

Table 4c. PEAK RADIATED SPURIOUS EMISSIONS (High)

Radiated Emissions										
Test By:	Test:	FCC Part 15 High Channel				Client:	Cirronet			
	Project:	06-0176		Class:	B	Model:	ZMN2400HP-A			
Frequency	Test Data	AF	Test Data	AF+CA-AMP	Results	Limits	Distance /	Margin	PK = n	
(MHz)	(dBm)	Table	(dBuV)	(dB)	(uV/m)	(uV/m)	Polarity	(dB)	/ QP	
2474.78	-28.4	1HN3mV	78.6	32.0	339124.1		3m./VERT		PK	
4949.71	-48.1	1HN3mV	58.9	5.6	1676.1	5000.0	3m./VERT	9.5	PK	
7424.51	-57.8	1HN1mV	49.2	11.1	1028.4	5000.0	1m./VERT	13.7	PK	
9899.31	-55.5	1HN1mV	51.5	13.8	1825.2	33912.4	1m./VERT	25.4	PK	

Data corrected by 0.1 dB for loss of high pass filter, except to fundamental


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

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog ((-48.1 + 5.6 + 107)/20) = 1676.1

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

Signature: 

Name: Austin Thompson

**Figure 4c - 1**  
**Peak Radiated Spurious Emission 15.247(c) Fundamental High**

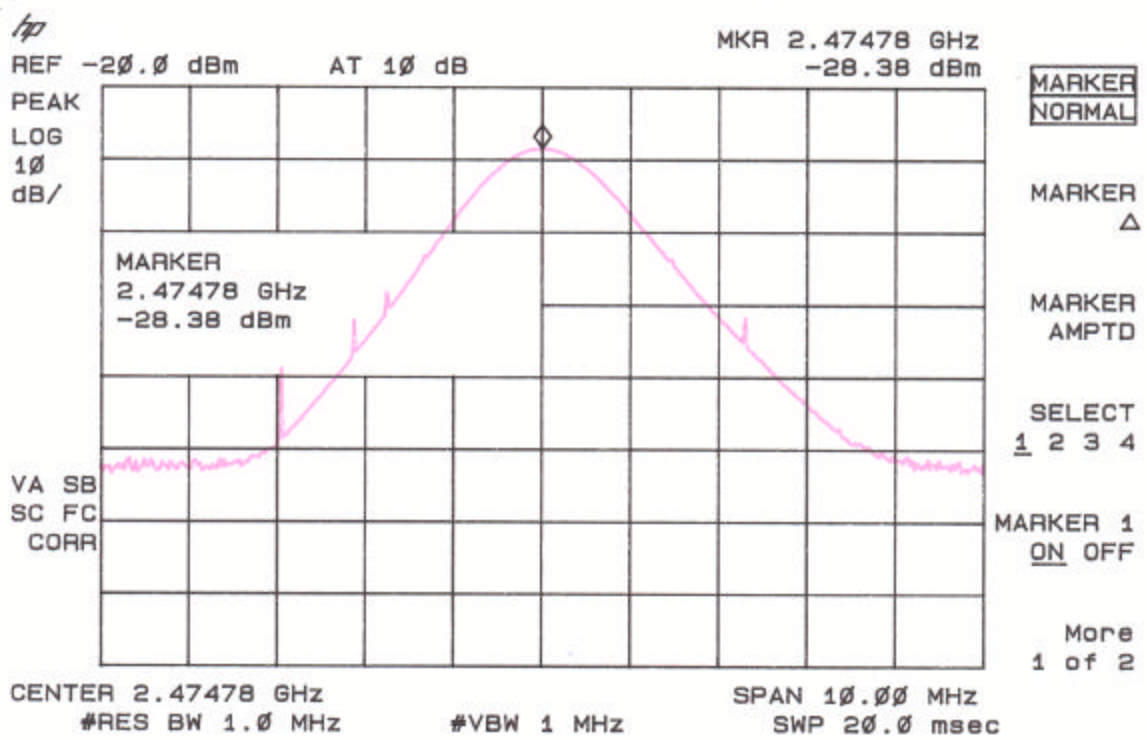
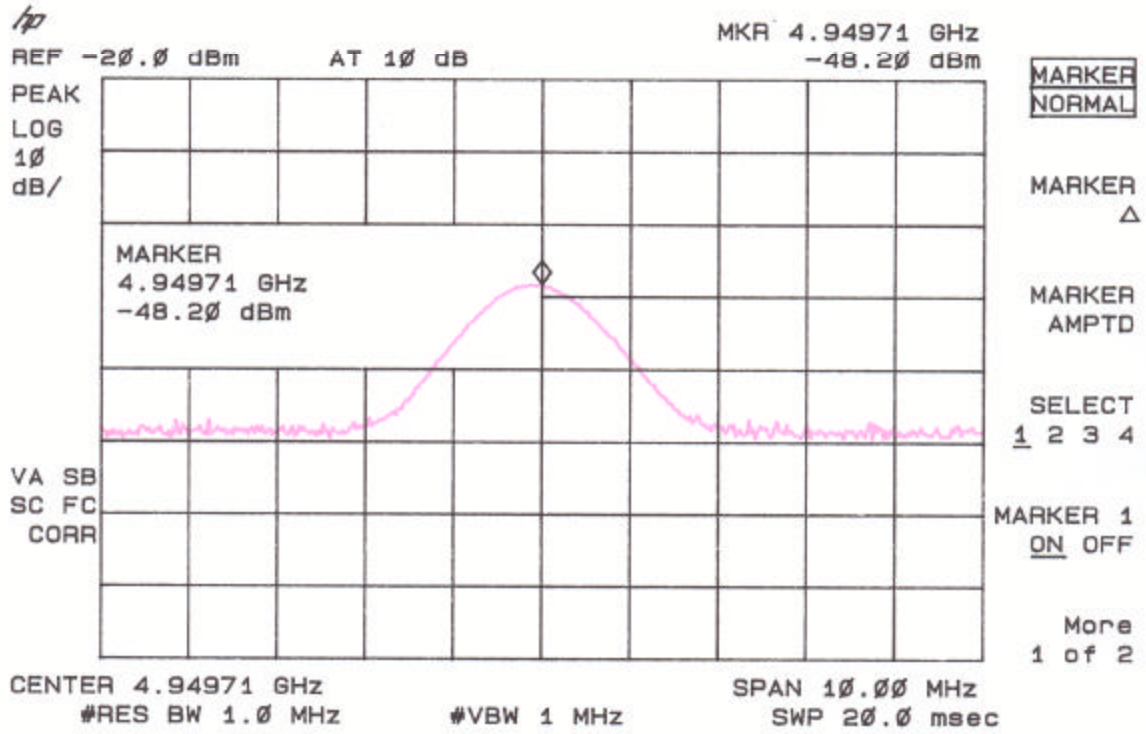
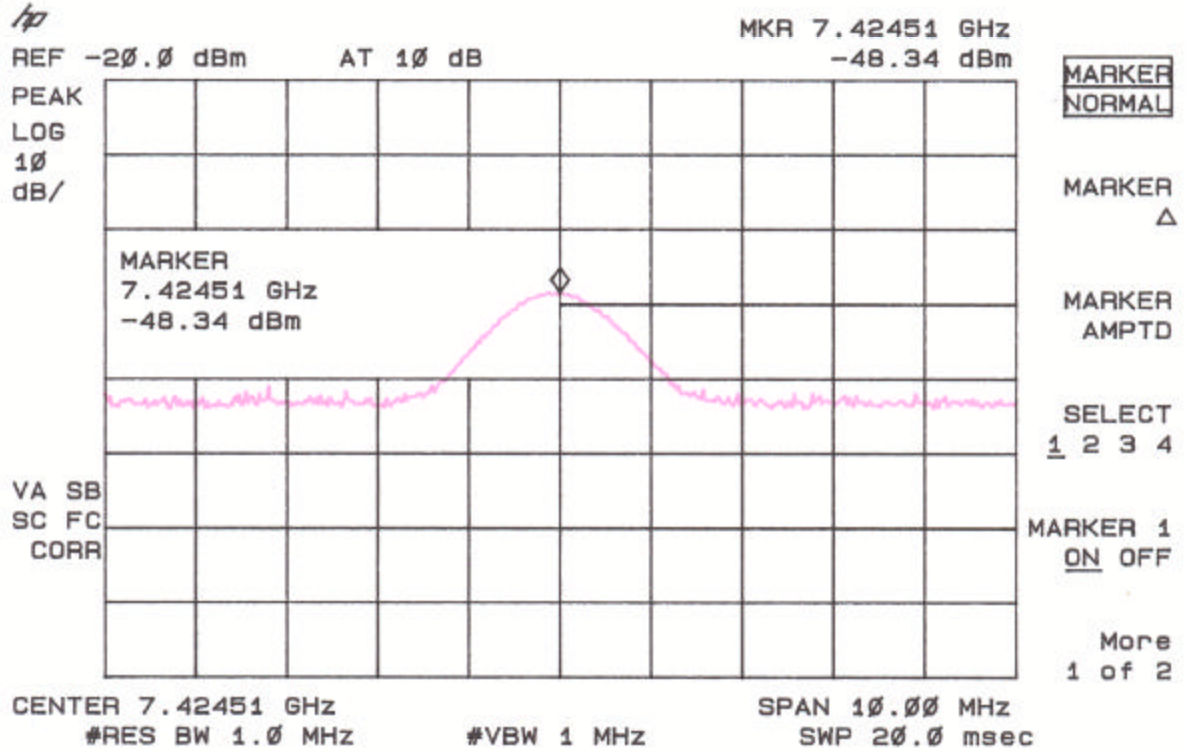


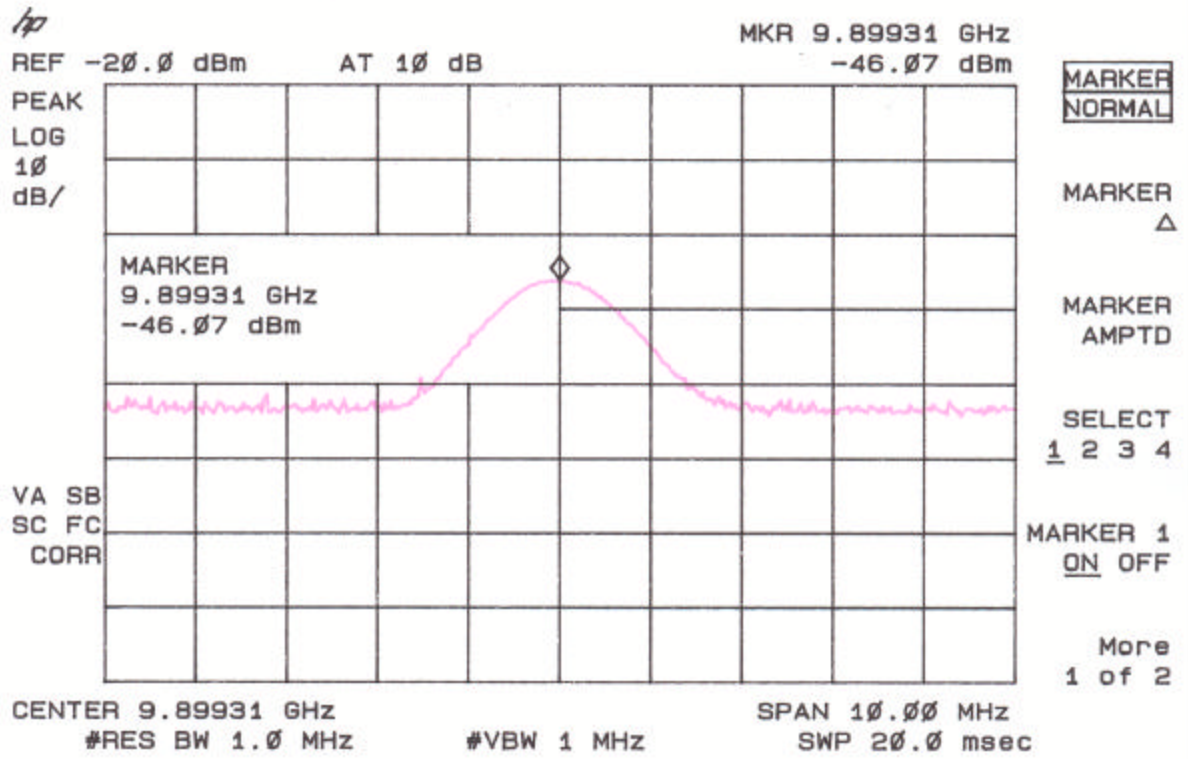
Figure 4c - 2  
Peak Radiated Spurious Emission 15.247(c) High



**Figure 4c - 3**  
**Peak Radiated Spurious Emission 15.247(c) High**



**Figure 4c - 4**  
**Peak Radiated Spurious Emission 15.247(c) High**



## 2.9 Average Spurious Emission in the Frequency Range 30 - 25000 MHz (FCC Section 15.247(c))

The results of average radiated spurious emissions falling within restricted bands are given in Tables 5a – 5c.

### **Worst Case Transmit Duty Cycle for ZMN2400HP-A**

The duty cycle de-rating factor used in the calculation of average radiated limits (per 15.209) is described below. This factor was calculated by first determining the worst case scenario for system operation. The worst case operating scenario is as follows:

Maximum transmit time/on equals 0.5ms over a 100 ms period.

The transmission duty cycle correction factor is then calculated as:

$$20 \log_{10} (0.5\text{ms}/100\text{ms}) = \mathbf{-46.02\text{dB}}$$

This value was subtracted from the peak data listed in Section 2.8 and compared to the average limits in the following tables.

Table 5a. AVERAGE RADIATED SPURIOUS EMISSIONS (Low)

Radiated Emissions									
<b>Test By:</b>	<b>Test:</b>	FCC Part 15				<b>Client:</b>	Cirronet		
A.T.	<b>Project:</b>	06-0176				<b>Model:</b>	ZMN2400HP-A		
Frequency	Test Data	AF	Test Data	AF+CA-AMP	Results	Limits	Distance /	Margin	PK = n
(MHz)	(dBm)	Table	(dBuV)	(dB)	(uV/m)	(uV/m)	Polarity	(dB)	/ QP
2404.78	-75.3	1HN3mV	31.7	31.9	1505.2		3m./VERT		AVG
4809.61	-98.1	1HN3mV	8.9	5.1	5.0	500.0	3m./VERT	40.0	AVG
7214.44	-100.6	1HN1mV	6.4	10.5	7.0	150.5	1m./VERT	26.7	AVG
9619.27	-101.2	1HN1mV	5.8	13.4	9.1	150.5	1m./VERT	24.4	AVG

Data corrected by 0.1 dB for loss of high pass filter, except to fundamental


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

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog ((-98.1 + 5.1 + 107)/20) = 5.0

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

Signature: 

Name: Austin Thompson

Table 5b. AVERAGE RADIATED SPURIOUS EMISSIONS (Mid)

Radiated Emissions										
Test By:	Test:	FCC Part 15					Client:	Cirronet		
A.T.	Project:	06-0176					Model:	ZMN2400HP-A		
Frequency	Test Data	AF	Test Data	AF+CA-AMP	Results	Limits	Distance /	Margin	PK = n	
(MHz)	(dBm)	Table	(dBuV)	(dB)	(uV/m)	(uV/m)	Polarity	(dB)	/ QP	
2439.75	-75.3	1HN3mV	31.7	31.9	1516.9		3m./VERT			
4879.63	-97.9	1HN3mV	9.1	5.4	5.3	500.0	3m./VERT	39.5	AVG	
7319.38	-101.5	1HN1mV	5.5	10.8	6.5	500.0	1m./VERT	37.7	AVG	
9759.2	-100.5	1HN1mV	6.5	13.6	10.1	151.7	1m./VERT	23.6	AVG	
12199.03	-114.3	1HN1mV	-7.3	18.1	3.4	500.0	1m./VERT	43.2	AVG	

Data corrected by 0.1 dB for loss of high pass filter, except to fundamental


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

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog ((-97.9 + 5.4 + 107)/20) = 5.3

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

Signature: 

Name: Austin Thompson



Table 5c. AVERAGE RADIATED SPURIOUS EMISSIONS (High)

Radiated Emissions										
<b>Test By:</b>	<b>Test:</b>	FCC Part 15					<b>Client:</b>	Cirronet		
A.T.	<b>Project:</b>	06-0176					<b>Model:</b>	ZMN2400HP-A		
Frequency	Test Data	AF	Test Data	AF+CA-AMP	Results	Limits	Distance /	Margin	PK = n	
(MHz)	(dBm)	Table	(dBuV)	(dB)	(uV/m)	(uV/m)	Polarity	(dB)	/QP	
2474.63	-74.4	1HN3mV	32.6	32.0	1695.7		3m./VERT		<b>AVG</b>	
4949.71	-94.1	1HN3mV	12.9	5.6	8.4	500.0	3m./VERT	<b>35.5</b>	<b>AVG</b>	
7424.51	-103.8	1HN1mV	3.2	11.1	5.2	500.0	1m./VERT	<b>39.7</b>	<b>AVG</b>	
9899.31	-101.5	1HN1mV	5.5	13.8	9.2	169.6	1m./VERT	<b>25.3</b>	<b>AVG</b>	

Data corrected by 0.1 dB for loss of high pass filter, except to fundamental


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

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog ((-94.1 + 5.6 + 107)/20) = 8.4

CONVERSION FROM dBm TO dBuV = 107 dB

Tester

Signature: 

Name: Austin Thompson

## 2.10 Band Edge Measurements

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, and the emission was measured using a peak setting. A Resolution Bandwidth of  $> 1\%$  of the emission bandwidth was used. This procedure was repeated for the high channel.

The plots shown were verified to be from the antenna used, using a 17 foot, Flexco cable and Horn Antenna. No preamp was used.

The limits were derived as follows:

High Bandedge

$$5000 \text{ uV/m} = -21.2 \text{ dBm}$$

$$-21.2 \text{ dBm} - 31.8 \text{ dB (antenna factor and cable loss)} = -53.0 \text{ dBm limit}$$

Fundamental measured at High Channel from Table 4c: -28.4

Delta from conducted measurement of band edge from fundamental peak to highest spur 10 MHz outside band edge: -50.87

$$(-28.4) - 50.87 = -79.27$$

Low Bandedge

$$-21.2 \text{ dBm} - 31.6 \text{ dB (antenna factor and cable loss)} = -52.8 \text{ dBm limit}$$

Fundamental measured at Low Channel from Table 4a: -29.3

Delta from conducted measurement of band edge from fundamental peak to highest spur 10 MHz outside band edge: -59.86

$$(-29.3) - 59.86 = -89.16$$

Figure 6a. Band Edge Compliance  
Antenna Conducted, High Channel

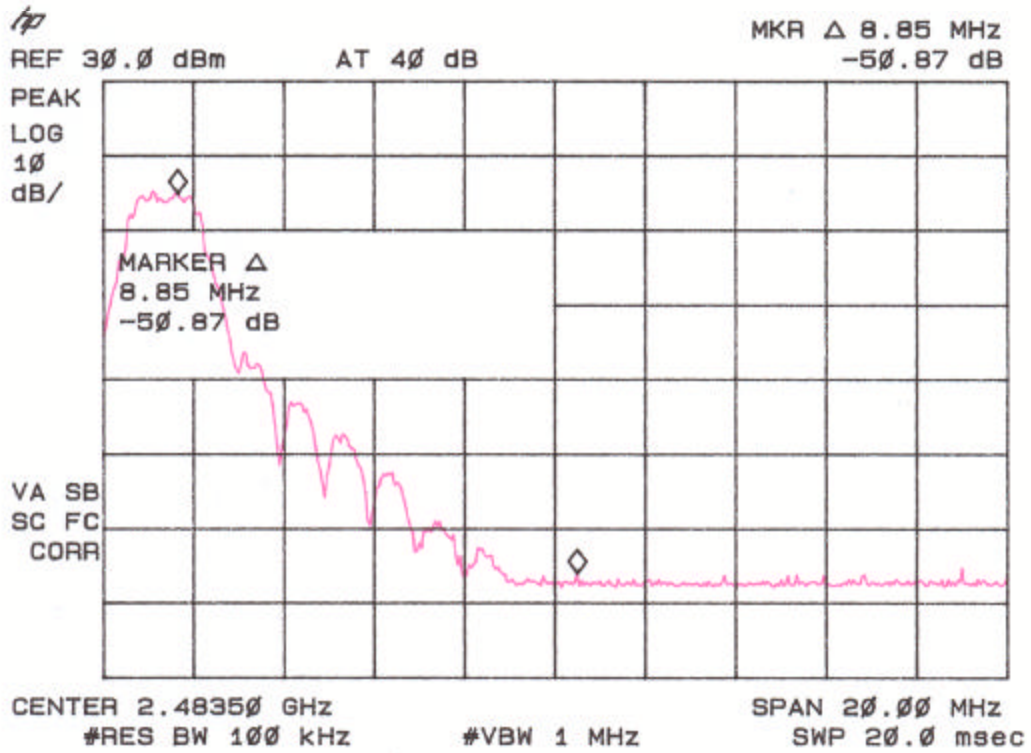
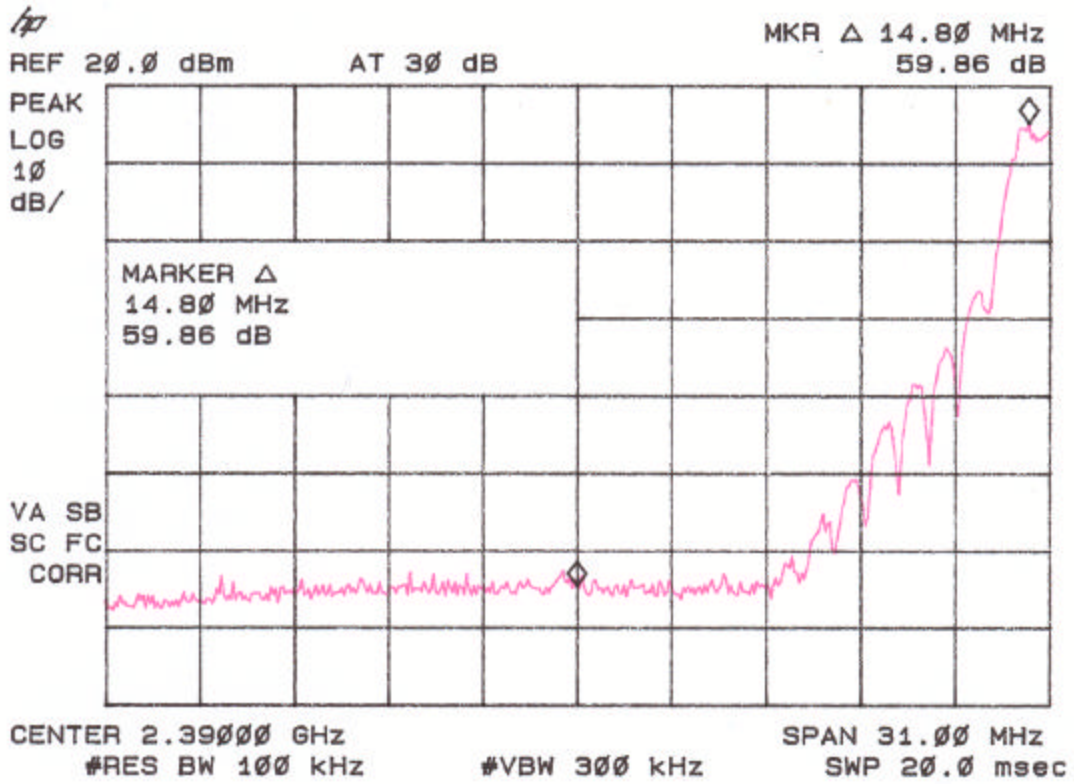


Figure 6b. Band Edge Compliance  
Antenna Conducted, Low Channel



### **2.11 6 dB Bandwidth per FCC Section 15.247(a)(1)(ii)**

The antenna port was connected to a spectrum analyzer that was set for a 50  $\Omega$  impedance with the RBW = approximately 1/100 of the manufacturers claimed RBW & VBW > RBW. The results of this test are given in Table 6 and Figure 7.

**TABLE 6**  
**6 dB Bandwidth**

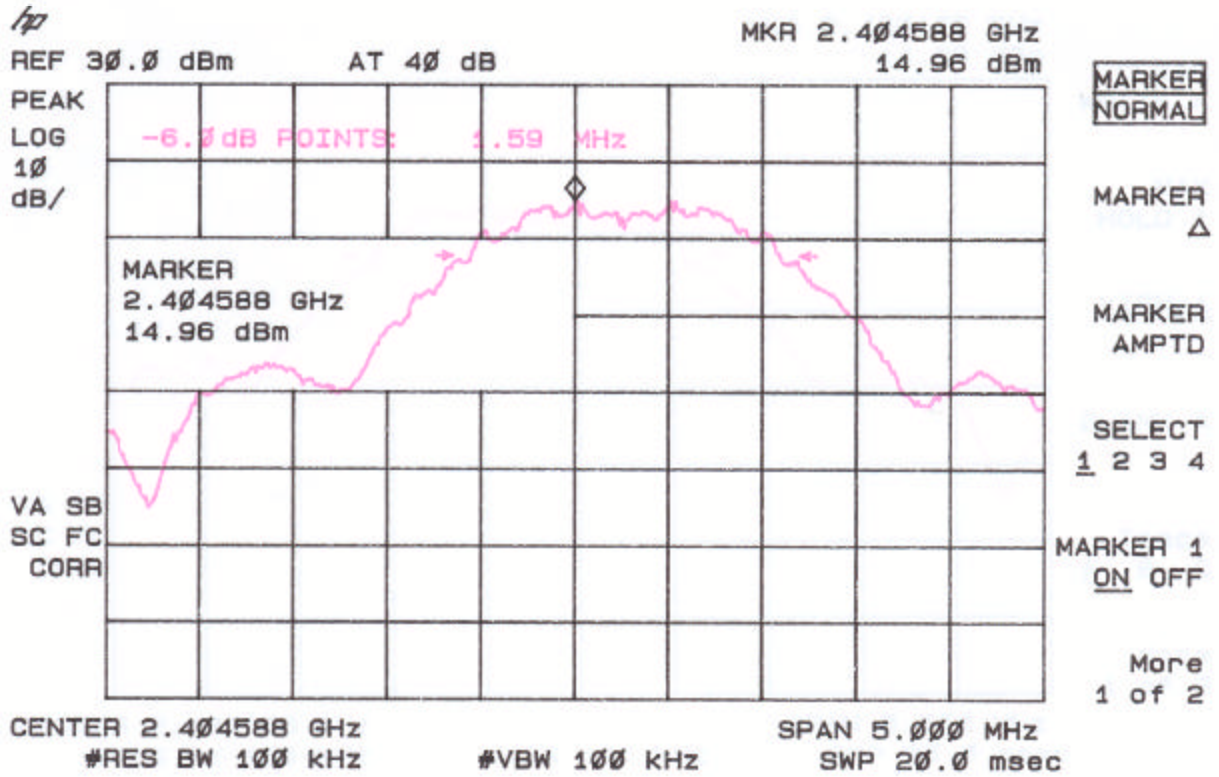
**Test Date:** July 25, 2006  
**UST Project:** 06-0176  
**Customer:** Cirronet Corporation  
**Model:** ZMN2400HP-A

Frequency (GHz)	6 dB Bandwidth (MHz)	FCC LIMIT >/= (kHz)
2.404588	1.59	500
2.444605	1.58	500
2.480105	1.60	500

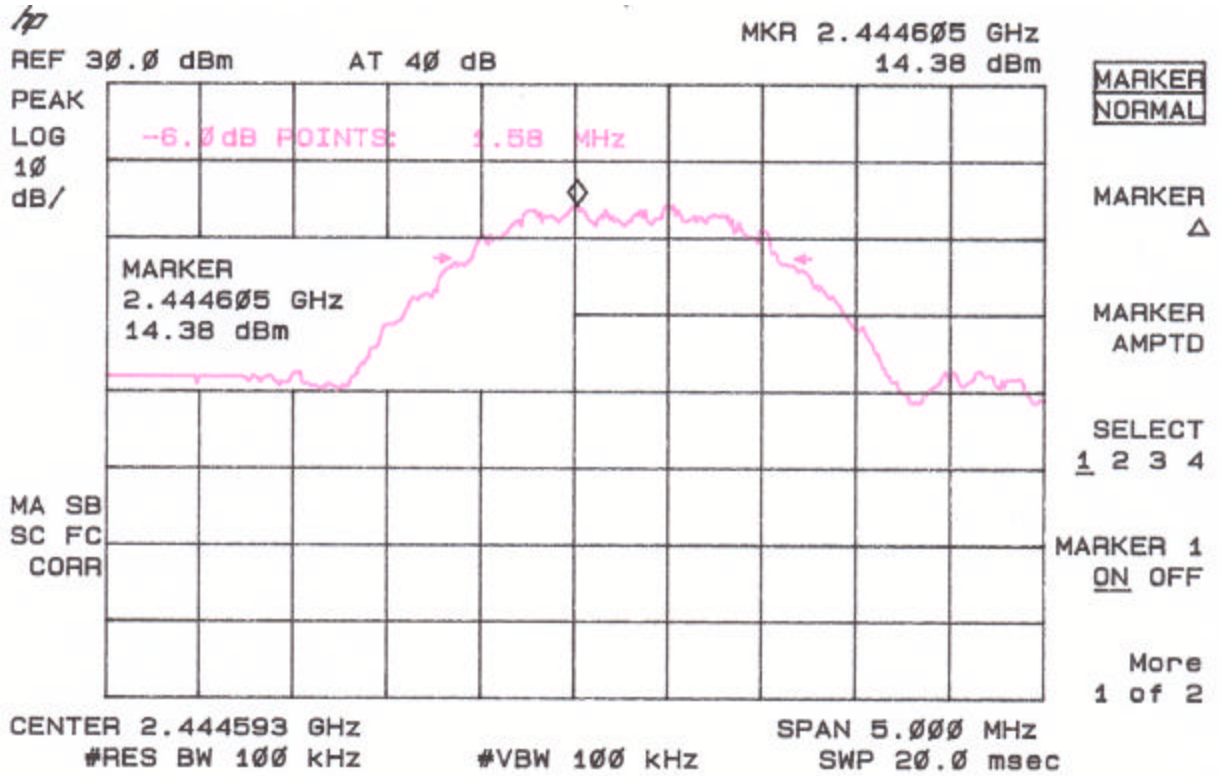
**Tester**  
**Signature:** 

**Name:** Austin Thompson

**Figure 7a.**  
 6 dB Bandwidth per FCC Section 15.247(a)(1)(ii) Low

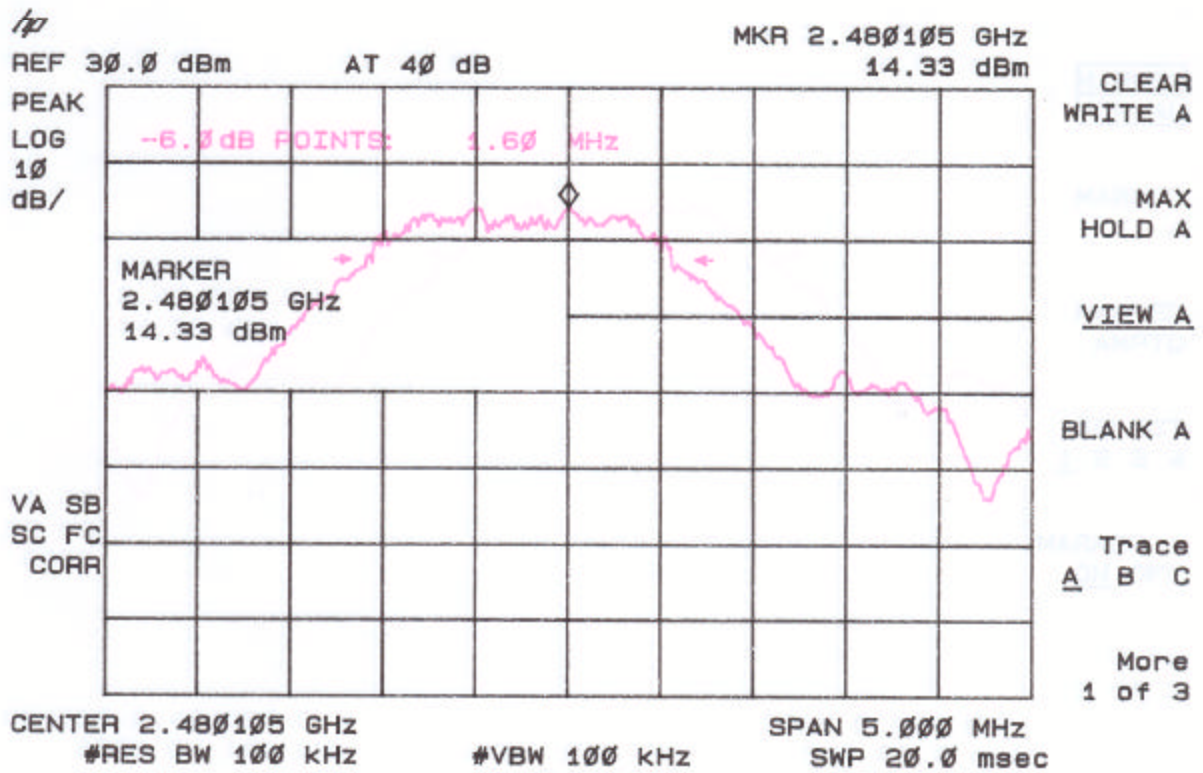


**Figure 7b.**  
6 dB Bandwidth per FCC Section 15.247(a)(1)(ii) Mid





**Figure 7c.**  
 6 dB Bandwidth per FCC Section 15.247(a)(1)(ii) High



## **2.12 Power Line Conducted Emissions for Digital Device and Receiver FCC Section 15.107**

The conducted voltage measurements have been carried out in accordance with FCC Section 15.107, with a spectrum analyzer connected to a LISN and the EUT placed into an idle condition or a continuous mode of receive. Similar results were seen as compared to the EUT in a transmit mode of operation.

**Therefore, please refer to the results as shown in Table 7.**

### **2.13 Power Line Conducted Emissions for Transmitter FCC Section 15.207**

The conducted voltage measurements have been carried out in accordance with FCC Section 15.207, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The results are given in Tables 7a-7b.

**TABLE 7a. CONDUCTED EMISSIONS DATA**

**CLASS B**

Test Date: August 24, 2006  
 UST Project: 06-0176  
 Customer: Cirronet Corporation  
 Model: ZMN2400HP-A

Worse Case Mode of Operaton (TX – Low channel)

(Peak vs Average Limits)

Conducted Emissions									
Test By:	Test: FCC Part 15B - Low Channel (PK vs. AVG)					Client:	Cirronet		
A.T.	Project: 06-0176		Class: B		Model:	ZMN2400HP-A			
Frequency	Test Data	AF	Test Data	AF+CA-AMP	Results	Limits	Distance /	Margin	PK = n
(MHz)	(dBm)	Table	(dBuV)	(dB)	(dBuV)	(dBuV)	Polarity	(dB)	/QP
0.16	-63.0	LISNP	44.0	-0.2	43.8	55.3		11.5	PK
0.208	-64.0	LISNP	43.0	-0.1	42.9	53.3		10.4	PK
0.305	-70.0	LISNP	37.0	-0.1	36.9	50.1		13.2	PK
6.338	-71.0	LISNP	36.0	0.4	36.4	50.0		13.6	PK
6.523	-73.0	LISNP	34.0	0.4	34.4	50.0		15.6	PK
6.953	-70.0	LISNP	37.0	0.4	37.4	50.0		12.6	PK
0.208	-63.0	LISNN	44.0	-0.1	43.9	53.3		9.4	PK
0.158	-63.0	LISNN	44.0	-0.2	43.8	55.6		11.8	PK
0.618	-71.0	LISNN	36.0	0.0	36.0	44.3		8.3	PK
7.568	-70.0	LISNN	37.0	0.4	37.4	50.0		12.6	PK
7.658	-71.0	LISNN	36.0	0.4	36.4	50.0		13.6	PK
7.308	-72.0	LISNN	35.0	0.4	35.4	50.0		14.6	PK

SAMPLE CALCULATIONS: 44.0 + -0.2 = 43.1 dBuV

Tester  
 Signature: \_\_\_\_\_



Name: Austin Thompson

**TABLE 7b. CONDUCTED EMISSIONS DATA**

**CLASS B**

Test Date: September 4, 2006  
 UST Project: 06-0176  
 Customer: Cirronet Corporation  
 Model: ZMN2400HP-A

Worse Case Mode of Operaton (TX – High channel)

(Peak vs Average Limits)

Conducted Emissions									
Test By:	Test: FCC Part 15B - High Channel (PK vs. AVG)				Client: Cirronet				
A.T.	Project: 06-0176			Class:	B	Model: ZMN2400HP-A			
Frequency	Test Data	AF	Test Data	AF+CA-AMP	Results	Limits	Distance /	Margin	PK = n
(MHz)	(dBm)	Table	(dBuV)	(dB)	(dBuV)	(dBuV)	Polarity	(dB)	/ QP
0.21	-63.3	LISNP	43.7	-0.1	43.6	53.4		9.8	PK
0.255	-65.8	LISNP	41.2	-0.1	41.1	51.6		10.5	PK
0.613	-68.3	LISNP	38.7	0.0	38.7	46.0		7.3	PK
4.183	-74.1	LISNP	32.9	0.3	33.2	46.0		12.8	PK
4.08	-74.3	LISNP	32.7	0.3	33.0	46.0		13.0	PK
4.383	-74.9	LISNP	32.1	0.3	32.4	46.0		13.6	PK
0.205	-64.0	LISNN	43.0	-0.1	42.9	53.4		10.5	PK
0.615	-69.8	LISNN	37.2	0.0	37.2	46.0		8.8	PK
0.155	-69.8	LISNN	37.2	-0.2	37.0	55.7		18.7	PK
0.165	-71.8	LISNN	35.2	-0.2	35.0	55.2		20.2	PK
3.978	-72.1	LISNN	34.9	0.3	35.2	46.0		10.8	PK
4.88	-72.4	LISNN	34.6	0.3	34.9	46.0		11.1	PK

SAMPLE CALCULATIONS: 43.7 +- 0.1 = 43.6 dBuV

Tester  
 Signature: 

Name: Austin Thompson

## **2.14 Radiated Emissions for Digital Device & Receiver (47 CFR 15.109a)**

Radiated emissions were evaluated from 30 to 14500 MHz while the EUT was placed into a Receive mode of operation. Measurements were made with the analyzer's bandwidth set to 120 kHz measurements made less than 1 GHz and 1 MHz for measurements made greater than or equal to 1 GHz. The results for less than 1 GHz are shown in Table 8a – 8b.

**TABLE 8a RADIATED EMISSIONS DATA  
(Digital Device & Receiver)**

**CLASS B**

**Test Date:** September 10, 2006  
**UST Project:** 06-0176  
**Customer:** Cirronet Corporation  
**Product:** ZMN2400HP-A

**Measurements 30 MHz – 1 GHz**

Radiated Emissions									
<b>Test By:</b>	<b>Test:</b>	FCC Part 15 High Channel				<b>Client:</b>	Cirronet		
A.T.	<b>Project:</b>	06-0176			<b>Class:</b>	A	<b>Model:</b>	ZMN2400HP-A	
Frequency	Test Data	AF	Test Data	AF+CA-AMP	Results	Limits	Distance /	Margin	PK = n
(MHz)	(dBm)	Table	(dBuV)	(dB)	(uV/m)	(uV/m)	Polarity	(dB)	/ QP
30.00	-90.0	GBI3mV	17.0	11.2	25.6	100.0	3m./VERT	11.8	PK

No other emissions were detected between 30 MHz and 1 GHz in either Vertical or Horizontal Polarity.

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) = Antilog  $((-90.0 + 11.2 = 107)/20) = 25.6$

CONVERSION FROM dBm TO dBuV = 107 dB

**Tester**  
**Signature:** 

**Name:** Austin Thompson

**TABLE 8b RADIATED EMISSIONS DATA  
(Digital Device & Receiver)**

**CLASS B**

**Test Date:** September 10, 2006  
**UST Project:** 06-0176  
**Customer:** Cirronet Corporation  
**Product:** ZMN2400HP-a

**Measurements 30 MHz – 1 GHz**

Radiated Emissions									
Test By: AT		Test: FCC Part 15 Idle			Client: Cirronet Corporation				
Project: 06-0176			Class: B		Model: ZMN2400HP-A				
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
38.10	-88.0	GBI3mV	19.0	11.6	34.0	100.0	3m./VERT	9.4	PK


No other emissions were detected between 30 MHz and 1 GHz in either Vertical or Horizontal Polarity.

**SAMPLE CALCULATION:**

RESULTS (uV/m @ 3m) = Antilog ((-88.0 + 11.6 = 107)/20) = 34.0

CONVERSION FROM dBm TO dBuV = 107 dB

**Tester**

**Signature:** 

**Name:** Austin Thompson



## 2.15 Peak Power Spectral Density (15.247(a)(1))

The EUT was placed into a continuous transmit mode of operation. The 2388 – 2488 MHz band was centered on the screen and the RBW was set to 10 kHz and the VBW>RBW. The span was decreased while continuing to center the max channel amplitude. The trace capture time was set to the maximum capability of the Spectrum Analyzer, at 100 s.

Results are shown in Figure 8a – 8c.

Figure 8a

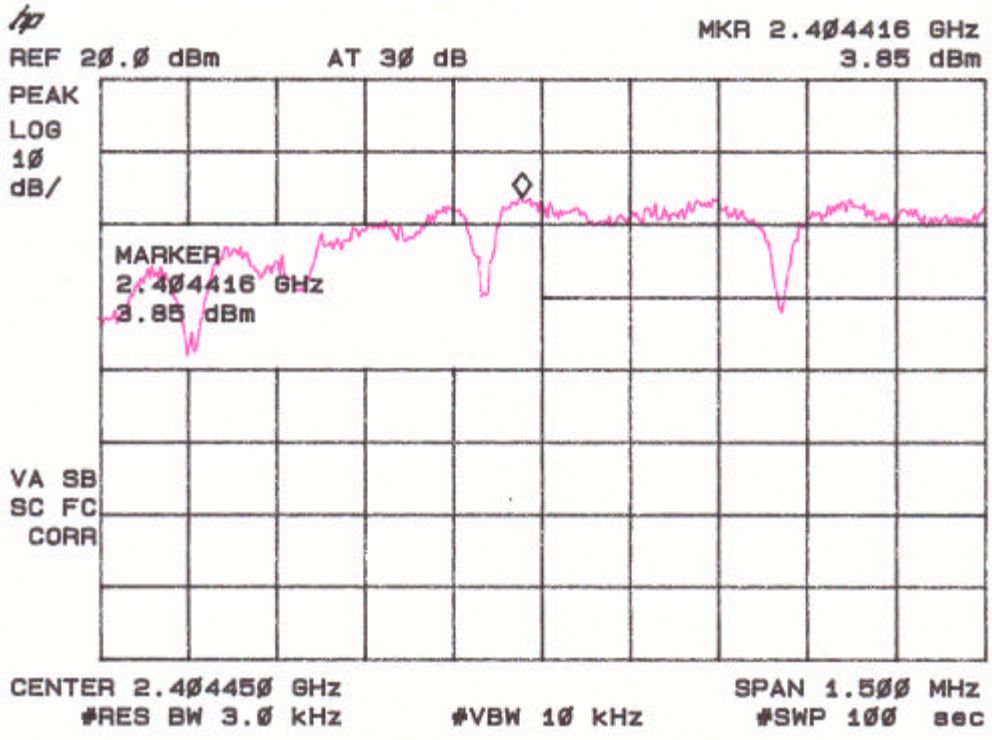


Figure 8b

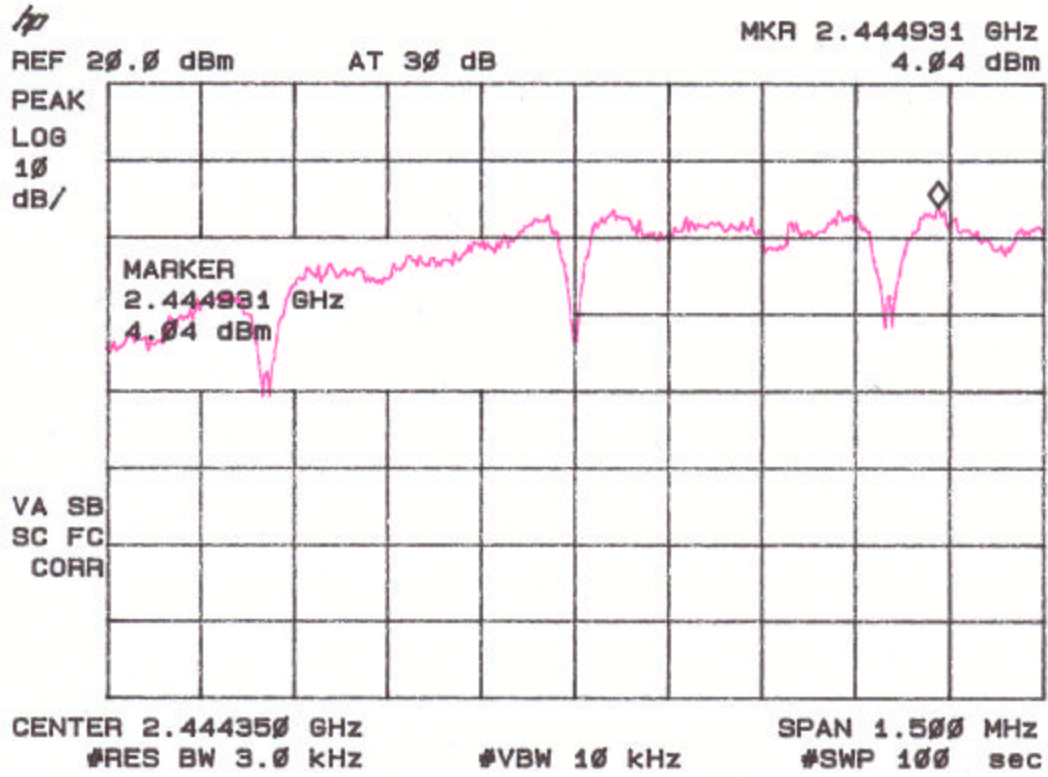


Figure 8c

