FCC Part 15 Subpart C

Frequency Hopping
Spread Spectrum Transmitter

Class II Permissive Change
Test Report

Manufacturer: Cirronet

Model: WIT2410

FCC ID: HSW-2410M

Rules Section: 15.203
15.205(a)&(b)
15.209(a)

Test Begin Date: August 7, 2002

Test End Date: August 7, 2002

Report Issue Date: September 11, 2002

ACS Report Number: 02-0129-15PC

Test Result: PASS

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1.0 GENERAL

1.1 Introduction

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 WIT2410 radio module manufactured by Cirronet Inc. Located at the following address:

Cirronet Inc.
5375 Oakbrook Parkway
Norcross, GA 30093
USA

The radio module was originally granted on October 6, 1999.

1.2.2 Intended Use

The WIT2410 is a frequency hopping spread spectrum transmitter module designed to be integrated into fixed location devices.

1.2.3 Technical Specifications

Table 1.2.3-1: Specifications

Frequency Band	2400-2483.5 MHz
Number of Channels	75
Channel Bandwidth	750kHz
Maximum User Rate	460 Kbps
Output power	20dBm nominal
Operating Voltage	3.3 v
Rx Sensitivity	-93dBm

1.2.4 Antennas

Table 1.2.4-1 through 1.2.4-3 below gives the antennas that were originally approved on November 30, 2001, and subsequent permissive change filings of 10/6/99 and 1/28/02. Table 1.2.4-4 gives the new antennas for which approval is being sought. Photographs and specification sheets of the new antenna are submitted separately with this filing.

Table 1.2.4-1: Antennas Approved in Original Filing Granted 10/6/99

MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB	Type of Connector
ACE	Dipole	ACE-2400NF	2 dBi	Reverse SMA to MMCX via adapter cable
Cushcraft	Yagi	PC2415-RTNF	15 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Omni-Directional	OD6-2400-RTNC	6 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Omni-Directional	OD12-2400PTA-RTNC	12 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Corner Reflector	SCR14-2400PTA-RTNC	14 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Patch	P7-2400RTNC	7 dBi	Reverse SMA to MMCX via adapter cable
Digital Wireless Corporation	Patch	PA2410	Appx. 3 dBi	Non-standard MMCX

Table 1.2.4-2: Antennas Approved in Permissive Change Filing Granted 3/29/2001

MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB	Type of Connector
Mobile Mark	Vehicle Mount	RM3-2400-RTNC	2.5 dBi	Reverse TNC to MMCX via adapter cable
Mobile Mark	Corner Reflector	SCR9-2400-RN	9 dBi	Reverse N to MMCX via adapter cable
MaxRad	Whip	MUF24005-RTNC	5 dBi	Reverse TNC to MMCX via adapter cable
Andrews	Parabolic Dish	26T-2400 A	24 dBi	Reverse N to MMCX via adapter cable
Andrews	Parabolic Dish	18T-2400 A	18 dBi	Reverse N to MMCX via adapter cable

Table 1.2.4-3: Antennas Approved in Permissive Change Filing Granted 1/28/2002

Mfg.	Mfg. Model No.	Antenna Type	Gain (dBi)	Connector Type	System EIRP (dBm)
Mobile Mark	0D9-2400	Omni	9	Unknown	26.1
Maxrad	MUF24005	Omni	5	Unknown	22.1

Table 1.2.4-4: New Antennas with this Filing

Mfg.	Mfg. Model No.	Antenna Type	Gain (dBi)	Connector Type	System EIRP (dBm)
Decibel Products	DB973G90-SR	Corner Reflector	11.1	N	28.1

2.0 LOCATION OF TEST FACILTY

All testing except for was performed at:

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

2.1 DESCRIPTION OF TEST FACILITY

All testing was conducted at an ACS facility specifically prepared for this testing. Where applicable, all sites have been fully described and submitted to, and accepted by the FCC and Industry Canada. FCC registration number 89450 and Industry Canada Lab Code IC 4175 have been assigned in recognition of the sites.

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:

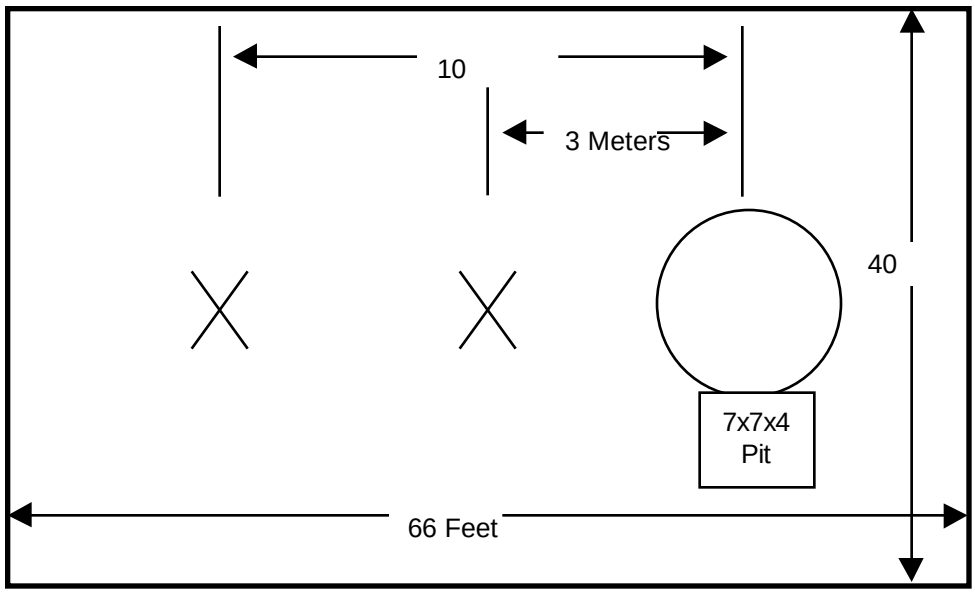


Figure 3.2-1: Open Area Test Site

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 4-1: Test Equipment

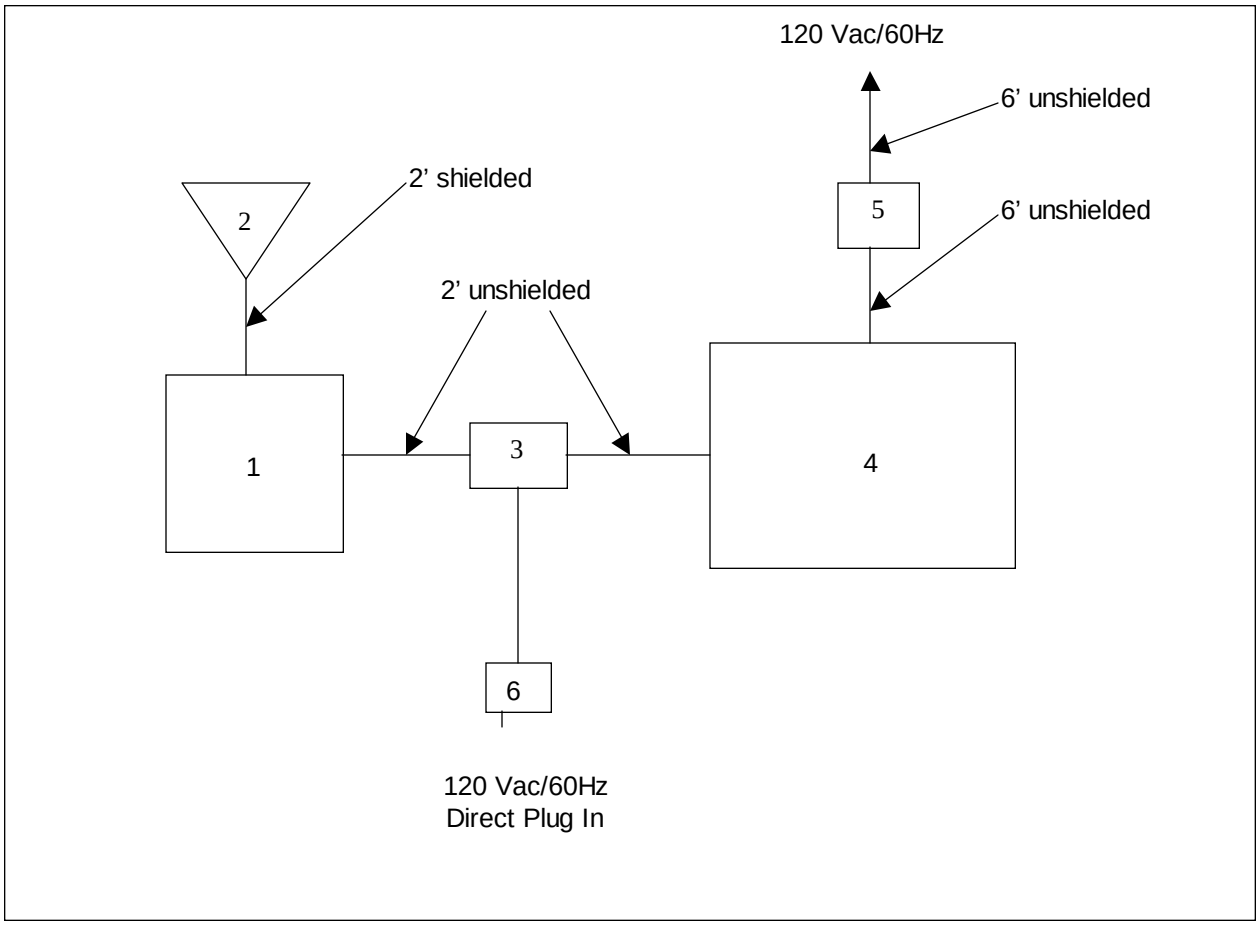
ACS ID#	MFG Name	Item Name	Model #:	Serial #	Recal Date:
22	Hewlett Packard	Amp, .01-26.5 GHz	8449B	3008A00526	9/24/02
None	Microwave Circuits	High-Pass Filter	H3G020G2	0001 DC9853	1/16/03
5	Harbour Industries	Cable	LL-335	None	7/31/03
6	Harbour Industries	Cable	LL-335	None	7/31/03
30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	9/9/02

5.0 SUPPORT EQUIPMENT

Table 5.1-1: Support Equipment Description

Diagram #	Description	Manufacturer	Model/Part #	Serial #
1	EUT	Cirronet	WIT2410	None
2	Antenna	Decibel Products	DB973G90-SR	None
3	USB/RS 232 Converter	None Given	WB SAB-R	None
4	Computer	IBM	560X Type 2640-70U	78-ATT47
5	AC/DC Power Converter	IBM	02K6491	J14FQ427B58
6	AC/DC Power Converter	Volgen	SPU10R-1	None

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



7.0 SUMMARY OF TESTS

The change to the EUT, that requires this filing, is the addition of an external antenna. Requirements affected by this change are:

- 15.203 antenna requirement
- 15.205 & 15.209 radiated spurious emissions in the restricted bands
- 15.247(b)(4) RF Exposure requirements

7.1 Antenna Requirement - FCC Section 15.203

To ensure compliance with 15.203, we propose attaching a reverse-sex TNC connector to the module, and an N to the 11.1 dBi Panel antenna which is only mounted high on a tower by professional installers A short cable from the module, which uses a MMCX connector, to the cabinet where the reverse-sex is located will prevent bypassing of the connector.

With the MMCX port on our module, and the reverse-sex TNC connector on the cabinet, and given the nonstandard nature of the interconnect between module and antenna and the difficulty involved in circumventing that connection, we believe that this procedure meets the requirements called out in 15.203.

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

7.2.1 Test Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency.

The receive antenna height was varied from 1m to 4m in both horizontal and vertical polarities so that the maximum radiated emissions level would be detected. The spectrum analyzer's resolution bandwidth was set to 1MHz and the video bandwidth set to 10Hz for average measurements.

The EUT was caused to generate a constant carrier on the high, mid and low channels of operation.

7.2.2 Duty Cycle Correction Factor(Taken directly from original report filing)

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 - worst case being defined as the scenario when the WIT2410 would be transmitting the longest period during a dwell.

This worst case operating scenario is as follows:

Maximum transmit time by Remote on a single channel: = 280 bytes * 8 bits/byte * (1/460.8Kbps) = 4.86ms

The minimum hop duration for this scenario would be 6.94ms. Given that we have 75 channels in our hop set, it takes 521ms to go through the entire hop table and repeat a transmission on the same channel. Therefore, only 4.86milliseconds worth of data can be transmitted on a single channel in any 100ms time period.

The transmission duty cycle correction factor is then calculated as: 20 * Log10 (4.86ms/100ms) = **-26.3 dB.**

7.2.3 Test Results

Detectable points are reported below in table 7.2.3-1. Plots of these points are included separately in this filing.

Table 7.2.3-1: Radiated Spurious Emissions

Channel	Frequency (MHz)	Antenna Polarity	Detector (P/A)	Level (dBuV)	Correction Factors (dB)	Corrected Level (dBuV)	Corrected Level (uV/m)	Margin (uV)	Final Result (Pass/Fail)
Low: 2402MHz	4885	40.79	V	6.42	20.91	11.10	500.00	479.09	PASS
	7321	45.87	V	12.53	32.10	40.27	500.00	467.90	PASS
	9761	27.76	V	12.37	13.83	4.91	500.00	486.17	PASS
Mid: 2440MHz	4941	35.05	V	6.42	15.17	5.73	500.00	484.83	PASS
	7412	47.59	V	12.53	33.82	49.09	500.00	466.18	PASS
	9883	28.4	V	12.37	14.47	5.29	500.00	485.53	PASS
High: 2480MHz	4804	37.57	V	6.42	17.69	7.66	500.00	482.31	PASS
	7205	43.14	V	12.53	29.37	29.41	500.00	470.63	PASS
	9608	32.28	V	12.37	18.35	8.27	500.00	481.65	PASS

Correction Factors = Antenna Factor + Cable Attenuation – Amplifier Gain – Duty Cycle Correction
Margin = 500uV/m – Corrected Level

8.0 RF EXPOSURE SECTION 15.247(b)(4)

The EUT is a module designed for integration into fixed location devices only. In accordance with FCC rules, the antennas of these devices will be located at a distance greater than 20cm for the user or the general population. Due to the intended use of this device, it was determined SAR evaluation is not required.

9.0 CONCLUSION

In the opinion of ACS, Inc. the WIT2410 frequency hopping spread spectrum module, manufactured by Cirronet, Inc. continues to meet the requirements of FCC Part 15 subpart C with the new antenna as described in this filing.