Testing Tomorrow's Technology

Application
For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraph 15.247

and

IC Radio Standards Specification: RSS-210

Permissive Change

For the

RFM / Cirronet Inc.,

Model: WIT-934

FCC ID: HSW-934
IC: 4492A-934

UST Project: 11-0049
Issue Date: April 11, 2011

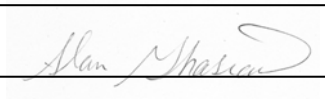
Total Pages: 46

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 Test Agency 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: Alan Ghasiani

Name: 

Title: Consulting Engineer - President

Date: April 11, 2011

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

MEASUREMENT TECHNICAL REPORT

COMPANY NAME: RFM / Cirronet Inc.

MODEL: WIT-934

FCC ID HSW-934

DATE: April 11, 2011

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

Equipment type: FHSS Transceiver Module

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

If yes, defer until: _____N/A_____
date
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

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1 General Information

1.1 Purpose of this Report

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210 for a Class II Permissive Change to include the use of two new antennas. This evaluation is also required per FCC Docket # 178919, section 1 Antenna Changes.

The following antennas are being added to be used with this radio module.

Antenna Type	Gain	Model	Manufacturer
Yagi	9 dBi	HG909Y	L-Com
Patch	-5dBi	TWP900A	Think Wireless Inc.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on March 16, 2011 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the Cirronet WIT-934. The EUT is a Spread-Spectrum Frequency Hopping RF Module operating in the 902-928 MHz ISM band.

The EUT was tested with the antennas declared herein.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2003)* for FCC subpart B Digital equipment Verification requirements and per FCC Public Notice DA 00-705 released April 11, 2000 for Frequency Hopping Spread Spectrum Systems operating under section 15.247. Also, Marker-Delta Method was followed to measure the upper band-edge.

Digital RF conducted and radiated Verification emissions data (FCC 15.107 and 109) below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is US5117. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 2982A-1.

Table 1 - EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
(EUT) RFM / Cirronet Inc.	WIT-934	None	HSW-934	6' U serial cable
Evaluation Board RFM/Cirronet	WIT-934 Eval Board	None	None	--
Switching Power Supply Volgen	NP12-US0520	None	None	6' U Power cable 120 VAC/ 60 Hz

2 Tests and Measurements

2.1 Test Equipment

Table 2 below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herewith.

Table 2 - Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/18/2010
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2410A00109	10/29/10
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2944A06291	9/7/10
BICONICAL ANTENNA 25 MHz to 200 MHz	BIA-25	Electro-Metrics	2451	12/29/09 2 Year
LOG PERIODIC 100 MHz to 1000 MHz	3146	EMCO	3110-3236	1/22/10 2 Year
HORN ANTENNA 1 GHz to 18 GHz	SAS-571	A. H. Systems	605	2/9/2010 2 Year
PREAMP 1 GHz to 26.5 GHz	8449B	HEWLETT-PACKARD	3008A00480	9/21/10
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

2.2 Modifications to EUT Hardware

No modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 as follows:

Table 3 - Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates over 902 MHz to 928 MHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10^{th} harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following:

2.6 EUT Antenna Requirements (CFR 15.203)

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. RFM / Cirronet Inc. will sell the RF Module with the following antennas:

Table 4 - Allowed Antenna(s)

MANUFACTURER	TYPE OF ANTENNA	MODEL	REPORT REFERENCE	GAIN dB_i
L-Com	Yagi	HG909Y	Antenna 1	9
Think Wireless, Inc	Patch	TWP900A	Antenna 2	-5

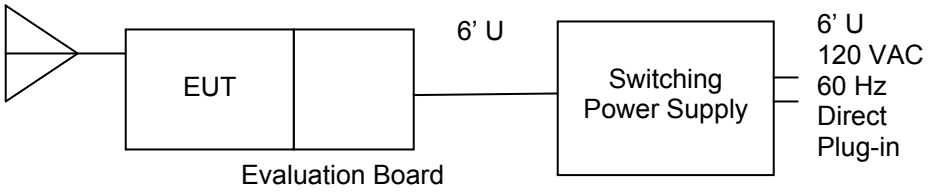


Figure 1 - Test Configuration

2.7 Intentional Radiator, Radiated Emissions (Antenna Conducted) (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a))

The EUT was put into a continuous-transmit mode of operation and tested per FCC Public Notice DA 00-705, for conducted out of band emissions emanating from the antenna port over the frequency range of 30 MHz to 12.5 GHz. A conducted scan was performed on the EUT to identify and record spurious signals that were related to the transmitter. Antenna Conducted Emissions of a significant magnitude that fell within restricted bands were then measured as radiated emissions on the OATS. The conducted emissions graphs are found in figures 4 through 10 below. The limit for antenna conducted power is 1 Watt (30 dBm) per 15.247 (b)(3) and b(4).

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW ≥ RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 5 to 8 below.

For Average Voltage measurements above 1 GHz, the emissions were measured using RBW = 1 MHz and VBW = 10 Hz. For a pulse-modulated transmitter, the EUT's average emissions are further modified by adding to them the worst-case duty cycle, determined by adding the EUT's total pulse widths (on time) over a 100 ms period and dividing by 100 ms.

On the OATS, the EUT was mounted on top of a non-conductive table, 80 cm above the floor, by placing it in the X-Z plane along the Z axis with its bottom cover in parallel with the ground. The front of the EUT faced the measurement antenna located 3 meters away. Each signal measured was maximized by raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display (with channel A in the Clear-Write mode and channel B in the Max-Hold mode) for the largest signal visible. That exact antenna height where the signal was maximized was recorded for reproducibility purposes. Also, the EUT was rotated about its Y-axis while monitoring the Spectrum Analyzer display for maximum. The EUT azimuth was recorded for reproducibility purposes. The EUT was measured when both maxima were simultaneously satisfied. Data is shown in table 5~8.

For test data, see Tables 5 to 8. Radiated emissions were measured at a distance of 1 meter for frequencies above 2 GHz. There were no test failures.

2 Test and Measurements (Cont'd)

2.8 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 210, A2.9 (a)) (Cont'd).

Note: Large Signal shown is Fundamental Frequency

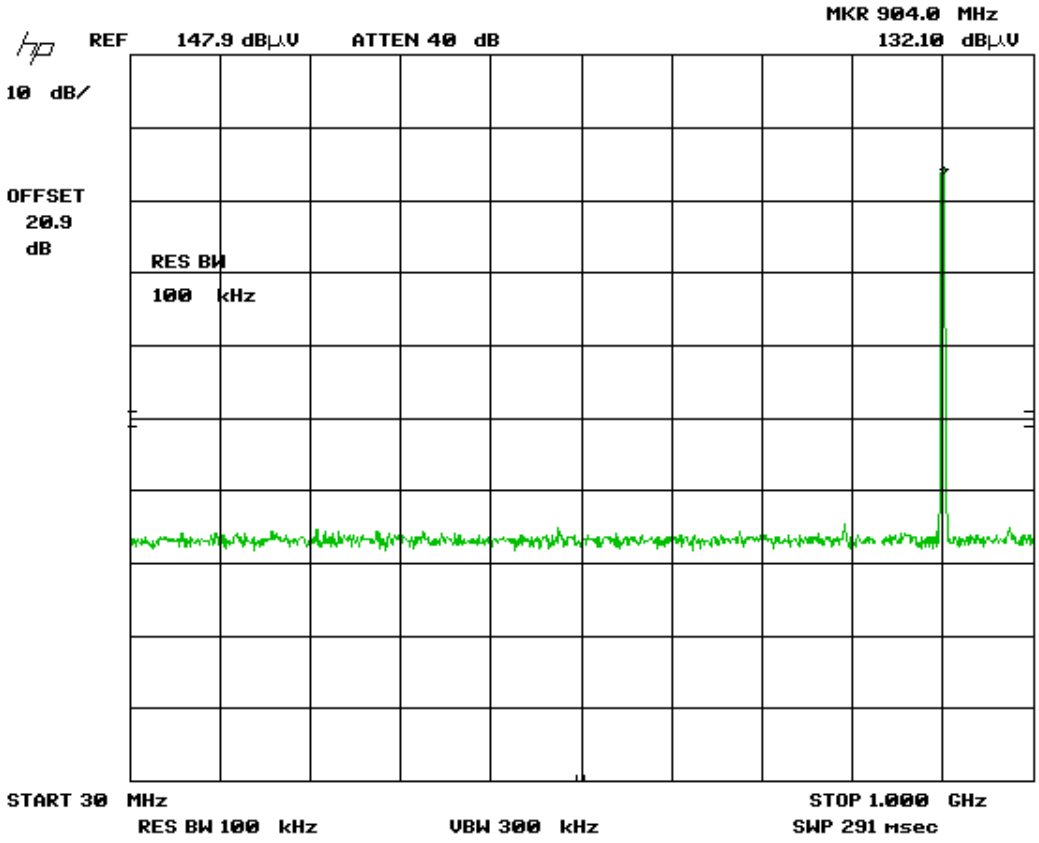


Figure 2 - Antenna Conducted Spurious Emissions – Low Channel, Part 1

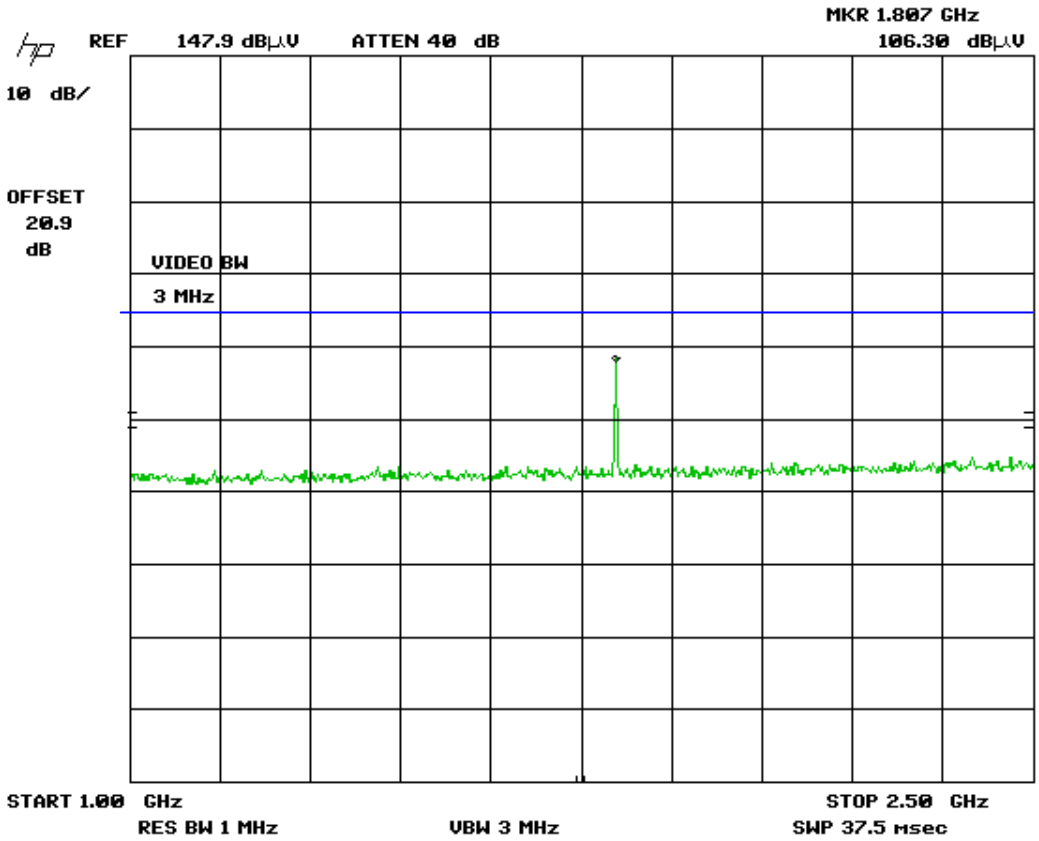


Figure 3 - Antenna Conducted Spurious Emissions – Low Channel, Part 2

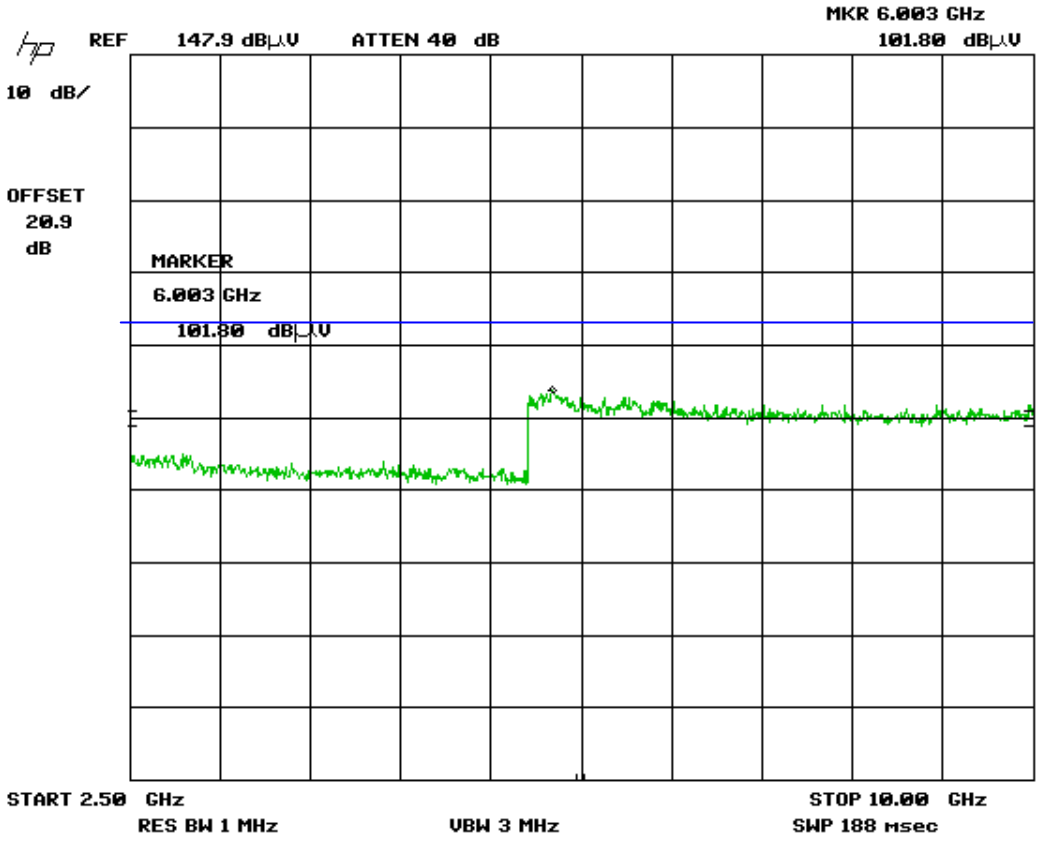


Figure 4 - Antenna Conducted Spurious Emissions – Low Channel, Part 3

Note: Signal shown represents Fundamental Frequency

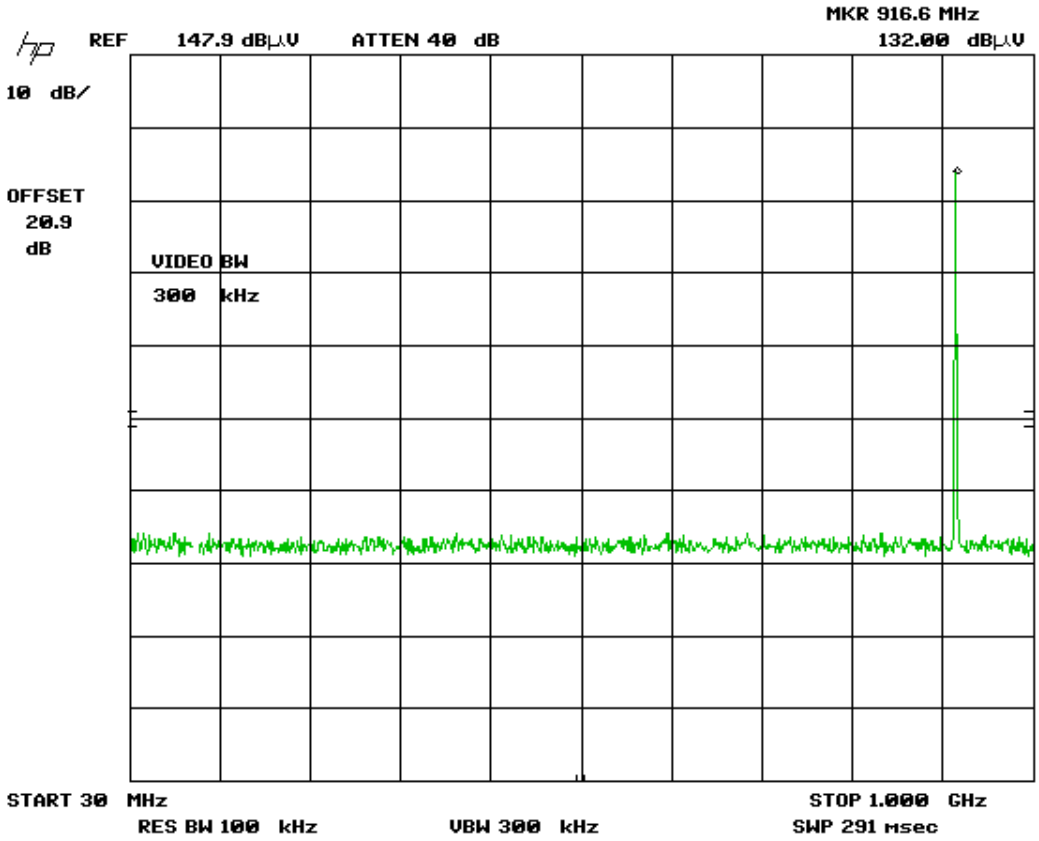


Figure 5 - Antenna Conducted Spurious Emissions - Mid Channel, Part 1

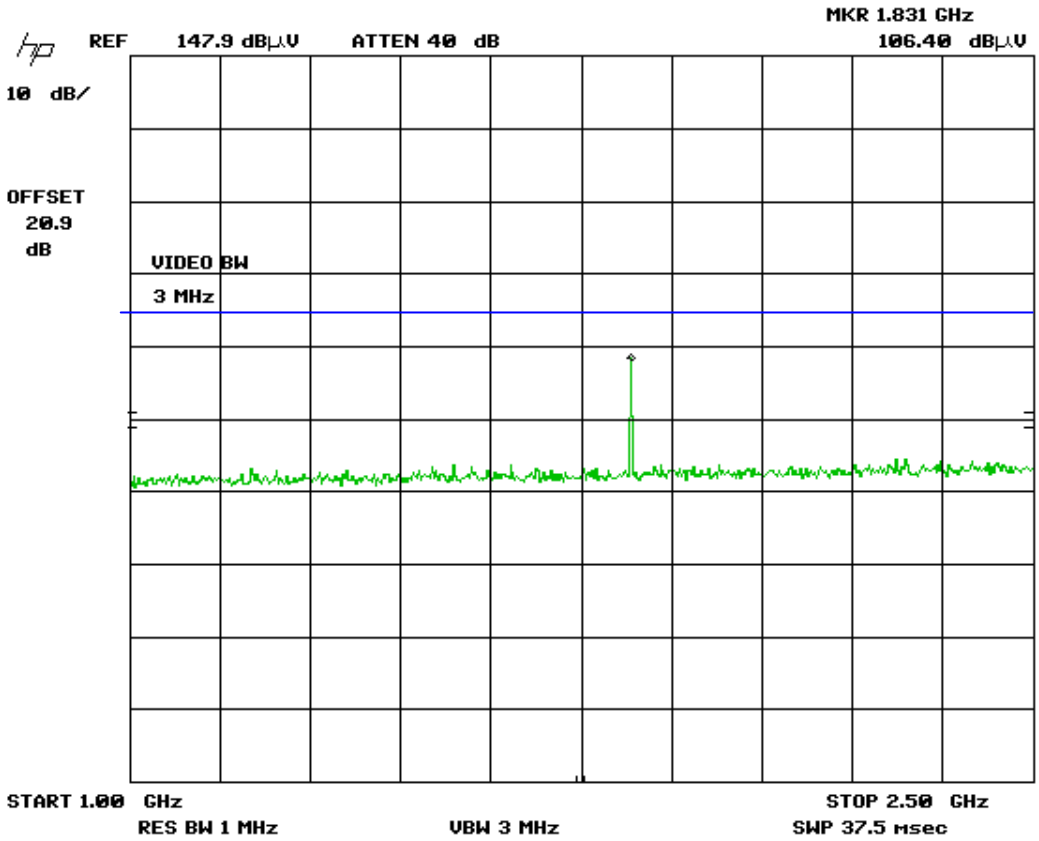


Figure 6 - Antenna Conducted Spurious Emissions – Mid Channel, Part 2

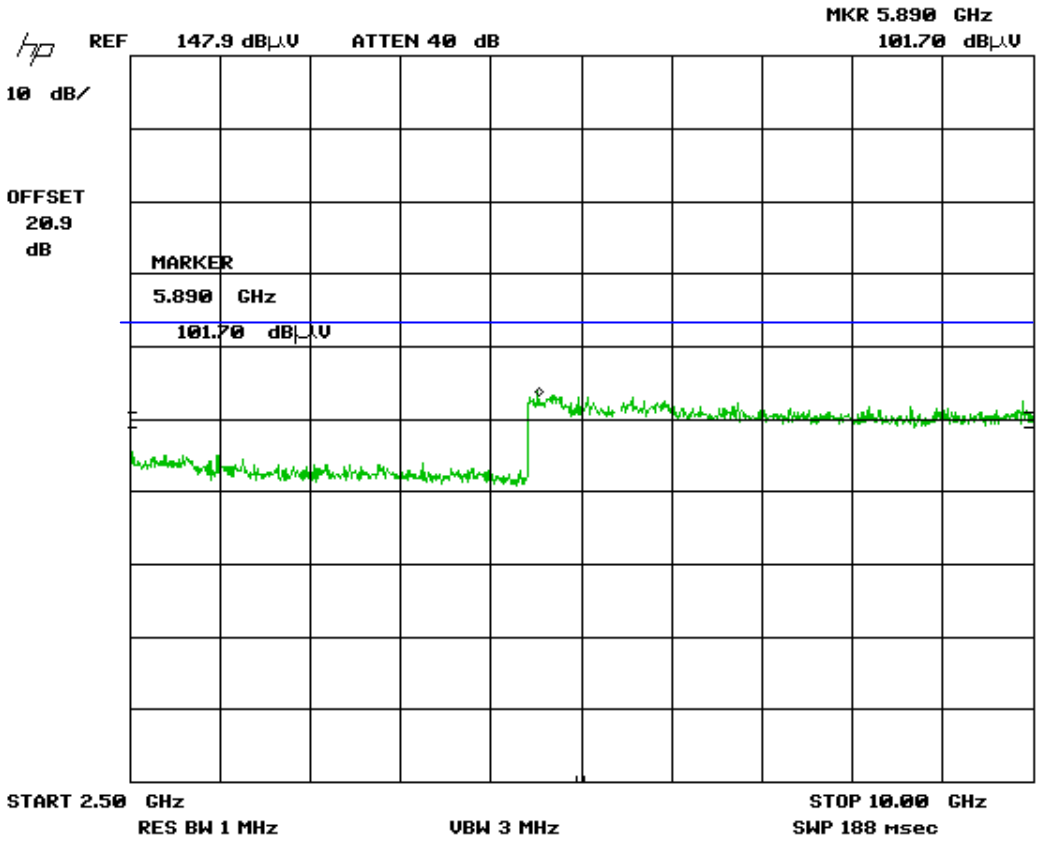


Figure 7 - Antenna Conducted Spurious Emissions – Mid Channel, Part 3

Note: Large Signal shown is Fundamental Frequency

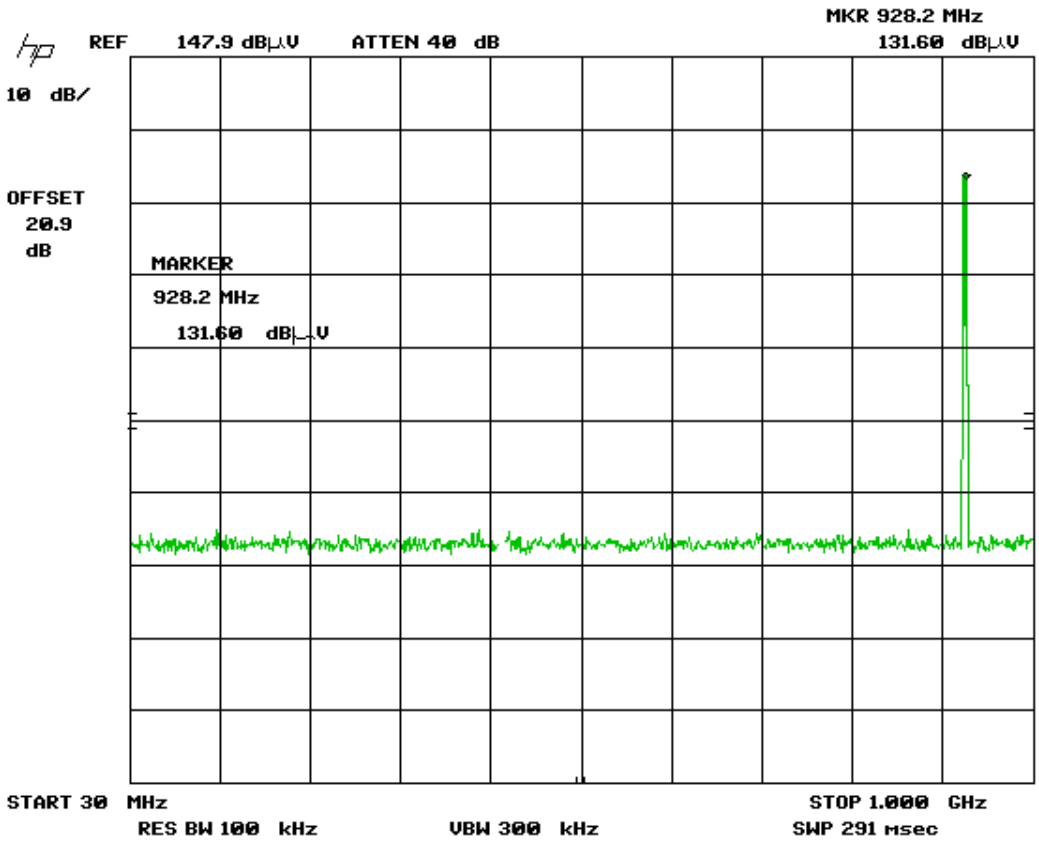


Figure 8 - Antenna Conducted Spurious Emissions – High Channel, Part 1

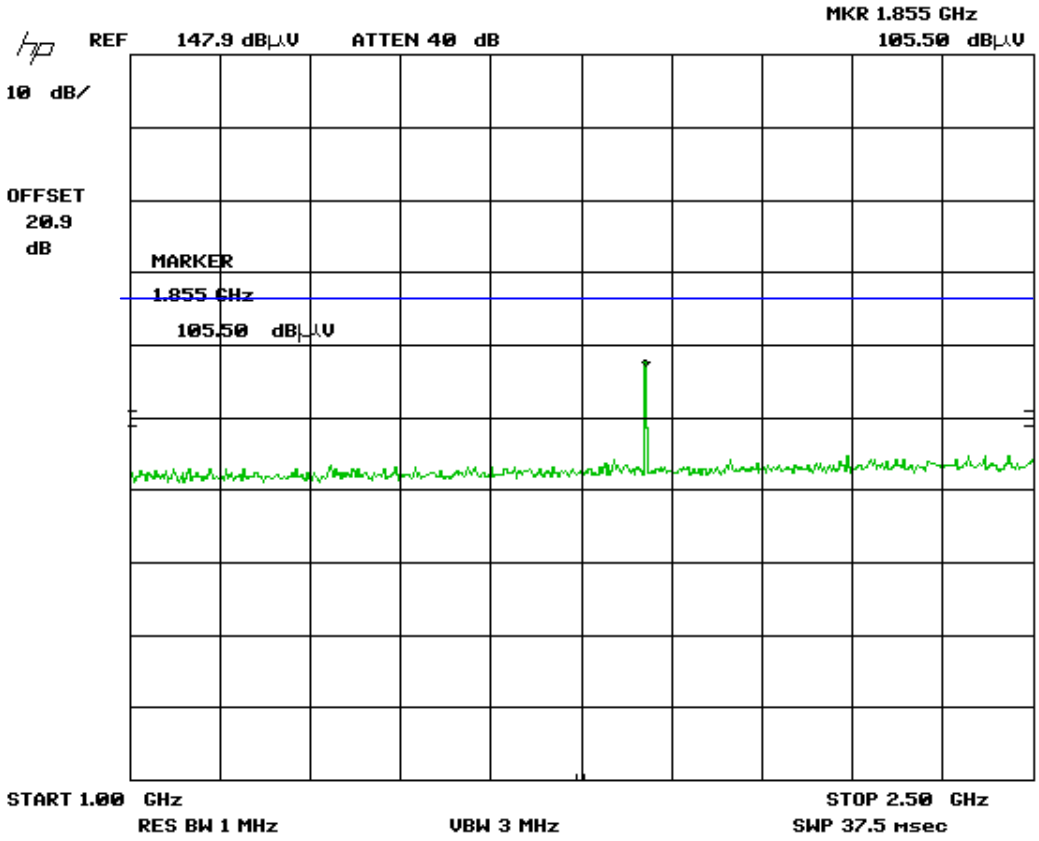


Figure 9 - Antenna Conducted Spurious Emissions - High Channel, Part 2

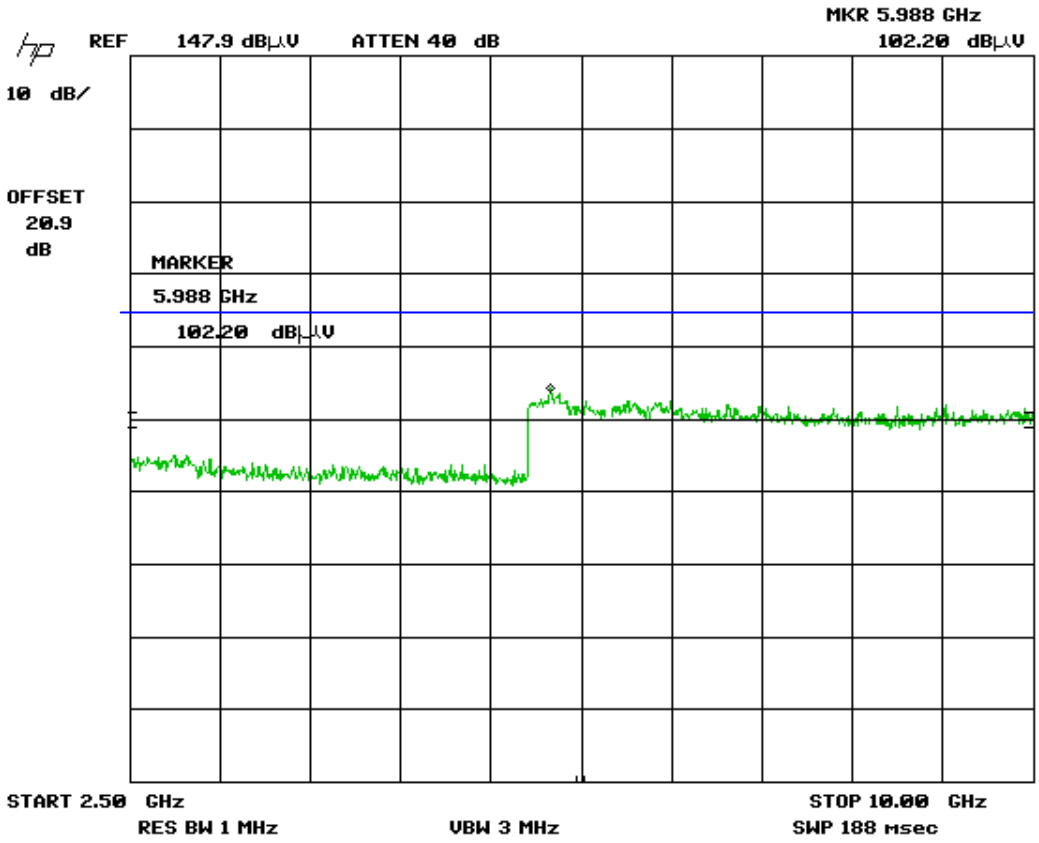


Figure 10 - Antenna Conducted Spurious Emissions - High Channel, Part 3

Table 5 - Peak Radiated Harmonic & Spurious Emissions-Antenna 1 (Yagi)

Radiated Harmonic and Spurious Emissions								
Tested By: G.Y.	Test: FCC Part 15, Para 15.247(d)				Client: RFM / Cirronet Inc.			
	Project: 11-0049				Model: WIT-934			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK								
2707.76	57.28	-8.00	-1.42	47.86	74.0	1.0m./	26.1	**PK**
3610.40	51.09	-8.00	0.69	43.78	74.0	1.0m./	30.2	**PK**
4513.41	57.08	-8.00	4.20	53.28	74.0	1.0m./	20.7	**PK**
5415.75	49.98	-8.00	7.19	49.17	74.0	1.0m./	24.8	**PK**
6318.20	54.07	-8.00	9.20	55.27	74.0	1.0m./	18.7	**PK**
MID BAND- PEAK								
2743.69	56.99	-8.00	-1.44	47.55	74.0	1.0m./	26.4	**PK**
3658.88	55.08	-8.00	0.91	47.99	74.0	1.0m./	26.0	**PK**
4575.00	60.43	-8.00	4.42	56.85	74.0	1.0m./	17.1	**PK**
5488.80	52.93	-8.00	7.30	52.23	74.0	1.0m./	21.8	**PK**
6402.60	55.00	-8.00	9.48	56.48	74.0	1.0m./	17.5	**PK**
HIGH BAND- PEAK								
2780.14	56.74	-8.00	-1.43	47.31	74.0	1.0m./	26.7	**PK**
4632.59	60.64	-8.00	4.76	57.40	74.0	1.0m./	16.6	**PK**

- - Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
- Emissions outside of restricted bands were more than 20 dB within the limit.
- Additional factors include 1.5 dB loss due to filter and extrapolation factor of -9.5dB for 1meter to 3meter distance.

SAMPLE CALCULATION:
RESULTS: At 2707.76 MHz: = 57.28 dBuV +(-8.00)+(-1.42) dB/m = 47.86 dBuV/m @ 3m
Margin = (74.0 – 47.86) = 26.1 dB

Test Date: April 4, 2011
Tested By
Signature:  Name: **Sina Sobhaniyan**

Table 6 - AVG Radiated Harmonic & Spurious Emissions-Antenna 1(Yagi)

Radiated Harmonic and Spurious Emissions								
Tested By: G.Y.	Test: FCC Part 15, Para 15.247(d)				Client: RFM / Cirronet Inc.			
	Project: 11-0049				Model: WIT-934			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK								
2707.76	48.24	-21.70	-1.42	25.12	54.0	1.0m./	28.9	**AVG**
3610.40	42.20	-21.70	0.69	21.19	54.0	1.0m./	32.8	**AVG**
4513.41	49.66	-21.70	4.20	32.16	54.0	1.0m./	21.8	**AVG**
5415.75	41.59	-21.70	7.19	27.08	54.0	1.0m./	26.9	**AVG**
6318.20	43.97	-21.70	9.20	31.47	54.0	1.0m./	22.5	**AVG**
MID BAND- PEAK								
2743.69	51.17	-21.70	-1.44	28.03	54.0	1.0m./	26.0	**AVG**
3658.88	48.59	-21.70	0.91	27.80	54.0	1.0m./	26.2	**AVG**
4575.00	56.58	-21.70	4.42	39.30	54.0	1.0m./	14.7	**AVG**
5488.80	45.17	-21.70	7.30	30.77	54.0	1.0m./	23.2	**AVG**
6402.60	47.13	-21.70	9.48	34.91	54.0	1.0m./	19.1	**AVG**
HIGH BAND- PEAK								
2780.14	50.11	-21.70	-1.43	26.98	54.0	1.0m./	27.0	**AVG**
4632.59	55.09	-21.70	4.76	38.15	54.0	1.0m./	15.9	**AVG**

- - Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
- Emission outside of restricted bands were more than 20 dB within the limit.
- Additional factors include 1.5 dB loss due to filter and extrapolation factor of -9.5dB for 1meter to 3meter distance.
- The AVG factor of -13.7 has been included in the additional factors column.

SAMPLE CALCULATION:
RESULTS: At 2707.76 MHz: = 48.24 dBuV +(-30.00)+(-1.42) dB/m = 16.82 dBuV/m @ 3m
Margin = (54.0 – 16.82) = 37.2 dB

Test Date: April 4, 2011
Tested By:
Signature: Sina Sobhaniyan Name: **Sina Sobhaniyan**

Table 7 - Peak Radiated Harmonic & Spurious Emissions-Antenna 2(Patch)

Radiated Harmonic and Spurious Emissions,								
Tested By: G.Y.	Test: FCC Part 15, Para 15.247(d)				Client: RFM / Cirronet Inc.			
	Project: 11-0049				Model: WIT-934			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK								
1805.13	68.57	1.50	-6.29	63.78	74.0	3.0m./	10.2	**PK**
2707.16	57.47	-8.00	-1.42	48.05	74.0	1.0m./	25.9	**PK**
3609.61	50.93	-8.00	0.69	43.62	74.0	1.0m./	30.4	**PK**
4512.21	53.73	-8.00	4.19	49.92	74.0	1.0m./	24.1	**PK**
MID BAND- PEAK								
1829.03	68.05	1.50	-6.14	63.41	74.0	3.0m./	10.6	**PK**
2744.93	57.32	-8.00	-1.44	47.88	74.0	1.0m./	26.1	**PK**
3658.95	50.95	-8.00	0.91	43.86	74.0	1.0m./	30.1	**PK**
4573.16	54.90	-8.00	4.41	51.31	74.0	1.0m./	22.7	**PK**
HIGH BAND- PEAK								
1853.05	68.65	1.50	-5.97	64.18	74.0	3.0m./	9.8	**PK**
2780.33	55.58	-8.00	-1.43	46.15	74.0	1.0m./	27.9	**PK**
4633.77	53.80	-8.00	4.76	50.56	74.0	1.0m./	23.4	**PK**

- - Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
- Emissions outside of restricted bands were more than 20 dB within the limit.
- Additional factors include 1.5dB loss due to filter and extrapolation factor of -9.5dB for 1meter to 3meter distance.

SAMPLE CALCULATION:
RESULTS: At 2707.16 MHz: = 57.47 dBuV+(-8.00)+ (-1.42) dB/m = 48.05 dBuV/m @ 3m
Margin = (74.0 – 48.05) = 25.9 dB

Test Date: April 5, 2011
Tested By:
Signature: Sina Sobhaniyan Name: **Sina Sobhaniyan**

Table 8 - AVG Radiated Harmonic & Spurious Emissions-Antenna 2(Patch)

Radiated Harmonic and Spurious Emissions,								
Tested By: G.Y.	Test: FCC Part 15, Para 15.247(d)				Client: RFM / Cirronet Inc.			
	Project: 11-0049				Model: WIT-934			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Pass Margin (dB)**	**Detector PK / AVG**
LOW BAND - PEAK								
1805.13	65.03	-20.50	-6.29	38.24	54.0	3.0m./	15.8	**AVG**
2707.16	48.83	-30.00	-1.42	17.41	54.0	1.0m./	36.6	**AVG**
3609.61	42.77	-30.00	0.69	13.46	54.0	1.0m./	40.5	**AVG**
4512.21	45.30	-30.00	4.19	19.49	54.0	1.0m./	34.5	**AVG**
MID BAND- PEAK								
1829.03	64.20	-20.50	-6.14	37.56	54.0	3.0m./	16.4	**AVG**
2744.93	50.33	-30.00	-1.44	18.89	54.0	1.0m./	35.1	**AVG**
3658.95	42.05	-30.00	0.91	12.96	54.0	1.0m./	41.0	**AVG**
4573.16	47.10	-30.00	4.41	21.51	54.0	1.0m./	32.5	**AVG**
HIGH BAND- PEAK								
1853.05	65.73	-20.50	-5.97	39.26	54.0	3.0m./	14.7	**AVG**
2780.33	48.20	-30.00	-1.43	16.77	54.0	1.0m./	37.2	**AVG**
4633.77	45.79	-30.00	4.76	20.55	54.0	1.0m./	33.4	**AVG**

- - Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation of CFR 15.35.
- Emissions outside of restricted bands were more than 20 dB within the limit.
- Additional factors include 1.5dB loss due to filter and extrapolation factor of -9.5dB for 1meter to 3meter distance.
- The AVG factor of -22.0 has been included in the additional factors column.

SAMPLE CALCULATION:
RESULTS: At 2707.16 MHz: = 48.83 dBuV+(-30.00)+ (-1.42) dB/m = 17.41 dBuV/m @ 3m
Margin = (54.0 – 17.41) = 36.6 dB

Test Date: March 16, 2011
Tested By:
Signature: Sina Sobhaniyan Name: **Sina Sobhaniyan**

2.9 Transmitter Duty Cycle – (CFR 15.35) (RSS-210 A8.1c)

The duty cycle de-rating factor used in the calculation of average radiated limits (per CFR 15.209 and 15.35(c)) is described below. This factor was calculated by first determining the worst case scenario for system operation. Details for the worst case scenario are found below.

Operating Scenario for the WIT-934

The WIT934 is used in a portable microphone application. The system is set up as a star network with 5 radios, called remotes, all linked to one central base radio. These remote radios are installed in belt packs that fit around the waist of the user. Given this configuration, the remote radios will generally be closer than 2.5 cm to the user and will require an appropriate designation as part of the grant. The Base (Access Point) radio is placed at some central point, usually as high as possible, in the facility to provide better coverage to all remotes.

Any remote can communicate with any other remote by means of data packets routed back and forth through the base radio. The base radio provides synchronization for the entire system, passes messages from one remote to another, and provides broadcast messages for all remotes to hear.

The WIT934 uses Frequency Hopping technology to mitigate the effects of fading and jamming. The dwell time for this system is fixed at 10 milliseconds. In any 10 ms dwell period, the following process takes place sequentially in time:

Start of dwell

1. Base broadcasts messages to all remotes,
2. Remote #1 sends its message to Base,
3. Remote #2 sends its message to Base,
4. Remote #3 sends its message to Base,
5. Remote #4 sends its message to Base,
6. Remote #5 sends its message to Base

End of dwell

After the Remote #5 sends its message to the Base, the 10 millisecond dwell time is complete and all 6 radios hop to the next frequency channel in their hopset and the cycle is repeated.

We are asking for portable designation of the remote radios since they will be operated in close (< 2.5 cm) proximity to the user.

Maximum Transmission Duty Cycle

As outlined in Appendix I, each remote WIT934 can transmit only once during a dwell time. The maximum length of the transmitted packet from each remote is set by the system design and cannot be adjusted by the user. That packet length is calculated as follows:

Data	Remote/Portable	Access Point/Base
Preamble	9 bytes	9 bytes
Sync and CRC	10 bytes	10 bytes
Data Payload	13 bytes	70 bytes
Maximum packet length (MPL)	32 bytes	89 bytes
Bit time (1/345.6 Kbps)	2.984 us	2.984 us
Byte time (bit time * 8)	23.15 us	23.15 us
Maximum packet time (byte time * MPL)	740.7 us	2.060 ms

The maximum amount of time that our Remote/Portable transmitter can operate in any 10 millisecond period is 740.74 us. Therefore, our source-averaged transmit duty cycle becomes 0.074 (740.74 us / 10 ms). Note that this duty cycle is not dependent on our use of Frequency Hopping. We do not claim to average our power over the number of hops. The above calculation is strictly based on the maximum amount of time our transmitter can transmit in any 10 ms time period – regardless of the channel the radio happens to be on at the time.

The maximum amount of time that the Access Point/Base transmitter can operate in any 10 millisecond period is 2.060 ms. Therefore, our source-averaged transmit duty cycle becomes 0.206 (2.060 ms / 10 ms).

The transmission duty cycle correction factor is then calculated as:

20 log10 (0.074)= **-22.6 dB (DC for Patch Antenna)**
20 log10 (.206)= **-13.7 dB (DC for Yagi Antenna)**

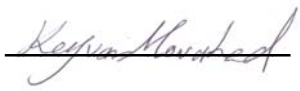
2.10 Peak Conducted Power – (CFR 15.247 (b3))

Peak power within the band 902 MHz to 928 MHz was measured per FCC KDB Publication DA 00-705 as an Antenna Conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, to the antenna output terminals on the EUT. The spectrum analyzer was set for an impedance of 50 Ω with the RBW set greater than the 6 dB bandwidth of the EUT, and the VBW ≥ RBW. The loss of the short cable is 0.9 dB, and was included in spectrum analyzer reading as can be see in the offset. The final measured value is the actual correct measurement including the 0.9 dB loss which can be seen below.

Antenna Conducted Output Power was measured at Low Channel, Mid Channel and High Channel frequencies. See Figures 3 to 8 above. The 0.9 dB loss for the RF wire is taken into consideration here (Corrected Measurement column).

Table 9 – Peak Antenna Conducted Output Power per Part 15.247 (b) (3) (Same as EIRP)

Frequency of Fundamental (MHz)	Corrected Measurement (dBm)	(mW)	FCC Limit (mW Maximum)
Low Band (902.5 MHz)	23.60	229.08	250
Mid Band (914.6 MHz)	23.62	230.14	250
High Band (926.6 MHZ)	23.46	221.82	250

Test Date: March 22, 2011
Tested By
Signature:  Name: Keyvan Muvahhid

2 Test and Measurements (Cont'd)

2.10 Peak Power Output (CFR 15.247 (b)(3))

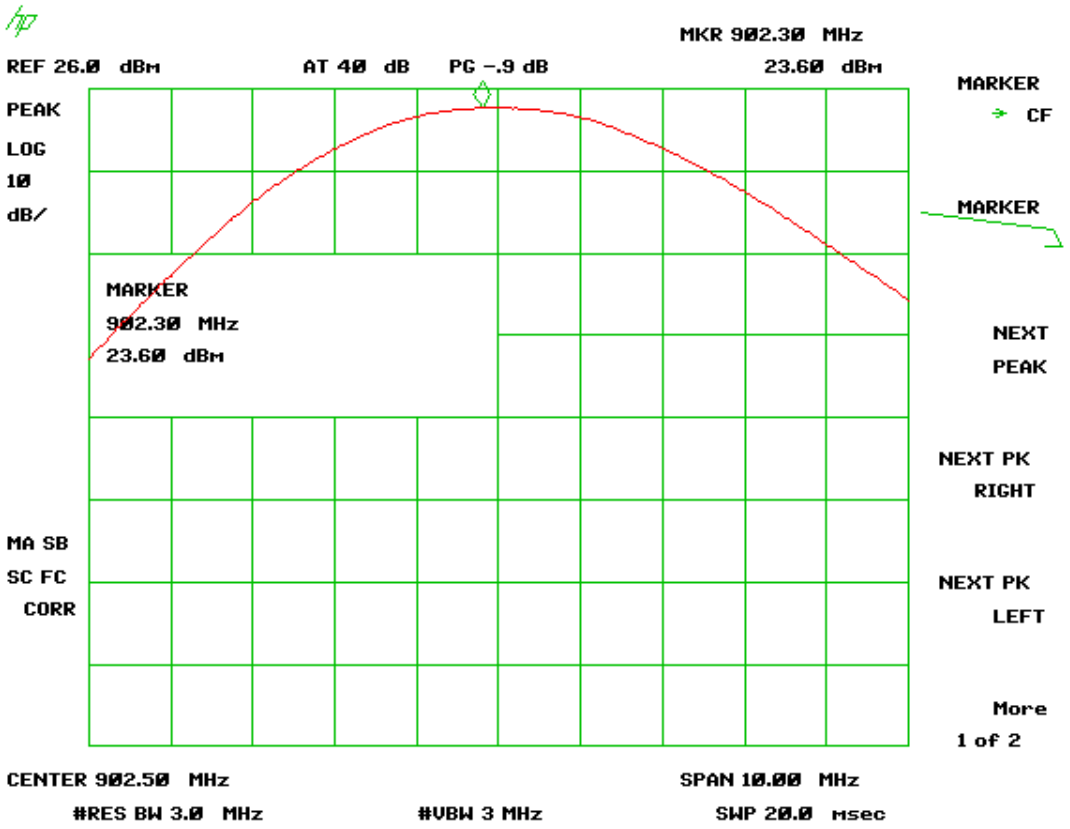


Figure 11 - Peak Antenna Conducted Output Power, Low Channel

2 Test and Measurements (Cont'd)

2.10 Peak Power Output (CFR 15.247 (b)(3))

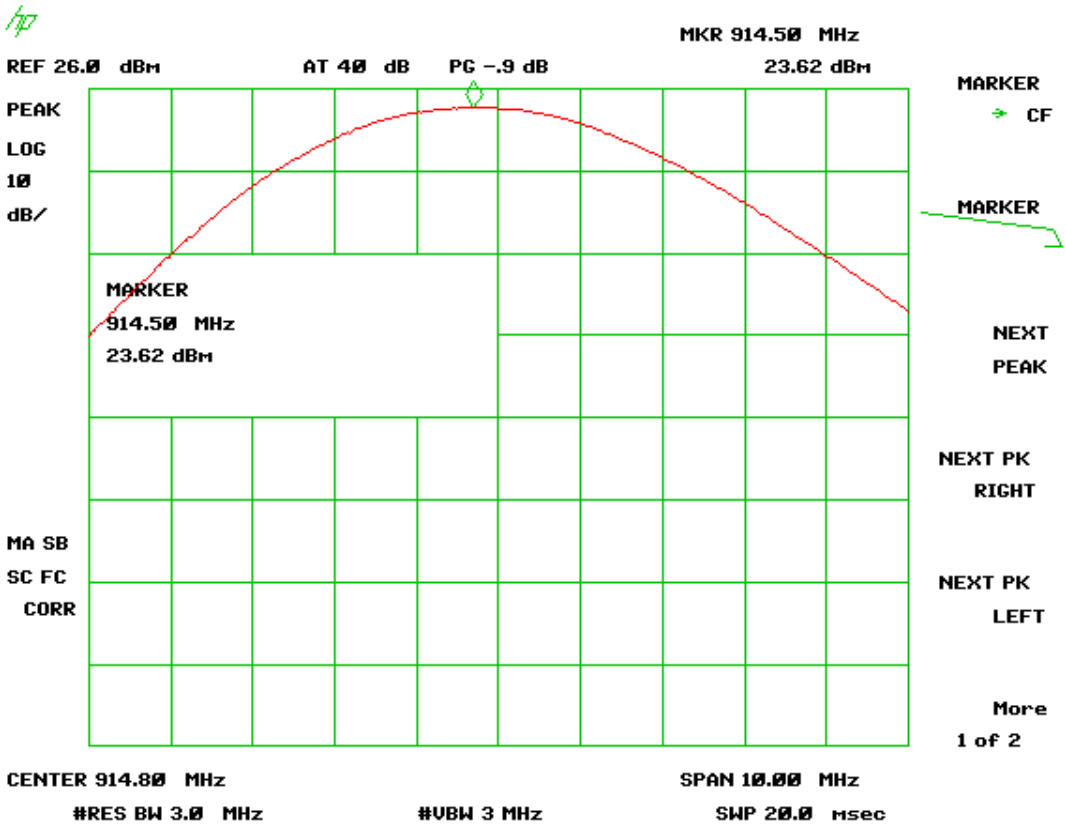


Figure 12 - Peak Antenna Conducted Output Power, Mid Channel

2 Test and Measurements (Cont'd)

2.10 Peak Power Output (CFR 15.247 (b)(3))

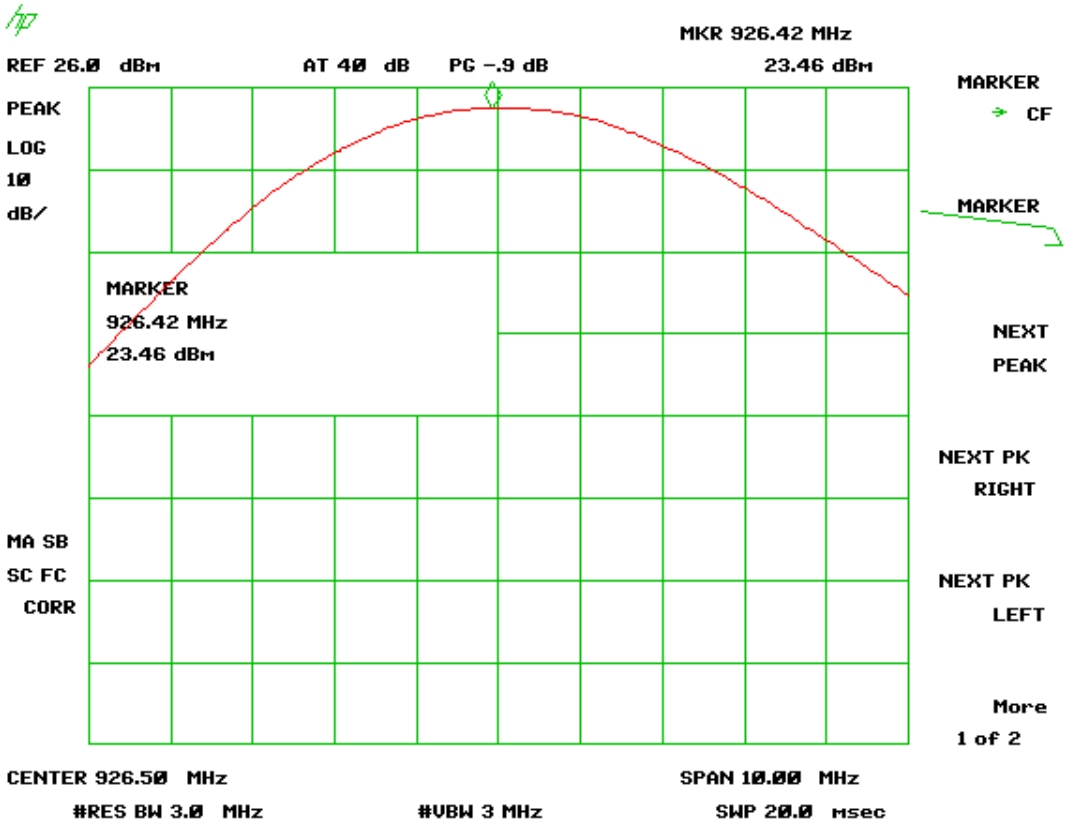


Figure 13 - Peak Antenna Conducted Output Power, High Channel

2.11 Band Edge Measurements – (CFR 15.247 (d))

Band Edge measurements are made following the guidelines in FCC docket # DA00-705 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port conducted measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band). Because these frequencies occur above 1000 MHz they have both a peak and average requirement.

Set the Spectrum Analyzer frequency span large enough (usually around 10 MHz) to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Conducted measurements are performed with RBW ≥1% of the frequency span. In all cases, the VBW is set ≥ RBW.

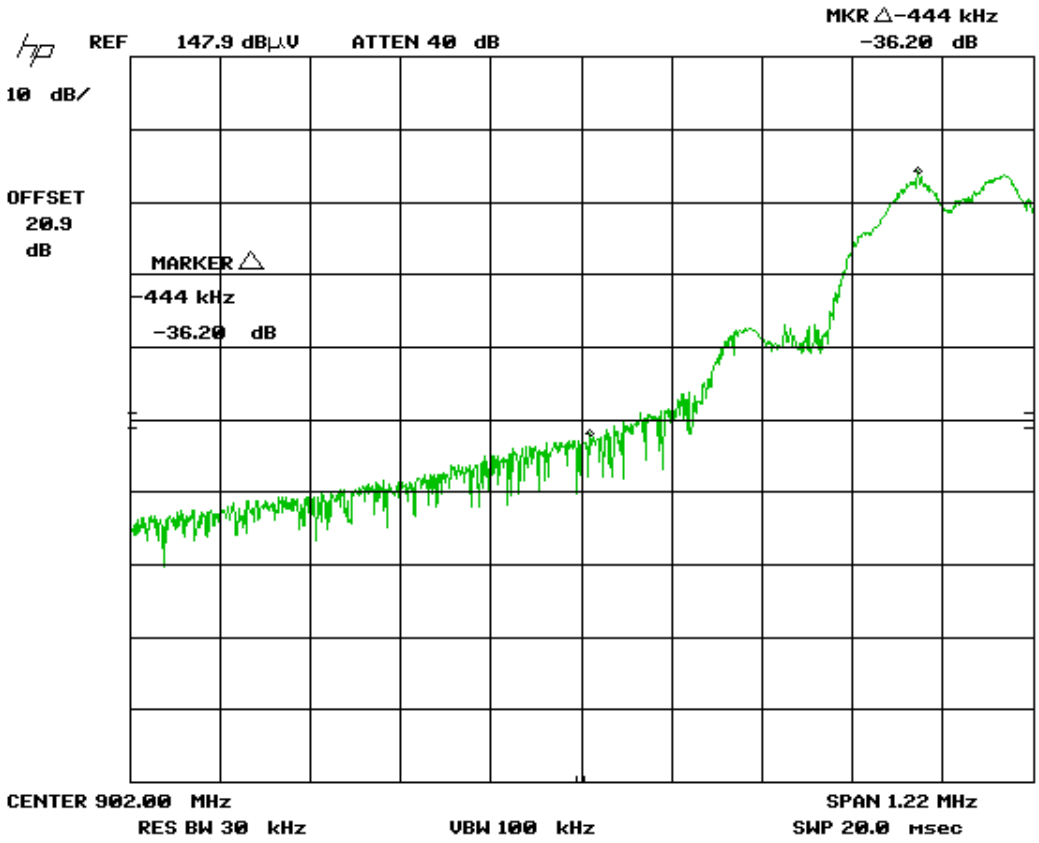


Figure 14 - Radiated Band Edge Compliance – Low Channel

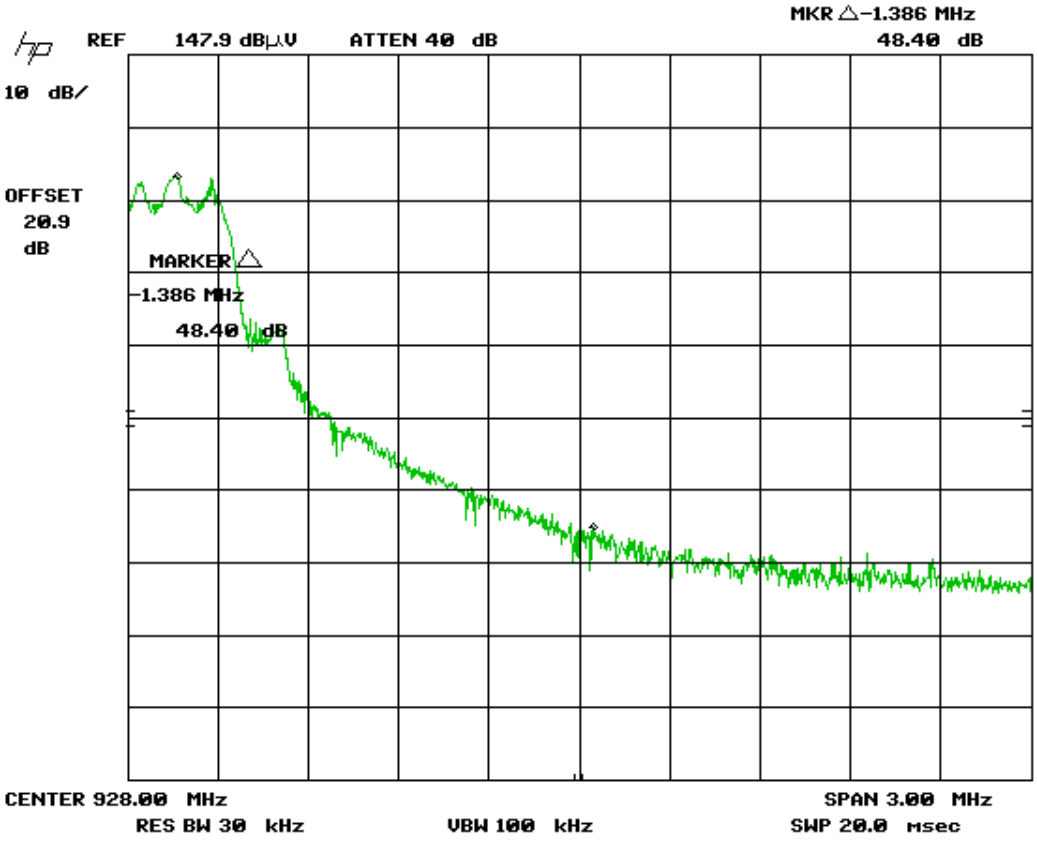


Figure 15 - Radiated Band Edge Compliance – High Channel

2.12 Unintentional Radiator, Radiated Emissions (CFR 15.109 (a))

The test data is provided herein to support the Verification requirement for digital devices. Radiated emissions coming from the EUT in a non-transmit state were evaluated from 30 MHz to 12.5 GHz per ANSI C63.4, Paragraph 8.

Measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth; 1 MHz RBW and 3 MHz VBW. The test data was maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

All measured signals were at least 2.5 dB below the specification limit. The results are shown in Table 12 following.

Table 10 – Unintentional Radiator, Radiated Emissions.

Unintentional Radiator, Radiated Emissions- Antenna 1							
Test By: S.S.	Test: FCC Part 15.109, 15.209			Client: RFM/Cirronet			
	Project: 11-0049 Class: B			Model: WIT-934			
Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP
Tested from 30 MHz to 1 GHz							
110.4990	21.50	14.39	35.89	43.5	3m./VERT	7.6	**QP**
113.7400	23.80	14.77	38.57	43.5	3m./VERT	4.9	**QP**
133.4460	23.30	14.69	37.99	43.5	3m./VERT	5.5	**QP**
133.2070	20.80	14.42	35.22	43.5	3m./HORZ	8.3	**QP**
199.3870	17.60	19.65	37.25	43.5	3m./HORZ	6.3	**PK**
233.1620	16.30	15.01	31.31	46.0	3m./HORZ	14.7	**QP**
300.1210	19.30	18.92	38.22	46.0	3m./HORZ	7.8	**PK**
333.8360	17.20	18.23	35.43	46.0	3m./HORZ	10.6	**PK**
366.4440	21.80	18.86	40.66	46.0	3m./HORZ	5.3	**QP**
398.7950	15.60	19.97	35.57	46.0	3m./HORZ	10.4	**QP**
432.2260	19.80	20.76	40.56	46.0	3m./HORZ	5.4	**PK**
465.1660	15.40	21.74	37.14	46.0	3m./HORZ	8.9	**PK**
532.1880	14.70	23.18	37.88	46.0	3m./HORZ	8.1	**QP**
232.6500	20.40	15.01	35.41	46.0	3m./VERT	10.6	**QP**
299.0920	15.80	19.11	34.91	46.0	3m./VERT	11.1	**PK**
332.6120	18.60	18.06	36.66	46.0	3m./VERT	9.3	**QP**
365.5790	20.90	18.81	39.71	46.0	3m./VERT	6.3	**QP**
398.7360	19.20	19.49	38.69	46.0	3m./VERT	7.3	**QP**
465.2310	19.00	21.44	40.44	46.0	3m./VERT	5.6	**PK**
728.5300	15.70	26.43	42.13	46.0	3m./VERT	3.9	**PK**

No other emissions detected within 20 dB of the FCC Part 15.109 limits

AF is antenna factor. CL is cable loss. PA is preamplifier gain
SAMPLE CALCULATION:
RESULTS: At 199.387 MHz: = 17.60+(19.65) = 37.25 dBuV/m @ 3m
Margin = (43.5-37.25) = 6.3 dB

Test Date: March 29, 2011

Tested By Signature: Sina Sobhaniyan Name: Sina Sobhaniyan

Table 11 – Unintentional Radiator, Radiated Emissions.

Unintentional Radiator, Radiated Emissions- Antenna 1							
Test By: G.Y.	Test: FCC Part 15.109, 15.209			Client: RFM/Cirronet			
	Project: 11-0049 Class: B			Model: WIT-934			
Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP
Tested from 1 GHz to 12.5 GHz							
1314.5300	56.18	-8.69	47.49	54.0	3.0m./VERT	6.5	**AVG**
3943.7900	46.24	2.54	48.78	54.0	3.0m./VERT	5.2	**AVG**
1314.6300	54.80	-8.86	45.94	54.0	3.0m./HORZ	8.1	**PK**
3943.7900	45.31	2.74	48.05	54.0	3.0m./HORZ	6.0	**PK**

No other emissions detected within 20 dB of the FCC Part 15.109 limits

AF is antenna factor. CL is cable loss. PA is preamplifier gain
SAMPLE CALCULATION:
RESULTS: At 1314.53 MHz: = 56.18+(-8.69) = 47.49 dBuV/m @ 3m
Margin = (54.0-47.49) = 6.5 dB

Test Date: April 1, 2011

Tested By Signature: _____ Name: George Yang

Table 12 – Unintentional Radiator, Radiated Emissions.

Unintentional Radiator, Radiated Emissions- Antenna 2							
Test By: S.S.	Test: FCC Part 15.109, 15.209			Client: RFM/Cirronet			
	Project: 11-0049 Class: B			Model: WIT-934			
Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP
Tested from 30 MHz to 1 GHz							
158.7290	15.40	15.29	30.69	43.5	3m./HORZ	12.8	**PK**
166.1820	19.20	16.50	35.70	43.5	3m./HORZ	7.8	**PK**
199.7630	21.40	19.61	41.01	43.5	3m./HORZ	2.5	**PK**
166.2410	20.60	17.59	38.19	43.5	3m./VERT	5.3	**PK**
199.7870	19.70	19.93	39.63	43.5	3m./VERT	3.9	**PK**
232.6240	22.50	14.98	37.48	46.0	3m./HORZ	8.5	**QP**
266.5050	17.00	17.31	34.31	46.0	3m./HORZ	11.7	**PK**
300.3750	20.80	18.92	39.72	46.0	3m./HORZ	6.3	**PK**
365.5910	21.00	18.86	39.86	46.0	3m./HORZ	6.1	**QP**
399.3050	13.60	19.99	33.59	46.0	3m./HORZ	12.4	**QP**
465.2050	14.70	21.74	36.44	46.0	3m./HORZ	9.6	**PK**
232.6400	23.00	15.01	38.01	46.0	3m./VERT	8.0	**QP**
299.1230	19.00	19.11	38.11	46.0	3m./VERT	7.9	**PK**
333.6640	17.20	18.09	35.29	46.0	3m./VERT	10.7	**QP**
367.1540	21.20	18.78	39.98	46.0	3m./VERT	6.0	**QP**
432.0000	18.00	20.20	38.20	46.0	3m./VERT	7.8	**PK**
467.3690	17.10	21.50	38.60	46.0	3m./VERT	7.4	**PK**
598.1190	15.80	23.76	39.56	46.0	3m./VERT	6.4	**PK**

No other emissions detected within 20 dB of the FCC Part 15.109 limits

AF is antenna factor. CL is cable loss. PA is preamplifier gain

SAMPLE CALCULATION:

RESULTS: At 158.729 MHz: = 15.40+(15.29) = 30.69 dBuV/m @ 3m

Margin = (43.5-30.69) = 12.8 dB

Test Date: March 31, 2011

Tested By Signature: Sina Sobhaniyan Name: Sina Sobhaniyan

Table 13 – Unintentional Radiator, Radiated Emissions.

Unintentional Radiator, Radiated Emissions- Antenna 1							
Test By: G.Y.	Test: FCC Part 15.109, 15.209			Client: RFM/Cirronet			
	Project: 11-0049 Class: B			Model: WIT-934			
Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP
Tested from 1 GHz to 12.5 GHz							
1314.5300	56.18	-8.69	47.49	54.0	3.0m./VERT	6.5	**AVG**
3943.7900	46.24	2.54	48.78	54.0	3.0m./VERT	5.2	**AVG**
1314.6300	54.80	-8.86	45.94	54.0	3.0m./HORZ	8.1	**PK**
3943.7900	45.31	2.74	48.05	54.0	3.0m./HORZ	6.0	**PK**

No other emissions detected within 20 dB of the FCC Part 15.109 limits

AF is antenna factor. CL is cable loss. PA is preamplifier gain
SAMPLE CALCULATION:
RESULTS: At 1314.53 MHz: = 56.18+(-8.69) = 47.49 dBuV/m @ 3m
Margin = (54.0-47.49) = 6.5 dB

Test Date: April 1, 2011

Tested By Signature:  Name: George Yang

2.13 Unintentional Radiator Power Lines Conducted Emissions (CFR 15.107)

The test data provided herein is to support the Verification requirement for the digital apparatus. The power line conducted voltage measurements for Receiver and Digital Devices have been carried out in accordance with CFR 15.107 and ANSI C63.4, Paragraph 7, with a spectrum analyzer connected to an LISN and the EUT placed into an idle condition or a continuous mode of receive (non-transmitting). Please refer to the results as shown in Table 14 below.

Table 14 - Power Line Conducted Emissions Data, Class B

CONDUCTED EMISSIONS						
Tested By: S.S.	Specification Requirement: FCC Part 15, Para 15.107 Class B		Project No.: 11-0049	Manufacturer/Model: RFM/Cirronet model: WIT-934		
Frequency (MHz)	Test Data (dBuV)	LISN+CL-PA (dB)	Corrected Results (dBuV)	Avg Limits (dBuV)	Margin (dB)	Detector
This test was not re-evaluated because this is a Class 2 Permissive Change Filing and the change involves only the antenna. All other circuits and components remain the same.						

Test Date: January 25, 2010
Tested By Signature: Sina Sobhaniyan Name: Sina Sobhaniyan

2.14 Measurement Uncertainty

2.14.1 Conducted Emissions Measurement Uncertainty:

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB.

2.14.2 Radiated Emissions Measurement Uncertainty:

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.1 dB.

The data listed in this test report does not have sufficient margin to negate the effects of uncertainty, therefore, this test is conditionally acceptable.

2.15 20 dB Bandwidth Measurement per CFR 15.247, 99% Occupied Bandwidth (IC RSS 210, A8.1)

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed similar to the method of FCC Docket # DA00-705 for a bandwidth of 20 dB. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 15 and Figures 16 through 18.

Table 15 – 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	20 dB Bandwidth (KHz)	99% Occupied Bandwidth (KHz)
902.5	417	417
914.6	414	414
926.6	410	410

Test Date: March 19, 2011

Tested By
Signature: _____ Name: George Yang

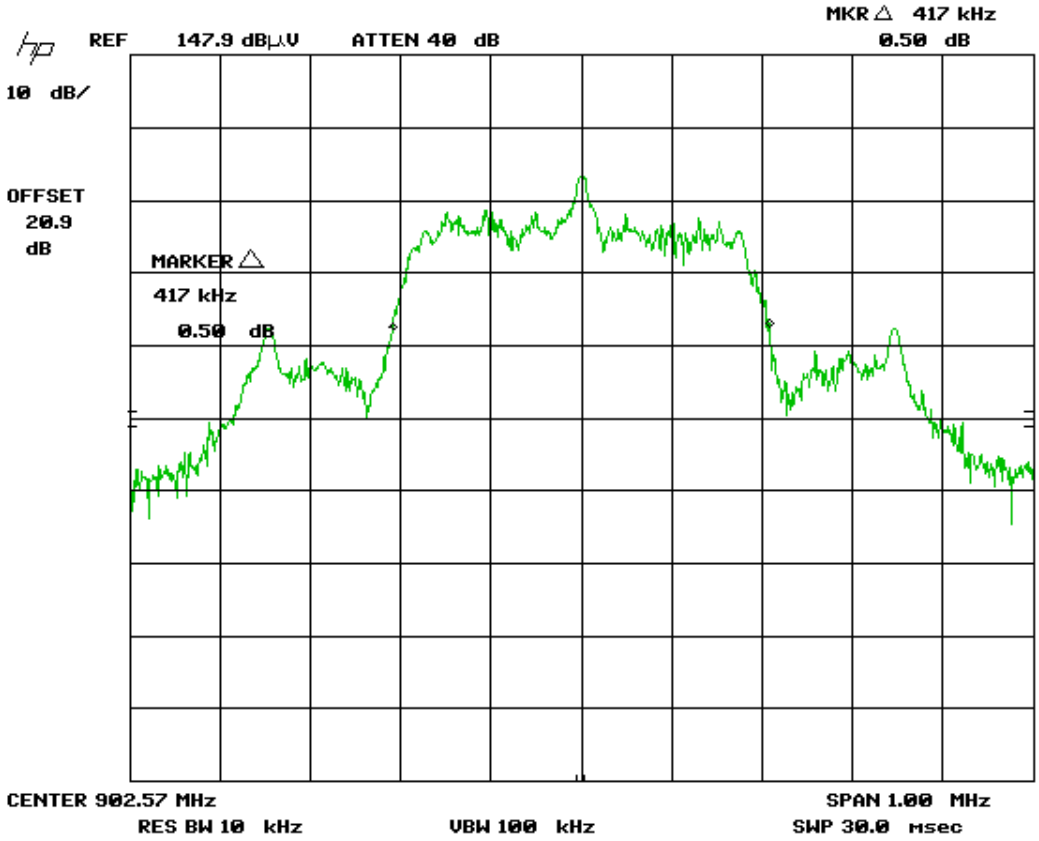


Figure 16 – Low Channel
(20dB and 99% BW)

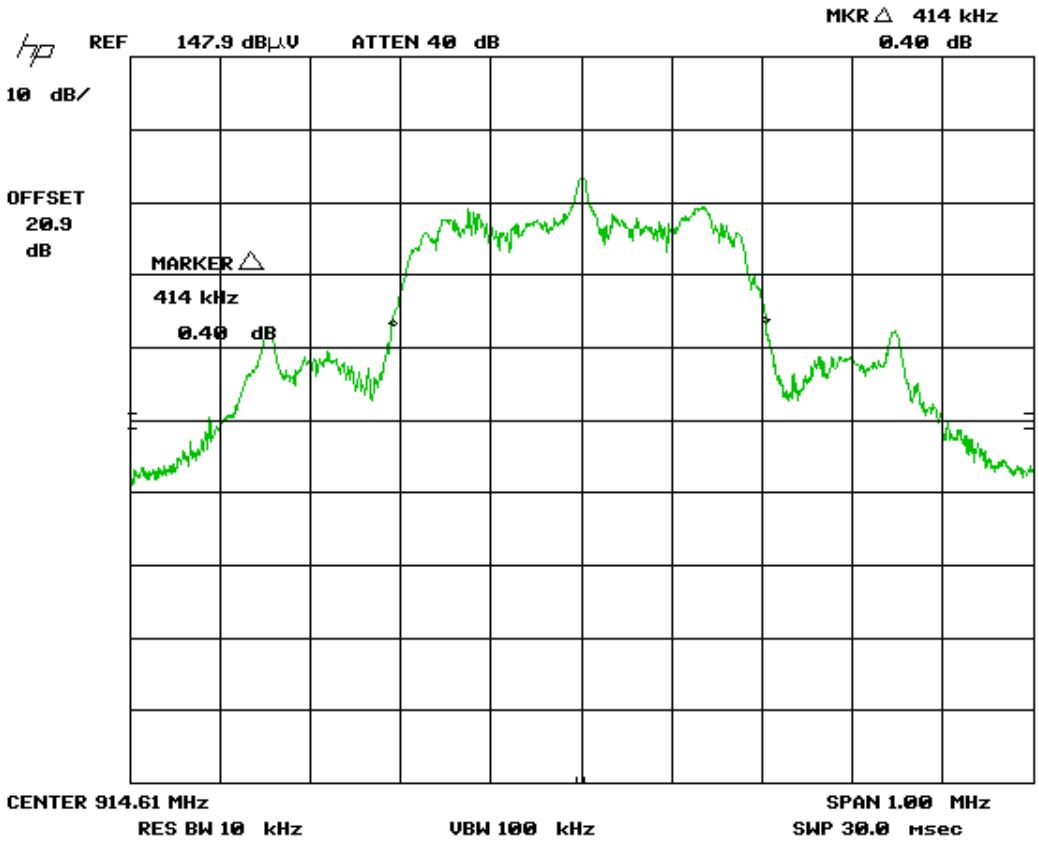


Figure 17 – Mid Channel
(20dB and 99% BW)

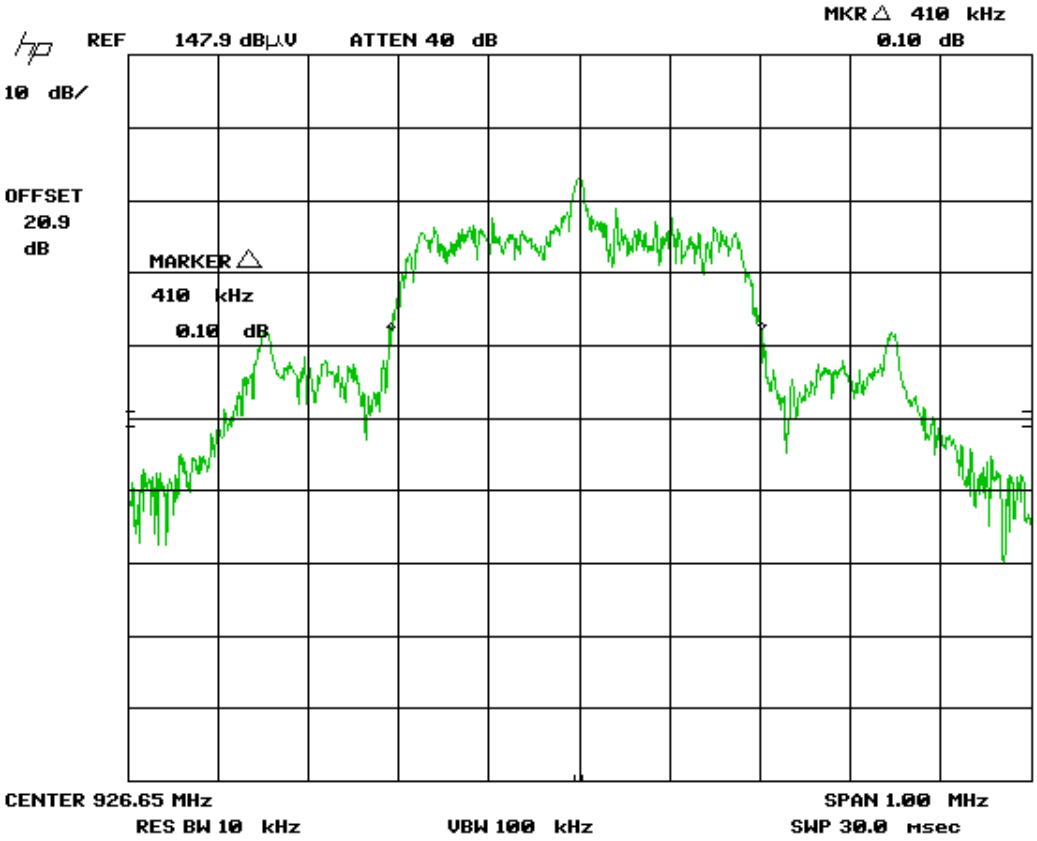


Figure 18 – High Channel
(20dB and 99% BW)