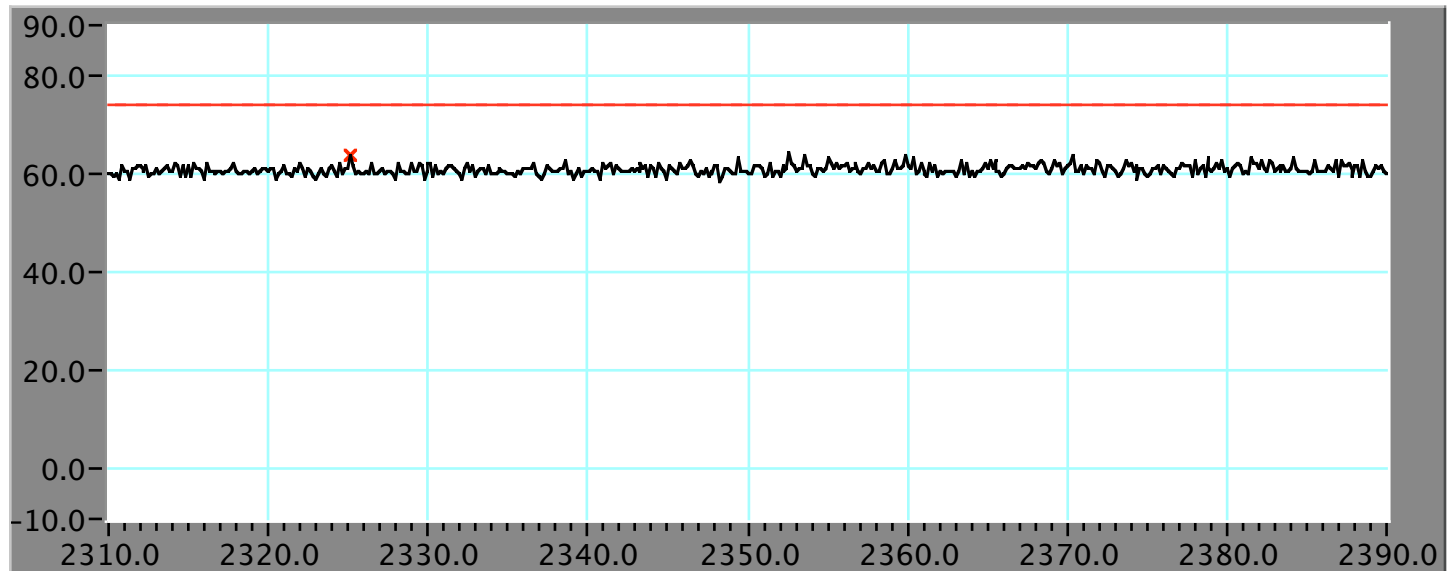
2483.5 MHz - 2500 MHz Restricted Band - Horizontal, channel 79 (2.480 GHz), Average Detection
Antenna Model 613-5956



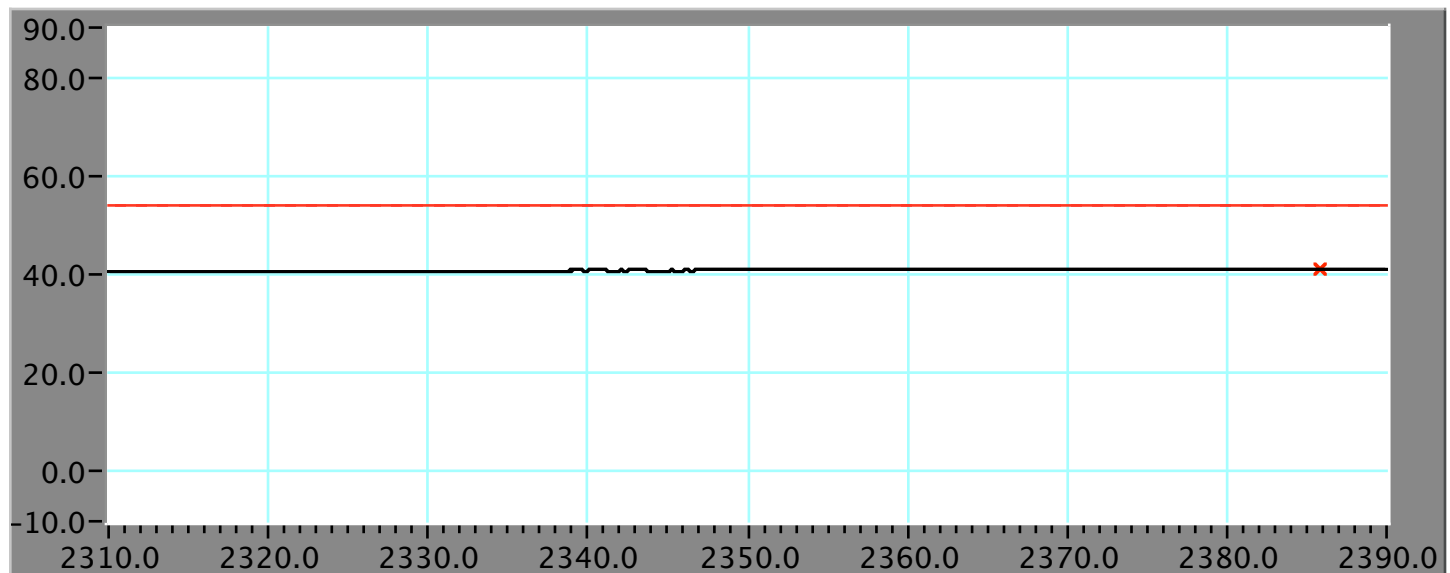
Frequency MHz	Level dBuV/m	Limit dBuV/m	Delta dB	Raw Data dBuV	Antenna dB	Cable dB	Amp dB
2497.21	63.8	74	-10.2	36.45	32.4	4.41	9.5
2484.46	41.5	54	-12.5	14.18	32.38	4.4	9.5

Date of Test: February 25, 2005

2310 MHz - 2390 MHz Restricted Band - Vertical, channel 1 (2.402 GHz), Peak Detection
Antenna Model A1067



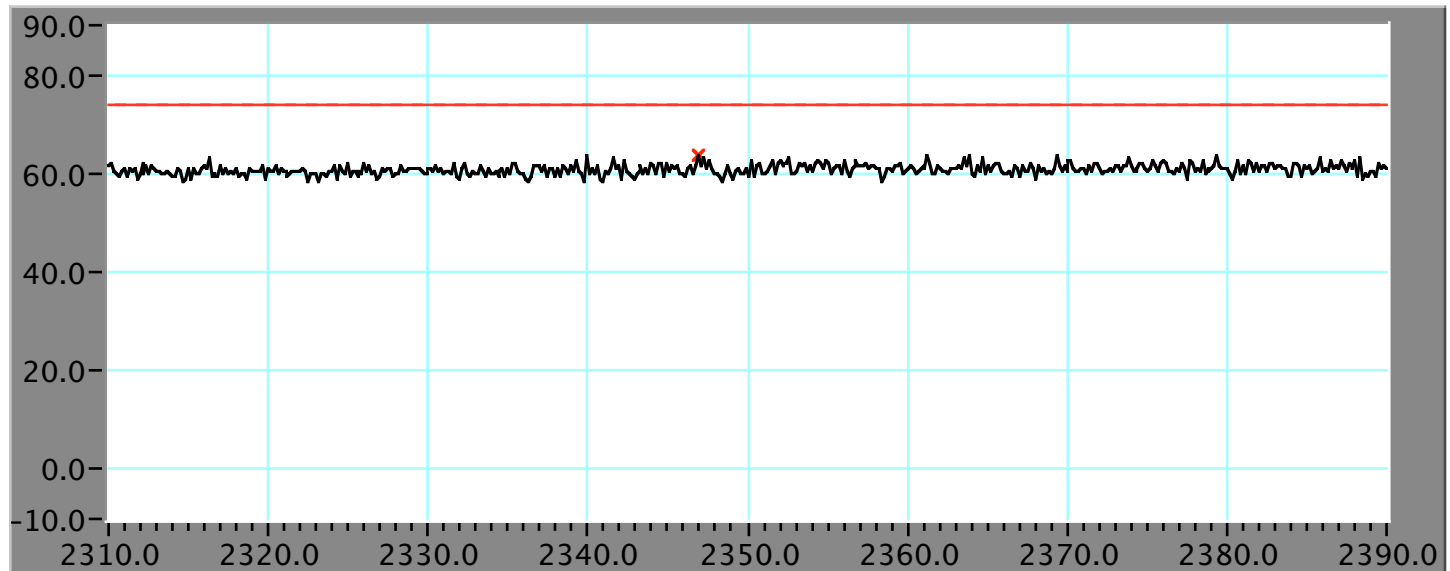
2310 MHz - 2390 MHz Restricted Band - Vertical, channel 1 (2.402 GHz), Average Detection
Antenna Model A1067



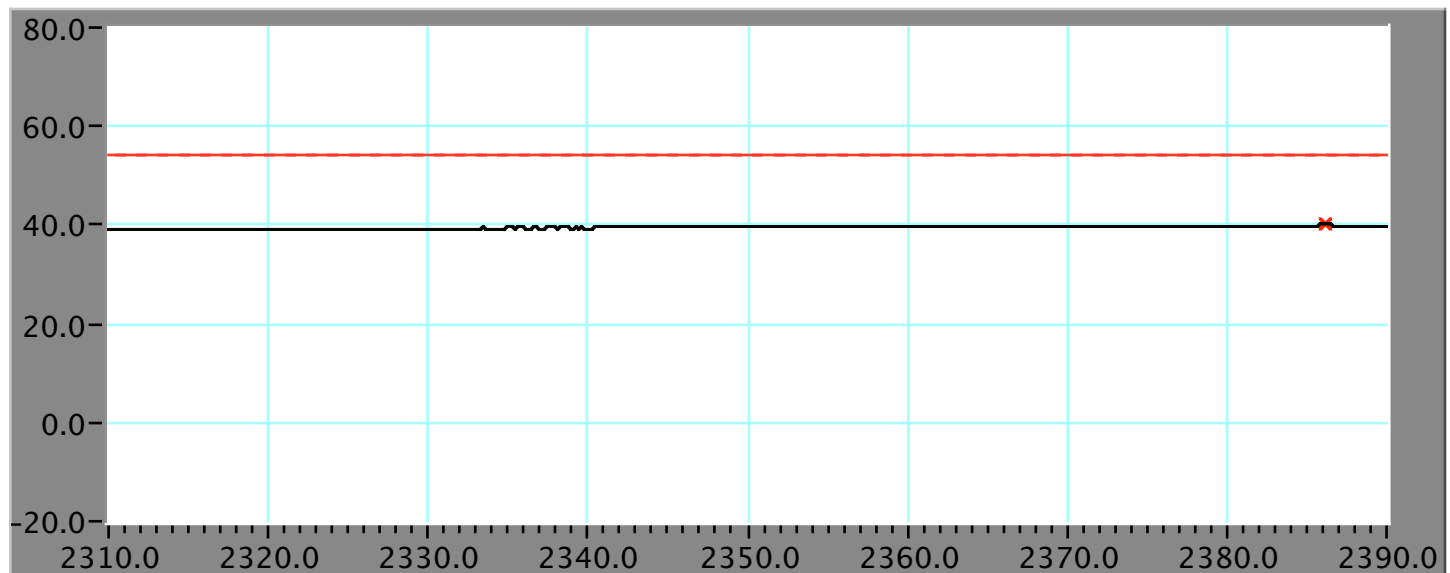
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2325.1	63.5	74	-10.5	36.54	32.23	4.23	9.5
2385.83	41.2	54	-12.8	14.15	32.29	4.3	9.5

Date of Test: February 25, 2005

2310 MHz - 2390 MHz Restricted Band - Horizontal, channel 1 (2.402 GHz), Peak Detection
Antenna Model A1067



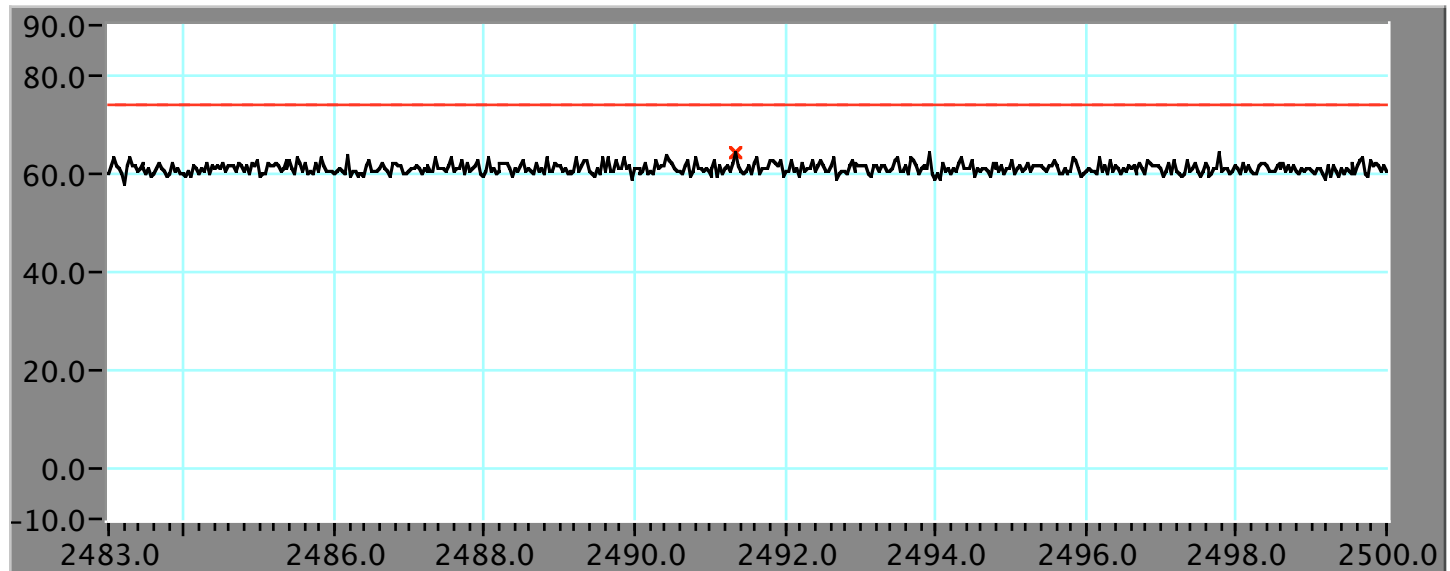
2310 MHz - 2390 MHz Restricted Band - Horizontal, channel 1 (2.402 GHz), Peak Detection
Antenna Model A1067



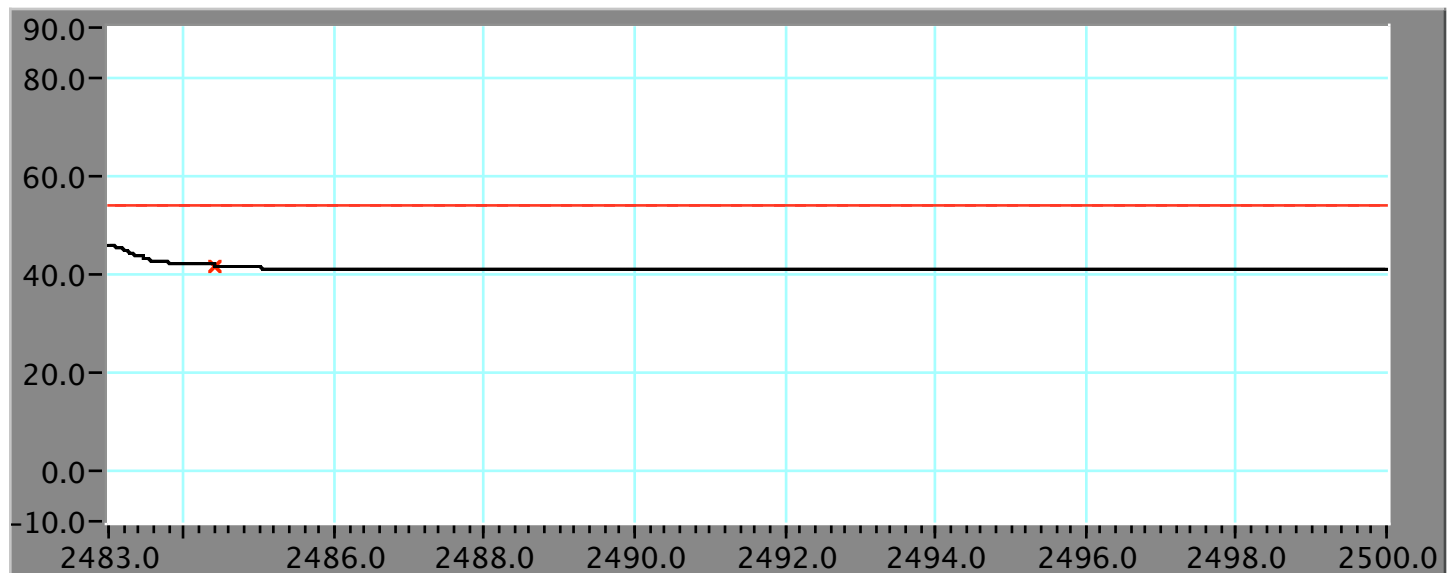
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2346.9	63.9	74	-10.1	36.90	32.25	4.24	9.5
2386.15	40	54	-14.0	13.6	32.29	4.3	9.5

Date of Test: February 25, 2005

2483.5 MHz - 2500 MHz Restricted Band - Vertical, channel 79 (2.480 GHz), Peak Detection
Antenna Model A1067



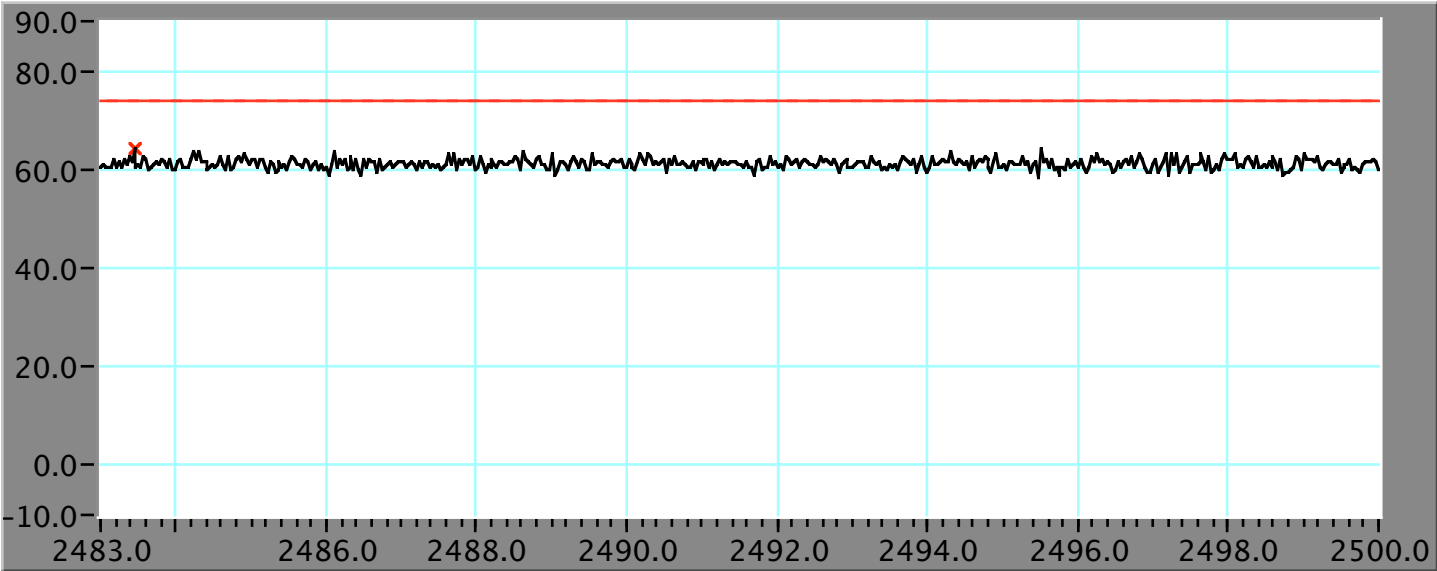
2483.5 MHz - 2500 MHz Restricted Band - Vertical, channel 79 (2.480 GHz), Average Detection
Antenna Model A1067



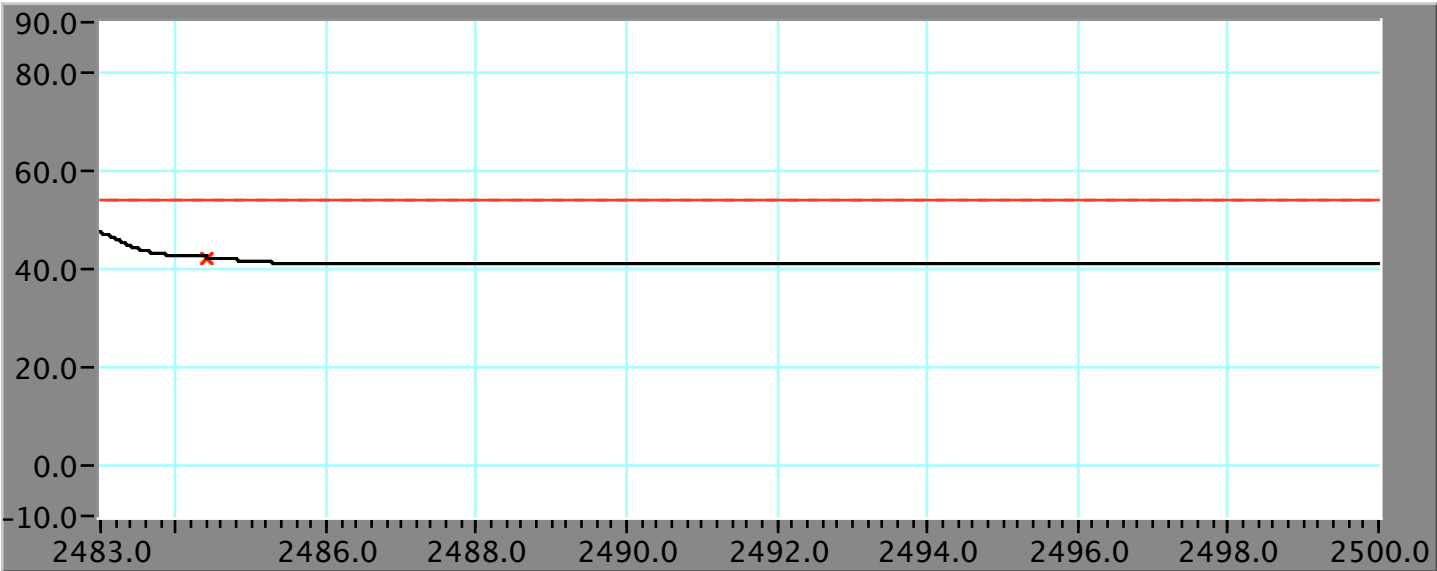
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2491.35	64.3	74	-9.7	36.98	32.39	4.41	9.5
2484.43	41.9	54	-12.1	14.57	32.38	4.4	9.5

Date of Test: February 25, 2005

2483.5 MHz - 2500 MHz Restricted Band - Horizontal, channel 79 (2.480 GHz), Peak Detection
Antenna Model A1067



2483.5 MHz - 2500 MHz Restricted Band - Horizontal, channel 79 (2.480 GHz), Average Detection
Antenna Model A1067



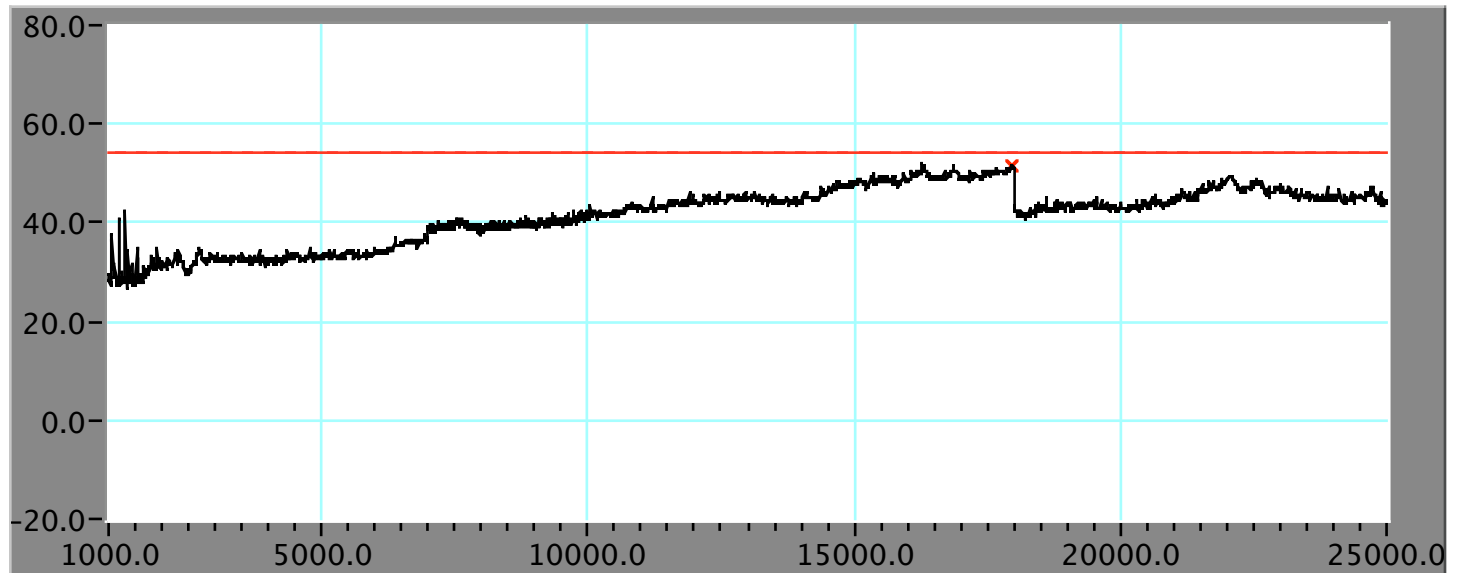
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2491.35	64.3	74	-9.7	36.98	32.39	4.41	9.5
2484.43	42.4	54	-11.6	15.12	32.38	4.4	9.5

Date of Test: February 25, 2005

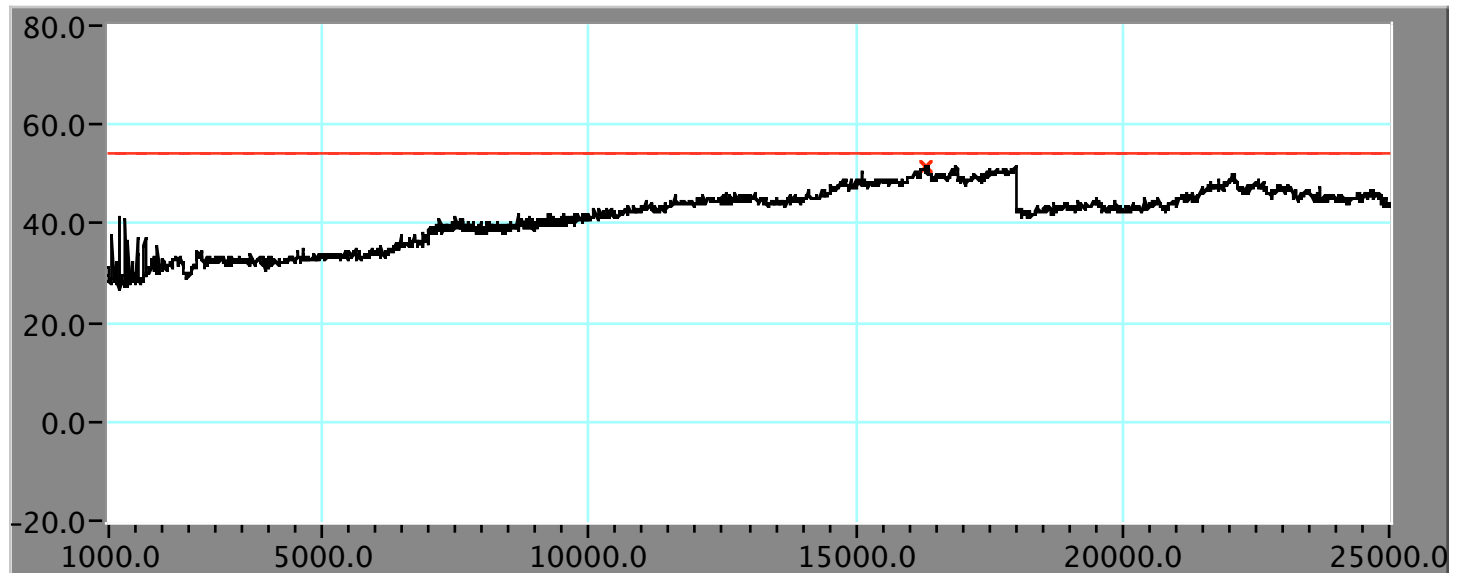
Spurious Radiated Emissions above 1 GHz

Radiated Emissions scans from 1 to 25 GHz for the low, mid and high channels were performed to demonstrate compliance with all of the restricted bands in RSS 210 Section 6.3. Radiated emissions data for two antenna are presented including antenna model A1067 and antenna model 613-5956.

Vertical, channel 1 (2.402 GHz)
Antenna Model 613-5956



Horizontal, channel 1 (2.402 GHz)
Antenna Model 613-5956

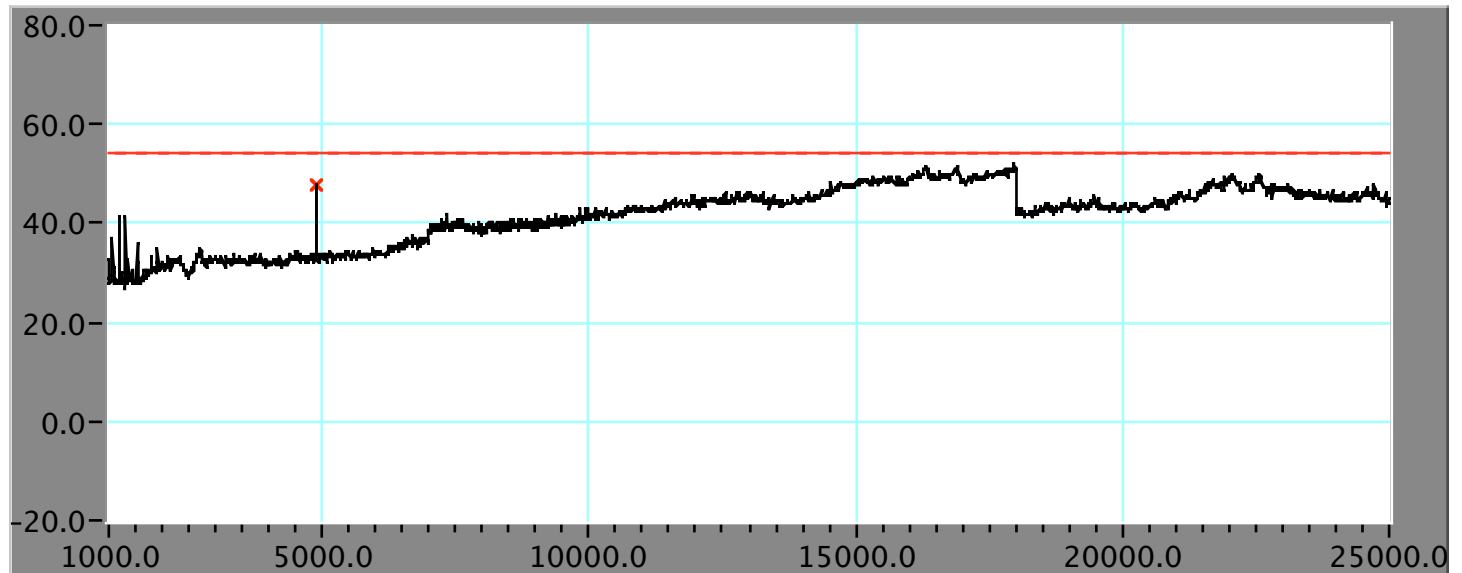


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
17,984	51.6 V	54	-2.4	39.3	41.92	14.92	44.55
16,316	51.7 H	54	-2.3	40.62	41.54	14.6	45.07

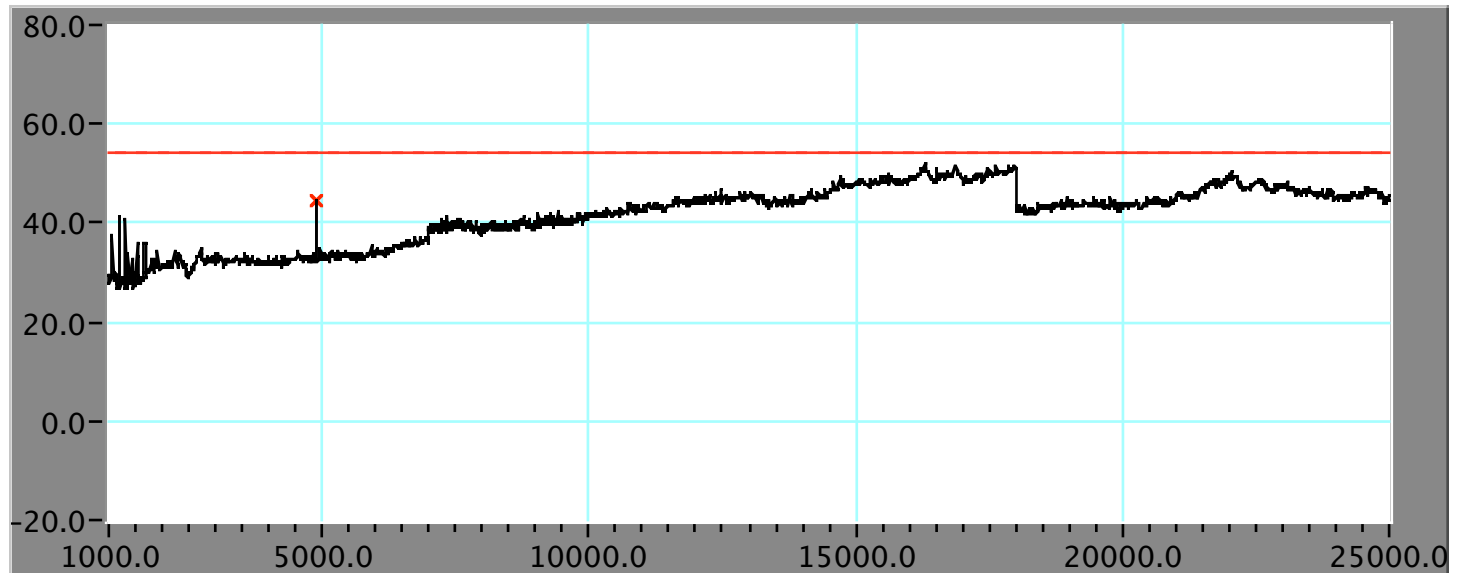
All levels are with a peak detector unless otherwise indicated.

Date of Test: March 1, 2005

Vertical , channel 40 (2.441 GHz)
Antenna Model 613-5956



Horizontal , channel 41 (2.442 GHz)
Antenna Model 613-5956

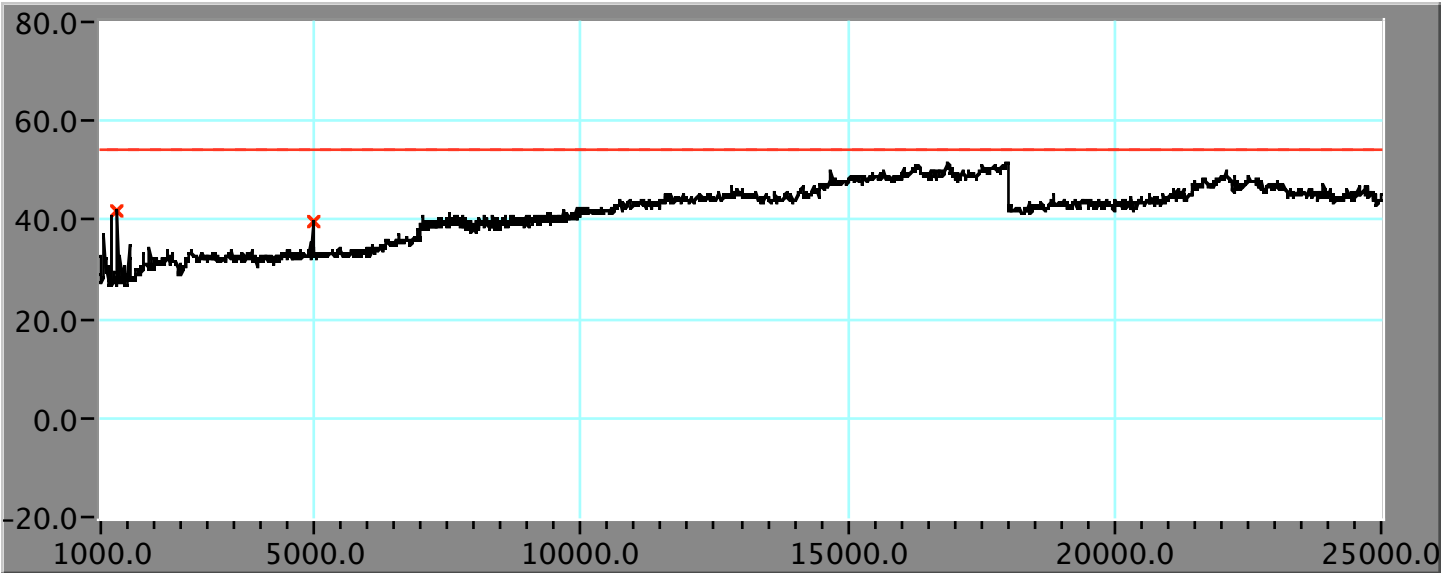


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
4882	47.7 V	54	-6.3	50.47	34.83	6.51	44.12
4882	44.7 H	54	-9.3	47.51	34.83	6.51	44.12

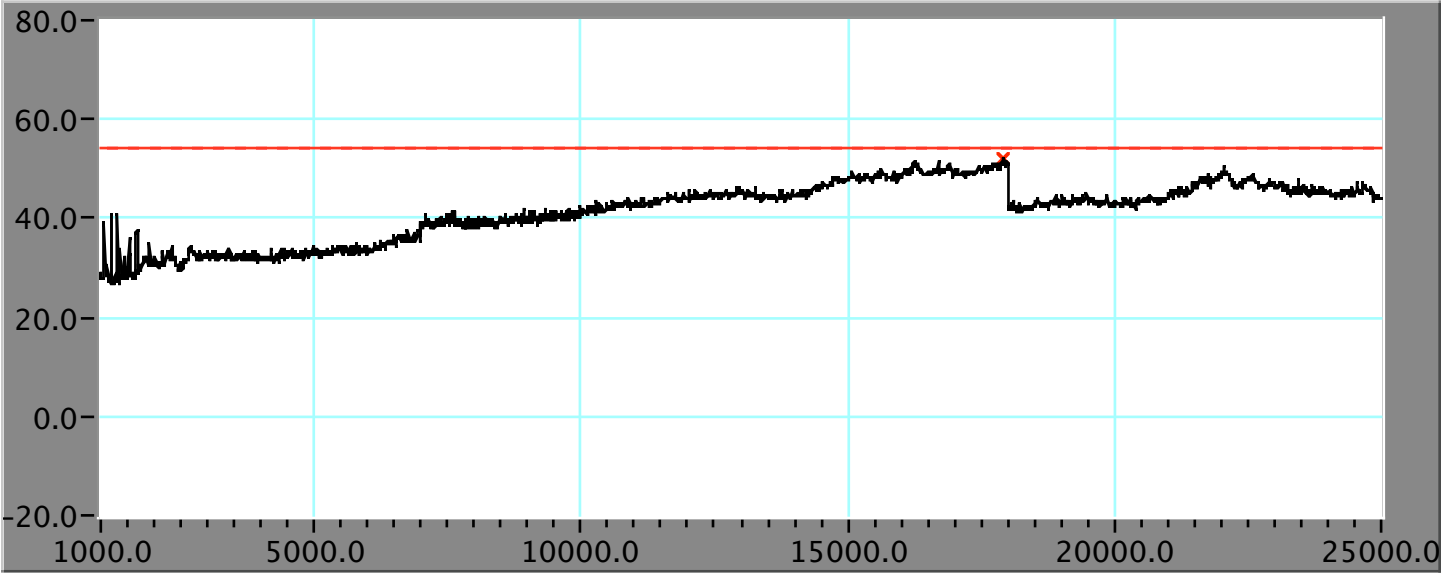
All levels are with a peak detector unless otherwise indicated.

Date of Test: March 1, 2005

Vertical Channel 79 (2.480 GHz) - Antenna Model 613-5956



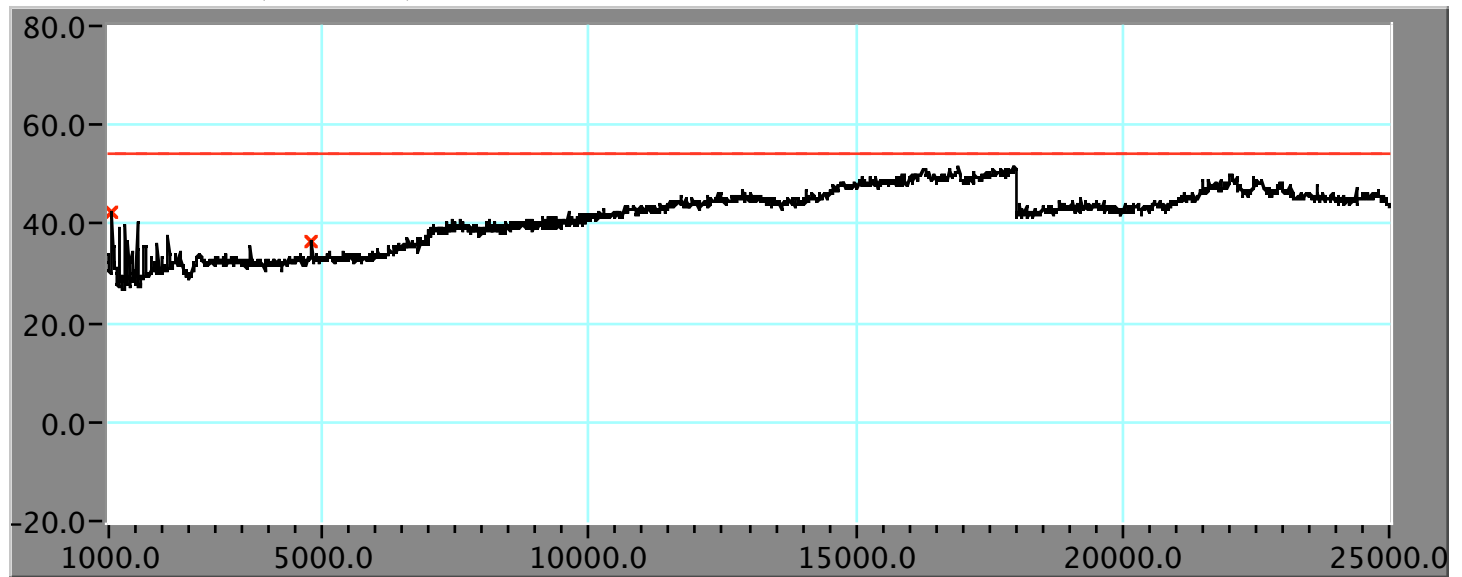
Horizontal Channel 79 (2.480 GHz) - Antenna Model 613-5956



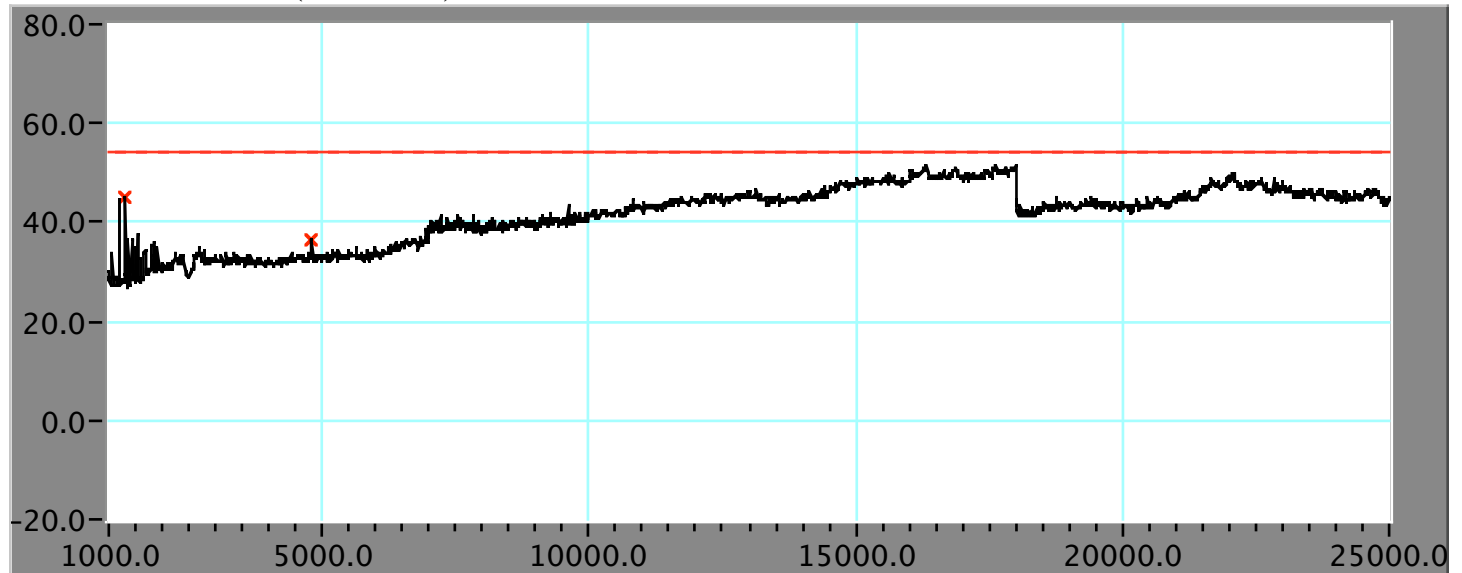
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
1312.6	41.6 V	54	-12.4	54.57	27.84	3.13	43.91
4960	44.7 V	54	-9.3	47.51	34.83	6.51	44.12
17,935.9	52 H	54	-2.0	39.9	41.96	14.64	-12.07

All levels are with a peak detector unless otherwise indicated.
Date of Test: March 1, 2005

Vertical Channel 1 (2.402 GHz) - Antenna Model A1067



Horizontal Channel 1 (2.402 GHz) - Antenna Model A1067

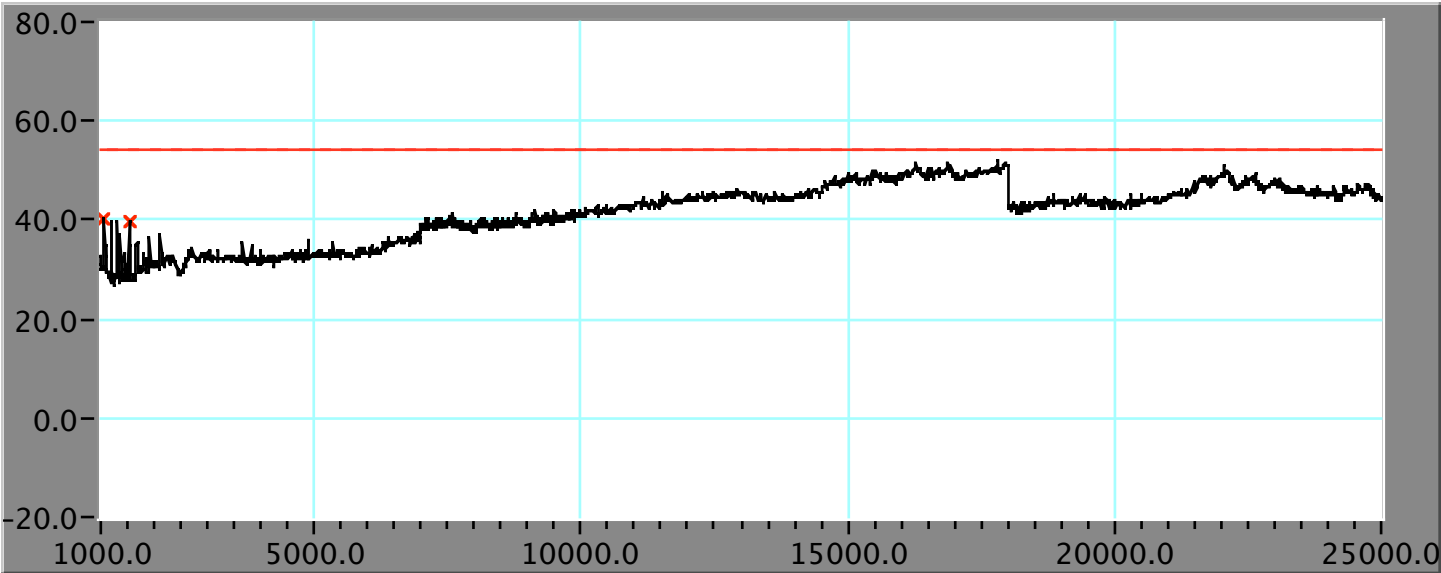


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
1072	42.2 V	54	-11.8	56.36	27.5	2.81	44.44
4804	36.4 V	54	-17.6	39.28	34.79	6.53	44.17
1312.6	45.0 H	54	-9.0	57.93	27.84	3.13	43.91
4808	36.5 H	54	-17.5	39.37	34.79	6.53	44.17

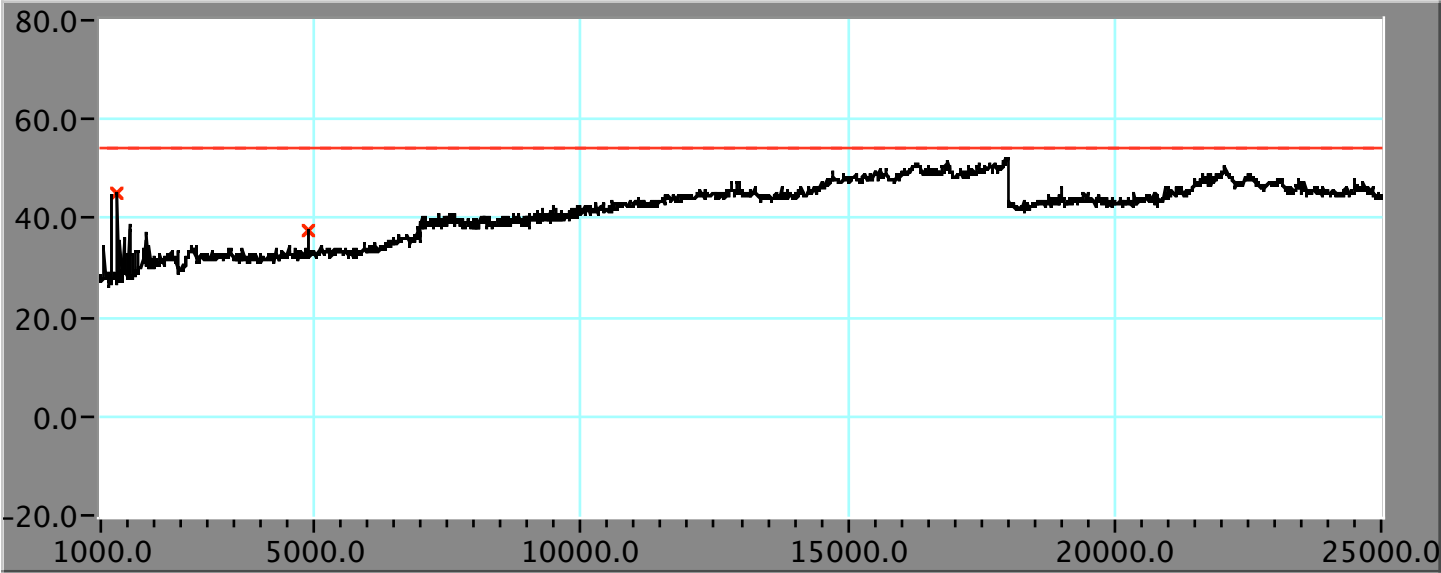
All levels are with a peak detector unless otherwise indicated.

Date of Test: March 1, 2005

Vertical Channel 40 (2.441 GHz) - Antenna Model A1067



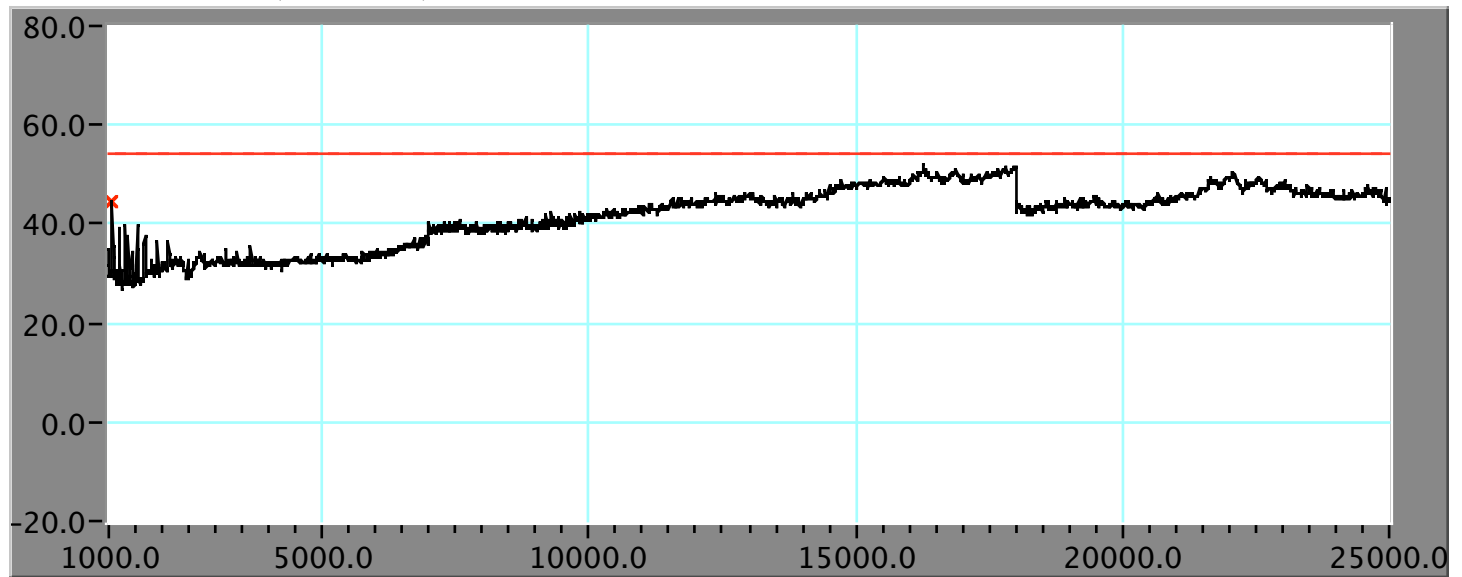
Horizontal Channel 40 (2.441 GHz) - Antenna Model A1067



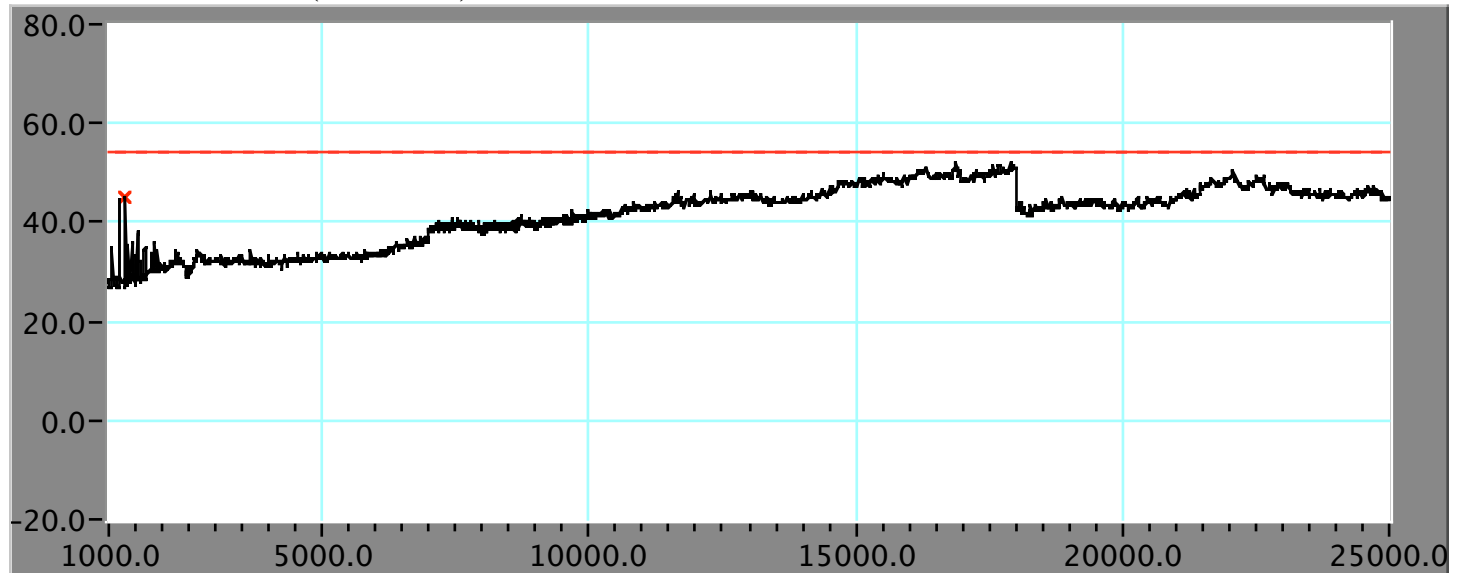
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
1072	40.4 V	54	-13.6	54.57	27.5	2.81	44.44
1529	39.8 V	54	-14.2	51.83	28.32	3.4	43.79
1312.6	45.0 H	54	-9.0	57.95	27.84	3.13	43.91
4882	37.4 H	54	-16.6	40.15	34.83	6.51	44.12

All levels are with a peak detector unless otherwise indicated.
Date of Test: March 1, 2005

Vertical Channel 79 (2.480 GHz) - Antenna Model A1067



Horizontal Channel 79 (2.480 GHz) - Antenna Model A1067

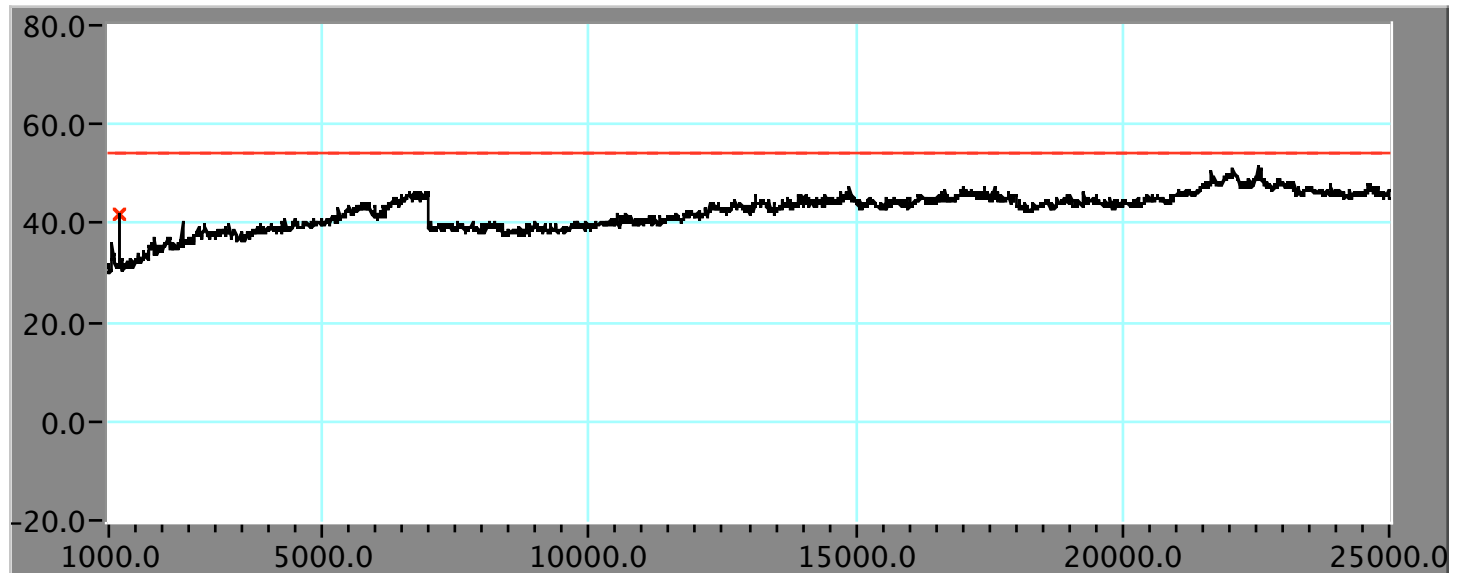


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
1072	44.5 V	54	-9.5	58.57	27.5	2.81	44.44
1312.6	45.0 H	54	-9.0	57.97	27.84	3.13	43.91

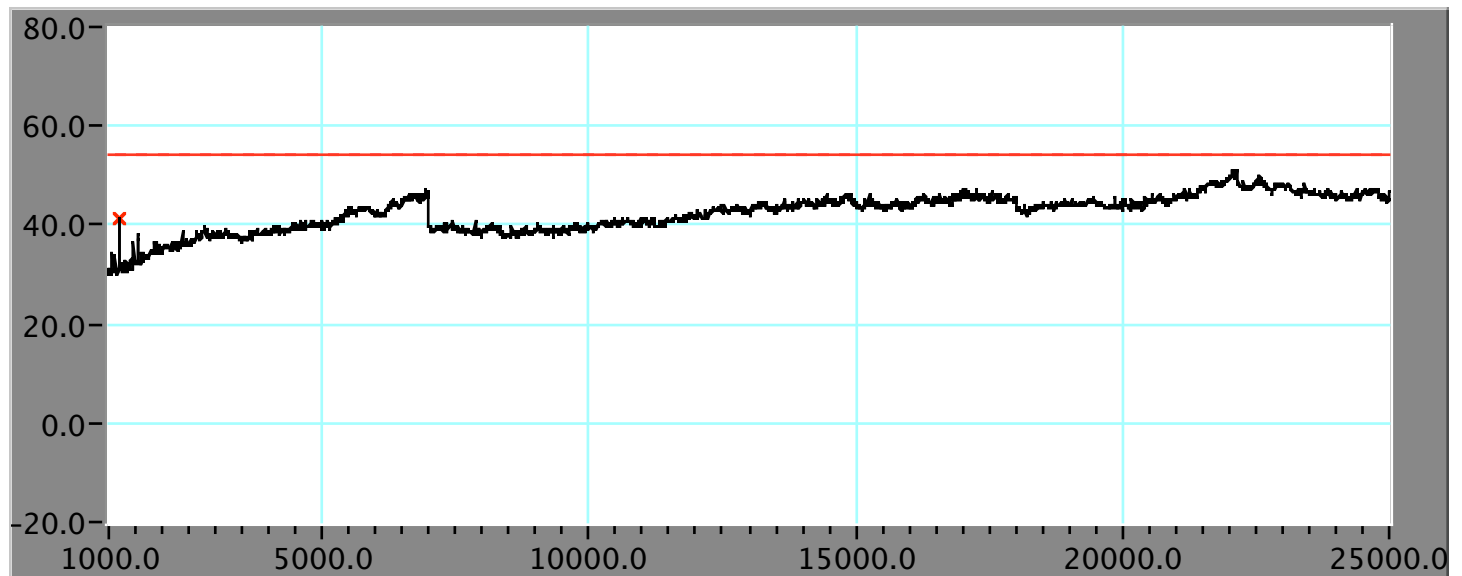
All levels are with a peak detector unless otherwise indicated.

Date of Test: March 1, 2005

Vertical Receive Mode - Antenna Model A1067



Horizontal Receive Mode - Antenna Model A1067

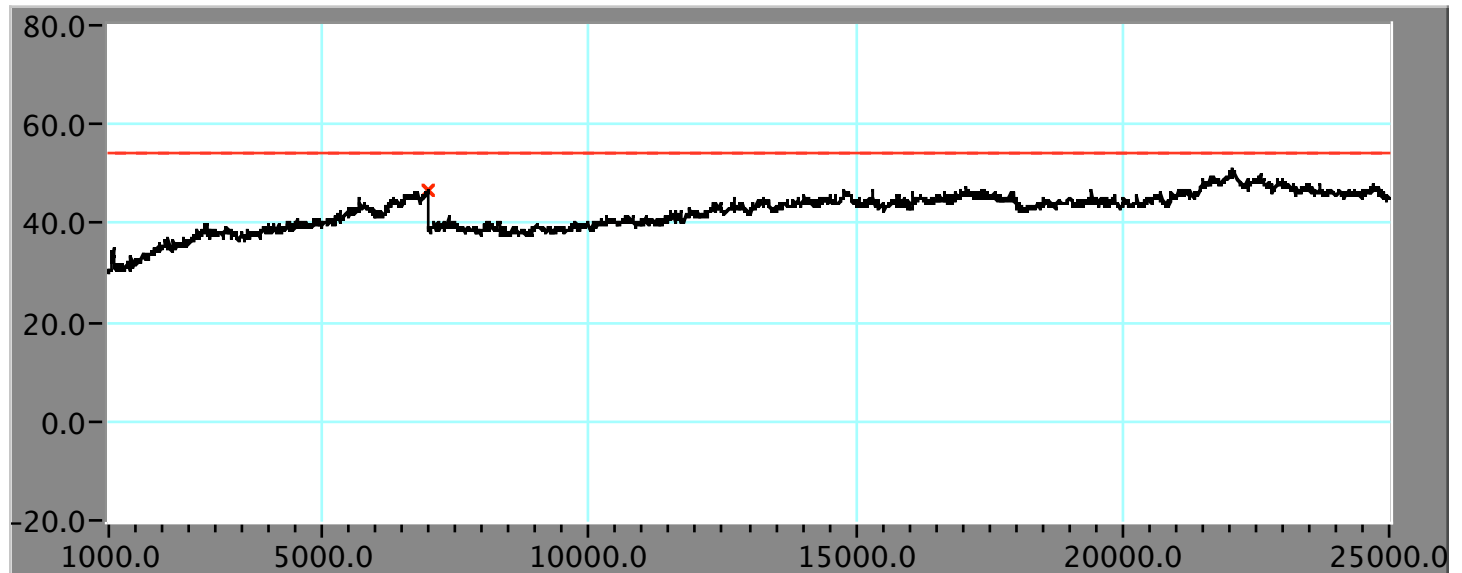


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
1192.4	41.7 V	54	-12.3	57.25	27.67	0.89	44.11
1192.4	41.2 H	54	-12.8	56.7	27.67	0.89	44.11

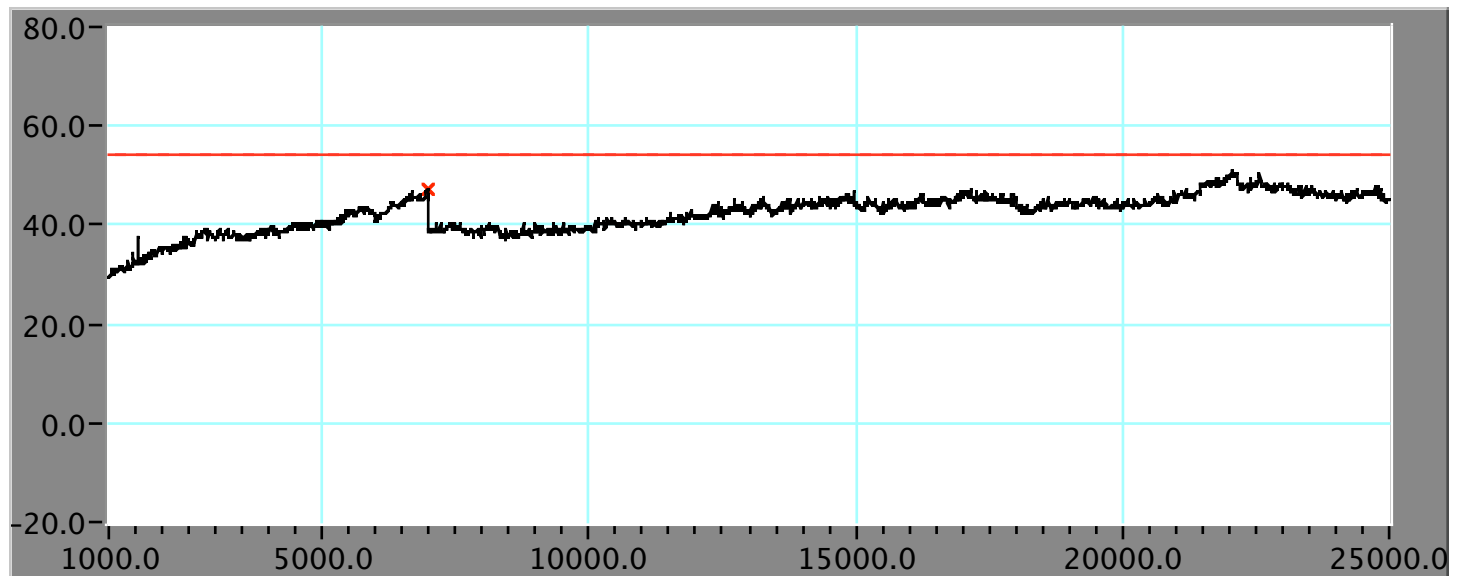
All levels are with a peak detector unless otherwise indicated.

Date of Test: March 4, 2005

Vertical Receive Mode - Antenna Model 613-5956



Horizontal Receive Mode - Antenna Model 613-5956



Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
7000	46.5 V	54	-7.5	50.94	36.2	3.6	44.24
6963.9	47 H	54	-7	51.39	36.19	3.59	44.2

All levels are with a peak detector unless otherwise indicated.

Date of Test: March 4, 2005

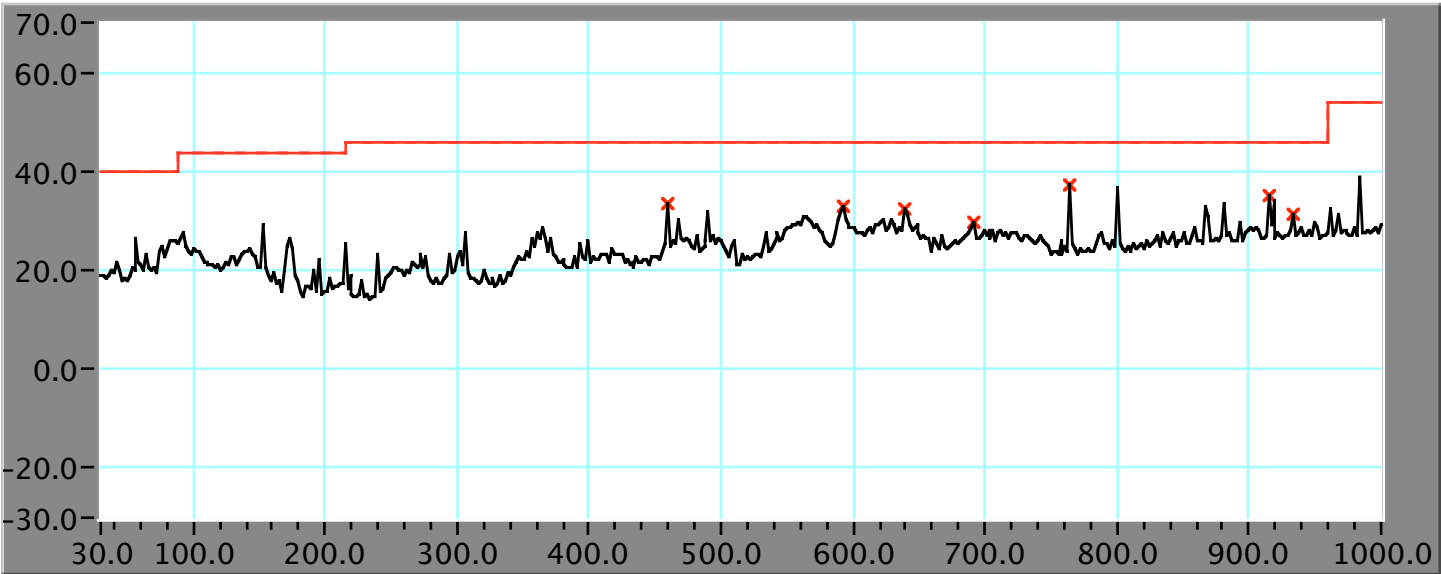
Radiated Emissions less than 1 GHz Instrument Settings:

Instrument Settings				
Frequency Range	Reference Level	Attenuation	Resolution BW	Video BW
30 MHz - 1 GHz	70 dBuV	10	120 kHz	300 kHz

Radiated emissions measurements from 30 MHz - 1 GHz were performed with the transmitter set to low, mid and high channels. Two antennas were tested including antenna model A1067 and antenna model 613-5956. In each of these cases, the results were similar. Only the data from the scans with channel 1 transmitting is presented with each of the two antennas.

Radiated Emissions less than 1 GHz

Channel 1 (2402 MHz) Vertical - Antenna Model 613-5956

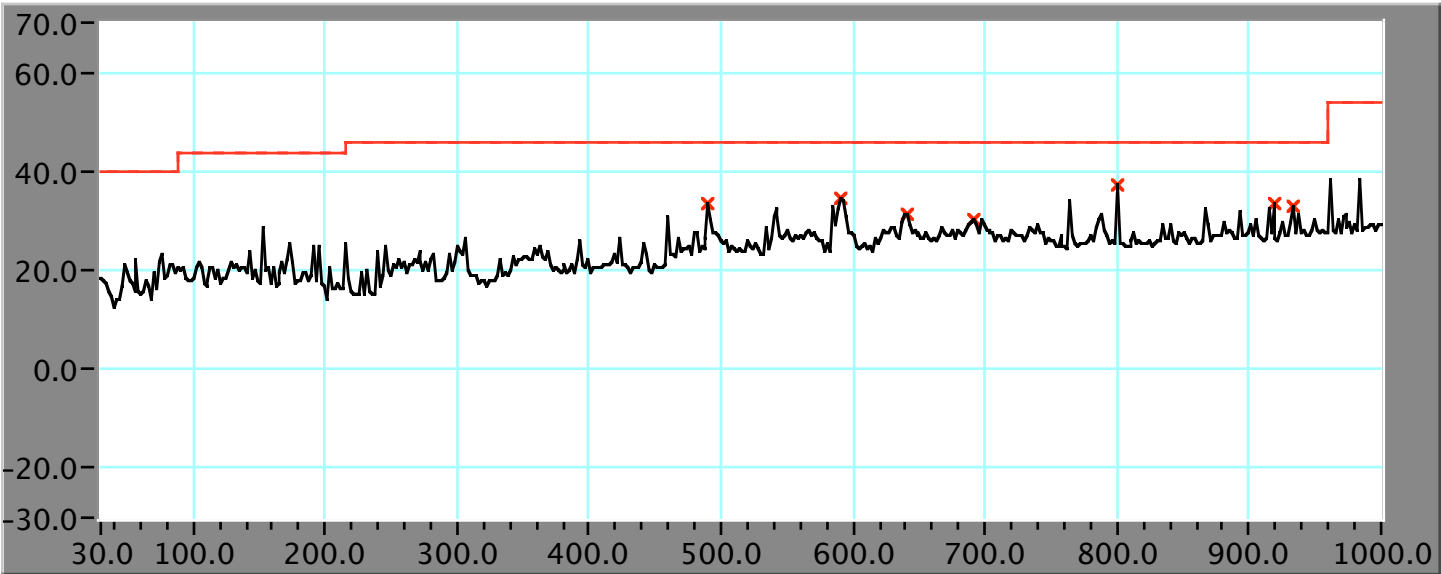


Frequency MHz	Level dBuV	Limit dBuV	Delta dB	Raw Data dBuV	Antenna dB	Cable dB	Amp dB
459.60	33.3	46.0	-12.7	45.79	17.20	2.98	32.67
591.78	33.0	46.0	-13.0	43.84	18.87	3.45	33.15
638.44	32.4	46.0	-13.6	41.91	19.70	3.66	32.91
690.92	29.7	46.0	-16.3	38.94	20.40	3.75	33.36
764.79	37.4	46.0	-8.6	45.80	21.22	4.12	33.71
914.47	35.2	46.0	-10.8	41.02	22.80	4.51	33.11
933.91	31.4	46.0	-14.6	37.07	22.90	4.60	33.17

Date of Test: February 23, 2005

Radiated Emissions less than 1 GHz

Channel 1 (2402 MHz) Horizontal - Antenna Model 613-5956

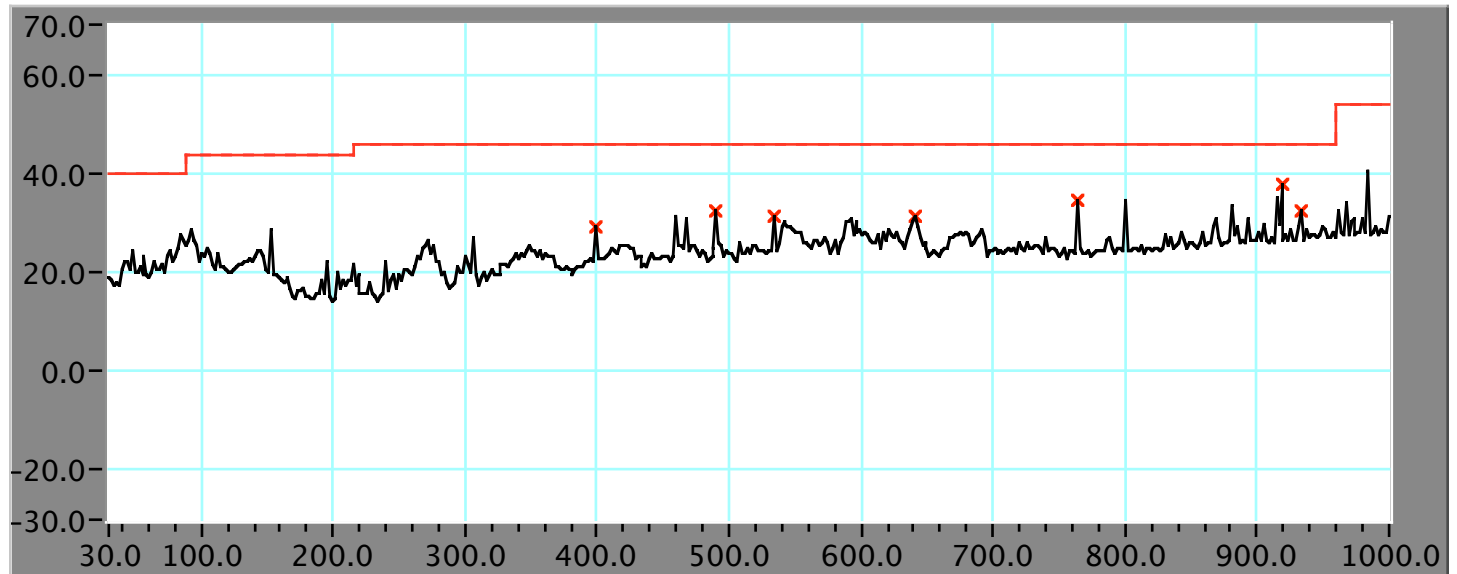


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV	dBuV	dB	dBuV	dB	dB	dB
490.70	33.6	46.0	-12.4	44.79	18.30	3.11	32.64
589.84	34.7	46.0	-11.3	44.60	19.70	3.45	33.01
640.38	31.5	46.0	-14.5	40.82	20.06	3.61	33.02
690.92	30.4	46.0	-15.6	39.40	20.60	3.75	33.36
799.78	37.2	46.0	-8.8	44.47	21.98	4.20	33.49
918.36	33.2	46.0	-12.8	38.62	22.99	4.57	32.95
933.91	33.0	46.0	-13.0	38.35	23.22	4.60	33.17

Date of Test: February 23, 2005

Radiated Emissions less than 1 GHz

Channel 1 (2402 MHz) Vertical - Antenna Model A1067

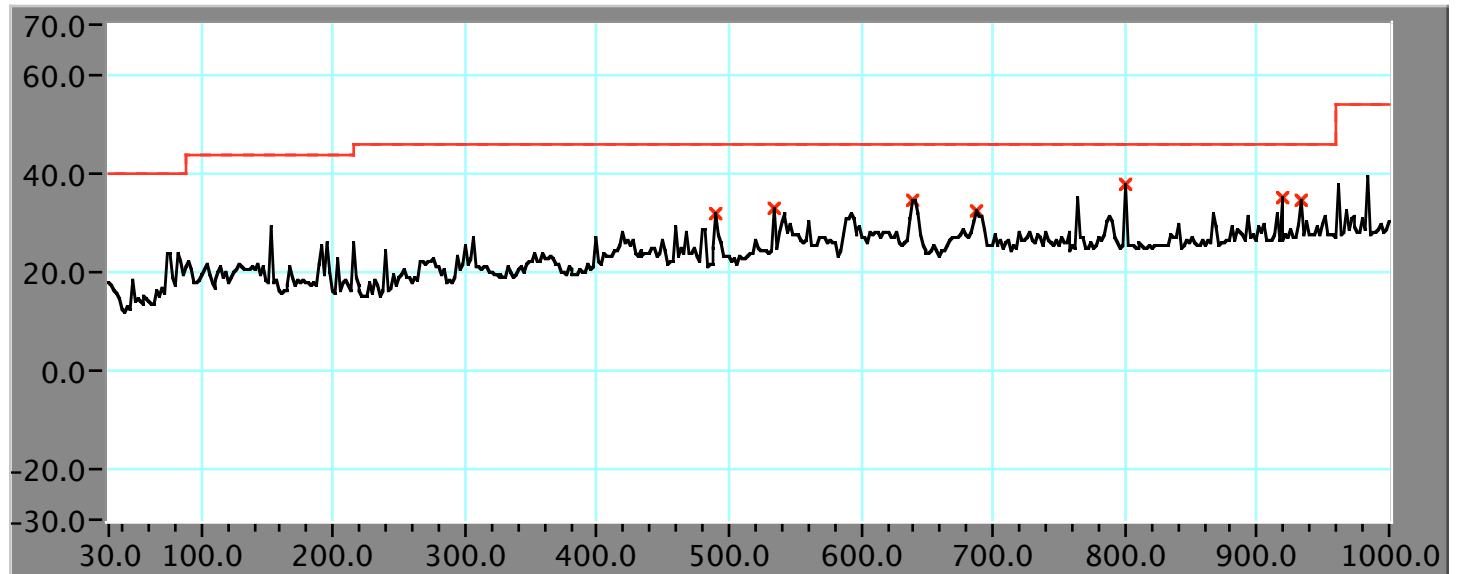


Frequency MHz	Level dBuV/m	Limit dBuV/m	Delta Deg	Raw dBuV	Ant. dB/m	Cable dB	Amp dB
459.60	33.3	46.0	-12.7	45.79	17.20	2.98	32.67
591.78	33.0	46.0	-13.0	43.84	18.87	3.45	33.15
638.44	32.4	46.0	-13.6	41.91	19.70	3.66	32.91
690.92	29.7	46.0	-16.3	38.94	20.40	3.75	33.36
764.79	37.4	46.0	-8.6	45.80	21.22	4.12	33.71
914.47	35.2	46.0	-10.8	41.02	22.80	4.51	33.11
933.91	31.4	46.0	-14.6	37.07	22.90	4.60	33.17

Date of Test: February 23, 2005

Radiated Emissions less than 1 GHz

Channel 1 (2402 MHz) Horizontal - Antenna Model A1067



Frequency	Level	Limit	Delta	Raw	Ant.	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	dB	dB
490.70	33.6	46.0	-12.4	44.79	18.30	3.11	32.64
589.84	34.7	46.0	-11.3	44.60	19.70	3.45	33.01
640.38	31.5	46.0	-14.5	40.82	20.06	3.61	33.02
690.92	30.4	46.0	-15.6	39.40	20.60	3.75	33.36
799.78	37.2	46.0	-8.8	44.47	21.98	4.20	33.49
918.36	33.2	46.0	-12.8	38.62	22.99	4.57	32.95
933.91	33.0	46.0	-13.0	38.35	23.22	4.60	33.17

Date of Test: February 23, 2005

7.10 AC Power Line

Limit

The emissions from the ac power line must conform to the limits specified in CFR 15.207(a)

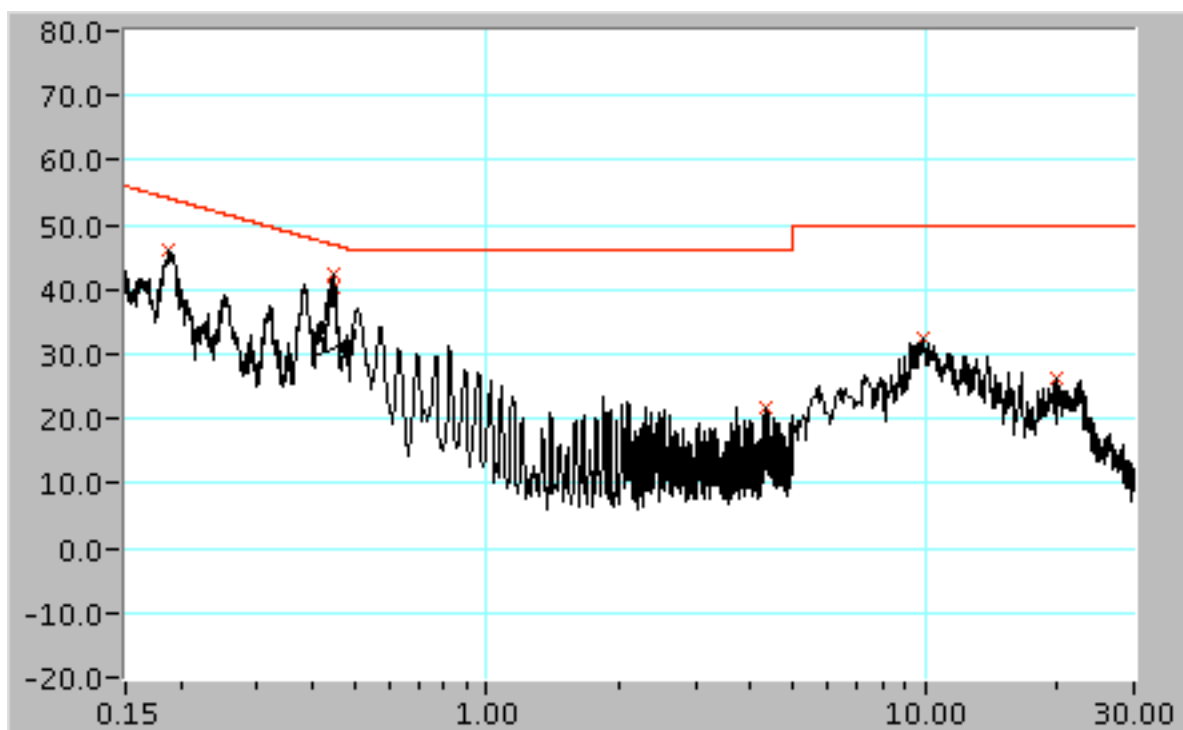
Test Procedure

The EUT is a 3.3 Volt DC device. However, it can be powered from a host system which does have an ac adapter. The power line measurements were performed at the ac power terminals of the host system. The transmitter was set to continuously transmit. Pre-scans were performed with the transmitter set to low, mid and high channels as well as hopping over 79 channels. In each of these cases, no difference in the ac power line conducted emission levels was detected. The data shown is with the transmitter set to continuously transmit on the low channel.

AC Power Line Results

No non-compliance was found.

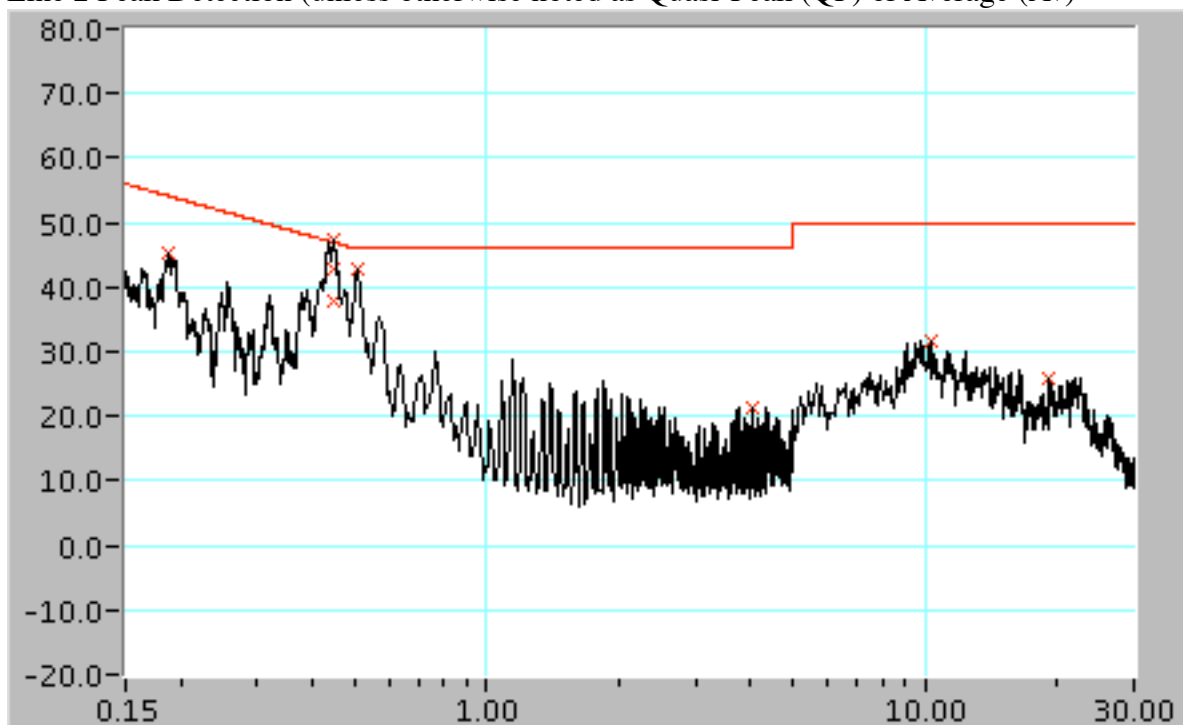
Line 1 – Peak Detection



Frequency MHz	Level dBuV	Limit dBuV	Delta dB	Raw dBuV	LISN dB	Cable dB
0.189	46	54.1	-8.2	44.7	1.18	.08
0.445	42.3	47	-4.6	41.96	0.34	.39
0.446	40.2	46.9	-6.7	39.86	0.34	.05
4.338	21.9	46	-24.1	21.63	0.14	0.17
9.906	32.6	50	-17.4	32.01	0.29	0.26
20.106	26.3	50	-23.7	25.11	0.79	0.38

Date of Test: February 24, 2005

Line 2 Peak Detection (unless otherwise noted as Quasi-Peak (QP) or Average (Av))



Frequency MHz	Level dBuV	Limit dBuV	Delta dB	Raw dBuV	LISN dB	Cable dB
0.188	45.2	54.1	-8.9	43.91	1.24	0.08
0.446	47.2 pk	N/A	N/A	46.84	0.34	0.05
0.446	42.7 QP	57	-14.2	42.34	0.34	0.05
0.446	38.0 Av	47	-9	37.59	0.34	0.05
0.509	42.9 pk	46	-3.1	42.51	0.31	0.05
10.3	31.7	50	-18.3	31.21	0.28	0.24
19.1	26	50	-24	24.96	0.71	0.36

Date of Test: February 24, 2005