RF EXPOSURE EVALUATION REPORT

FCC ID	:	**PKRISGMD2000**
Equipment	:	**Wireless Module**
Brand Name	:	**Inseego**
Model Name	:	**MD2000**
Applicant	:	**Inseego Corporation** **9710 Scranton Road Suite 200, San Diego, CA 92121**
Standard	:	**47 CFR Part 2.1091**

We, SPORTON INTERNATIONAL INC has been evaluated this product in accordance with 47 CFR Part 2.1091 and it complies with applicable limit.

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC evaluation.

Cona Huang

Approved by: Cona Huang / Deputy Manager

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

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Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FA090125-05	Rev. 01	Initial issue of report	Mar. 04, 2022

1. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	Wireless Module
Brand Name	Inseego
Model Name	MD2000
FCC ID	PKRISGMD2000
Wireless Technology and Frequency Range	WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 14: 788 MHz ~ 798 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 25: 1850 MHz ~ 1915 MHz LTE Band 26: 814 MHz ~ 849 MHz LTE Band 30: 2305 MHz ~ 2315 MHz LTE Band 38: 2570 MHz ~ 2620 MHz LTE Band 41: 2496 MHz ~ 2690 MHz LTE Band 42: 3550 MHz ~ 3600MHz LTE Band 48: 3550 MHz ~ 3700MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz 5G NR n2: 1850 MHz ~ 1910 MHz 5G NR n5: 824 MHz ~ 849 MHz 5G NR n7: 2500 MHz ~ 2570 MHz 5G NR n12: 699 MHz ~ 716 MHz 5G NR n25: 1850 MHz ~ 1915 MHz 5G NR n38: 2570 MHz ~ 2620 MHz 5G NR n41: 2496 MHz ~ 2690 MHz 5G NR n66: 1710 MHz ~ 1780 MHz 5G NR n71: 669 MHz ~ 698 MHz 5G NR n77: 3700 MHz ~ 3980 MHz WLAN 2.4GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.6GHz Band: 5470 MHz ~ 5725 MHz WLAN 5.8GHz Band: 5725 MHz ~ 5825 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz
Mode	RMC 12.2Kbps HSDPA HSUPA LTE: QPSK, 16QAM, 64QAM 5G NR: DFT-s-OFDM/CP-OFDM, Pi/2 BPSK/QPSK/16QAM/64QAM/256QAM WLAN: 802.11a/b/g/n/ac/ax HT20/HT40/VHT20/VHT40/VHT80/HE20/HE40/HE80 Bluetooth BR/EDR/LE
EUT Stage	Production Unit

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

Reviewed by: Jason Wang

Report Producer: Daisy Peng

2. Maximum RF average output power among production units

Mode		Maximum Average power dBm)
WCDMA	Band II	24.00
	Band IV	24.00
	Band V	24.00
LTE	LTE Band 2	24.00
	LTE Band 4	24.00
	LTE Band 5	24.00
	LTE Band 7	24.00
	LTE Band 12	24.00
	LTE Band 13	24.00
	LTE Band 14	24.00
	LTE Band 17	24.00
	LTE Band 25	24.00
	LTE Band 26	24.00
	LTE Band 30	24.00
	LTE Band 38	24.00
	LTE Band 41	26.00
	LTE Band 42	19.50
	LTE Band 48	19.50
	LTE Band 66	24.00
	LTE Band 71	24.00
NR	n2	24.00
	n5	24.00
	n7	24.00
	n12	24.00
	n25	24.00
	n38	24.00
	n41	24.00
	n66	24.00
	n71	24.00
	n77	24.00

Mode	Maximum Average power(dBm)
2.4GHz WLAN	17.0
5GHz WLAN	17.0

3. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

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	1.0	6
300-1500			f/300	6
1500-100,000			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			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm 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 Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

4. Radio Frequency Radiation Exposure Evaluation

4.1. Standalone Power Density Calculation

Band	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum ERP (dBm)	Maximum ERP (W)	Maximum EIRP (dBm)	Maximum EIRP (W)	Maximum Output Power Limit (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit
WCDMA Band 2	6.00	24.00	27.850	0.610	30.000	1.000	2.000	1000.000	0.199	1.000	0.199
WCDMA Band 4	6.00	24.00	27.850	0.610	30.000	1.000	1.000	1000.000	0.199	1.000	0.199
WCDMA Band 5	4.00	24.00	25.850	0.385	28.000	0.631	7.000	630.957	0.126	0.549	0.229
LTE Band 2	6.00	24.00	27.850	0.610	30.000	1.000	2.000	1000.000	0.199	1.000	0.199
LTE Band 4	6.00	24.00	27.850	0.610	30.000	1.000	1.000	1000.000	0.199	1.000	0.199
LTE Band 5	4.00	24.00	25.850	0.385	28.000	0.631	7.000	630.957	0.126	0.549	0.229
LTE Band 7	7.00	24.00	28.850	0.767	31.000	1.259	2.000	1258.925	0.251	1.000	0.251
LTE Band 12	3.20	24.00	25.050	0.320	27.200	0.525	3.000	524.807	0.104	0.466	0.224
LTE Band 13	3.50	24.00	25.350	0.343	27.500	0.562	3.000	562.341	0.112	0.518	0.216
LTE Band 14	3.60	24.00	25.450	0.351	27.600	0.575	3.000	575.440	0.115	0.525	0.218
LTE Band 17	3.20	24.00	25.050	0.320	27.200	0.525	3.000	524.807	0.104	0.469	0.223
LTE Band 25	6.00	24.00	27.850	0.610	30.000	1.000	2.000	1000.000	0.199	1.000	0.199
LTE Band 26	4.00	24.00	25.850	0.385	28.000	0.631	7.000	630.957	0.126	0.543	0.231
LTE Band 30	-0.60	24.00	21.250	0.133	23.400	0.219	0.250	218.776	0.044	1.000	0.044
LTE Band 38	7.00	24.00	28.850	0.767	31.000	1.259	2.000	1258.925	0.251	1.000	0.251
LTE Band 41	5.00	26.00	28.850	0.767	31.000	1.259	2.000	1258.925	0.251	1.000	0.251
LTE Band 42	3.50	19.50	20.850	0.122	23.000	0.200	0.200	199.526	0.040	1.000	0.040
LTE Band 48	3.50	19.50	20.850	0.122	23.000	0.200	0.200	199.526	0.040	1.000	0.040
LTE Band 66	6.00	24.00	27.850	0.610	30.000	1.000	1.000	1000.000	0.199	1.000	0.199
LTE Band 71	3.10	24.00	24.950	0.313	27.100	0.513	3.000	512.861	0.102	0.442	0.231
5G FR1 n2	6.00	24.00	27.850	0.610	30.000	1.000	2.000	1000.000	0.199	1.000	0.199
5G FR1 n5	4.00	24.00	25.850	0.385	28.000	0.631	7.000	630.957	0.126	0.549	0.229
5G FR1 n7	7.00	24.00	28.850	0.767	31.000	1.259	7.000	1258.925	0.251	1.000	0.251
5G FR1 n12	3.20	24.00	25.050	0.320	27.200	0.525	3.000	524.807	0.104	0.466	0.224
5G FR1 n25	6.00	24.00	27.850	0.610	30.000	1.000	2.000	1000.000	0.199	1.000	0.199
5G FR1 n38	7.00	24.00	28.850	0.767	31.000	1.259	2.000	1258.925	0.251	1.000	0.251
5G FR1 n41	5.00	24.00	26.850	0.484	29.000	0.794	2.000	794.328	0.158	1.000	0.158
5G FR1 n66	6.00	24.00	27.850	0.610	30.000	1.000	1.000	1000.000	0.199	1.000	0.199
5G FR1 n71	3.10	24.00	24.950	0.313	27.100	0.513	3.000	512.861	0.102	0.442	0.231
5G FR1 n77	6.00	24.00	27.850	0.610	30.000	1.000	1.000	1000.000	0.199	1.000	0.199

<EN-DC Simtaneous Transmission analysis>

EN-DC		Σ(Power Density / Limit) of LTE + 5G NR
LTE Power Density / Limit	5G NR Power Density / Limit	
0.251	0.251	0.502

General Note:

1. The device support 5G FR1 NSA mode, consider colocation analysis to selected worst case LTE and 5G NR power density / limit to summation to show compliance
2. Σ(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for LTE + 5G NR.
3. Considering the collocation with the four transmitters of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 2 collocated transmitters is compliant

4.2. EN-DC active and transmit with WLAN

Band	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit
WCDMA Band 2	6.00	24.00	30.0	1.00	1000.00	0.199	1.000	0.199
WCDMA Band 4	5.80	24.00	29.8	0.95	954.99	0.190	1.000	0.190
WCDMA Band 5	3.60	24.00	27.6	0.58	575.44	0.115	0.549	0.209
LTE Band 2	6.00	24.00	30.0	1.00	1000.00	0.199	1.000	0.199
LTE Band 4	5.80	24.00	29.8	0.95	954.99	0.190	1.000	0.190
LTE Band 5	3.60	24.00	27.6	0.58	575.44	0.115	0.549	0.209
LTE Band 7	7.00	24.00	31.0	1.26	1258.93	0.251	1.000	0.251
LTE Band 12	3.20	24.00	27.2	0.52	524.81	0.104	0.466	0.224
LTE Band 13	3.50	24.00	27.5	0.56	562.34	0.112	0.518	0.216
LTE Band 14	3.60	24.00	27.6	0.58	575.44	0.115	0.525	0.218
LTE Band 17	3.20	24.00	27.2	0.52	524.81	0.104	0.469	0.223
LTE Band 25	6.00	24.00	30.0	1.00	1000.00	0.199	1.000	0.199
LTE Band 26	3.60	24.00	27.6	0.58	575.44	0.115	0.543	0.211
LTE Band 30	-0.60	24.00	23.4	0.22	218.78	0.044	1.000	0.044
LTE Band 38	7.00	24.00	31.0	1.26	1258.93	0.251	1.000	0.251
LTE Band 41	5.00	26.00	31.0	1.26	1258.93	0.251	1.000	0.251
LTE Band 42	3.50	19.50	23.0	0.20	199.53	0.040	1.000	0.040
LTE Band 48	3.50	19.50	23.0	0.20	199.53	0.040	1.000	0.040
LTE Band 66	5.80	24.00	29.8	0.95	954.99	0.190	1.000	0.190
LTE Band 71	3.10	24.00	27.1	0.51	512.86	0.102	0.442	0.231
5G FR1 n2	6.00	24.00	30.0	1.00	1000.00	0.199	1.000	0.199
5G FR1 n5	3.60	24.00	27.6	0.58	575.44	0.115	0.549	0.209
5G FR1 n7	3.60	24.00	27.6	0.58	575.44	0.115	1.000	0.115
5G FR1 n12	3.20	24.00	27.2	0.52	524.81	0.104	0.466	0.224
5G FR1 n25	6.00	24.00	30.0	1.00	1000.00	0.199	1.000	0.199
5G FR1 n38	7.00	24.00	31.0	1.26	1258.93	0.251	1.000	0.251
5G FR1 n41	5.00	24.00	29.0	0.79	794.33	0.158	1.000	0.158
5G FR1 n66	5.80	24.00	29.8	0.95	954.99	0.190	1.000	0.190
5G FR1 n71	3.10	24.00	27.1	0.51	512.86	0.102	0.442	0.231
5G FR1 n77	6.00	24.00	30.0	1.00	1000.00	0.199	1.000	0.199
WLAN2.4GHz Band	6.0	17.0	23.0	0.20	199.53	0.040	1.000	0.040
WLAN5GHz Band	6.0	17.0	23.0	0.20	199.53	0.040	1.000	0.040

<EN-DC Simtaneous Transmission analysis with WLAN>

EN-DC		WLAN Power Density / Limit	Σ(Power Density / Limit) of LTE + 5G NR + WLAN
LTE Power Density / Limit	5G NR Power Density / Limit		
0.251	0.251	0.04	0.542

General Note:

1. The device support 5G FR1 NSA mode, consider colocation analysis to selected worst case LTE and 5G NR power density / limit to summation to show compliance
2. Σ(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for LTE + 5G NR + WLAN when EN-DC is active.
3. Considering the collocation with the three transmitters of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 3 collocated transmitters is compliant

Conclusion:

Based on 47 CFR §2.1091, the analysis concludes that this product when transmitting in standalone within a host device, is compliant with the FCC RF exposure requirements in mobile exposure condition, provided the conducted power and antenna gain do not exceed the limits for each given frequency band per wireless technology as follow table:

Device	Band	Maximum Conducted Power (dBm)	Stanalone Maximum Antenna Gain (dBi)	Collocated Maximum Antenna Gain (dBi)
MD2000	WCDMA Band 2	24.0	6.0	6.0
	WCDMA Band 4	24.0	6.0	5.8
	WCDMA Band 5	24.0	4.0	3.6
	LTE Band 2	24.0	6.0	6.0
	LTE Band 4	24.0	6.0	5.8
	LTE Band 5	24.0	4.0	3.6
	LTE Band 7	24.0	7.0	7.0
	LTE Band 12	24.0	3.2	3.2
	LTE Band 13	24.0	3.5	3.5
	LTE Band 14	24.0	3.6	3.6
	LTE Band 17	24.0	3.2	3.2
	LTE Band 25	24.0	6.0	6.0
	LTE Band 26	24.0	4.0	3.6
	LTE Band 30	24.0	-0.6	-0.6
	LTE Band 38	24.0	7.0	7.0
	LTE Band 41	26.0	5.0	5.0
	LTE Band 42	19.5	3.5	3.5
	LTE Band 48	24.0	-1.0	-1.0
	LTE Band 66	24.0	6.0	5.8
	LTE Band 71	24.0	3.1	3.1
	5G FR1 n2	24.0	6.0	6.0
	5G FR1 n5	24.0	4.0	3.6
	5G FR1 n7	24.0	7.0	3.6
	5G FR1 n12	24.0	3.2	3.2
	5G FR1 n25	24.0	6.0	6.0
	5G FR1 n38	24.0	7.0	7.0
	5G FR1 n41	24.0	5.0	5.0
	5G FR1 n66	24.0	6.0	5.8
	5G FR1 n71	24.0	3.1	3.1
	5G FR1 n77	24.0	6.0	6.0
	2.4GHz WLAN	17.0	17.0	6.0
	5GHz WLAN	17.0	13.0	6.0