

# Des-Case Corporation MPE REPORT

**SCOPE OF WORK**

MPE CALCULATION  
ON THE ISOLOGIC MODULE

**REPORT NUMBER**

103397344LEX-013

**ISSUE DATE**

8/13/2018

**[REVISED DATE]**

8/13/2018

**PAGES**

6

**DOCUMENT CONTROL NUMBER**

Non-Specific EMC Report Shell Rev. December 2017  
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## MPE TEST REPORT

**Report Number:** 103397344LEX-013

**Project Number:** G103397344

**Report Issue Date:** 8/13/2018

**Product Name:** IsoLogic Module

**Model:** 10000000

**FCC Standards:** FCC Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

**Industry Canada Standards:** RSS-102 Issue 5

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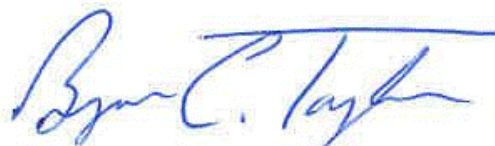
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## MPE Calculation

**§ 1.1310:** The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

### Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30–300 .....	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

**RSS-102 Issue 5 Exposure Limits:****Table 4: RF Field Strength Limits for Devices Used by the General Public  
(Uncontrolled Environment)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Reference Period (minutes)
0.003-10 <sup>21</sup>	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> <sup>0.5</sup>	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> <sup>0.25</sup>	0.1540/ <i>f</i> <sup>0.25</sup>	8.944/ <i>f</i> <sup>0.5</sup>	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> <sup>0.3417</sup>	0.008335 <i>f</i> <sup>0.3417</sup>	0.02619 <i>f</i> <sup>0.6834</sup>	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> <sup>1.2</sup>
150000-300000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> <i>f</i>	616000/ <i>f</i> <sup>1.2</sup>
Note: <i>f</i> is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

**1.1 Test Procedure**

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

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{ConductedPower(dBm)/10}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$

**1.2 Results (FCC):**

RFID	Value	Unit	Comments
Frequency	13.56	MHz	
Distance	20	cm	
Maximum Scaled Power	17.4	dBm	Maximum declared output power
TX Antenna Gain	0.5	dBi	From datasheet, or calculated from peak radiated field strength and measured conducted power
Source Based Duty Cycle	100	%	Percent of time transmitter is active
EIRP	17.9	dBm	Maximum Scaled Power x Antenna Gain
Source Based Output Power	17.9	dBm	EIRP x Duty Cycle
Power Density @ Distance	0.0123	mW/cm <sup>2</sup>	(Source Based Output Power, mW) / (4 $\pi$ x (distance, cm) <sup>2</sup> )
FCC Limit	0.9789	mW/cm <sup>2</sup>	180. x f <sup>-2</sup>
Ratio of Power Density to Limit	0.0125		Power Density / FCC Limit
Maximum Permissible Antenna Gain	19.52	dBi	((Limit, mW/cm <sup>2</sup> ) x 4 $\pi$ x (distance, cm) <sup>2</sup> ) / ((Maximum Scaled Power, mW) x Source Based Duty Cycle)
BLE	Value	Unit	Comments
Frequency	2440	MHz	
Distance	20	cm	
Maximum Scaled Power	4	dBm	Maximum declared output power
TX Antenna Gain	2.2	dBi	From datasheet, or calculated from peak radiated field strength and measured conducted power
Source Based Duty Cycle	100	%	Percent of time transmitter is active
EIRP	6.2	dBm	Maximum Scaled Power x Antenna Gain
Source Based Output Power	6.2	dBm	EIRP x Duty Cycle
Power Density @ Distance	0.0008	mW/cm <sup>2</sup>	(Source Based Output Power, mW) / (4 $\pi$ x (distance, cm) <sup>2</sup> )
FCC Limit	1.0000	mW/cm <sup>2</sup>	1. x f <sup>-2</sup>
Ratio of Power Density to Limit	0.0008		Power Density / FCC Limit
Maximum Permissible Antenna Gain	33.01	dBi	((Limit, mW/cm <sup>2</sup> ) x 4 $\pi$ x (distance, cm) <sup>2</sup> ) / ((Maximum Scaled Power, mW) x Source Based Duty Cycle)

The calculated maximum power density at 20cm distance is less than the limit for general population / uncontrolled exposure.

For simultaneous transmission, the sum of the ratios of the power density to the respective limit was determined to be:

$$(0.0123 \text{ mW/cm}^2) / (0.9789 \text{ mW/cm}^2) + (0.0008 \text{ mW/cm}^2) / (1 \text{ mW/cm}^2) = 0.0125 + 0.0008 = 0.0133$$

$$0.0133 < 1$$

Compliance is shown by the sum of the ratio of the power densities for all radios that can transmit simultaneously being less than 1.

**1.3 Results (IC):**

RFID	Value	Unit	Comments
Frequency	13.56	MHz	
Distance	20	cm	
Maximum Scaled Power	17.4	dBm	Maximum declared output power
TX Antenna Gain	0.5	dBi	From datasheet, or calculated from peak radiated field strength and measured conducted power
Source Based Duty Cycle	100	%	Percent of time transmitter is active
EIRP	17.9	dBm	Maximum Scaled Power x Antenna Gain
Source Based Output Power	17.9	dBm	EIRP x Duty Cycle
Power Density @ Distance	0.0123	mW/cm <sup>2</sup>	(Source Based Output Power, mW) / (4 $\pi$ x (distance, cm) <sup>2</sup> )
IC Limit	0.2000	mW/cm <sup>2</sup>	.2 x f <sup>0</sup>
Ratio of Power Density to Limit	0.0613		Power Density / IC Limit
Maximum Permissible Antenna Gain	12.62	dBi	((Limit, mW/cm <sup>2</sup> ) x 4 $\pi$ x (distance, cm) <sup>2</sup> ) / ((Maximum Scaled Power, mW) x Source Based Duty Cycle)
BLE	Value	Unit	Comments
Frequency	2440	MHz	
Distance	20	cm	
Maximum Scaled Power	4	dBm	Maximum declared output power
TX Antenna Gain	2.2	dBi	From datasheet, or calculated from peak radiated field strength and measured conducted power
Source Based Duty Cycle	100	%	Percent of time transmitter is active
EIRP	6.2	dBm	Maximum Scaled Power x Antenna Gain
Source Based Output Power	6.2	dBm	EIRP x Duty Cycle
Power Density @ Distance	0.0008	mW/cm <sup>2</sup>	(Source Based Output Power, mW) / (4 $\pi$ x (distance, cm) <sup>2</sup> )
IC Limit	0.5409	mW/cm <sup>2</sup>	.0026 x f <sup>0</sup>
Ratio of Power Density to Limit	0.0015		Power Density / IC Limit
Maximum Permissible Antenna Gain	30.34	dBi	((Limit, mW/cm <sup>2</sup> ) x 4 $\pi$ x (distance, cm) <sup>2</sup> ) / ((Maximum Scaled Power, mW) x Source Based Duty Cycle)

The calculated maximum power density at 20cm distance is less than the limit for general population / uncontrolled exposure.

For simultaneous transmission, the sum of the ratios of the power density to the respective limit was determined to be:

$$(0.0123 \text{ mW/cm}^2) / (0.2 \text{ mW/cm}^2) + (0.0008 \text{ mW/cm}^2) / (0.5409 \text{ mW/cm}^2) = 0.0613 + 0.0015 = 0.0628$$

$$0.0628 < 1$$

Compliance is shown by the sum of the ratio of the power densities for all radios that can transmit simultaneously being less than 1.