Testing Tomorrow's Technology

Application

For

Title 47 USC Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, Paragraphs 15.207 and 15.209

And

Industry Canada, Radio Standards Specifications: RSS Gen Issue 5 and RSS-210 Issue 10

For the

Neptune Technology Group, Inc.

Model: Advantage II

FCC ID: P2SNTGADV12O1

IC: 4171B-120O4

UST Project: 20-0256

Issue Date: September 30, 2020

Total Pages in This Report : 20

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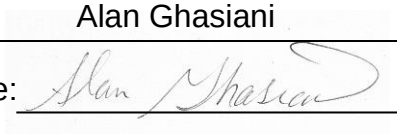
I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date September 30, 2020

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Neptune Technology Group, Inc.
MODEL: Advantage II
FCC ID: P2SNTGADV12O1
IC ID: 4171B-120O4
DATE: September 30, 2020

This report concerns (check one): ☒Original grant ☐Class II Permissive Change

Equipment type: Low Power Transmitter General Field Limits (9 kHz–30 MHz)

Transmitter details:
Frequency of operation: 19.2 kHz
Type of modulation: AMCW
Data/Bit Rate: N/A
Antenna Gain: __proprietary wire wrapped inductive coil__
Maximum Output Power: 84.23 dBuV/m @ 1 m
Software used to program EUT: N/A
EUT firmware number: 0.1.2075.86
Power setting: N/A

Collocated Transmitter:
914 MHz transmitter – FCC ID: P2SNTGADV12O1 (pending approval)
IC: 4171B-120O4

Summary of Test Results

FCC & ISED Rule	Description of Test	Result
RSS-Gen 6.7	99% Occupied Bandwidth	PASS
15.209 & RSS-Gen 6.13, RSS-210, 7.2	Spurious Radiated Emissions	PASS
15.207 & RSS-Gen 8.8, RSS-210, 7.2	Power line Conducted Emissions	PASS

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of conveying test results and information concerning the suitability of this exact product for public distribution according to the FCC Rules and Regulations Part 15, Sections 207 and 209, and IC RSS 210 Issue 10.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on September 8, 2020 in good operating condition.

1.3 Product Description

The equipment under test (EUT) is the Neptune Technology Group, Inc. model Advantage II. It is a handheld probe used to interrogate and read water meter encoders. The EUT includes a 19.2 kHz transmitter (pending approval) that's mounted on the partially extendable rod of the EUT and is designed to read a water meter by interrogating it with a 1200 baud, 19.2 kHz clock. It also includes a low power transmitter programmed to operate at 914 MHz and is designed to transmit the data allowing the data to be read remotely. The operating power of the EUT is 3.65 VDC and is powered by a rechargeable NiCd battery. This report reflects test data for the 19.2 kHz transmitter. Test data for the 914 MHz transmitter will be included in a separate test report.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for FCC subpart B Unintentional Radiators requirements and per *ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for FCC subpart C Intentional Radiators.

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 US5301. 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

The EUT is subject to the additional following FCC authorizations:

a) Certification under section 15.249 as a 902-928 MHz transmitter
b) SDoC under 15 Subpart B as an Unintentional Radiator device

Table 1. EUT and Peripherals

EUT MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
Meter Scanner Neptune Technology Group, Inc.	Advantage II	00013 0028 0004	FCC ID: P2SNTGADV12O1 IC: 4171B-120O4	N/A
PERIPHERAL MANUFACTURER	**MODEL NUMBER**	**SERIAL NUMBER**	**FCC/IC ID**	**CABLES P/D**
Battery Charger PowerStream	3P10-N0508	Engineering Sample	None	P/U

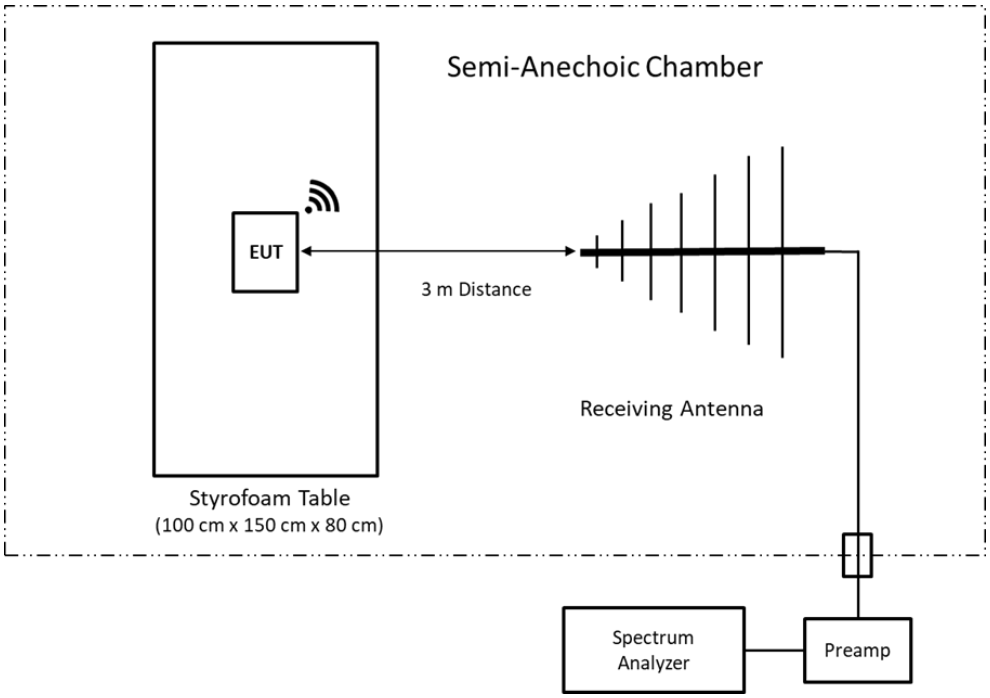


Figure 1. Block Diagram of Test Configuration

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	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	9/02/2022 2 yr.
LOOP ANTENNA	6502	EMCO	9810-3246	4/06/2022 2 yr
BICONICAL ANTENNA	3110B	EMCO	9306-1708	6/27/2021 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	2/01/2021 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	5/13/2021
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	5/13/2021
LISN x2	9247-50-TS-50-N	Solar Electronics	955824 and 955825	5/11/2021

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 to the EUT during testing.

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 19.2 kHz, one test frequency was 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 10th 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:

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.

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.

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 (CFR 15.203)

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.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	TYPE OF CONNECTOR
Antenna 1	Neptune Technology Group	Inductive Loop	Inductive coil loop antenna	solder

Note: This antenna is internally mounted and not user replaceable without damaging the device.

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious emissions cannot exceed the limits of 15.209. Radiated Harmonics and other Spurious Emissions are examined for this requirement; see paragraph 2.1.

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

Power line conducted emissions testing was performed to ensure that with the EUT in operation (exercising all transmitter functions), the complete system continues to meet the applicable requirements for CFR 15.207. Results are displayed along with the 15.107 power line test data in the sections below.

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, (IC RSS 210))

Radiated Radio measurements: The EUT was placed into a continuous transmit mode of operation and a preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the product. To obtain the worst case results, the EUT was placed on a table top of a non-conductive table, 80 cm above the ground floor. The EUT was positioned 3 meters away from the receiving antenna during testing (1 meter at frequencies above 6 GHz and if the emissions were less than 6 dB from the noise floor). The EUT was tested in X, Y and Z axes or the position of normal operation to determine the worst case orientation. Radiated measurements below 30 MHz were tested with a RBW = 9 kHz; emissions below 1 GHz were tested with a RBW = 120 kHz and radiated

measurements above 1 GHz were measured using a RBW =1 MHz. VBW was set to three times the RBW value.

For radiated emissions, any emission that was greater than 20 dB from the applicable limit was not recorded. If radiated emissions above 1 GHz were measured at a distance of 1 meter, the measured value at 1 meter was extrapolated to the results at 3 meters using an inverse distance extrapolation factor of -20 dB/decade. Results are displayed along with the 15.109 test data in the sections below.

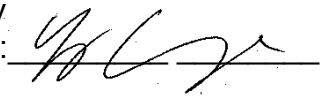
2.10 99% Occupied Bandwidth (IC RSS Gen, 6.7)

According to RSS-Gen, 6.7: The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

Table 5. 99% Occupied Bandwidth

Frequency (kHz)	99% Occupied Bandwidth (kHz)
19.2	4.6539

Test Date: October 13, 2020

Tested By
Signature:  Name: George Yang

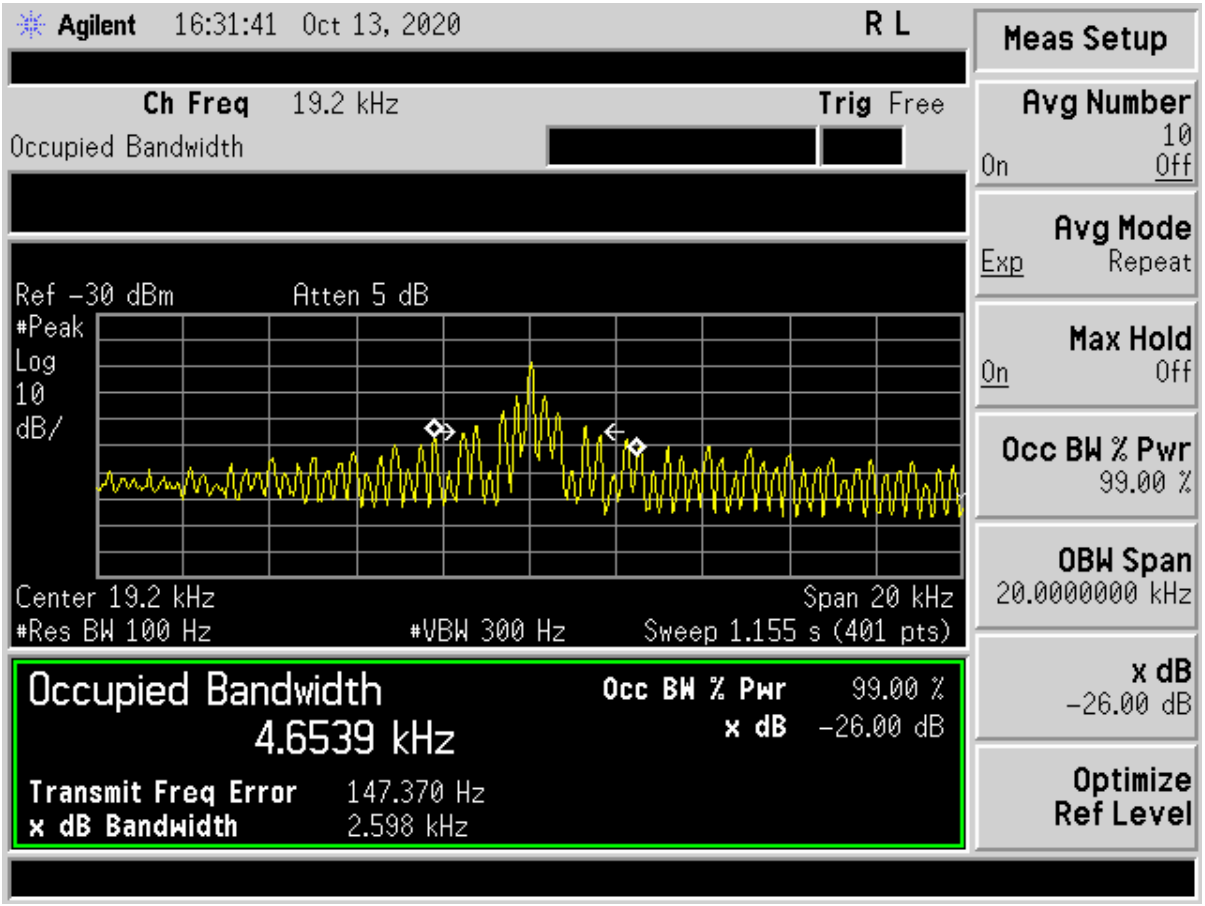


Figure 2. 99% Bandwidth

2.11 Unintentional/Intentional Radiator, Power line Emissions (CFR 15.107 and 15.207)

The power line conducted voltage emissions measurements have been carried out in accordance with CFR 15.107, per ANSI C63.4:2014 and ANSI C63.4:2013, Paragraph 7, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmission.

Table 6. AC Power Line Conducted Emissions Test Data, Phase Line (15.207)

150 kHz to 30 MHz						
Test: FCC Part 15, Para 15.207				**Client:** Neptune Technology Group, Inc.		
Project: 20-0256				**Model:** Advantage II		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
120 Vac / 60 Hz, Phase						
0.1596	61.26	0.07	61.33	*65.5	4.2	**QP**
0.1596	33.48	0.07	33.55	55.5	21.9	**AVG**
0.6070	47.53	0.25	47.78	*56.0	8.2	**QP**
0.6070	25.34	0.25	25.59	46.0	20.4	**AVG**
1.3100	46.61	0.32	46.93	*56.0	9.1	**QP**
1.3100	23.54	0.32	23.86	46.0	22.1	**AVG**
5.2380	43.61	0.00	43.61	50.0	6.4	**PK**
10.5800	36.30	0.31	36.61	50.0	13.4	**PK**
20.4500	26.25	0.88	27.13	50.0	22.9	**PK**

*QP limits were used.

Sample Calculation at: 0.1596 MHz

Magnitude of Measured Frequency	61.26	dBuV
+ LISN + Cable Loss	0.07	dB
Corrected Result	61.33	dBuV/m

Test Date: September 9, 2020

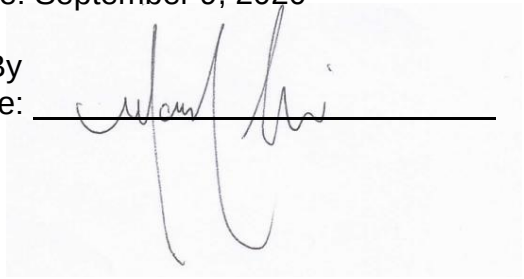
Tested By
Signature:  Name: Mark Afroozi

Table 7. Transmitter Power Line Conducted Emissions Test Data, Neutral Line

150 kHz to 30 MHz						
Test: FCC Part 15, Para 15.207				**Client:** Neptune Technology Group, Inc.		
Project: 20-0256				**Model:** Advantage II		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
120 Vac / 60 Hz, Neutral						
0.1876	53.57	0.12	53.69	*64.1	10.5	**QP**
0.1876	44.22	0.12	44.34	54.1	9.8	**AVG**
0.3749	57.80	0.11	57.91	*58.4	0.5	**QP**
0.3749	43.90	0.11	44.01	48.4	4.4	**AVG**
0.5638	55.21	0.53	55.74	*56.0	0.3	**QP**
0.5638	38.04	0.53	38.57	46.0	7.4	**AVG**
1.6900	52.21	0.57	52.78	*56.0	3.2	**QP**
1.6900	21.58	0.57	22.15	46.0	23.9	**AVG**
5.4630	40.20	0.27	40.47	50.0	9.5	**PK**
11.3000	34.79	0.56	35.35	50.0	14.7	**PK**
20.3800	30.66	1.27	31.93	50.0	18.1	**PK**

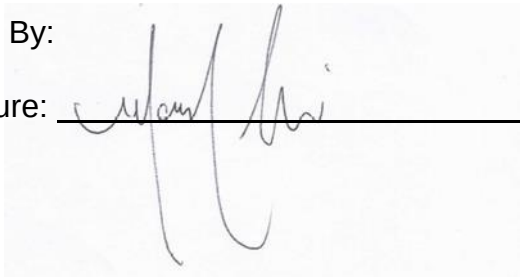
*QP limits were used.

Sample Calculation at: 0.1876 MHz

Magnitude of Measured Frequency	53.57	dBuV
+ LISN + Cable Loss	0.12	dB
Corrected Result	53.69	dBuV/m

Test Date: September 9, 2020

Tested By:

Signature: 

Name: Mark Afroozi

2.12 Unintentional/Intentional Radiator, Radiated Emissions (CFR 15.109 and 15.209)

Radiated emissions disturbance Measurements were performed with EUT in constant transmit mode and using an instrument having both peak and quasi-peak detectors over the frequency range of 9 kHz to 1 GHz. Measurements of the radiated emissions were made with the receiver antenna at a distance of 3 m from the boundary of the test unit.

The test antenna was varied from 1 m to 4 m in height while watching the analyzers' display for the maximum magnitude of the signal at the test frequency. The antenna polarization (horizontal or vertical) and test sample azimuth were varied during the measurements to find the maximum field strength readings to record.

2.13 Radiated Emission Limits - General Requirements

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permItted under other sections of this part, e.g., §§15.231 and 15.241.

Fundamental Limit calculation:
at 19.2 kHz = 2400/19.2 = 125 uV/m @ 300 m
Conversion from uV/m to dBuV/m = 20 log(125) = 41.94 dBuV/m
Conversion from 300 to 3 m = 40 log (300/3)= 80
Limit at 3 meter = 41.94 + 80 = 121.94 dBuV/m

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Table 8. Radiated Emissions 9 kHz to 30 MHz (15.209)

Test: FCC Part 15, Para 15.209				**Client:** Neptune Technology Group, Inc.			
Project: 20-0256				**Model:** Advantage II			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
0.0192	68.37	15.86	84.23	121.9	m./meters.	37.7	**PK**
0.0384	50.53	13.96	64.49	121.9	m./meters.	57.4	**PK**
0.0576	46.12	12.56	58.68	112.4	m./meters.	53.7	**PK**
0.0768	47.08	12.46	59.54	109.9	m./meters.	50.4	**PK**
0.0960	52.64	12.56	65.20	109.9	m./meters.	44.7	**PK**
0.1152	46.20	12.16	58.36	108.0	m./meters.	49.6	**PK**
0.1344	49.58	12.16	61.74	106.4	m./meters.	44.6	**PK**
0.1536	49.66	12.16	61.82	105.0	m./meters.	43.2	**PK**
0.1728	48.56	12.16	60.72	103.9	m./meters.	43.2	**PK**
0.1920	47.27	12.16	59.43	106.4	m./meters.	46.9	**PK**

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

Sample Calculation at 0.0192 MHz:

Magnitude of Measured Frequency	68.37	dBuV
+ Antenna Factor + Cable Loss - Amplifier Gain	15.86	dB/m
Corrected Result	84.23	dBuV/m

Test Date: September 9, 2020

Tested By

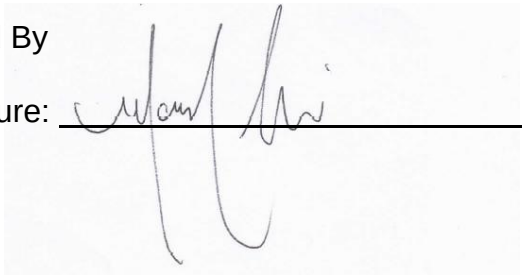
Signature:  Name: Mark Afroozi

Table 9. Intentional Spurious Radiated Emissions (CFR 15.209), 30 to 1 GHz

30 MHz to 1000 MHz with Class B Limits							
Test: FCC Part 15, Para 15.209				**Client:** Neptune Technology Group, Inc.			
Project: 20-0256				**Model:** Advantage II			
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**
115.85	50.37	-15.02	35.35	43.5	3m./HORZ	8.1	**QP**
177.05	54.35	-12.18	42.17	43.5	3m./HORZ	1.3	**QP**
214.00	55.07	-14.28	40.79	43.5	3m./HORZ	2.7	**PK**
404.00	48.25	-9.35	38.90	46.0	3m./VERT	7.1	**PK**

SAMPLE CALCULATION at 115.85 MHz:

Magnitude of Measured Frequency	50.37	dBuV
+ Antenna Factor + Cable Loss - Amp Gain	-15.02	dB
Corrected Result	35.35	dBuV

Test Date: September 9, 2020

Tested By

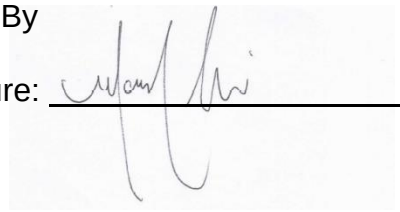
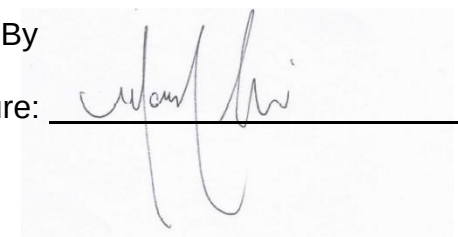
Signature:  Name: Mark Afroozi

Table 10. Intentional Spurious Radiated Emissions (CFR 15.209), 1 to 6 GHz

1000 MHz to 6000 MHz with Class B Limits							
Test: FCC Part 15, Para 15.209				**Client:** Neptune Technology Group, Inc.			
Project: 20-0256				**Model:** Advantage II			
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**
All emissions were more than 20 dB below the limit.							

Test Date: September 9, 2020

Tested By

Signature:  Name: Mark Afroozi

2.14 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%.

2.14.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.85 dB. 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.

2.14.2 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 ± 5.40 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 ± 5.19 dB.

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.

3 Conclusions

The EUT meets the requirements of Part 15.207/209 of Subpart C and RSS-Gen and RSS-210 based on the test results presented in this test report.