Class II Permissive Change Certification Test Report

FCC ID: VSF27065
IC: 7980A-27065

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

TÜV SÜD Report Number: RD72131890.100

Manufacturer: Juniper Systems, Inc.
Model: WT41u-E

Test Begin Date: October 16, 2017
Test End Date: October 19, 2017
Report Issue Date: October 20, 2018

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 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 Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-247 Certification.

The MS2 has been integrated with a different antenna type dedicated to the Bluetooth module. Therefore, a class II permissive change applies.

1.2 Product Description

The MS2 consists of ultra-rugged tablet computers, featuring a 7-inch touchscreen display and running Microsoft Windows 8.1/10 Professional, Bluetooth 4.0 and WLAN 802.11a/b/g/n. This test report documents the compliance of the Bluetooth transceiver with the integration of a new type of antenna.

Technical Information:

Detail	Description
Mode of Operation	Bluetooth 2.1+Enhanced Data Rate (EDR)
Frequency Range	2402-2480 MHz
Number of Channels	79
Modulation Format	GFSK, π/4-DQPSK, 8-DPSK
Data Rates	1 Mbps, 2 Mbps, 3 Mbps
Number of Inputs/Outputs	1 T/ 1 R
Operating Voltage	12VDC
Antenna Type / Gain	PCB Antenna / 2.1 dBi

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

EUT Serial Numbers: 205067

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

1.3 Test Methodology and Considerations

The EUT was evaluated due to a change in the antenna type. Therefore, a limited subset of tests were performed that could be affected based on the change of the antenna. The radiated emissions were fully evaluated on all the classic Bluetooth modes. At the antenna port, only the RF output power level was verified. To control the Bluetooth transceiver, instruction was provided by the client with the necessary software allowing the channels, power settings, and modes to be manually selected. The packet size and power settings were established using the tables below, specifically the DH5 format as it was found to be worse.

Mode	Packet	Packet Type	Packet Size
GFSK	DH1	4	27
	DH3	11	183
	DH5	15	339
π/4-DQPSK	2-DH1	20	54
	2-DH3	26	367
	2-DH5	30	679
8-DPSK	3-DH1	24	83
	3-DH3	27	552
	3-DH5	31	1021

Radio Module	Mode	Packet	Ext	Int
WT41u-E	GFSK	DH1, DH3, DH5	255	50
WT41u-E	π/4-DQPSK	2-DH1, 2-DH3, 2-DH5	255	82
WT41u-E	8-DPSK	3-DH1, 3-DH3, 3-DH5	255	82

To perform the RF conducted emissions evaluation, the antenna is detached from the U.FL connector and a SMA to U.FL ultra-short cable is tapped into the output of the transceiver.

The EUT was evaluated in 3 configurations for radiated emissions to determine the worst-case configuration and orientation. The 3 configurations were handheld with respect to the 3 orthogonal planes, on battery with respect to the 3 orthogonal planes, and charging using the power adapter. The results of the configuration leading to the highest emissions with respect to the limits are presented in this report.

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America Inc.
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. 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.

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:

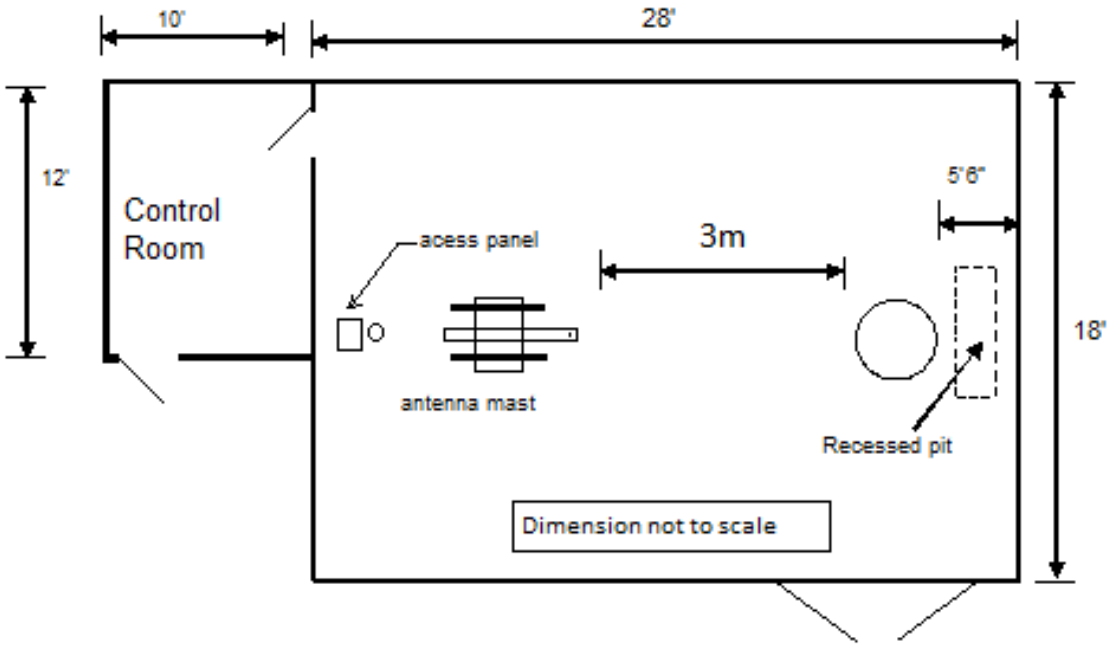

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

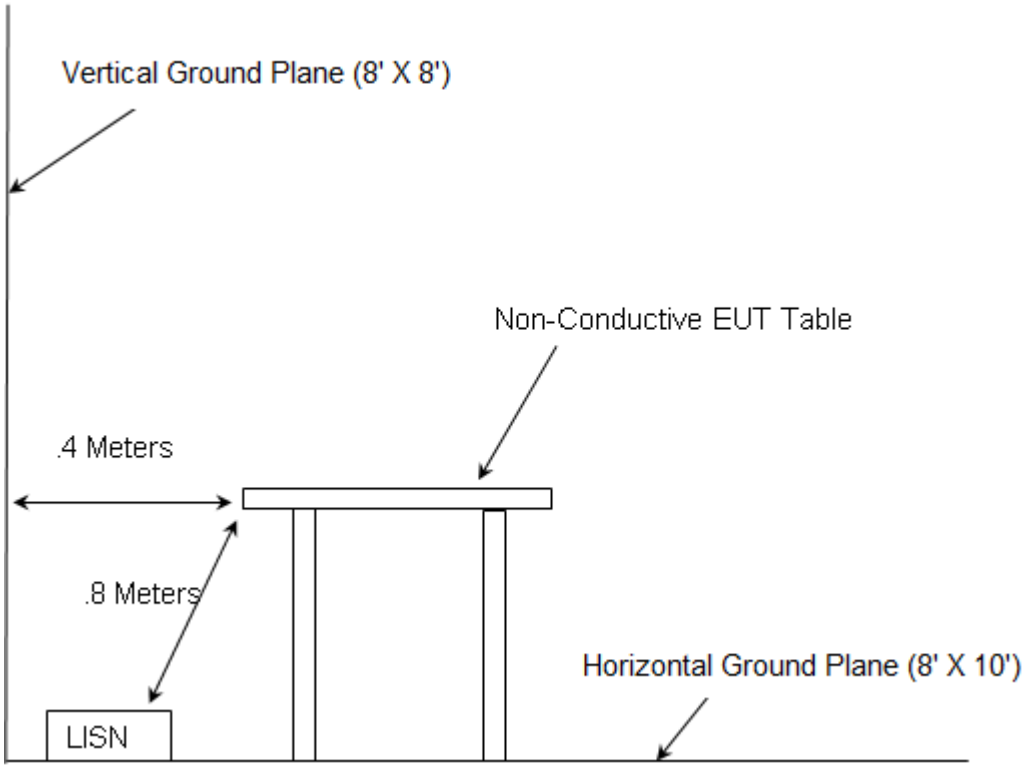

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: 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, 2017
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2017
- ISED Canada Radio Standards Specification: RSS-247, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017
- 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	3/21/2017	3/21/2019
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/12/2017	1/12/2018
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	1/11/2017	1/11/2018
3007	Rohde & Schwarz	TS-PR26	Amplifiers	100051	1/11/2017	1/11/2018
3008	Rohde & Schwarz	NRP2	Meter	103131	2/6/2017	2/6/2018
3009	Rohde & Schwarz	NRP-Z81	Meter	102397	2/6/2017	2/6/2018
3011	Rohde & Schwarz	ENV216	LISN	3011	1/12/2017	1/12/2018
3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
3027	Micro-Tronics	BRM50702	Filter	175	1/13/2017	1/13/2018
3028	Micro-Tronics	HPM50111	Filter	122	1/13/2017	1/13/2018
3037	Hasco, Inc.	HLL142-S1-S1-18	Cables	6367	1/11/2017	1/11/2018
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/3/2017	1/3/2018
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/3/2017	1/3/2018
3045	Aeroflex Inmet	18N10W-20	Attenuator	1437	1/3/2017	1/3/2018
3049	Aeroflex Inmet	26AH-20	Attenuator	1443	1/11/2017	1/11/2018
3051	Mountain View Cable	BMS-RG400-264.0-BMS	Cables	3051	1/3/2017	1/3/2018
3055	Rohde & Schwarz	3005	Cables	3055	1/3/2017	1/3/2018
3057	Advanced Technical Materials	42-441-6/BR	Antennas	R110602	NCR	NCR
3059	Mountain View Cable	A	Cables	3059	1/11/2017	1/11/2018
3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	6/9/2017	6/9/2018

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
Asset 3085: Instrument Firmware 2.41 SP1

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	EUT	Juniper Systems, Inc.	WT41u-E	205067
2	12VDC Power Adapter	PhiHong	PSAA20R-120L6	PQ2600407A1
3	USB Mouse	Dell	MS111-L	CN-09RRC7-48729-44P-1STT
4	Earbuds	Mobile Spec.	N/A	N/A

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

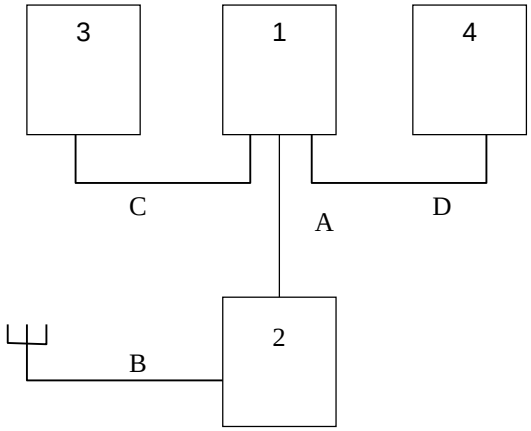

Figure 6-1: Test Setup Block Diagram

Table 6-1: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power cable	1.5 m	No	1 to 2
B	Power Extension	2.8 m	No	3 to AC mains
C	USB cable	1.8 m	No	1 to 3
D	Audio cable	1.25 m	No	1 to 4

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: 15.203

The antenna is integral to the device and is connected to the Bluetooth module using a non-standard U.FL connector. Therefore, the antenna requirement is met.

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

Performed by: Jean Tezil

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.166000	---	29.09	55.08	25.99	5000.0	9.000	L1	OFF	9.7
0.166000	47.96	---	65.09	17.13	5000.0	9.000	L1	OFF	9.7
0.202000	---	17.23	53.34	36.11	5000.0	9.000	L1	OFF	9.7
0.202000	38.76	---	63.37	24.61	5000.0	9.000	L1	OFF	9.7
0.396000	---	26.54	47.79	21.25	5000.0	9.000	L1	OFF	9.7
0.396000	36.55	---	57.81	21.26	5000.0	9.000	L1	OFF	9.7
0.412000	---	25.72	47.48	21.76	5000.0	9.000	L1	OFF	9.7
0.412000	37.38	---	57.50	20.12	5000.0	9.000	L1	OFF	9.7
0.908000	---	16.24	46.00	29.76	5000.0	9.000	L1	OFF	9.7
0.908000	26.24	---	56.00	29.76	5000.0	9.000	L1	OFF	9.7
1.252000	---	15.09	46.00	30.91	5000.0	9.000	L1	OFF	9.7
1.252000	25.41	---	56.00	30.59	5000.0	9.000	L1	OFF	9.7
3.128000	---	17.83	46.00	28.17	5000.0	9.000	L1	OFF	9.7
3.128000	25.10	---	56.00	30.90	5000.0	9.000	L1	OFF	9.7
18.766000	---	21.34	50.00	28.66	5000.0	9.000	L1	OFF	10.1
18.766000	28.31	---	60.00	31.69	5000.0	9.000	L1	OFF	10.1

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	---	20.12	56.00	35.88	5000.0	9.000	N	OFF	9.6
0.150000	45.43	---	66.00	20.57	5000.0	9.000	N	OFF	9.6
0.408000	---	24.45	47.55	23.10	5000.0	9.000	N	OFF	9.7
0.408000	35.72	---	57.58	21.86	5000.0	9.000	N	OFF	9.7
0.424000	---	25.91	47.26	21.35	5000.0	9.000	N	OFF	9.7
0.424000	34.80	---	57.27	22.47	5000.0	9.000	N	OFF	9.7
0.552000	---	22.51	46.00	23.49	5000.0	9.000	N	OFF	9.7
0.552000	31.01	---	56.00	24.99	5000.0	9.000	N	OFF	9.7
1.180000	---	20.93	46.00	25.07	5000.0	9.000	N	OFF	9.7
1.180000	27.94	---	56.00	28.06	5000.0	9.000	N	OFF	9.7
1.580000	---	20.64	46.00	25.36	5000.0	9.000	N	OFF	9.7
1.580000	27.48	---	56.00	28.52	5000.0	9.000	N	OFF	9.7
3.412000	---	20.19	46.00	25.81	5000.0	9.000	N	OFF	9.7
3.412000	26.76	---	56.00	29.24	5000.0	9.000	N	OFF	9.7
3.644000	---	18.32	46.00	27.68	5000.0	9.000	N	OFF	9.8
3.644000	25.26	---	56.00	30.74	5000.0	9.000	N	OFF	9.8
20.386000	---	18.90	50.00	31.10	5000.0	9.000	N	OFF	10.1
20.386000	26.46	---	60.00	33.54	5000.0	9.000	N	OFF	10.1

Table 7.2.2-2: Conducted EMI Results – Line 2

7.3 Fundamental Emission Output Power – FCC: 15.247(b)(3); ISED Canada: RSS-247 5.4(d)

7.3.1 Measurement Procedure

The maximum peak conducted output power was measured utilizing the Peak power meter method in accordance with ANSI C63.10 2013 section 7.8.5 note. The RF output of the equipment under test was directly connected to the input of the peak power meter applying suitable attenuation.

7.3.2 Measurement Results

Performed by: Jean Tezil

Table 7.3.2-1: Maximum Peak Conducted Output Power – Mode GFSK

Frequency (MHz)	Output Power (dBm)
2402	17.00
2441	16.67
2480	15.80

Table 7.3.2-2: Maximum Peak Conducted Output Power – Mode π/4-DQPSK

Frequency (MHz)	Output Power (dBm)
2402	10.34
2441	9.64
2480	7.98

Table 7.3.2-3: Maximum Peak Conducted Output Power – Mode 8-DPSK

Frequency (MHz)	Output Power (dBm)
2402	10.48
2441	9.89
2480	8.15

7.4 Emissions into Restricted Frequency Bands

7.4.1.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30MHz to 25GHz, 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 RBW of 120 kHz and a VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz 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.

7.4.1.2 Duty Cycle Correction

The Duty Cycle Correction was not required.

7.4.1.3 Measurement Results

Performed by: Jean Tezil

Table 7.4.1.3-1: Radiated Spurious Emissions Tabulated Data – Mode 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										
120		15.40	H	11.90	---------	27.30	--------	43.5	---------	16.2
257.27		16.40	H	13.31	---------	29.71	--------	46.0	---------	16.3
2376	60.60	48.70	H	-3.74	56.86	44.96	74.0	54.0	17.1	9.0
2376	61.60	51.00	V	-3.74	57.86	47.26	74.0	54.0	16.1	6.7
2386	63.10	48.10	H	-3.71	59.39	44.39	74.0	54.0	14.6	9.6
2386	63.70	50.30	V	-3.71	59.99	46.59	74.0	54.0	14.0	7.4
4804	42.90	35.20	H	3.68	46.58	38.88	74.0	54.0	27.4	15.1
4804	45.20	37.30	V	3.68	48.88	40.98	74.0	54.0	25.1	13.0
Middle Channel = 2441 MHz										
4882	41.90	32.70	H	3.67	45.57	36.37	74.0	54.0	28.4	17.6
4882	44.00	36.70	V	3.67	47.67	40.37	74.0	54.0	26.3	13.6
7323	38.50	24.70	H	7.88	46.38	32.58	74.0	54.0	27.6	21.4
7323	38.80	25.60	V	7.88	46.68	33.48	74.0	54.0	27.3	20.5
High Channel = 2480 MHz										
2483.5	70.80	50.30	H	-3.46	67.34	46.84	74.0	54.0	6.7	7.2
2483.5	70.10	53.00	V	-3.46	66.64	49.54	74.0	54.0	7.4	4.5
4960	42.30	34.00	H	3.65	45.95	37.65	74.0	54.0	28.1	16.4
4960	43.10	35.70	V	3.65	46.75	39.35	74.0	54.0	27.3	14.7
7440	38.00	25.20	H	8.48	46.48	33.68	74.0	54.0	27.5	20.3
7440	39.30	27.70	V	8.48	47.78	36.18	74.0	54.0	26.2	17.8

Table 7.4.1.3-2: Radiated Spurious Emissions Tabulated Data – Mode 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										
2385.99	66.50	50.10	H	-3.71	62.79	46.39	74.0	54.0	11.2	7.6
2385.99	65.40	50.60	V	-3.71	61.69	46.89	74.0	54.0	12.3	7.1
Middle Channel = 2441 MHz										
Noise Floor										
High Channel = 2480 MHz										
2483.5	64.00	49.30	H	-3.46	60.54	45.84	74.0	54.0	13.5	8.2
2483.5	67.50	52.80	V	-3.46	64.04	49.34	74.0	54.0	10.0	4.7

Table 7.4.1.3-3: Radiated Spurious Emissions Tabulated Data – Mode 8-DPSK

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										
2386	66.10	49.50	H	-3.71	62.39	45.79	74.0	54.0	11.6	8.2
2386	65.50	50.30	V	-3.71	61.79	46.59	74.0	54.0	12.2	7.4
4804	42.50	29.40	V	3.68	46.18	33.08	74.0	54.0	27.8	20.9
Middle Channel = 2441 MHz										
4882	42.90	29.20	H	3.67	46.57	32.87	74.0	54.0	27.4	21.1
4882	42.90	29.40	V	3.67	46.57	33.07	74.0	54.0	27.4	20.9
High Channel = 2480 MHz										
2483.5	69.10	49.20	H	-3.46	65.64	45.74	74.0	54.0	8.4	8.3
2483.5	66.90	52.00	V	-3.46	63.44	48.54	74.0	54.0	10.6	5.5
4960	42.90	29.10	H	3.65	46.55	32.75	74.0	54.0	27.5	21.3
4960	42.90	29.60	V	3.65	46.55	33.25	74.0	54.0	27.5	20.8

Notes:

- QP detector was used below 1GHz
- AVG detector was used above 1GHz

7.4.1.4 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 at 2376MHz

Corrected Level: 60.6 - 3.74 = 56.86dBuV/m
Margin: 74dBuV/m – 56.86dBuV/m = 17.14dB

Example Calculation: Average at 2376 MHz

Corrected Level: 48.7 - 3.74 = 44.96dBuV
Margin: 54dBuV – 44.96dBuV = 9.04dB

8 MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	**± 0.004%**
RF Conducted Output Power	**± 0.689 dB**
Power Spectral Density	**±0.5 dB**
Antenna Port Conducted Emissions	**± 2.717 dB**
Radiated Emissions	**± 5.877 dB**
Temperature	**± 0.860 °C**
Radio Frequency	**±2.832 x 10-8**
AC Power Line Conducted Emissions	**±2.85**

9 CONCLUSION

In the opinion of TÜV SÜD America Inc. The WT41u-E, manufactured by Juniper Systems, Inc. meets the requirements of FCC Part 15 subpart C and ISED Canada Radio Standards Specification: RSS-247 for the tests documented herein.

END REPORT