FCC Part 15.247 Subpart C
Frequency Hopping
Spread Spectrum Transmitter
Modular Approval

Certification Test Report

Manufacturer: Cirronet Inc.

Model: WIT910

Rules Section: 15.247

Test Begin Date: April 28, 2004

Test End Date: March 26, 2004

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ACS Report Number: 04-0132-15C

Test Result: PASS

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BOM
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Theory of Operation and System Block Diagram
Schematics

1.0 GENERAL

1.1 Purpose
The purpose of this report is to demonstrate compliance with Part 15, Subpart C of the FCC's Code of Federal Regulations.

1.2 Product Description

1.2.1 General
The Equipment Under Test (EUT) is the Model WIT910. The WIT910 Radio transceiver provides reliable wireless connectivity for either point-to-point or multipoint applications. Frequency hopping spread spectrum technology ensures maximum resistance to noise and multi-path fading and robustness in the presence of interfering signals, while operation in the 900 MHz ISM band allows license-free use and worldwide compliance. Standard communication rates between the WIT910 and the host are supported between 1200pbs and 57.6bps. Non-standard rates are supported as well. An on-board buffer and an error-correcting over-the-air protocol provide smooth data flow and simplify the task of integration with existing applications.

Detailed photographs of the EUT are filed separately with this filing.

1.2.2 Intended Use

The WIT910 is a Wireless Data modem that provides connectivity for either point-to-point or multipoint applications.

1.2.3 Technical Specifications

Table 1.2.3-1: Specifications

Frequency Band	902-928
Number of Channels	54
Channel Bandwidth	385.5kHz Nominal (20dB Bandwidth)
Channel Spacing	0.46083MHz
Output power	27dBm nominal
Antenna Type	Listed in section 1.2.4
Antenna Connector Type	Listed in section 1.2.4

1.2.4 Antennas

Testing was done using the Cushcraft Yagi PC906RTN36 and Cushcraft Omni S8963BRTN36 antennas.

Manufacturer	Model	Type	Connector	Gain
Cushcraft	S8963BRTN36	Omni	Male REV TNC	5 dBi
Cushcraft	PC904RTN36	YAGI	Male REV TNC	6 dBi
Cushcraft	PC906RTN36	YAGI	Male REV TNC	8.5 dBi
ACE Antenna	ACE-915NF	Omni	Male REV TNC	2 dBi

2.0 LOCATION OF TEST FACILTY

All testing was performed by qualified ACS personnel located at the following address:

ACS, Inc.
5015 B.U. Bowman Drive
Buford, GA 30518

2.1 DESCRIPTION OF TEST FACILITY

Both the Open Area Test Site(OATS) and Conducted Emissions site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.1.1 Open Area Test Site

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane, however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 3.2-1 below:

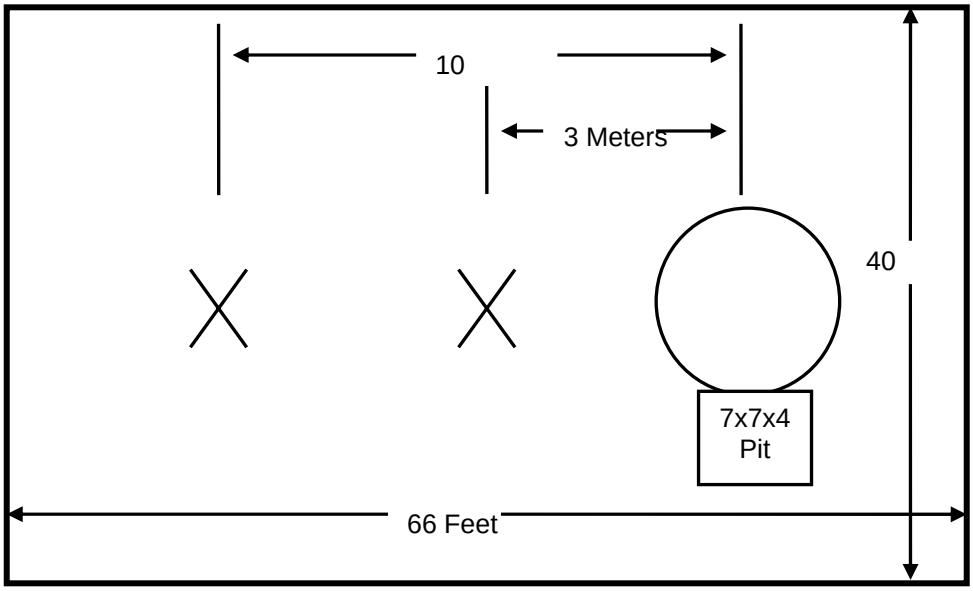


Figure 2.1.1-1: Open Area Test Site

2.1.2 Conducted Emissions Test Site Description

The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof Corporation.

The room is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 2.1.2-1:

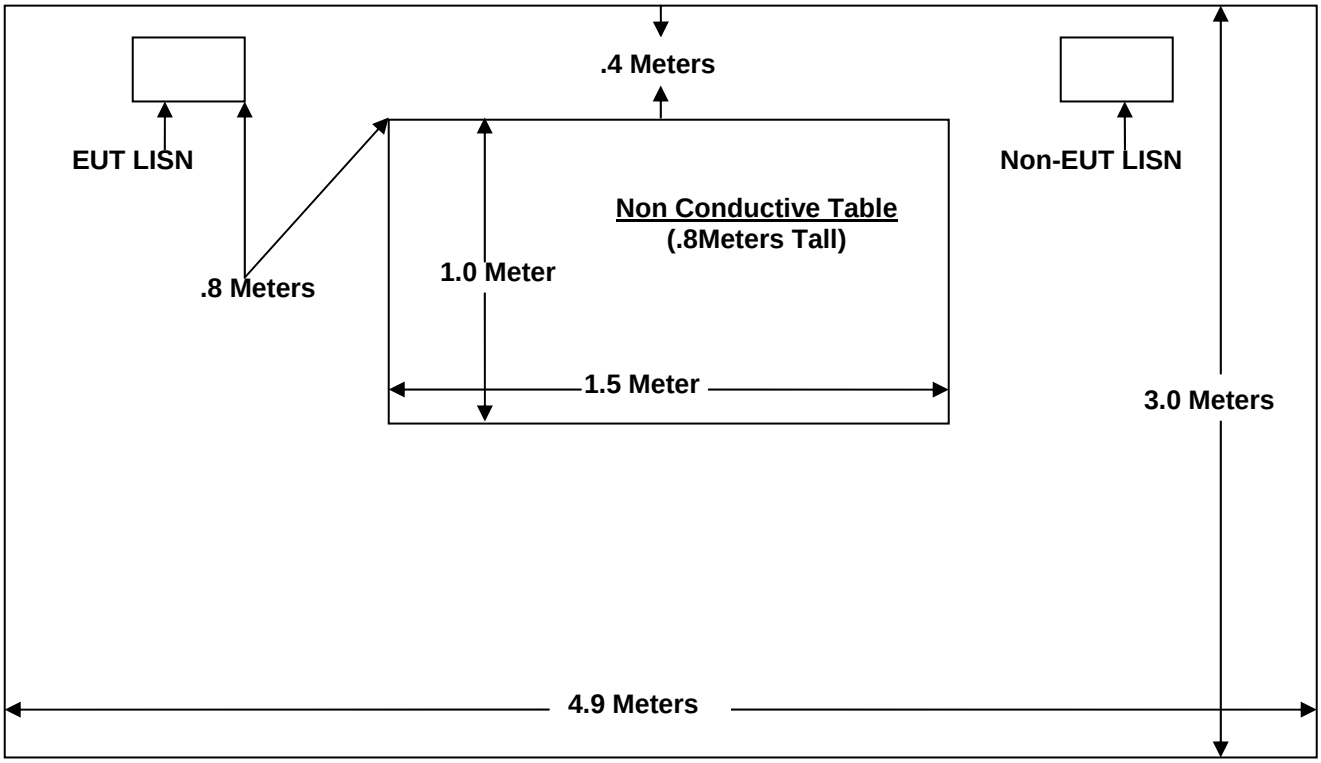


Figure 2.1.2-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

1 - ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz

2 - US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators (October 2000)

3 - FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4.0-1: Test Equipment

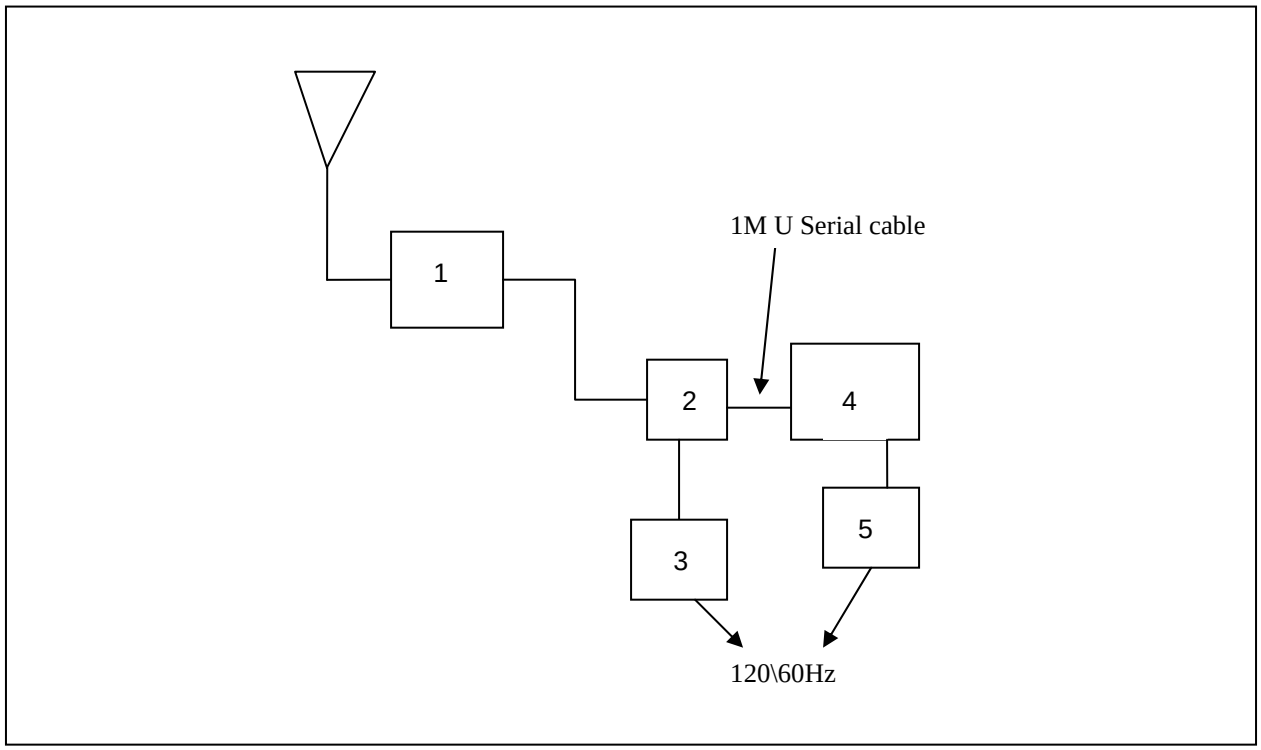
Equipment Calibration Information					
ACS #	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
---	Agilent	Spectrum Analyzer	E7402A	US40240259	02/26/05
26	Chase	Bi-Log Antenna	CBL6111	1044	10/14/04
152	EMCO	LISN	3825/2	9111-1905	01/08/05
153	EMCO	LISN	3825/2	9411-2268	12/11/04
193	ACS	OATS Cable Set	RG8	193	01/09/05
167	ACS	Conducted EMI Cable Set	RG8	167	01/09/05
5	Harbour Industries	Cable	LL-335	None	08/20/04
6	Harbour Industries	Cable	LL-335	None	08/06/04
22	Agilent	Pre-Amplifier	8449B	3008A00526	09/18/04
73	Agilent	Pre-Amplifier	8447D	272A05624	04/30/05
30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	05/08/05
105	Microwave Circuits	High Pass Filter	H1G810G1	2123-01 DC0225	06/09/05
209	Microwave Circuits	High Pass Filters	H3G020G2	4382-01 DC0421	06/09/05
40	EMCO	Biconical Antenna	3104	3211	09/19/04
1	Rohde & Schwarz	Receiver	804.8932.52	833771/007	02/26/05
2	Rohde & Schwarz	Receiver	1032.5640.53	839587/003	02/26/05
213	Test Equipment Corp.	Pre-Amplifier	PA-102	44927	06/28/05
211	Eagle	Band Reject Filter	C7RFM3NFNM	n/a	06/28/05
168	Hewlett Packard	Pulse Limiter	11947A	3107A02268	04/30/05
93	Chase	EM Clamp	CIC 8101	65	01/12/05
184	ACS	Cable	RG8	184	01/09/05
169	Solar Electronics	LISN	9117-5-TS-50-N	031032	04/12/05

5.0 SUPPORT EQUIPMENT

Table 5-3: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number	FCC ID
1	EUT	Cirronet	WIT910	W910-053	HSW-910M
2	RS232 COM	Cirronet	800610	N/A	N/A
3	Power Supply	Volgen	SPU10-102	N/A	N/A
4	Laptop	IBM	ThinkPad 600E	78-GCPT7	N/A
5	Power Supply	IBM	02K6496	N/A	N/A

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



M = Meters **S = Shielded** **U = Unshielded**

Figure 6-1: EUT Test Setup

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement - FCC Section 15.203

Both Omni directional and the Yagi Antennas are professionally installed equipment. The Radio module employs an MMCX connector requiring a special adapter cable to connect antennas that employ standard antenna connectors. According to FCC Public Notice, DA 00-2225, the MMCX qualifies as a unique antenna coupler.

7.2 Power Line Conducted Emissions - FCC Section 15.207

Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz

7.2.1 Test Results

The EUT will be provided DC power by the host device in which it is installed. With no connection to the AC mains this requirement is not applicable to the EUT.

7.3 Radiated Emissions - FCC Section 15.209(Unintentional Radiation)

Radiated emissions tests were performed over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements above 30MHz.

The EUT was caused to go into a "Receive Only" mode of operation for this test. Results of the test are given in Table 7.3-1 below:

Table 7.3-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Uncorrected Reading (dBµV/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Position (°)	Total Correction Factor (dB)	Corrected Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Results
30.78	10.71	V	100	0	19.60	30.31	40.0	9.7	**Pass**
44.24	20.23	V	100	541	12.93	33.16	40.0	6.8	**Pass**
128.96	8.32	V	100	0	13.25	21.57	43.5	21.9	**Pass**
189.44	14.04	H	100	303	11.05	25.09	43.5	18.4	**Pass**
351.92	35.52	H	100	541	-6.11	29.41	46.0	16.6	**Pass**
960.00	28.55	H	200	539	6.84	35.39	46.0	10.36	**Pass**

7.4 Peak Output Power Requirement - FCC Section 15.247(b)

The peak output power of the EUT was made at the antenna connector using an E7402A Spectrum Analyzer. The 20dB bandwidth of the device was measured to be 385.5kHz, therefore a spectrum analyzer with the RBW set to 1MHz was used to measure the output power of the device. For the measurement, the EUT was caused to generate a continuous carrier. A 20dB pad was used for this measurement therefore a correction factor of 20dB was adjusted up in the table to reflect the use of the pad. Results are shown below in Table 7.4-1 and Figure 7.4-1.

Table 7.4-1: Peak Output Power

Channel	Frequency (MHz)	Output Power (dBm)
Low	902.87	27.231
Mid	914.24	27.567
High	927.29	27.214

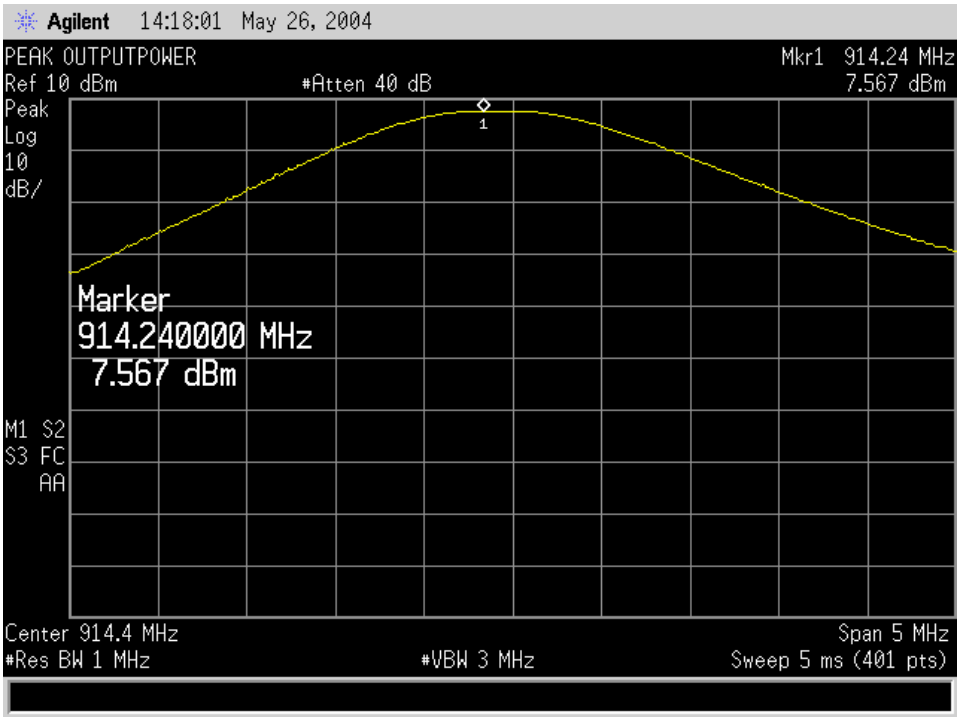


Figure 7.4-1: Output power – Middle Channel

7.5 Channel Usage Requirements - FCC Section 15.247(a)(1)

15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the wanted signal.

15.247(a)(1)(i): For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

7.5.1 Adjacent Channel Separation

Results: The 20dB bandwidth of the hopping channel was measured to be 385.5kHz (See figure 7.5.4-1 below). The adjacent channel separation was measured to be 450kHz. Results are shown in figure 7.5.1-1 below:

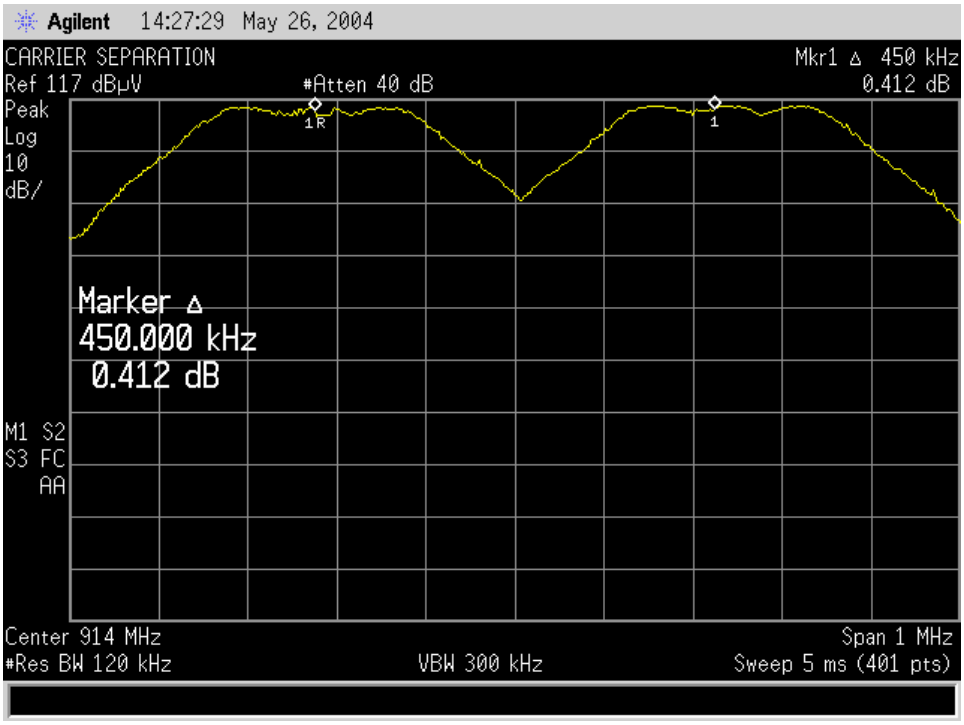


Figure 7.5.1-1: Adjacent Channel Separation

7.5.2 Number of Hopping Channels

Result: The 20dB bandwidth of the device is greater than 250kHz. The device employs 54 hopping channels as required. Results are shown in figure 7.5.2-1 below

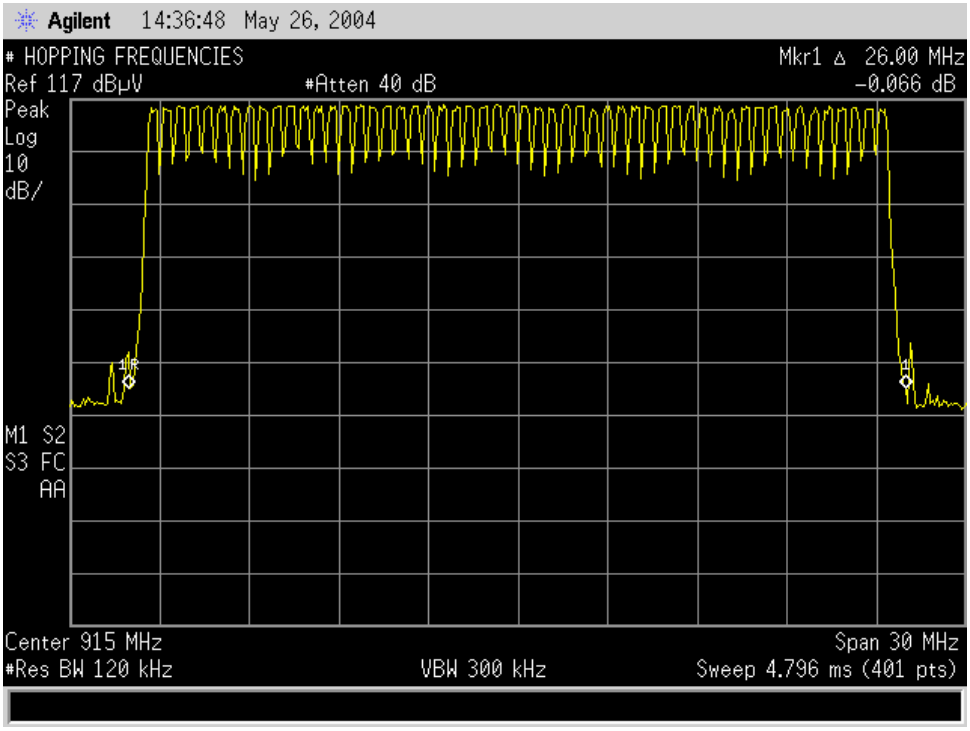


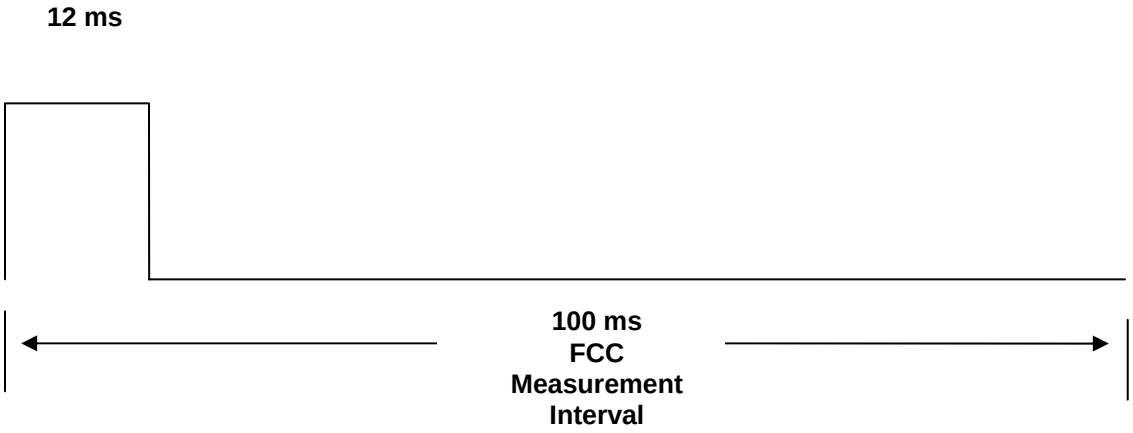
Figure 7.5.2-1: Number of Hopping Channels

7.5.3 Channel Dwell Time

Result: The duration of the RF transmission is 12ms in which the device hops to another channel according to the pseudorandom frequency table before transmitting another 12ms burst. Therefore the average time of occupancy on any channel in a 100ms period is 12ms. A single transmission is shown in figure 7.5.3-1 below:

Figure 7.5.3-1: Channel Dwell Time

Cirronet, Inc. WIT910M Module Transmit Timing
Total Transmit Time-12 ms



7.5.4 20dB Bandwidth

Result: The 20dB bandwidth was found to be less than 500kHz as required. Results are shown below in Table 7.5.4-1 figure 7.5.4-1.

Table 7.4-1: 20dB Bandwidth

Channel	Frequency	20dB Bandwidth
Low	902.77	368.0
Mid	914.24	384.4
High	927.19	385.5

Figure 7.5.4-1: 20dB Bandwidth

7.6 Spurious Emissions - FCC Section 15.247(c)

7.6.1 RF Conducted Spurious Emissions

The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. For each measurement, the spectrum analyzer's VBW was set to 100kHz and the RBW was set to 1MHz.

7.6.1.2 Test Results

All emission found were greater than 20dB down from the fundamental carrier. A 20dB pad was used for this measurement therefore a correction factor of 20dB was adjusted up in the table to reflect the use of the pad. The RF conducted spurious emissions found in the band of 30MHz to 10GHz are reported in table 7.6.1.2-1 below.

Table 7.6.1.2-1: Conducted Spurious Emissions

Channel	Carrier Power (dBm)	Frequency (MHz)	Level (dBm)	dB Down from Carrier (dB)	Margin (dB)	Results (Pass/Fail)
Low – 902.66.0MHz	28.07	1001	-39.54	67.61	47.61	**Pass**
		1306	-35.10	63.17	43.17	**Pass**
		1806	-36.22	64.29	44.29	**Pass**
		3433	-42.48	70.55	50.55	**Pass**
		4962	-48.71	76.78	56.78	**Pass**
		6322	-46.95	75.02	55.02	**Pass**
		9.931	-49.11	77.18	57.18	**Pass**
Middle - 914.18MHz	27.61	1317	-38.30	65.91	45.91	**Pass**
		1428	-42.70	70.31	50.31	**Pass**
		2744	-37.54	65.15	45.15	**Pass**
		5613	-44.29	71.90	51.90	**Pass**
		6402	-44.95	72.56	52.56	**Pass**
		8228	-42.71	70.32	50.36	**Pass**
High – 927.09MHz	26.29	1050	-41.37	67.66	47.66	**Pass**
		1331	-37.99	64.28	44.28	**Pass**
		1857	-40.13	66.42	46.42	**Pass**
		3591	-45.26	71.55	51.55	**Pass**
		5400	-49.31	75.60	55.60	**Pass**
		6491	-42.36	68.65	48.65	**Pass**

7.6.2 Radiated Spurious Emissions (Restricted Bands) - FCC Section 15.205

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency on each antenna given in section 1.2.3.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth(RBW) of 120kHz and a video bandwidth(VBW) of 300kHz. For frequencies above 1000MHz, average measurements were made using an RBW of 1MHz and a VBW of 10Hz and peak measurements were made with RBW of 1MHz and a VBW of 1MHz.

The EUT was caused to generate a continuous carrier signal on the hopping channel.

7.6.2.1 Duty Cycle Correction

For average measurements, the measured level was reduced by a factor 18.4dB to account for the duty cycle of the EUT. The EUT transmits for 12mS on a channel before hopping to the next channel. The EUT does not return to the same channel for over 1020ms. Therefore the duty cycle is 12%. The duty cycle correction factor is determined using the formula: 20log (.12) =-18.4dB.

7.6.2.2 Test Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in Table 7.6.2.2-1 and 7.6.2.2-2. Plots of these emissions are also presented separately in this filing. Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits for a class B device defined in section 15.209.

Table 7.6.2.2-1: Radiated Spurious Emissions – (Omni Antenna)

Frequency (MHz)	Level (dBuV/m)	Detector (P/A)	Antenna Polarity (H/V)	Turntable Position (o)	Correction Factors (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Low Channel								
2708	66.99	P	V	123	-1.59	65.40	74.00	8.60
2708	64.02	A	V	123	-20.09	43.93	54.00	10.07
3611	56.63	P	V	185	4.81	61.44	74.00	12.56
3611	53.89	A	V	185	-13.69	40.20	54.00	13.80
4514	57.57	P	V	159	6.41	63.98	74.00	10.02
4514	54.22	A	V	159	-12.09	42.13	54.00	11.87
5417	47.85	P	V	301	9.16	57.01	74.00	16.99
5417	41.5	A	V	301	-9.34	32.16	54.00	21.84
6319	58.77	P	H	267	10.53	69.30	74.00	4.70
6319	54.3	A	H	267	-7.97	46.33	54.00	7.67
8125	46.25	P	V	103	13.50	59.75	74.00	14.25
8125	33.57	A	V	103	-5.00	28.57	54.00	25.43
Middle Channel								
2778	59.94	P	V	137	-1.47	58.47	74.00	15.53
2778	56.28	A	V	137	-19.87	36.41	54.00	17.59
3704	56.23	P	V	148	5.14	61.37	74.00	12.63
3704	53.23	A	V	148	-13.26	39.97	54.00	14.03
4630	52.98	P	V	165	6.92	59.90	74.00	14.10
4630	49.12	A	V	165	-11.48	37.64	54.00	16.36
7409	45.28	P	V	184	12.34	57.62	74.00	16.38
7409	34.59	A	V	184	-6.06	28.53	54.00	25.47
High Channel								
2778	59.94	P	V	137	-1.47	58.47	74.00	15.53
2778	56.28	A	V	137	-19.87	36.41	54.00	17.59
3704	56.23	P	V	148	5.14	61.37	74.00	12.63
3704	53.23	A	V	148	-13.26	39.97	54.00	14.03
4630	52.98	P	V	165	6.92	59.90	74.00	14.10
4630	49.12	A	V	165	-11.48	37.64	54.00	16.36
7409	45.28	P	V	184	12.34	57.62	74.00	16.38
7409	34.59	A	V	184	-6.06	28.53	54.00	25.47

Table 7.6.2.2-2: Radiated Spurious Emissions – (YagiAntenna)

Frequency (MHz)	Level (dBuV/m)	Detector (P/A)	Antenna Polarity (H/V)	Turntable Position (o)	Correction Factors (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
Low Channel								
2708	67.83	P	V	130	-1.59	66.24	74.00	7.76
2708	65.29	A	V	130	-19.99	45.30	54.00	8.70
3610	57.75	P	V	131	4.80	62.55	74.00	11.45
3610	54.47	A	V	131	-13.60	40.87	54.00	13.13
4513	58.08	P	V	158	6.41	64.49	74.00	9.51
4513	53.16	A	V	158	-11.99	41.17	54.00	12.83
5416	48.31	P	V	323	9.16	57.47	74.00	16.53
5416	42.31	A	V	323	-9.24	33.07	54.00	20.93
6319	59.83	P	H	55	10.53	70.36	74.00	3.64
6319	55.01	A	H	55	-7.87	47.14	54.00	6.86
Middle Channel								
2747	61.31	P	V	130	-1.53	59.78	74.00	14.22
2742	58.79	A	V	130	-19.93	38.86	54.00	15.14
3656	59.91	P	H	212	4.97	64.88	74.00	9.12
3656	56.69	A	H	212	-13.43	43.26	54.00	10.74
4570	55.36	P	V	159	6.66	62.02	74.00	11.98
4570	51.33	A	V	159	-11.74	39.59	54.00	14.41
7413	43.15	P	V	213	12.33	55.48	74.00	18.52
7413	31.9	A	V	213	-6.07	25.83	54.00	28.17
High Channel								
2778	61.26	P	V	99	-1.47	59..79	74.00	14.21
2778	59.28	A	V	99	-19.87	39.41	54.00	14.59
3705	55.11	P	V	172	5.14	60.25	74.00	13.75
3705	51.78	A	V	172	-13.26	38.52	54.00	15.48
4631	53.03	P	V	118	6.93	59.96	74.00	14.04
4631	48.97	A	V	118	-11.47	37.50	54.00	16.50
7410	43.45	P	V	125	12.34	55.79	74.00	18.21
7410	31.77	A	V	125	-6.06	25.71	54.00	28.29

7.6.2.3 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC(Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation:

Corrected Level: 66.9 + -1.59 = 65.4 dBuV

Margin: 74dBuV – 65.4dBuV = 8.6dB

8.0 CONCLUSION

In the opinion of ACS, Inc. the WIT910, manufactured by Cirronet Inc., meets the requirements of FCC Part 15 subpart C.