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Class II Permissive Change
Wireless Test Report

FCC ID: VSF26593
IC: 7980A-26593

FCC Rule Part: 15.247
ISED Canada Radio Standards Specification: RSS-247

ACS Report Number: 16-3105.W04.1A

Manufacturer: Juniper Systems, Inc.
Model: MS2 MICRO

Test Begin Date: December 6, 2016
Test End Date: December 18, 2016

Report Issue Date: December 21, 2016

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 14 pages

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1 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 for Class II Permissive Change and ISED Canada's Radio Standards Specification RSS-247 Certification for Class 4 Permissive Change. The purpose for the change is to add a new antenna in the host and integration into portable host.

1.2 Product description

The MS2 Micro is a RFID transceiver operating within the frequency range 917.5 MHz – 922.5 MHz.

The host is an MS2GR and MS2GCR. The hosts are ultra-rugged handheld computers that are used for field data collection. They measure 5.4" x 8.48" x 1.36". They are constructed of a magnesium alloy case front and a plastic case back with easy to grip, impact absorbing bumper. They are powered by a lithium-ion rechargeable battery and may be charged and operated from 12 volt external power. The display is a 7 inch touchscreen. The processor is a Quad-core Intel Atom Z3745 and uses 4 GB RAM, up to 128GB GB flash storage. The operating system is Microsoft Windows 10. The I/O ports include a USB port and a 3.5 mm audio jack with speaker/microphone or stereo output. Wireless data connectivity is provided by Bluetooth and 802.11b/g radios.

The handheld integrates several features such as RFID reader (FCC ID: VSF26593), Bluetooth/802.11 a/b/g/n (FCC ID: VSFMS2), cellular radio (FCC ID: VSF25271), GNSS (optional), camera (optional), and barcode scanner (optional).

All radios can transmit simultaneously therefore the MS2GR and MS2GCR hosts have been evaluated for radiated inter-modulation products for all combinations of simultaneous transmission and found to be in compliance.

Technical Information:

Detail	Description
Frequency Range	917.5 MHz – 922.5 MHz
Number of Channels	50
Modulation Format	PR-ASK
Number of Inputs/Outputs	1 Input / 1 Output
Operating Voltage	120VAC and 12Vdc
Antenna Type / Gain	Patch Antenna / 4.5 dBi

Manufacturer Information:
Juniper Systems, Inc.
1132 West 1700 North
Logan, UT 84321

EUT Serial Numbers: MS2P2064

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

1.3 Test Methodology and Considerations

Preliminary measurements were collected for the EUT set in three orthogonal orientations. The measurements reported herein correspond to the worst case orientation with respect to the emission limit which was the X-Plane.

The EUT operates from internal batteries but can utilize an external power supply for battery charging therefore AC power conducted emissions measurements were performed.

The purpose for the change is to add a new antenna in the host, therefore the evaluation was limited to radiated emissions and power line conducted emissions testing only.

2 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC and Innovation, Science and Economic Development (ISED) Canada.

FCC Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm 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 short #6 copper wire. 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 turntable. 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.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase 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:

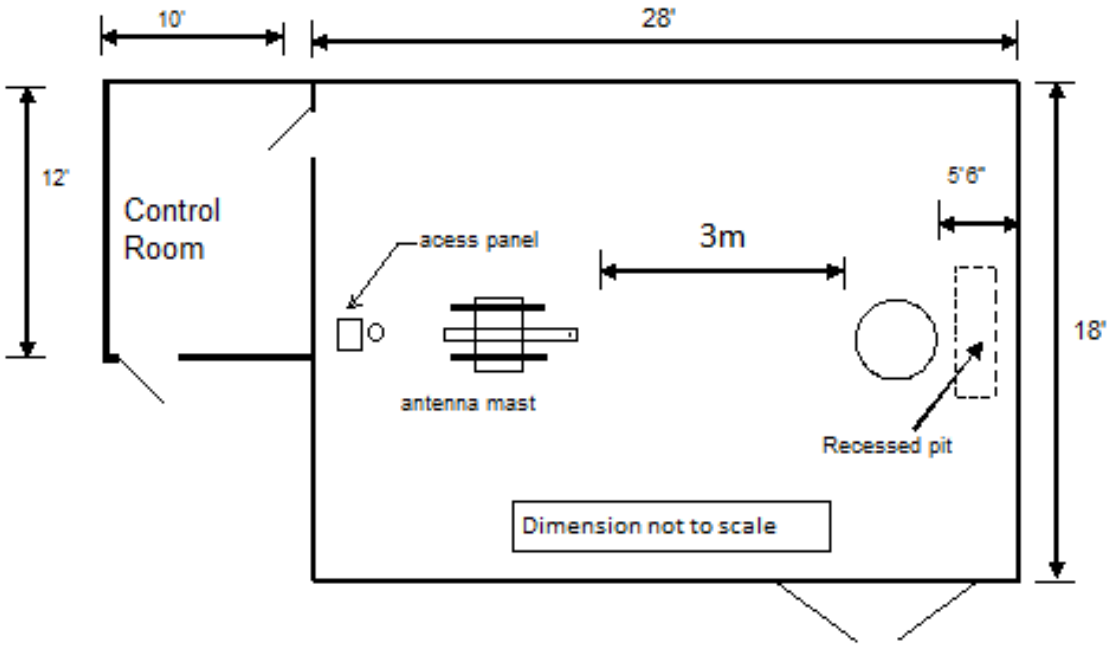

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 10' sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6" to an 8' X 8' aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.4-1:

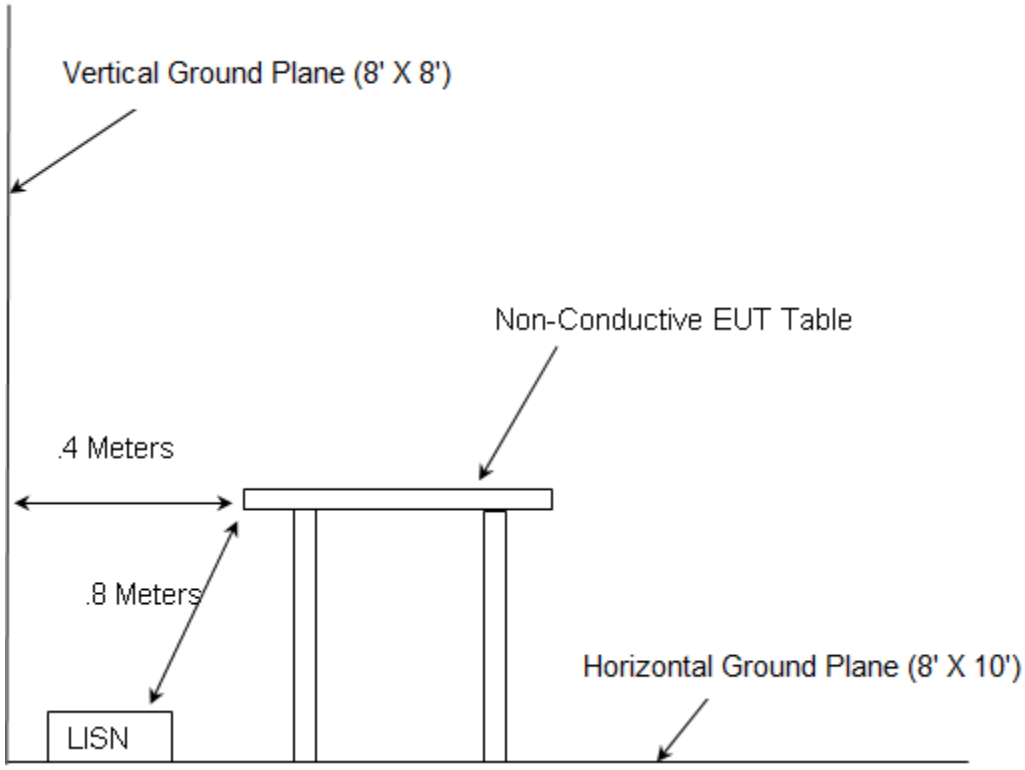

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9kHz to 40 GHz.
- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2016
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- FCC KDB 558074 D01 DTS Meas Guidance v03r05 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 8, 2016
- ISED Canada Radio Standards Specification: RSS-247, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Nov 2014

4 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

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	EMCO	93146	Antennas	9904-5199	9/12/2016	9/12/2018
626	EMCO	3110B	Antennas	9411-1945	2/29/2016	2/28/2017
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/8/2016	1/8/2017
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	6/29/2015	12/29/2016
3011	Rohde & Schwarz	ENV216	LISN	3011	7/10/2015	1/10/2017
3012	Rohde & Schwarz	EMC32-EB	Software	100731	8/2/2016	2/2/2017
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
3029	Micro-Tronics	HPM50108	Filter	134	12/21/2015	12/21/2016
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	12/22/2015	12/22/2016
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	12/22/2015	12/22/2016
3051	Mountain View Cable	BMS-RG400-264.0-BMS	Cables	3051	12/30/2015	12/30/2016
3055	Rohde & Schwarz	3005	Cables	3055	12/30/2015	12/30/2016

NCR = No Calibration Required
DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.
Asset 3002: Firmware Version: ESU40 is 4.73 SP4
Asset 3012: Software Version: EMC32-B is 9.15

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	EUT	Juniper Systems	MS2	MS2P2064
2	Power Supply	PHIHONG	PSAA20R-120	P51904232A1

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power	145cm	No	1 to 2

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

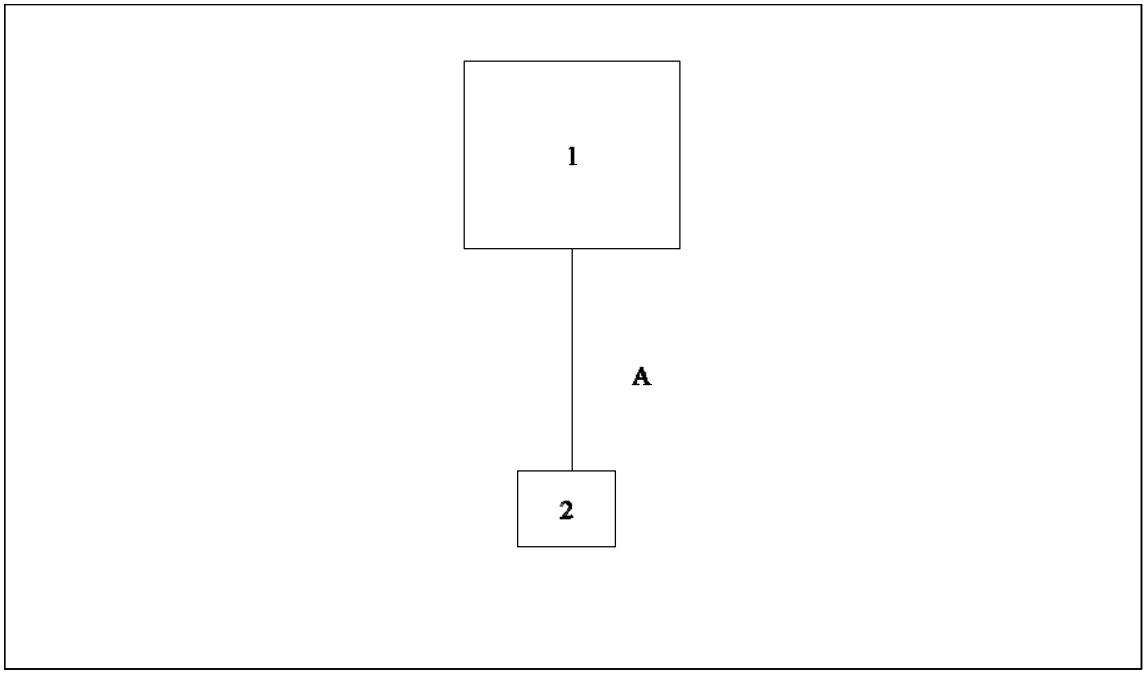

Figure 6-1: Test Setup Block Diagram

7 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 U.FL antenna connector, therefore satisfying the requirements of Section 15.203.

7.2 Power Line Conducted Emissions – FCC 15.207, ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

ANSI C63.10-2013 section 6 was the guiding document 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 Measurement Results

Table 7.2.2-1: Power Line Conducted Emissions – Line 1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.174000	50.69	---	64.68	13.99	2000.0	9.000	L1	OFF	9.5
0.174000	---	34.83	54.66	19.83	2000.0	9.000	L1	OFF	9.5
0.182000	50.75	---	64.28	13.53	2000.0	9.000	L1	OFF	9.5
0.182000	---	36.15	54.26	18.11	2000.0	9.000	L1	OFF	9.5
0.232000	---	28.50	52.15	23.65	2000.0	9.000	L1	OFF	9.6
0.232000	39.72	---	62.19	22.47	2000.0	9.000	L1	OFF	9.6
0.276000	---	26.76	50.69	23.93	2000.0	9.000	L1	OFF	9.5
0.276000	36.29	---	60.73	24.44	2000.0	9.000	L1	OFF	9.5
0.348000	---	24.30	48.81	24.51	2000.0	9.000	L1	OFF	9.6
0.348000	31.95	---	58.84	26.89	2000.0	9.000	L1	OFF	9.6
1.264000	---	21.69	46.00	24.31	2000.0	9.000	L1	OFF	9.6
1.264000	28.56	---	56.00	27.44	2000.0	9.000	L1	OFF	9.6
1.968000	---	22.69	46.00	23.31	2000.0	9.000	L1	OFF	9.7
1.968000	29.43	---	56.00	26.57	2000.0	9.000	L1	OFF	9.7
3.608000	---	23.67	46.00	22.33	2000.0	9.000	L1	OFF	9.7
3.608000	30.51	---	56.00	25.49	2000.0	9.000	L1	OFF	9.7
4.012000	---	25.70	46.00	20.30	2000.0	9.000	L1	OFF	9.7
4.012000	33.04	---	56.00	22.96	2000.0	9.000	L1	OFF	9.7
6.818000	---	24.71	50.00	25.29	2000.0	9.000	L1	OFF	9.8
6.818000	29.79	---	60.00	30.21	2000.0	9.000	L1	OFF	9.8

Table 7.2.2-2: Power Line Conducted Emissions – Neutral

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.182000	---	35.50	54.26	18.76	2000.0	9.000	N	OFF	9.7
0.182000	50.02	---	64.28	14.26	2000.0	9.000	N	OFF	9.7
0.190000	---	33.63	53.88	20.25	2000.0	9.000	N	OFF	9.7
0.190000	48.15	---	63.90	15.75	2000.0	9.000	N	OFF	9.7
0.232000	---	27.85	52.15	24.30	2000.0	9.000	N	OFF	9.7
0.232000	39.23	---	62.19	22.96	2000.0	9.000	N	OFF	9.7
0.308000	---	26.43	49.79	23.36	2000.0	9.000	N	OFF	9.7
0.308000	37.36	---	59.83	22.47	2000.0	9.000	N	OFF	9.7
0.536000	---	18.90	46.00	27.10	2000.0	9.000	N	OFF	9.8
0.536000	32.45	---	56.00	23.55	2000.0	9.000	N	OFF	9.8
0.892000	---	19.31	46.00	26.69	2000.0	9.000	N	OFF	9.8
0.892000	32.26	---	56.00	23.74	2000.0	9.000	N	OFF	9.8
1.360000	---	18.20	46.00	27.80	2000.0	9.000	N	OFF	9.8
1.360000	30.94	---	56.00	25.06	2000.0	9.000	N	OFF	9.8
3.644000	---	22.03	46.00	23.97	2000.0	9.000	N	OFF	9.9
3.644000	29.70	---	56.00	26.30	2000.0	9.000	N	OFF	9.9
3.920000	---	24.49	46.00	21.51	2000.0	9.000	N	OFF	9.9
3.920000	32.29	---	56.00	23.71	2000.0	9.000	N	OFF	9.9
22.866000	---	22.46	50.00	27.54	2000.0	9.000	N	OFF	10.5
22.866000	30.02	---	60.00	29.98	2000.0	9.000	N	OFF	10.5

7.2.3 Radiated Spurious Emissions - FCC 15.205, 15.209; ISED Canada RSS-247, RSS-Gen 8.9/8.10

7.2.3.1 Measurement Procedure

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 and average measurements were made with RBW and VBW of 1 MHz and 3MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

7.2.3.2 Duty Cycle Correction

The Duty Cycle Correction was not required.

7.2.3.3 Measurement Results

Table 7.5.3.3-1: Radiated Spurious 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
Low Channel										
2752.5	38.10	24.50	H	0.30	38.40	24.80	74.0	54.0	35.6	29.2
2752.5	39.40	24.60	V	0.30	39.70	24.90	74.0	54.0	34.3	29.1
3670	39.70	27.00	H	4.00	43.70	31.00	74.0	54.0	30.3	23.0
3670	40.30	29.30	V	4.00	44.30	33.30	74.0	54.0	29.7	20.7
4587.5	50.70	44.60	H	6.31	57.01	50.91	74.0	54.0	17.0	3.1
4587.5	53.40	47.50	V	6.31	59.71	53.81	74.0	54.0	14.3	0.2
7340	39.10	29.40	H	9.35	48.45	38.75	74.0	54.0	25.6	15.3
7340	40.10	31.50	V	9.35	49.45	40.85	74.0	54.0	24.6	13.2
High Channel										
2767.5	42.70	33.10	H	0.37	43.07	33.47	74.0	54.0	30.9	20.5
2767.5	45.60	37.80	V	0.37	45.97	38.17	74.0	54.0	28.0	15.8
3690	40.10	28.30	H	4.07	44.17	32.37	74.0	54.0	29.8	21.6
3690	42.00	32.70	V	4.07	46.07	36.77	74.0	54.0	27.9	17.2
4612.5	44.50	35.50	H	6.32	50.82	41.82	74.0	54.0	23.2	12.2
4612.5	48.60	40.90	V	6.32	54.92	47.22	74.0	54.0	19.1	6.8
7380	37.50	28.70	H	9.49	46.99	38.19	74.0	54.0	27.0	15.8
7380	39.60	31.20	V	9.49	49.09	40.69	74.0	54.0	24.9	13.3

Note: All emissions related to the transmitter were attenuated below the noise floor of the measurement instrumentation.

7.2.3.4 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: 42.70 + 0.37 = 43.07dBuV/m
Margin: 74dBuV/m – 43.07dBuV/m = 30.9dB

Example Calculation: Average

Corrected Level: 33.10 + 0.37 - 0 = 33.47dBuV/m
Margin: 54dBuV – 33.47dBuV = 20.5dBuV/m

8 CONCLUSION

In the opinion of ACS, Inc. the MS2 MICRO, manufactured by Juniper Systems, Inc. meets the requirements of FCC Part 15 subpart C Class II Permissive Change and ISED Canada's Class 4 Permissive Change for Radio Standards Specification RSS-247.

END REPORT