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## FCC Part 15 Subpart C

### Frequency Hopping Spread Spectrum Transmitter

### Class II Permissive Change Test Report

**Manufacturer:** Cirronet

**Model:** WIT2411

**FCC ID:** HSW-2411M

**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:** November 1, 2002

**ACS Report Number:** 02-0130-15PC

**Test Result:** PASS

**Prepared By:** \_\_\_\_\_

**Sam Wismer**  
**Engineering Manager**

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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 WIT2411 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 November 30, 2001.

#### 1.2.2 Intended Use

The WIT2411 is a wide band 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	43
Channel Bandwidth	1.625 MHz
Channel Spacing	1.8432 MHz
Maximum User Rate	1.8432 Mbps
Output power	17 to 18dBm nominal
Operating Voltage	3.3 v
Rx Sensitivity	-87 to -90 dBm (BER 10 <sup>-5</sup> )

#### 1.2.4 Antennas

Table 1.2.4-1 below gives the antennas that were originally approved on November 30, 2001. Table 1.2.4-2 gives the new antennas for which approval is being sought. Photographs and specification sheets of the new antenna are submitted separately with this filing.

Mfg.	Mfg. Model No.	Antenna Type	Gain (dBi)	Connector Type	System EIRP (dBm)	Operation Type	Grant Date
Mobile Mark		Vehicle Mount	2.5	R-TNC	19.6	Point to Multipoint	11/30/01
Mobile Mark		Corner Reflector	9	Reverse N	26.1	Point to Multipoint	11/30/01
MaxRad		Whip	5	R-TNC	22.1	Point to Multipoint	11/30/01
Andrews		Parabolic Dish	24	Reverse N	41.1	Point to Point	11/30/01
Andrews		Parabolic Dish	18	Reverse N	35.1	Point to Point	11/30/01
Mobile Mark	0D9-2400	Omni	9	Unknown	26.1	Point to Multipoint	1/28/02
Maxrad	MUF24005	Omni	5	Unknown	22.1	Point to Multipoint	1/28/02
Decibel Products	DB973G90-SR	Corner Reflector	11.1	N	28.1	Point to Multipoint	10/07/02

**Table 1.2.4-2: Description of New Antenna**

Mfg.	Mfg. Model No.	Antenna Type	Gain (dBi)	Connector Type	Operation Type	System EIRP (dBm)
Cirronet	Proprietary	Patch	12	R-N	Point to Multipoint	29.1

**2.0 LOCATION OF TEST FACILITY**

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:

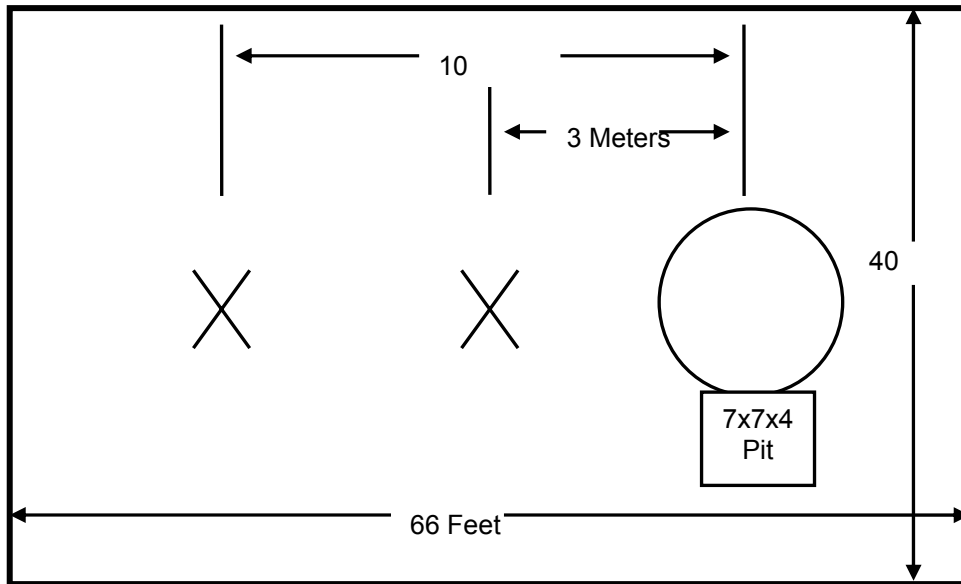


Figure 3.2-1: Open Area Test Site

**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.

able 4-1: Test Equipment

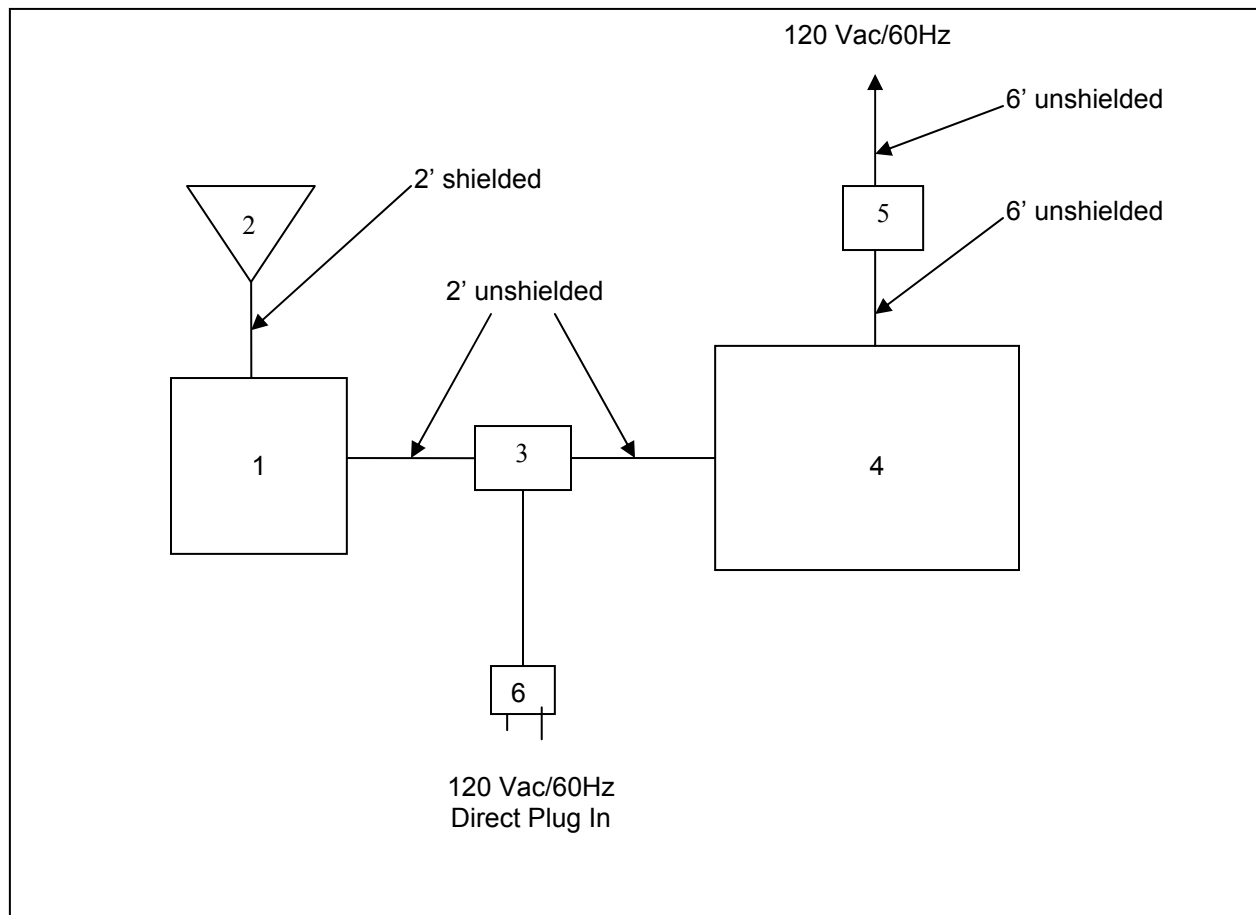
ACS ID#	MFG Name	Item Name	Model #:	Serial #	Recal Date:
22	Hewlett Packard	Amp, .01-26.5 GHz	8449B	3008A00526	9/21/03
None	Microwave Circuits	High-Pass Filter	H3G020G2	0001 DC9853	1/16/03
5	Harbour Industries	Cable	LL-335	None	7/31/03
6	Harbour Industries	Cable	LL-335	None	7/31/03
30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	9/17/03

5.0 SUPPORT EQUIPMENT

Table 5.1-1: Support Equipment Description

Diagram #	Description	Manufacturer	Model/Part #	Serial #
1	EUT	Cirronet	WIT2411	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 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

In the worst case operation, the EUT will operate for 30mS out of any 100mS duration. The transmitter is designed to transmit for 17mS and to receive for 13mS, then according to the pseudo random hopping pattern, the EUT will then change to a new channel and repeat the transmission. The EUT will never transmit more than once on any channel in any 100mS period.

Therefore the duty cycle of the EUT is 17% giving a correction factor of 15.4dB. The correction factor is figured using the formula  $20 \cdot \log(.17)$ . The measurements reported in tables 7-1 through 7-4 have been reduced by 15.4dB to account for the duty cycle as described above.

### 7.2.3 Test Results

Detectable points are reported below in table 7.6.2.4-1.

**Table 7.6.2.4-1: Radiated Spurious Emissions**

Frequency (MHz)	Level (dBuV)	Detector (P/A)	Antenna Polarity (H/V)	Turntable Position (o)	Correction Factors (dB)	Corrected Level (dBuV)	Limit (dBuV)	Margin (dB)	Final Result (Pass/Fail)
<b>Low Channel</b>									
4802	48.21	A	H	293	7.22	40.03	54.00	13.97	<b>PASS</b>
7206	42.11	A	V	0	14.25	40.96	54.00	13.04	<b>PASS</b>
9608	34.25	A	V	73	13.96	32.81	54.00	21.19	<b>PASS</b>
12010	27.54	A	V	0	22.64	34.78	54.00	19.22	<b>PASS</b>
<b>Middle Channel</b>									
4881	45.06	A	H	342	7.22	36.88	54.00	17.12	<b>PASS</b>
7320	35.74	A	H	0	14.25	34.59	54.00	19.41	<b>PASS</b>
9759	31.43	A	H	176	13.96	29.99	54.00	24.01	<b>PASS</b>
12203	8.69	A	H	0	22.64	15.93	54.00	38.07	<b>PASS</b>
<b>High Channel</b>									
4961	46.63	A	V	296	7.22	38.45	54.00	15.55	<b>PASS</b>
7441	42.77	A	V	17	14.25	41.62	54.00	12.38	<b>PASS</b>
9925	28.35	A	H	0	13.96	26.91	54.00	27.09	<b>PASS</b>

**Correction Factors = Antenna Factor + Cable Attenuation – Amplifier Gain – Duty Cycle Correction**  
**Margin = Limit – 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 WIT2411 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.