Certification Test Report

FCC ID: MS8ESPH
IC: 4202A-ESPH

FCC Rule Part: 15.249
IC Radio Standards Specification: RSS-210

ACS Report Number: 09-390-15C

Applicant: Blue Tower Communications Ltd
Model: ESP-PIT

Test Begin Date: November 17, 2009
Test End Date: November 18, 2009

Report Issue Date: November 23, 2009

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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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

ESP is an integrated water meter and AMR device. It comprises of an electronic water meter register and radio and is battery powered. Water flow is transmitted to the register by a rotating magnet which is converted into an analogue voltage pulse. This pulse is converted into a count which represents a unit of consumption and displayed on its internal LCD display. This data is fed to the radio for onward transmission in data packets

The ESP-PIT AMR meter transmitter is used in pit installations only and operates on a single channel at 919.9 MHz.

Manufacturer Information:
Blue Tower Communications Limited
2-3 Springlakes Industrial Estate
Deadbrook Lane
Aldershot
Hants
GU12 4UH
United Kingdom

Test Sample Serial Numbers: ACS#1

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

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

1.3 Test Methodology and Considerations

The ESP-PIT utility meter transmitter is intended for meter pit installation below ground level, therefore testing was performed as typically installed in a meter pits described in sections 5.0 – 6.0. A 4'x4'x4' dirt filled wooden test fixture (box) was used to simulate typically in-ground in use.
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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/IEC 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: 4175A
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:

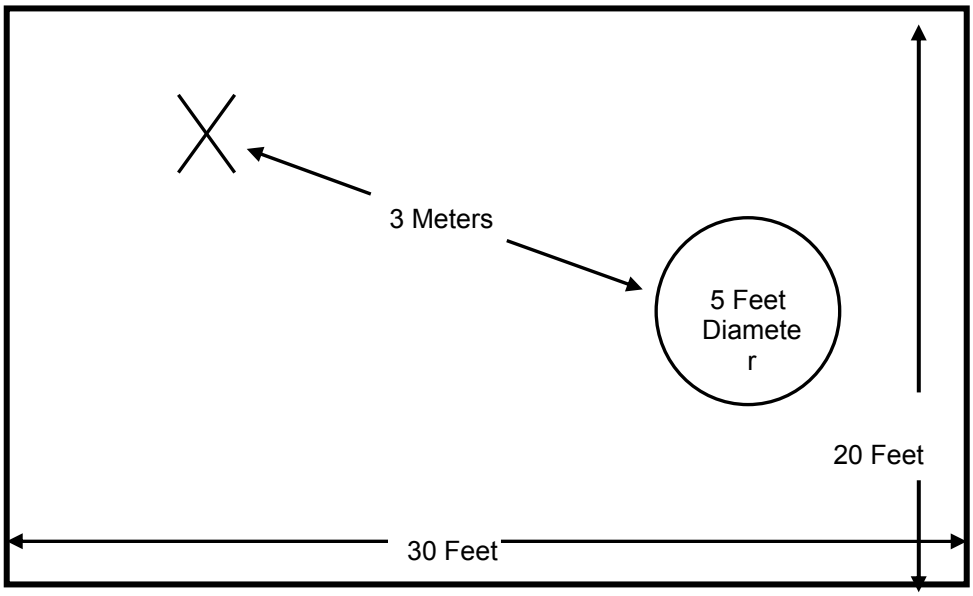

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

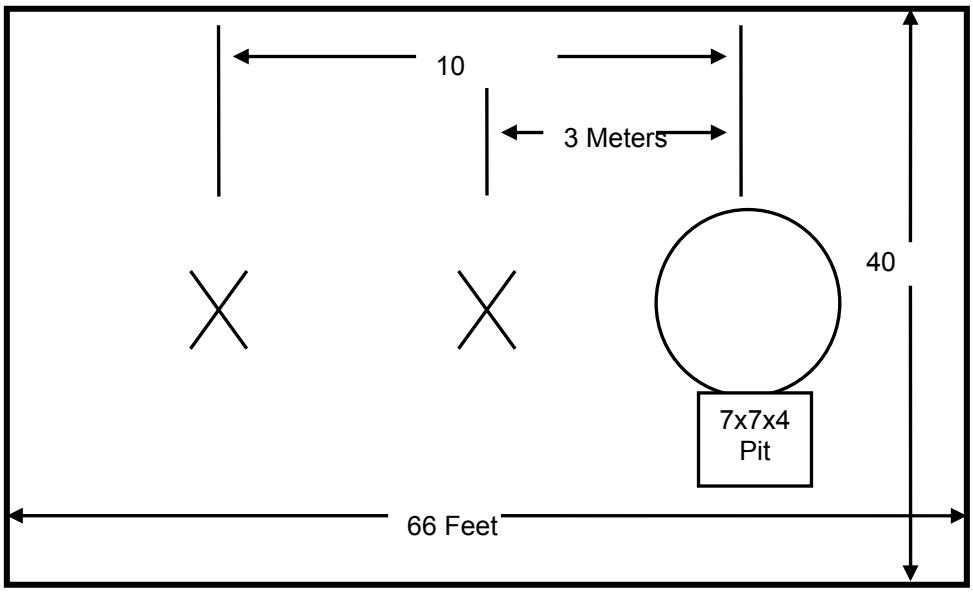

Figure 2.3-2: Open Area Test Site

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:

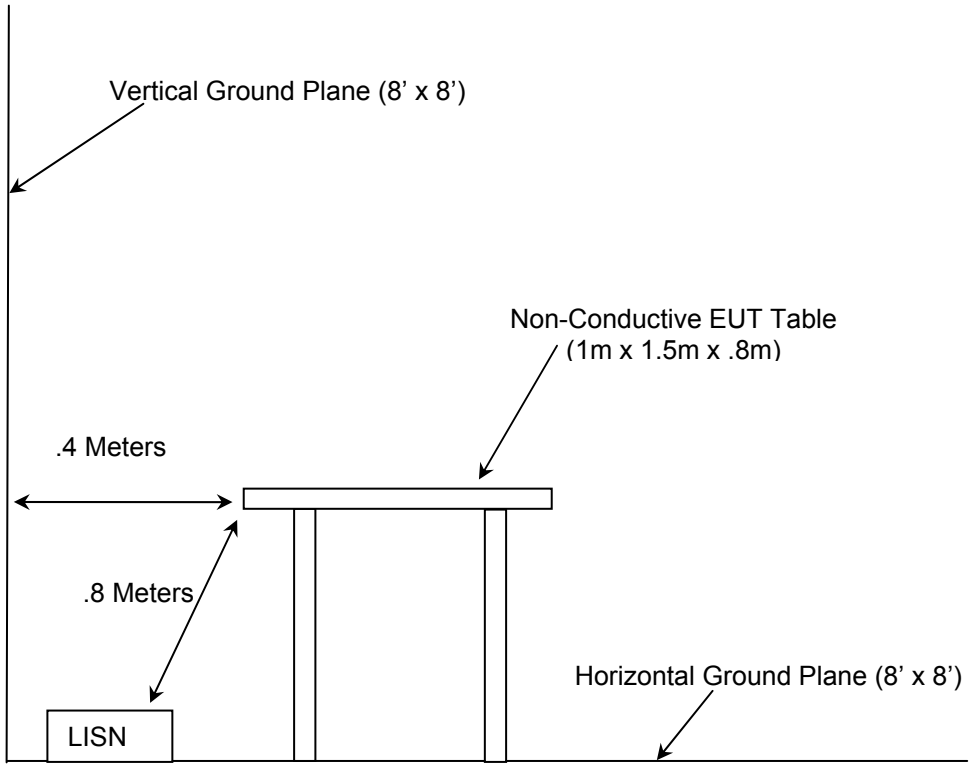

Figure 2.4-1: AC Mains Conducted EMI Site

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, 2009
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2009
- FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems, March 30, 2000
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radio communication 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 Radio communication Equipment, Issue2, June 2007.

4.0 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

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	09-21-2010
2	Rohde & Schwarz	Spectrum Analyzers	ESMI-Receiver	839587/003	09-21-2010
22	Agilent	Amplifiers	8449B	3008A00526	09-21-2010
25	Chase	Antennas	CBL6111	1043	09-02-2010
30	Spectrum Technologies	Antennas	DRH-0118	970102	05-08-2010
40	EMCO	Antennas	3104	3211	01-22-2010
73	Agilent	Amplifiers	8447D	2727A05624	07-15-2010
167	ACS	Cable Set	Chamber EMI Cable Set	167	02-06-2010 (See Note1)
193	ACS	Cable Set	OATS cable Set	193	01-05-2010 (See Note1)
211	Eagle	Filters	C7RFM3NFNM	HLC-700	01-05-2010 (See Note1)
213	TEC	Amplifiers	PA 102	44927	12-22-2009
277	Emco	Antennas	93146	9904-5199	09-18-2010
283	Rohde & Schwarz	Spectrum Analyzers	FSP40	1000033	09-21-2010
321	Hewlett Packard	Amplifiers	HPC 8447D	1937A02809	10-06-2010
337	Microwave Circuits	Filters	H1G513G1	282706	07-17-2010 (See Note1)
338	Hewlett Packard	Amplifiers	8449B	3008A01111	10-16-2010
343	Florida RF Cables	Cables	SMRE-200W-12.0-SMRE	N/A	05-04-2010 (See Note1)
430	RF Cables	Cables	SMS-290AW-480-SMS	N/A	05-04-2010 (See Note1)
RE15	Agilent	Analyzers	E7405	MY42000128	09-03-2010

Note1: Items characterized on an annual cycle. The date shown indicates the next characterization due date.
Note2: Items verified on an annual cycle. The date shown indicates the next verification due date.

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Meter Pit (Well)	Midwest Meter	18" Box Pipe Lot # 037S07035D	N/A
2	Collar	Tyler (Canada)	8150-R-18	N/A
3	Collar Lid	Tyler (Canada)	670610148593 Rev B	N/A

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAMS

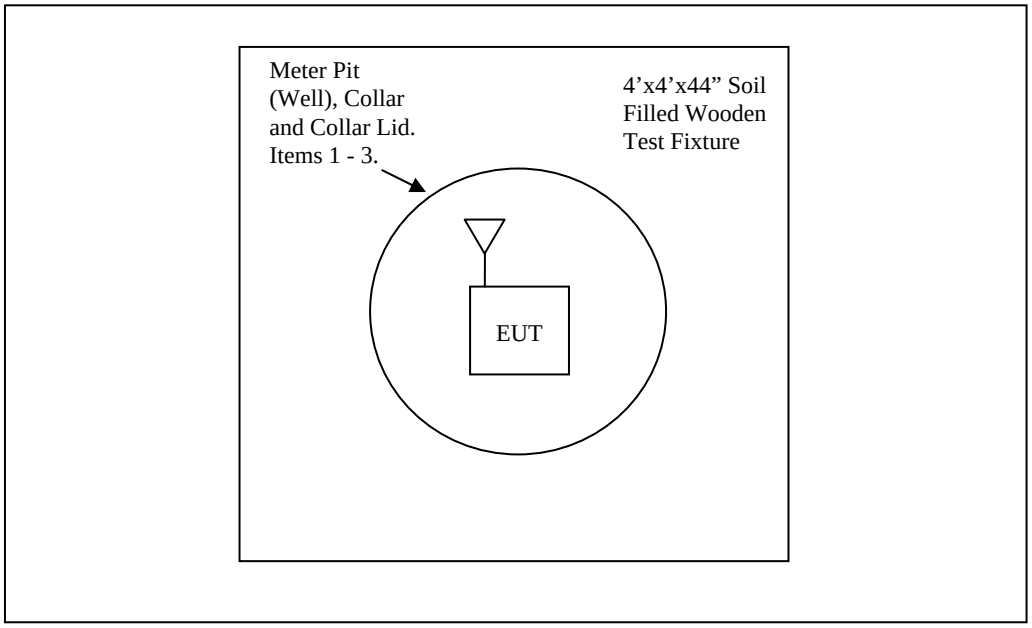

Figure 6-1: EUT Test Setup

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 utilizes an integral non-detachable Johanson Technologies chip antenna, Part no 0915AT43A0026, frequency range 902 - 928 MHz. The typical peak gain is specified as -1.0 dBi.

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

The EUT is powered by an internal battery and is therefore not designed to be connected to the public utility (AC) power line. No Power line conducted emissions testing was performed.

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

7.3.1 Measurement Procedure

Radiated emissions tests were performed over the frequency range of 30MHz to 1 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. For frequencies below 1000 MHz a Quasi-peak detector was enabled and measurements were taken with the Spectrum Analyzer's resolution and video bandwidths set to 120 KHz and 300kHz respectively. For frequencies above 1000MHz, measurements were made using an average detector and peak detector with the Spectrum Analyzer's resolution and video bandwidths set to 1 MHz and 3MHz respectively.

7.3.2 Measurement Results

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

Table 7.3.2-1: Unintentional Radiated 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
30	---------	18.05	V	-8.00	---------	10.05	--------	40.0	---------	29.95
95.5	---------	34.05	H	-15.22	---------	18.83	--------	43.5	---------	24.67
341.4	---------	18.92	H	-8.93	---------	9.99	--------	46.0	---------	36.01
470.8	---------	20.41	H	-5.69	---------	14.72	--------	46.0	---------	31.28
701.5	---------	20.49	H	-1.22	---------	19.28	--------	46.0	---------	26.73
953.6	---------	20.26	H	3.11	---------	23.37	--------	46.0	---------	22.63

* Note: All emissions above 953.6 MHz were not detected above the noise floor of the measurement equipment and therefore attenuated below the permissible limit.

7.4 Occupied Bandwidth – FCC: Section 15.215 IC: RSS-GEN 4.6.1

7.4.1 Measurement Procedure

The spectrum analyzer span was set to 2 to 3 times the estimated bandwidth of the emission. The RBW was to ≥ 1% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. Bandwidth is determined at the points 20 dB down from the modulated carrier. The 99% bandwidth was also measured and reported in Section 7.4.2 below.

7.4.2 Measurement Results

The 20 dB bandwidth was determined to be 558 kHz. The frequency band designated under Part 15.249 is 902 - 928MHz, therefore the 20dB bandwidth is contained within the frequency band designated under this rule part. Results are shown below in Table 7.4.2-1 and Figures 7.4.2-1 through 7.4.2-2.

Table 7.4.2-1 – Occupied Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)	99% OBW (kHz)
919.9	558	504.4

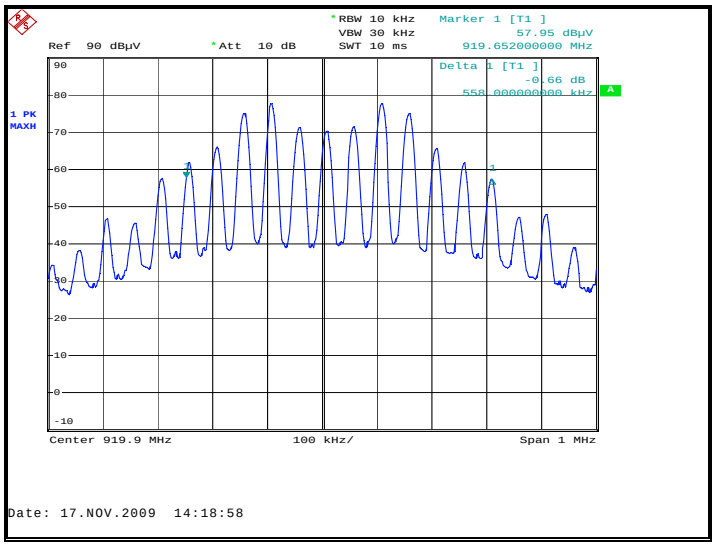

Figure 7.4.2-1: 20dB Bandwidth

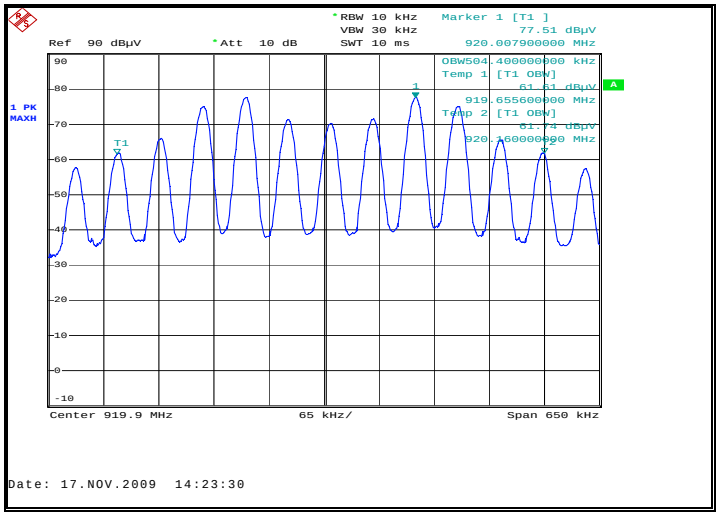

Figure 7.4.2-2: 99% Occupied Bandwidth

7.5 Fundamental Field Strength – FCC: Section 15.249(a) IC: RSS-210 A2.9(a)

7.5.1 Measurement Procedure

The fundamental field strength was evaluated at the single operating frequency of 919.9 MHz in the 902MHz to 928MHz frequency range.

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. Quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz.

7.5.2 Measurement Results

Results are shown below in table 7.5.2-1 below:

Table 7.5.2-1: Fundamental Field Strength

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
919.9	---------	85.49	H	1.90	---------	87.39	--------	94.0	---------	6.59
919.9	---------	82.75	V	1.90	---------	84.65	--------	94.0	---------	9.33

7.6 Band-Edge Compliance and Spurious Emissions – FCC: Section 15.249 IC: RSS-210 A2.9

7.6.1 Band-Edge Compliance – FCC: Section 15.249(d) IC: RSS-210 A2.9(b)

7.6.1.1 Measurement Procedure

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

Compliance for the lower and upper band-edge was determined using the radiated mark-delta method as outlined in FCC DA 00-705. The radiated field strength of the fundamental emission was first determined and then the mark-delta method was used to determine the field strength of the band-edge emissions as compared to the emission limits of 15.209. The marker-delta method was applied to the upper band-edge and based on symmetry the lower band-edge is also compliant.

7.6.1.2 Measurement Results

Table 7.6.1.2-1: Band-edge Marker Delta Method

Frequency (MHz)	Uncorrected Level (dBuV)		Antenna Polarity	Correction Factors	Fundamental Level (dBuV/m)		Marker-Delta	Band-Edge Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
919.9		85.49	H	1.90	---------	87.39	60.22	-------	27.17	---------	46	-------	18.83

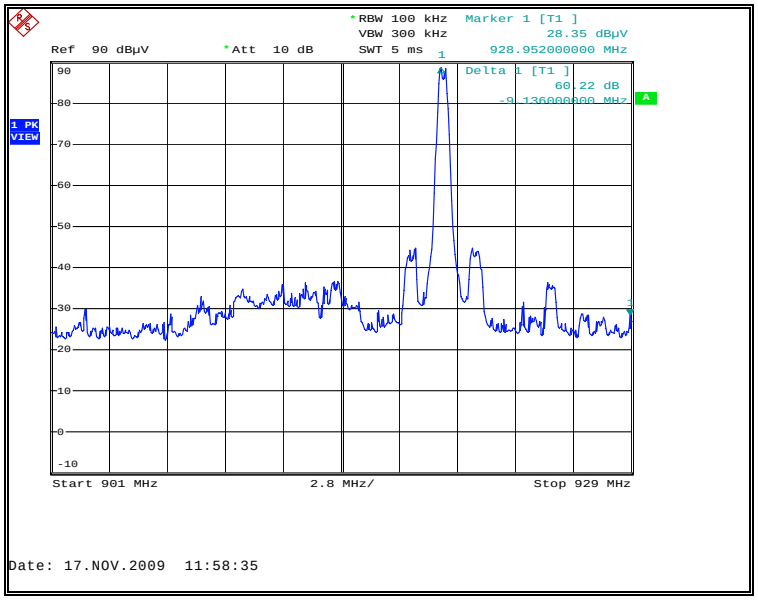

Figure 7.6.1.2-1 Band-edge

7.6.2 Radiated Spurious Emissions – FCC: Section 15.249(a), (c); IC:RSS-210 A2.9(a)

7.6.2.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10 GHz, 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 and average measurements were made using an RBW of 1 MHz and a VBW of 3MHz.

7.6.2.2 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in Table 7.6.2.3-1.

Table 7.6.2.3-1: 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
1839.8	47.60	40.22	H	-2.25	45.35	37.97	74.0	54.0	28.65	16.03
1839.8	50.95	44.94	V	-2.25	48.70	42.69	74.0	54.0	25.30	11.31

***** *The magnitude of all emissions not reported were below the noise floor of the measurement system.*

7.6.2.4 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: 47.6 – 2.25 = 45.35dBuV
Margin: 74dBuV – 45.35dBuV = 28.65dB

AVERAGE:
Corrected Level: 40.22 – 2.25 = 37.97dBuV
Margin: 54dBuV – 37.97dBuV = 16.03dB

8.0 CONCLUSION

In the opinion of ACS, Inc. the ESP-PIT, manufactured by Blue Tower Communication Limited, meets all the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT