RF Test Report

FCC ID: P2SNTGPKT11O1
IC: 4171B-12O88

FCC Rule Parts: 15.209
ISED Canada Radio Standards Specification: RSS-210

Report Number: AT72161635-1C2

Manufacturer: Neptune Technology Group
Model: Pocket ProReader RF

Test Begin Date: August 3, 2020
Test End Date: August 24, 2020

Report Issue Date: September 3, 2020

FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

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This report contains 20 pages

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate continued compliance with Parts 15.209 of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-210 for certification.

1.2 Applicant Information

Neptune Technology Group
1600 AL-229 South
Tallassee, Alabama 36078

1.3 Product Description

The Pocket ProReader RF Visual Reading Device is a compact visual reading device designed for reading remote receptacle pads. With the Pocket ProReader RF, meter readers can test new installations, obtain readings and meter identification numbers in a faster, more efficient manner. The Pocket ProReader RF can be conveniently carried in a pocket or clipped to a belt.

Technical Details

The model Pocket ProReader RF Visual Reading Device houses 2 distinct radios. This report documents the compliance of the Proprietary Near Field Communication radio.

Technical Information (Proprietary NFC):

Detail	Description
Frequency Range (kHz)	19.2 kHz
Number of Channels	1
Modulation Format	Biphase / AMCW
Data Rates	1200 baud
Operating Voltage (Host)	120Vac, 60Hz (Supplied Battery Charger) 3.7Vdc (Internal Rechargeable Battery)
Antenna Type / Gain	Proprietary Wire-Wrapped Inductive Coil

Test Sample Serial Number(s): "FCC"

Test Sample Condition: The equipment was provided in good condition without any physical damage.

1.4 Test Methodology and Considerations

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was the Z-orientation. See test setup photos for more information. The radio was continuously modulated at 19.2kHz. The EUT was labeled "Turn off before charging", therefore radiated emissions testing was performed on internal battery power only.

For power line conducted emissions, the EUT was evaluated while directly connected to the AC mains through a manufacturer supplied battery charger. The EUT was powered off while charging.

Intermodulation products were evaluated for all combinations of simultaneous transmission and found to comply.

Power setting during test: Power set in hardware (no software selectivity)

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Designation Accreditation Number:	US1233
FCC Test Site Registration Number:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

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 5' in diameter and is located 5'6" 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 EMCO Model 1060 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 chase from the turntable to the pit that allows 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 chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

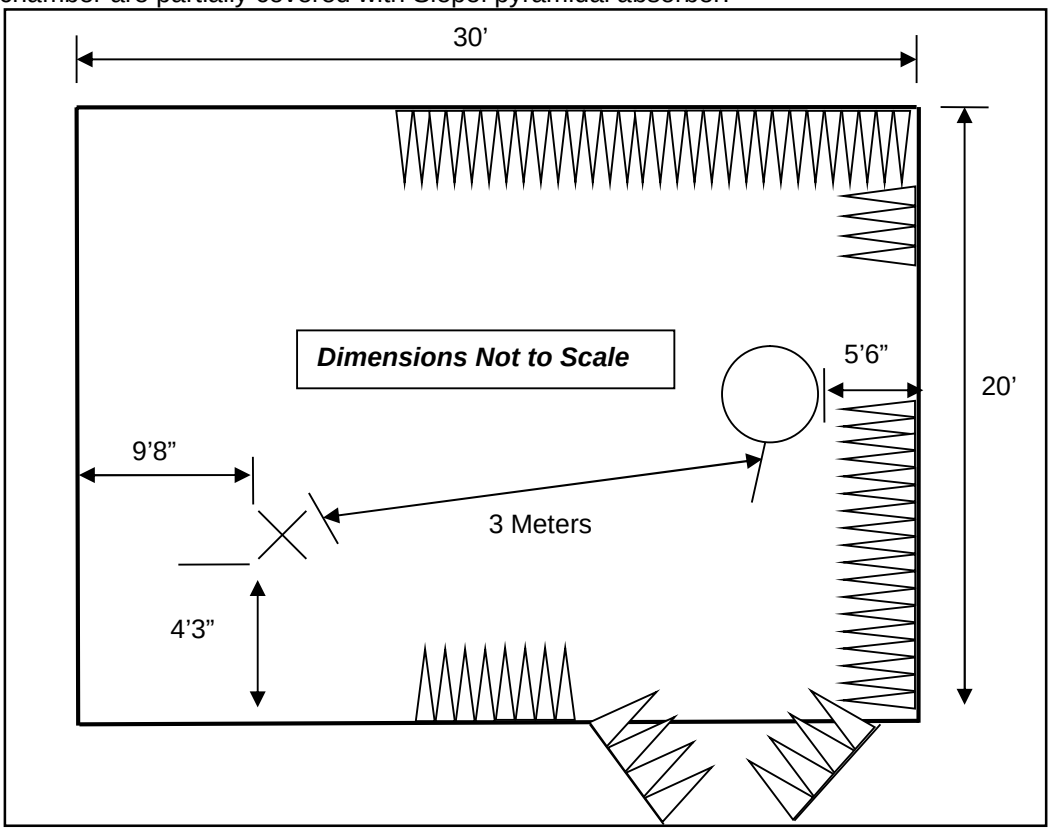


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" 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 shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

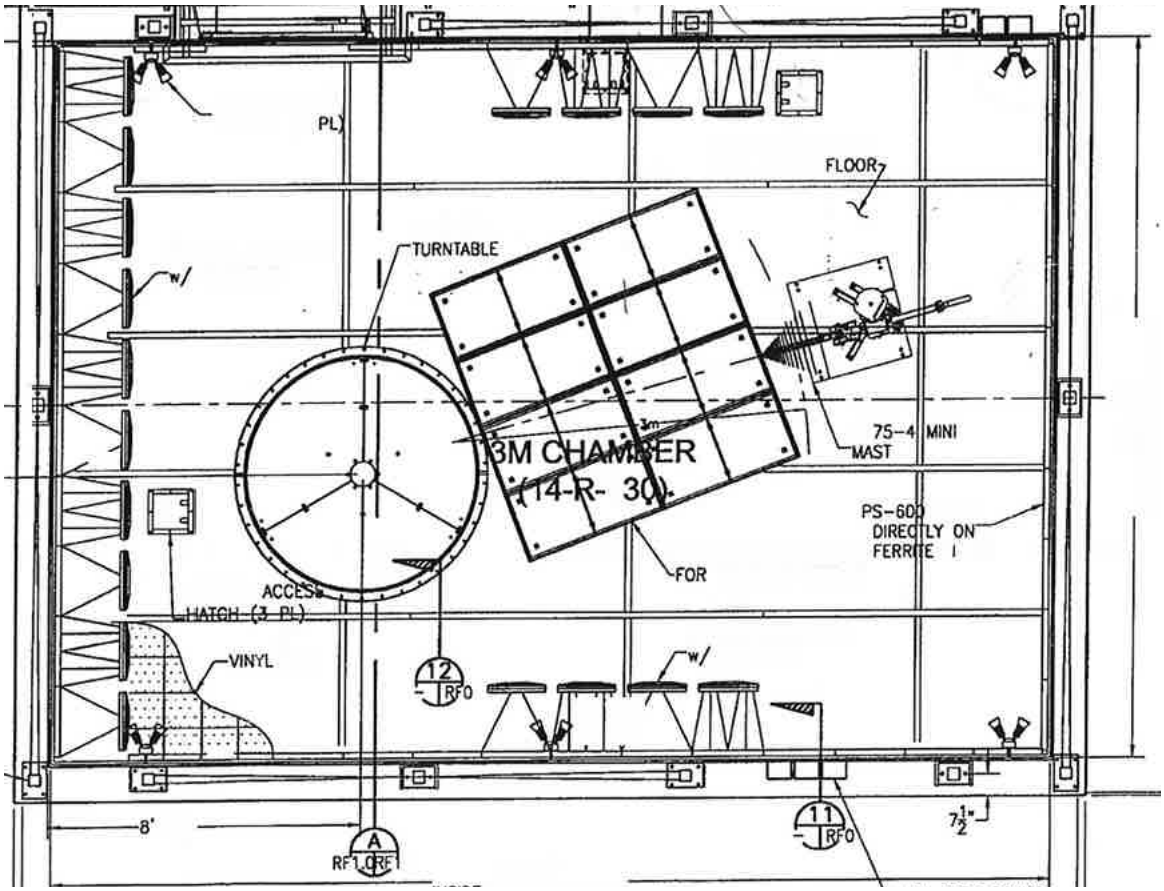


Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane (HCP) as well as a 12'x8' vertical coupling plane (VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test tabletop and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

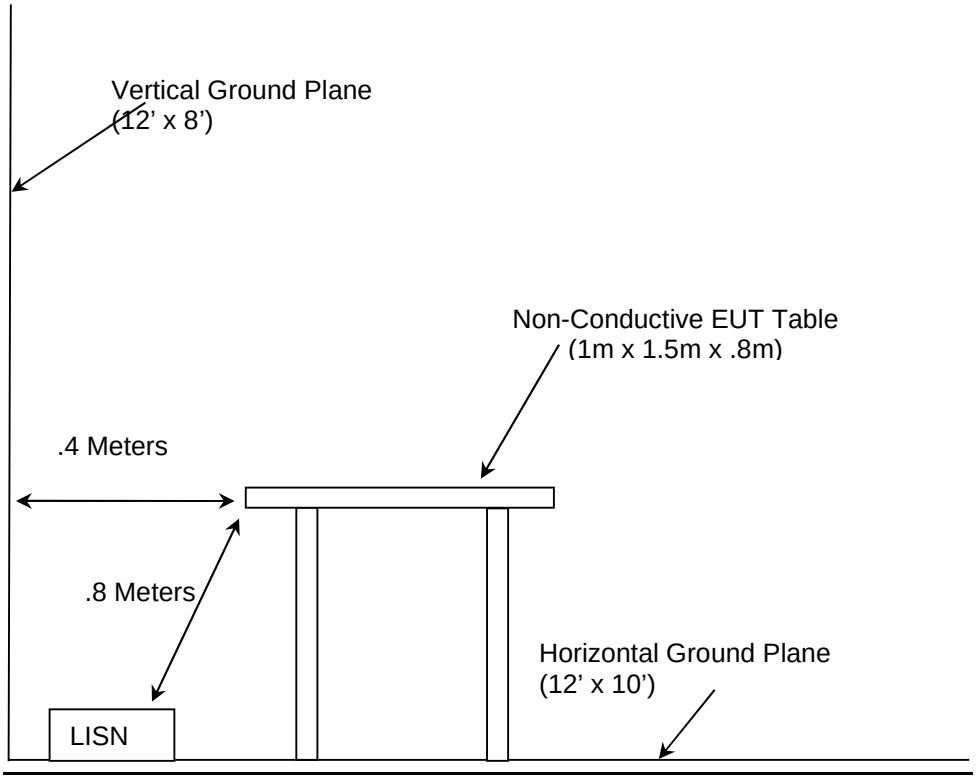


Figure 2.4.1-1: AC Mains Conducted EMI Site

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, 2020
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-210 – Licence-Exempt Radio Apparatus: Category I Equipment, Issue 10, December 2019
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, April 2018, Amendment March 2019

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 Number	Last Calibration Date	Calibration Due Date
213	TEC	PA 102	Amplifier	44927	07/30/2020	07/30/2021
324	ACS	Belden	Conducted EMI Cable	8214	04/03/2020	04/03/2021
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/15/2019	07/15/2021
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	02/11/2019	11/02/2021
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz	697WW30606	03/03/2020	03/03/2021
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	05/11/2020	05/11/2021
853	Teseq	CBL 6112D; 6804.17.A	Bilog Antenna; Attenuator	51616; 20181110A	10/15/2018	10/15/2020
857	ETS Lindgren	3117	Horn Antenna 1-18GHz	00153608	11/12/2019	11/12/2021
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	06/23/2020	06/23/2021
RE880	Rhode & Schwarz USA	ESW44	Test Receiver	1206247	04/02/2020	04/02/2021

NOTE: All test equipment was used only during active calibration cycles.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	PocketPro Reader	Neptune Technology Group	Pocket ProReader RF	FCC
2	AC-DC Battery Charger	PowerStream Technology	3P10-N0508	N/A

Table 5-2: Cable Description

Item	Cable Type	Length	Shield	Termination
A	DC Power Cable	150 cm	No	EUT – AC-DC Battery Charger
B	AC Power Cable	100 cm	No	AC-DC Battery Charger – AC Mains

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

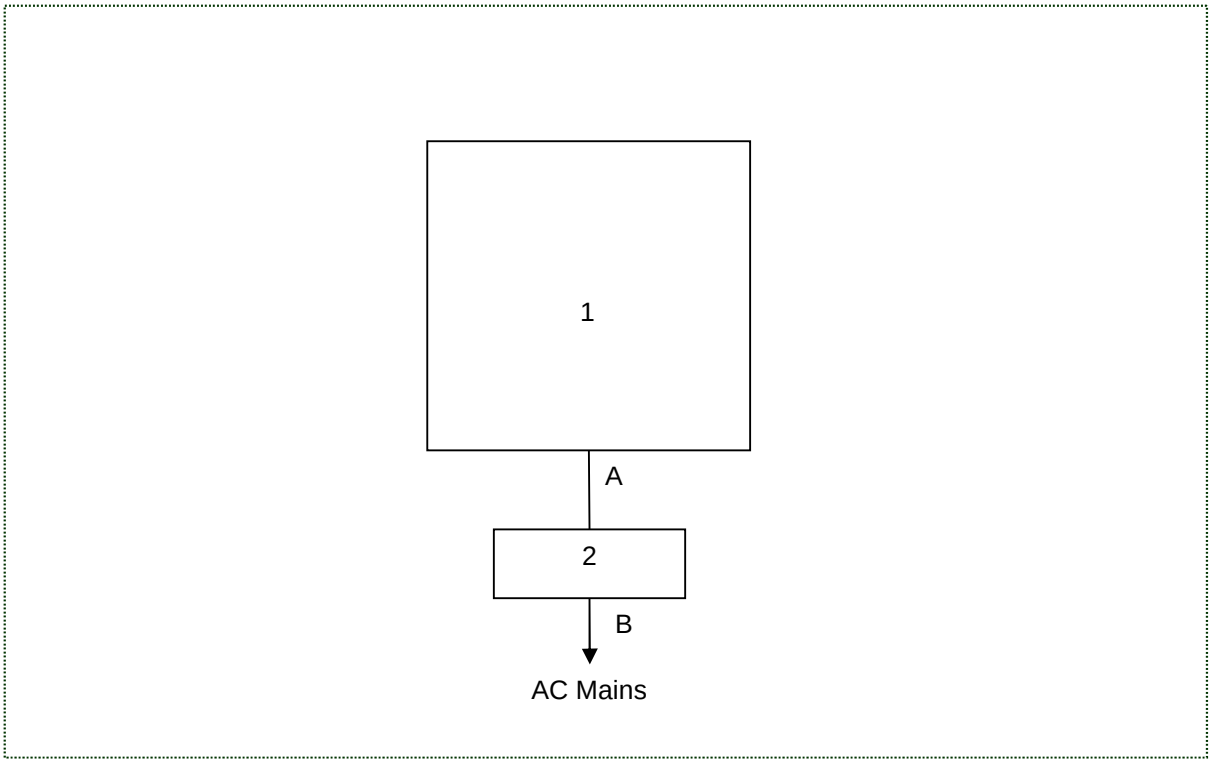


Figure 6-1: Test Setup Block Diagram

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 15.203

The EUT utilizes internal Proprietary Wire-Wrapped Inductive Coil Antenna that cannot be removed without damage to the device, therefore satisfying the requirements of FCC Part 15.203.

7.2 Power Line Conducted Emissions – FCC 15.207, ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

ANSI C63.10 section 6 was the guiding documents 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 = Corrected Reading – Applicable Limit

7.2.2 Measurement Results

Performed by: Sean Vick

Table 7.2.2-1: Conducted EMI Results – Line

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)	
0.158	51.54	29.68	65.57	55.57	14.03	25.89	9.43
0.166	57.09	35.77	65.16	55.16	8.07	19.39	9.44
0.202	56.87	24.08	63.53	53.53	6.66	29.45	9.45
0.218	24.12	10.44	62.89	52.89	38.77	42.45	9.46
0.25	23.88	10.23	61.76	51.76	37.88	41.53	9.46
0.29	24.42	10.25	60.52	50.52	36.1	40.27	9.48
0.302	23.89	10.25	60.19	50.19	36.3	39.94	9.48
0.326	29.59	22.33	59.55	49.55	29.96	27.22	9.47
0.338	29.21	10.25	59.25	49.25	30.04	39	9.47
0.378	34.38	16.56	58.32	48.32	23.94	31.76	9.46

Table 7.2.2-2: Conducted EMI Results – Neutral

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average	
	(dBµV)	(dBµV)	(dBµV)	(dBµV)	(dB)	(dB)	
0.15	27.53	26.74	66	56	38.47	29.26	9.41
0.182	26.05	16.4	64.39	54.39	38.34	37.99	9.42
0.366	25.55	11.37	58.59	48.59	33.04	37.22	9.43
0.374	41.02	33.58	58.41	48.41	17.39	14.83	9.43
0.382	33.54	14.32	58.24	48.24	24.7	33.92	9.43
0.55	26.95	10.38	56	46	29.05	35.62	9.43
0.562	39.13	31.41	56	46	16.87	14.59	9.44
1.494	37.97	17.78	56	46	18.03	28.22	9.47
1.682	33.41	21.07	56	46	22.59	24.93	9.48
1.87	31.57	20.35	56	46	24.43	25.65	9.48

7.3 Radiated Spurious Emissions – FCC: Section 15.209, ISED Canada: RSS-210 2.5

7.3.1.1 Measurement Procedure

Section 15.33(a)(4) specifies, if the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to frequency specified in 15.33(b)(1) for unintentional radiators. The upper frequency range for the digital device is 18GHz which greater than the 10th harmonic of the fundamental frequency. The upper frequency range measured was 18GHz.

Measurements below 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated through three orthogonal axis. The magnetic loop receiving antenna was positioned with its lowest point 1 meter above the ground.

The spectrum analyzer's resolution and video bandwidth was set to 200 Hz and 1 kHz respectively for frequencies below 150 kHz and 9 kHz and 30 kHz respectively for frequencies above 150 kHz and below 30 MHz. For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an peak detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a peak detector.

Measurements above 30 MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. 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 1000 MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz.

For measurements of fundamental emissions where average measurements are specified, the spectrum analyzer's resolution bandwidth (RBW) was adjusted equal to or greater than the emission bandwidth (EBW).

7.3.1.2 Distance Correction for Measurements Below 30 MHz – Part 15.31

Radiated measurements were performed at a distance closer than 300 meters and 30m as required, according to Part 15.209. Therefore a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor is shown below for limits expressed at a 300m measurement distance and a 30m measurement distance.

Distance correction factor (300m Specified Test Distance) = 40*Log (Test Distance/300)
= 40*Log (3/300)
= - 80 dB

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (3/30)
= - 40 dB

7.3.1.3 Measurement Results

Performed by: Ryan McGann

Table 7.3.1.2-1: Spurious Emissions Field Strength Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	Peak	QP/Avg	(H/V)	(dB)	Peak	QP/Avg	Peak	QP/Avg	Peak	QP/Avg
0.0192	66.29	66.29	H	14.28	80.57	80.57	141.9	121.9	61.3	41.4
0.0576	48.22	48.22	H	11.00	59.22	59.22	132.4	112.4	73.2	53.2
0.096	---------	40.12	H	10.46	---------	50.58	--------	108.0	---------	57.4

Note: All other emissions were below the noise floor of the instrumentation.

7.3.1.4 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 – Fundamental Emission

Corrected Level: 66.29 + 14.28 = 80.57dBuV/m
Margin: 141.9dBuV/m – 80.57dBuV/m = 61.3dB

Example Calculation: Average – Fundamental Emission

Corrected Level: 66.29 + 14.28 = 80.57dBuV/m
Margin: 121.9dBuV/m – 80.57dBuV/m = 41.4dB

7.4 20dB / 99% Bandwidth – FCC: Section 15.215, ISED Canada: RSS-Gen 4.6.1

7.4.1 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 50Hz. The trace was set to max hold with a peak detector active. The n-dB down function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to 50Hz. The video bandwidth shall be set to > 3 times the resolution bandwidth. A peak detector was used.

Each emission measured was a Continuous Wave transmission.

7.4.2 Measurement Results

Performed by: Ryan McGann

Table 7.4.2-1: 20dB / 99% Bandwidth

Frequency [kHz]	20dB Bandwidth [Hz]	99% Bandwidth [Hz]
19.2	1951.81	4683.33

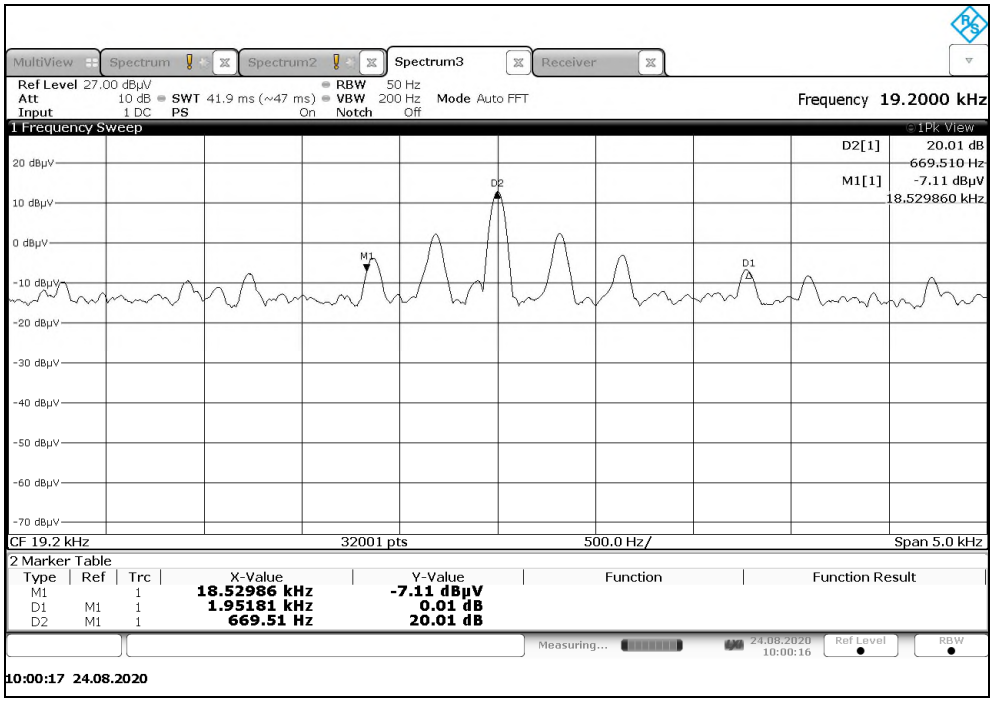


Figure 7.4.2-1: 20dB Emission Bandwidth Plot – 19.2kHz

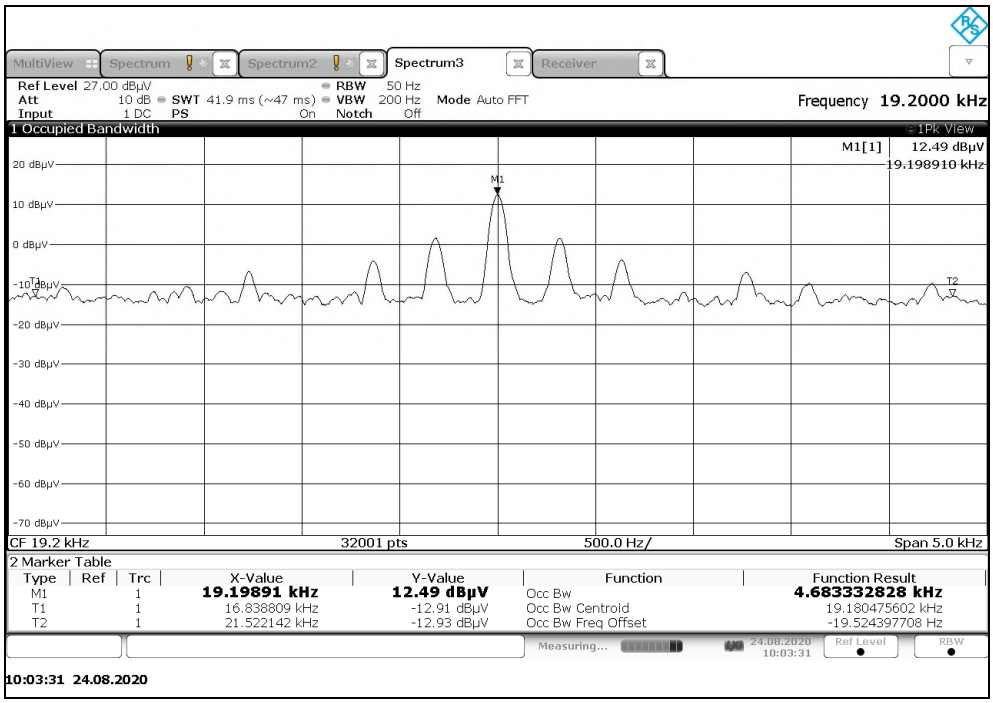


Figure 7.4.2-2: 99% Occupied Bandwidth Plot – 19.2kHz

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

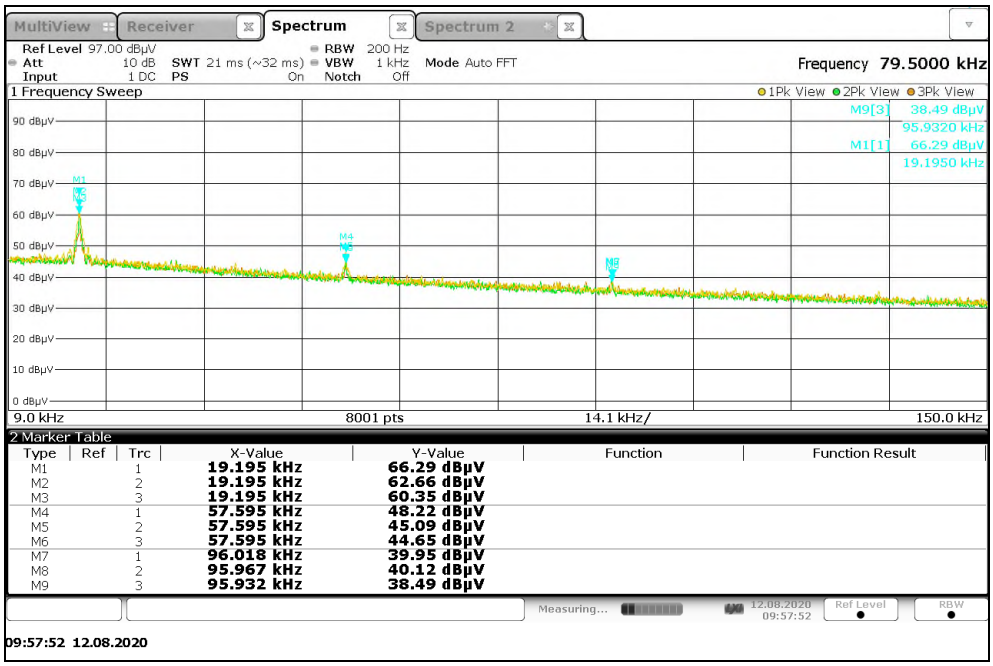
The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 0.349 dB
Power Spectral Density	± 0.372 dB
Antenna Port Conducted Emissions	± 1.264 dB
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	± 2.832 x 10^{-8}
AC Power Line Conducted Emissions	± 3.360 dB

9 CONCLUSION

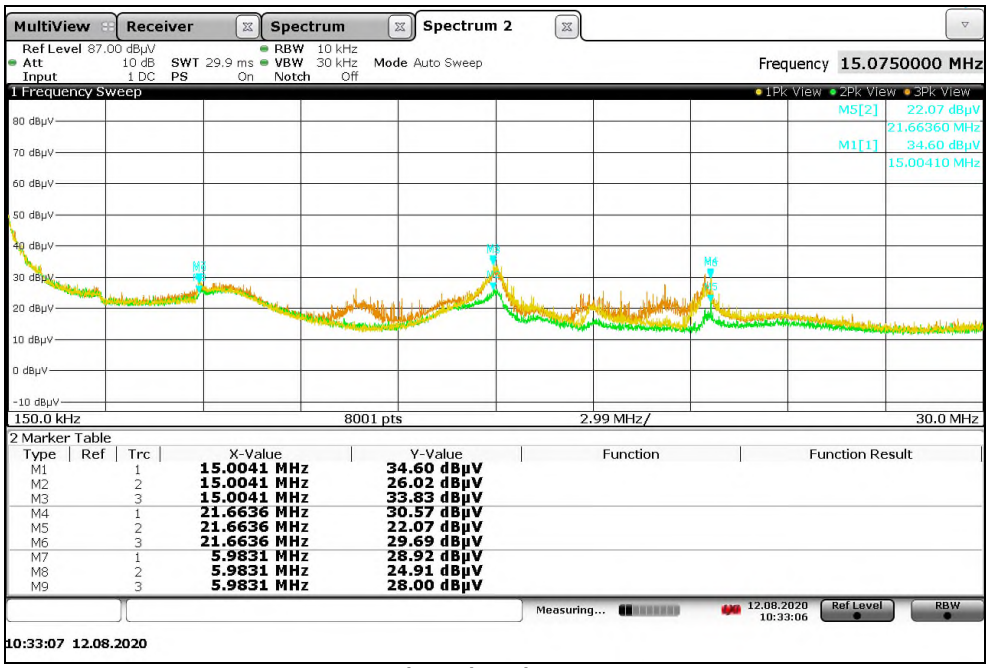
In the opinion of TUV SUD the PocketPro Reader RF, manufactured by Neptune Technology Group meets the requirements of Part 15.209 FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-210 for the tests documented in this test report.

Appendix A: Plots



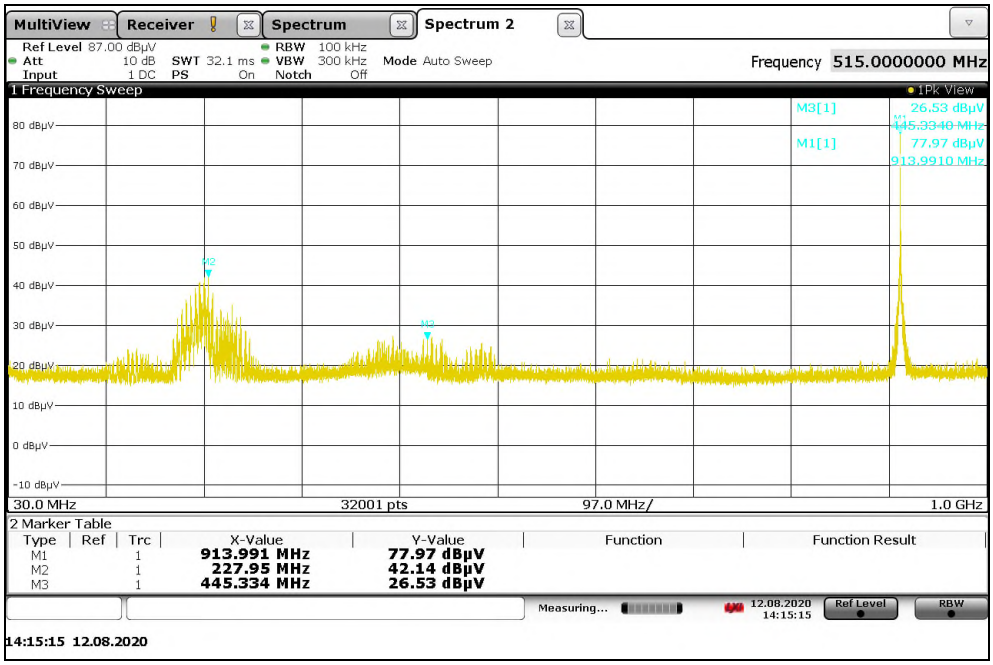
Note: Trace 1 = Measurement antenna along site axis.
Note: Trace 2 = Measurement antenna orthogonal to site axis.
Note: Trace 3 = Measurement antenna horizontal (ground parallel).

Figure A-1: Radiated Emissions – 9kHz-150kHz



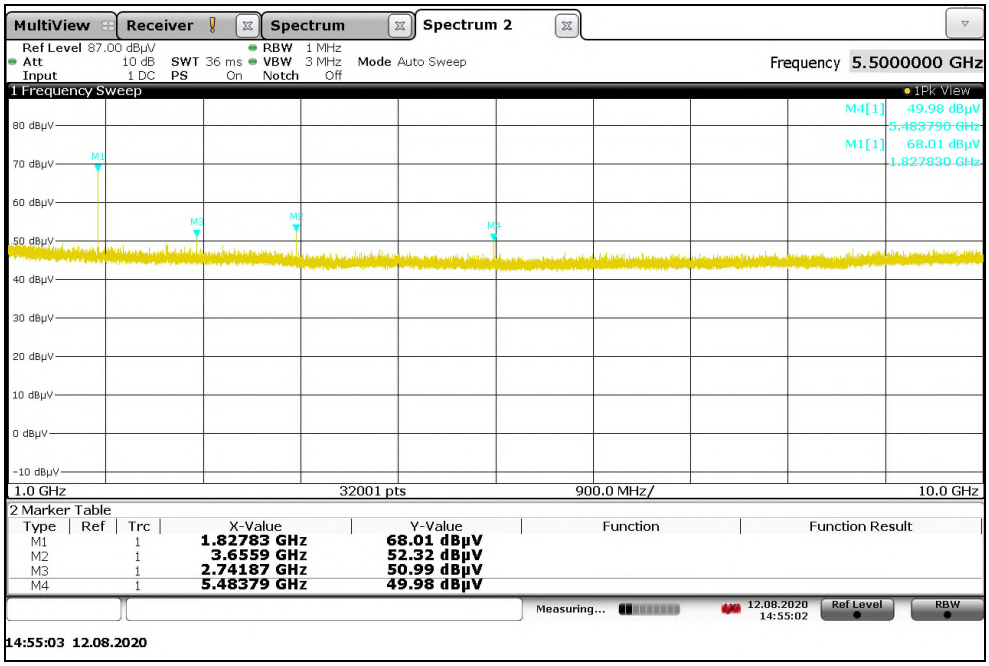
Note: Trace 1 = Measurement antenna along site axis.
Note: Trace 2 = Measurement antenna orthogonal to site axis.
Note: Trace 3 = Measurement antenna horizontal (ground parallel).
Note: All emissions present were related to the digital device or ambient emissions.

Figure A-2: Radiated Emissions – 150kHz-30MHz



Note: Emissions designated with markers are related to the digital device or the 900MHz radio fundamental and not associated with the NFC radio.

Figure A-3: Radiated Emissions – 30MHz-1GHz



Note: Emissions designated with markers are harmonics of the 900MHz radio and not associated with the NFC radio.

Figure A-4: Radiated Emissions – 1GHz-10GHz

END REPORT