Excellence in Compliance Testing

Certification Test Report

Test Report

FCC ID: R7PCG6R1S1
IC: 5294A-CG6R1S1

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

ACS Report Number: 08-0040-15C

Manufacturer: Cellnet Technology, Inc.
Model: 1-Way Repeater

Test Begin Date: February 11, 2008
Test End Date: February 21, 2008

Report Issue Date: April 29, 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 16 pages

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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

The Cellnet 1-Way Repeater is intended to be a low cost way to extending RF coverage in rural (low customer density) areas. The 1-Way Repeater uses a transceiver that listens to deployed one way TOMs (transmit only meters) that transmit at 917.58 MHz. It then repeats the message at 911.58 MHz. Both RF transmissions use direct sequence spread spectrum. These transmitted messages are received by other RF network products that collect these messages and send them to a centralized take out point.

Manufacturer Information:
Cellnet Technology, Inc.
30000 Mill Creek Ave. Suite 100
Alpharetta, GA 30022

Test Sample Condition:
The test sample was provided in working order with no visible defects.

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

1.3 Test Methodology and Considerations

The EUT can operate with input voltages between 120 VAC and 277 VAC. Measurements were made at all operating voltages and worst case data presented in this report where applicable.

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:

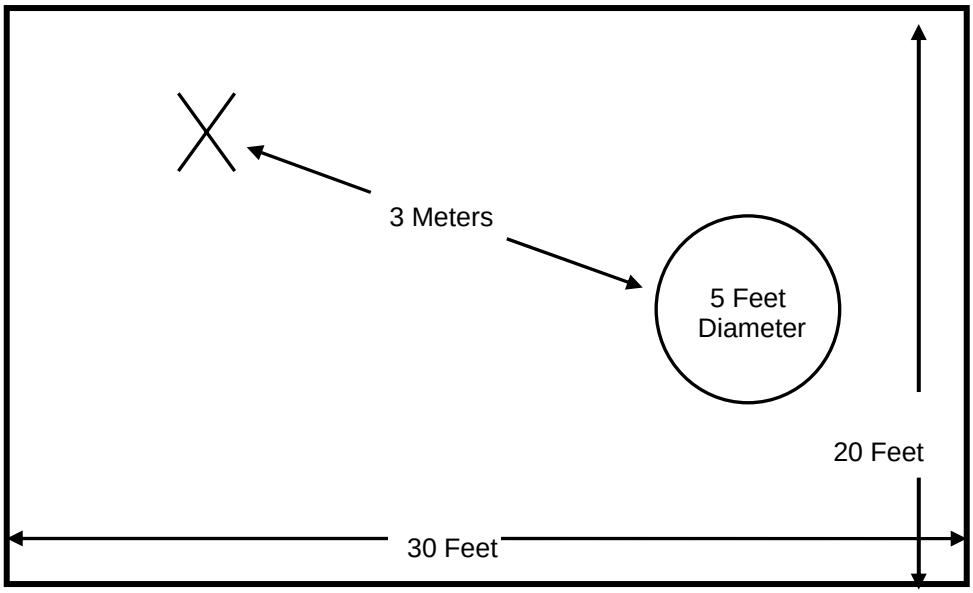

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

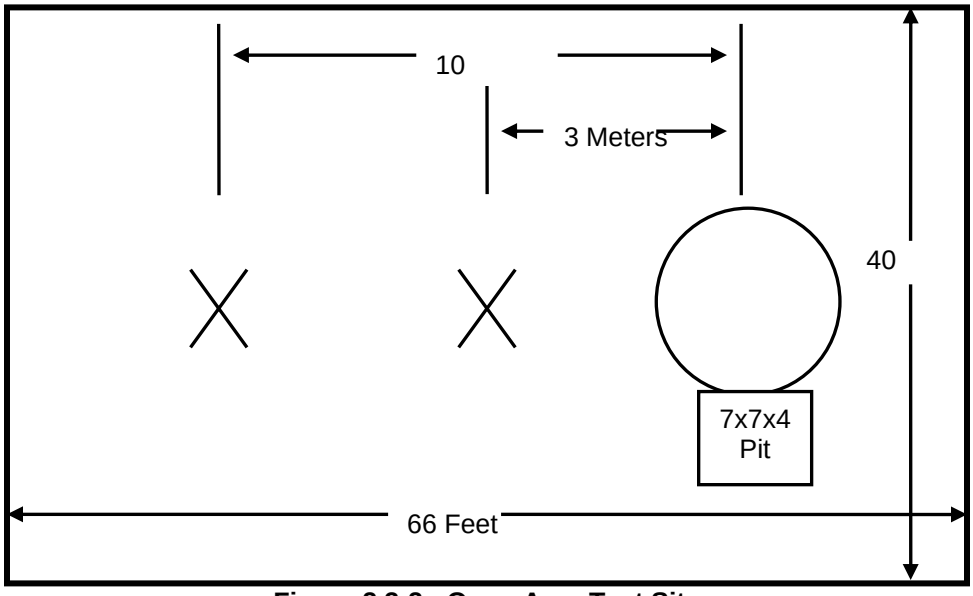

Figure 2.3-2: Open Area Test Site

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:

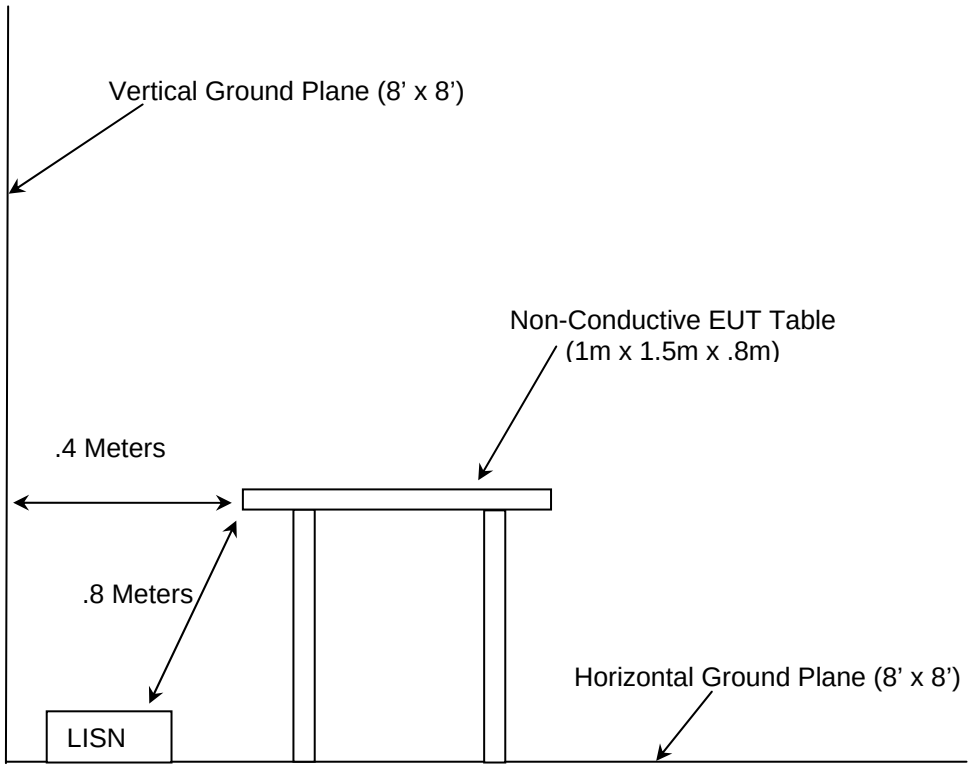

Figure 2.4-1: AC Mains Conducted EMI Site

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, 2007
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2007
- FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, 2001
- 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

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

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
1	Rohde & Schwarz	Spectrum Analyzers	ESMI - Display	833771/007	10-26-2008
2	Rohde & Schwarz	Spectrum Analyzers	ESMI-Receiver	839587/003	10-26-2008
16	ACS	Cables	Cable	16	05-21-2008
22	Agilent	Amplifiers	8449B	3008A00526	10-25-2008
25	Chase	Antennas	CBL6111	1043	06-06-2008
30	Spectrum Technologies	Antennas	DRH-0118	970102	05-10-2008
73	Agilent	Amplifiers	8447D	2727A05624	12-19-2008
152	EMCO	LISN	3825/2	9111-1905	03-26-2009
167	ACS	Cables	Chamber EMI Cable Set	167	01-04-2009
168	Hewlett Packard	Attenuators	11947A	44829	02-18-2009
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	11-09-2008
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
331	Microwave Circuits	Filters	H1G513G1	31417	08-27-2008
340	Aeroflex/Weinschel	Attenuators	AS-20	7136	10-24-2008

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
The EUT was test tested stand-alone with no support or ancillary equipment.				

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

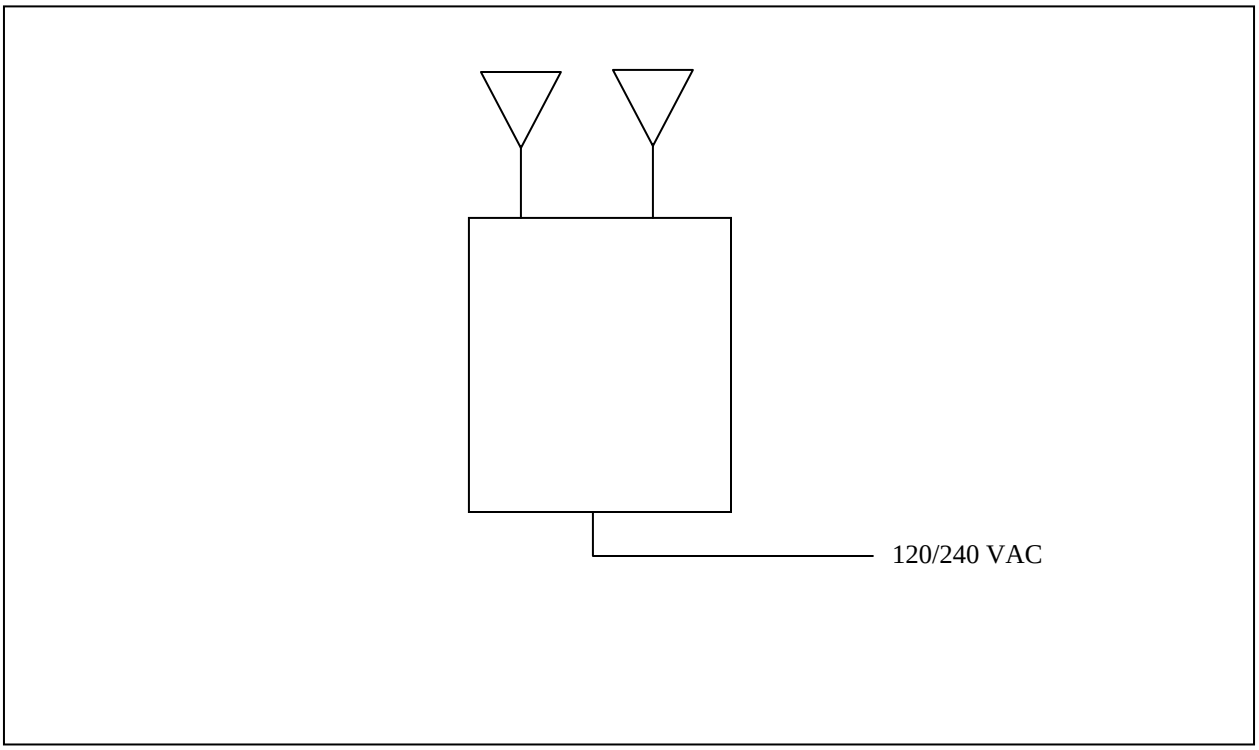

Figure 6-1: EUT Test Setup

*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

The Cellnet 1-Way Repeater uses N-Type connectors but is a non-consumer device which is professional installed by trained licensed technicians.

7.2 Power Line Conducted Emissions

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 7.2.2-1 and 7.2.2-2.

Table 7.2.2-1: Line 1 Conducted EMI Results (120V)

Frequency (MHz)	Uncorrected Reading (dBuV)		Total Correction Factor (dB)	Corrected Level (dBuV)		Limit (dBuV)		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.17	42.1	36	9.80	51.90	45.80	64.96	54.96	13.1	9.2
0.22	41.4	33.2	9.80	51.20	43.00	62.82	52.82	11.6	9.8
0.27	40.8	36.5	9.80	50.60	46.30	61.12	51.12	10.5	4.8
0.41	38.1	22.5	9.80	47.90	32.30	57.65	47.65	9.7	15.4
0.53	34.1	26.2	9.80	43.90	36.00	56.00	46.00	12.1	10.0
0.72	30.4	15.6	9.80	40.20	25.40	56.00	46.00	15.8	20.6
Line 2									
0.18	41.1	35.2	9.80	50.90	45.00	64.49	54.49	13.6	9.5
0.22	36.8	31.5	9.80	46.60	41.30	62.82	52.82	16.2	11.5
0.26	38.2	31.3	9.80	48.00	41.10	61.43	51.43	13.4	10.3
0.31	37.9	28.1	9.80	47.70	37.90	59.97	49.97	12.3	12.1
6.12	18.3	13.9	9.80	28.10	23.70	60.00	50.00	31.9	26.3
10.29	24.7	22.1	10.00	34.70	32.10	60.00	50.00	25.3	17.9

Table 7.2.2-1: Line 1 Conducted EMI Results (240V)

Frequency (MHz)	Uncorrected Reading (dBuV)		Total Correction Factor (dB)	Corrected Level (dBuV)		Limit (dBuV)		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.16	37.9	26.5	9.80	47.70	36.30	65.46	55.46	17.8	19.2
0.19	38.3	27.4	9.80	48.10	37.20	64.04	54.04	15.9	16.8
0.27	35.7	31	9.80	45.50	40.80	61.12	51.12	15.6	10.3
0.31	42.6	33.9	9.80	52.40	43.70	59.97	49.97	7.6	6.3
1.2	20.1	13.1	9.80	29.90	22.90	56.00	46.00	26.1	23.1
27.04	19.7	15.7	10.20	29.90	25.90	60.00	50.00	30.1	24.1
Line 2									
0.15	40.2	33.8	9.80	50.00	43.60	66.00	56.00	16.0	12.4
0.3	41.7	35.3	9.80	51.50	45.10	60.24	50.24	8.7	5.1
0.38	35	18.3	9.80	44.80	28.10	58.28	48.28	13.5	20.2
0.48	34.7	21.4	9.80	44.50	31.20	56.34	46.34	11.8	15.1
0.72	31.5	18.5	9.80	41.30	28.30	56.00	46.00	14.7	17.7
0.84	30.5	21.3	9.80	40.30	31.10	56.00	46.00	15.7	14.9

7.3 Radiated Emissions - Unintentional Radiation

7.3.1 Test Methodology

Radiated emissions tests were performed over the frequency range of 30MHz to 5 GHz. 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 Spectrum Analyzer's resolution and video bandwidths set to 1MHz and 10 Hz respectively. Measurements using a peak detector were also taken above 1 GHz with Spectrum Analyzer's resolution and video bandwidths set to 1MHz and 3MHz respectively.

7.3.2 Test Results

Results of the test are given in Table 7.3.2-1 below:

Table 7.3.2-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
47.24	41.39	38.92	H	-16.06	---------	22.86	--------	40.0	---------	17.14
120.53	53.02	50.17	H	-14.21	---------	35.96	--------	43.5	---------	7.54
122.68	47.29	44.76	H	-14.25	---------	30.51	--------	43.5	---------	12.99
233.7	42.55	33.90	V	-14.20	---------	19.70	--------	46.0	---------	26.30
246.63	39.51	32.12	V	-13.30	---------	18.82	--------	46.0	---------	27.18
505.3	36.11	34.33	H	-6.12	---------	28.21	--------	46.0	---------	17.79
544.1	34.01	31.38	V	-5.62	---------	25.76	---------	46.0	---------	20.24

* Note: All emissions above 544.1 MHz were attenuated below the permissible limit.

7.4 6dB Bandwidth

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.

7.4.2 Test Results

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

Table 7.4.2-1: 6dB Bandwidth

Frequency [MHz]	Bandwidth [MHz]
911.58	0.690

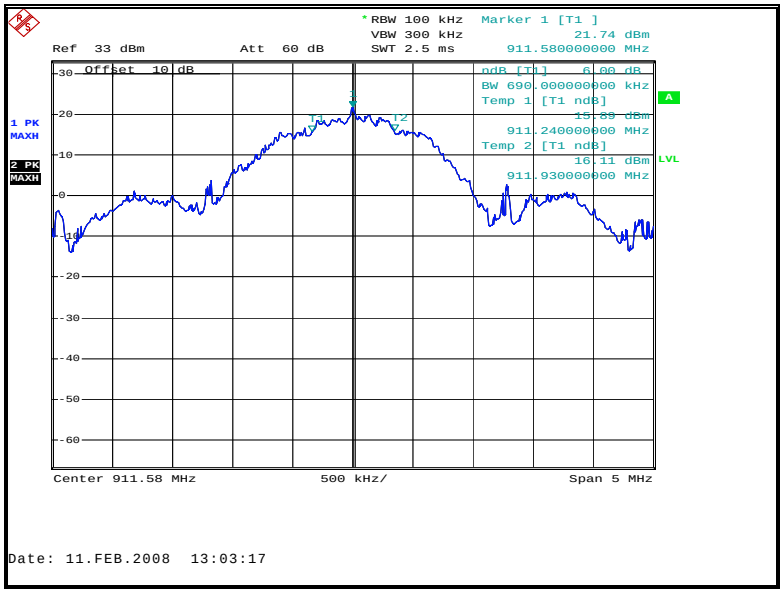

Figure 7.4.2-1: 6dB Bandwidth Plot

7.5 Peak Output Power Requirement

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 Spectrum Analyzer.

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 Figure 7.5.2-1.

Table 7.5.2-1: Peak Output Power

Frequency (MHz)	Output Power (dBm)
911.58	25.55

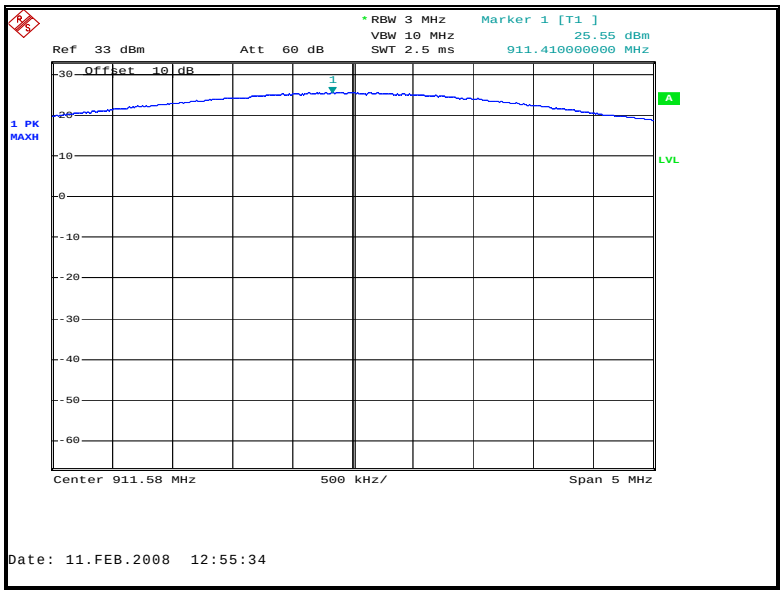

Figure 7.5.2-1: Output power

7.6 Band-Edge Compliance and Spurious Emissions

7.6.1 Band-Edge Compliance of RF Emissions

7.6.1.1 Test Methodology

The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For this measurement the spectrum analyzer's RBW and VBW was set to 100 kHz.

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 Figure 7.6.1.2-1.

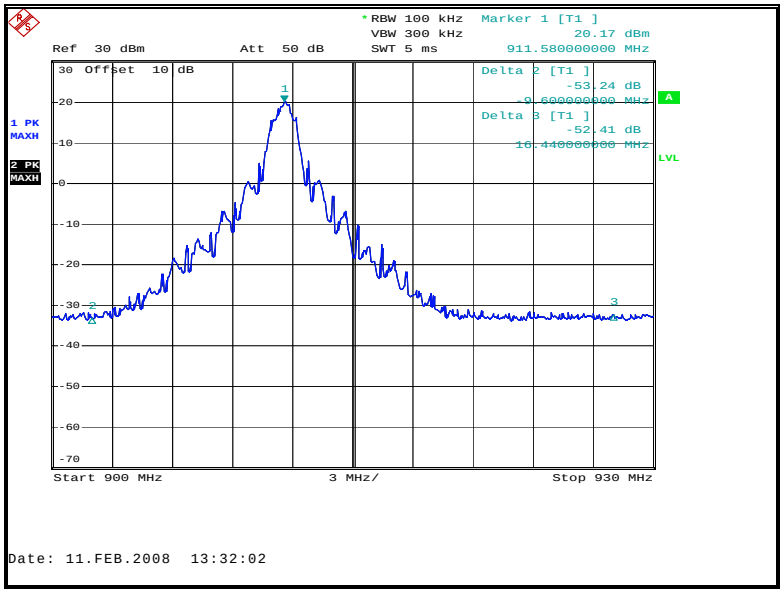

Figure 7.6.1.2-1: Band-edge

7.6.2 RF Conducted Spurious Emissions

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 7.6.2.2-2.

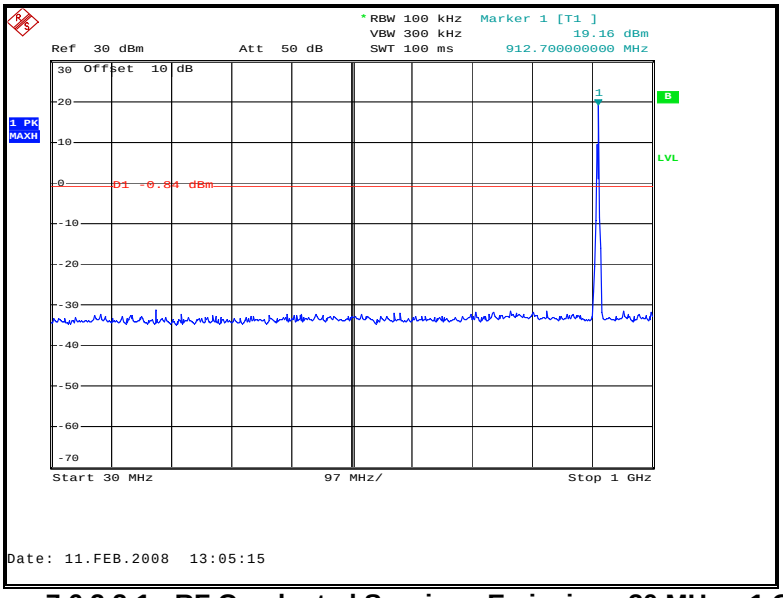

Figure 7.6.2.2-1: RF Conducted Spurious Emissions 30 MHz – 1 GHz

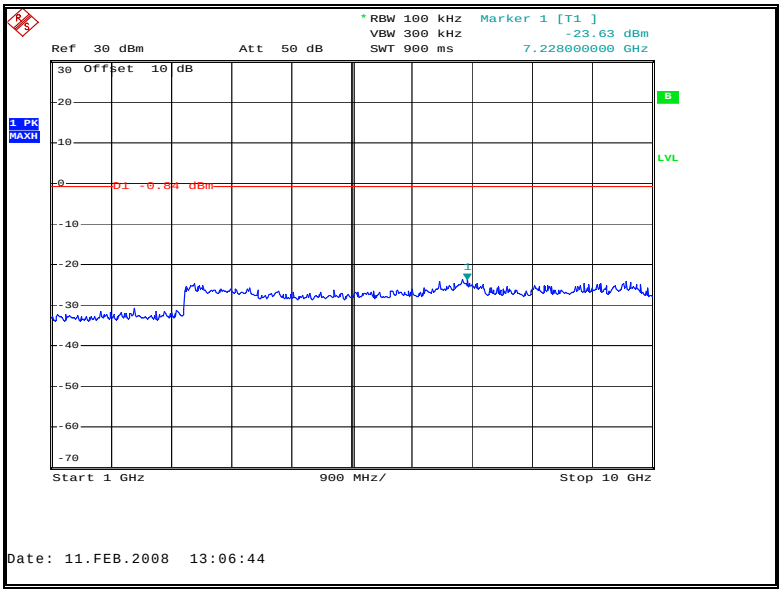

Figure 7.6.2.2-2: RF Conducted Spurious Emissions 1 GHz – 10 GHz

7.6.3 Radiated Spurious Emissions – Intentional Radiation (Restricted Bands)

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, using the procedures set forth in the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits as defined in section 15.209.

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 were made with RBW and VBW of 1 MHz. The EUT could not be placed in to a continuous transmit mode of operation there average measurements could not be made. Peak measurements were compared to the average limits.

7.6.3.2 Test Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in Table 7.6.3.2-1.

Table 7.6.3.2-1: Radiated Spurious Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2734.74	49.91	49.91	H	-0.18	49.73	49.73	74.0	54.0	24.27	4.27
2734.74	51.49	51.49	V	-0.43	51.06	51.06	74.0	54.0	22.94	2.94

Note: All frequencies not reported were below the noise floor of the spectrum analyzer.

7.6.3.3 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: Peak

Corrected Level: 49.91 - 0.18 = 49.73dBuV/m
Margin: 74dBuV/m – 49.73dBuV/m = 24.27dB

Example Calculation: Average

Corrected Level: 49.91 - 0.18 -0= 49.73dBuV
Margin: 54dBuV – 49.73dBuV = 4.27dB

7.7 Peak Power Spectral Density

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). Actual sweep time was set to 170s.

7.7.2 Test Results

Results are shown below in table 7.7.2-1 and figure 7.7.2-1:

Table 7.7.2-1: Peak Power Spectral Density

Frequency [MHz]	Level [dBm]
911.58	7.52

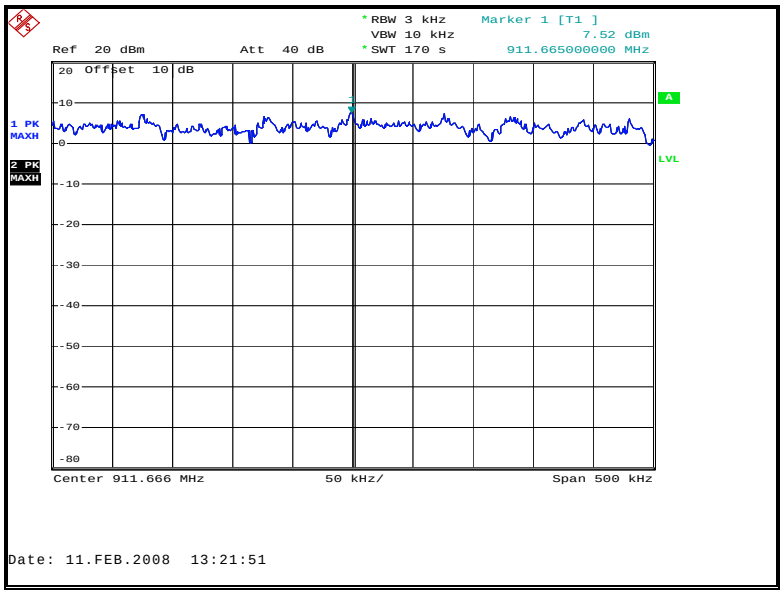

Figure 7.7.2-1: Power Spectral Density Plot

8.0 CONCLUSION

In the opinion of ACS, Inc. the 1-Way Repeater, manufactured by Cellnet Technology, Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT