Excellence in Compliance Testing

Certification Test Report

FCC ID: P2SNTGR900IV3
IC: 4171B-R900IV3

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

ACS Report Number: 11-0359.W06.12.A

Manufacturer: Neptune Technology Group, Inc.
Model: R900i SP

Test Begin Date: September 29, 2011
Test End Date: September 30, 2011

Report Issue Date: November 29, 2011

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

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

Reviewed by: _____

Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 18 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 Certification.

1.2 Product Description

The R900i SP is an integrated register designed for operation in water meter RF telemetry to collect meter reading data. The R900i SP transmits data using frequency-hopping spread-spectrum technology to ensure data security and improve meter reading accuracy. The R900i SP also communicates using a single channel data logging mode.

Technical Details:

The EUT provides the following modes of operation.

Mode of Operation	Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)
Frequency Hopping	911.0815 - 919.0769	50	130
Data Logging	914.0	1	N/A

Modulation format: OOK
Antenna Type/Gain: Internal: PIFA, Skywave Antennas Inc., P/N:1B-1006-PIFA, -3dBi
External: Patch, Neptune Technologies Group Inc., P/N:12527-XXX, 0dBi
Operating Voltage: 3.6VDC Lithium Battery

Manufacturer Information:
Neptune Technology Group, Inc.
1600 Alabama Highway 229
Tallassee, AL 36078

Test Sample Serial Number(s): 804

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

1.3 Test Methodology and Considerations

The device uses two modes of operations. There is a frequency hopping mode and a single channel data log mode. The single channel data log mode is compliant to FCC 15.249 and is covered under this test report. A separate report covers the frequency hopping mode under 15.247.

The R900i SP utilizes an internal antenna by default. This antenna is manufactured by Skywave Antennas Inc., part number 1B-1006- PIFA and has approximately -3dBi gain when configured in the unit. An optional external antenna manufactured by Neptune Technology Group Inc., part number 12527-XXX can be used in Pit applications to improve system link performance by providing approximately 0dBi gain. The external Pit antenna is a patch antenna, which is fabricated for road and traffic conditions. The R900i SP is placed into the water-utility Pit and antenna is mounted on the Pit's lid. The external Pit antenna is connected to the R900i SP via a coax cable and special hermetic connector. Both antenna configurations were evaluated and data provided in this report.

2 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 511277
Industry Canada Lab Code: IC 4175A-1
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm 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 3/4" stainless steel braided cable.

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 range. 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 during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases 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:

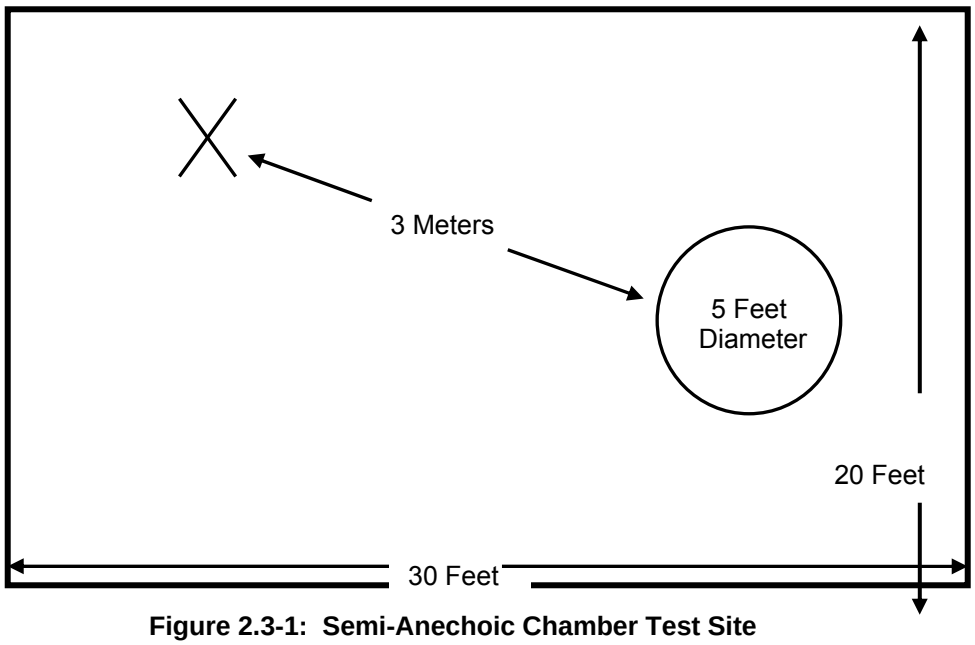


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. 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 during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room 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. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

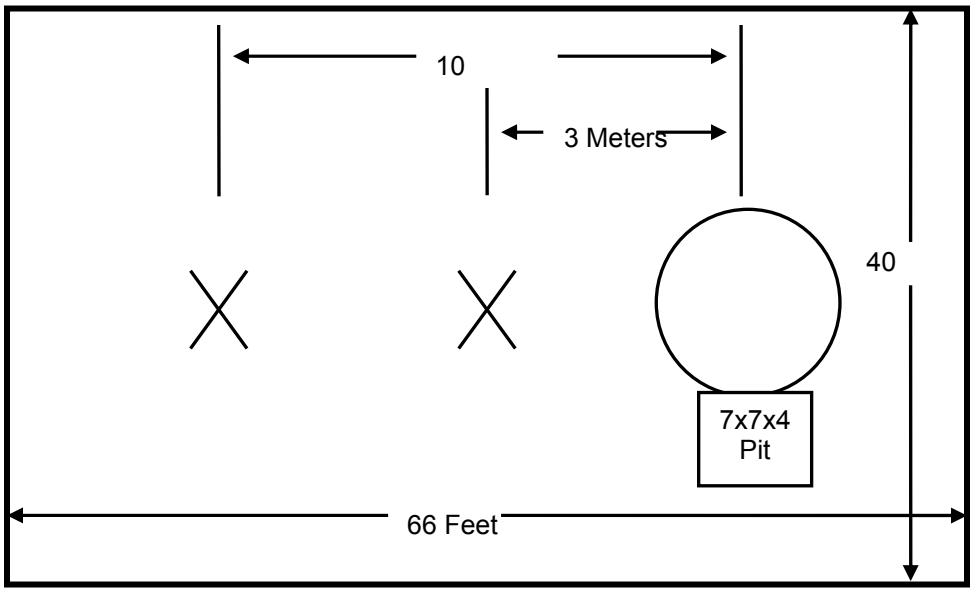


Figure 2.3-2: Open Area Test Site

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 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

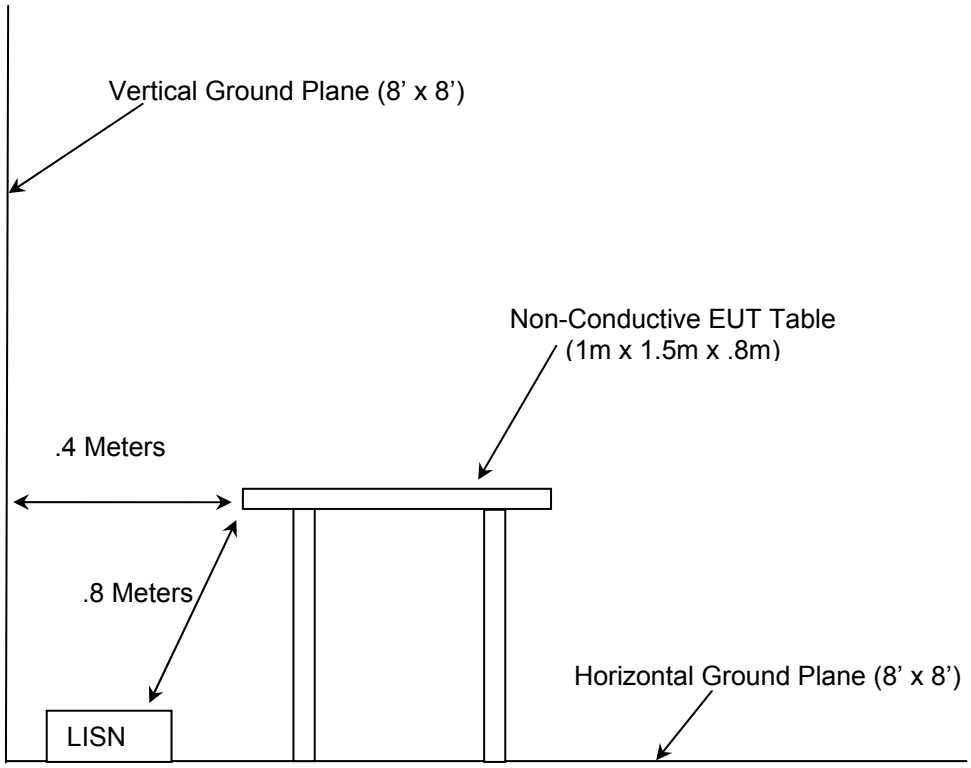


Figure 2.4-1: AC Mains Conducted EMI Site

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
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2011
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2011
- 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

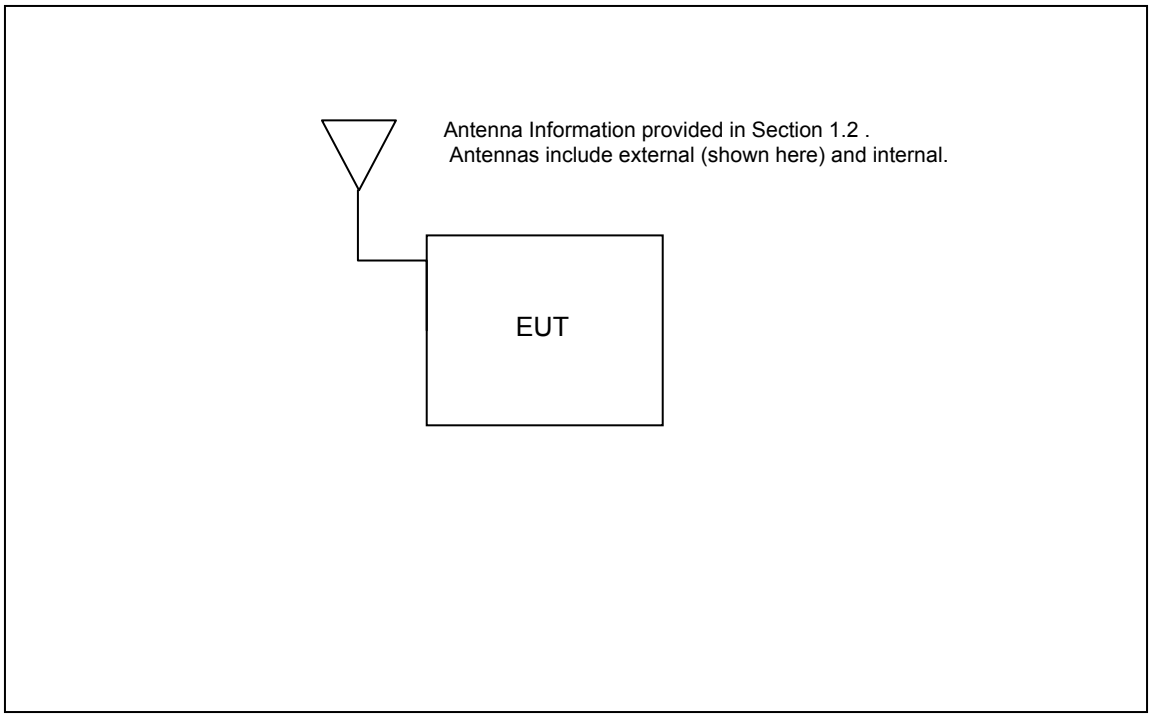
AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	9/23/2010	9/23/2012
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	9/23/2010	9/23/2012
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/27/2011	4/27/2013
41	Electro-Metrics	BIA-25	Antennas	2925	12/21/2010	12/21/2012
73	Agilent	8447D	Amplifiers	2727A05624	3/21/2011	3/21/2012
167	ACS	Chamber EMI Cable Set	Cable Set	167	1/26/2011	1/26/2012
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/26/2011	8/26/2012
291	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	None	12/7/2010	12/7/2011
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	4/11/2011	4/11/2012
331	Microwave Circuits	H1G513G1	Filters	31417	7/11/2011	7/11/2012
338	Hewlett Packard	8449B	Amplifiers	3008A01111	3/24/2011	3/24/2012
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	8/29/2011	8/29/2012
412	Electro Metrics	LPA-25	Antennas	1241	7/28/2010	7/28/2012
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	12/29/2010	12/29/2011

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
The EUT was tested and operates stand alone therefore no support equipment was utilized.				

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 external patch antenna interfaces with the EUT via a coax cable and special hermetic connector. The internal PIFA antenna is integral to the EUT and cannot be removed or modified without permanently damaging the device. Professional installation is applicable.

7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.4

7.2.1 Measurement Procedure

The EUT is battery operated therefore AC power line conducted emissions is not applicable.

7.3 Output Power - FCC Section 15.247(b)(2) IC: RSS-210 A8.4(1)

7.3.1 Measurement Procedure (Conducted Method)

The RF output of the equipment under test was directly connected to the input of the spectrum analyzer via the appropriate match pad and attenuators. The spectrum analyzer RBW was set such that RBW >> EBW. Data was collected with the EUT operating at maximum power per channelization.

7.3.2 Measurement Results

Results are shown below in Table 7.3.2-1 and Figures 7.3.2-1 to 7.3.2-2 below:

Table 7.3.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
911.0815	23.42
919.0769	22.60

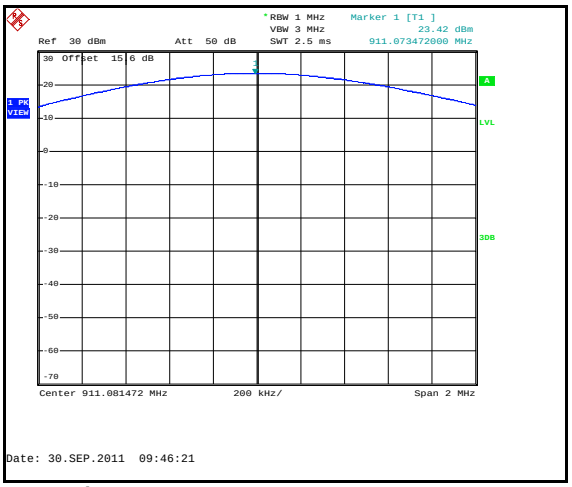


Figure 7.3.2-1: Output Power – 911.0815MHz

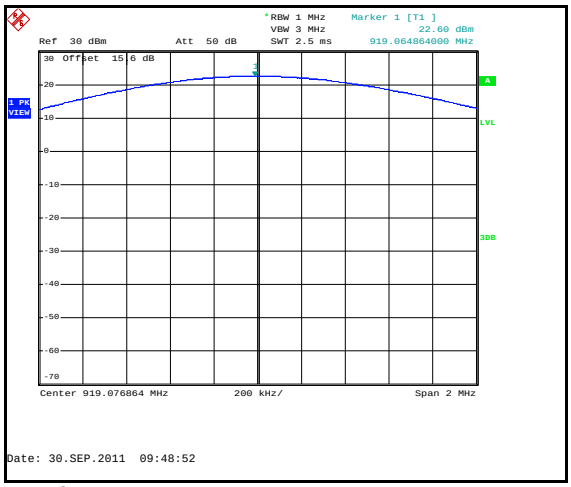


Figure 7.3.2-2: Output Power – 919.0769MHz

7.4 Channel Usage Requirements

7.4.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1) IC: RSS-210 A8.1(b)

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to ≥ 1% of the span.

7.4.1.2 Measurement Results

The adjacent channel separation was measured as 130 kHz. Results are shown below in Figure 7.4.1.2-1.

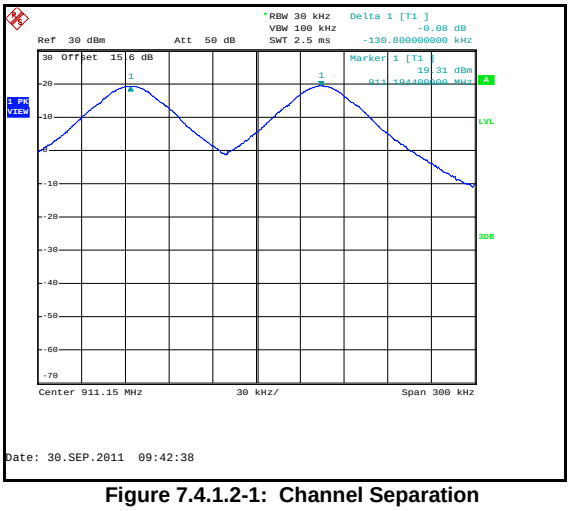


Figure 7.4.1.2-1: Channel Separation

7.4.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

The minimum 20dB bandwidth of the device is less than 250 kHz. The device employs ≥ 50 hopping channels as required. Results are shown below in Figure 7.4.2-1.

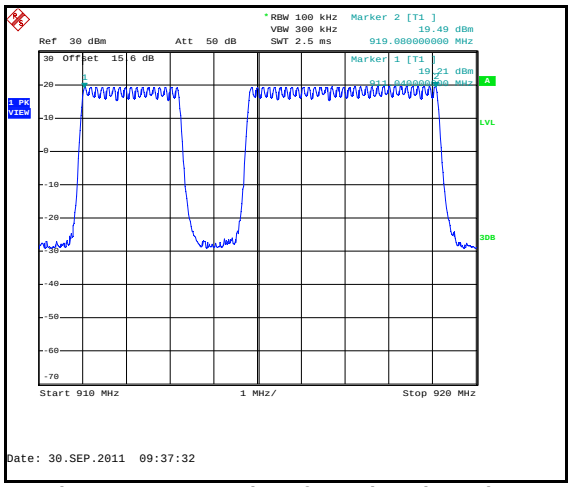


Figure 7.4.2-1: Number of Hopping Channels

7.4.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

7.4.3.1 Measurement Procedure

The emission measured centered on the analyzer and the span set to 0 Hz. The RBW was set to 1 MHz and the VBW to 3MHz. Sweep time was set to 15 ms to capture the burst duration of the emission. The marker – delta function of the analyzer was employed to measure the burst duration.

7.4.3.2 Measurement Results

The duration of the RF transmission was measured as 7 ms. There is a minimum 14 second rest period in which the device hops to another channel according to the pseudorandom frequency table before transmitting another 7 ms burst. Therefore the average time of occupancy on any channel in a 20 second period is 7ms. A single transmission is shown in figure 7.4.3.2-1 below:

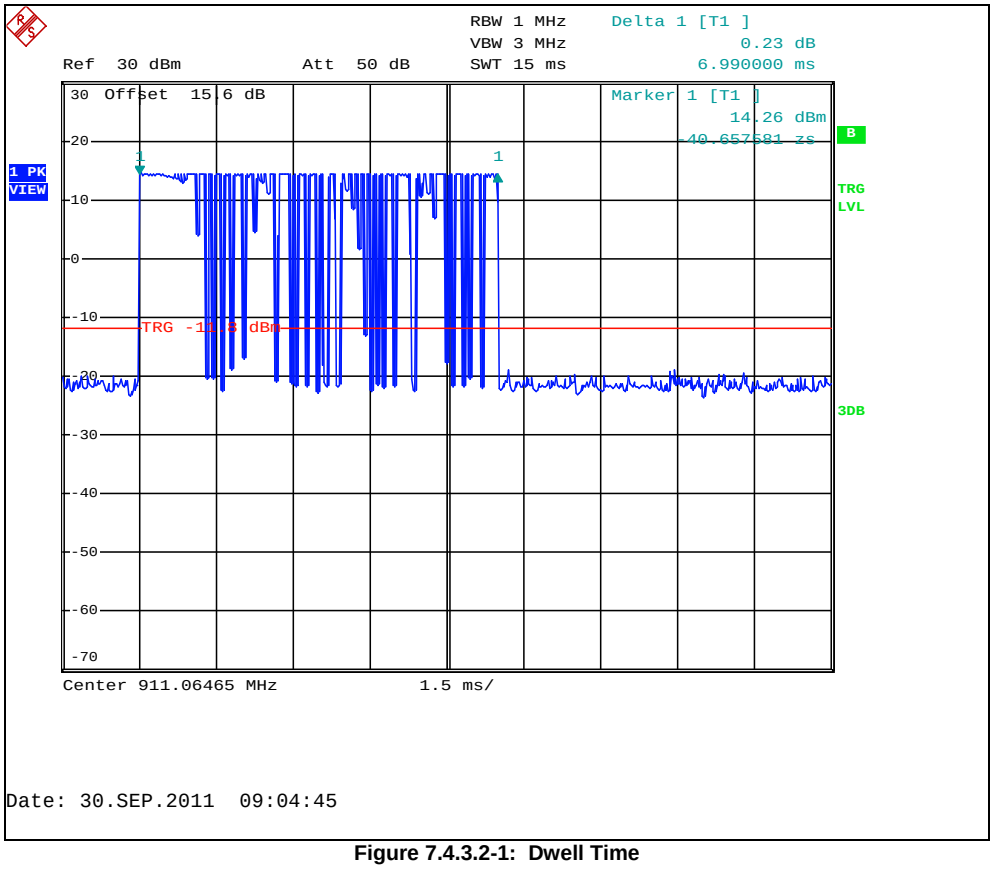


Figure 7.4.3.2-1: Dwell Time

7.4.4 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-210 A8.1(c)

7.4.4.1 Measurement Procedure

The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission and side bands. The RBW was to ~ 1% of the span. The trace was set to max hold with a sample detector. The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth.

7.4.4.2 Measurement Results

Results are shown below in Table 7.4.4.2-1 and Figures 7.4.4.2-1 through 7.4.4.2-4.

Table 7.4.4.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
911.0815	65.4	83.4
919.0769	66.6	81.6

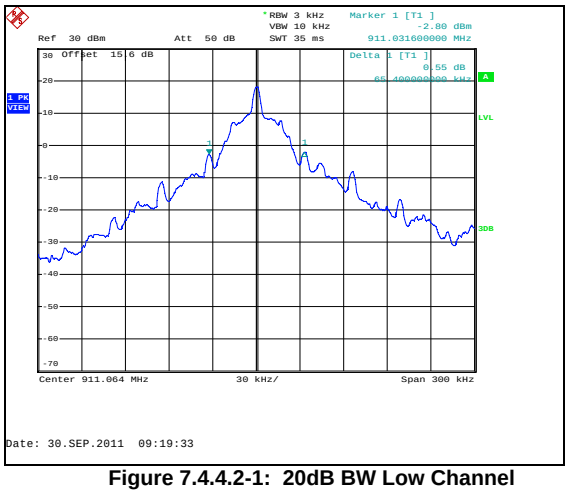


Figure 7.4.4.2-1: 20dB BW Low Channel

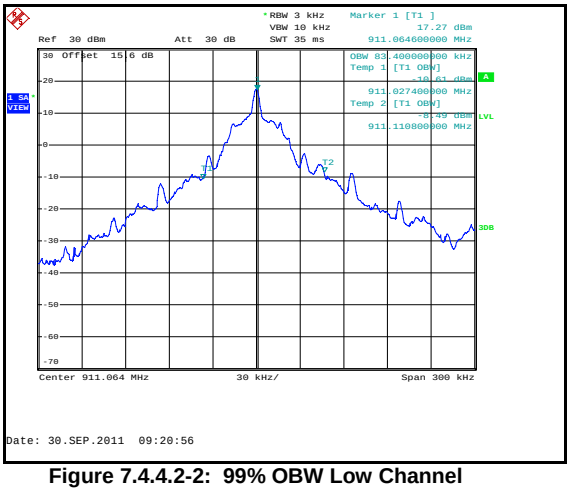


Figure 7.4.4.2-2: 99% OBW Low Channel

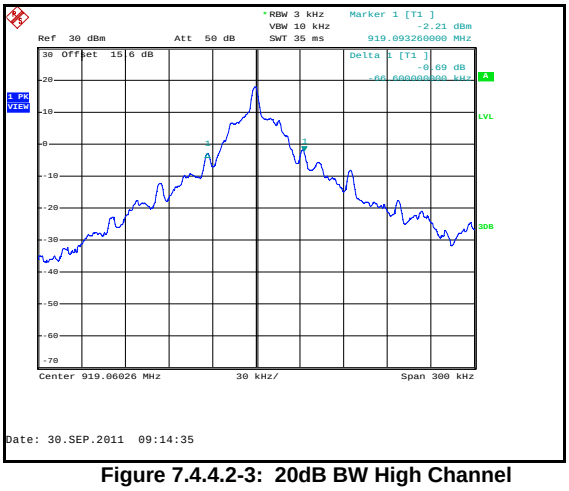


Figure 7.4.4.2-3: 20dB BW High Channel

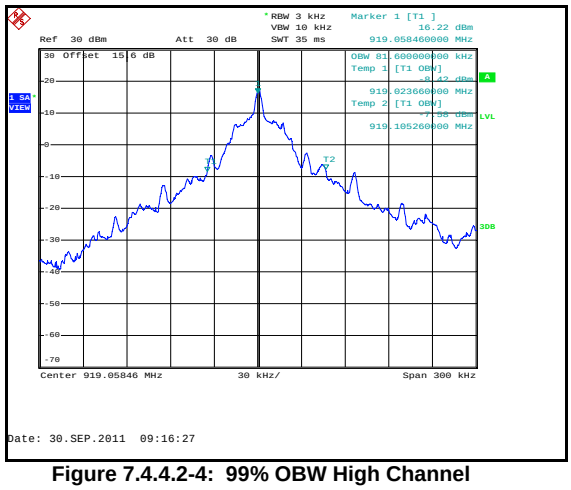


Figure 7.4.4.2-4: 99% OBW High Channel

7.5 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-210 2.2, A8.5

7.5.1 Band-Edge Compliance of RF Conducted Emissions

7.5.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300kHz.

7.5.1.2 Measurement Results

Results are shown in the figures 7.5.1.2-1 to 7.5.1.2-4 below.

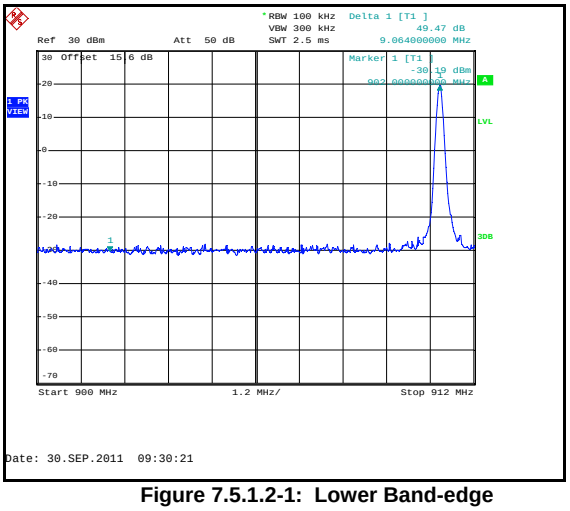


Figure 7.5.1.2-1: Lower Band-edge

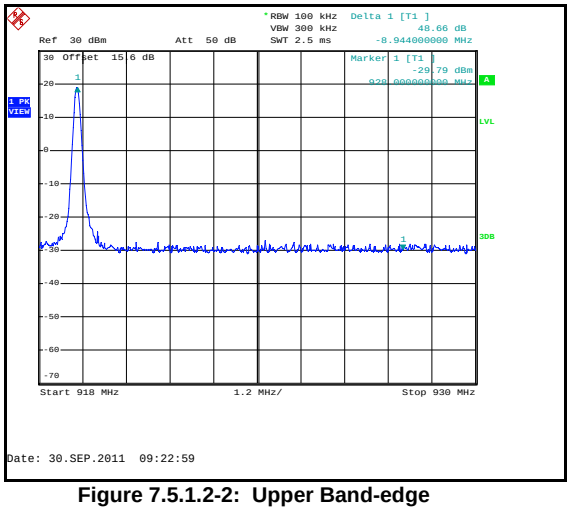


Figure 7.5.1.2-2: Upper Band-edge

HOPPING MODE:

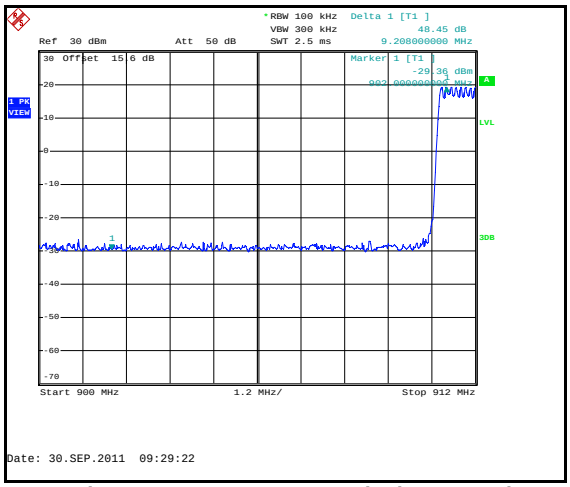


Figure 7.5.1.2-3: Lower Band-edge – Hopping

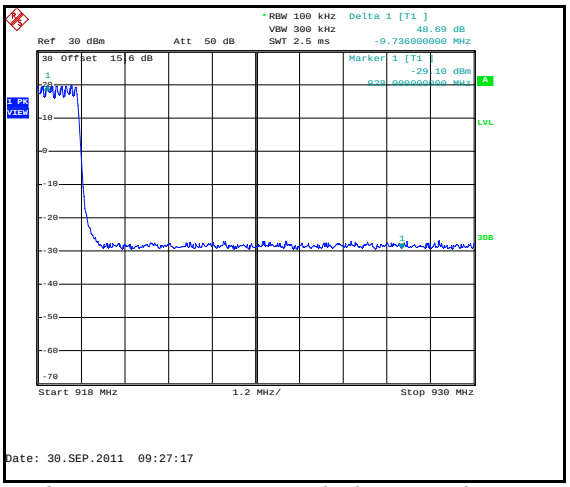


Figure 7.5.1.2-4: Upper Band-edge – Hopping

7.5.2 RF Conducted Spurious Emissions

7.5.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements were made at the low and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100kHz. A peak detector function was used with the trace set to max hold.

7.5.2.2 Measurement Results

Results are shown below in Figures 7.5.2.2-1 to 7.5.2.2-4:

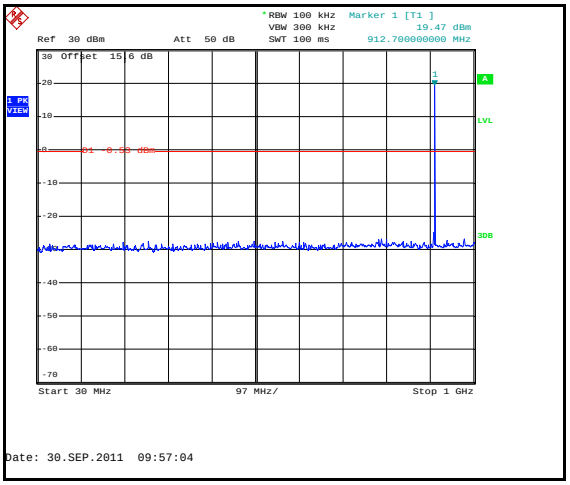


Figure 7.5.2.2-1: 30 MHz – 1 GHz – Low Channel

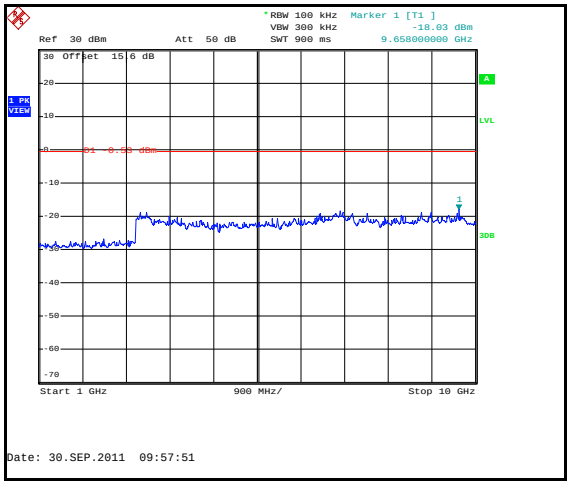


Figure 7.5.2.2-2: 1 GHz – 10 GHz – Low Channel

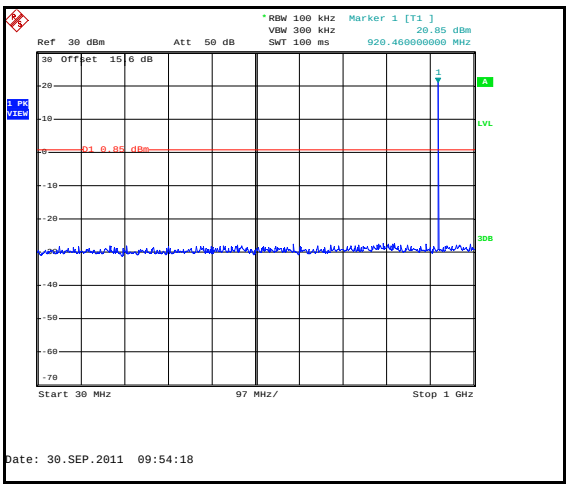


Figure 7.5.2.2-3: 30 MHz – 1 GHz – High Channel

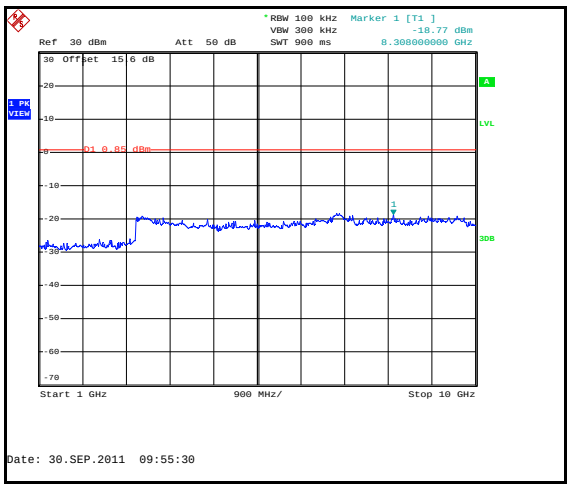


Figure 7.5.2.2-4: 1 GHz – 10 GHz –High Channel

7.5.3 Radiated Spurious Emissions (Restricted Bands)

7.5.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 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 1000MHz, peak and average measurements made with RBW and VBW of 1 MHz and 3MHz respectively.

The EUT was operating in a pulsed mode therefore peak emissions were taken for comparison to the average limits, after taking into account the duty cycle provided in 7.5.2.

7.5.3.2 Duty Cycle Correction

For average radiated measurements, using a 7% duty cycle, the measured level was reduced by a factor 23.1dB. The duty cycle correction factor is determined using the formula: 20log (0.07/100) = -23.1dB. See Section 7.4.3 for details.

7.5.3.3 Measurement Results

Radiated spurious emissions are reported in the Tables 7.5.3.3-1 to 7.5.3.3-2 below.

Table 7.5.3.3-1: Radiated Spurious Emissions Tabulated Data – Internal Antenna

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										
2733.243	54.00	54.00	H	-3.92	50.08	26.98	74.0	54.0	23.9	27.0
2733.243	54.99	54.99	V	-3.92	51.07	27.97	74.0	54.0	22.9	26.0
4555.405	53.14	53.14	H	1.47	54.61	31.51	74.0	54.0	19.4	22.5
4555.405	52.42	52.42	V	1.47	53.89	30.79	74.0	54.0	20.1	23.2
High Channel										
2757.2307	49.99	49.99	H	-3.86	46.13	23.03	74.0	54.0	27.9	31.0
2757.2307	52.42	52.42	V	-3.86	48.56	25.46	74.0	54.0	25.4	28.5
3676.3076	53.87	53.87	V	-0.23	53.64	30.54	74.0	54.0	20.4	23.5
4595.3845	53.59	53.59	H	1.54	55.13	32.03	74.0	54.0	18.9	22.0
4595.3845	55.23	55.23	V	1.54	56.77	33.67	74.0	54.0	17.2	20.3

Table 7.5.3.3-2: Radiated Spurious Emissions Tabulated Data – External Antenna

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										
2733.243	60.32	60.32	H	-3.92	56.40	33.30	74.0	54.0	17.6	20.7
2733.243	58.01	58.01	V	-3.92	54.09	30.99	74.0	54.0	19.9	23.0
4555.405	54.38	54.38	H	1.47	55.85	32.75	74.0	54.0	18.2	21.3
4555.405	53.90	53.90	V	1.47	55.37	32.27	74.0	54.0	18.6	21.7
High Channel										
2757.2307	55.17	55.17	H	-3.86	51.31	28.21	74.0	54.0	22.7	25.8
2757.2307	56.89	56.89	V	-3.86	53.03	29.93	74.0	54.0	21.0	24.1
4595.3845	56.56	56.56	H	1.54	58.10	35.00	74.0	54.0	15.9	19.0
4595.3845	55.27	55.27	V	1.54	56.81	33.71	74.0	54.0	17.2	20.3

7.5.3.4 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
Corrected Level: 54 - 3.92 = 50.08dBuV/m
Margin: 74dBuV/m – 50.08dBuV/m = -23.9dB

Example Calculation: Average
Corrected Level: 54 - 3.92 - 23.1 = 26.98dBuV
Margin: 54dBuV – 26.98dBuV = 27.0dB

8 CONCLUSION

In the opinion of ACS, Inc. the R900i SP, manufactured by Neptune Technology Group, Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT