SARGENT MANUFACTURING CO.

MPE CALCULATION REPORT

SCOPE OF WORK
MPE Calculation of Aperio RF Module, Model IN100

REPORT NUMBER
105746284BOX-001mpe.1

ISSUE DATE
April 30, 2024

REVISION DATE
June 3, 2024

DOCUMENT CONTROL NUMBER
Non-Specific Radio Report Shell Rev. December 2017

MPE CALCULATION REPORT

(FULL COMPLIANCE)

Report Number: 105746284BOX-001mpe.1
Project Number: G105746284

Report Issue Date: April 30, 2024
Report Revision Date: June 3, 2024

Model(s) Tested: IN100

Standards: **FCC Part 1 Subpart I, April 2021**
Procedures Implementing the National Environmental Policy Act of 1969
§1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.

ISED RSS-102 Issue 6 December 15, 2023
Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

Tested by:
Intertek
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Sargent Manufacturing Co.
110 Sargent Drive
New Haven, CT 6511
USA

Report prepared by

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Report reviewed by

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1 Introduction and Conclusion

This evaluation report covers for a mobile device subject to routine environmental evaluation for RF exposure. A mobile device is defined as a transmitting device designed to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structurer(s) and the body of the user or nearby persons.

The evaluation indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining sections are the verbatim text from the actual evaluation during the investigation. These sections include the evaluation name, the specified Method, and Results. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product evaluated **complies** with the requirements of the standard(s) indicated. The results obtained in this report pertain only to the item(s) evaluated. Intertek does not make any claims of compliance for samples or variants which were not evaluated.

2 Evaluation Summary

Section	Test full name	Result
3	Client Information	-
4	Description of Equipment Under Evaluation and Variant Models	-
5	System Setup and Method	-
6	Power Density Calculation (FCC §1.1310; ISED RSS-102 Issue 6)	Compliant
7	Revision History	-

3 Client Information

This EUT was tested at the request of:

Client: Sargent Manufacturing Company
100 Sargent Drive
New Haven, CT 6511
USA

Contact: Paul Wehbe
Telephone: 203-498-5536
Email: paul.wehbe@assaabloy.com

4 Description of Equipment Under Test and Variant Models

Manufacturer:

Sargent Manufacturing Co.
110 Sargent Drive
New Haven, CT 6511
USA

Description of Equipment Under Test (provided by client)
Electronic access control system. It contains the radio modules as below. The Limited Module FCC ID containing all 4 radios is: FCC ID: U4A-SCYMCA1 IC: 6982A-SCYMCA1 Contains BLE Limited Module FCC ID: Y88-MBM1CC2640 IC: 9504A-MBM1CC2640

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
9 V (6 x 1.5 V Batteries)	1.5 A	DC	N/A

Variant Models:

The following variant models have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 Power Density Calculation

5.1 Requirement(s)

FCC §1.1310 Radiofrequency radiation exposure limits

Table 1 below sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic field.

Table 1 – Limits for Maximum Permissible Exposure (MPE)

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 Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	842/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

F = frequency in MHz * = Plane-wave equivalent power density

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Table 2 below sets forth limits for the RF field strength.

Table 2 – RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency range (MHz)	Electric field strength (V/m rms)	Magnetic field strength (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
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	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz. *Based on nerve stimulation (NS) **Based on specific absorption rate (SAR)

5.2 Method

An MPE evaluation was performed in order to show that the device was compliant with FCC §2.1091 and ISED RSS-102. The maximum power density was calculated for each transmitter at a separation distance of 20 cm. The calculation was performed using the maximum gain from the internal and external antennas declared by the manufacturer.

The maximum permissible exposure (MPE) is predicted by using the following equation:

$$S = PG/4\pi R^2$$

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

5.3 Calculation:

EIRP [dBm] = E [dBµV/m] + 20*log [d(m)]-104.77, where d is the test distance

125 kHz RFID
Plastic Enclosure: 67.39 dBuV/m at 3 meters
Metal Enclosure: 66.32 dBuV/m at 3 meters

13.56 MHz RFID
Plastic Enclosure: 65.05 dBuV/m at 3 meters
Metal Enclosure: 61.13 dBuV/m at 3 meters

Zigbee
Plastic Enclosure: 92.14 dBuV/m at 3 meters
Metal Enclosure: 90.63 dBuV/m at 3 meters

Bluetooth Low Energy (BLE)
Plastic Enclosure: 92.71 dBuV/m at 3 meters
Metal Enclosure: 90.64 dBuV/m at 3 meters

Enclosure	Frequency	Field Strength	Distance (m)	Max. EIRP (dBm)	Max. EIRP (mW)	Power Density at 20 cm (mW/cm^2)	Power Density at 20 cm (W/m^2)	Limit at 20 cm (V/m)	Limit at 20 cm (W/m^2)	Result
125 kHz RFID										
Plastic	125 kHz	67.39 dBuV/m	3	--	--	--	--	--	--	--
		0.00234 V/m	3	--	--	--	--	614.00	--	Compliant
Metal	125 kHz	66.32 dBuV/m	3	--	--	--	--	--	--	--
		0.00207 V/m	3	--	--	--	--	614.00	--	Compliant
13.56 MHz RFID										
Plastic	13.56 MHz	65.05 dBuV/m	3	--	--	--	--	--	--	--
		0.00179 V/m	3	--	--	--	--	62.09	--	Compliant
Metal	13.56 MHz	61.13 dBuV/m	3	--	--	--	--	--	--	Compliant
		0.00139 V/m	3	--	--	--	--	62.09	--	Compliant
2.4 GHz Zigbee										
Plastic	2.405 GHz	92.14	3	-3.060	0.494311	9.83401E-05	0.000983401	--	1.00	Compliant
Metal	2.405 GHz	90.63	3	-4.570	0.34914	6.94593E-05	0.000694593		1.00	Compliant
2.4 GHz Bluetooth Low Energy (BLE)										
Plastic	2.402 GHz	92.71	3	-2.490	0.563638	0.000112132	0.001121322	--	1.00	Compliant
Metal	2.402 GHz	90.64	3	-4.560	0.349945	6.96194E-05	0.000696194	--	1.00	Compliant

Notes: Data for power density calculation was taken from Intertek test report number: 105746284BOX-001.125kHz, 105746284BOX-001.13.56MHz, 105746284BOX-001.zigbee, and 105746284BOX-001.BLE

5.4 Results:

The sample tested was found to Comply. The maximum calculated power density at 20 cm distance is less than the limits for general population / uncontrolled exposure of 1 mW/cm^2 for ZigBee and BLE. And the maximum calculated electric field strength at 20 cm distance is less than 614 V/m for 125 kHz RFID and 62.09 V/m for 13.56 MHz RFID.

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6.1 Requirement(s)

Power Density Limit: $0.02619\ f^{0.6834}$ W/m^2 (300 MHz ≤ f < 6 GHz), f is in MHz.
Power Density Limit: $0.02619 * (2405^{0.6834}) = 5.355$ W/m^2
Power Density Limit: $0.02619 * (2402^{0.6834}) = 5.351$ W/m^2

6.2 Calculation

Enclosure	Frequency	Field Strength	Distance (m)	Max. EIRP (dBm)	Max. EIRP (mW)	Power Density at 20 cm (mW/cm^2)	Power Density at 20 cm (W/m^2)	Limit at 20 cm (V/m rms)	Limit at 20 cm (W/m^2)	Result
125 kHz RFID										
Plastic	125 kHz	67.39 dBuV/m	3	--	--	--	--	--	--	--
		0.00234 V/m	3	--	--	--	--	83.00	--	Compliant
Metal	125 kHz	66.32 dBuV/m	3	--	--	--	--	--	--	--
		0.00207 V/m	3	--	--	--	--	83.00	--	Compliant
13.56 MHz RFID										
Plastic	13.56 MHz	65.05 dBuV/m	3	--	--	--	--	--	--	--
		0.00179 V/m	3	--	--	--	--	27.46	--	Compliant
Metal	13.56 MHz	61.13 dBuV/m	3	--	--	--	--	--	--	--
		0.00114 V/m	3	--	--	--	--	27.46	--	Compliant
2.4 GHz Zigbee										
Plastic	2.405 GHz	92.14	3	-3.060	0.49431069	9.83401E-05	0.000983401	--	5.355	Compliant
Metal	2.405 GHz	90.63	3	-4.570	0.34914032	6.94593E-05	0.000694593		5.355	Compliant
2.4 GHz Bluetooth Low Energy (BLE)										
Plastic	2.402GHz	92.71	3	-2.490	0.56363766	0.000112132	0.001121322	--	5.351	Compliant
Metal	2.402 GHz	90.64	3	-4.560	0.34994517	6.96194E-05	0.000696194	--	5.351	Compliant

Notes: Data for power density calculation was taken from Intertek test report number: 105746284BOX-001.125kHz, 105746284BOX-001.13.56MHz, 105746284BOX-001.zigbee, and 105746284BOX-001.BLE

Nerve stimulation exemption per RSS-102 Issue 6 Section 6.2.2.1 for 125 kHz RFID.

Sargent FCC turns/current calculator

30-May-24

HF Turns (Check)	2	Hf polling current default	0.187	A RMS
		Distance x to exposed tissue!	3	mm

Fcc formulae

		To power	
(x + 0.2786)**0.1557	3.2786	1.203074964	
Limit	9.401335		
nIrms	0.374		nIrms is less than the calculated limit

LF turns	104	LF Polling current	0.02	Arms
		Distance x	3	mm

(x + 0.2786)**0.1557	1.203075	
Limit	9.401335	
nIrms	2.08	nIrms is less than the calculated limit

INPUT
output

note: Currents shown are for continuous carrier

Currents taken from HID Tuning report of November 2023 for IN100 (Which is the worst case)
Distances estimated for finger tip on reader surface

6.3 Results:

The sample tested was found to Comply. The maximum calculated power density at 20 cm distance is less than the limits for general population / uncontrolled exposure of 5.355 W/m^2 for ZigBee and 5.351 W/m^2 BLE. And the maximum calculated electric field strength at 20 cm distance is less than 83 V/m for 125 kHz RFID and 27.46 V/m for 13.56 MHz RFID.

7 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	04/30/2024	105746284BOX-001mpe	KPS	VFV	Original Issue
1	06/03/2024	105746284BOX-001mpe.1	KPS	VFV	Added NS exemption calculation on page 10