Testing Tomorrow's Technology

Permissive Change Application

For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

Industry Canada, RSS-247 Issue 1, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices

And

Part 2, Subpart J, Section 2.902, Verification
Per
Part 15, Subpart B, for Unintentional Radiators, section 15.101, 15.107 and 15.109

For the

HDJ WIRELESS ENTERPRISE LLC

Model: VersaRouter 1100 - Titan

FCC ID: 2AHPM-TITAN
IC: 21163-TITAN

UST Project: 16-0184
Issue Date: August 30, 2016

Total Pages in This Report: 20

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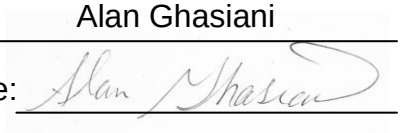
I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date August 30, 2016

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: HDJ WIRELESS ENTERPRISE LLC

MODEL: VERSA ROUTER 1100 - TITAN

FCC ID: 2AHPM-TITAN

IC: 21163-TITAN

DATE: August 30, 2016

This report concerns (check one): Original grant [X]
Class II change

Equipment type: DSS Router

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until: _____N/A_____
date
agrees to notify the Commission by N/A
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
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Alpharetta, GA 30004

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1 General Information

1.1 Purpose of this Report

The originally test radio product has been modified therefore this report has been generated and submitted for evaluation. The changes made to this product include the following:

- The power supply was replaced with the following MFG: PULS, Model: ML60.122
- Replaced battery with Power Sonic model: PS-1270
- Add a charge controller for the battery, MFG: Mini-box P/N: PicoUPS-120-ATV
- Increased the enclosure size to make room for the new power supply

The RF parts and circuits did not change. The enclosure is made of the same plastic materials. Only the parts listed above were changed. Based on those changes the EUT was retested for intentional emissions per 15.207 and 15.209 only.

The new test data is provided in this test report for consideration.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on August 1, 2016 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the HDJ WIRELESS ENTERPRISE LLC Model VersaRouter 1100 - Titan. The EUT is a standards-based 802.15.4g compliant router with co-located 3G module for 3G connectivity for IPv6/Internet of Things applications. The 802.15.4g radio module is amplified to supply up to 1Watt output power. The EUT is designed for outdoor operation having a back-up battery and external storage. The 3G radio module is mounted on the same host board, however the 3G radio does not transmit in the 902-928 MHz band and it has its own output RF port and its own external antenna (see attached exhibits). The EUT was tested for co-location emissions and meets the applicable requirements.

Antenna: Omni (3.0 dBi Gain)
Modulation: FHSS
Maximum measured output power: 26.4 dBm
Contains 3G radio module with FCC ID: XPYLISAU230, IC: 8595A-LISAU230

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4:2009, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2009)* for FCC subpart A Digital equipment Verification requirements and per FCC KDB Publication number 558074 for Digital Transmission Systems Operating Under section 15.247. Also, FCC, KDB Publication No. 558074 and FCC Public Notice DA 00-705 was used as a test procedure guide.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittals

1.6.1 The EUT is subject to the following FCC authorizations:

a) Certification under section 15.247 as a transmitter.
b) Verification under 15.101 as a digital device and receiver.

1.6.2 Verification of the Digital apparatus

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (part 15.107 and 15.109) for the EUT is included herein.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
EUT	VersaRouter 1100 - Titan	Engineering Sample	2AHPM-TITAN 21163-TITAN	None
Antenna See antenna details	--	--	--	--

U= Unshielded
S= Shielded
P= Power
D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2410A00109	5/07/2015 Extended to August 15, 2016
SPECTRUM ANALYZER	E4407B	Agilent	US41442935	2/11/2016
PREAMP	8449B	HEWLETT-PACKARD	3008A00480	12/01/2015
PREAMP	8447D	HEWLETT-PACKARD	1937A02980	12/02/2015
LOOP ANTENNA	SAS-200/562	A. H. Systems	142	9/28/2015 2 yr
BICONICAL ANTENNA	3110B	EMCO	9306-1708	11/24/2014 2 yr
BICONICAL ANTENNA	3110B	EMCO	9307-1431	8/25/2015 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9110-3236	11/19/2014 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	7/01/2014 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	7/8/2014 2 yr

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No modifications were made by US Tech to the EUT in order to meet the requirements of this subpart.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates at 902.4 MHz to 927.6 MHz, 3 test frequencies were used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10^{th} harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to 5 times the highest internal clock frequency.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following:

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

NOTE: If the transmitter was programmed to transmit at >98% duty cycle, then, wherever applicable (where the detection mode was AVG) the duty cycle factor calculated will be applied.

2.6 EUT Antenna Requirements, External Radio Frequency Power Amplifiers and Antenna Modifications (CFR 15.203, 15.204)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

An intentional radiator may be operated only with the antenna with which it is authorized. If an antenna is marketed with the intentional radiator, it shall be of a type which is authorized with the intentional radiator. An intentional radiator may be authorized with multiple antenna types. Exceptions to the following provisions, if any, are noted in the rule section under which the transmitter operates, e.g., §15.255(b)(1)(ii) of this part.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Antenna 1	Fei Teng Wireless Technology Co. Ltd.	Omni	OS-915M03-NM	3.0	N-type

Except as described in paragraph 15.204(d), an external radio frequency power amplifier or amplifier kit shall be marketed only with the system configuration with which it was approved and not as a separate product.

Table 5. Allowed External RF Power Amplifier(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Amplifier 1	SHIREEN	N/A	90303	12.0	SMA

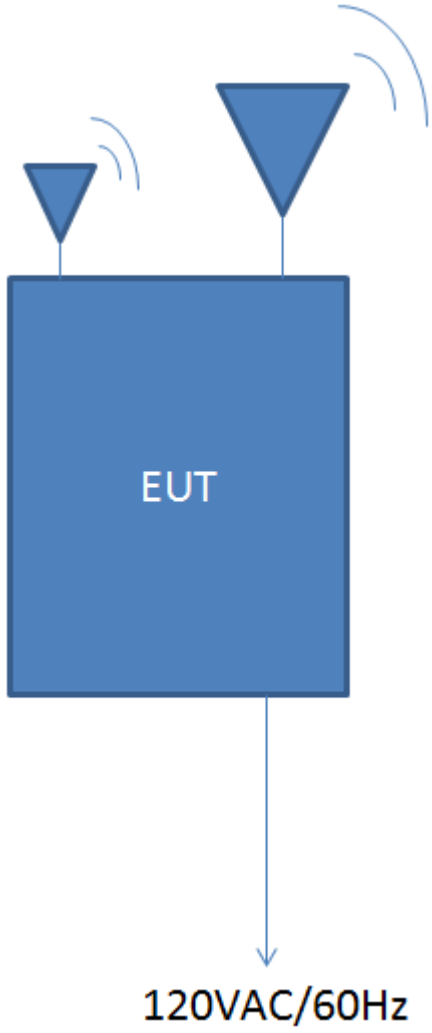


Figure 1. Block Diagram of Test Configuration

2.7 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the 15.207 limits

The EUT is designed to be connected the public utility (AC) power line, therefore this test was performed. The results are presented in the table below.

Table 6. Power Line Conducted Emissions Test Data, Part 15.207

150KHz to 30 MHz						
Test: Power Line Conducted Emissions				**Client:** HDJ WIRELESS ENTERPRISE LLC		
Project: 16-0184				**Model:** VERSA ROUTER 1100 TITAN		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL-PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
Phase Line						
0.3313	47.80	0.33	48.13	59.4	11.3	**PK**
0.6593	43.50	0.29	43.79	56.0*	12.2	**PK**
0.5185	26.60	0.31	26.91	46.0	19.1	**AVG**
4.8960	29.00	0.40	29.40	46.0	16.6	**PK**
8.7350	31.50	0.51	32.01	50.0	18.0	**PK**
18.9500	48.40	0.71	49.11	60.0*	10.9	**PK**
18.9180	47.30	0.69	47.99	50.0	2.0	**AVG**
20.3300	51.74	0.60	52.34	60.0*	7.7	**QP**
20.3300	48.70	0.60	49.30	50.0	0.7	**AVG**

(*)= Quasi Peak limit used
SAMPLE CALCULATION: 0.3313 MHz:

Magnitude of Measured Frequency	47.80	dBuV
+LISN Factor + Cable Loss+ Amplifier Gain	0.33	dB/m
Corrected Result	48.13	dBuV/m

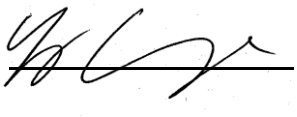
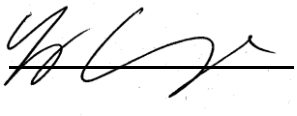
Test Date: August 5, 2016
Tested By
Signature:  Name: George Yang

Table 7. Power Line Conducted Emissions Test Data, Part 15.207

150KHz to 30 MHz						
Test: Power Line Conducted Emissions				**Client:** HDJ WIRELESS ENTERPRISE LLC		
Project: 16-0184				**Model:** VERSA ROUTER 1100 TITAN		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL-PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
Neutral Line						
0.1540	46.50	0.39	46.89	55.8	8.9	**PK**
0.6424	42.40	0.16	42.56	56.0*	13.4	**PK**
0.5180	29.70	0.18	29.88	46.0	16.1	**AVG**
1.5680	33.10	0.22	33.32	46.0	12.7	**PK**
8.7350	35.00	0.35	35.35	50.0	14.6	**PK**
18.9300	47.80	0.55	48.35	60.0*	11.7	**PK**
18.9200	45.50	0.55	46.05	50.0	4.0	**AVG**
23.3160	43.60	0.66	44.26	60.0*	15.7	**QP**
23.2880	47.30	0.66	47.96	50.0	2.0	**AVG**

(*)=Quasi Peak limit used
SAMPLE CALCULATION: 0.1540 MHz:

Magnitude of Measured Frequency	46.50	dBuV
+LISN Factor + Cable Loss+ Amplifier Gain	0.39	dB/m
Corrected Result	46.89	dBuV/m

Test Date: August 5, 2016
Tested By
Signature:  Name: George Yang

2.8 Intentional Radiator, Radiated Emissions (CFR 15.209)

The EUT has been evaluated for intentional spurious emissions per 15.209. The transmitter was turn on and exercising in a mode that simulated normal operation. In this case the EUT includes a two radio transmitters that are co-located on the same host board. Both radios were on and transmitting during the testing.

Table 8. Intentional Radiator, Spurious Radiated Emissions (CFR 15.209), 9 kHz to 30 MHz

9 kHz to 30 MHz							
Test: Radiated Emissions				**Client:** HDJ Wireless			
Project: 16-0184				**Model:** Titan 1100			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or QP**
Based on original test results, no emissions were detected below 30 Mhz; therefore this test was not performed for the Permissive Change Model. Radiated emissions were investigated starting at 30 MHz.							

SAMPLE CALCULATION: N/A

Test Date: August 5, 2016
Tested By
Signature: Name: George Yang

Table 9. Unintentional and Intentional Radiator, Spurious Radiated Emissions (CFR 15.109, 15.209) 30 MHz to 1000 MHz

30 MHz to 1000 MHz with Class B Limits							
Test: Radiated Emissions				**Client:** HDJ WIRELESS ENTERPRISE LLC			
Project: 16-0184				**Model:** VERSA ROUTER 1100 TITAN			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or QP**
141.50	68.00	-23.02	44.98	63.5*	3m./HORZ	18.5	**PK**
124.92	61.50	-24.54	36.96	43.5	3m./HORZ	6.5	**QP**
91.70	75.20	-26.33	48.87	63.5*	3m./VERT	14.6	**PK**
50.77	56.30	-26.71	29.59	40.0	3m./VERT	10.4	**QP**
201.20	57.80	-22.84	34.96	43.5	3m./HORZ	8.5	**PK**
300.00	60.30	-17.83	42.47	46.0	3m./VERT	3.5	**PK**
600.00	49.90	-11.97	37.93	46.0	3m./HORZ	8.1	**PK**
550.00	48.70	-13.60	35.10	46.0	3m./VERT	10.9	**PK**

(*)= Peak limit used.

SAMPLE CALCULATION: 141.50 MHz:

Magnitude of Measured Frequency	68.00	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-23.02	dB/m
Corrected Result	44.98	dBuV/m

Test Date: August 5, 2016

Tested By
Signature: _____ Name: George Yang

Table 10. Unintentional and Intentional Radiator, Spurious Radiated Emissions (CFR 15.109, 15.209) 1 GHz to 10 GHz

1 GHz to 10 GHz with Class B Limits							
Test: Radiated Emissions				**Client:** HDJ WIRELESS ENTERPRISE LLC			
Project: 16-0184				**Model:** VERSA ROUTER 1100 TITAN			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
2730.00	62.50	-12.36	50.14	54.0	3.0m./HORZ	3.9	**PK**
2730.00	59.20	-12.27	46.93	54.0	3.0m./VERT	7.1	**PK**
All other emissions seen were 20 dB or more from the limit.							

SAMPLE CALCULATION: N/A

Test Date: August 5, 2016

Tested By
Signature: _____ Name: George Yang

2.9 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.9.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.78 dB.

The data listed in this test report does have sufficient margin to negate the effects of uncertainty. Therefore, the EUT conditionally meets this requirement.

2.9.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.39 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.18 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.21dB.

The data listed in this test report does not have sufficient margin to negate the effects of uncertainty. Therefore, the EUT conditionally meets this requirement.