



Engineering and Testing for EMC and Safety Compliance

**CERTIFICATION APPLICATION REPORT
FCC PART 15.247 CERTIFICATION & INDUSTRY CANADA CERTIFICATION**

Test Lab: Rhein Tech Laboratories, Inc. 360 Herndon Parkway Suite 1400 Herndon, VA 20170 Contact: ATCBINFO@rheintech.com Phone: 703-689-0368 Fax: 703-689-2056 Web Site: www.rheintech.com		Applicant: Vivato, Inc. 12610 E. Mirabeau Parkway Suite 900 Spokane Valley, WA 99216 Email: jeff_gilbert@vivato.net Contact: Jeff Gilbert Phone: 509-343-6013 Fax: 509-343-6020 Web Site: www.vivato.net	
FCC ID:	QLNVSH24SWP	GRANTEE FRN NUMBER:	0004-3370-93
PLATFORM:	N/A	RTL WORK ORDER #:	2004017
MODEL(S):	VP2200A	RTL QUOTE NUMBER:	QRTL04-063
TEST REPORT DATE:	March, 16 2004		
American National Standard Institute:	ANSI/TIA/EIA603 and ANSI/TIA/EIA 603-1		
FCC Classification:	DSS – Spread Spectrum Transmitter		
FCC Rule Part(s):	Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System		
Industry Canada Standard:	RSS-210: Low Power License-Exempt WLAN Communication Devices (All Frequency Bands)		
Digital Interface Information	Digital Interface was found to be compliant		
Receiver Information	Receiver was found to be compliant		
Frequency Range (MHz)	Conducted Output Power (W)	Frequency Tolerance	Emission Designator
2412-2462	0.288	N/A	N/A

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. Transmit Power was modified as described in Section 2.1 to comply with the current FCC rules. The test results relate only to the item that was tested.

Furthermore, there was no deviation from, additions to, or exclusions from the FCC Part 2, FCC Part 15, Industry Canada RSS-210, ANSI C63.4, ANSI/TIA/EIA603, and ANSI/TIA/EIA 603-1.

Signature: 

Date: March 16, 2004

Typed/Printed Name: Desmond A. Fraser

Position: President

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1. GENERAL INFORMATION

1.1 SCOPE

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum, and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

IC RSS-210 Section 6.2.2(o): Frequency Hopping, Direct Spread Spectrum, and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

A direct sequence (DS) system is a spread spectrum (SS) system in which the carrier has been modulated with the worst-case speed spreading code and an information data stream. The high-speed code sequence dominates the “modulating function” and is the direct cause of the wide spreading of the transmitted signal. OFDM spreads the data to be transmitted over a large number of carriers, typically more than a thousand. The data rate to be conveyed by each of these carriers is correspondingly reduced. It follows that the symbol length is in turn extended. These modulation symbols on each of the carriers are arranged to occur simultaneously.

1.2 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated and conducted data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

1.3 RELATED SUBMITTAL(S)/GRANT(S)

This is an original application for certification for the Vivato, Inc. Model: VP2200A Wi-Fi Switch, FCC ID: QLNVSH24SWP. The IF, LO and up to the 2nd LO of the receiver, when the EUT is configured as a Receiver, were investigated and tested. There is a similar grant for the Vivato, Inc. 2.4 GHz Wi-Fi Switch, FCC ID: QLNVLJ24WFSW.

2. TEST INFORMATION

2.1 TEST JUSTIFICATION

The Vivato VP2200A Wi-Fi Switch's design allows point-to-point packet transmission to client devices through an integrated high gain, electronically steered transmitting antenna. The same antenna also functions as a high gain receiving antenna, allowing the Wi-Fi switch to receive signals from standard 802.11b/g clients, even at long distances or with high signal attenuation.

The Vivato Wi-Fi switch uses a planar array of 8*8 slot antennas. The array is comprised of 8 vertical sub-arrays. Each sub-array is comprised of 8 slots, and each sub-array is fed via a cavity beamforming network.

The EUT contains six 802.11b/g mini-PCI cards with modulated outputs, with eleven channels each as listed below:

- 1 Mbps – 802.11b – BPSK
- 2 Mbps – 802.11b – QPSK
- 5.5 Mbps – 802.11b – CCK
- 11 Mbps – 802.11b – CCK
- 6 Mbps – 802.11g – BPSK
- 9 Mbps – 802.11g – BPSK
- 12 Mbps – 802.11g – QPSK
- 18 Mbps – 802.11g – 16 QAM
- 24 Mbps – 802.11g – 16 QAM
- 36 Mbps – 802.11g – 16 QAM
- 48 Mbps – 802.11g – 64 QAM
- 54 Mbps – 802.11g – 64 QAM

The EUT can simultaneously receive signals from different directions, and transmit to different directions. However, only one signal is transmitted at a given time.

All of the conducted testing was performed on the EUT by connecting a fixture on a test point located on the main RF circuit. The attenuation that resulted in the use of the test fixture was accounted for in all final measurement data.

The EUT's worst-case mode data throughout this report represents the highest power when one WLAN circuit with modulated output is selected. There are six pointing directions numbered 0 through 5 within the 90-degree radiation angle of the EUT. Theoretically, the antenna will have the highest gain and hence the highest power at the broadside pointing direction, perpendicular to the antenna surface. At any other angle, the gain will be lower due to the lower effective aperture. This is supported by measurements of antenna gain for each pointing direction. WLANs 2 and 3 are closest to broadside, so these are the worst case pointing directions. WLAN 2 was found to have the worst-case emissions so this was used for testing purposes as the worst case pointing direction.

As is commonly done for 802.11g devices, two data rates were tested—one for 802.11b and one for 802.11g. The antenna and beamformer in this device are passive broadband devices that do not significantly alter the spectrum of the transmitted signal. All 802.11b data rates use the same channel filter and have the same chip rate. Similarly, all 802.11g data rates use OFDM with the same channel filter and same chip rate. All modulation types were investigated by the client, and the data rates at 1 and 9 Mbps modulation were found to represent the worst-case data rates for 802.11b and 802.11g, respectively.

Channel 1 at 2412 MHz, Channel 6 at 2437 MHz and Channel 11 at 2462 MHz were tested and investigated from 9 kHz to 24 GHz. Data for the three channels and the two modulation types are presented in this report. There is a pending NPRM (FCC 03-223, Sept 17, 2003) that provides for the harmonization of all power measurements to be measurements of average power. For tests in Sections 3 – 7, 9, and 10, the EUT was calibrated to an elevated power setting of 24 dBm average in anticipation of future approval of the NPRM.

However, since the NPRM is not yet approved, this is not the typical operation mode. The typical operation mode will be for power levels of less than 24.6 dBm peak. Power Output testing in Section 8 was performed in the typical operation mode. Since the results of all other tests in Sections 3 – 7, 9, and 10 included no non-conformance for an FCC Part 15.247 device, and since these results would only be improved at the lower power levels of the typical operation mode, these tests were not repeated at the lower power levels.

The power levels for the typical operation mode will be set to meet the existing peak power requirements.

2.2 EXERCISING THE EUT

The EUT was provided with software to continuously transmit during testing, including the enabling of steering modes, data rates and 100% duty. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standards and/or methods.

2.3 TEST RESULT SUMMARY

TABLE 2-1: FCC PART 15.247 DIRECT SEQUENCE SPREAD SPECTRUM TEST RESULT SUMMARY

SECTION	REQUIREMENT	2400-2483.5 MHz	SUMMARY
a) 2)	The minimum 6 dB bandwidth shall be at least 500 kHz.	Applicable	Results in this measurement report
b) 1)	The maximum peak output power shall not exceed 1 W.	Applicable	Conducted measurements
b) 3)	If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power stated in b) 1) shall be reduced by the amount of dB that the gain exceeds 6 dBi. Exceptions from this requirement are listed below in the b) 3) i, ii, iii.	Applicable	Results in this measurement report
b) 3) i)	Systems used exclusively for fixed, point-to-point operations may employ antennas with directional gain of more than 6 dBi. In this case, maximum peak output power of radiator must be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.	Applicable	Professional installation manual attached
b) 3) ii)	In the shown frequency range, systems used exclusively for fixed, point-to-point operations may employ antenna with gain more than 6 dBi without any corrections of transmitter output power.		Not applicable
b) 3) iii)	Exceptions from the b) 3) i and b) 3) ii) shall be made for: - point-to-multipoint systems, - omni directional applications, - multiple co-located intentional radiators. For these systems use requirement listed in Section b) 3).	Applicable	Professional installation manual attached

b) 4)	Systems shall be operated in a manner that ensures that the public is not exposed to RF energy levels more than are permitted via 47CFR paragraph 1.1307 (b) (1), (which refers to paragraph 1.1310).	Applicable	RF Exposure calculation attached
c)	In any 100 kHz bandwidths outside the frequency band in which the radiator is operating (and up to the tenth harmonic of the highest fundamental frequency, or to 40 GHz, whichever is lower – (see Section 15.33), the RF power that is produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency, shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the RF power produced by the radiator. - Attenuation below the general limits specified in 15.209(a) is not required. - Radiated emissions which fall in the restricted band specified in 15.205 (a), must comply with the radiated emission limits of 15.209(a) (up to the tenth harmonic of the highest fundamental frequency, or to 40 GHz, whichever is lower).	Applicable	Results in this measurement report
d)	The peak power spectral density conducted from the radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.	Applicable	Results in this measurement report
e)	The processing gain of this kind of system shall be at least 10 dB. (The processing gain shall be determined from the ratio in dB of the signal to noise ratio with the system spreading code turned off and the signal to noise ratio with the system spreading code turned on, as measured at the demodulated output of the receiver).	Applicable	Not applicable
f)	- Hybrid systems that employ a combination of both direct sequence and frequency hopping modulation techniques shall achieve a processing gain of at least 17 dB from the combined techniques. - The frequency hopping operation of the hybrid system, with the direct sequence operation turned off, shall have an average time of occupancy on any frequency less or equal to 0.4 sec within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. - The frequency hopping operation of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of 15.247.d	Applicable	Not applicable EUT is not a hybrid

TABLE 2-2: TEST RESULT SUMMARY WITH FCC RULES AND REGULATIONS

STANDARD	TEST	PASS/FAIL OR N/A
FCC 15.205	Compliance with the Restricted Band Edge	Pass
FCC 15.207	Conducted Emissions	Pass
FCC 15.209	Radiated Emissions	Pass
FCC 15.247(a)(2)	Modulated Bandwidth	Pass
FCC 15.247(b)	Power Output	Pass
FCC 15.247(c)	Antenna Conducted Spurious Emissions	Pass
FCC 15.247(d)	Power Spectral Density	Pass

2.4 TEST SYSTEM DETAILS

The test sample was received on March 2, 2004. The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system, are shown in Tables 2.3 and 2.4.

TABLE 2-3: EQUIPMENT UNDER TEST (EUT)

PART	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID	CONNECTORS	RTL BAR CODE
WI-FI SWITCH	VIVATO, INC.	VP2200A	N/A	QLNVSH24SWP	ETHERNET PORTS SHIELDED CABLE SERIAL CONTROL PORTS POWER SUPPLY	015715

TABLE 2-4: EXTERNAL COMPONENTS IN TEST CONFIGURATION

PART	MANUFACTURER	MODEL	SERIAL NUMBER	FCC ID	CABLE DESCRIPTION	RTL BAR CODE
POWER SUPPLY	CINCON ELECTRONICS	TR60A-POE-L	000051	DoC	ETHERNET/POWER SUPPLY	015716
PRINTER	HEWLETT PACKARD	C6410A	MY9321B26W	DoC	SERIAL CABLE	12295
USB LOAD	N/A	N/A	N/A	N/A	USB SHIELDED	11726
MOUSE	GATEWAY COMPANIES, INC.	6' FWIRE CABLE	C20003036	N/A	PS2	12224
MONITOR	MAG INNOVISION/MAG TECHNOLOGY INC. (USA)	U5013 (EV500)	HDK2k6003528	IAWU5013	SHIELDED	12406
HUB	US LOGIC	146877-000	22-10292	DoC	UNSHIELDED ETHERNET CABLE	901310
LAPTOP	PANASONIC	TOUGHBOOK	1KKS B13546	DoC	ETHERNET/POWER SUPPLY	13954

2.5 CONFIGURATION OF TESTED SYSTEM

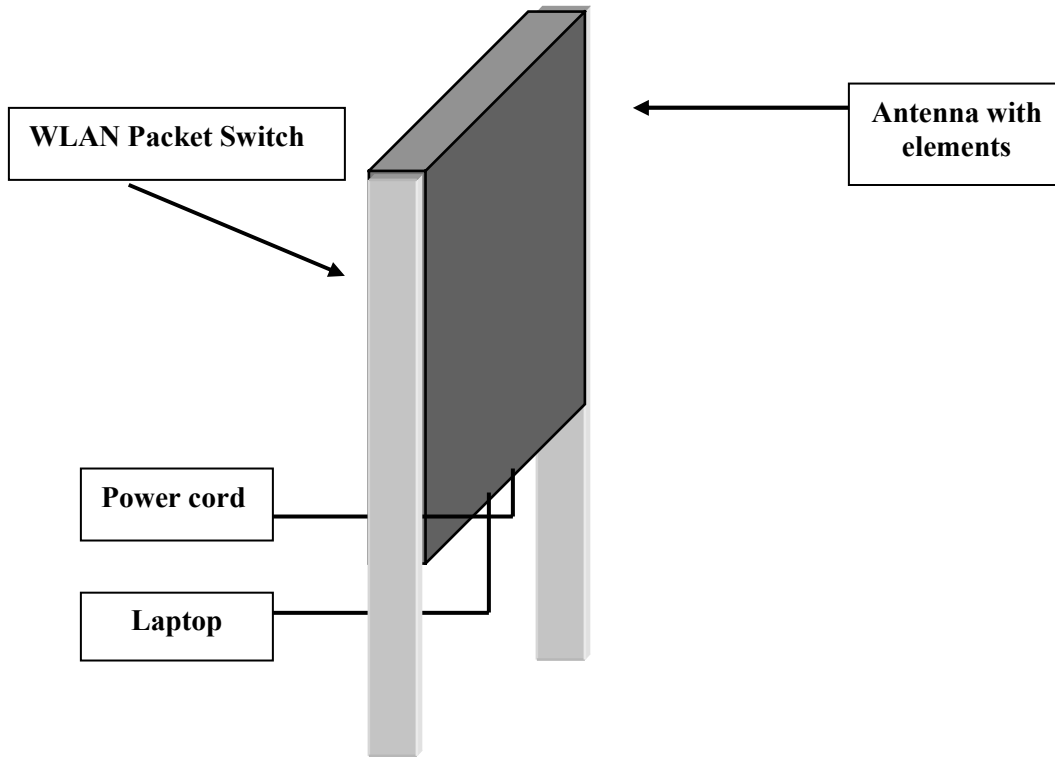


FIGURE 2-5: WORST CASE CONFIGURATION OF SYSTEM UNDER TEST

3. COMPLIANCE WITH THE RESTRICTED BAND EDGE - §15.205

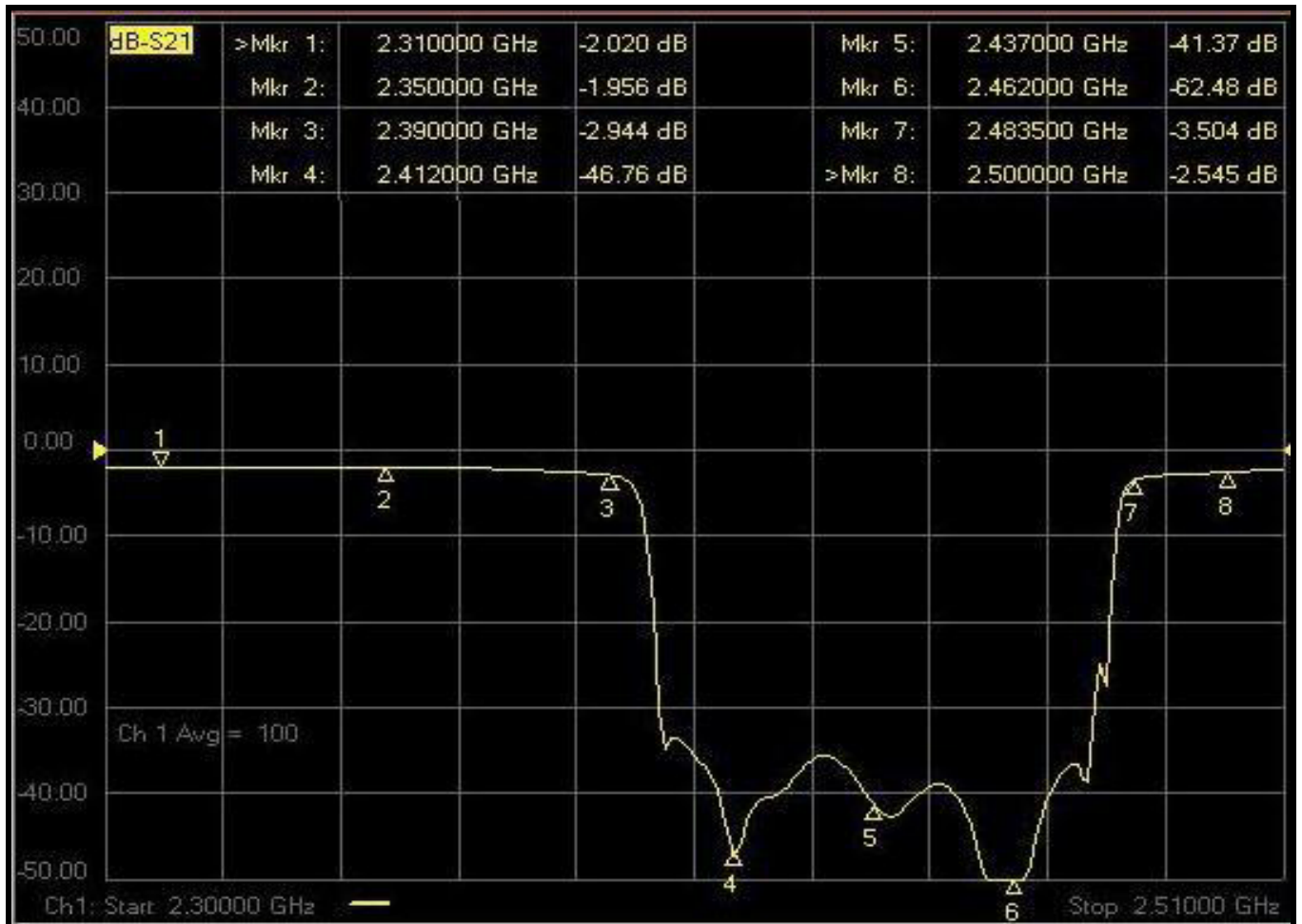
3.1 TEST PROCEDURE

Compliance with the band edges was performed using the rules found in FCC parts 15.205 and 15.209. The final data derived below are from radiated measurements applying absolute detector values only. The data taken in this report represents the worst-case band edges at 9 Mbps and 1 Mbps. The unit was tested in the following modes:

WLAN 2 on Channels 1, 11 for the modulation rates 1 and 9 Mbps (0 degree steering)
WLAN 5 on Channels 1, 11 for the modulation rates 1 and 9 Mbps (+45 degrees steering)
WLAN 0 on Channels 1, 11 for the modulation rates 1 and 9 Mbps (-45 degrees steering)

A cut band filter was used to attenuate the signal of the carriers so that the measurement instruments would not be saturated. All effects of the filter use were accounted for in the final data.

The characteristics of the filter can be found in Plot 3.1.



PLOT 3-1: INSERTION LOSS OF CUT BAND FILTER

3.2 COMPLIANCE WITH THE RESTRICTED BAND EDGE TEST DATA WLAN 2

Channels: 1 & 11
Operating Frequency (MHz): 2412-2462
Distance (m): 3
Limit (dBuV/m): 54

TABLE 3-1: RESTRICTED BAND EDGE TEST DATA (1 MBPS)

Channel Set to	Frequency Tested (MHz)	Detector	Field Strength Level (dBμV/m)	Level Corrected (dBμV/m)	FCC Limit (dBμV/m)	FCC Margin (dB)
1	2390.0	Absolute measurement	33.6	47.5	54.0	-6.5
11	2483.5	Absolute measurement	34.8	49.4	54.0	-4.6

TABLE 3-2: RESTRICTED BAND EDGE TEST DATA (9 MBPS)

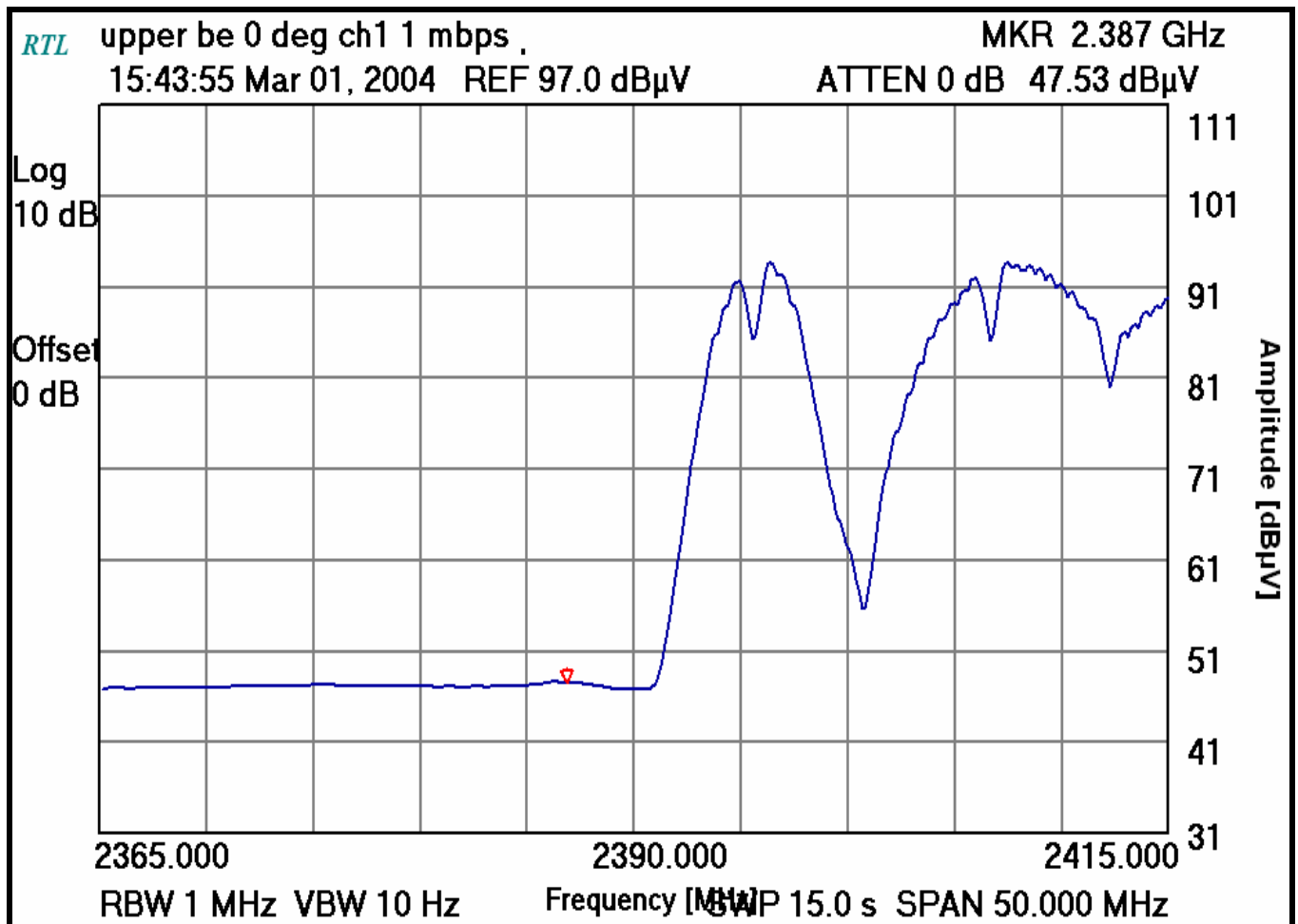
Channel Set to	Frequency Tested (MHz)	Detector	Field Strength Level (dBμV/m)	Level Corrected (dBμV/m)	FCC Limit (dBμV/m)	FCC Margin (dB)
1	2390.0	Absolute measurement	38.0	52.0	54.0	-2.0
11	2483.5	Absolute measurement	36.4	51.0	54.0	-3.0

TEST PERSONNEL:

Rachid Sehb		03/01/2004
Test Technician/Engineer	Signature	Date Of Test

Channel Number: 1
Frequency (MHz): 2412
Data Rate (Mbps): 1
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-2: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 1 AT 1 MBPS

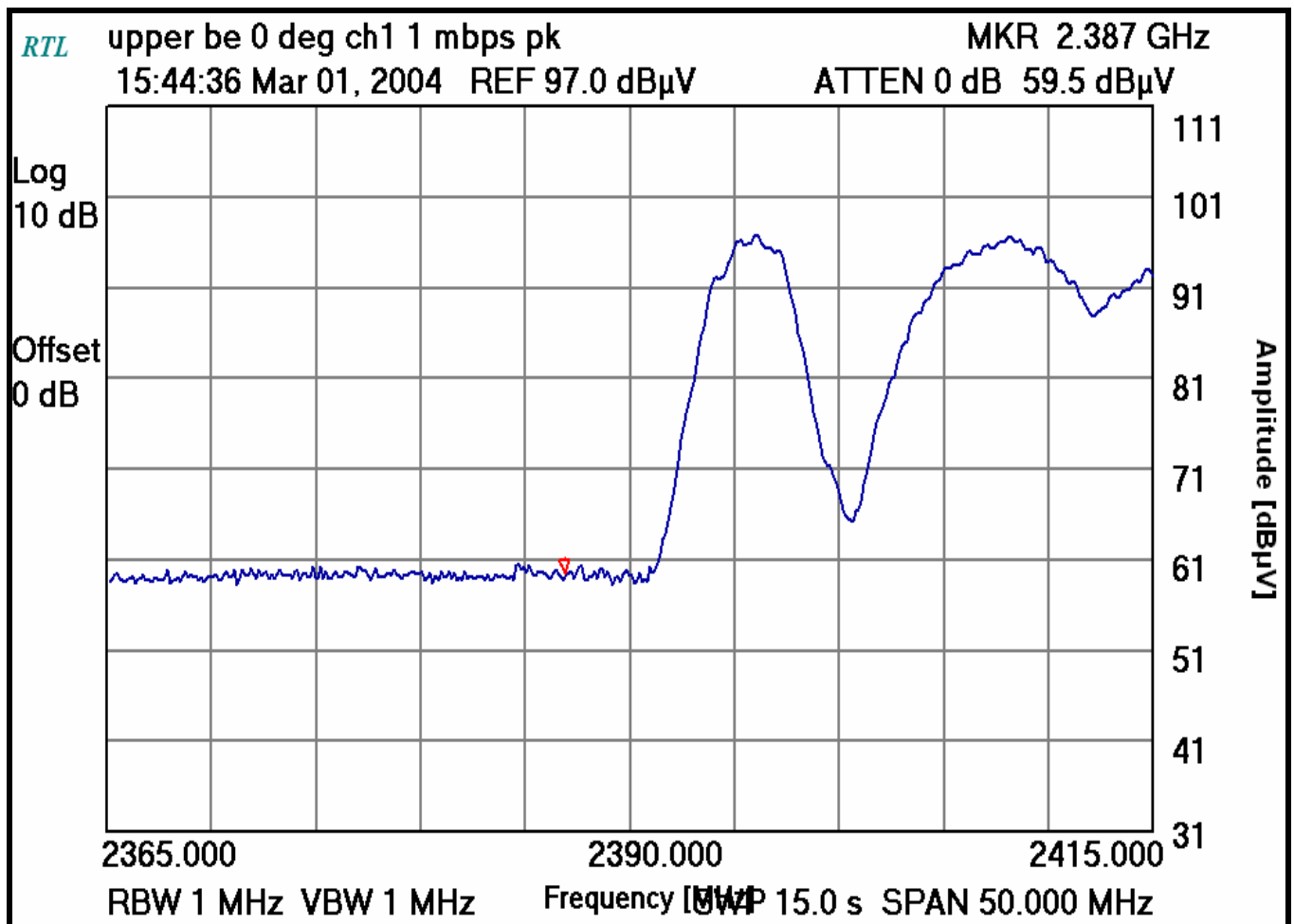


TEST PERSONNEL:

Rachid Sehb		03/01/2004
Test Technician/Engineer	Signature	Date Of Test

Channel Number: 1
 Frequency (MHz): 2412
 Data Rate (Mbps): 1
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-3: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 1 AT 1 MBPS



TEST PERSONNEL:

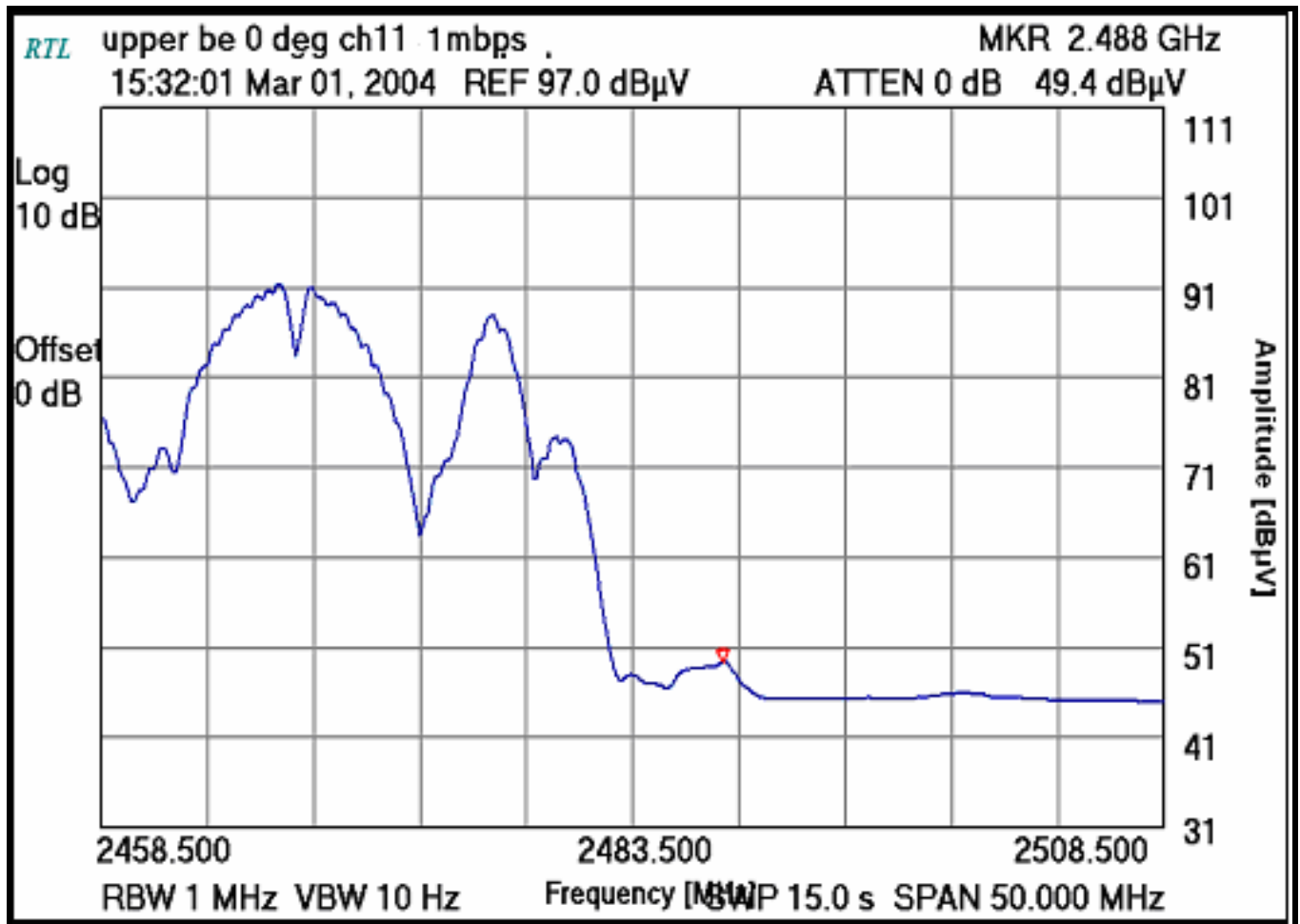
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
Frequency (MHz): 2462
Data Rate (Mbps): 1
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-4: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 11 AT 1 MBPS



TEST PERSONNEL:

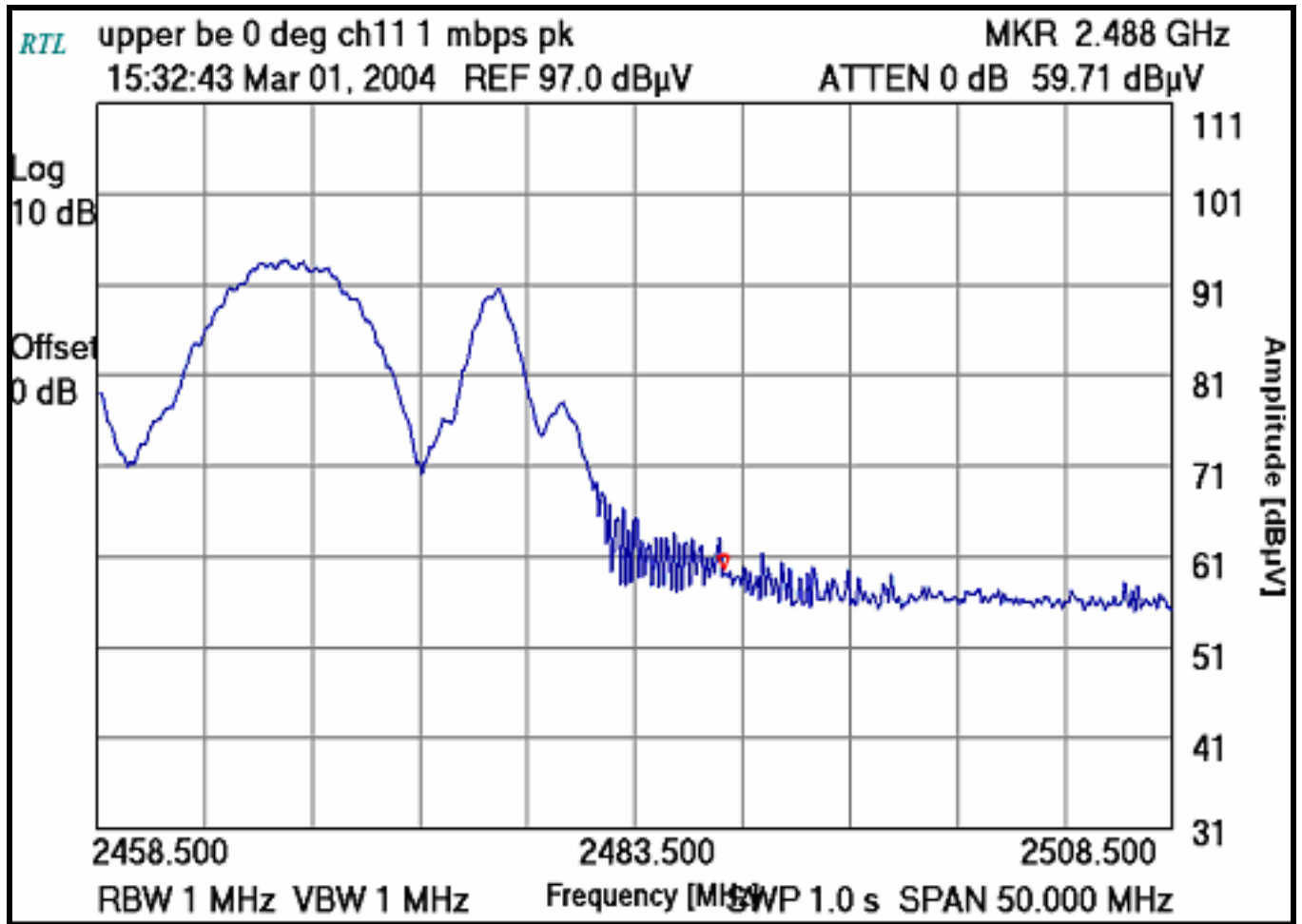
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
 Frequency (MHz): 2462
 Data Rate (Mbps): 1
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-5: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 11 AT 1 MBPS



TEST PERSONNEL:

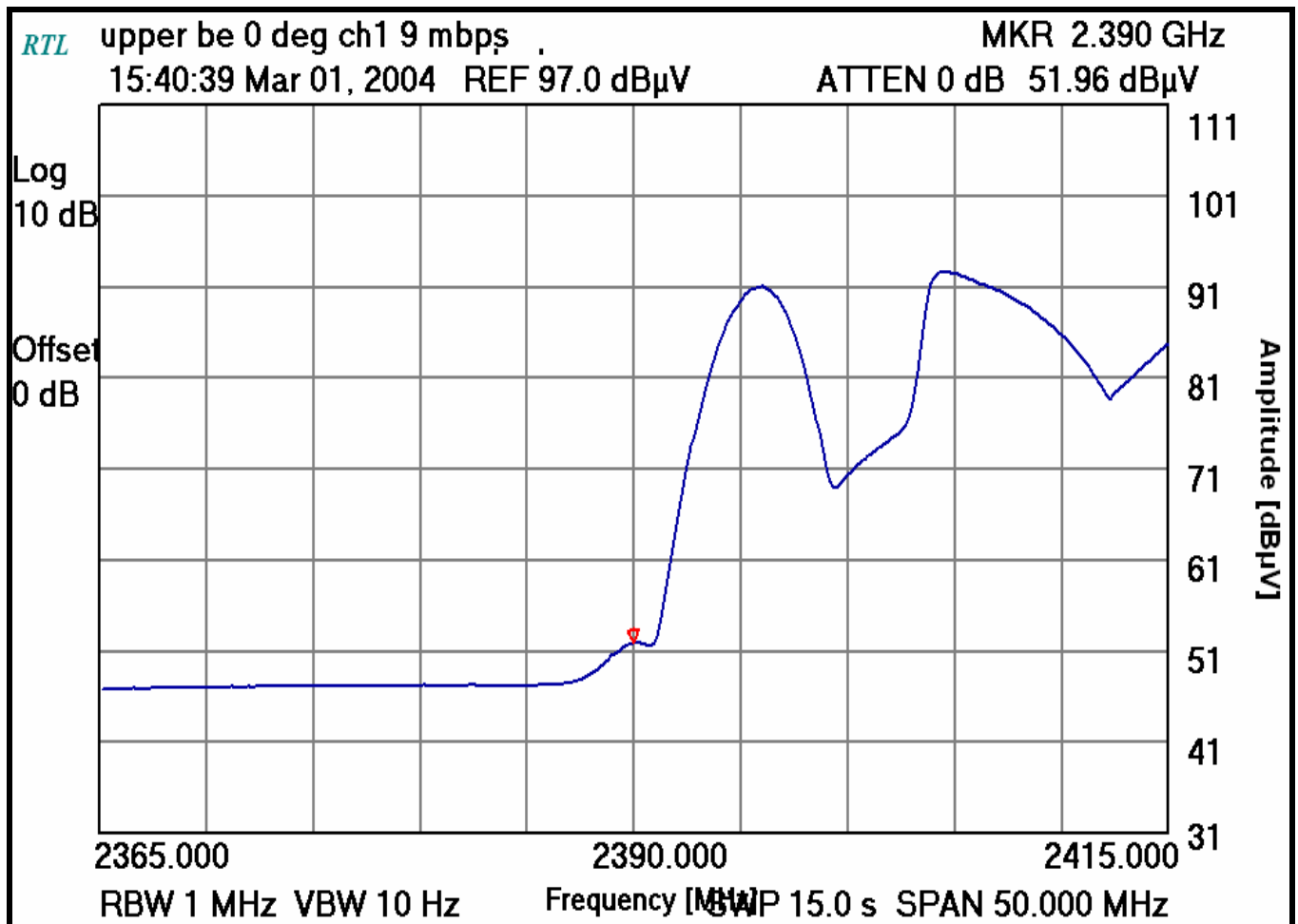
Rachid Sehb
 Test Technician/Engineer

See
 Signature

03/01/2004
 Date Of Test

Channel Number: 1
Frequency (MHz): 2412
Data Rate (Mbps): 9
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-6: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 1 AT 9 MBPS



TEST PERSONNEL:

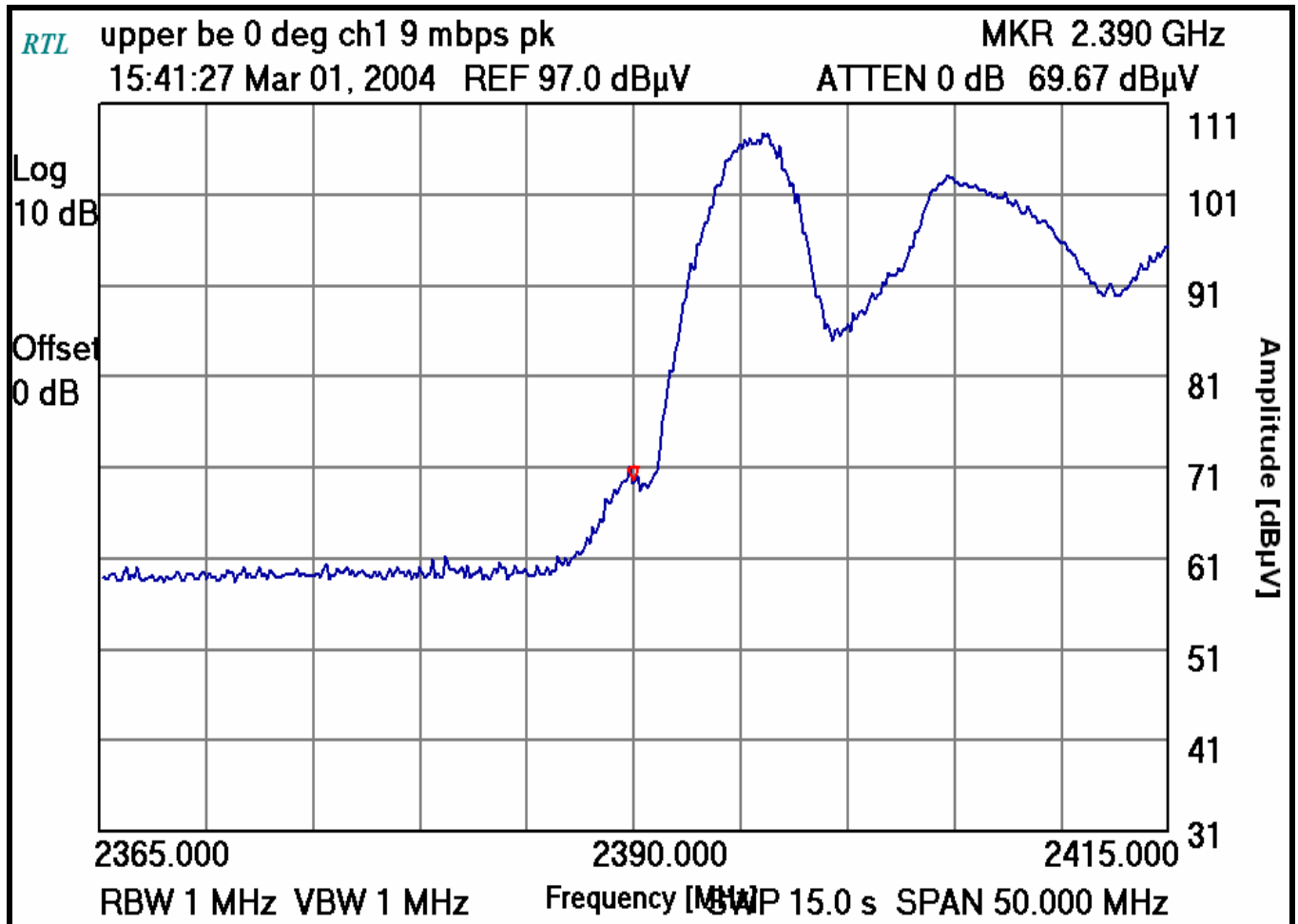
Rachid Sehb
Test Technician/Engineer


Signature

03/01/2004
Date Of Test

Channel Number: 1
 Frequency (MHz): 2412
 Data Rate (Mbps): 9
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-7: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 1 AT 9 MBPS



TEST PERSONNEL:

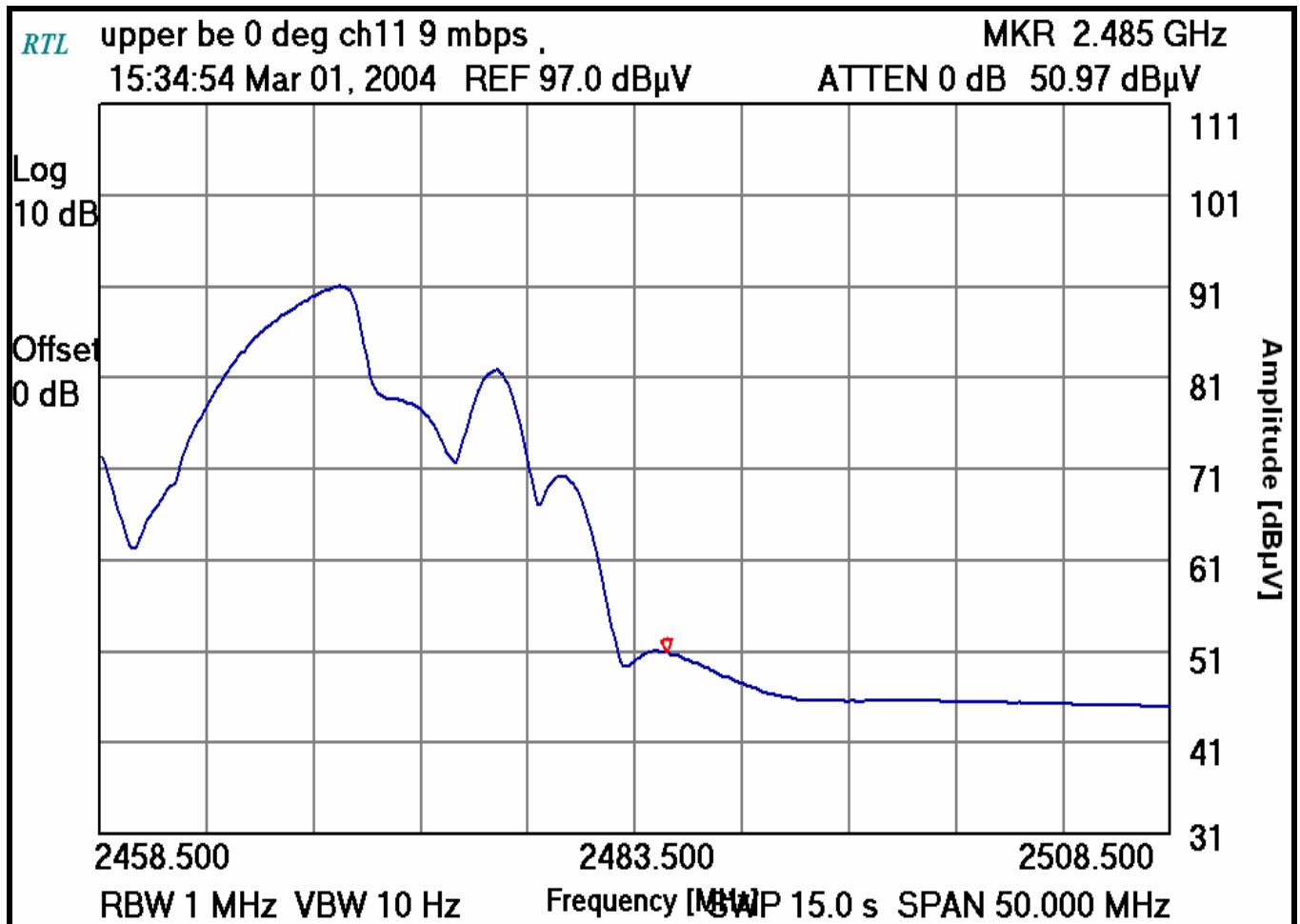
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
Frequency (MHz): 2462
Data Rate (Mbps): 9
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-8: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 11 AT 9 MBPS



TEST PERSONNEL:

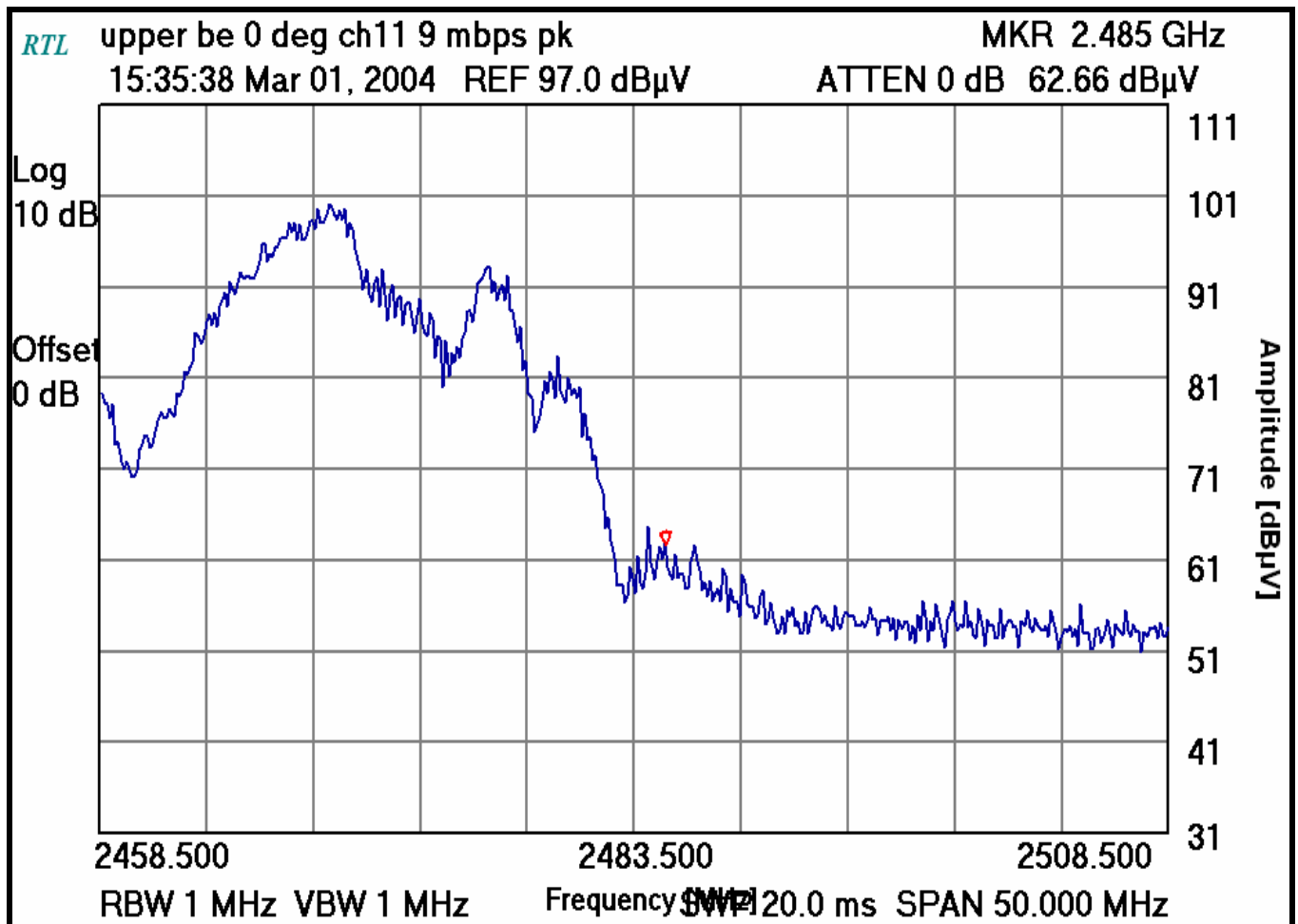
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
Frequency (MHz): 2462
Data Rate (Mbps): 9
Resolution Bandwidth (MHz): 1
Video Bandwidth (MHz): 1
Sweep Time (s): 15.0

PLOT 3-9: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 11 AT 9 MBPS



TEST PERSONNEL:

Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

3.3 COMPLIANCE WITH THE RESTRICTED BAND EDGE TEST DATA WLAN 5

Channels: 1 & 11
Operating Frequency (MHz): 2412-2462
Distance (m): 3
Limit (dBuV/m): 54


TABLE 3-3: RESTRICTED BAND EDGE TEST DATA (1 MBPS)

Channel Set to	Frequency Tested (MHz)	Detector	Field Strength Level (dBµV/m)	Level Corrected (dBµV/m)	FCC Limit (dBµV/m)	FCC Margin (dB)
1	2390.0	Absolute measurement	33.2	47.2	54.0	-6.8
11	2483.5	Absolute measurement	30.8	45.4	54.0	-8.6

TABLE 3-4: RESTRICTED BAND EDGE TEST DATA (9 MBPS)

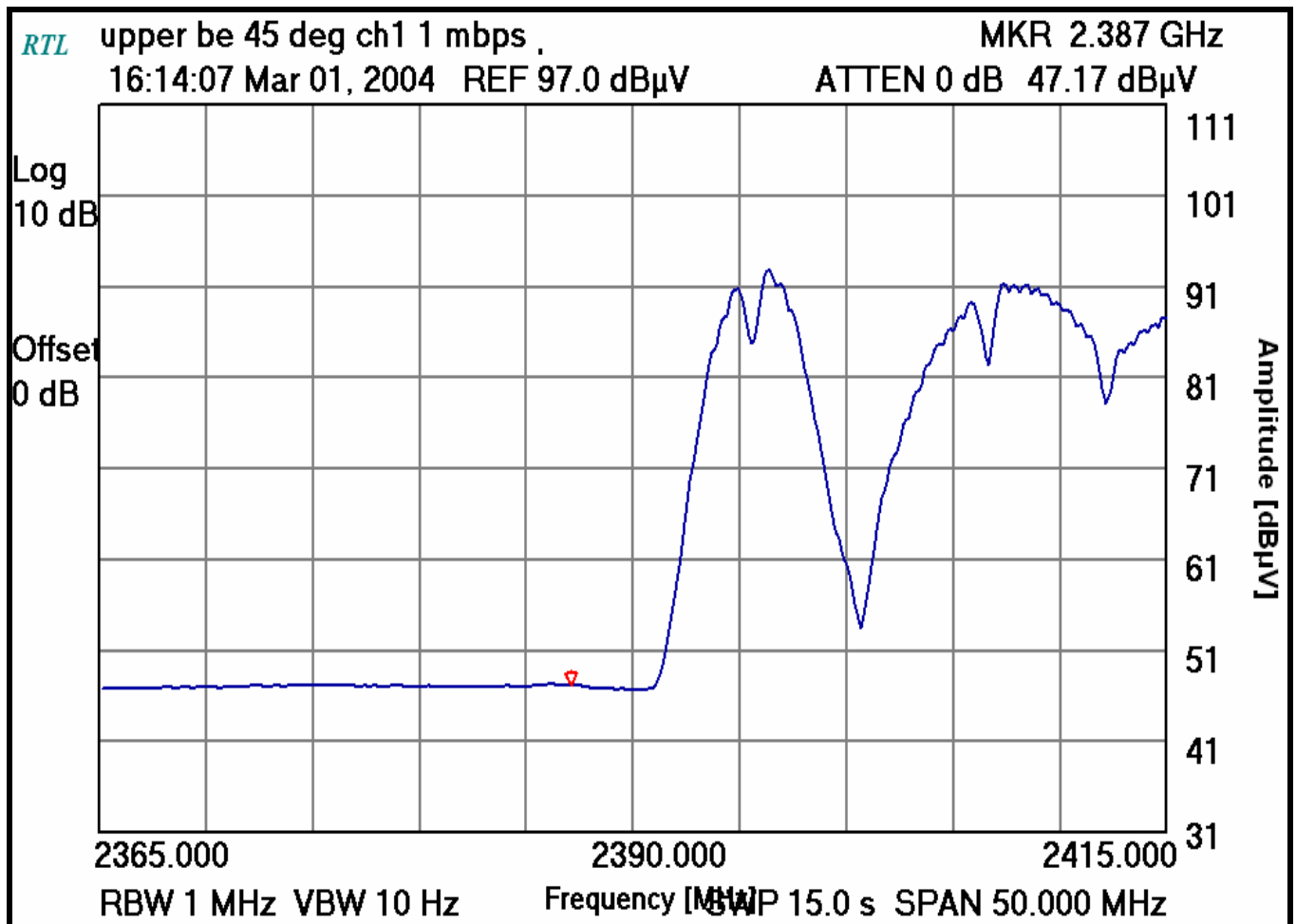
Channel Set to	Frequency Tested (MHz)	Detector	Field Strength Level (dBµV/m)	Level Corrected (dBµV/m)	FCC Limit (dBµV/m)	FCC Margin (dB)
1	2390.0	Absolute measurement	37.1	51.0	54.0	-3.0
11	2483.5	Absolute measurement	30.8	45.4	54.0	-8.6

TEST PERSONNEL:

Rachid Sehb		03/01/2004
Test Technician/Engineer	Signature	Date Of Test

Channel Number: 1
Frequency (MHz): 2412
Data Rate (Mbps): 1
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-10: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 1 AT 1 MBPS FOR 45 DEGREES



TEST PERSONNEL:

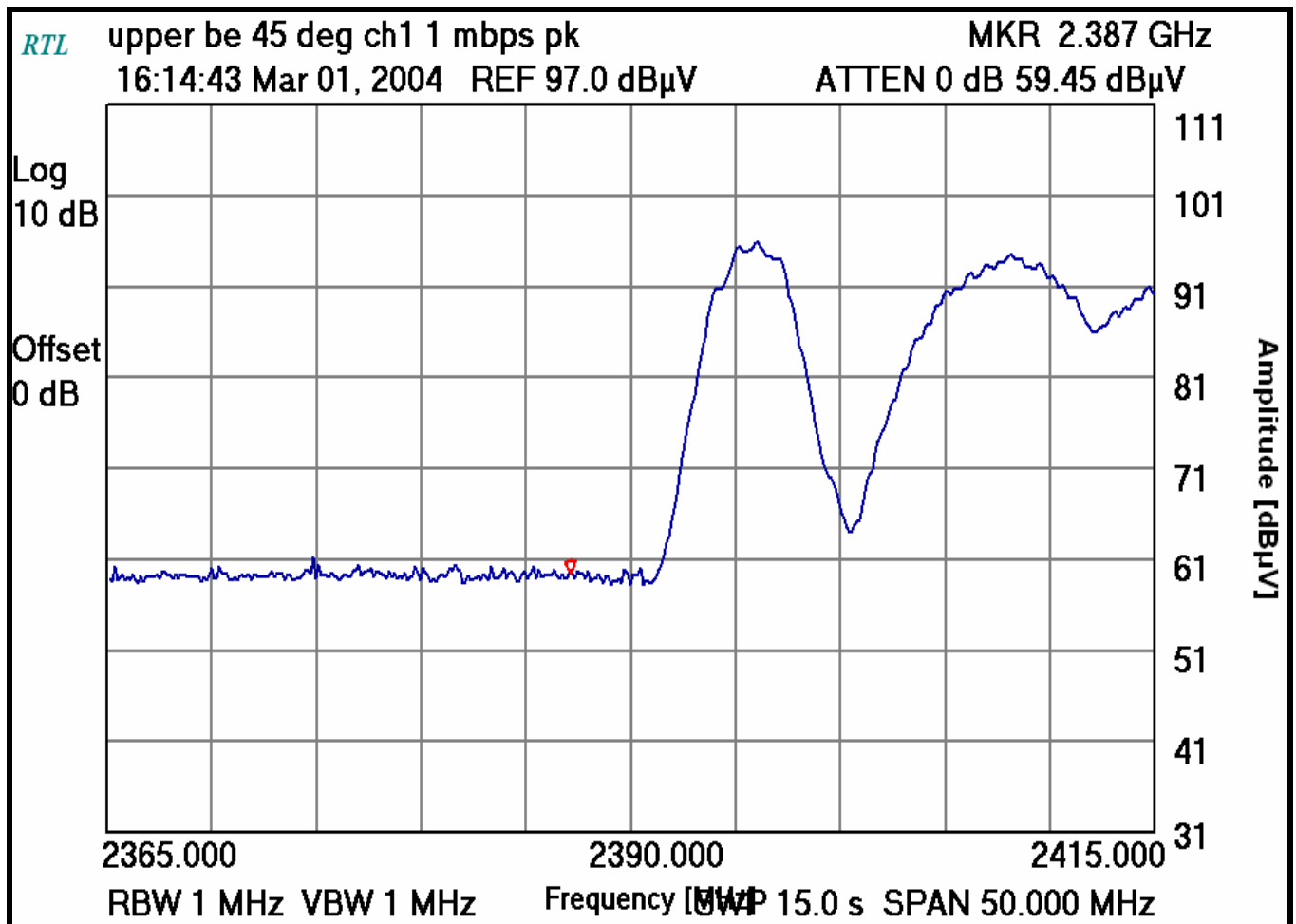
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 1
 Frequency (MHz): 2412
 Data Rate (Mbps): 1
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-11: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 1 AT 1 MBPS FOR 45 DEGREES



TEST PERSONNEL:

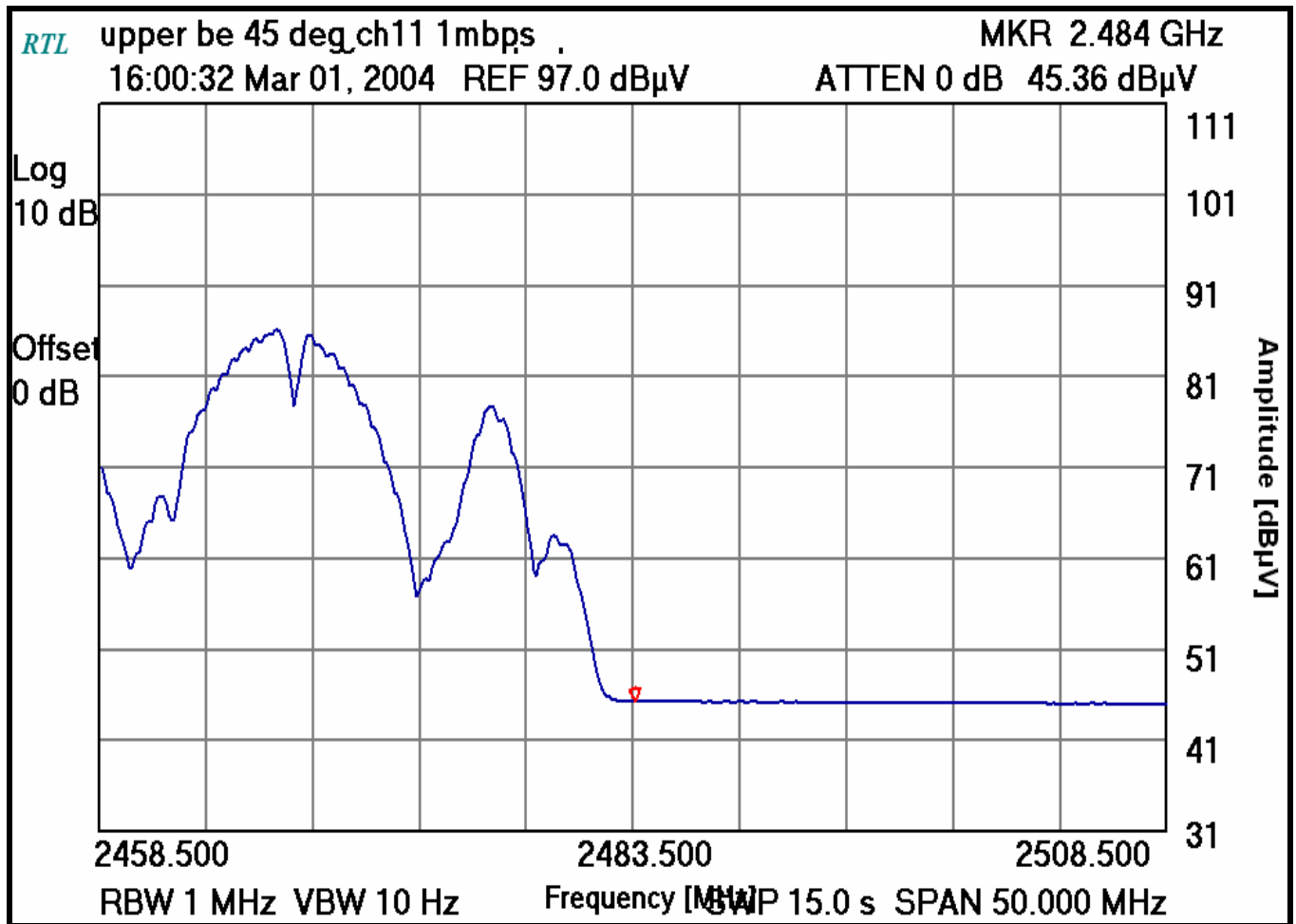
Rachid Sehb
 Test Technician/Engineer


 Signature

03/01/2004
 Date Of Test

Channel Number: 11
 Frequency MHz: 2462
 Data Rate (Mbps): 1
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (Hz): 10
 Sweep Time (s): 15.0

PLOT 3-12: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 11 AT 1 MBPS FOR 45 DEGREES



TEST PERSONNEL:

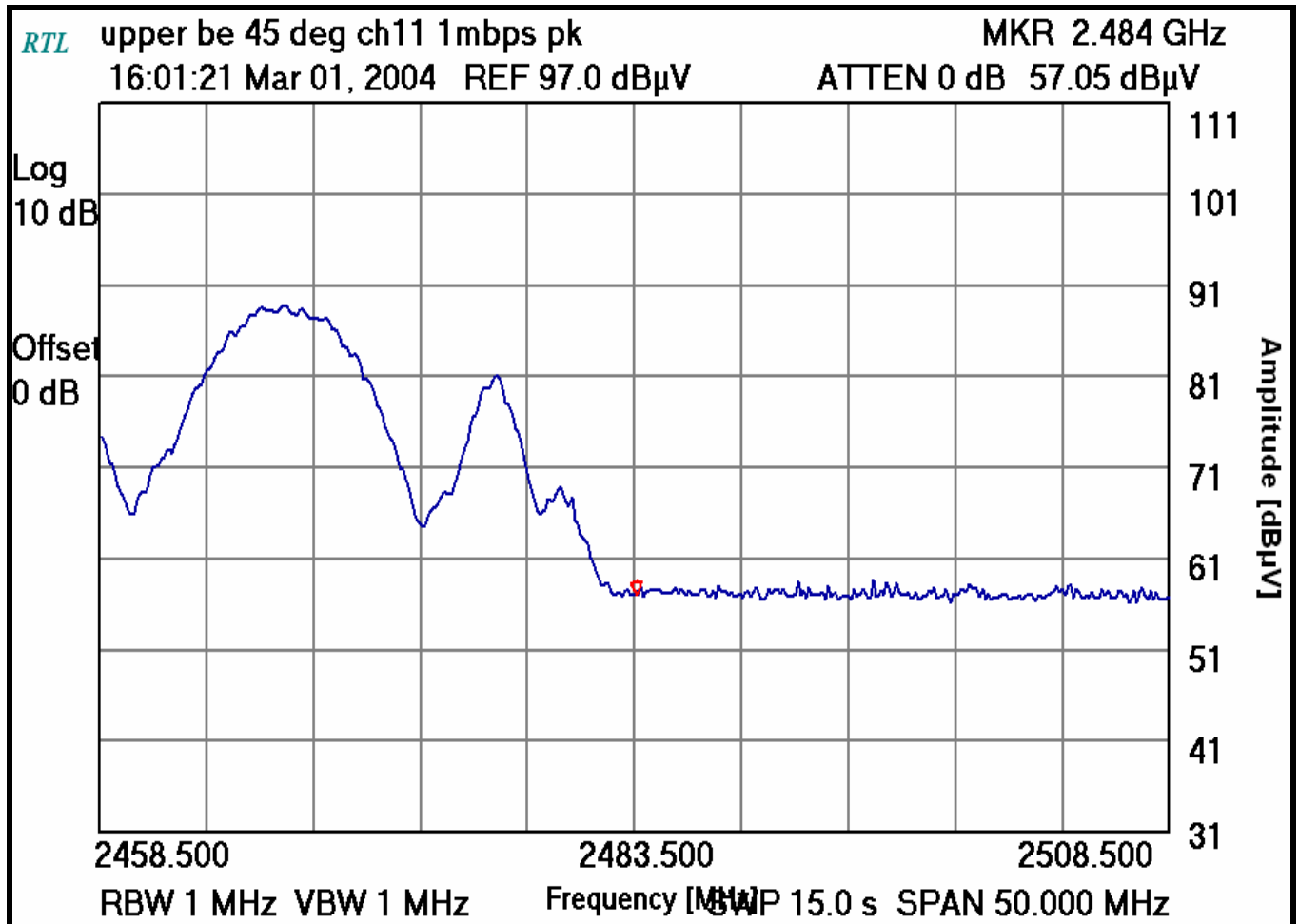
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
 Frequency (MHz): 2462
 Data Rate (Mbps): 1
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-13: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 11 AT 1 MBPS FOR 45 DEGREES



TEST PERSONNEL:

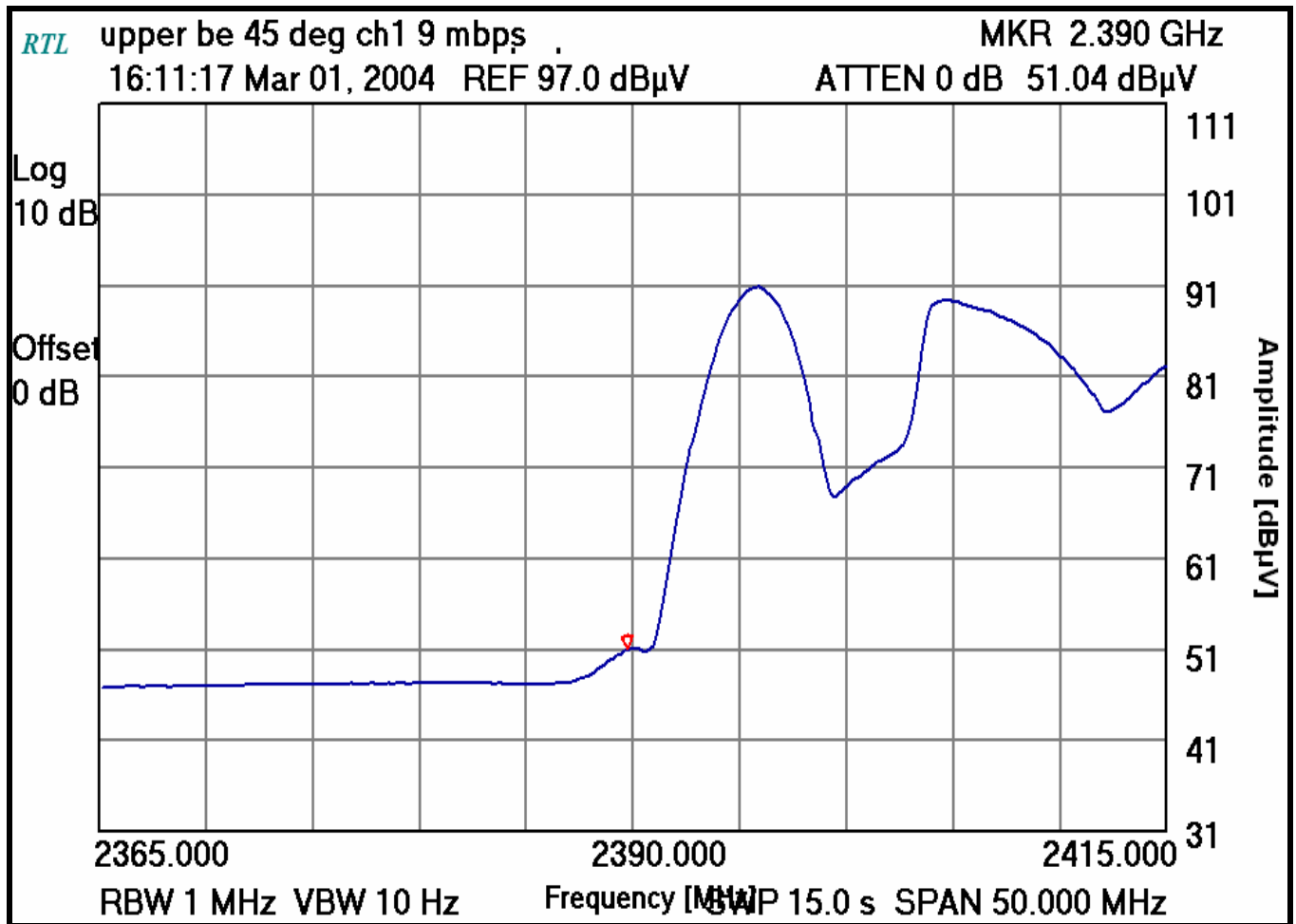
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 1
 Frequency (MHz): 2412
 Data Rate (Mbps): 9
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (Hz): 10
 Sweep Time (s): 15.0

PLOT 3-14: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 1 AT 9 MBPS FOR 45 DEGREES



TEST PERSONNEL:

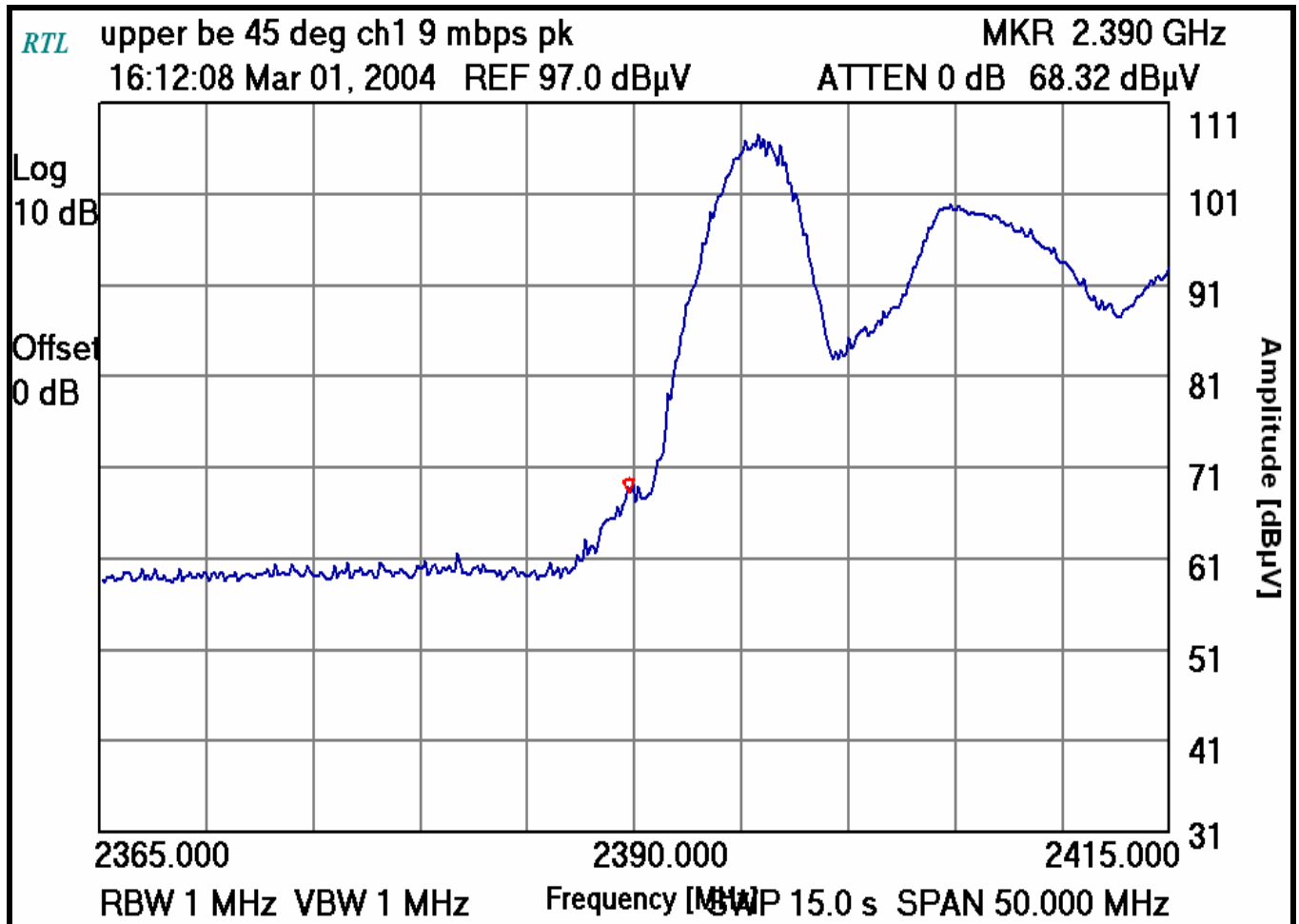
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 1
 Frequency (MHz): 2412
 Data Rate (Mbps): 9
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-15: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 1 AT 9 MBPS FOR 45 DEGREES



TEST PERSONNEL:

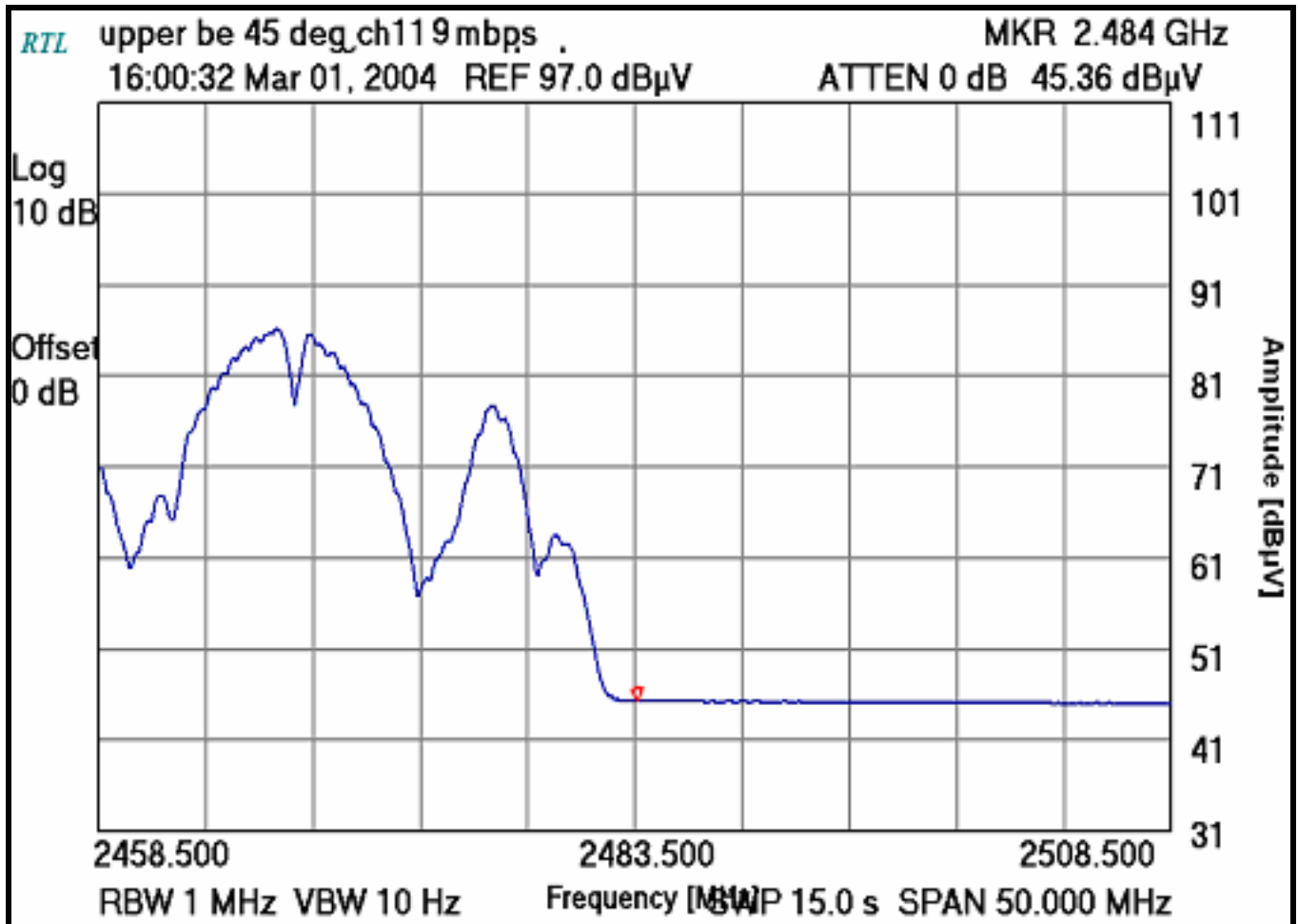
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
Frequency MHz: 2462
Data Rate (Mbps): 9
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-16: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 11 AT 9 MBPS FOR 45 DEGREES



TEST PERSONNEL:

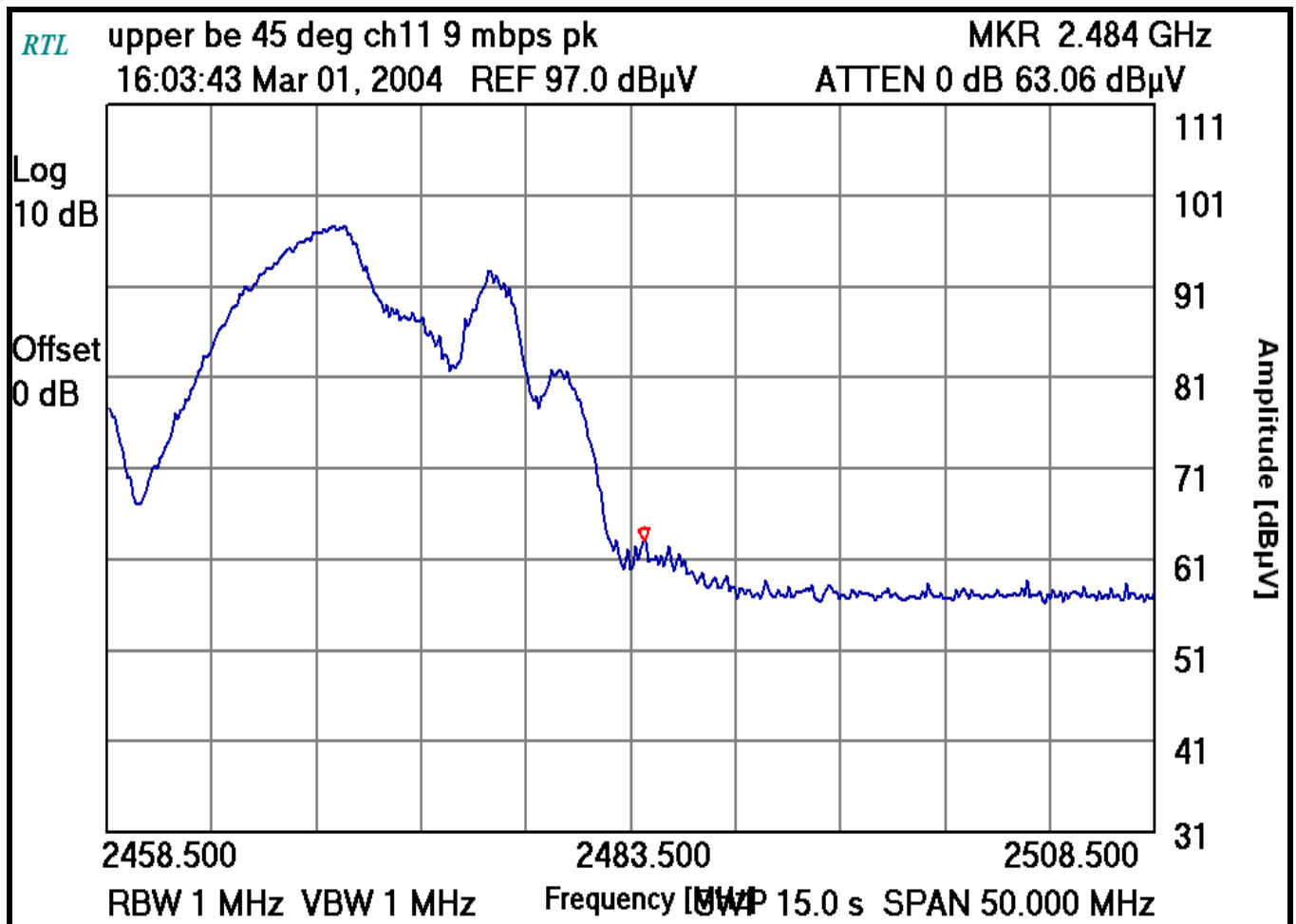
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
Frequency (MHz): 2462
Data Rate (Mbps): 9
Resolution Bandwidth (MHz): 1
Video Bandwidth (MHz): 1
Sweep Time (s): 15.0

PLOT 3-17: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 11 AT 9 MBPS FOR 45 DEGREES



TEST PERSONNEL:

Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

3.4 COMPLIANCE WITH THE RESTRICTED BAND EDGE TEST DATA WLAN 0

Channels: 1 & 11
Operating Frequency (MHz): 2412-2462
Distance (m): 3
Limit (dBuV/m): 54

TABLE 3-5: RESTRICTED BAND EDGE TEST DATA (1 MBPS)

Channel Set to	Frequency Tested (MHz)	Detector	Field Strength Level (dBµV/m)	Level Corrected (dBµV/m)	FCC Limit (dBµV/m)	FCC Margin (dB)
1	2390.0	Absolute measurement	33.9	47.8	54.0	-6.2
11	2483.5	Absolute measurement	36.8	51.4	54.0	-2.7

TABLE 3-6: RESTRICTED BAND EDGE TEST DATA (9 MBPS)

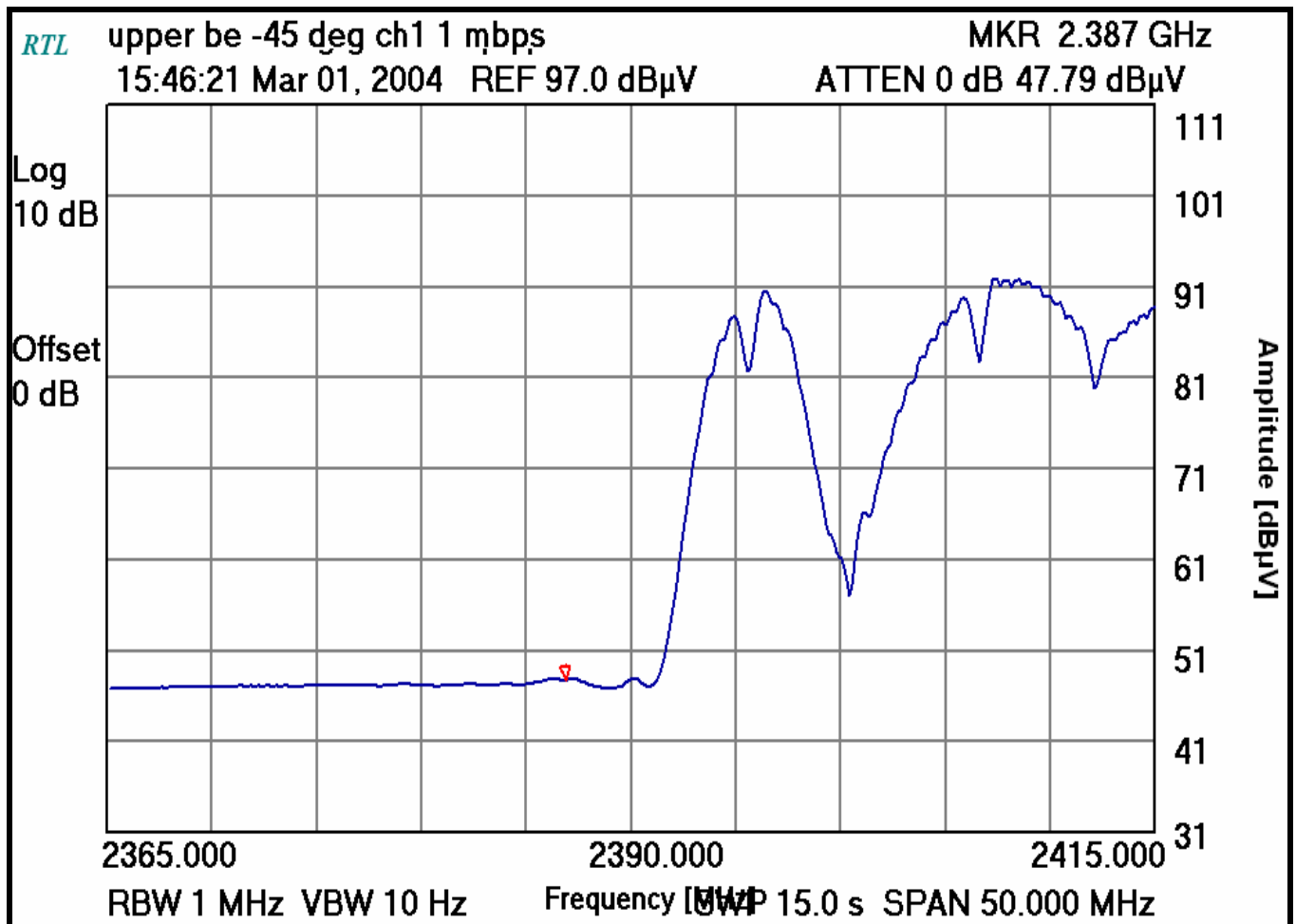
Channel Set to	Frequency Tested (MHz)	Detector	Field Strength Level (dBµV/m)	Level Corrected (dBµV/m)	FCC Limit (dBµV/m)	FCC Margin (dB)
1	2390.0	Absolute measurement	37.3	51.3	54.0	-2.7
11	2483.5	Absolute measurement	37.2	51.8	54.0	-2.2

TEST PERSONNEL:

Rachid Sehb Test Technician/Engineer	 Signature	03/01/2004 Date Of Test
---	--	----------------------------

Channel Number: 1
Frequency (MHz): 2412
Data Rate (Mbps): 1
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-18: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 1 AT 1 MBPS FOR -45 DEGREES



TEST PERSONNEL:

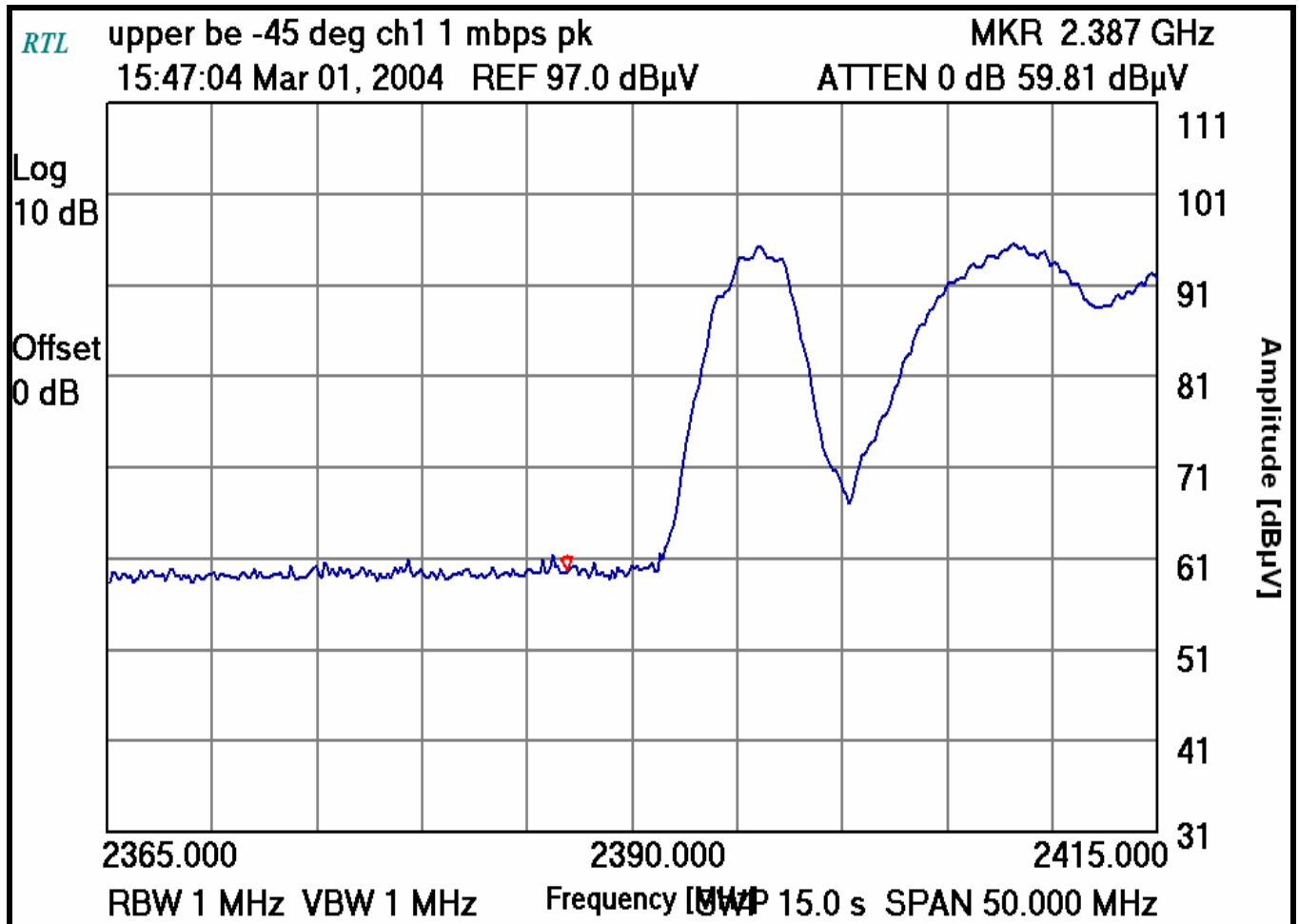
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 1
 Frequency (MHz): 2412
 Data Rate (Mbps): 1
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-19: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 1 AT 1 MBPS FOR -45 DEGREES



TEST PERSONNEL:

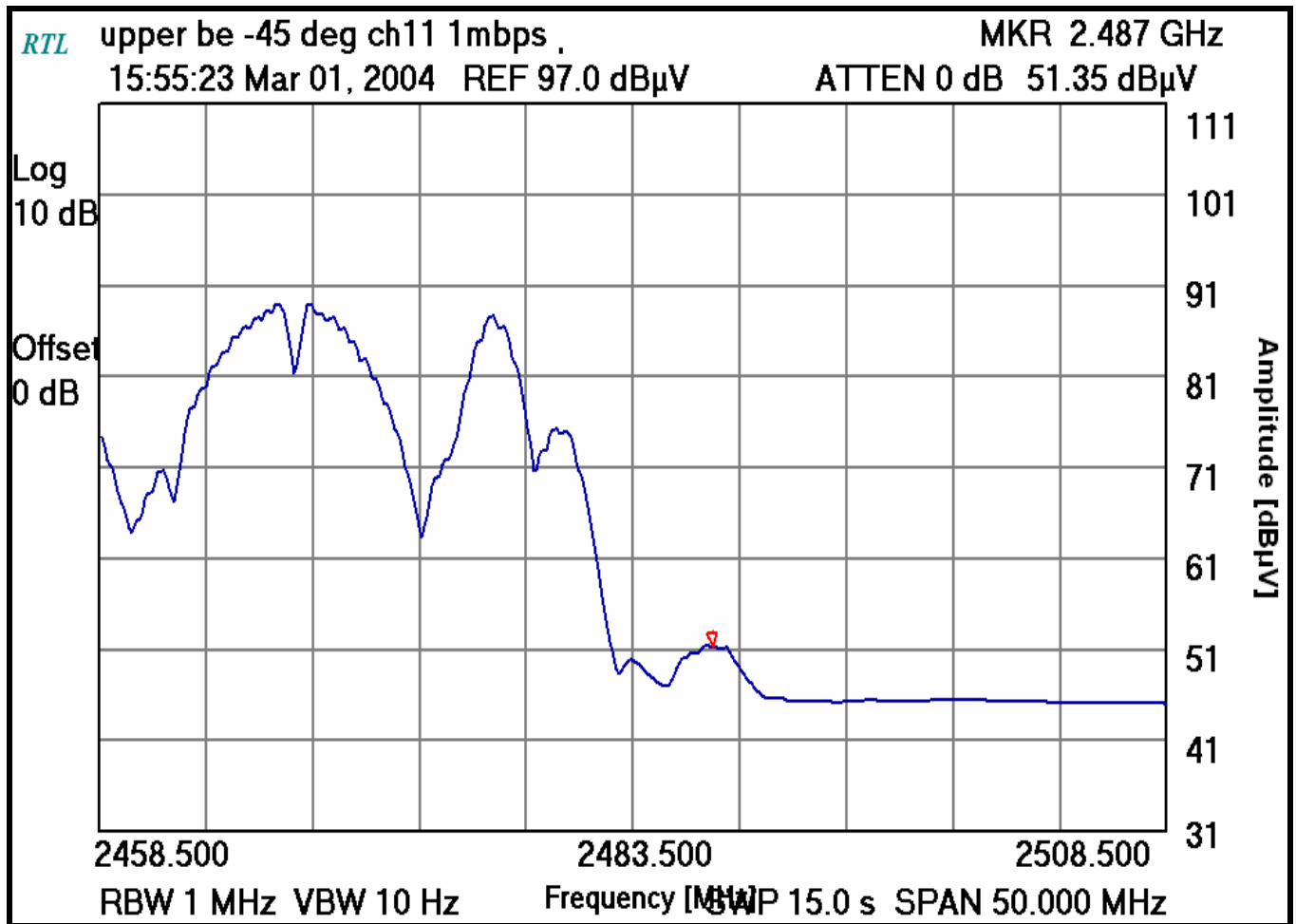
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
Frequency MHz: 2462
Data Rate (Mbps): 1
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-20: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 11 AT 1 MBPS FOR -45 DEGREES



TEST PERSONNEL:

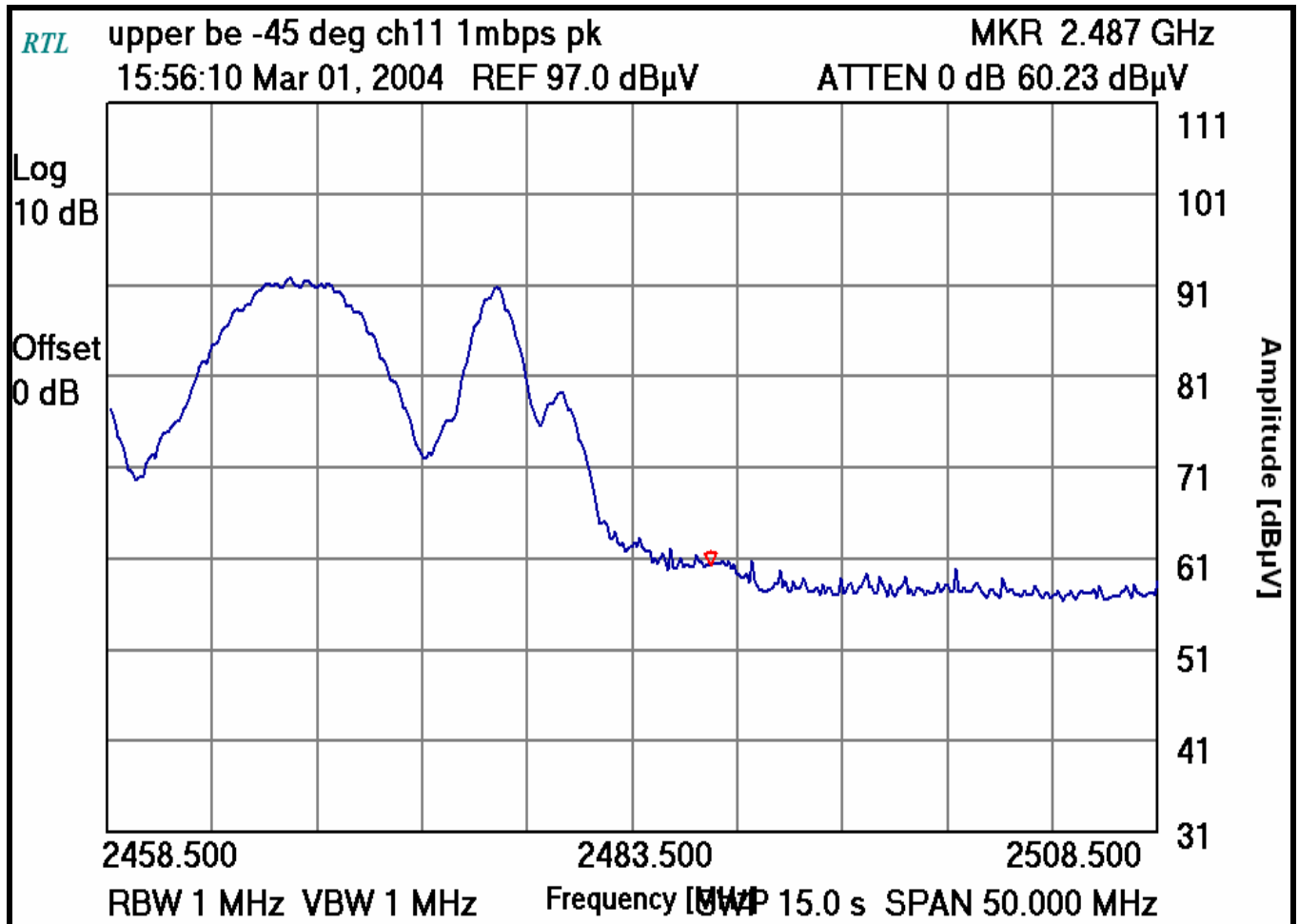
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
 Frequency (MHz): 2462
 Data Rate (Mbps): 1
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-21: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 11 AT 1 MBPS FOR-45 DEGREES



TEST PERSONNEL:

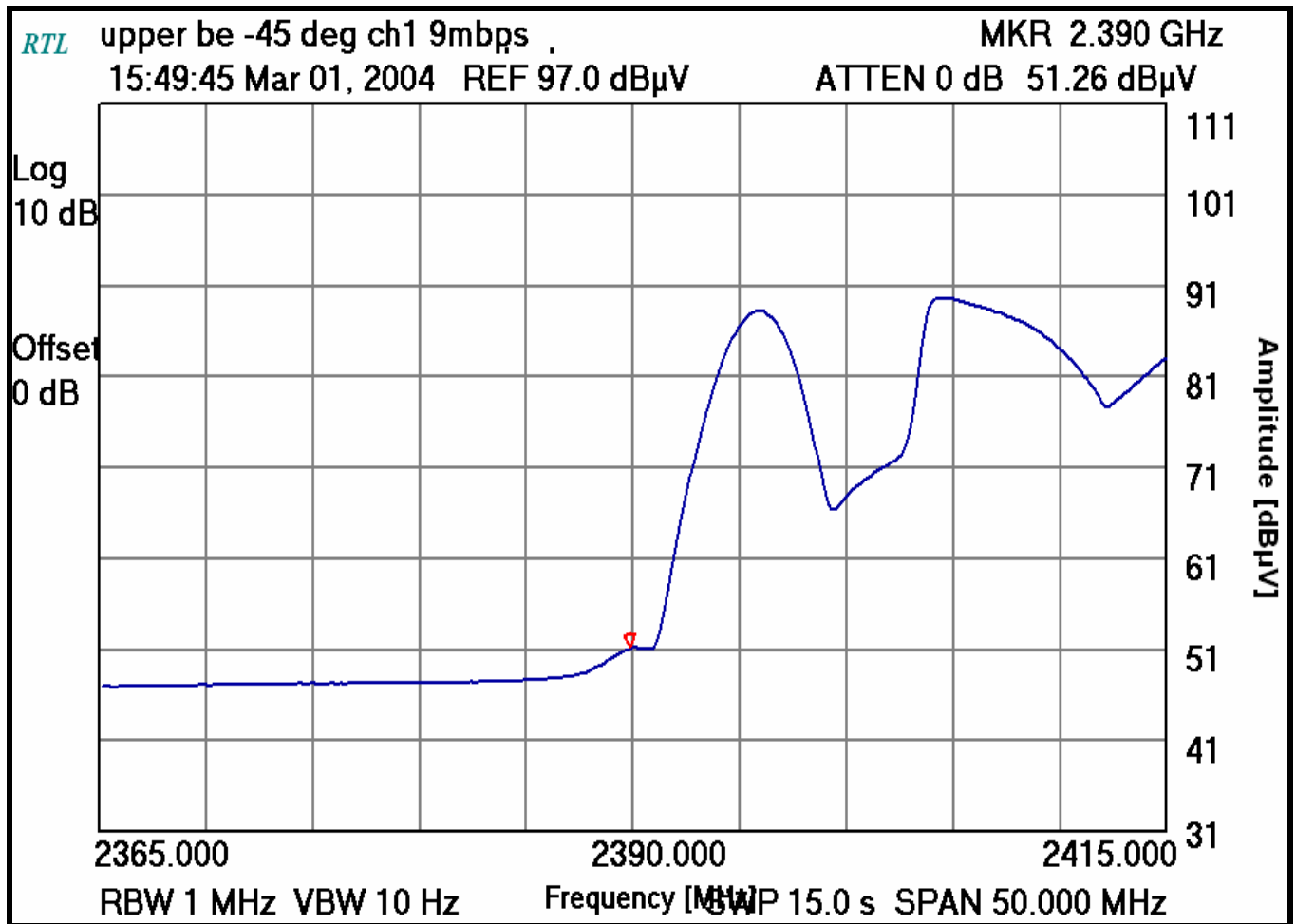
Rachid Sehb
 Test Technician/Engineer


 Signature

03/01/2004
 Date Of Test

Channel Number: 1
 Frequency (MHz): 2412
 Data Rate (Mbps): 9
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (Hz): 10
 Sweep Time (s): 15.0

PLOT 3-22: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 1 AT 9 MBPS FOR -45 DEGREES



TEST PERSONNEL:

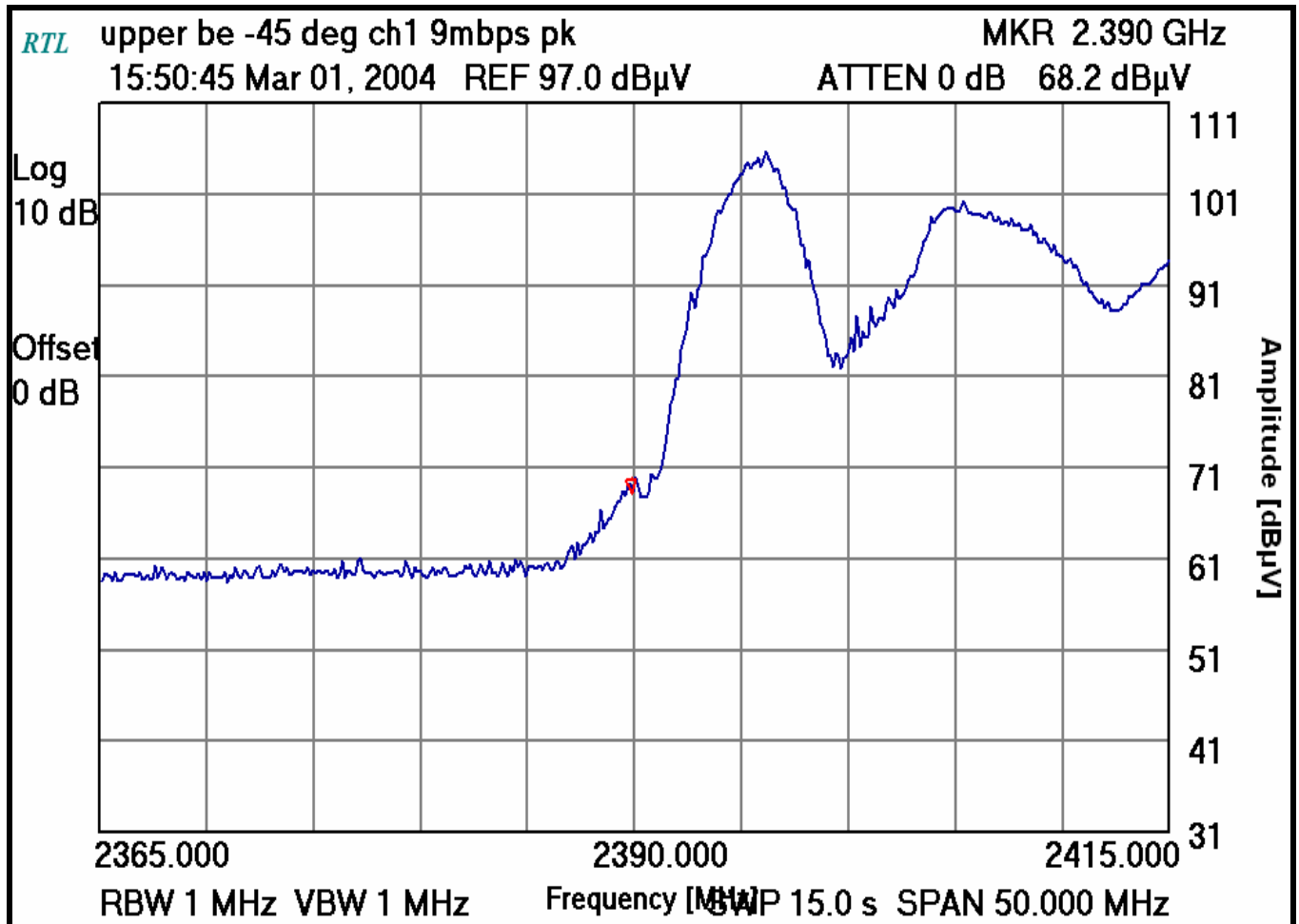
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 1
 Frequency (MHz): 2412
 Data Rate (Mbps): 9
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-23: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 1 AT 9 MBPS FOR -45 DEGREES



TEST PERSONNEL:

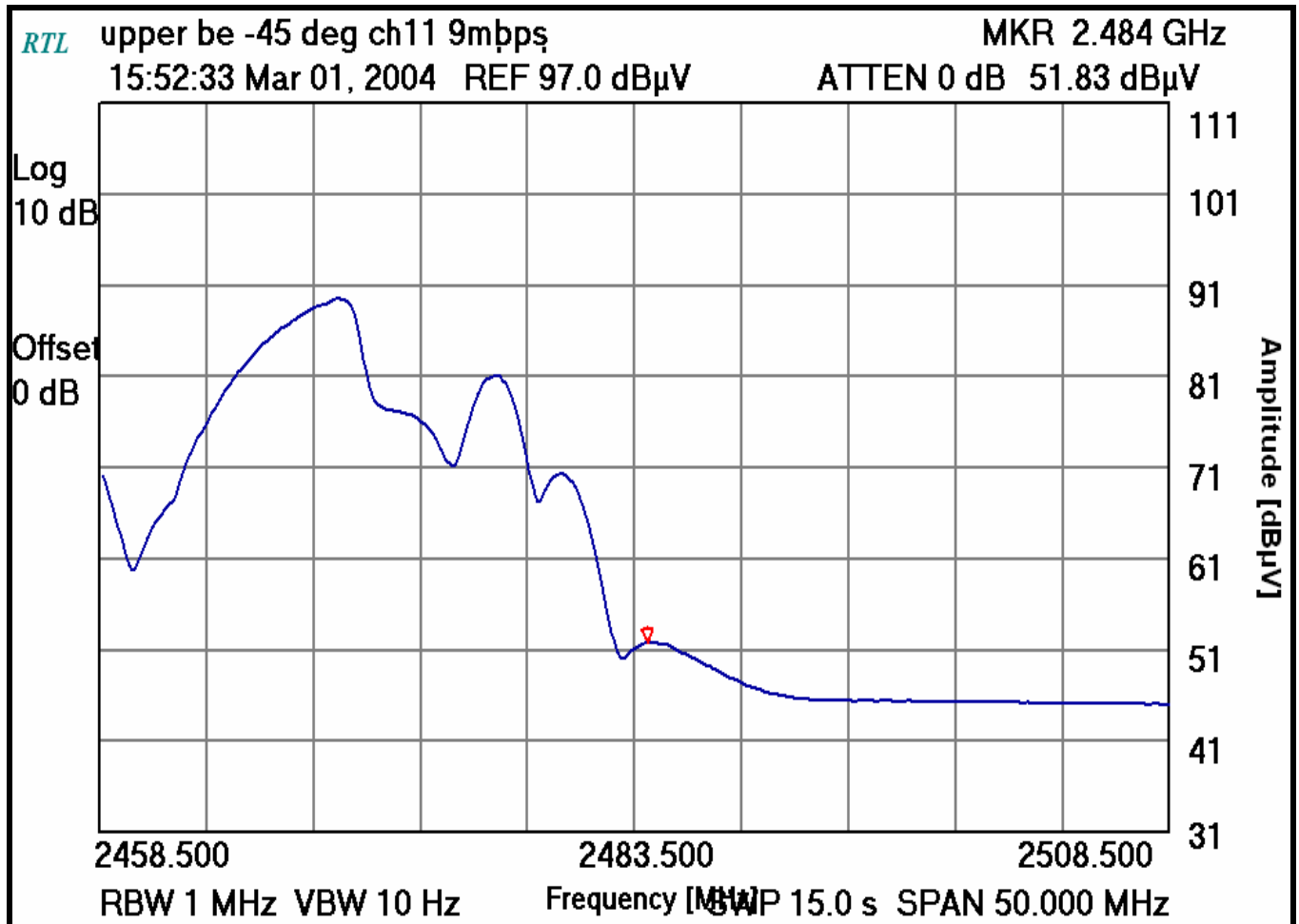
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
Frequency MHz: 2462
Data Rate (Mbps): 9
Resolution Bandwidth (MHz): 1
Video Bandwidth (Hz): 10
Sweep Time (s): 15.0

PLOT 3-24: BAND EDGE: AVERAGE MEASUREMENT FOR CHANNEL 11 AT 9 MBPS FOR -45 DEGREES



TEST PERSONNEL:

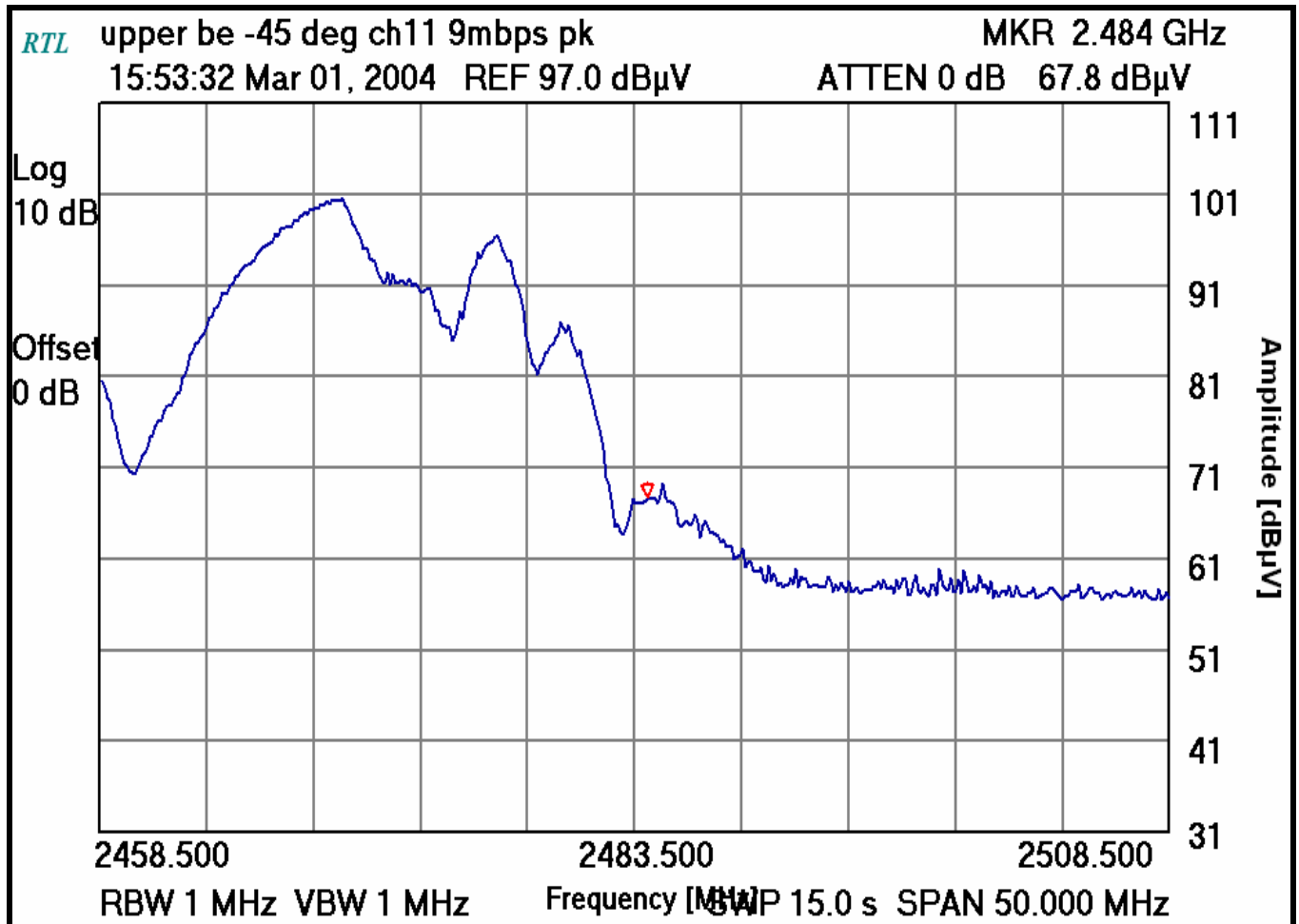
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/01/2004
 Date Of Test

Channel Number: 11
 Frequency (MHz): 2462
 Data Rate (Mbps): 9
 Resolution Bandwidth (MHz): 1
 Video Bandwidth (MHz): 1
 Sweep Time (s): 15.0

PLOT 3-25: BAND EDGE: PEAK MEASUREMENT FOR CHANNEL 11 AT 9 MBPS FOR -45 DEGREES



TEST PERSONNEL:

Rachid Sehb
 Test Technician/Engineer


 Signature

03/01/2004
 Date Of Test

TABLE 3-7: BAND EDGE TEST EQUIPMENT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DATE
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	3/15/04
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	7/15/04
900890	Rhein Tech Labs	Outdoor Range 1	OATS 1	N/A	3/26/2004
900878	Rhein Tech Labs	AM3-1197- 0005	3 meter antenna mast, polarizing	N/A	N/A
901242	Rhein Tech Labs	WRT-000- 0003	Wood rotating table	N/A	N/A
901231	IW Microwave Products	KPS-1503- 2400-KPS	High frequency RF cables	240"	9/5/2004
901235	IW Microwave Products	KPS-1503- 360-KPS	High frequency RF cables	36"	9/5/2004

4. CONDUCTED LIMITS - §15.207

4.1 TEST METHODOLOGY FOR CONDUCTED EMISSIONS MEASUREMENTS

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm / 50 micro Henry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. No video filter less than 10 times the resolution bandwidth was used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

4.2 CONDUCTED EMISSIONS TEST

The test was performed with the EUT exercise program loaded, and the emissions were scanned between 150 kHz to 30 MHz on the NEUTRAL SIDE and PHASE SIDE.

The conducted test was performed with the EUT exercise program loaded, and the emissions were scanned between 150 kHz to 30 MHz on the NEUTRAL SIDE and PHASE SIDE. The EUT was investigated and tested in channels 1, 6, and 11, namely for worst-case conducted data in both transmitting and receiving modes. Test data is provided for channel 6 at 1 MBPS for WLAN 0 in transmitting mode. Receiving modes were also investigated for worst-case conducted emissions in the various data rate modes with all WLAN in receiving mode.

TABLE 4-1: CONDUCTED SPURIOUS EMISSIONS TEST EQUIPMENT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DATE
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	05/12/2004
901082	AFJ International	LS16	16A LISN	16010020081	11/5/2004

TABLE 4-2: NEUTRAL SIDE TRANSMITTING 1 MBPS RATE

Temperature: 57°F Humidity: 87%								
Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	CISPR B QP Limit (dBuV)	CISPR B QP Margin (dBuV)	CISPR B AV Limit (dBuV)	CISPR B AV Margin (dBuV)
0.152	Qp	51.9	2.0	53.9	65.9	-12.0		
0.152	Av	29.6	2.0	31.6			55.9	-24.3
1.256	Qp	41.7	0.8	42.5	56.0	-13.5		
1.256	Av	41.5	0.8	42.3			46.0	-3.7
2.921	Qp	26.5	1.3	27.8	56.0	-28.2		
2.943	Av	24.6	1.3	25.9			46.0	-20.1
9.300	Qp	26.2	2.1	28.3	60.0	-31.7		
9.306	Av	26.2	2.1	28.3			50.0	-21.7
20.490	Qp	33.5	3.2	36.7	60.0	-23.3		
20.491	Av	27.2	3.2	30.4			50.0	-19.6
26.584	Qp	41.2	3.4	44.6	60.0	-15.4		
26.573	Av	18.8	3.4	22.2			50.0	-27.8

TABLE 4-3: PHASE SIDE TRANSMITTING 1 MBPS RATE

Temperature: 57°F Humidity: 87%								
Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	CISPR B QP Limit (dBuV)	CISPR B QP Margin (dBuV)	CISPR B AV Limit (dBuV)	CISPR B AV Margin (dBuV)
0.151	Qp	52.9	2.0	54.9	65.9	-11.0		
0.151	Av	23.9	2.0	25.9			55.9	-30.0
0.225	Qp	45.3	1.5	46.8	62.6	-15.8		
0.225	Av	23.9	1.5	25.4			52.6	-27.2
1.257	Qp	42.2	0.8	43.0	56.0	-13.0		
1.256	Av	42.0	0.8	42.8			46.0	-3.2
2.858	Qp	28.6	1.3	29.9	56.0	-26.1		
2.856	Av	24.1	1.3	25.4			46.0	-20.6
5.408	Qp	33.6	1.7	35.3	60.0	-24.7		
5.409	Av	29.0	1.7	30.7			50.0	-19.3
9.690	Qp	33.0	1.5	34.5	60.0	-25.5		
9.692	Av	28.6	1.5	30.1			50.0	-19.9

TEST PERSONNEL:

Rachid Sehb		03/01/2004
Test Technician/Engineer	Signature	Date Of Test

TABLE 4-4: NEUTRAL SIDE RECEIVING

		Temperature: 57°F			Humidity: 87%			
Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	CISPR B QP Limit (dBuV)	CISPR B QP Margin (dBuV)	CISPR B AV Limit (dBuV)	CISPR B AV Margin (dBuV)
0.151	Qp	52.0	2.0	54.0	65.9	-11.9		
0.151	Av	20.7	2.0	22.7			55.9	-33.2
1.257	Qp	40.6	0.8	41.4	56.0	-14.6		
1.258	Av	40.6	0.8	41.4			46.0	-4.6
4.999	Qp	37.0	1.6	38.6	56.0	-17.4		
5.002	Av	36.0	1.6	37.6			50.0	-12.4
9.413	Qp	34.1	2.1	36.2	60.0	-23.8		
9.413	Av	30.5	2.1	32.6			50.0	-17.4
10.162	Qp	32.2	2.1	34.3	60.0	-25.7		
10.166	Av	28.1	2.1	30.2			50.0	-19.8
20.859	Qp	33.3	3.2	36.5	60.0	-23.5		
20.862	Av	27.1	3.2	30.3			50.0	-19.7

TABLE 4-5: PHASE SIDE RECEIVING

		Temperature: 57°F			Humidity: 87%			
Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	CISPR B QP Limit (dBuV)	CISPR B QP Margin (dBuV)	CISPR B AV Limit (dBuV)	CISPR B AV Margin (dBuV)
0.153	Qp	48.3	2.0	50.3	65.8	-15.5		
0.153	Av	25.8	2.0	27.8			55.8	-28.0
0.299	Qp	41.3	0.9	42.2	60.3	-18.1		
0.297	Av	20.9	0.9	21.8			50.3	-28.5
0.944	Qp	34.0	0.2	34.2	56.0	-21.8		
0.944	Av	32.8	0.2	33.0			46.0	-13.0
1.258	Qp	40.2	0.8	41.0	56.0	-15.0		
1.257	Av	39.9	0.8	40.7			46.0	-5.3
2.859	Qp	25.6	1.3	26.9	56.0	-29.1		
2.857	Av	23.6	1.3	24.9			46.0	-21.1
20.388	Qp	32.7	3.1	35.8	60.0	-24.2		
20.388	Av	26.5	3.1	29.6			50.0	-20.4

TEST PERSONNEL:

Rachid Sehb Test Technician/Engineer	 Signature	03/01/2004 Date Of Test
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5. RADIATED EMISSION LIMITS RECEIVER/DIGITAL INTERFACE - §15.209

5.1 RADIATED EMISSION LIMITS TEST PROCEDURE

Radiated Spurious Emissions applies to harmonics and spurious emissions from oscillators, LO's, and IF's that fall in the restricted and non-restricted bands. The restricted bands are listed in Part 15.205. The maximum permitted average field strength for the restricted band is listed in Part 15.209. The oscillators, IF, LO and up to the 2nd LO were investigated and tested in all steering modes and data rates for all WLAN scanning to receive at all channels.

5.2 RADIATED EMISSION LIMITS TEST DATA DIGITAL NOISE

TABLE 5-1: RADIATED EMISSIONS LIMITS TEST DATA DIGITAL NOISE

Temperature: 69°F Humidity: 47%									
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
119.998	Qp	H	90	2.0	42.5	-14.9	27.6	43.5	-15.9
159.998	Qp	V	45	1.0	50.7	-18.5	32.2	43.5	-11.3
164.999	Qp	H	0	2.5	45.5	-19.5	26.0	43.5	-17.5
197.997	Qp	V	-10	1.0	37.6	-18.6	19.0	43.5	-24.5
265.995	Qp	V	20	1.0	35.1	-15.9	19.2	46.0	-26.8
279.998	Qp	H	123	1.0	41.6	-13.9	27.7	46.0	-18.3
299.996	Qp	H	180	1.0	42.9	-14.7	28.2	46.0	-17.8
428.996	Qp	H	182	1.5	32.2	-10.8	21.4	46.0	-24.6
672.105	Qp	V	50	1.0	30.0	-7.2	22.8	46.0	-23.2
799.986	Qp	H	12	1.0	37.7	-5.0	32.7	46.0	-13.3
1344.211	Av	V	90	1.0	28.4	1.3	29.7	54.0	-24.3

TEST PERSONNEL:

Rachid Sehb		03/01/2004
Test Technician/Engineer	Signature	Date Of Test

TABLE 5-2: RECEIVER/DIGITAL INTERFACE RADIATED EMISSIONS TEST EQUIPMENT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DATE
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	3/15/04
900323	EMCO	3160-7	Horn Antennas (8.2 – 12.4 GHz)	9605-1054	6/10/04
900356	EMCO	3160-08	Horn Antennas (12.4 – 18 GHz)	9607-1044	6/10/04
900890	Rhein Tech Labs	Outdoor Range 1	OATS 1	N/A	3/26/2004
900878	Rhein Tech Labs	AM3-1197-0005	3 meter antenna mast, polarizing	N/A	N/A
901242	Rhein Tech Labs	WRT-000-0003	Wood rotating table	N/A	N/A
901231	IW Microwave Products	KPS-1503-2400-KPS	High frequency RF cables	240"	9/5/2004
900321	EMCO	3161-03	Horn Antenna (4 - 8.2 GHz)	9508-1020	4/10/04
901053	Schaffner & Chase	CBL6112B	Bilog Antenna (20 MHz – 2 GHz)	2648	7/3/04
900905	Rhein Tech Labs	PR-1040	Pre Amplifier 40dB (10 MHz – 2 GHz)	1006	7/10/04
900325	EMCO	3160-9	Horn Antennas (18 – 26.5 GHz)	9605-1051	7/30/04

6. RADIATED EMISSION LIMITS RADIATED HARMONICS - §15.247

6.1 RADIATED EMISSION LIMITS TEST PROCEDURE

Radiated Spurious Emissions applies to harmonics and spurious emissions that fall in the restricted and non-restricted bands. The restricted bands are listed in Part 15.205. The maximum permitted average field strength for the restricted band is listed in Part 15.209.

The EUT was tested in its typical configuration in the X, Y-Z plane from 10 kHz to the 10th harmonic of the carrier on channels 1, 6, and 11 for WLAN 2 worst-case at 1 and 9 MBPS data rates. The worst-case results are presented. The test result table below represents the worst-case configuration.

6.2 RADIATED EMISSION LIMITS TEST DATA

Operating Frequency (MHz): 2412
 WLAN On: 2
 Channel: 1
 Data Rate (Mbps): 1

TABLE 6-1: HARMONICS/SPURIOUS (WLAN 2 CHANNEL 1) 1 MBPS

Emission Frequency (MHz)	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Peak Analyzer Readings (dBuV)	Average Analyzer Readings (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4824.08	H	90	1.3	43.4	33.5	13.8	47.3	54.0	-6.7
7235.97	H	90	1.3	37.2	28.9	14.6	43.5	54.0	-10.5
9606.00	H	90	1.3	32.3	23.6	17.1	40.7	54.0	-13.3
12047.00	H	90	1.2	34.2	24.9	15.4	40.3	54.0	-13.7

PEAK: RES. =1 MHz, VID= 1MHz; AVERAGE: RES. =1 MHz, VID= 10Hz; <20dB= 20dB BELOW THE LIMIT

Operating Frequency (MHz): 2412
 WLAN On: 2
 Channel: 1
 Data Rate (Mbps): 9

TABLE 6-2: HARMONICS/SPURIOUS (WLAN 2 CHANNEL 1) 9 MBPS

Emission Frequency (MHz)	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Peak Analyzer Readings (dBuV)	Average Analyzer Readings (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4835.13	H	90	1.3	41.2	31.7	13.8	45.5	54.0	-8.5
7239.88	H	90	1.3	46.1	32.0	14.6	46.6	54.0	-7.4
9639.30	H	90	1.3	32.3	23.5	17.1	40.6	54.0	-13.4
12061.30	H	90	1.2	35.4	24.8	15.4	40.2	54.0	-13.8

AVERAGE: RES. =1 MHz, VID= 10Hz; <20dB= 20dB BELOW THE LIMIT

TEST PERSONNEL:

Rachid Sehb
 Test Technician/Engineer


 Signature

03/04/2004
 Date Of Test

Operating Frequency (MHz): 2437
WLAN On: 2
Channel: 6
Data Rate (Mbps): 1

TABLE 6-3: HARMONICS/SPURIOUS (WLAN 2 CHANNEL 6) 1 MBPS

Emission Frequency (MHz)	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Peak Analyzer Readings (dBuV)	Average Analyzer Readings (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4874.15	H	90	1.3	40.1	29.2	15.2	44.4	54.0	-9.6
7311.35	H	90	1.3	39.7	28.8	13.9	42.7	54.0	-11.4
9749.90	H	90	1.3	32.3	23.8	15.8	39.6	54.0	-14.4

AVERAGE: RES. =1 MHz, VID= 10Hz; NF = NOISE FLOOR; <20dB= 20dB BELOW THE LIMIT

Operating Frequency (MHz): 2437
WLAN On: 2
Channel: 6
Data Rate (Mbps): 9

TABLE 6-4: HARMONICS/SPURIOUS (WLAN 2 CHANNEL 6) 9 MBPS

Emission Frequency (MHz)	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Peak Analyzer Readings (dBuV)	Average Analyzer Readings (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4867.50	H	90	1.3	24.6	15.6	15.2	30.8	54.0	-23.2
7298.00	H	90	1.3	31.4	23.0	13.9	36.9	54.0	-17.1
9735.00	H	90	1.3	35.7	23.8	15.8	39.6	54.0	-14.4
12172.00	H	90	1.3	35.6	24.5	15.7	40.2	54.0	-13.8

AVERAGE: RES. =1 MHz, VID= 10Hz; NF = NOISE FLOOR; <20dB= 20dB BELOW THE LIMIT

TEST PERSONNEL:

Rachid Sehb		03/04/2004
Test Technician/Engineer	Signature	Date Of Test

Operating Frequency (MHz): 2462
WLAN On: 2
Channel: 11
Data Rate (Mbps): 1

TABLE 6-5: HARMONICS/SPURIOUS (WLAN 2 CHANNEL 11) 1 MBPS

Emission Frequency (MHz)	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Peak Analyzer Readings (dBuV)	Average Analyzer Readings (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4924.04	H	90	1.3	41.2	32.1	14.3	46.4	54.0	-7.6
7386.04	H	90	1.3	37.8	21.3	15.6	36.9	54.0	-17.2
9848.80	H	90	1.3	35.8	22.8	16.5	39.3	54.0	-14.7
12311.30	H	90	1.3	35.7	24.8	15.6	40.4	54.0	-13.6

PEAK: RES. =1 MHz, VID= 1MHz; AVERAGE: RES. =1 MHz, VID= 10Hz; <20dB= 20dB BELOW THE LIMIT

Operating Frequency (MHz): 2462
WLAN On: 2
Channel: 11
Data Rate (Mbps): 9

TABLE 6-6: HARMONICS/SPURIOUS (WLAN 2 CHANNEL 11) 9 MBPS

Emission Frequency (MHz)	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Peak Analyzer Readings (dBuV)	Average Analyzer Readings (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4924.38	H	90	1.3	39.6	29.1	14.3	43.4	54.0	-10.6
7386.08	H	90	1.3	39.7	28.9	15.6	44.5	54.0	-9.5
9847.50	H	90	1.3	34.2	24.1	16.5	40.6	54.0	-13.5
1230.95	H	90	1.3	32.8	24.4	15.6	40.0	54.0	-14.0

AVERAGE: RES. =1 MHz, VID= 10Hz; <20dB= 20dB BELOW THE LIMIT

TEST PERSONNEL:

Rachid Sehb
 Test Technician/Engineer


 Signature

03/04/2004
 Date Of Test

TABLE 6-7: RADIATED SPURIOUS EMISSIONS TEST EQUIPMENT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DATE
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	3/15/04
900323	EMCO	3160-7	Horn Antennas (8.2 - 12.4 GHz)	9605-1054	6/10/04
900890	Rhein Tech Labs	Outdoor Range 1	OATS 1	N/A	3/26/2004
900878	Rhein Tech Labs	AM3-1197-0005	3 meter antenna mast, polarizing	N/A	N/A
901242	Rhein Tech Labs	WRT-000-0003	Wood rotating table	N/A	N/A
901231	IW Microwave Products	KPS-1503-2400-KPS	High frequency RF cables	240"	9/5/2004
900356	EMCO	3160-08	Horn Antennas (12.4 - 18 GHz)	9607-1044	6/10/04
900321	EMCO	3161-03	Horn Antenna (4 - 8.2 GHz)	9508-1020	4/10/04
901053	Schaffner & Chase	CBL6112B	Bilog Antenna (20 MHz - 2 GHz)	2648	7/3/04
900905	Rhein Tech Labs	PR-1040	Pre Amplifier 40dB (10 MHz - 2 GHz)	1006	9/10/04
900325	EMCO	3160-9	Horn Antennas (18 - 26.5 GHz)	9605-1051	7/30/04
900905	Rhein Tech Labs	PR-1040	Amplifier	900905	7/10/04
901020	Hewlett Packard	8564E	Portable Spectrum Analyzer (9 kHz - 40 GHz)	3943A01719	7/15/04

7. MODULATED BANDWIDTH - §15.247(A) (2)

7.1 MODULATED BANDWIDTH TEST PROCEDURE

The minimum 6 dB bandwidth per FCC 15.247 (a) (2) was measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The modulated bandwidth was measured from the WLAN with the maximum output power, WLAN2 steering mode 0. WLAN2 was investigated and tested for Channel 1, 6 and 11 in 1 MBPS and 9 MBPS modes. The test equipment used for this testing is listed in the table below.

TABLE 7-1: TEST EQUIPMENT USED FOR TESTING MODULATED BANDWIDTH

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DATE
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771	5/12/04

7.2 MODULATED BANDWIDTH TEST DATA WLAN 2

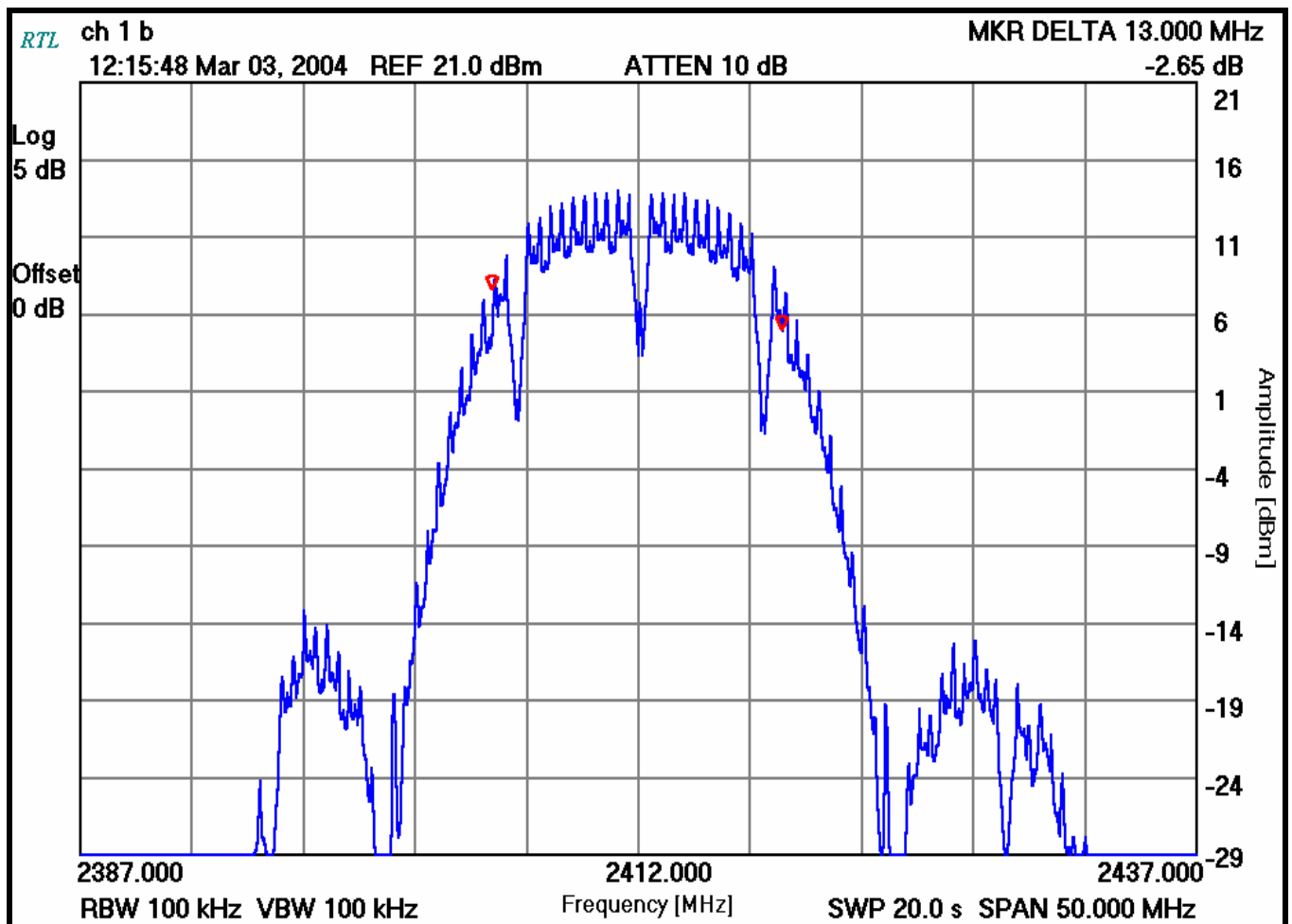
TABLE 7-2: MINIMUM 6 DB MODULATED BANDWIDTHS

CHANNEL 1	6 dB BANDWIDTH (MHz)
1 MBPS	13.0
9 MBPS	16.7
CHANNEL 6	6 dB BANDWIDTH (MHz)
1 MBPS	12.5
9 MBPS	16.4
CHANNEL 11	6 dB BANDWIDTH (MHz)
1 MBPS	12.4
9 MBPS	16.4

7.3 MODULATED BANDWIDTH TEST PLOTS WLAN 2

Operating Frequency (MHz): 2412
 WLAN On: 2
 Channel: 1
 Data Rate (Mbps): 1

PLOT 7-1: 6 DB BANDWIDTH: CHANNEL 1 SET FOR 1 MBPS



TEST PERSONNEL:

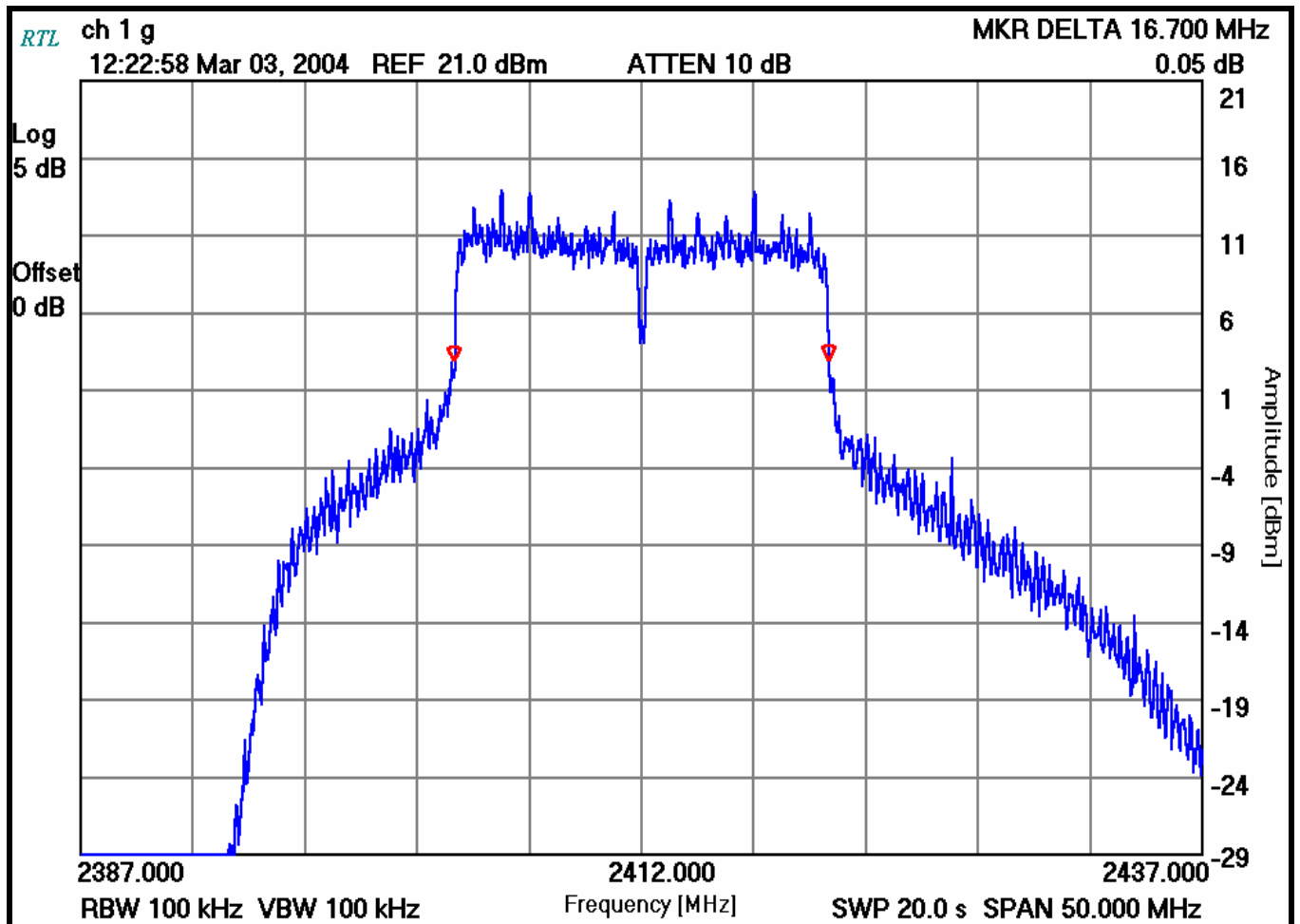
Rachid Sehb
 Test Technician/Engineer

See
 Signature

03/03/2004
 Date Of Test


Operating Frequency (MHz): 2412
WLAN On: 2
Channel: 1
Data Rate (Mbps): 9

PLOT 7-2: 6 DB BANDWIDTH: CHANNEL 1 SET FOR 9 MBPS



TEST PERSONNEL:

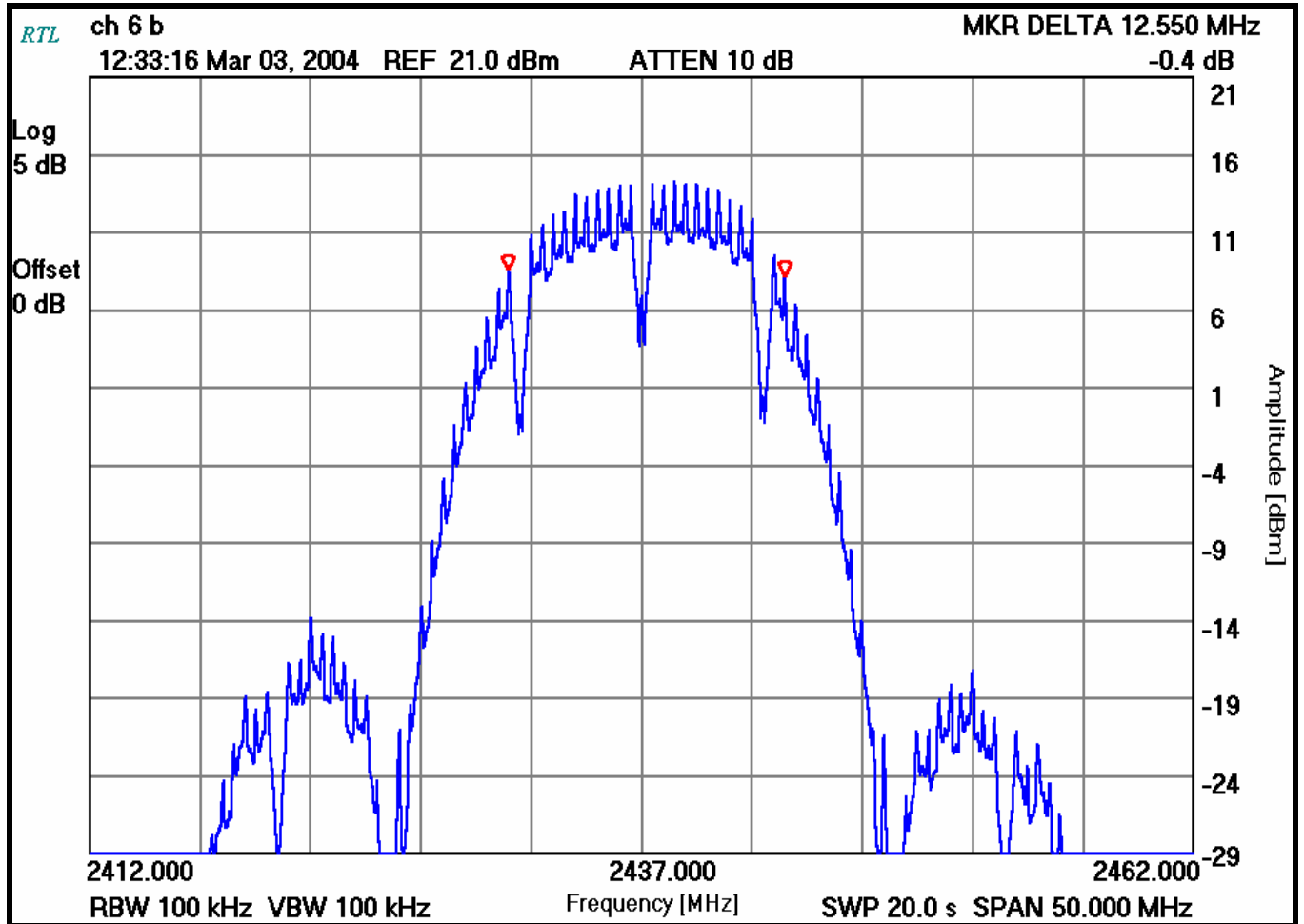
Rachid Sehb
Test Technician/Engineer


Signature

03/03/2004
Date Of Test

Operating Frequency (MHz): 2437
WLAN On: 2
Channel: 6
Data Rate (Mbps): 1

PLOT 7-3: 6 DB BANDWIDTH: CHANNEL 6 SET FOR 1 MBPS



TEST PERSONNEL:

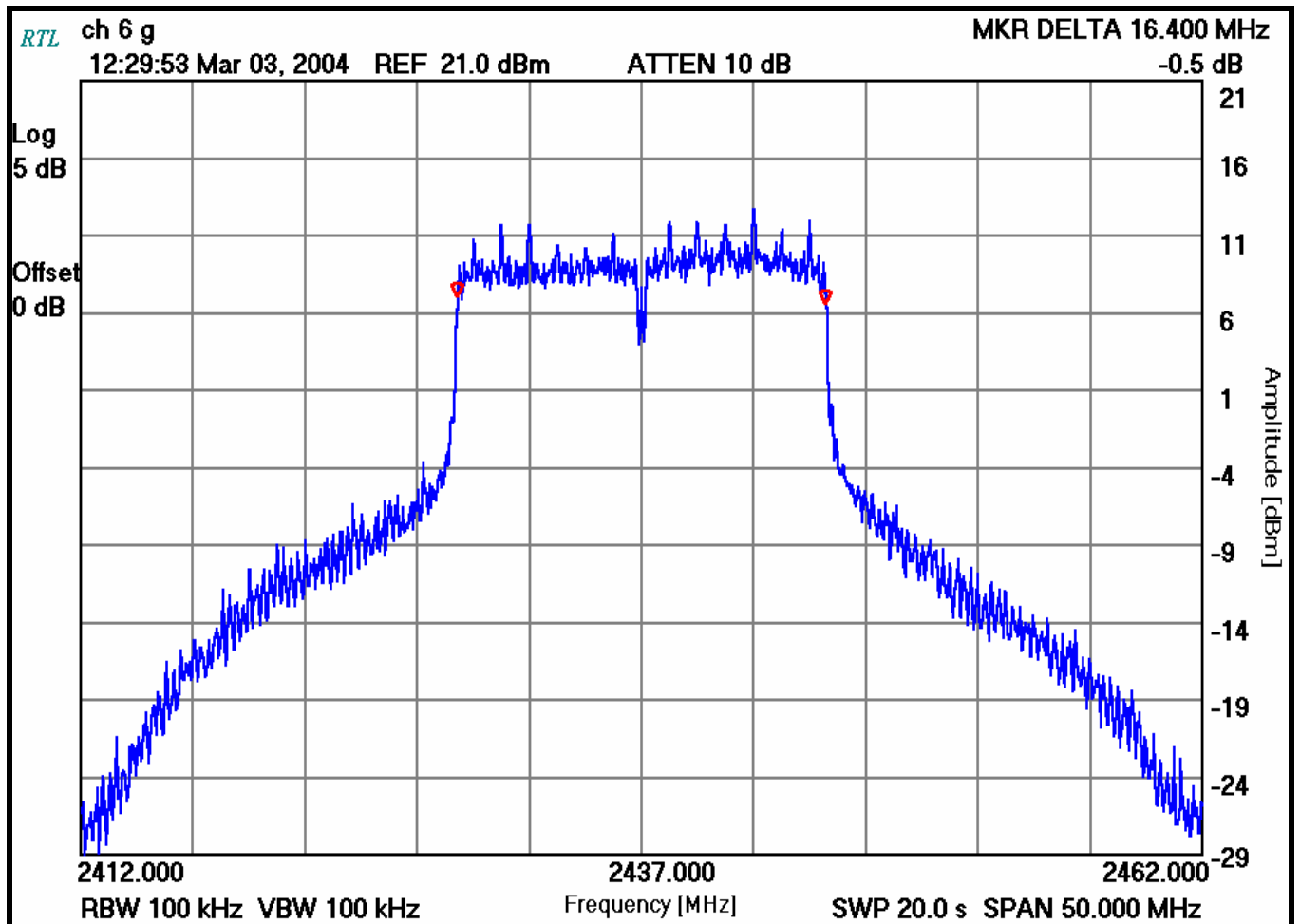
Rachid Sehb
Test Technician/Engineer

See
Signature

03/03/2004
Date Of Test


Operating Frequency (MHz): 2437
WLAN On: 2
Channel: 6
Data Rate (Mbps): 9

PLOT 7-4: 6 DB BANDWIDTH: CHANNEL 6 SET FOR 11 MBPS



TEST PERSONNEL:

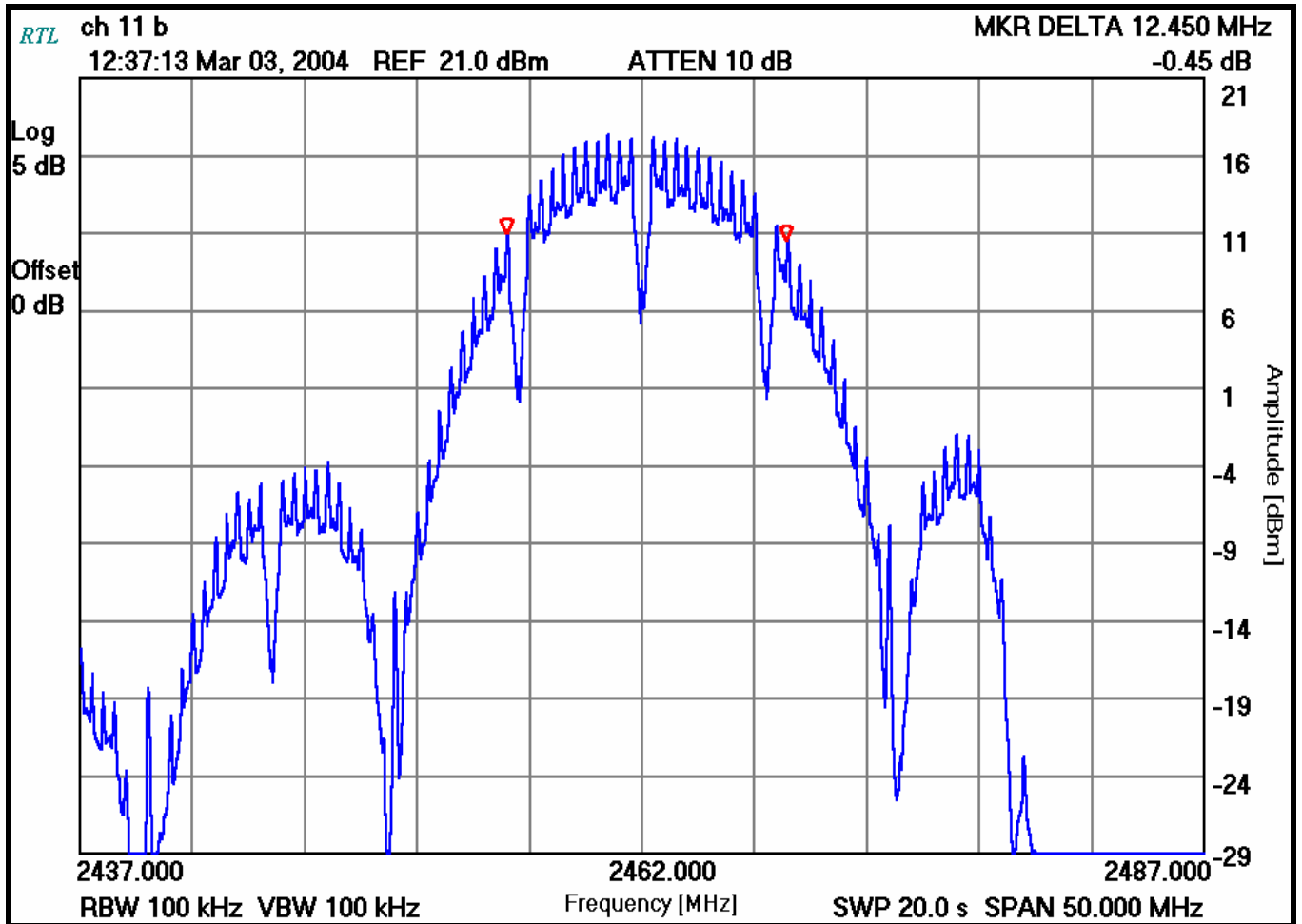
Rachid Sehb
Test Technician/Engineer


Signature

03/03/2004
Date Of Test

Operating Frequency (MHz): 2462
WLAN On: 2
Channel: 11
Data Rate (Mbps): 1

PLOT 7-5: 6 DB BANDWIDTH: CHANNEL 11 SET FOR 1 MBPS



TEST PERSONNEL:

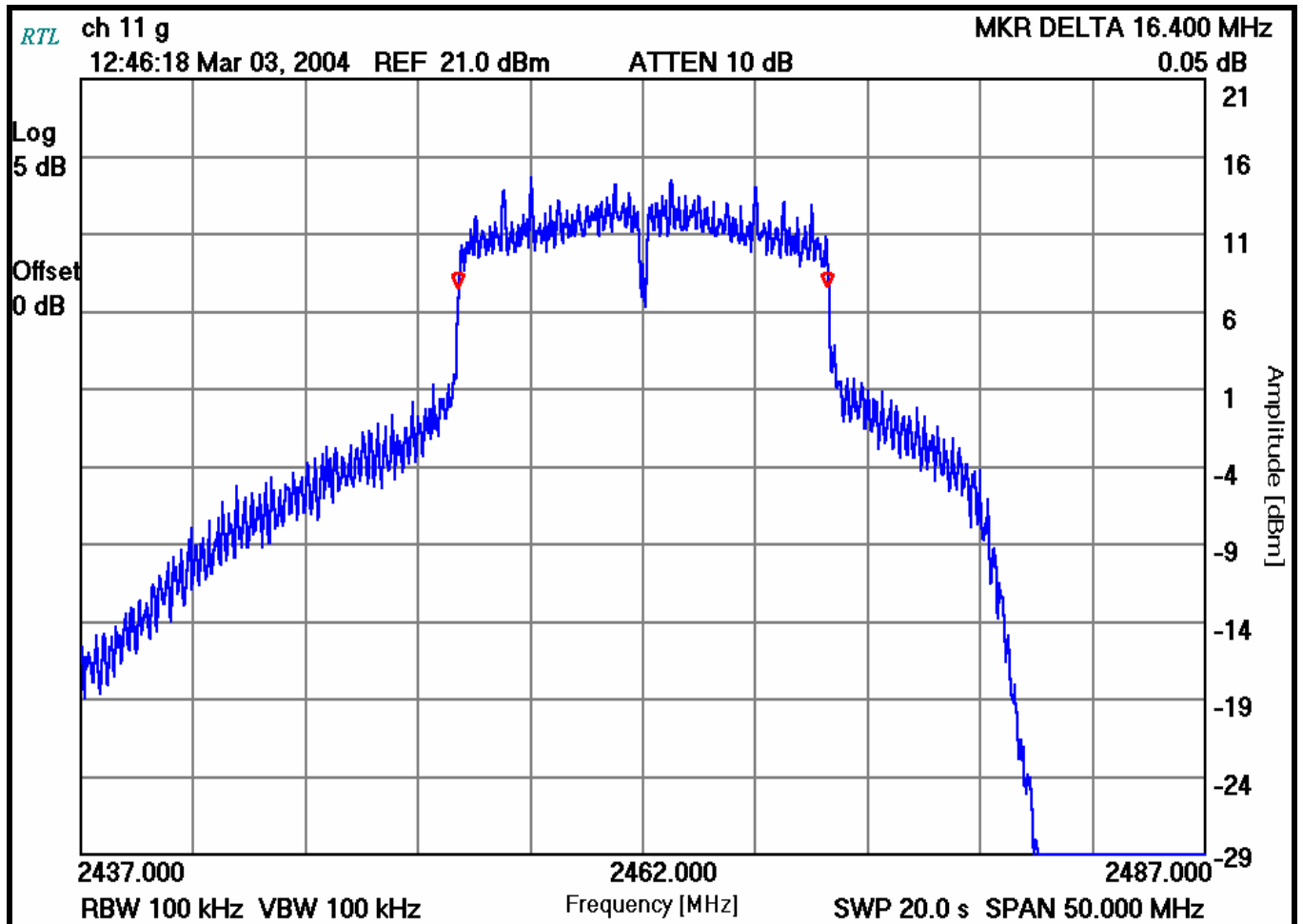
Rachid Sehb
 Test Technician/Engineer

Sehb
 Signature

03/03/2004
 Date Of Test

Operating Frequency (MHz): 2462
WLAN On: 2
Channel: 11
Data Rate (Mbps): 9

PLOT 7-6: 6 DB BANDWIDTH: CHANNEL 11 SET FOR 9 MBPS



TEST PERSONNEL:

Rachid Sehb
Test Technician/Engineer


Signature

03/03/2004
Date Of Test

8. POWER OUTPUT - §15.247(B)

8.1 POWER OUTPUT TEST PROCEDURE

The peak conducted output power of the EUT was measured using an oscilloscope and an RF diode detector to determine the maximum deviation. The substitution method was used to determine the conducted power output of the unit. The highest conducted output power from each WLAN was tested at 1 MBPS and 9 MBPS 0 degree, +45 degrees and -45 degrees steering modes.

The test equipment used for testing is listed in the table 8-1.

8.2 TEST EQUIPMENT USED FOR TESTING

TABLE 8-1: TEST EQUIPMENT USED FOR TESTING RADIATED RF OUTPUT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DATE
901186	Agilent Technologies	E9323A (50 MHz-6 GHz)	Peak & Average Power Sensor	US40410380	7/30/04
901184	Agilent Technologies	E4416A	EPM-P Power Meter	GB41050573	7/30/04
901263	Agilent Technologies	.01-12 GHz	SMA Detector	2936A05505	
900917	Hewlett Packard	8648C	Signal Generator (100 kHz - 3200 MHz)	3537A01741	5/2/2004
900561	Tektronix	TDS540B	Oscilloscope	B020129	3/2/2005

8.3 POWER OUTPUT TEST DATA

TABLE 8-2: POWER OUTPUT TEST DATA

Operating Frequency (MHz): 2412, 2437 & 2462

Channels: 1, 6 & 11

DATA RATE (MBPS)	POWER CONDUCTED OUTPUT (DBM) 0 DEGREES		
	CH 1	CH 6	CH 11
1	24.2	24.4	24.5
9	24.4	24.3	24.5
DATA RATE (MBPS)	POWER CONDUCTED OUTPUT (DBM) +45 DEGREES		
	CH 1	CH 6	CH 11
1	24.6	24.3	24.6
9	24.5	24.6	24.6
DATA RATE (MBPS)	POWER CONDUCTED OUTPUT (DBM) -45 DEGREES		
	CH 1	CH 6	CH 11
1	24.4	24.4	24.3
9	24.2	24.5	24.4

MEASUREMENT ACCURACY IS +/- 1.5 DB

TEST PERSONNEL:

Rachid Sehb		03/02/2004
Test Technician/Engineer	Signature	Date Of Test

9. ANTENNA CONDUCTED SPURIOUS EMISSIONS - §15.247(C)

9.1 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST PROCEDURES

Antenna conducted spurious emissions per FCC 15.247(c) were measured from the EUT antenna port using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 300 kHz. The modulated carrier was identified at 2.412 GHz for Channel 1, 2.437 GHz for Channel 6, and 2.462 GHz for Channel 11. No other harmonics or spurs were found within 20 dB of the carrier level, and from 9 kHz to the carrier's 10th harmonic. The EUT was tested in its typical configuration from 9 kHz to the 10th harmonic of the carrier at Channels 1, 6, and 11 for WLAN 2, 0 degree steering mode and at 1 and 9 MBPS data rates. Test results for antenna conducted spurious noise are listed in the table below.

9.2 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST DATA, WLAN 2 CHANNEL 1 AT 1 MBPS

Operating Frequency (MHz): 2412
Channel: 1
WLAN On: 2
Peak (dBm): 11.0

TABLE 9-1: WLAN 2 CHANNEL 1 AT 1 MBPS

Frequency (MHz)	Measured Level (dBm)	Notch Filter Insertion Loss +Cable loss (dB)	Corrected Measured Level (dBm)	Corrected Measured Level (dBc)	Limit (dBc)	Margin (dB)
5.41	-59.7	0.2	-59.5	-70.5	-20.0	-50.5
6.53	-60.1	0.2	-59.9	-70.9	-20.0	-50.9
4821.84	-54.1	1.5	-52.6	-63.6	-20.0	-43.6
7232.99	-79.9	3.6	-76.3	-87.3	-20.0	-67.3
9647.94	-76.4	8.4	-68.0	-79.0	-20.0	-59.0

TEST PERSONNEL:

Rachid Sehb		03/04/2004
Test Technician/Engineer	Signature	Date Of Test


9.3 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST DATA, WLAN 2 CHANNEL 1 AT 9 MBPS

Operating Frequency (MHz): 2412
Channel: 1
WLAN On: 2
Peak (dBm): 13.0

TABLE 9-2: WLAN 2 CHANNEL 1 AT 9 MBPS

Frequency (MHz)	Measured Level (dBm)	Notch Filter Insertion Loss +Cable loss (dB)	Corrected Measured Level (dBm)	Corrected Measured Level (dBc)	Limit (dBc)	Margin (dB)
4.92	-59.2	0.1	-59.1	-72.1	-20.0	-52.1
6.43	-59.7	0.2	-59.5	-72.5	-20.0	-52.5
1925.00	-75.2	1.7	-73.5	-86.5	-20.0	-66.5
3239.08	-75.8	1.8	-74.0	-87.0	-20.0	-67.0
4836.36	-62.9	1.5	-61.4	-74.4	-20.0	-54.4
7239.71	-75.8	3.6	-72.2	-85.2	-20.0	-65.2
9660.90	-77.7	8.4	-69.3	-82.3	-20.0	-62.3

TEST PERSONNEL:

Rachid Sehb Test Technician/Engineer	 Signature	03/04/2004 Date Of Test
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9.4 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST DATA, WLAN 2 CHANNEL 6 AT 1 MBPS

Operating Frequency (MHz): 2437
Channel: 6
WLAN On: 2
Peak (dBm): 12.1

TABLE 9-3: WLAN 2 CHANNEL 6 AT 1 MBPS

Frequency (MHz)	Measured Level (dBm)	Notch Filter Insertion Loss +Cable loss (dB)	Corrected Measured Level (dBm)	Corrected Measured Level (dBc)	Limit (dBc)	Margin (dB)
4.19	-58.8	0.1	-58.7	-70.8	-20.0	-50.8
6.15	-59.2	0.2	-59.0	-71.1	-20.0	-51.1
28.07	-67.5	0.3	-67.2	-79.3	-20.0	-59.3
63.10	-68.8	0.3	-68.5	-80.6	-20.0	-60.6
152.40	-71.0	0.3	-70.7	-82.8	-20.0	-62.8
2658.62	-76.0	4.3	-71.7	-83.8	-20.0	-63.8
4872.41	-49.3	2.1	-47.2	-59.3	-20.0	-39.3
7310.23	-58.4	5.1	-53.3	-65.4	-20.0	-45.4
9745.45	-56.2	9.1	-47.1	-59.2	-20.0	-39.2
12188.64	-71.0	13.0	-58.0	-70.1	-20.0	-50.1

TEST PERSONNEL:

Rachid Sehb Test Technician/Engineer	 Signature	03/04/2004 Date Of Test
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9.5 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST DATA, WLAN 2 CHANNEL 6 AT 9 MBPS

Operating Frequency (MHz): 2437
Channel: 6
WLAN On: 2
Peak (dBm): 10.4

TABLE 9-4: WLAN 2 CHANNEL 6 AT 9 MBPS

Frequency (MHz)	Measured Level (dBm)	Notch Filter Insertion Loss +Cable loss (dB)	Corrected Measured Level (dBm)	Corrected Measured Level (dBc)	Limit (dBc)	Margin (dB)
5.95	-58.2	0.1	-58.1	-68.5	-20.0	-48.5
11.42	-64.5	0.2	-64.3	-74.7	-20.0	-54.7
1728.72	-73.8	1.5	-72.3	-82.7	-20.0	-62.7
4869.47	-58.3	2.1	-56.2	-66.6	-20.0	-46.6
7320.22	-63.4	5.1	-58.3	-68.7	-20.0	-48.7
9748.31	-66.4	9.1	-57.3	-67.7	-20.0	-47.7

TEST PERSONNEL:

Rachid Sehb		03/04/2004
Test Technician/Engineer	Signature	Date Of Test

9.6 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST DATA, WLAN 2 CHANNEL 11 AT 1 MBPS

Operating Frequency (MHz): 2462
Channel: 11
WLAN On: 2
Peak (dBm): 13.9

TABLE 9-5: WLAN 2 CHANNEL 11 AT 1 MBPS

Frequency (MHz)	Measured Level (dBm)	Notch Filter Insertion Loss (dB)	Splitter Insertion Loss (dB)	Corrected Measured Level (dBm)	Limit (dBm)	Margin (dB)
5.58	-59.0	0.1	-58.9	-72.8	-20.0	-52.8
4.24	-58.8	0.1	-58.7	-72.6	-20.0	-52.6
1829.74	-74.6	1.4	-73.2	-87.1	-20.0	-67.1
4920.54	-44.3	2.0	-42.3	-56.2	-20.0	-36.2
7385.39	-51.9	2.9	-49.0	-62.9	-20.0	-42.9
9846.07	-49.9	9.0	-40.9	-54.8	-20.0	-34.8

TEST PERSONNEL:

Rachid Sehb		03/04/2004
Test Technician/Engineer	Signature	Date Of Test


9.7 ANTENNA CONDUCTED SPURIOUS EMISSIONS TEST DATA, WLAN 2 CHANNEL 11 AT 9 MBPS

Operating Frequency (MHz): 2462
Channel: 11
WLAN On: 2
Peak (dBm): 12.3

TABLE 9-6: WLAN 2 CHANNEL 11 AT 9 MBPS

Frequency (MHz)	Measured Level (dBm)	Notch Filter Insertion Loss (dB)	Splitter Insertion Loss (dB)	Corrected Measured Level (dBm)	Limit (dBm)	Margin (dB)
4.39	-58.3	0.1	-58.2	-70.5	-20.0	-50.5
5.71	-58.1	0.1	-58.0	-70.3	-20.0	-50.3
57.50	-74.6	0.2	-74.4	-86.7	-20.0	-66.7
662.10	-74.1	0.4	-73.7	-86.0	-20.0	-66.0
1886.49	-72.1	1.4	-70.7	-83.0	-20.0	-63.0
1346.20	-73.5	0.9	-72.6	-84.9	-20.0	-64.9
4919.41	-57.9	2.0	-55.9	-68.2	-20.0	-48.2
7387.06	-56.8	2.9	-53.9	-66.2	-20.0	-46.2
9834.83	-64.1	9.0	-55.1	-67.4	-20.0	-47.4

TEST PERSONNEL:

Rachid Sehb		03/04/2004
Test Technician/Engineer	Signature	Date Of Test

9.8 ANTENNA CONDUCTED SPURIOUS TEST EQUIPMENT

TABLE 9-7: ANTENNA CONDUCTED SPURIOUS TEST EQUIPMENT

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DATE
901020	Hewlett Packard	8564E	Spectrum Analyzer (30 Hz – 40 GHz)	3943A01719	7/15/04

10. POWER SPECTRAL DENSITY - §15.247(D)

10.1 POWER SPECTRAL DENSITY TEST PROCEDURE

The power spectral density per FCC 15.247(d) was measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 3 kHz, the video bandwidth set at 30 kHz, and the sweep time set at 1000 seconds. The spectral lines were resolved for the modulated carriers at 2.412 GHz, 2.437 GHz, and 2.462 GHz respectively. These levels are well below the +8 dBm limit. The maximum conducted power output, WLAN 2, 0 degree steering was investigated and tested for channel 1, 6 and 11 in 1 MBPS and 9 MBPS modes. The test equipment used for this testing is listed in the table below.

10.2 TEST EQUIPMENT USED FOR TESTING

TABLE 10-1: TEST EQUIPMENT USED FOR TESTING POWER SPECTRAL DENSITY

RTL ASSET #	MANUFACTURER	MODEL	PART TYPE	SERIAL NUMBER	CALIBRATION DATE
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz – 22 GHz)	3138A07771	03/15/04

10.3 POWER SPECTRAL DENSITY TEST DATA WLAN 2

Operating Frequency (MHz): 2412, 2437 & 2462

Channel: 1, 6 & 11

Limit (dBm): 8

TABLE 10-2: POWER SPECTRAL DENSITY TEST DATA

CHANNEL	POWER SPECTRAL DENSITY LIMIT = +8DBM	
	1 MBPS	9 MBPS
1	1.4	0.9
6	-0.6	1.2
11	2.9	3.3

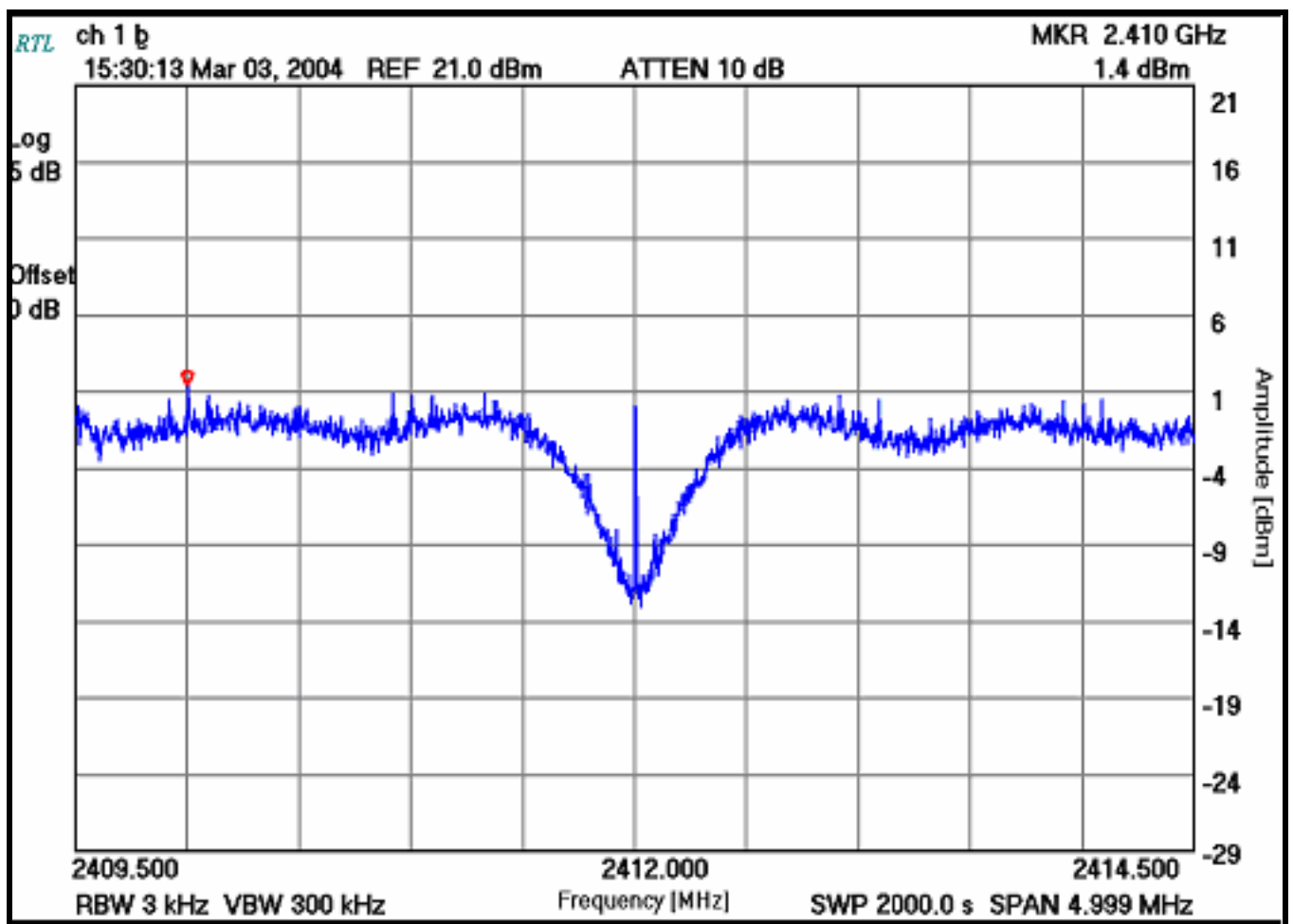
TEST PERSONNEL:

Rachid Sehb		03/03/2004
Test Technician/Engineer	Signature	Date Of Test

10.4 POWER SPECTRAL DENSITY TEST PLOTS WLAN 2

Operating Frequency (MHz): 2412
WLAN On: 2
Channel: 1
Data Rate (Mbps): 1
Bandwidth Resolution (kHz): 3
Bandwidth Video (kHz): 300
Sweep Time (s): 1000.0

PLOT 10-1: POWER SPECTRAL DENSITY: CHANNEL 1 AT 1 MBPS



TEST PERSONNEL:

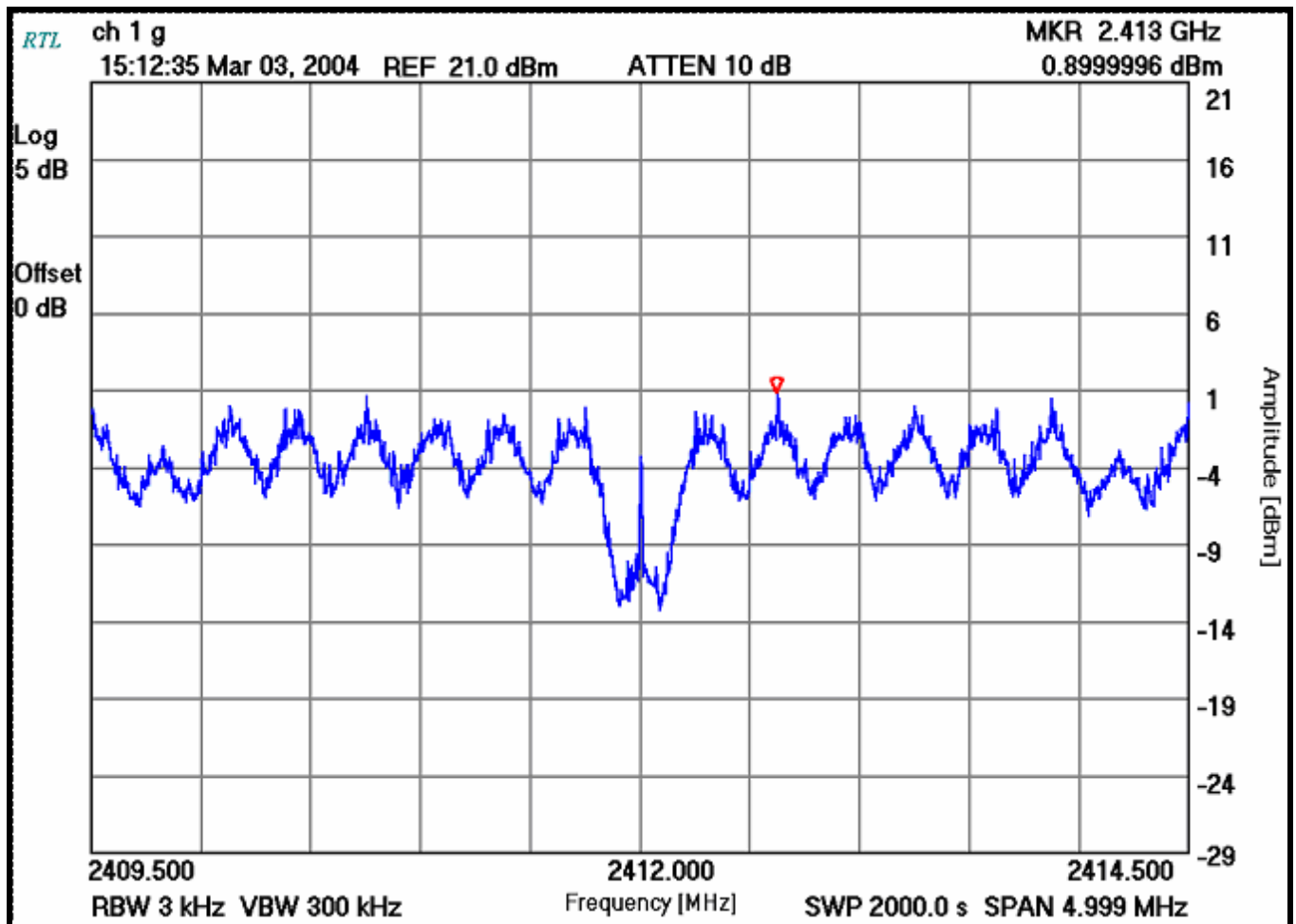
Rachid Sehb
Test Technician/Engineer


Signature

03/03/2004
Date Of Test

Operating Frequency (MHz): 2412
WLAN On: 2
Channel: 1
Data Rate (Mbps): 9
Bandwidth Resolution (kHz): 3
Bandwidth Video (kHz): 300
Sweep Time (s): 1000.0

PLOT 10-2: POWER SPECTRAL DENSITY: CHANNEL 1 AT 9 MBPS



TEST PERSONNEL:

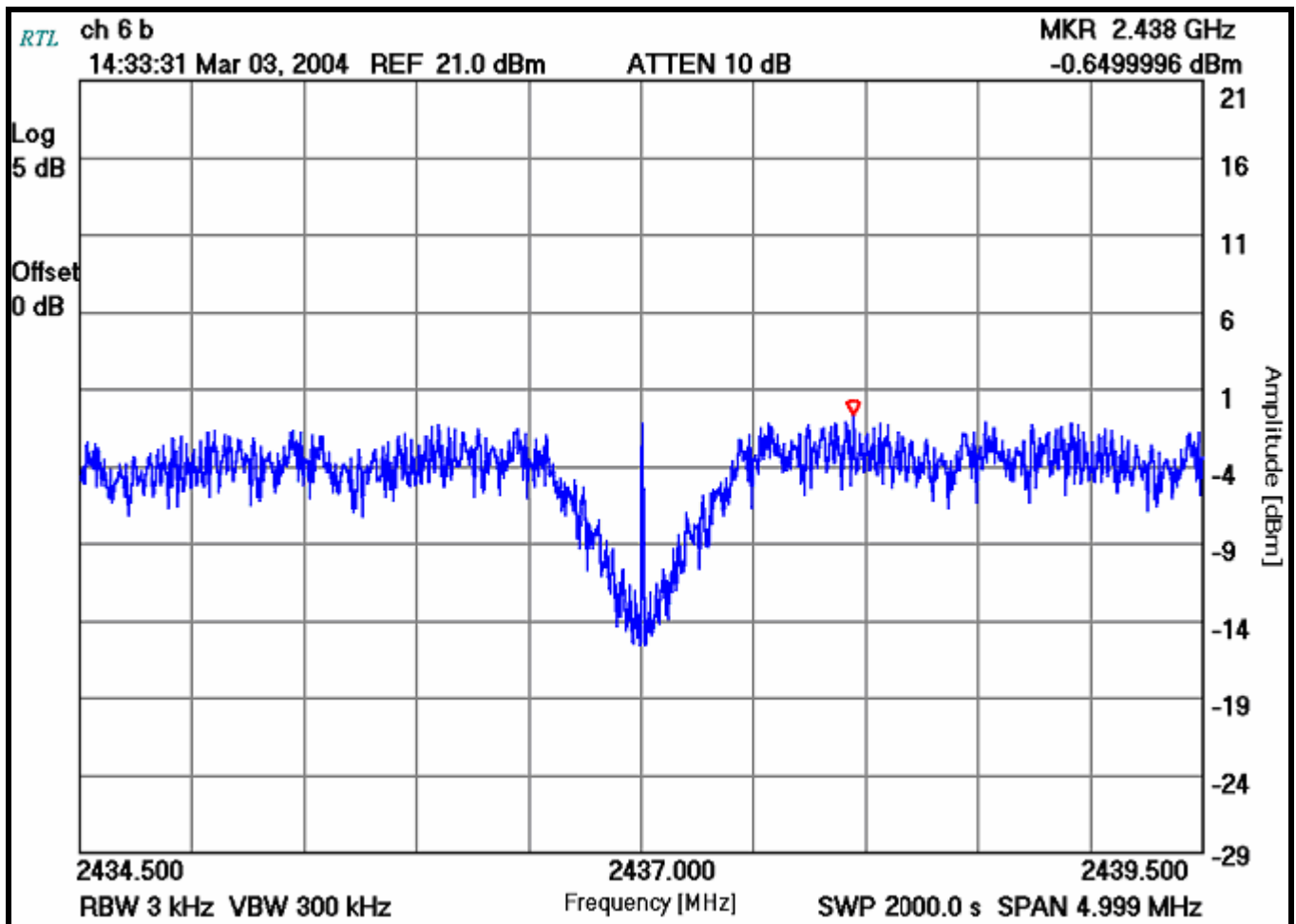
Rachid Sehb
 Test Technician/Engineer

See
 Signature

03/03/2004
 Date Of Test

Operating Frequency (MHz): 2436
WLAN On: 2
Channel: 6
Data Rate (Mbps): 1
Bandwidth Resolution (kHz): 3
Bandwidth Video (kHz): 300
Sweep Time (s): 1000.0

PLOT 10-3: POWER SPECTRAL DENSITY: CHANNEL 6 AT 1 MBPS



TEST PERSONNEL:

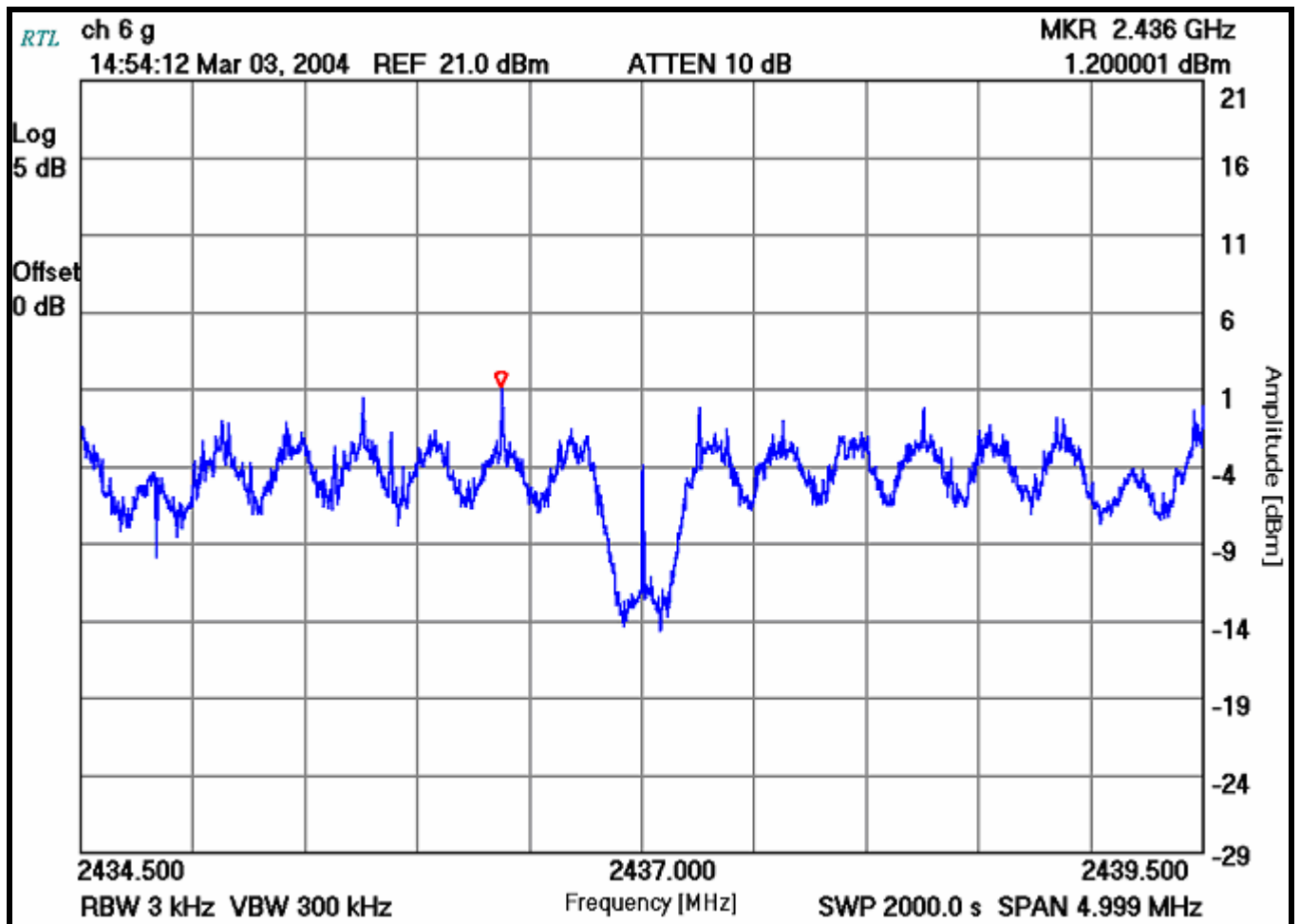
Rachid Sehb
 Test Technician/Engineer

See
 Signature

03/03/2004
 Date Of Test

Operating Frequency (MHz): 2436
WLAN On: 2
Channel: 6
Data Rate (MBPS): 9
Bandwidth Resolution (kHz): 3
Bandwidth Video (kHz): 300
Sweep Time (s): 1000.0

PLOT 10-4: POWER SPECTRAL DENSITY: CHANNEL 6 AT 9 MBPS



TEST PERSONNEL:

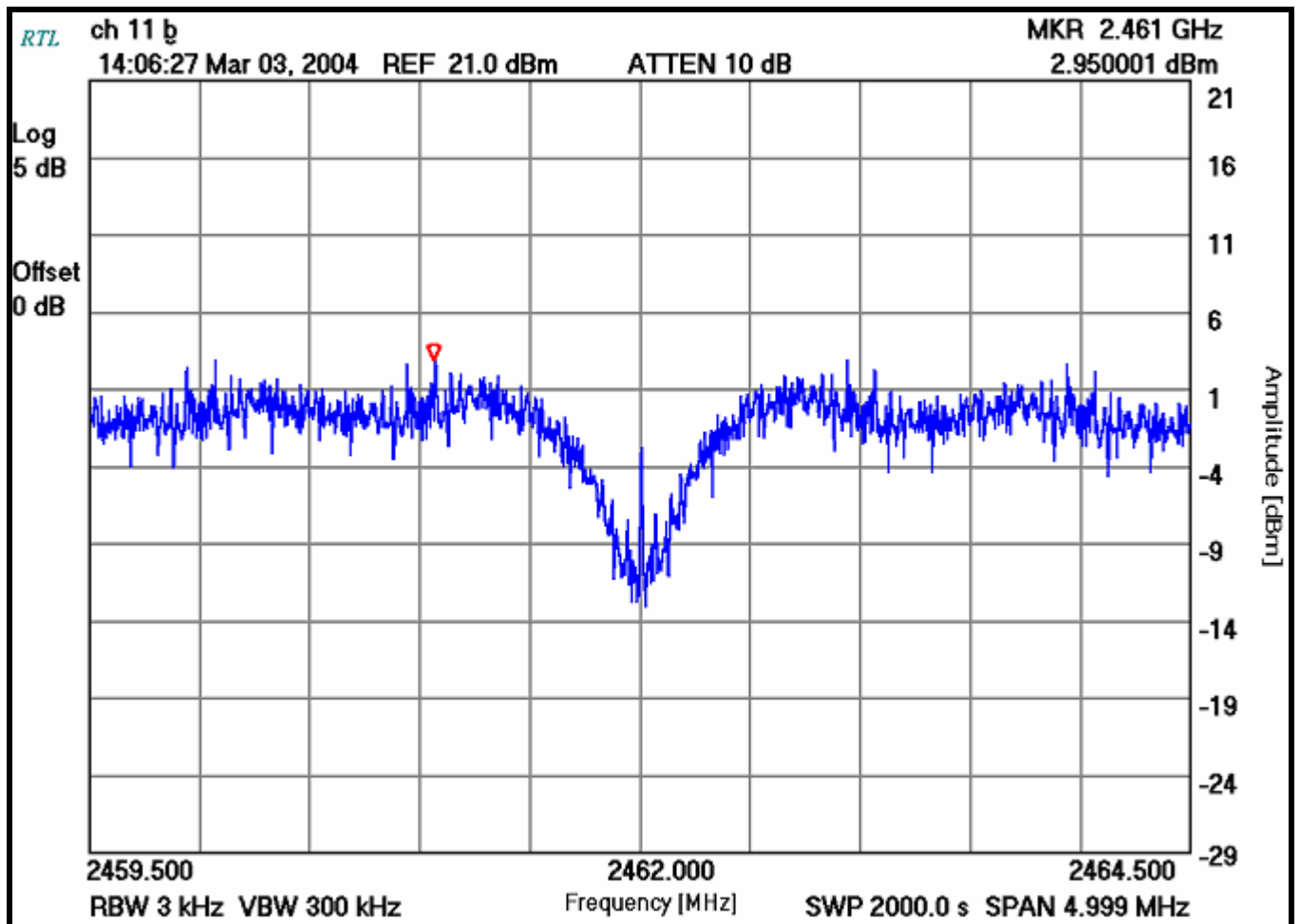
Rachid Sehb
 Test Technician/Engineer

See
 Signature

03/03/2004
 Date Of Test

Operating Frequency (MHz): 2462
WLAN On: 2
Channel: 11
Data Rate (Mbps): 1
Bandwidth Resolution (kHz): 3
Bandwidth Video (kHz): 300
Sweep Time (s): 1000.0

PLOT 10-5: POWER SPECTRAL DENSITY: CHANNEL 11 AT 1 MBPS



TEST PERSONNEL:

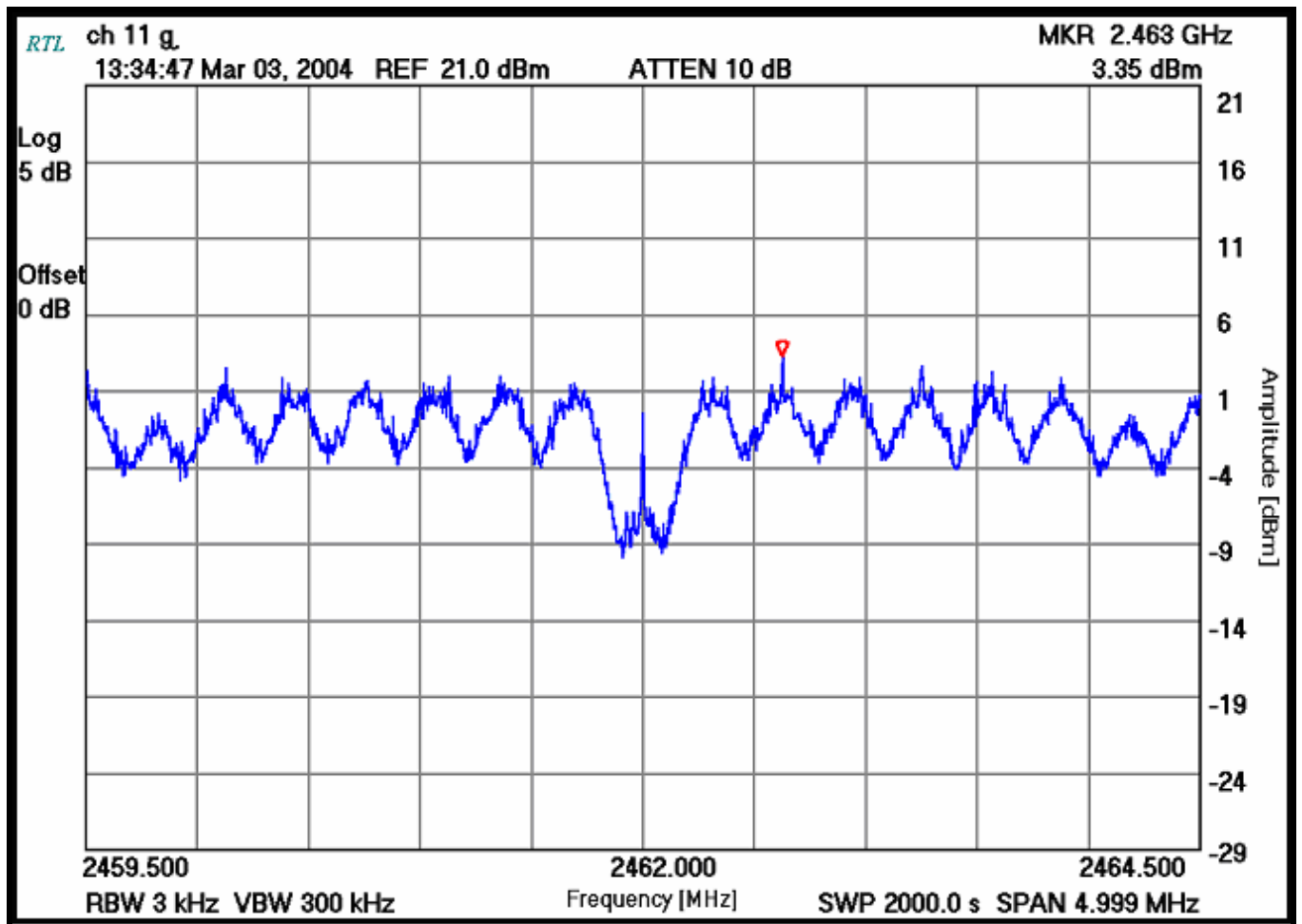
Rachid Sehb
Test Technician/Engineer


Signature

03/03/2004
Date Of Test

Operating Frequency (MHz): 2462
WLAN On: 2
Channel: 11
Data Rate (MBPS): 9
Bandwidth Resolution (kHz): 3
Bandwidth Video (kHz): 300
Sweep Time (s): 1000.0

PLOT 10-6: POWER SPECTRAL DENSITY: CHANNEL 11 AT 9 MBPS



TEST PERSONNEL:

Rachid Sehb
Test Technician/Engineer


Signature

03/03/2004
Date Of Test

11. CONCLUSION

The data in this measurement report shows that the Vivato, Inc. Model VP2200A, FCC ID: QLVNESH24SWP, complies with all the requirements of Parts 2 and 15 of the FCC Rules and Industry Canada RSS-210.