Testing Tomorrow's Technology

Class 2 Permissive Change Test Report

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 15.249

And

RSS-210 Issue 10: License-Exempt Radio Apparatus: Category I Equipment

For the

Neptune Technology Group

Model: Pocket ProReader RF

FCC ID: P2SNTGPKT11O1
IC ID: 4171B-12O88

UST Project: 21-0314

Test Dates: November 3-4, 2021
Issue Date: November 22, 2021

Total Pages: 20

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

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: November 22, 2021

NVLAP LAB CODE 200162-0

3505 Francis Circle Alpharetta, GA 30004
PH : 770-740-0717 Fax : 770-740-1508
www.ustech-lab.com

MEASUREMENT TECHNICAL REPORT

Company Name:	Neptune Technology Group
Address:	1600 Alabama Hwy 229 Tallassee, AL 36078 USA
Model:	Pocket ProReader RF
FCC ID:	P2SNTGPKT11O1
IC ID:	4171B-12O88
Date:	November 22, 2021

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

Equipment type: 19.2 kHz and 914 MHz Radio Transceiver

Technical Information:

Radio Technology:	FHSS
Frequency of Operation (MHz):	0.0192 & 914.0
Output Power (dBm):	N/A
Type of Modulation:	Bi-Phase
Data/Bit Rate:	1200 bps
Antenna Gain (dBi):	0.0 dBi
Software used to program EUT:	N/A
EUT firmware:	ppr_20210803
Power setting:	-10dBm

Report prepared by:

US Tech
3505 Francis Circle Alpharetta, GA 30004
PH : 770-740-0717 Fax : 770-740-1508
www.ustech-lab.com

Table of Contents

List of Figures

List of Tables

List of Attachments

FCC Agency Agreement
Application Forms
Internal Photographs
Canadian Rep Letter
Cover Letter
Block Diagram
ISED Agency Agreement
Test Configuration Photographs
Letter of Confidentiality
Permissive Change Letter
Schematic(s)

1 General Information

1.1 Purpose of this Report

The purpose of this report is to file for a Class II Permissive change for the following reasons:

- **MCU board changes**
  - Removed the 8051 MCU and RF transmitter IC.
  - Removed the 19.66kHz crystal
  - Removed the LCD bias supply circuitry
  - Removed the EEPROM IC
  - Removed the SRAM IC
  - Added the Silicon Labs MCU with integrated RF section.
  - Added a 38.4MHz crystal
  - Added a 5.5V power supply to the MCU board
  - Added a JTAG connection to the MCU board
- **Assembly changes**
  - Replaced the LCD module
  - Pocket ProReader RF - Added ferrites to battery and coil wires
  - Added a ferrite to coil wires
  - Added an extension cable to the new LCD module

Due to the changes above, the equipment was re-evaluated for continued compliance with Part 15.249, 15.209 and RSS-210 requirements. Based on the changes above, the following test were performed:

- Intentional Radiated emissions Part 15.249
- Spurious Radiated emissions Part 15.209
- Powerline Conducted emissions Part 15.207

All other tests were deemed to be not affected by the changes. The test data has been collected and is presented herein for consideration.

1.2 Characterization of Test Sample

The samples used for testing were received by US Tech on November 2, 2021 in good operating condition.

1.3 Product Description

The EUT remains the same as previously tested: The equipment under test (EUT) is the Neptune Technology Group, Inc. model Pocket ProReader RF. The EUT is a visual reading device for reading remote receptacle pads. With the EUT, meter readers can test new installations, obtain readings and meter identification numbers in a faster, more efficient manner. The EUT can be conveniently carried in a pocket or clipped to a belt.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *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 the unintentional radiator aspect of the device as well as FCC subpart B and C of Part 15 and per FCC KDB Publication number 558074 v05r02 for Digital Transmission Systems Operating Under section 15.247.

Per FCC Parts 15.107 and 15.109, digital RF conducted and radiated emissions below 1 GHz were measured with the spectrum analyzer's resolution bandwidth (RBW) adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the RBW or as required per the standard throughout the evaluation process.

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 for spurious and fundamental emissions 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 and ISED CAB # US0031.

Table 1. EUT and Peripherals

EUT MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
Neptune Technology Group.	Pocket ProReader RF	Engineering Sample	FCC ID: P2SNTGPKT11O1 IC: 4171B-12O88	N/A
PERIPHERAL MANUFACTURER	**MODEL NUMBER**	**SERIAL NUMBER**	**FCC/IC ID**	**CABLES P/D**
Power Adapter/ PowerStream	3P10-N0508	None	None	P
Antenna See antenna details	--	--	--	--

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

Table 2. Details of I/O Cables Attached to EUT

DESCRIPTION OF CABLE	DETAILS OF CABLE			CABLE LENGTH
Power Cable	**Manufacturer**	**Part Number**		2.0 m
	PowerStream	3P10-N0508		
	Shield Type	**Shield Termination**	**Back-shell**	
	N/A	N/A	N/A	

Shield Type
N/A = None
F = Foil
B = Braided
2B = Double Braided
CND = Could Not Determine

Shield Termination
N/A = None
360 = 360 Degrees
P = Pigtail/Drain Wire
CND = Could Not Determine
MU = Metal Unshielded

Back-shell
N/A = Not Applicable
PS = Plastic Shielded
PU = Plastic Unshielded
MS = Metal Shielded

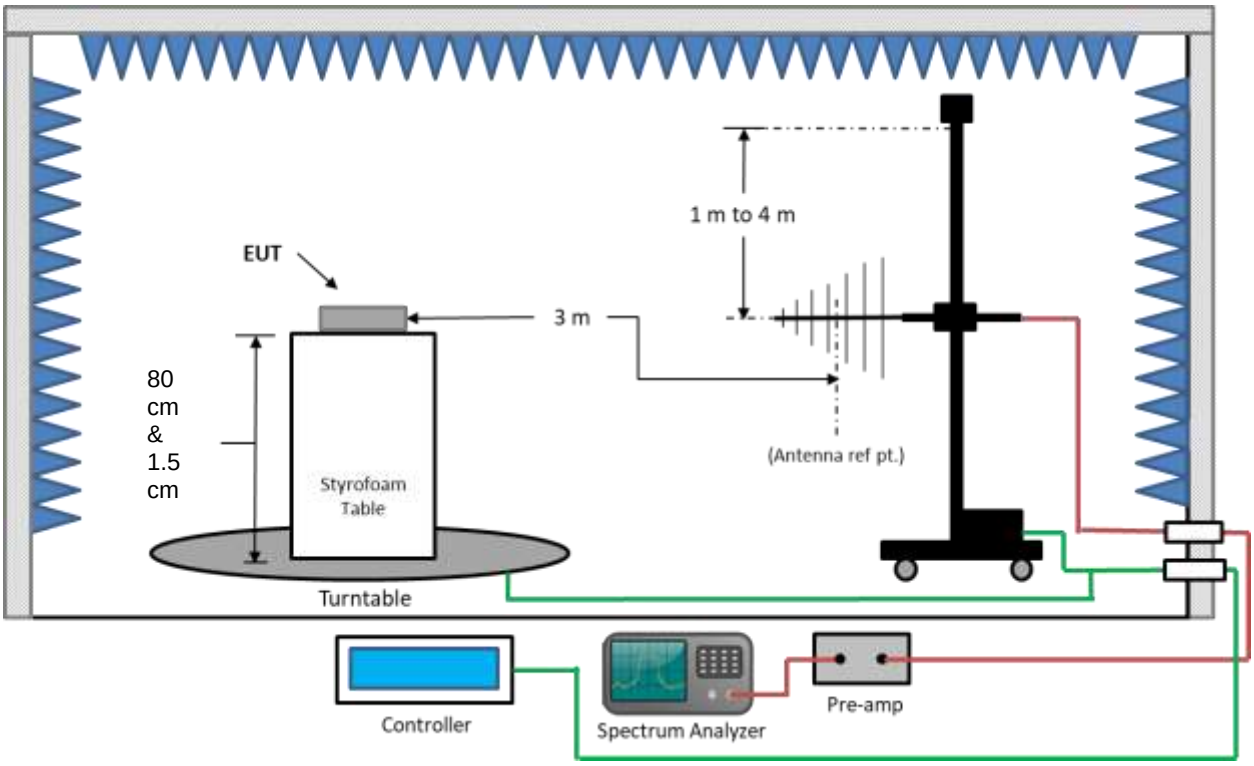


Figure 1. EUT Test Configuration Diagram

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product.

Table 3. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	9/02/2022 2 yr.
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	6/09/2022
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00914	2/28/2022
LOOP ANTENNA	6502	ETS Lindgren	9810-3246	4/06/2022 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9306-1708	8/17/2023 2 yr.
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	6/03/2023 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	2/03/2023 2 yr.
HIGH PASS FILTER	VHF-1320 15542	MINI-CIRCUITS, INC.	3 0843	7/16/2022

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 bring the EUT into compliance with FCC Part 15.249 and RSS-210 requirements.

2.3 Intentional Radiator, Radiated Emissions (CFR 15.249(a)(c)) (IC RSS 210, A2.9 (a))

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW ≥ 3 x RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 5 below. For average measurements above 1 GHz, the emissions were measured using an average detector. The measurement of each signal detected was maximized by rotating the turntable 360° clockwise and counterclockwise and raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display with Trace A in the Max-Hold mode and Trace B in the Clear-Write mode for the largest signal visible. The emission from the EUT was measured and recorded when both maxima were simultaneously satisfied.

2.3.1 EUT Worst Case Test Configuration

On the test site, the EUT was placed on top of a polystyrene table 80 cm above the ground plane inside a semi-anechoic test chamber. Two versions of the EUT was evaluated. The regular length and extended length. The EUT was also evaluated in each of its three axes (X/Y/Z) while transmitting on the channel that produced the highest output power for worst case condition. After evaluating the results of both version of the EUT the version with the extended length was deemed to be the worst case. The position of the EUT determined to be worst case was with the EUT positioned along its Z axis (see test configuration photos). This configuration was used as the representative configuration for both versions of the EUT. The test data is presented herein.

Table 4. Peak Radiated Fundamental and Harmonic Emissions

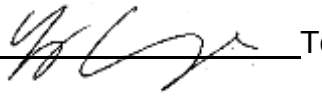
Test: FCC Part 15.249								
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector**
Vertical								
914.00	54.38	0.0	21.08	75.46	114.0	3m./VERT	38.5	**PK**
914.00	54.38	0.0	21.08	75.46	94.0	3m./VERT	18.5	**AVG**
Horizontal								
914.00	64.34	0.0	21.88	86.22	114.0	3m./HORZ	27.8	**PK**
914.00	64.34	0.0	21.88	86.22	94.0	3m./HORZ	7.8	**AVG**

Notes: The field strength emissions are in line with the originally recorded results as found in TUV SUD America, Inc test report AT72161635-2C2 Issue Date 9-3-2020.

Sample Calculation at 914.00 MHz:

Magnitude of Measured Frequency	54.38	dBuV
+Additional Factor	0.00	dB
+Antenna Factor + Cable Loss - Amplifier Gain	21.08	dB/m
Corrected Results	75.46	dBuV/m

Test Date: November 2, 2021

Signature:  Test Engineer: George Yang

2.4 Intentional Radiator Power Line Conducted Emissions (CFR 15.207)

The power line conducted voltage emission measurements have been carried out in accordance with CFR 15.207, per ANSI C63.10:2013, Clause 6.2, with a spectrum analyzer connected to a LISN and the EUT placed into its typical mode of operation when connected to the AC mains. In this case the user is instructed to ensure that the EUT is turned OFF before it is connected to the mains.

Table 5. Power Line Conducted Emissions 150 kHz to 30 MHz

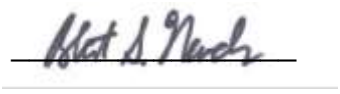
Frequency (MHz)	Test Data (dBuV)	LISN+CL (dB)	Corrected Results (dBuV)	Limits (dBuV)	Margin (dB)	Detector
Phase @ 120 Vac/60Hz						
0.1663	63.88	0.08	63.96	*65.1	1.2	**QP**
0.1663	43.88	0.08	43.96	55.1	11.2	**AVG**
0.5190	42.31	2.70	45.01	*56.0	11.0	**QP**
0.5190	27.23	2.70	29.93	46.0	16.1	**AVG**
1.4260	35.89	0.34	36.23	46.0	9.8	**QP**
5.5080	34.50	0.23	34.73	50.0	15.3	**PK**
11.0830	28.31	0.62	28.93	50.0	21.1	**PK**
28.1160	28.12	1.63	29.75	50.0	20.3	**PK**
Neutral @ 120 Vac/60Hz						
0.1710	60.40	0.13	60.53	*64.9	4.4	**QP**
0.1710	39.15	0.13	39.28	54.9	15.6	**AVG**
0.7108	42.64	0.51	43.15	*56.0	12.9	**QP**
0.7108	32.81	0.51	33.32	46.0	12.7	**AVG**
1.2660	41.30	0.51	41.81	*56.0	14.2	**QP**
1.2660	30.97	0.51	31.48	46.0	14.5	**AVG**
5.2830	29.31	0.31	29.62	50.0	20.4	**PK**
11.2830	23.48	0.79	24.27	50.0	25.7	**PK**
27.7500	30.91	2.13	33.04	50.0	17.0	**PK**

(*)= Quasi-peak limit applied

Sample Calculation at 0.1663 MHz:

Magnitude of Measured Frequency	63.88	dBuV
+ LISN + Cable Loss	0.08	dB
Corrected Result	63.96	dBuV/m

Test Date: November 4, 2021

Tested By
Signature:  Name: Robert Nevels

2.5 Intentional Radiator, Radiated Emissions (CFR 15.209)

The test data provided herein is to support the verification requirement for unwanted radiated emissions coming from the EUT in a transmitting state per 15.209 and was investigated from 9 kHz or the lowest operating clock frequency to 10 GHz or to the tenth harmonic of the highest fundamental frequency. The EUT was put into a continuous transmit mode of operation and tested as detailed in ANSI C63.10:2013, Clause 6.4.6. Data is presented in the table below.

The measurement bandwidths for each frequency scan that was evaluated were set as follows:

Frequency Span	RBW / VBW
9 kHz – 150 kHz	300 Hz / 1 kHz
150 kHz – 30 MHz	9 kHz / 30 kHz
30 MHz – 1 GHz	120 kHz / 300 kHz
Above 1 GHz	1 MHz / 3 MHz

The EUT was placed into a mode representative of normal operation and spurious emissions measurements were performed. The EUT with extended wand and EUT without extended wand were both tested. The test results show that the EUT with extended wand is the worst case sample. The test data collected during this testing is presented herein as representative sample for both configuration.

Table 6. Spurious Radiated Emissions (9 kHz – 30 MHz)

Test: FCC Part 15.209							
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector PK / QP / AVG**
All emissions were more than 20 dB below the applicable limit.							

Test Date: November 2, 2021

Signature: Test Engineer: Robert Nevels

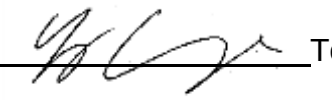
Table 7. Spurious Radiated Emissions (30 MHz – 1 GHz)

Test: FCC Part 15.209							
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector PK / QP**
119.64	45.93	-16.27	29.66	43.5	3m./HORZ	13.8	**PK**
125.23	45.38	-15.70	29.68	43.5	3m./HORZ	13.8	**PK**
160.48	43.98	-14.50	29.48	43.5	3m./HORZ	14.0	**PK**
124.59	39.55	-15.30	24.25	43.5	3m./VERT	19.3	**PK**
114.72	39.86	-16.37	23.49	43.5	3m./VERT	20.0	**PK**
232.64	53.52	-16.02	37.50	46.0	3m./HORZ	8.5	**PK**
585.80	38.12	-8.77	29.35	46.0	3m./HORZ	16.7	**PK**
230.12	44.30	-16.25	28.05	46.0	3m./VERT	18.0	**PK**
660.02	33.20	-7.59	25.61	46.0	3m./VERT	20.4	**PK**
839.92	29.00	-6.13	22.87	46.0	3m./VERT	23.1	**PK**
All other emissions were more than 20 dB below the applicable limit.							

Sample Calculation at 119.64 MHz:

Magnitude of Measured Frequency	45.93	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	-16.27	dB/m
Corrected Result	29.66	dBuV/m

Test Date: November 2, 2021

Signature:  Test Engineer: George Yang

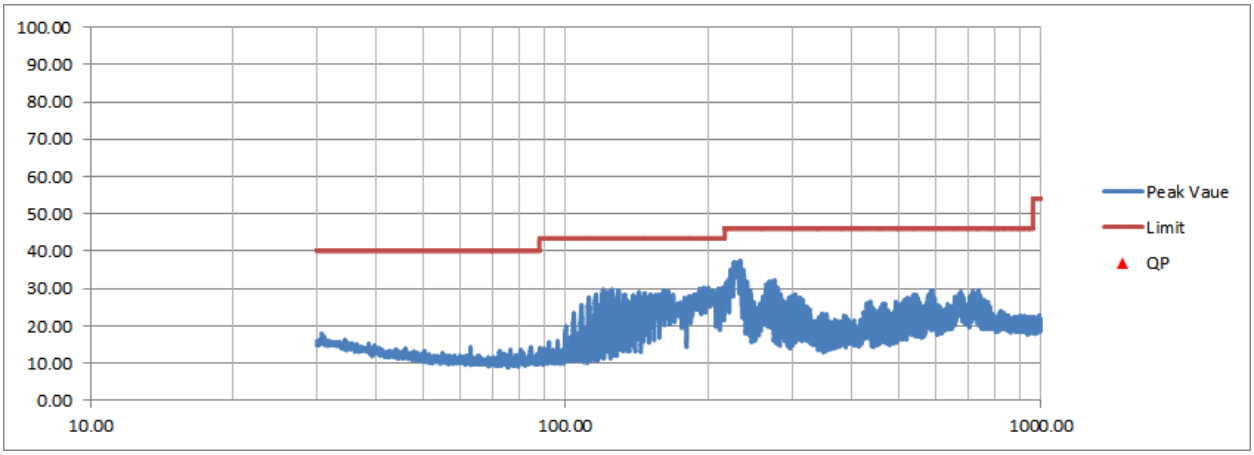


Figure 2. Radiated Emissions, Horizontal Polarity

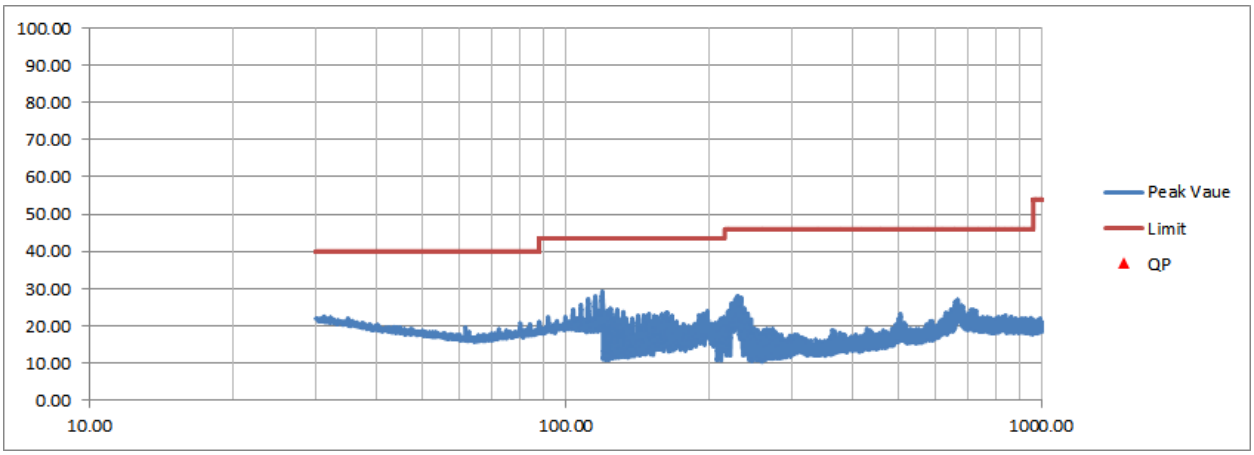


Figure 3. Radiated Emissions, Vertical Polarity

Table 8. Spurious Radiated Emissions (1 GHz – 10 GHz)

Test: FCC Part 15.209							
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detector PK / QP**
2415.50	54.81	-10.73	44.08	54.0	3.0m./HORZ	9.9	**PK**
5742.50	31.42	-6.47	24.95	54.0	3.0m./HORZ	29.0	**AVG**
2418.00	56.74	-8.82	47.92	54.0	3.0m./VERT	6.1	**PK**
5771.00	32.29	-6.48	25.81	54.0	3.0m./VERT	28.2	**AVG**
All other emissions were more than 20 dB below the applicable limit.							

Sample Calculation at 2415.5.00 MHz:

Magnitude of Measured Frequency	54.81	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	-10.73	dB/m
Corrected Result	44.08	dBuV/m

Test Date: November 3, 2021

Signature: Test Engineer: Robert Nevels

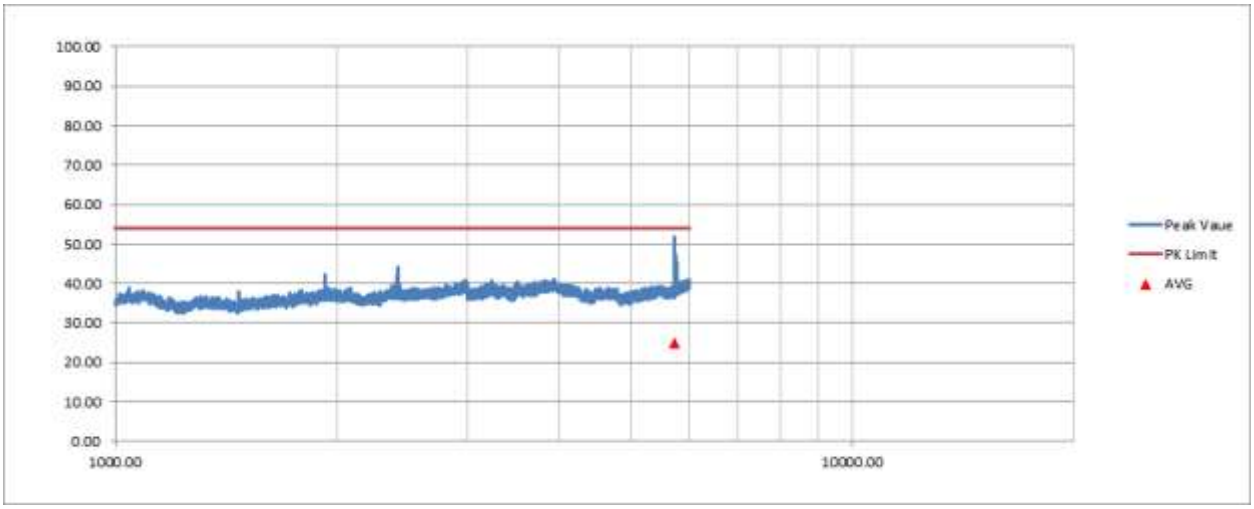


Figure 4. Radiated Emissions above 1 GHz, Horizontal Polarity

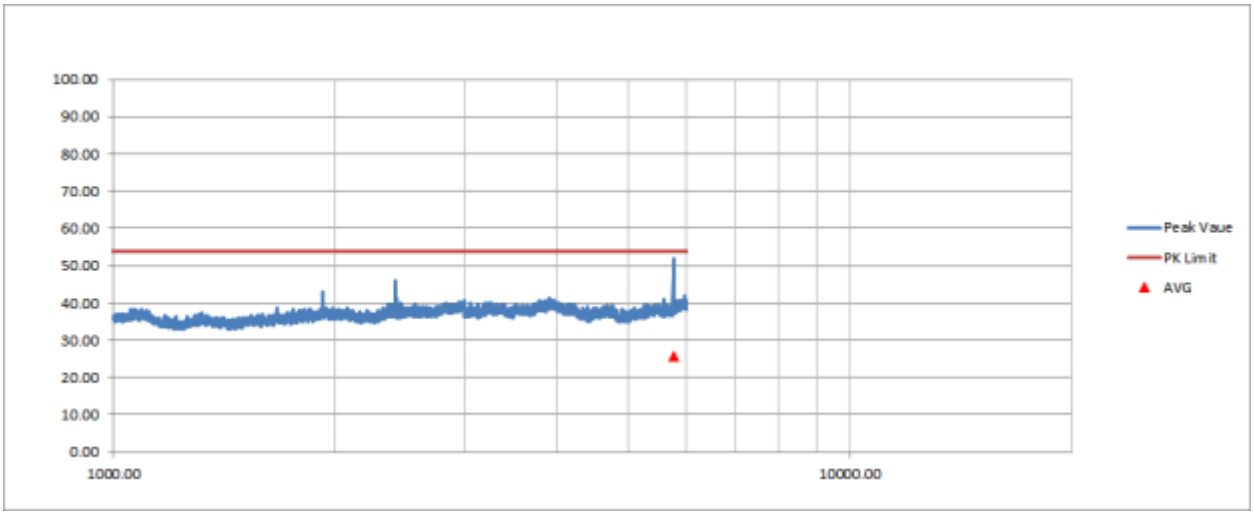


Figure 5. Radiated Emissions above 1 GHz, Vertical Polarity

2.6 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.6.1 Conducted Emissions Measurement Uncertainty

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

2.6.2 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 ±5.3 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 ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna (Above 1000 MHz) is ±5.1 dB.

3 Conclusions

The EUT continues to meet the compliance requirements. The emissions levels are all under the limits and there is no increase RF output power. No other hardware changes have been made to the original product other than the changes cited in paragraph 1.1 above. All other original test results continue to be representative of the equipment.