toll-free: (866) 311-3268
fax: (480) 926-3598
http://www.ComplianceTesting.com
info@ComplianceTesting.com

Test Report

Prepared for: Panasonic Corporation of North America

Model: WJ-VPU4000

Description: Network Recorder

FCC ID: ACJ9TAWJ-VPU4000
IC: 216A-WJVPU4000

To

FCC Part 15.247
IC RSS-247 Issue 2

Date of Issue: March 3rd 2021

On the behalf of the applicant:	**Panasonic i-PRO Sensing Solutions Corporation of America** **1701 Golf Rd., Suite 3-600** **Rolling Meadows, IL 60008**
Attention of:	**Michael Baumann, Product Manager** **Ph: 636-751-2469** **E-mail: michael.baumann@us.panasonic.com**

Prepared By
Compliance Testing, LLC
1724 S. Nevada Way
Mesa, AZ 85204
(480) 926-3100 phone / (480) 926-3598 fax
www.compliancetesting.com
Project No: p1120005

Alex Macon
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	March 3, 2021	Alex Macon	Original Document
2.0	March 31, 2021	Alex Macon	Updated bandwidth data

Table of Contents

ANAB

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Pressure (mbar)**
23.2 – 27.2	24 – 37.5	965– 971.8

EUT Description

Model: WJ-VPU4000
Description: Network Recorder
Firmware: N/A
Software: N/A
Serial Number: 2S47
Additional Information:
The EUT was tested conducted mode with RF connectors mounted on the EUT at the antenna input.
The EUT is comprised of two identical 2x2 WiFi modules and a BLE radio. The modules are utilized in separate modes, with different clients and are completely uncorrelated. The module that operates in “Station” mode utilizes 2.4 GHz, 5250 – 5350, 5470 – 5725 and 5725 – 5850. The module that operates in “AP” mode utilizes 2.4 GHz and 5725 – 5850 MHz
The EUT is intended to be mounted in a vehicle and is powered by the vehicles DC voltage.
The different data rates were evaluated and the worst case data rate was chosen for all the testing.
As the modules are identical and operate in separate, non-summing modes, the data below is taken on 1 of the modules.

EUT Operation during Tests
The EUT was placed into a test mode to enable constant transmit with >98% duty cycle. Measurements below are taken while connected to the “Station” radio.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	USB to RS232 converter	US Converters	XS880	XS2018011998
1	AC/DC Adapter	Shenzhen Boshenggao Technology Co.	BX~1208000	N/A

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Ferrite Y/N
1	Serial cable	2	Y	Y	N

Modifications: N/A

15.203: Antenna Requirement:

	The antenna is permanently attached to the EUT
X	The antenna uses a unique coupling
	The EUT must be professionally installed
	The antenna requirement does not apply

Test Results Summary

FCC 15.247 Specification	RSS-247 Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)	Section 5.4(d)	Output Power	Pass	
15.247(d)	Section 5.5	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Section 5.5	Emissions At Band Edges	Pass	
15.247(a)(2)	Sections 5.2(a)	Occupied Bandwidth	Pass	
15.247(e)	Section 5.2(b)	Transmitter Power Spectral Density	Pass	
15.207	RSS-GEN Section 8.8	A/C Powerline Conducted Emissions	N/A	EUT does not connect to the AC mains

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63.10-2013	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 558074 D01 v04	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating under §15.247

Conducted Output Power

Engineer: Alex Macon
Test Date: 1/19/2021

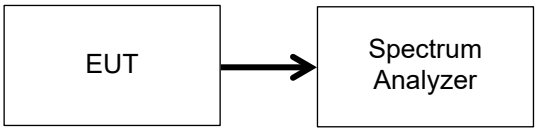
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 1-5% of the OBW, not to exceed 1MHz
VBW ≥ 3 x RBW
RMS Detector
Number of points in sweep ≥ 2 x span / RBW
Trace average at least 100 traces in power averaging mode
Sweep = auto
Span = 1.5 x EBW

The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The RF output power was measured using the spectrum analyzer's channel power function

Test Setup



Transmitter Output Power

Mode	Test Frequency	Data Rate	TP	P0 Level	P1 Level	P0 Level	P1 Level	Combined Output Power	Limit	Margin
MHz	MHz			dBm	dBm	mW	mW	dBm	dBm	dB
B	2412	1Mbps	18	16.59	16.17	45.6	41.4	19.4	30	-10.6
	2437	1Mbps	18	17.25	16.69	53.1	46.7	20.0	30	-10.0
	2462	1Mbps	18	16.97	17.01	49.8	50.2	20.0	30	-10.0
G	2412	6Mbps	13	11.4	11.7	13.8	14.8	14.6	30	-15.4
	2437	6Mbps	15	14.1	13.6	25.7	22.9	16.9	30	-13.1
	2462	6Mbps	13	12.2	12.4	16.6	17.4	15.3	30	-14.7
N	2412	MCS0	13	12.3	11.6	17.0	14.5	15.0	30	-15.0
	2437	MCS0	15	14	13.6	25.1	22.9	16.8	30	-13.2
	2462	MCS0	13	12.3	12.3	17.0	17.0	15.3	30	-14.7

See Annex A for Test Data

Conducted RF Measurements (15.209)

Engineer: Alex Macon
Test Date: 1/28/2021

Test Procedure

Antenna-port conducted measurements were performed as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands for 15.209.

The following offsets were added to the measurements:
The maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level
A maximum ground reflection factor to the EIRP level, 6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000MHz.

The following equations were used to determine the field strength from the conducted values.
E[dBµV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and d = 3m
E[dBµV/m] = EIRP[dBm] + 95.2, for d = 3 meters.

The Spectrum Analyzer was set to the following:

The Spectrum Analyzer was set to the following for emissions > 1000MHz:

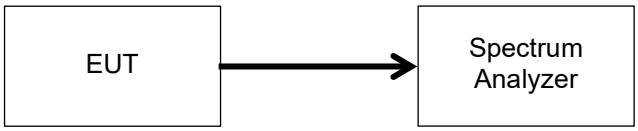
a. RBW = 1 MHz
b. VBW ≥ 3 MHz
c. Detector = Peak.
d. Sweep time = auto
e. Trace mode = max hold
    1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
f. RBW = 1 MHz
g. VBW ≤ RBW/100 (i.e., 10 kHz) but not less than 10 Hz

For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

a. RBW = 100 kHz
b. VBW ≥ 300 kHz
c. Detector = Peak
d. Sweep time = auto
e. Trace mode = max hold

The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was investigated.

Test Setup



See Annex B for test data

Radiated Spurious Emissions

Engineer: Alex Macon
Test Date: 2/16/2021

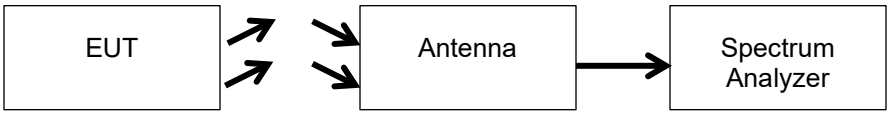
Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

All emissions from 30 MHz to 1 GHz were examined. There were no spurious emissions found below 1 Ghz. An example plot is included in the annex C
Measured Level includes antenna and receiver cable correction factors.
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz
VBW = 300 KHz
Detector – Quasi Peak

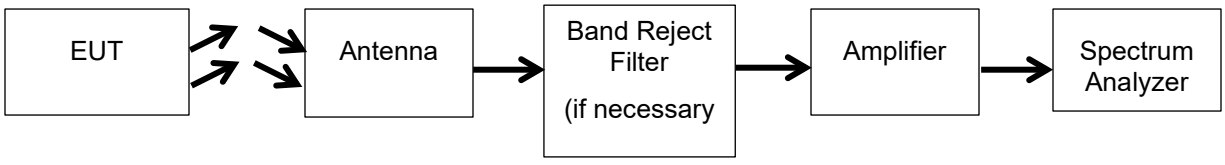
Test Setup



Test Procedure for
Radiated Spurious Emissions above 1 GHz

The EUT was setup in a semi-anechoic test chamber set 3m from the receiving antenna. The output of the transmitter was connected to a non-radiating balance load. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

Test Setup



See Annex C for Test Data

Conducted Spurious Emissions

Engineer: Alex Macon
Test Date: 1/20/2021

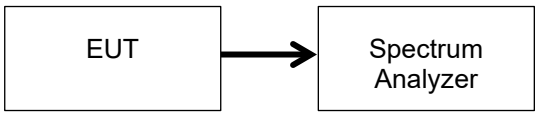
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Frequency Range = 30MHz – 10th Harmonic of the fundamental

The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The trace was allowed to stabilize. All emission were investigated to insure they were attenuated from the peak fundamental by at least 20dB. If the average power levels were measured then the out-of-band emissions needed to be attenuated by 30dB. In addition emissions were investigated at the band edges to insure all out-of-band emissions were attenuated 20 or 30dB as necessary.

Test Setup



DTS Bandwidth

Engineer: Alex Macon
Test Date: 3/5/2021

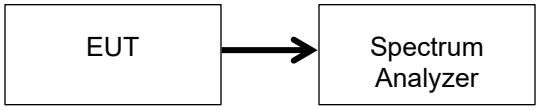
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Trace mode = max hold
Sweep = auto couple
Span = 1.5 x EBW

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. The maximum width of the emission that was determined by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that were attenuated by 6db and this value was used to determine the width of the carrier. Alternatively the spectrum analyzer's automatic bandwidth capability was used.

Test Setup



Occupied Bandwidth Summary

Frequency (MHz)	Mode	99% Measured Bandwidth (MHz)	6 dB Measured Bandwidth (MHz)	Specification Limit (kHz)	Result
2412	B	10.63	7.26	≥ 500	Pass
2437		10.70	7.26	≥ 500	Pass
2462		10.66	7.24	≥ 500	Pass
2412	G	17.29	16.16	≥ 500	Pass
2437		17.25	16.27	≥ 500	Pass
2462		17.21	16.28	≥ 500	Pass
2412	N	18.26	17.49	≥ 500	Pass
2437		18.24	17.47	≥ 500	Pass
2462		18.25	17.45	≥ 500	Pass

See Annex A for Test Data

Transmitter Power Spectral Density (PSD)

Engineer: Alex Macon
Test Date: 1/20/2021

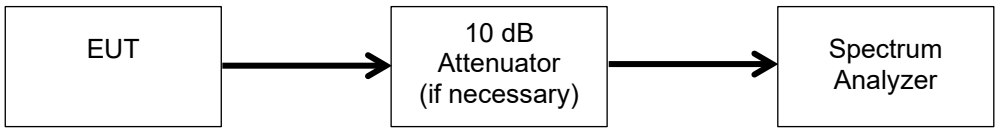
Test Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

DTS channel center frequency
Span 1.5 x DTS bandwidth
RBW =3 kHz ≤ RBW ≤ 100 kHz
VBW ≥ 3 x RBW
Peak Detector
Sweep time = auto couple
Trace mode = max hold

The EUT was set to transmit at the lowest, middle and highest channels of the band at the maximum power levels. Once the trace has stabilize the peak marker was used to determine the peak power spectral density.

Test Setup



PSD Summary

Mode	Test Frequency	Data Rate	TP	P0 Level	P1 Level	P0 Level	P1 Level	Combined Spectral Density	Limit	Margin
MHz	MHz			dBm	dBm	mW	mW	dBm	dBm	dB
B	2412	1Mbps	18	-6.50	-6.10	0.2	0.2	-3.3	8	-11.3
	2437	1Mbps	18	-6.10	-6.21	0.2	0.2	-3.1	8	-11.1
	2462	1Mbps	18	-7.10	-4.80	0.2	0.3	-2.8	8	-10.8
G	2412	6Mbps	13	-14.19	-13.16	0.0	0.0	-10.6	8	-18.6
	2437	6Mbps	15	-15.10	-10.83	0.0	0.1	-9.4	8	-17.4
	2462	6Mbps	13	-13.37	-12.30	0.0	0.1	-9.8	8	-17.8
N	2412	MCS0	13	-12.44	-12.54	0.1	0.1	-9.5	8	-17.5
	2437	MCS0	13	-11.66	-11.56	0.1	0.1	-8.6	8	-16.6
	2462	MCS0	13	-13.40	-15.67	0.0	0.0	-11.4	8	-19.4

See Annex A for Test Data

Test Equipment Utilized

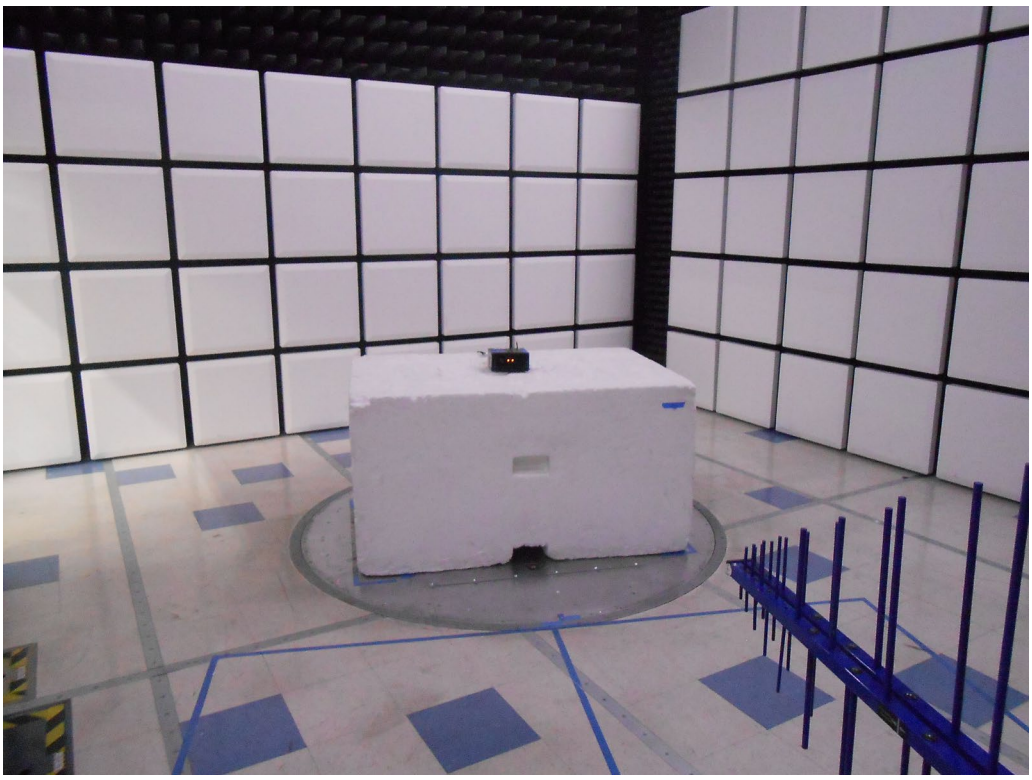
Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Temperature Chamber	Tenney	Tenney Jr	i00027	NCR	NCR
Horn Antenna	EMCO	3116	i00085	2/22/21	2/22/23
Bi-Log Antenna	Schaffner	CBL611C	i00267	8/28/20	8/28/22
Horn Antenna	ARA	DRG-118/A	i00271	8/3/20	8/3/22
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	8/28/20	8/28/21
Spectrum Analyzer	Agilent	E4407B	i00331	12/28/20	12/28/21
Data Logger	Fluke	Hydra Data Bucket	i00343	6/10/20	6/10/21
Signal Generator	HP	83650A	i00353	12/7/20	12/7/22
EMI Analyzer	Agilent	E7405A	i00379	12/29/20	12/29/21
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	7/17/20	7/17/21
EMI Receiver	Keysight	N9038A	i00552	1/12/21	1/21/22
Spectrum Analyzer	Agilent	E4445A	i00471	12/23/20	12/23/21

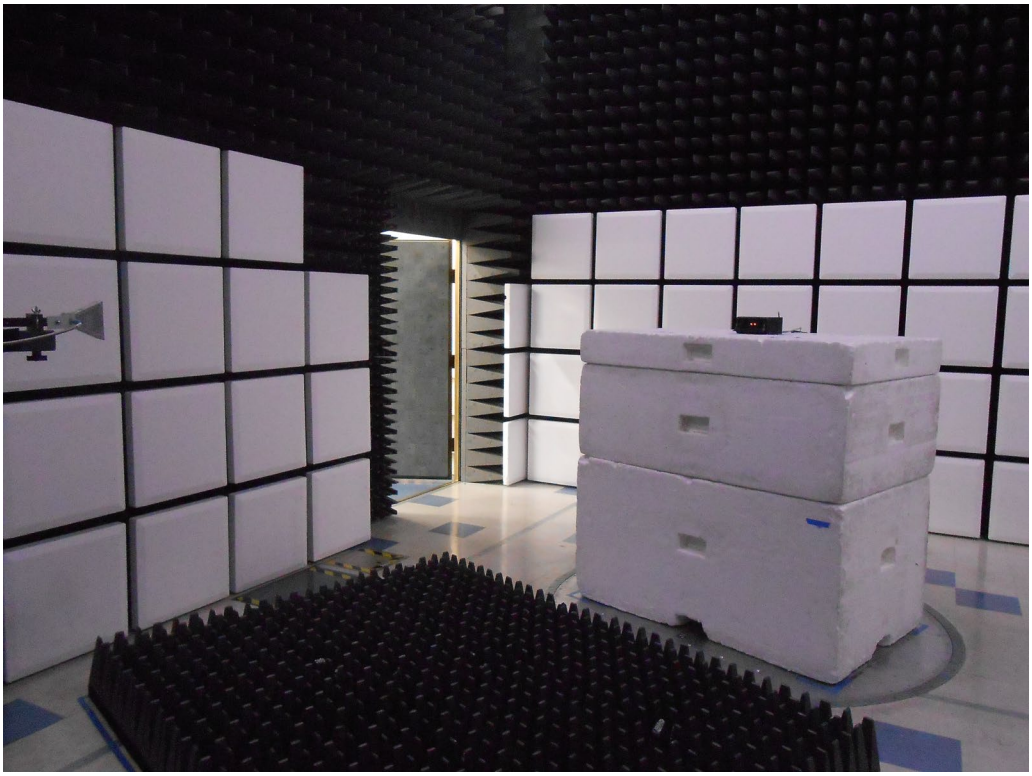
In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT

Test Setup Photos
FCC ID: ACJ9TAWJ-VPU4000
IC: 216A-WJVPU4000

Test Setup Photos
FCC ID: ACJ9TAWJ-VPU4000
IC: 216A-WJVPU4000





Test Setup Photos
FCC ID: ACJ9TAWJ-VPU4000
IC: 216A-WJVPU4000