

FCC Part 15 Subpart C Transmitter Certification

Direct Sequence Spread Spectrum Transmitter

Test Report

FCC ID: R7PCWE-WALL2

FCC Rule Part: 15.247

ACS Report Number: 06-0327 - 15C

Manufacturer: Cellnet Technology, Inc.
Model: Cellnet Water Endpoint 6075 Remote

Test Begin Date: August 31, 2006

Test End Date: August 31, 2006


Report Issue Date: November 8, 2006



FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

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

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This report contains 16 pages

Table of Contents

1.0 General	3
1.1 Purpose	3
1.2 Product Description	3
1.2.1 General	3
1.2.2 Intended Use	3
1.3 Test Methodology and Considerations	3
2.0 Test Facilities	4
2.1 Location	4
2.2 Laboratory Accreditations/Recognitions/Certifications	4
2.3 Radiated Emissions Test Site Description	5
2.3.1 Semi-Anechoic Chamber Test Site	5
2.3.2 Open Area Tests Site (OATS)	6
2.4 Conducted Emissions Test Site Description	7
3.0 Applicable Standards and References	7
4.0 List of Test Equipment	8
5.0 Support Equipment	9
6.0 EUT Setup Block Diagram	9
7.0 Summary of Tests	10
7.1 Section 15.203 - Antenna Requirement	10
7.2 Section 15.207 - Power Line Conducted Emissions	10
7.2.1 Test Methodology	10
7.3 Section 15.109 - Radiated Emissions (Unintentional Radiation)	10
7.3.1 Test Methodology	10
7.3.2 Test Results	10
7.4 Section 15.247(a)(2) – 6 dB Bandwidth	11
7.4.1 Test Methodology	11
7.4.1 Test Results	11
7.5 Section 15.247(b) – Peak Output Power	12
7.5.1 Test Methodology	12
7.5.2 Test Results	12
7.6 Section 15.247(c) – Band-Edge Compliance and Spurious Emissions	13
7.6.1 Section 15.247 (c) – Band-Edge Compliance	13
7.6.1.1 Test Methodology	13
7.6.1.2 Test Results	13
7.6.2 Section 15.247(c) – Conducted Spurious Emissions	14
7.6.2.1 Test Methodology	14
7.6.2.2 Test Results	14
7.6.3 Section 15.247(c) – Radiated Spurious Emissions	15
7.6.3.1 Test Methodology	15
7.6.3.2 Duty Cycle Correction	15
7.6.3.3 Test Results	15
7.6.3.4 Sample Calculation	15
7.7 Section 15.247(d) – Power Spectral Density	16
7.7.1 Test Methodology	16
7.7.2 Test Results	16
8.0 CONCLUSION	16

Additional Exhibits Included In Filing

Internal Photographs
External Photographs
Test Setup Photographs
Product Labeling
RF Exposure – MPE Calculations

Installation/Users Guide
Theory of Operation
BOM (Parts List)
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 Cellnet Water Endpoint (CWE) is a battery-powered radio transmitter operating in the 902-928 MHz unlicensed ISM band at 917.58MHz. It is designed to be connected to a variety of residential water meters and will periodically transmit water consumption information. This information is gathered by a Cellnet proprietary cellular network infrastructure.

There are two versions of the Cellnet Water Endpoint (CWE). The Pit version is designed for use in water meter pits installed at or below ground level. The Wall version, model Cellnet Water Endpoint 6075 Remote, is designed to be mounted on a wall in close proximity to the water meter. Documentation supplied with this report for the purpose of equipment authorization may make reference to both versions but the purpose of this report and the supporting documentation is to show compliance for the Wall unit only. The Pit unit is addressed in a separate report and filing.

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

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

1.2.2 Intended Use

It is designed to be connected to a variety of residential water meters and will periodically transmit water consumption information.

1.3 Test Methodology and Considerations

Not 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: 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

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:

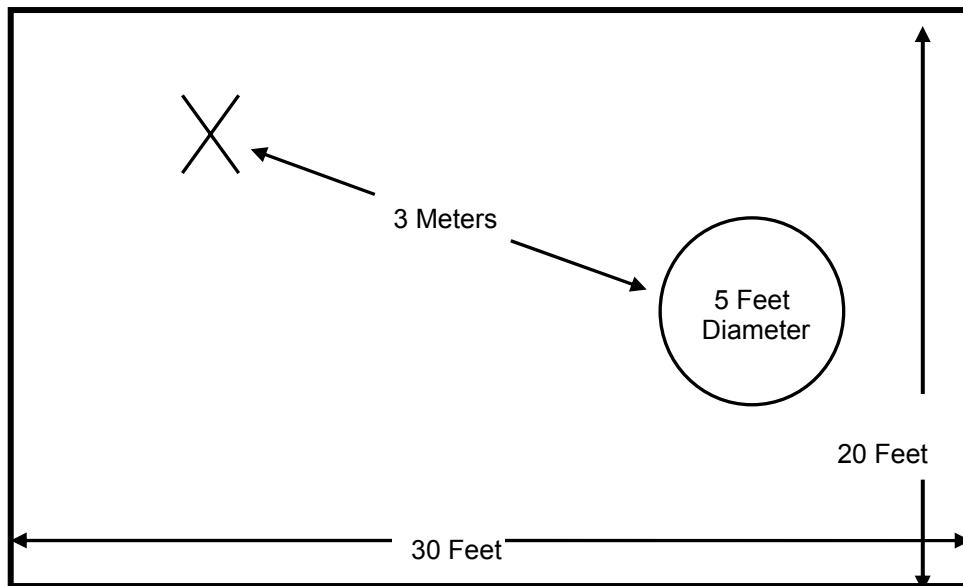


Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

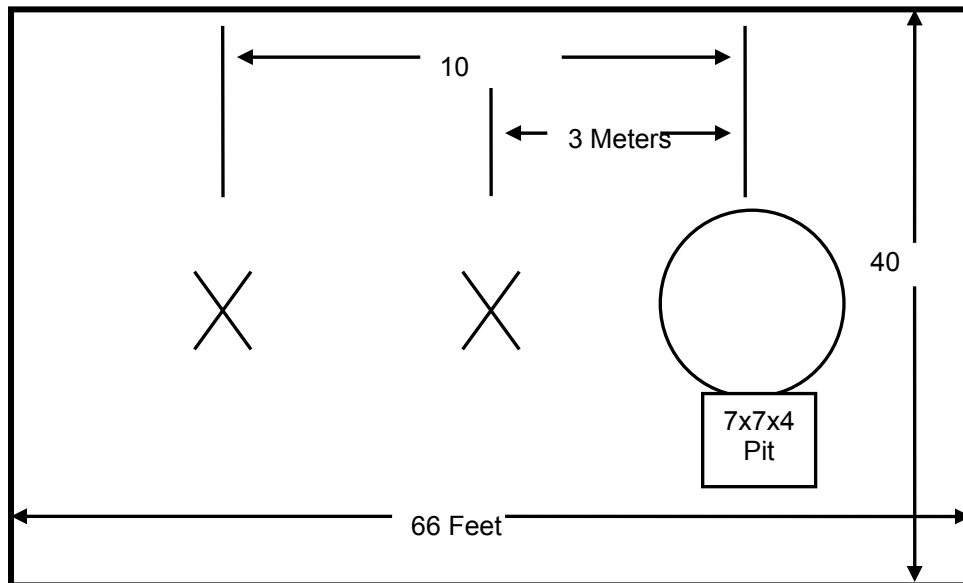


Figure 2.3-2: Open Area Test Site

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:

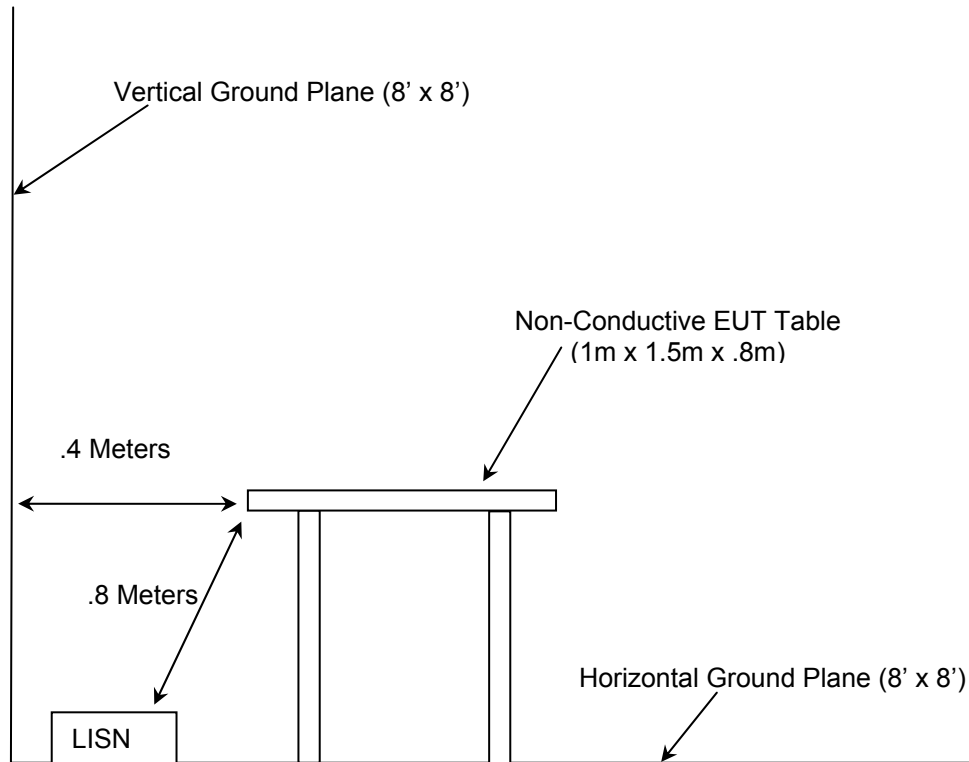


Figure 2.4-1: AC Mains Conducted EMI Site

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, 2005
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2005
- ❖ 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

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
<input checked="" type="checkbox"/> 25	Chase	Bi-Log Antenna	CBL6111	1043	5/30/07
<input checked="" type="checkbox"/> 22	Agilent	Pre-Amplifier	8449B	3008A00526	5/06/07
<input checked="" type="checkbox"/> 73	Agilent	Pre-Amplifier	8447D	272A05624	5/18/07
<input checked="" type="checkbox"/> 30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	5/12/07
<input checked="" type="checkbox"/> 105	Microwave Circuits	High Pass Filter	H1G810G1	2123-01 DC0225	9/13/06
<input checked="" type="checkbox"/> 283	Rohde & Schwarz	Spectrum Analyzer	FSP	100033	3/24/07
<input checked="" type="checkbox"/> 1	Rohde & Schwarz	Receiver Display	804.8932.52	833771/007	3/01/07
<input checked="" type="checkbox"/> 2	Rohde & Schwarz	ESMI Receiver	1032.5640.53	839587/003	3/01/07
<input checked="" type="checkbox"/> 290	Florida RF Labs	HF RF Cable	SMSE-200-72.0-SMRE	NA	5/08/07
<input checked="" type="checkbox"/> 291	Florida RF Labs	HF RF Cable	SMRE-200W-12.0-SMRE	NA	5/08/07
<input checked="" type="checkbox"/> 292	Florida RF Labs	HF RF Cable	SMR-280AW-480.0-SMR	NA	5/24/07
<input checked="" type="checkbox"/> 167	ACS	Chamber EMI Cable Set	RG6	167	1/7/07

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number	FCC ID
The EUT was tested as a stand alone device and no support equipment was utilized.					

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

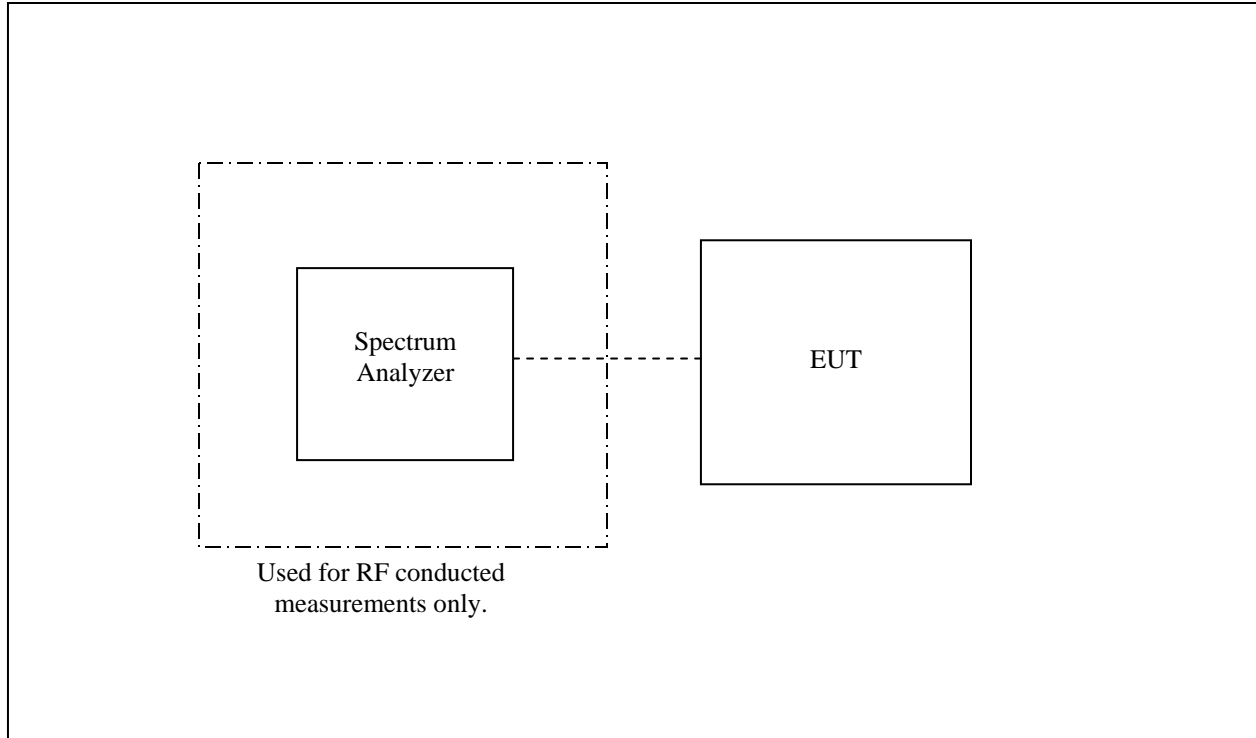


Figure 6-1: EUT Test Setup

Note: The EUT was modified with a temporary RF output at the antenna for test purposes. The temporary RF output was used and intended for RF conducted measurements only. The integral antenna was attached for radiated emissions measurements.

*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

The EUT employs an integral antenna that cannot be modified without damaging the device. The antenna type is loop, integral to the PWB, with a gain of 2.1dBi.

7.2 Power Line Conducted Emissions - FCC Section 15.207

7.2.1 Test Methodology

The Cellnet Water Endpoint 6075 Remote is battery powered therefore Power Line Conducted Emissions is not required.

7.3 Radiated Emissions - FCC Section 15.109(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 were made with the Spectrum Analyzer’s resolution bandwidth set to 120 KHz for measurements above 30MHz. Average measurements are taken with the RBW and VBW were set to 1MHz and 10 Hz respectively for measurements above 1000MHz.

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

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
<i>Spurious Emissions</i>										
31.88	-----	20.85	H	-13.46	-----	7.39	-----	40.0	-----	32.61
54.93	-----	21.03	V	-15.61	-----	5.42	-----	40.0	-----	34.58
90.25	-----	28.25	H	-14.07	-----	14.19	-----	43.5	-----	29.32
116.7	-----	21.25	V	-11.62	-----	9.63	-----	43.5	-----	33.87
191.31	-----	20.95	V	-8.10	-----	12.85	-----	43.5	-----	30.65
330.66	-----	21.25	H	-7.92	-----	13.33	-----	46.0	-----	32.67
492.44	-----	22.73	V	-6.23	-----	16.50	-----	46.0	-----	29.50
592	-----	28.54	H	-4.10	-----	24.44	-----	46.0	-----	21.56
686.22	-----	22.70	H	-0.45	-----	22.25	-----	46.0	-----	23.75
941.33	-----	22.37	V	1.39	-----	23.76	-----	46.0	-----	22.24

* Note: All emissions above 941.33 MHz were attenuated below the permissible limit.

7.4 6dB Bandwidth – FCC Section 15.247(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. 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]	Limit	Result
917.58	0.910	≥ 500 kHz	PASS

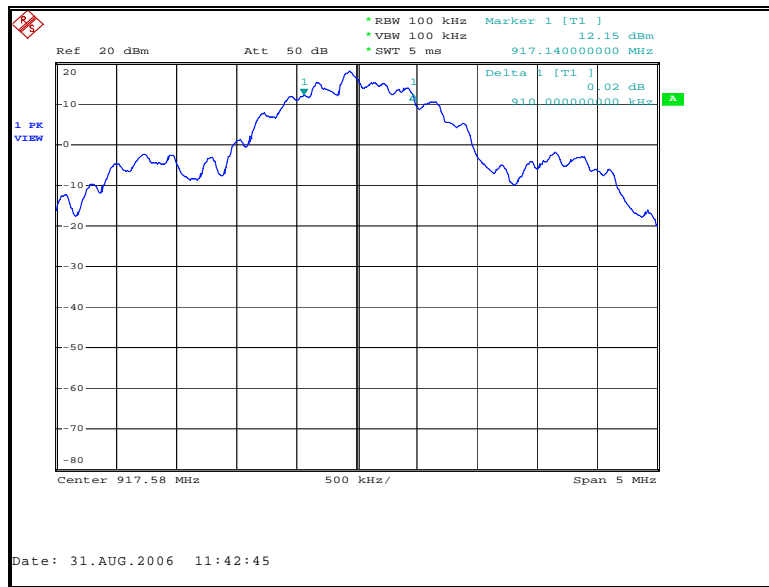


Figure 7.4.2-1: 6dB Bandwidth Plot

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

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 with the RBW>>EBW, 3MHz.

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)
917.58	22.34

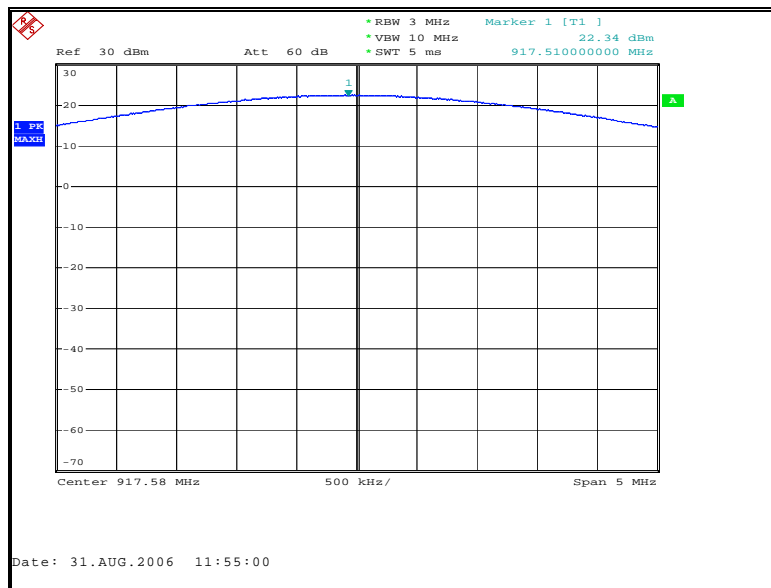


Figure 7.5.2-1: Output power

7.6 Band-Edge Compliance and Spurious Emissions - FCC Section 15.247(d)

7.6.1 Band-Edge Compliance of RF Emissions

7.6.1.1 Test Methodology

The EUT was investigated at the single operational frequency of 917.58MHz to determine band-edge compliance.

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.

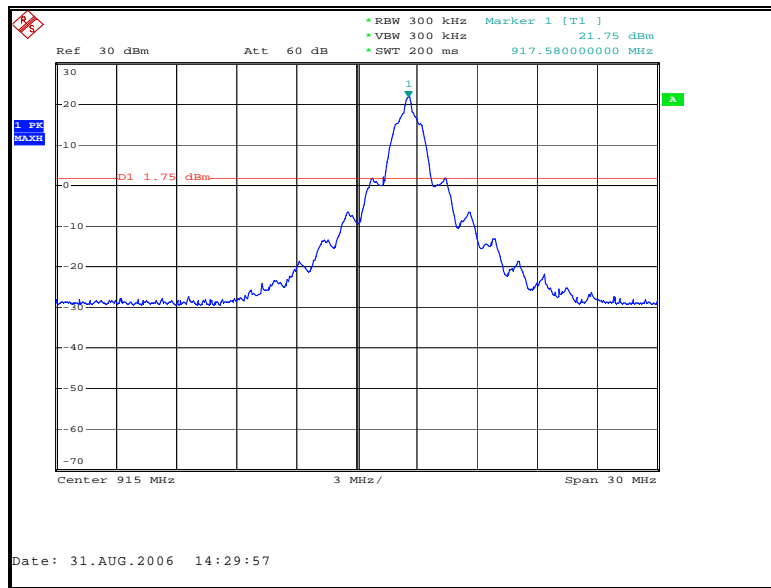


Figure 7.6.1.2-1: Band-edge

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.

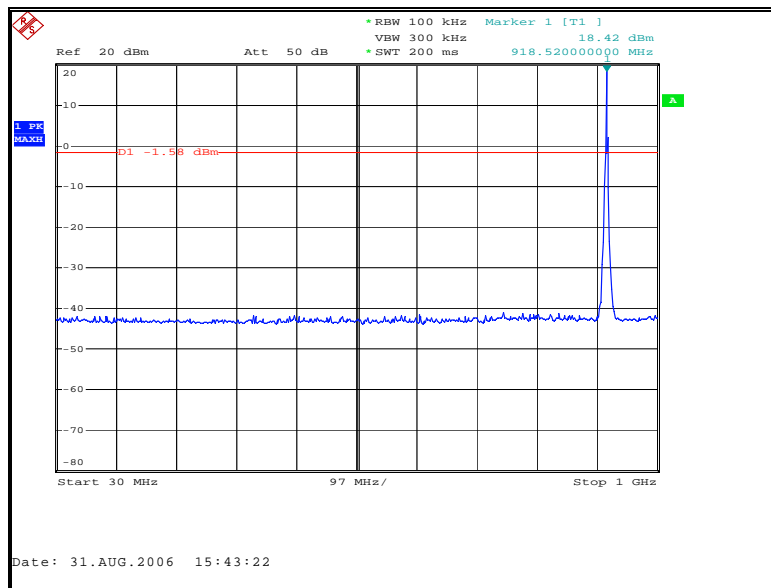


Figure 7.6.2.2-1: 30 MHz – 1 GHz

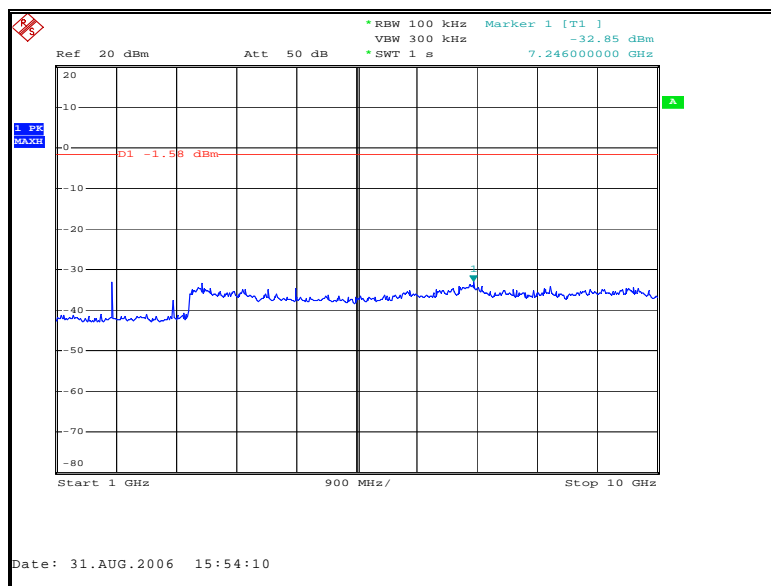


Figure 7.6.2.2-2: 1 GHz – 10 GHz

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

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.

7.6.3.2 Duty Cycle Correction

For average radiated measurements, the measured level was reduced by a factor 18.42dB to account for the duty cycle of the EUT. The packet transmissions length is 12ms. The duty cycle correction factor is determined using the formula: $20\log(0.12/100) = 18.42\text{dB}$.

A detailed analysis of the duty cycle timing is provided in the Theory of Operation provided with this report.

7.6.3.3 Test Results

Using the procedures set forth in the FCC KDB Publication No. 558074 “Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)”, radiated spurious emissions found in the band of 30MHz to 10GHz are reported in Table 7.6.3.3-1. 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.

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
Spurious Emissions										
2752.74	62.19	62.19	H	1.63	63.82	45.40	74.0	54.0	10.18	8.60
2752.74	65.47	65.47	V	1.43	66.90	48.49	74.0	54.0	7.10	5.51
3670.32	51.60	51.60	H	4.52	56.12	37.70	74.0	54.0	17.88	16.30
3670.32	51.32	51.32	V	4.52	55.84	37.42	74.0	54.0	18.16	16.58
4587.9	52.34	52.34	H	6.80	59.14	40.72	74.0	54.0	14.86	13.28
4587.9	53.84	53.84	V	6.92	60.76	42.34	74.0	54.0	13.24	11.66

Table 7.6.3.3-1: Radiated Spurious Emissions

7.6.3.4 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: $62.19 + 1.63 = 63.82\text{dBuV/m}$
 Margin: $74\text{dBuV/m} - 63.82\text{dBuV/m} = 10.18\text{dB}$

Example Calculation: Average

Corrected Level: $62.19 + 1.63 - 18.42 = 45.40\text{dBuV}$
 Margin: $54\text{dBuV} - 45.40\text{dBuV} = 8.60\text{dB}$

7.7 Peak Power Spectral Density- FCC Section 15.247(e)

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) which was set to 170ms for testing.

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]	Limit [dBm]	Result
917.58	6.28	8	PASS

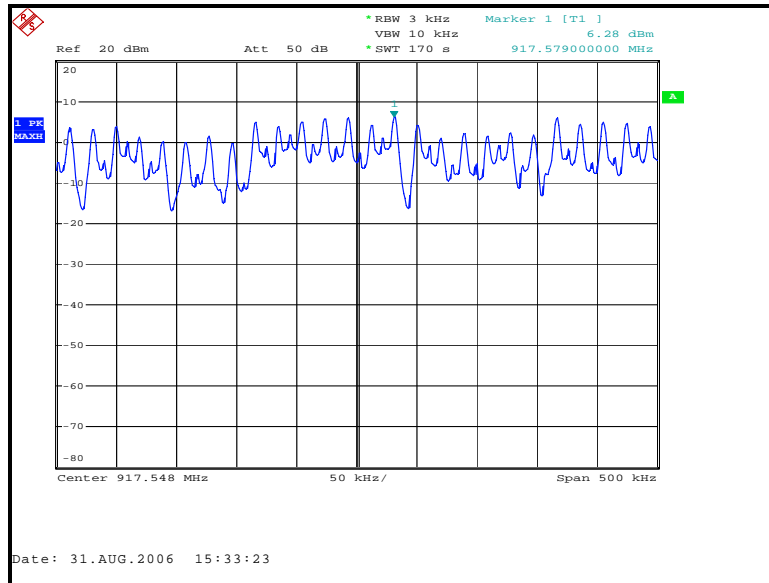


Figure 7.7.2-1: Power Spectral Density Plot

8.0 CONCLUSION

In the opinion of ACS, Inc. the Cellnet Water Endpoint 6075 Remote, manufactured by Cellnet Technology, Inc., does meet the requirements of FCC Part 15 subpart C.

END REPORT