Excellence in Compliance Testing

Certification Test Report

FCC ID: HSW-DNT900
IC: 4492A-DNT900

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number: 08-0361-15C-DTS

Manufacturer: **Cirronet Inc.**
Model(s): **DNT900C, DNT900P**

Test Begin Date: September 4, 2008
Test End Date: October 29, 2008

Report Issue Date: December 16, 2008

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

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This report contains 21 pages

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Product Labeling
RF Exposure – MPE Calculations
Installation/Users Guide
Theory of Operation
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 and Industry Canada's Radio Standards Specification RSS-210.

1.2 Product Description

1.2.1 General

The DNT900 series transceiver module is a low cost, high-power solution for point-to- I/O point and point-to-multipoint wireless systems in the 900 MHz ISM band. Two model variants of the DNT900 are available. Both model variants are electrically identical and differ only in the interface available for host integration. DNT900C radio modules are mounted by reflow soldering them to a host circuit board. DNT900P modules are mounted by plugging their pins into a set of mating connectors on the host circuit board.

Manufacturer Information:
Cirronet, Inc.
3079 Premiere Parkway, Suite 140
Duluth, GA 30097

Antenna Information:
Cushcraft S8963B - 5dBi gain dipole
Astron 918-2 - 6dBi gain yagi

Test Sample Serial Number(s):
4 and 5

Test Sample Condition:
Test samples were provided in good working order with no visible defects.

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

1.2.2 Intended Use

The DNT900 series transceivers provide highly reliable wireless connectivity for either point-to-point or point-to-multipoint applications.

1.3 Test Methodology and Considerations

DNT900 series modules achieve regulatory certification under FHSS rules at air data rates of 38.4, 115.2 and 200 kb/s. At 500 kb/s, the DNT900 series modules achieve regulatory certification under "digital modulation" or DTS rules. At 500 kb/s DNT900 series modules still employ frequency hopping to mitigate the effects of interference and multipath fading, but hop on fewer, more widely spaced frequencies than at lower data rates.

This report covers DTS operation for 500kb/s data rates only. A separate report will be issued covering the frequency hopping spread spectrum operation using 38.4, 115.2 and 200 kb/s data rates.

The DNT900 was tested with all available antennas.

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, 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. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

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

NVLAP Lab Code: 200612-0

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' 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.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit 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.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

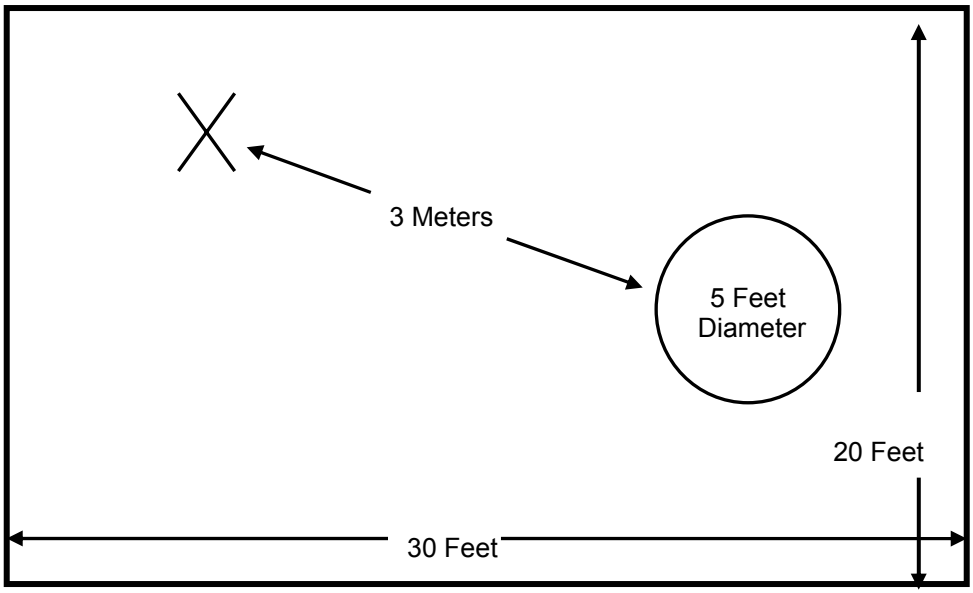

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

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 2.3-2 below:

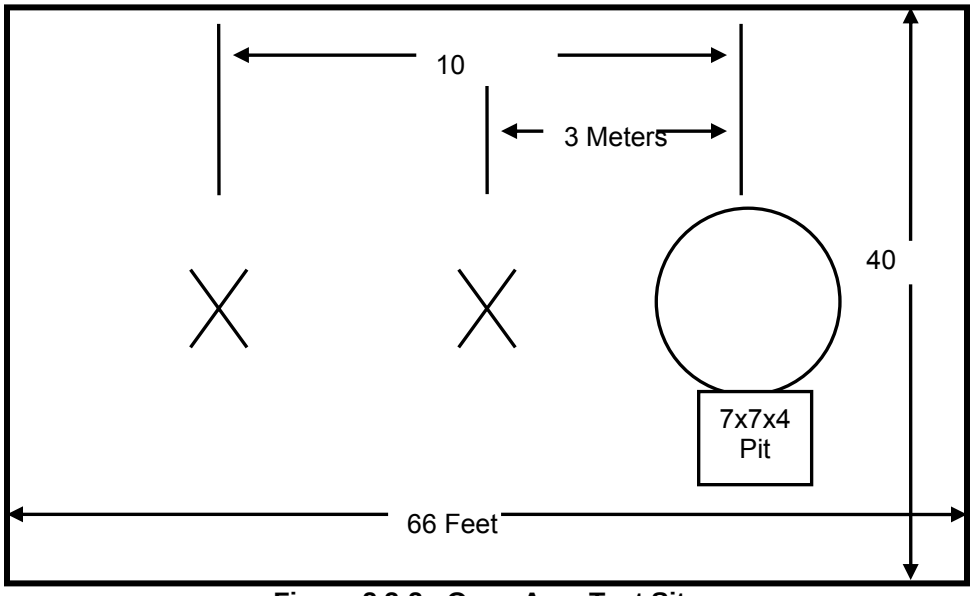

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site 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 4.1.3-1:

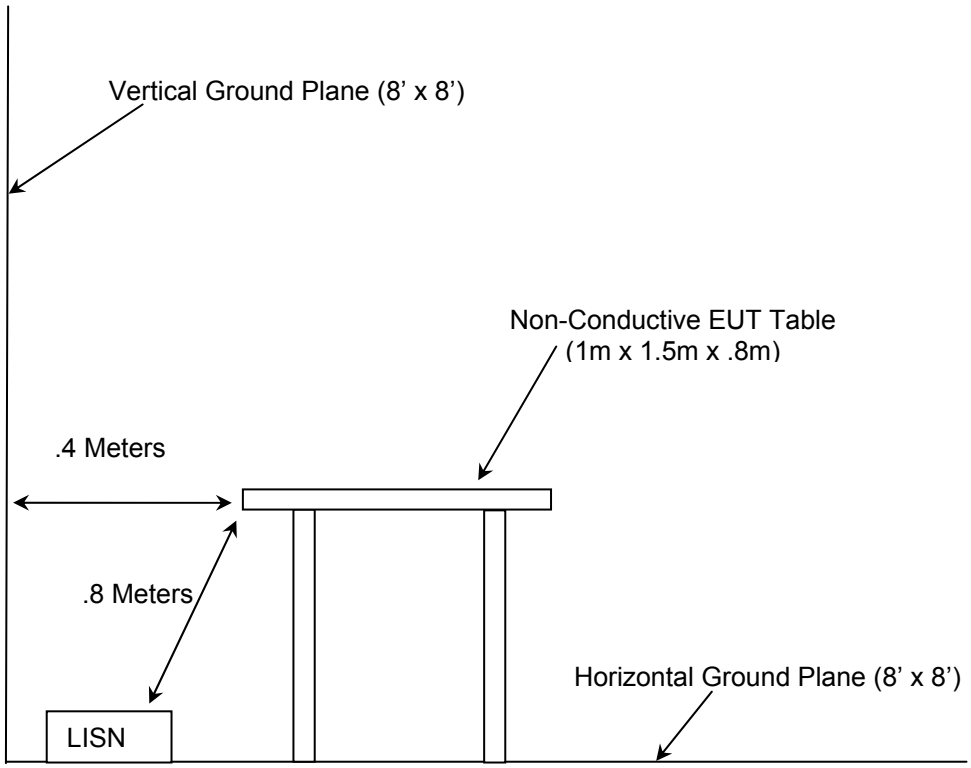

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2008
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2008
- FCC KDB Publication No. 558074 - Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), March 2005
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 7 June 2007
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue2, June 2007.

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**
1	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	833771/007	09-19-2009
2	Rohde & Schwarz	Spectrum Analyzers	ESMI-Receiver	839587/003	09-19-2009
22	Agilent	Amplifiers	8449B	3008A00526	10-22-2009
25	Chase	Antennas	CBL6111	1043	08-22-2009
30	Spectrum Technologies	Antennas	DRH-0118	970102	05-07-2009
152	EMCO	LISN	Feb-25	9111-1905	03-26-2009
167	ACS	Cable Set	Chamber EMI Cable Set	167	01-04-2009
168	Hewlett Packard	Attenuators	11947A	44829	02-18-2009
277	Emco	Antennas	93146	9904-5199	09-09-2009
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	09-19-2009
291	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	None	11-21-2008
292	Florida RF Cables	Cables	SMR-290AW-480.0-SMR	None	11-21-2008
321	Hewlett Packard	Amplifiers	HPC 8447D	1937A02809	10-08-2009
331	Microwave Circuits	Filters	H1G513G1	31417	07-28-2009
338	Hewlett Packard	Amplifiers	8449B	3008A01111	10-22-2009
340	Aeroflex/Weinschel	Attenuators	AS-20	7136	10-22-2009
343	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	N/A	11-21-2008
346	Aeroflex/Weinschel	Attenuators	54A-10	T1362	09-19-2009
422	Florida RF	Cables	SMS-200AW-72.0-SMR	805	02-25-2009
430	RF Cables	Cables	SMS-290AW-480-SMS	N/A	06-09-2009

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	AC Adapter 5V-2A	CUI Inc.	EPAS-101W-05	NA
2	DNT500 Evaluation Board	Cirronet	800886 Rev PR2	NA

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

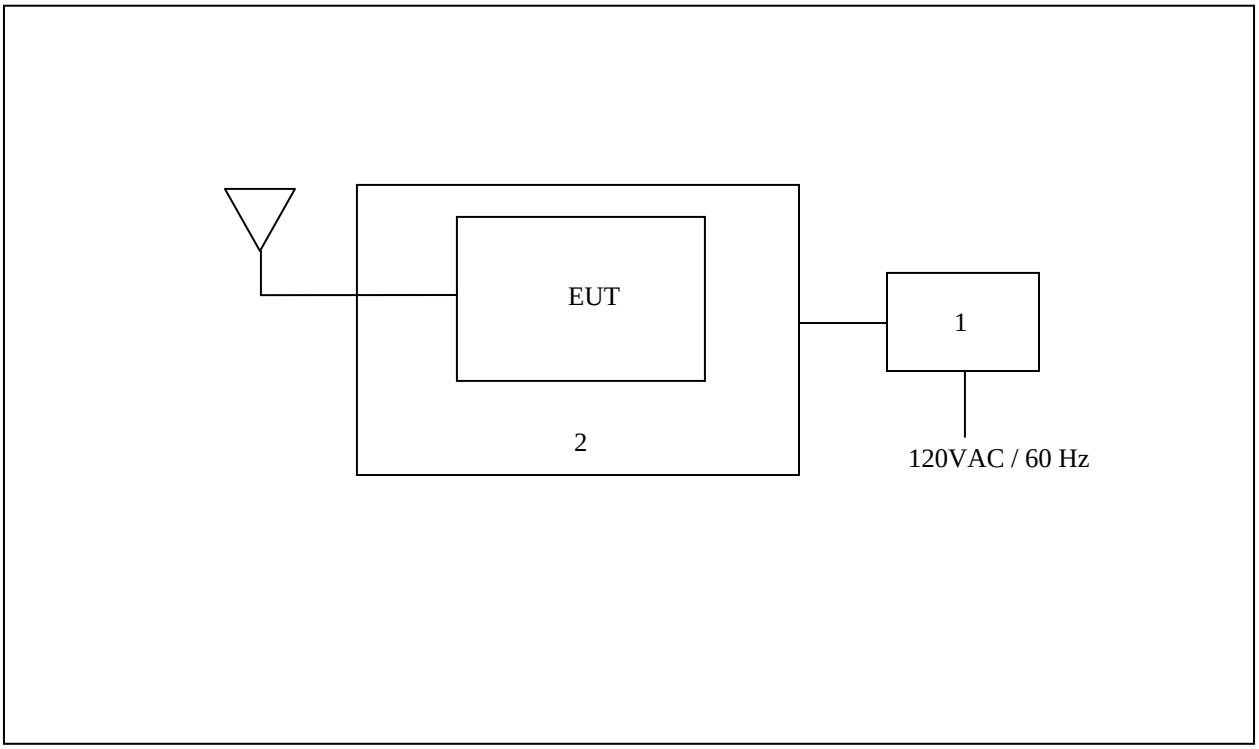

Figure 6-1: EUT Test Setup

*See Test Setup photographs for additional detail.

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

A U.FL miniature coaxial connector is provided on the DNT900 thus satisfying the requirements of Part 15.203 for unique antenna coupling.

7.2 Power Line Conducted Emissions - FCC Section 15.207 IC: RSS-Gen 7.2.2

7.2.1 Test Methodology

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. 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. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Test Results

Results of the test are shown below in and Tables 7.2-1 and 7.2.2

Table 7.2-1: Conducted EMI Results – Dipole Antenna

Frequency (MHz)	Uncorrected Reading (dBuV)		Total Correction Factor (dB)	Corrected Level (dBuV)		Limit (dBuV)		Margin (dB)		Line
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
Line 1										
0.2	35	31.4	9.80	44.80	41.20	63.61	53.61	18.8	12.4	FLO
0.31	30.3	29.2	9.80	40.10	39.00	59.97	49.97	19.9	11.0	FLO
0.51	26.8	26.7	9.90	36.70	36.60	56.00	46.00	19.3	9.4	FLO
0.61	29.8	29.1	9.90	39.70	39.00	56.00	46.00	16.3	7.0	FLO
0.71	26.7	25.7	9.90	36.60	35.60	56.00	46.00	19.4	10.4	FLO
26.08	24.6	22.4	10.30	34.90	32.70	60.00	50.00	25.1	17.3	FLO
Line 2										
0.2	35.1	31.3	9.80	44.90	41.10	63.61	53.61	18.7	12.5	FLO
0.31	29.4	27.8	9.80	39.20	37.60	59.97	49.97	20.8	12.4	FLO
0.51	24.3	24.1	9.90	34.20	34.00	56.00	46.00	21.8	12.0	FLO
0.61	26.7	26.4	9.90	36.60	36.30	56.00	46.00	19.4	9.7	FLO
0.71	28.1	27.4	9.90	38.00	37.30	56.00	46.00	18.0	8.7	FLO
26.29	25.2	24.1	10.31	35.51	34.41	60.00	50.00	24.5	15.6	FLO

Table 7.2-2: Conducted EMI Results – Yagi Antenna

Frequency (MHz)	Uncorrected Reading (dBuV)		Total Correction Factor (dB)	Corrected Level (dBuV)		Limit (dBuV)		Margin (dB)		Line
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
Line 1										
0.2	34.9	31.1	9.80	44.70	40.90	63.61	53.61	18.9	12.7	FLO
0.31	30.1	28.9	9.80	39.90	38.70	59.97	49.97	20.1	11.3	FLO
0.51	26.6	26.5	9.90	36.50	36.40	56.00	46.00	19.5	9.6	FLO
0.61	28.7	28.2	9.90	38.60	38.10	56.00	46.00	17.4	7.9	FLO
0.71	26.7	25.7	9.90	36.60	35.60	56.00	46.00	19.4	10.4	FLO
26.28	24.7	23.7	10.31	35.01	34.01	60.00	50.00	25.0	16.0	FLO
Line 2										
0.2	34.8	31.2	9.80	44.60	41.00	63.61	53.61	19.0	12.6	FLO
0.31	29.3	27.6	9.80	39.10	37.40	59.97	49.97	20.9	12.6	FLO
0.51	24.5	24.1	9.90	34.40	34.00	56.00	46.00	21.6	12.0	FLO
0.61	26.6	26.2	9.90	36.50	36.10	56.00	46.00	19.5	9.9	FLO
0.71	28.1	27.3	9.90	38.00	37.20	56.00	46.00	18.0	8.8	FLO
25.95	24.6	18.7	10.42	35.02	29.12	60.00	50.00	25.0	20.9	FLO

7.3 Radiated Emissions – FCC: Section 15.109(Unintentional Radiation) IC: RSS-210 2.6

7.3.1 Test Methodology

Radiated emissions tests were performed over the frequency range of 30MHz to 5GHz. 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 above 30MHz and below 1GHz were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz using a Quasi-peak detector. Above 1GHz, average measurements are taken with the RBW and VBW were set to 1MHz and 3Mz respectively.

Data displayed is the worst case of the 2 antenna configurations.

7.3.2 Test Results

Results of the test are given in Table 7.3-1 below:

Table 7.3-1: Radiated Emissions Tabulated Data – Dipole Antenna

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
38.62	---------	34.76	V	-13.07	---------	21.69	--------	40.0	---------	18.31
103.28	---------	36.51	V	-13.57	---------	22.94	--------	43.5	---------	20.56
116.22	---------	39.86	V	-12.83	---------	27.03	--------	43.5	---------	16.47
156.1	---------	34.53	V	-14.17	---------	20.36	--------	43.5	---------	23.14
297.28	---------	39.56	H	-11.08	---------	28.48	--------	46.0	---------	17.52
310.22	---------	41.77	H	-10.89	---------	30.88	--------	46.0	---------	15.12

* Note: All emissions above 310.22 MHz were attenuated below the permissible limit.

7.4 6dB & 99% Bandwidth – FCC Section 15.247(a)(2) IC: RSS-210 A8.2(a)

7.4.1 Test Methodology

The 6dB bandwidth was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the entire emissions and >> RBW.

The 99% occupied bandwidth was also measured in accordance to the measurement guidelines provided by Industry Canada (The Measurement of Occupied Bandwidth).

7.4.2 Test Results

Results are shown below in table 7.4.2-1 and figure 7.4.2-1 to 7.4.2-6:

Table 7.4.2-1: 6dB and 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [kHz]	99% Bandwidth [kHz]
903.25	576.0	1372.0
915.25	584.0	1412.0
926.24	584.0	1428.0

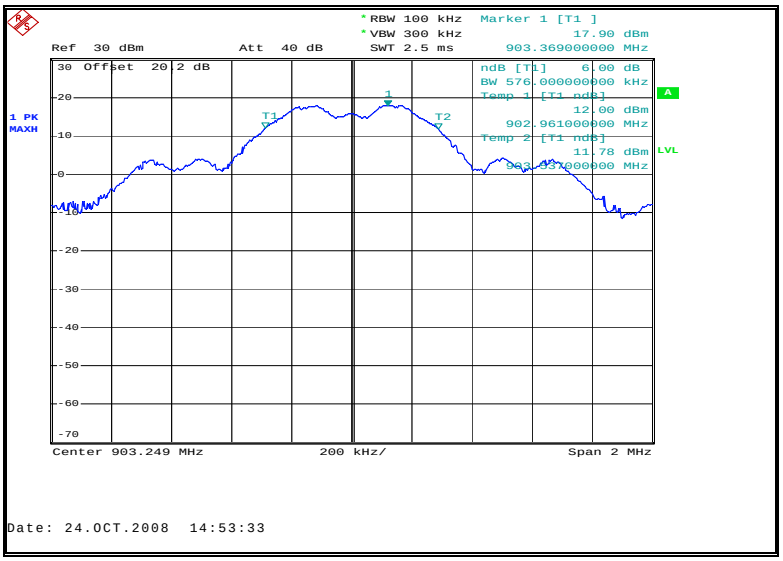

Figure 7.4.2-1: 6dB Bandwidth Plot – Low Channel

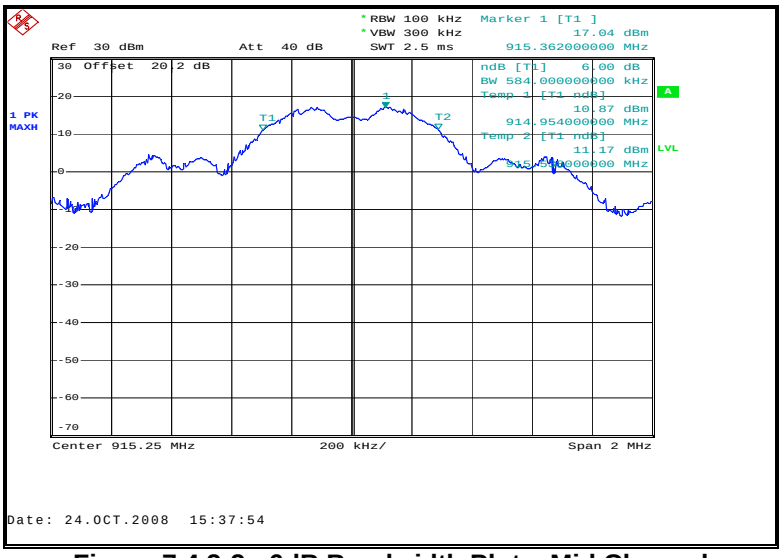

Figure 7.4.2-2: 6dB Bandwidth Plot – Mid Channel

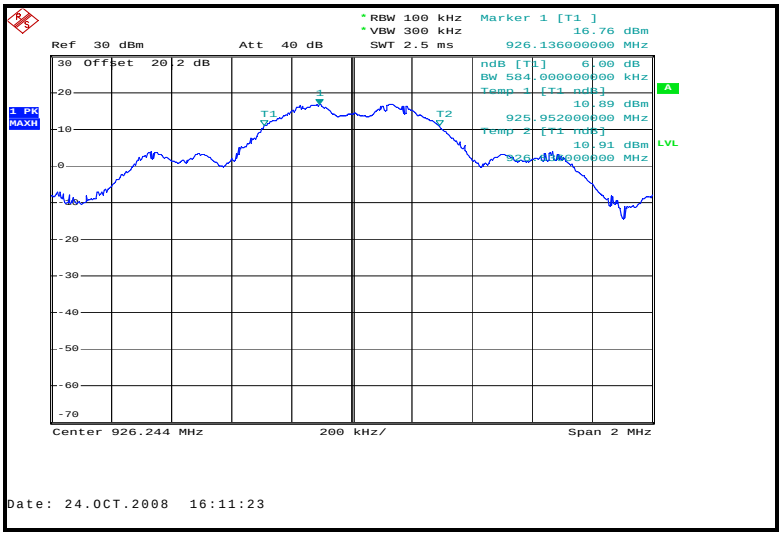

Figure 7.4.2-3: 6dB Bandwidth Plot – High Channel

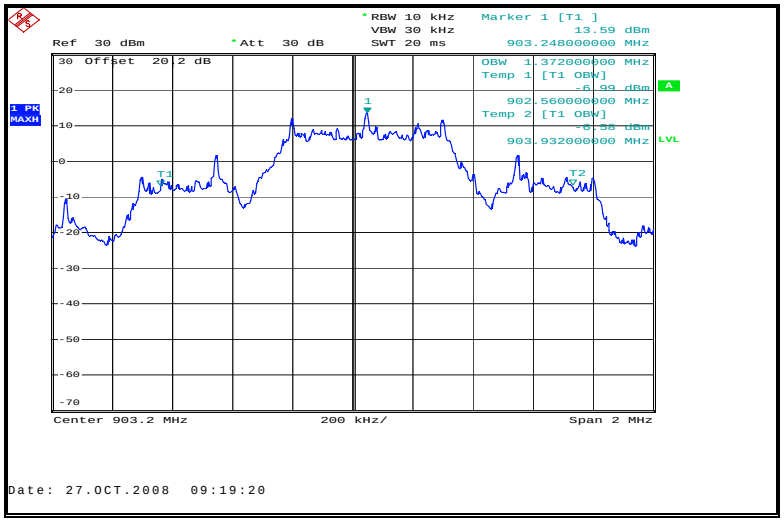

Figure 7.4.2-4: 99% Bandwidth Plot – Low Channel

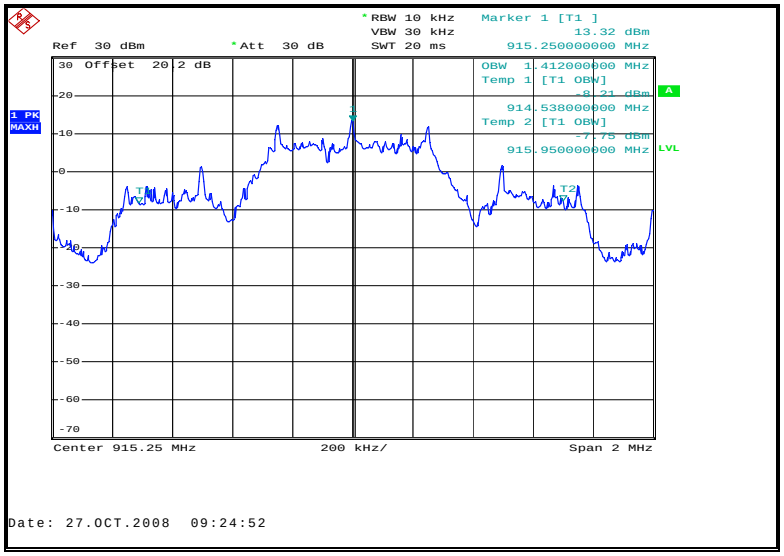

Figure 7.4.2-5: 99% Bandwidth Plot – Mid Channel

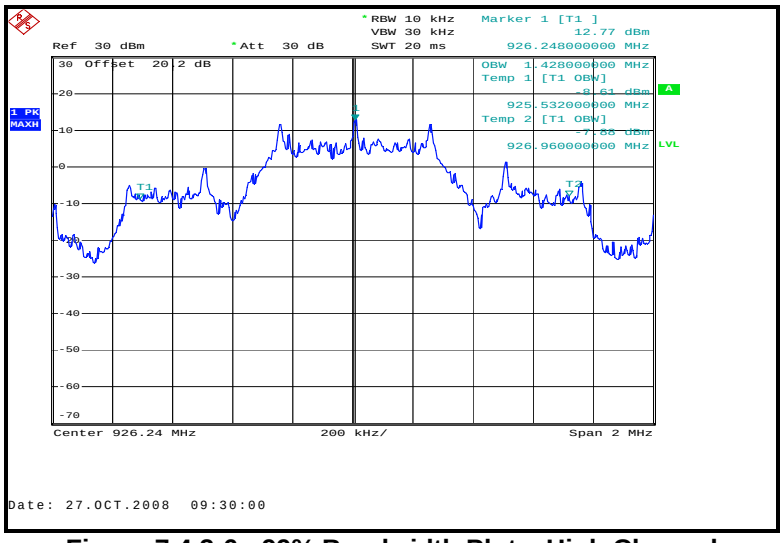

Figure 7.4.2-6: 99% Bandwidth Plot – High Channel

7.5 Peak Output Power Requirement - FCC Section 15.247(b)(3) IC: RSS-210 A8.4(4)

7.5.1 Test Methodology

The Peak Output Power was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" Power Option 1. The RF output of the equipment under test was directly connected to the input of the Power Meter. Data was collected with the EUT operating at maximum power.

7.5.2 Test Results

Results are shown below in Table 7.5.2-1 and Figures 7.5.2-1 to 7.5.2-3.

Table 7.5.2-1: Peak Output Power

Frequency (MHz)	Output Power (dBm)
903.25	17.49
915.25	17.53
926.25	17.34

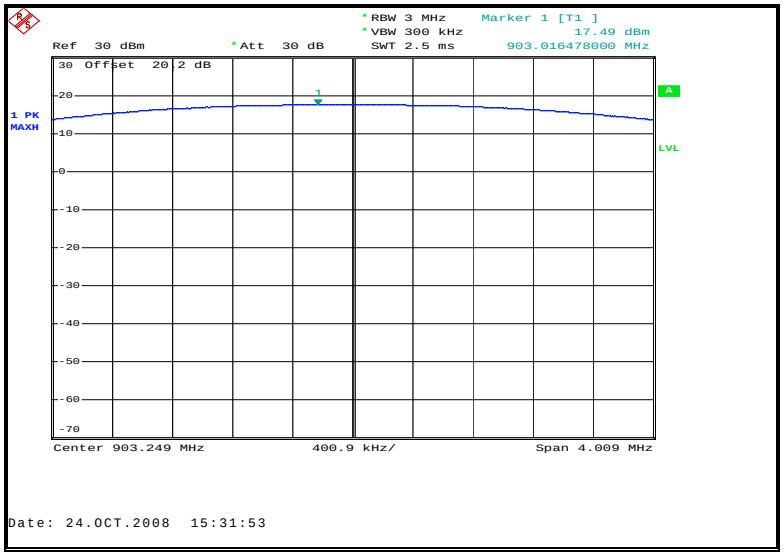

Figure 7.5.2-1: Output power – Low Channel

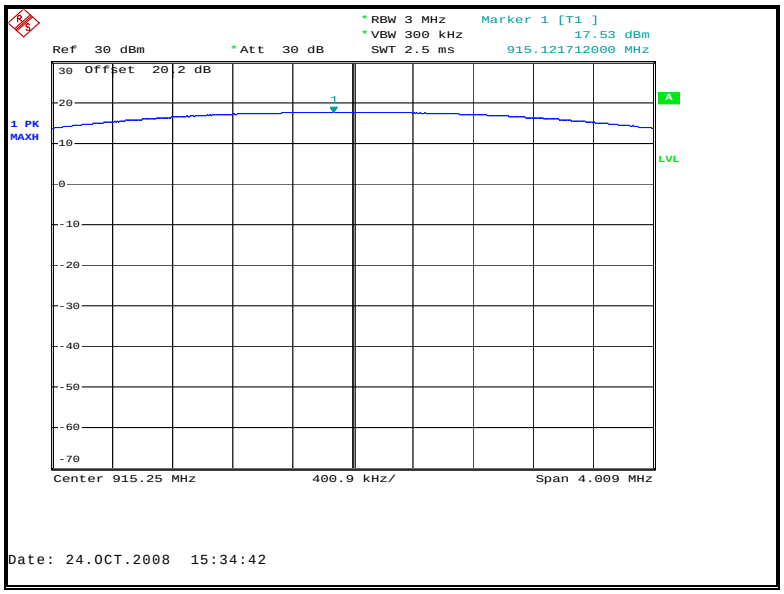

Figure 7.5.2-2: Output power – Mid Channel

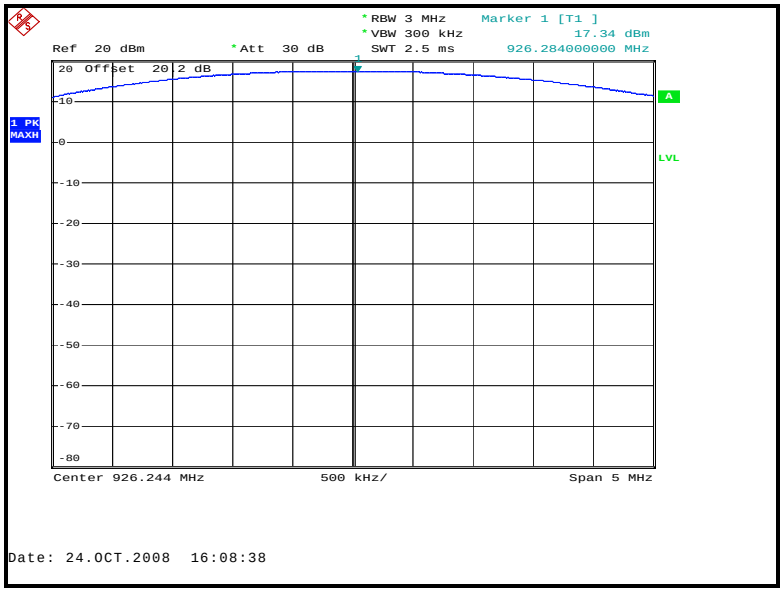

Figure 7.5.2-3: Output power – High Channel

7.6 Band-Edge Compliance and Spurious Emissions - FCC Section 15.247(d) IC: RSS-210 2.6, A8.5

7.6.1 Band-Edge Compliance of RF Emissions

7.6.1.1 Test Methodology

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, which is ≥ 1% of the span, and the VBW was set to 300kHz.

7.6.1.2 Test Results

In a 100 kHz bandwidth at the lower and upper band-edge, the radio frequency power that was produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. Band-edge compliance is displayed in Figures 7.6.1-1 and 7.6.2-2

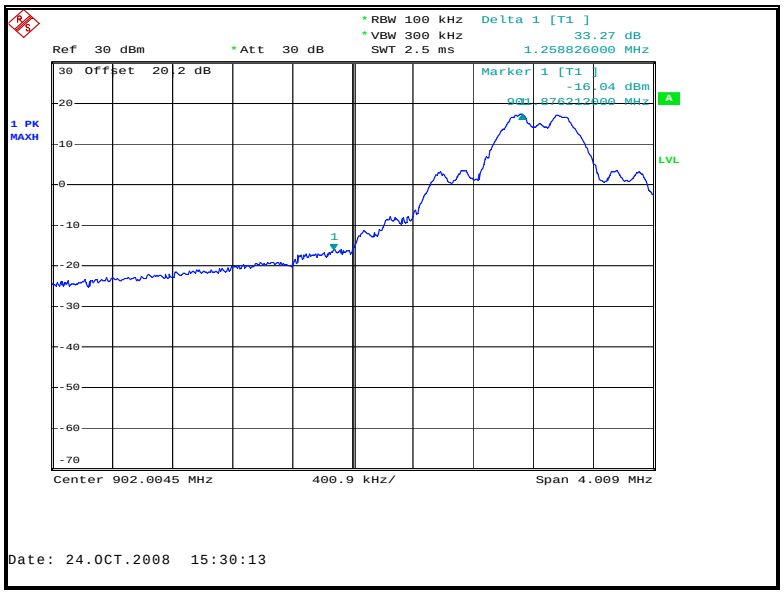

Figure 7.6.1.2-1: Lower Band-edge

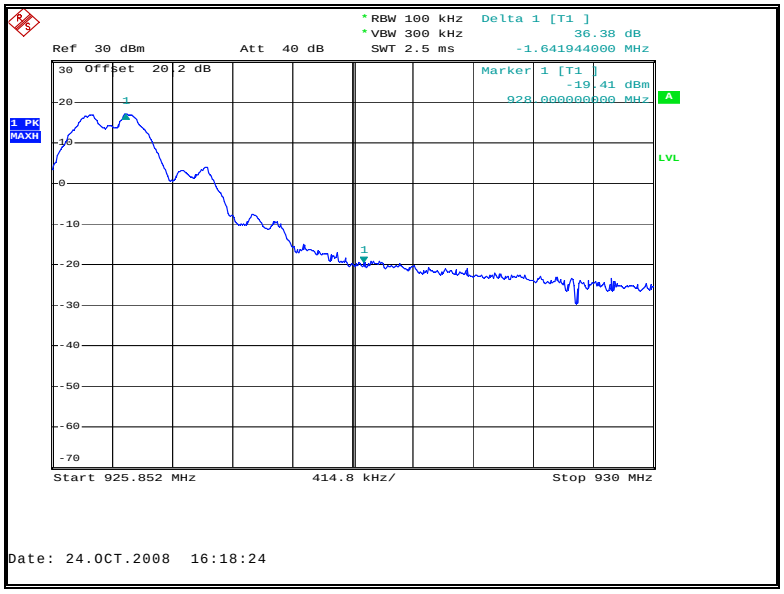

Figure 7.6.1.2-2: Upper Band-edge

7.6.2 RF Conducted Spurious Emissions

7.6.2.1 Test Methodology

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB Publication No. 558074 “Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)”. The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. 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 RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak detector and Max Hold function of the analyzer were utilized.

7.6.2.2 Test Results

In a 100 kHz bandwidth, the radio frequency power that was produced by the EUT emissions is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. RF Conducted Emissions are displayed in Figures 7.6.2.2-1 through 7.6.2.2-6.

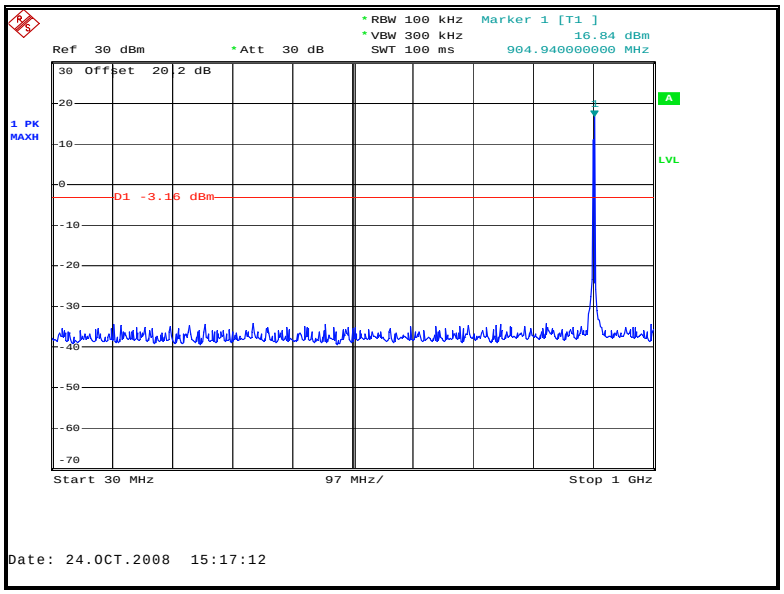

Figure 7.6.2.2-1: 30 MHz – 1 GHz – Low Channel

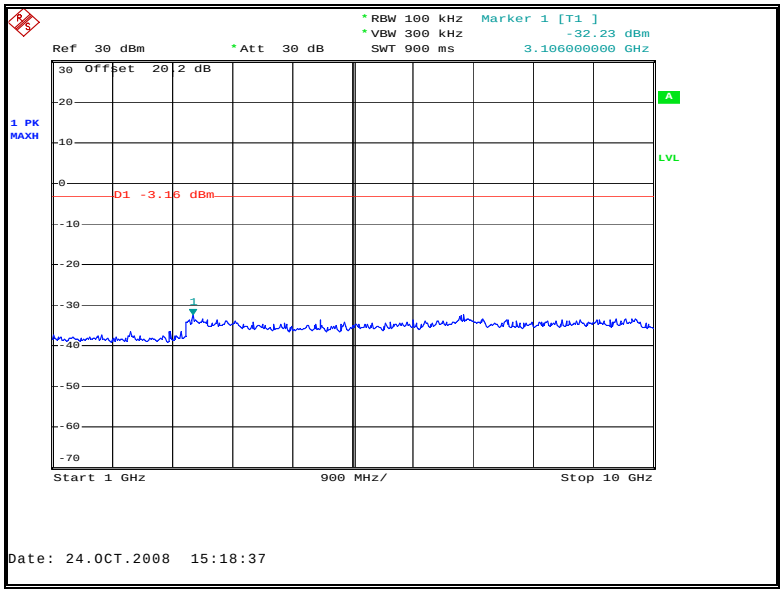

Figure 7.6.2.2-2: 1 GHz – 10 GHz – Low Channel

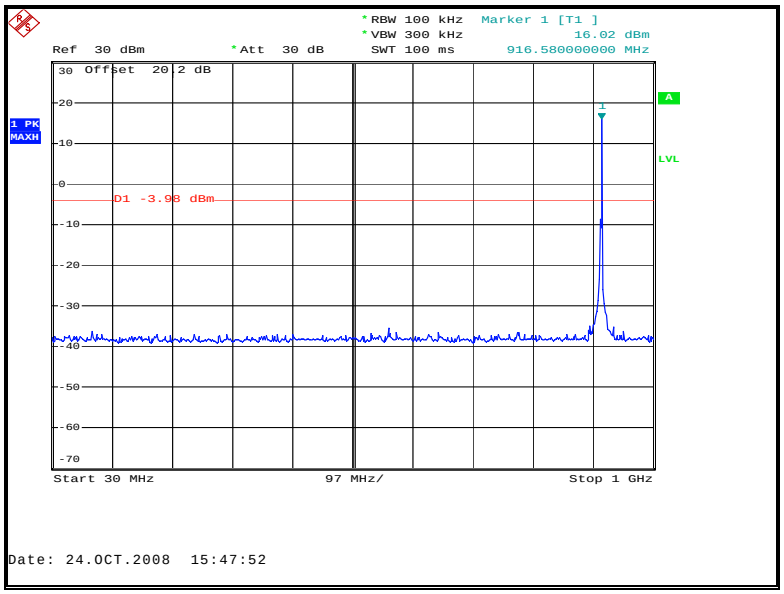

Figure 7.6.2.2-3: 30 MHz – 1 GHz –Mid Channel

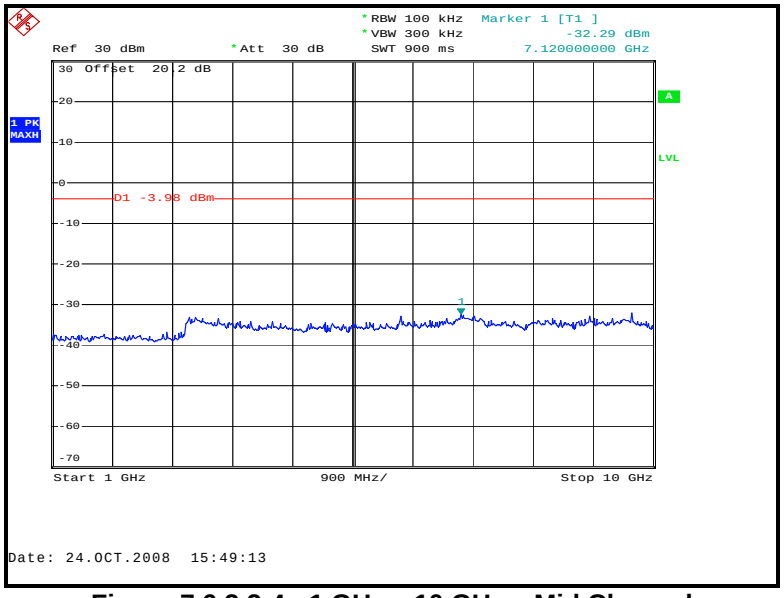

Figure 7.6.2.2-4: 1 GHz – 10 GHz – Mid Channel

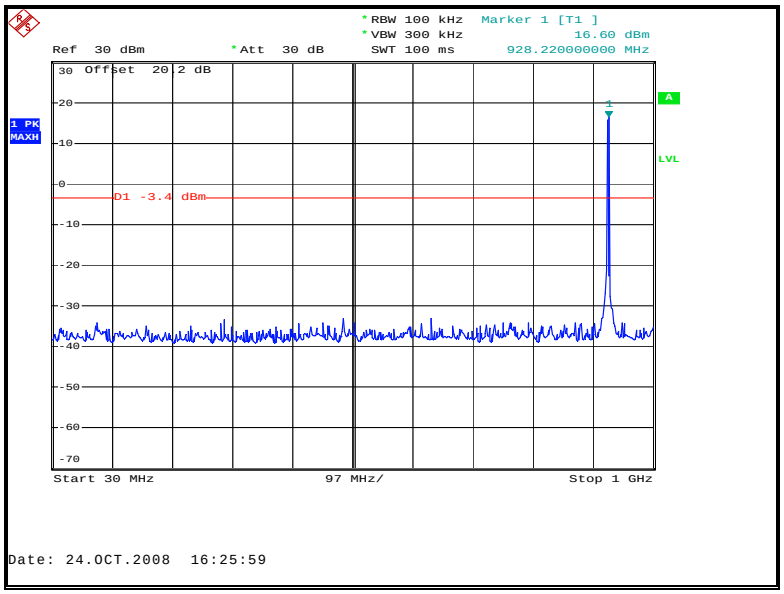

Figure 7.6.2.2-5: 30 MHz – 1 GHz – High Channel

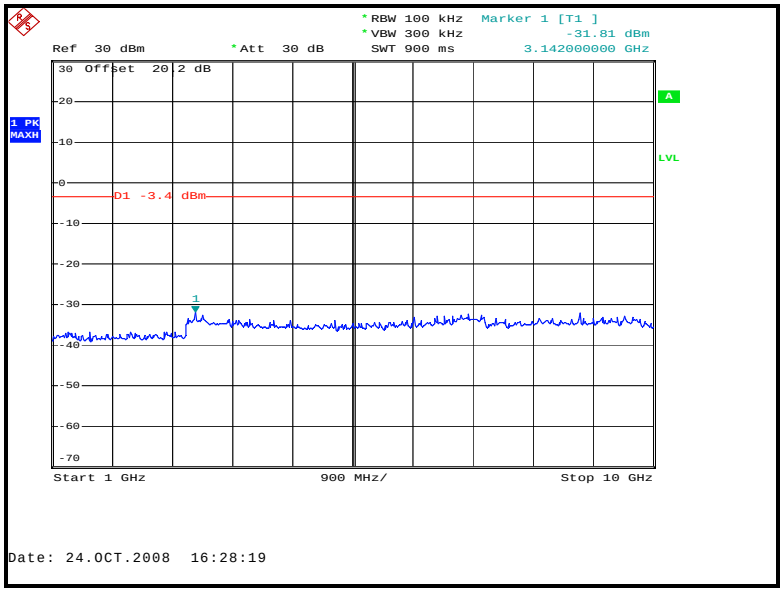

Figure 7.6.2.2-6: 1 GHz – 10 GHz –High Channel

7.6.3 Radiated Spurious Emissions (Restricted Bands) - FCC Section 15.205 IC: RSS-210 2.6

7.6.3.1 Test Methodology

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

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 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak measurements made with RBW and VBW of 1 MHz. Average measurements were made with RBW of 1MHz and a VBW of 10Hz. The average emissions were further corrected by applying the duty cycle correction of the EUT to the average measurements for comparison to the average limit.

7.6.3.3 Test Results

The magnitude of all emissions for low, mid, and high channels ere below the noise floor of the measurement system.

7.7 Peak Power Spectral Density- FCC Section 15.247(e) IC: RSS-210 A8.2(b)

7.7.1 Test Methodology

The power spectral density was measured in accordance with the FCC KDB Publication No. 558074 “Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)”. The emission peaks within the pass band were located and zoomed in on. The spectrum analyzer RBW was set to 3 kHz and VBW 10 kHz. Span was adjusted to 500 kHz and the sweep time was calculated to be 168s (Span/3 kHz).

7.7.2 Test Results

Results are shown below in table 7.7.2-1 and figures 7.7.2-1 – 7.7.2-3:

Table 7.7.2-1: Peak Power Spectral Density

Frequency (MHz)	PSD Level (dBm)
903.25	7.55
915.25	7.35
926.24	6.90

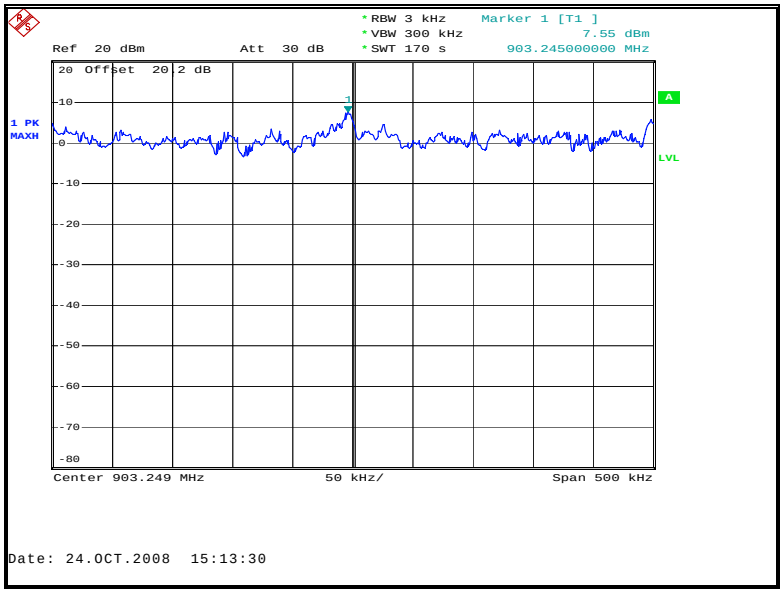

Figure 7.7.2-1: Power Spectral Density Plot – Low Channel

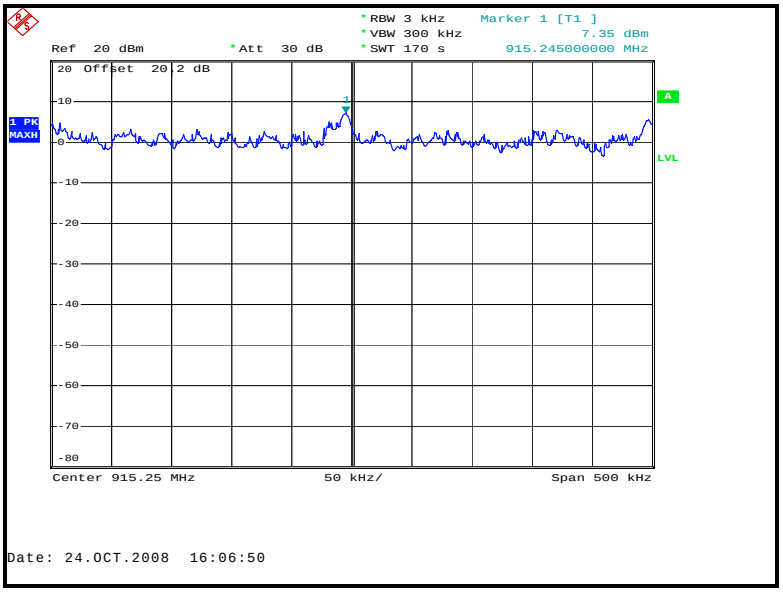

Figure 7.7.2-2: Power Spectral Density Plot – Mid Channel

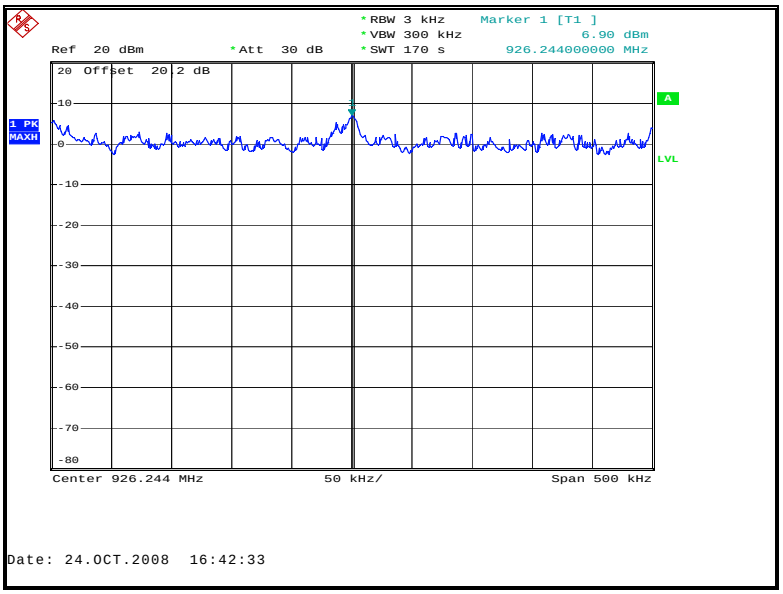

Figure 7.7.2-3: Power Spectral Density Plot – High Channel

8.0 CONCLUSION

In the opinion of ACS, Inc. the DNT900C and DNT900P, manufactured by Cirronet Inc.meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT