MPE TEST REPORT

for the

FREDERICK ENERGY PRODUCTS, LLC

FCC ID: QUI-DDAC-PDS-SXLC
IC ID: 11625A-DDACPDSSXLC

WLL REPORT# 16938-03 REV 3

Prepared for:

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Testing Certificate AT-1448

MPE Test Report

for the

Frederick Energy Products, LLC

Magnetic Field SXL Generator

FCC ID: QUI-DDAC-PDS-SXLC

ISED ID: 11625A-DDACPDSSXLC

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WLL Report# 16938-03 Rev 3

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Abstract

This report has been prepared on behalf of Frederick Energy Products, LLC to document the findings of the maximum permissible exposure evaluation on the Frederick Energy Products, LLC Magnetic Field SXL Generator. The information provided on this report is only applicable to device herein documented.

The purpose of this evaluation is to establish a minimum safe distance as per the RF exposure requirements as defined in FCC §1.1307 & §1.1310 and in RSS-102.

This report documents the results of testing to the requirements of:

- CFR Title 47 Volume 1 Practice and Procedure; (1.1307) Environmental Assessments
- RSS-102 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

The Evaluation was performed by Washington Laboratories, Ltd, 4840 Winchester Blvd., Suite 5, Frederick, MD 21703. Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

Revision History	Description of Change	Date
Rev 0	Initial Release	July 19, 2021
Rev 1	Update EUT Name	July 21, 2021
Rev 2	ACB Comments	August 9, 2021
Rev 3	Update Measured Field Strength	August 13, 2021

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1 Introduction

This report has been prepared on behalf of Frederick Energy Products, LLC for the Magnetic Field SXL Generator (IC ID: 11625A-DDACPDSSXLC) [dual-transmitter] to show compliance with the RF exposure requirements as defined in FCC §1.1307 & §1.1310 and in RSS-102.

The testing in-support of this evaluation was performed at Washington Laboratories, Ltd, 4840 Winchester Blvd., Frederick, MD 21703.

Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. is accredited with ANAB under Testing Certificate AT-1448.

2 Requirements

2.1 Transmitter Categories

2.1.1 Fixed Installations

A fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.

2.1.2 Mobile Devices

A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20-centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.

2.1.3 Portable Devices

A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

2.2 Exposure Categories

The limits for exposure are determined by the type of situation in which the individual is exposed. Table 1 lists the limits for the particular environment.

2.2.1 Occupational/Controlled Exposure

In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.

2.2.2 General Population/Uncontrolled Exposure

The general population / uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general-public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category and the general population/uncontrolled exposure limits apply to these devices.

Table 1: MPE Limits (FCC)

Frequency Range (MHz)	Electric field Strength (V/m)	Magnetic field Strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f2)	6
30–300	61.4	0.163	1	6
300–1500	N/A	N/A	f/300	6
1500–100,000	N/A	N/A	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f2)	30
30–300	27.5	0.073	0.2	30
300–1500	N/A	N/A	f/1500	30
1500–100,000	N/A	N/A	1	30

Table 2: MPE Limits (ISED)

Frequency Range (MHz)	**Electric Field (V/m rms)**	**Magnetic Field (A/m rms)**	**Power Density (W/m^2)**	**Reference Period (minutes)**
Limits for General Population/Uncontrolled Exposure				
0.003-10	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10\text{-}4\, f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$
Note: f is frequency in MHz.				
*Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				
Frequency Range(MHz)	**Electric Field (V/m rms)**	**Magnetic Field (A/m rms)**	**Power Density (W/m^2)**	**Reference Period (minutes)**
Limits for Occupational/Controlled Exposures				
0.003-1023	170	180	-	Instantaneous*
0.1-10	-	$1.6/f$	-	6**
1.29-10	$193/f$ 0.5	-	-	6**
10-20	61.4	0.163	10	6
20-48	$129.8/f$ 0.25	$0.3444/f$ 0.25	$44.72/f$ 0.5	6
48-100	49.33	0.1309	6.455	6
100-6000	$15.60f$ 0.25	$0.04138f$ 0.25	$0.6455f$0.5	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	$616000/f$ 1.2
150000-300000	$0.354f$ 0.5	9.40 x 10-4 f 0.5	3.33 x 10-4 f	$616000/f$ 1.2
f in MHz, * Based on nerve stimulation, ** Based on specific absorption rate(SAR)				

3 Device Summary

The table below summarizes the criteria used to evaluate the EUT.

Table 3: Device Summary – Magnetic Field SXL Generator

Transmitter Category:	Unlicensed
Exposure Category:	General
Antenna Gain:	0.0 dBi (for both transmitters)
TX 1 Power Output (dBm):	-4.46 dBm (0.36 mW)
TX 2 Power Output (dBm):	+ 8.45 dBm (7.0 mW)
Evaluation Distance:	20 cm
Transmitter Frequency:	(1) 916.48 MHz & (2) 2402 MHz
FCC Limit:	(1) 0.611 mW/cm^2 & (2) 1 mW/cm^2
ISED Limit:	(1) 0.277 mW/cm^2 & (2) 0.535 mW/cm^2

The power output, shown above for Transmitter 1, was calculated from 3m radiated emissions testing *(reference Test Report # 16938-01).*

The 916.5 MHz fundamental measured 38823.7 uV/m at 3m. This is value was converted to dBuV/m via the following formula: dBuV/m = 20*LOG(uV/m).

Further, Power(dBm) = (dBuV/m) + 20 * LOG(Distance) - 104.8

90.8 + 20LOG(3) – 104.8 = -4.46 dBm

The power output, shown above for Transmitter 2, was derived from the embedded module's granted power, of 8.45 dBm.

4 Radio Frequency Radiation Exposure Evaluation

The highest RF output power of the unit was measured and recorded. According to §1.1310 of the FCC rules, the power density limit for General Population/Uncontrolled Exposure is 1mW/cm^2. According to §1.1310 of the FCC rules, the power density limit for Occupational/Controlled Exposure is 5mW/cm^2.

The MPE shall be calculated at 20cm to show compliance with the power density limit. The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = Power Density

P = Output Power at the Antenna Terminals

G = Gain of Transmit Antenna (linear gain-isotropic)

R = Distance from Transmitting Antenna

Table 4: Transmitter MPE Calculation Summary (FCC)

One Transmitter				
Frequency	916.5	MHz		
Limit	0.611	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	-4.46	dBm		
TX Ant Gain (dBi), G =	0	dB		
Power Density:	0.0000712	mW/cm^2	**Separation<20 cm**	
Minimum Distance:	**0.2**	cm		
Second Transmitter				
Frequency	2402.12	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	8.45	dBm		
TX Ant Gain (dB), G =	0	dB		
Power Density:	0.001392	mW/cm^2	**Separation<20 cm**	
Minimum Distance:	**0.7**	cm		
Multiple Transmitter Summary				
Power Density:	0.001509	mW/cm^2	**Separation<20 cm**	
Minimum Distance:	**1.0**	cm	**Sum of the Distances**	

Table 5: Transmitter MPE Calculation Summary (ISED)

One Transmitter			
Frequency	916.5	MHz	
Limit	0.277	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	-4.46	dBm	
TX Ant Gain (dBi), G =	0	dB	
Power Density:	0.000071243	mW/cm^2	Separation<20 cm
Minimum Distance:	0.3	cm	

Second Transmitter			
Frequency	2402.12	MHz	
Limit	0.535	mW/cm^2	
Distance (cm), R =	20	cm	
Power (dBm), P =	8.45	dBm	
TX Ant Gain (dB), G =	0	dB	
Power Density:	0.001392	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**1.0**	cm	

Multiple Transmitter Summary			
Power Density:	0.002859	mW/cm^2	**Separation<20 cm**
Minimum Distance:	**1.3**	cm	**Sum of the Distances**