Application for

Cirronet, Incorporated
FCC Part 15, Certification
For the
ZMN2405HPA

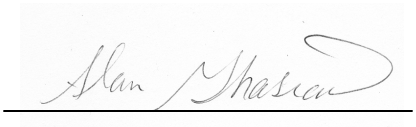
FCC ID: HSW-Z2405HPA

UST Project: 07-0297
Issue Date: February 13, 2008

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

I certify that I am authorized to sign for the manufacturer and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US Tech (AGENT RESPONSIBLE FOR TEST):

By: 

Name: Alan Ghasiani

Title: Operations & Engineering

Date: February 13, 2008

Cirronet, Incorporated
3079 Premiere Parkway
Duluth, GA 30097

By: _____

Name: _____

Title: _____

Date: _____

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Cirronet, Incorporated**

MODEL: **ZMN2405HPA**

FCC ID: **HSW- Z2405HPA**

DATE: **February 13, 2008**

This report concerns (check one): Original grant X
Class II change_____

Equipment type: **2.4 GHz Zigbee Radio**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____
date

N.A. agrees to notify the Commission by N.A.
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

Table Of Contents

List Of Figures

List Of Tables

1. General Information

1.1 Product Description

The Equipment Under Test (EUT) is a Cirronet, Incorporated, Model ZMN2405HPA High Power modular 2.4 GHz Spread Spectrum Transceiver. The EUT will be used with an integrated antenna.

1.2 Related Submittal(s)/Grant(s)

The EUT will be used to send/receive data. The transceiver presented in this report will be used with other like transceivers:

The EUT is subject to the following authorizations:

a) Certification as a transceiver (modular approval)
b) Verification as a digital device

The information contained in this report is presented for the certification & verification authorization(s) for the EUT. The manufacturer desires to seek a modular approval on this device.

2. Tests and Measurements

2.1 Configuration of Tested System

The EUT's antenna is not removable, therefore all measurements are performed using radiated techniques. The test sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2003), FCC KDB Publication Number 558074, FCC DA 00- 705. Conducted and radiated emissions data below 1 GHz were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. Above 1 GHz, bandwidths are 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Block diagrams of the tested systems are shown in Figure 1. Test configuration photographs for spurious and fundamental emissions measurement are shown in Figures 2 and 3. Power line conducted emissions measurement setup is shown in Figure 4.

The sample used for testing was received by US Tech on January 28, 2008 in good condition.

2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC under designation number US5117. Additionally this site has also been fully described and submitted to Industry Canada (IC) and has been approved under file number 2982A-1.

2.3 Test Equipment

Table 1 contains a list of EUT and peripherals. Table 2 describes test equipment used to evaluate this product.

2.4 Modifications

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15, Subpart C Limits for the transmitter portion of the EUT or the Subpart B, Class B Digital Device Requirements.

Figure 1.
Test Configuration

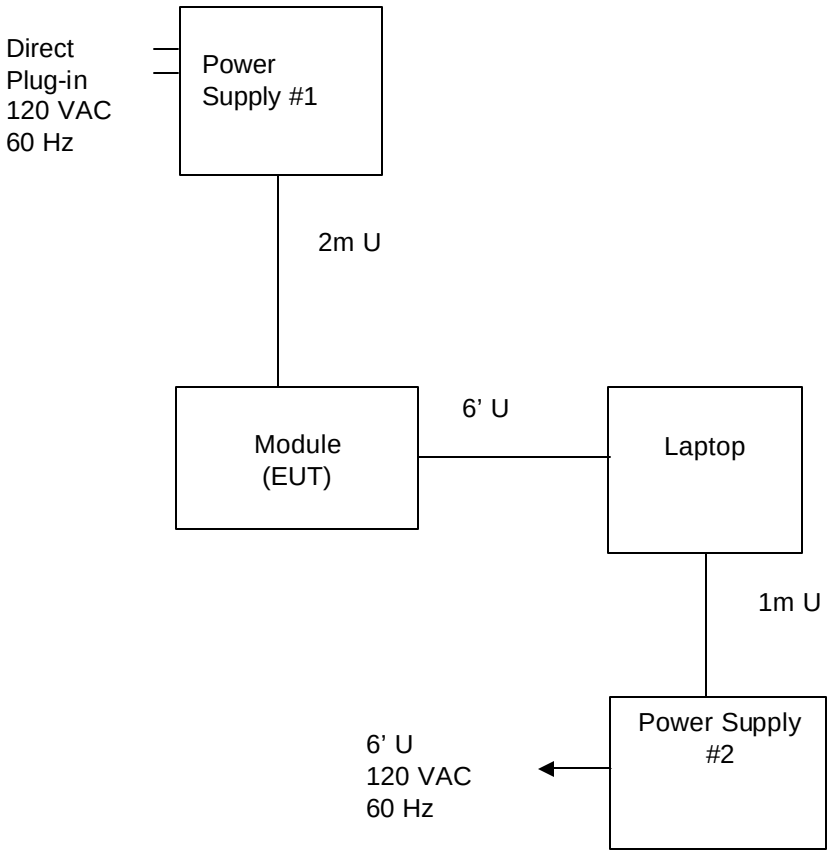


Table 1.

EUT and Peripherals

PERIPHERAL MANU.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
(EUT) Cirronet, Incorporated	ZMN2405HPA	None	Pending: HSW-Z2405HPA	2 m U
Antenna Various, see antenna descriptions			None	Varied from 0.2 to 1 meter,Shielded
Power Supply GlobTek	GT-41052-1509	None	None	Direct Plug-in 120 VAC/ 60 Hz
Laptop Computer IBM	600X	78-WHPB3	None	1m U 6' U
Power Supply IBM	None	None	None	6' U 120 VAC/ 60 Hz

Figure 2.

Photograph(s) of Fundamental and Spurious Emissions Measurement (Front View)

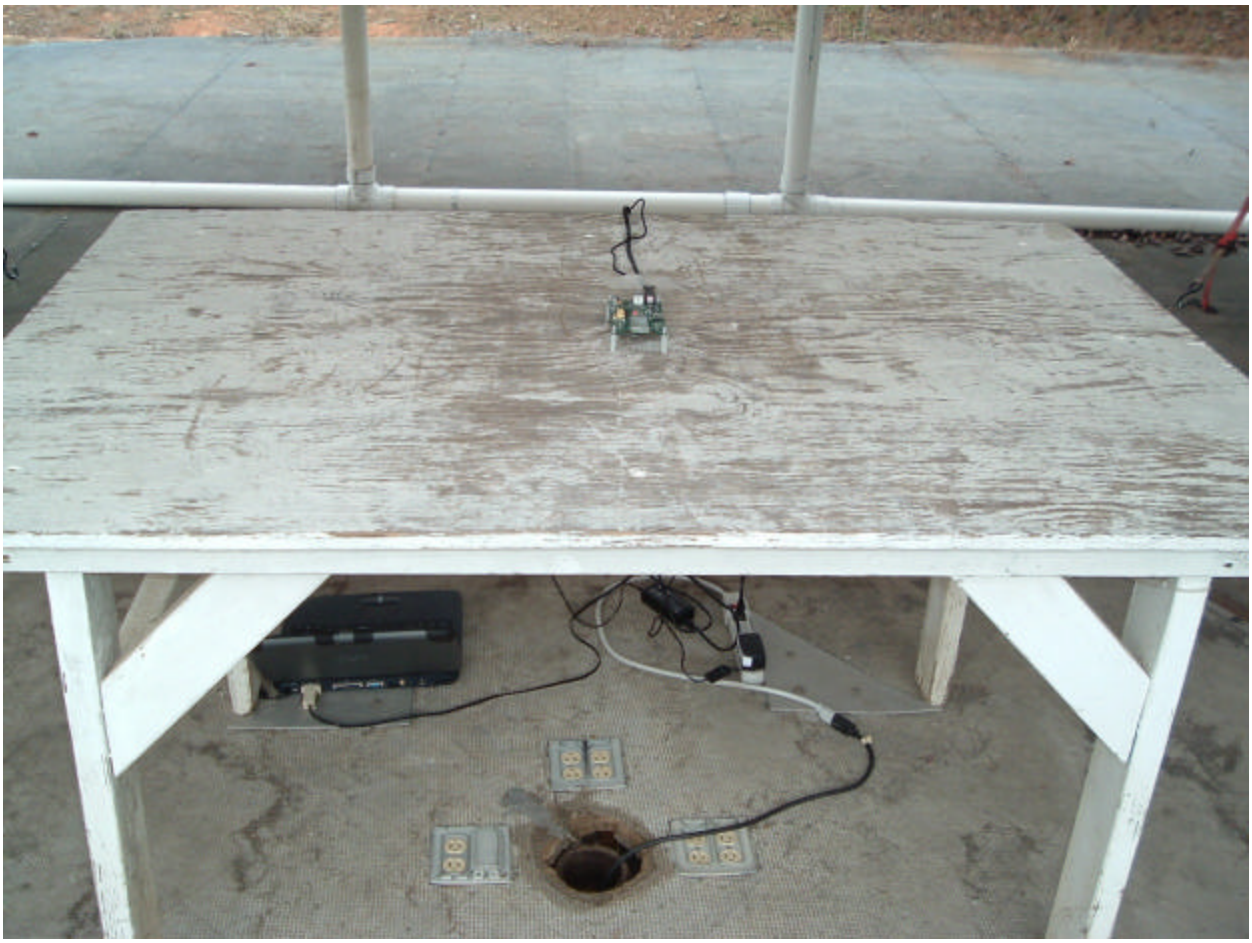


Figure 3.

Photograph(s) of Fundamental and Spurious Radiated Emissions Measurement (Rear View)

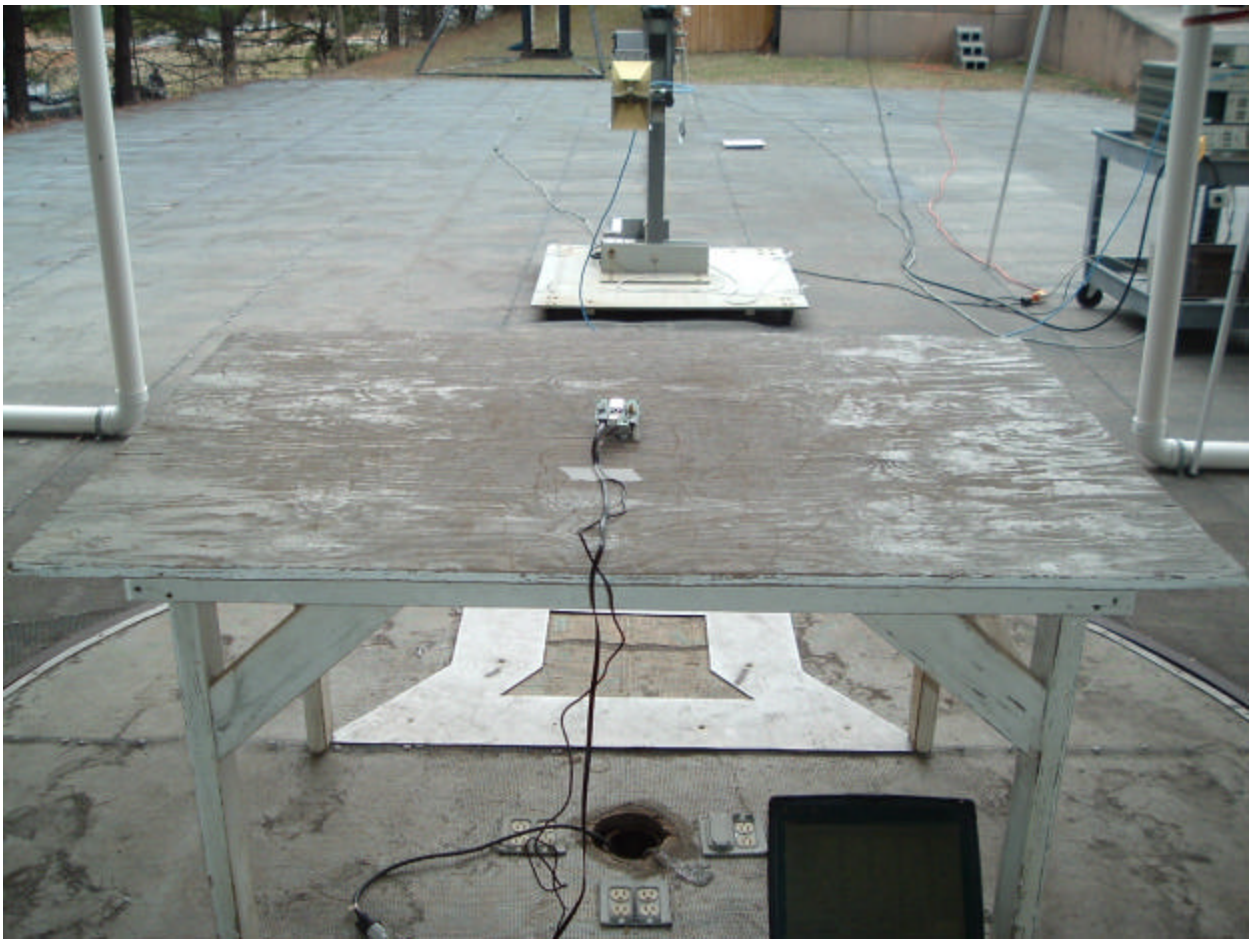


Figure 4.

Photograph of Conducted Emissions Measurement

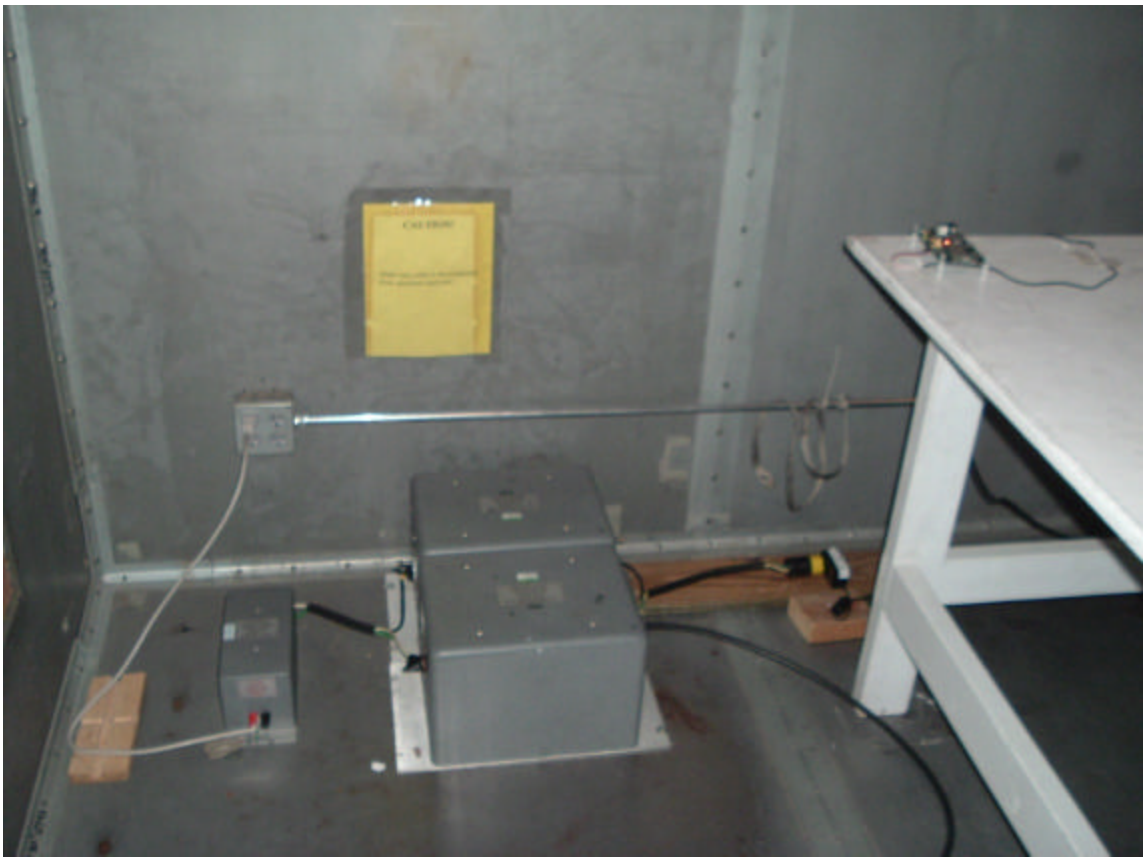


Table 2.
Test Instruments

EQUIPMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2332A10055	1/10/08
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	7/16/07
SIGNAL GENERATOR	8648B	HEWLETT-PACKARD	3642U01679	10/30/07
RF PREAMP	8447D	HEWLETT-PACKARD	2944A06291	6/14/07
BICONICAL ANTENNA	3110B	EMCO	9307-1431	11/15/07
LOG PERIODIC	3146	EMCO	3110-3236	11/21/07
LISN (x 2) 8028-50-TS24-BNC	8028	SOLAR ELE.	910494 & 910495	5/10/07
HORN ANTENNA	3115	EMCO	9107-3723	10/16/06 2 yr.
PREAMP	8449B	HEWLETT PACKARD	3008A00480	8/21/07
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

2.5 Number of Operating Frequencies (CFR15.31(m))

In accordance with the requirements of CFR 15.31 (m) the EUT was tested with three operating frequencies, low channel, mid channel and high channel.

2.6 Peak Limits for Signals above 1000 MHz (CFR 15.35)

In accordance with the requirements of CFR 15.35 the EUT measured peak signals have a limit relaxed by 20 dB from the limits stated in 15.209.

2.7 Antenna Description (CFR15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Table 3.

Antenna(s) Supplied With EUT

MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB	TYPE OR CONNECTOR
Antenna is integral with EUT, Gain = 0 dB_i				

2.8 Power Line Conducted Emissions for Digital Peripherals and Receivers (CFR15.107)

The conducted voltage measurements have been carried out in accordance with CFR 15.107, with a spectrum analyzer connected to a LISN and the EUT placed into an idle condition or a continuous mode of receive. The test procedure used was per ANSI C63.4, Paragraph 7. Please refer to the results as shown in Table 4 below.

Table 4. Conducted Emissions Test Data, Class B, Transmit and Receive modes.

Test Date: January 13, 2008
UST Project: 07-0297
Customer: Cirronet, Incorporated
Model: ZMN2405HPA

(Quasi-Peak vs Average Limits)

.

Conducted Emissions									
Test By:	**Test:**Quasi- Peak vs Average Conducted Emissions Transmit and Receive modes.				**Client:** Cirronet, Incorporated				
K.M.	**Project:** 07-0297			**Class:** B	**Model:** ZMN2405HPA				
Frequency	**Test Data**	**AF**	**Test Data**	**AF+CA-AMP**	**Results**	**Limits**	**Distance /**	**Margin**	**PK**
(MHz)	**(dBm)**	**Table**	**(dBuV)**	**(dB)**	**(dBuV)**	**(dBuV)**	**Polarity**	**(dB)**	**/ QP**
0.16	-59.1	LISNN	47.9	-0.2	47.7	56.0	Neutral	**8.3**	**PK**
0.696	-81.5	LISNN	25.5	0.1	25.5	46.0	Neutral	**20.5**	**PK**
2.49	-79.3	LISNN	27.7	0.2	28.0	46.0	Neutral	**18.0**	**PK**
7.238	-70.1	LISNN	36.9	0.4	37.3	50.0	Neutral	**12.7**	**PK**
18.15	-81.1	LISNN	25.9	0.7	26.6	50.0	Neutral	**23.4**	**PK**
24.23	-85.3	LISNN	21.8	0.7	22.4	50.0	Neutral	**27.6**	**PK**
0.165	-60.8	LISNP	46.2	-0.1	46.0	56.0	Phase	**10.0**	**PK**
0.671	-78.5	LISNP	28.6	0.0	28.6	46.0	Phase	**17.4**	**PK**
4.52	-77.6	LISNP	29.4	0.3	29.6	46.0	Phase	**16.4**	**PK**
7.288	-70.8	LISNP	36.2	0.4	36.6	50.0	Phase	**13.4**	**PK**
18.15	-80.0	LISNP	27.0	0.7	27.7	50.0	Phase	**22.3**	**PK**
24.23	-85.2	LISNP	21.8	0.6	22.4	50.0	Phase	**27.6**	**PK**

SAMPLE CALCULATIONS: 47.9 + -0.2 = 47.7 dBµV

Tester Signature:  **Name: Keyvan Movahed**

2.9 Power Line Conducted Emissions for Transmitter (CFR 15.207)

The conducted voltage measurements have been carried out in accordance with CFR15.207, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The test procedure used was ANSI C63.4, paragraph 7. The results are given in Table 4 above.

2.10 Worst-Case Transmitter Duty Cycle for ZMN2405HPA

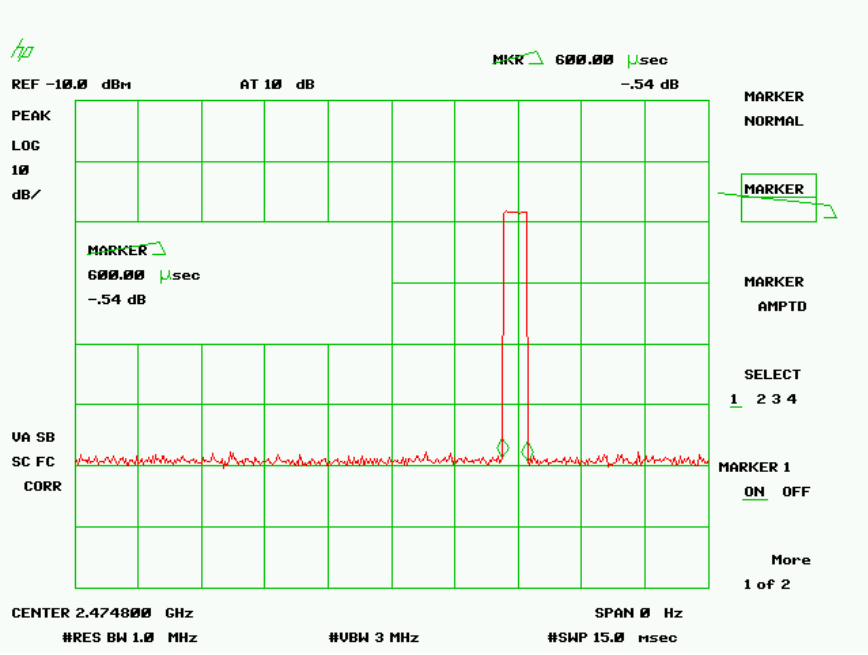
The duty cycle de-rating factor used in the calculation of average radiated limits (per CFR 15.209) is described below. This factor was calculated by first determining the worst case scenario for system operation. See Figure 5 Below

The worst case operating scenario is as follows:

Maximum transmit On-time over a 100 ms period:
The transmitter delivers 253 Bytes @ 8 bits/Byte with a rate of 1/4060 kbits per second = (253 x 8 x 1/4060) milli Seconds = 0.5
The transmission duty cycle correction factor is then calculated as:

$$20 \log_{10} (0.5\text{ms}/100\text{ms}) = -46\text{dB}$$

Figure 5 – Pulsed Timing



2.11 Radiated Emissions Measurement for Digital Peripherals and Receiver (CFR 15.109)

This test was performed per procedure ANSI C63.4, paragraph 8. The transmitter was powered off and the remaining electronics were left on. The receiving antenna was placed 3 meters distant from the EUT in the vertical attitude. The spectrum analyzer was scanned over the frequency range of 30 MHz to 25 GHz. Antennas were changed over this range to accommodate their useful operational range. Emissions were maximized by rotating the EUT through 360 degrees while monitoring the emission on the spectrum analyzer display for a maximum indication. Also, the receiving antenna was raised and lowered over heights of 1 to 4 meters while monitoring the emission magnitude on the spectrum analyzer display for a maximum indication. This process was again accomplished for a horizontal attitude of the receiving antenna.Test results are found in Table 5 below.

Table 5. Radiated Emissions Data, (Digital Device & Receiver)

Class B Limits

Test Date: **February 13, 2008**
UST Project: **07-0297**
Customer: **Coronet, Incorporated**
Product: **ZMN2405HPA**

Measurements 30 MHz – 25 GHz

Radiated Emissions									
Test By: K.M.		**Test:** FCC Part 15			**Client:** Cirronet, Incorporated				
Project: 07-0297			**Class: B**		**Model:** ZMN2405HPA				
Frequency	**Test Data**	**AF**	**Test Data**	**AF+CA-AMP**	**Results**	**Limits**	**Distance/ Polarity**	**Margin**	**PK**
(MHz)	**(dBm)**	**Table**	**(dBuV)**	**(dB)**	**(uV/m)**	**(uV/m)**		**(dB)**	**/ QP**
No emissions seen within 20 dB of the FCC Part 15 Class B Limit.									

Tester Signature: Keyvan Movahed **Name: Keyvan Movahed**

2.12 Radiated Emissions Measurement for Harmonics and other Spurious (CFR 15.209, ((IC RSS 210, A2.9 (a)))

Radiated spurious emissions in the frequency range of 30 MHz – 25000 MHz were measured per FCC KDB Publication 558074 as a radiated test using the Alternative test procedure with a spectrum analyzer by connecting the spectrum analyzer directly, via a pre-amplifier and High Pass filter above 2.4 GHz, to the test antenna output terminals. The spectrum analyzer was set for an RBW = 120 kHz & VBW = 300 kHz below 1 GHz. Above 1 GHz, the RBW and VBW were set to 1 MHz. The receiving antenna was placed 3 meters distant from the EUT in the vertical attitude. The spectrum analyzer was scanned over the above frequency range. Antennas were changed over this range to accommodate their useful operational range. Emissions were maximized by rotating the EUT through 360 degrees while monitoring the emission on the spectrum analyzer display for a maximum indication. Also, the receiving antenna was raised and lowered over heights of 1 to 4 meters while monitoring the emission magnitude on the spectrum analyzer display for a maximum indication. This process was again accomplished for a horizontal attitude of the receiving antenna. All spurious other than harmonics are greater than 20 dB below the limit. Harmonics were measured at 1 meter distance and a distance correction factor was applied. The result of the radiated spurious emissions test is given in Tables 6 and 7 below.

2.12 Radiated Emissions Measurement for Harmonics and other Spurious (CFR 15.209, ((IC RSS 210, A2.9 (a))) (Cont'd)

Table 6. Peak Radiated Emissions for Harmonics and other Spurious

Peak Radiated Emissions for Harmonics and other Spurious

Test By: DA	Test: FCC Part 15		Client: Cirronet, Incorporated	
	Project: 07-0297	Class: B	Model: ZMN2405HPA	

Frequency (MHz)	Test Data (dBm)	AF Table	Test Data (dBuV)	AF+CA-AMP (dB)	Results (uV/m)	Limits (uV/m)	Distance / Polarity	Margin (dB)	PK = n / QP
Low									
*4809.68	-49.0	1HN3mH	58.0	5.5	1487.8	5000.0 (1)	3m./HORZ	**10.5**	**PK**
7214.38	-58.6	1HN3mH	48.4	9.9	818.6	5000.0	3m./HORZ	**15.7**	**PK**
9619.2	-52.5	1HN3mV	54.5	13.1	2382.4	5000.0	3m./VERT	**6.4**	**PK**
*12023.9	-59.4	1HN3mV	47.6	17.3	1769.2	5000.0 (1)	3m./VERT	**9.0**	**PK**
Mid									
*4879.36	-53.2	1HN3mH	53.8	5.7	941.7	5000.0 (1)	3m./HORZ	**14.5**	**PK**
*7319.51	-60.3	1HN3mV	46.7	9.9	674.1	5000.0 (1)	3m./VERT	**17.4**	**PK**
9759.25	-50.6	1HN3mV	56.4	13.3	3062.0	5000.0	3m./VERT	**4.3**	**PK**
High									
*4949.28	-53.9	1HN3mH	53.1	5.9	892.0	5000.0 (1)	3m./HORZ	**15.0**	**PK**
*7424.23	-59.7	1HN3mH	47.4	10.4	775.0	5000.0 (1)	3m./HORZ	**16.2**	**PK**
9899.26	-50.1	1HN3mv	56.9	13.5	3299.9	5000.0	3m./VERT	**3.6**	**PK**

* - Harmonic falls into Restricted Bands of CFR 15.205.
Data corrected by 0.1 dB for loss of high pass filter.
(1) Limit from CFR 15.209 modified by 15.35. All other limits from 15.247(d).

Conversion from 1 meter to 3 meters = -9.54 dB

SAMPLE CALCULATION:
RESULTS At 4809 MHz, = Antilog ((-49.0 + 5.5 + 107)/20) = 1496.2 (uV/m @ 3m)
CONVERSION FROM dBm TO dBuV = 107 dB

Test Date: January 29, 2008

Tester Signature: Daniel Aparaschivei **Name: Daniel Aparaschivei**

2.12 Radiated Emissions Measurement for Harmonics and other Spurious (CFR 15.209, 15.249 ((IC RSS 210, A2.9(a)))

Table 7. Average Radiated Emissions for Harmonics and other Spurious

Average Radiated Emissions for Harmonics and other Spurious

Test By:	Test:		Client:	
DA	FCC Part 15		Cirronet, Incorporated	
	Project: 07-0297	Class: B	Model: ZMN2405HPA	

Frequency (MHz)	Test Data (dBm)	AF Table	Test Data (dBuV)	AF+CA-AMP (dB)	Results (uV/m)	Limits (uV/m)	Distance / Polarity	Margin (dB)	Average
LOW									
*4809.68	-95.0	1HN3mH	12.0	5.5	7.4	500.0 (1)	3m./HORZ	**36.5**	**AVG**
7214.38	-104.6	1HN3mH	2.4	9.9	4.1	500.0	3m./HORZ	**41.7**	**AVG**
9619.2	-98.6	1HN3mV	8.4	13.1	11.9	500.0	3m./VERT	**32.5**	**AVG**
*12023.9	-105.4	1HN3mV	1.6	17.3	8.8	500.0 (1)	3m./VERT	**35.0**	**AVG**
MID									
*4879.36	-99.2	1HN3mH	7.8	5.7	4.7	500.0 (1)	3m./HORZ	**40.5**	**AVG**
*7319.51	-106.3	1HN3mV	0.7	9.9	3.4	500.0 (1)	3m./VERT	**43.4**	**AVG**
9759.25	-96.6	1HN3mV	10.4	13.3	15.3	500.0	3m./VERT	**30.3**	**AVG**
HIGH									
*4949.28	-99.9	1HN3mH	7.1	5.9	4.5	500.0 (1)	3m./HORZ	**41.0**	**AVG**
*7424.23	-105.7	1HN3mH	1.3	10.4	3.9	500.0 (1)	3m./HORZ	**42.2**	**AVG**
9899.26	-96.1	1HN3mv	10.9	13.5	16.5	500.0	3m./VERT	**29.6**	**AVG**

* Falls within the Restricted Bands of CFR 15.205.
Data corrected by 0.1 dB for loss of high pass filter, except for fundamental
.
(1) limits from 15.209.

** Conversion from 1 meter to 3 meters = -9.54 dB

SAMPLE CALCULATION:
RESULTS = At 4809.68 MHz, Antilog ((-95.0 + 5.5 + 107)/20) = 7.1(uV/m @ 3m)
CONVERSION FROM dBm to dBuV = 107 dB

Test Date: January 29, 2008

Tester Signature: Daniel Aparaschivei **Name: Daniel Aparaschivei**

2.13 Restricted Bands (CFR15.205)

All radiated signals must be compared to the list of CFR 15.205. No fundamentals can be found in the restricted bands. All harmonics can be in the restricted bands but their limits must conform to 15.209 modified by 15.35. All other spurious can fall into the restricted bands but they must conform to the limits of 15.247.

2.14 Minimum Six (6) dB Bandwidth per CFR 15.247(a) (2)

This is a radiated measurement. The test antenna port was connected to a spectrum analyzer that was set for a 50 Ω impedance with the RBW = approximately 1/100 of the manufacturers claimed RBW & VBW > RBW. The results of this test are given in Table 8 and Figure 5 through Figure 7.

Table 8
Six (6) dB Bandwidth

Test Date: **February 12, 2008**
UST Project: **07-0297**
Customer: **Cirronet, Incorporated**
Model: **ZMN2405HPA**

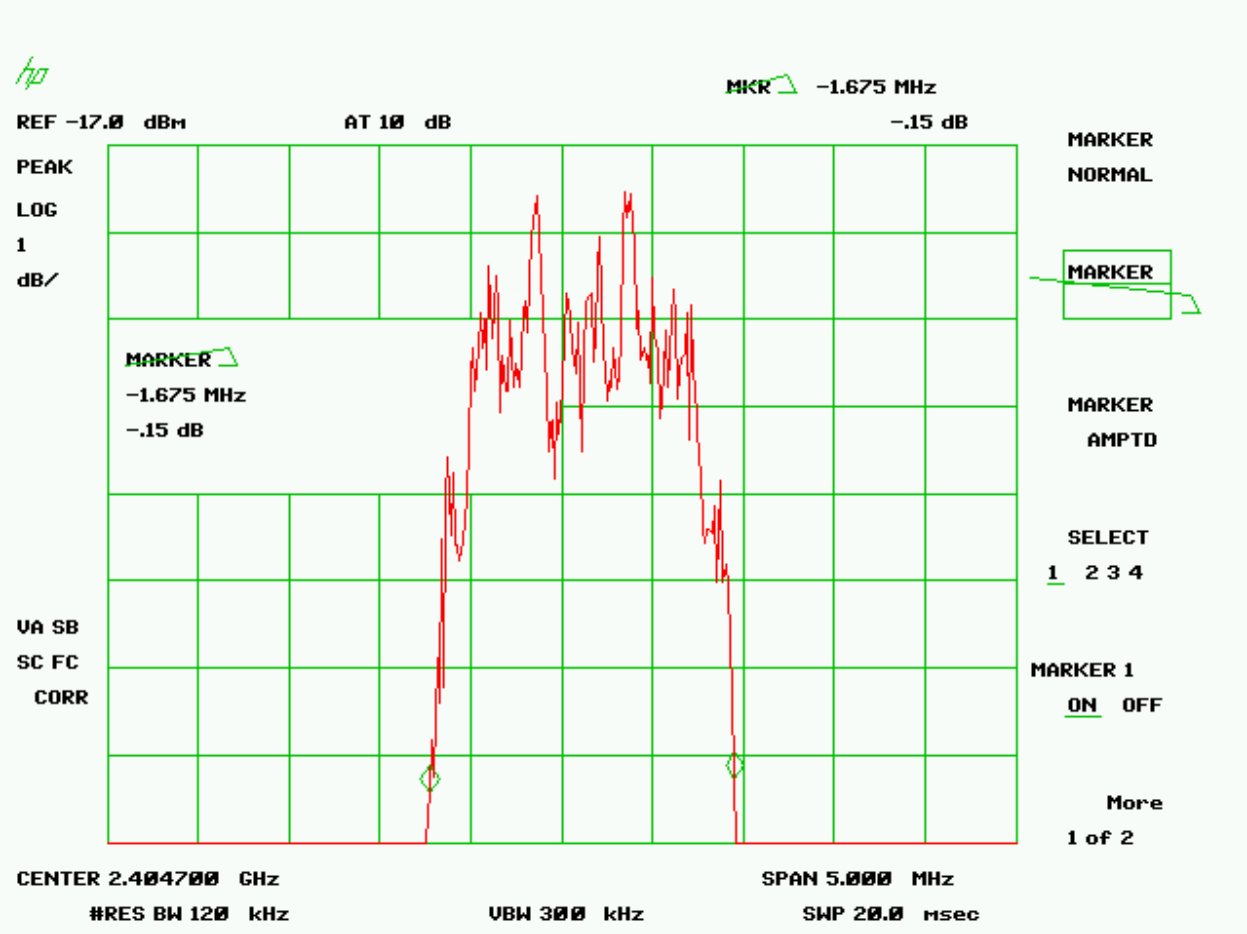
Frequency (GHz)	6 dB Bandwidth (MHz)	MINIMUM FCC LIMIT (MHz)
2.41020	1.6	0.5
2.43956	1.56	0.5
2.47518	1.6	0.5

.

Tester Signature: _____ **Name:** **John K. Livingston**

2.14 Minimum Six (6) dB Bandwidth per CFR 15.247(a) (2)

Figure 6.
Six (6) dB Bandwidth per CFR 15.247(a)(2), Low

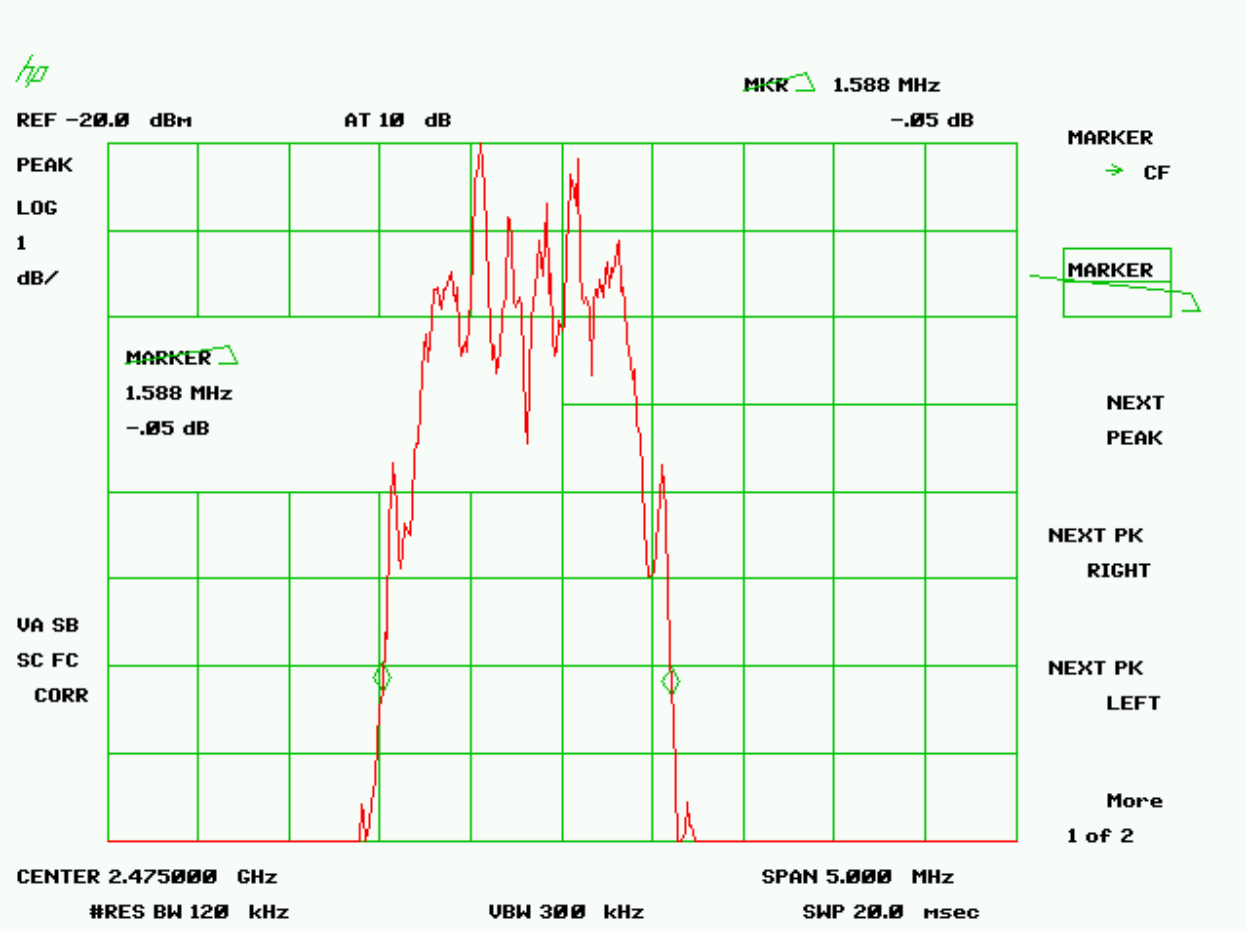


2.14 Minimum Six (6) dB Bandwidth per CFR 15.247(a) (2)

Figure 7.
Six (6) dB Bandwidth per FCC Section 15.247(a)(2), Mid

2.14 Minimum Six (6) dB Bandwidth per CFR 15.247(a) (2)

Figure 8.
Six (6) dB Bandwidth per FCC Section 15.247(a)(2), High



2.15 Peak Power Output (CFR 15.247(b)(3)) (IC RSS 210, A8.4(4))

For the ZMN2405HPA, the transmitter was programmed to operate at +16 dBm. Peak power of the fundamental for Low, Mid and High channels within the band 2400 MHz to 2483.5 MHz was measured per FCC KDB Publication 558074 alternative test procedure (radiated test) with a spectrum analyzer by connecting the spectrum analyzer directly to the test antenna at 3 meters distance. The spectrum analyzer was set for a VBW = RBW = 3 MHz. The results of the measurements are given in Table 9 and Figures 8 through 10.

$$P = (\mathbf{E}d)^2 /(30G_t)$$

With:

d = 3 meters
G_t = 0 dB_i = 1= gain of the transmitter antenna.
E = Electric field strength in Volts/meter

Fundamental Frequencies were measured at Low Channel, Mid Channel, and High Channel.

At 2405.02 MHz, the Low Channel signal was measured after maximization for direction and elevation, as –31.7 dBm on the spectrum analyzer. In order to calculate the electric field, **E**, the spectrum analyzer value (SA) must have antenna factors and cable loss values added to it. No pre-amplification was used because the signal had sufficient strength. The conversion to dBuV/m is done by adding 107 dB to the SA reading plus cable loss plus antenna factor; therefore the dBuV/m value is 107-31.7 +3.4 + 28.2 = 106.9 dBuV/m. Next we take the antilog of 106.9 to get the numeric value of the Electric field: $10^{(106.9/20)} = 10^{5.345}$ = 221,309 uV/m.
Therefore, **E** = 0.22 Volts per meter.

So that in the above equation, P = $(3^2(.22)(.22))/30$ = (9/30)(.22)(.22) = (.3)(.22)(.22) = 0.0145 Watts = 14.5 mW. This value is recorded in Table 9 in the measurement column. Values are found for the mid channel and high channel measurements in the same fashion.

Now, 14.5 mW is 10 $\log_{10}$(0.0145) +30 dBm equals +12 dBm. Now 12 dBm differs from the stated 16 dBm possibly because the EUT was not transmitting 16 dBm. The algorithm for setting the power is not exact. The actual output power is found by measurement.

2.15 Peak Power Output (CFR 15.247(b)(3)) (IC RSS 210, A8.4(4))

Table 9.
Radiated Peak Power Output

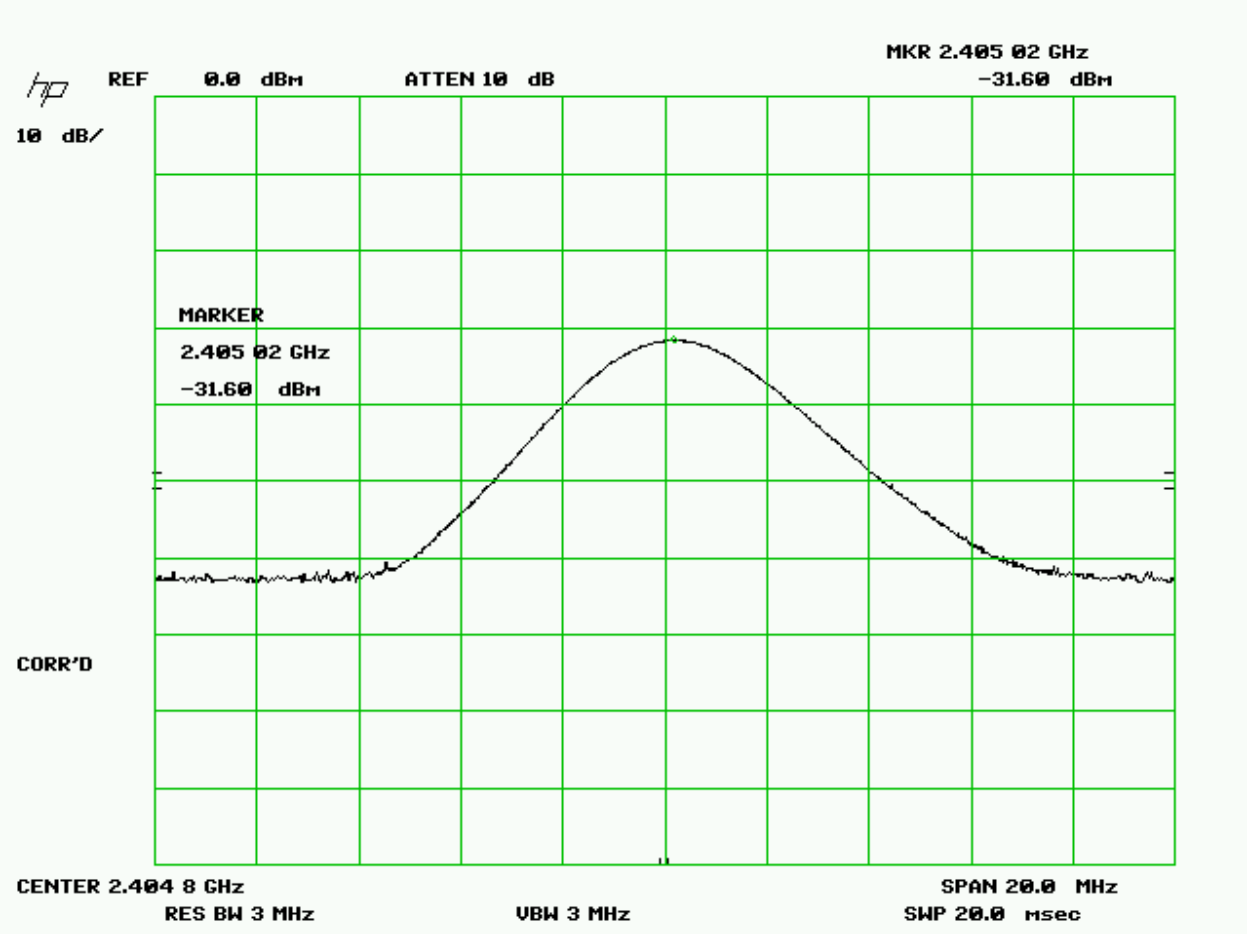
Frequency of Fundamental (MHz)	Measurement dBuV / (dBm)	Measurement (mW)*	FCC Limit (mW)
2405.02	106.9 / (-31.7)	14.5	1000
2439.96	105.2 / (-33.3)	9.72	1000
2474.78	105.1 / (-33.4)	9.72	1000

*** Measurement includes 0.1 dB for cable loss factor .**

Tester Signature: Daniel Aparaschivei **Name: Daniel Aparaschivei**

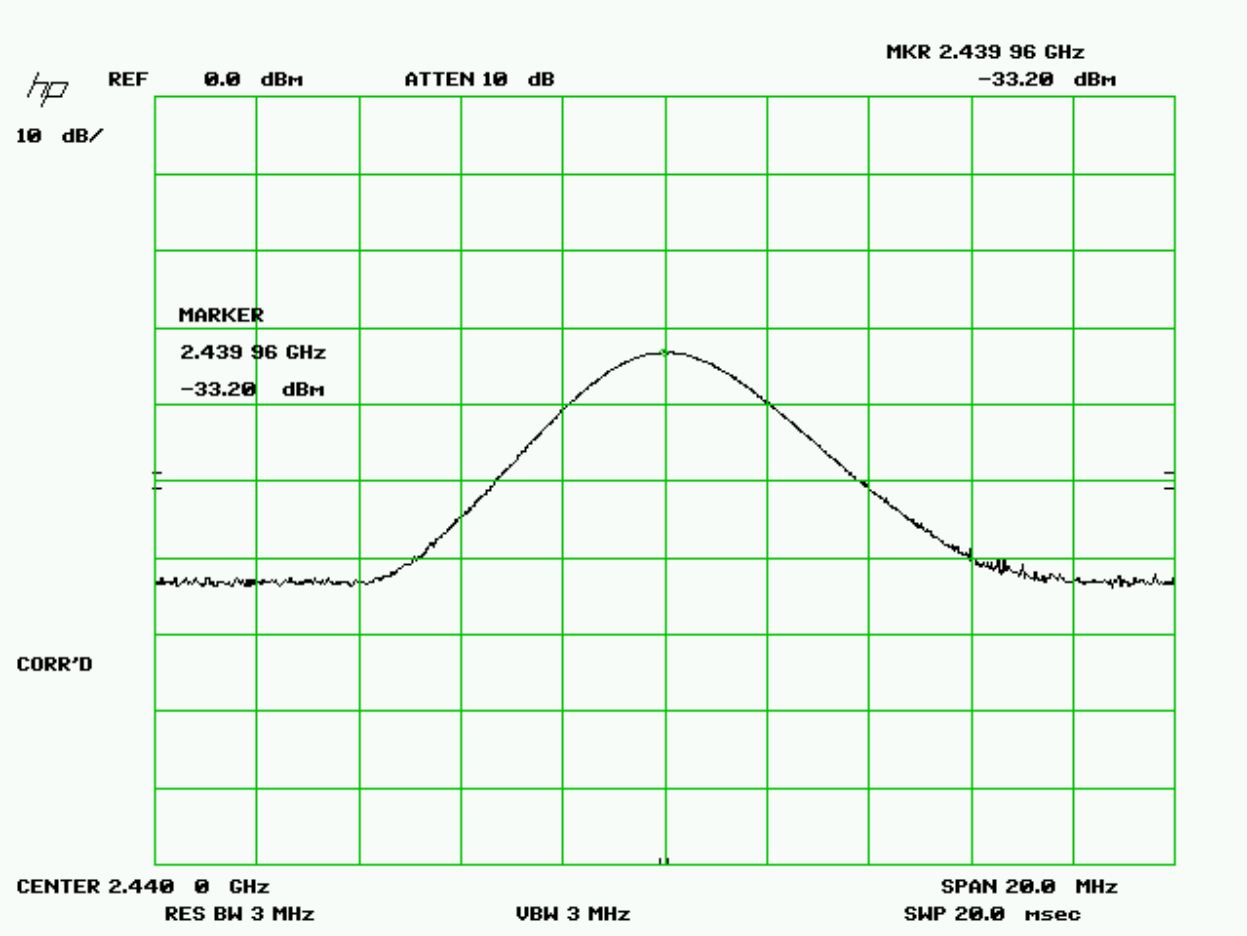
2.15 Peak Power Output (CFR 15.247(b)(3)) (IC RSS 210, A8.4 (4)) (Cont'd)

Figure 9.
Peak Power Output 15.247(b)(3) – Fundamental, Low Channel



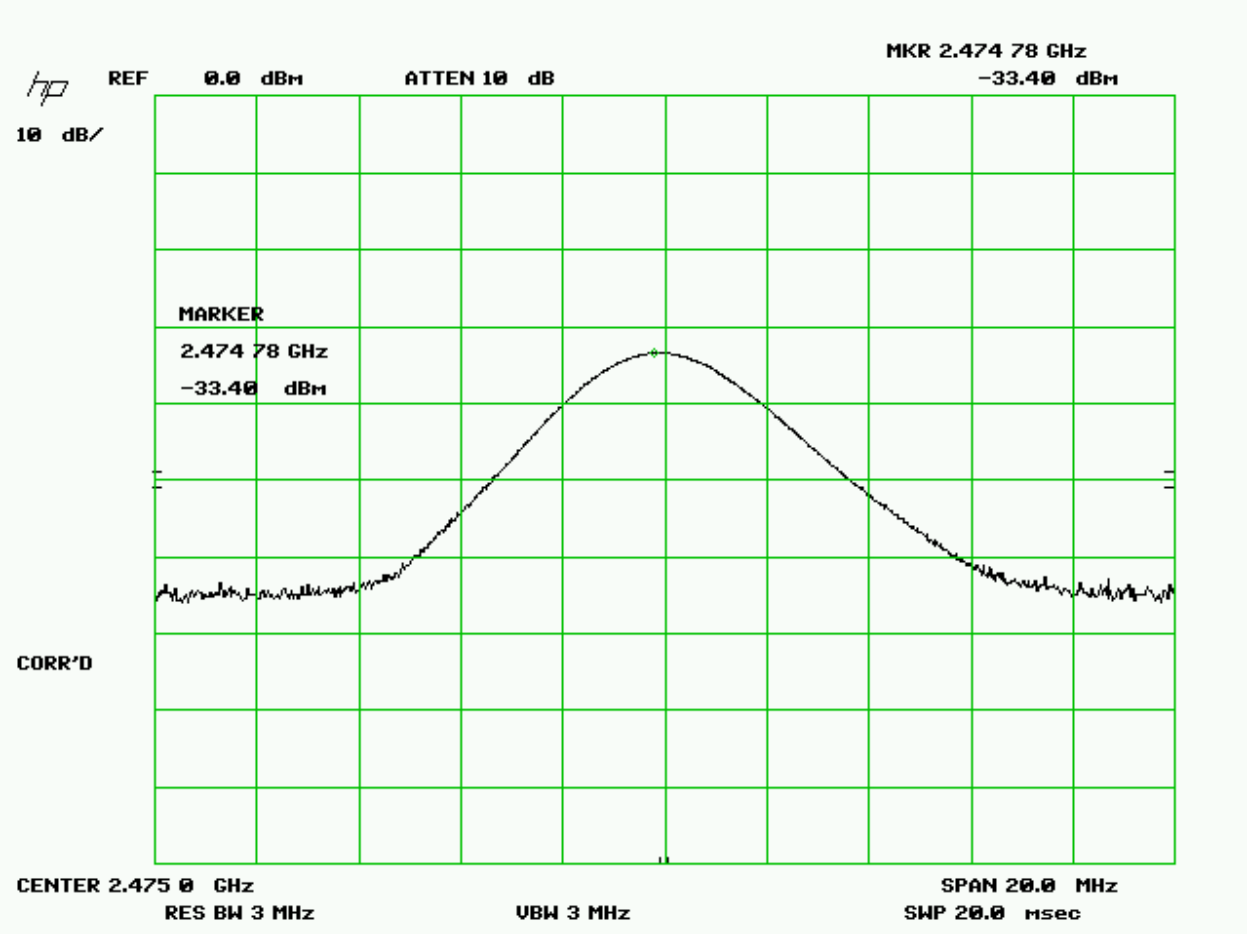
2.15 Peak Power Output (CFR 15.247(b)(3)) (IC RSS 210, A8.4(4)) (Cont'd)

Figure 10.
Peak Power Output 15.247(b)(3) Fundamental, Mid Channel



2.15 Peak Power Output (CFR 15.247(b)(3)) (IC RSS 210, A8.4(4)) (Cont'd)

Figure 11.
Peak Power Output 15.247(b)(3) Fundamental, High Channel



2.16 Directional Antenna Gains greater than 6 dBi (CFR 15.247 (c))

This EUT has a fixed antenna with 0 dB_i gain, therefore this requirement for this product is not applicable.

2.17 Band - Edge Measurements (CFR 15.247 (d))

Band Edge measurements were made at a Low Channel and High Channel peak at highest EUT related emission outside the occupied bandwidth. A peak measurement was made of the fundamental. The emission was measured using a peak detector setting. A Resolution Bandwidth of > 1% of the emission bandwidth was used; in this case, 100 kHz. This procedure was repeated for the high channel. Data for the mid channel is meaningless.

The limits were derived as follows:

2.17.1 Higher Band - Edge:

From CFR 15.209and 15.35, limit for Peak measurements of all but fundamental is 5000 uV/m = -33. dBm/m.

Subtract antenna factors and cable loss for this frequency = -33.0 dBm – 31.4 dB (antenna factor and cable loss) = - 64.4 dBm = Limit.

Maximum level of Fundamental measured at High Channel: -33.2 dBm

The difference of measurement, (delta), of band - edge from the fundamental peak to highest spur 10 MHz outside of the band edge: - 35.16 dB

Therefore: -33.2 dBm – 35.16 dBm = - 68.36 dBm < - 64.4. dBm

At 2483.5 MHz, for the limit = - 64.4 dBm/m, the dBuV are 45 dBuV/m = $10^{(45/20)}$ = $10^{2.25}$ = 188.8 uV/m which is less than CFR 15.209 requires (500 uV/m) and per 15.247(d) is not required(no signals are utilized above 2477.5 MHz, see page 49 of this report).

2.17.2 Lower Band - Edge:

Limit = -33.2 dBm – 31.9 dB (antenna factor and cable loss) = -65.1 dBm

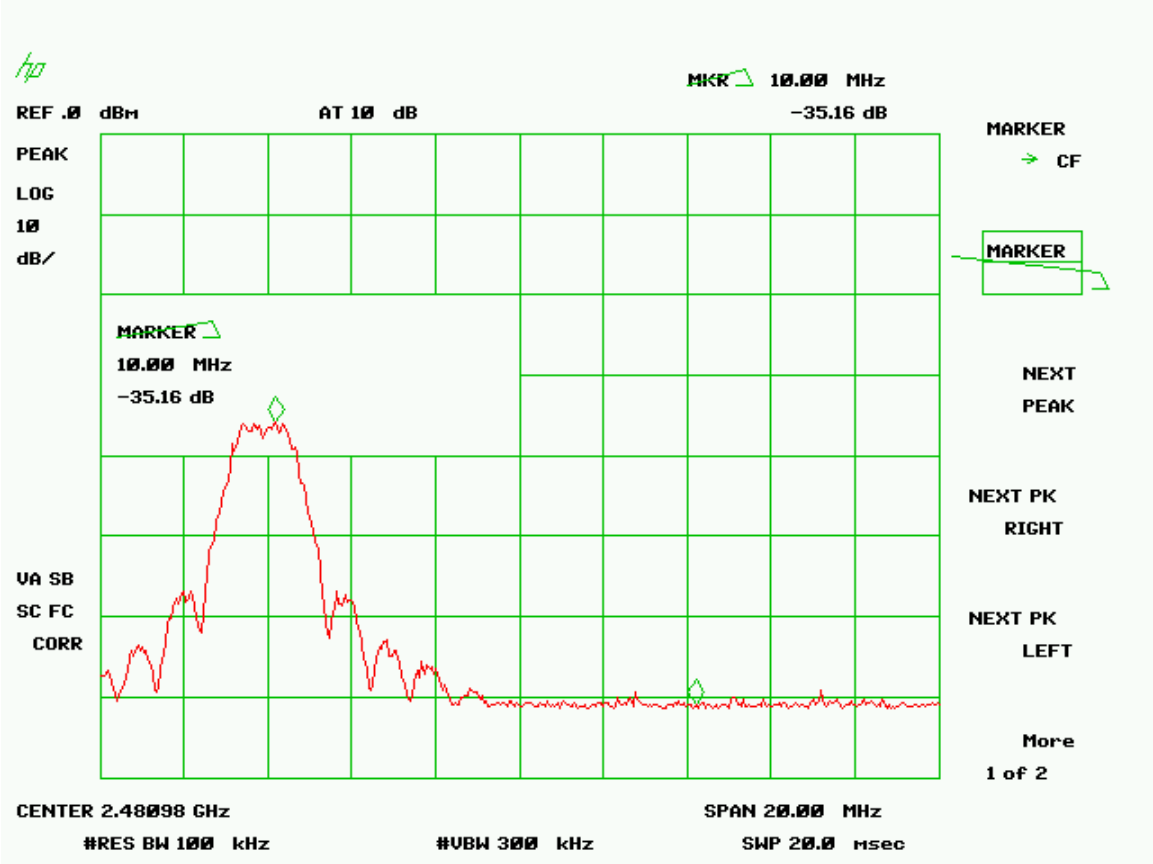
Maximum level of Fundamental measured at Low Channel: -31.6 dBm

Delta from conducted measurement of band - edge from fundamental peak to highest spur 10 MHz outside band edge: - 33.71

-31.6 dBm – 33.71 dBm = -65.31 dBm < -65.10 dBm. No signals are used below 2402.5 MHz and the restricted frequency of 2390 MHz is out of band.

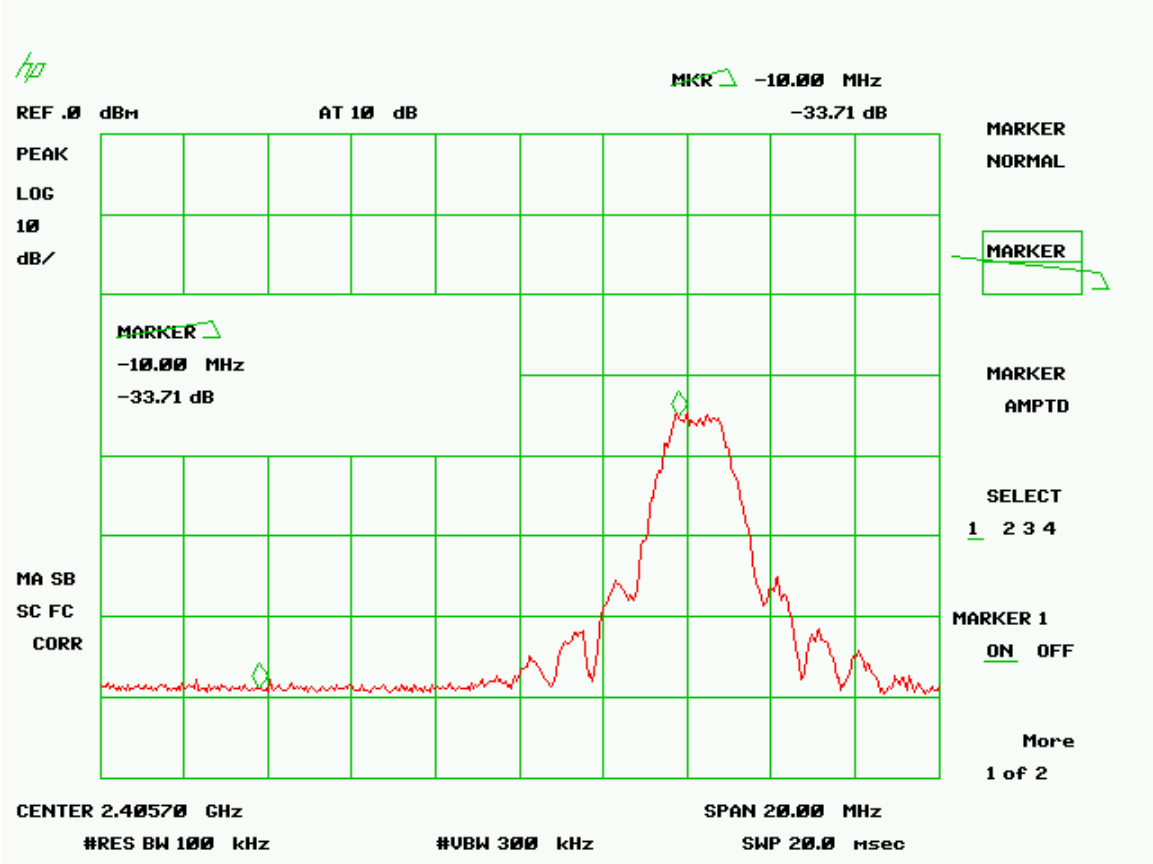
2.17 Band - Edge Measurements (CFR 15.247 (d))

Figure 12. Band Edge Compliance
Radiated Emissions, High Channel



2.17 Band - Edge Measurements (CFR 15.247 (d))

Figure 13. Band Edge Compliance
Radiated Emissions, Low Channel



2.18 Power Spectral Density (15.247(e))

Definitions:

Raw Measurement – The radiated emissions measured on the spectrum analyzer before factoring in cable loss, antenna factor, and pre-amp gain.

Corrected Field Strength – Resultant electric field strength derived from the raw measurement by factoring in the cable loss, pre-amp gain, and antenna factor.

Procedure:

For the power spectral density measurements, the FCC's published procedure for *Alternative Test Procedures* for radiated measurements, reproduced below for convenience, was followed:

(1) Calculate the transmitter's peak power using the following equation:

$$P = \frac{(Ed)^2}{30G}$$

E – Measured max. electric field strength in V/m
G – numeric gain of transmitting antenna over an isotropic radiator
d – distance in meters from which the field strength was measured
P – power in Watts for which we are solving

(2) Measure the power spectral density as follows:

A. Tune the analyzer to the greatest point of the maximized (in azimuth and elevation) fundamental emission. Reset the analyzer to a RBW = 3 kHz, VBW > RBW, span = 300 kHz, sweep = 100 sec.

B. From the peak level obtained in (A), derive the field strength, E, by applying the appropriate antenna factor, cable loss, pre-amp gain, etc. Using the equation listed in (1), calculate a power level for comparison to the +8 dBm/3kHz limit.

The power level, P, calculated must not exceed +8 dBm/3 kHz.
All emissions were measured from a distance, d, of 3 meters.
The numeric gain, G, of the transmitting antenna is 1.

2.18 Peak Power Spectral Density (15.247(e)) (cont.)

Test Date: **February 13, 2008**
UST Project: **07-0297**
Customer: **Cirronet, Incorporated**
Product: **ZMN2405HPA**

Table 10. Peak Power Spectral Density

Frequency (GHz)	Raw Value (dBm)	Corrected Field Strength (V/m)	Calculated Power (dBm/3kHz)	FCC Maximum Limit (dBm/3kHz)
2405.02	-45.14	0.0487528	-1.42	8
2439.96	-49.24	0.0306472	-5.5	8
2474.78	-49.8	0.0289319	-6.0	8

Frequency: 2405.02 MHz

Raw Measurement: -45.14 dBm. From para 2.17, factors = 31.9 dB; E = 93.76 dBuV/m = $10^{(93.76/20)}$ = $10^{(4.688)}$= 48752.8 uV/m = .049 V/m (rounded-off).
Adjusted measurement: .049 V/m
P = (9/30)(.049)(.049) = 0.00072.3 Watts = 0.723 mW = 10log(.000723) + 30 = -1.42 dBm
Margin: 9.42
Pass? YES

Frequency: 2439.96 MHz

Raw Measurement: -49.24 dBm. From para 2.17, factors = 32 dB.
Adjusted measurement: 30647.2 uV/m = 0.0306472 V/m
P = 0.000282 Watts = -5.5 dBm
Margin: 13.5 dB
Pass? YES

Frequency: 2474.78 MHz

Raw Measurement: -49.8 dBm. From para 2.17, factors = 32 dB.
Adjusted measurement: 28931.9 uV/m = 0.0289319 V/m
P = 0.000251 Watts = -6.0 dBm
Margin: 14 dB
Pass? YES

2.19 Maximum Public Exposure to RF Radiation (MPE) CFR 15.247 (i)

The maximum exposure level to the public from the RF power of the EUT shall not exceed a power density, S, of 1 mW/cm^2 at a distance, d, of 20 cm from the EUT.

Therefore, for :

Peak Power (Watts) = 0.0145 (from Table 6, herein)
Gain of Transmit Antenna = 0 dB$_i$ = 1 numeric (from Table 3, herein)
Distance = 20 cm = 0.2 meters

$$S = (PG/ 4\pi d^2) = EIRP/4A$$

Where: A = The area of the circle of radius, d = 20cm.

Therefore,

$S = (0.0145\ W x1)/(4x3.1416x20cmx20cm) = 0.0145/1600p =$
$2.88\ \mu W/cm^2$

Or,

$$S =(0.0145x1) / (4x3.1416 x (0.2)^2) = 0.0145/(0.16p) = 0.0288\ W/m^2$$

$$\frac{\cancel{W}}{\cancel{m^2}} \times \frac{1000\ mW}{\cancel{W}} \times \frac{\cancel{m^2}}{(100\ cm)^2} = \frac{1000\ mW}{10000\ cm^2} = \frac{0.1\ mW}{cm^2}$$

$S = 0.00288\ mW/cm^2 = 2.88\ \mu W/cm^2$