Excellence in Compliance Testing

Certification Test Report

FCC ID: VSF23545
IC: 7980A-23545

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

ACS Report Number: 13-2127.W04.1A

Responsible Party: Juniper Systems, Inc.
Model: TiWi-R2

Test Begin Date: **September 4, 2013**
Test End Date: **September 24, 2013**

Report Issue Date: October 3, 2013

ACCREDITED TESTING

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

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

Project Manager:

Thierry Jean-Charles
EMC Engineer
Advanced Compliance Solutions, Inc.

Reviewed by:

Kirby Munroe
Director, Wireless Certifications
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This report contains 16 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 and Industry Canada's Radio Standards Specification RSS-210 for a class II permissive change.

The purpose of the Class II Permissive Change is to add a new antenna type and co-location with the model PH8-P when integrated in the model Archer2 (Project Pulaski) host configuration.

1.2 Manufacturer Information

Juniper Systems, Inc.
1132 W 1700 N
Logan, UT 84321

1.3 Product Description

The model TiWi-R2 is an 802.11b/g/n 1x1 with Bluetooth 2.1 wireless transceiver module. The test report documents compliance when the unit is integrated in model Archer2 host system consisting of a handheld personal data terminal. The EUT may be co-located with a GSM/GPRS/UMTS/HSPA module in the Archer2 host configuration.

Table 1.3-1: Bluetooth Radio Properties

Mode of Operation	Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)	Data Rates Supported (kbps)
GFSK	2402 - 2480	79	1000	1000
π/4-DQPSK	2402 - 2480	79	1000	2000
8DPSK	2402 - 2480	79	1000	3000

Model Number: TiWi-R2

Test Sample Serial Number(s): N/A

Test Sample Condition: The samples were in good conditions with no observable physical damages.

Table 1.3-2: Co-located radios

Model	FCC ID	IC	Grantee or Responsible Party	Radio Type	Frequency Range (MHz)
TiWi-R2	VSF23545	7980A-23545	Juniper Systems, Inc.	IEEE 802.11 b/g/n	2412 - 2462
PH8-P	VSF23795	7980A-23795	Juniper Systems, Inc.	GSM/GPRS/ UMTS/HSPA Module	824.2 -848.8 826.4 – 846.6 1850.2 – 1909.8 1852.4 – 1907.6

Note: There is no co-transmission for the 802.11b\g\n and Bluetooth 2.1 radios.

1.4 Test Methodology and Considerations

The EUT was tested for radiated emissions for the Bluetooth radio for all available modulations when integrated in the model Archer2 (Pulaski) host configuration.

The radiated emissions evaluations were conducted up to the 10th harmonic for all available modulations. Preliminary measurements were collected for the EUT set in three orthogonal orientations. The measurements reported herein correspond to the orientation leading to the highest emissions relative to the limits.

Table 1.4-1: Bluetooth Radio Test configuration

Mode of Operations	Frequency (MHz)	Data Rate (kbps)
GFSK	2402	1000
	2441	1000
	2480	1000
π/4 DQPSK	2402	2000
	2441	2000
	2480	2000
8 DPSK	2402	3000
	2441	3000
	2480	3000

The EUT was also evaluated for inter-modulation products when transmitting at the same time with co-located GSM/GPRS/UMTS/HSPA module. All inter-modulation products were found compliant to the limits of FCC Section 15.209 and Industry Canada RSS-GEN.

2 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 475089
Industry Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ACLASS program and has been issued certificate number AT-1533 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.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl floor.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flushed with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1050 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

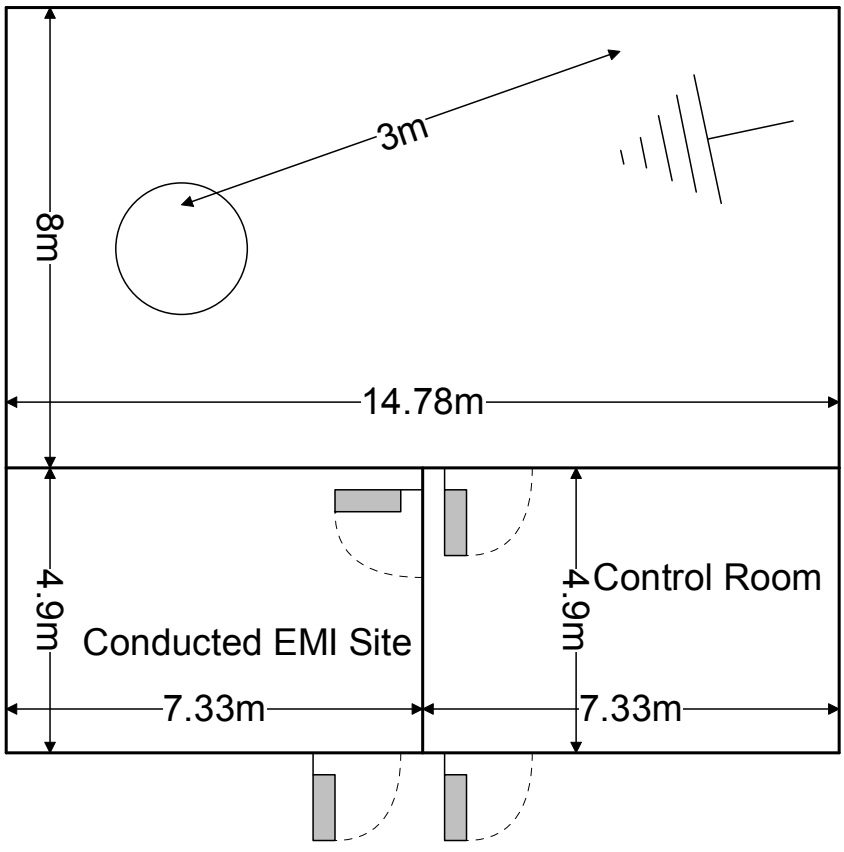


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. As per ANSI C63.4 2003 requirements, the data were taken using two LISNs; a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825, which are installed as shown in Photograph 3. For 220 V, 50 Hz, a Polarad LISN (S/N 879341/048) is used in conjunction with a 1 kVA, 50 Hz/220 V EDGAR variable frequency generator, Model 1001B, to filter conducted noise from the generator.

A diagram of the room is shown below in figure 2.3.2-1:

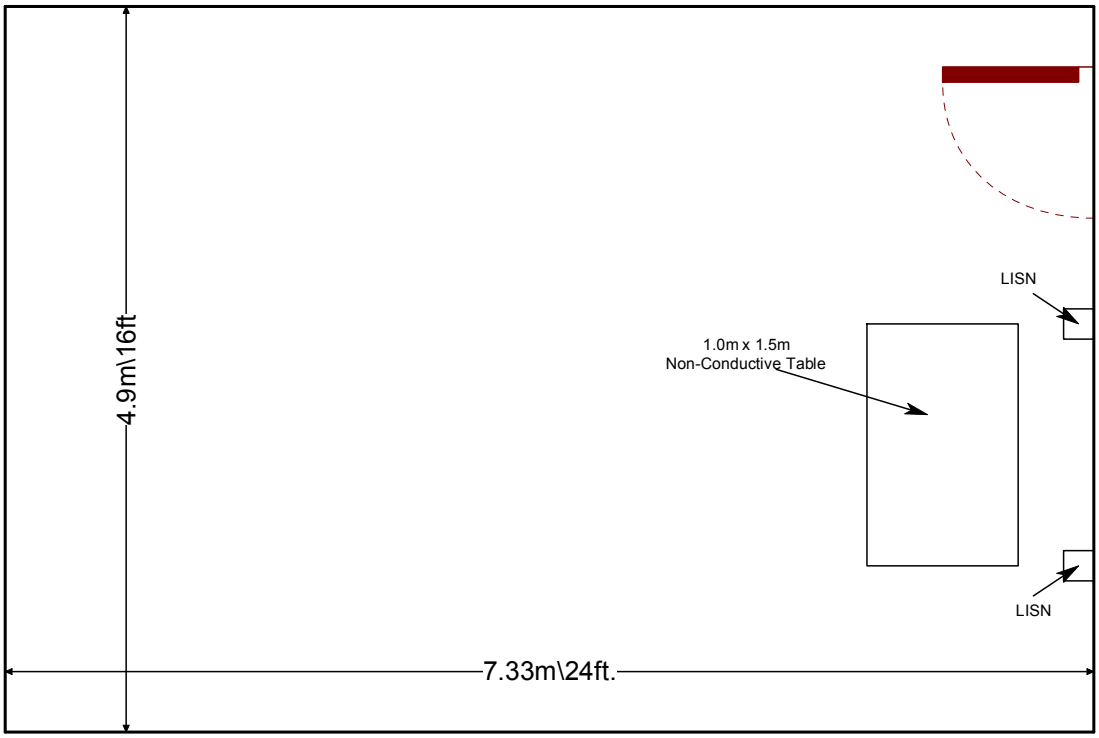


Figure 2.3.2-1: AC Mains Conducted EMI Site

3 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
- ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2013
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2013
- 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 Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8 December 2010.
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, December 2010.

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

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
523	Agilent	E7405	Spectrum Analyzers	MY45103293	1/8/2013	1/8/2015
524	Chase	CBL6111	Antennas	1138	1/7/2013	1/7/2015
2006	EMCO	3115	Antennas	2573	4/24/2013	4/24/2015
2008	COM-Power	AH-826	Antennas	81009	NCR	NCR
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	12/31/2012	12/31/2013
2037	ACS Boca	Chamber EMI Cable Set	Cable Set	2037	1/1/2013	1/1/2014
2044	QMI	N/A	Cables	2044	12/31/2012	12/31/2013
2076	Hewlett Packard	HP5061-5458	Cables	2076	12/29/2012	12/29/2013
2070	Mini Circuits	VHF-8400+	Filter	2070	12/31/2012	12/31/2013
2072	Mini Circuits	VHF-3100+	Filter	30737	12/31/2012	12/31/2013
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	12/29/2012	12/29/2013
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/20/2012	12/20/2013
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR

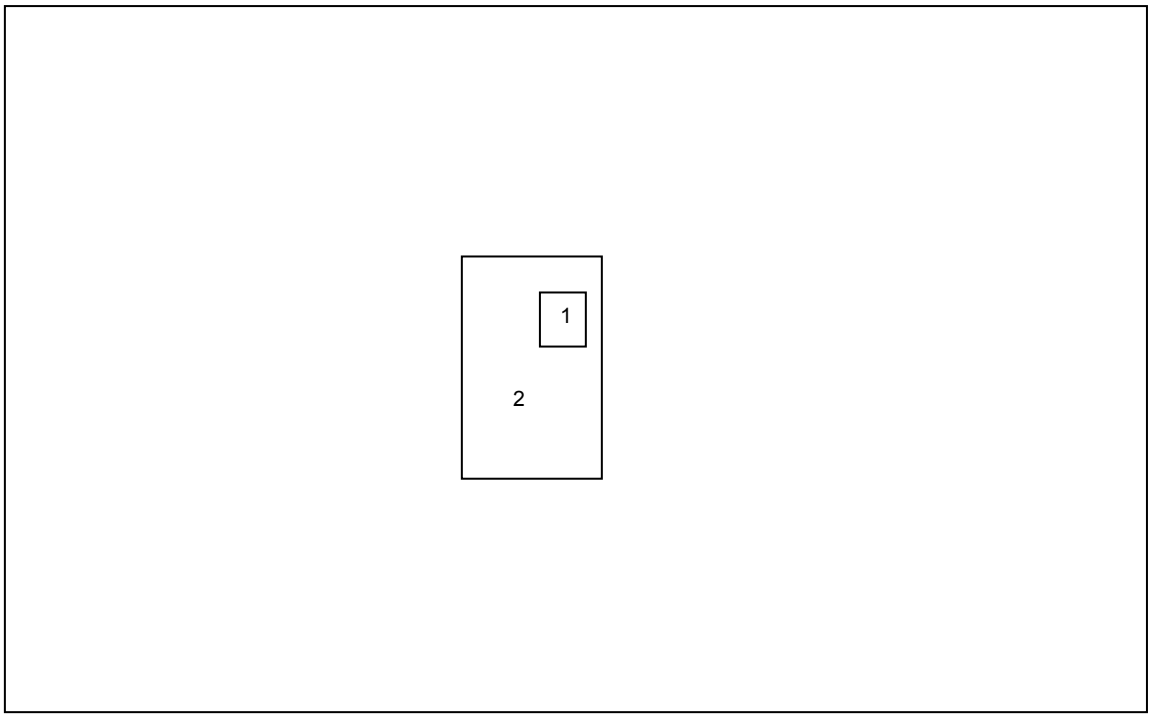
NCR=No Calibration Required

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment (Stand-alone)

Item #	Type Device	Manufacturer or Responsible Party	Model/Part #	Serial #
1	EUT	Juniper Systems	TiWi-R2	N/A
2	Host	Juniper Systems	Archer2	AR2X493

6 EQUIPMENT UNDER 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 uses a -3.0 dBi printed Inverted-F antenna provided by the host PCB. The antenna is not detachable but is etched on the host PCB, thereby meeting the requirements of FCC 15.203.

7.2 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-210 A8.5

7.2.1 Radiated Spurious Emissions - FCC 15.205, 15.209; IC: RSS-210 2.2, RSS-Gen 7.2.2, 7.2.5

7.2.1.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30 MHz to 26 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 1000 MHz, peak measurements made with RBW and VBW of 1 MHz and 3 MHz respectively. Average measurements were collected in the linear amplitude scale with VBW of 30 Hz.

The EUT was caused to generate a continuous carrier signal on the hopping channel.

7.2.1.2 Measurement Results

Band-Edge and radiated spurious emissions found in the band of 30MHz to 26 GHz are reported in the tables below.

Table 7.2.1.2-1: Radiated Spurious Emissions Tabulated Data - GFSK

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 (2402 MHz)										
4804	47.79	38.13	H	-0.89	46.90	37.24	74.0	54.0	27.1	16.8
4804	48.07	39.05	V	-0.89	47.18	38.16	74.0	54.0	26.8	15.8
12010	44.66	32.20	H	11.35	56.01	43.55	83.5	63.5	27.5	20.0
12010	44.22	32.55	V	11.35	55.57	43.90	83.5	63.5	27.9	19.6
19216	28.53	28.53	H	9.23	37.76	37.76	83.5	63.5	45.7	25.7
19216	43.15	29.93	V	9.23	52.38	39.16	83.5	63.5	31.1	24.3
Middle Channel (2441 MHz)										
4882	47.24	35.74	H	-0.66	46.58	35.08	74.0	54.0	27.4	18.9
4882	47.23	35.52	V	-0.66	46.57	34.86	74.0	54.0	27.4	19.1
7323	46.68	33.37	H	4.00	50.68	37.37	74.0	54.0	23.3	16.6
7323	47.40	34.98	V	4.00	51.40	38.98	74.0	54.0	22.6	15.0
12205	44.14	31.82	H	11.22	55.36	43.04	83.5	63.5	28.1	20.5
12205	44.29	32.23	V	11.22	55.51	43.45	83.5	63.5	28.0	20.0
19528	42.52	29.50	H	9.55	52.07	39.05	83.5	63.5	31.4	24.5
19528	43.84	31.59	V	9.55	53.39	41.14	83.5	63.5	30.1	22.4
High Channel (2480 MHz)										
2483.5	63.44	57.09	H	-8.26	55.18	48.83	74.0	54.0	18.8	5.2
2483.5	64.57	59.87	V	-8.26	56.31	51.61	74.0	54.0	17.7	2.4
4960	45.67	33.33	H	-0.43	45.24	32.90	74.0	54.0	28.8	21.1
4960	47.05	35.26	V	-0.43	46.62	34.83	74.0	54.0	27.4	19.2
7440	46.15	32.90	H	4.31	50.46	37.21	74.0	54.0	23.5	16.8
7440	46.42	34.37	V	4.31	50.73	38.68	74.0	54.0	23.3	15.3
12400	43.79	30.79	H	11.10	54.89	41.89	83.5	63.5	28.6	21.6
12400	43.83	30.74	V	11.10	54.93	41.84	83.5	63.5	28.6	21.7
19840	43.19	30.61	V	10.92	54.11	41.53	83.5	63.5	29.4	22.0

Notes:

- **All emissions above 19.84 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **Emissions above 10 GHz were measured at a distance of 1m. The limits are corrected using a distance correction factor of 20*log(3/1) = 9.5 dB.**

Table 7.2.1.2-2: Radiated Spurious Emissions Tabulated Data – (π/4) DQPSK

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 (2402 MHz)										
4804	47.58	33.86	H	-0.89	46.69	32.97	74.0	54.0	27.3	21.0
4804	46.94	35.00	V	-0.89	46.05	34.11	74.0	54.0	27.9	19.9
12010	44.44	30.95	H	11.35	55.79	42.30	83.5	63.5	27.7	21.2
12010	44.25	31.50	V	11.35	55.60	42.85	83.5	63.5	27.9	20.7
19216	43.25	29.52	V	9.23	52.48	38.75	83.5	63.5	31.0	24.7
Middle Channel (2441 MHz)										
4882	46.25	33.46	H	-0.66	45.59	32.80	74.0	54.0	28.4	21.2
4882	46.00	33.65	V	-0.66	45.34	32.99	74.0	54.0	28.7	21.0
12205	43.80	30.65	H	11.22	55.02	41.87	83.5	63.5	28.5	21.6
12205	44.24	31.24	V	11.22	55.46	42.46	83.5	63.5	28.0	21.0
19528	42.07	29.07	V	9.55	51.62	38.62	83.5	63.5	31.9	24.9
High Channel (2480 MHz)										
2483.5	66.12	56.28	H	-8.26	57.86	48.02	74.0	54.0	16.1	6.0
2483.5	67.75	58.62	V	-8.26	59.49	50.36	74.0	54.0	14.5	3.6
4960	45.78	33.08	H	-0.43	45.35	32.65	74.0	54.0	28.6	21.3
4960	46.77	33.71	V	-0.43	46.34	33.28	74.0	54.0	27.7	20.7
12400	43.38	30.18	H	11.10	54.48	41.28	83.5	63.5	29.0	22.2
12400	43.46	30.53	V	11.10	54.56	41.63	83.5	63.5	28.9	21.9
19840	42.42	29.64	V	10.92	53.34	40.56	83.5	63.5	30.2	22.9

Notes:

- **All emissions above 19.84 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **Emissions above 10 GHz were measured at a distance of 1m. The limits are corrected using a distance correction factor of 20*log(3/1) = 9.5 dB.**

Table 7.2.1.2-3: Radiated Spurious Emissions Tabulated Data – 8DPSK

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 (2402 MHz)										
4804	46.80	34.48	H	-0.89	45.91	33.59	74.0	54.0	28.1	20.4
4804	47.45	35.22	V	-0.89	46.56	34.33	74.0	54.0	27.4	19.7
12010	44.46	30.85	H	11.35	55.81	42.20	83.5	63.5	27.7	21.3
12010	43.80	31.32	V	11.35	55.15	42.67	83.5	63.5	28.4	20.8
19216	42.70	29.57	V	9.23	51.93	38.80	83.5	63.5	31.6	24.7
Middle Channel (2441 MHz)										
4882	46.41	33.89	H	-0.66	45.75	33.23	74.0	54.0	28.2	20.8
4882	46.41	33.88	V	-0.66	45.75	33.22	74.0	54.0	28.2	20.8
12205	44.11	30.64	H	11.22	55.33	41.86	83.5	63.5	28.2	21.6
12205	44.75	31.17	V	11.22	55.97	42.39	83.5	63.5	27.5	21.1
19528	42.16	29.26	V	9.55	51.71	38.81	83.5	63.5	31.8	24.7
High Channel (2480 MHz)										
2483.5	66.74	56.29	H	-8.26	58.48	48.03	74.0	54.0	15.5	6.0
2483.5	69.31	58.84	V	-8.26	61.05	50.58	74.0	54.0	13.0	3.4
4960	46.53	33.38	H	-0.43	46.10	32.95	74.0	54.0	27.9	21.0
4960	46.48	33.92	V	-0.43	46.05	33.49	74.0	54.0	27.9	20.5
12400	43.32	30.09	H	11.10	54.42	41.19	83.5	63.5	29.1	22.3
12400	43.43	30.39	V	11.10	54.53	41.49	83.5	63.5	29.0	22.0
19840	42.90	29.74	V	10.92	53.82	40.66	83.5	63.5	29.7	22.8

Notes:

- **All emissions above 19.84 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **Emissions above 10 GHz were measured at a distance of 1m. The limits are corrected using a distance correction factor of 20*log(3/1) = 9.5 dB.**

7.2.1.3 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: 47.79+ (-0.89) = 46.9dBµV/m
Margin: 74 dBµV/m – 46.9dBµV/m = 27.1dB

Example Calculation: Average
Corrected Level: 38.13 + (-0.89) = 37.24dBµV/m
Margin: 54 dBµV/m – 37.24 dBµV/m = 16.8 dB

8 CONCLUSION

In the opinion of ACS, Inc., the TiWi-R2 meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210 for the test procedures documented in this test report.

END REPORT