RADIO FREQUENCY
EXPOSURE REPORT

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RELEASE CONTROL RECORD

REVISION	REASON FOR CHANGE	DATE
1.00	Initial Release	03/24/2020

Table of Contents

1. DynaFlex Description

DynaFlex is a series of hybrid secure card reader authenticators. It can be a hand-held device. The device features three interfaces to read a secure card: Magnetic Stripe, Smart Card and Contactless (NFC). The device is portable in nature and can connect to a host via USB, 802.11 or Bluetooth LE. There are five variations of DynaFlex listed in the chart below.

DynaFlex, USB only	DynaFlex, USB/Bluetooth LE	DynaFlex, Pro USB only	DynaFlex, Pro USB/Bluetooth LE	DynaFlex, Pro USB/802.11
USB communication	USB communication	USB communication	USB communication	USB communication
		LCD	LCD	LCD
	Bluetooth LE		Bluetooth LE	802.11
	Rechargeable LIPO battery		Rechargeable LIPO battery	Rechargeable LIPO battery

2. Purpose of this Document

SAR is defined as the rate at which energy is absorbed per unit mass in an object exposed to a radio frequency field. SAR distribution in a biological body is complicated, and this testing is usually performed by experimental and/or numerical modeling in qualified laboratories, and test is mandatory for all cellphones, but not for "portable" or "mobile" devices. Such portable devices are sometimes exempt from SAR lab testing if their output power does not exceed a country's SAR exemption limits.

This Document will prove that the DynaFlex output power does not exceed the limits in each country it will be sold.

The Bluetooth LE and the 802.11 will be calculated separately since no variant will have both types of communication.

where **P** is the power loss density, **E** is the electric field strength (V/m), **J** (A/m^2) is the current density, ρ (kg/m^3) is the density of the tissue or material, and σ (S/m) is the conductivity of the material typically averaged over a pre-defined mass.

3. RF EXPOSURE Calculation

A worst-case scenario is being considered to determine the maximum power density as shown in equation 1.

$$S = \frac{EIRP}{4\pi R^2} \left(mW \Big/ cm^2 \right)$$

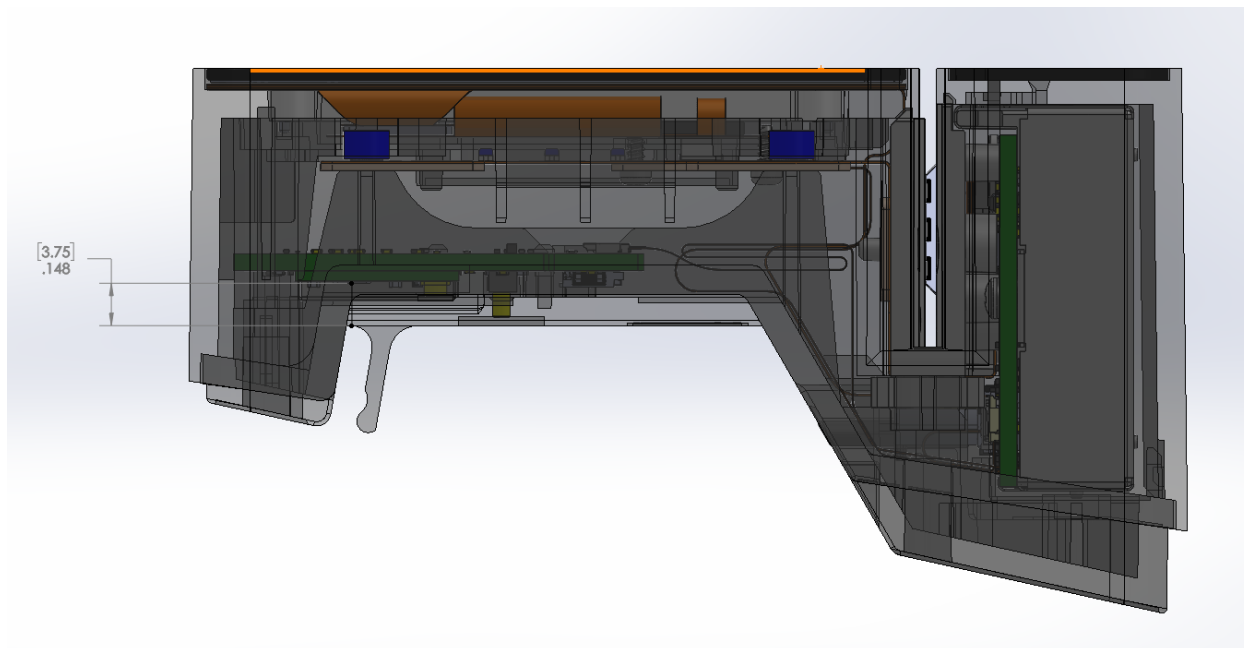*Equation 1 Power density definition*

Where,

S = Power density in (mW/cm^2)

EIRP = Effective isotropically radiated power (mW)
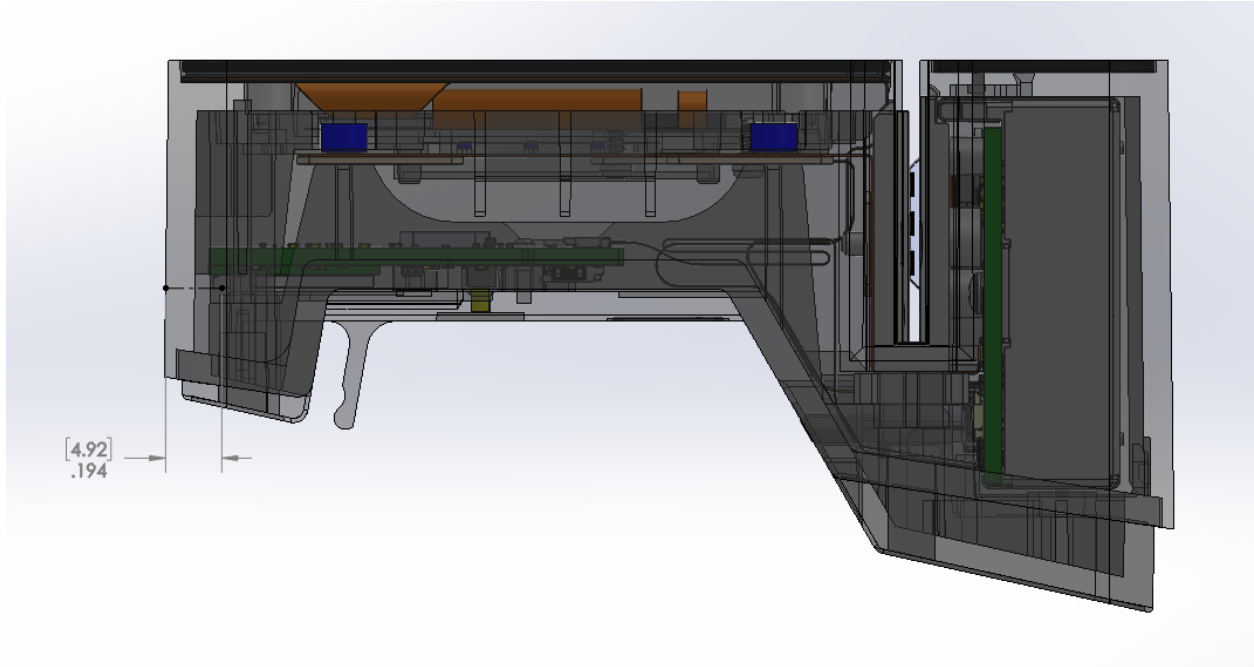
EIRP = *Transmitter Power x Gain*

R = Distance to the center of the antenna radiation (cm)

For the 802.11 antenna, the closest a user can be is 3.75 mm.

For the BlueTooth LE the closest distance is 4.92 mm.

[4.92]
.194

We shall determine the DynaFlex's maximum power using 100% duty cycle conducted power at the 802.11 module's antenna and the Bluetooth LE's antenna.

	Power dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)
802.11	17	3.2	20.2	104.7
Bluetooth LE	8.8	1	9.8	9.5

Both the 802.11 and Bluetooth LE exceed the limits of FCC and IC. However, this was calculated using 100% duty cycle.

A standard transaction consists of three phases of data transfer:

1) Host transaction initiation
2) Amount Approval by a customer
3) Customer's signature capture collection

The chart below shows the time (in ms) of actual data transfer for each step and the total time.

Step 1	time in ms		Step 2	time in ms		Step 3	time in ms
	0.15			0.16			1
	0.08			0.036			0.7
	0.17						0.9
	0.05						0.5
	0.36						0.7
	0.28						0.1
	0.68						0.05
	0.034						0.18
	0.034						0.08
	0.066						0.32
	0.036						0.56
	0.032						0.032
	0.036						0.18
	0.06						
	0.036						
	0.032						
	0.032						
	0.056						
	0.036						
	0.056						
	0.036						
	0.06						
	0.032						
	0.044						
Total broadcat time for each step	2.488			0.196			5.302
Total Time (ms)	510			200			340
Total Transaction broadcast time	7.986						
Total Transaction time	1050						
total broadcast time/total time	0.00760571						
	0.76057143	%					

The Duty Cycle of a transaction is the "Total Transaction broadcast time"/ "Total Transaction Time" which is calculated to be 0.76%.

The adjusted power density calculated and shown below.

	EIRP (mW)	Duty Cycle(%)	EIRP (mW) (adjusted)
802.11	104.7	0.76	**0.796**
Bluetooth LE	9.5	0.76	**0.072**

4. LIMITS

For FCC the limit is shown below from "RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES" appendix A:

https://apps.fcc.gov/kdb/GetAttachment.html?id=f8IQgJxTTL5y0oRi0cpAuA%3D%3D&desc=447498

Appendix A

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table. The equation and threshold in 4.3.1 must be applied to determine SAR test exclusion.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	SAR Test
1900	11	22	33	44	54	Exclusion
2450	10	19	29	38	48	Threshold (mW)
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

The Highlighted entry is the limit that our product needs to be below for FCC.

For Canada (ISED) the limit is shown below from **RSS-102 — Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands):**

Table 1: SAR evaluation — Exemption limits for routine evaluation based on frequency and separation distance[4,5]

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

The Highlighted entry is the limit that our product needs to be below for ISED.

5. REPORT FINAL CONCLUSIONS

DynaFlex was analyzed using the maximum power of the broadcasting module and minimum distance from the antenna to the user. The EIRP was then adjusted to take in account the duty cycle of the data transferred. The adjusted EIRP for 802.11 and Bluetooth LE fall below the requirements for FCC and ISED. See table below.

	EIRP (mW) (adjusted)	FCC Limit (mW)	ISED Limit (mW)
802.11	**0.796**	10	4
Bluetooth LE	**0.072**	10	4